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U.S. Fish and Wildlife Service
Region 3
Contaminants Program
Project ID #89-3-051

Preliminary Preassessment Screen For Waukegan Harbor-Outboard Marine Inc.

RPT # 141

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SUMMARY OF DETERMINATION

In accordance with 43 CFR Part 11 of the Code of Federal Regulations, as published in the August 1, 1986 Federal Register, a determination has been made as a part of the preassessment screening process that criteria listed as 1 through 5 under Section 11.23(e) have been or could be satisfactorily met.

1. A release of PCBs occurred prior to and continuous through the implementation of CERCLA.

2. Natural resources under the trusteeship of the U.S. Fish and Wildlife Service and other state and federal agencies are likely to have been adversely affected.

3. The quantity of PCBs is sufficient to have caused and continue to cause injury to natural resources.

4. Data sufficient to pursue a damage assessment currently exists and, with a minor investment, the answers to key questions about PCB toxicity can be answered.

5. Currently, it is unclear whether the proposed cleanup is sufficient to eliminate any further damages to natural resources. Data from experiments conducted to determine the effects of PCBs on fish egg and fry survival will aid in determining if the proposed cleanup plan is sufficient to eliminate natural resource injury.

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INTRODUCTION

The U. S. Fish and Wildlife Service (USF&WS) intends to ascertain whether or not a natural resources damage assessment is warranted due to the extended release of polychlorinated biphenyls (PCB) into Lake Michigan by the Outboard Marine Corporation (OMC) of Waukegan, Illinois. This report, a preassessment screen, shall provide a rapid review of all readily available information concerning OMC's discharge of PCBs and the potential impact on natural resources. The review will assist natural resource trustees, the USF&WS and state agencies, to determine if the concentration and quantity of PCBs released was sufficient to cause injury to these natural resources.

This report consists of a brief history of the site and the release of PCBs by OMC, a discussion of the quantities released and concentrations of PCBs available in the environment and a preliminary identification of the resources potentially at risk. The preassessment screen is organized according to the Natural Resource Damage Assessment, Final Rule under the authority of CERCLA, 43 CFR 11.23, August 1986.

DAMAGES EXCLUDED FROM LIABILITY

This preassessment screen finds that all criteria, as outlined in the Natural Resource Damage Assessment, have been satisfactorily met based on information currently available. These damages have resulted prior to and continuously through the enactment of CERCLA. The resulting damages are not excluded as a consequence of a licensed or permitted operation which obligated the irreversible and irretrievable allocation of natural resources. Additional damages caused by residual contamination resulting from cleanup operations are excluded from liability as stated in the Consent Decree of 1988.

The injury and loss of use of the natural resources can not be adequately addressed by cleanup efforts alone. Further action is deemed necessary by the natural resource trustees to remedy injury.

SITE HISTORY AND HAZARDOUS SUBSTANCE RELEASE

The Outboard Marine Corporation is a manufacturer of recreational marine products located on the west shore of Lake Michigan in Waukegan, Illinois. The OMC site is 37 miles north of Chicago and 10 miles south of the Wisconsin border on the west shore of Lake Michigan. Waukegan Harbor covers approximately 37 acres.

A total of 8.5 million pounds of PCBs were purchased by OMC from the Monsanto Company between the early 1950's and 1971. In 1975 high levels of PCBs were discovered in Waukegan Harbor and on the adjacent OMC site. The major source of contamination originated from the discharge of PCB-contaminated process cooling water and floor drain water from the OMC plant. Leaky hydraulic systems of the die-casting machinery allowed a continuous escape of 10-15% (OMC estimate) of all purchased PCBs from the site to Waukegan Harbor and the North Ditch. EPA figures indicate that the estimated discharge may be closer to 20% of the total purchased PCBs. The reportable quantity for PCBs, that quantity whose release requires notification under CERCLA, is ten pounds.

The production of PCBs ceased in 1977 under a U.S. ban but the compounds are still present and largely uncontrolled in the environment. The OMC site is considered the largest uncontrolled potential source of PCBs to Lake Michigan (ROD, 1984). Current estimates of PCBs released from the Harbor/Ditch system to Lake Michigan are 22-44 lbs/yr. Approximately 12-40 lbs of PCBs are volatilized from the harbor to the local airshed annually. The North Ditch provides roughly half (15 lb/yr) of this total. There is no available information giving evidence that other activities occurred at or near the OMC site which would have contributed to substantial additional PCB contamination. EPA is, however, currently investigating additional on-site contamination which may constitute a new release or presence of previously unknown contaminants.

