Stockton Deep Water Ship Channel
Demonstration Dissolved Oxygen Aeration Facility Project
Quality Assurance Project Plan

Objective

The Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project is a multiple-year study of the effectiveness of elevating dissolved oxygen (DO) concentrations in the Stockton DWSC. DO concentrations in the channel drop as low as 2 to 3 milligrams per liter (mg/L) during warmer and lower water flow periods in the San Joaquin River. The low DO levels can adversely affect aquatic life including the health and migration of anadromous fish (e.g., salmon). The objective of the study is to test the facilities ability to maintain DO levels above the minimum recommended levels specified in the State of California Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. The Basin Plan water quality objectives for DO are 6.0 mg/l in the San Joaquin River (between Turner Cut and Stockton, 1 September through 30 November) and 5.0 mg/l the remainder of the year.

Methods for sample collection and handling - RRI

The YSI sonde is deployed in the water body of interest at a sensor depth of 1 meter and ambient surface water WT, SpC, DO, pH, Turbidity, and chlorophyll fluorescence is measured *in situ*. DO concentrations can be measured by either a Polarographic membrane electrode sensor (EPA method 360.1) or an optical luminescence sensor (EPA method 360.3).

Water temperature is measured by a resistance thermistor.

The SpC sensor is a flow cell with four electrodes. Conductivity/specific conductance is measured through a 5.0/cm cell using alternating current. Conductivity measurements are temperature corrected to 25.0° C and are reported as SpC.

Polarographic membrane electrode DO sensors have a thin semi-permeable membrane covering a layer of electrolyte and two metal electrodes (EPA 360.2). Oxygen diffuses through the membrane and is electrochemically reduced at the cathode. There is a fixed voltage between the cathode and the anode. The temperature compensated current associated with this process is proportional to the oxygen concentration in the water outside the membrane. The YSI electrode has two cathodes which alternate during a measurement sequence resulting in a reduced consumption of oxygen at the membrane which allows better measurement in low flow conditions.

The optical (luminescence) DO sensor is based upon dynamic fluorescence quenching of a luminophore (luminescence dye molecule) by oxygen (EPA 360.3). A blue light is irradiated on the luminophore which causes the luminophore to luminesce. The duration of the luminophore luminescence is inversely proportional to the amount of oxygen present. The luminescence is measured by a photodiode. During the measurement the luminophore is irradiated with red light and this measurement is used as a reference. The DO concentration is calculated using a polynomial regression equation. The optical DO sensor does not consume oxygen at the sensor and has no flow dependence.

Sample depth is measured by a non-vented pressure transducer. The transducer measures the press of the water column plus the atmospheric pressure above the water with a differential strain gage.

The turbidity sensor uses a light emitting diode (LED) which produces radiation in the near infrared region of the spectrum with a wave length between 830 and 890 nm and a high sensitivity photodiode detector positioned 90 degrees to the emitted light source.

The fluorometric sensor induces chlorophyll molecules to fluoresce *in vivo* (without disrupting cells) using a blue LED with a peak wavelength of approximately 470 nanometers (nm). Once the chlorophyll molecules are fluoresced, the chlorophyll emits light in the 650 -700 nm region of the spectrum. The amount of fluorescence is measured by a photo diode that is screened by an optical filter that prevents 470 nm excitation light from being detected when it is back-scattered off of particles in the water. The sensor operates under whole-cell, heterogeneous conditions. The sensor measures overall fluorescence which includes chlorophyll *–a, -b, -c,* pheophytin *–a,* and non chlorophyll interfering species that fluoresces above 630 nm.

Foxboro 871EC sensors are used with a Foxboro 872 Electro-Chemical Monitor to monitor bottom of channel specific conductivity and water temperature. The sensor measures an induced current in a loop of solution. The design comprises two toroidally wound coils encapsulated within the sensor which is immersed in the solution to measure. An AC signal, applied to one toroidal coil, induces a current in the second coil that is directly proportional to the conductance of the solution. Conductivity reading are corrected to 25° C and reported as SpC. Temperature is measured using an integral 100kΩ thermistor.

River stage measurements are made by utilizing a shaft encoder with float and tape inside a stilling well. The shaft encoder converts shaft rotation to electronic signals which are then measured by the datalogger. The encoder generates two pulse strings, one indicating clockwise and the other counter-clockwise, in order to measure the rise

and fall of river stage level. The river stage is recorded in Mean Sea Level (MSL) using National Geodetic Vertical Datum 1988 (NGVD88).

