Report

# Vegetation and Floristics of Allouez Bay

## Superior, Wisconsin



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## Part I

## THE ALLOUEZ BAY WETLAND

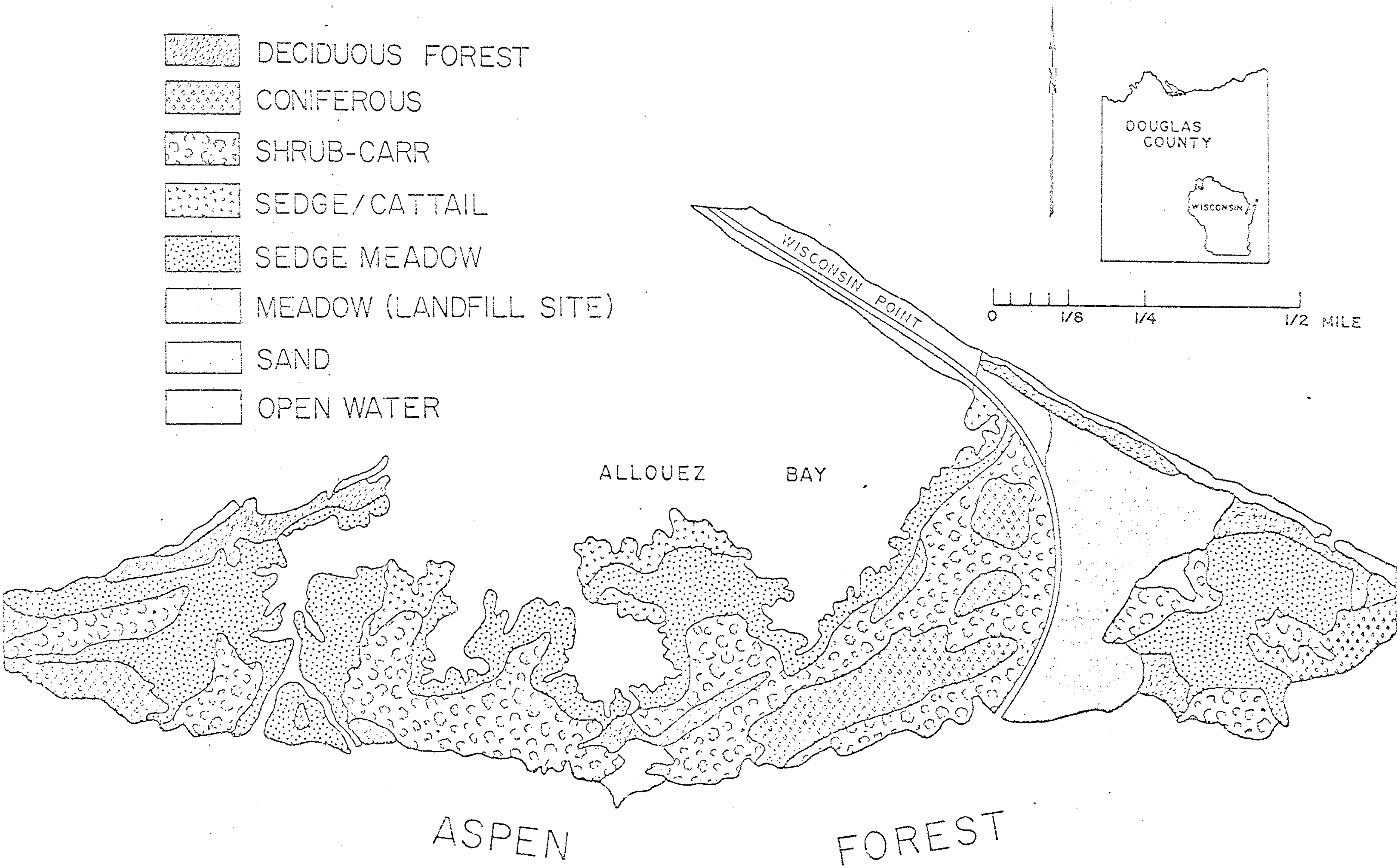
Few features of the landscape are as susceptible to encroachment by man as are wetlands. Typically located at the margin of water bodies, they are prime areas for development, particularly for transportation, industry and residential purposes. Yet these same wetlands play a very major role in the environment, serving to protect the shoreline, provide drainage and water storage capacity to the region, purify the waters, and provide wildlife habitat. Only in recent decades have we become sensitized to the role of wetlands and their importance in the environment.

At the Head of the Lakes, the formation of the harbor has been accompanied with an extensive wetland area. These wetlands exist in many areas in a form probably little different than before settlement, though other wetland areas have given way to development. One of the best wetland areas remaining is that of the Allouez Bay wetland (Figure 1-1). This extensive marsh and shrub-carr formation borders the southern and western margin of Allouez Bay from the base of Wisconsin Point to the ore docks on the mainland and comprises a sizable wetland area along the Lake Superior shore.

The study area lies primarily in sections 33, 34, and 35 of Township 49 North, Range 13 West of Douglas County. The marsh itself covers over 95 hectares and the Bay an additional 310 hectares. Water depth in the marsh is variable, often from 5 to 12 inches. Water depth in the Bay is equally variable, but is typically shallow averaging to 1.5 m.

Geologically the area is quite young, since the last glacial retreat occurred about 11,000 b.p. Cores in the area indicate that there are four

Figure 1, Location of study area and location of vegetation community types.



DECIDUOUS FOREST
CONIFEROUS
SHRUB-CARR
SEDGE/CATTAIL
SEDGE MEADOW
MEADOW (LANDFILL SITE)
SAND
OPEN WATER
N
DOUGLAS COUNTY
WISCONSIN
0
1/8
1/4
1/2 MILE
WISCONSIN POINT
ALLOUEZ BAY
ASPEN FOREST


Figure 1

sediment layers overlying a base basaltic lava capped with sandstone. A red-brown glacial drift (hardpan) layer up to 50 feet in depth is found on the sandstone cap. Above this layer is a deeper red-brown clay layer which varies from 100-150 feet. Above this is a relatively thin layer of fine to medium sand of 20-30 feet. In this layer can be found remnants of a forest dating to the Algoma Age (ca. 3,000 b.p.). The top, exposed layer is an organic clay and muck layer with sand, probably from alluvial deposits from Bear and Bluff Creeks. In more recent times industrial dust and dirt from shipping activities and sawdust and wood chips from previous lumbering activity have added to the organic composition (Mengel, 1971).

Speculation about the origin of the wetland is probably not warranted in view of our inadequate understanding of the evolution of Lake Superior. Evidences of earlier, higher lake levels exist in the form of former beach lines at higher elevation (Mengel, 1971). Connor's Point and Grassy Point in the harbor area evidence earlier, higher lake levels (607 ft., ca. 4,100 b.p.). The present bay-head bars were initiated when the lake reached its present level of 596 feet above sea level (Loy, 1963). This bar cut off the shallow waters to form Allouez Bay (and the Superior-Duluth harbor), though when the extensive marshes first existed is not now known. One can speculate that as the new sand bar gradually extended across the lake, sediments from the incoming streams filled the somewhat deeper basin until the present shallow levels were reached. At some point, the characteristic wetland developed when the substrate was sufficiently shallow and water level sufficiently constant to allow growth of aquatic and wetland species. Undoubtedly their presence also contributed to further growth and development of the area.

Current water levels are fairly constant, varying less than a foot since 1957 due to regulation (Mengel, 1971). Indeed, unlike marine coastal areas which are influenced by sizable tidal variation, the water levels of the lake are relatively constant. Sustained easterly or westerly winds may tend to shift water to one end or the other of the lake, and rapid changes of barometric pressure moving across the lake may produce more rapid changes in water level. Rarely does the total fluctuation exceed one foot, however. As a result, the conditions for the wetland remain more constant than might be the case if water level in Lake Superior paralleled marine movements.

Since settlement, the Bay area has been modified somewhat by human activity such as construction of docks along the mainland, sand borrowing for road construction and a sanitary landfill. None-the-less, the wetland area remains relatively undisturbed today.

The climate of the area is characteristically variable, and the adjacent lake serves to dampen extremes of temperature in both summer and winter. Prevailing winds are from the east off the lake in May, June and August, and from the west and northwest the remainder of the year. Cool summer temperatures are the rule, and daily summer highs that exceed 90°F are exceptional. Indeed, when winds are from the lake, daily highs may not exceed 60°F in the marsh area. The average growing season is 143 days (between first and last frosts) though areas adjacent to the lake may have larger frost free periods. The average date for the last spring frost (32°F) is 13 May and the average first fall date for frost (32°F) is 3 October. Winter temperatures are cold, but not extreme due to the buffering effect of Lake Superior. Temperature readings of -30°F or less occur, on the average, less than once every two years, but there is an average of 54 days with zero or below readings per year. Humidity levels vary depending upon wind direction, but even the drier westerly winds have little effect on the marsh vegetation.

