



NOAA NAVIGATION SERVICES

CALIFORNIA ACTIVITIES REPORT

Office of Coast Survey

Center for Operational Oceanographic Products & Services

National Geodetic Survey

April 2015



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CALIFORNIA ACTIVITIES REPORT

NAVIGATION SERVICES

GEOGRAPHY AND ENVIRONMENT

The state of California has the third longest coastline in the nation, stretching almost a thousand miles from Mexico to Oregon. The diverse coast ranges from heavily populated coastal cities and sandy beaches in the south, to remote, rocky shores in the north.

SOCIAL AND ECONOMIC CONTEXT

California seaports are a major economic force and are critically important elements to the growth of California and the nation's economy. According to the California Marine and Intermodal Transportation System Advisory Council, more than 40% of the total containerized cargo entering the United States arrives at California ports, and almost 30% of the nation's exports flow through ports in the Golden State. Port activities employ more than one-half million people in California and generate an estimated \$7 billion in state and local tax revenues annually. Nationwide, more than two million jobs are linked to California's public ports. Long Beach port activity generates one in every 22 jobs in Southern California and provides some \$14.3 billion annually in regional wages and salaries.

California has 11 public ports, which include three "mega ports" (Los Angeles, Long Beach, and Oakland); eight smaller niche ports (Hueneme, Humboldt Bay, Redwood City, Richmond, West Sacramento, San Diego, San Francisco, and Stockton); and one private port (Benicia). The state also has dozens of smaller harbor facilities to support recreational boaters, fishermen and other users.

CHALLENGES AND DRIVERS

Increasing populations and environmental concerns combined with ever-larger ships, challenges NOAA to balance stakeholder desires and provide new and improved suites of products and services.

COAST SURVEY REGIONAL NAVIGATION MANAGERS

Coast Survey’s [navigation managers](#), stationed strategically in port areas along U.S. coasts and Great Lakes, work directly with the U.S. Coast Guard, pilots, mariners, port authorities, and recreational boaters. They help identify navigational challenges facing the marine transportation system, and provide the resources and services that promote safe and efficient navigation.

COAST SURVEY HAS ONE NAVIGATION MANAGER FOR THE CALIFORNIA REGION

NAVIGATION MANAGER (BASE OF OPERATIONS)	PHONE/FAX
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NAVIGATION RESPONSE TEAMS

Coast Survey’s highly mobile [navigation response teams](#) (NRTs) provide both routine and rapid response hydrographic surveys, helping to protect life and property from underwater dangers to navigation. During emergency situations, such as following a hurricane, NRTs speed the resumption of shipping that provides critical supplies to the affected area. Outside of emergencies, NRTs serve the maritime economy by identifying critical chart discrepancies and investigating emergent navigational concerns for 175 major ports within the U.S. marine transportation system.

KEEPING MARINERS SAFE AND COMMERCE FLOWING

Coast Survey assets include six NRTs that conduct scheduled hydrographic projects in critical maritime areas. While performing these routine survey operations, the teams remain available to respond to emergent needs in their region, and emergencies anywhere on the nation’s coasts.

Working with NOAA’s regional navigation managers, NRTs search for shoaling waters and submerged dangers to navigation that could slow or halt ocean shipping. They provide time-sensitive information to the U.S. Coast Guard and port officials, and transmit data to NOAA cartographers for updating Coast Survey’s suite of navigational charts.

These agile hydrographic field units are equipped with trailer-able survey launches and mobile data processing trailers. The teams use state-of-the-art hydrographic equipment to determine water depths and acquire high-resolution imagery of the sea floor. All teams are equipped with sidescan sonar and multibeam echo sounders to generate three-dimensional views of what lies below the surface.

INITIATING A NOAA NAVIGATION RESPONSE

Requests for a NOAA navigation response team originate from the appropriate U.S. Coast Guard Captain of the Port, state pilot association, port authority, or U.S. Army Corps of Engineers office. Requesters work with NOAA's regional navigation managers to identify mission objectives and define the deliverable products.

Coast Survey's NRT6 is currently deployed to the California coast, supporting requests for surveys near Port of San Francisco.

