D·I·A·N·D

Contaminants & Waste Management Program

CARCROSS ORGANOCHLORINE CONTAMINATION REPORT

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BACKGROUND

The development of the Carcross waterfront is of interest to the Carcross Tagish First Nations (CTFN). During planning for the waterfront development, contaminants were found on a former tie plant site located on the north side of Nares River connecting Lake Bennett to Nares Lake (Map 1) (Photo A & B). White Pass and Yukon Railway preserved railway ties in the plant from the late 1940's until 1975.

Up until the 1940's, the White Pass and Yukon Railway imported pre-treated railway ties from outside sources. In the late 1940's, officials of White Pass decided it would be more economical to order locally cut ties and build a plant to treat them in. The company supplied the ties and the chemicals used for treatment. The tie plant ceased operation in 1975 and was dismantled in 1979.

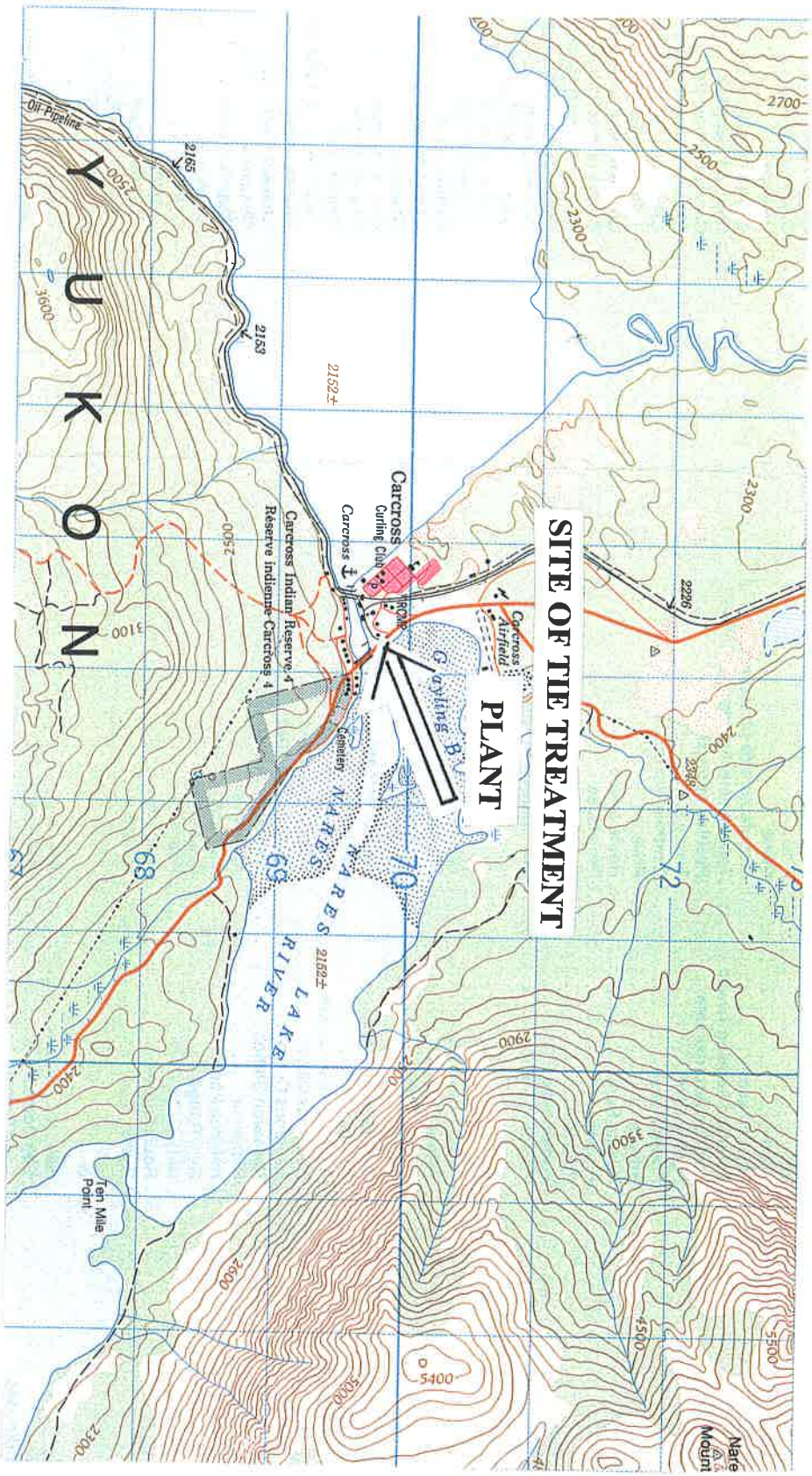
The Carcross tie treatment plant used a non-pressure process of tie preservation. The method used was known as hot and cold bath treatment. Until the 1940's, coal tar creosotes and zinc chloride, were generally recognized as the standard tie preservatives. Beginning in the mid 30's, other chemical were being used as a cleaner treatment. Pentachlorophenol (PCP) was one of these chemicals. The Carcross plant used diesel and PCP's throughout its operating history. (Dobrowolsky, 1997)

An initial assessment of the tie plant site was completed in January 1997. It was a preliminary regulatory assessment of any contamination being transmitted to the environment. Soil samples of the site and bore hole drilling in the area confirmed high levels of PCP, dioxin and furan contamination. The Local Contaminants Source (LCS) program was asked to investigate possible off-site contamination in the adjacent Nares River and surrounding lakes.

A sediment core sampling program of the adjacent Lake bottoms, upstream and downstream of the contaminated site, was undertaken. The sediment cores were dated and analyzed for chlorophenols and their corresponding anisoles, dioxins and furans. Samples of fish found in Nares Lake were also collected.

