The Cyano-HABs Advanced Monitoring Pilot

Tributary Monitoring and Assessment

Stream Survey Data Report for Seneca, Owasco, and Skaneateles Lake Watersheds

Stream Survey – Data Report

Owasco, Skaneateles, and Seneca Lake Watersheds

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Section I: General Information, Background, and Project Findings

Harmful algal blooms (HABs) are increasingly a global concern because they pose a threat to human and aquatic ecosystem health and cause economic damages. HABs represent a threat to drinking water supplies and recreation in freshwater resources in New York, including the Finger Lakes region. Toxins produced by some species of cyanobacteria (called cyanotoxins) can cause acute and chronic illnesses in humans. Environmental factors that have been attributed to HAB occurrence include elevated nutrient concentrations, invasive species, water temperature, and hydrologic and meteorological conditions. Yet despite a general understanding of factors contributing to HABs, many unanswered questions remain about occurrence, environmental triggers, and the ability to predict the timing, duration, and toxicity of HABs. For these reasons, the U.S. Geological Survey, in cooperation with New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH), conducted an intensive pilot monitoring program targeting HABs in three Finger Lakes: Owasco, Seneca, and Skaneateles Lakes. The pilot program consisted of interrelated monitoring strategies aimed at understanding HAB occurrence, biology, and trends in these Finger Lakes in support of the development of management strategies.

Most HAB management strategies are focused on reduction of nutrient loading (primarily phosphorus) to impacted lakes, consistent with existing watershed and lake management strategies in NYS (Total Maximum Daily Load analyses or Nine Elements Planning) to control for cultural eutrophication. Watershed nutrient data is a critical component for this planning strategy to understand tributary inputs to lake systems.

This report documents the sampling conducted in support of the tributary monitoring component of the overall pilot program. NYSDEC collected discrete water-quality data, consistent with NYSDEC's stream monitoring program, in 20 tributaries in the three watersheds in 2019. To evaluate water quality in selected streams, the Monitoring and Assessment Section (MAS) and Finger Lakes Watershed Hub conducted targeted stream monitoring that included four data types:

1. Benthic macroinvertebrate community analysis

2. Water chemistry through laboratory analysis and in situ measurements
3. Physical habitat characteristics
4. Observer ranking of recreational ability

Water quality data was also provided by several external partners in the Finger Lakes region and added to this report to supplement water quality analyses, sampled from 2017-2020. External data (External) was collected by the Seneca Lake Pure Waters Association (SLPWA), Owasco Watershed Lake Association (OWLA), and Skaneateles Lake Association (SLA) for various modeling and clean water planning projects for the Seneca, Owasco, and Skaneateles Lake watersheds, respectively. All External data used were determined to meet NYSDEC quality assurance requirements (*https://dec.ny.gov/environmental-protection/water/water-quality/assurance*) and were evaluated for quality control measures in the same manner as NYSDEC samples (NYSDEC SOP #102).presented in this report (SOP #102). The inclusion of External data allowed for an evaluation of an additional 10 streams in the three watersheds and numerous samples collected at elevated flows.

This data report is a summary and presentation of the results of the data types collected at each site. NYSDEC collected data can be accessed via the NYSDEC's Online Data Portal[1]. Additional interpretations have been or are being conducted on these data sets in the three watersheds through the completion of watershed models and Nine Elements Plans (*https://dec.ny.gov/environmental-protection/water/water-quality/clean-water-plans*). These watershed-based plans will identify the pollutant of concern's loading, reductions needed to meet the water quality target, and recommended actions to achieve to the water quality target.

Stream monitoring site descriptions (Table 1) and locations (Figure 1a-c) are included below. Site names are a concatenation of basin number, location ID and river mile [Basin-Location ID-River-mile].

Table 1. Sampling locations.

Location ID	Watershed	Stream	WI/PWL ID[1]	Waterbody Classification[2]	Description	Latitude	Longitude
07-CATH-0.6	Seneca	Catherine Creek	0705-0011	C(TS)	South Genesee St Bridge.	42.32875	-76.84401

[1] *DOW Monitoring Data Portal 2.0*

Location ID	Watershed	Stream	WI/PWL ID[1]	Waterbody Classification[2]	Description	Latitude	Longitude
07-KASH-0.3	Seneca	Kashong Creek	0705-0017	C	At West Lake Rd.	42.76482	-76.97656
07-KEUK-0.1	Seneca	Keuka Outlet	0705-0020	C(T)	0.5 m upstream of mouth	42.682	-76.949
07-REED-0.1	Seneca	Reeder Creek	0705-0074	C(T)	300' west of intersection with 125.	42.7862	-76.927
07-GLNK-0.2	Seneca	Glen Creek	0705-0082	C(TS)	Junction of Mcgee and Shannon St.	42.378	-76.862
07-BGST-0.1	Seneca	Big Stream	0705-0087	C(TS)	At South Glenora Rd.	42.49	-76.9143
07-THOL-1.8	Seneca	Tug Hollow Creek	0705-0073	C	10 m above Satterly Hill Rd. Bridge.	42.42696	-76.84438
07-CTLE-0.1	Seneca	Castle Creek	0705-0027	C	50 m from trib mouth.	42.873	-76.973
07-OWLI-3.0	Owasco	Owasco Lake Inlet	0706-0002	C(T)	20 m below State Rte 38.	42.71667	-76.43773
07-SCKR-0.1	Owasco	Sucker Brook	0706-0010	C	100 m upstream of State Rte 38a.	42.902	-76.527
07-OWAL_T2-0.1	Owasco	Trib at Martin Pt.	0706-0010	C	Near Martin Pt.	42.892	-76.522
07-VENE-1.5	Owasco	Veness Brook	0706-0010	C	Downstream of Silver Street Rd. Bridge.	42.88016	-76.56232
07-VENE-0.4	Owasco	Veness Brook	0706-0010	C	Veness Brook at Oltz residence	42.886	-76.548
07-DUCH-0.3	Owasco	Dutch Hollow Brook	0706-0003	C(TS)	East Lake Rd.	42.864	-76.508
07-DUCH-8.3	Owasco	Dutch Hollow Brook	0706-0003	C(TS)	10 m above Old State Rd. Bridge.	42.83167	-76.41277
07-OWAL_T5-0.2	Owasco	Trib at Fay's Pt.	0706-0010	C	Near Fay's Pt.	42.843	-76.503
07-OWAL_T46-0.1	Owasco	Unnamed Tributary To Owasco Lake	0706-0010	C	Off fire lane near State Rte 38.	42.824	-76.521
07-OWAL_T9-0.1	Owasco	Unnamed TributaryTo Owasco Lake	0706-0010	C	Off Widewaters Rd.	42.805	-76.491
07-OWAL_T9-0.1	Owasco	Trib at Rockefeller Rd. at lake shore	0706-0010	C	Near Rockefeller Rd. at lake shore	42.805	-76.491
07-OWAL_T16-0.4	Owasco	Trib at Rockefeller Rd. near Indian Cove	0706-0010	C	Rockefeller Rd. north of Indian Cove	42.776	-76.462
07-OWLI-0.1	Owasco	Owasco Lake Inlet	0706-0002	C(T)	Near mouth	42.755	-76.463

Location ID	Watershed	Stream	WI/PWL ID[1]	Waterbody Classification[2]	Description	Latitude	Longitude
07-SKAT_T93a-0.5	Skaneateles	Unnamed Tributary To Skaneateles Lake	0707-0005	AA	Just upstream of culvert on West Lake Rd.	42.93523	-76.43204
07-SKAT_T2-0.1	Skaneateles	Unnamed Tributary To Skaneateles Lake	0707-0005	AA	East Lake Rd. at public fishing access	42.92439	-76.40494
07-SKAT_T5-0.1	Skaneateles	Unnamed Tributary To Skaneateles Lake	0707-0005	AA	East Lake Rd. bridge	42.904	-76.39399
07-SKAT_T89-0.2	Skaneateles	Unnamed Tributary To Skaneateles Lake	0707-0005	AA	West Lake Rd. bridge	42.898	-76.419
07-SKAT_T14-0.2	Skaneateles	Unnamed Tributary To Skaneateles Lake	0707-0005	AA	At Route 41 bridge	42.878	-76.37499
07-BSWP-0.1	Skaneateles	Bear Swamp Creek	0707-0005	AA(T)	Appletree Fire Lane	42.82246	-76.32969
07-SKAT_T21-0.1	Skaneateles	Unnamed Tributary To Skaneateles Lake	0707-0005	AA	Near Glen Cove	42.81	-76.312
07-RAND-0.1	Skaneateles	Randall Gulf	0707-0005	AA	Near mouth	42.786	-76.274
07-BSWP-6.3	Skaneateles	Bear Swamp Creek	0707-0005	AA	Bear Swamp Creek upstream	42.751	-76.304
07-GROU-1.5	Skaneateles	Grout Brook	0706-0001	AA(T)	County Rte 101 at Sweeney Hill Rd. bridge	42.74194	-76.26528

[1] Waterbody Inventory/Priority Waterbodies List (see NYSDEC DECinfo Locator: *https://gisservices.dec.ny.gov/gis/dil/*)

[2] Waterbody classification information can be found at: *https://dec.ny.gov/environmental-protection/water/water-quality/standards-classifications* or *https://dec.ny.gov/nature/animals-fish-plants/biodiversity-species-conservation/biodiversity-mapping/environmental-resource-mapper*

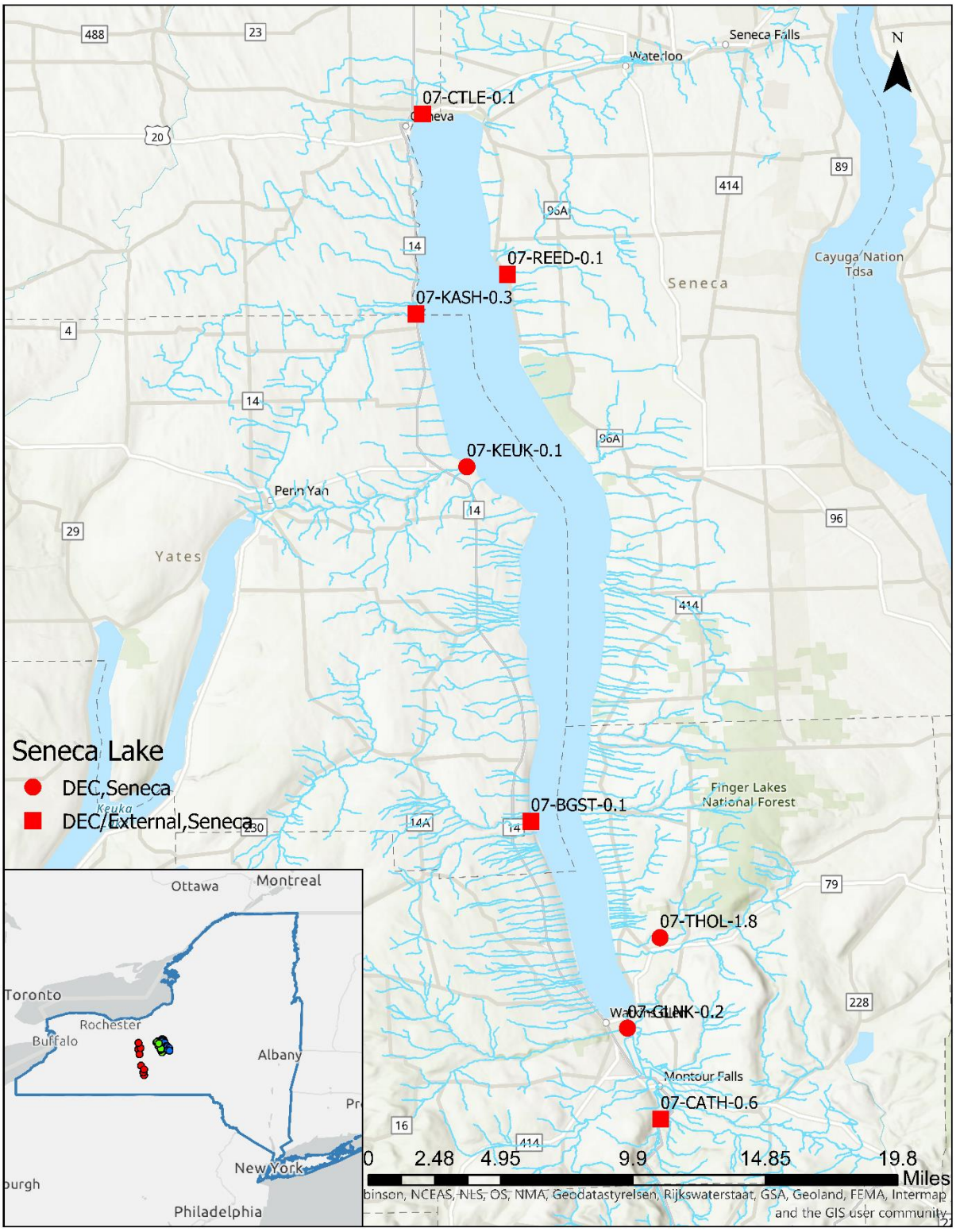

***Figure 1a**. Map of sampling locations for Seneca Lake. Site names reference the Location ID and River Mile and can be found above in Table 1.*

