Appendix C: Supplemental Utility Planning Information

Introduction

In conjunction with the Manhattan Urban Area Comprehensive Plan update, Olsson Associates was asked to prepare supplemental utility planning information for two portions of the Planning Area: the West US-24 Corridor and the Blue Township/East US-24 Corridor. Supplemental information for both areas is provided below.

West US-24 Corridor

Purpose

In conjunction with the Manhattan Urban Area Comprehensive Plan update, Olsson Associates was asked to perform an analysis on the Riley County Shops Lift Station for the West US-24 Corridor. A previous analysis, also performed by Olsson Associates, which determined the remaining capacity at the lift station, was summarized in a memo dated February 10, 2014.

The purpose of this summary is to outline future development areas near the lift station, and project the additional wastewater flows that they are anticipated to contribute to the Riley County Shops lift station. Also, utilization of rural water in the area will be reviewed for capacity as well as fire protection. In addition, the memo will estimate the amount of runoff that enters the lift station from the holding pond to the west, to help aid the County in coming up with a possible solution for diverting this water away from the lift station, opening up capacity to serve future growth.

This summary provides the following:

- The total area of the land that has been identified for potential development near the lift station, and the anticipated wastewater flows that the development will generate
- The additional development that the lift station may serve at its current capacity
- The additional development that the 4-inch force main may serve at its current capacity
- Options for serving future development at Seth Child Road with sewer
- Options for diverting storm water away from the lift station

Background Data

The Riley County Shops Lift Station is a duplex system consisting of dual end suction pumps. The pumps operate at 140 gallons per minute (gpm) at 99 feet of head. The lift station discharges into a 4-inch force main that empties into a City of Manhattan manhole approximately 5 miles away.

There is a maintenance facility west of the lift station that stores road salt, which slopes to a storm water basin, which then flows via gravity to the lift station.

There is a desire to build commercial and light industrial development north of the Riley County Shops (Option 5.B in the Comprehensive Plan).

STORM WATER INFLOW

The quantity of storm water entering the lift station from the salt facilities (outlined in yellow in Figure 1) was calculated using the Soil Conservation Service (SCS) method with the Hydraflow Hydrographs Extension for AutoCAD Civil 3D and Riley County IDF curves. The runoff was also calculated for the parking lot north of the salt facility area (outlined in green in Figure 1). There is a slight dip that diverts the water from the north parking lot to the east ditch along Marlatt, however, for large storm events it is possible the water is bypassing this dip and flowing into the salt facility area and holding pond. The dip is a maximum of 0.7 feet deep, according to survey information collected by Olsson Associates.

