Prairie Centre Redevelopment

Sanitary Sewer Evaluation

CITY OF
ST. CHARLES

ILLINOIS • SINCE 1834

Prepared by

WBK engineering

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Introduction

On behalf of the City of St. Charles, WBK Engineering has evaluated the existing sanitary sewer system downstream of the proposed redevelopment project known as Prairie Center. This project is a mixed use redevelopment of the former St. Charles Mall site near the Illinois Route 38 and Randall Road intersection. The project consists of residential uses including apartments and condos, and commercial uses such as general retail and restaurants. This report considers existing conditions as well as the ability of sanitary sewer system to facilitate flows from the Prairie Centre project and tributary undeveloped parcels. The extent of the collection system evaluated includes gravity sewers from the project site to the Park Shore siphon under the Fox River. A comparison of flows at the Park Shore was also performed to determine the impact of the proposed project on the Siphon as an initial evaluation.

Existing Conditions

The existing conditions evaluation of the wastewater collection system consisted of a "flowing full" capacity analysis of the gravity sanitary sewers serving the project from the former St. Charles Mall site to the Park Shore siphon.

Data Sources

Physical pipe characteristics including pipe diameter and slope were obtained from several sources:

- 1996 Black and Veatch Report
- 1999 RHAA Plans for Gray Street Improvements
- 2008 Ground Survey from Thompson Survey
- 2016 City GIS Data

Sanitary sewers from the siphon to the project site range in size from 12 to 21 inches in diameter. It should be noted that some pipes are identified as backpitched. It is our recommendation to correct this condition as part of any proposed sewer improvement project.

Existing flow data was evaluated from two data sources:

- 1996 Black & Veatch Report
- 2009 RJN Report

From these data sources several types of flows were compared including peak sanitary, infiltration and inflow. Both studies considered a 10 year recurrence frequency for infiltration and inflow. The most conservative value for each of these flow regimes was utilized. Peak sanitary flows were derived from the 2009 RJN report. Inflow and Infiltration flows were

derived from the 1996 Black and Veatch report. Flow values were distributed to each sewer segment based on the Black and Veatch distribution schema and extrapolated or interpolated as appropriate. The only variation from this approach is a flow split at manhole 5.1 200 where significant flow from the Fellow Street / Davis School collector sewer combines with the Gray Street collector sewer. At this manhole, flow values were assigned to Fellows and Gray Street sewers based on proportional tributary area to each sewer segment.

Proposed Conditions

Wastewater flows from Prairie Centre and undeveloped parcels (future development) were added to the sewer system network based on proposed land uses defined in Exhibit A. The Prairie Centre land uses were based on information provided by Dave Patzelt (ShoDeen Construction Co. LLC) via e-mail dated May 25, 2016.

Residential units include 287 one bedroom and 322 two bedroom units with 1.5 and 3.0 occupants per unit respectively in accordance with IEPA guidelines. A wastewater flow generation rate of 80 gal/capita/day for residential uses was utilized. This value was based on local water usage rates for similar land uses and within recognized study range values as determined by a 2002 USEPA study.

Commercial uses include several restaurant/retail and mixed use buildings. The City and developer expect 33,150 sf of restaurant use and 83,328 sf retail (i.e. non-restaurant general commercial uses). These uses will be spread and distributed between buildings and phases based on market conditions. For restaurants the wastewater flow was generated based on data from the Restaurant Operations Report, 2010 to derive the average seats per square foot and the average turnover (meals / seat). The Illinois Administrative Code wastewater rate of 10 gpd/meal was utilized and applied to establish the final rate of 0.563 gpd/sf for restaurant use. For all other non-specific commercial uses a wastewater generation rate of 0.12 gpd/sf was utilized.

A peaking factor was applied to all average daily wastewater rates noted above. This factor is commonly applied and referenced in The Great lakes – Upper Mississippi Recommended Standards for Wastewater Facilities 2014 edition. All flows are considered as “full build out” conditions and phasing of the project was not considered.

There are three undeveloped parcels tributary to the sewer segments which will serve the proposed redevelopment. These parcels; Anderson property, Tri-City Plaza and Moose property, have been assigned uses and allowable square footage build out based on allowable zoning classifications and through discussion and direction from City staff. For the sake of simplicity all parcels are considered as “full build out” and flows applied at the upstream end of the sanitary sewer segments being evaluated.

The former St. Charles Mall, now demolished, consisted of 290,000 square feet of retail space. This includes two anchor stores; Kmart and Spiess and the remainder specialty store square footage. Utilizing the same flow generation rate for non-specific commercial uses noted above the "Old Mall" had the potential to generate an average of 34,800 gpd. By comparison the proposed uses are expected to generate an average 140,380 gpd.

Redevelopment System Connection

The existing sanitary sewer network serving the redevelopment parcel is tributary to a collector sewer that flows east along Fellows Street and then south along Seventh Court to Gray Street. From Gray Street flows travel east along Gray to Elm, Roosevelt, IL 31 and ultimately the Park Shore Siphon. The Fellows Street collector serves the neighborhood known as the Davis School area and has had a history of sanitary sewer backups during extreme rainfall events. Accordingly we recommend an alternate route for the redevelopment parcel that will divert flows away from the Fellows collector sewer to the Gray Street collector sewer. This alternate routing will route all proposed flows and some existing flows from the Fellows Street sanitary sewer to Gray Street. The sanitary sewer from the redevelopment site to Gray Street is a minimum 8 inch diameter pipe with limited tributary area and connections. Additionally, the City increased the Gray Street sewer from the Seventh Court to Elm Street to a 21 inch diameter pipe. An initial evaluation of these sewers indicate they have adequate capacity for the design event and proposed conditions. Re-routing of redevelopment flows benefits the City by rerouting flows from the Davis School area and benefits the development from having to reconstruct the Fellows Street collector sewer.

Gravity Sewer Capacity Evaluation

The capacity of the existing gravity sanitary sewer from the project site to the Park Shore siphon was determined based on a flowing full capacity utilizing manning's equation. Pipe slopes were determined from data sources noted previously. Manning's roughness coefficients were selected based on "normal" pipe condition for vitrified clay and PVC pipe as appropriate. It was determined that a 90% capacity threshold would be utilized to identify pipe segments requiring replacement. The 90% threshold accounts for pipe conditions of a mature collection system such as root intrusion, joint displacement and pipe integrity.