PENTACHLOROPHENOLS (PCP) AND ANISOLES

PCP is used as an antifouling agent, wood preservative and as a fungicide by the forest products and leather industries. It has been shown to be toxic to fish at low concentrations. (Glickman, 1977) Pentachloroanisoles (PCA) and other anisoles are a methylated degradation product of Chlorophenols. Anisoles are comparatively volatile with a relatively short lived half life in fish. Therefore residues in environmental samples indicated recent inputs of Chlorophenols. Chlorophenol residues in fish muscle has a half-life of 6.9 hours while anisoles is 6.3 days. (Glickman, 1977)



MAP 1: CARCROSS, YUKON TERRITORY

PHOTO A: FORMER WHITE PASS AND YUKON RAILWAY TIE TREATMENT PLANT SITE

PHOTO B: FORMER RAILWAY TIE TREATMENT PLANT WITH A VIEW OF CARCROSS, YT AND NARES RIVER

There are no Canadian Standards for Chlorophenols or their anisoles in sediments. There is a Netherlands Objective Value of 0.02 ppm for chlorophenols in newly deposited sediments, that is employed in the Netherlands. The Yukon Aquatic Life Standard, for pentachlorophenol in soils is 0.02 ppm or 20,000 ppt. Chlorophenols are known to be chemically stable in sediment with the penta molecule considered to be the most toxic. There are no standards for anisoles, but they are considered to have a much lower toxicity and to be non-carcinogenic, as compared to chlorophenols. According to the Canadian Soil Quality Guidelines for Pentachlorophenol, a study conducted in the lower reaches of the Fraser River, B.C., where several chlorophenate wood treatment plants are located found a grand mean level of PCP for all edible species was 600 ppt. While in Lake Ontario for all edible species a mean level of PCP was 530 ppt.

DIOXINS AND FURANS

Dioxins and furans are generated from forest fires as well as man-made products. They exist as a contaminant in chlorophenols from the process used in their production and as degradation products when the chlorophenols are exposed to ultraviolet light. This can occur when the treated railway ties lie exposed to sunlight over the years. Dioxins created by this process wash off the ties in precipitation and enter the downstream environment.

There are no Canadian or Yukon standards for dioxins or furans in sediments, but here are values for soils. The Yukon Standard, for dioxin and furans in soils is 0.00035 ppm or 350 ppt.

SEDIMENT

BACKGROUND

Sediment core sampling were taken at 5 sites as follows (Map 2)(Photo C & D):

1. Coal Lake was selected as a representative background sample. The lake has not been exposed directly to chlorophenols and their anisoles. The presence of these compounds in sediment would be only from long-range air transport.

2. Bennett Lake—West Arm is located upstream from the tie plant site. It also represents a background sample, close to the contaminated site.

3. Bennett Lake—Mid Lake is the closest sample site upstream from the contaminated site.

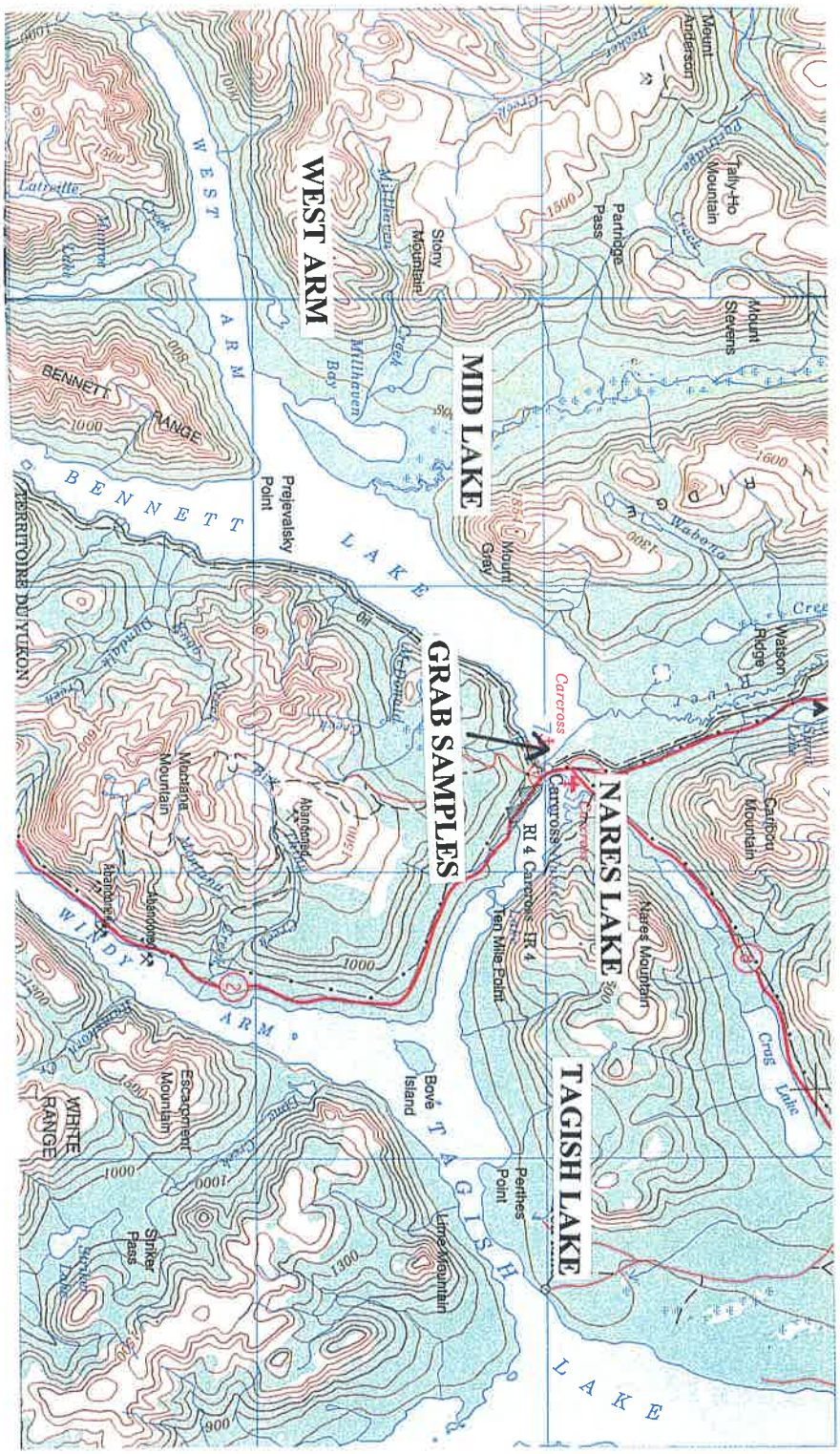
4. Nares Lake is immediately downstream from the tie treatment plant site and subject to the direct deposit of chlorophenol.

5. Tagish Lake is the farthest downstream sample site from the plant.

Seven grab samples of sediment where taken in the Nares River directly across from the tie treatment plant (Map 3). On the map TPP-1, TPP-2 and TPP-3 are original DIAND wells from the initial investigation of contamination. TPP-2 is the contaminated well center of the site. TPP-1 well is located closest to the actually tie treatment plant site. These were used as reference points in the water. The 7 grab samples were numbered with the flow of the river. Sample 1, 2, and 3 were taken 47 m from the foreshore in direct alignment with TPP-1, 2, and 3, on shore. Samples 4, 5 and 6 were taken at a distance of 90m in the same alignment pattern. The 7 sample was taken 160 m off the foreshore and was intended as a sample to determine the lateral dispersion of the contamination.