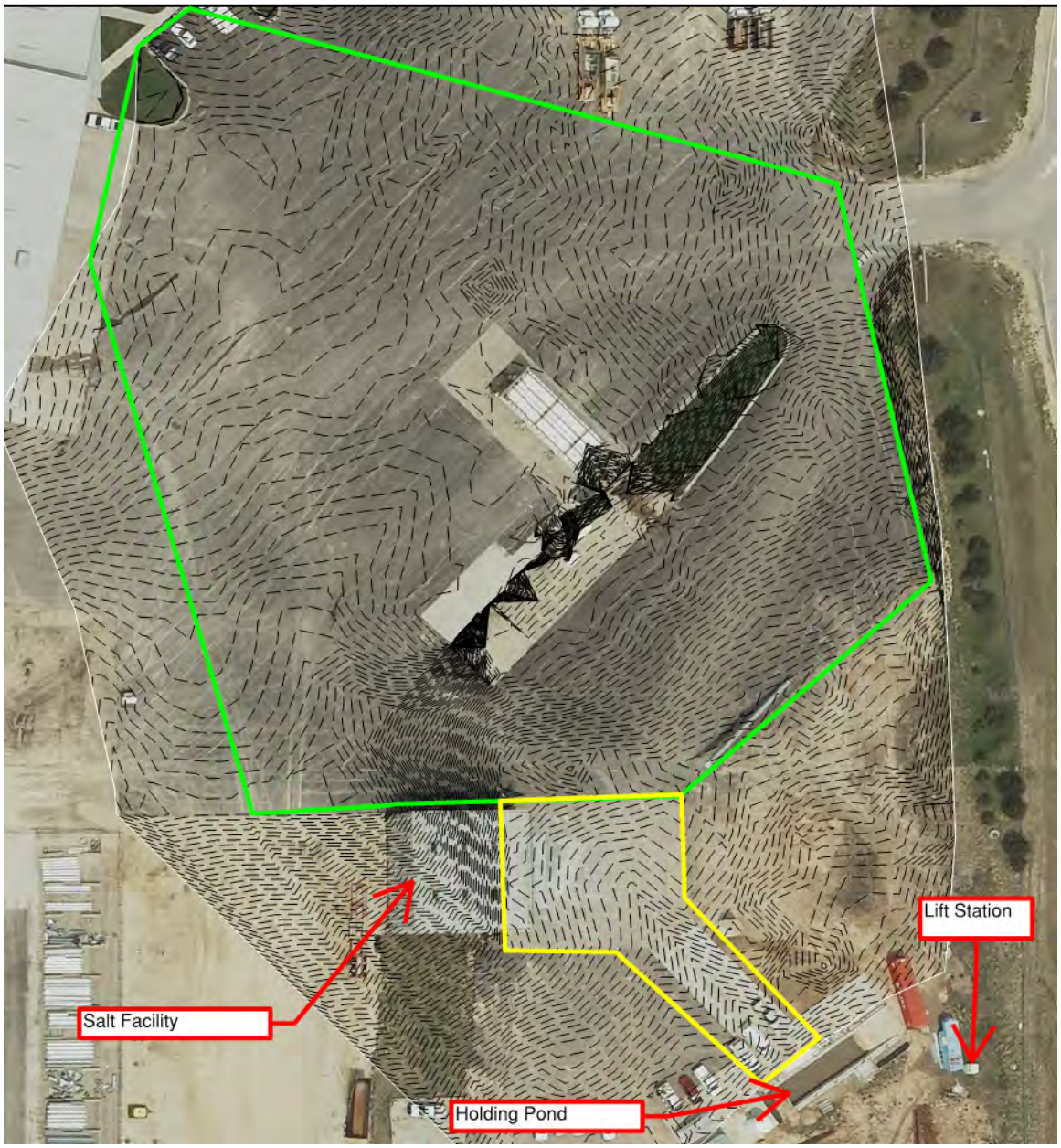


Figure 1-Study Area

The following parameters were used in each drainage area to calculate the total runoff:

	Yellow Paved Area	Green Paved Area
Drainage Area (Acres)	0.24	3.2
Curve Number	98	98
Basin Slope	0.02%	0.022%
Hydraulic Length (Ft)	160	600

The runoff rates and volumes were calculated as follows:

Yellow Paved Area						
EVENT	AVERAGE FLOW (CFS)	AVERAGE FLOW (GPM)	PEAK FLOW (CFS)	PEAK FLOW (GPM)	TOTAL VOLUME (CUFT)	TOTAL VOLUME (GAL)
1 year	0.032	14.36	0.69	309.69	2,801	20,953
10 year	0.049	21.99	1.052	472.17	4,342	32,480
25 year	0.058	26.03	1.232	552.96	5,113	38,248
50 year	0.064	28.73	1.362	611.31	5,670	42,414
100 year	0.073	32.76	1.543	692.54	6,441	48,182

Green Paved Area						
EVENT	AVERAGE FLOW (CFS)	AVERAGE FLOW (GPM)	PEAK FLOW (CFS)	PEAK FLOW (GPM)	TOTAL VOLUME (CUFT)	TOTAL VOLUME (GAL)
1 year	0.41	184.02	5.024	2,255	37,706	282,060
10 year	0.63	282.76	7.668	3,442	58,441	437,168
25 year	0.74	332.13	8.986	4,033	68,818	514,793
50 year	0.83	372.53	9.937	4,460	76,314	570,867
100 year	0.94	421.90	11.25	5,049	86,695	648,522

