DIAGNOSTIC AND FEASIBILITY STUDY
OF
SMITH & BYBEE LAKES

PORTLAND, OREGON

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METRO
Regional Services

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EXECUTIVE SUMMARY

Smith and Bybee Lakes and their associated sloughs and wetlands are remnants of formerly extensive river bottomlands located near the confluence of the Willamette and Columbia Rivers. Part of the Columbia Slough watershed, these large shallow lakes and wetlands are part of the 1,928-acre Smith and Bybee Lakes Wildlife Area, managed primarily for wildlife habitat protection and enhancement while providing passive recreational opportunities for the Portland, Oregon metropolitan region.

Considerable changes have occurred in the lakes watershed that have had significant impact on the lakes' system: construction of dam and dikes, filling with dredge spoils, and introduction of exotic species of plants and animals. The most recent significant alteration of this system occurred with the construction of a dam and water control structure in 1982 that separated the lakes from the Columbia Slough and Willamette River. Since that time, the lakes have essentially functioned as reservoirs, held at a static water level. Except during brief or rare flood events, the lakes are no longer influenced by the hydrological dynamics of the daily tidal forces and seasonal floods.

A number of studies were conducted from 1992 to 1995 to evaluate the impact of the current water management strategy on the lakes' system. Studies included a water quality assessment, a paleolimnological survey, a surficial sediment survey, screening-level risk assessment, groundwater modeling of the region, and hydrodynamic and water quality modeling of lakes, slough, and Willamette River surface waters.

Based on historical data, results from recent studies, and management recommendations made in several studies, a return to the hydrodynamic conditions existing prior to the construction of the dam in 1982 is recommended. A number of management options to achieve this goal are discussed, with advantages and disadvantages addressed. The water management recommendation is:

1. Remove the existing dam and flow control structure.
2. Replace it with a structure that allows unimpeded flow between the lakes and the Columbia Slough and Willamette River while maintaining the ability to retain water in the lakes' basin.
3. Determine the cost of pumping water from the Willamette or Columbia River on a limited basis.
4. Explore the potential benefits of maintaining the western arm of Bybee Lake as open water year-round.

HISTORICAL BACKGROUND

Smith and Bybee Lakes and their associated sloughs and wetlands are remnants of formerly extensive river bottomlands that extended from the western terminus of the Columbia Gorge to the mouth of the Columbia River. These river bottomlands were composed of a complex of permanent open water lakes and sloughs, tidal mudflats, shallow freshwater marshes, open meadow and forested wetlands, and riparian forests.

Archeological evidence indicates these lakes were used by Native Americans as a place for gathering food, especially wapato (Sagittaria sp.) (Oregon State Archeologist). The presence of fire-cracked rock indicates former sites of pits/ovens for drying the starchy roots of this plant for long-term storage.

Due to the periodic flooding of the river bottomlands, European settlers used the lakes and adjacent slough area on a seasonal basis, primarily for water transportation and livestock grazing. Construction of the Bonneville Dam resulted in increased control on the lower Columbia River, allowing construction of barns and dwellings within the floodplain in the lakes area. Dredging of the Willamette and Columbia Rivers in the vicinity resulted in dredge spoil material, primarily fine-grained sand, being disposed in and around the lakes. This material allowed further development to occur, primarily loading and storage facilities associated with Port facilities. Based on historical aerial photographs (Metro files), the complex of sloughs, lakes, and wetlands that formerly connected to Smith and Bybee Lakes no longer exists due to fill activities. Today, the lakes are hydrologically isolated from the nearby rivers, except for the flows occurring through the Columbia Slough to and from the lakes.

Located at the confluence of the Willamette and Columbia Rivers, Smith and Bybee Lakes have historically functioned in response to the hydrological patterns of these two rivers. Prior to the construction of hydroelectric and flood-control dams on these rivers (1938-1972), annual amplitude in river water levels in the Portland-Vancouver area ranged widely. Given the subtle topographic relief in the Smith and Bybee Lakes basins (4 ft. to 15 ft. AMSL), seasonal flooding significantly controlled the hydrologic regime of this area. The local tidal amplitude prior to the construction of Bonneville Dam is unknown, but the currently observed tidal amplitudes of 2 to 3 feet/day are probably within the historical realm.

Current land uses adjacent to the lakes are entirely commercial and industrial. The lakes border the Rivergate Industrial Area, managed by Port of Portland, which serves primarily as loading, storage and handling, and minor processing of shipped goods. The closed St. Johns Landfill, a 260-acre landfill that served the metropolitan region from the 1940's to 1991, borders the lakes to the southwest. North Portland Road forms the eastern boundary of the area. The remainder of the lakes boundary is separated from industrial lands by the Columbia Slough.

Today, Metro has primary responsibility for management of Smith and Bybee Lakes Wildlife Area (Figure 1). Management goals, objectives, and responsibilities are established in the *Natural Resources Management Plan for Smith and Bybee Lakes* adopted by Metro, City of Portland, and Port of Portland in 1990. This plan designated a 1,928-acre management area that included the lakes, adjacent sloughs and wetlands, the closed St. Johns Landfill, and 4.5 miles of the Columbia Slough. The plan sets a mission of managing the lakes area primarily as a wildlife refuge while maintaining and enhancing, to the extent possible, in a manner that is faithful to the lakes' original natural conditions. Passive recreational opportunities that do not compromise the primary goal are encouraged. A management committee composed of local and state resource management agencies, environmental groups, neighborhood and citizen organizations, meets monthly for making management recommendations.

PUBLIC USE

Public use of the Smith and Bybee Lakes area has always been limited by access. Beach access off North Portland Road was utilized by North Portland residents during the 1940's and 1950's. In the 1950's and 1960's, horses were rented locally for exploration of the area. Fishing has been a popular use of the area, especially with greater introduction of more warmwater species in the Willamette and Columbia River system. Due to the limited accessibility by foot, fishing access has often been by boat. Water skiing was enjoyed by users when water depths were sufficient. At certain times during drier years, cars were driven across the dry lakes bottom (Ted Smith, personal communication).

Current public use of the area is guided by the policies outlined in the Management Plan and the *Recreation Master Plan for Smith and Bybee Lakes* (1992), which has become policy adopted by the Metro Council in 1992. The Recreation Plan supports policies of the Management Plan, which states:

> "Smith Lake will be the principal area for water-related recreational activities such as canoeing, rowing, fishing, and birdwatching. Smith Lake will also be managed as a wildlife habitat and preservation area. No hunting, motorized boating, or other obtrusive forms of recreation will be allowed."

> "Bybee Lake and surrounding wetlands will be managed primarily as an environmental preserve. Bybee Lakes will be available for recreational use, although access by foot and boat will be more difficult than Smith Lake. No vehicular access will be provided to Bybee Lake."

The recreation plan envisions promotion of public access by a perimeter trail system, increased boat access to Smith Lake, and construction of an interpretive center adjacent to Smith Lake. Currently, an interlakes trail, approximately 4,500 feet in length, has been constructed with interpretive signs and observation shelters (Figure 25). With one mile of

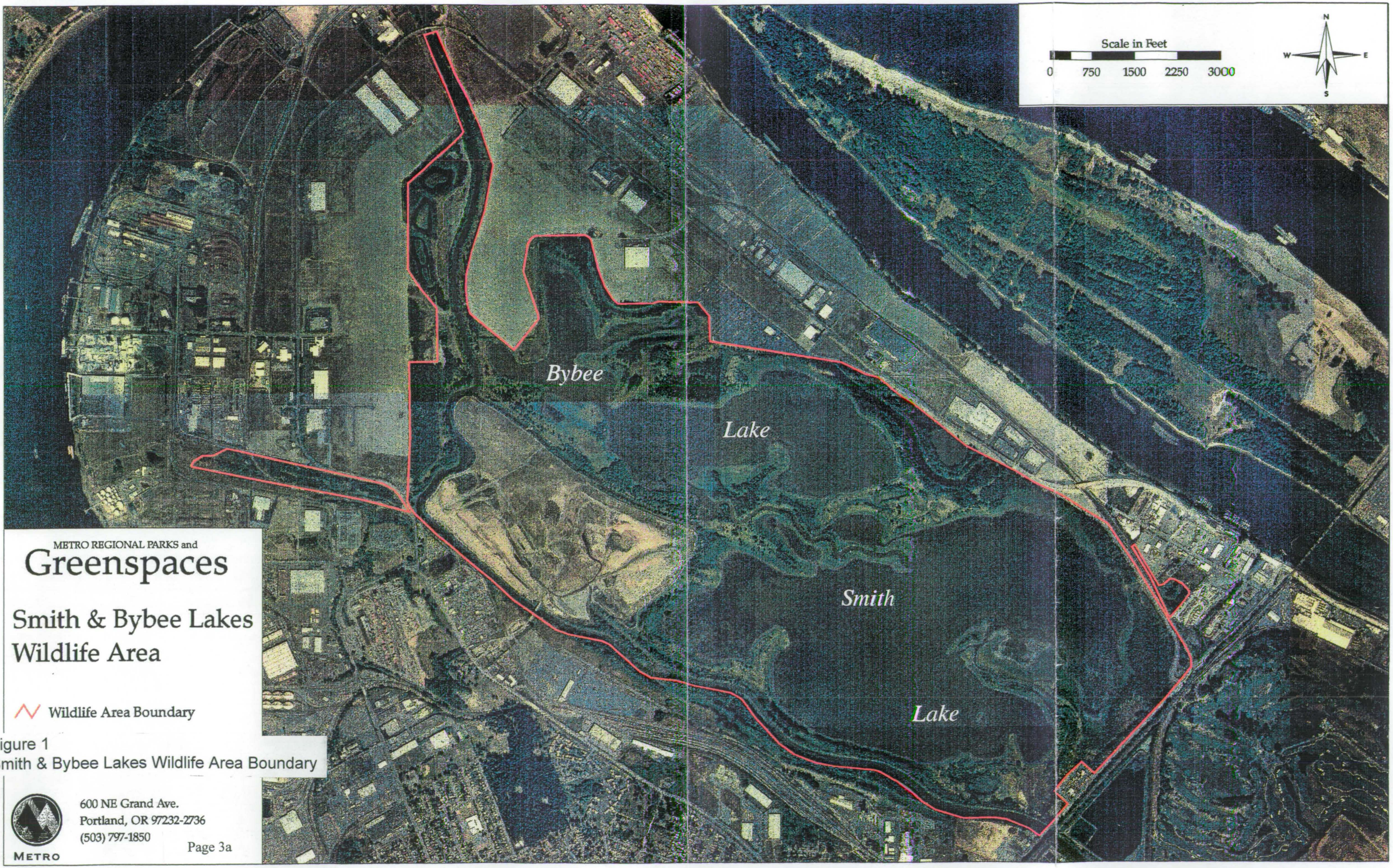


Figure 1
Smith & Bybee Lakes Wildlife Area Boundary

96108/photo.aml, plot date: June 20, 1996 the perimeter trail now open, 4.5 miles of additional trail is planned for construction in 1997-98 that will connect the lakes area to the neighborhoods and the regional trail system, the 40-Mile Loop Trail System. Boat access will be improved when the construction of the interpretive center occurs (estimated year 2000) and will be limited to non-motorized boats with the exception of electric motors, by order of the Oregon State Marine Board.

As a significant policy in both the management and recreation plans, environmental education, interpretation and research is being promoted in the lakes area. Currently, considerable Metro staff time is dedicated solely to involving local schools and citizens in education programs at the lakes. A citizens group is monitoring wildlife use of the area. When the interpretive center is constructed, on-site classrooms and demonstration restoration projects will be available.

DIAGNOSTIC SUMMARY

HYDROLOGY

Smith and Bybee Lakes is considered part of the Columbia Slough watershed, historically connected directly to the slough through the North Slough. With the construction of the dam separating the North Slough from Bybee and Smith Lakes in 1982, the lakes were no longer influenced by the hydrodynamics of the daily tidal prism, which formerly resulted in a daily water surface elevation change of 1 to 2 feet (USGS, 1982). This also reduced the flux of annual floodwaters from the Willamette and Columbia Rivers in and out of the lakes. However, during higher winter flows in the Willamette River (December/January) and the higher spring freshets of the Columbia River (May/June), water surface elevations often exceed the elevation of the lower portions of the banks separating the Columbia Slough from the lakes and exceed the earthen dam separating the lakes from the North Slough. This results in river waters mingling with lakes waters and a sudden increase of lake storage, as documented in 1987 (FES, 1988) and observed in 1993, 1994, and 1995 (Morgan, field notes).

Whenever flow from the Columbia Slough into the lakes occurs, the water entering the lakes is either predominantly Willamette River water or a mixture of Columbia Slough and Willamette River water, depending on flow from upstream in the Columbia Slough and the Willamette River water surface elevation at the confluence of the slough and river. This will be discussed in greater detail in later sections of this report.

Since the completion of the last dam on the Columbia River system in 1972 and the flood-control dams on the Willamette River, annual variation in the river levels have been reduced. Examining the 18-year (1973-90) means of daily maximum water surface elevations in the Columbia River at a Vancouver, Washington, gauging station (Figure 2), the elevation difference between the high flow period (May/June) and low flow period (August/September) is approximately 6 feet.

The variability in river water surface levels within any given year can be more dramatic. Examining the two years of highest and lowest water levels in the Columbia River in the last 30 years, 1974 and 1992, respectively (Figure 3), indicates a wide range of annual water levels. In 1972, the peak winter flows and low summer flows ranged from 25.2 ft. to 4.5 FT. AMSL. In the drought year of 1992, the water surface elevations at high and low flow periods range from 10.4 ft. to 3.6 ft. AMSL. For management of water levels in Smith and Bybee Lakes, the height and duration of flows in the Willamette and Columbia Rivers significantly determine the hydrology of the lakes, regardless of the management options exercised.

Other than the periodic overflow of the Columbia Slough into the lakes resulting from high river flows, the principal input of water into the lakes system is precipitation.

Figure 2 Columbia River Mean Daily Peak Head

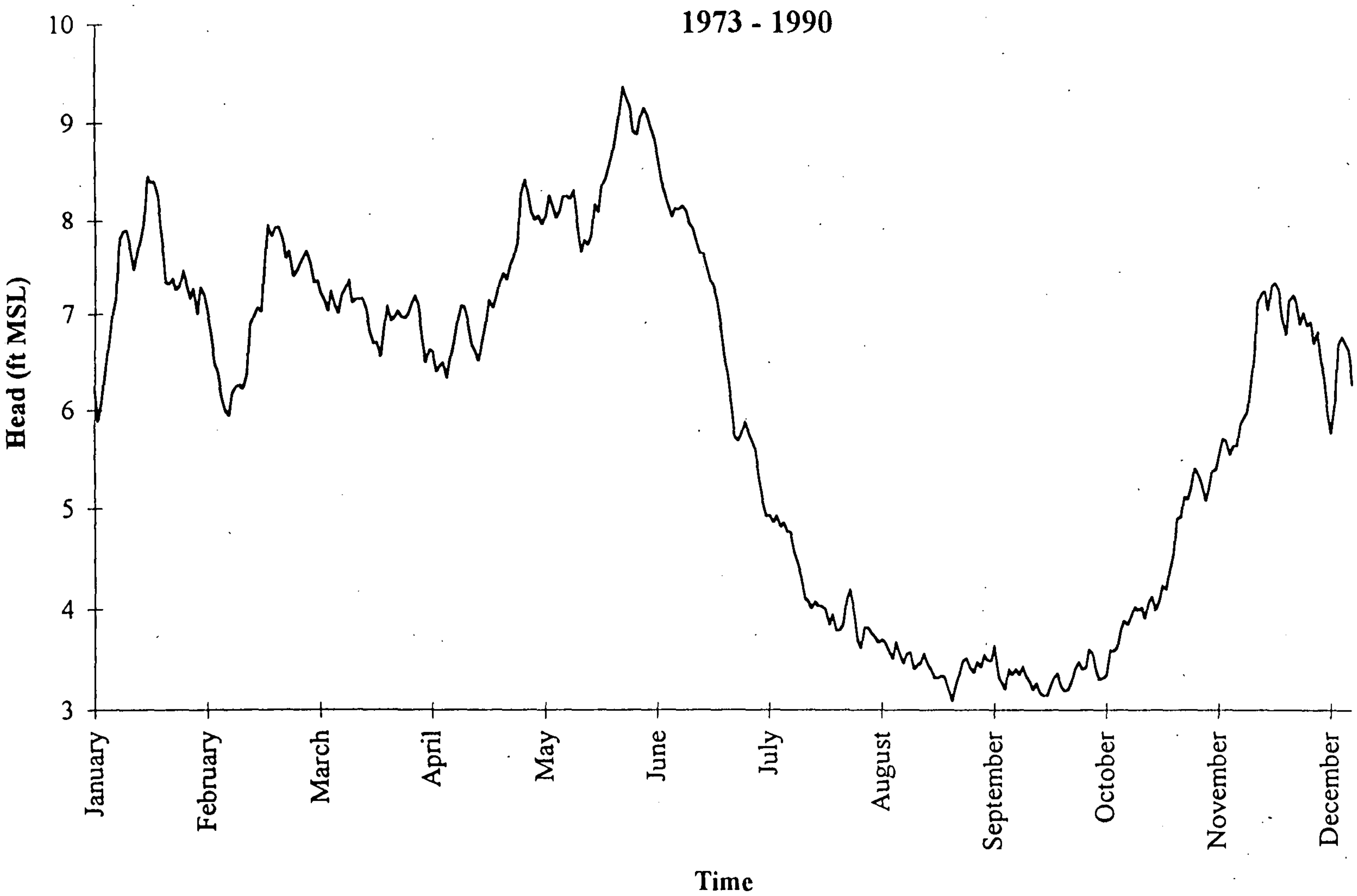
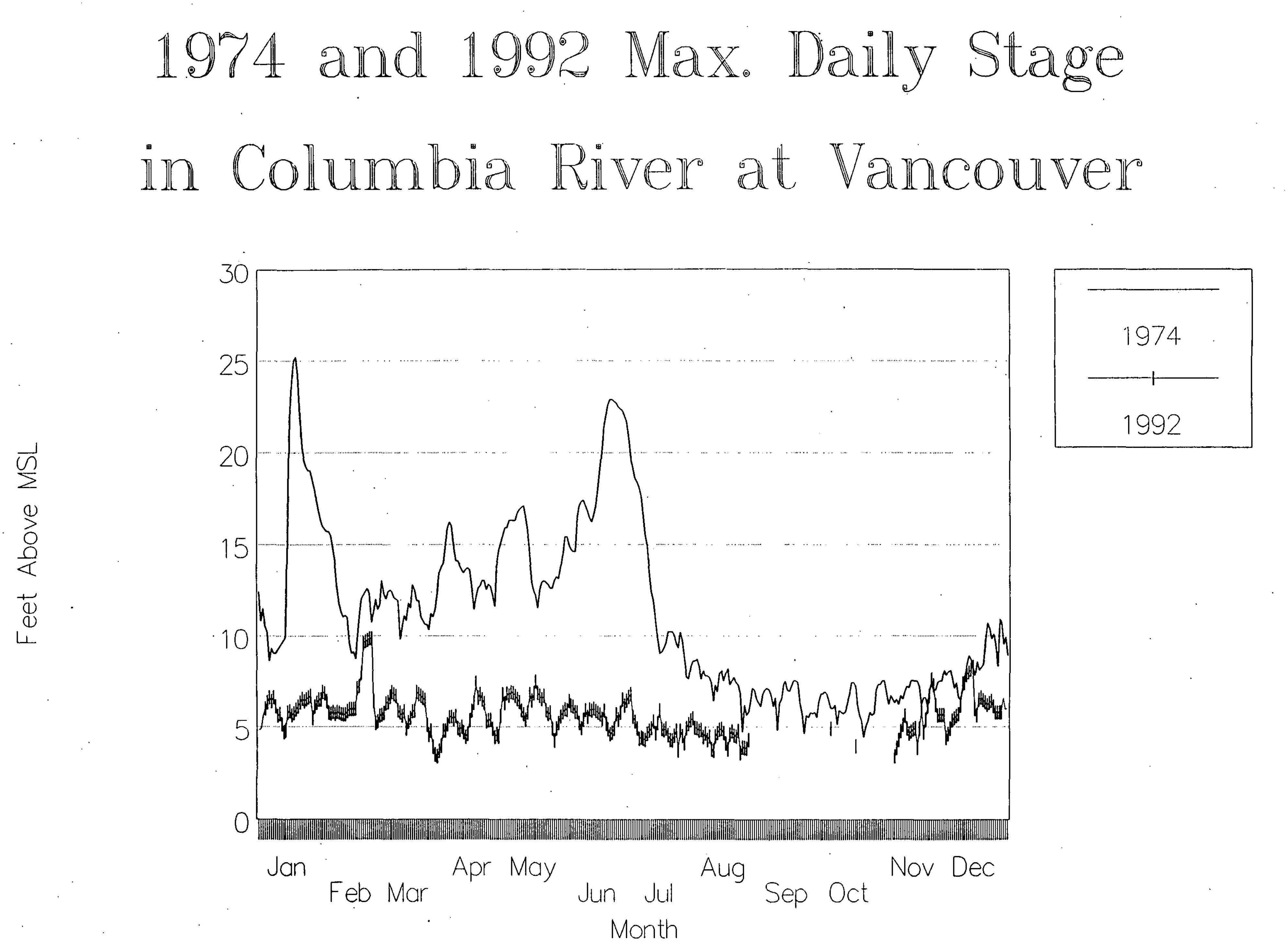


Figure 3 1974 and 1992 Max. Daily Stage in Columbia River at Vancouver



Hydrologically, the drainage area is small compared to surface area of the lakes. The total lakes' basin area is approximately 650 hectares (1600 acres). No streams enter the lakes other than storm water draining industrial lands or roads entering at four points. Additional runoff draining approximately 10 to 16 hectares (25 to 40 acres) of the surface of St. Johns Landfill discharges into Smith Lake. However, additional drainage area is being added as development occurs on adjacent industrial lands and ensuing storm water drainage is channeled to existing storm water outfalls into the lakes. Groundwater input is considered minimal, based on recent ground water monitoring by Metro and modeling exercises (PSU, 1995).

Under current conditions, the major loss of water from the lakes is through evaporation. Based on the surface elevation/area relationship (Figure 4) and the elevation/lakes' volume relationships, the relatively low volume to surface area ratio makes these lakes susceptible to significant loss due to evaporation. For example, at lakes' surface elevation of 10.4 feet AMSL, the ratio is 1.1. Evaporative loss from the lakes' surface can range from 12,000 to 21,000 m^3/day during the dry season (July-September) (Fishman, 1988; Boyko, 1995).

A typical annual water budget cannot be constructed for Smith and Bybee Lakes since the surface elevation of the Willamette and Columbia Rivers typically rise above the elevation of the lowest banks separating the lakes from the Columbia Slough and the two major rivers, resulting in an unmeasurable exchange of waters. Based on observations of flow over the banks during rising river levels, uncontrollable flow in and out of the lakes occurs at local river elevations of approximately 13.5 feet AMSL. During February, 1996, when the Willamette River surface elevation exceeded 28 feet AMSL near the confluence with the Columbia River and the entire lakes area was inundated, most of the banks separating the Columbia Slough from the lakes were 13 to 15 feet under water.

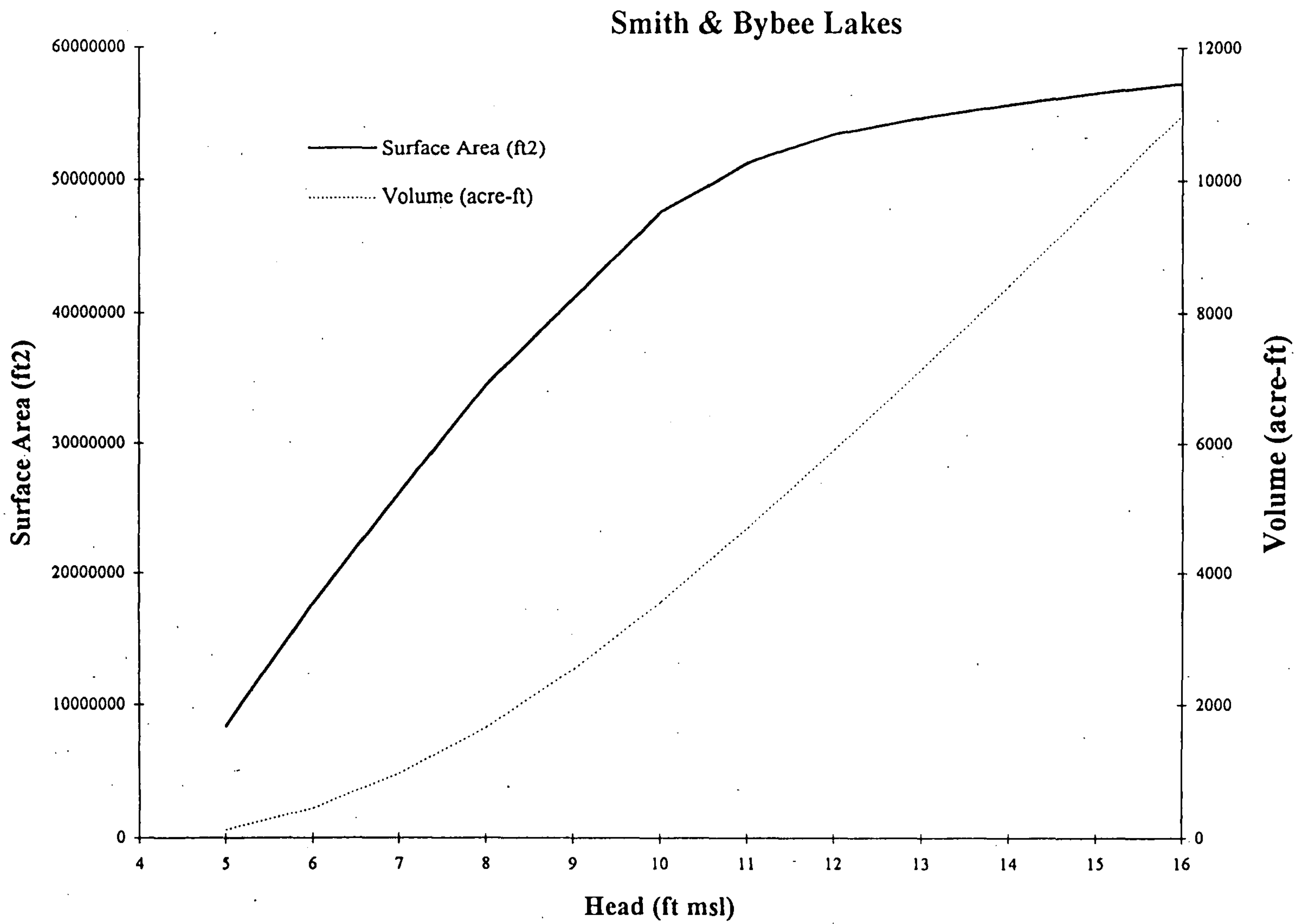
Other than brief periods of typical high winter flows in the Willamette River (December-March) and the Columbia River freshet (May-June), the lakes are separated from the Columbia Slough and the rivers by the earthen dam located at the eastern end of North Slough. Variation in the volume and surface elevation of the lakes during most of the year is primarily a function of direct precipitation and evaporation on and from the surface of the lakes.

HISTORICAL WATER QUALITY CONDITIONS

1971-72

The first recorded historical water quality data available to this researcher for the lakes area is the "Water Quality in Columbia Slough, Oregon 1971-1973" (ODEQ, 1974). DEQ staff surveyed in the lakes in December, 1971 and July, 1972. It was noted that "Smith Lake dries up nearly every summer.". The report indicated that the lakes "were generally good quality in December, 1971. During the July 5, 1972 survey, the lakes were probably a mixture of Columbia Slough, Columbia River and Willamette River waters."

Figure 4 Smith & Bybee Lakes Surface Elevation/ Area Relationship



The diatom population observed in the lakes in December, 1971 differed from those observed in the Columbia and Willamette Rivers only in that a greater variety is usually found in these rivers. Algal production and growth in the Columbia Slough were extensive during spring and summer months, as indicated by supersaturated dissolved oxygen conditions, with diatoms and filamentous green algae as the predominant phytoplanktors.

The organic content of Smith Lake sediments was significantly lower than observed in the lower Columbia Slough, where, based on percentages of organic carbon and organic nitrogen, the sediments in the lower slough were classified by actively decomposing. Up until that period of study, meat packing and rendering plant wastes and combined sewer overflow from City of Portland contributed significant organic matter.

The 1974 DEQ report recommended circulating Willamette River water through Smith and Bybee Lakes to reduce the effects of algal blooms at a maximum rate of complete exchange of water every 15 days, and a minimum exchange rate of once every 30 days.

1982

U.S. Geological Survey conducted a base-line limnological survey of the lakes from June to November, 1982. Weekly monitoring of water quality included temperature, pH, specific conductance, dissolved oxygen, and depth. Analysis of samples taken in the water column included chemical (alkalinity, dissolved carbon, total dissolved solids, nutrients), and biological parameters (chlorophyll, phytoplankton, zooplankton, and benthic invertebrates). Sediment samples from the lakes were analyzed for particle size, volatile solids, trace metals, total organic carbon, nutrients, and organic constituents. Data was presented but not analyzed in the report. A comparison of this data with recent data will be discussed in later sections.

The survey was conducted prior and after completion (September, 1982) of the earthen dam separating the lakes from the North Slough. Prior to dam construction, observations were made regarding the daily tidal fluctuations. Bybee Lake, which was directly connected to the North Slough, received daily tidal flushing, with water surface elevations varying 0.3 to 0.6 meters per day throughout the summer. Smith Lake, connected to Bybee Lake by a narrow channel, appeared to receive negligible tidal influence. The tidal influence was eliminated upon construction of the dam, except during high flows when the Willamette and Columbia Rivers rose above approximately 13 feet AMSL.

1986

In May and September, 1986, water quality sampling was conducted in the lakes and adjacent sloughs (Fishman, 1987). Much of this sampling effort was focused on evaluating the existing and potential impact of degraded Columbia Slough water quality (i.e., fecal coliform) and landfill leachate on the lakes. The report also summarized lake data collected from 1982 through 1986. Prior to 1982, data collection from the lakes was sporadic.

In the report, a number of conclusions were made regarding water quality of the lakes:

1. Separation of the lakes from the Columbia Slough as a result of the dam construction resulted in reducing the occurrences of violation of water quality standards for fecal coliform. Given the principle source of fecal coliform contamination is the combined sewer overflows discharged to the Columbia Slough, the dam prevents the intrusion of Columbia Slough waters except during periods of high flows in the Willamette and Columbia Rivers.

2. Each of the lakes are eutrophic, based on concentrations of nutrients and chlorophyll.

3. The eutrophic condition of the lakes have been exacerbated by the installation of the water control structure.

4. The source of increased fertility of each of the lakes appears to be the sediments, directly through wind mixing and indirectly through macrophytes mobilizing sediment nutrients into the water column..

5. The nutrient contribution of the Willamette and Columbia Rivers to the enrichment of the lakes appears to be negligible, whereas dilution and flushing effects from the freshet refilling of the lakes during winter and spring appears to be especially beneficial.

PRESENT WATER QUALITY CONDITIONS

With funds from the Clean Lakes Grant Program, water quality sampling was increased in the lakes during 1992 and 1993. Beginning in August, 1992, parameters for which lake sampling at two central lakes locations occurred are listed in Table 1 below. Grab samples were taken just below the water surface at two locations, BL and SL, as shown in Figure 5. A Hydrolab monitoring unit was used to measure temperature, pH, specific conductivity, dissolved oxygen, percentage saturation of dissolved oxygen, and oxidation/reduction potential.

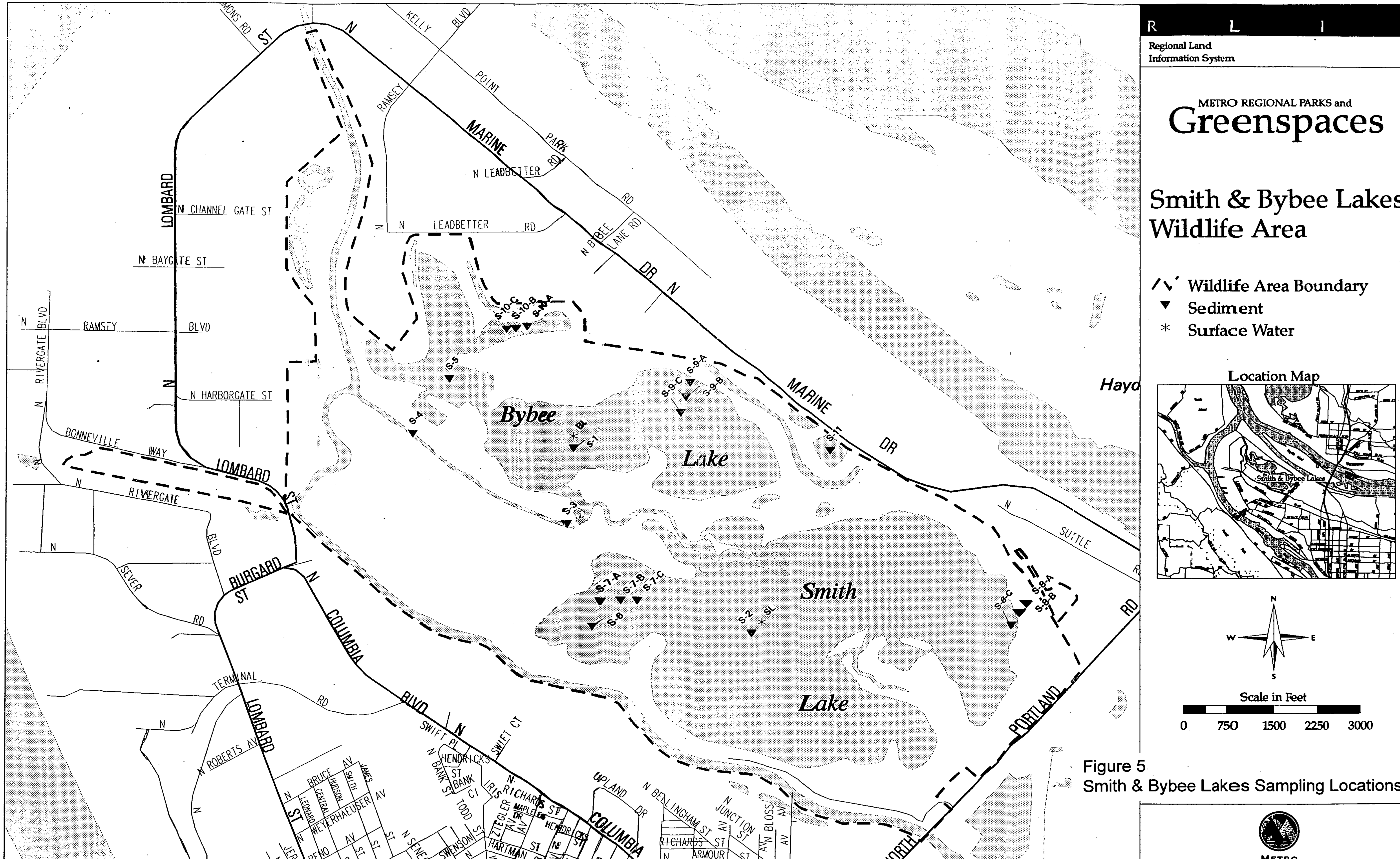


Figure 5
Smith & Bybee Lakes Sampling Locations

Table 1
Smith and Bybee Lakes
Water Quality Parameters

Basics	Nutrients
Water Temperature	NH3-N
Transparency *	NO2+NO3-N
Dissolved Oxygen	Total Kjeldahl Nitrogen
Specific Conductivity	Total Phosphorus
pH	Ortho-Phosphorus
Redox Potential	
Solids	Biological
Total Solids *	Fecal Coliform Bacteria
Total Suspended Solids *	Enterococci Bacteria
Total Dissolved Solids *	Chlorophyll *a*

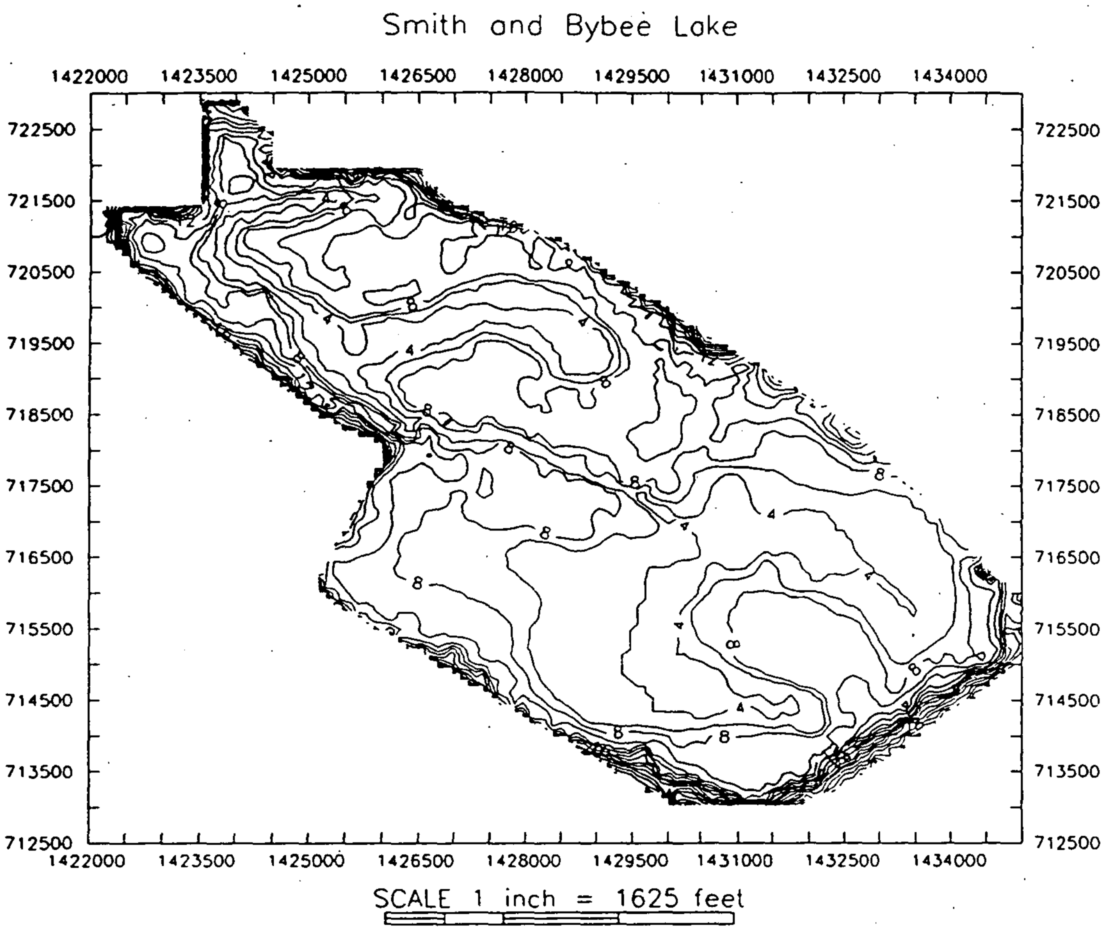
* Parameters added in 1993.

Physical Characteristics

Surface area of the lakes vary according to water surface elevation. Since 1982, attempt has been made to maintain the lakes surface at a static elevation of 10.4 ft. AMSL, the elevation of the overflow weir at the dam until 1992. At this elevation Smith Lake surface area is approximately 238 hectare (588 ac) and Bybee Lake is approximately 108.5 hectare (268 acres).

The bathymetry of Smith and Bybee Lakes is very similar (Figure 6): both are shallow basins connected by a slightly deeper channel when the water surface elevation is at or below approximately 11 feet AMSL. Above that elevation, the lakes merge across lower points along their banks. Average depths vary according to seasons, deepest in winter/spring when high water levels in the Willamette and Columbia Rivers overflow Columbia Slough banks and the dam normally separating the lakes from the Columbia Slough. At this time, the lakes generally average 7 feet in depth after the Columbia Slough water levels drop. During late summer/fall, when evapotranspiration and/or release of water through the water control structure has reduced the water level in the lakes, the average depth in both lakes is less than 2 feet.

Figure 6 Smith & Bybee Lake Bathymetry



Given the bathymetry of the lakes, the surface area of the lakes vary significantly with variation in water surface elevation (Figure 6). When the water surface elevation is at 10 feet AMSL, the surface area for Smith and Bybee Lakes are 238 hectares (588 acres) and 108.5 hectares (268 acres), respectively.

Because of the open fetch of the lakes, their shallow depths, and orientation, the lakes are susceptible to mixing in the water column and re-suspension of sediments induced by wind stress. Located adjacent to the Columbia River, the lakes receive winds associated with the river that decrease in intensity with increasing distance from the river. Turbulence in the water column associated with windy days results in high suspended solids, high dissolved solids, high specific conductance, and low transparency (Appendix A, Table 1) Re-suspended sediments most likely account for the low transparency in the water column than biotic factors, such as phytoplankton, which is discussed below.

