3.3 Deer Creek

The Deer Creek subwatershed encompasses approximately 26 square miles (8.8 in Cook County and 17.5 in Will County) within the southern portion of the Little Calumet River watershed, with 9.6 square miles of drainage area in Cook County, and the remaining in Will County. Deer Creek joins Thorn Creek near the junction of Main Street and State Street in Glenwood. **Table 3.3.1** lists the communities and the drainage areas contained within the Deer Creek subwatershed.

Table 3.3.1: Communities Draining to Deer Creek within Cook County

Community	Tributary Area (mi^2)
Chicago Heights	1.10
Crete	<0.01
Ford Heights	1.04
Glenwood	0.04
Lynwood	<0.01
Sauk Village	0.14
South Chicago Heights	0.24
Steger	0.02
Unincorporated Cook County/ Forest Preserve	6.22

Table 3.3.2 lists the land use breakdown by area within the Deer Creek 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.

Table 3.3.2: Land Use Distribution for Deer Creek Subwatershed within Cook County

Land Use	Acres	%
Agricultural	1,803	32
Commercial/Industrial	657	12
Forest/Open Land	1,314	23
Institutional	170	3
Residential	1,058	19
Transportation/Utility	268	4
Water/Wetland	371	6

Within the Deer Creek subwatershed, a total of 15.1 stream miles were studied among the five tributaries: Deer Creek, Unnamed Tributary to Deer Creek, Third Creek, Tributary B, and Tributary B Unnamed Tributary.

- Deer Creek (DRCR) – originates in Will County and crosses the Cook County line at Steger Road, 1.5 miles west of Illinois Route 394 (Calumet Expressway) and flows to the confluence with Thorn Creek within the Cook County Forest Preserve, 0.25 miles southwest of the intersection of State Street and Main Street in Glenwood.

- Unnamed Tributary to Deer Creek (UTDC) – being less than 3,000 linear feet, flows entirely through property owned by Exelon, to its confluence with Deer Creek north of Sauk Trail Road and 0.25 miles west of Cottage Grove Avenue.

- Third Creek (TDCR) – extends from south of Joe Orr Road and flows northerly to its confluence with Deer Creek located southwest of the intersection of Cottage Grove Avenue and Glenwood-Dyer Road in Glenwood.

- Tributary B (DCTB) – originates in Will County and crosses the Cook County border at Steger Road, 1,500 feet west of Illinois Route 394. It reaches its

confluence with Deer Creek just upstream of US Route 30 (Lincoln Highway) in Ford Heights. For approximately 3,200 feet at the downstream end of Tributary B, it flows along the north and east side of the Deer Creek Reservoir.

- Tributary B Unnamed Tributary (UTTB) – originates west of Cottage Grove Avenue, approximately 0.25 miles north of 229th Street in Steger. It extends less than 3,500 linear feet to its confluence with Tributary B, approximately 0.67 miles southwest of the intersection of Sauk Trail Road and Illinois Route 394.

The Deer Creek subwatershed contains one major detention facility, the Deer Creek Reservoir. The reservoir is located south of US 30 (Lincoln Highway) and west of Illinois Route 394 (Calumet Expressway) in Ford Heights. The reservoir was planned, designed, and constructed by the USACE Chicago District. The reservoir provides a total storage volume of 587 acre feet to a maximum stage of 639.0 feet.

3.3.1 Sources of Data

3.3.1.1 Previous Studies

Studies have been performed for the Deer Creek subwatershed with the purpose of assessing the stormwater flooding problems and evaluating structural solutions. Below is the list of studies that were identified for Deer Creek:

- *WSP-2 Study*, Illinois Department of Transportation, 1980.

- *Deer Creek Reservoir Study,* United States Army Corps of Engineers (USACE), 2006.

The USACE study was used to determine reservoir parameters for the Deer Creek Reservoir. No information from the IDOT was applicable to the development of the DWP.

During Phase A and B of DWP development, additional survey, topography, precipitation, stream flow, land use, and soils data needed for the development of the Deer Creek subwatershed model were identified and collected.

3.3.1.2 Water Quality Data

Water quality for the Deer Creek subwatershed is monitored by two agencies, the Illinois Environmental Protection Agency (IEPA) and the United States Geological Survey (USGS). IEPA monitors water quality at one location in the Deer Creek subwatershed as part of the Ambient Water Quality Monitoring Network (AWQMN). This water quality monitoring station (HBDC-02) is at the Cottage Grove Avenue crossing in Glenwood, Illinois. At the station, water samples are collected once every six weeks and analyzed for a minimum of 55 water quality parameters including pH, temperature, specific conductance, dissolved oxygen, suspended solids, nutrients, fecal coliform bacteria, and total and dissolved metals. Additional parameters specific to the station, watershed, or sub-network within the ambient network are also analyzed.

The USGS monitors water quality, including water temperature and instantaneous flow, at the USGS 05536235 gage located on Deer Creek at Joe Orr Road in Chicago Heights, Illinois. Several of the USGS stations identified for flow and stage recordings also have water quality measurements. Sporadic data recordings are taken at each of the sites, though they are typically recorded at least once a month. The period of record and type of data monitored vary from station to station.

