NOAA Technical Report NOS CO-OPS 030

NWLON/DMS Quality Control Software (QC): Functional Requirements Document

Joann Nault
Information Systems Division

Silver Spring, Maryland
June 2000
Revised, February 2002
Revised, September 2004
Revised, November 2004

noaa **National Oceanic And Atmospheric Administration**

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services (CO-OPS)

TABLE OF CONTENTS

1.0 General Information

The National Ocean Service (NOS) operates and maintains the National Water Level Observation Network (NWLON) to accomplish its mission requirement to collect and disseminate water level data. A key component of the NWLON is data ingestion into a central data repository. In May, 1997, an external technical review of the current data processing and analysis components of NWLON was performed. The review found the most serious performance problems to be with the data ingestion and the associated quality control software. The software was found to be aging, cumbersome, unstable, and inefficient. In 1999, CO-OPS modernized the processes by which data is ingested. CO-OPS now plans to modernize the associated quality control software. A team was established to verify existing software requirements and solicit new ones. Participants can be found in Appendix A.

This document defines the general functional requirements for the software which will perform the initial quality control of NWLON data ingested into the Data Ingestion System (DIS) and subsequently place the data into the NWLON Database Management System (DMS).

The remainder of this section contains a brief summary of the flow of data from an NWLON water level gauge to CO-OPS. In Section 2, a top-level data flow of the existing data ingestion and QC software is presented. The functional requirements of the NWLON data ingestion software are outlined in Section 3. The operating environment is described in Section 4, and includes equipment, support software, security and privacy, and operational control requirements.

1.1 Summary

This document contains the functional requirements for the application software associated with the quality control process executed during the ingestion of data into DIS and the process for placing data into the NWLON DMS. The task of preparing these requirements is the responsibility of the Information Systems Division (ISD), with guidance from the Products and Services Division (PSD) and the Requirements and Development Division (RDD).

1.2 Environment

- NOS responsibilities for collecting, processing, and analyzing tidal and Great Lakes data are held by the Center for Operational Oceanographic Products and Services (CO-OPS) located in Silver Spring, MD. The Center directs the establishment, operation, and maintenance of the NWLON, to provide oceanographic data, and produce tide and current predictions for direct use in marine navigation, civil engineering, environmental protection, and for correlation and analysis in scientific research.

- The NWLON software for collecting, analyzing, and disseminating water level data and associated hardware is operated and maintained by ISD. Primarily, ISD collects water level gauge data via the Internet from the

National Weather Service's (NWS), Office of System Operations (OSO). OSO receives its data directly from Wallops Island, Virginia. The water level gauges have transmitters, which transmit via a GOES data collection system to a receiver at Wallops. ISD also collects water level gauge data via telnet to Wallops, direct phone calls to gauges, Mitroned Analog to Digital Recorder (ADR), and diskettes from CO-OPS system personnel.

1.3 References

- Federal Information Processing Standards, Publication Number 38
- Quality Assurance of OLLD Data, January 4, 1995, William Stoney
- Mero, T.N. and W.M. Stoney, A Description of the National Ocean Service (NOS) Next Generation Water Level Measurement System, Proc. of the third biennial NOS International Hydrographic Conference, Baltimore, MD 109-116, 1988.
- Bethem,Thomas; External Technical Review: Data Processing and Analysis Subsystem (DPAS); May 1997. pp16.

2.0 Scope and Overview

This document will limit the scope of the requirements to only the applications associated with the QC processes. Gauge transmission and decoding requirements will not be addressed. This document is for the QC process only.

This section provides background information on the existing CO-OPS NWLON data ingestion QC process. Section 2.1 contains a diagram of the existing data flow through the QC process (Figure 1).

2.1 Background

The CO-OPS original water level quality control software (QC) was written around 1991 by Telos contractors and then modified throughout the years. The control program consisted of 49 different SYBASE SQL stored procedures which are used to process water level data recorded using five different types of gauges: 1) Acoustic, 2) Shaft Angle Encoder (SAE), 3) Single Pressure, 4) Dual Pressure, and 5) Ancillary. Ancillary data from other oceanographic and meteorological sensors are also collected by CO-OPS. The ancillary data have only maximum and minimum checks applied. CO-OPS modified to the now existing software in January 2000, which is FORTRAN based.

2.2 Summary of Data Flow

The front-end processes which bring data to the NWLON data ingestion server would be identical in the proposed data flow to those in the existing data flow. In the existing system, once DIS has been ingested and decoded the data, the data are bulk copied to temporary tables in the NWLON DMS, then the "QC" software is run. In the proposed process, the data would be QC'd before ingestion into the NWLON DMS.

