March 2015

Historic Rogers Road Area Sanitary Sewer Extension Preliminary Engineering and Field Investigations Report

Prepared for

OWASA

Orange Water and Sewer Authority
400 Jones Ferry Road
Carrboro, North Carolina 27510

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OWASA CIP Project No. 276-54

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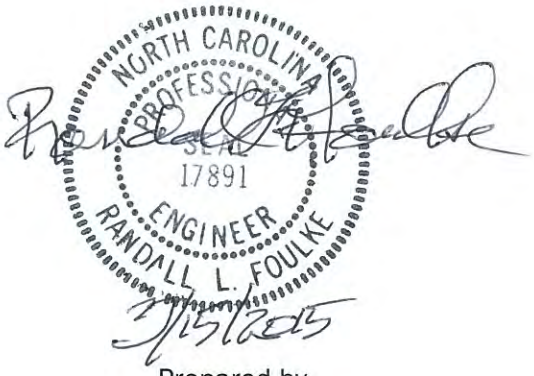

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EXECUTIVE SUMMARY

The Historic Rogers Road Area (HRRA) was evaluated to determine possible pipeline routes to serve 86 parcels designated by local governmental authorities to receive sanitary sewer service. Limited data and field investigations were conducted to determine how the sanitary sewer routes would be impacted by various factors. The following limited data and field investigations were performed:

- Existing archived historical documents
- Existing easements and rights-of-way
- Record drawings of existing sanitary sewers
- Archived environmental (plants and species) documents
- Geographic Information System (GIS)/survey data
- Photographic survey
- Geosciences/geotechnical soil borings
- Laboratory analysis for soil contamination
- Location of existing utilities
- Historical/archaeological/cultural review
- Environmental review (endangered and threatened species, wetlands, buffers)

The findings from the investigations were used to develop a conceptual sewer main alignment to serve the HRRA, and to be used for sanitary sewer design and construction. Additionally, a Project Budget-Level Cost Estimate and schedule was prepared based on the information collected and conceptual alignments developed. This report presents the findings of a preliminary engineering study, including the data and field investigations, of the feasibility and potential costs of providing sanitary sewer service to the 86 parcels within the HRRA.

The findings from the evaluations and field investigations revealed that the sanitary sewer alignment will be influenced by potential constructability issues, possible underground obstructions, and above ground conflicts. Possible underground obstructions include potential archaeological and historical sites, and possible above ground conflicts include wetlands and stream buffers.

Based on the field investigations and preliminary engineering, the recommended alignment for the proposed gravity sewer is depicted in Exhibit 1. The recommended alignment would provide sanitary sewer connection to each of the 86 parcels according to Orange Water and Sewer Authority (OWASA) policy, minimize the number of 86 parcels that would need to individually install a private dosing pump to convey wastewater from the residence to the gravity sewer main, mitigate issues discovered during the field investigations, and reduce permitting requirements. The work performed for this study indicates that there are no issues that will prevent the construction of sanitary sewers in the HRRA to serve the 86 parcels designated for service.

The project cost opinion for the project is $6,052,000. The level of certainty for the project cost opinion is +30%/-20%, meaning that the range of project costs could be from $4,842,000 to $7,868,000. The project cost opinion for the recommended sanitary sewer alignment is shown in the table below:

Table ES.1 Project Cost Opinion

Cost Item	Cost
Estimated Total Construction Costs	$4,040,000
Estimated Engineering, Design, and Permitting	$320,000
Additional Investigations	$50,000
Construction Administration	$120,000
Construction Inspection	$200,000
20% Contingency	$945,875
Estimated Total Service Availability Fees	$376,125
Estimated Total Overall Costs	**$6,052,000**

The cost opinion is based on price data from recent bid data of similar projects of surrounding areas, cost data obtained from manufacturers' representatives, and from published data of material and estimating databases. The cost opinion does not include the cost of easements or easement acquisition. It also does not include the cost of private sewer connection pipes between buildings and rights-of-way and easement boundary lines.

The preliminary engineering and field investigations identified areas of potential wetlands, which may require mitigation or alternative construction techniques. Exact delineation of potential wetlands was beyond the scope of this study. Preliminary field work also identified possible historical/archaeological resources, which may require minor adjustments in the final sewer alignment. It is not anticipated that the scale of these minor adjustments will significantly alter the proposed alignment corridor or costs. The potential costs related to the wetland and archaeological issues are believed to be contained within the current range of project costs presented above.

Some minor adjustments and modifications to the recommended alignment may be required due to potential constructability issues such as, but not limited to, soil contamination, locations of existing private wells and septic systems, and findings from utility investigations. Costs will be more accurately defined after completion of the adjustments and modifications.

Summary of Field Investigations/Evaluations of the Vicinity of the Selected Alignment

The potential sewer corridor routes were walked and pertinent photographs were taken. Record drawing data of existing sanitary sewer of the surrounding the area was reviewed and existing GIS data was evaluated. Various soil boring investigations (geosciences, geotechnical, environmental) were performed and analyzed. Historical/archeological information were collected and evaluated. All the information was compiled and the information was incorporated into Exhibit 3. A brief summary of the findings are listed below:

Record Drawing Data

- Record drawing data was obtained from OWASA of existing sanitary sewer that surrounds the HRRA.
- The record drawing data was data was utilized to see if the proposed sewer corridor was high enough to connect to existing sewer (invert record data).

Survey/GIS

- Potential sewer corridor alignments were walked and numerous photographs taken.
- Limited survey performed.
- Ground elevation survey shots adjacent to the some of the existing residential structures were taken. These elevation shots helped determine if some of the existing residential structures could be potentially served by gravity sewer.
- More extensive survey will need to be performed during the design phase.

Geotechnical Investigations

- Within confined excavations, pneumatic hammers or blasting may be required for removal of weathered rock and hard rock.
- It is anticipated that most of the on-site soils will be suitable for reuse as backfill in the utility excavations. However, there are conditions that will require special consideration such as the potential for highly plastic soils and soils wetter than optimum moisture conditions.

Subsurface Utility Investigation

- Limited information was obtained in exact horizontal location and none for vertical location.
- New sanitary sewers will need to be engineered to avoid existing utilities.
- More extensive subsurface utility excavations will need to be performed (but not limited to) at various locations along Rogers Road, Purefoy Road, Tallyho Drive, Lair Court, Eubanks Road, Priscilla Lane, and within a couple of existing water line easements. Existing utilities will need to be exposed to obtain more accurate depth measurements.

Geosciences Investigation (Soil Contaminants)

- Soil screening results did not detect the presence of any organic compounds in any of the three borings. Therefore, no follow up investigation appears warranted.

Historical/Archaeological/Cultural Investigation

- The project includes potential conceptual alignment corridors along some existing road right of way as well as corridors that extend cross-country through undeveloped terrain. Undeveloped portions of the project will likely require a systematic archaeological survey to search for and evaluate archaeological sites.
- The location of the conceptual corridor alignment along the edge of Purefoy Drive will not likely have any effect on the Hogan-Rogers House. However, due to the possibility of archaeological deposits associated with the house, construction plans developed in the design phase for the sanitary sewer line along this section of the road should be carefully reviewed to determine if further archaeological study is needed.

Environmental Investigation

- The HRRA study area does not contain any suitable Red-Cockaded Woodpecker (RCW) habitat.
- A review of the North Carolina Natural Heritage Program (NCNHP) records, updated in July 2014, indicates no known observable occurrences of federally listed threatened or endangered species within one mile of the HRRA.
- Soil that promotes the growth of Michaux's Sumac (a federally listed endangered species) occurs in a small area in the southeast corner of the study area.
- Based on the January 2015 field survey, perennial and intermittent streams are located within the study area. As such, Jordan Lake Buffer rules may apply to these streams. Prior to construction, it is recommended that formal wetland delineation be conducted and a buffer determination from the North Carolina Department of Water Resources (NC DWR) be obtained. If it is determined that buffers would be impacted by the subject project, a Jordan Lake Buffer Authorization must be obtained from the NC DWR prior to construction.

