Final Report

Detailed Watershed Plan for the Upper Salt Creek Watershed: Volume 1

Prepared for

Metropolitan Water Reclamation District of Greater Chicago

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MWH

Executive Summary

Background

The Metropolitan Water Reclamation District of Greater Chicago (District) has authority for regional stormwater management within Cook County as granted by the Illinois General Assembly in Public Act 93-1049 (the Act). The Act requires the District to develop watershed plans for six Cook County watersheds, which include the North Branch of the Chicago River, Lower Des Plaines River, Calumet-Sag Channel, Little Calumet River, Poplar Creek, and Upper Salt Creek. The District published the *Cook County Stormwater Management Plan* (CCSMP) in February 2007 to identify stormwater management goals and to outline the District's approach to watershed planning. Chapter 6 of the CCSMP defines the District's approach to and standards for Detailed Watershed Plans (DWPs), which address regional stormwater problems in Cook County. The six major watersheds for which DWPs are being developed cover approximately 730 square miles in Cook County. The primary goals of the DWPs are as follows:

- Document stormwater problem areas.
- Evaluate existing watershed conditions using hydrologic and hydraulic (H&H) models.
- Produce flow, stage, frequency, and duration information about flood events along regional waterways.
- Estimate damages associated with regional stormwater problems.
- Evaluate potential solutions to regional stormwater problems.

The Upper Salt Creek DWP was developed to meet the goals for the Upper Salt Creek Watershed as described in the CCSMP. The Act required the formation of Watershed Planning Councils (WPCs) to advise the District during development of its countywide stormwater management program; therefore, the DWPs were developed in coordination with the WPCs. Membership of the WPCs consists of the chief elected official of each municipality and township in each watershed, or their designees. Many municipalities and townships are represented by engineers, elected officials, or public works directors. WPC meetings are also open to the public. Frequent coordination with WPCs was performed to ensure that local knowledge is integrated into the DWP and the DWP reflects the communities' understanding of watershed issues as well as the practicability of proposed solutions.

Detailed Watershed Plan Scope

The scope of the Upper Salt Creek DWP includes the development of stormwater improvement projects to address regional problem areas along open waterways. Regional problems are defined as problems associated with waterways whose watersheds encompass multiple jurisdictions and drain an area greater than 0.5 square miles. Problems arising from capacity issues on local systems, such as storm sewer systems and minor open channel ditches, even if they drain more than one municipality, were considered local and beyond the scope of this study. Erosion problems addressed in this plan were limited to active erosion along regional waterways that pose an imminent risk to structures or critical infrastructure. Interstate highways, U.S. highways, state routes, county roads with four or more lanes, and smaller roads providing critical access that are impacted by overbank flooding of regional waterways at depths exceeding 0.5 feet were also considered regional problems.

Watershed Overview

Salt Creek is divided into two hydrologic parts by Busse Woods Dam: Upper Salt Creek and Lower Salt Creek. However, for the purposes of the development of this DWP, "Upper Salt Creek" will refer, hereafter, to the Salt Creek stream reaches and tributaries located upstream of the DuPage County/Cook County border. The "Watershed" will refer, hereafter, to the Upper Salt Creek Watershed. The total Watershed area is approximately 55 square miles. Land use is predominately residential with concentrations of commercial, light manufacturing and trucking facilities. Several large forest preserves are also present, notably Ned Brown Preserve (also known as Busse Woods), Paul Douglas Forest Preserve and Deer Grove Forest Preserve. Figure ES.1 shows a schematic of the Watershed showing the drainage boundary, stream channels, and municipality boundaries of the Watershed.

The Watershed is composed of three distinct subwatersheds: the Arlington Heights branch, the Mainstem, and the West Branch. The Arlington Heights Branch subwatershed covers the north and northeast portion of the watershed and flows directly into the Mainstem upstream of Algonquin Road in the City of Rolling Meadows. The West Branch subwatershed covers the southwest portion of the watershed and joins the Mainstem at the Busse Woods Reservoir.

Existing Conditions Evaluation

Locations with historic flooding and stream bank erosion problems on regional waterways exist throughout the watershed. Information on existing problem areas was solicited from WPC members as well as federal and state agencies and other stakeholders during the data collection and evaluation phase of the DWP development, which also included the collection of data regarding the watershed and evaluation of the data's acceptability for use. Responses from stakeholders were used to help identify locations of concern, and where field assessment or surveys were needed to support hydrologic and hydraulic modeling.

Hydrologic models were developed to represent runoff generated by rainfall throughout the Upper Salt Creek Watershed. The runoff was then routed through hydraulic models, which were created for the major open channel waterways within the watershed. Design rainfall events were simulated for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence interval events based upon Bulletin 71 rainfall data (ISWS, 1992). The simulated water surface profiles were overlaid upon a ground elevation model of the study area to identify structures at risk of flooding.

Property damages due to flooding were estimated using a methodology consistent with the U.S. Army Corps of Engineers (USACE) Flood Damage Assessment program. Estimated flood damages resulting from a range of possible storms was considered in combination with the probability of a particular storm occurring to estimate an expected annual damage. Erosion damages were assessed for structures or infrastructure at risk of loss due to actively eroding stream banks. Damages reported within this document refer to economic damages estimated over a 50-year period of analysis that result from regional overbank flooding or erosion of a regional waterway. Additional damages throughout the watershed exist, including damages due to flooding from local waterways and storm sewer systems, and also damages not easily quantified in financial terms such as water quality, wetland, riparian, and habitat impact, loss of emergency access, and loss of business or operations due to limited access.

FIGURE ES.1
Upper Salt Creek Watershed Overview (see Figure 1 in Volume 2 to view full color, 11 x 17 version of this map)

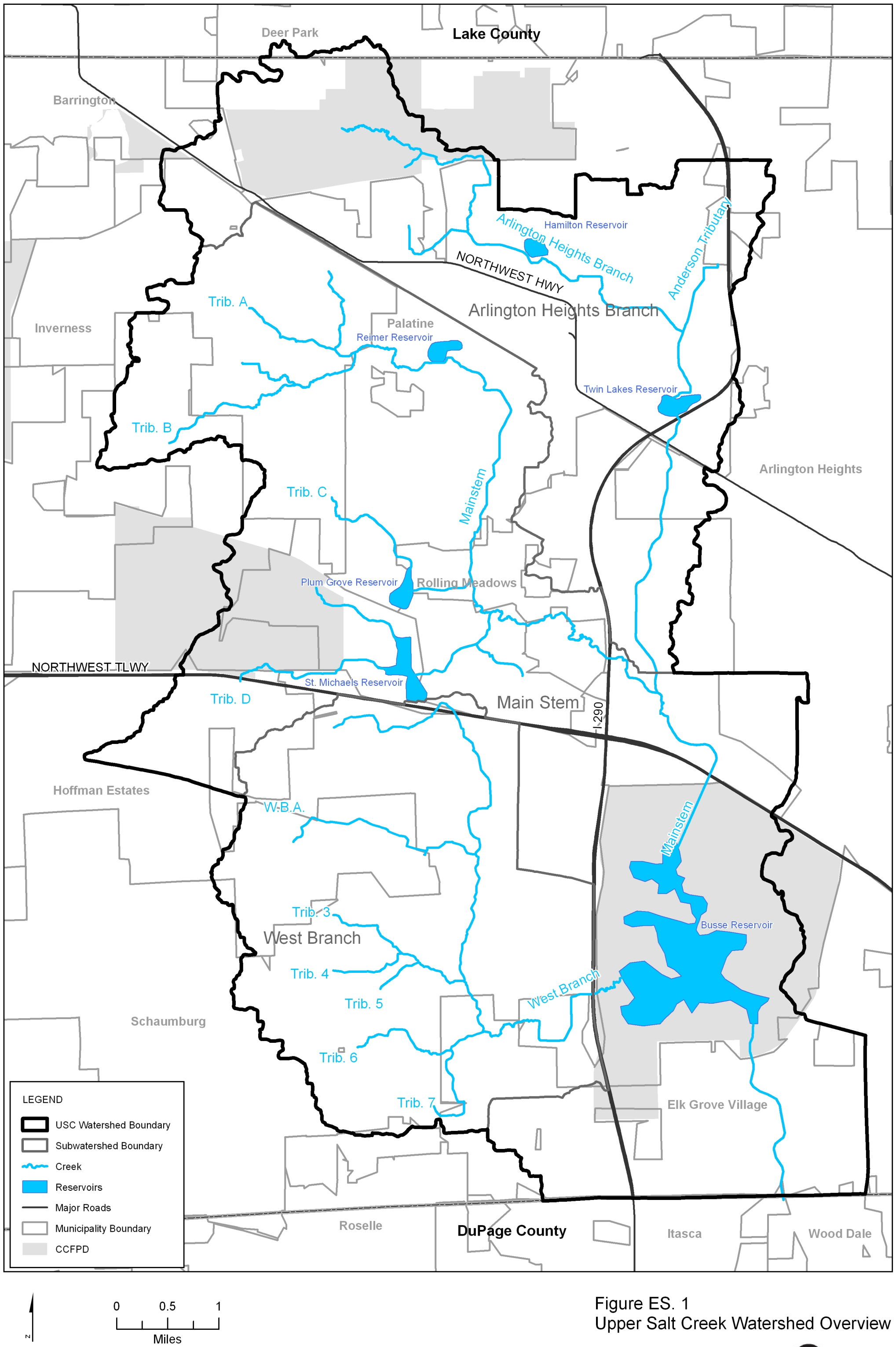

Figure ES. 1
Upper Salt Creek Watershed Overview

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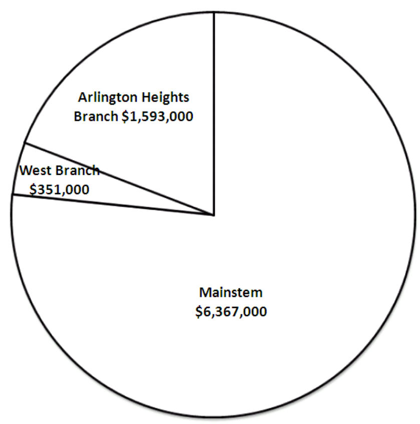
Figure ES.2 summarizes the distribution of existing conditions damages within the Upper Salt Creek Watershed over a planning period of analysis of 50 years. The Mainstem and its tributaries comprise nearly 75 percent of the existing conditions damage within the watershed; this system has the largest tributary area and the most river miles and is the most densely developed of the three subwatersheds in this DWP.

The estimated damages summarized in Figure ES.2 include calculated regional damages related to overbank flooding, transportation damages, and erosion problems on regional waterways that threaten structures only. Localized problems, such as storm-sewer capacity related problems, are not included in this estimate. Reported problems classified as local are presented in Table 2.2.1 in Section 2.2.1. Also provided in Table 2.2.1 is the reasoning behind classifying the problems as local or regional.

FIGURE ES.2
Summary of Existing Conditions Damages within the Upper Salt Creek Watershed over 50-Year Period of Analysis



Evaluation of Alternatives

Stormwater improvements, or alternatives, were developed to address regional stormwater problems along intercommunity waterways. WPC members participated in the alternative development process by providing input on possible solutions and candidate sites for new stormwater infrastructure. It should be noted that the alternatives presented in the DWP are developed at a conceptual level of feasibility.

Hydrologic and hydraulic models were used to determine the benefit of alternative stormwater improvement projects. Models were run and damages were calculated for the existing conditions evaluation. Benefits were calculated for each project as the difference between existing and alternative conditions damages. Only regional financial benefits (e.g., relief of flooding due to a regional problem as defined above) were considered. Local benefits (e.g., improved sewer drainage due to reduced outlet elevation) and non-economic benefits (e.g. improved emergency access, improved wetland, riparian, and habitat, and improved access to businesses) are not included in the benefits. The alternative stormwater improvement projects may have significant local and non-economic benefits. Local benefits are not reported in the DWP, which focuses on regional benefits.

Conceptual level cost estimates were produced to represent the estimated costs for design, construction, and maintenance of a specific alternative over a 50-year period of analysis. The cost estimates were developed using standard unit cost items located within a District database and used for all six watershed plans. In addition, standard markups on the estimated capital costs, such as utility relocation, design and engineering costs, profit and contingency were included.

A benefit-to-cost (B/C) ratio was developed for each alternative, which represents the ratio of estimated benefits to costs. The B/C ratios calculated may be used to rank the alternatives in a relative manner as the District's Board of Commissioners prioritizes the implementation of recommended stormwater improvement projects. Only regional financial benefits were considered in determination of the B/C ratios. The B/C ratios do not include local and non-economic benefits and should not be interpreted to be the sole measure of justification of an alternative. In addition to the B/C ratio, noneconomic criteria such as water-quality impact, number of structures protected, and impact on wetland and riparian areas were noted for each alternative. These criteria may also be considered along with the calculated B/C ratios as the District's Board of Commissioners prioritizes the implementation of recommended stormwater improvement projects.

Recommendations

Alternatives were recommended based upon consideration of their ability to reduce stormwater damages and to address problems reported by communities. Table ES.1 lists the recommended alternatives, their costs, and regional financial benefits.

Table ES.2 summarizes the extent to which the recommended alternatives address existing regional financial damages within each tributary, ordered by increasing existing conditions damages.

TABLE ES.1
Recommended Alternatives Summary for the Upper Salt Creek Watershed

Project	Category	Description	B/C Ratio	Total Benefits	Total Project Cost	Probable Construction Cost	Cumulative Structures Protected	Communities Involved
SCUP-49	Conveyance	Widen channel and increase conveyance capacity of five bridges.	0.15	$1,701,000	$11,030,000	$6,393,000	61	Palatine
SCUP-56	Conveyance/ Levee	Install pumping station with flap gate and construct three levees.	0.12	$166,000	$1,403,000	$956,500	0*	Rolling Meadows
SCAH-50	Conveyance	Widen channel and increase the conveyance capacity of two culverts.	0.93	$1,593,000	$1,707,000	$975,000	18	Palatine
SCWB-52	Conveyance	Lower weirs on two detention basins, increase capacity of bridge and create ditch in place of culvert.	0.31	$351,000	$1,149,000	$665,000	3	Schaumburg

* This alternative addresses regional transportation damages. The project cost includes $ 1,253,000 for necessary local improvements.

TABLE ES.2
Upper Salt Creek Watershed Alternatives Summary

Watershed	Existing Conditions Damages	Benefits from Recommended Alternatives	Percent of Damages Addressed	Benefit Cost Ratio
Upper Main Stem	$6,367,000	$1,867,000	29%	0.15
Arlington Heights Branch	$1,593,000	$1,593,000	100%	0.93
West Branch	$351,000	$351,000	100%	0.31
Total	$8,311,000	$3,811,000	46%	0.25

The Upper Salt Creek DWP integrated stormwater data from a large number of sources in order to identify and prioritize solutions to existing stormwater problems. An extensive data collection effort undertaken for the DWP development included surveying of streams, bridges, and culverts throughout the entire watershed. Field reconnaissance was performed throughout the watershed to understand conditions unique to the watershed. This compilation of current, accurate data was used by the District to document and identify existing stormwater problems throughout the study area.

Several alternatives were developed and evaluated for their effectiveness in reducing regional damages within the Upper Salt Creek Watershed. The alternatives listed in Table ES.1 were identified as the most effective improvements for reducing expected damages due to flooding within the watershed. In some tributaries, greater opportunities to reduce regional flooding were identified than in others. Factors such as the lack of availability of land and location of structures relative to stream channels limited the practicality of alternative projects to eliminate all flooding damages for all design storms evaluated.

The data provided in the Upper Salt Creek DWP will be used by the District, along with consistently developed data in DWPs for the other five major Cook County Watersheds, to prioritize the implementation of stormwater improvement projects.

Contents

Tables

Figures

Note: Figures not embedded in the chapters are contained in Volume 2.

Appendices

Acronyms and Abbreviations

ABM	Articulated Block Mat
AMC	Antecedent Moisture Conditions
B/C	Benefit to Cost Ratio
CCHD	Cook County Highway Department
CCSMP	Cook County Stormwater Management Plan
CCTA	Cook County Tax Assessor
cfs	cubic feet per second
CIP	Capital Improvement Program
CMAP	Chicago Metropolitan Agency for Planning
CN	Curve Number
CoCoRaHS	Community Collaborative Rain, Hail & Snow Network
CSSC	Chicago Sanitary and Shipping Canal
CWA	Clean Water Act
CWS	Chicago Waterway System
DEM	Digital Elevation Model
DFIRM	Digital Flood Insurance Rate Map
District	Metropolitan Water Reclamation District of Greater Chicago
DTM	Digital Terrain Model
DWP	Detailed Watershed Plan
FEMA	Federal Emergency Management Agency
FFE	first floor elevation
FGCS	Federal Geodetic Control Subcommittee
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
GPS	Geographic Positioning System
H&H	Hydrologic and Hydraulic
HARN	High Accuracy Reference Network
HEC-DSS	Hydrologic Engineering Center Data Storage System
HEC-HMS	Hydrologic Engineering Center Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center River Analysis System
IDNR	Illinois Department of Natural Resources
IDOT	Illinois Department of Transportation
IEPA	Illinois Environmental Protection Agency
ISWS	Illinois State Water Survey
LiDAR	Light Detection and Ranging
LOMR	Letter of Map Revision
M&O	Maintenance and Operations
NAD 29	North American Datum, 1929
NAD 83	North American Datum, 1983
NAVD 88	North American Vertical Datum, 1988

NGVD 29	National Geodetic Vertical Datum, 1929
NFIP	National Flood Insurance Program
NFIRA	National Flood Insurance Reform Act of 1994
NGS	National Geodetic Survey
NIPC	Northeastern Illinois Planning Commission
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
OWR	Office of Water Resources
PCB	Polychlorinated Biphenyl
ROW	Right-of-Way
SCS	Soil Conservation Service
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WPC	Watershed Planning Council
WSEL	Water Surface Elevation
WSP	Water Surface Profile

1. Introduction

The Upper Salt Creek Watershed in northwestern Cook County drains an area of 55.3 square miles that includes 15 communities. Figure ES.1 shows an overview of the Watershed. The watershed is primarily residential with concentrations of commercial, light manufacturing and trucking facilities. Several large forest preserves are also present, notably Ned Brown Preserve (also known as Busse Woods), Paul Douglas Forest Preserve and Deer Grove Forest Preserve.

All tributaries in the Watershed ultimately flow through the Busse Woods Reservoir and out of Cook County into DuPage County via the Salt Creek Mainstem. Since the flow from the subwatersheds merge and flow out through a common location, the subwatersheds were modeled together in one model rather than separately. However, the subwatersheds are described and summarized separately in this DWP.

The Upper Salt Creek DWP was developed by the Metropolitan Water Reclamation District of Greater Chicago (District) with the participation of the Upper Salt Creek Watershed Planning Council (WPC) which provided local input to the District throughout the development process. The DWP was developed to accomplish the following goals:

- Document stormwater problem areas.
- Evaluate existing watershed conditions using hydrologic and hydraulic (H&H) models.
- Produce flow, stage, frequency, and duration information along regional waterways.
- Estimate damages associated with regional stormwater problems.
- Evaluate solutions to regional stormwater problems.

Regional problems are defined as problems associated with waterways whose watersheds encompass multiple jurisdictions and drain an area greater than 0.5 square miles. Problems arising from capacity issues on local systems, such as storm sewer systems and minor open channel ditches, even if they drain more than one municipality, were considered local and beyond the scope of a regional stormwater management program. Erosion problems addressed in this plan were limited to active erosion along regional waterways that pose an imminent risk to structures or critical infrastructure. Interstate highways, U.S. highways, state routes, county roads with four or more lanes, and smaller roads providing critical access that are impacted by overbank flooding of regional waterways at depths exceeding 0.5 feet were also considered regional problems.

1.1 Scope and Approach

The Upper Salt Creek DWP scope included data collection and evaluation, H&H modeling, development and evaluation of alternatives, and recommendation of alternatives. The data collection and evaluation task included collection and evaluation of existing H&H models, geospatial data, previous studies, reported problem areas, and other data relevant to the watershed plan. H&H models were developed to produce inundation mapping for existing conditions for the 100-year storm event and to evaluate stormwater improvement project alternatives. Stormwater improvement project alternatives were developed and evaluated to determine their effectiveness in addressing regional stormwater problems. Estimates of damage reduction, or benefits, associated with proposed projects were considered along with conceptual cost estimates and noneconomic criteria to develop a list of recommended improvement projects for the Upper Salt Creek Watershed.

1.2 Data Collection and Evaluation

The data collection and evaluation phase (Phase A) of the DWP focused on obtaining data regarding the watershed and evaluation of the material's acceptability for use. The District contacted all WPC members as well as federal and state agencies and other stakeholders requesting relevant data. Coordination with WPC members to support the DWP took place throughout development of the DWP. Existing and newly developed data was evaluated according to use criteria defined in Chapter 6 of the *Cook County Stormwater Management Plan* (CCSMP), included in Appendix B. Where data was unavailable or insufficient to complete the DWP, additional data was collected. This report includes information on all data collected and evaluated as a part of the Upper Salt Creek DWP development. Table 1.3.1 lists key dates of coordination activities including meetings with WPC members prior to and throughout DWP development.

1.3 Hydrologic and Hydraulic Modeling

This section of the report provides a description of H&H modeling completed to support the DWP development. H&H models were developed for all tributaries within the watershed containing open waterways. The Hydrologic model was developed independent of any past modeling efforts. Data from previously developed models (see Section 1.3.6) in addition to new data that was collected during Phase A was used to support development of the Hydraulic model. Hydraulic model extent was defined based upon the extent of detailed study for effective Flood Insurance Rate Maps (FIRMs). However, revised Digital Flood Insurance Rate Map (DFIRM) data produced by the Federal Emergency Management Agency's (FEMA's) Map Modernization Program was unavailable at the time of model definition. The new models were extended further, where appropriate, to aid evaluation of damages associated with regional stormwater problems. Appendix A includes a comparison of FEMA's revised DFIRM panels with inundation areas developed for DWP modeling purposes. Tables comparing DWP inundation area to FEMA floodplain mapping by community and subwatershed are also included in Appendix A.