Smith Lake generally receives greater wind stress due to its shape and alignment with the prevailing wind direction, with wave action observed more often on Smith Lake than Bybee Lake. This is reflected in median values of suspended solids, dissolved solids, and specific conductivity being higher, while transparency is lower, compared to Bybee Lake.

Both lakes are generally polymictic, with frequent or continuous vertical circulation. During colder than normal winters, the lakes' surface has been completely frozen. During the warm season, water column temperatures can reach 26^{0}C. There has been no recorded distinctive stratification in the water column recorded in either lakes since the dam was constructed in 1982.

<u>Nutrients and Primary Productivity</u>

North American temperate lakes are usually considered nutrient-limited in terms of growth limiting factor for primary productivity, with phosphorus identified as the common limiting nutrient (Schindler, 1973). In attempts to control the rate of eutrophication in lakes, managers often seek to control and reduce sources of phosphorus as a primary goal for lake water quality improvement.

Phosphorus does not appear to be the principal limiting growth factor for phytoplankton in Smith and Bybee Lakes. Many lake empirical models use phosphorus, in the forms of total phosphorus, dissolved phosphorus, ortho-phosphorus, or soluble reactive phosphorus, to account for the variability observed in chlorophyll-a, a surrogate for estimating algal standing crop (Dillon and Rigler, 1974; Chapra and Reckow, 1983). The principal growth limiting factor may not be nutrients.

Using observations of nutrients made in Smith and Bybee Lakes (Appendix A, Table 1), linear regression models were constructed to examine the relationship between nutrients and algal standing crop. Using linear regression models, the variability in chlorophyll-a explained by phosphorus is comparable to that explained by nitrogen (r^2 values), as seen in the regression plots (Appendix B, Figures 1-10). Where nutrient concentrations may not be a good predictor of algal standing crop, the nutrient availability appears to be adequate for high algal yields. However, these models should be interpreted with caution due to the high variance of the data sets and limited number of observations. Median concentrations of total phosphorus observed in Smith and Bybee Lakes are 0.13 and 0.12 mg/l, respectively. Median chlorophyll-a concentrations observed in Smith and Bybee were 0.031 and 0.028 mg/l, respectively. The nutrient and chlorophyll-a concentrations observed in Smith and Bybee Lakes place them firmly in the eutrophic status (Carlson, 1977). Growth limitation of primary productivity in the water column may be a function of suspended sediments.

Suspended Solids and Transparency

Smith and Bybee Lakes have low transparency in the water column. Using Secchi disk measurements as an indicator of transparency, median depths at which the Secchi disk was no longer visible in Smith and Bybee Lakes were 43 cm and 44 cm, respectively. This low transparency is more likely a result of suspended solids, rather than phytoplankton. Comparing the amount of variability in transparency explained by total suspended solids is considerably higher when compared to that explained by chlorophyll-a (Appendix B, Figures 11-14). The source of suspended solid is mostly like re-suspended sediments, given the shallow depths and erosive turbulence caused by wind stress. Based on field observations, water column transparency noticeably decreased on windy days.

Macrophytes

Much of the primary productivity in the lakes is in the form of submergent and emergent macrophytes. Though no aquatic macrophyte biomass estimates were made. percent areal cover of Smith and Bybee Lakes by emergent macrophytes based on aerial photographs made in 1992 was approximately 65% and 15%, respectively. The dominant emergent macrophyte species is swamp smartweed (Polygonum coccineum). At the time of maximum standing crop in Smith Lake in August, 1992, this species covers approximately 80% of the south-central and northern portions, decreasing to 30% in other fringe areas, leaving approximately 25% of the area as open water. Stems below surface and stems and leaves extending above the water surface up to 3 feet serve as substrate for insects (see Biota report, Lev, et al., 1994), cover for fish, structure and hiding for predatory birds (i.e., Great blue heron), shade that inhibits phytoplankton growth, and structure that reduces wind stress and wave action.

As noted in an earlier report (Fishman, et al., 1988), maintenance of a limited range of water levels in the lakes since 1982 has been accompanied by a significant increase in swamp smartweed coverage. However, since the water control was improved to regulate the outflow at the end of 1992, water surface elevations have been kept at higher levels longer into the growing season. This has been accompanied by a decrease in swamp smartweed coverage in Smith Lake from 1992 to 1995 to the extent that allowed passage of canoes where before was nearly impossible.

Though a number of submergent macrophyte species are found in the lakes, the most abundant is Potomogeton crispus. Most of the biomass of this species found in Smith and Bybee Lakes has been observed floating at or near the water surface, given the plant's ability to access light in a water column of low transparency.

Comparison of Lower Willamette River and Lakes Water Quality

Since Willamette River water enters the lakes under current conditions during high water periods when the banks are overtopped, and river water would enter the lakes on a daily basis if the dam separating the lakes from the slough and river were to be removed, a comparison should be made between Willamette River and current Smith and Bybee Lakes water quality. Listed below are the median values observed in the Willamette River approximately 5.5 miles upstream of the confluence with the Columbia Slough, collected 1980-1990 (Bonn et al., 1995), and median water quality values for the lakes 1992-1995 .

Table 2
Median Water Quality Values

	Total Phosphorus	Ammonia-Nitrogen	Suspended Solids	pH	Nitrate + Nitrite	Specific Conductance
Smith Lake	0.13 mg/l	0.025 mg/l	34 mg/l	7.89	0.1 mg/l	214 mS
Bybee Lake	0.12 mg/l	0.025 mg/l	27 mg/l	7.69	0.1 mg/l	212 mS
Willamette River	0.105mg/l	0.07 mg/l	7 mg/l	7.3	0.36 mg/l	73 mS

Willamette River phosphorus concentrations appear to be slightly lower than the lakes, while nitrogen concentrations are higher. The distinctively lower suspended solids and specific conductance in the river compared to the lakes is most likely a result of the significant sediment re-suspension occurring in the lakes due to wind stress and their shallow depths.

FISH

Little historical information on fish populations in Smith and Bybee Lakes area exists. Gillnet sampling in the lakes and adjacent sloughs was conducted in 1973 and 1982 (Oregon State Game Commission) provided limited data not appropriate for comparison. More recent surveys (after 1982) of the fisheries in the lakes area include that in Smith and Bybee Lakes Environmental Studies (Fishman, 1988) and the fishery survey conducted by U.S. Fish and Wildlife Service (1992) for Metro. Both studies are discussed below in context of characterizing the fish populations in the lakes area, with some comparisons between years made where appropriate. Contaminants in fish tissue and risks associated with consuming fish are discussed in the later section on screening-level risk assessment.

1986

The study conducted in 1986 (Fishman, 1987) was designed to collect population and habitat utilization information for fish species in the lakes and surrounding sloughs and has been the most complete study of the area to date. The study included electro-fishing sampling throughout the various lake habitats (i.e., open water, smartweed swamp, Smith Channel) and in the adjacent Columbia Slough (i.e., tidal slough) inside the Management Area, at three time periods - late April/early May, late June, and late October. Stomach contents were examined in selected fish.

Over the three sampling periods, a total of 747 fish were captured, representing 16 taxa. In the lakes, carp (Cyprinus carpio) was clearly the dominate fish species in spring and summer, competing with young-of-the-year bluegill (Lepomis macrochirus) in fall sampling. In the tidal influenced Columbia Slough, chinook salmon was the most abundant in numbers in the spring sampling, with carp dominating in the summer and goldfish (Carassius auratus), carp, and sucker (Catostomus macrocheilus) dominating in the fall sampling. Based on the sampling data and "minimum acceptable size" for anglers, the lakes area appears to have good angling potential for bass and a moderate-to-good angling potential for white crappie and yellow perch.

The difference in composition of the fish community between the lakes and the Columbia Slough is a function of habitat structure and quality (Fishman, 1987). The lack of habitat structure (i.e., fallen riparian trees, brush, aquatic vegetation), unconsolidated sediment, and questionable water quality in the slough limit conditions for a more diverse warm-water fishery compared to the lakes. The exception area in the Columbia Slough system was the North Slough, containing a significant amount of logs, snags, and debris (a grounded barge), where there was an abundance of perch, crappie and bass found in the sampling period.

An important finding of this study was the use of the lakes by juvenile salmon, in particular, chinook salmon (Oncorhynchus tshawytscha). Data showed the lakes and slough heavily utilized by juvenile salmon migrating during the spring. Abundant zooplankton, warmer temperatures, and less predation pressure may have promoted the more rapid growth observed in those juvenile salmon observed in the lakes during the study. The impoundment of water during the spring freshet has the potential of trapping these salmon. High temperatures and other conditions reached in the summer and fall in the fall would most likely result in total mortality of these fish.

1992

An electrofishing survey of Smith and Bybee Lakes was conducted June 29 through July 2, 1992, by U.S. Fish and Wildlife Service (Wills and Olson, 1992). The study objective was to provide basic information on relative composition and abundance of fish species in the lakes system and their associated habitat types, designed to replicate as much as possible those stations sampled in the June, 1986 study (Fishman, 1987). Interpretation of the data is limited to qualitative only, given the limited data.

During the sampling, a total of 352 fish were captured, representing 14 species. Relative abundance of fish sampled in 1992 appeared to be different from that observed in 1986. Bluegill were more abundant than in 1986, ranging from 3 to 58% in relative abundance (Table 3). This high abundance of young-of-the-year bluegill was also observed in the fall sampling of 1986. Largemouth bass (Micropterus salmoides) had a narrower range of abundance among stations. Carp clearly dominated the relative biomass captured at all sites in 1992, similar to 1986. Results of comparing species biomass between the lakes and the slough (Table 4) mask the large number of fish captured (mostly Centrarchids) that were too small to obtain a reliable weight.

The change in relative abundance observed in 1986 and 1992 may be attributable to difference in water levels and habitat composition. An obvious difference between 1986 and 1992 is the hydrologic conditions. 1986 was a wet year, characterized by high flows in the Willamette and Columbia Rivers that resulted in river water levels topping the banks that normally separate the slough and the rivers from the lakes. 1992 was a record-breaking drought year in which water levels in the rivers never exceeded the height of the banks separating the slough from the lakes, causing lake levels to remain relatively low throughout the year. There was less open water habitat 1992 compared to 1986 resulting from vigorous growth of the submergent and emergent macrophytes, Potamogeton crispus and Polygonum coccineum, respectively.

Table 3

Abundance of Fish (%) in the Smith & Bybee Lakes System
June, 1986/June, 1992

Species	Bybee Lake	Smith Lake	Smith Channel	Dam Pool	Columbia Slough
Carp	44 / 27	43 / 11	46 / 23	64 / 23	39 / 72
Northern Squawfish	- / -	- / -	- / 1	3 / -	- / 2
Peamouth	- / -	14 / -	- / 1	3 / -	- / -
Yellow Bullhead	- / -	- / 2	- / -	- / 3	- / 3
Brown Bullhead	- / 4	10 / 2	- / -	- / -	12 / 3
Mosquitofish	- / -	- / -	- / 1	- / 3	- / -
Largemouth Bass	6 / 12	14 / 11	31 / 7	6 / 6	1 / 5
Black Crappie	- / 4	14 / 11	12 / -	- / -	- / 3
White Crappie	28 / 39	10 / 18	4 / 5	6 / 3	- / -
Warmouth	- / -	- / -	- / 4	- / 4	4 / -
Bluegill	6 / 12	- / 27	8 / 51	17 / 58	8 / 3
Pumpkinseed	- / -	- / 2	- / 1	- / -	- / 7
Yellow Perch	17 / 4	- / 16	- / 5	3 / 1	4 / 3
Sculpin	- / -	- / -	- / -	- / -	- / 2
Goldfish	- / -	- / -	- / -	- / -	14 / -
Large-scale Sucker	- / -	- / -	- / -	- / -	10 / -

Table 4

Biomass Fish (%) in the Smith & Bybee Lakes System
June, 1986/June, 1992

Species	Bybee Lake	Smith Lake	Smith Channel	Dam Pool	Columbia Slough
Carp	92 / 88	88 / 70	86 / 92	93 / 89	81 / 98
Northern Squawfish	- / -	- / -	- / <1	<1 / -	- / <1
Peamouth	- / -	3 / -	- / <1	<1 / -	- / -
Yellow Bullhead	- / -	- / 1	- / -	- / 1	- / <1
Brown Bullhead	- / 1	3 / 3	- / -	- / -	13 / <1
Mosquitofish	- / -	- / -	- / <1	- / <1	- / -
Largemouth Bass	4 / 1	3 / 6	11 / 2	5 / 4	1 / 1
Black Crappie	- / <1	1 / 4	<1 / -	- / -	- / <1
White Crappie	2 / 8	2 / 7	<1 / 1	<1 / <1	- / -
Warmouth	- / -	- / -	- / <1	- / <1	<1 / -
Bluegill	<1 / <1	- / 5	2 / 4	1 / 5	<1 / <1
Pumpkinseed	- / -	- / <1	- / <1	- / -	- / <1
Yellow Perch	2 / <1	- / 4	- / <1	<1 / <1	<1 / <1
Sculpin	- / -	- / -	- / -	- / -	- / <1
Goldfish	- / -	- / -	- / -	- / -	3 / -
Large-scale Sucker	- / -	- / -	- / -	- / -	13 / -

PALEOLIMNOLOGY

In 1994, a paleolimnological investigation was undertaken at Smith and Bybee Lakes. Paleolimnology is the study of the history of lakes' evolution focusing on interpretation of the sediments. The goal is to gain insight into historical conditions, changes in productivity, and inferences to the future changes in lakes, while linking these changes with watershed conditions. Tools used in interpreting sediments include dating sedimentary sequences, analysis of sediment chemical constituents, assessing historical algal populations through algal pigment and microfossil remains (i.e., diatom frustules), and identifying plant and animal remains.

Sediment sampling occurred on three dates in 1994 (Eilers et al. 1995). The lakes were sampled using a mini-Glew 2.5 cm diameter corer on January 27, to explore the variability in sediments in the lakes. The reconnaissance showed that the surficial sediments were relatively homogeneous and amenable to further analysis. On July 8, a large diameter (10 cm) corer with a sphincter closure device was utilized but was unable to function properly in the very dense sediments encountered in both lakes. On July 19, three sediment cores were collected from Smith and two cores from Bybee Lake using a 5-cm diameter piston corer. Depth of the sediments cores were about 40 cm. Cores were sectioned on-site for subsequent analysis.

Water Content and Loss-on-Ignition

Initial analysis of the sediment sections includes percent water and loss on ignition (LOI), which is an indirect estimate of organic content. Results of these analyses on the cores are shown in Figures 7 and 8. Examining the water content over depth of core, core samples over Smith and Bybee Lakes were similar. The water content decreased from 70% at the surface to approximately 40-55% at the base. This pattern is similar to other lakes but the values in Smith and Bybee Lakes are relatively lower (Eilers et al. 1994). Comparing results from cores taken in Devils Lake and Lake Lytle (Figure 9), both shallow eutrophic lakes in coastal Oregon, water content decreases from around 90% at the surface to less than 80% at the sediment core base.

LOI data reflects similar patterns, with the decreasing values over depth in Smith and Bybee Lakes sediment cores. However, the LOI values are significantly lower, by a factor of 3 to 5, than other productive lakes in Oregon (Eilers et al. 1995). For example, LOI content in sediments of Devils Lake and Lake Lytle greatly exceed those found in Smith and Bybee Lakes sediments (Figure 9). Lower organic contents in Smith/Bybee sediment may be partially attributable to the loss during the annual exposure of the sediments to atmospheric drying and oxidation during the annual low water level period when the lakes were open to the slough and rivers.

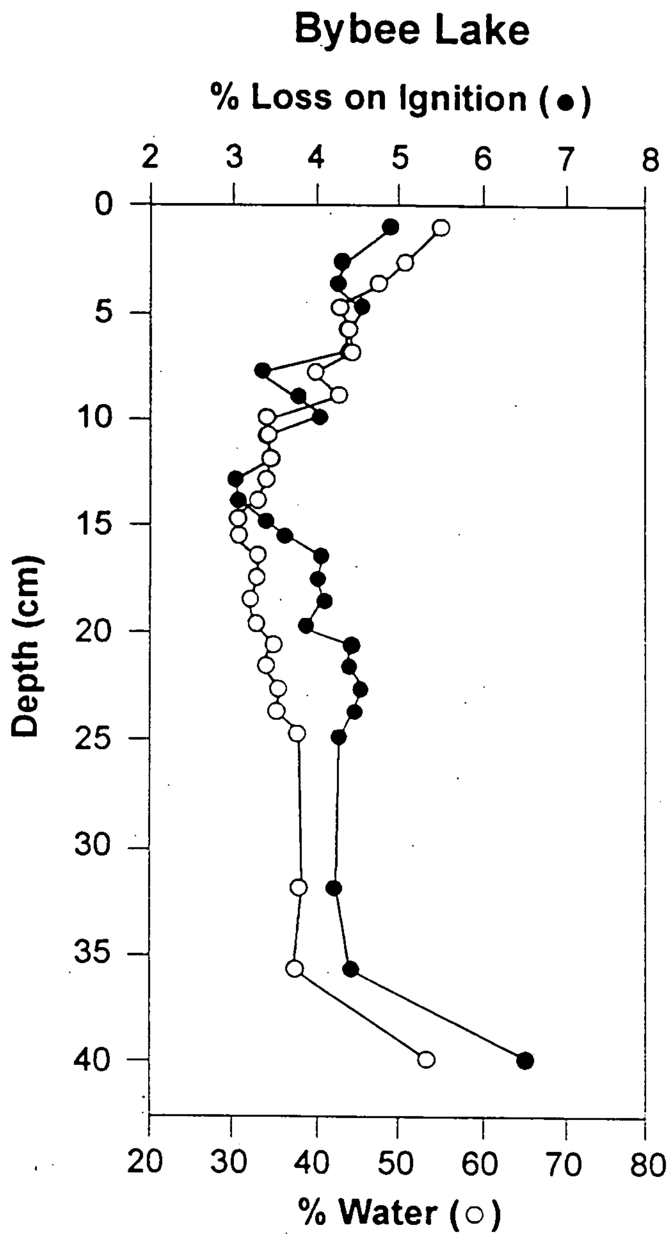


Figure 7 Percent Water and Loss on Ignition for Bybee Lake -Core Collected 7/94

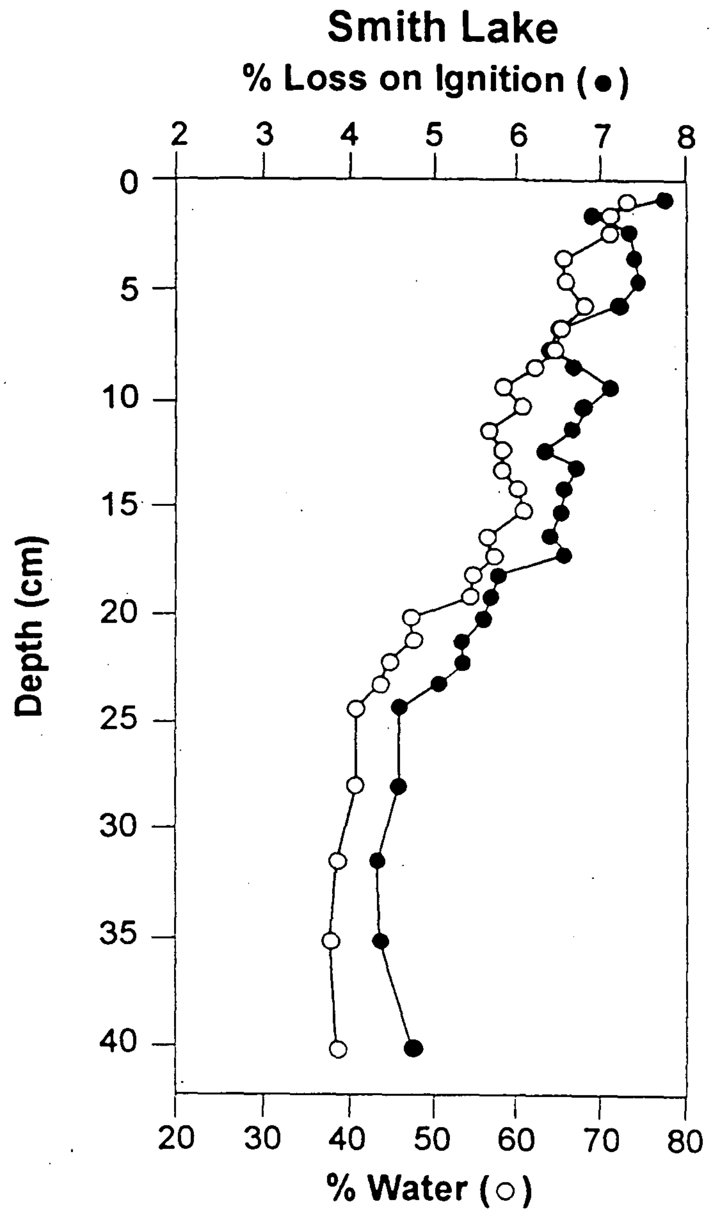


Figure 8 Percent Water and Loss on Ignition for Smith Lake -Core Collected 7/94

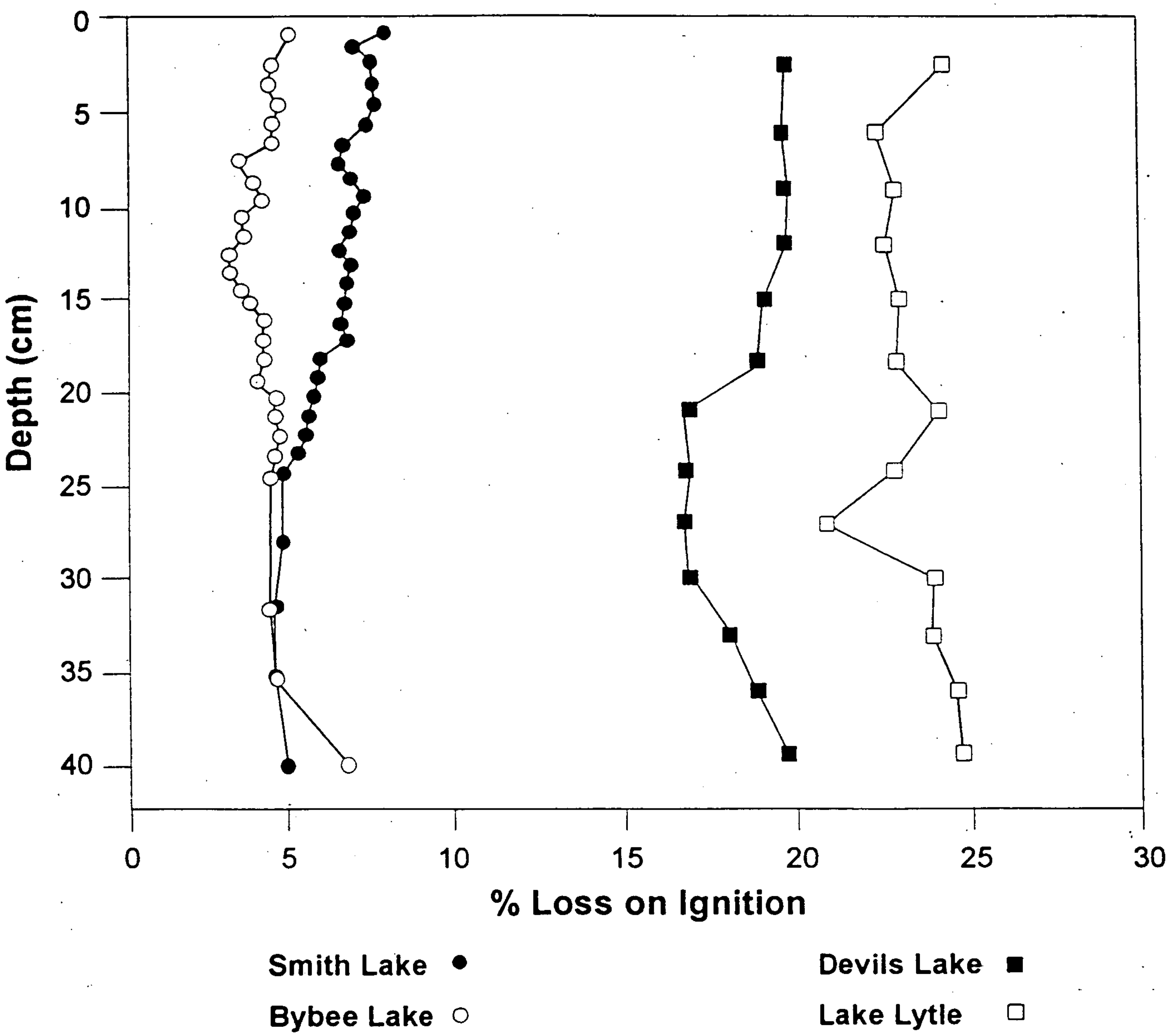


Figure 9 Percentage Loss on Ignition - Smith / Bybee/ Devils Lakes & Lake Lytle

Sediment Dating

Determining the age of each section of the sediment over depth is very important to understanding sedimentation rate and inferring changes in a lake. To determine the date of recent sediments, two popular dating techniques are analyzing the distribution of lead-210 and cesium-137 in the sediments. As a natural decay product of radium-226 in soils, lead-210 accumulates in lake sediments from precipitation from the atmosphere. Using the lead-210 technique, the age of the sediment can be determined at any depth and is limited to about a 150-year time span. The distribution of cesium-137 in the sediments is useful for about the last 30 years, since its presence is a result of above-ground atomic bomb testing since 1954.

Dating of the sediment cores from Smith and Bybee Lakes proved not feasible. Data from the lead-210 activity measurements show that activity levels are only slightly higher than background values (Figure 10). The low lead-210 activity in the lakes sediments can be due to one of three conditions:

(1) the lead-210 activity is diluted by a very high sedimentation rate;
(2) the sediments are well mixed; or,
(3) no recent sediments are present.

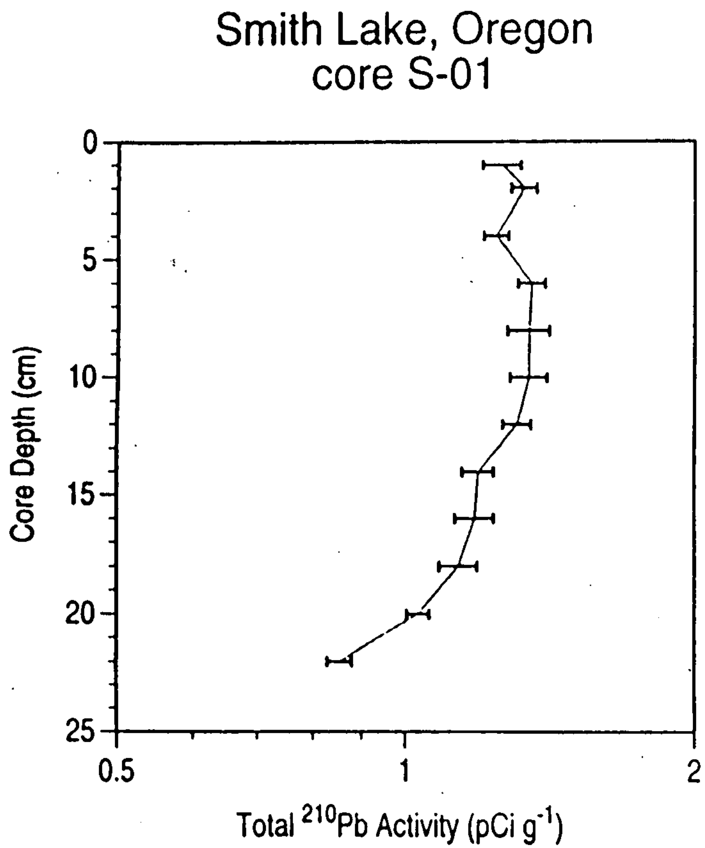
Analysis of sub-samples showed no cesium-137 present in the sediments. Regardless of the sedimentation rate or degree of disturbance, cesium-137 would appear in recent sediments (since 1954). Therefore, it is confirmed that little to no recent sediments have accumulated in Smith and Bybee Lakes.

Since the sediments could not be dated, further analysis for chemical constituents and algal pigments was not pursued.

Diatoms

Examining the stratigraphy of diatoms in sediments is useful in gaining insight into past conditions and causes for change. Examining the relative abundance of diatoms in Smith and Bybee Lakes sediments showed that most of the diatoms identified are numerous throughout the entire core (Table 5). There is a notable decrease of centric diatoms at the base of the core samples. In very general terms, centric diatoms are more associated with oligotrophic waters, although caution should be used in the interpretation. Results of diatom analysis is inconclusive in inferring patterns or changes in productivity.

Figure 10 Total ^{210}Pb Activity for Surface Sediments - Smith & Bybee Lakes



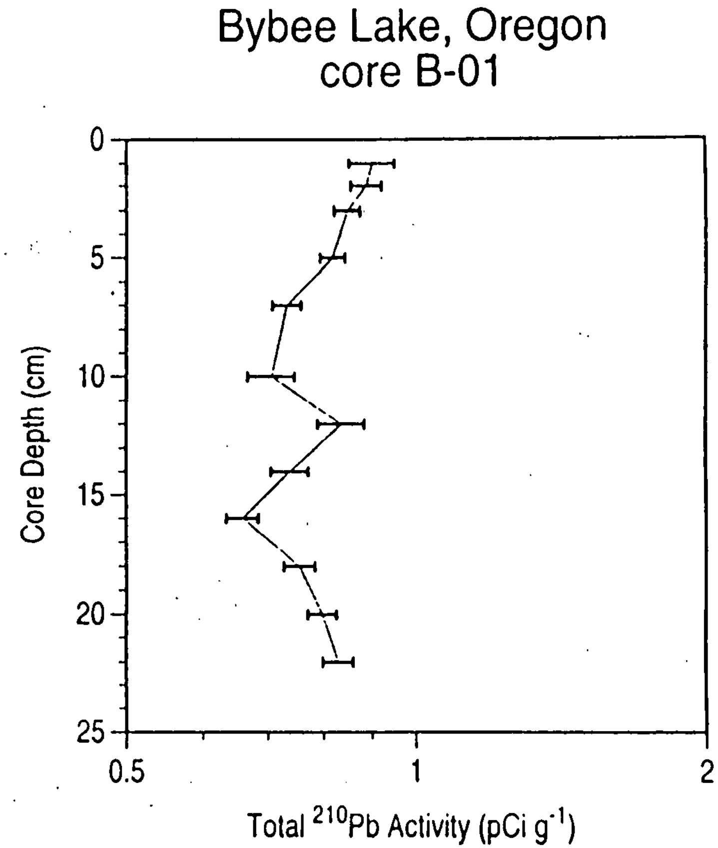


Table 5

Relative Abundance of Diatom Remains in Surface Sediments of Smith Lake

0Taxa	Relative Abundance (%) (n=320)
Achnanthes minutissima	1.3
Achnanthes spp.	0.3
Asterionella formosa	0.6
Aulacoseira spp.	28.4
Cyclostephanos dubia	16.9
Cyclotella meneghiniana	1.0
Cyclotella pseudostelligera	1.9
Cyclotella stelligera	0.6
Navicula halophila	0.3
Cymbella minuta	0.6
Cymbella spp.	1.0
Cocconeis placentula var. *lineata*	1.3
Diatoma sp.	0.3
Epithemia sorex	2.6
Fragilaria brevistriata	1.3
Fragilaria construens	3.8
Fragilaria construens var. *venter*	1.0
Fragilaria pinnata	12.2
Fragilaria spp.	4.1
Hantzschia sp.	1.0
Navicula gottlandica	0.3
Navicula radiosa	0.6
Nitzschia spp.	11.9
Rhopalodia spp.	1.0
Stephanodiscus hantzschia	2.8
Stephanodiscus spp.	0.6
*Others (obscured valves, rare forms)**	2.9

* Fragments of *Campylodiscus*, *Fragilaria binodis*, *Navicula bacillum*, *Gyrosigma* sp.
Scales of *Mallomonas crassisquama*
Sponge spicules, protozoan plates from *Trinema*

Conclusions

The analytical results from examining the sediment cores from the lakes indicate the sediments from both lakes have not accumulated in this century. Season flooding from the Willamette and Columbia Rivers have occurred throughout this century, transporting suspended sediments into the lakes area. However, the erosive forces associated with daily tidal action, which becomes more pronounced during the low water level period of July through October, probably removes unconsolidated sediments from the lakes.

Since the construction of the dam separating the lakes from the Columbia Slough and rivers in 1982, no new sediments were detected. The dam structure effectively prevents introduction of sediment-laden river waters and the Columbia Slough, except during very high flow events. The other source of sediments is limited to the surrounding small watershed that contributes to the lakes. The dam also eliminates the erosive action of tides. Since 1982, the very low sedimentation rate is attributable to (1) reduced input from the rivers, (2) reduced watershed area, and (3) re-suspension and transport to macrophyte beds (Eilers et al., 1995).

In summary, Smith and Bybee Lakes have been transformed from a highly dynamic depositional/erosional environment to one that is solely depositional at a much lower rate compared to historical conditions. Under the present hydrological conditions. the lakes will slowly begin to accumulate organic matter over the present inorganic sediments, albeit at a low rate since the future sediment sources will largely be internally derived (i.e., autochothonous sources). Internal recycling of nutrients will increase, facilitated by the lakes shallow depth.

SURFICIAL SEDIMENT SURVEY

Currently, there are three known storm water discharges to the lakes and two proposed storm water discharges. No quantity or quality data are available on existing discharges. Given their small catchment area relative to the size of the lakes and their adjacent uplands, the quantity of storm water discharge from these areas is relatively insignificant. However, given the industrial land use associated with these catchment areas. storm water impact on lake water quality may be significant locally. There are two storm water catchment areas proposed for discharge to the lakes. Passive treatment facilities are included in the design of the two proposed storm water discharges. The stormwater treatment facilities are designed according to performance standards that are intended to meet state and federal water quality standards.

The local proximity of the St. Johns Landfill has allowed surface water runoff from the landfill to enter Smith Lake. These discharges are known to contain landfill leachate. which is water that has had prolonged contact with landfill solid waste. Historical lake water quality sampling has focused on monitoring mid-lake water quality. Surficial sediment sampling stations in proximity of the landfill were added to evaluate relative local impact of landfill-influenced discharges to the lakes.

At known discharge locations, sediment surface grab samples (Eckmann dredge) were taken in a linear pattern radiating out into the lakes from the suspected sources. A control site within the lakes, where there is no known pollution source in proximity was included in the sampling strategy. Surficial sediment sampling locations are highlighted in Table 6. Sediment samples were analyzed for parameters listed in Table 6.

TABLE 6. Synoptic Sediment Sampling in Smith and Bybee Lakes

# Transacts	# Samples/ Transact	# Other Sampling Points	Parameters
4	3	6	Metals (Ar, Cd, Cu, Cr. Hg. Ni, Pb, Se, Zn) Polynuclear aromatic hydrocarbons (PAHs) Total solids, total volatile solids, grain size

Results of the sediment analysis is listed in Appendix A, Table 2. Examining the total metals concentrations in the surficial sediment by stations (Figure 11), zinc, copper, chromium, arsenic, cadmium and lead, appear distributed homogeneously throughout the lakes system. Mercury and selenium were found above the detection limits at a few locations in the lakes, with detected concentrations distributed seemingly at random among the points sampled. Metal concentrations in the sediment at two sampling stations in the North Slough, S-3 and S-4, also fell within the range of those found throughout the lakes (Figure 12).

Currently, there are no sediment quality standards for the State of Oregon to which analytical results can be compared. To evaluate sediment quality for metals, comparisons were made to the Washington State Sediment Quality Criteria (Long and Morgan, 1990). Concentrations of all metals analyzed in Smith and Bybee sediments fell below the concentration levels that are believed to evoke toxic responses in marine benthic organisms. No criteria was available for selenium. However, note that these criteria are based on research on marine sediments and calculated on a dry weight basis based on 2% total organic carbon (TOC). No TOC analysis was made on sediments taken from Smith and Bybee Lakes.