1.0 Development of Recommended Sewer Alignment

URS Corporation – North Carolina (URS) has developed a recommended sewer alignment of a possible new sanitary sewer collection system to serve the Historic Rogers Road Area (HRRA). URS conducted preliminary evaluations and field investigations with a team of environmental and pipeline engineers to identify possible sanitary sewer service options for the alignment of sewer corridors and to determine if alternative approaches (e.g. lift station; vacuum sewer system; or small diameter, low pressure sewer systems) may be necessary for specific parcels, if not feasibly served by gravity sewer. URS estimated depth of cover to verify the ability to serve existing structures. Along with the URS recommended sewer alignment , Appendix A and Appendix B includes specific locations where sewer alignment corridors may be modified slightly, to take advantage of existing easements, avoid potential conflicts with existing private land features, and better align with existing public infrastructure. A photographic record of the preliminary field investigations is included with each of the locations presented in Appendix A. Sub-areas are specific locations where, based on preliminary evaluations and field investigations, alternative approaches are available to provide service to existing residential structures in accordance with OWASA policies. Additionally, within the sub-areas and other location throughout the HRRA, slight modifications of the sewer corridor alignment may not result in substantial cost differences, but may provide additional benefits by co-locating the proposed sewer with existing utilities and/or avoiding conflicts with private infrastructure.

2.0 Preliminary Evaluations

URS performed a desktop review of potential impacts to cultural / historical / archaeological / environmental resources of the HRRA and reviewed existing site conditions, such as soils, underground and above ground utilities, topography, and other factors potentially influencing construction of new sanitary sewers. URS has included a preliminary evaluation of potential impacts and site conditions to help identify the recommended sewer alignment for serving the HRRA.

Preliminary evaluations included the following:

- Participating in a stakeholder meeting with OWASA, the Jackson Center, and primary community stakeholders to understand concerns of the potential sewer alignments, review goals of the study, and to collect general historical knowledge of the HRRA from longtime residents. Their historical knowledge may not have been included in recorded information for the HRRA.
- Developing recommended sewer alignments with information collected during preliminary evaluations. Appendix A describes alternatives/minor modifications to sewer alignments, and Exhibit 1 depicts parcel layouts, roadways, structures, and approximate 30-foot corridor alignments (including recommended URS alternatives).

- Comparing alternative sewer alignments within the depicted Sub-Areas to develop a recommended sewer alignment.
- Creating a preliminary project budget estimate for the recommended sewer alignment.

URS personnel reviewed and walked (photographic survey) the potential sewer alignment corridors within the HRRA. The purpose of walking the potential sewer corridors was to verify the overall potential feasibility of the sewer corridor alignment. A recommended corridor alignment was developed based on the desktop review and visually observing the topography and above ground structures within the sewer corridor alignment. Additional field investigations and data collection were performed and are described in more detail in the following sections.

3.0 Field Investigations

URS performed field investigations within the HRRA that included the limited review and field evaluation/investigation of potential impacts to cultural / historical / archaeological / environmental resources of the area, and existing site conditions, such as soils, utilities, topography, and other factors potentially influencing construction of the sanitary sewer within the recommended sewer corridor. In particular, the following were performed:

- Survey/GIS Investigations
- Geotechnical Investigations
- Subsurface Utility Exploration Investigations
- Contaminants/Subsurface Investigations
- Sensitive Cultural/Historical/Archaeological Investigations
- Environmental Impacts Investigations

Locations of the investigations and subsequent evaluations were collected and documented on Exhibit 3. The findings for these investigation and evaluations were used to develop the routing of the recommended sewer alignment.

A summary of findings and overall report for each specific evaluation are described in the following sections.

3.1 Surveying/GIS Investigations

URS provided limited survey services to aid in developing the recommended sewer alignment. Spot elevations were taken around numerous residential structures to help to determine what parcels could be served by gravity sewer or what parcels would require pumping to sewer. Several Global Positioning System (GPS) control points tied to the North Carolina State Plane Coordinate System was set within the HRRA to establish horizontal and vertical control; the Horizontal North American Datum (NAD 83) datum 2011 and The Vertical datum for this project was based on the North American Vertical Datum (NAVD) 88 vertical datum. In addition, potential sewer corridor alignments were walked and numerous photographs taken.

Summary of Findings/Recommendations

- Ground elevation survey shots adjacent to the some of the existing residential structures were taken. These elevation shots helped determine if existing residential structures could be potentially served by gravity sewer.
- Limited survey was conducted and indicated that with some minor exceptions, gravity sewer can be utilized to provide sanitary sewer service to the HRRA.
- More extensive survey will need to be performed during the design phase to provide complete topographic information.

Overall Report

In December 2014, CH Engineering (URS's surveying sub-consultant) was utilized to set GPS control points (Horizontal Datum NC Grid Coordinates (NAD83/NSRS2007); Vertical Datum NAVD88) throughout HRRA. Limited spot and locate shots were collected around certain residential structures to help determine the feasibility of providing gravity sewer service to that particular structure. Finished Floor (FF) spot elevations or Lowest Adjacent Grade (LAG) spot elevations were obtained next to various residential structures for preliminary calculation purposes along certain segments of the sewer alignment.

These structures included private wells, private septic systems, power transmission towers/poles, storm drainage structures, corner of fences, and, at one location, top of bank of a stream channel.

To support the preliminary engineering and planning studies for the potential extension of a sanitary sewer collection system within the HRRA, URS GIS Specialists collected sub-foot X, Y & Z values for strategic locations that will have an impact on the placement of the sanitary sewer system (Exhibit 3).

3.1.1 GPS Field Location

In December 2014 and January 2015, URS GIS professionals collected over 150 GPS data shots that ranged from property lines to manholes. Below is a matrix of what types of data were collected (Table 3.1). These data shots/locations/structures included private wells, private septic systems, power transmission towers/poles, storm drainage structures, corner of fences, and top of bank of a stream at one location. This information was used to determine potential conflicts or issues impacting the potential sewer alignments in the HRRA.

The GPS equipment used for the study provided real time accuracy (within 10 centimeter (cm)). The X, Y & Z coordinates were collected in NAD83 NC State Plane System. Also used in the field was an 8.0 megapixel digital camera for reference.

During data collection, GPS data was collected at two of the established survey control points by CH Engineering and was compared to validate accuracy. The URS data fell within the accuracy threshold of one foot for both vertical and horizontal data.

Table 3.1 GPS Count - Types

Count	Type	Count	Type
8	Bores	10	Surveyed Roads Points/Lines
5	Boundary Points	6	Communication Towers
2	Control Points	3	Unknown Underground Utility
8	Electric Points/Lines	1	Unknown Gas Line
26	Gas Points/Lines	1	Unknown Septic Sewer Appurtenance
4	Hydrants	21	Water Points/Lines
6	Water Manholes/Valves	6	Water Meters
3	Property Points/Lines	8	Wells
5	Miscellaneous	1	Sewer Manholes
1	Phone Box	1	Sewer Tie-In
29	Phone Lines/Points		
97		**58**	**Sub-Total**

3.2 Geotechnical Investigations

URS provided limited geotechnical investigations within the right of way of roadways and an existing water line easement. The work included exploratory work, field and laboratory testing, engineering interpretations and evaluation of exploratory and test data, and technical recommendations.

Summary of Findings/Recommendations

- Within confined excavations, pneumatic hammers or blasting may be required for removal of weathered rock and hard rock.
- It is anticipated that most of the on-site soils will be suitable for reuse as backfill in the utility excavations. However, there are conditions that will require special consideration such as the potential for highly plastic soils and wetter soils.

Overall Report

On December 22-23, 2014, URS collected soil samples at locations within designated areas within road right of way and recorded water line easements (See Appendix D). Some locations had to be field adjusted due to underground and overhead utilities, sloping terrain, and NCDOT regulations for boring locations within NCDOT right of way.