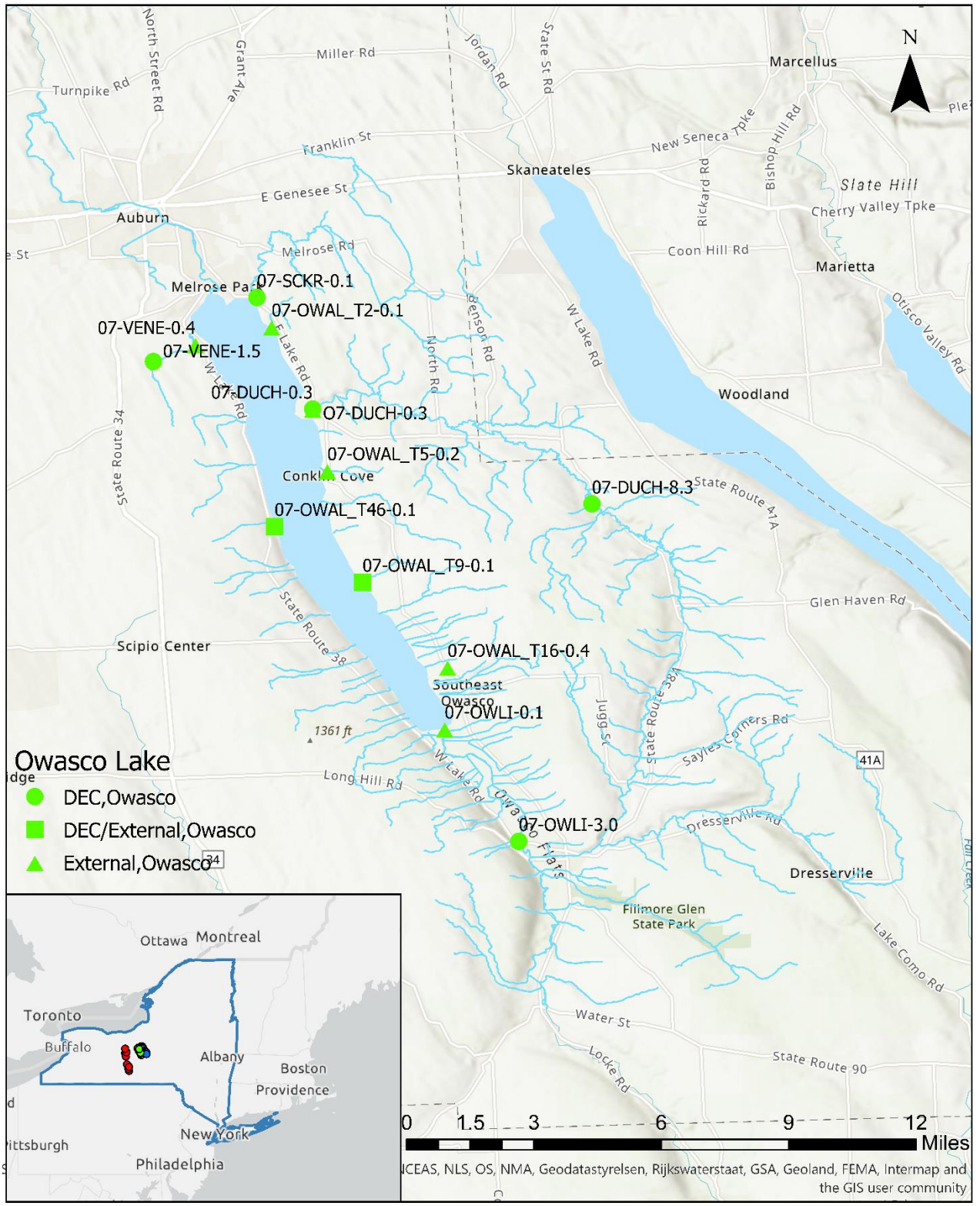

***Figure 2b**. Map of sampling locations for Owasco Lake. Site names reference the Location ID and River Mile and can be found above in Table 1.*

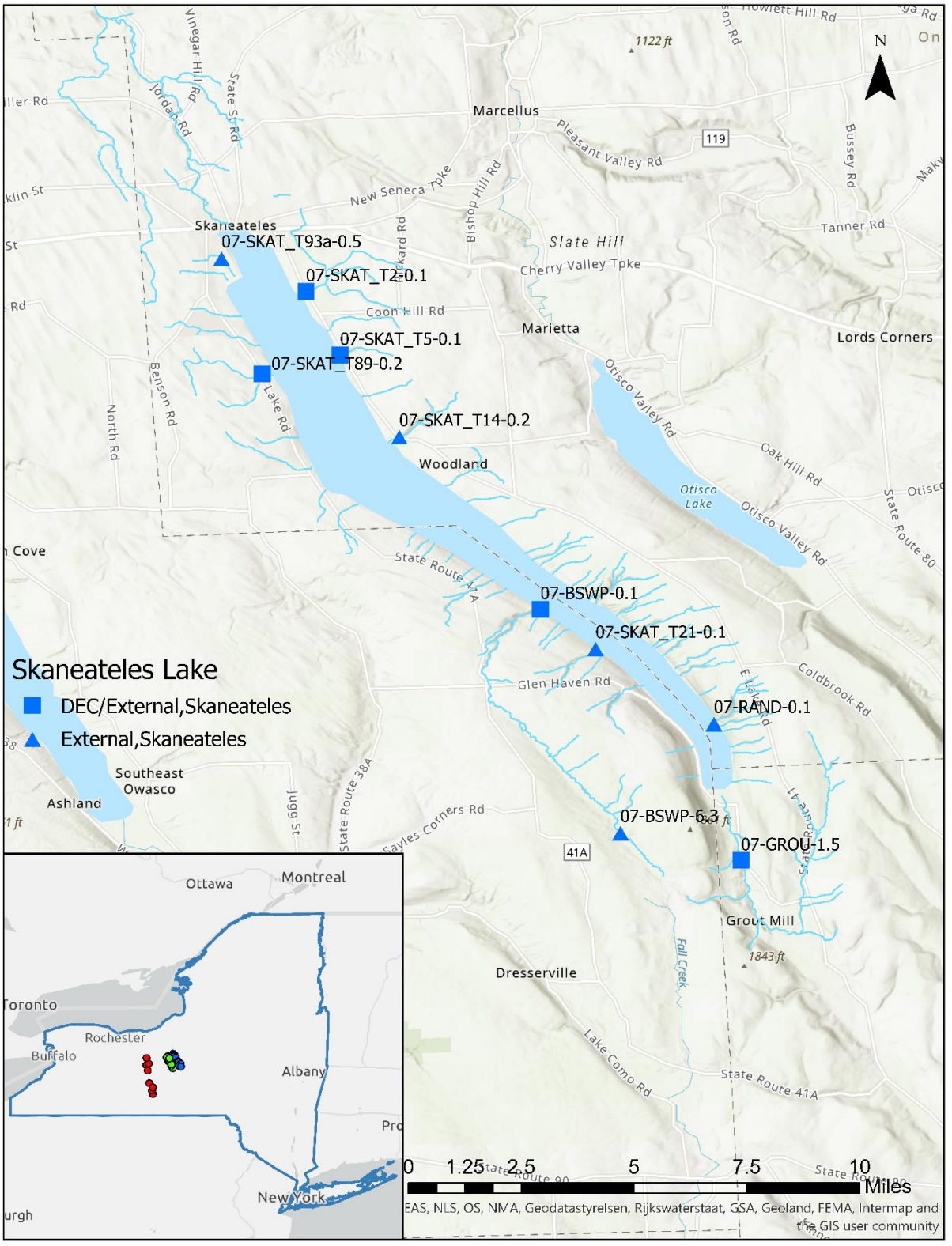

***Figure 3c**. Map of sampling locations for Skaneateles Lake. Site names reference the Location ID and River Mile and can be found above in Table 1.*

1. Benthic Macroinvertebrate Community Analysis – DEC Samples

Biological assessments based on the macroinvertebrate community provide the ability to detect water quality problems that are intermittent, not detected, and/or underestimated by water chemistry sampling alone. These biological assessments of water quality are generated using calculated Biological Assessment Profile (BAP) scores (NYSDEC SOP #216). BAP scores are calculated by taking the average of five normalized 10-scale community metrics and assigning that score to a four-tiered system of impact category of non (>7.5-10), slight (5.0-7.49), moderate (2.5-4.99), or severe (< 2.49) impacts (see Figure 4; NYSDEC SOP #216). A final BAP score below 5 is associated with significant loss of biodiversity, functional organization, and ability to support a balanced community compared to natural conditions (Karr, 1991; Davis, 1995). A BAP score of 5.0 or above indicates that aquatic life in the sampled stream reflects that of natural conditions or only slightly altered from natural. Expected variability in the results of benthic macroinvertebrate community samples is presented in Smith and Bode (2004).

For this survey, traveling kick samples were collected by MAS at each site and processed according to NYSDEC SOP #208 and #214. Several sites had mean BAP scores between 2.5-4.99 suggesting moderate impacts to benthic communities (Figure **Error! Reference source not found.**).

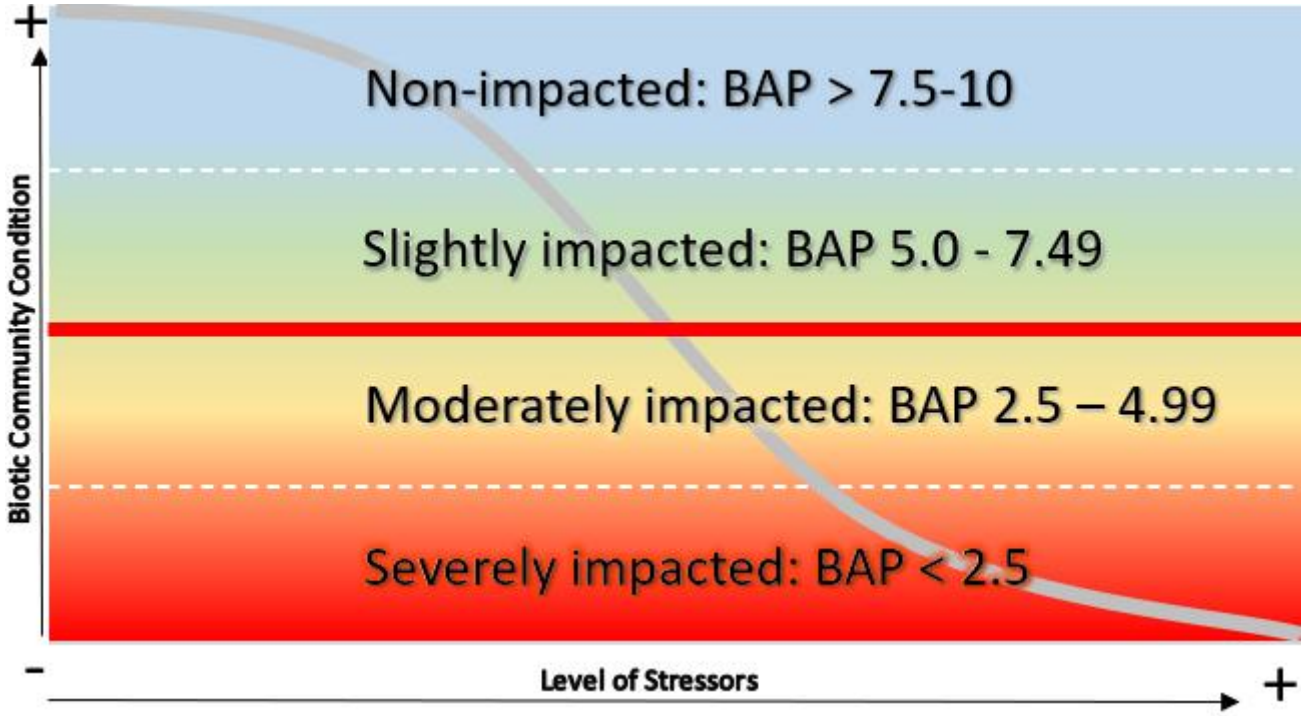

***Figure 4**. Biological Assessment Profile (BAP) score impact categories based on the macroinvertebrate community.*

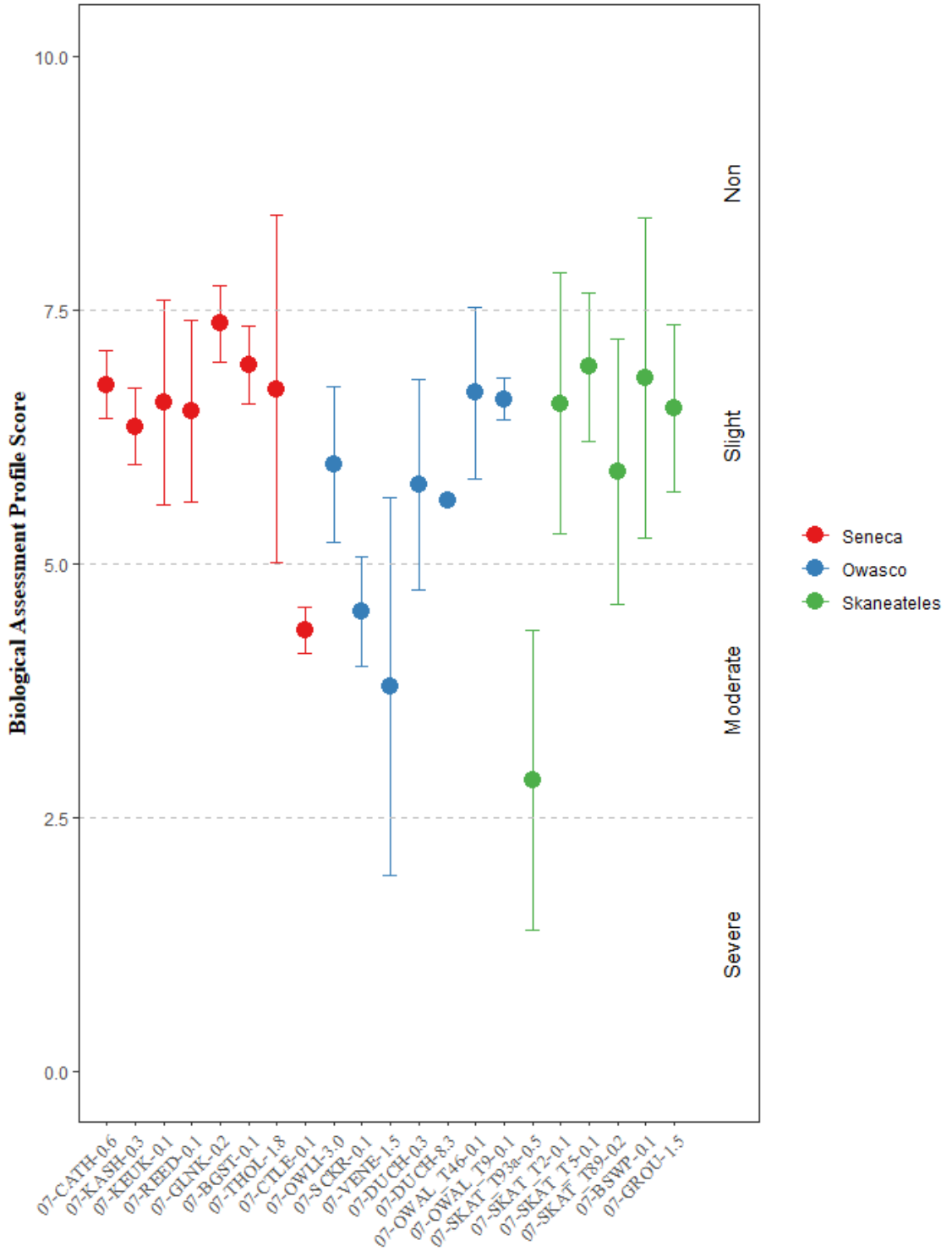

***Figure 5**. Biological Assessment Profile (BAP) Scores and 95% confidence intervals for benthic macroinvertebrate community assessment data. Symbology corresponds with watershed category (Seneca, Owasco or Skaneateles). Site names reference the Location ID and River Mile and can be found above in Table 1.*

