CO-OPS WATER LEVEL PARTNERSHIP POLICY:

NOS WATER LEVEL DATUM PARTNERSHIPS

Purpose of this document:

This document outlines the parameters for water level partnerships that advance CO-OPS mission by providing official National Ocean Service (NOS) tidal or Great Lakes datums, as well as other water level products. CO-OPS recognizes that other entities have the need to collect high-quality water level observations, and that where CO-OPS and another entity share strategic interest in the specific station location, both can realize benefits through a collaborative partnership.

CO-OPS has a strategic mission interest in accessing short- (e.g., 90 days) and medium- (e.g., one year) length time series of water level observations collected to NOS standards in specific areas. Filling gaps in coastal datum coverage helps NOS with the production of NOS VDatum models, NOAA Navigation Charts, and other NOS mapping and charting products; and the associated water level observations also directly support NOS' oceanographic, inundation, and sea level change modeling efforts. It is critical that water level observations collected by partners and used by NOS are of high quality and appropriately vertically-referenced, and have appropriate station documentation and metadata. Associated water level observations are ingested in the CO-OPS database, and the data and associated products are available on the NOS Tides and Currents website as authoritative government products.

This policy also recognizes that some entities have a statutory or regulatory requirement to use official NOS datums for coastal construction projects or legal boundary determination in a location that is of less strategic interest to CO-OPS, and as such, it provides a mechanism for a full cost-reimbursable partnership for these situations.

There are three general partnership pathways, which are discussed in further detail below:

- Collaborations using a partner's short- or medium-length time series of water level observations that can be used to fill critical datum gaps for the development of NOAA VDatum models, as well as supporting the production of nautical charts, determination of coastal boundaries, and/or development and validation of oceanographic, inundation, or sea level change models. Typically, this involves the non real-time transfer to CO-OPS of a short- or medium-length time series of water level observations collected to NOS standards. In this partnership pathway, CO-OPS can process the water level data and create tidal products as an in-kind contribution to the partnership. See *Section A* below for associated partnership parameters.

    - For the purposes of this policy, a short-length time series of water level observations is typically 90 days, with a minimum of 30 days. A medium-length time series of water level observations is typically one year. A long-term time series is one that is expected to collect at least 19-years of data (a full tidal datum epoch).
- Where CO-OPS does not have a strategic mission interest in the station location, CO-OPS provides a cost reimbursement arrangement in situations where the partner requires an official NOS tidal or Great Lakes datum for policy, regulatory, or legal reasons. Typically, this involves the non real-time transfer to CO-OPS of a short- or medium-length time series of water level observations collected to NOS standards. In occasional instances, the partner's requirements may result in the ongoing processing of water level observations from a long-term station, again through an appropriate cost reimbursement arrangement. See *Section B* below for associated partnership parameters.
- Collaborations using a partner's long-term (e.g., multi-decade) time series of water level observations that can be used to fill critical gaps in the National Water Level Observation Network (NWLON) for primary datum control, with data collected by the partner to NOS standards and NWLON station specifications, and typically made available to CO-OPS in non real-time. In this partnership pathway, CO-OPS can process the water level data and create tidal products as an in-kind contribution to the partnership. See *Section C* below for associated partnership parameters.

How this policy relates to the National Water Level Observation Network

CO-OPS operates the NWLON to provide primary vertical control of the nation's tidal and Great Lakes datums. NWLON observations are held to a very strict error tolerance, since the NWLON must generate a long-term, continuous time series of highly accurate water level observations for the purposes of creating the tidal and Great Lakes datum components of the National Spatial Reference System (NSRS), as well as generating authoritative tide predictions and sea level trends for the nation. NWLON stations also collect water level observations in real-time to support safe marine navigation and associated decision-support tools. NWLON mission outcomes require:

- Highly accurate real-time data collection through both primary and backup water level sensors (typically using different technologies) to support safe marine navigation in our nation's coastal waterways.
- Continuous, highly accurate water level observations over 19-year tide cycles in order to update the authoritative National Tidal Datum Epoch (NTDE).
- Continuous, highly accurate water level observations over at least 30-year periods in order to generate authoritative NOS Sea Level Trends, which are averaged by month to compute an accurate linear trend with a 95% confidence interval.

