

# Penobscot Indian Nation Water Resources Program



## Water Quality Assessment Report

# 2007 Monitoring Season

## Baseline Water Quality Data

The summer of 2007 found the Water Resources Program (WRP) staff conducting the normal level of baseline water quality monitoring - collecting and analyzing over

- 1,375 samples on lakes,
- 4,800 samples on rivers and
- 990 samples on tributaries.

PIN field work occurred at 96 sites within the Penobscot River watershed approximately weekly and 21 sites at 11 lakes and ponds of tribal Trust Lands. The work included the direct measurement of (profiles done on lakes and impoundment sites)

- Air temperature
- Water temperature
- Dissolved oxygen
- Secchi depth



and water samples collected for

- *E. coli*
- Conductivity
- Turbidity
- TSS
- BOD

- Alkalinity
- Total P
- Chlorophyll a
- Closed-cell pH



PIN laboratory assessment work included the analysis of

- *E. coli*
- Conductivity
- Turbidity
- TSS
- BOD
- Alkalinity

All of this data was entered electronically using handheld devices in the field and a laptop for the laboratory. Electronic data entry into an Access-based database allowed for the timely review of violations and facilitated the creation of an assessment report.

## Summary

The attached Water Quality Data Summary reports for each water body type describe the average, minimum and maximum for each constituent measured in the field or

the PIN laboratory. All dissolved oxygen and water temperature measurements were those at the surface.

\*\*\*\*\* Lakes\*\*\*\*\*

EBL3, the inlet to East Branch Lake, is the only site where the dissolved oxygen at the surface went below 7 mg/L; on Aug 7 it was measured at 6.1 mg/L.

Generally, as to be expected, low dissolved oxygen levels were only found in the greater depths during summer stratification. By early July, ML1, the deep hole on Mattamiscontis Lake, was stratified enough to have levels below 7.0 mg/L at a depth of 7m. By late July the stratification was even more pronounced with values below 7 starting at 5m. Other lakes in which values below 7mg/L were seen include:

<u>Date</u>	<u>Site</u>	<u>Depth(m)</u>
6/26/2007	BP1	4
7/23/2007	USL1	6
8/21/2007	USL1	7
9/27/2007	BP1	4
10/25/2007	MGL1	23

PIN alkalinity, conductivity and chlorophyll a levels tend to fall within the low end of the distribution for the entire state of Maine while total phosphorus and transparency readings fall right around the mean (see the VLMP site for a reference [www.mainevolunteerlakemonitors.org/waterquality/DistributionOfData.php](http://www.mainevolunteerlakemonitors.org/waterquality/DistributionOfData.php)). The



min and max values for each constituent between all sites over the entire sampling season are as follows:

<u>Constituent</u>	<u>Min</u>	<u>Max</u>
Alkalinity	0.2	5.5
Conductivity	14.7	76.5
Chlorophyll a	1.2	9.4
Total P	3.9	15.0
Transparency	0.5	7.2

\*\*\*\*\* Rivers\*\*\*\*\*

The min and max values for each constituent between all sites over the entire sampling season are as follows:

<u>Constituent</u>	<u>Min</u>	<u>Max</u>
BOD	0.11	7.96
Conductivity	24.6	686
DO	5.6	10
E coli	2.0	296
Transparency	0.08	4.71
TSS	0.1	9.4
Turbidity	0.365	11.2
Water temperature	12.6	26.3

\* Nutrient and chlorophyll a data are described later in the Cyanobacteria Bloom section

\*\* Additional water quality data collected during a collaborative wasteload allocation study with the Maine Department of Environmental Protection (DEP) is described in the Data Collected with DEP



section

\*\*\*\* Tributaries \*\*\*\*

The min and max values for each constituent between all sites over the entire sampling season are as follows:

<u>Constituent</u>	<u>Min</u>	<u>Max</u>
Conductivity	.98	133.2
DO	3.5	9.7
E coli	4.0	424
TSS	0.1	153.4
Turbidity	0.345	66.0
Water temperature	15.2	23.3

*Violations of Water Quality Standards*

The details of each of the violations are described in the attached reports.

\*\*\*\* Dissolved oxygen \*\*\*\*

There were a total of 17 violations of dissolved oxygen standards during the sampling season. Fifteen (15) of these violations occurred within the 110 measurements taken on 27 tributary sites. Two (2) of these occurred within the 939 measurements taken on 59 river sites.

\*\*\*\* E coli \*\*\*\*

The instantaneous colony count standard was violated five (5) times between three (3) different sites. The geometric mean colony count standard was violated at only one (1) site.

These data will be shared with the Maine DEP per our Water Quality Monitoring Cooperative Agreement. Consequently this data will also benefit the citizens of Maine by helping with water resources management, planning, reporting and attainment status purposes.