A different pattern of distribution in the sediments was observed for PAHs. For those sites for which concentrations of PAHs were above the detection level, the concentrations generally feel into two groups: mid-lake and stormwater outfalls. A number of PAHs were detected at the mid-lake stations, S-1, S-2, S-5, and S-6 (Figure 13). However, all concentrations at these locations were below 0.1 mg/kg (ppm) dry weight and below any

Figure 11

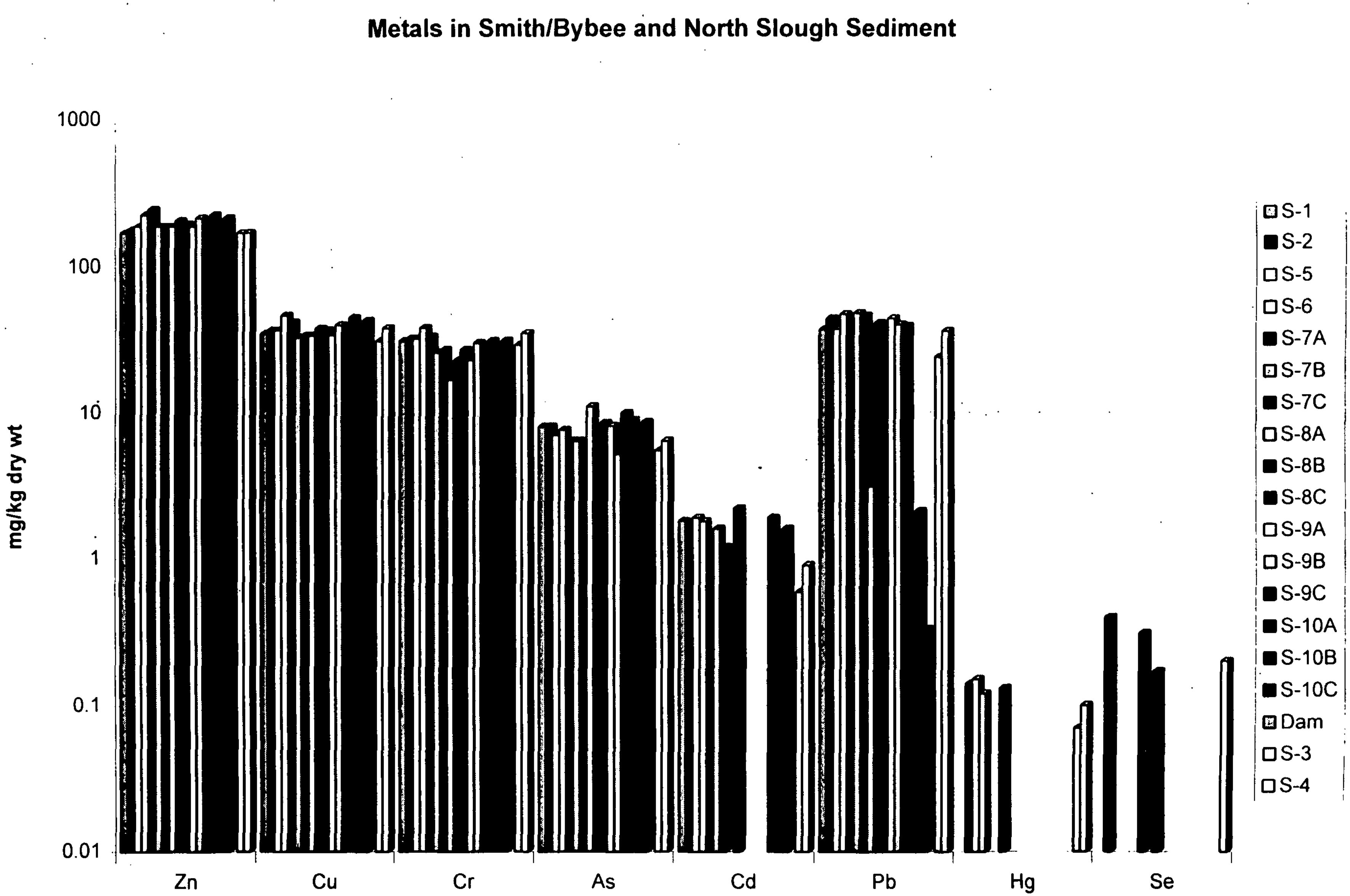

Metals in Smith/Bybee and North Slough Sediment
1000
100
10
1
0.1
0.01
mg/kg dry wt
Zn
Cu
Cr
As
Cd
Pb
Hg
Se
S-1
S-2
S-5
S-6
S-7A
S-7B
S-7C
S-8A
S-8B
S-8C
S-9A
S-9B
S-9C
S-10A
S-10B
S-10C
Dam
S-3
S-4

Figure 12

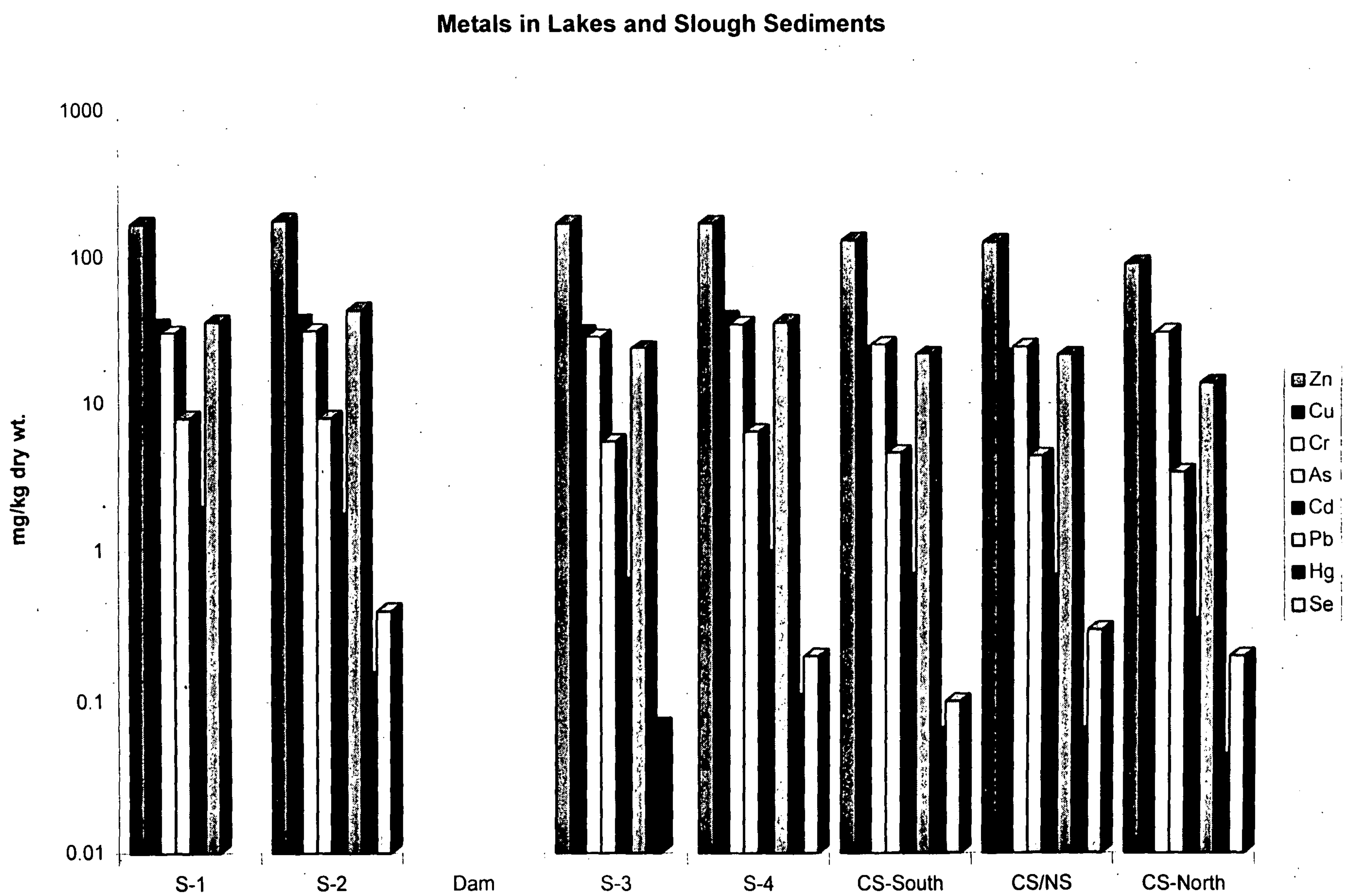
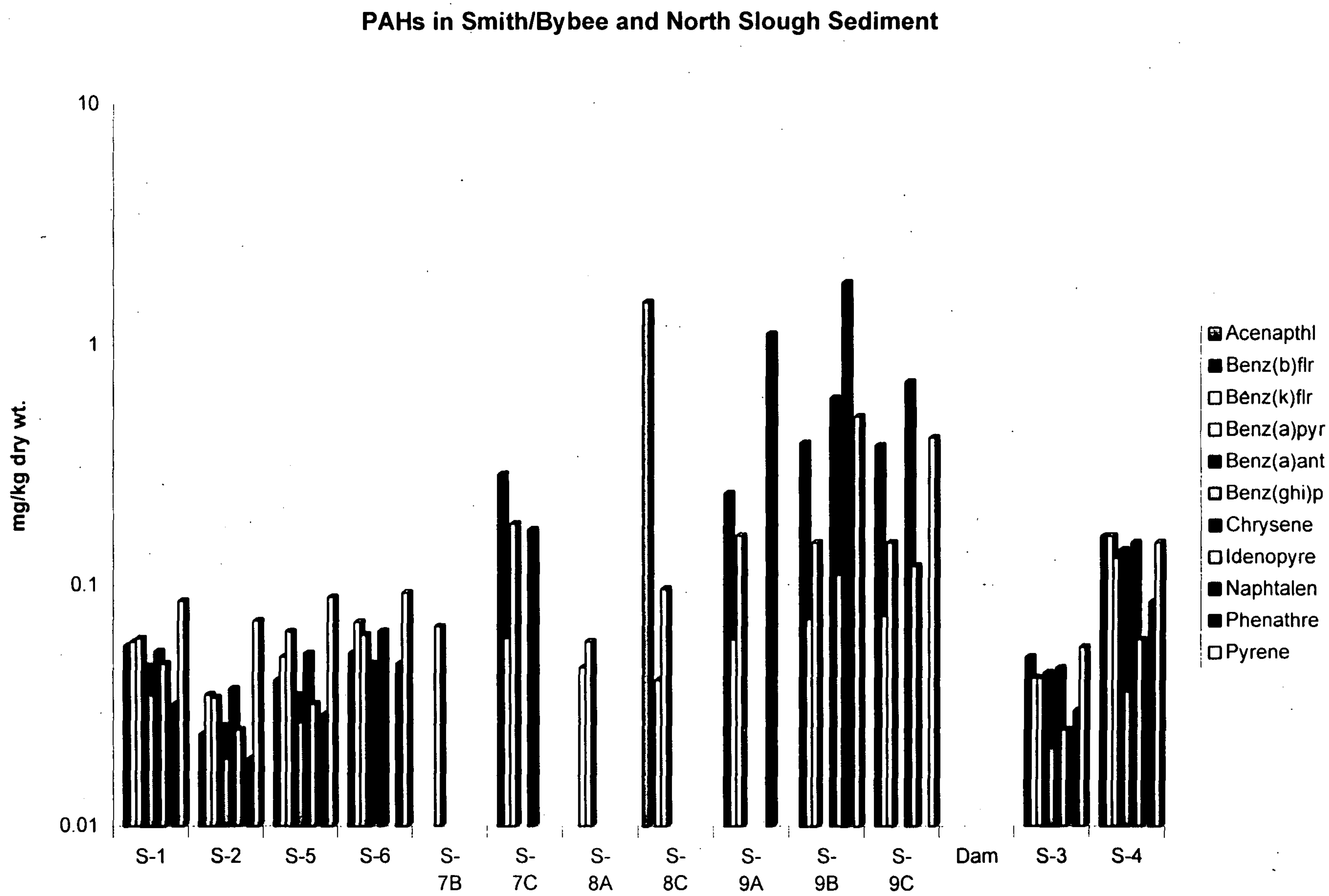

Metals in Lakes and Slough Sediments
1000
100
10
1
0.1
0.01
mg/kg dry wt.
S-1
S-2
Dam
S-3
S-4
CS-South
CS/NS
CS-North
Zn
Cu
Cr
As
Cd
Pb
Hg
Se

Figure 13


PAHs in Smith/Bybee and North Slough Sediment
mg/kg dry wt.
10
1
0.1
0.01
S-1
S-2
S-5
S-6
S-7B
S-7C
S-8A
S-8C
S-9A
S-9B
S-9C
Dam
S-3
S-4
Acenapthl
Benz(b)flr
Benz(k)flr
Benz(a)pyr
Benz(a)ant
Benz(ghi)p
Chrysene
Idenopyre
Naphtalen
Phenathre
Pyrene

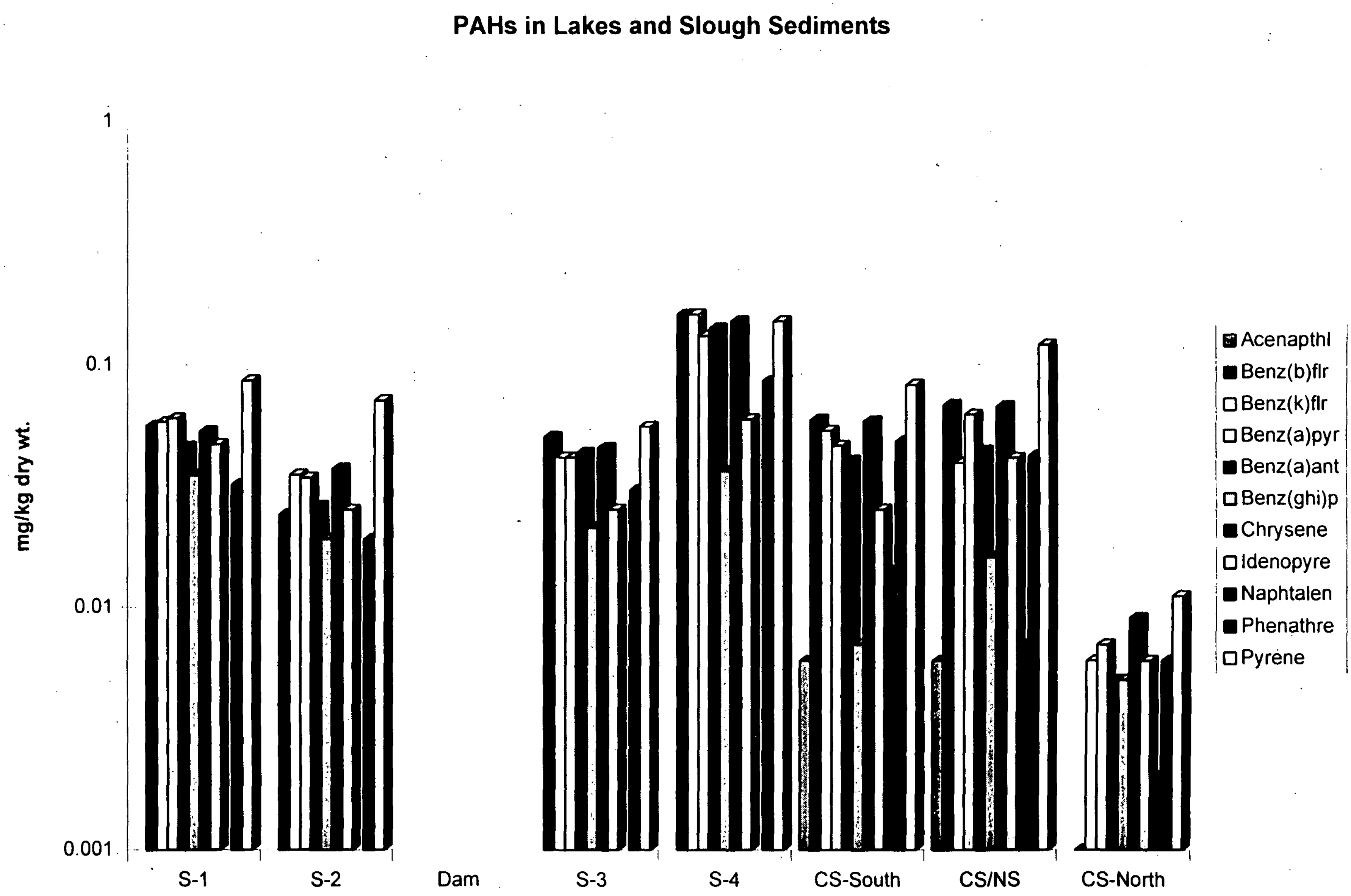
threshold that evokes toxic responses in marine benthic organisms. Among the stations located near stormwater outfalls, S-7, S-8, and S-9, individual PAH compounds, where detected, were considerably higher in concentrations. Though sediment quality criteria are not available for all PAH compounds tested in this study, criteria for lower threshold effects on benthic organisms was exceeded for three compounds found in the lakes: chrysene, naphthalene, and pyrene. These occurred at one site, S-9, located in Bybee Lake adjacent to the stormwater outfall that drains a portion of Marine Drive and associated industries that access via approximately 4500 feet of Marine Drive. Total drainage area is unknown at this time, but more development is occurring in the drainage, adding more industry and impervious surfaces that will increase the potential sources of PAHs. Site S-8 receives stormwater from an area that includes an oil recycling firm and a large bus repair shop. Site S-7 in Smith Lake has historically received runoff and leachate discharges from the adjacent landfill.

Since one enhancement option for the lakes includes restoring the flow between Columbia Slough and the lakes, comparison of sediment quality is useful. Choosing S-1 and S-2 as representative of sediment quality in the lakes, concentrations at these locations are compared to those in the North Slough, S-3 and S-4, and the Columbia Slough. Using sediment quality data acquired for the Columbia Slough Screening-Level Risk Assessment (BES, 1995), three locations were chosen:

CS-South: approximately 130 meters south of the confluence of the Columbia Slough and North Slough,
CS/NS: at the confluence in the Columbia Slough channel. and
CS-North: approximately 260 meters north of the confluence (CS-North).

Based on the station shown in Figure 14, metal concentrations appear to be evenly distributed throughout the lakes and slough; in other words, there appears to be no significant differences in metal concentrations between the lakes and the slough. PAH concentrations in the North Slough and in the Columbia Slough in vicinity of its confluence with the Columbia Slough also appear to be within similar range of values compared to the lakes mid-lake stations. S-4, which is located in the North Slough between the confluence and the sunken barge blocking flow in the North Slough, appears to have higher concentrations of PAHs as a group. This could be a result of a high rate of settling of sediments transported from the Columbia Slough that occurs at the sunken barge. CS-North, located in the Columbia Slough north of the confluence, appears to be lowest in PAH compounds as a group. Since this data is limited to a single sampling point in time, significant differences cannot be determined. Interestingly, PAH concentrations in the slough and mid-lake sediments are lower than those found near the storm water outfalls in the lakes (Figure 14).

Figure 14


PAHs in Lakes and Slough Sediments
mg/kg dry wt.
1
0.1
0.01
0.001
S-1
S-2
Dam
S-3
S-4
CS-South
CS/NS
CS-North
Acenapthl
Benz(b)flr
Benz(k)flr
Benz(a)pyr
Benz(a)ant
Benz(ghi)p
Chrysene
Idenopyre
Naphtalen
Phenathre
Pyrene

RELATED STUDIES - BIOTA

In 1992-93, a study of the biota of the Smith and Bybee Lakes Management Area was undertaken. The study (Lev et al. 1994) focused on acquiring baseline data so that current conditions would be assessed and comparisons with future conditions of the area's biota would be possible. Data was acquired for (1) species presence and abundance (plants, macroinvertebrates, amphibians, reptiles, birds, and mammals), (2) the patterns of species use, and (3) habitat quality. Assessment of fish populations was not included in this biological survey.

The study report provides:

1) the documentation for the vegetation and fauna studies conducted from June 1992 to August 1993
2) management recommendations based on study results
3) proposal for a monitoring program
4) identification of salient data gaps needed to refine future management options.

The authors of the study were requested to make management recommendations that would increase native species richness and diversity and minimize the establishment of exotic species. The main recommendation of the study is to allow the water levels in the lakes to fluctuate with the change in the levels of the Columbia and Willamette Rivers by removal of the existing control structure separating the lakes from the slough.

Vegetation

Two major modifications in the vegetation of the lakes have occurred since the water control structure has been in place, keeping the inundated area larger and inundation period longer: (1) loss of extensive willow assemblage on the lake margins and (2) increase in flooded emergent, submerged, and floating aquatic plant communities accompanied by a loss of open water in the lakes. If the water levels in the lakes were allowed to vary with those of the Willamette and Columbia Rivers, then moisture conditions would favor an increase in the lake margin willow assemblage and increase the ratio of open water to submerged and floating aquatic vegetation.

Certain invasive pest plant species may be favored under different hydrologic conditions. Isolated colonies of purple loosestrife have been found in the Lakes Management Area since 1987. Control by hand removal has had limited success. Exposing larger areas of the lakes to drier conditions may provide better conditions for proliferation of purple loosestrife. Prolonged inundation is one effective tool for control. Currently, diligent hand removal is detering its spreading. Biological controls are being researched now for application in the lakes area. Oregon Department of Agriculture is currently conducting an experimental release of insects within the Lakes Management Area that are host-specific predators on purple loosestrife.

To maximize native plant species diversity and minimize establishment of exotic plant species, the main recommendation is to allow for more significant seasonal fluctuations of the lake levels, mimicking those of the Willamette and Columbia Rivers.

Aquatic Macroinvertebrates

Smith and Bybee Lakes support only a fraction of potential aquatic invertebrate taxa associated with either permanent or seasonally flooded lentic habitat at lower elevation in the Pacific Northwest (Lev et al. 1994). All strictly aquatic invertebrates in both lakes are classified as highly tolerant of nutrient enriched and low dissolved oxygen conditions. Greater richness of invertebrate species is associated with any type of dense vegetation, which provides cover from predators and substrate for attachment, resting, perching or crawling. Absent from the lakes sediments are fingernail clams (Sphaeriidae), indicating anoxic conditions at or near the sediment surface occurs at times. Mayflies (Ephemeroptera) were also conspicuously absent, attributable to fish predation and low dissolved oxygen conditions at the sediment surface during warmer months.

A recommendation was made to lower the water levels further than the existing structure allows to increase exposure of sediments, particularly in the summer, which will accelerate decomposition of the surficial organic sediment layer and allow aeration of the sediments. This should lead to a lower biochemical oxygen demand during periods when sediments are inundated. Invertebrate species' richness and production should increase in more oxygenated sediments.

Amphibians and Reptiles

Compared to a similar site in the region, Sandy River Delta, and judging from what a similar habitat could support, the Smith and Bybee Lakes Management Area was deemed depauperate in amphibian and reptile fauna. (Lev et al. 1994). This is attributable primarily to a relatively static water level and high benthic biochemical oxygen demand conditions. To enhance these fauna groups, it is recommended that there is a more dynamic fluctuation in the inundation regime and a reduction in the benthic biochemical oxygen demand. This would result in the following:

1) A more diverse and invertebrate macrofauna would be available as a food resource.
2) More cover for native amphibians would be available.
3) The number of exotic warmwater predators (bullfrogs, carp, sunfish, etc.) would be reduced.
4) Higher reproduction among native amphibians and reptiles would be possible.

It is notable that the western painted turtle (Chrysemys picta belli) population in the Smith and Bybee Lakes Management Area may represent the largest western painted turtle population in the region. Insufficient data or understanding exists at this time to make management conditions that would ensure their populations' health or survival. Also notable is the unusually high density of the Northwestern garter snake (Thamnophis ordinoides) and common garter snake (T. sirtalis) found on the willow wetlands on the western side of the Columbia Slough within the Management Area.

Mammals

Observer sightings, recently documented observations, and trappings were used to determine species present in the Lakes Management Area. Mammal use by habitat type (vegetation assemblage) was determined, with management recommendations forwarded based on those observations. Mammal species seen in the area are listed in Table 7.

Table 7
Mammals Seen at Smith and Bybee Lakes

Common Name	Latin Name
Beaver	*Castor canadensis*
Coyote	*Canis latrans*
Deer	*Odocoileus hemionus*
Deer Mouse	*Peromyscus oreas*
Domestic Cat	*Felix cattus*
Domestic Dog	*Canus familiaris*
Eastern Cottontail	*Sylvilagus floridanus*
Long-tailed Weasel	*Mustela frenata*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethica*
Nutria	*Myocaster coypus bonariensis*
Oppossum	*Didelphis marsupialis virginiana*
Raccoon	*Procyon lotor*
Red Fox	*Vulpes fulva*
River Otter	*Lutra canadensis*
Short-tailed Weasel	*Mustela erminea*
Townsend's Mole	*Scapanus townsendi*
Townsends' Vole	*Microtus townsendi*
Trowbridge's Shrew	*Sorex trowbridgi*
Western Pocket Gopher	*Thomomys talpoides*

Populations of smaller mammals sampled in the area indicate suitable habitat for species such as deer mice and Trowbridge's shrew. The data indicated that the mammals utilized most of the vegetation assemblages during some portion of the year. even if those assemblages are not considered preferred by a specific species.

Nutria and beaver are observed in prolific numbers to be having a significant impact on the area. The nutria make burrows and trails along the lakes and channels that are devoid of vegetation in contrast to areas with few or no nutria burrows. Nutria impacts are also evident in emergent wetland habitats near open water that contain lush, palatable vegetation. Vegetation in these areas has been severely grazed, thus reducing vegetative cover.

Beaver have also impacted herbaceous vegetation at or near water by digging burrows and establishing trails on or along the lakes and channel banks. The most obvious impact is seen in the willow and ash forests. Persistent high water levels held nearly constant by the water control structure built in 1982 have created habitat suitable year-round for easy access to trees along the shoreline, as well as protection of underwater entrances from exposure and susceptibility to predators, and reduction in flooding of lodges and bank dens. Lower water levels produce conditions that encourage emigration of young beaver, as well as nutria. Juvenile dispersing mammals are a key component of terrestrial carnivores and raptors.

Willow is a preferred food of beaver. Beaver grazing on the existing willow and ash forests are most likely reducing this limited resource at a higher rate than the rate prior to construction of the water control structure. Much of the areas formerly forested are now covered by water either year-round or for most of the year. This resulted in significant mortality of willows without regeneration. Beaver have been observed cutting down significant portions of the Oregon ash, a secondary food source, some of which are older trees (greater than 18 inches diameter).

The recommended management strategy for mammals is to increase water level fluctuations in a manner that mimics the water levels in the adjacent Willamette and Columbia Rivers, both on a daily tidal and seasonal basis. Promotion of freshwater tidal marsh and seasonally flooded emergent wetlands would increase diversity and abundance of palatable vegetation, seed-producing vegetation, and invertebrate productivity that should assist in maintenance of healthy populations of most mammals of the lakes area. The anticipated increase in emergent vegetation coincides with the time of dispersal for many breeding populations of small mammals.

Birds

Survey data on bird use of the lakes area include resident and migratory birds, passerine as well as waterfowl. Birds observed at Smith and Bybee Lakes are listed in Table 8. Waterfowl and shorebirds are the groups most significantly affected by the hydrology and water quality of the lakes. Therefore, this discussion will be limited to those groups.

Smith and Bybee Lakes are in the same flyway and provide similar habitat conditions for waterfowl and shorebird species as Sauvie Island in Oregon and Vancouver Lake wetlands and Ridgefield Wildlife Refuge in Washington. Waterfowl species commonly found in large numbers include Northern pintails, common merganzer, cinnamon teal, Greater scaup, mallard, Northern shoveler, and wigeon. Even under existing limited conditions for exposed shore habitat, use by shorebirds has been observed, including Greater yellowlegs, solitary and spotted sandpiper, long-billed dowitcher, killdeer, and snipe. Common waders include the prolific Great blue heron, green-backed heron, and, in recent winters, Great egrets.

Recommendations made to enhance waterfowl and shorebird habitat include:

(1) provide greater seasonal fluctuations to promote productivity of food sources, including vegetation, aquatic macroinvertebrates, amphibians and reptiles.
(2) increasing water level fluctuations that results in raising winter water levels, thereby providing more open water habitat.
(3) allow water levels to decrease in summer/fall to promote development of willow fringe, which provides cover for waterfowl.

RELATED STUDIES - SCREENING - LEVEL RISK ASSESSMENT

A *Screening-Level Risk Assessment for Smith-Bybee Lakes Natural Resources Management Area* was completed for Metro by Parametrix (1995). The objective of the screening-level risk assessment (SLRA) was to assess potential risks, based on purposefully conservative exposure conditions, to three different receptor classes: aquatic life, wildlife, and people. The assessment was conducted using historical surface water, sediment, fish and crayfish tissue, groundwater, and landfill gas data. Additional sediment and tissue data was collected in summer of 1994 to fill identified gaps in the historical database. The assessment area included Smith and Bybee Lakes, the North Slough, and the Columbia Slough from river mile 0.5 to 4.5 from the confluence with the Willamette River.

Conservative exposure assumptions were used to quantify chemical doses through each exposure pathway. For example, the fish consumption rate used in the SLRA were considerably higher than that identified in consumption surveys conducted in 1994.

Aquatic Life Risks

Potential risks to water column organisms were predicted to be low. The chemical of greatest concern for Smith and Bybee Lakes was phosphorus, not for toxicity, but for the potential to increase the rate of eutrophication in the lakes. For benthic organisms, estimates of interstitial water concentrations, which were derived from mass sediment sample measurements, were compared to chronic toxicity values protective of aquatic life to assess potential risks. Mostly metals were identified as chemicals of potential concern. The predicted risks to benthic organisms are uncertain given that the interstitial water concentrations were calculated from sediment/water partition coefficients based on literature values.

Table 8 Results of Waterfowl and Shorebird Surveys at Bybee & Smith Lakes

NOVEMBER 1992 AND FEBRUARY 1993

BYBEE LAKES

Species	Field Visit 10/3	Field Visit 10/27	Field Visit 2/10
American Coot	12		3
Canada Goose		15	10
Cinnamon Teal		80	158
Common Merganser	2	2	7
Double crested Cormorant			10
Dowitcher	3	1	
Gadwal			7
Great Blue Heron	12	8	7
Greater Yellowlegs	6	2	
Green wing Teal	2	3	3
Killdeer	2	2	
Kingfisher	3	4	1
Mallard	30	20	77
Northern Pintail			29
Snipe	7	3	
Spotted Sandpiper	6	6	
Wigeon	12	6	480
Wood Duck	37	1	
Total	**134**	**153**	**792**

SMITH LAKE

Species	Field visit 10/3/92	Field Visit 10/20/92	Field Visit 2/10/93
American Coot			31
American Pintail			4
American Wigeon			
Belted Kingfisher		1	2
Canvasback		2	4
Cinnamon Teal		2	62
Common Merganser			3
G. Yellowlegs	4	2	
Gadwall			70
Great Blue Heron	3	5	2
Gr Wing Teal	4	2	10
Greater Scaup			280
Killdeer	1	1	
Long billed Dowitcher	7	6	
Mallard		10	60
Snipe	1	5	
Spotted Sandpiper	2	4	
Total	**22**	**40**	**528**

Wildlife Risks

The river otter and Great blue heron were selected as the wildlife receptors for the purpose of the SLRA. The primary component of their diet is fish, they are both exposed to incidental ingestion of water and sediment, and are year-round residents of the area. For both river otter and Great blue heron, the majority of predicted risks were from exposures to chemicals in fish tissue (i.e., pesticides and metals) and the sediments (i.e., metals). Comparing areas of relative risk, the lower Columbia Slough (within 3.2 miles of confluence with Willamette River) posed higher risk for these two species, followed by North Slough and the lakes, in that order.

The conservative assumptions used to determine the expected environmental concentrations, expected environmental doses, and the toxicity values, resulted in risk estimates that substantially overestimate true wildlife risks from sediment, surface water, and tissue chemicals. For this reason, the results of the SLRA should be viewed as relative risk comparisons between different locations in the Management Area rather than absolute risk for wildlife.

Human Health Risks

Human health risks were evaluated for landfill workers and recreational users. Since the latter is of primary concern for this report, discussions will be limited to recreational users. The assumptions used in the SLRA for determining potential human health risks associated with exposure through surface water, sediment, and fish consumption, are listed in Table 9.

Potential cancer and non-cancer risks to humans from recreational exposures to the sediment and surface water in the lakes and adjacent lower Columbia Slough were low to negligible. Non-cancer risks were predicted to be negligible from the consumption of fish caught in the lakes, and were predicted to be low for fish caught and consumed from the Slough.
Potential carcinogenic risks were calculated using fish obtained by electrofishing in the lakes, North Slough, and lower Columbia Slough. A summary of human health total cancer risks for ingestion of fish fillets and whole fish by fish groups is given in Table 10 and illustrated in Figure 15.

Table 9 Assumptions Used for Estimating Human Exposure

Parameter	Value	Units	Reference
Child sediment ingestion rate	200	mg/day	Best Professional Judgement
Adult sediment ingestion rate	100	mg/day	Best Professional Judgement
Sediment deposition rate to skin	1	mg/cm^2	U.S. EPA 16 August 1991
Child skin surface area exposed to sediments[a]	2,466	cm^2	U.S. EPA July 1989
Adult skin surface area exposed to sediments[b]	3,100	cm^2	U.S. EPA January 1992
Child skin surface area exposed to surface water	7,280[c]/2,466[e]	cm^2	U.S. EPA January 1992
Adult skin surface area exposed to surface water	23,000[d]/5,170[f]	cm^2	U.S. EPA January 1992
Child exposure frequency to sediments and surface water while swimming[g]	14	days/year	Best Professional Judgement
Adult exposure frequency to sediments and surface water while swimming[g]	14	days/year	Best Professional Judgement
Incidental ingestion rate of surface water while swimming for children and adults	50	mL/hour	U.S. EPA December 1989
Child exposure time while swimming	2.6	hr/day	U.S. EPA April 1988
Adult exposure time while swimming	2.6	hr/day	U.S. EPA April 1988
Child ingestion rate of fish[h]	54	g/day	Best Professional Judgement
Adult ingestion rate of fish	250	g/day	Best Professional Judgement
Child exposure frequency for ingestion of fish	104	day/year	Best Professional Judgement
Adult exposure frequency for ingestion of fish	104	day/year	Best Professional Judgement
Child ingestion rate of crayfish[h]	4.3	g/day	Best Professional Judgement
Adult ingestion rate of crayfish	20	g/day	Best Professional Judgement
Child exposure frequency for ingestion of crayfish	12	day/year	Best Professional Judgement
Adult exposure frequency for ingestion of crayfish	12	day/year	Best Professional Judgement
Child exposure duration	6	yr	U.S. EPA 16 August 1991
Adult exposure duration	24	yr	U.S. EPA 16 August 1991
Child body weight	15	kg	U.S. EPA 16 August 1991
Adult body weight	70	kg	U.S. EPA 16 August 1991
Averaging time for noncarcinogens	30	yr	U.S. EPA 16 August 1991
Averaging time for carcinogens	75	yr	U.S. EPA 16 August 1991

[a] Average area of hands, feet, one-half of arms, and one-half of legs of 3-4 year old.
[b] Average area of hands, forearms and feet of adult male.
[c] Average total body surface area of 3-6 year old male for swimming exposures.
[d] Upper estimate of average total body area of adult male for swimming exposures.
[e] Average area of hands, feet, one-half of arms, and one-half of legs of 3-4 year old for wading exposures.
[f] Average area of hands, forearms, lower legs, and feet of adult male for wading exposures.
[g] Equal to swimming once per week for 14 weeks (3½ months).
[h] Calculated as the product of the adult ingestion rate of fish (250 g/day) or crayfish (20 g/day) and the ratio of child to adult body weights (15 kg / 70 kg).

Table 10

Summary of Human Health Total Cancer Risks for the Ingestion of Fish Fillets and Whole Fish

	Carp		Bass		Other*	
	Fillet	Whole Body	Fillet	Whole Body	Fillet	Whole Body
Smith & Bybee Lakes	7.5×10^{-6}	8.2×10^{-4}	1.3×10^{-6}	7.2×10^{-6}	1.4×10^{-6}	1.0×10^{-5}
North Slough	3.0×10^{-5}	6.2×10^{-4}	N/AP	N/AP	4.0×10^{-4}	6.2×10^{-4}
Lower Slough River miles 0-3	6.5×10^{-5}	6.6×10^{-5}	N/AP	N/AP	2.5×10^{-6}	8.8×10^{-5}
Lower Slough River Miles 3-6	7.9×10^{-5}	1.9×10^{-4}	N/AP	N/AP	1.2×10^{-5}	1.5×10^{-4}

* "Other" for the lakes are Centrarchids, excluding bass;
"Other" for North Slough are all Centrarchids.

For the consumption of carp fillets, arsenic presented the greatest potential carcinogenic risk, ranging from a minimum of 7×10^{-6} (or 7 in 1,000,000 chance of developing cancer during a lifetime) in Smith and Bybee Lakes to a maximum of 8×10^{-5} (or 8 in 100,000 chance of developing cancer during a lifetime) in the lower Columbia Slough between river miles 3 and 6. Potential risks associated with consumption of whole body carp was higher, ranging from a minimum of 7×10^{-5} in the lower Columbia Slough to a 8×10^{-4} in Smith and Bybee Lakes. Chemicals of potential concern for consumption of whole body carp include PCBs, DDE, and arsenic.

Potential non-carcinogenic and carcinogenic risks for ingesting bass, both fillet and whole body, in the lakes and slough are negligible to less than 1 chance in 1,000,000. Potential non-carcinogenic risks from consumption of fillets and whole body of "other" fish were low to negligible. "Other" fish are Centrarchids other than bass, including black crappie, bluegill, and yellow perch. As observed in other fish, whole body tissue posed the higher risk, with potential carcinogenic risks ranging from 1×10^{-5} in Smith and Bybee Lakes to 6×10^{-4} in the North Slough. The chemicals of potential concern in whole body tissue were PCBs, arsenic, and dieldrin.

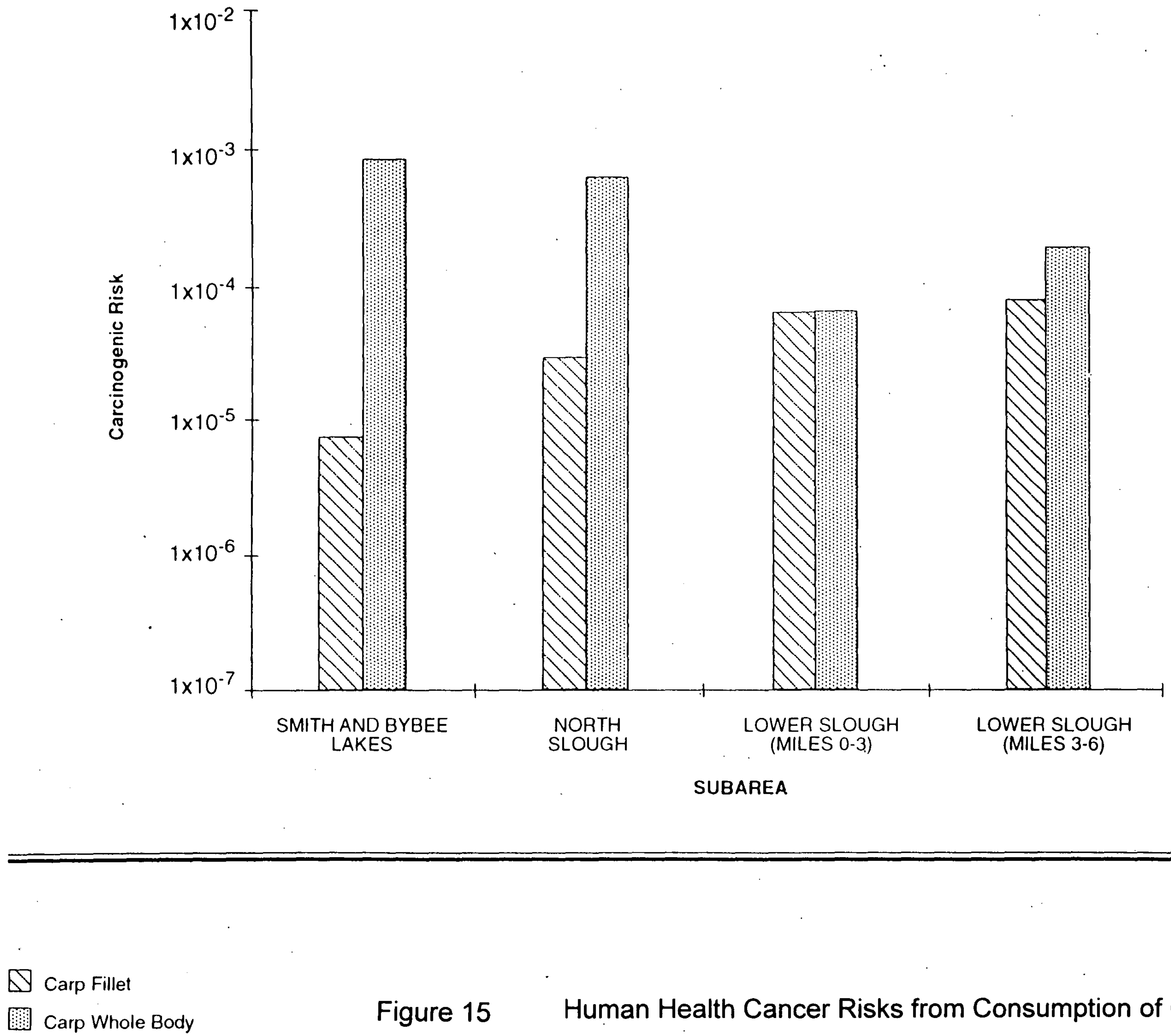


Figure 15 Human Health Cancer Risks from Consumption of Carp

The magnitude of the predicted cancer risk values from fish consumption are consistent with the risk predictions used as the basis for the Columbia Slough fish consumption health advisory currently instituted by the Oregon Health Division.

Crayfish were found in the lower Columbia Slough but not in the North Slough or Smith and Bybee Lakes, indicating limited availability for harvesting and consumption. In the lower Columbia Slough, potential non-carcinogenic and carcinogenic risks from the consumption of crayfish were negligible. Therefore, no chemicals of potential concern were identified for consumption of crayfish tissue. Analytical results of fish and crayfish tissue samples taken from the lakes and the North Slough in 1994 are listed in Appendix C.

RELATED STUDIES - ST. JOHNS LANDFILL GROUNDWATER MODEL

The St. Johns Landfill is a prominent feature within the Smith and Bybee Lake Wildlife Area. This approximately 260-acre landfill ceased receiving solid waste in February, 1991, with a 5-year closure program beginning in 1992, which includes capping the entire landfill with polyethylene. The landfill is bordered by Smith Lake to the east, North Slough to the north, and Columbia Slough to the south and west. The landfill occupies the former site of a seasonal lake/wetland very similar to Smith and Bybee Lake. The eastern portion of the landfill actually extends into Smith Lake, separated by a constructed dike. There is considerable concern that contaminants associated with landfill leachate are entering the surface waters and sediments of the refuge area and affecting the biota. In December, 1995, Metro and Portland State University completed development of a groundwater model of the St. Johns Landfill system (Li et al., 1995) to assist in characterizing the landfill's interaction with the surrounding groundwater and surface water systems.

The floodplain sediments that comprise most of the banks surrounding the landfill also underlie the landfill. These sediments, which also extend beneath Smith and Bybee Lakes, are clayey silts, silty clays and fine sands. Thickness of the underlying silts below the landfill vary from 30 feet to 150 feet. Below the silts are the more permeable Columbia River sands and gravels, which extend beneath the lake and the adjacent Willamette and Columbia Rivers. Because of the direct contact of the sands and gravels with the rivers, the interaction with the Columbia and Willamette Rivers greatly controls the sand/gravel aquifer and greatly impacts the groundwater flow pattern in the St. Johns Landfill region.

To understand the local effect of the landfill on surrounding waters, the following five model components were developed, the output of each being used as input for successive model components:

1. <u>Dynamic Water Balance</u> - A dynamic water balance model simulating mean leachate mounding, lateral seepage flux to the sloughs and vertical flux to the deep gravel

aquifer. It is calibrated to reproduce the long-term space-time average of the observed mound height.

2. Spatially-distributed Mound - This refined version of the dynamic water balance model is an unsteady spatially-distributed leachate mound model predicting the spatial distribution of landfill mound height as a function of time. It is calibrated to the time-averaged measurements of head differences measured in monitoring wells across the landfill.
3. Regional-scale Flow - An unsteady quasi-three-dimensional regional model simulating the regional flow system and its dynamic interaction with the Columbia and Willamette Rivers. It is calibrated to reproduce the seasonal fluctuation as determined by the measured hydrographs in six gravel wells measured during Nov. 2, 1988 to Nov. 1, 1989.
4. Local-scale Flow - A local-scale flow model that reproduces detailed three-dimensional flows at enhanced resolutions, particularly in the vicinity of the landfill. The calibrated parameters in the regional flow system were used in calibration of local-scale models.
5. Local-scale Transport - A local-scale transport model to predict leachate migration in the silt, gravel, and off-site.

Conclusions from model investigations are summarized below.

- **Leachate mounding** in the landfill reached a "quasi-steady state" for some time (i.e., inflow=outflow) at a mound height of approximately 25 feet. The leachate mound has started to dissipate after the landfill capping began in 1992. The mound is predicted to dissipate completely in 15-25 years.

- **Lateral seepage flux** to the sloughs prior to landfill capping was 0.15-0.21 cfs. The corresponding **vertical flux** to the gravel aquifer was 0.03-0.10 cfs. With decreasing flux after closure, the lateral flux to sloughs will become 0.046-0.083 cfs by the year 2000. The corresponding vertical flux will be 0.015-0.027 cfs.

