

**SANITARY SEWER  
DESIGN MEMORANDUM**

**Prepared For:  
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**Project:  
The Grove  
U.S. HWY 50 and Missouri HWY 291  
Lee's Summit, Missouri**

**BHC Rhodes # 021730**

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***BHC RHODES***  
*Civil Engineering • Surveying • Utilities*

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**GENERAL INFORMATION:**

BHC Rhodes was contracted to analyze the impact on the Big Creek Watershed created by a proposed development on the south side of U.S. Highway 50 and on the east side of Missouri Highway 291 in Lee's Summit, Jackson County, Missouri. The project site property is located in Sections 8 and 17, Township 47 North, Range 31 West.

The proposed development site currently contains approximately 113 acres that is mostly undeveloped or previously developed but now vacant. The proposed development is bound on the north by U.S. Highway 50, the east by the Union Pacific railroad, the west by Missouri Highway 291, and the south by a series of commercial properties consisting of Industrial Manufacturing-Light, Parking-Surface Lot, Miscellaneous Industrial/Office Warehouse, and undeveloped land. The proposed redevelopment will include 73 acres of industrial, commercial, warehouse and office space with the some residential and retail use proposed. The location of the site is indicated on **Figure 1** in Appendix A.

**SERVICE AREA AND LAND USE:**

The proposed development site straddles the Cedar Creek Watershed to the north and west, the West Prairie Lee Watershed to the north and east, and the Big Creek Watershed to the south. **Figure 1** depicts the watershed limits and existing wastewater conveyance system surrounding the proposed development site.

Systems available to serve the proposed development consist of one gravity sewer located west of Missouri Highway 291 and one gravity sewer located directly to the south of the development. The gravity collection line west of Missouri Highway 291 discharges to the Cedar Creek interceptor line and ultimately to the Little Blue Valley Sewer District (LBVSD) S-8 connector. The south gravity collection line flows through the Big Creek Watershed to the Greenwood Pump Station. The existing Zoetis property, located immediately to the northeast of the Missouri 291 and SE Bailey Road intersection, is currently within the Big Creek Watershed but is on a force main system which pumps into the Cedar Creek Watershed.

No portions of the proposed development will utilize the gravity sewer west of Missouri Highway 291 following project completion. The proposed plan will redirect wastewater from the entire development to the Big Creek Watershed sewer system. The existing Zoetis building is proposed to be removed from the current pump station/force main and connected to the proposed gravity system which will flow south of the proposed Grove development then connect to the existing Big Creek gravity system at a point just north of SE Thompson Drive as shown on **Figure 1**.

The Big Creek Watershed is one of 11 major watersheds covering the City of Lee's Summit and also covers a portion of the City of Greenwood. **Figure 2** in Appendix A shows the limits of the Big Creek Watershed which covers approximately 11.5 square miles and includes both residential and non-residential developments. The Big Creek Watershed sewer system trunk line travels generally alongside the northern stretch of Big Creek until it reaches its destination at the existing Greenwood Pump Station.

**DESIGN FLOWS:**

The existing wastewater facilities were analyzed to determine the gravity capacity of the existing Big Creek Watershed sewer system downstream to the Greenwood Pump Station.

The tributary flows for each branch were determined using Section 6500 of the Lee's Summit Design and Construction Manual. Peak wastewater flows were determined by summing a peak base flow, a peak infiltration, and a peak inflow. The peak base flow used for residential development was 1,500 gallons per day per acre while the peak base flow for non-residential development was found by multiplying an Equivalent Domestic Unit (EDU) by both the respective parameter and by 300 gallons per day. EDU values for different types of non-residential land uses are found in Table 6501-1 of the Lee's Summit Design and Construction Manual. 500 gallons per day per acre for residential areas and 250 gallons per day per acre for non-residential areas determined peak infiltration. Peak inflow was calculated using the following formula:

$$\text{Peak Inflow} = KiA \times 0.6517 = \text{million gallons per day}$$

Where:  $K$ =dimensionless inflow factor  
(0.006 for residential & 0.003 for non-residential)  
 $I$ =intensity (inches per hour)  
 $A$ =tributary area (acres)

The rainfall intensity,  $i$ , corresponds to the tributary area's time of concentration for a 50-year storm event. The time of concentration is determined as follows:

$$\text{Time of Concentration} = 18.56 \times \text{Area}^{0.2524}$$

After determining the time of concentration, the intensity is obtained from the table in Section 6501-C of the Lee's Summit Design and Construction Manual.

SDR 26 PVC pipe will be used for all proposed reaches of buried pipe, based on durability and in accordance with the Lee's Summit Design and Construction Manual.

Building square footages and acreages for existing development in the Big Creek Watershed were obtained from City GIS while building areas and acreages for the proposed Grove development were derived from drawings submitted with the Preliminary Development Plan package for the project. Building square footages used for the Calmar property design flow calculations were based on drawings from Lee's Summit Community and Economic Development Committee (CEDC). Proposed building footprints for The Grove and estimated footprints for the Calmar piece can be seen in Figure 1.

