# MEMORANDUM

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| To: | TDI-NE NECPL Project File | Date: | March 16, 2015 |
| From: | TRC | Re: | Assessment of Paper Mill Sedimentation Areas in Lake Champlain in Relation to the Proposed NECPL Route |

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The New England Clean Power Link (NECPL) project is a proposed installation of High Voltage Direct Current (HVDC) transmission cables in Lake Champlain. This installation, as proposed, passes within the vicinity of two (one historic and one current) International Paper (IP) paper mill facilities (Figure 1). Each of these facilities is associated with an area of sedimentation in Lake Champlain which has accumulated as a result of effluent discharge. Several studies have been performed over a span of more than a century (with studies performed as early as 1905) with regard to the character, composition and contamination of these areas, particularly the material releases associated with the historic Ticonderoga mill.

The proposed NECPL project route passes through small, peripheral areas on the east edge of the sedimentation areas that are associated with the current and historic paper mills (see Figure 1). Initial installation activities have the potential to temporarily disturb the lake bed. The intent of this document is to summarize previous studies that have assessed sediment quality in the vicinity of the two IP mills. Furthermore, this document assesses the results of these studies relevant to potential impacts of project installation.

Past studies regarding the sludge beds associated with the historic Ticonderoga mill and the effluent from the current IP paper mill are described, respectively, in Section 2 of this document. An assessment of available data relevant to potential impacts of the proposed NECPL project is provided in Section 3.

## 1.0 BACKGROUND

In 1925 the International Paper Company (IP) purchased the Ticonderoga Pulp and Paper Company, which remained in operation from approximately 1884 to 1971 (Myer and Gruendling, 1979). This historic Ticonderoga mill discharged its effluent into Ticonderoga stream, with outlets into Ticonderoga Bay on the west shore of Lake Champlain. At one point the facility was discharging 200 tons of pulping wastes and 330 tons of paper processing wastes per day into Ticonderoga Stream, resulting in approximately 30 tons of solids per day (Federal Water Pollution Control Administration, 1968). The New York State Department of Environmental Conservation

(NYSDEC) alleged that the paper mill discharged “celluous fibers and sundry other organic and inorganic material” on a “nearly continuous basis” into the Lake George Outlet, which is located upstream from Lake Champlain (NYSDEC 1970). When the facility was shut down in 1971, it was estimated that approximately 1,236,000 cubic yards of paper making waste, covering approximately 243 acres, were present in Ticonderoga Bay (Myer and Gruendling, 1979).

## FIGURE 1
## OVERVIEW MAP

In the same year that the historic Ticonderoga mill closed, IP opened the new mill facility approximately four miles north of the historic mill. Effluent discharge levels for total suspended solids were initially set at a daily average of 10,000 pounds/day and a daily maximum of 20,000 pounds/day. The limit for total phosphorus concentration in the discharge was set at 0.5 mg/L. In 1989, the New York State Department of Environmental Conservation (NYSDEC) modified the facility's National Pollution Discharge Elimination System (NPDES) permit to include monthly sampling for dioxin, specifically 2,3,7,8-tetrachloro di-benzo-p-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachloro dibenzofuran (2,3,7,8-TCDF).

International Paper received the "New York State Governor's Award for Pollution Prevention" in the late 1990s[1]. The citation for this award stated that the facility initiated a "series of operational changes and capital improvements beginning in 1988" to reduce potential dioxin discharges. After a series of measures designed to reduce chlorine use, in 1996 IP stopped using elemental chlorine in the bleaching operation. This change eliminated the potential for the formation of dioxin compounds in the effluent while also reducing chlorine and chloroform emissions.

## 2.0 PREVIOUS STUDIES

### 2.1 Historic Ticonderoga Mill (1884 to 1971)

Wastes from the historic Ticonderoga Pulp and Paper Company have been the subject of several studies for over a century. A United States Geological Survey report at the turn of the 20th century (Leighton 1905) documented that there was, at that time, "a sedimentation bed covering 15 acres" and that it had raised the natural bottom of the lake "about 12 feet". Based on two sampling events, Leighton found evidence of wastes from the mill to a distance of "about 3 miles down the lake." Leighton stated that wastes "were plainly apparent nearly three miles down the lake" to the north. Leighton also concluded that "the inevitable conclusion must therefore be that the waste from the Ticonderoga pulp mill is in no wise detrimental to Lake Champlain." This conclusion must be understood as being based on the available science during that time period.

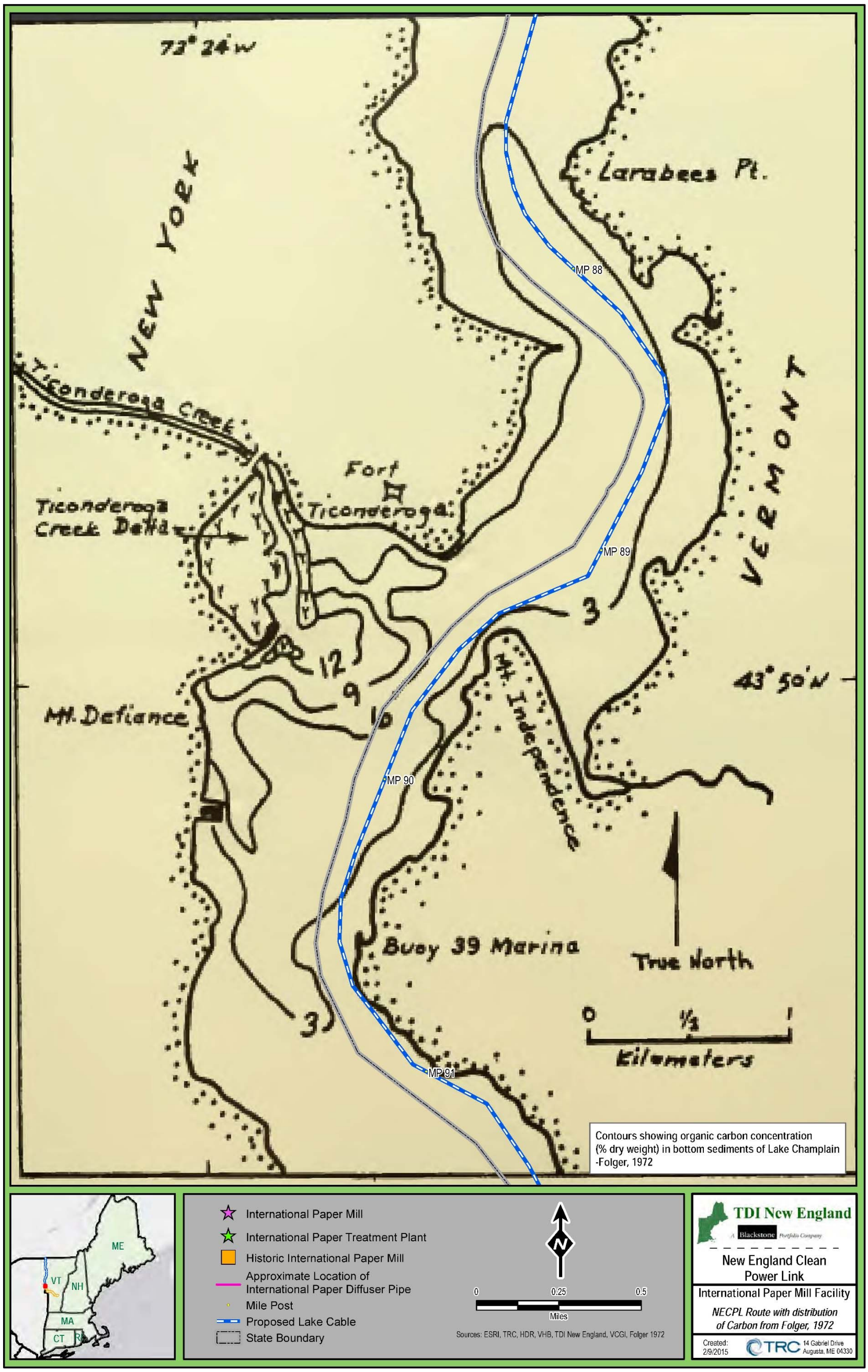
The extent and degree of contamination associated with the historic Ticonderoga mill's sludge bed was of keen interest to federal and state agencies in the late 1960s / early 1970s. A sampling program conducted by the U.S. Army Corps of Engineers indicated that sludge bed deposits in Ticonderoga Creek and Lake Champlain consisted of wood chips, cinders, and other organic material. These materials were reported to range in depth from 6 inches to 12 feet (Weist 1970). According to Weist, the deposits extended "in the lake out to a radius of approximately 600 yards