- **Vertical migration** in the silt below the landfill is much slower than the lateral migration through the dike because of the thicker silts and small vertical silt conductivity. The model predicts that contamination has broken through the silt below the landfill only in a localized area on the north side of the landfill near a mid-point of the North Slough.

- **Time of travel** for a particular solute in the leachate to pass through the dikes surrounding the landfill is highly dependent on the physical/chemical interaction of the solute with the soils in the dike. The time for which a conservative (not retarded) solute (e.g., chloride) may take to break through the dike is approximately 2-3 years. A reactive solute may take 20-30 years to break through, while highly reactive solutes may never penetrate through the silt dikes surrounding the landfill.

- **Regional groundwater flow patterns** are completely controlled by seasonal fluctuations in the Columbia and Willamette Rivers and by the temporal variability in regional recharge. The frequent change in flow direction and velocity has a long-term effect of dispersing any leachate plume, if it has penetrated the silt layer.

- **Interaction between the lakes and the sand/gravel aquifer** is weak because of the small vertical conductivity associated with fine-grained silt separating the two systems. For example, permeability of one sediment sample from Bybee Lake was measured in a tri-axial test to be $6x10^{-7}$ cm/sec. Generally, the lakes recharge the aquifer at a low rate, for example, 0.08 cfs in 1989. If Bybee Lake is restored to intertidal conditions, upwelling into the lake will occur at a very low rate, on the order of 0.04 cfs. The lake dynamics have essentially little or no influence on the rate of any plume migration that may occur in the aquifer. Aquifer dynamics have no influence either on lake water balance or dynamics.

Interaction between the lakes and the aquifer is of interest since consideration is being given to significantly alter the hydrology of the lakes by removing the existing dam that separates the lakes from the Columbia slough for most of the year. In the regional-scale flow model, water flux between the lakes and the aquifer were modeling both under conditions of the lakes open and closed to the North Slough. In the case where Bybee and Smith Lakes are separated from the slough (present conditions), the lakes recharge the groundwater aquifer at a rate that represents approximately 1% of the total recharge to the regional groundwater system. Modeled in the condition of opening Bybee Lake to North Slough, there would be a net inflow from groundwater into the lakes approximately equal to the outflow under closed conditions. The Willamette and Columbia Rivers are always the main outlet for regional groundwater flow with almost all recharge going into the rivers.

More important is the effect of lake levels on plume migration that may be emanating from the landfill. Plume migration in the regional aquifer were examined using three factors: (1) anisotropy, (2) dispersivity, and (3) lake level. Anisotropy describes soils where permeability is different in different directions. The anisotropy of the alluvial silts is high, resulting in horizontal flow an order-of-magnitude higher than vertical flow. Anisotropy is bar far the most important parameter that controls plume migration in the silt and indirectly affects plume extent in the underlying gravel aquifer. Dispersivity affects the plume in the gravel aquifer as a secondary affect. **Based on the model sensitivity analysis, lake level has no effect on groundwater plume movement.**

A groundwater contamination "hot spot" was identified in the model study, located on the northern-central boundary of the landfill and the North Slough. Though the model indicated a limited plume extent, additional sampling wells in the vicinity are needed to define the plumes extent and movement.

FEASIBILITY STUDIES

DIRECT FLOW BETWEEN COLUMBIA RIVER AND LAKES

One option for improving the hydrodynamics and water quality of Smith and Bybee Lakes is to establish a direct connection with the Columbia River. Allowing Columbia River water to enter the lakes directly could conceivably (1) introduce generally higher water quality (i.e., lower nutrient concentrations) at certain times of year; (2) increase the variation in lake surface elevation both daily and seasonally; and (3) avoid the introduction of lower quality Columbia Slough water.

Columbia River/Lake Flow-Through Model

A numerical flow model was used to evaluate this option of opening the lakes directly to the Columbia River. The model (Boyko, 1995) was conceived to maximize flow through the lakes system utilizing gravity flow from the Columbia River directly through Smith Lake and out through the existing flow control structure at the end of North Slough (Figure 16). The northeastern shore of Smith Lake is the closest point to the Columbia River, the shortest distance between the shorelines of the river and Smith Lake being approximately 1600 feet through industrial lands. The model explores both open and closed channel flow configurations, using different dimensions to reduce frictional head loss while maximizing flow volumes.

Existing Flow Control Structure

The existing flow control structure housed within the dam separating the lakes from the Columbia Slough was built in 1992. The new structure utilized the existing earthen dam with a 60" diameter corrugated metal pipe 63 feet long through its base connecting Bybee Lake to the eastern end of the North Slough (Figure 17). The flow control structure was intended to provide more control over regulating the surface water levels in the lakes. Prior to this new structure, a weir fixed at 10.4 feet AMSL was in place on the Bybee Lake side of the pipe.

The new flow control structure attaches to the 60 inch diameter pipe on the Bybee Lake side of the dam. The structure houses a vertical overflow pipe, an adjustable high-flow weir and a low-flow control gate (Figure 18). The 4-foot wide adjustable weir, which has a minimum elevation at 8.4 ft. AMSL, receives water through a 36-inch diameter grated intake pipe with an invert elevation of 6.9 ft. AMSL. The low-flow control gate, a 30-inch diameter opening covered with a regulated circular plate, receives water through a 30-inch pipe with an invert elevation of 5.5 ft. AMSL. At lake surface elevations less than 5.5. ft. AMSL, no water from the lakes will flow through the structure.

Figure 16 Conceptual Model Flowchart: Maximize Flow Through Lake System and Flush North Slough

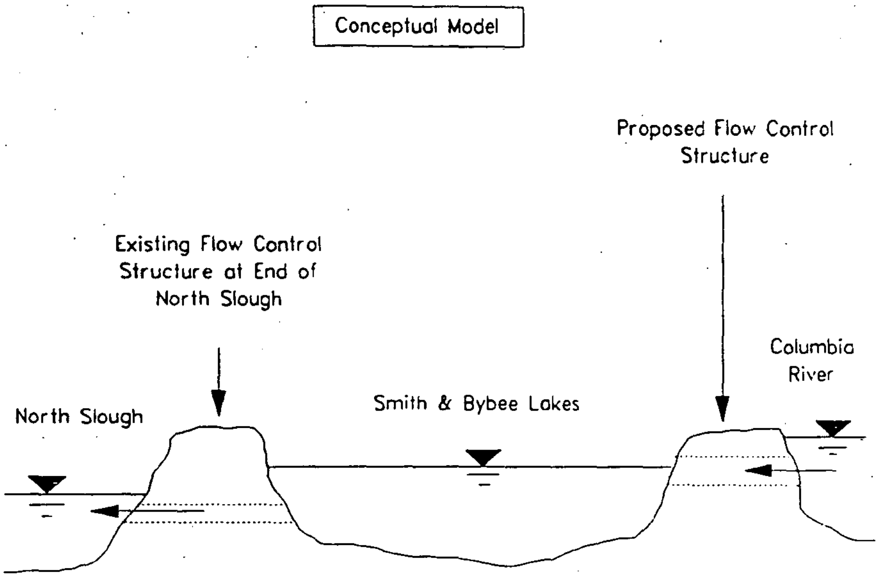
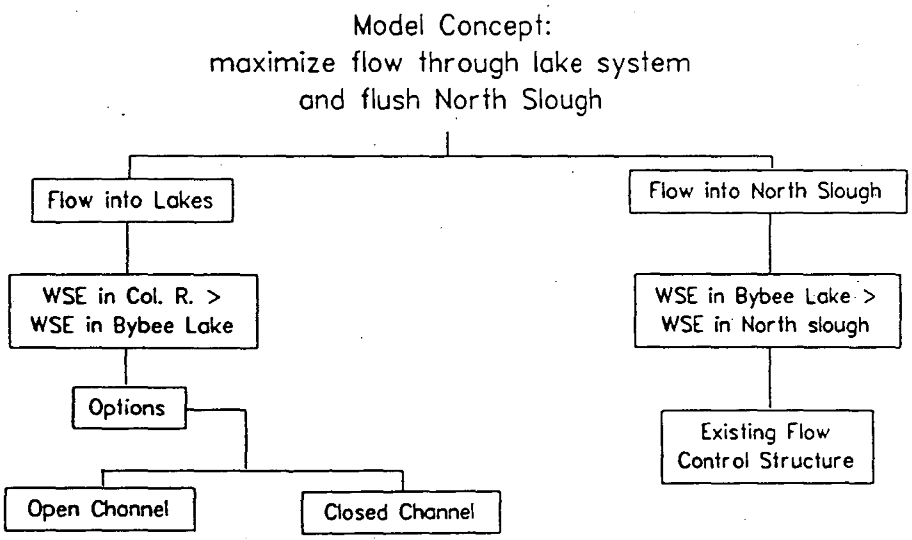


Figure 2: Conceptual Model



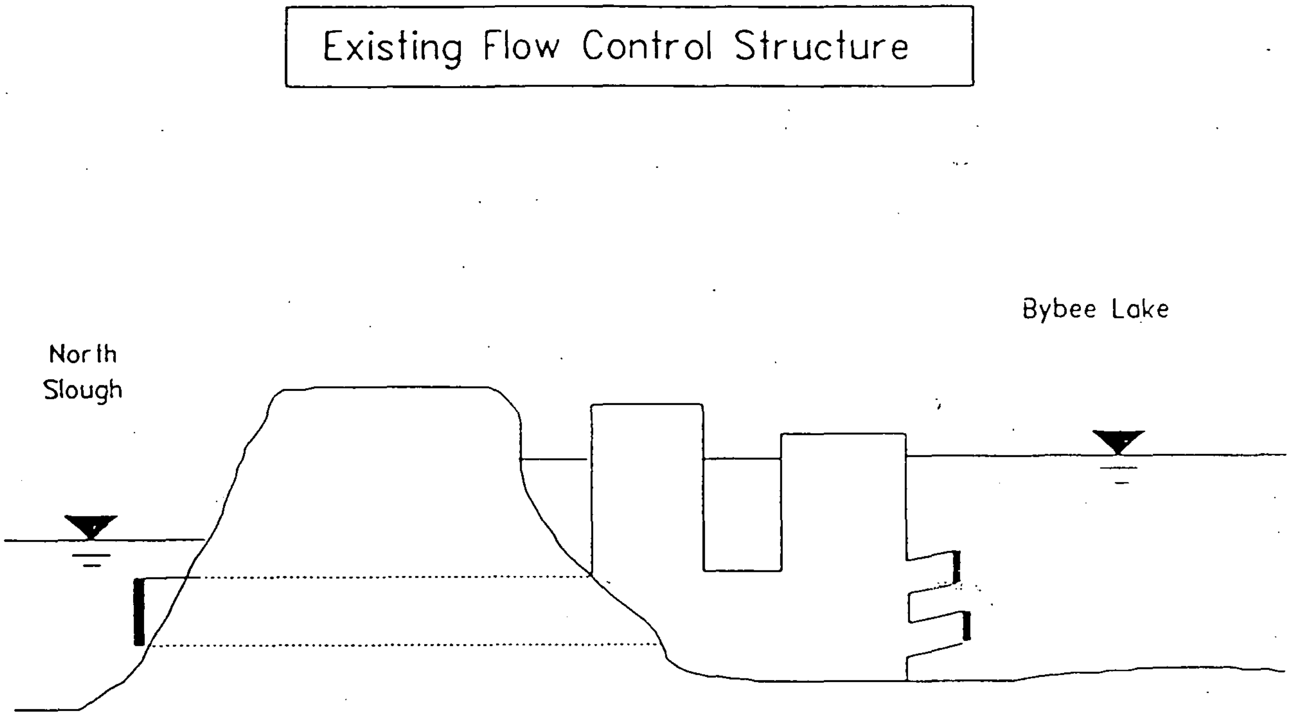


Figure 17 Existing Flow Control Structure

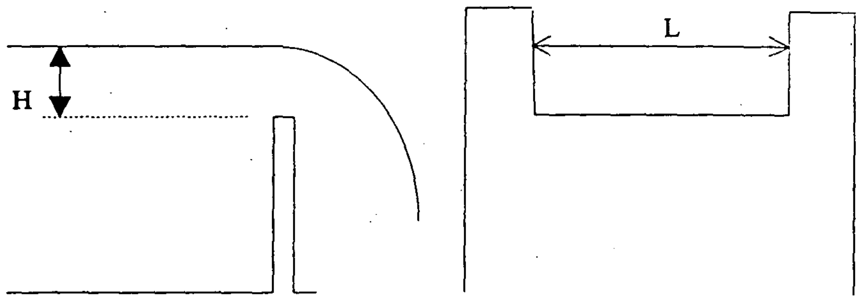


Figure 11: Weir Configuration

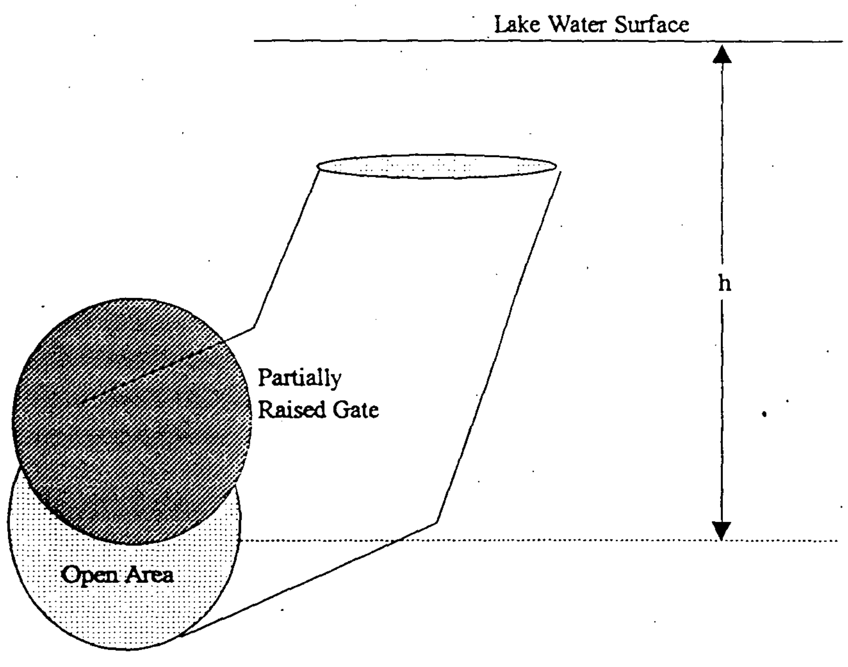


Figure 18 Weir Configuration and Canal Gate Configuration

Given the configuration of the new structure, water from the North Slough would enter the lakes through the structure when slough water surface elevations exceeded that of the lakes. Due to concern of entry of water of lower quality from the Columbia Slough via the North Slough into the lakes, an iron flap gate was mounted on the slough side of the 60-inch diameter pipe upon completion of the structure. This gate allows lake water to flow out and prevents slough water from entering the lakes through the structure.

Model Results

Gravity flow into the lakes would occur when the water surface elevation in the Columbia River exceeds that of the lakes. Outflow from the lakes into the North Slough occurs when the lakes' water surface elevation exceeds that of the North Slough. The water surface elevations in the North Slough are controlled primarily by forcing action of the daily tidal prism, surface elevations in the Willamette and Columbia Rivers. and, to a lesser extent, flows originating in the Columbia Slough (Wells, 1994).

Placement of proposed channels relative to the river and Smith Lake is restricted by the difference between the elevations during the river's low flow period (Part 1 of Figure 16) and the elevation of the sediment surface of Smith Lake (see bathymetry map, Fig.6). To take the maximum advantage of Columbia River flow, the lowest elevation assumed for the intake invert elevation was 9 feet AMSL. The invert elevation of the outflow in Smith Lake was assumed to be 8.4 feet AMSL, the lowest point at which it could enter Smith Lake.

Modeling results indicated augmenting flow from the Columbia River directly into the lakes utilizing gravity flow is impractical due to the following reasons:

1. The closed channel configuration is impractical due to a much smaller cross-sectional area of the discharge for a circular channel compared to a trapezoidal channel of the same invert elevations.
2. Using an open channel configuration, very little net inflow from the Columbia River would reach Smith Lake, even with varying bottom widths and entrance invert elevations.
3. The low water surface elevations in the Columbia River in late summer through early fall do not provide enough head for gravity flow into the lakes system and then out through North Slough. Late summer/early fall is a critical period in which water augmentation from the Columbia could improve water quality in the lakes.

One potential problem not addressed in the modeling, but would have to be addressed if this option was explored, is sediment accumulation. Once the sediment-laden lotic waters of the Columbia River reach the relatively-quiescent waters of Smith Lake, settling will occur. Without the erosive action of historical floods and tidal forces, there would likely be a net sediment accumulation in the lakes, especially in the inflow channels. Accumulation of sediments from faster-flowing Columbia River to slower reaches off channel has been observed in similar systems in proximity along the lower Columbia

River, including the Peninsula Slough in the Columbia Slough (BES, 1989) and Dairy Creek leading to Sturgeon Lake (DEQ, 1994).

WATER QUALITY IMPACTS OF OPENING LAKES TO SLOUGH

Restoring the hydraulic connection between Smith and Bybee Lakes and the Columbia Slough and Willamette River is a management option that is being recommended for consideration. As stated in the mission statement of the management plan for the lakes (Portland Parks and Port of Portland, 1990), the lakes "will be maintained and enhanced, to the extent possible, in a manner that is faithful to their original natural condition." Removing the dam and water control structure at the eastern end of North Slough would restore the historical condition and allow tidal forces and seasonal river floods to exert their influences on the lakes system.

Contaminant Sources

Re-opening the lakes to the Columbia Slough and Willamette River restore the hydraulic and hydrologic conditions prior to 1982. However, water quality conditions of the slough and river will continue to improve compared to earlier conditions. In the Columbia Slough, combined sewer overflows (CSOs) are being eliminated, with total removal scheduled for 2001. As part of the same program, most of the CSOs discharged from Portland's collection system into the Willamette River are being eliminated. Since CSOs are the major source of fecal bacteria contamination in the slough and lower river (Wells, 1994), CSO abatement should dramatically reduce the possibility of exceedances of water quality standards for fecal bacteria in the lakes, assuming they are open to the slough. Until this CSO abatement program is completed, opening the lakes to the slough and river will open the lakes to influences of CSOs in the interim.

Other potential sources of contaminants to the lakes, once they are re-opened to the Columbia Slough, are the landfill and Willamette River. Leachate from the landfill can enter the lakes via groundwater or surface water. As discussed above in the groundwater model results, interaction between the lakes and the sand/gravel aquifer is weak because of the small vertical conductivity associated with fine-grained silt separating the two systems. Therefore, any potential landfill leachate entering the lakes through groundwater flow is ignored for this modeling exercise. The subsurface flow rate from the landfill into the Columbia Slough and North Slough was assumed to be 0.070 cfs and 0.024 cfs, respectively. This combined flow is within the range of lateral seepage flux to the sloughs prior to landfill capping, estimated to be 0.10-0.21 cfs. With decreasing flux after closure, the lateral flux to sloughs will become 0.046-0.083 cfs by the year 2000. For conservative modeling purposes, landfill leachate flow input values are closer to pre-capping conditions.

Prior to construction of the dam separating the lakes from the slough in 1982, Willamette River water entered the lakes under most flow conditions. The timing and amount of

Willamette River water that enters the lakes is dependent on interactions of the driving forces: tidal forces, Willamette and Columbia Rivers surface water elevations, and flow from the Columbia Slough (Fishman, 1988, Wang, et al., 1994; Wells, 1994). Water flowing into the slough from the Willamette River translates to a flow reversal as much as 4.5 miles "upstream" from the slough/river confluence (i.e., North Portland Road bridge). Actual Willamette River water is commonly recorded as dominating the water quality in the Columbia Slough as far as the St. Johns Landfill bridge, 2.85 miles from the confluence (Metro, 1994, Wells, 1994). In Figure 19, the passage of undiluted Willamette River water at the St. Johns Landfill bridge is seen in the daily tidal cycle when there is a simultaneous drop in electrical conductivity and rise in temperature and pH.

Model Runs

To evaluate the potential impact of CSOs on the lakes open to the slough under current and interim conditions until the CSO abatement program is completed, many scenarios could be simulated. In this numerical modeling exercise (Wells, 1995), six scenarios were chosen to assess the relative impacts of three sources of contaminants on the lakes under low-flow and high-flow condition, once the lakes are open to the North Slough. The three principal sources of contaminants were assumed to be: (1) CSOs in the Columbia Slough; (2) Willamette River water; and, (3) landfill leachate.

The model runs developed for this study were an enlargement of the modeling study of the lower Columbia Slough initially described in Wells (1992a). The model is a two-dimensional (longitudinal-vertical), unsteady, hydrodynamic and water quality model originally developed by Army Corps of Engineers (1990) called CE-QUAL-W2. The model has undergone extensive calibration to water level and velocity field data and water quality field data. The model enlargement for the lakes utilized existing bathymetry data and was refined with historical aerial photographs from the files of Army Corps of Engineers.

Six model runs were conducted to evaluate the potential impact of CSOs, Willamette River, and landfill leachate on Smith and Bybee Lakes upon removal of the dam (Table 11). A typical low water period, 8/8/90 - 9/11/90, and a typical high water period, 2/8/91 - 4/2/91, were chosen for which adequate calibration data were available. For each model run, a conservative tracer was used to simulate transport from each source independently. For each run, the conservative tracer emanated from one source, while the other two sources were set at 0 mg/l concentration. Arbitrary concentrations for the conservative tracer were set at 100 mg/l for CSOs and Willamette River, while landfill leachate conservative tracer was set at 463 mg/l, based on measured chloride concentrations in landfill leachate.

Figure 19

Hydrolab continuous sampling results

Hydro lab file is SJB.DAT (from METRO)

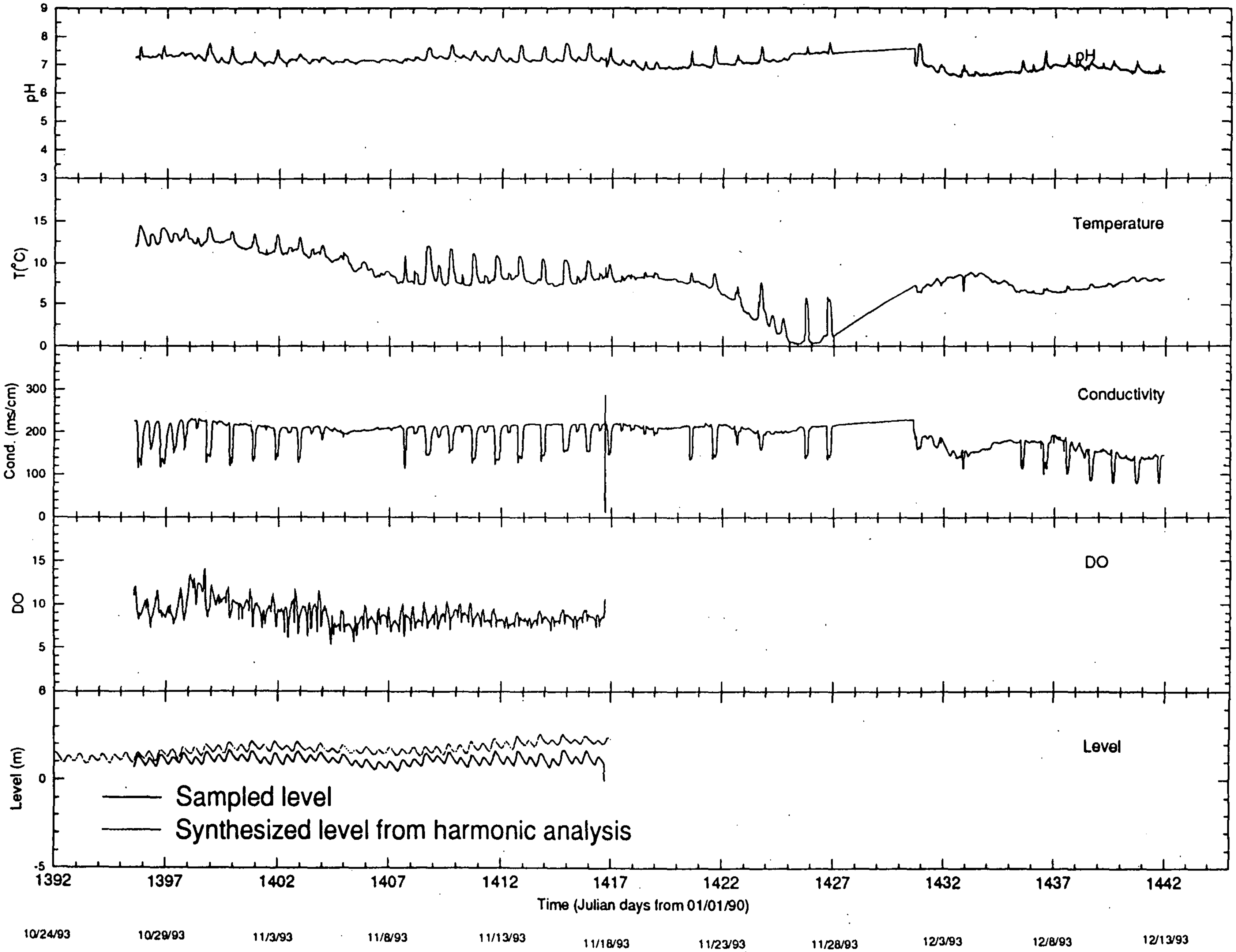


Table 11

Summary of Model Simulations During Low water and High water Conditions

Run Number	Time Period of Simulation	Description
1	8/8/90 - 9/11/90	Low water, 4 storm events, CSO tracer conc 100 mg/l, WRR* tracer 0 mg/l, landfill tracer 0 mg/l
2	2/8/91 - 4/2/91	High water, 15 storm events, CSO tracer conc 100 mg/l, WRR* tracer 0 mg/l, landfill tracer 0 mg/l
3	8/8/90 - 9/11/90	Low water, 4 storm events, WRR* tracer conc 100 mg/l, CSO tracer 0 mg/l, landfill tracer 0 mg/l
4	2/8/91 - 4/2/91	High water, 15 storm events, WRR* tracer conc 100 mg/l, CSO tracer 0 mg/l, landfill tracer 0 mg/l
5	8/8/90 - 9/11/90	Low water, 4 storm events, Landfill leachate tracer 463 mg/l**, CSO tracer 0 mg/l, WRR* tracer 0 mg/l
6	2/8/91 - 4/2/91	High water, 15 storm events, Landfill leachate tracer 463 mg/l**, CSO tracer 0 mg/l, WRR* tracer 0 mg/l

* WRR = Willamette River outside mouth of Columbia Slough
** The value of 100 mg/l of tracer in the CSOs and Willamette River was arbitrary, but the 463 mg/l in the landfill leachate was measured concentration of Cl in landfill seeps (unless noted, the background concentrations of tracer were set equal to 0 for each run).

Results of the low water model simulations show that water surface elevations in Bybee Lake are similar in timing and magnitude to that of east end of North Slough, which is expected given the direct, open channel that would connect the two after removal of the dam. Smith Lake, which would be connected to the North Slough through a long, sinuous channel with considerable frictional head loss, has a phase lag between Bybee Lake of about 0.2 days and an amplitude difference of less than 1 foot over a tidal cycle (Figures 20-22).

Model runs under high water conditions showed that there is little difference in tidal dynamics between the two lakes under high water conditions. The narrow channel connecting the two lakes does not restrict flow significantly, making the amplitude variation about the same. For high water periods, both lakes and east end of North Slough track similarly, but Smith Lake begins to show a phase lag and an amplitude reduction as the water surface elevation decreases (Figure 23).

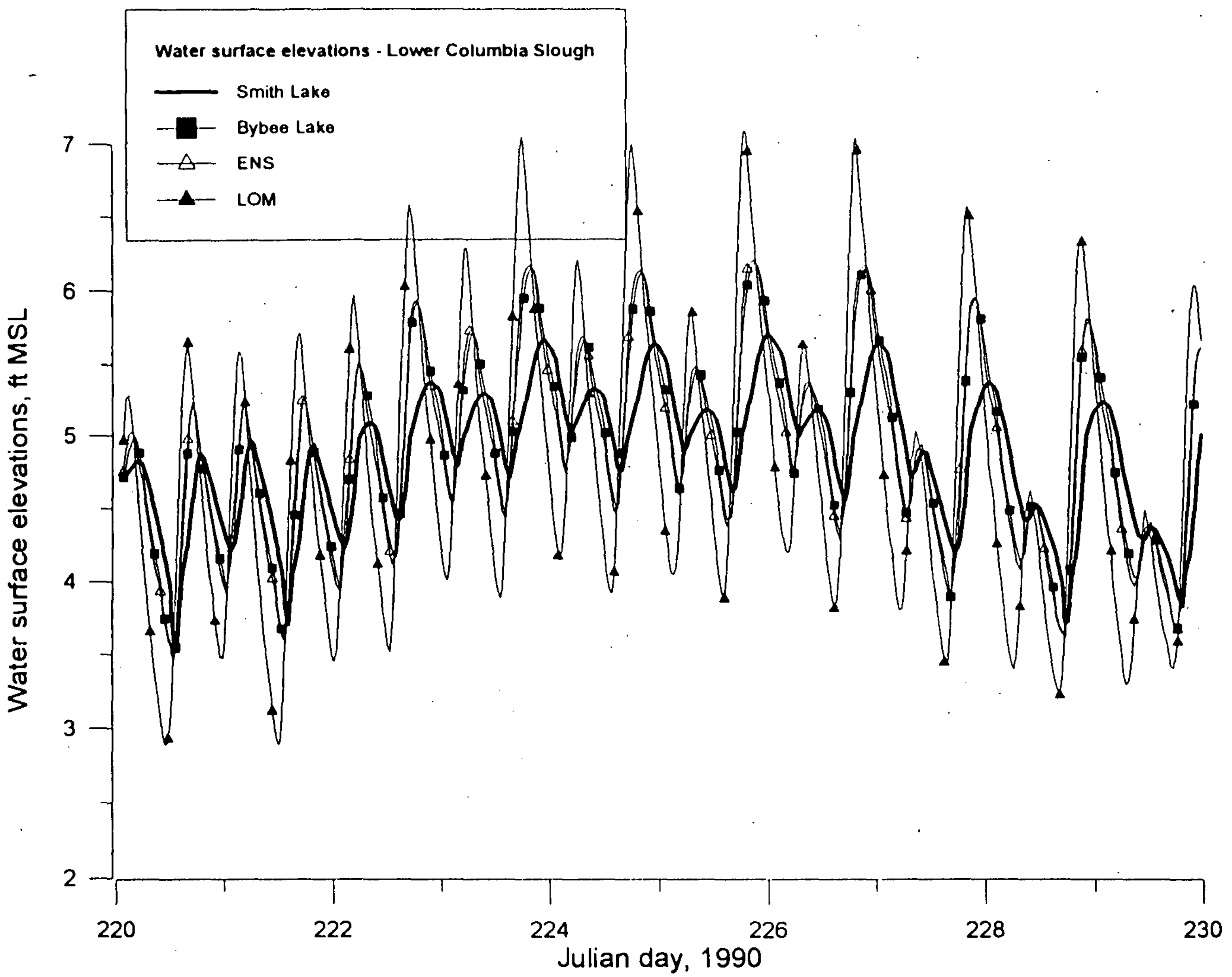


Figure 20 Water Level Variation in Smith & Bybee Lakes, East End of North Slough - During Julian Day 220-230

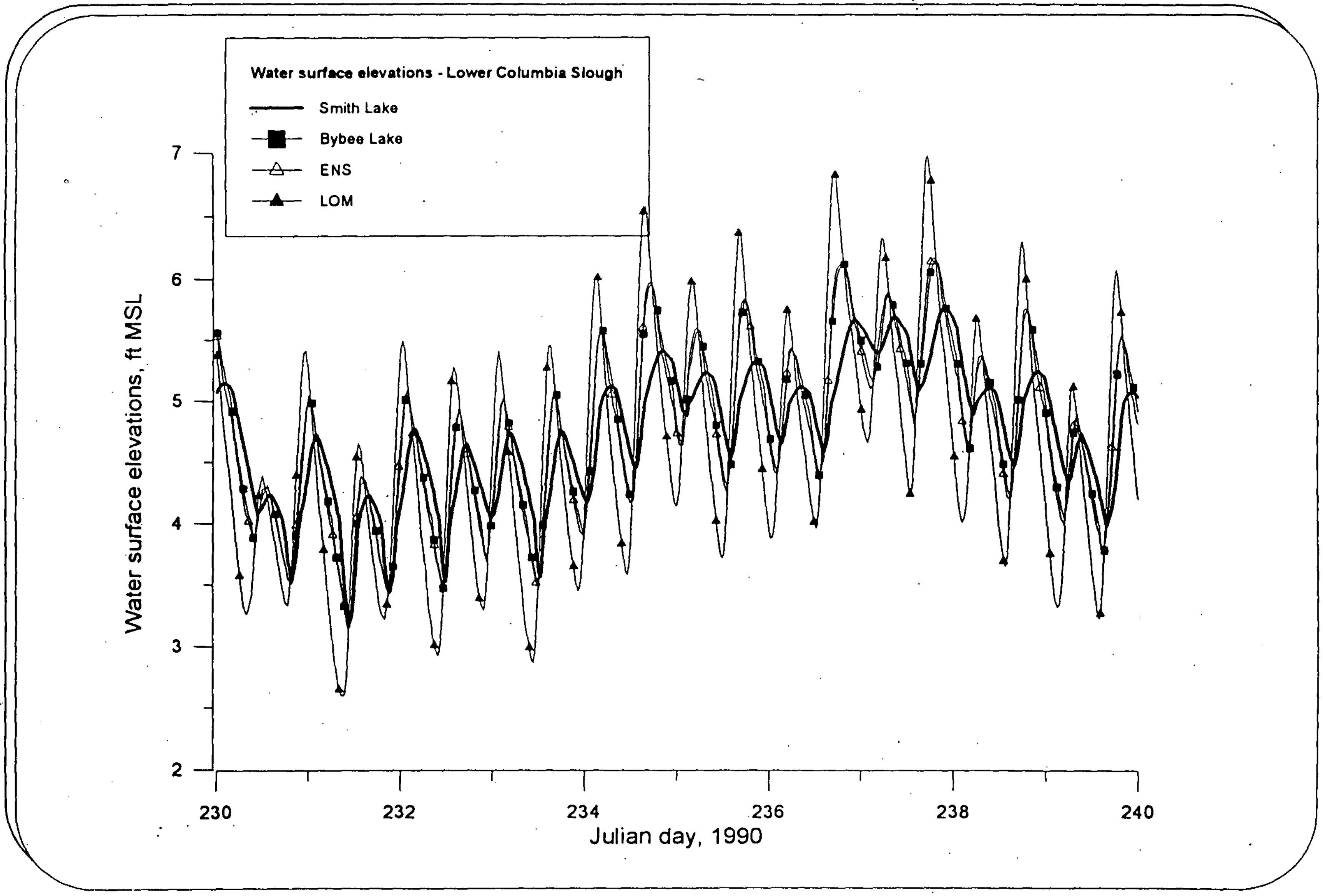


Figure 21 Water Level Variation in Smith & Bybee Lakes, East End of North Slough - During Julian Day 230-240

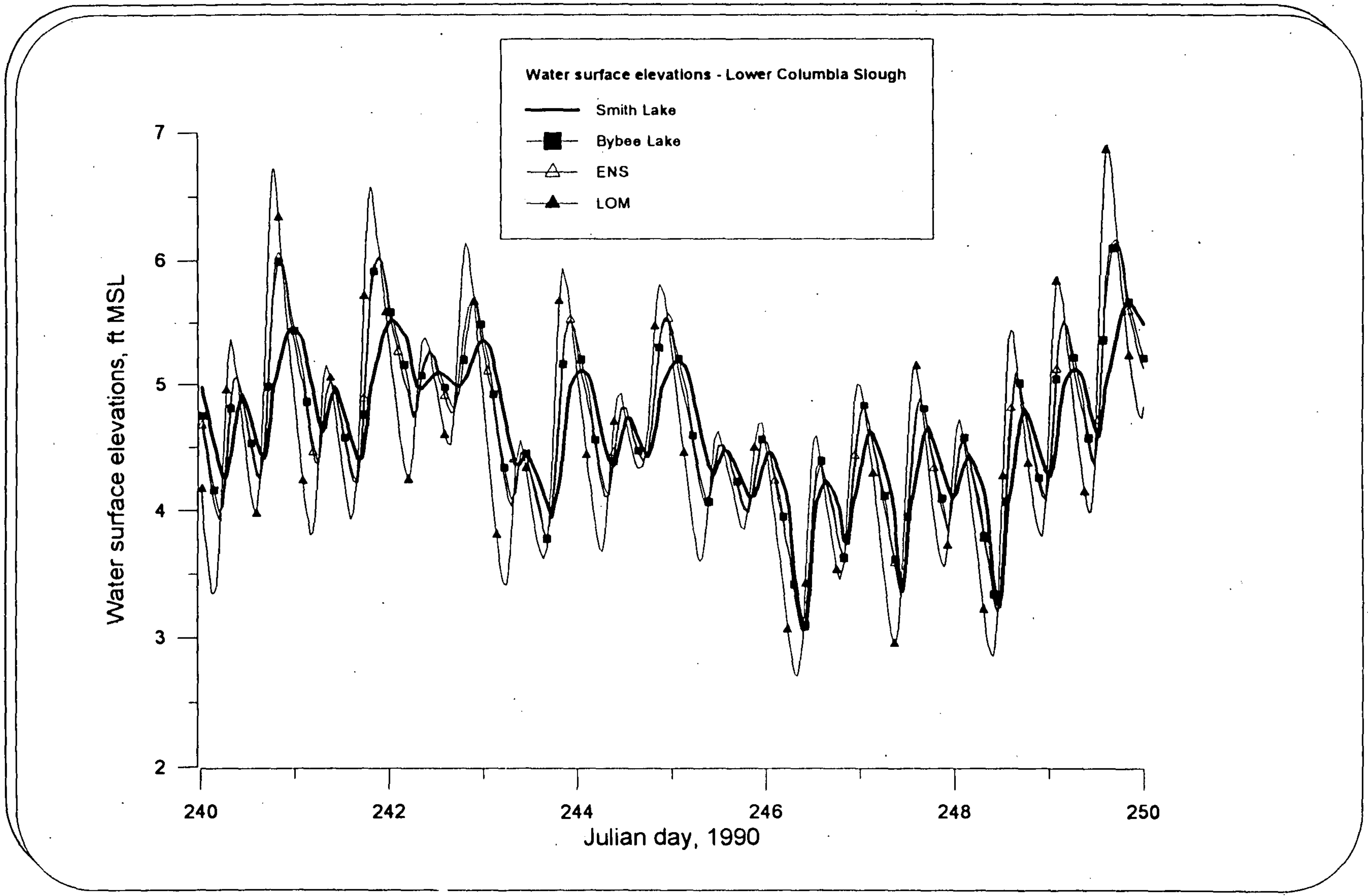


Figure 22 Water Level Variation in Smith & Bybee Lakes, East End of North Slough - During Julian Day 240-250

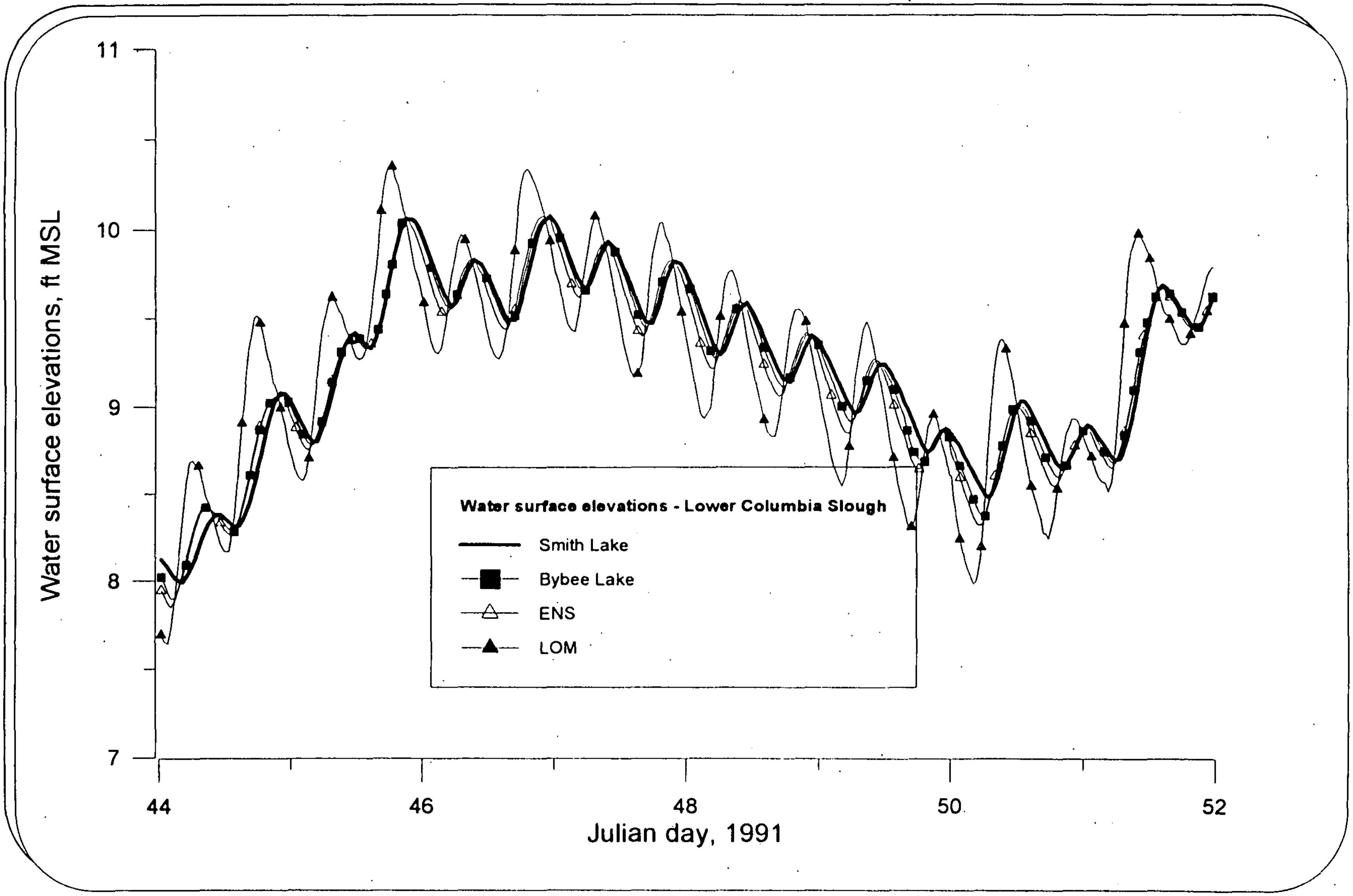


Figure 23 Water Level Variation in Smith & Bybee Lakes, East End of North Slough - During Julian Day 44-52

The relative impact of the three contaminant sources can be evaluated in terms of dilution factors. Dilution is defined as C_0/C, where C_0 is the initial tracer concentration, and C is the model predicted concentration at a given location. Listed in Table 12 are average and minimum dilutions in Smith and Bybee Lakes under the six model simulations. The table shows that: (1) Willamette River often reaches Smith and Bybee Lakes undiluted during low water and high water conditions; (2) CSOs will be diluted 20-40 times at a minimum; and, (3) landfill leachate is diluted, at a minimum, on the order of 1000 times.

