

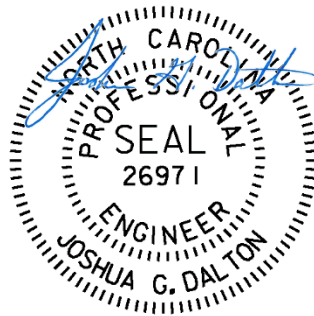
PRELIMINARY ENGINEERING REPORT

PHASES 1, 2, 3, 4, 5, 6 and 7

Stormwater Management Master Plan

City of Boiling Spring Lakes

Brunswick County, NC



5-6-2021

PREPARED BY:



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I. Project Background

Sungate Design Group, P.A. (Sungate) was contracted by the City of Boiling Spring Lakes (BSL) to develop a Stormwater Management Master Plan (SMP). The SMP consists of delineating and mapping the existing drainage patterns, ditch locations, and major outfalls for drainage areas greater than 5 acres within the City limits using a combination of available contour and aerial photograph data. This data is being compiled into a database map using ArcGIS software with the ultimate goal of protecting critical drainageways, to ensure no disruption of flows due to new development or modifications to existing permitted lots. For the study, BSL was divided into 7 areas for a phased approach (see Attachment A). This report currently addresses all seven Phases.

The study area for Phase 1 is bounded by the Military Ocean Terminal Sunny Point (MOTSU) railroad line to the east, Pine Road and North Lake to the west, BSL city limits to the north, and Patricia Lake to the south. The currently undeveloped areas to the north and west of Juniper Road were not included in Phase 1.

The study area for Phase 2 is bounded by the MOTSU railroad line to the east, NC 87 to the west, Patricia Lake to the north, and Fifty Lakes Drive to the south.

The study area for Phase 3 is bounded by the Allen Creek to the north, Fifty Lakes Drive to the south, MOTSU railroad line to the west, and BSL city limits to the east.

The study area for Phase 4 is bounded by Pine Road to the east, NC 87 to the west, the BSL city limits to the north, and Patricia Lake to the south.

The study area for Phase 5 is bounded by the MOTSU railroad line to the west, Allen Creek to the south, the BSL city limits to the north and east.

The study area for Phase 6 is bounded by Fifty Lakes Drive to the north, BSL city limits to the south and east, and NC 87 to the west.

The study area for Phase 7 is bounded by NC 87 to the east and BSL city limits to the north, south, and west.

II. Data Collection

Sungate obtained the Quality Level 2 Light Detection and Ranging data (QL2 LiDAR) from the NC Spatial Data website. After extensive review of the available data, Sungate determined that it was not adequate to depict the level of detail required to determine existing drainage patterns and complete the SMP.

Sungate supplemented the LiDAR data with visual and conventional field surveys using a Trimble R8S GNSS (global navigation satellite system) receiver using Spectra Precision Survey Pro software. This device connects to a network of satellites, each of which measures distance between itself and the receiver and reports the receiver location. Connection to the North



Carolina Geodetic Survey Real-Time Network (NCGS RTN) allows for real time correction of location data. This method of data collection is preferable to conventional survey in this context because it mitigates the need for multiple total station setup locations and vastly streamlines the survey process. Key drainage features within Phases 1 through 6 including ditch lines, crests, sags, and cross pipes were surveyed in order to obtain critical elevation data. Data collected in 2014 by Sungate for preliminary drainage studies was used to supplement the current study.

On July 18, 2019, Sungate met with BSL Board of Commissioner Mark Stewart and BSL Public Works Director Michael Mack. Sungate and the BSL representatives drove along all roads within Phase 1 and discussed existing drainage patterns and areas that experience regular flooding issues. Sungate completed additional data collection surveys on multiple days after the initial field visit.

III. General Recommendations

During the course of our field observations, it was apparent that most of the ditches in the city were full of sand and debris. At most of the driveways, only the top portion the driveway pipe, if at all, was visible. Cross pipes, where found, were typically half buried with several completely buried.

Below are several general recommendations that can be applied throughout the City limits:

A. Ditch Maintenance Program

Sungate recommends that BSL develop a proactive Ditch Maintenance Program to inspect and clean out ditches on regular intervals. Typical ditches should be a minimum of one foot deep and provide positive drainage toward an outfall. During these regular operations, maintenance staff can assess problem areas and define action plans.

Due to the sandy soils present in the city, ditches with side slopes 3:1 (horizontal:vertical) or flatter are recommended where possible. If slopes steeper than 3:1 are required, permanent slope stabilization methods (matting, sod, or stone) should be used to prevent ditch slope erosion.

Prior to completing any ditch modifications, the City or contractor should contact the NC One Call Center (811) to verify the location of existing underground utilities.

As a general recommendation, the City should attempt to use ditches instead of pipes where possible. Ditches provide a much greater flow capacity than pipes and are easier to clean out and maintain.

The NCDOT should be included in the Ditch Maintenance Program and any substandard ditches with their right of way identified. For any proposed modifications that will be completed by the City within existing NCDOT right-of-way, encroachment agreements will be required.



B. Acquire Permanent Drainage Easements

After reviewing the plat maps for Phases 1 through 7 there are several drainage easements shown along property lines between lots. However, the easements are very narrow (10' wide or less) and not adequate for ditches. These appear to be private easements with no associated ditching.

Based on our field observations, there are several ditches that cross private lots that provide drainage for surrounding lots which are critical to the overall network of drainage ditches. These drainage ditches have not been maintained by the property owners with some entirely filled.

Sungate recommends that BSL acquire permanent drainage easements where possible so maintenance of ditches can be completed as part of an annual program. Where permanent easements are not an option, we recommend creating maintenance agreements with the property owners that allows City staff to access and maintain critical drainage features.

C. Pipe Replacement Recommendations

Based on our field observations, there are a considerable number of existing cross pipes that are smaller than 18-inches in diameter. When pipes are being replaced, a qualified professional engineer should properly size the cross pipe to handle runoff from the 25-year storm event on City streets. A minimum pipe diameter of 18-inches is recommended for cross pipes as well as new driveway pipes. The larger diameter pipe will allow for easier cleanout during routine maintenance. In some instances, due to minimal cover over the pipe, multiple pipes or arch pipes may be necessary to adequately handle the storm flows.

Several of the existing pipes were noted as corrugated steel. In a coastal setting, steel pipe is not desirable and prone to corrosion and rusting. Severe corrosion was noted at multiple existing pipes. Polypropylene pipe (PP) or corrugated aluminum alloy pipe (CAAP) is recommended on City maintained streets. Reinforced concrete pipe (RCP) is recommended on NCDOT maintained streets.



IV. Site Specific Recommendations

Below are specific site recommendations based on field survey data. All recommendations are preliminary, and no final designs have been completed. Each site will need to have detailed surveys, final construction plans, and technical specifications completed prior to implementation.

Each site has been classified according to severity based on the following table:

Level	Priority	Notes
1	Critical	Flooding impacts emergency vehicle access and evacuation routes along major roads.
2	High	Major flooding impacts to neighborhood roads and/or buildings above the finished floor elevation.
3	Medium	Minor flooding impacts to neighborhood roads and/or buildings but not above the finished floor elevation.
4	Low	Nuisance flooding or general maintenance item. Does not impact roads or buildings.

The recommendations included in this report are preliminary and no work should be undertaken until final construction plans are completed. Construction plans consisting of grading plans, storm drainage, sediment and erosion control plans, with all pertinent details should be completed prior to applying for any permits.



PHASE 1

The study area for Phase 1 is bounded by the Military Ocean Terminal Sunny Point (MOTSU) railroad line to the east, Pine Road and North Lake to the west, BSL city limits to the north, and Patricia Lake to the south. The currently undeveloped areas to the north and west of Juniper Road were not included in Phase 1 in order to expedite the field surveys. These areas will be added at a later date.

Site 1.05-1:

Level 2 – Areas along Walnut, Holly, and Redwood Roads have low areas with no apparent outfall and experience significant flooding. For the portion of the study area generally bounded by Crabapple Road to the south, Walnut Road to the north, middle of the blocks on Walnut and Holly to the west, and the Military Ocean Terminal Sunny Point (MOTSU) railroad line to the east, refer to the Preliminary Engineering Report titled *Holly, Walnut, and Redwood Roads Preliminary Drainage Study* dated 7/24/2014 previously completed by Sungate for recommendations.

Site 1.05-2

Level 3 – The existing 12” HDPE pipe is buried and full of sediment. The pipe is also considerably undersized. Recommend replacing with 18” pipe.

Site 1.05-3

Level 3 – There is an existing ditch that connects from Crabapple to Sycamore to Elm to Cherry. The existing ditch is heavily wooded and has not been maintained. The ditch is located along the property line between 6 lots. Recommend acquiring permanent drainage easements or maintenance agreements and cleaning out the ditches to provide positive drainage. The 15” HDPE pipe under Crabapple, 18” HDPE pipe under Sycamore, and the 24” HDPE pipe under Elm should be cleaned out.

Site 1.05-4

Level 3 – The inlet end of an existing 18” corrugated metal pipe (CMP) is visible on the east side of Cherry Road. However, the outlet end was not found on the west side of the road. The pipe is not functioning which causes runoff to be conveyed toward the southeast by the ditch along the east side of Cherry road. Replacement of the pipe is not recommended as the current configuration uses ditches along both sides of Cherry to convey flow. Also, flow from the west side crosses to the east side through an existing 48” CMP approximately 850 feet southeast of the existing pipe.

Recommend cleaning out the ditch along the east side of Cherry Road from the inlet end of the 18” CMP to the first driveway (approximately 260 feet toward the southeast) to provide positive drainage.



Site 1.05-5

Level 3 – There is a sag on Sycamore Road approximately 550' northwest of the intersection with Bay Street with no apparent outfall. It is recommended to install a cross pipe under Sycamore Road approximately 380' northwest of the intersection with Bay Street and install a ditch from Sycamore to Elm Road along the property line between Parcels 142GD016-142GD014 and 142GD008-142GD009. An easement or maintenance agreement will need to be obtained for the affected parcels.

The ditch installed in this easement will tie to an existing 15" CMP under Elm Road. Recommend replacing the existing pipe with a 24" pipe.

Between Elm Road and Cherry Road, there is an existing ditch that has not been maintained. Recommend reconstructing the ditch along the property line between Parcels 142GC00901-142GC009 and 142GC001-142GC002. An easement or maintenance agreement will need to be obtained for the affected parcels.

Site 1.05-6

Level 3 – The existing 12" CMP on Cedar Road, approximately 300' southeast of the intersection with Juniper Road, is in poor condition and was completely buried. It is recommended that this cross pipe be replaced with an 18" pipe.

Site 1.05-7

Level 3 – There is an existing ditch that connects the cross pipe under Cedar (Site 1.05-6) to an existing channel at the rear of Parcels 142GB004-142GB005. The existing ditch is heavily wooded and has not been maintained. Recommend cleaning out the ditch and obtaining a permanent drainage easement or maintenance agreement.

Site 1.05-8

Level 4 – The side slopes for the roadway ditches along Cherry Road from approximately 320' Southeast of intersection with Juniper Road to the intersection with Bay Street are steep (approximately 1:1) and susceptible to soil erosion. It is recommended that the ditch side slopes in this region be flattened to 3:1. While this will provide additional flow area within the ditches, the flow capacity is controlled by the existing driveway and cross pipe sizes.

This is a lower priority item and can be included as part of the Ditch Maintenance Program.

Site 1.05-9

Level 3 – There is a sag on Sycamore Road approximately 400' southeast of the intersection with Bay Street with no apparent outfall. It is recommended to install an 18" pipe under Sycamore Road and install a ditch from Sycamore to Elm Road along the property line between Parcels 142JF032-142JF031 and 142JF005-142JF006. An easement or maintenance agreement will need to be obtained for the affected parcels.



Site 1.05-10

Level 3 – There is an existing ditch that connects from Cedar Road to Cherry Road approximately 150' southeast of the intersection with Bay Street. The existing ditch is heavily wooded and has not been maintained. The ditch is located along the property line between parcels 142JD023-142JD024 and 142JD020-142JD019. Recommend acquiring permanent drainage easements or maintenance agreements and cleaning out the ditches to provide positive drainage.

The existing 12" CMP cross pipe located approximately 150' southeast of the intersection with Bay Street is clogged and undersized. Recommend replacing with an 18" pipe with a lower invert elevation.

Site 1.05-11

Level 3 – There is an existing sag on Ash Road approximately 575' northwest of the intersection with Bay Street with no apparent outfall. It is recommended to install an 18" pipe under Ash Road and regrade the ditches along Ash Road to drain toward the pipe. Install a ditch from Ash Road to Spring Lake along the property line between Parcels 142JA044-142JA043. An easement or maintenance agreement will need to be obtained for the affected parcels.

Site 1.05-12

Level 3 – The ditch along the west side of Cedar Road flows toward Bay Street from a crest approximately 900' northwest of the intersection. A cross pipe under Bay Street was not found which causes stormwater to flow across Bay Street into the yard at 195 Cedar Road. Recommend installing a cross pipe under Bay Street along the west side of Cedar Road. Install a ditch on the west side of Cedar Road from the new pipe outlet to the cross pipe (Site 1.05-10). Also, it is recommended to reestablish the roadway ditch along the south side of Bay Street from Ash Road to Cedar Road.

Site 1.06-1

Level 3 – There is an existing sag on both sides of Ash Road just northwest of the intersection with Bay Street with no apparent outfall. It is recommended that an 18" pipe be installed under Ash Road and a ditch constructed from Ash Road to Spring Lake across parcel 142JA034. An easement or maintenance agreement will need to be obtained for the affected parcels.

Site 1.06-2

Level 3 – There is an existing sag on the north side of East Boiling Springs Road (SR 1539) approximately 350' southwest of Ash Road with no apparent outfall. NCDOT should be contacted and a cross pipe investigated to provide drainage for this area.



Site 1.06-3

Level 3 – There is an existing sag on the north side of Cottage Road approximately 450' southwest of Canal Drive with no apparent outfall. It is recommended to install an 18" pipe to provide drainage for this area to Patricia Lake.

Site 1.06-4

Level 3 – A portion of the existing ditch on the south side of East Boiling Springs Road (SR 1539) flows toward the northeast with no cross pipe under Canal Drive. Recommend installing an 18" pipe under Canal Drive and reestablishing the ditch from Canal to the existing cross pipe under Lakewood Drive. An encroachment agreement with NCDOT will be required.

Site 1.06-5

Level 3 – There is an existing 15" CMP cross pipe on Cedar Road located approximately 135' northwest of the intersection with East Boiling Spring Road (SR 1539) that is in poor condition with bottom rusted out. Recommend replacing with an 18" pipe.

There is an existing ditch that connects from the cross pipe noted above on Cedar Road to Cherry Road. The existing ditch is heavily wooded and has not been maintained. The ditch is located along the property line between parcels 142JD038, 142JD001, 142JD002, 142JD003, 142JD004, and 142JD005. Recommend acquiring permanent drainage easements or maintenance agreements and cleaning out the ditch to provide positive drainage.

The ditch noted above flows through a recently installed 15" HDPE pipe under Cherry Road. There is an existing ditch that connects from the cross pipe to an existing channel at the back of the properties. The ditch is located along the property line between parcels 142JE026, 142JE027, and 142JE028. Recommend acquiring permanent drainage easements or maintenance agreements and cleaning out the ditch to provide positive drainage.

Site 1.06-6

Level 3 – The ditches along the east side of Elm Road and the north side of East Boiling Springs Road (SR 1539) flow toward a low point at the north corner of the intersection of the two roads. A cross pipe under Elm Road was not found and flow spills across Elm Road. Recommend installing a 24" pipe under Elm Road. An encroachment with NCDOT may be required.

Site 1.06-7

Level 3 – The ditches along the east side of Redwood Road and the north side of East Boiling Springs Road flow toward a low point at the north corner of the intersection of the two roads. A cross pipe under Redwood Road was not found and flow spills across Redwood Road. Recommend installing an 18" pipe under Redwood Road. An encroachment with NCDOT may be required.



PHASE 2

The study area for Phase 2 is bounded by the MOTSU railroad line to the east, NC 87 to the west, Patricia Lake to the north, and Fifty Lakes Drive to the south.

Site 2.02-1:

Level 3 – The existing cross pipe on Masters Drive, approximately 240' west of the northern intersection with Windmere Drive, was noted as being in poor condition during our field surveys. The existing outfall ditch through parcel 157PD003 is overgrown with vegetation and inhibits flow. Recommend replacing cross pipe (see general pipe replacement recommendations), and grading ditch from outlet end of pipe eastward along Masters Drive towards Windmere Drive, then north along Windmere Drive towards the existing 18" HDPE located approximately 480' north of Windmere Drive/Masters Drive intersection.

Site 2.02-2:

Level 3 – The existing 12" HDPE cross pipe on Masters Drive at the southern intersection with Windemere Drive was noted as being in poor condition during our field surveys. There is also an existing 15" pipe along the west side of Masters Drive that runs parallel to parcel 157PD012 and outlets at the pipe noted above. The inlet end of the pipe is RCP and appears to have been extended with HDPE. Immediately downstream, both pipes drain into an existing 12" HDPE pipe that extends approximately 300 feet from parcel 157PD012 to 157PD015. This pipe is undersized. Recommend replacing the 12" pipes with larger pipes (see general pipe replacement recommendations). Due to the minimal cover over the existing pipes, the new pipes would need to be deeper which would require grading at the system outlet to the outfall channel. Additional surveys will be necessary.

Site 2.02-3:

Level 3 – The existing cross pipe on Windemere Drive, approximately 365' northwest of the intersection with Birdie Lane is in poor condition. Recommend replacing with a larger cross pipe (see general pipe replacement recommendations). The inlet and outlet ditches are located within an existing City owned drainage easement. The inlet and outlet ditches are heavily wooded and have not been maintained. Recommend clearing and regrading the upstream and downstream ditches. According to Brunswick County GIS data, the existing easement is approximately 20' wide which should be sufficient for a ditch with a 3' base width 3' deep with 3:1 side slopes. The existing drainage easement width and location should be verified prior to construction.

Site 2.02-4:

Level 3 – The existing pipe under Windemere Drive at the intersection with Birdie Lane is undersized and in poor condition. The outfall ditch for this area is along the property line between parcels 157PD024 and 157PD025 and is overgrown and has not been maintained. In order to reach the outfall ditch, flow from the pipe under Windemere must travel around the cul-de-sac. Recommend replacing the pipe under Windemere Drive with a larger pipe and installing



a new cross pipe under Birdie Lane that aligns with the outfall ditch. Obtain Easement or maintenance agreement between parcels 157PD024 and 157PD025 and clear and reestablish the outfall ditch.

Site 2.03-1:

Level 3 – The existing ditches along Nicklaus Road drain to an existing 15” CMP which drains to a small pond that does not appear to have an outfall. Most of the surrounding lots are undeveloped. Prior to development of this area, recommend obtaining an easement along the property line between parcels 157BF012 and 157BF013 and establishing an outfall ditch across parcel 157BE00101 to the lake. The ditches along Nicklaus Road should be regraded to drain to a new pipe that aligns with the new outfall channel. Since this area is currently undeveloped and appears to have one owner, the outfall ditch location can be coordinated with the owner.

Site 2.03-2:

Level 2 – The pipe under South Shore Road, approximately 320’ south of intersection with Lisa Drive, is in poor condition. Scour was noted at both ends of the pipe. Recommend replacing with a larger cross pipe (see general pipe replacement recommendations).

Site 2.03-3:

Level 3 – The existing ditches along the east side of Crestview Drive and the north side of Lisa Drive appear to drain to the northeast corner of the intersection of the roads. A pipe to drain the area was not located during field surveys. Recommend installing a pipe under Lisa Drive and grading a ditch along the east side of South Shore Drive to Forest Lake.

Site 2.04-1:

Level 3 – The existing ditch along the south side of South Shore Drive flows from Tate Lake Drive to the intersection with South Shore Drive and Palmer Drive. A pipe under Palmer Drive was not located during field surveys. Currently, this area does not appear to drain to an outfall. Recommend installing a pipe under Palmer Drive and grading ditches to drain toward the south.

Site 2.04-2:

Level 3 – The ditches along both sides of Tate Lake Drive are flat and do not appear to drain properly. Some driveways have pipes installed in the ditch while several driveways do not. The ditch crests on Tate Lake Drive appear to be adjacent to parcels 157GB010 and 157GC011. Recommend regrading ditches from the crest to South Shore Drive in both directions. This will require installation and possibly replacement of driveway pipes. Recommend installing a pipe under Tate Lake Drive at the southern intersection with South Shore Drive. Improvements to the ditch from the proposed pipe outlet to Tate Lake will be necessary.



Site 2.04-3:

Level 3 – The following issues and recommendations are for the Twin Lakes neighborhood, including Twin Lakes Drive, South Twin Lakes Drive, and Summit Road which surround Silver Lake and Shadow Lake.

- 1) The ditches along the inside of the streets that encircle Shadow Lake formed by Twin Lakes Drive and Summit Road are filled in or not present with very few driveway pipes installed. Recommend grading ditches and installing driveway pipes to drain to the pipe under Twin Lakes Drive located adjacent to parcel 157FA010.
- 2) The outfall channel downstream of the existing pipe under Twin Lakes Drive on parcel 157FA004 is overgrown and has not been maintained. Recommend obtaining an easement or maintenance agreement and clearing the channel and regrading the outfall channel as necessary.
- 3) The ditch along the south side of the northern most Twin Lakes Drive entrance road appear to drain toward the intersection with Summit Road. However, no pipes were located during field surveys. Recommend installing a pipe under Twin Lake Drive and regrading ditches as necessary.
- 4) The ditch along the north side of South Twin Lakes Drive entrance road appear to drain toward the intersection with Summit Road. However, no pipes were located during field surveys. Recommend installing a pipe under Twin Lake Drive and regrading ditches as necessary.
- 5) Replace the existing pipe under Twin Lake Drive with a larger pipe.

Site 2.04-4:

Level 2 – For this site, reference the Preliminary Engineering Report dated July 9, 2014 previously completed by Sungate titled *Trevino, Souchak and Fifty Lakes Drive Preliminary Drainage Study*. Based on discussions with the City, the recommendations from the report were not implemented because adjacent property owners were not agreeable to easements or agreements necessary to complete the project.

Site 2.04-5:

Level 3 – Ditches along both sides of Batton Road appear to flow to low areas adjacent to parcel 157GF044 on the north side and parcel 157GF032 on the south side of the road with no apparent outfall. A pipe under Batton Road was not located during field surveys. Based on contour data and field surveys, the low area drains across parcel 157GF022 and eventually to the roadway ditch on the north side of Trevino Road. Based on site visits and available aerial photographs, parcel 157GF022 and adjacent parcel 157GF024 currently have new homes under construction. Grading from the construction could result in ponding and inadequate drainage on parcels 157GF031 and 157GF032. Recommend obtaining an easement and constructing a ditch on parcels 157GF032 and 157GF022 to the roadway ditch along the north side of Trevino Road.



Site 2.04-6:

Level 3 – The cross pipe on Boros Road approximately 370’ southwest of the intersection with Palmer Drive was noted as being in poor condition during our field surveys. The outlet ditch is heavily wooded and has not been maintained. The outlet ditch appears to be located within an existing City owned drainage easement. Recommend replacing the existing pipe with a larger cross pipe (see general pipe replacement recommendations). Recommend clearing and regrading the downstream outfall ditches are heavily wooded and have not been maintained. According to Brunswick County GIS, the existing easement is only 14-feet wide. The existing drainage easement width and location should be verified prior to construction. Additional easement width may be required in order to construct and maintain the outfall ditch.

Site 2.04-7:

Level 3 – The cross pipe on Boros Road at intersection with Palmer Drive on northern side was noted as being in poor condition during our field surveys. The inlet end of the pipe is almost entirely buried. The outlet end of pipe was completely buried and could not be located. Recommend replacing with a larger cross pipe. (see general pipe replacement recommendations).

Site 2.04-8:

Level 4 – The existing ditches on both sides of Littler Road drain toward the cul-de-sac. There is an existing berm that prevents the ditches from draining to the adjacent Green Lake. Recommend obtaining an easement or maintenance agreement between parcels 157GH003 and/or 157GH00101. Construct an outfall ditch from the roadway to Green Lake.