[1] New York State Department of Environmental Conservation. NYS Governor's Awards for Pollution Prevention - International Paper. March 8, 1999. http://www.dec.ny.gov/public/22498.html

from the mouth of the [Ticonderoga] creek". The NECPL route as proposed is outside of this described limit.

In 1972, a study by Folger utilized the distribution of organic carbon to outline the sludge bed emanating from the historic Ticonderoga mill (Figure 2). The highest concentrations (14%) radiated outward from the Ticonderoga Creek towards the center of Lake Champlain, with declining values to the north and south (~2%). Folger further noted that outside of the area immediately adjacent to the discharge zone, the highest values of carbon extended to the north, indicating a predominant northward flow in the lake. A smaller tongue of carbon that was observed reaching to the south was judged by Folger as likely due to the physiography of the delta which directs some flow southward, particularly on the west side of the lake.

**FIGURE 2**
**NECPL ROUTE WITH DISTRIBUTION OF CARBON FROM FOLGER, 1972**



Myer and Gruendling (1979) reported on a study completed by Pagel in 1975, in which grab samples were taken from the bottom of the Ticonderoga Bay and Lake Champlain to assess sediment distribution. As shown in Figure 3, a large part of the sediment in the area consists of silty clay. The source of the clay is believed to be Kaolinite, a type of clay that was reportedly added by IP as a paper filler material. According to Myer and Gruendling (1979), Pagel (1975) reported that the large sludge deposit was "undergoing decomposition". The NECPL route as proposed is located in an area identified by Pagel (1975) as silty clay with detritus and oil reported from approximately MP 90 to 90.5.

In 1994, McIntosh reported on a study performed by the Lake Champlain Sediment Toxics Assessment Program (McIntosh 1994). This study collected and analyzed three core samples, two in the channel of the Ticonderoga Creek off of the sludge bed and one near the mouth of Ticonderoga Creek. The cores were taken in the upper 50 centimeters (1.6 feet) of the lake bed. Chemical analysis of the cores indicated that the concentrations of all metals were elevated in the upper sections of the cores. Metal concentrations in the lower depths also exceeded background levels (Attachment A). Metal concentrations exceeded existing standards for chromium, lead, nickel, and zinc. Grain size analysis indicated there was a "cap" of fine material on top of the sludge bed, which primarily consisted of silt grains and wood chips.

In 2010 and 2012, Champlain Hudson Power Express Inc. completed a Marine Route Survey (MRS) for the Champlain Hudson Power Express. This study (HDR 2010 and HDR 2012) included the collection of core samples at discrete locations (see Figure 4). Composite samples were developed using the upper 3 to 5 feet of the core sample in order to represent the likely values throughout the area which would be disturbed through the installation of the cables to the target burial depth. Each core was analyzed for eight heavy metals (arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc), mercury, and other contaminants which were detected through standard analysis protocols. Table 2-1 presents the results for core locations that were located in close proximity to the historic Ticonderoga mill.