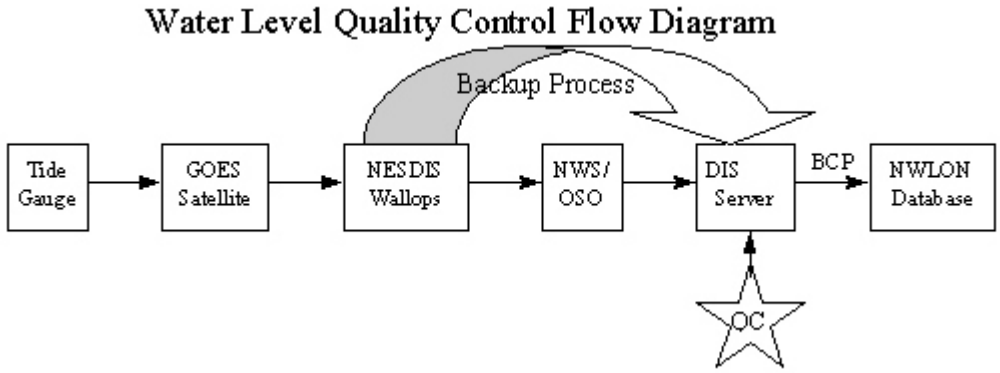


Figure 1

A separate program collects information about the gauge on an hourly basis. The station information file contains: station id, DCP#, platform id, datum offset, accepted datum offset, sensor offset, accepted sensor offset, accepted orifice offset, water level min, water level max, water level temp max, water level temp min, water level sigma max, air temp max, air temp min, dew point max, dew point min, rainfall max, rainfall min, wind speed max, wind speed min, wind gust max, water current max, water current min, water conductivity max, water conductivity min, temperature correction flag, pressure density delta, aquatrak calibration length, temperature gradiance correction factor, temperature gradiance correction tolerance, height correction tolerance, primary versus predicted tolerance, primary versus backup tolerance, accepted backup gain, accepted backup offset, and accepted harmonic constituents. Also a valid sensor file is created and contains all valid sensors installed for each station.

Having the most recent data quality controlled prior to the ingestion into the database allows other processes to use this data without retrieving it directly from the database. This is useful for the Tides Online application as well as CREX and SHEF data bulletins which are provided to NWS. This will provide a consistent level of quality control for all outgoing CO-OPS water level data and products.

3.0 Requirements

3.1 Quality Control Checks

For the following sensor types, the water level value is calculated using the following quality control checks as follows:

For Acoustic, SAE, and Air Gap:

WL = Datum Offset - sensor offset - raw sensor measurement

For Pressure - Single Orifice:

WL = raw sensor measurement + accepted orifice offset

For Pressure - Dual Orifice:

Instantaneous density *Rho* in gm/cm3 = (N1 press - T1 press) * 1000000 / [(HN - HT) * g]

N1 and NT WL = N1 press * 1000000 / [*Rho* * g] + accepted orifice offset N1

T1 = T1 press * 1000000 / [*Rho* * g] + accepted orifice offset T1

Acoustic, SAE, ADR, Single and Dual Pressure, and Air Gap Sensor Checks/flags:

- Datum Offset Value/Check: A datum offset and an accepted datum offset are maintained for each station in the dpasman.dbo.SENSOR_PARAMETER table in the NWLON DMS. The datum offset in the dpasman.dbo.SENSOR_PARAMETER table is used for the water level equation above. A line is written to the error file when the incoming datum offset value do not match with the datum offset stored in the database.

- Sensor Offset Value/Check: An accepted sensor offset and a sensor offset are maintained for each station in the dpasman.dbo.SENSOR_PARAMETER table in the NWLON DMS. If the incoming sensor offset is equal to the sensor offset in the dpasman.dbo.SENSOR_PARAMETER table, then the incoming sensor offset is used in the above water level equation. If the incoming sensor offset is not equal to the sensor offset in the table, then add a new record to the SENSOR_PARAMETER table. Provided that the difference between the two values is less than 0.010 meters. If the incoming sensor offset is not equal to the sensor offset in the table and the difference between the two values is greater than .010, then use the sensor offset in the SENSOR_PARAMETER table for the above water level equation (see Figure 2 for Sensor Offset flow chart).

