4.4.4. Quality Control

It is essential for tidal datum quality control to have data processing and leveling procedures carried out to the fullest extent. Caution must also be used in computing tidal datums in riverine systems or in regions of unknown tidal regimes. Tide-by-tide comparisons between subordinate and control station data will often detect anomalous differences which should be investigated for possible gauge malfunction or sensor movement. Datums shall be established from more than one bench mark. Differences in elevations between bench marks based on new leveling must agree with previously established differences from the published bench mark sheets. Any changes in the elevation differences must be reconciled before using in any datum recovery procedure. Datum accuracy at a subordinate station depends on various factors, but availability and choice of an adequate control station of similar tidal characteristics, similar daily mean sea level and seasonal mean sea level variations, and similar sea level trends are the most important. The length of series will also determine accuracy. The longer the series, the more accurate the datum and the greater quality control and confidence gained from analyzing numerous monthly mean differences between the subordinate and control station. At reoccupied historical stations for which datum recoveries are made, updated datums shall be computed from the new time series and compared with the historical datums as the survey progresses.

4.4.5. Geodetic Datum Relationships

Tidal datums are local vertical datums which may change considerably within a geographical area. A geodetic datum is a fixed plane of reference for vertical control of land elevations. The North American Vertical Datum of 1988 (NAVD 88) is the accepted geodetic reference datum of the National Geodetic Spatial Reference System and is officially supported by the National Geodetic Survey (NGS) through a network of GPS continuously operating reference stations. The relationship of tidal datums to NAVD has many hydrographic, coastal mapping and engineering applications including monitoring sea level change and the deployment of GPS electronic chart display and information systems, etc.

Existing geodetic marks in the vicinity of a subordinate tidal station shall be searched for and recovered. A search routine is available at http://www.ngs.noaa.gov. An orthometric level connection and ellipsoidal GPS tie is required at a subordinate tide station which has geodetic bench marks located nearby. NAVD 88 height elevations for published bench marks are given in Helmert orthometric height units by NGS. The GPS ellipsoid network height accuracies are classified as conforming to 2 cm or 5 cm standards accuracies (Refer to *NOAA Technical Memorandum NOS NGS-58*). At the present time, GPS ellipsoid heights conforming to the 2 cm accuracy standards are required for contract hydrographic surveying projects. Refer to Section 4.2.8 GPS Observations and *User's Guide for GPS Observations, NOAA/NOS, Updated January 2003.*

An orthometric level connection is preferred over ellipsoidal GPS tie, where applicable, for deriving NAVD 88 heights. An orthometric level connection is required if any geodetic marks (up to five marks) are located within a radius of 0.8 km (0.5 mi) from the subordinate tide station location. If suitable marks are found in the NGS database, and are farther than 0.8 km (0.5 mi) but less than 10 km (6 mi) from a subordinate tide station, then a GPS tie is required to derive the ellipsoid heights. If a minimum of five existing tidal bench marks within 1 km of a subordinate tide station location are not found, or suitable geodetic marks are not found in the NGS database within 10 km (6 mi) of a subordinate tide station, then five new bench marks shall be installed, described, connected by levels, and GPS observations shall be done on at least one of the five marks. (Refer to *User's Guide for Writing Bench Mark Descriptions, NOAA/NOS, Updated January 2003*, *User's Guide for GPS Observations, NOAA/NOS, Updated January 2003*, and the Section 4.2.8 GPS Observations.) At least two geodetic bench marks should be used to validate the leveling or GPS ellipsoid height connection for quality control purposes.

4.5. Final Zoning and Tide Reducers

Data relative to MLLW from subordinate stations or from NWLON stations, as appropriate, shall be applied to reduce sounding data to chart datum, either directly or indirectly through a correction technique referred to as tidal zoning. Whether corrected or direct, time series data relative to MLLW or other applicable LWD applied to reference hydrographic soundings to chart datum are referred to as "tide reducers" or "water level reducers".

4.5.1. Water Level Station Summaries

Data are reduced to mean values and subsequently adjusted to National Tidal Datum Epoch (NTDE) values for tidal datums and characteristic tidal attributes as prescribed in Section 4.4. and 4.5. "Summary files" shall be created for each subordinate tide station occupied for the survey. These summary data facilitate the development of corange and cophase lines and final zoning schemes. They also provide input into the NOS tidal datum bench mark publication process which supports navigation, boundary and shoreline determination, coastal engineering and management. NTDE values for Greenwich high and low water intervals, mean and diurnal ranges and high and low water inequalities shall be tabulated in these summary files which also contain the datums, the time and length of the series and NOS control station which was used to compute 19-year equivalent NTDE values. NTDE datums shall be tabulated in the summary file relative to a documented consistent station datum such as tide staff zero or arbitrary station datum. The elevation of the primary bench mark shall be provided in this summary relative to the same zero or station datum. Latitude and longitude positions shall also be provided. An example of a summary file is provided in Figure 4.9.

Summary file data from new station occupations and NOS provided summaries from historical occupations and control stations within the survey area shall be used as input data to the tidal zoning process.

4.5.2. Construction of Final Tidal Zoning Schemes

As tidal characteristics vary spatially, data from deployed water level gauges may not be representative of water levels across a survey area. Tidal zoning shall be implemented to facilitate the provision of time series water level data relative to chart datum for any point within the survey area such that prescribed accuracy requirements are maintained for the water level measurement component of the hydrographic survey. NOS currently utilizes the "discrete tidal zoning" method for operations, where survey areas are broken up into a scheme of zones bounding areas of common tidal characteristics. The minimum requirement is for a new zone for every 0.06 m change in mean range of tide and every 0.3 hour progression in time of tide (Greenwich high and low water intervals). Phase and amplitude corrections for appropriate tide station data shall be assigned to each zone.

As part of the process, tidal characteristics shall be accessed using geographic spacial placement of summary data in a commercial GIS compatible format to assess spatial variations in tidal characteristics. Corange and cophase maps shall be generated to provide the base for development of zoning schemes. Preliminary zoning, which is based on available historical tide station data and estuarine and global tide models, is referenced to an applicable predictions reference station for utilization during field work. For final processing, preliminary zoning shall be superseded by "final zoning" which is a refinement based on new data collected at subordinate stations during the survey. With the final zoning scheme, correctors for each zone shall be derived from a subordinate station specifically installed for the survey rather than the reference station used with preliminary zoning. For contract surveys, the contractor shall develop and utilize a zoning scheme to the specifications mentioned above such that water level reducers are within required accuracy across the entire survey area. Zoning errors shall be minimized such that when combined with errors from actual water level measurement at the gauge and errors in reduction to chart datum, the total error of the tide reducers is within specified tolerances. The final zoning scheme and all data utilized in its development shall be documented and submitted. Examples of zoning files and graphics are provided in Figures 4.10, 4.11, 4.12, 4.13 and 4.15.

4.5.3. Tide Reducer Files and Final Tide Note

Verified time series data collected at appropriate subordinate stations are referenced to the NTDE Mean Lower Low Water (Chart Datum) through datum computation procedures outlined in Section 4.4. Time series data collected in six-minute intervals and reduced to chart datum as specified, both from subordinate gauges operated by the contractor and from NWLON stations where appropriate, shall be used either directly or corrected through use of a zoning scheme as determined appropriate by the contractor such that tide reducers are within specified tolerances. A Final Tide Note shall be submitted for each hydrographic sheet with information as to what final tidal zoning should be applied to which stations to obtain the final tide reducers. An example Final Tide Note and final tidal zoning graphic is found in Figure 4.15.

