QC CHECKS OF DATA SHEETS FROM QUARTERLY MONITORING *Rev. 9/15/18*

- Definitions of "levels" of monitoring events, for Streamkeepers' quarterly stream-teams:
  - Episode: entire quarterly monitoring set
  - Tour: one team's outings for that Episode (could be more than one day)
    - Usually the same team leader
    - Requirement for field replicates
  - Visit: one team's sampling at one place on one day
    - Could be multiple visits to same site in one tour
- Write all QC comments in colored pencil
- Qualifiers—see QAPP (Quality Assurance Project Plan) for details:
  - Data with no qualifier passes all QC tests
  - EST: data questionable because protocol not followed or not documented, but probably OK
  - REJ: data not acceptable
- Write Qualifiers on the data sheet, indicating which data need to be qualified and why
  - All data that are qualified need an explanation—this is required by the WA Dept. of Ecology
- In general, ALL boxes should be filled in—consult with teams as necessary—blanks may result in qualifiers
- **All unresolved QC problems should be discussed with the team leader**—this is an important learning experience for the team leader

CREATING EPISODE PACKETS:

- When data sheets for a new Episode are received, create a new packet for the Episode—please use a pencil:
  - Hanging file folder with plastic tab marked with Episode Period Descriptor
  - Manila folder inside of hanging file folder, marked with Episode Period Descriptor and "To Enter"
  - Episode Cover Sheet, filled out, to go in front of the Tour packets in the manila folder (see http://www.clallam.net/SK/monitoringusables.html for a copy of this form)
  - As you do QC checks on Tour packets, put them behind the Episode Cover Sheet in the folder
- After you think you've checked all the data sheets for that Episode, check all the Tours and Visits against the sampling plan for that time period (the most current one should be at http://www.clallam.net/SK/programplanning.html) to see if there are sites that should have been visited but don't have data sheets; if so, check with team leaders, and if necessary, make appropriate comments on Tour cover sheets (or on Episode cover sheet if a team didn't go out at all).
- It's nice (but not necessary) to line the Tours and Visits up the same way they are on the Sampling Plan.
- After finishing QC for all data sheets in that Episode, file the hanging file folder in the "DATA" file drawer, behind the divider labeled "SK Quarterly Monitoring," with the most recent quarter in front.

QUICK CHECK OF TEAM PACKET (done by Streamkeepers staff on receipt from team):

- Tour sheet complete?
  - All initials and full last names.
  - Field Kit must be indicated
  - Look at Kit Comments: anything needing to be done?
  - Chain of custody (block at bottom of Tour Cover Sheet):
    - Confirm initials and dates on first two lines
    - If they're blank, fill them in with team leader's initials and date discovered

- Volunteer hours sheet—initial that it was there
    - Check Vol Hrs sheet for proper entry
    - Put Vol Hrs sheet into “Vol Hrs To Enter” folder
- Quick check of data sheets:
    - Top of each sheet has site name and date
    - Site names match current sampling plan
    - Check for equipment comments
    - Staple
    - Check to see if all the sites are there
    - Check all comments written on all sheets to see if there are any situations calling for special judgment
    - Strike out internal comments not relevant to recording in the database
- Tour sheet: Fill in “Received at office” initials & date
    - Clip data sheets to Tour sheet
    - Put packet in “To QC Check” inbox

DETAILED CHECKS OF DATA SHEETS:

