

APPENDIX D

Tampa Harbor Navigation Project: Evaluation of the Project Datum and Implementation of a VDatum Model (Jacksonville District)

D-1. Purpose. This appendix contains excerpts from Jacksonville District reports that illustrate the evaluation of the adequacy of a project datum for a typical deep-draft navigation project. It outlines the procedures for updating the reference tidal datum along with procedures for implementing use of VDatum for dredging and construction surveys.

a. Section 1. Section 1 in this appendix contains excerpts from a 2007 Comprehensive Evaluation of Project Datums (CEPD) report on Tampa Harbor. This report was prepared by HQUSACE directive. This CEPD report evaluated the current condition of the project's datums and recommended corrective actions to bring the project into compliance with Corps policy.

b. Section 2. Section 2 outlines excerpts from a 2009 internal Jacksonville District channel framework report on subsequent actions proposed to correct the deficiencies identified in the Section 1 CEPD report. It also illustrates recommended VDatum site calibration requirements for a project with full VDatum and partial RTN coverage. (Portions of this report were revised and edited since it was based on a superseded version of VDatum and the latest [2010] release of the VDatum model for Tampa Bay has not yet been field calibrated).

D-2. Project Description. The total project consists of a channel from the Gulf of Mexico to ports in Tampa Bay—see Figure D-1. Project features include the entrance channel from the Gulf of Mexico to Hillsborough Bay. At Hillsborough Bay, the channel splits into two legs, with one continuing west to Port Tampa and the other east to Gadsden Point. The west channel continues to Port Tampa and ends in a turning basin. The west channel to Gadsden Point includes the Alafia River, Port Sutton, East Bay, and Seddon Channels. The project depth varies from 45 feet in the entrance channel at the Egmont Bar Channel to 30 feet in the Alafia River. Length of the project is about 67 miles including 3.6 miles in the Alafia River. The Port of Tampa has more cargo tonnage than all other Florida ports combined.