Air temperature is measured using a Met One instruments model 062 temperature sensor mounted in a Met One model 076B power-aspirated radiation shield. The sensor is a multi-stage solid state thermistor that produces a relatively large resistance change per degree of temperature change, allowing the use of normal signal voltages without self-heating of the sensor. The shield reduces the radiation error to less than 0.05°F under maximum solar radiation of 1.6 gm-cal/cm^2/min.

Wind speed measurements use a Met One model 010C sensor. The sensor uses a durable, three-cup anemometer assembly and solid-optical link with a 40-slot chopper disk to produce a pulsed output whose frequency is proportional to wind speed. An internal heater reduces moisture for extended bearing life.

Wind direction measurements use a Met One model 020 sensor. The sensor uses a lightweight, vane and a micro torque potentiometer to produce an analog voltage proportional to wind direction. An internal heater reduces moisture for extended bearing life.

Solar radiation intensity is measured using a Li-Cor LI-200 Pryanometer sensor. The LI-200 features a silicon photovoltaic detector mounted in a fully cosine-corrected miniature head. Current output, which is directly proportional to solar radiation, is calibrated against an Eppley Precision Spectral Pryanometer under natural daylight.

Procedure

Before the sonde is deployed, the sensors are cleaned and calibrated in the RTM Lab. Dissolved oxygen is calibrated at the station using a Winkler titration. Once the sonde is deployed, Real-time Monitoring Section staff remotely monitors to evaluate operational status of the station. Additionally staff will visit twice monthly to clean sondes and verify station values using calibrated field instruments. If errors are found the sonde is either replaced, recalibrated or removed from service.

Sonde Deployment

Sondes are deployed at most stations in a float inside a 12" PVC pipe attached to the station. This allows the sondes to remain at a constant one meter sample depth independent of the tide.

Typically, each station has two sondes per station. The stations are monitored daily by remote telemetry.

Calibration (reference established YSI6600 calibration procedure)

Sondes are calibrated at DES RTM Lab a minimum of once every month. More frequent sonde calibrations may be necessary depending on sensor fouling rates and instrument drift.

Methods for sample collection and handling – NA 40, 42, 43, and 48

1. A **Field Record** data sheet should be filled out for each site you visit during a field run. This section will focus on the field record sheet and what information should be recorded.
    a. **Sonde ID 6600#:** Number (i.e. SD 30) of the sonde recording data at the station.
    b. **Station:** Long name of the station (i.e. Middle River at Howard Road)
    c. **Date:** Current date
    d. **Time:** Arrival time at station (**PST)**
    e. **Performed by:** Name of samplers
    f. **Sonde Removal Time:** If a sonde is swapped out and replaced by another sonde, record the time (**PST)** it was removed from the water. Note: When removing and replacing a sonde it's important to note the time, so a sonde is not pulled and replaced while it's recording.
    g. **Weather/water conditions:** Circle all conditions that apply and if possible determine the tidal action. Also, make any pertinent comments about conditions at the station. (i.e. low water levels, agriculture pump on, temporary barrier being removed…etc.)

2. **Field Instrument readings**
    a. **Sampling device:** A metal bucket or Van Dorn water sampler should be used to collect a representative sample at a depth of 1 meter (~3 ft.). For comparison purposes the sample should be collected at or near the time when the YSI 6600 sonde is recording data. (i.e. the sonde records data every 15 minutes, so collect data at times such as: 11:00, 11:15, 11:30, 11:45…etc.)
    b. **Record sample collection time (PST)**
    c. **Water Temperature:** The YSI-63 handheld unit is used to take water temperature field readings and has an accuracy specification of ± 0.1°C.
    d. **Specific conductivity:** The YSI-63 handheld unit is used to take specific conductance field readings and has an accuracy specification of ± 0.5% µS/cm.
    e. **Dissolved oxygen:** The HACH HQ10 LDO dissolved oxygen meter is used to take dissolved oxygen field readings and has an accuracy specification ± 0.1 mg/L for values ranging from 0-8 mg/L; and ± 0.2 mg/L for values ranging from 8-20 mg/L.

f. **pH:** The YSI-63 handheld unit is used to take pH field readings and has an accuracy specification of ± 0.2 units.
g. **Turbidity:** The HACH 2100-P is used to take turbidity field reading and has an accuracy specification of ± 2% NTU.