The NWLON operates with a configuration and for timeframes that is typically beyond the needs of other entities, and operating a real-time water level station at NWLON standards over these 19- and 30-year timeframes comes with a significant cost and administrative responsibility. CO-OPS maintains its NWLON water level observation standards in the document, *Standing Project Instructions for Coastal and Great Lakes Water Level Stations*. Partners in active NOS Datum Partnerships will not be expected to meet NWLON standards, but instead will be required to meet NOS standards found in *CO-OPS' Specifications and Deliverables for Installation, Operation, and Removal of Water Level Stations*. A list of acceptable water level sensors is provided in the document, *NOAA CO-OPS Environmental Measurement Systems Sensor Specifications and Measurement Algorithms*.

Would an NOS Tidal and Water Level Datum Partnership station be referred to as an NWLON station? No. NWLON stations nationally are NOAA-funded water level stations, where the agency has made a long-term commitment to the maintenance of high quality water level observations in a specific geographic location. Collaborative partnerships that provide high quality water level observations in critical gaps in the NWLON are not considered NWLON stations.

What are some key considerations before entering into this type of partnership with CO-OPS? Water level observations under this partnership type must be collected and processed to NOS standards, and must include all associated station documentation and metadata. Typically, partners will be experienced in collecting high quality water level observations and will have sufficient funding available to perform all the steps that will result in an official NOS datum.

A. SHORT AND MEDIUM-TERM TIDAL AND WATER LEVEL DATUM PARTNERSHIPS

CO-OPS seeks a limited number of collaborative partnerships to fill specific datum gaps with high quality water level observations. CO-OPS uses a Geographic Information System (GIS)-based visualization tool of existing datums and gaps - including gaps in the NWLON - in order to identify locations where CO-OPS has a strategic mission interest. In all cases, associated water level observations must be collected and processed to NOS standards, and must include all associated station documentation and metadata. These water level observations are ingested in the CO-OPS database, and the data and associated products are available on the NOS Tides and Currents (T&C) website. CO-OPS and the partner will establish a formal, signed data sharing agreement that outlines the responsibilities of both parties, and references applicable NOS standards. CO-OPS will process these short- and mid-term water level data sets at no cost to the partner.

CO-OPS predominately seeks partnerships using data made available to CO-OPS in non real-time, irrespective of whether the water level observations are disseminated by the

partner in real-time or not. The simple reason is that hosting a partner's real-time water level observations on the Tides and Currents website comes at a higher relative administrative cost to CO-OPS, since these observations are treated just like a typical NWLON or Physical Oceanographic Real Time System (PORTS®) station with 24-7-365 real-time quality control, daily station status notifications, and auto-generated internal troubleshooting processes.

Non-real time data and metadata can be passed to CO-OPS at any time, or if disseminated in real-time by the partner, picked up by CO-OPS at any time via web services. In addition, verification of NOS standards through station documentation and metadata records, as well as associated data processing can be completed on a schedule that does not conflict with real-time NWLON and PORTS® operations.

How are data and products displayed?

- Data are available, with an appropriate disclaimer, on the Historic Water Level-Station Selection Page
    - Wherever possible, CO-OPS will provide a link to the original data source on the station home page
    - The station will be available through the advanced visualization options (i.e., Historic Data under Data Type) in the Tides and Currents website map
- Products provided through this partnership include:
    - CO-OPS standard verified water level products (six minute water level, hourly heights, highs/lows, and monthly mean water level)
    - Published (accepted) NOS Tidal Datums
    - Published benchmark elevations (e.g., benchmark sheets)
    - NOAA tide predictions
    - Harmonic constituents
- Products are available on the following webpages: Datums, Benchmark Sheets, Tide Predictions, and Harmonic Constituents

What kind of in-kind support can CO-OPS provide?

While it is expected that most NOS Datum Partners will have experience in collecting high quality water level observations, the in-kind services CO-OPS can provide include:

- Technical assistance with water level data collection (consulting on sensors, hardware, and how to establish and maintain vertical control), including complete specifications for a Scalable Water Level Station
- Technical assistance with station documentation and metadata reporting
- IT support for data ingestion via web services or electronic file transfer
- Data ingestion and station configuration for display on the T&C website
- QA/QC of data

- Processing short- and medium- length time series of water level observations and production of tidal products at no cost to the partner. CO-OPS will generate a datum and associated tidal products from the time series of water level observations made available, typically up to a maximum of one year of data. If the partner continues to collect water level observations to NOS standards at the same location over several years to decades, CO-OPS may choose to update the associated datum and associated tidal products with another year-long time series of water level observations, as needed (e.g., in a location with known land subsidence).
- Data availability through the CO-OPS Data Application Programming Interface (API)
- Data archival at NCEI (for verified data)

What are the specific partnership requirements?