Table 12

Average and Minimum Dilutions in Smith and Bybee Lakes During Each of the Model Simulations

Run No.	Time Period of Simulation	Average Dilution* at SL-A	Average Dilution* at BY1	Minimum Dilution at SL-A	Minimum Dilution at BY1	Description
1	8/8/90 - 9/11/90	578	416	40	20	Low water, 4 storm events, CSO tracer conc=100 mg/l
2	2/8/91 - 4/2/91	335	255	45	30	High water, 15 storm events, CSO tracer conc=100 mg/l
3	8/8/90 - 9/11/90	2.1	2.8	1	1	Low water, 4 storm events, Willamette River tracer conc=100 mg/l
4	2/8/91 - 4/2/91	1.4	1.4	1	1	High water 15 storm events, Willamette River tracer cone=100 mg/l
5	8/8/90 - 9/11/90	5,091	3,607	1,800	1,000	Low water, 4 storm events, Landfill leachate tracer=100 mg/l
6	2/8/91 - 4/2/91	9,267	7,937	3,000	2,500	High water, 15 storm events, Landfill leachate tracer=463 mg/l

* The average calculated dilution for each run did not factor in cases where there was no tracer (i.e., infinite dilution). This was accomplished by evaluating averages after the first couple days of the simulation. For the CSO events in the summer, because of there being no CSO events during the latter period of the summer simulation, averages were made only between JD 230 (8/18/90) and JD 240 (8/28/90).

Based on the modeling results, CSOs in low water and high water conditions could cause water quality violation (i.e., fecal bacteria) until they are removed from the lower Columbia Slough. With CSO fecal coliform concentrations on the order of 100,000 colonies/100 ml, the dilution rate is not sufficient to prevent excursions above the Oregon Department of Environmental Quality's standard of 200 colonies/100 ml (Figure 24).

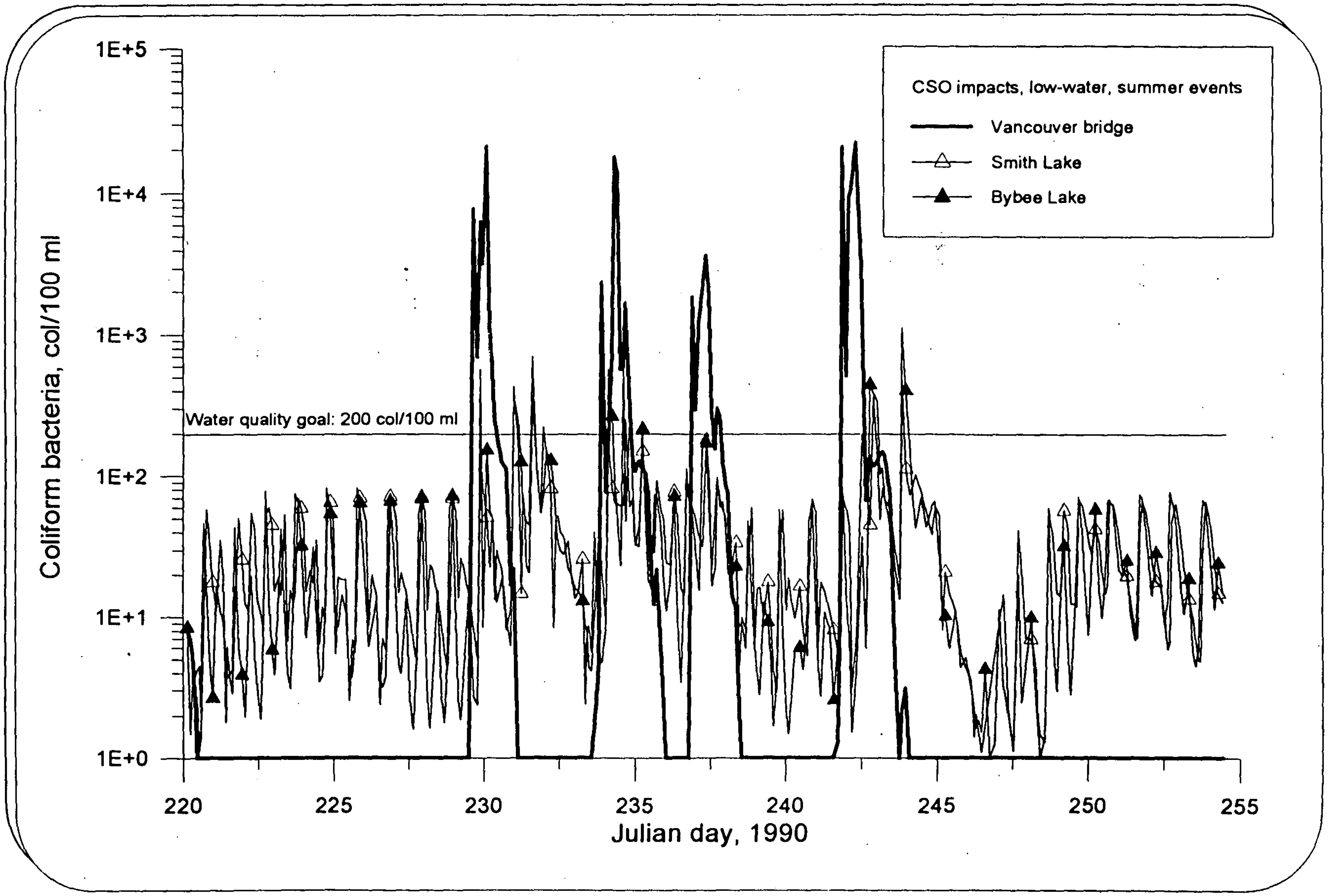


Figure 24 Coliform Bacteria at Vancouver Bridge, Smith & Bybee Lakes During Low Water Summer CSO and Storm Water Events

Once CSOs are removed from the slough, excursions above the DEQ standard could possibly occur resulting from inflow from the Willamette River, where fecal coliform concentrations are commonly on the order of 90 colonies/100 ml.

A sensitivity analysis was performed on the model, varying model branch geometry and friction factors in the system. Conclusions were not significantly altered by adjusting the model's layout or decreasing the Manning's friction factor. The model is more sensitive to significant changes in lakes bathymetry, upon which precision and resolution can be improved.

RESTORATION AND ENHANCEMENT OPTIONS

The studies discussed above made similar recommendations for enhancement of Smith and Bybee Lakes:

"The eutrophic condition of these two lakes has been exacerbated by the installation of a control structure whereby the water is now retained in the lakes during summer and fall....The source of the increased fertility of each of the lakes appears to be sediment, directly through wind mixing and indirectly through rooted plants that utilize nutrients from the sediment, that partially decompose and release nutrients to the water....The nutrient contribution of the Willamette-Columbia Rivers to the enrichment of the lakes appear to be negligible, whereas dilution and flushing effects from freshet refilling of the lakes by river water during winter and spring appears to be especially beneficial."

(Fishman et al., 1988)

"The main recommendation of this study, which is designed to maximize native species diversity and minimize establishment of exotic species, is to allow water levels to fluctuate with the changes in the levels of the Columbia and Willamette Rivers by removal of the existing structure on the outflow of the lakes. This will result in larger seasonal fluctuations as the result of the freshets of the Columbia and Willamette Rivers, and increase diel fluctuations in these systems as result of tidal movements. Such a pattern would be an approach toward fluctuations observed historically, and would benefit native plants, macro-invertebrate, amphibians and reptiles, mammal and bird species."

(Lev et al., 1994)

"The lakes historically were depositional/erosional systems receiving seasonal inputs of sediment and exporting sediment and nutrients with the outgoing tides. They have been transformed into depositional environments which effectively retain sediment and nutrients. The long-term consequences of maintaining the current management regime will be to increase the productivity of Smith and Bybee Lakes."

(Eilers et al., 1995)

Role of Committees in Management Decisions

Management decisions for the Smith and Bybee Lakes Wildlife Area are made through a consensus process. Generally, decisions and actions area typically begin with staff preparation and presentation to a technical advisory committee on specific issues. Recommendations are carried to a management committee, where action is taken. When significant policy issues are being formed, recommendations from the management committee may require review by Metro Council.

Technical Advisory Committee

The Smith and Bybee Lakes Technical Advisory Committee (TAC) was formed in 1991 to assist the Management Committee in implementing the Management Plan's projects and programs. This group is composed of representatives of:

- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- U.S. Army Corps of Engineers
- Oregon Division of State Lands
- Oregon Department of Fish and Wildlife
- Portland State University
- City of Portland Environmental Services
- City of Portland Parks Bureau
- Port of Portland
- Environmental Consultants.

This committee meets on an as-needed basis as technical issues arise which require the group's expertise. The Management Committee is dependent on TAC for reviewing technical information and forming a recommendation on complex, technical issues. The composition of the committee also can streamline permit processes since permits for most developments inside the management area will require approval by one or more of the participating agencies.

Management Committee

Smith and Bybee Lakes Management Committee was formed in 1991 to oversee implementation of the *Natural Resources Management Plan for Smith and Bybee Lakes* (1990) and provide ongoing policy guidance. The committee is the principal advisory body to Metro, which has ultimate responsibility in managing the area. The committee meets monthly to provide general oversight for managing the lakes area and to develop and recommend an annual budget to Metro Council, which is composed of elected officials. The committee is composed of representatives from resource management agencies (including a member of TAC), a "friends group", an environmental organization, a neighborhood representative, a recreational user group, and Metro. The Management Committee reviews recommendations made by the Technical Advisory Committee and takes action accordingly.

While most ongoing management decisions are made by the Management Committee, changes in policies outlined in the Management Plan and final budget approval is the responsibility of the elected Metro Council.

Technical Advisory Committee Recommendations

Results of all the studies conducted on the lakes area have been reviewed by the Smith and Bybee Lakes Technical Advisory Committee (TAC). In May and June 1995, the committee was asked to review studies recently completed, in context of other existing information, and to make water management recommendations. At the June 28, 1995, TAC meeting, water management recommendations were made by TAC and are described below.

Objective

> Manage the hydrology of Smith and Bybee Lakes in a manner that allows the water surface elevations in the lakes to mimic those of the Columbia River, both daily and seasonally.

Strategies

1. Replace the existing water control structure with one that will allow unobstructed flow both in and out of the lakes on a daily and seasonal basis, and allow retention of water in the lakes or exclusion of water from the slough, based upon management needs.
2. Develop a water source and distribution system to augment flow into the lakes from an outside source as needed to control avian botulism, mimic river hydrology, and other management needs.
3. Remove the sunken barge obstructing flow in the North Slough while replacing equivalent habitat values the barge has afforded the North Slough.
4. Develop a water management plan that includes monitoring and assessment to ensure that management goals are being met.

Proposed Schedule

1. Complete construction and have operational the replacement water control structure no later than December 1997.
2. Develop a water source and have operational a distribution system by the summer of 1998.
3. Remove barge before the replacement water control structure becomes operational.
4. Have fish habitat enhancements mitigating barge removal in place when the replacement water control structure becomes functional.
5. Develop water management plan prior to the construction of the replacement water control structure.

The TAC recommendations were forwarded to the Smith and Bybee Lakes Management Committee for consideration for adoption as management policy. The Lakes Management

Committee, established in 1992 with the adoption of the Management Plan, is comprised of local government agencies, Port of Portland, neighborhood associations, a "friends" group, an environmental organization, and Metro. The Management Committee adopted the recommendations of TAC on August 8, 1995.

ENHANCEMENT OPTIONS

The major options identified for restoration and enhancement of the Smith and Bybee Lakes system are discussed below, with advantages and disadvantages listed, and an estimate of implementation costs provided. Location of management projects being considered are indicated on Figure 25.

I. Removal of Dam and Existing Control Structure

Complete removal of the earthen dam, estimated to be approximately 2,000 cu.yds., and the control structure containing the weir and gates.

Advantages

- Restore pre-1982 hydrologic conditions; water surface elevation dynamics would mimic those observed at the confluence of Willamette and Columbia Rivers.
- Long-term improvement in water quality, including reducing rate of eutrophication.
- Reduce rate of net sediment accumulation, especially the organic fraction.
- Low cost for removal only.
- No maintenance.
- Increase species richness and diversity in vegetation communities.
- Increase species richness and secondary production in macroinvertebrates.
- Allow seasonal use by migrating juvenile salmon.
- Provide more food sources and cover for amphibians and reptiles, increasing production as well as diversity.
- Diversify habitat for birds, especially shore birds.
- Increase food sources for mammals.
- Reduce habitat for beaver and nutria, which are over-populating the area.
- Provide direct boat access from the Columbia Slough.

Disadvantages

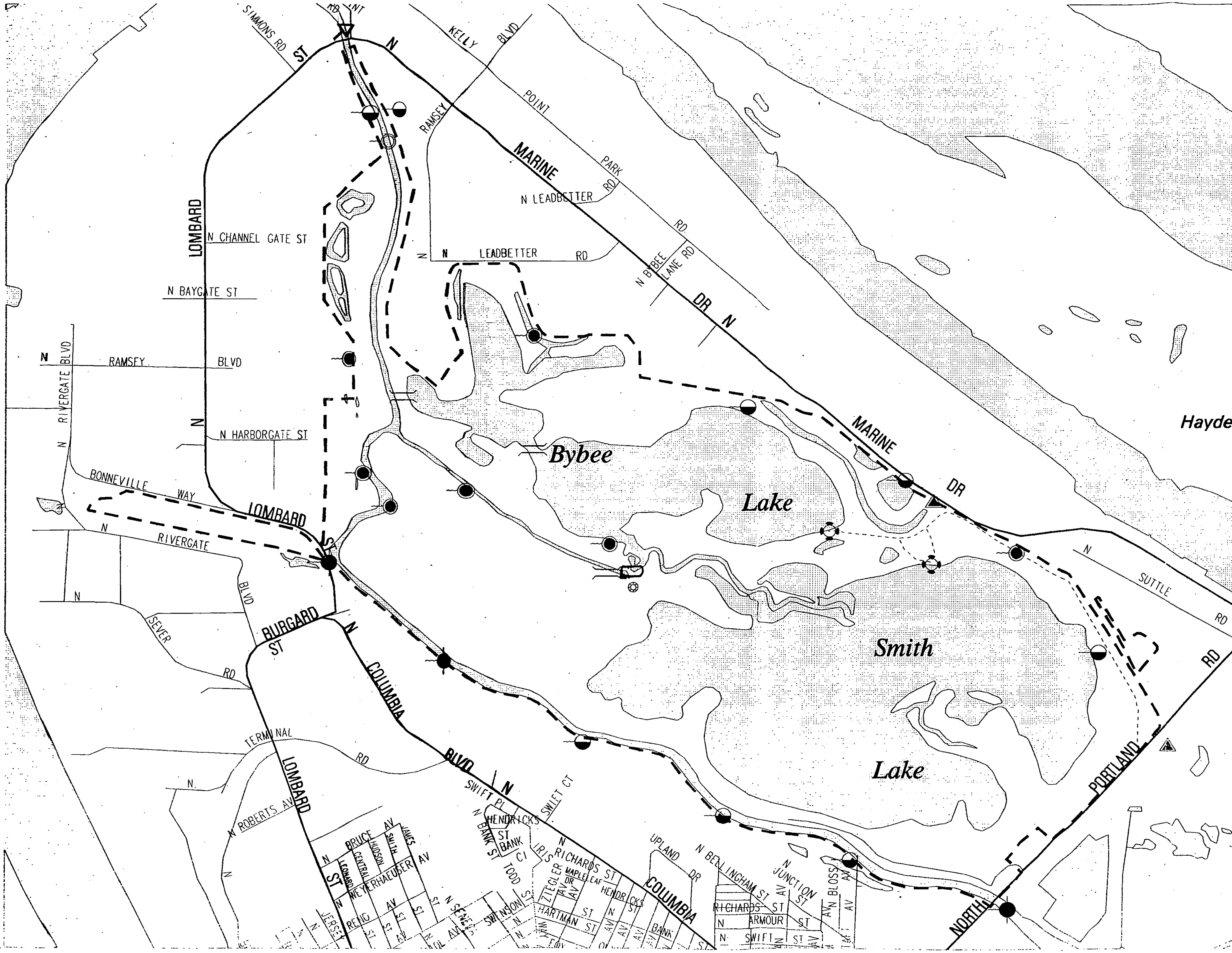
- Allows for no other water management options since there would be no control on hydrology.
- Short-term, and possibly long-term to a lesser extent, compromise in certain water quality parameters (i.e., fecal bacteria).

R L I S

Regional Land
Information System

METRO REGIONAL PARKS and
Greenspaces

Smith & Bybee Lakes Wildlife Area
Management Projects



Existing Dam

Wildlife Area Boundary

Proposed Flow Structure

STORMWATER

Untreated

Passive Treatment

Proposed

CSO

Proposed Pump

Observation Structure

Canoe Launch

Trail Head

Trail

Figure 25

Scale: 1" = 1550'

0 1550 3100

600 NE Grand Ave
Portland, OR 97232-2736
(503) 797-1742

METRO

- No ability to control pests through hydrologic control (i.e., invasive plants, mosquitoes, and beaver).
- Reduce or eliminate boating during the low water period August-September.
- Reduce the angling period from year-round to approximately nine to ten months.
- Possibly allows conditions for avian botulism to develop.

Estimated Capital Costs

Removal of the earthen structure and disposal of the material will be approximately $25,000, assuming the earthen material can be utilized on-site at the landfill. Removal of the existing metal water control structure may be cost neutral assuming it has high re-use or recycling potential.

II. Removal of Dam and Replacement with Open Structure

Removal of earthen dam and replacement with a structure that allows unobstructed flow through North Slough to and from Bybee Lake and the channel connecting to Smith Lake. The structure would have an opening equal to the cross-sectional area of the eastern end of North Slough. The structure would allow closing the opening between the slough and the lakes as needed. The structure may be as simple as a concrete-lined rectangular opening into which stop-logs may be placed and removed easily.

Advantages

Same advantages as Option I above. In addition:

- Relatively low cost of structure.
- Simple operation and low maintenance (i.e., no clogging).
- Water can be released incrementally, allowing control of surface water level elevations.
- Water entering the lakes from the slough could be regulated during the rising portion of the river hydrograph.
- Allows some hydrologic control for pest management through retention of Willamette River, precipitation, and Columbia Slough water.
- Allows option of precluding lower water quality from the Columbia Slough during the interim period until the slough water quality is improved.
- Will provide some options for manipulating the fishery.
- Allows exclusion of water entering from the slough.

Disadvantages

- Hydrologic control is limited to retention of whatever volume is within the lakes at the time of closure. During the low water period of August through September, little water will be available for retention.
- Limited control over eliminating conditions favorable to avian botulism.

Estimated Capital Cost

Estimated costs for removal of existing dam and design, construction, and management for a replacement structure is approximately $300,000. This assumes use of earth material from existing dam in building wing walls of the new structure.

III. Remove Dam, Replace with Open Structure, Have Ability to Pump from Columbia River

Port of Portland currently holds a permit to withdraw water from the Columbia and Willamette Rivers for the purpose of wildlife habitat enhancement in Smith and Bybee Lakes. Water supply lines and pumps will have to be installed, with the likely discharge point at the north side of Bybee Lake. Water could also be pumped directly from the Columbia Slough into the lakes utilizing a low-head, high volume irrigation pump.

Advantages

Same as Option II. In addition:

- More options for managing water levels at all times of year.
- Ability to introduce higher quality Columbia River water during the late summer/fall period of lower water quality in the lakes.
- Ability to augment water to the lakes' basins during the period when avian botulism may occur.
- Allows more options for manipulating fishery.

Disadvantages

- Increased dependency on infrastructure of pumps and transmission lines.
- Long-term expenses of pumping operations and maintenance.
- The critical period for water needs for the lakes coincides with peak demand period for the Port, which may limit pumping rate at certain times.

Estimated Capital Cost

Along with the cost of removing the existing dam and constructing the replacement structure (estimated $300,000), the additional cost for pumping ranges from $20,000 to $1,800,000, depending on the source. To utilize Columbia River water for augmentation, cost for development of an intake, installation of conveyance pipe, and pumps is approximately $800,000. Based on recent groundwater well pump test results from Port of Portland (Montagne letter, 1996), there is sufficient yield of groundwater for augmenting the needed flow rate to the lakes if seven to ten wells were developed. Development of the sufficient number of wells will cost approximately $1,800,000. If an irrigation pump of sufficient size is used to pump water from the Columbia Slough into the lakes, the purchase price of the pump plus piping is approximately $20,000.

IV. Remove Dam, Replace with Open Structure, Have Ability to Pump from Columbia River, Regulate Western Arm of Bybee Lake

Placement of earth fill with an adjustable weir across the narrow constriction separating the western arm of Bybee Lake can potentially provide permanent open water habitat. In addition, cutting a channel connecting western arm of Bybee Lake directly with Columbia Slough and inserting an adjustable weir with tide gate increases water management options.

Advantages

Same as Option III above. In addition:

- Ability to maintain most of the lakes area open to tidal and seasonal water levels variation, while maintaining an open water area year-round of about 90 acres.
- Provides waterfowl nesting and feeding habitat in a more inaccessible area.
- Low maintenance needs inherent in low technology approach.
- Pumping water into this smaller sub-basin allows a number of ecosystem manipulation options.
- Provides opportunity to regulate western arm of Bybee as either year-round open water or tidal.

Disadvantages

- Vehicular access to weir structure for operations and maintenance will impact resource area.
- Small loss of wetland habitat from filling area for the weir's wing walls and access road.

Estimated Capital Costs

The estimated cost of removal of the existing structure and construction of the replacement structure is approximately $300,000. Having the ability to pump cost ranges from $20,000 to $1,800,000, depending on the water source. More data is needed to estimate the cost of separating the western arm of Bybee Lake and connecting it directly with the Columbia Slough. Importantly, the environmental impact of exercising this option are unknown and will require further data gathering (i.e., detailed bathymetry and surface elevation data).

V. No Action

Advantages

- No additional capital costs
- Provides greater year-round open water.

Disadvantages

- Decreasing habitat diversity.
- Decreasing species richness and biodiversity.
- Decreasing water quality conditions and increasing rate of eutrophication.
- Increase cost of pest control (i.e., beaver, invasive plants).
- Limited boat access.

SUMMARY OF ISSUES AFFECTED BY OPENING LAKES

Water Quality

Opening the lakes to Columbia Slough and Willamette River water will result in a short-term higher frequency of exceedences for fecal bacteria standards. With the removal of all CSOs from the Columbia Slough by the year 2000, this should not be a long-term problem. The nutrient concentrations in the lakes will decrease, reflecting the concentrations found in the Willamette River and the Columbia Slough, which are generally lower than those observed in the lakes in recent years. The lakes would be more open to any contaminants possibly released into the water column in the slough and river.

Stormwater

Stormwater, that which results from runoff from developed areas within the watershed, is currently and will be a significant source of pollution to the lakes and associates sloughs. Local sources of stormwater primarily come directly from industrial development adjacent to the lakes and the landfill. Improved and new stormwater discharges utilize on-site passive treatment processes (e.g. settling, bacterial transformation, plant uptake). These include discharges from the new Marine Drive extension, the Leadbetter Road drainage area, the former Ramsey Lake area, and the St. Johns Landfill. As indicated in elevated contaminant concentrations measured in the sediments, untreated local stormwater sources continue to allow contaminants to enter the lakes unabated. These sources include the area northeast of Smith Lake and the developed area along Marine Drive north of Bybee Lake.

Currently, stormwater originating outside of the immediate vicinity of the lakes area is primarily associated with combined sewer overflow (CSO) discharges. These discharges enter the slough throughout the year and enter the lakes only under high water level periods when the slough overtops the dam and banks around the lakes. According of Portland Bureau of Environmental Services, all CSO discharges will be eliminated from the Columbia Slough by the year 2000. However, stormwater associated with developed areas within the Columbia Slough drainage will actually increase as development continues to occur throughout the basin. Currently, most stormwater daining into the Columbia Slough is untreated. With most of the open spaces within the basin being rapidly developed, contaminants associated with stormwater (i.e. metals, PAHs) will continue to enter the Columbia Slough and Smith and Bybee Lakes. Once the unimpeded flow between the lakes and the slough is restored, stormwater in the slough will enter the lakes regularly. **Treating stormwater as close to the place of origin as possible throughout the Columbia Slough basin is of primary importance insuring the protection and enhancement of Smith and Bybee Lakes.**

Sediments

The change in the lakes' hydrological conditions, as induced by the construction of the dam, has caused a transition from an erosional/depositional system to a net depositional system. Net deposition occurs from (1) suspended sediment transported into the lakes during flows that overtop the banks and settle and (2) autochothonous sources. Restoring the lakes to the tidal and seasonal dynamic influences will promote transport of sediment both in and out of the lakes' basin, similar to historical conditions.

Having water surface elevations mimic those of the Willamette River and Columbia River will allow mudflats to occur during the low water period (August-September). This will allow drying of sediments on the fringe and re-oxygenation in sediments where anaerobic conditions now exist, promoting loss of the organic fraction from the sediments.

Once the dam is replaced and unimpeded flow returns to the North Slough, there is an opportunity for unconsolidated sediments in the North Slough to move into the lakes. Based on the sediment samples taken in this study, concentrations of metals and PAHs do not appear to be different in the sloughs and the lakes. Re-suspension of North Slough sediments and transport into the lakes does not appear to pose a significant pollutant source. However, sediments associated with transport (unconsolidated) quantity and quality will be monitored before and after removal of the existing dam.

Landfill Impact

Based on the groundwater model applied to the lakes and landfill region, calibrated with an extensive groundwater monitoring system, opening the lakes to the slough and river will allow upwelling from the groundwater into Bybee Lake to occur. But the strength of water exchange between the Bybee Lake and the aquifer is very weak. The lake's dynamics will have essentially little to no influence on the rate of contaminant plume migration in the aquifer.

Contaminants in the leachate generated by rain infiltration into the landfill mostly leave the landfill laterally through the surrounding dikes and into the sloughs. Coverage of the landfill with an impervious layer has resulted in dissipation of the leachate mound. Coverage for the entire landfill will be completed in 1996. By year 2000, the lateral flux from the landfill to the Columbia and North Slough is 0.046-0.083 cfs. Of the leachate reaching the slough, some solutes are retained by the surrounding dike soils. Based on hydraulic and water quality modeling, any leachate reaching the lakes from the sloughs will be diluted 1000 times, at a minimum.

Vegetation Assemblages

Two major modifications in the vegetation of the lakes have occurred since the lakes have been transformed from a tidal freshwater marsh system to a managed reservoir: loss of the extensive willow assemblage on the lake margins, and (2) increase in the emergent (i.e., smartweed), submerged, and floating aquatic plant communities. Wetland vegetation in the Pacific Northwest is strongly adapted to varying degrees of drying during summer/fall accompanied by varying levels of inundation during winter and spring. If the water levels in the lakes vary more as a result of opening to the rivers, there would be a return to the willow assemblages and associated emergents on the lakes fringes.

Opening the lakes will indirectly benefit the ash forests in the area by reducing the beaver population (discussed below). Under the present hydrologic condition, beaver are significantly reducing the ash forest.

Returning to the influence of river hydrology will most likely favor expansion of wapato (Sagittaria latifolia). Adjacent to the lakes in the Columbia Slough, there is a blind slough where wapato dominate the aquatic plant community. Growth conditions in this slough are very similar to those conditions found along the lakes' fringes. The principal difference between the two sites is hydrology. In the blind slough, hydrology is dominated by the Willamette River. If the lakes were open to the slough and river, the hydrologic conditions would likely promote growth of wapato in the lakes' basin.

Control of Invasive Plant

Opening the lakes to the slough and river without any control may promote increased growth of undesirable wetland and aquatic plant species, including purple loosestrife, reed canarygrass, and yellow water flag (Iris pseudacorus). While returning to a more natural fluctuation in water levels would approach historical conditions, exotic species introduced in this century may preclude the development of native plant assemblages unless certain management tools are available. Being able to maintain a large area inundated for an extended period of time, from several months into the growing season to one year, is an important management option to retain.

Macroinvertebrates

Under present conditions, benthic sediments anoxic for extended periods, as a result of prolonged inundation, severely limit the establishment of many lentic invertebrates taxa. Opening the lakes to the slough and river will increase habitat complexity, reduce anoxic conditions in sediments, and probably increase overall invertebrate species richness and secondary production.

Mosquitoes

Multnomah County Vector Control has the responsibility for mosquito control in the lakes area. Reed canarygrass provides highly favorable habitat for pest mosquito egg deposition and development. There is evidence that reed canarygrass colonized the lake fringes, even beneath the willows, when the lakes were open to the slough and river prior to 1982 (DeChant, 1995). Returning the lakes to its former hydrologic conditions should be accompanied with some ability to control reed canarygrass. The most effective control is inundation for critical periods.

Fish

Fish species found in the lakes are a subset of total species found in the Columbia Slough and Willamette River. Fish are free to move in and out of the lakes during the high water period when the rivers' water levels exceed that of the lake banks. Opening the lakes to the slough will allow more species to move into the lakes on a daily and seasonal basis. During the low water period, large areas of both Smith and Bybee Lakes will become exposed mudflats, reducing the fish habitat significantly.

With dam removal and a replacement structure using gravity flow, water surface elevations can be manipulated to provide spawning, nesting, and feeding habitat for the warmwater fish species, which are mostly non-native species. Based on Figure 26 (Daily, 1992), the critical period where there is greatest overlap for spawning and nesting of most species found in the lakes is between April through July. This coincides with the high water period in the rivers. After this period, fish move to deeper, cooler water.

Evidence from an earlier study (Fishman, 1988) indicates juvenile salmon heavily utilize the lower Columbia Slough and the lakes during the spring. Abundant zooplankton, warmer temperature, and refuge from predators may be factors in the more rapid growth observed in these juveniles. Under the present impoundment conditions, the lakes may be trapping migrating juvenile salmon that move into the lakes during high water periods. The high temperature conditions in the lakes after June are most likely fatal to any trapped salmon. Opening the lakes to the slough would allow movement of these migrating juveniles both in and out of lakes as water temperatures rise.

Amphibians/Reptiles

The lakes area is considered depauperate in amphibian and reptile fauna, given its habitat potential (Lev et al., 1994). A principal factor is the prolonged inundation caused by the existing dam. To increase the diversity and abundance of these groups, it is recommended that a water management regime similar to that of the adjacent rivers be maintained. This would:

- Make available a more diverse and abundant invertebrate macrofauna as a food source.
- Provide more cover for native amphibians and reptiles.
- Reduce the number of exotic warmwater predators (i.e., bullfrogs).
- Increase the possibility for higher production among amphibians and reptiles.

Birds

Greater seasonal fluctuations in water levels closer to that of the Willamette and Columbia Rivers will increase available food and increase habitat for waterfowl and shorebird species. Fluctuating water levels will provide more critical food for fall-migrant shorebird and waterfowl species. There is greater potential for maintaining a larger water surface area in the winter if the lakes were open to the

Figure 26 Activity Periodicity Table for Warmwater Game Fish in Smith & Bybee Lakes

GROUPING OF SPECIES PRESENT:

- LARGEMOUTH BASS (LB)
- BULLHEADS (B)
  - YELLOW
  - BROWN
- CRAPPIES (C)
  - WHITE
  - BLACK
- SUNFISHES (S)
  - BLUEGILL
  - PUMPKINSEED
  - WARMOUTH
- YELLOW PERCH (YP)

ACTIVITY	SPECIES	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SPAWNING													
	LB				<—	——	——	—>					
	B				<—	——	——	——	——>				
	C			<—	——	——	—>						
	S					<——	——	——	——>				
	YP			<——	——	——>							
NESTS AND FRY SUSCEPTIBLE TO DEWATERING													
	LB				<—	——	——	——>					
	B				<—	——	——	——	——	—>			
	C			<—	——	——	——>						
	S					<——	——	——	——	—>			
	YP			<——	——	——	—>						
ACTIVE FEEDING AND GROWTH													
	ALL			<——	——	——	——	——	——	——	——>		
MOVE TO DEEPER COOL WATER													
	ALL						<—	——	——	—>			
MOVE TO DEEPER WARMER WATER													
	ALL	<——	——	—>							<—	——	——>

slough and rivers, which would provide greater open water habitat needed by resident and migrant waterfowl.

Avian Botulism

In certain years between 1974 and 1980, up to 2,000 waterfowl were reported found dead within Smith and Bybee Lake basins. In 1978, one mallard specimen reportedly collected from the lakes area was submitted to National Fish and Wildlife Health Laboratory in Madison, Wisconsin. The mallard was diagnosed as containing the type C botulism bacteria. From this evidence, it was concluded that conditions in Smith and Bybee Lakes in late summer/early fall are conducive to the development and spread of this avian disease. Based on this evidence, the U.S. Fish and Wildlife Service obtained a permit from Army Corps of Engineers to place a water control structure at the eastern end of the North Slough.

Considerable controversy arose over this decision due to the paucity of evidence that the lakes environment was indeed the source of the avian botulism outbreak (Larson, 1983). Regardless of the source, with the potential for infected birds to congregate in dwindling pools of water in the fall and spread the disease upon death, a monitoring and response plan should be in place for the lakes area. The principal options for response are (1) early removal of infected birds and (2) increase the storage pool, thereby reducing conditions for proliferation of the disease.

Mammals

Managing the lakes area as tidal freshwater marshes and seasonally flooded emergent wetlands will increase the diversity and abundance of palatable vegetation, seed-producing vegetation, and invertebrate populations for mammal consumption. Emergent vegetation development will coincide with the time of dispersal for many breeding populations of small mammals, which serve as additional food source for terrestrial carnivores and raptors.

Beaver continue to reduce the ash forest, a limited resource, at an alarming rate. Seasonal fluctuations in water levels that mimic the river levels will reduce the suitable habitat for beaver and nutria, particularly during late summer and fall. Lower water levels will expose lodges and bank dens to predators and induce emigration of young of the species out of the lakes area.

Recreational Use

Passive recreational uses that would not be impacted or will be enhanced by returning the lakes to a freshwater tidal marsh system include hiking and wildlife viewing. Boat and fishing access will be enhanced most of the year with the lakes open to the slough. During the low water period, late July through early October, boat access and fishing will become more limited, and become non-existent in areas of exposed sediments.

Operation Costs

With a replacement water control structure that allows unobstructed flow between the lakes and the slough, operation costs should be minimal. Dropping stop-logs into channels fitted into an open structure once a year or every few years is a minor operation with very little maintenance required. A more complex structure, such as adjustable weirs, increase the installation and operational costs, increasing the possibilities for malfunctioning. Augmenting water by pumping from the Columbia River incurs a long-term operation and maintenance cost. Augmenting water by pumping from the Columbia Slough directly into the lakes using a high volume, low-head irrigation pump will have minimal operation and maintenance costs.

RECOMMENDED WATER MANAGEMENT OPTION

In accordance with the management goal for the Smith and Bybee Lakes area, which is **"to maintain and enhance the lakes** (area) **in a manner that is faithful to their original natural condition"**, the water management option recommended is Option III discussed above. This preferred option includes:

1. Remove the existing dam and control structure;
2. Construct an open structure that will allow unrestricted flow between the lakes and the Columbia Slough and Willamette River while maintaining the ability to retain water in the lakes; and,
3. Develop the ability to augment water to the lakes by pumping from another source.

Additional information is needed to refine the cost estimates for developing the ability to pump water from the Columbia River or groundwater aquifer to the lakes on a limited basis.

The environmental impacts of placing a weir structure separating the western arm of Bybee Lake and connecting the lakes directly to the Columbia slough will be evaluated. Additional data will be gathered for estimating cost of constructing this option.

