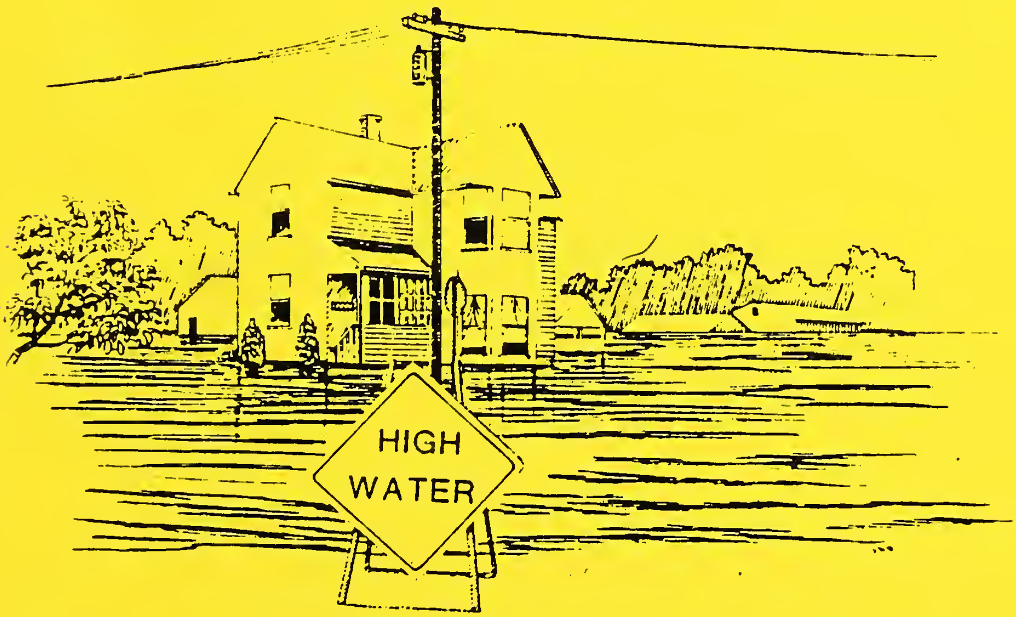
FLOOD PLAIN MANAGEMENT STUDY

MATTESON LAKE/LITTLE SWAN CREEK

BRANCH COUNTY, MICHIGAN

SEPTEMBER 1993



prepared by:

U.S. Department of Agriculture
Soil Conservation Service
East Lansing, Michigan

in cooperation with:

Michigan Department of Natural Resources
Branch County Road Commission
Branch County Drain Commissioner
Matteson Township
Matteson Lake Association
Branch County Soil Conservation District

United States
Department of
Agriculture

National Agricultural Library

FOREWORD

This report defines the flood characteristics of Matteson Lake/Little Swan Creek located in Matteson Township, Branch County, Michigan. Development exists within the flood plain and can be expected to increase in the future.

This cooperative report was prepared for the guidance of local officials in planning the use and regulation of the flood plain. Four potential floods are used to represent the degree of major flooding that may occur in the future. These floods, the 10-year, 50-year, 100-year and 500-year, are defined in the report and should be given appropriate consideration in future planning for safety of development in the flood plain. Five miles of high water profiles along Little Swan Creek show the expected flood elevations and water depths relative to the stream bed and flood plain. The 100-year and 500-year potential floods around Matteson Lake are further defined by flood hazard area maps that show the approximate areas that would be flooded.

Flood hazard area maps and high water profiles were based on existing conditions of the basin, stream and valley when the report was prepared.

Information in this report does not imply any federal authority to zone or regulate the use of flood plains; this is a state and local responsibility. This report provides a suitable basis for adoption of land use controls to guide flood plain development, thereby preventing intensification of flood losses.

Technical documentation for this study is on file with the Soil Conservation Service-USDA, 1405 South Harrison Road, East Lansing, Michigan 48823 (telephone (517) 337-6701) and the Land and Water Management Division, Michigan Department of Natural Resources, Mason Building, P.O. Box 30028, Lansing, Michigan 48909.

Assistance and cooperation of the Branch County Soil Conservation District, Branch County Road Commission, Branch County Drain Commissioner, Matteson Township, Matteson Lake Association and Michigan Department of Natural Resources in the preparation of this report are greatly appreciated.

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FLOOD PLAIN MANAGEMENT STUDY

MATTESON LAKE/LITTLE SWAN CREEK

BRANCH COUNTY, MICHIGAN

INTRODUCTION

The flood plains of rivers, lakes and streams have been formed by nature to provide for the conveyance of flood flows resulting from large amounts of snowmelt and rainfall. Floods are acts of nature which cannot be wholly prevented by man. Therefore, the long-term solution to reducing flood damage and loss of life is to keep the flood plain void of development which could be damaged or which could obstruct the conveyance of flood waters. There are three basic actions which can be used to assure that flood plain areas are kept open:

1. Provide information to make lending institutions and prospective property buyers aware of the flood hazards.

2. Initiate flood plain regulations to prevent the development of the flood plain in a manner which would be hazardous during floods.

3. Acquisition of flood prone areas for use as parks, open space, wildlife habitat and other public uses.

Potential users of the flood plain should base their decisions upon the advantages and disadvantages of such a location. Knowledge of flood hazards is not widespread and, consequently, the managers, potential users and occupants cannot always accurately assess the risks. In order for flood plain management to be effective in the planning, development and use of flood plains, it is necessary to:

1. Develop appropriate technical information and interpretations for use in flood plain management.

2. Provide technical services to managers of flood plain property for community, recreational, industrial and agricultural uses.

3. Improve basic technical knowledge about flood hazards.

Two Michigan state laws provide the Michigan Department of Natural Resources the responsibility and the authority to regulate all development in the flood plain areas.

> Act 288, Public Acts of 1967, establishes minimum standards for subdividing land and for new development for residential purposes within flood plain areas. This act requires that preliminary plats be submitted to the Land and Water Management Division, Michigan Department of Natural Resources for review and determination of flood plain limits. Upon completion of review and establishment of the 100-year frequency flood plain limits, the preliminary plat may be approved and minimum building requirements specified.

Act 245, Public Acts of 1929 as amended by Act 167, Public Acts of 1968, requires that a permit be obtained from the Land and Water Management Division, Michigan Department of Natural Resources before filling or otherwise occupying the flood plain or altering any channel or watercourse in the state. The purpose of this control is to assure that the channels and the portion of the flood plain that are the floodways are not inhabited and are kept free and clear of interference or obstruction which will cause undue restriction of flood carrying capacities.

Requirements established by the Michigan Department of Natural Resources for occupation and development of flood plain areas under Acts 288 and 245 are intended to be minimum requirements only. The Michigan Department of Natural Resources urges local units of government to adopt reasonable regulations which can be used to guide and control land use and development in flood hazard areas.

The Soil Conservation Service, United States Department of Agriculture carries out flood plain management studies under the authority of Section 6 of Public Law 83-566, in response to Recommendation 9(c), "Regulations of Land Use", of House Document No. 465, 89th Congress, 2nd Session and in compliance with Executive Order 11988, dated May 24, 1977. Flood plain management studies are carried out in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management". The Soil Conservation Service and the Michigan Department of Natural Resources have agreed to carry out flood plain management studies in Michigan under provisions of the Joint Coordination Agreement. Priorities regarding location and extent of such studies in Michigan have been set in cooperation with the Michigan Department of Natural Resources.

The Branch County Soil Conservation District, Branch County Road Commission, Branch County Drain Commissioner, Matteson Township, Matteson Lake Association and Michigan Department of Natural Resources (Sponsors) believed that a flood plain management study was needed for Matteson Lake/Little Swan Creek due to the flooding problems that have already occurred. The Sponsors have determined that there is an increasing need to properly plan for the preservation and use of the flood plain. They have indicated a need to develop technical information along Matteson Lake/Little Swan Creek to develop effective management programs.

The Sponsors have adopted resolutions indicating they intend to use the technical information from the flood plain management study as a basis for adopting zoning regulations, health and building codes, subdivision control regulations and such other regulations that may be needed to preserve the environmental quality of their natural resources, and to protect the health, safety, welfare and well-being of the citizens of their communities.

