3.8 Little Calumet River

The Little Calumet River subwatershed encompasses approximately 33 square miles (27.66 in Cook County and 4.86 in Lake County, Indiana) within the northwestern portion of the Little Calumet River watershed. **Table 3.8.1** lists the communities that lie within the subwatershed and the associated drainage area for each community contained within the subwatershed.

Table 3.8.1: Communities Draining to Little Calumet River Subwatershed Within Cook County

Community	Tributary Area (mi^2)
Blue Island	0.30
Calumet City	2.44
Calumet Park	<0.01
Country Club Hills	0.02
Dixmoor	1.24
Dolton	2.40
Harvey	4.35
Lansing	4.35
Markham	2.26
Midlothian	0.51
Oak Forest	0.44
Phoenix	0.44
Posen	0.17
Riverdale	1.95
South Holland	4.20
Unincorporated Cook County/ Forest Preserve	2.59

Table 3.8.2 lists the land use breakdown by area within the Little Calumet River subwatershed. **Figure 3.8.1** 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.

Within the Little Calumet River subwatershed, a total of 13.8 stream miles were studied among two tributaries, the Little Calumet River main stem and an Unnamed Tributary to the Little Calumet River. The remaining tributaries to the Little Calumet River were studied as separate subwatersheds (See **Sections 3.1** through **3.7**).

Table 3.8.2: Land Use Distribution for Little Calumet River Subwatershed Within Cook County

Land Use	Acres	%
Commercial/Industrial	2,466	13.9
Forest/Open Land	4,279	24.1
Institutional	1,023	5.8
Residential	8,137	46
Transportation/Utility	1,396	7.9
Water/Wetland	262	1.5
Agricultural	126	0.7

- Little Calumet River (LCRW) – The Little Calumet River originates in Indiana near Hart Ditch (Plum Creek) at a flow divide, which varies in location depending on flow conditions and precipitation distribution across the watershed. At the flow divide, a portion of the Little Calumet River flows easterly and becomes Burns Ditch at the confluence with Deep River, ultimately discharging into Lake Michigan. This occurs entirely within the State of Indiana. The easterly flowing portion of the Little Calumet River, although included in the hydrologic and hydraulic models created for the DWP, was not studied further as part of the DWP.

- The westerly flowing portion continues west towards the Illinois State Line through Calumet City and Lansing. The River then turns north and flows through South Holland, turns west through Dolton, and then northwest through Riverdale and Dixmoor. The Little Calumet River meets its confluence with the Calumet-Sag Channel in Unincorporated Cook County, near Joe Louis the Champ Golf Course between Ashland Avenue and Halstead Street.

- An unnamed Tributary to the Little Calumet River (ULCR) originates in South Holland near the intersection of 165th Street and Cottage Grove Avenue and flows easterly, underneath the Bishop Ford Expressway, to its confluence with the Little Calumet River south of 159th Street in South Holland.

Within the Little Calumet River subwatershed, one major detention facility has an effect on flows, the Thornton Transitional Reservoir.

- Thornton Transitional Reservoir – The reservoir is located off of Thorn Creek and has a diversion structure 17,000 linear feet upstream of the confluence of Thorn Creek with the Little Calumet River. The existing Thornton Transitional Reservoir holds approximately 11,000 acre-feet in its current configuration. The Thornton Transitional Reservoir, which is estimated to be completed in 2013, will use the same diversion structure on Thorn Creek and will allow 9,600 acre-feet of water to be diverted from Thorn Creek, affecting flows and stages in Thorn Creek and the Little Calumet River.

3.8.1 Sources of Data

3.8.1.1 Previous Studies

Two previous studies were made available pertaining to the Little Calumet River:

- Interim Review Report of Little Calumet River, U.S. Army Corps of Engineers, December 1973

- Little Calumet River Watershed Engineering Design Report (Revised), U.S. Department of Agriculture, Metropolitan Sanitary District of Greater Chicago and the Illinois Department of Conservation, January 1977

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

3.8.1.2 Water Quality Data

Water quality for the Little Calumet River subwatershed is monitored by the Metropolitan Reclamation District of Greater Chicago (the District), Illinois Environmental Protection Agency (IEPA) and the United States Geological Survey (USGS). The District is responsible for monitoring the water quality of the streams and canals within its jurisdiction, and has three water quality monitoring stations on the Little Calumet River: Station 52, at Wentworth Avenue and the Little Calumet

River; Station 57, at Ashland Avenue and the Little Calumet River; and Station 97, at 170th Street and Thorn Creek. Annual water quality summaries have been published by the District from 1970 through the present for Stations 52 and 57, and from 2001 through the present for Station 97.

IEPA monitors water quality data at five locations in the Little Calumet River subwatershed as a part of the Ambient Water Quality Monitoring Network (AWQMN) in Cook County. **Table 3.8.3** lists the locations of the five water quality monitoring stations.

Table 3.8.3: IEPA Water Quality Monitoring Stations in the Little Calumet River Subwatershed

Station ID	Waterbody	Location
HA-06	Little Calumet River	I-94, Dolton
HB-03	Little Calumet River	South US Route 6 Torrence Avenue
HB-02	Little Calumet River	South Wentworth Avenue
HB-04	Little Calumet River	South US Route 6 and 159th Street, South Holland
HB-05	Little Calumet River	South IL Route 83, Harvey

Source: EPA STORET (Storage and Retrieval) database.

At each station, 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 operates two water quality monitoring stations in the Little Calumet River subwatershed as shown in **Table 3.8.4**. 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.

Table 3.8.4: USGS Water Quality Monitoring Stations in the Little Calumet River Subwatershed

Station ID	Waterbody	Location
5536290	Little Calumet River	South Holland
5536325	Little Calumet River	Harvey

Source: http://waterdata.usgs.gov/usa/nwis/qw

IEPA's *2008 Integrated Water Quality Report*, which includes the Clean Water Act (CWA) 303(d) and the 305(d) list, lists two segments within the Little Calumet River subwatershed as impaired. **Table 3.8.5** lists the 303(d) listed impairments. No Total Maximum Daily Loads (TMDL) has been developed for the Little Calumet River subwatershed.

Table 3.8.5: IEPA Use Support Categorization and 303(d) Impairments in the Little Calumet River Watershed

IEPA Segment ID	Waterbody	Impaired Designated Use	Potential Cause	Potential Source
IL_HB-42	Little Calumet River	Aquatic Life	Fluoride, Nitrogen (Total), Oxygen, Dissolved, Phosphorus (Total), Sedimentation/Siltation, Silver, Total Dissolved Solids and Total Suspended Solids	Urban Runoff/Storm Sewers, Combined Sewer Overflows
		Fish Consumption	Mercury	Source Unknown
		Primary Contact Recreation	Fecal Coliform	Urban Runoff/Storm Sewers, Combined Sewer Overflows
IL_ HB-01	Little Calumet River	Aquatic Life	Fluoride, Nitrogen (Total), Oxygen, Dissolved, Phosphorus (Total), Sedimentation/Siltation, Silver, Oil and Grease, and Hexachlorobenzene	Contaminated Sediments, Municipal Point Source Discharges, Urban Runoff/Storm Sewers and Combined Sewer Overflows
		Fish Consumption	Mercury	Source Unknown
		Primary Contact Recreation	Fecal Coliform	Urban Runoff/Storm Sewers, Combined Sewer Overflows

NPDES point source discharges within the Little Calumet River subwatershed are listed in **Table 3.8.6**. In addition to the point source discharges listed, municipalities discharging to the Little Calumet River 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 3.8.6: Point Source Discharges in the Little Calumet River Subwatershed

Name	NPDES	Community	Receiving Waterway
PHOENIX CSOs	IL0072834	Phoenix	Little Calumet River
INDIANA HARBOR BELT RAILROAD	IL0062863	Riverdale	Little Calumet River
RIVERDALE INDUSTRIES, INC	IL0068926	Riverdale	Little Calumet River via storm sewer

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.

3.8.1.3 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 549 acres of wetland areas in the Little Calumet River 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.

3.8.1.4 Floodplain Mapping

The floodplain boundaries for the subwatershed were revised in 2008 as part of the FEMA's Map Modernization Program. Floodplain boundaries were revised based on the recent Cook County topographic data.

FEMA's 2006 effective models were not available during the development of the subwatershed hydraulic model; however the US Army Corps of Engineers Little Calumet River model was available. **Appendix A** includes a comparison of FEMA's effective floodplain mapping from updated DFIRM panels with inundation areas developed for the DWP.

3.8.1.5 Stormwater Problem Data

Table 3.8.7 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 3.8.7** as regional or local. This classification is based on the criteria described in **Section 2.2.1** of this report.

3.8.1.6 Near Term Planned Projects

Currently planned projects in the Little Calumet River subwatershed include the conversion from the existing Thornton Transitional Reservoir, currently providing 11,000 acre-feet of storage, to the Thornton Composite Reservoir which will provide 9,600 acre-feet of storage.

In Indiana, upgraded levees are currently under construction as well as a control structure just west of the Little Calumet River's confluence with Hart Ditch. According to USACE, the Little Calumet River flood control project in Indiana has no adverse impact on flood conditions in Illinois. Some features of the project that reduces the flood impacts in Illinois are:

- Cady Marsh Ditch Diversion Tunnel – This 10 foot diameter tunnel diverts flood waters 3 miles farther east of the hart Ditch flow split, thus reducing the flows to the west.