Figure 4-9 Tide Station Summary

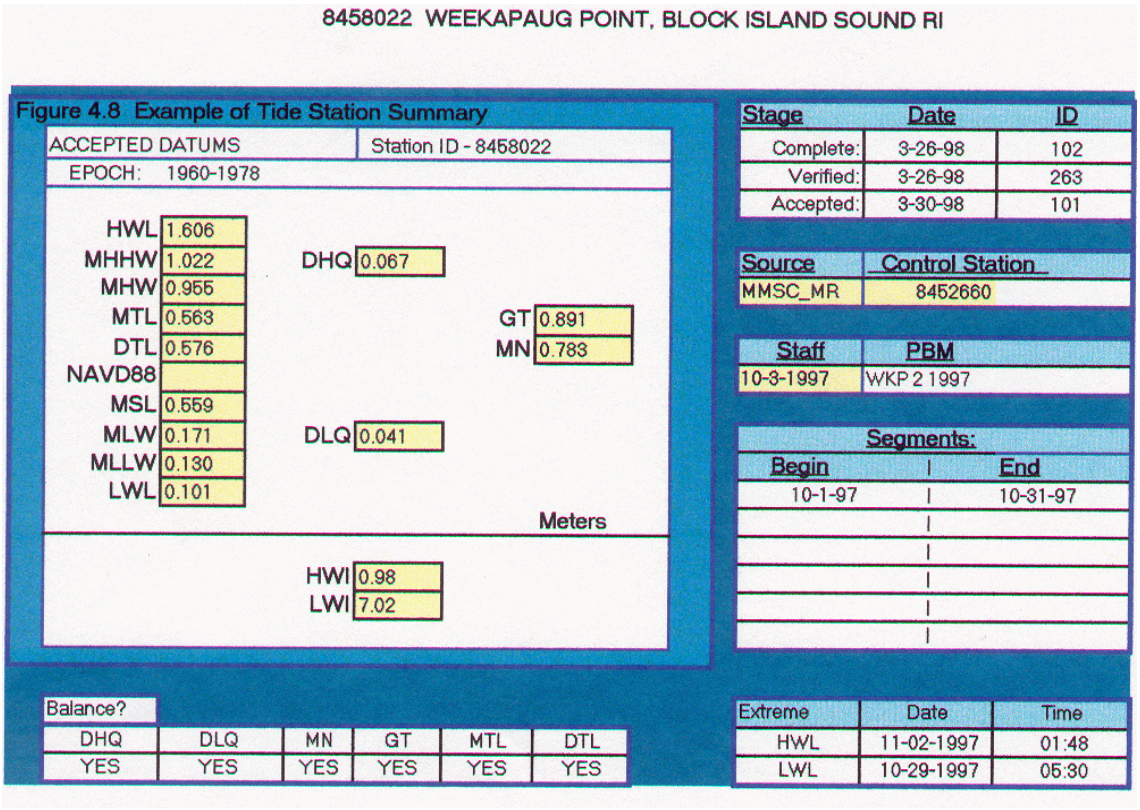


Figure 4-10 GIS Summary Data File

GIS Summary Data File

STATION	NAME	ST	HWI	LWI	TCHHWI	TCLLWI	MN	DHQ	DLQ	GT	EPOCH	SERIES	HA_SERIES	COMP_STAT	COMMENTS	LATITUDE	LONGITUDE
9455176	BURNT ISLAND, JURNALAIN ARM	AK	3.67	10.25	N/A	N/A	28.0	0.8	2.4	31.2		4H/L,1912	N/A	Fire Island		60.950000000	-149.883333333
9455182	CAIRN POINT, KNIK HARBOR	AK	3.69	10.35	N/A	N/A	26.97	0.76	2.38	30.11		224H/L,1918	N/A	Anchorage staff		61.233333333	-149.916666667
9455697	SISTERS ROCK, COOK INLET	AK	0.31	6.85	N/A	N/A	16.31	0.85	2.02	19.18	41-59	34H/32L,Jul-Aug79	N/A	Seldovia		60.301666667-	-151.455000000
9455711	CAPE KASILOF, COOK INLET	AK	0.43	6.80	N/A	N/A	17.66	0.60	2.08	20.34	41-59	60H/L,Jun-Aug74	N/A	Seldovia		60.336666667	-151.380000000
9455715	KASILOF, KASILOF RIVER	AK			N/A	N/A						36H,Jul80	N/A		High waters only	60.358333333	-151.276666667
9455722	KALGIN ISLAND (WEST)	AK	0.36	6.71	N/A	N/A	15.63	0.71	1.90	18.24	41-59	128H/127L,Jun-Aug74	N/A	Seldovia	mean of 2 series	60.453333333	-151.956666667
9455728	LIGHT POINT, KALGIN ISLAND	AK	0.70	7.13	N/A	N/A	15.95	0.70	2.00	18.65		58H/L,Jul-Aug75	N/A	Nikiski		60.486666667	-151.835000000
9455735	CHINULNA POINT, COOK INLET	AK	0.68	7.22	N/A	N/A	17.89	0.74	2.02	20.65	60-78	1Mo,Jun95	N/A	Seldovia	3 series	60.503333333	-151.283333333
9455737	KENAI RIVER	AK	0.80		N/A	N/A		0.67			41-59	24Dy,Jul-Aug74	N/A	Nikiski	high waters only	60.521666667	-151.206666667
9455741	DRIFT RIVER	AK	0.69	7.04	N/A	N/A	15.58	0.68	1.93	18.19		64H/L,Jul-Aug74	N/A	Seldovia	superceded	60.555000000	-152.133333333
9455742	KENAI	AK	0.78	7.75	N/A	N/A	14.49	0.73	1.64	19.86	41-59	2Mo,Jun-Jul76	N/A	Seldovia		60.545000000	-151.218333333
9455760	NIKISKI	AK	1.22	7.60	N/A	N/A	17.69	0.70	2.08	20.47	60-78	5Yr,1972-75&77	N/A	Seldovia		60.683333333	-151.396666667
9455768	WEST FORELAND	AK	1.53	7.56	N/A	N/A	13.30	0.68	2.23	18.21	60-78	1Mo,Jul76	N/A	Seldovia		60.713333333	-151.710000000
9455769	NIKISHKA, 1ST EAST FURGUNA	AK	1.43	8.03	N/A	N/A	18.05	0.49	2.11	20.65		9H/L,1909	N/A	Seldovia		60.733333333	-151.333333333
9455771	PLATFORM DILLON,T-39,COOK INLET	AK	1.48	7.70	N/A	N/A	17.28						N/A		CHART 16660	60.736666667	-151.513333333
9455772	NIKISHKA #2, COOK INLET	AK	1.59	8.22	N/A	N/A	17.33	0.65	2.21	20.19	41-59	4Mo,Jul-Oct71	N/A	Seldovia		60.743333333	-151.308333333
9455779	SHELL PLATFORM, GIDDLE GROUND	AK	1.68	8.06	N/A	N/A	16.4					1Mo,1966	N/A		Chart 16660	60.795000000	-151.495000000
9455781	JUMBO ROCK, BOULDER POINT	AK	1.83	8.48	N/A	N/A	18.02	0.68	2.06	20.76	41-59	15H/L,Sep76	N/A	Nikiski		60.797000000	-151.170000000
9455782	DOLLY VARDEN PLATFORM,COOK INLET	AK	1.68	8.14	N/A	N/A	16.22	0.68	2.11	19.01		1Mo,Dec71	N/A	Anchorage		60.808333333	-151.636666667
9455783	TRADING BAY, COOK INLET	AK	1.47	7.88	N/A	N/A	16.5	0.8	2.20	19.50		22H.12L,1910	N/A	Seldovi/1st Red.		60.801666667	-151.776666667
9455787	GRAY CLIFFE	AK	1.95	8.58	N/A	N/A	19.47	0.79	2.06	22.32	41-59	2Mo,Jul-Aug77	N/A	Anchorage		60.833333333	-150.971666667
9455799	MIDDLE RIVER, COOK INLET	AK			N/A	N/A							N/A			60.911666667	-151.616666667
9455809	T-37 PLATFORM (OPR 469)	AK			N/A	N/A	16.82	0.63	2.15	19.60	60-78	24H/L,Jul75	N/A	Nikiski		60.928333333	-151.530000000
9455824	MOOSE POINT	AK	2.73	9.23	N/A	N/A	20.6	0.8	2.3	23.7		4H/L,1910	N/A	Chinulna Pt.		60.953300000	-150.731600000
9455826	MOOSE POINT T33 (OPR 469)	AK			N/A	N/A							N/A			60.975000000	-150.606666667
9455828	T-29 CHICALOON BAY,TURNAGAIN ARM	AK			N/A	N/A							N/A			60.966666667	-149.850000000
9455845	T-36 PLATFORM, OFF GRANITE POINT	AK	2.25	8.68	N/A	N/A	16.73	0.65	2.08	19.46		62h/l,Jul-Aug1975	N/A	Nikiski		61.000000000	-151.330000000
9455846	T-29 RAINBOW (OPR-469)	AK	3.59	11.28	N/A	N/A	27.51	0.59	1.56	29.66		20H/L,Jul1975	N/A	Anchorage		61.000000000	-149.640000000
9455856	TYONEK, COOK INLET	AK	2.32	8.77	N/A	N/A	17.5	0.8	2.3	20.6		4H/L,1910	N/A	Chinulna Pt.		61.020000000	-151.316666667
9455866	T-39 POINT POSSESSION (OPR-469)	AK	3.00	9.68	N/A	N/A	23.19	0.66	2.20	26.05	41-59	1Mo,Jul1975	N/A	Anchorage		61.036666667	-150.413000000
9455869	NORTH FORELAND	AK	2.71	9.03	N/A	N/A	17.88	0.61	2.08	20.57	41-59	107H/L,Jun-Aug1975	N/A	Nikiski	GP changed 5/5/98	61.048300000	-151.158300000
9455885	PHILLIPS PLATFORM	AK	2.79	9.21	N/A	N/A	19.20	0.64	2.19	13.04	60-78	1Mo,Jul1975	N/A	Anchorage	not verified	61.076700000	-150.951666667
9455909	THREE MILE CREEK, COOK INLET	AK	2.68	9.18	N/A	N/A	19.2	0.8	2.3	22.3		7H/8L,1919	N/A	Chinulna Pt.		61.143333333	-151.075000000
9455911	FIRE ISLAND (WEST SIDE)	AK			N/A	N/A	24.6	0.7	2.2	27.5		22H/21L,May1941	N/A			61.156666667	-150.240000000
9455912	FIRE ISLAND	AK	3.27	10.00	N/A	N/A	24.01	0.65	2.08	26.74	60-78	108H/107LMay-Jun1982	N/A	Anchorage		61.173333333	-150.213333333
9455915	PT. WORONZOF	AK	3.41	10.15	N/A	N/A	24.43	0.68	2.12	27.23	60-78	2Mo,Jul-Aug1971	N/A	Anchorage		61.196666667	-150.030000000
9455920	ANCHORAGE, KNIK ARM, COOK INLET	AK	3.72	10.42	N/A	N/A	26.25	0.71	2.28	29.24	60-78	8Yr,1984-91	N/A	Seldovia		61.238333333	-149.888333333
9455921	ANCHORAGE (ADR)	AK			N/A	N/A							N/A			61.238333333	-149.888333333
9456043	HARRIET POINT	AK	0.50	6.72	N/A	N/A	14.19	0.70	1.95	16.84	41-59	100H/99L,Jun-Jul1974	N/A	Seldovia		60.403333333	-152.255000000
9456094	REDOUBT PT	AK	0.33	6.50	N/A	N/A	14.01	0.44	1.95	16.40	41-59	1Mo,Jul75	N/A	Nikiski		60.301666667	-152.385000000

