GEO-REFERENCING OF
WATER SURVEY OF CANADA HYDROMETRIC STATIONS

1. OBJECTIVE

Standardization of the method of collection and documentation of latitude and longitude coordinates at Water Survey of Canada (WSC) hydrometric stations.

2. SCOPE

This procedure applies to active Water Survey of Canada stations. The application of this procedure is encouraged but not mandatory for composite stations. However, compliance is expected at stations of contributed data. This procedure does not preclude other critical location identification data that may be needed to satisfy individual program or project needs, such as site access information details, street address, elevation or altitude, to be recorded separately on the station description.

3. PROCEDURE

For publication in Hydex, hydrometric stations latitude and longitude ("lat/long") coordinates must be collected and documented according to standards defined below:

Station Location – The location of a monitoring station is defined to be the position where the primary stage data is measured along the river reach (i.e. near the water's edge over the intake or the orifice line, at the stilling well or staff gauge). For most cases, the shelter location can be considered representative of such position. This position must be measured to within 15 meter. The use of global positioning systems (GPS) is recommended to obtain lat/longs of the highest possible accuracy. Guidelines for obtaining coordinates using a GPS are appended (Appendix 'A' –Guidelines for Obtaining GPS Coordinates)

Latitude/Longitude – The two accepted formats for recording latitude/longitude coordinates are:

Decimal Second Format: +/-DD MM SS.S (latitude)
+/-DDD MM SS.S (longitude)

Or

Decimal Degree Format: +/-DD.DDDDD (latitude)
+/-DDD.DDDDD (longitude)

where:

- DD represents degrees of latitude; a number ranging from 00 through 90.
- DDD represents degrees of longitude; a number ranging number ranging from 000 through 180. NOTE: a leading zero must be given for degrees longitude less than 100, (e.g., 089 degrees longitude).
- MM represents minutes of latitude or longitude; a number ranging from 00 through 59.
- SS represents seconds of latitude or longitude; a number ranging from 00 through 59.

- In decimal degree format, a precision to the hundred-thousandths of degrees is required. In decimal second format, a precision to the tenth of seconds is required.

- + specifies latitudes north of the equator and longitudes east of the prime meridian. - specifies latitudes south of the equator and longitudes west of the prime meridian.

Collection Method – Specific method used to determine the coordinates are to be recorded in HYDEX (e.g., GPS differential, handheld GPS, remote sensing techniques, paper map, digital map, cadastral survey). Any of these methods are acceptable if shown to be capable of providing accuracy within the ±15 meter required. If maps are used to define the location, their scale must be no smaller than 1:50 000 (Scales of 1:250 000 or less are not acceptable).

Note: The coordinate sampling position for the site should be documented in the station description to allow for the relevant repeatability of such readings.

Accuracy – Estimate of accuracy, in terms of the most precise units of measurement used (e.g., if the coordinates can be given to tenths-of-seconds precision, the accuracy estimate should be expressed in terms of the range of tenths-of-seconds within which the true value should fall, such as "+/- 0.5 seconds"). This data element is usually derived, based on the collection method. Note that because of the prescribed data format, precision is limited to 0.1 seconds (0.00003 degrees) for all data.

Reference Datum – The standard horizontal reference datum is the North American Datum of 1983 (NAD 83). For horizontal data collection using maps, the map number and its scale is required.

Date – Date of Collection (i.e., the date when the coordinates were determined).

APPENDIX A – GUIDELINES FOR OBTAINING COORDINATES WITH GPS

The Water Survey of Canada accuracy goal is to achieve a position that is within ±15 meters of where the primary stage data is measured along the river reach. It is recognized that a "one size fits all" approach to quality requirements is not appropriate for the diversity of sites and conditions at hydrometric sites. In order to ensure that data collected with GPS meets the needs of the program, the following guidelines should be used.

GPS Collection Methods:

The following describes the methods to collect and process data with GPS. The method selected must allow the attainment of the accuracy goal of ±15 m to within 1 standard deviation (68% confidence interval calculated by adding and subtracting one standard deviation from the mean value):

a) Stand-alone – With the stand-alone or autonomous method such as handheld units, positions are calculated by a single GPS receiver operating at the location of interest. This method provides the lowest degree of accuracy. Stand-alone GPS have a horizontal accuracy close to our accuracy goal at one standard deviation.

b) Differential – For higher accuracy data collection, differential GPS (DGPS) is used. This technique involves the improved positioning accuracy done by determining the positioning error at a known location and subsequently incorporating a correction factor into the position calculated by another receiver operating in the same area while both GPS are tracking the same satellites. There are two modes of differential correction:

> Real-Time: Differential correction employs either a radio link between the rover and base station receivers or a commercial satellite service such as OmniStar. Correction factors broadcasted to the GPS receiver acting as the rover are applied almost instantaneously to the uncorrected positions collected. If using a correction such as OMNISTAR or WAAS, ensure that the correction is valid for the area of operation.
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> Post-Processed: Used when high accuracy data is needed but real-time high accuracy is not required. Post-processing involves recording autonomous data with a GPS receiver acting as rover and then correcting the data after the survey is completed using post-processing software.

Site and Observation Characteristics:

- The site must have good satellite visibility, free of tree canopy, away from power lines, substations or large metal objects to ensure clear and direct signal reception. In any situation, it is good practice to raise the antenna as high as possible.
- GPS surveys in areas near large reflective flat surfaces (such as buildings) must be at a sufficient distance from the large reflective areas so that the GPS antenna sees the sky from forty-five (45) degrees and above.
- The GPS recorder must be set to read satellites at no smaller than a ten (10) degrees angle above the horizon.
- If nearby signal obstructions or multi-path features are unavoidable, it may be necessary to physically offset the GPS measurement point from the targeted benchmark. This can effectively be accomplished using a compass and tape measure.
- A minimum of four (4) GPS satellites must be tracked for accuracy.

- The Horizontal Dilution of Precision (HDOP, indicator of proper satellite configuration for horizontal positioning) should be no more than two (2).
- No data must be collected during heavy precipitation.

Data Collection Process:

- Turn on the GPS only when it has been positioned exactly above the location to be measured and record data for at least 13 minutes to ensure that all information required by the GPS for its computation (ephemerid and satellite observation table) has been received.
- Collect data at intervals of a few seconds (5 seconds recommended) and average it at least until the level of confidence for 1 standard deviation is below 15 meters.
- For the maximum accuracy of the true position, it is best to collect data over the longest time possible (e.g.: during the full station visit or even collecting data on different observation dates).

REFERENCES

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