STORMWATER ANALYSIS AND RECOMMENDATIONS

Michael Baker
INTERNATIONAL

Michael Baker
INTERNATIONAL

Memorandum

TO:	Sauk Village Advisory Committee Nora Beck, CMAP	DATE:	March 4, 2019
FROM:	Tatiana H. Papakos, Michael Baker International	SUBJECT:	Stormwater Plan Recommendations for Sauk Village Comprehensive Plan

This memorandum is an appendix to the Community Facilities Chapter 9 of the Comprehensive Plan for Sauk Village and more specifically the stormwater related plan recommendations. It provides further details on how to implement the stormwater management goals and projects of the plan, including maintenance and monitoring, development standards, and capital improvements.

BACKGROUND INFORMATION

Michael Baker performed a stormwater analysis for Sauk Village using CMAP's approach to identify areas with potential flooding issues and prioritize them. Although the village does not experience frequent flooding, past street and basement flooding issues have been reported. The analysis used a statistical method based on the observed relationship between the distribution of reported flood locations and flooding-related factors such as topographic wetness index, proximity to floodplains, impervious cover, depression or low laying areas, and age of first development. The results of the analysis identified three priority areas that would benefit from green infrastructure and stormwater management. The stormwater analysis, including the determination of priority catchment areas are included in the "Sauk Village Stormwater Analysis" memorandum dated December 4. 2018, attached at the end of this memo.

An opportunity analysis performed for the priority areas identified the land uses having potential for community-level stormwater improvements. These land uses include open spaces in parks, churches, schools, vacant land, rights-of-ways, and future commercial/industrial areas. Exhibit A shows the land uses within the priority areas that offer opportunities for the locations of flood mitigation strategies.

RECOMMENDATIONS

Since parts of the Village were developed prior to the adoption of modern stormwater management regulations, there is a need for increase detention and storage of stormwater. To help Sauk Village plan for adequate stormwater management to support reinvestment in the community, we are describing in detail the following recommendations for plan implementation. Enhancing the Village's maintenance and monitoring plan will help the Village maintain their existing stormwater detention and storage. Updating development standards will allow new development and redevelopment to incorporate stormwater management best practices. Retrofitting existing development sites will help reduce flooding risk to nearby neighborhoods.

Michael Baker
INTERNATIONAL

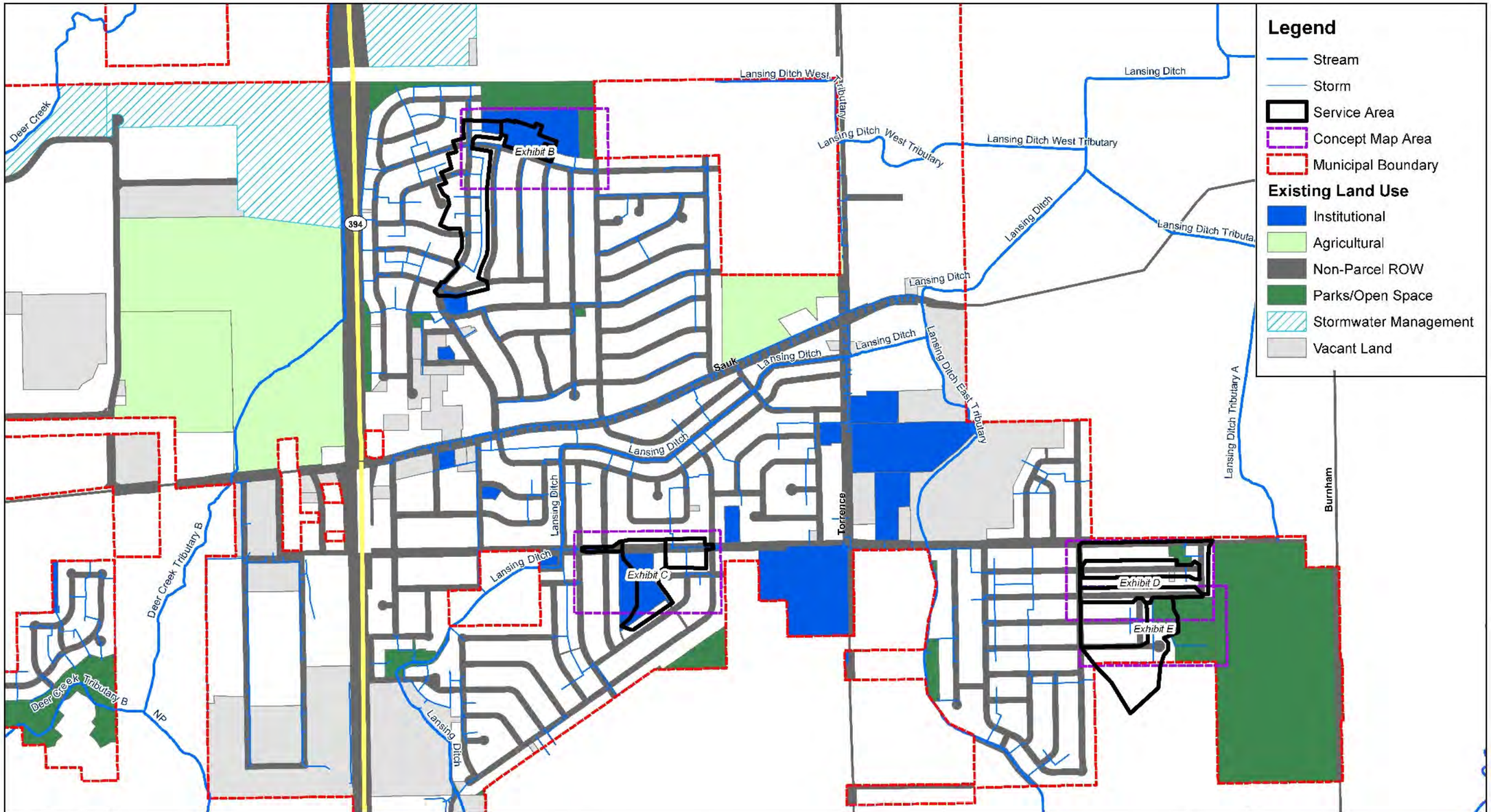


Exhibit	Landuse Opportunites and Service Areas for Concept Plans Sauk Village, Illinois	1 inch = 1,000 Feet	Michael Baker INTERNATIONAL 200 W. Adams St. Suite 2800 Chicago, IL 60606
A		N	

1. MAINTENANCE AND MONITORING PLAN FOR VILLAGE'S STORMWATER ASSETS

The Village will benefit from maintaining an up-to-date stormwater atlas and GIS database to map, inventory and describe its stormwater infrastructure. The Village currently has a GIS map of stormwater structures and pipes with some diameter data, provided by Robinson Engineering. This map can be improved with the following recommendations:

- Update the GIS map on a regular basis. After a development, road or sewer improvement is completed, as-built data could be used for the updates.
- Add other stormwater infrastructure, including detention basins, outfall structures, ditch/cannels, and green infrastructure.
- Add a GIS database that provides attribute data such as pipe material, size, inverts, and condition.

Village staff can use the stormwater atlas and GIS database to identify deficiencies in the stormwater infrastructure, target stormwater improvements, and inform capital improvement programs. Planners and engineers would use the atlas to generate more accurate estimates of stormwater runoff and flow volume when designing new infrastructure. Private developers when conducting their due diligence to select a site, would use the stormwater atlas to determine stormwater connections and limitations for their project. Having this information available will facilitate the site selection process and help minimize risk to the developer.

Sauk Village should take the lead in assessing the condition of their entire stormwater infrastructure, develop an asset management plan to bring their drainage system into a good state of repair and fund maintenance activities on a regular basis. Stormwater infrastructure have been designed to convey a specific flow capacity. Damage and deterioration of these assets can lead to reductions on their design capacity and performance. The asset management plan will ensure the long-term sustainability of the infrastructure and help public works decide when to repair, replace or rehabilitate a specific asset. Public works staff could use the atlas and GIS database to document conditions of the storm sewers during inspections and facilitate maintenance activities.

The Lansing Ditch is located within one of the priority areas and it is under jurisdiction of the Lincoln-Lansing Drainage District. Sauk Village should coordinate with the Drainage District to ensure frequent maintenance and monitoring of Lansing Ditch is performed. This will help minimize riverine flooding during high storm events.

Resources to help support some of the stormwater atlas and GIS database efforts may be available through MWRD or the South Suburban Mayors and Managers Association (SSMMA). The Village could also partner with MWRD through their Small Streams Maintenance Program (SSMP). Through this program, MWRD provides assistance by removing debris from creeks, streams, and waterways.

2. STORMWATER DEVELOPMENT STANDARDS

Sauk Village should establish well defined, enforceable stormwater performance standards for existing and new development that align with the MWRD Watershed Management Ordinance (WMO) requirements. The

WMO requirements get triggered by parcel sizes for runoff and volume control at 0.5 acres of development for multi-family/non-residential and at 1 acres of development for residential subdivisions. The WMO's threshold for detention storage is 3 acres of multi-family/non-residential and 5 acres for residential subdivisions. Stormwater improvements on new development or redevelopment that requires a WMO permit, will be designed to meet those standards which are more stringent than Sauk Village's current stormwater development standards.

Currently, regulations for stormwater management in Sauk Village are in Chapter 26, Articles III and IV, and Chapter 82, Articles IV and XII of the Sauk Village Municipal Code. These regulations are comprehensive regarding development in the floodplain/floodway and the Village should make sure these regulations are enforced. However, for development outside the floodplain, the current regulations only apply to development that disturbs more than 1 acre and detention is required for developments larger than 2 acres or with more than 50% impervious. The performance criteria under the current regulations do not designate a specific design storm event, such as the 10-yr, 50-year, or 100-yr which is needed to size stormwater facilities. For example, the WMO requires detention facilities to be designed for the 100-yr/24-hr storm event. In addition, the current regulations do not require volume control which is now required under the WMO to detain the first inch of runoff from impervious areas.

To regulate development that does not require a WMO permit, Sauk Village should adopt minimum design performance standards for runoff, volume control, and detention to manage additional stormwater generated from new impervious areas. These standards should include at least reducing the threshold for stormwater requirement to developments greater than 0.5 acres, capturing the first 0.5 inches of rainfall, providing detention for the 50-year storm event, and designing conveyance improvements for the 10-year storm event. Landscape and zoning ordinances should also be revisited to ensure they do not conflict with new stormwater standards and do not have barriers for the use of green infrastructure.

The Village should also consider developing stormwater detention/retention requirements for single-family residential lots, which are currently exempt from meeting those requirements under the current Village and WMO ordinances. The use of green infrastructure could be encouraged by creating permit guidelines that give credits or provide reduction on detention requirements.

