Proposal to Harden Three NOAA Water Level Gauges

Executive Summary

During hurricanes and large storm events like Nor'easters, knowing the real-time water levels is crucial to Department of Transportation, emergency managers, Coast Guard, Pilots and others in the maritime community. This information is also important after storms to aid in the transport of goods to storm effected areas. During the resent Hurricane Sandy storm, the New Haven, CT water level gauge was crucial in the transportation of gas to the New York area. To assure data is available during these storm events, water level stations need to be "hardened" or raised and strengthened to survive storm surge and strong winds during major storms. Connecticut has three water level gauges, two are part of the National Oceanic and Atmospheric Administration's (NOAA) Nation Water Level Observation Network (NWLON) and one is part of the Connecticut Department of Transportation's (CDOT) sponsored Physical Oceanographic Real-time system (PORTS®). The CDOT wished to partner with NOAA to harden all three of these water level stations so this crucial data will be available during major storm events.

Background

NOAA is a bureau of the U.S. Department of Commerce (DOC). The Center for Operational Oceanographic Products and Services (CO-OPS) of the National Ocean Service (NOS), an organizational element of NOAA, operates and maintains a network of approximately 210 long-term water level measurement stations as a part of the NWLON around the U.S. coasts and the Great Lakes.

CO-OPS installs and operates water level stations in support of a variety of programs including hydrographic and shoreline mapping projects, marine boundary determination, real time navigation systems, and NOS VDatum projects. The data collected and products derived are also used to ensure safe, efficient, and environmentally sound maritime commerce. There are several other non-navigational, critical applications which utilize water-level and datum information including coastal engineering, dredging, coastal planning and management, marsh restoration projects, long-term sea-level assessments, storm-surge monitoring, emergency preparedness, climate change, HAZMAT response, and water level regulation.

CO-OPS provides a set of water level and coastal current products. These include data and products required by NOAA's National Weather Service (NWS) to meet flood and tsunami warning responsibilities and a national network of PORTS® in major United States harbors.

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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 many meteorological parameters (e.g. winds, atmospheric pressures, visibility, etc.) needed by the mariner to navigate safely. All data are quality controlled through the Continuous Operational Real-Time Monitoring System (CORMS). CORMS is the primary system for real-time Quality Control (QC) in the Center for Operational Oceanographic Products and Services (CO- OPS). The primary mission of CORMS is the QC of all real-time data, systems, and products in the CO- OPS domain, ensuring that a reliable source of real-time data is readily available, while not disseminating data of questionable quality.

PORTS® primary mission is to prevent maritime accidents. Preventing an accident from occurring is the most cost effective approach and the best way to avoid damage to the environment. When accidents do occur, PORTS® data is used to improve the effectiveness of response efforts by providing input for trajectory models and real time conditions for response efforts. However, benefits derived from PORTS® go well beyond navigation safety. Another large benefit to the local maritime community is potential efficiencies in optimizing use of the existing water column and transit schedules. PORTS® data helps improve and validate local NWS marine weather forecasts. PORTS® provides information that can be used to make economic decisions to add or offload cargo to a vessel and/or to maintain or adjust transit schedules based upon availability of water depth, strength/timing of tidal currents, and other conditions. PORTS® sensors are also crucial during big storm events as well to assist in storm-surge monitoring, emergency preparedness and planning and evacuations.

PORTS® is a partnership program where NOAA provides program management, the data collection and dissemination infrastructure, 24x7 QA/QC, new technology development and national standards. The PORTS® local partner provides the requirements for the system and funding for the local equipment, installation and annual operations and maintenance of the equipment. The New Haven PORTS®, is a partnership between NOAA and the CDOT

Hurricane Sandy, a Category 1 storm, made landfall near Atlantic City, NJ on October 30, 2012. The storm traversed from New Jersey through Pennsylvania to Canada where it ended. Record setting storm surges occurred along coastal states from New Jersey to Massachusetts prior to landfall. This record storm surge caused damage at many of the CO-OPS water level stations in this area. Fortunately, Connecticut, while experiencing effects of the storm, was spared the brunt of the storm. Had Connecticut experienced the same storm surge as the New Jersey and New York region, all three water level stations in Connecticut would have been lost as none would have survived the storm surge.

