LOW PRESSURE SEWER SYSTEM
FOR AFFLUENT EXISTING NEIGHBORHOOD

Presented at:

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ABSTRACT

The River Oaks subdivision is an affluent, mature residential community located in Fairfax, County Virginia which includes 114 existing single family dwelling units with individual septic tank drainfields. The Fairfax County Health Department determined that several drainfields have failed and expressed concern that others would soon fail. In order to prevent the health and environmental problems associated with failing drainfields, a wastewater collection system was needed to convey wastewater to the nearby County integrated sewer system. Numerous meetings were held with residents of River Oaks to plan and design a collection system with minimal impact to the existing community. Wherever feasible, existing homes were served by 8-inch sanitary sewers. Homes which could not be served by gravity sewers, were served by a low pressure sewer system including individual home grinder pumps and force main. The project included special provisions to minimize the impact to private property including directional drilling. The project consisted of the construction of 3,271 feet of 8-inch sanitary sewer, 900 feet of 8-inch water main, 12,175 feet of PVC force main in 1.25 inch through 3 inch sizes, 4,148 feet of 1.25 inch HDPE force main installed by directional drilling, 3,013 feet of HDPE force main installed by open cut construction, and 69 grinder pumps. Construction began in January 2007 at a cost of $6,048,000.

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INTRODUCTION

The River Oaks residential subdivision is located in Fairfax County just northeast of the intersection of the Capital Beltway and Georgetown Pike south of Washington D.C. This existing community consists of 114 single family dwelling units. Typically, these homes include a septic tank and drainfield for sewage disposal. The Fairfax County Health Department has identified 22 lots with septic system failures. Due to the type of soils in the area and the age of the community, Fairfax County was concerned that many other on site sewage disposal systems within River Oaks would eventually fail. To alleviate the health hazards and environmental problems associated with septic system failures, the County decided to construct a wastewater collection system to convey flows to the nearby existing County Integrated Sewer System.

Health Effects of a Failing Septic Tank/Drainfield System

The most serious effect of a failing system is the potential for serious disease from the leaking and improperly treated waste. Dysentery and hepatitis can be spread by these wastes. In addition, to the diseases themselves, mosquitoes and flies that spread some illnesses can breed in areas where liquid waste reaches the surface.

Chemical or nutrient poisoning can also be a problem. Many of the synthetic products used in households, such as strong cleaning products, can travel through soil to the surface of streams or ponds. These products can be poisonous to humans, pets and wildlife in contact with the contaminated surface water.

Selected Wastewater Collection System

There are several existing Fairfax County 8-inch diameter sanitary sewer lines located in the vicinity of the River Oaks Community. Unfortunately, because of the varying topography of River Oaks, most of the 114 single family homes cannot be sewer by gravity to these existing sewers. The depth of sanitary sewers should not exceed 20 feet, and because of the hills in River Oaks, many of the sewers would have to be more than 20 feet deep. Also, many of the house basement elevations are much lower than the depth of the existing sewers and thus it is impossible to serve these houses by gravity. As a result the only way that all of River Oaks could be served by a conventional gravity sewer system is by the construction of a sewage pump station located in a low area within River Oaks. The pump station influent sewer would have to be low enough to serve all houses within River Oaks by gravity.

Most gravity sewer collection systems are constructed when the community streets and houses are built such that there are not impacts to homeowners. Installation of a gravity sewer collection system in an older established, affluent community such as River Oaks with numerous mature trees, landscaped lots, utilities, roads, and other features would have a major impact on the community. The necessary construction activities would also impact the daily lives of citizens in the area. In addition, the costs associated with acquiring sewer easements across private property and restoration of private property following construction of gravity sewer laterals would be very high. Based on the 2007 property assessment records just about every lot in River Oaks has an assessed land value of at least $544,000 and a total property assessment of close to $1,000,000. One house has a 2007 total assessed property value of $3,624,510.
Due to the varying topography in the project area, and the potential for significant community impacts resulting from construction, various wastewater collection systems were studied. These alternatives included 1) a low-pressure small diameter sewer system with individual grinder pumps, 2) a conventional gravity sewer system and pump station and 3) a vacuum sewer system. Based on a review of alternatives and several public meetings with residents a preliminary engineering report was prepared describing the proposed alternatives and the recommended alternative. It was decided that wherever feasible, existing homes would be served by conventional 8-inch sanitary sewers. In order to minimize tree loss, it was decided that both the 8 inch gravity collection sewers and low pressure force main would be constructed within the existing streets. Homes which could not be served by gravity street sewers, would be served by a low pressure sewer system including individual home grinder pumps and force main. Detailed design drawings were prepared for the wastewater collection system and considerable effort was dedicated to minimizing construction impacts on citizens as described herein.