Appendix A

TABLE NO.	TITLE
Table 1	Smith & Bybee Lakes Water Quality Data
Table 2	Smith & Bybee Lakes Sediment Data (Heavy Metals – Summer 1994 Sampling)
Table 3	Smith & Bybee Lakes Sediment Data (PAH-Summer 1994 Sampling)

Appendix A Smith and Bybee Lakes Water Quality Data
Table 1

SMITH LAKE

Date	TSS	TDS	TS	Cond-field	Temp(C)	PH-field	Fecal coli	Fecal entr	DO-%	DO-field	Clorophl-a	Secchi(cm
05-Aug-92				231	21.5	8.6			95.7	8.49	0.082	
20-Aug-92				225	20.7	8.56			78.3	7.01	0.081	
25-Sep-92				183	16.85	10.28			86.3	8.44	0.406	
11-Nov-92				186	9.4	8.09			77.3	8.66	0.31	
25-Feb-93	34			212	4.02	7.47			97.8	12.8	0.099	
01-Apr-93	50			196	12.29	7.34			96.6	10.28	0.055	
15-Apr-93	33			195	12.54	7.12			100	10.62	0.041	
06-May-93	30			199	16.21	8.07	4	1	100.6	9.87	0.067	43
27-May-93	22			217	21.11	7.7			85.5	7.57	0.022	43
10-Jun-93	24		171	216	18.49	7.52	1	1	79	7.4	0.029	50
01-Jul-93	35			272	20.67	7.47	1	13	88	7.98	0.007	50
15-Jul-93		147	174	239	19.53	7.09	1	8	83.6	7.7	0.01	45
03-Aug-93	19			239	24.85	8.15	500	80	108.1	8.91	0.003	40
20-Aug-93	18	149	187	204	21.64	7.78			97.1	8.53	0.02	49
09-Sep-93	22		167	220	23.34	8.74	8	300	130	11.07	0.033	49
20-Sep-93	39		198	232	16.37	7.27	21	4	70.4	6.93	0.023	30
08-Oct-93	36		190	240	15.77	7.38	23	1	68.1	6.76	0.003	31
22-Oct-93	42	130	160	231	15.02	7.96	45	45	84.3	8.51		
09-Feb-94	10	120	110	205	2.75	7.5	23	9	101.3	13.63		61
28-Jun-94	53	130	210	219	21.5	8.64	9	9	90	8.08		
25-Aug-94	64		150	200	21.15	9.25	4		88.5	8.73	0.006	18
25-Jan-95				146	4.96	7.73			97.9	12.68		
26-Jan-95	24	62	110				330	78				
17-May-95	38		120				2				0.027	
08-Aug-95	70	120	180	169	19.15	8.94	1	2	79.4	7.38		
24-Aug-95	68		170	158	20.01	9.05	2	2	69.2	6.25	0.27	21
14-Feb-96	12	80	100				32	2				
Mean	35.38	117.3	159.8	209.75		8.070833			89.708	8.92833	0.0797	40.76923
Median	34	125	170	214		7.87			88.25	8.5	0.031	43
Std. Dev.	17.44	30.88	34.58	28.57066		0.794092			13.92	1.99416	0.113172	12.46431
Minimum	10	62	100	146		7.09			68.1	6.25	0.003	18
Maximum	70	149	210	272		10.28			130	13.63	0.406	61

BYBEE LAKE

Date	TSS	TDS	T.Solids	Cond-field	Temp (C)	PH-field	Fecal coli	Fecal entr	DO-%	DO-field	Clorophl-a	Secchi(cm)
05-Aug-92				216	22.1	8.53			102	8.9	0.069	
20-Aug-92				186	20.8	8.82			91.1	8.16	0.192	
26-Aug-92				170	20.8	8.82						
25-Sep-92				162	17.32	10.53			108.6	10.47	0.038	
11-Nov-92				158	9.03	8.37			79.2	9.14	0.286	
25-Feb-93	27	100		188	4.31	7.62		1	96.1	12.49	0.052	
01-Apr-93	56			174	12.92	7.32			98.8	10.38	0.056	
15-Apr-93	33			175	12.89	7.26			94.5	9.98	0.047	
06-May-93	45			173	16.45	9.01	13	1	123	12.01	0.158	29
27-May-93	26			214	21.01	7.45			94.2	7.46	0.031	44
10-Jun-93	19		166	219	19.06	7.69	1	1	88.3	8.15	0.022	51
01-Jul-93	26			274	21.52	7.55	4	1	89.3	7.89	0.009	44
15-Jul-93		140	185	242	19.77	7.09	1	2	80	7.33	0.011	41
03-Aug-93	17			247	26	7.98	1	30	102.5	8.28	0.003	48
20-Aug-93	18	145	175	212	22.46	7.59			94.7	8.19	0.008	50
30-Aug-93				233	22.74	8			107.7	9.29		44
31-Aug-93				231	20.62	7.06			79.4	7.12		39
09-Sep-93	20		174	234	24.02	8.01	13	4	104.2	8.75	0.005	50
20-Sep-93	40		190	239	17.29	7.23	17	23	75.1	7.23	0.01	34
08-Oct-93	33		184	240	16.26	7.65	4	13	68.4	6.73	0.014	34
22-Oct-93	46	120	150	229	14.32	7.82	20	130	75	7.69		
09-Feb-94	8	110	98	198	3.19	7.56	5	9	104.3	13.9		66
28-Jun-94	52	130	170	205	20.4	8.98	9	45	106.6	9.75		
25-Aug-94	32		150	233	21.85	9.14	1		87.5	7.64	0.025	31
25-Jan-95				138	4.89	7.47			95.9	12.49		
26-Jan-95	27	68	120				9	9				
17-May-95	52		150				4				0.032	
08-Aug-95	46	120	170	207	19.56	8.1	2	2	62.9	5.97		
24-Aug-95	26		150	197	20.76	7.57	4	1	57.5	5.2	0.019	30
14-Feb-96	10	76	100				30	2				
Mean	31.38	112.1	155.47	207.18519		8.00815			91.03	8.86885	0.05435	42.33333
Median	27	120	166	212		7.69			94.35	8.235	0.028	44
Std. Dev.	32.63	26.7	29.147	32.627309		0.7965			15.44	2.10475	0.0735744	10.0119
Minimum	8	68	98	138		7.06			57.5	5.2	0.003	29
Maximum	56	145	190	274		10.53			123	13.9	0.286	66

SMITH LAKE

Date	NH3	TKN	NO2+NO3	Total-P	O-PO4-P	Chlor-a
05-Aug-92	0.025	2.5	0.1	0.26	0.02	0.082
20-Aug-92	0.025	1.7	0.1	0.38	0.02	0.081
25-Sep-92	0.07	9.3	0.1	0.91	0.07	0.406
11-Nov-92	0.025	9.7	0.1	0.94	0.02	0.31
25-Feb-93	0.025	2.3	0.1	0.22	0.03	0.099
01-Apr-93	0.06	1.3	0.1	0.21	0.01	0.055
15-Apr-93	0.025	1.8	0.1	0.073	0.028	0.041
06-May-93	0.025	1.7	0.1	0.15	0.003	0.067
27-May-93	0.67	2.5	0.2	0.16	0.012	0.022
10-Jun-93	0.025	1.8	0.1	0.12	0.003	0.029
01-Jul-93	0.025	1.9	0.1	0.13	0.006	0.007
15-Jul-93	0.025	2.2	0.1	0.13	0.022	0.01
03-Aug-93	0.025	1.54	0.1	0.12	0.003	0.003
20-Aug-93	0.07	1.5	0.1	0.1	0.007	0.02
09-Sep-93	0.18	1.7	0.1	0.1	0.011	0.033
20-Sep-93	0.11	1.7	0.1	0.15	0.007	0.023
08-Oct-93	0.05	2	0.1	0.17	0.007	0.003
22-Oct-93	0.029	2.3	0.061	0.072	0.003	
09-Feb-94	0.036	1.3	0.1	0.087	0.01	
28-Jun-94	0.063	0.33	0.028	0.12	0.024	
25-Aug-94	0.066	1.8	0.005	0.23	0.005	0.006
26-Jan-95	0.025	0.68	0.005	0.045	0.003	
17-May-95	0.025	1.3	0.005	0.069	0.007	
08-Aug-95	0.006	1.1	0.011	0.061	0.022	0.027
24-Aug-95	0.023	4.2	0.005	0.23	0.024	
14-Feb-96	1.3	2.4	1	0.042	0.025	0.27
Mean	0.116654	2.405769	0.116154	0.203038	0.015462	0.0797
Median	0.025	1.8	0.1	0.13	0.0105	0.031
Std. Dev.	0.273058	2.207098	0.185897	0.22601	0.014255	0.11317202
Minimum	0.006	0.33	0.005	0.042	0.003	0.003
Maximum	1.3	9.7	1	0.94	0.07	0.406

BYBEE LAKE

Date	NH3	TKN	NO2+NO3	Total-P	O-PO4-P	Chlor-a
05-Aug-92	0.025	1.5	0.1	0.24	0.02	0.069
20-Aug-92	0.025	2.4	0.1	0.52	0.04	0.192
25-Sep-92	0.025	4.2	0.1	0.67	0.03	0.038
11-Nov-92	0.07	7.7	0.1	0.84	0.04	0.286
25-Feb-93	0.15	2.2	0.1	0.2	0.02	0.052
01-Apr-93	0.025	1.1	0.1	0.18	0.02	0.056
15-Apr-93	0.025	1.7	0.1	0.07	0.014	0.047
06-May-93	0.025	2.5	0.1	0.22	0.003	0.158
27-May-93	0.77	2.1	0.2	0.15	0.01	0.031
10-Jun-93	0.025	1.6	0.1	0.12	0.003	0.022
01-Jul-93	0.025	1.3	0.1	0.11	0.007	0.009
15-Jul-93	0.025	1.8	0.1	0.12	0.025	0.011
03-Aug-93	0.025	0.73	0.1	0.12	0.003	0.003
20-Aug-93	0.06	1.3	0.1	0.1	0.009	0.008
09-Sep-93	0.025	1.2	0.1	0.09	0.033	0.005
20-Sep-93	0.025	1.5	0.1	0.21	0.003	0.01
08-Oct-93	0.025	1.7	0.1	0.15	0.003	0.014
22-Oct-93	0.07	1.8	0.005	0.071	0.003	
09-Feb-94	0.032	1.1	0.1	0.056	0.01	
28-Jun-94	0.064	1	0.094	0.11	0.017	
25-Aug-94	0.031	1.6	0.005	0.17	0.005	0.025
26-Jan-95	0.013	0.71	0.01	0.042	0.003	
17-May-95	0.19	1.8	0.062	0.077	0.003	0.032
08-Aug-95	0.012	1.1	0.005	0.029	0.003	
24-Aug-95	0.018	3	0.005	0.14	0.01	0.019
14-Feb-96	1.1	2.1	1	0.039	0.026	
Mean	0.111731	1.951538	0.118692	0.186308	0.013962	0.05435
Median	0.025	1.65	0.1	0.12	0.01	0.028
Std. Dev.	0.250213	1.388322	0.185105	0.194634	0.012071	0.07357436
Minimum	0.012	0.71	0.005	0.029	0.003	0.003
Maximum	1.1	7.7	1	0.84	0.04	0.286

Smith-Bybee Lakes Sediment Data
Heavy Metals
Summer, 1994 Sampling

Mg/Kg (dry weight)

Metal	Station 3	Station 4
Zn	170.000	170.000
Cu	31.000	38.000
Cr	29.000	35.000
Pb	24.000	36.000
Ni	23.000	26.000
As	6.400	5.500
Be	.600	.500
Cd	.590	.900
Ag	.200	.350
Sb	.200	.200
Hg	.070	.100
Se	-------	.200

4/01/96

Appendix A
Table 2

Smith-Bybee Lakes Sediment Data
PAH
Summer, 1994 Sampling

Mg/Kg (dry weight)

Metal	Station 3	Station 4
Pyrene	.055	.150
Benz (b) flr	.050	.160
Chrysene	.045	.150
Benz (a) ant	.043	.140
Benz (a) pyr	.041	.130
Benz (k) flr	.041	.160
Phenanthre	.030	.085
Indenopyre	.025	.025
Benz (ghi) p	.021	.036
Anthracene	-------	.022
DB (ah) ant	-------	.020

4/01/96

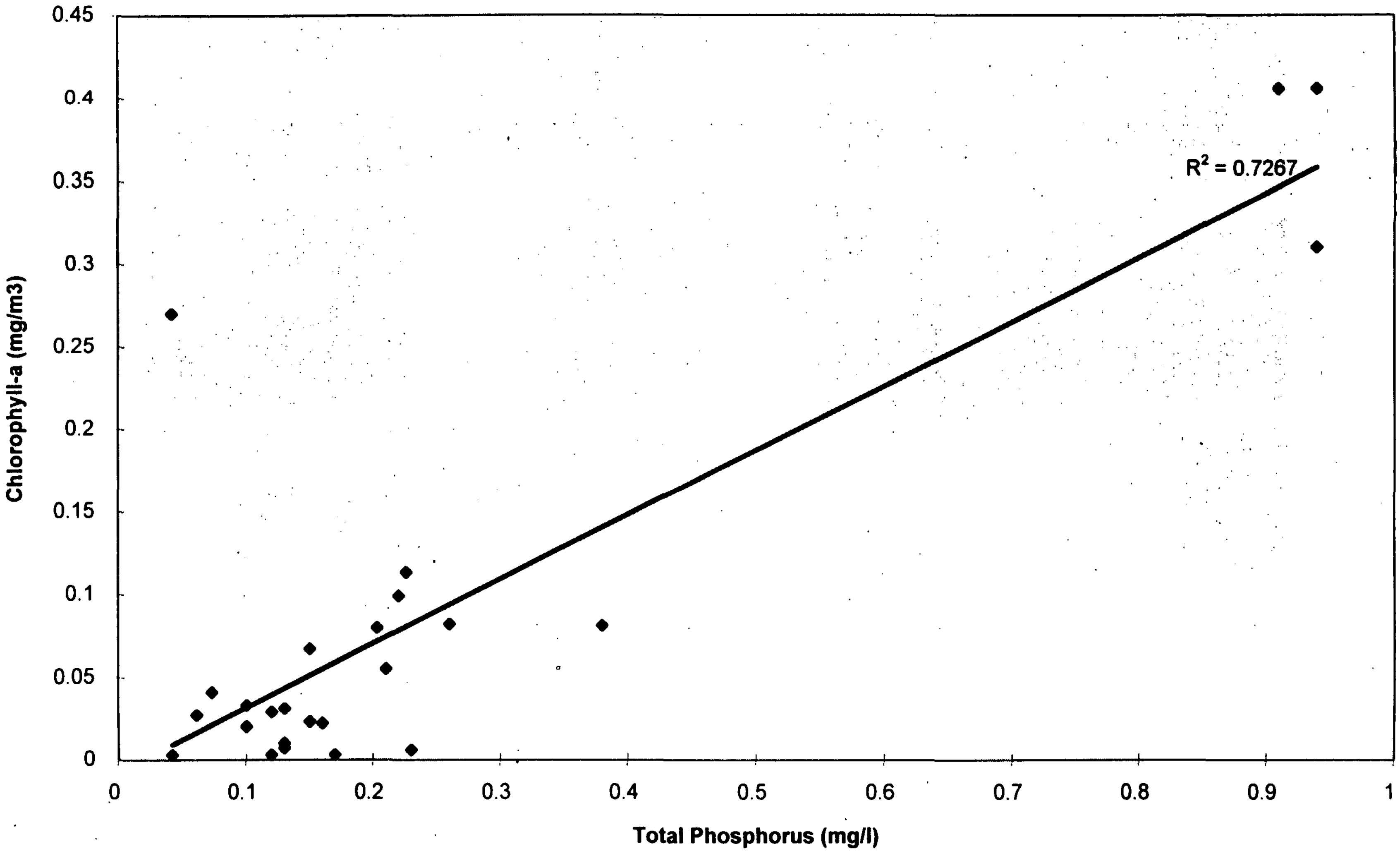
Appendix A
Table 3

Appendix B

FIGURE NO.	TITLE
Figure 1	Total Phosphorus vs. Chlorophyll-a in Smith Lake
Figure 2	Dissolved Phosphorus vs. Chlorophyll-a in Smith Lake
Figure 3	Total Nitrogen vs. Chlorophyll-a in Smith Lake
Figure 4	Ammonia-N vs. Chlorophyll-a in Smith Lake
Figure 5	Nitrite + Nitrate vs. Chlorophyll-a in Smith Lake
Figure 6	Total Phosphorus vs. Chlorophyll-a in Bybee Lake
Figure 7	Dissolved Phosphorus vs. Chlorophyll-a in Bybee Lake
Figure 8	Total Nitrogen vs. Chlorophyll-a in Bybee Lake
Figure 9	Ammonia-N vs. Chlorophyll-a in Bybee Lake
Figure 10	Nitrite + Nitrate vs. Chlorophyll-a in Smith Lake
Figure 11	Total Suspended Solids vs. Transparency in Bybee Lake
Figure 12	Total Suspended Solids vs. Transparency in Smith Lake
Figure 13	Chlorophyll-a vs. Transparency in Bybee Lake
Figure 14	Chlorophyll-a vs. Secchin in Smith Lake