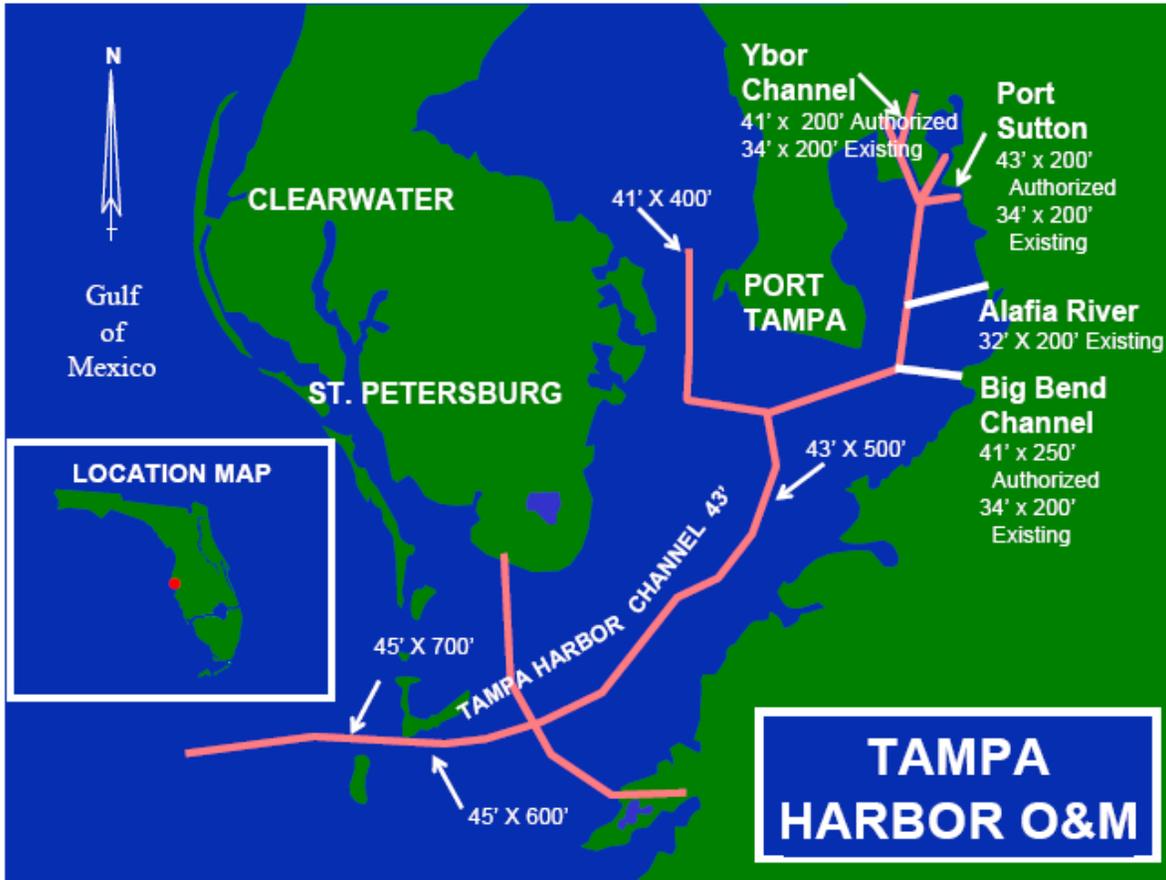


Figure D-1. Tampa Harbor Deep-Draft navigation project.

D-3. Section 1—Tampa Harbor CEPD Project Datum Evaluation Report (Jacksonville District).

*US ARMY ENGINEER DISTRICT, JACKSONVILLE
Comprehensive Evaluation of Project Datums*

PROJECT DATUM EVALUATION REPORT

*Tampa Harbor, Florida (30 to 45-Foot Projects)
Hillsborough River (9 & 12-Foot Project)
Alafia River (30-Foot Project)*

9 September 2007 (Revised 15 Oct 07)

Synopsis of Overall Project Assessment

This report assesses the adequacy and accuracy of reference datums for the Tampa Harbor Project, including all related shore protection control structures, and/or upland/offshore disposal sites associated with this project, as described in the project authorization documents. This evaluation is performed in compliance with the Commanding General's 4 December 2006 directive memorandum, subject, "Implementation of Findings from the Interagency Performance Evaluation Task Force for Evaluating Vertical Datums and Subsidence/Sea Level Rise Impacts on Flood Control, Shore Protection, Hurricane Protection, and Navigation Projects." The findings in this report are summarized below.

- 1. The project is NOT compliant with the standards and guidance in EC 1110-2-6065¹.*
- 2. The current tidal MLLW reference datum model for this project is of uncertain origin, not fully documented, and appears not to have been updated to the latest 1981-2001 sea level epoch in accordance with WRDA 92. NOAA CSDL has developed a VDatum hydrodynamic model of the MLLW gradient throughout the area. This model is not being used in USACE surveys.*
- 3. Currently, water surface elevation corrections for dredging measurement & payment are based on extrapolated staff gage readings set from benchmarks of uncertain origin, that are not referenced to the NSRS, and/or are referenced to the superseded NGVD29 datum. Use of NOAA PORTS gage readings may be resulting in mixed tidal epochs. Recent RTK surveys have originated at NOAA tidal benchmark sites; however, survey and dredging reference are still on the superseded 1960-1978 tidal epoch. Project framework and control documents do not clearly define references or relationships between these benchmarks and NOAA tidal gages or tidal benchmarks.*
- 4. Given VDatum coverage, no significant corrective actions will be required to hydrodynamically model the tidal regime, or model the geoid. Corrective actions will be*

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required to establish a fully calibrated RTK horizontal and vertical positioning network throughout the project, and update project framework documents. Recommended actions are outlined in this report.

5. The estimated cost to effect corrective actions is \$76,000.

6. Corrective actions should be budgeted and programmed for completion in FY 2008.

7. Estimated cost avoidance savings potentially realized in effecting corrective actions is \$7,500,000.

Hydrological and Hydraulic Modeling Requirements

1. Figure CEPD-1 shows the typical tidal correction locations currently used on a portion of this project. The reference datum is referred to MLLW as required under WRDA92. However, the tidal epoch has not been updated from 1960-1978 to 1983-2001. Water surface elevations are extrapolated from shore-based gages.

