Memorandum

DRAFT

Date: September 20, 2010

To: Mike Lawless

From: Steve Yonker
Larry Close

Re: Wakarusa Wastewater Treatment Plant
Flow/Development Trigger for Design and Construction
Wastewater Facilities Master Plan
City of Lawrence, Kansas
B & McD Project No. 54793

The Wastewater Facilities Master Plan scope includes developing a flow/development "trigger" for initiating the design of the future Wakarusa Wastewater Treatment Plant (Wakarusa). The intent of the trigger is to provide sufficient time for design and construction of the Wakarusa so that it will come on line before growth and development within the City's wastewater utility service area would exceed the existing design capacity of the Kansas River Wastewater Treatment Plant (KRWWTP). This memorandum sets forth two alternative approaches to a flow/development trigger for the City's initial consideration.

General Considerations

The flow/development trigger must anticipate how much time will be needed to complete the design and construction of the Wakarusa. Based on our experience with projects of this type, a minimum of four years should be scheduled for design and construction of a new wastewater treatment plant of the scale of the Wakarusa. A five year schedule is recommended to provide for scheduling uncertainties such as permitting and regulatory reviews of the project.

The flow/development trigger should also be based on bringing the Wakarusa on line before the full capacity of the KRWWTP is reached. This will provide an appropriate contingency for various factors such as accelerated growth during the five year project design and construction schedule, to insure the KRWWTP will perform within its permitted effluent limits up to the time the Wakarusa is on line, and to provide time for the start-up phase of the Wakarusa.

The City Commission has initially approved a 20 year forecast of population to be used for planning purposes by this wastewater facilities master plan. The initially approved plan is subject to some adjustment based on input received during a public participation process before it is finally approved by the City Commission. The initially approved

forecast is between the "Low" and "Medium" Horizon 2020 Projections with a 2030 population forecast of 125,000. The current 2010 population using a figure between the low and medium Horizon 2020 Projections is estimated to be 92,000. The Horizon 2020 Projections from 2010 to 2030 are linear projections. This results in a forecasted annual population increase of 1,650 from 2010 to 2030.

For master planning of the collection system components, it is appropriate to use a long term population growth rate that may be somewhat higher than recent growth trends. For the purpose of anticipating the timing of the Wakarusa, a near term growth trend more in line with recent growth trends is appropriate to use. From 2000 to 2009, actual population growth has averaged 1,250. Recent and current economic conditions suggest that near term future growth will not exceed this rate. As such, a near term growth rate of 1,250 will be used for evaluating the flow/development trigger for the Wakarusa.

Population Based Trigger

The first flow/development trigger is based on wastewater utility service area population. Population is seen to be a more meaningful trigger than wastewater flow for the following reasons:

- Wastewater flow can vary significantly from year to year due to reasons that do not relate to service area development, such as unusually wet or dry conditions.

- Population accounts for other parameters which affect wastewater treatment plant capacity in addition to flow rate, such as pollutant loading rates that tend to relate closely to service area population.

The 1999 KRWWTP design memorandum establishes plant capacities based on a design population of 100,000, or an estimated 8,000 more than existing population. There is some possibility that parts of the plant are designed for somewhat more capacity, such as an extra 10% aeration basin capacity for nitrification (ammonia reduction). This analysis, however, is based on an overall plant capacity for a population of 100,000. As suggested earlier, a contingency should be incorporated into the setting of the trigger. A population contingency of 2,000 is recommended to provide a buffer of more than one year. Therefore, we recommend the Wakarusa be scheduled to be on line when population reaches 98,000. With population forecasted to grow annually by 1,250, it will be necessary for design and construction of the proposed Wakarusa to start at a population trigger of 92,000. This would provide a schedule of about five years to complete the project and have the Wakarusa on line before development exceeds the design capacity of the KRWWTP. Based on an estimated current population of 92,000 and this population

trigger, it is necessary to immediately start design of the proposed Wakarusa. The Wakarusa would be in operation at the end of 2015.

Pollutant Loading Based Trigger

The second flow/development trigger is based on pollutant loading rates. A brief review of KRWWTP operating data indicates influent wastewater characteristics that are typical for municipal wastewater. There are several pollutant loading rate parameters used for establishing wastewater treatment plant capacities. The single most significant pollutant loading parameter for establishing wastewater treatment plant capacities is BOD. Unlike flow rates which can vary from year to year for reasons unrelated to service area development, BOD loading rates for typical municipal wastewater normally track population and commercial development in a fairly predictable manner.