**METHODOLOGY**

The design effort included the following steps:

1) An aerial survey was done to prepare 1”= 50’ topographic mapping of the entire River Oaks project area.

2) All available Fairfax County Health Department records on the location of existing septic tanks and drainfields within the community were obtained. Based on these records, the location of the septic tank and drainfield for each lot were drawn on the topographic mapping.

3) All existing basement elevations were field surveyed.

4) The required depth of the 8-inch sanitary sewer in the street was estimated based on the surveyed basement elevation minus a depth of 3 feet to get under the basement slab, minus the fall of the 4 inch sewer lateral equal to the length of the proposed 4-inch sewer lateral times a minimum slope of 2%, and the vertical drop for the 4-inch wye pipe connection to the 8 inch sanitary sewer. The maximum depth of gravity sewers in the street was set at 20 feet below existing pavement grade. Houses requiring a sewer depth greater than 20 feet required grinder pumps with a low pressure sewer system. A total of 88 of the 114 lots required grinder pumps.

5) Meetings were held with each property owner at their house on Saturday mornings to review the project and determine the most favorable location for the grinder pump, force main and pump electrical wiring on the lot. Every effort was made to save trees and minimize impacts to private property in accordance with the specific requests of homeowners.

6) Based on the location of the grinder pump and discharge force main to the street a detailed field survey was done to identify all features within the proposed construction area. Tree sizes and types were identified. Landscaping features were identified including steps, ornaments, planters, bushes, stone, fencing, retaining walls, pavement, walkways, equipment,
sprinklers, dog fence, lighting, mailboxes, signs, railroad ties, air conditioning units, overhead, storm sewers including manhole and inlet elevations, driveway culverts, electric power lines, electric meter boxes, etc.

7) A subsurface utility locating firm located existing buried utilities within the proposed construction areas on private property and within existing streets. Approximately 25 test pits were taken at proposed sewer or force main crossings to determine the depth of the existing utility to avoid conflicts. In some cases it was necessary to coordinate with existing utility companies to relocate existing water mains, gas mains, and power poles to avoid conflicts.

8) Several soil borings were taken to determine the depth to rock, groundwater elevations and the type of soils.

9) Photographs were taken of the existing electric meter boxes at the homes with grinder pumps. Later during the design drawings were prepared showing the proposed grinder pump control panels, wiring and interface with the existing electric meter boxes on these photographs so that the bidders and the selected contractor could see exactly how the grinder pump electrical systems would be installed at each house.

10) Contract drawings were prepared on 1” = 25’ scale topographic mapping showing the location of the proposed grinder pumps, force main, electrical wiring, easements, sanitary sewer, manholes, utility relocations, and restoration requirements. At a public meeting individual property owners were given the opportunity to meet with an engineer to discuss the proposed work on their property as shown on the drawings. Revisions were made to address the issues discussed with property owners.

11) Engineers and construction inspectors visited each lot with the design drawings and marked each tree to be removed and adjusted the location of the grinder pumps, force main piping and electrical wiring based on a constructability review.

12) Detailed contract documents and construction specifications were prepared with special attention to safety, restoration and testing. The Table of Contents for the Specifications is included in Attachment A at the end of this paper.

13) Detailed traffic control plans were prepared for each separate street showing traffic routing detours and traffic control signs required whenever work is done within the street.