Proposed flow values were input for all proposed land development including the Prairie Centre project as well as all future development at the upstream end of the collection system. This is a conservative approach since the future Anderson property would connect to the system several segments downstream from the end segment.

Three flow scenarios were considered including:

- Existing Conditions (based on 2009 flow monitoring values)
- Proposed Conditions with Prairie Centre (full build out)
- Future Conditions with Prairie Centre and Future Development

A spreadsheet was developed that distributed peak sanitary, inflow and infiltration flows to each pipe segment within the system based on the Black and Veatch assignment except manhole 5.1 200 where flow values were determined based on proportional tributary area to each sewer segment. The total flow for the three conditions herein are compared to the 90% Manning's capacity to provide a recommendation for system improvements.

Results

Existing Conditions - Three segments of gravity sanitary sewer pipe are noted as deficient (greater than 90% capacity) under existing conditions with the worst segment being 100% flowing full capacity for the 10 year design event.

Proposed with Prairie Centre - Five segments of gravity sanitary sewer pipe are noted as deficient (greater than 90% capacity) under proposed conditions with Prairie Centre with the worst segment being 106% flowing full capacity for the 10 year design event.

Prairie Centre and Future Development - Five segments of gravity sanitary sewer pipe are noted as deficient (greater than 90% capacity) under future conditions with the worst segment being 108% flowing full capacity for the 10 year design event. It is noted that the first segment (upstream end) is reported at 91% capacity but not highlighted because flows from the Anderson property will connect well downstream of this location.

Four gravity sanitary sewer pipe segments are identified as backpitched and are noted as such on the spreadsheet. All segments are relatively short with the longest being 27 feet in length.

It is noted that the I & I values from flow monitoring are significantly greater than values generally used for sanitary sewer construction. The acceptable testing standards for new sewers according to the Greg Lakes – Upper Mississippi River Board - Ten State Standards of 100 gal/in/mi/day. It is common practice to utilize a factor of safety of 2.0 to this value to account for a mature or aging system. Applying a factor of 200 gal/in/mi/day to all segments in the system being evaluated results in a total I & I flows of 0.50 cfs. The I & I determined from the flow monitoring is 4.32 cfs or 864% of the design value noted herein.

Park Shore Siphon Flow Comparison

A comparison of flows at the Park Shore siphon was performed to determine the relative impact of the proposed Prairie Centre project with and without future development. A detailed evaluation and analysis of the siphon is not in the scope of this study and was not performed.

Similar to the gravity sewer analysis, flows from the Black and Veatch and RJN studies were compared and combined to establish three conditions:

- Existing
- Proposed with Prairie Centre
- Prairie Centre with future conditions

Peak sanitary flows were derived from the RJN flow monitoring study while I & I flows were derived from the Black and Veatch Study. The Proposed Prairie Centre and Future Development flows calculated for the gravity sewer evaluation were used in this flow comparison as well.

The estimated 10 year design event flows are 16.16 cfs for existing conditions, 16.47 cfs including Prairie Centre and 16.58 cfs including Prairie Centre with Future Development conditions. The increase in flow as a result of the Prairie Centre project is 2% of the existing flow to the siphon and not considered significant. Based on the limited increase in flows further evaluation of the siphon is not warranted as a result of the Prairie Centre project.

Recommendations

The results indicate a number of segments are over capacity and require replacement. As a practical matter, we recommend that sewer segments be grouped and replaced in series of pipes to create a defined project based on logical beginning and end locations. We also recommend that pipe diameters are dimensionally consistent and that no downstream pipe diameter is smaller than the upstream pipe diameter. Since there are significant segments of 21” diameter pipe on Gray and Elm Street (2,650 lf) we recommend all pipe downstream from these segments be no less than 21” diameter. A pipe system where downstream pipes have a smaller diameter are more prone to obstructions and blockages than a system where pipe sizes are consistent or increasing. Additionally the hydraulic losses due to a constriction and the smaller pipe size is significant. Additionally, a comparison of friction losses for the segments recommended for replacement show the existing 15” VCP to create 19.5 feet and 28.3 feet of friction losses when the pipes are in good (new) and poor (end of service life) conditions respectively. By comparison the proposed 21” PVC creates 2.1 feet and 3.2 feet of friction

losses when the pipes are in good (new) and poor (end of service life) conditions respectively. These values were calculated assuming 5 cfs peak design flow. This improvement in friction loss provides the potential to convey flow greater than the 10 year I & I design event considered herein and provides a factor of safety against increasing I & I as the City's sewer system ages.

Accordingly 21 segments of sanitary sewer along IL 31, Roosevelt and Elm Street are recommended for replacement and two segment recommended for lining.

Nine segments along IL 31 from the Park Shore Siphon to Roosevelt Street are recommended for replacement including eight 15" vitrified clay pipes (VCP) and one 18" VCP pipe. Nine segments of 15" VCP pipe along Roosevelt Street from IL 31 to Elm Street are recommended for replacement. Three segments of 15" VCP pipe along Elm Street from Roosevelt to Gray Street are recommended for replacement while two segments of 21"VCP are recommended for lining. It is noted that the segments recommended for lining are assumed to be in satisfactory structural condition which should be verified with preliminary design of any rehabilitation project. A Recommended Improvement evaluation was performed and the proposed sanitary sewer pipe size was determined based on the system being able to convey flows such that the flowing full capacity is less than 75% of the projected wastewater flows. It should be noted that all backpitched segments are replaced as a result of these recommendations except for one at the west end of Gray Street. We recommend this segment be surveyed to verify inverts and actual field conditions.

It is noted that some of the pipes recommended for replacement are not specifically attributable to the proposed Prairie Centre project. However, the rerouting of flows to Gray Street takes advantage of a prior sanitary sewer improvements funded entirely by the City. Additionally, consideration should be given to the age and condition of the downstream sewer system. Based on the assumed age of the pipes along IL 31 and Roosevelt the system can be generally considered to be near the end of its service life. The age of downstream sanitary sewers provides an opportunity for financial participation in sanitary sewer improvements and for the development to partner with the City in infrastructure improvements benefitting both the project and surrounding neighborhoods.

