

ENGINEERING REPORT
OF
PROPOSED WASTEWATER SYSTEM ADDITIONS
FOR
NORTHERN HEIGHTS ESTATES II SUBDIVISION
AN ADDITION TO NORTHERN HEIGHTS ESTATES SUBDIVISION
PULASKI COUNTY, MISSOURI
FOR
4J LAND & CATTLE COMPANY
P.O. BOX 308
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October 2008
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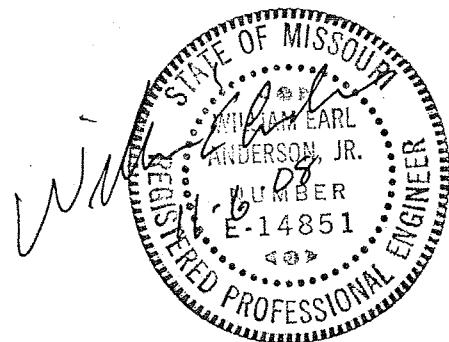


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I. Summary

A. Findings

1. POPULATION - The proposed development is "*Northern Heights Estates II Subdivision*" located adjacent to North Heights Estates Subdivision just North of Waynesville, Missouri and east of Missouri Highway 17, in Pulaski County, Missouri. The land is presently under development and the ultimate projected population is 522 persons.

2. LAND USE - As per the site map attached as Appendix A, the subdivision is located in portions of Sections 12 and 13 of Township 36 North, Range 12 West of the 5th Principal Meridian and encompasses approximately 187 acres which will be developed into 117 single family home lots with roads and utility areas. The system's continuing operating authority will be: Highway H Utilities, Inc., P.O. Box 308, Waynesville, Missouri 65583.

3. WASTEWATER CHARACTERISTICS - The projected wastewater flow based upon 149 homes at 3.5 persons at 75 gallons per day is approximately 39,200 gallons per day with a standard domestic waste load of 150 mg/l to 200 mg/l BOD and 150 mg/l to 200 mg/l Suspended Solids.

4. SELECTED PROCESS - The selected process is individual 1,500 gallon septic tanks for each residence and a Septic Tank Effluent Pump (STEP) system to deliver the partially treated waste via small diameter force main to a recirculating sand filter followed by a chlorine contact tank.

The projected effluent quality will be less than 10 mg/l BOD and 15 mg/l Suspended Solids.

5. RECEIVING WATERS - The receiving waters will be an unnamed tributary (which is classified as a losing stream) which flows to the Gasconade River at the

northeast corner of Section 12, Township 36 North, Range 12 West in Pulaski County, Missouri.

B. Conclusions

The recommended treatment process of a STEP system followed by a recirculating sand filter and chlorination is an economical system that will produce an effluent that meets the discharge limitations for a losing stream of 10 mg/l BOD and 15 mg/l Suspended Solids per 10CSR 20-7.015(4).

C. Recommendations

It is the recommendation of this firm that 4J Land & Cattle Company apply to the Missouri Department of Natural Resources for a construction permit and construct and place into operation the STEP with recirculating sand filter system.

II. INTRODUCTION

The proposed development is "*Northern Heights Estates II Subdivision*", which is an addition to Northern Heights Estates Subdivision located just North of Waynesville, Missouri and east of Missouri Highway 17, in Pulaski County, Missouri. As per the site map attached as Appendix A, the subdivision is located in portions of Sections 12 and 13 of Township 36 North, Range 12 West of the 5th Principal Meridian and encompasses approximately 187 acres which will be developed into 117 single family home lots with roads and utility areas. The wastewater treatment system's continuing operating authority will be: Highway H Utilities, Inc., P.O. Box 308, Waynesville, Missouri 65583.

The purpose of preparing the report is to investigate alternative sewage collection and treatment systems and to recommend the best system for the subdivision.

III. EXISTING CONDITIONS

A. Land Use

The subdivision is located in undeveloped, forested areas of Sections 12 and 13 of Township 36 North, Range 12 West of the 5th Principal Meridian and encompasses approximately 139 acres which will be developed into 133 single family home lots with roads and utility areas as shown in Figure 1, Appendix A.

The *Northern Heights Estates Subdivision* lies on a high ridge system between the Gasconade River and Roubidoux Creek drainage areas. The northern and eastern portions of the subdivision drain into the Gasconade River while the southwestern portion drains into Roubidoux Creek.