3.2.1 Purpose and Scope of Geotechnical Services

The purpose of the geotechnical services was to explore subsurface conditions in order to identify the general subsurface soil stratigraphy and provide geotechnical recommendations along the recommended sewer alignment. The following services were provided in order to achieve the objectives of this investigation:

1. Execute a limited program of subsurface exploration consisting of subsurface sampling, field analysis, and laboratory testing.
2. Visually classify and stratify the samples using the Unified Soil Classification System.
3. Collect groundwater level measurements.
4. Analyze field and laboratory testing data.
5. Summarize the course of limited study pursued, the field data generated, subsurface conditions, and geotechnical recommendations.

3.2.2 Site Description and Geology

The site is located on the northern half of Rogers Road, located between Eubanks Road and Homestead Road, in Chapel Hill, North Carolina. The proposed sanitary sewer extension will be mainly along Rogers Road and surrounding side roads in the HRRA. The site consists of gently rolling terrain in a residential area.

According to *The Geologic Map of North Carolina* (1985), the project site is part of the Piedmont Physiographic Providence and is located in the Carolina Slate Belt. Bedrock at the site is noted to consist of felsic metavolcanic rock interlayered with mafic and intermediate metavolcanic rock, meta-argillite and metamudstone. Areas of metamorphosed granitic rock are also present at the site.

3.2.3 Field Exploration

In order to determine the subsurface conditions at this site, five hand auger borings (B-1, B-2, B-4, B-6, and B-7) and three standard penetration test (SPT) borings (B-3, B-5, and B-8) were performed along the proposed sanitary sewer alignment and were advanced to depths of approximately 5 to 10 feet below existing site grades.

Boring locations were established in the field by a qualified staff professional based on existing site features. SPT borings were performed in general accordance with American Society for Testing and Materials (ASTM) D-1586, "Penetration Test and Split Barrel Sampling of Soils." Standard penetration testing, utilizing split barrel sampling techniques was performed at regular intervals to evaluate relative density and consistency of subsurface soils.

Soil samples were obtained from soil borings and visually classified in accordance with the Unified Soil Classification System (USCS). Visual field classifications were performed in general accordance with ASTM D-2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)."

Subsurface and Groundwater Conditions

In general, the soils at the drilling locations consist of man-placed fill, alluvial deposits, and residual soils. Man-placed fill was encountered at borings B-2 and B-3 near ground surface and consists of approximately 3 to 6 feet of silty sand and sandy clay. Alluvial deposits were encountered at borings B-4, B-5, B-6, B-7, and B-8 near ground surface and extended approximately 3 to 6 feet below the existing ground surface. Alluvial deposits consist of soft to stiff, sandy clay, and medium dense, silty and clayey sand. Residual soils were encountered at the surface at boring B-1, and below the placed fill and alluvial deposits in borings B-3, B-4, and B-8, and extended to boring termination depths. Residual soils consist of very stiff to hard, sandy silt and clay, and medium dense to very dense, silty and clayey sand. Weathered rock consisting of Quartzite and Slate was encountered in borings B-5 and B-6 below the alluvial deposits and extended to boring termination depths. Auger refusal was encountered at boring B-6 at a depth of approximately 8 feet below existing ground surface, potentially indicating the presence of rock.

Groundwater was not encountered in any of the borings performed. Borings were subsequently backfilled from the bottom of the borehole up to the ground surface. It should be noted that groundwater depths represent only the conditions encountered at the time the field activities and that fluctuations are possible. Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns.

Laboratory Testing

Representative split-spoon samples were selected from the test borings to verify visual field classification and determine soil index and engineering properties. The laboratory tests were performed in general accordance with ASTM standards and are summarized below:

A total of three (3) samples were tested for Atterberg limits, natural moisture content, and grain size analysis. The results of these tests are summarized in Table 3.2, and indicate the site soils range from silty sand to sandy clay, with moisture contents ranging from approximately 19 to 21 percent.

Table 3.2 Laboratory Testing Summary

Boring Number	Sample Number	Depth Below Ground Surface (ft)	Moisture Content (Percent)	USCS Classification	Liquid Limit	Plasticity Index	Percent Gravel (> #4 Sieve)	Percent Sand	Percent Fines (< #200 Sieve)
B-3	SS-1	0.5-2.0	19.7	SM	36	11	25.0	27.1	47.9
B-5	SS-2	3.5-5.0	19.3	CL	46	28	0.2	29.9	69.9
B-8	SS-1	0-2.0	21.2	CL	28	9	0.3	20.9	78.8

3.2.4 Engineering Evaluations and Recommendations

Based upon the results of the test borings and laboratory testing, there are several geotechnical conditions that may impact the planned construction. These conditions are discussed below.

Difficult Excavation

Weathered rock and/or auger refusal were encountered at borings B-5 and B-6, and may be encountered at other locations between test borings as well. Difficult excavations should be anticipated during pipe installation. Track excavators equipped with ripping teeth or hoe rams are anticipated. However, within confined excavations, pneumatic hammers or blasting may be required for removal of weathered rock and hard rock.

Backfill

In general, it is anticipated that most of the on-site soils will be suitable for reuse as backfill in the utility excavations. However, there are conditions that will require special consideration such as the potential for highly plastic soils and soils wetter than optimum moisture conditions.

Due to the current moisture levels (i.e. 19 to 21 percent), some of the site soils are anticipated to be wetter than optimum moisture conditions and may require drying the soils as well as conducting fill placement and compaction efforts in the drier months of the year.

Drainage and Groundwater Concern

Based upon the field observations, groundwater was generally not encountered above the proposed pipe invert elevations. However, considering the presence of the streams/creeks within the site, and the seasonal fluctuations and variations in stream/creek levels and precipitation, dewatering of excavation may be required during excavation. Excavations should be conducted during the drier months of the year when groundwater conditions are typically lower.

3.3 Subsurface Utility Exploration Investigations

URS provided Level "C" Subsurface Utility Exploration (SUE) for existing utilities at various locations within the HRRA. Level "C" SUE is an industry standard and recommended during project planning stages to aid site layout decisions. Level "C" SUEs are approximate utility locations and are estimated using visible above ground utility features/paint markings.

Summary of Findings/Recommendations

- Limited information was obtained in exact horizontal location and none for vertical location.
- New sanitary sewers will need to be engineered to avoid existing utilities.
- More extensive subsurface utility excavations (Level "A") will need to be performed (but not limited to) at various locations along Rogers Road, Purefoy Road, Tallyho Drive, Lair Court, Eubanks Road, Priscilla Lane, and within a couple of existing water line easements. Level "A" SUEs are defined as precise horizontal and vertical location of utilities obtained by accurate measurements of exposed structures at given points. This is the most precise level of service, offering the most complete, reliable data available.

3.3.1 Methods

North Carolina (NC) 811 One Call was contacted, and utility location was coordinated with local utilities during the study. NC 811 One Call is a non-profit organization funded by its member facilities. Information about proposed excavation during the study (borings) was collected by NC 811 and then transmitted to the member facility owners that provided service in the requested excavation (boring) area.

NC 811 was notified to locate nearby existing utility lines and to locate utilities at major intersections. Locate tickets were created and sent to the following utilities: AT&T, Duke Energy, PSNC Energy, USIC Locating Services, Timer Warner Cable, and Orange Water and Sewer Authority. The bore locations were physically marked in the field so NC 811 would know precisely where the borings would be made. Also, locate tickets were created for major intersections. Most utilities within 50 feet of the intersection were marked by NC 811. The utility marking data was collected by GIS and included with survey point data.

Level 'C" SUE was used to estimate the location of underground utilities in the HRRA based on the marked utilities by NC 811. The Level "C" results show existing gas lines, water lines, communication/cable lines, power, and fiber optic lines that will; need to be avoided. Verifying vertical/horizontal clearances with existing underground utilities is critical for the design of gravity infrastructure where numerous existing underground utilities exist.

Level "A" SUE investigations will have to be done in various locations of the project area. Level "A" SUEs are precise horizontal and vertical location of utilities obtained by accurate measurements of exposed structures at given points. This is the most precise level of service, offering the most complete, reliable data available.

3.4 Contaminants/Subsurface Investigations

URS conducted limited soil assessments (at three locations) within the HRRA. The work included field testing, laboratory testing, engineering interpretations and evaluation of exploratory and test data.