2. Water Quality Measurements – DEC and External Samples

DEC establishes water quality standards (WQS) and guidance values for many specific substances. Waters are classified for their best uses and WQS are set to protect those uses (6 NYCRR Part 703). See the *DEC Info Locator* and factsheets[2] for individual WI/PWL ID segments presented in this report (Table 1).

NYSDEC Samples

Ambient water chemistry sampling included in-situ and lab measured water quality analytes (Table 2). Samples were collected by MAS under the NYSDEC QAPP (2019) using a direct grab (NYSDEC SOP #210). Water samples were sent for processing using a contract lab with NYS Environmental Laboratory Approval Program (ELAP) certification. All DEC sample were collected under a Quality Assurance Project Plan (QAPP WQM #005-2019).

Following sample collection, all data processing followed quality assurance/quality control (QA/QC) protocols (NYSDEC SOP #102, and #110) outlined in the SOP. For water chemistry, an evaluation of the precision, accuracy, and completeness of processed water chemistry samples after lab analyses was performed following the methods detailed in NYSDEC SOP #102. Only data meeting data quality objectives described in NYSDEC SOP#110 were reported and used in this report. Analytes that fell below the minimum detection limit (MDL) were replaced with one-half the MDL, as sample sizes were too small to utilize other estimation methods (Helsel, 1990). Where applicable, non-replaced raw chemistry results were analyzed for excursions from state WQS and summarized using R programing software (R Core Team, 2017). An excursion is defined as analyte detection in a sample which exceeds the applicable water quality standard. All accepted results (in-situ and lab reported) are available through the DOW Monitoring Data Portal (*DOW Monitoring Data Portal 2.0*).

External Samples

All External samples were collected under Quality Assurance Project Plans (QAPPs) and processed through the same QC procedures as described above for NYSDEC samples. External data were mostly nutrients (phosphorus and nitrogen)[3]. Analytical specifications for Externally collected water chemistry can be found in those project-specific QAPPs.

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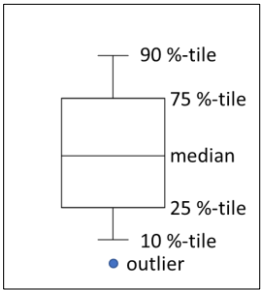
[2] Compilation of the state's Integrated Report and updates to WI/PWL ID factsheets typically occur during even (example: 2022, 2024) years following the state's Consolidated Assessment and Listing Methodology. Best use assessments and factsheets may not immediately reflect data generated in this report.

[3] NYSDEC WQS for total phosphorus and total nitrogen is narrative. There is a numeric interpretation (guidance value) for phosphorus in ponded waters with a best use of primary contact recreation, though no guidance value for phosphorus in flowing waters. Please see: 6 NYCRR Chapter X, Part 703 (*https://www.dec.ny.gov/chemical/23853.html*).

Plots

Plots illustrating the range of water chemistry concentration values for each site are included below. Analytes selected for presentation were subset to those of specific interest to the study; nitrate, nitrate + nitrite (as N), nitrite (as N), total nitrogen, ammonia, total kjeldahl nitrogen (TKN), total phosphorus, and turbidity, and in-situ parameters: dissolved oxygen, temperature, pH, and specific conductance. Excursions are indicated by a star in the applicable plots. There were excursions in pH, dissolved oxygen, and iron at several sites.

Subsequent data figures below utilize boxplots to represent the median and interquartile range or IQR (25th to 75th percentiles) of the data for each site. Whiskers represent the IQR +/- 1.5 times the IQR, and dots indicate potential outlier values (the full range of data) or those outside of the IQR (+/- 1.5 times the IQR). Samples collected during elevated flows are referred to as high flow events.



Description of box plot definitions.

Table 2. Water chemistry analytes sampled as part of the Stream Assessment Survey (NYSDEC Samples). Table lists sampled analytes and analytical specifications.

Analytes	Analytical Lab	Method	Precision	Accuracy	Calibration: Initial	Calibration: Ongoing	Calibration: Blanks	Detection Limit	Reporting Limit
Alkalinity	ALS	SM 2320B	^	± 25%	Daily	Every 10	Every 10	1.0 mg/L	2.0 mg/L
Aluminum (total)	ALS	EPA 200.8	^	± 25%				7.6 µ/L	10 µ/L
Arsenic (total)	ALS	EPA 200.8	^	± 25%				0.3 µ/L	1 µ/L
Cadmium (total)	ALS	EPA 200.8	^	± 25%				0.03 µ/L	1 µ/L
Calcium	ALS	EPA 200.7	^	± 25%				0.1 mg/L	1.0 mg/L
Dissolved Organic Carbon	ALS	5310C	^	± 25%	As needed			0.4 mg/L	10 mg/L
Chloride	ALS	EPA 300.0	^	± 25%	As needed	Every 10		0.02 mg/L	0.2 mg/L
Chlorophyll A	ALS	SM 10200 H	^	N/A		Every 20		0.4 µ/L ~	0.4 µ/L
Copper (total)	ALS	EPA 200.8	^	± 25%	Daily	Every 10		0.04 µ/L	1 µ/L
Hardness	ALS	SM 2340B	^	± 25%				0.3 mg/L	6.62 mg/L
Iron (total)	ALS	EPA 200.7	^	± 25%				20 µ/L	100 µ/L
Lead (total)	ALS	EPA 200.8	^	± 25%				0.19 µ/L	1 µ/L
Magnesium	ALS	EPA 200.7	^	± 25%				0.04 mg/L	1.0 mg/L
Nickel (total)	ALS	EPA 200.8	^	± 25%				0.04 µ/L	1 µ/L
Ammonia	ALS	D6919-09	^	± 25%	As needed			0.0025 mg/L	0.01 mg/L
Total Kjeldahl Nitrogen	ALS	EPA 351.2	^	± 25%	Daily			0.08 mg/L	0.1 mg/L

Analytes	Analytical Lab	Method	Precision	Accuracy	Calibration: Initial	Calibration: Ongoing	Calibration: Blanks	Detection Limit	Reporting Limit
Nitrate-nitrite	ALS	EPA 351.2	^	± 25%	Daily	Every 10		0.007 mg/L	0.01 mg/L
Nitrogen, Nitrate	ALS	EPA 353.2	^	± 25%	Daily			0.007 mg/L	0.01 mg/L
Nitrogen, Nitrite	ALS	EPA 351.2	^	± 25%	Daily			0.007 mg/L	0.01 mg/L
Nitrogen, Total	ALS	Calculated	^	~	~	~	~	~	~
Orthophosphate	ALS	EPA 365.1	^	± 25%	Daily	Every 10		0.001 mg/L	0.005 mg/L
Total Phosphorus	ALS	EPA 365.1	^	± 25%	Daily			0.002 mg/L	0.003 mg/L
Silver (total)	ALS	EPA 200.8	^	± 25%	Daily			0.07 µ/L	1 µ/L
Turbidity	ALS	EPA 180.1	^	± 20%	Daily			0.06 NTU	0.1 NTU
Zinc (total)	ALS	EPA 200.8	^	± 25%	Daily			0.7 µ/L	10 µ/L
Chlorophyll A	in-situ	~	~	~	Factory Set	~	~	~	~
Dissolved Oxygen	in-situ	4500-O G	± 1%	± 2%	Daily	~	~	0%	~
pH	in-situ	4500-H+B	± .05 SU	± .2 SU	Weekly	~	~	0 SU	~
Salinity	in-situ	Calculated	0.001 ppt	± 1%	N/A	~	~	0%	~
Specific Conductance	in-situ	2510 B	± 1µs/cm	± 1%	Weekly	~	~	0%	~
Temperature	in-situ	2550 B	± 1oC	± 1.5oC	Factory Set	~	~	0oC	~

^ Precision objectives are defined by results of duplicate samples as described in NYSDEC SOP #102, and #110.