Fog occurs on an average of 53 days per year. Although the heaviest precipitation occurs during summer, some of the 28-30 inches average annual precipitation occurs every month. Average snowfall is 53 inches per year. Snow cover remains until March or April, and harbor ice which typically begins to form in mid-November breaks up in mid-April, though ice may persist in the area for an additional month or more depending upon depth, wind and temperature. (Climate summary adapted from U.S. Dept. of Commerce, 1965.)

# Part II

# VEGETATION

## A. Early Vegetation

When the mosaic of vegetation patterns on the landscape are viewed over time, there is little as certain as change. The lowering lake levels some 3,500 b.p. account for the present formation of the natural sand bar (Wisconsin and Minnesota Points) which have formed the Superior harbor on the outside of older points (such as Connor's Point) (Loy, 1963). In more recent times, there is evidence that both the vegetation and the shape of the wetland have changed. Although current records are not adequate to portray this change in detail, we can gain a sense of the change from survey records and, more recently, aerial imagery and early maps.

One of our earliest views of the vegetation to provide some insight into the presettlement wetland vegetation is found in the early survey records. Earlier accounts of regional vegetation are available (Schoolcraft, 1821), but none have been found which relate to the Allouez Bay wetland.

The Allouez Bay wetland was surveyed by George Stuntz in 1852 and 1853. An examination of his records for T49N, R13W, in which the study area is located, suggests the presence of more woody vegetation than is now the case. Spruce, birch, tamarack, aspen and cedar were commonly noted with hazel, alder and spruce common understory species. His records indicate that maple was a common understory species on the upland sites, though no maple trees were listed for the township. Several of the section corners which appears now to be marsh had woody species present at the time of the survey.

Both the soil and the vegetation were considered "second rate" by the survey team, and much of the area was noted as "not fit for cultivation." When the recorded information concerning the trees is summarized (Table 2-1), one can see that tree size is relatively small and species composition favors those taxa more tolerant of mesic conditions. The latter observation is strengthened if the exterior township data is eliminated since most of those corners are on upland sites.

A further indication of the increase of the marsh area is suggested by a sketch of section 29 from the field notes of Mr. Stuntz (Figure 2-1). That the subsequent construction of the ore docks has changed the landscape is expected, but the limited expanse of marsh at the mouth of the Nemadji River is somewhat surprising if one assumes the sketch to be an accurate rendition of vegetation cover for the section.

In addition to the survey records, an examination of early maps suggests the size and shape of the open water in Allouez Bay have changed over the years. This is illustrated in Figure 2-2 in which the shoreline and vegetation pattern for the study areas as represented in earlier aerial imagery is compared.

Both the early maps and survey records simply reinforce the accepted notion concerning the changeable nature of wetlands. These areas are susceptible to a wide array of perterbations, both natural and man-made. The wetlands of Allouez Bay have not remained static over the past century reflecting both natural and cultural changes. Yet the wetland was well established before the area was extensively settled and measures that would change its basic character should be resisted.

Table 2-1

Importance value of major tree species of early vegetation, based on survey records (1852-1853) for T49N,R13W.

| Taxon | Relative Density | Relative Frequency | Importance Value | Rank | Mean Diameter dbh (inches) |
|---|---|---|---|---|---|
| *Picea* sp. (Spruce) | 30.0 | 46.1 | 76.1 | 1 | 9.9 |
| *Betula* sp. (Birch) | 21.7 | 30.7 | 52.4 | 2 | 8.6 |
| *Larix laricina* (Tamarack) | 20.0 | 23.0 | 43.0 | 3 | 8.4 |
| *Populus tremuloides* (Aspen) | 13.3 | 19.2 | 32.5 | 4 | 9.4 |

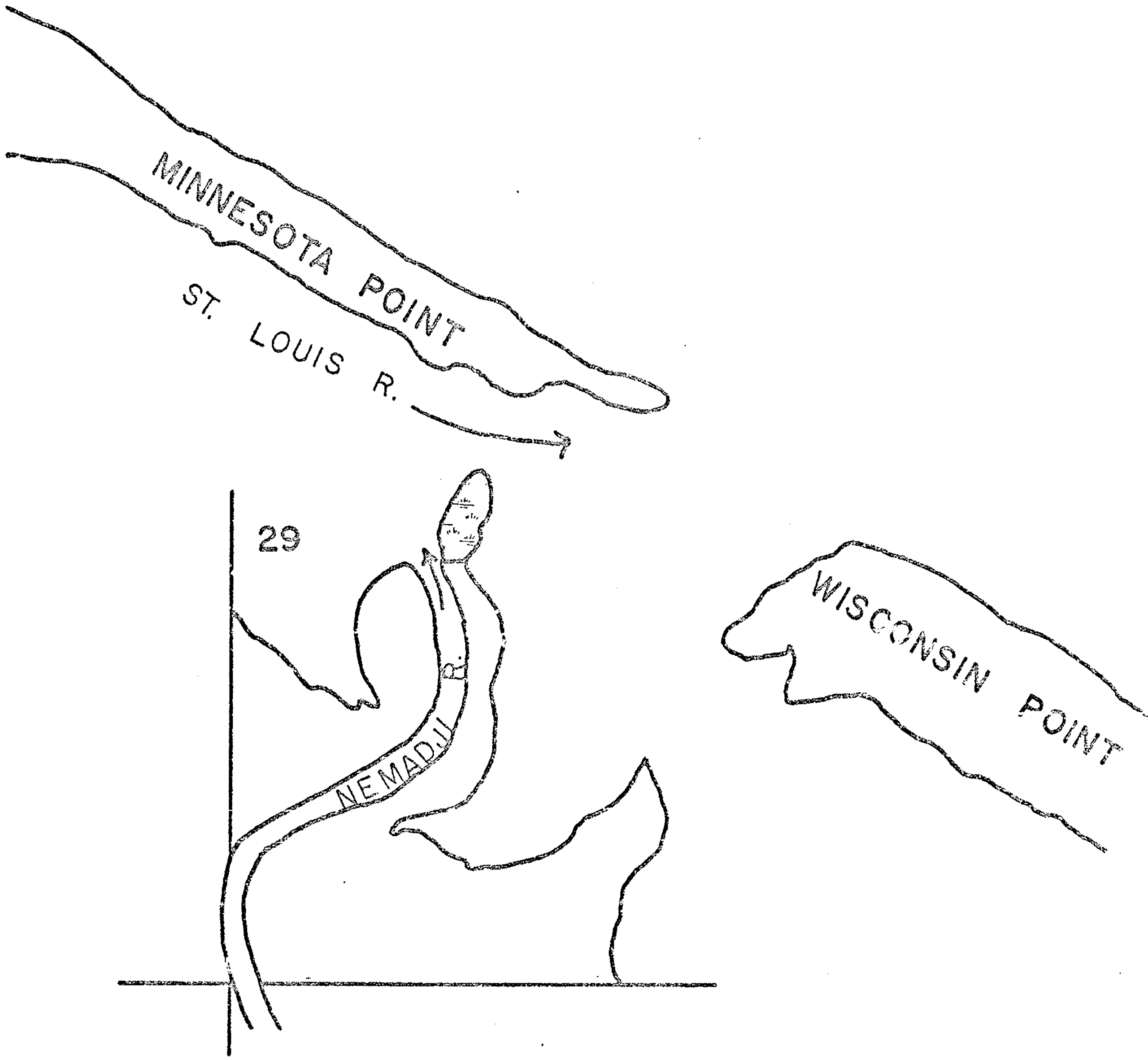



Figure 2-1. Surveyor's sketch of the mouth of the Nemadji River in 1852. (Redrawn from the surveyor's records).

