

# DRAFT

## Conceptual Stormwater Improvements near the Axtell Creek Headwaters February 25, 2005

### Overview

There are 1,519 acres of land within the Axtell Creek subwatershed. Approximately 856 acres are defined as non-contributing areas, as they are not hydraulically connected to the surface water flow of Axtell Creek. These areas include the Woods Lake drainage area, the Pike's Pond drainage area, and the Kleinstuck Marsh drainage area. The remaining 663 acres (north of Pike's Pond and Kleinstuck Marsh) are defined as contributing areas, as they are hydraulically connected to the surface water flow of Axtell Creek (roughly beginning at Maple Street and Bronson Blvd). Refer to Figure 1 for a map of the Axtell Creek contributing drainage areas.

### Concept #1

- The City of Kalamazoo owns approximately 9.5 acres of property at the Axtell Creek headwaters (municipal well field #4 located between Maple Street, Hudson Street and Peeler Street). Refer to Figure 2.
- A stormwater diversion structure could be placed along the existing 42-inch storm sewer pipe from the Bronson Blvd drainage area just south of Peeler Street to intercept and redirect stormwater volumes into a lower portion of the City's municipal well field properties (approximately 3.2 acres).
- The Bronson Blvd 42-inch storm sewer outfall collects runoff from approximately 131.3 acres (or 19.8% of the 663 acre Axtell Creek contributing drainage area). This area is defined as drainage area #1 within the Portage-Arcadia 319 Project runoff maps for Axtell Creek posted on the web site.
- The Hudson Street 27-inch storm sewer outfall collects runoff from approximately 11.2 acres (or 1.7% of the 663 acre Axtell Creek contributing drainage area). This area is defined as drainage area #2 within the Portage-Arcadia 319 Project runoff maps for Axtell Creek posted on the web site.
- If drainage area #1 and drainage area #2 are combined, a stormwater volume of approximately 14.1 ac-ft from these two drainage areas could be redirected, captured, detained, treated, and slowly released.
- This 14.1 ac-ft of stormwater equates to a 1-year, 24-hour precipitation event of 1.95 inches from these two drainage areas. Refer to Table 1.
- If the Bronson Blvd (drainage area #1) and Hudson Street (drainage area #2) storm sewer outfalls were to be rerouted within the municipal well field property, the 100-year storm volume to Axtell Creek from these two drainage areas could be reduced by approximately 31.7% (that's 31.7% of the 100-year storm volume from these two drainage areas). This combination would amount to 6.8% of the 100-year storm volume of runoff from the entire 663 acres of the contributing areas of the Axtell Creek subwatershed.
- Discussions with the City are needed to determine the overall feasibility of this concept and to identify any concerns related to the municipal wells and site security.