~ Not Applicable

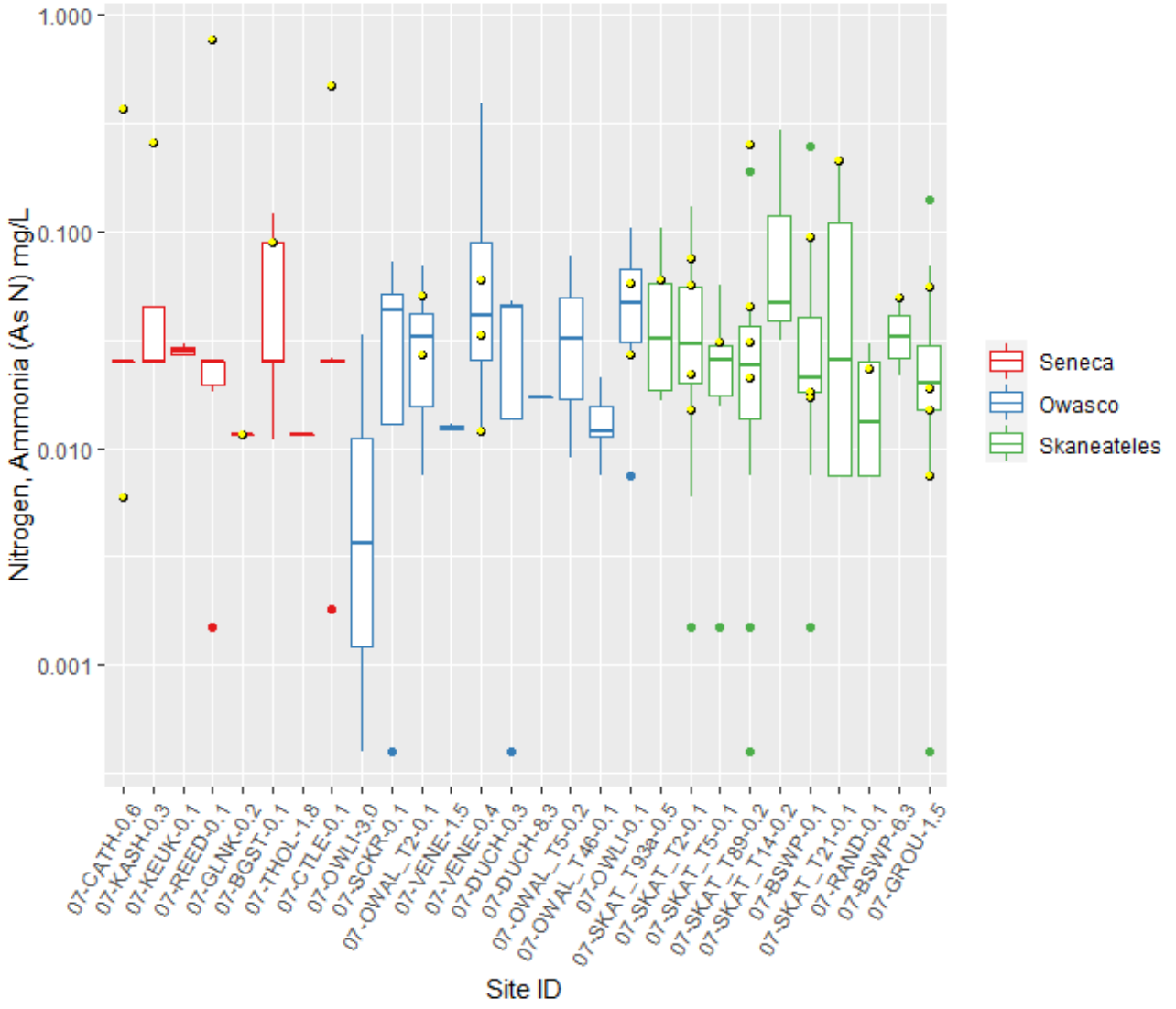


***Figure 6**. Nitrogen, Ammonia (As N), Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

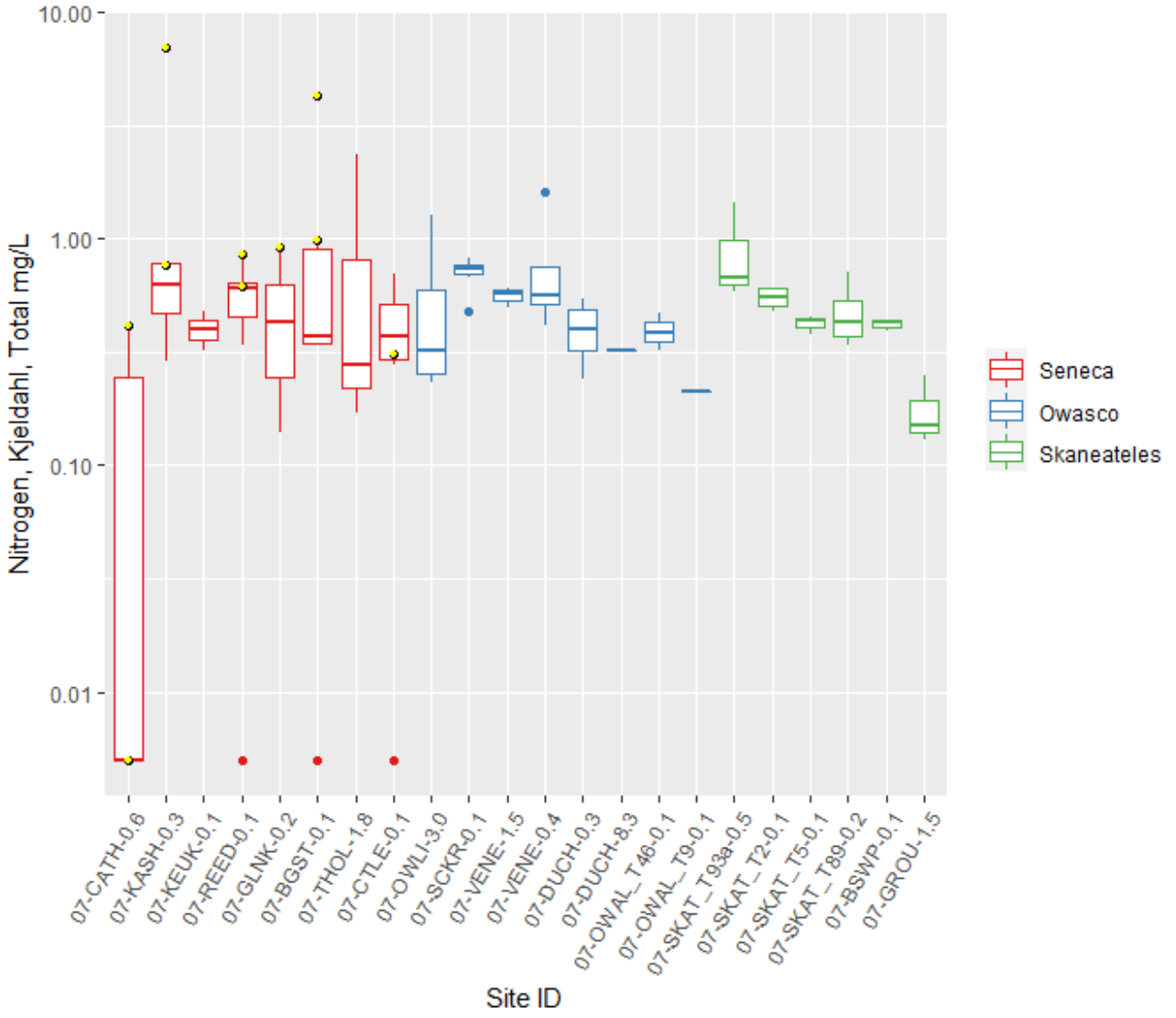


***Figure 7**. Nitrogen, Kjeldahl, Total. Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

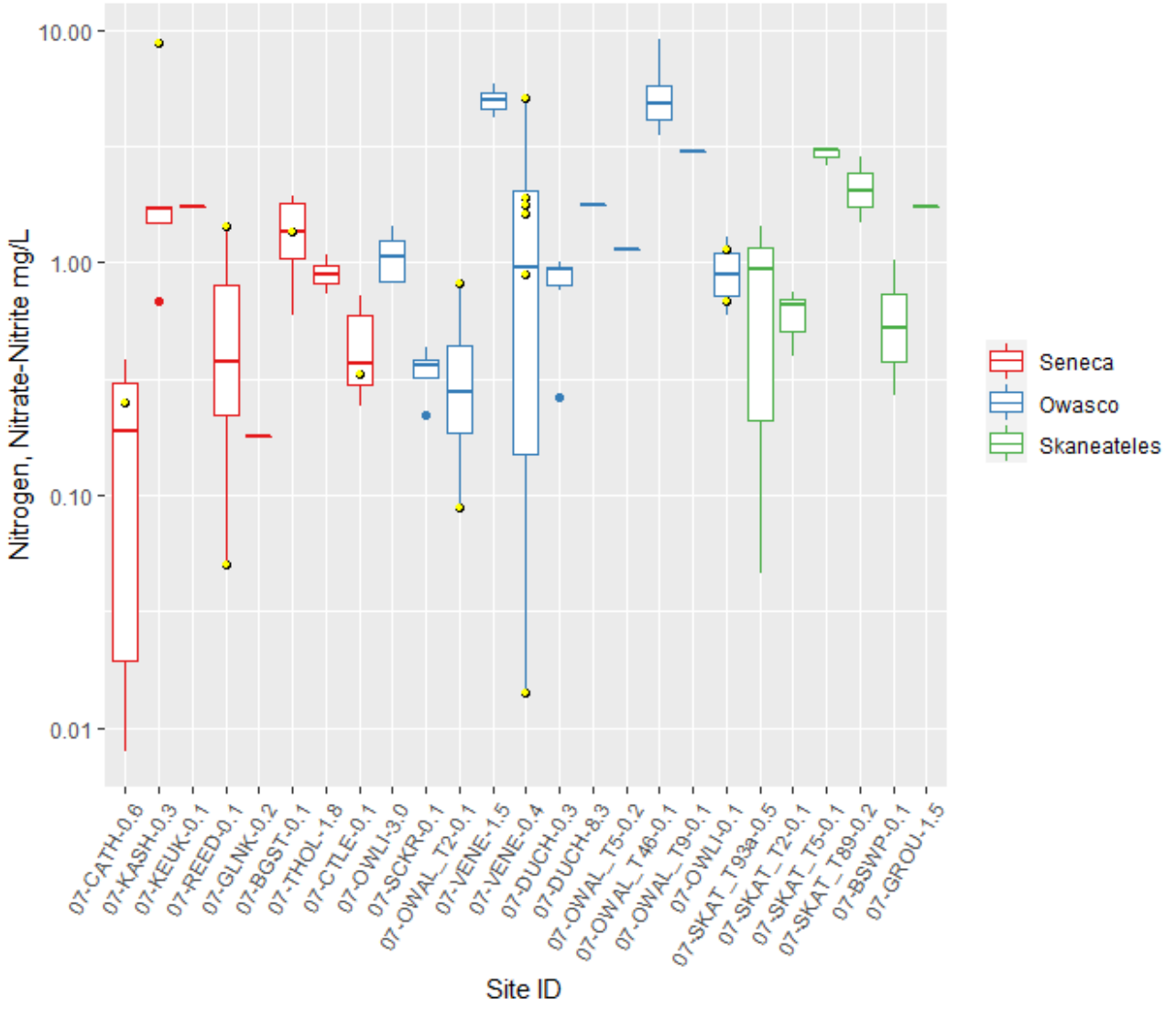


***Figure 8**. Nitrogen, Nitrate-Nitrite. Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

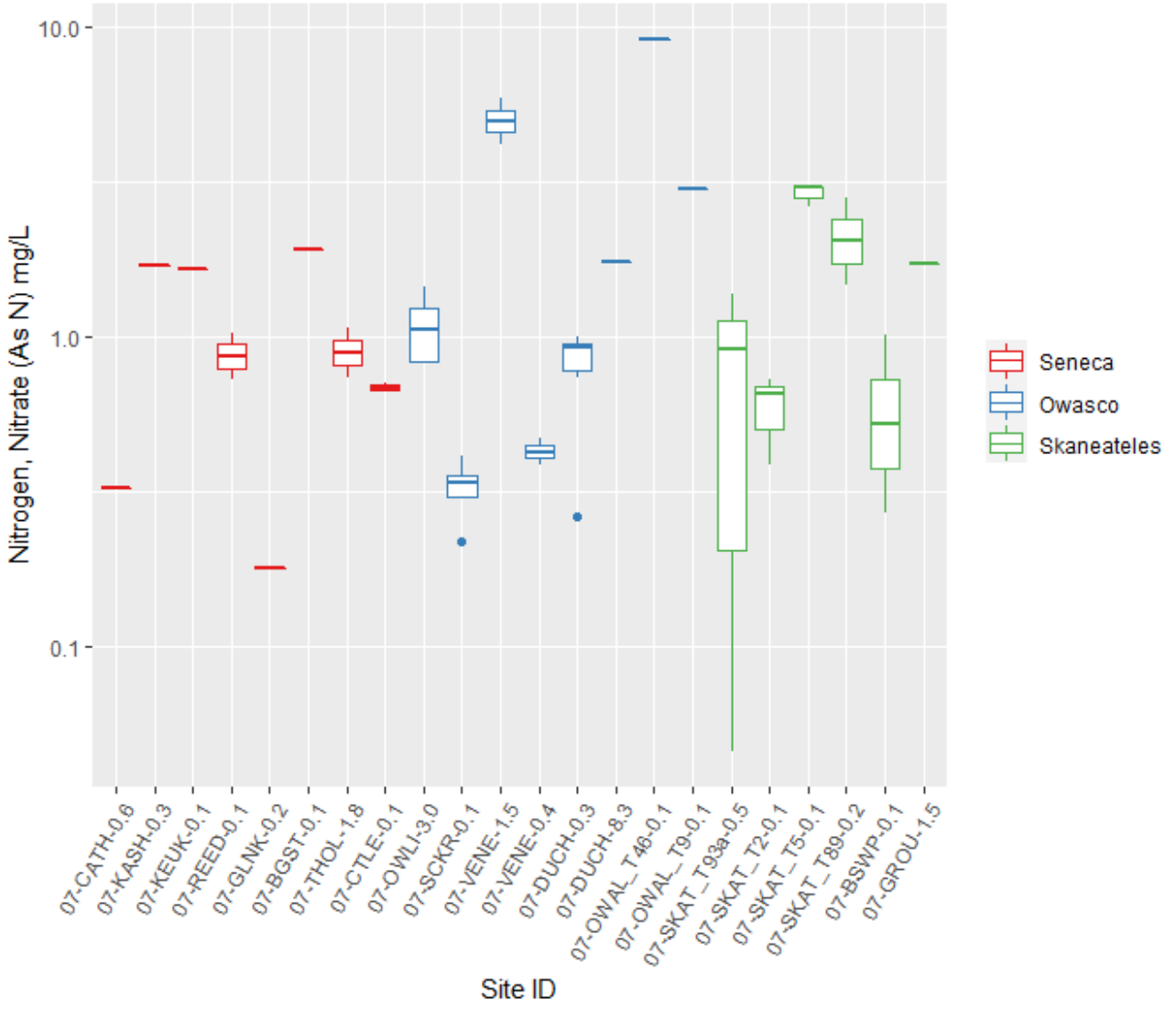