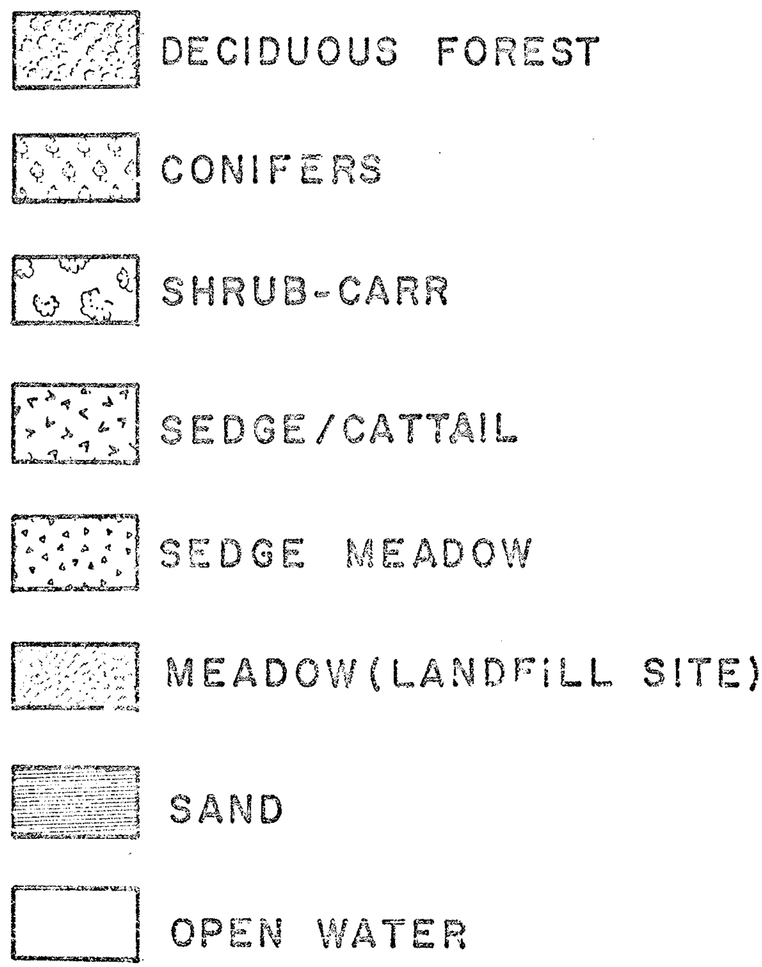
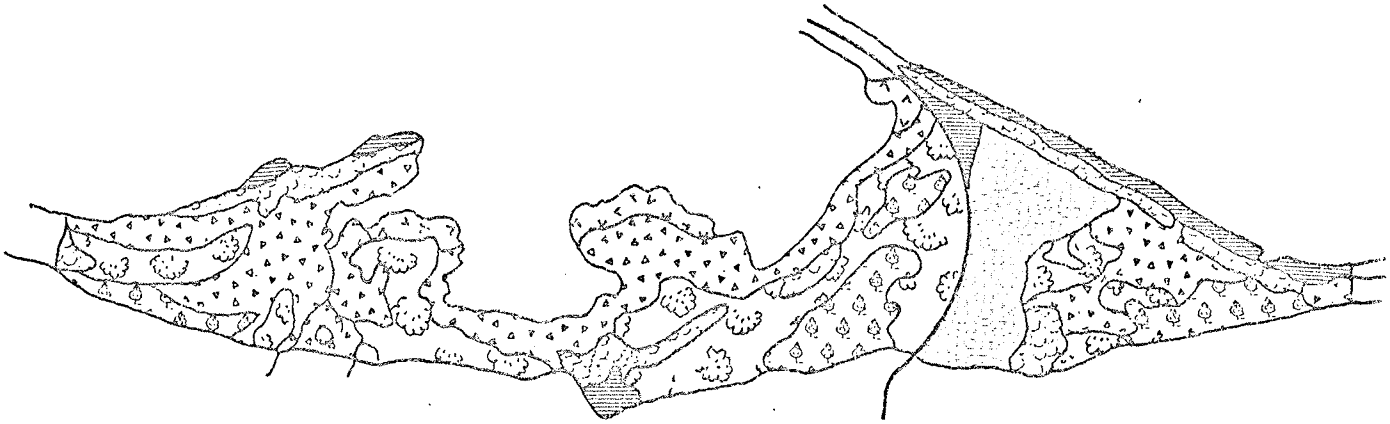
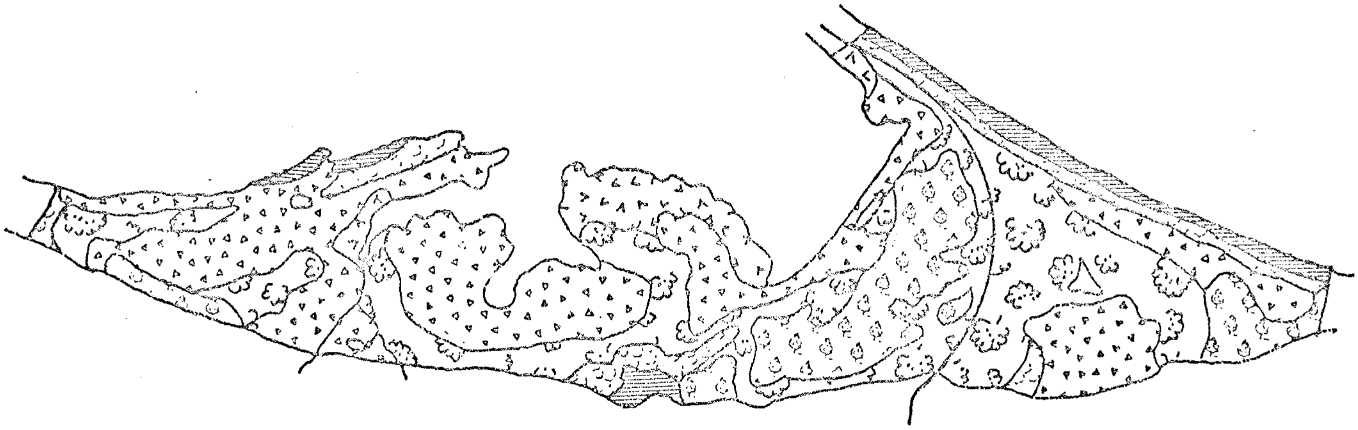


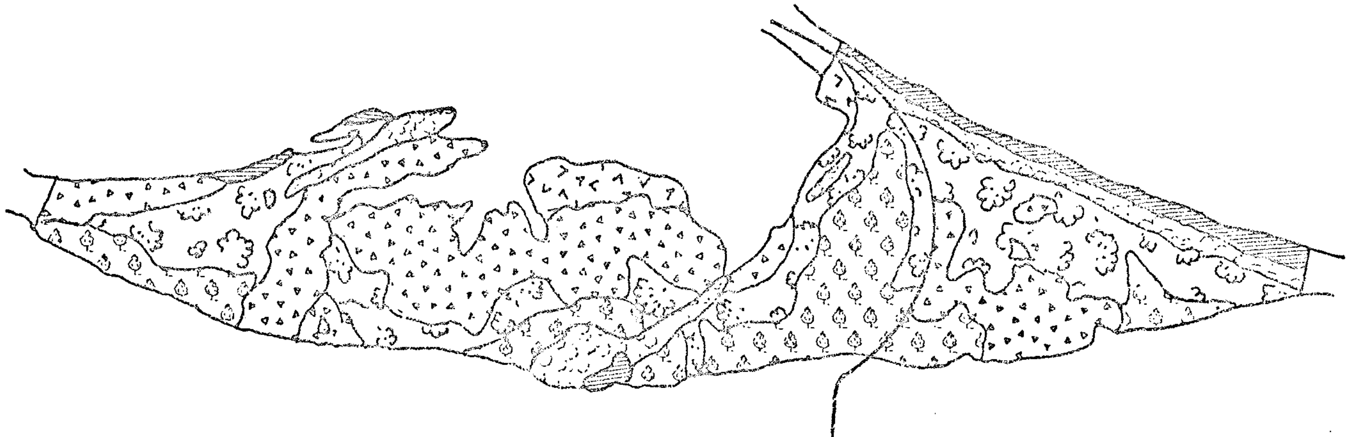

Figure 2-2. Vegetation cover of the Allouez Bay wetland as interpreted from 1938, 1950 and 1979 aerial photography.



1979



1950



1938

Figure 2-2.

## B. Present Vegetation

Analysis of vegetation of the Allouez Bay wetland was undertaken in order to delimit the major vegetational communities present, their major component species and to estimate productivity of the wetland species. Although nearly 90% of all wetlands in the United States are freshwater wetlands, our understanding of the dynamics of wetland ecosystems is not adequate. As the area of wetlands has steadily decreased since colonization from 127 million acres to under 75 million acres in 1955 (Shaw and Fredine, 1956), the need for an adequate data base to develop energy flow models, define nutrient cycling, and understand carbon balances hinders efforts to develop sound management strategies.

Richardson (1978) has reviewed productivity studies in various wetlands and finds that net primary productivity in *Carex* dominated wetlands is only 30% of that of cattail and reed marsh values. An understanding of productivity in the Allouez Bay wetland will allow comparison with other wetlands and establish a bench mark of production to use for the indirect measurement of vegetational change. In addition, such data should assist in quantifying the value of the wetland in the area ecosystem.

### Methods

Productivity of wetland vegetation was determined by clipping, at ground level, the aerial portion of plants within a 0.25 $m^2$ round quadrat. Ten clip quadrats were taken at 20 m intervals along a 200 m transect perpendicular to the water. Four transects, located as follows,

a. east of landfill site

b. east of Bear Creek

c. midway between Bear Creek and western margin

d. western margin, near disposal pier

were sampled at about three week intervals from May to September. The clipped vegetation was returned to the laboratory, sorted to species, dried to constant weight, and the above-ground biomass recorded.

The adjacent emergent stand of *Sparganium eurycarpum* was sampled during late summer to obtain an estimate of biomass produced. Sampling was done by dropping a cylinder with an end area of $0.33m^{-2}$ over the emergents and removing the plants from the substrate by means of a rake. Both above and below ground samples were taken. The results are reported in Table 2-10.

