

DEWBERRY PROJECT NO: 50191103

OWASA SOUTHERN
BOUNDARY AREA SANITARY
SEWER EXTENSION

Preliminary Engineering Report

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ORIGINAL

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Abbreviations and Definitions

Abbreviations

FEMA – Federal Emergency Management Agency

GDP – Gallons per Day

LF – Linear Feet

LUMO – Land Use Management Ordinance

NCDOT – North Carolina Department of Transportation

NCDEQ – North Carolina Department of Environmental Quality

NC DNCR – North Carolina Department of Natural and Cultural Resources

NCNHP - North Carolina Natural Heritage Program

NCFMP - North Carolina Floodplain Mapping Program

OWASA – Orange Water and Sewer Authority

PER – Preliminary Engineering Report

RCD – Resource Conservation District

USACE – United States Army Corps of Engineers

WASMPBA – Water and Sewer Management and Planning Boundary Agreement

1. Executive Summary

Dewberry Engineers Inc. (Dewberry) has prepared this Preliminary Engineering Report (PER) for Orange Water and Sewer Authority (OWASA) to compare the technical feasibility and potential impacts of two conceptual sanitary sewer extension alignments within OWASA’s Southern Boundary Area located in Chapel Hill, North Carolina. This study was performed in close collaboration with the Town of Chapel Hill.

In 2024, at the request of the Town of Chapel Hill and subsequently effected through an amendment to the Water and Sewer Management and Planning Boundary Agreement (WASMPBA), the OWASA service area was expanded by approximately 360 acres to include an area along the US 15-501 corridor, with eastern and western boundaries generally following Wilson Creek and Fan Branch, respectively. This expanded area is referred to as the Southern Boundary Area and is the focus of this report. The two sewer alignment alternatives being considered for the Southern Boundary Area are:

- Alternative 1 – Fan Branch and Wilson Creek: Sewer alignments along Fan Branch to serve west of US 15-501 and Wilson Creek to serve east of US 15-501
- Alternative 2 – US 15-501: A single sewer alignment along US 15-501 to serve both east and west of the highway.

Discussions with multiple stakeholders were held during the development of this PER to incorporate and document objectives and goals. Identifying the recommended conceptual alignments for each alternative accounted for the features and aspects of the Southern Boundary Area, including OWASA and Town of Chapel Hill standards, topographic analysis, property parcel analysis, environmental features and constraints, design standards and best practices, and currently known future development plans. A comparison of the alternatives is based on serviceable area for gravity sewer, capital and operating costs, potential easement and property impacts, environmental impacts, and constructability. A table comparing these evaluation factors for the two alternatives is shown below:

| Evaluation Matrix | | |
|---|--|--|
| Evaluation Factors | Alternative 1 - Creekside | Alternative 2 - US 15-501 |
| Linear Feet of Gravity Sewer | 12,590 | 7,755 |
| Sewer Pump Stations Required | No | Yes |
| Serviceable Area % By Gravity Sewer | 75% | 15% |
| Initial Capital Costs | \$15,100,000 | \$17,550,000 |
| Lifecycle O&M Costs (50 yr) | \$4,320,000 | \$20,180,000 |
| Total Costs | \$19,420,000 | \$38,110,000 |
| # of Parcels Impacted (Temp. or Perm. Easement) | 34 | 18 |
| Environmental Impact | Tree clearing, stream crossings, and construction near streams | Risk of sewer pump failure, pump station impacts similar to Alternative 1 |
| Constructability Challenges | Construction near streams, construction on steep slopes, poor soils, access challenges, stream crossings | Construction in NCDOT R/W, potential impacts to traffic, crowded utility corridor, sewer pump station construction |

| Table Legend | |
|--------------|--|
| | Criteria Strongly Supports Alternative |
| | Criteria Mildly Supports Alternative |
| | Criteria Mildly Opposes Alternative |
| | Criteria Strongly Opposes Alternative |

Overall, Alternative 1 provides a considerably larger area for gravity sewer serviceability than Alternative 2. Alternative 2 will require most future developments and/or existing properties to install a sewer pump station and force main to connect to a future gravity sewer network. With sewer pump stations and force mains, Alternative 2 could serve the same area as Alternative 1. However, sewer pump stations require significant energy use, more extensive operation and maintenance activities than gravity sewers, leading to high lifecycle costs. The location of the future sewer pump station will also have potential environmental impacts, as they will need to be located in lower lying areas. These areas are typically adjacent or in regulated buffer areas along the creek.

Alternative 1 does not require any sewer pump stations but has a longer run of gravity sewer that will require significant tree clearing along its alignment. Alternative 1 will also cause some disturbances to the Resource Conservation District (RCD) and will require a large number of easements from private property owners. Alternative 2 has its own constructability issues, requiring easements as well as potential traffic disturbance to a main throughfare road in US 15-501.

The future Flintrock Knoll development was used as a case study to further analyze the two alternatives. To serve this parcel, Alternative 1 could be used to construct a portion of the Wilson Creek gravity sewer alignment. Alternative 2 required a portion of the US 15-501 gravity sewer and a sewer pump station to serve this parcel, resulting in higher initial capital costs and higher lifecycle costs than Alternative 1.

Considering that the initial capital costs are similar between Alternative 1 and Alternative 2, the life-cycle costs, constructability concerns, impacts to commuters and residences, easement acquisition, and the small serviceability area for gravity sewer for Alternative 2 do not provide sufficient benefits to recommend it over Alternative 1.

Dewberry recommends prioritization of Alternative 1 – Fan Branch and Wilson Creek conceptual alignments over Alternative 2 – US 15-501 conceptual alignment.

2. Introduction

Dewberry Engineers Inc. (Dewberry) has prepared this Preliminary Engineering Report (PER) for Orange Water and Sewer Authority (OWASA) to compare the technical feasibility and potential impacts of two potential sanitary sewer extension alignments within OWASA's Southern Boundary Area located in Chapel Hill, North Carolina. This study was performed in close collaboration with the Town of Chapel Hill. The findings of this report are intended to identify optimal sewer routes to serve the area and inform engineering and planning by providing minimum and optimum design criteria.

OWASA provides water, wastewater, and reclaimed water services to an area in the Towns of Chapel Hill and Carrboro defined by the Water and Sewer Management, Planning and Boundary Agreement (WASMPBA) between Chapel Hill, Carrboro, Orange County, Town of Hillsborough, and OWASA. In 2024, at the request of the Town of Chapel Hill and subsequently effected through an amendment to the WASMPBA, the OWASA service area was expanded by approximately 360 acres to include an area along the US 15-501 corridor, with eastern and western boundaries generally following Wilson Creek and Fan Branch, respectively. This expanded area is referred to as the Southern Boundary Area, referred to throughout this report as the study area.

The Southern Boundary Area is located within the Town of Chapel Hill's Jurisdictional Limits and is characterized by a mix of existing neighborhoods, stand-alone homes, undeveloped properties, and environmentally sensitive features. The development of parcels in the Town of Chapel Hill is governed by the Town's Land Use Management Ordinance (LUMO) which outlines the requirements for developers to abide by and submit plans for review and approval.

The two sewer alignment alternatives evaluated are:

- Alternative 1 - Fan Branch and Wilson Creek: Sewer alignments along Fan Branch to serve west of US 15-501 and Wilson Creek to serve east of US 15-501, and
- Alternative 2 - US 15-501: A single sewer alignment along US 15-501 to serve both east and west of the highway.

Identifying the recommended conceptual alignments for each alternative accounted for the features and aspects of the Southern Boundary Area, including OWASA and Town of Chapel Hill design standards, topographic analysis, property parcel analysis, environmental features and constraints, design standards and best practices, and currently known future development plans.

Figure 1 presents the study area and general conceptual alignments.

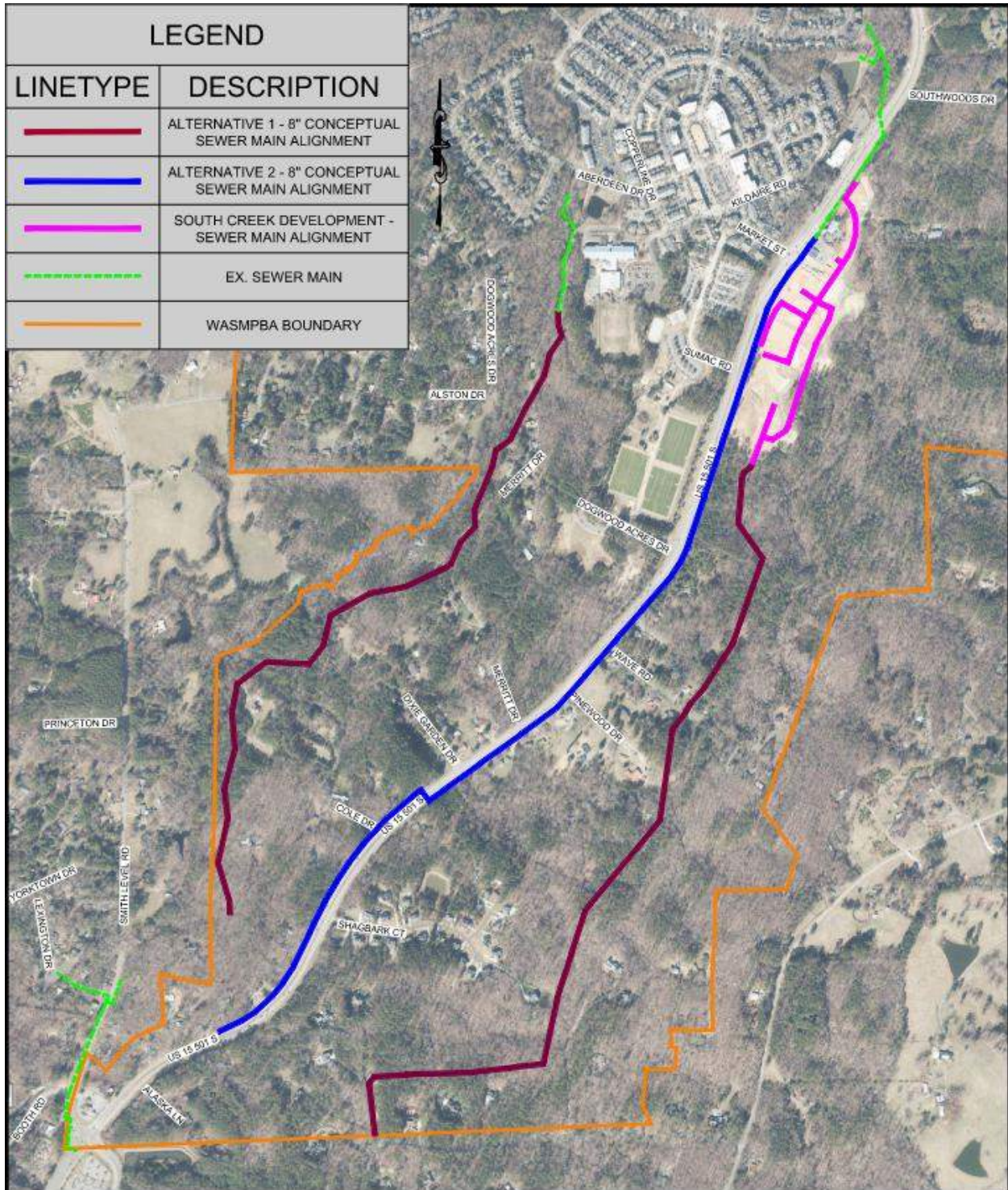


Figure 1: Overall Southern Boundary Area

3. Alignments

The two sewer alignment alternatives evaluated are:

- Alternative 1 - Fan Branch and Wilson Creek: This alternative includes two sewer alignments, one along Fan Branch to serve west of US 15-501 and one along Wilson Creek to serve east of US 15-501
- Alternative 2 - US 15-501: This alternative is a single sewer alignment along US 15-501 to serve both east and west of the highway.

3.1 Fan Branch and Wilson Creek (Alternative 1)

The conceptual alignments for the Fan Branch and Wilson Creek sanitary sewer extension are shown in Figure 4. Other alignment configurations were evaluated and considered, but were ultimately eliminated for various reasons.

3.1.1 Fan Branch

The conceptual Fan Branch alignment is approximately 5,870 LF of 8-inch gravity sewer. The conceptual alignment would begin at the south end of the Southern Boundary Area, south of Cole Drive, and connect downstream to an existing sewer manhole behind Scroggs Elementary School. Most of the conceptual alignment is outside of the 150' Resource Conversation District (RCD), floodway, and floodplain. There are two (2) major perpendicular crossings along the Fan Branch conceptual alignments, which would have RCD and buffer impacts. Both crossings will be underneath the perennial stream tributaries of Fan Branch. Overall, there are eight (8) proposed stream crossings across Fan Branch tributaries along this conceptual alignment. All stream crossings along this alignment can be installed at least 3 feet underneath the streambed. These crossing locations are shown in Figure 13.

The topography at the intersection of Dogwood Acres Drive and Merritt Drive presented the biggest challenge in this study area. An alignment on the west side of the Southern Community Park was considered; however, this was not feasible as the gravity sewer would be approximately 30-40' deep or greater in this area due to steep slopes and changes in topography. The conceptual alignment shown in Figure 4 was determined to be the best fit alignment while considering impacts to existing property owners.

The Fan Branch Trail and Fitness Circuit is a 1.62-mile-long greenway that is on the north side of this study area. The existing OWASA sanitary sewer system is currently adjacent to this greenway, with the most upstream manhole serving Scroggs Elementary School.

Dogwood Acres Drive and Merritt Drive are two local roads near the Fan Branch corridor and are access points for single family homes in this area. As of the date of this report, there are no known active development plans for the west side of US 15-501 in this area.

3.1.1.1 Fan Branch Alternate Routes

Other variations of the Fan Branch conceptual alignment were explored before the route shown as Alternative 1 was selected. Initially, a route that closely followed the Fan Branch was explored to maximize the developable and serviceable areas. This was deemed not feasible after further exploration. This conclusion was based on variations in topography, particularly the creek crossing at Merritt Drive, as well as the potential impact to several properties off of Merritt Drive with houses that border the RCD. Another route was explored that would have had the proposed gravity sewer be installed along Merritt Drive until it intersects with Dogwood Acres Drive and connects to the greenway in Southern Community Park. However, the depths of installation required for this path would exceed 30 feet for roughly 150 linear feet, making this an unfeasible option.

3.1.2 Wilson Creek

The conceptual Wilson Creek alignment is approximately 6,720 linear feet (LF) of 8-inch gravity sewer. Most of the conceptual alignment for Wilson Creek is outside of the 150' RCD, floodway, and floodplain. There are two (2) major perpendicular crossings along the Wilson Creek conceptual alignment, which

would have RCD and buffer impacts. The first crossing will be underneath Wilson Creek, and the second will be an aerial crossing over a perennial stream tributary of Wilson Creek. Overall, there are eleven (11) proposed stream crossings included in the Wilson Creek conceptual alignment. Of these eleven, five (5) are proposed as aerial crossings. These crossing locations are shown in Figure 14.

The conceptual alignment would begin at the south end of the Southern Boundary Area at Sun Forest Way and connect downstream to the 8-inch sewer within the new South Creek development. South Creek is a development currently under construction on the east side of US 15-501 and west of Wilson Creek, extending from the vicinity of the Holy Trinity Anglican Church of Chapel Hill to Dogwood Acres Drive. South Creek's project includes the installation of a new 8-inch gravity sanitary sewer line extending south from the existing OWASA gravity sewer system at the Holy Trinity Anglican Church of Chapel Hill towards Dogwood Acres Drive. South Creek's gravity sewer main will be installed outside of Wilson Creek's Jordan Lake buffer zones and the Town of Chapel Hill RCD zones. It is understood South Creek Phase 2 is currently under design, and there is a future South Creek Phase 3 in the preliminary design stages.

Additionally, a proposed future development, known as Flintrock Knoll, is to be located east of US 15-501 and south of the South Creek development, between Pinewood Drive and Shagbark Court. The ability to serve this future development was a priority in the location of the Wilson Creek alignment.

3.1.2.1 Wilson Creek Alternate Routes

An alternative conceptual alignment was prepared by the Flintrock Knoll developer to serve their development with gravity sewer. This conceptual alignment runs parallel to Wilson Creek from the Flintrock Knoll development to the existing OWASA gravity sewer system, as shown in Figure 2 below. The alignment proposed by the developer would require an additional 1,250 feet of sewer than the alignment connecting to the South Creek development. Included in this conceptual alignment are major buffer and RCD impacts, severe property impacts, deep sewer and manhole installations, and unstable soils. Notably, this alignment is designed to run between the South Creek Development and Wilson Creek.

The area between the South Creek development and Wilson Creek was deemed to be unsuitable for buried utilities due to poor soil conditions, the presence of wetlands, stream buffer impacts, and the threat of shifting streambeds exposing and disrupting buried infrastructure. The Town of Chapel Hill has documented the shift of this streambed over the past years. Connecting the proposed gravity sewer to the South Creek Development sets the fixed downstream tie-in elevation and prevents installation at any lower elevation areas. However, much of these lower elevation areas that cannot be reached by the Wilson Creek conceptual alignment are within the RCD, which would make them subject to developmental restrictions with or without a gravity sewer to service them. For these reasons, the Flintrock Knoll alternative conceptual alignment was passed over in favor of the alignment that is presented as part of Alternative 1 throughout this report.

3.2 US 15-501 (Alternative 2)

US 15-501 is a major thoroughfare road that runs through the Town of Chapel Hill and Orange County. The portion of US 15-501 included in the study area is located on a ridge that separates the Wilson Creek and Fan Branch sewer shed areas. US 15-501 is a four-lane highway with a median dividing both sides of traffic, providing access to single-family homes, residential areas, parks, and commercial development.

As stated earlier, there are two proposed developments on the east side of US 15-501, South Creek, which is currently under construction, and Flintrock Knoll, which is currently in the conceptual phase. Additionally, there is a proposed Town of Chapel Hill North-South Bus Rapid Transit project to construct additional exclusive bus lanes and stations near the South Creek development.

The conceptual alignment and profile for the US 15-501 sanitary sewer extension is shown in Figure 5. This conceptual alignment is approximately 7,755 LF of 8-inch gravity sewer with manholes spaced no more than 400 feet apart per OWASA standards. The conceptual alignment begins in the west shoulder of US 15-501 just north of Alaska Lane and connects downstream at the existing sanitary sewer network just north of Market Street in the east shoulder of US 15-501.

