Final Audit Report

Normandeau Associates, Inc.

Stream Condition Index Laboratory Audit
OGC Case No. 15-0346

Aquatic Ecology and Quality Assurance Section
Water Quality Standards Program
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection
June 9, 2015

STREAM CONDITION INDEX LAB AUDIT

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Florida Department of Environmental Protection
2600 Blair Stone Road, MS 6511
Tallahassee, FL 32399-2400

Scope of Audit
Environmental Services & Permitting, Inc. (ESP), has provided Stream Condition Index (SCI) data to the Florida Department of Environmental Protection (DEP) in support of site specific alternative criteria (SSAC) studies conducted on streams receiving effluent from the Potash Corporation of Saskatchewan (PCS). Normandeau Associates, Inc. (Normandeau) is processing the SCI samples and provides the results to ESP. To provide assurance that Normandeau is following the SCI sample processing and index calculation protocols in DEP SOP SCI 2000, DEP conducted a records audit of the required documentation associated with a subset of sample results submitted by ESP as part of its SSAC studies.

For this audit, two SCI samples were examined. Both samples were collected on September 12, 2013; one was collected in Swift Creek and the other in Hunter Creek in Hamilton County. Some of the audit findings are unique to each individual SCI sample, while other findings and comments pertain to Normandeau's overall laboratory protocols for the handling and processing of SCI samples.

Summary of Findings/Acceptance of Corrective Actions/Data Usability Recommendation
A preliminary audit report was sent to Normandeau on January 15, 2015 outlining the initial findings. Normandeau responded to the preliminary report on January 26, 2015. The findings, Normandeau's responses, and DEPs comments are in Tables 1 and 2.

DEP's Aquatic Ecology and Quality Assurance Section (AEQAS) found that the Normandeau's macroinvertebrate taxonomy lab procedures complied with DEP SOP SCI 2000 for sample sorting, taxonomic identification, and index calculation with only a few minor deficiencies as noted below. Normandeau has provided acceptable responses to all of the listed findings, and DEP accepts the corrective actions to the deficiencies indicated in Table 2. Based on the results of this audit, the DEP auditors have concluded that the Normandeau laboratory follows all appropriate Department Standard Operating Procedures (SOPs) for SCI sample analysis. SCI data produced by Normandeau meets DEP's data quality objectives, and the AEQAS recommends that the data may be used for SSAC development under Chapter 62-302, Florida Administrative Code.

SCI Sites:	Swift Creek and Hunter Creek
Sample Collection Date(s):	September 12, 2013
Macroinvertebrate Lab:	Normandeau Associates, Inc.
Analysis Dates:	September 24 and 25, 2013
Auditor:	Joy Jackson
Records Provided Date:	May 21, 2014; August 27, 2014; October 8, 2014; January 26, 2015
Final Audit Report Date:	May 21, 2015

Records Evaluated

The following records (with file names) were submitted to DEP by Normandeau and evaluated for this audit:

- Taxonomic keys most frequently used, description of corrective actions, Quality Control (QC) records for the sorting of macroinvertebrate samples for 2012, list of SCI samples analyzed in 2012, sample sorting bench sheets, taxonomic identification bench sheets, taxonomic attributes for metrics, metric values and SCI score values (*SCI Audit Documentation*),
- List of verified taxa in reference collection (*Item 2 – Ref. Coll. – NA Laboratory*)
- Resume of Benthic Laboratory Manager (*Resume – Geo. Christian*)
- List of vouchered specimens for project (*Item 2 – Ref. Coll. – FL SCI – Conf. J. Epler*)
- Quality Assurance (QA) records for taxonomic QC for 2012 (*Taxonomy QA/QC Resolution Form SCI audit.xls, Taxonomy QA/QC Sheet SCI samples 2012*)
- Collapsed taxa list and metric calculations as initially reported on 6/1/12.
- Normandeau's Response to Initial Audit Report (*FL DEP: SCI Lab Audit – requested documents and FW: FL DEP: SCI Lab Audit - requested documents*)

Audit Findings

Lab Quality System: Overall, Normandeau conducts the QC measures as required by the DEP SCI SOP. The organisms found in the samples that were reviewed as part of this audit were represented in Normandeau's reference collection and have been verified by outside experts. One of the listed experts for a number of specimens was the Normandeau Benthic Laboratory Manager, Mr. George Christian. Mr. Christian's qualifications were requested and submitted (*Resume – Geo. Christian)* and it was concluded that his education and experience qualify him to verify commonly encountered taxa.

***Sample Sorting and Identification Process*:** The auditor concludes that Normandeau properly follows DEP SOPs resulting in a homogenized sample with two replicates with the required number of individuals. Neither slides nor vials were requested or reviewed by the DEP auditor, and documentary linkage between the slide and vial labels and the lab data sheet for either sample was not verified.