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## Concept #2

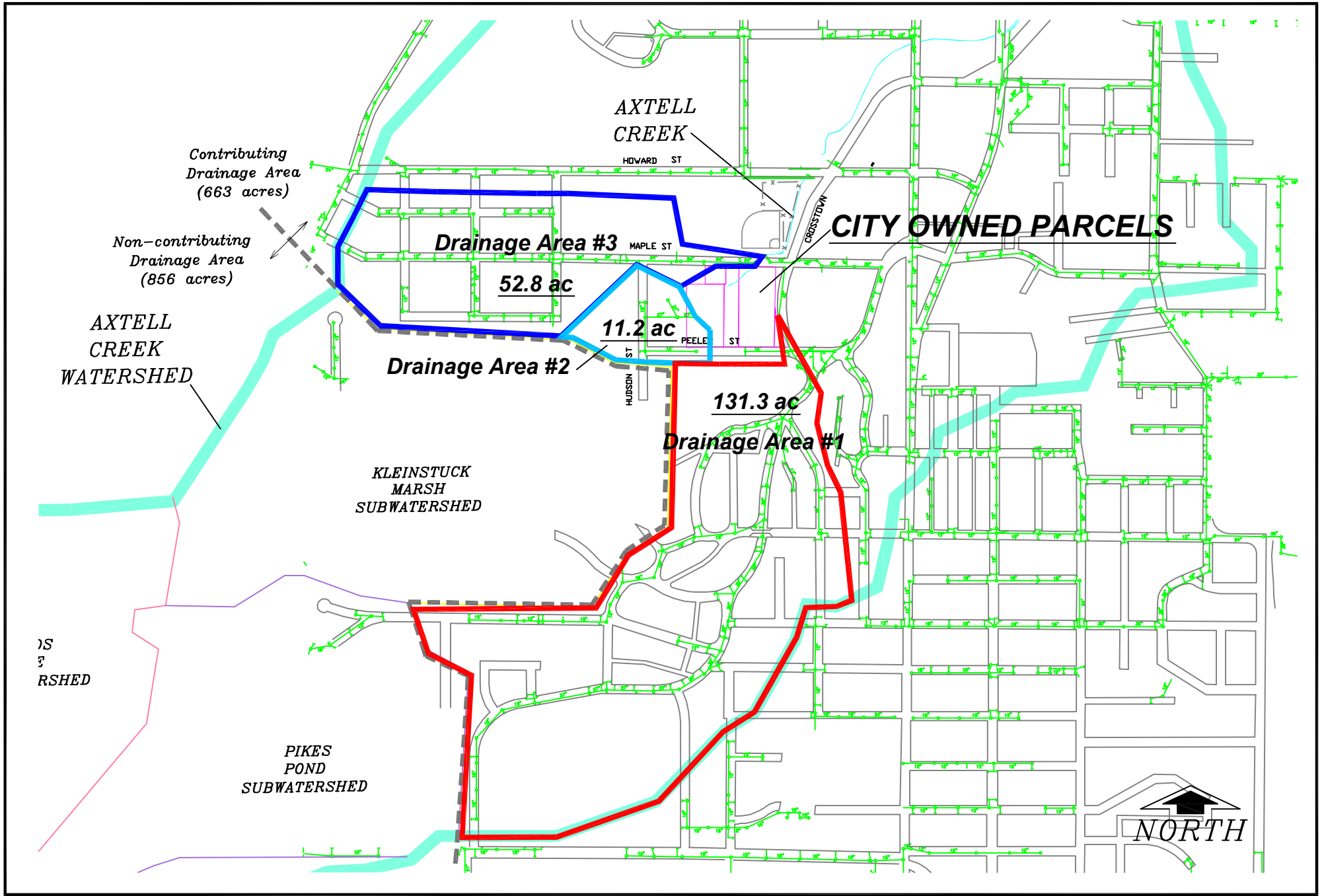
- The South Maple Street Magnet School for the Arts (Kalamazoo Public Schools) has expressed interest in continued participation with environmental related projects to enhance and protect Axtell Creek along Crosstown Parkway.
- The Maple Street School has recently fenced off approximately 1.4 acres of riparian property along the west side of Axtell Creek to be used for wetland planting and educational monitoring. This wetland educational area can still be utilized within this Axtell Creek improvement concept. Refer to Figure 3.
- A stormwater diversion structure could be placed along the existing 24-inch storm sewer pipe from Maple Street (drainage area #3) just west of the existing outfall connection with Axtell Creek to intercept and redirect stormwater volumes to the southeastern portion of the school's riparian property.
- The Maple Street 24-inch storm sewer outfall collects runoff from approximately 52.8 acres (or 8% of the 663 acre Axtell Creek contributing drainage area).
- If diverted, a stormwater volume of approximately 5.2 ac-ft from the Maple Street drainage area could be redirected, captured, detained, treated, and infiltrated in a pond of 4 ft deep and 0.6 acres in size and a wetland of 1 ft deep and 1.3 acres in size. Refer to Figure 3. This acreage would encompass the current backstop area of the existing softball field. Using only areas to the east of the new fence would only provide a capture volume of less than a 2-month, 24-hour precipitation event.
- This 5.2 ac-ft of stormwater equates to a 1-year, 24-hour precipitation event of 1.95 inches from this drainage area. Refer to Table 2.
- If the Maple Street storm sewer outfall (drainage area #3) is rerouted within the southeastern portion of the school's riparian property, the 100-year storm volume to Axtell Creek from this drainage area could be reduced by approximately 31.6% (that's 31.6% of the 100-year storm volume from this drainage area). This 5.2 ac-ft capture volume would amount to 2.5% of the 100-year storm volume of runoff from the entire 663 acres of the contributing areas of the entire Axtell Creek subwatershed.
- Discussions with the Maple Street School and KPS are needed to determine the overall feasibility of this concept and to merge long-term land use/educational wetland plans with potential stormwater treatment concepts for this riparian buffer area.