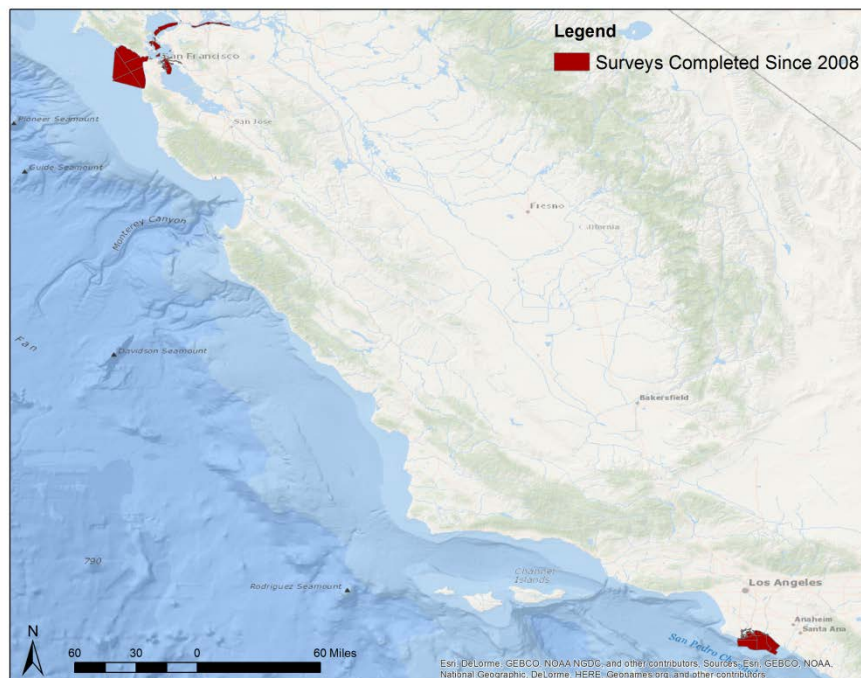
CHART COVERAGE – CALIFORNIA REGION

Coast Survey raster navigational charts (NOAA RNC®) provide complete coverage off the California coast. There are 123 unique panels (kapps) ranging in scale from 1:5000 to 1:1,000,000. There are 70 individual RNCs that cover any portion of California.

Coast Survey electronic navigational charts (NOAA ENC®) provide complete coverage off the California coast. There are 75 ENCs that include any portion of California.

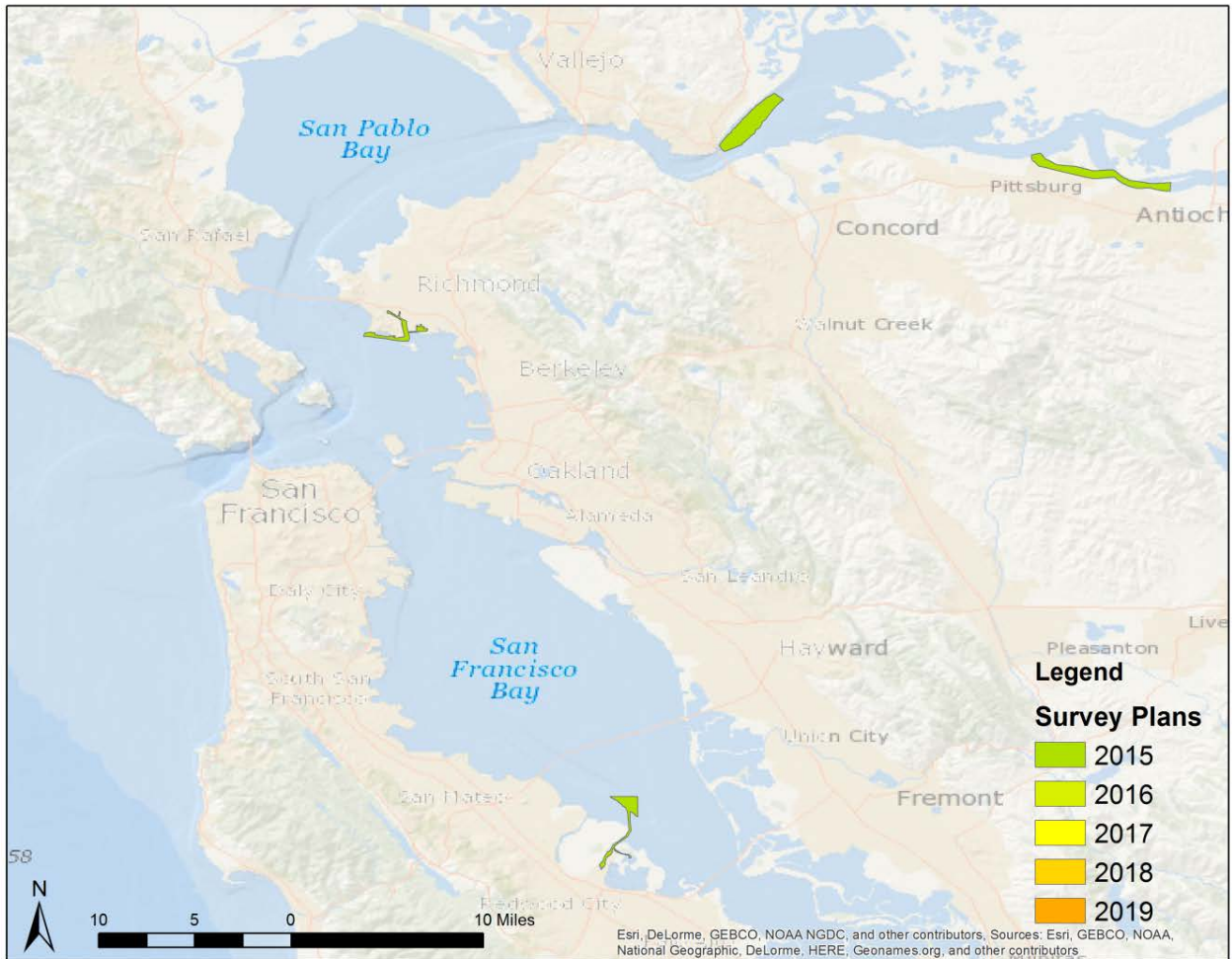
CALIFORNIA SURVEY OPERATIONS

Over the past five years (2009-2014), NOAA has conducted hydrographic surveys in the San Francisco Bay area and near the ports of Los Angeles and Long Beach. Navigation Response Team 6 and a private contractor surveyed the San Francisco Bay area, and NOAA Ship *Fairweather* conducted the southern California surveys.