Vegetational communities were delimited by using available aerial photography from the Wisconsin Department of Natural Resources. The most recent aerial imagery (1979) was used as the basis for the cover map, and field reconnaisance was used to verify the accuracy of the map. Earlier imagery (1938, 1968) was used to compare changes over time to gain insight into vegetational cover changes.

During field work, different plant species were collected, pressed and prepared consistent with standard herbarium procedures. A list of taxa observed to occur in the wetland was then prepared from these collections.

## Results

Results of field sampling are reported in Tables 2-2 to 2-10 by transect site. *Carex lacustris* is the most abundant species (in biomass) in three of the four study areas, followed by other sedges (*Carex* sp.), cattail (*Typha latifolia*) and bur-weed (*Sparganium eurycarpum*). One site, adjacent to the western margin, is dominated by sedge species other than *Carex lacustris*.

An analysis of the various vegetational communities reveals five different types (Figure 2-1). These are sedge-meadow, sedge-cattail,

Table 2-2

Mean standing crop biomass ($g/m^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Spring.
(Week of 1 June)

| Taxon | Biomass ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n = 10) | Site B (n = 10) | Site C (n = 10) | Site D (n = 10) |
| *Carex lacustris* | 196.68 | 102.52 | 112.12 | 4.90 |
| *Carex rostrata* | -- | -- | -- | 8.20 |
| *Carex* sp* | -- | 41.88 | 37.34 | 50.38 |
| *Calla palustris* | 5.72 | -- | -- | -- |
| *Potentilla palustris* | --- | 2.38 | 2.82 | 5.02 |
| *Sagittaria latifolia* | -- | -- | -- | -- |
| *Sparganium eurycarpum* | -- | 3.38 | -- | -- |
| *Typha latifolia* | -- | -- | -- | -- |
| Total Quadrat Biomass | 108.30 | 152.42 | 157.96 | 74.88 |

*Includes sterile material from *C. diandra* and *C. lasiocarpa* which could not be field separated by species.

Table 2-3

Mean standing crop biomass ($g/m^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Late Spring (Week of 15 June)

| Taxon | Biomass ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n = 10) | Site B (n = 10) | Site C (n = 10) | Site D (n = 10) |
| *Carex lacustris* | 325.12 | 99.72 | 212.12 | 35.42 |
| *Carex rostrata* | 14.54 | -- | -- | 8.82 |
| *Carex sp** | -- | 27.14 | 38.20 | 59.10 |
| *Calla palustris* | -- | -- | 4.68 | -- |
| *Potentilla palustris* | -- | -- | 8.88 | 3.64 |
| *Sagittaria latifolia* | -- | -- | -- | -- |
| *Sparganium eurycarpum* | -- | 5.68 | 16.42 | -- |
| *Typha latifolia* | -- | -- | 12.22 | -- |
| Total Quadrat Biomass | 340.26 | 137.70 | 300.18 | 119.16 |

*Includes sterile material from *C. diandra* and *C. lasiocarpa* which could not be field separated by species.

Table 2-4

Mean standing crop biomass ($g/m^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Early Summer (Week of 6 July)

| Taxon | Biomass ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n = 10) | Site B (n = 10) | Site C (n = 10) | Site D (n = 10) |
| *Carex lacustris* | 431.92 | 128.50 | 189.88 | 3.2 |
| *Carex rostrata* | 20.10 | -- | -- | 22.44 |
| *Carex* sp* | -- | 85.20 | 105.42 | 75.46 |
| *Calla palustris* | 10.66 | 6.38 | 3.14 | -- |
| *Potentilla palustris* | -- | 10.02 | 21.08 | -- |
| *Sagittaria latifolia* | -- | 2.90 | -- | -- |
| *Sparganium eurycarpum* | -- | 11.48 | 5.78 | 3.74 |
| *Typha latifolia* | 4.10 | 4.14 | -- | 2.02 |
| Total Quadrat Biomass | 479.06 | 256.14 | 337.82 | 217.64 |

*Includes sterile material from *C. diandra* and *C. lasiocarpa* which could not be field separated by species.

Table 2-5

Mean standing crop biomass ($g/m^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Summer. (Week of 27 July)

| Taxon | Biomass ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n = 10) | Site B (n = 10) | Site C (n = 10) | Site D (n = 10) |
| *Carex lacustris* | 535.84 | 195.04 | 287.40 | 30.34 |
| *Carex rostrata* | 16.48 | -- | 101.20 | 5.18 |
| *Carex* sp* | -- | 146.04 | 136.44 | 151.80 |
| *Calla palustris* | 15.56 | 6.74 | 4.00 | -- |
| *Potentialla palustris* | -- | 16.44 | 8.26 | 5.92 |
| *Sagittaria latifolia* | -- | 12.36 | 14.42 | 11.46 |
| *Sparganium eurycarpum* | -- | 43.94 | 42.96 | 23.06 |
| *Typha latifolia* | -- | 50.76 | -- | 4.84 |
| Total Quadrat Biomass | 567.96 | 494.44 | 590.18 | 285.80 |

*Includes sterile material from *C. diandra* and *C. lasiocarpa* which could not be field separated by species.

Table 2-6

Mean standing crop biomass ($g/m^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Late Summer (Week of 17 August)

| Taxon | Biomass ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n = 10) | Site B (n = 10) | Site C (n = 5) | Site D (n = 5) |
| *Carex lacustris* | 606.64 | 254.10 | 234.44 | -- |
| *Carex rostrata* | 54.82 | 15.72 | 35.96 | -- |
| *Carex* sp* | -- | 123.72 | 137.38 | 536.60 |
| *Calla palustris* | 19.30 | 4.74 | 3.16 | -- |
| *Potentilla palustris* | -- | 7.40 | 18.94 | -- |
| *Sagittaria latifolia* | -- | 26.58 | 18.80 | 10.46 |
| *Sparganium eurycarpum* | -- | 87.62 | 19.16 | -- |
| *Typha latifolia* | -- | 25.84 | 17.94 | -- |
| Total Quadrat Biomass | 681.26 | 559.06 | 590.64 | 578.30 |

*Includes sterile material from *C. diandra* and *C. lasiocarpa* which could not be field separated by species.

Table 2-7

Mean standing crop biomass ($g/m^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Early Fall. (5 September)

| Taxon | Biomass ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n = 10) | Site B (n = 10) | Site C (n = 5) | Site D (n = 5) |
| *Carex lacustris* | 469.68 | 359.76 | 263.74 | -- |
| *Carex rostrata* | -- | -- | -- | -- |
| *Carex* sp* | -- | 59.30 | 124.44 | 341.28 |
| *Calla palustris* | 8.44 | 5.40 | -- | -- |
| *Potentilla palustris* | -- | 11.50 | 2.24 | -- |
| *Sagittaria latifolia* | -- | 13.96 | 17.00 | 32.80 |
| *Sparganium eurycarpum* | -- | 32.88 | 33.28 | 3.00 |
| *Typha latifolia* | 5.04 | 10.04 | 28.56 | 27.62 |
| Total Quadrat Biomass | 483.80 | 489.02 | 473.00 | 417.80 |

*Includes sterile material from *C. diandra* and *C. lasiocarpa* which could not be field separated by species.

Table 2-8

Mean standing crop biomass (g/m$^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Fall (26 September)

| Taxon | Biomass (gm$^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n = 10) | Site B | Site C | Site D (n = 5) |
| Carex lacustris | 361.40 | | | 60.68 |
| Carex rostrata | -- | | | 5.26 |
| Carex sp* | -- | | | 373.04 |
| Calla palustris | -- | | | -- |
| Potentilla palustris | -- | | | -- |
| Sagittaria latifolia | -- | | | 13.12 |
| Sparganium eurycarpum | -- | | | 33.46 |
| Typha latifolia | -- | | | -- |
| Total Quadrat Biomass | 361.40 | | | 480.16 |

*Includes sterile material from C. diandra and C. lasiocarpa which could not be field separated by species.

Table 2-9

Mean standing crop biomass ($g/m^{-2}$ dry weight) of major (more than 4g) wetland taxa in quadrat clips, Late Fall (10 October)

| Taxon | Biomass ($gm^{-2}$) | | | |
|---|---|---|---|---|
| | Site A (n - 10) | Site B (n - 10) | Site C (n = 5) | Site D (n = 5) |
| *Carex lacustris* | 346.68 | 171.74 | 238.40 | -- |
| *Carex rostrata* | 49.08 | 46.54 | 48.96 | -- |
| *Carex* sp* | -- | 92.58 | 95.76 | 236.32 |
| *Calla palustris* | -- | -- | -- | -- |
| *Potentilla palustris* | -- | 11.20 | -- | -- |
| *Sagittaria latifolia* | -- | 6.06 | -- | -- |
| *Sparganium eurycarpum* | -- | 16.14 | 16.10 | -- |
| *Typha latifolia* | -- | 3.52 | -- | -- |
| Total Quadrat Biomass | 397.10 | 358.34 | 402.4 | 249.36 |

*Includes sterile material from *C. diandra* and *C. lasiocarpa* which could not be field separated by species.