The city and Port Authority of Waukegan have extensive development plans for the harbor. There are fifteen businesses located in the immediate harbor area and an additional ten which depend on the Waukegan Harbor water supply (ROD, 1984). The presence of high levels of PCBs has prevented the dredging of Waukegan Harbor since 1969 (ROD, 1984).

EPA first filed suit against OMC and Monsanto Company in 1976. After years of investigation and negotiation Region V has recommended that Superfund be accessed for cleanup.

PRELIMINARY ASSESSMENT CRITERIA

More than 1 million pounds of PCBs are retained on the OMC site. There are three major sources of contamination: 1) Waukegan Harbor, which includes the Upper Harbor and Slip #3, 2) the North Ditch and 3) the parking lot of OMC. Slip #3 is estimated to contain roughly 98% of the total PCBs discharged from OMC. These sites contribute to the release of PCBs via surface water runoff, ground water, volatilization from sediment, terrestrial land and water, flushing of water from the Harbor and intervention in the biological food chain. Ultimately, Lake Michigan serves as the final repository for PCB-contaminated water, sediment and particulate bound PCBs.

Open water levels of PCBs in Lake Michigan range between 5-10 ppt (parts per trillion). Near shore areas show much higher levels at roughly 50 ppt. These concentrations exceed the EPA Ambient Water Quality Criteria of 14 ppt. At the mouth of Waukegan Harbor, mean PCB levels are 70 ppt and the Harbor area across from Slip #3 and the North Ditch show levels of 0.6 and 7.0 ppb (parts per billion), respectively (ROD, 1984). The groundwater is within 3 feet of the parking lot. Presently groundwater concentrations show maximum levels of 35,000 μg/L. This contaminated groundwater is moving slowly toward Lake Michigan and will become a problem to the Lake in 30-60 years unless remediated (ROD, 1984).

Table 1 gives the quantities of PCBs at the OMC site and Table 2 shows the annual release rates of PCBs from the OMC site.

TABLE 1: PCB Quantities at OMC site

Site	Mean PCB Concentrations (ppm)	PCBs (lbs)	PCB Contaminated Sediment (yd^3)
Slip #3	up to 520,000 mean > 500	300,000	10,000
Upper Harbor	up to 500 range 50-500	5,000	35,700
North Ditch	35,000ppm	495,000	70,800
Parking Lot	5,000ppm	277,700	105,800

Note: Surficial sediments in Waukegan Harbor show a wide range of concentrations (between 8-3,600 ppm). These figures are considerably higher than levels in the water column.

TABLE 2: Annual release rates of PCBs

Site	Surface Water and Sediment (lbs)	Groundwater (lbs)	Air (lbs)
Harbor	22	N.A.	12-40
North Ditch	7-20 (model)	N.A.	15
Parking Lot	N.A.	Future release	N.A.

Note: These rates do not include materials that may have been added to the sediment due to disturbances from severe winter storms, navigation and recreational boating. This potential turbulence would also increase the amount of PCBs in the water column and ultimately the amount volitilized to the air.

PRELIMINARY IDENTIFICATION OF RESOURCE POTENTIALLY AT RISK

SITE CHARACTERISTICS

Waukegan Harbor covers approximately 37 acres on the western shore of Lake Michigan. The OMC site is located on the Harbor and includes the North Ditch, a small tributary of Lake Michigan which drains surface run-off from 0.11 square miles of the OMC site and the property of the North Shore Sanitary District. Water depth in the Harbor ranges from 14 to 25 feet. The sediment is composed of three layers. The first layer is 1 to 7 feet of soft organic muck followed by 4 feet of fine to coarse sand and an underlying stiff silt or glacial till layer of 50 to 100 feet. The Harbor experiences much turbulence and mixing of water and sediment due to severe winter storms, navigational disturbances and recreational activities. Lake Michigan is the ultimate repository for flow and contaminated sediment from OMC and Waukegan Harbor.