Cost Estimate

Concept level cost estimates have been developed to help determine the magnitude of cost for sanitary sewer rehabilitation projects. It is generally assumed that the sanitary sewer will be replaced in the same location as they exist today with an increase in pipe size or pipes will be lined. Costs have been developed considering three separate and distinct construction conditions and segment lengths. These segments are: Elm Street, Roosevelt Street and Illinois

Route 31 Sewers. The cost table below summarizes the project costs based on the afore-noted procedure and conclusions.

These costs are conceptual only and not based on preliminary engineering. Further refinement is recommended to better define project costs subsequent to approval of a final land plan and project scope evaluation by City staff.

			2016
Segment 1:	Elm Street	Sub-Total =	$226,000
Segment 2:	Roosevelt Street	Sub-Total =	$864,000
Segment 3:	IL Route 31	Sub-Total =	$857,000
		TOTAL =	**$1,947,000**

Additional Consideration

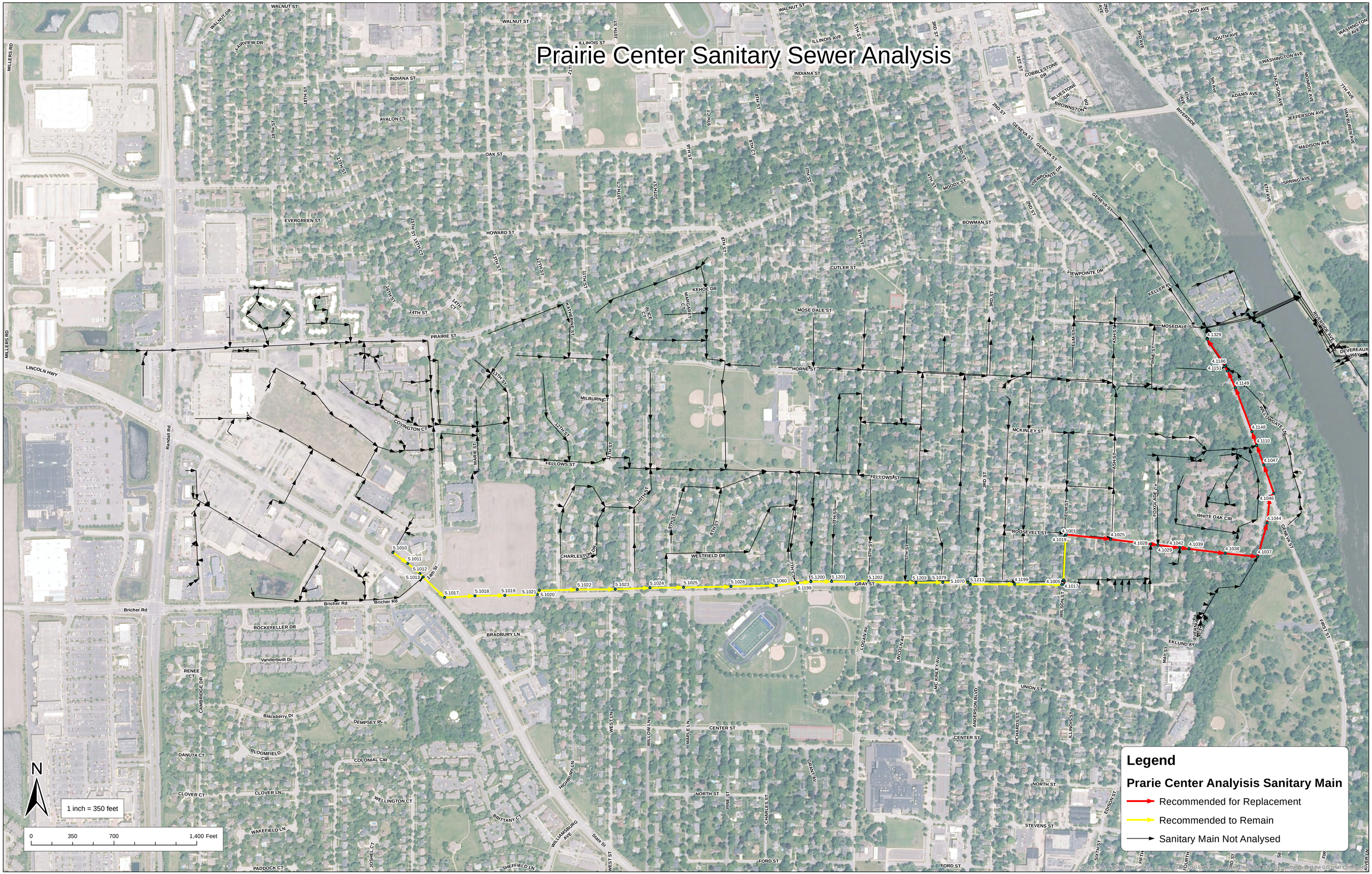
The City has recently drafted a Capacity Management Operations and Maintenance Plan (CMOM) for the wastewater collection system. The goal of the CMOM program is to reduce sanitary system overflows and basement backups through implementation of asset management techniques developed for wastewater collection systems. This plan sets forth a program of activities and funding strategies that will help the City manage the wastewater collections system and achieve the goals of the CMOM plan. The data collected for the CMOM plan is system wide and not specific to our study area. It was determined the CMOM data available at the time of this report would not be useful to this study and evaluation. However we advocate the City's efforts in developing a CMOM plan and recommend a continuing program to study and remove inflow and infiltration (I & I) from the wastewater collection system.

Also, it is recognized that the flow projections from the 1996 Black & Veatch study are extrapolated from flow monitor locations and data. Although this is determined to be the best available information, it is recommended that additional flow monitoring consistent with the CMOM plan for the sewer segments evaluated herein be initiated. Additional flow monitoring will provide specific flow values to better define the extent and timing of required sanitary sewer improvements.

Finally, this study is limited based on the focus towards the Prairie Centre project. The recommended improvements and costs noted herein require further evaluation and refinement and warrant a preliminary engineering phase prior to initiation of final design.

