NORTH SIDE SURFACE WATER STUDY

CITY OF STEVENS POINT, WISCONSIN

DONOHUE & ASSOCIATES, INC.
Consulting Engineers
Stevens Point, Wisconsin

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SUMMARY

Annual flooding along Moses Creek will continue to be a severe problem unless major improvements are made to the existing storm sewer system. Development of a computer model to simulate runoff conditions during an actual storm event identified specific problem areas. Superimposing future land use characteristics into the model identified locations where problems will become more severe.

Alternatives that were considered for alleviating the flooding problems range from a complete pumping system to a complete gravity system, with discharge in all cases to the Wisconsin River. With a total present worth of $3,854,000 for Phase I, the complete gravity system following a route along Prentice Street and Wisconsin Street is the more favorable alternative.

Prior to adopting a plan, the following course of action is recommended:

a) Obtain public input on the alternatives
b) Prepare an environmental assessment on the favorable alternatives
c) Review the report with Consolidated Papers, Inc. and University personnel from the University of Wisconsin - Stevens Point
d) Review the effects of each alternative on the long range planning goals of the community.

Following the adoption of the preferred alternative, implementation of the project can begin. Implementation should be in a systematic manner, and coordinated with other programs proposed by the City within the project areas.

CHAPTER 1

INTRODUCTION

BACKGROUND

As a result of urban expansion in the Stevens Point area, storm water runoff along the Moses Creek watershed has increased significantly. Evidence of this increase is annual flooding during the spring and summer.

A direct result of urban development is the reduction of pervious area, restricting the absorption of storm runoff directly into the soil. Decreasing the pervious area results in a larger volume of surface water contributed as runoff into open channels and storm sewers. When the volume of runoff exceeds the capacity of the open channel or storm sewers, flooding occurs as evidenced along Moses Creek.

Recognizing the severity of the problem, the City of Stevens Point authorized the preparation of this study to determine alternative solutions for the management of storm water runoff from the Moses Creek watershed.

PURPOSE AND SCOPE

This report investigates flooding within the Moses Creek watershed and determines the facilities required to alleviate the current problem. It also considers the measures necessary to control increased storm runoff as additional development occurs. More specifically, this study includes:

1. A detailed description of the existing storm water system.

2. An analysis of the capacity of the existing system to carry storm water runoff under existing and future land use conditions.

3. An analysis of alternative methods of solving the Moses Creek flooding problem.

4. Recommendations for controlling storm water runoff in the Moses Creek watershed.

It should be recognized that this is a study and not a design document. Its purpose is to define problems, forecast future situations, examine a range of alternative solutions to existing and future problems, and recommend a course of action and way of implementing that course of action. Implementation of the adopted plan will require preparation of detailed designs, contract documents and construction services.

OBJECTIVES OF THE PLAN

Objectives established to guide the analysis of the Moses Creek watershed included:

1. Provide a sound method for alleviating the current flooding problem, as well as satisfying storm water drainage requirements for future land use conditions.

2. Incorporate land use concepts currently adopted by local planning agencies.

3. Utilize existing wetland areas, wherever practical, for retention of storm water runoff.

These objectives take into consideration principles supported by the City of Stevens Point and the University of Wisconsin - Stevens Point for the Schmeeckle Reserve area north of Maria Drive.

CHAPTER 2

DESCRIPTION OF THE STUDY AREA

MOSES CREEK WATERSHED

The Moses Creek watershed is midway between the Plover River and Hay Meadow Creek watersheds within the Town of Hull and City of Stevens Point as shown on Figure 1. It is comprised of approximately 5000 acres of rural area and 500 acres of urban area. The entire watershed drains into a holding pond, referred to as the Crosby Avenue Slough, in the City of Stevens Point east of Crosby Avenue and south of the Public Service Corporation storage yard. Storm water is pumped from the slough into the Wisconsin River by two 50,000 gallon per minute (gpm) pumps and two 3,000 gpm pumps owned and operated by Consolidated Papers, Inc.

CLIMATE AND WEATHER

The Stevens Point area has a climate characterized by significantly different seasons with corresponding large variations in temperature and precipitation type, amount and intensity. Historically, peak stream flows in the area are in April when the snows are melting and the ground is frozen, allowing little or no infiltration to occur. However, because of large seasonal variations in weather conditions, flooding has been known to occur from the first spring runoff to the late fall rains.

Precipitation

Precipitation in the Stevens Point area has occurred as rain, sleet, hail and snow, with ranges from brief showers to brief, intense thunderstorms and longer duration rainfall/snow melt events. The average annual total precipitation is 31.6 inches of which approximately 33 percent runs off into streams. Rainfall intensities of about 1.8 inches in 1 hour, 2.95 inches in 6 hours, and 3.5 inches in 24 hours can be expected about once in 10 years. The greatest amount of rain occurring in 24 hours was 5.01 inches on August 18, 1947.

Temperature

Temperature is important in storm water studies because it influences the form of precipitation, rain or snow, the depth of frost which in turn affects run off conditions, and the likelihood of snow melt. Temperatures in the Stevens Point area range from a mean monthly temperature of 72°F in July to a mean average 16°F in January. Extreme temperatures are from the high 90's in July to 20 to 30 below in January and February.

Soils

The nature of the soils comprising the top layer of unconsolidated material in the study area is important because soil properties are a primary determinant of the volume of runoff for a given rainfall. The study area is comprised of soils from each of the four hydrologic soil groups A, B, C and D. Soils in group A and B are primarily sandy loams with high infiltration capacities; while those in groups C and D are clays with low infiltration capacity. Soils belonging to hydrologic groups C and D are located primarily in the upper

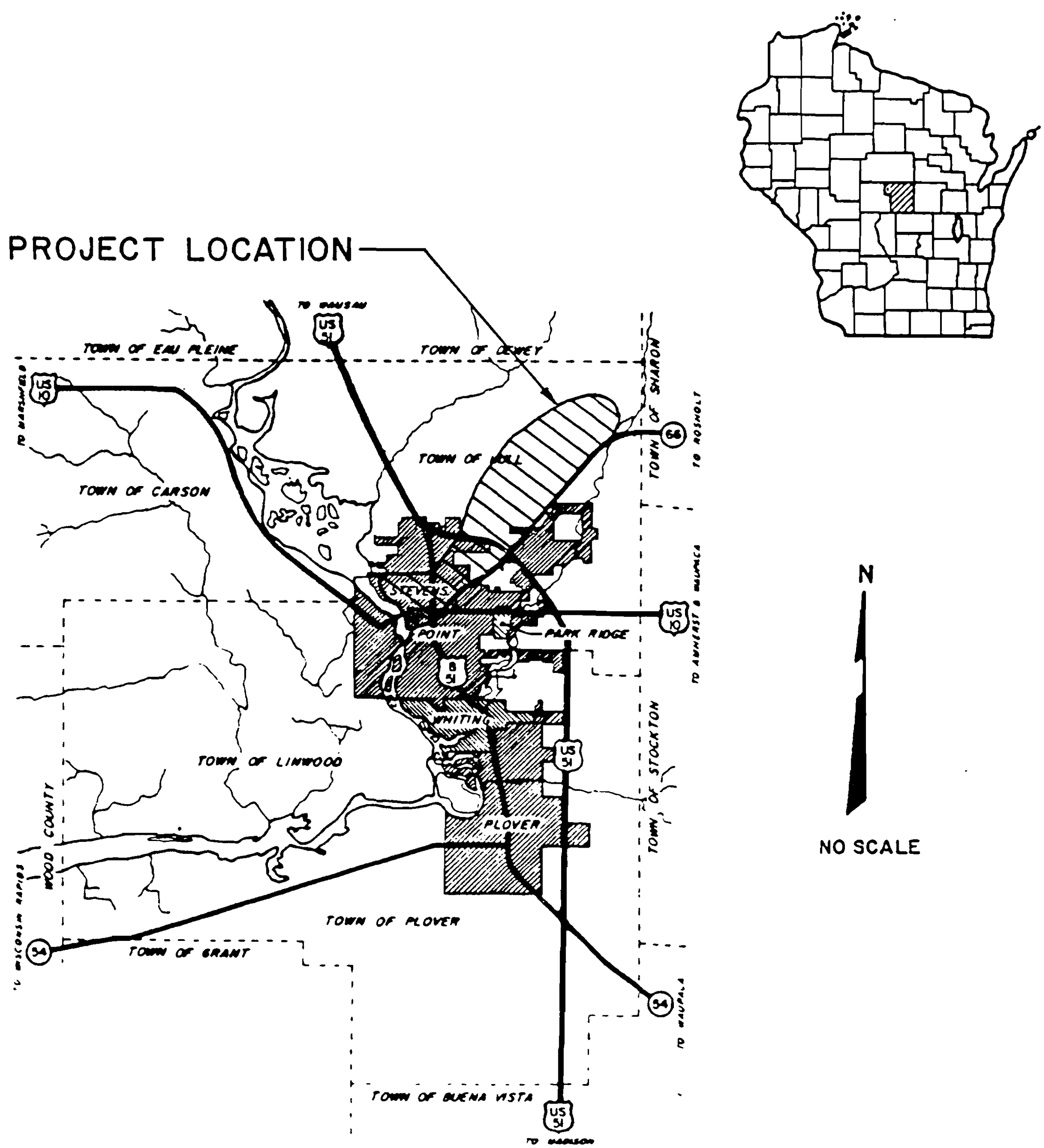

FIGURE 1
PROJECT LOCATION
NORTH SIDE SURFACE WATER STUDY
STEVENS POINT, WISCONSIN

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1979

rural area adjacent to the Moses Creek area corridor. Soils in the A and B group are located where there is extensive agricultural usage and residential development. Surface runoff of the soils in groups A and B is not expected to be significant because of the high infiltration capacity of the soils. This capacity can vary, however, depending on the level of the ground water table during various times of the year. Soils in groups C and D have a rather high runoff potential because of the low infiltration capacity.

TOPOGRAPHY

Land slope is important in storm water system planning and design. The Moses Creek watershed is flat and has approximately a 25 foot relief or a grade of 5 feet per mile from the upper reaches at Jordan Park to the discharge at the Crosby Avenue pump station. The contour of the land, which is fairly uniform, does not have any significant high or low spots. The flatter slopes in the Moses Creek system cause runoff to have a slow velocity. Therefore, larger diameter storm sewers and storm water channels are required to handle the peak volumes of runoff.

DRAINAGE STRUCTURES

Surface water runoff from the Moses Creek watershed is collected in natural and manmade swales and channels, culverts and storm sewers, and discharged into the Crosby Avenue Slough adjacent to the Wisconsin River. Surface water runoff is then pumped from the slough into the Wisconsin River.

Open Channels

Surface runoff from the rural area in the Town of Hull is conveyed through open channels. A defined channel exists for Moses Creek from Michigan Avenue to a point approximately 2000 feet northeast of Highway 51. North of that location, Moses Creek is an undefined channel with several areas being characterized by marsh type vegetation. Shallow ditches convey some surface runoff along the primary roadways in the Town of Hull. However, most surface water infiltrates into the soil and then moves laterally, to the Moses Creek system.

Detention/Retention Facilities

The Moses Creek watershed is characterized by a number of natural and manmade detention facilities. North of Dubay Avenue extended, Moses Creek is a retention area. Two manmade lakes north of Highway 51, Lake Susan and a borrow pit lake, also function as detention/retention facilities. The Sentry Insurance Company has constructed small detention ponds at their World Headquarters to assist in retaining storm water runoff from their facility. Dreyfus Lake, constructed by the University of Wisconsin - Stevens Point, functions as an overflow for high frequency storms. Schmeeckle Reserve, a natural wetland area north of Maria Drive, has been recognized as a viable retention area for storm runoff from the Sentry property and North Division Street commercial district.

Culverts

The culverts observed did not appear to be creating any significant backwater problems. Appendix H summarizes the characteristics of the culverts and maintenance considerations.

Storm Sewers

The 500 acre urban segment of the watershed, located south of Maria Drive and west of Michigan Avenue, is served by the Moses Creek storm trunk line. It is comprised of a 72 inch line from Michigan Avenue to Division Street, and an 84 inch line from Division Street to the Crosby Avenue pump station. The Moses Creek trunk line is shallow and at a very flat slope of 0.08 percent to 0.10 percent. In several areas, there is only one foot of cover over the pipe. Flooding problems occur first at these locations. A network of smaller lines serving the adjacent area connect to the Moses Creek trunkline. The majority of the residential areas apparently have an adequate storm sewer system. The storm sewer system in higher density land use areas, including the central business district, will need extensive upgrading in the future.