IEPA's 2008 Integrated Water Quality Report, which includes the Clean Water Act (CWA) 303(d) and the 305(d) lists, identifies the main stem of Deer Creek as impaired for dissolved oxygen impairments, with a Stage 1 TMDL status being designated for Deer Creek for dissolved oxygen. In addition, total nitrogen, total phosphorous, and sedimentation/siltation are listed as "potential causes for stream impairment" even though there are no TMDL developed for these constituents.

NPDES point source discharges within the Deer Creek subwatershed are listed in **Table 3.3.3.** In addition to the point source discharges listed, municipalities discharging to Deer Creek or its tributaries are regulated by IEPA's NPDES Phase II Stormwater Permit Program, which was created to improve the quality of stormwater runoff from urban areas, and requires that municipalities obtain permits for discharging stormwater and implement six minimum control measures for limiting runoff pollution to receiving systems. Also as part of the Phase II Stormwater Permit Program, construction sites disturbing greater than 1 acre of land are required to get a construction permit.

Table 3.3.3: Point Source Dischargers in Deer Creek Area

Name	NPDES	Community	Receiving Waterway
Mid-West Manufacturing Co.	IL0059421	Chicago Heights	State Street Ditch tributary to Thorn Creek
Chicago Heights Steel	IL0001678	Chicago Heights	State Street Ditch tributary to Thorn Creek
Innophos Inc.	IL0035220	Chicago Heights	State Street Ditch tributary to Thorn Creek

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.

3.3.1.3 Wetland and Riparian Areas

Figures 2.3.6 and **2.3.7** contain mapping of wetland and riparian areas in the Little Calumet River Watershed. Wetland areas were identified using National Wetlands Inventory (NWI) mapping. NWI data includes roughly 290 acres of wetland areas in the Deer Creek 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

The floodplain boundaries for the Deer Creek subwatershed were revised in 2008 as part of FEMA's Map Modernization program. Floodplain boundaries were revised

based on the recent Cook County topographic data and an updated downstream boundary condition for the Deer Creek effective model. Deer Creek was mapped as Zone AE study (detailed).

The FEMA 2006 effective models were not available from the Illinois State Water Survey during the development of the Deer Creek subwatershed hydraulic model; however, other models were obtained from different agencies. A WSP-2 model from 1980 which includes Deer Creek, Tributary B, Unnamed Tributary to Tributary B and Third Creek was provided by IDOT, but was not considered usable since it was developed over ten years ago. A HEC-RAS model developed in 2008 by the USACE was made available and was used in hydraulic model development.

3.3.1.5 Stormwater Problem Data

Table 3.3.4 summarizes reported problem areas reviewed as a part of 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 criteria described in **Section 2.2.1** of this report.

Table 3.3.4: Community Response Data for Deer Creek Subwatershed

Problem ID	Municipality	Problems as Reported by Local Municipality	Location	Problem Description	Local/ Regional	Resolution in DWP
BL02	Bloom Township	Storm sewer, other	Sauk Trail Road from Western Avenue to Torrence Avenue	Partially related to local storm sewer system; maintenance issue and overbank flooding near State Street	Regional	Channel improvements and maintenance (Alternative DRCRG2-A4)
BL06	Bloom Township	Siltation	Cottage Grove Avenue from Steger Road to 183rd Street	Siltation; stream is migrating	Channel maintenance	Removal of silt to be addressed by stream maintenance
CHT3	Chicago Heights	Pavement flooding	US 30 at Cottage Grove Avenue (IDOT)	Roadway flooding at US 30; properties flooded north of US 30	Regional	Channel improvements, floodwall, additional storage (Alternative DRCRG1-A5)
FHT1	Ford Heights	New reservoir not in service	Woodlawn Avenue and 17th Street	Residences south of US 30 flooded	Regional	Channel improvements, floodwall, additional storage (Alternative DRCRG1-A5)

Table 3.3.4: Community Response Data for Deer Creek Subwatershed

Problem ID	Municipality	Problems as Reported by Local Municipality	Location	Problem Description	Local/ Regional	Resolution in DWP
GLW3	Glenwood	Channel restriction	Deer Creek/Thorn Creek confluence	Prone to beaver dams	Channel maintenance	Removal of debris to be addressed by stream maintenance
STE1	Steger	Pavement flooding	State Street at 227th Place (IDOT)	Flooding of residential properties, overtopping of Sauk Trail	Regional	Channel improvements and maintenance (Alternative DRCRG2-A4)

3.3.1.6 Near Term Planned Projects

No near-term planned major flood control projects to be constructed by others were identified for the Deer Creek subwatershed.

3.3.2 Watershed Analysis

3.3.2.1 Hydrologic Model Development

3.3.2.1.1 Subbasin Delineation

The Deer Creek subwatershed was delineated according to the methods described in **Sections 1.3.2** and **2.3.2**. There are 34 subbasins ranging in size from 0.049 to 8.43 square miles with an average size of 0.793 square miles.