Table 2-10

Mean standing crop biomass (g/m$^{-2}$ dry weight)
of emergent *Sparganium eurycarpum*
from emergent beds.
(4 August)

| Taxon | Biomass n = 5 |
|---|---|
| *Sparganium eurycarpum* | |
| Above ground | 416.88 |
| Below ground | 160.65 |
| *Sagittaria* sp. | |
| Above ground | 5.7 |

shrub-carr, coniferous, and meadow (landfill site). In addition, open water and sandy beach areas were noted. The presence of emergent vegetation was not mapped because it was not present at the time aerial photography was taken. Surrounding the wetland is a deciduous forest comprised chiefly of aspen (Populus tremuloides).

Comparison of present cover with earlier cover maps based upon earlier available photography (Figure 2-2) suggests that the area of the wetland has declined over the last 40 years, particularly in the outflow area of the streams. The cause of this trend is difficult to ascertain. One would tend to expect the reverse, anticipating increasing sedimentation and thus greater areas of the bay bing colonized by emergents to finally yield to typical wetland species. Postulating a causative factor based upon available evidence is not warranted, though one might hypothesize changing lake levels to be contributary. Lake levels in 1925-1926 tended to be low; (598.2 ft. in April) and high in the early 1950's and late 1970's; (601.6 in June, 1951). Should continued decline of the wetland area continue, investigation to determine probable cause would be warranted.

The taxa found in conjunction with this study are listed in Appendix I with a descriptive habitat note. To date, no taxa considered endangered or threatened have been noted.

Discussion

The wetland is comprised of a mosaic of vegetational patterns controlled primarily by the saturated substrate. The abundance of water limits both the number of plant species present and their dynamics. This work indicates that the dominant plant in open areas is Carex lacustris. Other sedges, (C. lasiocarpa, C. diandra, and C. rostrata) are more important than Sparganium eurycarpum and Typha latifolia, though the latter two species are present in near monotypic stands in some areas.

When comparing primary production of the dominant species of the Allouez Bay wetland to other areas, productivity in the Allouez Bay wetland is lower, undoubtedly reflecting the cooler temperatures caused in part by the tempering influence of Lake Superior. For instance, Bernard and Solsky (1978) reported that maximum standing crop biomass for Carex lacustris in New York reached a value of 1100 $g/m^{-2}$ in contrast to 607 $g/m^2$ recorded in this study. Other species also demonstrated relatively lower productivity than reported in the literature, but these reports tend to be from more southern locations with presumably better growing conditions. Values of standing crop biomass for sites comparable to Allouez Bay were not available, though values for Typha sp. in the Dakotas (McNaughton, 1966) suggest that the general range of values found in this study are not unusually low for the location. Maximum standing crop in the wetland is in excess of 2.5 ton per acre which represents an annual contribution of over 220 ton of organic nutrient production by the wetland to the regional ecosystem. The total biomass produced would be greater if emergent and submerged aquatics from the bay were included.

The vegetational types delimited are fairly typical of wetlands. Several large expanses of sedge meadow which are dominated by one or more species of Carex are present. Commonly, Carex lacustris is the most important member, but C. rostrata, C. diandra or C. lasiocarpa are also frequent. The sedge species may be partially replaced by cattail (Typha latifolia) in some areas. Burweed (Sparganium eurycarpum and Iris (Iris sp.) are more frequently encountered in the sedge-cattail vegetation. In both types other species will occur, depending upon water level. These include duckweek (Lemna sp.), cottongrass (Eriophorum angustifolium), wild calla (Calla palustris), water parsnip (Sium suave), loosestrife (Lysimachia thrysiflora), bedstraw (Galium sp.) and the marsh bellflower (Campanula aparinoides).

Closer to the upland edge of the marsh is shrub-carr vegetation. This is comprised of woody shrub species, chiefly willow (Salix sp.) and sweet gale (Myrica gale) with some meadow sweet (Spiraea alba) and some ericads (Ledum groenlandicum and Chamaedaphne calyculata). A small area dominated by tamarack (Larix laricina) and spruce (Picea mariana) is also present. Both of these woody vegetation types have herbaceous layers dominated by sedges (Carex sp.)

Adjacent to the wetland, and comprised of fill over the site of the old landfill is a meadow. This was not examined as part of this study, though its extent is noted on the map.

# Part III

## WILDLIFE (AVIAN) USE

Major wildlife use is centered upon avian and fish utilization. Both have received attention in previous studies (Niemi, et al., 1977, 1978; Devore, 1978). These studies indicate the important role of the wetland in relation to avian and fish populations. During the course of this study, additional observations of the avian populations in the wetland were noted and are reported here but are only incidental ot the purpose of this study. Reference to the previous studies will provide more information. Limited observations also suggest that the wetland provides habitat for other vertebrates as well, but the greatest value appears to be for bird habitat.

### Procedure

Methods used to determine bird use of the Allouez Bay wetland area included (1) walking the very edge of the marshes and into them when possible, (2) a trip by boat edging the marsh and emergent vegetation in Allouez Bay, and (3) observations of bird use by spotting scope setup on Wisconsin Point near the old landfill. Observations were made in June and early July on mornings when visibility was good and winds were light or non-existant. The placement of bird species in vegetation types was done using these field observations during 1981. (A few species known to be using the wetlands this summer but not observed during sampling trips are included as a separate listing [Table 3-11]). Numbers of individuals were recorded on each sampling trip but are not listed. Because subsequent trips often overlapped and because of the high mobility of some species, individuals may have been recorded twice. Most common species are listed using the largest number seen in one area during any one sampling trip.

Table 3-1

Non-migratory bird species known to be using wetland areas of Allouez Bay during June and July but not observed.

---

*Double crested Cormorant - *Phalacrocorax auritus*

Mute Swan - *Cygnus olor*

Canada Goose - *Branta canadensis*

Northern Shoveler - *Spatula clypeata*

*Canvasback - *Aythya valisineria*

Hooded Merganser - *Lophodytes cucullatus*

Bald Eagle - *Haliaeetuc leucocephalus*

Sora - *Porzana carolina*

American Coot - *Fulica americana*

Common Snipe - *Capella gallinago*

Eastern Kingbird - *Tyrannus tyrannus*

Brown thrasher - *Toxostoma rufum*

Starling - *Sturus vulgaris*

Brown-headed Cowbird - *Molothrus ater*

---

*Audubon Blue-listed Species.

Some species such as common Tern and Great Blue Heron were not found to be nesting in the wetland but used it extensively for foraging. No attempts were made to locate or count nests, since our purpose was to determine species distribution according to cover vegetation types.

Results

Summaries of our observations are noted in the following tables. Included are species, by cover type, for the area near the landfill (Table 3-2), the wetland east of the landfill (Table 3-3) and a list of other species previously noted for the wetland (Table 3-1). A list of all species observed, their scientific name and status (rare or endangered) is noted in Table 3-4.

Bird species found nesting or feeding in the wetlands were typical of what one would find in similar habitats in Douglas County.

Black terns were the only species (actually nesting?) in emergent vegetation. Nests were not observed, but the terns displayed excited territorial defense of emergent vegetation areas. Black terns could be observed feeding young in late July. The only perches in the emergent area appeared to be debris from old duck blinds which the terns used extensively.

The two deciduous forest "island" areas within Allouez Bay held two species that may not otherwise have occupied the marsh. These were the warbling Vireo and Northern Oriole.

In both wetland areas, conifers occur within shrub-carr areas. Bird species found in shrub-carr with conifers did not appear to differ from those found in shrub-carr without conifers. The greatest number of species were found using these two vegetation types.

Table 3-2

Bird species observed near the landfill site by habitat type.

| Shrub/Carr | Coniferous | Sedge/Cattail | Sedge Meadow |
|---|---|---|---|
| Mourning Dove | Mourning Dove | Long-billed Marsh Wren (Marsh Wren) | Tree Swallow |
| Common Flicker | Alder Flycatcher | Red-winged Blackbird | Barn Swallow |
| Alder Flycatcher | Black-capped Chickadee | Brewer's Blackbird | Short-billed Marsh Wren (Sedge Wren) |
| Black-capped Chickadee | Gray Catbird | | |
| Yellow Warbler | Yellow Warbler | | |
| Chestnut-sided Warbler | Mourning Warbler | | |
| Common Yellowthroat | Common Yellowthroat | | |
| American Redstart | American Redstart | | |
| Red-winged Blackbird | Red-winged Blackbird | | |
| Brewer's Blackbird | Swamp Sparrow | | |
| Swamp Sparrow | Song Sparrow | | |
| Song Sparrow | | | |

| Meadow | Sand | Most Common Species (those numbering 15 or more) | |
|---|---|---|---|
| Killdeer | Killdeer | Red-winged Blackbird | 31 |
| Brewer's Blackbird | Spotted Sandpiper | Common Yellowthroat | 19 |
| Savannah Sparrow | | | |

Table 3-3

Bird species observed in the Allouez Bay wetland by habitat type.