Figure 4-11 CORANGE LINE of GREENWICH, High and Low Water Intervals (In Hours)

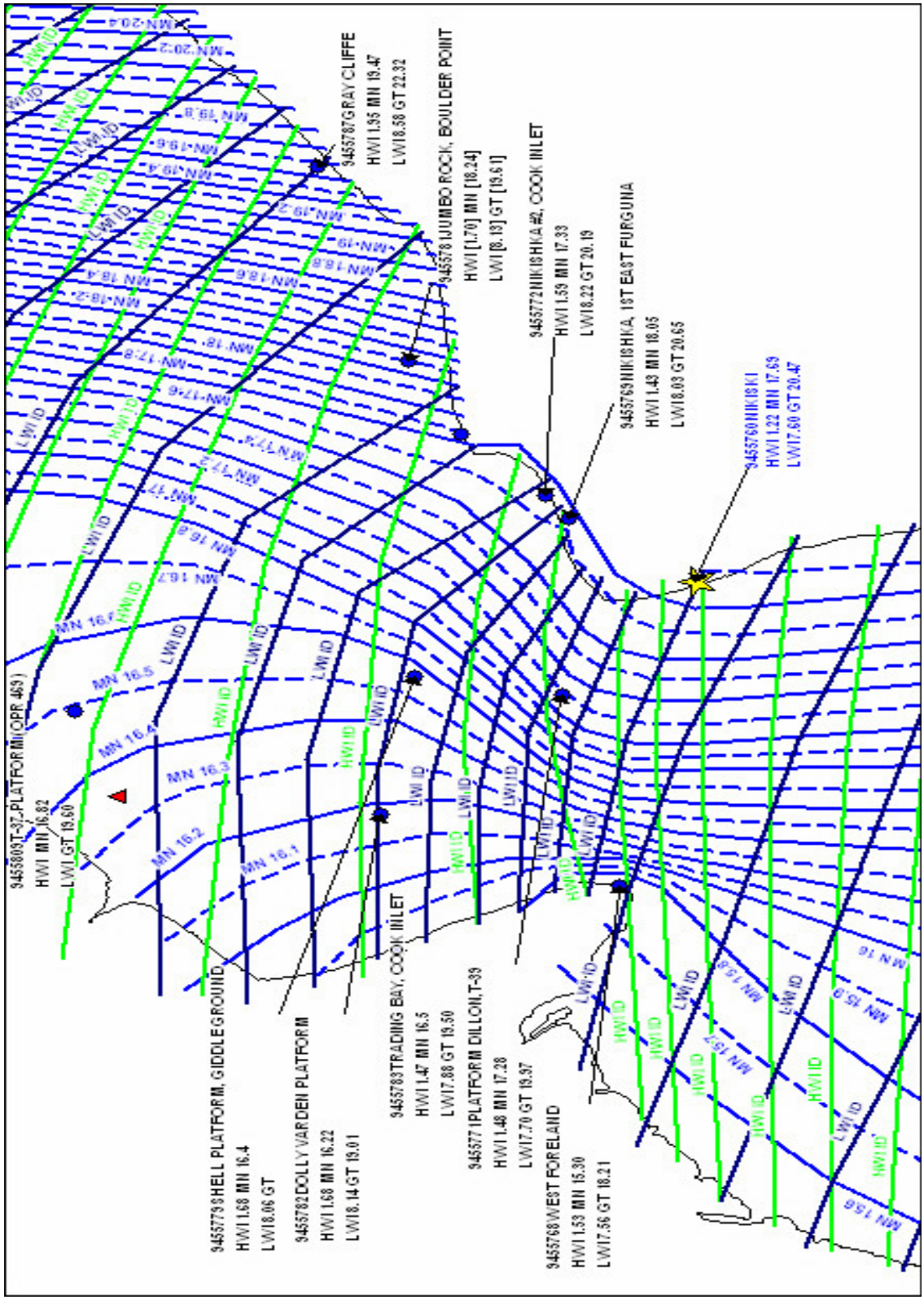


Figure 4-12 TIDAL ZONING for APPROACHES TO NIKISKI, ALASKA

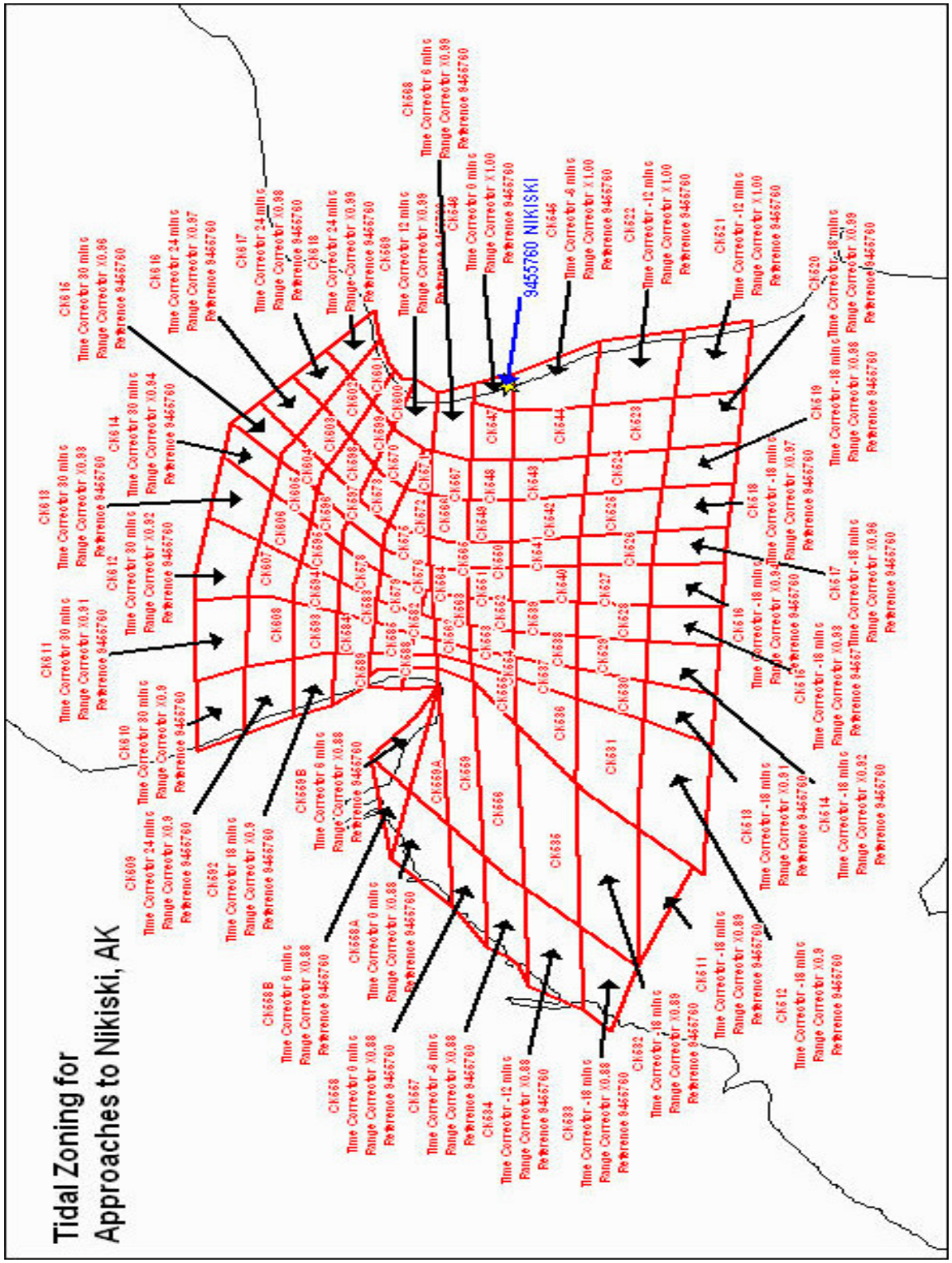


Figure 4.13 Example Tide Reducer File from NOAA acoustic system

STATION	DATE/TIME	WL VALUE on MLLW	WL SIGMA	inferred	quality control flags: flat	rofc	temp
	utc	meters	meters				
9414290	10/1/98 0:00	1.373	0.042	0	0	0	0
9414290	10/1/98 0:06	1.390	0.043	0	0	0	0
9414290	10/1/98 0:12	1.403	0.036	0	0	0	0
9414290	10/1/98 0:18	1.424	0.039	0	0	0	0
9414290	10/1/98 0:24	1.426	0.033	0	0	0	0
9414290	10/1/98 0:30	1.436	0.034	0	0	0	0
9414290	10/1/98 0:36	1.458	0.032	0	0	0	0
9414290	10/1/98 0:42	1.489	0.035	0	0	0	0
9414290	10/1/98 0:48	1.507	0.032	0	0	0	0
9414290	10/1/98 0:54	1.520	0.038	0	0	0	0
9414290	10/1/98 1:00	1.533	0.042	0	0	0	0
9414290	10/1/98 1:06	1.537	0.029	0	0	0	0
9414290	10/1/98 1:12	1.541	0.033	0	0	0	0
9414290	10/1/98 1:18	1.548	0.032	0	0	0	0
9414290	10/1/98 1:24	1.572	0.033	0	0	0	0
9414290	10/1/98 1:30	1.596	0.037	0	0	0	0
9414290	10/1/98 1:36	1.609	0.039	0	0	0	0
9414290	10/1/98 1:42	1.624	0.036	0	0	0	0
9414290	10/1/98 1:48	1.639	0.040	0	0	0	0
9414290	10/1/98 1:54	1.638	0.036	0	0	0	0
9414290	10/1/98 2:00	1.649	0.032	0	0	0	0
9414290	10/1/98 2:06	1.658	0.036	0	0	0	0
9414290	10/1/98 2:12	1.659	0.033	0	0	0	0
9414290	10/1/98 2:18	1.660	0.041	0	0	0	0
9414290	10/1/98 2:24	1.671	0.029	0	0	0	0
9414290	10/1/98 2:30	1.669	0.039	0	0	0	0
.	.	.	.				
.	.	.	.				
.	.	.	.				
.	.	.	.				
9414290	11/30/98 23:00	0.350	0.120	0	0	0	0
9414290	11/30/98 23:06	0.342	0.124	0	0	0	0
9414290	11/30/98 23:12	0.343	0.090	0	0	0	0
9414290	11/30/98 23:18	0.359	0.106	0	0	0	0
9414290	11/30/98 23:24	0.389	0.079	0	0	0	0
9414290	11/30/98 23:30	0.412	0.087	0	0	0	0
9414290	11/30/98 23:36	0.446	0.128	0	0	0	0
9414290	11/30/98 23:42	0.459	0.102	0	0	0	0
9414290	11/30/98 23:48	0.399	0.089	0	0	0	0
9414290	11/30/98 23:54	0.463	0.136	0	0	0	0