Storm Water Pumping Facilities

As previously indicated, the Moses Creek watershed drains into the Crosby Avenue Slough, adjacent to the Wisconsin River, and storm water is then pumped into the Wisconsin River. Constructed in 1931, the pump station is owned and operated by Consolidated Papers, Inc. The pumping facilities include two 50,000 gpm rated pumps, and two 3,000 gpm rated pumps. Consolidated Papers, Inc. has indicated that they will soon be replacing the 3,000 gpm pumps with two 5,000 gpm pumps. During moderate rains, water backs up in the upstream system because the pumps cannot retain the pumping level in the slough below the top of the 84 inch pipe.

LAND USE

Land use, both existing and future, plays an important part in storm water planning since both the volume and timing of runoff to the storm sewers or open channels are influenced by land use. Although the underlying soil type, a natural condition, is an important factor in determining hydrologic and hydraulic characteristics, the land use superimposed on that soil can markedly alter that response. Significant adverse effects often occur when land is converted from rural to urban usage. Such a conversion results in large increases in impervious surface and, therefore, an increase in the volume of runoff and a decrease in runoff time. The net effect is to produce a very large increase in peak flows.

Existing Land Use

The rural area is comprised primarily of agricultural, wooded and low density residential land use. The urban area, almost totally developed, is comprised of residential areas, university areas, high density residential areas, and a central commercial district. The dominant existing land use for each subbasin, percentage of impervious surface, and time of concentration are summarized for the rural and urban areas in Appendices I and J, respectively.

Future Land Use

Land use plans prepared by the Portage County Planning Department were utilized for each subbasin in the watershed to determine future flow requirements. Significant flow increases from the rural area are anticipated as development occurs along the Highway 51 and Highway 66 corridors. The dominant future land use by subbasin, percentage of impervious surface, and time of concentration are summarized for the rural and urban areas in Appendices I and J, respectively.

CHAPTER 3

STORM WATER PROBLEMS

INTRODUCTION

Storm water problems within the Moses Creek watershed were common even before the extensive urban development of the area east of Division Street. Basements flooded frequently in the downtown area as early as the 1920's. Extensive urban development east of Division Street has compounded the problem. The Moses Creek watershed is unique to the central Wisconsin area because surface runoff from the watershed is pumped to a higher discharge elevation. The following is a brief review of the events that led up to the development of the Moses Creek pumping system.

SLOUGH HISTORY

Significant items concerning the Moses Creek watershed that were noted during a review of documents furnished by Consolidated Papers, Inc., include:

1. Original dam on the Wisconsin River in the City of Stevens Point was authorized by Act of the Territory of Wisconsin, approved on February 3, 1846. Abraham Brawley was authorized to construct a dam for running mill machinery and generating hydraulic power.

2. In 1918, the Jackson Milling Company petitioned and received permission from the Railroad Commission of Wisconsin, to raise, enlarge and rebuild a dam on the Wisconsin River.

3. In 1920, the City of Stevens Point and Consolidated Papers, Inc., discussed the feasibility of constructing a sewer from the Crosby Avenue Slough to the Wisconsin River, at a location below the power house. The project was to alleviate flooding problems in the Fourth Ward. It was estimated, at that time, that the cost could approach $25,000.

4. In 1923, the City of Stevens Point and Consolidated Papers, Inc., discussed the feasibility of installing a pump station at the westerly end of the Crosby Avenue Slough, enclosing Moses Creek from the slough area to Union Street, and dredging of Moses Creek from Union Street to the east City limits.

5. In 1930, the City began installation of the Moses Creek storm sewer easterly from the slough. At that time, the water level in the Wisconsin River above the dam was low enough to permit a free discharge of the Moses Creek system. During periods of high water in the spring and summer, backup of storm water occurring in the slough caused basement flooding in the downtown area. For this reason, the City requested Consolidated Papers, Inc. to consider installation of temporary pumps at the discharge of the Moses Creek storm sewer until the storm sewer construction could be completed to a point below the dam. The City concluded that until such time as either the pumps or the sewer installation were completed, the success of the project would not be evident to the public.

6. Headlines appearing in the Stevens Point Daily Journal in November, 1930, announced that two 50,000 gpm pumps would be installed by Consolidated Papers, Inc.. in the Crosby Avenue Slough.

After the installation of the slough pumps, significant development has occurred in the City of Stevens Point. Additional extensions of the Moses Creek storm sewer have occurred with the last extension to Michigan Avenue in the early 1970's. Peak flows from the urban area have increased significantly resulting in a greater burden being placed on the existing pumps. Often the peak volumes exceed the 106,000 gpm capacity of the existing pump system.

PREVIOUS STUDIES

Problems associated with drainage of the Moses Creek watershed have been addressed in several other studies prepared for the City.

In 1965, Harland Bartholomew & Associates of St. Louis, Missouri, prepared a comprehensive plan for the City of Stevens Point. They concluded that the Moses Creek flooding problem could be alleviated by intercepting the flow between Michigan and Minnesota Avenues and draining the area to the south along Minnesota Avenue in a new interceptor sewer.

In 1966, Krebs Engineering Company prepared a comprehensive storm sewer program for the City of Stevens Point. Included as part of their recommendations was a 96 inch gravity line to intercept the Moses Creek system at Minnesota Avenue draining it easterly to the Plover River. They further recommended that Moses Creek also be intercepted at Highway 51 and drained easterly to the Plover River.

In 1971, the City Engineering Department conducted a study of the Moses Creek watershed and recommended that it be diverted at a point north of the Stevens Point airport easterly to the Plover River across airport property.

In 1972, the City Engineering Department prepared a preliminary study of the Michigan Avenue drainage area and identified its northerly boundary as Highway 66. Identification of Highway 66 as the northerly boundary prohibited future diversion of Moses Creek into the Michigan Avenue drainage basin as suggested by Harland Bartholomew & Associates in their 1965 study.

In 1976, the City Planning Commission in conjunction with the University of Wisconsin - Stevens Point approved a concept plan for the Schmeeckle Reserve north of Maria Drive. It was concluded that the Schmeeckle Reserve area would be utilized as a retention area for storm water runoff and would be retained as a natural wetland area.

In December, 1974, an Environmental Impact Assessment was prepared for the Dreyfus Lake area by Warzyn Engineering of Madison, Wisconsin. It was noted in the report that the proposed lake would contain a spillway to accommodate peak storm water runoff. The spillway elevation was set at 1091.5 in order to divert storms with a frequency equivalent to 7 to 9 years. The report also noted that flooding of the area around Dreyfus Lake is caused, in part, by the inadequate downstream storm sewer system. Warzyn Engineering estimated that the existing 72 inch sewer was adequate to serve a storm with a two to three-year frequency.

In December, 1974, an environmental impact assessment for Michigan Avenue was prepared by Strand Engineering of Madison, Wisconsin. The report noted that culverts were to be installed across Michigan Avenue in order to provide east to west drainage in the Schmeeckle Reserve.

In 1978, the Town of Hull Development Guide prepared by the Portage County Planning Department further recognized surface drainage problems along Moses Creek, and suggested that future development along the southern reach of the creek provide on-site detention. The Development Guide further recommended the development of wide greenways along the northern reaches of the creek.

CHAPTER 4

STORM WATER ANALYSIS PROCEDURES

INTRODUCTION

Storm water drainage basins of less than 200 acres can be analyzed with good results by the use of the rational method. For drainage basins larger than 200 acres, use of computer modeling techniques has proven to be effective. Computer modeling utilizes an accumulation of hydrographs from the various subbasins to develop composite hydrographs at select locations in the system. A hydrograph is a graph showing discharge or flow on the vertical axis and time on the horizontal axis. The area beneath the curve is the volume of stream flow at that location during the specified time interval. Each drainage subbasin develops a different hydrograph for each storm event that occurs. The hydrographs are based on the antecedent moisture conditions or the amount of moisture in the ground at the time of rain fall.

Since the Moses Creek Drainage Basin is comprised of a rural and urban basin, two separate drainage models were developed. Hydrographs developed for the rural area were used as input into the urban model. A detailed discussion of each of the storm water models is included in Appendix K.

MODEL STORM EVENT

To effectively model the drainage basin, the storm water models were calibrated using data from a known storm event. On July 5, 1978, maintenance staff of the University of Wisconsin - Stevens Point recorded ponding levels at several areas near the University caused by a storm on that same date. The storm event measuring 1.62 inches occurred from approximately 5:00 a.m. until 10:00 a.m. Severe ponding occurred around 10:00 a.m. and had subsided by 12:00 noon.

Observed flow depths were recorded near the Quandt Gym, the Moses Creek entrance at Michigan Avenue and the pond levels were measured at Sentry Insurance at the entrance to the storm system on Northpoint Drive.

The 1.6 inches of rainfall occurring over the five days prior to the storm event on July 5, 1978, and including the storm event on July 5, were utilized as input into the computer model. Runoff associated with the rainfall during the previous five days established a base flow in the system. Hydrographs developed for the entire storm event defined separate times of peak flow for the rural area and densely developed urban area.

DESIGN FLOWS

The storm water models were calibrated to duplicate an actual storm event. Other storms were then modeled to determine the effect they would have on the system for both current and future land use conditions. Two 10 year recurrent storm events were selected - a one-hour storm with a rainfall of 2 inches, and a 24 hour storm with a rainfall of 3.5 inches. Hydrographs for each of these storm events were developed utilizing current and future land use projections. Flows were also observed during March, 1979, for the effects that spring thaws have on the system. From these data, critical flows were determined for the Moses Creek system during spring runoff and during intense summer rains. These flows were then compared with the existing capacity of the system to identify deficiencies, as shown on Figure 2.

DEFICIENCIES IN EXISTING SYSTEM

Development adjacent to Highway 66 will further compound the flooding problems in the Moses Creek system because storm water runoff will significantly increase. Intermittent ponding will be more frequent and of longer duration because of the inadequate pumping capacity at the Crosby Avenue Slough.

