NOAA Technical Report NOS CO-OPS 026

# A NWS Guide to the Use of NWLON and PORTS Computer-Based Products

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**U.S. DEPARTMENT OF COMMERCE**
**National Ocean Service**
**Center for Operational Oceanographic Products and Services**

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## 1.0 INTRODUCTION

The National Weather Service (NWS) is responsible for providing marine forecasts and warnings for the protection of life and property along the bays and coasts of the United States. The Center for Operational Oceanographic Products and Services (CO-OPS) within the National Ocean Service (NOS) contributes to the success of meeting these goals through the provision of real-time and near real-time water level, current, and meteorological information to NWS.

CO-OPS currently provides this information to NWS through:

- CREX (Character Form for the Representation and Exchange of Data) Bulletins
  - Routine Water Level Data Bulletins
  - Routine Meteorological Data Bulletins
  - Storm Surge Water Level Data Bulletins
  - Storm Surge Meteorological Data Bulletins

- Raw Data Transmissions for Tsunami Event Evaluation

- ASCII (American Standard Code for Information Interchange) Text Files

- PORTS (Physical Oceanographic Real-Time System) Voice System

- CO-OPS Web-Accessible Products
  - Tides Online
  - Water Level Station Status Report
  - Retrieval of Historical Water Level Data
  - PORTS PICS (PORTS Image Component System)
  - PORTS Text Screen

Each of these products is discussed in further detail later in this document.

With these NOS products, the water level, current, and associated meteorological data are available to all NWS offices with marine and coastal responsibilities on a routine basis. The products allow NWS to compare observed water level data to the predicted astronomical tide heights as well as provide additional data quality information that was not available in any form before. Through these NOS products, increased sensitivity to routine marine changes is provided which allows the NWS field forecasters to make better use of the information in order to meet its short-term weather warning and forecasting responsibilities. The routine availability of this data leads to increased familiarity with changes in oceanographic conditions.. This in turn should better alert surrounding offices of both upcoming and ongoing events. These products decrease the NWS workload associated with the collection of water level and current data. This is a benefit to forecasters during coastal storm events when the workload is higher than usual.

## 2.0 BACKGROUND

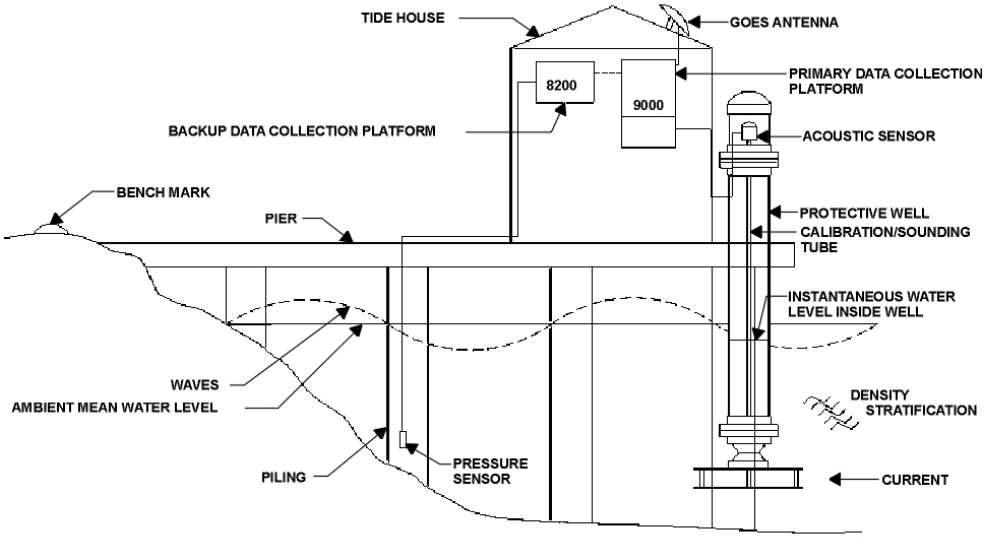
The NOS is responsible for the management and operation of the National Water Level Observation Network (NWLON), a network of tide and water level gauges installed along U.S. coastlines, estuaries, and bays, and a national network of Physical Oceanographic Real-Time Systems (PORTS) installed in major U.S. harbors. The National Water Level Measurement System (NGWLMS) is the computer-based data collection, processing, and dissemination system which supports the NWLON. The Information Dissemination System (IDS) is the computer-based data collection, processing, and dissemination system which supports PORTS. The NOS established the NWLON and PORTS, using state-of-the-art technology, to measure water levels, currents, and meteorological data and provide baseline data for activities such as navigation and marine forecasts.

There are 189 water level gauge and 11 acoustic current profiler installations along the U.S. coasts, in major U.S. harbors, in the Great Lakes and connecting channels, and in the U.S. territories and possessions. The primary sensor used for measuring water levels is a self-calibrating, downward-looking acoustic device that reports 3-minute averages of 1-second measurements every six minutes. For the Great Lakes, the primary sensor is a shaft encoder. For measuring currents, the primary sensor is a acoustic doppler device that takes continuous samples and provides an average measurement on the hour and at succeeding six minute intervals. Some stations also have been equipped with meteorological sensors. See Figure 1 for a diagram of a typical NWLON installation.

For the NWLON network, gauges collect the data at each site and relay it via the Geostationary Operational Environmental Satellite (GOES) in near real-time to the National Environmental Satellite, Data, and Information Service (NESDIS) downlink at Wallops Island, Virginia. The data is then sent to the NWS Office of System Operations (OSO) via an X.25 dedicated land line. Using File Transfer Protocol (FTP), a CO-OPS workstation retrieves the data from OSO.

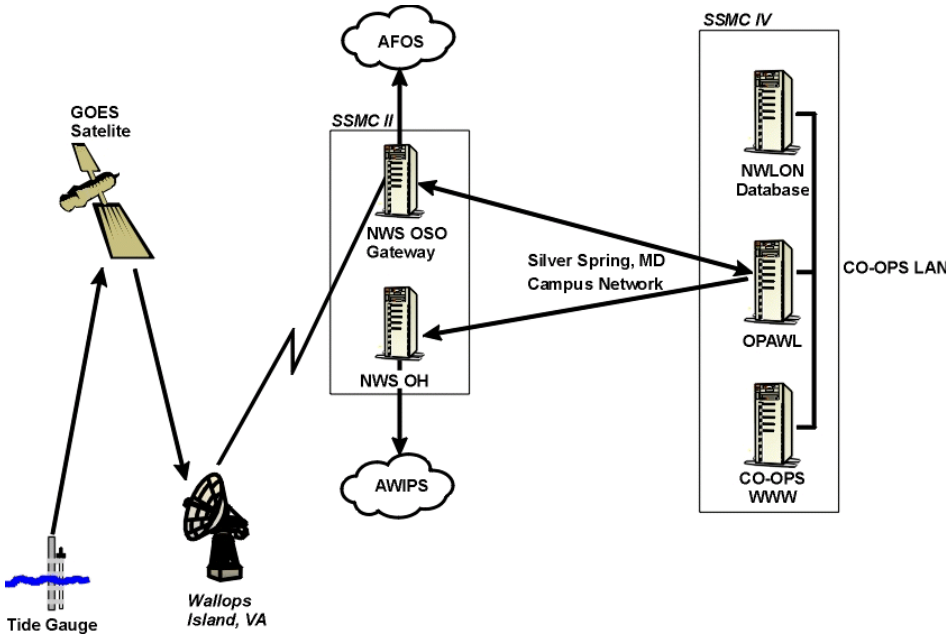
For the PORTS network, a PC-based Data Acquisition System (DAS), installed at each of the local PORTS sites, ingests all PORTS data at that site. The DAS polls installed instruments every 6 minutes. The polling is achieved using land line telephone calls, line-of-site radio communications or dedicated leased lines. The instrument data is converted to engineering units, quality controlled and formatted. Using FTP, each DAS sends this formatted data to a central PC data collection platform located in SSMC II, Silver Spring, Maryland, over the commercial and dedicated MCI Worldcom network. Again using FTP, all data is then sent via the local NOAA campus network to several CO-OPS special purpose workstations.

For both NWLON and PORTS, once the data is received by CO-OPS, various products are generated to be used in satisfying NOAA mission requirements such as the NWS' mission to provide marine forecasts and warnings for the protection of life and property along the bays and coasts of the United States. See Figure 2 for a diagram of the NGWLMS system topology.




**NATIONAL WATER LEVEL OBSERVATION NETWORK INSTALLATION**

**Figure 1**




**NGWLMS System Topology**
**Figure 2**

## 3.0 CREX BULLETINS

Upon receiving data from OSO, a CO-OPS Silicon Graphics $O_2$ workstation, running Unix, performs outlier and rate-of-change quality checks on the data. Then, for a given list of stations of interest to NWS, the data, along with the appropriate quality indicators, are formed into appropriate World Meteorological Organization (WMO) data bulletins for distribution to NWS. The data is arranged within a bulletin according to the NWS-defined CREX format definitions. The completed bulletins are placed in an area accessible to OSO on the CO-OPS $O_2$ workstation. OSO continuously checks this CO-OPS system for available bulletins. When found, these bulletins are collected from CO-OPS, by OSO, and sent through the NWS Telecommunications Gateway for dispersal to the NWS field offices over the NWS Automation of Field Operations and Services (AFOS) network. See Appendix 1 (NWS Station List) for a list of stations for which CREX bulletins are currently being generated.