Appendix A

Prairie Center Sanitary Sewer Analysis



Prairie Center Sanitary Sewer Capacity Analysis - 10 Year Event

Line ID	Street Name	Diameter (in)	Existing Pipe capacity (CFS)	90% Capacity	2009 Design Flow (CFS)	2009 Percent of Total Capacity	With Prairie Center Flow (CFS)	W/ P.C. % of Pipe Capacity	W/ P.C. & Future Dev. Flow (CFS)	W/ P.C. & F.D % of Pipe Capacity	Proposed Pipe Diameter (in)	Proposed Pipe Capacity	W/ P.C. & F.D. % of Pr. Pipe Capcity
4.1186 - 4.1329	IL Rte 31	18	6.9	6.22	5.184	75%	5.50	80%	5.60	81%	21	10.43	54%
4.1187 - 4.1186	IL Rte 31	15	0.0	0.00	5.183	Backpitched	5.50	Backpitched	5.60	Backpitched	21	0.00	Backpitched
4.1187 - 4.1150	IL Rte 31	15	5.7	5.13	5.177	91%	5.49	96%	5.60	98%	21	13.98	40%
4.1149 - 4.1150	IL Rte 31	15	9.4	8.44	5.145	55%	5.46	58%	5.56	59%	21	23.00	24%
4.1148 - 4.1149	IL Rte 31	15	5.5	4.96	5.128	93%	5.44	99%	5.55	101%	21	13.52	41%
4.1110 - 4.1148	IL Rte 31	15	6.5	5.84	5.100	79%	5.42	84%	5.52	85%	21	15.91	35%
4.1047 - 4.1110	IL Rte 31	15	7.8	7.06	5.073	65%	5.39	69%	5.49	70%	21	19.25	29%
4.1046 - 4.1047	IL Rte 31	15	7.7	6.92	5.070	66%	5.39	70%	5.49	71%	21	18.85	29%
4.1045 - 4.1046	IL Rte 31	15	5.0	4.54	5.029	100%	5.35	106%	5.45	108%	21	12.38	44%
4.1044 - 4.1045	Roosevelt St	15	5.8	5.24	5.003	86%	5.32	91%	5.42	93%	21	14.28	38%
4.1037 - 4.1044	Roosevelt St	15	7.0	6.33	4.987	71%	5.30	75%	5.41	77%	21	17.25	31%
4.1038 - 4.1037	Roosevelt St	15	10.2	9.17	4.969	49%	5.29	52%	5.39	53%	21	25.00	22%
4.1039 - 4.1038	Roosevelt St	15	10.5	9.41	4.908	47%	5.22	50%	5.33	51%	21	25.64	21%
4.1042 - 4.1039	Roosevelt St	15	9.2	8.27	4.838	53%	5.15	56%	5.26	57%	21	22.54	23%
4.1029 - 4.1042	Roosevelt St	15	6.5	5.81	4.780	74%	5.10	79%	5.20	81%	21	15.83	33%
4.1028 - 4.1029	Roosevelt St	15	7.6	6.88	4.706	62%	5.02	66%	5.13	67%	21	18.76	27%
4.1025 - 4.1028	Roosevelt St	15	5.5	4.97	4.665	85%	4.98	90%	5.08	92%	21	13.53	38%
4.1019 - 4.1025	Roosevelt St	15	5.8	5.22	4.607	79%	4.92	85%	5.03	87%	21	14.24	35%
4.1001 - 4.1019	Elm St	21	14.2	12.81	4.604	32%	4.92	35%	5.02	35%		14.24	35%
4.1005 - 4.1001	Elm St	21	14.2	12.81	4.515	32%	4.83	34%	4.93	35%		14.24	35%
4.1017 - 4.1005	Elm St	21	14.2	12.81	4.512	32%	4.83	34%	4.93	35%		14.24	35%
4.1016 - 4.1017	Elm St	15	0.0	0.00	4.436	Backpitched	4.75	Backpitched	4.86	Backpitched	21	0.00	Backpitched
4.1198 - 4.1016	Gray St	21	0.0	0.00	4.435	Backpitched	4.75	Backpitched	4.86	Backpitched	21	0.00	Backpitched
4.1199 - 4.1198	Gray St	21	9.0	8.12	4.426	49%	4.74	53%	4.85	54%		9.02	54%
5.1213 - 4.1199	Gray St	21	9.9	8.90	4.416	45%	4.73	48%	4.84	49%		9.88	49%
5.1070 - 5.1213	Gray St	21	18.1	16.26	4.416	24%	4.73	26%	4.84	27%		18.07	27%
5.1079 - 5.1070	Gray St	21	11.1	10.00	4.378	39%	4.69	42%	4.80	43%		11.11	43%
5.1203 - 5.1079	Gray St	21	9.2	8.32	4.368	47%	4.69	51%	4.79	52%		9.25	52%
5.1202 - 5.1203	Gray St	21	9.8	8.85	4.352	44%	4.67	48%	4.77	49%		9.83	49%
5.1201 - 5.1202	Gray St	21	11.2	10.12	4.339	39%	4.66	41%	4.76	42%		11.25	42%
5.1200 - 5.1201 *	Gray St	21	8.5	7.65	4.332	51%	4.65	55%	4.75	56%		8.50	56%
5.1199 - 5.1200 *	Gray St	21	16.3	14.66	0.999	6%	1.32	8%	1.42	9%		16.29	9%
5.1060 - 5.1199	Gray St	12	4.3	3.85	0.973	23%	1.29	30%	1.39	33%		4.28	33%
5.1026 - 5.1060	Gray St	12	4.0	3.64	0.920	23%	1.24	31%	1.34	33%		4.05	33%
5.1025 - 5.1026	Gray St	12	2.5	2.23	0.865	35%	1.18	48%	1.28	52%		2.48	52%
5.1024 - 5.1025	Gray St	12	2.4	2.19	0.826	34%	1.14	47%	1.25	51%		2.44	51%
5.1023 - 5.1024	Gray St	12	2.4	2.18	0.784	32%	1.10	45%	1.20	50%		2.43	50%
5.1022 - 5.1023	Gray St	12	3.3	2.96	0.741	23%	1.06	32%	1.16	35%		3.29	35%
5.1021 - 5.1022	Gray St	12	2.3	2.07	0.696	30%	1.01	44%	1.12	48%		2.31	48%
5.1020 - 5.1021		12	0.0	0.00	0.694	Backpitched	1.01	Backpitched	1.11	Backpitched		0.00	Backpitched
5.1019 - 5.1020		12	1.5	1.35	0.656	44%	0.97	65%	1.08	72%		1.50	72%
5.1018 - 5.1019		12	1.6	1.48	0.617	38%	0.93	57%	1.04	63%		1.64	63%
5.1017 - 5.1018		12	1.7	1.52	0.579	34%	0.90	53%	1.00	59%		1.69	59%
5.1013 - 5.1017	IL Rte 38	12	1.9	1.75	0.552	28%	0.87	45%	0.97	50%		1.94	50%
5.1012 - 5.1013	IL Rte 38	8	3.2	2.84	0.533	17%	0.85	27%	0.95	30%		3.15	30%
5.1011 - 5.1012	IL Rte 38	8	2.0	1.84	0.469	23%	0.79	38%	0.89	43%		2.05	43%
5.1010 - 5.1011	IL Rte 38	8	0.9	0.80	0.385	43%	0.70	79%	0.81	91%		0.89	91%