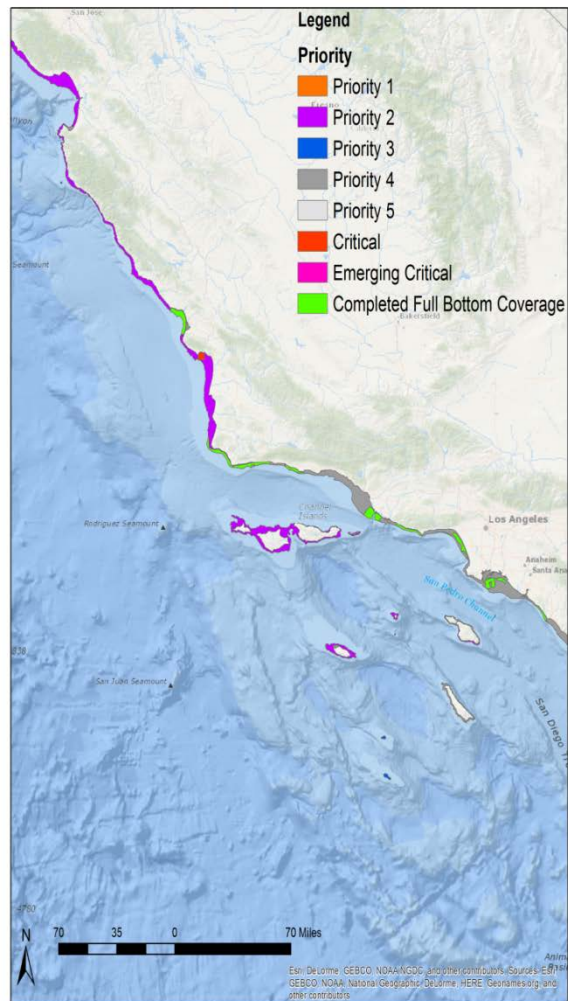
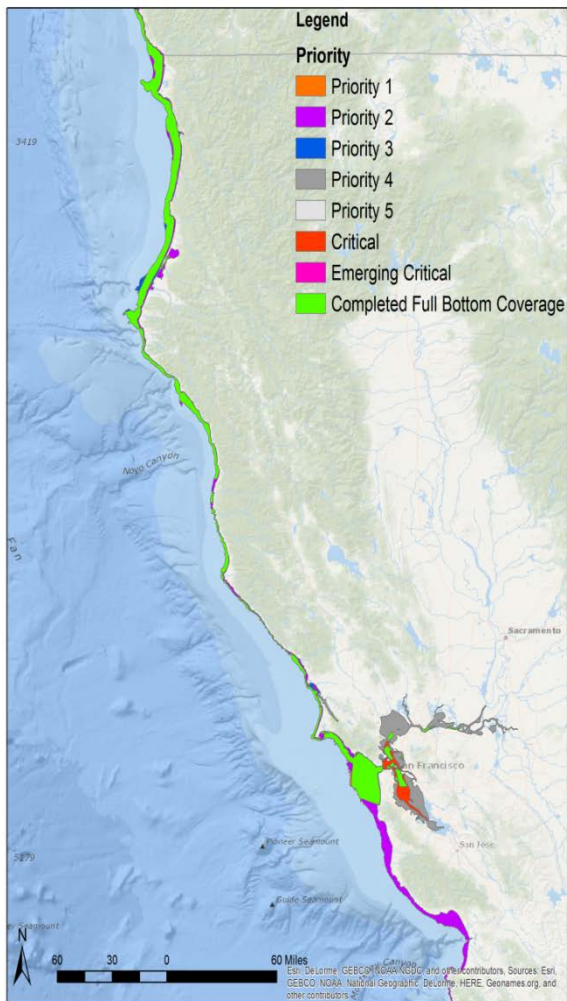


NOAA has also incorporated a significant amount of data collected via the California Seafloor Mapping Project, a successful Integrated Ocean and Coastal Mapping partnership project initiated in 2007 among the state, NOAA, U.S. Geological Survey, the private sector, and others.

Over the next five years, Coast Survey is planning surveys covering approximately 150 square nautical miles in the San Francisco Bay area, focusing on remaining critical survey areas. Most of the surveys will be 100% multibeam surveys. The map below shows planned survey areas.



The graphs on the next page display current survey needs in the California. The complete *NOAA Hydrographic Survey Priorities* is at <http://www.nauticalcharts.noaa.gov/hsd/NHSP.htm>.

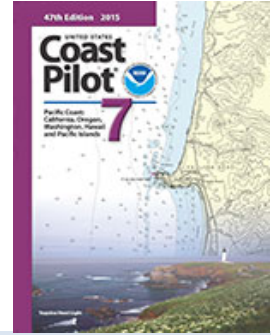


Surveys are classified according to need and a variety of other factors.

- **Critical survey areas** are waterways with high commercial traffic volumes; extensive petroleum, liquefied natural gas or hazardous material transport; compelling requests from users to survey; or transiting vessels with low under-keel clearance over the seafloor.
- **Emerging critical areas** meet the definition of critical area, but are tracked separately from critical areas.
- **Priority One areas** are navigationally significant areas that have pre-1940 surveys and annual petroleum transports over 1,000,000 tons; coal transports over 600,000; cargo traffic over 5,000,000 tons; or passenger traffic over 10,000 persons.
- **Priority Two areas** are navigationally significant areas that have pre-1940 surveys, but no specified traffic level.
- **Priority Three areas** are those that contain pre-1970 surveys that have not been categorized previously as Priority One or Two.
- **Priority Four areas** are those areas with surveys completed between 1970 and 1994 that are not defined as a critical area.
- **Priority Five areas** are unsurveyed areas or pre-1940 prior surveys and not defined as critical area.