PHYSICAL AND CHEMICAL CHARACTERISTICS OF HAZARDOUS SUBSTANCE

Polychlorinated biphenyls belong to the family of chlorinated hydrocarbons. Approximately 635,000 tons of PCBs were produced in North America and were widely used by industry (Mac, 1989). PCBs exhibit thermal stability, non-flammability and low solubility making them desirable materials for industry. PCBs are designated as hazardous substances in Table 302.4 under section 102(a) of CERCLA and sections 311(b) (4) and 307(a) of the Clean Water Act.

PCBs represent a complex mixture of 209 individual isomers or congeners (NFC, 1987). Mixtures of these congeners were sold commercially as Aroclors. Aroclors were described by their percent of chlorine by weight. Aroclor 1242, for example, is 42% chlorine by weight. OMC primarily used a 2:1 mixture of Aroclors 1242 and 1248, respectively, known as Pydraul A-200 (Swackhamer and Armstrong, 1988). These congeners, in spite of their similar basic structures, show vastly differing degrees of toxicity, environmental responses and physiochemical properties (Henry et al., 1987). Only 12% of the 209 isomers are toxic although these select few rank among the most bioavailable and environmentally persistent contaminants (Swackhamer and Armstrong, 1987).

Congener compounds also differ in their physiochemical properties, environmental behavior and their tendency to accumulate in aquatic organisms (Field and Dexter, 1988). The more highly chlorinated congeners exhibit lower solubilities in water, lower vapor pressure and are not metabolized as completely as the lower chlorinated compounds (Field and Dexter, 1988). These characteristics plus a general low rate of degradation cause PCBs to be highly persistent in sediment. This persistence is heightened in the tissues of aquatic organisms exposed to the more highly chlorinated congeners (Field and Dexter, 1988). Bacterial degradation of PCBs increases with the lower chlorinated congeners (Field and Dexter, 1988). The chlorine substitution pattern and the degree of chlorination is related to PCB mobility in sediment (Field and Dexter, 1988). Mobility has been shown to increase with a decreasing degree of chlorination. In conjunction with higher water solubility this results in greater dispersion of PCBs from a point source for the lower chlorinated compounds than for the more highly chlorinated congeners (Field and Dexter, 1988).

PCBs are typically found in higher concentrations in the sediment than in the water column (Field and Dexter, 1988). This is due to their hydrophylic nature, affinity for organic compounds and general low solubility characteristics (Field and Dexter, 1988). Many factors including particle size and total organic content of the sediment, body size, lipid content and reproductive state of the organism and the characteristics of the specific PCB congener affect the availability and accumulation of PCBs by aquatic organisms (Field and Dexter, 1988). PCBs are known to adsorb to organic compounds and therefore tend to concentrate in two sections of the water column: the surficial bottom sediment is the primary area of concentration of PCBs due to the settling of organic particles (ROD, 1984). Additionally the air/water interface shows higher levels of organics by drawing particles from plankton and foam which are then held in an organic rich surface film (ROD, 1984).

PCB contamination results from the discharge and disposal of manufactured materials containing PCBs (Ross et al., 1988). There is no empirical proof that PCBs are produced or transformed from other compounds in the environment. Impurities, however, have been noted in many commercial Aroclor mixtures (EPA, 1980). Some of these impurities are polychlorinated dibenzofurans (PCDFs) which are highly toxic. A study in 1986 showed the transformation of PCBs into PCDFs as a result of heat used in industrial processes (Eisler, 1986). PCBs may also be converted into PCDFs in the environment through photochemical processes or metallic salt formation (Field and Dexter, 1988). The highly toxic dioxin and furan compounds are structurally related to and often associated with PCB

contamination. These compounds may be found in commercial PCB mixtures as impurities and/or by-products of the manufacturing process. Also, commercial PCB mixtures used under intensive heat may convert some forms of PCBs into related dioxin or furans.