14) A detailed sequence of construction was prepared showing how the low pressure system would be constructed in segments to allow some of the houses to come on line when the downstream force main was operational. Testing and warranty requirements were clearly identified.

15) A detailed bid schedule with quantities for 145 separate bid items was prepared along with a cost estimate included in Attachment B at the end of this paper. The numerous bid items were intended to assure that the bidders included all of the special requirements including restoration in their bid and to provide unit prices for additions and deletions from the scope of work.
16) Staging areas were identified where the Contractor could store equipment, materials, and excavated soil to minimize impacts to the community. The Contractor loaded excavated materials into a dump truck which hauled the materials to the nearby staging area. Immediately after the pipe was installed the material was hauled back to the trench and used as backfill. There was very little stockpiling of soil materials along the pipe trench in the streets which minimized cleanup.

17) The project was advertised for bids and was awarded to the low bidder Anchor Construction Corporation at a total bid cost of $6,048,000. Construction began in January 2007 and is scheduled for completion in mid 2008.

RESULTS

County policy requires that when the County installs a new gravity sewer to serve an existing community, the homeowners are responsible for construction of the 4 inch lateral sewer from their septic tank to the property line where they connect to a County installed 4-inch stubout to the sanitary sewer in the street. However, for the 69 houses to be equipped with grinder pumps, the County decided to furnish, install and test the grinder pump and force main piping all the way to the connection to the street force main. The grinder pump homeowners were only required to construct the lateral sewer tie in to the grinder pump 5 foot sewer stubout after the grinder pump and downstream receiving force main was constructed, tested and operational. For this reason many of the grinder pump homeowners demanded that the grinder pumps be located as close to their septic tank as possible to minimize their construction costs. Some of the homeowners did not want grinder pumps installed and did not want to participate in the project. For these few homeowners, the force main service line from the street force main was installed up to the property line where a valve assembly was installed to allow them to connect in the future at their cost in the event that their septic system failed.

Based on field inspections and meetings with homeowners, it soon became evident that open cut construction of many of the force mains would result in unacceptable property damage and/or expensive restoration requirements. For this reason the contract documents require that the Contractor directional drill the force main piping on identified lots. Directional drilling eliminated damage to trees, driveways, walkways, steps, landscaping, fencing, irrigation systems and other features. Directional drilling required the use of HDPE DR 11 pipe and it was decided that all 1.25 inch grinder pump discharge force main on private property be constructed of HDPE pipe, whether or not directional drilled or open cut, so that there would be no confusion years in the future on what type of pipe was installed. The street force main was constructed of PVC SDR 21. All force main was conveyed into the existing County owned Dead Run Wastewater Pump Station.

The Contractor video taped all construction areas prior to construction and is required to video tape all areas after construction to verify that property was restored to existing condition or better. The Contractor, Anchor Construction Corp., set up a project web site at http://www.anchorconst.com/riveroaks_update.asp which is updated to provide residents and others information on construction progress including pictures.
CONCLUSION

The planning and design of new wastewater collection systems to replace failing septic drainfield systems in existing affluent residential communities requires careful planning and design to minimize construction impacts to the community. Detailed surveys of existing conditions, site visits, meetings with property owners, and a detailed bid schedule are recommended to minimize construction problems and misunderstandings between the Contractor, residents and Owner. Directional drilling of grinder pump discharge force mains minimizes disturbances on existing private property. Extensive public participation and education was necessary to win the support of the vast majority of the residents of River Oaks.
Low Pressure Sewer System for Affluent Existing Neighborhood

presented by:
Jeff Chapin, PE

October 16, 2007
Session 51
RIVER OAKS COMMUNITY

- 114 Existing Single Family Homes
- 22 Failed Septic Tank Drainfields
- Minimum Assessed Land Value $544,000
- Property Assessments from $1M to $3.6M
- Heavily Wooded Properties
River Oaks Sanitary Sewer Extension and Improvement Project

Scale: 1” = 136’

