

**Center for Operational Oceanographic Products and Services Implementation Plan
Water Level Observation Network for Central America**

**US Department of Commerce, National Oceanic and Atmospheric Administration
National Ocean Service, February 11, 2000**

TABLE OF CONTENTS

Background.....	1
Objectives	1
Water Level Observation Network	2
Station Configuration.....	3
Equipment Procurement and Station Installation	3
Data Acquisition, Data Analysis, and Data Dissemination	4
Geocentric Fixing of Water Level Stations	4
Capacity Building	4
Benefits to Other Projects/activities in the Region	4
References.....	6
Figure 1. Water Level Observation Network Stations to Support Mitch Reconstruction	7
Figure 2. Typical WLON station configuration.....	8
Figure 3. Data acquisition, data analysis, and data dissemination system.....	9

Water Level Observation Network For Central America

Background

The Center for Operational Oceanographic Products and Services (CO-OPS) was requested by DOC/NOAA to submit a plan for the reconstruction of the water level observation network in Honduras for the U.S. Department of Commerce's Implementation Plan For Reconstruction Work in Central America (DOCIP). DOCIP is an intergovernmental cooperative effort, funded by Congress, to assist Central American countries affected by hurricane "Mitch" with the reconstruction of damaged infrastructure. USAID missions in Central America reviewed the DOCIP and indicated that it was not necessary to install a dense network of water level stations in Honduras or any of the other affected countries. However, USAID did agree that it was necessary to install water level stations to support the reconstruction and improvement of the Geodetic Control Network in Central America. The following water level network was designed to provide the required mean sea level (MSL) data to support the development and reconstruction of the geodetic control networks in El Salvador, Guatemala, Honduras, and Nicaragua. CO-OPS used an existing technical agreement between NOAA and the Organization of American States (OAS) to obtain contractual services to procure equipment, install the stations, train host country participants, and set up a sea level analysis and sensor calibration center.

Objectives

The objectives of this activity are:

- 1) install 6 state-of-the-art sea level and meteorological monitoring stations, recover historical MSL data and update the local MSL datum at these stations to support the development of a geodetic framework for Central America;
- 2) develop a national and regional capacity to install and maintain the stations, conduct data acquisition, data analysis, data archiving and data dissemination activities using automated data base management technology; and
- 3) strengthen professional and technical skills of host country agencies as well as national and regional institutions through technology transfer and capacity building.

Successful implementation of this activity is directly related to the degree of participation provided by host country agencies and national and regional institutions. Presently NOAA is in contact with the Instituto Nicaraguense de Estudios Territoriales (INETER) and the Empresa Nacional Portuaria (ENP) in Nicaragua, the Instituto Geografico Nacional (IGN) and the ENP in Honduras, the Instituto Nacional de Sismologia, Vulcanologia, Meteorologia E Hidrologia (INSVMEH) in Guatemala, and the Instituto Geografico Nacional (IGN) in El Salvador.

NOAA will coordinate hands-on training, seminars, and workshops to ensure that the designated host country agencies as well as national and regional institutions are fully capable of operating and maintaining the WLON.

Water Level Observation Network (WLON)

Final WLON design and site selections were a the result of discussions with the host country agency participants and a site reconnaissance of existing and historical water level sites. The site reconnaissance were conducted by representatives of the host country agency, CO-OPS and OAS contract personnel. Some of the site selection criteria consist of:

- 1) length of the MSL series available;
- 2) adequate bench mark network available;
- 3) adequate facilities and security for long term measurements; and
- 4) for existing site, did the MSL data represent an open coast environment.

The following list was prepared from information in the CO-OPS historical water level archives, station lists from host country agencies and from meeting with officials from the ENP in Nicaragua and Honduras. The US Department of Transportation, Maritime Administration was requested by the ENP to conduct a Port Damage Assessment and several stations were identified by the ENP as critical to port operations and safe navigation as a result of this assessment. The final WLON consists of 6 stations selected from the list of historical and existing stations in each country (Fig. 1). USAID and the National Weather Service requested that CO-OPS add a new site to the WLON. The new site is at the entrance to the Rio Lempa River in El Salvador and is required to assist with regulating river flow during dam discharge operations upstream. Timing the discharge with the falling tide or low waters is critical to mitigating upstream flooding.