RUNOFF DIVERSION

As indicated earlier, runoff from the paved areas to the north and west enters the lift station via gravity flow after leaving a holding pond north of the facility. In order to increase capacity at the lift station, Riley County wishes to look at the possibility of diverting this runoff to a complete retention lagoon or into the nearby roadway ditch. Discussions with Kansas Department of Health and Environment (KDHE) have indicated that diverting the water into the roadway ditch is a possibility, but future investigation is necessary to determine that the water quality meets the KDHE requirements for discharging.

The City and County do recognize that it is undesirable to discharge stormwater inflow in the sanitary sewer system. Measures will be reviewed in the future as a suitable method to eliminate the stormwater inflow.

The existing holding pond is approximately 50 feet long, 15 feet wide, and 2 feet deep from the bottom of the pond to the entrance of the gravity flow pipe, however the total pond is about 5 feet deep. Using the 2 feet depth, the holding pond can accommodate 1,500 cubic feet of water or 11,221 gallons before it starts to discharge to the lift station, which is less than the 1 year storm quantity for the salt facility area. If the gravity pipe is blocked, the holding pond can accommodate 3,750 cubic feet of water or 28,052 gallons, which is slightly less than a 10 year storm.

Using the runoff volume for the yellow paved area, lagoon sizes were estimated. The lagoons were assumed to be concrete lined and no infiltration, additionally evaporation was not taken into account in order to provide a more conservative estimate. The first set of lagoon sizes were assuming a square lagoon with equal sides, 5 feet depth of water with an additional 2 feet of lagoon depth for a buffer. The second set of lagoon sizes assumed deepening the existing holding pond. See the tables below.

Square Lagoon Sizes					
Event	Water Depth (ft)	Lagoon Depth (ft)	Surface Area (sf)	Square - side length (ft)	Lagoon Volume (cuft)
1 year	5	7	560	24	3,921
10 year	5	7	868	29	6,079
25 year	5	7	1,023	32	7,158
50 year	5	7	1,134	34	7,938
100 year	5	7	1,288	36	9,017

Depth Needed at Existing Holding Pond					
Event	Existing Length (ft)	Existing Width (ft)	Surface Area (sf)	Needed Water Depth (ft)	Needed Lagoon Depth (ft)
1 year	50	15	750	4	6
10 year	50	15	750	6	8
25 year	50	15	750	7	9
50 year	50	15	750	8	10
100 year	50	15	750	9	11

The gravity sewer main that delivers flow from the holding pond to the lift station, according to the lift station record drawings, is eight inches in diameter, and is installed at a slope of 1.00%. Using the Manning Equation, and a Manning coefficient of 0.013, when the gravity line flows full, it flows at 542 gpm. Riley County staff have indicated that the lift station is unable to keep up with these high flows, presently during large rain events, as the capacity of the lift station is limited to the 140 gpm capacity of the pumps. Removing this source of flow into the lift station increases the lift station capacity significantly, as the total for all other sources was determined to only be 6 gpm in the previous memo. Currently, no backflow measures are in place preventing sanitary backup into this holding basin.

Another option to consider is covering the concrete apron in front of the salt storage building. If this is done, the runoff from the rest of the drainage area can be diverted around the lift station thus keeping the largest portion of the storm water from being pumped by the force main.

FUTURE GROWTH AREAS

Four locations were identified north and west of the Riley County Shops for future Commercial and Light Industrial Development. In addition, a 20 acre plot of land at Highway 24 and Seth Child road is included in this analysis.