April, 2004

LEGEND
- Existing Sewer Force Main
- Proposed Sewer Force Main
- Existing Sewer Main
- Proposed Sewer Main
- Existing Sewer Laterals
- Proposed Sewer Laterals
- Easements
- New laterals
- Roadway intersections
- Existing utility lines
- Proposed utility lines
- Property lines
- Public right-of-way
- Existing trees
- Proposed trees
- Existing buildings
- Proposed buildings

Key Issues
- Citizen Participation
- Tree Surveys
- Property Impacts
- Landscape Restoration
- Easements
- Design Reviews
Sewer System Components:

- 3,271 ft. 8” Ductile Iron Sewer Pipe
- 44 Sewer Laterals
- 70 Grinder Pumps
- 12,175 ft. 1.5” to 3” PVC Force Main
- 3,013 ft. 1.25” HDPE Force Main
DESIGN PROBLEMS

HEAVILY WOODED AREAS
DESIGN PROBLEMS

WALLS AND LANDSCAPING
HOUSES BELOW STREETS
DESIGN PROBLEMS

HOUSES TORN DOWN AND REBUILT
DESIGN PROBLEMS

SAUDI ARABIA EMBASSY BUILDING
SEQUENCE OF DESIGN

- Aerial Survey
- Locate Existing Septic Tank/Drainfields
- Survey Basement Elevations
- Sewer Versus Grinder Pump
- Meet Each Property Owner
- Survey Each Lot
- Locate All Utilities
- Obtain Soil Borings
PUBLIC PARTICIPATION

- CITIZENS MEETING DURING STUDY
- VISIT EACH HOME TO LOCATE PUMP
- CITIZEN MEETINGS DURING DESIGN
- CONSTRUCTABILITY REVIEW ONSITE
- CONSTRUCTION WEB SITE
GRINDER PUMPS

SIMPLEX PUMP

DUPLEX PUMP
GRINDER PUMP INSTALLATION

DROP ASSEMBLY IN PIT TO AVOID SHEETING
GRINDER PUMP INSTALLATION

MINIMIZE SITE IMPACTS WITH BOARDS AND COMPACT EQUIPMENT
GRINDER PUMP INSTALLATION

ELECTRICAL
<table>
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<tr>
<th>Item</th>
<th>Cost</th>
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<td>4-inch Sewer Stub-out</td>
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<td>Control Panel</td>
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<tr>
<td>200 Amp Electrical Service</td>
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<td>Test Pump Operation</td>
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<td>Total</td>
<td>$10,745</td>
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FORCE MAIN CONSTRUCTION

DIRECTIONAL DRILLING 1.25" HDPE
FORCE MAIN CONSTRUCTION

DIRECTIONAL DRILLING 1.25” HDPE
FORCE MAIN CONSTRUCTION

HDPE PIPE ROLL
FORCE MAIN CONSTRUCTION

DIRECTIONAL DRILLING 1 ¼” FORCE MAIN TO PUMP

09.25.2007 09:50
FORCE MAIN CONSTRUCTION

SAWCUTTING EXISTING PAVEMENT
CONSTRUCTION

TRENCH EXCAVATION AND REMOVAL
FORCE MAIN CONSTRUCTION

TRENCH EXCAVATION
FORCE MAIN CONSTRUCTION

BORE ACROSS GEORGETOWN PIKE
SANITARY SEWER CONSTRUCTION

MANHOLE INSTALLATION
SANITARY SEWER CONSTRUCTION

DEEP MANHOLE BOTTOM
SANITARY SEWER CONSTRUCTION

TEMPORARY PUMP AROUND 24 HOURS PER DAY
<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Unit Cost Per Foot</th>
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<td>Directional Drill 11/4” HDPE</td>
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<td>Open Cut 11/4” HDPE</td>
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<td>8” Dip Sewer</td>
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SAFETY

PROTECTED WALKWAY FOR SCHOOL CHILDREN FROM BUS STOP TO HOUSES
Sanitary Sewer Construction

Temporary Pavement Patch

03.26.2007 11:12
RIVER OAKS COST SUMMARY

Costs:

- Construction Bid Price $6,048,000
- Total Project Cost $7,271,332
- 114 Single Family Homes Served
- Average Cost per Home $63,783
Conclusion