EL SALVADOR

<i>Station</i>	<i>Latitude (N)</i>	<i>Longitude (W)</i>	<i>Years</i>
Acajutla	13° 35'	89° 51'	>2
La Union	13° 20.0'	87° 49.3'	19
Rio Lempa	New Site		

GUATEMALA

<i>Station</i>	<i>Latitude (N)</i>	<i>Longitude (W)</i>	<i>Years</i>
Puerto San Jose	13° 55.0'	90° 49.8'	20
Matias DeGalvez	15° 41.6'	88° 37.2'	6

HONDURAS

<i>Station</i>	<i>Latitude (N)</i>	<i>Longitude (W)</i>	<i>Years</i>
Puerto Cortes	15° 50.1'	87° 57.2'	19
Puerto Castilla	16° 01.0'	86° 02.0'	13
San Lorenzo	IGN Site		

NICARAGUA

<i>Station</i>	<i>Latitude (N)</i>	<i>Longitude (W)</i>	<i>Years</i>
Puerto Cabezas	14° 01.2'	83° 22.9'	11
Corinto	12° 28.7'	87° 10.1'	4

Station Configuration

A typical station in the Central American WLON consists of an air acoustic water level sensor, a backup pressure water level sensor, a protective well, meteorological sensors, a data collection platform (DCP), a Geostationary Earth Orbiting Satellite (GOES) radio transmitter, a voice modem, a 12 V battery and 35 W solar panel, and a permanent bench mark network composed of a minimum of five survey monuments (Fig. 2). The DCP provides on-site data acquisition, storage, and telemetry options, which include GOES satellite, telephone, line-of-sight radio, and on-site download via an RS232 port. GOES telemetry is the primary mode of data retrieval for the WLON, telephone is optional. Since GOES transmission time is critical, the DCP's will be equipped with a GPS board to ensure the system is on the precise UTC time. WLON station design and components comply with the minimum

standards of the Global Sea Level Observing System network of the Intergovernmental Oceanographic Commission (UNESCO 1990) and consistent with the sea level stations in the Caribbean: Planning for Adaptation to Global Climate Change network (Martin, et. al. 1998).

NOAA shall provide engineering support to investigate the possibility of acquiring high quality tsunami measurements (Gonzalez, et. al. 1993) from WLON stations to enhance the Tsunami Warning System (TWS) on the Pacific Coast and to initiate the installation of a warning system on the Caribbean Coast in response to growing concerns of the Tsunami hazard (UNESCO, 1996) in that tectonically active region.

Equipment Procurement and Station Installations

Equipment procurement and the installation and the operation and maintenance (until December 31, 2001) is being accomplished through an existing cooperative agreement between NOAA and the General Secretariat of the Organization of American States (GS/OAS) in accordance with Section II.A. of the Agreement for Technical Cooperation. CO-OPS provided GS/OAS with a set of specifications for the required equipment and a statement-of-work (SOW) for the proper installation, operation, and maintenance of the stations. GS/OAS is managing the contracting requirements. A project monitor from CO-OPS ensures compliance with the equipment specifications and SOW.

Data Acquisition, Data Analysis, and Data Dissemination

Data acquisition of the GOES telemetry data shall be accomplished via GOES ground stations located in Central America. National and Regional users have direct access to all of the data over the INTERNET (Fig. 3). NOAA shall provide on-site assistance with any operational problems and on-site training on database management and quality control and quality assurance procedures, in addition to providing training at NOAA facilities. Data analysis and data archiving capabilities are being developed within the host country agencies and Regional institutions. However, NOAA shall process and analyze one year of sea level (tide) data from each of the 6 stations in the WLON. During this time, NOAA shall work closely with National agencies and Regional institutions to provide technical assistance in developing the WLON to it's fullest capacity.

Geocentric Fixing of Tide Stations

A minimum of one bench mark at each WLON station will be occupied with GPS to precisely position the stations in the International Terrestrial Reference Framework (ITRF). Multiple days of GPS observations will be conducted with GPS receivers and antenna that meet geodetic standards to obtain geodetic quality 3-D positioning of the stations. CO-OPS/OAS will provide on-site training to host country agency staff on the standard procedures for conducting precise GPS surveys at each WLON station. Precise positioning of WLON stations in the ITRF provides National and Regional consistency to the network. More importantly, this provides an opportunity to monitor crustal motion at the National and Regional level and determine absolute sea level change in the area.