**FIGURE 3**
**NECPL ROUTE WITH SEDIMENT CHARACTERISTICS BASED ON PAGEL (1975)**

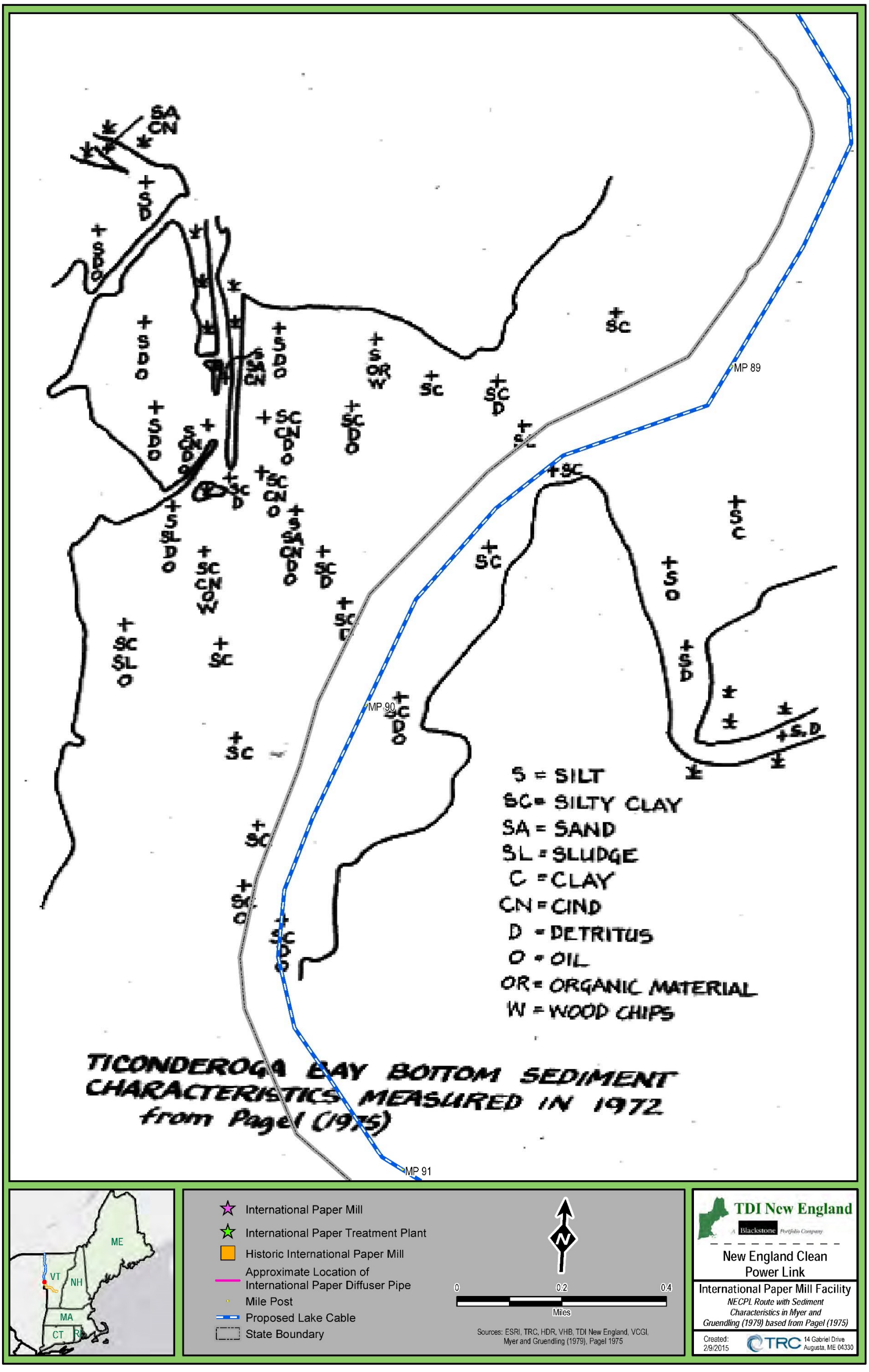


**FIGURE 4**
**NECPL ROUTE WITH 2010 AND 2012 SAMPLE POINTS**

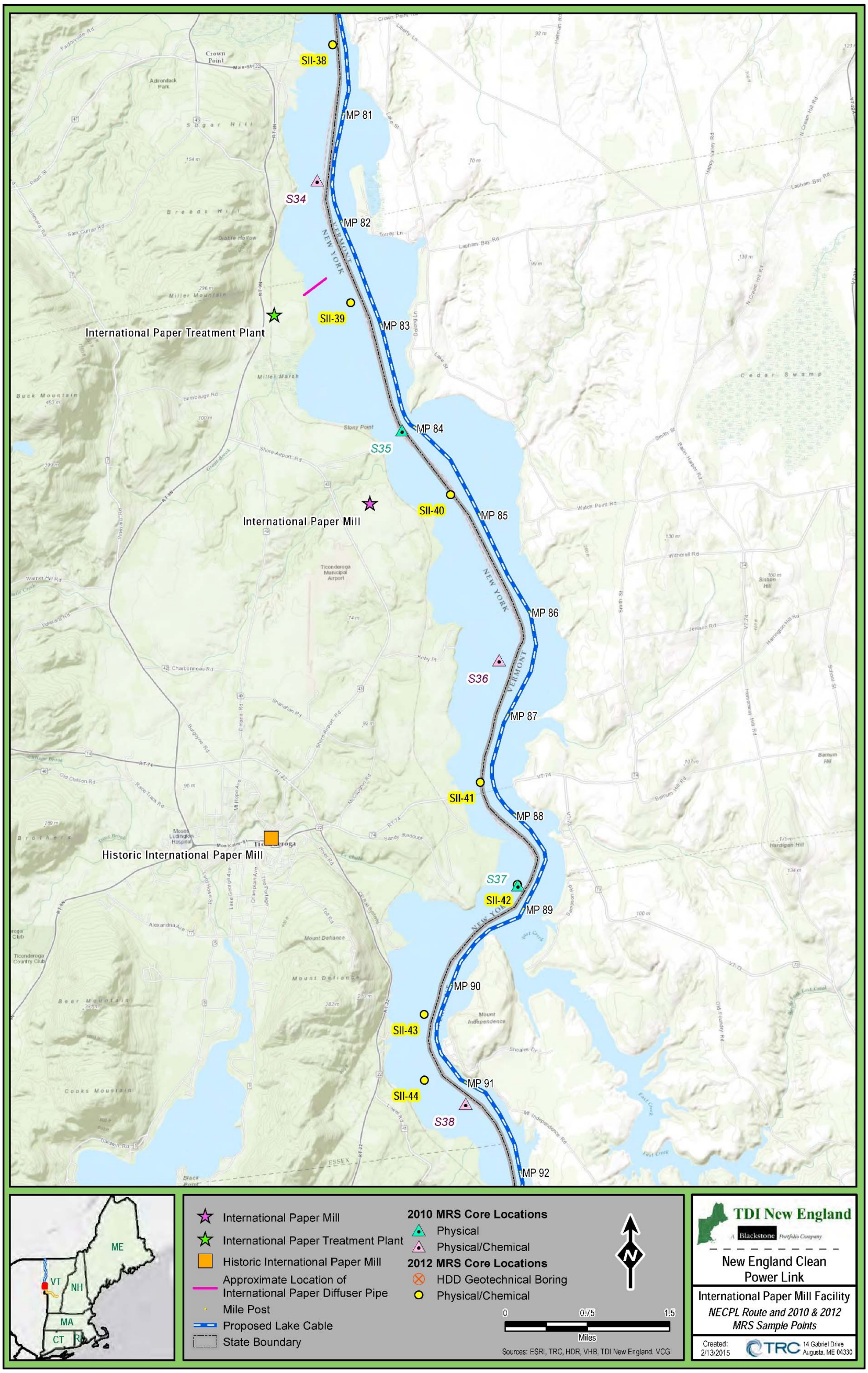


**Table 2-1: Results of Champlain Hudson Power Express Sampling Near Historic Ticonderoga Mill**

| Contaminant | Core Location ID | | | | | |
|---|---|---|---|---|---|---|
| | S36 (mg/kg) | SII-41 (mg/kg) | SII-42 (mg/kg) | SII-43 (mg/kg) | SII-44 (mg/kg) | S38 (mg/kg) |
| Arsenic, Total | 3.71 | 3.89 | 3.82 | 4.18 | 5.91 | 3.42 |
| Cadmium, Total | 0.174 | 0.232 | 0.26 | 0.317 | 0.244 | 0.223 |
| Chromium, Total | 40.7 | 41.4 | 46.5 | 46.9 | 39.9 | 40.5 |
| Copper, Total | 25.2 | 25.8 | 27.7 | 28.3 | 28.5 | 23.5 |
| Iron, Total | 43,700 | 37,900 | 42,300 | 42,700 | 36,900 | 49,000 |
| Lead, Total | 15.6 | 20.2 | 18.5 | 20.7 | 16.8 | 14.8 |
| Mercury, Total | ND | 0.064 | 0.064 | 0.063 | 0.062 | ND |
| Nickel, Total | 44.7 | 41.2 | 43.8 | 44.2 | 42.9 | 43.5 |
| Zinc, Total | 112 | 109 | 113 | 118 | 103 | 116 |
| trans-Nonachlor | ND | 0.00065 | ND | ND | ND | ND |
| 4,4'-DDD | ND | 0.00171 | ND | ND | ND | ND |
| Fluorene | ND | ND | ND | 0.0112 | ND | ND |
| Fluoranthene | ND | 0.0129 | 0.0136 | 0.0162 | ND | ND |
| Pyrene | ND | 0.0124 | 0.0136 | 0.0164 | 0.00922 | ND |

Source: HDR 2010 and HDR 2012

## 2.2 Current IP Paper Mill (1971 to Present)

Mason et al. (1977) reported the results of sediment trapping that was conducted in 15 locations in 1972 – 1973. These locations were distributed from Benson Landing north to the Crown Point Bridge. Kaolinite (a type of clay) to chlorite ratios were calculated as an indicator of plant effluent (see Figure 5). The results indicated that as much as 2.3 centimeters (cm) of sediment had accumulated over a six month period near the mill's outfall. Meanwhile, less than 1 cm of sediment had accumulated in the other sampling locations. The maximum thickness of sediment associated with the plant was 4.5 cm, which was identified near the mill's diffuser.

In 1988, core samples were collected to update the previous study results as reported by Mason et al. (1977). Haupt and Folger (1993) reported that, in the vicinity of the diffuser, sediment depths associated with the mill's effluent had increased from 4.5 cm (as reported by Mason et al. 1977) to 17 cm. The ratios of sulfur, aluminum, and chlorine in relation to silicon were found to be higher in the effluent than the intake water. Chlorine and sulfur were observed "only in the cores closest to the diffuser" (Haupt and Folger, in 1993).