Wastewater flows of 1,000 gpd/acre were assumed to estimate future wastewater flows as a result of the building in the four identified growth areas. In addition, the following other information is known about the lift station, as summarized in the previous memo:

- Existing Flows from the Riley County Shops: 6 gpm

- Maximum capacity of existing 4” force main: 290 gpm
- Remaining capacity of existing 4” force main (at Max. Capacity of current LS): 150 gpm
- Maximum Capacity at Lift Station: 140 gpm

The areas listed assume that the entire parcel of land may be built upon, and include areas that may already have buildings in place. Review of the topography in the vicinity has determined that portions of some of the growth areas drain away from the road, which may require substantial grading work and/or individual lift stations to collect and discharge wastewater into the sewer system. Storm water flows from the nearby salt facilities are not included in this analysis.

Growth Area	Area (Acres)	Estimated Flow (gpd)	Estimated Flow (gpm)
1	42.7	42,700	30
2	24.7	24,700	17
3	70.7	70,700	49
4	19.9	19,900	14
Subtotals	158.0	*158,000*	*110*
Riley County Shop		8,640	6
Grand Totals		**166,640**	**116**

ADDITIONAL DEVELOPMENT THAT THE LIFT STATION MAY SERVE AT ITS CURRENT CAPACITY

The lift station, in its current configuration, is limited in capacity by the size of its pumps, which are 140 gpm, with one of the pumps being a backup. The total estimated flow from the future growth areas and the existing Riley County Shops was determined to be 116 gpm. Subtracting this from the available capacity of 140 gpm leaves an additional 24 gpm of capacity at the lift station. Assuming wastewater flows of 1,000 gpd/acre, this indicates that the existing lift station can serve all of the planned development, as well as an additional 35 acres of land for future development at the same flow assumptions. This assumption is being made based on the stormwater that is taken off of the lift station.

ADDITIONAL DEVELOPMENT THAT THE 4-INCH FORCE MAIN MAY SERVE AT ITS CURRENT CAPACITY

The previous memo that Olsson completed determined that the existing 4-inch force main currently has 150 gpm of extra capacity available of the total 290 gpm. Subtracting the total estimated wastewater flows from 150 gpm indicates that with the anticipated flows from new development, there is still an additional 34 gpm of capacity left in the force main, equivalent to approximately 49 acres of developable land assuming 1,000 gpd/acre. Overall the area could develop within a total of 242 acres (158+35+49).

SEWERS TO SERVE SETH CHILD ROAD DEVELOPMENT

The Seth Child Road development site sits at an elevation of approximately 1172 feet. The nearest sewer system to this location, depicted in the Manhattan GIS System, is the force main that leaves the Riley County lift station, approximately 9,500 feet (1.8 miles) to the south, at Seth Child & Marlatt Road. The Riley County Shops lift station is approximately 9,950 feet (1.9 miles) west of the Seth Child development site. The wastewater flows from the Seth Child Road development were determined to be approximately 14 gpm. The force main was determined in the previous study to have an additional 150 gpm of remaining capacity, so the existing 4-inch force main is adequate to handle the additional flow from the future Seth Child Road Development. As indicated in the previous memo, if additional flow is to be injected into the force main, the controls at the new lift station should be set up such that additional flows are not entering the force main concurrent with existing flows traveling through the force main.

Building upon this location would require a 4-inch force main and two pumps, the lift station structure, an electrical connection, controls, and other miscellaneous work and equipment necessary to run the lift station.

Using the Hazen-Williams equation, a flow rate of 140 gpm (the same flow rate at the Riley County Shops lift station), and a C-Factor of 120, the following head loss conditions are calculated:

Route	Length(ft)	Calculated Head loss	Elevation at Seth Child	Elevation at end of force main	Elevation Difference	Total Head
West to Lift Station	9,950	164	1172	1344	172	336
South to Marlatt	9,500	157	1172	1292	120	277

Rural Water Evaluation

Currently, the area to be served by sanitary sewer is served with domestic water by RWD #1. The RWD purchases water from the City of Manhattan at the Colbert Hills water tower and a booster pump is installed near the Riley County Shops. The booster pump is 500 gpm and pumps to the RWD water tower on US-24 west of the county shops. Waterlines are 8" and 10" from the Colbert Hills tower to the RWD tower.