H&H models were developed to be consistent with the protocols defined in Chapter 6 of the CCSMP. In numerous instances, models included additional open channel or other drainage facilities not strictly required by Chapter 6, to aid the evaluation of community reported problem areas. Available monitoring data, including USGS stream gauge data, District facility data, information provided by some communities in the Watershed, and high water marks observed following storm events were used to perform model verification and calibration consistent with Chapter 6 guidelines. All H&H modeling data and documentation of the data development are included in the appendices as referenced in the report sections below.

TABLE 1.3.1
Upper Salt Creek DWP WPC Coordination Activities

06-495-5C Upper Salt Creek Detailed Watershed Plan - Phase A - Contract start date		December 1, 2006
07-496-5C Upper Salt Creek Detailed Watershed Plan - Phase B - Contract start date		August 13, 2007
Information Gathering		
Data Request (Forms A and B) sent out as part of Phase A		November 24, 2006
Watershed field visit		December 27, 2007
District phone calls to communities after the September 13^{th} and 14th, 2008 storm event		September 15, 2008
Upper Salt Creek Watershed Planning Council Meetings (12)		
October 18, 2006	January 17, 2007	April 18, 2007
July 18, 2007	October 17, 2007	January 16, 2008
April 16, 2008	July 16, 2008	October 15, 2008
April 15, 2009	July 15, 2009	October 21, 2009
Modeling Results and Alternatives Review Meetings		
Initial Model Review Workshop		April 1, 2008
Preliminary Alternatives and Inundation Map Review Workshop		July 16, 2008
Alternatives and Inundation Map Review Workshop		August 26, 2008
Final Alternatives and Inundation Map Presentation (working session)		April 15, 2009
MWRDGC Board of Commissioners' Study Sessions		January 10, 2006
		April 27, 2006
		October 2, 2008

1.3.1 Model Selection

H&H models were developed within the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) Version 3.3.0 modeling application and Hydrologic Engineering Center-River Analysis System (HEC-RAS) Version 4.0. These applications were identified as acceptable in Tables 6.10 and 6.11 of the CCSMP. The Soil Conservation Service (SCS) curve number (CN) loss module was used with the Clark's Unit Hydrograph methodology within HEC-HMS to model basin hydrology. The dynamic unsteady flow routing methodology was used within HEC-RAS. Both applications have an extensive toolkit to interface with geographic information systems (GIS) software to produce input data and display model results.

1.3.2 Model Setup and Unit Numbering

1.3.2.1 Hydrologic Model Setup

ArcView GIS Version 9.2 served as the primary tool to develop and extract data required for the hydrologic analysis from the available GIS data. Basic GIS functions were utilized to calculate the CN, define the longest flow path, and to determine basin slope and length. HEC-HMS was used to create stormwater runoff hydrographs tributary to the stream branches and reservoirs/detention basins modeled within HEC-RAS. Hydrologic model data was transferred between HEC-HMS and HEC-RAS through HEC-DSS files.

Subbasin Delineation. The entire watershed was subdivided into subbasins ranging from 34 acres to 3091 acres with an average subbasin size of approximately 250 acres, excluding the two very large subbasins directly tributary to the Busse Woods reservoir. These subbasins form the basis of the hydrologic model and were modeled assuming a unified response to rainfall based on land use characteristics and soil type. Elevation data provided by Cook County, described in Section 2.3.4, was the principal data source used for subbasin delineation. Drainage divides were established based upon consideration of the direction of steepest descent from local elevation maxima, and refined in some instances to reflect modifications to topographic drainage patterns caused by stormwater management infrastructure (storm sewer systems, culverts, etc.). Subbasin boundaries were modified to encompass areas with similar development patterns. Finally, boundaries were defined to most accurately represent the area tributary to specific modeled elements, such as constrictions caused by crossings, and reservoirs. GIS data was developed for all subbasins delineated and used for hydrologic model data development.

Runoff Volume Calculation. The SCS CN loss model uses the empirical CN parameter to calculate runoff volumes based on landscape characteristics such as soil type, land cover, imperviousness, and land use development. Areas characterized by saturated or poorly infiltrating soils, or impervious development, have higher CN values, converting a greater portion of rainfall volume into runoff. The SCS methodology uses Equation 1.1 to compute stormwater runoff volume for each time step:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad (1.1)$$

Where:

Q	=	runoff volume (in.)
P	=	precipitation (in.)
S	=	storage coefficient (in.)
I_a	=	initial abstractions (in.)

Rainfall abstractions due to ponding and evapotranspiration can be simulated using an initial abstractions (I_a) parameter. In this DWP, the commonly used default value of I_a, estimated as $0.2 \times S$, where S is the storage coefficient for soil in the subbasin. S is related to CN through Equation 1.2:

$$S = \frac{1000}{CN} - 10 \qquad (1.2)$$

where:

CN	=	curve number (dimensionless)
S	=	storage coefficient (in,)

Table 1.3.2 describes the input data used to develop the CN values throughout the watershed.

TABLE 1.3.2
Description of Curve Number Input Data

Variable Used to Determine CN	Approach for Definition of Variable for Upper Salt Creek Watershed Hydrologic Modeling
Ground cover	Chicago Metropolitan Agency for Planning (CMAP) 2001 land use inventory (v.1.2 2006) is used to define land use. A lookup table was developed to link CMAP categories to categories for which CN values have been estimated.
Soil type	The Natural Resources Conservation Service (NRCS) publishes county soil surveys that include a hydrologic classification of A, B, C, or D. If a soil group's infiltration capacity is affected by a high water table, it is classified as, for instance, "A/D," meaning the drained soil has "A" infiltration characteristics, undrained "D." It was assumed that all of this soil adjacent to the FEMA floodplain was undrained and the other areas were considered drained.
Antecedent moisture condition	Antecedent Moisture Conditions (AMC) reflect the initial soil storage capacity available for rainfall. AMC values used for the modeling were based on calibration procedures, described in Section 1.3.8.

Specific combinations of land use and soil type were linked to CN values using a lookup table based on values recommended in Table 1.3.3 excerpted from *TR-55: Urban Hydrology for Small Watersheds* (U.S. Department of Agriculture [USDA], 1986). The CN matrix includes assumptions about the imperviousness of land use classes, and therefore, percent impervious does not need to be explicitly considered as the SCS runoff volume calculation. Since the CMAP land-use data does not correspond to the categories in Table 1.3.3, a mapping between TR-55 land use categories and CMAP land use categories was necessary. This process is detailed in Appendix C, which includes a technical memorandum detailing the process used to develop CN values for the Upper Salt Creek Watershed. The memorandum was prepared by CH2MHill, a consultant to the District.

Runoff Hydrograph Production.

The runoff volume produced for a subbasin is converted into a basin-specific hydrograph by using a standard unit hydrograph and an estimate of basin time of concentration. The time of concentration is the time it takes for a drop of water to travel from the hydraulically furthest point in a watershed to the outlet. The time of concentration can be estimated as the sum of the travel time for three different segments of flow, split-up by flow type in each subbasin.

The current study used the Clark unit hydrograph method to generate the runoff hydrographs. When this method is used the time of concentration is estimated from Equation 1.3.

$$(T_C + R) = 35.2 \cdot L^{0.39} \cdot S^{0.78} \qquad (1.3)$$

where:

T_c	=	Time of Concentration
R	=	Watershed Storage Coefficient
L	=	Flow path length (mi)

S = Main Channel Slope (ft/mi)

The storage coefficient is determined during calibration of the hydrologic model. Starting values are taken using Equation 1.4.

$$\frac{R}{T_C + R} = C \qquad (1.4)$$

where C is a constant that is determined during the calibration process. Initial values were taken from USGS Water Resources Investigation Report 00-4184.

The two equations are solved simultaneously to determine R and T_c for use in HEC-HMS.

TABLE 1.3.3
Runoff Curve Numbers for Urban Areas

Cover Type and Hydrologic Condition	Avg. % Impervious Area	A	B	C	D
Fully developed urban areas (vegetation established)					
Open Space (lawns, parks, golf courses, cemeteries, etc.)					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50 to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious Areas					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western Desert Urban Areas					
Natural desert landscaping (pervious areas only)		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin barriers		96	96	96	96
Urban Districts					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93

TABLE 1.3.3
Runoff Curve Numbers for Urban Areas

Cover Type and Hydrologic Condition	Avg. % Impervious Area	A	B	C	D
Residential Districts by Average Lot Size					
1/8 acre or less	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing Urban Areas					
Newly Graded Areas (pervious areas only, no vegetation)		77	86	91	94

Note: Average runoff condition, and $I_a = 0.2S$.

Source of table is *TR-55: Urban Hydrology for Small Watersheds* (U.S. Department of Agriculture [USDA], 1986)

Rainfall Data. Observed and design event rainfall data was used to support modeling evaluations for the DWP. Monitored rainfall data is described in Section 2.3.1. Design event rainfall data was obtained from Bulletin 71, *Rainfall Frequency Atlas of the Midwest* (Huff, 1992). Design event rainfall depths obtained from Bulletin 71 were used to support design event modeling performed for existing and proposed conditions assessment.

1.3.3 Storm Duration

A critical-duration analysis was performed to determine the storm duration that generally results in higher water surface estimates for a range of tributary sizes within the Watershed. The 24-hour duration storm was identified as the critical duration. A third quartile storm is recommended for storms of this duration (Huff, 1992). Table 1.3.4 summarizes rainfall depths for the 24-hour duration storm.

TABLE 1.3.4
Rainfall Depths

Recurrence Interval	24-hr Duration Rainfall Depth
2-year	3.04
5-year	3.80
10-year	4.47
25- year	5.51
50- year	6.46
100-year	7.58
500-year	11.00

[a]500-year rainfall depth was determined based on a logarithmic relationship between rainfall depth and recurrence interval.

1.3.4 Areal Reduction Factor

The rainfall depths presented in Table 1.3.4 summarize expected point rainfall accumulation for modeled recurrence intervals. The probability of uniform rainfall across a subwatershed decreases with increasing watershed size. Table 21 of Bulletin 71 relates areal mean rainfall depth to rainfall depth at a point (Huff, 1992). Subwatersheds in the Upper Salt Creek Watershed were not large enough to warrant use of an areal reduction factor.

1.3.5 Hydrologic Routing

Stormwater runoff hydrographs were sometimes routed within HEC-HMS in upstream areas where the resolution of subbasins defined was greater than the hydraulic model extent. In areas where a channel cross section could be identified from topographic data, Muskingum-Cunge routing was performed using the approximate channel geometry from a representative cross section of the modeled hydrologic reach. Where no channel was discernable, a kinematic wave routing was performed.

1.3.6 Hydraulic Model Setup

The hydraulic model was largely completed using data from previously developed models with the addition of new data that was collected as part of this DWP as necessary. Model coverage of the streams within the Watershed was very extensive for both the IDNR HEC-2 (1996) and the DuPage County FEQ (1998) models reviewed during Phase A of the watershed planning process. The steady state HEC-2 hydraulic model used for the most recent FEMA floodplain mapping was selected as the base for the DWP and was converted for use with unsteady flows and extended to meet the CCSMP criteria for sub-basin size. Most tributary models end at detention basins within less than one square mile of the edge of the Watershed. Where necessary the models of some small tributaries were extended to come closer to the edge of the watershed.

Numerous errors in channel reach lengths were found in the original HEC-2 model when overlaid on the aerial photography – and were corrected. Cross-section data used for this model was collected in the late 1980's. As such, some of the base cross sections required field verification or resurveying. All previously surveyed model cross sections were updated in the floodplain using the most recent topographic mapping.

1.3.6.1 Bridges, Culverts, and Hydraulic Structures

Bridges, culverts, and hydraulic structures were surveyed consistent with FEMA mapping protocol as identified in *Guidelines and Specifications for Flood Hazard Mapping Partners*, "Guidance for Aerial Mapping and Surveying" (FEMA 2003). A State of Illinois licensed professional land surveyor certified each location as FEMA compliant. Documentation of certifications is provided in Appendix D. Bridges, culverts, and hydraulic structures were surveyed consistent with the NAVD 1988 datum using 5-centimeter or better GPS procedures (as specified in NGS-58 for local network accuracy) or third-order (or better) differential leveling, or trigonometric leveling for short distances. Ineffective flow areas were placed at cross sections upstream and downstream of crossings, generally assuming a contraction ratio of 1:1 and an expansion ratio of 2:1. Contraction and expansion coefficients generally were increased to 0.3 and 0.5, respectively, at cross sections adjacent to crossings.

1.3.6.2 Cross-Sectional Data

Cross-sectional data was surveyed consistent with FEMA mapping protocol as identified in *Guidelines and Specifications for Flood Hazard Mapping Partners*, "Guidance for Aerial Mapping and Surveying" (FEMA 2003).

All survey work, including survey of cross sections, was certified as compliant to FEMA mapping protocol by a licensed professional land surveyor. Documentation of certifications is provided in Appendix D. Cross sections were surveyed consistent with the North American Vertical Datum, 1988 (NAVD 1988) using 5-centimeter or better GPS procedures (as specified in NGS-58 for local network accuracy) or third-order (or better) differential leveling, or trigonometric leveling for short distances. Cross sections were interpolated at many locations within the hydraulic models, to aid model stability and reduce errors.

In total, 97 cross sections and 43 structures (culverts and bridges) were surveyed. In general, the surveyed sections were in areas where the model was extended past the extent of the existing models (Arlington Heights South Branch, Mainstem Tributary A North, Mainstem Tributaries B and D, West Branch) as well as other areas within the watershed that were a need for more data points between existing cross sections or for verification of data that was in the existing models was identified.

1.3.6.3 Boundary Conditions

The separate tributaries were combined in one model. As a result, only one boundary condition was necessary for the model setup. The downstream boundary condition at the DuPage County line was developed from the flows and stages presented in the current Cook County FIS (2008) for Upper Salt Creek.

1.3.7 Model Run Settings

All hydraulic model simulations were carried out using the fully dynamic, unsteady flow simulation settings within HEC-RAS. The Saint-Venant equations, or the continuity and momentum balance equations for open channel flow, were solved using implicit finite difference scheme. HEC-RAS has the ability to model storage areas and hydraulic connections between storage areas and between stream reaches. The computational time step for model runs varied between 1 and 3 minutes, adjusted as necessary for model stability.

1.3.8 Model Calibration and Verification

Model calibration and verification were performed to ensure that the hydrologic and hydraulic models accurately predict stormwater runoff response for a range of storm magnitudes. As the tributaries were modeled together in one model, the tributaries were calibrated together. Two recent events were used in the calibration: September 13, 2008 and August 19, 2007. These events were selected as the largest in the recent record for which the current land use would still be applicable and for which substantial rainfall data and stream gauge data are available. During the September 2008 event, approximately 9 inches of rainfall fell in 30 hours, which is equivalent to about a 100-year storm event. This event resulted in overbank flooding in several locations within the watershed. During the August 2007 event, approximately 5 inches of rain fell in little more than 24 hours, which is equivalent to an approximately 15-year event and produced water levels in the channels to the tops of banks in many areas.

Two stream flow gauges are available within the Watershed to be used to compare simulated results: at Algonquin Road (also known as the Rolling Meadows gauge) on the Upper Mainstemand at the Busse Woods Dam. Both gauges are located within the Mainstem tributary, one downstream of the Arlington Heights confluence and one downstream of the West Branch confluence. The location of these gauges allowed for separate calibration of the West Branch tributary.

Runoff and stage values were compared to modeled values for the calibration and verification storms. Hydrologic and hydraulic parameters with uncertainty were modified within a reasonable range to better match measured flows and stages.

Initial calibration model results generally over-predicted peak flow rates and stages. Modification to the storage coefficient and curve number estimates, in the hydrologic model, and the roughness coefficient in the hydraulic model, was considered to address the observed differences. Reduction of curve number values was considered the best method of achieving better correspondence between observed and modeled parameters followed closely by the adjustment of the storage coefficient. Adjustment of the curve numbers was done on a watershed wide basis while the determination of the storage coefficient was done separately for the West Branch and the Mainstem/Arlington Heights Branches.

After several iterations, it was determined that the base curve numbers used should be set to those equivalent to the curve numbers represented by the AMC I. A value of $R/(T_c+R)$ of 0.6 for the Mainstem and 0.9 for the West Branch was used to determine the storage coefficient for the Clark Unit hydrograph method and time of concentration as discussed in Section 1.3.2.1.

Detailed calibration results are presented in the subwatershed subsections, including hydrographs and comparisons of stage and flow values.

1.3.9 Flood Inundation Mapping

Flood inundation maps were produced to display the inundation areas associated with the 100-year event. The flood inundation maps were produced by overlaying the results of the hydraulic modeling on the ground elevation model of the watershed, which was derived from Cook County LiDAR data.

1.3.10 Discrepancies between Inundation Mapping and Regulatory Flood Maps

Discrepancies may exist between inundation mapping produced under this DWP and regulatory flood maps. Discrepancies may be the result of updated rainfall data, more detailed topographic information, updated land use data, and differences in modeling methodology. A discussion of discrepancies is included in Appendix A.

1.3.11 Model Review

The hydrologic and hydraulic models developed under this DWP were independently reviewed by Christopher B. Burke Engineering, Ltd (CBBEL). CBBEL's review of the hydrologic models included a general verification of drainage areas, sub-basin divides, and hydrologic model parameters such as Curve Number and Time of Concentration. CBBEL's review of the hydraulic models included a general verification of roughness values, bank stations, ineffective flow areas, hydraulic structures, boundary conditions and connectivity with the hydrologic model output files. A significant recommendation from the independent review was to calibrate the models to a large storm event which occurred in the Upper Salt Creek watershed over the period September 13th to 14th, 2008. This and other recommendations from the independent review have been addressed in the hydrologic and hydraulic models developed to support the Upper Salt Creek DWP.

1.4 Development and Evaluation of Alternatives

1.4.1 Problem Area Identification

Problem area data for the Upper Salt Creek Watershed was generated from two sources. The first was community, agency and stakeholder response data that identified flooding, erosion, water quality, and maintenance issues recognized by the communities to be problems. In addition, problem areas were identified by overlaying the results of H&H modeling on the ground elevation model of the watershed to identify structures at risk of flooding along regional waterways. Modeled flood problems generally corroborated the communities' reported problems; however, in many instances, the model results also showed additional areas at risk of flooding for larger magnitude events. A secondary source of problem area identification was the existing FEMA FIRM panel maps. Areas shown within FEMA floodplain were carefully considered in H&H modeling and communication with communities in order to identify problem areas.

1.4.2 Economic Analysis

1.4.2.1 Flood Damages

Property damages due to flooding were assessed based upon the intersection of inundation areas for modeled recurrence intervals (2-, 5-, 10-, 25-, 50-, and 100-year) with the Cook County parcel data, considering ground elevation data, to calculate estimated flood depths. Damages were estimated using a methodology consistent with one developed by the USACE that estimates structure and contents damage as a fraction of structure value and based upon the estimated depth of flooding (USACE 2003). The general procedure estimating property damage due to flooding is outlined in Appendix F of the CCSMP. This method of damage calculation requires estimating a number of parameters for properties at risk of flooding which are detailed below.

The foundation for property damage values due to flooding is derived from the 2006 Cook County Tax Assessor (CCTA) data multiplied by a standard factor derived from a statistical analysis comparing recent sales data to the CCTA property values. The CCTA data includes tax assessed value of land, improvements, total tax assessed value, structure class (residential single family, multi-family, industrial etc.), number of stories, basement information, land area (square footage), and other data fields not relevant to this study.

1.4.2.2 Identification of Parcels at Risk of Flooding

An initial estimate was made to identify parcels at risk of flooding by using the existing FEMA 100-yr inundation boundary plus a 100-ft buffer to a reasonable upper bound of what might be included in the new flood inundation boundary.

For all parcels within this area a point was placed manually at the low side of the structure as identified from the aerial photographs and topographic mapping. Intersection of the floodplain surface with the location of these points was then performed for each modeled recurrence interval storm and used to identify parcels within the subwatershed that may, based upon their zero-damage elevations, be subject to property damage due to flooding for a particular recurrence interval.

In addition, a second area was developed to identify structures at risk of stream bank erosion by taking the stream centerline and adding a 30-ft buffer to either side.

1.4.2.3 Parcel Zero Damage Elevation

Structures do not incur damage due to flooding until the water surface exceeds the *zero-damage elevation,* at which water is assumed to begin flowing into the structure and cause damages. For most structures, the zero-damage elevation is the ground surface. Floodwaters exceeding the ground surface may enter the structure through doorways, window wells, and other openings within the structure. The zero-damage elevation was assumed to be the ground elevation for all parcels within the Upper Salt Creek Watershed. The ground elevation estimate was obtained at the point representing the parcel, generally on the lower, stream-side of the actual structure.

1.4.2.4 Parcel First Floor Elevation

USACE depth-damage curves relate flooding depths to the first floor elevation of the structure, a value not provided within the CCTA data. First floor elevations (FFE) generally were not surveyed for the Upper Salt Creek DWP, as that would require several hundred field measurements. As an alternative, in each area of significant overbank flooding a sample of field measurements of the FFE offset from ground elevation were collected.. A review of the collected first floor elevations identified a pattern used to predict the FFE based upon general groupings of similar structures in each area. These values varied from 0.5 to 1.5 ft.

1.4.2.5 Structure Estimated Value

The estimated value of flooded structures is an input to damage calculations. The CCTA data included data that identified values for the land value as well as the improvement value (i.e., building, garage, etc.). The values in the CCTA data are assessed valuations of the estimated property value, which require a factor to bring the value, depending on the structure's use, to the CCTA estimation of property value. For example, residential structures receive an assessed valuation of 16 percent, thus the value identified by CCTA is the CCTA estimated value divided by a standardized 0.16. The adjusted CCTA data (reported values divided by the assessed valuation factor) was then compared with recent sales data throughout the county to statistically derive a multiplier that brings the 2006 CCTA estimated value of the properties to 2008 market value of properties. This multiplier was calculated to be 1.66. Since this plan analyzes damage to the structure, the land component of the property value was removed from the analysis by applying the assessed valuation multiplier and the District calculated market value multiplier to the improvement value identified in the CCTA data to produce a value of the structure. This method was used on all property types to generate information to be used in the damage calculations.