***Figure 9**. Nitrogen, Nitrate (As N). Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend.*

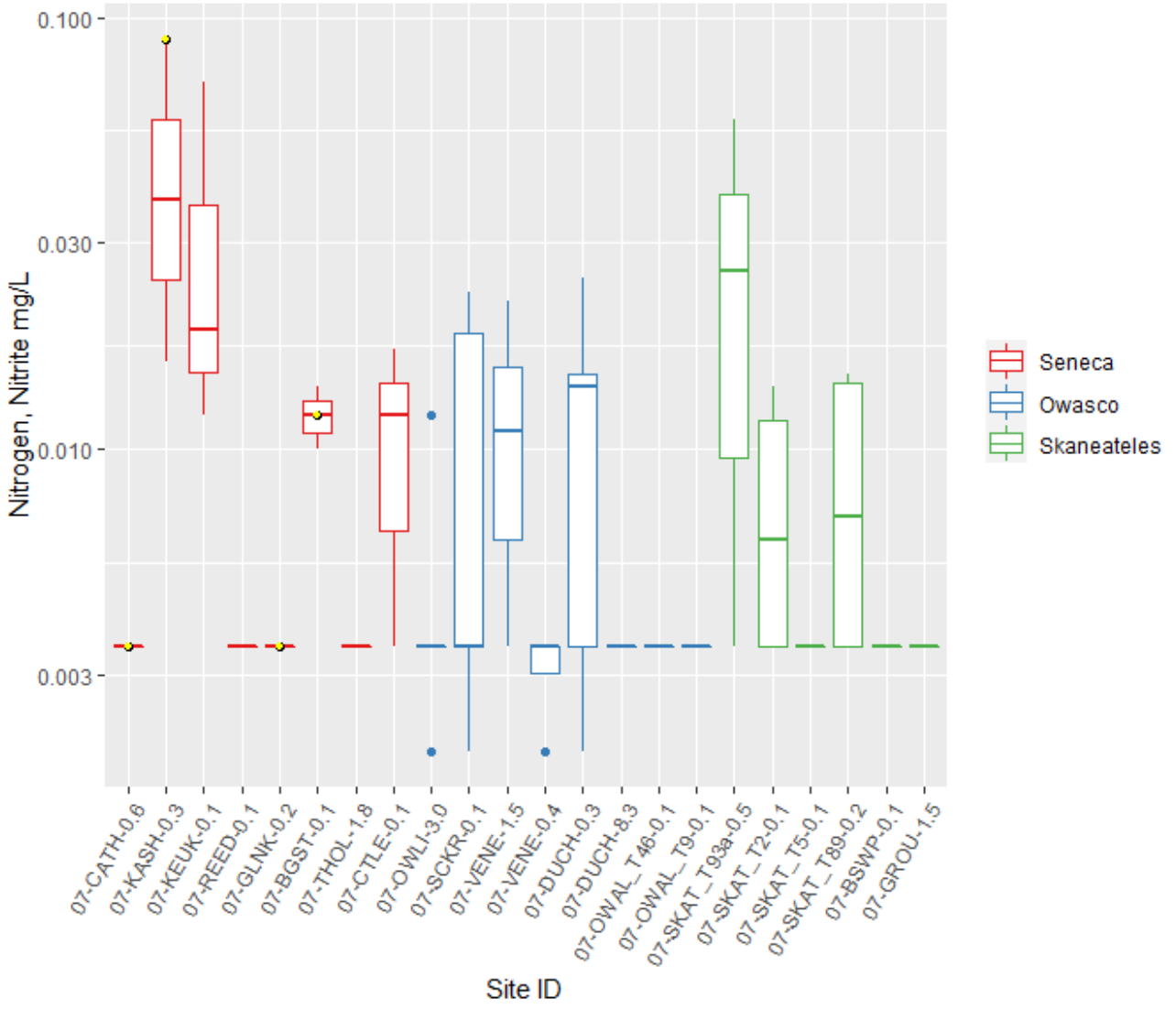


***Figure 10**. Nitrogen, Nitrite. Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

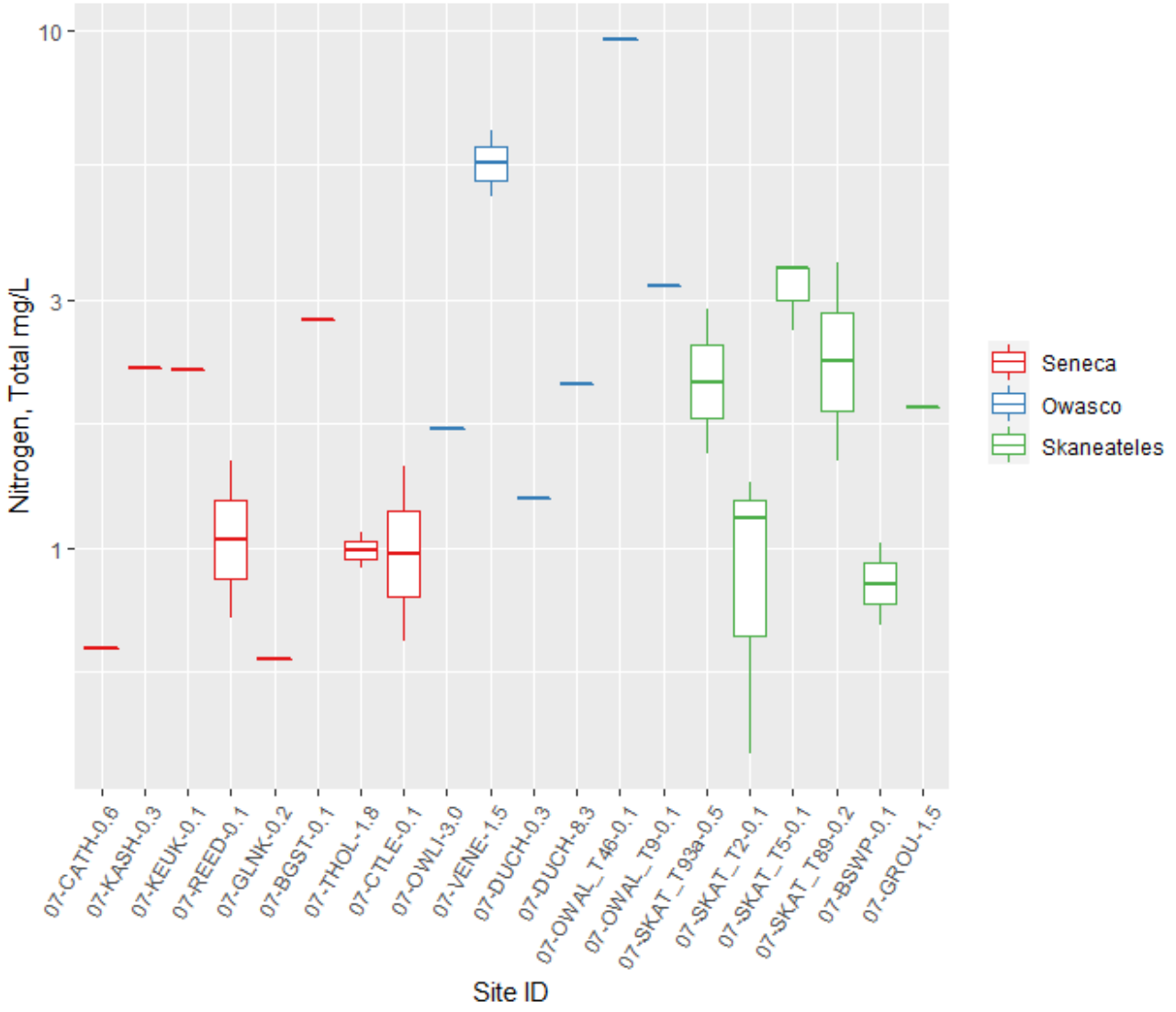


Figure 11. *Nitrogen, Total. Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend.*