Most of this conceptual alignment is located within the existing NCDOT right-of-way along US 15-501. The conceptual alignment starts on the west shoulder to avoid conflicting with an existing gas main and an existing water main in the east shoulder from Smith Level Rd to Shagbark Ct. The conceptual alignment continues on the west side, and then crosses US15-501 to the east shoulder between Cole Drive and Dixie Garden Drive. The intent of this is to avoid the narrow shoulder with a steep drop off just beyond the guard rail on the east side of US 15-501 at Cole Drive. After this crossing, the gravity sewer can be installed in the east shoulder of US 15-501 until it connects to the existing sanitary sewer network near Market Street. Permanent and temporary easements will be needed throughout this alignment to meet OWASA sanitary sewer easement requirements and to facilitate installation and maintenance.

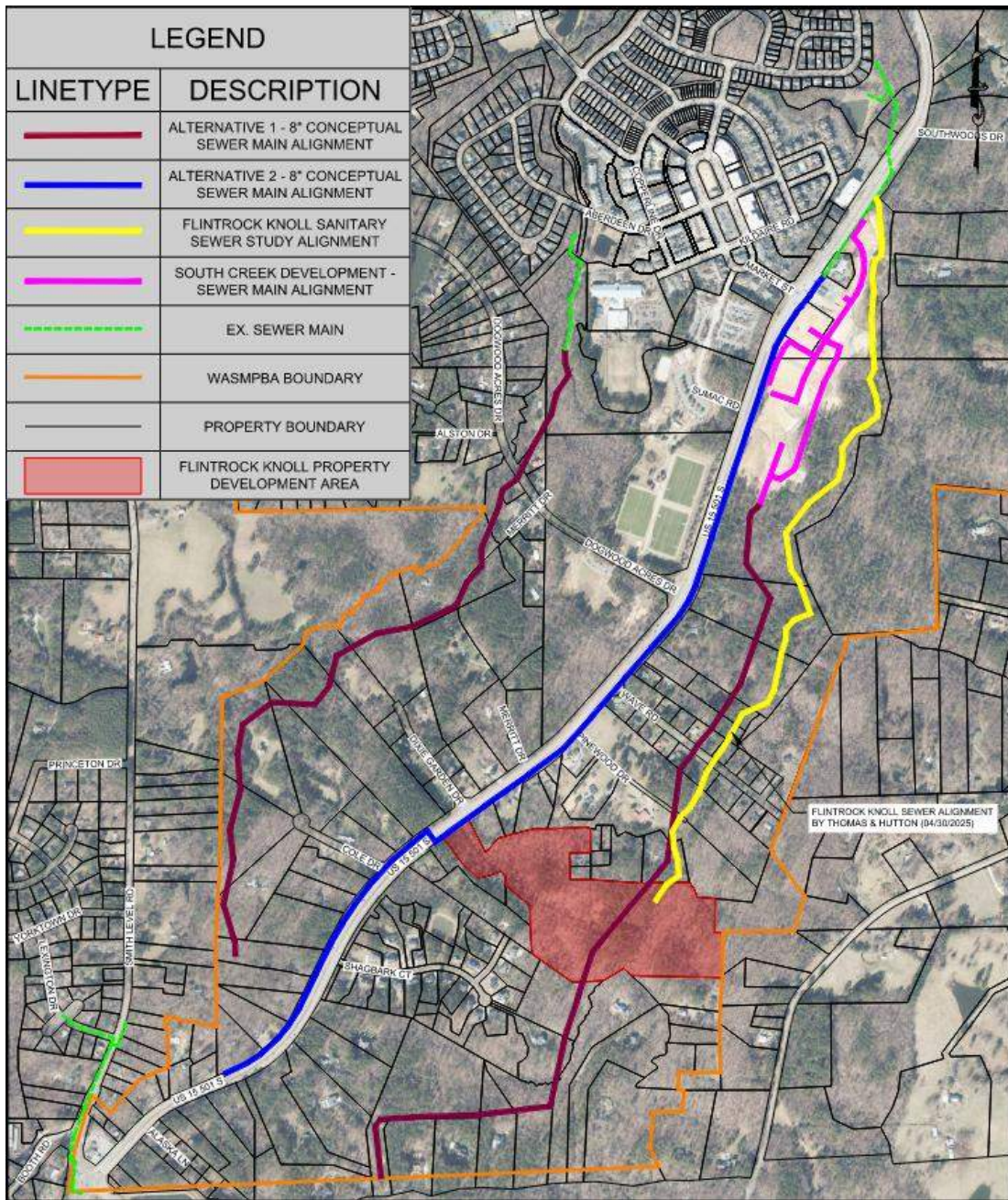


Figure 2: Overall Southern Boundary Area including Flintrock Knoll Developer Alignment Alternative

4. Alternatives Analysis

A comparison of the two alternatives will be made based on the following considerations:

- Serviceable area by gravity sewer or sewer pump stations
- Life cycle costs
- Easements and existing property impacts
- Environmental regulations and impacts
- Constructability

4.1 Serviceable Area

The serviceable area represents two categories: areas that can be serviced by gravity and areas that require a sewer pump station and force main. Both categories were based on the topographic data and conceptual sewer depths. The conceptual service areas of the sewer alignments for Alternative 1 and Alternative 2 are shown in Figures 6 and 8. The parcels and buildings that can be serviced by gravity must meet the following criteria:

- downward slopes to the conceptual sewer alignment
- sufficient cover – minimum 3 foot of cover from parcel / building to sewer alignment
- sufficient slope – assume 4-inch pipe with 1.00% slope from parcel / building to sewer alignment

Anything that did not meet these criteria will require a sewer pump station to be serviced. Sewer pump stations could either be single-family grinder sewer pump stations or regional sewer pump stations, but defining the number, type, and location of sewer pump stations was beyond the scope of this report.

4.1.1 Fan Branch and Wilson Creek (Alternative 1)

Figure 6 shows the conceptual alignment overlaid with the serviceable area, showing existing homes, and parcels that can be serviced by gravity with this alignment. This alignment can service approximately 75% of the Southern Boundary Area by gravity. Much of the 25% of the area that cannot be served by gravity is located within the RCD and would be subject to developmental restrictions regardless of gravity sewer access. The conceptual alignments along the creeks have been arranged to produce as much serviceable area as possible, given the other design guardrails of the area. Figure 7 shows a cross-section along Wave Road to illustrate how the conceptual sewer alignment would serve this area by gravity.

4.1.2 US 15-501 (Alternative 2)

Figure 8 shows the conceptual alignment overlaid with the serviceable area, showing existing homes, and parcels that can be serviced by this alignment by gravity (in green) and by sewer pump stations (in red). This alignment can serve approximately 15% of the Southern Boundary Area by gravity. Sewer pump stations would be required for Alternative 2 to serve the same area that Alternative 1 can serve by gravity.

The topography of this area is defined by the ridge that is formed by US 15-501 and the adjacent basins formed by the Fan Branch and Wilson Creek. This topography severely limits the service area of a gravity sewer that runs along this ridge. Placing a gravity sewer along a ridge like this creates a challenging scenario for developers and existing residents to connect with their own gravity sanitary sewer services, since these parcels will be at lower elevations than the ridge. To maximize this service area, the conceptual sewer depth is approximately 18 to 20 feet deep. This allows some properties to be able to connect by gravity services where the slope away from the ridge is not as steep. Figure 9 presents a cross-section along US 15-501 at Wave Road of how and where the conceptual sewer alignment would serve this area by gravity or a sewer pump station.

OWASA and the Town of Chapel Hill have indicated a desire to avoid installing sewer pump stations that would require perpetual operation, maintenance, and energy consumption. A comparison of regional or local sewer pump stations to single-parcel sewer pump stations has not been included in this evaluation. The intention of this evaluation is to highlight which areas can be served by gravity, and which existing

and future areas would need to install a sewer pump station (private or regional) and force main to connect to the US 15-501 gravity sewer line.

This conceptual alignment strategy provides the necessary infrastructure to support development but would require developers and property owners who opt to connect to this extension to construct sewer pump stations and force mains to connect to the gravity system.

4.2 Life Cycle Operating Costs

This section provides high-level conceptual life cycle cost estimates for each alternative. Assumptions were made for each alternative and are included for reference. This section concludes with a case study example of the proposed Flintrock Knoll subdivision that shows conceptual life cycle cost estimates for serving the development with each alternative.

4.2.1 Comparison of Alternatives 1 & 2

4.2.1.1 Fan Branch and Wilson Creek (Alternative 1)

The following assumptions were made while developing the life cycle cost estimates for the Fan Branch and Wilson Creek Alternative:

- Lifecycle costs have been developed as if the entirety of this alternative was fully constructed as one single project and then operated and maintained for 50 years.
- On-site sewer (within the development) is not included in these life cycle cost estimates. Analysis begins where wastewater would leave the development.
- Costs include gravity sewer construction, easement acquisition, clearing, and ongoing operational and maintenance costs such as easement mowing, sewer line cleaning, and general inspections.

Initial Capital Costs (2026 value)

| | |
|---------------|---------------|
| Gravity Sewer | \$ 15,100,000 |
|---------------|---------------|

Lifecycle O&M Costs (net present value)

| | |
|---------------|--------------|
| Gravity Sewer | \$ 4,320,000 |
|---------------|--------------|

| | |
|--|----------------------|
| Total Costs (net present value) | \$ 19,420,000 |
|--|----------------------|

4.2.1.2 US 15-501 (Alternative 2)

The following assumptions were made while developing the life cycle costs estimates for the US 15-501 Alternative:

- Lifecycle costs have been developed as if the entirety of this alternative was fully constructed as one single project and then operated and maintained for 50 years.
- On site sewer (within the development) is not included in these life cycle estimates. Analysis begins where wastewater would flow into a pump station.
- Costs include gravity sewer construction, sewer pump station and force main construction, easement acquisition, clearing, and ongoing operational and maintenance costs such as easement mowing, sewer line cleaning, general inspections, energy costs, and mechanical equipment maintenance.
- Single resident grinder pump stations are excluded from this analysis because it is assumed that individual homeowners would pay for construction and all on going operational and maintenance costs themselves.
- Future sewer pump stations have been grouped according to future development size based on the following: small is 50 units or less, medium is 51 – 250 units, and large is 251 units or more.
- At full build out of the service area, it assumed that 2 large, 3 medium, and 4 small sewer pump stations will be constructed to pump wastewater to the US 15-501 alignment.

| | |
|---|----------------------|
| <u>Initial Capital Costs (2026 Value)</u> | |
| Gravity Sewer | \$ 7,800,000 |
| 4 Small Sewer Pump Stations | \$ 2,000,000 |
| 3 Medium Sewer Pump Stations | \$ 3,750,000 |
| 2 Large Sewer Pump Stations | \$ 4,000,000 |
| Subtotal | \$ 17,550,000 |
| | |
| <u>Lifecycle O&M Costs (net present value)</u> | |
| Gravity Sewer | \$ 2,350,000 |
| 4 Small Sewer Pump Stations | \$ 4,200,000 |
| 3 Medium Sewer Pump Stations | \$ 6,810,000 |
| 2 Large Sewer Pump Stations | \$ 7,200,000 |
| Subtotal | \$ 20,560,000 |
| | |
| Total Costs (net present value) | \$ 38,110,000 |

4.2.1.3 Analysis Between Alternatives 1 & 2

The initial capital cost for Alternative 1 is estimated to be similar to Alternative 2; however the net present value of total cost of Alternative 1 is estimated to be 50% less than that of Alternative 2 due to the lifecycle operation and maintenance costs of the pump stations.

4.2.2 Flintrock Knoll Development Case Study

The Flintrock Knoll Development is a proposed development on the Wilson Creek side of US 15-501. This case study is intended to serve as a comparison of how the life cycle costs differ for a single proposed development. The Flintrock Knoll Development is the only project within the study area known to be actively pursuing development. As such, it may be the first project to require construction of a portion of Alternative 1 or Alternative 2 to serve the development. The initial capital costs and lifecycle costs shown in this study are only for the sections required to serve this development and are different from the costs for the full alternatives. The portions of each alignment needed to serve Flintrock Knoll are shown in Figure 3.

4.2.2.1 Flintrock Knoll Development - Wilson Creek Alignment

| | |
|---|---------------------|
| <u>Initial Capital Costs (2026 Value)</u> | |
| Gravity Sewer to Serve Flintrock Development (3,750 LF) | \$ 5,600,000 |
| | |
| <u>Lifecycle O&M Costs (net present value)</u> | |
| Gravity Sewer to Serve Flintrock Development (3,750 LF) | \$ 1,370,000 |
| | |
| Total Costs (net present value) | \$ 6,970,000 |

4.2.2.2 Flintrock Knoll Development - US 15-501 Alignment

Initial Capital Costs (2026 Value)

| | |
|---|---------------------|
| Gravity Sewer to Serve Flintrock Development (5,280 LF) | \$ 5,800,000 |
| 1 Medium Sewer Pump Station | \$ 1,250,000 |
| Subtotal | <u>\$ 7,050,000</u> |

Lifecycle O&M Costs (net present value)

| | |
|---|---------------------|
| Gravity Sewer to Serve Flintrock Development (5,280 LF) | \$ 1,480,000 |
| 1 Medium Sewer Pump Station | \$ 2,270,000 |
| Subtotal | <u>\$ 3,750,000</u> |

Total Costs (net present value) \$ 10,800,000

4.2.2.3 Case Study Analysis

The initial capital cost for the portion of Alternative 1 (Wilson Creek) needed to serve the development is approximately 20% less than the portion of Alternative 2 needed. When lifecycle operation and maintenance costs are included, the cost for Alternative 1 is estimated to be approximately 35% less than Alternative 2.

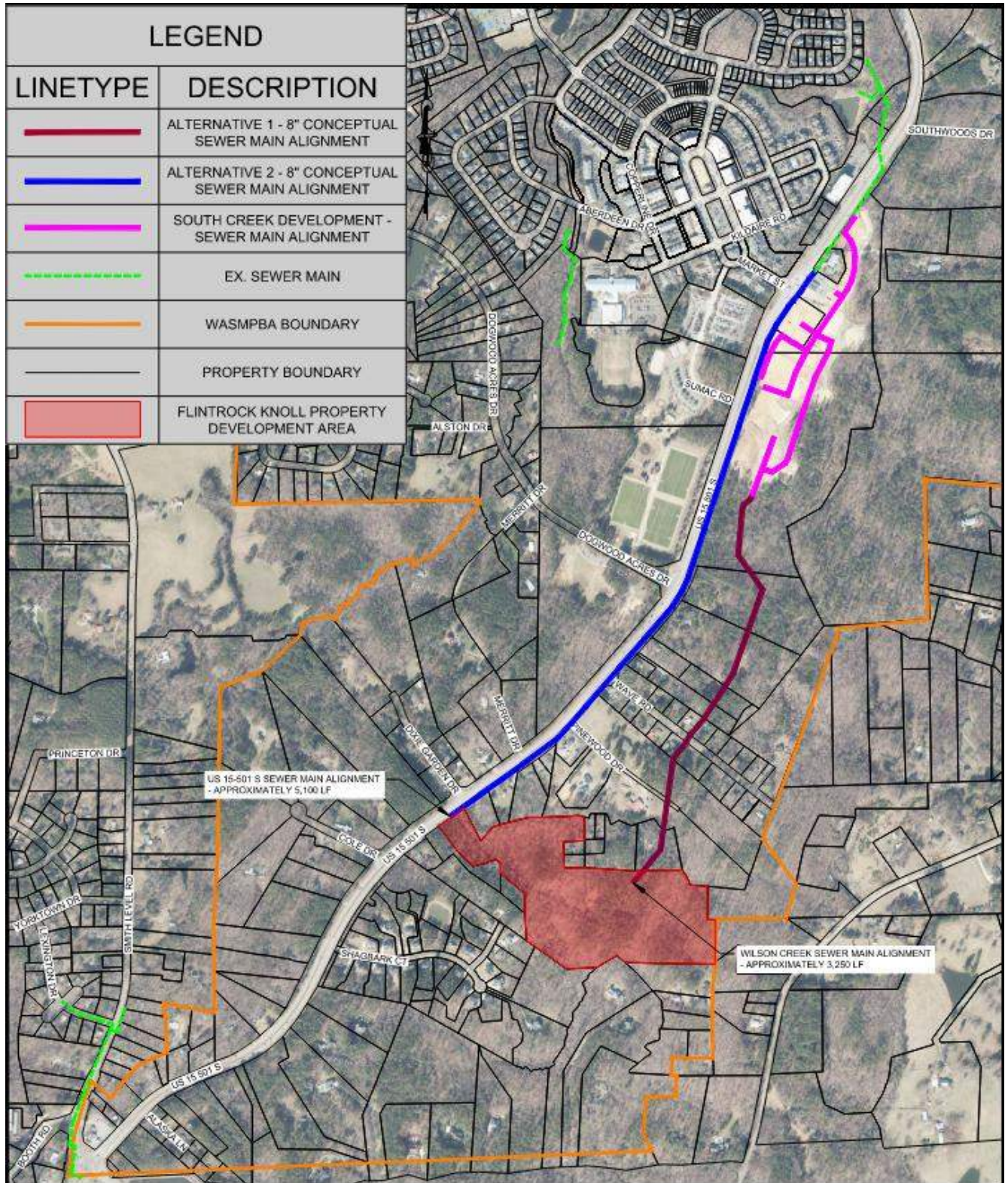


Figure 3: Flintrock Knoll Alignment Case Study

4.3 Easements and Existing Property Impacts

4.3.1 Fan Branch and Wilson Creek (Alternative 1)

Both Wilson Creek and Fan Branch conceptual alignments cross and impact numerous parcels and private properties. The conceptual Fan Branch sewer alignment crosses 13 privately owned parcels and two parcels owned by the Town of Chapel Hill. The conceptual Wilson Creek sewer alignment crosses 19 privately owned parcels. Construction would require both permanent and temporary easements on parcels to allow for trenching, equipment access, and future access for maintenance. Easement access may be influenced by existing development, steep or sloping terrain, buffer areas, and dense vegetation.

The conceptual alignments mostly traverse along parcel lines to limit disturbance to existing homeowners and to maximize the properties future development potential. There are multiple parcels that require specific attention and coordination along this alignment. These are parcels where the alignment cannot adhere to parcel lines or where the alignment comes close to an existing structure. Other properties along this alignment will still be affected by construction activities and will need to be coordinated with for easements, access, and traffic control. However, the parcels listed below will have greater impacts due to topography and buffer constraints:

| Wilson Creek | Fan Branch |
|--------------------|-------------------------|
| 530 Sun Forest Way | 145 Dixie Garden Drive |
| 2018 Shagbark Ct | 150 Dixie Garden Drive |
| 111 Pinewood Dr | 151 Dogwood Acres Drive |
| 1017 Wave Road | 148 Dogwood Acres Drive |
| 1015 Wave Road | |
| 1014 Wave Road | |
| 1010 Wave Road | |
| 1431 US 15-501 S | |
| 1412 US 15-501 S | |
| 1411 US 15-501 S | |

Additional details for 2018 Shagbark Ct, parcels along Wave Road, and along Dogwood Acres are shown in Figures 10, 11, and 12, respectively.