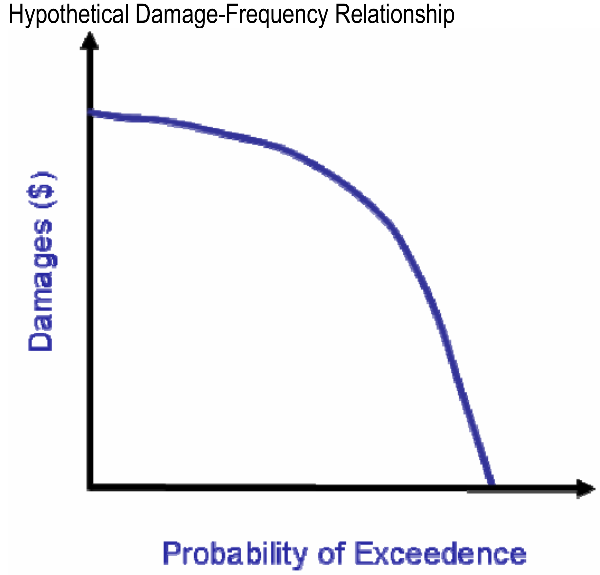
1.4.2.6 Depth-Damage Curves

Six residential depth-damage curves were obtained from the USACE technical guidance memorandum EGM 04-01 (USACE, 2003) to relate estimated structure and contents damage to structure replacement value as a function of flooding depth. These damage curves are one story, two-story, and split-level resident structures, either with or without basements. For nonresidential structures, a depth-damage curve representing the average of structure and contents depth damage curves for a variety of structure types, generated by the Galveston District of the USACE was selected for use. Appendix F contains the depth-damage curves used to calculate property damage due to flooding. CCTA data was analyzed to identify the number of stories on residential structures and the presence or absence of a basement.

1.4.2.7 Property Damage Calculation

The estimated structure value, flooding depth, and depth-damage curve information were used to estimate the property damage from flooding for a specific structure due to a storm of given recurrence interval. Higher magnitude events, such as the 100-year event, cause higher damages for flooded properties but also have a lower likelihood of occurring in a given year. Figure 1.4.1 shows the hypothetical relationship between expected damage and modeled recurrence interval. Estimated annual damages were calculated according to Appendix F of Chapter 6 of the CCSMP, essentially weighting the expected annual damages by their annual probability of occurrence. Damages were then capitalized over a 50-year period of analysis, consistent with the period of analysis over which maintenance and replacement costs were calculated, using the federal discount rate for 2008 of 4.875 percent.

FIGURE 1.4.1
Hypothetical Damage-Frequency Relationship



1.4.2.8 Erosion Damages

Locations of potential erosion risk were identified through community response data. The CCSMP directs that erosion damages be estimated as the full value of structures at "imminent risk" of damage due to stream bank erosion, and that erosion damages not be assessed for loss of land. Field visits to areas identified as erosion problems were performed. No properties or infrastructure were judged to be at imminent risk within the watershed.

1.4.2.9 Transportation Damages

Transportation damage generally was estimated as 15 percent of property damage due to flooding. In some specific instances, significant transportation damages may occur in absence of attendant property damage due to flooding. For the Upper Salt Creek Watershed, specific transportation damages were calculated when flooding fully blocked all access to a specific area in the watershed and these damages were not adequately captured as a fraction of property damages. In such instances, transportation damages were calculated according to FEMA guidance in the document "What Is a Benefit?" (FEMA, 2001). The duration of road closure was estimated for the modeled storms, and transportation damage was calculated according to a value of $32.23 per hour of delay per vehicle based on average traffic counts.

1.4.3 Alternative Development and Evaluation

Potential stormwater improvements, referred to within the DWP as alternatives, were developed using a systematic procedure to screen, develop, and evaluate technologies consistently throughout the Upper Salt Creek Watershed. Tributary-specific technologies were screened and evaluated in consideration of the stormwater problems identified through community response data and modeling. An alternative is defined as a combination of the technologies developed to address the identified stormwater problems.

Alternatives were evaluated with respect to their ability to reduce flooding under existing conditions. The reduction in expected damages for an alternative is called a *benefit.* Conceptual level costs were developed for each alternative using countywide unit cost data that considered expected expenses such as excavation, land-acquisition, pipe costs, channel lining, etc. Standard countywide markups were used to account for the cost of utility relocation, profit, design engineering and construction management costs, and contingency. Expected maintenance and replacement costs were considered over a 50-year design period. Detailed design studies are required to confirm details associated with the feasibility of construction and precise configuration of proposed facilities.

Additional non-economic factors, such as the number of structures protected, the expected water-quality benefit, and the impact on wetland or riparian areas were considered in alternative development and evaluation.

1.4.3.1 Flood Control

Flood control technologies were considered during the development of alternatives for addressing flooding problems, as summarized in Table 1.4.1. After selection of an appropriate technology or technologies for a problem area, and review of information provided by communities and obtained from other sources (such as aerial photography and parcel data) regarding potentially available land, conceptual alternatives were developed.

Hydrologic or hydraulic models for alternative conditions were created to analyze the effect of the conceptual alternatives. Initial model runs were performed to determine whether an alternative significantly affected water surface elevation (WSEL) near the target problem area, or had negative impacts in other parts of the tributary area. For models that resulted in significant reduction in WSEL, a full set of alternative conditions model runs was performed, and expected damages due to flooding were evaluated for the alternative conditions. Benefits were calculated based on damages reduced from existing to proposed conditions.

TABLE 1.4.1
Flood Control Technologies

Flood Control Option	Description	Technology Requirements
Detention/Retention		
Detention facilities (Dry basins)	Impoundments to temporarily store stormwater in normally dry basins.	Open space, available land. Only an upstream option.
Retention facilities (Wet basins)	Impoundments that include a permanent pool which stores stormwater and removes it through infiltration and evaporation. Retention facilities generally have an outfall to the receiving waterway that is located at an elevation above the permanent pool.	Open space, available land. Only an upstream option.
Pumped detention	Similar to detention or retention facilities, but includes a portion of the impoundment which cannot be drained by gravity and must be pumped out.	Open space, available land. Only an upstream option. Best applied when significant area is available to allow for filling only during large storms.
Underground detention	A specialized form of storage where stormwater is detained in underground facilities such as vaults or tunnels. Underground detention may also be pumped.	Space without structures, available land. Only an upstream option. Significantly more expensive than above ground facilities. Surface disruption must be acceptable during construction.
Bioretention	Decentralized microbasins distributed throughout a site or watershed to control runoff close to where it is generated. Runoff is detained in the bioretention facilities and infiltrated into the soil and removed through evapotranspiration.	Open space, multiple available opportunities for various sizes of open space.
Conveyance Improvement		
Culvert/bridge replacement	Enhancement of the hydraulic capacity of culverts or bridges through size increase, roughness reduction, and removal of obstacles (for example, piers).	Applicable only if restricted flow and no negative impact upstream or downstream. May require compensatory storage to prevent negative downstream impact. Permitting requirements and available adjacent land.
Channel improvement	Enhancement of the hydraulic capacity of the channels by enlarging cross sections (for example, floodplain enhancement), reducing roughness (for example, lining), or channel realignment.	No negative upstream or downstream impact of increased conveyance capacity. Permitting requirements and available adjacent land. Permanent and/or construction easements.
Flood Barriers		
Levees	Earth embankments built along rivers and streams to keep flood waters within a channel.	Permitting requirements and available adjacent land. Wide floodplains will be analyzed. Requires 3 feet of freeboard to remove structures behind levees from regulatory floodplain. Often requires compensatory storage.
Floodwalls	Vertical walls typically made of concrete or other hard materials built along rivers and streams to keep flood waters within a channel.	Permitting requirements and available adjacent land. Permanent and/or construction easements.

TABLE 1.4.1
Flood Control Technologies

Flood Control Option	Description	Technology Requirements
Acquisition	Acquisition and demolition of properties in the floodplain to permanently eliminate flood damages. In some cases, acquired property can be used for installation of flood control facilities.	Severe flooding, repetitive losses, other alternatives are not feasible.
Floodproofing		
Elevation	Modification of a structure's foundation to elevate the building above a given flood level. Typically applied to houses.	Severe flooding, repetitive losses, other alternatives are not feasible.
Dry Floodproofing	Installation of impermeable barriers and flood gates along the perimeter of a building to keep flood waters out. Typically deployed around commercial and industrial buildings that cannot be elevated or relocated.	Better suited for basement or shallow flooding. Need the ability to provide closure of openings in walls or levees. Plan for emergency access to permit evacuation.
Wet Floodproofing	Implementation of measures that do not prevent water from entering a building but minimize damages; for example, utility relocation and installation of resistant materials.	Most applicable for larger buildings where content damage due to flooding can be minimized. Waterproofing sealant applied to walls and floors, a floor drain and sump pump.

1.4.3.2 Floodproofing and Acquisition

Alternatives consisting of structural flood control measures may not feasibly provide a 100-year level of protection for all structures. The DWP identifies areas that will experience flooding at the 100-year event, even if recommended alternatives are implemented. Floodproofing and/or acquisition of such structures are nonstructural flood control measures that may reduce or eliminate damages during flood events, which is why these measures are listed in Table 1.4.1. However, due to the localized nature of implementing such solutions, the District may look to address structures that are candidates for nonstructural flood control measures under separate initiatives, outside of the Capital Improvement Program (CIP).

1.4.3.3 Streambank Stabilization

As discussed above, this watershed does not have any structures known to be threatened by erosion and therefore no exclusively streambank stabilization alternatives were considered. Several projects require channel bank modification, however. For these projects streambank stabilization is included as part of the project. A full range of alternative technologies is summarized in Table 1.4.2.

1.4.3.4 Water Quality

The potential effect of alternatives on water quality was considered qualitatively. Most detention basins built for flood control purposes have an ancillary water quality benefit because pollutants in sediment will settle out while water is detained. Sediments can be removed as a part of maintenance of the detention basin, preventing the pollutants from entering the waterway. Detention basins typically have a sediment forebay specifically designed for this purpose. Some detention basins could be designed as created wetland basins with wetland plants included which could naturally remove pollutants and excess nutrients from the basin. Streambank stabilization alternatives can help address water quality problems through reduction of sedimentation.

TABLE 1.4.2
Streambank Stabilization Technologies

Streambank Stabilization Option	Description	Technology Requirements
Natural (vegetated or bioengineered) stabilization	The stabilization and protection of eroding overland flow areas or stream banks with selected vegetation using bioengineering techniques. The practice applies to natural or excavated channels where the stream banks are susceptible to erosion from the action of water, ice, or debris and the problem can be solved using vegetation. Vegetative stabilization is generally applicable where bankfull flow velocity does not exceed 5 ft/sec and soils are more erosion resistant, such as clayey soils. Combinations of the stabilization methods listed below and others may be used.	Requires stream bank slopes flat enough to prevent slope failure based upon underlying soils. Channels with steep banks with no room for expansion or high bank full velocities (> 5 ft/sec) should avoid these technologies.
Vegetating by sodding, seeding, or planting	Establishing permanent vegetative cover to stabilize disturbed or exposed areas. Required in open areas to prevent erosion and provide runoff control. This stabilization method often includes the use of geotextile materials to provide stability until the vegetation is established and able to resist scour and shear forces.	
Vegetated armoring (joint planting)	The insertion of live stakes, trees, shrubs, and other vegetation in the openings or joints between rocks in riprap or articulated block mat (ABM). The object is to reinforce riprap or ABM by establishing roots into the soil. Drainage may also be improved through extracting soil moisture.	
Vegetated cellular grid (erosion blanket)	Lattice-like network of structural material installed with planted vegetation to facilitate the establishment of the vegetation, but not strong enough to armor the slope. Typically involves the use of coconut or plastic mesh fiber (erosion blanket) that may disintegrate over time after the vegetation is established.	
Reinforced grass systems	Similar to the vegetated cellular grid, but the structural coverage is designed to be permanent. The technology can include the use of mats, meshes, interlocking concrete blocks, or the use of geocells containing fill material.	
Live cribwall	Installation of a regular framework of logs, timbers, rock, and woody cuttings to protect an eroding channel bank with structural components consisting of live wood.	
Structural stabilization	Stabilization of eroding stream banks or other areas by use of designed structural measures, such as those described below. Structural stabilization is generally applicable where flow velocities exceed 5 ft/sec or where vegetative stream bank protection is inappropriate.	Applicable to areas with steep stream bank slopes (> 3:1) and no room for channel expansion, or areas with high velocities (> 5 ft/sec) can benefit from this technology.
Interlocking concrete	Interlocking concrete may include A-Jacks®, ABM, or similar structural controls that form a grid or matrix to protect the channel from erosion. A-Jacks armor units may be assembled into a continuous, flexible matrix that provides channel toe protection against high velocity flow. The matrix of A-Jacks can be backfilled with topsoil and vegetated to increase system stability and to provide in-stream habitat. ABM can be used with or without joint planting with vegetation. ABM is available in several sizes and configurations from several manufacturers. The size and configuration of the ABM is determined by the shear	

TABLE 1.4.2
Streambank Stabilization Technologies

Streambank Stabilization Option	Description	Technology Requirements
	forces and site conditions of the channel.	
Riprap	A section of rock placed in the channel or on the channel banks to prevent erosion. Riprap typically is underlain by a sand and geotextile base to provide a foundation for the rock, and to prevent scour behind the rock.	
Gabions	Gabions are wire mesh baskets filled with river stone of specific size to meet the shear forces in a channel. Gabions are used more often in urban areas where space is not available for other stabilization techniques. Gabions can provide stability when designed and installed correctly, but failure more often is sudden rather than gradual.	
Grade Control	A constructed concrete channel designed to convey flow at a high velocity (greater than 5 ft/sec) where other stabilization methods cannot be used. May be suitable in situations where downstream areas can handle the increase in peak flows and there is limited space available for conveyance.	
Concrete channels	Prevent stream bank erosion from excessive discharge velocities where stormwater flows out of a pipe. Outlet stabilization may include any method discussed above.	

2. Watershed Characteristics

2.1 General Watershed Description

Salt Creek is divided into two hydrologic parts by Busse Woods Dam: Upper Salt Creek and Lower Salt Creek. However, for the purposes of the development of this DWP, "Upper Salt Creek" will refer, hereafter, to the Salt Creek stream reaches and tributaries located upstream of the DuPage County/Cook County border. The "Watershed" will refer, hereafter, to the Upper Salt Creek Watershed.

The total Watershed area is approximately 55 square miles. Land use is predominately residential with concentrations of commercial, light manufacturing and trucking facilities. Several large forest preserves are also present, notably Ned Brown Preserve (also known as Busse Woods), Paul Douglas Forest Preserve and Deer Grove Forest Preserve. Figure 1 shows a schematic of the Watershed showing the drainage boundary, stream channels, and municipality boundaries.

Upper Salt Creek is comprised of three branches: the Mainstem, the West Branch, and the Arlington Heights Branch. Starting at the downstream end of the Watershed at the DuPage County/Cook County border, Upper Salt Creek proceeds north to the Ned Brown Preserve and Busse Woods Reservoir. Above the dam that forms the reservoir, Upper Salt Creek divides into two branches – the West Branch and the Mainstem. Following the West Branch upstream, the channel leaves the reservoir heading due west, crossing under Interstate 290 (I-290) and Meacham Road before turning north paralleling Plum Grove Road. The headwaters of the stream are in a small detention pond located just upstream of Roselle Road and south of Interstate 90 (Northwest Tollway). The West Branch has several tributaries, designated (north to south) Tributaries A, 3, 4, 5, 6 and 7.

Just upstream of Algonquin Road is the confluence of the Arlington Heights Branch and the Mainstem. The Arlington Heights Branch parallels I-290 until it crosses Palatine Road, where it turns northwesterly. The headwaters of this branch are located within the Deer Grove Forest Preserve. This branch has a small tributary called the Anderson Drive Tributary that connects to the Arlington Heights Branch upstream of Palatine Road. A small tributary, the South Branch, of the Arlington Heights Branch is near the Branch's headwaters within the Forest Preserve.

From the confluence with the Arlington Heights Branch, the Mainstem heads upstream westerly and northerly until finally splitting into two small tributaries (designated A and B) near Roselle Road. The Mainstem has two other tributaries (designated C and D) that join near where the Mainstem turns northerly.

During the late 1970's and early 1980's a number of flood control reservoirs were constructed within the Watershed: the Busse Woods Dam and Reservoir in 1976, the Tom Hamilton Reservoir in 1981, the Margreth Riemer and Plum Grove Reservoirs in 1984, and the

Saint Michaels and Twin Lakes Reservoirs in 1986. These reservoirs were constructed based on a plan prepared for the NRCS and sponsored by the District, and have a combined active storage capacity of approximately 4000 acre-feet.

Table 2.1.1 lists the municipalities within the Upper Salt Creek Watershed. Table 2.1.2 lists the major streams and tributaries to the Upper Salt Creek and stream lengths. Each stream is briefly described with a narrative in the following subsection.

Table 2.1.1
Municipalities in the Upper Salt Creek Watershed

Municipality	Total Area (square miles)	% of Municipality Area within Upper Salt Creek Watershed	% of Upper Salt Creek Watershed Area by Municipality
Village of Schaumburg	11.2	58.9	20.2
Village of Palatine	11.1	85.4	20.0
FPDCC	7.2	-	13.1
Village of Hoffman Estates	5.5	27.2	10.0
Village of Elk Grove Village	5.3	47.7	9.6
City of Rolling Meadows	4.8	87.3	8.6
Village of Inverness	4.5	69.2	8.2
Palatine Township*	2.5	-	4.6
Village of Arlington Heights	1.5	9.1	2.7
Schaumburg Township*	0.9	4.7	1.6
Elk Grove Township*	0.4	-	0.7
Village of Barrington	0.2	4.1	0.4
Wheeling Township*	0.1	-	0.2
Village of Itasca	<0.1	0.4	<0.1
Village of Deer Park	<0.1	2.7	<0.1
Village of Wood Dale	<0.1	<0.1	<0.1
TOTAL	55.3	-	100%

* Includes only unincorporated portions of townships (excludes FPDCC)

Table 2.1.2
Upper Salt Creek Watershed Open Channel Stream Lengths

Open Channel Name	Length (miles)	Open Channel Name	Length (miles)
Upper Main Stream	13.7	Mainstream D Branch North Tributary	1.1
Arlington Heights Branch	9.3	Arlington Heights Branch South	0.9
West Branch	7.5	Mainstream A Branch North Tributary	0.9
Salt Creek Tributary D	3.0	Anderson Drive Tributary	0.8
West Branch Tributary A	2.2	Salt Creek Tributary B	0.8
Salt Creek Tributary C	2.0	West Branch Tributary 4	0.8
West Branch Tributary 3	1.6	Mainstream D Branch South Tributary	0.6
West Branch Tributary 6	1.6	West Branch Tributary 5	0.5
Salt Creek Tributary A	1.3	Deer Grove Tributary	0.2
West Branch Tributary 7	1.1	West Branch Tributary A South	<0.1
		TOTAL	49.9

Table 2.1.3 lists the subwatersheds each municipality drains to, with subwatersheds listed in decreasing order based upon the area within the municipality. Although municipalities contribute stormwater to the listed subwatersheds, the actual stream may not be included within the municipality's boundaries.

TABLE 2.1.3
Municipality and Subwatersheds within the Municipality Boundary

Municipality	Subwatersheds within Municipality boundary (square miles)
Arlington Heights	Arlington Heights Branch, (0.87), Mainstem (0.64)
Barrington	Arlington Heights Branch, (0.21)
Deer Park	Arlington Heights Branch, (<0.1) [b]
Elk Grove Township[c]	Mainstem(0.39), West Branch (<0.1)[b]
Elk Grove Village	Mainstem(4.26), West Branch (1.04)
FPDCC	Mainstem(5.46), Arlington Heights Branch (1.75), West Branch (<0.1) [b]
Hoffman Estates	Mainstem(3.23), West Branch (2.31)
Itasca	Mainstem(<0.1) [b]
Inverness	Mainstem(4.07), Arlington Heights Branch (0.47)
Palatine	Arlington Heights Branch (7.02), Mainstem(4.06)
Palatine Township[c]	Mainstem(1.3), Arlington Heights Branch (1.23)
Rolling Meadows	Mainstem(2.61), Arlington Heights Branch (2.17)
Schaumburg	West Branch (8.22), Mainstem(2.96)
Schaumburg Township[c]	West Branch (0.58), Mainstem(0.32)
Wheeling Township[c]	Arlington Heights Branch (0.11)
Wood Dale	Mainstem(<0.1)[b]

[a]Subwatersheds are ordered in decreasing order of area within municipality
[b]Less than 0.1 square miles within municipality contributes to subwatershed
[c]Includes only unincorporated portions of townships (excludes FPDCC)

2.2 Stormwater Problem Data

To support DWP development, the District solicited input from stakeholders within the watershed. Municipalities, townships, and countywide, statewide, and national agencies such as Cook County Highway Department (CCHD), Illinois Department of Natural Resources (IDNR), Illinois Department of Transportation (IDOT), and the USACE, for example, were asked to fill out two forms with information to support DWP development. Organizations such as ecosystem partnerships were also contacted by the District as part of this information-gathering effort. Form A included questions on stormwater data and regulations, Form B questions on known flooding, erosion, and stream maintenance problem areas. In addition to problem areas reported by municipalities, townships, public agencies and other stakeholders, results of H&H modeling performed as a part of DWP development identified stormwater problem areas. The H&H modeling process is described in general in Section 1.3 and specifically for each modeled tributary in Chapter 3.

Figure 2.2.1 and Table 2.2.1 summarize the responses to Form B questions as well as other problem area information collected by the District about flooding, erosion, and stream maintenance problem areas. As noted, the scope of the DWP addresses regional problems along open channel waterways. The definition of regional problems was provided in Chapter 1.