As previously discussed (relevant to the historic Ticonderoga mill), the Champlain Hudson Power Express Inc. completed core sampling, in 2010 and 2012, at several discrete locations in Lake Champlain (see Figure 4). Cores were analyzed for eight heavy metals (arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc), mercury, and other contaminants through standard analysis protocols. The results of this study for locations that are in close proximity to the current IP paper mill are presented in Table 2-2

**FIGURE 5**
**NECPL ROUTE WITH 1977 TESTING AT NEW INTERNATIONAL PAPER FACILITY**

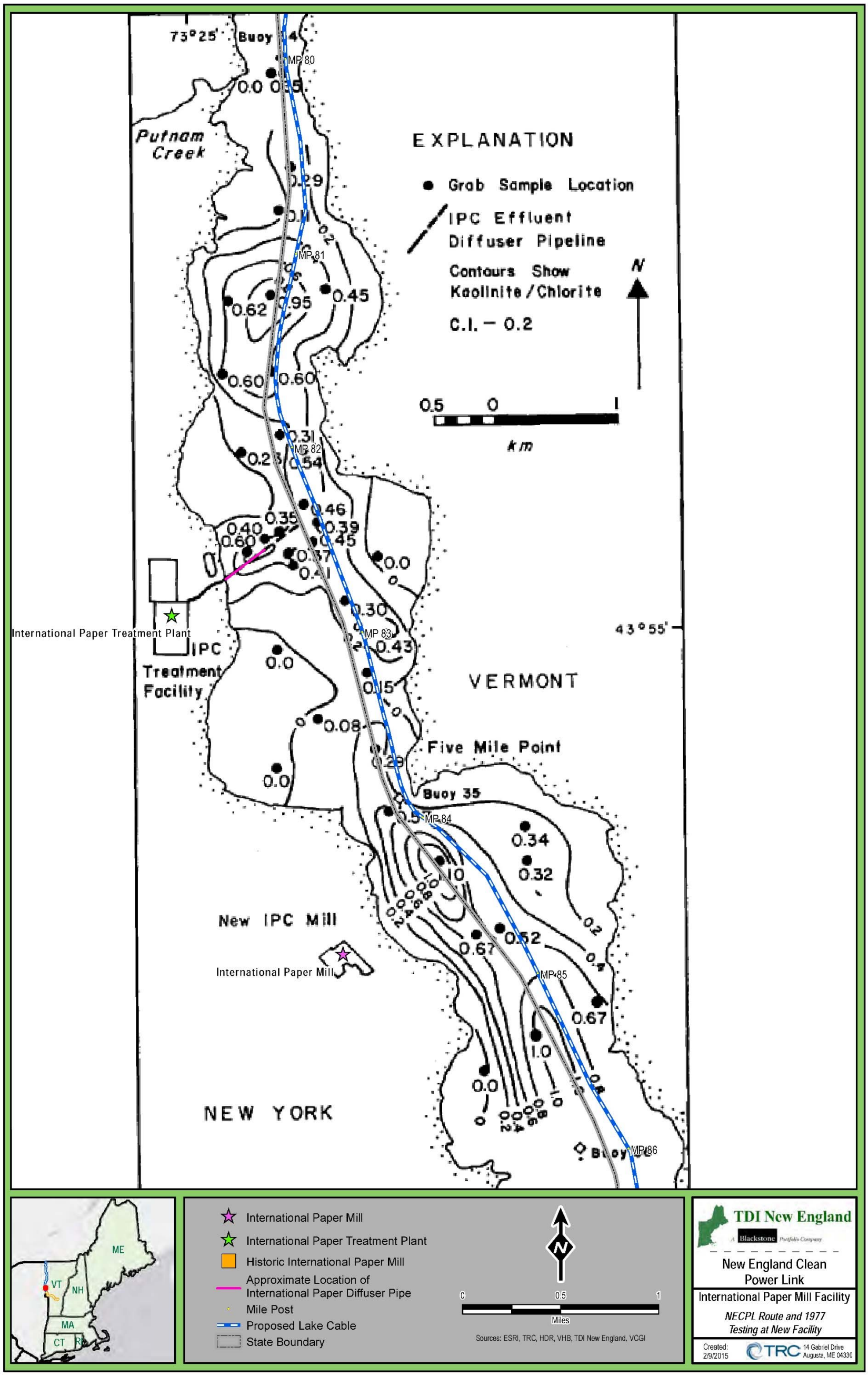


**Table 2-2: Results of Champlain Hudson Power Express Sampling Near Current IP Paper Mill**

| Contaminant | Core Location ID | | | |
|---|---|---|---|---|
| | SII-38 (mg/kg) | S34 (mg/kg) | SII-39 (mg/kg) | SII-40 (mg/kg) |
| Arsenic, Total | 3.84 | 4.67 | 3.59 | 3.66 |
| Cadmium, Total | 0.243 | 0.333 | 0.21 | 0.198 |
| Chromium, Total | 43.4 | 41.6 | 41.8 | 39.8 |
| Copper, Total | 27 | 25.3 | 25.4 | 25.3 |
| Iron, Total | 44,000 | 43,300 | 40,400 | 37,800 |
| Lead, Total | 17.8 | 16 | 15.4 | 15.9 |
| Mercury, Total | 0.054 | 0.031 | 0.041 | 0.046 |
| Nickel, Total | 46 | 44.8 | 44.6 | 42.2 |
| Zinc, Total | 113 | 119 | 106 | 99.6 |
| trans-Nonachlor | ND | ND | ND | ND |
| 4,4'-DDD | ND | ND | ND | ND |
| Fluorene | ND | ND | ND | ND |
| Fluoranthene | ND | ND | ND | ND |
| Pyrene | ND | ND | ND | ND |

Source: HDR 2010 and HDR 2012

# 3.0 ASSESSMENT OF AVAILABLE DATA

## 3.1 Best Available Data

The Lake Champlain Sediment Toxics Assessment Program (McIntosh 1994) sampling program, as described in Section 2, provides a "worst case" picture of contaminant levels in the area that may potentially be temporarily disturbed by the installation of the proposed NECPL project as all of the samples collected were in close proximity to the historic sludge bed and in the upper 50 centimeters of the lake bottom. More recently, in 2010 and 2012, composite samples were developed using the upper three to five feet of the lake bed along the routing for the Champlain Hudson Power Express (HDR 2010 and HDR 2012) in the vicinity of both the historic and new International Paper facilities. This dataset should be considered a more reliable indicator than McIntosh (1994) of the likely level of contamination within this segment of the waterway. In terms of relevance to the NECPL project, it may be noted that the 2010/2012 samples were collected considerably closer to the proposed location of the NECPL project than those reported by McIntosh. In addition and as noted above, the values represent composite samples taken from the upper three to five feet of the lake bed so that the concentrations are representative of the likely impacts associated with installation.

## 3.2 Water Quality Modeling

In order to assess the proposed project's potential impact on water quality in Lake Champlain, water quality modeling was completed to estimate the potential dispersion of sediment and other constituents during the cable installation (HDR 2014). The modeling analyzed the expected impact associated with both the shear-plow and jet-plow installation method, with the shear-plow being the proposed technology for the segment of the routing in proximity to the current and historic IP facilities. The model inputs included data from the 2010 Champlain Hudson Power Express sampling event. Five representative locations along the proposed cable installation route were selected for the development of a detail analysis of water quality impacts. One of these, Mile Post (MP) 83, is located within one mile of the current IP Treatment Plant diffuser.