4.6. Data Submission Requirements

Data submission requirements for water level measurement stations are comprised of both supporting documents for the installation, maintenance, and removal of stations, and the formatted digital water level data collected by the water level measurement system required for NOS quality control and ingestion into the NOS data base management system. In addition, documentation for processing and tabulation of the data, tidal datum computation, and final tidal zoning are required.

Data submission requirements for GPS project consists of project reports, station (bench mark) description or recovery notes, observation log sheets, station visibility diagrams, photographs or rubbings of station marks, raw GPS data, Rinex GPS data, and other info as pertinent.

4.6.1. Station Documentation

The documentation package shall be forwarded to CO-OPS within 10 business days of: a) installation of a station, b) performance of bracketing levels, c) gauge maintenance and repair, or d) removal of the station. Refer to Section 4.2.6 for general documentation requirements and Figure 4.14, Water Level Station Documentation Checkoff List. The station documentation generally includes, but is not limited to the following:

(a) Field Tide Note

(b) Calibration test documentation from an independent source other than the manufacturer for each sensor used to collect water level or ancillary data.

(c) NGWLMS Site Report (see *Next Generation Water level Measurement System Site Design, Preparation, and Installation Manual*) , and/or Tide Station Report (NOAA Form 77-12), or Great Lakes Water Level Station Report (NOAA Form 77-75) or equivalent. Contractor created Site Reports are acceptable as long as the reports provide same required information.

(d) New or updated Nautical chart section or U.S. Geological Survey quadrangle map indicating the exact location of the station, with chart number or map name and scale shown.

(e) Large-scale sketch of the station site and digital GIS compatible file provided on diskette showing the relative location of the water level gauge, staff (if any), bench marks, and major reference objects found in the bench mark descriptions. The sketch shall include an arrow indicating north direction, a title block, and latitude and longitude (derived from handheld GPS) of the gauge and all bench marks.

(f) New or updated description of how to reach the station from a major geographical landmark.

(g) Photographs of station components and bench marks. Digital photographs are preferred. As a minimum, photographs shall show a view of the water level measurement system as installed, including sensors and DCP; a front view of the staff (if any); multiple views of the surroundings and other views necessary to document the location; and photographs of each bench mark, including a location view and a close-up showing the bench mark stamping. All photographs shall be annotated and referenced with the station name, number, location, and date of the photograph.

(h) Description/Recovery Notes of Bench Marks (see *User's Guide for Writing Bench Mark Descriptions*, NOAA/NOS, Updated January 2003).

(I) Level records and level abstract, including level equipment information.

(j) Datum offset computation worksheet or Staff/Gauge difference work sheet as appropriate showing how sensor "zero" is referenced to the bench marks.

4.6.2. GPS Project Documentation

The following information shall be submitted to CO-OPS at the end of the project so that proper information can be forwarded to NGS.

This documentation is important because most of the information is used to submit the GPS data to NGS. In addition to the log, data must comply with the "Data Submission to NGS Section" of NGS-58 and the "Input Formats and Specifications of the National Geodetic Survey (NGS) Data Base" to become part of the NSRS.

GPS data collected by contractors or NOAA Ships for hydrographic survey support, or special projects shall be processed by the parties, and final data product - Receiver Independent Exchange Format (RINEX) data and appropriate forms - shall be submitted to CO-OPS which will be forwarded to NGS, as per the contracts, project instructions, statement of work, or as appropriate.

GPS forms in PDF format can be found at the following NGS Federal Base Network web site:

http://www.ngs.noaa.gov/PROJECTS/FBN/index.htm

Refer to Figures 4.16 through 4.22 for GPS projects submission checklist and sample package contents.

(A) Project report (Refer to Figure 4.16):
One project report per GPS project is required.

(B) Station (bench mark) description or recovery notes (Refer to Figure 4.17)
One per bench mark, for which GPS observations are submitted, is required.

(C) Observation log sheets (Refer to Figure 4.18 and 4.19)
One per each GPS observation session is required.

(D) Station/bench mark visibility diagrams (Refer to Figure 4.20)
One per each bench mark, for which GPS observations are submitted, is required.

(E) Photographs or rubbings of station (bench) marks (Refer to Figure 4.22 and 4.21)
One per each bench mark, for which GPS observations are submitted, is required.

(F) Raw GPS data

(G) Rinex GPS data

Figure 4.14

I. For Each Water Level Station:

PROJECT DOCUMENTATION AND DATA CHECKOFF LIST

Project Number: _____ Locality: _____

Station Number: _____ Station Name: _____

A. Field Tide Note

____ 1.Verify latitude and longitude with handheld GPS.
____ 2.Verify dates.

B. Site Report (required for both installation and removal)

____ 1.All applicable information complete, especially serial numbers of DCP/sensors and dates of installation/removal of DCP/sensors and levels.
____ 2.Verify latitude and longitude (ensure that this is the same as on the field tide note).
____ 3.Denote latitude and longitude as NAD 83. Also note if position was derived from handheld GPS.

C. Chart Section

____ 1.Ensure that station location is clearly depicted with circle and station number.
____ 2.Note chart number, edition, date and scale.

D. Bench Mark/Station Location Sketch

____ 1.Gage/staff and bench marks shown.
____ 2.Title block provided (NOAA Form 76-199).
____ 3.North arrow depicted.
____ 4.Include hard copy sketch and GIS digital format on diskette.

E. Photographs

____ 1.Digital photographs of gage, staff and surrounding area.

F. Bench Mark Descriptions/Recovery Notes

____ 1.Stampings for new and recovered marks verified.
____ 2.Descriptions for new marks provided in NOS format (WordPerfect).
____ 3.Recovery notes provided for all historical marks.

Figure 4.14 (continued)

G. Levels

____ 1.Ensure all information written in ink.
____ 2.Cover information complete; station name, number, instrument and rod type, serial numbers, date, personnel.
____ 3.Note types of levels; installation, bracketing and closing.
____ 4.Staff information complete (if applicable).
____ 5.Collimation check shown.
____ 6.Note that bench mark descriptions are submitted on separate sheets.
____ 7.Headers on all applicable pages complete.

H. Datum Offset Computation Worksheet

____ 1. Submit for stations using Vitel or Sutron 8200 DCP with Aquatrak sensor.

I. Data Submitted on Diskettes

____ 1.Label diskettes with contractor name and list of files on each diskettes.
____ 2.Data files should be named in the following format: xxxxxxx1.dat, where xxxxxxx = seven digit station number and 1 is the DCP designation. For multiple files from the same station, change the extension, i.e., xxxxxxx1.da1, da2, etc.
____ 3.Check the begin and end dates of data submitted with dates of hydrographic operations.
____ 4.Check data continuity.

II For the Project:

A. Files

____ 1. GIS files for final zoning
____ 2. Final Tide Reducer Files for each H-Sheet

B. Final Tide Notes

____ 1.Final Tide Note for each H-Sheet

C. Transmittal Letter

____ 1.Transmittal letter attached with current contractor address, phone number and email.

D. All Documentation Enclosed in Tide Level Envelope (NOAA Form 75-29A)

____ 1.Leave “sheets” box blank, complete other information in title boxes.
____ 2.Verified complete by Contractor and Include date.

Figure 4.15: **FINAL TIDE NOTE and FINAL TIDAL ZONING CHART**

DATE: December 22, 1999

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-P342-RA-99
HYDROGRAPHIC SHEET: H-10910

LOCALITY: 6 NM Northwest of Cape Kasilof, AK

TIME PERIOD: July 22 - August 20, 1999

TIDE STATION USED: 945-5711 Cape Kasilof, AK
Lat. 60º 20.2'N Lon. 151º 22.8'W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 5.850 meters

REMARKS: RECOMMENDED ZONING
Use zone(s) identified as: CK394, CK395, CK399, CK400, CK401, CK407, CK408, CK409, CK434, CK435, CK441, CK442, CK443, CK467, CK468, CK469, CK470, CK477, CK480, CK481, CK482, CK483, CK493 & CK494.

Refer to attachments for zoning information.

Note 1: Provided time series data are tabulated in metric units (Meters), relative to MLLW and on Greenwich Mean Time.

Note 2: Nikiski, AK served as datum control for subordinate tide stations and for tidal zoning in this hydrographic survey. Accepted datums for this station have been updated recently and have changed significantly from previous values.