Site 2.04-9:

Level 3 – Several parcels along Nicklaus Road and Boros Road appear to be low areas with no apparent outfall. These parcels include 157GF121, 157GF122, 157GF171, 157GF170, 157GI032, and 157GI031. This area warrants an independent study with more extensive surveys and input from the City.

Site 2.04-10:

Level 3 – The cross pipe on Sanders Road at the intersection with Palmer Drive, was noted as being in poor condition during field survey on 10/2/2019. Outlet end appears damaged and blocked, Inlet end appears mostly buried. Recommend replacing with a larger cross pipe (see general pipe replacement recommendations).

Site 2.04-11:

Level 3 – At the intersection of Barber Road and Boros Road, there are two existing pipes that cross Barber Road. The inlet and outlet end of both pipes are both mostly buried. Recommend replacing the pipes with larger size (see general pipe replacement recommendations). The existing outfall drains across parcel 157GF150 toward the golf course. The outfall ditch is heavily wooded and not currently maintained. Recommend obtaining an easement between



parcels 157GF149 and 157GF148 and construct an outfall ditch to drain to the existing golf course ditch at the rear of the parcels.

Site 2.05-1:

Level 1 – The ditches on both sides of Fifty Lakes Drive drain from a crest point near the intersection with Morehead Road toward the east to the outfall ditch between Cardinal Road and the Military Ocean Terminal Sunny Point (MOTSU) railroad line. The drainage area for both ditches appears to be significant and the existing ditches appear to be well maintained; however, the existing driveway and cross pipes appear to be considerably undersized with all pipes 18-inches or smaller. Due to the proximity of the fire station and potential overtopping of Fifty Lakes Drive, this site warrants a Level 1 priority classification.

Sungate completed additional field surveys of the existing pipe under the railroad. The existing pipe is a 24” RCP and is significantly undersized. The drainage area is approximately 150 acres. Using the equations from USGS SIR 2014-5030, the 100-year discharge is approximately 330 cfs. The approximate replacement pipe size is a 72” welded steel pipe. Based on the size of the contributing drainage area, this site warrants an independent study with more extensive surveys and input from the City.

Site 2.05-2:

Level 3 – The neighborhood bounded by Golfview Road, Fox Squirrel Road, Morningside Road, and Fifty Lakes Drive is primarily undeveloped with only a few homes currently constructed. Drainage in this neighborhood includes ditches at the rear of all parcels that run generally from south to north. A few of the ditches are located in existing City owned drainage easements (between Golfview and Westway Road) however the ditches are heavily wooded and have not been maintained. Between Westway Road and Morningside Road, there does not appear to be any existing easements. Prior to this area being developed, easements should be obtained where missing and cleared with ditches reestablished.



PHASE 3

The study area for Phase 3 is bounded by the Allen Creek to the north, Fifty Lakes Drive to the south, MOTSU railroad line to the west, and BSL city limits to the east.

Site 3.02-1

Level 3 – The existing 18” CMP at the corner of Dartmouth Road and Wimberly Road is in poor condition with the outlet of the pipe completely buried. Based on the size of the contributing drainage area, the pipe appears to be sized appropriately. Recommend replacing the pipe and cleaning out all ditches along Wimberly, Cambridge, and Dartmouth Roads.

Site 3.02-2

Level 4 – Along both sides of Mohawk Road just north of the intersection with Lumbee Road, there are low areas on several parcels (142ND00309, 142ND00306, and 142ND00422). The elevations of the low areas are considerably lower than the surrounding areas. In order to drain these low areas, a ditch approximately 10 feet deep and 1,000 feet in length would be needed. This does not appear to be a feasible option. An alternative option is to fill the low areas and construct ditches to drain. The low areas do not appear to cause flooding on any existing adjacent structures.

Site 3.02-3

Level 3 – The ditches along the west side of Mohawk Road drain to a low spot approximately 530 feet south of the intersection with East Navaho Road. A pipe to drain this area under Mohawk Road was not located during our field surveys. Recommend installing a cross pipe to drain this area.

A well-defined existing ditch is located along the property line of parcels 142ND00404 and 142ND00402. However, the ditch is not located in an easement. Recommend extending the defined ditch to the proposed cross pipe on Mohawk Road along the property line of parcels 142ND00414 and 142ND00415. An easement or maintenance agreement will need to be obtained for the four affected parcels listed above.

Site 3.02-4

Level 3 – The existing cross pipe under Sioux Road located approximately 200 feet south of the intersection with East Navaho Road was noted as being in poor condition during our field surveys. Based on the size of the contributing drainage area, the pipe appears to be considerably undersized. Recommend installing a new properly sized cross pipe at this location.

Site 3.02-5

Level 3 – The cross pipe under Lumbee Road located just north of the intersection of East Navaho Road was noted as being in poor condition during our field surveys. Based on the size



of the contributing drainage area, the pipe appears to be considerably undersized. Recommend installing a new properly sized cross pipe at this location.

Site 3.03-1

Level 3 – Three small unnamed ponds are located to the rear of parcel 157FC00205. The ponds do not appear to be connected with no evident natural outfall observed. Constructing an overflow ditch from the ponds would require significant ditch work with no desirable outfall location. Recommend elevating the manufactured home that is currently located on the parcel to a higher elevation and out of the known flooding limits.

Site 3.03-2

Level 3 – The cross pipe under Pinecrest Road just north of the intersection with Greenview Road was noted as being in poor condition during our field surveys. Lake Marsh does not appear to have a natural outfall. Lake Marsh appears to overflow to the ditch along the west side of Pinecrest Road and flows to the existing pipe noted above. This pipe drains to an unnamed pond with no outfall. Recommend replacing the cross pipe with a properly sized pipe in the same location.

There are two more unnamed ponds with one located between Greenview and Bayside Roads and another located south of Greenbay Road and east of Pinecrest Road. Neither pond has a natural outfall. We are unaware of any property owner flooding complaints associated with these unnamed ponds.

Site 3.03-3

Level 3 – There is an existing low area along the west side of Mirror Lake Drive near 1065 and 1073 Mirror Lake Drive with no cross pipe located during our field surveys. Flow from the ditch would need to overtop the roadway in order to drain. There is an existing city owned 10' wide easement along the property line of parcels 157FC01601 and 157FC016 on the east side of Mirror Lake Drive. Recommend regrading ditches along the west side to a new cross pipe that aligns with the existing easement. Recommend installing an outfall ditch to the unnamed lake adjacent to Mirror Lake. Additional easement may be required in order to construct an adequate outfall ditch.

Site 3.03-4

Level 3 – East of the Sunny Point railroad crossing, there are two drainage issues along Fifty Lakes Drive.

- a) The ditch along the east side of Pinecrest Road and north side of Fifty Lakes Drive flow to a low area at the intersection of the two roads with no pipe found during our field surveys. Recommend installing a cross pipe under Pinecrest Road.
- b) The ditch along the east side of Poplar Road and north side of Fifty Lakes Drive flow to a low area at the intersection of the two roads with no pipe found during our field surveys. Recommend installing a cross pipe under Poplar Road. Recommend installing an outfall



ditch along the north side of Fifty Lakes Drive from Poplar Road to the railroad ditch. An easement may be necessary to construct and maintain the proposed ditch.



PHASE 4

The study area for Phase 4 is bounded by Pine Road to the east, NC 87 to the west, the BSL city limits to the north, and Patricia Lake to the south. A significant portion of Phase 4 north of Drayton Road consists of undeveloped parcels.

Site 4.01-1

Level 3 – No cross-pipe was found for ditches on the west side of Crystal Road and north side of Camelia Road. There is an existing channel on the east side of Crystal Road located approximately 80' north of Camelia Road. A properly sized cross-pipe should be installed at this location to provide drainage for the ditches noted above.

An easement or maintenance agreement is also recommended for the existing channel on the east side of Crystal Road across parcels 14100024, 14100025, and 1410005711.

Site 4.01-2

Level 3 – The 12" cross-pipe under Azalea Road at the Crystal Road intersection was observed to be buried and in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.02-1

Level 3 – The 12" cross-pipe under Persimmon Road at the Pine Lake Road intersection was observed to be buried and in poor condition. Recommend replacement with properly sized cross-pipe.

Site 4.02-2

Level 3 – The 18" cross-pipe under Pine Lake Road located approximately 550' southeast of Queens Road was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.02-3

Level 3 – An easement or maintenance agreement is recommended for the existing channel across parcel 14100063.

Site 4.02-4

Level 3 – An easement or maintenance agreement is recommended for the existing channel across parcels 141MB003, 141MB004, 141MB059, and 141MB060.

Site 4.03-1

Level 3 – The 15" cross-pipe under Bordeaux Lane located approximately 1250' southeast of Drayton Road was observed to be buried and in poor condition. Recommend replacement with a properly sized cross-pipe.



Site 4.03-2

Level 3 – The 15” cross-pipe under Bordeaux Lane at the Pine Lake Road intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.03-3

Level 4 – An easement or maintenance agreement is recommended for the existing channels across parcels 156EB008, 156EB009, 156EA04901, 156EA05201, 156EA053, and 156EA05301.

Site 4.03-4

Level 3 – The 24” cross-pipe under Pine Lake Road located approximately 190’ southeast of Miller Road has a drop inlet on the upstream end with 12” pipes connecting from each direction. The 24” cross-pipe was observed to be in good condition. However, both 12” pipe inlets were observed to be buried. Recommend cleaning out both 12” pipe inlets.

Site 4.03-5

Level 3 – An existing easement or maintenance agreement is recommended for the existing channel across parcel 156LC023.

Site 4.04-1

Level 3 – No cross-pipe was found under Bobolink Road at the Pine Road intersection. Recommend installing a properly sized cross-pipe.

Site 4.04-2

Level 3 – No cross-pipe was found under Audobon Road at the Pine Road intersection. Recommend installing properly sized cross-pipe.

Site 4.04-3

Level 3 – The 18” cross-pipe under Robin Road at the Pine Road intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.04-4

An easement or maintenance agreement is recommended for the existing channels upstream and downstream of the existing cross-pipe under Mallard Drive, approximately 180’ southeast of Pine Road, across parcels 14200014, 1420000205, 1420011916, 1420000211, 1420000204, 1420000213, 1420000212, 1420000201, and 1420000203.

Site 4.04-5

An easement or maintenance agreement is recommended for the existing channel between Mallard Drive and Drayton Drive across parcels 14100063 and 1410001503.



Site 4.04-6

Level 3 – The three 18” cross-pipes at the intersection of Maple Road and Pine Road, one under Maple and two under Pine, were noted to have debris at the inlets and partially filled with sediment at the outlets. Recommend pipe cleanout for all three.

Site 4.04-7

Level 3 – The inlet of a 15” pipe was found on the east side of Grace Road just north of the Pine Road intersection. The outlet was not found but should be located just before the 15” cross-pipe under Pine Road. Recommend ditch and pipe cleanout in this area.

Site 4.04-8

Level 3 – The 18” cross-pipe under N. Hills Drive located approximately 230’ southwest of Pine Road was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

An easement or maintenance agreement is recommended for the existing channel upstream and downstream of the cross-pipe across parcels 142PA05103, 142PA04802, 142PA04803, 142PA04804, 142PA04805, 142PA04806, 142PA03110, 142PA03111, 142PA03112, 142PA03113, 142PA03114, 142PA03116, 142PA02712, AND 142PA02713.

Site 4.04-9

Level 3 – Drainage patterns indicate that a cross-pipe should be located under Seagull Drive approximately 175’ southwest of Pine Road, however no pipe was found and may be buried. Recommend installing an appropriately sized cross-pipe at this location.

An easement or maintenance agreement is recommended for the existing channel downstream of the cross-pipe across parcels 1420011916 and 1410003602.

Site 4.04-10

Level 3 – An easement or maintenance agreement is recommended for the existing channel between Blueberry Road and Baymeade Road across parcels 142PA040, 142PA04102, 142PA04006, and 142PA04009.

Site 4.05-1

Level 3 – The 15” cross-pipe under Drayton Dr at the Crystal Road intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.05-2

Level 3 – The 36” cross-pipe under Crystal Road located approximately 170’ southeast of Queens Road was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.



An easement or maintenance agreement is recommended for the existing channel upstream of the cross-pipe across parcels 156DC021, 156DC022, 156DC023, 156DC024, 156DC025, 156DC026, 156DC027, and 156DC028.

Site 4.05-3

Level 3 - The 18" cross-pipe under Queens Road located approximately 240' southwest of Crystal Road was observed to be buried and in poor condition. Recommend replacement with a properly sized cross-pipe.

An easement or maintenance agreement is recommended for the existing channel upstream of the cross-pipe on parcels 156DB028, 156DB029, 156DB034, and 156DB035.

Site 4.05-4

Level 3 – The 12" cross-pipe under Burton Road at the E. Boiling Spring Road intersection was observed to be buried and in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.05-5

Level 3 – A local resident noted roadway flooding during heavy rain in the general vicinity of an 18" cross-pipe under Nassau Lane approximately 200' west of Prospect Road. This pipe was observed to be in good condition however, it appears to be undersized for its drainage area. Recommend replacing with a properly sized cross-pipe.

An easement or maintenance agreement is recommended for the existing downstream channel across parcel 156EA010.

Site 4.05-6

Level 3 – The 15" cross-pipe under Westwood Road at the Nassau Lane intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

An easement or maintenance agreement is recommended for the existing downstream channel across parcels 156EA009 and 156EA00902.

Site 4.05-7

Level 3 – The 15" cross-pipe under Edgewood Road at the Nassau Lane intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.05-8

Level 3 – The 15" cross-pipe under Russel Road at the E. Boiling Spring Road intersection was observed to be in fair condition with the outlet end buried. Recommend cleanout of the pipe outlet.



Site 4.05-9

Level 3 – The 36” cross-pipe under N. Shore Drive between Darnell Road and Burton Road was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.05-10

Level 3 – The 15” cross-pipe under N. Shore Drive at the Burton Road intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.05-11

Level 3 – The 18” cross-pipe under N. Shore Drive at the northern Sigman Road intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.05-12

Level 3 – The 18” cross-pipe under Crystal Road at the E. Boiling Spring Road intersection was observed to be partially filled with sediment. Recommend pipe cleanout.

Site 4.05-13

Level 3 – The 15” cross-pipe under Holly Point Road at the N. Shore Dr intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

An easement or maintenance agreement is recommended for the existing downstream channel across parcel 157BC001.

Site 4.05-14

Level 3 – Per an email from City Manager Jeff Repp dated 1/22/2020, the property owner at 798 Edgewood Drive reported flooding issues following Hurricane Florence. Based on topographic data and existing roadway ditch drainage patterns, it appears most of the stormwater runoff flowing towards and across 798 Edgewood Drive is coming from the adjacent lot at 86 Crystal Road. Since the source of the runoff is originating on private property and no public drainage easements are located between the two properties, this appears to be a property owner issue that would need to be resolved by the owner.

A potential solution would be for the 798 Edgewood Drive property owner to excavate a drainage ditch along the southwest property line that would intercept runoff from 86 Crystal Road and divert it to the roadway ditch at the front of the property and/or the lake at the back of the property.

Site 4.05-15

An easement or maintenance agreement is recommended for the outfall channel downstream of the cross-pipe under Crystal Road at the intersection of Westwood Road across parcels 142PA00207 and 142PA00209.



Site 4.05-16

An easement or maintenance agreement is recommended for the existing channels upstream and downstream of the cross-pipe under Colonial Drive, approximately 560' north of Crystal Road, across parcels 141MC002, 141MC00208, 141MC00406, 141MC00407, 141MC00408, 141MC00409, 141MC00410, 141MC00411, 141MC00404, 141MC00403, 141MC00205, 141MC00448, 141MC00447, and 141MC006.

Site 4.06-1

Level 3 – The 15" cross-pipe under Nassau Lane located approximately 160' north of Pepperhill Road was observed to be in good condition. However, a local resident reported that this location floods during heavy rainfall. The 15" cross-pipe appears to be undersized for its drainage area. Recommend replacement with a properly sized cross-pipe.

An easement or maintenance agreement is recommended for the existing channel across parcels 156EA00503 and 156EA00504.

Site 4.06-2

Level 3 – The 15" cross-pipe under Shands Road at the E. Boiling Spring Road intersection was observed to be buried on the outlet end. Recommend cleanout of the pipe outlet.

Site 4.06-3

Level 3 – No cross-pipe was found under Bridges Road at the E. Boiling Spring Road intersection. The cross-pipe is likely completely buried. Recommend replacement with a properly sized cross-pipe and regrading of inlet and outlet ditches, as needed.

Site 4.06-4

Level 3 – The 15" cross-pipe under Nassau Ln at the E. Boiling Spring Road intersection was observed to be buried and in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.06-5

Level 3 – The two 12" cross-pipes approximately 20' apart under N. Shore Road at the southern E. Boiling Spring Road intersection were observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.06-6

Level 3 – The 15" cross-pipe under Watts Road at the Bridges Road intersection was observed to be buried and in poor condition. Recommend replacement with a properly sized cross-pipe.

Site 4.06-7

Level 3 – The 15" cross-pipe under Bridges Road at the N. Shore Road intersection was observed to be in fair condition and partially filled with sediment. Recommend pipe cleanout.



Site 4.06-8

Level 3 – An easement or maintenance agreement is recommended for the existing channel across parcel 156EA005.

Site 4.06-9

Level 3 – An easement or maintenance agreement is recommended for the existing channel across parcel 156LF006.

Site 4.06-10

Level 3 – The 18” cross-pipe under Willetts Drive located approximately 680’ northwest of N. Shore Road was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.

An easement or maintenance agreement is recommended for the existing channel upstream of the cross-pipe across parcel 156LC014.

Site 4.06-11

Level 3 – The 15” cross-pipe under Windover Road at the N. Shore Drive intersection was observed to be in poor condition. Recommend replacement with a properly sized cross-pipe.



PHASE 5

The study area for Phase 5 is bounded by the MOTSU railroad line to the west, Allen Creek to the south, and the BSL city limits to the north and east. A significant portion of Phase 5 consists of undeveloped and inaccessible parcels.

Site 5.04-1

Level 3 - No pipe was located at the intersection of Jamesville Lane and Greensboro Road; however excessive ponding was observed at the time of the survey. It is suspected that an existing pipe is completely buried. A property owner indicated that ponding along the west side of Jamesville Lane has been an ongoing issue. Recommend installing an 18" cross pipe under Jamesville Lane and cleaning out the existing ditch along the south side of Greensboro Road, between Jamesville Lane and Southport Road, to provide positive drainage.

Site 5.04-2

Level 3 - The existing 15" HDPE cross pipe under Concord Road, at the intersection of Greensboro Road, was completely submerged at the time of survey. Based on the size of the contributing drainage area, the pipe appears to be considerably undersized. Recommend removing and replacing with an adequately sized cross pipe.

Site 5.04-3

Level 3 - The existing 15" CMP under South High Point Road, between West Lake Keziah Drive and East Lake Keziah Drive, is completely buried and in poor condition. It is recommended that this pipe be removed and replaced with an 18" cross pipe.

Site 5.04-4

Level 3 - The existing two 18" HDPE's under Greensboro Road, approximately 360' east of Gastonia Road, were 50% submerged at the time of survey. Based on the size of the contributing drainage area, the pipes appear to be undersized. Recommend removing and replacing with adequately sized cross pipe(s).

Site 5.04-5

Level 3 - The existing 36" CMP under East Boiling Springs Road (SR 1539), between Lumberton Drive and Polaris Drive, was observed to be in fair condition, however it appears to be considerably undersized for the contributing drainage area. Recommend submitting a request to NCDOT to replace the pipe with an appropriately sized cross pipe that meets current NCDOT standards for material and conveyance.

Site 5.04-6

Level 3 - An existing 30" cross pipe, under the MOTSU railroad, outfalls through parcels 142FL065 and 142FL066 and overtops a sag on Southport Lane to a small pond. The pond inundates multiple parcels between Southport Lane and Gastonia Road. When at capacity, the



pond overflows into an existing roadway ditch along the east side of Southport Lane, ultimately draining to a well-defined channel on parcel 142FL055. Recommend installing an adequately sized cross pipe at the sag on Southport Lane and grading the road to provide appropriate pipe cover and prevent overtopping. The existing overflow ditch and driveway pipes, along the east side of Southport Lane, should be further analyzed for capacity and conveyance and upgraded, as necessary.

Site 5.04-7

Level 3 - There is an existing low area in the roadway ditch along the west side of Frink Lake Drive, between parcels 142CF014 and 142CF017, with no cross pipe located during our field surveys. This low area also appears to be the natural outfall for Frink Lake. Recommend regrading existing ditches along the west side of Frink Lake Drive to a new adequately sized cross pipe that drains to the east. A new outfall channel, between parcels 142CG041 and 142CG03901, and 142CG024 and 142CG026, may be required to accommodate the new cross pipe. An easement or maintenance agreement should also be obtained for the four affected parcels listed above.

Site 5.04-8

Level 3 – An easement or maintenance agreement is recommended for the existing channel across parcel 12700015. This channel serves as the outfall for Harper Lake.

Site 5.04-9

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142BB023, 142BB022 and 142BB051. This channel serves as the outfall for Lake Keziah.

Site 5.04-10

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142CC024, 142CC025, 142CC005 and 142CC006.

Site 5.04-11

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142FL072, 142FL073 and 142FL074.

Site 5.04-12

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142FL070, 142FL055 and 142FL032.

Site 5.04-13

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142FL023, 142FL024, 142FL027 and 142FL028.



Site 5.05-1

Level 3 - There is a sag in the existing ditch on the south side of Greenville Road, between Albemarle Road and Pinehurst Road. No cross pipe was located while conducting the field survey, and it appears that water ponds regularly. Recommend installing an 18" cross pipe, under Greenville Road, to drain the existing ditch from the south side of Greenville Road to the pond on the north side, and obtain easement or maintenance agreement between parcels 142FA020 and 142FA001 in order to establish and maintain the outfall ditch.

Site 5.05-2

Level 2 - Two small unnamed ponds are located on the east and west side of Albemarle Road, just north of Greenville Road. The ponds do not appear to be connected by a pipe under Albemarle Road, and no evident natural outfall was observed. Recommend installing an equalizer pipe under Albemarle Road, connecting the two ponds, and constructing an overflow ditch along the west side of Pinehurst Road to an outfall at the north end of Pinehurst Road. Installation of a new pipe under Laurinburg Road and upgraded driveway pipes along Pinehurst Road would also be required.

Site 5.05-3

Level 3 - The existing 42" CMP under East Boiling Springs Road (SR 1539), approximately 350' south of Greensboro Road, was completely submerged at the time of survey. The pipe appears to be considerably undersized for the contributing drainage area. Recommend submitting a request to NCDOT to replace the pipe with an appropriately sized cross pipe that meets current NCDOT standards for material and conveyance.

Site 5.05-4

Level 3 - The existing 24" RCP under East Boiling Spring Road, approximately 30 feet east of the MOTSU railroad line, was observed to be completely buried at its outlet end. Recommend coordinating with MOTSU to locate and clear the pipe to allow proper conveyance and prevent possible flooding and erosion issues.

Site 5.05-5

Level 3 - Existing roadway ditches are graded toward the southwest quadrant of the Chapel Hill Road and Salisbury Road intersection; however, no cross pipe was located during the field survey. Recommend installing an 18" cross pipe under Salisbury Road to convey stormwater along the south side of Chapel Hill Road.

Site 5.05-6

Level 3 - The existing 15" CMP under Raeford Road, along the south side of Chapel Hill Road, is 90% buried and in poor condition. It is recommended that this pipe be removed and replaced with an 18" cross pipe.



Site 5.05-7

Level 3 - There is a sag in the existing ditch on the west side of Raeford Road, approximately 80 feet south of Tarheel Road. No cross pipe was located while conducting the field survey, and it appears that water ponds regularly. Recommend installing an 18" cross pipe, under Raeford Road, to drain the existing ditch from the west side of Raeford Road to a depression on the east side.

Site 5.05-8

Level 3 - An existing 12" PVC cross pipe was located under Salisbury Road, between Chapel Hill Road and Greenville Road. The pipe appears to be considerably undersized for the contributing drainage area and could be prone to clogging due to its size. Recommend removing and replacing with an adequately sized cross pipe.

Site 5.05-9

Level 3 – An easement or maintenance agreement is recommended for the existing channel and ponded areas on parcels 142FL017, 142FL014, 142FL003, 142FL004, 142FL007, 142FL008 and 142FL009. The ponding appears to be backwater from the submerged 42" CMP under East Boiling Springs Road.