Capacity Building

The designated National agencies participated in the final site selections and will participate in all of the sensor installations and GPS observations. NOAA and contract personnel will provide on-site training to host country staff during these activities and coordinate the development of in-country tides workshops. These in-country workshops will be coordinated with the National Weather Service/NOAA training activities. In addition to the on-site training, NOAA will provide in-house training to the staff from the designated

agencies on the proper installation, operation, and maintenance of water level stations at a NOAA facility to ensure full capability in all aspects of operating and maintaining the WLON stations. NOAA will also make available and provide training on the use of quality control and quality assurance and sea level analysis software to assist with processing and archiving the data.

Benefits to Other Projects/activities in the Region

The primary purpose of the WLON is to provide support for the development and improvement of the geodetic framework of Central America. However, information and data derived from WLON will be used in decision making by a variety of National and Regional agencies responsible for coastal resource management. Coastal management agencies will use these data to assist with monitoring the water quality, impact of sea level rise as a result of global climate change, and preparing coastal zone management plans. Regulatory agencies will use the data for permitting and enforcement and to determine marine boundaries for jurisdiction and managing offshore minerals resources. Emergency management agencies will use the data to prepare storm evacuation maps, to assist with early coastal hazard warnings for hurricanes and tsunamis, and coastal sea level predictions associated with climate change (Pugh, D. T. and Maul G. A., 1999).

Data from the WLON supports the design, development and construction of harbor facilities to enhance maritime commerce, to produce accurate nautical charts, and to improve marine nowcasts and forecasts. WLON stations will also have the capability of providing real-time water level and meteorological data to large vessels (oil tankers, containers, and cruise) to improve safe navigation and docking operations.

References

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Fig. 1 Water Level Observation Network Stations to support Mitch Reconstruction