The majority of the Fan Branch and Wilson Creek conceptual alignments extend through wooded areas. These conditions will require tree clearing for installation and access, proper erosion control measures, and soil stabilization measures to support safe and effective construction. In some locations the alignment extends directly through residential yards, requiring additional easements and coordination with property owners.

4.3.2 US 15-501 (Alternative 2)

The US 15-501 conceptual alignment requires numerous permanent and temporary easements to meet OWASA sanitary sewer easement requirements and to facilitate installation and maintenance based on the conceptual sewer depths. It is estimated that easements will be needed from 18 properties along this alignment. Additionally, there are numerous utilities, including, but not limited to, water, gas, fiber, telecommunications, and overhead electricity, throughout this corridor. These conflicts have left minimal room in the NCDOT right-of-way for future sewer infrastructure.

Permanent and temporary easements will also have an impact on property owners along US15-501. If there is not enough room in the NCDOT right-of-way, easements will be required to obtain land from owners to facilitate the installation of the sanitary sewer. Additionally, as shown in the serviceability figures and life cycle section, existing homeowners and future developers would need to install sewer pump stations to connect to the gravity sewer line along US 15-501. This will create additional impacts to the property and will require maintenance.

4.4 Environmental Regulations and Impacts

This section summarizes noteworthy environmental features and impacts for each alignment. Additional details for environmental considerations are provided in Appendix A.

4.4.1 Fan Branch and Wilson Creek (Alternative 1)

The conceptual Fan Branch and Wilson Creek alignments would be constructed in areas that are heavily vegetated, experience flood events, and are adjacent to environmentally sensitive areas. Even as most of the alignment is outside of the RCD and associated buffer zones, it is expected there will be buffer impacts, and appropriate permitting and mitigation measures will be required. Additionally, it is expected that saturated soils will be encountered. Proper fill material would need to be brought in to replace poor soils throughout this area.

Both the Fan Branch and Wilson Creek areas in the Southern Boundary Area are located in the Jordan Lake Watershed and are subject to both State and Town riparian buffer protection rules. Installing sewer lines in riparian buffers is considered a high-impact activity and is heavily regulated by state and local authorities. Installing sewers in the riparian buffers is allowable under certain conditions, but typically requires special authorization, mitigation, and adherence to environmental regulations. Additional details on specific environmental regulations is provided in Appendix A. In general, it is a best practice for sewers to be installed outside the buffer areas where possible. Where sewer lines must cross streams, crossing perpendicular to the creek and buffer areas are preferred to minimize impacts.

Wetlands, floodplains, and floodways are also present within stream buffers in this area. Potential stream bank erosion and increased sedimentation to waterways could occur if proper erosion control measures are not installed. At a minimum, silt fencing, matting, slope stabilization, sediment traps and check dams should be installed to ensure safe construction while protecting environmental areas. Infrastructure installed in stream buffers and crossing streams would need to be designed to withstand flood events in the event of a major storm to minimize the risk of sewer breaks near the streams. The conceptual alignments for Fan Branch and Wilson Creek are located outside of the FEMA regulatory floodways, and it is anticipated that a no-rise study will not be required.

4.4.2 US 15-501 (Alternative 2)

Installation in the US 15-501 shoulder is expected to have less environmental impact compared to the Fan Branch and Wilson Creek alignments. Most of this area is already cleared approximately 50 feet from the edge of pavement, so less tree clearing will be required than with Alternative 1. The conceptual alignment does not cross or border upon any of the RCD buffer zones or riparian areas.

However, a majority of the Southern Boundary serviceable area will require sewer pump stations and force mains to connect to the US 15-501 conceptual alignment, which will be subject to the same environmental regulations listed above for Alternative 1. Generally, sewer pump stations need to be constructed in low areas to allow gravity to collect flow at the sewer pump station. The topography of this area will cause sewer pump stations and force mains to be constructed near the stream buffers creating many of the same environmental impacts described in Alternative 1. Sewer pump stations create an increased risk of sewer overflows and environmental damage due to potential mechanical and electrical failures, especially in high-water events. Sewer pump stations also require constant energy to pump sewage to the gravity system and create odor and noise pollution.

4.5 Constructability

4.5.1 Fan Branch and Wilson Creek (Alternative 1)

The Fan Branch and Wilson Creek conceptual alignments are constructable, but each present challenging conditions for construction. These challenges include areas of deep installation, construction in areas with steep slopes, limited access to portions of the route, removal of dense vegetation, impacts to property owners, variable soil conditions, and potential environmental impacts. The conceptual alignment and profiles for Alternative 1 with points of interest are shown in Figures 13 and 14.

The Fan Branch conceptual alignment generally avoids linear disturbance to the RCD, buffer areas and is outside of the floodway and floodplain. There are eight (8) proposed stream crossings which include two (2) perennial, one (1) ephemeral, one (1) intermittent, and four (4) classification unknown, along this conceptual alignment which will have perpendicular impacts to the RCD and buffer areas. Based on this conceptual alignment, it is anticipated that there will be approximately 2.10 acres of disturbance within the RCD. No aerial crossings will be required along this alignment. The stream crossings will be a minimum of three feet under the streambed. Additionally, trenchless installation methods, such as bore and jack, may be used for the stream crossing before Dogwood Acres Drive to limit disturbance within the buffer areas.

Segments of the Fan Branch alignment will need to be installed in the upland zone (150' RCD) due to existing condition restraints. Existing homes and buildings are located near or within the upland zone adjacent to Cole Drive and Dogwood Acres Drive. Due to the location of these homes and buildings, segments of the conceptual alignment for the sanitary sewer are pushed into the upland zone.

Segments along Fan Branch will require installation depths of approximately 20 feet and installation in areas with steep slopes. Several steep areas have a slope greater than 25% and will need a variance granted from the Town of Chapel Hill. Additional construction methods may be needed to facilitate deep sewer installation. Areas exceeding the steep slopes threshold of 25% along Fan Branch are shown in Figure 16.

The Wilson Creek conceptual alignment generally avoids long segments of linear disturbance to the RCD and buffer areas and is outside of the floodway and floodplain. Due to the varying topography along Wilson Creek, the conceptual alignment will require installation depths of up to approximately 20 feet in areas to avoid long runs of longitudinal RCD and buffer impacts, maintain adequate cover, and connect to the set invert at South Creek. Areas exceeding the steep slopes threshold of 25% along Wilson Creek are shown in in Figure 17.

The Wilson Creek conceptual alignment has eleven (11) stream crossings which include two (2) perennial, five (4) ephemeral, one (1) intermittent, one (1) classification unknown, and one (1) not classified streams. Unlike Fan Branch, Wilson Creek could have five (5) aerial crossings, one (1) across a perennial stream, two (2) across ephemeral streams, one (1) across an intermittent stream and one (1) across a not classified stream. The aerial crossing of the perennial stream will be outside of the floodplain and floodway. Additionally, based on this conceptual alignment, it is anticipated that there will be approximately 1.90 acres of disturbance within the RCD. These crossings are also shown in Figure 14.

For both Fan Branch and Wilson Creek alignments, dense vegetation and wooded areas may restrict equipment access and make the placement and installation of the sewer main difficult, potentially increasing construction duration and cost. Clearing vegetation from these areas may widen the impact area past the 30-foot utility easement, require significant restoration, and create permanent environmental and visual changes.

Along Fan Branch the area of most concern is at the intersection of Merritt Drive and Dogwood Acres Drive due to dense tree vegetation and where clearing is required to install deeper portions of the sanitary sewer. For Wilson Creek, the crossing of Wave Road will provide the biggest challenge due to impact to property owners.

Soils along both alignments include Chewacla loam and other sandy loams which exhibit moderate cohesion and stability. However, existing soils may be unsuitable for reuse as trench backfill in certain areas due to moisture content and compaction attributes. As a result, significant quantities of off-site backfill material may be required for portions of the sewer installation, which could affect overall project costs.

4.5.2 US 15-501 (Alternative 2)

The US 15-501 conceptual alignment and profile is shown in Figure 15. The US 15-501 conceptual alignment is constructible but presents areas with constructability concerns. The majority of the conceptual sewer alignment would be installed at depths of 18 to 20 feet to maximize the area served by

gravity. Although there appears to be ample room for construction within the right-of-way, these installation depths will provide challenges due to potential utility conflicts. Additionally, NCDOT construction requires a 1:1 slope from the edge of pavement to the bottom of excavation. If a 1:1 slope cannot be maintained, methods such as positive shoring or temporary shoring would be required for sewer installation. This method is associated with high costs and long construction durations. Incorporating these factors increases the potential for permanent and temporary easements from parcels that are along the frontage of US 15-501.

Traffic impacts would also have to be managed during construction. Four roadway crossings will require a jack and bore installation with a casing pipe. This would include additional permanent and temporary easements.

Existing utilities within the US 15-501 right-of-way include both public and private utilities. The gravity sewer should be placed at least 10' from public water mains. Private utilities include power, gas, telecom, and fiber. These private utilities present a greater challenge as they may have existing easements in the corridor and can dictate whether to allow other utilities in their space. The existing topography of US 15-501 is shown in Figure 16.

Future developments will encounter constructability challenges to connect to the US 15-501 alignment. Any areas outside of the gravity-serviceable region will need to establish a sewer pump station and force main connection. Generally, these sewer pump stations need to be constructed downhill from the units they collect from, far enough away from other buildings to eliminate odor and noise concerns, and outside of the floodplain. The spatial requirements for sewer pump stations may cut into the amount of developable space within a parcel and raise environmental concerns if installed in or near the RCD buffer.

Additional issues with sewer pump stations include permitting by State agencies, continuous operation and maintenance by the private owner or OWASA if the sewer pump station ownership is transferred, energy consumption and the potential for sewer overflows if systems are not maintained properly or cannot be operated during power outages.

5. Design Guardrails

The Fan Branch and Wilson Creek conceptual alignments should follow best practices for design and installation to minimize the environmental impacts outlined in Section 4.4 while providing long-term infrastructure resiliency and servicing as much area as possible. In general, the optimal location for a sewer alignment paralleling a creek is to locate the sewer alignment outside the RCD and riparian buffer zones. The outermost RCD boundary, known as the Upland Zone, is located between 150' and 100' from the top of bank of perennial streams. The managed use zone is located between 100' and 50', and the stream side zone is located within 50' from the top of bank of perennial streams, respectively. Additionally, the Jordan Lake Riparian Buffers are located within 50' from the top of bank of perennial and intermittent streams, with Zone 1 being 30' from the top of bank and Zone 2 being the next 20'. Incorporating these constraints, the optimum location would be for the conceptual sanitary sewer to be located at least 150' feet from the top of bank of perennial streams and 50' from intermittent streams while keeping the alignment downhill of surrounding properties when feasible.

In locations where a sewer is installed parallel to a stream and the optimum separation from the stream bank cannot be provided, the sewer should be installed as far from the stream bank as practical and either outside the floodway area or in a location where the ground elevation over the sewer is a minimum of 3' above the adjacent stream bank elevation.

As shown in the conceptual alignments, it is not always feasible to maintain the above-listed separations from the top of bank of perennial and intermittent streams. Disturbances within the RCD and riparian buffer zones can be allowable depending on location and direction of the alignment. These design parameters are described in further detail in Appendix A. In general, any disturbance made to Zone 2 or Zone 1 of the Jordan Lake Riparian Buffers should be perpendicular and avoid any longitudinal disturbance greater than 40 feet. Longitudinal disturbances are allowed but will require additional permitting and mitigation efforts depending on the design.

Additionally, floodplains and floodways are present along Fan Branch and Wilson Creek. Sewers can be installed in the floodplain via approved discharge mitigation measures but should generally avoid being installed in the floodway. These measures are outlined in Appendix A and described under Section 404 / 401 permitting requirements. Any aerial crossings located in the floodplain will need to be above the 25-year floodplain.

Installing sewers in steep slope areas should also be avoided when possible. In general, any slopes greater than 25% are considered steep slopes. Alignments should prioritize following contour lines rather than straight downslopes to reduce pipe loading and erosion. In general, geotechnical investigations are always recommended throughout a proposed sewer alignment but are highly recommended in areas with steep slopes to evaluate soil strength parameters and groundwater and seepage concerns.

Furthermore, the proposed sewer design and conceptual alignments must be compliant with all OWASA design standards and Town of Chapel Hill Land Use Management Ordinance (LUMO).

6. Recommendation

Dewberry recommends prioritization of Alternative 1, Fan Branch and Wilson Creek conceptual alignments, over the Alternative 2, US 15-501 alignment. The primary driver for this recommendation is the overall serviceability by gravity along Fan Branch and Wilson Creek as compared to US 15-501. The environmental impacts, constructability concerns, and property impacts for Fan Branch and Wilson Creek do not outweigh the drawbacks of the required sewer pump stations and force mains in addition to the constructability challenges for the US 15-501 alignment. Although the environmental impacts would be less along US 15-501 for the gravity sewer, the easement impacts and constructability concerns along US 15-501 are still considerable and do not provide a benefit to this option due to the lesser serviceable area by gravity.

Additionally, as shown in the Life Cycle section, the life cycle costs for the Fan Branch and Wilson Creek conceptual alignments are significantly lower than the lifecycle costs for the US 15-501 conceptual alignment, which would include a series of privately or OWASA owned and operated sewer pump stations. Maintenance requirements for sewer pump stations will present operations challenges that are not present with a gravity sewer. A series of sewer pump stations created by multiple developments can also result in capacity concerns as flow is transferred at higher flow in short durations compared to gravity.

7. References

Information and data for this evaluation were obtained from the following entities.

| DATA | ENTITY |
|--|---|
| Existing Sanitary Sewer | OWASA |
| WASMPBA Boundary | OWASA |
| Resource Conservation District | Town of Chapel Hill |
| Flintrock Knoll Drawings | OWASA |
| South Creek Drawings Phase 1 & Phase 2 | OWASA |
| Natural Features Model | Town of Chapel Hill |
| Important Ecological Area | NCNHP |
| Imagery / Aerial Data | State of NC – NC OneMap |
| Contour Data | Town of Chapel Hill |
| Floodplain and Floodway Data | North Carolina Floodplain Mapping Program (NCFMP) |
| Soils Data | Natural Resources Conservation Service (NRCS) |
| Stream Data | Town of Chapel Hill |
| Water Bodies Data (Includes Wetlands) | Town of Chapel Hill |
| Zoning Districts Data | Town of Chapel Hill |
| Parcel Data | Town of Chapel Hill |
| Street Data | Town of Chapel Hill |

Appendix A Environmental Regulation Additional Information

Appendix A provides additional detail on environmental considerations for selection of the conceptual alignments and recommendations.

Stream Classifications and RCD Buffer Restrictions

Stream classification directly affects allowable development activities by defining regulated corridor zones and buffer zones. Stream classifications correspond to regulated stream corridor zones, which are defined as horizontal, linear distances measured from top of the stream bank. The Town of Chapel Hill Land Use Management Ordinance (LUMO) establishes required buffer widths based on the type of stream or water body, complying with the Town of Chapel Hill Resource Conservation District (RCD) zones.

The RCD is an overlay zoning district and is intended to preserve water quality, minimize danger and property damage from flooding, protect streams from erosion and sedimentation, preserve urban wildlife corridors and plant habitats, and manage development in Federal Emergency Management Agency (FEMA)-regulated floodplains in this area. There are three defined zones within the RCD: Stream Side, Managed Use, and Upland.

Wilson Creek and Fan Branch are both classified as perennial streams. Perennial streams contain flowing water year-round, with groundwater serving as the primary source of streamflow and the water table usually located above the streambed. Wilson Creek and Fan Branch have perennial, intermittent, and ephemeral stream tributaries within the project area. RCD and Jordan Buffer regulations apply to perennial and intermittent stream tributaries.

Intermittent streams have flowing water during parts of the year, typically during wetter seasons, and may be dry during extended periods without rainfall. Streamflow in intermittent streams involves a combination of seasonal groundwater discharge and surface runoff.

Ephemeral streams, where present, convey flow only in direct response to precipitation events and do not receive groundwater flow. These channels are generally dry for most of the year and lack continuous base flow.

These stream classifications form the basis for determining applicable buffer widths and regulatory constraints within the study area. Table A.1 provides a summary of the stream classifications.

Table A.1 RCD Stream Corridor Zone Requirements Chapel Hill LUMO §3.6.3

| STREAM CORRIDOR ZONE REQUIREMENTS CHAPEL HILL LUMO §3.6.3 | | | |
|---|--------------------------|-------------------------------|--------------------------------|
| TYPE OF STREAM OR WATER BODY | CORRIDOR ZONE | | |
| | STREAM SIDE | MANAGED USE | UPLAND |
| Perennial Stream | 50 feet from stream bank | 50 feet from stream side zone | 50 feet from managed use zone* |
| Intermittent Stream | 50 feet from stream bank | None required | Non required |
| Ephemeral Stream | None required | None required | None required |
| Perennial Water Body | 50 feet from stream bank | None required | None required |

* or out to the point of resource conservation district elevation, whichever is greater.

Chapel Hill LUMO Section 3.6.3 Resource Conservation District, App. A Section 3-6 3

Within these corridor zones, the Town of Chapel Hill Land Use Management Ordinance establishes permitted, prohibited, and conditional uses. Table A.2 summarizes relevant allowable activities within the stream side, managed use, and upland zones. Activities related to public utilities and storm drainage facilities are generally permitted where there is a demonstrated practical necessity, while other land-disturbing activities may be restricted or require conditional approval. Compliance with these regulations is a key consideration in evaluating the feasibility and permitting requirements.

Table A.2 Relevant Permitted Uses within the Resource Conservation District

| RELEVANT PERMITTED USES WITHIN THE RESOURCE CONSERVATION DISTRICT | | | |
|---|------------------|------------------|-------------|
| USE | STREAM SIDE ZONE | MANAGED USE ZONE | UPLAND ZONE |
| Public utility and storm drainage facilities where there is a practical necessity to their location within the Resource Conservation District | P | P | P |
| Driveways and utility service lines when there is a practical necessity | P | P | P |
| Public maintenance of streets, bridges, other similar transportation facilities and/or public utility and storm drainage facilities | P | P | P |

(Ord. No. 2004-02-23/O-2; Ord. No. 2020-10-28/O-10, § 9; Ord. No. 2023-11-29/O-5, § 1)

Jordan Lake Watershed Riparian Buffer Protection Ordinance

The North Carolina Department of Environmental Quality Division of Water Resources (DWR) implements riparian buffer rules to protect vegetated areas adjacent to perennial and intermittent streams, as well as other regulated water bodies.