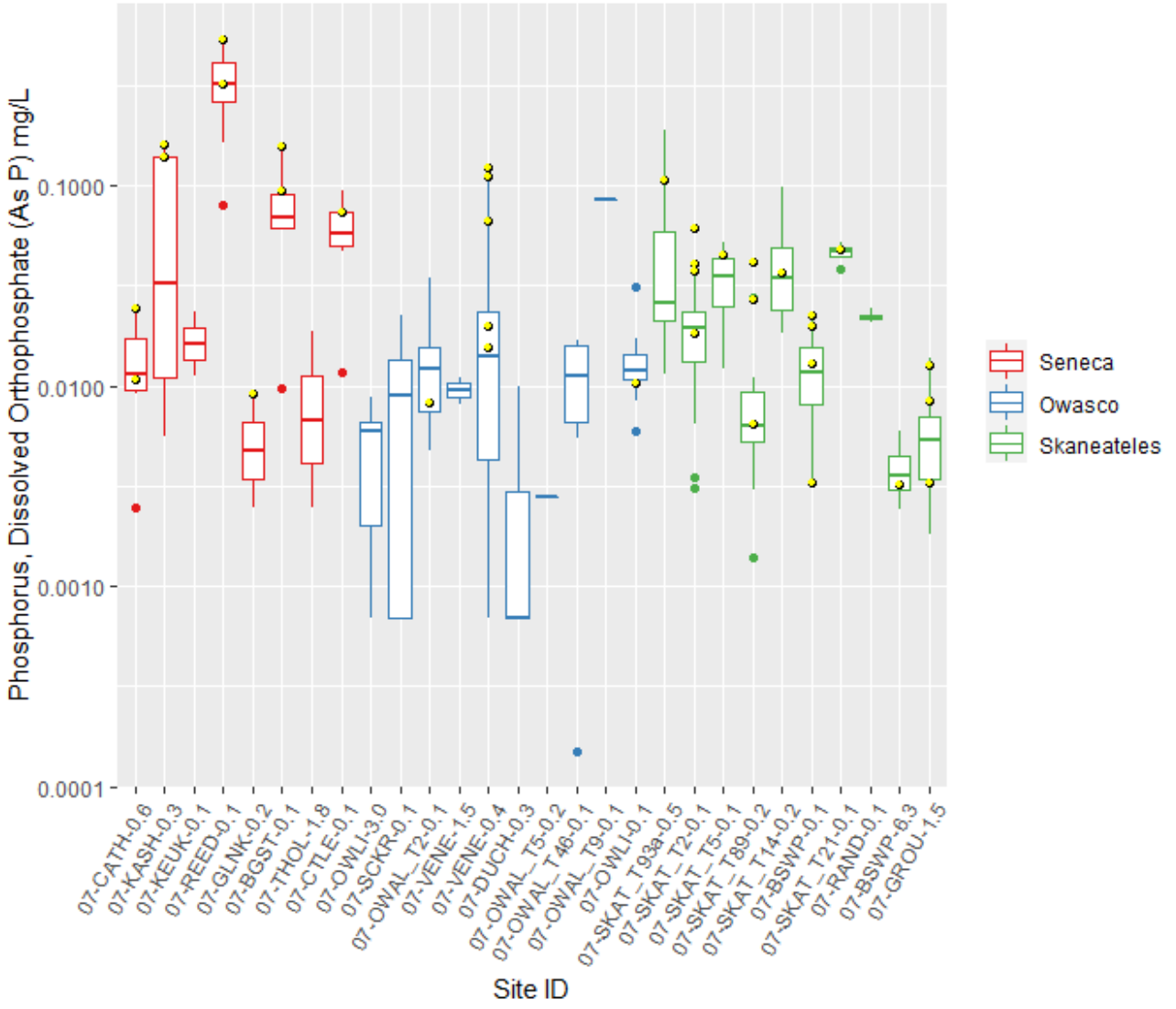


***Figure 12**. Phosphorus, Dissolved Orthophosphate (As P). Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

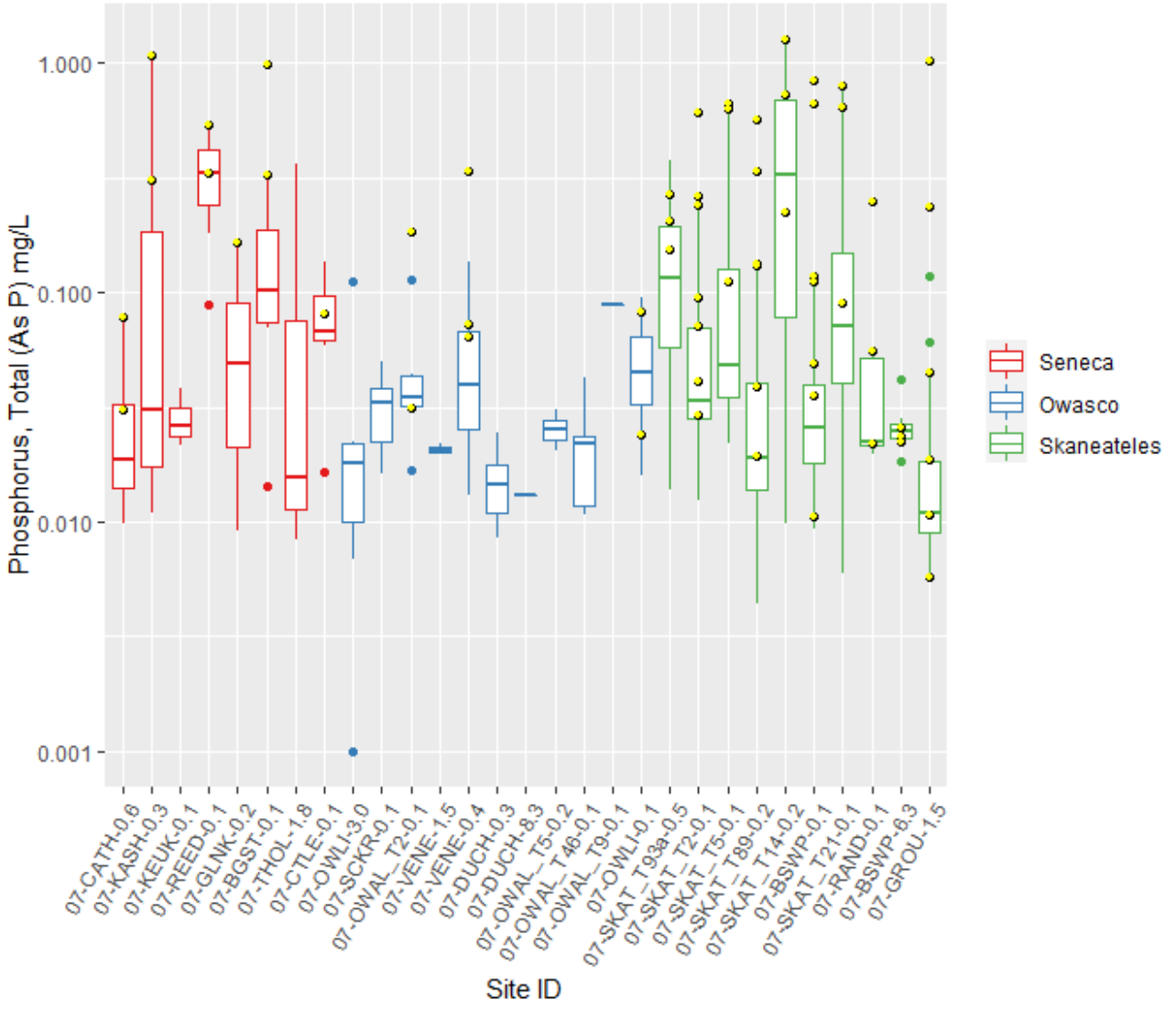


***Figure 13**. Phosphorus, Total (As P). Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

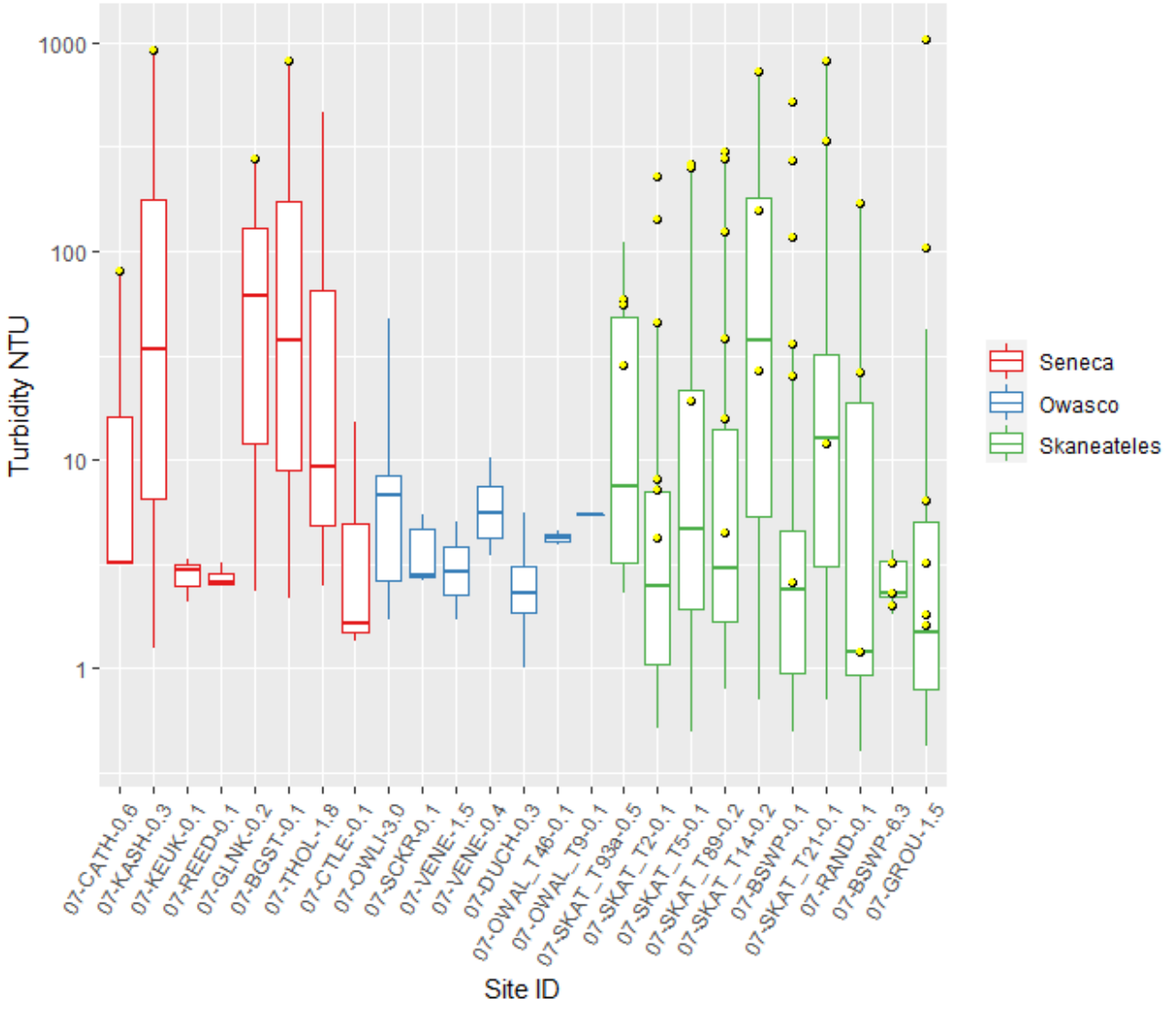


***Figure 14**. Turbidity. Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The Y axis is presented in log scale for comparison. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

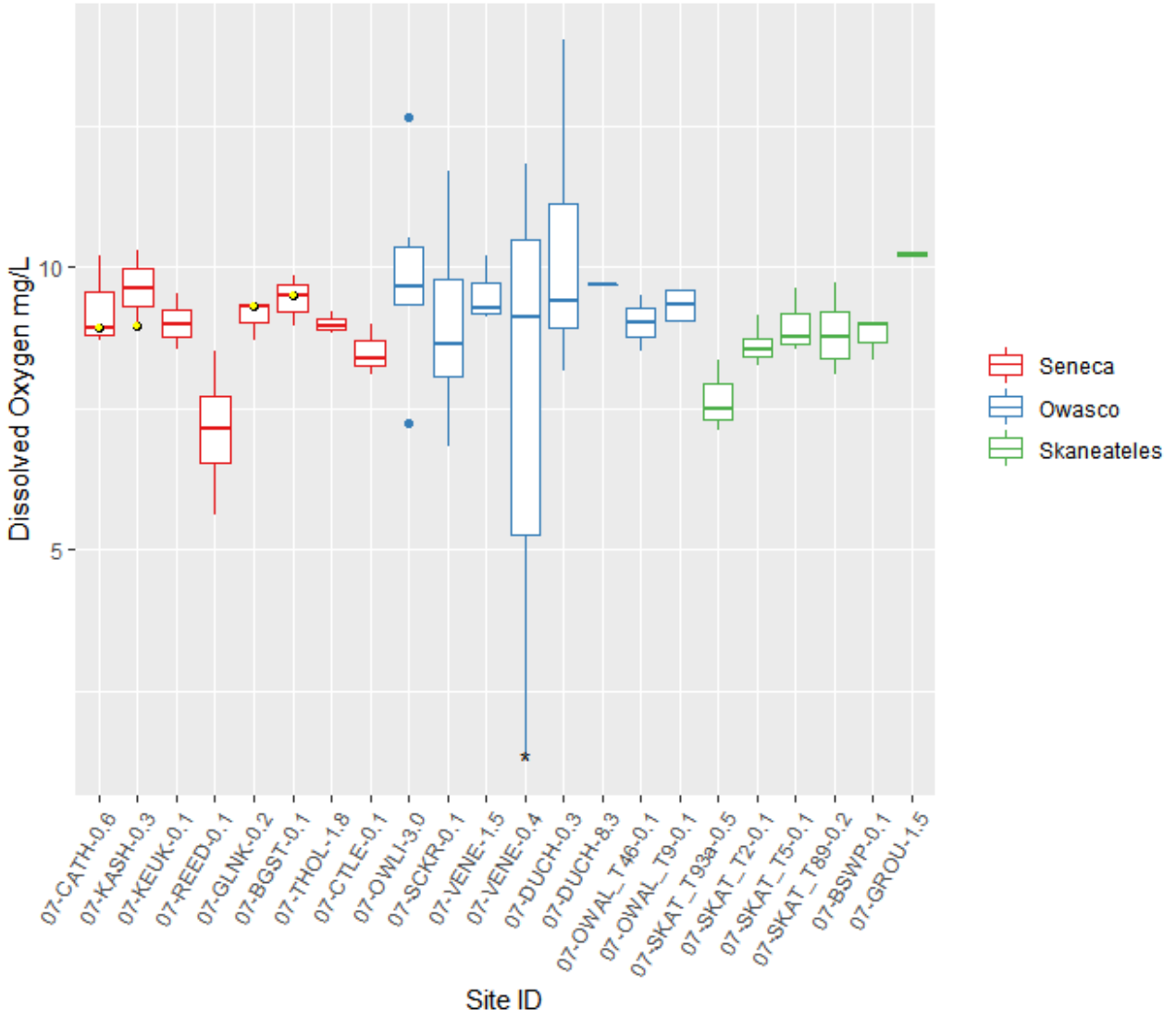


***Figure 15**. Dissolved Oxygen, stars at the bottom of the graph indicate an excursion of a WQS (where applicable). Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

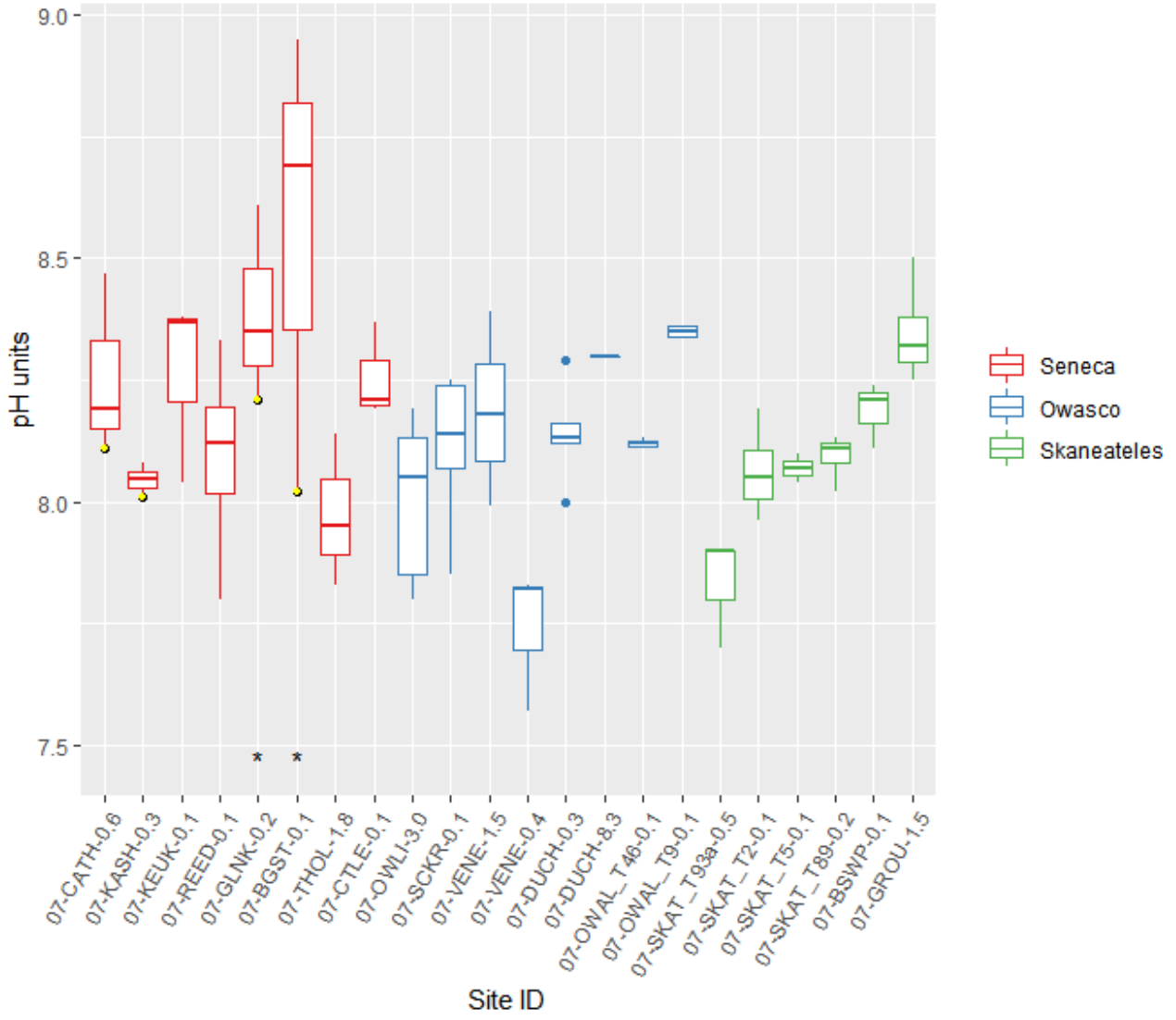


***Figure 16**. pH, stars at the bottom of the graph indicate an excursion of a WQS (where applicable). Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