Hydrologic Parameter Calculations. Curve numbers (CN) and directly connected impervious percentages were estimated for each subbasin as described in **Section 1.3.2**. An area-weighted average of the CN was generated for each subbasin. The Clark's unit hydrograph parameters were estimated using the method described in **Section 1.3.2**. Appendix G provides a summary of the hydrologic parameters used for the subbasins in each subwatershed.

3.3.2.2 Hydraulic Model Development

3.3.2.2.1 Field Data, Investigation, and Existing Model Data.

The FEMA effective hydraulic models were not available for use in developing the hydraulic model for the Deer Creek subwatershed. A WSP-2 model from 1980 which includes Deer Creek, Tributary B, Unnamed Tributary to Tributary B and Third Creek was provided by IDOT, but was not considered usable since it was developed over ten years ago. A HEC-RAS model from 2008 by the USACE was made available, and was created for a Deer Creek Reservoir Letter of Map Change (LOMC# 08-05-2074P-170054).

The USACE HEC-RAS model was reviewed to determine which portions of the geometry could be used in DWP development. The entire portion of the model that defined the geometry of the Deer Creek Reservoir, including storage cells, storage

volumes, connections between storage areas, and connections to Deer Creek and Tributary B were used. However, the channel geometry for Deer Creek or Tributary B as defined in the USACE HEC-RAS model was not used since the number and density of the cross sections provided did not meet the modeling requirements for use in the DWP.

After a review of existing models, field reconnaissance data and hydraulic structures dimensions data, a field survey plan for Deer Creek was developed. Field survey was performed under the protocol of FEMA's *Guidelines and Specifications for Flood Hazard Mapping partners, Appendix A: Guidance for Aerial Mapping and Surveying*. Field survey was performed in early 2008. Cross sections were generally surveyed between 500 to 1,000 feet apart. The actual spacing and location was determined based on the variability of the channel's shape, roughness, and slope. A total of 32 cross sections and 36 hydraulic structures were surveyed to develop the hydraulic model for the Deer Creek subwatershed.

The Manning's n-values at each cross section were estimated using a combination of aerial photography and photographs from field survey and field reconnaissance. The horizontal extent of each type of land cover and the associated n-value for each cross section were manually entered in to the HEC-RAS hydraulic model. The initial n-values were used as a model starting point and were adjusted within the provided ranges during calibration. All the n-values were manually adjusted using the HEC-RAS cross-sectional data editor.

The n-values were increased where buildings are located within the floodplain to account for conveyance loss. The n-values in these areas may range from 0.06 for areas with few buildings to 0.15 for fully developed areas. If significant blockage is caused by buildings in the flood fringe, the developed areas were modeled as ineffective flow. **Table 3.3.5** is the list of channel and overbank ranges of n-values that were used for the Deer Creek subwatershed model.

Table 3.3.5: Channel and Overbank Associated Manning's n-Values[1]

Tributary	Range of Channel n-Values	Range of Overbank n-Values
DRCR	0.045 - 0.07	0.05 - 0.15
UTDC	0.055	0.08
DCTB	0.055 - 0.06	0.06 - 0.075
UTTB	0.055 - 0.06	0.07 - 0.1
TDCR	0.06 - 0.065	0.05 - 0.1

[1]**Source**: Open Channel Hydraulics, Chow 1959

3.3.2.2.2 Boundary Conditions.

The Deer Creek hydraulic model requires one boundary condition at its downstream end, at the confluence with Thorn Creek. FEMA's Cook County FIS 100-year elevation of 618.0 feet was used as a boundary condition at this location.

3.3.2.3 Calibration and Verification

A detailed calibration was performed for the Deer Creek subwatershed using historic gage records under the guidelines of Chapter 6 of the Cook County Stormwater Management Plan (CCSMP). Three historical storms, April 2006, April 2007 and September 2008, were evaluated based on the stream gage flows, precipitation amounts and records of flooding in the Deer Creek subwatershed, and were found to be applicable for calibration and verification.

For the calibration storms, Illinois State Water Survey (ISWS) Cook County precipitation gages, National Weather Service (NWS) recording and non-recording gages, and Community Collaborative Rain, Hail & Snow Network (CoCoRAHS) precipitation amounts were used. Theissen polygons were developed for each storm based on the rain gages available for that storm. The gage weightings for the recording and non-recording gages were computed in ArcGIS for each subbasin.

There is one active stream gage in the Deer Creek subwatershed. USGS Gage 05536235 on Deer Creek near Chicago Heights, Illinois, located where Deer Creek passes under US 30, is at latitude 41°31'15" longitude 87°35'25" (NAD27). The datum of the gage is 615.95 feet NGVD29 (615.65 feet NAVD88). Instantaneous flow data is available at this gage from 09/01/1986 through the present.