* Jump in profile at structure 5.1200 due to discrete data sets not aligning and may not be representative of actual conditions.

Restaurant Wastewater Generation Rates

Restaurant Type	Median Sales ($/seat)*	Median Sales ($/SF)*	Average Daily Turnover*	SF/Seat	Meals / SF	GPD / Meal**	GPD/SF
Full Service - Mean Check < $15	$ 9,414.00	$ 275.50	1.9	34	0.056	10	0.556
Full Service - Mean Check $15-$15	$ 10,154.00	$ 362.00	1.5	28	0.053	10	0.535
Full Service - Mean Check >$25	$ 11,474.00	$ 415.50	0.8	28	0.029	10	0.290
Limited Service	$ 11,197.00	$ 314.69	3.1	36	0.087	10	0.871
						Average GPD/SF	0.563

* Source: Restaurant Industry Operation Report, 2010 edition, published by the National Restaurant Association

** Source: IL Admin. Code Section 370, Appendix B, Table No. 2

Prairie Center Design Flow Rates

Use Type	Square feet	Units	Wastewater Generation Rate	Total GPD	Population Equivalent (assumes 100 gal/cap/day**)	Peaking Factor**	Peak Flow (GPD)	Peak Flow (CFS)
Residential - One Bedroom	N/A	287	120 GPD / unit*	34,440	345	1.6	55,799	0.086
Residential - Two Bedroom	N/A	322	240 GPD / unit*	77,280	773	1.4	111,300	0.172
Commercial - Restaurant	33,150	N/A	0.563 GPD / SF	18,661	187	1.8	33,443	0.052
Commercial - Non-Restaurant	83,328	N/A	0.1 GPD / SF + 20 GPD / Employee, (1 Employee / 1000 SF)	9,999	100	2.0	19,999	0.031
							Total peak flow (CFS)	0.341

On-site Buidings to be Demolished

Use Type	Square feet	Units	Wastewater Generation Rate	Total GPD	Population Equivalent (assumes 100 gal/cap/day**)	Peaking Factor**	Peak Flow (GPD)	Peak Flow (CFS)
Restaurant - Burger King	6000	N/A	0.563 GPD / SF	3378	34	2.4	8,189	0.013
Restaurant - Colonial Café	5400	N/A	0.563 GPD / SF	3040	31	2.5	7,489	0.012
							Total peak flow (CFS)	0.024

* Assumes 80 gal/cap/day

** From Recommended Standards for Wastewater Facilities 2014 Edition

$$\frac{Q_{Peak\ Hourly}}{Q_{Design\ Average}} = \frac{18+\sqrt{P}}{4+\sqrt{P}}$$

Proposed Development	0.341
Demolished Buildings	-0.024
Net Total Site Flow	0.317

Future Land Use Flow Rates

Future Development

Site	Use	Wastewater Generation Rate	Total Site Area (SF)	Floor Space (SF)**	Units	Wastewater Flow (GPD)	Population Equivalent (assumes 100 gal/cap/day***)	Peaking Factor***	Peak Flow (GPD)	Peak Flow (CFS)
Anderson Property	Retail	0.1 GPD / SF + 20 GPD / Employee, (1 Employee / 1000 SF)	217,800	54450	N/A	6,534	66	2.2	14,079	0.022
Anderson Property	Residential Senior Living*	144 GPD	309,276	N/A	46	6624	67	2.1	14,234	0.022
Tri-City Property	Retail	0.1 GPD / SF + 20 GPD / Employee, (1 Employee / 1000 SF)	264,152	66038	N/A	7,925	80	2.1	16,495	0.026
Tri-City Property	Resturant	0.563 GPD / SF	28,000	7000	N/A	3941	40	2.4	9,285	0.014
Moose Property	Retail	0.1 GPD / SF + 20 GPD / Employee, (1 Employee / 1000 SF)	189,000	47250	N/A	5,670	57	2.2	12,543	0.019
									Total Peak Flow	0.103

* Assumes 80% 1 bedroom units (120 GPD), 20% 2 and 3 bedroom units (240 GPD)

** Assumes 1/4 of land will be developed as floor space

*** From Recommended Standards for Wastewater Facilities 2014 Edition

$$\frac{Q_{Peak\ Hourly}}{Q_{Design\ Average}} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

Park Shore Siphon Flow Comparison

Basin	Existing Conditions					
	Peak Sanitary*		Peak I/I**		Sub-Basin Total	
	MGD	CFS	MGD	CFS	MGD	CFS
SC01	0.2	0.31	1.38	2.14	1.58	2.45
SC02	0.56	0.87	2.78	4.30	3.34	5.17
R4	0.48	0.74	5.04	7.80	5.52	8.54
				Siphon Total	10.44	16.16

* From 2009 RJN Monitoring

** From 1996 B&V Report

Basin	Existing Conditions + Prairie Center Development[+]					
	Peak Sanitary		Peak I/I		Sub-Basin Total	
	MGD	CFS	MGD	CFS	MGD	CFS
SC01	0.2	0.31	1.38	2.14	1.58	2.45
SC02	0.76	1.18	2.78	4.30	3.54	5.48
R4	0.48	0.74	5.04	7.80	5.52	8.54
				Siphon Total	10.65	16.47