- Partner enters into a formal, signed data sharing agreement with CO-OPS that outlines the responsibilities of both parties, and references applicable NOS standards. As long as the associated water level observations and tidal products are available on the NOAA Tides and Currents website, CO-OPS will keep this agreement on file.
- Partner is responsible for the acquisition of all station components, installation of the station and instrumentation, and ongoing operations and maintenance (O&M) of the station to NOS standards
    - CO-OPS approved water level sensor and data collection configuration, including data collection with 6-minute averaging (either internal or external)
    - Data stored locally in a Data Collection Platform (DCP)
- Partner makes the data available to CO-OPS
    - Water level data is available on a functional API that can be queried to retrieve data (i.e., a web service); this query should return 6-minute data and a time stamp of the observation centered on the 6-minute mark, i.e. 00, 06, 12, 18, 24,... past the hour
    - Other electronic file transfer in a format to NOS standards
- Partner ensures sensor vertical stability based on NOS standards found in the *User's Guide to Vertical Control and Geodetic Leveling for CO-OPS Observing Systems*
    - Install the sensor on a stable platform (e.g., a concrete pier or bulkhead)
    - Maintain a network of at least 3 (preferably 5) bench marks of Class B or higher
    - Leveling equipment and techniques that meet 2nd order class I standards as defined by NOAA/NGS are required.

    - A primary bench mark must be established and included in the leveling runs every time
    - Leveling surveys must be performed at regular intervals and after major events, and must include the sensor.
    - For new or upgraded stations, bracketing levels are also required within one year (for medium-length time series of water level observations), or for the data collection period if less than one year (for short-length time series of water level observations)
    - A geodetic tie will be made (at least once every 5 years for medium-term stations) at each location to establish appropriate NGS-approved vertical datum (e.g., soon to be NAPGD2022) heights of the gauge and reference marks.
    - The total error of the 6-minute water level observations relative to a defined vertical datum must not exceed 5 cm (at 95% confidence), plus additional datum error associated with short- and medium-length time series of water level observations.
- Partner provides station documentation and metadata per NOS standards
    - Installation and operation procedures
    - Sensor calibration and verification information
    - Bench mark descriptions and leveling abstracts
    - Sensor and datum offsets
    - Station maintenance/site visit information
    - Annual leveling information (for medium-term stations)
- Partner designates a POC and participates in check-in meetings every 6 months with a designated Partnership Coordinator at CO-OPS

B. FULL COST REIMBURSEMENT FOR STATION LOCATIONS WHERE CO-OPS DOES NOT HAVE A STRATEGIC MISSION INTEREST

Certain partners require an official NOS tidal or Great Lakes datum for policy, regulatory, or legal reasons in a specific location where CO-OPS does not have a strategic mission interest because one or more high quality water level observation records exist in the location or area. In these cases, where water level observations are collected to NOS standards and associated station documentation and metadata is provided, CO-OPS will produce an official NOS datum at a fixed cost. Typically, this type of partnership involves the non real-time transfer of a short- or medium-term series of water level observations to CO-OPS via web services or electronic file transfer in a format to NOS standards. In occasional instances, the partner's requirements may result in the ongoing processing of water level observations from a long-term station, again through an appropriate cost reimbursement arrangement.

How are the data and products displayed?

Data and products are displayed as detailed in Section A.

What kind of in-kind support can CO-OPS provide?

CO-OPS does not provide any services in-kind, as this is a full cost reimbursement arrangement.

What are the specific partnership requirements?