UNITED STATES COAST PILOT

United States Coast Pilot 7 covers the California-Oregon-Washington coast between Mexico on the south and Canada's British Columbia on the north. It is mostly rugged and mountainous, with high land rising abruptly from the sea. *Coast Pilot 7* also covers the Hawaiian Islands and Pacific Islands, including Samoa and the Marshall Islands. All nine volumes of the *United States Coast Pilot* are now updated every week, and are available as PDFs for free download from nauticalcharts.noaa.gov.



RECENT ACTIVITIES

PORT OF LONG BEACH PRECISION NAVIGATION PROJECT

The Port of Long Beach began a project in 2012 to develop an under keel clearance system using the software PROTIDE (developed by Charta Software in the Netherlands). This system supports the transport of ultra large crude carriers in and out of the port. NOAA is supporting this project with high-resolution hydrographic surveys, wave buoys, water levels, and the development of a new nearshore wave prediction system. While the port's project only entails the build-out of the PROTIDE computation system, NOAA is using this work to pursue a larger objective of creating a suite of harmonized data that mariners can use for precise navigation and decision support. The project will integrate NOAA products and services for safe navigation of deep-draft ships into the port.

For this project, NOAA intends to provide high quality, operational, environmental information to support the PROTIDE software system in a manner consistent with existing NOAA product delivery. All NOAA data streams used by PROTIDE will also be publicly available, so that other users can develop similar decision systems. The NOAA products include harbor and channel bathymetry; forecasts of waves, water levels and currents and; if feasible, additional observations usable by the decision support tool and for wave model validation.

If this project succeeds in aiding navigation of deep draft vessels in constricted channels, we will recommend new NOAA products and services that could better meet the maritime community's needs in similar port systems around the country.

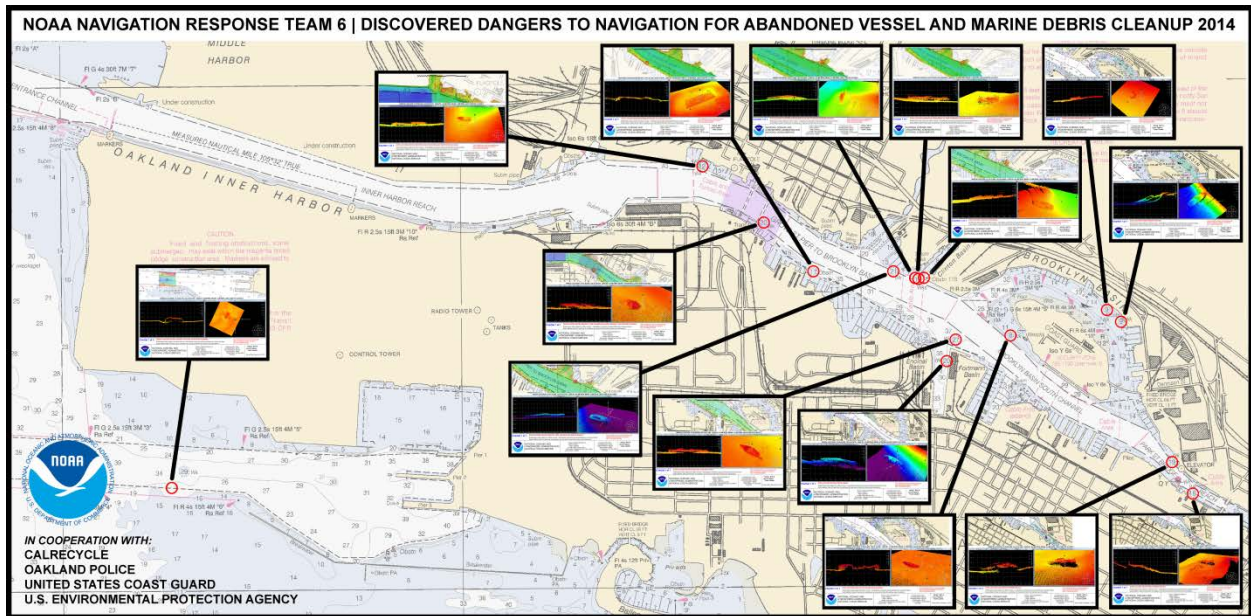
ENSURED SAFE WATER DEPTHS FOR SEMI-SUBMERSIBLE VESSEL

In mid-September 2014, the Coast Guard and Port of San Francisco prepared for arrival of new gantry cranes via the semi-submersible, heavy lift vessel M/V *Tern*. The *Tern*, when submerged, has a 60-foot draft. The proposed submersion site had charted depths of 62 feet and 63 feet – leaving no room for error. NOAA's [NRT6 responded to a request](#) to investigate the depths, to ensure that the *Tern* would have the under keel clearance needed. Among the many small, pocked features, the NRT6 team found six features that exhibited a height above bottom. The most notable of these features had a 60 foot least depth in close proximity to the location where *Tern* was planning to submerge.

After receiving NRT6's report of obstructions, the Coast Guard requested a second survey to investigate an alternate submersion location. The team quickly verified that there were no obstructions in the new location, and water depths were at least 62 feet. As a result, M/V *Tern* was able to safely complete her mission to deliver new gantry cranes to one of the country's top seaports.