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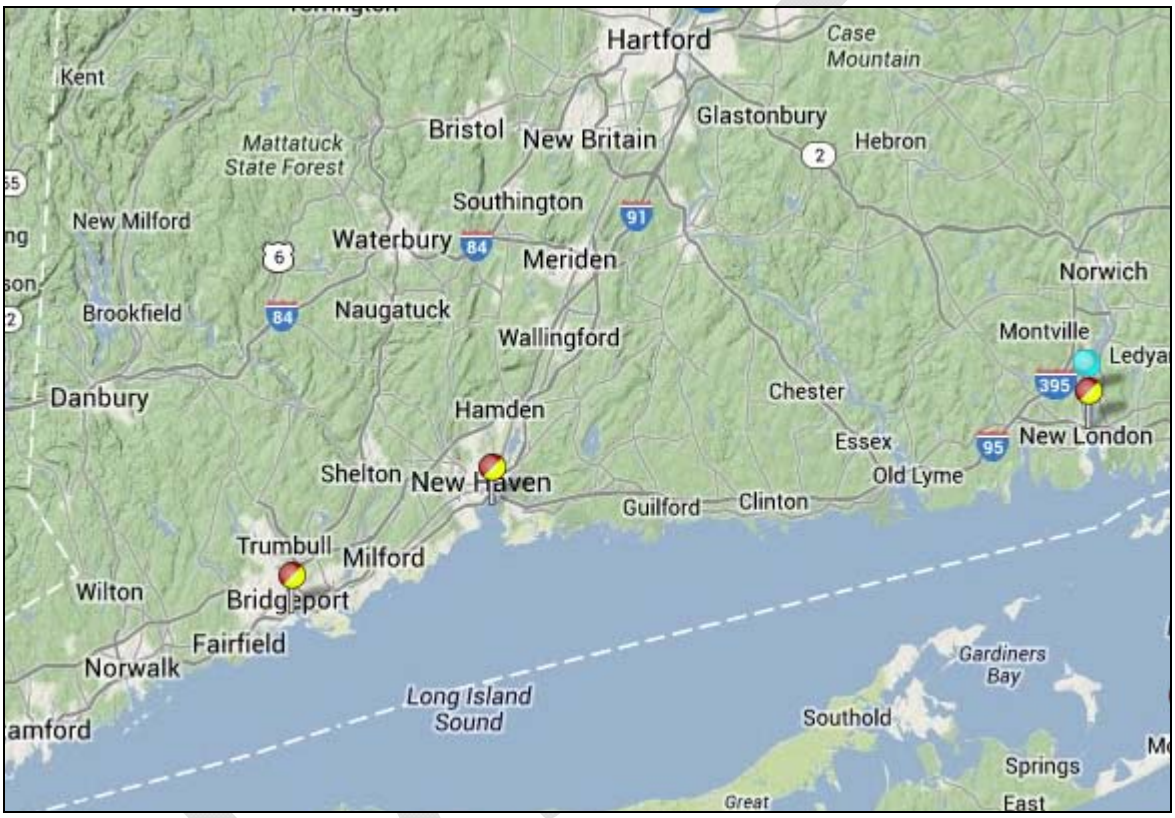
Proposed Hardening

The CDOT proposes to use CDOT capital improvement funds to assist NOAA in hardening the three water level station with Connecticut, so data will be available during major storm events. In addition to hardening, these funds will be used to operate and maintain the New Haven PORTS sensor for an additional five years to assure it's available. The three locations in the state of Connecticut are plotted in figure 1. below.

Figure 1.



Cost of Hardening

The cost of hardening these water level stations involves installing an elevated platform as seen in figures 2 &3. It is also recommended that the use of a new microwave technology be used to reduce maintenance costs and improve reliability. Figure 2. shows the older acoustic technology (white PVC tube) which is currently used at the stations. This method measures the speed of sound from the acoustic sensor in the head to the water surface and back. From this measurement the water level can be determined very accurately. However, the drawback is that components of this system are in the water and require cleaning using divers, driving up maintenance costs. The new microwave technology, used for several years on our bridge air gap sensors, uses a microwave signal that bounces off the water from a fixed height. This is

averaged over six minutes to factor out wave action. Figure 4. is an image of a microwave sensor that is proposed for this project. This system does not have any components in the water and requires less maintenance.

Figure 2.

Figure 3.

Figure 4.

This upgrade will require adding an elevated platform and the microwave sensor to the system and moving the equipment to the platform. The costs below utilizes as much existing equipment as possible.

Table 1. – Equipment and Installation Costs

Preliminary Cost Estimate for three stations

		Summary
Equipment Costs		$85,622
Installation Cost		$87,900
Total Equipment & Installation		$173,522
Spares (% of Equipment costs)	20%	$17,124
Total Equipment, Installation & Spares		$190,647

Operation and Maintenance of the New Haven PORTS® Water Level Gauge

The routine maintenance of the water level station in the New Haven PORTS® is every two months. Routine maintenance involves visiting the station, cleaning solar panels, checking battery levels, downloading stored data, checking for station damage, and verifying all sensors are functioning properly. Annual maintenance is also required at each water level station, where in addition to routine maintenance includes leveling to the station from nearby benchmarks to check vertical stability and a thorough cleaning of the station. Maintenance of this station will cost $15,000 per year for the five year period, see Table 2. below.

