# Watershed Plan

## East Branch Tributary No. 2

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ACKNOWLEDGMENTS

This watershed plan was prepared by Rust Environment & Infrastructure Inc. under the direction of the DuPage County Stormwater Management Committee and in cooperation with the DuPage County Department of Environmental Concerns, Stormwater Management Division.

Rust Environment & Infrastructure gratefully acknowledges the efforts of Linda M. Mele, Watershed Engineer at DuPage County Department of Environmental Concerns for her substantial contribution to the preparation of the final text of the watershed plan. Additional assistance was provided by Mike Semenek, Bruce Maki and Jeff Dailey of the Department of Environmental Concerns.

We also wish to thank the residents of the watershed who assisted this planning effort by allowing engineers and surveyors access to their property and by providing information and flood questionnaire responses.
REPORT AVAILABILITY

The watershed plan and appendices are available for public review at:

DuPage County Department of Environmental Concerns
421 North County Farm Road
Wheaton, Illinois  60187
708/682-7130

The Department also can provide copies of reference documents which were prepared at County expense. These documents are identified in the reference section of the report.
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<table>
<thead>
<tr>
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<th>Definition</th>
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<tbody>
<tr>
<td>BMPs</td>
<td>best management practices</td>
</tr>
<tr>
<td>cfs</td>
<td>cubic feet per second</td>
</tr>
<tr>
<td>CMP</td>
<td>corrugated metal pipe</td>
</tr>
<tr>
<td>DEC</td>
<td>DuPage County Department of Environmental Concerns</td>
</tr>
<tr>
<td>DOT</td>
<td>Department of Transportation</td>
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<tr>
<td>DPCSFPO</td>
<td>DuPage County/Countywide Stormwater and Flood Plain Ordinance</td>
</tr>
<tr>
<td>ES</td>
<td>Executive Summary</td>
</tr>
<tr>
<td>FABXS</td>
<td>fabricated cross-section</td>
</tr>
<tr>
<td>FAC</td>
<td>tributary area factor</td>
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<tr>
<td>FEMA</td>
<td>Federal Emergency Management Agency</td>
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<tr>
<td>FEQ</td>
<td>Full Equations Unsteady Flow Hydraulic Computer Program</td>
</tr>
<tr>
<td>FEQUTL</td>
<td>Full Equations Utility computer program</td>
</tr>
<tr>
<td>FIS</td>
<td>Flood Insurance Study</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>HSPF</td>
<td>Hydrologic Simulation Program - Fortran</td>
</tr>
<tr>
<td>IDNR/OWR</td>
<td>Illinois Department of Natural Resources/Office of Water Resources</td>
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<tr>
<td>IDOT</td>
<td>Illinois Department of Transportation</td>
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<tr>
<td>IEPA</td>
<td>Stormwater Management Committee</td>
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<tr>
<td>IPCB</td>
<td>Illinois Pollution Control Board</td>
</tr>
<tr>
<td>IRS</td>
<td>Internal Revenue Service</td>
</tr>
<tr>
<td>LWE</td>
<td>low water entry elevation</td>
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<tr>
<td>NCDC</td>
<td>National Climatic Data Center</td>
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<tr>
<td>NIPC</td>
<td>Northeastern Illinois Planning Commission</td>
</tr>
<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NRCS</td>
<td>Natural Resources Conservation Service</td>
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</table>
LIST OF ABBREVIATIONS AND ACRONYMS
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PEV ➞ Peak Elevation-to-Volume statistical method
PVSTATS ➞ computer program for doing flood frequency analysis using the
           Peak Elevation-to-Volume statistical method
RDSPOUT ➞ computer program that reads FEQ special output, determines flood
           volumes, and develops data in PVSTATS input format
SCADA ➞ Supervisory Control and Data Acquisition system
SCS ➞ Soil Conservation Service (currently known as the Natural
       Resources Conservation Service), part of the United States
       Department of Agriculture
SMC ➞ Stormwater Management Committee
SPOUT Utilities ➞ computer programs for reading and analyzing flood data contained
                 in an FEQ Special Output file.
STA ➞ station
SW Trib ➞ southwest tributary to East Branch Tributary No. 2
Trib ➞ Tributary
TSF ➞ Time Series File
TSFCAL.nn ➞ time series file for calibration to storm events in year nn
TSFLONG.MP2 ➞ name of time series file for floodplain mapping and project analysis
USDA ➞ United States Department of Agriculture
USGS ➞ United States Geological Survey
WHPA ➞ Wellhead Protection Area
WY ➞ water year
XS ➞ cross-section
ES. EXECUTIVE SUMMARY

This document presents the stormwater management plan for the watershed of Unnamed Tributary No. 2 of the East Branch of the DuPage River, hereinafter called East Branch Tributary No. 2. This watershed plan has been prepared by the DuPage County Department of Environmental Concerns (DEC) and its engineering consultant, Rust Environment and Infrastructure. The plan presents watershed analysis and project evaluation leading to a set of recommendations which have been formulated to achieve the goals and objectives of the DuPage Countywide Stormwater Management Plan. Upon approval and acceptance by the DuPage County Stormwater Management Committee this plan will be incorporated into the watershed plan being prepared for the East Branch of the DuPage River.

Authority

Illinois Public Act 85-905 authorized DuPage County to develop a Countywide Stormwater Management Program to fund and regulate stormwater and floodplain management activities. The Countywide Stormwater Management Program is directed by the Stormwater Management Committee (SMC) of the DuPage County Board and the DuPage County Board which have authorized the preparation of this plan.

Public Participation

Public involvement is accomplished initially through mailing of questionnaires to property owners, and through response to drainage complaints filed with DEC. The submittal of the Tributary No. 2 Watershed Plan to the SMC will trigger the start of a public comment period which will include a public meeting/hearing. All comments received will be addressed by the SMC in a comment response document, which will be incorporated into the Watershed Plan.

Plan Components

Components of the plan summarized in the executive summary include the following:

- Watershed Description
- Hydrologic/Hydraulic Analysis
- Damage Analysis
Watershed Plan
East Branch Tributary No. 2

carry flow north along Main Street to the Tributary No. 2 main channel.

Between Main Street and Park Boulevard, low flows are carried in a corrugated metal storm sewer, and an overflow channel is provided for high flows. A cross-over structure just east of Main Street is designed to assure full flow in the storm sewer before flow enters the overflow channel. Streambank stabilization was completed by DuPage County on the overflow channel in 1994 for the reach between Main Street and Forest Avenue, and the reach between Park Boulevard and Goodrich Avenue. Between Forest Avenue and Park Boulevard, the overflow passes through a wide grassy area that may have been designed for flood storage. The culverts at both Forest Avenue and Park Boulevard consist of one circular and one arch-shaped corrugated metal pipe (CMP).

Hydrologic/Hydraulic Analysis

A detailed FEQ unsteady flow hydraulic model was developed to simulate flood responses in the Tributary No. 2 drainage system. FEQ is designed to accurately compute flood flows and elevations in a stream network consisting of open channels, storm sewers, reservoirs and hydraulic structures. Hydrologic inputs used in FEQ are runoff time series based on historic rainfall events. The hydrologic inputs were developed in previous studies conducted by DEC and the Northeastern Illinois Planning Commission. A field survey was conducted to obtain 25 channel cross-sections and measurements of 15 hydraulic structures which comprise the physical data requirements of FEQ. The model was calibrated to observed high water marks from the 1972, 1979 and 1987 storm events.

Damage Analysis

The calibrated FEQ model was used to conduct simulations of a 45-year record of historical storm events. Resulting peak flood elevations were employed in a damage analysis to determine expected damages to residential structures and roads in the watershed. Quantifiable damages affect six residential properties, one County highway, and three secondary roads. Two homes are subject to inundation in the historical series. Total damages in the historical series are estimated to be $256,200 or an average of $5,600 per year.

Identification of Watershed Problems and Issues

Flooding problems were identified and characterized by utilizing five sources of flooding information. These information sources were drainage complaints, flooding damage questionnaires,
field observations, FEQ hydraulic analysis of historical storms, and damage analysis based on the FEQ results. Current FEMA floodplain limits also provided a means of identifying areas at risk of flooding. Questionnaires and drainage complaints identified problems such as overbank flooding, basement backups, septic system backups, ponding, seepage, maintenance deficiencies, and severe erosion. Many of these reports were checked in the field to verify whether the source of the problem was stormwater related. Structure flooding and road overtopping risk was determined from the FEQ hydraulic analysis.

The watershed modeling, damage analysis and citizen reports indicate the presence of serious flooding problems in the Tributary No. 2 Watershed. These problems include:

1. Overbank Flooding of Structures

   Residential structures are at risk of overbank flooding along two reaches of the Tributary No. 2 stream channel. These reaches are located between Main Street and Forest Avenue, and in the vicinity of the intersection of Goodrich Avenue and Second Street. Verifiable inundation damages have been reported at two residences and one garage in the Main Street to Forest Avenue reach.

   The FEQ model results show that two houses are inundated.

2. Yard Flooding and Associated Damages

   According to resident damage reports and drainage complaints, septic system backup due to flooding of the septic field is a persistent problem in areas adjacent to the stream downstream of Park Boulevard. Specifically residents on Park Boulevard, Glenrise Avenue, Second Street, and Eastern Avenue submitted reports to DEC. Sixteen property owners reported yard flooding; seven property owners reported sewer backup or basement flooding. Three property owners with septic systems reported flooding problems.

   The FEQ analysis identifies six properties with associated damages.

3. Overtopping of Main Street

   The calibrated FEQ hydraulic model indicates that Main Street would have been overtopped
seven times during the historical sequence of storm events. In two events, the depth of overtopping would have exceeded six inches, thus leading to serious disruption of traffic flow and emergency services. It is possible that police and fire department services would have been compromised.

Drainage complaints filed with DEC report several instances of flooding of Main Street.

4. Overtopping of Glenrise Avenue

Glenrise Avenue is overtopped by flow in Tributary No. 2 thirteen times in the historical period, or an average of once every four years. In six of these events, the overtopping exceeds six inches, thus creating an impediment to emergency services and other traffic. This is substantiated by drainage complaints received by DEC citing frequent overtopping.

5. Overtopping of Forest Avenue

Forest Avenue is overtopped three times in the historical series modeled in FEQ. Two of these overtoppings exceeded six inches in depth.

6. Streambank Erosion

Citizen complaints and field observations have identified reaches of serious bank erosion. Erosion is prevalent in the reach extending a total of 1,250 feet from 500 feet upstream of Glenrise Avenue to Eastern Avenue, and the 450-foot reach from Park Boulevard to Goodrich Avenue. This bank erosion causes loss of residential property and degraded water quality and stream habitat. This erosion is predominantly caused by years of land use changes in the watershed, such as residential and commercial development without stormwater detention.

7. Inadequate Local Drainage System

Roadside ditches with significant erosion, deterioration, insufficient capacity or inadequate driveway culverts exist throughout unincorporated areas in the watershed.
The following issues have been brought to the attention of DEC in the recent past, and were also part of the impetus to prepare the Watershed Plan.

8. Unauthorized Culvert Installation

Upstream of Glenrise Avenue, a 180-foot long corrugated metal pipe culvert was installed on private property without obtaining the required DuPage County excavation and fill permit and the appropriate State permit. This culvert increases flood stages upstream and contributes to erosion downstream.

9. Development Issues at Eastern Avenue

The owner of 9 acres of vacant land downstream of Eastern Avenue approached the County regarding the potential of his site for residential development, a flood control facility, or a wetland bank.

10. Development Issues in Upper Watershed

The owner of 56 acres in the upper watershed, upstream of (west of) Main Street, and the Village of Glendale Heights have attended several pre-application meetings regarding development of the 56-acre site under the Countywide Stormwater and Flood Plain Ordinance (DPCSFPO). The site contains Tributary No. 2 floodplain and riparian areas, as well as critical wetlands and depressional upland storage. Part of their development site includes the site of Alternatives 3 and 4 presented in this Watershed Plan.

11. Floodplain Map Adequacy

The existing FEMA floodplain map ends just upstream of (west of) Main Street. Over 50 acres of developable property lie in the area upstream of the map limit. This area contains unmapped floodplain storage critical to the downstream watershed. Additionally, there are suspected problems with the current FEMA map: the flood profiles do not reflect the hydraulics of the watershed, and the 100-year elevation at the upstream map limit (upstream of Main Street) appears to be too high.
Due to the adverse impacts on public health, safety, and property values, alternative measures to reduce or mitigate problems 1 through 7 have been prepared. Additionally, issues 8 through 11 have been addressed, either in conjunction with the flood mitigation measures, where appropriate, or separately.

Recommended Plan Development

Both structural and non-structural alternatives were considered when addressing the flooding problems in the Tributary No. 2 Watershed (issues 1 through 5 in the preceding section). Combinations of structural and non-structural methods were also considered, as well as a no-action alternative. A greenway alternative could not be considered in the Tributary No. 2 Watershed due to the fact that only one property is eligible for buyout.

Because the watershed is small and damages are concentrated in the center of the watershed, each alternative was designed to address all of the flooding problems in the entire watershed.

Three alternative capital improvement strategies, plus the alternative of no action, were evaluated in detail to address the flooding problems in the watershed. These alternatives are briefly described below. Benefit/cost data for each alternative is summarized in Table ES-1, and their locations are shown in Figure ES-2.

Alternative 1: **No Action.** This alternative consists of no capital improvements to mitigate flooding in the Tributary No. 2 Watershed. This alternative has no cost and yields no flood control benefits.

Alternative 2: **Buyouts/Floodproofing.** This alternative solves structure inundation problems through County buyout of the one eligible property, and floodproofing of the structure that is not eligible for County buyout. This project does not solve road overtopping or associated damages (except at the location of the buyout). The cost of this alternative is estimated to be $144,000 for the buyout and $10,000 for floodproofing, or a total of $154,000. Benefits gained (reduction in flood damages) are $145,700, while residual (unsolved) damages are $110,500.

Alternative 3: **Buyouts/Floodproofing with Culvert Improvements.** In this alternative, inundation damages to structures are eliminated through County buyout of the
### TABLE ES-1

**ALTERNATIVE ANALYSIS SUMMARY**

East Branch Tributary No. 2  
DuPage County, Illinois

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<th>TOTAL CAPITAL COST</th>
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<td>$1,701,000</td>
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<td>$254,100</td>
<td>71</td>
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Alternative 1: No action.

Alternative 2: Buyouts and floodproofing.

Alternative 3: Buyouts, floodproofing, replacement of Glen Ellyn Road and Glenrise Avenue culverts, compensatory storage, sedimentation basin.