The development area can be served with domestic water without much of an issue. The RWD board would need to determine that the usage will not impact the system but overall this area is well served with larger pipes and a water tower.

Another issue that will take further investigation is fire protection and the use of fire sprinkler systems. The general requirements for sprinkler systems are 70 psi minimum pressure and 1,200 gpm at fire hydrants. The RWD has a position that they do not allow fire sprinkler systems or fire hydrants on rural waterlines and they cannot produce the requirements anyway. Riley County has expressed interest in talking to the RWD board about this issue and some options could be discussed. Those options could be:

- Riley county to construct another water tower or storage tank to obtain pressure and flows needed.
- A joint water tower owned by the County and RWD
- Construct a County owned waterline from the RWD tower with pump, meter at water tower (excess capacity of water tower unknown.
- Have each business that wants fire flow and sprinklers to purchase a 3" compound meter or storage tank
- RWD sell Riley County water for fire protection and build parallel water system.
- OR a combination of the above to provide adequate fire protection

Conclusion

Additional wastewater flows into the Riley County Shops lift station are limited to the available capacity of the pumps that are currently in place. The available capacity at the pumps indicates that the current lift station can serve the projected wastewater flows from all four growth areas, as well as an additional 35 acres of land.

Currently, the existing 4" force main can handle 290 gpm and is limited to a current lift station that is rated at 140 gpm. The current Riley County shop area is estimated currently to generate 6 gpm of wastewater without any storm water. The best option is to remove the storm water from the lift station and increase the size of the lift station as development occurs to the force main is maximized to its full capacity.

As the stormwater is removed the overall development area could reach a total of 242 acres. This is a sizable area that will enhance the growth of the region.

The storm water from Riley County Shops will need to be either diverted east to the ditch along Marlatt or held in a retention lagoon in order for the lift station to handle capacity of the future growth areas. Discussions with KDHE have determined that diverting the storm water into the roadway ditch would require a water quality analysis and KDHE approval before it would be allowed. Storm water north of the salt facility area is already flowing to the ditch, however,

for large storm events, it is possible this water is also flowing into the existing holding pond. Further investigation is necessary to determine the water quality of the storm water at the salt facility area if it is desired to discharge this water to the ditch. The estimated retention lagoon sizes given earlier will be able to retain the water for the specified storm events. The lagoon would be designed as a complete retention lagoon, which does not discharge to a body of water, and maintains its level based upon evaporation alone. In the case of several consecutive large storm events, the lagoon may need to be manually pumped out.

The Seth Child development area must be served by a lift station/force main due to the elevation difference between the site and both the nearest force main connection to the south, and the Riley County Shops lift station. The force main lengths are similar between the two sites, so both alignments have similar headloss conditions, but the elevation difference is greater between the Seth Child development and the Riley County Shops lift station, resulting in the need to use a pump with higher head conditions. Looking at the linear feet of force main required, and the need for a pump with higher head conditions, connecting a new force main to the existing one at Marlatt and Seth Child is the more desirable of the two options.

Future meetings will need to be set up with the RWD to discuss water in the development area.

Blue Township/East US-24 Corridor

Purpose

A preliminary analysis was performed to identify potential capacity deficiencies within the Blue Township sanitary sewer collection system.

Preliminary Information

Existing sewer main information was taken from the Blue Township Sewer District 2014 map. Basin areas were determined using this map and junction points of sewer mains. Potential areas of development as shown in the Manhattan Area 2035 Plan was considered.

Assumptions

Design data was taken from the Minimum Standards of Design for Water Pollution Control Facilities, Kansas Department

of Health and Environment (KDHE) 1978. Population for all residential areas was assumed to be 3 to 3.5 units per acre with 3 people per unit for a total of 10 people per acre. Usage for residential areas was assumed to be 100 gallons per capita per day. Industrial and commercial areas were grouped together based on light industrial use. 1,000 gallons per day per acre was used for both commercial and industrial land use, even though KDHE suggests 5,000 to 10,000 gallons per day per acre. A peak hour factor of 3.0 was provided.