Currently, two types of CREX-formatted bulletins are distributed to NWS: routine and storm surge.

### 3.1 Routine Data Bulletins

The routine bulletins are generated every hour on the hour. These routine bulletins contain data reported from gauges while in their "routine" reporting mode. For some stations, routine reporting is every hour, for others it is every 3 hours. There are two types of routine bulletins that can be created: water level and ancillary.

#### 3.1.1 Routine Water Level Data Bulletins

Each routine water level bulletin contains the hourly and thirty-minute observed water level values reported in the most recent one-hour or three-hour transmission. Residual information which is calculated by subtracting the predicted astronomical water level value from the actual observed water level value is provided in the bulletin except for the Great Lakes stations. Great Lakes stations do not have predictions; therefore, no residual values can be calculated. Also included in the bulletin are two quality control flags which represent the overall quality of the transmission: an automatic flag which indicates if any water level tolerances such as rate-of-change have been exceeded; and a manual flag which indicates problems with the water level gauge itself, such as sensor problems or clogging. See Appendix 2 (CREX Bulletin Descriptions) for more detailed information on the format of the routine water level bulletin and Appendix 4 (Code Definitions) for more information about the water level quality control flags.

#### 3.1.2 Routine Ancillary Data Bulletins

If meteorological data exists for a station, the appropriate routine ancillary bulletin is generated at the same time that the routine water level bulletin is generated. The meteorological data values that can be included in the bulletin are air temperature, barometric pressure, wind

speed, and wind direction. Not all stations have all sensors, so it is possible to have ancillary bulletins that do not contain information for all of the given data types. Each ancillary bulletin includes the hourly meteorological data value for each data type for the most recent one-hour or three-hour transmission. Also included in the bulletin are two quality control flags which represent the overall quality of the transmission: an automatic flag which indicates if any meteorological tolerances have been exceeded; and a manual flag which indicates problems with the meteorological gauge itself. See Appendix 2 (CREX Bulletin Descriptions) for more detailed information on the format of the routine ancillary bulletin and Appendix 4 (Code Definitions) for more information about the meteorological quality control flags.

### 3.2 Storm Surge Data Bulletins

Storm surge data bulletins are generated every 20 minutes, at two minutes, twenty-two minutes, and forty-two minutes past the hour. These storm surge bulletins contain data reported from gauges every 18 minutes while in their "storm surge" reporting mode. If no gauge is in storm surge mode than no storm surge data bulletins will be generated.

In order for a gauge to be placed in storm surge mode, the gauge must be capable of transmitting in storm surge mode and either a "storm event" must occur which will automatically cause the gauge to enter into its storm surge mode, based on gauge specific criteria, or CO-OPS personnel must manually place the gauge into storm surge mode.

- Automatic Activation

  For automatic activation, a "storm event" is defined as reaching a pre-determined critical water level height, typically a high or low value, or a pre-determined rate-of-change in the water level for east coast stations or reaching a pre-determined critical water level height for west coast stations. If a west coast station exceeds a pre-determined rate-of-change in the water level, it is considered a "tsunami event" and the gauge is placed into "tsunami" reporting mode rather than "storm surge" reporting mode. Tsunami reporting is handled differently than storm surge reporting and is not addressed here. See Section 4.0 for information about tsunami reporting mode. The threshold values used to define a storm event are determined in conjunction with the individual NWS field offices in whose area of responsibility the gauge is located and their respective NWS Regional Headquarters. The NWS Office of Meteorology (OM) then provides these trigger values to NOS. When a storm event causes the gauge to switch to storm surge mode, 18-minute data transmissions continue until the values no longer exceed those limits coded into the gauge.

- Manual Activation

  A gauge may also be placed manually into storm surge reporting mode. To have a gauge turned on manually, the CO-OPS 24-hour Continuous Operational Realtime

Monitoring System (CORMS) staff must be contacted at 301-713-2540. The person requesting the manual trigger will need to provide CORMS with their name, telephone number, the name of the office making the request, a list of the NOS Station IDs for which the storm surge mode should be set, and the length of time for which the station should remain in this state. When a gauge is turned on manually, the 18-minute data transmissions continue for the length of time requested. If no length of time is specified, the transmissions will continue for approximately 24 hours or until the storm surge mode is turned off manually.

Currently, there are two types of storm surge bulletins that can be created: storm surge water level and storm surge ancillary.

### 3.2.1 Storm Surge Water Level Data Bulletins

Each storm surge water level bulletin contains the 6-minute water level values reported from the most recent 18-minute transmission. Residual information which is calculated by subtracting the predicted astronomical water level value from the actual observed water level value is included in the bulletin except for the Great Lakes stations. Great Lakes stations do not have predictions; therefore, no residual can be calculated. Also included in the bulletin are two quality control flags which represent the overall quality of the transmission: an automatic flag which indicates if any water level tolerances have been exceeded; and a manual flag which indicates problems with the water level gauge itself, such as sensor problems or clogging. See Appendix 2 (CREX Bulletin Descriptions) for more detailed information on the format of the storm surge water level bulletin and Appendix 4 (Code Definitions) for more information about the water level quality control flags.

### 3.2.2 Storm Surge Ancillary Data Bulletins

If meteorological data exists for a station, the appropriate storm surge ancillary bulletin is generated at the same time that the storm surge water level bulletin is generated. The meteorological data values that can be included in the bulletin are air temperature, barometric pressure, wind speed, and wind direction. Not all stations have all sensors, so it is possible to have ancillary bulletins that do not contain information for all of the given data types. Each ancillary bulletin includes the first 6-minute meteorological data value for each data type reported in the most recent 18-minute transmission. Also included in the bulletin are two quality control flags which represent the overall quality of the transmission: an automatic flag which indicates if any meteorological tolerances have been exceeded; and a manual flag which indicates problems with the meteorological gauge itself. See Appendix 2 (CREX Bulletin Descriptions) for more detailed information on the format of the storm surge ancillary bulletin and Appendix 4 (Code Definitions) for more information about the meteorological quality control flags.

## 4.0 SUPPORT TO THE TSUNAMI WARNING CENTERS

The NWS Tsunami Warning Program requires real-time access to water level data in the Pacific Ocean Basin. Currently, the Pacific Tsunami Warning Center and the Alaska Tsunami Warning Center have dial-in access to water level data for certain NWLON stations located in their areas of responsibility. In addition, the Pacific area stations are capable of being placed into "tsunami" reporting mode in order to track possible tsunami events.

Just as with storm surge, in order for a gauge to be placed in tsunami mode, the gauge must be capable of transmitting in tsunami mode and either a "tsunami event" must occur which will automatically cause the gauge to enter into its tsunami mode, based on gauge specific criteria, or CO-OPS personnel must manually place the gauge into tsunami mode.

- Automatic Activation

  For automatic activation, a "tsunami event" is defined as exceeding a pre-determined rate-of-change in the water level. When a tsunami event causes the gauge to switch to tsunami mode, 6-minute data transmissions continue until the values no longer exceed those limits coded into the gauge.

- Manual Activation

  A gauge may also be placed manually into tsunami reporting mode. To have a gauge turned on manually, the CO-OPS 24-hour Continuous Operational Realtime Monitoring System (CORMS) staff must be contacted at 301-713-2540. The person requesting the manual trigger will need to provide CORMS with their name, telephone number, the name of the office making the request, a list of the NOS Station IDs for which the tsunami mode should be set, and the length of time for which the station should remain in this state. When a gauge is turned on manually, the 6-minute data transmissions continue for the length of time requested. If no length of time is specified, the transmissions will continue for several hours or until the tsunami mode is turned off manually.

The 6-minute tsunami transmissions are sent *directly* to the tsunami warning centers in a raw format for evaluation. The data is not processed by CO-OPS. No bulletins are generated.

## 5.0 ASCII TEXT FILES

Whenever a routine or storm surge water level CREX bulletin is generated, an ASCII file containing water level information is created for distribution to the NWS Office of Hydrology (OH). All 6-minute water level values obtained from the same transmission used to create the water level CREX bulletin are included in the file. An associated residual and quality indicator

for each 6-minute water level value are placed in the file as well. The data is arranged in the ASCII file according to a format agreed upon between OH and CO-OPS. CO-OPS places these ASCII files in an area accessible to OH on a CO-OPS Silicon Graphics $O_2$ system, running Unix. OH continuously checks this CO-OPS system for available ASCII files. When found, these files are collected from CO-OPS, by OH, reformatted into the Standard Hydrometeorological Exchange Format (SHEF) bulletins and sent through the NWS Telecommunications Gateway for dispersal to the NWS River Forecast Offices over the NWS Advanced Weather Information Processing System (AWIPS) network. See Appendix 3 (ASCII File Definition) for more detailed information on the format of these ASCII files and Appendix 4 (Code Definitions) for more information about the water level quality control flags.