For MP 83, the calculated increases in total suspended solids (TSS) predict a one-time event of short duration with a limited horizontal and vertical extent. Within 200 feet from the point of installation, and within 3-10 feet from the lake bottom, TSS concentrations temporarily increase along the lake bottom but return to less than 3 mg/L TSS above background levels in one hour after cable installation. All of the calculated metals concentration increases are less than applicable acute and chronic Vermont Water Quality Standards (VWQS), and, therefore, water quality impacts associated with the eight constituents (arsenic, cadmium, copper, lead, nickel, zinc, silver and mercury) due to the installation of the cable in Lake Champlain are expected to

be in compliance with VWQS. In addition, the concentration increases are all less than method detection limits (MDLs) for these metals and are not measureable.

## 4.0 CONCLUSIONS

A review of previous studies indicates that the proposed NECPL route is predominately outside or on the fringe of the discharged material from the two IP facilities. Water quality modeling based on sampling completed in same portion of the lake indicates that concentrations of eight constituents of concern (arsenic, cadmium, copper, lead, nickel, zinc, silver and mercury) during installation would be below applicable Vermont Water Quality Standards and that any impacts would be of a short duration. Based on the best available information, the Project will not adversely impact water quality in Lake Champlain.

## 5.0 LITERATURE REVIEW

Federal Water Pollution Control Administration, 1968. Pollution of the interstate waters of Lake Champlain and its tributary basin, New York-Vermont: Proc. Conf. on Enforcement.

Folger, D.W., 1972. The sludge bed at Ticonderoga, New York, in Doolan, B. L., and R. S. Stanley, eds., New England Intercollegiate Geol. Conf. Guidebook, p. 401 - 406.

Haupt, R.S. and D.W. Folger, 1993. "Paper plant effluent revisited – Southern Lake Champlain, Vermont and New York." Environmental Geology 21: 77-83.

HDR, 2010. Champlain Hudson Power Express: Marine Route Survey Summary Report. 2010.

_____, 2012. Champlain Hudson Power Express: Marine Route Survey Summary Report. 2012.

Leighton, Marshall Ora, 1905. Preliminary Report on the Pollution of Lake Champlain. United States Geological Survey. Water-Supply and Irrigation Paper No. 121.

Mason, D.L., D.W. Folger, R.S. Haupt, R.R. McGirr, and W.H. Hoyt, 1977. "Distribution of pollutants from a new paper plant in southern Lake Champlain, Vermont and New York." Environmental Geology 1(6): 341-347.

McIntosh, Alan, 1994. An assessment of sediment – associated contaminants in Lake Champlain – Phase 1. Lake Champlain Basin Program. February 1994.

Myer, Glenn E. and Gerhard K. Gruendling, 1979. Limnology of Lake Champlain. Lake Champlain Basin Study, New England River Basins Commission.

New York State Department of Environmental Conservation, 1970. Complaint in the Matter of Alleged Violations of Article 12 of the Public Health Law by International Paper Company. August, 1970.

Pagel, Carl W., 1975. A study of the influence of pulp and paper waste on the benthos of southern Lake Champlain: Burlington, Vermont, Univ. Vermont, unpub. Ph.D. dissert., 339p.

Weist, Andrew, 1970. Water Pollution Case Report for Sludge Bed at Ticonderoga. July 17, 1970.