FACILITATED CLEAN-UP OF INNER OAKLAND HARBOR

NOAA's NRT6 provided critical survey information to support the Inner Oakland Harbor Abandoned Vessel and Marine Debris Cleanup project, 2013-2014. The team's discovery of 15 dangers to navigation located within the Oakland Inner and Outer Harbors not only kept mariners safe, but also facilitated a comprehensive cleanup in which most of the obstructions were removed. According to Todd Thalhamer, CalRecycle waste management engineer, "navigation response team maps were critical to our project. Let me just say their efforts made a huge difference in our success and from our team we thank you." In total, 73 sites were processed, yielding 58 abandoned or wrecked vessels removed. Over 350 tons of debris, 125 tons of creosote, and \$68,000 of metal were recycled.



CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES (CO-OPS)

PHYSICAL OCEANOGRAPHIC REAL-TIME SYSTEM (PORTS®)

PORTS® is a decision-support tool that improves the safety and efficiency of maritime commerce and coastal resource management through the integration of real-time environmental observations, forecasts and other geospatial information. PORTS® measures and disseminates observations and predictions of water levels, currents, salinity, and meteorological parameters (e.g., winds, atmospheric pressure, air and water temperatures) that mariners need to navigate safely.

HUMBOLDT BAY PORTS®

A Physical Oceanographic Real-Time System (PORTS) in Humboldt Bay, California, is operated through a partnership with the Humboldt Bay Harbor, Recreation and Conservation District and the Center for Operational Oceanographic Products (CO-OPS). The coastal ocean observing system in Humboldt Bay collects oceanographic data from four current meters, an existing long-term tide station belonging to CO-OPS' National Water Level

Observation Network, and a wave buoy operated the Coastal Data Information Program. The Humboldt Bay PORTS monitors currents, waves, water levels, and meteorological factors in real-time in order to improve navigation safety and aid in the protection of public health from any potential hazardous material spills.

tidesandcurrents.noaa.gov/ports/index.shtml?port=hb

SAN FRANCISCO BAY PORTS®

A Physical Oceanographic Real-Time System (PORTS) is operated cooperatively with the local maritime community in greater San Francisco Bay, and the system's real-time data are quality-controlled and disseminated to local users for safe and efficient navigation. Real-time data are available for water levels from six stations, meteorological data from fourteen stations, current data from four stations, and surface wave data from one station. A new visibility sensor on the Oakland 38 Pier will help mariners determine fog conditions in the region and support safe navigation in the challenging San Francisco Bay marine environment. The partnership also recently added an air gap sensor on the San Francisco-Oakland Bay Bridge. tidesandcurrents.noaa.gov/ports/index.shtml?port=sf

LOS ANGELES/LONG BEACH HARBOR PORTS®

A Physical Oceanographic Real-Time System (PORTS) is operated cooperatively with the Los Angeles/Long Beach Pilots Association and the local maritime community in the metropolitan Los Angeles/Long Beach area, and the system's real-time data are quality controlled and disseminated to local users for safe and efficient navigation. Real-time data are available for water levels from one station, meteorological data from eight stations, surface wave data from one station, and air gap data from one station.

tidesandcurrents.noaa.gov/ports/index.shtml?port=ll

NATIONAL WATER LEVEL OBSERVATION NETWORK (NWLON)

CO-OPS operates and maintains the National Water Level Observation Network (NWLON), which is a network of 210 continuously operating water-level stations throughout the U.S., including its island possessions and territories and the Great Lakes. Additionally, NWLON is the foundation for reference stations supporting NOAA's tide prediction products, and serve as control stations in determining tidal datums for all short-term water-level station. CO-OPS operates 14 long-term, continuously operating tide stations in the state of California that provide data and information on tidal datums, relative sea level trends, and are capable of producing real-time data for tsunami and storm surge warning. For instance, the NWLON is a key part of the NOAA Tsunami Warning System and the NOAA Storm Surge Warning System. NWLON also stations support PORTS in major ports and harbors.

tidesandcurrents.noaa.gov

OTHER NOAA NAVIGATION ACTIVITIES

NOAA Navigation Services has completed many activities in the San Francisco Bay region in recent years, including development of a nowcast/forecast hydrodynamic model, a tidal current survey, and support for the multi-agency Salt Ponds Restoration Project in the South Bay. Efforts are underway to engage local stakeholders to identify additional requirements for NOAA Navigation Services, including the development of decision support tools focused on coastal decision making in the bay, particularly with respect to coastal inundation and sea level change. Products from this effort will include accurate elevations and water levels, tidal current information, shallow water bathymetry, updated digital elevation models, and more. Efforts in support of the South San Francisco Bay Salt Ponds Restoration project has focused on providing technical assistance in the area of tide station installation and

water level measurement. CO-OPS is currently developing an IAA with USFWS to upgrade one tide station in the South Bay and work collaboratively with USFWS, USGS, USACE, and Santa Clara Valley Water District to maintain that station over at least the next five years in partnership.