Alternative 4: Wetland/flood storage facility.
one eligible property and floodproofing of the other. The culverts at Main Street and Glenrise Avenue would be rebuilt and the road profiles raised to eliminate overtopping greater than 6 inches. Additional flood storage would be created upstream of Main Street to prevent any increases in flood heights due to culvert replacement. This storage would be designed as wetland creation or enhancement if possible. A sedimentation basin would be created in conjunction with the compensatory storage to provide water quality benefits to the wetland.

Residual damages of $2,300 would be present after implementation of this alternative because it does not eliminate associated damages at five properties. However, at four of these five properties, the total associated damages for the 45-year historical period are less than $200 each.

The total cost of this alternative is $751,480. Benefits are $253,900; residual damages are $2,300.

Road overtopping at Forest Avenue is not benefitted by this project.

This alternative results in negligible increases in velocity downstream of Main Street.

**Alternative 4: Flood Control/Wetland Facility.** This alternative consists of expanding and partially berming the wetland and providing substantial (14 to 18 acre-feet) of additional flood storage upstream of Main Street. This facility would eliminate all of the structure inundation (two houses), and the only damages that would remain are associated damages at one structure. Road overtopping at Forest Avenue is completely eliminated with this alternative, and all instances of road overtopping is eliminated at Glenrise Avenue.

The total cost of these improvements is estimated to be $1,701,011 (including land acquisition). Benefits are $254,000, and residual damages are $2,100.

This alternative causes reductions in flood heights of 2.9 to 0.2 ft (in the reach of stream from Forest Avenue to Eastern Avenue, respectively) in the 1987 event. Average flood height reduction over the historical periods is 0.53 to 0.13
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ft (again from Forest Avenue to Eastern Avenue). This reduction in flood height is expected to benefit nine properties with associated damages which are not quantified (reported by the FEQ analysis), including one property with a septic system.

This alternative also causes reductions in velocities of 10 to 15 percent. These reductions are in the following three reaches: Main Street to Forest Avenue, downstream of Park Boulevard, and Goodrich Avenue to Eastern Avenue.

The remaining watershed issues (issues 8 through 11 in the preceding section) were addressed by formulating a package of actions, which are described below:

Action 1: Stream Maintenance. This action is recommended for the entire watershed before streambank stabilization is initiated. Stream maintenance activities such as debris removal and removal of non-native vegetation eliminate some of the causes of streambank erosion.

Action 2: Streambank Stabilization. Bioengineering techniques previously utilized by the County in Glencrest Creek, such as lunker structures, A-jacks, vortex weirs, and the establishment of deep-rooted native vegetation are recommended for much of the stream channel between Park Boulevard and Eastern Avenue.

Action 3: Removal of Unauthorized Culvert. Removal of the culvert installed on private property upstream of Glenrise Avenue would eliminate the increases in flood heights on upstream properties. It would also reduce the potential for streambank erosion by reducing the concentration of flow and increase in velocity caused by the pipe.

A court order issued by the 18th Judicial Circuit Court of DuPage County, in approximately 1993, required the owner to remove the existing pipe, to restore the stream to its natural condition, and further, to allow the owner to leave a 6- to 8-foot culvert to act as a horse crossing. However, the order did not place a time limit on the owner to complete these directives.
Because the presence of the culvert would prevent the streambank stabilization work of Action 2, it is recommended that the County negotiate removal of the unauthorized culvert with the property owner as part of the stabilization work to be done in this reach.

Action 4: **Private Wetland Bank at Eastern Avenue.** The private property downstream of Eastern Avenue was analyzed for its potential as both a flood control facility and a wetland mitigation bank. The site has little potential as a flood control facility, due to its extreme downstream location in the watershed. (The damages in the watershed are all located well upstream.) However, DEC staff feels that the property has potential as a wetland mitigation bank site under the DPCSFPO. A wetland bank here could serve as a bank site for the entire East Branch Watershed.

Action 5: **Ditch Rehabilitation.** Roadside drainage systems (mainly ditch and culvert) have been assessed for adequate conveyance capacity throughout the watershed. These capacities have been ranked and prioritized on a street-by-street basis by the need for rehabilitation work. This rehabilitation work has been budgeted under the recent County Drainage Bond Issue. This work is expected to address 6 properties with drainage problems not addressed by the overbank flooding alternatives presented above.

Action 6: **Remapping of Tributary No. 2 Floodplain.** Remapping of the floodplain using County modeling methods and land-use and survey data will yield a more accurate, up-to-date floodplain map.

Action 7: **Coordination with Development in Upper Watershed.** To accommodate the needs of both the proposed development upstream of Main Street and the needs for flood control, DEC staff must continue coordination of these projects with the developers and the Village of Glendale Heights.

**Recommended Plan**

Components of the recommended plan have been selected based on the following factors:
effectiveness in eliminating existing flooding (both quantifiable and non-quantifiable benefits), cost, impact on water quality, velocities/erosion potential, impact on aquatic habitat, ease/difficulty of implementation, and conformance to DPCSFPO requirements.

A comparative analysis of the four flood control alternatives considered is provided in Table ES-1. The recommended plan for this watershed is Alternative 3 because it is significantly more cost-effective than Alternative 4 and achieves nearly the same level of quantifiable benefits. The cost-effectiveness of Alternative 3 over Alternative 4 is true both when looking at the overall capital cost of the project and when considering just the County's cost. Residual damages are $2,300 for Alternative 3, as opposed to $2,100 for Alternative 4. The benefits given by Alternative 4 for the additional $950,000 cost are: flood level reductions, elimination of some instances of road overtopping which are less than 6 inches in depth, decreased velocities, and potential for greater wetland expansion and enhancement. Alternative 4 would reduce flood heights in many properties between Main Street and Eastern Avenue. It would benefit at least nine properties where yard flooding has been reported. On the negative side, the flood level reduction does not translate into quantifiable damage reductions using the current County methodology, the velocity reductions will not eliminate the need for streambank stabilization, and Alternative 4 would be difficult to implement because purchase or easements on twelve parcels would have to be obtained. Many of the easements represent significant portions of residential lots. Alternative 3 offers opportunities for wetland expansion and water quality enhancement, both by itself and if coordinated with the proposed development in that part of the watershed. Table ES-2 summarizes the preceding factors used for evaluating the alternatives.

The package of actions 1 through 7 is recommended in conjunction with whatever flood control alternative is chosen by the SMC and the County Board. These actions were chosen for the following reasons:

- They are consistent with the goals and objectives of the DuPage County Stormwater Management Plan.

- Action 1 would be completed as part of the ongoing Stormwater Division Stream Maintenance program.

- Action 2 would be completed as part of ongoing Stormwater and Drainage programs.
**TABLE ES-2**

**ALTERNATIVES COMPARISON SUMMARY**

*East Branch Tributary No. 2*

*DuPage County, Illinois*

<table>
<thead>
<tr>
<th>EVALUATION CATEGORY</th>
<th>1: NO ACTION</th>
<th>2: BUYOUT AND FLOODPROOF</th>
<th>3: BUYOUT, FLOODPROOF, AND CULVERT IMPROVEMENTS</th>
<th>4: WETLAND/FLOOD CONTROL FACILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of Implementation</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Buyout/Floodproofing Requirements</td>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
<td>None</td>
</tr>
<tr>
<td>Relocation of Residents Due to Buyouts</td>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
<td>None</td>
</tr>
<tr>
<td>Flood Level Reduction</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>High</td>
</tr>
<tr>
<td>Wetland Creation/Enhancement</td>
<td>None</td>
<td>None</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Yard and Septic Flooding Reduction</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>High</td>
</tr>
<tr>
<td>Water Quality Benefits</td>
<td>None</td>
<td>None</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Emergency Services Required</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Road Maintenance Requirement</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Road Accessibility during Flood Events</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>
• Actions 3, 4, and 7 would be consistent with administration of the DPCSFPO. Action 7 is also needed to successfully implement the flood control of Alternative 3 or 4.

• Action 5 involves maintenance of existing unincorporated drainage systems and is the responsibility of the local government. Funds have been budgeted under the recent County Drainage Bond Issue.

• Action 6 is part of ongoing Stormwater Division work in preparing watershed plans and models, and updating floodplain maps, in DuPage County watersheds.

Recommended Plan Funding

In Table ES-3 funding plans have been presented for all alternatives considered. Alternative 1 (no action) obviously requires no outlay of funds. For Alternative 2, the Stormwater Division would fund the one buyout; the property owners would fund the floodproofing. The numerous funding sources for Alternatives 3 and 4 appear in Table ES-3. Following is the rationale for the recommended alternative. The culvert replacement cost for Main Street is the responsibility of the County Transportation Department. Supporting the Transportation Department contribution is the fact that over 40 percent of the overbank flooding damages in the Tributary No. 2 Watershed are traffic damages on Main Street. County Stormwater funds pay for the one buyout and the compensatory storage. The Glenrise Avenue culvert replacement will be funded through the County Drainage Bond Issue, as will the sedimentation basin. Property owners pay for floodproofing, with technical assistance available through the Stormwater Division.

For the package of seven recommended actions, the only expenditure of Stormwater funds needed would be for stream maintenance, design of streambank stabilization, and remapping of the Tributary No. 2 floodplain. Funding estimates and their sources are as follows:

Action 1: The stream maintenance work on Tributary No. 2 has already been scheduled and budgeted for 1996, in the amount of $90,000.

Action 2: Design would be paid for under 1996 Stormwater funds currently budgeted for streambank stabilization design, and construction would be completed through the County Drainage Bond. The design cost is estimated to be $19,110, and construction cost is estimated to be $191,100.
<table>
<thead>
<tr>
<th>ALTERNATIVE</th>
<th>COUNTY STORMWATER</th>
<th>COUNTY TRANSPORTATION DEPT.</th>
<th>PROPERTY OWNER</th>
<th>LOCAL COST</th>
<th>TOTAL COST</th>
<th>COUNTY STORMWATER COST PER PT. REDUCTION</th>
<th>LOCAL &amp; COUNTY TRANSPORTATION COST PER PT. REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>$144,000</td>
<td>$0</td>
<td>$10,000</td>
<td>$0</td>
<td>$154,000</td>
<td>$3,600</td>
<td>$0</td>
</tr>
<tr>
<td>3</td>
<td>$296,280</td>
<td>$183,700</td>
<td>$10,000</td>
<td>$261,500</td>
<td>$751,480</td>
<td>$4,489</td>
<td>$6,745</td>
</tr>
<tr>
<td>4</td>
<td>$296,280</td>
<td>$137,830</td>
<td>$0</td>
<td>$1,266,900</td>
<td>$1,701,010</td>
<td>$4,173</td>
<td>$19,785</td>
</tr>
</tbody>
</table>

Note: Local cost refers to DuPage County Drainage/Bond cost.
Action 3: Removal of the unauthorized culvert placed upstream of Glenrise Avenue is the responsibility of the property owner. However, staff recommends that removal be negotiated as part of streambank stabilization in order to achieve the removal in a timely manner (see discussion under Recommended Plan Development).

Action 4: A private wetland bank on the property downstream of Eastern Avenue, if implemented, would be funded entirely by the property owner and future developers. The property owner would fund the preliminary engineering necessary for the concept plan which would form the basis for an agreement with the County. Wetland mitigation credits from future developers in the East Branch Watershed would fund construction, monitoring, and long-term maintenance. The cost estimate for this bank is currently being developed by the consultants hired by the property owner.

Action 5: Funding for the ditch segments ranked as high and medium priority in needing rehabilitation has been included in the recent County Drainage Bond Issue. The cost of this work is estimated at $420,000.

Action 6: Funding for the watershed modeling and statistical analysis necessary to remap the floodplain has already been encumbered in the 1996 Stormwater budget.

Action 7: Coordination will be performed by DEC staff. No further allocation of funds is necessary.

The impact of the recommended plan on the Stormwater Financial Plan is minimal. Funds for buyouts County-wide are already set aside in the Plan. A commitment is needed from the Highway Department to replace the Main Street culvert before Stormwater funds for the compensatory storage ($152,280) are placed in the Financial Plan.

The above funding information and Tables ES-1 and ES-3 are the best possible estimates available from the watershed planning process. These figures may change during final design.
Implementation of Recommended Plan

The following steps must be completed in order to implement the recommended Alternative 3:

- The public review process must be successfully completed, and the Watershed Plan must be adopted by the County Board.

- A public notice must be posted regarding the voluntary buyout program in Tributary No. 2.

- Through the public meeting/hearing process, property owners can be notified of the availability of technical assistance for floodproofing.

- The land rights must be acquired to place the necessary compensatory storage. The property needed for this is one parcel comprising the wetland upstream of Main Street. Staff recommends the other parcel comprising the wetland be dedicated to either the Village of Glendale Heights or to the County. The developer has already stated that this may be a possibility.

- Final design must be accomplished within the next six months, so it can be coordinated with the neighboring development proposal: land rights can be obtained from the developer, and enough space made available for not only the compensatory storage and sedimentation basin, but for the developer's stormwater and wetland mitigation needs.

- The compensatory storage must be constructed before the Main Street culvert can be replaced. The property needed for this is one parcel comprising the wetland upstream of Main Street. Staff recommends the other parcel comprising the wetland be dedicated to either the Village of Glendale Heights or to the County. The developer has already stated his willingness to do this.

- Construction of the Main Street culvert replacement is dependent upon the County Transportation Department committing funding for it.

- Because the proposed development carries with it the requirement to extend Second Place to Main Street (imposed by the Village of Glendale Heights), the impact of this road extension on the recommended project design, as well as on Tributary No. 2 floodplain,
 riparian, and wetland areas must be examined and resolved. One alternative to the Second Place road extension is the improvement of Highland Avenue and the Poss Street/Main Street intersection. Ideally, the County Transportation Department would commit to analyzing this in the next six months, so the above-mentioned issues can be resolved.

- The Glenrise Avenue culvert replacement can be constructed independently of the Main Street culvert replacement and compensatory storage.

The following steps are necessary to implement the recommended actions:

Action 1: No further steps are necessary.

Action 2: Schedule construction of streambank stabilization with County staff managing the Drainage Bond.

Action 3: Negotiate timely removal of the unauthorized culvert with the property owner in return for streambank stabilization.

Action 4: Review wetland mitigation bank concept plan when completed by owner and consultant. Bring this concept plan to SMC and County Board for approval.

Action 5: Schedule construction of ditch rehabilitation with County staff managing the Drainage Bond.

Action 6: Complete the floodplain remapping work currently underway. The statistical analysis will be completed by June, 1996. Map preparation and submittal to FEMA are expected to be completed by September, 1996.

Action 7: Provide coordination by DEC staff in the course of designing the recommended alternative and by pre-application meetings with the developer.