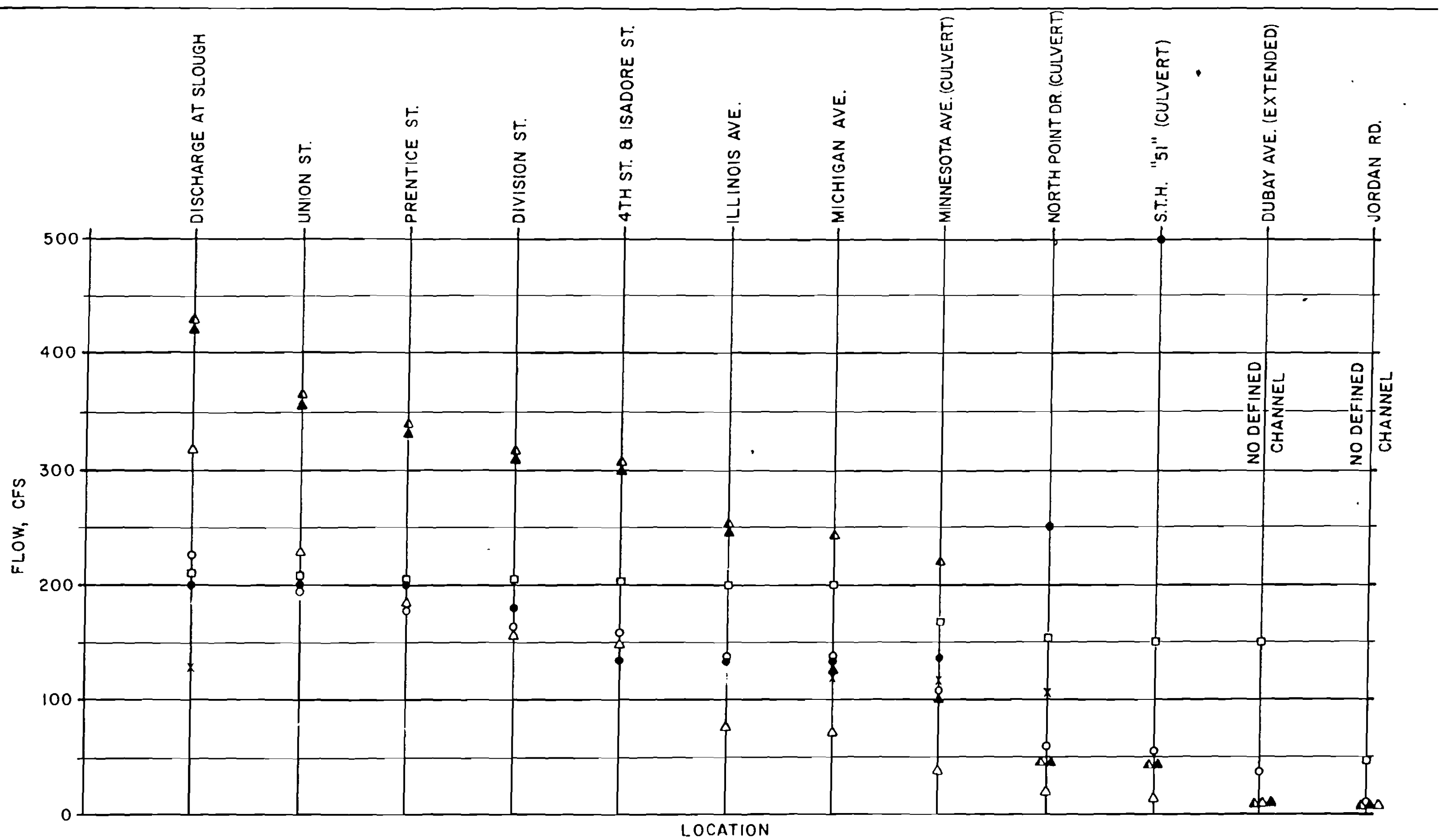
Moses Creek System

The Moses Creek system does not have adequate capacity to handle flows generated by moderately severe summer rains such as those during the summer of 1978. East of Isadore Street, the system has a capacity of 130 cubic feet per second (cfs) while the design flow is approximately 220 cfs. Detention upstream from Minnesota Avenue could be feasible to detain flows in excess of 100 cfs during summer rains. Detention does not appear to be effective for improving the spring runoff conditions because of high groundwater. The observed flow in that area during March, 1979, was approximately 120 cfs. Water surfaces in Moses Creek between Minnesota Avenue and Michigan Avenue during those observations were at the top of bank. The system, from Fourth and Isadore to Prentice Street, appears to be adequate until extensive development occurs east of Minnesota Avenue.

The entire system needs upgrading from Prentice Street to the Crosby Avenue Slough. The 200 cfs capacity of the 84 inch discharge is surpassed during moderate rains each summer, causing flooding in several areas near the downtown. A capacity of 420 cfs would be required to satisfy future flow conditions.

Slough Pump Station

The Crosby Avenue pump station does not have sufficient capacity to handle runoff from storms such as that which occurred during the summer of 1978. The level of the pond remains too high to prevent backup in the system upstream. The 84 inch discharge is often completely submerged during peak runoff conditions. The entire Moses Creek system is at a flat grade of 0.10 percent with several areas having only one to two feet of cover over the top of the pipe. When the discharge at the slough is completely submerged, the pipe is operating under pressure. Because of the shallow amounts of cover upstream, these areas become flooded first. Frequent ponding at Main Street and Division Street is an example. The problem could be temporarily alleviated if additional pumping capacity were provided at the slough. When extensive development occurs east of Minnesota Avenue, the problem would re-occur because of a lack of capacity in the existing storm sewer system.



LEGEND

● CAPACITY OF EXISTING CULVERTS OR STORM SEWERS IN CFS (CUBIC FEET PER SECOND)

○ FLOWS CALCULATED DURING MODEL STORM (JULY, 1978) BASED ON FIELD OBSERSERVATIONS

PROJECTED FLOWS DURING SHORT DURATION STORM (2 INCHES IN 1 HOUR)

△ WITH EXISTING LAND USE

▵ WITH FUTURE LAND USE

▲ WITH FUTURE LAND USE AND DETENTION

□ PROJECTED FLOW DURING LONG DURATION STORM (3.5 INCHES IN 24 HOURS - EXISTING LAND USE)

× FLOWS OBSERVED DURING SPRING THAW MARCH, 1979

FIGURE 2

STORM WATER FLOWS AT SELECT LOCATIONS ALONG MOSES CREEK

NORTH SIDE SURFACE WATER STUDY

STEVENS POINT, WISCONSIN

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1979

Downtown Area

The storm sewer system in the central downtown area, bounded by Clark Street, Church Street, Briggs Street and First Street, is inadequate to accommodate the type of surface area being drained. The area is served by a system comprised of small diameter pipes, ranging from 10 inch to 15 inch diameter sections. These do not provide the type of storm water protection recommended for a commercial district.

Northwest Area

The area west of First Street and south of Maria Drive drains to the Crosby Avenue Slough through a 36 inch discharge pipe.

The City Engineering Department has proposed that a program be developed for upgrading the system along Franklin Street.

North Division Street Area

The commercial area adjacent to Division Street north of Maria Drive, is served by a 42 inch storm sewer in the K-Mart parking lot. The sewer appears to have adequate capacity to handle flows from future development. However, it would be advisable to install a sedimentation basin at the discharge, prior to entering the Schmeeckle Reserve. This basin would permit the removal of nutrients from the storm runoff.

Wisconsin Street System

Analysis of the Wisconsin Street system has been completed by the City Engineering Department. They have determined a need to install an 84 inch line along Wisconsin Street from the river to Pine Street. On Pine Street from Wisconsin to Clark Street a 78 inch storm sewer is proposed. This information is presented because in the development of the alternatives, the Wisconsin Street route will again be reviewed.

CHAPTER 5

ALTERNATIVE SOLUTIONS

CONCEPTS

Because of extremely shallow storm sewer depths and high ground water table during various seasons, extensive use of storm water detention basins is only moderately beneficial along Moses Creek. Considering that the top of the existing storm sewer near Minnesota Avenue is at the same elevation as the bank of the Moses Creek, it is obvious that when the storm sewer flows full, Moses Creek is also full. Only a limited amount of storage capacity is available without excavating a very extensive land area.

Detention ponds can, however, be used to moderately control peak runoff during spring thaws and summer rains. Effective locations would be at the southeast corner of Maria Drive and Michigan Avenue and along Moses Creek east of Dreyfus Lake. Locating a detention facility north of North Point Drive would be ineffective for controlling runoff from development along Highway 66 west of Highway 51. It is suggested that storm water detention be continued by the Town of Hull in the existing natural detention area north of Dubay Avenue extended. The proposed pond near Maria Drive would also serve as a sedimentation basin and would require periodic maintenance. It would also need to be landscaped for a better appearance.

Without providing the limited detention described above, replacing the Moses Creek system east of Isadore Street with an equivalent 96 inch low-head pipe would be necessary.

Plover River/Wisconsin River Routes

In order to alleviate flooding along the Moses Creek system, relief routes to the Plover River and to the Wisconsin River were considered. Since the immediate need for relief of the Moses Creek system is down stream from Prentice Street with eventual relief to Fourth and Isadore, a gravity line to the Plover River from either of these locations appears to be impractical. The distance to the Plover River is considerably greater from either location than the comparable distance to the Wisconsin River. Only a small area would benefit from a major storm sewer placed along a corridor to the Plover River. The area east of Wilshire Blvd., although lacking storm sewers, is intended to be served by French drains. The French drain concept is preferred by the City Engineering Department.

Providing increased capacity to the Wisconsin River appears feasible. Several areas west of Division Street are slated for major public improvements in the future. The City is currently contemplating a major storm sewer project along Wisconsin Street. Relocation of Highway 10 west of Division Street is scheduled. The possibility of additional major redevelopment of the central downtown area may result from the Highway 10 reconstruction. In conjunction with each of these programs, major storm sewer work will be required in the project areas.

Relief Route Corridors

Possible street corridors that would be acceptable as routes for major storm sewers were reviewed with the City before detailed development of the alternatives described herein. Routes approved by the City Engineering Department included Franklin Street west of Division Street, Prentice Street south of Franklin Street, Rogers Street south of Briggs Street, Pine Street south of Ellis Street, Wisconsin Street west of Pine Street, and the Highway 10 relocation corridor.

The Water Street corridor from the Crosby Avenue Slough to Wisconsin Street was not deemed practical by the City Engineering Department because of the shallow rock depth and the extensive number of utilities currently in the right-of-way. Strongs Avenue and Church Street also were unacceptable corridors because of recent reconstruction along segments of these corridors. As a result of the City's preference, these corridors were given no further consideration.

ALTERNATES

Considering the available corridors, four alternates were developed providing for discharge to the Wisconsin River. Each of the alternatives consider maximum practical use of detention storage facilities to control projected storm water flows from the area east of Minnesota Avenue.

Development of each alternative included the preparation of a preliminary profile along each route, a review of major utility relocations and reconnections, pavement replacement and disruption to neighborhoods.

Crosby Avenue Pump Station

For the purpose of this report, we assumed that it would not be economical to remodel the existing pump station to handle increased flows. This decision was based on the age and size limitations of the existing facility. The station has nearly reached its economic life of 50 years. Extensive renovation would be required to accommodate new pumping equipment sized to handle projected design flows. The limited useful life of the existing building does not warrant such renovation For alternates II and IV where only small flow increases are anticipated at the slough, additional cost analysis of the existing station may be warranted. Installation of a new pump station and wet well will permit the slough area to be filled in. The pump station would occupy an area of land less than one acre in size.

Cost Analysis

A detailed cost estimate is included in Appendices B, C, D and E for each alternate. Capital costs are provided for the gravity system and pumping system. Annual costs included for the pump station are power, maintenance, and labor.

The present worth (1979 cost) of the annual operating costs were computed using a 50 year life cycle, an annual interest rate of 7 percent, and an annual inflation rate of 5 percent.

Depreciation of the pump station was based on a 25 year life for mechanical equipment including pumps, motors and generator, and a 50 year life on the building and remaining equipment.

The present worth of depreciation was based on an annual interest rate of 7 percent for a 50 year design period.

Costs shown for the large diameter storm sewers were based on costs furnished by pipe suppliers and contractors who are capable of manufacturing and installing the materials listed.

Program Cost Summary

A program cost summary is included in Appendix A. It includes the present worth of each alternate discussed, and also includes the effects of the Wisconsin Street project, and future work along Moses Creek.

Consideration of the Wisconsin Street project is essential when comparing costs in order to arrive at the most cost-effective alternative. As evidenced by the program cost summary, a different conclusion could be reached if the Wisconsin Street project is ignored.

ALTERNATE I - FRANKLIN STREET PARALLEL RELIEF SYSTEM

This alternate includes the installation of an 84 inch storm sewer from the Crosby Avenue Slough to Vincent Court, following a route along First Street and Franklin Street. The existing 84 inch Moses Creek storm sewer will be left in place to handle flows from the downtown area, south of Briggs Street, and part of the upstream flow east of Vincent Court.

The capacity of the storm water pump station will need to be increased to 230,000 gpm. The new station will include a new 2,000 square foot facility, wet well, 4 axial flow pumps, and standby generator.

Related Work

Major utility and street replacement costs that are contemplated with this alternative include:

- Reconstruction of a 21 inch sanitary sewer on Franklin Street from Second Street to Union Street and along Union Street from Franklin to Briggs. This sewer will be necessary in order to reconnect all sanitary sewers at intersections and all house laterals.
- Installation of an 8 inch sanitary sewer on Franklin Street from Union to Vincent.
- Lowering of the water main crossings at each of the intersections along Franklin Street.
- Replacement of curb and gutter on Franklin Street from First Street to Union Street.

- Replacement of all street surfacing on streets affected by the project.

Cost Estimate

The total estimated present worth of this alternative is $3,257,000, excluding rock excavation. No data was available on rock along the Franklin Street corridor.

ALTERNATE II - WISCONSIN STREET RELIEF SYSTEM

This alternate includes blocking the 84 inch Moses Creek storm sewer at Smith Street. The system downstream from Smith Street would be left to serve the area currently contributing to it. The area east of Smith Street will be diverted south through a 96 inch storm sewer following a route along Prentice, Rogers, and Pine to Wisconsin Street, and westerly on Wisconsin Street to the Wisconsin River. At Water Street, the sewer will be increased to 102 inch diameter.

The proposed system will have adequate capacity to accommodate the flows projected from the Wisconsin Street drainage basin. This will satisfy the intent of the project programmed by the City for the Wisconsin Street area.