## 6.0 PORTS VOICE SYSTEM

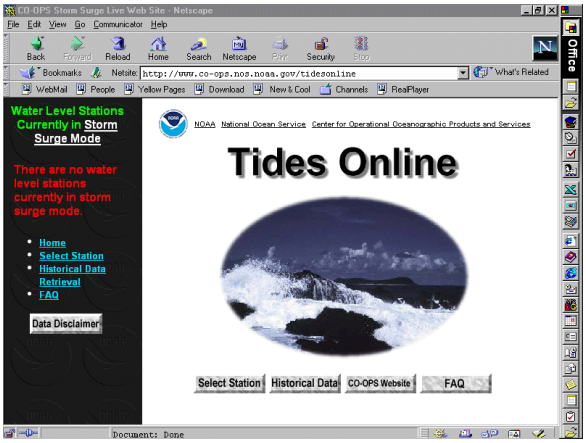
Each PORTS system disseminates observations through a voice data product available via a dial-up touch tone phone which speaks the latest real-time observations. The voice system allows the user to choose what data to hear by providing a menu from which the user selects by pressing the appropriate touch tone keys on the phone. An additional selection is not spoken but available. By pressing 0, the caller can listen to an instrument status check. This is a quick way to determine if any instruments are not available before going through all of the menus. If the user wants to hear all the information, about three minutes expire while navigating through the entire menu. The voice quality is like that of a recorded magnetic tape. The voice system information is available 24 hours a day, seven days a week. Phone numbers associated with the voice system at each PORTS site are available through the CO-OPS Web Page by connecting to **co-ops.nos.noaa.gov/d_ports.html** and selecting the desired site.

## 7.0 CO-OPS WEB-ACCESSIBLE PRODUCTS

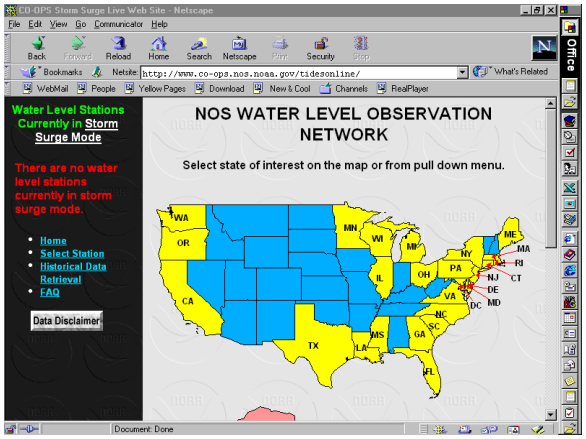
### 7.1 Tides Online

Tides Online is a CO-OPS Web-based product which provides users with the latest graphical and tabular water level and meteorological data for all NOS water level stations. For those stations activated, manually or automatically, for storm surge transmission rates, the Tides Online product also isolates their selection for convenient interactive display. These activated stations are typically located along the projected path of severe storms such as hurricanes.

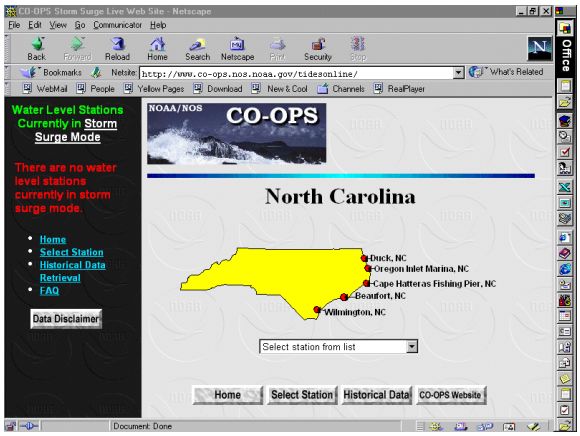
Tides Online can be accessed through the CO-OPS=s Web Page by connecting to **tidesonline.nos.noaa.gov**. Some example screens for navigating from the Tides Online main page to data for Wilmington, North Carolina are shown in Figure 3.



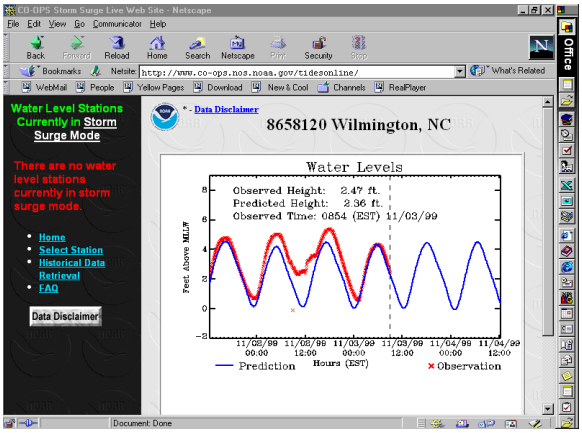

3a.




3b.




3c.




3d.

**TIDES ONLINE**

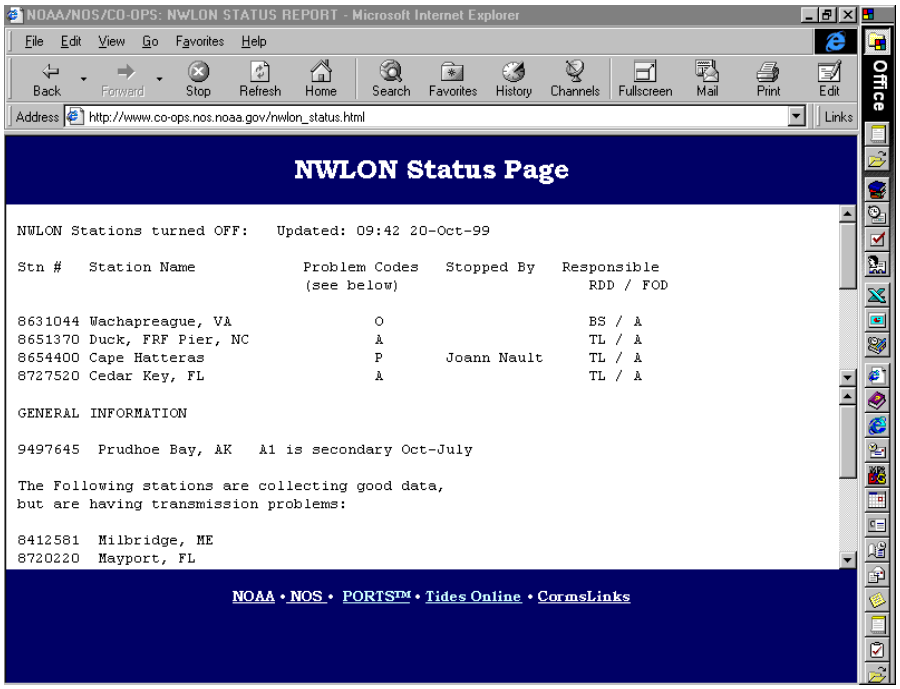
**FIGURE 3**

## 7.2 Water Level Station Status Report

CO-OPS generates a report which provides status information on stations in the NWLON and any other locations equipped with NGWLMS sensors. The purpose of this report is to provide information on stations with acoustic or shaft angle encoder water level sensors that are not, for some reason, transmitting data via GOES; that are experiencing sensor problems and have had data dissemination to external users discontinued; that are scheduled for maintenance; or other events that temporarily or permanently have an impact on the operation of the station.

Only stations with reported problems or special circumstances are listed in this report. The status report is periodically updated by the CORMS operator on duty. If a user suspects that the report does not reflect present situations or conditions, they can call (301) 713-2540, twenty-four hours a day, to get the most up-to-date information.

The Water Level Station Status Report can be accessed through the CO-OPS's Web Page by connecting to **co-ops.nos.noaa.gov/nwlon_status.html.** An example of the report is shown in Figure 4.