Sample Sorting QC: Normandeau did not initially provide cumulative sorting efficiency records by analyst; however, the sorting efficiencies for each analyst over a 12 month period could be ascertained from the information provided for the 2012 SCI samples. Per SCI 2210, this information should be maintained for each analyst, and should be cumulative over the entire work history (excluding the initial training). Normandeau provided this information in its response to the draft audit checklist and findings provided by DEP. Normandeau conducts QC checks on a minimum of 10% of aliquots sorted for each replicate with a minimum of at least one aliquot per replicate. Quality control evaluation of sorting efficiency follows the DEP SOP procedure, and with one noted exception, all analysts are performing sample sorting with greater than 95% cumulative efficiency. Normandeau initiates precautionary measures when the sorting efficiency on an individual sample falls below 95%.

Taxonomic Identification QC: Normandeau's taxonomic identification procedures and quality control evaluations of individual taxonomist performance meet DEP SOP requirements.

SCI Index Calculation: Normandeau correctly classified taxa according to their attributes, assigned the correct SCI Bioregion, and calculated the SCI metrics and final score as demonstrated in the *Normandeau ID'd Samples* document.

Corrective Actions

The findings for this audit, as listed in Table 1, indicate that Normandeau should implement corrective actions to ensure conformance with DEP SOP requirements for SCI data submitted to DEP, as listed in Table 2.

Table 1. Lab records audit checklist for SCI sample processing and data analysis, for audit conducted on Normandeau's analysis of samples collected by ESP from Swift and Hunter Creeks on 9/12/13.

PERFORMANCE MEASURE		PERFORMANCE ASSESSMENT	
		Assessment	**Remarks**
1. Lab quality system (SCI 2200)		***Refer to list of taxonomic keys and list of reference collection specimens to address the following requirements.***	
1.1	Lab maintains copies of appropriate taxonomic identification keys.	YES	Reviewed *Letter - FL DEP Records Audit*. Normandeau provided information on the most commonly used references per DEP's request, and those were appropriate references. Normandeau should also use the following keys when identifying samples from Florida: Epler, J. H. 2014. Identification Guide To The Larvae Of The Tribe Tanytarsini (Diptera: Chironomidae) In Florida; and, the 2009 update to Pescador, M. L., A. K. Rasmussen, and S. C. Harris. 2004. Identification manual for the caddisfly (Trichoptera) larvae of Florida (Revised edition).
1.2	Lab maintains taxonomic specimen collection.	YES	Reviewed *Item 2 – Ref. Coll. – FL SCI – Conf. J. Epler* and *Item 2 – Ref. Coll. _NA Laboratory*. The specimens in the sample reviewed for this audit were represented in the reference collection, and a voucher collection of specimens collected for this particular study were maintained and confirmed by an outside expert. The overall reference collection is well organized and contains a large number of representative taxa of various life stages. The majority of specimens have been verified by outside experts.
1.3	Taxa found in samples are represented in the reference collection.	YES	This requirement was covered by *Item 2 – Ref. Coll. – FL SCI – Conf. J. Epler*. A representative of every taxon collected for this study has been verified by an outside expert.
1.4	Lab retains extramural experts to verify identifications.	YES	Reviewed *Item 2 – Ref. Coll. _NA Laboratory*. A variety of experts have been used to verify identifications.
1.5	Specimens in collection are verified by extramural expert.	YES	Reviewed *Item 2 – Ref. Coll. _NA Laboratory*. One of the verifiers listed for a number of specimens was the Normandeau Benthic Laboratory Manager, Mr. George Christian. Mr. Christian's qualifications were requested and submitted in the document, "Resume – Geo. Christian.docx". Mr. Christian's years of professional taxonomy experience, certifications, and specialized training qualify him to verify taxonomic identifications of commonly encountered organisms.
1.6	Lab contains basic equipment necessary for sorting and taxonomic analysis (compound and dissecting microscopes,	N/A	Auditor did not visit the lab; therefore, this element was not evaluated.