TOXICOLOGICAL EFFECTS

PCBs constitute a hazardous substance whose acute and chronic effects are well documented. Due to bioaccumulation, availability, and their highly lipophylic nature, PCB concentrations in the tissues of aquatic organisms may be greater than or equal to levels found in the water or sediment (Field, 1988). Fish are capable of bioaccumulating PCBs to levels 100,000 - 1,000,000 times of those found in ambient waters (ROD, 1984). The highly lipophylic nature of PCBs results in the accumulation of PCBs in the fatty tissue of fish from ingested insects, fish and plants as well as from direct water exposure (ROD, 1984). Top predator fish as well as fish-eating birds and mammals show reduced reproductive success resulting from the bioaccumulation of toxic PCBs (Terns and colonial nesting birds - Kubiak et al. 1989, Gilbertson 1989, Hoffman et al. 1987, Rathke 1989; mink - Aulerich and Ringer 1977, Heaton 1989; lake trout - Mac and Seelye 1981). Reduced reproductive success is largely due to reduced hatching rates or swim up fry mortality in lake trout (Mac, 1989). A positive correlation exists between the concentration of PCBs available in the water column and fish size, percent fat and age (ROD, 1984). Salmon and trout tend to bioaccumulate very high levels of PCBs. Due to continual exposure to contaminated sediment, bottom dwelling fish exhibit even higher bioaccumulation levels.

The quality of bottom sediment is of particular concern because of its role as a food source for bottom feeding fish and as the major depository for developing fish eggs and larvae (ROD, 1984). Most Great Lakes fish deposit their eggs on the lake bottom where toxic contaminants have accumulated. The hatchability of Lake Michigan lake trout eggs is lower than either Lake Superior or Lake Huron (Mac, 1989). Hatching rates in trout eggs correlate positively with the concentration of 3, 3', 4, 4' tetrachlorobiphenyl, a likely component of Aroclor 1248 (Mac, 1989). Contaminants degrade spawning areas and inhibit, if not preclude, recovery of former spawning habitat (NFC, 1987).

Contaminated sediment impacts the benthic invertebrate community which is a fundamental and crucial link in the food chain. High PCB levels pose a special danger to juvenile fish.

Willford (1980) noted a direct correlation between fry mortality in Lake Michigan lake trout and increased PCB and DDE levels in the water column. Lakes Michigan and Ontario, which have the highest levels of PCB contamination, also have high levels of swim up fry mortality syndrome in lake trout. These lakes show the poorest success in natural reproduction of stocked fish particularly in the southern portion of Lake Michigan (Mac, 1989). Unusually high fry mortality was noted in Lake Michigan between 1978-1985. These levels did not occur in Lakes Superior or Huron during the same time period (NFC, 1987). This mortality affected fry at the same developmental stage each year and behavioral signs preceding mortality remained constant (NFC, 1987). No evidence of disease was detected and histological examination showed liver pathology consistent with PCB exposure (NFC, 1987).

GENERAL SYNOPSIS OF ADDITIONAL EFFECTS DUE TO PCBs:

- causes carcinogenic effects in rodents (liver cancers)
- suppresses immune system activity
- tremendous bioaccumulation of PCBs in food chain fish often containing several thousand times the concentration of PCBs found in ambient waters
- impaired reproductive potential of commercial mink
- high PCB levels found in birds, especially gulls and carnivorous birds
- teratogenetic effects -
  death to developing organism
  structural abnormalities
  growth retardation
  development of functional deficiencies
- reduced hatching success and congenital malformations in several Gr. Lake bird species
- reduced reproductive success in eagles nesting on shoreline is lower than inland species
- causes reproductive dysfunction in piscivorous birds

(ROD, NFC 1987)

EXPOSED AREAS

Possible receptors of PCB contamination include the biological community of Waukegan Harbor, the North Ditch and Lake Michigan. Modeling studies have attempted to show the impact of the OMC site on Lake Michigan. A nearshore area of a 10 km radius was selected to model the localized impact outside Waukegan Harbor excluding influences from other industries and metropolitan areas. The model conservatively estimates 22-44 lb/yr of PCBs added to Lake Michigan from the North Ditch and Waukegan Harbor and a uniformly distributed dry deposition load of 550-1100 lb/yr. of PCB to the entire lake. The 22-44 pounds, therefore, could represent 49% - 80% of the total PCB load to this nearshore area (Kontaxis, 1981).

PCBs tend to adsorb to suspended particulate matter in the water column or to the surficial bottom sediment. The distribution of PCBs in Lakes Michigan sediments is determined in part by sediment accumulation patterns related to sedimentation zones (Swackhamer and Armstrong, 1988). Three sediment zones are associated with Lake Michigan. The non-depositional zone consists of a scoured, and sandy region, the transitional zone has areas of silts, clays and Type B muds and the depositional zone is a high sedimentation zone largely comprised of Type A muds (Cahill, 1981). The amount of PCBs accumulated in the sediment is determined by various physical and chemical interactions between the PCBs and the associated sediment type. PCBs are primarily associated with fine-grained sediments that are transported to zones of sediment deposition over time.