A request for a flood plain management study was made by the Sponsors and a plan of work, dated October 1992, was agreed to by the Sponsors, along with the Soil Conservation Service. Financial contributions for this study were made by the Sponsors and the Soil Conservation Service. The Branch County Soil Conservation District will assist the other Sponsors with public information dissemination.

The Sponsors provided money and surveying assistance for this study. They also furnished assistance to the Soil Conservation Service in gathering basic data. In addition, they also provided input to identify and select appropriate flood plain management alternatives.

The Land and Water Management Division, Michigan Department of Natural Resources provided coordination services with respect to study area discharges and hydraulics. They reviewed the technical aspects of the study and concurred with study results, as applicable, to implement various state statutes and provisions of the Federal Flood Insurance Program.

Natural flood plain values were obtained by the Tri-Agency Team consisting of the Michigan Department of Natural Resources, U.S. Fish and Wildlife Service and the Soil Conservation Service in June 1989. U.S. Geologic Survey quadrangle maps and field checks were used to identify and delineate wetland areas. Topographic maps, planning commission data and communications with government officials were used to determine land use and development trends. Soils information was obtained from the published soil survey report for Branch County.

In addition to flood prone areas, two floods are delineated, the 100-year and the 500-year frequency events. These floods have an average occurrence of once in the number of years as indicated; e.g., the 100-year flood occurs once in 100 years on the average. The 100-year flood has a 1 percent chance of being equaled or exceeded in any given year. In addition to flood prone areas and the two floods delineated on the aerial maps, the 10-year and 50-year floods are also shown on the high water profiles. The flood plain management program enacted by local action is to be based on the technical results and recommendations of this report.

The Land and Water Management Division, Michigan Department of Natural Resources and the Soil Conservation Service-USDA will, upon request, provide technical assistance to federal, state and local agencies and organizations in the interpretation and use of the information developed in this study. For assistance contact:

Branch County Soil Conservation District
1110 West Chicago Road
Coldwater, Michigan 49036-7307
Telephone: (517) 278-8008

DESCRIPTION OF STUDY AREA

Watershed Area

Little Swan Creek is located in the south-central part of lower Michigan in the southwestern portion of Branch County. It is located in U.S. Geological Survey's State Hydrologic Unit 04050001. Its headwaters are located in the central portion of Branch County. From there, Little Swan Creek flows through Matteson Lake in a westerly direction, and eventually outlets into Swan Creek. Swan Creek flows into St. Joseph County and into Long Lake and Palmer Lake, near the town of Colon. The level of Matteson Lake is controlled by a dam on the west side of the lake at Butz Road.

The drainage area to the Matteson Lake outlet is approximately 17.9 square miles and to Linley Road is 20.9 square miles, with land uses of residential, recreation, agriculture, forest and open space. About 13 percent of the area is in woodland, 73 percent is in cultivated crops and 6 percent is brush, weeds and grass. The remaining 8 percent is roads, residential areas and water areas. There are numerous culverts and crossings along the creek system. Some of these are restrictive and cause the flooding of buildings and roads. Any replacement of crossings should be evaluated to see what the effect would be on downstream flooding.

The physiography of the watershed has been influenced by the Wisconsin Glaciation. The main land forms are ground moraines, end moraines and outwash plains. The materials deposited in these land forms range in texture from clay loam to sand. Gravel deposits are common on outwash areas. Organic soils are common in depressions throughout the area and there are some natural lakes. The glaciation and post-glacial erosion have contributed to the wide range of soils which occur in the area.

The major soils in the watershed consist of nearly level to moderately sloping, poorly drained to well drained loamy soils on ground moraines and end moraines. Included are the Barry, Hillsdale, Locke and Riddles soils.

Outwash areas are nearly level to moderately steep and consist of well drained loamy soils. In addition there are very poorly drained organic soils in depressions and drainageways. Included are the well drained Fox, Ormas and Oshtemo soils and the very poorly drained Edwards, Houghton and Sebewa soils.

In winter, the average temperature is 25.0°F, and the average daily minimum temperature is 17.0°F. In summer, the average temperature is 69.1°F, and the average daily maximum temperature is 80.7°F.

The average annual temperature is 47.8°F. The average annual precipitation is 33.49 inches. Of this, 20.68 inches, or 62 percent, usually falls in April through September, which includes the growing season for most crops. The average annual snowfall is 47.8 inches.

Historically, much of the watershed has been used for agriculture. Since the 1930s, farming has shifted somewhat from livestock to cash crops; mainly corn, soybeans and wheat.

Study Area Flood Plain

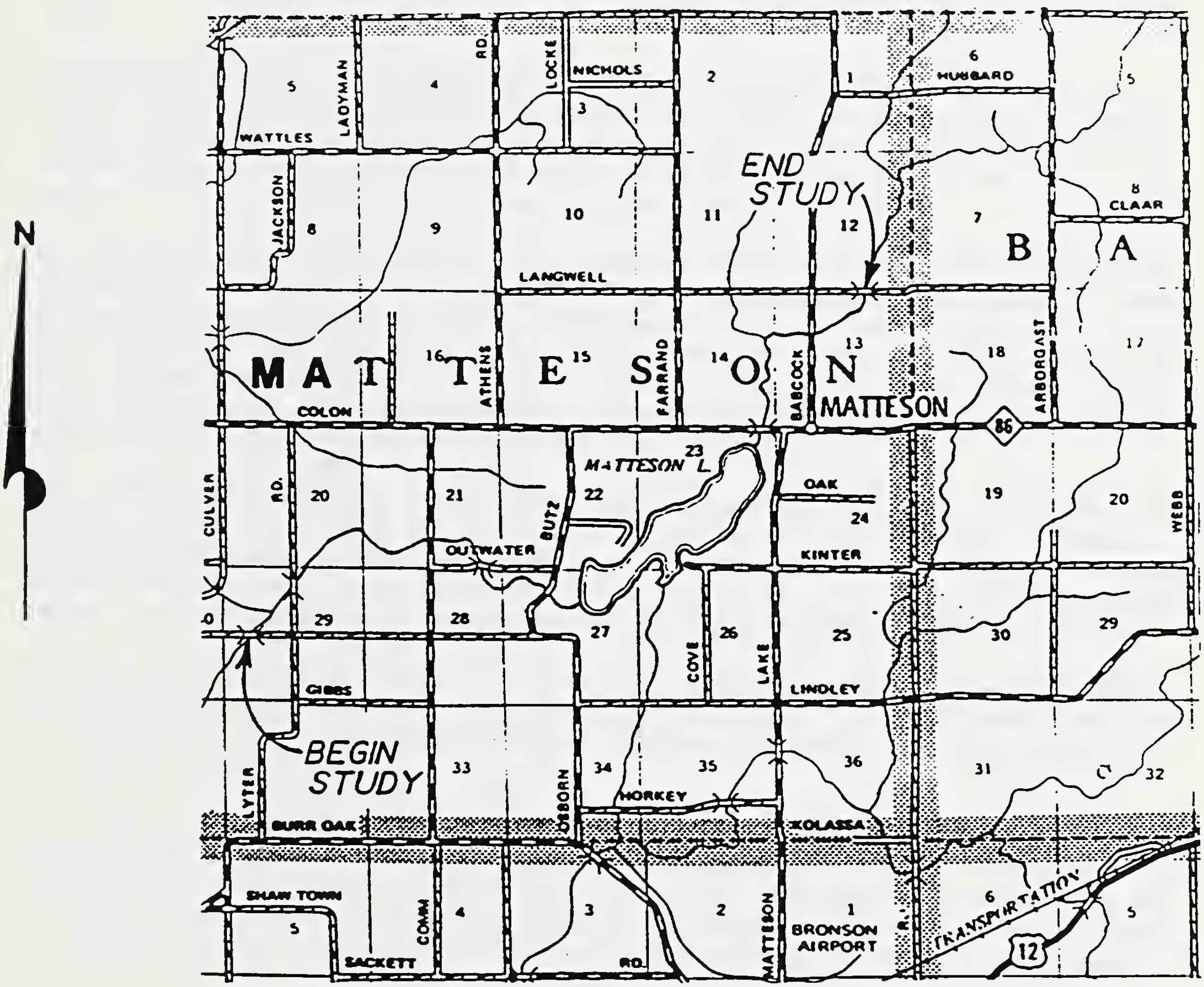
The study area is contained within Matteson Township. High water profiles and flood plain delineations were made along Little Swan Creek for a distance of about 5 miles. In addition, flood plain delineations were made around Matteson Lake. The study area is identified on Figure 1.