	divided trays, #30 sieve) [applicable to lab visit audit only]		
2. Sample sorting and identification process (SCI 2100) - *Applies to processing for SCI samples*		***Refer to raw bench sheets to address the following requirements.***	
2.1	Sample homogenized and subdivided at prescribed levels; records indicate fractions of samples sorted and reflects that 2 or 3 trays were used (may only have 2 if insufficient material to warrant 3 trays)	YES	Reviewed *Item 3 – Tracking Records – Sort QC.*
2.2	Two aliquots of 150 (±10) organisms picked from sample material.	YES	Reviewed *Item 7 - Bench Sheets - SCI Samples.* The original number of organisms in Rep 1 of the Hunter Creek sample was 148; however, 15 additional organisms were found during the QC sorting check. Adding these specimens resulted in 163 organisms, which would exceed the target number. In his response to a request for additional information ("FW: FL DEP: SCI Lab Audit - requested documents"), Mr. Christian clarified that the additional organisms were not included in the total and the metrics were based on the original number of organisms (148).
2.3	The X qualifier is used if insufficient organisms are in the sample to obtain 2 replicates of 150. (only applicable if <300 organisms were in the sample)	N/A	Reviewed *Item 7 - Bench Sheets - SCI Samples.* There was sufficient material for two reps of 150 so this element was not evaluated.
2.4	Analysts prepare slides and use a compound microscope for identification of appropriate groups when needed (typically worms, midges, mites)	YES	Reviewed *Item 7 - Bench Sheets - SCI Samples.* Only midges were mounted for the audited samples.
2.5	Individual taxon names and counts are recorded on bench sheet	YES	Reviewed *Item 7 - Bench Sheets - SCI Samples.*
2.6	Slides clearly identified and linked to the sample vials and sample data sheets by unique sample ID and specimen ID	N/A	Reviewed *Item 7 - Bench Sheets - SCI Samples*. Bench sheets clearly indicate which specimens were mounted, but slides and vials were not examined for audit, and linkage was not verified for this audit.
2.7	Taxonomic bench sheet indicates when specimens are removed from sample vial for any reason (e.g., placed in reference collection or send to extramural expert).	YES	Reviewed *Item 7 - Bench Sheets - SCI Samples.*
2.8	Taxa collapsing routine conducted per SOP SCI 2100 section 4. Original and collapsed taxonomic lists maintained.	YES	Reviewed *Nov 2013 SCI's (Swift, Camps, Hunter).*

2.9	Documentation available for items listed in SCI 2110	N/A	Sample Log-in records were not requested or provided. The number of slides and the individual organisms mounted were identified on the bench sheets. Neither the slides nor the information linking them to the original sample were provided or requested. Linkage was not verified for this audit.
3. Sample sorting QC (SCI 2210)		***Refer to sorting efficiency tracking records, corrective action protocol, list of analyzed samples, and raw bench sheets to address the following requirements.***	
3.1	Sorting efficiency check conducted for a minimum of 10% of aliquots per sample.	YES	Reviewed *Item 3 - Tracking Records - Sort QC.* All samples are checked for sorting efficiency.
3.2	Sorting efficiency calculation conducted per SOP	YES	Reviewed *Item 3 - Tracking Records - Sort QC.*
3.3	Sorting efficiency tracked for each analyst.	NO	Reviewed *tem 3 - Tracking Records - Sort QC*. Initially, the cumulative sorting efficiency per analyst was not provided but could be ascertained from the information provided.
3.4	Cumulative sorting efficiency 95% or greater for each analyst.	NO	Reviewed *Item 3 - Tracking Records - Sort QC*, which show two SCI samples sorted by George Christian with an average cumulative sorting efficiency of 92.9%. No SCI samples were listed beyond this point for this particular analyst. Other Normandeau analysts demonstrated the required sorting efficiency.
3.5	Precautionary measures taken when single-analyst cumulative sorting efficiency falls below 95%.	YES	Reviewed *Item 3 - Tracking Records - Sort QC*. Document showed two samples sorted by George Christian with a cumulative sorting efficiency of 92.9%. The records do not indicate what, if any, precautionary measures were taken. In response to the draft checklist, Mr. Christian supplied *Required Documentation of Quality Control for Macroinvertebrates Taxonomic Identification and Enumeration (SCI 2221*) which highlighted the samples below the 95% threshold and noted the precautionary measures taken as a result of falling below the acceptance threshold.
3.6	Corrective action taken when single-analyst cumulative sorting efficiency falls below 90%.	YES	Initially, the cumulative sorting efficiencies were not specifically provided by analyst although it could be calculated based on the information provided. Subsequent documentation showed the cumulative sorting efficiency was maintained.
3.7	Documentation available for items listed in SCI 2211	YES	The cumulative sorting efficiencies were not originally provided by analyst although it could be calculated based on the information provided. They were subsequently provided in the response to the draft checklist, *FW: FL DEP: SCI Lab Audit - requested documents.* All QC information was recorded.
4. Taxonomic identification QC (SCI 2220)		***Refer to taxonomic QC tracking records, corrective action protocol, list of analyzed samples, and raw bench sheets to address the following requirements.***	