The total PCB accumulation in southern Lake Michigan sediments is calculated to be 5900 kg. The average annual rate of accumulation is 7.1$\mu g/m^2yr$ since 1929 (Swackhamer and Armstrong, 1988). Due to the strong affinity of PCBs to particulate matter, PCB levels are higher in the depositional zone of southern Lake Michigan than in either the transitional zone or the non-depositional zone (Table 3) (Swackhamer and Armstrong, 1988). Mean PCB values decline and differ significantly as the distance from Waukegan Harbor increases within the non-depositional zone: near-harbor, nearshore and open-lake non-depositional (Table 3) (Swackhamer and Armstrong, 1988). PCB values were higher in the northern section of the harbor and directly east of the North Ditch. This is consistent with both lake circulation patterns and the larger quantities of PCBs released to the harbor from the North Ditch (Swackhamer and Armstrong, 1988). The particular Aroclor composition within the sediment coupled with declining PCB values in the non-

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depositional zone indicates an influence originating from Waukegan Harbor to the 10 km area surrounding the harbor (Swackhamer, 1988). Weathering and degradation of the PCBs may account for some distributional and proportional changes in the Aroclor composition. Certainly an impact is associated within the near shore area and very conceivably in the remainder of southern Lake Michigan (Swackhamer and Armstrong, 1988).

Table 3: PCB Concentrations in southern Lake Michigan

Location	Distance from Waukegan Harbor	Mean PCB Concentration (ng/g)	Aroclors 1242 and 1248 (percent)
Near-harbor	(0-1 km)	26	82
Nearshore	(1-10 km)	19	68
Open lake	(> 10 km)		
non-depositional		7.2	62
Open lake			
transitional		26	41
depositional		81	54

(Swackhamer and Armstrong, 1988)

ESTIMATES OF CONCENTRATIONS

PCBs are highly persistent in the environment and much of the 635,000 tons produced between 1930 and 1977 remains uncontrolled and bioavailable. The National Fisheries Laboratory of the Great Lakes (NFL-GL) has monitored PCB levels in several Great Lakes fish populations since 1972. As a result of severely restricted use and the 1977 ban of PCBs in the U.S., monitoring data show a declining concentration of bioavailable PCBs. The quantity of PCBs remaining, however, is sufficient to cause injury to fish and other natural resources.

PCBs pose a threat to fish populations by reducing phytoplankton abundance (McNaught, 1981). Phytoplankton functions as the base of the food chain and any decline in phytoplankton production will ultimately limit total fish production . Phytoplankton photosynthesis has been shown to be impaired due to small quantities of PCBs dissolved in water. Five ppt of dissolved PCBs inhibits photosynthesis by 5.7% and 500 ppt by 18.9% (McNaught, 1981). These levels approximate those found in the open waters of Lake Michigan and Waukegan Harbor respectively (ROD, 1984).

Larval fish are highly sensitive to PCB toxicity. Aroclors 1242 and 1248 produced 96-hour LC_{50} values of 73 and 20 μg/L respectively (Preassessment, 1988). PCBs appear to reduce growth, cause chronic mortality in early life stages and impair backbone development. In adult fish, PCBs induce chronic sublethal physiological effects on reproduction and growth (Preassessment, 1988). Sublethal toxicological effects of PCBs in the tissues of marine and freshwater fish species are documented in the literature at levels of 1 ppm and as low as 0.1 ppm (Field, 1988). EPA has shown mean PCB levels for all species of fish in Lake Michigan are between 2.7 - 187 ppm. All trout and salmon greater than 12 inches exhibited PCB levels exceeding the FDA standard of 2.0 ppm for consumption (ROD, 1984). The EPA Ambient Water Quality Criteria for protection of fresh water aquatic life from chronic toxicity due to PCBs is 14 ppt. This concentration is exceeded at the site, Slip 3, the North Ditch, and in Waukegan Harbor. Target levels of less than 0.1 ppm are suggested for sediment to ensure healthy aquatic organisms (Field, 1988).