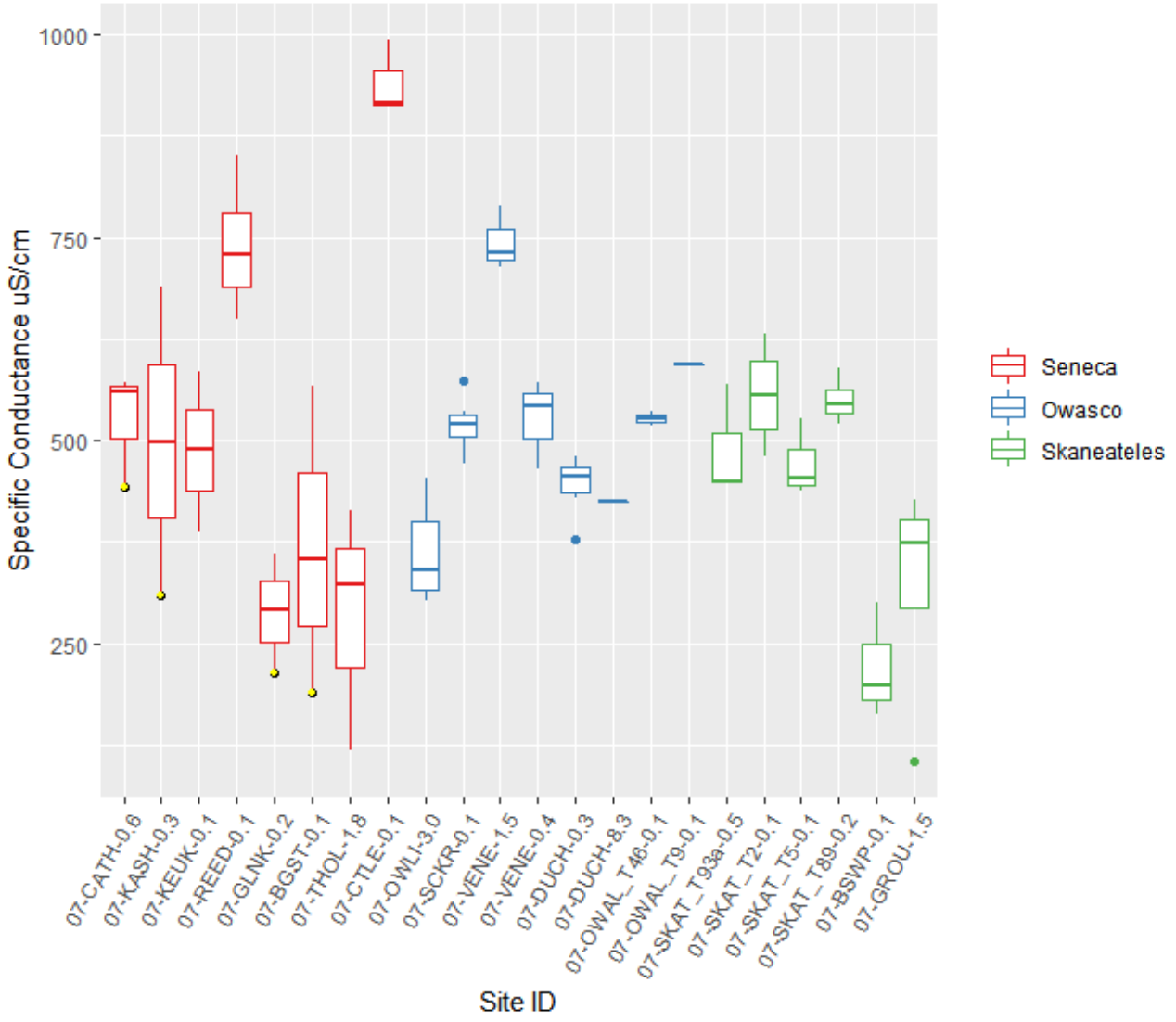


***Figure 17**. Specific Conductance. Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

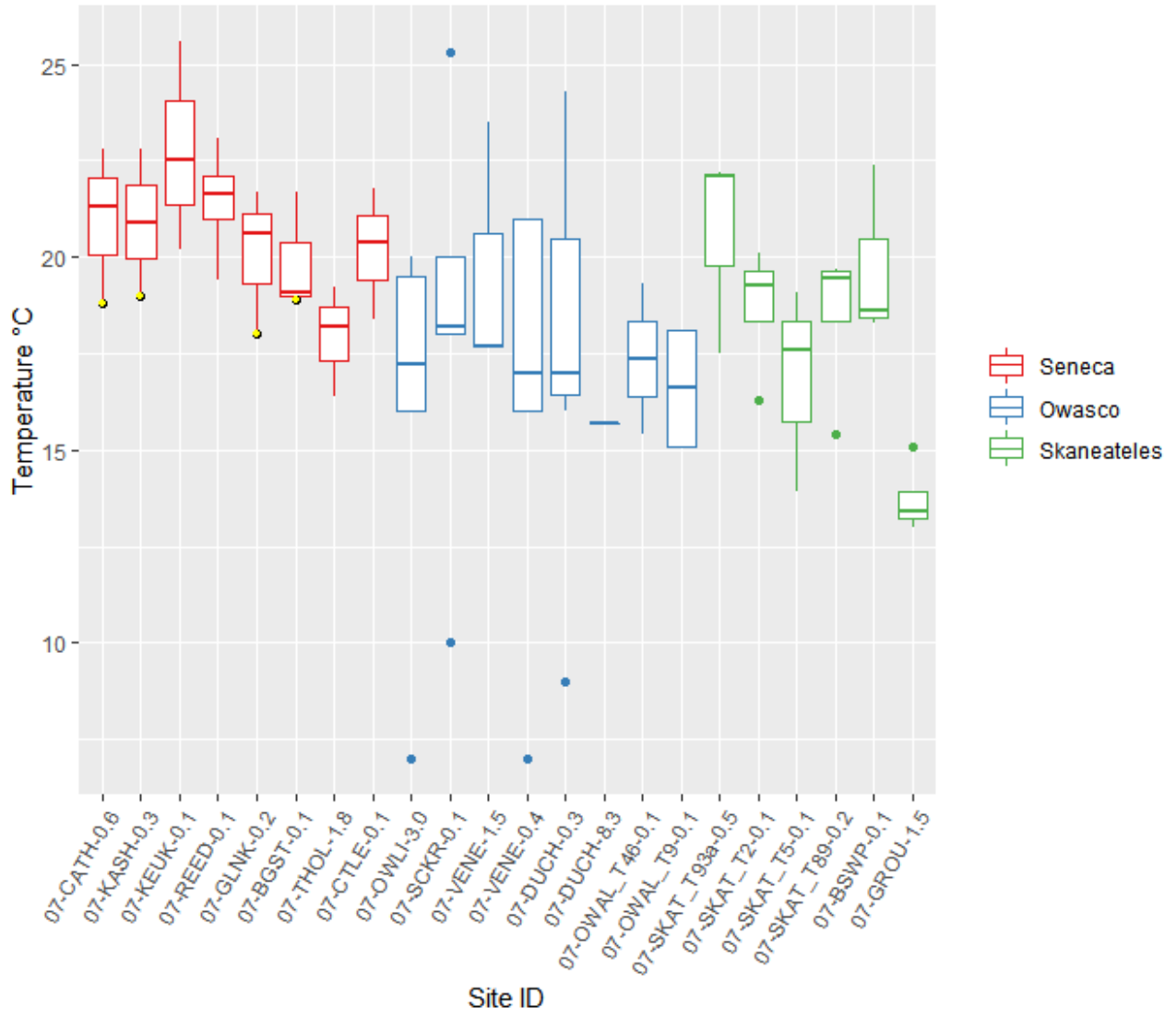


***Figure 18**. Temperature. Boxes represent the interquartile range or IQR (25th to 75th percentiles) of the data for each site, whiskers represent the IQR +/- 1.5 times the IQR and dots indicate potential outlier values (the full range of data) or those outside of the IQR +/- 1.5 times the IQR. The total number of reported values illustrated for each sampling location can vary due to non-detection and QA/QC procedures. Color corresponds to watershed group indicated in legend. Yellow dots indicate samples taken at event flow rates.*

3. Stream Reach Physical Habitat Characteristics – DEC Samples

Assessments of the physical habitat were also collected to calculate the Habitat Model Affinity (HMA) (Table 3). HMA is an overall estimate of habitat quality which describes potential habitat stress on biologic community. The HMA is based on rankings of individual habitat characteristics on a scale from 0 (poor) to 20 (optimal) which are then compared to a statewide reference condition (NYSDEC SOP #208). HMA scores are used to make final

physical habitat assessments; Natural (80-100), Altered (70 – 80), Moderate (60 – 70), and Severe (< 60). Results are described in terms of percent similarity to the reference condition.

Habitat model affinity (HMA) scores and resulting final physical habitat assessments are presented below (Table 3).

- Epifaunal substrate (Epi. Cover).
- Embeddedness/Pool Substrate Characterization (Embed. Pool.).
- Velocity Depth Regime/Pool Variability (Vel/Dep Reg.).
- Sediment Deposition (Sed. Dep.).
- Channel Flow Status (Flow Status).
- Channel Alteration (Chan. Alt.).
- Riffle Frequency/Stream Sinuosity (Rif. Freq.).
- Left and Right Bank Stability (L.B. and R.B. Stability).
- Left and Right Bank Vegetation (L.B. and R.B. Veg).
- Width of Left and Right Bank Vegetative Zone (L.B. and R.B. Veg Zone).

Table 3. Ranked habitat characteristics and calculated HMA. All habitat rankings were conducted according to protocols specific to gradients of streams according to SOP #216. nr = not reported.

PWL	Site	Gradient	Epi. Cover	Embed. Pool.	Vel/Dep. Reg.	Sed. Dep.	Flow Status	Chan. Alt	Rif. Freq	L.B. Stability	R.B. Stability	L.B. Veg	R.B. Veg	L.B. Veg Zone	R.B. Veg Zone	HMA Score	HMA Assess.
0705-0011	07-CATH-0.6	High	14	17	17	18.0	10	13.0	10	3	3.0	7.0	7	3.0	3.0	69	Moderate
0705-0017	07-KASH-0.3	High	11	16	18	13.0	7	13.0	15	8	4.0	8.0	1	8.0	0.0	67	Moderate
0705-0020	07-KEUK-0.1	High	14	15	19	14.0	16	14.0	19	9	9.0	9.0	9	9.0	9.0	91	Natural
0705-0074	07-REED-0.1	High	16	17	12	7.0	10	20.0	16	10	6.0	9.0	9	5.0	5.0	77	Altered
	07-REED-0.1	Low	13	17	13	17.0	13	13.0	14	8	7.0	1.0	4	0.0	4.0	76	Altered
0705-0082	07-GLNK-0.2	High	12	18	19	20.0	13	8.0	18	8	4.0	2.0	2	1.0	1.0	68	Moderate
0705-0087	07-BGST-0.1	High	8	17	19	20.0	18	18.0	18	9	9.0	9.0	4	10.0	1.0	87	Natural
0705-0073	07-THOL-1.8	High	17	16	19	17.0	14	18.0	19	8	8.0	10.0	10	10.0	10.0	95	Natural
0705-0027	07-CTLE-0.1	High	10	10	9	18.0	15	5.0	17	9	9.0	4.0	4	1.0	1.0	62	Moderate
0706-0002	07-OWLI-3.0	High	14	17	15	13.0	19	17.0	18	6	6.0	8.0	9	5.0	4.0	83	Natural
0706-0010	07-SCKR-0.1	High	15	16	6	16.0	7	nr	13	9	10.0	7.0	7	7.0	8.0	76	Altered
	07-VENE-1.5	High	10	12	10	9.5	16	15.5	7	8	8.0	9.0	9	8.5	5.5	72	Altered
0706-0003	07-DUCH-0.3	High	17	18	18	18.0	18	18.0	19	9	9.0	9.0	9	8.0	9.0	98	Natural
	07-DUCH-8.3	High	8	12	12	10.0	12	12.0	12	6	6.0	6.0	7	7.0	7.0	65	Moderate
0706-0010	07-OWAL_T46-0.1	High	17	18	13	18.0	18	19.0	19	9	8.0	9.0	8	3.0	2.0	88	Natural

PWL	Site	Gradient	Epi. Cover	Embed. Pool.	Vel/Dep. Reg.	Sed. Dep.	Flow Status	Chan. Alt	Rif. Freq	L.B. Stability	R.B. Stability	L.B. Veg	R.B. Veg	L.B. Veg Zone	R.B. Veg Zone	HMA Score	HMA Assess.
	07-OWAL_T9-0.1	High	14	15	9	10.0	14	17.0	16	8	7.0	7.0	8	4.0	4.0	74	Altered
	07-OWAL_T9-0.1	High	14	15	9	10.0	14	17.0	16	8	7.0	7.0	8	4.0	4.0	74	Altered
0707-0005	07-SKAT_T93a-0.5	High	14	14	13	16.0	17	13.0	11	6	5.0	8.0	7	7.0	7.0	76	Altered
	07-SKAT_T2-0.1	High	13	9	14	16.0	15	9.5	16	8	7.0	8.5	6	6.0	6.0	74	Altered
	07-SKAT_T5-0.1	High	19	nr	18	17.0	10	16.0	18	8	6.0	9.0	9	9.0	9.0	90	Natural
	07-SKAT_T89-0.2	High	12	16	13	14.5	13	12.0	16	7	6.0	8.0	7	9.0	8.0	79	Altered
	07-BSWP-0.1	High	18	17	16	12.0	16	17.0	19	7	8.0	9.0	3	9.0	2.0	84	Natural
0706-0001	07-GROU-1.5	High	16	16	15	18.0	16	13.0	18	9	9.5	9.5	5	8.0	3.5	86	Natural

4. Observer Ranking of Recreational Ability – DEC Samples

Perceptions of recreational ability were ranked at all sampling locations as per standard site visit protocols (NYSDEC SOP #208 and #216). The observer (NYSDEC field staff) ranking of recreational ability is a method of visually evaluating impacts to the recreational use of a stream segment. Perceived impacts to recreational use have been correlated with biological impact from nutrient enrichment and water quality (Smith et al., 2014). Observer rankings above slightly impacted (rank of 3) are indicative of significant impacts to recreational ability, and correlate to biological impacts to the affected stream reaches (Smith et al., 2014). Biological impact, or BAP scores below 5, are associated with significant loss of biodiversity, functional organization, and ability to support a balanced community compared to natural conditions.

The results of this ranking evaluate primary and secondary contact recreation, as well as a user's desire to fish. The first two questions of the recreational use evaluation describe the observers perceived ability to participate in primary and secondary contact recreation. Observer rankings of recreational desirability ranged from 0 (best) to 5 (worst) where, as described above, a measurable impact was related to a ranking of 3 and above (Smith et al., 2014). Figure 19 illustrates the average observer ranking for desire to participate in primary and secondary contact recreation at each sampling location with 9 sites having a measurable, perceived impact to recreation. Results of this survey suggest observers considered the desire to participate in primary and secondary contact recreation to be slightly impacted (ranked > 3) at 7 WI/PWL segments 0705-0011, 0705-0017, 0705-0020, 0705-0027, 0705-0073, 0705-0082, 0705-0087, 0707-0005 (Figure 20).