- The Hart Ditch Control Structure – The Hart Ditch Control Structure is a 14 foot wide channel construction located just west of the Hart Ditch flow split that will reduce flows to the west.

- Channel Improvements – Most of the bridge openings east of the Hart Ditch confluence within the project limits have been increased. This also reduces flows to the west.

Table 3.8.7: Community Response Data for Little Calumet River Subwatershed

Problem ID	Municipality	Problems as Reported by Local Agency	Location	Problem Description	Local/ Regional	Resolution in DWP
BLI1	Blue Island	Flooding due to culvert blockages	Western Avenue and 139th Street	Stream maintenance	Channel maintenance	Removal of debris to be addressed by stream maintenance
CAC4	Calumet City	Pavement flooding	US 6 from I-94 to Torrence Avenue	Pavement flooding	Local	Pavement flooding related to local drainage system
CAC6	Calumet City	Bank erosion and sedimentation	160th Street and Torrence	Bank erosion and sedimentation near a culvert	Local	Local authority responsible for maintenance of culvert
CAC7	Calumet City	Water quality, wetland/riparian areas at risk	River Oaks Drive and Wentworth Avenue	Appears to be a local issue. No problem observed in the field	Local	Problem not located on a regional waterway
DIX1	Dixmoor	Pavement flooding	Wood Street at Thornton Road	Low spot along roadway causing conveyance problems	Local	Pavement flooding related to local drainage system
DOL3	Dolton	Roadway ponding	144th Street from Indiana Avenue to Jackson Street	Excessive roadway ponding occurs on 144th Street from Indiana Avenue to Jackson Street during large rain events	Local	Problem not located on a regional waterway. This is a local conveyance issue
DOL4	Dolton	Roadway p	Between State Street and Indiana from 146th Street to Village	Excessive roadway ponding occurs between Main Street and 146th Street from Ingleside to Dante Avenue during large events	Local	Problem not located on a regional waterway. This is a local conveyance issue
DOL5	Dolton	Pavement flooding	Indiana Avenue at 146th Street to 147th Street	Pavement flooding of IDOT roadway due to undersized culvert	Local	Pavement flooding related to local drainage system

Table 3.8.7: Community Response Data for Little Calumet River Subwatershed

Problem ID	Municipality	Problems as Reported by Local Agency	Location	Problem Description	Local/ Regional	Resolution in DWP
HAR2	Harvey	Pavement flooding	US 1 at 151st Street	Pavement flooding of IDOT roadway due to undersized culvert	Local	Although this is a local problem, it will be benefited from the Reservoir expansion and upsizing of conduit (Alternative CUDDG1-A8)
HAR3	Harvey	Pavement flooding	US 6 at Park Avenue (River Oaks golf course)	Overbank pavement flooding of golf course property	Local	Problem not located on a regional waterway. This is a local drainage issue
HAR5	Harvey	Pavement flooding	IL 83 at Clinton Street	Pavement flooding of IDOT roadway due to undersized culvert	Local	Although this problem is local, it will be benefited from the proposed reservoir and diversion conduit expansion (Alternative CUDDG1-A8)
HAR6	Harvey	Pavement flooding	IL 83 east of US 1	Pavement flooding of IDOT roadway due to undersized culvert	Local	Although this problem is local, it will be benefited from the proposed reservoir and diversion conduit expansion (Alternative CUDDG1-A8)
HAR7	Harvey	Pavement flooding	Rt.83 at Illinois Central Railroad	Pavement flooding of IDOT roadway due to undersized culvert	Local	Although this problem is local, it will be benefited from the proposed reservoir and diversion conduit expansion (Alternative CUDDG1-A8)

Table 3.8.7: Community Response Data for Little Calumet River Subwatershed

Problem ID	Municipality	Problems as Reported by Local Agency	Location	Problem Description	Local/ Regional	Resolution in DWP
LAN4	Lansing	Pavement flooding	Burnham Avenue at 170th Street (at river)	Road is overtopped by Little Calumet River	Regional	Sufficient land was not available to address all flooding in this area. Properties at risk of flooding in this area are candidates for protection using non-structural measures, such as floodproofing or acquisition
LAN5	Lansing	Pavement flooding	I-80 at Torrence Avenue	Pavement flooding of IDOT roadway due to undersized culvert	Local	Problem not located on a regional waterway. This is a local conveyance issue
RVD1	Riverdale	Pavement flooding	Ashland Avenue at near 138th Street	Pavement flooding of IDOT roadway due to undersized culvert	Local	Problem not located on a regional waterway. This is a local conveyance issue
RVD2	Riverdale	Pavement flooding	Ashland Avenue at North Crossing	Pavement flooding of IDOT roadway due to undersized culvert	Local	Problem not located on a regional waterway. This is a local conveyance issue
RVD3	Riverdale	Pavement flooding	Ashland Avenue at South Crossing	Pavement flooding of IDOT roadway due to undersized culvert	Local	Problem not located on a regional waterway. This is a local conveyance issue
SHO1	South Holland	Overbank flooding	Little Calumet River throughout South Holland	Ponding and flooding adjacent to the Little Calumet River in South Holland	Regional	Construction of levees in various locations along Little Calumet River through South Holland (Alternative LCRWG2-A1, LCRWG3-A1, LCRWG4-A1, LCRWG5-A1, LCRWG6-A1, LCRWG7-A1, and LCRWG8-A5)

Table 3.8.7: Community Response Data for Little Calumet River Subwatershed

Problem ID	Municipality	Problems as Reported by Local Agency	Location	Problem Description	Local/ Regional	Resolution in DWP
THO1	Thornton Township	Bank erosion and sedimentation	Thornton Road from Dixie Highway (Chatham) to Wood Street	Stretch of creek bank has rip-rap and appears to be at least partially addressed	Local	Problem is not located on a regional waterway. This is a local drainage issue.

3.8.2 Watershed Analysis

3.8.2.1 Hydrologic Model Development

3.8.2.1.1 Subbasin Delineation The portion of the Little Calumet River subwatershed in Illinois and Indiana that was not included in other tributary subwatersheds was delineated according to the methods described in **Sections 1.3.2** and **2.3.2**. There are 120 subbasins ranging in size from 0.019 to 17.8 square miles with an average size of 3.21 square miles.

3.8.2.1.2 Hydrologic Parameter Calculations
Curve numbers (CN) 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.

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.

3.8.2.2 Hydraulic Model Development

3.8.2.2.1 Field Data, Investigation, and Existing Model Data During Phase A, available existing models were collected and analyzed to determine if data could be used for developing the comprehensive model. Only existing models that were less than 10 years old were reviewed.

Three HEC-RAS models were available for use in the development of the Little Calumet River subwatershed hydraulic model: a model of the Little Calumet River (east and west portions), Deep River, Burns Ditch, and Thorn Creek developed by the ISWS in 2006; a model of the Little Calumet River (east and west portions), Deep River, Burns Ditch, and Thorn Creek developed by the USACE in 2005; and a model of the Little Calumet River (east and west portions), Deep River, Burns Ditch, and Thorn Creek (with Thornton Composite Reservoir) developed by the USACE in 2008.

The available models were reviewed to determine if any of the cross–sectional data and hydraulic structure information could be used. If any information regarding location, date, and vertical datum was not available, the cross-sectional data was not used. Cross sections with available data were compared to the current channel conditions to ensure that the cross section was still representative of current conditions. The hydraulic structure dimensions were compared to 2007 field reconnaissance data and also to bridge/culvert dimensions data provided by Cook County Highway Department (data provided for state/county highways only). Based on the existing model analysis, the location of additional cross sections and hydraulic structures to be surveyed was determined. Any data used from the existing models were geo-referenced to represent true physical coordinates.

After review of existing models, field reconnaissance data, and hydraulic structure dimension data, a field survey plan 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 shape and roughness and slope of the channel. A total of 27 cross sections and 11 hydraulic structures were surveyed to develop the hydraulic model for the Little Calumet River subwatershed. Additional cross sections were developed by interpolating the surveyed channel data and combining with contour data.

The Manning's n-value at each cross section was 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 0.060 for areas with few buildings to 0.22 for fully developed areas. If significant blockage is caused by buildings in the flood fringe, the developed areas were modeled as ineffective flow. **Table 3.8.8** lists the channel and overbank ranges of n-values that were used for the Little Calumet River subwatershed model.

Table 3.8.8: Channel and Overbank Associated Manning's n-Values[1]

Tributary	Range of Channel n-Values	Range of Overbank n-Values
LCRW	0.038 - 0.076	0.095 - 0.22
ULCR	0.045 - 0.12	0.045 - 0.119

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

3.8.2.2.2 Boundary Conditions There are two downstream locations were boundary conditions were required to run the hydraulic model. Since the stage of the Calumet-Sag Channel is highly variable, the stage was obtained from the USACE – Chicago District 's *Chicagoland Underflow Plan McCook Reservoir, Illinois (November 1999)* as the modeled 1% chance exceedance event near the confluence of the Little Calumet River and the Calumet-Sag Channel. Since Lake Michigan is relatively independent of local rainfall events, the historic average water surface elevation was used. Below are the boundary conditions used.