Summary of Findings/Recommendations

- Soil screening results did not detect the presence of any organic compounds in any of the three borings. Therefore, no follow up investigation appears warranted.

3.4.1 Methods

On December 22-23, 2014, URS collected soil samples from three borings (B-6, B-7, and B-8) in areas previously identified as the outer boundaries of historic landfill operations (See Appendix E). The presence of significant underground and overhead utilities in two of these areas restricted the use of mechanized digging to collect the samples. Therefore, one of the borings (B-8) was installed by Froehling and Robertson, Inc. (F&R), under technical oversight from a URS geologist, utilizing a drill rig. The remaining two borings (B-6 and B-7) were installed manually, Standard Penetration Test (SPT). Encountered soils included sandy clays, silty sands, and clays. Partially weathered slate was encountered at 4-feet below ground surface (bgs) in boring B-6. Hand auger refusal was noted at 4.5-feet and 6-feet bgs in borings B-6 and B-7, respectively. SPT refusal was noted at 9.5-feet bgs in boring B-8.

The objective of the soil sampling was to determine if any compounds had spread from the historic landfill site into adjacent soils. Due to the likely surficial nature of the former landfill, soil sample depths were collected no greater than 10 feet bgs. Depth intervals for soil sampling were 2-feet for both the hand auger and SPT borings. Soil from each interval was collected in 2 new, sealable, plastic bags. One bag was placed in direct sunlight and near a heat source (e.g. hood of a recently running vehicle), and the other bag was placed directly on ice. After sufficient time to allow for the volatilization of organic compounds (at least 15 minutes), a photo-ionization detector (PID) was utilized to screen the soil samples for the presence of organic compounds. Based on these readings, a sample from each boring was submitted for laboratory analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, and general chemistry (Nitrogen, Ammonia, Sulfate). The analytical parameters were selected to detect potential releases from the historic landfill that could pose a risk in a scenario in which construction workers were installing utility lines in a trench.

3.4.2 Results

PID screening results did not detect the presence of any organic compounds in any of the three borings. Therefore, the deepest sample interval in borings B-6 and B-7 (2-4' and 4-6', respectively) were submitted for laboratory analysis. Due to stiffening of the soil profile deeper than approximately 6-feet bgs in SPT boring B-8, the interval 4-6' was submitted.

For VOC, SVOC, and metals analysis, laboratory results were compared to the NCDENR Preliminary Soil Remediation Goals (PSRGs) for human contact, which consist of residential and industrial comparison criteria. The table included in Appendix E summarizes the laboratory results and a complete laboratory report is included as Appendix E.

VOCs

No detections of VOCs were noted in any of the three borings.

SVOCs

One SVOC detection was noted in boring B-8. Caprolactam was detected at levels approximately three orders of magnitude less than the most stringent PSRG.

Metals

Several metals were detected in each of the borings. These included Arsenic, Beryllium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, and Zinc. Each was detected at generally consistent levels between the borings, indicating that these elements were likely naturally occurring in the soil minerals.

Of these, Arsenic, Iron, and Manganese indicated exceedances of various PSRGs. Arsenic exceeded both PSRGs in all borings. However, URS notes that each detection was below the standard residential cleanup standard used by NCDENR and the EPA of 40 mg/kg. Iron exceeded the Residential PSRG in all borings, but never the Industrial value, which is most appropriate given the expected scenario at the site (e.g. construction workers in a trench). Manganese exceeded the Residential PSRG in boring B-8, but was well below the Industrial *value.*

3.4.3 Discussion

Laboratory analysis of soil samples collected at the three boring locations indicates little or no risk to workers. The SVOC detection in B-8 is three orders of magnitude less than the most stringent soil comparison criteria. Therefore, no follow up investigation appears warranted at this time. However, pending conceptual corridor alignment changes/additions, more borings and testing may be required.

The majority of metals did not exceed relevant comparison criteria. Metal detections were generally on the same order of magnitude across all borings, indicating consistent soil-metal content across the site. Especially in the case of Arsenic, Iron, and Manganese, which are

commonly found in Piedmont soils, it appears reasonable to conclude the levels of metals detected are background levels and do not indicate a contamination point-source. Each of the concentrations detected were below either industrial screening levels or, in the case of arsenic, standard residential cleanup levels.

3.5 Sensitive Cultural/Historical/Archaeological Investigations

URS conducted a limited Cultural Resource Records Check and Field Inspection within the HRRA. The work included comparing records/data to records/data evaluated by the Jackson Center. URS identified and noted differences and similarities in information previously collected and analyses previously performed. The reconnaissance work encompassed three tasks: background research, field inspection, and reporting.

Summary of Findings/Recommendations

- The project includes potential conceptual alignment corridors along some existing road rights of way as well as corridors that extend cross-country through undeveloped terrain. Undeveloped portions of the project may require a systematic archaeological survey to search for and evaluate archaeological sites. Alignments can be adjusted to preclude disturbance to any archaeological sites.
- The location of the conceptual corridor alignment along the edge of Purefoy Drive will not likely have any effect on the Hogan-Rogers House. However, due to the possibility of archaeological deposits associated with the house, construction plans developed in the design phase for the sanitary sewer line along this section of the road should be carefully reviewed to determine if further archaeological study is needed.

Overall Report

To support the preliminary engineering and planning studies for the potential extension of a sanitary sewer collection system within the HRRA, URS archaeologists and architectural historians conducted a cultural resources review of the OWASA HRRA study Area.

3.5.1 Background Review

URS reviewed records maintained by the State Historic Preservation Office (SHPO) and the Office of State Archaeology (OSA) in Raleigh, NC. The SHPO and the OSA maintain records on the number, location, and characteristics of archaeological sites, cemeteries, standing resources, and other cultural features found within the state. In addition, they have collections of cultural resource studies that indicate the level, results, and scope of previously conducted surveys in the vicinity of the project. URS also reviewed information compiled by the Preservation Society of Chapel Hill concerning the Lloyd-Rogers or Hogan-Rogers House and other African-American heritage sites in the area.

The study area is located in a mostly suburban setting in Orange County, in the Chapel Hill/Carrboro area. It is approximately bounded by Rogers Road to the west, the Southern Railway to the east, the Orange County Landfill to the north, and Homestead Road to the south. Single-family residential properties are located along several streets, including Merin

Road, Billabong Lane, Rusch Road, Zieger Lane, and Purefoy Drive. A recent residential development constructed by Habitat for Humanity is located centrally within the study area along Edgar Street, Phoenix Drive, Lizzie Lane, and Gracie Circle. In addition, several large undeveloped tracts are located within the study area. Most of the undeveloped areas are depicted on aerial photography as dominated by hardwood/pine forest.

The study area is located within the Haw River drainage, which is part of the larger Cape Fear River watershed. Streams mapped on the property are unnamed tributaries to Old Field Creek, Booker Creek, or Bolin Creek.

Review of the SHPO online GIS database identified two previously-recorded aboveground historic resources near the current project. One is identified as Farm (OR-430). It dates from the late nineteenth century and is located southeast of the end of Leak Lane and northwest of Tallyho Trail, at least 1000 feet west of the closest potential project component. The other is the ca. 1850 Lloyd-Rogers House (OR-431), also known as the Hogan-Rogers House, which is located approximately 150 feet north of Purefoy Drive and 500 feet west of Edgar Street. Both were identified in 1992 as part of a historic architectural survey of Orange County. Neither resource has been listed in or determined eligible for listing in the National Register of Historic Places (NRHP), nor has neither been placed on the North Carolina Study List of resources that appear potentially eligible for NRHP listing. However, the NRHP eligibility of the two resources has not been addressed as part of the current work effort.

In 2012, the Preservation Society of Chapel Hill compiled a report on the Hogan-Rogers House and other African-American heritage sites in the general area. At the time of that report the property was owned by the St. Paul A.M.E. Church, and plans were being developed to relocate the house to serve as a community center for the surrounding neighborhood. Currently, the house is still standing in its original location.