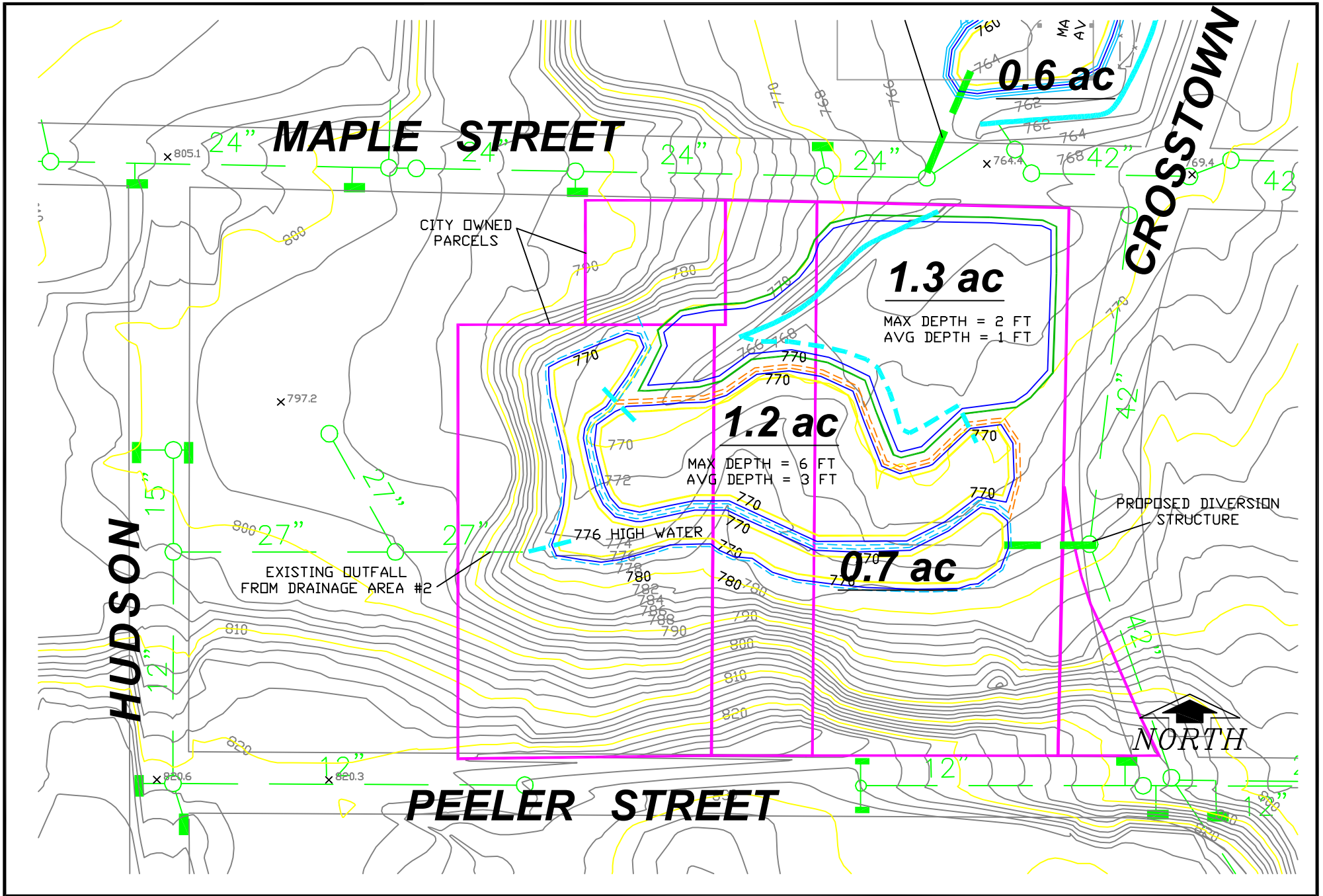
## Summary

These two improvement concepts, could divert stormwater volumes equal to a 1-year, 24-hour precipitation event of 1.95 inches. As a result, 28% of the Axtell Creek contributing watershed area (drainage areas #1, #2 and #3) could be effectively managed to reduce direct stormwater inputs to Axtell Creek and ultimately diminish the impacts of problematic flooding in downstream areas by providing additional storage and floodplain within the Axtell Creek headwaters. Although the capture and treatment of a 1-year, 24-hour stormwater volume might seem insignificant at first glance, it could effectively reduce the 100-year stormwater volume by 31.6% within these three drainage areas and approximately 9.3% of the 100-year storm volume from the entire 663 acre Axtell Creek contributing subwatershed. In a watershed that is plagued with problematic flooding, these two stormwater improvement concepts could potentially yield notable benefits.

# DRAFT

Refer to Table 3 for additional storm volume reduction information. Approximately 75-80% of all storms in our region are 1.5 inches or less.







**Table 1. Estimated Runoff Volumes for Concept #1 of Axtell Creek Stormwater Improvements.**

Calculated for Various Sized Rain Events<sup>a</sup> (inches) using a 0.61 Runoff Coefficient for Residential Land Use.

