TIDE STATIONS

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PRIMARY CONTROL TIDE STATION - A tide station at which continuous observations have been made over a minimum of 19 years. Its purpose is to provide data for computing values of the harmonic and non-harmonic constants essential to tide predictions, for the determination of tidal datums for charting and for coastal and marine boundaries and for the monitoring sea level variations.

The data series from this station also serves as primary control for the reduction of a relatively short series of tide observations from subordinate tide stations, through the method of comparison of simultaneous observations to obtain accepted values.

In tidal theory harmonic constants are a variation in the relative positions of the earth, moon and sun affecting the amplitudes (heights) and epochs (time lag) of the tide at any given place.

Non-harmonic constants are tidal constants such as Greenwich intervals (useful for project tide predictions), range, etc. which may be derived directly from high and low water measurements.

SECONDARY CONTROL TIDE STATION - A tide station at which continuous observations have been made over a minimum period of 1 year but less than 19 years. The series is reduced by comparison of simultaneous observations from a primary control tide station. This station provides accepted values of tidal datums. This station also provides for a 365-day harmonic analysis that is used to produce tide prediction tables and provides the data to determine annual inequalities, factors influencing local heights and times.

TERTIARY TIDE STATION - A tide station at which continuous observations have been made over a minimum period of one month but less than 1 year. The series is reduced by comparison of simultaneous observations from a primary or a secondary control tide station. This station provides accepted values of tidal datums. This station also provides a 29-day harmonic analysis used to produce tables for tide predictions.

SUBORDINATE TIDE STATION - A tide station that is subordinate to a control tide station. For example:

1. A tide station from which a relatively short series of observations is reduced by comparison with simultaneous observations from a tide station with a relatively long series of observations, such as secondary and tertiary tide stations.

2. A station listed in the tide tables from which tide predictions are to be obtained by means of differences and ratios applied to the full predictions at a reference station.

3. A term used in Florida to refer to a very short-term (three day) tide station set at a project site.

REFERENCE STATION- A tide station for which independent daily predictions are given in the tide tables and from which corresponding tide predictions are obtained for subordinate stations by means of differences and ratios.

VERY SHORT-TERM TIDE STATION - A location were tide studies as short as three days are made. They are used to extrapolate tidal datums from a control tide station to a nearby project site. The datums obtained are used for MHW survey procedures or for a local hydrographic study.

There are three types of very short-term tide studies in use today: Range Ratio, Amplitude Ratio and Height Difference A control tide station, for a three day tide study, is any location where tidal datums have been determined and have been perpetuated by tidal bench marks.

EARLY WATER LEVEL MEASUREMENTS - The first tide measuring devices, called Nilometers were used by the Egyptians 3000 years ago. They were the equivalent of our tide staffs. Next, high and low indicators were developed. They consisted of a rope over a pulley with a wooden float and a counter weight. Two friction rings were attached to the rope and were restricted by fixed guides. When the tides changed, the rings would slip along the rope to mark the height of the tide. The rings had to be reset for each subsequent tide.

RECORDING TIDE GAGES - These devices consist of a wire or tape hung over a pulley wheel. At one end, there is a metal float and at the other end a counter weight. As the tide fluctuates, the wire turns the pulley that is geared to a pen that runs over a paper chart held in tension over a platen. The paper is moved from a supply spool to a take-up spool by a clock driven mechanism.

The recorder is placed in a shelter or in a security box on top of a stilling well consisting of a pipe attached vertically to a pier. The stilling well has a sealed bottom with an inlet hole of about 1/50 of the diameter of the well. This stills wave action. The tide gage is correlated to a tide staff, consisting of a graduated scale or to an electric tide gage (ETG) attached to the pier, through visual observations of the water level. The staff is referenced to tidal bench marks on the shore by leveling. The charts are then read visually and datums determined as chart datums. These chart datums are then correlated to the staff, using the visual staff readings, resulting in staff datums. These staff datums are then correlated to the tidal bench marks. Elevations for all datums are referenced to MLLW which is set at 0. Most tidal bench marks are then tied to a geodetic datum by leveling. North American Vertical Datum of 1988 elevations are now, or will soon be, available for all tidal bench marks that had been referenced to the National Geodetic Vertical Datum of 1929.

Gas purged tide gages, called bubbler gages, have been developed to eliminated the float and stilling well. Also, in newer gages, pens and chart paper have been replaced with punched paper tape that is later read by optical readers. In the gas purged system, the tide level is sensed by variation of hydrostatic pressure of the water above a remote submerged orifice.

NEXT GENERATION WATER LEVEL MEASUREMENT SYSTEM (NGWLMS or "Next") - Although all of the previously described tide gages are still in use today, the National Ocean Service needed a better system to record the daily staff readings at its many stations. A fully integrated system encompassing electronic sensors and recording equipment, multiple data transmission options, and an integrated data processing, analysis, and dissemination subsystem was developed. The tide gage is directly related to bench marks on the shore so that when the tidal datums are computed, they are directly referenced to the bench marks. Tidal heights can also be transmitted, in real time, to hydrographic survey crews or to ships entering a harbor.