- QC checks: **make any comments in colored pencil**
  - Database ID #s top: ignore
  - Sampler in charge: initials + last name - required on Tour cover sheets; optional on Visit cover sheets
  - Field kit deviations: make sure notes are clear
  - General comments: review for clarity
    - If only relevant to equipment maintenance and not data quality, write note to Ed & cross out comment
  - Things to always look for:
    - Legibility
    - Sampler's initials—all 3 initials
    - Sampling times—when left blank, try to ascertain by other times that are indicated; for example, flow is usually done by separate people at the same time as water chemistry. It may help to look at other data sheets for the same team during the same tour.
  - Fish & Wildlife
    - If no data and no initials, leave as is—can't assume they looked.
    - If there are initials but no data, write "None" in grid because we assume they looked and saw nothing.
    - Correct critter names (or write out abbreviations) as necessary.
    - Change check marks under "Number" to default: "1+"
  - Noxious Weeds
    - If Yes, there should be a separate "Noxious Weed" form
      - If weeds are written in on the Visit form but there is no Noxious Weed form, fill one out—needs to be copied & submitted to Weeds office
    - Noxious Weed form
      - Everything is filled out
      - Location is described well if the site isn't in the CCWR database
      - Check entries—do they make sense?
      - Make a copy; put the **copy** in inter-office envelope addressed to Noxious Weeds office for SK staff to send; alternatively, email scanned copy to SK staff so they can print and send to Noxious Weeds office
      - Original: initial/date at top that copy was sent, then staple to data sheets for that site
  - Photos
    - Make sure all fields are filled in both above & below cut-off line
    - Frame # must have all numbers: xxx-xxxx; if 1st three are blank, assume "100"

- Flow
  - All fields should be filled in:
    - "Streamkeeper" protocol if not checked
    - Flow meter numbers and tests—fill in or consult with team as needed
    - Use your judgment in terms of interpolating instrument-related data where not indicated; for instance, you can often find Rotor and Meter calibration numbers on other data sheets from the same team, or from the last calibration event for the meters.
    - Time and starting bank (can often figure out starting bank from the rest of the sheet)
  - Check the interval-calculation section, particularly the MAX interval calculation (see below).
  - Cell entries:
    - Need at least 15 cells with a velocity, unless intervals are 0.3"; if not, mark it "EST"
    - All 4 columns should be filled out; if angle is blank, can assume 0
    - Must have wetted-edge readings; if blank, you can usually tell from calculation section
      - At minimum, the first and last readings must have zero velocities; if that is not the case, you may have to extrapolate first or last zero-velocity readings based on existing data (look at the calculation section for wetted- & prop-turnable edges, as well as intervals being used between cells, and use your best judgment)
      - If these are missing, add rows at the beginning and end of the wade-across cells section
      - If you had to extrapolate wetted edges, no need for QC downgrade unless the end-cell is large and the first velocity is also large (such that ½ of their product would be >2% of the entire flow calculation)
    - Where depth >2', the team must record velocity readings at both 2/10 & 8/10 depth – or maybe the decimal is in the wrong place; for example, if the the depth is marked as 2.5, it might actually be 0.25; use your judgment and check with the team as necessary
      - On the data sheet, write the average of the two velocity readings for that tape distance—there should be only one entry.
    - Go down each column:
      - Look for fairly regular intervals and decimal problems in each column; if not resolvable, check with team leader
      - Keep in mind the maximum and minimum intervals
      - Zero velocities OK even if not accompanied by "insf/v" or "insf/d"
      - A whole string of "insf/v" or "insf/d" entries is OK; even though they'll have no impact on the flow calculation, they help provide a picture of what the channel cross-section looked like that day.
  - Other possible reasons for marking flow "EST":
    - Intervals > the MAX interval as calculated on the data sheet
    - Lots of non-zero angles
    - No measurements taken between the Wetted-Edge and Prop-Turnable locations
    - Cells at depths below prop height. In the summertime when flows are low, teams should be using the "3-inch" prop, which is actually 0.23' in diameter, because it turns more easily than the "2-inch" prop, even if it's partially out of the water. However, if a lot of cells are less than 0.23', and if these cells are carrying most of the total discharge, the data should be qualified. (In a tiny creek, the protocol asks the team to use sandbags or other objects to create a little flume where the velocity and other dimensions can be measured more easily; communicate with the team leader if you think the team should have used this approach.)