**Bronson Blvd (drainage area #1) and Hudson St (drainage area #2)**

Return Frequency	Rainfall (inches)	Area (sq ft)	Area (ac)	Runoff Volume (cu ft)	Runoff Volume (ac-ft)
2-Month	1.07	6,205,780	142.5	337,543	7.7
3-Month	1.25	6,205,780	142.5	394,326	9.1
4-Month	1.37	6,205,780	142.5	432,181	9.9
6-Month	1.58	6,205,780	142.5	498,428	11.4
9-Month	1.79	6,205,780	142.5	564,674	13.0
1-Year	1.95	6,205,780	142.5	615,148	14.1
2-Year	2.37	6,205,780	142.5	747,641	17.2
5-Year	3.00	6,205,780	142.5	946,381	21.7
10-Year	3.52	6,205,780	142.5	1,110,421	25.5
25-Year	4.45	6,205,780	142.5	1,403,799	32.2
50-Year	5.27	6,205,780	142.5	1,662,477	38.2
100-Year	6.15	6,205,780	142.5	1,940,082	44.5

<sup>a</sup>Precipitation values from "Rainfall Frequency Atlas of the Midwest", Midwestern Climate Center and Illinois State Water Survey, 1992.

proposed forebay/wetpond area = 82,065 ft<sup>2</sup> or 1.88 ac

Depth (ft)	Area (sq ft)	Area (ac)	Volume (cu ft)	Volume (ac-ft)
1	82,065	1.9	82,065	1.9
2	82,065	1.9	164,130	3.8
3	82,065	1.9	246,195	5.7
4	82,065	1.9	328,260	7.5
5	82,065	1.9	410,325	9.4
6	82,065	1.9	492,390	11.3

total storage = 14.1 ac-ft

proposed wetland (existing) area = 60,056 ft<sup>2</sup> or 1.38 ac

Depth (ft)	Area (sq ft)	Area (ac)	Volume (cu ft)	Volume (ac-ft)
1	60,056	1.4	60,056	1.4
2	60,056	1.4	120,112	2.8

**Table 2. Estimated Runoff Volumes for Concept #2 of Axtell Creek Stormwater Improvements.**

Calculated for Various Sized Rain Events<sup>a</sup> (inches) using a 0.61 Runoff Coefficient for Residential Land Use.