FIGURE 1

FLOOD PLAIN MANAGEMENT STUDY AREA

MATTESON LAKE / LITTLE SWAN CREEK

BRANCH COUNTY, MICHIGAN



KEY TO COUNTIES

LEGEND

STUDY REACH

NATURAL VALUES 1/

Little Swan Creek is a second class warm-water stream. The associated flood plain of Little Swan Creek and Matteson Lake provides a number of beneficial functions including flood storage, wildlife and fisheries habitat and filtering for maintaining water quality.

Water quality in Little Swan Creek and Matteson Lake has been greatly impaired by non-point source pollution. Excessive turbidity, increasing sedimentation, large areas of dense aquatic vegetation and stunted fish populations have limited the recreational and aesthetic values of Matteson Lake and Little Swan Creek.

Matteson Lake has a long history of water quality problems. In the winter of 1985-86, the lake was treated with Rotenone to kill the existing fish populations. Fish were restocked in the spring of 1986, along with Brown Trout in Little Swan Creek below Matteson Lake. It appears that the Brown Trout stocking was not successful and will not be continued.

Representative mammals found in the watershed area include white-tailed deer, striped skunk, mink, raccoon, woodchuck and eastern cottontail rabbit. Representative birds include killdeer, mourning dove, ring-necked pheasants, flickers, starlings and bobwhite quail. Common waterfowl that may be found in the area during migration include Canada goose, mallard duck, wood duck, pintail, green-winged teal and ring-neck duck. Great blue herons, little blue herons, green herons and American bitterns may also be found.

The federally endangered Indiana Bat (Myotic Sodalis) is known to inhabit the area. During the spring and summer, this southern bat migrates to southern Michigan and forms nursery colonies in riparian and flood plain forests along rivers and streams. Activities which remove or alter flood plain forests will need to be investigated to determine their impact on the Indiana Bat.

Matteson Lake, with its public access site, provides opportunities for fishing, boating and swimming. Since the riparian areas of Little Swan Creek are privately owned, the fishing opportunities for the public are generally limited to road crossings.

Little Swan Creek below Matteson Lake provides a diversity of aquatic insects, including caddisflies and mayflies, as a food source for fish. Woody debris provides cover for fish. Activities which alter the channel by deepening and widening should include plans for practices such as bank covers, an undulating bottom to provide pools and riffles and establishing streamside vegetation.

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1/ Information from Swan Creek Watershed Tri-Agency Team Report dated July 1989 by Lynn Sampson, State Biologist, SCS, Michigan.

Annual flooding occurs in the early spring due to a combination of snowmelt and rainfall, and occasionally in the fall due to heavy rains.

Flood damages along Matteson Lake/Little Swan Creek in Matteson Township are primarily limited to roads and residences around Matteson Lake. The 100-year flood inundates approximately 980 acres. Forty-five residences would experience first-floor flooding during a 100-year flood. In addition, 29 residences would sustain yard damage and 29 basements would be flooded during a 100-year flood.

Lyter, Outwater, Butz, Langwell and Babcock Roads would be impassible in the event of a 100-year flood. Flood flows would be less than 0.5 feet deep over Comm and Linley Roads and M-86 in the event of a 100-year flood, and could be used by emergency vehicles assuming the roads are structurally adequate.

This study provides high water profiles and areas subject to flooding based on analyses of existing stream hydraulics and current watershed and flood plain conditions. Water surface profiles along the study reaches are shown for the 10-year, 50-year, 100-year and 500-year flood events. The approximate areas of inundation for two floods, the 100-year and 500-year, are shown on the Flood Hazard Maps.

There are areas in Matteson Township that are flood-prone and are not shown in this report. These flood-prone areas are a result of soil and high water table conditions. The Soil Survey of Branch County, issued in September 1986, describes and delineates these areas.

Typical valley sections shown in Appendix B indicate the effects of the four floods. Flood discharges used for computing high water profiles in the study area are shown in Table 1 in Appendix C. Table 2 in Appendix C shows flood elevations at each of the surveyed valley sections for present conditions.

Floodways have been delineated for Matteson Lake/Little Swan Creek and have been provided to the Sponsors in a separate report.

While no computations were made to reflect the problems of ice and debris blockage at bridges, because of the wide possible variations in conditions, a few generalized comments can be made. Ice and debris can often totally block an opening. To determine possible effects, look at the high water profile sheets. At each bridge or culvert, a "low point or road overflow" symbol is shown. Based on field surveys, this is the elevation at which the road would flood. If there is no culvert capacity available, all flows would need to go over the road through this low section. The depth of flow and flooding would depend on the quantity of flow, as well as cross-sectional area available for flow.

DETERMINATION OF FLOOD HAZARD FOR SPECIFIC LOCATION

To determine flood levels for a specific location, locate the area on the Flood Hazard Map (Sheet 1 of 2) and its relationship to the nearest identification point (cross-section, road).

For those areas within the flood hazard boundaries, refer to the high water profile (Sheet 2 of 2), locating the area on the profile. The mean sea level flood elevation can then be determined for the appropriate flood event. Table 2 (Appendix C) shows flood elevations at each cross-section.

If the specific location is outside the flood hazard boundaries, there is no apparent flood hazard, unless the area is subject to high water table conditions (see soil survey report) or localized flooding.

EXISTING FLOOD PLAIN MANAGEMENT

Currently, Matteson Township has no existing flood plain ordinances or flood insurance. Even though a flood plain ordinance is not in effect, the Basic Building Code (BOCA) is enforced in the community and requires that the lowest horizontal structural member be at or above the 100-year flood plain elevation. The flood plain management study will provide the information needed to enforce the existing building code.

The objectives of flood plain management are to reduce the damaging effects of floods, preserve and enhance natural values and provide for optimal use of land and water resources within the flood plain. Flood plain management can minimize potential flood damages by:

1. Prohibiting uses which are dangerous to public health or safety in times of flood.

2. Restricting building or other development which may cause increased flood heights or velocities.

3. Requiring that public or private facilities that are vulnerable to floods be protected against flood damage at the time of construction.

4. Protecting individuals from investments in flood hazard areas which are unsuited for their intended purposes.

5. Providing information on flood-proofing techniques for existing structures in the flood plain.

There are numerous flood plain management alternative categories and tools that can be employed to accomplish the above objectives and goals. The ones that apply to this area are suggested below. Other flood plain management techniques should be considered and may well prove to be effective in reducing or preventing flood damages. Many of the road crossings should be resized when replacement is necessary. These alternatives may not completely solve the flooding problems but will help reduce flooding damages.

Present Condition

This is the "no change" alternative, which reflects ongoing flood plain development pressures and management trends. Local governmental units can continue to plan, zone and accept or reject requests for alternative flood plain and adjacent land uses. Flood problems may continue to increase if development continues.

Land Treatment

This alternative discusses opportunities to minimize or decrease changes in upland runoff and erosion because of land use changes. The traditional approach of accelerating conservation land treatment, by working with landowners to install conservation practices, will minimize soil erosion and reduce runoff. Installation of such measures as tree planting, windbreaks, forest management, permanent vegetative cover and on-site water storage will all reduce runoff, erosion and sedimentation.

As rural areas urbanize, the increase in peak discharges due to more efficient conveyance paths and increased impervious areas can have a significant adverse impact on downstream areas. There is a growing interest on the part of planners, developers and the public in protecting downstream areas from induced flood damages that may accompany increased peaks and stages. Planning authorities are proposing local ordinances that restrict the type of development permitted and the impact development can have on the watershed. One of the primary controls that could be imposed is that future-condition discharges cannot exceed present-condition discharges at some predetermined frequency of occurrence at specified points on the channel.