Site 5.05-10

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142FG016, 142FG017, 142FG003 and 142FG004.

Site 5.05-11

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142FH018, 142FH001 and 142FH004.

Site 5.05-12

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining across parcels 142FI005, 142FI016 and 142FI017.

Site 5.08-1

Level 3 - An existing 30" CMP under East Boiling Spring Road (SR 1539), between Corral Drive and Ranch Road, was observed to be in poor condition and was 50% submerged at the time of the field survey. The pipe also appears to be considerably undersized for the contributing drainage area. Recommend submitting a request to NCDOT to replace the pipe with an appropriately sized cross pipe that meets current NCDOT standards for material and conveyance.

Site 5.10-1

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining south along property lines of parcels 142CI00101, 142CI00102, 142CI00103,



142CI00104, 142CI00105, 142CI00106, 142CI00108, 142CI168, 142CI170, 142CI171, 142CI172 and 142CI001.

Site 5.10-2

Level 3 – An easement or maintenance agreement is recommended for the existing channel draining east across parcels 142CI00109, 142CI001 and 142CI00111.

Site 5.11-1

Level 3 - An existing 15” CMP under Foxcroft Road, approximately 240 feet west of Meadowood Road, was observed to be in poor condition and was mostly buried at the time of the survey. It is recommended that this pipe be removed and replaced with an 18” cross pipe.

Site 5.11-2

Level 3 - An existing outfall drains to a low ponded area, on parcels 142CI221 and 142CI222, between Foxcroft Road and Meadowood Road. During wet periods, Meadowood Road is inundated, overtops, and ultimately drains to a cross pipe under Fieldcrest Road. Recommend installing an adequately sized cross pipe at the sag on Meadowood Road and grade the road to provide appropriate pipe cover and prevent overtopping. Ditches should be graded along the west side of Meadowood Drive to direct flow to the new cross pipe.



PHASE 6

The study area for Phase 6 is bounded by Fifty Lakes Drive to the north, BSL city limits to the south and east, and NC 87 to the west. A significant portion of Phase 6 consists of undeveloped parcels.

Site 6.02-1

Level 3 - The cross pipes on the east and west sides of the following intersections were completely blocked at the time of our field surveys: Kannapolis Road and Liberty Road; Rockingham Road and Liberty Road; Statesville Road and Liberty Road. Recommend cleaning the out the ditches and existing pipes, investigating the conditions of the pipes, and replacing pipes as needed.

Site 6.02-2

Level 3 - The pipe located under Greenwood Drive at the intersection with Charlestown Road was in poor condition and completely buried. Recommend replacing with an 18" cross pipe.

Site 6.02-3

Level 3 - Between Charlestown Road and Carolina Road at the rear property lines, there is a large existing channel that drains a significant portion of this area that is not contained in an easement or being maintained. Recommend obtaining an easement along the rear of the lots and maintaining the existing ditch.

Site 6.02-4

Level 4 - Along Charlestown Road between parcels 173BH027 and 173BH024, there is an existing easement that does not appear to be currently used or maintained.

Site 6.02-5

Level 3 - Along Charlestown Road near the intersection with Rockingham Road, parcel 173BH01103 is shown as a private drainage easement and contains an existing ditch outfall. This easement is not being maintained. Recommend obtaining this parcel and maintaining the existing ditch.

Site 6.02-6

Level 2 - The pipe under Lexington Road approximately 180 feet south of the intersection with Charlestown Road is a 60" CMP that was noted in fair condition. The two pipes located downstream appear to be smaller diameter pipes (48" CMP under Beaufort Road and 54" RCP under Washington Road). Recommend replacing all three of the cross pipes with properly sized pipes.



The channel between the 48" pipe at Beaufort Road and the 54" RCP at Washington Road is not located in an easement and meanders across lots 173BL015, 173BL016, and 173BL007.

Recommend relocating the replacement for the 48" CMP to the middle of lot 173BL016 to line up with the downstream pipe and acquiring easements (or the entire lot) across lots 173BL016 and 173BL007. Relocating and realigning this channel may not be an option if this is considered a jurisdictional stream.

Site 6.02-7

Level 3 - Between Pee Dee Road and Catawba Road at the rear property lines, there is a large existing channel that drains a significant portion of this area that is not contained in an easement or being maintained. Recommend obtaining an easement along the rear of the lots and maintaining the existing ditch.

Site 6.02-8

Level 3 - On Carolina Road approximately 610' southwest of the intersection with Lexington Road, the roadside ditches appear to drain to a low point. A cross pipe under Carolina Road was not found during our field surveys. Recommend installing a properly sized cross pipe under Carolina Road to allow this area to drain to the large ditch between Carolina and Charlestown Roads.

City owned easements exist on both sides of Carolina Road at this location. However, they are only 6-feet wide and the ditches are not maintained. Recommend clearing the vegetation and reconstructing the ditches along the property lines between Parcels 173BH028-173BH02801 and 173GA008-173GA007. A wider easement or maintenance agreement will need to be obtained for the affected parcels to accommodate the ditches and provide access for maintenance.

Site 6.02-9

Level 3 - There is a sag in the roadside ditch on the southwest corner of intersection of Goldsboro Road and Carolina Road with no pipe. Recommend installing a cross pipe under Carolina Road and ensuring ditch is graded towards large ditch between Carolina and Charlestown Roads.

Site 6.02-10

Level 3 - The roadside ditches on the north side of Pee Dee Road appear to flow to a low point that is approximately 1000' east of the intersection with Goldsboro Road. Recommend installing a properly sized cross pipe under Pee Dee Road to facilitate drainage towards large ditch between Pee Dee and Catawba Roads.

Site 6.02-11

Level 3 - Between Pee Dee Road and Catawba Road, there appear to be existing ditches along the property lines between lots 173GB00309-173GB00310 and 173GB00402-173GB00403 that convey flow from the roadway ditches to the channel at the rear property lines. Recommend obtaining easements along these property lines and maintaining the existing ditches.



Site 6.05-1

Level 3 - Just south of Charlestown Road, there are a series of existing ditches between Jackson Road and Monroe Road, between Monroe Road and Madison Road, and between Madison Road and Jefferson Road that are currently not maintained or in an easement. Recommend obtaining easements along the property lines and maintaining the existing ditches.

Also, we could not locate cross pipes under Jackson, Monroe, Madison, and Jefferson Roads at the ditch locations. Recommend installing properly sized cross pipes at each location.

Site 6.05-2

Level 3 - There is a drainageway and low area on the west side of Filmore Road approximately 300' north of the intersection with Charlestown Road. A pipe under Filmore Road was not found during our field surveys. Recommend installing a properly sized cross pipe under Filmore Road to allow the area to drain properly.

Site 6.05-3

Level 3 - There is an existing 24" cross pipe located on Springdale Road near the intersection with Charlestown Road. This pipe drains to an existing pipe under the MOTSU RR. This pipe size will be investigated during our next field visit.



PHASE 7

The study area for Phase 7 is bounded by NC 87 to the east and BSL city limits to the north, south, and west. Based on our site visits and available aerial photography, a majority of Phase 7 is currently undeveloped with unpaved roads. Sungate attempted to locate pipes that were critical to ingress and egress for emergency vehicles.

Many of the undeveloped parcels in Phase 7 are owned by the State of North Carolina, under the NC Plant Conservation Program. There are a number of critical drainage ways that cross through or along the property lines of these North Carolina owned parcels. It is unlikely that easements or maintenance agreements can be obtained for these drainage ways.

Site 7.01-1

Level 3 – At the rear of the properties between 6th and 7th Avenue, 7th and 8th Avenue, 8th and 9th Avenue, 9th and 10th Avenue, 10th and 11th Avenue, 11th and 12th Avenue, 12th and 13th Avenue, 14th and 15th Avenue, 15th and 16th Avenue, and 16th and 17th Avenue, are existing ditches that flow toward the southwest. Recommend reestablishing and maintaining the existing ditches and obtaining easements along the property lines for the associated parcels prior to allowing lots to be developed. If easements are unattainable for these parcels, then a maintenance agreement will suffice.

Site 7.01-2

Level 3 – There is an existing ditch ultimately draining to the dual pipe (1 @ 48" CMP and 1 @ 60" CMP) crossing under W Boiling Spring Road, between Deep Run Road and Trent Road (Parcel 1720002303 – See Site 7.05-18). The ditch begins flowing east from 17th Avenue to 1st Avenue, then turns south, flowing parallel to Jasmine Drive, before turning east to the crossing. According to Brunswick County GIS, the ditch becomes Allen Creek just upstream of W Boiling Springs Road. Recommend maintaining existing ditch and obtaining easement along the property lines if possible. If an easement is unattainable for these parcels, then a maintenance agreement will suffice.

Site 7.01-3

Level 3 – The existing 18" CMP under 17th Avenue was submerged at the time of the survey. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.



Site 7.01-4

Level 3 – For the existing ditch along 17th Avenue, it is recommended to obtain an easement along the property line for parcel 15500066 and maintain the existing ditch.

Site 7.02-1

Level 3 – Between Waccamaw Road and W Boiling Spring Road is an existing ditch flowing across parcels 172AB018 and 172AB005. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement. Also, a pipe was not found under W Boiling Springs Road during our field surveys at this location, however standing water was observed along the south side shoulder.

Site 7.04-1

Level 3 - Between Brittany Road and Holiday Road there is an existing ditch flowing along the back of the lots where the property lines meet. Recommend maintaining the existing ditch and obtaining easements along the property lines from parcels 156OC050 and 156OC00301 to parcels 156OC052 and 156OC00201.

Site 7.04-2

Level 3 – During our field surveys, a cross-pipe was not found at the intersection of Bermuda Road and Normandy Road. Recommend installing an adequately sized cross-pipe near parcels 156OB007 and 156OA006.

Site 7.04-3

Level 3 – During our field surveys, a cross-pipe was not found at the intersection of Bermuda Road and Brittany Road. Recommend installing an adequately sized cross-pipe near parcels 156OC011 and 156OB00903.

Site 7.04-4

Level 3 – There is an existing 15” CMP at the intersection of W Ridge Road and Normandy Road near parcels 156OA040 and 156OB00302. At the time of the survey, the pipe was fully submerged. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.



Site 7.04-5

Level 3 – There is an existing 15” RCP at the intersection of Sparrow Road and Blackhawk Road. The pipe is in poor condition and the upstream end is crushed. Recommend removing and replacing with an 18” pipe.

Site 7.04-6

Level 3 – There is an existing 15” RCP at the intersection of Bermuda Road and Barclay Road. The pipe is in poor condition with crushed ends. Recommend removing and replacing with an 18” pipe.

Site 7.04-7

Level 3 - There is an existing 30” CMP at the intersection of Barclay Road and W Boiling Spring Road near parcels 156NF008 and 156LA018. The pipe is in poor condition with both ends crushed. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.04-8

Level 3 - Between Bluebird Road and Blackhawk Road is an existing ditch flowing along the back of the lots where the property lines meet. Recommend maintaining the existing ditch and obtaining easements along the property lines from parcels 156KC062 and 156KC022 to parcels 156KC041 and 156KC042.

Site 7.05-1

Level 3 - Between 5th Avenue and 4th Avenue is an existing ditch flowing along the back of the lots where the property lines meet. Recommend maintaining the existing ditch and obtaining easements along the property lines from parcels 156OD00503 and 156OD00502 to parcels 156OD00507 and 156OD108. The recommended easement would also travel across parcel 156OD108. If an easement is unattainable for this parcel, then a maintenance agreement will suffice.

Site 7.05-2

Level 3 - Between 3rd Avenue and 2nd Avenue is an existing ditch flowing along the back of the lots where the property lines meet. Recommend maintaining the existing ditch and obtaining easements along the property lines from parcels 156OD00309 and 156OD00310 to parcels 156OD00306 and 156OD104. The recommended easement would also travel across parcel 156OD00301 and 156OD104. If an easement is unattainable for these parcels, then a maintenance agreement will suffice.



Site 7.05-3

Level 3 – There is an existing 18” CMP in poor condition at the intersection of Brittany Road and W Ridge Road near parcels 156OB003 and 156OC052. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-4

Level 3 – There is an existing 18” CMP in poor condition at the intersection of Holiday Road and W Ridge Road near parcels 156OC00201 and 156KA013. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-5

Level 3 – There is an existing cross pipe at the intersection of Green Lawn Road and W Ridge Road near parcels 156KA012 and 156NA00103. At the time of the survey, the pipe was completely buried, therefore, the size and material are unknown. Recommend removing and replacing with an adequately sized pipe. Also, channel cleanout at the inlet and outlet may also be needed.

Site 7.05-6

Level 3 – At the end of 3rd Ave, there is an existing 48” CMP in poor condition near parcels 156OD105 and 156OD104. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-7

Level 3 - Between 4th Avenue and 3rd Avenue is an existing ditch flowing along the back of the lots where the property lines meet. Recommend maintaining the existing ditch and obtaining easements along the property lines for parcels 156OD00401, 156OD105, and 156OD00408.

Site 7.05-8

Level 3 – Between Hunters Road and Jasmine Road is an existing ditch flowing across parcels 156NE011, 156NB03717, 156NE020, 156NE01001, and 156NE01002. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement with the property owners of the aforementioned parcels. Also, no pipe was located under Jasmine Road where this ditch terminates, and significant ponding was observed. Recommend cleaning out existing roadway ditches or installing an adequately sized cross pipe to drain east towards Elkhorn Road.



Site 7.05-9

Level 3 – There is an existing 24” RCP in poor condition at the intersection of W Ridge Road and W Boiling Spring Road near parcels 156NF01601 and 156NG008. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-10

Level 3 - Between W Boiling Spring Road and Ridgewood Road is an existing ditch flowing along the back of the lots where the property lines meet. Recommend maintaining the existing ditch and obtaining easements along the property lines for parcels 172CD027, 172CD029, and 172CD014.

Site 7.05-11

Level 3 – An existing 24” CMP under W Ridge Road, between W Boiling Springs Road and Ridgewood Road, is in poor condition. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-12

Level 3 – There is a sag in the roadway ditches flowing along both sides of W Boiling Springs Road, between Oakley Road and West Ridge Road. At the time of the survey, no pipe was found. This could point towards either a completely buried pipe or the lack of a pipe at the crossing. There are 6 existing ditches flowing in a fashion that would allude to a pipe crossing. Recommend removing any existing pipe that may be at the crossing and replacing with/adding an adequately sized pipe.

Site 7.05-13

Level 3 – Between W Boiling Spring Road and Ridgewood Road is an existing ditch flowing along several property lines. Recommend maintaining the existing ditch and obtaining easements along the property line for parcels 172CD021 and 172CD022. If an easement is unattainable for this parcel, then a maintenance agreement will suffice.

Site 7.05-14

Level 3 – There is an existing CMP in poor condition at the intersection of W Ridge Road and Sunset Road near parcels 156NG00102 and 172CE001. At the time of the survey, the pipe was crushed and buried, therefore the size is unknown. Recommend removing and replacing with an adequately sized pipe.



Site 7.05-15

Level 3 – There is an existing 24” CMP in poor condition underneath Trent Road at the corner of Trent Road and Waccamaw Road near parcels 172GA020 and 1720002303. At the time of the survey, the upstream end was crushed. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-16

Level 3 – There is an existing 18” CMP in poor condition at the intersection of Trent Road and W Boiling Spring Road underneath Trent Road. At the time of the survey, the upstream end was crushed. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-17

Level 2 – There are dual cross pipes (1 @ 48” CMP, 1 @ 60” CMP) in poor condition underneath W Boiling Spring Road, between Trent Road and Deep Run Road. At the time of the survey, the 60” CMP was severely deformed on the upstream end and both pipes showed significant deterioration. Based on the size of the contributing drainage area, the pipes also appear to be considerably undersized. Recommend removing and replacing with adequately sized pipes or box culvert.

Site 7.05-18

Level 3 – There is an existing 15” RCP in fair condition at the intersection of Deep Run Road and W Boiling Spring Road. At the time of the survey, the upstream end was 50% buried. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.05-19

Level 3 – There is a low point in the roadway ditches on either side of Sunset Road between Stag Road and Virginia Drive near parcel 156MC008. With a downstream ditch flowing south across 156MC008, the area is typical of a pipe crossing. At the time of the survey, no pipe was found. It is possible that there is a completely buried pipe at this location. Recommend removing any existing pipe and replacing with/adding an adequately sized pipe for the crossing. Also, recommend obtaining an easement or maintenance agreement for the downstream ditch flowing south across parcel 156MC008.



Site 7.06-1

Level 3 – There is an existing 15” CMP in poor condition underneath W Branch Drive. At the time of the survey, the pipe was buried. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.06-2

Level 3 – There is an existing 15” CMP in fair condition underneath Bohemia Road. At the time of the survey, the pipe was submerged. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe. Additionally, there is an existing ditch flowing downstream of the pipe along the shared property line of parcels 172JC006 and 172JC005. Recommend maintaining the existing ditch and obtaining an easement.

Site 7.08-1

Level 3 – There is an existing 15” CMP in poor condition under Virginia Drive, at the intersection of Sunset Road. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.08-2

Level 3 – There is an existing ditch on Virginia Drive that flows along the shared property line of parcels 156MC019 and 156MC017. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement with the property owners.

Site 7.08-3

Level 3 – There are existing ditches between Leeds Road and NC 87 flowing across parcels 1730002801, 173AB003, and 156MD025. Recommend maintaining the existing ditches and obtaining an easement or maintenance agreement with the property owners.

Site 7.08-4

Level 3 – Between Leeds Road and NC 87, north of W South Shore Drive, is an existing outfall flowing along the shared property line with parcels 156MB004 and 156MB00102. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement with the property owners.



Site 7.08-5

Level 3 – Between Lake Mt Road and NC 87 on the other side of W North Shore Drive is an existing ditch flowing across parcel 156MB00203. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement with the property owner.

Site 7.09-1

Level 3 – There is an existing 18” HDPE in good condition underneath Virginia Drive on either side of parcel 1720000216. At the time of the survey, the pipe was 90% submerged. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe. Additionally, the downstream existing ditch travels across parcel 156MC00205. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement with the property owner.

Site 7.09-2

Level 3 – There is an existing 18”CMP in poor condition underneath W South Shore Drive near parcels 172DC017 and 172DC005. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe. Additionally, the downstream existing ditch travels across parcels 172DC005 and 172DC006. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement with the property owner.

Site 7.09-3

Level 3 – There is an existing 15” CMP in poor condition underneath Overlook Circle at the intersection of Virginia Drive. Recommend removing and replacing with a minimum 18” pipe.

Site 7.09-4

Level 3 – There is an existing 24” CMP in poor condition underneath Midwood Street near parcels 1720000213 and 1720000209. At the time of the survey, the bottom of the pipe was rusted. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.09-5

Level 3 – At the intersection of Camden Street and Bladen Street is an existing pipe of unknown size that is 100% submerged underneath Camden Street between parcels 1720000213 and 172DB002. Recommend removing and replacing with an adequately sized pipe.



Site 7.09-6

Level 3 – There is an existing pipe of unknown size and material that is 100% buried underneath Columbus Road, between Lenoir Street and Bladen Street. Recommend removing and replacing with an adequately sized pipe.

Site 7.09-7

Level 3 – Downstream of 2 existing 18” HDPE pipes crossing underneath W South Shore Drive is an existing ditch traveling across parcels 156MD004 and 156MD022. Recommend maintaining the existing ditch and obtaining an easement or maintenance agreement with the property owner.

Site 7.09-8

Level 3 – Multiple existing ditches are meeting in an area on both side of Lenoir Street between Sampson Street and Cumberland Street near parcels 1720000211, 172EI005, 172EE003, and 172EF002. There is existing easement on either side of the road further indicating the location of the crossing. At the time of the survey, no pipes were located. Recommend adding adequately sized pipe underneath Lenoir Street.

Site 7.09-9

Level 3 – There is an existing 15” CMP in poor condition under Duplin Street, near the intersection with Craven Street. At the time of the survey, the pipe was 100% submerged. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.10-1

Level 3 – In between Sampson Street and Cumberland Street is an existing 24” CMP in poor condition underneath Craven Street. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

Site 7.10-2

Level 3 – Downstream of site 7.10-2 is a 24” CMP in poor condition underneath Craven Street. Based on the size of the contributing drainage area, the pipe appears to be undersized. Recommend removing and replacing with an adequately sized pipe.



Site 7.10-3

Level 3 – An existing 15” CMP under Brunswick Street, between Craven Street and Bladen Street, is in poor condition and 100% submerged. Based on the size of the contributing drainage area, the pipe also appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

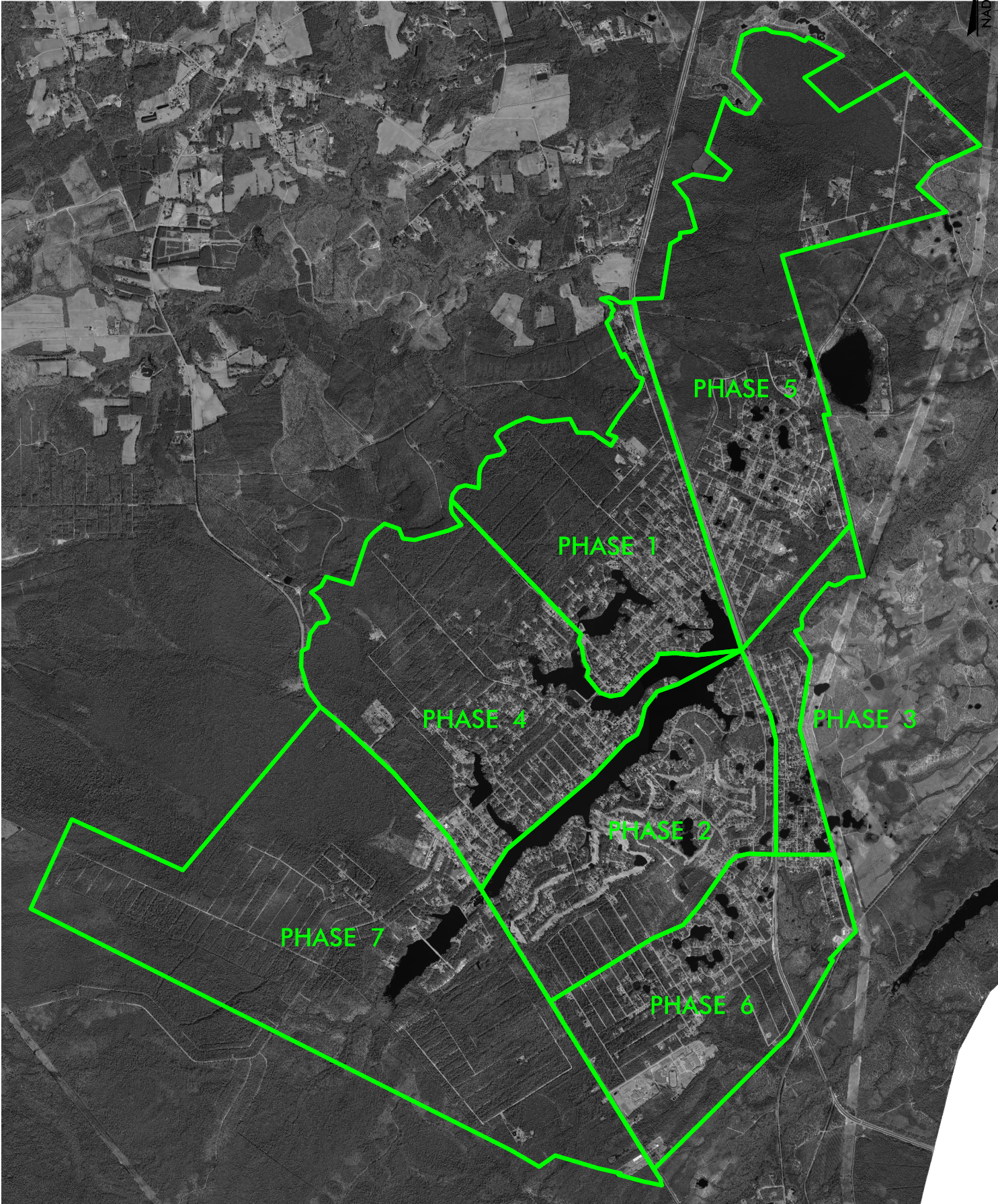
Site 7.10-4

Level 3 – An existing 15” CMP under Pender Street, between Craven Street and Bladen Street, is in poor condition and 100% submerged. Based on the size of the contributing drainage area, the pipe also appears to be undersized. Recommend removing and replacing with an adequately sized pipe.