*Data Collected with DEP*

Penobscot Nation Water Resources Program contributed the bulk of staff time to collecting the data for the 2007 Waste-load

Allocation Study. Consequently, we feel that it is important to incorporate some of the preliminary summaries in this report. The data is being used to validate the Penobscot River Model previously created and updated by DEP (using data that was also, in part, collected by PIN staff) and for setting permit limits in discharge licenses. The data collection efforts included a 3-day intensive survey of 103 miles of the Penobscot River to collect information on properties of the water column, sediments and plant growth. Please refer to the Penobscot River Data Report put together by DEP staff for details ([www.maine.gov/dep/blwq/topic/Penobscot/index.htm](http://www.maine.gov/dep/blwq/topic/Penobscot/index.htm)). Quoted highlights of this report are as follows:

“Class C minimum DO criteria of 5 ppm and 60% of saturation were met at all 6 sampling locations that are classified C (five locations on West Branch, and one above Weldon impoundment). However on class B segments, where there are fifteen sampling locations, only five locations (Winn, N. Lincoln, S. Lincoln, Passadumkeag and above Great Works dam) met minimum class B criteria of 7 ppm and 75% of saturation. DO readings of sampling locations which didn’t meet class B minimum criteria, ranged from 6.4 to 6.9 ppm. In the estuary, a minimum class SC D O criterion of 75% of saturation was met at all nine sampling locations.”

“Water temperatures on the Penobscot in 2007 during the sampling period were high compared to most summers. The data were collected during an extended heat wave in which air temperatures typically exceeded 32oC during the afternoon sampling run. Penobscot River temperature generally was lowest at the upstream boundary or most inland station (Ferguson Lake outlet) and increased in the downstream direction reaching the maximum temperature in the Bangor area. The three-day average temperature for all riverine sampling locations varied from a low of 24C at Ferguson Lake outlet to a high of 27.4C at Bangor.”

“More than 80% the BODu is carbonaceous. Average NBODu levels were always less than 1.2 ppm and CBODu levels ranged from 3 to 6 ppm. The observed BODu of the Penobscot River are typical values seen on rivers with low levels of pollution.”

“Average total phosphorus observed below point source discharges was usually in between 20 and 30 ppb on the riverine sample stations with the exception of the sampling locations South Orrington and Fort Knox. TP ranges of 20 to 30 ppb are indicative of nutrient enrichment, and 70 ppb a high level of nutrient enrichment. Orthophosphorus (OPO4-P) was usually less than 10 ppb at riverine locations.”

“Average TKN for all riverine and estuarine locations ranged from 0.2 to 0.5 ppm. Average ammonia nitrogen was less than 0.01 ppm at all locations. Average nitrite plus nitrate nitrogen for all riverine and estuarine stations was less than 0.01 ppm at all locations. These values represent relatively low levels of nitrogen and are consistent with the reported low NBODu levels. Tributary stations had similar low nitrogen levels, except TKN levels on two occasions were 0.5 ppm.”

“Chlorophyll a levels at seven of the ten stations on the Penobscot ranged from 2 to 3 ppb indicating low levels of algae. Chlorophyll a was similarly low on all of the tributary stations. At Dolby Pond, and Weldon dams chlorophyll a values ranged from 20 to 30 ppb and represent conditions of a bloom. Chlorophyll a in the tidal portion gradually increased in the seaward direction reaching levels indicative of mild bloom conditions at Orrington Center location. It can be concluded that eutrophication on the Penobscot is approaching levels of concern.”

“All (transparency) values ranged from 1.4 to 4.2 meters. The lowest readings occurred at Weldon dam, which also had high chlorophyll-a levels. All of the estuary sites had low transparency readings.”

“The field monitoring data shows that 5 out of the 8 tributaries had DO levels below 7.0 mg/L on July 31, 2007. On August 1 and 2, 2007 the monitoring data shows that 3 out of the 8 tributaries had DO levels below 7.0 mg/L. Afternoon DO levels were always above 7.0 mg/L.”

## Cyanobacteria Bloom

In August we discovered and investigated an extensive cyanobacteria bloom in the Penobscot River. The bloom began on the lower West Branch and extended approximately 50 miles downstream. WRP

used aerial surveys and water quality sampling (including nutrients, chlorophyll a, algal taxonomy, and toxicity testing) to document the extent, severity, and duration of the bloom.

The bloom was first noticed on July 31st during a cooperative intensive sampling effort with the Maine Department of Environmental Protection (DEP) to collect information for the revision of the Penobscot River model. However, when looking back



*Dolby Pond looking downriver - West Branch flows in from right.*

at chlorophyll a data we received back from an outside lab, the bloom was possibly beginning earlier. Results from June 21st revealed the following chlorophyll a levels:

- DP1 (where the West Branch flows into Dolby Pond) - 7.4 µg/L
- DP3 (at the Dolby impoundment) - 6.0 µg/L.

During the time PIN and DEP were sampling together the chlorophyll a levels at DP3 seemed to reach their peak at this site and begin declining with the following pattern:

- 7/31/08 - 27 µg/L
- 8/1/08 - 32 µg/L
- 8/2/08 - 15 µg/L

PIN continued to collect more chlorophyll a data throughout August and the pattern of

decline remained at DP3.