Methods to control runoff in urbanizing areas reduce either the volume or the rate of runoff. The effectiveness of any control method depends on the available storage, the outflow rate and the inflow rate. Because a great variety of methods can be used to control peak flows, each method proposed should be evaluated for its effectiveness in the given area.

MEASURES FOR REDUCING AND DELAYING URBAN STORM RUNOFF

Area	Reducing Runoff	Delaying Runoff
Parking Lots	1. Porous pavement a. Gravel parking lots b. Porous or punctured asphalt 2. Concrete vaults and cisterns beneath parking lots in high value areas 3. Vegetated ponding areas around parking lots 4. Gravel trenches	1. Grassy strips on parking lots 2. Grassed waterways draining parking lot 3. Ponding and detention measure for impervious areas a. Rippled pavement b. Depressions c. Basins
Residential	1. Cisterns for individual homes or groups of homes 2. Gravel driveways (porous) 3. Contoured landscape 4. Groundwater recharge a. Perforated pipe b. Gravel (sand) c. Trench d. Porous pipe e. Dry wells 5. Vegetated depressions	1. Reservoir or detention basin 2. Planting a high delaying grass (high roughness) 3. Gravel driveways 4. Grassy gutters or channels 5. Increased length of travel of runoff by means of gutters or diversions

Preservation and Restoration of Natural Values

Flood plains, in their natural or relatively undisturbed state, provide three broad sets of natural and beneficial resources and resource values.

Water resource values include natural moderation of floods, water quality maintenance and groundwater recharge. The physical characteristics of the flood plain shape flood flows. Flood plains generally provide a broad area to spread out and temporarily store flood waters. This reduces flood peaks and velocities and the potential for erosion.

Flood plains serve important functions in protecting the physical, biological and chemical integrity of water. A vegetated flood plain slows the surface runoff, causing it to drop most of its sediment load on the flood plain. Pathogens and toxic substances entering the main water body through surface runoff and accompanying sediments are decreased.

The natural flood plain has surface conditions favoring local ponding and flood detention, plus subsurface conditions favoring infiltration and storage. The slowing of runoff provides additional time for it to infiltrate and recharge available ground water aquifiers, and also provides for natural purification of the waters.

Flood plains support large and diverse populations of plants and animals. In addition, they provide habitat and critical sources of energy and nutrients for organisms in adjacent and downstream terrestrial and aquatic ecosystems. The wide variety of plants and animals supported directly and indirectly by flood plains constitutes an extremely valuable, renewable resource important to economic welfare, enjoyment and physical well-being.

The flood plain is biologically important because it is the place where land and water meet and the elements of both terrestrial and aquatic ecosystems mix. Shading of the stream by flood plain vegetation moderates water temperatures; roots and fallen trees provide instream habitat; and near stream vegetation filters runoff, removing harmful sediments and buffering pollutants, to further enhance instream environments.

Flood plains contain cultural resources important to the nation and to individual localities. Native American settlements and early cities were located along the coasts and rivers in order to have access to water supply, waste disposal and water transportation. Consequently, flood plains include most of the nation's earliest archeological and historical sites. In addition to their historical richness, flood plains may contain invaluable resources for scientific research. For example, where flood plains contain unique ecological habitats, they make excellent areas for scientific study. Flood plains may provide open space community resources. In urban communities, they may provide green belt areas to break urban development monotony, absorb noise, clean the air and lower temperatures. Flood plain parks can also serve as nature study centers and laboratories for outdoor learning experiences.

It is recommended that several selected open space areas be preserved, especially in the undeveloped areas. Their preservation, in accordance with soil limitations and good land use management, will reduce development hazards, prevent additional future flood damages and enhance the urban environment.

1. Soils with high water tables should be retained in natural vegetation. No commercial or residential construction should take place on these soils since the limitations are severe. The Soil Conservation Service has completed a detailed soil survey of Branch County. Copies of the material, including maps and interpretations, are available for reference in the Branch County Soil Conservation District Office located at 1110 West Chicago Road, Coldwater, Michigan 49036-9307. This information can be used to determine the kinds of soils in a given area and their limitations for various uses.

2. Upland open space should be retained in the natural state as much as possible.

3. Private wooded areas on steep slopes should be preserved from all development. Destruction of natural cover on these steep slopes usually causes excessive erosion during construction. Preservation of these wooded sites would also enhance housing developments in the area.

4. Developing areas should provide on-site flood water storage to temporarily store additional runoff volumes and peaks created by their urbanization.

5. Undeveloped flood plain areas should be managed for wildlife and recreation. These areas have potential for an excellent outdoor classroom. The Matteson Lake/Little Swan Creek system is easily accessible to many school and college students.

<u>Non-Structural Measures</u>

1. Develop and implement, or update, a flood plain protection and zoning ordinance based on the 100-year frequency high water profile and the flood plain delineations (Appendix A). Retaining the storage in the existing flood plain area will be necessary if this flood profile is to remain valid. Reducing the storage capacity in the system will tend to increase elevations and discharges above that indicated in this report.

2. Flood-proof buildings and residences already in the flood plain to reduce flood damages. Some basement windows and doors, floor drains and foundations can be modified to reduce effects of flood waters. Materials and supplies stored in vulnerable positions can be relocated and protected. These modifications can be planned and installed where it is desirable and/or feasible to continue using facilities currently in the flood plain.

3. Plans should be developed for alternate routes for automobile, truck and emergency vehicle traffic around those roads that will be inundated during the flood. This will require cooperation between city, township, county and state officials.

4. Maintenance of Little Swan Creek appears to be good. Debris, fallen trees and brush should be removed at least yearly. Snow and ice from road clearing operations should not be piled in the flood plain.

5. Owners and occupants of all types of buildings and mobile homes should obtain flood insurance coverage for the structure and contents, especially if located within or adjacent to the delineated flood hazard areas. The Sponsors should make necessary applications and pass needed resolutions

and zoning ordinances to qualify for subsidized federal flood insurance. Contact the Land and Water Management Division, Michigan Department of Natural Resources, Mason Building, P.O. Box 30028, Lansing, Michigan 48909 for additional information.

6. Due to the type of flooding that occurs around Matteson Lake, a flood warning system is not appropriate. It takes several hours for the lake to peak and loss of life is very unlikely.

Structural Measures

Flood stages can be reduced by improving flow conditions within the channel by increasing the stream's carrying capacity. Methods recommended are improved bridge openings with reduced channel obstructions and channel construction.

The following structural measures were considered, as requested by the Sponsors:

1. Replace existing 15-foot weir and 4-foot x 15-foot box culvert under Butz Road with a 66-foot weir and a 7-foot x 24-foot reinforced concrete box culvert. In addition, an 8-foot x 16-foot reinforced concrete box culvert would be required under Comm Road. The opening under Outwater Road would have to be enlarged by excavating under the bridge, and underpinning the abutments. The abutments would need to be analyzed for structural adequacy. Channel construction (10-foot bottom width, 2:1 side slopes and 0.10 percent grade) would be required from Comm Road to Butz Road. Estimated construction cost, based on 1993 prices, for this project is $250,000. The installation of these structural measures would reduce the 100-year flood elevation from 892.00 feet to 890.50 feet, protecting 72 homes. The flooding of two basements and minor yard damage would still occur as the result of a 100-year flood.