Sauk Village should consider participating in the Community Rating System (CRS) program. The CRS is a voluntary program of the National Flood Insurance Program (NFIP). Participating communities in this program implement floodplain management activities that exceed the minimum NFIP standards. The Village already maybe performing some of these activities, which include public information, mapping and regulation, and flood damage reduction. Having and enforcing the current Village's floodplain/floodway regulations are one of the activities required by the NFIP. Improving those regulations would help the Village with the activities required for CRS program participation. Although not many structures appear to be within the floodplain, there are many residential lots that are adjacent to and with parts of the lots that are within the floodplain area. Properties that are within an NFIP and CRS-participating community receive flood insurance premium discounts. Also, implementing some CRS activities can help projects qualify for federal assistance programs.

3. CAPITAL IMPROVEMENTS

Retrofitting existing development in Sauk Village with green or grey infrastructure can help reduce flooding events while also improving water quality. Stormwater management could be incorporated on schools, churches, single-family, and public rights-of-way (ROW) redevelopments, especially those located in the priority areas which are at a higher risk of flooding. A combination of green infrastructure and stormwater detention could be applied in capital projects.

Four concept plans were developed to aid the Village with implementation of the stormwater management projects. These concept plans were located in the priority areas that have likely experienced past flooding. The concept plans were developed for school, street parkway, residential public ROW, and parks. The conceptual plans can serve as pilot projects to be replicated elsewhere in Sauk Village and could be phased over several years depending on funding sources and partnership agreements.

When considering which stormwater projects to implement, the Village should assess the severity of the flooding problem area against the expected performance of the project and ease of implementation. The Village should use the land use opportunity map (Exhibit 6 on the Stormwater Analysis Memo, included at the end of this memo) to identify potential project locations in areas of high risk. The Village should meet with the various land owners involved to understand their interest level, capital improvement plans, and the types of flooding or stormwater management issues they experience. Soil borings and/or information tests will be required to determine the soil permeability, seasonal high-water table, and need for underdrains. Stormwater easements would also be required. Detail hydrologic and hydraulic calculations, along with preliminary and final engineering design will be required for the detention facilities. Maintenance plans will be required to ensure the investment last. Educational signage should be incorporated in the projects. The signs could explain how the system feeds into the new facilities, quantify their service area, and identify the stormwater benefits provided. This could be an opportunity for educational benefits by having school children participate in the sign creation.

Sauk Village should develop a detailed understanding of annual future costs associated with implementing the stormwater recommendations that will serve as the basis for determining funding needs. Annual future cost should include maintenance of these facilities, performed by or directed by the Village and incorporated in the Village's maintenance plan. Some of the financing options when implementing a stormwater funding mechanism include property tax/general fund, sewer fees, development fee, fee-in-lieu option, or stormwater utility fee.

Funding from cost share and other programs could be available for some project through the Illinois Emergency Management Agency (IEMA) and MWRD. MWRD's Green Infrastructure Program provides cost share funding for projects at the conceptual and shovel-ready levels. Sauk Village should also coordinate with other agencies such as Illinois Environmental Protection Agency (IEPA), USEPA, Illinois State Revolving Fund, and Cook County Planning and Development Department for funding. Leveraging funding can provide for greater opportunities to enhance and expand the scope and goals of the projects. The Village should coordinate with MWRD, Illinois of Transportation, and Cook County Department of Transportation and Highway (CCDTH) on local projects to see if additional stormwater benefits can be implemented.

- School Concept Plan

Schools and churches present an opportunity to provide additional stormwater detention and storage for the surrounding area. Schools typically have athletic or play fields and large impervious areas, such as parking lots, that contribute to runoff. However, these surfaces can be redesigned with green infrastructure and stormwater detention to reduce the flow rate and runoff volume that discharges into nearby storm sewers and streams, thus reducing potential flooding.

The school concept plan in Exhibit B shows the green and gray infrastructure proposed for the Wagoner Elementary School. The three stormwater facilities included in this concept plan are independent from each other and could be installed in phases. The installation and maintenance of these projects on school grounds can also provide community and educational benefits. The green infrastructure will help bring the school up to the WMO standards for stormwater management. Green infrastructure for this concept plan includes a rain garden and permeable pavement with a service area of 3.6 acres, based on available data. The permeable pavement would be installed in a portion of the school parking lot (approximately 9,200 square feet) and would provide water quality treatment and detention for a volume of approximately 0.15 acre-feet of runoff from the parking lot. The permeable pavement is a type of pavement with high porosity that allows rainwater to infiltrate into the ground. The surface could be of permeable concrete or asphalt. A storage gravel bed installed underneath the porous pavement provides detention. If soil permeability is limited, an underdrain should be installed and could be drained to the proposed underground detention. The proposed rain garden (approximately 9,500 square feet) would be installed on the grass area in front of the school building to capture stormwater from the building. The rain garden is a garden with a soil media mix and native shrubs, perennials, and flowers planted on a small depression, usually 6 to 12 inches deep. The rain garden would provide water quality treatment and detention for a volume of approximately 0.34 acre-feet. The building downspouts would be disconnected and drained to the rain garden. The design could also include a learning garden for native plants or vegetables and fruits.

The gray infrastructure proposed provides an opportunity for a partnership between the Village and the School District to assist the neighborhood reducing their stormwater discharges. The grey infrastructure includes an underground stormwater detention area west of the school building and parking lot. This detention facility would serve approximately 17 acres of residential neighborhood south of the school along Jeffery Avenue, between 217th Place and 215th Place (See Exhibit A). The existing storm sewer currently collects runoff from this area, conveys it north, and discharges into a ditch tributary to the Lansing Ditch West Tributary. The proposed detention area would divert stormwater from this storm sewer (30-inch diameter) and store it underground during large storm events. Storm sewer pipes from the main storm line to the detention area, along with an outlet control structure would be required. The control structure would allow water to flow downstream when the detention area reaches capacity. The detention volume is approximately 1.2 acre-feet, which is estimated to significantly reduce peak flows and provides storage up to the 10-year storm event. If permeable soils are available at the site, the underground detention system can be designed with an open bottom to allow infiltration into the ground. An underground detention system is proposed in this concept plan to preserve the existing open area in case the school later wants to develop this area. However, above ground detention could be proposed here – see last concept plan for an example. The estimated cost for this project is approximately $1,688,000 and a breakdown of the cost for each stormwater facility is shown on Table 1.

Michael Baker
INTERNATIONAL

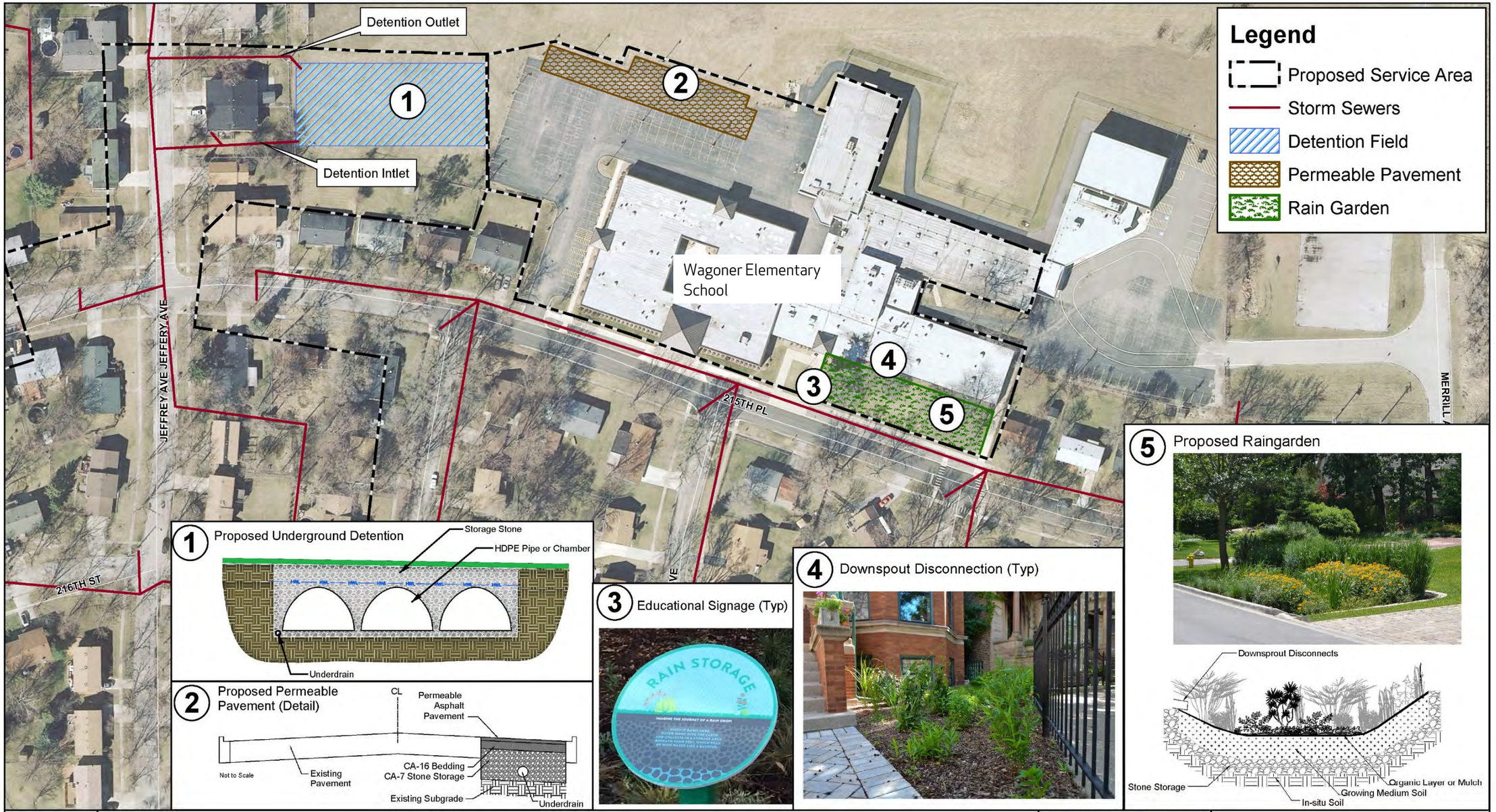


Exhibit B

Stormwater Improvements for School Concept Plan, Sauk Village, IL

Note: Photos courtesy of Center for Neighborhood Technology and Space to Grow

1 inch = 100 Feet

Michael Baker
INTERNATIONAL
Michael Baker International, Inc.
200 W. Adams St. Suite 2800
Chicago, IL 60606