**Maple St. (drainage area #3)**

Return Frequency	Rainfall (inches)	Area (sq ft)	Area (ac)	Runoff Volume (cu ft)	Runoff Volume (ac-ft)
2-Month	1.07	2,298,425	52.8	125,015	2.9
3-Month	1.25	2,298,425	52.8	146,046	3.4
4-Month	1.37	2,298,425	52.8	160,066	3.7
6-Month	1.58	2,298,425	52.8	184,602	4.2
9-Month	1.79	2,298,425	52.8	209,138	4.8
1-Year	1.95	2,298,425	52.8	227,831	5.2
2-Year	2.37	2,298,425	52.8	276,903	6.4
5-Year	3.00	2,298,425	52.8	350,510	8.0
10-Year	3.52	2,298,425	52.8	411,265	9.4
25-Year	4.45	2,298,425	52.8	519,923	11.9
50-Year	5.27	2,298,425	52.8	615,729	14.1
100-Year	6.15	2,298,425	52.8	718,545	16.5

<sup>a</sup>Precipitation values from "Rainfall Frequency Atlas of the Midwest", Midwestern Climate Center and Illinois State Water Survey, 1992.

proposed forebay/wetpond area = 27,400 ft<sup>2</sup> or 0.6 ac

Depth (ft)	Area (sq ft)	Area (ac)	Volume (cu ft)	Volume (ac-ft)
1	27,400	1.9	27,400	0.6
2	27,400	1.9	54,800	1.3
3	27,400	1.9	82,200	1.9
4	27,400	1.9	109,600	2.5

total storage = 5.2 ac-ft

proposed wetland (created) area = 58,200 ft<sup>2</sup> or 1.3 ac

Depth (ft)	Area (sq ft)	Area (ac)	Volume (cu ft)	Volume (ac-ft)
1	58,200	1.3	58,200	1.3
2	58,200	1.3	116,400	2.7

**Table 3. Estimated Storm Volume Reduction Information and Potential Impact to the Axtell Creek Subwatershed.**

Calculated for Various Sized Rain Events<sup>a</sup> (inches) using a 0.61 Runoff Coefficient for Residential Land Use.

Return Frequency	Rainfall (inches)	{1} Axtell Creek Runoff Volume (ac-ft)	{2} Concept #1 Runoff Volume (ac-ft)	{3} Concept #2 Runoff Volume (ac-ft)	{4} Concept #1 & #2 Capture Volume (ac-ft)	{5} Percent Reduction of Entire Axtell Creek Runoff Volume (%)
1-Year	1.95	65.7	14.1	5.2	19.3	29.4
2-Year	2.37	79.9	17.2	6.4	19.3	24.2
5-Year	3.00	101.1	21.7	8.0	19.3	19.1
10-Year	3.52	118.6	25.5	9.4	19.3	16.3
25-Year	4.45	150.0	32.2	11.9	19.3	12.9
50-Year	5.27	177.6	38.2	14.1	19.3	10.9
100-Year	6.15	207.3	44.5	16.5	19.3	9.3

**Notes:**

<sup>a</sup>Precipitation values from "Rainfall Frequency Atlas of the Midwest", Midwestern Climate Center and Illinois State Water Survey, 1992.

{1} These estimated runoff volumes are from the entire 663 acres of the contributing areas of the Axtell Creek subwatershed (Fig 1).