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NATURAL RESOURCES AT RISK

AFFECTED NATURAL RESOURCES

A. General list:

Lake trout

Anadromous fishes

Colonial waterbirds, shore birds and migratory waterfowl

Piscivorous raptors

Mammals

Freshwater invertebrates

Phytoplankton and microorganisms

Water

Sediment

Ground water

Air

B. See Appendix II for list of fishes of Lake Michigan.

C. See Appendix III for fishes on 1989 Sport Fish Health Advisories for Illinois Waters.

D. See Appendix IV for a complete list of flora and fauna of southern Lake Michigan.

POTENTIALLY AFFECTED RESOURCES

The City of Waukegan and the Port Authority have extensive development plans for the Harbor. The Harbor continues to silt in and its industrial and recreational uses have greatly deteriorated. Ore boats must travel at half capacity and sail boat keels routinely hit bottom. There has been a general economic loss to the community from the deterioration of recreational opportunities due to the presence of toxic chemicals. Fishing is the predominant recreational activity although pleasure boating, sailing and other water related activities are popular. According to a 1972 Illinois Department of Conservation (DOC) creel survey, Waukegan Harbor experienced the heaviest pier and breakwater fishing pressure as well as the heaviest off-shore boat fishing pressure along the Illinois portion of

Lake Michigan (ROD, 1984). The average number of fish caught, however, was the second lowest of the 14 sites included in the DOC creel survey. Charter boat service operates at the limit (35 boats) set by the state of Illinois. These boats serve between 12,000 - 15,000 paying customers annually (ROD, 1984). There is a great local demand for additional boat launching and mooring facilities.

The Fish and Wildlife Service began a lake trout restoration program in 1958. Since 1967, approximately 148,000 yearling lake trout have been released annually into the Illinois portion of southern Lake Michigan. Recruitment has been shown to be directly related to stocking efforts in previous years.

The sports fishery in southern Lake Michigan has not grown since 1980 (Hay, 1988). The acute and chronic effects of PCBs are well recognized as demonstrated by the consumption advisories issued for the area. Much of the loss of use can be attributed to health advisories cautioning against fish consumption. Anglers are aware of the dangers posed by contaminants and surveys show that they have modified their fishing behavior patterns accordingly. The decline in value of the recreational fishery is calculated as the difference between the number of sport fishing days with known PCB contamination and estimates of what would occur without any contamination (Hay, 1988). USF&W Service economists estimate the value of loss of use from $30-467 million for the time period outlined (Hay, 1988). Those figures are limited to recreational opportunities in Waukegan Harbor and do not reflect damage to the Lake Michigan sport fishery. This value would obviously be much greater if damages to Lake Michigan are included. EPA estimates that OMC has contributed between 4.1 and 8.2% of all Lake Michigan point source PCBs (FWS personal communication, 1988). Diminished resource use and economic loss to activities other than recreational fishing have not been addressed in the above figure.

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Appendix II

Fishes of Lake Michigan from Bailey and Smith 1981 and Becker 1983.

Petromyzontidae	
Ichthyomyzon castaneus	Chestnut lamprey
I. unicuspis	Silver lamprey
Petromyzon marinus	Sea lamprey
Acipenseridae	
Acipenser fulvescens	Lake sturgeon
Lepisosteidae	
Lepisosteus osseus	Longnose gar
L. platostomus	Spotted gar
Amiidae	
Amia calva	Bowfin
Anguillidae	
Anquilla rostrata	American eel
Hiodontidae	
Hiodon tergisus	Mooneye
Clupeidae	
Alosa pseudoharenqus	Alewife
Dorosoma cepedianum	Gizzard shad
Salmonidae	
Oncorhynchus gorbuscha	Pink salmon
O. kisutch	Coho salmon
O. tshawytscha	Chinook salmon
O. mykiss	Rainbow trout
S. salar	Atlantic salmon
S. trutta	Brown trout
Salvelinus fontainalis	Brook trout
S. namaycush	Lake trout
Coregonus artedii	Lake herring
C. alpenae	Longjaw cisco
C. hoyi	Bloater
C. johannae	Deepwater cisco
C. kiyi	Kiyi
C. niqripinnis	Blackfin cisco
C. reighardi	Shortnose cisco
C. zenithicus	Shortjaw cisco
C. clupeaformis	Lake whitefish
P. cylindraceum	Round whitefish
Osmeridae	
Osmersus mordax	Rainbow smelt
Umbridae	
Umbra limi	Central mudminnow