| Deciduous Forest | Shrub/Carr | Coniferous | Sedge/Cattail |
|---|---|---|---|
| Great Blue Heron | Mourning Dove | Mourning Dove | Tree Swallow |
| Yellow-billed Cuckoo | Alder Flycatcher | Alder Flycatcher | Long-billed Marsh Wren (Marsh Wren) |
| Gray Catbird | Black-capped Chickadee | Gray Catbird | Red-winged Blackbird |
| Warbling Vireo | Cedar Waxwing | Cedar Waxwing | |
| American Redstart | Yellow Warbler | Yellow Warbler | |
| Red-winged Blackbird | Common Yellowthroat | Common Yellowthroat | |
| Northern Oriole | Red-winged Blackbird | American Redstart | |
| Common Grackle | American Goldfinch | Red-winged Blackbird | |
| Song Sparrow | Swamp Sparrow | American Goldfinch | |
| | Song Sparrow | Song Sparrow | |

| Sedge Meadow | Open Water | Emergent | Most Common Species (those numbering 15 or more) | |
|---|---|---|---|---|
| Tree Swallow | Great Blue Heron | Great Blue Heron | Red-winged Blackbird | 45 |
| Short-billed Marsh Wren (Sedge Wren) | Mallard | Black Tern | Black Tern | 43 |
| | Blue-wing Teal | Tree Swallow | Mallard | 17 |
| | American Wigeon | | Swamp Sparrow | 15 |
| | Wood Duck | | | |
| | Herring Gull - at marsh edge | | | |
| | Ring-billed Gull - at marsh edge | | | |
| | Common Tern | | | |
| | Caspian Tern | | | |
| | Black Tern | | | |
| | Tree Swallow | | | |

Table 3-4

Bird species found on sampling trips
in Allouez Bay wetland and their status.

*Great Blue Heron
Mallard - *Anas platyrhynchos*
Blue-winged Teal - *Anas discors*
American Wigeon - *Mareca americana*
Wood Duck - *Aix sponsa*
Killdeer - *Charadrius vociferus*
Spotted Sandpiper - *Actitis macularis*
Herring Gull - *Larus argentatus*
Ring-billed Gull - *Larus delawarensis*
*Common Tern - *Sterna hirundo*
Caspian Tern - *Hydroprogne caspia*
*Black Tern - *Chlidonias niger*
Mourning Dove - *Zenaidura macroura*
Yellow-billed Cuckoo - *Coccyzus americanus*
Common Flicker - *Colaptes auratus*
Alder Flycatcher - *Empidonax alnorum*
Tree Swallow - *Iridoprocne bicolor*
Barn Swallow - *Hirundo rustica*
Black-capped Chickadee - *Parus atricapillus*
Long-billed Marsh Wren (Marsh Wren) - *Telmatodytes palustris*
*Short-billed Marsh Wren (Sedge Wren) - *Cistothorus platensis*
Gray Catbird - *Dumetalla carolinensis*
Cedar Waxwing - *Bombycilla cedrorum*
Warbling Vireo - *Vireo gilvus*
*Yellow Warbler - *Dendroica petechia*
Chestnut-sided warbler - *Dendroica pensylvanica*
Mourning warbler - *Oporornis philadelphia*
Common Yellowthroat - *Geothlypis trichas*
American Redstart - *Setophaga ruticilla*
Red-winged Blackbird - *Agelaius phoeniceus*
Northern Oriole - *Icterus galbula*
Brewer's Blackbird - *Euphagus cyanocephalus*
Common Grackle - *Quiscalus quiscula*
American Goldfinch - *Spinus tristis*
Savannah Sparrow - *Passerculus sandwichensis*
Swamp Sparrow - *Melospiza georgiana*
Song Sparrow - *Melospiza melodia*

*Audubon Blue List 1981.

Sedge/cattail and sedge meadow areas produced few species. However, long-billed marsh wrens were found only in the sedge/cattail habitat, and short-billed marsh wrens only in sedge meadow.

One species was found only in the meadow (old landfill) area and that was the Savannah sparrow. Killdeer and spotted sandpipers also use the meadow, although spotted sandpipers were also found on the sand edge (beach) nearby during sampling trips.

Ducks observed in open water within the marsh must have used other parts of the marsh to nest, but were observed only on open water. Ducklings were observed in Allouez Bay in July.

Species using deciduous forest edges of the wetland were typical of other Douglas County deciduous forest and are not included in this report.

## Discussion

A total of 36 species was observed using the wetlands during sampling trips in June and July, 1981. Five of these species are on the Audubon Blue List for 1981. One, the Common Tern (*Sterna hirundo*) is also on the Wisconsin Endangered Species List. Fourteen more species were seen using the wetlands but were not found on sampling trips. Of these, two are blue listed, and one, the Bald Eagle, which often uses the wetland for foraging, is federally listed as threatened, and is endangered in Wisconsin.

But the birds found using the wetlands this summer include only a fraction of the birds that use this area over the course of the year. Over the last several years thousands of migratory birds on Wisconsin Point have been observed. These, and the birds that nest here, tend to use the entire area (Wisconsin Point and the adjacent wetland) utilizing different habitat types for different purposes. Some of the birds that

that nest on other parts of Wisconsin Point or stop here during migrations use the wetland for foraging; others use it only for shelter in bad weather. Huge numbers of ducks and other waterfowl rest and feed here during spring and fall migrations, and other birds use the mudflats that appear in Allouez Bay in the fall.

The importance of the wetland to the avian populations is well documented and is a major management consideration.

# Part IV

## MANAGEMENT CONSIDERATIONS

Any management concerns regarding the wetland must be framed within the context of an applicable values system. Generally, the value and need of wetlands is increasingly recognized in both political and economic circles. Unfortunately, a major set of values cannot be quantified, and this is particularly true of these wetlands under consideration. Even the fish and wildlife value is difficult to evaluate, but potential contributions in hydrology and biomass productivity are nearly impossible to assess in our market system. Even more difficult would be the assessment of waste assimilation value, contribution to the atmosphere, and various aesthetic contributions. Although Odum (1978) has suggested a method with the potential of ascribing some types of market values to such natural resources as wetlands, the data base for such computations is not yet adequate for the Allouez Bay wetland. We have little trouble, however, in recognizing non-consumptive uses of the wetland even if we cannot establish a market value. Such uses include:

a) aesthetic (viewing, smelling, hearing, etc.),

b) recreation (bird watching, hunting, etc.) and

c) research

Factors which tend to devalue wetlands include:

a) ignorance of the role wetlands in the ecosystem,

b) psychological alienation of man from the natural world, and

c) desire for a "techno-industrosphere." (Reimold and Hardisty, 1978)

Thus the following suggestions are framed within the assumption that the wetlands are a valuable resource which should be protected from man-made destructive influences.

The land use and management plan for the Duluth-Superior Harbor (MIC, 1978) recognizes the unique nature of both Wisconsin Point and Allouez Bay.

> "Wisconsin Point and Allouez Bay form an outstanding natural resource that as a natural area and as a recreation area is firmly embedded in the harbor plan. Within this area is one of Lake Superior's few marshes, . . . abundant wildlife habitat . . . .
>
> "Allouez Bay and Wisconsin Point should be kept free of any substantive developments. Both areas should be left in their natural state as habitat for wildlife and as scenic attractions. Also, the Point and the Bay themselves represent significant landforms and vegetative communities which should be highly regarded and preserved in their own right."

The same document also notes that the management of these areas must be within the context of the entire local ecosystem. Because of the extensive role of this wetland in both the avian and fish population of the harbor, protection of the Allouez Bay wetland area is important. Designation of the region as a natural scientific area has merit in the sense of assuring long term protection, though there appears to be little immediate threat to the wetland.

There is, however, the need for vigilance. Unlike the adjacent Wisconsin Point area, the wetland is not readily accessible for most visitors, nor are the physical attributes of the wetland particularly conducive to the casual visitor. Therefore, disturbance by human use is not, at this time, a major problem. Potential threats exist from three sources, however. The landfill site, though now adequately contained, has the potential of releasing toxic materials into the wetland. There is now no evidence that failure of the landfill is likely, but current efforts to monitor the site should be maintained and/or expanded. Unfortunately, the landfill will remain a threat far into the future, though any breach is likely to occur on the lake side and to be less a threat to the wetland than to the lake (Mengel, 1978).

Development of adjacent lands may pose potential difficulties in the future. Again, there is no immediate threat of development due in part to location and the physical characteristics of the area. Never-the-less, disturbance from development-related activities needs to be monitored. An example of this potential threat that exists at the site of the Allouez Dredged Spoil Site. Here inadequate erosion control has allowed some movement of red clay into the adjacent shrub-carr area and has the potential of filling prematurely the wetland in that immediate area.

Finally, the presence of permanent duck blinds in the area represents an intrusion into landscape scene available to visitors and may lower the quality of the aesthetic value of the area. Additionally, the potential role of hunting in an area with extensive avian populations should be examined, though such considerations are beyond the scope of this project.