Table 2.2.1
Summary of Responses to Form B Questionnaire

ID	Municipality	Problem as Reported by Local Agency	Location	Problem Description	Local/ Regional	Reason for Classification
1	Elk Grove Village	Bank Erosion & Sedimentation	Cypress Lane & Rev. Morrison Boulevard (6 channels from Cypress Lane to Salt Creek)	Channels have become inundated with heavy vegetation, debris, silt, and bank erosion obstructing the conveyance of storm water	Local	5
2	Elk Grove Village	Bank Erosion & Sedimentation	Devon Avenue & Arlington Heights Road, Unincorporated Cook County (Salt Creek / Devon Avenue, north 600 feet)	Severe erosion, slope failure and exposed tree roots along 1,200-foot section of Salt Creek in unincorporated Elk Grove Township	Regional	1
3	Hoffman Estates and Schaumburg	Flooding	Golf Road & Higgins Road	Intersection flooding at Jones and Highland, typically in medium to heavy rainfall events. Study and design completed	Local	5
4	Elk Grove Village	Stream Maintenance	Near intersection of Elmhurst Rd. and Landmeier Rd.	Flooding - Outside of the Watershed	Local	-
5	Palatine Township	Flooding	Plum Grove Estates Neighborhood; Mainstem and Briarwood Lane.	Overbank flooding	Regional	1
6	Hoffman Estates	Stream Maintenance, Streambank Erosion	West Branch Between Apple St. and Basswood St.	Streambank erosion	Regional	1
7	Inverness	Flooding	Upstream of Mainstem Tributary B; 2211 Palatine Rd.	Flooding damaging residence	Local	4
8	Rolling Meadows	Streambank Erosion and Water Quality	Mainstem between Rt. 53 and Rt. 62	Erosion affects downstream water quality	Regional	1
9	Rolling Meadows	Streambank Erosion	Mainstem Tributary C at Kennedy Pond	Erosion	Regional	1
10	Schaumburg	Flooding	Ditch along Tower Rd. and State Parkway	Flooding along roadway median; begins to flood streets and encroaches industrial properties	Local	4
11	Schaumburg	Streambank Erosion	East of Schaumburg Village Hall; including parts of the West Branch and West Branch Tributaries 3 and 5	Erosion	Regional	1

Table 2.2.1
Summary of Responses to Form B Questionnaire

ID	Municipality	Problem as Reported by Local Agency	Location	Problem Description	Local/ Regional	Reason for Classification
12- 13	Cook County Highway Department	Flooding	Various	Flooding - Outside of the Watershed	Local	-
14	Illinois Department of Transportation (IDOT)	Flooding	Route 68 and Route 12	Pavement Flooding - Outside of the Watershed	Local	-
15	IDOT	Flooding	Route 62 at Magnolia Rd.	Pavement Flooding	Local	4
16	IDOT	Flooding	Route 62 at Plume Grove Rd.	Pavement Flooding	Local	4
17	IDOT	Flooding	Route 62 at Meacham Rd.	Pavement Flooding	Local	4
18	IDOT	Flooding	Higgins Rd. and I-290	Pavement Flooding	Local	4
19	IDOT	Flooding	Golf Rd. and Plum Grove Rd.	Pavement Flooding	Local	4
20	IDOT	Flooding	Golf Rd. and Roselle Rd.	Pavement Flooding	Local	4
21	IDOT	Flooding	Higgins Rd. and Roselle Rd.	Pavement Flooding	Local	4
22	IDOT	Flooding	Higgins Rd. and Woodfield Rd.	Pavement Flooding	Local	4
23	IDOT	Flooding	Higgins Rd. and Woodfield Rd.	Pavement Flooding	Local	4
24	IDOT	Flooding	Higgins Rd. at Golf Rd.	Pavement Flooding	Local	4
25	IDOT	Flooding	Palatine Rd. at Ela Rd.	Pavement Flooding	Local	4
26	IDOT	Flooding	Palatine Rd. at Smith Rd.	Pavement Flooding	Local	4
27	IDOT	Flooding	I 290 at Biesterfield Rd.	Pavement Flooding	Local	4

Table 2.2.1
Summary of Responses to Form B Questionnaire

ID	Municipality	Problem as Reported by Local Agency	Location	Problem Description	Local/ Regional	Reason for Classification
28	IDOT	Flooding	I 290 at Devon Ave.	Pavement Flooding	Local	4
29	IDOT	Flooding	IL 53 at US 12	Pavement Flooding - Outside of the Watershed	Local	-
30	IDOT	Flooding	IL 53, US 14 to Euclid Ave.	Pavement Flooding	Local	4
31	IDOT	Flooding	IL 53 at Palatine Rd.	Pavement Flooding - Outside of the Watershed	Local	4
32	IDOT	Flooding	IL 53 at Algonquin Rd.	Pavement Flooding	Local	4
33	IDOT	Flooding	Rand Rd. at Kennicott Ave.	Pavement Flooding - Outside of the Watershed	Local	-
34	IDOT	Flooding	NW Hwy at Sterling Rd. to Baldwin Rd.	Pavement Flooding	Local	4
35	IDOT	Flooding	NW Hwy at Ela Rd.	Pavement Flooding	Local	4
36	IDOT	Flooding	NW Hwy at Dundee Rd.	Pavement Flooding	Local	4
37	IDOT	Flooding	NW Hwy at Euclid Ave. to Ridge Rd.	Pavement Flooding - Outside of the Watershed	Local	-
38	IDOT	Flooding	Hicks Rd. at Rand Rd. to Dundee Rd.	Pavement Flooding - Outside of the Watershed	Local	-
39	IDOT	Flooding	Arlington Heights Rd at IL72	Pavement Flooding - Outside of the Watershed	Local	-
40	IDOT	Flooding	Arlington Heights Rd at I 90	Pavement Flooding - Outside of the Watershed	Local	-
41	Palatine	Flooding	Palanois Park	Combined sewer overflow	Local	5
42	Palatine	Flooding	Winston Park	Flooding – sewer	Local	5
43	Palatine	Flooding	South/ Central Downtown Palatine	Flooding - sewer	Local	5

Table 2.2.1
Summary of Responses to Form B Questionnaire

ID	Municipality	Problem as Reported by Local Agency	Location	Problem Description	Local/ Regional	Reason for Classification
44	Palatine	Flooding	Palatine Rd. at Winston Dr.	Flooding - sewer	Local	5
45	Schaumburg Township	Flooding	Outside of the Watershed	Outside of the Watershed	Local	-
46	Schaumburg	Flooding	Ditch along Tower Rd. and State Parkway	Village performed study and recommended improvements are completed	Local	5
47	Schaumburg	Flooding	Niagara Ave. and Sunset Dr.	Flooding – sewer and overbank	Local	5
48	Elk Grove Village	Flooding	Rev. Morrison Blvd. & Elk Grove Village Blvd.	Drainage ditches overtop, resulting in flooding of the roadways. Village performed study in the 1990's and recommended improvements addressing up to the 10-year flood completed.	Local	5
49	Forest Preserve District of Cook County (FPDCC)	Water Quality	Lake-Cook Rd. and Quentin Rd.	Sump pump discharge into the preserve results in degradation of water and habitat quality	Local	7
50	FPDCC	Water Quality	Woodfield Rd. and Rohlwing Rd.	Runoff from Woodfield Mall discharges into the ditch draining to Busse Reservoir causing erosion and adding sediment and pollution to the reservoir	Local	7
51	FPDCC	Erosion	Hillside Rd. and Ela Rd.	Overland flow into Deer Grove Preserve causes erosion	Regional	6
52	FPDCC	Water Quality	Golf Rd. and I-90	Salt Creek floodwaters are heavily silted causing habitat degradation in Busse Reservoir	Local	7
53	Rolling Meadows	Flooding	Main Stem at Algonquin Road	Street/Surface Flooding -- data from Sept. 2008 rainfall	Regional	1

Table 2.2.1
Summary of Responses to Form B Questionnaire

ID	Municipality	Problem as Reported by Local Agency	Location	Problem Description	Local/ Regional	Reason for Classification
54	Rolling Meadows	Flooding	Arlington Heights Branch north of Central Road	Street/Surface Flooding -- data from Sept. 2008 rainfall	Regional	1
55	Arlington Heights	Flooding	South of Rand Road, east of 53: includes Canterbury Ct, Roanoke Dr, Raleigh St, Suffield Ct, Waverly Ct	Street/Surface Flooding -- data from Sept. 2008 rainfall	Local	4

Reasons for Regional / Local Classifications:
1. Located on an open channel waterway with greater than 0.5 square mile drainage area
2. Roadway culvert (two-lane road)
3. Roadway culvert (greater than two-lane road)
4. Located in headwater area (less than 0.5 square mile drainage area)
5. Located within storm sewer or local drainage system (regardless of drainage area)
6. Erosion does not impact structure(s)
7. No structural/transportation damages associated with problem area

2.3 Watershed Analysis Data

2.3.1 Monitoring Data

2.3.1.1 USGS Gauge Data

The U.S. Geological Survey (USGS) owns and maintains a nationwide network of stream gauges used to record real-time measurements of the monitored stream's water surface elevations. Rating curves developed through periodic paired stage and flow measurements are used to develop rating curves for the stream, relating estimated flow to measured stage.

There are two USGS surface water data monitoring sites within the Upper Salt Creek Watershed: "05530990" at the Mainstem in Rolling Meadows at the Algonquin Road crossing and "05531044" located on the Mainstem at the Busse Woods Dam on Cook County Forest Preserve property. Table 2.3.1 summarizes the data available from these sites.

2.3.1.2 Rainfall Data

The USGS owns and maintains one rainfall gauge within the Upper Salt Creek Watershed – at the Rolling Meadows surface water station. Rainfall data is recorded continuously at 10-minute intervals, processed by the USGS to ensure quality, and available for purchase. USGS rainfall data was obtained for specific gauges and dates to support calibration of the complete Upper Salt Creek model. In addition, the Village of Palatine has recently installed 6 continuous recording gauges, located throughout the village which record on a 10-minute interval, and a real-time weather station is installed atop their Village Hall.

The District maintains a network of rain gauges; however, none are located in the Watershed.

A volunteer organization known as CoCoRahs[1] collects daily rainfall data from more than 11,000 gauges in 35 states. Within the Upper Salt Creek Watershed there are a total 7 gauges. The data from these gauges are collected daily and posted to the web. The volunteer operators receive a modicum of training such that their data is considered reliable by the USGS. Only reported data from gauges that took reliable daily readings were used for the calibration efforts.

Figure 2.3.1 shows locations where rainfall gauge data was available to support the Upper Salt Creek Watershed DWP.

[1] Community Collaborative Rain, Hail and Snow Network, http://www.cocorahs.org/

TABLE 2.3.1
USGS Gauge Data in the Upper Salt Creek Watershed

Description	USGS 5536500		USGS 05537500	
Location	Salt Creek at Rolling Meadows		Salt Creek near Elk Grove Village	
Latitude	42°03'38"		42°01'01"	
Longitude	88°01'00" NAD83		88°00'03" NAD83	
	Cook County, Hydrologic Unit 07120004: Des Plaines Watershed		Cook County, Hydrologic Unit 07120004: Des Plaines Watershed	
Contributing drainage area:	30.50 square miles		51.9 square miles	
Datum of gauge:	686.40 ft above sea level NGVD29		674.75 ft above sea level NGVD29	
Data Type	**Begin Date**	**End Date**	**Begin Date**	**End Date**
Real-time	This is a real-time site.		This is a real-time site.	
Peak stream flow	07/04/1973	05/22/2009	01/13/2005	08/24/2007
Daily Data				
Discharge, cubic feet per second (ft^3/sec)	07/12/1973	06/02/2009		
Gauge height, ft	10/1/1993	06/02/2009	06/15/1992	06/02/2009
Daily Statistics				
Discharge, ft^3/sec	07/12/1973	09/30/2007		
Gauge height, ft	10/01/1993	09/30/2007	06/15/1992	09/17/2007
Monthly Statistics				
Discharge, ft^3/sec	07/1951	09/2007		
Gauge height, ft	10/1993	09/2007	06/1992	09/2007
Annual Statistics				
Discharge, ft^3/sec	1973	2007		
Gauge height, ft	1994	2007	1992	2007
Field/lab water quality samples	10/02/1974	07/12/1989	04/27/1995	05/07/2009

2.3.1.3 Stage Data

Stage data is available at both gauges discussed in Section 2.3.1.1. In addition, stage data is taken manually at all of the District flood control structures during storm events. Figure 2.3.1 shows locations where monitoring data was available to support the Upper Salt Creek Watershed DWP. Thiessen polygons, which divide the watershed into areas closest to each available rain gauge, are also shown on Figure 2.3.1.

2.3.2 Subwatershed Delineation

The Upper Salt Creek Watershed was divided into subwatersheds representing areas tributary to the waterways in the study area. Elevation data provided by Cook County, described further in Section 2.3.4, was the principal data source used for subwatershed delineation. Drainage divides were established based upon consideration of the direction of steepest descent from local elevation maxima.

Following the definition of subwatersheds, tributaries studied in detail were divided into smaller subbasins, represented in the hydrologic model as having a unified response to rainfall. The size of subbasins varied based upon the drainage network density and proximity to the hydraulically modeled waterway. Subbasin boundaries were modified to generally encompass areas with similar development patterns. Boundaries were defined to most accurately represent the actual area tributary to specific modeled elements, such as constrictions caused by road crossings, reservoirs and larger detention basins, etc.

Figure 2.3.2 shows the subwatersheds and subbasins developed for the DWP.

2.3.3 Drainage Network

The principal waterways of the Upper Salt Creek Watershed were defined during Phase A of the watershed study. Initial identification of the stream centerline was made using planimetry data obtained from Cook County. Stream centerlines were reviewed against aerial photography and Cook County contour data at a 1:500 scale, and modified to best represent existing conditions. These streamlines were included in the topographic model of the Upper Salt Creek Watershed (see Section 2.3.4), and collect runoff from upland drainage areas. Secondary drainageways that were not modeled were identified based upon review of contour data. These secondary drainageways were used to help define flow paths in the hydrologic models for individual tributaries. Figure 2.3.3 shows the major drainageways within the Upper Salt Creek Watershed superimposed upon an elevation map of the watershed.

2.3.4 Topography and Benchmarks

Topographic data for the Upper Salt Creek watershed was developed from Cook County light detection and ranging (LiDAR) data generated from a 2003 LiDAR mission (Cook County, 2003). The LiDAR data was obtained along with break lines from Cook County. A digital elevation model (DEM) was developed for the Upper Salt Creek Watershed model based upon these elevation points. Figure 2.3.3 shows elevations within the watershed.

Stream channel cross section and stream crossing structure (such as bridge and culvert) topographic data needed to extend or supplement the existing modeling was collected during field survey work conducted primarily between November 2007 and January 2008 to support the DWP.

Rather than use an established network of benchmarks, the horizontal and vertical ground control was established by GPS technology that meets the specifications of the Federal Geodetic Control Subcommittee (FGCS) Second Order Class One and the accuracy standards specified in FEMA's *Guidelines and Specifications for Flood Hazard Mapping,* "Guidance for Aerial Mapping" (FEMA 2003).

2.3.5 Soil Classifications

NRCS soil data representative of 2002 conditions was obtained for Cook County except for unmapped areas (which include the City of Chicago and some portions of nearby communities). Peotone silty clay loam is the predominating soil type in the study area. Other types of silt loams and urban altered soils are also found in the watershed.

The NRCS soil data includes hydrologic soil group, representing the minimum infiltration rate of the soil after wetting. Table 2.3.2 summarizes the hydrologic soil groups.

TABLE 2.3.2
Hydrologic Soil Groups

Hydrologic Soil Group	Description	Texture	Infiltration Rates (in./hr)
A	Low runoff potential and high infiltration rates even when wetted	Sand, loamy sand, or sandy loam	> 0.30
B	Moderate infiltration rates when wetted	Silt loam or loam	0.15–0.30
C	Low infiltration rates when wetted	Sandy or silty clay loam	0.05–0.15
D	High runoff potential and very low infiltration when wetted	Clay loam, silty clay loam, sandy clay, silty clay, or clay	0–0.05

All data from *Technical Release 55, Urban Hydrology for Small Watersheds*, NRCS, June 1986

Soil groups with drainage characteristics affected by a high water table are classified uniformly as Group D. Table 2.3.3 summarizes the distribution of hydrologic soil type throughout the Upper Salt Creek Watershed. Figure 2.3.4 shows the distribution of soil types throughout the watershed.

TABLE 2.3.3
Hydrologic Soil Group Distribution

Hydrologic Soil Group	Acres	Acres Assumed D (% of total)	% of Upper Salt Creek Watershed
Open Water	876	231 ac. (73.64%)	2.9
A	1262	-	0
A/D	4871	2323 ac. (52.31%)	2.47
B	27213	-	3.56
B/D	11	7.7 ac. (27.40%)	13.74
C	193	-	76.74
D	1034	-	0.55

2.3.6 Land Use

Land use has a significant effect on basin hydrology, affecting the volume of runoff produced by a given area and the speed of runoff delivered to the receiving system. Impervious areas restrict infiltration and produce more runoff, which is often delivered to receiving systems more rapidly through storm sewer networks. Land use was one of two principal inputs into the calculation of CN for the Upper Salt Creek Watershed, detailed more extensively in Section 1.3.2.

A 2001 land use inventory for the Chicago metropolitan area was received from CMAP in GIS format. The data was used to characterize existing conditions land use within the Upper Salt Creek Watershed. The data include 49 land use classifications, grouped into seven general categories for summarizing land use within the DWP. Table 2.3.4 summarizes the land use distribution within the Upper Salt Creek Watershed. Figure 2.3.5 shows the distribution of general land use categories throughout the watershed.

TABLE 2.3.4
Land Use Distribution within the Upper Salt Creek Watershed

Land Use Type	Area (mi^2)	Area (%)
Residential	27	49
Forest/Open Land	11	20
Commercial/Industrial	7	12
Vacant/Under Const.	3	5
Institutional	3	5
Transportation/Utility	2	3
Water/Wetland	2	3
Industrial/Warehousing	1	1
Agricultural	1	1

2.3.7 Anticipated Development and Future Conditions

Anticipated development within the Upper Salt Creek Watershed was analyzed using population projection data. Projected future conditions land use data for the Upper Salt Creek Watershed are unavailable from CMAP or other regional agencies. Projected 2030 population data for Cook County was obtained from CMAP. Population data was overlaid upon subwatershed boundaries to identify the potential for increases in subwatershed populations. Table 2.3.5 shows subwatersheds with a projected population increase from the year 2000 population. Projected increases in population along with current subwatershed land use conditions make it possible that there will also be a corresponding increase in impervious surface area. This potential change in impervious surface area could contribute to higher flow rates and volumes of stormwater runoff drained by those tributaries.

Management of future development may be regulated through both local ordinances and the WMO as described below in Section 2.3.9. This regulation would be an effort to prevent an increase in peak flows, via the construction of site-specific stormwater controls. The impact of the modified hydrologic and hydraulic characteristics of the subwatersheds due to changing land use over time may require the recommended projects to be re-evaluated under the conditions at the time of implementation to refine the details of the final design. To accomplish this, it is recommended that at the time projects are implemented, if updated land use and topographic information is available, the H&H models be rerun incorporating this new data.

TABLE 2.3.5
Projected Population Increase by Subwatershed

Name	2000 Population	2030 Population	% Change	Population Change
Mainstem	77,800	80,200	3	2,400
West Branch	47,800	50,200	5	2,400
Arlington Heights Branch	46,200	48,700	5	2,500

While population is expected to increase in the area, the open space is limited and the projected development increase is not expected to affect hydrology.

2.3.8 Wetland and Riparian Areas

Wetland areas within the Upper Salt Creek Watershed were identified using National Wetlands Inventory (NWI) mapping. NWI data includes approximately 3.4 square miles of wetland areas in the Upper Salt Creek Watershed. Riparian areas are defined as vegetated areas between aquatic and upland ecosystems adjacent to a waterway or body of water that provide flood management, habitat, and water quality enhancement. Identified riparian areas defined as part of the DWP offer potential opportunities for restoration. Figures 2.3.6 and 2.3.7 contain mapping of wetland and riparian areas in the Upper Salt Creek Watershed.

2.3.9 Management of Future Conditions through the regulations of Site Stormwater Management

The District regulates the discharge of stormwater runoff from development projects located within separate sewer areas within the District's corporate boundaries through its Sewer Permit Ordinance. Currently, development projects meeting certain thresholds must provide stormwater detention in an effort to equate the post-development flow rate to the predevelopment flow rate. A number of communities enforce standards beyond the District's currently required standards and thresholds. This DWP supports the continued regulation of future development through countywide stormwater management.

The Cook County Watershed Management Ordinance (WMO) is under development and is proposed to provide uniform, minimum, countywide standards for site stormwater runoff for events up to and including the 100-year event that are appropriate for Cook County. This effort seeks to prevent post-development flows from exceeding pre-development conditions.. The WMO is proposed to be a comprehensive ordinance addressing site runoff, floodplains, floodways, wetlands, soil erosion and sedimentation, water quality, and riparian environments.

3. Tributary Characteristics and Analysis

3.1 Upper Salt Creek Mainstem

The Mainstem of Upper Salt Creek is a natural waterway through the central part of the watershed. The creek and its tributaries are about 27.5 miles long and they drain an area of 29.3 square miles. Table 3.1.1 lists the communities draining to the Upper Salt Creek Mainstem watershed.

TABLE 3.1.1
Communities Draining to Mainstem

Community	Tributary Area (mi^2)
Unincorporated/Forest Preserve	7.47
Elk Grove Village	4.26
Inverness	4.07
Palatine	4.06
Hoffman Estates	3.23
Schaumburg	2.96
Rolling Meadows	2.61
Arlington Heights	0.64
Itasca	0.02
Wood Dale	>0.01

Between 1974 and 1984, four large flood control reservoirs were constructed in the subwatershed providing approximately 3,000 acre-feet of flood storage. Four reservoirs, Busse Woods, Plum Grove, St. Michael, and Margreth Riemer, were constructed based on a plan prepared by the NRCS and sponsored by the District.