SLOPES REQUIRED FOR V= 2fps FOR FULL AND HALF FULL FLOW n=0.013	
Pipe Diameter (inches)	Slope (%)
10	0.248
12	0.194
15	0.145
18	0.114
21	0.092
24	0.077
27	0.065
30	0.057
33	0.051
36	0.045

Pipe capacities were computed using Manning's Equation and the minimum allowable slopes provided in Table 1 by

KDHE. Existing slopes were unknown so minimum slopes has to be used for this analysis.

Results, Existing Development

The existing developed area was divided into 10 basins as shown in Figure 1. Basin flows were calculated using the design assumptions above. Collective flows were calculated at the 6 points shown in Figure 1 and compared to the estimated capacity of the sewer main at those points. Percent of capacity utilization for average and peak hour flows is shown in Table 2.

Point	Basins	Pipe Diameter (inches)	Avg Flow (GPM)	Peak Hour Flow (GPM)	Capacity (GPM)	% Capacity Utilized Avg Flow	% Capacity Utilized Peak Hour Flow
1	A-B	18	294	881	1592	18%	55%
2	A-D	18	450	1351	1592	28%	85%
3	A-F	21	502	1507	2157	23%	70%
4	A-I	24	685	2055	2817	24%	73%
5	J	18	41	122	1592	3%	8%
6	A-J	27	726	2177	3544	20%	61%

Results, Manhattan Area 2035 Plan

The development area identified was divided into 16 basins as shown in Figure 2. Basins A3, B2, B3, and J1 were added to the basins in Figure 1. Basin B from Figure 1 was divided into basins B1 and A2 to account for the flow east of Excel Road that would be directed into the planned transmission line that is noted on Figure 2. Basin flows were calculated using the design assumptions above. Collective flows were calculated at the 6 points shown in Figure 2, the same 6 points from Figure 1, and compared to the estimated capacity of the sewer main at those points. Percent of capacity utilization for average and peak hour flows is shown in Table 3.

Table 3: Existing System Capacity, Manhattan Area 2035 Plan

Point	Basins	Pipe Diameter (inches)	Avg Flow (GPM)	Peak Hour Flow (GPM)	Capacity (GPM)	% Capacity Utilized Avg Flow	% Capacity Utilized Peak Hour Flow
1	A_1, A_2, A_3	18	1365	4094	1592	86%	257%
2	A_1, A_2, A_3, C, D	18	1521	4564	1592	96%	287%
3	A_1, A_2, A_3, C-F	21	1573	4720	2157	73%	219%
4	A_1, A_2, A_3, C-I	24	1756	5268	2817	62%	187%
5	J_1, J_2, B_1-B_3	18	1173	3518	1592	74%	221%
6	A-J	27	2929	8786	3544	83%	248%