Michael Baker
INTERNATIONAL

Table 1. School Concept Plan Cost Estimate

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
RAINGARDEN				
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	1407	$21	$29,556
RAINGARDEN - SOIL MEDIA, STORAGE, VEGETATION	SQ FT	9500	$16	$152,475
DOWNSPOUT DISCONNECTION	DOWNSPOUT	2	$156	$312
EDUCATIONAL SIGNAGE	EACH	1	$200	$200
			SUBTOTAL	$182,543
PERMEABLE PAVEMENT				
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	1022	$21	$21,467
PAVEMENT REMOVAL	CU YD	341	$27	$9,111
UNDERDRAIN - 4" PERF	LF	230	$30	$6,900
PERMEABLE PAVEMENT - POROUS ASPHALT	SQ FT	9200	$8	$73,600
EDUCATIONAL SIGNAGE	EACH	1	$200	$200
			SUBTOTAL	$111,278
STORMWATER DETENTION				
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	2852	$21	$59,889
NATURAL TURF (50/50 SAND TOPSOIL, SOD)	SQ YD	2222	$23	$51,111
UNDERGROUND DETENTION	AC-FT	1.45	$500,000	$723,140
EROSION CONTROL BLANKET	SQ YD	2222	$4	$8,889
STORMWATER PIPES	LF	200	$75	$15,000
CONTROL STRUCTURE	EACH	2	$10,000	$20,000
EDUCATIONAL SIGNAGE	EACH	1	$200	$200
			SUBTOTAL	$878,229
MOBILIZATION (5%)	LSUM	1	$58,603	$58,603
ENGINEERING DESIGN (10%)	LSUM	1	$117,205	$117,205
CONSTRUCTION MANAGEMENT (5%)	LSUM	1	$58,603	$58,603
			Sub-Total	$1,406,460
CONTINGENCY (20%)				$281,292
			Total	**$1,688,000**

Three schools and five churches are located within the priority areas. Though Wagoner Elementary School was chosen to illustrate the concept, other schools and the local churches may be interested in how their campuses could be improved with these strategies. The Village should consider partnering with the Community Consolidated School District 168 and the local churches to implement regional stormwater management and green infrastructure projects on their properties when redevelopment is

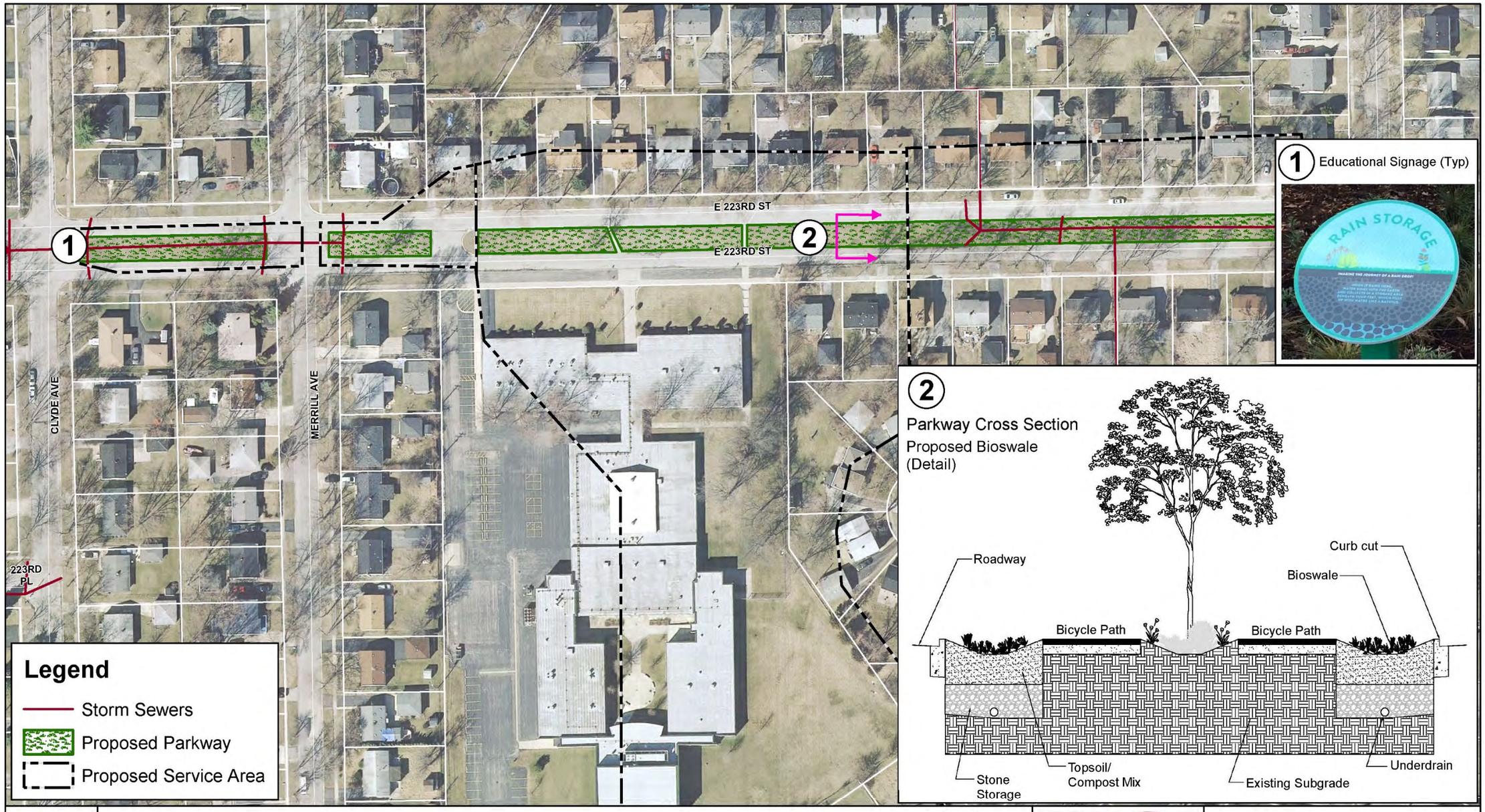
been planned. Through these partnerships, green infrastructure projects could be incorporated into their capital improvement plans. In addition, grant proposals to redesign their green space, playgrounds, or athletic fields could incorporate stormwater management best practices. Conversely, the school district could apply for stormwater funds, such as Metropolitan Water Reclamation District (MWRD)'s Green Infrastructure Fund, and note the additional educational benefits for students and the community.

- Street Parkway Concept Plan

  Public rights-of-way (ROW) offer opportunities for the installation of green infrastructure practices such as permeable pavers, bioswales, and bioretention basins. Sauk Village should implement these practices in the streets, parkways and other public ROWs under the jurisdiction of the Village during reconstruction or repair of streets, sidewalks, and storm sewers (see Figure 7.3 of Comprehensive Plan).

  The street parkway concept plan in Exhibit C shows the green infrastructure proposed for the 223rd Street. 223rd Street is a transportation corridor with a significant large parkway in its ROW that is owned and maintained by the Village. The Village's comprehensive plan identified this parkway as an opportunity to build an east-west connection for bicycles while also adding stormwater management services for the nearby neighborhood. The concept plan envisions a multi-use path that incorporates two lanes for bicycle paths with bioswales to provide stormwater management services. Bioswales are swales with gently sloped sides and filled with native vegetation and compost (soil media mix). A layer of gravel is installed underneath the soil media mix to store stormwater runoff. The bioswales in this concept plan occupy an area of about 0.3 acres and would provide water quality treatment and detention for a volume of approximately 0.5 acre-feet. Sections of the roadway curb would be cut to allow runoff from the road to drain into the bioswale and reduce flow discharges to the storm sewer system and Lansing Ditch. Overflow structures would be installed on the bioswales to allow drainage into the storm sewer system when the bioswales reach their storage capacity. Educational signage about the stormwater benefits could be incorporated in the project; perhaps in conjunction with way finding signage. The signs would explain how rainwater is redirected into the bioswales and identify the stormwater benefits provided. The estimated cost for this project is approximately $787,000 and a breakdown of the cost for each is shown on Table 2.

Michael Baker
INTERNATIONAL



1 Educational Signage (Typ)

2 Parkway Cross Section
Proposed Bioswale
(Detail)

Exhibit
C

Stormwater Improvements for Street Parkway Concept Plan, Sauk Village, IL

N

1 inch = 100 Feet

Michael Baker
INTERNATIONAL
Michael Baker International, Inc.
200 W. Adams St. Suite 2800
Chicago, IL 60606

Michael Baker
INTERNATIONAL

Table 2. Street Parkway Concept Plan Cost Estimate

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	3357	$21	$70,504
ENGINEERED TOPSOIL, FURNISH AND PLACE	CU YD	93	$65.00	$6,062
UNDERDRAIN - 4" PERFORATED	LF	2518	$30	$75,540
CURB REMOVAL	LN FT	126	$10.00	$1,259
BIOSWALES - SOIL MEDIA/STORAGE/VEGETATION	SQ FT	12590	$24.00	$302,160
TREE	EACH	50	$400.00	$20,144
OVERFLOW STRUCTURE	EACH	8	$2,500	$20,000
BICYCLE PATH (ASPHALT)	SQ YD	1679	$30.00	$50,360
EDUCATIONAL SIGNAGE	EACH	2	$200	$400
			SUBTOTAL	$546,429
MOBILIZATION (5%)	LSUM	1	$27,321	$27,321
ENGINEERING DESIGN (10%)	LSUM	1	$54,643	$54,643
CONSTRUCTION MANAGEMENT (5%)	LSUM	1	$27,321	$27,321
			Sub-Total	$655,715
CONTINGENCY (20%)				$131,143
			Total	**$ 787,000**

- Residential Concept Plan

  Most of the residential properties in the priority areas are single-family. The plan recommends promoting stormwater management practices on private property through education and outreach (see Project CF3.4 in the Comprehensive Plan). However, some areas may necessitate larger scale interventions and undeveloped lots, public ROWs, and other open space land in residential neighborhoods offer opportunities for the implementation of green and grey infrastructure that provide stormwater detention and storage.

  The residential concept plan in Exhibit D shows the green and gray infrastructure proposed for a single-family residential neighborhood block located along 223rd Road Place between Brookwood Drive and Murphy Avenue. Gray infrastructure proposed for this block includes expanding the existing stormwater detention pond by 223rd Street and Murphy Avenue. The existing detention facility serves approximately 16 acres (See Exhibit A). The pond has flooded in the past and currently has overgrown vegetation and discharge issues with the outlet that discharges north of 223rd Street into a swale located on a private property. The swale eventually discharges to the Lansing Ditch West Tributary. Runoff from the block drains east along the road, is collected by the storm sewer, and conveyed to the pond. Expanding this detention pond would provide an additional storage volume of approximately 1.5 acre-feet for the same service area. The project would include improving the outlet structure and verifying positive drainage downstream of the outlet. Detail hydrologic and hydraulic calculations, along with preliminary and final engineering design will be required for the detention pond expansion.