Wetlands are very susceptible to change from both man-made and natural causes. As a result, change in the wetland over time is part of the natural sequence of events and can be expected. Changes depicted from a survey of available records are consistent with the nature of the changes observed generally in natural wetlands. Thus, management plans should be consistent with changes which characterize wetlands. Water level and sedimentation are both major factors influencing the wetland, but control of these for the Allouez Bay wetland are problem areas of such magnitude that little direct impact can be made within the context of current political and economic conditions.

Therefore, the recommendations which follow do not speak to enhancement of the wetland, but essentially suggest a "leave-it-alone" view.

## Recommendations

1. The Allouez Bay wetland area should be designated as a natural resource area to be preserved and managed to that end, either by local ordinance or through state/federal means. The general thrust of such designation would be to prevent development and use, but note 6 and 7 below.
2. The on-going, continuous monitoring of the land-fill site for potential leaching into the wetland should be maintained. Detection of leachate damage early should minimize risk to the wetland and facilitate containment.
3. Land use adjacent to the wetland should be carefully managed to avoid increasing sedimentation and filling of the wetland.
4. Evaluation of the role of permanent duck blinds in the wetland area should be undertaken in view of potential negative impact upon visual aesthetics. Presumably, this evaluation could occur by either state or local jurisdictions.
5. Efforts to contain the landfill site against the erosional activity of Lake Superior should continue.
6. Efforts to enlist both state and local interests in furthering a public educational effort concerning and utilizing the Allouez Bay wetland and Wisconsin Point should be initiated. Agencies such as UW-Superior, UW-Extension and/or Sea Grant might well be in a position to assist in this effort.
7. If, indeed, further development of Wisconsin Point park and recreation area occurred, some provision such as a small board walk into the wetland with educational signing would be useful.

8. Continued monitoring of the wetland area, particularly to determine factors which might contribute to changes in its size, should continue.

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Appendices

Appendix I

## Appendix I

### Check list of Vascular Plants found in the Allouez Bay Wetland

(Nomenclature follows that of Gleason and Cronquist (1963). Families are arranged in the familiar Englerian sequence.)

| | |
|---|---|
| **Ricciacea** | |
| *Riccia fluitans* L. | standing water in marsh open area |
| *Ricciocarpus natans* (L.) Corda | standing water in marsh open area |
| **Equisetaceae** | |
| *Equisetum sylvaticum* L. | upland woods beyond this site - moist shady |
| *E. fluviatile* L. | shady - moist clay area near drainage release |
| **Polypodiaceae** | |
| *Onoclea sensibilis* L. | marsh - not in standing water, along Bear Creek |
| *Dryopteris cristata* (L.) Gray | marsh - not in standing water, along Bear Creek |
| **Pinaceae** | |
| *Larix larcinia* (Du Roi) K. Koch. | area by road - marsh dominated by *Carex* sp. |
| **Typhaceae** | |
| *Typha latifolia* L. | marsh - all over |
| **Sparganiaceae** | |
| *Sparganium eurycarpum* Engelm | sand, moist soils of marsh (wet) |
| *S. fluctuans* (Morong) Robinson | rooted aquatic floating leaves |

Najadaceae

| | |
|---|---|
| *Potamogeton Richardsonii* (Benn.) Rydb. | floating leaved rooted, shallow water in creek and along shore |
| *P. epihydrus* Raf. | floating leaved rooted aquatic, shallow water at mouth of Bear Creek |
| *P. zosteriformis* Fernald | floating leaved rooted aquatic |
| *P. natans* L. | floating leaved aquatic plant |

Poaceae

| | |
|---|---|
| *Agropyron repens* (L.) Beauv | flat clay soils |
| *Hordeum jubatum* L. | flat clay soils |
| *Phalaris arundinacea* L. | marsh area |
| *Phleum pratense* L. | flat clay soils |

Cyperaceae

| | |
|---|---|
| *Eleocharis* sp. | marsh habitat rooted in standing water |
| *Eriophorum angustifolium* Honck. | scattered in marsh, water fairly deep, 6-10" deep |
| *Carex vesicaria* L. | marsh habitat, plenty of standing water |
| *C. lasiocarpa* Ehrh. | marsh habitat, plenty of standing water |
| *C. diandra* Schrank | marsh habitat, plenty of standing water |
| *Scirpus validus* Vahl | marsh - along shore |

Araceae

| | |
|---|---|
| *Acorus calamus* L. | rooted in shallow water of sedge marsh |
| *Calla palustris* L. | shallow water in the marsh, all over |

Lemnaceae

| | |
|---|---|
| *Lemna minor* L. | standing water in marsh near moss covered log |

| | |
|---|---|
| Liliaceae | |
| _Clintonia borealis_ (Ait) Raf. | moist shady sand bar deciduous trees |
| _Smilacina stellata_ (L.) Desf. | moist sand bar of deciduous trees, shady |
| _Maianthemum canadense_ Desf. | moist sand bar of deciduous trees, shady, upland woods type |
| _Trillium cernuum_ L. | upland deciduous woods beyond the marsh |
| Iridaceae | |
| _Iris pseudacorus_ L. | sandy area, frequently moist north face of sand bar |
| _I. versicolor_ L. | marsh - standing water rooted in shallow water |
| _Sisyrinchium montanum_ Greene | short grass area roadside |
| Salicaceae | |
| _Salix pedicellaris_ Pursh. var. _hypoglauca_ Fernald | wet marsh inhabited by various _Carex_ sp. |
| _S. discolor_ | wet marsh with other salix and _Carex_ sp. |
| Myricaceae | |
| _Myrica gale_ L. | marsh; shallow water |
| Urticaceae | |
| _Boehmeria cylindrica_ (L.) Sev. | moist upland woods |
| Polygonaceae | |
| _Rumex mexicanus_ Meissn | sandy soil |
| _Polygonum convolvulus_ L. | sandy soil |
| _P. hydropiperoides_ Michx. | pretty moist |
| Caryophyllaceae | |
| _Stellaria longifolia_ Muhl. | small shrub and herb area, sandy/clay soil |

Ceratophyllaceae

| | |
|---|---|
| *Ceratophylum demersum* L. | |

Nymphaeaceae

| | |
|---|---|
| *Nuphar variegatum* Engelm | |
| *N. microphyllum* (Pers) Fernald | |
| *Nymphaea tuberosa* Paine | |

Ranunculaceae

| | |
|---|---|
| *Actea rubra* (Ait) Willd. | moist upland woods, deciduous trees |
| *Thalictrum dasycarpum* Fisch. & Lall. | moist woodsy areas |
| *Caltha palustris* L. | marsh woods interface very moist but shady |
| *Ranunculus arbortivus* L. | woods area |
| *R. septentrionalis* Poir | clay soils, woods near marsh |
| *R. acris* L. | sandy - short grass area around marsh |
| *Anemone canadensis* L. | deciduous woods upland but moist |
| *A. quinquefolia* L. var. *interior* Fern. | upland forests |

Brassicaceae

| | |
|---|---|
| *Thlaspi arvense* L. | along creek - dry section of marsh, sandy soil |
| *Cardamine pensylvanica* Muhl | sandy point |
| *Barbarea vulgaris* R. Br. | shallow water, moist soils near sand bar and roadside |
| *Rorippa islandica* (Oeder) Borbas | along creek - dry section on marsh |
| *Erysium cheiranthoides* L. | moist sandy soil of sand bar |

Saxifragaceae

| | |
|---|---|
| Saxifraga pensylvanica L. | wet deciduous woods upland forest |
| Ribes hirtellum Michx. | roadside and woods |
| R. glandulosum Grauer. | upland woods, moist deciduous forests |
| R. americanum Mill. | upland woods and roadside |

Rosaceae

| | |
|---|---|
| Fragaria vesca L. var. americana Porter | upland woods, deciduous forests |
| F. virginiana Duchesne. | sandy short grass roadside area |
| Potentilla norvegica L. var. hirsuta (Michx) T. & G. | moist woods sand soil, deciduous forests |
| Potentilla palustris (L.) Scop. | marsh - standing shallow water |
| Rubus pubescens Raf. | shrub/herb area of deciduous woods |
| R. idaeus L. var. strigosus (Michx.) Maxim | upland woods and sand bar moist deciduous forests |
| Rosa acicularis Lindl | roadsides and woods, sand bar too |
| Prunus pensylvanica L.f. | upland woods type moist soil |
| Sorbus decora (Sarg.) Hyland | upland woods |
| Amelanchier sanguinea (Pursh) DC. | upland woods |
| Spiraea alba Du Roi | upland along the marsh |
| Agrimonia striata Michx. | along Bear Creek moist soil |