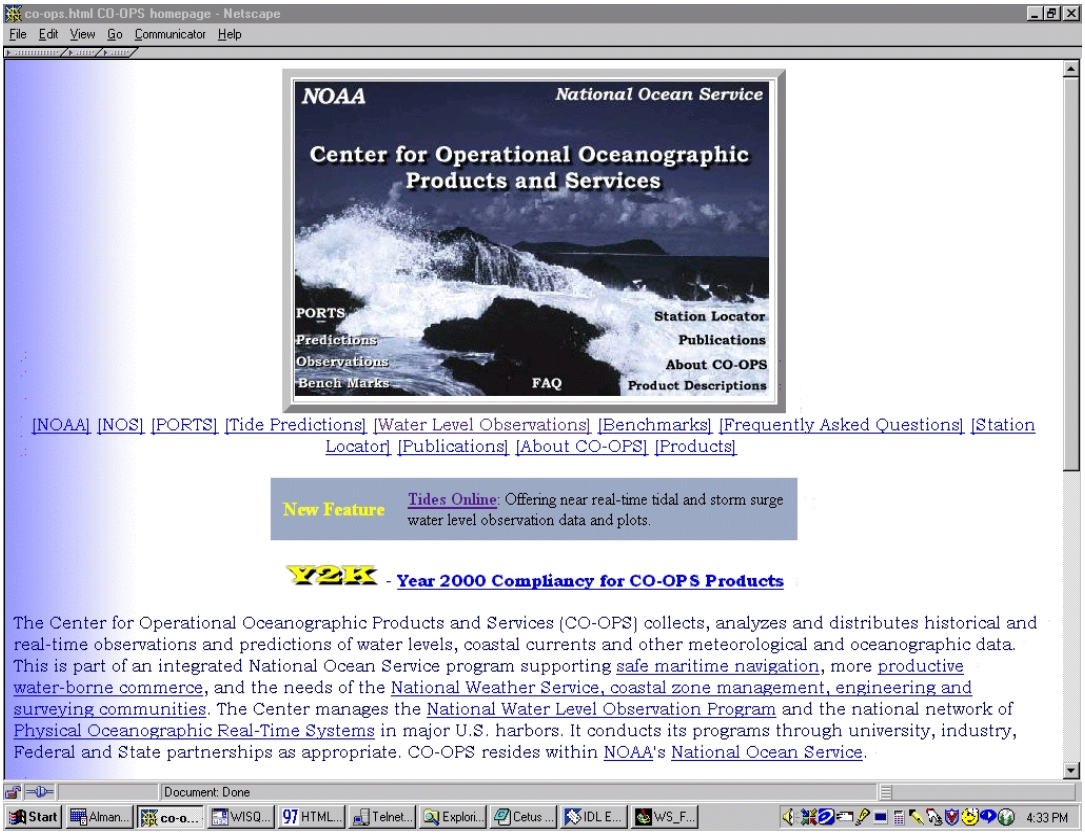

**Water Level Station Status Report**

**FIGURE 4**

## 7.3 Retrieval of Historical Water Level Data

CO-OPS maintains a web site that provides users with direct access to the database which stores all data collected through the NWLON. Through an interface to this database, users can access near-real time water level and ancillary meteorological and oceanographic data from the various water level stations. In addition, users have access to historic 6-minute, hourly, monthly, and annual water level data, six months of tide predictions, and tidal datum information. Users can access and download bench mark descriptions and elevations. The site provides inventory lists of stations for which different types of data are available, as well.

The CO-OPS web site can be accessed by connecting to **co-ops.nos.noaa.gov**. The home page for CO-OPS is shown in Figure 5.

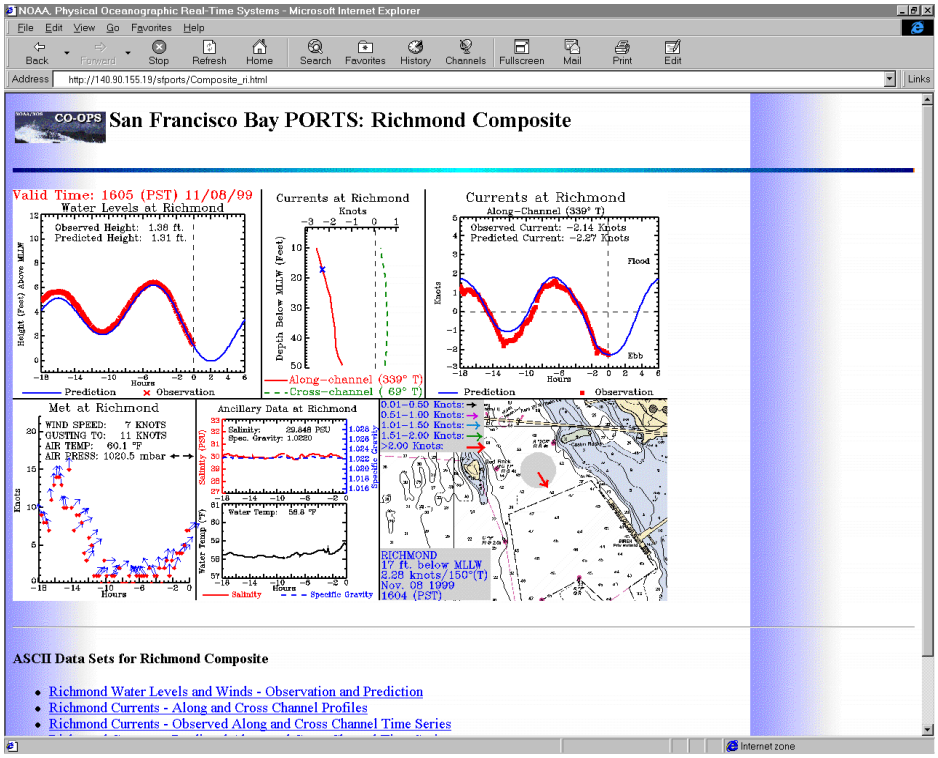



**CO-OPS Home Page**

**Figure 5**

## 7.4 PORTS PICS

PORTS provides real time currents, water levels, and meteorological data every 6 minutes. The PORTS PICS provides a graphical representation of all these real-time PORTS observations as well as predictions. Displays that are offered include time series plots for water level data, current data, wind speed and direction, salinity, water temperature, and specific gravity. The time series for water level and current data includes observed and predicted data for 18 hours in the past and predicted data for 6 hours in the future from the given time stamp for the most recent 6-minute sampling. The remaining time series include observed data for 18 hours in the past. Other displays provide a vertical profile for current data and a vector plot for current data with a cartographic background. A user can gain access to a PICS display through the web by connecting to **co-ops.nos.noaa.gov/d_ports.html**, selecting the desired PORTS site, and selecting to view PORTS data products. A sample of a composite of these various displays for Richmond in San Francisco Bay is shown in Figure 6.

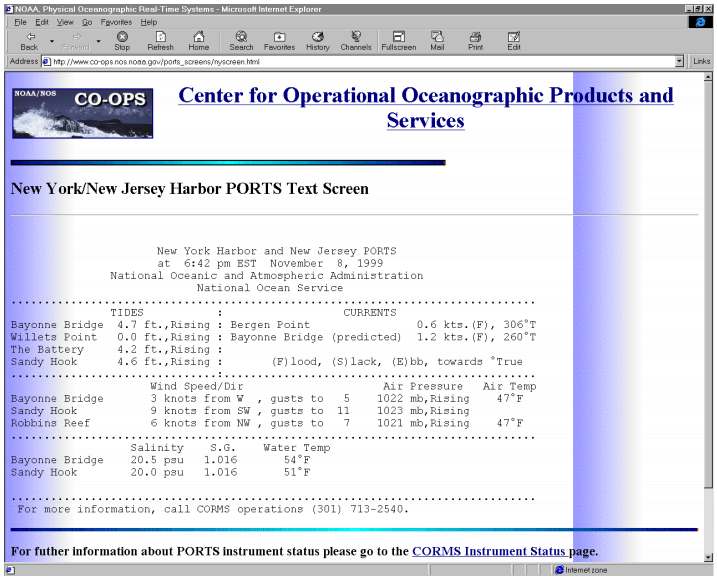



**PICS Display for Richmond at San Francisco Bay PORTS**

**Figure 6**

## 7.5 PORTS Text Screen

Another product provided by PORTS is a text-based real-time data display which shows the latest instrument measurements from the most recent 6-minute sampling for all sensor locations at a single PORTS site. It is a single screen, 22 line message. Access to this screen is provided through the web by connecting to **co-ops.nos.noaa.gov/d_ports.html** and selecting the desired PORTS site. A sample of this screen for New York Harbor is shown in Figure 7.




**Text Screen for New York PORTS**

**Figure 7**

## 8.0 REPORTING PROBLEMS AND REQUESTING CHANGES TO NOS PRODUCTS

It is expected that from time to time there may be questions regarding the operation of these various products or suggestions for improvement. There may also be questions concerning data quality that may not be sufficiently addressed through the NOS Station Status Report. Field offices should work through their Regional Marine Focal Points with these questions or suggestions. The Regional offices will contact the Office of Meteorology (OM).

Similarly, there may be sites where the trigger levels for the event data need to be adjusted. Proposed changes should also filter through the Regional Marine Focal as described above. This will ensure that all changes are fully considered and coordinated prior to their implementation.

The OM Focal Point for these NOS products is Richard May. He will determine if the problem or suggestion is best addressed within the NWS or the NOS and make appropriate contacts or assignments. He can be reached by telephone at (301) 713-1677, extension 127, by fax at (301) 713-1598, or by e-mail at **richard.may@noaa.gov**.

## 9.0 FUTURE PLANS FOR NOS PRODUCTS

CO-OPS has received inquiries from NWS as to plans for providing our data to them in SHEF format. Currently, NOS is investigating the dissemination of bulletins in this format. SHEF is the format used to broadcast information over the AWIPS network. Since NWS plans to replace AFOS with AWIPS, most NWS software is being developed for information received in the SHEF format as opposed to information received in the CREX format. CO-OPS hopes to make SHEF formatted bulletins available to NWS within FY00. It is expected that once SHEF formatted bulletins are available, the CREX formatted bulletins will be phased out.