Green infrastructure for this concept plan includes installation of rain gardens on the parkway in front of some of the residential properties and along the detention pond. The location of rain gardens depends on the availability of the nearby storm sewer connection and a parkway area without large trees. The rain garden is a garden with a soil media mix and native shrubs, perennials, and flowers planted on a small depression, usually 6 to 12 inches deep. A layer of gravel is installed underneath the soil media mix to store stormwater runoff. The total service area for the rain gardens is approximately 5 acres. The proposed rain garden square footage is approximately 716 and would provide water quality treatment and detention for a combined volume of approximately 0.03 acre-feet. Sections of the roadway curb would be cut to allow runoff from the road to drain into the rain gardens and reduce flow discharges to the storm sewer system and to the pond.

The estimated cost for this project is approximately $231,000 and a breakdown of the cost for each stormwater facility is shown on Table 3.

Table 3. Residential Concept Plan Cost Estimate

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
RAINGARDEN				
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	716	$ 21	$ 15,036
RAINGARDEN - SOIL MEDIA, STORAGE, VEGETATION	SQ FT	716	$ 16	$ 11,492
UNDERDRAIN - 4" PERF	LF	537	$ 30	$ 16,110
CURB REMOVAL	LN FT	100	$ 10.00	$ 1,000
EDUCATIONAL SIGNAGE	EACH	1	$ 130	$ 130
			SUBTOTAL	$ 43,768
STORMWATER DETENTION				
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	3378	$ 21	$ 70,933
ENGINEERED TOPSOIL, FURNISH AND PLACE	CU YD	281	$ 65.00	$ 18,296
EROSION CONTROL BLANKET	SQ YD	1689	$ 4	$ 6,756
OUTLET/CONTROL STRUCTURE IMPROVEMENT	LS	1	$ 20,000	$ 20,000
			SUBTOTAL	$ 115,985
MOBILIZATION (5%)	LSUM	1	$ 7,988	$ 7,988
ENGINEERING DESIGN (10%)	LSUM	1	$ 15,975	$ 15,975
CONSTRUCTION MANAGEMENT (5%)	LSUM	1	$ 7,988	$ 7,988
			Sub-Total	$ 191,704
CONTINGENCY (20%)				$ 38,341
			Total	**$ 231,000**

Michael Baker
INTERNATIONAL

Exhibit

D

Stormwater Improvements for Residential Concept Plan, Sauk Village, IL

N

1 inch = 100 Feet

village of SAUK Village
pride & progress

Michael Baker
INTERNATIONAL

Michael Baker International, Inc.
200 W. Adams St. Suite 2800
Chicago, IL 60606

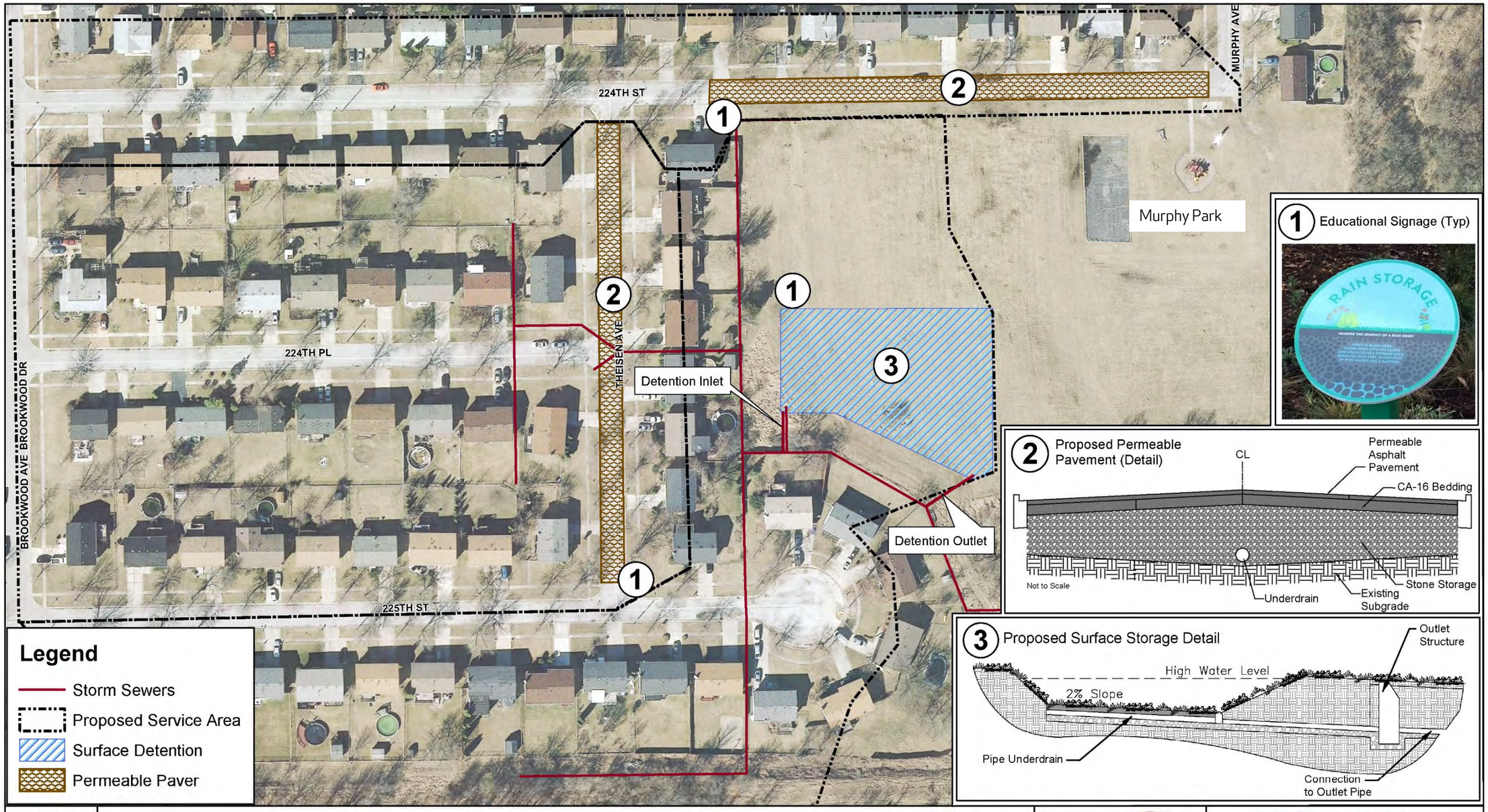
- Park Concept Plan

Parks in residential neighborhoods are prime locations for the implementation of stormwater management that provide local and regional detention and storage. The park concept plan in Exhibit E shows the green and gray infrastructure proposed for Murphy Park and the residential neighborhood around the park. Murphy Park, located by 224th Street and Theisen Avenue, is in a single-family residential neighborhood with moderate road slopes. Runoff drains to the road and east until it is captured by the storm sewer system located by the park. Gray infrastructure recommended for this area includes a stormwater surface detention area on the park parcel. The area for the proposed detention would have multiple uses as it could serve as athletic/recreational field most of the time and as off-line detention basin during large storm events. This detention facility would serve approximately 24 acres of residential neighborhood east of Brookwood Avenue, between 224th Street and 225th Street (See Exhibit A). The existing storm sewer currently collects runoff from this area, conveys it east, and discharges into a ditch tributary to the Lansing Ditch. The proposed detention area would divert stormwater from the storm sewer (36-inch diameter) and store it above ground during large storm events. Storm sewer pipes from the main storm line to the detention area, along with an outlet control structure would be required. The control structure would allow water to flow downstream when the detention area reaches capacity. The proposed detention volume is approximately 3 acre-feet, which will significantly reduce peak flows and provide storage up to the 100-year storm event. Detail hydrologic and hydraulic calculations, along with preliminary and final engineering design will be required for the detention basin.

Green infrastructure for this concept plan includes permeable pavement to reduce stormwater flow discharges to the existing storm system that eventually discharges to the Lansing Ditch. The service area for the permeable pavement along 224th Street is 4 acres and the service area for the permeable pavement along Theisen Avenue is 8 acres. The permeable pavement would be installed along the entire width of the road and would provide water quality treatment and detention for a volume of approximately 0.41 acre-feet. However, if underground utilities are present, the width of the permeable pavement would need to be adjusted. This project could also be timed with roadway repairs or reconstruction. If soil permeability is limited, an underdrain should be installed and connected to the existing storm sewer system.

The estimated cost for this project is approximately $724,000 and a breakdown of the cost for each stormwater facility is shown on Table 4. The installation and maintenance of these projects would also provide community and educational benefits.

Michael Baker
INTERNATIONAL



Exhibit

E

Stormwater Improvements for Parkland Concept Plan, Sauk Village, IL

N

1 inch = 100 Feet

Village of SAUK Village
pride & progress

Michael Baker
INTERNATIONAL
Michael Baker International, Inc.
200 W. Adams St. Suite 2800
Chicago, IL 60606

Michael Baker
INTERNATIONAL

Table 4. Park Concept Plan Cost Estimate

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
PERMEABLE PAVEMENT				
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	2773	$ 21	$ 58,240
PAVEMENT REMOVAL	CU YD	924	$ 27	$ 24,720
UNDERDRAIN - 4" PERF	LF	1040	$ 30	$ 31,200
PERMEABLE PAVEMENT - POROUS ASPHALT	SQ FT	24960	$ 8	$ 199,680
EDUCATIONAL SIGNAGE	EACH	2	$ 200	$ 400
			SUBTOTAL	$ 314,240

STORMWATER DETENTION				
EARTH EXCAVATION, REMOVAL AND DISPOSAL	CU YD	4978	$ 21	$ 104,533
ENGINEERED TOPSOIL, FURNISH AND PLACE	CU YD	622	$ 65.00	$ 40,444
EROSION CONTROL BLANKET	SQ YD	3733	$ 4	$ 14,933
STORMWATER PIPES	LF	110	$ 75	$ 8,250
MANHOLE	EACH	2	$ 5,000	$ 10,000
OUTLET CONTROL STRUCTURE	EACH	1	$ 10,000	$ 10,000
EDUCATIONAL SIGNAGE	EACH	1	$ 200	$ 200
			SUBTOTAL	$ 188,361

MOBILIZATION (5%)	LSUM	1	$ 25,130	$ 25,130
ENGINEERING DESIGN (10%)	LSUM	1	$ 50,260	$ 50,260
CONSTRUCTION MANAGEMENT (5%)	LSUM	1	$ 25,130	$ 25,130
			Sub-Total	$ 603,121
CONTINGENCY (20%)				$ 120,624
			Total	**$ 724,000**

Michael Baker
INTERNATIONAL

Memorandum

TO:	Nora Beck, CMAP	DATE:	December 4, 2018
FROM:	Tatiana H. Papakos, Michael Baker International	SUBJECT:	Sauk Village Stormwater Analysis

This memorandum provides an overview of the stormwater analysis and findings for Sauk Village.