Busse Woods Reservoir was constructed at the confluence of the Mainstem and the West Branch within the Ned Brown Preserve of the FPDCC. The reservoir is formed by an earthen dam approximately 20 feet high and about 1,000 feet long. Discharge from the reservoir is controlled by a concrete overflow structure with a crest length of 80 feet. The surface area of the reservoir at normal pool level is 590 acres.

Plum Grove Reservoir is located along Tributary C of the Mainstem in the Village of Palatine and the City of Rolling Meadows and has a tributary area of about 1,240 acres. The reservoir is formed by an earthen dam 25 feet high and approximately 2,700 feet long. Discharge from the reservoir is controlled by a hooded riser spillway of standard Soil Conservation Service (SCS) design. The spillway discharges to a 42-inch diameter culvert pipe through the embankment. Energy dissipation at the downstream end of the culvert is provided by a standard United States Bureau of Reclamation (USBR) Type VI structure. Emergency overflows are accommodated in an earthen spillway in the left abutment of the dam.

Saint Michael Reservoir is located along Tributary D of the Mainstem in the Village of Schaumburg and the City of Rolling Meadows and has a tributary area of about 2,420 acres. The reservoir is formed by an earthen dam 20 feet high and approximately 4,800 feet long. The service spillway arrangement is nearly identical to that at the Plum Grove Reservoir discussed above. The emergency spillway is located on the right abutment of the dam.

The Margreth Riemer Reservoir is located along the Mainstem in the Village of Palatine and has a tributary area of 3,400 acres. The basin is divided into two pools, the main west pool and a smaller east pool connected by a 48-inch diameter equalizer pipe. The bypass control structure has been modified from the original design to force water into the reservoir more frequently than originally designed.

TABLE 3.1.2
Land Use Distribution for Mainstem

Land Use	Acres	%
Residential	8983.6	47.9
Open Land	5046.1	26.9
Commercial	2078.5	11.1
Industrial	777.4	4.1
Water	706.4	3.8
Transportation	520.3	2.8
Meadow	282.8	1.5
Agricultural	273.1	1.5
Disturbed/ Transitional	94.4	0.5

Table 3.1.2 lists the land use breakdown by area within the Upper Salt Creek Mainstem subwatershed. Figures 3.1.1a and 3.1.1b provide an overview of the tributary area of the subwatershed. Reported stormwater problem areas and proposed alternative projects are also shown on the figure and are discussed in the following subsections.

3.1.1 Sources of Data

3.1.1.1 Previous Studies

Since the mid-1950's numerous public organizations have produced reports describing flooding in the Watershed and have developed possible solutions. All of the reports discussed below evaluate either the entire Upper Salt Creek Watershed (Mainstem, Arlington Heights Branch and West Branch subwatersheds) or a smaller part of it. Ultimately, all three subwatersheds join as one at the Busse Woods Reservoir so all reports are relevant for the Mainstem subwatershed.

IDNR. From about 1955 to the present, the Illinois Department of Natural Resources (IDNR) produced a number of flood control reports focused on Upper Salt Creek:

Survey Report for Flood Control – Salt Creek	1955
Report on Plan for Flood Control and Drainage – Salt Creek	1958
Survey Report – Busse Woods Forest Preserve Reservoir	1963
Report for Flood Control and Drainage Development	1965
Supplemental Report - Report for Flood Control and Drainage Development	1967
Feasibility Report on Drainage Development – West Branch	1972
Upper Salt Creek Watershed Management Plan	1979

These reports are primarily of historical interest, as land use and design rainfall amounts have changed significantly in the interim. They are available in the IDNR Office of Water Resources library in Springfield, Illinois.

USGS. The USGS has been investigating real-time flood control on Salt Creek, including Upper Salt Creek. Two papers have been produced summarizing the work performed by the USGS, including:

Modeling System for Near Real-time Flood Simulation for Salt Creek	1998
NEXRAD and Rainfall-Gauge Precipitation Inputs for Near Real-Time Flood Simulation of Salt Creek	2003

United States Department of Agriculture (USDA). During the late 1960's and early 1970's the USDA performed two studies within the Watershed, including:

Preliminary Investigation Report – Salt Creek Watershed	1968
Watershed Work Plan	1971

These documents are also of historical interest only. If needed, they are also available in the IDNR Office of Water Resources library in Springfield.

Chicago Metropolitan Agency for Planning (CMAP – formerly NIPC). CMAP has produced numerous reports over the years addressing flood control issues in Northeast Illinois. Two reports with particular applicability to Upper Salt Creek are summarized below.

"Evaluation of Stormwater Detention Effectiveness in Northeastern Illinois" (CMAP, 1989): CMAP developed LANDS and Full Equations (FEQ) models of the Watershed to evaluate the effectiveness of detention in preventing increases in instream flow rates at the watershed scale. In the study, it was concluded that detention designed using the CMAP two-year and 100-year release rates would prevent increases for typical northeastern Illinois watersheds up to at least 30 square miles.

"Investigation of Hydrologic Design Methods for Urban Development in Northeastern Illinois" (CMAP, 1991): As part of this study HSPF (successor to LANDS) was calibrated to the Upper Salt Creek (Algonquin Road gauge) and the Lower Salt Creek (Wolf Road gauge) watersheds. The calibrated model was then used to evaluate the various design storm methods used to size detention basins. In the report, it was concluded that the modified rational formula underestimates required detention volumes and that hydrograph methods such as TR-20 and ILLUDAS overpredict detention volumes under some circumstances and underpredict for others. A detention sizing chart was developed using the HSPF model and continuous rainfall-runoff simulations to provide an easy-to-use method for detention sizing. The chart (and variations for different release rates) has been included in DuPage and Lake County stormwater ordinances.

Metropolitan Water Reclamation District of Greater Chicago (District). The District, in association with NRCS, the North Cook County Soil and Water Conservation District (SWCD), the Forest Preserve District of Cook County (FPDCC), the State of Illinois, and the local municipalities and park districts, produced the "Upper Salt Creek Watershed Floodwater Management Plan" (1973). This report led to the construction of the Watershed reservoir system and the construction of the reservoirs described above.

DuPage County. DuPage County has prepared numerous reports on flood forecasting, model calibration, project evaluation, and methods of using continuous simulation and dynamic flood routing for establishing floodplain limits. Three reports that are specific to the Watershed are described below.

"Hydrologic Calibration of HSPF Model for DuPage County" (1994): This study established countywide HSPF model parameters for use in DuPage County. The Salt Creek stream gauge at Algonquin Road, which is located within the Watershed, was one of five calibration points used for the countywide calibration.

"Meteorologic Database Extension and Hydrologic Model Verification of HSPF Model for DuPage County" (1994): The countywide HSPF model was verified at seven streamflow gauges that were not used in the original 1994 calibration. The meteorologic database and runoff simulation were extended from water year 1988 through water year 1993.

"Hydraulic Evaluation of HSPF Model for Upper Salt Creek Watershed" (Conservation Design Forum, 2005): The HSPF and FEQ models were verified for simulation through water year 1996. During this effort, it was found that the 1985 land cover data within Cook County required significant adjustment to achieve an acceptable model calibration at the Algonquin Road and Busse Woods streamflow gauges. Using impervious cover as a calibration parameter for the Cook County simulation, the impervious land cover had to be increased from 17% to 36%. This suggests that the 1985 land cover in the FEQ model needs significant updating.

3.1.1.2 Water Quality Data

Water quality data for the Watershed were collected from IEPA and CMAP.

Monitoring Data. The IEPA (STOrage and RETrieval) STORET database contains water quality data collected as part of the Ambient Water Quality Monitoring Network (AWQMN) program. Two Salt Creek AWQMN segments are present within northern Cook County, segments GL and GL-10. Segment GL represents the upper portion of the Watershed between the headwaters in Inverness and Busse Woods. Segment GL-10 extends from Busse Woods downstream into DuPage County and a portion of this segment is located within the Watershed. Additionally, Busse Woods Reservoir, the 590-acre lake within the Ned Brown Preserve, contains multiple sampling locations identified in the STORET database with the prefix RGZX.

The STORET database was used to search for water quality data pertaining to dissolved oxygen, nitrite plus nitrate nitrogen, total phosphorus, ammonia nitrogen, unionized ammonia nitrogen (unionized ammonia), dissolved copper, dissolved zinc, and dissolved lead between 1990 and 2007 within the Watershed. This data search yielded no results for dissolved copper, zinc, or lead, but yielded more than 400 samples for the remaining parameters.

The mean dissolved oxygen concentration in Salt Creek was 7.38 mg/L, while in Busse Reservoir it was 8.76 mg/L. No dissolved oxygen sample from either location was below 5.00 mg/L, the Illinois Water Quality Standard.

The mean nitrite plus nitrate concentration was 8.71 mg/L in Salt Creek, with a range of 1.20 to 13.20 mg/L. Ammonia concentrations were much lower, with a mean of 0.09 mg/L and a range of 0.01 to 0.18 mg/L. Busse Reservoir had a mean nitrite plus nitrate concentration of 0.12 mg/L (range of 0.01 to 0.40 mg/L) and a mean ammonia concentration of 0.15 mg/L (range of 0.01 to 0.63 mg/L). Although no Illinois Water Quality Standard exists for nitrogen concentrations, a nitrite plus nitrate concentration exceeding 7.8 mg/L qualifies as impaired under IEPA guidelines, and Salt Creek has exceeded this limit during many collections. No samples exceeded the Illinois Water Quality Standard for ammonia (15.0 mg/L). Unionized ammonia concentrations were much lower at both sampling locations. In Salt Creek, the mean unionized ammonia concentration was 0.00093 mg/L with a range of 0.00007 to 0.00190 mg/L, while the mean concentration in Busse Reservoir was 0.01061 mg/L with a range of 0.00060 to 0.05518 mg/L.

Phosphorus samples were collected at the same locations as dissolved oxygen, nitrogen, and ammonia samples. The mean phosphorus concentration in Salt Creek was 2.58 mg/L, with a range of 0.28 to 3.9 mg/L. In Busse Reservoir, the mean concentration was 0.06 mg/L, with a range of 0.03 to 0.09 mg/L. There is an Illinois Water Quality Standard of 0.05 mg/L for phosphorus which pertains only to lakes greater than 20 acres. Multiple samples in Busse Reservoir exceeded the 0.05 mg/L limit. Although no standards exist for streams, a phosphorus concentration greater than 0.61 mg/L qualifies as an impairment under IEPA guidelines, and Salt Creek exceeded this value during the majority of the collections.

National Pollutant Discharge Elimination System (NPDES) Permit. There are no permitted point source discharges within the subwatershed.

Municipalities discharging to the Mainstem are regulated by IEPA's NPDES Phase II Stormwater Permit Program, which was created to improve the water quality of stormwater runoff from urban areas, and requires that municipalities obtain permits for discharging stormwater and implement the six minimum control measures for limiting runoff pollution to receiving systems.

Impaired Waterways. The 2006 IEPA *Illinois Integrated Water Quality Report and Section 303(d) List* was used to determine the 303(d) status of Upper Salt Creek. Upper Salt Creek was assessed under the 303(d) program at segment GL and segment GL-10; both locations are included on the impaired waterways list. Busse Woods Reservoir is also listed as an impaired waterway. The entirety of Upper Salt Creek is categorized as 'Not Supporting' for aquatic life, fish consumption, and primary contact uses. The 303(d) report lists ten impairments for segment GL and eleven for GL-10. General categories of impairments at both segments include channel alteration, high nutrient concentrations, and pollutant loading. Busse Woods Reservoir achieves 'Full Support' for aquatic life use, but does not support fish consumption use. Impairments at the lake include PCB contamination and algae growth.

Total Maximum Daily Loads (TMDLs). The Salt Creek Watershed was assessed by the EPA's TMDL program. A TMDL study was conducted for the entire Salt Creek Watershed and published in 2004. The TMDL report concluded an 8 percent reduction in chloride load, a 56 percent reduction in Carbonaceous Biochemical Oxygen Demand (CBOD) load, and a 38 percent reduction in ammonia nitrogen load are needed to meet the maximum daily load of Salt Creek. The report lists high nutrient concentrations (from runoff, wastewater treatment plant effluent, and storm sewer overflow discharges), high CBOD, and impoundments as major causes of low dissolved oxygen concentrations.

3.1.1.3 Wetland and Riparian Areas

Figures 2.3.8.1 and 2.3.8.2 contain mapping of wetland and riparian areas, respectively, in the Upper Salt Creek Watershed. Wetland areas were identified using National Wetlands Inventory (NWI) mapping in addition to observations made in the field during site visits. NWI data includes roughly 19,000 acres of wetland areas in the Mainstem subwatershed. Riparian areas are defined as vegetated areas between aquatic and upland ecosystems adjacent to a waterway or body of water that provides flood management, habitat, and water quality enhancement. Identified riparian environments offer potential opportunities for restoration.

3.1.1.4 Floodplain Mapping

Flood inundation areas supporting the NFIP were revised in 2008 as a part of FEMA's Map Modernization Program. Floodplain boundaries were revised based upon updated Cook County topographic information, but the effective models, which are used to estimate flood levels, generally were not updated. LOMRs were incorporated in the revised floodplains. The entire Upper Salt Creek Watershed is mapped in detail in the DFIRM mapping update. Appendix A includes a comparison of FEMA's effective floodplain mapping from updated DFIRM panels with inundation areas developed for the DWP.

3.1.1.5 Stormwater Problem Data

Table 3.1.3 summarizes reported problem areas reviewed as a part of the DWP development. The problem area data was obtained primarily from Form B questionnaire responses provided by watershed communities to the District. Problems are classified in Table 3.1.3 as regional or local. This classification is based on a process described in Section 2.2 of this report.

3.1.1.6 Near Term Planned Projects

This subwatershed does not contain any known near-term planned projects.

TABLE 3.1.3
Community Response Data for Upper Salt Creek Mainstem

Prob. ID	Municipality	Problems as reported by local agency	Location	Problem Description	Local/ Regional	Resolution in DWP
1	Elk Grove Village	Bank Erosion & Sedimentation	Cypress Lane & Rev. Morrison Boulevard	Channels inundated with heavy vegetation, debris, silt, and bank erosion.	Local	This is a local problem because the channels are small drainage ditches.
2	Elk Grove Village	Bank Erosion & Sedimentation	Devon Avenue & Arlington Heights Road, Unincorporated Cook County	Severe erosion, slope failure and exposed tree roots along 1,200 foot-section of Salt Creek in unincorporated Elk Grove Township.	Regional	Erosion problem does not threaten structures, not addressed by DWP.
3	Hoffman Estates and Schaumburg	Flooding	Golf Road & Higgins Road	Intersection flooding at Jones and Highland. Study and design completed.	Local	Problem not located on a regional waterway. This is a local problem.
5	Palatine Township	Flooding	Plum Grove Estates Neighborhood; at Briarwood Lane	Overbank flooding	Regional	Project SCUP-05 was evaluated but did not effectively reduce flood elevations. Properties at risk of flooding are candidates for protection using nonstructural flood control measures such as floodproofing and acquisition.
7	Inverness	Flooding	Upstream of Tributary B; 2211 Palatine Rd	Overbank flooding	Local	This is located in an area draining less than 0.5 sq mi– thus it is a local problem.
8	Rolling Meadows	Streambank Erosion & Water Quality	Between Rt. 53 and Rt. 62	Erosion affects downstream water quality.	Regional	Erosion problem does not threaten structures, not addressed by DWP.
9	Rolling Meadows	Streambank Erosion	Tributary C at Kennedy Pond	Erosion	Regional	Erosion problem does not threaten structures, not addressed by DWP.
15 - 18, 23, 25 - 28, 32	IDOT	Flooding	Various	Pavement flooding	Local	Problems not located on a regional waterway. These are local problems.
43	Palatine	Flooding	South/ Central Downtown Palatine	Flooding – sewer	Local	Problem not located on a regional waterway. This is a local storm-sewer problem.
48	Elk Grove Village	Flooding	Rev. Morrison Blvd & Elk Grove Village Blvd.	Drainage ditches overtop, resulting in flooding of roadways. Village performed study in 1990's and recommended improvements completed	Local	Problem not located on a regional waterway. This is a local storm-sewer problem. Problem does not include flooding that causes regional transportation damages.
50	FPDCC	Erosion	Woodfield Rd. and Rohlwing Rd.	Erosion and sedimentation	Local	Erosion problem does not threaten structures, not addressed by DWP.

TABLE 3.1.3
Community Response Data for Upper Salt Creek Mainstem

Prob. ID	Municipal-ity	Problems as reported by local agency	Location	Problem Description	Local/ Regional	Resolution in DWP
52	FPDCC	Water Quality	Golf Rd. and I-90	Sedimentation	Local	No flooding or erosion damages to structures associated with this problem area, not addressed by DWP.
53	Rolling Meadows	Flooding	Main Stem at Algonquin Road	Street/Surface Flooding -- data from Sept. 2008 rain-fall	Regional	Model results did not confirm roadway or structure flooding due to a regional problem in this area. The observed flooding may have been the result of debris accumu-lation on the upstream side of the Algonquin Road bridge.

3.1.2 Watershed Analysis

3.1.2.1 Hydrologic Model Development

Subbasin Delineation. The Mainstem subwatershed was delineated based upon LiDAR topographic data developed by Cook County in 2003. Sixty-two subbasins were delineated for the area, with an average subbasin area of 302 acres (221 acres not including the two large subbasins directly tributary to the Busse Woods reservoir) and a total drainage area of 29.3 square miles.

Hydrologic Parameter Calculations. Curve Numbers were estimated for each subbasin based upon NRCS soil data and 2001 CMAP land use data. This method is further described in Section 1.3.2, with lookup values for specific combinations of land use and soil data presented in Appendix C. An area-weighted average of the CN was generated for each subbasin.

Appendix G provides a summary of the hydrologic parameters used for subbasins in each subwatershed.

The time of concentration and storage coefficient were determined as discussed in Section 1.3.2.1.

3.1.2.2 Hydraulic Model Development

Field Data, Investigation, and Existing Model Data. The computer modeling used to develop the original Flood Insurance Study (FIS) flood profiles was done by FEMA using TR-20 for the hydrology and WSP-2 for the hydraulics and dates from 1972 to 1976.

In 1983, the Illinois Department of Transportation (IDOT) Office of Water Resources (now part of IDNR) developed a small, 10-branch, unsteady flow model of the Watershed upstream of the Busse Woods Reservoir. HSPF was used for the hydrology modeling and FEQ for the hydraulics modeling.

In 1988, IDNR contracted to obtain more data (e.g., cross sections and structure data) in anticipation of creating completely new models of the Watershed. By 1996 this modeling had been completed using HEC-1 for the hydrology and HEC-2 for the hydraulics. All of the main channels and tributaries were modeled. These models are the basis for the current FEMA regulatory mapping.

Subsequently in 1998, a more comprehensive FEQ model of Upper Salt Creek was constructed by DuPage County based on the data contained in the HEC-1/HEC-2 models. The stream channel coverage of the two models is identical. The purpose of this new model is to provide more accurate inflows to DuPage County's Lower Salt Creek model and to study possible modifications to the Busse Woods Dam spillway. The model is also utilized as a part of the USGS plan to provide near real-time flood simulation of Salt Creek in order to provide more accurate flood forecasts and to allow more efficient operation of the Elmhurst Quarry Flood Control Project in DuPage County.

The HEC-2 model created by the IDNR in 1996 was used as the base model for the HEC-RAS model developed as part of this DWP. The geometry of the HEC-2 model was imported into HEC-RAS and aligned over the project area using current aerial photography, available HEC-2 model documentation, and the FIS profiles as a check. Reach lengths between cross sections were adjusted proportionally where necessary based on known river lengths between bounding bridge sections to ensure that the HEC-RAS model matched the aerial photographs and known lengths determined with GIS.

Due to uncertainty of the precise location of individual cross sections, the current Digital Elevation Model (DEM) was used to identify the overbank geometry for each cross section to ensure a proper geo-spatial match between the natural topography and model. This is particularly important for mapping of the inundation boundaries. The cross sections were extended within GIS and HEC-GeoRAS was used to create a cross section profile from the 10-ft DEM for each cross section. The channel section from the HEC-2 model was retained for each section while left and right overbanks of the cross sections were replaced utilizing the Graphic Cross Section Editor tool in HEC-RAS. Interpolated sections were also added to the model within HEC-RAS to provide input locations for lateral inflow hydrographs developed within HEC-HMS and to improve the computational stability of the model.

In general, cross section spacing from the HEC-2 model was between 500- and 1,000-feet. Additional cross sections were surveyed in locations in which cross section spacing was greater than 1,000 feet. Additional cross sections and culverts/bridges were also field surveyed where required or to bring the hydraulic model to within 1 square mile of the Watershed boundary or closer.

Boundary Conditions. The downstream boundary condition at the DuPage County line was developed from the flows and stages presented in the current Cook County FIS for Upper Salt Creek.