- Any measurement using the Floating-Object method

- Single-point hydraulic method (see Handbook) should be an accurate method of measuring flow in low-flow situations if done correctly; no need to qualify the data unless there's a particular reason to do so.
- If, in your judgment, the measurement method can't be trusted to give a value within 20% of the true value when rounded to 0.1 cfs, qualify as REJ

- Water level—for sites with gauges: "EST" if gauge damaged
  - Can be before, after, or both before and after flow sampling
  - Units must be circled
  - Benchmark must be circled; if not circled, assume "stream gauge"
  - Gauges measured at non-team sites: Sometimes teams are asked to check gauges during their sampling Tours that aren't part of their team's site assignments, in order to establish stage-discharge curves between a gauge and another stream. In such a case, the team should enter this gauge-measurement Visit on the bottom of their Tour sheet; e.g.:

    SEPARATE VISIT:
    Peabody 0.2 stream gage
    0.66' @ 1700 DJL

    This observation becomes a Visit of its own, connected to flow measurements at the team's other sites by its temporal and spatial relationships.

o Chemistry

- YSI ProDSS
  - Meter #; not required if Kit# has been given
  - Decimals: must go to at least the # of decimals listed
    - OK if there are too many decimals
  - Check reasonableness (look at ranges listed)
  - DO Drift check: should be between 98-102%; "EST" if fail by <2; "REJ" if fail by >2
    - NOTE: For the ProDSS, the saturated-air drift check is just a secondary field check. We only calibrate the LDO probe once per quarter, and the true post-check of the meter happens in air-saturated water (a bucket with a bubbler) at the end of the quarter. The in-situ drift checks are just secondary checks to tell you if there's something fishy going on. Technically, if an in-situ drift check fails but the end-of-quarter drift check passes, the data should be acceptable, regardless of the results of the in-situ drift check. The final call would rest with the QC officer.
- YSI-60 (pH)
  - ALL pH measurements done during this Tour will be qualified by the pre-sampling calibration; then each Visit's measurement is qualified by its post-check
  - Look through team's packet to find visit where meter calibration was done
  - pH calibration: check all fields and confirm QC pass; "EST" or "REJ" (see below) if fails
  - Post-check: check all fields and confirm QC pass; "EST" or "REJ" (see below) if fails
  - WHEN/WHY mark it "REJ": The QAPP (see table at end) calls for a tolerance of 0.2 pH units for EST and 0.5 units for REJ; however, these calibrations/tests by the teams are performed with secondary (field) rather than primary (office) standards, and therefore we "cinch up"

the thresholds by a factor of two to insure a safe margin of error. In general, the threshold for these tests with field standards would be 0.1 for EST and 0.25 for REJ; however, the analyst can relax these margins by examining the post-quarter checks of the secondary standards; you basically add the error of the secondary-standard field checks to the error of the secondary standards themselves, comparing to the QAPP thresholds.

- HF DRT 15CE (Turbidity)
  - Field calibration check:
    - # of NTUs on reference vial: should be close to 10
    - Turbidimeter reading for this reference vial: should be close to 10
    - If there are problems, look at other sheets for this Tour or check with team
    - The two numbers should be within 5% of each other, i.e. within 0.5 (if not, need to confirm a passing quarterly instrument post-check)
    - If no expiration date, look at other sheets or check equipment or Standards inventory in database
  - Readings within a Visit should be within one unit or 10% of each other, else "EST" ("REJ" if > 20% diff)
  - Also "REJ" if it's noted that the stream has been disturbed upstream of the sampling site
- Air temperature, Barometric pressure if measured by separate instruments:
  - Check that all boxes are filled in.
  - Check for reasonable readings (temp in °C, pressure ~30 in.).
- YSI-85 (DO, temp, conductivity, salinity)
  - Meter #; not required if Kit# has been given
  - Decimals: must go to at least the # of decimals listed
    - OK if there are too many decimals
  - Check reasonableness
    - Salinity should be no higher than 0.1 (unless near creek mouth) —if higher, consult with SK staff.
  - DO Drift check: should be between 98-102%; "EST" if fail by <2; "REJ" if fail by >2
    - If replicates done, drift check will be at bottom of Replicates section

Parameters &Water-Quality Exceedances

Temperature: > 16° C
pH: > 8.5 or < 6.5 pH
Turbidity: >5 NTU higher than any upstream site on the same stream, or 10% higher if the upstream turbidity is >50.
(As a general rule, take a turbidity replicate if you're at a downstream site, the turbidity is ≥10, and you'll be visiting an upstream site on the same day. If the upstream value exceeds the threshold, take a replicate there too.)