PROBLEM UNDERSTANDING

Sauk Village is 3.4 square miles and is located in the southeast of Cook County, approximately 20 miles south of the Chicago border. Sauk Village is bordered by Chicago Heights, Ford Heights, and Lynwood to the north; Steger and Crete to the south, South Chicago Heights to the west; and Dyer, Indiana to the east.

Sauk Village is predominately a bedroom community. In recent years, a warehouse/small industry district was developed on the west side of IL-394 which runs through the village. Most of the residential development was built between 1920 and 1989 and large-scale business started moving in by the 1990s.

Surface runoff drains mainly to two creeks: Lansing Ditch and Deer Creek Tributary B. Highway IL-394 acts as the water divide for these two watersheds. Exhibit 1 shows the location of the streams in and around Sauk Village, along with their floodplain and drainage areas (catchments). Lansing Ditch flows in the northerly and northeastly direction and eventually discharges to North Creek. Most of the village drains to this creek, which has a drainage area of approximately 2.5 square miles (sq. mi) within the village. Deer Creek Tributary B flows in a northerly direction and is tributary to Deer Creek. Its drainage area within the village is approximately 0.1 sq.mi. A small portion of the village (0.01 sq.mi) also drains to Plum Creek, located east of the village boundary.

Stormwater is conveyed through the village-owned separate storm sewer system and eventually discharges to the creeks. The majority of the residential areas do not have detention and are mainly served by the storm sewer system. The village does not appear to experience frequent flooding. Feedback obtained from public outreach events did not highlight any flooding issues. Past reported flooding issues include street flooding due to undersized or blocked culverts, basement flooding, and overbank flooding from Lansing Ditch. Exhibit 2 shows a reported flood density map for the village which was developed input from FEMA, MWRD, and Sauk Village.

Both urban and riverine flooding can cause serious problems in developed areas including damage to property, disruption of traffic flow, delay of emergency services, debris build-up, and nuisance flooding. CMAP developed an approach to identify areas with potential flooding issues for communities in the Chicago region. CMAP's approach was applied to the Sauk Village to better incorporate stormwater and flood mitigation strategies in the Village 's Comprehensive Plan.

Michael Baker
INTERNATIONAL

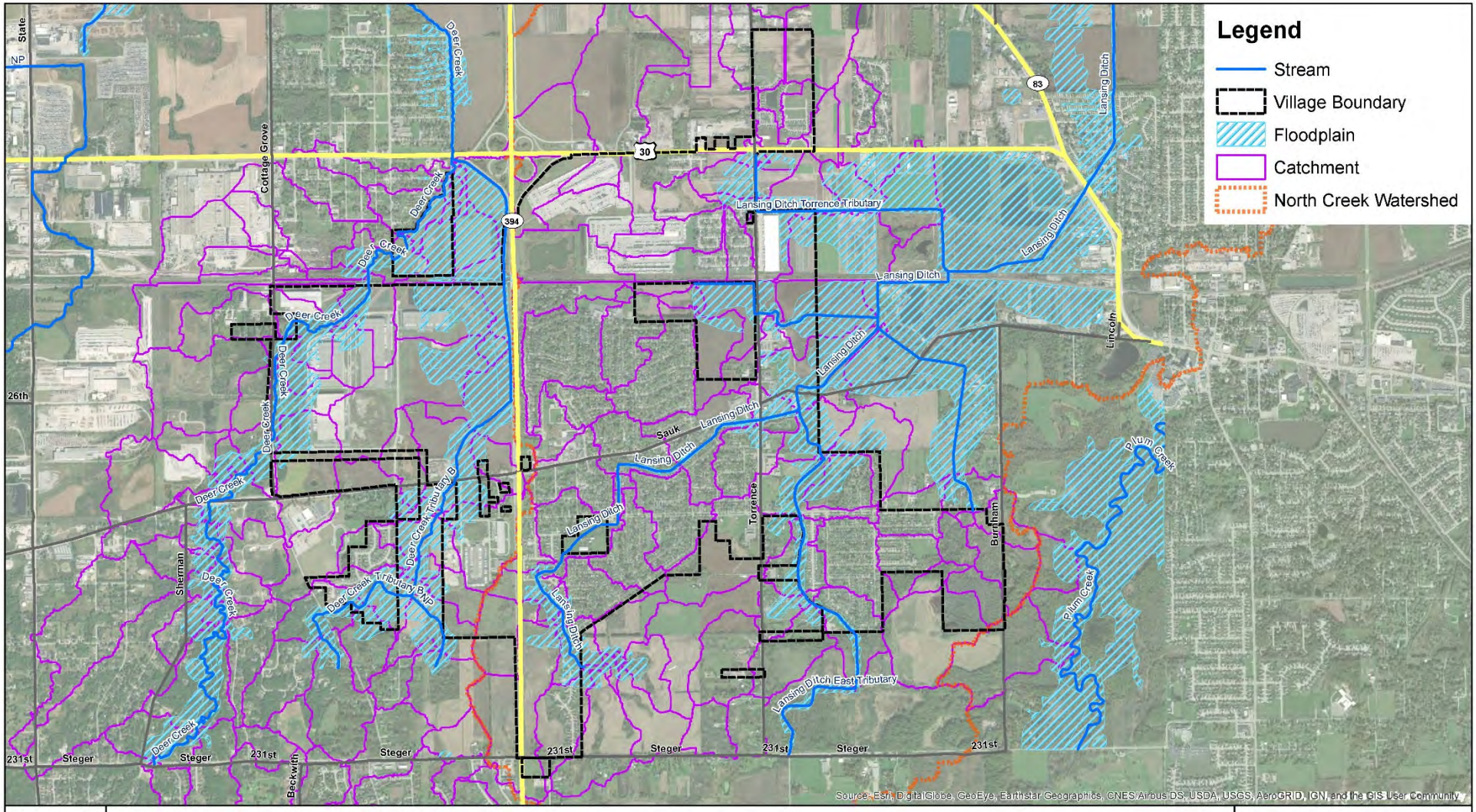


Exhibit 1

Hydrology Map - Streams, Catchment, and Floodplains
Sauk Village, Illinois

1 inch = 2,000 Feet

Michael Baker
INTERNATIONAL
200 W. Adams St. Suite 2800
Chicago, IL 60606

Michael Baker
INTERNATIONAL

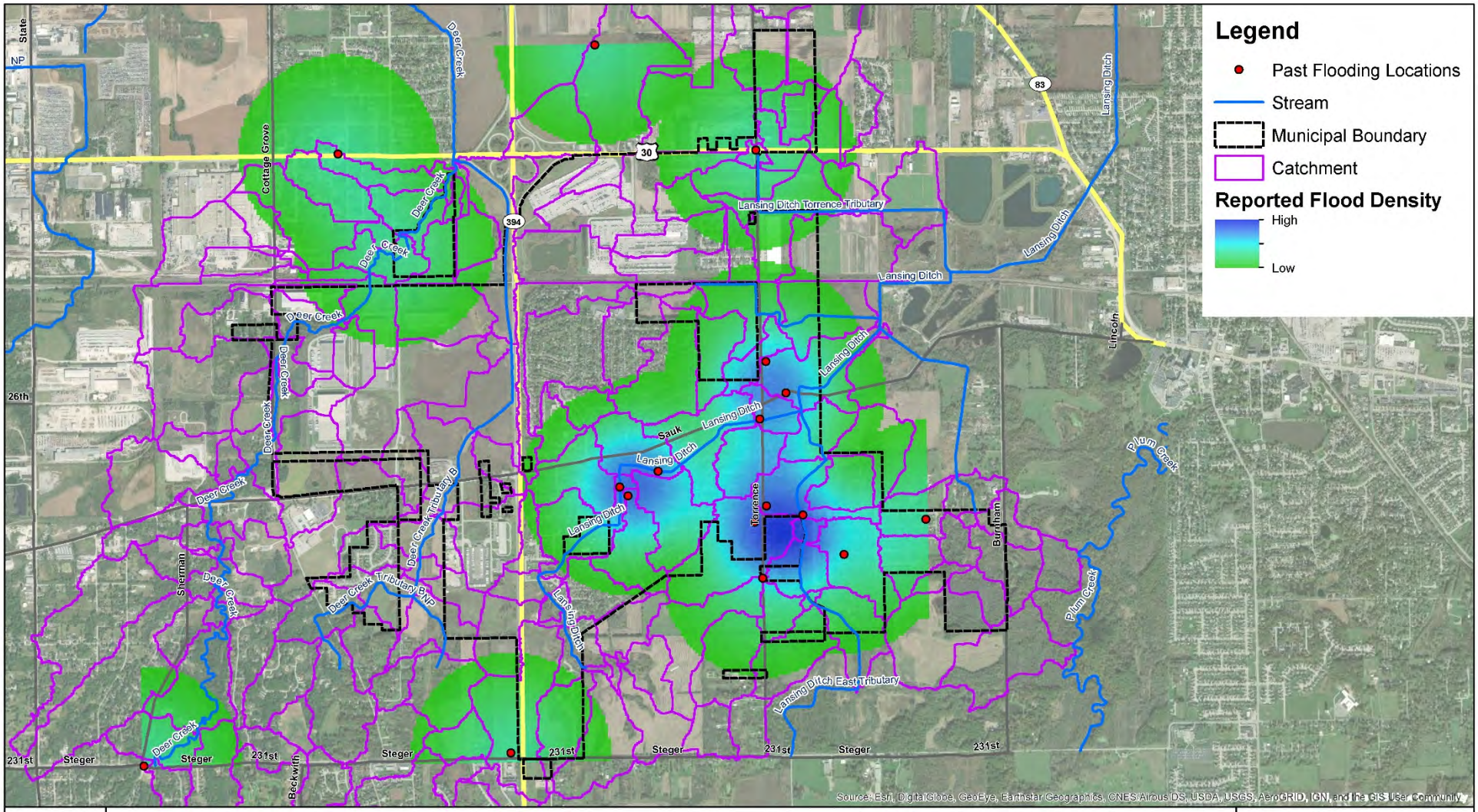


Exhibit 2

Reported Flood Density Map
Sauk Village, Illinois

1 inch = 2,000 Feet

Michael Baker
INTERNATIONAL
200 W. Adams St. Suite 2800
Chicago, IL 60606

DATA COLLECTION AND ANALYSIS

CMAP's approach uses a data-driven process at the planning level to integrate stormwater management into decisions about land use and development. It is designed to prioritize areas of the community that would benefit from green infrastructure, stormwater management, and land use intervention.