3. **Sonde data:** YSI data should be recorded here once the file has been processed. **Record sonde data from the same date and closest approximate time as the field data you collected.**
   a. **Record sample collection time (PST)**
   b. **Water Temperature:** record water temperature sonde data. YSI water temperature probes have a range of -5 to +45°C and an accuracy of ± 0.15°C.
   c. **Specific conductivity:** record specific conductance sonde data. YSI specific conductance probes have a range of 0 to 100 mS/cm and an accuracy of ±0.5°C of reading.
   d. **Dissolved Oxygen:** record dissolved oxygen sonde data. YSI dissolved oxygen probes have a range of 0 to 50 mg/L and an accuracy of ± 0.2 mg/L for values ranging from 0 to 20 mg/L.
   e. **pH:** record pH sonde data. YSI pH probes have a range of 0 to 14 units and an accuracy of ± 0.2 units.
   f. **Turbidity:** record turbidity sonde data. YSI turbidity probes have a range of 0 to 1000 NTU and an accuracy of ± 5% of the reading or 2 NTU, whichever is greater.

4. **Total Deviation:** The total deviation is calculated by subtracting the sonde data value from the field instrument reading. (i.e. if the sonde read 6.36 mg/L and the HACH LDO read 6.52 mg/L, then the total deviation would be 6.36 mg/L – 6.52 mg/L = -0.15 mg/L)

5. **Biofouling:** Circle one of the ratings from 7 (highest growth) to 1 (minimal or no growth). The Biofouling rating is a subjective scale indicating how much algal and/or bacterial growth an instrument has accumulated during the deployment period.

6. **Additional Samples/Notes:** Indicated any other samples that were taken (i.e. chlorophyll, chloride...etc) and any other pertinent information about the site and/or the sampling you performed.

Processing Continuous Data Files

1. Open your YSI data file (.dat) in Ecowatch and check to make sure all the parameters you want to export into Hydstra are: **displayed graphically, in the correct order, and have the correct units.**

2. **Removing or displaying data in Ecowatch graphically**: If there is data displayed graphically in Ecowatch that you do not want to export or data that you do want to export is missing click "Setup" in Ecowatch, then go to "Parameters" and click "Add/Remove". A small box will pop up with "Selected Parameters" on the left side and "Available Parameters" on the right side. If you highlight one of the parameters, such as "Battery", under "Available Parameters" the "←==add" box will turn bold and if you click on it, "Battery" will move over to the 'Selected Parameters" side. If you want to remove a parameter click on one of the "Selected Parameters", such as "Temp", and now the "Remove==→" will turn bold. If you click on "Remove==→", "Temp" will move from "Selected Parameters" to "Available Parameters". Note: "DateTime" can't be removed from the "Selected Parameters" List.

3. **Changing the order of parameters in Ecowatch**: When data is imported into Hydstra the order of your parameters is **extremely important**! Once you have the parameters you want to export into Hydstra in the "Selected Parameters" column, you can change the order by using the "Up" and "Down" buttons when parameter you want to move is selected. Note: "DateTime" is always the first parameter and cannot be moved.

4. **Parameter Orders**:
   2 Channel: Temp(C), SpCond (µS/cm)

   7 Channel: Temp(C), DO (mg/L), DO(%), pH, SpCond (µS/cm), Turbidity (NTU), Salinity (ppt)

   8 Channel: Temp(C), DO (mg/L), DO(%), pH, SpCond (µS/cm), Turbidity (NTU), Salinity (ppt), Chlorophyll (µg/L)

5. **Changing Units in Ecowatch:** To change the units of a parameter in Ecowatch click "Setup", then go to "Parameters" and click "Units" and a "Change Parameter Units" box will appear. If you click on one of the parameters in the box, the dropdown box under "Unit" will display the units for that parameter. If you want to change the units, click on the drop down box and select the units you want to be displayed. Note: You can only change units for: DateTime, Temp, SpCond, and Chlorophyll.