Chlorophenols and Anisoles

The sediment results indicated contamination of sediments both upstream and downstream of the contaminated site (Figure 1 and 2). All pentachlorophenol levels are below the Yukon Aquatic Life Standard of 20,000 ppt. The detection of these compounds in years predating their existence is the subject of speculation. It is possible that these compounds have moved or been transported through the sediment column.



Scale 1:250 000 Échelle

Miles 5 0 5 10 15 20 Miles

Kilometres 5 0 5 10 15 20 25 30 Kilometres

MAP 2: OVERVIEW MAP OF SAMPLING SITES

PHOTO C: SEDIMENT CORE SAMPLING

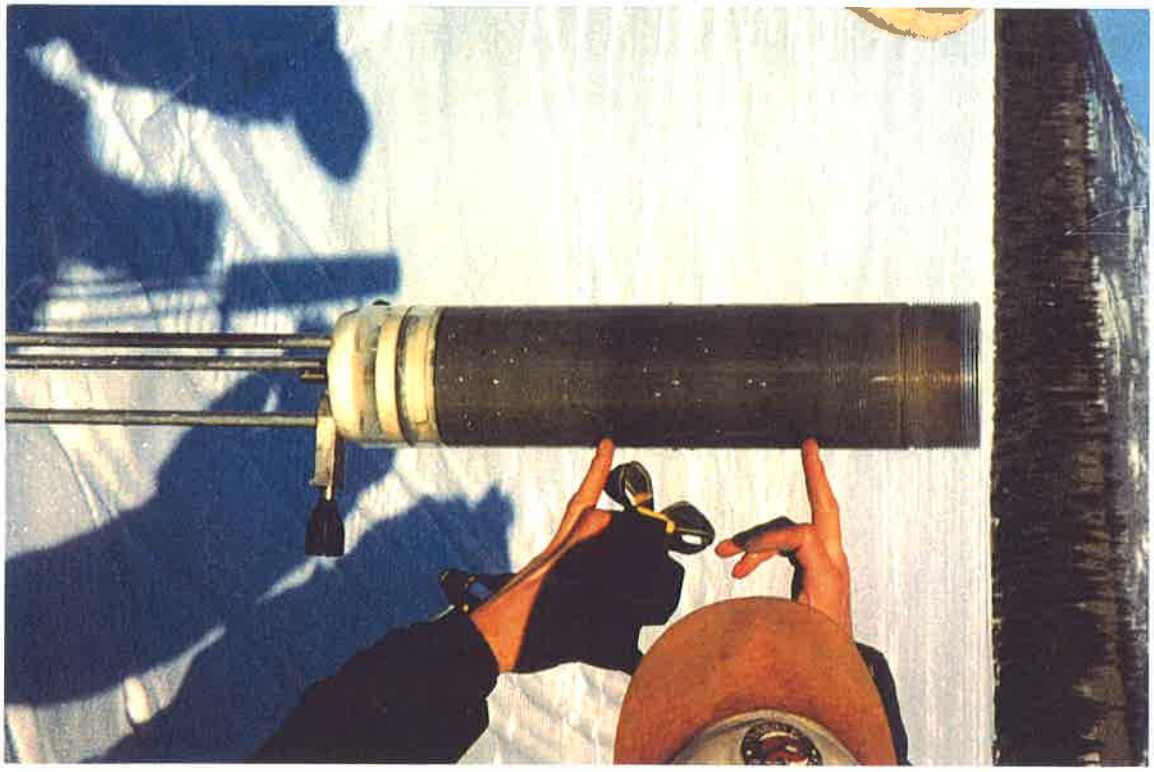
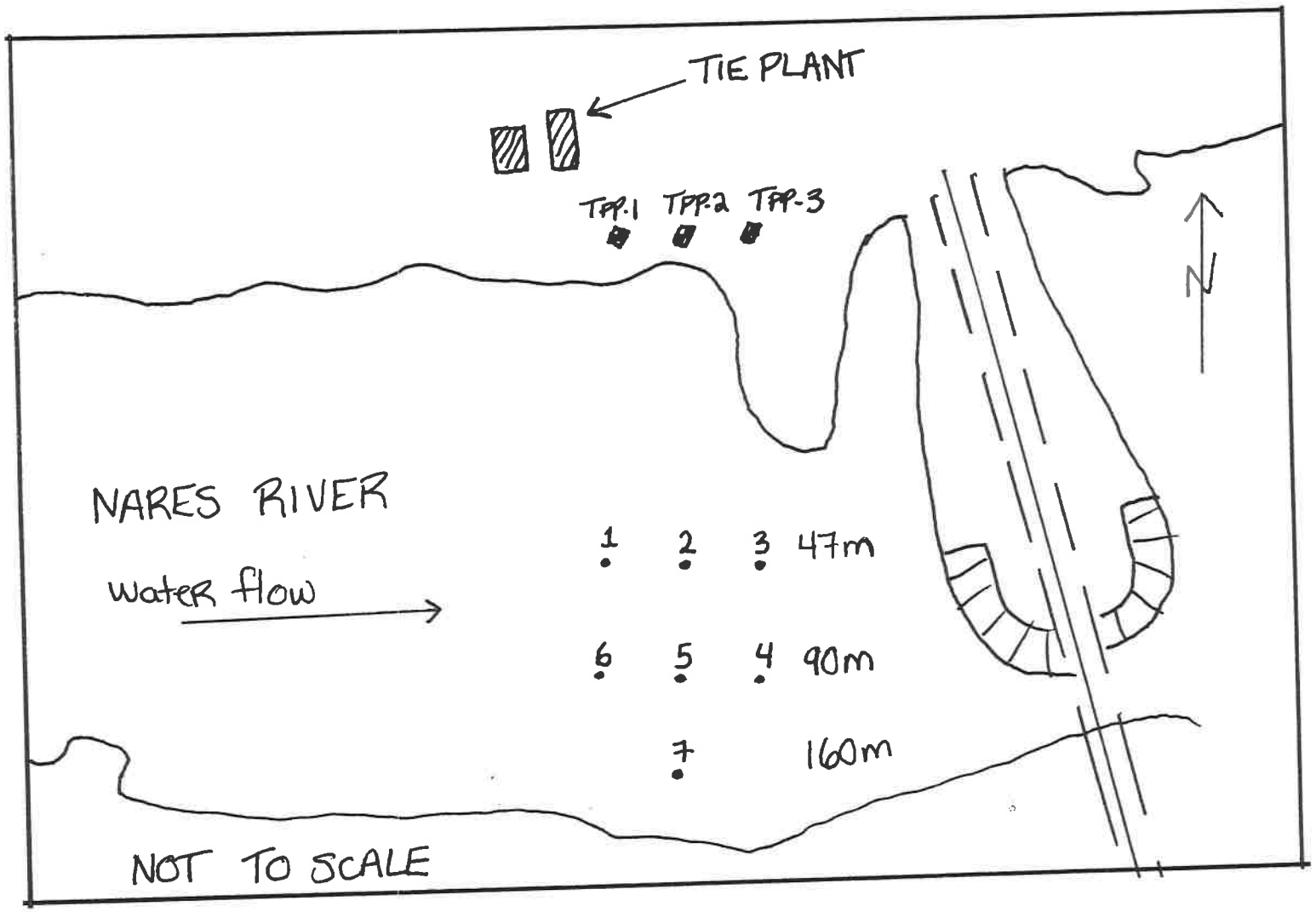