The first step in the analysis is to get a better understanding of the locations and conditions that can cause flooding in Sauk Village. Data obtained from several sources, as shown in Table 1, was reviewed and included in the analysis. These data included water resources, topography, land use, and infrastructure data as well as available information on past flooding events. The approach used does not include hydrologic and hydraulic (H&H) modeling, which is cost intensive and beyond the scope of this analysis.

Table 1. Data Collected for Sauk Village Stormwater Analysis

Data	Source
Hydrology	NHD, County
Wetlands	National Wetlands Inventory
Watersheds (HUC 12)	NRCS
1-foot Contours	Cook County
Floodplains and BFE (for 1% annual chance)	FEMA/MWRD
FEMA Flood Risk/Discovery Feedback	FEMA
Reported Problem Areas	Village, MWRD, and FEMA Discovery Process
Flow Paths	CMAP
Catchments	CMAP
Depressions	CMAP
Building Footprints	CMAP
Storm Sewer Infrastructure	Sauk Village Engineer
Land use	CMAP Land Use Inventory
Regional Flooding Susceptibility Indexes	CMAP
Public Land Map	Cook County
Soil Survey	USDA-NRCS

The delineated catchments provided by CMAP identify the extent of area contributing to surface water flow. These areas are approximate because the catchment delineation does not consider subsurface stormwater infrastructure and its related capacity. However, a planning level review of the existing storm system shows good agreement with the delineated catchments.

Catchments within the village were summarized using the regional flooding susceptibility index (FSI). Exhibits 3 and 4 show the FSIs values by catchment for riverine and urban areas, respectively. The CMAP's Regional FSIs were constructed using a statistical method based on the observed relationship between the distribution of reported flood locations and flooding-related factors such as topographic wetness index, combined sewer service areas, elevation differential between property and nearest base flood elevation, impervious cover, and age of first development.

Michael Baker
INTERNATIONAL

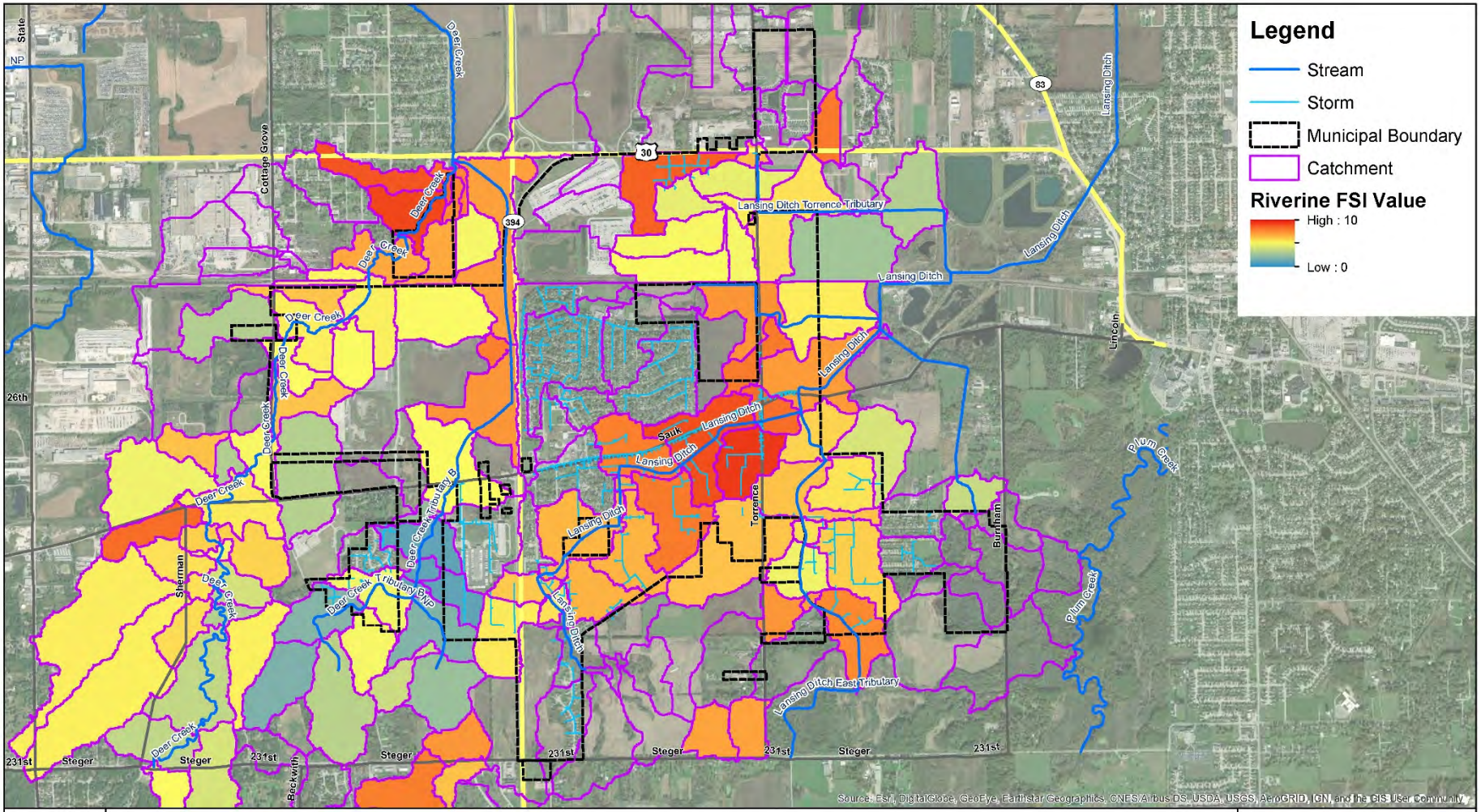


Exhibit 3

Riverine Flooding Susceptibility Index (FSI) Summarized by Catchment
Sauk Village, Illinois

1 inch = 2,000 Feet

Michael Baker
INTERNATIONAL
200 W. Adams St. Suite 2800
Chicago, IL 60606

Michael Baker
INTERNATIONAL

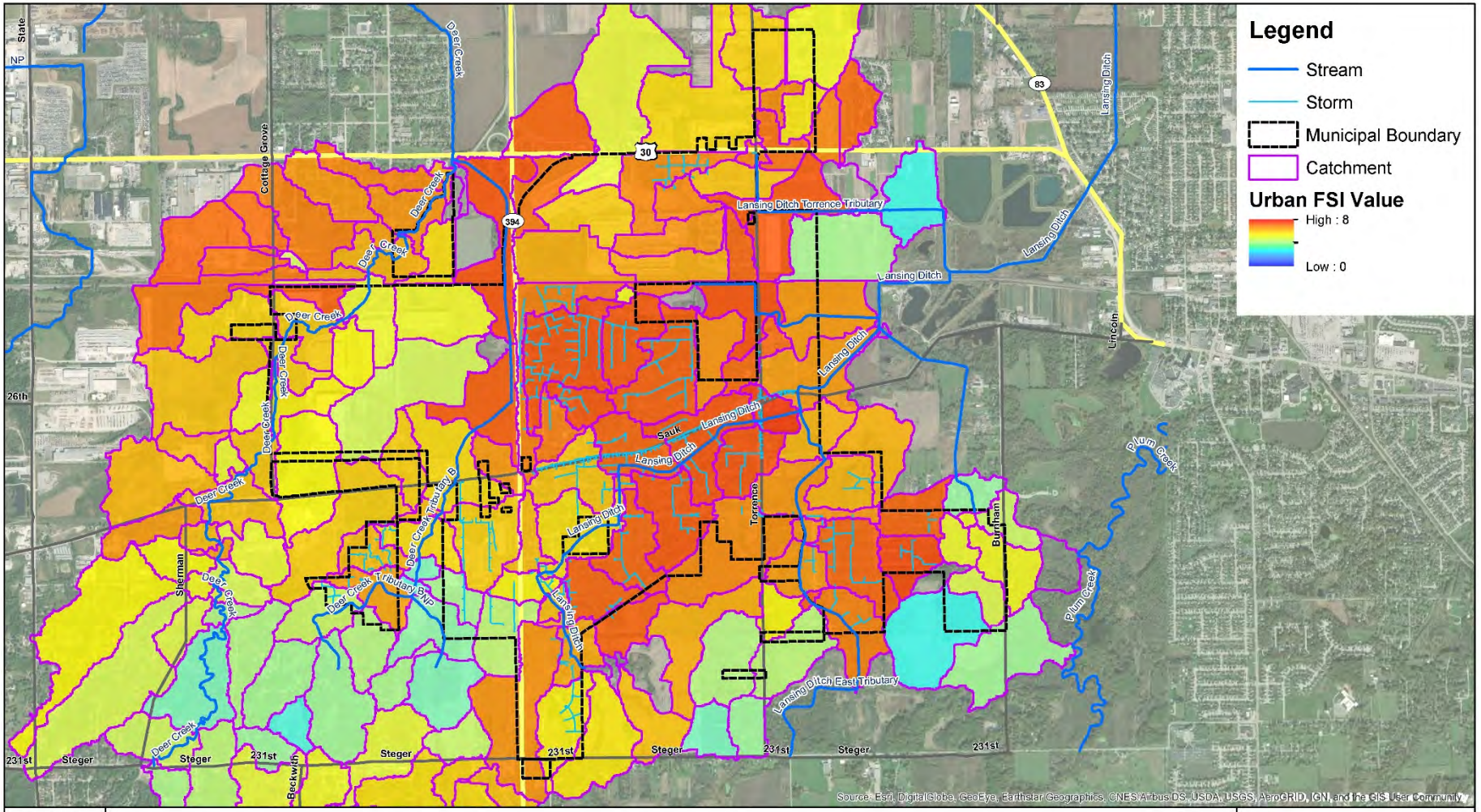


Exhibit
4

Urban Flooding Susceptibility Index (FSI) Summarized by Catchment
Sauk Village, Illinois

N
1 inch = 2,000 Feet

Michael Baker
INTERNATIONAL
200 W. Adams St. Suite 2800
Chicago, IL 60606

The FSIs identify locations that are more susceptible to either riverine or urban flooding than other portions of the region. While specific locations may not currently flood, streets and buildings within these areas could be more susceptible to overbank flooding, surface ponding, overland flow, water seepage, and basement backups.

Exhibits 3 and 4 show the catchments with higher flood risk areas in orange and red colors. Areas in the village with a high Riverine FSI value are areas with dense development around the floodplain that occurred prior to the 1990s. Areas in the village with a high Urban FSI value are older residential areas with moderate to high percentage of impervious cover and with a high elevation differential between the properties and nearest base flood elevation (BFE).