Related Work

Major utility and street replacement costs that are contemplated with this alternative include:

- Replacement of a 21 inch sanitary sewer on Wisconsin Street.

- Replacement of a 10 inch sanitary sewer on Pine Street & Rogers Street.

- Replacement of a 6 inch water main in Wisconsin Street. Based on preliminary plans prepared by the City Engineering Department, installation of the storm sewer appears to be feasible without damaging the water transmission main.

- Replace curb and gutter on one side of the street along the entire corridor.

- Replacement of all street surfacing on streets affected by the project.

Cost Estimate

The total estimated present worth of this alternative is $4,607,000, including rock excavation. Rock excavation quantities along the Wisconsin Street corridor were based on data provided by the City Engineering Department.

ALTERNATE III - WISCONSIN STREET TRUNK LINE SYSTEM (Including HY. 10 Relocation)

This alternate includes the installation of a 96 inch storm sewer along Prentice Street from its existing junction with Moses Creek south to Main Street. It also includes the installation of an 84 inch storm sewer along the proposed Highway 10 corridor from Third Street to Main and Prentice. The existing 84 inch Moses Creek system from Third Street to the Crosby Avenue Slough would be left in place. However, revamping of the flow line is recommended in order to direct the flow to the east along the Highway 10 corridor. The existing Moses Creek sewer from Third Street to Prentice Street would be abandoned. Storm sewer stubs of adequate size to adequately accommodate flow from the downtown area would be provided at each of the intersections along Highway 10 .

From Prentice and Main, a 120 inch storm sewer would be installed along Rogers and Pine to Wisconsin Street, then west on Wisconsin Street to the Wisconsin River. As provided in Alternate II, this system also would have sufficient capacity to handle the Wisconsin Street basin.

In conjunction with this alternate, the existing Crosby Avenue pump station would be abandoned. The slough area would be filled in, resulting in additional land area for private development in the downtown area.

Related Work

Major utility and street replacement costs that are contemplated with this alternative include:

- Replacement of a 21 inch sanitary sewer on Wisconsin Street.
- Replacement of a 10 inch sanitary sewer on Pine and Rogers Street.
- Replacement of a 6 inch water main on Wisconsin Street. As indicated in Alternate II, installation of the storm sewer appears to be feasible without damaging the water transmission main.
- Replace curb and gutter and sidewalk on the north side of Wisconsin Street.
- Replace curb and gutter on both sides of Pine Street and Rogers Street.
- Replacement of all street surfacing on streets affected by the project.

Cost Estimate

The total estimated present worth of this alternative is $ 3,854,000, including rock excavation. Rock excavation quantities along the Wisconsin Street corridor were based on data provided by the City Engineering Department.

ALTERNATE IV - MULTIPLE STORM WATER PUMPING FACILITIES

This alternate includes the installation of two pump stations. The upper station located at Fourth and Isadore would have a pumping capacity of 30,000 gpm. The pump station would include a 1700 square foot building, wet well and 4 nonclog pumps. Dual service is recommended for the electrical service, instead of a standby generator. A generator at this location would cost four to five times more than the dual service.

The lower station at the Crosby Avenue Slough, with a pumping capacity of 130,000 gpm, would pump all low flows in the system and peak flows from the area west of Isadore Street. The pump station would include a new 2,000 square foot facility, wet well, 4 axial flow pumps and standby generator.

West of Meadow Street, installation of a relief system for the 84 inch sewer, ranging from 48 inches to 72 inches, will be necessary.

A 42 inch force main would be installed along Franklin Street from the upper pump station on Isadore to the Wisconsin River.

Related Work

Major utility reconstruction and street replacement costs contemplated with this alternative include:

- Reconstruction of a 21 inch sanitary sewer on Franklin Street from Second Street to Union Street and along Union Street from Franklin to Briggs, in order to reconnect sanitary services.

- Lowering of the water main crossings at each of the intersections along Franklin Street.

- Replacement of curb and gutter on Franklin Street from First Street to Meadow Street.

- Replacement of all street surfacing on streets affected by the project.

Cost Estimate

The total estimated present worth of this alternative is $ 5,113,000, excluding rock excavation. Information on rock depth was not available along this corridor.

WISCONSIN STREET CITY PROJECT

This project is presented because the Wisconsin Street corridor is considered a viable alternative for relief of the Moses Creek system. The City Engineering Department has proposed a project for upgrading the Wisconsin Street basin to include a 78 inch storm sewer along Pine Street to Clark Street and an 84 inch storm sewer on Wisconsin Street, from the Wisconsin River to Pine Street. The City Engineering Department proposes that this sewer accommodate all surface water runoff south of Main Street and west of Division Street.

Increasing the size of this system, as described in the previous alternatives, would not only handle the drainage from the Wisconsin Street basin, but would also accommodate the flow from the Moses Creek system, east of Prentice Street. Therefore, including the cost of the Wisconsin Street City project when analyzing the costs for upgrading the Moses Creek system is essential.

Cost Estimate

The total estimated present worth of the Wisconsin Street City project is $1,651,000, including rock excavation.

PHASE II FOR ALTERNATES I, II & III - PARALLEL RELIEF TO FOURTH & ISADORE

To be considered with Alternates I, II and III is the future relief of the Moses Creek System from Prentice to Fourth and Isadore. The need for a relief project is not contemplated until additional development occurs east of Minnesota Avenue, particularly along Highway 66. It will include the replacement of the existing 72 inch line with a 96 inch sewer.

Related Work

Major utility and street replacement costs that are contemplated with this phase of the project include:

- Replacement of a sanitary sewer along the corridor ranging in size from 8 inches to 18 inches.
- Lowering of the water main crossings at each of the intersections.
- Replacement of curb and gutter along one side of the street.
- Replacement of all street surfacing on streets affected by the project.

Cost Estimate

The total estimated present worth of the relief system is $838,000.

DISCUSSION OF ALTERNATIVES

The alternatives presented offer a spectrum of possible solutions to the Moses Creek flooding problem ranging from a complete pumping system to a complete gravity system. A multiple pumping system is the least cost-effective because of high capital costs for equipment and high annual operating costs.

The other three alternatives are comparable in cost when reviewed in terms of total present worth. With the cost of service to the Wisconsin Street basin included, the total gravity system addressed in Alternate III appears to be the most favorable.

Based on data presented in this report alone, we recommend that the City adopt Alternate III and proceed with implementation of the plan. However, the City has other capital improvement programs slated in the project areas with some timetables already established.

The City of Stevens Point should consider Alternates I, II, and III for the effect that each one would have on long-range planning prior to adopting an alternate for implementation.

In order to evaluate the alternatives, the following course of action is recommended:

1. Assign the City/County Planner the task of preparing an environmental assessment for each of the three alternates.

2. Circulate the draft report for public input.

3. Submit the report to Consolidated Papers, Inc. and University of Wisconsin - Stevens Point for comment.

4. Review the long range planning goals of the downtown area and the effect that each of the alternatives would have on them.

5. Hold a public informational meeting on the alternatives considered.

6. Select an alternative.

Following the selection of an alternative by the City of Stevens Point, public input and review comments will be included in the final report.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Based on the material presented and discussed in this report, the following conclusions and recommendations are presented:

1. Circulate the report for public input and comment as described in the previous chapter.

2. Before further sewer construction or street reconstruction commences west of Division Street, develop a detailed storm sewer system plan for the Wisconsin Street area, the downtown area and along the Highway 10 relocation corridor.

3. Following completion of the storm sewer system plan, prepare construction plans for the entire area. Based on the complexity of the project areas, we recommend that plans be prepared before construction begins to assure that utility crossovers can be accomplished.

4. Coordinate the design of the Highway 10 project with the selected alternative for Moses Creek. Since the Moses Creek system is very shallow, excessive cuts on the new highway alignment could cause severe problems.

5. Begin acquisition of property for development of a detention pond east of Dreyfus Lake and at the southeast corner of Maria Drive and Michigan Avenue.

6. Continue to block the 54 inch storm sewer line on North Point Drive in front of the Sentry World Headquarters so that only high water overflows into the storm sewer. Drainage from the Sentry property should continue to drain south into the Schmeeckle Reserve. Removal of the wall in the 54 inch storm sewer would cause a rapid runoff into the downstream system, further complicating the ponding problems.

7. Consider construction of a sedimentation basin west of Schmeeckle Reserve to accumulate sediment from commercial runoff along Division Street. Drainage concepts should be developed for the North Division area, in order to prevent ecological damage to Schmeeckle Reserve.

8. Raise the grade of Maria Drive, west of Michigan Avenue, or construct a berm along the north side of Maria Drive to an elevation of 1,094, in order to retain maximum usage of Schmeeckle Reserve as a detention area.

9. Retain a 100 foot right-of-way for Moses Creek, south of Highway 51, in order to properly maintain the open channel section.

10. Dredge Moses Creek to a uniform cross section north of Minnesota Avenue with the channel slopes stabilized to prevent erosion.

11. The Town of Hull should consider developing a local drainage plan for the area north of Highway 51. Extensive residential development is contemplated along Torun Road, north of Highway 66. A drainage plan

should be prepared before the development occurs in order to determine how the local runoff will be accommodated.

12. Retain the existing wetland area along the upper reaches of the Moses Creek, north of Dubay Avenue extended and west of the Town Hall. This area will provide adequate detention for runoff from the Town of Hull as development occurs.

13. Require commercial development along Highway 66 east of Minnesota Avenue contributing to Moses Creek to provide adequate storm water facilities to prevent erosion of the Moses Creek channel and excessive accumulations of sediment.

14. Implement the recommendations regardless of Sentry's plans to construct local detention facilities north of North Point Drive. Ponds constructed in that area will be located too far upstream in the Moses Creek system to significantly reduce peak runoff in the downstream system.

15. Conduct an internal inspection of the segment of the Moses Creek system left in service. Comments were made by individuals during the analysis that utilities extended through the storm sewer at various locations. If obstructions do exist, they impede the flow of water, resulting in a reduced pipe capacity.

APPENDIX A
PROGRAM COST SUMMARY

PHASE I	ALTERNATE I (Franklin Street Relief)	ALTERNATE II (Wisconsin Street Relief)	ALTERNATE III (Wisconsin Street & HY 10)	ALTERNATE IV (Multiple Pumping)
Initial Capital Costs	$ 2,467,800	$ 3,835,000	$ 3,854,000	$ 3,840,000
Annual Operating Costs	11,600	11,000	0	17,000
Depreciation	31,300	31,300	0	54,200
Total Present Worth	$ 3,257,000	$ 4,607,000	$ 3,854,000	$ 5,113,000
Wisconsin St. City Project	1,651,000	0	0	1,651,000
Total Phase I Program	$ 4,908,000	$ 4,607,000	$ 3,854,000	$ 6,764,000
PHASE II				
Moses Creek Relief to Fourth & Isadore	$ 838,000	$ 838,000	$ 838,000	0
Detention Basins *	450,000	450,000	450,000	450,000
Total Program Costs	$ 6,196,000	$ 5,895,000	$ 5,142,000	$ 7,214,000

* Option - Delete detention basins and replace 72 inch Moses Creek Storm Sewer with 96 inch Low-Head from Fourth & Isadore to Michigan Avenue - Add $1,000,000 to Total Program Costs.