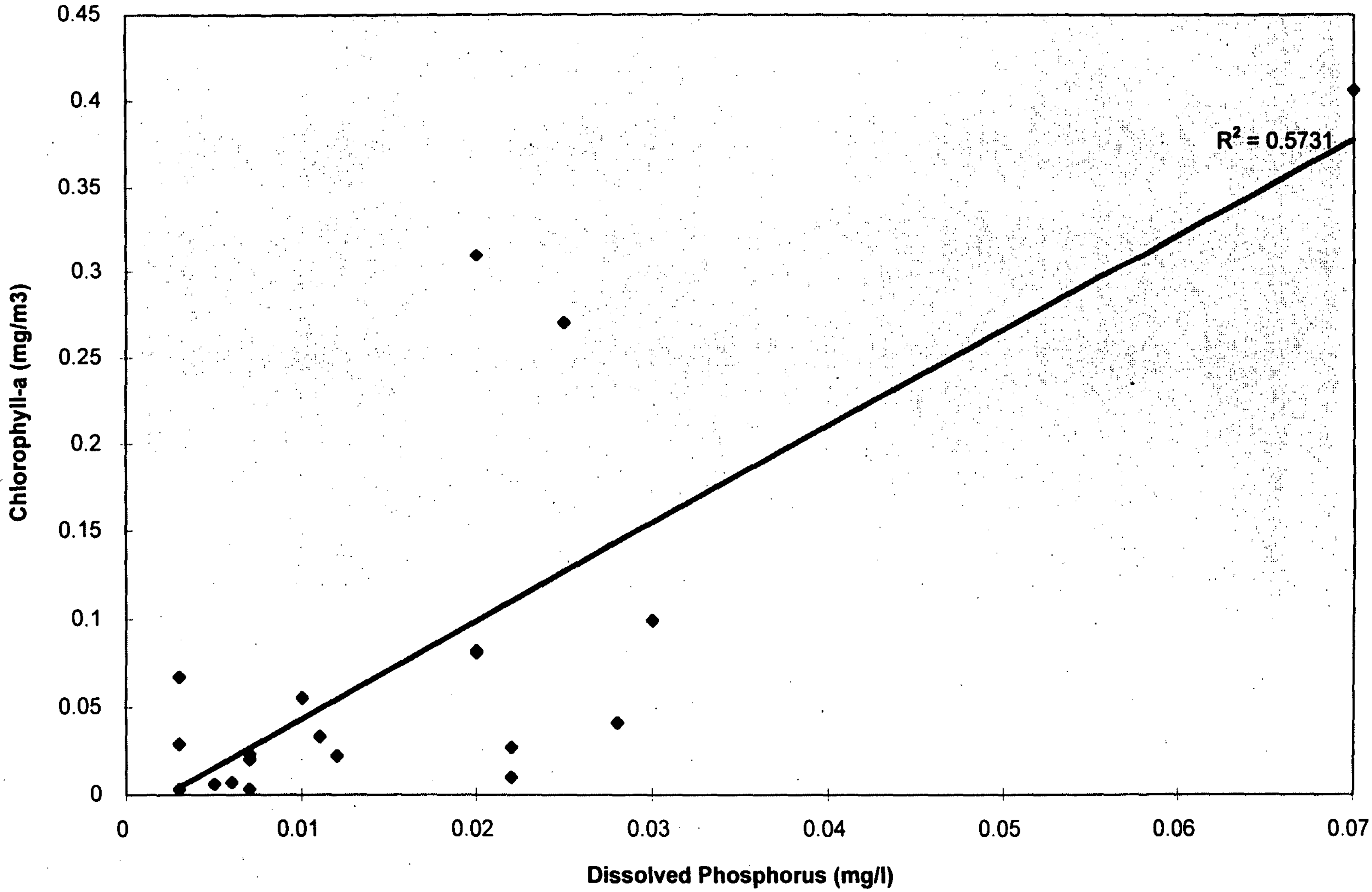
Appendix B
Figure 1

Total Phosphorus vs. Chlorophyll-a in Smith Lake

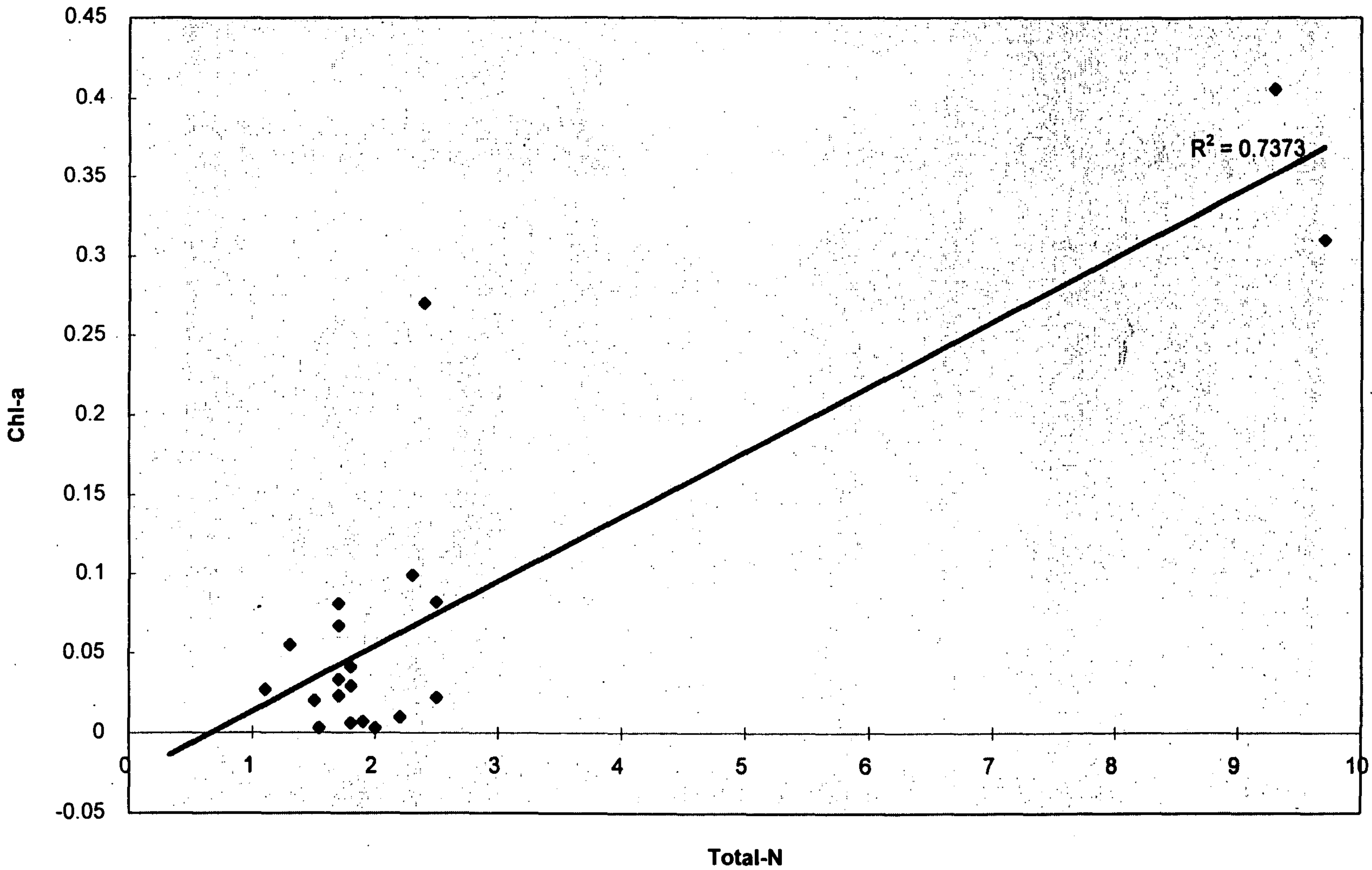


Appendix B
Figure 2

Dissolved Phosphorus vs. Chlorophyll-a in Smith Lake

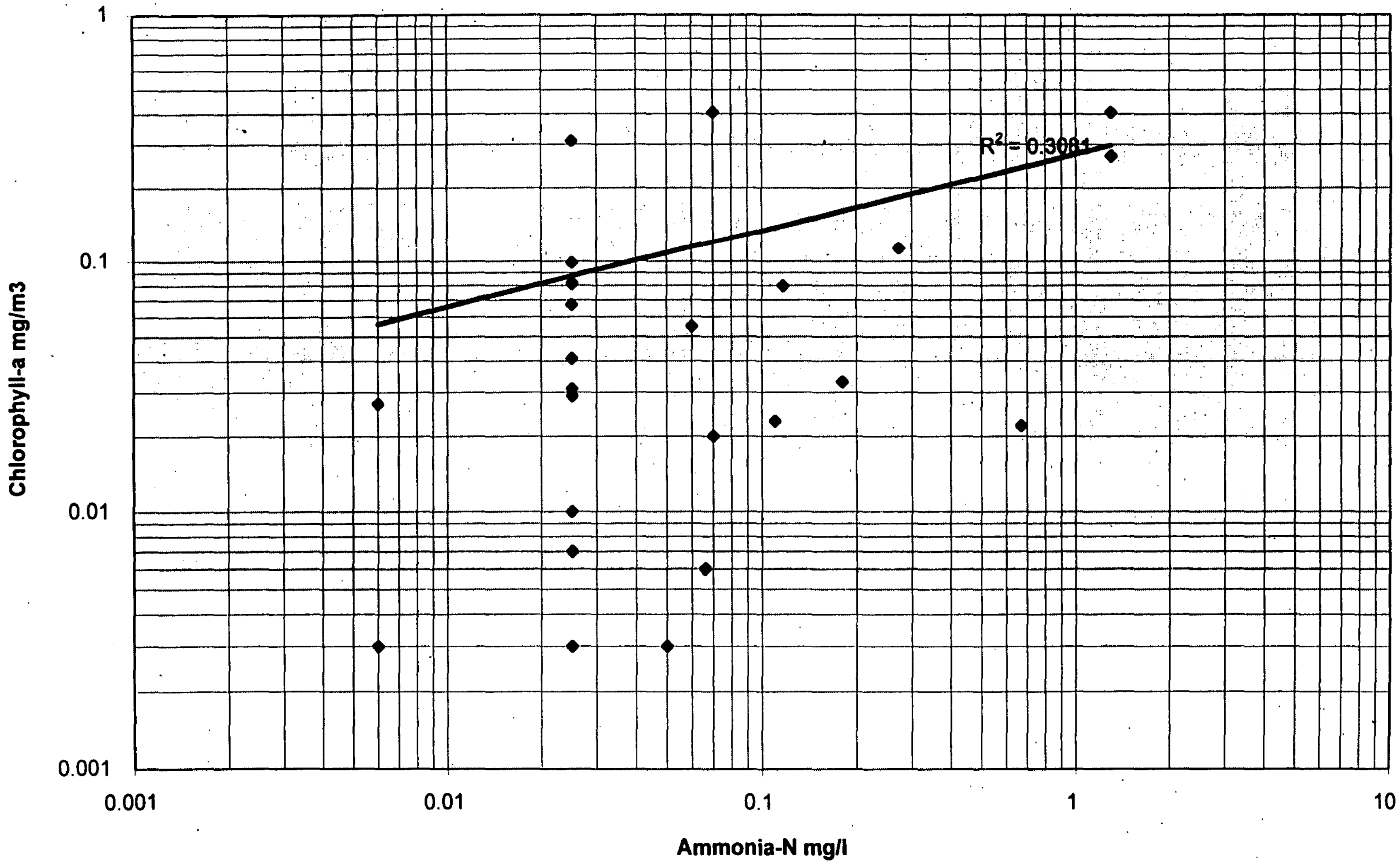


Appendix B
Figure 3 Total Nitrogen vs. Chlorophyll-a in Smith Lake



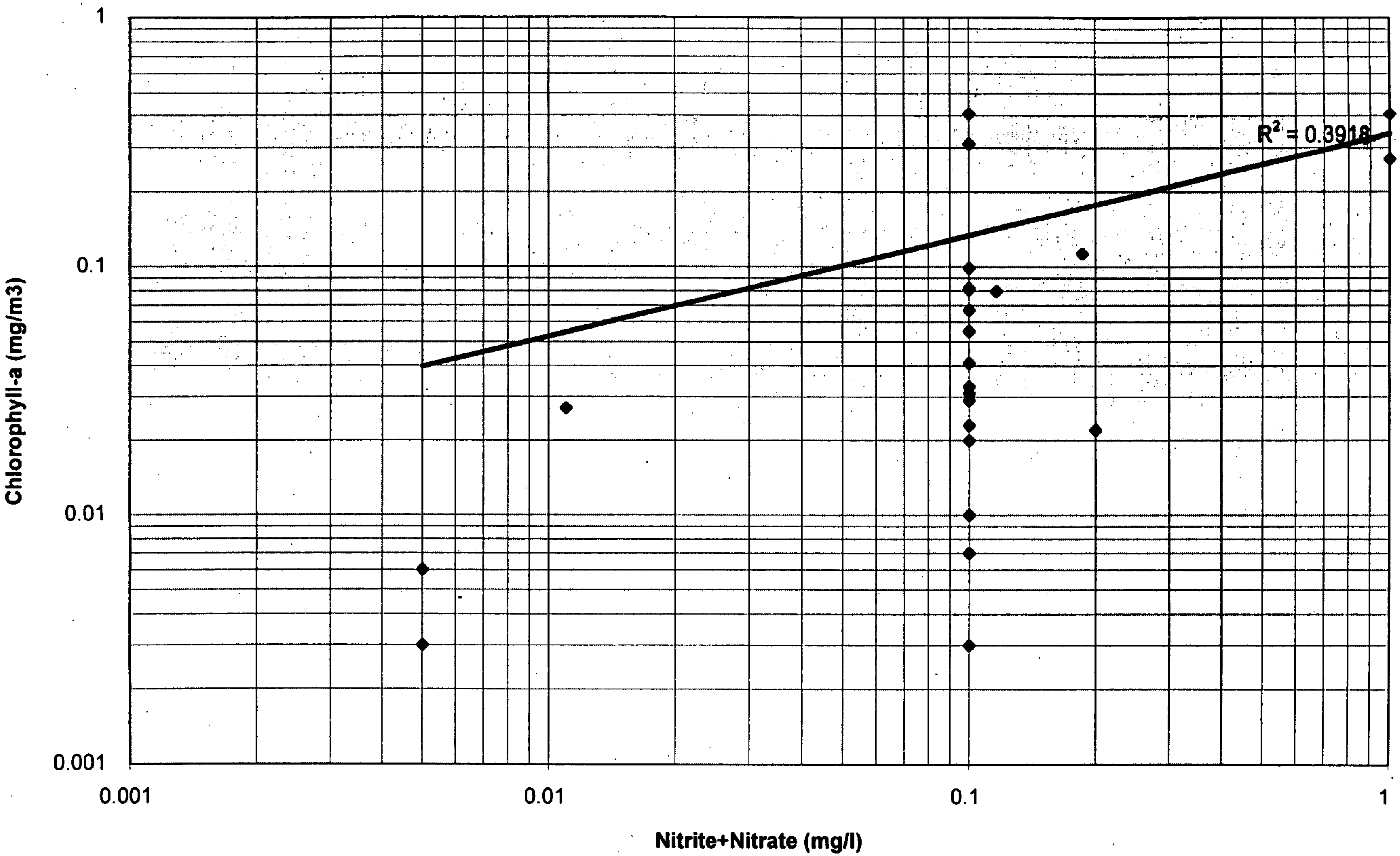
Appendix B
Figure 4

Ammonia-N vs. Chlorophyll-a in Smith Lake



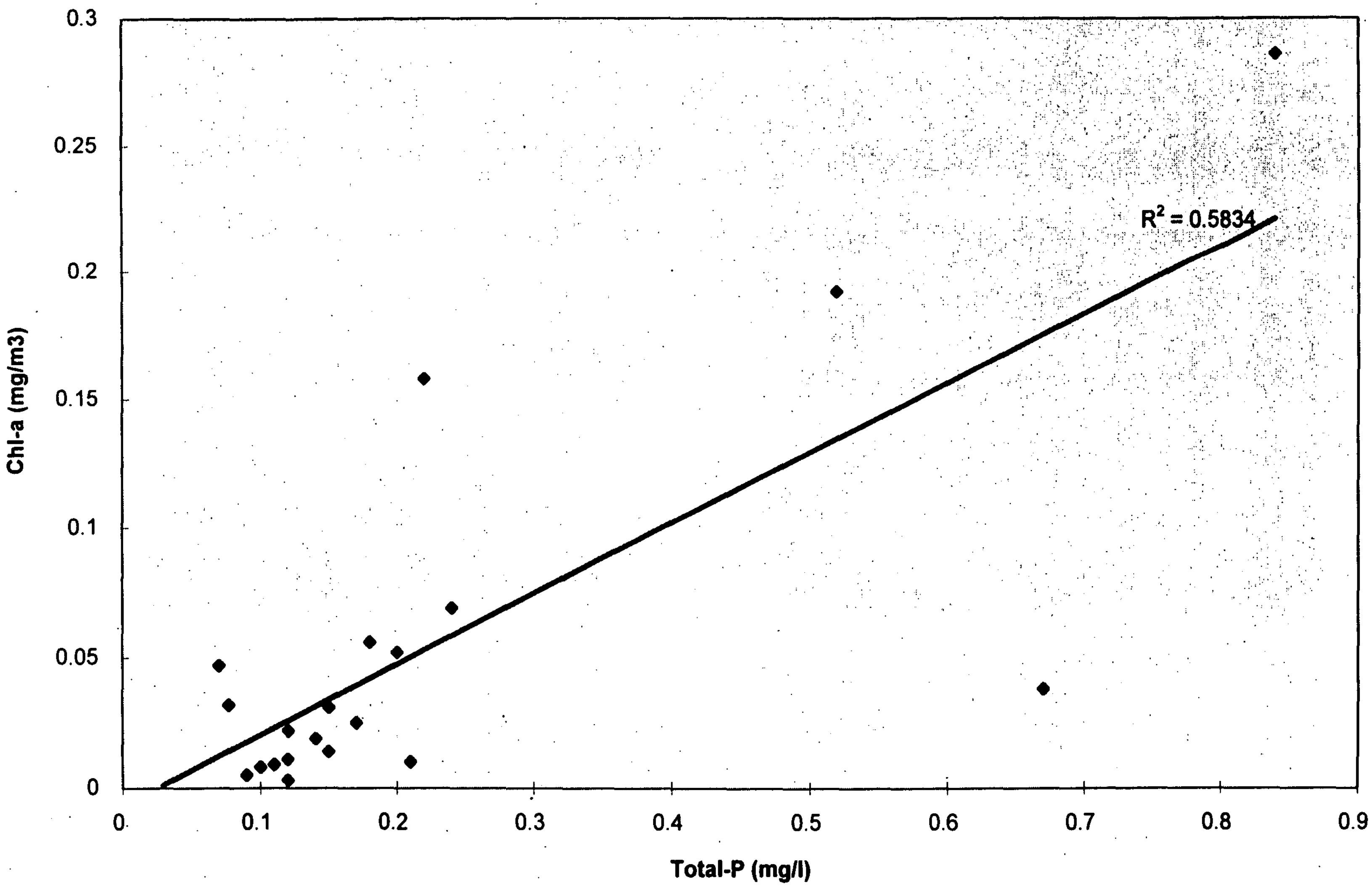
Appendix B
Figure 5

Nitrite + Nitrate vs. Chlorophyll-a in Smith Lake



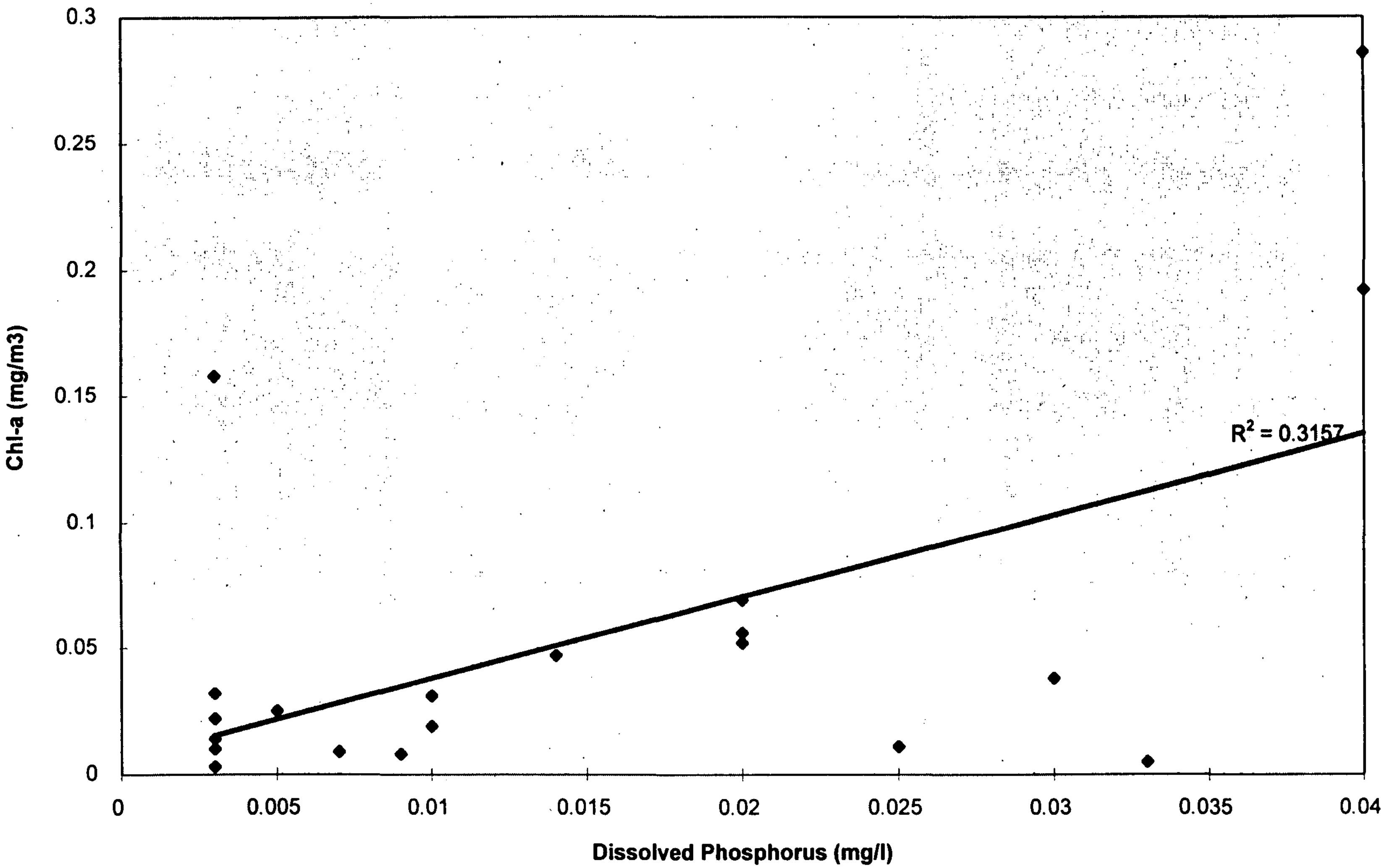
Appendix B

Figure 6 Total Phosphorus vs. Chlorophyll-a in Bybee Lake



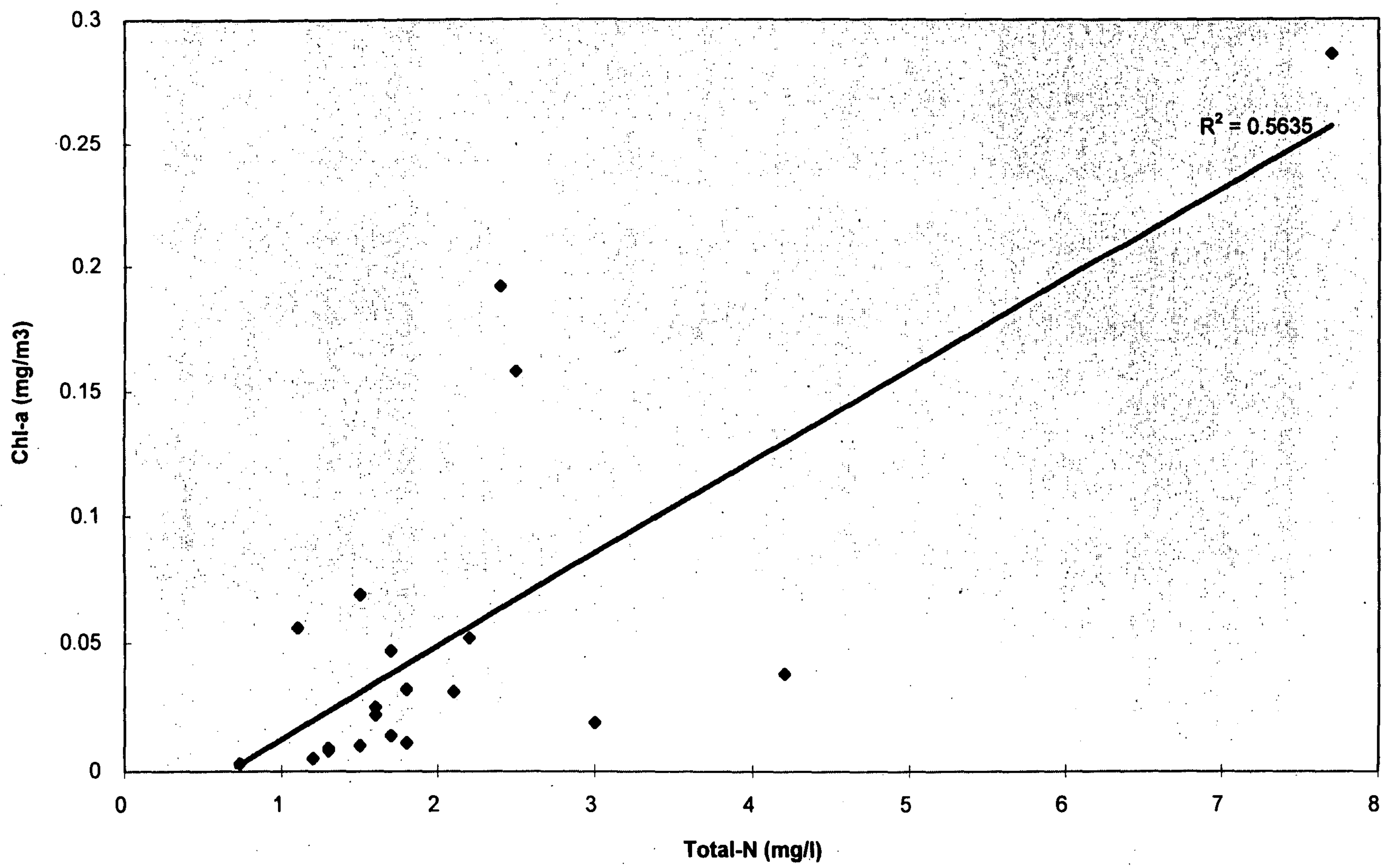
Appendix B

Figure 7 Dissolved Phosphorus vs. Chlorophyll-a in Bybee Lake

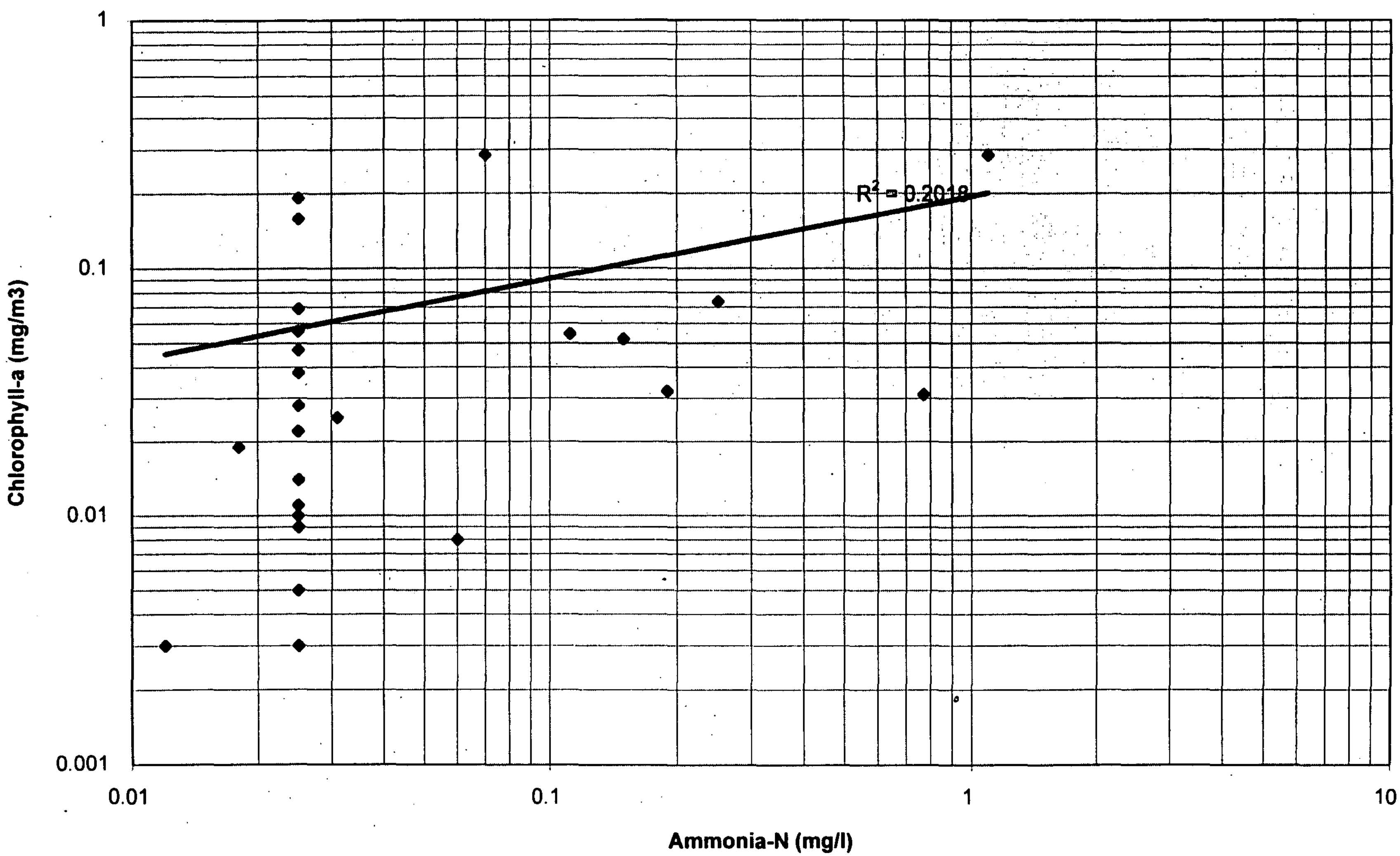


Appendix B
Figure 8

Total Nitrogen vs. Chlorophyll-a in Bybee Lake

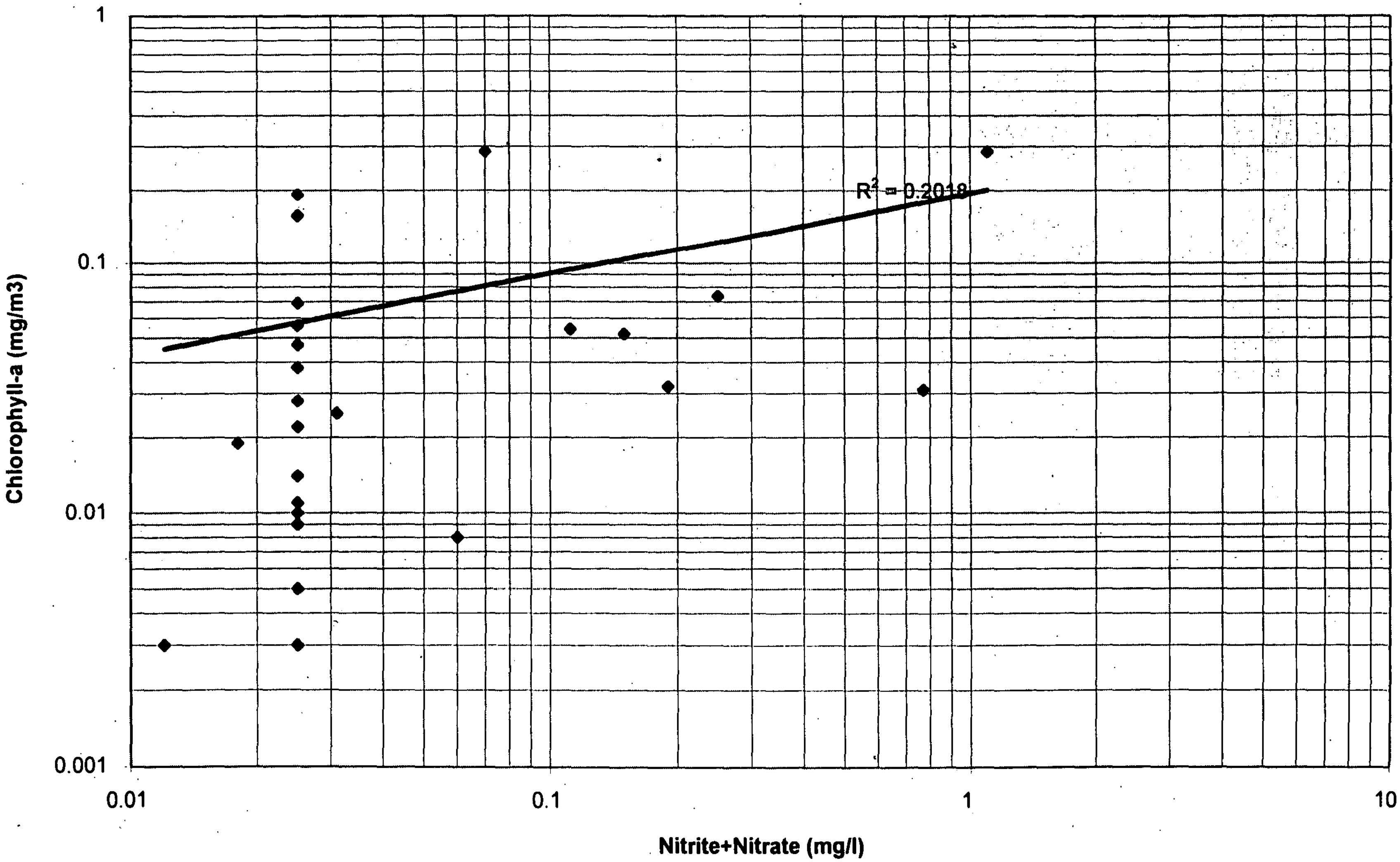


Appendix B
Figure 9 Ammonia-N vs. Chlorophyll-a in Bybee Lake

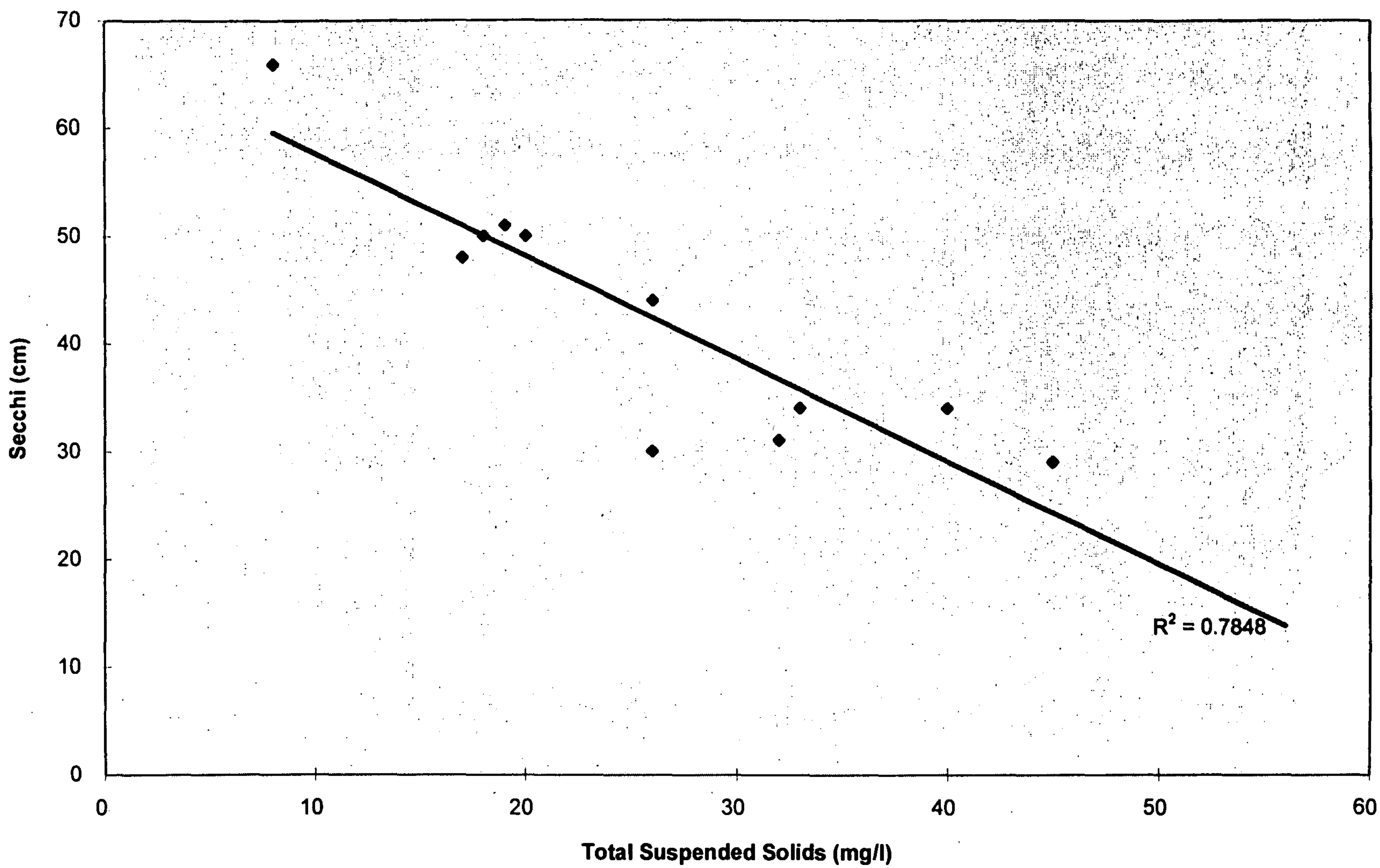


Appendix B

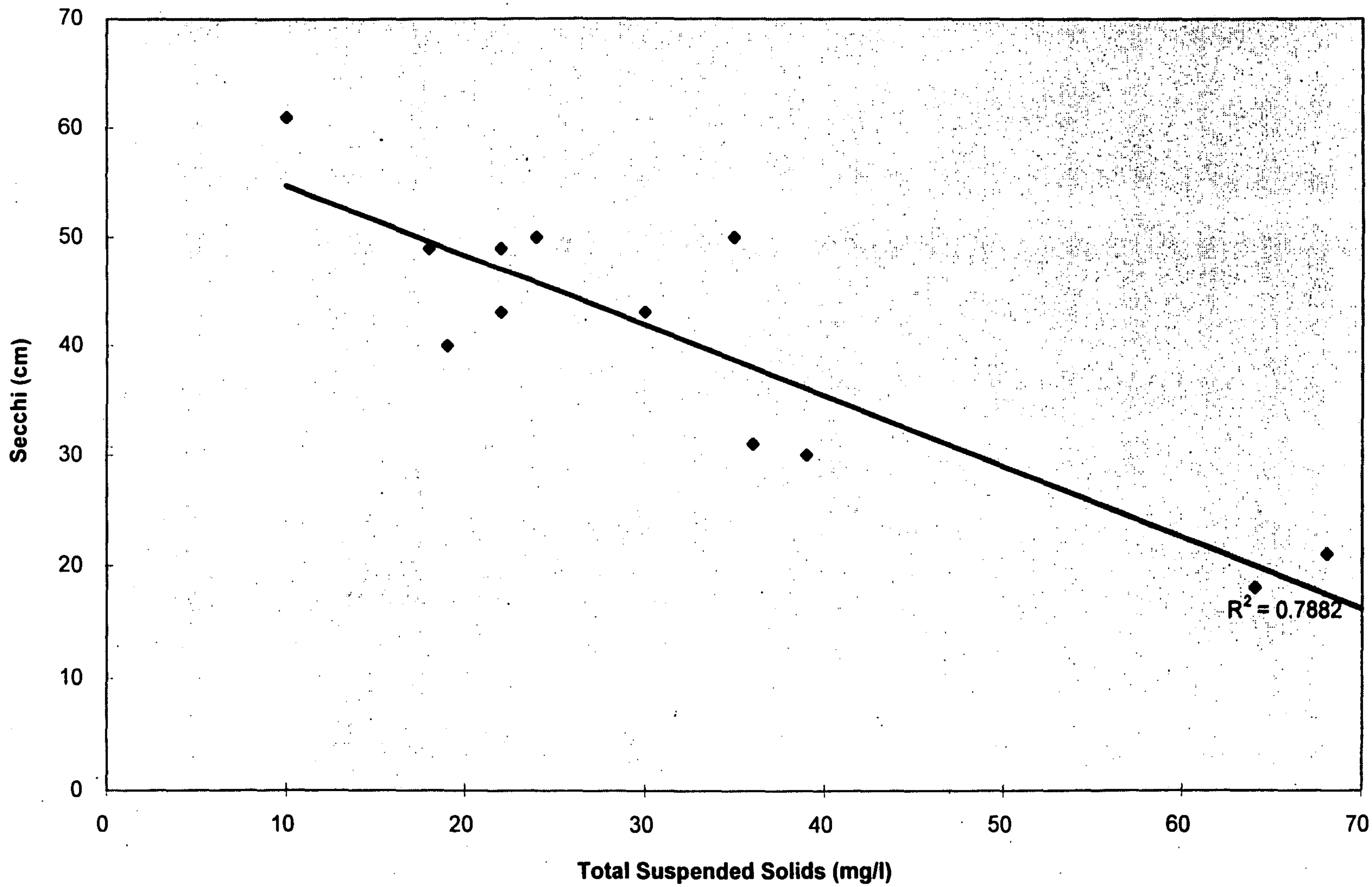
Figure 10 Nitrite + Nitrate vs. Chlorophyll-a in Bybee Lake



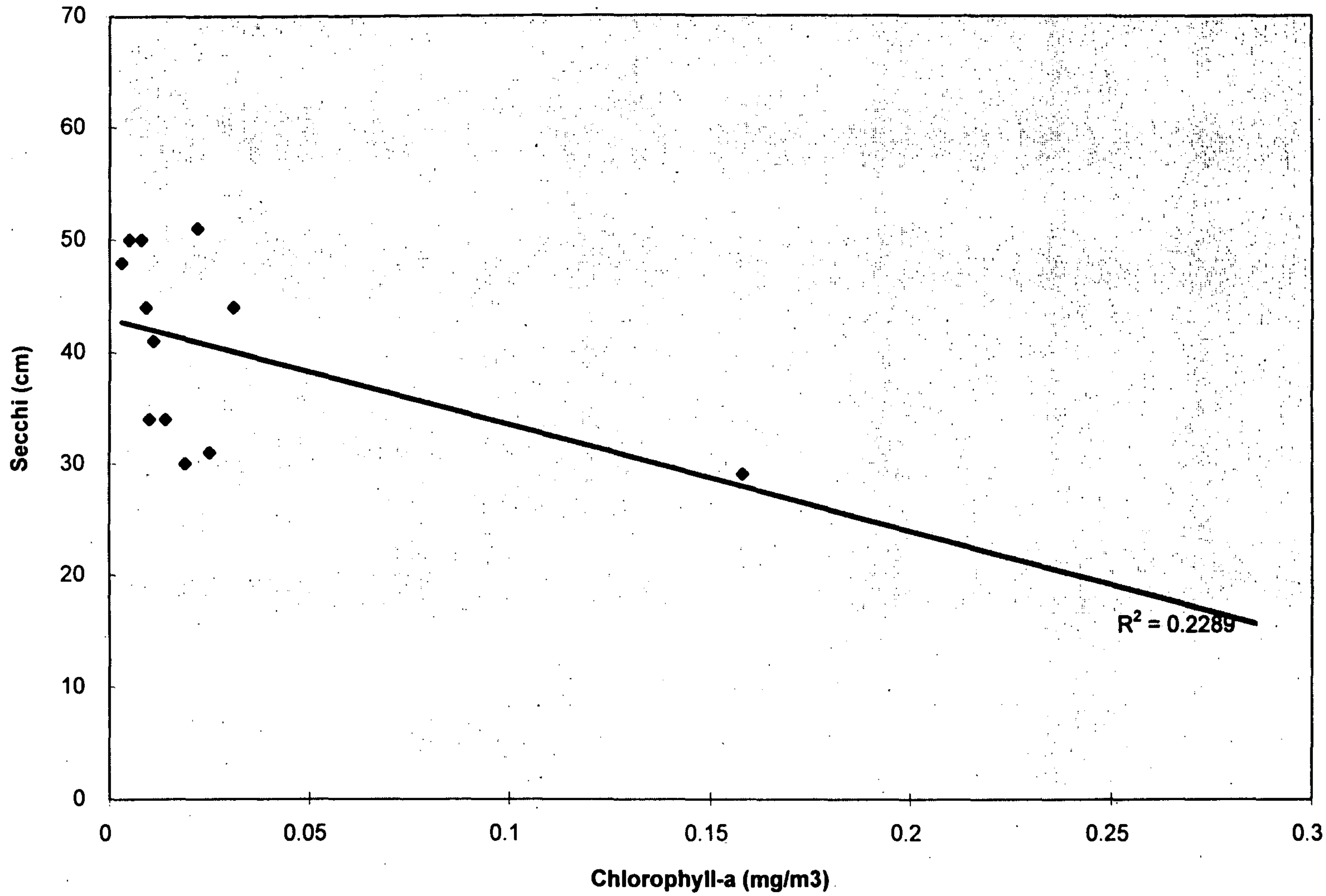
Appendix B
Figure 11 Total Suspended Solids vs. Transparency in Bybee Lake



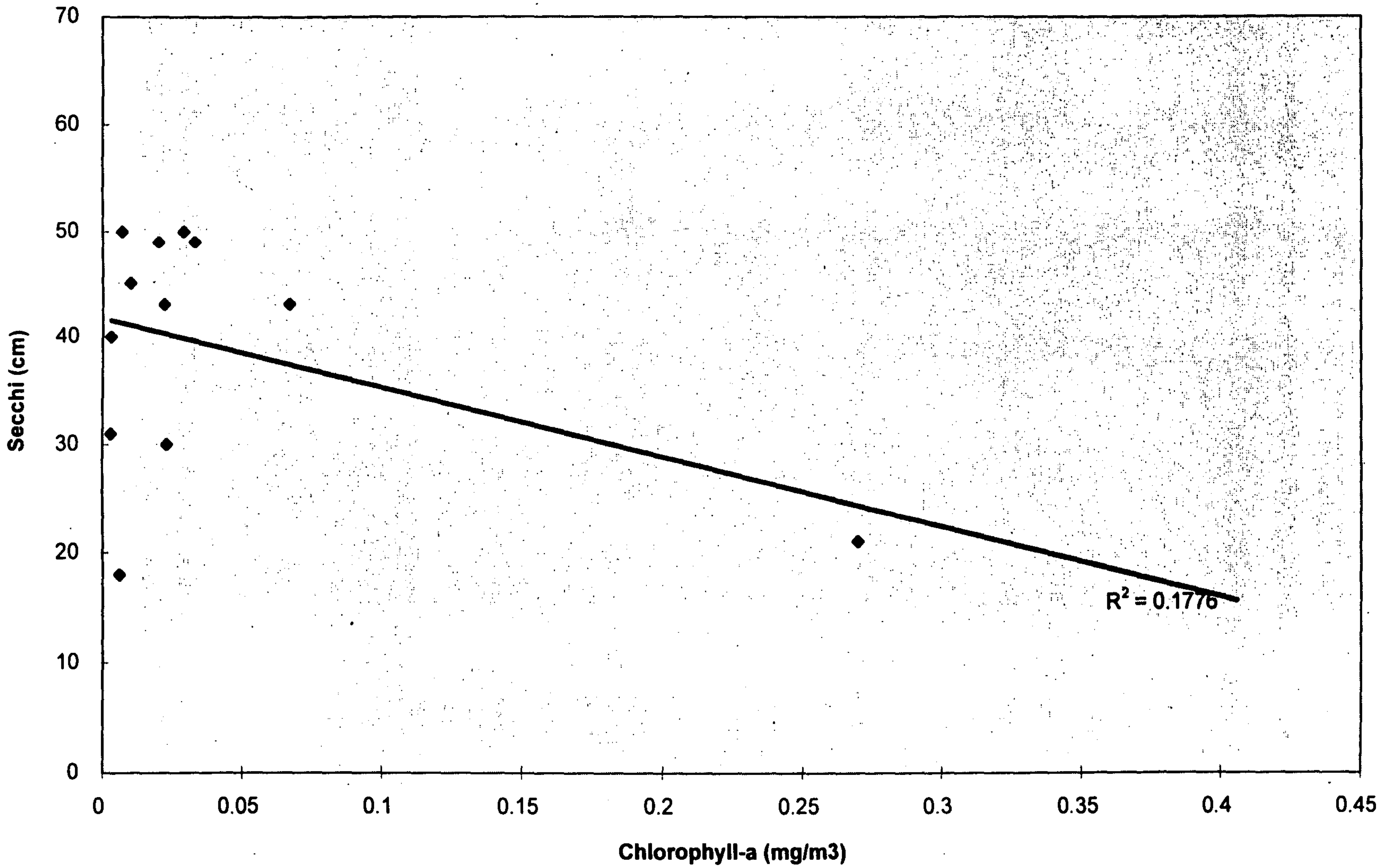
Appendix B
Figure 12 Total Suspended Solids vs. Transparency in Smith Lake



Appendix B
Figure 13 Chlorophyll-a vs. Transparency in Bybee Lake



Appendix B
Figure 14 Chlorophyll-a vs. Secchi in Smith Lake



Appendix C

FIGURE NO.	TITLE
Table A	1994 Tissue Data for Smith & Bybee Lakes and the North Slough

Appendix C

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
SBNEP		Percent Lipids	1.63		%		
	SW8270	Phenol		ND	ug/kg-as-rec	110	340
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	78	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	440
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	76	240
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	50	160
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	100	660
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	75	240
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	200	610
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	65	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	480
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	53	170
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	78	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	49	150
	SW8270	Isophorone		ND	ug/kg-as-rec	65	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	68	660
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	340	1100
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	71	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	88	400
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	66	210
	SW8270	Naphthalene		ND	ug/kg-as-rec	70	220
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	640
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	67	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	120	370
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	67	210
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	50	660
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	84	660
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	50	660
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	66	210
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	38	660
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	80	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	220	690
	SW8270	Acenaphthene		ND	ug/kg-as-rec	60	190
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	180	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	660
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	62	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	84	660
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	44	660
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	43	140
	SW8270	Fluorene		ND	ug/kg-as-rec	60	190
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	830
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	180	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	170	530
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	44	140
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	65	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	65	660
	SW8270	Phenanthrene		ND	ug/kg-as-rec	65	210
	SW8270	Carbazole		ND	ug/kg-as-rec	110	360
	SW8270	Anthracene		ND	ug/kg-as-rec	87	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	390
	SW8270	Fluoranthene		ND	ug/kg-as-rec	67	210

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	Pyrene		ND	ug/kg-as-rec	57	180
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	44	140
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	660
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	77	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	80	250
	SW8270	Chrysene		ND	ug/kg-as-rec	90	280
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	46	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	86	270
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	150	470
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	79	250
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	53	170
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	63	200
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	57.3		%		
	SW8270	2-Fluorobiphenyl	65.4		%		
	SW8270	d14-p-Terphenyl	65.8		%		
	SW8270	d4-1,2-Dichlorobenzene	47		%		
	SW8270	d5-Phenol	57.5		%		
	SW8270	2-Fluorophenol	52.7		%		
	SW8270	2,4,6-Tribromophenol	64.2		%		
	SW8270	d4-2-Chlorophenol	58.8		%		
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	52.1		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	45.7		%		
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.62	2
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.94	3
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.97	3.1
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.76	2.4
	SW8080M	Heptachlor		ND	ug/kg-as-rec	0.87	2.8
	SW8080M	Aldrin		Y	ug/kg-as-rec	2.1	2.1
	SW8080M	Heptachlor Epoxide		ND	ug/kg-as-rec	0.76	2.4

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.5
	SW8080M	Dieldrin	3.9		ug/kg-as-rec	1.2	3.8
	SW8080M	4,4'-DDE	26		ug/kg-as-rec	0.98	3.1
	SW8080M	Endrin		Y	ug/kg-as-rec	5.6	5.6
	SW8080M	Endosulfan II		ND	ug/kg-as-rec	1.6	5.1
	SW8080M	4,4'-DDD	8.8		ug/kg-as-rec	1.2	3.8
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.4	7.7
	SW8080M	4,4'-DDT		Y	ug/kg-as-rec	20	20
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.4	27
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.2	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.2	7
	SW8080M	gamma Chlordane		Y	ug/kg-as-rec	2.9	2.9
	SW8080M	alpha Chlordane		ND	ug/kg-as-rec	0.62	2
	SW8080M	Toxaphene		ND	ug/kg-as-rec	73	230
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	87	280
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	35	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	100	330
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	85	270
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	92.5		%		
	SW8080M	Tetrachlorometaxylene	75.7		%		
	EPA 335.2	Total Cyanide	0.78	U	mg/kg-as-rec		
	ICP	Aluminum	1		mg/kg-as-rec		
	GFA	Antimony	0.02	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.02	U	mg/kg-as-rec		
	GFA	Cadmium	0.004	U	mg/kg-as-rec		
	ICP	Calcium	354	j	mg/kg-as-rec		
	ICP	Chromium	0.13		mg/kg-as-rec		
	ICP	Cobalt	0.06	U	mg/kg-as-rec		
	ICP	Copper	0.5		mg/kg-as-rec		
	ICP	Iron	10		mg/kg-as-rec		
	GFAA	Lead	0.02	U	mg/kg-as-rec		
	ICP	Magnesium	300		mg/kg-as-rec		
	ICP	Manganese	0.27	j	mg/kg-as-rec		
	CVAA	Mercury	0.04		mg/kg-as-rec		
	ICP	Molybdenum	0.1	U	mg/kg-as-rec		
	ICP	Nickel	0.2	U	mg/kg-as-rec		
	GFAA	Selenium	0.7	j	mg/kg-as-rec		
	GFAA	Silver	0.004	U	mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	9.36		mg/kg-as-rec		
SBNNP		Percent Lipids	7.29		%		
	SW8270	Phenol		ND	ug/kg-as-rec	110	340
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	78	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	450
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	76	240
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	50	160
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	100	660
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	75	240
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	200	610

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	65	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	480
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	53	170
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	78	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	49	150
	SW8270	Isophorone		ND	ug/kg-as-rec	65	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	68	660
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	340	1100
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	71	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	88	400
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	66	210
	SW8270	Naphthalene		ND	ug/kg-as-rec	70	220
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	640
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	67	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	120	370
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	67	210
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	50	660
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	85	660
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	50	660
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	66	210
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	38	660
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	81	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	220	690
	SW8270	Acenaphthene		ND	ug/kg-as-rec	61	190
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	180	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	660
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	62	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	84	660
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	44	660
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	43	140
	SW8270	Fluorene		ND	ug/kg-as-rec	60	190
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	830
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	180	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	170	530
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	44	140
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	65	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	66	660
	SW8270	Phenanthrene		ND	ug/kg-as-rec	66	210
	SW8270	Carbazole		ND	ug/kg-as-rec	110	360
	SW8270	Anthracene		ND	ug/kg-as-rec	87	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	390
	SW8270	Fluoranthene		ND	ug/kg-as-rec	67	210
	SW8270	Pyrene		ND	ug/kg-as-rec	57	180
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	44	140
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	660
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	77	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	80	250
	SW8270	Chrysene		ND	ug/kg-as-rec	90	280
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	46	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	86	270
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	150	470

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	79	250
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	53	170
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	64	200
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	56		%		
	SW8270	2-Fluorobiphenyl	70.6		%		
	SW8270	d14-p-Terphenyl	44		%		
	SW8270	d4-1,2-Dichlorobenzene	29.3		%		
	SW8270	d5-Phenol	77.4		%		
	SW8270	2-Fluorophenol	53.5		%		
	SW8270	2,4,6-Tribromophenol	39		%		
	SW8270	d4-2-Chlorophenol	59.9		%		
	SW8270-SIM	Naphthalene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	19	j	ug/kg-as-rec		
	SW8270-SIM	Fluorene	16	j	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	20	j	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U, uj	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U, uj	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	47.2		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	18.2		%		
	SW8080M	alpha-BHC		Y	ug/kg-as-rec	8.4	8.4
	SW8080M	beta-BHC		Y	ug/kg-as-rec	13	13
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.99	3.1
	SW8080M	gamma-BHC (Lindane)		Y	ug/kg-as-rec	32	32
	SW8080M	Heptachlor		Y	ug/kg-as-rec	8.1	8.1
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.62	2
	SW8080M	Heptachlor Epoxide		Y	ug/kg-as-rec	5.5	5.5
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.6
	SW8080M	Dieldrin		Y	ug/kg-as-rec	16	16
	SW8080M	4,4'-DDE	110	j**	ug/kg-as-rec	1	3.2
	SW8080M	Endrin		Y	ug/kg-as-rec	8.4	8.4
	SW8080M	Endosulfan II		Y	ug/kg-as-rec	11	11
	SW8080M	4,4'-DDD	45	j**	ug/kg-as-rec	1.2	3.9
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.5	7.9
	SW8080M	4,4'-DDT		Y	ug/kg-as-rec	19	19
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.6	27

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.3	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.2	7.1
	SW8080M	gamma Chlordane		Y	ug/kg-as-rec	7.8	7.8
	SW8080M	alpha Chlordane	9.9	j	ug/kg-as-rec	0.64	2
	SW8080M	Toxaphene		Y	ug/kg-as-rec	320	320
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	89	280
	SW8080M	Aroclor 1248	j		ug/kg-as-rec	35	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	110	340
	SW8080M	Aroclor 1260		Y	ug/kg-as-rec	330	330
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	81		%		
	SW8080M	Tetrachlorometaxylene	185		%		
	EPA 335.2	Total Cyanide	0.52	U	mg/kg-as-rec		
	ICP	Aluminum	22.9		mg/kg-as-rec		
	GFA	Antimony	0.07		mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.02	U	mg/kg-as-rec		
	GFA	Cadmium	0.025		mg/kg-as-rec		
	ICP	Calcium	6140	j	mg/kg-as-rec		
	ICP	Chromium	0.31		mg/kg-as-rec		
	ICP	Cobalt	0.08		mg/kg-as-rec		
	ICP	Copper	1.47		mg/kg-as-rec		
	ICP	Iron	61.1		mg/kg-as-rec		
	GFAA	Lead	0.1		mg/kg-as-rec		
	ICP	Magnesium	325		mg/kg-as-rec		
	ICP	Manganese	2.73	j	mg/kg-as-rec		
	CVAA	Mercury	0.009		mg/kg-as-rec		
	ICP	Molybdenum	0.1	U	mg/kg-as-rec		
	ICP	Nickel	0.2	U	mg/kg-as-rec		
	GFAA	Selenium	0.4	j	mg/kg-as-rec		
	GFAA	Silver	0.007		mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	89.9		mg/kg-as-rec		
SBNEA	-	Percent Lipids	1.28		%		
	SW8270	Phenol		ND	ug/kg-as-rec	100	320
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	75	230
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	430
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	73	230
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	48	150
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	99	640
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	72	230
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	190	590
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	62	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	460
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	51	160
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	75	250
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	47	150
	SW8270	Isophorone		ND	ug/kg-as-rec	62	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	65	640
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	330	1000
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	68	210
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	85	380
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	64	200
	SW8270	Naphthalene		ND	ug/kg-as-rec	68	210
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	620
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	65	250
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	110	350
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	65	200
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	49	640
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	81	640
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	48	640
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	64	200
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	36	640
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	68	210
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	78	240
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	210	660
	SW8270	Acenaphthene		ND	ug/kg-as-rec	58	180
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	170	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	640
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	59	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	81	640
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	43	640
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	67	210
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	42	130
	SW8270	Fluorene		ND	ug/kg-as-rec	58	180
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	250	800
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	170	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	160	510
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	42	130
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	62	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	63	640
	SW8270	Phenanthrene		ND	ug/kg-as-rec	63	200
	SW8270	Carbazole		ND	ug/kg-as-rec	110	350
	SW8270	Anthracene		ND	ug/kg-as-rec	84	260
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	380
	SW8270	Fluoranthene		ND	ug/kg-as-rec	65	200
	SW8270	Pyrene		ND	ug/kg-as-rec	55	170
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	42	130
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	640
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	74	230
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	77	240
	SW8270	Chrysene		ND	ug/kg-as-rec	86	270
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	83	260
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	140	450
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	76	240
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	51	160
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	42	130
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	61	190
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	48.7		%		
	SW8270	2-Fluorobiphenyl	65.7		%		
	SW8270	d14-p-Terphenyl	68.1		%		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	d4-1,2-Dichlorobenzene	44.1		%		
	SW8270	d5-Phenol	61.8		%		
	SW8270	2-Fluorophenol	47.2		%		
	SW8270	2,4,6-Tribromophenol	75.1		%		
	SW8270	d4-2-Chlorophenol	58.4		%		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	53.9		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	48.4		%		
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.61	1.9
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.92	2.9
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.95	3
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.75	2.4
	SW8080M	Heptachlor		ND	ug/kg-as-rec	0.86	2.7
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.6	1.9
	SW8080M	Heptachlor Epoxide		ND	ug/kg-as-rec	0.75	2.4
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.5
	SW8080M	Dieldrin		ND	ug/kg-as-rec	1.2	3.7
	SW8080M	4,4'-DDE	24		ug/kg-as-rec	0.96	3.1
	SW8080M	Endrin		ND	ug/kg-as-rec	0.96	3
	SW8080M	Endosulfan II		ND	ug/kg-as-rec	1.6	5
	SW8080M	4,4'-DDD	4		ug/kg-as-rec	1.2	3.7
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.4	7.6
	SW8080M	4,4'-DDT		ND	ug/kg-as-rec	2.2	7
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.3	26
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.1	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.2	6.8
	SW8080M	gamma Chlordane		ND	ug/kg-as-rec	0.52	1.6
	SW8080M	alpha Chlordane		ND	ug/kg-as-rec	0.61	1.9
	SW8080M	Toxaphene		ND	ug/kg-as-rec	72	230
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	85	270
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	34	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	100	330
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	84	260
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	64.8		%		
	SW8080M	Tetrachlorometaxylene	64.9		%		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	EPA 335.2	Total Cyanide	0.36	U	mg/kg-as-rec		
	ICP	Aluminum	0.8		mg/kg-as-rec		
	GFA	Antimony	0.02	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.02	U	mg/kg-as-rec		
	GFA	Cadmium	0.004	U	mg/kg-as-rec		
	ICP	Calcium	1300	j	mg/kg-as-rec		
	ICP	Chromium	0.14		mg/kg-as-rec		
	ICP	Cobalt	0.06	U	mg/kg-as-rec		
	ICP	Copper	0.8		mg/kg-as-rec		
	ICP	Iron	3.84		mg/kg-as-rec		
	GFAA	Lead	0.02	U	mg/kg-as-rec		
	ICP	Magnesium	280		mg/kg-as-rec		
	ICP	Manganese	0.6	j	mg/kg-as-rec		
	CVAA	Mercury	0.05		mg/kg-as-rec		
	ICP	Molybdenum	0.1	U	mg/kg-as-rec		
	ICP	Nickel	0.2	U	mg/kg-as-rec		
	GFAA	Selenium	0.3	j	mg/kg-as-rec		
	GFAA	Silver	0.088		mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	5.15		mg/kg-as-rec		
SBNNA		Percent Lipids	7.49		%		
	SW8270	Phenol		ND	ug/kg-as-rec	110	340
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	78	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	450
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	76	240
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	50	160
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	100	660
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	76	240
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	200	620
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	65	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	480
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	53	170
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	78	270
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	49	160
	SW8270	Isophorone		ND	ug/kg-as-rec	65	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	68	660
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	340	1100
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	71	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	88	400
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	66	210
	SW8270	Naphthalene		ND	ug/kg-as-rec	71	220
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	640
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	67	270
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	120	370
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	67	210
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	51	660
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	85	660
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	50	660
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	66	210
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	38	660
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	71	220

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	81	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	220	690
	SW8270	Acenaphthene		ND	ug/kg-as-rec	61	190
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	180	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	660
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	62	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	85	660
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	44	660
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	44	140
	SW8270	Fluorene		ND	ug/kg-as-rec	60	190
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	270	830
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	180	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	170	530
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	44	140
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	65	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	66	660
	SW8270	Phenanthrene		ND	ug/kg-as-rec	66	210
	SW8270	Carbazole		ND	ug/kg-as-rec	120	360
	SW8270	Anthracene		ND	ug/kg-as-rec	88	280
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	390
	SW8270	Fluoranthene		ND	ug/kg-as-rec	68	210
	SW8270	Pyrene		ND	ug/kg-as-rec	57	180
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	44	140
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	120	660
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	78	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	80	250
	SW8270	Chrysene		ND	ug/kg-as-rec	90	280
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	46	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	87	270
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	150	470
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	79	250
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	54	170
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	64	200
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	51.3		%		
	SW8270	2-Fluorobiphenyl	64.8		%		
	SW8270	d14-p-Terphenyl	51.8		%		
	SW8270	d4-1,2-Dichlorobenzene	27.7		%		
	SW8270	d5-Phenol	60.9		%		
	SW8270	2-Fluorophenol	39.1		%		
	SW8270	2,4,6-Tribromophenol	42.5		%		
	SW8270	d4-2-Chlorophenol	47.6		%		
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	18		ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	50.4		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	22		%		
	SW8080M	alpha-BHC		Y	ug/kg-as-rec	5.6	5.6
	SW8080M	beta-BHC		Y	ug/kg-as-rec	9.7	9.7
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.99	3.1
	SW8080M	gamma-BHC (Lindane)		Y	ug/kg-as-rec	4	4
	SW8080M	Heptachlor		Y	ug/kg-as-rec	5.9	5.9
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.62	2
	SW8080M	Heptachlor Epoxide		Y	ug/kg-as-rec	6	6
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.6
	SW8080M	Dieldrin	14		ug/kg-as-rec	1.2	3.9
	SW8080M	4,4'-DDE	170	**	ug/kg-as-rec	1	3.2
	SW8080M	Endrin		Y	ug/kg-as-rec	5.3	5.3
	SW8080M	Endosulfan II		Y	ug/kg-as-rec	14	14
	SW8080M	4,4'-DDD	51		ug/kg-as-rec	1.2	3.9
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.5	7.9
	SW8080M	4,4'-DDT		Y	ug/kg-as-rec	17	17
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.6	27
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.3	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.3	7.1
	SW8080M	gamma Chlordane		Y	ug/kg-as-rec	6.3	6.3
	SW8080M	alpha Chlordane	7.9		ug/kg-as-rec	0.64	2
	SW8080M	Toxaphene		Y	ug/kg-as-rec	290	290
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	89	280
	SW8080M	Aroclor 1248	160		ug/kg-as-rec	35	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	110	340
	SW8080M	Aroclor 1260		Y	ug/kg-as-rec	330	330
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	58.7		%		
	SW8080M	Tetrachlorometaxylene	112		%		
	EPA 335.2	Total Cyanide	0.44	U	mg/kg-as-rec		
	ICP	Aluminum	62.3		mg/kg-as-rec		
	GFA	Antimony	0.1	U	mg/kg-as-rec		
	GFA	Arsenic	0.1		mg/kg-as-rec		
	ICP	Beryllium	0.04	U	mg/kg-as-rec		
	GFA	Cadmium	0.011		mg/kg-as-rec		
	ICP	Calcium	12200	j	mg/kg-as-rec		
	ICP	Chromium	0.5		mg/kg-as-rec		
	ICP	Cobalt	0.1	U	mg/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	ICP	Copper	0.98		mg/kg-as-rec		
	ICP	Iron	95.4		mg/kg-as-rec		
	GFAA	Lead	0.1		mg/kg-as-rec		
	ICP	Magnesium	400		mg/kg-as-rec		
	ICP	Manganese	7.29	j	mg/kg-as-rec		
	CVAA	Mercury	0.011		mg/kg-as-rec		
	ICP	Molybdenum	0.2	U	mg/kg-as-rec		
	ICP	Nickel	0.4	U	mg/kg-as-rec		
	GFAA	Selenium	0.2	j	mg/kg-as-rec		
	GFAA	Silver	0.004	U	mg/kg-as-rec		
	GFAA	Thallium	0.03		mg/kg-as-rec		
	ICP	Zinc	21.3		mg/kg-as-rec		
SBCEP		Percent Lipids	1.74		%		
	SW8270	Phenol		ND	ug/kg-as-rec	110	340
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	77	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	440
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	75	240
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	50	160
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	100	660
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	75	230
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	190	610
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	64	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	470
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	53	170
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	77	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	49	150
	SW8270	Isophorone		ND	ug/kg-as-rec	64	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	68	660
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	340	1100
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	70	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	87	390
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	66	210
	SW8270	Naphthalene		ND	ug/kg-as-rec	70	220
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	640
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	67	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	120	360
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	67	210
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	50	660
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	84	660
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	50	660
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	66	210
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	38	660
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	80	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	220	690
	SW8270	Acenaphthene		ND	ug/kg-as-rec	60	190
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	180	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	660
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	61	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	84	660
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	44	660
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	69	220