All necessary permits (federal, state, local, and County Stormwater) shall be obtained before construction of the recommended alternative and actions is begun.
I. INTRODUCTION

This report presents the watershed plan for Tributary No. 2 of the East Branch of the DuPage River. This watershed plan has been prepared by Rust Environment & Infrastructure and Department of Environmental Concerns staff at the direction of the DuPage County Stormwater Management and Drainage Committee. The watershed plan will identify flood damage reduction projects which comply with the following goals. The watershed plan will also define the extent of special management areas including wetlands, riparian areas, recharge areas, depressional storage areas, and floodplains.

A. Jurisdictional Authority

Illinois Public Act 85-905 authorized certain counties in northeastern Illinois to develop countywide stormwater management plans. The Act gave these counties, which include DuPage County, the ability to levy a dedicated stormwater tax and the authority to set countywide standards for stormwater and floodplain management. DuPage County implemented this authority by adopting the DuPage County Stormwater Management Plan in 1989 (DuPage County Stormwater Management Committee, 1989). The Plan:

1. consolidates stormwater and floodplain management activities throughout the County into a unified, countywide structure (the DuPage County Stormwater Management Program);

2. sets minimum standards for stormwater and floodplain management. These standards have been incorporated into the DuPage County Stormwater and Flood Plain Ordinance (DPCSFPO), which became effective in 1992;

3. sets forth six objectives and fifteen policies which define the direction and technical and institutional characteristics of the Program;

4. establishes standards for components of the Plan. The reader is referred to the Plan document for a full discussion of this; however, one of the key components is the requirement to address stormwater and floodplain management activities on a watershed basis.
Watershed Plan
East Branch Tributary No. 2

The DuPage County Stormwater Management Program is directed by the Stormwater Management Committee (SMC), which is comprised of one municipal member and one County Board member from each of the six County Board Districts. The directives of the Committee are executed by the staff of the County Department of Environmental Concerns Stormwater Management Division.

Under the direction of the SMC, the staff is developing watershed plans for each of the major stream basins within the County. The final watershed plan will be completed in accordance with the criteria and standards established by the committee in the DuPage County Stormwater Management Plan, adopted September 1989, and will be a component of the East Branch DuPage River Watershed Plan. Each plan will identify regulatory requirements, maintenance requirements, and capital improvement projects necessary to reduce and control the potential for catastrophic flooding within DuPage County.

B. Goals

The goals of this watershed plan and the DuPage County Stormwater Management Plan are the following:

1. Reduce existing potential for stormwater damage to public health, safety, life, and property.

2. Control future increases in stormwater damages.

3. Protect and enhance the quality, quantity, and availability of surface and groundwater resources.

4. Encourage preservation of aquatic and riparian environments.

5. Control sediment and erosion in and from drainage ways, developments, and construction sites.

6. Promote equitable, acceptable, and legal stormwater management measures.
This preliminary engineering study examines cost-effective solutions to reduce the potential for recurrence of flood damage and avoid further environmental degradation associated with drainage development.

C. Plan Overview

Key components of the plan are characterization and inventory of watershed resources, hydrologic and hydraulic analysis, identification of watershed issues and problems, and development of recommended solutions. This plan document is divided into nine sections including the Introduction. Section II provides a description of the watershed area and its drainage system and summarizes the environmental resources found there. Section III presents the hydrologic and hydraulic computer modeling approaches developed for analysis of flooding. Sections IV and V deal with identification and quantification of stormwater management problems, and Section VI presents the potential alternative solutions to solve these problems. Section VII ties the previous sections together into a recommended plan. The plan consists of mechanisms for protection and enhancement of watershed resources and capital improvements that mitigate flooding hazards. Section VII also includes institutional and regulatory issues such as floodplain mapping and a maintenance plan to preserve the effectiveness of existing and proposed flood control mechanisms.

D. Public Involvement

Public involvement in the Tributary No. 2 Watershed planning process is accomplished by several means. In May, 1994, flood damage questionnaires were distributed by mail to 143 property owners whose property is in or near the floodplain. The cover letter alerted recipients to the fact that a Watershed plan was being developed. Drainage complaints filed with DEC provided impetus to investigate some of the flooding problems discussed in the plan. The initial submittal of this plan to the SMC will trigger the start of a public comment period, during which a public meeting/hearing will be held. Also during this time, copies of the plan will be distributed to all local, state, and federal agencies having jurisdiction with the Tributary No. 2 Watershed. All comments from the public, agencies, and SMC will be addressed in a comment response document and will be incorporated into the Tributary No. 2 Watershed Plan accordingly.
II. CHARACTERISTICS OF THE WATERSHED

A. Watershed Description

The East Branch Tributary No. 2 Watershed covers approximately 1.16 square miles (740 acres) in Glen Ellyn, Glendale Heights, and unincorporated Milton and Bloomingdale Townships. The tributary flows into the main channel of the East Branch of the DuPage River 3,500 feet south of North Avenue, just upstream of the Great Western Trail. The watershed boundary, shown in Figure 1, includes about 1 mile each of North Avenue and Main Street/Main Street and short sections of St. Charles Road and Geneva Road. The watershed is developed primarily with single family residential subdivisions. Small open space tracts are still present including Stacy Park and a large wetland south of North Avenue behind a nearly vacant strip mall formerly anchored by a Venture store. Additional commercial developments are located along North Avenue and along the west side of Main Street. Main Street is known as Main Street north of North Avenue.

As shown in Figure 1, Tributary No. 2 flows from west to east between Main Street and the East Branch of the DuPage River. The main stem begins at a retention pond serving a subdivision north of North Avenue in Glendale Heights. Flow proceeds in a series of closed conduits leading to an outfall located 900 feet south of North Avenue behind the former site of the Venture store. The flow continues in a poorly defined channel through a wooded wetland to just upstream of Main Street. At Main Street, a secondary branch draining from the southwest joins the main stem of Tributary No. 2.

The southwest branch begins at a 27-inch storm sewer outfall just south of the Great Western Trail. The flow travels through a series of culverts and constructed channels past the Center Ice of DuPage ice arena north of Poss Street. From the ice arena, the southwest branch flows due east under Highland Avenue and past the Seventh Day Adventist Church School to Main Street. Storm sewers carry flow north along Main Street to the Tributary No. 2 main channel.

Between Main Street and Park Boulevard, low flows are carried in a corrugated metal storm sewer, and an overflow channel is provided for high flows. A cross-over structure just east of Glen Ellyn Road is designed to assure full flow in the storm sewer before flow enters the overflow channel. Streambank stabilization was completed by DuPage County on the overflow channel in 1994 for the reach between Main Street and Forest Avenue. Between Forest Avenue and Park Boulevard, the overflow passes through a wide grassy area that may have been designed for flood control.
storage. The culverts at both Forest Avenue and Park Boulevard consist of one circular pipe and one arch-shaped corrugated metal pipe (CMP).

Approximately 450 feet downstream of Park Boulevard, the flow is confined in two 400-foot long corrugated metal pipes which carry the flow under Second Street and Goodrich Avenue. Downstream of the outlets of these pipes, the County has constructed channel improvements and erosion protection for a distance of 400 feet. Just downstream of this channel improvement, there is a 200-foot long box culvert that was installed by the owner of parcel number 05-02-215-013. The fill over the culvert has completely eliminated the channel across most of the parcel. The culvert outlet is approximately 120 feet upstream of Glenrise Avenue. There are three CMP arch culverts at both Glenrise and Eastern avenues. Both sets of culverts exhibit poor alignment and accumulation of sediment. A fourth circular pipe at Eastern Avenue is completely blocked by sediment and debris. The area from downstream of Goodrich Avenue to just upstream of Eastern Avenue also has experienced erosion problems. Downstream of Eastern Avenue, portions of the channel banks and floodplain are heavily wooded with areas of both wooded and open wetland. Approximately 500 feet downstream of Eastern Avenue, the Tributary No. 2 channel splits into two distributaries for the remaining 700 feet to the East Branch. The south distributary channel is dry during low flow periods.

B. Land Use

Most of the watershed has residential land use, but there are significant areas of commercial development at the intersection of North Avenue and Main Street and extending along North Avenue in each direction. There are also several relatively large parcels of undeveloped land. Key undeveloped areas are the forested wetland south of the former Venture store west of Main Street, upland areas adjacent to the west side of this wetland and parcels totaling 9.1 acres located east of Eastern Avenue just north of the Great Western Trail. There is also undeveloped land west and northwest of the ice arena.

C. Soils and Geology

The watershed soils were determined using the “Soil Survey of DuPage and Part of Cook Counties, Illinois,” (USDA-SCS, 1979). The soils can be split into three categories: urban land, moderately well drained silt loam, and poorly drained silt loam and silty clay loam. In general, the
area soils are classified as Urban Land-Markham-Ashkum soils formed in glacial till on till plains and glacial moraines.

The undeveloped, upland portions of the watershed are primarily comprised of Markham Silt Loam and Morley Silt Loam. These soils are defined as having a high to moderate erosion potential and are poorly suited for septic drain fields. The remaining undeveloped areas along the drainage ways are a mixture of poorly drained soils. These soils, silt loam and silty clay loam, require artificial drainage to enable development and require septic systems be placed on fill or above the water table.

D. Environmental Resources

The watershed lies within the heavily urbanized corridor of the County along the East Branch of the DuPage River. Due to this urbanization, a limited portion of the watershed remains undeveloped and able to support wetlands, riparian environments, and groundwater recharge areas. This plan identifies these resources, as well as depression storage area and floodplains. Protection of these resources is provided under the DuPage Countywide Stormwater and Flood Plain Ordinance.

1. Wetlands

The wetland areas were defined using a combination of existing mapping resources and field investigation. The maps used included the NRCS (formerly SCS) Soil Survey (USDA-SCS, 1979), DuPage County wetland inventory maps, topographic maps, and aerial photo maps. A field investigation was then conducted to verify location and extent, to evaluate vegetation, and to assess wildlife habitat and use of the wetlands. A compilation of wetland area boundaries from these sources is provided in Figure 2. The marked areas indicate locations of confirmed wetlands for planning purposes. The boundaries are not exact and wetlands may exist outside of the boundaries shown. Regulatory wetlands can only be identified through a wetland delineation conducted by a certified wetland specialist.

A large contiguous wetland area is located west of Main Street and south of the former Venture store. The wetland has been classified as critical under the DPCSFPO for its vegetation quality, in spite of having been adversely impacted by changes in runoff patterns and by discharge of sediments, pollutants and debris originating from North Avenue and adjacent commercial areas upstream. There has also been encroachment due to development on the south and east sides of the wetland which has impaired both the flood control and riparian functions of the wetland. Portions
of the wetland are wooded, and there is additional wooded area adjacent to the wetland on its west side creating a large riparian environment that could support a diverse animal and plant population.

2. Riparian Areas

A riparian area is, in simple terms, the land adjacent to a waterway such as Tributary No. 2. In ecological terms, it is a zone along rivers, streams, or any body of water which serves as a transition between upland and aquatic systems. The riparian zone provides many important functions which serve to maintain water quality and a healthy aquatic ecosystem. These functions include streambank stability, erosion control, flood management, instream temperature control, nutrient filter and storage, and denitrification (Kelsey, 1995) as well as habitat for wildlife.

In the Tributary No. 2 Watershed, riparian areas with significant riparian functions exist downstream of Eastern Avenue and between the site of the former Venture store on North Avenue to Main Street. There are also areas with more limited riparian functions between Main Street and Eastern Avenue.

3. Groundwater Recharge Areas

The potential for groundwater recharge within the watershed was determined by reviewing the "Potential for Aquifer Recharge in Illinois Map," (Illinois State Geological Survey, 1990). The map was created to define areas of appropriate recharge as required by the Illinois Groundwater Protection Act. Based on geologic information, presence of a major aquifer, and infiltration potential, the map illustrates the potential for precipitation to reach the uppermost aquifer. The geologic information used included distribution, thickness, texture, and hydraulic conductivity of shallow geologic materials.

The Tributary No. 2 Watershed is defined as having 1) a low potential for infiltration of the surface soils, 2) a depth to the uppermost aquifer of greater than 15 meters, and 3) a major aquifer present below. This information combines to rank as levels five and six on a scale of potential for aquifer recharge that ranges from one to seven. Levels five and six have nearly the lowest potential for recharge. However, the potential for groundwater recharge increases to the highest level along the floodplain of the East Branch of the DuPage River. The floodplain is defined as having a moderate infiltration potential, presence of a major aquifer, and a depth of less than 1.5 meters to the uppermost aquifer.
The DPCSFPO also provides for protection of groundwater recharge areas through the wellhead protection zone provision. Wetlands within a wellhead protection zone are critical regulatory wetlands and thus avoidance must be considered and evaluated. Wellhead protection zones in the Tributary No. 2 Watershed are delineated in Figure 2. Further discussion of public water supply issues is provided in Section VII.

4. Depressional Storage Areas

Depressional storage is a drainage feature that does not have a low level outlet to the main drainage system. Depressional storage areas are extremely important because they retain runoff for extended periods of time and often contribute to groundwater and baseflow recharge. These areas are regulated by the DuPage County Stormwater and Floodplain Ordinance. Three major depressional storage sites have been identified in the watershed, and their locations are shown in Figure 2. One is the wetland area on the north side of Petersen Avenue, and the other two are located between Highland and Western Avenues. There are also many additional small depressional storage areas. These must be identified in the stormwater management plan for any proposed development.
III. HYDROLOGIC AND HYDRAULIC ANALYSIS

A. Approach

A detailed discussion of DuPage County's technical methods can be found in "Hydrologic and Hydraulic Methods Used for Flood Plain Mapping of DuPage County Watersheds," (DuPage DEC, 1994). (Note: All reports cited in this section are available through DEC.) This section of the Plan gives an overview of the methods and details particular to the Tributary No. 2 Plan.

The continuous simulation hydrology program, HSPF, was utilized to produce 45 years of hourly runoff data for six land cover types. This continuous data was stored in a Watershed Data Management (WDM) file. From this simulated runoff record, selected large events were chosen for hydraulic simulation. Runoff for these events was transferred from the WDM file to a Time Series File (TSF). The time series file was input into the dynamic flood routing program, FEQ, along with land cover data and hydraulic characteristics of the Tributary No. 2 Watershed to produce simulated, routed flood hydrographs of the selected events. The Peak Elevation-to-Volume (PEV) statistical method was applied to the flood data to obtain predicted flood frequency data (elevation and flow) up to the 100-year frequency. Appendix D provides a more detailed description of the PEV method.

B. Hydrologic Input Data and Sources

Forty-five years of continuous meteorologic data was used as input to the HSPF model of the East Branch DuPage River, along with land cover data derived from land use data obtained from the County's GIS system. Precipitation data was obtained from National Climatic Data Center (NCDC) gage records. More detailed discussion of the HSPF model can be found in the 1994 report by Thomas Price (Price, 1994a) of the Northeastern Illinois Planning Commission (NIPC), who performed this work under contract to the County.

