5.4.1.5 (O) Hydraulic Corrector Field Application for Referencing the International Great Lakes Datum of 1985 (IGLD 85)

Procedure Number: SOP # 5.4.1.5 (O)
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1. Title

Hydraulic Corrector Field Application for Referencing the International Great Lakes Datum of 1985 (IGLD 85).

2. Purpose

The purpose of this document is to describe the process and procedures for determining and applying the station Hydraulic Corrector (HC) to the dynamic height of the Electric Tape Gauge (ETG) Reading Mark and Spike so these elevations are referenced to the International Great Lakes Datum of 1985 (IGLD 85). This is computed by subtracting the HC from the surveyed Dynamic Height. Once the HC is applied to both, the surveyed ETG elevation becomes the Zero of the Electric Tape Gauge (ZETG) and the Spike elevation becomes the Spike Zero. In accordance with all elevations associated with IGLD, the surveyed ETG and Spike are Dynamic Heights prior to the HC being applied. Refer to "The Establishment of the International Great Lakes Datum (1985)" for more information regarding Dynamic Heights and Hydraulic Correctors.

3. Background/History

The Hydraulic Corrector Field Application (HCFA) is a spreadsheet that was developed due to the migration of the CO-OPS computer operating system to Windows 7. The previous HCFA was a DOS program developed in 1991 and could not function in the new Windows 7 operating system. This spreadsheet was created as a replacement to that program.

4. Scope/Applicability

The organizations that are affected by this SOP include the Field Operations Division (FOD), and the Engineering Division/Operational Engineering Team (OET). These groups will be directly involved in using and verifying this spreadsheet. The Field Operations Division will be on site in the Great Lakes conducting this application to reference IGLD along with the inside-outside water level check SOP component #5.4.1.5 (N). The Operational Engineering Team (OET) will be using the spreadsheet completed by the Field Operations Division. This is to verify the correct HC was used to determine

the IGLD reference for both the ETG and Spike and that the inside and outside water level measurements were within tolerance.

5. Main Processes

The current spreadsheet requires the user to input the following data in the appropriate cells:

- Date
- Time
- Weather Conditions
- Station identification number (chosen from drop down menu in the spreadsheet)
- Surveyed ETG Elevation (taken from the leveling abstract)
- Surveyed Spike Elevation (taken from the leveling abstract)
- Electric Tape Gage Measurement to the Water Surface (meters)
- Spike Measurement to the Water Surface in either meters or feet

The spreadsheet outputs the following values:

- Station Name
- Engineering Rounded Surveyed ETG Elevation (meters)
- Hydraulic Corrector
- ZETG Elevation
- Engineering Rounded Surveyed Spike Elevation (meters)
- Spike Zero (meters)
- Inside Water Surface Reading (meters)
- Outside Water Surface Reading (meters)
- Inside – Outside Reading Difference (meters)
- Within 6 Millimeter Allowable

The spreadsheet contains two tabs. The first tab entitled “HYD. COR. FIELD APP” contains all of the inputs and outputs mentioned previously. An example of the first tab has been placed below.

HYDRAULIC CORRECTOR FIELD APPLICATION	
INSTRUCTIONS: ENTER DATA INTO YELLOW HIGHLIGHTED REGIONS OF THE SPREADSHEET. ALL OTHER VALUES ARE CALCULATED OR WILL REMAIN THE SAME.	
DATE	9/22/2011
TIME (LOCAL STANDARD TIME)	14:48
WEATHER CONDITIONS	Windy
STATION IDENTIFICATION NUMBER	9075080
STATION NAME	Mackinaw City, MI
SURVEYED ETG (METERS)	180.61470
ENGINEERING ROUNDED SURVEYED ETG (METERS)	180.615
HYDRAULIC CORRECTOR (METERS)	0.043
ZETG (METERS)	180.572
SURVEYED SPIKE (METERS)	178.76160
ENGINEERING ROUNDED SURVEYED SPIKE (METERS)	178.762
SPIKE ZERO (METERS)	178.719
INSIDE - OUTSIDE READINGS	
ETG MEASUREMENT TO THE WATER SURFACE (METERS)	4.495
SPIKE MEASUREMENT TO THE WATER SURFACE (FEET)	8.670
INSIDE - OUTSIDE COMPARISON	
INSIDE WATER SURFACE READING (METERS)	176.077
OUTSIDE READING (METERS)	176.076
INSIDE - OUTSIDE COMPARISON	
INSIDE READING - OUTSIDE READING (METERS)	0.001
WITHIN 6 MILLIMETER ALLOWABLE	**YES**

The spreadsheet contains yellow highlighted regions where the user inputs information. The station identification number has a drop down list that the user must choose from. The use of a drop down list aides to ensure the station name, hydraulic corrector, and station identification number are matched correctly. The station identification number is linked to the station name and the hydraulic corrector through a look up table function internal to the spreadsheet. The user can gain access to the look up table on the second tab of the spreadsheet entitled “STATION NAME, ID NO, & HYD COR.”. The table has been included below.