The current National Tidal Datum Epoch (NTDE) used to compute tidal datums at tide stations is the 1960-78 NTDE. Traditionally, NTDEs have been adjusted when significant changes in mean sea level (MSL) trends were found through analyses amongst the National Water Level Observation Network (NWLON) stations. Epochs are updated to ensure that tidal datums are the most accurate and practical for navigation, surveying and engineering applications and reflect the existing local sea level conditions. For instance, analyses of sea level trends show that a new NTDE is necessary and efforts are underway to update the 1960-1978 NTDE to a more recent 19-year time period.

Note: This example of Field Tide Note and Final Tidal Zoning Chart was written in December 1999, at that time NTDE was 1960-1978, now the new NTDE is 1983-2001.

Figure 4.15 (continued)

However, analyses also show that there are several geographic areas whose sea level trends are strongly anomalous from the average trends found across the NWLON and thus, must be treated differently. One of these areas is in Cook Inlet, Alaska. Nikiski has shown a significant relative sea level change due to continued vertical land movement after the 1964 earthquake. NOS has adopted a procedure for computing accepted tidal datums for this anomalous region by using an MSL value calculated from the last several years of data rather than the 19-year NTDE. The accepted range of tide is still based on the 19-year NTDE and, when applied to the updated MSL, will result in updated values for Mean High Water (MHW) and Mean Lower Low Water (MLLW) derived through standard datum calculation procedures. For Nikiski, the MSL value was computed from the period of 1994-1998. This resulted in a lowering of the MLLW datums relative to land by approximately 1.0 ft at Nikiski compared to the previous MLLW elevations used in surveys prior to January 1, 1998. Subordinate tide stations in the area used for hydrographic surveys and controlled by Nikiski will be affected similarly. Accepted datums have been computed and may be accessed on the Internet through the URL specification **http://www.co-ops.nos.noaa.gov**.

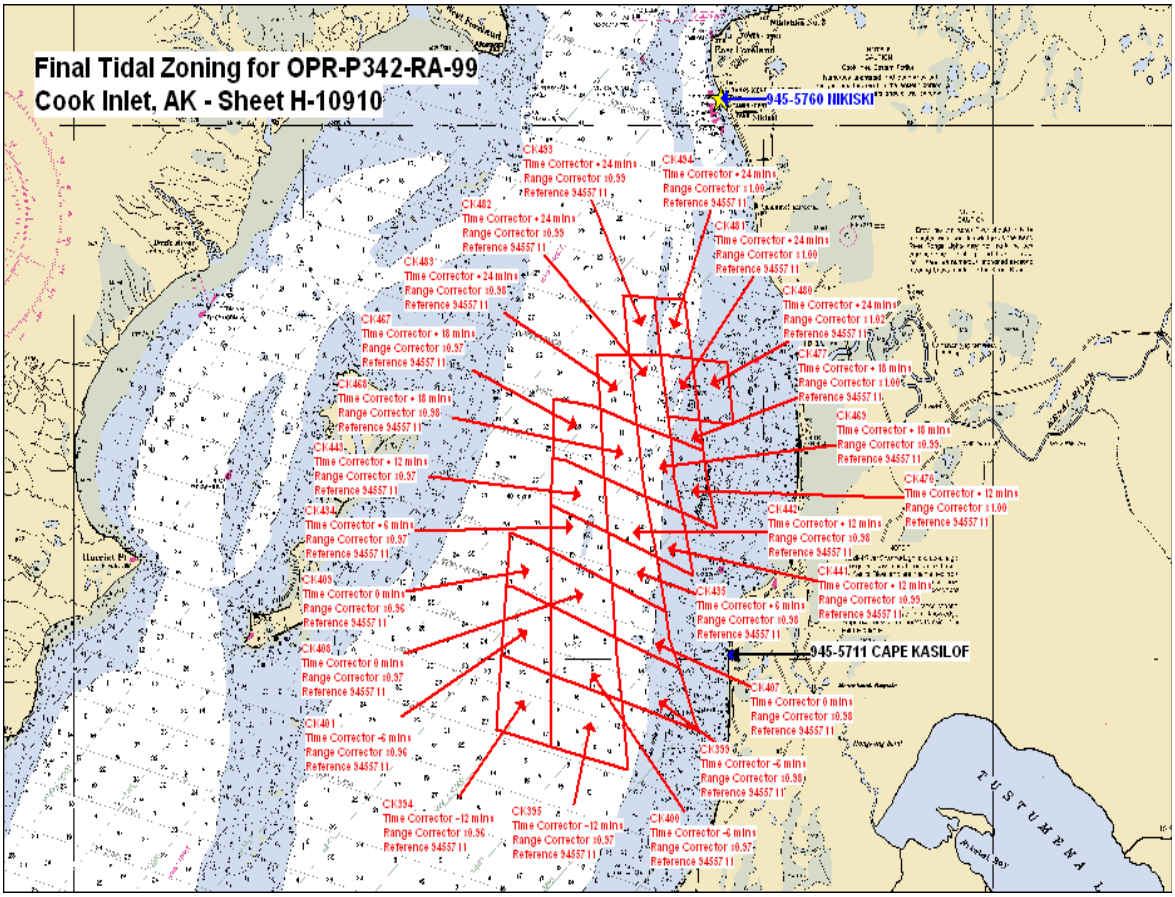


Figure 4.16 **PROJECT SUBMISSION CHECKLIST**
GPS PROJECTS

Project Title : _____

Submitting Agency: _____

Observing Agency: _____

Receiver Type: _____

Antenna Type: _____

PACKAGE CONTENTS

( ) Project Report

( ) Station Description or Recovery notes

( ) Observations Logs Sheets
Data which must be filled out: Station Designation, Date (UTC), General Location, Day of Year, Project Name, Session ID, Observation Session Times, Agency Full Name, Operator Full Name, Phone Number, GPS Receiver, GPS Antenna, Antenna Height, Data File Name

( ) Station Visibility Diagrams

( ) Photographs or Rubbings of Station Marks

( ) Raw GPS data

( ) Rinex GPS Data - See below

( ) Other

DATA REFORMATTING

Convert the raw GPS data to RINEX2 format with your manufacturer's software. The software should require you to enter the raw data filename, the output filenames, your name, the observer's name and agency, and the antenna type used.

The NGS-standard data filenames are as follows:

Raw GPS input files: aaaaddds.xxx
Where: aaaa = alphanumeric 4-character station identifier, ddd = day of year, s = session, yy = year of observations, and xxx is the receiver-dependent file extension (e.g., .DAT, .EPH, .ION, .MES, etc.)

RINEX2 Navigation File: aaaaddds.yyn
RINEX2 Observation File: aaaaddds.yyo

For example, RINEX2 filenames from station BALD 2 on session A of 12/31/98 are BALD365A.98o and BALD365A.98n Copy the raw GPS data files and the converted RINEX2 data files onto separate 3.5-inch diskettes or CD ROM.

Figure 4.17: Station (Bench mark) Description/ Recovery Form

--> Click here to clear the sample data <--

NATIONAL GEODETIC SURVEY
STATION DESCRIPTION / RECOVERY FORM

PID: QE2736 Designation & Alias: BALD 2 RESET

Country: (USA / USA) State: OR County: LINCOLN

Latitude: N 44 49 49.17802 " Longitude: W 124 03 56.23447 " Elevation: 17.0 (meter / ft)

Original Description (check one):	
☐ P	Preliminary (mark has not been set yet)
☐ D	A newly set mark
☑ R	A recovered mark
Established by: (NGS / CGS / Other:)	Oregon DOT
Date:	Chief of Party (initials): ???

Recovery Description (check one):	
☐ F	Full description of a station *not* in the database
☑ T	Full description of a station *in* the database
☐ M	*Partial* description of a station in the database
Recovered by: (NGS / Other:)	Oregon DOT
Date:	Chief of Party (initials): CFS

Monument Stability (check one):	
☑ A	Of the most reliable nature; expected to hold well
☐ B	Will probably hold position and elevation well
☐ C	May hold well, but subject to ground movement
☐ D	Of questionable or unknown reliability

Recovery Condition (check one):	
☑ G	Recovered in good condition
☐ N	Not recovered or not found
☐ P	Poor, disturbed, or mutilated
☐ X	Surface mark known destroyed

Setting Information:	
Marker Type: (Rod / Disk / Other)	
Setting Type: (Bedrock / Concrete / Other:)	
☑ / N / ?	Monument contains magnetic material?

Stamping:	BALD 2 1991
Agency Inscription: (NGS / CGS / Other:)	Oregon DOT
Rod Depth: (meter/ft), Sleeve Depth:	(meter/ft)
Monument is: (flush / projecting / recessed)	(cm/inch)

Special Type (check all applicable):	
☐ F	Fault monitoring site
☐ T	Tidal Station
☑ --	Control Station: (FBN / CBN / Benchmark)
☐ --	Airport Control Station: (PACS / SACS)
☑ /N	Mark is suitable for GPS use?

Transportation (check one):	
☑ C	Car
☐ P	Light truck (pickup, carry-all, etc.)
☐ X	Four-Wheel Drive Vehicle
☐ __	Other (SnowCat, Plane, Boat; describe)
☑ /N	Pack Time (hike) to mark? (hh:mm): 00:03

See Back of Form to add Text Description

General Station Location: The station is located in about 10 km south from Lincoln Bay, 13 km north from Depoe Bay, and at the US101 Boiler Bay wayside rest area.

(Describe general location; include airline distances to three towns or mapped features.)

Ownership: The station is on the property of Oregon State Department of Parks and Recreation.