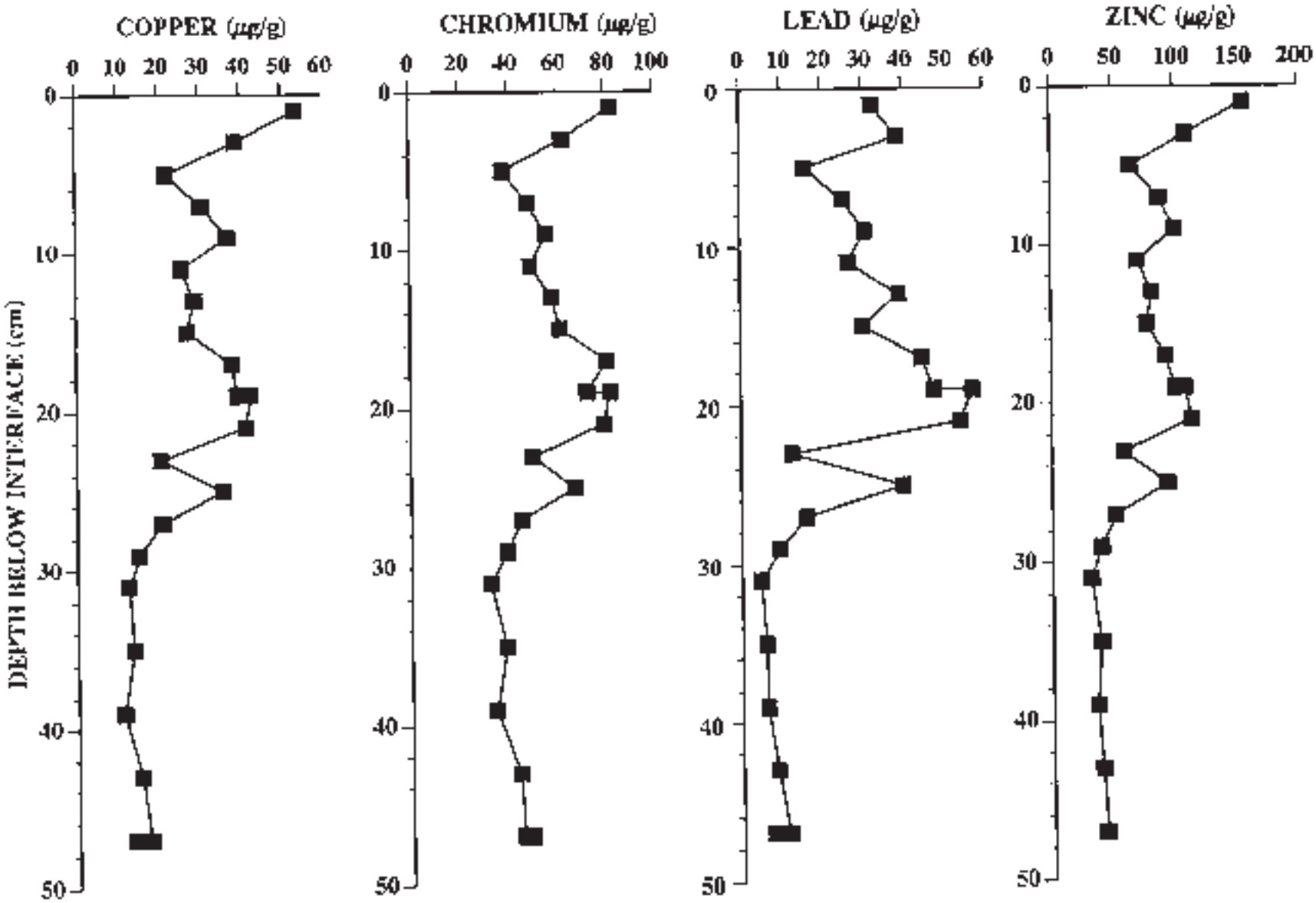
# MEMORANDUM

## ATTACHMENT A

## TRACE METAL CONCENTRATIONS IN TICONDEROGA CREEK

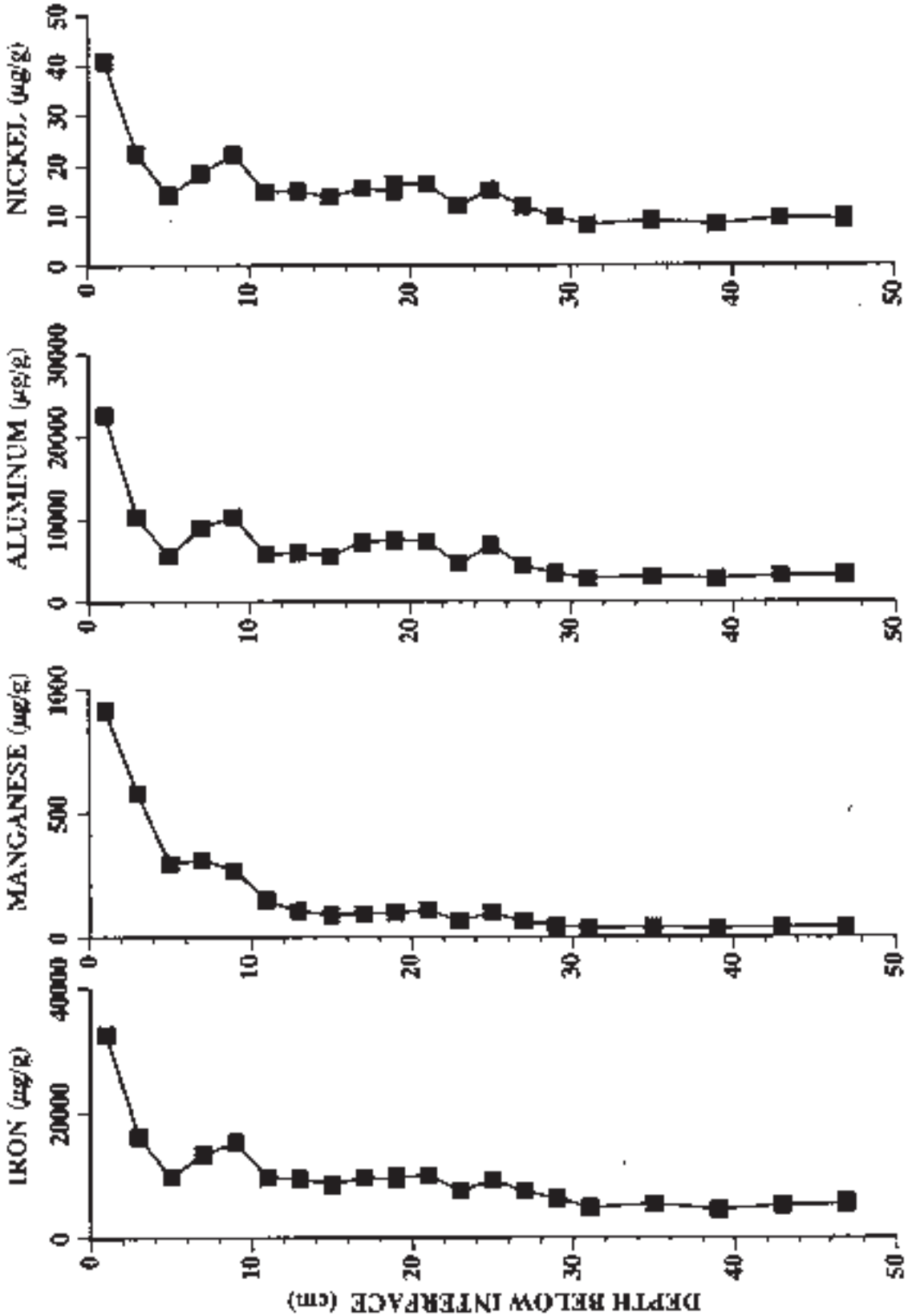
## FROM MCINTOSH (1994)

# FIGURE B-39. TICONDEROGA CREEK TRACE METALS

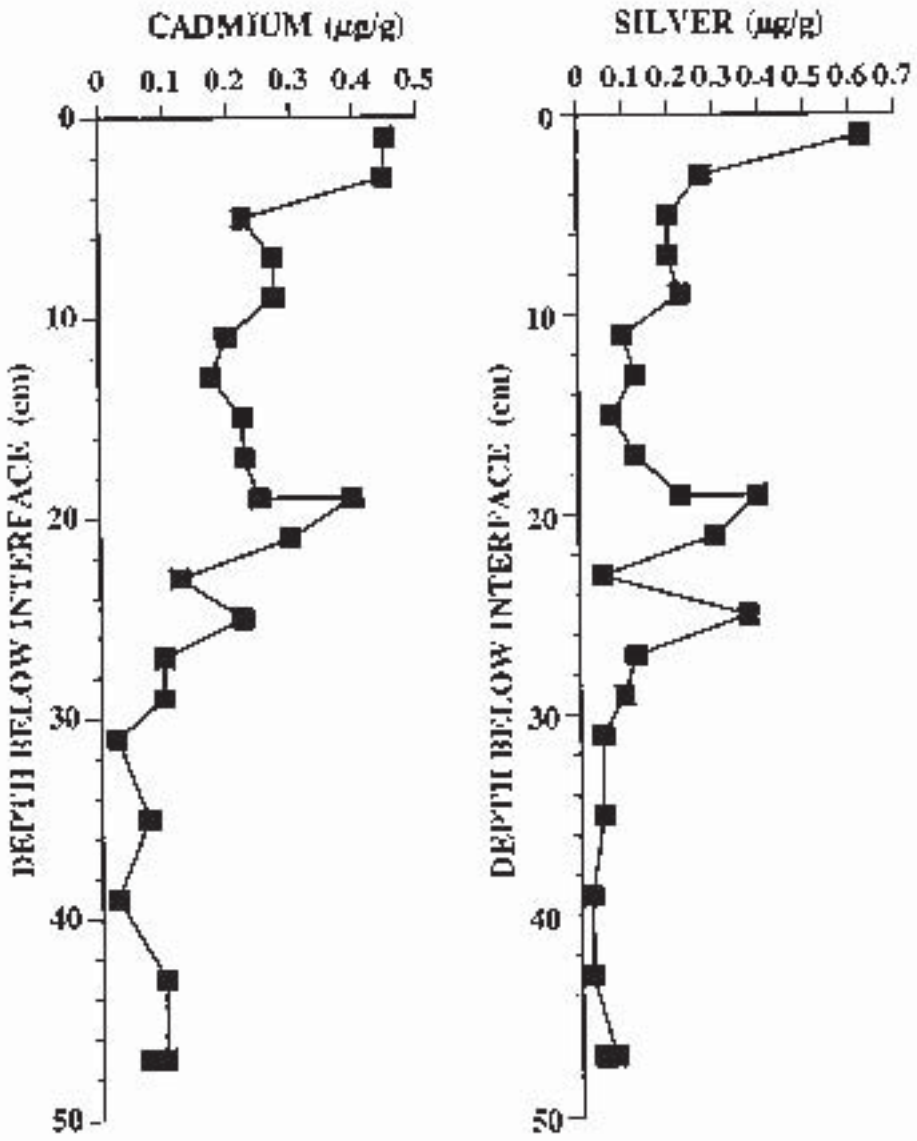



All concentrations based on dry weight.