Table A.3 describes the permitted activities within the Jordan Watershed Riparian Buffer Zones, which represents a 50' buffer around all intermittent and perennial streams and perennial waterbodies within the Jordan Watershed.

Exempt means that activities are allowed within the riparian buffer without needing approval from DWR or a local delegated authority. Allowable means that activities may occur in the buffer, but only after receiving written authorization from the DWR or a delegated local authority. Allowable with Mitigation refers to activities that may occur in the buffer only after written authorization, and that require a specific mitigation strategy to offset environmental impacts.

Table A.3 Permitted Activities within Jordan Lake Watershed Riparian Buffers

| Disturbance | Exempt* | Allowable* | Allowable with Mitigation* |
|--|---------|------------|----------------------------|
| Utility, non-electric, perpendicular crossings of streams and other surface waters subject to this section ^{3, 5} : | | | |
| <ul style="list-style-type: none"> Disturb equal to or less than 40 linear feet of riparian buffer with a maintenance corridor equal to or less than 10 feet in width | X | | |

| | | | |
|---|--|---|---|
| • Disturb equal to or less than 40 linear feet of riparian buffer with a maintenance corridor greater than 10 feet in width | | X | |
| • Disturb greater than 40 linear feet but equal to or less than 150 linear feet of riparian buffer with a maintenance corridor equal to or less than 10 feet in width | | X | |
| • Disturb greater than 40 linear feet but equal to or less than 150 linear feet of riparian buffer with a maintenance corridor greater than 10 feet in width | | | X |
| • Disturb greater than 150 linear feet of riparian buffer | | | X |
| Utility, non-electric, other than perpendicular crossings ^{4, 5} : | | | |
| • Impacts in Zone Two | | X | |
| • Impacts in Zone One ¹ | | | X |

Information from Riparian Buffer Protection Ordinance for Lands within the Joran Watershed and Town of Chapel Hill's LUMO Section 5.18

¹Provided that:

- No heavy equipment is used in Zone One.
- Vegetation in undisturbed portions of the buffer is not compromised.
- Felled trees are removed by chain.
- No permanent felling of trees occurs in protected buffers or streams.
- Stumps are removed only by grinding.
- At the completion of the project the disturbed area is stabilized with native vegetation.
- Zones one and two meet the requirements of Sections 7.(D) and 7.(E) within the Riparian Buffer Protection Ordinance for Lands within the Joran Watershed.

³ Provided that poles or aerial infrastructure shall not be installed within ten (10) feet of a water body unless the town completes a no practical alternative evaluation as defined in the Town of Chapel Hill's LUMO subsection 5.18.8(c) and section 9 (A) of the Riparian Buffer Protection Ordinance for Lands within the Joran Watershed.

⁴ Provided that, in Zone One, all of the following BMPs for underground utility lines are used. If all of these BMPs are not used, then the underground utility line shall require a no practical alternative evaluation by the town, as defined in subsection 5.18.8(c).

- Woody vegetation shall be cleared by hand. No land grubbing or grading is allowed.
- Vegetative root systems shall be left intact to maintain the integrity of the soil. Stumps shall remain, except in the trench where trees are cut.
- Underground cables shall be installed by vibratory plow or trenching.
- The trench shall be backfilled with the excavated soil material immediately following cable installation.
- No fertilizer shall be used other than a one-time application to re-establish vegetation.
- Construction activities shall minimize the removal of woody vegetation, the extent of the disturbed area, and the time in which areas remain in a disturbed state.

- Measures shall be taken upon completion of construction and during routine maintenance to ensure diffuse flow of stormwater through the buffer.
- In wetlands, mats shall be utilized to minimize soil disturbance.

⁵Perpendicular crossings are those that intersect the surface water at an angle between seventy-five (75) degrees and one hundred five (105) degrees.

The mitigation requirement may be met through one of the following options

- Payment of a compensatory mitigation fee to the Riparian Buffer Restoration Fund pursuant to 15A NCAC 02B.0269 and contingent upon acceptance of payments by the N.C. Ecosystem Enhancement Program, or to a private mitigation bank that complies with banking requirements of the U.S. Army Corps of Engineers and the applicable trading criteria in 15A NCAC 02B.0273;
 - At the date of this report, NCDEQ has suspended accepting new buffer and nutrient offset applications for mitigation in the Upper & Lower New Hope watersheds. Private banks are currently the only option to directly pay mitigation in-lieu fees.
- Donation of real property or of an interest in real property pursuant to subsection 5.18.8(e)(6); or
- Restoration or enhancement of a non-forested riparian buffer pursuant to the requirements of subsection 5.18.8(e)(7).

Sections 404 & 401 Water Quality Certification Permits

Sections 401 and 404 of the Clean Water Act are permitting programs to protect wetlands, streams, and other water bodies. Section 401 is a Water Quality Certification, issued at the state level by NCDEQ's 401 & Buffer Permitting Branch. This permitting program ensures a project's compliance with state water quality standards and dictates any required mitigation efforts required for any adverse impacts to water quality. This permit is required for any project that may discharge into a state water body and impact water quality.

Section 404 is a federal permitting program designed to regulate the discharge of dredged or fill materials into waterbodies, streams, and wetlands. This is particularly applicable in environmentally sensitive areas and areas with erosion concerns. This permit is required when a project causes a physical alteration of a wetland or water body or potentially discharges any material into a wetland or water body. This permit is filed with and issued by the U.S. Army Corps of Engineers (USACE). To obtain a permit, the project must avoid wetland impacts, minimized potential impacts to wetlands, and provided compensation for any remaining unavoidable impacts.

Natural Heritage Program

The North Carolina Natural Heritage Program (NCNHP) is designed to document and protect natural areas, unique natural communities, important animal assemblages, and rare plant and animal species. The NCNHP is not a regulatory agency and sewer installation is allowable within these areas. The publicly available NCNHP data, which included the natural areas and managed areas, was reviewed and the conceptual alignments do not significantly disturb any of these areas that are currently documented in the database. It should be noted that NCNHP records depend on areas that have been field surveyed and all data may not be publicly available.

OWASA Standard for Sewers in Relation to Streams

Per OWASA specifications and design guidelines, sanitary sewers paralleling creek shall be below the streambed elevations, which also includes lateral connections. For stream crossings, the crossings shall be perpendicular to the creek where possible and encased in concrete. The top of all sewers entering or crossing stream shall be at a sufficient depth below the natural bottom of the streambed to protect the sewer line. In general, a minimum of three (3) feet of cover is required.

For aerial crossings, the creek crossings shall be constructed with I-beam support carriage. The bottom of the pipe should be placed no lower than the elevation of the 25-year flood. Proper joint technology, such as flanges or restrained joints, adequate supports to prevent excessive deflection and flexion, or a combination of both shall be provided for all aerial pipe crossings. In certain cases, a no-rise study will be

required when the project enters a FEMA-designated regulatory floodway. A no-rise study is required for sewer crossings when the proposed construction or utility installation encroaches or block flow, changes conveyance, or cause a change in the elevation of the stream channel. However, both the Fan Branch and Wilson conceptual alignments avoid disturbing the designated floodways and a no-rise study is not anticipated.

A minimum buffer separation of 50 feet shall be maintained between sewer and streams/water classified as nutrient sensitive stream or watershed buffers. There should be no more than 40 linear feet (longitudinal) disturbance of a riparian buffer. A variance would be required if these constraints cannot be met.

Appendix B Anticipated Permits

Anticipated permits for Alternative 1 are the following:

1. Section 404 – USACE
2. Section 401 – NCDEQ
3. NCDEQ Erosion & Sediment Control
4. NCDEQ Sewer Extension Permit
5. OWASA Construction Plan Review
6. Town of Chapel Hill Jordan Watershed Riparian Buffer Authorization Application
7. Town of Chapel Hill Resource Conservation District Encroachment
8. Town of Chapel Hill Zoning Compliance Permit Application
9. Town of Chapel Hill Special Use Permit Steep Slope Development

Anticipated Permit for Alternative 2 are the following:

1. NCDOT Encroachment Agreement
2. NCDEQ Erosion & Sediment Control
3. NCDEQ Sewer Extension Permit
4. OWASA Construction Plan Review
5. Town of Chapel Hill Zoning Compliance Permit Application

Appendix C Site Photos



Photo C.1: Saturated soils conditions from top of bank to South Creek retaining wall



Photo C.2: New stormwater pipes from South Creek

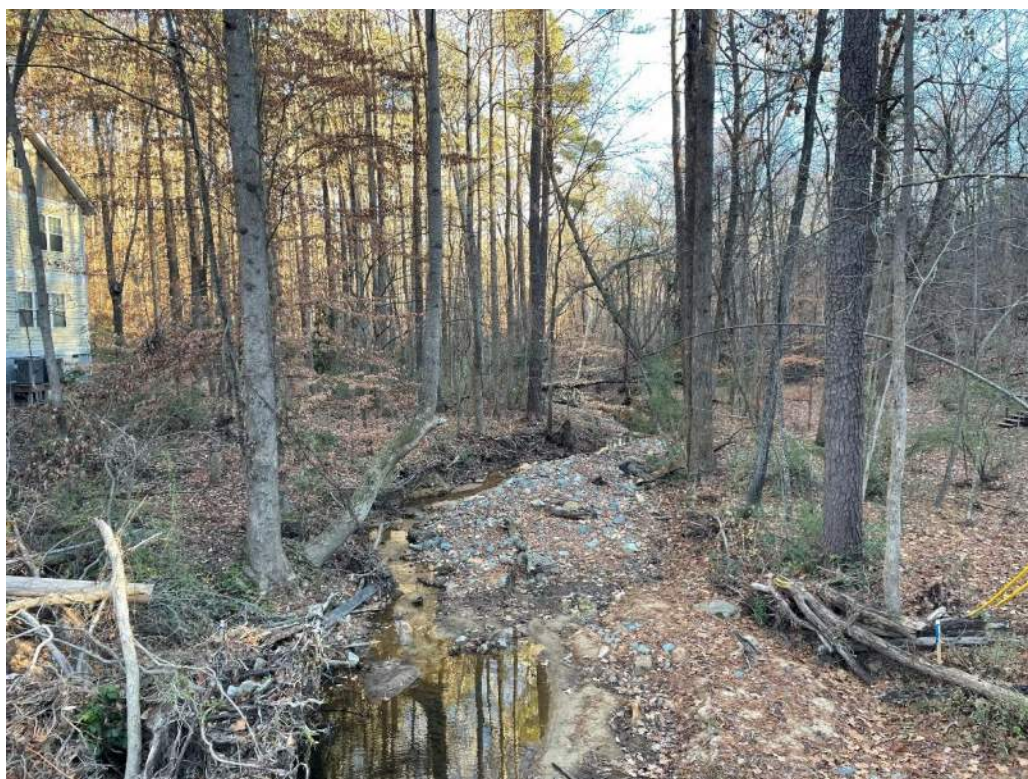


Photo C.3: Wilson Creek at Wave Road

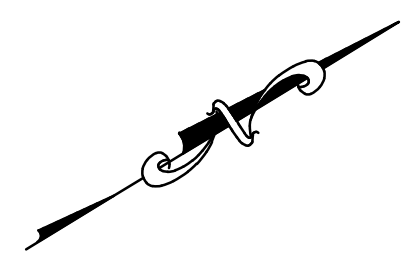


Photo C.4: US 15-501 shoulder at Dogwood Acres Drive



Photo C.5: Existing sanitary sewer and easement downstream of Fan Branch near Aberdeen Dr.

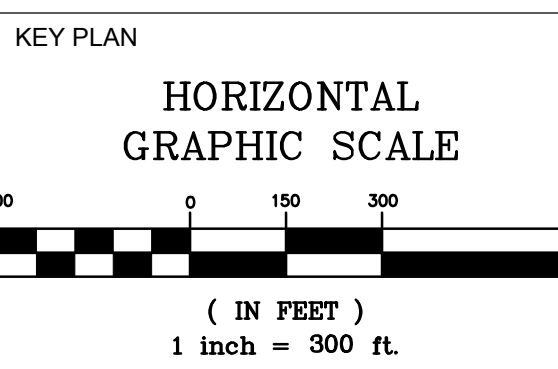
Appendix D – Figures 4 – 18



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A

OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION

SEAL



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REVISIONS
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 APPROVED BY _____
 CHECKED BY _____
 DATE 03/04/2026

TITLE
**OVERALL STUDY
 AREA
 ALTERNATIVE 1**

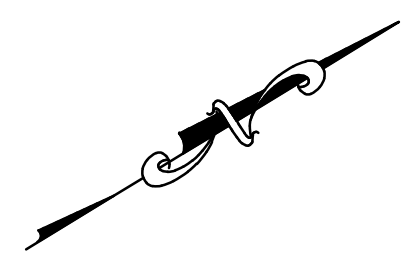
PROJECT NO. 50191103

FIG 4

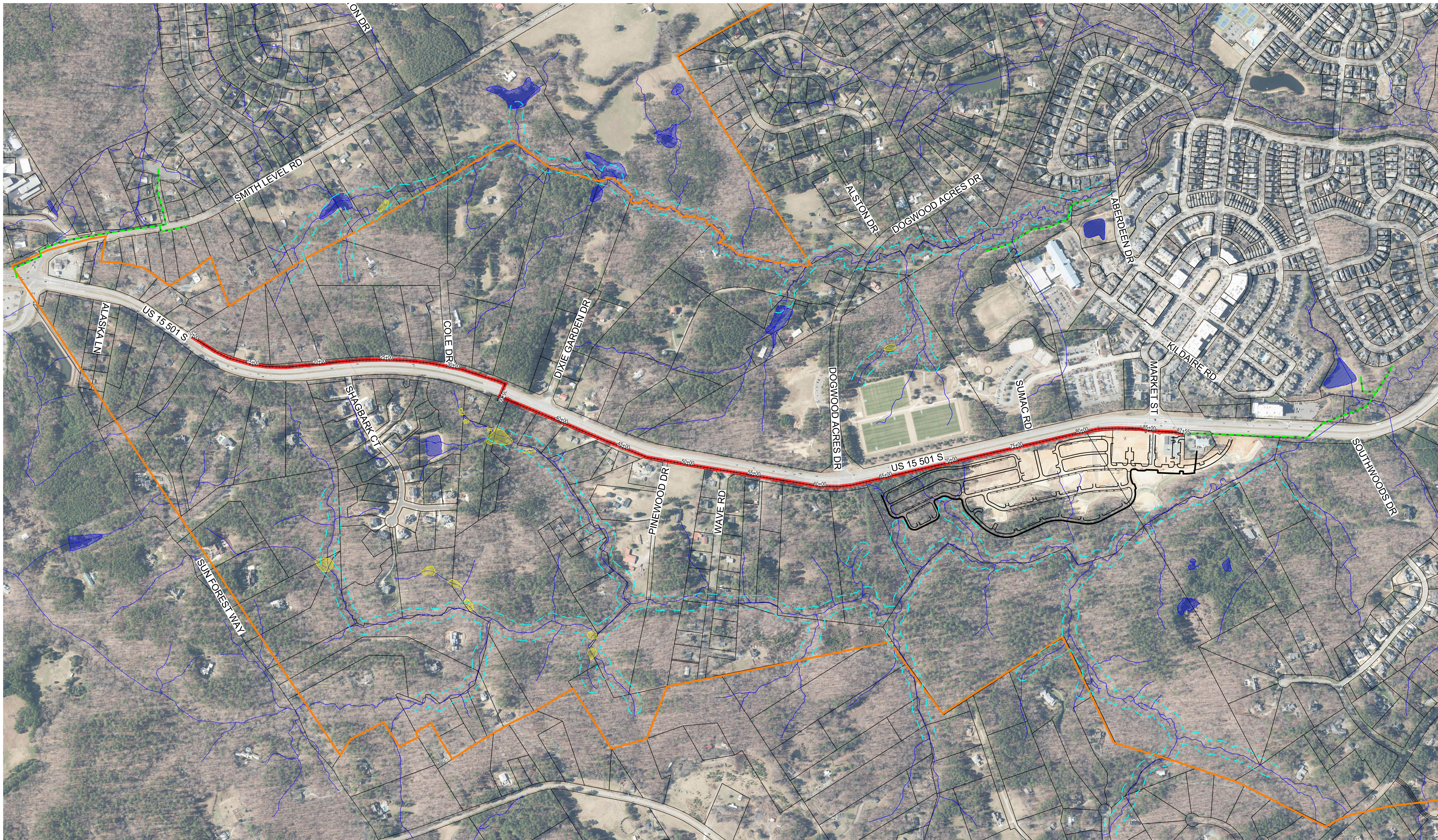
GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.

| LEGEND | | | |
|----------|------------------------------------|----------|---|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | PROPERTY BOUNDARY | | WASMPBA BOUNDARY |
| | STREAM CENTERLINE | | WATERBODY |
| | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | WETLAND |
| | EX. 8" SEWER MAIN | | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) |



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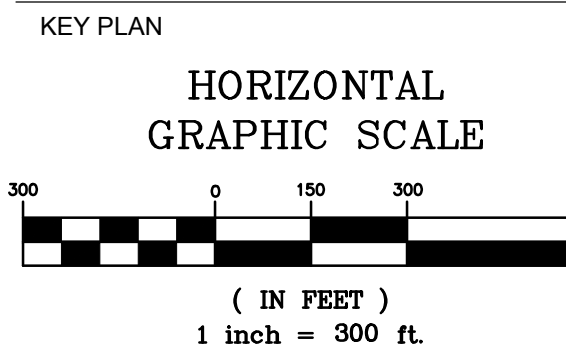
GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.

| LEGEND | | | |
|----------|------------------------------------|----------|---|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | PROPERTY BOUNDARY | | WAMPBA BOUNDARY |
| | STREAM CENTERLINE | | WATERBODY |
| | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | WETLAND |
| | EX. 8" SEWER MAIN | | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) |