Currently, there are still several NWLON gauges that are reporting via satellite every 3 hours. CO-OPS is in the process of moving all gauges to a 1 hour reporting cycle. In addition, when a gauge is placed on a 1 hour reporting cycle, enhancements will be included so that the gauge reports the previous hour of data from the most recent minute, as opposed to the most recent hour.

Historically, local NWS offices monitored the water levels in their area of responsibility through direct interrogation of the gauges. As a result of the NOS products now being provided to NWS, direct interrogation no longer needs to be done, and effective January 1, 2000, direct access to the gauge will no longer be available.

# APPENDIX 1

## NWS STATION LIST

Below is a listing of the gauges for which data is currently being reported to NWS. Both the NOS and NWS station identification numbers are given, along with the common station name, and its latitude and longitude. NOS station identifiers have been assigned by NOS, using a two-digit number for each state followed by five digits for the number assigned to that station in that state. NWS station identifiers have been assigned by NWS, using the two-letter abbreviation for each state followed by three digits for the number assigned to that station in that state. The NWS numbers are generally in increments of ten from north to south, or east to west as appropriate, allowing for additional gauges to be added in the future and using the intermediary numbers.

If the gauge is equipped to report meteorological data, the data type(s) it is able to report are annotated as follows: "A" indicates air temperature; "B" indicates barometric pressure; and "W" indicates wind speed and wind direction.

| NWS ID | NOS ID | Location | Latitude | Longitude | Met Data |
|---|---|---|---|---|---|
| AK010 | 9450460 | Ketchikan, AK | 55 20.0N | 131 37.5W | |
| AK020 | 9451600 | Sitka, AK | 57 3.1N | 135 20.5W | |
| AK030 | 9452210 | Juneau, AK | 58 17.9N | 134 24.7W | |
| AK040 | 9453220 | Yakutat, AK | 59 32.9N | 139 44.1W | |
| AK050 | 9454050 | Cordova, AK | 60 33.5N | 145 45.2W | |
| AK060 | 9454240 | Valdez, AK | 61 7.5N | 146 21.7W | B |
| AK070 | 9455090 | Seward, AK | 60 7.2N | 149 25.6W | |
| AK080 | 9455500 | Seldovia, AK | 59 26.4N | 151 43.2W | |
| AK090 | 9457292 | Kodiak Island, AK | 57 43.9N | 152 30.7W | |
| AK100 | 9459450 | Sand Point, AK | 55 20.2N | 160 30.1W | |
| AK110 | 9461380 | Adak Island, AK | 51 51.8N | 176 37.9W | A,B,W |
| AK120 | 9462620 | Unalaska, AK | 53 52.8N | 166 32.2W | |
| AK130 | 9497645 | Prudhoe Bay, AK | 70 24.0N | 148 31.6W | A,B,W |
| AL020 | 8735180 | Dauphin Island, AL | 30 15.0N | 88 4.5W | |

| NWS ID | NOS ID | Location | Latitude | Longitude | Met Data |
|---|---|---|---|---|---|
| CA010 | 9410170 | San Diego, CA | 32 42.8N | 119 10.4W | |
| CA020 | 9410230 | La Jolla, CA | 32 52.0N | 119 15.5W | |
| CA030 | 9410660 | Los Angeles, CA | 33 43.2N | 119 16.3W | |
| CA040 | 9410840 | Santa Monica, CA | 34 0.5N | 119 30.0W | |
| CA050 | 9411340 | Santa Barbara, CA | 34 24.5N | 119 41.1W | A,B,W |
| CA060 | 9412110 | Port San Luis, CA | 35 10.6N | 120 45.6W | |
| CA070 | 9413450 | Monterey, CA | 36 36.3N | 121 53.3W | |
| CA075 | 9414523 | Redwood City, CA | 37 30.4N | 122 12.6W | |
| CA080 | 9414290 | San Francisco, CA | 37 48.4N | 122 27.9W | A,B,W |
| CA085 | 9414750 | Alameda, CA | 37 46.3N | 122 17.9W | A,B,W |
| CA087 | 9414863 | Richmond, CA | 37 55.7N | 122 24.0W | A,B,W |
| CA090 | 9415020 | Point Reyes, CA | 37 59.8N | 122 58.5W | |
| CA100 | 9415144 | Port Chicago, CA | 38 3.4N | 122 2.3W | A,B,W |
| CA110 | 9416841 | Arena Cove, CA | 38 54.8N | 123 42.5W | |
| CA120 | 9418767 | North Spit, CA | 40 46.0N | 124 13.0W | |
| CA130 | 9419750 | Crescent City, CA | 41 44.7N | 124 11.0W | |
| CT010 | 8461490 | New London, CT | 41 21.3N | 72 5.2W | |
| CT020 | 8467150 | Bridgeport, CT | 41 10.4N | 73 10.9W | |
| DC010 | 8594900 | Washington, DC | 38 52.4N | 77 1.3W | |
| DE010 | 8551910 | Reedy Point, DE | 39 33.5N | 75 34.4W | |
| DE020 | 8557380 | Lewes, DE | 38 46.9N | 75 7.2W | |
| FL005 | 8720030 | Fernandina Beach, FL | 30 40.3N | 81 27.9W | |
| FL010 | 8720220 | Mayport, FL | 30 23.7N | 81 25.9W | A,B,W |
| FL020 | 8720587 | St. Augustine Beach, FL | 29 51.4N | 81 15.7W | A,W |
| FL025 | 8721604 | Trident Pier, FL | 28 24.9N | 80 35.6W | |

| NWS ID | NOS ID | Location | Latitude | Longitude | Met Data |
|---|---|---|---|---|---|
| FL040 | 8723214 | Virginia Key, FL | 25 43.9N | 80 9.7W | A,B,W |
| FL050 | 8723970 | Vaca Key, FL | 24 42.7N | 81 6.3W | |
| FL060 | 8724580 | Key West, FL | 24 33.2N | 81 48.5W | |
| FL070 | 8725110 | Naples, FL | 26 7.8N | 81 48.4W | A,B,W |
| FL080 | 8726520 | St. Petersburg, FL | 27 45.6N | 82 37.6W | W |
| FL085 | 8726724 | Clearwater Beach, FL | 27 58.6N | 82 49.9W | A,B,W |
| FL087 | 8727520 | Cedar Key, FL | 29 8.1N | 83 1.9W | |
| FL090 | 8728690 | Apalachicola, FL | 29 43.6N | 84 58.9W | A,B,W |
| FL097 | 8729108 | Panama City, FL | 30 9.1N | 85 40W | |
| FL100 | 8729210 | Panama City Beach, FL | 30 12.8N | 85 52.8W | A,B,W |
| FL110 | 8729840 | Pensacola, FL | 30 24.2N | 87 12.8W | |
| GA010 | 8670870 | Fort Pulaski, GA | 32 2.0N | 80 54.1W | |
| HI010 | 1611400 | Nawiliwili, HI | 21 57.4N | 159 21.6W | |
| HI020 | 1612340 | Honolulu, HI | 21 18.4N | 157 52.0W | A,B |
| HI030 | 1612480 | Mokuoloe, HI | 21 26.2N | 157 47.6W | |
| HI040 | 1615680 | Kahului, HI | 20 53.9N | 156 28.3W | A,B,W |
| HI050 | 1617760 | Hilo, HI | 19 44.0N | 155 3.5W | |
| HI060 | 1619000 | Johnston Atoll | 16 44.3N | 169 31.8W | |
| HI070 | 1619910 | Sand Island, Midway Islands | 28 12.7N | 177 21.6W | W |
| HI080 | 1630000 | Guam | 13 26.5N | 144 39.2E | A,B,W |
| HI090 | 1820000 | Kwajalein, Marshall Islands | 8 44.2N | 167 44.3E | A,B,W |
| HI100 | 1890000 | Wake Island | 19 17.4N | 166 37.1E | B |
| IL010 | 9087044 | Calumet Harbor, IL | 41 43.8N | 87 32.3W | |
| LA010 | 8760551 | South Pass, LA | 28 59.4N | 89 8.4W | |
| LA020 | 8761724 | Grand Isle, LA | 29 15.8N | 89 57.4W | |
| MA010 | 8443970 | Boston, MA | 42 21.3N | 71 3.1W | |