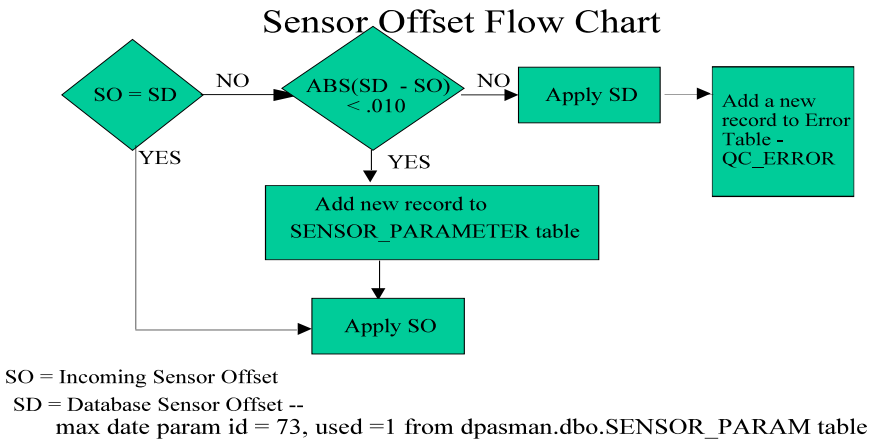


Figure 2

- Water Level Maximum/Minimum Flag – The water level maximum/minimum flag gets set for a given 6-minute interval water level data point if this 6-minute value exceeds the prescribed tolerances (is above the maximum tolerance plus 3 m or is below the minimum tolerance minus 3 m). This flag, when set to 1, indicates that either the maximum or minimum observed water level height limit was exceeded.

  The maximum and minimum tolerances are prescribed for each station in the dpasman.dbo.STATION_PARAM table in the NWLON DMS. Default values for tide stations were originally derived from the maximum and minimum observed water levels for the time period of record at each station. These defaults have been refined over time to narrow the maximum and minimum tolerances, in order to catch more than just the most severe problems. Operationally, these flags typically get set when sensor or datum offset problems occur and when abnormally high and/or low waters occur due to tsunami or storm events. The offline QC check program for the NWLON DMS also uses these tolerances.

- Water Level Flat Flag – The water level flat flag, when set to 1, indicates that the water level data value is identical to the two values before and two values after the current value.

- Water Level Third Difference Flag – The third difference (rate of change) flag is used to manage potential anomalous water level data points in a 6-minute data series. This flag, when set to 1, indicates that the third difference (or rate of change) maximum limit is exceeded. The flag is set on the first water level value which is greater than the tolerance. Tolerance for each station is found in the dpasman.dbo.STATION_PARAMETER in NWLON DMS. The NWLON DMS offline QC check program is typically used to obtain and set the third difference tolerance value for each station.

Third difference is calculated as follows:

Diff (I) = Height (I-3) - 3*Height (I-2) + 3*Height(I-1) - Height (I)
(height = water level value)

Tolerances are determined from looking at the distribution and standard deviations of these third differences over time. The offline QC check program provides a suggested third difference limit by computing a value of 5 times the standard deviation of the differences. Operationally, third difference flags get set when the 6-minute data are abnormally "noisy" due to sensor problems or due to local sea state and waves from storm, tsunami, or seiche events. Open coast stations with high energy wave environments generally have higher third difference tolerances than inside 'quiet' stations.

- Temperature Correction Required Parameter (TEMP_CORR) - This parameter is unique to the acoustic sensors only. This parameter is set manually in dpasman.dbo.SENSOR_STATUS for a selected few stations that need temperature correction applied during the processing of data. Temperature Correction Required Parameter, when set to 0, indicates that the station does not need temperature correction applied during processing. Temperature Correction Required Parameter, when set to 1, indicates that the station needs temperature correction applied during processing.

- Height Correction Flag (HEIGHT_CORR_FLAG)- This flag is also unique to acoustic sensors only. The flag provides information regarding correction required due to temperature effects related to the length of the protective well.

  The height correction = (Acoustic measurement) * (T1-T2) * (TGCF)

  Where TGCF is Temperature Gradient Correction Factor which can be set for each station based upon the local protective well height and other factors. HEIGHT_CORR_TOL is a tolerance (Default value is set as 5 cm) in the dpasman.dbo.SENSOR_PARAM table. The height correction is computed for all acoustic stations but is not applied, at present, to the water level data. The Height Correction Flag, when set to 0, indicates that the height correction value was less than or equal to the HEIGHT_CORR_TOL. The Height Correction Flag, when set to 1, indicates that the height correction value exceeded the HEIGHT_CORR_TOL.

- Water Level Temperature Adjustment - Two separate flags are set during this check. The TEMP_FLAG, when set to 1, indicates that the temperature difference was greater than the temperature gradient tolerance (Param id = 109, Param name = TEMP_GRAD_TOL1, default = 5). The TEMP_FLAG, when set to 2, indicates that the temperature difference was greater than the

temperature gradient tolerance (Param id = 111, Param name = TEMP_GRAD_TOL2, default = 20). Thus Temperature Gradient Flag provides information about working or non working condition of the two thermistors.