Tables 1A-1D in Appendix B give the calculated design flows for each phase of the proposed Grove development and the "Calmar" property to the immediate north of The Grove development as shown in Figure 1 of Appendix A. Note that the Phase 2 design flow includes

the existing Zoetis facility located immediately to the northeast of the intersection at Missouri Highway 291 and SE Bailey Road. Table 2 in Appendix B gives the design flows for existing development in the Big Creek Watershed with development references consistent with Figure 3 in Appendix A.

The total design flow for Phases 1, 2, and 3 of the proposed Grove development were calculated at 0.70 cfs, 0.44 cfs, and 0.34 cfs respectively. If we assume we may have to take the Calmar piece in the future an additional 0.41 cfs would need to be accounted for.

The total design flow from existing development in the entire Big Creek Watershed sewer system totals 10.61 cfs by the time the system reaches the Greenwood Pump Station. With the addition of the proposed Grove and Calmar developments, the total design flow for the the Big Creek Watershed gravity sewer system is 12.50 cfs when the system reaches its destination at the Greenwood Pump Station.

### **HYDRAULIC ANALYSIS:**

Manning's pipe flow was calculated for each pipe downstream of the proposed development in the existing system down to the Greenwood Pump Station. Parameters of existing sanitary main pipes in the Big Creek Watershed sewer system were obtained using City GIS and As-Built drawings recorded by George Butler Associates in April of 2000. These pipe properties can be seen in Table 3 of Appendix B.

The proposed portions of the project site can be served by a 12" PVC pipe at minimum slope. This 12" pipe could also provide capacity for inclusion of the Calmar piece. Refer to the table on Figure 1 in Appendix A for a comparison of design flows and full flow capacity of the system proposed for The Grove development.

In order to analyze the hydraulic capacity of the existing Big Creek gravity sewer system, pipe parameters from Lee's Summit GIS were used along with As-Built drawings recorded by George Butler Associates in April of 2000.

A discrepancy between the GIS data and the as-built drawings was discovered during analysis regarding a stretch of the sewer system between the point at which pipe #56581 extends beneath the railroad tracks and where pipe #81785 crosses beneath SE Hamblen Road. GIS data shows that ten pipes exist between pipes #56581 and #81785 while the as-built drawings show only nine pipes between pipes #56581 and #81785. This study assumes the as-builts to be more accurate and analyzes the system as such.

Hydraulic analysis shows that the existing Big Creek gravity sewer system can safely handle Phase 1 of the proposed Grove development. Refer to Table 3 for a comparison of calculated design flows and existing pipe capacity at 94% Manning flow.

Upon completion of Phase 2 of The Grove, the wastewater flow from the proposed construction will cause 693 linear feet of existing sanitary main pipe to be over the 94% Manning's capacity.

Table 3 gives the comparison of existing pipe capacity versus design flows after the addition of flow from Phases 1 and 2 of The Grove with pipes over capacity shown in red.

Design flows from Phase 3 of The Grove cause an additional 1852 linear feet of existing pipe in the Big Creek wastewater system to become over capacitated as shown in the Table 3 comparison of 94% Manning's pipe capacity versus wastewater demand.

If the future Calmar development is included in the design flow calculations, an additional 2831 linear feet of existing pipe in the Big Creek gravity sewer system is over the 94% Manning's capacity as found in Table 3. Assuming the phasing of The Grove construction follows the above stated order and the Calmar piece is developed afterward, the conclusion of the Calmar project would put a total of 5375 linear feet of existing sanitary pipe over capacity.

Refer to Figure 3 in Appendix A for the location of Big Creek sewer sytem stretches that will require improvements with a color coded guide indicating which phase causes the over capacity.

### **CONCLUSION:**

The purpose of this study was to investigate the impact of the proposed Grove development, according to project phasing, on the existing Big Creek Watershed gravity sewer system from the northern reaches of the watershed down to the Greenwood Pump Station.

This sanitary sewer design memorandum was prepared utilizing the City of Lees Summit Design standards. City GIS was used to gather building square footages and acreages of existing development within the Big Creek Watershed in order to compute existing design flows. Design flows from the proposed Grove development were calculated per Preliminary Development Plans submitted on October 4, 2016 while design flows from the Calmar piece were computed based upon drawings obtained from Lee's Summit CEDC. Pipe parameters of existing sanitary main pipes used in the hydraulic analysis portion of the study were collected from City GIS.

Refer to the previous "Hydraulic Analysis" section for a detailed description of the state of the existing Big Creek sewer system in terms of capacity versus wastewater demand for each project phase. Table 3 in Appendix B displays the hydraulic calculations with over-capacity pipes shown in red font and Figure 3 in Appendix A illustrates the general location of each stretch of over-capacity sanitary main in colors corresponding to the development phase which causes the over capacity of that particular stretch of gravity sewer.

*The Grove*

*Lee's Summit, MO*

## APPENDIX A