PHOTO D: SEDIMENT CORE SAMPLE



MAP 3: GRAB SEDIMENT SAMPLE CHANNEL POSITIONS IN NARES RIVER

Coal Lake levels of chlorophenols and anisoles are representative of airborne deposition. The presence of higher levels of the most volatile (lighter) of the chlorophenols and anisoles, support this assessment and are similar to other lake levels not directly affected by contamination. In comparison, the values for Bennett Lake are higher and may represent an airborne deposition that is higher due to the proximity of the site. This is a short-range transport of the volatile chlorophenols from the tie treatment plant. The levels of contamination in Nares Lake is over double that of Bennett Lake samples. Tagish Lake levels are also elevated in comparison to Bennett Lake, but lower than the Nares values. It is unknown if the tie treatment tanks containing the pentachlorophenols were drained directly into the Nares River, or if the contamination is from run off at the tie plant site.

The grab samples levels represent a logical reduction in contamination as you move across the Nares River current from the site. All of the samples are below those suggested for action in the Netherlands guidelines.

Dioxins and Furans

The dioxin and furan values are all below the levels in the Netherlands guidelines (Figure 4 and 5). The tetra molecule of dioxin (TCDD) is the most toxic and is not present in these samples. Nares Lake and Tagish Lake levels are elevated in comparison to Bennett Lake but still below the regulatory action levels.