{2} These runoff volumes are from the Bronson Blvd and Hudson St outfalls of the Axtell Creek headwaters (Fig 2 and Table 1).

{3} These runoff volumes are from the Maple St outfall of the Axtell Creek headwaters (Fig 3 and Table 2).

{4} The 19.3 ac-ft of capture volume is achieved by capturing a 1-yr storm volume from drainage areas identified in Concepts #1 and #2.

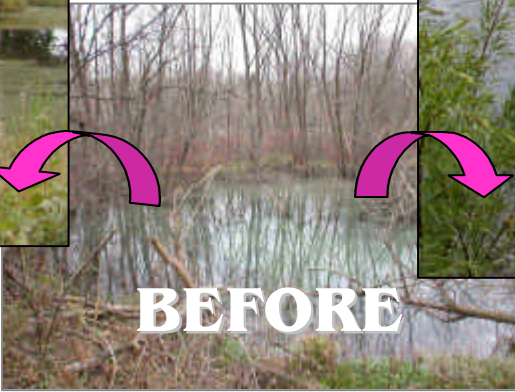
{5} These estimates represent storm volume reductions on the entire Axtell Creek subwatershed for each return frequency precipitation event listed above.

# DETENTION/FLOODPLAIN IMPROVEMENT CONCEPTS

City  
Property



**AFTER**



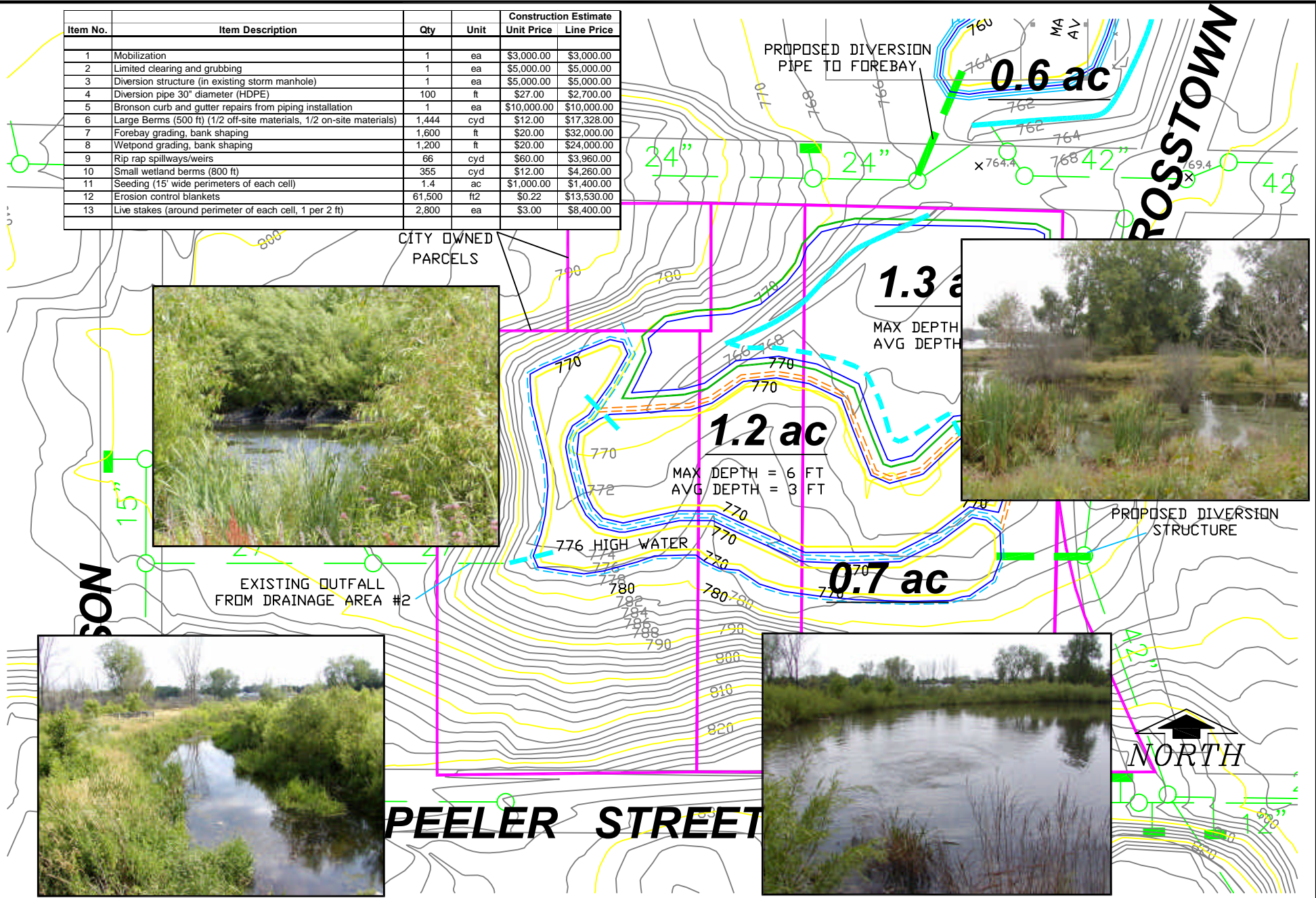
**BEFORE**



**AFTER**



Item No.	Item Description	Qty	Unit	Construction Estimate	
				Unit Price	Line Price
1	Mobilization	1	ea	\$3,000.00	\$3,000.00
2	Limited clearing and grubbing	1	ea	\$5,000.00	\$5,000.00
3	Diversion structure (in existing storm manhole)	1	ea	\$5,000.00	\$5,000.00
4	Diversion pipe 30" diameter (HDPE)	100	ft	\$27.00	\$2,700.00
5	Bronson curb and gutter repairs from piping installation	1	ea	\$10,000.00	\$10,000.00
6	Large Berms (500 ft) (1/2 off-site materials, 1/2 on-site materials)	1,444	cyd	\$12.00	\$17,328.00