STATION IDENTIFICATION NUMBER	STATION NAME	HYDRAULIC CORRECTOR
8311030	Ogdensburg, NY	0.000
8311062	Alexandria Bay, NY	0.000
9014070	Algonac, MI	0.000
9014080	St. Claire State Police, MI	0.000
9014087	Dry Dock, MI	0.000
9014090	Mouth of the Black River, MI	0.000
9014096	Dunn Paper, MI	0.000
9014098	Fort Gratiot, MI	0.000
9034052	St Clair Shores, MI	0.000
9044020	Gibraltar, MI	0.000
9044030	Wyandotte, MI	0.000
9044036	Fort Wayne, MI	0.000
9044049	Windmill Point, MI	0.000
9052000	Cape Vincent, NY	0.008
9052030	Oswego, NY	0.000
9052058	Rochester, NY	0.006
9052076	Olcott, NY	0.008
9063007	Ashland Avenue, NY	0.000
9063009	American Falls, NY	0.000
9063012	Niagara Intake, NY	0.000
9063020	Buffalo, NY	-0.026
9063028	Sturgeon Point, NY	-0.023
9063038	Erie, PA	-0.025
9063053	Fairport, OH	0.000
9063063	Cleveland, OH	0.010
9063079	Marblehead, OH	-0.006
9063085	Toledo, OH	-0.005
9063090	Fermi Power Plant, MI	0.023
9075002	Lakeport, MI	0.013
9075014	Harbor Beach, MI	0.000
9075035	Essexville, MI	-0.002
9075065	Alpena, MI	0.031
9075080	Mackinaw City, MI	0.043
9075099	De Tour Village, MI	0.005
9076024	Rock Cut, MI	0.000
9076027	West Neebish Island, MI	0.000
9076033	Little Rapids, MI	0.000
9076060	U.S. Slip, MI	0.000
9076070	S.W. Pier, MI	0.000
9087023	Ludington, MI	0.087
9087031	Holland, MI	0.090
9087044	Calumet Harbor, IL	0.104
9087057	Milwaukee, WI	0.106
9087068	Kewaunee, WI	0.114
9087072	Sturgeon Bay Canal, WI	0.106
9087079	Green Bay, WI	0.114
9087088	Menominee, MI	0.184
9087096	Port Inland, MI	0.046
9099004	Point Iroquois, MI	-0.100
9099018	Marquette C.G., MI	0.000
9099044	Ontonagon, MI	0.049
9099064	Duluth, MN	0.079
9099090	Grand Marais, MN	0.046

The outputs of the spreadsheet are a series of functions and equations that are completed after the inputs are entered.

6. Detailed Sub-Processes/Checklists

Spreadsheet Formulas

The formulas for the outputs of the spreadsheet are as follows:

- Station Name = lookup(b9,'station name,id no, & hyd cor.'!A2:b55)
- Engineering Rounded Surveyed ETG = CLEVERROUND((b12) ,6)
- Hydraulic Corrector = LOOKUP(B9,'STATION NAME, ID NO, & HYD COR.'!A2:A55,'STATION NAME, ID NO, & HYD COR.'!C2:C55)
- Zetg = CLEVERROUND((B12-B14),6)
- Spike Zero (Meters) = CLEVERROUND((B18-B14),6)
- Inside Water Surface Reading (meters) = CLEVERROUND((B15-B22),6)
- Outside Reading (meters) = CLEVERROUND((B19-(B23*0.3048)),6)
- Inside Reading – Outside Reading (meters) = abs (b26 – b27)
- Within 6 Millimeter Allowable = IF(B30 > 0.006000000000001,"NO","YES")

The last row of tab one of the spreadsheet entitled "Within 6 millimeter allowable" tells the user if the inside-outside check is successful. "YES" denotes success and "NO" denotes failure.

Engineering Rounding

Engineering Rounding is the accepted methodology of rounding numbers that are used in surveying and water level measurements. Engineering rounding methodology is CO-OPS policy. To accommodate the requirement, a macro (code added to the normal functionality of the spreadsheet) for the engineering rounding function was added to the spreadsheet. This macro is documented below:

```
Function CleverRound(Item As Double, Sig As Integer) As Double
Dim DecPart, FracPart As Double
Dim DecDigits As Integer

If Item = 0 Then
CleverRound = 0
Else
DecDigits = Sig - Application.WorksheetFunction.Max _
(0, Application.WorksheetFunction.RoundUp(Log(Abs(Item)) / Log(10), 0))
DecPart = Application.WorksheetFunction.Round(Item, DecDigits)
FracPart = Item - DecPart

If 1 - Abs((FracPart * 2) / (10 ^ (-DecDigits))) < 10 ^ (-9) Then
CleverRound = Application.WorksheetFunction.Round(Item / 2, DecDigits) * 2
```

```
Else
CleverRound = DecPart
End If
End If
End Function
```

7. Quality Assurance/Control

The spreadsheet has been protected and shared so that the formulas and the macro are not tampered with unintentionally. The user does have the option to unlock the spreadsheet and turn off the protection which would allow for changes to the spreadsheet formulas.

8. Management/Responsibility

The Hydraulic Corrector Field Application was created by Derrell Lorthridge in FOD. OET or Derrell Lorthridge should be contacted for any issues with the spreadsheet. OD is responsible for the computation of any new Hydraulic Correctors that are to be added to this spread sheet. FOD personnel are responsible for the applications in the field and OET is responsible for oversight to see that the correct HCs have been applied where applicable.