Figure 1: Chlorophenols in Lake Sediment Samples

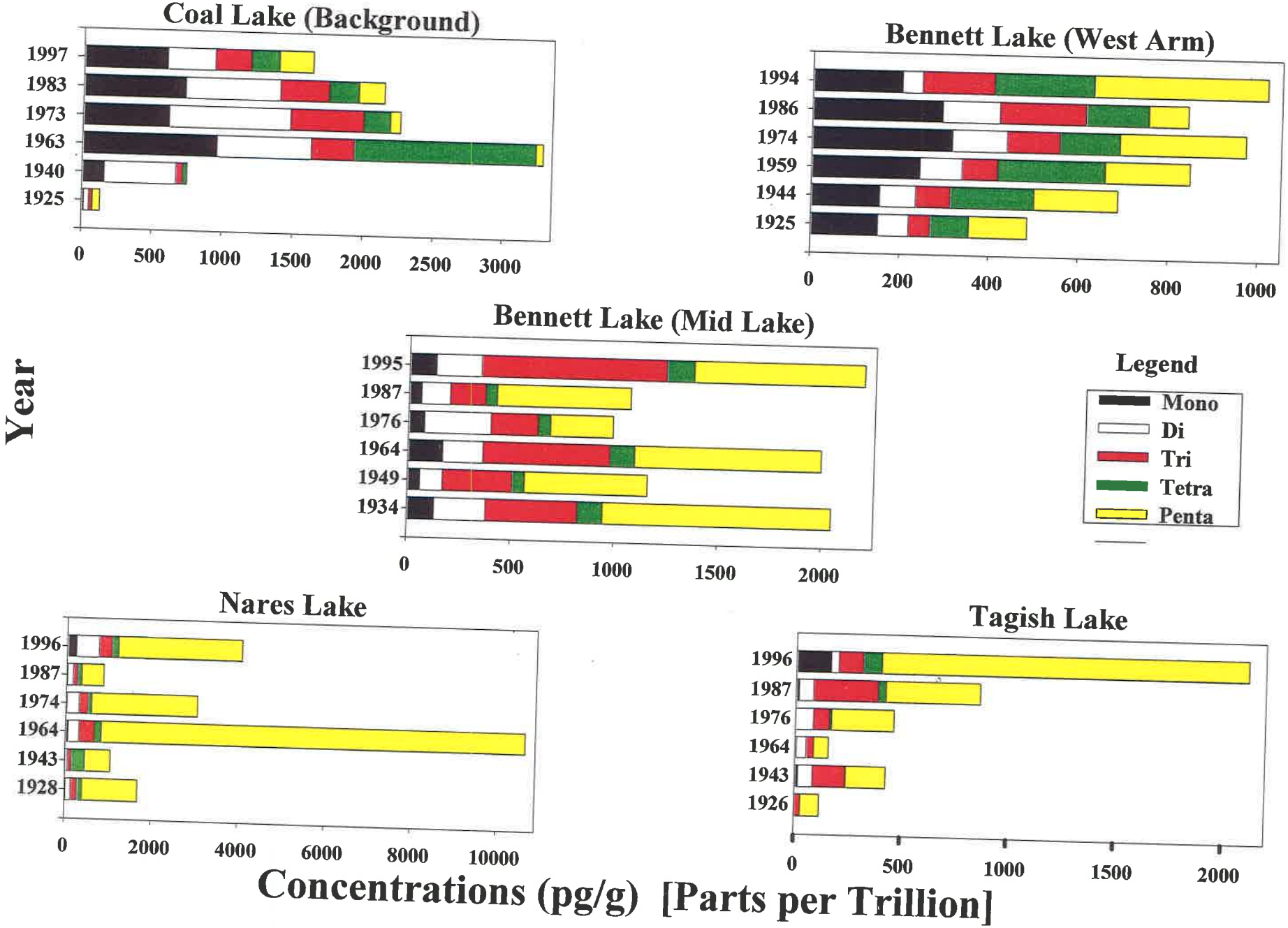


Figure 2: Chlorinated Anisoles in Lake Sediment Samples