[+] equal to exisitng conditions, but adds Prairie Center sanitary flow

Basin	Existing Conditions + Prairie Center + Future Development[++]					
	Peak Sanitary		Peak I/I		Sub-Basin Total	
	MGD	CFS	MGD	CFS	MGD	CFS
SC01	0.2	0.31	1.38	2.14	1.58	2.45
SC02	0.83	1.29	2.78	4.30	3.61	5.59
R4	0.48	0.74	5.04	7.80	5.52	8.54
				Siphon Total	10.71	16.58

[++] equal to exisitng conditions, but adds Prairie Center sanitary flow and other future development sanitary flow

Pipe and Flow Distribution Data Sources

	Thompson	99 RHAA Plans		Linearly Interpolated			B&V Data	B&V Data, not direct ID Match			From 2009 RJN Report	Adjusted	Proportionally
	GIS Data			Set = U/S invert in same structure			Interpolated	Flow split proportionally by area			Asjusted Absolute Difference		
	B&V Data			Assume 0.5%			Extrapolated				Peak Sanitary x 4.5 (10-yr peaking factor)		
	Final Data						Final 1996 Flow Data				Adjust based on 2009 Data		
SEGMENTID	From Invert (ft)	To Invert (ft)	Length (ft)	Diameter (in)	Slope (%)	Cumulative Length (ft)	Peak Sanitary (CFS)	10-yr Total Infil. (CFS)	10-yr Total Infil. (CFS)	Total Flow (CFS)	Peak 10-yr 60-min total flows	Peak Sanitary (CFS)	I/I 10-yr 60 Total flows
4.1186 - 4.1329	679.3	677.81	298	18	-0.500%	298	0.495	0.186	4.132	4.813	1.980	0.866	2.847
4.1187 - 4.1186	679.27	679.3	9	15	0.333%	307	0.494	0.186	4.132	4.811	1.980	0.866	2.846
4.1187 - 4.1150	679.71	679.27	49	15	-0.898%	356	0.491	0.184	4.131	4.805	1.977	0.863	2.840
4.1149 - 4.1150	685.86	679.71	253	15	-2.431%	609	0.474	0.172	4.127	4.773	1.964	0.846	2.810
4.1148 - 4.1149	688.37	685.86	299	15	-0.839%	908	0.46	0.164	4.132	4.756	1.957	0.832	2.789
4.1110 - 4.1148	689.8	688.37	123	15	-1.163%	1031	0.448	0.155	4.125	4.728	1.946	0.820	2.765
4.1047 - 4.1110	692.78	689.8	175	15	-1.703%	1206	0.436	0.147	4.118	4.701	1.935	0.808	2.742
4.1046 - 4.1047	696.96	692.78	256	15	-1.633%	1462	0.424	0.138	4.136	4.698	1.933	0.796	2.729
4.1045 - 4.1046	697.27	696.96	44	15	-0.705%	1506	0.412	0.13	4.115	4.657	1.916	0.784	2.700
4.1044 - 4.1045	699.33	697.27	220	15	-0.936%	1726	0.4	0.121	4.11	4.631	1.906	0.772	2.678
4.1037 - 4.1044	703.5	699.33	305	15	-1.367%	2031	0.387	0.112	4.116	4.615	1.899	0.759	2.658
4.1038 - 4.1037	711.71	703.5	286	15	-2.871%	2317	0.375	0.104	4.118	4.597	1.892	0.747	2.639
4.1039 - 4.1038	721.06	711.71	309.6	15	-3.020%	2627	0.369	0.102	4.065	4.536	1.867	0.741	2.607
4.1042 - 4.1039	722.85	721.06	76.7	15	-2.335%	2703	0.363	0.1	4.003	4.466	1.838	0.735	2.573
4.1029 - 4.1042	725	722.85	186.9	15	-1.151%	2890	0.357	0.099	3.952	4.408	1.814	0.729	2.543
4.1028 - 4.1029	726	725.00	61.8	15	-1.617%	2952	0.35	0.097	3.887	4.334	1.783	0.722	2.505
4.1025 - 4.1028	728.88	726.00	342.2	15	-0.842%	3294	0.344	0.095	3.854	4.293	1.767	0.716	2.482
4.1019 - 4.1025	732.37	728.88	374.6	15	-0.931%	3669	0.338	0.093	3.804	4.235	1.743	0.710	2.453
4.1001 - 4.1019	732.48	732.37	11.9	21	-0.931%	3681	0.338	0.093	3.802	4.232	1.742	0.709	2.451
4.1005 - 4.1001	735.98	732.48	375.9	21	-0.931%	4057	0.325	0.090	3.728	4.143	1.705	0.697	2.402
4.1017 - 4.1005	736.10	735.98	12.9	21	-0.931%	4070	0.325	0.09	3.725	4.140	1.704	0.697	2.400
4.1016 - 4.1017	736.05	736.10	27.3	15	0.183%	4097	0.319	0.088	3.657	4.064	1.672	0.691	2.363
4.1198 - 4.1016	736.51	740.65	19.7	21	21.062%	4117	0.319	0.088	3.657	4.064	1.672	0.690	2.363
4.1199 - 4.1198	737.56	736.64	398.8	21	-0.231%	4515	0.309	0.085	3.659	4.054	1.668	0.681	2.349
5.1213 - 4.1199	738.70	737.66	375.3	21	-0.277%	4891	0.301	0.083	3.661	4.045	1.664	0.672	2.337
5.1070 - 5.1213	738.99	738.74	27.0	21	-0.926%	4918	0.300	0.083	3.661	4.044	1.664	0.672	2.336
5.1079 - 5.1070	739.83	739.09	211.4	21	-0.350%	5129	0.294	0.081	3.631	4.006	1.649	0.666	2.314
5.1203 - 5.1079	740.48	739.93	226.7	21	-0.243%	5356	0.292	0.080	3.625	3.997	1.645	0.663	2.308
5.1202 - 5.1203	741.68	740.58	401.4	21	-0.274%	5757	0.287	0.079	3.614	3.980	1.638	0.659	2.297
5.1201 - 5.1202	742.90	741.78	312.1	21	-0.359%	6069	0.284	0.078	3.605	3.967	1.633	0.656	2.288
5.1200 - 5.1201	743.36	743.00	175.8	21	-0.205%	6245	0.282	0.078	3.6	3.960	1.630	0.654	2.283
5.1199 - 5.1200	743.51	742.75	101	21	-0.752%	6346	0.045	0.012	0.571	0.628	0.258	0.417	0.675
5.1060 - 5.1199	748.35	745.2	189	12	-1.667%	6535	0.043	0.012	0.547	0.602	0.248	0.415	0.662
5.1026 - 5.1060	754.1	748.35	386	12	-1.490%	6921	0.039	0.011	0.498	0.548	0.226	0.411	0.637
5.1025 - 5.1026	756.35	754.1	402	12	-0.560%	7323	0.035	0.010	0.448	0.493	0.203	0.407	0.610
5.1024 - 5.1025	757.87	756.35	282	12	-0.539%	7605	0.032	0.009	0.413	0.454	0.187	0.404	0.591
5.1023 - 5.1024	759.48	757.87	301	12	-0.535%	7906	0.029	0.008	0.375	0.412	0.170	0.401	0.571
5.1022 - 5.1023	762.59	759.48	316	12	-0.984%	8222	0.026	0.007	0.335	0.369	0.152	0.398	0.550
5.1021 - 5.1022	764.14	762.59	321	12	-0.483%	8543	0.023	0.006	0.295	0.325	0.134	0.395	0.529
5.1020 - 5.1021	763.91	764.14	18	12	1.278%	8561	0.023	0.006	0.293	0.322	0.133	0.395	0.527
5.1019 - 5.1020	764.47	763.91	274	12	-0.204%	8835	0.020	0.006	0.258	0.284	0.117	0.392	0.509
5.1018 - 5.1019	765.16	764.47	282	12	-0.245%	9117	0.017	0.005	0.223	0.245	0.101	0.389	0.490
5.1017 - 5.1018	765.87	765.16	275	12	-0.258%	9392	0.015	0.004	0.189	0.207	0.085	0.387	0.472
5.1013 - 5.1017	766.55	765.87	198	12	-0.343%	9590	0.013	0.004	0.164	0.180	0.074	0.385	0.459
5.1012 - 5.1013	769.53	766.55	38	8	-7.842%	9628	0.011	0.003	0.146	0.161	0.066	0.383	0.449
5.1011 - 5.1012	773.66	769.53	125	8	-3.304%	9753	0.007	0.002	0.089	0.097	0.040	0.379	0.419
5.1010 - 5.1011	774.69	773.66	165	8	-0.624%	9918	0.001	0.000	0.012	0.014	0.006	0.373	0.378