Conclusions

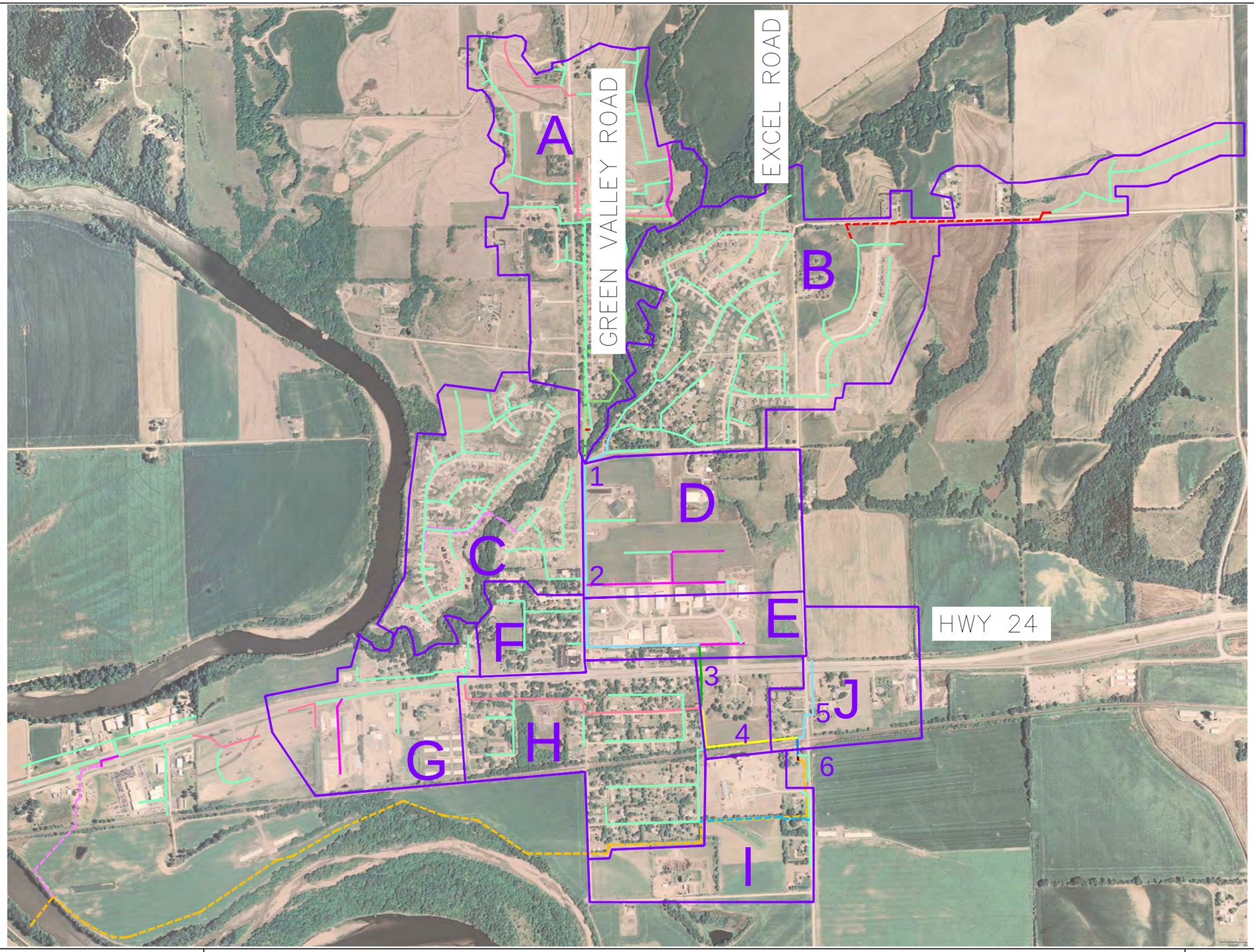
Under the assumptions made above, the existing collection system appears to have sufficient capacity to support the existing township. Under the assumptions made above for the areas designated in the Manhattan Area 2035 plan, the system does not appear to have the capacity to support the proposed future development. Several points in the

collection system have the potential to approach 200% of available capacity at peak hour conditions.

This analysis relied entirely on design data. Further investigation is recommended to more accurately identify existing flows and pipe capacities.

The condition and slope of the existing sanitary sewer pipes and inflow and infiltration play a big role and will impact this analysis and a future study is needed. Flow monitoring should also be considered to determine current capacity of the lines.

A further study is needed to determine future growth areas for new sanitary sewer mains and proper sizing is will lead the county past 2035.