Fabaceae

| | |
|---|---|
| Lotus corniculatus L. | sand/gravel area grows abundantly |
| Trifolium pratense L. | sand gravel areas roadside |
| T. hybridum L. | grassy area, roadside |

| | |
|---|---|
| **Fabaceae** | |
| *Melilotus alba* Desr. | growing in sandy soil shrub/herb area |
| *M. officinalis* (L.) Lam. | roadside |
| *Vicia americana* Muhl. | grassy bank along road herb/shrub areas |
| *Lathyrus ochroleucus* Hook. | grassy banks herb/shrub area next to woods |
| **Balsaminaceae** | |
| *Impatiens biflora* Walt | scattered in the marsh and other moist soils |
| **Violaceae** | |
| *Viola renifolia* Gray var. *brainerdii* (Greene) Fern. | moist moss covered rock amid the marsh |
| *V. pubescens* Ait var. *eriocarpa* (Schwein) Russel | upland woods beyond marsh - deciduous forest |
| **Onagraceae** | |
| *Oenothera parviflora* L. | edge of bay - upland, along shore |
| *Epilobium angustifolium* L. | upland woods |
| *E. liptophyllum* Raf. | in marsh |
| **Araliaceae** | |
| *Aralia nudicaulis* L. | moist upland woods deciduous forests |
| **Apiaceae** | |
| *Heracleum lanatum* Michx. | moist upland woods of sand bar |
| *Sium sauve* Walt. | marsh habitat |
| **Cornaceae** | |
| *Cornus canadensis* L. | herb layer of deciduous woods |
| *Cornus stolonifera* Michx. | sand bar - shrub of deciduous woods - moist forests |

| | |
|---|---|
| Ericaceae | |
| *Ledum groenlandicum* Oeder. | moist soils of the marsh |
| *Chamaedaphne calyculata* (L.) Moench | shallow water of marsh area |
| *Vaccinium angustifolium* Ait. | sunny regions of moist woods |
| *Pyrola elliptica* Nutt. | moist woods on sand bar |
| Primulaceae | |
| *Lysimachia ciliatum* (L.) Raf. | moist area of marsh at Bear Creek |
| *L. thyrsiflora* Gray | wet marsh mixed with the sedge |
| *L. terrestris* (L.) BSP. | moist sand |
| *Trientalis borealis* Raf. | moist uplands - deciduous woods |
| Oleaceae | |
| *Fraxinus pennsylvanica* Marsh. | tree on sand bar, moist sand/dirt |
| Gentianaceae | |
| *Menyanthes trifoliata* L. | wet marsh, water ∿ 10" deep amid the slim carex |
| Apocynaceae | |
| *Apocynum androsaemifolium* L. | moist woods |
| Boraginaceae | |
| *Mertensia paniculata* (Ait) G. Don. | moist upland woods, deciduous forests |
| Lamiaceae (Labiatae) | |
| *Scutellaria galericulata* L. | found in marsh along Bear Creek - moist but no standing water |
| *Galeopsis tetrahit* L. | found in marsh along Bear Creek - moist but no standing water |

| | |
|---|---|
| Lamiaceae (Labiatae) | |
| Mentha arvensis L. | found in marsh along Bear Creek - moist but no standing water |
| Stachys hispida Pursh. | found in marsh along Bear Creek - moist but no standing water |
| Scrophulariaceae | |
| Mimulus ringens L. | along shoreline of marsh moist soils |
| Lentibulariaceae | |
| Utricularia vulgaris L. | marsh |
| Rubiaceae | |
| Galium tinctorium L. | in marsh, matted and on other plants |
| G. triflorum Michx. | |
| Caprifoliaceae | |
| Lonicera dioica L. var. glaucescens (Rydb) Butters | moist upland woods, vining shrub |
| Campanulaceae | |
| Campanula aparinoides Pursh | marsh |
| Astuaceae | |
| Erigeron annuus (L.) Pers. | sand/gravel, short grass area, roadside |
| Cirsium arvense (L.) Scop. | along Bear Creek shore line - moist, not wet, soil |
| Matricaria maritima L. | weedy thing, found many moist sunny places |
| Erigeron philadelphicus L. | along shoreline, moist clay soils |
| Sonchus uliginosus Bieb. | sand soils on sand bar |

Appendix II

## Appendix II

Upon request of the City Engineer's office, depths of the bottom of Lake Superior adjacent to the protective groins were obtained. This work was done by Dr. Paul Tychsen of the Geology Department at UW-Superior using the research vessel SMITH. His report follows:

On the morning of September 3, 1981, the University of Wisconsin-Superior, research vessel Smith was utilized to chart water depths and locations at nine (9) stations located off of the four (4) rock groins constructed by the city of Superior, Wisconsin.

The rock groins were constructed to prevent further erosion of the shoreline in the vicinity of the old Superior garbage dump. The dump is located immediately landward from the groin location (see sketch map).

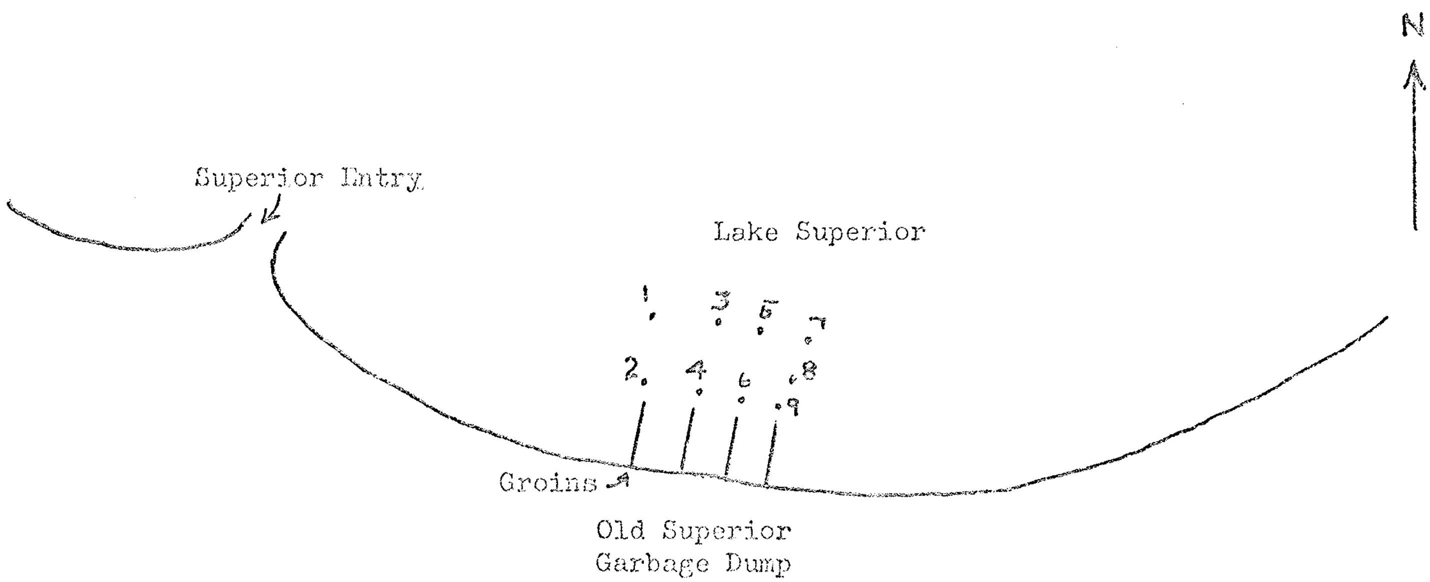
The position of each of the nine (9) recording stations is noted as recorded below. Each position was determined by the use of the Loran-C Log equipment aboard the vessel and noted as to latitude and longitude to the closest second. The water depth at each station was recorded by the ship's electronic fathometer and the results are also noted on the table below:

| Station Number | Location | Water Depth (below vessel) | Nature of Bottom |
|---|---|---|---|
| 1 | Lat. 46° 42' 06"<br>Long. 91° 59' 08" | 40' | Sand |
| 2 | Lat. 46° 41' 19"<br>Long. 91° 58' 58" | 10' | Sand |
| 3 | Lat. 46° 41' 52"<br>Long. 91° 58' 30" | 44' | Sand-Gravel |
| 4 | Lat. 46° 41' 16"<br>Long. 91° 58' 44" | 8' | Sand |
| 5 | Lat. 46° 41' 52"<br>Long. 91° 58' 09" | 42' | Gravel |
| 6 | Lat. 46° 41' 13"<br>Long. 91° 58' 36" | 6' | Sand |
| 7 | Lat. 46° 41' 20"<br>Long. 91° 56' 51" | 22' | Gravel |
| 8 | Lat. 46° 41' 02"<br>Long. 91° 56' 49" | 10' | Sand |
| 9 | Lat. 46° 41' 36"<br>Long. 91° 58' 21" | 10' | Sand |

The research vessel SMITH can be programmed to return to each of the sample sites indicated and it is anticipated that if any marked lakebottom changes result (aggradation or degradation) - they will be detected by subsequent investigations.

The fathometer chart, the Loran-C visual map plot and the Loran-C log is enclosed for your information. [Note: the originals were sent to City Engineer's Office]

David Anderson
Paul Tychsen




Sketch Map showing location of groins and off-shore sample sites