Prairie Centre
Elm / Roosevelt / Illinois Route 31 Sanitary Trunk Sewer
Estimate Summary

Segment 1:	Elm Street	Sub-Total = $225,533
Segment 2:	Roosevelt Street	Sub-Total = $864,321
Segment 3:	Illinois Route 31	Sub-Total = $857,457

TOTAL= $1,947,311

Dollar Values are for year 2016

TOWNE CENTRE SANITARY IMPROVEMENTS
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST
ELM STREET IMPROVEMENTS

GJC
7/11/2016

	ITEM		UNIT	QUANTITY	UNIT PRICE	TOTAL	
				60			
			SOIL EROSION CONTROL				
	INLET PROTECTION		EA	4	$ 150.00	$ 600.00	
	EROSION CONTROL MAINTENANCE	STREET CLEANING	LF	100	$ 15.00	$ 1,500.00	
							$ 2,100.00
			SANITARY SEWER IMPROVEMENTS				
	REMOVE MANHOLE STRUCTURE		EA	3	$ 1,000.00	$ 3,000.00	
	REMOVE EXISTING SEWER	AVERAGE DEPTH 12'	LF	60	$ 20.00	$ 1,200.00	
	SANITARY SEWER, PVC SDR 26	21"	LF	60	$ 250.00	$ 15,000.00	
	SANITARY MANHOLE, TYPE A	48" DIA, 10'-15' DEEP	EA	3	$ 4,500.00	$ 13,500.00	
	SANITARY TRENCH BACKFILL	CA-7	LF	60	$ 20.00	$ 1,200.00	
	BYPASS PUMPING SYSTEM	MOBILIZATION, PUMP, PIPE	DAY	10	$ 1,500.00	$ 15,000.00	
	SERVICE RECONNECTION		EA	2	$ 3,000.00	$ 6,000.00	
	PIPE LINING 21"		LF	388	$ 200.00	$ 77,600.00	
							$ 132,500.00
			ROADWAY IMPROVEMENTS (PATCHING)				
	REMOVE BITUMINOUS, SAW CUT	FULL DEPTH	LF	100	$ 10.00	$ 1,000.00	
	HOT-MIX ASPHALT SURFACE COURSE	2", MIX "C", N50	TON	10	$ 150.00	$ 1,500.00	
	HOT-MIX ASPHALT BINDER COURSE	2-1/2", IL-19.0, N50	TON	10	$ 150.00	$ 1,500.00	
	AGGREGATE BASE COURSE	12", TYPE B	SY	111	$ 20.00	$ 2,222.22	
	TRAFFIC CONTROL		DAY	15	$ 200.00	$ 3,000.00	
							$ 9,222.22
			RESTORATION				
	FINAL RESTORATION		SY	50	$ 15.00	$ 750.00	
							$ 750.00
						SUB-TOTAL	$ 144,572.22
			MISCELLANEOUS				
	CONSTRUCTION LAYOUT/STAKING			5%	$ 7,228.61	$ 7,228.61	
	ENGINEERING			15%	$ 21,685.83	$ 21,685.83	
	INSPECTION			10%	$ 14,457.22	$ 14,457.22	
							$ 43,371.67
	CONTINGENCY		20%			$ 37,588.78	
						TOTAL	**$ 225,532.67**
		COST PER LINEAR FOOT OF SANITARY SEWER:			**$ 503.42**		
				USE	**$ 510.00**		