Boundary Conditions

Location	Elevation (ft)
Little Calumet River confluence with Calumet-Sag Channel	584.7
Burns Ditch Confluence with Lake Michigan	579.0

3.8.2.3 Calibration and Verification A detailed calibration was performed for the Little Calumet River subwatershed using historic gage records under the guidelines of the Cook County Stormwater Management Plan (CCSMP). Three historic storm events in April 2006, April 2007 and September 2008 were evaluated based on the stream gage flows, precipitation totals and records of flooding in the Little Calumet River 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 are two stream gages on the Little Calumet River. USGS Gage 05536290, Little Calumet River at South Holland, is at latitude 41°36’25” longitude 87°35’52” (NAD27). The datum of the gage is 575.00 ft NGVD29 (574.72 NAVD88). Instantaneous flow data is available at this gage from 10/1/1990 through 9/30/2008. The second stream gage, USGS Gage 05536195, Little Calumet River at Munster, IN is at latitude 41°34'38" longitude 87°31'17" (NAD27). The datum of the gage is 580.72 ft NGVD29 (580.44 NAVD88). Instantaneous flow data is available at this gage from 10/01/1987 through 9/30/2008.

Runoff hydrographs were developed using HEC-HMS and routed through the Little Calumet River hydraulic model. The stages and flows produced for each calibration storm were compared to the observed stream gage data. During calibration of the Little Calumet River subwatershed model, the curve number, directly connected impervious area percentage, and Clark’s storage coefficient were adjusted so that the peak flow rate, hydrograph shape and timing, and total volume matched the observed hydrographs within the District’s criteria. During calibration, the Clark’s storage coefficient R was increased by 25%.

The hydraulic model was verified by comparing the model results with available high water marks from the September 2008 storm event. High water marks were surveyed in June 2009 using field photos taken after the event**.** **Table 3.8.9** shows the comparison of the modeled and observed stages for the September 2008 storm event.

Table 3.8.9: Little Calumet River Subwatershed Verification Results

Storm Event	Location	Field Elevation (ft)	Model Elevation (ft)	Difference in Stage (ft)
Sep-08	Little Calumet W Reach 5 RS 87401	597.16	597.01	0.15
Sep-08	Little Calumet W Reach 5 RS 86195	597.15	596.99	0.16
Sep-08	Little Calumet W Reach 5 RS 78426	596.81	596.87	-0.06
Sep-08	Little Calumet W Reach 5 RS 72121	596.13	596.00	0.13
Sep-08	Little Calumet W Reach 5 RS 67516	595.65	595.65*	0.00
Sep-08	Little Calumet W Reach 5 RS 67399	594.31	593.98	0.33
Sep-08	Little Calumet W Reach 5 RS 63229	594.72	593.94	0.78
Sep-08	Little Calumet W Reach 5 RS 54871	600.52	600.54	-0.02
Sep-08	Little Calumet W Reach 3 RS 43997	600.67	600.21	0.46
Sep-08	Calumet Union Reach 1 RS 1978	598.92	598.45	0.47
Sep-08	Calumet Union Reach 1 RS 1650.42	597.76	597.29	0.47

*Average of 3 observed high water marks

After the final adjustments to the HEC-HMS and HEC-RAS models, the flow and stage comparisons to the observed data were within the District's criteria. **Table 3.8.10** and **Table 3.8.11** show the comparison of the flows and stages for all calibration storms at the South Holland and Munster gages, respectively. **Figures 3.8.2, 3.8.3, 3.8.4 and 3.8.5** show the calibration results for the April 2006 and April 2007 storm events at the South Holland and Munster gage.

Table 3.8.10: Little Calumet River at South Holland Gage Calibration Results

Storm Event	Observed		Modeled		District's Criteria[1]	
	Flow	Stage	Flow	Stage	Percentage Difference in Peak Flow	Difference in Stage
Apr-06	2,600	591.33	1,676	590.21	-36%	-1.12
Apr-07	1,580	588.30	1,208	589.18	-24%	0.88
Sep-08	3,930	594.60	4,228	594.82	8%	0.22

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

Table 3.8.11: Little Calumet River at Munster, IN Gage Calibration Results

Storm Event	Observed		Modeled		District's Criteria[1]	
	Flow	Stage	Flow	Stage	Percentage Difference in Peak Flow	Difference in Stage
Apr-06	781	N/A	669	593.81	-14%	N/A
Apr-07	596	N/A	394	592.05	-34%	N/A
Sep-08	1,553	597.45	1,604	597.3	3%	-0.15

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

The April 2006 storm at South Holland and the April 2007 storm at Munster, Indiana didn't meet the CCSMP criteria. This is likely due to the spatial distribution of the storm and missing coverage by some of the rain gages.

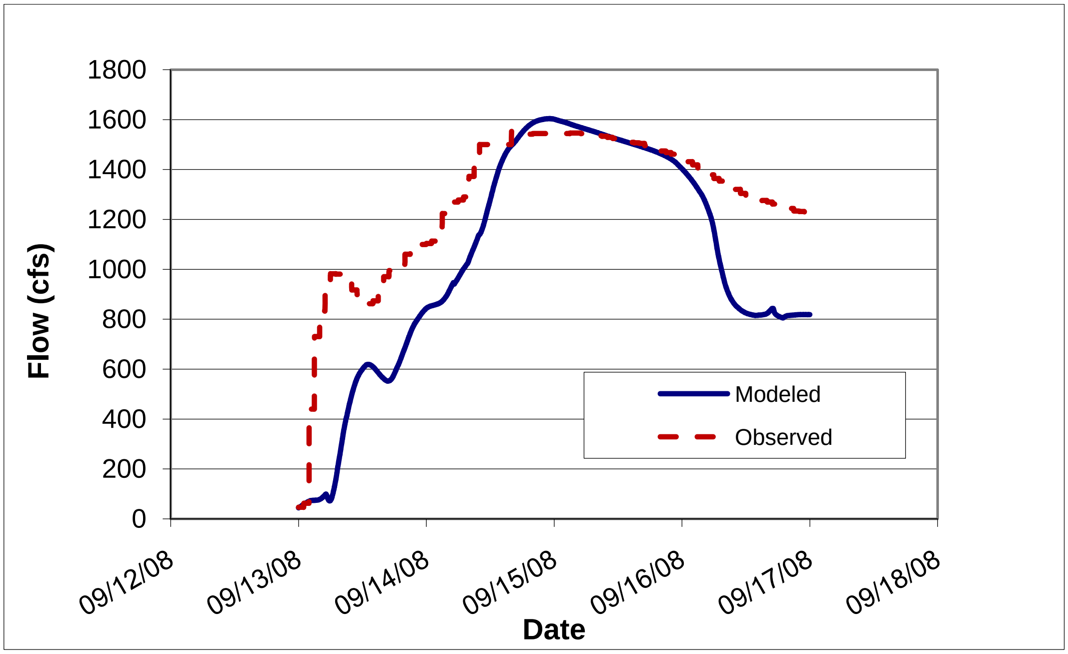

Figure 3.8.2: Little Calumet River Subwatershed at South Holland Gage Calibration Results, April 2006 Storm Event

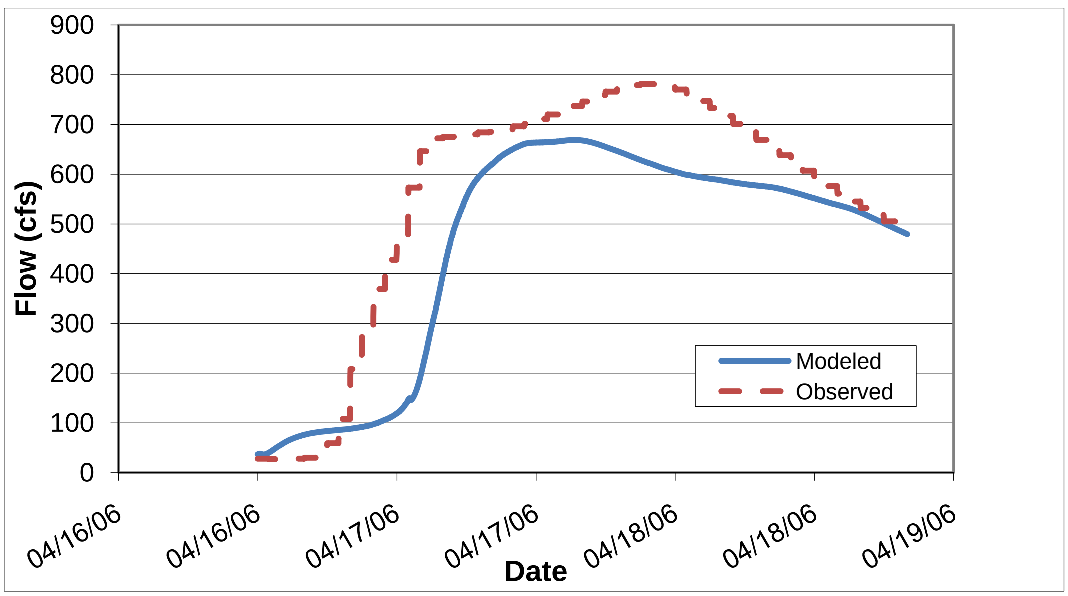

Figure 3.8.3: Little Calumet River Subwatershed at Munster Gage Calibration Results, April 2006 Storm Event