C. Hydrologic Calibration

Calibration of the East Branch HSPF model was performed using the Maple Avenue stream gage record. This gage is operated by the Illinois Department of Natural Resources/Office of Water Resources. The calibration period was from water year 1980 (WY80) through WY88. The calibration was evaluated on an annual, monthly, and storm event basis. Details of the HSPF model calibration can be found in another NIPC report (Price, 1994b).
D. Hydrologic Verification

Verification of the East Branch HSPF model was performed using the Butterfield Road and Royce Road stream gage records. These gages are operated by the U.S. Geological Survey (USGS). The period used for verification was WY90 through WY93 for the Butterfield Road gage, and WY89 through WY93. Again, the verification was evaluated on an annual, monthly, and storm event basis.

E. Creation of Time Series File

Runoff data for flood events was extracted from the continuous runoff data series produced by HSPF to create a time series file or TSF. Events were selected to create both partial duration and annual duration series for use in floodplain mapping and project analysis in all watersheds in DuPage County. The resulting file, TSFLONG.MP2, has 115 events. Events in TSFLONG.MP2 were selected based on peak runoff exceeding a threshold value for 3-hour, 1-day, 2-day, and 3-day durations. The thresholds were established for both O'Hare and Wheaton runoff series produced by HSPF, for 10 percent and 25 percent impervious land uses.

F. Hydraulic Modeling

Flood routing was performed using the unsteady flow program FEQ. The FEQ computer program and its companion utility program FEQUTL were developed by Dr. Delbert D. Franz of Linsley, Kraeger Associates, Ltd. (Franz, 1995). FEQ can read the TSF created from the HSPF output and can adequately represent the effects of floodplain encroachment, on-line and off-line storage, diversions, channel improvements, bridges, culverts, dams, weirs, and other drainage system features.

Input data to the Tributary No. 2 FEQ model includes land cover data and hydraulic characteristics of the watershed.

Hydraulic characteristics of the stream system was obtained from field surveys performed in 1987 and 1995. Additional data were collected from DuPage County aerial photo and topographic maps and from IDOT plans for North Avenue. Hydrologic inputs and East Branch main channel data were provided by DuPage DEC. Watershed subbasin delineations were conducted on DuPage DEC 2-foot contour interval topographic maps and verified during field reconnaissance. The outer watershed delineation for Tributary No. 2 had been established previously by DEC and was verified.

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to be correct during this study. Field survey data collected includes cross-sections of the stream and floodplain, hydraulic structures such as bridges, culverts, dams, weirs, and other hydraulic controls.

Both existing (1990) and future conditions (ultimate development) land cover data for the Tributary No. 2 Watershed was obtained from the County's GIS system. Future conditions land use was used for economic and project analysis and for floodplain mapping. Existing conditions land use was used for hydraulic calibration. The land cover data for the Tributary No. 2 input to the FEQ program represents the tributary area characteristics of the Tributary No. 2 Watershed. This data is combined with the individual land cover runoff series obtained from the HSPF simulation. This process is further described in the Hydrologic and Hydraulic Methods Report (DuPage DEC, 1994). Approximately 20 percent of the watershed was found to have impervious land cover under current land use conditions. Impervious area is estimated to increase to 28 percent under future land use conditions.

The O'Hare NCDC precipitation gage was assigned to the entire Tributary No. 2 Watershed, for purposes of using the FEQ model for baseline economic analysis, project analysis, and floodplain mapping. Discussion of rain gage assignment can be found in the Hydrologic and Hydraulic Methods Report (DuPage DEC, 1994).

Detailed FEQ modeling was developed for 1.193 miles (6,300 feet) of the main channel of Tributary No. 2 and for 2,000 feet of the southwest branch. Modeling of the main channel continues an additional 1,700 feet through storm sewers north to a detention pond in Glendale Heights. Key elements of the hydraulic analysis are illustrated in Figure 3 which shows stream stationing, surveyed cross-section locations, subbasin delineations and major storm sewers. Stream stations from 0.000 to 1.528 are used to represent distances in miles on the Tributary No. 2 main channel and stations 7.000 to 7.342 are used for locations on the southwest branch. These stations are used to specify reach lengths and surveyed cross-section locations in the FEQ model.

The schematic and input and output listing of the FEQ model developed for study of the East Branch Tributary No. 2 is contained in Appendix B (bound separately). In summary, the model consists of 26 branches representing reaches of channel and storm sewers in the Tributary No. 2 drainage system, and 12 branches in the section taken from the FEQ model of the East Branch main channel. There are function tables to represent additional hydraulic features such as culverts, expansions, contractions, inlet structures, and weirs. There are four linear reservoirs and two real detention ponds represented in the model. The wetland area west of Main Street, is represented in FEQ as
Hydraulic Calibration

Calibration of the FEQ model was completed using maximum flood elevations obtained from flooding questionnaire responses. Specific high water information obtained from the public were the maximum 1987 event water elevations in the channel reaches upstream and downstream of Glenrise Avenue, reports of frequent overtopping of Glenrise Avenue, reports of yard flooding and two reports of water entering residences during the 1972 event. Many of the residents who responded to the flooding questionnaire did not live in their current residence at the time of the August 1972 flood of record; thus, a majority of the specific high water elevations were available for only the 1987 event. High water marks observed during a storm on June 24, 1994 were subsequently surveyed by DEe. Although a TSF is available for this event, an isohyetal map was not available during preparation of the Tributary No. 2 Watershed Plan. Therefore, this event could not be used in calibration of the Tributary No. 2 FEQ model. However, these are the only true observations of flood heights in the watershed and, thus, were incorporated to the extent possible. Currently, a calibration TSF containing runoff rates based on gage records in the hydraulic calibration network is available for only the August 1987 event. The local Wheaton gage runoff rates were used to evaluate the 1972 and 1979 storm events. See the Hydrologic and Hydraulic Methods Report (DuPage DEC, 1994) for discussion of DuPage County's approach to hydraulic calibration.

DuPage County DEC provided an isohyetal map of the August 1987 rainfall derived from the hydraulic calibration network. The gage nearest all points within the Tributary No. 2 watershed is the local Wheaton-North gage. Therefore, tributary area factors (FAC values) were developed to relate estimated actual rainfall (taken from the isohyetal map) to the 24-hour total measured at Wheaton-North. The FAC values were computed for each subbasin as the ratio of the rainfall depth at the subbasin centroid estimated using the isohyetal map to the rainfall at the gage of 7.23 inches. The isohyetal map and a table of FAC values is provided in Appendix C.

A summary of FEQ model calibration results is provided in Table 1. The calibration was achieved by making improvements to the model schematic and by adjusting the representations of key culverts and channel reaches. Improvements to the model schematic were mainly the addition of overflow paths to bypass overloaded pipes. These included null branches added during the calibration process to represent overland flows that bypass branch numbers 18, 21, 22, 14, 24, and
<table>
<thead>
<tr>
<th>LOCATION</th>
<th>STATION (miles)</th>
<th>HISTORICAL EVENT</th>
<th>OBSERVED ELEVATION (feet)</th>
<th>MODELED ELEVATION (feet)</th>
<th>TIME SERIES FILE</th>
<th>GAGE ASSIGNMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 ft Downstream of Glenrise Avenue</td>
<td>0.405</td>
<td>August 1987</td>
<td>705.5</td>
<td>705.8</td>
<td>TSFCAL.87</td>
<td>Wheaton North</td>
</tr>
<tr>
<td>300 ft Upstream of Glenrise Avenue</td>
<td>0.500</td>
<td>August 1987</td>
<td>709.0</td>
<td>709.0</td>
<td>TSFCAL.87</td>
<td>Wheaton North</td>
</tr>
<tr>
<td>300 ft Upstream of Glenrise Avenue</td>
<td>0.500</td>
<td>April 1979</td>
<td>708.5</td>
<td>708.1</td>
<td>TSFLONG.MP2</td>
<td>Wheaton-NOAA</td>
</tr>
<tr>
<td>Downstream Face of Second/Goodrich Culvert</td>
<td>0.593</td>
<td>June 1994</td>
<td>708.39</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Downstream Forest Avenue</td>
<td>0.822</td>
<td>June 1994</td>
<td>713.19</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Yard Flooding at Residence</td>
<td>0.881</td>
<td>August 1972</td>
<td>720.4+</td>
<td>720.3</td>
<td>TSFLONG.MP2</td>
<td>Wheaton-NOAA</td>
</tr>
<tr>
<td>Yard Flooding at Residence (on SW Trib)</td>
<td>7.030</td>
<td>August 1987</td>
<td>721.5</td>
<td>721.4</td>
<td>TSFCAL.87</td>
<td>Wheaton North</td>
</tr>
</tbody>
</table>

* Model rainfall data not available for June 1994 storm.
100. Selected channel and culvert representations in the FEQ model were modified so modeled water levels would be consistent with the available high water reports. Adjustments were made to the analysis of culverts at Forest Avenue, Park Boulevard, Glenrise Avenue, and Eastern Avenue; all of which are multiple barrel culverts. The culverts at Glenrise Avenue and Eastern Avenue have three and four barrels, respectively. Through field investigations and preliminary calibration results, it was determined that some of the barrels were not effective in conveying flow. Eliminating one barrel at Glenrise Avenue and two barrels at Eastern Avenue in the culvert analysis provided better correlation of observed and modeled stages.

H. Hydraulic Evaluation

Many of the tributaries to the East Branch DuPage River (as well as to the West Branch DuPage River and Salt Creek) do not have continuous stream gage records, including Tributary No. 2. In an attempt to ensure that the FEQ model adequately represents the timing of flood peaks and hydrographs, DEC is currently involved in an effort to compare the recorded and simulated hydrographs on the main stream systems in the County. This process is ongoing for the East Branch DuPage River, where hydrograph comparison is being done at Butterfield Road, Maple Avenue, and Royce Road. Results are not available at the time of this writing. However, hydraulic evaluations for other watersheds in the County (Salt Creek and Sawmill Creek) showed that simulated and recorded hydrographs compared well when event runoff volumes were accurately simulated. See Price, 1994a and Price, 1994b for further discussions of these hydraulic evaluations.

I. Hydraulic Modeling Results and Statistical Analysis

Following calibration of the FEQ model, the model was run to determine flood profiles and to compute design flows and stages under existing land and future use conditions. These results were used to analyze problem areas, estimate resulting flood damages, develop flood mitigation project components, and estimate flood quantiles for floodplain mapping. According to DEC analysis procedures (DuPage DEC, 1994), rainfall from the O'Hare rain gage is the basis for project analysis and floodplain mapping for Tributary No. 2.

Hydraulic simulations of existing and possible future land use conditions were conducted for the 45-year period of record consisting of 115 significant storm events. Water levels produced by the simulated storm event of August 1987 were found to be maximums for the entire period of record.
Peak flows, depths, and stages achieved at key locations in the modeled August 1987 event for future conditions are provided in Table 2.

A flow profile of the modeled August 1987 flows and preliminary estimates of the 100-year stages are provided in Figure 4. Further discussion of how the 100-year profiles were determined from FEQ results is presented in Appendix D. It is not discussed in the main body of the Plan as the results of, as well as the approach to, statistical analysis are preliminary at this time. The 100-year profile obtained from the Federal Emergency Management Agency (FEMA) flood insurance study (FIS) is also shown in Figure 4 for comparison. Deviations between the FIS profile and those derived in the present study are apparent at Forest Avenue and downstream of Eastern Avenue. Forest Avenue was ignored in the FIS, and the FIS did not incorporate any surveyed cross-sections downstream of Eastern Avenue.
TABLE 2
MAXIMUM FLOWS AND STAGES
IN THE MODELED AUGUST 1987 FLOOD EVENT (FUTURE LAND USE)
East Branch Tributary No. 2
DuPage County, Illinois

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>MAXIMUM FLOW (cfs)</th>
<th>MAXIMUM STAGE (feet)</th>
<th>MAXIMUM FLOW DEPTH (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tributary No. 2 Main Channel Downstream of Venture Store in Wetland</td>
<td>190</td>
<td>722.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Upstream of Main Street</td>
<td>400</td>
<td>722.3</td>
<td>5.7</td>
</tr>
<tr>
<td>Upstream of Forest Avenue</td>
<td>410*</td>
<td>719.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Upstream of Park Boulevard</td>
<td>380*</td>
<td>716.4</td>
<td>6.7</td>
</tr>
<tr>
<td>Upstream of Second Street</td>
<td>430</td>
<td>714.3</td>
<td>7.3</td>
</tr>
<tr>
<td>Model Node 510 - (400 ft. Upstream of Glenrise Avenue)</td>
<td>440</td>
<td>709.1</td>
<td>5.6</td>
</tr>
<tr>
<td>Upstream of Glenrise Avenue</td>
<td>440</td>
<td>708.9</td>
<td>6.2</td>
</tr>
<tr>
<td>Upstream of Eastern Avenue</td>
<td>440</td>
<td>704.4</td>
<td>5.4</td>
</tr>
<tr>
<td>Southwest branch Outlet of 36-inch Pipe North of Parking Lot</td>
<td>150</td>
<td>743.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Along South Side of Ice Arena</td>
<td>170</td>
<td>734.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Downstream of Highland Avenue</td>
<td>35</td>
<td>728.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Upstream of Main Street</td>
<td>50</td>
<td>723.3</td>
<td>3.1</td>
</tr>
</tbody>
</table>

* Additional flow is carried in a parallel storm sewer.
IV. ECONOMIC ANALYSIS

A. Approach

Five classes of economic damages due to flooding are addressed in DuPage County Watershed plans. These are damages to residential property and business property, associated damages, traffic damages, and emergency services. Other damages not accounted for in the economic analysis include damages resulting from backup of sanitary sewers into homes, failure of local drainage systems and environmental degradation due to erosion, siltation, or loss of riparian function. These types of damages are extremely difficult to quantify accurately, but they should not be neglected when making policy decisions. The economic analysis results presented in this report provide estimates for relative differences in quantifiable damages only.

Residential and business property damages are computed using the DEC-2 flood damage economic analysis model (DuPage DEC, 1995). The DEC-2 model input consists of flood elevation data produced by the FEQ hydraulic model at various locations along the stream and data associated with each residential or commercial structure including low water entry elevation, first floor elevation, structure and contents value, and the relationship between depth and percent damage. DEC-2 determines the number of structures damaged and the dollar amount of structural and contents damage to each structure resulting from each storm event.

Associated damages are also computed with DEC-2 using depth versus percent damage curves which reflect damage to auxiliary structures and landscaping, emergency living costs, lost wages, and yard clean-up costs. Under DuPage DEC procedures, associated damages are assumed to occur when the peak flood elevation rises to within 0.5 feet below the low water entry elevation of a residential structure.