Runoff hydrographs were developed using HEC-HMS and routed through the Deer Creek hydraulic model. The stages and flows produced for each calibration storm were compared to the observed stream gage data. During calibration of the Deer Creek subwatershed model, the curve number, directly connected impervious area percentage, and lag times were adjusted so that the peak flow rate, hydrograph shape and timing, and total volume matched the observed hydrographs within the CCSMP's criteria.

During calibration, the curve number and directly connected impervious percentage were reduced by 5% and 10%, respectively. The Clark's storage coefficient R was increased by 25%.

After the final adjustments to the HEC-HMS and HEC-RAS models, the modeled flows and stages were compared to the observed data to determine if they were within the CCSMP's criteria. **Table 3.3.6** shows the comparison of the flows for all three calibration storms. **Figures 3.3.2**, **3.3.3**, and **3.3.4** show the calibration results for the April 2006, April 2007 and September 2008 storm events, respectively. The modeled flow is within 30% of the observed flow, which is within CCSMP's criteria. The modeled stage is within 0.5 feet of the observed stage for the September 2008 event and within 0.75 feet of the observed stage for the other two events. Since the CCSMP's criteria for calibration is 0.5 feet for stage and 30% for flow, the April 2006 and April 2007 storm events are slightly outside of this range.

Table 3.3.6: Deer Creek Subwatershed Calibration Results

	Observed		Modeled		CCSMP's Criteria[1]	
Storm Event	**Flow (cfs)**	**Stage (ft)**	**Flow (cfs)**	**Stage (ft)**	**Percentage Difference in Peak Flow**	**Difference in Stage (ft)**
Apr-06	873	627.80	789	627.04	-10%	-0.75
Apr-07	402	625.79	290	625.09	-28%	-0.69
Sep-08	1,320	628.24	1,542	628.06	17%	-0.18

[1]Flow within 30% and stage within 6 inches.