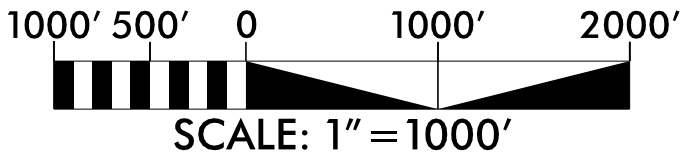
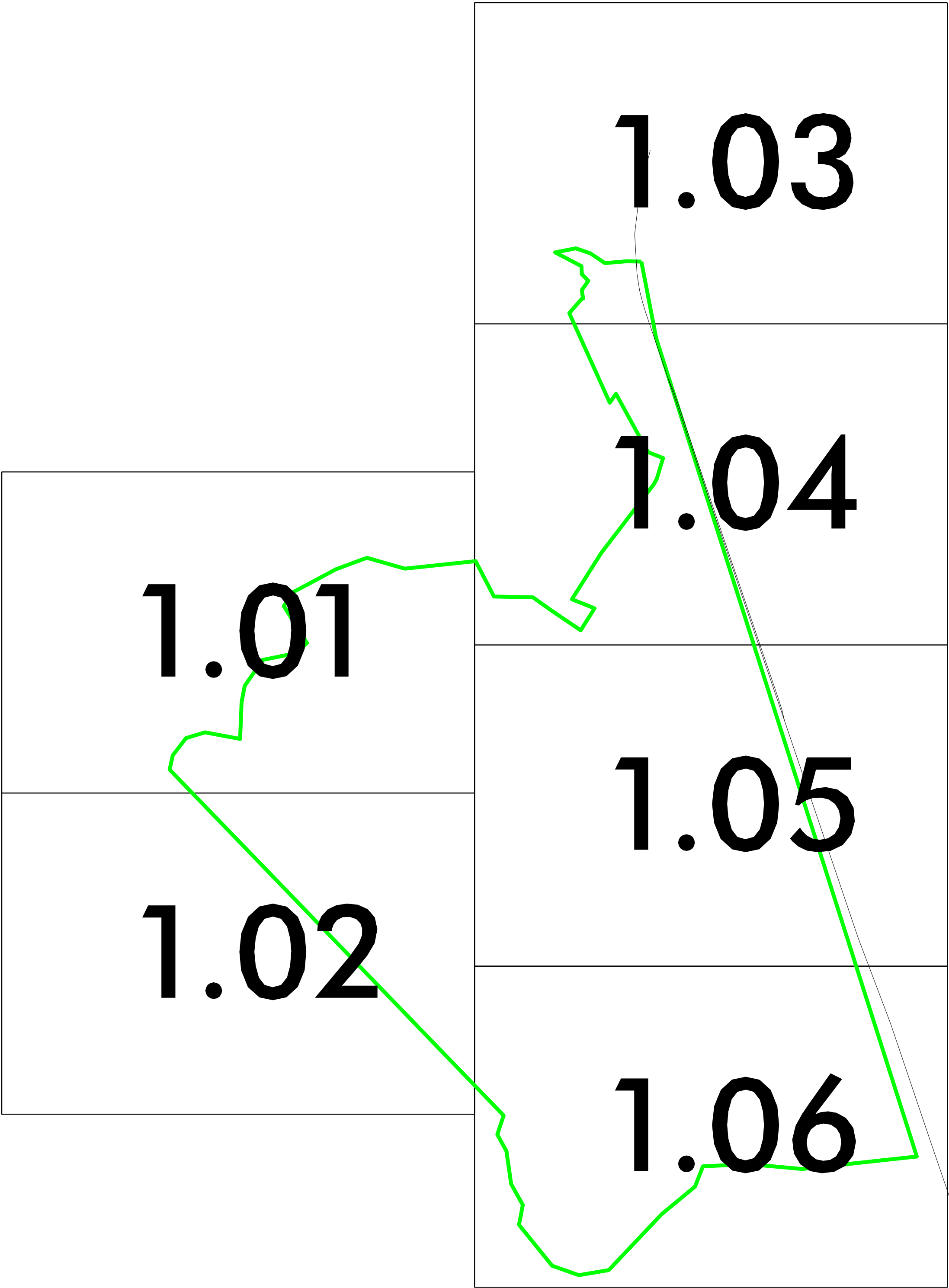
The recommendations included in this report are preliminary and no work should be undertaken until final construction plans are completed. Construction plans consisting of grading plans, storm drainage, sediment and erosion control plans, with all pertinent details should be completed prior to applying for any permits.



CITY OF BOILING SPRING LAKES
STORMWATER MANAGEMENT MASTER PLAN
PHASING MAP
NOT TO SCALE



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C1.00

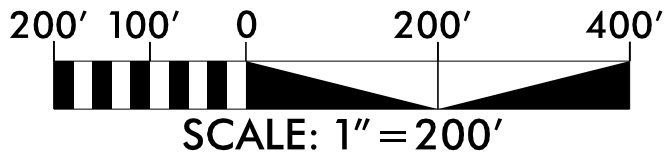
STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC
PHASE 1 – PLAN SHEET LAYOUT

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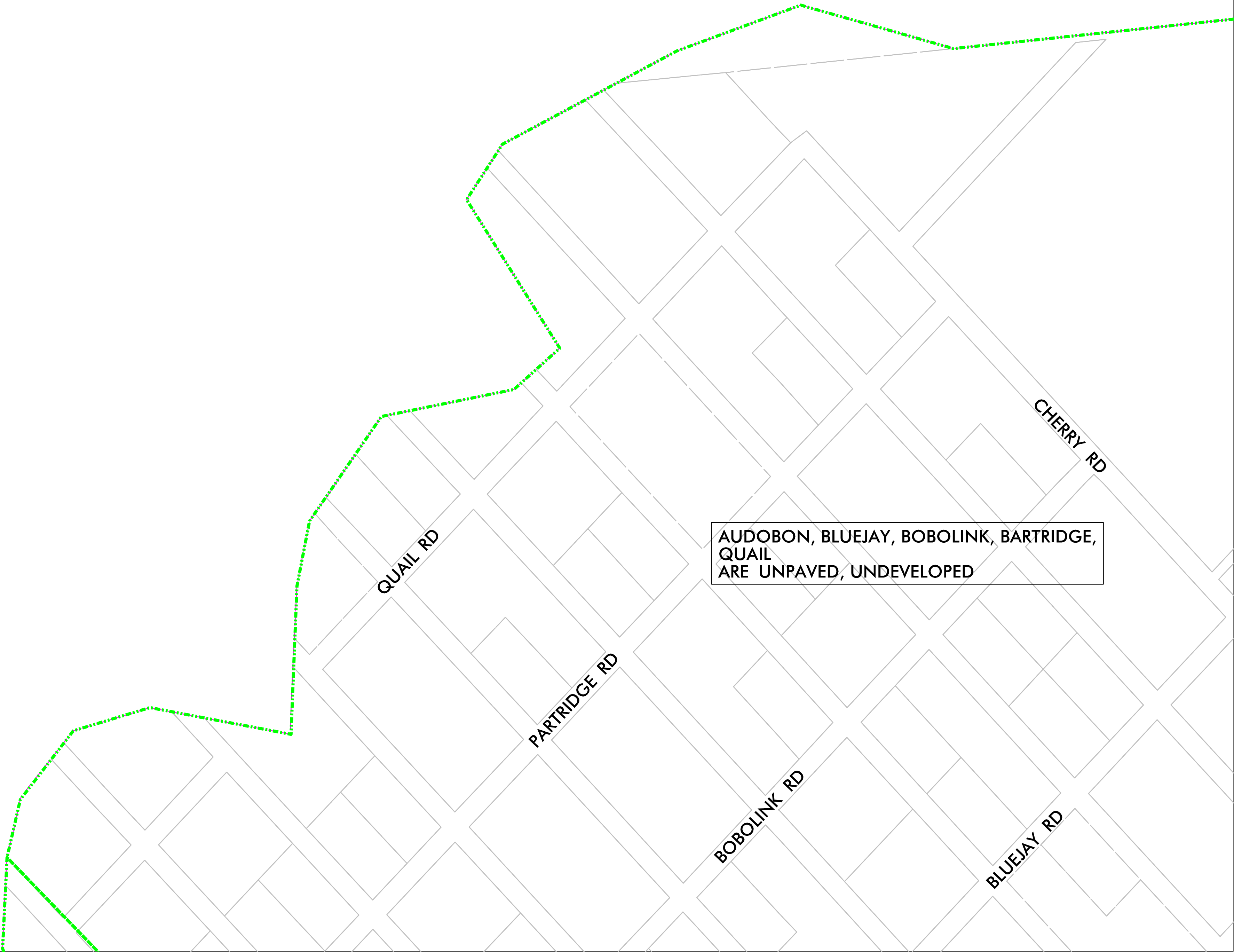


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MATCHLINE - SEE SHEET C1.04

MATCHLINE - SEE SHEET C1.05



MATCHLINE - SEE SHEET C1.02

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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PHASE 1

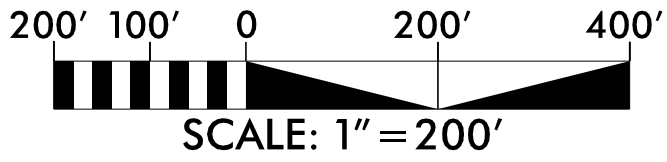
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MATCHLINE - SEE SHEET C1.01



MATCHLINE - SEE SHEET C1.05

MATCHLINE - SEE SHEET C1.06

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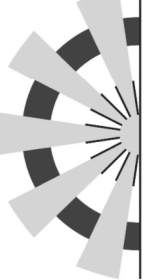
STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

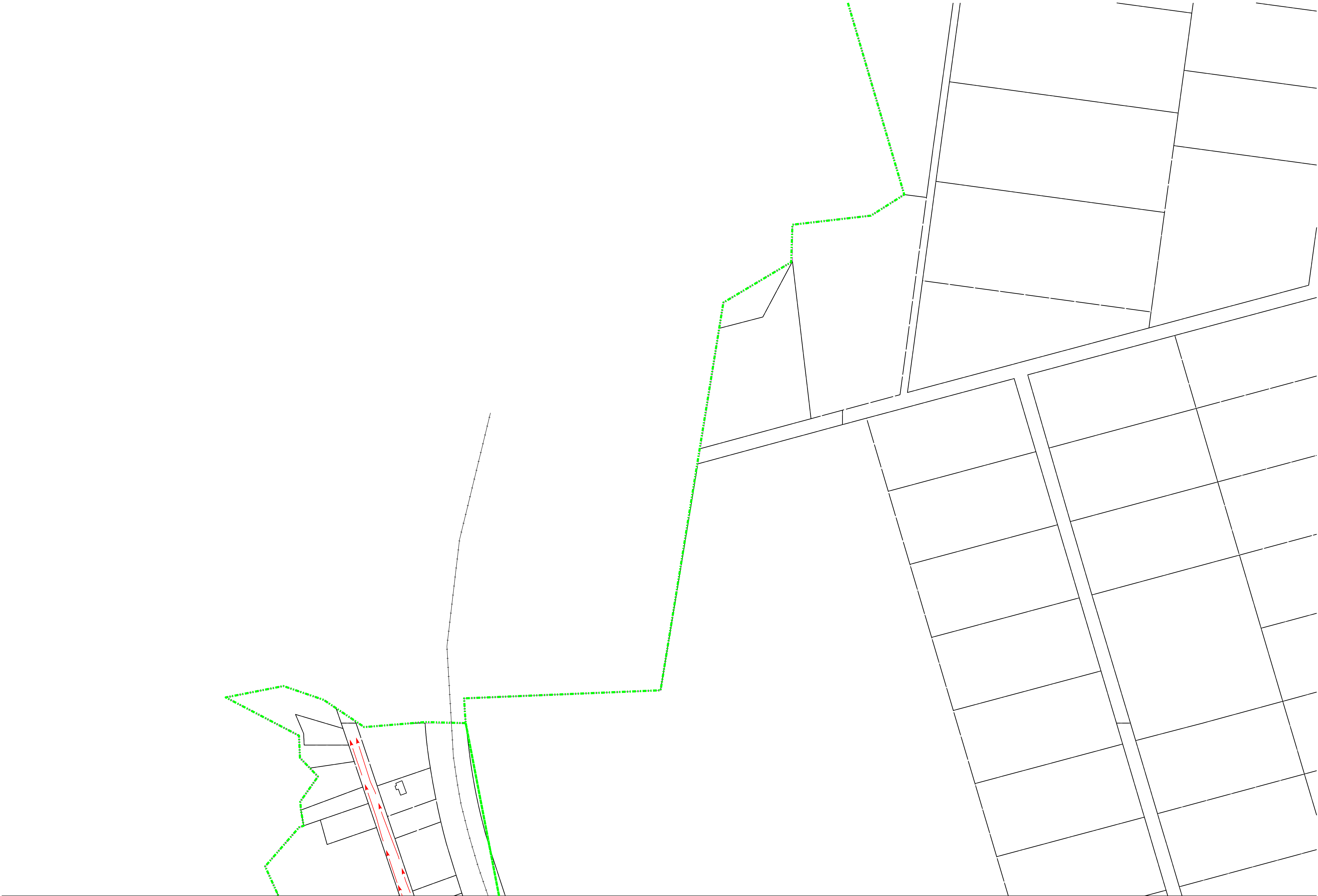
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MATCHLINE - SEE SHEET C1.04

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STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

PHASE 1

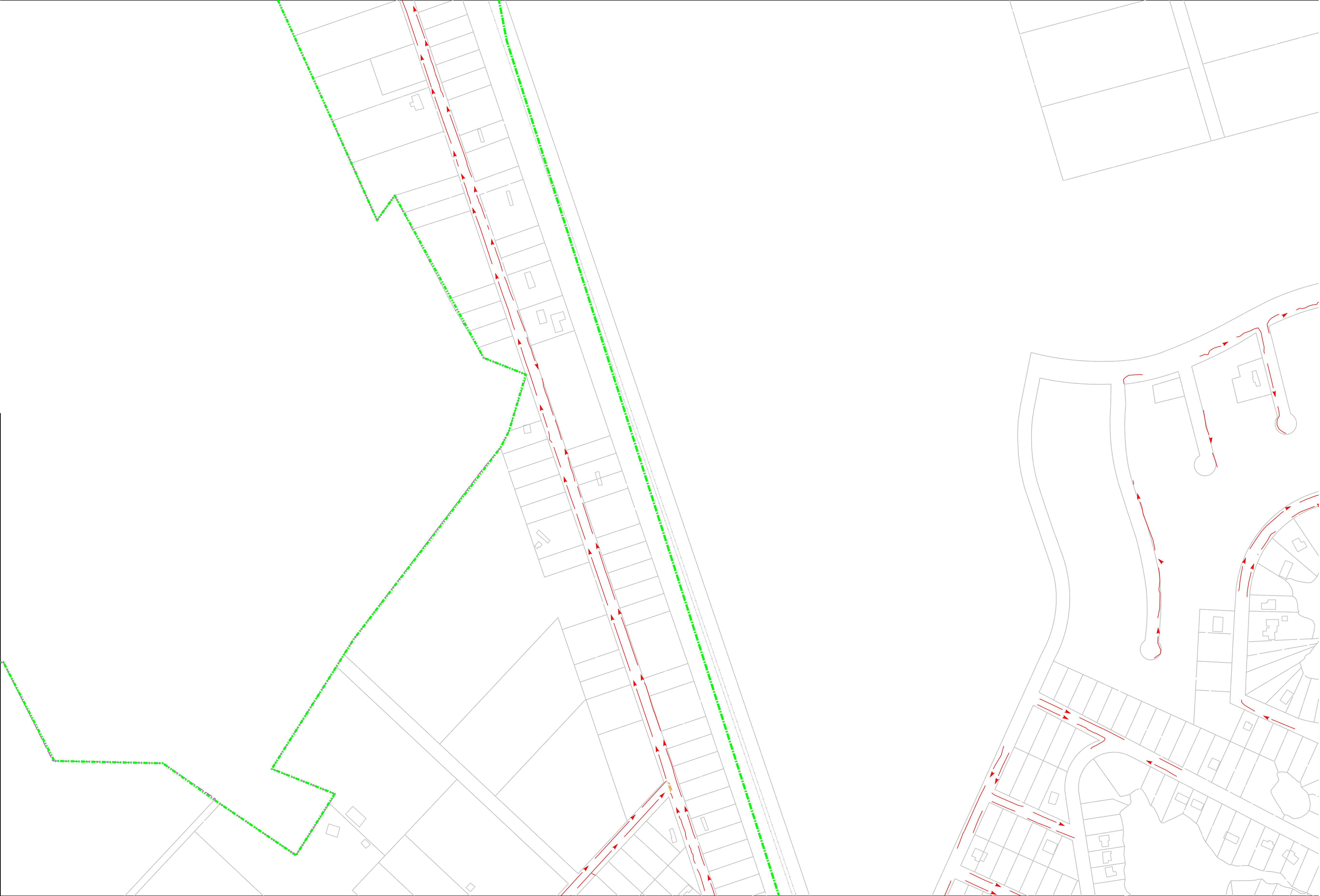
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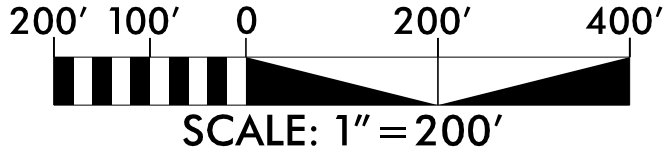
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MATCHLINE - SEE SHEET C1.01



MATCHLINE - SEE SHEET C1.03

MATCHLINE - SEE SHEET C1.05



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CITY OF BOILING SPRING LAKES, NC

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MATCHLINE - SEE SHEET C1.02

MATCHLINE - SEE SHEET C1.04

MATCHLINE - SEE SHEET C1.06

200' 100' 0 200' 400'
SCALE: 1" = 200'



SEE NOTE 1.05-1

SEE NOTE 1.05-5

SEE NOTE 1.05-9

SEE NOTE 1.05-10

SEE NOTE 1.05-3

SEE NOTE 1.05-4

SEE NOTE 1.05-2

SEE NOTE 1.05-8

SEE NOTE 1.05-7

SEE NOTE 1.05-6

SEE NOTE 1.05-5

SEE NOTE 1.05-12

SEE NOTE 1.05-11

ASPBON RD

BEECH RD

MAPLE RD

GRACE RD

ASH RD

CEDAR RD

CHERRY RD

ELM RD

SYCAMORE RD

CRABAPPLE RD

HOLLY DR

WALNUT RD

JUNIPER RD

BEECH RD

ROBIN RD

REDWOOD RD

SUNNY POINT ACCESS RAILROAD

BAY ST

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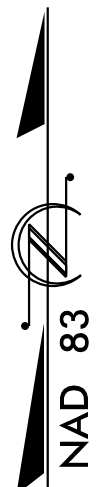
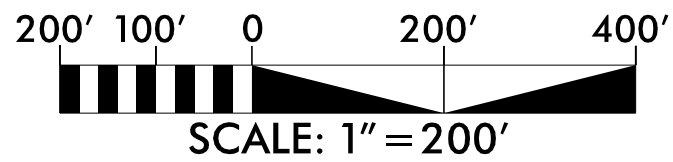
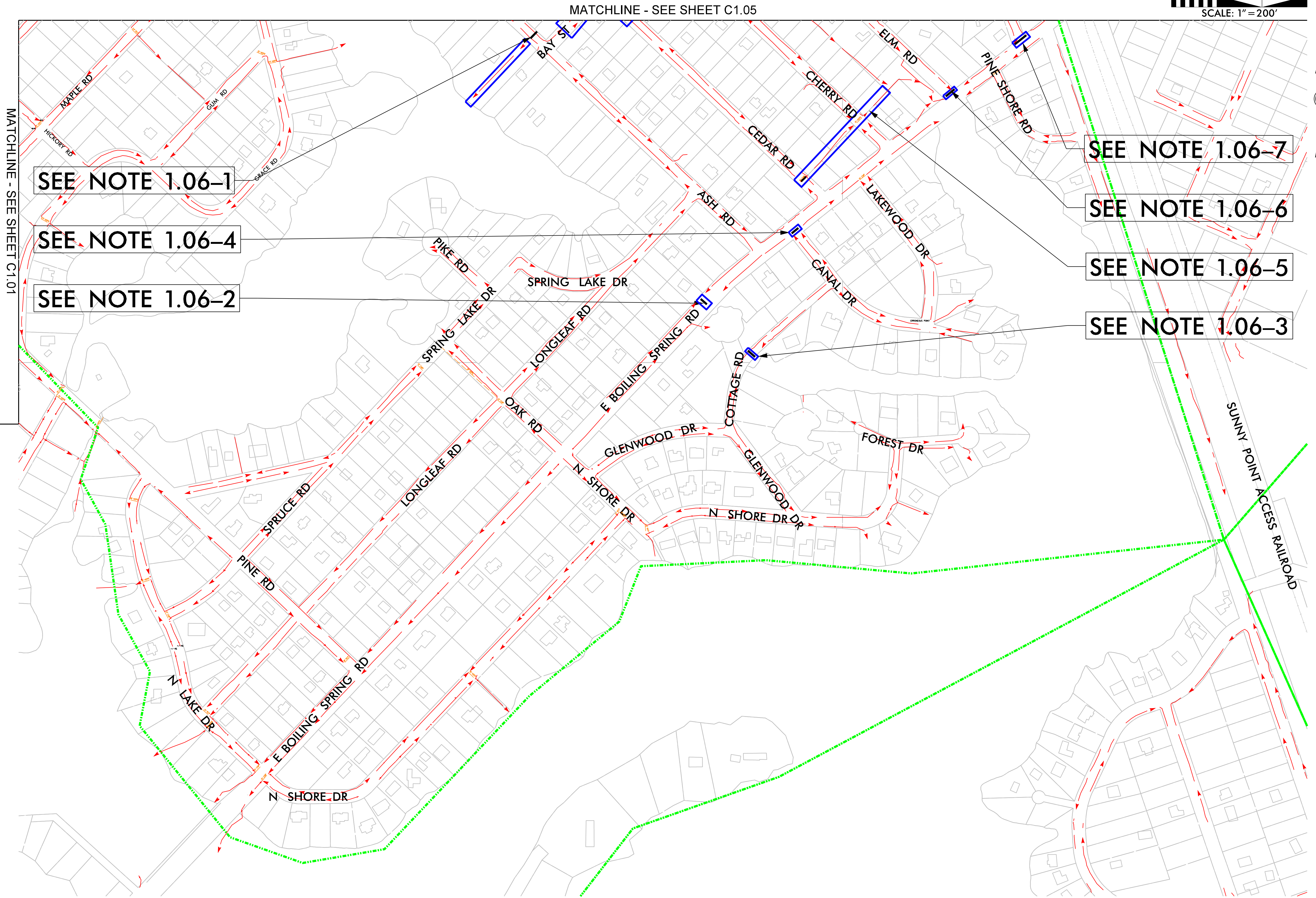
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SEE NOTE 1.06-7