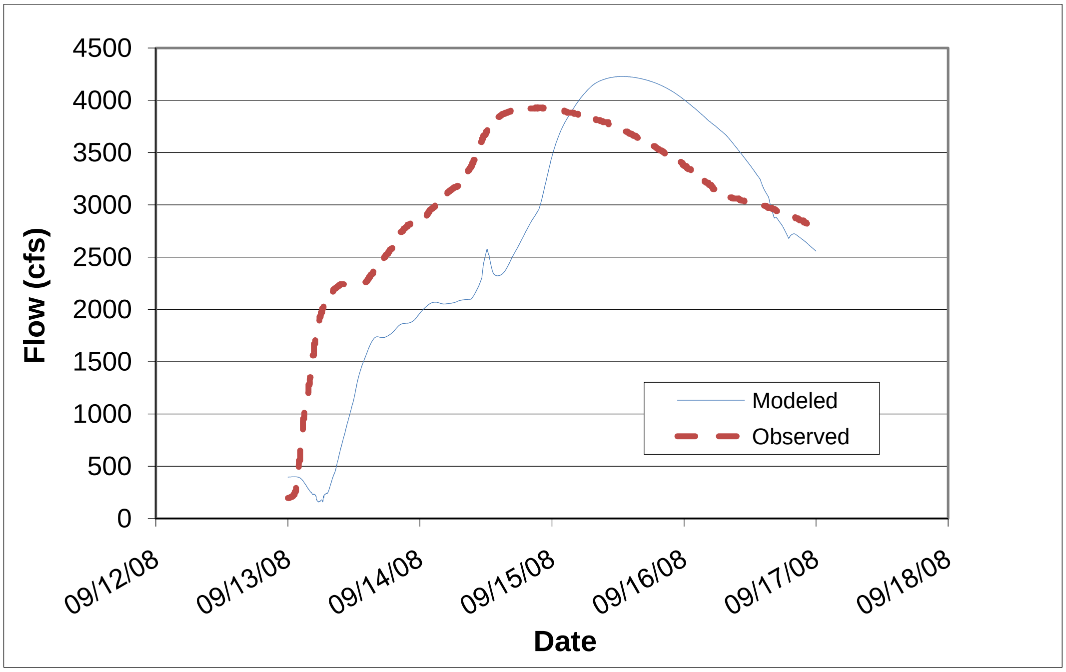

Figure 3.8.4: Little Calumet River Subwatershed at South Holland Gage Calibration Results, September 2008 Storm Event

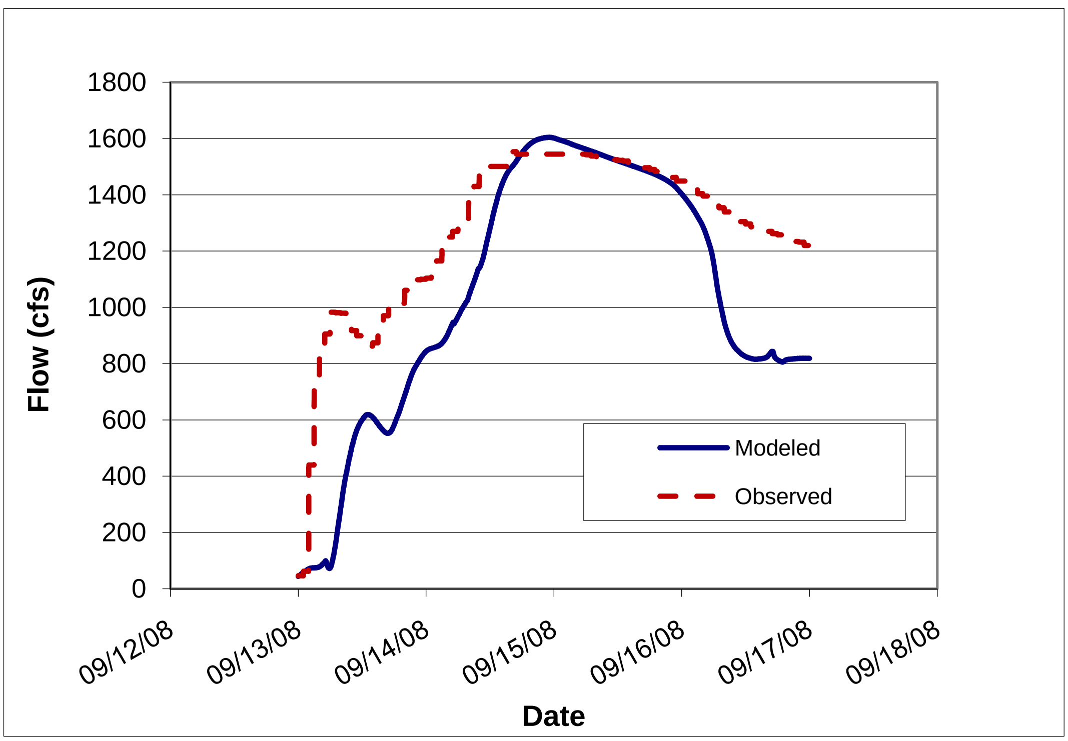

Figure 3.8.5: Little Calumet River Subwatershed at Munster Gage Calibration Results, September 2008 Storm Event

3.8.2.4 Existing Conditions Evaluation

Flood Inundation Areas. A critical duration analysis was performed for the Little Calumet River subwatershed hydraulic model. The 100-year, 1-, 3-, 6-, 12-, 24- and 48-hour storm events were run to determine the critical duration. The 48-hour storm event was found to be the critical duration for the Little Calumet River and the Unnamed Tributary to the Little Calumet River.

Figure 3.8.1 shows the inundation area produced for the 100-year critical duration storm event.

Hydraulic Profiles. Hydraulic profiles for the Little Calumet River and the Unnamed Tributary to the Little Calumet River are shown in **Appendix H**. Profiles are shown for the 2-, 5-, 10-, 25-, 50-, 100- and 500-year recurrence interval design storm events.

3.8.3 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 3.8.12** summarizes problem areas identified through hydraulic modeling of the Little Calumet River subwatershed.

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

Table 3.8.12: Modeled Problem Definition for the Little Calumet River Subwatershed

Problem ID	Group ID	Location	Recurrence Interval (yr) of Flooding	Associated Form B	Resolution in DWP
LCRW1	LCRW-G1	Upstream of Sibley Blvd., near 147th Street and Riverside Drive, Harvey	25, 50 & 100	None	LCRWG1-A3
LCRW2	LCRW-G2	At CUDD Confluence. 158th Place and 159th Street, east of State Street/Indiana Avenue, South Holland	10, 25, 50 & 100	SHO1	LCRWG2-A1
LCRW3	LCRW-G3	158th Street, east of Chicago Road, South Holland	50 & 100	SHO1	LCRWG3-A1
LCRW4	LCRW-G4	Riverview Drive between Parkside Avenue and School Street, South Holland	100	SHO1	LCRWG4-A1
LCRW5	LCRW-G5	Along 158th Street near the intersection with Church Street, South Holland	2, 5, 10, 25, 50 & 100	SHO1	LCRWG5-A1
LCRW6	LCRW-G6	N Riverview Drive/Blouin Drive, from Ingleside Avenue to Dobson Avenue, Dolton	25, 50 & 100	None	LCRWG6-A1
LCRW7	LCRW-G7	158th Street from Kenwood Avenue to Dobson Avenue, South Holland	50 & 100	SHO1	LCRWG7-A1

Table 3.8.12: Modeled Problem Definition for the Little Calumet River Subwatershed

Problem ID	Group ID	Location	Recurrence Interval (yr) of Flooding	Associated Form B	Resolution in DWP
LCRW8	LCRW-G8	158th Street from Greenwood Road to Madison Avenue, South Holland	5, 10, 25, 50 & 100	SHO1	LCRWG8-A5
LCRW9	LCRW-G9	Area adjacent to 163rd Street from Balmoral Drive to Stateline Road, Calumet City and Lansing	2, 5, 10, 25, 50 & 100	LAN4	Floodproofing/ Acquisition

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

3.8.3.1 LCRW-G1 – Little Calumet River Problem Group 1

3.8.3.1.1 Problem Definition, LCRW-G1

The LCRW-G1 problem area consists of overbank flooding upstream of Sibley Boulevard, near 147th Street and Riverside Drive in Harvey. In this reach, the 100-year flow of 4,138 cfs at Sibley Boulevard exceeds the capacity of the channel. The flooding impacts 4 structures. The area is shown on the recent DFIRM floodplain maps with flooding to a similar extent.

3.8.3.1.2 Damage Assessment, LCRW-G1

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for the Little Calumet River. 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. **Table 3.8.13** lists the estimated damages for the problem group.

Table 3.8.13: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G1

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G1	Property	$13,978	Structures at risk of flooding.
	Transportation	$2,096	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.1.3 Technology Screening, LCRW-G1

Several combinations of technologies were analyzed to address flooding problems associated with LCRW-G1. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.14** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.14: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G1

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage and lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.1.4 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 3.8.15** summarizes flood control alternatives developed for Problem Group LCRW-G1.

Table 3.8.15: Flood Control Alternatives for Problem Group LCRW-G1

Alternative	Location	Description
LCRWG1-A1	Forest Preserve District	Construct detention basin to reduce peak flows. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible
LCRWG1-A2	Thornton Composite Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible
LCRWG1-A3	Vicinity of Sibley Boulevard	Construct a levee/floodwall in form of a concrete wall with length of 600 LF and height between 6 to 13 ft

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

3.8.3.1.5 Alternative Evaluation and Selection

Alternatives included in **Table 3.8.15** 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 3.8.17** 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 LCRW-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 LCRWG1-A3 from **Table 3.8.15** provides the preferred alternative for Problem Group LCRW-G1. A floodwall could be constructed upstream of Sibley Boulevard to protect residences near 147th Street and Riverside Drive in Harvey. The wall would be approximately 600 linear feet of concrete varying between 8 to 13 feet in height with a maximum elevation of 695.6 feet NAVD. Adding a levee to protect the building structures was shown to have a negligible effect on baseline stages (i.e., stage increases were not greater than 0.04 feet) therefore would not require compensatory storage.