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Esocidae	
Esox americanus vermiculatus	Grass pickerel
E. lucius	Northern pike
E. masquinongy	Muskel lunge
Cyprinidae	
Carassius auratus	Goldfish
Couesius plumbeus	Lake chub
Cyprinus carpio	Carp
Notemigonus crysoleucas	Golden shiner
N. atherinoides	Emerald shiner
N. chrysocephalus	Striped shiner
N. cornutus	Common shiner
N. heterodon	Blackchin shiner
N. heterolepis	Blacknose shiner
N. hudsonius	Spottail shiner
N. rubellus	Roseyface shiner
N. spilopterus	Spotfin shiner
N. stramineus	Sand shiner
N. volucellus	Mimic shiner
Phoxinus eos	Northern redbelly dace
Pinephales notatus	Bluntnose minnow
P. promelas	Fathead minnow
Rhinichthys atratulus	Blacknose dace
R. cataractae	Longnose dace
Semotilus atromaculatus	Creek chub
S. margarita	Pearl dace
Ctenopharyngodon idella	Grass carp
Catostomidae	
Carpiodes cyprinus	Quillback
Catostomus catostomus	Longnose sucker
C. commersoni	White sucker
Moxostoma anisurum	Silver redhorse
M. erythrurum	Golden redhorse
M. macrolepidotum	Shorthead redhorse
M. valenciennesi	Greater redhorse
Ictaluridae	
Ictalurus melas	Black bullhead
I. natalis	Yellow bullhead
I. nebulosus	Brown bullhead
I. punctatus	Channel catfish
Percopsidae	
Percopsis omiscomaycus	Trout-perch
Gadidae	
Lota lota	Burbot
Cyprinadontidae	
Fundulus diaphanus	Banded killifish

Atherinidae	
Labidesthes sicculus	Brook silverside
Gasterosteidae	
Culaea inconstans	Brook stickleback
Pungitius pungitius	Ninespine stickleback
Gasterosteus aculeatus	Threespine stickleback
Percichthyidae	
Morone chrysops	White bass
M. americana	White perch
Centranchidae	
Ambloplites rupestris	Rock bass
Lepomis gibbosus	Pumpkinseed
L. macrochirus	Bluegill
Micropterus dolomieui	Smallmouth bass
M. salmoides	Largemouth bass
Pomoxis anmularis	White crappie
P. nigromachulatus	Black crappie
Percidae	
Etheostoma exile	Iowa darter
E. flabellare	Fantail darter
E. nigrum	Johnny darter
Perca flavescens	Yellow perch
Percina caprodes	Longperch
Stizostedion canadense	Sauger
S. vitreum vitreum	Walleye
Sciaenidae	
Aplodinotus grunniens	Freshwater drum
Cottidae	
Cottus bairdi	Mottled sculpin
C. cognatus	Slimy sculpin
C. ricei	Spoonhead sculpin
Myoxocephalus quadricornis	Deepwater sculpin

Appendix III

The following species are listed on the 1989 Sport Fish Health Advisories for Illinois waters of Lake Michigan due to organochlorine contamination. The advisory is issued jointly by the Illinois departments of Public Health (IDPH), Conservation (IDOC), Agriculture (IDOA) and the Illinois Environmental Protection Agency (IEPA).

Lake trout	<20"	Low level of contamination
Coho salmon	<26"	
Chinook salmon	<21"	
Brook trout		
Rainbow Trout		
Pink salmon		
Smelt		
Perch		
Lake trout	20-23"	Moderate level of contamination
Coho salmon	>26"	
Chinook salmon	21-32"	
Brown trout	<23"	
Lake trout	>23"	High level of contamination
Chinook salmon	>32"	
Brown trout	>23"	
Carp		
Catfish		

BATCH LOG SHEET

DATE: _____

JOB NAME: F+W
BATCH NAME: _____
RPT 00141

( ) BATCHES

JOB INPUT TYPE: ENTRY ____ SCAN ____
JOB OUTPUT TYPE: ASCII ____ EBCDIC ____
WP ____ IMAGE ____
OUTPUT MEDIA: 5¼ ___ 3½ ___ 9TRACK ___

BATCH ID	ENTRY/ SCAN	DATE OUT	DATE IN	VERIFY/ EDIT	DATE OUT	DATE IN	QC	DATE OUT	DATE IN	ERRORS
	WRIT/	7/13			7-19					
	Simm	7/14/96	7/18/96							
					No	6 IFs.				

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00141	NONE	