Traffic damages are the costs of lost wages due to delay and the cost of increased travel distances caused by flooding of county and state highways. The damages are based on the average daily traffic volume, duration of the highway closure, vehicle operating cost and length of an assumed detour.

Emergency services damages include the cost of providing rescue service, sandbags, and overtime wages of local government employees to provide these services. These damages are assumed to be 5 percent of residential damages.
The DEC-2 computer program is used to compute property damage, associated damages, and emergency services damages based on maximum water levels from each storm in the 1948 to 1993 historical record. Traffic damages are calculated from the duration of road overtopping which is also obtained from FEQ output. The total damages for the period of record are divided by the number of years of record to determine the average annual damages for a given scenario.

B. Data Collection

The data required to perform economic analysis of flood damages include:

1. **Residential and Business Damages** Low water entry elevation, first floor elevation, structure type, structure value, contents value, stream station, and water depth-percent damage relationships for each structure type are required inputs.

2. **Associated Damages** Computation of associated damages requires the same data used to calculate residential and business damages with adjusted damage curves.

3. **Emergency Services Damage** Computation of emergency services damage requires the same data used to calculate residential and business damages.

4. **Traffic Damage** The required inputs for traffic damage calculations are traffic counts, duration of road closure, length of detour, average vehicle occupancy, per capita wage, and IRS vehicle operating cost per mile.

The sources of economic analysis data are summarized in Table 3. House data, DEC-2 model input and output, and the traffic damage computations are provided in Appendix E (bound separately).

C. Results

According to DEC analysis procedures, stormwater runoff rates based on the O'Hare rainfall record are to be used for project evaluation and floodplain mapping in the East Branch Tributary No. 2. Therefore, the expected annual damages to be used for project justification are based on flood stages obtained from FEQ analysis using the O'Hare historical series. However, results based on the Wheaton rainfall record are also included in this presentation for comparison. The results of the
<table>
<thead>
<tr>
<th>DATA</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Elevations</td>
<td>FEQ model analysis of historical storms</td>
</tr>
<tr>
<td>Stream Stations</td>
<td>Aerial photos and 1&quot;=100' scale topographic maps</td>
</tr>
<tr>
<td>Structure Elevations</td>
<td>Field survey of low-water entry elevations and first floor elevations by Rust (1987 &amp; 1994)</td>
</tr>
<tr>
<td>Structure Values</td>
<td>Supplied by DuPage DEC, based on 1993 records from the DuPage County Tax Assessor’s office</td>
</tr>
<tr>
<td>Structure Classifications</td>
<td>Provided by DuPage DEC</td>
</tr>
<tr>
<td>Contents Value</td>
<td>Total contents value assumed to be 30% of structure value; damage is prorated by depth of flooding</td>
</tr>
<tr>
<td>Damage Relations</td>
<td>Developed by DuPage DEC staff from information compiled by FEMA, SCS and U.S. Army Corps of Engineers</td>
</tr>
<tr>
<td>Average Daily Traffic</td>
<td>Counts and analyses conducted by DuPage DOT (1993)</td>
</tr>
<tr>
<td>Duration of Road Closure</td>
<td>FEQ model analysis of historical storms</td>
</tr>
<tr>
<td>Length of Detour</td>
<td>Minimum detour distance over County highways measured on USGS 1&quot;=2000' maps</td>
</tr>
<tr>
<td>Average Vehicle Occupancy</td>
<td>DuPage DOT</td>
</tr>
<tr>
<td>Vehicle Speed</td>
<td>DuPage DOT</td>
</tr>
<tr>
<td>Per Capita Wage</td>
<td>DuPage Department of Development</td>
</tr>
</tbody>
</table>
damage analysis are presented in Table 4. The DEC-2 analysis indicates total residential property damages due to entry of flood waters based on the O’Hare historical series are $131,700. These damages result from water entry that occurs three times at one house, once at a second house and four times at one garage. There are also associated damages (severe yard flooding) at six residential locations. Overtopping of Main Street exceeding six inches occurs in two historical event leading to total traffic damages of $108,200. Total damages for the historical series of flood events is approximately $256,200. Average annual damages over the 45-year period are approximately $5,600 per year.

County project evaluation procedures dictate that O’Hare gage historical rainfall be used for project analysis and justification in the northeast part of DuPage County including the Tributary No. 2 Watershed area. However, FEQ modeling was also conducted for the Wheaton-NOAA analysis was conducted because historical flooding in some events, namely 1972 and 1979, was found to be better represented by the Wheaton-NOAA data. Thus, the Wheaton gage analysis was useful in verifying damages reported by residents.

Residential and traffic damages based on the Wheaton-NOAA rainfall record were found to exceed O’Hare damages. The Wheaton storms caused overbank flooding damage at eight structures and total residential damage was found to be $391,300. Total damages based on the Wheaton rainfall are $610,800 for the full historical series or an average of $12,900 per year. Under County procedures, only the O’Hare record will be considered in the economic justification of potential capital improvement projects. However, the potential hazard for the additional structures will be considered in the final assessment of the proposed flood control plan.
## TABLE 4

**BASELINE FLOOD DAMAGES**

East Branch Tributary No. 2  
DuPage County, Illinois

### A. O'HARE RAINFALL SERIES

<table>
<thead>
<tr>
<th>DAMAGE CATEGORY</th>
<th>JULY 1953</th>
<th>AUGUST 1987</th>
<th>OTHER EVENTS</th>
<th>45-YEAR TOTAL DAMAGES</th>
<th>AVERAGE ANNUAL DAMAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Property</td>
<td>$31,700</td>
<td>$69,300</td>
<td>$30,700</td>
<td>$131,700</td>
<td>$2,900</td>
</tr>
<tr>
<td>Associated</td>
<td>$1,700</td>
<td>$6,400</td>
<td>$1,600</td>
<td>$9,700</td>
<td>$200</td>
</tr>
<tr>
<td>Emergency Services</td>
<td>$1,600</td>
<td>$3,500</td>
<td>$1,500</td>
<td>$6,600</td>
<td>$100</td>
</tr>
<tr>
<td>Traffic</td>
<td>$54,100</td>
<td>$54,100</td>
<td>$0</td>
<td>$108,200</td>
<td>$2,400</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$89,100</strong></td>
<td><strong>$133,300</strong></td>
<td><strong>$33,800</strong></td>
<td><strong>$256,200</strong></td>
<td><strong>$5,600</strong></td>
</tr>
</tbody>
</table>

### B. WHEATON-NOAA RAINFALL SERIES

<table>
<thead>
<tr>
<th>DAMAGE CATEGORY</th>
<th>AUGUST 1972</th>
<th>AUGUST 1982</th>
<th>JULY 1983</th>
<th>OTHER EVENTS</th>
<th>45-YEAR TOTAL DAMAGES</th>
<th>AVERAGE ANNUAL DAMAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Property</td>
<td>$175,900</td>
<td>$32,900</td>
<td>$151,900</td>
<td>$30,600</td>
<td>$391,300</td>
<td>$8,700</td>
</tr>
<tr>
<td>Associated</td>
<td>$19,200</td>
<td>$3,400</td>
<td>$13,200</td>
<td>$1,900</td>
<td>$37,700</td>
<td>$800</td>
</tr>
<tr>
<td>Emergency Services</td>
<td>$8,800</td>
<td>$1,600</td>
<td>$7,600</td>
<td>$1,500</td>
<td>$19,500</td>
<td>$400</td>
</tr>
<tr>
<td>Traffic</td>
<td>$54,100</td>
<td>$54,100</td>
<td>$54,100</td>
<td>$0</td>
<td>$162,300</td>
<td>$3,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$258,000</strong></td>
<td><strong>$92,000</strong></td>
<td><strong>$226,800</strong></td>
<td><strong>$34,000</strong></td>
<td><strong>$610,800</strong></td>
<td><strong>$12,900</strong></td>
</tr>
</tbody>
</table>
V. IDENTIFICATION OF WATERSHED PROBLEMS AND ISSUES

Watershed issues ranging from flooding, drainage, and streambank erosion to various regulatory and development issues are addressed in this Plan. The regulatory issues have been identified through public contact with the DEC and through field inspection. Development issues have been brought to the attention of DEC by property owners, the Village of Glendale Heights, and developers. Flooding and drainage problems were identified and characterized by utilizing five sources of flooding information. These information sources were drainage complaints, flooding damage questionnaires, field observations, FEQ hydraulic analysis of historical storms, and damage analysis based on the FEQ results. Current FEMA floodplain limits also provided a means of identifying areas at risk of flooding. Questionnaires and drainage complaints identified problems such as overbank flooding, basement backups, ponding, seepage, maintenance deficiencies, and severe erosion. Many of these reports were checked in the field to verify that the source of the problem was stormwater related. Projected structure flooding and road overtopping risk over a 45-year period was determined from the FEQ hydraulic analysis. The DEC-2 analysis presented in Section IV of this plan measures the flood hazard in economic terms and identifies serious problems in the watershed.

A. Drainage Complaints/Flooding Questionnaires

Drainage complaints constituted one form of information used to identify problem areas within the East Branch Tributary No. 2 Watershed. Drainage complaints are received and documented by DEC as one of the regular functions of the Department. If the problem is in an unincorporated area, DEC also sends a drainage engineer to inspect the problem and to determine whether there is a County maintenance responsibility involved or if a private party is in violation of any County ordinances. Table 5 includes information derived from the 17 drainage complaints received that are related to overbank flooding or stream stability of Tributary No. 2. Drainage complaints as recorded by the County are provided in Appendix F.

A questionnaire related to flooding damages and stormwater issues was distributed to all property or home owners adjacent to the stream or major stormwater detention facilities. A blank sample questionnaire is included in Appendix G. Responses were received from 22 of the 143 residents surveyed. Among the 22 questionnaire responses, some type of flooding problem was reported by 12 residents. The information received is also included in summary form in Table 5.
TABLE 5
SUMMARY OF DRAINAGE COMPLAINTS AND FLOOD DAMAGE QUESTIONNAIRE RESPONSES
East Branch Tributary No. 2
DuPage County, Illinois

<table>
<thead>
<tr>
<th>FLOODING PROBLEM</th>
<th>NUMBER OF REPORTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overbank Flooding (Basement)</td>
<td>7</td>
</tr>
<tr>
<td>Overbank Flooding (First Floor)</td>
<td>0</td>
</tr>
<tr>
<td>Yard Flooding</td>
<td>16</td>
</tr>
<tr>
<td>Crawl Space Flooding</td>
<td>0</td>
</tr>
<tr>
<td>Street Flooding</td>
<td>2</td>
</tr>
<tr>
<td>Sewer Backup</td>
<td>3</td>
</tr>
<tr>
<td>Garage/Barn Flooding</td>
<td>1</td>
</tr>
<tr>
<td>Seepage</td>
<td>2</td>
</tr>
<tr>
<td>Erosion</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>
As indicated in the table, key flooding problems in the watershed are basement flooding caused by overland or out of bank flows, yard flooding, channel erosion and sewer backup. The house and yard flooding appear to occur mainly in three locations along the stream: between Main Street and Forest Avenue, along Park Boulevard, and in the reach between Goodrich and Glenrise Avenues. Some basement backups have been attributed to ponding above septic tanks in these same areas. Channel erosion is prevalent in the reach extending from the outlet of the private pipe downstream to Eastern Avenue.

B. Damage Analysis

Water surface elevations obtained in the FEQ simulation of the 45-year historical series were used to identify potential structure flooding and road overtopping. Residential structures, contents, and garages subject to flooding were incorporated in the damage analysis conducted using the DEC-2 computer model. As indicated previously in Section IV, the quantifiable property damages in the Tributary No. 2 Watershed are approximately $131,700 for the historical series or $2,900 per year. There are no commercial buildings subject to flooding in the Tributary No. 2 Watershed. The frequency that each major street is overtopped during the 45-year historical series is summarized in Table 6. The frequency that the depth of street overtopping exceeds six inches is also provided in the table. Main Street is a major arterial and a designated County Highway; thus, its closure results in quantifiable damages which have been incorporated in the overall damage analysis. Additional serious road overtopping problems are evident at Glenrise Avenue and possibly along Poss Street. Quantifiable traffic damages were determined to be $108,200 or $2,400 per year. According to the damage analysis conducted on the 45-year historical series, total quantifiable damages are $256,200 or $5,600 per year. This is based on verified damages to one residential structure and one County highway.

An additional analysis using the Wheaton NOAA gage record showed seven additional structures are at risk and overtopping of secondary roads is a problem. However, due to DEC watershed planning policy, this analysis could not be used as the baseline condition to which flood control design is targeted. This Plan uses the results based on the O'Hare rainfall gage as a basis for project evaluation and design.
### TABLE 6

**FREQUENCY OF ROAD OVERTOPPING IN THE 45-YEAR O'HARE HISTORICAL SERIES**

**East Branch Tributary No. 2**
**DuPage County, Illinois**

<table>
<thead>
<tr>
<th>STREAM CROSSING</th>
<th>MINIMUM ROAD ELEVATION (feet)</th>
<th>FREQUENCY OVERTOPPED</th>
<th>FREQUENCY OVERTOPPED SIX INCHES OR MORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Avenue</td>
<td>703.77</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Glenrise Avenue</td>
<td>707.78</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Goodrich Avenue/2nd Street</td>
<td>714.00</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Park Boulevard</td>
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C. Problems Identified

The watershed modeling, damage analysis and citizen reports indicate the presence of serious flooding problems in the Tributary No. 2 Watershed. These problems include overbank flooding of structures, road overtopping, yard flooding, and streambank erosion. The yard flooding is reported to cause additional problems such as basement seepage and septic system overflow. As well, several other watershed issues have been brought to DEC's attention. Based upon this information, eleven specific issues have been identified which the Tributary No. 2 Watershed Plan addresses.

1. Overbank Flooding of Structures

Residential structures are at risk of overbank flooding along two reaches of the Tributary No. 2 stream channel. These reaches are located between Main Street and Forest Avenue, and in the vicinity of the intersection of Goodrich Avenue and Second Avenue. Verifiable inundation damages have been reported at two residences and one garage in the Main Street to Forest Avenue reach. The FEQ model results show that two houses are inundated.

2. Yard Flooding and Associated Damages

According to resident damage reports and drainage complaints, septic system backup due to flooding of the septic field is a persistent problem in areas adjacent to the stream downstream of Park Boulevard. Specifically residents on Park Boulevard, Glenrise Avenue, Second Street, and Eastern Avenue submitted reports to DEC. Sixteen property owners reported yard flooding; seven property owners reported sewer backup or basement flooding. Three property owners with septic systems reported flooding problems. According to questionnaire responses, the eastern portion of the Tributary No. 2 Watershed is served by private septic systems. This area includes Eastern and Glenrise Avenues.