Table 3.8.16 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G1.

Table 3.8.16: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G1

Location	Station	Existing Conditions		Alternative LCRWG1-A3	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
Upstream face of Sibley Blvd	LCRW 22905	592.6	4,057	592.6	3,982

3.8.3.1.6 Data Required for Countywide Prioritization of Watershed Projects

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.17** lists the alternative analyzed in detail. The recommended alternative consists of the construction of a 600 linear-foot concrete floodwall near Sibley Boulevard in Harvey. **Figure 3.8.6** 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 3.8.17: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G1

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LCRW-G1	LCRWG1-A3	Levee/ floodwall	< 0.01	$16,000	$3,412,000	4 structures	No Impact	Harvey

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

3.8.3.2 LCRW-G2 – Little Calumet River Problem Group 2

3.8.3.2.1 Problem Definition, LCRW-G2

The LCRW-G2 problem area consists of overbank flooding in the area of the Calumet Union Drainage Ditch confluence with the Little Calumet River, near 158th Place and 159th Street in South Holland, east of State Street/Indiana Avenue on the left bank of the Little Calumet River. The 100-year peak flow is 1,441 cfs at the footbridge just upstream of the Calumet Union confluence, which exceeds the capacity of the channel. The flooding impacts 6 structures. The area is shown on the recent DFIRM floodplain maps with flooding to a slightly lesser extent.

3.8.3.2.2 Damage Assessment, LCRW-G2

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for the Little Calumet River and its tributary. 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. **Table 3.8.18** lists the estimated damages for the problem group.

Table 3.8.18: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G2

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G2	Property	$128,915	Structures at risk of flooding.
	Transportation	$19,336	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.2.3 Technology Screening, LCRW-G2

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.19** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.19: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G2

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and Calumet Union Drainage Ditch and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage and lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.2.4 Alternative Development, LCRW-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 3.8.20** summarizes flood control alternatives developed for Problem Group LCRW-G2.

Table 3.8.20: Flood Control Alternatives for Problem Group LCRW-G2

Alternative	Location	Description
LCRWG2-A1	Little Calumet River and Calumet Union Drainage Ditch confluence	Construct 1,900 LF levee/floodwall near 158th Place/159th Street in South Holland
LCRWG2-A2	Forest Preserve District	Construct detention facility. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible
LCRWG2-A3	Thornton Transitional Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible

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

3.8.3.2.5 Alternative Evaluation and Selection, LCRW-G2

Alternatives included in **Table 3.8.20** 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 3.8.22** 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 LCRWG2-A1 from **Table 3.8.20** provides the preferred alternative for this problem group. The preferred alternative consists of construction of a 1,900 linear-foot concrete levee/floodwall and earthen berm that that varies from 4 to 14 ft in height and has a maximum elevation of 697.3 feet NAVD. This levee/floodwall would protect residences on 158th Place and 159th Street, east of State Street/Indiana Avenue in South Holland.

Table 3.8.21 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G2.

Table 3.8.21: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G2

Location	Station	Existing Conditions		Alternative LCRWG2-A1	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
Upstream of the Foot Bridge at the confluence of CUDD with LCRW	CUDD 258	594.0	1,436	594.0	1,441

3.8.3.2.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G2

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.22** lists the alternative analyzed in detail. The recommended alternative consists of the construction of a 1,900 linear-foot levee/floodwall near 158th Place and 159th Street. **Figure 3.8.7** 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 3.8.22: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G2

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LCRW-G2	LCRWG2-A1	Construct levee	0.03	$148,000	$5,752,000	6 structures	No impact	South Holland

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

3.8.3.3 LCRW-G3 – Little Calumet River Problem Group 3

3.8.3.3.1 Problem Definition, LCRW-G3

The LCRW-G3 problem area consists of overbank flooding in the area near 158th Street east of Chicago Road (Park Avenue) in South Holland, on the north bank of the Little Calumet River. The 100-year peak flow rate is 3,156 cfs, which exceeds the capacity of the channel. The flooding impacts 2 structures. The area is shown on the recent DFIRM floodplain maps with flooding to a slightly lesser extent.

3.8.3.3.2 Damage Assessment, LCRW-G3

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for Little Calumet River and its tributary. 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. **Table 3.8.23** lists the damages caused from the problem group.

Table 3.8.23: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G3

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G3	Property	$3,296	Structures at risk of flooding.
	Transportation	$500	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.3.3 Technology Screening, LCRW-G3

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.24** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.24: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G3

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage and due to lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.3.4 Alternative Development, LCRW-G3

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 3.8.25** summarizes flood control alternatives developed for Problem Group LCRW-G3.

Table 3.8.25: Flood Control Alternatives for Problem Group LCRW-G3

Alternative	Location	Description
LCRWG3-A1	158th Street and Chicago Road	Construct 850 LF levee/floodwall near 158th Street and Chicago Road (Park Avenue) in South Holland
LCRWG3-A2	Forest Preserve District	Construct detention facility. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible

Table 3.8.25: Flood Control Alternatives for Problem Group LCRW-G3

Alternative	Location	Description
LCRWG3-A3	Thornton Transitional Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for the LCRW-G3 Problem Group.

3.8.3.3.5 Alternative Evaluation and Selection, LCRW-G3

Alternatives included in **Table 3.8.25** 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 3.8.27** 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 LCRWG3-A1 from **Table 3.8.25** provides the preferred alternative for this problem group. Under this recommendation, an 850 linear-foot concrete levee/floodwall that varies in height from 3 to 10 feet in height and has a maximum elevation of NAVD 597.6 ft could be constructed in the vicinity of 158th Street and Chicago Road in South Holland to protect the nearby residences. Adding a levee to protect the building structures was shown to have a negligible effect on baseline stages (i.e., stage increases were not greater than 0.04 feet) therefore would not require compensatory storage.

Table 3.8.26 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G3.

Table 3.8.26: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G3

Location	Station	Existing Conditions		Alternative LCRWG3-A1	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
850 ft Upstream of South Park Avenue	LCRW 35148	594.2	3,809	594.2	3,805

3.8.3.3.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G3

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.27** lists the alternative analyzed in detail. The recommended alternative consists of the construction of an 850 linear-foot floodwall near 158th Street and

Chicago Avenue in South Holland. **Figure 3.8.8** 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 3.8.27: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G3

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures Protected	Water Quality Benefit	Involved Community
LCRW-G3	LCRWG3-A1	Construct levee	< 0.01	$4,000	$4,332,000	2 structures	No Impact	South Holland

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

3.8.3.4 LCRW-G4 – Little Calumet River Problem Group 4

3.8.3.4.1 Problem Definition, LCRW-G4

The LCRW-G4 problem area consists of overbank flooding on Riverview Drive between Parkside Avenue and School Street in South Holland, on the south bank of the Little Calumet River. The 100-year peak flow rate is 3,156 cfs in the vicinity of the problem area and exceeds the capacity of the channel. The flooding impacts 1 structure. The area is shown on the recent DFIRM floodplain maps with flooding to a slightly lesser extent.

3.8.3.4.2 Damage Assessment, LCRW-G4

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for the Little Calumet River and its tributary. 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. **Table 3.8.28** lists the estimated damages for the problem group.

Table 3.8.28: Estimated Damages Little Calumet River Subwatershed, Problem Group LCRW-G4

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G4	Property	$2,882	Structures at risk of flooding.
	Transportation	$430	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.4.3 Technology Screening, LCRW-G4

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.29** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.29: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G4

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage; also Infeasible due to lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.4.4 Alternative Development, LCRW-G4

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 3.8.30** summarizes flood control alternatives developed for Problem Group LCRW-G4.

Table 3.8.30: Flood Control Alternatives for Problem Group LCRW-G4

Alternative	Location	Description
LCRWG4-A1	Riverside Street & Parkside Avenue	Construct 825 LF levee/floodwall near Riverside Street and Parkside Avenue in South Holland
LCRWG4-A2	Forest Preserve District	Construct detention facility. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible
LCRWG4-A3	Thornton Transitional Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for Problem Group LCRW-G4.

3.8.3.4.5 Alternative Evaluation and Selection, LCRW-G4

Alternatives included in **Table 3.8.30** 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 3.8.32** 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, and thus costs were not calculated for these alternatives.

Alternative LCRWG4-A1 from **Table 3.8.30** provides the preferred alternative for this problem group. Under this recommendation, an 825 linear-foot concrete wall that that varies in height from 4 to 8.5 ft with a maximum elevation of 597.6 feet NAVD could be constructed along the south bank of the Little Calumet River near Parkside Avenue and School Street to protect residences on Riverside Street.

Table 3.8.31 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G4.