OWASA SOUTHERN BOUNDARY AREA SEWER EXTENSION

SEAL

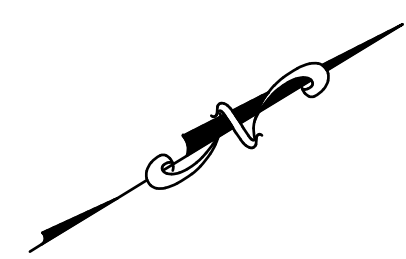


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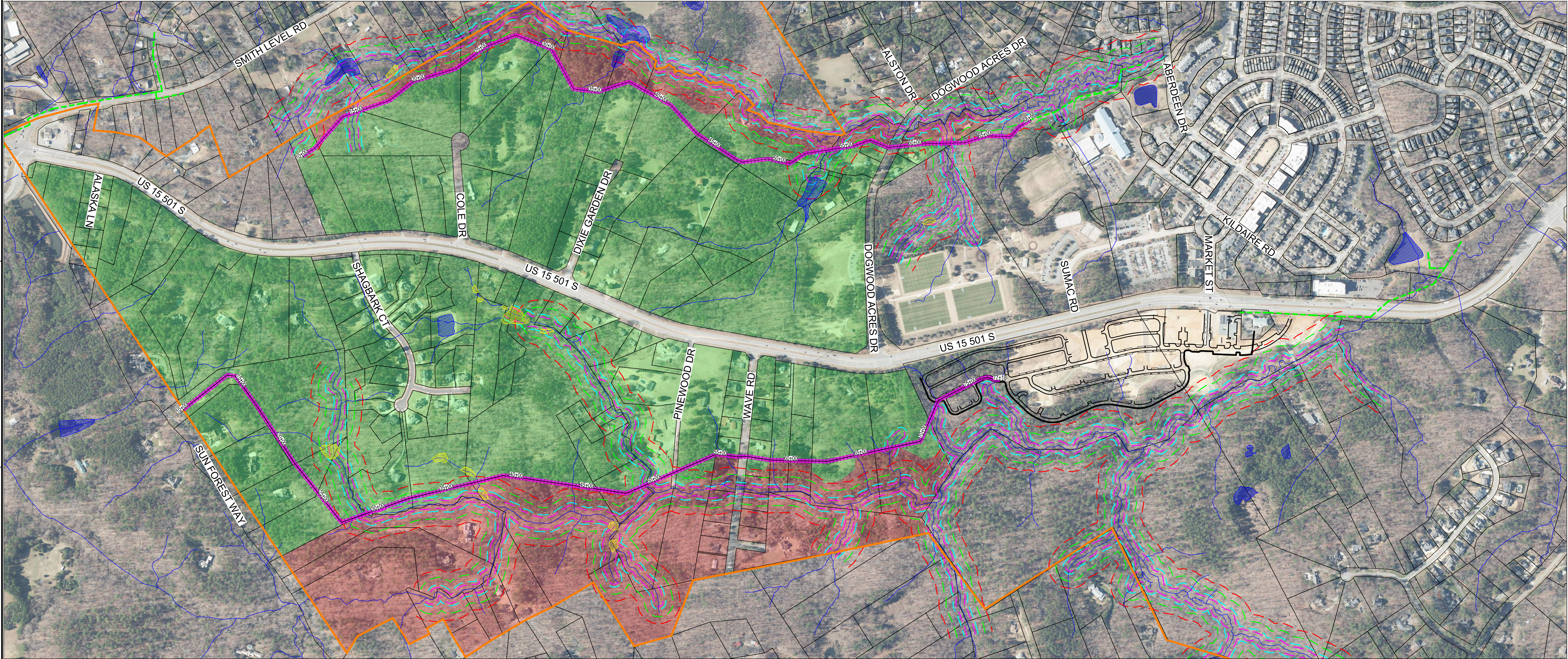
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OVERALL STUDY AREA ALTERNATIVE 2

PROJECT NO. 50191103

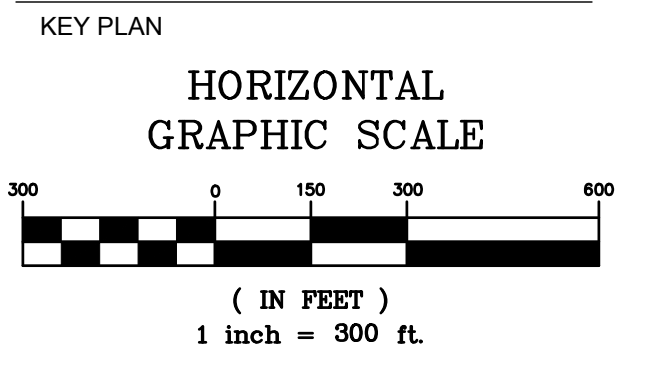


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OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION

SEAL



| LEGEND | | | |
|----------|---|----------|--|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | 30' ZONE 1 JORDAN RIPARIAN BUFFER | | EX. SEWER MAIN |
| | 20' ZONE 2 JORDAN RIPARIAN BUFFER | | STREAM CENTERLINE |
| | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) | | SERVICEABLE AREAS W/ GRAVITY SEWER MAIN |
| | 50' MANAGED USE ZONE (100' RCD) | | SERVICEABLE AREAS W/ PUMP STATION SEWER MAIN |
| | 50' UPLAND ZONE (150' RCD) | | WATERBODY |
| | WASMPBA BOUNDARY | | WETLAND |
| | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | PROPERTY BOUNDARY |

GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.

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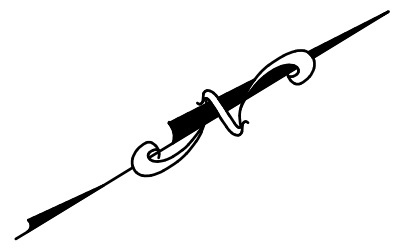
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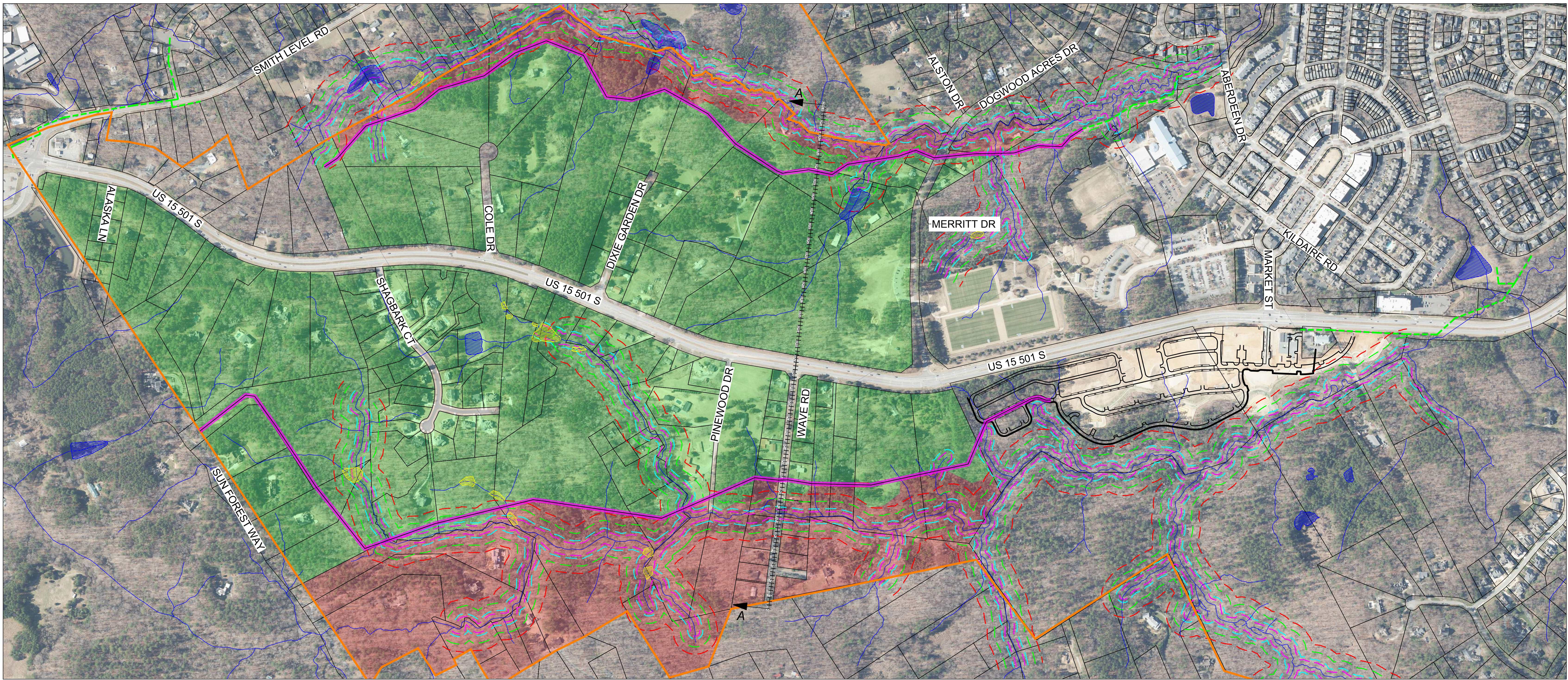
SERVICEABLE AREAS
ALTERNATIVE 1

PROJECT NO. 50191103

FIG 6

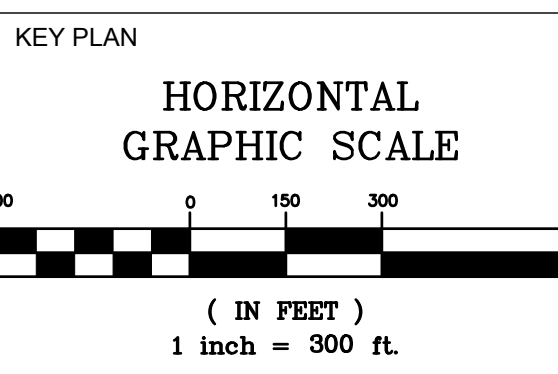


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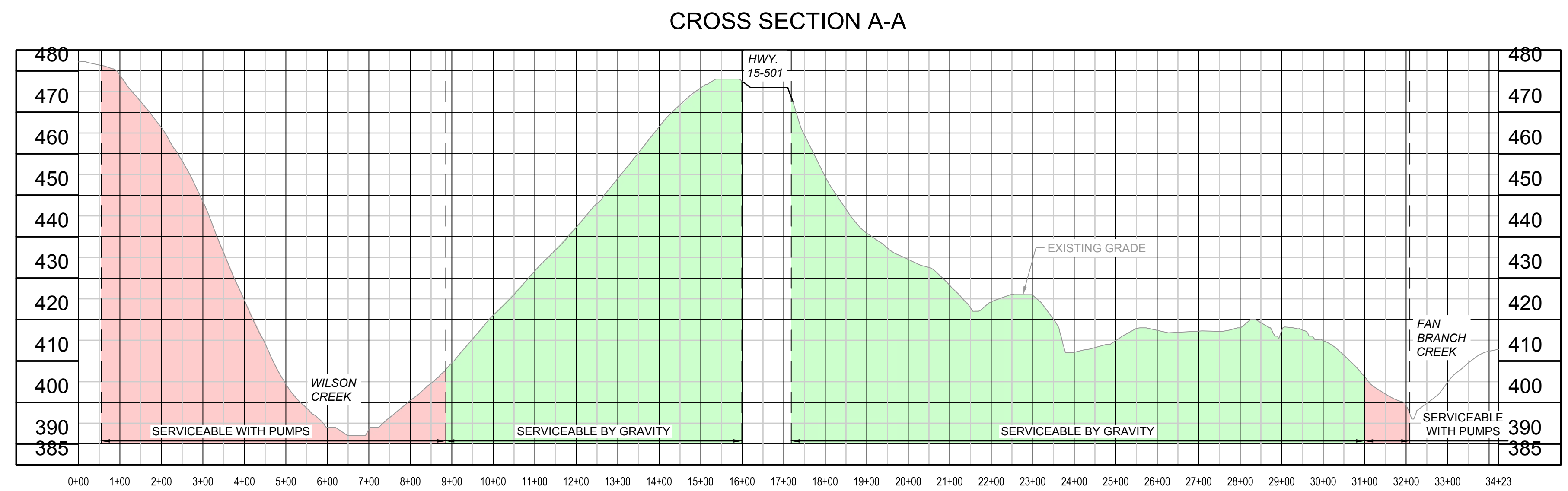


OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION

SEAL



| LEGEND | | | |
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| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | 30' ZONE 1 JORDAN RIPARIAN BUFFER | | PROPERTY BOUNDARY |
| | 20' ZONE 2 JORDAN RIPARIAN BUFFER | | EX. SEWER MAIN |
| | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) | | STREAM CENTERLINE |
| | 50' MANAGED USE ZONE (100' RCD) | | SERVICEABLE AREAS W/ GRAVITY SEWER MAIN |
| | 50' UPLAND ZONE (150' RCD) | | SERVICEABLE AREAS W/ PUMP STATION SEWER MAIN |
| | WASMPBA BOUNDARY | | WETLAND |
| | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | WATERBODY |



GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
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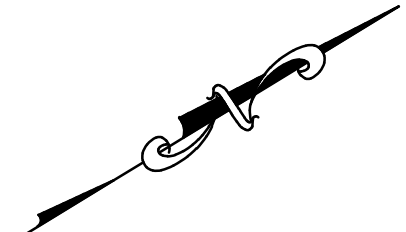
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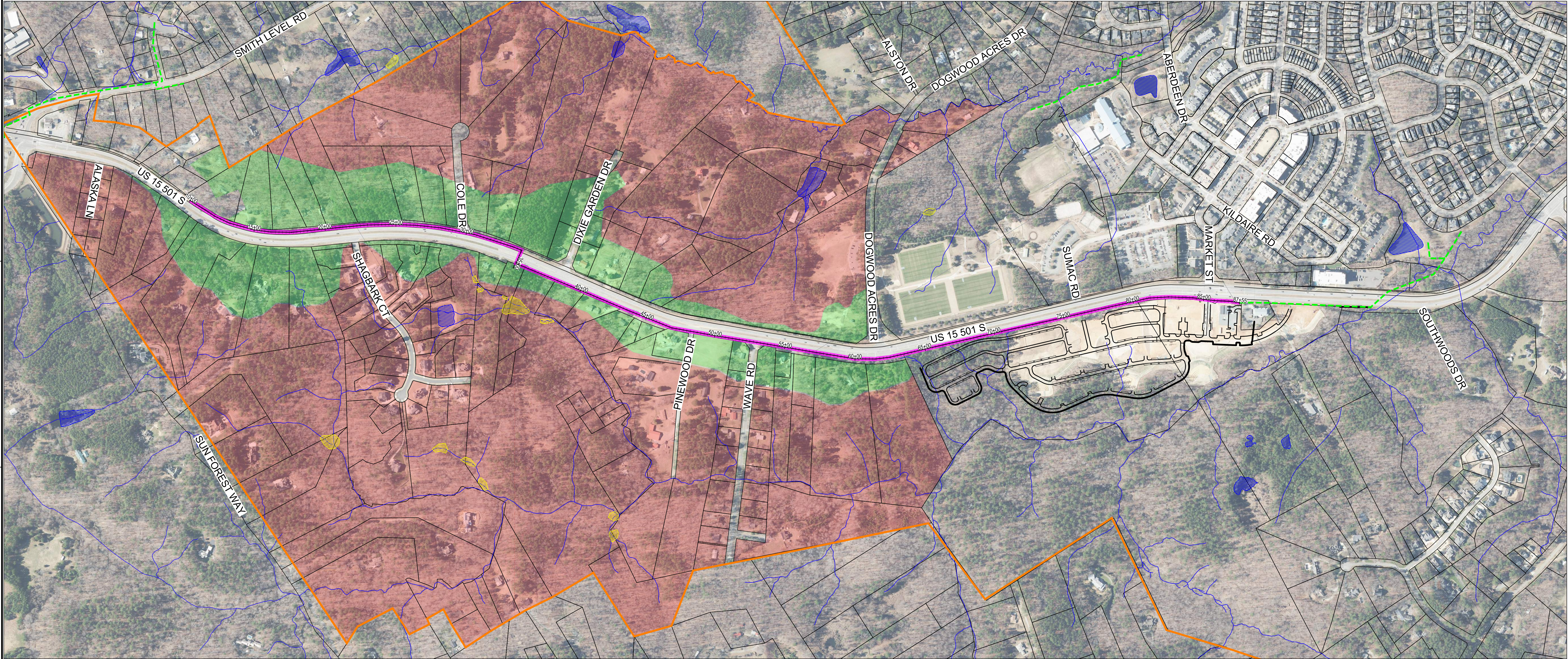
SERVICEABLE AREAS
 CROSS SECTION
 ALTERNATIVE 1

PROJECT NO. 50191103

FIG 7

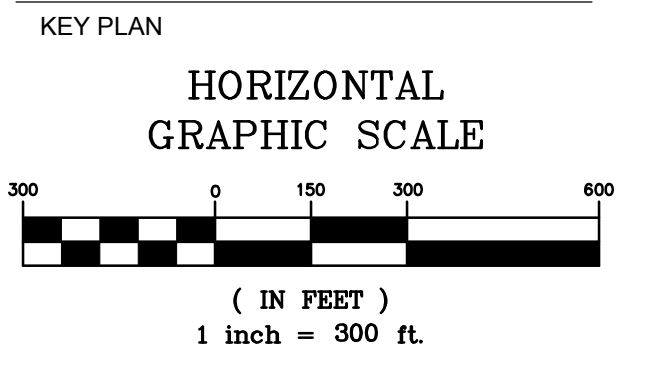


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OWASA SOUTHERN BOUNDARY
 AREA SEWER EXTENSION

SEAL



| LEGEND | | | |
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| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | PROPERTY BOUNDARY | | SERVICEABLE AREAS W/ GRAVITY SEWER MAIN |
| | STREAM CENTERLINE | | SERVICEABLE AREAS W/ PUMP STATION SEWER MAIN |
| | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | WSMPBA BOUNDARY |
| | EX. 8" SEWER MAIN | | WETLAND |
| | WATERBODY | | |