LEGEND

BASIN BOUNDARY

SEWER

- FORCE MAIN, 1.5
- FORCE MAIN, 4
- FORCE MAIN, 6
- FORCE MAIN, 8
- FORCE MAIN, 14
- GRAVITY, 6
- GRAVITY, 8
- GRAVITY, 10
- GRAVITY, 12
- GRAVITY, 18
- GRAVITY, 21
- GRAVITY, 24
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BLUE TOWNSHIP SEWER DISTRICT 2014

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FIGURE 1

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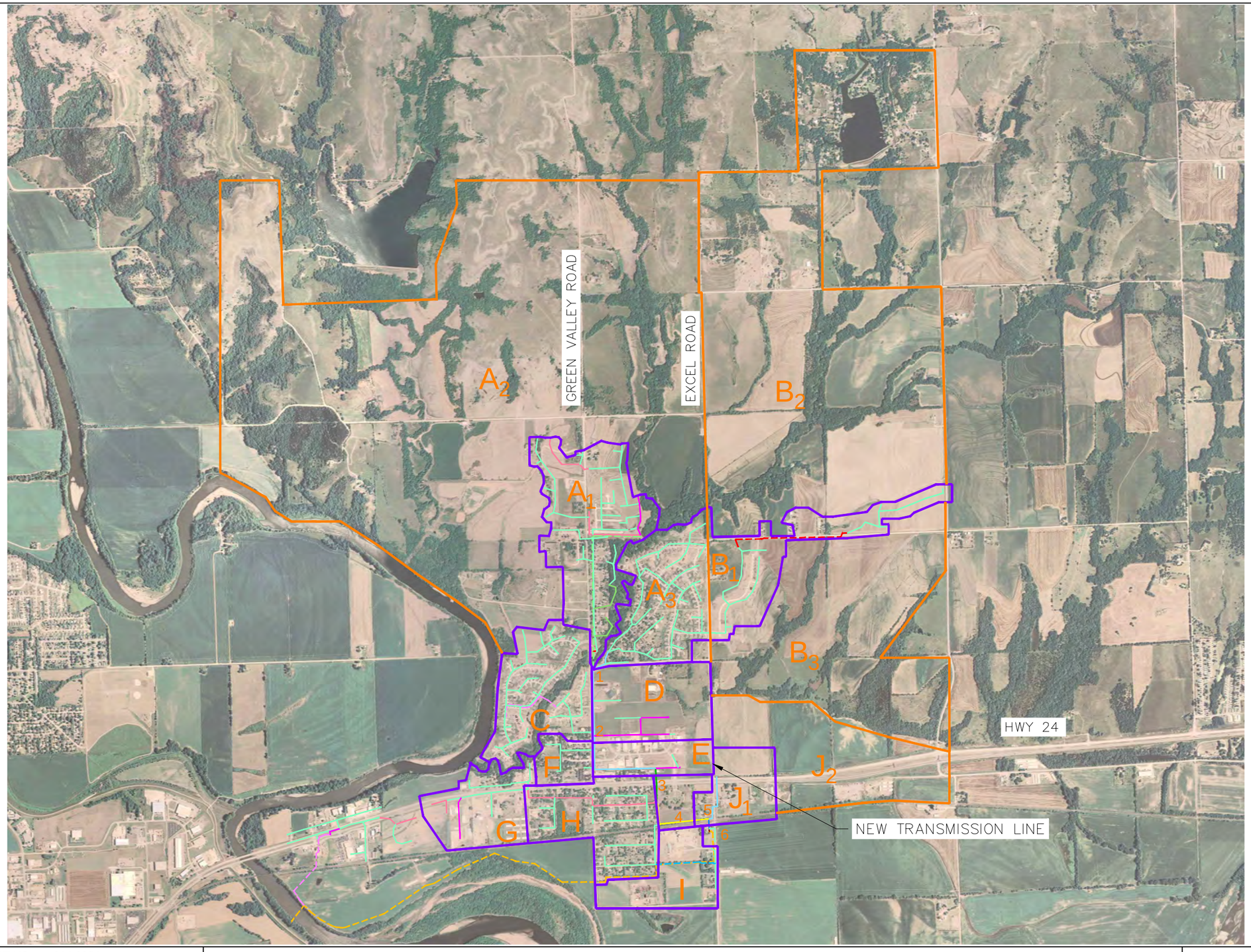

LEGEND

BASIN BOUNDARY
FUTURE BOUNDARY

SEWER

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