APPENDIX B

ALTERNATE I

FRANKLIN STREET RELIEF SYSTEM
COST ESTIMATE

CAPITAL COSTS

Gravity System	Unit Price	Total Cost
Item		
3550 L.F. of 84" Storm Sewer	$ 175.00	$ 621,250
150 L.F. of 84" Mitered Storm Sewer	210.00	31,500
60 V.F. of Storm Manholes (10 units)	70.00	4,200
1 Discharge Structure at Crosby Ave.Slough	4,000.00	4,000
1 Junction Chamber	4,000.00	4,000
4 Railroad Crossings	5,000.00	20,000
2080 L.F. of 8" Sanitary Sewer Replacement	20.00	41,600
1700 L.F. of 21" Sanitary Sewer Replacement	40.00	68,000
140 V.F. of Sanitary Manholes (12 units)	70.00	9,800
Lowering of Watermain at 8 Intersections	1,000.00	8,000
Rock Excavation (No data on rock profile available)		
Gravel Bedding		33,300
13500 Sq.Yds. of Pavement Removal	1.00	13,500
13500 Sq.Yds. of Subgrading & 6" Gravel Base Course	2.00	27,000
1100 L.F. of Curb & Gutter Replacement	7.50	8,250
3300 Tons of Bituminous Surfacing	13.00	42,900
Subtotal		$ 937,300

Crosby Avenue Pump Station	
Building and Wet Well	$ 405,000
Piping and Valves	70,000
Pumps and Motors	205,000
Electrical	75,000
Standby Generator	275,000
Plumbing, Heating and Ventilating	55,000
Subtotal	$ 1,085,000

Contingencies (10%)	$ 202,300
Engineering	142,000
Legal & Administrative (5%)	101,200
Total Estimated Capital Cost	$ 2,467,800
	($ 2,467,800)

ANNUAL COSTS

Operating Costs

Power	$ 1,600
Maintenance & Labor	10,000
Total	$11,600

Depreciation

Building	$12,100
Mechanical Equip.	19,200
Total	$31,300

Present Worth

Initial Capital Outlay	$ 2,467,800
Present Worth Operating Cost	358,000
Present Worth Depreciation	432,000
Total Present Worth	$ 3,257,000

APPENDIX D

ALTERNATE III
WISCONSIN STREET TRUNK LINE SYSTEM
(Including Hy. 10 Relocation)
COST ESTIMATE

CAPITAL COSTS

Gravity System

Item	Unit Price	Total Cost
2110 L.F. of 120" Storm Sewer (less than 14' deep)	$ 340.00	$ 717,400
2660 L.F. of 120" Storm Sewer (over 14' deep)	350.00	931,000
150 L.F. of 120" Mitered Storm Sewer (less than 14' deep)	390.00	58,500
1160 L.F. of 96" Horizontal Elliptical Storm Sewer	275.00	319,000
1380 L.F. of 84" Storm Sewer (less than 14' deep)	175.00	241,500
610 L.F. of 84" Storm Sewer (over 14' deep)	180.00	109,800
1 Discharge Structure at Wisconsin River	12,500.00	12,500
80 V.F. of Storm Manholes (19 units)	70.00	5,600
1 Conversion Unit 96" H.E to 84" Round	4,000.00	4,000
1 Conversion Unit 96" H.E to 120" Round	4,000.00	4,000
1 Junction Chamber (84" to 120")	2,500.00	2,500
1 Cast in place Junction unit (84" Cast in place to 96" Cast in place)	1,000.00	1,000
4 Railroad Crossings	5,000.00	20,000
2880 L.F. of 21" Sanitary Sewer Replacement	55.00	158,400
2300 L.F. of 10" Sanitary Sewer Replacement	25.00	57,500
260 V.F. of Sanitary Manholes (16 units)	70.00	18,200
200 V.F. of Sanitary Drop Manholes (12 Units)	75.00	15,000
1450 L.F. of 6" Watermain Replacement	15.00	21,750
Lowering of Watermain at 14 Intersections	1,000.00	14,000
6300 C.Y. of Rock Excavation	40.00	252,000
6300 C.Y. of Sand Backfill	1.60	10,080
Gravel Bedding		48,000
14800 Sq.Yds. of Pavement Removal	1.00	14,800
14800 Sq.Yds. of Subgrading & 6" Gravel Base Course	2.00	29,600
4000 L.F. of Curb & Gutter Replacement	7.50	30,000
3600 Tons of Bituminous Surfacing	13.00	46,800
11000 Sq.Ft. of Sidewalk Replacement	1.80	19,800
1500 Sq.Ft. of Driveway Replacement	2.00	3,000
2000 Sq.Yds of Boulevard Replacement	2.00	4,000
Subtotal		$ 3,169,730
Contingencies (10%)		316,970
Engineering		208,400
Legal & Administrative (5%)		158,500
Total Estimated Capital Cost		$ 3,853,600
		($ 3,854,000)

APPENDIX E

ALTERNATE IV
MULTIPLE STORM WATER PUMPING FACILITIES
COST ESTIMATE

CAPITAL COSTS

Gravity System

Item	Unit Price	Total Cost
635 L.F. of 72" Storm Sewer	$ 115.00	$ 73,025
75 L.F. of 72" Mitered Storm Sewer	135.00	10,125
300 L.F. of 60" Storm Sewer	80.00	24,000
700 L.F. of 48" Storm Sewer	60.00	42,000
1 Discharge Structure at Lagoon	4,000.00	4,000
1 Junction Chamber (60" to 72")	3,500.00	3,500
45 V.F. of Storm Manholes (6 units)	70.00	3,150
4 Railroad Crossings	5,000.00	20,000
1700 L.F. of 21" Sanitary Sewer Replacement	40.00	68,000
950 L.F. of 8" Sanitary Sewer Replacement	20.00	19,000
90 V.F. of Sanitary Manholes (7 units)	70.00	6,300
Lowering of watermain at 5 locations	1,000.00	5,000
Rock Excavation (No data on Rock Profile)		
Gravel Bedding		13,000
7700 Sq. Yds. Pavement Removal	1.00	7,700
7700 Sq. Yds. of Subgrading & 6" Gravel Base Course	2.00	15,400
1700 L.F. of Curb & Gutter Replacement	7.50	12,750
1900 Tons of Bituminous Surfacing	13.00	24,700
Subtotal		$ 351,650

Crosby Avenue Pump Station

Building & Wet Well	$ 405,000
Piping & Valves	70,000
Pumps & Motors	205,000
Electrical	75,000
Standby Generator	275,000
Plumbing, Heating & Ventilating	55,000
Subtotal	$1,085,000

4th & Isadore Pump Station

Building & Wet Well	$ 300,000
Piping & Valves	175,000
Pumps & Motors	245,000
Electrical	125,000
Dual Electric Service	250,000
Plumbing, Heating & Ventilating	55,000
6000 Ft. of 42" Force Main	570,000
Subtotal	$1,720,000

APPENDIX F

WISCONSIN STREET CITY PROJECT

COST ESTIMATE

CAPITAL COSTS

Item	Unit Price	Total Cost
2880 L.F. of 84" Storm Sewer	$ 175.00	$ 504,000
1790 L.F. of 78" Storm Sewer	145.00	259,550
250 L.F. of 78" Mitered Storm Sewer	174.00	43,500
65 V.F. of Storm Manholes (10 units)	70.00	4,550
1 Reducer (84" to 78")	1,500.00	1,500
1 End Cap on 78"	500.00	500
1 Discharge Structure at Wisconsin River	10,000.00	10,000
2880 L.F. of 21" Sanitary Sewer Replacement	50.00	144,000
1750 L.F. of 10" Sanitary Sewer Replacement	25.00	43,750
200 V.F. of Sanitary Manholes (14 units)	70.00	14,000
150 V.F. of Sanitary Drop Manholes (10 units)	75.00	11,250
4 Railroad Crossings	5,000.00	20,000
1200 L.F. of 6" Watermain Replacement	15.00	18,000
Lowering of Watermain at 7 Intersections	1,000.00	7,000
3000 C.Y. Rock Excavation	40.00	120,000
3000 C.Y. Sand Backfill	1.60	4,800
Gravel Bedding		29,000
14,100 S.Y. of Pavement Removal	1.00	14,100
14,100 S.Y. of Subgrading & 6" Gravel Base	2.00	28,200
3800 L.F. of Curb & Gutter Replacement	7.50	28,500
3400 Tons of Bituminous Surfacing	13.00	44,200
Subtotal		$ 1,350,400
Contingencies (10%)		$ 135,000
Engineering		98,500
Legal & Administrative (5%)		67,500
Total Estimated Capital Cost		$ 1,651,400

ANNUAL COSTS

None Included

Present Worth

Initial Capital Outlay	$ 1,651,400
Present Worth Operating Cost	0
Present Worth Depreciation	0
Total present Worth	$ 1,651,400
	($ 1,651,000)

APPENDIX G

PHASE II FOR ALTERNATES I, II & III

PARALLEL RELIEF TO FOURTH AND ISADORE
COST ESTIMATE

CAPITAL COSTS

Item	Unit Price	Total Cost
1730 L.F. of 96" H.E. Storm Sewer	$ 275.00	$ 475,750
200 L.F. of 96" H.E. Mitered Storm sewer	320.00	64,000
20 V.F. of Storm Manholes (5 Units)	70.00	1,400
2 Junction Chambers	2,000.00	4,000
1 Reducer (96" to 72")	500.00	500
340 L.F. of 18" Sanitary Sewer Replacement	35.00	11,900
650 L.F. of 15" Sanitary Sewer Replacement	27.00	17,550
1500 L.F. of 8" Sanitary Sewer Replacement	20.00	30,000
90 V.F. of Sanitary Manholes (7 units)	70.00	6,300
100 V.F. of Sanitary Drop Manholes (8 units)	75.00	7,500
Lowering of Watermain at 5 Intersections	1,000.00	5,000
6900 S.Y. of Pavement Removal	1.00	6,900
6900 S.Y. of Subgrading & 6" Gravel Base Course	2.00	13,800
1900 L.F. of Curb & Gutter Replacement	7.50	14,250
1700 Tons of Bituminous Surfacing	13.00	22,100
Subtotal		$ 680,950
Contingencies (10%)		$ 68,100
Engineering		55,000
Legal & Administrative (5%)		34,050
Total Estimated Capital Cost		$ 838,100
		($ 838,000)

ANNUAL COST

None Included

Present Worth

Initial Capital Outlay	$ 838,000
Present Worth Operating Cost	0
Present Worth Depreciation	0
Total Present Worth	$ 838,000

Sub-Basin Number	Identi-fication	Location	Material	Size	Comments	Recommendations
11-1	11-1	On North Point Dr. 1700 Ft. W of Wilshire Dr.	RCCP	36"	1978 Const.	
12-0	12-0	On HY 51 By-Pass at west side of Lake Susan	RCCP	Twin 36"		
15-0	15-0	On North Point Dr. at Sentry Insurance Bldg.	RCCP	48"	Inlet erosion caused by water running along side culvert through gravel bedding material	Construct Concrete Head Wall
16-0	16-0	On North Point Dr., 500 ft. E of North Michigan Ave.	RCCP & CMCP	36"		
17-0	17-0	On North Division St. between Maria Dr. & North Point Dr.	RCCP	36"		
17-1	17-1	On North Michigan Ave. approx. 745 ft. N of Maria Dr.	RCCP	27"		

Sub-Basin Area No.	Area (Acres)	Soil Type Hydrologic Soils Group	Percent	Dominant Land Use Existing (Acres)	Future (Acres)	Runoff Curve No. Exist.	Future	Time of Concentration (Hours) Exist.	Future
8-3	254.5	A	56.6	178.5 Natural Area	142	59	61	4.6	4.0
		B	13.0	76 Residential	92.5				
		D	30.4	0 Industrial	14.5				
				0 Natural Area	5.5				
9-0	191	A		143 Natural Area	119	68	77	3.3	2.1
		B		5.5 Lake	5.5				
		D		32 Residential	0				
				10.5 Highway Interchange	10.5				
				0 Industrial	21				
				0 General Commercial	35				
10-0	45	A	21.1	89 Natural Area	0	68	71	0.88	0.31
		D	44.4	9 Agricultural	0				
				9.5 Highway Interchange	9.5				
				.5 Business & Dense Residential	9.5				

Sub-Basin Area No.	Area (Acres)	Soil Type Hydrologic Soils Group	Percent	Dominant Land Use Existing (Acres)	Future (Acres)	Runoff Curve No. Exist.	Future	Time of Concentration (Hours) Exist.	Future
11-0	121	A B D	21.1 33.9 45.0	89 Natural Area 8 Highway Use 24 Lake Susan 0 Industrial	0 8 24 89	72	91	2.7	0.4
11-1	166.5	A B D	10.0 45.6 44.4	159 Natural Area 7.5 Highway Use	159 7.5	65	70	7.7	2.8
11-2	99	A B D	62.6 7.6 29.8	36.5 Natural Area 58 Residential 4.5 Highway Interchange 0 General Commercial 0 Neighborhood Commercial	0 66 4.5 20 8.5	64	80	1.9	0.7
12-0	161.5	A B D	34.7 58.5 6.8	112.5 Natural Area 44.5 Agricultural 4.5 Highway Use 0 Industrial	0 0 4.5 157	59	86	4.0	0.6