4.1	For freshwater sampling, identify taxa to the lowest practical taxonomic level as listed in Table LT 7900-1 or SCI 2230.	YES	Reviewed *Item 7 Bench Sheets - SCI Samples.*
4.2	Quality control performed on 5% of samples (or SCI replicates), per LQ 7420 section 3.	YES	Reviewed *Letter - FL DEP Records Audit.*
4.3	Taxonomic discrepancies associated with the QC check resolved through use of extramural expert when needed. (may only be able to evaluate this element if corrections were made on bench sheet)	N/A	Reviewed *FW: FL DEP: SCI Lab Audit.* Requested documents and the original taxonomist agreed with the QC taxonomists' identifications and records were amended accordingly.
4.4	The single-analyst cumulative correct identification rate is 95% of the total number of individual organisms and 95% of taxa identified in all samples or subsamples enumerated by the analyst (5% cumulative error rate over 12 months)	YES	Reviewed *Letter - FL DEP Records Audit.* .The information was not organized by analyst but could be ascertained from what was provided for each analyst. This information was subsequently provided in the response to the draft checklist ("FW: FL DEP: SCI Lab Audit - requested documents") and the taxonomists identifying SCI samples have a cumulative accuracy of >95%.
4.5	Corrective action undertaken if single-analyst cumulative correct identification rate is < 95% of the total number of individual organisms or < 95% of taxa identified in all samples or subsamples enumerated by the analyst	YES	Reviewed *Letter - FL DEP Records Audit.* .It was initially difficult to ascertain the identification rate for each analyst. Information subsequently provided ("FW: FL DEP: SCI Lab Audit - requested documents") showed the taxonomists identifying SCI samples have a cumulative accuracy of >95% and institute precautionary measures on a per sample basis.
4.6	Documentation available for items listed in SCI 2221.	YES	Reviewed *Letter - FL DEP Records Audit*. All items were available.
5. SCI Index calculation (SOP SCI 2100 section 5.) - *Applies to SCI only.*		***Refer to SCI metric and index calculation records to address the following requirements.***	
5.1	Taxa correctly labeled as long-lived, sensitive, and very tolerant per SOP SCI 2100 section 5.1-5.3	YES	Reviewed *Nov 2013 SCI's (Swift, Camps, Hunter).* All taxa were accurately categorized.
5.2	Taxa correctly assigned to the following taxonomic groups, as required for metric calculations in SOP SCI 2100 section 5.4: Ephemeroptera, Trichoptera, Tanytarsini tribe	YES	Reviewed *Nov 2013 SCI's (Swift, Camps, Hunter).* All taxa were accurately categorized.
5.3	Taxa correctly labeled as having a clinger or filter feeder habit, per Merritt and Cummins, An Introduction to the Aquatic Insects of North America (SOP SCI 2100 section 5.5)	YES	Reviewed *Nov 2013 SCI's (Swift, Camps, Hunter).* All taxa were accurately categorized.
5.4	Sample correctly assigned to SCI region	YES	Big Bend Region was used in conjunction with SCI_2012 equations.

5.5	Metrics and index calculated for each replicate following instructions in SOP SCI 2100 Table SCI 2100-1 and steps 1-6 following the table.	YES	Reviewed *Nov 2013 SCI's (Swift, Camps, Hunter).* Calculations were correct.
5.6	Did this sample compare well with most recent DEP samples at this site?	YES	Taxonomy compares well overall with DEP samples. Overall score was higher but this is due to the revised region and calculations. Taxa lists were very similar to samples collected by DEP Staff.

Table 2. Deficiencies noted and corrective action approved for SCI sample processing and data analysis, for Normandeau's analysis of samples collected by ESP from Swift and Hunter Creeks on 9/12/13.

	Performance Assessment Remarks	**Normandeau Explanation and/or Corrective Action**	**Approved by AEQA auditors**
3.3 and 3.7 (Samples 1, 2)	The cumulative sorting efficiency per analyst was not tracked or provided but could be ascertained from the information provided for SCI samples for samples processed in the previous 12 months. This information should be maintained for each analyst and should be cumulative over the entire work history for that analyst.	This information will be maintained for each analyst and will be cumulative over the entire work history for that analyst.	2/17/15
3.4 (Samples 1, 2)	The sorting efficiency for George Christian through the period of record for this audit was 92.9%.	In the response to the draft checklist, it was indicated that the analyst will scan smaller portions of the matrix to avoid concealment of specimens.	2/17/15
3.5 (Samples 1, 2)	In the original materials submitted, there was no mention of precautionary measures taking as a result of the 92.9% sorting efficiency. These records should be maintained for all samples that fall below the sorting efficiency target.	In response to the draft checklist, additional documentation was submitted indicating the precautionary measures taken as a result of falling below the acceptance threshold. These records will be maintained for all samples that fall below the sorting efficiency target.	2/17/15