In addition to those listed in Section A, requirements for full cost reimbursement datum partnerships include:

- Partner enters into a formal, signed reimbursable agreement with CO-OPS that outlines the responsibilities of both parties, and references applicable NOS standards

C. PARTNERSHIPS TO COLLECT WATER LEVEL OBSERVATIONS TO FILL CRITICAL GAPS IN THE NWLON

CO-OPS operates the NWLON to provide primary vertical control of the nation's coastal and Great Lakes datums. At present, CO-OPS operates 210 NWLON stations on the U.S. coast, including Alaska, Hawaii, and the U.S. Territories, and the Great Lakes. A complete NWLON would comprise just over 320 station locations. These specific gaps are identified in CO-OPS Technical Report 48 - "A Network Gap Analysis for NWLON": https://www.tidesandcurrents.noaa.gov/publications/Technical_Memorandum_NOS_COOPS_0048.pdf. CO-OPS seeks a limited number of collaborative partnerships to fill critical gaps in the NWLON. The partner must demonstrate a long-term (multi-decade) administrative and financial commitment to maintain the water level station per NOS standards, since the period of observational record needed to support a National Tidal Datum Epoch update is 19 years of continuous water level data, and an NOS Sea Level Trend is 30 years of more-or-less continuous water level data.

Long-term collaborations that fill critical datum gaps in the NWLON can be accomplished using data collected to NOS standards and made available to CO-OPS in non real-time (typically through web services), irrespective of whether the water level observations are disseminated by the partner in real-time or not. CO-OPS will process water level data from non real-time partnerships on a monthly basis, such that these tasks fall into the normal cadence of data processing workflows. In special cases it might be in CO-OPS strategic interest to ingest and process water level data collected prior to the start of the partnership. That decision will be determined on a case-by-case basis.

Real-time data from the partner station can be used, however, in the large majority of these cases, CO-OPS data telemetry/ingestion systems have been used. A real-time data partnership will be driven by one or more strategic mission interests over and above filling the NWLON datum gap, for example, the specific station location would also

support safe and efficient navigation and/or monitor coastal inundation and storm surge (and other coastal hazards, such as tsunamis). More details for real-time partnerships are discussed in Section D below. In addition, CO-OPS reserves the right to ask prospective partners to operate real-time stations at NWLON gaps for some length of time (while we monitor associated station documentation and metadata), prior to entering into a data sharing agreement and disseminating real-time data on the Tides and Currents website.

How are data and products displayed?

In addition to those listed in Section A, data and products displayed for non real-time NWLON gap partnerships include:

- Inclusion and display on the NOS Sea Level Trends webpage, once 30 years of data exist at the station location.

What kind of in-kind support can CO-OPS provide?

In addition to those listed in Section A, in-kind services provided by CO-OPS for non real-time NWLON gap partnerships include:

- Processing resulting water level observations and generating tidal products at no cost to the partner
- Station design consultation at no cost to the partner. The desire is for an NWLON gap partnership to provide a missing location for primary vertical control of the nation's coastal and Great Lakes datums. Therefore, it is in CO-OPS strategic interest to review and approve the station design for newly constructed stations, or review and approve the appropriateness of existing stations. That said, it is not a requirement that the partner participate in a design consultation, nor accept the recommendations of a design consultation. If a design consultation occurs, CO-OPS will formally document associated recommendations in a signed letter to the partner.
- The desire is for an NWLON gap partnership to provide a missing location for primary vertical control of the nation's coastal and Great Lakes datums. Therefore, it is in CO-OPS strategic interest to reduce the risk of potential measurement error by calibrating, testing, and/or configuring the water level sensor and associated equipment at no cost to the partner.
- It is in CO-OPS strategic interest to ensure that partner water level stations operating in order to fill an NWLON gap are meeting NOS standards. Therefore, CO-OPS reserves the right to inspect stations at no cost to the partner. Typically, station inspections may occur after installation or after a major upgrade or repair, or if there is some concern about the resulting water level observations. Station inspection may be done physically by onsite CO-OPS personnel, or virtually, by requesting photos and/or video of the station and specific station components.

- While an occasional practice in the past, it is not in CO-OPS strategic interest to accept funding from a partner and acquire needed oceanographic sensors and equipment for the partner station. The exchange of funds requires a legally-reviewed MOA, which is a highly-burdensome administrative process for both CO-OPS and the partner.

What are the specific partnership requirements?

In addition to those listed in Section A, requirements for non real-time NWLON gap partnerships include:

- Partner ensures sensor vertical stability
    - Maintain a network of a minimum of 5 (preferably 10) bench marks of Class B or higher
    - The total error of 6-minute water level observations relative to a defined vertical datum must not exceed 5 cm (at 95% confidence) for stations with at least 19 years of data.