Table 3.8.31: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G4

Location	Station	Existing Conditions		Alternative LCRWG4-A1	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
1000 ft Upstream of South Park Avenue	LCRW 35298	594.2	3,810	594.2	3,805

3.8.3.4.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G4

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.32** lists the alternative analyzed in detail. The recommended alternative consists of constructing an 825 linear-foot concrete levee/floodwall along the South bank of the Little Calumet River near Parkside Avenue and School Street in South Holland. **Figure 3.8.9** 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 3.8.32: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G4

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LCRW-G4	LCRWG4-A1	Construct 825 LF levee	< 0.01	$3,000	$3,427,000	1 structure	No Impact	South Holland

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

3.8.3.5 LCRW-G5 – Little Calumet River Problem Group 5

3.8.3.5.1 Problem Definition, LCRW-G5

The LCRW-G5 problem area consists of overbank flooding along 158th Street near the intersection of 158th Street and Church Drive in South Holland, on the north bank of the Little Calumet River. In this reach, the 100-year peak flow rate of 2,979 cfs exceeds the capacity of the channel. The flooding impacts 6 structures. The problem area is shown on the recent DFIRM floodplain maps with flooding to a slightly lesser extent.

3.8.3.5.2 Damage Assessment, LCRW-G5

Damages were defined following the protocol defined in of the CCSMP. Critical duration analysis was performed to determine the highest flood stages for Little Calumet River and its tributary. 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. **Table 3.8.33** lists the estimated damages for the problem group.

Table 3.8.33: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G5

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G5	Property	$2,169,000	Structures at risk of flooding
	Transportation	$325,500	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.5.3 Technology Screening, LCRW-G5

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.34** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.34: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G5

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage; also infeasible due to lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.5.4 Alternative Development, LCRW-G5

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 3.8.35** summarizes flood control alternatives developed for Problem Group LCRW-G5.

Table 3.8.35: Flood Control Alternatives for Problem Group LCRW-G5

Alternative	Location	Description
LCRWG5-A1	158th Street and Church Drive	Construct 930 LF levee/floodwall near 158th Street and Church Drive in South Holland
LCRWG5-A2	Forest Preserve District	Construct detention facility. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible
LCRWG5-A3	Thornton Transitional Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for Problem Group LCRW-G5.

3.8.3.5.5 Alternative Evaluation and Selection, LCRW-G5

Alternatives included in **Table 3.8.35** 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 3.8.37** 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 LCRWG5-A1 from **Table 3.8.35** provides the preferred alternative for this problem group. Under this recommendation, a 930 linear-foot concrete wall and earthen berm that that varies in height from 3 to 8 feet and has a maximum elevation of 597.3 feet NAVD could be constructed along the north bank of the Little Calumet River near 158th Street and Church Drive in South Holland to protect residences along 158th Street. Adding a levee to protect the building structures has a negligible effect on baseline stages (i.e., stage increases were not greater than 0.04 feet) therefore would not require compensatory storage.

Table 3.8.36 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G5.

Table 3.8.36: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G5

Location	Station	Existing Conditions		Alternative LCRWG5-A1	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
600 ft Downstream of Cottage Grove Boulevard	LCRW 36294	594.3	3,813	594.3	3,807

3.8.3.5.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G5

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.37** lists the alternative analyzed in detail. The recommended alternative consists of constructing a 930 linear-foot concrete levee/floodwall and earthen berm near 158th Street and Church Drive in South Holland. **Figure 3.8.10** 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 3.8.37: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G5

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LCRW-G5	LCRWG5-A1	Construct 930 LF levee/berm	2.21	$2,494,000	$1,126,000	6 structures	No impact	South Holland

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

3.8.3.6 LCRW-G6 – Little Calumet River Problem Group 6

3.8.3.6.1 Problem Definition, LCRW-G6

The LCRW-G6 problem area consists of overbank flooding on Blouin Drive from Ingleside Avenue east to Dobson Avenue in Dolton, on the north bank of the Little Calumet River. The 100-year peak flow rate is 2,998 cfs, which exceeds the capacity of the channel. The flooding impacts 2 structures. The problem area is shown on the recent DFIRM floodplain maps with flooding to a slightly lesser extent.

3.8.3.6.2 Damage Assessment, LCRW-G6

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for the Little Calumet River and its tributary. 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. **Table 3.8.38** lists the estimated damages for the problem group.

Table 3.8.38: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G6

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G6	Property	$52,420	Structures at risk of flooding.
	Transportation	$7,860	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.6.3 Technology Screening, LCRW-G6

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.39** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.39: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G6

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage; also infeasible due to lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.6.4 Alternative Development, LCRW-G6

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 3.8.40** summarizes flood control alternatives developed for Problem Group LCRW-G6.

Table 3.8.40: Flood Control Alternatives for Problem Group LCRW-G6

Alternative	Location	Description
LCRWG6-A1	Blouin Drive from Ingleside Avenue east to Dobson Avenue	Construct 1,285 LF levee/floodwall near Blouin Drive in Dolton
LCRWG6-A2	Forest Preserve District	Construct detention facility. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible
LCRWG6-A3	Thornton Transitional Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for Problem Group LCRW-G6.

3.8.3.6.5 Alternative Evaluation and Selection, LCRW-G6

Alternatives included in **Table 3.8.40** 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 3.8.42** 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 LCRWG6-A1 from **Table 3.8.40** is the preferred alternative for this problem group. The preferred alternative consists of the construction of a 1,285 linear-foot concrete levee/floodwall that that varies in height from 3 to 5 feet with a maximum elevation of 597.6 feet NAVD along the north bank of the Little Calumet River parallel to Blouin Drive near Ingleside Avenue and Dobson Avenue in Dolton. This levee protects residences along Blouin Drive. Adding a levee to protect the building structures has a negligible effect on baseline stages (i.e., stage increases were not greater than 0.04 feet) therefore would not require compensatory storage.

Table 3.8.41 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G6.

Table 3.8.41: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G6

Location	Station	Existing Conditions		Alternative LCRWG6-A1	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
2500 ft Downstream of the Bishop Ford Freeway	LCRW 38893	594.5	3,825	594.6	3,819

3.8.3.6.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G6

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.42** lists the alternative analyzed in detail. The recommended alternative consists of the construction of a 1,285 linear-foot concrete wall along the north bank of the Little Calumet River near Blouin Drive in Dolton. **Figure 3.8.11** shows the location of the recommended alternative.

Table 3.8.42: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G6

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LCRW-G6	LCRWG6-A1	Construct 1,285 LF levee	0.03	$60,000	$2,401,000	2 structures	No Impact	Dolton

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

3.8.3.7 LCRW-G7 – Little Calumet River Problem Group 7

3.8.3.7.1 Problem Definition, LCRW-G7

The LCRW-G7 problem area consists of overbank flooding along 158th Street from Kenwood Avenue east to Dorchester Avenue in South Holland, on the north bank of the Little Calumet River. The 100-year peak flow rate of 2,534 cfs exceeds the capacity of the channel. The flooding impacts 2 structures. The area is shown on the recent DFIRM floodplain maps with flooding to a lesser extent.

3.8.3.7.2 Damage Assessment, LCRW-G7

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for the Little Calumet River and its tributary. 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. **Table 3.8.43** lists the estimated damages for the problem group.

Table 3.8.43: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G7

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G7	Property	$18,000	Structures at risk of flooding
	Transportation	$2,700	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.7.3 Technology Screening, LCRW-G7

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.44** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.44: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G7

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage; also infeasible due to lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.7.4 Alternative Development, LCRW-G7

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 3.8.45** summarizes flood control alternatives developed for Problem Group LCRW-G7.

Table 3.8.45: Flood Control Alternatives for Problem Group LCRW-G7

Alternative	Location	Description
LCRWG7-A1	Kenwood Avenue to Dorchester Avenue	Construct 785 LF levee/floodwall along Little Calumet River near Kenwood Avenue and Dorchester Avenue in South Holland
LCRWG7-A2	Forest Preserve District	Construct detention facility. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible
LCRWG7-A3	Thornton Transitional Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for Problem Group LCRW-G7.

3.8.3.7.5 Alternative Evaluation and Selection, LCRW-G7

Alternatives included in **Table 3.8.45** 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 3.8.47** 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 LCRWG7-A1 from **Table 3.8.45** is the preferred alternative for this problem group. The preferred alternative consists of the construction of a 785 linear-foot earthen berm, that that varies in height from 5 to 5.5 ft with a maximum elevation of 597.8 ft NAVD along the north bank of the Little Calumet River parallel to 158th Street from Kenwood Avenue to Dorchester Avenue in South Holland. This levee protects residences along 158th Street. Adding a levee to protect the building structures has a negligible effect on baseline stages (i.e., stage increases were not greater than 0.04 feet) therefore would not require compensatory storage.

Table 3.8.46 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G7.

Table 3.8.46: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G7

Location	Station	Existing Conditions		Alternative LCRWG7-A1	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
700 ft Downstream of the Bishop Ford Freeway	LCRW 40671	594.8	2,563	594.8	2,565

3.8.3.7.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G7

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.47** lists the alternative analyzed in detail. The recommended alternative consists of the construction of a 785 linear-foot earthen berm, along the north bank of the Little Calumet River near 158th Street in South Holland. **Figure 3.8.12** shows the location of the recommended alternative.

Table 3.8.47: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G7

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LCRW-G7	LCRWG7-A1	Construct 785 LF levee	0.01	$21,000	$3,040,000	2 structures	No Impact	South Holland

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

3.8.3.8 LCRW-G8 – Little Calumet River Problem Group 8

3.8.3.8.1 Problem Definition, LCRW-G8

The LCRW-G8 problem area consists of overbank flooding on 158th Street from Greenwood Road to Madison Avenue in Dolton. The 100-year peak flow rate of 3,805 cfs exceeds the capacity of the channel. The flooding impacts 8 structures. The area is shown on the recent DFIRM floodplain maps with flooding to a similar extent.