7	Forebay grading, bank shaping	1,600	ft	\$20.00	\$32,000.00
8	Wetpond grading, bank shaping	1,200	ft	\$20.00	\$24,000.00
9	Rip rap spillways/weirs	66	cyd	\$60.00	\$3,960.00
10	Small wetland berms (800 ft)	355	cyd	\$12.00	\$4,260.00
11	Seeding (15' wide perimeters of each cell)	1.4	ac	\$1,000.00	\$1,400.00
12	Erosion control blankets	61,500	ft2	\$0.22	\$13,530.00
13	Live stakes (around perimeter of each cell, 1 per 2 ft)	2,800	ea	\$3.00	\$8,400.00



# DETENTION/FLOODPLAIN IMPROVEMENT CONCEPTS

Maple St.  
School



**AFTER**



**BEFORE**



**AFTER**



Item No.	Item Description	Qty	Unit	Construction Estimate	
				Unit Price	Line Price
1	Mobilization	1	ea	\$3,000.00	\$3,000.00
2	Diversion structure (in existing storm manhole)	1	ea	\$5,000.00	\$5,000.00
3	Diversion pipe 24" diameter (HDPE)	120	ft	\$18.00	\$2,160.00
4	Maple curb and gutter repairs from piping installation	1	ea	\$10,000.00	\$10,000.00
5	Excavate forebay	3,053	cyd	\$6.00	\$18,318.00
6	Rip rap spillways/weirs	53	cyd	\$60.00	\$3,180.00
7	Wetland/forebay berms	1,044	cyd	\$6.00	\$6,264.00
8	Seeding berms	0.43	ac	\$1,000.00	\$430.00
9	Erosion control blankets	18,800	ft <sup>2</sup>	\$0.22	\$4,136.00
10	Live stakes (around forebay, 1/ft)	850	ea	\$3.00	\$2,550.00