Catchments that scored in the top 15% high FSI values for urban flooding and for riverine flooding were further analyzed to determine causes of potential flooding and select priority areas for flood mitigation. Each of these catchments was scored based on the following criteria:

- Scored as an average index by catchment in the top 15% for both urban and riverine FIS values
- Past reported flooding by count per catchment
- Depressions or low laying areas with flow accumulation as percentage of catchment
- More than 50 percent of impervious surface by catchment

Areas that met two or more of the criteria above were selected as priority areas. In overall, 12 catchment areas were selected and separated in three areas:

1. Residential Area Southeast of IL-394 and the CN Rail Road. Two catchments (49 and 50) have a high Urban FSI value due to their high percent of impervious area and their high elevation differential between the properties and the BFE. These areas also have several depressions that could pond surface water and cause street and residential flooding.
2. Residential Area by Lansing Ditch. Seven catchments encompass this area, including 71, 73, 74, 84, 85, 89, and 94. This is a very dense residential area with some urban mix development along Sauk Trail. The area is drained by a storm sewer system that discharges to Lansing Ditch. These area has flooded in the past due to overbank flooding from the creek that has caused basement and street flooding.
3. Residential Area South of 223rd Street. Three catchments were selected in this area, including 91, 111 and 116. This is a residential area with some open space for parks and forest preserve.

Attachment 1 shows a summary of the stormwater analysis results that aided in the prioritization of the catchment areas. Exhibit 5 shows the selected catchments or priority areas.

Some catchments had high FSI values due to their proximity to floodplains (13, 54, 65, and 130). However, those areas were excluded because they were undeveloped or with very low percentage of impervious cover. In addition, two catchments (19 and 20) that drain to Deer Creek and met two of the criteria were not selected because the areas at risk of flooding is in the Village of Ford Heights, outside of Sauk Village limits. The Metropolitan Water Reclamation District (MWRD) has identified this area as flood problem area and is currently designing a flood control improvement project that includes Deer Creek stream improvements north of US-30 Hwy.

Michael Baker
INTERNATIONAL

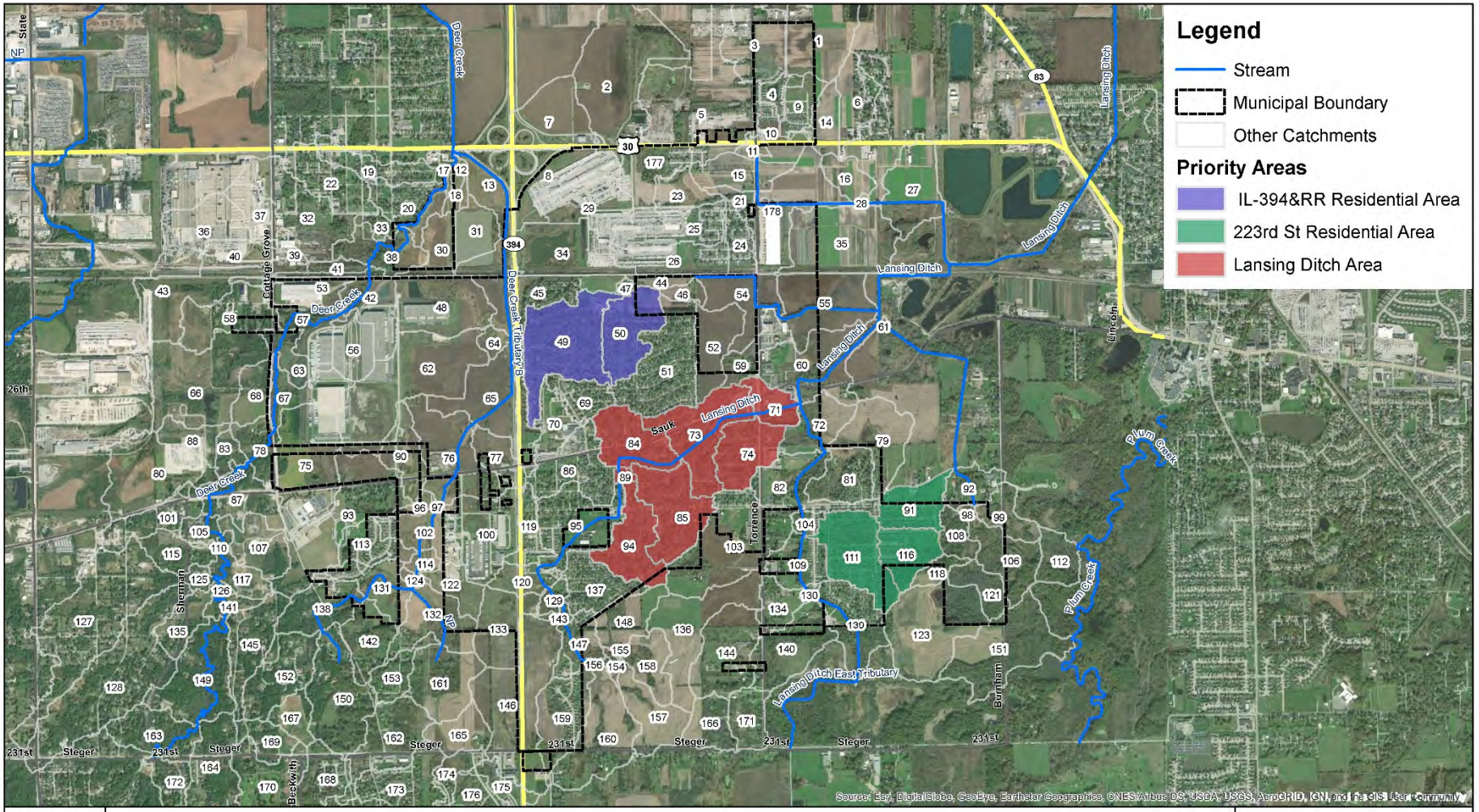


Exhibit 5

Priority Areas Selected for Stormwater Management Improvements
Sauk Village, Illinois

N

1 inch = 2,000 Feet

Michael Baker
INTERNATIONAL
200 W. Adams St. Suite 2800
Chicago, IL 60606

OPPORTUNITY ANALYSIS

To help Sauk Village prioritize their efforts to address the catchments with a higher risk of flooding, potential opportunities for land use and soil types were explored.

The USDA-NRSC soil survey for the village was analyzed to determine the location, hydrologic soil group (HSG) and infiltration capability. HSG type A (sands) and B (loam) are ideal for infiltration practices. There are a few sandy soils with HSG A and B within the village. However, these soils are not within the priority areas. Most of the soils in the residential neighborhoods are clay with low permeability rates. If green infrastructure is to be implemented within the residential areas, underdrains should be considered unless site specific soil boring data indicates high permeability rates.

An initial assessment of land use within the priority areas included land use categories such as open spaces, churches, schools, vacant land, and rights-of-ways. These land uses were identified as having potential for community-level stormwater improvements. Exhibit 6 shows the priority areas with potential land use opportunities. The residential area southeast of IL-394 and CN railroad has a school, a couple of vacant parcels and the rights-of-ways where stormwater improvements could be located. The residential area around Lansing Ditch has two schools, a vacant parcel adjacent to the Ditch and a large right-of-way on 223rd Street as potential opportunities for stormwater improvements. The residential area south of 223rd Street has a park, an open space parcel with stormwater detention and the rights-of-ways that serve as potential opportunities.

Commercial and Industrial areas also present opportunities for stormwater improvements. While there are no existing commercial land uses within the priority areas, there is an agricultural area northwest of Sauk Trail and Torrence Avenue that drains to the priority areas. This area is planned for future commercial development and could present another opportunity for flood mitigation.

In addition, there is another agricultural land by the LogistiCenter northwest of IL-394 and Sauk Trail that is being proposed for the expansion of the Industrial Park. This land is outside of the priority areas and therefore, will not be included in this analysis for flood mitigation activities. However, this land presents stormwater management opportunities for the Industrial Park. Cook County Department of Transportation and Highways (CCDOTH) recently studied this area to provide roadway and rail access to the parcels within the LogistiCenter (Technical Memorandum – Sauk Village LogistiCenter Concept Study Project Drainage Report). The report explains in detail existing drainage, flooding concerns, and the Stormwater Management Plan completed for the LogistiCenter in 2005. A significant part of the available land is located within the FEMA regulated floodplain. Future development must incorporate the floodplain and floodway into the proposed conditions and provide compensatory storage to offset any fill in the floodplain.

RESULTS

CMAP's stormwater approach to identify areas with potential flooding issues and prioritize them for flood mitigation was applied to the Sauk Village. This approach was coupled with a more detailed review of problem areas and hydrological conditions that aided in the prioritization of areas that would benefit from green infrastructure. A total of 12 catchments were selected as priority areas. In addition, land use opportunities were identified as potential locations for flood mitigation activities.