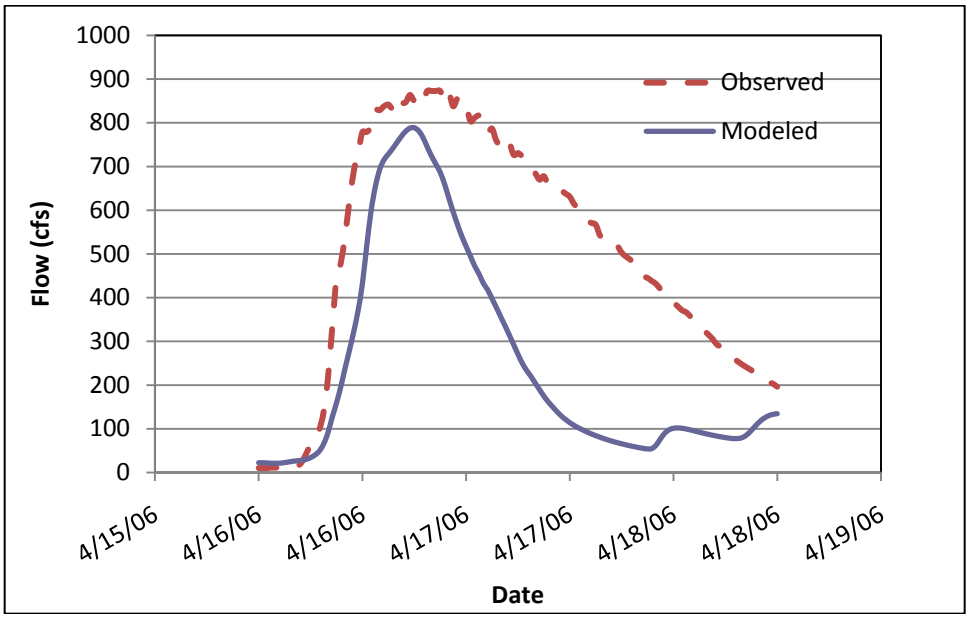

Figure 3.3.2: Deer Creek Calibration Results, April 2006 Storm Event

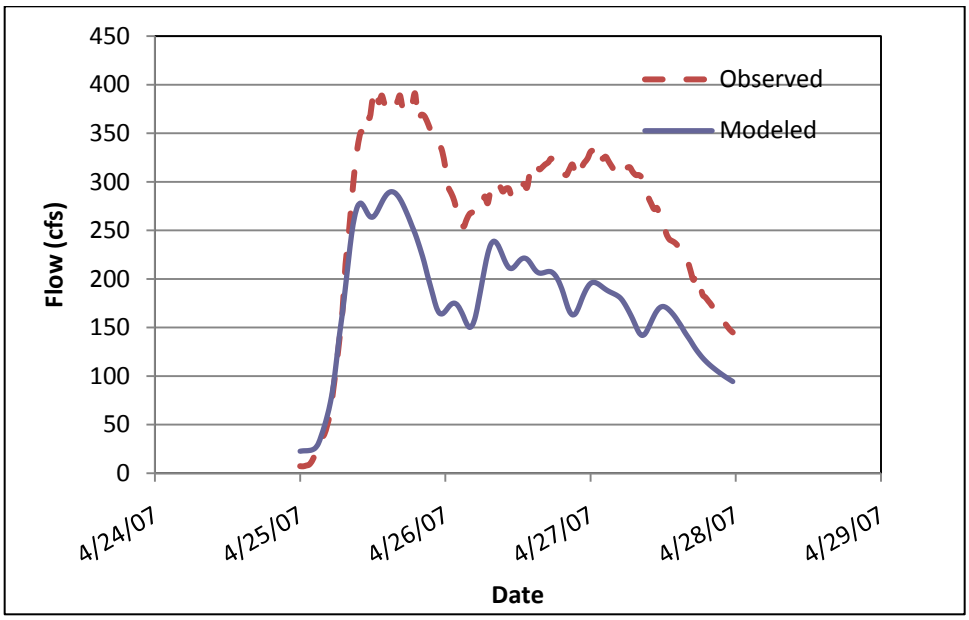

Figure 3.3.3: Deer Creek Calibration Results, April 2007 Storm Event

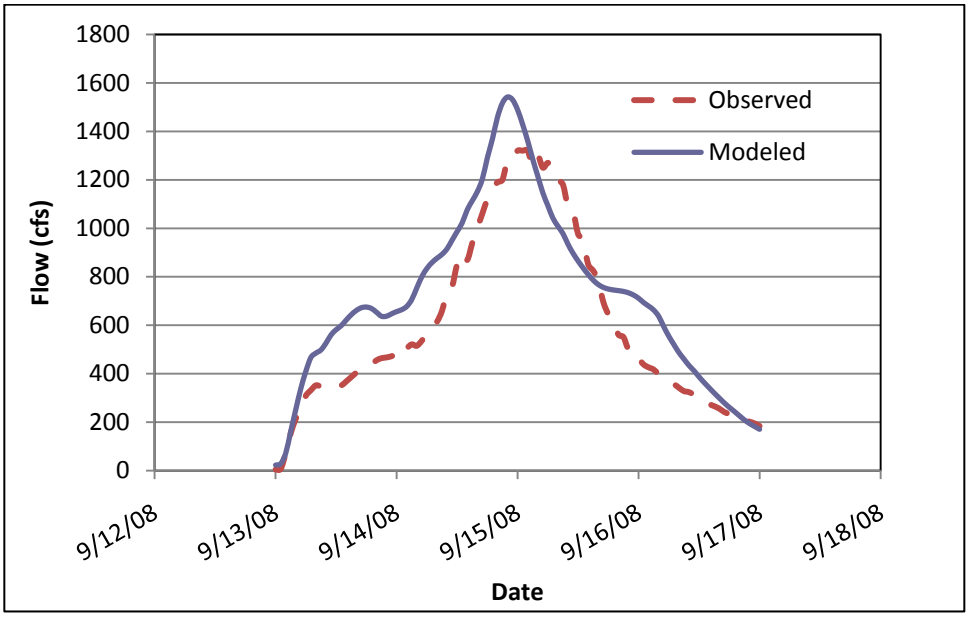

Figure 3.3.4: Deer Creek Calibration Results, September 2008 Storm Event

Although the April 2006 and April 2007 storm events do not meet the CCSMP's criteria, the model is considered well calibrated. Since the stages are seen to be generally on the low side, raising the Manning's n-values was initially considered, but more research was performed to understand this discrepancy, as follows.

Figure 3.3.5 depicts the rating curve with the three simulated events (black squares) as well as all events measured by the USGS since 1995. The USGS measurements have been further broken down into those for which the field notes stated "Heavy Debris", and those for which the field notes stated "Clear or Medium Debris".