Table 2. – Operation and Maintenance Costs for New Haven Water Level

Measurement System	**Annual Operations and Maintenance Costs**				
	Period 1 **Signature – 10/31/14**	**Period 2** **11/1/14 - 10/31/15**	**Period 3** **11/1/15 - 10/31/16**	**Period 4** **11/1/16 – 10/31/17**	**Period 5** **11/1/17 - 10/31/18**
Routine Maintenance	$3,000	$3,000	$3,000	$3,000	$3,000
Annual Maintenance	$12,000	$12,000	$12,000	$12,000	$12,000
Total Operations and Maintenance	**$15,000**	**$15,000**	**$15,000**	**$15,000**	**$15,000**

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Total cost for this upgrade and the maintenance for the New Haven station are as follows:

Total Costs for Proposal

Total Equipment, Installation & Spares	$190,647
Total Operations and Maintenance (New Haven)	$75,000
Total for Project	**$265,647**

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Appendix A

Water Level Station Equipment list

Below is a total equipment list of components in a water level station. The components in yellow are the additional equipment needed for the station upgrades.

Client: Connecticut DOT				
Three New PORTS Microwave Water Level Stations				
Preliminary Equipment Cost Estimate minus the existing equipment already onsite				
Infrastructure Components	**Model #**	**Qty**	**Unit Cost**	**Total Cost**
Sutron NOS G3 Main Station (Xpert 2 Data Logger, Satlink 2 GOES Transmitter, etc.)	3001-0000-1	0	$12,904	$0
Sutron NOS G3 Redundant Gauge (Xpert 2 Dark Data Logger, etc.)	3101-0000-2	0	$6,445	$0
Sandisk 2GB SD Card	2GB	0	$10	$0
Druck Millivolt Output Pressure Transducer	PDCR 4010-A093-A	0	$960	$0
Design Analysis H-3611 Radar Water Level Sensor	H-3611	1	$3,095	$3,095
MWWL Mount Assembly* (Leveling Collar, Protective Cap, Catwalk, etc.)	N/A	1	$2,153	$2,153
Water Temperature Probe	YSI 55032	0	$200	$0
Air Temperature Probe	YSI 44032	0	$185	$0
Double Anemometer "Goal Post" Masthead	N/A	0	$525	$0
RM Young 05103 Wind Monitor	5103	0	$950	$0
Sutron Accubar Barometer	5600-0120-1	0	$758	$0
Trimble GPS Antenna (CO-OPS)	57861-00	0	$65	$0
Digital Antenna (IP Modem)	883-CW	0	$180	$0
Shakespeare Composite Structures Fiberglass White Pole (25 ft.)	AH25-02N7BB01	0	$455	$0
Power Up 40W Multicrystalline Solar Panels	BSP40-12	0	$250	$0
Power Up Solar Panel Mounting Kit	HPM 18/30	0	$50	$0
Carol 2-Conductor Solar Panel Cable (50 ft.)	010305.15T	0	$25	$0
Stevens V2th 5.5 dB GOES Satellite Antenna (Mount Included)	70018	0	$325	$0
Raven XT EV-DO IP Modem w/ DC Power Cable, Bracket (VERIZON)	V2221-V	0	$500	$0
2" Aluminum Alloy Pipe/Mast (10 ft.)	ASTM-B429 6061-T6	0	$53	$0
Mounting Stand for Instrument Enclosure (T6061) 60"X15"	N/A	0	$544	$0
Macromatic Time Delay Relay (TDR) w/ Din Rail Panel Mount & Hold Down Spring	TR-63126	1	$80	$80
Alpha 5-Conductor Signal Cable - (100 ft. - Wind Monitors)	1295C	1	$115	$115
L-COM GPS Cable (15-30 ft.)	SP 57471	1	$50	$50

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Coax RG-213 Antenna Cable Terminated with Female N-Type Connectors (20-50 ft.)	N/A	2	$50	$100
Power Sonic 12V/40AH AGM Battery	PS-12400	3	$150	$450
BatteryMINDer 12V Charger-Maintainer-Desulfator-Conditioner	12248	1	$100	$100
Andrews Mounting Clamp Kit (IP Antenna Mount)	ASPA320	1	$45	$45
West Marine 12" Heavy Duty S/S Antenna Extension	534610	1	$40	$40
Surge Protectors	TWLINX	2	$50	$100
Polyphaser Ring Voltage Protector	1X-1T	1	$55	$55
Loop Current Regulator	LCR-125	1	$39	$39
ASC Solar Voltage Regulator	ASC-12/8	1	$50	$50
PolyPhaser Surge Protector	IS-B50LN-C2	1	$69	$69
Misc. Materials (Conduits, Bolts, Weight Anchors, Rods, Clamps, etc.)	N/A	0	$2,100	$0
Windlass Operated Track Style Mount (NEMA Enclosure, Chain, etc.)	N/A	0	$1,260	$0
APX NEMA 4X Enclosure (30"H X 24"W X 12"D) w/ White Polyester Powder Finish	1-650-000283	0	$565	$0
Modular Elevated Frame Stack Module w/ Ladder	N/A	1	$22,000	$22,000
Modular Elevated Frame Deck Module w/ Grate and Ladder	N/A	0	$22,000	$0
Total Estimated Cost for one Station				$28,541
Number of Stations				3
Total Estimated Equipment Cost for 3 stations positioned on bridge foundations along I-95 corridor in Connecticut				$85,622

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