3.8.3.8.2 Damage Assessment, LCRW-G8

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for the Little Calumet River and its tributary. 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. **Table 3.8.48** lists the estimated damages for the problem group.

Table 3.8.48: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G8

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G8	Property	$610,500	Structures at risk of flooding
	Transportation	$91,600	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.8.3 Technology Screening, LCRW-G8

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.49** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.49: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G8

Flood Control Option	Feasibility
Detention Facilities	Infeasible due to large and sustained stream flows from the Little Calumet River and lack of available storage area for such large volumes
Conveyance Improvement – Culvert/Bridge Replacement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvement – Channel Improvement	Infeasible due to resultant downstream increases in stage without available compensatory storage
Conveyance Improvements – Diversion	Infeasible due to resultant downstream increases in stage without available compensatory storage; also infeasible due to lack of available alternate receiving waters for such a discharge
Flood Barriers, Levees/Floodwalls	Feasible and necessary

3.8.3.8.4 Alternative Development, LCRW-G8

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 3.8.50** summarizes flood control alternatives developed for Problem Group LCRW-G8.

Table 3.8.50: Flood Control Alternatives for Problem Group LCRW-G8

Alternative	Location	Description
LCRWG8-A1	Near Greenwood Road and 158th Street	Add backflow protection to existing culvert
LCRWG8-A2	Greenwood Road to Madison Avenue	Modify existing berm to act as a levee/floodwall parallel to 158th Street near Greenwood Road and Madison Avenue in Dolton
LCRWG8-A3	Forest Preserve District	Construct detention facility. Due to the very large volume which would be required, massive excavation and removal of acres of recreational forest preserve would be required and was not considered feasible

Table 3.8.50: Flood Control Alternatives for Problem Group LCRW-G8

Alternative	Location	Description
LCRWG8-A4	Thornton Transitional Reservoir	Adjust operations of reservoir. The current operational scheme was found to be close to optimal in preventing stage increases in the Little Calumet River. The Little Calumet River experiences two instances of peak stages during the 48-hour storm event. Any adjustment in reservoir operation was predicted to increase one of the peak stages above its current level. Any changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible
LCRWG8-A5	Near Greenwood Road and 158th Street and Greenwood Road to Madison Avenue	Add backflow protection to existing culvert and modify existing berm to act as a levee/floodwall parallel to 158th Street near Greenwood Road and Madison Avenue in Dolton (combination of LCRWG8-A1 & LCRWG8-A2)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for Problem Group LCRW-G8.

3.8.3.8.5 Alternative Evaluation and Selection, LCRW-G8

Alternatives included in **Table 3.8.50** 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 3.8.52** 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 LCRWG8-A5 from **Table 3.8.50** is the preferred alternative for this problem group. The preferred alternative consists of the modification of an existing earthen berm to upgrade it to a levee that varies in height from 3.5 to 6 ft with a maximum elevation of 597.8 ft NAVD parallel to 158th Street from Greenwood Road to Madison Avenue in Dolton. The addition of a backflow protector on the existing culvert under the footpath will reduce the impact of backflow from the Little Calumet River.

Table 3.8.51 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G8.

Table 3.8.51: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G8

Location	Station	Existing Conditions		Alternative LCRWG8-A1	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
700 ft Downstream of the Bishop Ford Freeway	LCRW 41528	594.8	3,880	594.8	3851

3.8.3.8.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G8

Appendix I presents conceptual level cost estimates for the recommended alternative. **Table 3.8.52** lists the alternative analyzed in detail. The recommended alternative consists of the construction of a 785 linear-foot earthen berm, along the Little Calumet River near 158th Street in South Holland. **Figure 3.8.13** shows the location of the recommended alternative.

Table 3.8.52: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G8

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Involved Community
LCRW-G8	LCRWG8-A5	Convert existing berm into levee and add backflow protection to existing culvert	0.30	$702,000	$2,373,000	8 structures	No Impact	South Holland

3.8.3.9 LCRW-G9 – Little Calumet River Problem Group 9

3.8.3.9.1 Problem Definition, LCRW-G9

The LCRW-G9 problem area consists of a large area of overbank flooding at State Line Road (extended) in Lansing on the east to Balmoral Avenue and 163rd Street in Calumet City on the west, on both the north and south banks of the Little Calumet River. The 100-year peak flow rate varies from 1,464 cfs at State Line Road (extended) to 1,534 cfs near Balmoral Avenue and 163rd Street, and exceeds the capacity of the channel. The flooding impacts approximately 880 structures. The inundated area is shown on the recent DFIRM floodplain maps with flooding to a somewhat lesser extent.

3.8.3.9.2 Damage Assessment, LCRW-G9

Damages were defined following the protocol defined in the CCSMP. Critical duration analysis was performed to determine the highest flood stages for the Little Calumet River 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. **Table 3.8.53** lists the estimated damages for the problem group.

Table 3.8.53: Estimated Damages for Little Calumet River Subwatershed, Problem Group LCRW-G9

Problem Group ID	Damage Category	Estimated Damage ($)	Description
LCRW-G9	Property	$11,476,000	Structures at risk of flooding
	Transportation	$1,721,000	Assumed 15% of the property damages
	Recreation	$0	

3.8.3.9.3 Technology Screening, LCRW-G9

Several combinations of technologies were analyzed to address flooding problems at this location. Flood control technologies from the CCSMP were considered as potential solutions for the regional flooding problems. **Table 3.8.54** summarizes the evaluation of these technologies in terms of their potential feasibility for this problem group.

Table 3.8.54: Evaluation of Flood Control Technologies for Little Calumet River Subwatershed, Problem Group LCRW-G9

Flood Control Option	Feasibility
Detention Facilities	Due to the large extent of flooding, would only be feasible if a suitable site were available with sufficient storage volumes
Conveyance Improvement – Culvert/Bridge Replacement	Feasible if used in a setback levee option
Conveyance Improvement – Channel Improvement	Feasible for a setback levee option
Conveyance Improvements – Diversion	Due to the large extent of flooding, would be feasible if a suitable site or receiving water were available
Flood Barriers, Levees/Floodwalls	Would be feasible if sufficient space and easements
Flooding Easements	Feasible when compensatory storage is not an option to prevent stage increases

3.8.3.9.4 Alternative Development, LCRW-G9

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 3.8.55** summarizes flood control alternatives developed for Problem Group LCRW-G9.

Table 3.8.55: Flood Control Alternatives for Problem Group LCRW-G9

Alternative	Location	Description
LCRWG9-A1	Various locations along banks of Little Calumet River	Construct levees/floodwalls to protect residences inundated from the main reach of the Little Calumet River. Option would result in stage increases and require compensatory storage or purchase of flooding easements
LCRWG9-A2	Various locations along banks of Little Calumet River	Construct setback levees by placing levees at a set distance from the channel and purchasing any properties between the proposed levee and the channel bank. The area between the channel and the levee could be smoothed or deepened to better serve as an effective flow area
LCRWG9-A3	Various locations along banks of Little Calumet River	Upgrade existing levees to provide a higher level of protection. Option would result in stage increases and require compensatory storage or purchase of flooding easements
LCRWG9-A4	Forest Preserve Property	Construct detention facility to decrease flood stages below damage levels by decreasing flows through diversion to an offline storage area or for use as compensatory storage
LCRWG9-A5	Various locations along banks of Little Calumet River	Retrofit restrictive culverts to provide increased hydraulic capacity

Table 3.8.55: Flood Control Alternatives for Problem Group LCRW-G9

Alternative	Location	Description
LCRWG9-A6	Various locations along banks of Little Calumet River	Widen and/or regrade channel to increase hydraulic capacity
LCRWG9-A7	Various locations along banks of Little Calumet River	Purchase flooding easements when flooding cannot be avoided in an area; option is only feasible when stage increases are minor
LCRWG9-A8	Modifications to operation of the Thornton Composite Reservoir	Any adjustments in operations to Thornton Composite Reservoir will increase peak stages above existing conditions. Changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible
LCRWG9-A9	Various locations along banks of Little Calumet River	Construct levees/floodwalls to protect residences inundated from the main reach of the Little Calumet River and construct 500 ac-ft detention facility in forest preserve property (Combination of LCRWG9-A1 & LCRWG9-A4)
LCRWG9-A10	Various locations along banks of Little Calumet River	Construct levees/floodwalls to protect residences inundated from the main reach of the Little Calumet River and construct 2,600 ac-ft detention facility in forest preserve property (Combination of LCRWG9-A1 & LCRWG9-A4)

Streambank Stabilization Alternatives. No streambank stabilization alternatives were developed for Problem Group LCRW-G9.

3.8.3.9.5 Alternative Evaluation and Selection, LCRW-G9

Alternatives included in **Table 3.8.55** 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 3.8.57** 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.

The alternatives listed in **Table 3.8.55** are considered infeasible for this area due to the lack of sufficient available area for the large storage volumes necessary for storage alternatives to be feasible, the lack of resulting benefits and necessary easements associated with levee alternatives, and the inability to control additional flows resulting from storage and levee solutions, resulting in increased flood stages.