2. Unless otherwise noted, the following road crossings are undersized for a 50-year flood in accordance with Branch County Road Commission Criteria and should be replaced as follows:

Crossing	Existing	Improved
Lindley Road, C.S.10.0	8.2'X40' Bridge	Existing Opening Adequate
Lyter Road, C.S.11.0	8.2'X40' Bridge	2/
Comm Road, C.S.12.0	Twin 7' CMPs	8'X16' RC Box Culvert 1/
Outwater Road, C.S.13.0	6.4'X 19'Bridge	Enlarge Existing Opening to 10.2'X19' 1/
Butz Road, C.S.14.0	4'X15' Box Culvert	7'X24' RC Box Culvert 1/
M-86, C.S.15.0	5'X35' Bridge	Enlarge Existing Opening to 6.4'X35' and Underpin Abutments
Babcock Road, C.S.16.0	5'X13' Bridge	7'X18' RC Box Culvert
Langwell Road, C.S.17.0	Twin 6' CMPs	7'X18' RC Box Culvert

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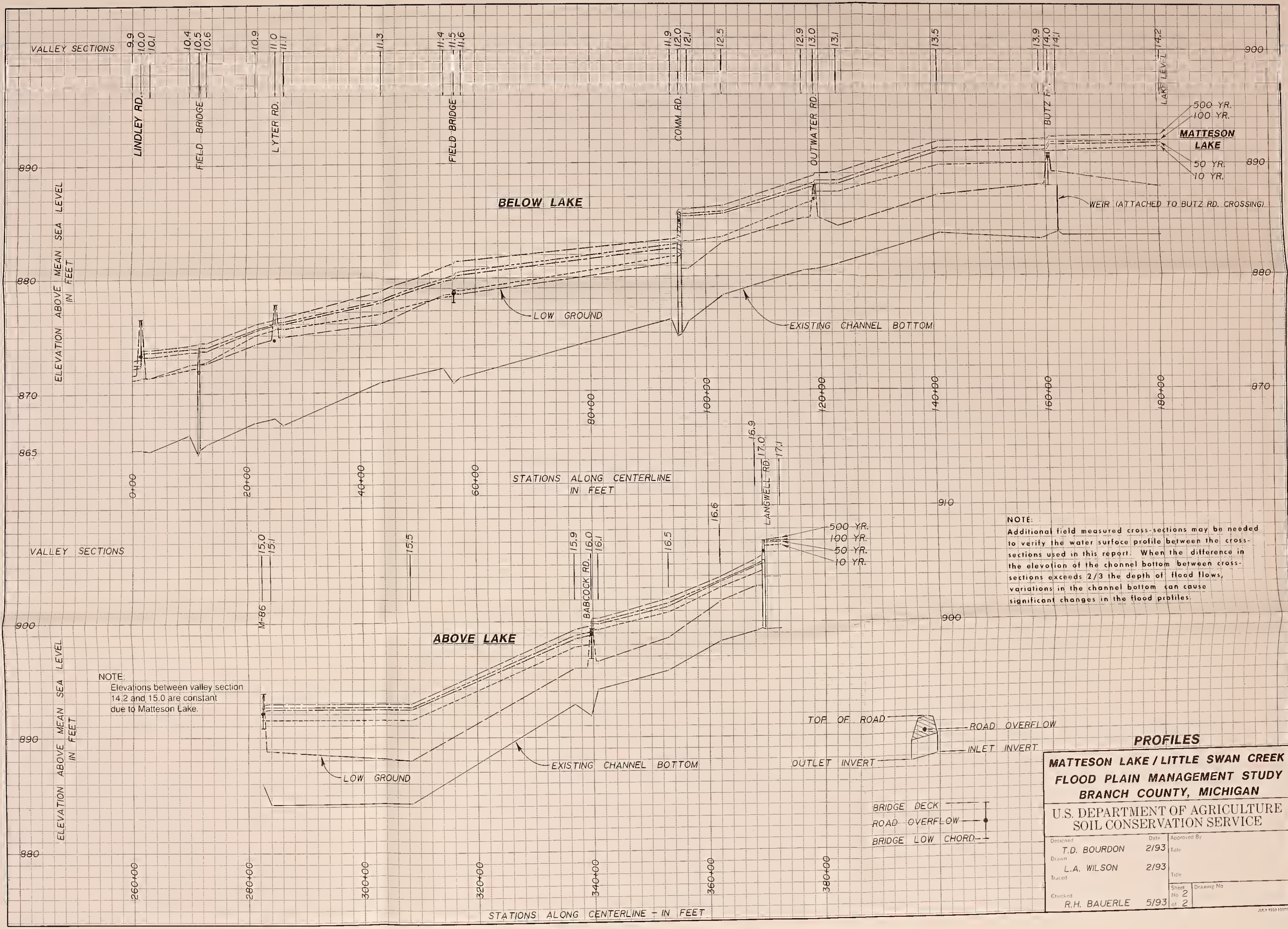
1/ Improved for 100-year flood due to residential areas around Matteson Lake.

2/ Clean out under bridge and build up 1000 ft. of road 1 to 1-1/2 ft. from 600 to 1600 ft. south of crossing. Minimum road elevation at 876.5'.

APPENDIX A



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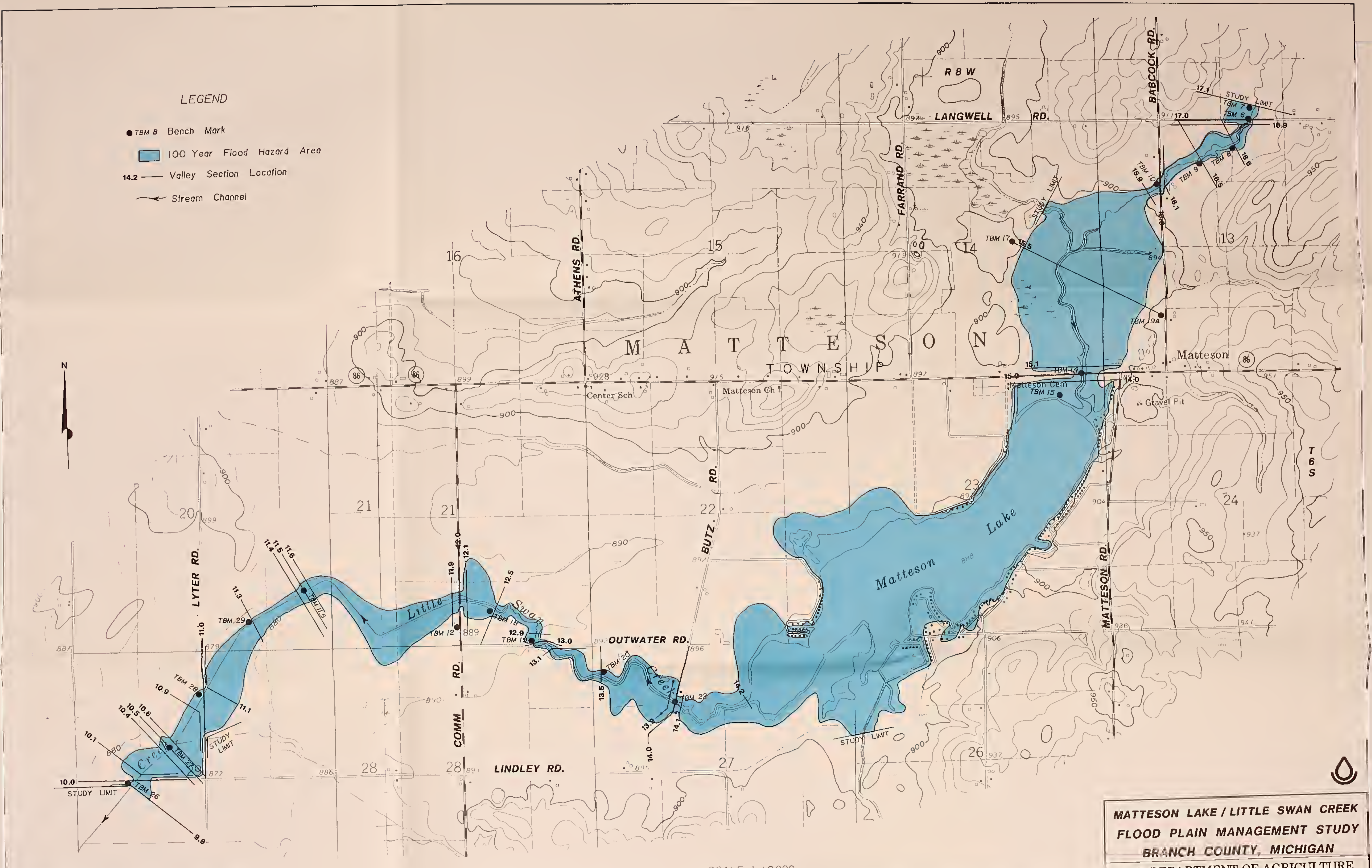

NOTES:

Limits of flooding shown may vary from actual locations on the ground and due to inherent aerial photographic displacement the photographic image may vary from true ground location.