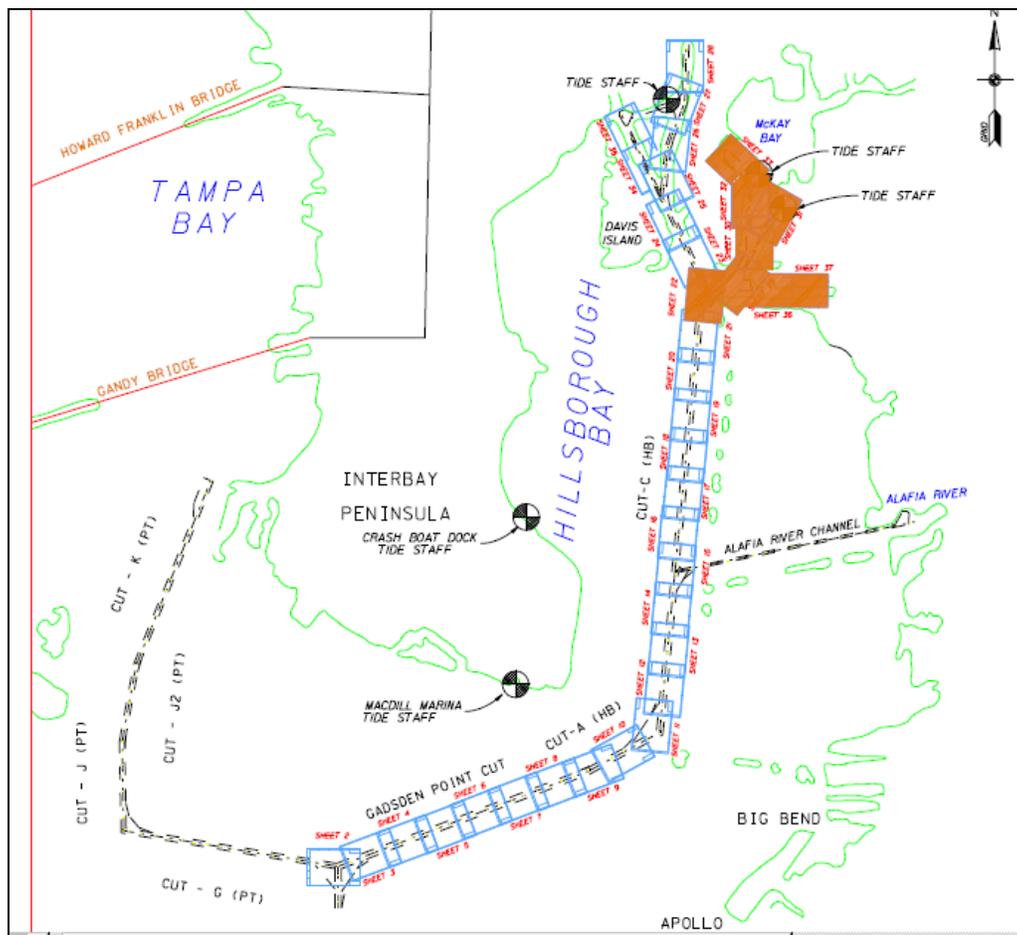


Figure CEPD-1. Typical tidal gage locations currently used in northern portion of project (07-076)—reference NGVD29 & 1960-78 epoch.

2. Figure CEPD-2 depicts the existing NOAA CSDL VDatum model that can be used to develop MLLW-NAVD88-geoid relationships throughout this project. Note that the VDatum model is currently on the 1960-1978 tidal epoch.