Information in the files of the OSA documents that several previous cultural resources studies have taken place in the area between Eubanks Road and Homestead Road, and 30 previously recorded archaeological sites are located within a mile of the project area. These include the Alexander Hogan Plantation site, which is listed on the National Register of Historic Places and is located north of Eubanks Road near the Rogers Road intersection. The closest previous projects include a survey of the Carolina Commons (Horace Williams Homestead Tract) project on a 55-acre tract located just southwest of the current project area (Fitts 2007). Nine prehistoric and historic period archaeological sites were identified in that study.

In 1999, Legacy Research Associates surveyed a parcel on Eubanks Road for a proposed C&D landfill project and documented one archaeological site (Joy 1999) and, in 2000, TRC Garrow & Associates surveyed the 169-acre Greene tract between the end of Purefoy Drive and the railroad line for the Town of Chapel Hill (Millis 2000). Eight prehistoric and historic archaeological sites were recorded.

Most recently, in 2013, archaeologists from UNC-Chapel Hill conducted test excavations adjacent to the Hogan-Rogers House. The goal of this project was to locate outbuildings and activity areas associated with the extant house (Dedrick et al 2014).

3.5.2 Field Review

On January 5 and 7, 2015, a URS archaeologist conducted a cultural resources field inspection of the HRRA study area. Fieldwork consisted of vehicle and pedestrian inspection of the project area to evaluate the terrain, examine environmental features such as soils, ground cover and drainage, and identify potential areas of previous disturbance. The fieldwork provided the basis for recommendations concerning the relative archaeological sensitivity of the project area but did not constitute an intensive archaeological survey as defined by the Secretary of the Interior's *Standards and Guidelines for Archaeological Investigations.* The project includes potential conceptual corridor alignments along some existing road corridors as well as corridors that extend cross-country through undeveloped terrain.

3.5.3 Recommendations

Based on the environmental setting and the presence of multiple nearby previously-documented archaeological sites, the project in general should be considered to have a high archaeological sensitivity. However, there is only a possibility that anything will be found. Undeveloped portions of the project may require a systematic archaeological survey to search for and evaluate archaeological sites. Where the actual conceptual corridor alignment can be constructed within existing road rights-of-way, such as portions of Rogers Road and Purefoy Drive, previous disturbance has likely removed any significant archaeological sites, and additional survey is not recommended in these areas.

Placement of a sanitary sewer line along the edge of Purefoy Drive will not likely have any effect on the Hogan-Rogers House. However, due to the possibility of archaeological deposits associated with the house, construction plans for the sewer line along this section of the road should be carefully reviewed to determine if further archaeological study is needed.

3.5.4 References and Resources

Dedrick, Maia; Geoffrey Hughes; James Nyman; and Ashley Peles. 2014. Public Archaeology at the Hogan Rogers House, Chapel Hill, NC Roots of the Piedmont: History & Preservation in Central NC. 1st Annual Symposium, Chapel Hill, NC.

Fitts, Mary Elizabeth. 1997. An Archaeological Assessment of the Carolina Commons Tract. Prepared for the University of North Carolina by the Research Laboratories of Archaeology, UNC-Chapel Hill.

Joy, Debrah. 1999. Archaeological Survey Report for Proposed Orange County Landfill, Eubanks Road, Chapel Hill, NC. Prepared for Joyce Engineering, Greensboro, NC by Legacy Research Associates, Durham, NC.

Millis, Heather. 2000. Cultural Resource Survey of the Greene Tract. Prepared for the Town of Chapel Hill by TRC Garrow Associates, Inc., Chapel Hill, NC.

Preservation Society of Chapel Hill. 2012. Hogan Rogers House Preservation Project. Compiled by the Preservation Society of Chapel Hill, Chapel Hill, NC.

U.S. Geological Survey (USGS). 2002. Chapel Hill [map]. 1:24000. U.S. Department of the Interior. Washington, D.C.

3.6 Environmental Impacts Investigations

Work included the review and field investigation of potential environmental impacts that may affect the alignment of sanitary sewer corridors in the HRRA. URS biologists conducted a natural resources review of the OWASA HRRA study Area. See Appendix F for supporting documentation and figures.

URS biologists conducted a natural resources review of the OWASA HRRA study Area. The work included a limited desktop background evaluation of the area and reviewed mapped jurisdictional waters and wetlands, as well as any potential protected species. The background data collection was followed by a field study to determine the presence-absence of jurisdictional areas and potential protected species habitat. The findings of this evaluation allowed documentation of any evidence suggesting the presence of potential jurisdictional wetlands and were documented on a GIS map. See Appendix F for supporting documentation and figures.

Summary of Findings/Recommendations

- The HRRA study area does not contain any suitable Red-Cockaded Woodpecker (RCW) habitat.
- A review of the North Carolina Natural Heritage Program (NCNHP) records, updated in July 2014, indicates no known observable occurrences of federally listed threatened or endangered species within one mile of the HRRA.

- Soil that promotes the growth of Michaux's Sumac (a federally listed endangered species) occurs in a small area in the southeast corner of the study area. Michaux's Sumac has not been observed in the area for over a century.
- Based on the January 2015 field survey, perennial and intermittent streams are located within the study area. As such, Jordan Lake Buffer rules may apply to these streams. Prior to construction, it is recommended that formal wetland delineation be conducted and a buffer determination from the North Carolina Department of Water Resources (NC DWR) be obtained. If it is determined that buffers would be impacted by the subject project, a Jordan Lake Buffer Authorization must be obtained from the NC DWR prior to construction.

Overall Report

This report included the review and field investigation of potential environmental impacts that may affect the alignment of sanitary sewer corridors in the HRRA. URS biologists conducted a natural resources review of the OWASA HRRA study Area. See Appendix F for supporting documentation and figures.

3.6.1 Background Review

URS conducted a desktop evaluation of jurisdictional wetlands and streams and threatened and endangered species within the HRRA, prior to commencing fieldwork. Research included publicly available information on soils, water resources, geology, mapped wetlands, and protected species, including but not limited to the US Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, US Department of Agriculture (USDA) Natural Resources and Conservation Service (NRCS) county soil survey and maps, US Geological (USGS) topographic quadrangle maps, the North Carolina Division of Water Resources (NCDWR) Geographic Information System (GIS) hydrological data, the USFWS Threatened and Endangered Species databases, and the NC Natural Heritage Program's (NCNHP) databases.

The study area is located in a mostly suburban setting in Orange County, in the Chapel Hill/Carrboro area. The study area is bounded approximately by Rogers Road to the west, the Southern Railway to the east, the Orange County Landfill to the north, and Homestead Road to the south. Single-family residential properties are located along several streets, including Merin Road, Billabong Lane, Rusch Road, Zieger Lane, and Purefoy Drive. A recent residential development constructed by Habitat for Humanity is located centrally within the study area along Edgar Street, Phoenix Drive, Lizzie Lane, and Gracie Circle. In addition, several large undeveloped tracts are located within the study area. Most of the undeveloped areas are depicted on aerial photography as dominated by pine forest (Appendix F).

The study area is located within the Haw River USGS Hydrological Unit Code (HUC) 03030002, which is located within the larger Cape Fear River watershed. Streams mapped on the property are unnamed tributaries to Old Field Creek, Booker Creek, or Bolin Creek (USDA, 1977; USGS, 2002) (Appendix F). All of these named streams have a Water Supply V water quality classification and are Nutrient Sensitive Waters (NCDWR, 2014). Additionally,

Booker Creek is a Class B water. All streams are within the Jordan Lake Watershed and are subject to the Jordan Lake buffer rules.

According to USFWS NWI mapping, there are two small ponds within the study area (USFWS, 2014). These ponds are also visible on aerial imagery. According to the 1977 USDA Orange County soil survey, no soils mapped within the study area are classified as hydric (Appendix F) (USDA, 1977). Two of the soils, Enon loam and Helena sandy loam, although dominantly nonhydric, can have inclusions of hydric soils in lower portions of a landform.