The limits of the 100-Year and 500-Year Floods were too close to delineate, and the limits of the two flood plains are shown as the same line.

SCALE 1:12000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

MATTESON LAKE / LITTLE SWAN CREEK
FLOOD PLAIN MANAGEMENT STUDY
BRANCH COUNTY, MICHIGAN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed T. D. BOURDON	4/93	Approved by
Drawn L. A. WILSON	4/93	Title
Traced		Title
Checked R. H. BAUERLE	5/93	Sheet No 1 of 2 · Drawing No

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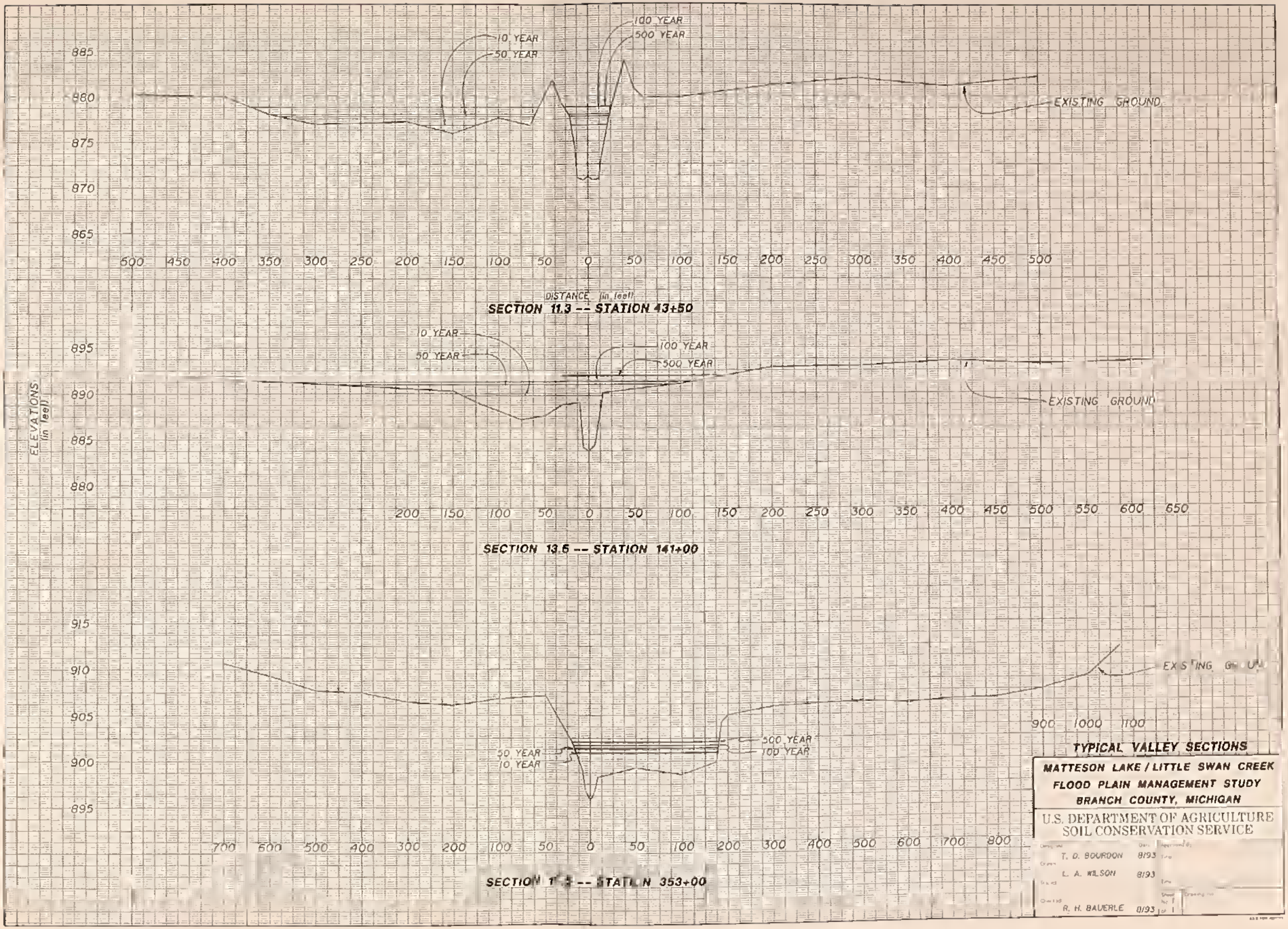
APPENDIX B



10 YEAR
50 YEAR
100 YEAR
500 YEAR
EXISTING GROUND
885
880
875
870
865
500 450 400 350 300 250 200 150 100 50 0 50 100 150 200 250 300 350 400 450 500
DISTANCE (in feet)
SECTION 11.3 -- STATION 43+50
10 YEAR
50 YEAR
100 YEAR
500 YEAR
EXISTING GROUND
ELEVATIONS (in feet)
895
890
885
880
200 150 100 50 0 50 100 150 200 250 300 350 400 450 500 550 600 650
SECTION 13.5 -- STATION 141+00
915
910
905
900
895
500 YEAR
100 YEAR
50 YEAR
10 YEAR
700 600 500 400 300 200 100 50 0 50 100 200 300 400 500 600 700 800 900 1000 1100
SECTION
353+00
TYPICAL VALLEY SECTIONS
MATTESON LAKE / LITTLE SWAN CREEK
FLOOD PLAIN MANAGEMENT STUDY
BRANCH COUNTY, MICHIGAN
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
T. D. BOURDON 8/93
L. A. WILSON 8/93
R. H. BAUERLE 8/93

APPENDIX C

TABLE 1 - FLOOD DISCHARGES

LOCATION	TR-20 SEC.	FROM WSP-2 SEC.	TO WSP-2 SEC.	DRAINAGE AREA SQ MILES	ESTIMATED PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-YR	50-YR	100-YR	500-YR
To M-86	001	15.5	17.1	9.24	480	760	890	1,210
To Matteson Lake (into lake)	004	14.9	15.1	13.51	690	1,070	1,260	1,700
To Butz Road (out of lake)	01	12.5	14.1	17.85	370	690	840	1,250
To Lyter Road	011	11.3	12.1	19.07	410	725	875	1,280
To Lindley Road	017	9.9	11.1	20.92	470	720	870	1,270

TABLE 2 - FLOOD ELEVATIONS AT SECTIONS - BELOW LAKE

LOCATION	SECTION	STATION	10-YEAR	50-YEAR	100-YEAR	500-YEAR
Lindley Road	9.9	0+00	871.2	872.2	872.5	872.9
	10.0 D	1+41	871.3	872.3	872.5	873.0
	10.0 U	1+59	871.4	873.2	873.5	873.8
	10.1	3+00	871.4	873.2	873.6	873.8
	10.4	10+00	872.1	873.6	873.9	874.2
Farm Crossing	10.5 D	11+50	872.2	873.6	873.9	874.3
	10.5 U	11+80	872.6	873.7	874.0	874.4
	10.6	13+00	872.7	873.7	874.0	874.4
	10.9	21+50	875.0	875.4	875.5	876.0
Lyter Road	11.0 D	24+91	875.5	875.9	876.0	876.4
	11.0 U	25+09	875.6	876.0	876.1	876.5
	11.1	26+50	875.6	876.0	876.2	876.6
	11.3	43+50	876.8	877.8	878.0	878.8
	11.4	54+50	878.2	879.7	880.0	881.0
Farm Crossing	11.5 D	56+29	878.3	879.9	880.3	881.3
	11.5 U	56+45	878.8	880.2	880.5	881.5
	11.6	57+50	878.8	880.3	880.6	881.5
	11.9	94+00	881.8	882.5	882.8	883.3
Comm Road	12.0 D	95+17	881.8	882.5	882.9	883.4
	12.0 U	95+83	882.9	885.3	885.5	885.8
	12.1	97+00	882.9	885.3	885.5	885.8
	12.5	103+00	883.4	885.5	885.7	886.2
	12.9	117+00	886.3	887.6	887.9	888.5
Outwater Road	13.0 D	119+90	886.6	887.9	888.2	888.8
	13.0 U	119+10	887.4	888.1	888.4	889.0
	13.1	123+00	887.4	888.1	888.4	889.1
	13.5	141+00	889.8	891.0	891.3	891.9
	13.9	159+00	890.0	891.1	891.5	892.1
Butz Road	14.0 D	160+32	890.0	891.2	891.5	892.1
	14.0 U	160+69	891.0	891.6	891.8	892.3
	14.1	162+00	891.0	891.6	891.8	892.3
Lake Level	14.2	180+50	891.5	891.8	892.0	892.5