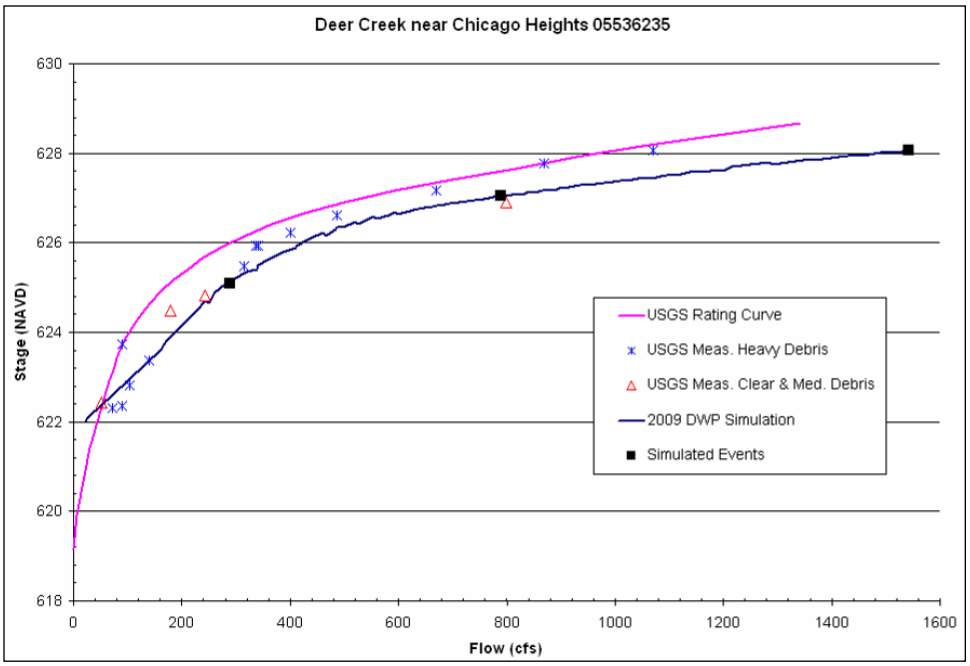

Figure 3.3.5: USGS Rating Curve vs. Simulated Events, Deer Creek Gage

Although the three simulated events are slightly outside the limits for stage as required by the CCSMP, the three USGS measurements that were noted either "Clear" or "Medium" debris lie very close to the simulated rating curve. The modeled event of April 2006 lies almost directly over one of the USGS "Clear or Medium" measurements (Dated January 8, 2008 with flow = 799 cfs and stage = 626.91 feet). This measurement's flow is within 10 cfs of the simulated event and has a stage within 0.13 feet of the simulated event.

Figure 3.3.5 includes the USGS station rating curve. The term "Observed" in **Table 3.3.6** refers to the stage that the USGS gage automatically measured via a pressure transducer. The stage value was correlated to a flow value based on the USGS station rating curve. Thus, in order to obtain a well calibrated model based solely on the USGS data output from a stream gage, a simulated rating curve is required that matches well with the USGS station rating curve.

In **Figure 3.3.5**, the rating curve developed by the model (2009 DWP simulation) matches well with the three "Clear or Medium" USGS measurements. It is likely that if a rating curve was developed solely on "Clear or Medium" measurements, that rating curve would agree almost exactly with the modeled rating curve. Because of this, the HEC-RAS model for this subwatershed is considered well calibrated to conditions in the channel that can be described as either "Clear" or "Medium" debris. The option of including debris in the model during the final calibration was considered as it is well documented and would also raise the stages in Table 3.3.6 to within the CCSMP's criteria; however, this was deemed to be an unacceptable option.

3.3.2.4 Existing Conditions Evaluation

3.3.2.4.1 Flood Inundation Areas.

A critical duration analysis was performed for the Deer Creek subwatershed hydraulic model. The 100-year, 1-, 3-, 6-, 12-, 24-, 48- and 72-hour storm events were run to determine the critical duration. The 6-hour duration was found to be the critical duration for Tributary B upstream of Sauk Trail. The 12-hour duration was found to be the critical duration for Deer Creek upstream of the EJ&E Railroad tracks. The 48-hour duration was found to be the critical duration for the remainder of the reaches. **Figure 3.3.1** shows inundation area produced for the 100-year critical duration storm event.

3.3.2.4.2 Hydraulic Profiles.

Hydraulic profiles for Deer Creek and its tributaries are shown in Appendix H. Profiles are shown for the 2-, 5-, 10-, 25-, 50-, 100-, and 500 year recurrence interval design storm events.

3.3.3 Development and Evaluation of Alternatives

Hydraulic model results were reviewed with inundation mapping to identify locations where property damage due to flooding is predicted. **Table 3.3.7** summarizes problem areas identified through hydraulic modeling of the Deer Creek subwatershed.

Problem areas that were hydraulically interdependent or otherwise related were grouped for alternatives analysis. Each project group is addressed in terms of combined damages and alternatives/solutions.

Table 3.3.7: Modeled Problem Definition for the Deer Creek Subwatershed

Problem ID	Group ID	Location	Recurrence Interval (yr) of Flooding	Associated Form B	Resolution in DWP
DRCR1	DRCR-G1	North of US 30, Ford Heights	5, 10, 25, 50 & 100	CHT3	DRCRG1-A5
DRCR2	DRCR-G2	South of Sauk Trail Road, Steger	10, 25, 50, & 100	BL02, STE1	DRCRG2-A4

Damage assessment, technology screening, alternative development and alternative selection were performed by problem grouping, since each group is independent of the other. Each problem grouping is evaluated in the following sections by group ID.

3.3.3.1 DRCR-G1 – Deer Creek Problem Group 1

3.3.3.1.1 Problem Definition, DRCR-G1

The DRCR-G1 problem area consists of overbank flooding along Deer Creek in the Village of Ford Heights, between US Route 30 and 8th Street. North of US 30 is a dense residential neighborhood, with approximately 270 structures subject to flooding. South of US 30, approximately 24 residential structures in the vicinity of 14th Place and one business on US Route 30 are subject to flooding during the 100-year storm event.