Dissolved Oxygen: < 9.5 mg/L
In the case of dissolved oxygen, the field readings must be corrected for pressure in the following manner:
$DO_{corrected} = DO_{field}$ *X Pressure/29.92*
At a high-elevation site on a low-pressure day, the corrected reading could be 10% lower than the field reading; so if the pressure is low and the DO field reading is near the threshold, calculate the corrected reading. (And you can do the same if the field reading is below the threshold but the pressure is high.)

- Most common exceedance: Dissolved Oxygen < 9.5 mg/L.
- Did team do a 2nd set of readings when there was an exceedance? If not, remind the team leader that this would be a good idea, and scrutinize the data a bit more carefully for reasonableness, but otherwise, use the same QC procedure.

- Judgment needed: shallow, warm in late summer, fall algae die-off, etc.

- Replicates
  - Must be at least one valid set per tour.
  - Variances should be within Streamkeepers' QAPP guidelines:

  Replicate qualification criteria excerpted from the QAPP for quick reference:

Replicated Parameter:	**"EST" if difference is:**	**"REJ" if difference is:**
pH	>0.2 pH units	>0.5 pH units
Barometric Pressure	>0.05 inches Hg	>0.1 inches Hg
Turbidity	> 1 NTU & RSD* > .05	> 1 NTU & RSD* > .10
Water Temp	> 0.2 degrees C	> 0.5 degrees C
DO Concentration	>0.3 mg/L	>0.55 mg/L
Conductivity	RSD* > .05	RSD* > .10

  *RSD = Absolute Value of the (Difference divided by the Sum) times the SQRT(2)
  Alternative to RSD calculation: "EST" if Difference x 30 > Sum, "REJ" if Difference x15 > Sum

- Replicates are used to qualify the precision of an entire Tour's measurements:
  - Any "EST" or "REJ" applied to a rep/sample pair affects all such measurements for that Tour.
  - Any qualifier applied to DO Concentration affects DO Saturation as well.
- Additional sets of readings: When there are additional sets of Water Chemistry readings on the data sheet (other than a set of Replicates), a determination should generally be made of which set(s) to enter. Often, the team will indicate, by circling or crossing out, which set(s) to use. Or you may be able to tell that one or more sets of data are anomalous. (One specific situation to look for is when a subsequent set of data shows higher DO concentrations, in which case you can assume that the team did a better job of stirring the DO probe in the latter data set.) You may have to consult with the field team if unsure.

- Data Qualifiers and Failed measurements: The following table shows various "data qualifier codes" that should be attached to data that matches the conditions described:

Code	Description	Notes
EST	Measurement value reported is estimated. You MUST enter a Comment at some level that explains why your result is an estimate.	Indicates that QA/QC measures were not completely followed and/or documented, but QC officer believes data to be reasonably reliable, or that result was > Detection Limit but < Reporting Limit.
E	Reported result is an estimate because it exceeds the calibration range.	
OUT	Outlier within dataset; single result is unexpected or discontinuous.	For *individual* data points that are out of characteristic range, but for which the QC analyst sees no good reason to apply the EST or REJ qualifiers.
OOR	Out of range; dataset not in expected range for instrument type, data type, or historical climatology; reported result meets study objectives.	For *sets* of data that are out of characteristic range, but for which the QC analyst sees no good reason to apply the EST or REJ qualifiers.
VAR	Variation within dataset; multiple results creating an unexpected pattern; reported result is an estimate.	For a group of data results that the QC analyst believes to show a less-credible pattern.
FD	Site was dry	To explain zero flows or failed attempts to gather data
FS	Stagnant water--no flow	To explain zero flows or failed attempts to gather data
FA	No site access	
FE	Equipment failure	
FH	Flow too high to measure	
FI	Ice-impacted	
FT	Flow tidally impacted	
FL	Above or below instrument or method limit	e.g., when water level is too low to measure stage or flow