3.6.2 Field Review

On January 5 and 7, 2015, a URS biologist conducted a natural resources field investigation of the HRRA study area, including a presence/absence determination of jurisdictional Waters of the US (WOUS). Ten intermittent streams were identified, with a total approximate length of 6,200 feet. In addition, four perennial streams were also identified, totaling approximately 4,500 linear feet. The streams that were identified in the field generally matched up with the streams depicted on the Orange County Soil Survey map. However, some additional streams were found in the field. The one unnamed tributary to Booker Creek that is shown on the Soil Survey map does not exist within the study area. Table 3.3 lists the streams identified within the study area, and the approximate locations of the streams are shown on Figures G.5A through G.5O (Appendix F). Photographs of the streams are presented in Appendix F.

Table 3.3 Streams identified within the study area

Label	Unnamed tributary to	Type	Approximate length (feet)
SA	Old Field Creek	Intermittent	1630
SA	Old Field Creek	Perennial	660
SB	Old Field Creek	Intermittent	210
SC	Bolin Creek	Intermittent	540
SD	Bolin Creek	Intermittent	290
SD	Bolin Creek	Perennial	2400
SE	Bolin Creek	Intermittent	310
SF	Bolin Creek	Intermittent	1320
SF	Bolin Creek	Perennial	1250
SG	Bolin Creek	Intermittent	410
SH	Bolin Creek	Intermittent	350
SI	Bolin Creek	Intermittent	1120
SI	Bolin Creek	Perennial	150
SJ	Bolin Creek	Intermittent	10

In addition to the streams, ten jurisdictional wetland areas were also identified. None of these wetland areas are depicted on the USFWS NWI mapping. Six palustrine forested wetlands, three palustrine open waters, and one palustrine emergent wetland, with approximate areas of 3.35 acres, 1.62 acres, and 0.1 acre, respectively, were identified. As discussed above, the USFWS NWI mapping depicts two ponds within the HRRA study area (USFWS, 2014). The field survey confirmed the presence of these ponds, each approximately 0.8 acres. Table 3.4 lists the wetlands identified within the study area, and the approximate locations of wetlands are shown on Figures G.5A through G.5O (Appendix F). Photographs of the wetlands are presented in Appendix F.

During the field investigation, the majority of the area was dominated by a Dry-Mesic Oak-Hickory Forest (Schafale, 2012). Dominant canopy species include loblolly pine, white oak, and red oak. In certain areas, red maple and tulip poplar are common. The understory is dominated by sourwood and flowering dogwood. Red maple and American beech are common understory species in some areas. Throughout most of the study area, loblolly pine is the most common tree species. In areas with more mature forest, white and red oak and hickory species are dominant. Closer to the wetter areas of the site, the Dry-Mesic Oak-Hickory Forest grades into a Mesic Mixed Hardwood Forest.

Table 3.4 Wetlands and ponds identified within the study area

Label	Type	Approximate area (acres)
WA	PFO	0.1
WC	PFO	0.05
WD	PFO	1.2
WD	PEM	0.1
WD	POW	1.0
WD2	POW	0.6
WF	PFO	1.5
WI	PFO	0.1
WI2	POW	0.02
WI2	PFO	0.4
PA	Pond	0.8
PB	Pond	0.8

In these areas, tulip poplar becomes the dominant hardwood species. Loblolly pine is still very common. The wettest areas of the site, including the forested wetland areas, are characterized by Piedmont Alluvial Forest, and the dominant canopy species include tulip poplar, sweetgum, American sycamore, and sugarberry. In some of these wet areas, loblolly pine is common. Shrub species include Chinese privet, winterberry, and black willow. Greenbrier is prevalent in most of the wetter areas. Table 3.5 provides for a list of common and scientific names for plant and animal species that were observed within the study area.

Table 3.5 Species observed within study area

Common name	Scientific name
American beech	*Fagus grandifolia*
American crow	*Corvus brachyrhynchos*
American holly	*Ilex opaca*
American sycamore	*Platanus occidentalis*
Black willow	*Salix nigra*
Carolina chickadee	*Poecile carolinensis*
Chinese privet	*Ligustrum sinese*
Christmas fern	*Polystichum acrostichoides*
Eastern gray squirrel	*Sciurus carolinensis*
Eastern red cedar	*Juniperus virginiana*
Flowering dogwood	*Cornus florida*
Greenbrier	*Smilax rotundifolia*
Hickory	*Carya sp.*
Loblolly pine	*Pinus taeda*
Mourning dove	*Zenaida macroura*
Northern flicker	*Colaptes auratus*
Northern red oak	*Quercus rubra*
Red maple	*Acer rubrum*
Red-tailed hawk	*Buteo jamaicensis*
Sourwood	*Oxydendrum arboreum*
Southern magnolia	*Magnolia grandiflora*
Sugarberry	*Celtis laevigata*
Sweetgum	*Liquidambar styraciflua*
Tufted titmouse	*Baeolophus bicolor*
Tulip poplar	*Liriodenron tulipfera*
White oak	*Quercus alba*
White-tailed deer	*Odocoileus virginianus*
Winterberry	*Ilex verticillata*

3.6.3 Federally-Listed Species

Species with the federal status of endangered (E), threatened (T), proposed endangered (PE), and proposed threatened (PT) are protected under provisions of the Endangered Species Act (ESA) of 1973 as amended (16 USC 1531 et. seq.). Any action likely to adversely affect a species classified as federally protected will be subject to review by the USFWS. The USFWS and NCNHP online databases were reviewed for federally listed species potentially occurring in Orange Counties (USFWS, 2012; NCNHP, 2014).

As of December 2012, the USFWS lists four federally protected species for Orange County, as shown in Table 3.6. A review of the NCNHP records, updated in July 2014, indicates no known occurrences of federally listed threatened or endangered species within 1.0 mile of the study area.

Table 3.6 Federally listed threatened and endangered species within Orange County

Common name	Scientific name	Federal status	State Status	Habitat presence within study area
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered	No
Dwarf wedgemussel	*Alasmidonta heterodon*	Endangered	Endangered	No
Michaux's sumac	*Rhus michauxii*	Endangered	Endangered	Yes
Smooth coneflower	*Echinacea laevigata*	Endangered	Endangered	No

A brief description of each species' habitat requirements follows, along with a habitat presence/ absence determination within the study area. Habitat requirements for each species are based on the current best available information provided by the USFWS and the NCNHP.

The red-cockaded woodpecker (RCW) typically inhabits pine forests with trees at least 60-120 years old, depending on the species. Longleaf pine (*Pinus palustris*) is preferred. Stands that are primarily hardwood and stands with a thick understory are avoided. The HRRA study area does not contain any suitable RCW habitat. It is characterized by mostly younger pine, and most areas have a thick hardwood understory. Longleaf pine was not observed.

The dwarf wedgemussel is a generalist, found in both small streams and large rivers and in a variety of substrate types. It typically prefers hydrologically stable areas, such as very shallow water along stream banks and under root mats. The entire project study area is within the Cape Fear River Basin, which is not known to contain this species.

Michaux's sumac is typically found in sandy or rocky open woods with basic soils. It prefers sites where some form of disturbance has created an open area. According to the Orange County Soil Survey, most of the soils in the study area are not basic. Enon loam, found on the site, can be basic, with a pH range of 5.1-7.8. This soil occurs in a small area in the southeast corner of the site.

Smooth coneflower is found in open woods, glades, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and power line rights-of-way. It typically occurs in xeric hardpan forest, diabase glade, or dolomite woodland plant communities. None of these community types were observed in the study area.

3.6.4 State-Listed Species

North Carolina protects locally or regionally rare species in addition to federally listed species. Protection for plants and animals in North Carolina is recognized under two separate laws. Animals are currently addressed by the North Carolina Endangered Species Act administered by the NCWRC. Endangered, threatened, and rare plants are addressed in the North Carolina Plant Protection and Conservation Act administered by the Plant Conservation Program in the North Carolina Department of Agriculture.

The NCNHP lists 14 state-protected species for Orange County, as shown in Table 3.7. A review of the NCNHP records, updated in October 2014, within 1.0 mile of the study area indicates that the only state listed threatened or endangered species that has been observed is the Chapman's redtop. This observation is considered historical, and this species was last observed in the area in 1894. The observation was outside of the HRRA study area. Chapman's redtop is typically found in dry pine and oak woods and sandy roadsides (Gadd and Finnegan, 2014). Habitat that meets this description was found within the study area.