| NWS ID | NOS ID | Location | Latitude | Longitude | Met Data |
|---|---|---|---|---|---|
| MA015 | 8447930 | Woods Hole, MA | 41 31.4N | 70 40.3W | |
| MA020 | 8449130 | Nantucket Island, MA | 41 17.1N | 70 5.8W | |
| MD010 | 8574680 | Baltimore, MD | 39 16.0N | 76 34.7W | |
| MD015 | 8573364 | Tolchester Beach, MD | 39 12.8N | 76 14.7W | A,B,W |
| MD020 | 8575512 | Annapolis, MD | 38 59.0N | 76 28.8W | |
| MD025 | 8571892 | Cambridge, MD | 38 34.4N | 76 4.1W | |
| MD030 | 8577330 | Solomons Island, MD | 38 19.0N | 76 27.1W | A,B,W |
| ME010 | 8410140 | Eastport, ME | 44 54.2N | 66 59.1W | A,B,W |
| ME012 | 8411250 | Cutler Naval Base, ME | 44 38.5N | 67 17.8W | |
| ME014 | 8413320 | Bar Harbor, ME | 44 23.5N | 68 12.3W | |
| ME020 | 8418150 | Portland, ME | 43 39.4N | 70 14.8W | |
| MI010 | 9063090 | Fermi Power Plant, MI | 41 57.6N | 83 15.5W | |
| MI013 | 9075014 | Harbor Beach, MI | 43 50.8N | 82 38.6W | |
| MI016 | 9075035 | Essexville, MI | 43 38.5N | 83 50.8W | |
| MI019 | 9075080 | Mackinaw City, MI | 45 46.7N | 84 43.2W | |
| MI020 | 9087096 | Port Inland, MI | 45 58.2N | 85 52.3W | |
| MI025 | 9087023 | Ludington, MI | 43 56.8N | 86 26.5W | |
| MI100 | 9076060 | De Tour Village, MI | 45 59.5N | 83 53.8W | |
| MI110 | 9076060 | U.S. Slip, MI | 46 30.0N | 84 20.4W | |
| MI120 | 9076070 | S.W. Pier, MI | 46 30.1N | 84 22.4W | |
| MI130 | 9099004 | Point Iroquois, MI | 46 29.1N | 84 37.9W | |
| MI140 | 9099018 | Marquette C. G., MI | 46 32.7N | 87 22.7W | |
| MI200 | 9044020 | Gibraltar, MI | 42 5.5N | 83 11.2W | |
| MI210 | 9044030 | Wyandotte, MI | 42 12.2N | 83 8.8W | |
| MI220 | 9044036 | Fort Wayne, MI | 42 17.9N | 83 5.6W | |
| MI230 | 9034052 | St Clair Shores, MI | 42 28.4N | 82 52.8W | |
| MI240 | 9014070 | Algonac, MI | 42 37.2N | 82 31.6W | |

| NWS ID | NOS ID | Location | Latitude | Longitude | Met Data |
|---|---|---|---|---|---|
| MI250 | 9014080 | St Clair State Police, MI | 42 48.7N | 82 29.2W | |
| MI260 | 9014087 | Dry Dock, MI | 42 56.7N | 82 26.6W | |
| MN100 | 9099064 | Duluth, MN | 46 46.5N | 92 5.6W | |
| MS100 | 8747766 | Waveland, MS | 30 16.9N | 89 22W | |
| NC010 | 8651370 | Duck, NC | 36 11.0N | 75 44.8W | A,B,W |
| NC015 | 8652587 | Oregon Inlet Marina, NC | 35 47.8N | 75 33W | |
| NC020 | 8654400 | Cape Hatteras Fishing Pier, NC | 35 13.4N | 75 38.1W | A,B,W |
| NC030 | 8656483 | Beaufort, NC | 34 43.2N | 76 40.2W | |
| NC040 | 8658120 | Wilmington, NC | 34 13.6N | 77 57.2W | |
| NJ010 | 8531680 | Sandy Hook, NJ | 40 28.0N | 74 0.1W | |
| NJ015 | 8534720 | Atlantic City, NJ | 39 21.3N | 74 25.1W | |
| NJ020 | 8536110 | Cape May, NJ | 38 58.1N | 74 57.6W | |
| NY010 | 8510560 | Montauk, NY | 41 2.9N | 71 57.6W | |
| NY020 | 8516990 | Willets Point, NY | 40 47.6N | 73 46.9W | |
| NY030 | 8518750 | The Battery, NY | 40 42.0N | 74 0.9W | |
| NY033 | 8519483 | Bergen Point West Reach, NY | 40 38.4N | 74 8.8W | A,B,W |
| NY034 | 8311030 | Ogdensburg, NY | 44 42.2N | 75 29.7W | |
| NY036 | 8311062 | Alexandria Bay, NY | 44 19.9N | 75 56.1W | |
| NY038 | 9052000 | Cape Vincent, NY | 44 7.8N | 76 20.2W | |
| NY040 | 9052030 | Oswego, NY | 43 27.8N | 76 30.7W | |
| NY041 | 9052058 | Rochester, NY | 43 16.2N | 77 37.6W | |
| NY043 | 9063007 | Ashland Ave., NY | 43 6.0N | 79 3.6W | |
| NY046 | 9063009 | American Falls, NY | 43 4.9N | 79 3.7W | |
| NY050 | 9063020 | Buffalo, NY | 42 52.6N | 78 53.4W | |
| NY060 | 9063028 | Sturgeon Point, NY | 42 41.4N | 79 2.9W | |
| OH010 | 9063053 | Fairport, OH | 41 45.0N | 81 17.0W | |
| OH020 | 9063063 | Cleveland, OH | 41 32.4N | 81 38.1W | |

| NWS ID | NOS ID | Location | Latitude | Longitude | Met Data |
|---|---|---|---|---|---|
| OH030 | 9063085 | Toledo, OH | 41 41.6N | 83 28.3W | |
| OR010 | 9431647 | Port Orford, OR | 42 44.4N | 124 29.8W | |
| OR020 | 9432780 | Charleston, OR | 43 20.7N | 124 19.3W | |
| OR030 | 9435380 | South Beach, OR | 44 37.5N | 124 2.6W | A,B,W |
| OR040 | 9439040 | Astoria, OR | 46 12.5N | 123 46.0W | |
| PA010 | 8545240 | Philadelphia, PA | 39 56.0N | 75 8.5W | |
| PR010 | 9755371 | San Juan, PR | 18 27.7N | 66 7.0W | |
| PR020 | 9759110 | Magueyes Island, PR | 17 58.3N | 67 2.8W | |
| PR030 | 9751639 | Charlotte Amalie, VI | 18 20.1N | 64 55.2W | A |
| PR040 | 9751401 | Lime Tree Bay, VI | 17 41.8N | 64 45.2W | |
| RI010 | 8452660 | Newport, RI | 41 30.3N | 71 19.6W | |
| RI015 | 8454000 | Providence, RI | 41 48.4N | 71 24.1W | |
| SC010 | 8661070 | Springmaid Pier, SC | 33 39.3N | 78 55.1W | |
| SC020 | 8665530 | Charleston, SC | 32 46.9N | 79 55.5W | |
| TX010 | 8770570 | Sabine Pass North, TX | 29 43.8N | 93 52.2W | |
| TX017 | 8771328 | Port Bolivar, TX | 29 21.8N | 94 46.7W | A,B,W |
| TX020 | 8771450 | Galveston Pier 21, TX | 29 18.6N | 94 47.6W | |
| TX030 | 8771510 | Galveston Pleasure Pier, TX | 29 17.2N | 94 47.4W | A,B,W |
| TX033 | 8771013 | Eagle Point, TX | 29 28.8N | 94 55.1W | |
| TX036 | 8770613 | Morgans Point, TX | 29 40.9N | 94 59.1W | A,B,W |
| TX040 | 8772440 | Freeport, TX | 28 56.9N | 95 18.5W | W |
| TX050 | 8774770 | Rockport, TX | 28 1.3N | 97 2.8W | |
| TX060 | 8775870 | Corpus Christi, TX | 27 34.8N | 97 13.0W | W |
| TX080 | 8779770 | Port Isabel, TX | 26 3.6N | 97 12.9W | |
| VA010 | 8631044 | Wachapreague, VA | 37 36.4N | 75 41.2W | B |
| VA020 | 8632200 | Kiptopeke Beach, VA | 37 10.0N | 75 59.3W | W |
| VA030 | 8635150 | Colonial Beach, VA | 38 15.1N | 76 57.6W | |

| NWS ID | NOS ID | Location | Latitude | Longitude | Met Data |
|---|---|---|---|---|---|
| VA040 | 8635750 | Lewisetta, VA | 37 59.7N | 76 27.9W | A,B,W |
| VA045 | 8636580 | Windmill Point, VA | 37 36.7N | 76 16.5W | |
| VA050 | 8637624 | Gloucester Point, VA | 37 14.8N | 76 30.0W | |
| VA060 | 8638863 | Chesapeake Bay Bridge Tunnel | 36 58.0N | 76 6.8W | A,B,W |
| VA070 | 8638610 | Sewells Point, VA | 36 56.8N | 76 19.8W | A,B,W |
| WA010 | 9440910 | Toke Point, WA | 46 42.5N | 123 57.9W | |
| WA020 | 9443090 | Neah Bay, WA | 48 22.1N | 124 37.0W | |
| WA030 | 9444090 | Port Angeles, WA | 48 7.5N | 123 26.4W | |
| WA040 | 9444900 | Port Townsend, WA | 48 6.7N | 122 45.5W | |
| WA045 | 9446484 | Tacoma, WA | 47 16N | 122 24.8W | |
| WA050 | 9447130 | Seattle, WA | 47 36.3N | 122 20.3W | A,B,W |
| WA060 | 9449424 | Cherry Point, WA | 48 51.8N | 122 45.5W | |
| WA070 | 9449880 | Friday Harbor, WA | 48 32.8N | 123 0.6W | |
| WI010 | 9087057 | Milwaukee, WI | 43 0.1N | 87 53.2W | |
| WI040 | 9087079 | Green Bay, WI | 44 32.4N | 88 0.5W | |

# APPENDIX 2

## CREX Bulletin Descriptions

The format that is used for the relay of NOS data to NWS is called CREX (Character Form for the Representation and EXchange of data). A formal description of CREX code is available from NWS. The following descriptions apply only to the formats being used by CO-OPS for providing data to NWS.