The FEQ analysis identifies six properties with associated damages.

3. Overtopping of Main Street

The calibrated FEQ hydraulic model indicates that Main Street would have been overtopped seven times during the historical sequence of storm events. Road overtopping frequencies determined in

May 1996
the FEQ historical series simulation are shown in Table 6. In two events, the depth of overtopping would have exceeded six inches, thus leading to serious disruption of traffic flow and emergency services. It is possible that police and fire protection would have been compromised.

Drainage complaints filed with DEC report several instances of flooding of Main Street.

4. Overtopping of Glenrise Avenue

As indicated in Table 6, Glenrise Avenue is overtopped by flow in Tributary No. 2 thirteen times in the historical period, or an average of once every four years. In six of these events, the overtopping exceeds six inches, thus creating an impediment to emergency services and other traffic. This is substantiated by drainage complaints received by DEC citing frequent overtopping.

5. Overtopping of Forest Avenue

Forest Avenue is overtopped three times in the historical series modeled in FEQ. Two of these overtoppings exceeded six inches in depth.

6. Streambank Erosion

Citizen complaints and field observations have identified reaches of serious bank erosion. Erosion is prevalent in the reach extending a total of 1,250 feet from 500 feet upstream of Glenrise Avenue to Eastern Avenue, and a reach 450 feet long from Park Boulevard to Goodrich Avenue. This bank erosion causes loss of residential property and degraded water quality and stream habitat. This erosion is predominantly caused by years of land use changes in the watershed, such as development without stormwater detention.

7. Inadequate Local Drainage

Roadside ditches with significant erosion, deterioration, insufficient capacity or inadequate driveway culverts exist throughout unincorporated areas in the watershed.

8. Unauthorized Culvert Installation

Upstream of Glenrise Avenue, a 180-foot long corrugated metal pipe culvert was installed on private
property without obtaining the required DuPage County excavation and fill permit and the appropriate State permit. This culvert increases flood stages upstream and contributes to erosion downstream.

9. Development Issues at Eastern Avenue

The owner of 9 acres of vacant land downstream of Eastern Avenue approached the County regarding the potential of his site for residential development, a flood control facility, or a wetland bank.

10. Development Issues in Upper Watershed

The owner of 56 acres in the upper watershed, upstream of (west of) Main Street, and the Village of Glendale Heights, have attended several pre-application meetings regarding development of the 56 acre site under the Countywide Stormwater and Flood Plain Ordinance (DPCSFPO). The site contains Tributary No. 2 floodplain and riparian areas, as well as critical wetlands and depressional upland storage. Part of this development site includes the site of Alternatives 3 and 4 presented in this Watershed Plan.

11. Floodplain Map Adequacy

There are several problems with the existing Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) floodplain map: it does not extend far upstream enough, it is out-of-date in terms of the land use and hydraulic conditions it represents, and it was prepared using steady-state, design-event methodology. The County has chosen to update the existing flood insurance studies using technology considered more accurate for its watersheds.

Due to the adverse impacts on public health, safety, and property values, alternative measures to reduce or mitigate problems 1 through 5 have been prepared. Analysis of these measures is discussed in Section VI Part B, Flood Control Analysis and the recommended plan appears in Section VII Part A, Flood Control. Issues 6 through 11 are discussed in Section VI Part C, Other Watershed Issues and recommended actions to address them appears in Section VII Part B, Actions for Other Watershed Issues.
VI. DEVELOPMENT OF RECOMMENDED PLAN

This section of the plan presents alternative solutions to the eleven watershed problems and stormwater management issues identified in Section V. Part A of this section presents four alternative strategies to address economic damages caused by overbank flooding and road overtopping. Part B presents specific actions that address the remaining watershed issues.

A. Flood Control Analysis

Both structural and non-structural alternatives were considered when addressing the flooding problems in the Tributary No. 2 Watershed (issues 1 through 5 in the preceding section). Combinations of structural and non-structural methods were also considered, as well as a no-action alternative. A greenway alternative could not be considered in the Tributary No. 2 Watershed because only one property is eligible for buyout.

Because the watershed is small and damages are concentrated in the center of the watershed, each alternative was designed to address all of the flooding problems in the entire watershed.

Three alternative capital improvement strategies, plus the alternative of no action, were evaluated in detail to address the flooding problems in the watershed. These alternatives are briefly described below. Their locations are shown in Figure 5. Project cost and project benefits are summarized in Table 7.

1. Alternative 1: No Action

This alternative consists of no capital improvements to mitigate flooding in the Tributary No. 2 Watershed. This alternative has no cost and yields no flood control benefits.

2. Alternative 2: Buyouts/Floodproofing

This alternative solves structure inundation problems through County buyout of the one eligible property and floodproofing of the structure that is not eligible for County buyout.
TABLE 7

ALTERNATIVE ANALYSIS SUMMARY
East Branch Tributary No. 2
DuPage County, Illinois

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Alternative 1: No action.

Alternative 2: Buyouts and floodproofing.

Alternative 3: Buyouts, floodproofing, replacement of Glen Ellyn Road and Glenrise Avenue culverts, compensatory storage, sedimentation basin.

Alternative 4: Wetland/flood storage facility.
Residential structures may be considered for County buyout if the Low Water Entry Elevation (LWE) of the structure is exceeded by one foot or more in any one storm event in the historical storm series, or if the LWE is exceeded by 0.5 feet in any two storm events. In the Tributary No. 2 Watershed, there is one residential structure that qualifies for buyout under this criteria. Four storms in the series cause damage to this structure. Of these, two events exceed the LWE by one foot or more, and three by 0.50 feet or more; therefore, this structure is eligible under the criteria.

Floodproofing is any action taken by an individual property owner to reduce or eliminate their risk of flooding. (For the purposes of this Plan, it is assumed that floodproofing eliminates all damage to the structure.) Floodproofing is recommended for structures ineligible for buyouts. There are many methods available to floodproof a structure including structure elevation, floodwall or berm construction, and sealing of water entry points. The appropriate method and cost are highly variable depending on the layout of the structure, the location of the property relative to the stream, the depth of flooding, and owner preferences. In the Tributary No. 2 Watershed, floodproofing is recommended for the one residence which is inundated but does not meet the buyout criteria.

This alternative does not solve road overtopping. The only parcel for which associated damages are affected is at the location of the buyout; because the parcel goes into public ownership as open space, all associated damages are eliminated.

Buyout cost is assumed to be 120 percent of the fair market value of the property. The cost of this alternative is estimated to be $144,000 for the buyout and $10,000 for floodproofing or a total of $154,000. Benefits gained (reduction in flood damages) are $145,700. Residual damages are $110,500.

3. Alternative 3: Buyouts/Floodproofing with Culvert Improvements

In this alternative, inundation damages to structures are eliminated through County buyout of the one eligible property and floodproofing of the other, as in Alternative 2. The culverts at Main Street and Glenrise Avenue would be rebuilt and the road profiles raised to eliminate road overtopping greater than 6 inches. Additional flood storage would be created upstream of Main Street to prevent any increases in flood heights due to culvert replacement. This storage would be designed as
wetland creation or enhancement if possible. A sedimentation basin would be created in conjunction with the compensatory storage to provide water quality benefits to the wetland upstream of Main Street.

Glenrise Avenue overtops in many heavy rainstorms. FEQ analysis of the existing culvert indicates the road is overtopped in the 2 to 5-year event. The culvert alignment is poor, and the culvert inverts appear to be higher than the approach and departure channel inverts. A proposal to improve the culvert to eliminate overtopping was developed. The preliminary design calls for installing two 4 feet by 8 feet box culverts. A layout of this proposal is provided in Appendix H. The project would include channel modifications upstream and downstream of the culvert to provide a better transition for flow entering and leaving the culvert. The estimated design and construction cost of these improvements is $89,000. An itemized project cost estimate for this proposal is provided in Appendix I.

The proposed improvements were analyzed using the FEQ model and the historical hydrologic inputs. Tables J-1 and J-2 in Appendix J summarize the impacts immediately upstream and downstream of the proposed culvert improvement, respectively. The improvements generally reduce stages upstream of the culvert and increase stages slightly downstream of the culvert. Downstream stage increases are within the ordinance tolerance of 0.05 feet in all events. The culvert improvement causes the peak discharge to increase by up to 12 cfs. During final design these flow increases must be reduced to 2 percent of the historical flood peak or an easement must be provided. These flow increases lead to stage increases downstream of the project limits of up to 0.05 feet. The improvement of culvert approach and the increased capacity cause upstream stages to drop by as much as 2.1 feet.

Main Street also overtops in the historical sequence of storms to a depth exceeding 6 inches. A proposal to eliminate the overtopping was developed. The preliminary design calls for installing two 4 feet high by 5 feet wide box culverts and raising of the road profile by 0.5 feet at the stream crossing. A layout of the proposal is provided in Appendix H. The existing storm sewer inlet, just north of the existing culvert, would be maintained. The estimated design and construction cost of the improvements is $183,700 excluding the cost of compensatory storage. An itemized project cost estimate is provided in Appendix I.

The Main Street culvert improvement was analyzed using FEQ and the historical hydrologic inputs. The results are summarized in Tables J-3 and J-4 in Appendix J. These tables illustrate the impact
upstream and downstream of the proposed culvert improvement. The proposed culvert improvement causes peak flow increases by as much as 17 cfs. Therefore, under the ordinance, compensatory storage will be required to implement this project. Approximately 2.0 acre feet of storage will be needed. This storage could be provided adjacent to the existing wetland upstream of Main Street. The DEC currently is working with the owner of two parcels in the area to identify possible uses of the site. The owner, a site development and construction company, is planning to use part of the parcels for wetland mitigation. The site might be transferred to the County for use as a compensatory storage site, as well.

Residual damages of $2,300 would be present after implementation of this alternative because it does not eliminate associated damages at five properties. However, at four of these five properties, the total associated damages for the 45-year historical period are less than $200 each. Road overtopping at Forest Avenue is not benefitted by this project; however, this road does not flood to a depth of 6 inches.

The total cost of this alternative is $751,480. Benefits are $253,900; residual damages are $2,300.

4. Alternative 4: Flood Control/Wetland Enhancement Facility

This alternative consists of expanding the wetland downstream of the former Venture store. Area adjacent to the wetland on the west would be excavated to increase flood storage and create additional wetland area. Construction of a control structure and berm across Tributary No. 2 approximately 200 feet upstream of Main Street would detain water in the wetland during large storm events. Wetland quality would be improved by removal of accumulated silt, introduction of native vegetation, and installation of a sedimentation basin. This basin would be constructed at the outlet of the sewer that discharges into the wetland at its north end to reduce the loading of pollutants and sediment to the wetland. The project provides between 14 and 18 acre feet of storage in addition to the 8 acre feet currently available in the wetland. The layout of the proposal is shown in Appendix K.

This facility would eliminate all of the structure inundation (two houses), and the only quantifiable damages that would remain are associated damages at one structure. Road overtopping at Forest Avenue is completely eliminated with this alternative, and all instances of road overtopping is eliminated at Glenrise Avenue.
This alternative causes reductions in flood heights of 2.9 to 0.2 feet (in the reach of stream from Forest Avenue to Eastern Avenue, respectively) in the 1987 event. Average flood height reduction over the historical periods is 0.53 to 0.13 feet (again from Forest to Eastern Avenues). This reduction is flood height is expected to benefit nine properties with associated damages which are not quantified (not reported by the FEQ analysis), including one property with a septic system.

This alternative also causes reductions in velocities of 10-15 percent. These reductions are in the following three reaches: Main Street to Forest Avenue, downstream of Park Boulevard, and Goodrich Avenue to Eastern Avenue. The reduction in velocity and flow rates will decrease erosion potential in the watershed.

The project would improve water quality downstream as well as within the wetland.

The total cost of these improvements is estimated to be $1,701,000 (including land acquisition). Benefits are $254,100, and residual damages are $2,100. Additional funds ($5,000 - $10,000 per year) would be required for ongoing maintenance of the facility. A detailed cost estimate for construction and design is provided in Appendix L.

The proposed improvements were analyzed using the FEQ model and the historical hydrologic inputs. The results are summarized in Tables M-1 and M-2 in Appendix M. Table M-1 provides results showing the reductions in flow and stage at the upstream face of Main Street while Table M-2 summarizes the reductions in stages and flows further downstream at Glenrise Avenue. As shown in Table M-1, immediately downstream maximum flows are reduced by up to 137 cfs by the project, and the average reduction is 30 cfs. Stages are reduced by as much as 1.44 feet, and the average decrease in stage is 0.51 feet. Further downstream of the project, at Glenrise Avenue, significant flow and stage reductions are achieved. As indicated in Table M-2, maximum flows are reduced by as much as 204 cfs, and peak stages are reduced by a much as 1.32 feet. The average reduction in flow is 33 cfs; the average reduction in stage is 0.44 feet. The reductions in peak flow should also reduce channel erosion in the vicinity of Glenrise Avenue.

Hydrologic impacts to the wetland from construction of the berm and control structure would have to be approved through the DPCSFPQ permit process during final design. Preliminary analysis shows floodwaters would be released by gravity outflow within 12 hours for all events through the simulated flood of record; thus, the detention of water is not expected to be detrimental to the vegetation.
B. Other Watershed Issues

The following discusses possible actions to address issues 6 through 11 identified in Section V, Part C. Any necessary hydraulic analysis is also described in this part of the plan.

1. Streambank Erosion

It is recommended that a channel erosion assessment be conducted for the reach of Tributary No. 2 between Park Boulevard and Eastern Avenue. This assessment would determine the feasibility and appropriate methods for streambank stabilization in that reach. Bioengineering techniques previously utilized by the County in Glencrest Creek, such as lunker structures, A-jacks, vortex weirs, and the establishment of deep-rooted native vegetation, are recommended for consideration as stabilization methods.

Stream maintenance is recommended for the entire watershed before streambank stabilization is initiated. Stream maintenance activities such as debris removal and removal of non-native vegetation eliminate some of the causes of streambank erosion.