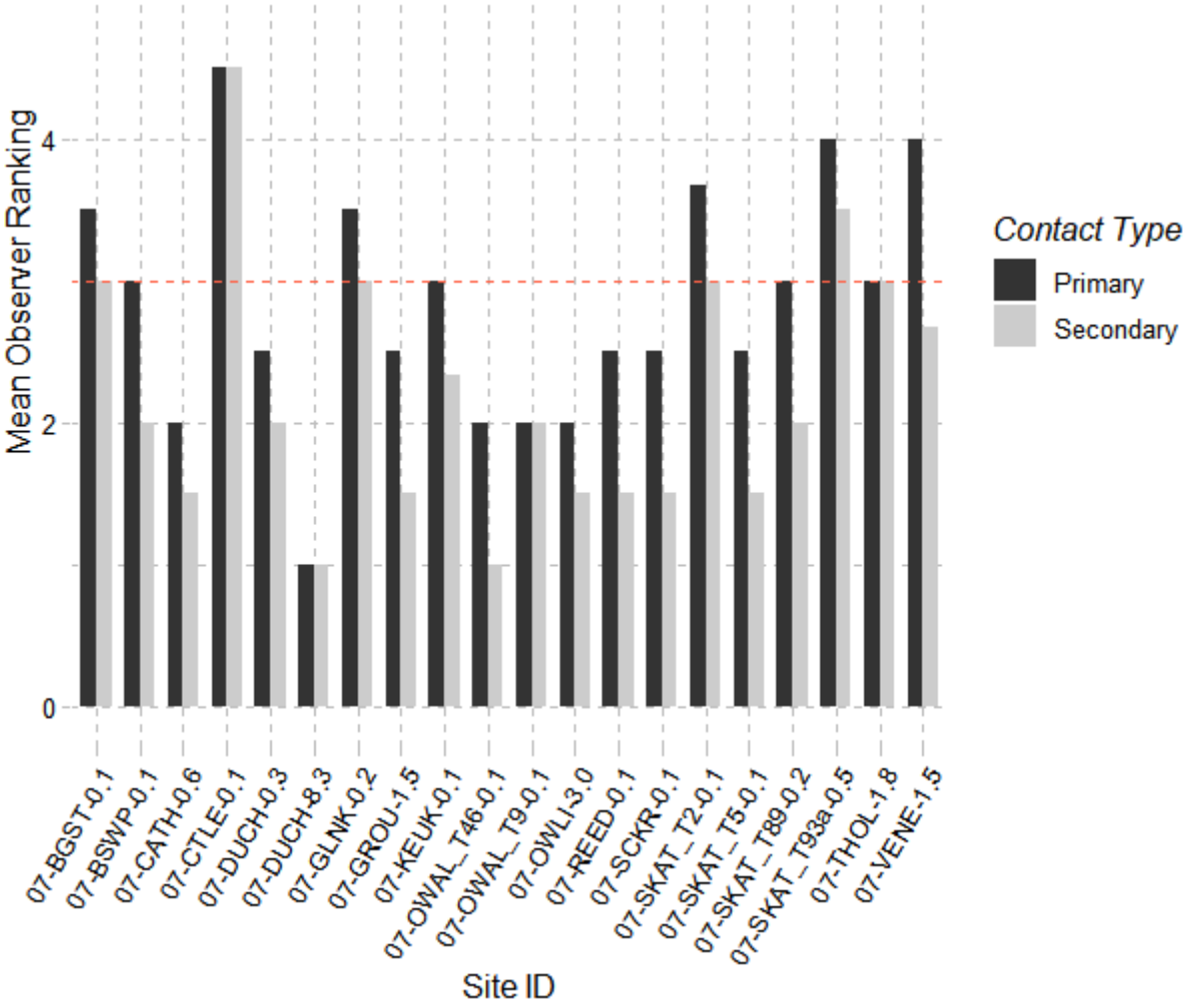


***Figure 19**. Mean observer ranking of recreational ability for each sampling location. Columns represent observer rankings for the desire to participate in primary and secondary contact recreation. Ranking of recreation ability was performed for all locations during each site visit. Red dotted line indicates the threshold for perceived impact to recreational ability identified in Smith (2014).*

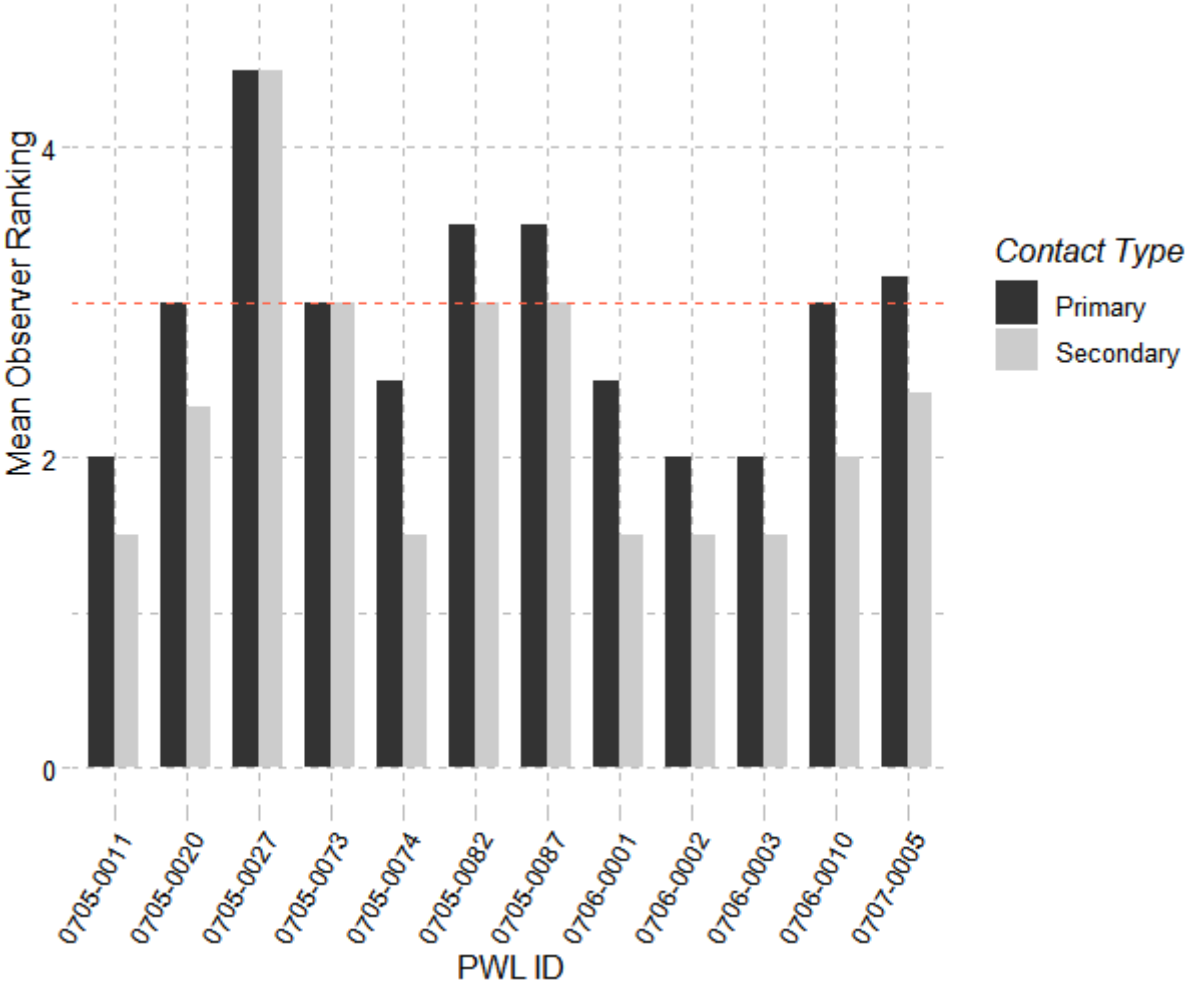


***Figure 20**. Mean observer ranking of recreational ability for sampling locations, grouped by WI/PWL. Columns represent observer rankings for the desire to participate in primary and secondary contact recreation. Ranking of recreational ability was performed for all locations during each site visit. Red dotted line indicates level for perceived impacts to recreational ability.*

Additional recreational usability questions rank in-stream and stream-side factors on a scale of 0-10 (0 – Best/Natural; 10 Worst/Severe). Those factors are: 1) Water Clarity, and the presence of 2) Trash, 3) Periphyton, 4) Odor, and 5) Discharge Pipes. These visual and olfactory observations help isolate negative factors which may influence the observer's perception of recreational use. Table 4 shows the mean recorded value for these factors at each sampling location and Table 5 lists the observer's selection of the most dominant impediment that reduced their desire to participate in recreational activities, which can include the factors above in addition to others. Factors were ranked on a 10 scale (0 – Best/Natural; 10 Worst/Severe) according to perceived impact on a location. Ranking of recreational ability was performed for all locations during each site visit. For Table 6, Factors influencing desire to recreate were ranked and a primary factor influencing the desire to participate in primary and secondary contact recreation was chosen during each site visit. Column values represent the factor selected most frequently at each site.

Table 4. Mean observer ranked value for factors influencing desire to participate in primary and secondary contact recreation.

PWL	Site	Water Clarity	Susp. Phyto.	Periphyton	Macro.	Odor	Trash	Discharge Pipes
0705-0011	07-CATH-0.6	3	0	2	1	0	0	0
0705-0017	07-KASH-0.3	6	0	2	0	0	0	0
0705-0020	07-KEUK-0.1	1	0	3	0	3	0	0
0705-0074	07-REED-0.1	2	1	2	1	0	0	0
0705-0082	07-GLNK-0.2	6	0	2	0	0	2	0
0705-0087	07-BGST-0.1	6	0	1	1	2	0	0
0705-0073	07-THOL-1.8	4	0	0	0	0	0	0
0705-0027	07-CTLE-0.1	2	0	6	1	3	4	3
0706-0002	07-OWLI-3.0	4	1	2	1	0	0	0
0706-0010	07-SCKR-0.1	2	0	2	0	0	0	0
0706-0010	07-VENE-1.5	1	0	5	0	1	0	0
0706-0003	07-DUCH-0.3	4	0	2	0	0	0	0
0706-0003	07-DUCH-8.3	1	0	2	0	0	0	0
0706-0010	07-OWAL_T46-0.1	0	0	2	0	2	0	0
0706-0010	07-OWAL_T9-0.1	3	0	2	0	0	1	0
0706-0010	07-OWAL_T9-0.1	3	0	2	0	0	1	0
0707-0005	07-SKAT_T93a-0.5	4	1	3	1	0	0	1
0707-0005	07-SKAT_T2-0.1	3	2	3	1	1	0	0
0707-0005	07-SKAT_T5-0.1	0	0	2	0	0	0	0
0707-0005	07-SKAT_T89-0.2	2	0	4	0	0	0	0

PWL	Site	Water Clarity	Susp. Phyto.	Periphyton	Macro.	Odor	Trash	Discharge Pipes
0707-0005	07-BSWP-0.1	2	0	2	0	0	1	0
0706-0001	07-GROU-1.5	2	0	4	0	0	0	0

Table 5. Most frequently ranked factor influencing observer desire to participate in primary and secondary contact recreation.

PWL	SITE_ID	Primary	Secondary
0705-0011	07-CATH-0.6	Periphyton	Periphyton, Water Clarity
	07-CATH-0.6	Water clarity	Periphyton, Water Clarity
0705-0017	07-KASH-0.3	Periphyton	Other
	07-KASH-0.3	Water clarity	Other
0705-0020	07-KEUK-0.1	Odor	None, Odor, Periphyton
	07-KEUK-0.1	Periphyton	None, Odor, Periphyton
	07-KEUK-0.1	Water clarity	None, Odor, Periphyton
0705-0074	07-REED-0.1	Periphyton	Periphyton
	07-REED-0.1	Water clarity	Periphyton
0705-0082	07-GLNK-0.2	Periphyton	Trash
	07-GLNK-0.2	Water clarity	Trash
0705-0087	07-BGST-0.1	Odor	Other, Periphyton, Water Clarity
	07-BGST-0.1	Water clarity	Other, Periphyton, Water Clarity
0705-0073	07-THOL-1.8	Other	Other, Water Clarity
	07-THOL-1.8	Water clarity	Other, Water Clarity
0705-0027	07-CTLE-0.1	Odor	Proximity to development roads, Trash, Water Clarity
	07-CTLE-0.1	Periphyton	Proximity to development roads, Trash, Water Clarity
0706-0002	07-OWLI-3.0	Water clarity	Water Clarity
0706-0010	07-SCKR-0.1	Other	None, Water Clarity
	07-SCKR-0.1	Water clarity	None, Water Clarity
	07-VENE-1.5	Other	Other, Periphyton, Water Clarity
	07-VENE-1.5	Periphyton	Other, Periphyton, Water Clarity
0706-0003	07-DUCH-0.3	Water clarity	Periphyton, Water Clarity
	07-DUCH-8.3	Water clarity	None
0706-0010	07-OWAL_T46-0.1	None	None, Odor
	07-OWAL_T46-0.1	Odor	None, Odor
	07-OWAL_T9-0.1	Other	Trash, Water Clarity
	07-OWAL_T9-0.1	Water clarity	Trash, Water Clarity
0707-0005	07-SKAT_T93a-0.5	Periphyton	Periphyton
	07-SKAT_T93a-0.5	Water clarity	Periphyton

PWL	SITE_ID	Primary	Secondary
	07-SKAT_T2-0.1	Odor	None, Water Clarity
	07-SKAT_T2-0.1	Periphyton	None, Water Clarity
	07-SKAT_T2-0.1	Water clarity	None, Water Clarity
	07-SKAT_T5-0.1	Periphyton	Periphyton
	07-SKAT_T5-0.1	Proximity to development roads	Periphyton
	07-SKAT_T5-0.1	Water clarity	Periphyton
	07-SKAT_T89-0.2	Periphyton	Discharge/Pipes, Periphyton
	07-SKAT_T89-0.2	Water clarity	Discharge/Pipes, Periphyton
	07-BSWP-0.1	Periphyton	Periphyton
	07-BSWP-0.1	Water clarity	Periphyton
0706-0001	07-GROU-1.5	Periphyton	Periphyton
	07-GROU-1.5	Water clarity	Periphyton

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