SEE NOTE 1.06-6

SEE NOTE 1.06-5

SEE NOTE 1.06-3

SEE NOTE 1.06-1

SEE NOTE 1.06-4

SEE NOTE 1.06-2

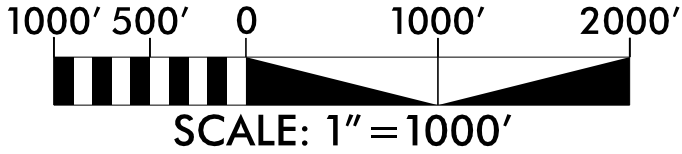
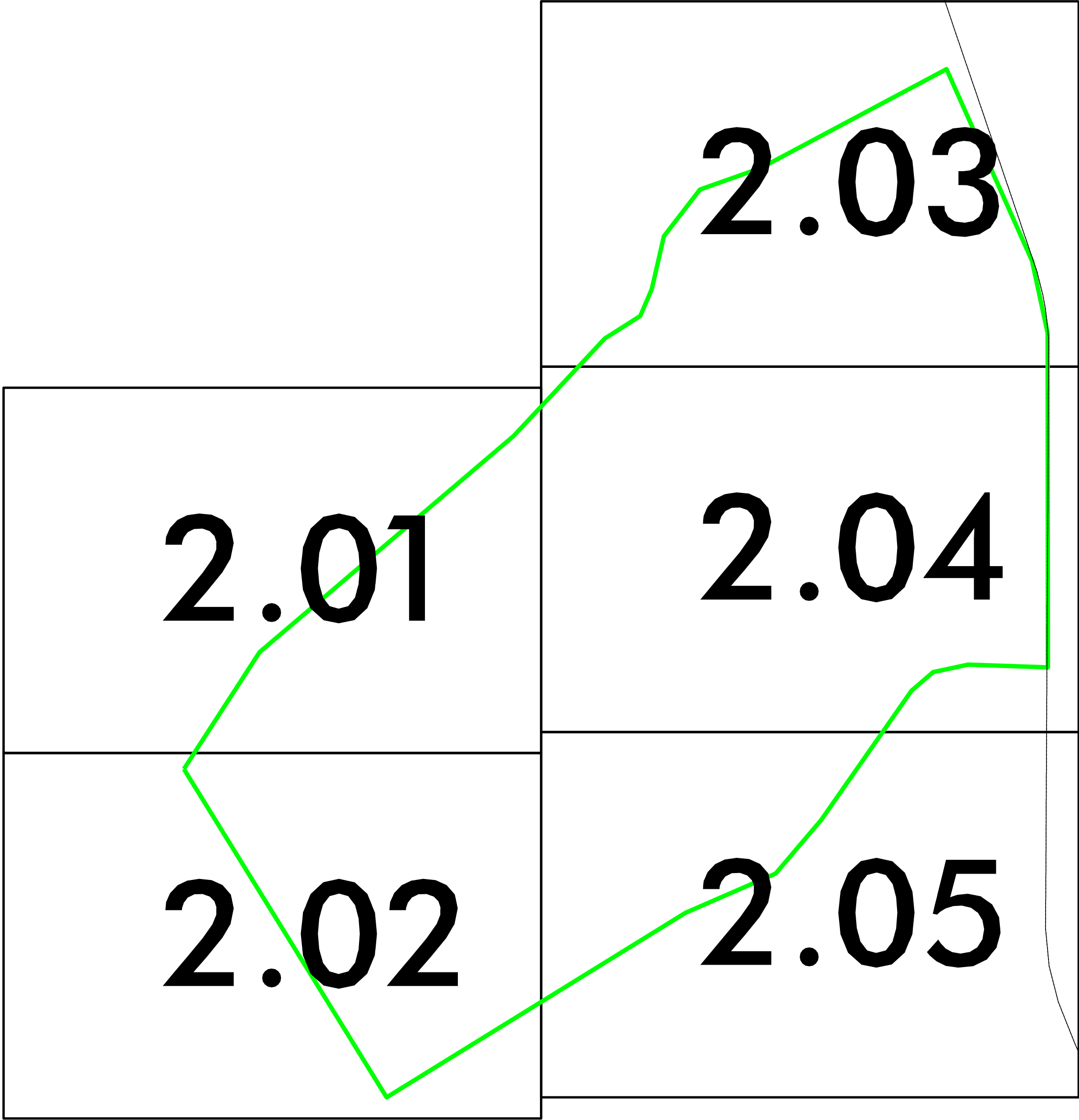
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MATCHLINE - SEE SHEET C1.05

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PHASE 1	

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SCALE: 1"=1000'



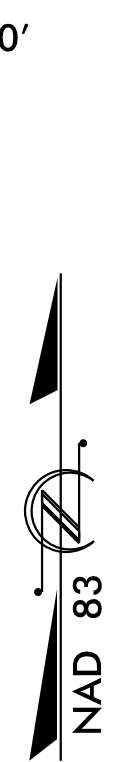
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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

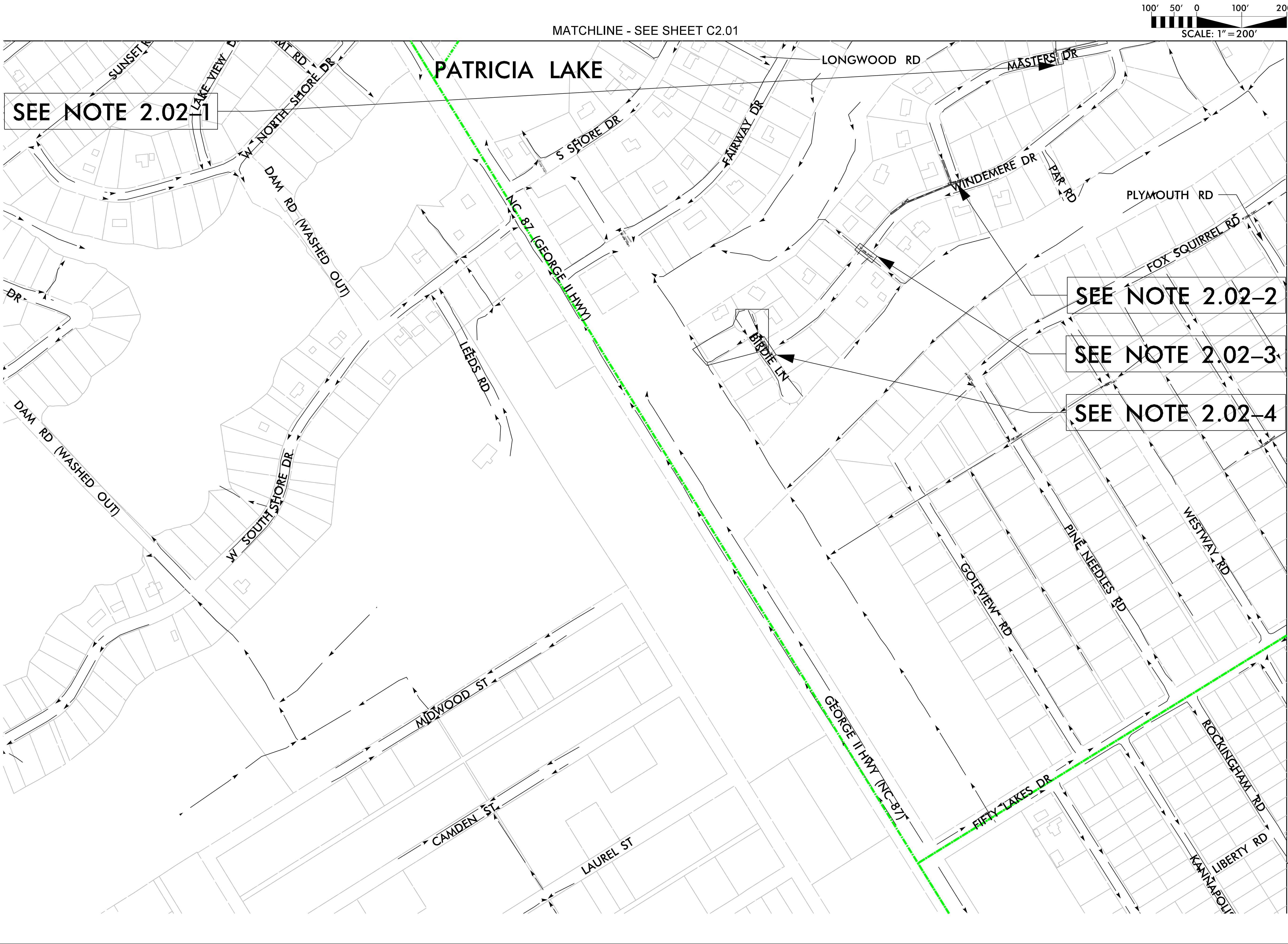
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PHASE 2

SEE NOTE 2.01-1

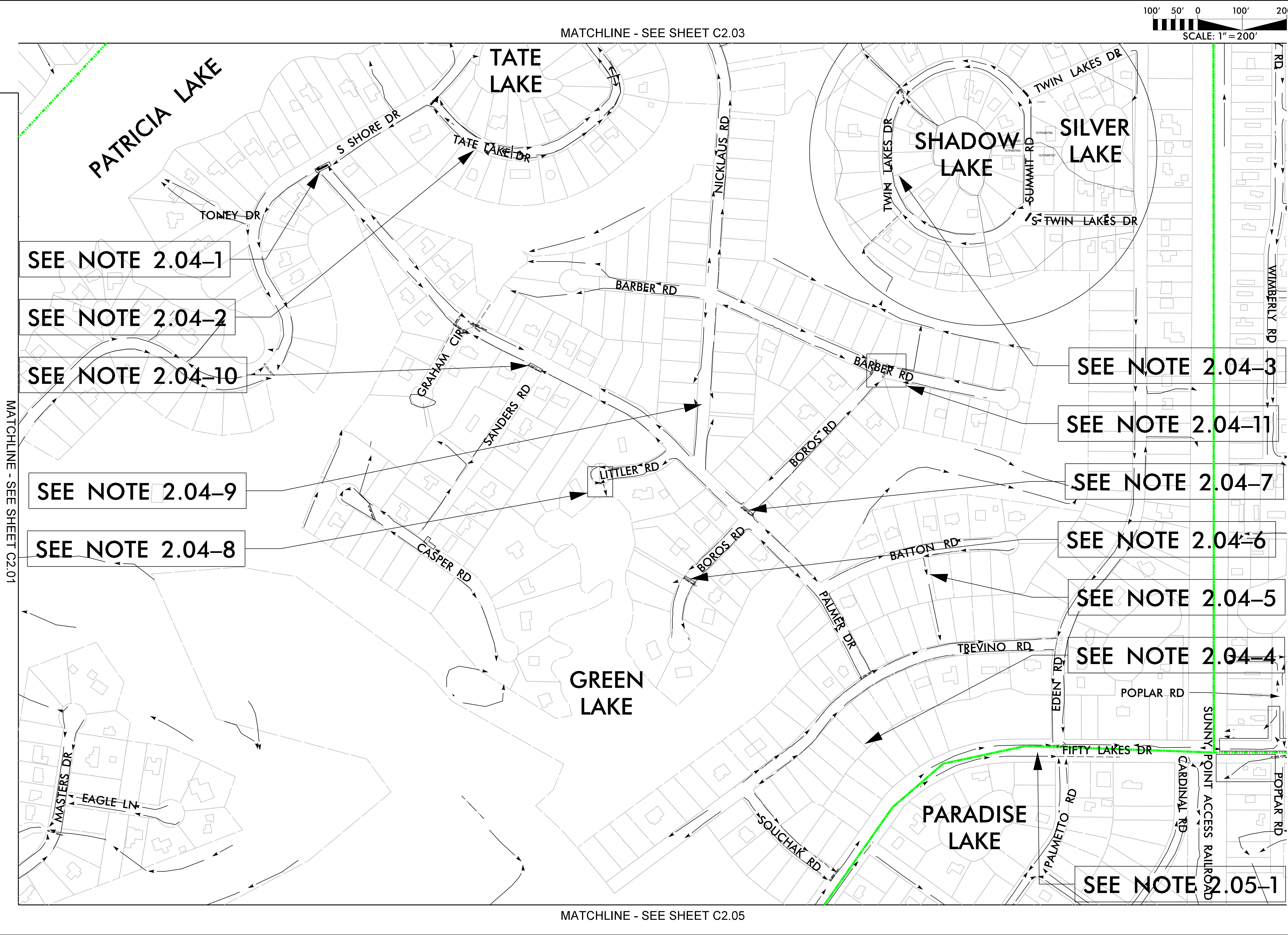
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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PHASE 2

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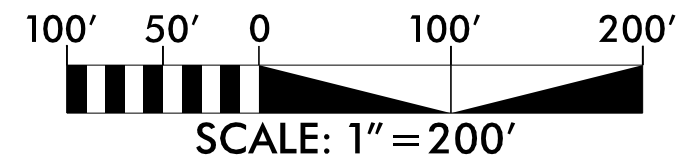
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Freeze

MATCHLINE - SEE SHEET C2.02

MATCHLINE - SEE SHEET C2.04



SEE NOTE 2.05-2

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STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

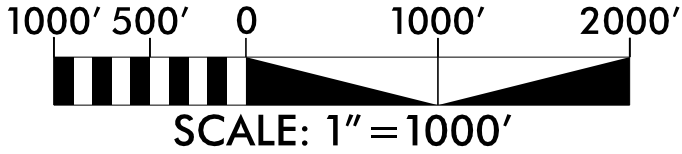
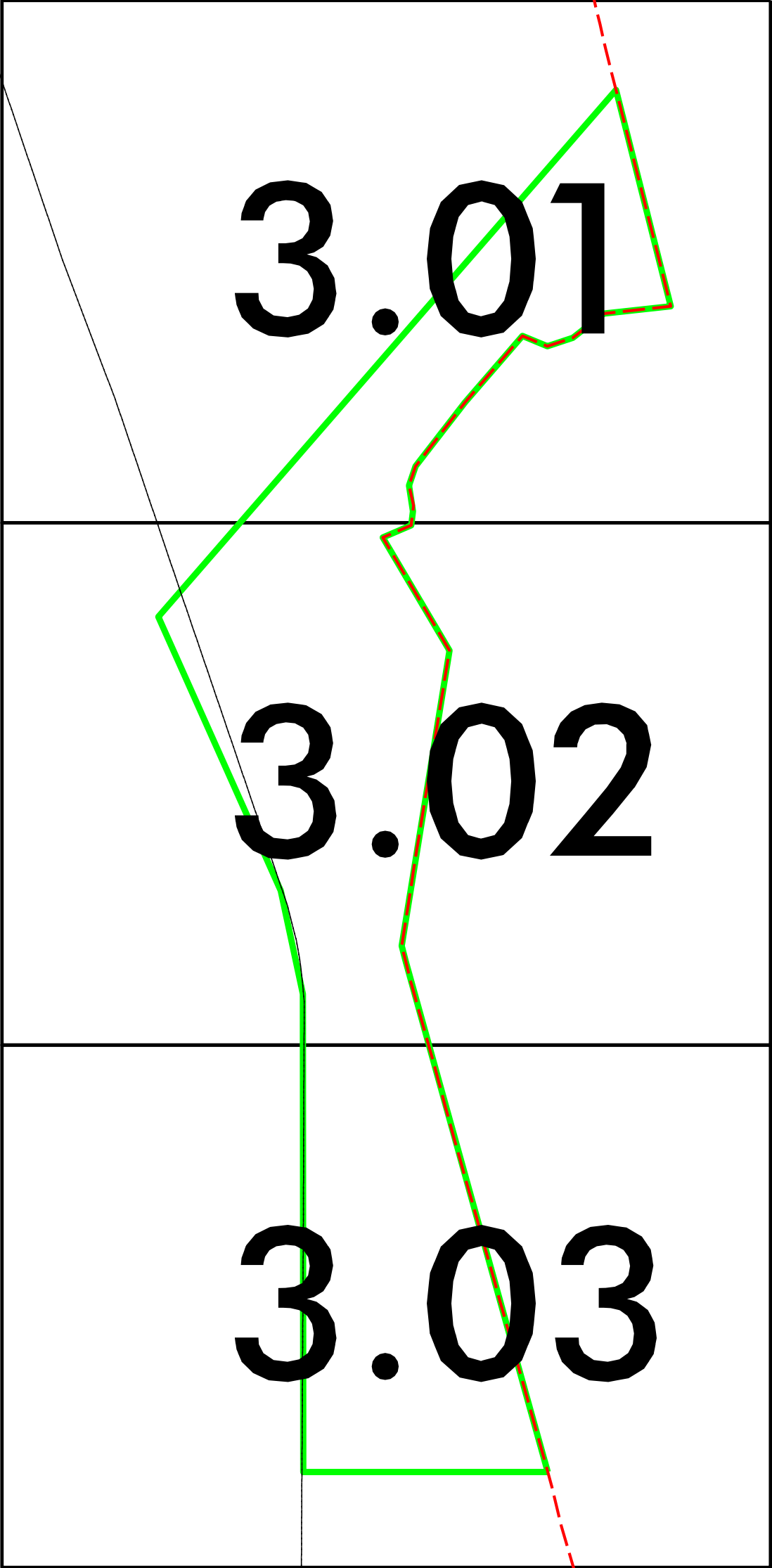
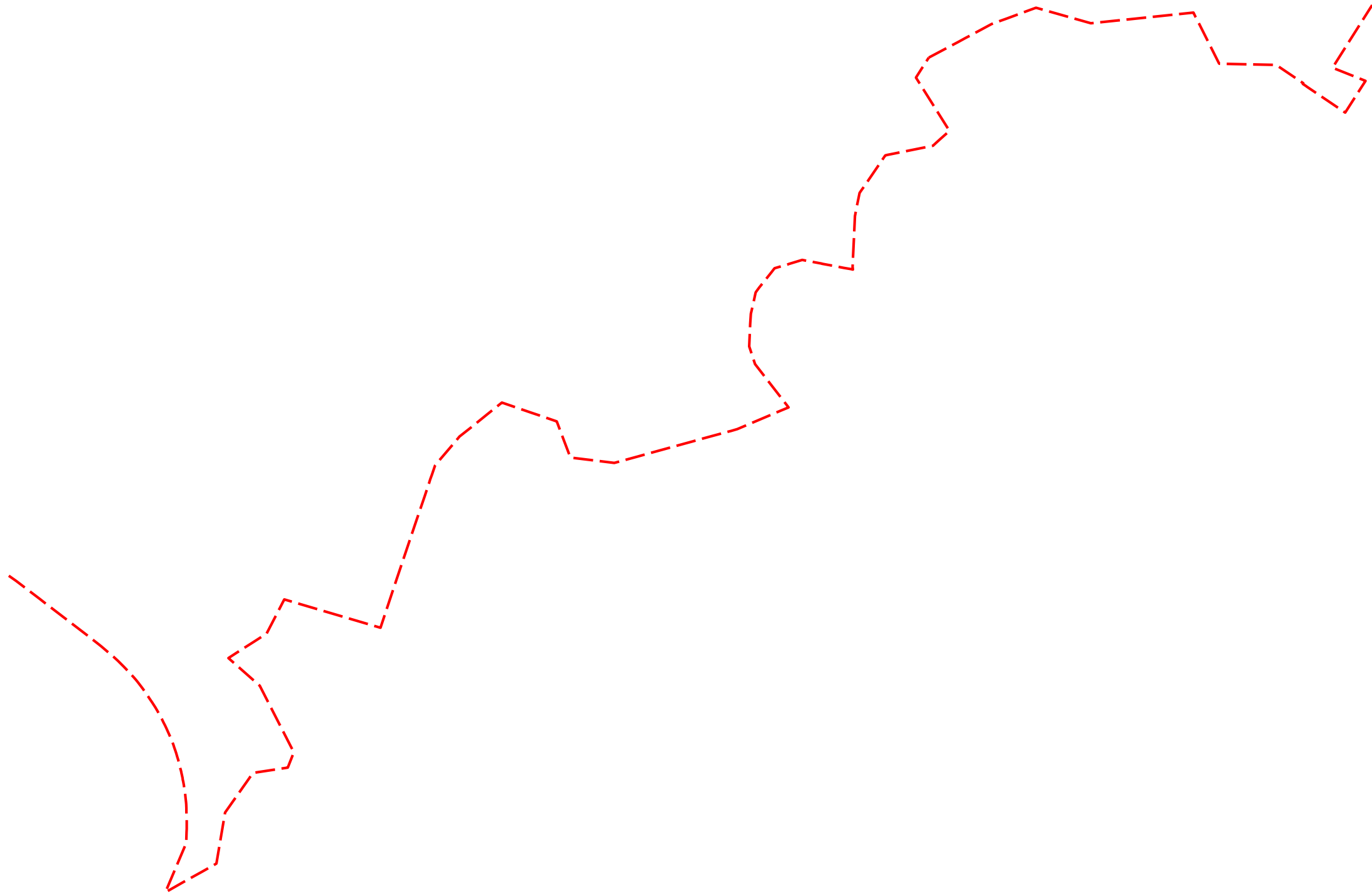
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SHEET NO.
C2.05

PHASE 2



2/24/2020
Boiling_Spring_Hyd_Storm_Mgmt_P3_PSH_C300.dgn
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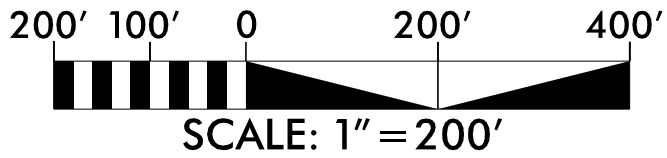
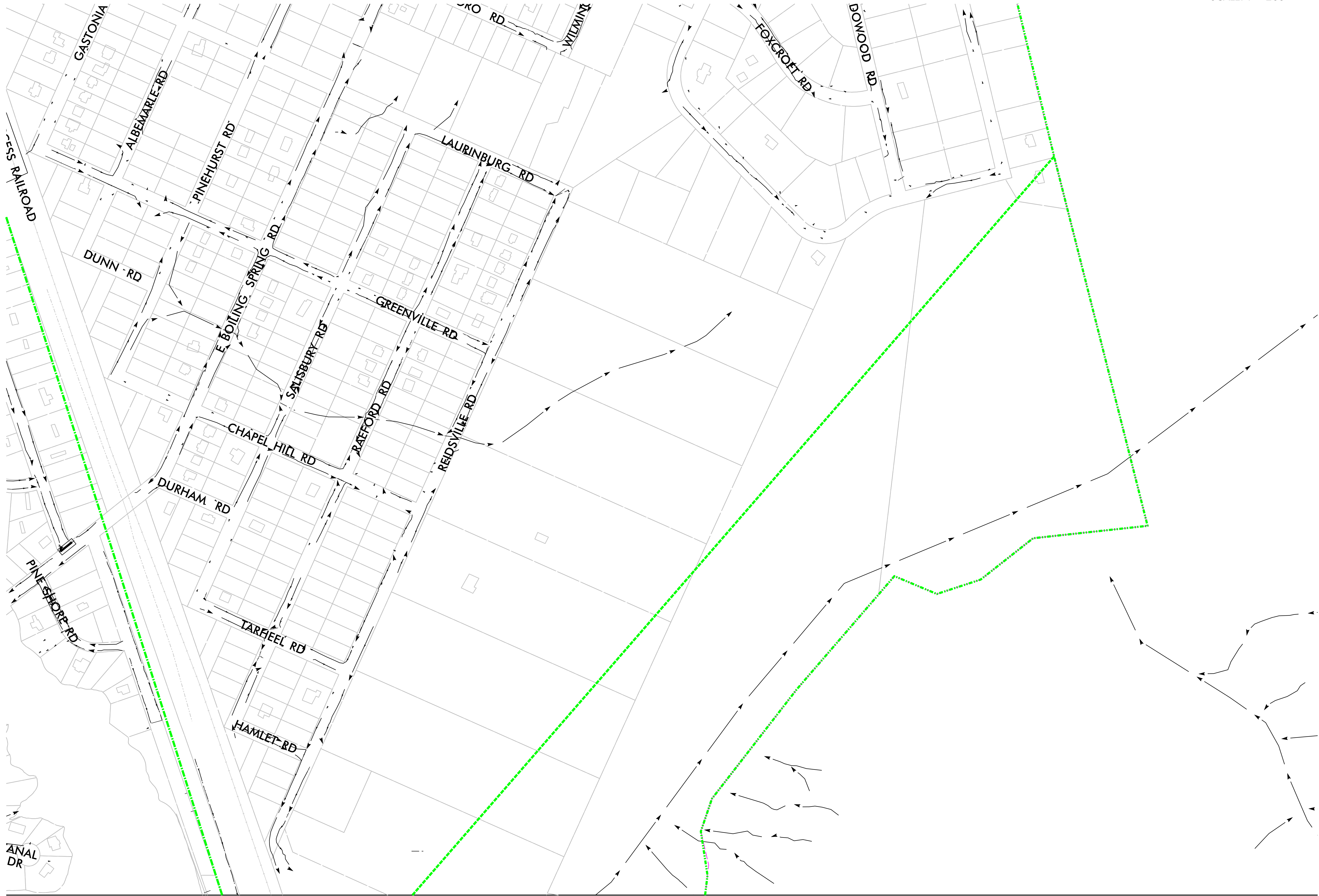
STORMWATER MANAGEMENT MASTER PLAN	
CITY OF BOILING SPRING LAKES, NC	
PHASE 3 – PLAN SHEET LAYOUT	

PROJECT # :
DRAWING NAME:
DATE:
DRAWN BY:
REVIEWED BY:
REVISIONS:
SHEET NO. C3.00

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CITY OF BOILING SPRING LAKES, NC