Sub-Basin Area No.	Area (Acres)	Soil Type Hydrologic Soils Group	Percent	Dominant Land Use Existing (Acres)	Future (Acres)	Runoff Curve No. Exist.	Future	Time of Concentration (Hours) Exist.	Future
13-0	171	A	43.6	127.5 Natural Area	28	63	80	2.6	0.9
		B	16.1	23 Lake Dreyfus	23				
		D	40.3	20.5 Residential	80.5				
				0 Neighborhood Commercial	9				
				0 Convention Center	30.5				
14-0	35	A	20.0	6 Natural Area	6	74	84	1.3	0.5
		B	64.3	22 Agricultural	0				
		D	15.7	5.5 Commercial & Business	5.5				
				1.5 Highway Use	1.5				
				0 Industrial	22				
15-0	277.5	A	43.8	120 Natural Area		77	85	4.0	1.1
		B	43.8	62 Highway Interchange	62				
		D	12.4	95.5 Commercial & Business	132				
				0 Industrial	83.5				

Sub-Basin Area No.	Area (Acres)	Soil Type Hydrologic Soils Group	Percent	Dominant Land Use Existing (Acres)	Future (Acres)	Runoff Curve No. Exist.	Future	Time of Concentration (Hours) Exist.	Future
16-0	95.5	A	17.8	95.5 Natural Area	86.5	52	62	2.5	2.5
		B	70.7	0 General Commercial	9				
		D	11.5						
16-1	16.5	A	6.1	16.5 Natural Area	16.5	72	72	1.4	1.4
		B	18.2						
		C	75.7						
17-0	32	A	50	6 Natural Area	0	83	91	2.1	0.2
		B	50	2 Highway Use	2				
				12 Residential	0				
				12 Commercial & Business	30				
17-1	139	A	25.6	114 Natural Area	100	67	70	4.6	4.6
		B	38.8	3.5 Highway Use	3.5				
		D	35.6	21.5 Commercial & Business	29				
				0 University Facilities	6.5				

APPENDIX J

SELECTED CHARACTERISTICS OF URBAN SUB-BASINS
(Map Reference - Appendix N)

Sub-Basin No.	Urban Area (Acres)	Dominant Land Use Existing	Dominant Land Use Future	Impervious Area (Acres) Existing	Impervious Area (Acres) Future	Sub-Basin Time of Concentration of Impervious Areas (Minutes)	Comments
3	20	Multiple Family	Multiple Family	4	15	3	Moses Creek Hydrograph Input at Minnesota Ave.
2	27	Multiple Family	Multiple Family	14.0	20	6	
60	5	Roadway	Roadway	4	4	15	Rural Submodel Hydrographs Input Along Branch 60
53	15	Univer-sity	University	6	11	4	Sewers In Sub-Basin May Need Upgrading If Exten-sive Development Occurs.
6	41	Univer-sity	University	7	12	26	
11	23	Univer-sity	University	14	14	13	
7	35	Univer-sity	University	16	16	28	
12	26	Commer-cial	Commercial	18	23	52	
19	16	Univer-sity	University	9	9	11	
14	52	Residen-tial	Multiple Family	14	25	20	

Sub-Basin No.	Urban Area (Acres)	Dominant Land Use Existing	Dominant Land Use Future	Impervious Area (Acres) Existing	Impervious Area (Acres) Future	Sub-Basin Time of Concentration of Impervious Areas (Minutes)	Comments
20	15	Residential	Multiple Family	8	9	10	
23	24	Residential	Multiple Family	16	16	27	
33	9	Residential	Multiple Family	4	6	6	
26	8	Residential	Residential	4	6	8	
34	18	Residential	Multiple Family	8	12	18	Sewers May Require Upgrading
27	12	Residential	Multiple Family	6	8	5	
28	10	Commercial	Commercial	10	10	14	Sewers Require Upgrading
36	36	Residential	Residential	14	18	35	
30	8	Commercial	Commercial	7	8	12	Sewers Require Upgrading
37	52	Residential	Residential	24	28	27	
31	13	Commercial	Commercial	12	13	17	Sewers Require Upgrading

Sub-Basin No.	Urban Area (Acres)	Dominant Land Use Existing	Dominant Land Use Future	Impervious Area (Acres) Existing	Impervious Area (Acres) Future	Sub-Basin Time of Concentration of Impervious Areas (Minutes)	Comments
44	30	Residential	Residential	13	15	16	
50	12	Residential	Residential	7	10	8	
92	10.5	Residential	Residential	35	50	12	Trunk Line Upgrading Required
82	60	Res/Comm	Res/Comm	20	30	10	Collection Sewers Require Upgrading
84	90	Residential	Residential	30	50	15	Collection Sewers Require Upgrading

APPENDIX K

STORM WATER SYSTEM MODEL

INTRODUCTION

Evaluation of the Moses Creek Watershed under current and future land use conditions was accomplished by developing a computer model to simulate actual conditions. By inputing data on land use and drainage basin characteristics, hydrographs were developed for each sub-basin. Resultant hydrographs developed at select locations along Moses Creek indicated how the specified storm event would react on the existing system. Utilization of a computer model permitted the investigation of numerous alternatives under various runoff conditions in order to arrive at reasonable design conditions.

DESCRIPTION OF THE MODEL

The storm water model developed to simulate actual conditions of the Moses Creek Watershed was comprised of submodels for the rural and urban areas. Each of the submodels have been used and tested extensively in areas having land and channel characteristics similar to the study area and can be expected to give satisfactory results.

Rural Submodel

The function of the rural submodel was to develop hydrographs for each of the rural subbasins, with composite hydrographs developed at the downstream discharge points where drainage enters the urban system. Hydrographs developed at each of the discharge locations were applied as input data into the urban submodel.

Urban Submodel

The urban submodel applied the output hydrographs from the rural area and runoff hydrographs from each urban subbasin accumulating them into one composite hydrograph at the Crosby Avenue pump station.

The urban submodel was operated in both the analysis and design mode. The existing system was analyzed to determine the location of deficient sections of storm sewer. Subsequently, the input data was applied in a design mode to determine storm sewer sizes needed to handle the design conditions.

DATA REQUIREMENTS

Each submodel required extensive data gathering for each of the subbasins modeled. Although the submodels utilized essentially the same type of data, it was necessary to arrange it in a different format for each one.

Rural Submodel

Data that was necessary for input into the rural submodel included information on land use, structure size and elevations, channel cross-sections, and storm events.

Examples of necessary land use data required for each subbasin included:

- Size of the area
- Breakdown of the area according to land use such as agricultural, wooded, residential development, commercial, and industrial usage.
- Hydrologic soil characteristics of the land use within each subbasin
- Time of concentration for flow across the subbasin

Examples of structure data included:

- Length of reach across the subbasin
- Slope of channel
- Cross section of channel
- Manning roughness coefficients of the channel
- Size and shape of culverts including back water storage
- Storage/discharge relationships of detention areas

Storm event data utilized in the model included:

- Volume of rainfall
- Duration of rainfall
- Distribution of rainfall over a given period of time
- Antecedent moisture conditions

Urban Submodel

Data that was necessary for input into the urban submodel included information on land use, structure size and elevation, and storm events.

Examples of land use data necessary for each subbasin included:

- Size of area
- Percent directly connected impervious area
- Percent indirectly connected pervious area
- Time of concentration of the pervious and impervious areas
- Hydrologic characteristics of the soil

Examples of structure data included:

- Storm sewer sizes
- Storm sewer slopes

Storm event data included:

- Volume of rainfall
- Duration of rainfall
- Distribution of rainfall over a given period of time
- Antecedent moisture conditions

Antecedent moisture conditions were utilized in both submodels to account for rainfall that occurred during the previous five days on the watershed.

The input data developed for the models will be maintained on file and may be used in the future for additional modeling of the watershed. For example, if land use planning changes are suggested, the impact that the changes would have on storm water runoff could be investigated prior to developing final recommendations.

MODEL USES

The storm water models were used to determine runoff, discharge volumes and velocities at select locations in the watershed. The model was first applied to existing land use conditions and calibrated to duplicate the storm event which occurred on July 5, 1978. The response to future land use conditions was then analyzed to determine the impact of additional development in the watershed and to identify potential problem areas. Design of the new system was based on future land use conditions and storm water flows projected from spring thaws and 10 year recurrent summer rains.

APPENDIX L

REFERENCE MANUAL

Consolidated Papers, Inc., Correspondence and file data from 1918 to 1966.

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U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Portage County, Wisconsin, December, 1978.

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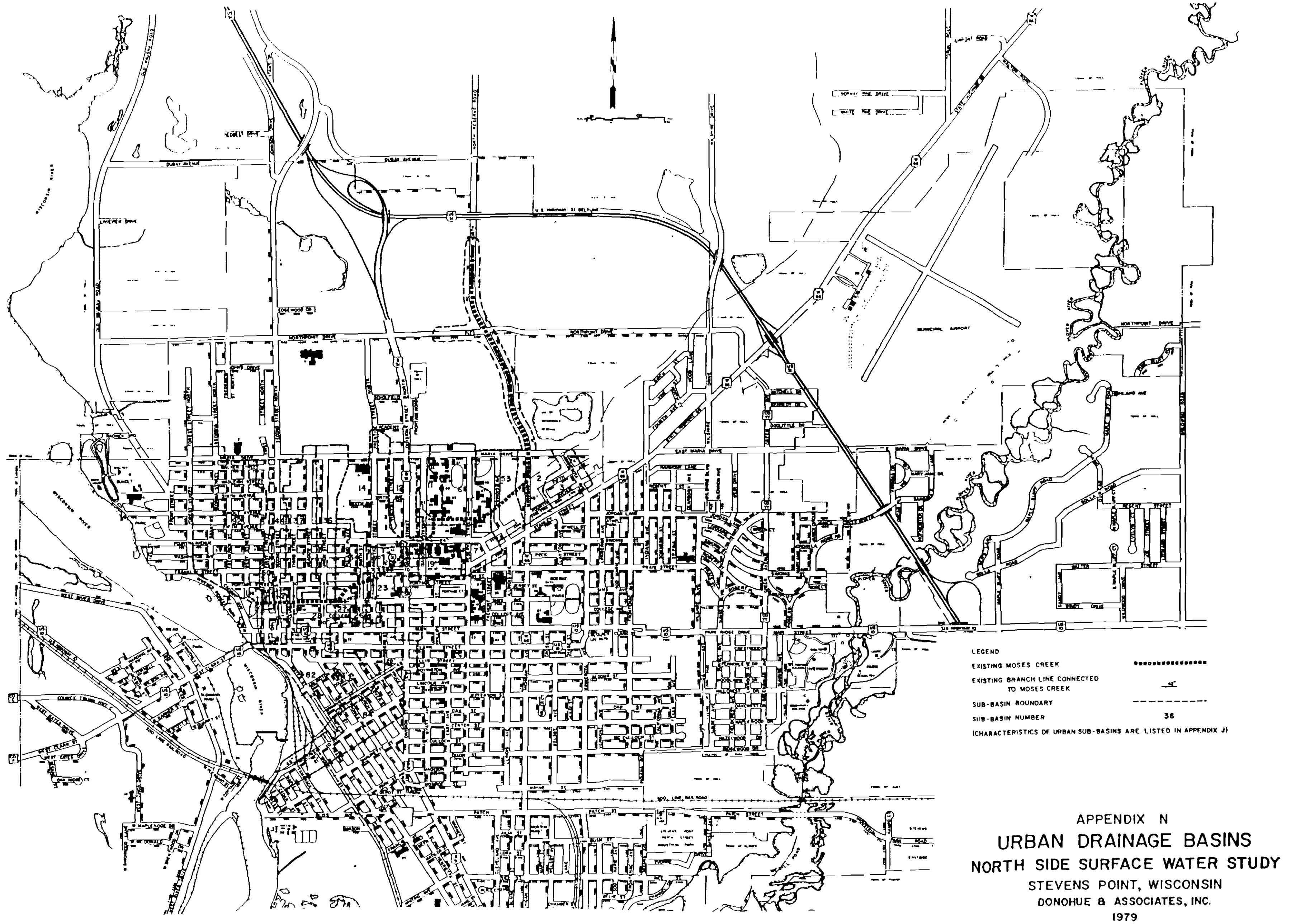