B. Demographic Data

The existing population of the undeveloped pasture and forest land is zero. The proposed development will build out at 133 single family homes that will contain approximately 466 persons. Also included in this project are 16 additional lots in Northern Heights Estates Subdivision that will flow through and be treated by the Northern Heights Estates II Subdivision collection system and sewage treatment plant.

C. Topography and Geology

The topography of the undeveloped area as shown on Figure 1 in Appendix A is a high ridge system with steep ravines that slope to the rivers and creeks below. The subdivision is accessed by Missouri Highway 17 just north of Waynesville, Missouri.

The proposed subdivision is located in the Ozark Highland Physiographic Province. A review of the published literature indicates the site is underlain by either the Roubidoux Formation or the Jefferson City Dolomite Formation of Ordovician Age. The Roubidoux Formation consists of dolomite, cherty dolomite, sandy dolomite, dolomitic sandstone and sandstone. The dolomite in the Roubidoux Formation is finely crystalline, light-gray to brown and thinly to thickly bedded. The sandstone is composed of fine to medium grained quartz sand which characteristically is subrounded and frosted. Gray and brown are predominant on weathered surfaces, but the color of fresh sandstone is commonly light yellow, tan or red at the surface and white in the subsurface. The thickness of the Roubidoux ranges from 100 to 250 feet.

The Gasconade Dolomite Formation consists of light gray, medium to coarsely crystalline, thin to thick bedded, cherty dolomite, divisible into two units. The upper unit is a massive bedded, relatively cherty-free dolomite, that forms bluffs and pinnacled glades. The upper unit consists of vuggy, medium to coarse crystalline and weathers to a coarsely pitted surface. It also consists of sparse dark gray or brown chert nodules or stringers with some druse. The thickness of the unit ranges from 40 to 70 feet. The lower unit is similar to the upper unit but contains 30 to 50 percent chert. The lower unit is light gray, medium to coarsely crystalline dolomite, containing thin beds or nodules of white to gray porcelaneous chert. Cryptozoan structures are common in the upper portion of the lower unit by a persistent, locally silicified cryptozoan reef two (2) to eight (8) feet thick. Thin beds of silicified oolites are common, as are karst features such as solution cavities (caves), sinkholes and weather joints or seams. The Missouri Department of Natural Resources Geological Survey & Resources Assessment Division Geohydrologic Evaluation of Liquid Waste Treatment Site is attached in Appendix G.

D. Forecast of Flow and Waste Loads

The projected wastewater flow of approximately 39,200 gallons per day (gpd) is based upon 149 single family homes (133 + 16) occupied by an average of 3.5

persons that produce up to 75 gallons per day which projects to 262 gpd of wastewater per house. These projections are based upon Missouri Department of Natural Resources 10CSR 20-8.020(11)(B)3 Table 1 and 4. The projected waste loads are based upon standard domestic loadings of 150 mg/l to 200 mg/l BOD and 150 mg/l to 200 mg/l of Suspended Solids.

IV BASIC PROJECT DEVELOPMENT

A. Proposed Collection System

Northern Heights Estates Subdivision is located on a high ridge system with steep side slopes to two drainage sheds. For this reason, gravity sewers were not considered practical because of the rough terrain and the requirement for many lift stations to deliver the sewage to a central treatment site.

A Septic Tank Effluent Pump System was utilized because it allows for small diameter pressure force mains. The mains will not be restricted by the build up of solids because the solids will be collected and stored in the septic tanks.

B. Design Wastewater Characteristics

The 1,500 gallon septic tanks on each house sewer will conservatively reduce the waste load to the secondary treatment facility by 50% of the BOD and 70% of the Suspended Solids. Then the treatment unit should receive a waste with approximately 75 mg/l BOD and 45 mg/l Suspended Solids.

C. Receiving Stream Characteristics

As previously discussed, *Northern Heights Estates II Subdivision* lies on the top of a high ridge system that drains to the Gasconade River and Roubidoux Creek. The decision was made to discharge to the Gasconade River side because the receiving stream is an unnamed wet weather flow creek that travels approximately 8,800 feet before it's confluence with the Gasconade as shown on Figure 1 in Appendix A. Note that the first 1,200 feet of travel is down a steep ravine dropping over 100 feet in elevation. This turbulent flow will re-aerate the treated effluent before it reaches the Gasconade.

The unnamed tributary is listed as a losing stream on page 130 of Table J of 10CSR 20-7.

On the other hand a discharge to Roubidoux Creek would travel only a few hundred feet to Missouri Highway 17 and then Roubidoux Creek. This short distance would require dechlorination of the chlorinated effluent.