### Routine Water Level Bulletin

The following is a detailed explanation of a routine water level CREX bulletin. Throughout the bulletin, one or more slashes (///) indicate that a value was not available and two plus signs (++) indicate the end of a line. A routine water level bulletin contains 30-minute water level values.

SOUS52 KWBC 021659
CREX0101 A001 D06022++
MA015 1999 11 02 16 00 027 GO 30-30++
0031 0008 0032 0010 0034 0010 0035 0012 0038 0011 0041 0009++
RI015 1999 11 02 16 00 015 GO 30-30++
//// //// //// //// //// //// //// //// //// //// 0068 0041++
7777++

The first line of each bulletin is a WMO header. **SOUS52 KWBC** identifies the region in which the data was collected. The region specified here is the Atlantic Coast. See Appendix 4 for a list of all the region identifiers. **021659** specifies the GMT day, hour, and minute the bulletin was created. In this case, the bulletin was created on day 02, at hour 16, and minute 59.

The second line of each bulletin indicates the bulletin type. **CREX0101** indicates that it is a CREX bulletin, using CREX edition 01 and version 01 of that edition. **A001** indicates the bulletin contains sea surface information. **D06022** indicates the bulletin contains water level data.

The third and fourth lines of this bulletin are specific to the station for which data is being reported. One line is header information and the other line contains the actual data. These two lines will be repeated for each station for which data exists.

In the header record, the NWS Station Identifier is given which in this case is **MA015** and is the identifier for Woods Hole, Massachusetts. **1999 11 02 16 00** (year/month/day/hour/minute) is the initial time stamp that is to be used to calculate the measurement time stamps for the 30-minute water level values contained in the bulletin for the given station. If the data is from a

Great Lakes station, this time is local standard time. For all other stations, the time is GMT. **027** is the sea temperature in degrees Celsius. **GO** are the two flags which indicate the overall quality of the data. The first character is the automatic flag and indicates the quality of the data. The second character is the manual flag and indicates the quality of the gauge. In this example, the letter **G** indicates that the quality of the data is good and the letter **O** indicates that the gauge is operational. See Appendix 4 for a list of all flags. **30** indicates the amount of minutes that are to be added to the initial time stamp, referred to earlier, in order to determine a base time stamp from which the water level time stamps are to be calculated. **-30** indicates the amount of minutes that are to be added to the base time stamp to determine the first and most recent 30-minute water level value time stamp for the given station. The same **-30** also indicates the amount of minutes that are to be added to determine each succeeding measurement time stamp for each succeeding 30-minute water level value. How to use this information to determine the time of each measurement is discussed in the next paragraph.

In a routine water level bulletin, a data record contains six water level values along with an associated residual value for each. The values are reported in centimeters. In this example, **0031**, **0032**, **0034**, **0035**, **0038**, and **0041** are the water level values. **0008**, **0010**, **0010**, **0012**, **0011**, and **0009** are the associated residual values. To determine the time of each measurement, start with the time provided in the station header record which in this case is **1999 11 02 16 00**. The header record indicates **30** minutes need to be added to **1999 11 02 16 00** to calculate the base time stamp of **16:30**. Then **-30** minutes are to be applied to the base time stamp to determine the first and most recent water level value time stamp of **16:00**. **-30** minutes continue to be applied to determine each succeeding time stamp. This means, in keeping with the given example:

| | | |
|---|---|---|
| **0031** | was measured at | **1999 11 02 16:00 GMT** |
| **0032** | was measured at | **1999 11 02 15:30 GMT** |
| **0034** | was measured at | **1999 11 02 15:00 GMT** |
| **0035** | was measured at | **1999 11 02 14:30 GMT** |
| **0038** | was measured at | **1999 11 02 14:00 GMT** |
| **0041** | was measured at | **1999 11 02 13:30 GMT** |

The last line of each bulletin will be **7777++** to indicate the end of the bulletin.

## Routine Meteorological Data Bulletin

The following is a detailed explanation of the routine meteorological CREX bulletin. Throughout the bulletin, one or more slashes (///) indicate that a value was not available and two plus signs (++) indicate the end of a line. A routine meteorological bulletin contains hourly meteorological values.

```
SOUS54 KWBC 021411
CREX0101 A001 D06021++
TX030 1999 11 02 14 11 GO 014 1016 35  //++
TX040 1999 11 02 14 11 GO /// //// 00  //++
7777++
```

The first line of each bulletin is a WMO header. **SOUS54 KWBC** identifies the region in which the data was collected. The region specified here is the Gulf of Mexico Coast. See Appendix 4 for a list of all the region identifiers. **021411** specifies the GMT day, hour, and minute the bulletin was created. In this case, the bulletin was created on day 02, at hour 14, and minute 11.

The second line of each bulletin indicates the bulletin type. **CREX0101** indicates that it is a CREX bulletin, using CREX edition 01 and version 01 of that edition. **A001** indicates the bulletin contains sea surface information. **D06021** indicates the bulletin contains meteorological data.

The third line of this bulletin is specific to the station for which data is being reported. It contains both the station header information and the actual data. This line will be repeated for each set of hourly meteorological values for each station for which data exists. In this record, the NWS Station Identifier is given, which in this case, is **TX030** and is the identifier for Galveston Pleasure Pier, Texas. **1999 11 02 14 11** (year/month/day/hour/minute) is the time stamp that is to be assigned as the measurement time stamp for each set of hourly meteorological values contained in the bulletin for the given station. If the data is from a Great Lakes station, this time is local standard time. For all other stations, the time is GMT. **GO** are the two flags which indicate the overall quality of the data. The first character is the automatic flag and indicates the quality of the data. The second character is the manual flag and indicates the quality of the gauge. In this example, the letter **G** indicates that the quality of the data is good and the letter **O** indicates that the gauge is operational. See Appendix 4 for a list of all flags. The remaining values in the record are the actual data values. In a set, the first value is Air Temperature in degrees Celsius, the second value is Sea Level Pressure in hPa, the next value is Wind Direction in tens of degrees, and the final value is Wind Speed in m/sec. So for Galveston Pleasure Pier, Texas, the following is being reported:

| | | | |
|---|---|---|---|
| Air Temperature | **014** | measured at | **1999 11 02 14:11 GMT** |
| Sea Level Pressure | **1016** | measured at | **1999 11 02 14:11 GMT** |
| Wind Direction | **35** | measured at | **1999 11 02 14:11 GMT** |
| Wind Speed | **Not Available** | measured at | **1999 11 02 14:11 GMT** |

The last line of each bulletin will be **7777++** to indicate the end of the bulletin.

**Storm Surge Water Level Bulletin**

The following is a detailed explanation of a storm surge water level CREX bulletin. Throughout the bulletin, one or more slashes (///) indicate that a value was not available and two plus signs (++) indicate the end of a line. A storm surge water level bulletin contains 6-minute water level values.

SOUS52 KWBC 021406
CREX0101 A001 D06022++
NC040 1999 11 02 14 36 /// MO 6-6++
0075 0043 0076 0041 0078 0041 0080 0040 0082 0040 0083 0039++
7777++

The first line of each bulletin is a WMO header. **SOUS52 KWBC** identifies the region in which the data was collected. The region specified here is the Atlantic Coast. See Appendix 4 for a list of all the region identifiers. **021406** specifies the GMT day, hour, and minute the bulletin was created. In this case, the bulletin was created on day 02, at hour 14, and minute 06.

The second line of each bulletin indicates the bulletin type. **CREX0101** indicates that it is a CREX bulletin, using CREX edition 01 and version 01 of that edition. **A001** indicates the bulletin contains sea surface information. **D06022** indicates the bulletin contains water level data.

The third and fourth lines of this bulletin are specific to the station for which data is being reported. One line is header information and the other line contains the actual data. These two lines will be repeated for each station for which data exists.

In the header record, the NWS Station Identifier is given which in this case is **NC040** and is the identifier for Wilmington, North Carolina. **1999 11 02 14 36** (year/month/day/hour/minute) is the initial time stamp that is to be used to calculate the measurement time stamps for the 6-minute water level values contained in the bulletin for the given station. If the data is from a Great Lakes station, this time is local standard time. For all other stations, the time is GMT. /// is the sea temperature in degrees Celsius, which in this example, is not available. **MO** are the two flags which indicate the overall quality of the data. The first character is the automatic flag and indicates the quality of the data. The second character is the manual flag and indicates the quality of the gauge. In this example, the letter **M** indicates that multiple quality control checks failed for this collection of data and the letter **O** indicates that the gauge is operational. See Appendix 4 for a list of all flags. **6** indicates the amount of minutes that are to be added to the initial time stamp, referred to earlier, in order determine a base time stamp from which the water level time stamps are to be calculated. **-6** indicates the amount of minutes that are to be added to the base time stamp to determine the first and most recent 6-minute water level value time stamp for the given station. The same **-6** also indicates the amount of minutes that are to be added to determine each succeeding measurement time stamp for each succeeding 6-minute water level

value. How to use this information to determine the time of each measurement is discussed in the next paragraph.