PROJECT # :
DRAWING NAME:
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C3.01

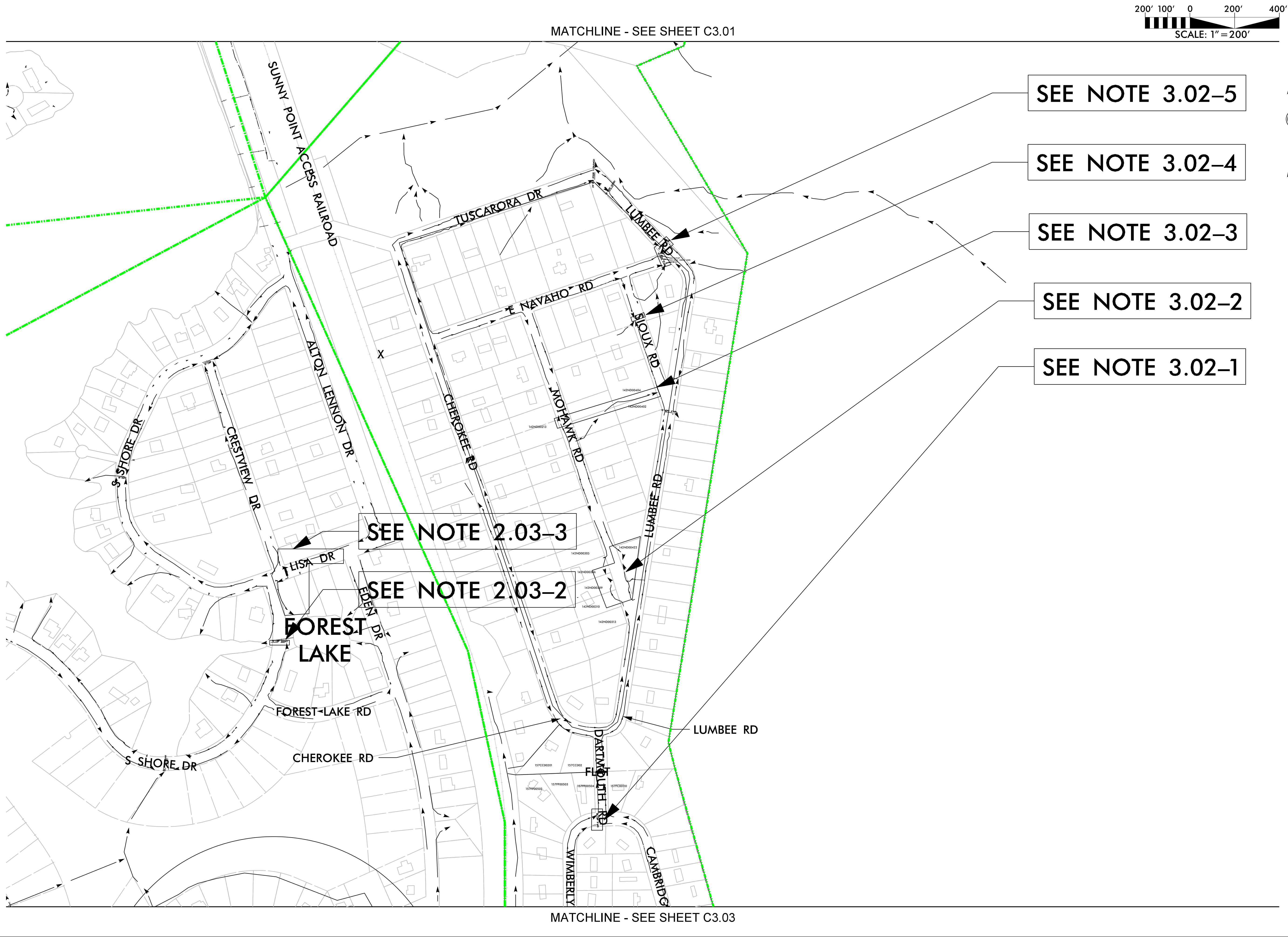
PHASE 3

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906 JONES FRANKLIN ROAD
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SEE NOTE 3.02-5

SEE NOTE 3.02-4

SEE NOTE 3.02-3

SEE NOTE 3.02-2

SEE NOTE 3.02-1

SEE NOTE 2.03-3

SEE NOTE 2.03-2

FOREST LAKE

200' 100' 0 200' 400'
SCALE: 1" = 200'

NAD 83

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STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

PHASE 3

PROJECT # :

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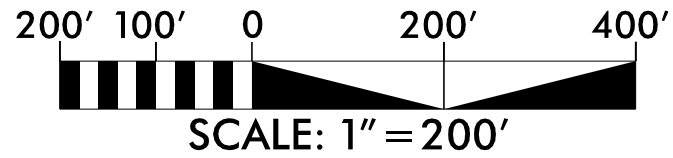
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C3.02

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CITY OF BOILING SPRING LAKES, NC

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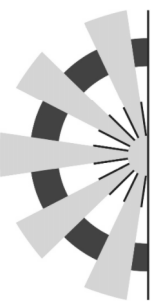
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SHEET NO.

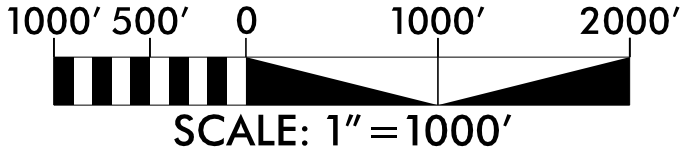
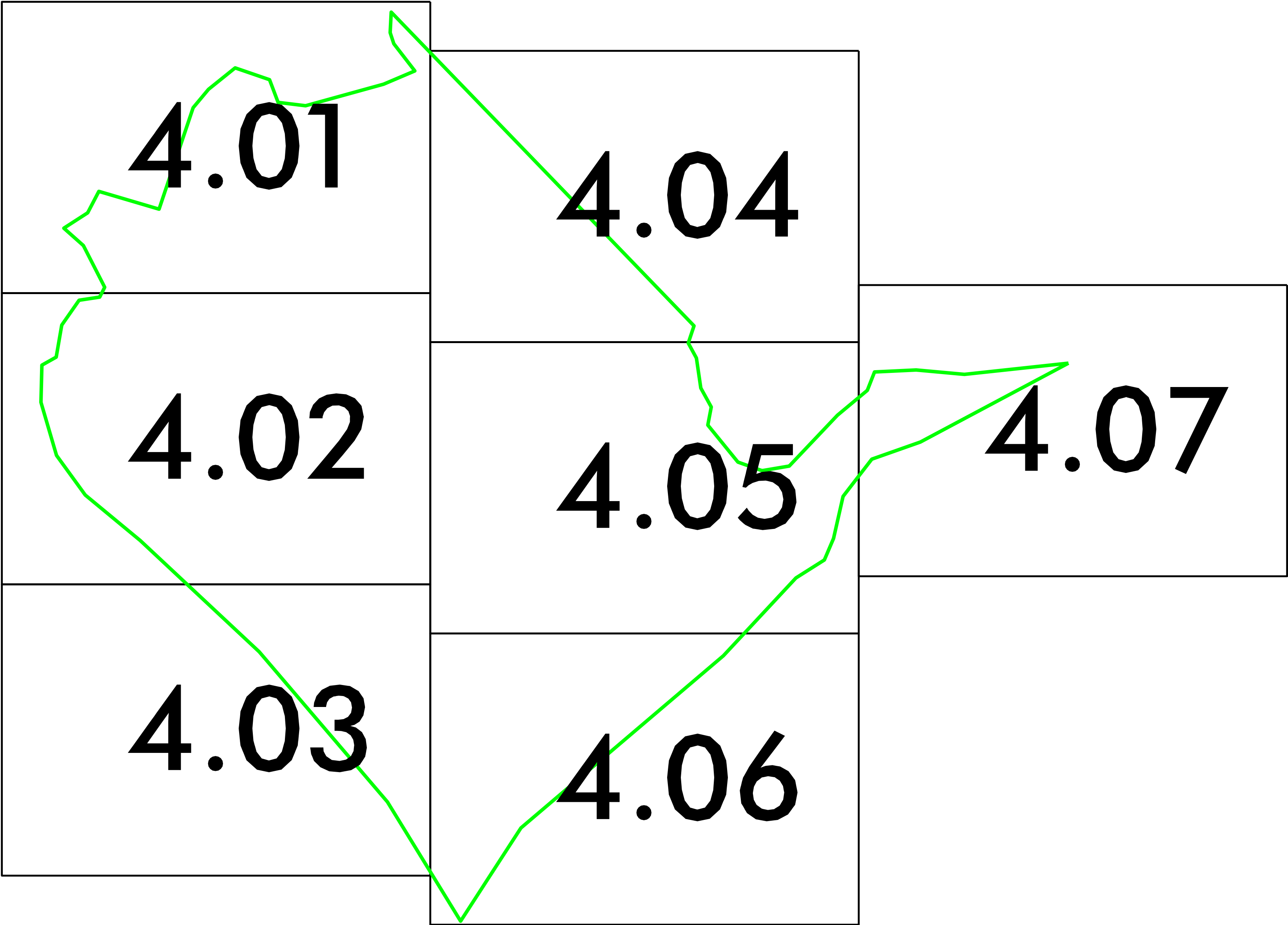
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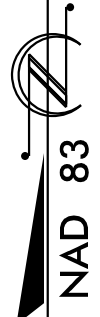
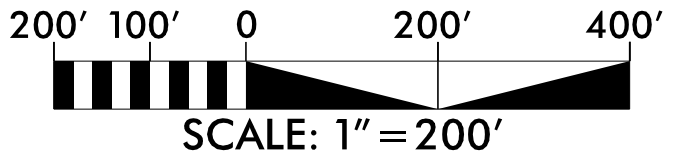
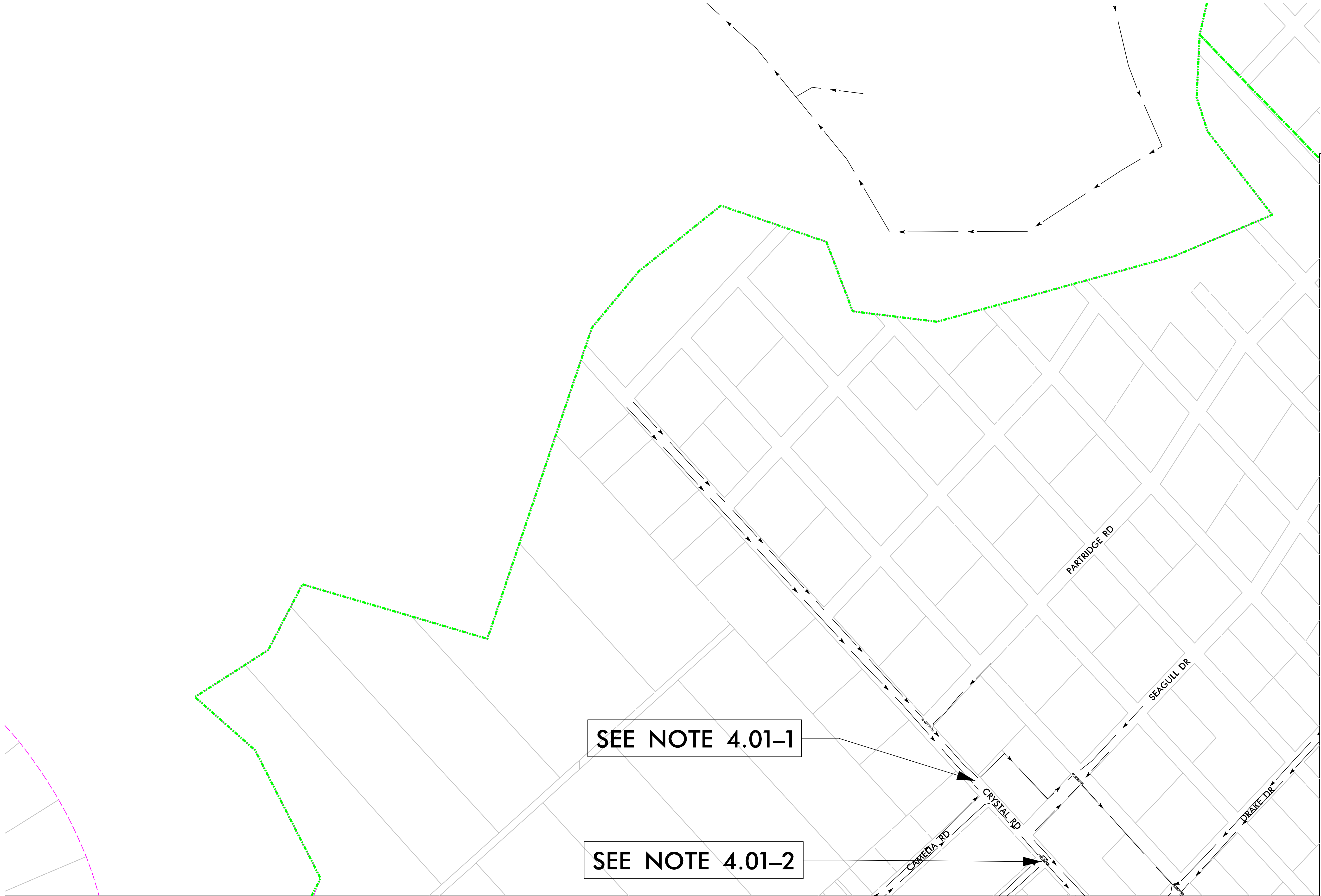
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Boiling_Spring_Hyd_Storm_Mgmt_P4_PSH_C400.dgn
10:45:01



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PHASE 4 – PLAN SHEET LAYOUT	
PROJECT # :	
DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	
SHEET NO. C4.00	

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Boiling_Spring_Hyd_Storm_Mgmt_P4_PSH_C4.01.dgn
lbrave



MATCHLINE - SEE SHEET C4.04

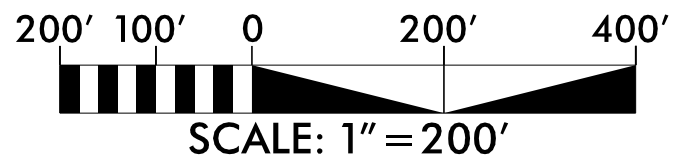
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PHASE 4	
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SHEET NO.	

C4.01

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lbrave

MATCHLINE - SEE SHEET C4.01



SEE NOTE 4.02-4

SEE NOTE 4.02-3

SEE NOTE 4.02-1

SEE NOTE 4.02-2

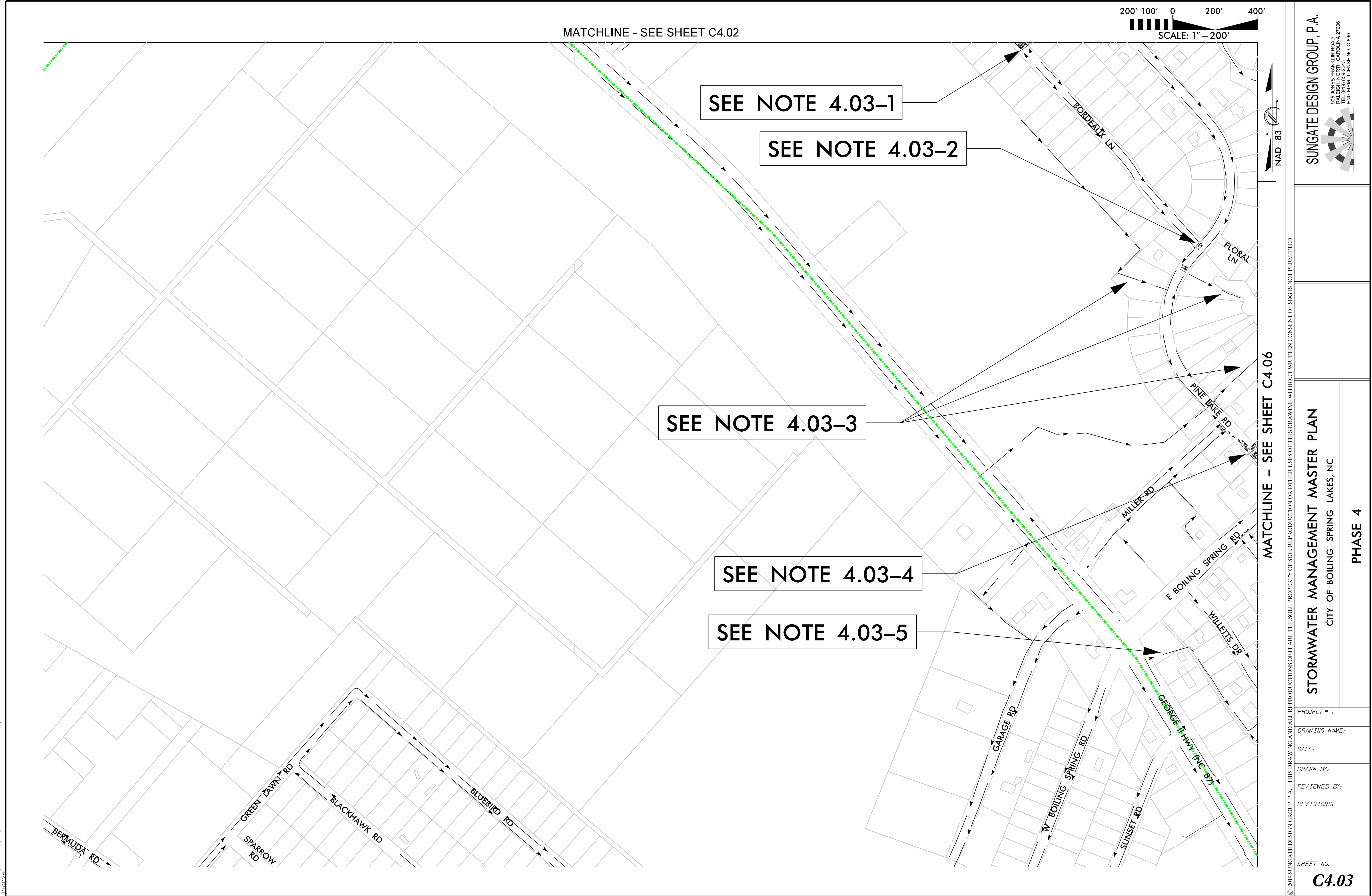
MATCHLINE - SEE SHEET C4.03

MATCHLINE - SEE SHEET C4.05

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PHASE 4	
PROJECT # :	
DRAWING NAME:	
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DRAWN BY:	
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SHEET NO. C4.02	

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Boiling Spring Hyd. Storm Mgmt. P4_PSH_C4.03.dgn
lhp



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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PHASE 4

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MATCHLINE - SEE SHEET C4.02

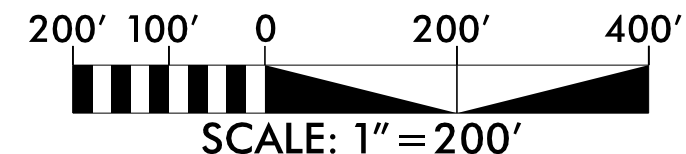
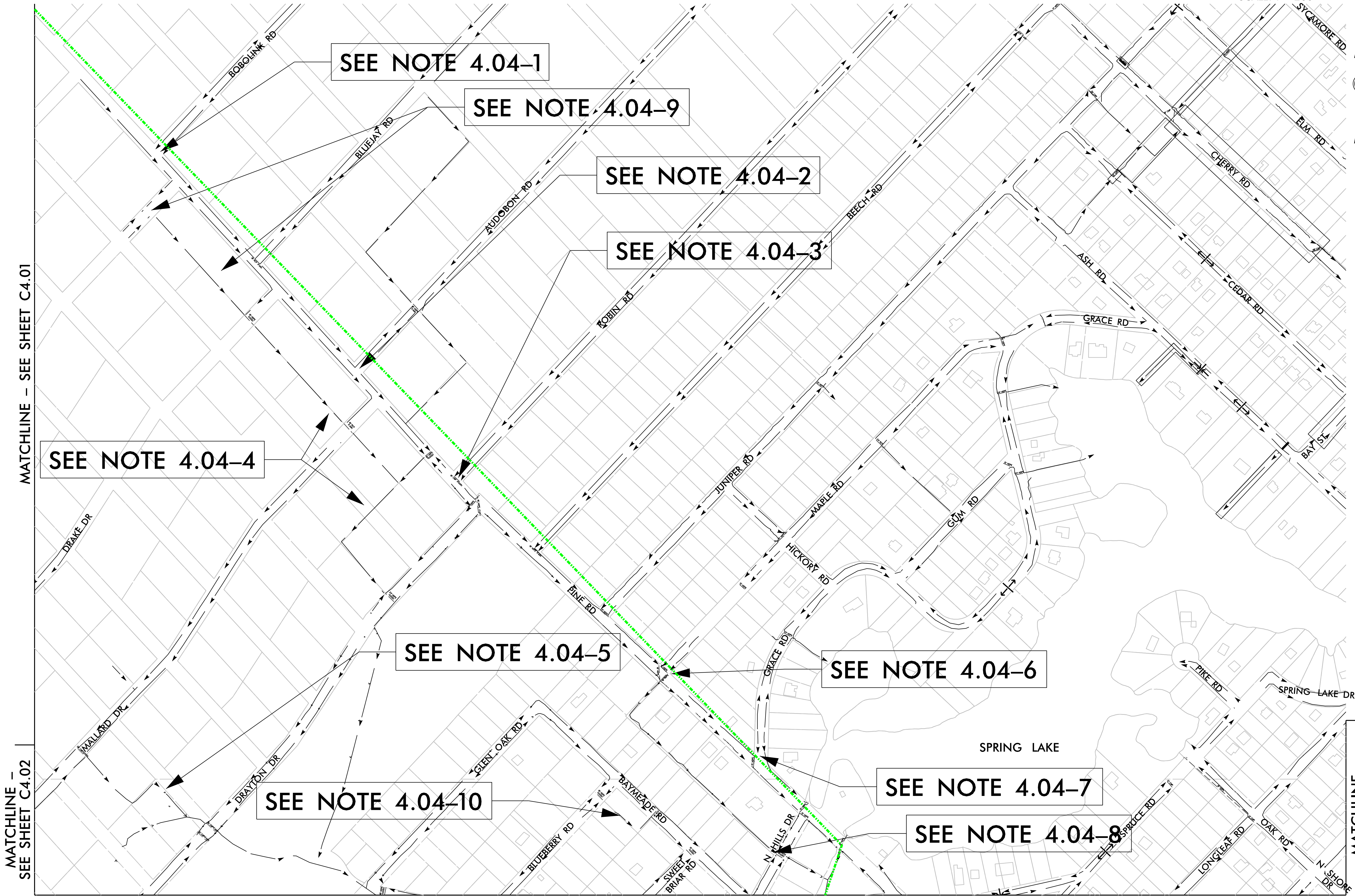
MATCHLINE - SEE SHEET C4.06

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SCALE: 1" = 200'

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Boiling Spring Hyd.Storm.Mgmt.P4_PSH-C404.dgn
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CITY OF BOILING SPRING LAKES, NC