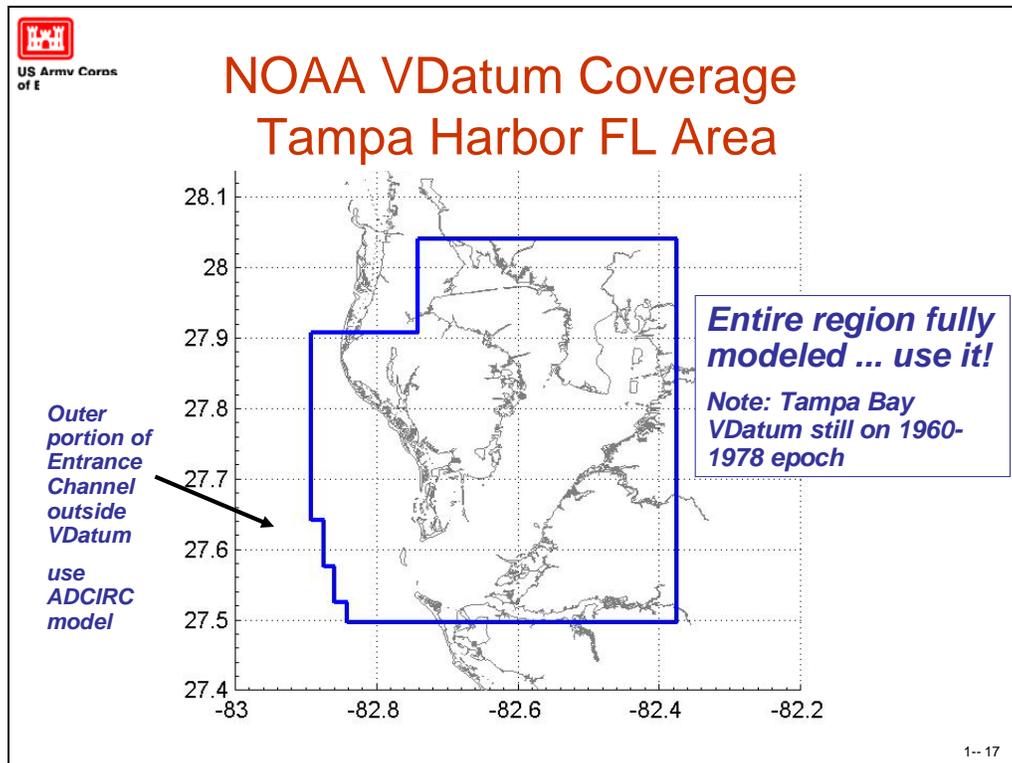


Figure CEPD-2. NOAA CSDL VDatum model coverage.

3. Figure CEPD-3 depicts tidal bench mark gage sites maintained in the NOAA CO-OPS database. It is presumed that these gages were used to develop the VDatum model—this should be verified with NOAA CSDL. Not all these gages have been updated to the 1983-2001 epoch.



Figure CEPD-3. NOAA CO-OPS tidal bench mark sites in Tampa Harbor area.

4. The outermost portion of Egmont Cut 1 does not have VDatum coverage. ADCIRC data may be used to estimate the tidal range gradient in this area if it is significant (i.e., gradient and/or maintenance).

5. No requirement for additional gages is anticipated on this project.

6. The 10-mile Hillsborough River shallow draft portion of the project may not warrant detailed modeling or RTK coverage. Ascertain if this area was picked up within the resolution/coverage of the VDatum model. Determine effort, if any, based on past survey/maintenance activity. (This portion of project not researched during CEPD assessment).

7. Actions.

(1) Obtain updated tidal epoch data from NOAA CO-OPS on tide stations not yet updated to 1983-2001.

(2) Request CSDL Update VDatum model to 1983-2001 epoch.

(3) From VDatum model, generate a 3D digital gridded (100 ft x 100 ft) tidal model for the entire project area depicting the relationship between MLLW (1983-2001), NAVD88, and LMSL.

(4) RTK network calibration verification. The RTK network corrections derived from the updated model needs to be verified at NOAA tide gages in the area. Any variations need to be resolved and the model corrected accordingly.

8. Geoid Model Update Requirements

(1) Action. None—geoid heights are included in the VDatum model.

9. NOAA Tidal Gage RTK Network Calibration and NSRS Connection Requirement.s

(1) Sufficient NSRS high-order accuracy vertical control exists in this project area to provide NAVD88 reference for navigation measurement & payment surveys, topographic surveys of upland disposal sites, or construction surveys of coastal protection structures—see Figure CEPD-4. These NSRS control points will suffice as "Primary Project Control" PBMs in accordance with the requirements of EC 1110-2-6065¹. All supplemental or local project control PBMs, RTK calibration PBMs, and existing USACE PBMs deemed suitable for future use, must be directly connected to these NSRS "Primary Control" PBMs using either GPS or differential leveling methods. Reference EC 1110-2-6065¹ for detailed survey specifications, metadata reporting, documentation requirements, and requirements for NSRS input. (Note that supplemental or local PBMs, although tied to the NSRS, do not need to be input into the NSRS; however, there may be exceptions at NOAA or Corps gage sites).