However preliminary assessments suggested the presence of *Anabaena* species and concentrations were still high in other locations downriver. Samples collected at our site just above Mattaceunk (Weldon) Dam, WD2 on Aug 17 showed these chlorophyll a values:

- center of the channel - 23 µg/L
- near the shore - 72 µg/L

Because caution should be exercised whenever this genus is present and any cyanobacteria are dominant at these chlorophyll a levels, we collected samples and sent them to GreenWater Laboratories in Florida for species identification and analysis for the presence of microcystin and anatoxin-a.

However, before the samples could be analyzed PIN Water Resources staff decided to advise the community of the potential problem. All of the health department advisories and guidance documents (from other states) we reviewed, as well as the feedback from scientists in this field, suggest that it is best to be proactive and warn people about the presence of a bloom and the potential for toxins. It is said that it cannot be assumed that a bloom is not toxic until it is known which genus of cyanobacteria are present and toxin analyses have been completed.

Specifically, the World Health Organization (WHO), suggests that if there are 10 µg/L or more of chlorophyll a, with a dominance of cyanobacteria, there should be risk advisories posted on site. The August 17 chlorophyll a reading put the risk at the next level of concern on the WHO standards at which they suggest restricting bathing and further investigating the hazard. We felt that this affirmed/legitimized our desire to be proactive and post advisories.



Confluence of Mattawamkeag River (right) with the mainstem of the Penobscot River.

In addition to these symptoms, a dissolved oxygen profile taken by DEP on August 17 revealed violations of the standard (5.0 mg/L) starting at 4m down from the surface. Between 4m and 11m down from the surface dissolved oxygen readings went from 4.8 mg/L to 1.7 mg/L.

GreenWater Laboratories found that *Anabaena smithii* comprised approximately 90% of the total cyanobacteria cell numbers and 84% of the total cell numbers. Other species of cyanobacteria found included: *Snowella lacustris*, *Woronichinia naegeliana*, *Microcystis* sp., *Anabaena* sp. and *Planktothrix* species. We were told that *Anabaena smithii* is not listed as a known toxin producer, but is morphologically similar (with the exception of akinete shape) to other known toxin-producing species including *A. planctonica*, *A. macrospora* and

*A. solitaria*. Species identification in 2004 suggested that *A. macrospora* was the dominant species accompanied by *Anabaena spiroides*, *Microcystis aeruginosa*, and *Microcystis flos-aquae*.

Communication about 2007 species identification also described the fact that *Snowella lacustris* and *Woronichinia naegeliana* are both suspected toxin producers, but to date no toxin has been isolated and positively identified from them.

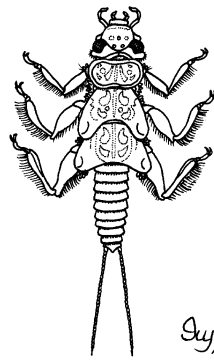
Thankfully neither microcystin nor anatoxin-a were present at levels above their respective detections limits; 0.15 µg/L and 0.05 µg/L.

We lifted the advisory on September 6, 2007. Even though the visual presence of the bloom had decreased dramatically we purchased a kit that can be used as a screening tool for the presence of microcystin in water samples (EnviroLogix Algal Toxin). Because toxins can be present even after the bloom has visually disappeared we took samples from 20 locations along the river at places in which we thought accumulations would occur and where people usually swim/are exposed to the cyanobacteria. All of these samples were below a very low level, well out of the range of problematic conditions.

All of the PIN data and work contributed to the issuance of an official Notice of Violation (NOV) and the associated fine. Data collected by PIN are also being used to establish phosphorous discharge limits for at least one of the paper mills on the river.

### Aquatic Benthic Macroinvertebrates

We monitored aquatic benthic macroinvertebrates from three (3) locations within the Penobscot basin for use in determining attainment of aquatic life criteria

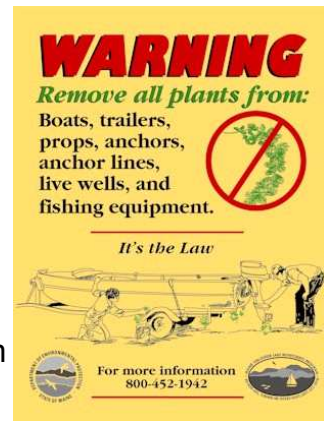


and for upcoming wastewater licensing. We also provided assistance to DEP with biomonitoring of wetlands and streams within the Penobscot watershed. The sample data is still with the taxonomist so a summary is

pending.

### Aquatic Invasive Plants

PIN WRP continued to carry out an aquatic invasive plants program including education, posting signs, and enforcement of Maine's law. Five (5) staff received Invasive Plant Patroller training from the Maine Center for Invasive Aquatic Plants.



### Water Quality Investigation

WRP staff discovered, investigated, and reported to Maine DEP, Maine LURC or EPA numerous violations of environmental regulations affecting the Penobscot Reservation. Some noteworthy examples include:

- Staff discovered a broken wastewater line in town of Mattawamkeag's public treatment system.
- Staff responded and reported to DEP an incident involving improper disposal of septage and a broken wastewater line at a Milford trailer park.