6. **If all the data is displayed in the correct order with the right units the file is ready to be exported into a Comma Delimited File format.**

7. **Exporting a .DAT file in Ecowatch to a Comma Delimited File (.CDF) Format:** Click on "File" and then go to "Export: and click "CDF/WMF…" and a "File Export" Box will appear. The "Export Format" on the box will already have CDF selected. **You have to deselect the check box for "Separate Time/Date" or else the file will import incorrectly into Hydstra.** After you have deselected the check box for date and time you are ready to export. Go ahead and click "Export". Note: The CDF file will be exported to the same location as the .dat file. So, if you know where your .dat file is then you know where your new CDF file is. Also, whenever you open a .dat file in Ecowatch a .INI file is automatically produced. **The DAT, CDF, and INI files should all be kept in the same location with the same name (i.e. MRUN1024.dat, MRUN1024.CDF, and MRUN1024.INI).**

8. **Opening a CDF file:** To open a CDF file right click on the selected file, scroll down to "Open With" and click on "Choose Program". Then scroll through the list of programs and select "Microsoft Excel". If Microsoft Excel is not listed under chose program you have to click on "Browse" and find it that way. Note: Once you go through this process once and choose Microsoft Excel, you won't have to click on "Choose Program" again. The next time you want to open a CDF file, "Microsoft Excel" will appear as a choice under "Open With".

9. **Working with the CDF file in Excel:** When you have the CDF file open in Excel you have to convert the text to columns before you can look at the data and have it make sense. First, Click on "Column A" in the upper left hand corner of the spreadsheet to select the entire column. Then click on "Data" on the tool bar and find "Text to Columns" and click on it. This will bring up the "Convert Text to Columns Wizard". In Step 1 you want to make sure that "Delimited" is selected and NOT "Fixed Width". Once you have done that click "Next" and move on to step 2. The wizard brings up "Delimiters" in step 2 with the box for "Tab" already checked. (Note: It does not matter whether the "Tab" box is checked or not) Then put a check in the box next to "Comma" and the graphic below will show your data in columns. You don't need to click next for step 3, click "Finish" instead and your data will now be in columns.

10. **Getting a file ready for Hydstra – Step 1: Formatting the DateTime:** The date must now be formatted specifically for Hydstra. Highlight all of "DateTime" column by clicking on "A" just above "DateTime", then click on "Format" and then "Cells" to bring up the "Format Cells" box. Under "Category" select "Custom" and

then type in **'mm/dd/yy hh:mm:ss'** where is reads "General" under the "Type:" heading. **You must change it to read exactly 'mm/dd/yy hh:mm:ss'. The single quotes must be included.** Note: if you look under "Sample" it will show you the format of the date-time you entered.

11. **Getting a file ready for Hydstra – Step 2:** Make sure you have the **Pre-Calibration Sheet Field Sheet, and Post-Calibration sheet** that corresponds to the file you are working on.

12. **Getting a file ready for Hydstra – Step 3:** The time the instrument was installed is recorded on the Pre-Calibration sheet and should be used to the find the first good data point. (If the time installed was 10/24/06 at 9:27 (PST), then the first good reading would be at 9:30 on 10/24/06. All data prior to that reading must be deleted. Check and make sure that first reading makes sense relative to the rest of the "good" data. For example: If the Specific Conductance reading at 9:30 is 3 µS/cm and at 9:45 the reading is 569 µS/cm, it's a good indication the sonde was out of water at 9:30 and the first good data point is really at 9:45.

13. **Getting a file ready for Hydstra – Step 4:** Find the time that the sonde was removed on
either the field sheet or the post-calibration sheet. If the time removed was 10/26/06 at 9:35, then all data after that reading must be deleted. Again, make sure to check and see if the last data reading makes sense relative the data points before it.

14. **Getting a file ready for Hydstra – Step 5:** Record sonde data on the field sheet for the same
date and time. For Example: If field readings were recorded on 10/24/06 at 9:30, then the sonde data that corresponds to that same date and time should be recorded. Note: Record the last accurate sonde readings on the field sheet under "Sonde Data".