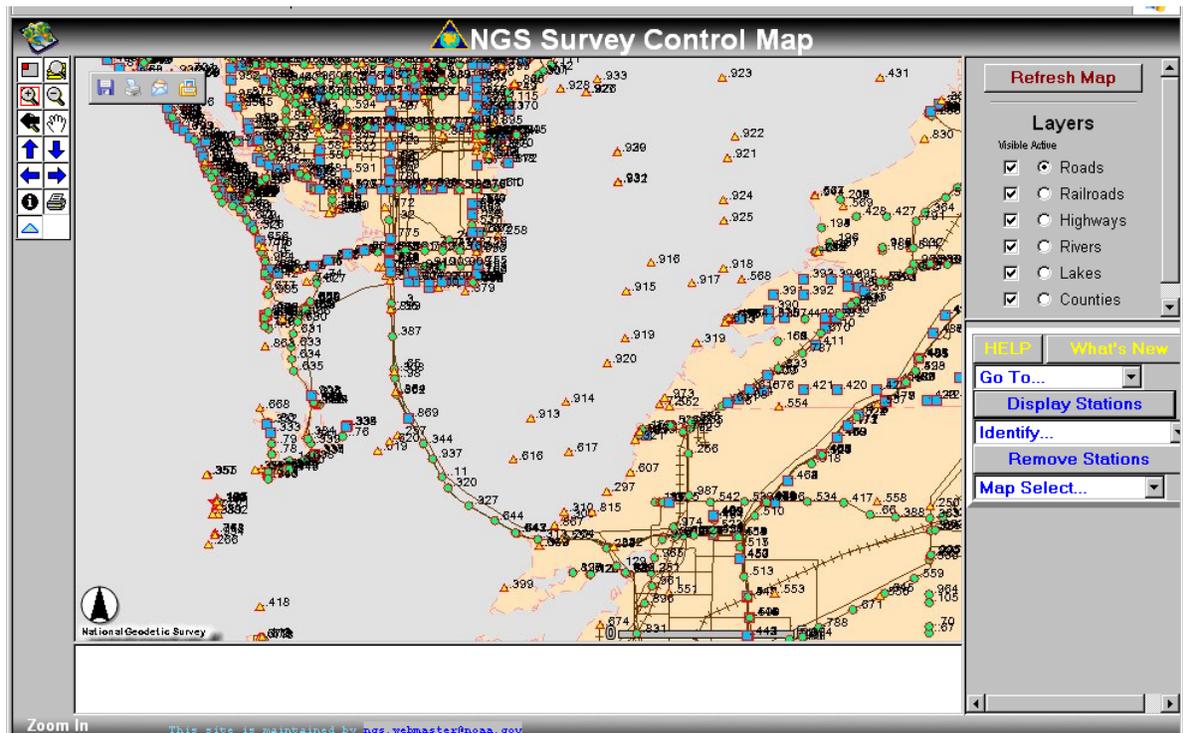


Figure CEPD-4. NGS/NSRS control data in southern region of Tampa Bay.
(Squares-H+V, Circle-V)

(2) Sufficient NOAA tide gages and benchmarks (see Figures CEPD-3 and CEPD-4) exist throughout the project area to facilitate calibration of the combined tidal-geoid model used with a RTK elevation measurement system. Tide staffs should be set at NOAA gage sites on MLLW (1983-2001) to calibrate the model and for use as a QC on periodic RTK measurement & payment surveys.

10. Actions.

(1) Recover tidal benchmarks and set RTK calibration staffs at approximately eight to ten NOAA tide gage sites along the project reach; as needed to afford RTK coverage to the work sites. Follow EC 1110-2-6065¹ bench mark recovery and documentation requirements.

(2) As required, perform full OPUS DB/PROJECT observations at tidal benchmarks at each of the above tidal gage sites, per EC 1110-2-6065¹ specifications. No GPS observations are required if the site has NSRS NAVD88 control, or can be leveled to.

(3) Tidal benchmarks at existing NOAA CO-OPS sites are recommended as temporary RTK base stations for local dredge operations and measurement & payment surveys.

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¹ Above references to "EC 1110-2-6065" in this 2007 CEPD report refer to an interim guidance document in effect at that time. This manual replaces the interim circular]

D-4. Section 2—Tampa Harbor Channel Framework Report (Jacksonville District).

Tampa Harbor Navigation Project

Master Channel Control Framework Report

21 August 2009

REFERENCES:

CESAJ-EN-DW “Procedures & Standards for Developing & Maintaining Master Channel Control Framework Documents” (7 August 2009)

CEPD PROJECT DATUM EVALUATION REPORT—Tampa Harbor, dated 9 Sep (15 Oct) 2007

2009 Project Condition Survey: (Reference File 09-083)

1. Overview

a. This report summarizes actions in developing a Master Channel Control Framework for the subject project. The scope of this report includes all channels from Egmont Cut in the Gulf into Tampa Bay and Hillsborough Bay; including the Alafia River and port areas. It does not include the 9- & 12-ft Hillsborough River project.

b. The master channel control framework version was developed using a composite of the most recent PCS Survey (2009)--referenced above—and updated channel framework dgn files. The composite Master Channel Control Framework dgn file was developed using these various sources. The project has been transformed to NAD83 and the MLLW vertical reference grade updated to the current tidal epoch (1983-2001).