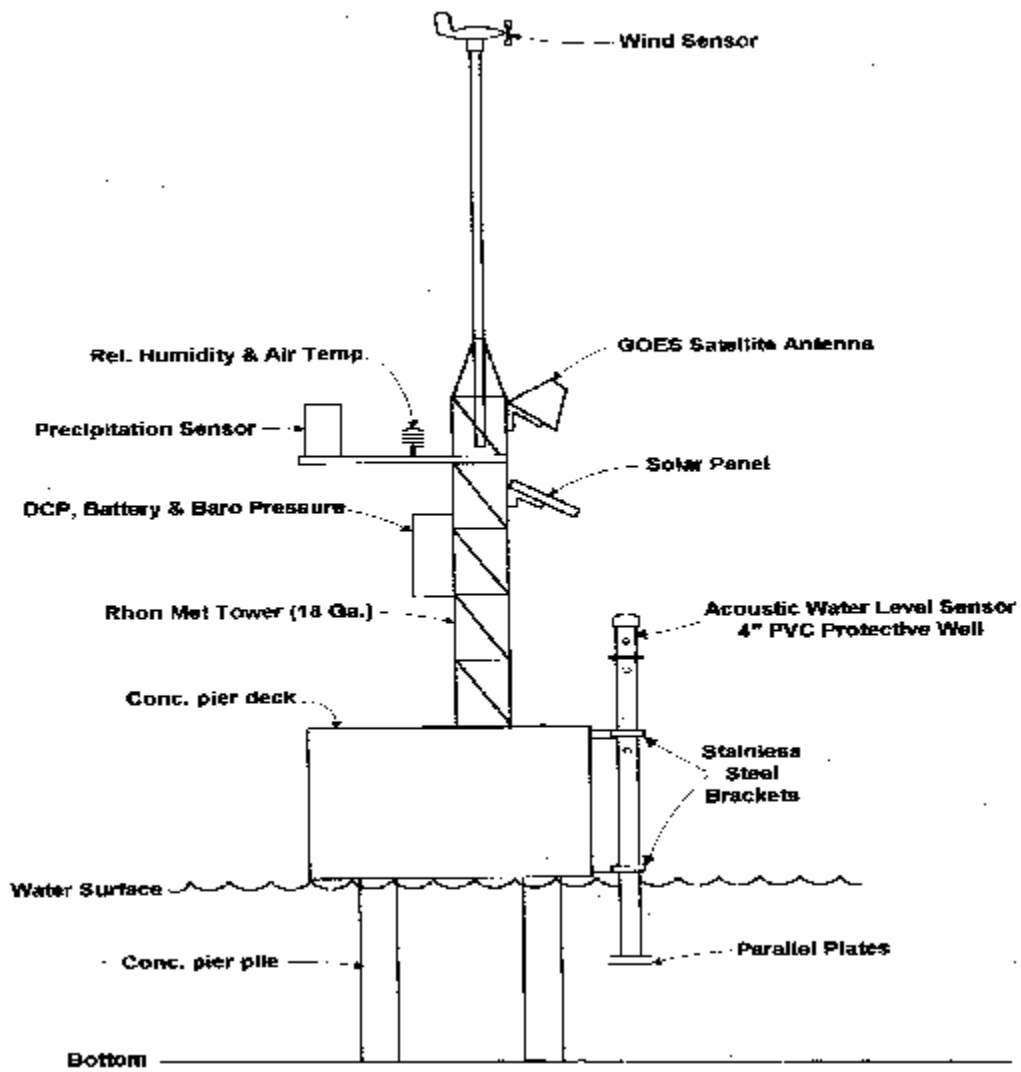


Fig. 2 Typical WLOn station configuration.

Data Acquisition, Data Analysis, and Data Dissemination System

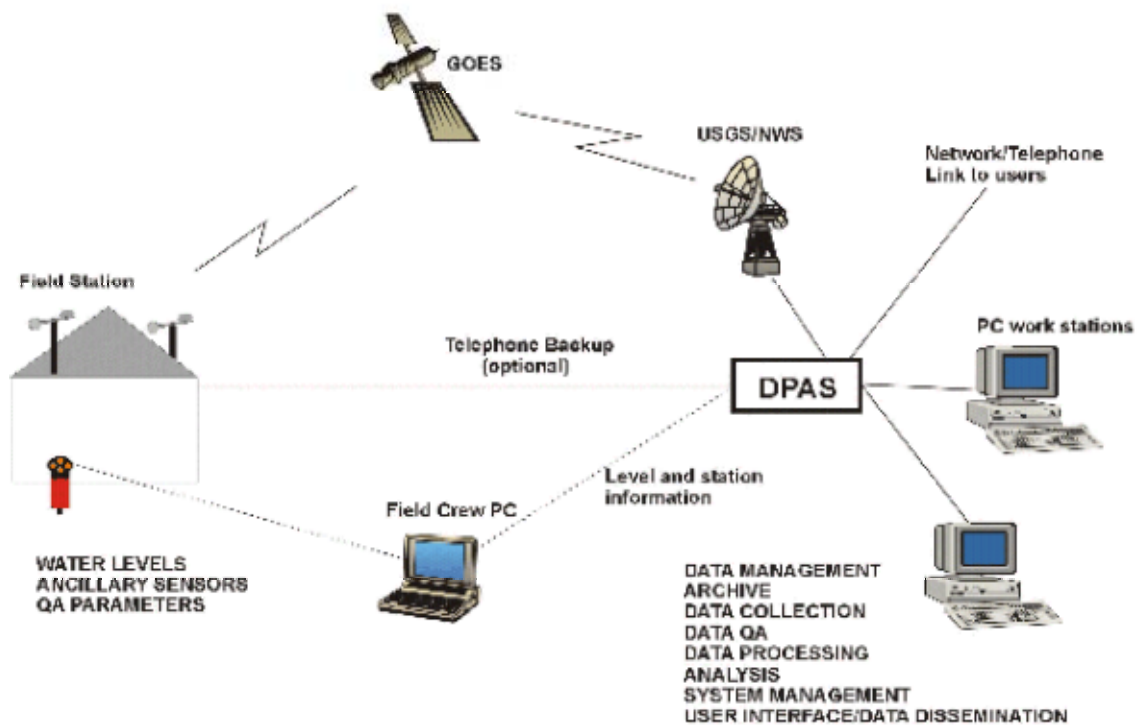


Fig. 3 Data Acquisition, Data Analysis, and Data Dissemination System