Table 3.7 State listed threatened and endangered species within Orange County

Common name	Scientific name	State Status	Federal status
Atlantic pigtoe	*Fusconaia masoni*	Endangered	Under Review
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Delisted
Brook floater	*Alasmidonta varicosa*	Endangered	Under Review
Carolina fatmucket	*Lampsilis radiata conspicua*	Threatened	Not Listed
Chapman's redtop	*Tridens chapmanii*	Threatened	Not Listed
Creeper	*Strophitus undulatus*	Threatened	Not Listed
Dwarf wedgemussel	*Alasmidonta heterodon*	Endangered	Endangered
Michaux's sumac	*Rhus michauxii*	Endangered	Endangered
Prairie blue wild indigo	*Baptisia minor*	Threatened	Not Listed
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered
Savannah Lilliput	*Toxolasma pullus*	Endangered	Under Review
Small whorled pogonia	*Isotria medeoloides*	Endangered	Threatened
Smooth coneflower	*Echinacea laevigata*	Endangered	Endangered
Triangle floater	*Alasmidonta undulata*	Threatened	Not Listed
Yellow lampmussel	*Lampsilis cariosa*	Endangered	Not Listed

3.6.5 Jurisdictional Issues

Jurisdictional Waters of the US

During a field survey in January 2015 conducted by a URS biologist, the presence of wetlands and streams were identified within the HRRA study area. Prior to any project construction that would adversely affect these wetland and stream areas, a formal wetland delineation should be performed and a jurisdictional determination from the U.S. Army Corps of Engineers (USACE) should be obtained, as well as the appropriate permit approvals from the USACE and the NCDWR.

Jordan Lake Riparian Buffer Protection Rules

In an effort to improve water quality in the Jordan Lake watershed, on August 11, 2009, a new mandatory buffer rule (15A NCAC 02B .0267) was adopted by the North Carolina Environmental Management Commission (EMC). The purpose of the rule is to protect and preserve existing riparian buffers to maintain their nutrient removal function. Riparian buffers act to remove nitrogen, phosphorus, and other pollutants from rainwater and runoff.

The buffer rule applies to all perennial and intermittent streams, lakes, ponds, and estuaries in the Jordan Lake water basin that are shown on the latest US Geologic Survey (USGS) topographic quadrangle maps and Natural Resources Conservation Service soil survey maps. It does not apply to agricultural, forestry, or stormwater ditches. The buffer rule establishes a protected 50-foot wide riparian buffer consisting of two zones. Zone 1 consists of a vegetated area that extends landward a distance of 30 feet on all sides of a surface water. Zone 2 begins at the outer edge of Zone 1 and extends landward 20 feet. Under the buffer rules, Zones 1 and 2 are to remain essentially undisturbed, except for certain exempted and allowed uses provided by 15A NCAC 02B .0267 (6). Uses designated as prohibited under this rule may not proceed within the riparian buffer unless a variance is granted pursuant to 15A NCAC 02B .0267 (9). The buffer rules are administered by the NCDWR.

Based on the January 2015 field survey, perennial and intermittent streams are located within the study area. As such, Jordan Lake Buffer rules may apply to these streams. Prior to construction, it is recommended that formal wetland delineation be conducted and a buffer determination from the NCDWR be obtained. If it is determined that buffers would be impacted by the subject project, a Jordan Lake Buffer Authorization must be obtained from the NC DWR prior to construction.

3.6.6 References and Resources

LeGrande, Harry, J.T. Finnegan, S.P. Hall, A.J. Leslie, and J.A. Ratcliffe. 2012. List of the Rare Animal Species of North Carolina. Natural Heritage Program, N.C. Department of Environment and Natural Resources, Raleigh.

N.C. Division of Water Quality (NC DWR). 2014. Surface Water Classification website. N.C. Department of Environment and Natural Resources. Raleigh. Available URL: http://portal.ncdenr.org/web/wq/ps/csu/maps

N.C. Natural Heritage Program (NCNHP). 2014. Heritage Data Search. Orange County, North Carolina. Available URL: http://www.ncnhp.org/web/nhp/database-search

Robinson, Laura Gadd and John T. Finnegan. 2012. List of the Rare Plant Species of North Carolina. Natural Heritage Program, N.C. Department of Environment and Natural Resources, Raleigh.

Schafale, Michael P. 2012. Guide to the Natural Communities of North Carolina. Fourth Approximation. North Carolina Natural Heritage Program. N.C. Department of Environment and Natural Resources. Raleigh.

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U.S. Fish and Wildlife Service (USFWS). 2014. National Wetland Inventory website. U.S. Department of the Interior. Washington, D.C. Available URL: http://www.fws.gov/wetlands

U.S. Geological Survey (USGS). 2002. Chapel Hill [map]. 1:24000. U.S. Department of the Interior

4.0 Sewer Alignment Alternatives in Sub-Areas 1 – 4

Once the preliminary evaluations and field investigations were completed, several sewer corridor alignment alternatives were identified (See Exhibits 2, 2A, 2B, 2C, and 2D) in various locations (sub-areas) within the HRRA.

URS Recommended Sewer Alignment - Sub-Area 1

Sub-Area 1 (See Exhibits 2 and 2A) is located near the northwest portion of the HRRA. Due to the finished floor elevation of the residential structures on the west side of Rogers Road URS's recommendation is to provide a sewer corridor alignment in back of the properties of the Mink, Maxwell, Thompson, Blue Mountain Homes, LLC, and Stewart parcels. This alignment would allow the sewer corridor alignment on the east side of Rogers Road to be installed at a shallower depth.

Alternative Sewer Alignment Discussion along Rogers Road, between Meadow Run Court and Priscilla Lane (Sub-Area - 1)

Within this sub-area the recommended sewer alignment consists of two proposed sanitary sewer corridor alignments instead of one. One sewer corridor alignment would be located on the eastern side of Rogers Road and the other sanitary sewer alignment on the west side, as described below.

The recommended sewer corridor alignment on the west side of Rogers Road is recommended to be located behind the Mink residence (west of the intersection of Meadow Run and Rogers Road) and continue behind the Maxwell, Thompson, Blue Mountain Homes LLC, and Stewart parcels. Since the finished floor elevations of the structures are below the center line elevation of the Rogers Road, a sewer alignment located behind these residential structures would allow for the installation of shallower gravity sewer service laterals.

As an alternative, the residential structures on the west side of Rogers Road could be served by gravity by a single sanitary sewer alignment located on the eastern side of Rogers Road. However, the depth of the sewer would be approximately 20 to 22 feet deep just southeast of the intersection of Meadow Run Court and Rogers Road to allow collection of sewage from the residential structure(s) on the Mink parcel. This alternative of increasing the depth of the sewer along the east side of Rogers Road requires an installion deep enough to collect sewage from the residential structures located on the west side of Rogers Road, and based on current information, deep enough to avoid future Town of Carrboro sidewalk/storm water improvements. However, since the road is NCDOT maintained, each sewer service lateral serving residential structures on the west side of Rogers Road (between Meadow Run Court and Priscilla Lane) would require trenchless installation beneath Rogers Road.

Estimated cost for this alternative compared to recommended alignment: break-even.

Another alternative to provide sewer service to the residential structures on the west side of Rogers Road would be a single, shallower sanitary sewer alignment located on the eastern side of Rogers Road that would include the use of residential pump tanks. The depth of the sewer would be approximately 8 to 10 feet deep on average. This alternative of a single, shallower depth sewer along the east side of Rogers Road would be, based on current information, deep enough to avoid future Town of Carrboro sidewalk/storm water improvements. However, since the depth of the sewer is shallower, the residential structures located on the western side of Rogers Road would have to pump to the sewer. Additionally, the road is NCDOT maintained so each sewer service located on the west side of Rogers Road (between Meadow Run Court and Priscilla Lane) would require the use of trenchless installation beneath Rogers Road.

Estimated cost reduction for this alternative: approximately $40,000.