PRAIRIE CENTRE SANITARY IMPROVEMENTS
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST
ROSEVELT ROAD IMPROVEMENTS

GJC
7/11/2016

	ITEM		UNIT	QUANTITY	UNIT PRICE	TOTAL	
				2163			
			SOIL EROSION CONTROL				
	INLET PROTECTION		EA	10	$ 150.00	$ 1,500.00	
	EROSION CONTROL MAINTENANCE	STREET SWEEPING	LF	2200	$ 3.00	$ 6,600.00	
							$ 8,100.00
			SANITARY SEWER IMPROVEMENTS				
	ROCK EXCAVATION		LF	2200	$ 10.00	$ 22,000.00	
	REMOVE MANHOLE STRUCTURE		EA	9	$ 1,000.00	$ 9,000.00	
	REMOVE EXISTING SEWER	AVERAGE DEPTH 9.5'	LF	2200	$ 15.00	$ 33,000.00	
	SANITARY SEWER, PVC SDR 26	21"	LF	2200	$ 100.00	$ 220,000.00	
	SANITARY MANHOLE, TYPE A	48" DIA, <10' DEEP	LF	9	$ 3,500.00	$ 31,500.00	
	SANITARY TRENCH BACKFILL	CA-7	LF	2200	$ 20.00	$ 44,000.00	
	BYPASS PUMPING SYSTEM	MOBILIZATION, PUMP, PIPE	DAY	30	$ 1,500.00	$ 45,000.00	
	SERVICE RECONNECTION		EA	38	$ 1,500.00	$ 57,000.00	
							$ 461,500.00
			ROADWAY IMPROVEMENTS				
	REMOVE BITUMINOUS, SAW CUT	FULL DEPTH	LF	2200	$ 10.00	$ 22,000.00	
	HOT-MIX ASPHALT SURFACE COURSE	2", MIX "C", N50	TON	141	$ 75.00	$ 10,541.67	
	HOT-MIX ASPHALT BINDER COURSE	2-1/2", IL-19.0, N50	TON	176	$ 75.00	$ 13,177.08	
	AGGREGATE BASE COURSE	12", TYPE B	SY	1222	$ 15.00	$ 18,333.33	
	TRAFFIC CONTROL		DAY	45	$ 400.00	$ 18,000.00	
							$ 82,052.08
			RESTORATION				
	FINAL RESTORATION		SY	200	$ 12.00	$ 2,400.00	
							$ 2,400.00
						SUB-TOTAL	$ 554,052.08
					$ 111,968.00		
			MISCELLANEOUS				
	CONSTRUCTION LAYOUT/STAKING			5%	$ 27,702.60	$ 27,702.60	
	ENGINEERING			15%	$ 83,107.81	$ 83,107.81	
	INSPECTION			10%	$ 55,405.21	$ 55,405.21	
							$ 166,215.63
	CONTINGENCY		20%			$ 144,053.54	
						TOTAL	**$ 864,321.25**
		COST PER LINEAR FOOT OF SANITARY			**$ 399.59**		
				USE	**$ 400.00**		

Notes
1. Sewer connections assumed based on adjacent rooftops. Services NOT replaced to ROW.

TOWNE CENTRE SANITARY IMPROVEMENTS
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST
ILLINOIS ROUTE 31 IMPROVEMENTS

GJC
7/11/2016

	ITEM		UNIT	QUANTITY	UNIT PRICE	TOTAL	SUB-TOTAL
				1506			
			SOIL EROSION CONTROL				
	STABILIZED CONSTRUCTION ACCESS		EA	2	$ 1,500.00	$ 3,000.00	
	INLET PROTECTION		EA	12	$ 150.00	$ 1,800.00	
	EROSION BARRIER		LF	1500	$ 3.00	$ 4,500.00	
	EROSION CONTROL MAINTENANCE	STREET SWEEPING	LF	1500	$ 9.00	$ 13,500.00	
							$ 22,800.00
			SANITARY SEWER IMPROVEMENTS				
	ROCK EXCAVATION		LF	1500	$ 25.00	$ 37,500.00	
	REMOVE MANHOLE STRUCTURE		EA	10	$ 1,000.00	$ 10,000.00	
	REMOVE EXISTING SEWER	AVERAGE DEPTH 9.5'	LF	1500	$ 15.00	$ 22,500.00	
	SANITARY SEWER, PVC SDR 26	21"	LF	1500	$ 120.00	$ 180,000.00	
	SANITARY MANHOLE, TYPE A	48" DIA, <10' DEEP	EA	10	$ 4,000.00	$ 40,000.00	
	SANITARY TRENCH BACKFILL	CA-7	LF	1500	$ 20.00	$ 30,000.00	
	BYPASS PUMPING SYSTEM	MOBILIZATION, PUMP, PIPE	DAY	30	$ 1,500.00	$ 45,000.00	
							$ 365,000.00
			ROADWAY IMPROVEMENTS				
	REMOVE C & G, SAW CUT	FULL DEPTH	LF	1500	$ 10.00	$ 15,000.00	
	B 6.12 C & G	ALL CURB DAMGED	LF	1500	$ 25.00	$ 37,500.00	
	HMA REMOVAL	2"	SY	5000	$ 2.50	$ 12,500.00	
	HOT-MIX ASPHALT SURFACE COURSE	1.5", MIX "C", N50	TON	431	$ 80.00	$ 34,500.00	
	HOT-MIX ASPHALT LEVEL BINDER	3/4"	LF	216	$ 80.00	$ 17,250.00	
	DRAINAGE STRUCTURE ADJUSTMENTS		EA	6	$ 1,500.00	$ 9,000.00	
	TRAFFIC CONTROL		DAY	45	$ 800.00	$ 36,000.00	
							$ 161,750.00
			RESTORATION				
	FINAL RESTORATION	SOD AND WATERING	SY	2000	$ 12.00	$ 24,000.00	
							$ 24,000.00
						SUB-TOTAL	$ 573,550.00
			MISCELLANEOUS				
	CONSTRUCTION LAYOUT/STAKING			5%	$ 28,677.50	$ 28,677.50	
	ENGINEERING			15%	$ 86,032.50	$ 86,032.50	
	INSPECTION			10%	$ 57,355.00	$ 57,355.00	
							$ 172,065.00
	CONTINGENCY		15%			$ 111,842.25	
						TOTAL	**$ 857,457.25**
		COST PER LINEAR FOOT OF SANITARY SEWER:			**$ 569.36**		
				USE	**$ 570.00**		