(name, address, phone of landowner)

To Reach Narrative: To reach the station from the intersection of US routes 5 and 101 in Depoe Bay, go north on US 101 for 1 km to the south entrance of the Boiler Bay wayside. Bear left on entrance road for 0.4 km to the parking area on the left. Pack northwest inside fence for about 90 meters to end of fence and the station on the right.

(Leg-by-leg distances and directions from major road intersection to mark)

Monument Description and Measurements: The station is set into drill hole in bedrock, 7.6 m south from the north fence corner, 8.8 m east from the west fence corner, and 3.6 m southeast from the northwest end of the outcrop.

(Add at least three measurements to permanent, identifiable, nearby objects; and a description of the monument size, shape, height, etc.)

NOTE: - Include a pencil rubbing, sketch, or photographs of mark.

Described by: John Q. Surveyor Phone: (301) 713-3194 e-mail: jqs@ordot.gov

Figure 4.18: GPS Station Observation Log

--> Click here to clear the sample data <--

GPS STATION OBSERVATION LOG (01-Nov-2000)

Station Designation: (check applicable: FBN / CBN / PAC / SAC / PM) BALD 2 RESET		Station PID, if any: QE2736	Date (UTC): 31-Dec-98
General Location: Boiler Bay Wayside	Airport ID, if any: ---	Station 4-Character ID: BALD	Day of Year: 365
Project Name: Sample GPS, 1998	Project Number: GPS- 1234	Station Serial # (SSN):	Session ID:(A,B,C etc) A

NAD83 Latitude: 44° 49' 49.17802"	NAD83 Longitude: 124° 03' 56.23447"	NAD83 Ellipsoidal Height: -6.44 meters NAVD88 Orthometric Ht.: 17.0 meters GEOID99 Geoid Height: -23.52 meters	Agency Full Name: Oregon DOT Operator Full Name: John Q. Surveyor Phone #: ( ) (301) 713-3194 e-mail address: jqs@ordot.gov
Observation Session Times (UTC): Sched. Start 12:00 Stop 17:30 Actual Start 11:55 Stop 17:32	Epoch Interval= 15 Seconds Elevation Mask = 10 Degrees		

GPS Receiver:
Manufacturer & Model: Leica SR530
P/N: p/n 667122
S/N: s/n 0030354
Firmware Version: Version 3.0
✔ CamCorder Battery, ☐ 12V DC, ☐ 110V AC, ☐ Other

GPS Antenna:
Manufacturer & Model: Trimble Choke Ring
P/N: p/n 29659-00
S/N: s/n 02200-63591
Cable Length, meters: 30 meters
Vehicle is Parked 25 meters N (direction) from antenna.

		Circle Yes or No -If no, explain "
Antenna plumb before session?	✔ (Y / N)	
Antenna plumb after session?	✔ (Y / N)	
Antenna oriented to true North?	✔ (Y / N)	
Weather observed at antenna ht	✔ (Y / N)	
Antenna ground plane used?	✔ (Y / N)	
Antenna radome used?	(Y / N) ✔	If yes, describe. Use Vis. form
Eccentric occupation (>0.5 mm)?	(Y / N) ✔	
Any obstructions above 10°?	(Y / N) ✔	
Radio interference source nearby	(Y / N) ✔	

Tripod or Ant. Mount: Check one:
✔ Fixed-Height Tripod, ☐ Slip-Leg Tripod, ☐ Fixed Mount
Manufacturer & Model: SECO
P/N: none.
S/N: 97-G
Last Calibration date: 1998-11-01

Tribrach: Check one:
✔ None, ☐ Wild GDF 22, ☐ Topcon, ☐ Other (describe)
Last Calibration date:

**** ANTENNA HEIGHT ****
(see back of form for measurement illustration)

	Before Session Begins: measure and record both Meters	AND Feet	After Session Ends: measure and record both Meters	AND Feet
A= Datum point to Top of Tripod (Tripod Height)	2.000		2.000	
B= Additional offset to ARP if any (Tribrach/Spacer)	-0.003		-0.003	
H= Antenna Height = A + B = Datum Point to Antenna Reference Point (ARP)				

Note: Meters = Feet X (0.3048)
Height Entered Into Receiver = 2.000 meters.
Please note &/or sketch **ANY** unusual conditions. Be **Very Explicit** as to where and how Measured!

Barometer:
Manufacturer & Model: pretel altiplus A2
P/N: none.
S/N: J.Q.S.
Last Calibration or check Date: 11-Sep-01

Psychrometer:
Manufacturer & Model: Psychrodyne
S/N: J.Q.S.

Weather DATA	Time (UTC)	Dry-Bulb Temp Fahrenheit	Celsius	WetBulb Temp Fahrenheit	Celsius	Rel. % Humidity	Atm. Pressure inches Hg	millibar	Weather Codes *
Before	12:00	74.0		68.0		74	29.4		00000
Middle	14:45	77.0		72.5		81	29.6		00001
After	17:30	82.5		78.0		82	29.7		00102
Average of Readings				Calculate					* See back of form for codes

Remarks, Comments on Problems, Sketches, Pencil Rubbing, etc:

1. Winds, calm at start, gradually increased to 20 knots by end of session.

2. Semi-trailer parked 12 meters SSE of antenna from 15:17 to 15:32 UTC, possibly blocking satellites and causing multipath environment.

3. Center pole of tripod projected 3 mm into dimple of disk.
Antenna height was therefore 2 m - 3 mm = 1.997 m

Note: Entries are Required in all Unshaded areas.

Data File Name(s): BALD365A.dat
(Standard NGS Format = aaaadddd.xxx)
where aaaa=4-Character ID, ddd=Day of Year, s=Session ID, xxx=file dependant extension

Updated Station Description:	✔ Attached	☐ Submitted earlier	LOG CHECKED BY: JGE
Visibility Obstruction Form:	✔ Attached	☐ Submitted earlier	
Photographs of Station:	✔ Attached	☐ Submitted earlier	
Pencil Rubbing of Mark:	✔ Attached		

Figure 4.19: GPS Antenna Height Measurements

ILLUSTRATION FOR ANTENNA HEIGHT MEASUREMENTS:

I. Instructions for Fixed-Height Tripods:

Measure & record the fixed-height tripod length **(A)** and other offsets, if any, between the tripod and the Antenna Reference Point (ARP) **(B)**

$$Antenna.Height = H = A + B$$

II. Instructions for Slip-Leg Tripods:

1. Measure the Slant Height (S)

Measure the slope distance from the mark to at least three notches on the Bottom of Ground Plane (BGP) using two independent rulers (e.g., metric and Imperial). Record measurements in the table below, and compute the average.

Measure S	Notch #_	Notch #_	Notch #_	Average
Before, cm	223.40	223.30	223.30	
Before, inch	87.95	87.94	87.93	
After, cm	223.40	223.40	223.30	
After, inch	87.97	87.96	87.95	
Note: cm= inch x (2.54)		Overall average, cm		

S = _____ cm

2. Record the Antenna Radius (R) and the Antenna Constant (C)

The antenna radius (R) is the horizontal distance from the center of the antenna to the measurement notch. The antenna constant (C) is the vertical distance from the ARP to the BGP. Consult your antenna users manual for exact measurements.

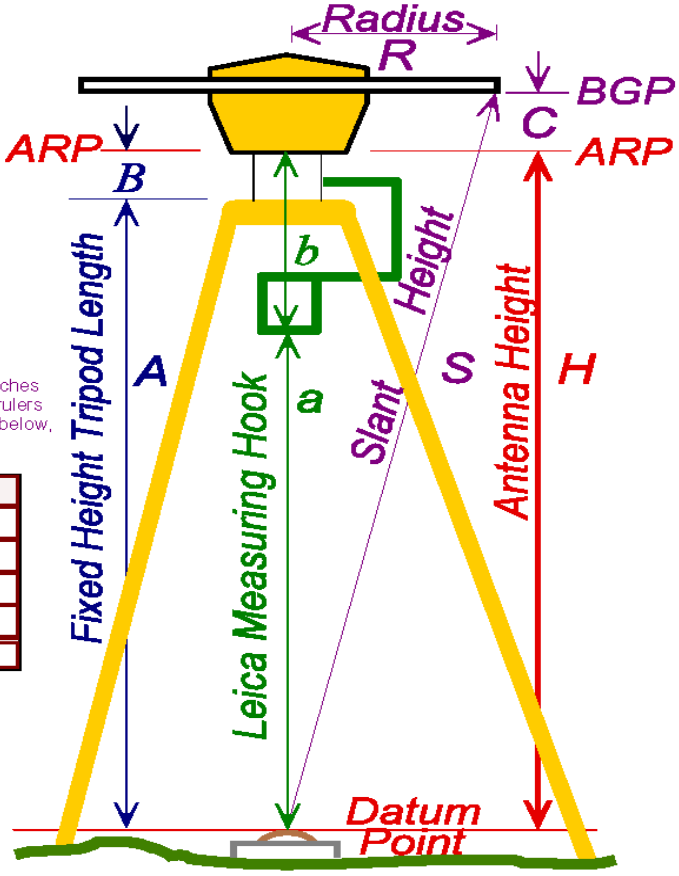
R = 19.05 cm

C = 3.50 cm

3. Compute Antenna Height (H)

Use the following Pythagorean equation:

$$Antenna.Height = H = ((\sqrt{S^2 - R^2}) - C)$$



III. Instructions for using the Leica Brand Measuring Hook:

Follow the Leica operating instructions, being sure to reduce the height to the Antenna Reference Point (ARP), NOT the L1 Phase Center.