# FIGURE B-39. CONTINUED

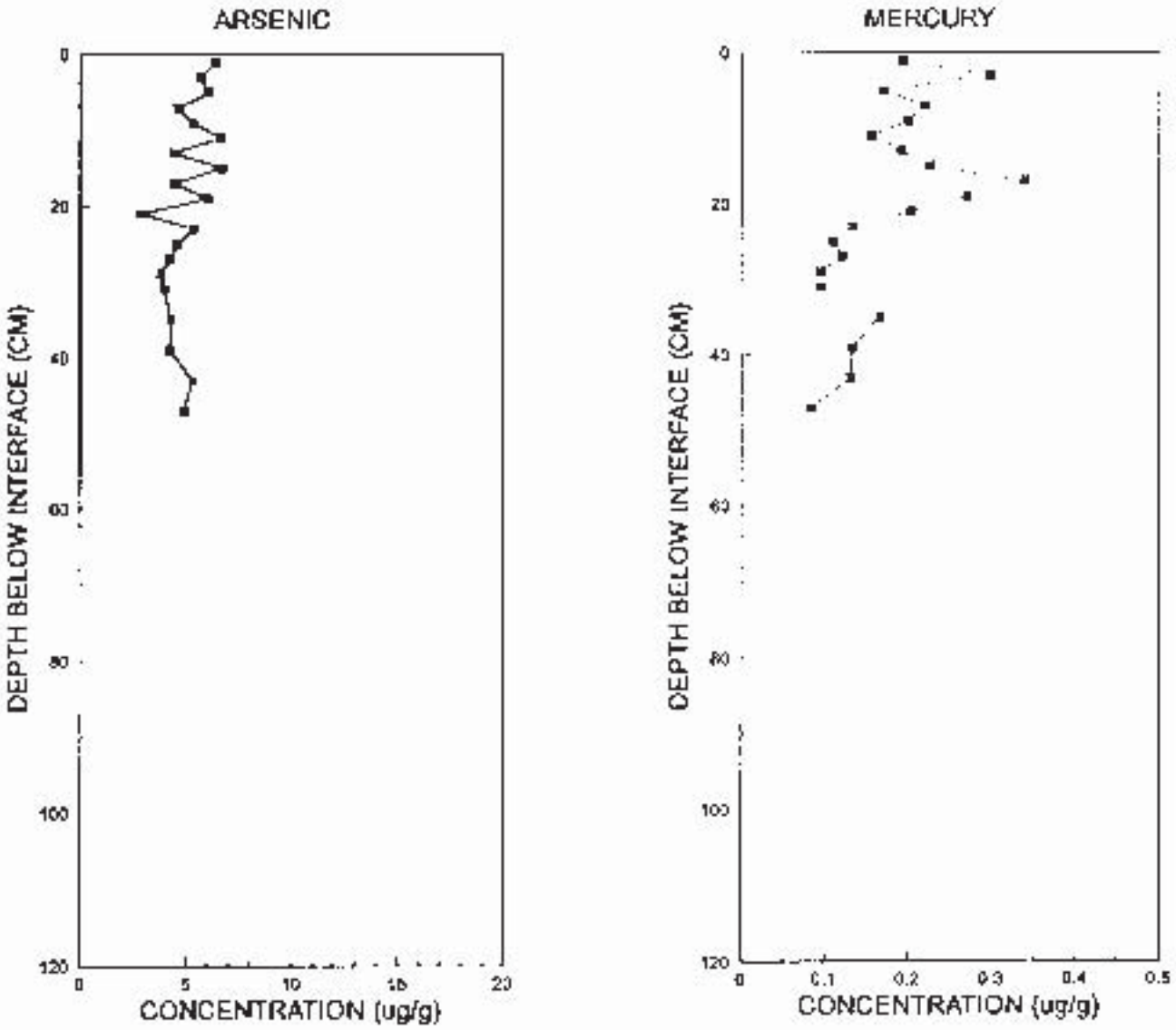


# FIGURE B-39. CONTINUED



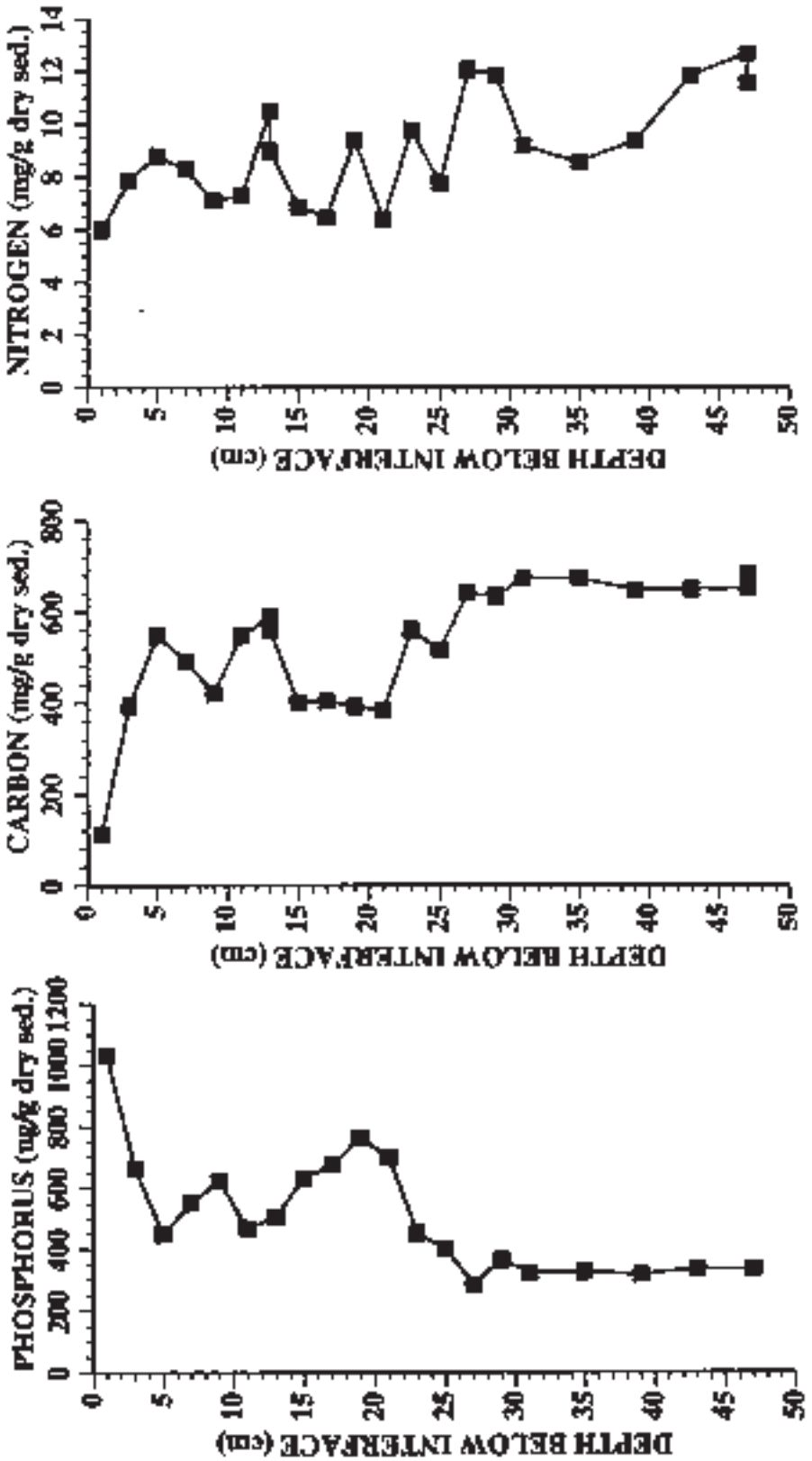

All concentrations based on dry weight.