15. **Getting a file ready for Hydstra – Step 6:** To save the file in the correct format click "File" and then "Save As". First select the location where you want the file stored by using the "Save In" drop down box. The "File Name" does not have to be changed, but under "Save as Type" scroll down the drop box to **CSV (Comma delimited) (*.csv)** and click on it. Then click "Save" and a message will pop up asking you, "Do you want to replace the existing file", click "Yes". Another message will then ask if you are sure you want to keep it in this format, click "Yes" again. Lastly, when you close the spreadsheet, a message will ask "Do you want to save changes", click "No" since the file has already been saved. The file is now ready to exported into Hydstra! **(Hydstra Manual – Appendix F)**

16. **Importing a file into Hydstra:** First, open up Hydstra and double click on "Company Favorites". Then double click on "HYDMWB – Data Managers Workbench" to bring up the Hydstra Data Manager's Workbench box. Click on either the icon that says "Import Data" when the cursor is on it or click on "File" and then click on "Import data". An "Import Data" box will appear, which will take you through a series of steps to help ensure the file is imported correctly:

    a. **Site:** Either type the station code in or click on "Site" to pull up the "Lookup SITE database", which is a list of all the sites in Hydstra. Double click on the station you want and the code will appear in the "Import Data" box. Once the correct station is selected click "Next". The long name of the station should now be next to the station code.
    b. **Logger:** A drop down box for logger will now appear where you can choose your instrument brand. Click on the drop down arrow and click on "YSI". After "YSI" is selected click "Next".
    c. **Variant:** This is where you will choose the number of channels you want based on the number of parameters being imported. Refer to data processing procedure # 4 to determine if you need to select 2CH, 7CH, or 8CH. After choosing the correct variant click "Next".
    d. **Filename:** First, click on "Browse" to locate the file you want to import. Then click on it and click "Open". This will take you back to the "Import Data" box and your file should be listed after "Filename". **Click "Finish" to import your file.**

17. **Opening a work file in Hydstra:** After you click "Finish" the "Hydstra Data Manager's Workbench" will pop back up with a graphic of a page with a blinking green light in the middle. This is the file you just imported. The file is named with the station code and one capital letter of the alphabet, such as; TWA B or B95530 B. Make sure you remember what file you are working on, because there may be other working files in the same location. To open the file double click on the blinking icon and a "Work File" box will open with the station name as the heading. Note: After the file is opened, the blinking green light will be gone and won't reappear.

18. **Viewing data in Hydstra:** The work file has a list of all the variables you imported (i.e. water temperature, specific conductance...etc.). Double click on one of the variables (i.e. water temperature) and a "Variable" page will open up for that specific variable. The header on the page lists the site id and variable information. Below the header there are four major tabs: **"Blocks", "Summary", "Text" and "Graphics"**

    a. **Blocks:** Hydstra automatically partitions data into blocks depending on the amount of information imported. There may be one, two, three, or more

blocks. The first block will be highlighted in blue and the header will read "Current Block: 1 of 2" or "Current Block 1 of 1"; again depending on the number of blocks. For each block there will be a start date and time and an end date and time.

b. **Summary:** Provides information, such as min, max for the block/s highlighted.
c. **Text:** A list of each data point for the block selected. There are four headings for the data: "Time", "Value", "Quality", and "Type". "Time" is the date and time of a selected date point and "Value" is the numeric value of the selected variable. "Quality" is the code for the quality of the date (i.e Quality Code 1 is for a good continuous record). "Type" describes what kind of value you are looking at (i.e. Code 1 is for Instantaneous data point, Code 2 is for mean, Code 3 is for maximum etc.) Note: The first and last lines of a block cannot be deleted.
d. **Graphics:** Is a graphical representation of the block or blocks selected. This tab allows you to view data in a linear, log, or slope format. **The graphics tab is where you will enter in the Quality Assurance/Quality Control (QA/QC) information from the post calibration data sheet. All comments for the deployment period and specific data points can be entered in the comment boxes**

Quality Assurance/Quality Control of Data in Hydstra

1. **Water Temperature:** The YSI temperature probe has a range of -5 to +45°C and an accuracy of ±0.15°C and is factory calibrated. While periodic checks are done to ensure the accuracy of the probe, there are no specified post-calibration procedures for water temperature. Once in Hydstra the temperature data should be **visually and slope inspected**. (Unreliable temperature data may result from the sonde being out of water, an abundance of mud and silt in the sonde guard, etc.) First, inspect the graphical representation of the data in linear view and look for an obvious outliers or missing data points that need to be flagged. Next, change the view from "linear" to "slope" to see the change in slope from one point to the next. Inspect any points with a slope of ≥ ±0.25. All suspect data points should be flagged as "unreliable" (code 170). Lastly, in the comment box for the data set, you should type in "Data has been visually/slope QA/QC'd" and any other remarks pertinent to the data set.