A temperature gradient develops inside a protective well at the station due to differential heating or cooling and lack of air circulation in the protective well, or if one or both of the thermistors are malfunctioning. If there is a true chronic problem, then either the protective well needs to be reconfigured to mitigate the problem or the station needs to be flagged in the NWLON DMS as one requiring on-the-fly temperature corrections. This correction is applied to the acoustic sensor measurement before the datum and sensor offset corrections are applied.

When the dpasman.dbo.SENSOR_STATUS table TEMP_CORR_FLAG value is set to 1, then compute the Sutron or Bartex equation below (as is done now for the selected few stations). The TEMP_CORR_FLAG flag, when set to1, indicates that thermistors difference was less than the Temperature correction tolerance (TEMP_GRAD_TOL2) and the Temperature Correction Required flag was set to 1 and the below equation was applied to the water level value. The TEMP_CORR_FLAG flag, when set to 2, indicates that the thermistors difference exceeded the temperature correction tolerance (TEMP_GRAD_TOL2) and the below equation was not applied.

Sutron Aquatrak Equation:

Water level = datum offset - (Aquatrak reading + sensor offset) - [(Aquatrak reading * (air temp1 - air temp2) * TGCF)]

Bartex Aquatrak Equation:

Water level = datum offset - (Aquatrak reading + sensor offset) - [(Aquatrak reading - calibration length(m) * (air temp1 - air temp2) * TGCF)]

To determine controller type (Sutron or Bartex):

If sensor offset is greater than zero, then use Sutron Aquatrack equation, else use Bartex Aquatrak equation. Temperature Correction Flag (TEMP_CORR_FLAG)- The water level correction due to the Temperature Gradient Flag and Temperature Correction Required Parameter are combined into this final phase. This flag is also unique to acoustic sensors. This Temperature Correction Flag is set as PARAM_ID 125 in dpasman.dbo.SENSOR_PARAM table. This flag's status reports whether temperature correction was applied to the data or not.

The Temperature Correction Flag, when set to 0, indicates that the Temperature Correction Required Parameter was set to 0. The Temperature Correction Flag, when set to 1, indicates that the Temperature Gradient Flag was not equal to 2 (good working thermistors) and Temperature Correction Required Flag was equal to 1 (temp correction required at those selected few stations), and temperature correction was applied to the data. The temperature Correction Flag, when set to 2, indicates that the above two conditions were not met and temperature correction was not applied to the data.

Here are the equations for the above flags and parameters:

```
TEMP_FLAG = 0       (T1-T2) <= TEMP_GRAD_TOL1
TEMP_FLAG = 1       TEMP_GRAD_TOL1 < (T1-T2) <  TEMP_GRAD_TOL2
TEMP_FLAG = 2       (T1-T2) >= TEMP_GRAD_TOL2

TEMP_CORR= 0        No temperature correction required for the data
TEMP_CORR=1         Temperature correction is required for the data

HEIGHT_CORR_FLAG=0    Height Correction   <=  HEIGHT_CORR_TOL
HEIGHT_CORR_FLAG=1    Height Correction   >   HEIGHT_CORR_TOL

TEMP_CORR_FLAG=0      No temperature correction applied because
TEMP_CORR=0
TEMP_CORR_FLAG=1      Temperature correction applied to data because
                          TEMP_CORR=1 and   TEMP_FLAG < 2
TEMP_CORR_FLAG=2      No temperature correction applied because
                          temperature sensor data is out of range;
                          i.e. TEMP_FLAG = 2  and  TEMP_CORR=1
```

- Water Level Outlier Flag - The outlier flag is set for the given 6-minute interval water level data point when the associated incoming outlier value (number of individual one second acoustic sensor measurements which were omitted for averaging because they exceeded the three sigma criteria) is greater than the outlier value stored in the dpasman.dbo.STATION_PARAMETER table.

- Water Level Sigma Flag -The sigma flag is set for a given 6-minute interval water level data point when the associated incoming sigma value (standard deviation) is greater than the sigma stored in the dpasman.dbo.STATION_PARAMETER table.

Acoustic and SAE Sensor Checks/flags:

- Primary Water Level versus Backup Water Level – Check the difference between the primary water level value and backup water level value with the

gain and offset value applied (should remain nearly constant for a given station), and set a flag if the difference exceeds a specified tolerance.