2. Horizontal Datum Transform

Existing project framework drawings were converted to NAD83 at some point prior to the 2007 CEPD Report—no documentation exists on this effort. It is assumed that the process outlined in EM 1110-2-1005 (and prior guidance documents) was followed and the current channel PI framework coordinates adequately define the geospatial channel alignment.

3. Vertical Datum Modeling (VDatum)

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This project area is covered by a VDatum model referenced to the 1960-1978 epoch—refer to the 2007 CEPD Report. In 2009, CESAJ-EN-DG updated the current VDatum model for Tampa Bay to the latest tidal epoch (1983-2001)—a 0.20 ft average change in MLLW was assumed constant throughout the project. A Kinematic Tidal Datum (KTD) file was then created for Tampa Bay. This updated model (and KTD file) should be used until NOAA releases a new version of VDatum in FY10 which will be on the 1983-2001 epoch. A "preliminary" site calibration of the epoch-corrected VDatum model was performed at various NOAA gage sites around the perimeter of Tampa Bay. NOAA gage MLLW elevations were compared with the VDatum MLLW from RTK/RTN observations. Maximum deviations between RTK tide and gage tide observations were not more than 0.2 ft. Once the new FY10 release of VDatum is available, a final site calibration should be performed for the channel reaches, as outlined below.

4. Geoid Model

The current NGS geoid model shall be used to correct for undulations over the project. The extrapolated geoid heights shall be considered as absolute for correcting observed ellipsoid heights.

5. Construction Survey Positioning Criteria

a. Horizontal Vessel Positioning. A regional RTN network based on NSRS CORS covers most of the Tampa Bay project. Therefore, the RTN indirectly represents the PPCP(s) for this project, subject to local site calibration at a NSRS or NWLON point.

b. The following reaches are outside the RTN coverage and require an RTK base station.

<u>Channel Reach</u>	<u>RTK Base</u>	<u>PID</u>
Egmont Cut 1	Desoto C	AG 0489

c. Vertical Control. Vertical RTK/MLLW calibrations on the most recent surveys have been "checked" by comparisons with real-time PORTS values. When the FY10 update of VDatum is released, a complete RTK/RTN vertical calibration of "RTK Tides" against gage tide readings should be performed relative to a staff gage set to MLLW from tidal bench marks at the following NOAA gage stations.

<u>NOAA Gage</u>	<u>Station ID</u>	<u>"RTK Tide" Calibration</u>	
		<u>Check Results</u>	
Egmont Key	872 6347 or	_____	
Port Manatee	872 6384	_____	
St. Petersburg	872 6520	_____	
Gadsden Point	872 6573	_____	

<i>Long Shoal-MacDill</i>	872 6604	_____
<i>Davis Island</i>	872 6657	_____
<i>Port Tampa</i>	872 6607	_____

d. RTN/RTK observed tide levels above MLLW should ideally agree with the staff gage observations to around 0.2 ft. If these differences at a gage are consistent, then these gage-channel-zoned RTK/RTN site calibration values should be applied by all users.

6. Master Channel Control Framework Drawing Notes

The following notes shall be placed on the master channel control framework drawing.

HORIZONTAL REFERENCE SYSTEM:

THE HORIZONTAL REFERENCE DATUM FOR THIS PROJECT IS NAD83, BASED ON THE CURRENT VERSION OF THE NOAA NATIONAL SPATIAL REFERENCE SYSTEM (NSRS). GRID COORDINATES ARE SHOWN IN THE FLORIDA STATE PLANE COORDINATE SYSTEM (SPCS)—WEST ZONE (0902). CHANNEL STATIONING AND OFFSET COORDINATES ARE RELATIVE TO THE INDICATED CHANNEL BASELINE FOR EACH CHANNEL REACH. CHANNEL ALIGNMENTS ARE GRID BEARINGS REFERENCED TO THE SPCS GRID. UNLESS OTHERWISE INDICATED, CHANNEL WIDTHS AND LIMITS CONFORM TO THE AUTHORIZED PROJECT DIMENSIONS.