# FIGURE B-39. CONTINUED

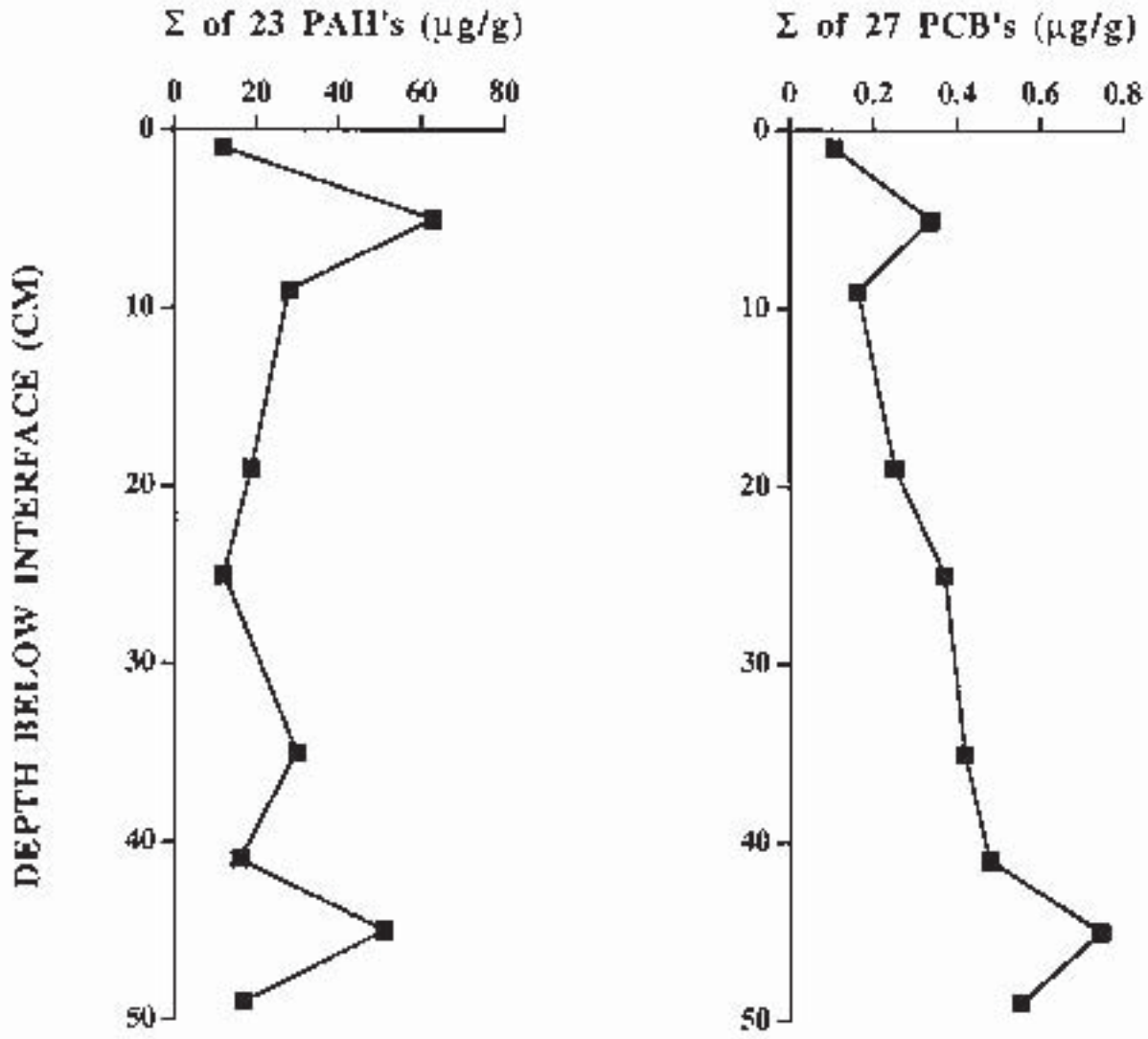



All concentrations based on dry weight.

# FIGURE B-40. TICONDEROGA CREEK NUTRIENTS

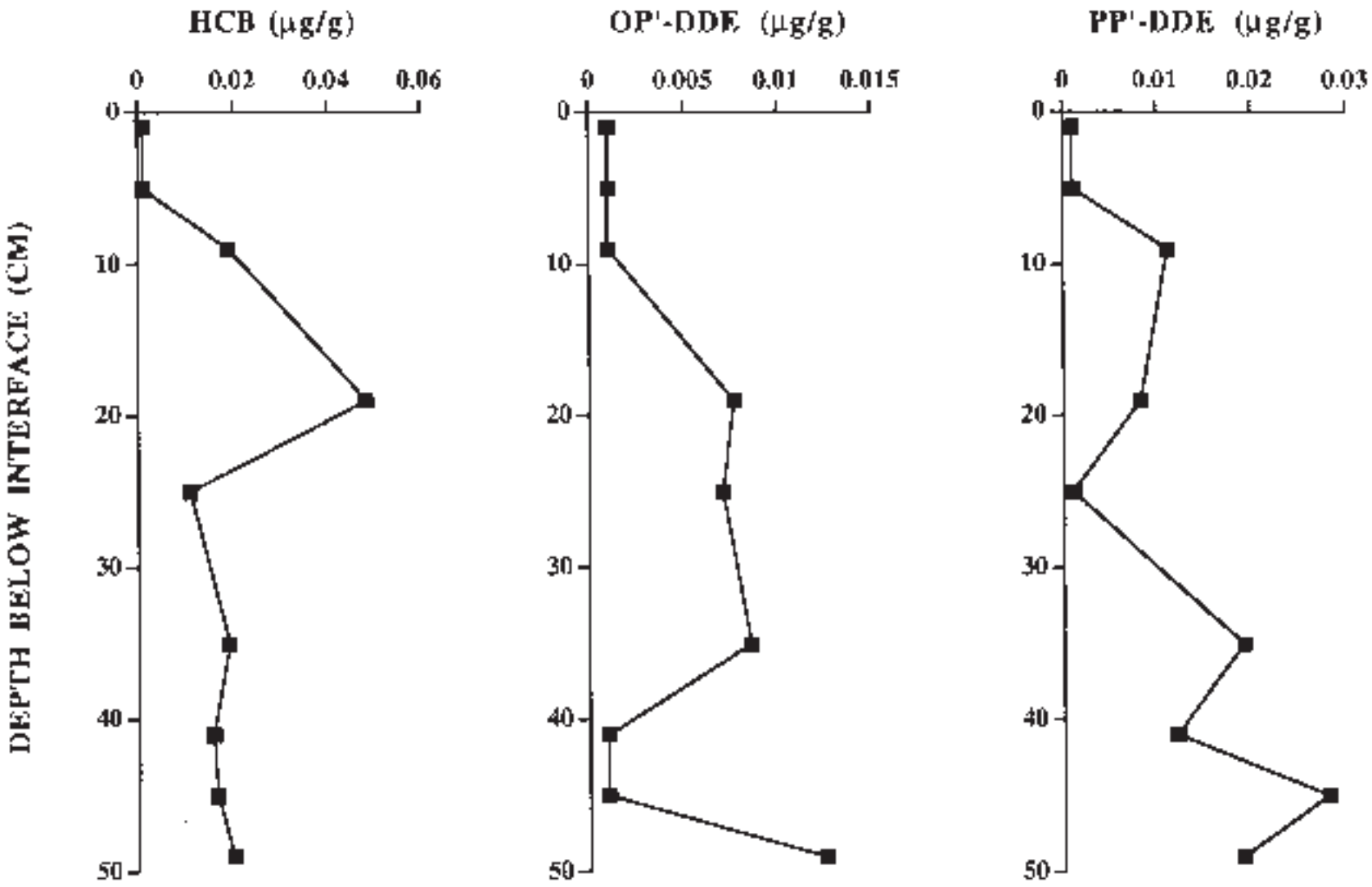


# FIGURE B-41. TICONDEROGA CREEK TRACE ORGANICS




All concentrations based on dry weight.

# FIGURE B-42. TICONDEROGA CREEK PESTICIDES




All concentrations based on dry weight.

# FIGURE B-43. TICONDEROGA CREEK GRAIN SIZE