Acoustic, SAE, Single and Dual Pressure Sensor Checks/flags:

- Predicted value check – Check the difference between the primary water level value relative to station datum for Acoustic, Single and Dual Pressure; and the predicted value relative to station datum; and set a flag if a specified tolerance limit is exceeded.

Single Pressure Sensor Checks/flags:

- N1 value versus Predicted – Check the difference between the N1 water level value plus accepted orifice offset against the predicted water level and set a flag if the difference exceeds a specified tolerance.

Dual Pressure Sensor Checks/flags:

- N1 Pressure versus T1 Pressure – Check the difference between the N1 pressure sensor value, with the T1 pressure sensor value plus the delta H correction value (separation of two orifices); and set a flag if the difference exceeds a specified tolerance.

- NT value versus Predicted – Check the difference between the NT water level value plus accepted orifice offset against the predicted water level on the station datum; and set a flag if the difference exceeds a specified tolerance. If NT value does not exist check N1 plus accepted orifice offset against the predicted water level value.

Ancillary Sensor Flags (Air Temperature, Barometric Pressure, Dew Point, Rainfall, Wind Speed, Water Conductivity, Water Temperature, Wind Gust, Water Current):

- Air Temperature – Maximum flag is set if the measurement is greater than the dpasman..STATION_PARAMETER table AIR_TEMP_MAX value in the NWLON DMS.

  Minimum flag is set if the measurement is less than the dpasman..STATION_PARAMETER table AIR_TEMP_MIN value in the NWLON DMS.

- Barometric Pressure – Maximum flag is set if measurement is greater than the dpasman..STATION_PARAMETER table BAROMETRIC_MAX in the NWLON DMS.

Minimum flag is set if the measurement is less than the dpasman..STATION_PARAMETER table BAROMETRIC_MIN value in the NWLON DMS.

- Dew Point – Maximum flag is set if measurement is greater than the dpasman..STATION_PARAMETER table DEW_POINT_MAX value in the NWLON DMS.

  Minimum flag is set if the measurement is less than the dpasman..STATION_PARAMETER table DEW_POINT_MIN value in the NWLON DMS.

- Rainfall – Maximum flag is set if incoming value is greater than the dpasman..STATION_PARAMETER table RAINFALL_MAX value in the NWLON DMS.

  Minimum flag is set if the measurement is less than the dpasman..STATION_PARAMETER table RAINFALL_MIN value in the NWLON DMS.

- Wind Speed – Maximum flag is set if measurement is greater than the dpasman..STATION_PARAMETER table WIND_SPEED_MAX value in the NWLON DMS.

  Minimum flag is set if the measurement is less than the dpasman..STATION_PARAMETER table WIND_SPEED_MIN value in the NWLON DMS.

- Wind Gust – Maximum flag is set if measurement is greater than the dpasman..STATION_PARAMETER table WIND_GUST value in the NWLON DMS or if wind gust value is less than zero.

- Wind Direction – Maximum flag is set if measurement is less than zero or greater than 360.

- Water Conductivity – Maximum flag is set if measurement is greater than the dpasman..STATION_PARAMETER table H2OCON_MAX value in the NWLON DMS.

  Minimum flag is set if the measurement is less than zero.

- Water Temperature – Maximum flag is set if measurement is greater than the dpasman..STATION_PARAMETER table H2OTEMP_MAX value in the NWLON DMS.

  Minimum flag is set if the measurement is less than the dpasman..STATION_PARAMETER table H2OTEMP_MIN value in the NWLON DMS.

- Water Current – Maximum flag is set if speed value is greater than the dpasman..STATION_PARAMETER table H2OCURRN_MAX value in the NWLON DMS, or if the value is less than zero, or if the wind direction value is greater than 360.

3.2 Inputs and Outputs

Input files:

- Valid Sensor file: station id, dcp number, sensor ids, primary or secondary.

- XXX.QC: station id, dcp number, space, water level time, space, sensor id, space, data source, space, primary or redundant, pressure_value, water level value, water level sigma, water level outlier, backup water level value, backup water level sigma, backup water level outlier, water temperature, first air temperature, second air temperature, datum offset, sensor offset, backup water level gain, backup water level offset (a7,a1,1x,a18,1x,a2,1x,a1,1x,a1,14(1x,i6))

- Station information file: station id, harmonic constituent number, status of harmonic constituent number, algorithm used for harmonic constituents, state, common name, station location (lat/lon), time zone correction information, datum offsets (MLLW, MHW, MTL, MSL, etc.), station datum and sensor offsets, tolerances for testing (max/min water level, rate-of-change, sigma max, air temp max/min, etc.), and harmonic constituents.