3.1.2.3 Calibration and Verification

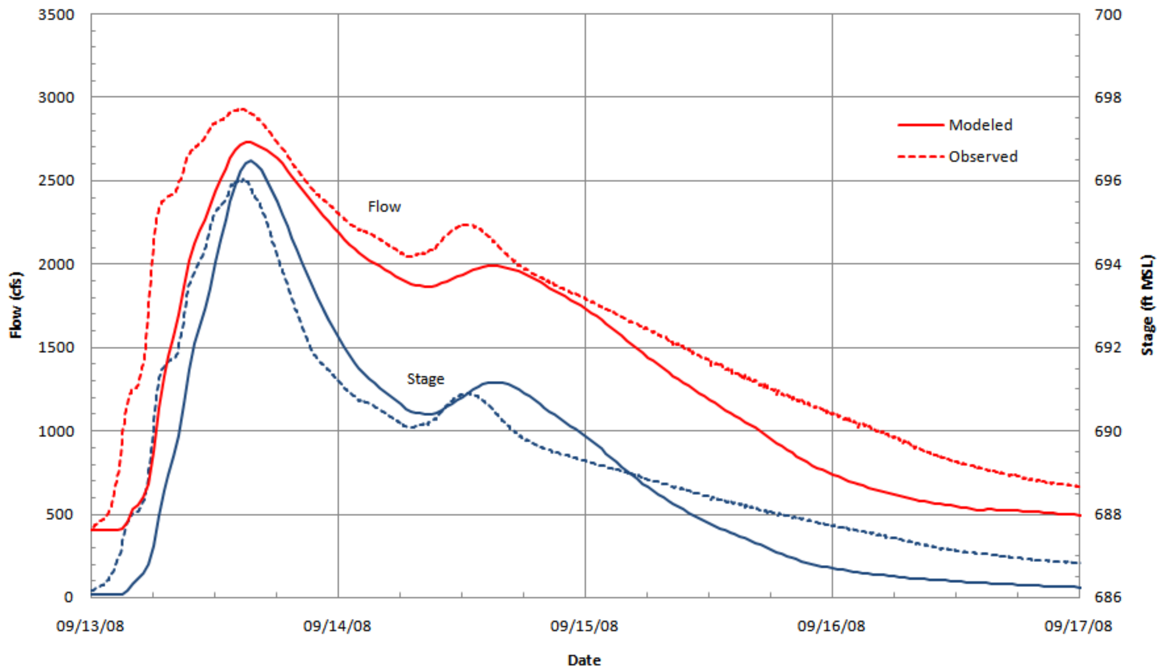
Observed Data. Two USGS stream flow gauges are located on the Upper Salt Creek Mainstem; 5536500 at Rolling Meadows located just upstream of Algonquin Road and 05537500 near Elk Grove Village located at the Busse Woods dam. Analysis of the available record for the two recording gauges shows that there are two large recent events that could be used for calibration and verification.

In August of 2007 there was a significant rainfall event resulting in two peaks; one during the early hours of August 19th and the other late on August 23rd. The total amount of rainfall was about 9 inches, with about 5 inches falling on the 19th and another 4 inches on the 23rd. Only the first rain event will be used for calibration purposes as the HEC-HMS program is not designed to model multiple events.

Another, larger event occurred in September of 2008. During this event about 9 inches of rain fell in about 30 hours. This event was selected to calibrate the model. The August 2007 event was used to validate the calibration.

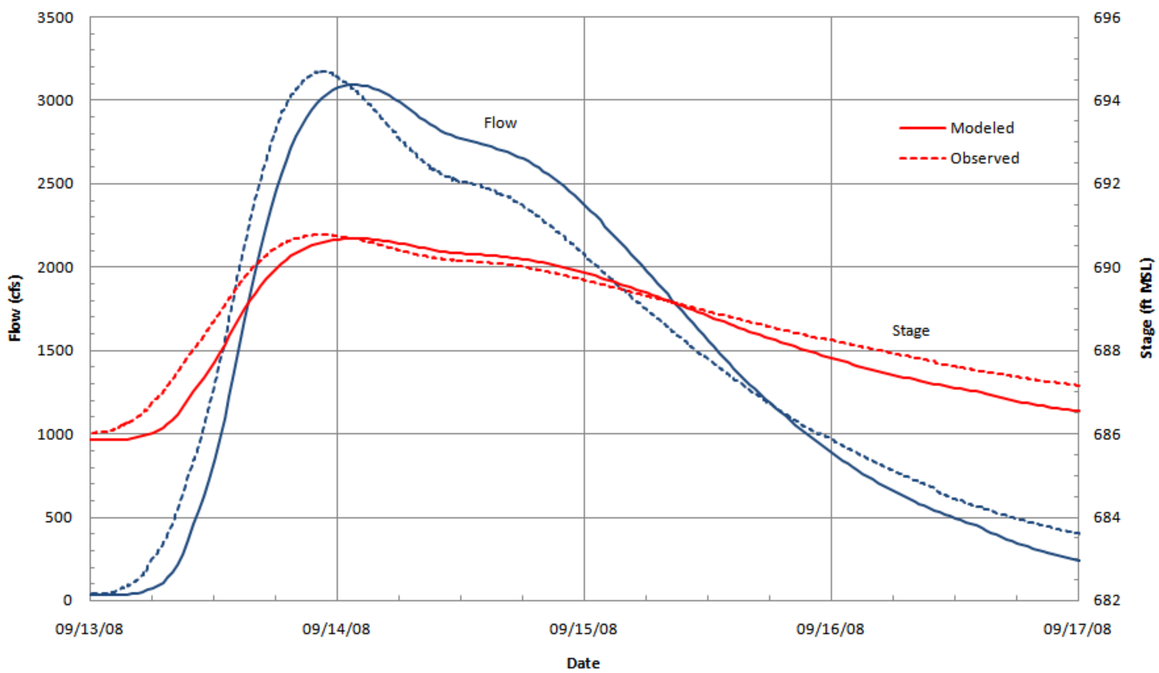
Calibration Results. A comparison of the modeled and recorded stage and flow at the Rolling Meadows gauge shows an excellent agreement for both parameters. Peak flow is within about 4%. Peak stage is about 0.7 feet low. A small change to the channel roughness factors in the area of the gauge could bring this down within the 0.5 foot calibration limit but this change would have no effect on the flows at this location and would only affect a very small reach of the stream channel so the originally estimated roughness values were left unchanged. Figure 3.1.3 shows a graphical comparison of the modeled and observed stage and flow for that event at the Rolling Meadows gauge. The shape of the flow and stage hydrographs also match the observed values except that there is some delay in the response. The recession limb is also fairly close which is unusual in a single event model. This is probably due to the relatively large volume of reservoir storage releasing back into the system as the storm dissipates.

FIGURE 3.1.4
Mainstem Calibration – Gauge 05530990 – Rolling Meadows
September 13, 2008 Storm



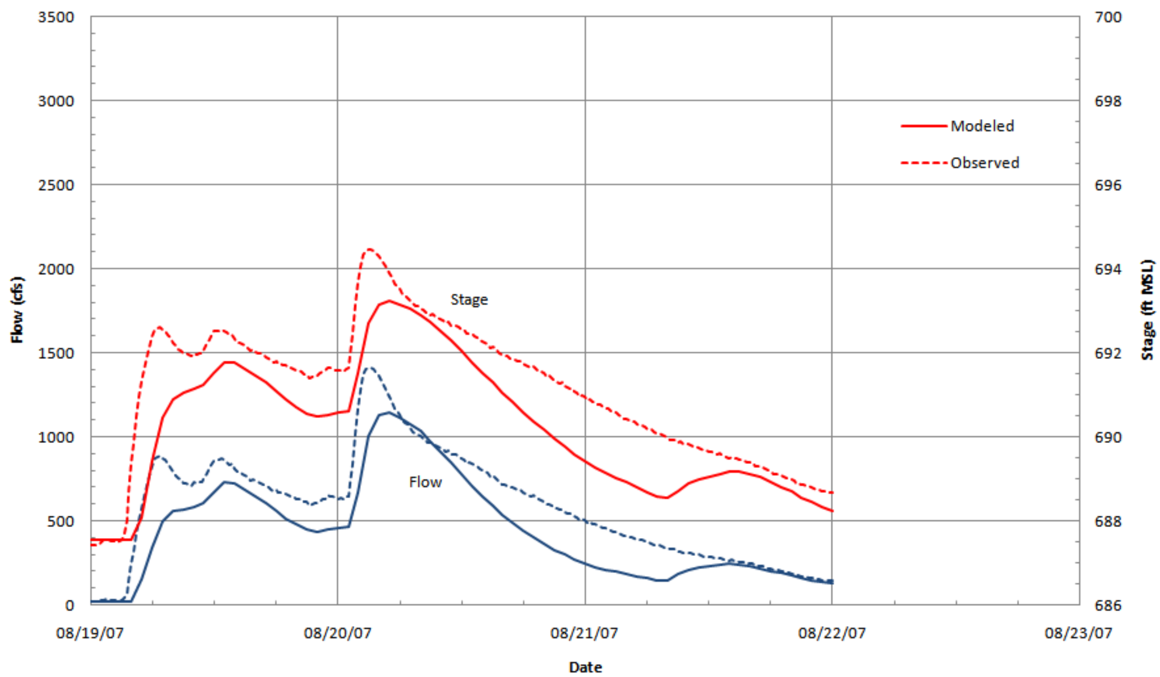
The same comparison can be done at the Busse Dam gauge. As with the Rolling Meadows gauge the modeled flow is within about 3% of the observed flow. The stage is within about 0.1 feet – which is to be expected since the flow here is controlled by a single fixed structure and not a channel reach. Figure 3.1.4 shows a graphical comparison of the modeled and observed stage and flow for the same event at the Busse Dam gauge. The shape of the flow and stage hydrographs here also matches the observed values. The recession limbs follow the observed values closely, again due to the very large storage reservoir just upstream of the gauge.

FIGURE 3.1.5
Mainstem Calibration – Gauge 05531044 – Busse Dam
September 13, 2008 Storm



Using the same parameters developed for the September 2008 event a verification run was made using the August 2007 event. This event was considerably smaller in flow but still significant when compared to the historical record. The antecedent conditions were drier for this event, but since the AMC had already been reduced to I for the calibration event (September 2008), it was not reduced further. The comparison of flows shows a difference of about 20% between the August 2007 and September 2008 events. The stage, however, shows an approximately one foot difference. Figure 3.1.5 shows a graphical comparison of the modeled and observed stage and flow for the August 2007 event at the Rolling Meadows' gauge.

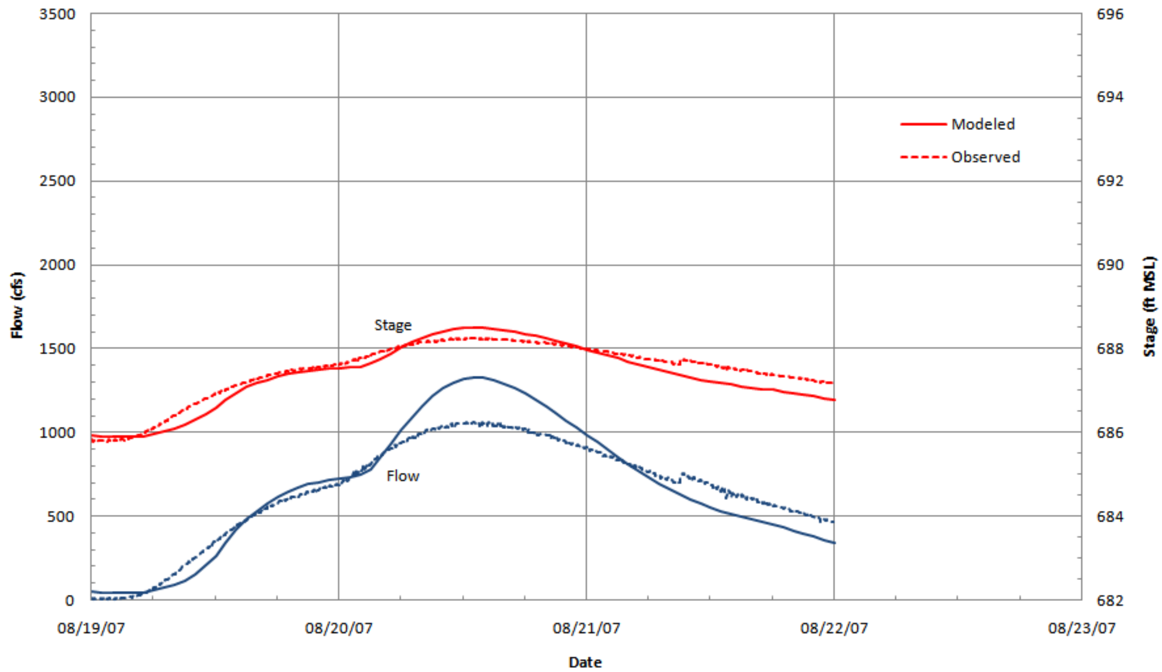
FIGURE 3.1.6
Mainstem Calibration – Gauge 05530990 – Rolling Meadows
August 19, 2007 Storm



The difference could be reduced by increasing the AMC used in the hydrologic model but this is not supported by the measured rainfall so an adjustment for this event would require a commensurate change in the AMC selected for the 2008 event. However, this would adversely impact the calibration to the 2008 event. As that event is much larger it was decided that the calibration parameters would be set by calibration to the 2008 event.

A similar comparison at the Busse Dam gauge shows a much better fit for both flow and stage. The flows are different by about 25% at the peak although they match the flow hydrograph very well for a large portion of the storm event. The peak stage is within 0.25 feet of the observed stage. Figure 3.1.6 shows a graphical comparison of the modeled and observed stage and flow for the same event at the Busse Dam gauge.

FIGURE 3.1.7
Mainstem Calibration – Gauge 05531044 – Busse Dam
August 19, 2007 Storm



Modifications to Model Input. As discussed in the previous sections the changes made to the model to effect a good calibration were limited to the AMC assumed, and thus the overall curve numbers and the storage coefficient used in the Clark unit hydrograph method. An AMC condition of I was selected as the best fit for the storms used in the calibration/verification process. Values of $R/(T_c+R)$ of 0.6 for the Mainstem and Arlington Heights Branch and 0.9 for the West Branch were used to determine the storage coefficient and time of concentration used in each area.

3.1.2.4 Existing Conditions Evaluation

Flood Inundation Areas. Figures 3.1.1a and 3.1.1b show inundation areas in the Mainstem subwatershed produced by the hydraulic model for the 100-year, 24 hour inundation boundary.

Hydraulic Profiles. Appendix H contains hydraulic profiles of existing conditions on the watershed. Profiles are shown for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence interval design storm events.

Reservoir Operation. The existing District reservoirs within the Mainstem subwatershed were evaluated during the existing conditions analysis. In general the reservoirs operated as designed during the 100-year event. Both the St. Michaels and Plum Grove reservoirs fill to just below their overflow spillways during this event. The Margreth Reimer reservoir also fills to near capacity without backing up over the inflow weir. This reservoir, being an offline reservoir, is pumped out after the storm event. Originally, there were three pumps provided at the pumping station, two large pumps for dewatering of the reservoir and a smaller pump to drain the permanent pool for maintenance. However, during initial operations it was determined that the discharge from the dewatering pumps was causing problems in the receiving stream. Since that time only the smaller pump has been used for dewatering. This pump is operated manually from the reservoir site based on direct observation of the water levels in the channel at the station. There is no coordination required with the dewatering of the other pumped reservoir in the Upper Salt Creek Watershed as the dewatering flows are relatively small and the reservoirs are on different branches.

3.1.3 Development and Evaluation of Alternatives

3.1.3.1 Problem Definition

Hydraulic model results were reviewed with inundation mapping to identify locations where property damage due to flooding is predicted. Table 3.1.4 summarizes problem areas identified through modeling of the Mainstem subwatershed.

TABLE 3.1.4
Modeled Problem Definition for the Upper Salt Creek Mainstem

Problem ID	Location	Recurrence Interval (yr) of Flooding	Associated Form B	Resolution in DWP
MPA05	Portion of the City of Rolling Meadows and Unincorporated Cook County within the Plum Grove Village neighborhood	100-, 50-, 25-, 10-, 5-, 2-	5	Previous work done by consultants hired by the Palatine Township Road District indicates that a channel improvement will not provide the required reduction in the water surface elevation. The option of adding storage to reduce flooding was also evaluated as part of the DWP but sufficient storage could not be added close enough to the project area to reduce flooding Benefits and costs were not developed for this alternative.
MPA49	Village of Palatine between Illinois Avenue and Smith Street	100-, 50-, 25-, 10-, 5-, 2-	43	Project SCUP-49 created to reduce flooding in this area.
MPA51	Village of Palatine near the intersection of Palatine and Quentin Roads upstream of Margreth Riemer Reservoir	100-, 50-, 25-, 10-, 5-	-	Project SCUP-51 created to reduce flooding in this area. This project was not recommended because the benefit-cost ratio was very low. The subject properties are candidates for protection using non-structural measures such as flood proofing or acquisition.
MPA56	In Rolling Meadows Industrial park near Intersection of New Wilke Rd. and Golf Rd.	100-, 50-, 25	-	Project SCUP-56 created to address flooding in this area.
MPA58	Village of Elk Grove Village downstream of Busse Dam	100-, 50-, 25-, 10-, 5-, 2-	-	Project SCUP-58 created to reduce flooding in this area. This project was not recommended because the benefit-cost ratio was very low. The subject properties are candidates for protection using non-structural measures such as flood proofing or acquisition.

3.1.3.2 Damage Assessment

Damages were defined following the protocol established in Chapter 6.6 of the CCSMP. No erosion damages or recreation damages due to flooding were identified for the subwatershed. Transportation damages were estimated as 15 percent of property damages plus additional site specific traffic damages computed at the intersection of Golf Road and New Wilke Road. Table 3.1.5 lists the damage assessment for existing conditions.

TABLE 3.1.5
Estimated Damages for Upper Salt Creek Mainstem

Damage Category	Estimated Damage ($)	Description
Property	$5,392,000	
Erosion	$0	
Transportation	$975,000	For most locations, assumed as 15% of property damage due to flooding, MPA56 includes a site-specific estimate

3.1.3.3 Technology Screening

Flood control technologies were screened to identify those most appropriate for addressing the flooding problems in the subwatershed. Increased conveyance or storage were identified as the principal technologies applicable for addressing the existing stormwater problems.

3.1.3.4 Alternative Development

Flood Streambank Stabilization Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in Section 1.4 of this report. Table 3.1.6 summarizes flood control alternatives developed for the Mainstem.

Stormwater detention alternatives were modeled to address flooding problems along the Mainstem.

The flooding problems identified in the Mainstem watershed generally involve conveyance capacity issues associated with road crossings and the size of the stream channel. Solutions to these types of problems can include increasing the conveyance capacity by enlarging the culvert or bridge cross section and increasing the size of the channel. Alternatively, if the space is available, the flows in the stream channel can be reduced by providing a storage reservoir upstream of the problem location. In the Upper Mainstem there was no available undeveloped land area upstream of the problem areas to warrant investigating a storage option. Conveyance capacity was increased to lower the water level by modifying the local constrictions, such as bridges, culverts or weirs, and enlarging the channel cross section. Model runs were made to ensure that the improvements did not negatively impact the downstream areas which would necessitate the construction of a storage component to mitigate these effects. The model runs determined that this was not necessary as the scope of the improvements did not produce increased downstream flows.

TABLE 3.1.6
Flood Control Alternatives for Upper Salt Creek Mainstem

Alternative	Location	Description
SCUP-5	Portion of the City of Rolling Meadows and Unincorporated Cook County within the Plum Grove Village neighborhood	Previous work done by consultants hired by the Palatine Township Road District indicates that a channel improvement will not provide the requisite reduction in the water surface elevation. The option of adding storage to reduce flooding was also evaluated. This alternative did not effectively reduce water surface elevations in the flooding problem area, thus benefits and costs were not developed.
SCUP-49	Village of Palatine between Illinois Avenue and Smith Street.	The channel improvements include approximately 2,800 ft of linear river channel widening requiring an estimated 28,000 yd^3 of excavation.
SCUP-51	Village of Palatine near the intersection of Palatine and Quentin Roads upstream of Margreth Riemer Reservoir	The project includes expanding the culvert under the Palatine/ Quentin Rd. intersection from three 8.1 x 6.6 foot box culverts to two 7.4 x 16.9 foot box culverts and expanding the culvert under Palatine Road upstream of this intersection from the existing two 8.3 x 5 foot box culverts with an additional four 11 x 6 foot box culverts. The channel between these culverts is expanded to a 50-ft bottom width concrete lined trapezoidal section to improve conveyance, which will require the excavation of approximately 24,000 yd^3 along 1,700 ft of channel.
SCUP-56	City of Rolling Meadows around the intersection of Golf Road and New Wilke Road.	The project includes a flap gate on the local sewer and a small levee along a local ditch to isolate the project area from the Salt Creek. Two small levees are constructed along each side of Golf Road just west of the I-90 to prevent overland flow from Salt Creek. A 50-cfs low-head pumping station is also required to handle sewer flows during times when Salt Creek is in flood.
SCUP-58	Village of Elk Grove Village downstream of Busse Dam	Major channel expansion downstream of Busse Woods including approximately 47,500 yd^3 of excavation. Two solutions were considered: SCUP-58a and SCUP-58b. SCUP-58a evaluated the option of increasing the storage capacity of the Busse Woods Reservoir by decreasing the spillway capacity of the Busse Dam. SCUP-58b evaluated channel improvements along the creek. This project would need additional modeling along the Upper Salt Creek in DuPage County to evaluate its effectiveness and to ensure no negative downstream impacts.

SCUP-5 looked at several alternative strategies for dealing with the flooding in this area. As mentioned in Table 3.1.6, previous work had been done on a pure conveyance option to lower water levels in that area. Because of the close proximity to the stream channel of a number of homes the channel improvements were necessarily limited in width and consequently provide little benefit. To significantly reduce water levels the channel improvements would need to be both wide and deep. This would require the removal of many of the closer homes, eliminating the stream meanders in the area as well as the destruction of many of the tress along the stream channel, thus effectively destroying the neighborhood. A storage option was also investigated. Approximately 1000 acre-feet of storage would be required in close proximity to the upstream end of the problem area to be effective in reducing water levels and eliminate flooding in this area. Open space upstream of this site is at a premium and at most about 200 acre-feet could be constructed close enough to have a significant impact on water levels. A program of limited buy-outs and flood proofing could be an effective solution that would preserve the neighborhood while reducing damages from the more frequent floods.

SCUP-49 includes the expansion of several culverts along the Mainstem at Pleasant Hill Avenue, Michigan Avenue, Illinois Avenue, Imperial Court and Helen Road. It also proposed channel improvements between Pleasant Hill Avenue and Illinois Avenue. Expansion of the culverts and an increase in channel conveyance capacity work together to reduce head loss along the channel and to lower the peak water surface elevation up to 3.4 feet.

SCUP-51 includes expanding the culvert capacity under the intersection of Quentin Road and Palatine Road and expanding the culvert under the second Palatine Road crossing approximately 940 feet upstream. The channel between these culverts is expanded to a concrete lined trapezoidal section to improve conveyance. Expansion of the culverts and channel improvements act together to lower the peak flood elevation approximately 3.4 feet. This project was not recommended because the benefit-cost ratio was very low. A program of property acquisition and/or flood proofing could be an alternative solution.