2. **Dissolved Oxygen:**
    a. Enter the data rating from the post-deployment sheet into the comment box. (i.e. "Data rating was excellent") If the data rating was poor specify how far the post calibration reading deviated from the standard. ((i.e. "Data rating was poor (-13.2%)")
    b. The maximum allowable limit for dissolved oxygen data is ± 20%. If the post calibration value for the deployment period is greater than the

maximum allowable limit then all data for the deployment period should be marked as unreliable (code 170). Note: if the bad post calibration value was due to probe failure, please note that in the comment box. Probe failure is usually indicated by a dissolved oxygen charge number near zero and a dissolved oxygen saturation value near zero.

c. Flag all missing data, note any possible outliers and/or times where the sonde may have been out of water.
d. Make sure to record all deviations between sonde data and field data on the field sheet and enter them into the comment box. This should be done for the specific data point the field data is being compared too. (i.e. At 11:30 on 05/12/06 there was a sonde reading of 6.60 mg/L and a field reading of 6.75 mg/L. In the comment box you would enter "Field reading was 6.75 mg/L (+.15 mg/L)".)

3. **pH:**

a. Enter the data rating from the post-deployment sheet into the comment box. (i.e. "Data rating was excellent") If the data rating was poor specify how far the post calibration reading deviated from the standard. ((i.e. "Data rating was poor (+1.0 units)")
b. The maximum allowable limit for pH data is ±0.80 units. If the post calibration value for the deployment period is greater than the maximum allowable limit then all data for the deployment period should be marked as unreliable (code 170). Note: if the bad post calibration value was due to probe failure, please note that in the comment box. Probe failure is usually indicated by post calibration values deviating from the standards by ≥ 1.0 units and/or a slope value of less than 160 mV.
c. Flag all missing data, note any possible outliers and/or times where the sonde may have been out of water.
d. Make sure to record all deviations between sonde data and field data on the field sheet and enter them into the comment box. This should be done for the specific data point the field data is being compared too. (i.e. At 11:30 on 05/12/06 there was a sonde reading of 7.62 units and a field reading of 7.70 units. In the comment you would enter "Field reading was 7.70 mg/L (+.08 units)".)

4. **Specific Conductance:**

a. Enter the data rating from the post-deployment sheet into the comment box. (i.e. "Data rating was excellent") If the data rating was poor specify how far the post calibration reading deviated from the standard. ((i.e. "Data rating was poor (-140 µS/cm)")
b. The maximum allowable limit for Specific Conductance data is a ± 15% difference between the standard and the sonde reading. (i.e. A standard of 2767 µS/cm would have a maximum allowable limit of ± 415 µS/cm) If

the post calibration value for the deployment period is greater than the maximum allowable limit then all data for the deployment period should be marked as unreliable (code 170). Note: if the bad post calibration value was due to probe failure, please note that in the comment box.

c. Flag all missing data, note any possible outliers and/or times where the sonde may have been out of water.
d. Make sure to record all deviations between sonde data and field data on the field sheet and enter them into the comment box. This should be done for the specific data point the field data is being compared too. (i.e. At 11:30 on 05/12/06 there was a sonde reading of 365 µS/cm and a field reading of 368 µS/cm. In the comment you would enter "Field reading was 368 µS/cm (+3.0 µS/cm)".)

5. **Turbidity:**

a. Enter the data rating from the post-deployment sheet into the comment box. (i.e. "Data rating was excellent") If the data rating was poor specify how far the post calibration reading deviated from the standard. (i.e. "Data rating was poor (+20 NTU)")
b. The maximum allowable limit for turbidity data is a ± 20% difference between the standard and the sonde reading. (i.e. A standard of 100 NTU would have a maximum allowable limit of ± 20 NTU) If the post calibration value for the deployment period is greater than the maximum allowable limit then all data for the deployment period should be marked as unreliable (code 170). Note: If the post calibration turbidity reading for the zero standard deviates by > ± 6 NTU the data for the deployment period should be marked as unreliable. Note: if the bad post calibration value was due to probe failure, please note that in the comment box. Probe failure is usually indicated by the turbidity wiper parking incorrectly, which results in numerous erroneous readings during the deployment period.
c. If the optical beam is interfered with while reading, an erroneous turbidity reading will occur. Possible causes of interference are leaves, fish, fouling, wiper parking incorrectly, etc. When viewing the data these points will stand out as obvious outliers. (i.e. The data set will read 4.5, 5.0, **1005**, 3.5, 4.6….)
d. It is difficult to determine if values less than 40 NTU are outliers unless field data or the data rating indicate the data is erroneous. If the data looks suspect, document the reasons why it may be unreliable.
e. Criteria for marking a single turbidity point greater than 40 NTU, but less than 200 NTU as unreliable: Note: **All** conditions must be met to flag the data point as unreliable.
    1) The slope between the suspected outlier and the points immediately before and after the reading is > 3.
    2) There is no obvious trend that would indicate the value of > 40 NTU is valid.