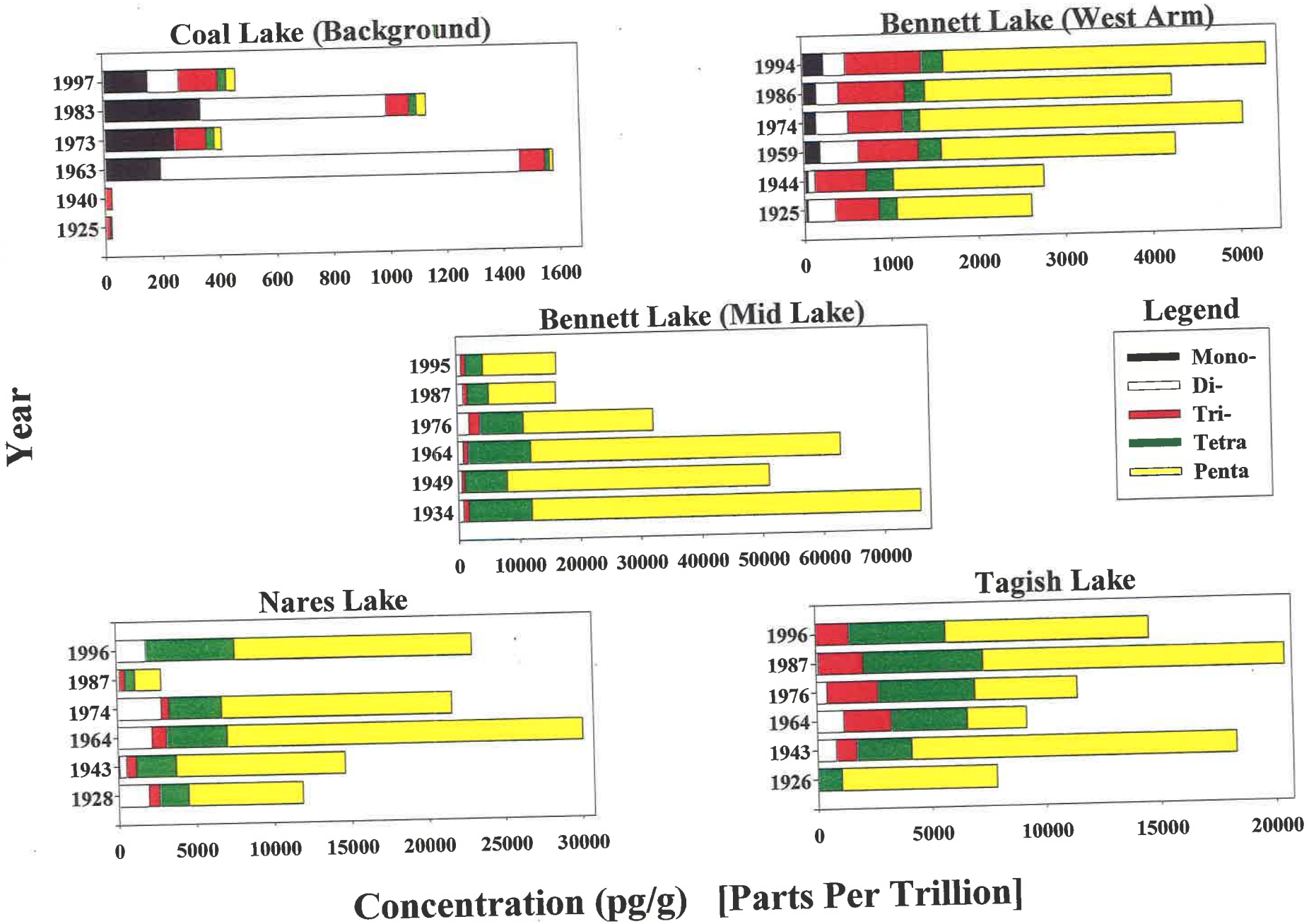


Figure 3: Grab Sediment Samples from Nares River

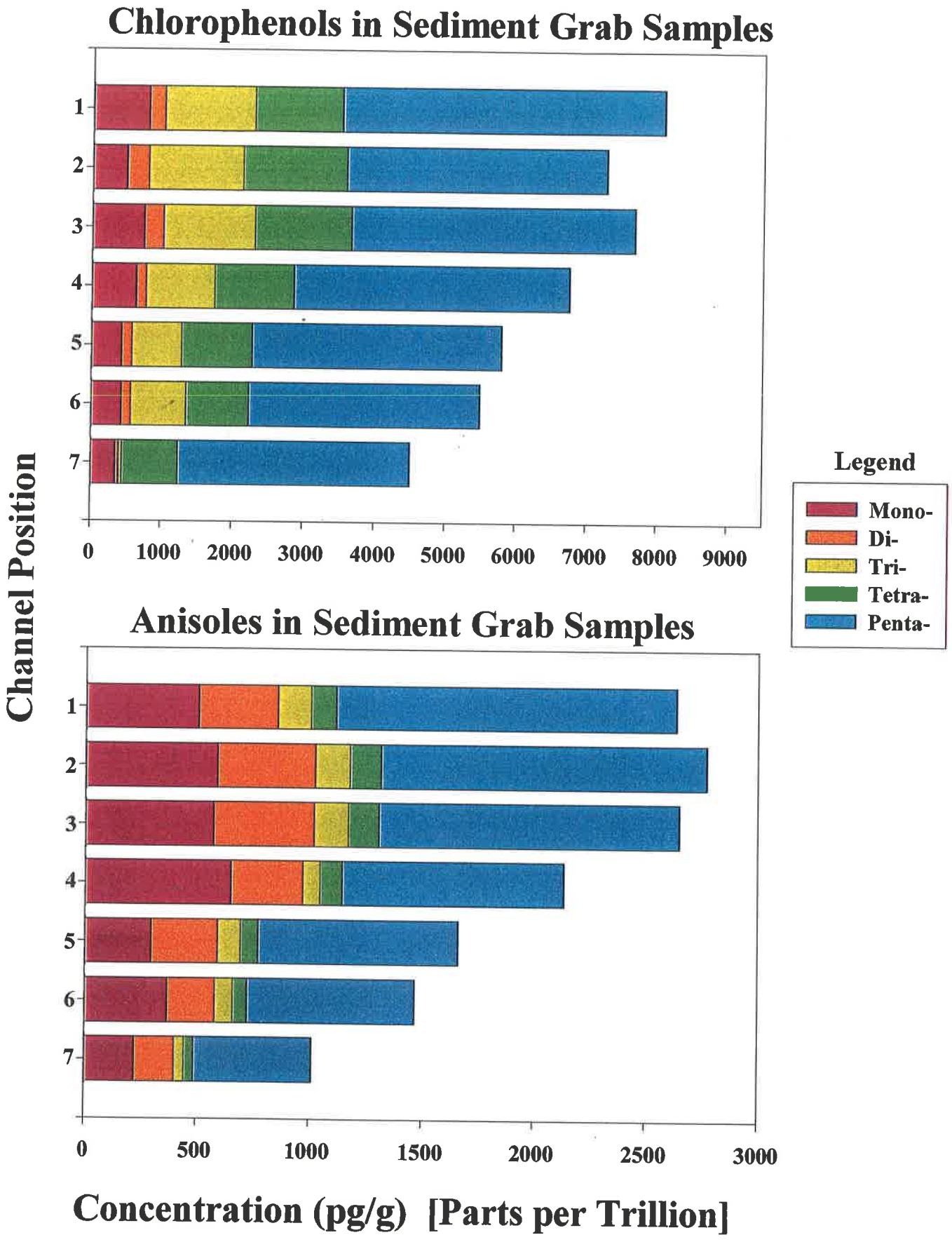
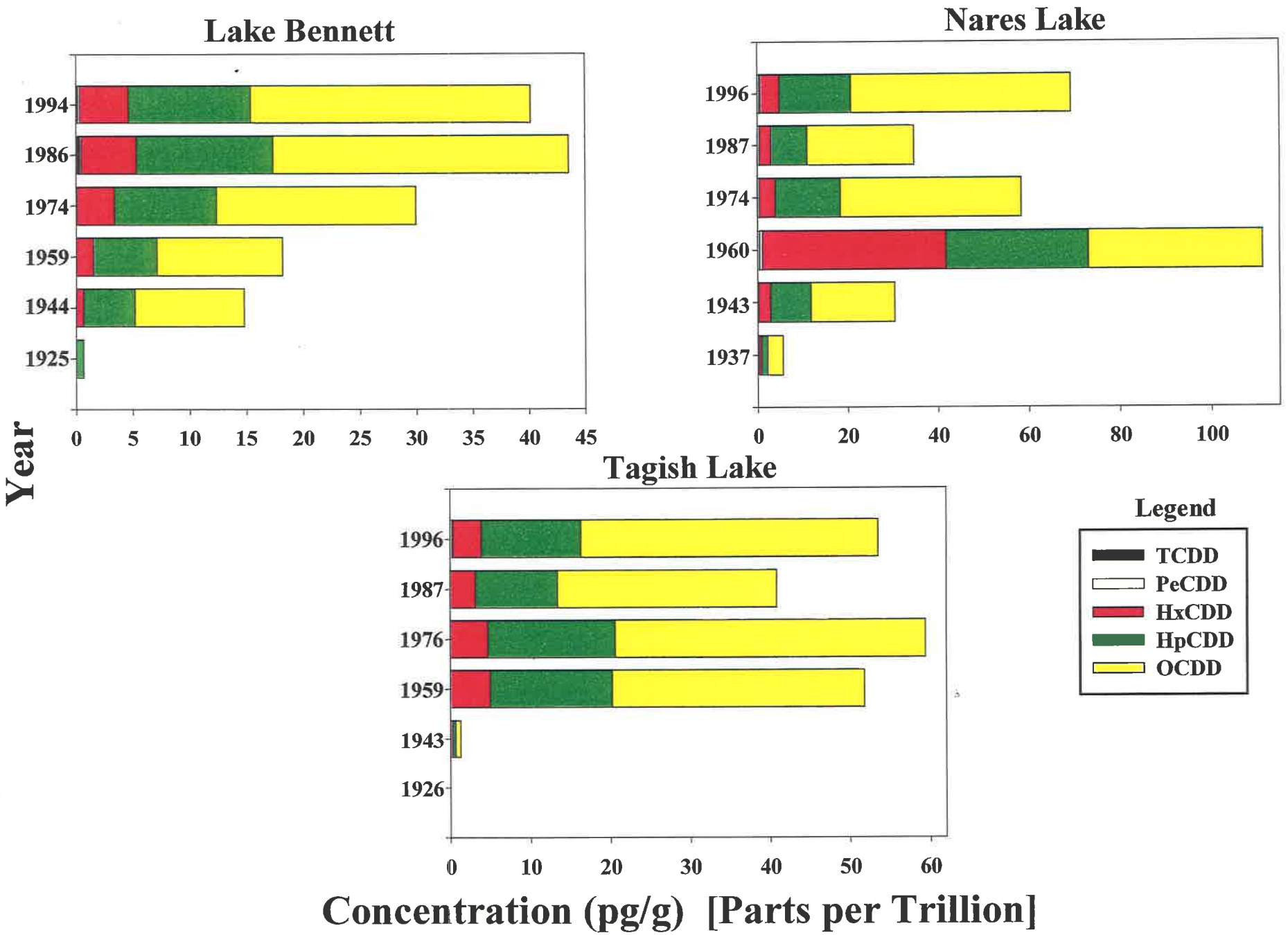