TABLE 2 - FLOOD ELEVATIONS AT SECTIONS - ABOVE LAKE 1/

LOCATION	SECTION	STATION	10-YEAR	50-YEAR	100-YEAR	500-YEAR
M-86	15.0 D	282+31	891.5 2/	891.8 2/	892.0 2/	892.5 2/
	15.0 U	282+69	891.5 2/	892.3	892.6	892.8
	15.1	284+00	891.5 2/	892.4	892.6	892.9
	15.5	308+50	891.5 2/	892.4	892.6	892.9
	15.9	336+85	897.8	898.5	898.8	899.3
Babcock Road	16.0 D	339+57	898.0	898.8	899.1	899.6
	16.0 U	339+83	899.3	899.8	900.0	900.3
	16.1	340+86	899.3	899.8	900.0	900.3
	16.5	353+00	900.9	901.4	901.7	902.1
	16.6	361+85	903.0	903.5	903.6	903.9
	16.9	368+10	904.2	904.8	904.9	905.4
Langwell Road	17.0 D	369+08	904.4	905.0	905.2	905.7
	17.0 U	369+62	906.5	906.8	906.9	907.0
	17.1	372+35	906.6	906.9	907.0	907.2

1/ Starting Lake Level at Elevation 889.3.
2/ Tailwater from Matteson Lake.

APPENDIX D

Survey Procedures

Field surveys were made of bridges, roads, structures, channels and flood plains of Matteson Lake and Little Swan Creek by the Soil Conservation Service (SCS) in December 1992 and completed in January 1993. Temporary bench marks, based on USC and GS mean sea level elevation datum of 1929, were established using second order accuracy. Temporary bench marks are described in Appendix E. For Matteson Lake and Little Swan Creek, 10 road bridges and 25 valley cross-sections were surveyed. In addition, ground elevations and first-floor elevations were surveyed around the lake to determine if residences were in or out of the 100-year flood plain.

Hydrology and Hydraulics

Physical data were obtained from U.S. Geological Survey (USGS) topographic maps and soil survey maps, as well as on-site field inspections. The watershed boundary was determined from map studies and field checks. The watershed was divided into 7 sub-watershed areas for use in evaluating the runoff volumes. Drainage areas for the sub-watersheds were measured from USGS topographic maps. Times of concentration were calculated for the sub-watersheds using the Michigan Department of Natural Resources' UD-21 method and Manning's formula. Each sub-watershed was evaluated for land use, cover and soils. Runoff curve numbers were calculated using Geographic Information Systems as described in Part 7 of the technical support documentation book.

Channel flood routings to establish peak discharge-frequency relationships were made using the PC version of the SCS TR-20 Hydrology Computer Program dated September 1, 1983. The Modified Attenuation-Kinematic (Att-Kin) method of routing through stream channels is used by this program. This method is derived from inflow-outflow hydrograph relationships. Elevation-storage relationships for the dam were obtained from USGS quadrangle maps. The SCS WSP-2 computer program was used to obtain stage-discharge relationships. The TR-20 computer program uses these data and the Storage-Indication Method of evaluating the effect of the structures in reducing peak flood discharges. The TR-20 Flood Routing Schematic can be found in Part 12 of the technical support documentation. Table 1, in Part 2, lists discharges obtained from the flood routings and Table 2, in Part 3, lists flood elevations at sections located in the study area. In accordance with criteria as set forth in SCS TR-60, Earth Dams and Reservoirs (Rev. 8/1985), 4 cfs/square mile (csm) was added to account for snow melt and base flow in the 2-, 10-, 50-, 100- and 500-year floods.

The TR-20 model was calibrated to reproduce the May 30-31, 1989 flood event and has been accepted as a basis of the hydrology and flood routing for Matteson Lake and Little Swan Creek. The MDNR Dimensionless Hydrograph was used in the TR-20 Computer Program. Hourly rainfall information from the weather station at Coldwater, Michigan was used to model the May 30-31, 1989 flood. The predicted flood elevation was within 0.1 foot of the observed elevation. The Antecedent Moisture Condition (AMC) for the time before the storm was determined from the rainfall data and NEH-4, Table 4.2. The AMC is based upon the 5-day antecedent rainfall before the storm event. From the rainfall data, the AMC was between AMC I and AMC II. The condition selected was 0.75 of the way between I and II, closer to II.

Water surface profiles for Matteson Lake and Little Swan Creek were developed using the SCS WSP-2 computer program. Separate runs were made for upstream and downstream of the lake. The starting elevation of the lake was based upon 4 cfs/square mile (csm) and 17.85 square miles of runoff at the outlet of the lake. This gives 71 cfs of baseflow. Based on weir flow calculations at the outlet of the lake, 889.3 feet was used as the starting lake elevation. This program uses the step method of computation to solve the Bernoulli equation, and the Bureau of Public Roads bridge loss analysis. Flood discharges determined from flood routings were used in the water surface profile program to develop high water profiles along the channel. Manning's "n" values were determined from photographs and field investigations of the channel and flood plain.

Normal bridge and channel flow conditions were assumed in the hydraulic computations. No consideration was made for openings blocked by ice or other debris. Channel and flood plain flow characteristics may change due to vegetative growth, sedimentation, scour, debris accumulation, filling and encroachment. Computations for this study considered only those features in the flood plain at the time of the field surveys. Future flood plain developments and modifications, as well as changes in the upstream drainage area land use and cover will require recomputation of water surface profiles.

Flood plain delineations were made on the USGS quadrangle contour maps. Computed water surface elevations at surveyed sections and bridges were used to identify flood plain limits. Between sections, topographic map interpretations and field inspections were used to delineate the flood boundary lines. Limits of flooding shown on the maps may vary from true ground location due to inherent photographic displacement. High water profile elevations and detailed field surveys should be used to determine the extent or depth of flooding at any specific site.

The limits of the 100-year and 500-year floods were too close to deferentiate, so the limits of the two flood plains are shown as the same line on the quadrangle sheet.

APPENDIX E

BENCH MARK DESCRIPTIONS

MATTESON LAKE/LITTLE SWAN CREEK

BRANCH COUNTY, MICHIGAN

TBM 6

Section 13, T6S, R8W - Top of downstream end of west (right side looking downstream) 7' x 6.0' twin CMP arch culvert at Langwell Road.

Elev. 904.89

TBM 7

Section 12, T6S, R8W - Top of SCS spike and disc in south side 6" diameter Cherry tree located on west side of creek approximately 200' north of Langwell Road.

Elev. 907.62

TBM 8

Section 13, T6S, R8W - Top of SCS spike and disc in east side of 5" diameter Elm tree located on east side of creek approximately 700' south of Langwell Road.

Elev. 904.73

TBM 9

Section 13, T6S, R8W - Top of SCS spike and disc in west side 36" diameter tree (Hickory) located on E. side of creek approximately 1,500' south of Langwell Road.

Elev. 909.05

TBM 10

Section 13, T6S, R8W - Northwest headwall marked by orange painted square approximately 0.3 miles south of intersection of Langwell Road and Babcock Road.