In a storm surge water level bulletin, a data record contains six water level values along with an associated residual value for each. The values are reported in centimeters. In this example, **0075**, **0076**, **0078**, **0080**, **0082**, and **0083** are the water level values. **0043**, **0041**, **0041**, **0040**, **0040**, and **0039** are the associated residual values. To determine the time of each measurement, start with the time provided in the station header record which in this case is **1999 11 02 14 36**. The header record indicates **6** minutes need to be added to **1999 11 02 14 36** to calculate the base time stamp of **14:40**. Then **-6** minutes are to be applied to the base time stamp to determine the first and most recent water level value time stamp of **14:36**. **-6** minutes continue to be applied to determine each succeeding time stamp. This means, in keeping with the given example:

| | | |
|---|---|---|
| **0075** | was measured at | **1999 11 02 14:36 GMT** |
| **0076** | was measured at | **1999 11 02 14:30 GMT** |
| **0078** | was measured at | **1999 11 02 14:24 GMT** |
| **0080** | was measured at | **1999 11 02 14:18 GMT** |
| **0082** | was measured at | **1999 11 02 14:12 GMT** |
| **0083** | was measured at | **1999 11 02 14:06 GMT** |

The last line of each bulletin will be **7777++** to indicate the end of the bulletin.

**Storm Surge Meteorological Data Bulletin**

The following is a detailed explanation of the storm surge meteorological CREX bulletin. Throughout the bulletin, one or more slashes (///) indicate that a value was not available and two plus signs (++) indicate the end of a line. A storm surge meteorological bulletin contains the first set of 6-minute meteorological data values reported in the given18-minute transmission.

```
SOUS52 KWBC 021615
CREX0101 A001 D06021++
VA020 1999 11 02 16 15 GO 025 1020 00  //++
7777++
```

The first line of each bulletin is a WMO header. **SOUS52 KWBC** identifies the region in which the data was collected. The region specified here is the Atlantic Coast. See Appendix 4 for a list of all the region identifiers. **021615** specifies the GMT day, hour, and minute the bulletin was created. In this case, the bulletin was created on day 02, at hour 16, and minute 15.

The second line of each bulletin indicates the bulletin type. **CREX0101** indicates that it is a CREX bulletin, using CREX edition 01 and version 01 of that edition. **A001** indicates the bulletin contains sea surface information. **D06021** indicates the bulletin contains meteorological data.

The third line of this bulletin is specific to the station for which data is being reported. It contains both the station header information and the actual data. This line will be repeated for each station for which data exists. In this record, the NWS Station Identifier is given, which in this case, is **VA020** and is the identifier for Kiptopeke Beach, Virginia. **1999 11 02 16 15** (year/month/day/hour/minute) is the time stamp that is to be assigned as the measurement time stamp for the set of meteorological values contained in the bulletin for the given station. If the data is from a Great Lakes station, this time is local standard time. For all other stations, the time is GMT. **GO** are the two flags which indicate the overall quality of the data. The first character is the automatic flag and indicates the quality of the data. The second character is the manual flag and indicates the quality of the gauge. In this example, the letter **G** indicates that the quality of the data is good and the letter **O** indicates that the gauge is operational. See Appendix 4 for a list of all flags. The remaining values in the record are the actual data values. In a set, the first value is Air Temperature in degrees Celsius, the second value is Sea Level Pressure in hPa, the next value is Wind Direction in tens of degrees, and the final value is Wind Speed in m/sec. So for Kiptopeke Beach, Virginia, the following is being reported:

| | | | |
|---|---|---|---|
| Air Temperature | **025** | measured at | **1999 11 02 16:15 GMT** |
| Sea Level Pressure | **1020** | measured at | **1999 11 02 16:15 GMT** |
| Wind Direction | **00** | measured at | **1999 11 02 16:15 GMT** |
| Wind Speed | **Not Available** | measured at | **1999 11 02 16:15 GMT** |

The last line of each bulletin will be **7777++** to indicate the end of the bulletin.

# APPENDIX 3

## ASCII FILE DESCRIPTION

The following is a detailed explanation of the ASCII file sent to the Office of Hydrology for conversion to SHEF. Each record within the ASCII file contains a 6-minute water level value.

| | | | | | |
|---|---|---|---|---|---|
| HI010 | 1611400 | 19991028 02:00 | 0.316 | 0.039 | GO |
| HI010 | 1611400 | 19991028 02:06 | 0.324 | 0.044 | GO |
| HI010 | 1611400 | 19991028 02:12 | 0.321 | 0.039 | GO |
| HI010 | 1611400 | 19991028 02:18 | 0.320 | 0.035 | GO |
| HI010 | 1611400 | 19991028 02:24 | 0.328 | 0.041 | GO |
| HI010 | 1611400 | 19991028 02:30 | 0.337 | 0.049 | MO |
| HI010 | 1611400 | 19991028 02:36 | 0.323 | 0.033 | GO |
| HI010 | 1611400 | 19991028 02:42 | 0.325 | 0.034 | GO |
| HI010 | 1611400 | 19991028 02:48 | 0.335 | 0.043 | GO |
| HI010 | 1611400 | 19991028 02:54 | 0.318 | 0.025 | GO |
| HI020 | 1612340 | 19991028 02:00 | 0.292 | 0.062 | GO |
| HI020 | 1612340 | 19991028 02:06 | 0.294 | 0.059 | GO |

Each record is specific to the station for which data is being reported. It contains both the station header information and the actual data. This line will be repeated for each 6-minute water level value for each station for which data exists.

Looking at the first record as an example, the NWS Station Identifier, **HI010**, and the NOS Station Identifier, **1611400** are specified and are the identifiers for Nawiliwili, Hawaii. **19991028 02:00** (year/month/day/hour/minute) is the measurement time stamp for the 6-minute water level value included with this record. If the data is from a Great Lakes station, this time is local standard time. For all other stations, the time is GMT. The next two values are the actual data, reported in centimeters. **0.316** is the 6-minute water level value and **0.039** is the associated residual. **GO** are the two flags which indicate the quality of the given 6-minute water level value. The first character is the automatic flag and indicates the quality of the actual data value. The second character is the manual flag and indicates the quality of the gauge which measured the given value. In this example, the letter **G** indicates that the quality of the data is good and the letter **O** indicates that the gauge is operational. See Appendix 4 for a list of all flags.

# APPENDIX 4

## CODE DEFINITIONS

### WMO Header Geographic Identifiers

| AFOS Header | WMO Header | Geographic Area |
|---|---|---|
| NMCTIDATL | SOUS52 KWBC | Atlantic Coast and Bays |
| NMCTIDMEX | SOUS54 KWBC | Gulf of Mexico Coast and Bays, Puerto Rico, and the Virgin Islands |
| NMCTIDPAC | SOPA56 KWBC | Pacific Coast and Bays |
| NMCTIDGTL | SOUS53 KWBC | Great Lakes |
| NMCTIDAK | SOAK58 KWBC | Alaskan Coast and Bays |
| NMCTIDHI | SOUS50 KWBC | Hawaii and Pacific Basin |

### Automated Water Level Quality Control Flags

| Code | Meaning |
|---|---|
| G | Good data |
| H | Maximum (high) water level limit exceeded |
| L | Minimum (low) water level limit exceeded |
| R | Rate-of-change limit for water level exceeded |
| F | Flat limit for water level exceeded |
| P | Observed water level minus predicted water level value limit exceeded |
| B | Observed primary water level value minus backup water level value limit exceeded |
| Q | Water level QA parameter (sigmas and/or outliers) limits exceeded |
| S | Sea temperature outside of expected range |
| M | Multiple QC checks listed above failed |

## Manual Water Level Quality Control Flags

| Code | Meaning |
|---|---|
| O | Operational |
| C | Possible clogging problem or otherwise degraded water level data |
| D | Possible datum shift |
| U | Unknown status of water level sensor |
| S | Suspected or known sea temperature sensor problem |
| M | Multiple possible problem listed above |
| X | Bad data - DO NOT DISSEMINATE! |

## Automated Meteorological Quality Control Flags

| Code | Meaning |
|---|---|
| G | Good data from all sensors |
| D | Wind direction outside of allowable range |
| S | Wind speed outside of expected range |
| P | Barometric pressure outside of expected range |
| M | Multiple sensors failed QC checks |

## Manual Meteorological Quality Control Flags

| Code | Meaning |
|---|---|
| O | Operational |
| W | Suspected or known problem with wind sensor |
| P | Suspected or known problem with barometric pressure sensor |
| A | Suspected or known problem with air temperature sensor |
| U | Unknown status of all sensors |
| M | Suspected or known problems with multiple sensors |
| X | Bad data - DO NOT DISSEMINATE! |