Figure 4: Dioxins in Lake Sediment Samples



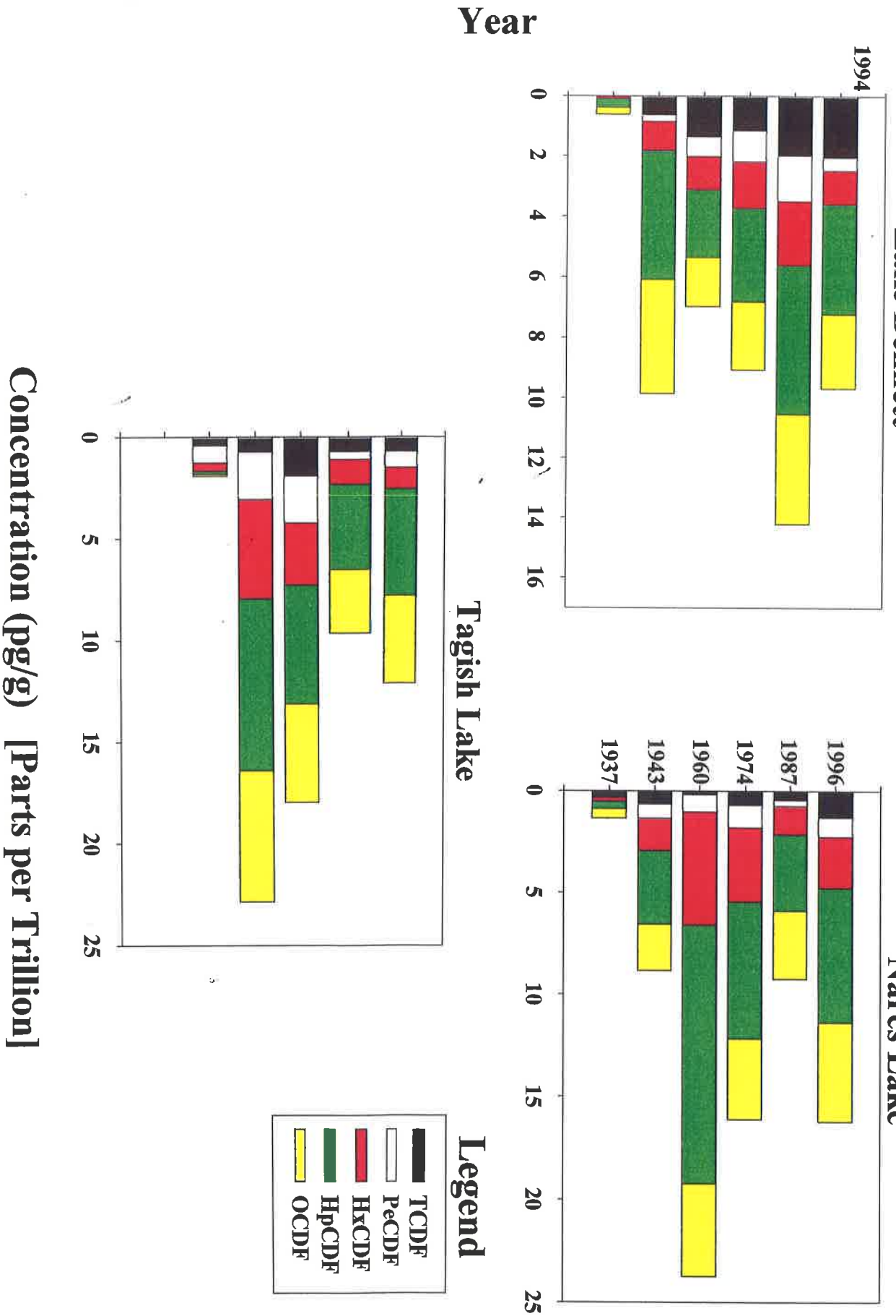


Figure 5: Furans in Lake Sediment Samples

AQUATIC LIFE

BACKGROUND

Fish were collected in Nares Lake and tissue samples were analyzed for chlorophenols and their corresponding anisoles. This data was then compared to Lake Laberge Trout and Hanson Lake Pike.

Chlorophenols

Chlorophenols were found to be significantly lower in Nares Lake Trout and Pike compared to those from Laberge and Hanson Lakes (Figure 6). The chlorophenol levels in Laberge and Hanson Lake fish are indicative of long-range transport, with the lighter fractions being represented. It is unknown why the Nares Lake values are so low. However, chlorophenols have a short transit time of 6.9 hours, in fish tissues, and the samples may represent a difference in feeding behavior between the Lakes. The fish were also collected at different times of the year making it difficult for direct comparisons. All of these levels are still significantly lower then the study in the Fraser River and Lake Ontario. The mean level of pentachlorophenols found in all edible species was 600 ppt and 530 ppt, respectively. The mean level of pentachlorophenols in Nares Lake Pike was 2.14 ppt and Hanson Lake Pike was 2.99 ppt.

Anisoles

Nares Lake Pike and Lake Trout had significantly higher levels of anisoles present than those in the comparison lakes and may represent the proximity to sediment contamination, rather than long-range transport (Figure 7). The longer residence time of anisoles in tissue (6.9 days), may mitigate the other variables associated with the fish sampling, such as feeding behavior and time of season. There is no known consumption guideline for anisoles but based on the extremely low concentrations it is unlikely to be toxic in the short term. Anisoles are methylated and more readily metabolized than chlorophenols. An acceptable consumption guideline for anisoles in food has yet to be established.

Figure 6: Chlorophenols in Nares Lake Fish Compared with Lake Laberge Lake Trout and Hanson Lake Pike