SAN FRANCISCO BAY OPERATIONAL FORECAST SYSTEM

CO-OPS, in partnership with the Office of Coast Survey and NWS' National Center for Environmental Predictions, implemented a hydrodynamic model system to provide operational forecast guidance of total water level (without waves), currents, water temperature, and salinity for the San Francisco Bay estuary and near coastal waters. This system has been operational since 2013, runs in the NOAA high performance computing environment, and provides 48-hour forecasts of the parameters noted above at numerous locations of concern for mariners. This guidance is updated four times a day. tidesandcurrents.noaa.gov/ofs/sfbofs/sfbofs.html

TIDAL CURRENT SURVEY

In 2012-2013, NOAA conducted a current survey in the San Francisco region, to update tidal current data which are included in the annual tables and new Tidal Currents web interface, and to support the San Francisco Bay Operational Forecast System. tidesandcurrents.noaa.gov/noaacurrents/Stations?g=696

SAN FRANCISCO BAY HF RADAR PRODUCT

CO-OPS partners with NOAA IOOS to display near-real-time surface current data from high frequency radars in San Francisco Bay and tidal current predictions derived from the observations. The observations of the currents are usually one-hour averages displayed in near-real-time. There are over 100 HF radar systems presently operating throughout the coastal United States, most of which are with the NOAA IOOS system. CO-OPS has a similar HF radar product at the mouth of the Chesapeake Bay and in Lower New York Bay.

tidesandcurrents.noaa.gov/hfradar/Hfscm.jsp?port=SFCA

NATIONAL GEODETIC SURVEY (NGS)

PERSONNEL, PRODUCTS & PROJECTS RELEVANT TO CALIFORNIA

STATE GEODETIC ADVISORS

The NGS state geodetic advisor program is a cost-sharing program that provides a liaison between NOAA and the host state, usually with a jointly funded NOAA employee residing in the state to guide and assist the state's geodetic and surveying programs. The program is transitioning from a state-based cost share program to a regional NGS-funded structure. This will be accomplished through a phased shift from a "state" advisor approach to a "regional" advisor focus. As part of this transition, in October 2014 NGS hired a Pacific Southwest regional advisor, who currently covers California and Nevada. The advisor, Dana Caccamise, is working out of offices provided by the Scripps Institution of Oceanography of the University of California-San Diego.

www.geodesy.noaa.gov/ADVISORS/AdvisorsIndex.shtml

V DATUM

NOAA's Vertical Datum Transformation (VDatum) is a free software tool jointly developed by NGS, CO-OPS, and Coast Survey, first made available in 2010 for the entire contiguous United States. This online tool enables users to transform geospatial data – based on different vertical reference systems – into one uniform surface or “datum.” Transforming data to a single vertical datum removes the most serious impediments to data sharing and is necessary to harmonize the differences between the vertical reference systems of land- and water-based spatial data.

VDatum was introduced to help create a seamless bathymetric-topographic digital elevation model for Florida's Tampa Bay region. The digital elevation model that resulted from the VDatum demonstration project has not only solved the problem of inconsistency among diverse datasets that causes difficulty in mapping coastal regions, but also provides standard geospatial data for multiple applications, such as inundation modeling, monitoring sea level change impacts, coastal management, and more.

V DATUM MODEL GRID UPDATES IN CALIFORNIA

We continue to collect geodetic and tidal data in California in support of an updated VDatum model grid. The current schedule for release of updated VDatum models for the San Francisco region is planned for 2016 and for the entire West Coast in 2019. vdatum.noaa.gov/

SHORELINE COVERAGE FOR CALIFORNIA

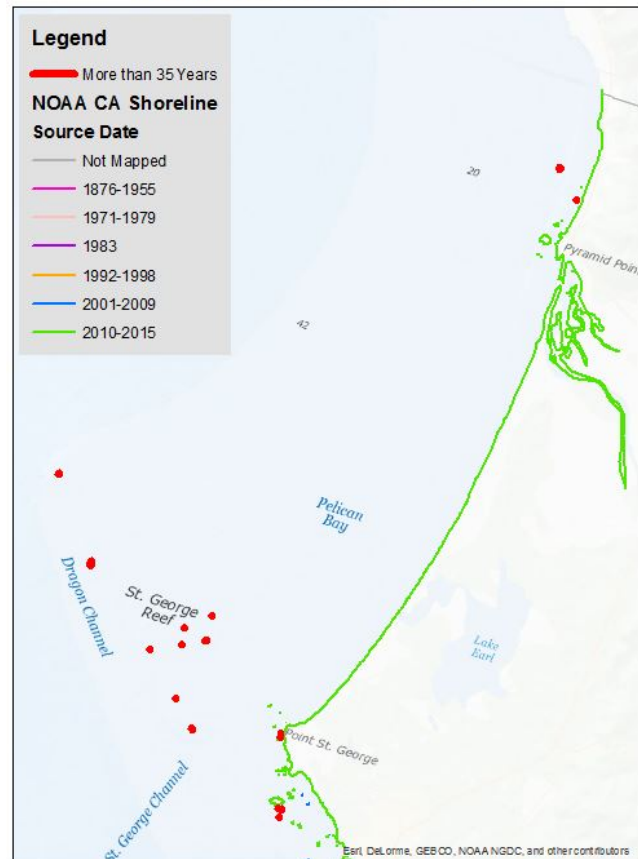
The state of NOAA shoreline coverage in California is relatively good. The average age of shoreline source is 3.9 years, which is the lowest on the west coast. Sixty-nine percent of the California shoreline is contemporary. Lidar sources account for 45% of California's contemporary shoreline, with most of the outer coast mean-high-water shoreline derived from 2010-2011 U.S. Army Corps of Engineers Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) lidar. Currently the shoreline for all major ports was either verified or compiled from 2008-2013 sources.