f. Criteria for marking a single turbidity point greater than 200 NTU as unreliable: Note: **All** conditions must be met to flag the data point as unreliable.
    1) Turbidity value is > 200 NTU.
    2) The slope between the suspected outlier and the points immediately before and after the reading is > 2.
    3) There is no obvious trend that would indicate the value of > 200 NTU is valid.
e. Flag all missing data, note any possible outliers and/or times where the sonde may have been out of water.
f. Make sure to record all deviations between sonde data and field data on the field sheet and enter them into the comment box. This should be done for the specific data point the field data is being compared too. (i.e. At 11:30 on 05/12/06 there was a sonde reading of 11.7 NTU and a field reading of 13.5 NTU. In the comment you would enter "Field reading was 13.5 NTU (+1.8 NTU)".)

6. **Chlorophyll:**

a. Enter the data rating from the post-deployment sheet into the comment box. (i.e. "Data rating was excellent") If the data rating was poor specify how far the post calibration reading deviated from the standard. (i.e. "Data rating was poor (+7 µg/L)")
b. The maximum allowable limit for chlorophyll data is a ± 10% difference between the standard and the sonde reading. If the post calibration value for the deployment period is greater than the maximum allowable limit then all data for the deployment period should be marked as unreliable (code 170). Note: if the bad post calibration value was due to probe failure, please note that in the comment box. Probe failure is usually indicated by the chlorophyll wiper parking incorrectly, which results in numerous erroneous readings during the deployment period.
c. If the optical beam is interfered with while reading, an erroneous chlorophyll reading will occur. Possible causes of interference are leaves, fish, fouling, wiper parking incorrectly, etc. When viewing the data these points will stand out as obvious outliers. (i.e. The data set will read 3.2, 3.1, **395**, 3.5, 4.6....)
d. It is difficult to determine if values less than 10 µg/L are outliers unless field data or the data rating indicate the data is erroneous. If the data looks suspect, document the reasons why it may be unreliable.
e. Criteria for marking a single chlorophyll point greater than 10 µg/L, but less than 50 µg/L as unreliable: Note: **All** conditions must be met to flag the data point as unreliable.
    a. The slope between the outlier and the points immediately before and after the reading is > 3.
    b. There is no obvious trend that would indicate the value of > 10 µg/L is valid.

f. Criteria for marking a single chlorophyll point greater than 50 µg/L as unreliable: Note: **All** conditions must be met to flag the data point as unreliable.
    a. Chlorophyll value is > 50 µg/L.
    b. The slope between the outlier and the points immediately before and after the reading is > 2.
    c. There is no obvious trend that would indicate the value of > 50 µg/L is valid.
g. Flag all missing data, note any possible outliers and/or times where the sonde may have been out of water.
h. The YSI chlorophyll probe provides an estimate of chlorophyll concentrations by measuring fluorescence. To get a more precise representation of chlorophyll *a* concentrations grab samples for chlorophyll *a* are taken bi-monthly at each site for analysis at Bryte lab. Regression analysis is used to determine a relationship between continuous chlorophyll values from the YSI 6600 sonde and extracted chlorophyll *a* values.

Training

All DWR staff collecting and processing data has been trained through vendors that supply the equipment used as well as various training courses aimed at properly training staff before being assigned responsibility of collecting and processing data. Further training occurs as new technological advances occur with equipment and methods.

Certification of the adequacy of the QAPP

I, Bill McLaughlin, Senior Engineer and Project Manager of the Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project certify that the procedures used to collect and process the data submitted are valid and that the data is of good quality.