3.3.3.1.2 Damage Assessment, DRCR-G1

Damages were defined following the protocol defined in Chapter 6.6 of the CCSMP. Critical duration analysis was performed to determine the highest flood stages for Deer Creek and its tributaries. These stages were used to calculate the depth of flooding and to estimate damages at each flooding problem area. The District's Stormwater Planning Database Tool was used to estimate the damages. Property damages for each building structure were calculated and transportation damages were estimated at 15% of the property damages, unless otherwise noted. Recreation damages were estimated based on depth and duration of flooding. **Table 3.3.8** lists the estimated damages for the problem group.

Table 3.3.8: Estimated Damages for Deer Creek Subwatershed, Problem Group DRCR-G1

Problem Group ID	Damage Category	Estimated Damage ($)	Description
DRCR-G1	Property	$3,305,000	Structures at risk of flooding
	Transportation	$496,000	Assumed as 15% of property damage due to flooding
	Recreation	$0	

3.3.3.1.3 Technology Screening, DRCR-G1

Several combinations of technologies were analyzed to address the flooding problems associated with DRCR-G1. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.3.9** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem grouping.

Table 3.3.9: Evaluation of Flood Control Technologies for Deer Creek Subwatershed, Problem Group DRCR-G1

Flood Control Option	Feasibility
Detention Facilities	Feasible. Potential to increase size of Deer Creek reservoir
Conveyance Improvement – Culvert/Bridge Replacement	Feasible. Enhance hydraulic capacity at crossing at Joe Orr Road by modifying or removing bridge
Conveyance Improvement – Channel Improvement	Feasible. May result in need for compensatory storage
Conveyance Improvements – Diversion	Not feasible
Flood Barriers, Levees/Floodwalls	Feasible. May result in need for compensatory storage

3.3.3.1.4 Alternative Development, DRCR-G1

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 3.3.10** summarizes flood control alternatives developed for Problem Group DRCR-G1.

Table 3.3.10: Flood Control Alternatives for Problem Grouping DRCR-G1

Alternative	Location	Description
DRCRG1-A1	Deer Creek north of US 30	Increase channel capacity of adjacent reach. This requires compensatory storage
DRCRG1-A2	Joe Orr Road	Modification or removal of crossing at Joe Orr Road. This alternative does not provide the needed reduction in stage
DRCRG1-A3	Deer Creek Reservoir	Increase storage volume of Deer Creek Reservoir to provide 24 ac-ft of compensatory storage
DRCRG1-A4	Along Deer Creek, from US 30 to 15th Street	Construct a floodwall to protect residential and commercial properties
DRCRG1-A5	Deer Creek north of US 30, Deer Creek reservoir, Deer Creek from US 30 to 15th Street	Increase channel capacity of reach, increase storage volume of reservoir and construct floodwall (combination of Alternatives DRCRG1-A1, DRCRG1-A3 and DRCRG1-A4)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the DRCR-G1 Problem Group.

3.3.3.1.5 Alternative Evaluation and Selection, DRCR-G1

Alternatives included in **Table 3.3.10** were evaluated to determine their effectiveness and produce the 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 3.3.12** provides the B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data for the preferred alternative for Problem Group DRCR-G1. Alternatives that did not produce a significant change in inundation areas are not listed as benefits were negligible, thus costs were not calculated for these alternatives.

Alternative DRCRG1-A5 from **Table 3.3.10** is the preferred alternative for Problem Group DRCR-G1. The preferred alternative includes channel capacity improvements along Deer Creek north of US Route 30 with compensatory storage provided upstream in the Deer Creek Reservoir. A floodwall would be constructed from US 30 to 16th Street. Since the land in the vicinity of Deer Creek Drive and 14th Place is a local low spot and collects overflows from the surrounding area, building a floodwall along Deer Creek to reduce the overflow from the creek into the residential neighborhood will alleviate flooding.

Table 3.3.11 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for DRCR-G1.

Table 3.3.11: Alternative Condition Flow & WSEL Comparison for Problem Group DRCR-G1

Location	Station	Existing Conditions		Alternative DRCRG1-A5	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
USACE Reservoir Access Road	23099	637.17	1726	634.40	1461
US Highway 30	22545	635.80	2470	2454	634.13

3.3.3.1.6 Data Required for Countywide Prioritization of Watershed Projects, DRCR-G1

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.3.12** lists the alternative analyzed in detail. The recommended alternative consists of channel capacity improvements along Deer Creek and compensatory storage in the Deer Creek Reservoir. **Figure 3.3.6** shows the location of the recommended alternative and a comparison of the inundation area for existing conditions with the reduced inundation area resulting from the recommended alternative.

Table 3.3.12: Deer Creek Project Alternative Matrix to Support District CIP Prioritization for Problem Grouping DRCR-G1

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
DRCR-G1	DRCRG1-A5	Conveyance Improvement, Storage	0.49	$3,801,000	$8,331,000	270 Structures	No Impact	Ford Heights

3.3.3.2 DRCR-G2 – Deer Creek Problem Group 2

3.3.3.2.1 Problem Definition, DRCR-G2

The DRCR-G2 problem area consists of overbank flooding along Deer Creek south of Sauk Trail Road in Steger. Approximately 2 structures, including residences and a church, are flooded.