Michael Baker
INTERNATIONAL

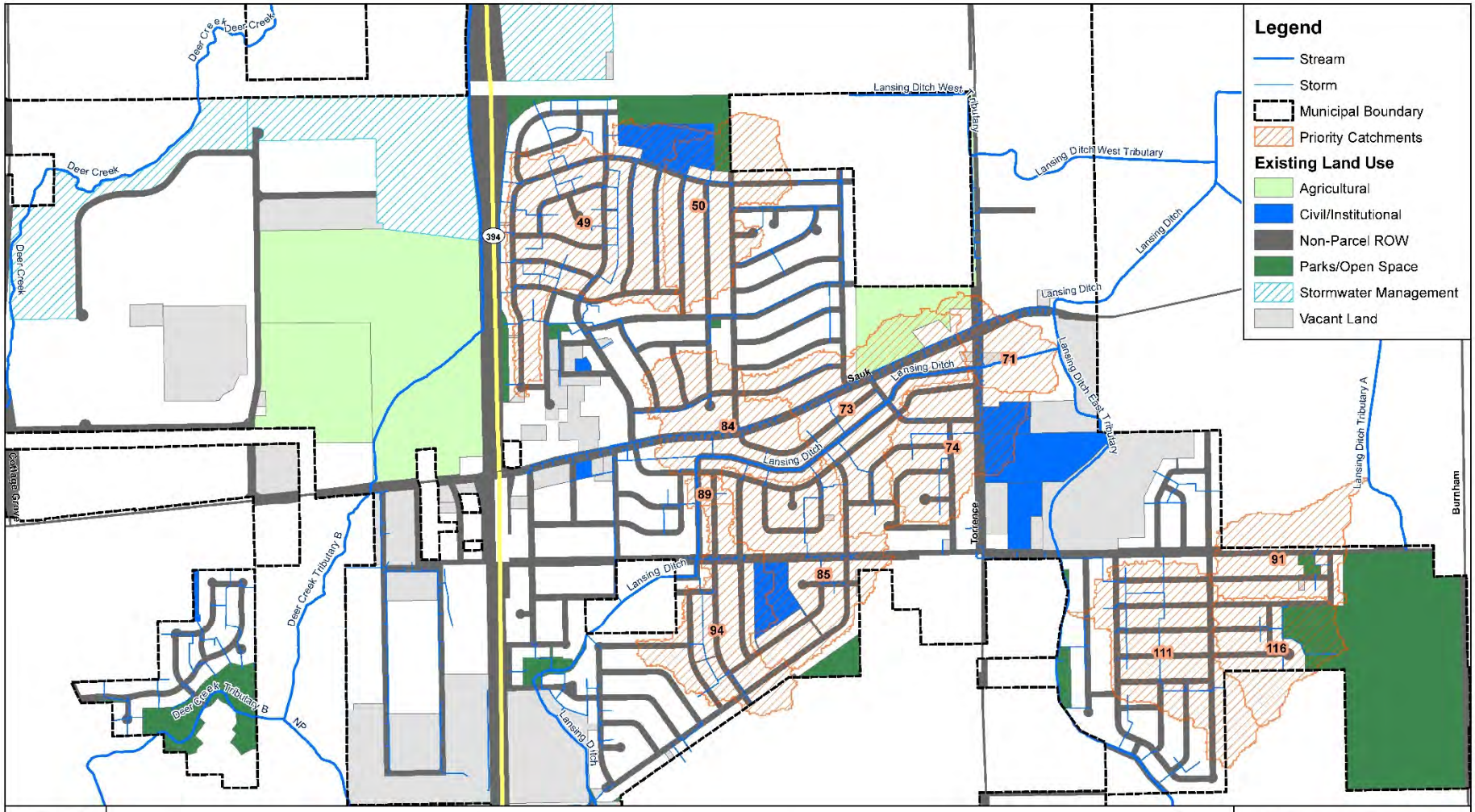


Exhibit 6

Landuse Opportunites for Stormwater Management Improvements
Sauk Village, Illinois

Michael Baker
INTERNATIONAL
200 W. Adams St. Suite 2800
Chicago, IL 60606

Michael Baker
INTERNATIONAL

ATTACHMENT 1

Michael Baker INTERNATIONAL

Attachment 1
Stormwater Analysis Results - Catchment Prioritization Table

Catchment Number	Area, Ac	Urban FIS	Riverine FIS	Reported Flood Type	Top 15% FSI Value for both U/R	Reported flooding	>50% Impervious coverage	Depressions	Selected	Notes
49	77.6	7.47	0.00				X	X	X	
50	44.8	7.40	0.00				X	X	X	
71	19.4	7.73	8.27	Street flooding -	X	X	X	X	X	
73	59.8	7.48	8.92		X		X		X	
74	38.9	7.46	9.37		X		X	X	X	
84	41.9	7.27	7.78	Basement flooding -	X	X	X	X	X	
85	53.5	7.42	8.00		X		X	X	X	
89	3.2	6.61	6.98	Basement flooding -		X		X	X	
91	31.9	7.26	0.00	Street flooding -		X	X	X	X	
94	43.1	7.27	6.66	Street flooding -		X	X	X	X	
111	53.8	7.27	6.05				X	X	X	
116	30.6	7.57	0.00				X	X	X	
1	70.0	5.21	0.00							
2	123.5	5.00	0.00							
3	49.1	5.82	0.00							
4	9.6	6.74	0.00							
5	104.4	5.75	0.00							
6	29.1	7.16	0.00							
7	50.0	7.25	0.00							
8	35.3	7.08	0.00							
9	19.0	5.61	0.00							
10	20.0	7.13	0.00							
11	5.8	6.92	6.37	Street flooding -		X				Undersized Storm - Road/Commercial
12	4.1	0.00	7.76							
13	74.0	7.47	7.14		X					Undeveloped area
14	19.8	6.83	8.00							
15	29.6	6.09	4.47							
16	17.2	0.00	0.00							
17	5.1	6.24	8.25				X			
18	6.0	0.00	7.55							
21	8.0	7.34	5.38							
22	38.2	6.61	0.00							
23	20.2	6.76	4.41							
24	18.0	7.25	4.88				X			
25	35.5	6.65	4.91							
26	35.8	6.34	5.00							
27	46.7	2.84	3.00							
28	1.6	0.00	0.00							
29	41.8	5.97	0.00							
30	23.1	5.71	6.85							
31	23.6	0.00	4.83							
32	61.3	6.96	0.00							
33	7.6	6.52	0.00							
34	54.1	6.34	0.00							
35	75.8	3.91	2.55							
36	52.5	7.15	0.00							
37	22.3	7.12	0.00							
38	32.0	6.26	6.91	Street flooding -		X				Overbank Flooding -Undeveloped
39	2.8	4.66	0.00							
40	20.4	7.07	0.00							
41	7.6	6.27	5.09							
42	39.4	5.13	5.21							
43	58.2	7.00	0.00							
44	8.0	6.94	0.00							
45	48.7	6.95	0.00							
46	8.0	0.00	0.00							
47	2.7	5.25	0.00							
48	56.1	5.16	4.92							
51	69.4	7.33	0.00				X			High surface slope & no depressions
52	33.9	6.66	0.00							

Michael Baker INTERNATIONAL

Attachment 1
Stormwater Analysis Results - Catchment Prioritization Table

Catchment Number	Area, Ac	Urban FIS	Riverine FIS	Reported Flood Type	Top 15% FSI Value for both U/R	Reported flooding	>50% Impervious coverage	Depressions	Selected	Notes
53	19.7	7.25	6.17							
54	39.2	7.44	7.31		X					Undeveloped area
55	57.5	6.54	5.38							
56	25.9	5.36	4.99							
57	35.7	5.97	5.24							
58	45.1	5.82	3.00							
59	21.5	7.16	8.00				X			
60	63.2	6.57	7.24							
61	1.2	0.00	0.00							
62	105.3	4.66	0.00							
63	18.6	5.87	4.93							
64	7.3	0.00	7.85							
65	50.9	7.33	7.27		X					Undeveloped area
66	91.0	6.06	0.00							
67	28.2	5.48	6.20							
68	21.6	5.21	0.00							
69	20.6	7.47	0.00				X			High surface slope & no depressions
70	21.2	6.99	0.00							
72	31.1	6.27	5.93							
75	74.6	5.30	3.01							
76	64.1	5.75	5.02							
77	19.8	6.62	0.00							
78	23.6	6.00	4.90							
79	45.0	6.29	4.00							
80	67.2	6.24	4.64							
81	31.6	6.26	5.53							
82	43.2	6.67	6.31	Street flooding -		X				Undersized Storm - Road/Commercial
83	10.1	5.11	3.00							
86	46.0	6.03	0.00							
87	39.9	6.07	5.41							
88	19.9	6.22	6.29							
90	27.8	5.91	0.00							
92	21.1	3.71	3.51							
93	82.5	5.90	0.00							
95	54.3	5.69	6.58							
96	5.4	6.13	2.28							
97	1.2	6.00	0.00							
98	2.5	5.23	0.00							
99	21.2	4.48	0.00							
100	54.4	5.89	0.00							
101	29.1	6.57	8.26				X			
102	30.3	5.77	1.00							
103	87.3	6.80	6.25	Street flooding - Urban		X				Undersized Storm - Road/Commercial
104	6.9	6.68	5.70							
105	10.6	6.10	5.99							
106	37.3	5.22	0.00							
107	32.0	5.07	5.90							
108	15.8	5.13	0.00							
109	28.7	6.60	4.71							
110	4.6	6.40	4.87							
112	21.6	0.00	0.00							
113	24.3	6.17	0.00							
114	7.0	3.40	1.00							
115	22.9	5.33	5.58							
117	18.5	4.71	3.92							
118	9.8	0.00	0.00							
119	18.7	6.17	0.00							
120	18.0	5.43	6.10							
121	19.7	4.79	0.00							

Michael Baker INTERNATIONAL

Attachment 1
Stormwater Analysis Results - Catchment Prioritization Table

Catchment Number	Area, Ac	Urban FIS	Riverine FIS	Reported Flood Type	Top 15% FSI Value for both U/R	Reported flooding	>50% Impervious coverage	Depressions	Selected	Notes
122	19.8	3.91	1.00							
123	79.1	2.83	0.00							
124	3.7	3.02	1.00							
125	6.8	5.25	5.55							
126	2.7	5.08	3.26							
127	118.0	5.34	5.28							
128	115.9	4.74	5.24							
129	8.0	6.09	5.57							
130	2.5	7.33	7.00		X					Undeveloped area
131	31.8	6.44	4.75							
132	41.9	3.61	1.79							
133	40.6	4.32	5.41							
134	19.5	5.42	7.29							
135	22.5	4.90	5.73							
136	61.0	6.32	0.00							
137	33.0	7.26	6.63				X			
138	38.3	4.52	1.82							
139	45.5	6.93	7.62							
140	46.9	4.22	0.00							
141	9.9	4.09	3.05							
142	32.0	4.14	4.81							
143	3.4	6.21	0.00							
144	54.2	4.12	0.00							
145	41.0	4.08	5.25							
146	96.2	6.67	0.00	Street flooding -		X				Storm Flow Restriction - Commercial
147	24.3	6.38	0.00							
148	29.0	7.30	0.00							
149	62.6	3.41	3.40							
150	64.4	3.82	3.22							
151	72.1	3.81	0.00							
152	45.2	3.90	1.67							
153	19.7	3.97	3.62							
154	3.5	0.00	0.00							
155	1.1	0.00	0.00							
156	2.1	0.00	0.00							
157	35.3	6.03	0.00							
158	25.6	0.00	0.00							
159	44.1	5.46	0.00							
160	60.6	5.58	0.00							
161	45.6	3.40	2.35							
162	48.4	5.02	0.00							
163	38.0	4.57	3.37							
164	76.2	4.27	4.02							
165	23.6	4.41	7.26							
166	23.5	3.32	7.00							
167	16.8	2.96	0.00							
168	113.4	5.15	0.00							
169	18.5	3.80	0.00							
170	61.3	5.02	0.00							
171	23.2	3.79	7.00							
172	17.6	4.06	4.93							
173	47.3	5.67	7.87							
174	15.8	5.83	6.30							
175	17.0	6.12	0.00							
176	55.0	5.73	0.00							
177	47.2	6.77	8.57							
178	62.2	7.41	5.57							
19	28.0	6.82	8.82				X	X		Not selected because residential area is
20	33.1	6.67	9.09				X	X		Not selected because residential area is