The 1999 KRWWTP design memorandum establishes plant capacities based on an average BOD loading rate of 15,800 pounds per day (ppd), and a maximum month BOD loading rate of 20,370 ppd. The resulting BOD loading rates per person based on the design population of 100,000 are 0.158 ppd/person and 0.204 ppd /person respectively at the average and maximum month BOD loading rates. Based on plant operating data and population estimates from 2003 to present, daily BOD loadings per person have averaged 0.165 ppd, and maximum month BOD loadings have averaged 0.194 ppd. The historical average BOD loading rate per person is somewhat higher than the plant design average loading rate, but the historical maximum month BOD loading rate per person is lower than the plant design maximum month BOD loading rate. Plant facilities are sized for the maximum month BOD loading rate. As such, the KRWWTP has sufficient capacity for a population of 105,000 based on its design maximum month BOD loading rate of 20,370 and the recent historical maximum month BOD loading rate per person of 0.194 ppd/person.

Once again a population contingency of 2,000 is recommended to provide a buffer of more than one year. Therefore, we recommend the Wakarusa be scheduled to be on line when population reaches 103,000. This would result in a population trigger of 97,000. At the forecasted increase in population of 1,250, design of the Wakarusa would need to start in 2014 and construction be completed in 2019.

Comparison of Triggers

A comparison of the Population Based and Pollutant Loading Based triggers and their outcomes are summarized below. The recommended Near Term Growth Trend and the Linear Projection population projections are provided for comparison.

Recommended Near Term Growth Trend – 1,250/year

	Population Based	**Pollutant Loading Based**
Plant Design	100,000	**105,000**
Wakarusa Plant Operational	98,000	**103,000**
Current Estimated Population	92,000	**92,000**
Population Start Wakarusa Design	92,000	**97,000**
Year Start Wakarusa Design	2010	**2014**
Year Finish Wakarusa Construction	2015	**2019**

Linear Projection – 1,650/year

	Population Based	Pollutant Loading Based
Plant Design	100,000	105,000
Wakarusa Plant Operational	98,000	103,000
Current Estimated Population	92,000	92,000
Population Start Wakarusa Design	90,000	95,000
Year Start Wakarusa Design	2009	2012
Year Finish Wakarusa Construction	2014	2017

It is recommended to use the Near Term Growth Trend with the Pollutant Loading Based criteria as the trigger for scheduling the start of the Wakarusa Project.

We suggest you keep the following in mind as you consider a course of action:

- Regardless of the method used for establishing a trigger, some judgment will be needed to decide when conditions have actually reached the trigger point to start design. For example:
    - The recommended outcomes are based on population increasing at a rate of 1,250 per year. If actual growth proves to be slower - say 1,000 per year - the pollutant loading based trigger can be revised to 98,000 with design starting in 2016 and construction completed in 2021.
    - There has been scatter in BOD loading rates measured from month to month and year to year due to various factors including sampling frequency and technique, and analytical methods used. This is why we have converted the BOD loading analysis to an equivalent population, which we believe will track actual BOD loading rates to the KRWWTP closely. It is probably unreasonable, for example, to use a single high month BOD result that exceeds the BOD loading trigger to start the Wakarusa design.
- The above analysis of triggers is based on KRWWTP design capacities established at the time the current plant facilities were designed in 1999. It is possible that actual plant capacities could be greater than design capacities which may be proven out by historical operating data and plant performance. This would involve a formal process with KDHE to re-rate the plant capacity and modify the NPDES discharge permit to reflect the revised capacity. This topic was discussed with KDHE during a meeting on future regulation changes and effluent limits. KDHE indicated that re-rating the Kansas River WWTP would require an antidegradation review, likely resulting in nutrient limits for the re-rated plant and is therefore not a practical option.
- Not addressed by this analysis is the likelihood of future nutrient limits at the KRWWTP and their timing. Some de-rating of KRWWTP capacity might be necessary to meet future nutrient limits depending on what limits may be required, and the type and size of new facilities that are needed to meet the limits. Based on available information, however, having to de-rate the plant capacity to meet future nutrient limits appears unlikely.

Initial Wakarusa Water Reclamation Facility Plant Capacity

Past planning for the Wakarusa has been based on a wastewater utility service area design population of 153,000 in 2025. This population was expected to generate an annual average wastewater flow rate of 18.6 MGD, of which 7 MGD would be treated by the proposed Wakarusa. The revised population forecast for this master plan is 125,000 in 2030. This suggests a smaller initial Wakarusa capacity than has previously been planned will be required. We expect a design population of 125,000 will result in an annual average flow rate of about 15.5 MGD. The portion of this flow that will be sent to the Wakarusa and thus the capacity needed remains to be determined by the master plan.