3.3.3.2.2 Damage Assessment, DRCR-G2

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for Deer Creek and its tributaries. These stages were used to calculate the depth of flooding and then to estimate damages at each flooding problem area. The District's Stormwater Planning Database Tool was used to estimate the damages. Property damages for each building structure were calculated and transportation damages were estimated at 15% of the property damages, unless otherwise noted. Recreation damages were estimated based on depth and duration of flooding. **Table 3.3.13** lists the estimated damages for the problem group.

Table 3.3.13: Estimated Damages for Deer Creek Subwatershed, Problem Group DRCR-G2

Problem Group ID	Damage Category	Estimated Damage ($)	Description
DRCR-G2	Property	$58,000	Structures at risk of flooding
	Transportation	$9,000	Assumed as 15% of property damage due to flooding
	Recreation	$0	

3.3.3.2.3 Technology Screening, DRCR-G2

Several combinations of technologies were analyzed to address the flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.3.14** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem grouping.

Table 3.3.14: Evaluation of Flood Control Technologies for Deer Creek Subwatershed, Problem Group DRCR-G2

Flood Control Option	Feasibility
Detention Facilities	Not needed given alternative
Conveyance Improvement – Culvert/Bridge Replacement	Feasible at Sauk Trail Road
Conveyance Improvement – Channel Improvement	Feasible north of Sauk Trail Road
Conveyance Improvements – Diversion	Not needed given alternative
Flood Barriers, Levees/Floodwalls	Not needed given alternative

3.3.3.2.4 Alternative Development, DRCR-G2

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 3.3.15** summarizes flood control alternatives developed for Problem Group DRCR-G2.

Table 3.3.15: Flood Control Alternatives for Problem Grouping DRCR-G2

Alternative	Location	Description
DRCRG2-A1	Sauk Trail Road	Improve conveyance capacity by unblocking debris at crossing
DRCRG2-A2	Upstream of Sauk Trail Road	Increase channel conveyance; widen to 50 ft with 3:1 side slopes for 1,800 LF
DRCRG2-A3	Sauk Trail Road	Remove crossing. This alternative does not provide required reduction in stages
DRCRG2-A4	Vicinity of Sauk Trail Road	Unblock debris from crossing and increase channel conveyance (combination of Alternatives DRCRG2-A1 and DRCRG2-A2)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the DRCR-G2 Problem Group.

3.3.3.2.5 Alternative Evaluation and Selection, DRCR-G2

Alternatives included in **Table 3.3.15** 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 3.3.17** provides the B/C ratio, net benefits, total project costs, number of structures protected, and other relevant alternative data for the preferred alternative. Alternatives that did not produce a significant change in inundation areas are not listed as benefits were negligible, thus costs were not calculated for these alternatives.

Alternative DRCRG2-A4 from **Table 3.3.15** is the preferred alternative for this Problem Group. The existing culvert under Sauk Trail Road is partially blocked, and maintenance is required to unblock the culvert. However, even with the culvert able to convey its full capacity, the peak water surface elevation is not reduced enough to remove the structures from the inundation area. Conveyance improvements in the channel from Sauk Trail Road to 1,800 feet upstream consisting of widening the channel to a 50-foot width with 3:1 side slopes are recommended to increase the capacity of the channel.

Table 3.3.16 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for DRCR-G2.

Table 3.3.16: Alternative Condition Flow & WSEL Comparison for Problem Group DRCR-G2

Location	Station	Existing Conditions		Alternative DRCRG2-A4	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
300 feet upstream of Sauk Trail Road	35977	656.14	1940	655.91	1931

3.3.3.2.6 Data Required for Countywide Prioritization of Watershed Projects, DRCR-G2

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.3.17** lists the alternative analyzed in detail. The recommended alternative consists of maintenance at the Sauk Trail Road culvert crossing and 1,800 linear feet of channel conveyance improvements. **Figure 3.3.7** shows the location of the recommended alternative and a comparison of the inundation area for existing conditions with the reduced inundation area resulting from the recommended alternative.

Table 3.3.17: Deer Creek Project Alternative Matrix to Support District CIP Prioritization for Problem Grouping DRCR-G2

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
DRCR-G2	DRCRG2-A4	Maintenance at culvert crossing, channel widening	< 0.01	$55,000	$14,312,000	2 Structures	No Impact	Steger

3.3.4 Recommended Alternatives, Deer Creek Subwatershed

Table 3.3.18 summarizes the recommended alternatives for the Deer Creek subwatershed. The District will use data presented here to support prioritization of a countywide stormwater CIP.

Table 3.3.18: Deer Creek Project Alternative Matrix to Support District CIP Prioritization, All Problem Groups

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
DRCR-G1	DRCRG1-A5	Conveyance improvement, storage, floodwall	0.49	$3,801,000	$8,331,000	270 Structures	No Impact	Ford Heights
DRCR-G2	DRCRG2-A4	Maintenance at culvert crossing, channel widening	< 0.01	$55,000	$14,312,000	2 Structures	No Impact	Steger

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