2. Inadequate Local Drainage System

Some reports of yard flooding and erosion in the Tributary No. 2 Watershed are the result of deficiencies in the roadside ditch drainage system rather than a problem associated with the Tributary No. 2 main channel. The roadside ditches in unincorporated neighborhoods of the Tributary No. 2 were assessed to determine if they provide adequate drainage. The two areas reviewed, shown in Figure 6, included the ditches along Prairie Avenue and Pleasant Avenue between the Great Western Trail and St. Charles Road, and ditches along the ten streets bounded by North Avenue to the north, Main Street to the west, First Street to the south, and River Drive to the east. The ditch system was broken down into segments (reaches) for analysis. Each segment was evaluated for its hydraulic capacity. A weighted rating system was developed to prioritize the proposed improvements. The rating system incorporated the following factors: hydraulic capacity, potential for sedimentation, condition of driveway culverts, field observations of erosion and ponding, and public complaints. Appendix N contains more information on the rating system, the ranked results of the rating, and hydraulic capacities for each reach. After ranking, the ditch reaches were grouped into three categories: reaches having high and medium priority for rehabilitation, and reaches where rehabilitation is not required. The evaluation identified 23 ditch reaches in the high
priority category, with a total of 12,100 feet needing repair. There were 20 reaches in the medium priority, with a total of 7,700 feet of ditch needing repair. The locations where repairs are required are indicated in Figure N-2. The cost estimates are $209,700 for the high priority ditch repair and $149,800 for the medium priority ditches. It is estimated that additional construction, totaling $60,000 will be required outside the high and medium priority rehabilitation areas. This work is necessary to provide proper transitions and matching of grades.

This work is expected to address six properties with drainage problems not addressed by the overbank flooding alternatives presented above.

Prior to construction, an evaluation of the adequacy of roadway culverts should be performed. If the conveyance of the ditches is improved, these culverts will be required to pass higher flows under the roads. The size and condition of the existing roadway culverts should be determined and potential improvements identified if ditch improvements are contemplated.

3. Unauthorized Culvert Installation

The purpose of the subsurface culvert pipe installed on a parcel between Goodrich Avenue and Glenrise Avenue is to allow horses to cross the stream and access the southwest side of the property. The culvert appears to be a 65 by 40 inch corrugated metal pipe that is 180 feet in length. At low flow, the downstream end of the pipe is completely submerged, indicating the channel was excavated in an attempt to install the culvert at a slope exceeding that of the natural channel. Survey conducted at the site supports this conclusion as indicated on the streambed profile in Figure 4. It was assumed that the culvert was constructed at a constant slope, but this is difficult to verify as most of the pipe is submerged continually. The cross-section above the culvert is nearly flat indicating the channel was filled completely. However, without historic records it is impossible to determine the quantity of fill placed during culvert installation.

The pipe was installed without first obtaining a DuPage County excavation/fill permit and therefore is in violation of the governing County ordinances. Additionally, the pipe increases water levels upstream, as demonstrated by detailed hydraulic analysis.

The Illinois Department of Natural Resources/Office of Water Resources (IDNR/OWR) also considered this a violation of Sections 70 and 78 of the Illinois Administrative Code. The State had indicated that they would let the County take the lead on enforcement action.
A court order issued by the 18th Judicial Circuit Court of DuPage County, in approximately 1993, required the owner to remove the existing pipe, to restore the stream to its natural condition, and further, to allow the owner to leave a 6- to 8-foot culvert to act as a horse crossing. However, the order did not place a time limit on the owner to complete these directives.

Using the Tributary No. 2 FEQ model, two scenarios were analyzed to evaluate the culvert's hydraulic impact. One scenario depicted conditions as they presently exist, and the second represented conditions prior to pipe installation. This second scenario was constructed by assuming the channel cross-sections surveyed in 1994 and 1987, immediately upstream and downstream of the culvert, are representative of the former channel. Historical series flow and elevation results for FEQ model node 510 on branch 5 are provided in Table O-1 in Appendix O. This model node is located approximately 90 feet upstream of the pipe entrance and represents conditions at the upstream property line. As indicated in Table O-1, the presence of the pipe increases peak flood stages up to 0.51 feet. The average stage increase is 0.31 feet, and the median increase is 0.32 feet. Increases in stage do not cause any house inundation but do add to associated damages suffered by one upstream property owner. Peak flow rates during the historical floods are not affected. The largest floods in the historical series are affected little by the pipe because the area of the filled channel is small in comparison to the area needed to convey large flows. However, the pipe causes increased stages in 112 of 115 events in the historical series, and the stage increase exceeds 0.30 feet in more than half of the modeled storm events.

Three alternative courses of action have been identified as possible solutions to this problem. They are:

1. Wait for the property owner to remove the pipe and restore the channel to its previous condition (however, this may not be completed within the next 10 to 15 years).

2. Negotiate for timely removal of the culvert, and design a stream crossing and associated floodplain work which would meet the requirements of the DPCSFPO.

3. Obtain a County Stormwater permit and flood easements from the affected property owners for the existing culvert.

Option 1 would not address the need for a stream crossing which horses would be able to use. It also would make it difficult for the County to design an effective streambank stabilization project in the
area in the near future. Option 3 would not address the increased erosion potential caused by the existing culvert. Thus, Option 2 is the most reasonable course of action.

4. Development Issues at Eastern Avenue

A developer has approached DEC regarding the development potential of 9.2 acres extending southeast from the corner of First Street and Eastern Avenue. The property was evaluated for three different uses: a) a 10-lot residential development, b) a flood control facility, and c) a private wetland bank.

a) DEC held a pre-application meeting with the owner to discuss the DPCSFPO permit requirements for residential development of this parcel. Available field reconnaissance and mapping indicates more than half of the property is occupied by regulatory wetland and floodplain.

b) A hydraulic analysis was conducted to determine whether a flood control facility could be designed for the site that would have local or regional flood control benefits. For this preliminary analysis, the largest possible storage facility was devised for the available land lying north of Tributary No. 2 on the parcel and outside the regulatory floodway. Such a reservoir would be created by excavation and construction of a berm to create a storage area adjacent to the floodway. The natural minimum elevation of the area, 693.0 feet, would be the reservoir low point, and the berm would be built up to an elevation of 700.0 feet. Water would be diverted over a weir into the storage area when the creek elevation reaches an elevation of 698.5. The maximum available storage is 15.0 acre-feet, and outflow is restricted by two 12 inch pipes. The estimated cost for design and construction of this facility is $399,600. However, this cost estimate excludes amounts needed for wetland mitigation and to satisfy the additional DPCSFPO permit requirements that are necessitated by construction activity entirely in wetland, floodplain and riparian areas.

The performance of the preliminary design for the flood control facility was evaluated using the FEQ hydraulic model. Flows downstream of the facility are reduced an average of 30 cfs, and stages are reduced by as much as 0.2 feet. There is a beneficial effect in 112 of the 115 historical events, and there are no appreciable adverse hydraulic impacts. Channel velocities through the site vary by less than 2 percent in existing versus proposed conditions. Despite these apparent beneficial hydraulic impacts, there are no tangible economic benefits to downstream properties as a result of this project. This is due to its location at the downstream end of the watershed, which is approximately 3,000 feet downstream of the location of the most severe flood damages. The results
indicate that the Janis property reservoir proposal is somewhat beneficial on a local basis. However, the benefits are restricted to Commonwealth Edison right of way. There are no houses or other buildings downstream of the Janis property on Tributary No. 2. No appreciable East Branch main channel benefits are evident because maximum water level reductions are generally less than 0.2 feet. These reductions are negligible in the nearest main channel damage areas.

Additionally, substantial refinement would be necessary to develop a facility that is fully consistent with the DuPage County Stormwater Management Plan. Issues which must be addressed are protection of wetlands and riparian environments, maintenance of floodway conveyance, and preservation of floodplain storage. The current layout minimizes impact to known wetland areas; however, the design assumes a viable wetland can be maintained in the bottom of the reservoir. The damage to riparian areas and wildlife habitat could be significant due to tree removal. Thus, the maximum storage configuration on this site would be difficult to achieve.

c) A third alternative use for this property would be to establish a private wetland mitigation bank for use by developers under the DPCSFPPO. At this time, there is no wetland bank for the East Branch DuPage River Watershed. Such a bank is required under the DPCSFPPO. Existing wetlands on the site could be expanded and enhanced by grading and by management of water levels and vegetation.

5. Development Issues in Upper Watershed

A series of permit pre-application meetings have been held with the prospective developer of 56 acres upstream of Main Street in Tributary No. 2. This land includes Tributary No. 2 floodplain and on-line wetland areas as well as upland isolated wetlands (see Figure 2). Specific regulatory issues for proposed development at this locations include: whether the upland isolated wetlands can be filled and mitigated, incorporating the storage these isolated wetlands provide into stormwater detention, designing site detention so it has no negative impact on the main on-line critical wetland, designing site detention so it works under 100-year tailwater conditions, avoiding development impacts to the main wetland, and extending Second Street without impact to the critical wetland, floodplain, and riparian areas.

This development site also contains area which may be necessary for wetland and floodplain expansion needs in flood control Alternatives 3 and 4.
6. Floodplain Map Adequacy

There are a number of problems with the existing Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) floodplain map, prepared in the late 1970's and early 1980's. These problems stem from the age of the data used to prepare the study, the scope of the study, and the technical methods used in the study. The FIS map ends approximately 600 feet upstream of (west of) Main Street, thus neglecting the flood storage provided in the wetland area south of the former Venture store. This wetland provides approximately 8 acre feet of flood storage. Over 50 acres of developable property lie in the area upstream of the map limit. The Forest Avenue culvert and the parallel storm sewer extended from Main Street to Park Boulevard were not considered in the FIS analysis. Also, the FEMA map and profile shows two farm bridges which are no longer present. Additionally, there are suspected problems with the current FEMA map: the flood profiles do not reflect the hydraulics of the watershed, and the 100-year elevation at the upstream map limit (upstream of Main Street) appears to be too high.

The County's floodplain remapping effort was initiated to address the issues raised above. A new hydraulic field survey of the entire watershed was conducted in 1987 and supplemented in 1995. Land use data on a parcel basis has been obtained from the County Development Department's database. Revised floodplain elevations will be delineated on County 2-foot topographic maps, produced in the early 1990's. The County's technical methodology, including continuous simulation hydrology, unsteady flow hydraulics, and statistics based on flood volume, addresses the following deficiencies in the steady-state/design storm method used in the FIS: backwater effects and floodplain storage, antecedent moisture conditions, snowmelt events, the assumption that rainfall probabilities translate directly into runoff (flood) probabilities, and discontinuities in flood frequency curves for urbanized watersheds.
VII. RECOMMENDED PLAN

The recommended plan consists of a capital improvement plan to address overbank flooding damages, a package of actions to address the other watershed issues, and funding, maintenance, and implementation plans. The recommended plan also addresses the following issues: special management areas, water quality, flood forecasting, and groundwater resources.

A. Flood Control

The following factors were used to evaluate the four flood control alternatives: effectiveness in eliminating existing flooding (both quantifiable and non-quantifiable benefits), cost, impact on water quality, velocities/erosion potential, impact on aquatic habitat, ease/difficulty of implementation, and conformance to DPCSFPO requirements.

A comparative analysis of the four flood control alternatives considered is provided in Table 8. The recommended plan for this watershed is Alternative 3 because it is significantly more cost-effective than Alternative 4, and achieves nearly the same level of quantifiable benefits. The cost-effectiveness of Alternative 3 over Alternative 4 is true both when looking at the overall capital cost of the project, and when considering just the County's cost. Residual damages are $2,300 for Alternative 3, as opposed to $2,100 for Alternative 4. Alternative 4 would cost $950,000 more to build than Alternative 3. The additional benefits given by Alternative 4 for the added cost are: flood level reductions, elimination of some instances of road overtopping which are less than 6 inches in depth, decreased velocities over existing conditions, and potential for greater wetland expansion and enhancement. Alternative 4 reduces flood heights in all flood events in all areas downstream of the wetland south of the former Venture store. This flood height reduction benefits three properties with quantifiable associated damages and nine properties with associated damages that were not evident in the FEQ modeling including one property that has experienced septic sewer backup. On the negative side, the flood level reductions do not translate into quantifiable damage reductions using the current County methodology, the velocity reductions will not eliminate the need for streambank stabilization, and Alternative 4 would be difficult to implement because easements on twelve parcels would have to be purchased. Also, permitability under the DPCSFPO is not a given. The preliminary hydrologic analysis appears to be favorable in terms of maintaining a high-quality wetland, but these impacts would have to be evaluated by the DEC wetland specialist. Many of the required easements represent significant portions of residential lots. Alternative 3 offers opportunities for wetland expansion and water quality enhancement, both by itself, and if coordin-
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Note: Local cost refers to DuPage County Drainage/Bond cost.
Action 1: The stream maintenance work on Tributary No. 2 has already been scheduled and budgeted for 1996, in the amount of $90,000.

Action 2: Design would be paid for under 1996 Stormwater funds currently budgeted for streambank stabilization design, and construction would be completed through the County Drainage Bond. The design cost is estimated to be $19,110, and construction cost is estimated to be $191,100.

Action 3: Removal of the unauthorized culvert placed upstream of Glenrise Avenue is the responsibility of the property owner. However, staff recommends that removal be negotiated as part of streambank stabilization in order to achieve the removal in a timely manner (see discussion in Section VI Part B).

Action 4: A private wetland bank on the property downstream of Eastern Avenue, if implemented, would be funded entirely by the property owner and future developers. The property owner would fund the preliminary engineering necessary for the concept plan which would form the basis for an agreement with the County. Wetland mitigation credits from future developers in the East Branch Watershed would fund construction, monitoring, and long-term maintenance. The cost estimate for this bank is currently being developed by the consultants hired by the property owner.

Action 5: Funding for the ditch segments ranked as high and medium priority in needing rehabilitation has been included in the recent County Drainage Bond Issue. The cost of this work is estimated at $360,000. The total final cost of the rehabilitation will be approximately $60,000 more for a total of $420,000. The additional work will be to adjust grades and provide flow transitions outside the high and medium priority areas.

Action 6: Funding for the watershed modeling and statistical analysis necessary to remap the floodplain has already been encumbered in the 1996 Stormwater budget.

Action 7: Coordination of prospective development upstream of Main Street with County flood control work will be done by DEC staff as part of the pre-application and permit review processes. No additional funding is necessary for this coordination.
Likewise, DEC staff time will be needed to provide technical assistance for floodproofing. The property owner pays for the needed improvement.

The impact of the recommended plan on the Stormwater Financial Plan is minimal. Funds for buyouts County-wide are already set aside in the Plan. A commitment is needed from the DuPage DOT to replace the Main Street culvert before Stormwater funds for the compensatory storage ($152,280) are placed in the Financial Plan.

The above funding information and Table 7 and Table 9 are the best possible estimates available from the watershed planning process. These estimated funding amounts may change during final design.

D. Maintenance Plan

Existing maintenance responsibilities in the Tributary No. 2 Watershed are as follows:

DuPage County Department of Environmental Concerns: unincorporated area drainage, stream maintenance. Stream maintenance activities include stream removal of debris and fallen trees close to falling in the stream. Exotic and nuisance vegetation is also removed in an effort to allow sunlight to reach the streambank, aiding revegetation and stabilization of the bank.