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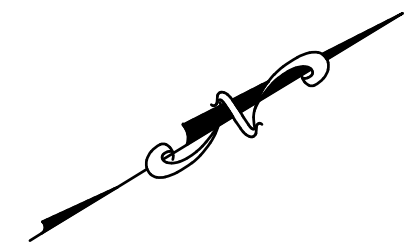
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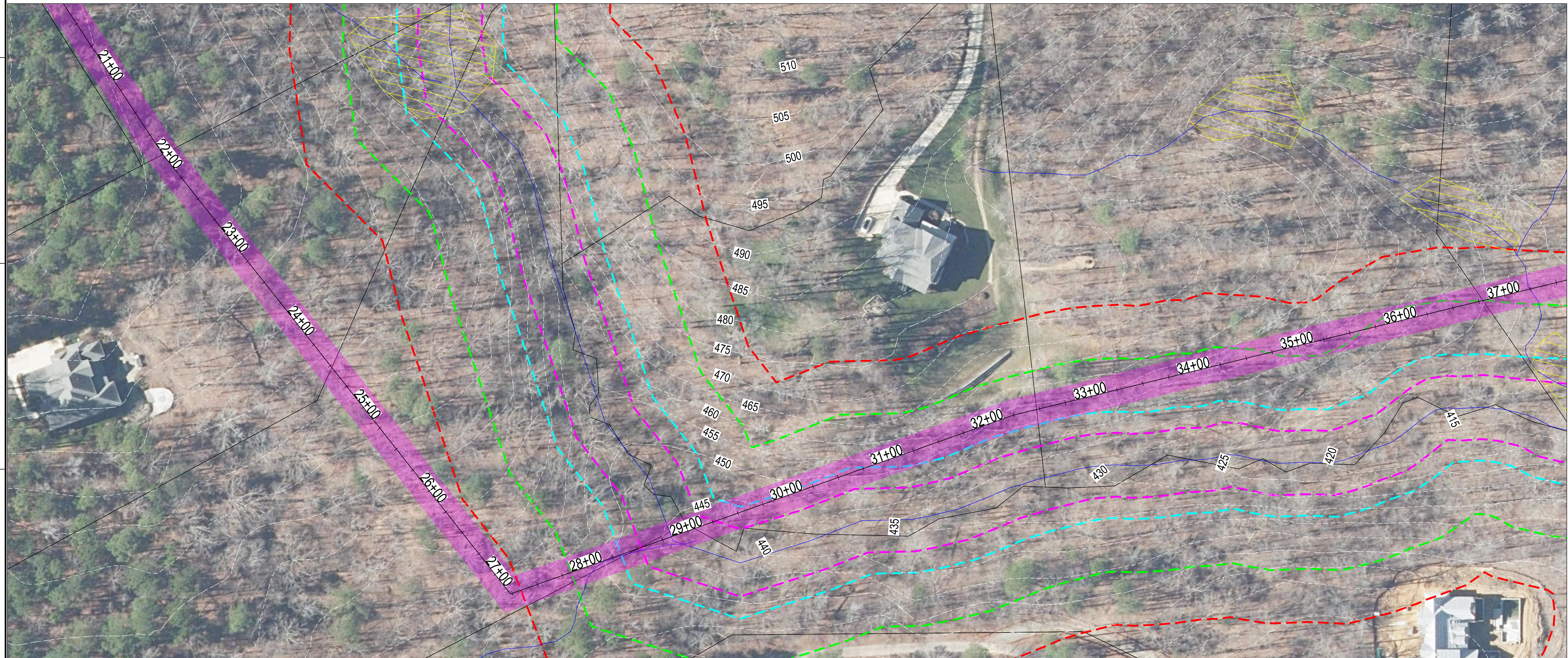
SERVICABLE AREAS
 ALTERNATIVE 2

PROJECT NO. 50191103

FIG 8

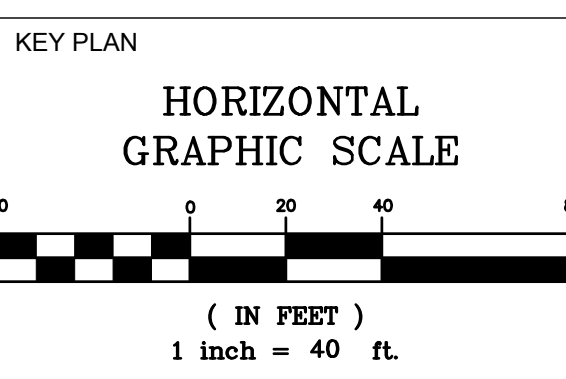


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OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION

SEAL



| LEGEND | | | |
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| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | 30' ZONE 1 JORDAN RIPARIAN BUFFER | | 8" CONCEPTUAL SEWER MAIN ALIGNMENT |
| | 20' ZONE 2 JORDAN RIPARIAN BUFFER | | PROPERTY BOUNDARY |
| | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) | | STREAM CENTERLINE |
| | 50' MANAGED USE ZONE (100' RCD) | | WETLAND |
| | 50' UPLAND ZONE (150' RCD) | | EXISTING CONTOURS |

GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.

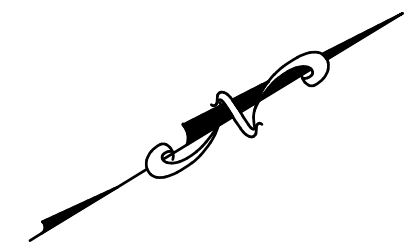
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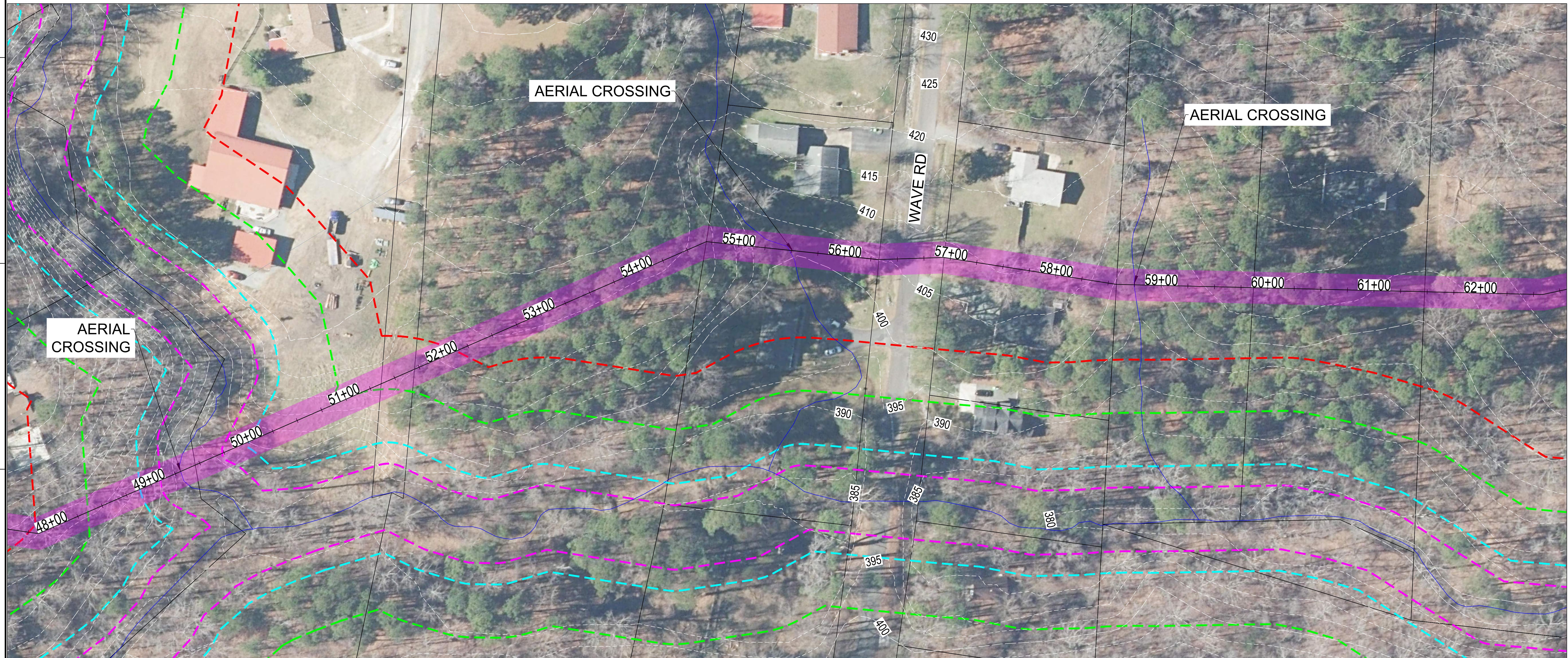
FOCUS AREA
 2018 SHAGBARK CT

PROJECT NO. 50191103

FIG 10

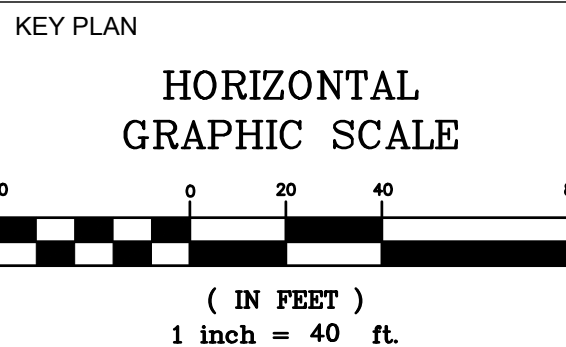


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OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION

SEAL



| LEGEND | | | |
|----------|---|----------|------------------------------------|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | 30' ZONE 1 JORDAN RIPARIAN BUFFER | | 8" CONCEPTUAL SEWER MAIN ALIGNMENT |
| | 20' ZONE 2 JORDAN RIPARIAN BUFFER | | PROPERTY BOUNDARY |
| | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) | | STREAM CENTERLINE |
| | 50' MANAGED USE ZONE (100' RCD) | | EXISTING CONTOURS |
| | 50' UPLAND ZONE (150' RCD) | | |

GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.

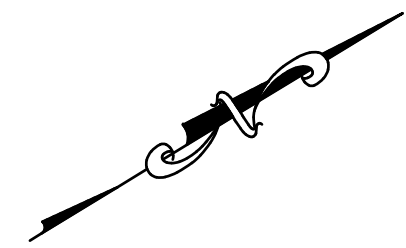
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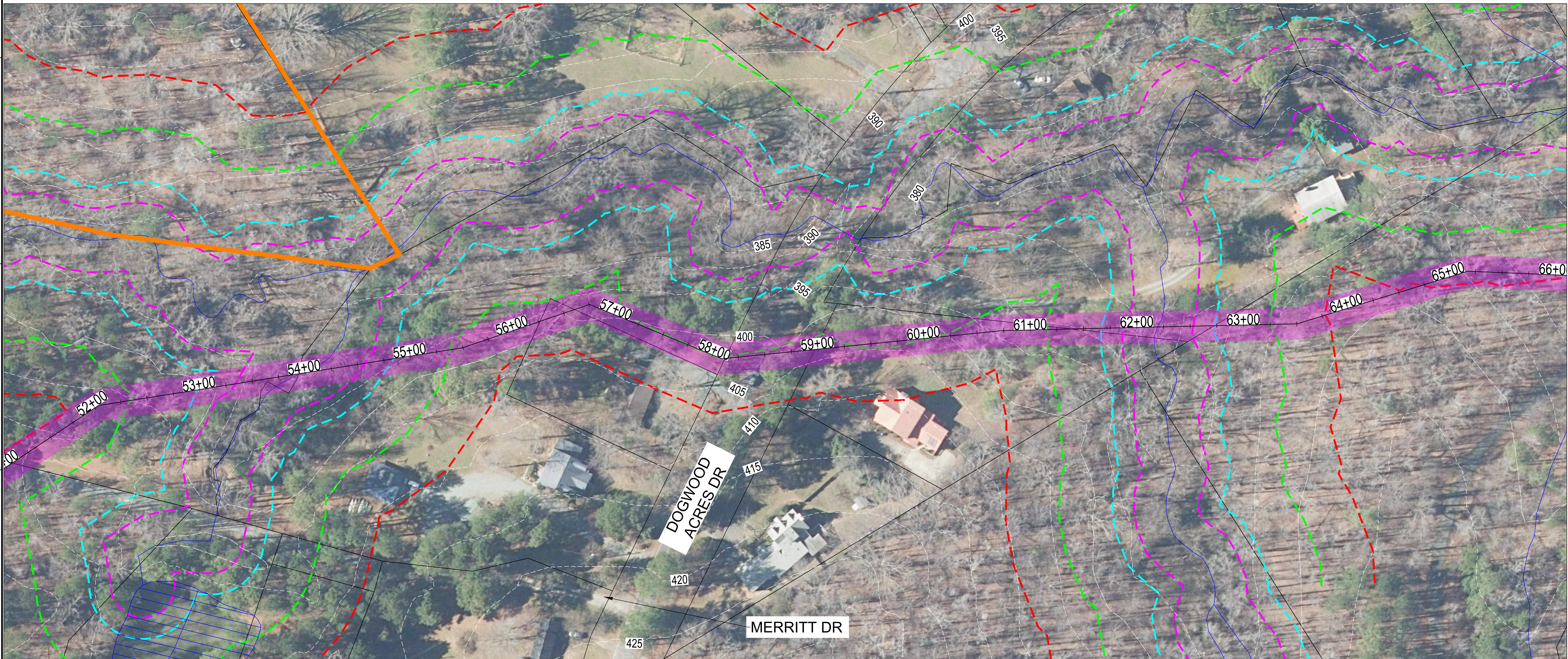
TITLE
**FOCUS AREA
 WAVE RD**

PROJECT NO. 50191103

FIG 11
 PRELIMINARY ENGINEERING REPORT

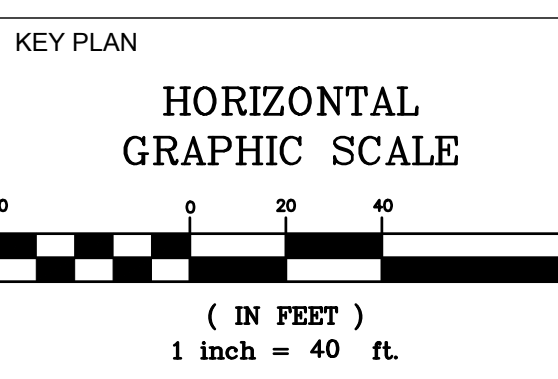


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OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION

SEAL



| LEGEND | | | |
|----------|---|----------|------------------------------------|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | 30' ZONE 1 JORDAN RIPARIAN BUFFER | | 8" CONCEPTUAL SEWER MAIN ALIGNMENT |
| | 20' ZONE 2 JORDAN RIPARIAN BUFFER | | PROPERTY BOUNDARY |
| | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) | | STREAM CENTERLINE |
| | 50' MANAGED USE ZONE (100' RCD) | | WATERBODY |
| | 50' UPLAND ZONE (150' RCD) | | EXISTING CONTOURS |
| | WASMPBA BOUNDARY | | |

GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.

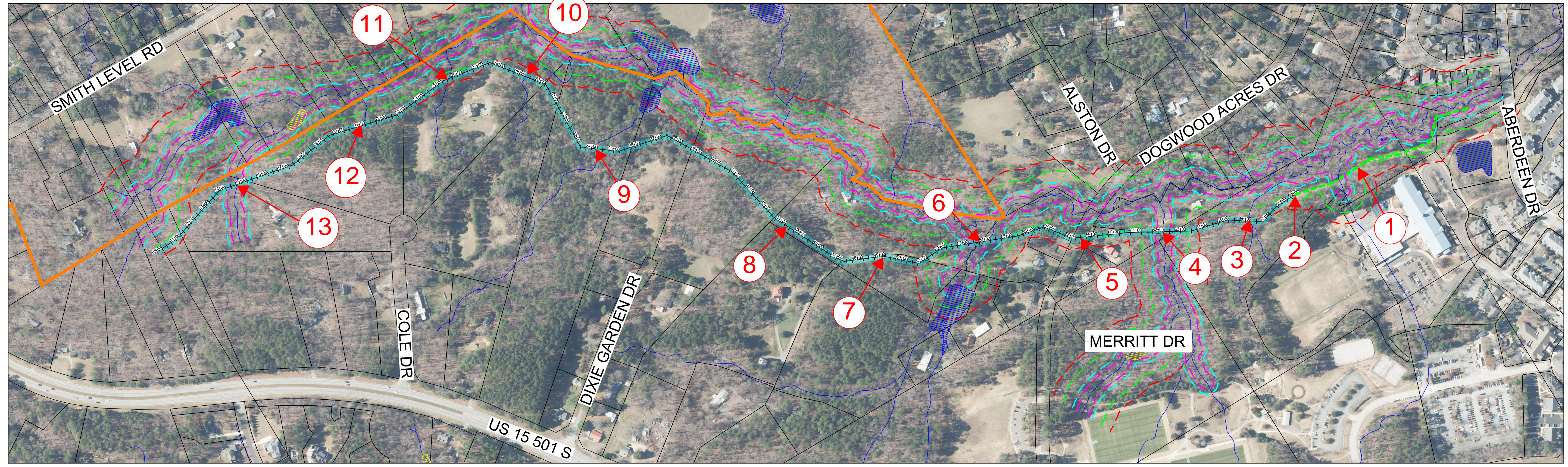
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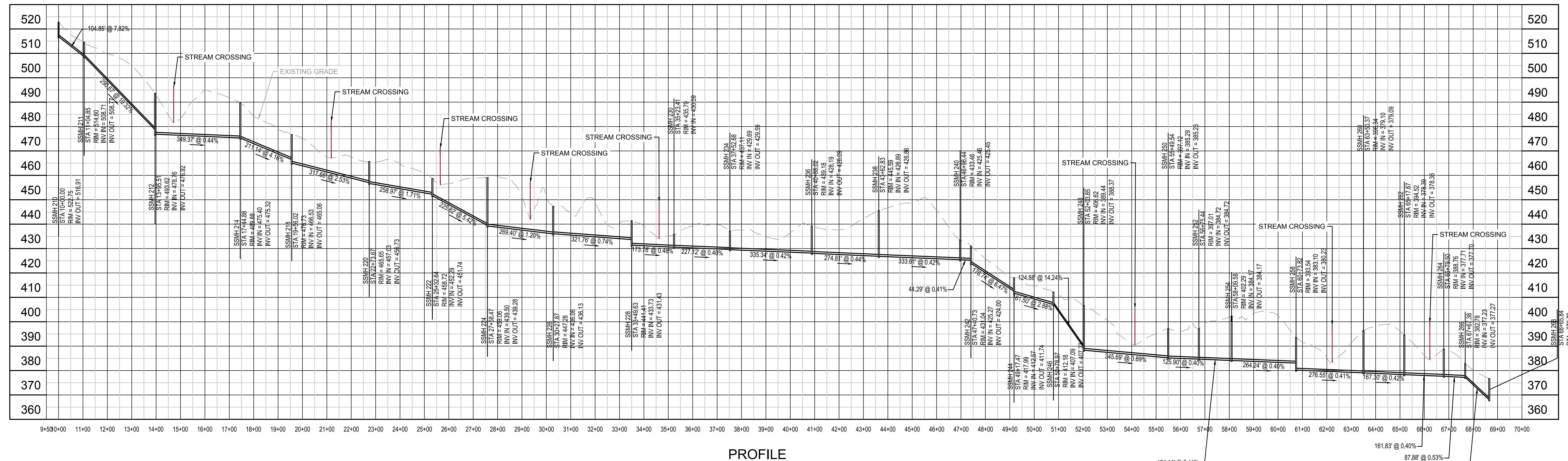
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**FOCUS AREA
 DOGWOOD ACRES DR**