SCUP-56 addresses regional flooding on Golf Road near the intersection with New Wilke Road. This alternative includes a combination of both regional and local components. To isolate the project area from flooding due to high water in Salt Creek, two small levees must be constructed along both sides of Golf Road just west of I-90 to prevent overland flooding from the creek (regional). The elevation of the top of both levees is 696.0 giving three feet of freeboard. The levees extend from the embankment of I-90 west to the abutment of the Golf Road Bridge over Salt Creek, a distance of about 400 feet. The levees are approximately 4 feet high. To ensure the project area is not inundated through a local drainage ditch and storm sewer, a third levee just north of I-90 at the downstream end of the roadside drainage ditch must be constructed to an elevation of 696.2, and the storm sewer in Golf Road must be isolated from the creek by a flap gate. A pumping station with a peak capacity of 50-cfs will also be required to handle local drainage during periods when Salt Creek is high. Since this project requires regional and local components to address the problem area, the local municipality/agency with jurisdiction will be required to contribute resources for the local components while the District would contribute resources for the regional components, should this project be implemented.

SCUP-58 considered both a storage and a conveyance solution, SCUP-58a and SCUP-58b respectively. While the problem area is located just downstream of a large reservoir (Busse Woods Reservoir) the storage volume cannot be expanded without large-scale modification of the forest preserve. Alternatively, DuPage County is investigating a modification of the spillway at the dam to provide some seasonal flood control benefit. Because these benefits can only accrue during certain times of the year, they cannot be counted on when developing a flood control plan. However, as an example of what might be achieved if the spillway at the dam could be modified for year-round flood control, a sample project was developed (SCUP-58a) to maximize the storage available. The width of the spillway was decreased until the water level in the reservoir began to have a detrimental effect on water levels upstream along the West Branch and the Upper Mainstem. The width of the spillway was decreased to 52 feet raising the 100-yr water level in the reservoir 1-ft to 692.7 ft. The emergency spillway would need to be raised to or above this new peak level. The effect of this modification would reduce the peak 100-yr outflow from 4,863 cfs to 3,729 cfs and lower the 100-yr water levels downstream about 0.3 ft. This would have a minimal impact on the number of structures in the floodplain.

A channel improvement project was also developed (SCUP-58b), to provide the necessary reduction in water surface elevation of about 1.5 feet. This required an increase in the cross section of the channel by about 40% which would need to start several miles downstream of John F. Kennedy Boulevard in the vicinity of the Village of Addison, well outside the boundaries of Cook County. This is because the water surface slope in the reach downstream of the DuPage/Cook County line is very flat at about 0.5 ft per mile. Before this project could be finalized detailed modeling would need to be done along Upper Salt Creek in DuPage County. A rough cost and possible benefits for this project are included in the DWP. This project has a very low B/C ratio and is not recommended for implementation by the District. A program of property acquisition and/or flood proofing could be an alternative solution.

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for this subwatershed.

3.1.3.5 Alternative Evaluation and Selection

Modeling analysis concluded that SCUP-5 could not provide effective stormwater detention resulting in flood damage reduction due to the severity of the current flooding and the lack of available open space for the construction of additional storage. Projects SCUP-49 and SCUP-56, shown in Figures 3.1.2 and 3.1.3, are recommended.

Project SCUP-49 results in reduced stage along the waterway. Table 3.1.7 provides a comparison of the modeled maximum WSEL and modeled flow at the time of peak at representative locations along the waterway.

TABLE 3.1.7
Mainstem Existing and Alternative Condition Flow and WSEL Comparison

		Existing Conditions		SCUP-49	
Location	Station	Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
Cedar Street	62565	740.57	604	740.58	604
Rose Street	61171	733.42	604	733.09	605
Smith Street	60459	732.02	605.	729.59	607
Helen Road	59545	731.5	582	729.21	607
Imperial Court	59182	731.25	580	728.67	608
Pleasant Hill Boulevard	57746	730.28	572	727.93	612

TABLE 3.1.7
Mainstem Existing and Alternative Condition Flow and WSEL Comparison

		Existing Conditions		SCUP-49	
Location	**Station**	**Max WSEL (ft)**	**Max Flow (cfs)**	**Max WSEL (ft)**	**Max Flow (cfs)**
Cedar Street	62565	740.57	604	740.58	604
Michigan Avenue	56875	729.63	574	726.8	616
Illinois Avenue	56102	729.41	576	726.09	620
Euclid Avenue	53212	724.62	538	724.63	584

Project SCUP-56, although it addresses flooding in the project area, is not included in Table 3.1.7 above because it results in no impact on the water surface elevations upstream or downstream of its location. However, the flood level at the intersection of Golf Road and New Wilke Road is lowered from 693.2 to below the street level of 691.9.

A number of properties are at risk of shallow flooding during the 100-year flood event under existing conditions or recommended alternative conditions. In addition, due to their locations, other properties' risk of flooding cannot be feasibly mitigated by structural measures. Such properties are candidates for protection using nonstructural flood control measures, such as flood-proofing or acquisition. These measures may be considered to address damages that are not fully addressed by capital projects recommended in the Upper Salt Creek DWP.

The alternatives listed Table 3.1.6 were evaluated to determine their effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. Table 3.1.8 provides a summary B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data. Alternative SCUP-5 did not produce a significant change in inundation areas and is not listed as benefits were negligible and thus costs were not calculated for this alternative.

3.1.3.6 Data Required for Countywide Prioritization of Watershed Projects

Appendix I presents conceptual level cost estimates for the recommended alternatives. Table 3.1.8 lists the alternatives analyzed in detail. Figures 3.1.2 and 3.1.3 schematically show the proposed improvement as well as a comparison of the with and without project inundation mapping.

TABLE 3.1.8
Upper Salt Creek Mainstem Alternative Matrix to Support District CIP Prioritization

Project	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures Protected	Water Quality Benefit	Recommended	Communities Involved
SCUP-49	Widen channel and increase conveyance capacity of five bridges.	0.15	1,701,000	11,030,000	61	No Impact	Yes	Palatine
SCUP-51	Widen channel and increase conveyance capacity of two bridges.	0.02	156,000	7,262,000	7	No Impact	No	Palatine
SCUP-56	Install pumping station with flap gate and construct three levees.	0.12	166,000	1,403,000*	0	No Impact	Yes	Rolling Meadows
SCUP-58	Widen Channel	0.01	87,000	5,696,000	10	No Impact	No	Elk Grove Village

Note: Net Benefits values do not include local benefits or non-economic benefits
* Includes $1,253,000 for necessary local improvements.

3.2 West Branch

The West Branch of the Upper Salt Creek is a natural waterway though the southern part of the watershed. The creek and its tributaries are about 17.0 miles long and they drain an area of 12.2 square miles. Table 3.2.1 lists the communities draining to the Upper Salt Creek West Branch subwatershed.

TABLE 3.2.1
Communities Draining to West Branch

Community/Tributary	Tributary Area (mi^2)
Schaumburg	3.76
Hoffman Estates	2.57
Elk Grove Village	1.51
Unincorporated/Forest Preserve	0.13

Other than several small residential or golf course detention ponds, there are no large flood control reservoirs within the West Branch subwatershed.

Table 3.2.2 lists the land use breakdown by area within the Upper Salt Creek West Branch subwatershed. Figure 3.2.1 provides an overview of the tributary area of the subwatershed. Reported stormwater problem areas and proposed alternative projects are also shown on the figure and are discussed in the following subsections.

3.2.1 Sources of Data

3.2.1.1 Previous Studies

Since the mid-1950's numerous public organizations have produced reports describing flooding in the Watershed and developed possible solutions. All of the reports discussed in Section 3.1.1.1 evaluate either the entire Upper Salt Creek Watershed (Mainstem, Arlington Heights Branch and West Branch subwatersheds) or a smaller part of it. Ultimately, all three subwatersheds join as one at the Busse Woods Reservoir so all reports are relevant for this analysis.

TABLE 3.2.2
Land Use Distribution for West Branch

Land Use Category	Area (acres)	%
Residential	4041	51.9
Commercial	1676	21.5
Open Land	1290	16.6
Disturbed/ Transitional	200	2.6
Meadow	180	2.3
Industrial	139	1.8
Water	100	1.3
Transportation	85	1.1
Agriculture	81	1.0

3.2.1.2 Water Quality Data

Water quality data for the Watershed were collected from IEPA and CMAP.

Monitoring Data. Section 3.1.1.2 (Monitoring Data) discusses water quality data collected in the Upper Salt Creek Watershed. The Data is collected from sites on the Mainstem only, but since the West Branch subwatershed feeds into the Mainstem upstream of the Busse Woods monitoring site, the data gives an approximation of the general conditions of the West Branch subwatershed as well.

National Pollutant Discharge Elimination System (NPDES) Permit. There is one permitted point source discharges within the subwatershed. The permitted discharge is associated with the District's Egan Water Reclamation Plant (IL0036340).

TABLE 3.2.3
Point Source Dischargers in West Branch Area

Name	NPDES	Community	Receiving Waterway
MWRDGC Egan Wastewater Treatment Plant	IL0036340	Cook County Forest Preserve	West Branch

Note: NPDES facilities were identified from the USEPA Water Discharge Permits Query Form at http://www.epa.gov/enviro/html/pcs/pcs_query_java.html.

Municipalities discharging to the West Branch are regulated by IEPA's NPDES Phase II Stormwater Permit Program, which was created to improve the water quality of stormwater runoff from urban areas, and requires that municipalities obtain permits for discharging stormwater and implement the six minimum control measures for limiting runoff pollution to receiving systems.

Impaired Waterways. As stated in Section 3.1.1.2 (Impaired Waterways), the 2006 IEPA *Illinois Integrated Water Quality Report and Section 303(d) List* lists Upper Salt Creek on the impaired waterways list. The entirety of Upper Salt Creek is categorized as 'Not Supporting' for aquatic life, fish consumption, and primary contact uses.

Total Maximum Daily Loads (TMDLs). As stated in Section 3.1.1.2 (Total Maximum Daily Loads), an 8 percent reduction in chloride load, a 56 percent reduction in Carbonaceous Biochemical Oxygen Demand (CBOD) load, and a 38 percent reduction in ammonia nitrogen load are needed to meet the maximum daily load of Salt Creek. The report lists high nutrient concentrations (from runoff, wastewater treatment plant effluent, and storm sewer overflow discharges), high CBOD, and impoundments as major causes of low dissolved oxygen concentrations.

3.2.1.3 Wetland and Riparian Areas

Figures 2.3.8.1 and 2.3.8.2 contain mapping of wetland and riparian areas in the Upper Salt Creek Watershed. Wetland areas were identified using National Wetlands Inventory (NWI) mapping in addition to observations made in the field during site visits. NWI data includes roughly 8,000 acres of wetland areas in the West Branch subwatershed. Riparian areas are defined as vegetated areas between aquatic and upland ecosystems adjacent to a waterway or body of water that provides flood management, habitat, and water quality enhancement. Identified riparian environments offer potential opportunities for restoration.

3.2.1.4 Floodplain Mapping

Flood inundation areas supporting the NFIP were revised in 2008 as a part of FEMA's Map Modernization Program. Floodplain boundaries were revised based upon updated Cook County topographic information, but the effective models, which are used to estimate flood levels, generally were not updated. LOMRs were incorporated in the revised floodplains. The entire Upper Salt Creek Watershed is mapped in detail in the DFIRM mapping update. Appendix A includes a comparison of FEMA's effective floodplain mapping from updated DFIRM panels with inundation areas developed for the DWP.

3.2.1.5 Stormwater Problem Data

Table 3.2.4 summarizes reported problem areas reviewed as a part of the DWP development. The problem area data was obtained primarily from Form B questionnaire response data provided by watershed communities to the District. Problems are classified in Table 3.2.4 as regional or local. This classification is based on a process described in Section 2.2 of this report.

TABLE 3.2.4
Community Response Data for West Branch

Prob. ID	Municipality	Problems as Reported by Local Agency	Location	Problem Description	Local/ Regional	Resolution in DWP
6	Hoffman Estates	Stream Maintenance, Streambank Erosion	Between Apple St. and Basswood St.	Streambank erosion	Regional	Erosion problem does not threaten structures, not addressed by DWP.
10	Schaumburg	Flooding	Ditch along Tower Rd. and State Parkway	Flooding	Local	Although the specific problem is local, recommended alternative Project SCWB-52 will lower peak WSEL at this location.
11	Schaumburg	Streambank Erosion	East of Schaumburg Village Hall; including parts of the West Branch and West Branch Tributaries 3 and 5	Erosion	Regional	Erosion problem does not threaten structures, not addressed by DWP.
19	IDOT	Flooding	Golf Rd. and Plum Grove Rd.	Pavement flooding	Local	Problem not located on a regional waterway. This is a local problem.
46	Schaumburg	Flooding	Ditch along Tower Rd. and State Parkway	Have study	Local	Although the specific problem is local, recommended alternative Project SCWB-52 will lower peak WSEL at this location.
47	Schaumburg	Flooding	Niagara Ave. and Sunset Dr.	Study in progress	Local	Problem not located on a regional waterway. This is a local problem.

3.2.1.6 Near-Term Planned Projects

The subwatershed has one near-term planned project that is included in the hydraulic model as part of the baseline runs. This area, discussed as problem areas 10 and 46 within the Village of Schaumburg above, currently experiences repeated flooding of the ditch along State Parkway and encroachment of floodwaters upon adjacent buildings. This project, located on the West Branch, involves moving the weir control structure for the pond in the commercial complex near the intersection of State Parkway and Tower Road. Currently, this control structure is located in the middle of the parkway between northbound and southbound traffic. The planned project moves the weir upstream of the parkway to minimize overbank flooding in the parkway and onto the roadway.

3.2.2 Watershed Analysis

3.2.2.1 Hydrologic Model Development

Subbasin Delineation. The West Branch subwatershed was delineated based upon LiDAR topographic data developed by Cook County. Thirty-two subbasins were delineated for the area, with an average subbasin area of 243 acres and a total drainage area of 12.2 square miles.

Hydrologic Parameter Calculations. Curve Numbers were estimated for each subbasin based upon NRCS soil data and 2001 CMAP land use data. This method is further described in Section 1.3.2, with lookup values for specific combinations of land use and soil data presented in Appendix C. An area-weighted average of the CN was generated for each subbasin.

Appendix G provides a summary of the hydrologic parameters used for subbasins in each subwatershed.

The time of concentration and routing coefficient were determined as discussed in Section 1.3.2.1.

3.2.2.2 Hydraulic Model Development

Field Data, Investigation, and Existing Model Data. As discussed in section 3.1.2.2, several existing models were available for this watershed. The HEC-2 model created by the IDNR in 1996 was used as the base model for the HEC-RAS model. Refer to section 3.1.2.2 for additional details regarding the model development phase and general model information.

Boundary Conditions. As mentioned in Section 1.3.6.3, since the 3 subwatersheds were combined in one model, only one boundary condition was necessary for the model setup. The downstream boundary condition at the DuPage County line was developed from the flows and stages presented in the current Cook County FIS for Upper Salt Creek.

3.2.2.3 Calibration and Verification

As described in Section 3.1.2.3, the watershed models were calibrated using two USGS stream flow gauges located on the Upper Salt Creek Mainstem. Calibration and Verification was completed using data from and September 13, 2008 and August 19, 2007 rain events, respectively. The Clark Unit Hydrograph method using an AMC of 1 was selected as the best fit for the storms. Values of $R/(T_c+R)$ of 0.6 for the Mainstem and Arlington Heights Branch and 0.9 for the West Branch were used to determine the storage coefficient and time of concentration used in each area.

While no stream flow gauges were available in the Arlington Heights Branch, both USGS gauges are located downstream of the junction of the Arlington Heights Branch with the Mainstem and therefore allowed for calibration of the Arlington Heights Branch.

3.2.2.4 Existing Conditions Evaluation

Flood Inundation Areas. Figure 3.2.1 shows inundation areas in the West Branch subwatershed produced by the hydraulic model for the 100-year, 24 hour inundation boundary.

Hydraulic Profiles. Appendix H contains hydraulic profiles of existing conditions on the watershed. Profiles are shown for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence interval design storm events.

3.2.2.5

3.2.3 Development and Evaluation of Alternatives

3.2.3.1 Problem Definition

Hydraulic model results were reviewed with inundation mapping to identify locations where property damage due to flooding is predicted. Table 3.2.5 summarizes problem areas identified through modeling of the West Branch subwatershed.

TABLE 3.2.5
Modeled Problem Definition for West Branch

Problem ID	Location	Recurrence Interval of Flooding (yr)	Associated Form B	Resolution in DWP
MPA52	Village of Schaumburg at State Parkway and Tower Rd.	100-, 50-, 25-	10, 46	Project SCWB-52 created

3.2.3.2 Damage Assessment

Damages were defined following the protocol established in Chapter 6.6 of the CCSMP. No erosion damages or recreation damages due to flooding were identified for the subwatershed. Transportation damages were estimated as 15 percent of property damages. Table 3.2.6 lists the damage assessment for existing conditions.

TABLE 3.2.6
Estimated Damages for West Branch

Damage Category	Estimated Damage ($)	Description
Property	305,000	
Erosion	0	
Transportation	46,000	Assumed as 15% of property damage due to flooding

3.2.3.3 Technology Screening

Flood control technologies were screened to identify those most appropriate for addressing the flooding problems in the subwatershed. Increased conveyance or storage were identified as the principal technologies applicable for addressing the existing stormwater problems.

3.2.3.4 Alternative Development

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in Section 1.4 of this report. Table 3.2.7 summarizes flood control alternatives developed for the West Branch.

TABLE 3.2.7
Flood Control Alternatives for West Branch

Alternative	Location	Description
SCWB-52	Village of Schaumburg along State Parkway and Tower Road	The project involves lowering the weirs at the detention basin upstream of Woodfield Road and at Tower Rd, expanding and shortening the culvert under State Parkway at the intersection of Tower and creating an open channel ditch along State Parkway to replace the shortened culvert

SCWB-52 includes lowering the weir elevation at the detention basin upstream of Woodfield Road that will provide an additional 26 acre-feet of storage, increasing the size of the culvert at Remington Road, expanding and shortening the culvert under State Parkway and creating an open channel ditch, and lowering the weir that controls the pond in the industrial complex near the intersection of State Parkway and Tower Road. This project extends the benefits derived from the near-term project planned by the Village of Schaumburg and described in Section 3.2.1.6. The model results show that this project requires no compensatory storage to mitigate downstream effects.

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for this subwatershed.

3.2.3.5 Alternative Evaluation and Selection

Alternative SCWB-52 was evaluated to determine its effectiveness and produce data required for the countywide prioritization of watershed projects. The alternative resulted in reduces stage along the waterway and is recommended. Table 3.2.8 provides a comparison of the modeled maximum WSEL and modeled flow at the time of peak at representative locations along the waterway.

TABLE 3.2.8
West Branch Existing and Alternative Condition Flow and WSEL Comparison

		Existing Conditions		SCUP-52	
Location	Station	Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
Northwest Tollway	36002	734.69	136	734.39	140
Wiley Road	35702	731.28	137	730.69	141
State Parkway Weir	33469	730.14	148	729.45	150
State Parkway Culvert	33361	729.76	146	728.69	149
Remington Road	32343	729.33	150	727.83	155
Golf Road	31403	727.51	167	726.49	176
American Lane	29659	727.15	178	725.94	189

TABLE 3.2.8
West Branch Existing and Alternative Condition Flow and WSEL Comparison

		Existing Conditions		SCUP-52	
Location	**Station**	**Max WSEL (ft)**	**Max Flow (cfs)**	**Max WSEL (ft)**	**Max Flow (cfs)**
Northwest Tollway	36002	734.69	136	734.39	140
Basin Outlet	27627	726.81	239	725.52	261
Woodfield Road	27385	724.26	247	724.37	269
Thacker Street	24395	720.06	539	720.09	564

A number of properties are at risk of shallow flooding during the 100-year flood event under existing conditions or recommended alternative conditions. In addition, due to their locations, other properties' risk of flooding cannot be feasibly mitigated by structural measures. Such properties are candidates for protection using nonstructural flood control measures, such as flood-proofing or acquisition. These measures may be considered to address damages that are not fully addressed by capital projects recommended in the Upper Salt Creek DWP.

The alternative in Table 3.2.7 was evaluated to determine its effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. Table 3.2.9 provides a summary B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data.

3.2.3.6 Data Required for Countywide Prioritization of Watershed Projects

Appendix I presents conceptual level cost estimates for the recommended alternative. Table 3.2.9 lists the alternatives analyzed in detail. Figure 3.2.2 schematically shows the proposed improvements as well as a comparison of the with and without project inundation mapping.

TABLE 3.2.9
West Branch Project Alternative Matrix to Support District CIP Prioritization

Project	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures Protected	Water Quality Benefit	Recommended	Communities Involved
SCWB-52	Lower weirs on two detention basins, increase capacity of bridge and create ditch in place of culvert.	0.27	351,000	1,149,000	3	No Impact	Yes	Schaumburg

Note: Net Benefits values do not include local benefits or non-economic benefits.

3.3 Arlington Heights Branch

The Arlington Heights Branch of the Upper Salt Creek is a natural waterway though the northern part of the watershed. The creek and its tributaries are about 12.6 miles long and they drain an area of 13.9 square miles. Table 3.3.1 lists the communities draining to the Upper Salt Creek Arlington Heights Branch subwatershed.

TABLE 3.3.1
Communities Draining to Arlington Heights Branch

Community	Tributary Area (mi^2)
Palatine	7.02
Unincorporated/Forest Preserve	3.08
Rolling Meadows	2.17
Arlington Heights	0.87
Inverness	0.47
Barrington	0.21
Deer Park	0.11

Between 1981 and 1986, two large flood control reservoirs were constructed in the subwatershed providing approximately 1,000 acre-feet of flood storage. The two reservoirs: Twin Lakes and Tom T. Hamilton were constructed based on a plan prepared by the NRCS and sponsored by the District.