VERTICAL REFERENCE SYSTEM:

THE TIDAL REFERENCE GRADE FOR THIS PROJECT IS MEAN LOWER LOW WATER (MLLW), BASED ON THE NOAA 1983-2001 NATIONAL TIDAL DATUM EPOCH. THE NAVD88-MLLW RELATIONSHIP ON THIS PROJECT HAS BEEN HYDRODYNAMICALLY MODELED USING NOAA VDATUM--REFERENCE "TAMPA HARBOR FRAMEWORK REPORT." THE ESTIMATED LOCAL (RELATIVE) ACCURACY OF THIS TIDAL MODEL IS ± 0.1 FT.

CONSTRUCTION SURVEY POSITIONING CRITERIA:

HORIZONTAL POSITIONING AND WATER SURFACE ELEVATION MEASUREMENTS (INCLUDING CALIBRATIONS) SHALL BE PERFORMED UTILIZING REAL-TIME KINEMATIC (RTK) OR RTN GPS OBSERVATIONS FROM (OR CALIBRATED TO) THE FOLLOWING PRIMARY REFERENCE PBMS. PBM COORDINATES AND TIDAL PBM MLLW ELEVATION DATA SHALL BE OBTAINED FROM THE CURRENT NOAA NSRS AND NWLON DATABASES.

MLLW CALIBRATION GAGES (NOTE THAT SOME GAGES MAY HAVE SITE CALIBRATION ADJUSTMENTS):

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<i>Channel Reach</i>	<i>NOAA Gage</i>	<i>Station ID</i>
<i>Egmont Cuts</i>	<i>Egmont Key</i>	<i>872 6347 or</i>
<i>Mullet Key Cut</i>	<i>Mullet Key</i>	<i>872 6364</i>
<i>Cut A, Cut B, and Cut C</i>	<i>Port Manatee</i>	<i>872 6384</i>
<i>Cut D, Cut E, and Cut F</i>	<i>St. Petersburg</i>	<i>872 6520</i>
<i>Gadsden Point Cut to PI Cut A & C (HB)</i> <i>and Cut G (PT)</i>	<i>Gadsden Point</i>	<i>872 6573</i>
<i>Cut C (HB) and Alafia River Channel</i>	<i>Long Shoal-MacDill</i>	<i>872 6604</i>
<i>Davis Island, Seddon Island</i>	<i>Ballast Point</i>	<i>872 6639 or</i>
<i>Port Sutton, & McKay Bay Channels</i>	<i>Hooker Point</i>	<i>872 6668 or</i>
	<i>Davis Island</i>	<i>872 6657</i>
<i>Cut J (PT) & Cut K (PT)</i>	<i>Port Tampa</i>	<i>872 6607</i>

RTK BASE STATIONS OUTSIDE RTN COVERAGE:

<i>Channel Reach</i>	<i>RTK Base</i>	<i>PID</i>
<i>Egmont Cut 1</i>	<i>Desoto C</i>	<i>AG 0489</i>

THE SPATIALLY MODELED NAVD88-MLLW RELATIONSHIPS FOR EACH CHANNEL REACH HAVE BEEN INCORPORATED INTO A KINEMATIC TIDAL DATUM MODEL FOR TAMPA HARBOR. THIS KTD FILE INCORPORATES A 0.20 FT EPOCH CORRECTION INTO THE NOAA PUBLISHED VDATUM MODEL ON THE 1960-1978 EPOCH. THIS CESAJ-OD-H KTD MODEL SHALL BE USED TO CORRECT MEASURED RTK/RTN ELLIPSOID HEIGHTS FOR NAVD88-MLLW DATUM AND GEOID HEIGHT VARIATIONS; FOR SURVEY OPERATIONS PERFORMED ON THIS PROJECT. [AN UPDATED NOAA VDATUM MODEL IS EXPECTED IN 2010].

REFERENCES:

“TAMPA HARBOR FRAMEWORK REPORT,” VERSION DATED 21 AUG 09. MASTER CHANNEL FRAMEWORK FILE [TampaHbrV-SPmccf.dgn] VERSION ____ 09 AUTHORIZATION DATA: (REFER TO TAMPA HARBOR FRAMEWORK REPORT) LOCATION OF REFERENCES AND KTD FILE: PROJECTWISE\CONTROL DATA\NAVIGATION PROJECTS\TAMPA HARBOR