Advantages and disadvantages of the recommended and the alternative sewer alignment are indicated in Appendix B.

URS Recommended Sewer Alignment - Sub-Area 2

Sub-Area 2 (See Exhibits 2 and 2B) is located in the northern part of the HRRA. URS recommends the sewer alignment be located along the eastern boundary of Orange County and Duke Energy parcels and end at the Nunn parcel. This alignment will allow the existing structure on the Nunn parcel to be served by gravity sewer. URS recommends the West/Harris parcel to be served by sewer corridor alignment on the west side of the parcel.

The recommended sewer alignment is to be shifted east from the eastern property boundary of Orange County (Landfill) due to existing monitoring wells and methane gas line. Additionally, the conceptual sanitary sewer alignment of the sanitary sewer will be shifted east from the northwest corner of the Nunn parcel due to a possible conflict with a Duke Energy power transmission tower. The presence of the existing monitoring wells, methane gas line, and Duke Energy power transmission lines may preclude the ability to construct new sewer along property lines. The recommended sewer alignment will have to be offset.

Alternative Sewer Alignment Discussion near West/Harris Parcel (Sub-Area 2)

The West/Harris property could be served by a new gravity sanitary through the Nunn parcel and Orange County parcel. However, this sewer alignment is estimated to be 24 to 26 feet deep near the southwest corner of the Nunn parcel. Additionally, the sewer service to the existing residential structure on the West/Harris parcel would require approximately 1,000 feet of sewer service lateral to connect to this sewer alignment. If the existing residential structure on the West/Harris property is served from the recommended sewer alignment to be located on the east side of the West/Harris parcel, this recommended sewer alignment would be estimated to be installed at a depth of 8 to 10 feet.

The lower elevations of the West/Harris parcel (approximately the northern half of the parcel) could be served with a small pump station and force main. Proposed sewer alignments located near the northeast corner of the West/Harris parcel would possibly need an additional archaeological survey performed.

No additional planned development of the northern portion of the West/Harris parcel is known at this time. Potentially 1,400 LF of 8" sanitary sewer located along the northern property boundary of the Orange County parcel and the eastern property boundary of the Nunn parcel can be eliminated.

Advantages and disadvantages of the recommended and the alternative sewer alignment are indicated in Appendix B.

Estimated cost reduction: approximately $230,000.

URS Recommended Sewer Alignment - Sub-Area 3

Sub-Area 3 (See Exhibits 2 and 2C) is located in the southern portion of the HRRA. There are two separate recommended sewer corridor alignments located within this sub-area.

The first recommended sewer alignment is located approximately at the intersection of Homestead Road and Seawell School Road, and then runs southward along the east side of Seawell School Road (approximately 150 feet) and ends at an existing sanitary sewer manhole.

The second recommended sewer alignment is located approximately at the intersection of Homestead Road and Hearthstone Lane, and then southward along the center of Hearthstone Lane (approximately 100 feet) and ends at an existing sanitary sewer manhole. A sewer service would be extended (bored) beneath Homestead Road from each recommended sewer alignment. The sewer service would then be stubbed out to serve each residential structure on the Homestead Group LLC parcel and the Dayspring Investments Inc. parcel. Each residential structure on each parcel may need a residential pump tank to pump to the stubbed out sewer service.

Alternative Sewer Alignment Discussion (Sub-Area 3)

Due to the shallowness of the existing sewer located approximately 150 feet south of the intersection of Homestead Road and Seawell School Road and the shallowness of the existing sanitary sewer located approximately 100 feet south of the intersection of Hearthstone Lane and Homestead Road, it appears that the finished floor elevations of the residential structures would be too low to be served by gravity. It appears that the existing residential structures would require residential pump tanks and force mains to be installed so the structures could be served by sewer. A more extensive topographic survey is recommended to verify this finding.

An alternative to the residential pump tanks and force mains is to lower a portion of the existing sewer located approximately 150 feet south of the intersection of Homestead Road and Seawell School Road. Approximately 100 feet of existing sewer could be removed and relayed at a flatter slope (0.5%). This would make the sewer deep enough to serve the residential structures on the Homestead Group LLC parcel and the Dayspring Investments Inc. parcels. However portions of the sewer would have an estimated depth of 14-18 feet deep in places.

Advantages and disadvantages of the recommended and the alternative sewer alignment are indicated in Appendix B.

Estimated cost reduction: approximately $100,000.

URS Recommended Sewer Alignment - Sub-Area 4

Sub-Area 4(See Exhibits 2 and 2D) is located in the right center of the HRRA. URS recommends the recommended sewer alignment to be located approximately along the southern boundary of the parcels, south of Purefoy Drive and along Sandberg Lane. The recommended sewer alignment would allow the residential structures to be potentially connected to sewer by gravity.

Alternative Sewer Alignment Discussion (Sub-Area 4)

The residential structures on the south side of Purefoy Drive are located significantly below the centerline elevation of Purefoy Drive, and the topography of the properties slope to the back of the parcels (southward). An alternative is to have the existing residential structures located south of Purefoy Drive install residential pump tanks and pump to the recommended sewer alignment to be installed along Purefoy Drive and move the recommended sewer alignment that is located along the southern boundary of the parcels, further south.

Advantages and disadvantages of the recommended and the alternative sewer alignment are indicated in Appendix B.

Estimated cost reduction: approximately $110,000.

5.0 Recommended Sewer Alignment

Based on the preliminary evaluations and field investigations, the recommended alignment for the proposed gravity sewer is depicted in Exhibit 1. This includes the recommended sewer alignments discussed in the previous section (See Appendix C). The recommended sewer alignment would provide sanitary sewer connection to each of the 86 parcels according to OWASA policy and minimize the number of 86 parcels that would need to individually install a private residential pump tanks to convey wastewater from the residence to the gravity sewer main. The recommended sewer alignment would also mitigate issues discovered during the preliminary evaluations and field investigations (See Appendix A and Appendix B), and reduce permitting requirements. The work performed for this report indicates that there are no issues that will prevent the construction of sanitary sewers in the HRRA to serve the 86 parcels designated for service.

The number of sewer service laterals (service stub outs), length of gravity sanitary sewers (including size and depths), manholes (including size), and other appurtenances are conceptually estimated during this stage of the project and are subject to change once more extensive evaluations/investigations/surveys are performed in the design and construction phase of the project.

6.0 Budget Level Total Project Cost Opinion

The budget level total project cost opinion for the project is $6,052,000. The level of certainty for the project cost opinion is +30%/-20%, meaning that the range of project costs could be from $4,842,000 to $7,868,000. The range of costs falls within the Association for the Advancement of Cost Engineering (AACE) International definition of a Class 4 industry standard for cost opinions at this stage of a project. The project cost opinion for the recommended sanitary sewer alignment is shown in the table below:

Table 6.1 Project Cost Opinion

Cost Item	Cost
Estimated Total Construction Costs	$4,040,000
Estimated Engineering, Design, and Permitting	$320,000
Additional Investigations	$50,000
Construction Administration	$120,000
Construction Inspection	$200,000
20% Contingency	$945,875
Estimated Total Service Availability Fees	$376,125
Estimated Total Overall Costs	**$6,052,000**

The cost opinion is based on price data from recent bid data of similar projects of surrounding areas, cost data obtained from manufacturers' representatives, and from published data of material and estimating databases, such as RS Means Site Work & Landscape Cost Data. The cost opinion does not include the cost of easements or easement acquisition and wetland/buffer mitigation. It also does not include the cost of private sewer connection pipes between buildings and rights-of-way and easement boundary lines.

Variance in alignment and discovery of adverse underground conditions could impact the construction cost. The cost opinion will be updated during design when site conditions can be more accurately defined.

7.0 Project Schedule

See Exhibit 5 for the Conceptual Project Schedule. This schedule predicts a completion of the project in approximately 22 months from a notice to proceed for design. Exhibit 5 includes some items that could impact the schedule length. Besides the items listed in Exhibit 5, other factors influencing the schedule length include weather conditions, bid protests, unknown site conditions, and extended permitting review by regulatory agencies. Some float is included in the schedule shown on Exhibit 5.