TABLE 3.3.2
Land Use Distribution for Arlington Heights Branch

Land Use Category	Area (acres)	%
Residential	14,916	57.5
Commercial/Industrial	4,506.8	17.4
Forest/Open Land	3,971	15.3
Institutional	1,404	5.4
Transportation/Utility	889.2	3.4
Water/Wetland	180	0.7
Agricultural	69	0.3

The Twin Lakes Reservoir is located along the Arlington Heights Branch in the Village of Palatine and has a tributary area of 2,330 acres. The reservoir is formed by the embankment along Illinois Route-53. The reservoir is divided into two cells connected by twin 24-inch diameter pipes. High flows can also pass over a concrete weir that also serves as a parking lot for the recreational facilities. Flow enters the west cell of the reservoir through a culvert/weir combination and exits the same cell through a 10-foot by 12-foot box culvert under the expressway. An orifice/weir control structure limits flows through the box culvert. The emergency spillway is located on the far Southwest edge of the West pond.

The Tom T. Hamilton Reservoir is located on the Arlington Heights Branch in the Village of Palatine and has a tributary area of about 3,600 acres. The reservoir is located adjacent to the stream channel. A bypass control structure on the stream restricts the downstream flow; the remaining flow passes over a weir into the reservoir. After a storm event the reservoir is pumped down. The bypass control structure has been modified from the original design to force water into the reservoir more frequently than originally designed.

Table 3.3.2 lists the land use breakdown by area within the Upper Salt Creek Arlington Heights Branch subwatershed. Figure 3.3.1 provides an overview of the tributary area of the subwatershed. Reported stormwater problem areas and proposed alternative projects are also shown on the figure and are discussed in the following subsections.

3.3.1 Sources of Data

3.3.1.1 Previous Studies

Since the mid-1950's numerous public organizations have produced reports describing flooding in the Watershed and developed possible solutions. All of the reports discussed in Section 3.1.1.1 evaluate either the entire Upper Salt Creek Watershed (Mainstem, Arlington Heights Branch and West Branch subwatersheds) or a smaller part of it. Ultimately, all three subwatersheds join as one at the Busse Woods Reservoir so all reports are relevant for the Arlington Heights Branch subwatershed.

3.3.1.2 Water Quality Data

Water quality data for the Watershed were collected from IEPA and CMAP.

Monitoring Data. Section 3.1.1.2 (Monitoring Data) discusses water quality data collected in the Upper Salt Creek Watershed. The Data is collected from sites on the Mainstem only, but since the Arlington Heights subwatershed feeds into the Mainstem, the data gives an approximation of the general condition of the Arlington Heights Branch subwatershed as well.

National Pollutant Discharge Elimination System (NPDES) Permit. There are two permitted point source discharges within the subwatershed. The permitted discharges are associated with Arlington International Racecourse (IL0063487) in Arlington Heights and Prairie Material Sales-Yard 35 (IL0066427) in Palatine.

TABLE 3.3.3
Point Source Dischargers in Arlington Heights Branch Area

Name	NPDES	Community	Receiving Waterway
Arlington International Racecourse	IL0063487	Arlington Heights	Arlington Heights Branch
Prairie Materials Sales – Yard 35	IL0066427	Rolling Meadows	Arlington Heights Branch

Municipalities discharging to the Arlington Heights Branch are regulated by IEPA's NPDES Phase II Stormwater Permit Program, which was created to improve the water quality of stormwater runoff from urban areas, and requires that municipalities obtain permits for discharging stormwater and implement the six minimum control measures for limiting runoff pollution to receiving systems.

Impaired Waterways. As stated in Section 3.1.1.2 (Impaired Waterways), the 2006 IEPA *Illinois Integrated Water Quality Report and Section 303(d) List* lists Upper Salt Creek on the impaired waterways list. The entirety of Upper Salt Creek is categorized as 'Not Supporting' for aquatic life, fish consumption, and primary contact uses.

Total Maximum Daily Loads (TMDLs). As stated in Section 3.1.1.2 (Total Maximum Daily Loads) , an 8 percent reduction in chloride load, a 56 percent reduction in Carbonaceous Biochemical Oxygen Demand (CBOD) load, and a 38 percent reduction in ammonia nitrogen load are needed to meet the maximum daily load of Salt Creek. The report lists high nutrient concentrations (from runoff, wastewater treatment plant effluent, and storm sewer overflow discharges), high CBOD, and impoundments as major causes of low dissolved oxygen concentrations.

3.3.1.3 Wetland and Riparian Areas

Figures 2.3.8.1 and 2.3.8.2 contain mapping of wetland and riparian areas in the Upper Salt Creek Watershed. Wetland areas were identified using National Wetlands Inventory (NWI) mapping in addition to observations made in the field during site visits. NWI data includes roughly 9,000 acres of wetland areas in the Arlington Heights Branch subwatershed. Riparian areas are defined as vegetated areas between aquatic and upland ecosystems adjacent to a waterway or body of water that provides flood management, habitat, and water quality enhancement. Identified riparian environments offer potential opportunities for restoration.

3.3.1.4 Floodplain Mapping

Flood inundation areas supporting the NFIP were revised in 2008 as a part of FEMA's Map Modernization Program. Floodplain boundaries were revised based upon updated Cook County topographic information, but the effective models, which are used to estimate flood levels, generally were not updated. LOMRs were incorporated in the revised floodplains. The entire Upper Salt Creek Watershed is mapped in detail in the DFIRM mapping update. Appendix A includes a comparison of FEMA's effective floodplain mapping from updated DFIRM panels with inundation areas developed for the DWP.

3.3.1.5 Stormwater Problem Data

Table 3.3.4 summarizes reported problem areas reviewed as a part of the DWP development. The problem area data was obtained primarily from Form B questionnaire response data provided by watershed communities to the District. Problems are classified in Table 3.3.4 as regional or local. This classification is based on a process described in Section 2.2 of this report.

TABLE 3.3.4
Community Response Data for Arlington Heights Branch

Prob. ID	Municipality	Problems as Reported by Local Agency	Location	Problem Description	Local/ Regional	Resolution in DWP
20, 21, 22, 24, 30, 34, 35, 36	IDOT	Flooding	Various	Pavement Flooding	Local	Problems not located on a regional waterway. These are local problems.
41	Palatine	Flooding	Palanois Park	CSO	Local	Problem not located on a regional waterway. This is a local stormsewer problem.
42	Palatine	Flooding	Winston Park	Flooding – sewer	Local	Problem not located on a regional waterway. This is a local stormsewer problem.
44	Palatine	Flooding	Palatine Road at Winston Drive	Flooding – sewer	Local	Problem not located on a regional waterway. This is a local stormsewer problem.
49	FPDCC	Water Quality	Lake-Cook and Quentin Road	Sump Pump Discharge into Forest Preserve	Local	No structural/ transportaton damages associated with problem area.
51	FPDCC	Erosion	Hillside and Ela Road	Erosion in Forest Preserve	Regional	Erosion problem does not threaten structures, not addressed in DWP.
54	Rolling Meadows	Flooding	Arlington Heights Branch north of Central Road	Street/Surface Flooding -- data from Sept. 2008 rainfall	Regional	Model results did not confirm roadway or structure flooding due to a regional problem in this area.
55	Arlington Heights	Flooding	South of Rand Road, east of 53: includes Canterbury Ct, Roanoke Dr, Raleigh St, Suffield Ct, Waverly Ct	Street/Surface Flooding -- data from Sept. 2008 rainfall	Local	Problem not located on a regional waterway. This is a local problem.

3.3.1.6 Near Term Planned Projects

This subwatershed does not contain any known near term planned projects.

3.3.2 Watershed Analysis

3.3.2.1 Hydrologic Model Development

Subbasin Delineation. The Arlington Heights Branch subwatershed was delineated based upon LiDAR topographic data developed by Cook County in 2003. Twenty-six subbasins were delineated for area, with an average subbasin area of 343 acres and a total drainage area of 13.9 square miles.

Hydrologic Parameter Calculations. Curve Numbers were estimated for each subbasin based upon NRCS soil data and 2001 CMAP land use data. This method is further described in Section 1.3.2, with lookup values for specific combinations of land use and soil data presented in Appendix C. An area-weighted average of the CN was generated for each subbasin.

Appendix G provides a summary of the hydrologic parameters used for subbasins in each subwatershed.

The time of concentration and routing coefficient were determined as discussed in Section 1.3.2.1.

3.3.2.2 Hydraulic Model Development

Field Data, Investigation, and Existing Model Data. As discussed in section 3.1.2.2, several existing models were available for this watershed. The HEC-2 model created by the IDNR in 1996 was used as the base model for the HEC-RAS model. Refer to that section for additional details regarding the model development phase and general model information.

Boundary Conditions. As mentioned in Section 1.3.6.3, since the 3 subwatersheds were combined in one model, only one boundary condition was necessary for the model setup. The downstream boundary condition at the DuPage County line was developed from the flows and stages presented in the current Cook County FIS for Upper Salt Creek.

3.3.2.3 Calibration and Verification

As described in Section 3.1.2.3, the watershed models were calibrated using two USGS stream flow gauges located on the Upper Salt Creek Mainstem. Calibration and Verification was completed using data from and September 13, 2008 and August 19, 2007 rain events, respectively. The Clark Unit Hydrograph method using an AMC of 1 was selected as the best fit for the storms. Values of $R/(T_c+R)$ of 0.6 for the Mainstem and Arlington Heights Branch and 0.9 for the West Branch were used to determine the storage coefficient and time of concentration used in each area.

While no stream flow gauges were available in the Arlington Heights Branch, both USGS gauges are located downstream of the junction of the Arlington Heights Branch with the Mainstem and therefore allowed for calibration of the Arlington Heights Branch.

3.3.2.4 Existing Conditions Evaluation

Flood Inundation Areas. Figure 3.3.1 shows inundation areas in the Arlington Heights subwatershed produced by the hydraulic model for the 100-year, 24 hour inundation boundary.

Hydraulic Profiles. Appendix H contains hydraulic profiles of existing conditions on the watershed. Profiles are shown for the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year recurrence interval design storm events.

Reservoir Operation. The existing District reservoirs within the Arlington Heights Branch subwatershed were evaluated during the existing conditions analysis. In general the reservoirs operated as designed during the 100-year event. The Twin Lakes reservoir fills both lakes to just below the overflow spillway during this event. The Tom Hamilton reservoir also fills to near capacity without backing up over the inflow weir. This reservoir, being an offline reservoir, is pumped out after the storm event. Originally, there were three pumps provided at the pumping station, two large pumps for dewatering of the reservoir and a smaller pump to drain the permanent pool for maintenance. However, during initial operations it was determined that the discharge from the dewatering pumps was causing problems in the receiving stream. Since that time only the smaller pump has been used for dewatering. This pump is operated manually from the reservoir site based on direct observation of the water levels in the channel at the station. There is no coordination required with the dewatering of the other pumped reservoir in the Upper Salt Creek Watershed as the dewatering flows are relatively small and the reservoirs are on different branches.

3.3.3 Development and Evaluation of Alternatives

3.3.3.1 Problem Definition

Hydraulic model results were reviewed with inundation mapping to identify locations where property damage due to flooding is predicted. Table 3.3.5 summarizes problem areas identified through modeling of the Arlington Heights Branch subwatershed.

TABLE 3.3.5
Modeled Problem Definition for Arlington Heights Branch

Problem ID	Location	Recurrence Interval of Flooding (yr)	Associated Form B	Resolution in DWP
MPA50	Between Dundee Rd. and Cherrywood Dr.	100-, 50-, 25-, 10-, 5-	-	Project SCAH-50 created

3.3.3.2 Damage Assessment

Damages were defined following the protocol established in Chapter 6.6 of the CCSMP. No erosion damages or recreation damages due to flooding were identified for the subwatershed. Transportation damages were estimated as 15 percent of property damages. Table 3.3.6 lists the damage assessment for existing conditions.

TABLE 3.3.6
Estimated Damages for Arlington Heights Branch

Damage Category	Estimated Damage ($)	Note
Property	1,385,000	
Erosion	0	
Transportation	208,000	Assumed as 15% of property damage due to flooding

3.3.3.3 Technology Screening

Flood control technologies were screened to identify those most appropriate for addressing the flooding problems in the subwatershed. Increased conveyance or storage were identified as the principal technologies applicable for addressing the existing stormwater problems.

3.3.3.4 Alternative Development

Flood Control Alternatives. Alternative solutions to regional flooding problems were developed and evaluated consistent with the methodology described in Section 1.4 of this report. Table 3.3.7 summarizes flood control alternatives developed for the Arlington Heights Branch.

SCAH-50 includes expanding the capacity of the culvert under Dundee Road and replacing the box culverts under Cherrywood Drive. In addition, the channel between these road crossings is widened. This project significantly reduces the peak water surface elevation in this area, removing all structures from the 100-year inundation area..

TABLE 3.3.7
Flood Control and Streambank Stabilization Alternatives for Arlington Heights Branch

Alternative Number	Location	Description
SCAH-50	Village of Palatine between Dundee Rd and Cherrywood Drive.	Expanding the capacity of the culvert under Dundee Road and Cherrywood Drive. In addition, the channel between these road crossings is widened to a 30 foot bottom depth

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for this subwatershed.

3.3.3.5 Alternative Evaluation and Selection

Alternative SCAH-50 was evaluated to determine its effectiveness and produce data required for the countywide prioritization of watershed projects. The alternative resulted in reduces stage along the waterway and is recommended. Table 3.3.8 provides a comparison of the modeled maximum WSEL and modeled flow at the time of peak at representative locations along the waterway.

TABLE 3.3.8
Arlington Heights Branch Existing and Alternative Condition Flow and WSEL Comparison

		Existing Conditions		SCAH-50	
Location	Station	Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
1/4 Mile upstream of Dundee Road	41553	767	473.67	767.34	478
Dundee Road	40248	767	495.03	763.33	501
Cherrywood Drive	39330	761	497.83	759.31	504
1/4 Mile downstream of Cherrywood Drive	37918	756	501.72	756.23	507

A number of properties are at risk of shallow flooding during the 100-year flood event under existing conditions or recommended alternative conditions. In addition, due to their locations, other properties' risk of flooding cannot be feasibly mitigated by structural measures. Such properties are candidates for protection using nonstructural flood control measures, such as flood-proofing or acquisition. These measures may be considered to address damages that are not fully addressed by capital projects recommended in the Upper Salt Creek DWP.

The alternative in Table 3.3.7 was evaluated to determine its effectiveness and produce data required for the countywide prioritization of watershed projects. Flood control alternatives were modeled to evaluate their impact on water elevations and flood damages. Table 3.3.9 provides a summary B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data.

3.3.3.6 Data Required for Countywide Prioritization of Watershed Projects

Appendix I presents conceptual level cost estimates for the recommended alternative. Table 3.3.9 lists the alternative analyzed in detail. Figure 3.3.2 compares the existing 100-year inundation boundary through area with the boundary after implementation of the project and also shows the location of the suggested improvements.

TABLE 3.3.9
Arlington Heights Branch Project Alternative Matrix to Support District CIP Prioritization

Project	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures Protected	Water Quality Benefit	Recommended	Communities Involved
SCAH-50	Widen channel and increase the conveyance capacity of two culverts.	0.81	1,593,000	1,707,000	18	No Impact	Yes	Palatine

Note: Net Benefits values do not include local benefits or non-economic benefits.

4. Watershed Action Plan

This section summarizes the DWP recommendations. The recommendations and supporting information will be considered by the District's Board of Commissioners in their prioritization of a countywide Stormwater Capital Improvement Program (CIP). The recommendations within the DWP consist of maintenance activities (Section 4.1) and recommended capital improvements (Section 4.2).

4.1 Watershed Maintenance Activities

Review of reported stormwater problem data indicated that certain types of maintenance activities would be helpful in preventing these stormwater problems. The District, through its maintenance activities, has been actively removing blockages such as tree limbs and woody debris from channels throughout Cook County. Local communities have reported benefits from these maintenance activities. It is recommended that the District maintenance activities be continued to address ongoing future maintenance needs.

Sedimentation is a dynamic process that is affected by soil protective measures taken in upland tributary areas as well as dynamic streambank conditions. The District's Watershed Management Ordinance will define standard practices for erosion protection on construction sites. Best management practices in upland areas should be paired with stream maintenance measures to reduce sediment delivered to waterways to reduce the need for extensive dredging programs.

Stormwater improvement projects recommended in the Upper Salt Creek DWP including culvert and bridge replacement, weir modifications and channel improvements, will require ongoing maintenance after construction. Costs associated with maintenance over a 50-year life-cycle period were included in cost estimates. It is recommended that the District develop maintenance plans for capital improvements, and where applicable, execute agreements with local governments, delegating certain maintenance responsibilities. Maintenance agreements will follow current District practice, where the District is responsible for operation and maintenance of structural, electrical, and mechanical facilities and grounds are the responsibility of partnering organizations.

4.2 Recommended Capital Improvements

Table 4.2.1 lists all recommended improvements for the Upper Salt Creek DWP. The District will use data presented here to support prioritization of a countywide stormwater CIP.

4.3 Implementation Plan

Alternatives listed in Table 4.2.1 can be constructed independently. The data presented in Table 4.2.1, along with non-economic factors, will allow the District to prioritize its CIP and to implement projects. A number of alternatives in Table 4.2.1 require the acquisition of land that currently may be unavailable. It is recommended that upon selecting an alternative for implementation, the District identify land acquisition needs and procedures.

TABLE 4.2.1
Upper Salt Creek Watershed Prioritization Matrix

Project	B/C Ratio	Total Benefits	Total Project Cost[1]	Probable Construction Cost	Relative Damage Averted 25% 50% 75%	Acreage Removed from Inundation	Wetland or Riparian Areas Impacted	Cumulative Structures Protected	Implementation[1] Time (Months)	Water Quality Benefit	Communities Involved
SCUP-49	0.15	$1,701,000	$11,030,000	$6,393,000		39.3	11.7	61	18	No Impact	Palatine
SCUP-56	0.12	$166,000	$1,403,000[2]	$956,500		11.9	0.0	0	12	No Impact	Rolling Meadows
SCAH-50	0.93	$1,593,000	$1,707,000	$975,000		2.1	2.1	18	8	No Impact	Palatine
SCWB-52	0.31	$351,000	$1,149,000	$665,000		6.8	2.2	3	6	No Impact	Schaumburg

Property Damage Erosion Transportation Recreation

1. Implementation time includes construction time, but does not include time for design, permitting or land acquisition.
2. Total Project Cost includes $1,253,000 required for necessary local improvements.

5. Summary and Conclusions

The Upper Salt Creek DWP was developed in coordination with the Upper Salt Creek WPC. The coordination focused on integrating community knowledge of stormwater problems and ideas for feasible solutions into the District's regional stormwater plan. All stormwater problem data received from stakeholders was recorded in a spatial database, and classified as local or regional according to the criteria defined in Section 1. Hydrologic and hydraulic models were developed to estimate flow and stage along regional waterways and assess the frequency and depth of flooding problems for a range of modeled recurrence intervals. Inundation mapping was developed for the 2-, 5-, 10, 25, 50, 100-year, and 500-year modeled storm events, identifying areas estimated to be at risk of flooding. Modeled water depths and inundation mapping were used to help estimate damages due to flooding within each tributary.

Stormwater improvements were developed to address regional problems throughout the Upper Salt Creek Watershed. Appropriate tributary-specific technologies were screened considering their applicability for addressing problem areas, constructability in the area required, and regulatory feasibility. Damage estimates for proposed alternatives were performed to evaluate the alternative's effectiveness at reducing regional stormwater damages. The difference in damages between existing and alternative conditions was quantified as the alternative's benefit. In addition to numeric benefits, several other criteria were noted for each alternative, such as the number of structures protected, water-quality benefit, and wetland/riparian areas affected. Conceptual level cost estimates were developed to estimate the construction and maintenance cost of proposed alternatives over a 50-year period. The estimated benefits were divided by the conceptual cost to develop a B/C ratio for each alternative.

Table 5.1 illustrates the potential of alternatives within the DWP to address regional damages throughout the watershed. As an example, the recommended the West Branch alternatives address 100 percent of estimated damages, which corresponds to a benefit of $351,000.

Recommended alternatives are estimated to reduce regional damages by $3,811,000 over a 50-year period, at an estimated cost of $15,289,000. Estimated damage reductions result from proposed stormwater improvements that increase conveyance to receiving systems, only if increased flows do not cause downstream damages. Floodproofing alternatives, though feasible for addressing isolated shallow flooding issues, are not included in the summary statistics due to the individualized way in which such measures would be implemented. All of the projects address damages at all levels of frequency up to and including the 100-year flood. As discussed in the previous chapters the recommended projects were focused on concentrations of damaged structures to make the projects as cost effective and beneficial as possible. It was not feasible to develop individual projects to protect isolated or small groups of structures. These are more easily addressed using flood proofing or acquisition methods that are outside of the scope of this plan

TABLE 5.1
Upper Salt Creek Watershed Alternative Summary

Watershed	Existing Conditions Damages	Benefits from Recommended Alternatives	Percent of Damages Addressed	Benefit Cost Ratio
Upper Main Stem	$6,367,000	$1,867,000	29%	0.15
Arlington Heights Branch	$1,593,000	$1,593,000	100%	0.93
West Branch	$351,000	$351,000	100%	0.31
Total	$8,311,000	$3,811,000	46%	0.25

Stormwater problems, whether identified by stakeholders or identified by modeling of intercommunity waterways, indicate a need for regional stormwater management solutions throughout the Upper Salt Creek Watershed. Although problem areas are concentrated in the more intensively developed central section of the watershed, stormwater problems exist throughout the watershed. If constructed, the recommended alternatives in Table 4.2.1 are expected significantly to reduce stormwater damages, although damages are expected to persist within the watershed even following construction of those projects. However, implementation of the recommended projects should reduce the number of homes and businesses adversely affected by flooding, and also the severity of damages. Communities can continue to work toward reducing stormwater damage by ensuring that development is responsibly managed with consideration given to potential stormwater impacts and the existing stormwater problems within the watershed.

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