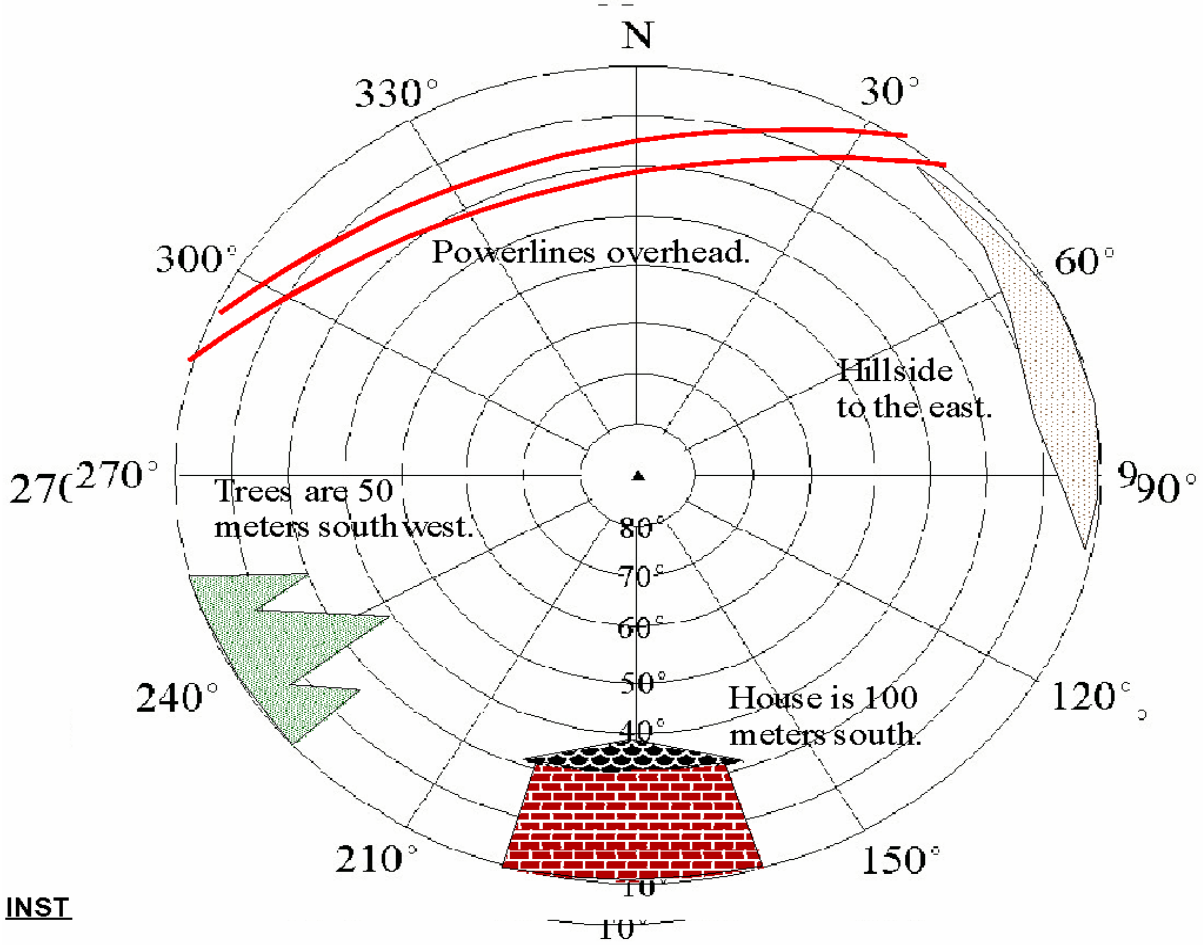
$$Antenna.Height = H = a + b$$

Table of Weather Codes -- for entry into Weather Data Table on front of form:					
CODE	PROBLEM	VISIBILITY	TEMPERATURE	CLOUD COVER	WIND
0	NO PROBLEMS encountered	GOOD More than 15 miles	NORMAL 32° F to 80°F	CLEAR Below 20%	CALM Under 5mph (8km/h)
1	PROBLEMS encountered	FAIR 7 to 15 miles	HOT Over 80°F (27 C)	CLOUDY 20% to 70%	MODERATE 5 to 15 mph
2	-- NOT USED --	POOR Less than 7 miles	COLD Below 32° F (0 C)	OVERCAST Over 70%	STRONG over15mph (24km/h)
Examples: Code 00000 =	0 - No problems,	0 - good visibility,	0 - normal temperature,	0 - clear sky,	0 - calm wind
Code 12121 =	1 - Problems,	2 - poor visibility,	1 - hot temperature,	2 - overcast,	1 - moderate wind

Figure 4.20: Visibility Obstruction Diagram

--> Click here to clear the sample data <--

NATIONAL GEODETIC SURVEY
VISIBILITY OBSTRUCTION DIAGRAM



INST

Identify obstructions by azimuth (magnetic) and elevation angle (above horizon) as seen from station mark.
Indicate distance and direction to nearby structures and reflective surfaces (potential multipath sources).

Designation: BALD 2 RESET PID: QE2736

Location: Boiler Bay Wayside County: LINCOLN

Reconnaissance By: John Q. Surveyor Height above mark: 2 Meters

Agency/Company: Oregon DOT Phone: ((301))713-3194 Date: 1998-12-31

Figure 4.21: Station Pencil Rubbing Form

Station Pencil Rubbing Form

--> Click here to clear the sample data <--

Location / Airport Name and ID: Boiler Bay Wayside Project: Sample GPS, 1998

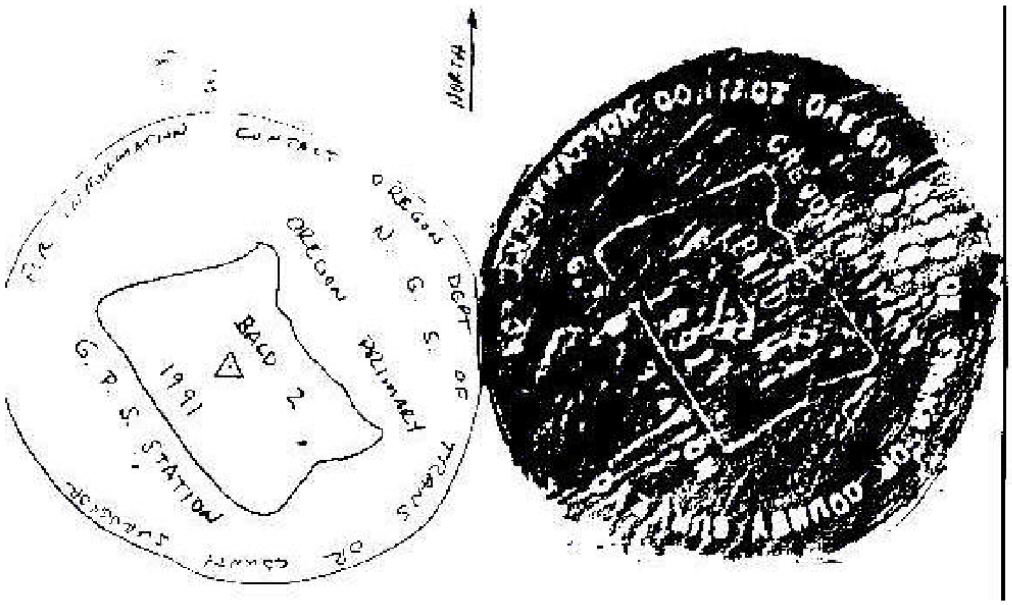
Station Designation: BALD 2 RESET PID: QE2736 Date: 1998-12-31

Circle all applicable: PACS SACS PM FBN CPN OTHER_____

Observer & Organization: John Q. Surveyor, ORDOT

Station Pencil Rubbing

Instructions: Place the blank form (or other blank paper) over the mark and rub over the entire disk with a pencil. For rod marks, rub only the designation and date stamping from the rim of the aluminum logo cap. If it is impossible to make a rubbing of the mark, or if the rubbing appears indistinct, a sketch and/or photograph may be substituted.



Remarks:
This disk is reset into the same drill hole as the original station BALD 1962.

Monument Type: Brass Disk

Inscribed Agency: Oregon DOT

Stamping: BALD 2 1991

Figure 4-22: Digital Photograph of a Stamping of a Bench Mark

4.6.3. Water Level Data

The final observed water level measurements shall be reported as heights in meters to three decimal places (i.e. 0.001 m). All heights shall be referenced to station datum and shall be referenced to UTC. The final tide reducer time series data shall be referenced to MLLW and shall be referenced to UTC. The contractor must provide CO-OPS with the water level data from all tide gauges installed with in 90 days of removal of stations/gauges.

The original raw water level data and also the correctors used to convert the data to chart datum shall be retained until notified in writing or at least two years after the survey is completed. All algorithms and conversions used to provide correctors shall be fully supported by the calibrations, maintenance documentation, leveling records, and sound engineering/oceanographic practices. Sensors for measurements used to convert data (e.g. pressure to heights) shall be calibrated and maintained for the entire water level collection period.

All digital water level and ancillary data shall be transmitted to CO-OPS in a format dependent on the DCP configuration. If GOES satellite is used, the data shall be transmitted and received using the NOS compressed pseudo binary format (see NGWLMS GOES Message Formatting, Libraro, 1998). These satellite messages are then decoded by NOS DMS upon receipt from NESDIS before further processing and review by CORMS can be completed. If satellite transmission configurations cannot be installed, the data shall be manually downloaded from the DCP and submitted to NOS, as shown in the format below, in a digital format, on 3.5 inch floppy disks, CD-ROM, or by email as an ASCII data attachment. It may be prudent to submit data at more frequent intervals under specific circumstances. Data download files shall be named in the following format: xxxxxxxy.DAZ, where xxxxxxx is the seven digit station number, y is the DCP number (usually 1), and DAZ is the extension (where Z = 1,2,3...if more than one file is from the same station and DCP). This is the format needed when the data is loaded into DMS.