D. Effluent Limitations

Per Missouri Department of Natural Resources 10CSR20-7.015(4), the effluent limitations can be summarized as a monthly average of less than; 10 mg/l BODs and 15 mg/l NFRs, with a pH in the range of 6 to 9 units and 400 fecal coliform colonies per 100 ml. Because the 8,800 flow distance to the Gasconade is via a losing stream, dechlorination will be required.

E. Treatment Plant Requirements

The site requirement for the recirculating sand filters and chlorination and dechlorination tanks is approximately one-half acre. The filter system will be located on an unplatted area of *Northern Heights Estates II Subdivision*, adjacent to the existing sewage treatment plant for Northern Heights Estates. Potable water will be available at the cul-de-sac at Lot 103.

F. Alternatives

Alternative collection and treatment systems considered included: collection and discharge to the City of Waynesville; collection and discharge to Pulaski County Water and Sewer District No. 2; and collection and treatment on-site.

G. Alternative Processes and Sites

Alternative treatment processes considered included: gravity and pressure collection sewer and treatment by an extended aeration plant with polishing filter and the Septic Tank Effluent Pump (STEP) system to a recirculating sand filter. Three sites were considered, one discharging to Roubidoux Creek and two discharging to the Gasconade system.

H. Selected Process and Site

Because of the topography of the subdivision, gravity collection was considered not feasible due to cost. The Waynesville sewage collection system is approximately 1.5 miles away and Pulaski County Water and Sewer District has no facilities in the area thus ruling them out as an option.

The STEP system with recirculating sand filter was chosen over the extended aeration plant with polishing filter due to construction cost, ease of operation and maintenance considerations. The site adjacent to the existing sewage treatment plant was chosen because of its convenient access, relatively level grade, availability of power and water, and central location.

The STEP system will consist of a 1,500 gallon septic tank for each house, an effluent pump which will deliver the primarily treated wastewater via a small diameter (1.5 to 3 inch) force main to a recirculating sand filter system which will provide secondary and tertiary treatment to the wastewater which will then be chlorinated and held in a chlorine contact chamber before discharge to the water shed.

The septic tank will be an Orenco System's 1,500 STEP unit with "3" series control panel which will have a nominal capacity of 1,400 gallons which will provide 5.7 days of detention time for anaerobic decomposition and settlement of wastewater biological waste. The STEP pump will be an Orenco System Effluent Pump P1005 with a 1/4 inch flow control nozzle to lessen fluctuations to the system. The pump shall deliver 5.7 gallons per minute at a total dynamic head of 167 feet. Hydraulic calculations are included in Appendix C.

The force main system will consist of approximately 9,480 lineal feet of 1.5 inch through 3 inch PVC schedule 40 pipe as shown on the attached plans in Appendix D.

The recirculating filter will consist of two filter beds, each 48 feet by 108 feet by 4 feet deep built to Orenco specifications with distribution piping, graded sand bed, collection piping, and an 80,000 gallons recirculation tank with recirculating pumps and controls.

The total surface area of the filter will be ^{10,368}~~6,144~~ square feet which will provide for a surface loading of 4.0 gallons per day per square foot at design flow ⁶⁴

slightly less than
→ 39,200 gallons per day.

The treated effluent will be split with 80 percent being returned to the filter with the incoming wastewater for further treatment and 20 percent being discharged to the chlorination system.

The chlorinator will be a Norweco Bio-dynamic Model XT 4000 Tablet Feeder supplied by Murdon Corporation which can be operated to dispense sodium hypochlorite to produce a chlorine residual of 0.5 to 1.0 mg/l. The chlorine contact tank will be a Murdon Corporation precast basin 5 feet by 8 feet by 5.5 feet tall with four baffles which will produce a chlorine contact time of 34 minutes at design flow. A 45 degree V-notch weir and box will be provided downstream from the chlorine contact chamber for flow measurement. The dechlorination unit will be a AQUAWARD Model 1000 tablet feeder using Severn Trent D-Chlor Tablets. The dechlorination unit will be housed in a Murdon Corporation Precast basin 5 feet by 8 feet by 5.5 feet tall with four baffles which will produce a contact time of 34 minutes at design flow. The plans and specifications are included as a separate package as Appendix E.

I. Project Cost

A summary of the estimated construction cost for the project is included in Appendix F.

The cost of construction of the collection system and the recirculating sand filter and appurtenances will be financed by 4J Land & Cattle Company which will be reimbursed by income from lot sales. The cost of the septic tank and effluent pump and the line to the collection system will be borne by the purchaser of the lot.