D. CONSIDERATIONS FOR NOS TIDAL AND WATER LEVEL DATUM PARTNER STATIONS COLLECTED AND DISSEMINATED IN REAL-TIME

There may be instances where CO-OPS has a strategic mission interest to display and disseminate the partner's water level observations in real-time. This will be driven by one or more strategic mission interests over and above filling a critical datum gap, for example, the specific station location also supports safe and efficient navigation and/or monitors coastal inundation, storm surge, or other coastal hazards, such as tsunamis. In these cases, both the proven timeliness and reliability of the station's real-time observations, as well as the documented vertical control and stability of the water level sensor over time, will be requirements for consideration of a real-time data partnership. In addition, a CO-OPS-compatible real-time data telemetry capability will be provided by the partner.

How are data and products displayed?

In addition to those listed in Sections A and C, data and products displayed for real-time data partnerships include:

- Real-time data are available on the active Water Level-Station Selection webpage and the station will be available on the default Tides and Currents website map
- In most cases, the station is also available on the Coastal Inundation Dashboard
- Real-time data from the station are displayed as part of an Operational Forecast System display, if they fall within a regional model domain

What kind of in-kind support can CO-OPS provide?

While it is expected that partners will have experience in collecting high quality water level observations in real-time, in addition to those listed in Sections A and C, in-kind services provided by CO-OPS for real-time data partnerships include:

- IT support for real-time data ingestion via partner-supplied Iridium, GOES, or IP modem data telemetry capability, or real-time data accessibility using an existing API / web services
- Real-time 24/7/365 monitoring and QA/QC of data

What are the specific partnership requirements?

In addition to those listed in Sections A and C, requirements for real-time NWLON gap partnerships include:

- Partner transmits data to CO-OPS in real-time, meeting all NOS standard message encoding and formatting requirements
    - Water level data is available as 6-minute data and a time stamp of the observation centered on the 6 minute mark, i.e. 00, 06, 12, 18, 24… past the hour
    - Use a CO-OPS-compatible data telemetry mechanism, specifically, Iridium, GOES, IP modem, or API / web services
    - Both primary and backup data telemetry capabilities are recommended
- Partner transmits data with as short a latency as is reasonable given technical and budget realities. The maximum acceptable latency is 18 minutes.
- Partner ensures sensor vertical stability
    - Maintain a network of at least 5 bench marks of Class B or higher

For real-time stations providing water level observations in NWLON gaps, the following additional recommendations apply:

- Typically, a real-time data partnership is negotiated because there is a shared mission interest over and above producing a datum, for example, real-time observations will support safe navigation and/or monitoring coastal inundation. Therefore, to ensure data are available when needed, it is in CO-OPS strategic interest that the partner acquires and uses CO-OPS-approved primary and backup water level sensors and redundant data collection platforms. This recommendation should be considered a requirement on a case-by-case basis.
- For this same reason, it is recommended that the partner's station and its systems are designed to (1) disseminate real-time data throughout extreme events; (2) ensure that the full range of water levels is recorded during such events; and (3) minimize data loss during such events. This recommendation should be considered a requirement on a case-by-case basis.

E. WHAT HAPPENS WHEN A PARTNER IS UNABLE TO MAINTAIN WATER LEVEL OBSERVATIONS TO NOS STANDARDS?

It is understood that a partner's mission requirements can evolve, and that plans for future funding priorities can change over longer time periods. That said, it is critical that water level observations collected through NOS Datum Partnerships meet NOS standards. Therefore, in situations where CO-OPS becomes aware of an ongoing issue with the partner's water level observations, becomes aware of a risk to future funding for station maintenance and recapitalization, or is informed by the partner that they can no longer be a party to the agreement, CO-OPS will deliver written correspondence to the partner outlining expected changes to partnership parameters. This could include changes like a halt to data processing to produce NOS tidal products, and a halt to real-time data dissemination, if appropriate. If there is an ongoing issue with maintaining NOS standards, and the partner makes the data available in real-time through web services, the partnership with CO-OPS may be more appropriate for a Coastal Hazards Products and Services Partnership for display only through products like the Coastal Inundation Dashboard (https://tidesandcurrents.noaa.gov/inundationdb/) or the Tsunami Capable Tide Stations webpage (https://tidesandcurrents.noaa.gov/tsunami/).