DuPage County Department of Transportation: road maintenance and drainage within County road right-of-ways, including Main Street, St. Charles, Geneva Road, and the Great Western Trail. Roadside drainage maintenance includes cleaning and repair of culverts, ditches, and sewers.

Village of Glendale Heights: drainage systems and problems within municipal limits.

Village of Glen Ellyn: drainage systems and problems within municipal limits.

Milton Township: road maintenance and drainage systems within local road right-of-ways.

Illinois Department of Transportation/Division of Highways: road maintenance and drainage within North Avenue right-of-way.
Management of wetlands in the Tributary No. 2 Watershed is accomplished in two ways: by regulating development impacts to wetlands and by the recommendations contained in this Watershed Plan.

The DPCSFPO regulates development impacts by its identification, avoidance, and mitigation requirements. DEC has received the authority, via a programmatic general permit, to assume responsibility for the review of projects within DuPage County which currently require permits under Section 404 program from the U.S. Army Corps of Engineers.

Appropriate uses and management strategies for major wetlands in the Tributary No. 2 Watershed have been identified:

- the private wetland mitigation bank concept for the wetland at Eastern Avenue
- donation of the wetland upstream of Main Street to the Village or County and its expansion in conjunction with the proposed development and recommended flood control project there.

3. Riparian Areas

Riparian areas are regulated under the DPCSFPO and loss of, or damage to, their functions must be mitigated. The present Ordinance language allows a default riparian zone width of 50 feet from the waterway, or a site-specific delineation. However, the 50-foot width is arbitrary and there is a lack of consensus in the scientific community on a consistent, repeatable methodology for delineating riparian zones in the field (Kelsey and Womack, 1995). The SMC decided on December 5, 1995 to adopt, on an interim basis, a methodology that identifies riparian functions within the regulatory flood plain and provides guidance for mitigating impacts from development.

The DEC revised floodplain will be used to determine riparian areas in the Tributary No. 2 Watershed.

Riparian zone management will be accomplished through the stream maintenance and stabilization actions, and through continuing education of streamside property owners (through brochures, site...
visits, and public meetings). This public education process has already been started with a streambank stabilization project constructed by DuPage County in 1993 between Main Street and Forest Avenue.

F. Water Quality Considerations

1. Background and Authority

The DuPage County Stormwater Management Plan (1989) contains the following objectives:

- Protect and enhance the quality, quantity, and availability of surface and groundwater resources.

- Preserve and enhance existing aquatic and riparian environments and encourage restoration of degraded areas.

The Plan also requires each watershed plan to identify projects, policies, and regulations that will enhance water quality.

Future federal regulations which will affect water quality in the Tributary No. 2 Watershed are the 1987 revisions to the Clean Water Act. Under this legislation, stormwater discharge is subject to the National Pollutant Discharge Elimination System (NPDES). Rules and procedures have been promulgated pursuant to this. However, at the time of this writing, only municipalities of population 100,000 or more are subject to it. There are no municipalities (including unincorporated DuPage) in the Tributary No. 2 Watershed with populations greater than 100,000. It is not known when Phase II, which applies to municipalities under 100,000, will take effect.

The water quality of all major streams in DuPage County has been rated by the Illinois Environmental Protection Agency (IEPA) as "fair", meaning that water quality has been impaired, but that the water body meets the needs of a designated use most of the time (IEPA, May, 1995). Tributaries to the major streams have not been rated. The Illinois Pollution Control Board (IPCB) has designated all DuPage County lakes and streams as "general use" waters. The general uses to be protected by appropriate criteria are: aquatic life, fish, and wildlife; primary and secondary contact recreation; and agricultural and industrial uses.
2. Plan for Maintaining and Enhancing Water Quality in Tributary No. 2

Water quality maintenance within the Tributary No. 2 Watershed will be achieved firstly through enforcement of the following DPCSFPO requirements:

a) The incorporation of best management practices (BMPs) within new developments to minimize increases in pollutant loads to the stream system. Examples of BMPs include wet detention ponds, offline detention, grassed drainageways, and indirect stormwater discharges. Guidance for designing and implementing BMPs can be found in the following sources:

- Appendix P to the Tributary No. 2 Watershed Plan titled Best Management Practices
- DuPage County Stormwater Management Plan, Appendix E - Technical Guidance for the DPCSFPO

b) The installation of proper sediment and erosion control measures within new developments to control sediment loadings to the stream and its associated drainageways during construction.

The Tributary No. 2 Plan also identifies and recommends implementation of water quality enhancement features in the following projects and actions:

c) Part of the recommended flood control project in this Watershed Plan includes the construction of a sedimentation basin upstream of the wetland west of Main Street. This basin will settle out and filter pollutants from the commercial area and transportation corridor along North Avenue. The sedimentation basin will also improve water quality entering the wetland, which discharges into the open channel system of Tributary No. 2.

d) Stream maintenance and streambank stabilization activities have been included as elements of the recommended Watershed Plan for Tributary No. 2.
e) A private wetland mitigation bank downstream of Eastern Avenue is another element of the recommended Watershed Plan for Tributary No. 2.

f) Streamside property owner education, an ongoing activity of DEC's Stormwater Management Program, will continue to be emphasized as part of the Tributary No. 2 Plan.

G. Flood Forecasting

Flood forecasting is not feasible for Tributary No. 2 because of the small size of the watershed. The stream itself is only 1.19 miles long (from the former Venture store to the confluence). The time of concentration from the wetland upstream of Main Street to the confluence is 45 minutes. This does not allow enough time for computations and predictions to be made regarding flood heights in the watershed. However, DuPage County is planning to have a world-wide web home page available on the Internet in 1996. DEC is considering making the County's radar data from its Supervisory Control and Data Acquisition (SCADA) system available through the home page. This data would include predicted rainfall amounts and intensities.

H. Groundwater Resources

The Illinois Groundwater Protection Act was adopted in part to protect groundwater recharge zones affecting public water supplies. Phase I of the related Illinois Wellhead Protection Plan establishes a 1,000-foot radius Wellhead Protection Area (WHPA) for all public water supply wells. The Illinois Groundwater Protection Act establishes regulatory management zones within these WHPAs. According to Section 14.2 of the Act, no new potential primary or secondary source or potential route of contamination can be located within the minimum setback zone of any potable water supply well.

A wetland located within a 1,000 foot WHPA is considered a critical wetland in accordance with the DPCSFPO. Additional information on WHPAs is contained in Exhibit E-13, Appendix E of the DuPage County Stormwater Management Plan, (DuPage SMC, October 26, 1993).

The locations of all public water supply wells in and near the Tributary No. 2 Watershed were obtained from the IEPA's Division of Public Water Supplies. Those locations are shown in Figure 2, as are the WHPA protection zones - the areas within a 1,000-foot radius of each well. More detailed information regarding these public water supply wells can be found in Appendix Q.
The information found in Appendix Q and Figure 2 is to be used for guidance and for preliminary decision making. Site visits and verification of well locations with the IEPA are recommended for development purposes.

I. Institutional Considerations

A few issues related to the recommended project and actions are addressed in this section. The responsibility of various institutions to carry out elements of the Tributary No. 2 Watershed Plan is discussed in the Funding, Maintenance, and Implementation sections.

1. Transportation Issues

The County Department of Transportation (DOT) must schedule and budget for the Main Street culvert improvement before Alternative 3 can be completed, although the compensatory storage necessary can be constructed before the culvert improvement.

An issue related to Alternative 3 is the extension of Second Street to Main Street. As discussed in other sections of the Plan, this extension will be required by the Village of Glendale Heights as part of the proposed development upstream of Main Street. The alignment of this extension raises both traffic and DPCSFPO regulatory issues (avoidance of the critical wetland, impact on floodplain storage and riparian areas), as well as the need to coordinate design of this route with design of compensatory storage for the culvert improvement. One alternative to the extending Second Street east to Main Street would be to route the traffic south down Highland Avenue and then east on Poss Street. However, there is an elevation in grade at the intersection of Poss Street and Main Street which poses line of sight problems. The County DOT has considered studying this problem in the next two years. Performance of this study in 1996 would expedite resolution of the development issues and construction of Alternative 3.

2. Private Wetland Bank at Eastern Avenue

DEC, the Village of Downers Grove, the Downers Grove Park District, and the DuPage County Forest Preserve District have been discussing the possibility of establishing a wetland bank in Downers Grove. DEC feels that this does not preclude the possibility for a wetland bank at Eastern Avenue, given the demand for wetland mitigation in the East Branch Watershed, and size and timing factors. Currently wetland mitigation credits have been temporarily transferred to other watershed
banks. A bank at Eastern Avenue could be established much more quickly than in Downers Grove, because the land has only one owner. (A bank in Downers Grove would involve a minimum of four agencies.) Also, all sites being considered are relatively small in size: the Eastern Avenue bank would yield a maximum of about 9 acres of wetland creation; a Downers Grove bank would have about 10 to 20 acres of wetland creation.

3. Permits

Required construction permits will be obtained by DEC or other participating agencies. Required permits and their issuing agencies for the capital improvements are identified and described in Item 6, below Implementation Issues.

In addition the project must meet all requirements of the Countywide Stormwater Management and floodplain ordinance.

4. Floodplain Remapping

FEMA must approve DEC’s technical methodology before the revised floodplain mapping developed for Tributary No. 2 can be used for flood insurance purposes. Discussions expected to lead to this approval have been going on for over two years, but at this time, there is no anticipated date for approval. In the meantime, the need for two regulatory maps will continue - FEMA’s FIS will be used for flood insurance purposes, and DEC’s remapped floodplain will be used for DPCSFPO requirements.

An issue yet to be resolved is whether DEC will delineate a floodway in Tributary No. 2. No floodway has been established by FEMA or IDNR/OWR.

5. Development Issues in Upper Watershed

The owner of the potential development site upstream of Main Street may need to mitigate. This mitigation will be in addition to mitigation required for any permitted wetland impacts.

The project will be built, if approved by the SMC and the County Board, under a cooperative agreement between DEC, the Village of Glendale Heights and a local developer.
The residence to be floodproofed must be floodproofed to the Flood Protection Elevation (two feet above the base flood elevation), according to the DuPage County Zoning Ordinance (Section 37-13.7-3, paragraph 8). The preferable means of floodproofing would be to elevate the structure to the Flood Protection Elevation. If this cannot be accomplished, then the structure can be dry floodproofed to the Flood Protection Elevation.

Assuming the property owner decides to sell, the residence which qualifies for buyout will be purchased by the DuPage County Stormwater Division and remain as open space owned by a public agency, most likely by DuPage County. The County will negotiate for maintenance responsibility with a local government agency.

The buyout and floodproofing activities need to be coordinated with the DuPage County Development Department’s Zoning Division to ensure that all zoning requirements are met.

J. Implementation

The following steps must be completed in order to implement the recommended Alternative 3:

- The public review process must be successfully completed, and the Watershed Plan must be adopted by the County Board.

- A public notice must be posted regarding the voluntary buyout program in Tributary No. 2.

- Through the public meeting/hearing process, property owners can be notified of the availability of technical assistance for floodproofing.

- The land rights must be acquired to place the necessary compensatory storage. The property needed for this is one parcel comprising the wetland upstream of Main Street. Staff recommends the other parcel comprising the wetland be dedicated by the developer to either the Village of Glendale Heights or to the County. The developer has already stated that this may be a possibility. DEC will be responsible for negotiation of interagency agreements for land acquisition.

- Final design of the compensatory storage area must be accomplished within the next six months, so it can be coordinated with the neighboring development proposal. Land rights
can be obtained from the developer, and enough space made available for not only the compensatory storage and sedimentation basin but for the developer's stormwater and wetland mitigation needs.

- The compensatory storage must be constructed before the Main Street culvert can be replaced. The property needed for this is one parcel comprising the wetland upstream of Main Street. Staff recommends the other parcel comprising the wetland be dedicated by the developer to either the Village of Glendale Heights or to the County. The developer has already stated his willingness to do this. The owner has stated that he is willing to donate the two parcels comprising the wetland site to the County or Village if the development and project can be coordinated and permitted.

- Construction of the Main Street culvert replacement is dependent upon the County Transportation Department committing funding for it.

- Because the proposed development carries with it the requirement to extend Second Place to Main Street (imposed by the Village of Glendale Heights), the impact of this road extension on the recommended project design, as well as on Tributary No. 2 floodplain, riparian, and wetland areas, must be examined and resolved. One alternative to the Second Place road extension is the improvement of Highland Avenue and the Poss Street/Main Street intersection. Ideally, the County Transportation Department would commit to analyzing this in the next six months, so the above-mentioned issues can be resolved.

- The Glenrise Avenue culvert replacement can be constructed independently of the Main Street culvert replacement and its compensatory storage.

The following steps are necessary to implement the recommended actions:

Action 1: No further steps are necessary.

Action 2: Schedule construction of streambank stabilization with County staff managing the Drainage Bond.

Action 3: Negotiate timely removal of the unauthorized culvert with the property owner in return for County-provided streambank stabilization.
Action 4: Review wetland mitigation bank concept plan when completed by owner and consultant. Bring this concept plan to SMC and County Board for approval.

Action 5: Schedule construction of ditch rehabilitation with County staff managing the Drainage Bond. Prior to construction, an evaluation of the adequacy of roadway culverts should be performed. If the conveyance of the ditches is improved, these culverts will be required to pass higher flows under the roads. The size and condition of the existing roadway culverts should be determined and potential improvements identified if ditch improvements are contemplated.

Action 6: Complete the floodplain remapping work is currently underway. The statistical analysis will be completed by June 1996. Map preparation and submittal to FEMA are expected to be completed by September 1996.

Action 7: Provide coordination by DEC staff in the course of designing the recommended alternative and by pre-application meetings with the developer.

All necessary permits (federal, state, local, and County Stormwater) shall be obtained before construction of the recommended alternative and actions is begun. These permits include a County Stormwater permit, and may also include some or all of the following:

- Section 404 wetland permit - US Army Corps of Engineers
- Floodway/floodplain construction permit - IDNR-OWR
- A 401 Water Quality Certification from IEPA
- Illinois Historic Preservation Agency Approval
- unincorporated DuPage County excavation/fill permit
- DuPage County Zoning Board of Appeals approval.
VIII. CONFORMANCE WITH THE Dupage County Stormwater Management Plan

This watershed plan has been conducted and completed in accordance with the DuPage County Stormwater Management Plan. All components of this watershed plan are intended to be consistent with the goals and objectives of the County Plan. The watershed model and recommended plan is a component of the East Branch of the DuPage River Watershed Plan.
REFERENCES


Kelsey, Patrick, personal communication to the DuPage County Municipal Engineers Committee, 1995.