PROJECT NO. 50191103

FIG 10
 PRELIMINARY ENGINEERING REPORT



PLAN



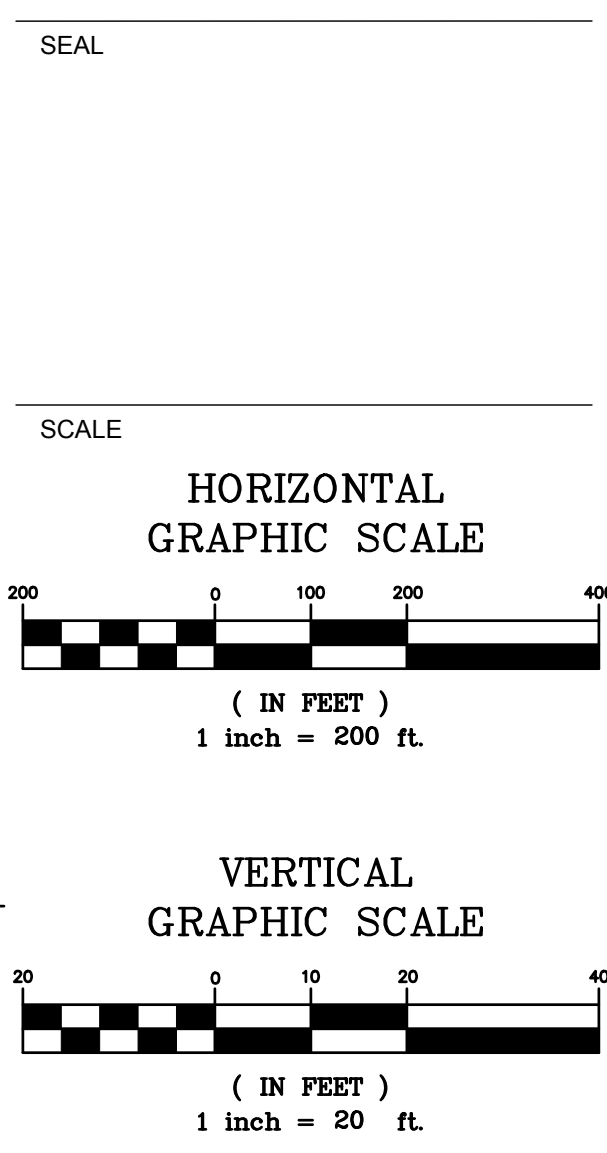
PROFILE

| LEGEND | | | |
|----------|---|----------|------------------------------------|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | 30' ZONE 1 JORDAN RIPARIAN BUFFER | | PROPERTY BOUNDARY |
| | 20' ZONE 2 JORDAN RIPARIAN BUFFER | | EX. SEWER MAIN |
| | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) | | STREAM CENTERLINE |
| | 50' MANAGED USE ZONE (100' RCD) | | WATERBODY |
| | 50' UPLAND ZONE (150' RCD) | | WETLAND |
| | WASMPBA BOUNDARY | | 8" CONCEPTUAL SEWER MAIN ALIGNMENT |

| Fan Branch Creek | |
|------------------|---|
| POINT # | DESCRIPTION |
| 1 | Existing Sanitary Sewer - with cleared corridor along the Fan Branch Trail mixed use greenway in Southern Community Park |
| 2 | Connection point of proposed gravity sewer to existing sewer system |
| 3 | Stream Crossing - Ephemeral stream. Trenchless installation under stream encased in concrete. |
| 4 | Stream Crossing - Perennial stream. Trenchless installation under stream encased in concrete. Topography - Hills and Valleys here will require deep installation and special considerations |
| 5 | Road Crossing - Cross Underneath Dogwood Acres Dr (SR1962) |
| 6 | Stream Crossing - Perennial stream. Trenchless installation under stream encased in concrete. |
| 7 | Install gravity sewer in Merritt Drive 10' from the water main in this area. Existing water main easement. |
| 8 | Topography - Hills and Valleys along Merritt Road will require deep installation and special considerations |
| 9 | Stream Crossing - Unknown stream. Trenchless installation under stream encased in concrete. |
| 10 | Stream Crossing - Unknown stream. Trenchless installation under stream encased in concrete. |
| 11 | Stream Crossing - Unknown stream. Trenchless installation under stream encased in concrete. |
| 12 | Stream Crossing - Unknown stream. Trenchless installation under stream encased in concrete. |
| 13 | Stream Crossing - Intermittent stream. Trenchless installation under stream encased in concrete. |

GENERAL NOTES:

1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.

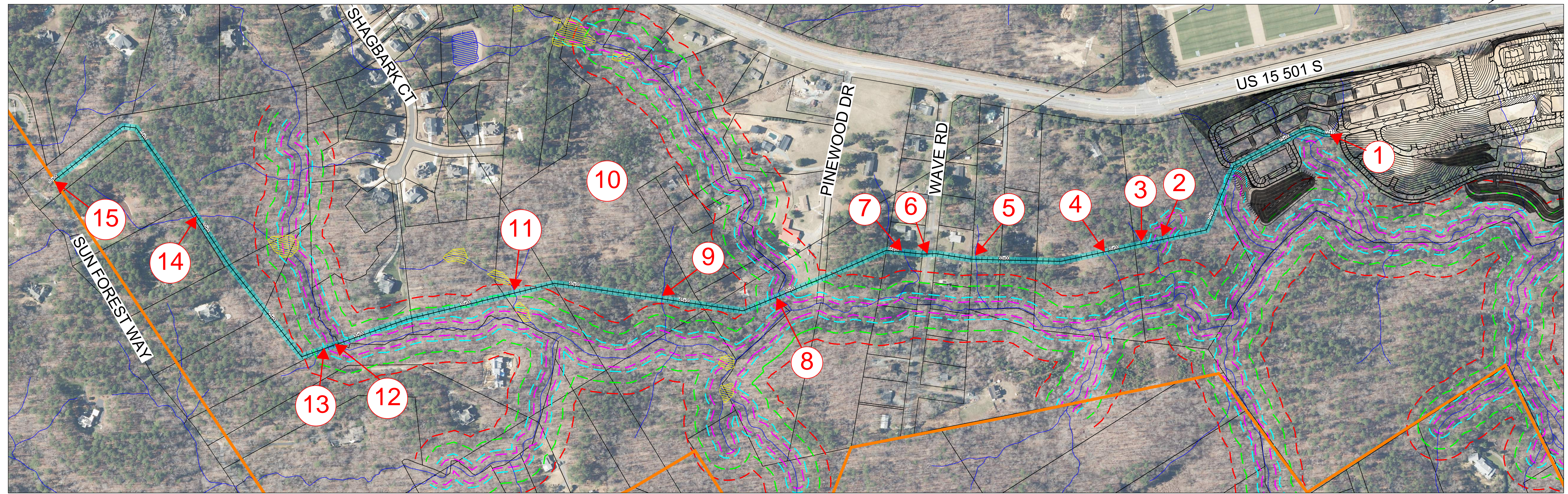


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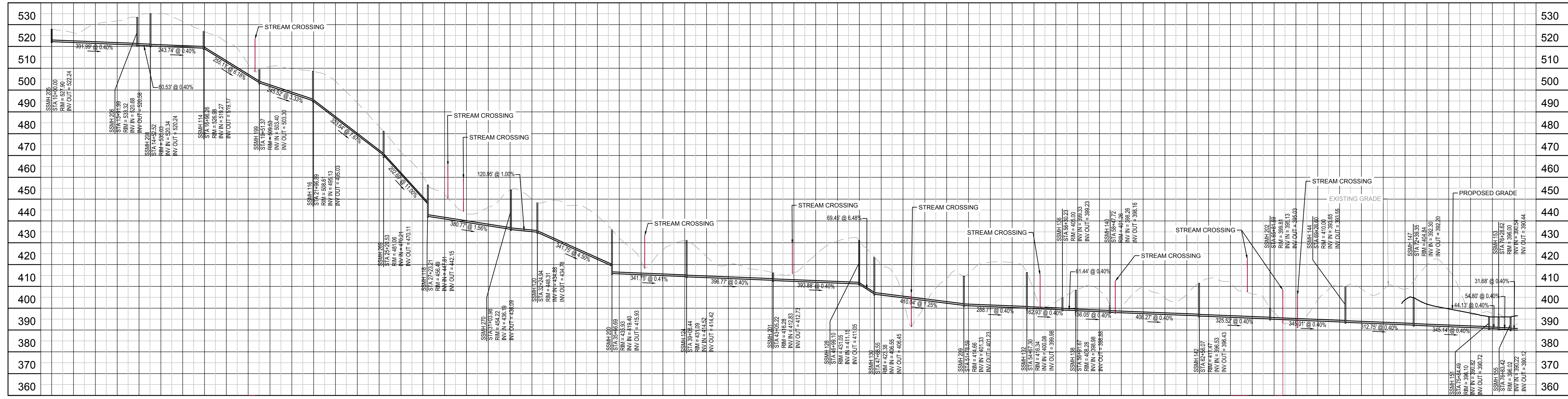
PLAN & PROFILE
FAN BRANCH

PROJECT NO. 50191103

OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION



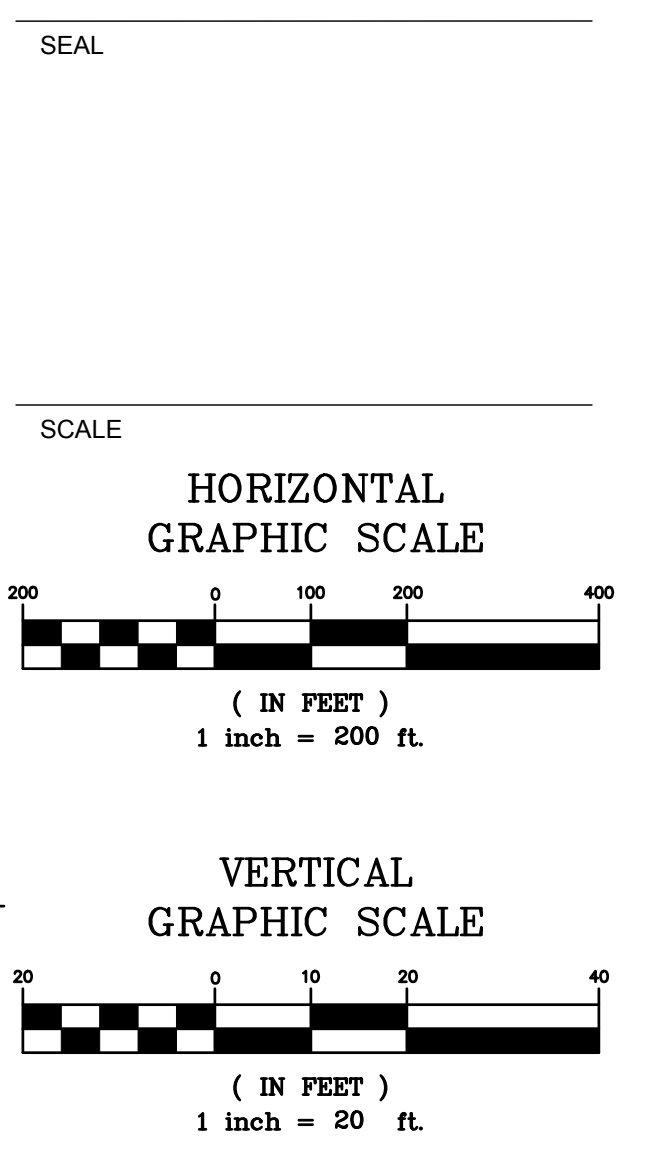
PLAN



| LEGEND | | LEGEND | |
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| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | 30' ZONE 1 JORDAN RIPARIAN BUFFER | | PROPERTY BOUNDARY |
| | 20' ZONE 2 JORDAN RIPARIAN BUFFER | | STREAM CENTERLINE |
| | 50' JORDAN BUFFER / STREAMSIDE ZONE (50' RCD) | | WATERBODY |
| | 50' MANAGED USE ZONE (100' RCD) | | WETLAND |
| | 50' UPLAND ZONE (150' RCD) | | WASMPBA BOUNDARY |
| | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | |

| PROFILE | |
|---------|---|
| POINT # | DESCRIPTION |
| 1 | Connection point of proposed gravity sewer to an existing sewer system located at the South Creek Development (Mixed Use development with its own sewer system that connects to the greater OWASA system) |
| 2 | Stream Crossing - Intermittent stream. Aerial crossing needed with I-beam support. |
| 3 | Stream Crossing - Ephemeral stream. Aerial crossing needed with I-beam support. |
| 4 | Stream Crossing - Ephemeral stream. Trenchless installation under stream encased in concrete. |
| 5 | Stream Crossing - Ephemeral stream. Aerial crossing needed with I-beam support. |
| 6 | Road Crossing - Cross Underneath Wave Rd (SR2002) - NCDOT permitting required |
| 7 | Stream Crossing - Unknown stream. Aerial crossing needed with I-beam support. |
| 8 | Stream Crossing - Perennial stream. Aerial crossing needed with I-beam support. |
| 9 | Stream Crossing - No channel classification. Trenchless installation under stream encased in concrete. |
| 10 | Angelic Acres / Flintrock Knoll LLC - Residential development plan that would connect to proposed sewer |
| 11 | Stream Crossing - Ephemeral stream. Trenchless installation under stream encased in concrete. |
| 12 | Stream Crossing - Perennial stream. Trenchless installation under stream encased in concrete. |
| 13 | Stream Crossing - Ephemeral stream. Trenchless installation under stream encased in concrete. |
| 14 | Stream Crossing - No channel classification. Trenchless installation under stream encased in concrete. |
| 15 | End of OWASA Southern Boundary Service Area |

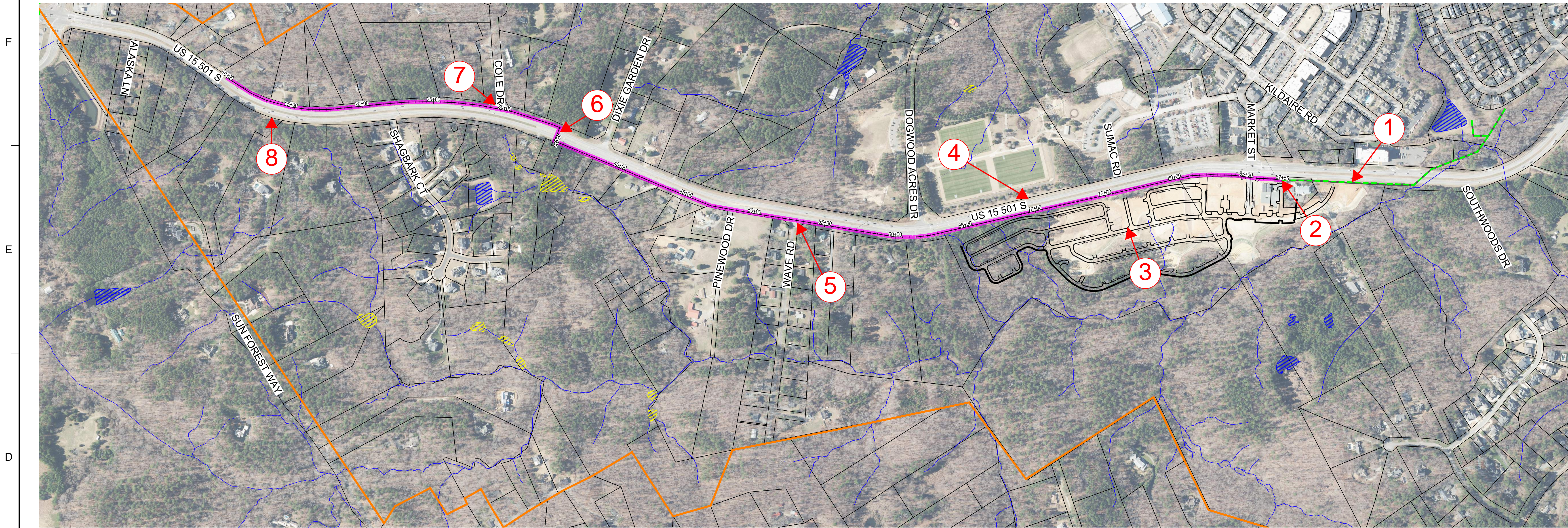
- GENERAL NOTES:**
1. STREAM BUFFERS SHOWN ON THIS FIGURE ARE DELINEATED FROM THE APPROXIMATE STREAM CENTERLINE, NOT THE TOP OF BANK.
 2. NO FLOODPLAIN OR FLOODWAY IS SHOWN ON THESE DRAWINGS. NO STRUCTURES ARE PROPOSED WITHIN ANY DESIGNATED FLOODPLAIN OR FLOODWAY.