- PORTS file: see Information Systems Branch PORTS Uniform Flat File Format (PUFFF) document.

- Some existing input files may be modified, these will be provided in the next revision of this document.

Output files:

- Adjusted water level values with QC values used for ingestion into NWLON dms: Acoustic (*.ACO_QCd), Backup water level

(*,BWL_QCd), Shaft Angle Encoder (*.SAE_QCd), and PRESSURE (*.PRE_QCd) have the same format:

station id, dcp number, water level time, two spaces, sensor id, space, data source, two spaces, water level value, two spaces, water level max/min flag, two spaces, flat flag, two spaces, rate-of-change flag, two spaces, water level sigma, two spaces, sigma max/min flag, two spaces, water level outlier, two spaces, outlier flag, two spaces, pressure value, two spaces, first air temperature, two spaces, second air temperature, two spaces, temperature flag, two spaces, temperature correction flag, two spaces, primary versus backup flag, two spaces, primary versus predicted flag (a7, a1, a20, 2x, a2, 1x, a1, 2x, f9.3, 2x, i1, 2x, i1, 2x, i1, 2x, f9.3, 2x, i1, 2x, i8, 2x, i1, 2x, f9.3, 2x, f9.3, 2x, f9.3, 2x, i1, 2x, i1, 2x, i1, 2x, i1)

- Primary water levels data file (*.WaterLevels) used for Tides Online and NWS bulletins (CREX and SHEF):

  Station id, dcp number, water level time, mllw water level, mllw residual, mllw predicted water level, crex flag, number of parity errors, storm surge flag (a7, a1, a20, 2x, f9.3, 2x, f9.3, 2x, f9.3, 2x, a2, 2x, i6, 2x, a3)

- Error file (*.ERR_QCd) used for ingestion into NWLON DMS. Error file contains, datum offset, sensor offset, invalid sensor, gain, and/or backup offset:

  station id, dcp number, two spaces, sensor id, two spaces, processing time, two spaces, dcp error time, two spaces, error type, space, incoming value, database value, two spaces, description (a7, a1, 2x, a2, 2x, a17, 2x, a17, 2x, a1, 1x, 3(f10.3), 2x, a80)

- Ancillary data file (*.ANC_QCd) used for ingestion into NWLON DMS. Format for all ancillary data is (a7, a1, a20, 2x, a2, 1x, f9.3, 2x, i1, 2x, i1, 2x, i1, 2x, f9.3, 2x, i1, 2x, f9.3, 2x, i1, 2x, a1):

  Wind (C1) line contains: station id, dcp number, dcp time, sensor id, wind speed, minimum flag (not used), maximum flag, rate-of-change flag, wind direction, extra, wind gust, wind gust maximum flag, data source.

  Air temperature (D1) line contains: station id, dcp number, dcp time, sensor id, air temperature, minimum flag, maximum flag, rate-of-change flag, four fields not used and data source.

  Water temperature (E1) line contains: station id, dcp number, dcp time, sensor id, water temperature, minimum flag, maximum flag, rate-of-change flag, four fields not used, and data source.

Barometric pressure (F1) line contains: station id, dcp number, dcp time, sensor id, barometric pressure, minimum flag, maximum flag, rate-of-change flag, four fields not used, and data source.

Water conductivity (G1) line contains: station id, dcp number, dcp time, sensor id, water conductivity, minimum flag, maximum flag, rate-of-change flag, four fields not used, and data source.

Water current (H1) line contains: station id, dcp number, dcp time, sensor id, water current speed, minimum flag, current maximum flag, rate-of-change flag, direction, three fields not used, and data source.

Dew point (I1) line contains: station id, dcp number, dcp time, sensor id, dew point value, minimum flag, maximum flag, rate-of-change flag, four fields not used, and data source.

Rain fall (J1) line contains: station id, dcp number, dcp time, sensor id, rain fall value, minimum flag, maximum flag, rate-of-change flag, four fields not used, and data source.

Solar radiation (K1) line contains: station id, dcp number, dcp time, sensor id, solar radiation value, minimum flag, maximum flag, rate-of-change flag, four fields not used, and data source.

Analog sensors (L1 and M1) lines contains: station id, dcp number, dcp time, sensor id, data value, minimum flag, maximum flag, rate-of-change flag, four fields not used, and data source.

- Ancillary data file (*.Met) used for Tides Online and NWS bulletins (CREX and SHEF).