Providing a storage alternative would require a large scale storage area similar in magnitude to the existing Thornton Composite Reservoir. Within the main stem of the Little Calumet River, flows are very large and sustain a peak stage for many hours. A potentially feasible storage alternative would be to use a large tract of land belonging to the Forest Preserve District (FPD). This would require massive excavation and removal of acres of recreational forest preserve and trees. This option would likely face public protest, and protests from the FPD and environmental advocates, further reducing the feasibility. Similarly, diverting flows to a further downstream reach or to the Calumet-Sag Channel, for instance, was considered but would require a very large compensatory storage area. Altering current channel geometry and existing structures would require large scale storage to prevent increases in stage in other portions of the Little Calumet River and was considered infeasible.

An option to adjust the operations of the Thornton Composite Reservoir was found to be infeasible since the current operational scheme was shown to be close to optimal in preventing stage increases in the Little Calumet River. It should be noted that the Little Calumet experiences two periods of peak stages during the 48-hour storm. Any adjustment in operations was shown to increase one or the other peak stage above its current level. Changes to the operations of the Thornton Composite Reservoir were therefore considered infeasible.

Erecting a levee/floodwall between the channel bank and the closest residential property would prevent most residential flooding in the problem group. However floodwalls would likely result in unacceptable increases (greater that 0.04 ft) in river stages upstream and/or downstream of the levee structures. Such increases would need to be mitigated by diverting flows from the channel to an offline storage area, which would need to be large, and infeasible as described above. Currently, open space for a significant offline storage area is not available except for Forest Preserve Property. A second way to deal with these increased stages would be to purchase flood easements from individual property owners which would allow flooding to increase by the property owner's permission.

A second option involving floodwalls would be to create set-back levees. This involves placing levees at a set distance from the channel and purchasing any properties that happen to be between the proposed levee and the channel bank. The area between the channel and the levee can also be smoothed or deepened and better serve as an effective flow area without structures impeding the flow. Set-back levees therefore have the advantage of potentially requiring less compensatory storage and/or less purchase of flood easements.

The following potential levee component combinations were considered:

1. Project Component Combination 1 – Erect Levees to Prevent Ponding and Divert Flows to an Offsite Detention Location to Prevent Stage Increases Outside of the Levee Protection Area.

The two proposed levees and the three existing levees at problem area LCRW9, on both sides of the river, have a total length of 19,780 ft with heights varying between 3 and 8.57 feet, set 3 feet above the 100-year flood elevation. This levee system includes upgrades to existing levees which are already in place in order that the levee system would be certifiable by FEMA (i.e., 3 feet above the 100-year flood elevation, and tied back to 3 feet above the 100-year flood elevation).

The two proposed levees are located at:

- Between Balmoral Ave/163rd Street and 169th Street/State-Line Rd, Calumet City, IL (10,550 feet)

- Between Chicago Ave/170th Street to near 175th Street and State-Line, Lansing, IL (9,230 feet)

The levees vary between concrete walls and earthen berms. The three existing levees would also be upgraded to a height of 3 feet above the 100 year flood stage, thus forming a protective barrier when combined with the proposed levee system. This levee system protects approximately 880 residences west of State Line Road in Lansing and Calumet City. This system also requires interior drainage to prevent flooding behind the floodwalls.

To prevent increases in stages due to the creation of this new levee system, this combination requires offline storage of between 500 and 2,600 acre-feet, according to the approximate volume of flooding removed from the floodplain, and the results of hydraulic modeling, respectively. Estimates were made for both the offline storage areas. The construction of a 500 acre-feet, 33 feet deep storage area assumes a 1 mile diversion tunnel and has an approximate footprint of 22 acres. The construction of a 2,600 acre-feet, 33 feet deep storage area assumes a 2.4 mile diversion tunnel and has an approximate footprint of 92 acres.

The 2,600 acre-feet represents the volume currently needed to be diverted to prevent increased levee stages upstream and downstream of the levee improvements. This was based on opening gates of the diversion tunnel at a water surface elevation of 595.80 feet NAVD and closing gates at a water surface elevation of 595.55 feet NAVD. Some combination of optimization of the gate operation scheme, relocation of the diversion tunnel, or inclusion of a control structure may result in a lower compensatory storage volume between 500 and 2,600 acre-feet.

Project Component Combination 2 – Erect Levees to Prevent Ponding in Problem Area LCRW9 and Purchase Flooding Easements where Stage Increases Occur Outside of the Levee System

This combination assumes the same levee configuration as combination #1, but excludes offline storage. Due to the potential difficulty in obtaining offline storage area with the storage capacity required for combination #1, this combination implements the purchase of flood easements which allow increases in stages outside the levees through a negotiated contract with any properties affected by such flooding.

1. Project Component Combination 3 – Erection of Set-back Levees to Prevent Ponding in Problem Area LCRW9, with Floodproofing or Property Acquisition and Purchase of Flooding Easements where Stage Increases Occur Outside of the Levee System.

This combination assumes levees to be setback 600 ft from the bank of the channel with buyouts of properties between the channel bank and set-back levee. Levees would be located as described in Combination #1 above, except 600 feet from the current channel bank. Existing levees would be upgraded but remain in their current locations. While the additional setback distance would decrease increases in stages outside the levee system, hydraulic modeling indicates that the purchase of flood easements would still be necessary due to increased stages to outside the levee system.

The estimated total cost and benefit/cost ratio of levee solutions were analyzed, and as shown in **Table 3.8.57**. These costs, relatively limited resulting benefits, increased resulting flows and stages, limited available land, and necessary purchase of easements limit the feasibility of implementing these levee solutions.

This analysis suggests that the properties at risk of flooding during the 100-year event are candidates for protection using non-structural flood control measures, such as floodproofing or acquisition. These measures may be considered to address damages that are not fully addressed by capital projects recommended in the Little Calumet River DWP.

Table 3.8.56 provides a comparison of the modeled water surface elevation and modeled flow at the time of peak for LCRW-G9.

Table 3.8.56: Alternative Condition Flow & WSEL Comparison for Problem Group LCRW-G9

Location	Station	Existing Conditions		Alternative LCRWG9-A10	
		Max WSEL (ft)	Max Flow (cfs)	Max WSEL (ft)	Max Flow (cfs)
Downstream Face of Hohman Avenue	LCRW 72150	597.2	1,696	596.6	1,801
Upstream Face of Wentworth Avenue	LCRW 67516	596.7	1,462	595.6	1,184
Downstream Face of Wentworth Avenue	LCRW 67399	596.7	1,462	595.4	1,184
1,000 ft downstream of Wentworth Avenue	LCRW 66253	596.7	1,388	595.4	1,155
Downstream Face of Burnham Avenue	LCRW 63309	596.6	1,477	595.3	1,063
Upstream of Pennsylvania Railroad/Bike Trail	LCRW 58194	596.2	1,534	595.2	1,242

3.8.3.9.6 Data Required for Countywide Prioritization of Watershed Projects, LCRW-G9

None of the structural measures analyzed were considered feasible for implementation. Therefore data for prioritization of recommended capital improvement projects is not provided. **Table 3.8.57** lists the alternative analyzed in detail. The recommended alternative consists of acquiring or floodproofing the impacted structures. **Figure 3.8.14** shows the general location of the recommended alternative.

Table 3.8.57: Little Calumet River Project Alternative Matrix to Support District CIP Prioritization for Problem Group LCRW-G9

Group ID	Alternative ID	Description	B/C Ratio	Net Benefits ($)	Total Project Cost ($)	Cumulative Structures & Roadways Protected	Water Quality Benefit	Recommended	Involved Community
LCRW-G9	LCRWG9-A9*	2 proposed levees, modifications to 3 existing levees and 500 ac-ft of storage area on forest preserve land*	0.08	$13,197,000	$162,975,000	880	Positive	No	Lansing, Calumet City
LCRW-G9	LCRWG9-A10	2 proposed levees, modifications to 3 existing levees and 2,600 ac-ft of storage area on forest preserve land	0.03	$13,197,000	$441,967,000	880	Positive	No	Lansing, Calumet City

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

*This alternative would need a control structure upstream of problem area LCRW9 to limit the higher flows coming from the Little Calumet River. The total project cost does not include a control structure.

3.8.4 Recommended Alternatives, Little Calumet River Subwatershed

Table 3.8.58 summarizes the recommended alternatives for the Little Calumet River subwatershed. The District will use data presented here to support prioritization of a countywide stormwater CIP.

Table 3.8.58: Little Calumet River 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
LCRW-G1	LCRWG1-A3	Levee/ floodwall	< 0.01	$16,000	$3,412,000	4 structures	No Impact	Harvey
LCRW-G2	LCRWG2-A1	Construct levee	0.03	$148,000	$5,752,000	6 structures	No impact	South Holland
LCRW-G3	LCRWG3-A1	Construct levee	< 0.01	$4,000	$4,332,000	2 structures	No Impact	South Holland
LCRW-G4	LCRWG4-A1	Construct 825 LF levee	< 0.01	$3,000	$3,427,000	1 structure	No Impact	South Holland
LCRW-G5	LCRWG5-A1	Construct 930 LF levee/berm	2.21	$2,494,000	$1,126,000	6 structures	No impact	South Holland
LCRW-G6	LCRWG6-A1	Construct 1,285 LF levee	0.03	$60,000	$2,401,000	2 structures	No Impact	Dolton
LCRW-G7	LCRWG7-A1	Construct 785 LF levee	0.01	$21,000	$3,040,000	2 structures	No Impact	South Holland
LCRW-G8	LCRWG8-A5	Convert existing berm into levee and add backflow protection to existing culvert	0.30	$702,000	$2,373,000	8 structures	No Impact	South Holland

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