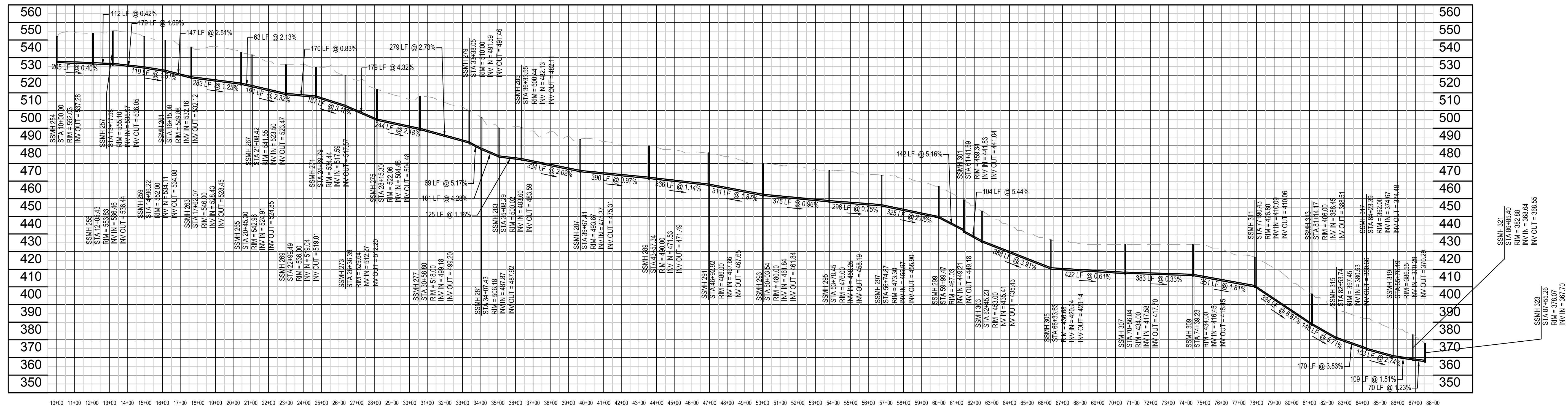
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PLAN & PROFILE
WILSON CREEK

PROJECT NO. 50191103



PLAN

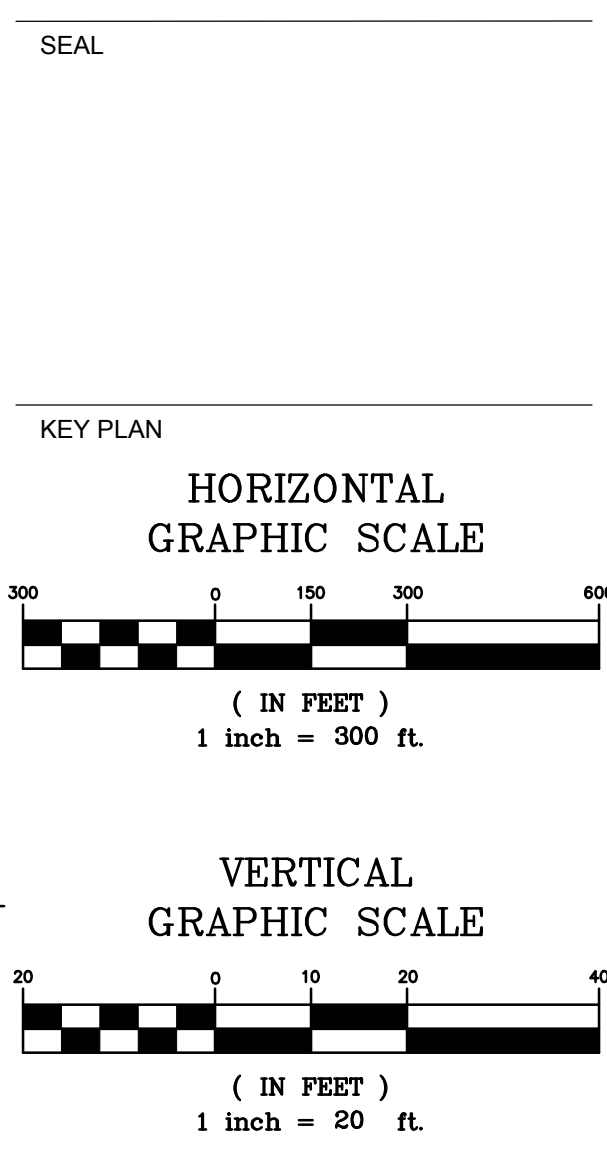


PROFILE

| US 15-501 Gravity Sewer | |
|-------------------------|---|
| POINT # | DESCRIPTION |
| 1 | Existing Sanitary Sewer |
| 2 | Connection point of proposed gravity sewer to existing sewer system |
| 3 | South Creek Development – Mixed Use development with its own sewer system that connects to the greater OWASA system |
| 4 | Existing Water Main – Alignment begins on the west side of the US 15-501 shoulder to avoid a water main. |
| 5 | Road Crossing - Crossing under Wave Road (paved) by open cut or jack and bore |
| 6 | Road Crossing - Crossing under US 15-501 (paved) by jack and bore with casing |
| 7 | Road Crossing - Crossing under Cole Drive (paved) by open cut or jack and bore |
| 8 | Existing Water Main – Alignment begins on the west side of the US 15-501 shoulder to avoid a water main. |

| LEGEND | | | |
|----------|------------------------------------|----------|------------------|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| | PROPERTY BOUNDARY | | WASMPBA BOUNDARY |
| | STREAM CENTERLINE | | WATERBODY |
| | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | WETLAND |
| | EX. 8" SEWER MAIN | | |

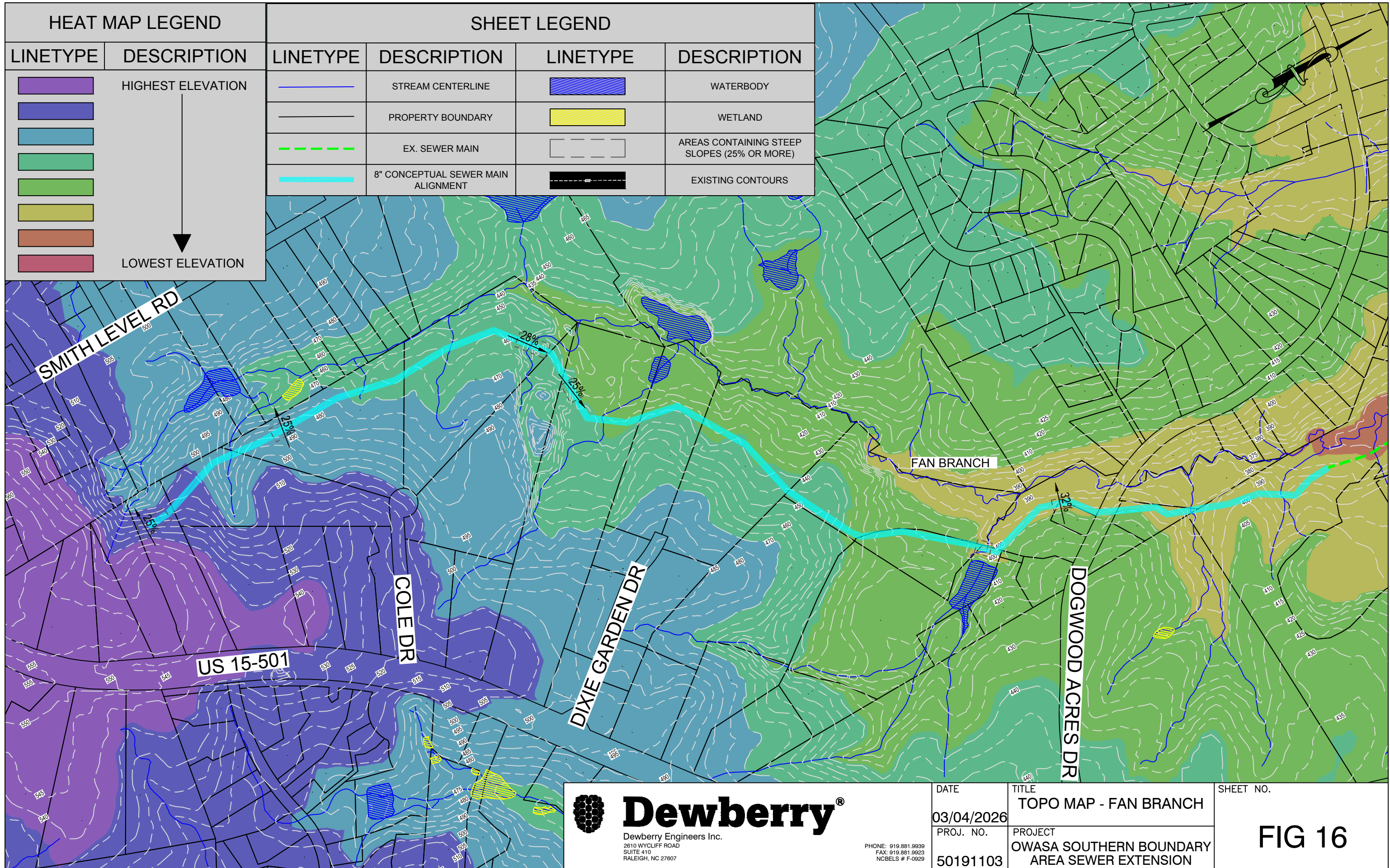
OWASA SOUTHERN BOUNDARY
 AREA SEWER EXTENSION



| No. | DATE | BY | DESCRIPTION |
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PLAN & PROFILE
 US 15-501

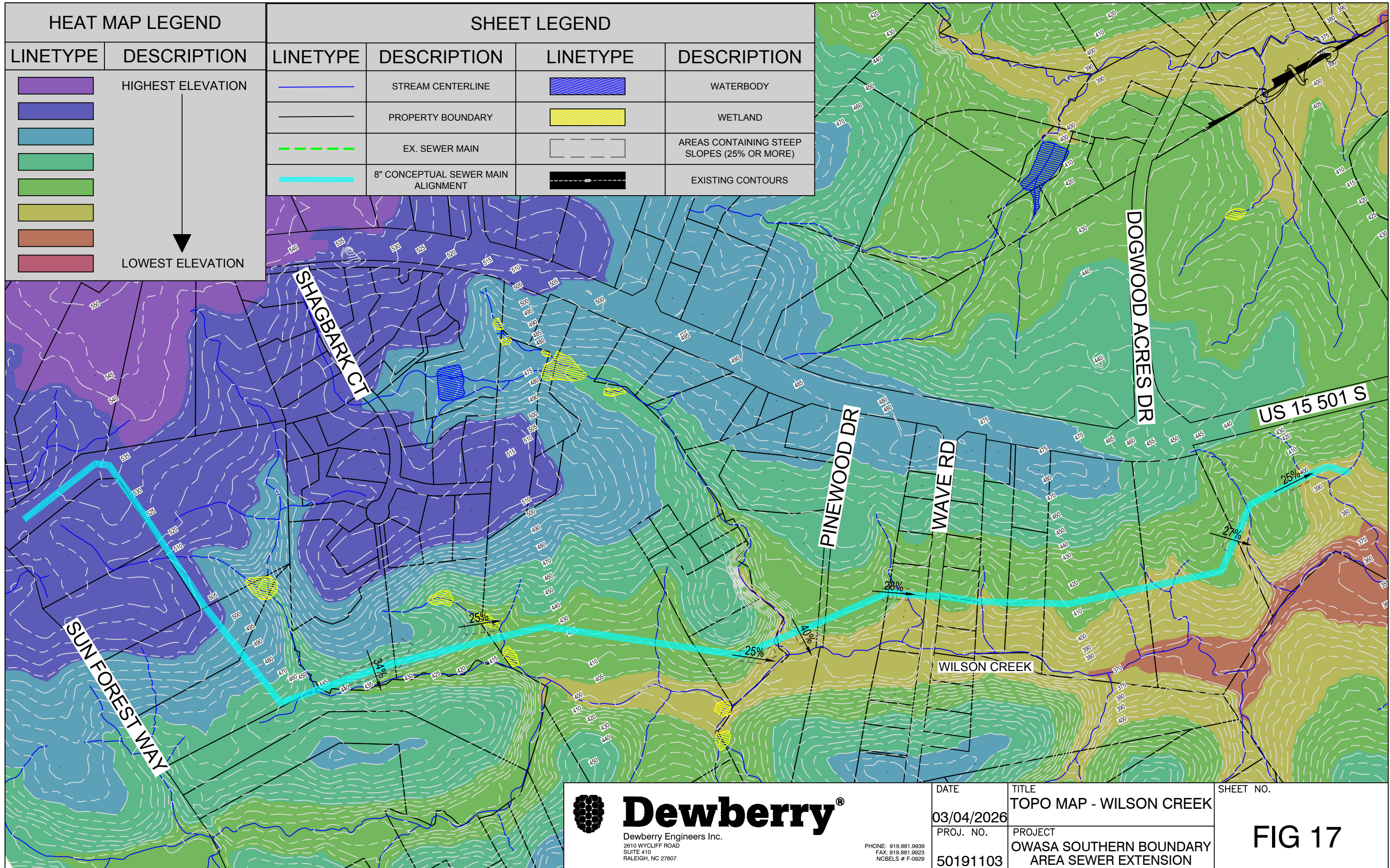
PROJECT NO. 50191103



| HEAT MAP LEGEND | |
|-------------------|-------------------|
| LINETYPE | DESCRIPTION |
| [Purple Box] | HIGHEST ELEVATION |
| [Dark Blue Box] | |
| [Light Blue Box] | |
| [Green Box] | |
| [Light Green Box] | |
| [Yellow Box] | |
| [Orange Box] | |
| [Red Box] | LOWEST ELEVATION |

| SHEET LEGEND | | | |
|---------------------|------------------------------------|--------------------------------|---|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| [Blue Line] | STREAM CENTERLINE | [Blue Hatched Box] | WATERBODY |
| [Black Line] | PROPERTY BOUNDARY | [Yellow Hatched Box] | WETLAND |
| [Green Dashed Line] | EX. SEWER MAIN | [White Box with Dashed Border] | AREAS CONTAINING STEEP SLOPES (25% OR MORE) |
| [Cyan Line] | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | [Black Dashed Line] | EXISTING CONTOURS |

| | | | |
|--|---|-----------------------|-----------|
| <p>Dewberry[®] Dewberry Engineers Inc. 2610 WYCLIFF ROAD SUITE 410 RALEIGH, NC 27607</p> | DATE | TITLE | SHEET NO. |
| | 03/04/2026 | TOPO MAP - FAN BRANCH | |
| | PROJ. NO. | PROJECT | |
| 50191103 | OWASA SOUTHERN BOUNDARY AREA SEWER EXTENSION | FIG 16 | |



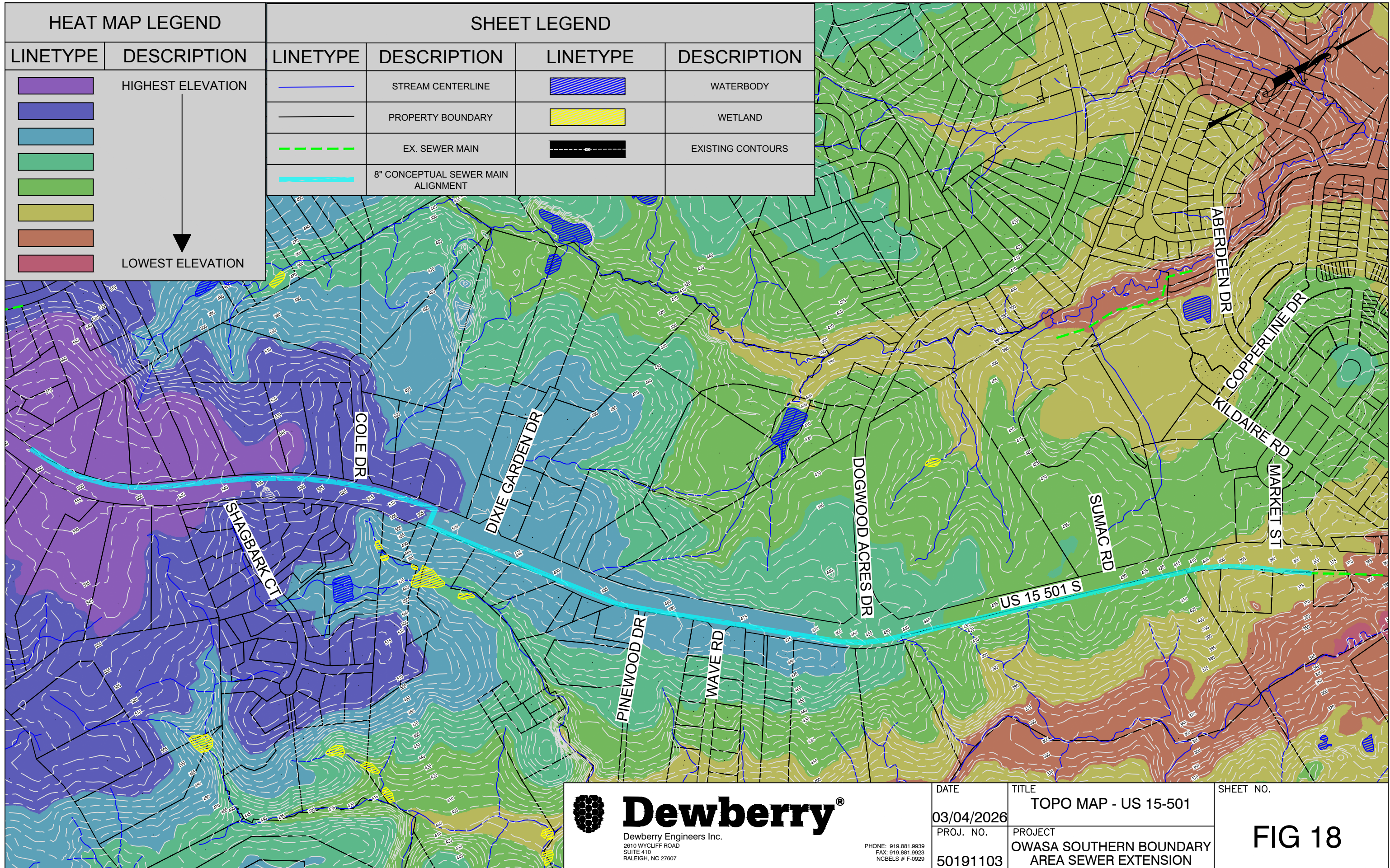
Dewberry Engineers Inc.
2610 WYCLIFF ROAD
SUITE 410
RALEIGH, NC 27607

PHONE: 919.881.9939
FAX: 919.881.9923
NCBELS # F-0929

DATE
03/04/2026
PROJ. NO.
50191103

TITLE
TOPO MAP - WILSON CREEK
PROJECT
OWASA SOUTHERN BOUNDARY
AREA SEWER EXTENSION

SHEET NO.
FIG 17



| HEAT MAP LEGEND | |
|--------------------|-------------------|
| LINETYPE | DESCRIPTION |
| [Purple Box] | HIGHEST ELEVATION |
| [Blue Box] | |
| [Light Blue Box] | |
| [Green Box] | |
| [Light Green Box] | |
| [Yellow-Green Box] | |
| [Orange Box] | |
| [Red Box] | LOWEST ELEVATION |

| SHEET LEGEND | | | |
|---------------------|------------------------------------|----------------------|-------------------|
| LINETYPE | DESCRIPTION | LINETYPE | DESCRIPTION |
| [Blue Line] | STREAM CENTERLINE | [Blue Hatched Box] | WATERBODY |
| [Black Line] | PROPERTY BOUNDARY | [Yellow Hatched Box] | WETLAND |
| [Dashed Green Line] | EX. SEWER MAIN | [Black Dashed Line] | EXISTING CONTOURS |
| [Cyan Line] | 8" CONCEPTUAL SEWER MAIN ALIGNMENT | | |

| | | | |
|--|------------|---|---------------|
| <p>Dewberry[®] Dewberry Engineers Inc. 2610 WYCLIFF ROAD SUITE 410 RALEIGH, NC 27607</p> | DATE | TITLE | SHEET NO. |
| | 03/04/2026 | TOPO MAP - US 15-501 | |
| | PROJ. NO. | PROJECT | |
| 50191103 | 50191103 | OWASA SOUTHERN BOUNDARY AREA SEWER EXTENSION | FIG 18 |