The 6-minute interval data (acoustic sensor and pressure sensor examples follow) shall have the following format once decoded:

Acoustic Sensor Data (XXX.ACO format)

Column 1-7	Station ID (assigned in the project instructions)
Column 8	1 (DCP number, use 2, 3 , etc., for additional DCPs)
Column 9-19	Date (MMM DD YYYY format, e.g. JAN 01 1998)
Column 20	Blank
Column 21-22	Hours in 24 hour format (i.e. 01, 01, ..., 23)
Column 23	: (place a colon)
Column 24-25	Minutes (00,06,12,etc..)
Column 26-32	Data value in millimeters, right justified, (e.g. 1138)
Column 33-38	Sigma (standard deviation in millimeters in integer format)
Column 39-44	Outlier (integer format)
Column 45-50	Temperature 1 (tenth of degrees C in integer format)
Column 51-56	Temperature 2 (tenth of degrees C in integer format)
Column 57-58	Sensor type (A1 for acoustic type)
Column 59-60	blank
Column 61-61	Data Source (S for Satellite, D for Diskette)

Sample data:

```
85169901AUG 17 1993 05:00   1138   23    0   308   297A1 S
85169901AUG 17 1993 05:06   1126   26    0   308   298A1 S
85169901AUG 17 1993 05:12   1107   26    1   309   298A1 S
```

Pressure Sensor Data (XXX.BWL format)

Column 1-7	Station ID (assigned in the project instructions)
Column 8	1 (DCP number, use 2, 3 , etc., for additional DCPs)
Column 9-19	Date (MMM DD YYYY format, e.g. JAN 01 1998)
Column 20	Blank
Column 21-22	Hours in 24 hour format (i.e. 01, 01, ..., 23)
Column 23	: (place a colon)
Column 24-25	Minutes (00-59)
Column 26-32	Data value in millimeters, right justified, (e.g. 1138)
Column 33-38	Sigma (standard deviation in millimeters in integer format)
Column 39-44	Outlier (integer format)
Column 45-50	DCP temperature (tenth of degrees C in integer format)
Column 51-52	Sensor type (B1 for pressure type)
Column 53-53	blank
Column 54-54	Data Source (S for Satellite, D for Diskette)

```
85169901AUG 17 1993 05:00   1138   23    0   308B1 S
85169901AUG 17 1993 05:06   1126   26    0   308B1 S
85169901AUG 17 1993 05:12   1107   26    1   309B1 S
```

Note: pressure data must be accompanied by documented staff observations as listed in Section 4.2.2. and 4.2.4.

4.6.4. Tabulations and Tidal Datums

For contract surveys, the contract hydrographer shall provide digital and hard copies of tabulations of staff/gauge differences, hourly heights, high and low waters, and monthly means for the entire time series of observations from each station. Along with the final contractor computed tidal datums, the contractor shall provide copies of the tide-by-tide and/or monthly mean simultaneous comparison sheets from which the final tidal datums were determined. Audit trails of data edits and gap-filling shall be summarized and provided also.

The digital tabulation files for hourly heights and high and low waters shall have the following formats:

Hourly height data

COLUMN	
1 - 7	Station ID number
8 - 11	Year
12 - 13	Month
14 - 15	Day
16	Line Number (1 = 1st line of day for 0 to 11 hours, 2 = 2nd line of day for 12 to 23 hours).
17 - 20	Time Meridian (Example: 000W)

21 - 26	0/12 Hourly height in meters (to millimeter resolution)
27 - 32	1/13 Hourly height in meters (to millimeter resolution)
33 - 38	2/14 Hourly height in meters (to millimeter resolution)
39 - 44	3/15 Hourly height in meters (to millimeter resolution)
45 - 50	4/16 Hourly height in meters (to millimeter resolution)
51 - 56	5/17 Hourly height in meters (to millimeter resolution)
57 - 62	6/18 Hourly height in meters (to millimeter resolution)
63 - 68	7/19 Hourly height in meters (to millimeter resolution)
69 - 74	8/20 Hourly height in meters (to millimeter resolution)
75 - 80	9/21 Hourly height in meters (to millimeter resolution)
81 - 86	10/22 Hourly height in meters (to millimeter resolution)
87 - 92	11/23 Hourly height in meters (to millimeter resolution)

High and Low Water data

COLUMN

1 - 7	Station ID Number	
8 - 9	Year	
10 - 11	Month	
12 - 13	Day	
14 - 17	Time Meridian (Example: 075W)	
18 - 26	First Tide	
	18	1 = High
		2 = Low
		3 = Higher High
		4 = Lower Low
	19	0 Nothing unusual/Normal
		1 If Inferred Tide
		2 If Flat Tide
		3 If Extra Tide
		4 If Inferred and Flat Tide
		5 If Extra and Flat Tide
	20 - 22	Hour (Tenths of Hours)
	23 - 27	Height (in meters to millimeter resolution)
28 - 37	Second Tide	
38 - 47	Third Tide	
48 - 57	Fourth Tide	
58 - 67	Fifth Tide (If any)	
68 - 77	Sixth Tide (If any)	
78 - 87	Seventh Tide (If any)	

4.6.5. Tide Reducers and Final Zoning and Final Tide Note

The final zoning scheme shall be fully supported by documentation of data and methodology which comprised the final zoning model. The contractor must provide CO-OPS with his/her final tidal zoning scheme digitally and it must be in the MAPINFO or ARCVIEW compatible format. Final tidal zoning scheme in AUTOCAD format is not acceptable.

Final tide reducers shall be submitted in the specified format.

All documentation listed below shall be forwarded to CO-OPS:

(b) Contractor created summary files.
(c) Documentation of NOS summary files utilized for final zoning
(c) GIS compatible zoning development steps including geographical presentation of summary data and cophase/corange maps
(d) GIS compatible digital final zoning files
(e) Final tide reducer data files
(f) Final Tide Note

The final zoning scheme shall be fully supported by documentation of data and methodology which comprised the final zoning model.

4.6.6. Submission

The check list in Figure 4.14 shall be used to check and verify the documentation that is required for submission. All documentation, water level data, GPS info and data, and other reports as required shall be forwarded to the following address:

NOAA, National Ocean Service
Thomas Mero
Chief, Requirements and Development Division
SSMC4 - Station 6531, N/OPS1
1305 East-West Highway
Silver Spring, MD 20910

Voice: 301-713-2897 ext. 145
Fax: 301 - 713-4436

4.7. Guidelines and References

References for the water level measurement and leveling requirements issued by the NOS Center of Operational Oceanographic Products and Services (CO-OPS) and the National Geodetic Survey (NGS) are listed below.

Some of these documents are available on CO-OPS web site at http://www.CO-OPS.nos.noaa.gov.

1 Next Generation Water Level Measurement System (NGWLMS) Site Design, Preparation, and Installation Manual, NOAA/NOS, January 1991.

2. User's Guide for the Installation of Bench Marks and Leveling Requirements for Water Level Stations, NOAA/NOS, dated October 1987.

3. User's Guide for Writing Bench Marks Descriptions, NOAA/NOS, Updated January 2003.

4. User's Guide for Electronics Levels, NOAA/NOS, updated January 2003.

5. User's Guide for 8200 Bubbler Gauges, NOAA/NOS, updated February 1998.

6. User's Guide for 8200 Acoustic Gauges, NOAA/NOS, updated August 1998.

7. User's Guide for 8210 Bubbler Gauges, NOAA/NOS, updated February 2001.

8. User's Guide for GPS Observations, NOAA/NOS, updated January 2003.

9. Tidal Datums and Their Applications, Special Publication No. CO-OPS 1, NOAA/NOS, June 2000.

10. Manual of Tide Observations, U.S. Department of Commerce, Publication 30-1, Reprinted 1965.

11. Tidal Datum Planes, U.S. Department of Commerce, Special Publication No.135, Marmer 1951.

12. Tide and Current Glossary, U.S. Department of Commerce, NOAA, NOS, October 1989.

13. Standing Project Instructions: Great Lakes Water Levels, June 1978.

14. NOAA Technical Report NOS 64 "Variability of Tidal Datums and Accuracy in Determining Datums from Short Series of Observations", Swanson, 1974.

15. Data Quality Assurance Guidelines for Marine Environmental Programs, Robert J. Farland, Office of Ocean Engineering, NOAA, March, 1980.

16. System Development Plan, CORMS: Continuous Operational Real-Time Monitoring System, NOAA Technical Report NOS OES 014, U.S. Department of Commerce, NOAA, NOS February, 1997.

17. NGWLMS GOES MESSAGE FORMATTING, Phil Libraro, 6/98.

18. Computational Techniques for Tidal Datums, NOAA Technical Report NOS CO-OPS 2, U.S. Department of Commerce, NOAA, NOS, DRAFT December 1998.

17. Standards and Specifications for Geodetic Control Networks, Federal Geodetic Control Committee, September 1984.

18. Guidelines for Establishing GPS-Derived Ellipsoid Heights (Standards: 2CM and 5CM) Version 4.3, NOAA Technical Memorandum NOS NGS-58, November 1997.

19. Geodetic Leveling, NOAA Manual NOS NGS 3, U.S. Department of Commerce, NOAA, National Ocean Survey, August, 1981.

20. NOAA Special Publication NOS CO-OPS 1Tidal Datums and Their Applications, February 2001.