  Station id, dcp number, dcp time, wind speed, wind speed flag, wind direction, wind direction CREX flag, wind gust, barometric pressure, pressure CREX flag, air temperature, data source, storm surge flag (a7, a1, a20, 2x, f9.3, 2x, i1, 2x, f9.3, 2x, i1, 2x, f9.3, 2x, f9.3, 2x, i1, 2x, f9.3, 2x, f9.3, 2x, a1, 2x, a3)

3.3 Error and Recovery

The current QC program has error handling for a number of items: valid sensors for gauge, error when applying temperature corrections, datum and sensor offset differences, and ingestion errors. Email messages will be sent to ISD stand-by staff, RDD, FOD, PSD, and CORMS for major problems as appropriate. Data would be QC'd even if the database is not available, making data available to the Near-Real-time Tides On-Line web pages, CREX bulletins, and SHEF bulletins.

3.4 Testing

The Acoustic, Backup Water Level, Pressure, Wind, Water Temperature, Barometric Pressure, Water Conductivity, Ancillary tables will be verified against the production database for a four week time period. Selected values for a given time period in each table will be evaluated. A test plan will be written and used prior to operation, that will explain testing methodology.

4.0 Operating Environment

ISD has chosen SGI as the data ingestion workstation platform. This allows for a homogeneous development environment within the office.

4.1 Hardware Requirements

Processor:	200 MHz MIPS R5000 (IP32)
Memory:	192 MB
Disk:	9 GB
Peripherals:	Mouse; Monitor
Operating System:	SGI IRIX UNIX

4.2 Support Software

- The major software components will be written in the C or C++ programming language.
- Some components of the software will use the SYBASE query language and Open Client object programming language to interface with the database.
- Some software components will use the IRIX/UNIX Korn shell scripting language.

4.3 Interfaces

The process will consist of several components performing various tasks. One component would get the water level gauge offset information from the database hourly; another component would put QC'd data into an archive directory. From the archive directory, data will be inserted into the NWLON DMS, and used to create CREX and SHEF messages to be sent to NWS Forecast Offices over AWIPS.

4.4 Security

- Since the product will be the property of the federal government, there should not be any proprietary regulation imposed on the product.

- Access to the DIS platform and the NWLON DMS is restricted and controlled via user names and passwords. Both platforms are behind the CO-OPS firewall.

Appendix A - QC Requirements Team

Name	CO-OPS Division
Joann Nault (project manager)	Information Systems Division
Thomas Bethem	Information Systems Division, Chief
Janet Burton	Information Systems Division, Deputy
Steve Gill	CO-OPS Staff
Leonard Hickman	Products and Services Division, Deputy
Jeannine Kimball James	Information Systems Division
Thomas Landon	Requirements and Development Division
Phil Libraro	Field Operations Division
Thomas Mero	Requirements and Development Division, Chief
Mike O'Hargan	Field Operations Division, Chief
William Stoney	Products and Services Division, Chief
George Story	Information Systems Division (contractor)

Other Reviewers:

Thomas Huppmann	Products and Services Division
Manoj Samant	Requirements and Development Division
Bruce Servary	Requirements and Development Division

Appendix B - Equations

Water Level at Station Datum:

Datum Offset - (aquatrak measurement + sensor offset)

Third difference:

Diff (I) = Height (I-3) - 3*Height (I-2) + 3*Height(I-1) - Height (I)

Water Level Temperature Adjustment for Sutron Aquatrak Equation:

Water level = datum offset - (Aquatrak reading + sensor offset) - [(Aquatrak reading * (air temp1 - air temp2) * TGCF)]

Water Level Temperature Adjustment for Bartex Aquatrak Equation:

Water level = datum offset - (Aquatrak reading + sensor offset) - [(Aquatrak reading - calibration length(m) * (air temp1 - air temp2) * TGCF)]

For Acoustic and SAE:

WL = Datum Offset - sensor offset - raw sensor measurement

For Pressure - Single Orifice:

WL = raw sensor measurement + accepted orifice offset

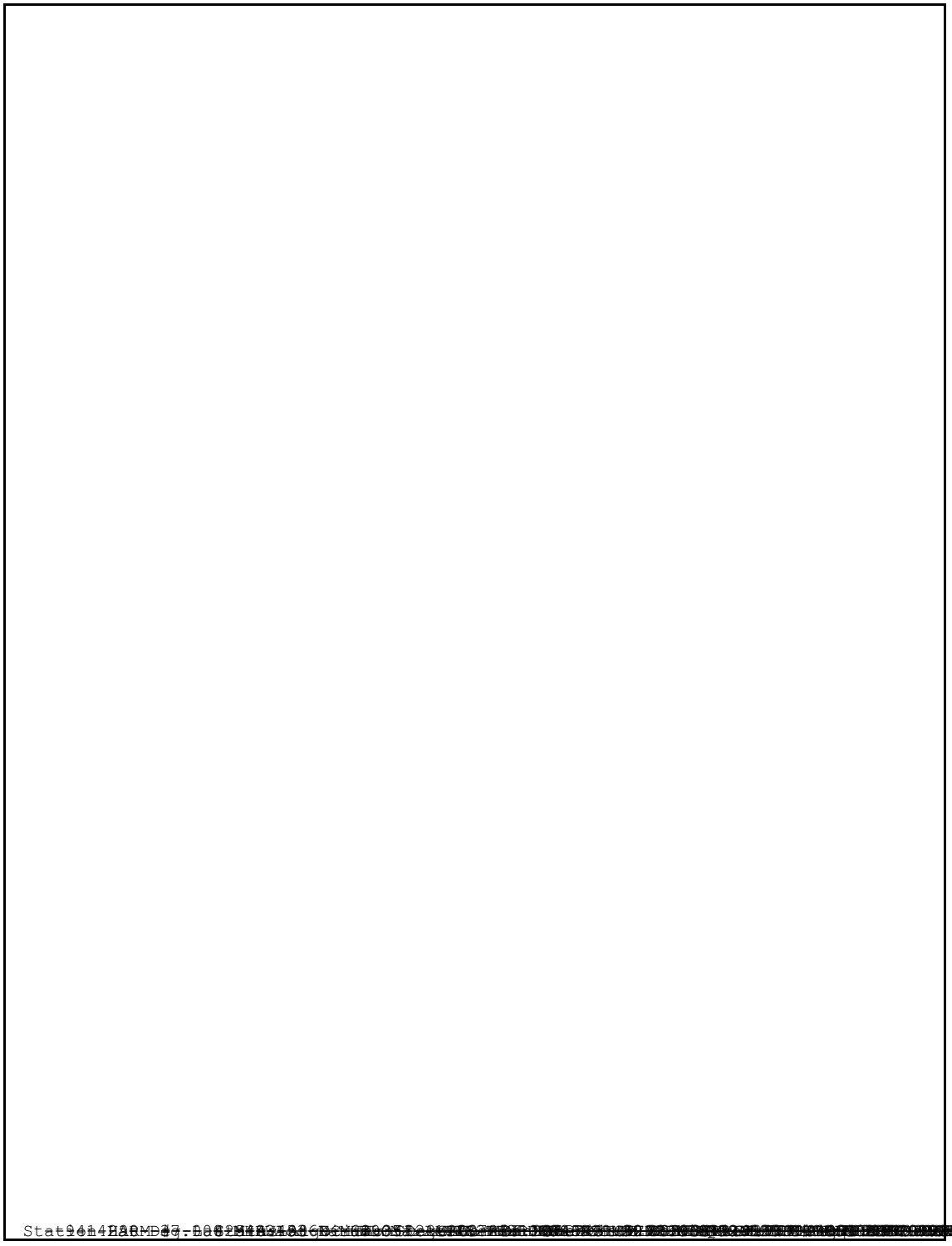
For Pressure - Dual Orifice:

Instantaneous density *Rho* in gm/cm3 = (N1 press - T1 press) * 1000000. / [(HN - HT) * g]

N1 and NT WL = N1 press * 1000000 / [*Rho* * g] + accepted orifice offset N1

T1 = T1 press * 1000000 / [*Rho* * g] + accepted orifice offset T1

Appendix C - Station Information Sample File



GLOSSARY

ADR	Analog to Digital Recorder
AFOS	Automation of Field Operations and Services
AWIPS	Advanced Weather Information Processing System
BCP	Bulk Copy for Sybase
CO-OPS	Center for Operational Oceanographic Products and Services
DCP	Data Collection Platform
DIS	Data Ingestion System
DMS	Database Management System
GOES	Geostationary Operational Environmental Satellite
H2O	Water
IGLD	International Great Lakes Datum
ISD	Information Systems Division
MLLW	Mean Lower Low Water
N1	Single or Dual Orifice Digibub Primary Sensor
NOAA	National Oceanic And Atmospheric Administration
NT	Water level derived from N1 and T1 Sensors
NWLON	National Water Level Observation Network
NWS	National Weather Service
OSO	Office of System Operations
PSD	Products and Services Division
RDD	Requirements and Development Division
SAE	Shaft Angle Encoder
SGI	Silicon Graphics Inc.
SHEF	Standard Hydrometeorological Exchange Format
SYBCHAR	Sybase character field
T1	Dual Orifice Digibub Secondary Sensor
TGCF	Temperature Gradient Correction Factor