Plans are underway to continue the analysis of all priority ports so that shoreline in those areas is two years old or newer. JALBTCX and NOAA are coordinating on 2014-15 lidar updates to West Coast shoreline.

NEW SHORELINE REQUIREMENTS

The 1983 shoreline in eastern San Francisco Bay is currently being updated with 2013 aerial imagery. There is a continued need for better-refined VDatum modelling particularly in the estuarine regions. Shoreline that

Example NOAA Shoreline Source in California More than 35 Years



predates 1983 consists of either rivers and streams or charted offshore rocks. It is recommended that a coordinated and perhaps multi-sensor approach, be made to update these extended offshore rocks.

Another consideration for shoreline update is Lake Tahoe. The southern portion of Lake Tahoe was surveyed with a T-Series Map (T-2397 (1899)) during an oblique boundary survey. There are significant changes within the lake, including uncharted marinas, overhead cables, charted road and causeway not visible, and some positional shifts in the order of 50 meters from the 1:40,000 scale chart (18665).

DAMAGE RESPONSE IMAGERY

NGS conducts flights to collect imagery after natural (hurricane, earthquake, tsunami, and tornado) and man-made (oil spill) disasters.

High resolution, geo-referenced airborne imagery using NOAA aircraft supports NGS' coastal mapping program. NGS posts images on the web, often within hours, to make these images available to the public. The imagery is used to determine impacts to NOAA as well as federal, state, local, and public interests.

NGS has been called on to collect imagery following many different types of disasters, including the 2011 Joplin and Tuscaloosa tornados, the 2010 Haiti earthquake, and all major hurricanes since 2003. From the imagery, those in charge of response and restoration can determine the effect of storms for faster and better decision making during and after the response. ngs.woc.noaa.gov/eri_page/

CALIFORNIA SPATIAL REFERENCE CENTER

In a model partnership with NOAA, the California Spatial Reference Center (CSRC) serves as a way of providing a spatial referencing liaison between federal and local authorities. The Center is a non-profit organization affiliated with the Scripps Institution of Oceanography of the University of California-San Diego. The mission of the Center is to provide the necessary geodetic services to ensure the availability of accurate, consistent, and timely spatial referencing data for California. In partnership with several other organizations, CSRC has developed a plan to establish and maintain a state-of-the-art network of GPS control stations necessary for a reliable spatial reference system in California. csrc.ucsd.edu/

NEW NATIONAL REPLACEMENT DATUMS PLANNED FOR RELEASE IN 2022

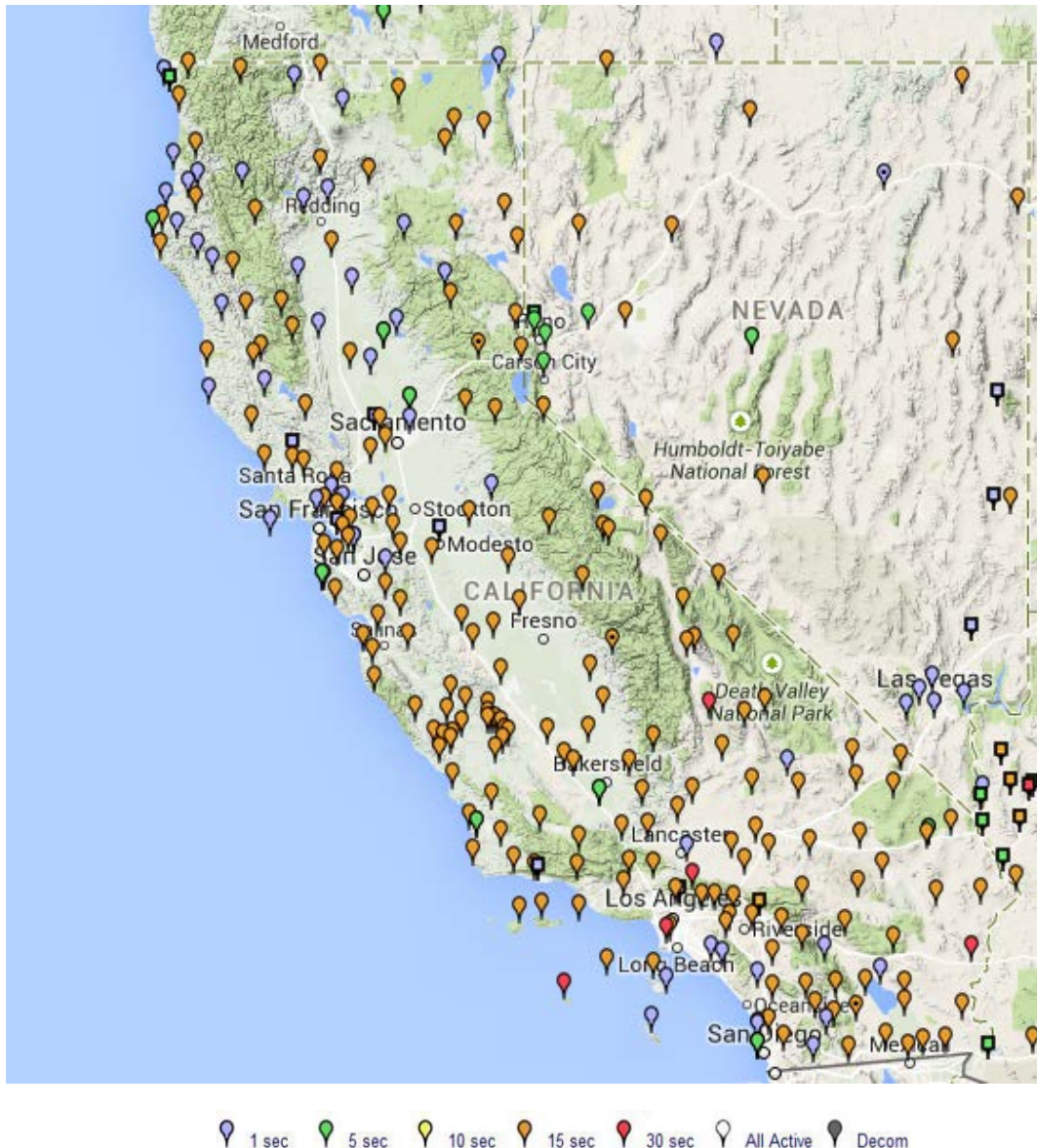
Congress (Coast and Geodetic Survey Act) requires National Geodetic Survey to maintain the national spatial reference system, which defines latitude, longitude, height, scale, gravity, and orientation throughout the U.S. Over time, systematic errors have accumulated in that reference system. To significantly improve that system and the quality of the data it produces, NGS plans to replace two fundamental system components in 2022:

- NAVD 88 - North American Vertical Datum of 1988: A new geopotential (gravity-based) datum realized through a combination of GNSS technology and gravity field modeling.
- NAD 83 - North American Datum of 1983: A new geometric datum fixed to Earth's center of mass that accounts for motion in the Earth's crust.

CONTINUOUSLY OPERATING REFERENCE STATIONS (CORS)

NGS manages a network of CORS that provide Global Navigation Satellite System data consisting of carrier phase and code range measurements in support of three dimensional positioning, meteorology, space weather, and geophysical applications throughout the United States, its territories and a few foreign countries. The CORS network is a multi-purpose cooperative endeavor involving government, academic and private organizations. Currently, the CORS network contains over 1900 stations. ngs.noaa.gov/CORS/

THE LOCATION OF ALL CORS IN CALIFORNIA

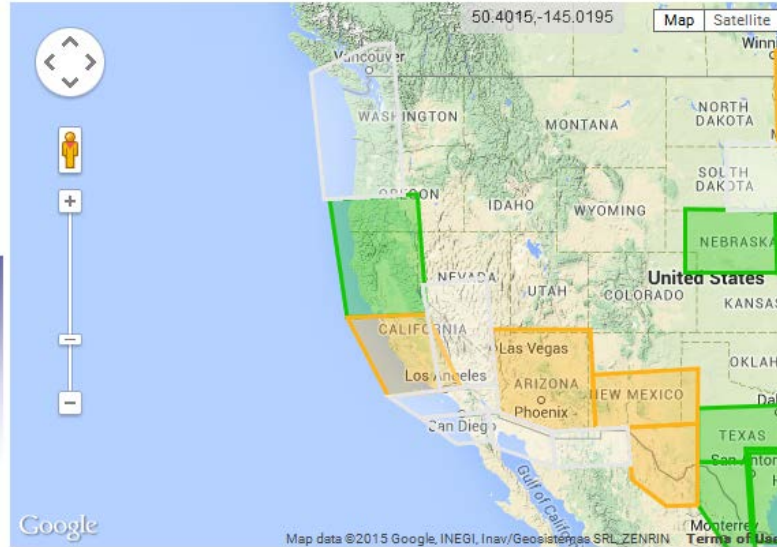


(Color-coded bubbles represent the sampling rate of the GPS receiver at the site)

GRAV-D: ONGOING PROJECT TO SUPPORT THE NEW GEOPOTENTIAL DATUM

The data required for gravity field modeling is being collected under a project that is called GRAV-D: Gravity for the Redefinition of the American Vertical Datum. Gravity data collection is ongoing and is being conducted in California as a priority.

Map Key - Airborne Gravity Data
Green: Available data and metadata
Blue: Data being processed
Orange: Data collection underway
White: Planned for data collection



STATUS OF PACIFIC COAST GRAV-D COLLECTION AS OF 23 MARCH 2015

GRAV-D project consists of two main campaigns:

- a high-resolution ‘snapshot’ of gravity in the US. This predominantly airborne campaign started in 2007, and is over 40% complete as of March 2015. www.geodesy.noaa.gov/GRAV-D/data_products.shtml
- a low-resolution ‘movie’ of gravity changes. This is primarily a terrestrial campaign to make repeated absolute gravity measurements in the same locations over time.

NOAA HERITAGE ASSET ON LOAN TO CITY OF UKIAH, CALIFORNIA

In January 2015, the National Geodetic Survey loaned a Wanschaff zenith telescope to the City of Ukiah for display in the original observatory building where it was used for nearly a century. This zenith telescope was one of six that observed the wobble of the Earth on its axis.

The International Geodetic Association organized a formalized polar motion program in 1899, with a central bureau in Europe and six observing stations, each situated near latitude 39° 08' north, with observatories in the United States located in Ukiah, California, and Gaithersburg, Maryland. NGS transferred ownership of the Ukiah observatory to the city at the end of the program, and the property is now a city park. In conjunction with the transfer, the Pacific Southwest Regional Advisor gave a lecture on the use of the telescope. Initially carried out by astronomers, this program was actually a study in geodesy and Earth physics. The loan will help promote NGS’ rich historical heritage and thereby generate interest in our positioning products and services.