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	43	140
	SW8270	Fluorene		ND	ug/kg-as-rec	59	190
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	820
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	180	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	170	520
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	43	140
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	64	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	65	660
	SW8270	Phenanthrene		ND	ug/kg-as-rec	65	200
	SW8270	Carbazole		ND	ug/kg-as-rec	110	360
	SW8270	Anthracene		ND	ug/kg-as-rec	87	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	390
	SW8270	Fluoranthene		ND	ug/kg-as-rec	67	210
	SW8270	Pyrene		ND	ug/kg-as-rec	57	180
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	44	140
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	660
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	77	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	79	250
	SW8270	Chrysene		ND	ug/kg-as-rec	89	280
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	45	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	85	270
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	150	460
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	78	250
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	53	170
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	63	200
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	47.3		%		
	SW8270	2-Fluorobiphenyl	59		%		
	SW8270	d14-p-Terphenyl	57		%		
	SW8270	d4-1,2-Dichlorobenzene	38.9		%		
	SW8270	d5-Phenol	49.4		%		
	SW8270	2-Fluorophenol	41.1		%		
	SW8270	2,4,6-Tribromophenol	50.9		%		
	SW8270	d4-2-Chlorophenol	46.4		%		
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	52.4		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	42.2		%		
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.63	2
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.95	3
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.98	3.1
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.77	2.4
	SW8080M	Heptachlor		ND	ug/kg-as-rec	0.88	2.8
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.61	1.9
	SW8080M	Heptachlor Epoxide		ND	ug/kg-as-rec	0.77	2.4
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.6
	SW8080M	Dieldrin		ND	ug/kg-as-rec	1.2	3.8
	SW8080M	4,4'-DDE	47		ug/kg-as-rec	0.99	3.1
	SW8080M	Endrin		Y	ug/kg-as-rec	5.2	5.2
	SW8080M	Endosulfan II		ND	ug/kg-as-rec	1.6	5.1
	SW8080M	4,4'-DDD		ND	ug/kg-as-rec	1.2	3.8
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.5	7.8
	SW8080M	4,4'-DDT		ND	ug/kg-as-rec	2.3	7.2
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.5	27
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.2	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.2	7
	SW8080M	gamma Chlordane	1.8		ug/kg-as-rec	0.54	1.7
	SW8080M	alpha Chlordane		ND	ug/kg-as-rec	0.63	2
	SW8080M	Toxaphene		Y	ug/kg-as-rec	300	300
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	88	280
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	35	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	110	340
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	86	270
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	58.2		%		
	SW8080M	Tetrachlorometaxylene	71.7		%		
	EPA 335.2	Total Cyanide	0.48	U	mg/kg-as-rec		
	ICP	Aluminum	0.6		mg/kg-as-rec		
	GFA	Antimony	0.02	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.02	U	mg/kg-as-rec		
	GFA	Cadmium	0.004	U	mg/kg-as-rec		
	ICP	Calcium	584	j	mg/kg-as-rec		
	ICP	Chromium	0.18		mg/kg-as-rec		
	ICP	Cobalt	0.06	U	mg/kg-as-rec		
	ICP	Copper	0.68		mg/kg-as-rec		
	ICP	Iron	17.5		mg/kg-as-rec		
	GFAA	Lead	0.02	U	mg/kg-as-rec		
	ICP	Magnesium	286		mg/kg-as-rec		
	ICP	Manganese	0.41	j	mg/kg-as-rec		
	CVAA	Mercury	0.109		mg/kg-as-rec		
	ICP	Molybdenum	0.1	U	mg/kg-as-rec		
	ICP	Nickel	0.2	U	mg/kg-as-rec		
	GFAA	Selenium	0.2	j	mg/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	GFAA	Silver	0.004	U	mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	9.28		mg/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
SBCNP		Percent Lipids	6.8		%		
	SW8270	Phenol		ND	ug/kg-as-rec	100	330
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	75	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	430
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	74	230
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	49	150
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	99	640
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	73	230
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	190	600
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	63	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	460
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	52	160
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	76	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	48	150
	SW8270	Isophorone		ND	ug/kg-as-rec	63	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	66	640
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	330	1000
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	69	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	85	390
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	64	200
	SW8270	Naphthalene		ND	ug/kg-as-rec	68	210
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	620
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	65	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	110	360
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	65	200
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	49	640
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	82	640
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	49	640
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	64	200
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	37	640
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	68	210
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	78	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	210	670
	SW8270	Acenaphthene		ND	ug/kg-as-rec	59	180
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	170	1300
	SW8270	4-Nitrophenol	140	J	ug/kg-as-rec	130	640
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	60	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	82	640
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	43	640
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	68	210
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	42	130
	SW8270	Fluorene		ND	ug/kg-as-rec	58	180
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	800
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	170	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	160	510
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	42	130
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	63	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	64	640
	SW8270	Phenanthrene		ND	ug/kg-as-rec	64	200
	SW8270	Carbazole		ND	ug/kg-as-rec	110	350
	SW8270	Anthracene		ND	ug/kg-as-rec	85	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	380
	SW8270	Fluoranthene		ND	ug/kg-as-rec	65	210

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	Pyrene		ND	ug/kg-as-rec	55	170
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	43	130
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	640
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	75	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	77	240
	SW8270	Chrysene		ND	ug/kg-as-rec	87	270
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	84	260
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	140	450
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	77	240
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	52	160
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	43	130
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	62	190
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	69.1		%		
	SW8270	2-Fluorobiphenyl	65.2		%		
	SW8270	d14-p-Terphenyl	50.5		%		
	SW8270	d4-1,2-Dichlorobenzene	31.1		%		
	SW8270	d5-Phenol	73.6		%		
	SW8270	2-Fluorophenol	56		%		
	SW8270	2,4,6-Tribromophenol	53		%		
	SW8270	d4-2-Chlorophenol	60.3		%		
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	14	Y	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	67.1		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	28.4		%		
	SW8080M	alpha-BHC		Y	ug/kg-as-rec	2.5	2.5
	SW8080M	beta-BHC		Y	ug/kg-as-rec	7.8	7.8
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.96	3
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.76	2.4
	SW8080M	Heptachlor		Y	ug/kg-as-rec	3	3
	SW8080M	Aldrin		Y	ug/kg-as-rec	5.2	5.2
	SW8080M	Heptachlor Epoxide		Y	ug/kg-as-rec	4.6	4.6

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.5
	SW8080M	Dieldrin		ND	ug/kg-as-rec	1.2	3.7
	SW8080M	4,4'-DDE	200	j**	ug/kg-as-rec	0.97	3.1
	SW8080M	Endrin		Y	ug/kg-as-rec	5.8	5.8
	SW8080M	Endosulfan II		Y	ug/kg-as-rec	13	13
	SW8080M	4,4'-DDD	23		ug/kg-as-rec	1.2	3.7
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.4	7.6
	SW8080M	4,4'-DDT		ND	ug/kg-as-rec	2.2	7.1
	SW8080M	Methoxychlor		Y	ug/kg-as-rec	33	33
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.2	10
	SW8080M	Endrin Aldehyde		Y	ug/kg-as-rec	18	18
	SW8080M	gamma Chlordane		Y	ug/kg-as-rec	5.6	5.6
	SW8080M	alpha Chlordane	5.8		ug/kg-as-rec	0.62	2
	SW8080M	Toxaphene		ND	ug/kg-as-rec	72	230
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	86	270
	SW8080M	Aroclor 1248		Y	ug/kg-as-rec	320	320
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	100	330
	SW8080M	Aroclor 1260	380		ug/kg-as-rec	84	270
	Surrogate Recpvery						
	SW8080M	Decachlorobiphenyl	45		%		
	SW8080M	Tetrachlorometaxylene	90		%		
	EPA 335.2	Total Cyanide	0.27	U	mg/kg-as-rec		
	ICP	Aluminum	4.8		mg/kg-as-rec		
	GFA	Antimony	0.02	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.02	U	mg/kg-as-rec		
	GFA	Cadmium	0.16		mg/kg-as-rec		
	ICP	Calcium	6310	j	mg/kg-as-rec		
	ICP	Chromium	0.26		mg/kg-as-rec		
	ICP	Cobalt	0.06	U	mg/kg-as-rec		
	ICP	Copper	1.76		mg/kg-as-rec		
	ICP	Iron	43		mg/kg-as-rec		
	GFAA	Lead	0.1		mg/kg-as-rec		
	ICP	Magnesium	316		mg/kg-as-rec		
	ICP	Manganese	3.04	j	mg/kg-as-rec		
	CVAA	Mercury	0.02		mg/kg-as-rec		
	ICP	Molybdenum	0.1	U	mg/kg-as-rec		
	ICP	Nickel	0.2	U	mg/kg-as-rec		
	GFAA	Selenium	0.2	j	mg/kg-as-rec		
	GFAA	Silver	0.005		mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	86.7		mg/kg-as-rec		
SBCEB		Percent Lipids	0.781		%		
	SW8270	Phenol		ND	ug/kg-as-rec	110	340
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	77	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	440
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	75	240
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	50	160
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	100	660
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	75	230
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	190	610

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	64	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	470
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	53	170
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	77	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	49	150
	SW8270	Isophorone		ND	ug/kg-as-rec	64	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	68	660
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	340	1100
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	70	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	87	390
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	66	210
	SW8270	Naphthalene		ND	ug/kg-as-rec	70	220
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	640
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	67	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	120	360
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	67	210
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	50	660
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	84	660
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	50	660
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	66	210
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	38	660
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	80	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	220	690
	SW8270	Acenaphthene		ND	ug/kg-as-rec	60	190
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	180	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	660
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	61	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	84	660
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	44	660
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	69	220
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	43	140
	SW8270	Fluorene		ND	ug/kg-as-rec	59	190
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	820
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	180	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	170	520
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	43	140
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	64	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	65	660
	SW8270	Phenanthrene		ND	ug/kg-as-rec	65	200
	SW8270	Carbazole		ND	ug/kg-as-rec	110	360
	SW8270	Anthracene		ND	ug/kg-as-rec	87	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	390
	SW8270	Fluoranthene		ND	ug/kg-as-rec	67	210
	SW8270	Pyrene		ND	ug/kg-as-rec	57	180
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	44	140
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	660
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	77	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	79	250
	SW8270	Chrysene		ND	ug/kg-as-rec	89	280
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	45	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	85	270
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	150	460

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	78	250
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	53	170
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	63	200
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	39.1		%		
	SW8270	2-Fluorobiphenyl	46.7		%		
	SW8270	d14-p-Terphenyl	53.9		%		
	SW8270	d4-1,2-Dichlorobenzene	25.9		%		
	SW8270	d5-Phenol	38.5		%		
	SW8270	2-Fluorophenol	30.4		%		
	SW8270	2,4,6-Tribromophenol	50.8		%		
	SW8270	d4-2-Chlorophenol	36.1		%		
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	48.5		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	25.3		%		
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.63	2
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.95	3
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.98	3.1
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.77	2.4
	SW8080M	Heptachlor		ND	ug/kg-as-rec	0.88	2.8
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.61	1.9
	SW8080M	Heptachlor Epoxide		ND	ug/kg-as-rec	0.77	2.4
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.6
	SW8080M	Dieldrin		ND	ug/kg-as-rec	1.2	3.8
	SW8080M	4,4'-DDE	9.5		ug/kg-as-rec	0.99	3.1
	SW8080M	Endrin		ND	ug/kg-as-rec	0.98	3.1
	SW8080M	Endosulfan II		ND	ug/kg-as-rec	1.6	5.1
	SW8080M	4,4'-DDD		ND	ug/kg-as-rec	1.2	3.8
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.5	7.8
	SW8080M	4,4'-DDT		ND	ug/kg-as-rec	2.3	7.2
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.5	27

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.2	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.2	7
	SW8080M	gamma Chlordane		ND	ug/kg-as-rec	0.54	1.7
	SW8080M	alpha Chlordane		ND	ug/kg-as-rec	0.63	2
	SW8080M	Toxaphene		ND	ug/kg-as-rec	74	230
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	88	280
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	35	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	110	340
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	86	270
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	44.4		%		
	SW8080M	Tetrachlorometaxylene	64.8		%		
	EPA 335.2	Total Cyanide	0.61	U	mg/kg-as-rec		
	ICP	Aluminum	0.4		mg/kg-as-rec		
	GFA	Antimony	0.02	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.02	U	mg/kg-as-rec		
	GFA	Cadmium	0.004	U	mg/kg-as-rec		
	ICP	Calcium	431	j	mg/kg-as-rec		
	ICP	Chromium	0.19		mg/kg-as-rec		
	ICP	Cobalt	0.06	U	mg/kg-as-rec		
	ICP	Copper	0.19		mg/kg-as-rec		
	ICP	Iron	1.94		mg/kg-as-rec		
	GFAA	Lead	0.02	U	mg/kg-as-rec		
	ICP	Magnesium	289		mg/kg-as-rec		
	ICP	Manganese	0.12	j	mg/kg-as-rec		
	CVAA	Mercury	0.013		mg/kg-as-rec		
	ICP	Molybdenum	0.1	U	mg/kg-as-rec		
	ICP	Nickel	0.2	U	mg/kg-as-rec		
	GFAA	Selenium	0.2	j	mg/kg-as-rec		
	GFAA	Silver	0.004	U	mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	4.92		mg/kg-as-rec		
SBCNB		Percent Lipids	4.94		%		
	SW8270	Phenol		ND	ug/kg-as-rec	100	330
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	75	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	430
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	74	230
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	49	150
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	99	640
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	73	230
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	190	600
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	63	200
	SW8270	4-Methylphenol	800		ug/kg-as-rec	150	460
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	52	160
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	76	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	48	150
	SW8270	Isophorone		ND	ug/kg-as-rec	63	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	66	640
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	330	1000
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	69	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	85	390
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	64	200
	SW8270	Naphthalene		ND	ug/kg-as-rec	68	210
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	620
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	65	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	110	360
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	65	200
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	49	640
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	82	640
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	49	640
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	64	200
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	37	640
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	68	210
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	78	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	210	670
	SW8270	Acenaphthene		ND	ug/kg-as-rec	59	180
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	170	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	640
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	60	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	82	640
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	43	640
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	68	210
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	42	130
	SW8270	Fluorene		ND	ug/kg-as-rec	58	180
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	800
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	170	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	160	510
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	42	130
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	63	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	64	640
	SW8270	Phenanthrene		ND	ug/kg-as-rec	64	200
	SW8270	Carbazole		ND	ug/kg-as-rec	110	350
	SW8270	Anthracene		ND	ug/kg-as-rec	85	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	380
	SW8270	Fluoranthene		ND	ug/kg-as-rec	65	210
	SW8270	Pyrene		ND	ug/kg-as-rec	56	170
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	43	130
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	640
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	75	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	77	240
	SW8270	Chrysene		ND	ug/kg-as-rec	87	270
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	84	260
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	140	450
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	77	240
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	52	160
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	43	130
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	62	190
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	59.8		%		
	SW8270	2-Fluorobiphenyl	71.1		%		
	SW8270	d14-p-Terphenyl	48.2		%		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	d4-1,2-Dichlorobenzene	40.5		%		
	SW8270	d5-Phenol	83.6		%		
	SW8270	2-Fluorophenol	62.1		%		
	SW8270	2,4,6-Tribromophenol	59		%		
	SW8270	d4-2-Chlorophenol	68		%		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	60.3		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	41.3		%		
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.41	1.3
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.62	2
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.64	2
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.5	1.6
	SW8080M	Heptachlor		Y	ug/kg-as-rec	5.9	5.9
	SW8080M	Aldrin		Y	ug/kg-as-rec	1.7	1.7
	SW8080M	Heptachlor Epoxide		Y	ug/kg-as-rec	3	3
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	0.73	2.3
	SW8080M	Dieldrin		ND	ug/kg-as-rec	0.79	2.5
	SW8080M	4,4'-DDE	55	**	ug/kg-as-rec	0.65	2.1
	SW8080M	Endrin		Y	ug/kg-as-rec	4.7	4.7
	SW8080M	Endosulfan II		Y	ug/kg-as-rec	6.2	6.2
	SW8080M	4,4'-DDD	5		ug/kg-as-rec	0.79	2.5
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	1.6	5.1
	SW8080M	4,4'-DDT		Y	ug/kg-as-rec	22	22
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	5.6	18
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	2.1	6.7
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	1.5	4.6
	SW8080M	gamma Chlordane	2.1		ug/kg-as-rec	0.35	1.1
	SW8080M	alpha Chlordane		Y	ug/kg-as-rec	2.4	2.4
	SW8080M	Toxaphene		Y	ug/kg-as-rec	180	180
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	57	180
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	23	73
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	69	220
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	56	180
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	59.1		%		
	SW8080M	Tetrachlorometaxylene	94		%		
	EPA 335.2	Total Cyanide	0.32	U	mg/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	ICP	Aluminum	3.4		mg/kg-as-rec		
	GFA	Antimony	0.1	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.04	U	mg/kg-as-rec		
	GFA	Cadmium	0.004	U	mg/kg-as-rec		
	ICP	Calcium	12700	j	mg/kg-as-rec		
	ICP	Chromium	0.3		mg/kg-as-rec		
	ICP	Cobalt	0.1	U	mg/kg-as-rec		
	ICP	Copper	0.32		mg/kg-as-rec		
	ICP	Iron	13.8		mg/kg-as-rec		
	GFAA	Lead	0.02		mg/kg-as-rec		
	ICP	Magnesium	399		mg/kg-as-rec		
	ICP	Manganese	1.35	j	mg/kg-as-rec		
	CVAA	Mercury	0.009	U	mg/kg-as-rec		
	ICP	Molybdenum	0.2	U	mg/kg-as-rec		
	ICP	Nickel	0.4	U	mg/kg-as-rec		
	GFAA	Selenium	0.2	j	mg/kg-as-rec		
	GFAA	Silver	0.004	U	mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	14.8		mg/kg-as-rec		
SBCET		Percent Lipids	0.859		%		
	SW8270	Phenol		ND	ug/kg-as-rec	110	330
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	76	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	440
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	75	230
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	49	160
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	100	650
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	74	230
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	190	600
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	64	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	470
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	52	160
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	77	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	48	150
	SW8270	Isophorone		ND	ug/kg-as-rec	64	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	67	650
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	330	1000
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	70	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	87	390
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	65	200
	SW8270	Naphthalene		ND	ug/kg-as-rec	69	220
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	630
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	66	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	110	360
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	66	210
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	50	650
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	83	650
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	49	650
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	65	200
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	37	650
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	69	220
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	79	250

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	220	680
	SW8270	Acenaphthene		ND	ug/kg-as-rec	60	190
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	170	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	650
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	61	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	83	650
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	44	650
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	69	220
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	43	130
	SW8270	Fluorene		ND	ug/kg-as-rec	59	190
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	820
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	170	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	170	520
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	43	130
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	64	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	64	650
	SW8270	Phenanthrene		ND	ug/kg-as-rec	64	200
	SW8270	Carbazole		ND	ug/kg-as-rec	110	350
	SW8270	Anthracene		ND	ug/kg-as-rec	86	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	380
	SW8270	Fluoranthene		ND	ug/kg-as-rec	66	210
	SW8270	Pyrene		ND	ug/kg-as-rec	56	180
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	43	140
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	650
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	76	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	79	250
	SW8270	Chrysene		ND	ug/kg-as-rec	88	280
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	45	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	85	270
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	150	460
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	78	240
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	53	160
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	43	140
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	62	200
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	35.5		%		
	SW8270	2-Fluorobiphenyl	53.8		%		
	SW8270	d14-p-Terphenyl	42.8		%		
	SW8270	d4-1,2-Dichlorobenzene	32.1		%		
	SW8270	d5-Phenol	45.5		%		
	SW8270	2-Fluorophenol	35.6		%		
	SW8270	2,4,6-Tribromophenol	41.4		%		
	SW8270	d4-2-Chlorophenol	38.5		%		
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	37.4		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	34.9		%		
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.63	2
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.94	3
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.97	3.1
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.77	2.4
	SW8080M	Heptachlor		ND	ug/kg-as-rec	0.88	2.8
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.61	1.9
	SW8080M	Heptachlor Epoxide		ND	ug/kg-as-rec	0.77	2.4
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.5
	SW8080M	Dieldrin		ND	ug/kg-as-rec	1.2	3.8
	SW8080M	4,4'-DDE	10		ug/kg-as-rec	0.99	3.1
	SW8080M	Endrin		ND	ug/kg-as-rec	0.98	3.1
	SW8080M	Endosulfan II		ND	ug/kg-as-rec	1.6	5.1
	SW8080M	4,4'-DDD		ND	ug/kg-as-rec	1.2	3.8
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.4	7.7
	SW8080M	4,4'-DDT		ND	ug/kg-as-rec	2.3	7.2
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.5	27
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.2	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.2	7
	SW8080M	gamma Chlordane		ND	ug/kg-as-rec	0.53	1.7
	SW8080M	alpha Chlordane		ND	ug/kg-as-rec	0.63	2
	SW8080M	Toxaphene		ND	ug/kg-as-rec	73	230
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	87	280
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	35	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	110	330
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	85	270
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	47.9		%		
	SW8080M	Tetrachlorometaxylene	73.5		%		
	EPA 335.2	Total Cyanide	0.31	U	mg/kg-as-rec		
	ICP	Aluminum	0.4		mg/kg-as-rec		
	GFA	Antimony	0.02	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.02	U	mg/kg-as-rec		
	GFA	Cadmium	0.004	U	mg/kg-as-rec		
	ICP	Calcium	1860	j	mg/kg-as-rec		
	ICP	Chromium	0.14		mg/kg-as-rec		
	ICP	Cobalt	0.06	U	mg/kg-as-rec		
	ICP	Copper	0.13		mg/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	ICP	Iron	1.63		mg/kg-as-rec		
	GFAA	Lead	0.02	U	mg/kg-as-rec		
	ICP	Magnesium	305		mg/kg-as-rec		
	ICP	Manganese	0.7	j	mg/kg-as-rec		
	CVAA	Mercury	0.03		mg/kg-as-rec		
	ICP	Molybdenum	0.1	U	mg/kg-as-rec		
	ICP	Nickel	0.2	U	mg/kg-as-rec		
	GFAA	Selenium	0.1	j	mg/kg-as-rec		
	GFAA	Silver	0.004	U	mg/kg-as-rec		
	GFAA	Thallium	0.1	U	mg/kg-as-rec		
	ICP	Zinc	5.4		mg/kg-as-rec		
SBCNT		Percent Lipids	4.33		%		
	SW8270	Phenol		ND	ug/kg-as-rec	110	340
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	77	240
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	140	440
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	76	240
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	50	160
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	100	660
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	75	240
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	190	610
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	65	200
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	150	480
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	53	170
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	78	260
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	49	150
	SW8270	Isophorone		ND	ug/kg-as-rec	65	200
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	68	660
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	340	1100
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	110	1300
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	71	220
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	88	400
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	66	210
	SW8270	Naphthalene		ND	ug/kg-as-rec	70	220
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	200	640
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	67	260
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	120	370
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	67	210
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	50	660
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	84	660
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	50	660
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	66	210
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	38	660
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	70	220
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	80	250
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	220	690
	SW8270	Acenaphthene		ND	ug/kg-as-rec	60	190
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	180	1300
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	130	660
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	62	190
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	84	660
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	44	660
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	69	220
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	43	140

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	Fluorene		ND	ug/kg-as-rec	60	190
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	260	830
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	180	1300
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	170	530
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	44	140
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	65	200
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	65	660
	SW8270	Phenanthrene		ND	ug/kg-as-rec	65	210
	SW8270	Carbazole		ND	ug/kg-as-rec	110	360
	SW8270	Anthracene		ND	ug/kg-as-rec	87	270
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	120	390
	SW8270	Fluoranthene		ND	ug/kg-as-rec	67	210
	SW8270	Pyrene		ND	ug/kg-as-rec	57	180
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	44	140
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	110	660
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	77	240
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	80	250
	SW8270	Chrysene		ND	ug/kg-as-rec	89	280
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	46	140
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	86	270
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	150	470
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	79	250
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	53	170
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	44	140
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	63	200
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	65.3		%		
	SW8270	2-Fluorobiphenyl	74.8		%		
	SW8270	d14-p-Terphenyl	54.1		%		
	SW8270	d4-1,2-Dichlorobenzene	54.1		%		
	SW8270	d5-Phenol	75.4		%		
	SW8270	2-Fluorophenol	67.6		%		
	SW8270	2,4,6-Tribromophenol	50.7		%		
	SW8270	d4-2-Chlorophenol	68.5		%		
	SW8270-SIM	Naphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	13	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	26		ug/kg-as-rec		
	SW8270-SIM	Anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	13	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	13	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	13	U	ug/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	58.1		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	41		%		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.63	2
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.96	3
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.98	3.1
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.78	2.5
	SW8080M	Heptachlor		Y	ug/kg-as-rec	4.1	4.1
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.62	2
	SW8080M	Heptachlor Epoxide		Y	ug/kg-as-rec	3	3
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.6
	SW8080M	Dieldrin		ND	ug/kg-as-rec	1.2	3.8
	SW8080M	4,4'-DDE	85	**	ug/kg-as-rec	1	3.2
	SW8080M	Endrin		ND	ug/kg-as-rec	0.99	3.1
	SW8080M	Endosulfan II		ND	ug/kg-as-rec	1.6	5.1
	SW8080M	4,4'-DDD	3.9		ug/kg-as-rec	1.2	3.8
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.5	7.8
	SW8080M	4,4'-DDT		Y	ug/kg-as-rec	25	25
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.6	27
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.3	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.2	7.1
	SW8080M	gamma Chlordane	2.2		ug/kg-as-rec	0.54	1.7
	SW8080M	alpha Chlordane		ND	ug/kg-as-rec	0.63	2
	SW8080M	Toxaphene		ND	ug/kg-as-rec	74	230
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	88	280
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	35	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	110	340
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	87	270
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	44.8		%		
	SW8080M	Tetrachlorometaxylene	85.7		%		
	EPA 335.2	Total Cyanide	0.51	U	mg/kg-as-rec		
	ICP	Aluminum	5.5		mg/kg-as-rec		
	GFA	Antimony	0.1	U	mg/kg-as-rec		
	GFA	Arsenic	0.1	U	mg/kg-as-rec		
	ICP	Beryllium	0.04	U	mg/kg-as-rec		
	GFA	Cadmium	0.004		mg/kg-as-rec		
	ICP	Calcium	19300	j	mg/kg-as-rec		
	ICP	Chromium	0.4		mg/kg-as-rec		
	ICP	Cobalt	0.1	U	mg/kg-as-rec		
	ICP	Copper	0.24		mg/kg-as-rec		
	ICP	Iron	12.7		mg/kg-as-rec		
	GFAA	Lead	0.03		mg/kg-as-rec		
	ICP	Magnesium	440		mg/kg-as-rec		
	ICP	Manganese	5.98	j	mg/kg-as-rec		
	CVAA	Mercury	0.009	U	mg/kg-as-rec		
	ICP	Molybdenum	0.2	U	mg/kg-as-rec		
	ICP	Nickel	0.4	U	mg/kg-as-rec		
	GFAA	Selenium	0.3	j	mg/kg-as-rec		
	GFAA	Silver	0.004	U	mg/kg-as-rec		
	GFAA	Thallium	0.04	U	mg/kg-as-rec		
	ICP	Zinc	18.5		mg/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
Method Blank	SW8270	Phenol		ND	ug/kg-as-rec	54	170
	SW8270	Bis-(2-Chloroethyl) Ether		ND	ug/kg-as-rec	39	120
	SW8270	2-Chlorophenol		ND	ug/kg-as-rec	71	220
	SW8270	1,3-Dichlorobenzene		ND	ug/kg-as-rec	38	120
	SW8270	1,4-Dichlorobenzene		ND	ug/kg-as-rec	25	79
	SW8270	Benzyl Alcohol		ND	ug/kg-as-rec	52	330
	SW8270	1,2-Dichlorobenzene		ND	ug/kg-as-rec	38	120
	SW8270	2-Methylphenol		ND	ug/kg-as-rec	99	310
	SW8270	2,2'-Oxybis(1-Chloropropane)		ND	ug/kg-as-rec	33	100
	SW8270	4-Methylphenol		ND	ug/kg-as-rec	77	240
	SW8270	N-Nitroso-Di-N-Propylamine		ND	ug/kg-as-rec	27	84
	SW8270	Hexachloroethane		ND	ug/kg-as-rec	39	130
	SW8270	Nitrobenzene		ND	ug/kg-as-rec	25	78
	SW8270	Isophorone		ND	ug/kg-as-rec	33	100
	SW8270	2-Nitrophenol		ND	ug/kg-as-rec	34	330
	SW8270	2,4-Dimethylphenol		ND	ug/kg-as-rec	170	540
	SW8270	Benzoic Acid		ND	ug/kg-as-rec	57	670
	SW8270	bis(2-Chloroethoxy) Methane		ND	ug/kg-as-rec	36	110
	SW8270	2,4-Dichlorophenol		ND	ug/kg-as-rec	44	200
	SW8270	1,2,4-Trichlorobenzene		ND	ug/kg-as-rec	33	100
	SW8270	Naphthalene		ND	ug/kg-as-rec	35	110
	SW8270	4-Chloroaniline		ND	ug/kg-as-rec	100	320
	SW8270	Hexachlorobutadiene		ND	ug/kg-as-rec	34	130
	SW8270	4-Chloro-3-methylphenol		ND	ug/kg-as-rec	59	180
	SW8270	2-Methylnaphthalene		ND	ug/kg-as-rec	34	110
	SW8270	Hexachlorocyclopentadiene		ND	ug/kg-as-rec	25	330
	SW8270	2,4,6-Trichlorophenol		ND	ug/kg-as-rec	43	330
	SW8270	2,4,5-Trichlorophenol		ND	ug/kg-as-rec	25	330
	SW8270	2-Chloronaphthalene		ND	ug/kg-as-rec	33	100
	SW8270	2-Nitroaniline		ND	ug/kg-as-rec	19	330
	SW8270	Dimethylphthalate		ND	ug/kg-as-rec	36	110
	SW8270	Acenaphthylene		ND	ug/kg-as-rec	41	130
	SW8270	3-Nitroaniline		ND	ug/kg-as-rec	110	350
	SW8270	Acenaphthene		ND	ug/kg-as-rec	30	96
	SW8270	2,4-Dinitrophenol		ND	ug/kg-as-rec	90	670
	SW8270	4-Nitrophenol		ND	ug/kg-as-rec	66	330
	SW8270	Dibenzofuran		ND	ug/kg-as-rec	31	98
	SW8270	2,6-Dinitrotoluene		ND	ug/kg-as-rec	43	330
	SW8270	2,4-Dinitrotoluene		ND	ug/kg-as-rec	22	330
	SW8270	Diethylphthalate		ND	ug/kg-as-rec	35	110
	SW8270	4-Chlorophenyl-phenylether		ND	ug/kg-as-rec	22	69
	SW8270	Fluorene		ND	ug/kg-as-rec	30	95
	SW8270	4-Nitroaniline		ND	ug/kg-as-rec	130	420
	SW8270	4,6-Dinitro-2-Methylphenol		ND	ug/kg-as-rec	89	670
	SW8270	N-Nitrosodiphenylamine		ND	ug/kg-as-rec	85	270
	SW8270	4-Bromophenyl-phenylether		ND	ug/kg-as-rec	22	69
	SW8270	Hexachlorobenzene		ND	ug/kg-as-rec	33	100
	SW8270	Pentachlorophenol		ND	ug/kg-as-rec	33	330
	SW8270	Phenanthrene		ND	ug/kg-as-rec	33	100
	SW8270	Carbazole		ND	ug/kg-as-rec	58	180
	SW8270	Anthracene		ND	ug/kg-as-rec	44	140
	SW8270	Di-n-Butylphthalate		ND	ug/kg-as-rec	63	200
	SW8270	Fluoranthene		ND	ug/kg-as-rec	34	110
	SW8270	Pyrene		ND	ug/kg-as-rec	29	90

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270	Butylbenzylphthalate		ND	ug/kg-as-rec	22	70
	SW8270	3,3'-Dichlorobenzidine		ND	ug/kg-as-rec	58	330
	SW8270	Benzo(a)anthracene		ND	ug/kg-as-rec	39	120
	SW8270	bis(2-Ethylhexyl)phthalate		ND	ug/kg-as-rec	40	130
	SW8270	Chrysene		ND	ug/kg-as-rec	45	140
	SW8270	Di-n-Octyl phthalate		ND	ug/kg-as-rec	23	72
	SW8270	Benzo(b)fluoranthene		ND	ug/kg-as-rec	43	140
	SW8270	Benzo(k)fluoranthene		ND	ug/kg-as-rec	75	240
	SW8270	Benzo(a)pyrene		ND	ug/kg-as-rec	40	120
	SW8270	Indeno(1,2,3-cd)pyrene		ND	ug/kg-as-rec	27	84
	SW8270	Dibenz(a,h)anthracene		ND	ug/kg-as-rec	22	69
	SW8270	Benzo(g,h,i)perylene		ND	ug/kg-as-rec	32	100
	Surrogate Recovery						
	SW8270	d5-Nitrobenzene	42.4		%		
	SW8270	2-Fluorobiphenyl	51.7		%		
	SW8270	d14-p-Terphenyl	71.4		%		
	SW8270	d4-1,2-Dichlorobenzene	55.8		%		
	SW8270	d5-Phenol	71.7		%		
	SW8270	2-Fluorophenol	49.8		%		
	SW8270	2,4,6-Tribromophenol	52.7		%		
	SW8270	d4-2-Chlorophenol	66.3		%		
	ICP	Total Solids for Metals	0		%		
	ICP	Aluminum	0.4	U	mg/kg-wet		
	GFA	Antimony	0.02	U	mg/kg-wet		
	GFA	Arsenic	0.02	U	mg/kg-wet		
	ICP	Beryllium	0.02	U	mg/kg-wet		
	GFA	Cadmium	0.004	U	mg/kg-wet		
	ICP	Calcium	0.2	U	mg/kg-wet		
	ICP	Chromium	0.1	U	mg/kg-wet		
	ICP	Cobalt	0.06	U	mg/kg-wet		
	ICP	Copper	0.04	U	mg/kg-wet		
	ICP	Iron	0.1	U	mg/kg-wet		
	GFA	Lead	0.02	U	mg/kg-wet		
	ICP	Magnesium	0.4	U	mg/kg-wet		
	ICP	Manganese	0.02	U	mg/kg-wet		
	CVA	Mercury	0.01	U	mg/kg-wet		
	ICP	Molybdenum	0.1	U	mg/kg-wet		
	ICP	Nickel	0.2	U	mg/kg-wet		
	GFA	Selenium	0.02	U	mg/kg-wet		
	GFA	Silver	0.004	U	mg/kg-wet		
	GFA	Thallium	0.02	U	mg/kg-wet		
	ICP	Zinc	0.08	U	mg/kg-wet		
	SW8270-SIM	Naphthalene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	2-Methylnaphthalene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthylene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Acenaphthene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Fluorene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Phenanthrene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Anthracene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Fluoranthene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Pyrene	6.7	U	ug/kg-as-rec		

Table A 1994 tissue data for Smith and Bybee Lakes and the North Slough.

Sample ID	Method	Compound	Value	Qualifier *	Units	DL	PQL
	SW8270-SIM	Benzo(a)anthracene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Chrysene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(b)fluoranthene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(k)fluoranthene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(a)pyrene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Indeno(1,2,3-cd)pyrene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzo(a,h)anthracene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Benzo(g,h,i)perylene	6.7	U	ug/kg-as-rec		
	SW8270-SIM	Dibenzofuran	6.7	U	ug/kg-as-rec		
	Surrogate Recovery						
	SW8270-SIM	d10-2-Methylnaphthalene	35.8		%		
	SW8270-SIM	d14-Dibenzo(a,h)anthracene	42.4		%		
	SW8080M	alpha-BHC		ND	ug/kg-as-rec	0.64	2
	SW8080M	beta-BHC		ND	ug/kg-as-rec	0.97	3.1
	SW8080M	delta-BHC		ND	ug/kg-as-rec	0.99	3.1
	SW8080M	gamma-BHC (Lindane)		ND	ug/kg-as-rec	0.78	2.5
	SW8080M	Heptachlor		ND	ug/kg-as-rec	0.9	2.8
	SW8080M	Aldrin		ND	ug/kg-as-rec	0.62	2
	SW8080M	Heptachlor Epoxide		ND	ug/kg-as-rec	0.78	2.5
	SW8080M	Endosulfan I		ND	ug/kg-as-rec	1.1	3.6
	SW8080M	Dieldrin		ND	ug/kg-as-rec	1.2	3.9
	SW8080M	4,4'-DDE		ND	ug/kg-as-rec	1	3.2
	SW8080M	Endrin		ND	ug/kg-as-rec	1	3.2
	SW8080M	Endosulfan II		ND	ug/kg-as-rec	1.6	5.2
	SW8080M	4,4'-DDD		ND	ug/kg-as-rec	1.2	3.9
	SW8080M	Endosulfan Sulfate		ND	ug/kg-as-rec	2.5	7.9
	SW8080M	4,4'-DDT		ND	ug/kg-as-rec	2.3	7.4
	SW8080M	Methoxychlor		ND	ug/kg-as-rec	8.7	27
	SW8080M	Endrin Ketone		ND	ug/kg-as-rec	3.3	10
	SW8080M	Endrin Aldehyde		ND	ug/kg-as-rec	2.3	7.2
	SW8080M	gamma Chlordane		ND	ug/kg-as-rec	0.54	1.7
	SW8080M	alpha Chlordane		ND	ug/kg-as-rec	0.64	2
	SW8080M	Toxaphene		ND	ug/kg-as-rec	75	240
	SW8080M	Aroclor 1016/1242		ND	ug/kg-as-rec	89	280
	SW8080M	Aroclor 1248		ND	ug/kg-as-rec	36	110
	SW8080M	Aroclor 1254		ND	ug/kg-as-rec	110	340
	SW8080M	Aroclor 1260		ND	ug/kg-as-rec	87	280
	Surrogate Recovery						
	SW8080M	Decachlorobiphenyl	76.7		%		
	SW8080M	Tetrachlorometaxylene	69.2		%		
	EPA 335.2	Total Cyanide	0.004	U	mg/L		

* = Qualifiers applied by Parametrix in lower case.
** = Diluted 1:10 because analyte concentration exceeded linear range of instrument detector (E qualified by lab).
DL = Detection Limit
PQL = Practical Quantitation Limit