APPENDIX N

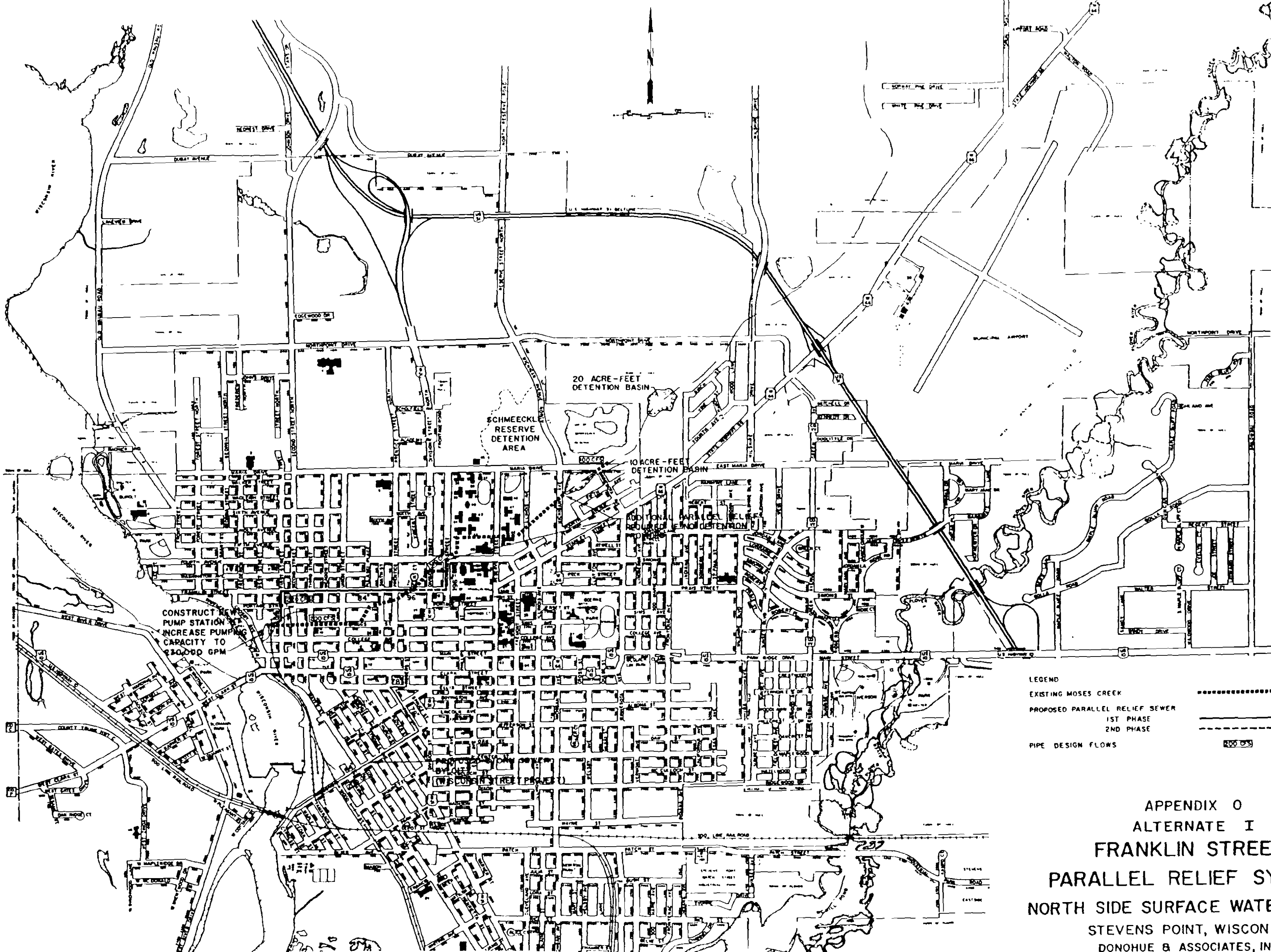
URBAN DRAINAGE BASINS

NORTH SIDE SURFACE WATER STUDY

STEVENS POINT, WISCONSIN

DONOHUE & ASSOCIATES, INC.