Elev. 899.07

TBM 11.5

Section 20, T6S, R8W - Top of downstream, right wingwall, marked by orange painted dot on southwest corner of wingwall on a farm lane bridge over Little Swank Creek on the south end of Tom Miller's property between Comm Road and Lyter Road and south of M-86.

Elev. 877.67

TBM 12

Section 21, T6S, R8W - USGS concrete monument and brass plate approximately 585' south of Little Swan Creek crossing Comm Road and approximately 5.1' west of center line of Comm Road.

Elev. 888.501

TBM 14

Section 14, T6S, R8W - Southwest corner of wingwall, top marked by a painted orange chiseled square on bridge over M-86 over Little Swan Creek.

Elev. 894.37

TBM 15

Section 23, T6S, R8W - Southwest corner of outhouse at public access on Matteson Lake chiseled orange square in round concrete corner post piling.

Elev. 890.82

TBM 17

Section 14, T6S, R8W - Top of irrigation riser (paint mark) approximately 150^{o} (degrees) southeast Consumers Power pipeline marker.

Elev. 900.34

TBM 18

Section 21, T6S, R8W - SCS spike and disc in 20' diameter Cherry tree, south side of tree and south side of Little Swan Creek approximately 680' east of road crossing of Little Swan Creek and Comm Road parallel to creek.

Elev. 884.36

TBM 19

Section 21, T6S, R8W - Orange painted dot on northeast corner of bridge over Little Swan Creek on Outwater Road. Orange dot on top of northwest "I" beam.

Elev. 887.24

TBM 19A

Section 13, T6S, R8W - SCS spike and disc northwest side power pole (telephone) 150' east of Babcock Road on CS 15.5 E. end.

Elev. 905.30

TBM 20

Section 27, T6S, R8W - SCS spike and disc in 3" diameter Oak Tree approximately 400' south of Outwater Road in line with west end of brown pole barn.

Elev. 892.17

TBM 22

Section 27, T6S, R8W - SCS spike and disc in guardrail post on northwest corner of bridge over Little Swan Creek on Butz Road.

Elev. 891.32

TBM 26

Section 29, T6S, R8W - Top of downstream wingwall west side marked by a chiseled square painted orange on bridge over Little Swan Creek and Linley Road.

Elev. 875.71

TBM 27

Section 29, T6S, R8W - Top of steel tube 9' diameter. Orange dot on downstream end between stations 11.0 and 10.0.

Elev. 873.22

TBM 28

Section 29, T6S, R8W - Top of downstream wingwall, northside, marked by a chiseled square painted orange on bridge over Little Swan Creek and Lyter Road.

Elev. 877.30

TBM 29

Section 20, T6S, R8W - SCS spike and disc in south side of 16" Shagbark Hickory just south of home at 322 Lyter Road (in landowners' yard).

Elev. 882.40

APPENDIX F

GLOSSARY

BACKWATER - The resulting highwater surface upstream from a dam, bridge or other obstruction in a river channel or high stages in a receiving stream.

BRIDGE DECK - Elevation of road surface at the bridge.

BRIDGE LOW CLEARANCE - The lowest point of a bridge or other structure over or across a river, stream or water course that limits the opening through which water flows. This is referred to as "low steel" or "low chord". It often is higher than the low point of the roadway.

CHANNEL or WATER COURSE - An elongated depression either natural or man-made having a bed and well-defined banks varying in depth, width and length which gives direction to a current of water and is normally described as a creek, stream or riverbed.

CHANNEL BOTTOM - The lowest part of the stream channel (either in a constructed cross-section or a natural channel). Bottom elevations at a series of points along the length of a stream may be plotted and connected to provide a stream bottom profile.

CONFLUENCE - A flowing together or place of junction of two or more streams.

CROSS-SECTION or VALLEY SECTION - A graph showing the shape of the stream bed, banks and adjacent land on either side made by plotting elevations at measured distances along a line perpendicular to the flow of the stream.

DATUM - An assumed reference plane from which elevations and depths are measured such as from sea level.

ELEVATION-DISCHARGE RELATIONSHIP - The relationship between water surface elevation and rate of flow at a specified location for a range of flow rates.

FLOOD - A temporary overflow by a river, stream, ocean, lake or other body of land not normally covered by water. It does not include the ponding of surface water due to inadequate drainage such as within a development. It is characterized by damaging inundation, backwater effects of surcharging sewers and local drainage channels, and by unsanitary conditions within adjoining flooded habitated areas attributable to pollutants, debris and water table.

FLOOD CREST - The maximum stage or elevation reached by flood waters at a given location.

FLOOD FREQUENCY - A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative stream flow or rainfall and runoff records. It is customary to estimate the frequency with which specific flood stages or discharges may be equaled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates by strict definition are designated "exceedence frequence", but in practice the term "frequency" is used. The frequency of a particular stage or discharge is usually expressed as occurring once in a specified number of years.

10-YEAR FLOOD - A flood having a long-term average frequency of occurrence in the order of once in 10 years. It has a ten percent chance of being equaled or exceeded in any given year.

100-YEAR FLOOD - A flood having a long-term average frequency of occurrence in the order of once in 100 years. It has a one percent chance of being equaled or exceeded in any given year. This flood is comparable to the "Intermediate Regional Flood" used by the U.S. Army Corps of Engineers.

FLOOD PEAK - The maximum instantaneous discharge or volume of flow in cubic feet per second passing a given location. It usually occurs at or near the time of the flood crest.

FLOOD PLAIN - The relatively flat area or low lands covered by flood waters originating with either the adjoining channel of a water course such as a river or stream, or a body of standing water such as an ocean or lake.

FLOOD PRONE AREA - Areas that experience ponding due to high water table soils and/or inadequate outlets.

FLOOD ROUTING - The process of determining progressively the timing and shape of a flood wave at successive points along a stream. This procedure is used to derive a downstream hydrograph from an upstream hydrograph. Local inflow and tributary hydrographs are considered.

FLOOD STAGE - The elevation at which overflow of the natural stream banks or body of water occurs.

FLOODWAY - The portion of the flood plain including the channel of the stream that is required for the conveyance of flood flow.

FLOODWAY FRINGE - The area of the flood plain lying outside the floodway which may be covered by flood waters originating from an adjoining river or stream.

HEAD LOSS - The effect of obstructions, such as narrow bridge openings, dams or buildings, that limit the area through which water must flow, raising the surface water upstream from the obstruction.

HEADWATER - The tributaries and upper reaches which are the sources of the stream.

HIGH WATER or FLOOD PROFILE - A graph showing the relationship of water surface elevation location along the stream. While it is drawn to show surface elevations for the crest of a specific flood, it may be prepared for conditions at any other given time or stage.

HYDRAULICS - The science of the laws governing the motion of water and their practical applications.

HYDROGRAPH - A graph denoting the discharge or stage of flow over a period of time.

HYDROLOGY - The science dealing with the occurrence and movement of water upon and beneath the land areas of the earth.

INUNDATION - The flooding or overflow of an area with water.

LEFT BANK - The bank of the left side of a river, stream or water course, looking downstream.

LOW GROUND - The highest elevation at a specific stream channel cross-section at which the flow in the stream can be contained in the channel without overflowing into adjacent overbank areas.

MANNING'S "n" - A coefficient of channel and overbank roughness used in Manning's open channel flow formula, commonly called a retardance factor.

REACH LENGTH - A longitudinal length of stream channel selected for use in hydraulic or other computations.

RIGHT BANK - The bank on the right side of the river, stream or water course, looking downstream.

ROAD OVERFLOW - The lowest elevation on a road profile in the vicinity of where the road and stream cross. It is the first point on the roadway inundated if overtopping of the road occurs during a storm.

RUNOFF - That part of precipitation, as well as any other flow contributions, which appears in surface streams of either perennial or intermittent form.

TIME OF CONCENTRATION - Time required for water to flow from the most remote point of a watershed to the outlet or other point of reference.

WATERSHED - A drainage basin or area which collects runoff and transmits it, usually by means of streams and tributaries, to the outlet of the basin.

WATERSHED BOUNDARY - The divide separating one drainage basin from another.

APPENDIX G

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