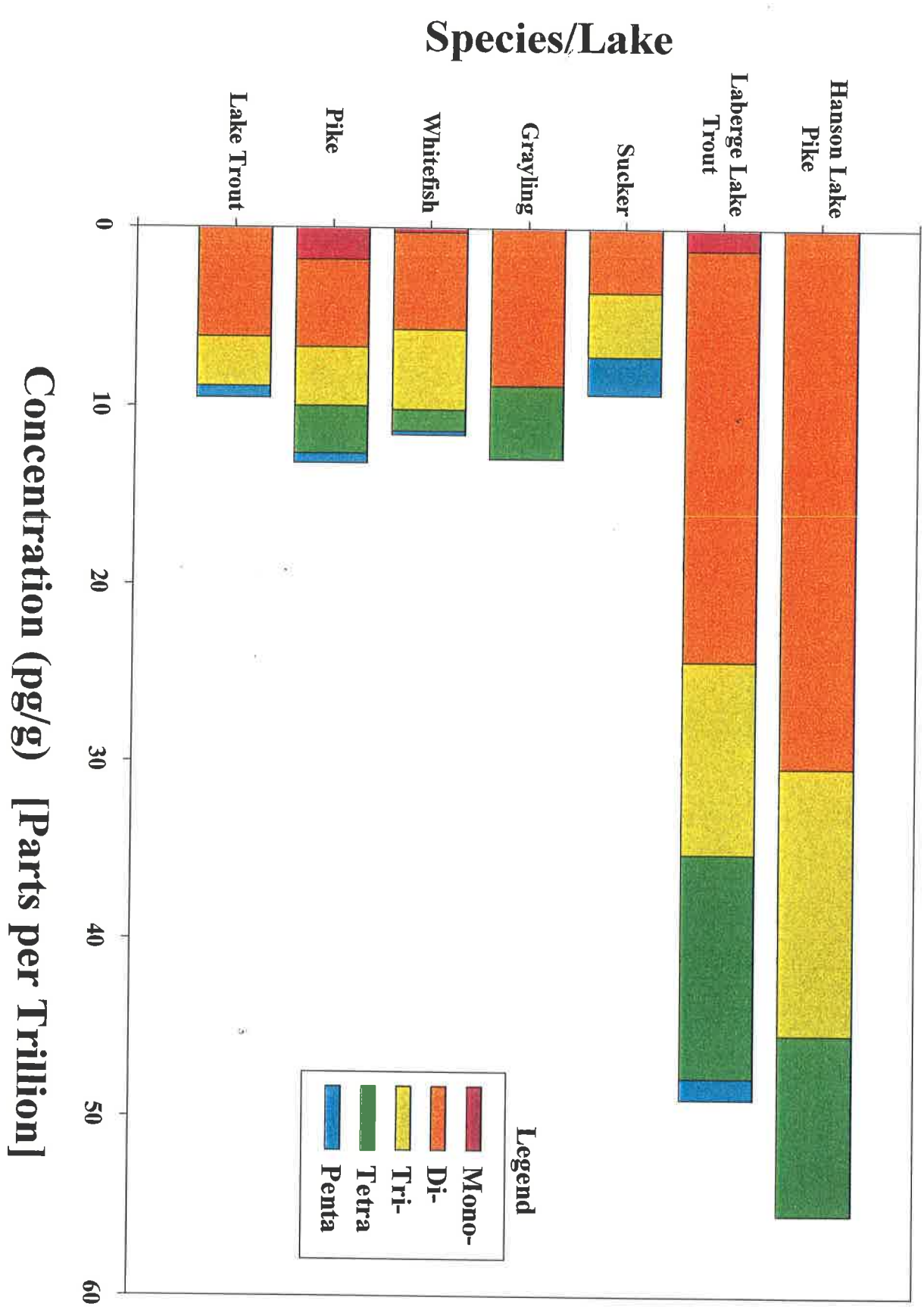
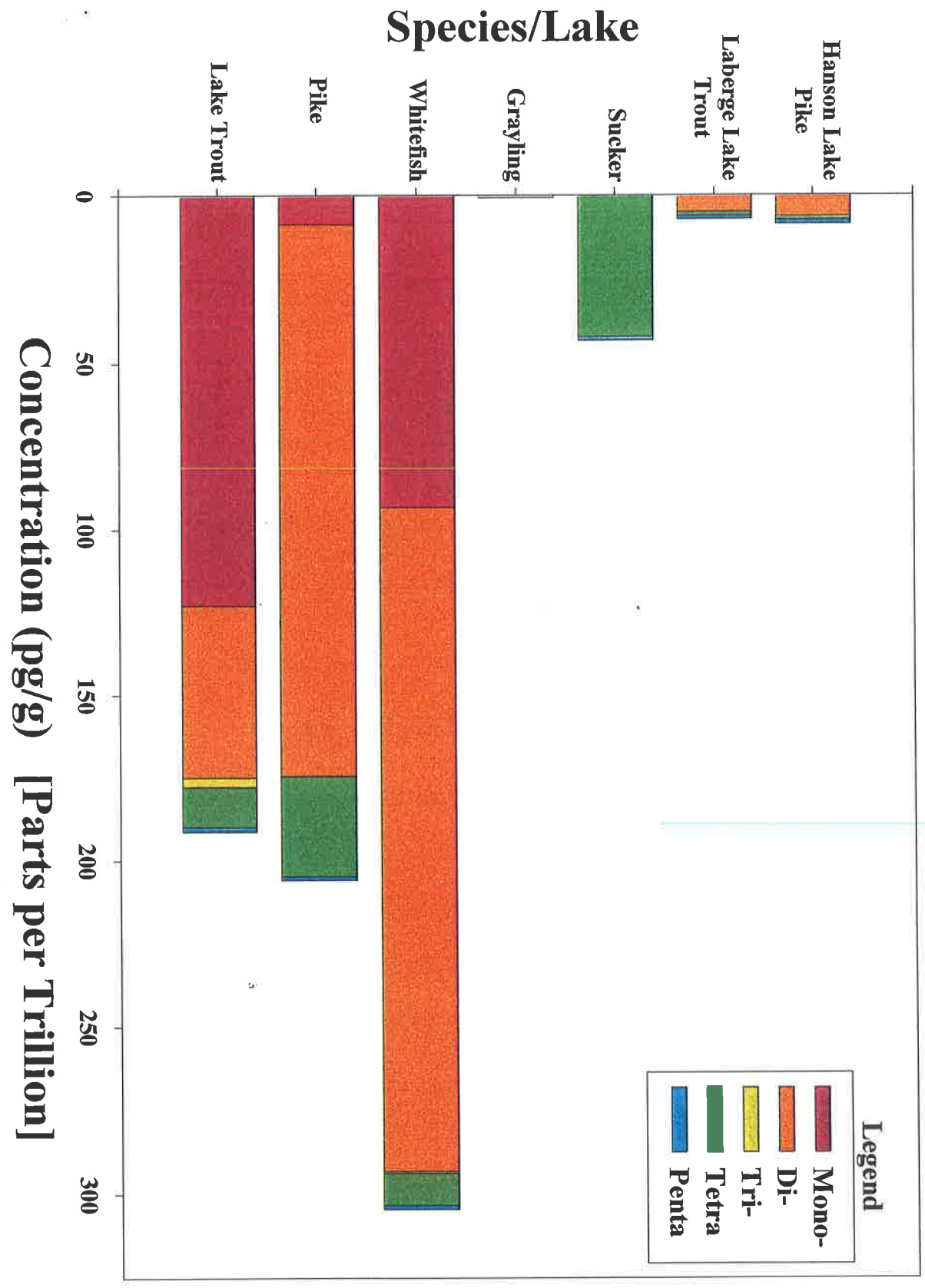


Figure 7: Chlorinated Anisoles in Nares Lake Fish Compared with Lake Laberge Lake Trout and Hanson Lake Pike



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CCME Penatchlorophenol Reference

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Glickman, Andrew H., Statham, Charles N., Wu, Anthony, and Lech, John J. Studies on the Uptake, Metabolism, and Disposition of Penatchlorophenol and Pentachloroanisole in Rainbow Trout. Toxicology and Applied Pharmacology. 1977. pp. 649-658.

Map 1 and Map 2: Canada Centre for Mapping. Natural Resources Canada. 1996