1979



APPENDIX O

ALTERNATE I

FRANKLIN STREET

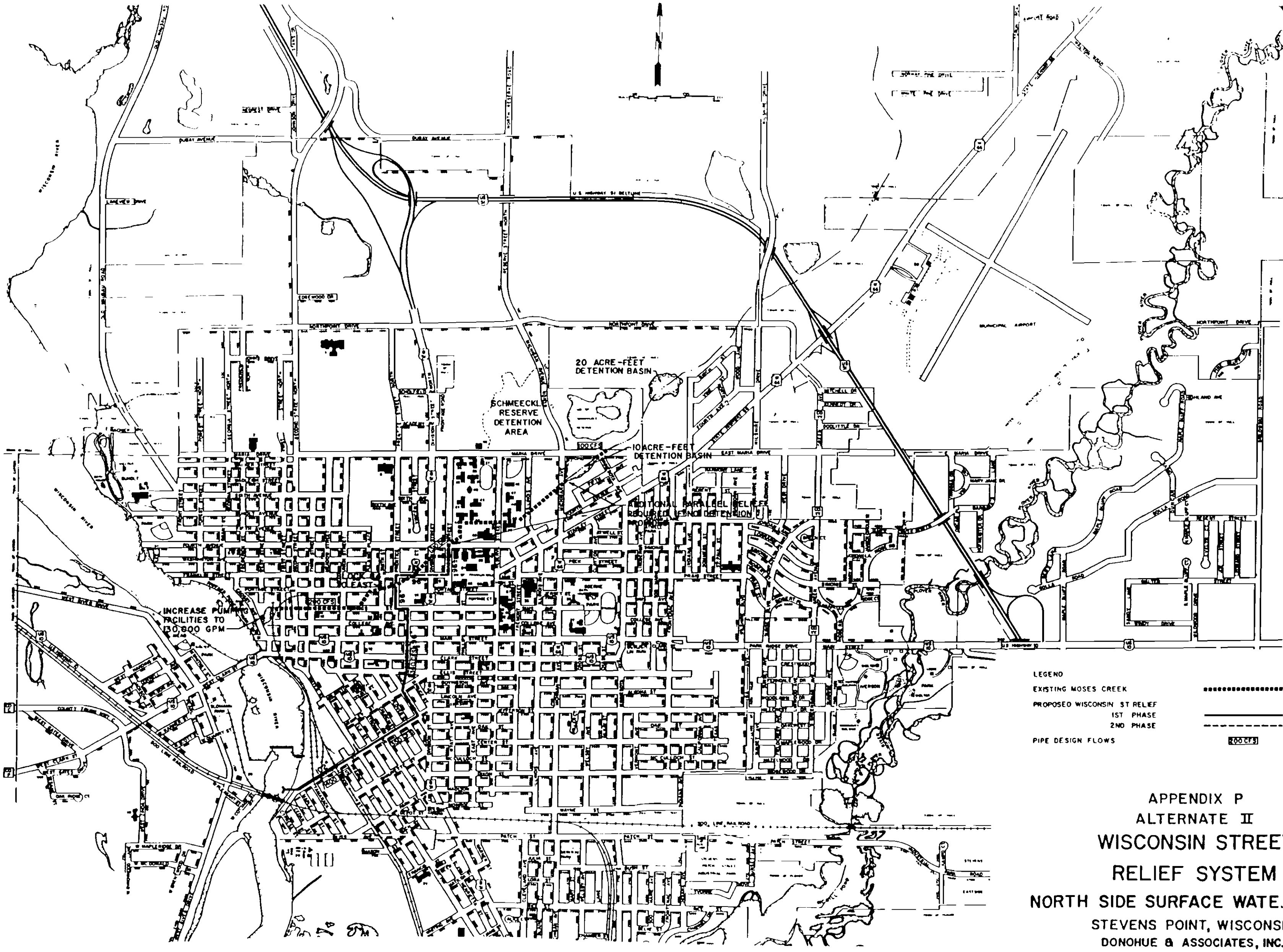
PARALLEL RELIEF SYSTEM

NORTH SIDE SURFACE WATER STUDY

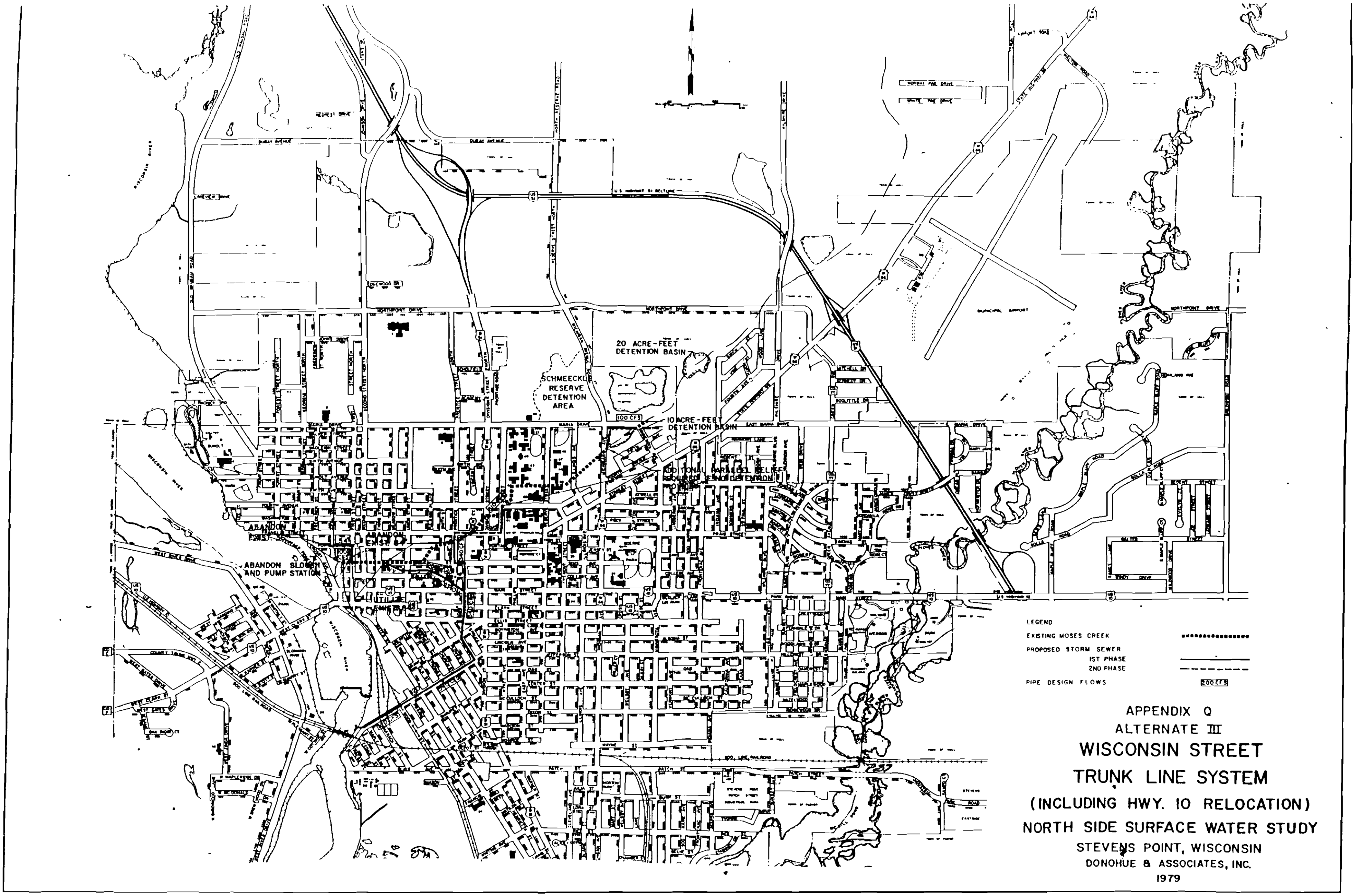
STEVENS POINT, WISCONSIN

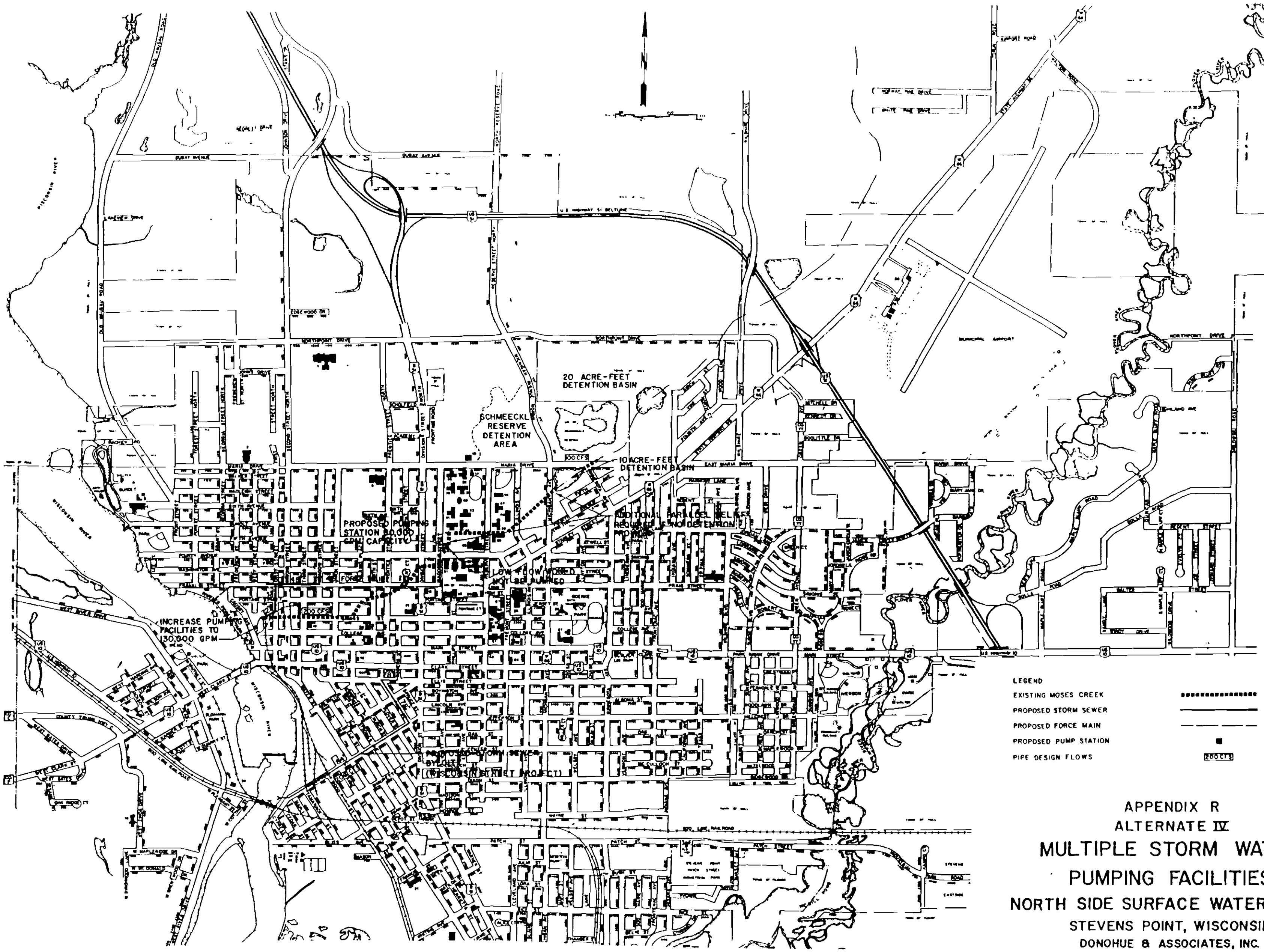
DONOHUE & ASSOCIATES, INC.

1979



APPENDIX P
ALTERNATE II
WISCONSIN STREET
RELIEF SYSTEM
NORTH SIDE SURFACE WATER STUDY
STEVENS POINT, WISCONSIN
DONOHUE & ASSOCIATES, INC.
1979


20 ACRE-FEET
DETENTION BASIN
SCHMEECKLE
RESERVE
DETENTION
AREA
100 CFS
10 ACRE-FEET
DETENTION BASIN
ABANDON
ABANDON
ABANDON SLOUGH
AND PUMP STATION
NORTHPOINT DRIVE
DUBAY AVENUE
MARIA DRIVE
EAST MARIA DRIVE
PARK RIDGE DRIVE
MUNICIPAL AIRPORT
LEGEND
EXISTING MOSES CREEK
PROPOSED STORM SEWER
1ST PHASE
2ND PHASE
PIPE DESIGN FLOWS
200 CFS
APPENDIX Q
ALTERNATE III
WISCONSIN STREET
TRUNK LINE SYSTEM
(INCLUDING HWY. 10 RELOCATION)
NORTH SIDE SURFACE WATER STUDY
STEVENS POINT, WISCONSIN
DONOHUE & ASSOCIATES, INC.
1979



APPENDIX R

ALTERNATE IV

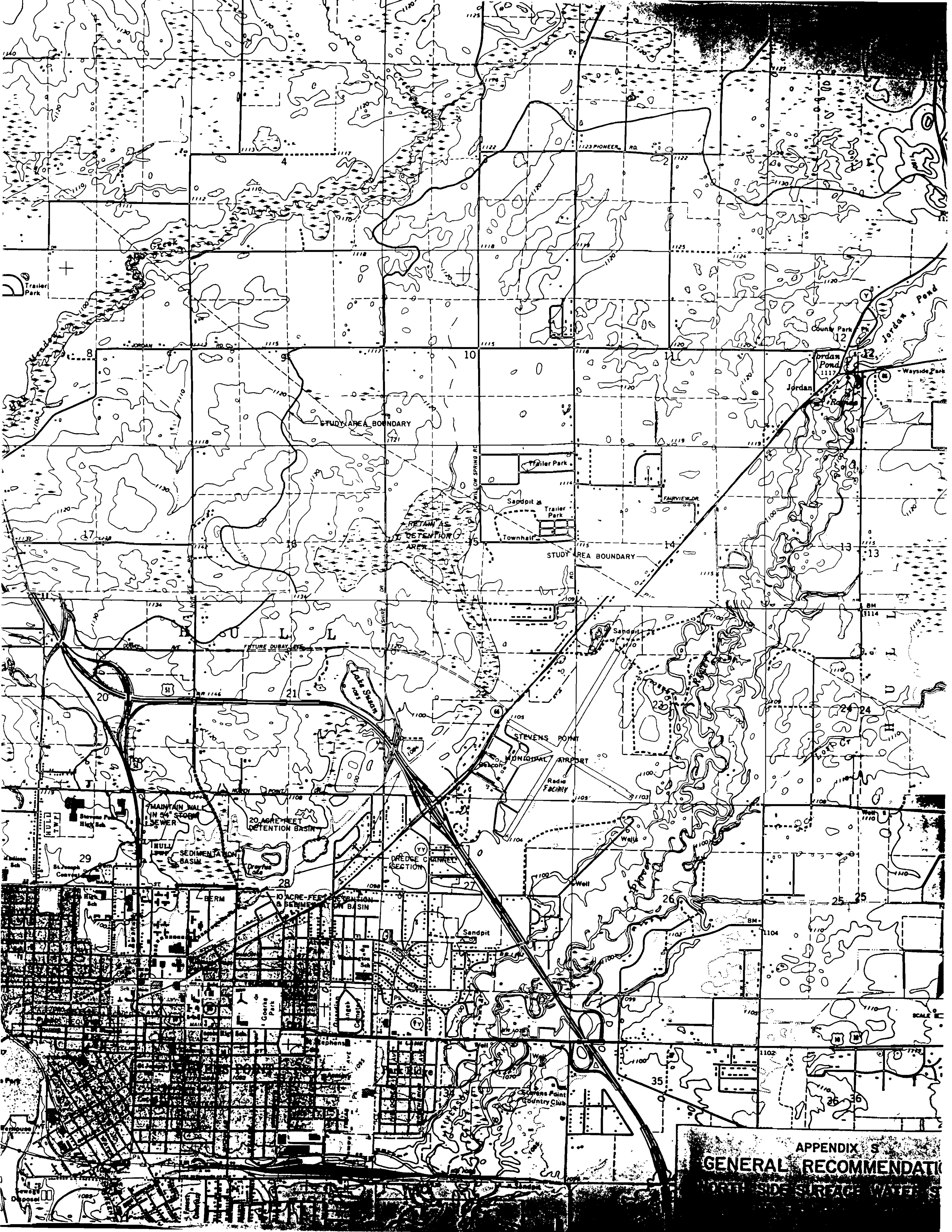
MULTIPLE STORM WATER PUMPING FACILITIES

NORTH SIDE SURFACE WATER STUDY

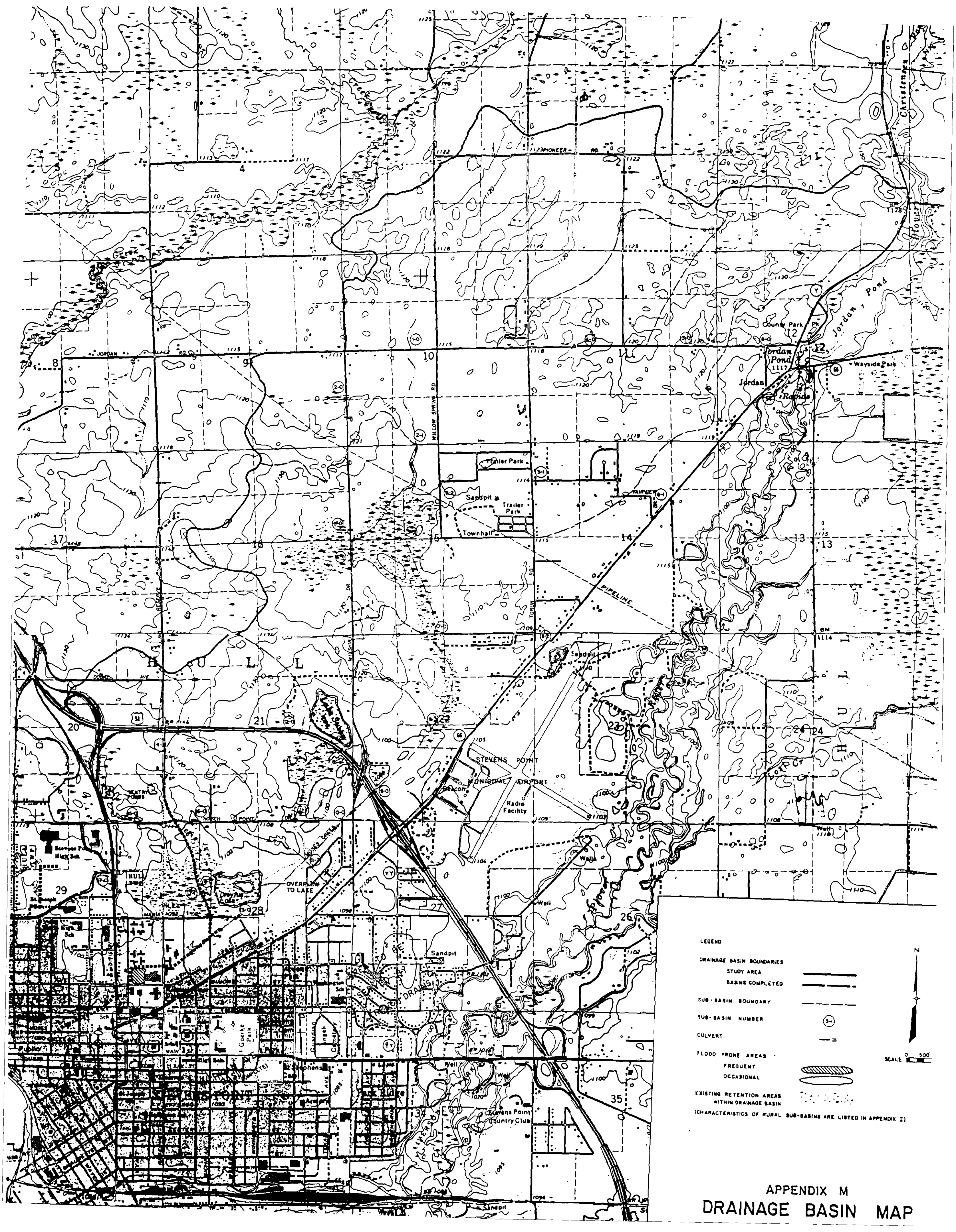
STEVENS POINT, WISCONSIN

DONOHUE & ASSOCIATES, INC.

1979



APPENDIX S
GENERAL RECOMMENDATI
NORTH SIDE SURFACE WATER S



APPENDIX M
DRAINAGE BASIN MAP