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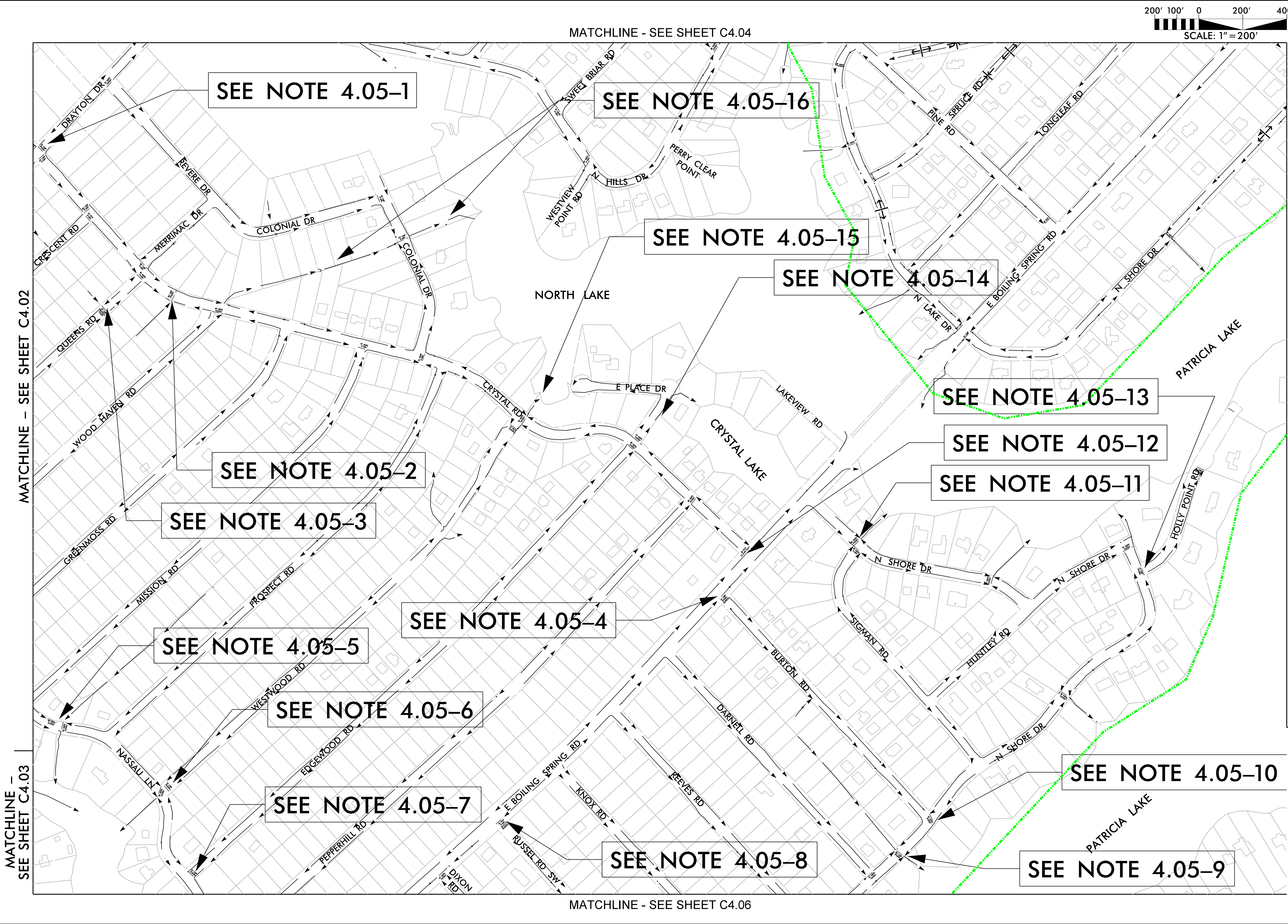
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C4.04

PHASE 4

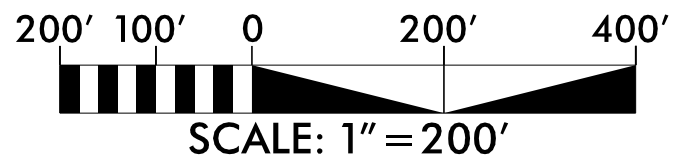
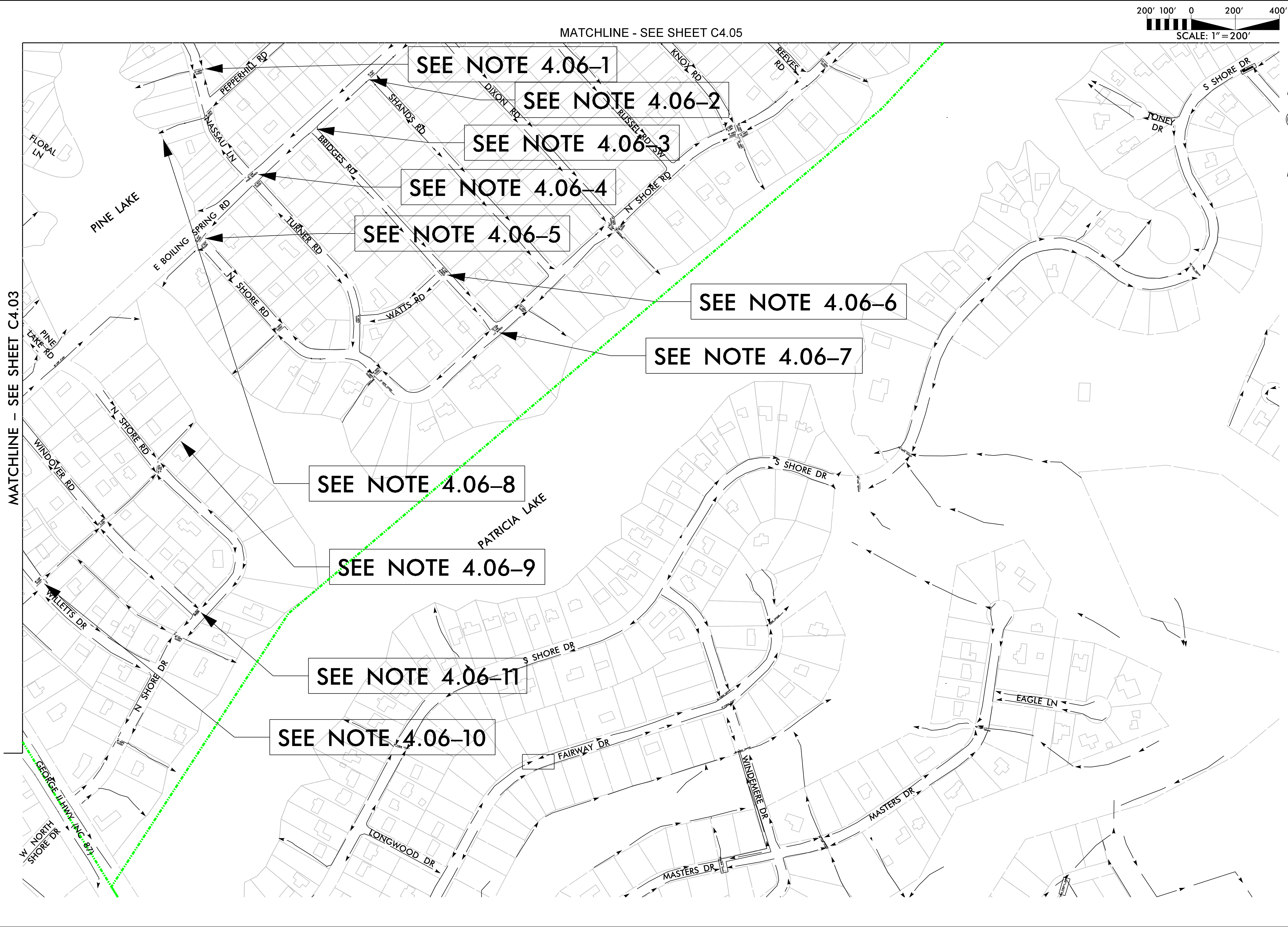
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PHASE 4	
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DRAWING NAME:	
DATE:	
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SHEET NO.	C4.05

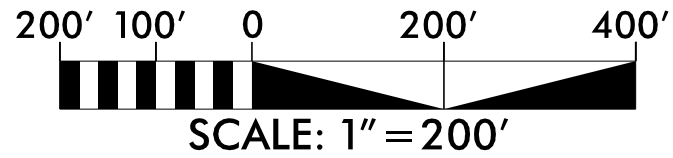
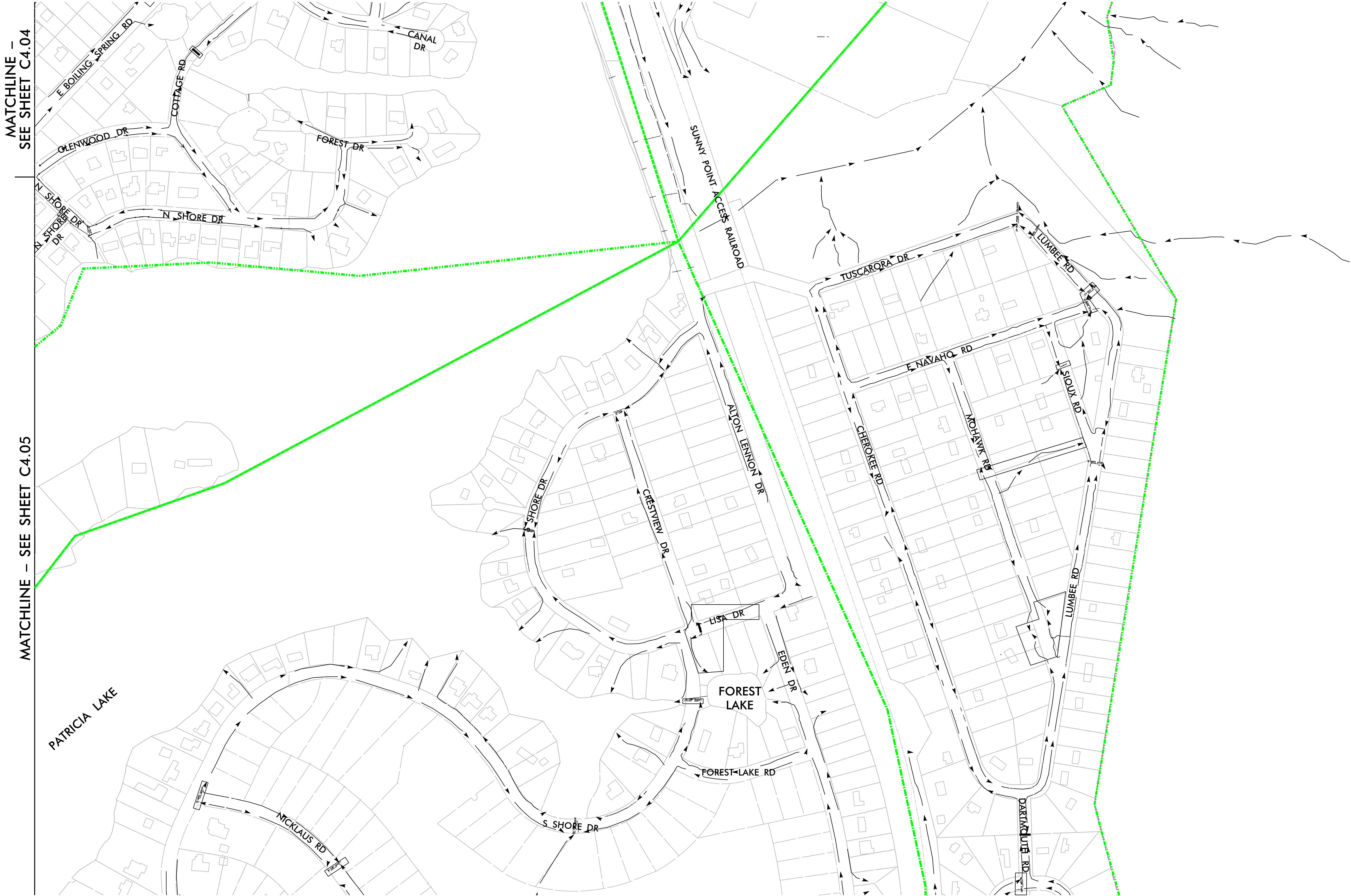
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PHASE 4	
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SHEET NO.	C4.06

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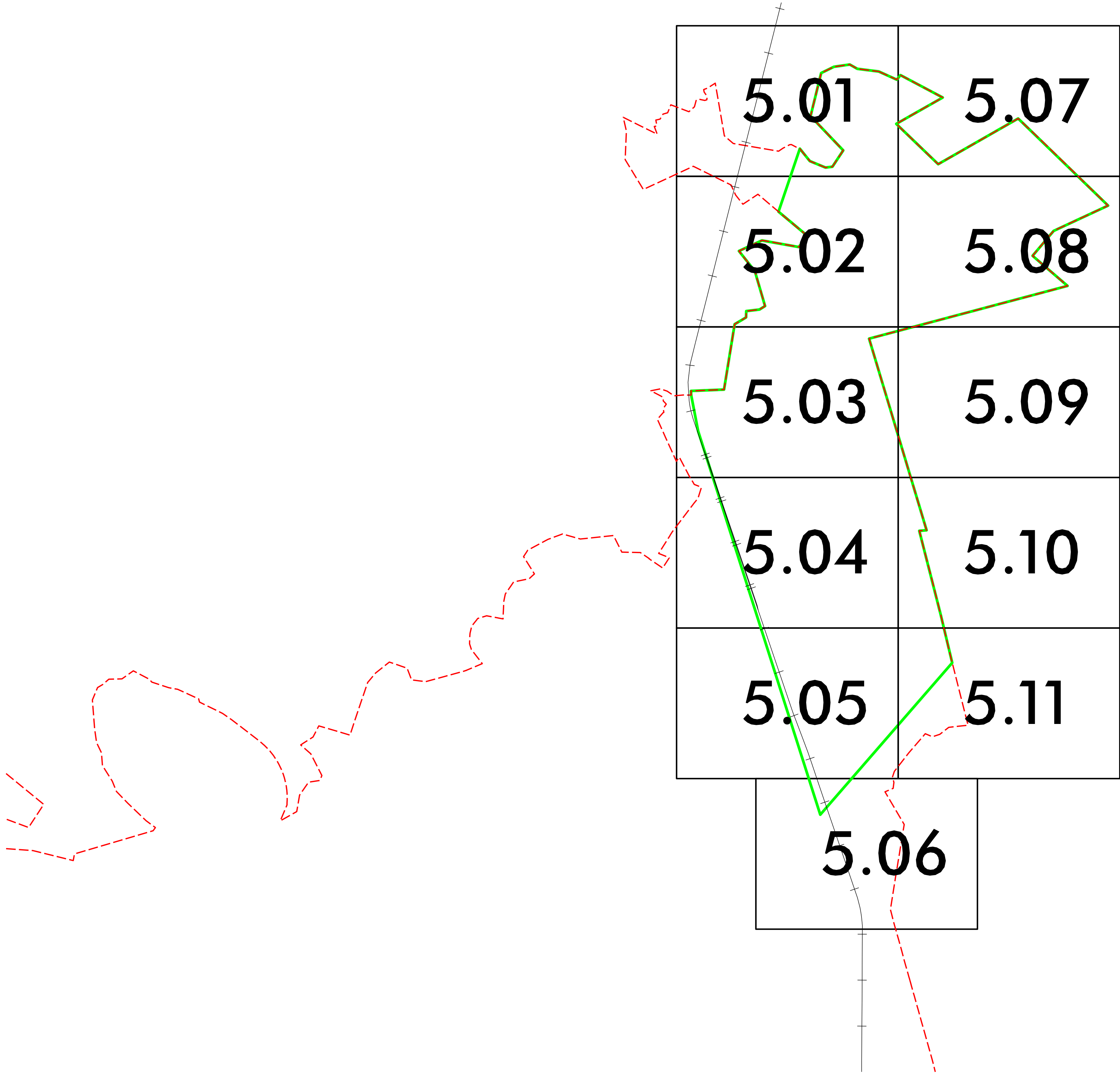
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PROJECT # :	
DRAWING NAME:	
DATE:	
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REVIEWED BY:	
REVISIONS:	
SHEET NO.	
C4.07	

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PHASE 4

10/15/2020
Boiling_Spring_Hyd_Storm_Mgmt_P5_PSH_C500.dgn
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1500' 750' 0 1500' 3000'
SCALE: 1" = 1500'

NAD 83

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CITY OF BOILING SPRING LAKES, NC

PROJECT # :

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REVISIONS:

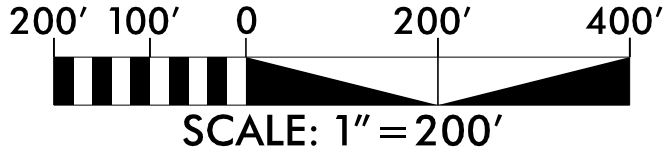
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C5.00

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MATCHLINE - SEE SHEET C5.07

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REVISIONS:	
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STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

PHASE 5

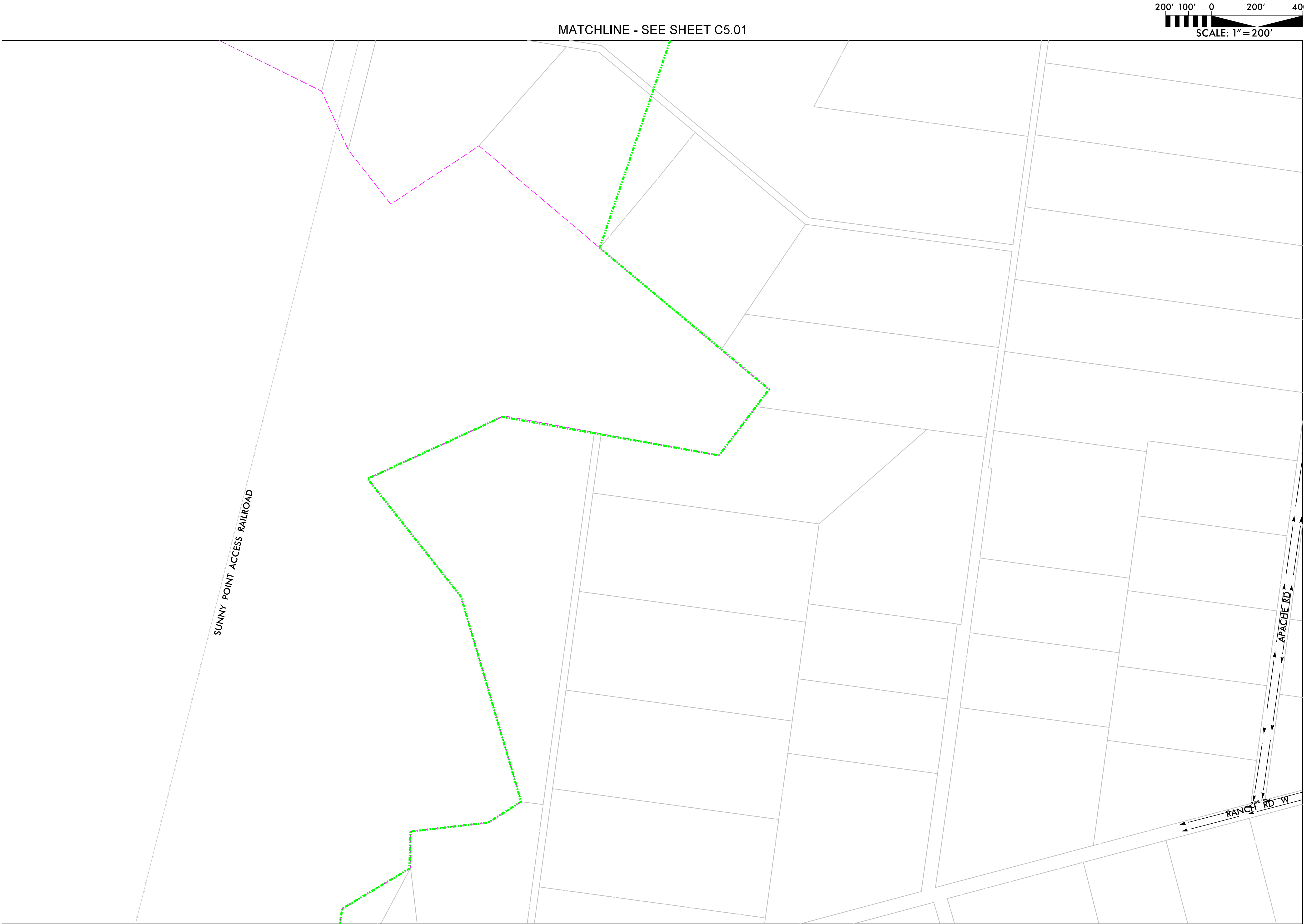
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C5.01

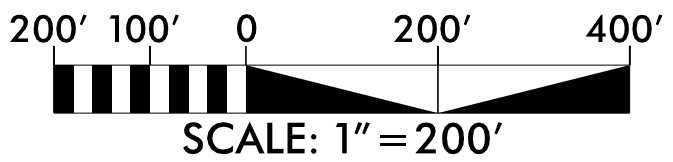
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MATCHLINE - SEE SHEET C5.08

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PHASE 5	
PROJECT # :	
DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	
SHEET NO.	C5.02

10/15/2020
Boiling_Spring_Hyd_Storm_Mgmt_P5_PSH_C503.dgn
lhpave



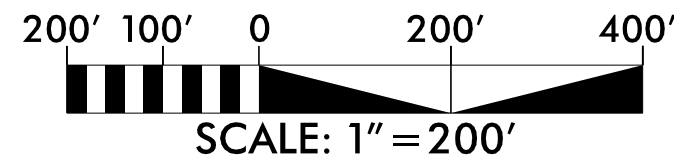
NAD 83

MATCHLINE - SEE SHEET C5.09

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<div>SUNGATE DESIGN GROUP, P.A.</div>		<div></div>	
<div>STORMWATER MANAGEMENT MASTER PLAN</div>		<div>CITY OF BOILING SPRING LAKES, NC</div>	
<div>PROJECT # :</div>		<div>PHASE 5</div>	
<div>DRAWING NAME:</div>			
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<div>DRAWN BY:</div>			
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10/15/2020
Boiling Spring Hyd. Storm Mgmt. P5_PSH-C504.dgn
lbarve

MATCHLINE - SEE SHEET C5.03



NAD 83

SEE NOTE 5.04-3

SEE NOTE 5.04-9

SEE NOTE 5.04-2

SEE NOTE 5.04-1

SEE NOTE 5.04-11

SEE NOTE 5.04-12

SEE NOTE 5.04-6

SEE NOTE 5.04-5

SEE NOTE 5.04-8

SEE NOTE 5.04-7

SEE NOTE 5.04-10

SEE NOTE 5.04-4

SEE NOTE 5.04-13

MATCHLINE - SEE SHEET C5.10

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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PHASE 5

PROJECT # :

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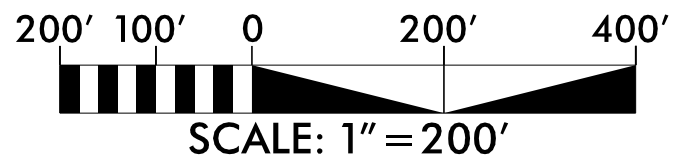
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C5.04

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Boiling Spring Hyd. Storm Mgmt. P5_PSH_C505.dgn
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MATCHLINE - SEE SHEET C5.04



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MATCHLINE - SEE SHEET C5.06

MATCHLINE - SEE SHEET C5.11

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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PROJECT # :

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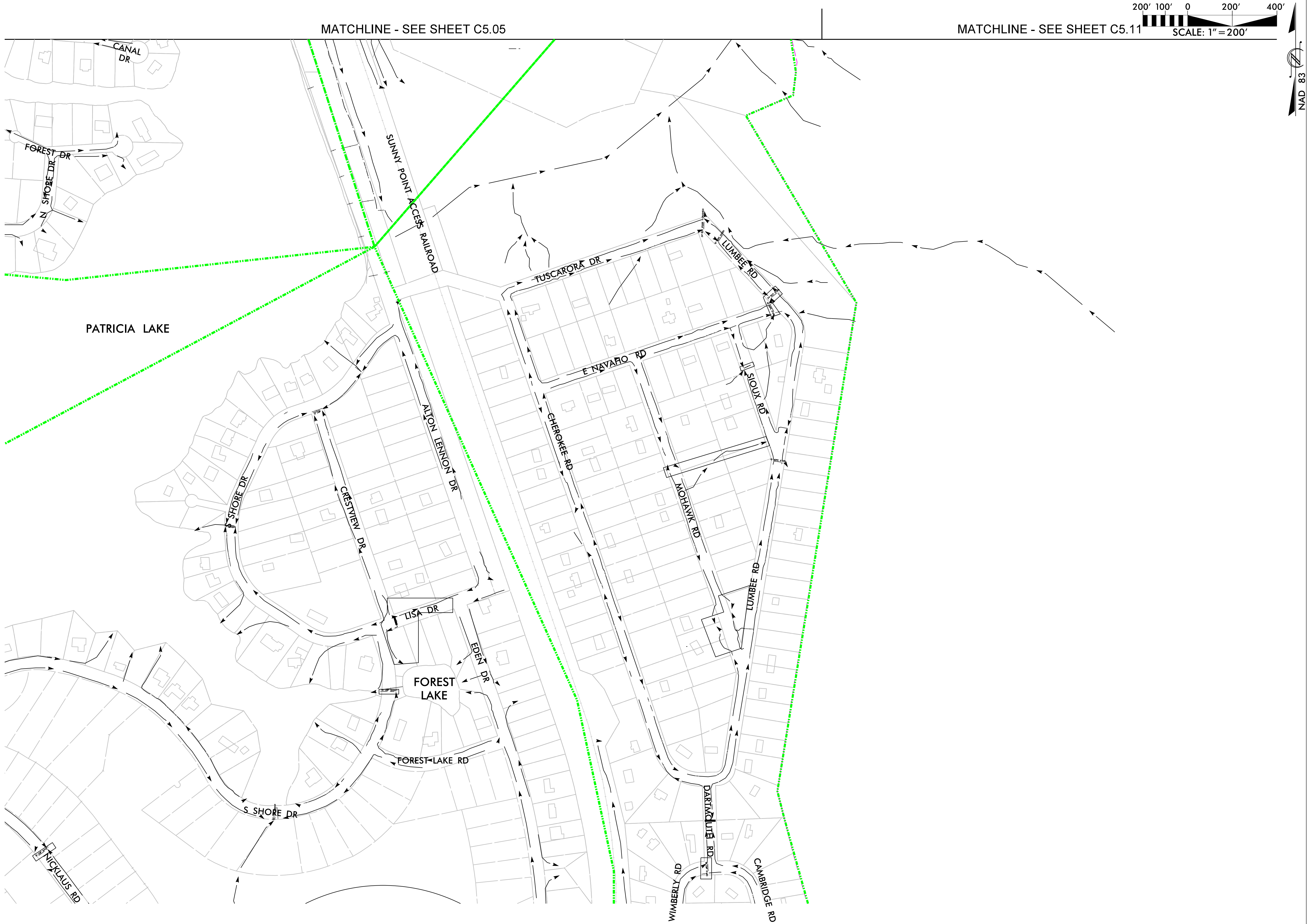
REVISIONS:

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PHASE 5

C5.05

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CITY OF BOILING SPRING LAKES, NC

PROJECT # :
DRAWING NAME:
DATE:
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C5.06

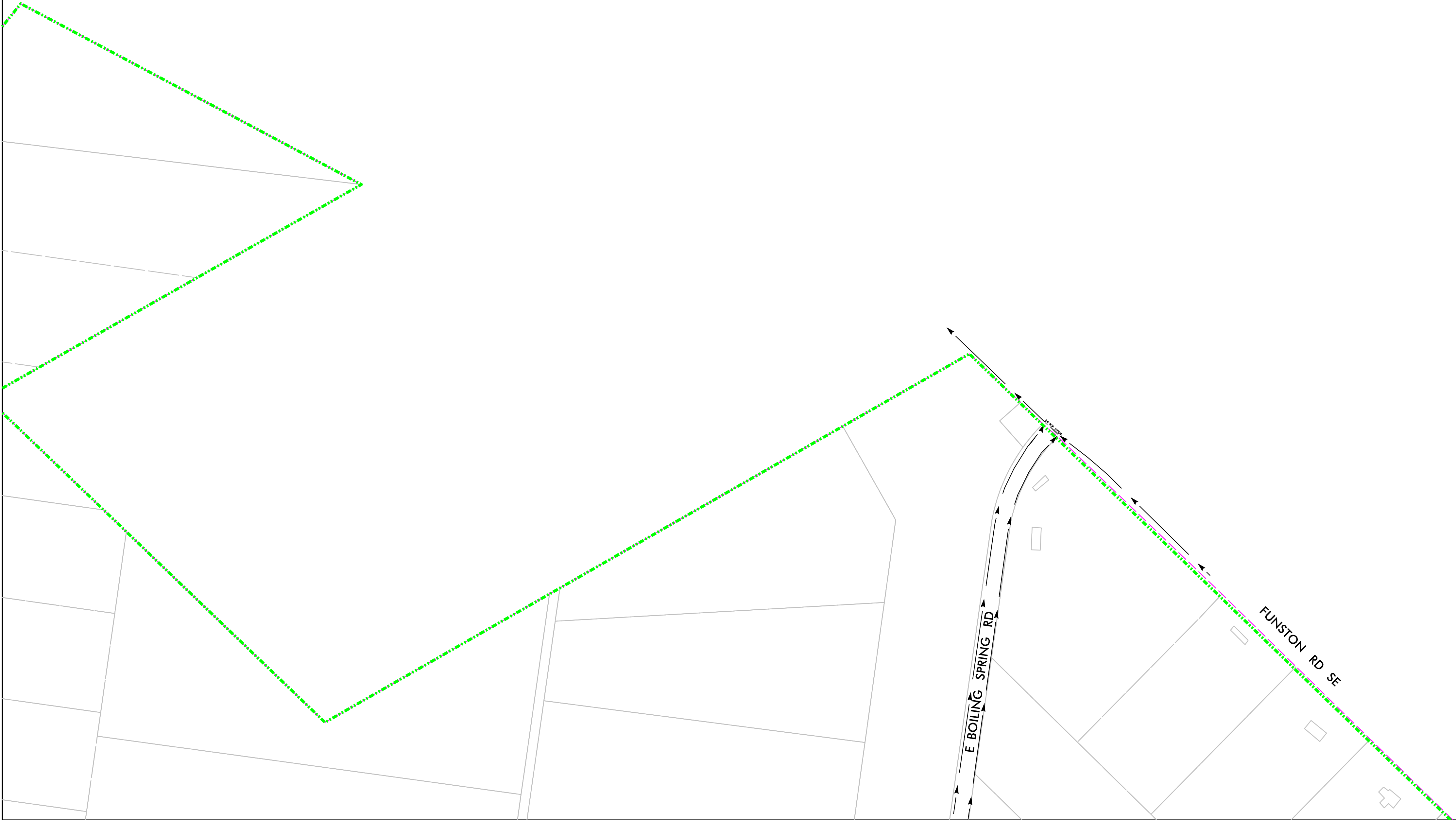
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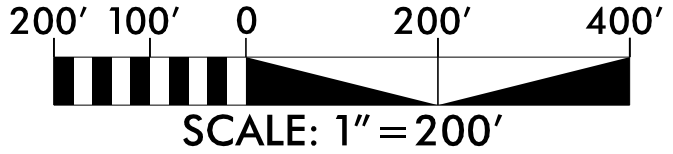


10/15/2020
Boiling_Spring_Hyd_Storm_Mgmt_P5_PSH_C507.dgn
lhpave

MATCHLINE – SEE SHEET C5.01




MATCHLINE - SEE SHEET C5.08



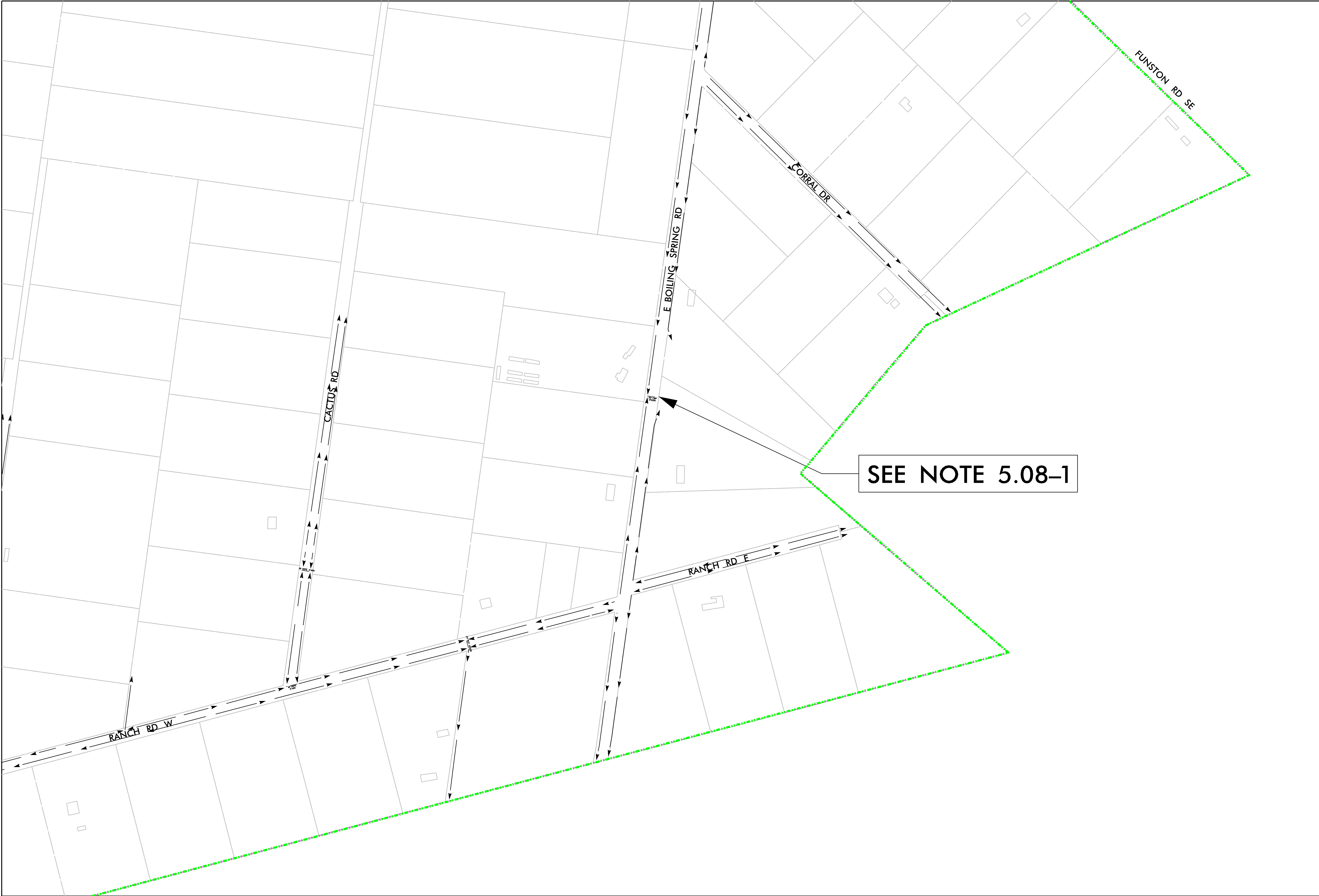
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PHASE 5	
PROJECT # :	
DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	
SHEET NO.	
C5.07	

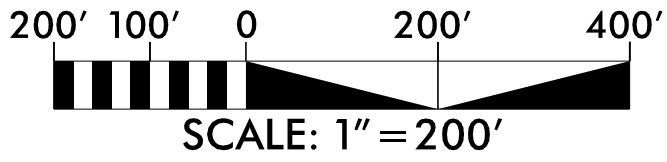
10/15/2020
Boiling_Spring_Hyd_Storm_Mgmt_P5_PSH_C508.dgn
lhpave

MATCHLINE - SEE SHEET C5.02



MATCHLINE - SEE SHEET C5.07

MATCHLINE - SEE SHEET C5.09



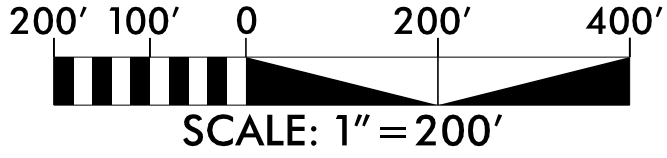
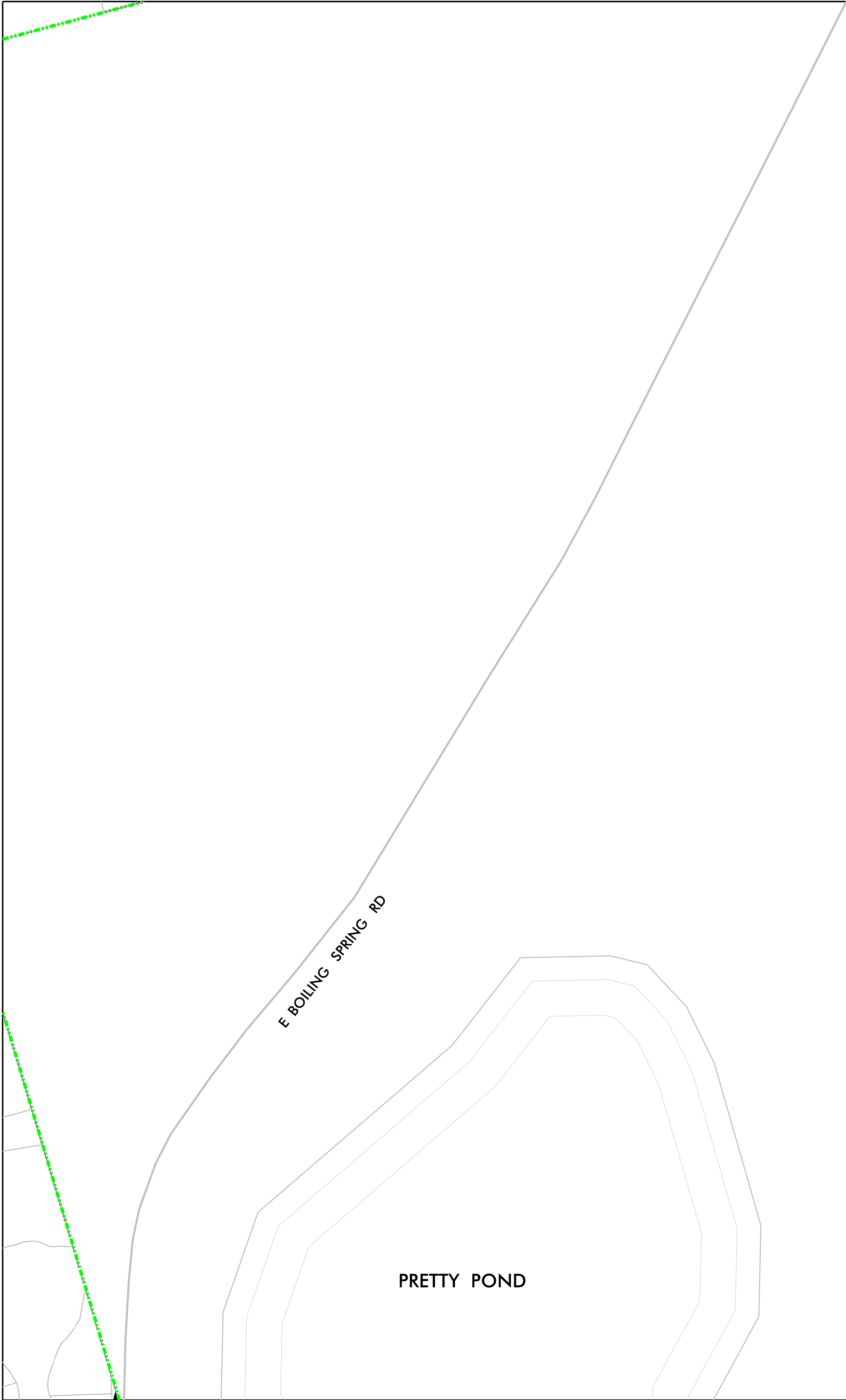
NAD 83

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PHASE 5	
PROJECT # :	
DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	
SHEET NO. C5.08	

10/15/2020
Boiling_Spring_Hyd_Storm_Mgmt_P5_PSH_C509.dgn
lhpave

MATCHLINE – SEE SHEET C5.03



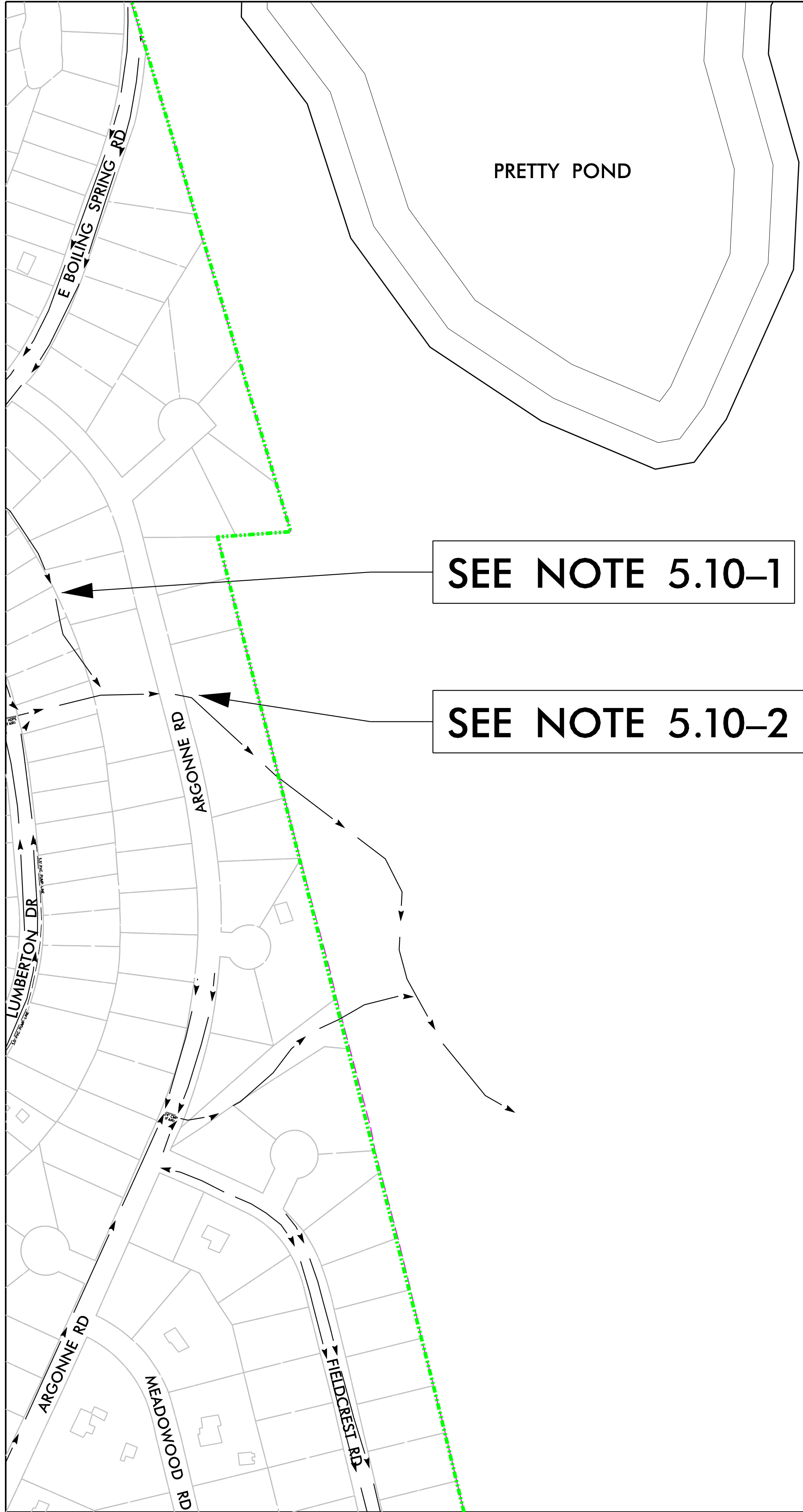
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PHASE 5	
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DRAWING NAME:	
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DRAWN BY:	
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REVISIONS:	
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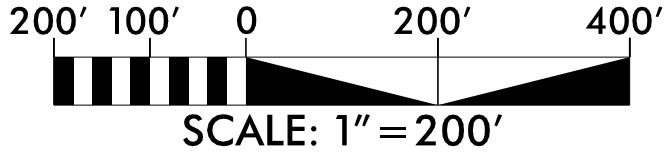
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bclan

MATCHLINE - SEE SHEET C5.04



MATCHLINE - SEE SHEET C5.09

MATCHLINE - SEE SHEET C5.11



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DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	
SHEET NO.	

C5.10

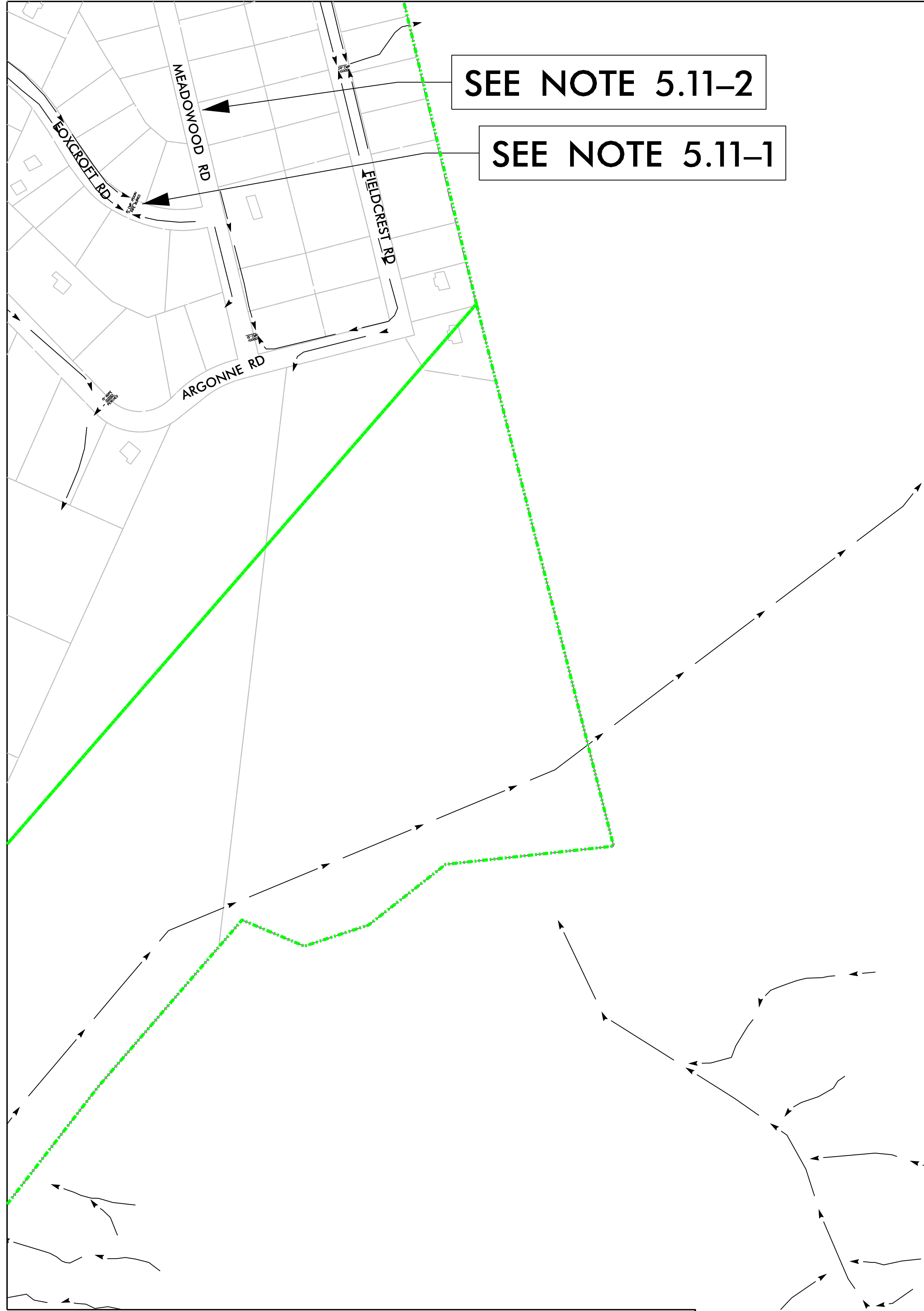
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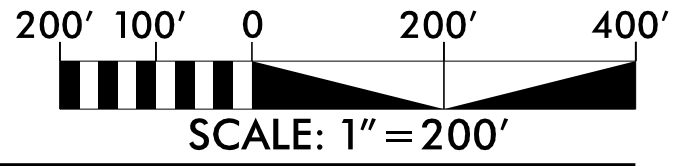
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Boiling_Spring_Hyd_Storm_Mgmt_P5_PSH_C511.dgn
lhpave

MATCHLINE - SEE SHEET C5.05



MATCHLINE - SEE SHEET C5.06

MATCHLINE - SEE SHEET C5.10



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CITY OF BOILING SPRING LAKES, NC

PROJECT # :
DRAWING NAME:
DATE:
DRAWN BY:
REVIEWED BY:
REVISIONS:

SHEET NO.

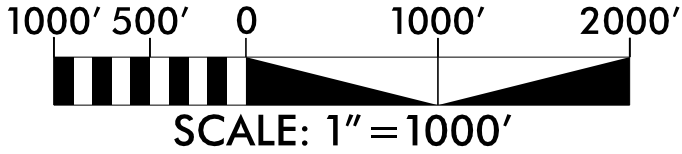
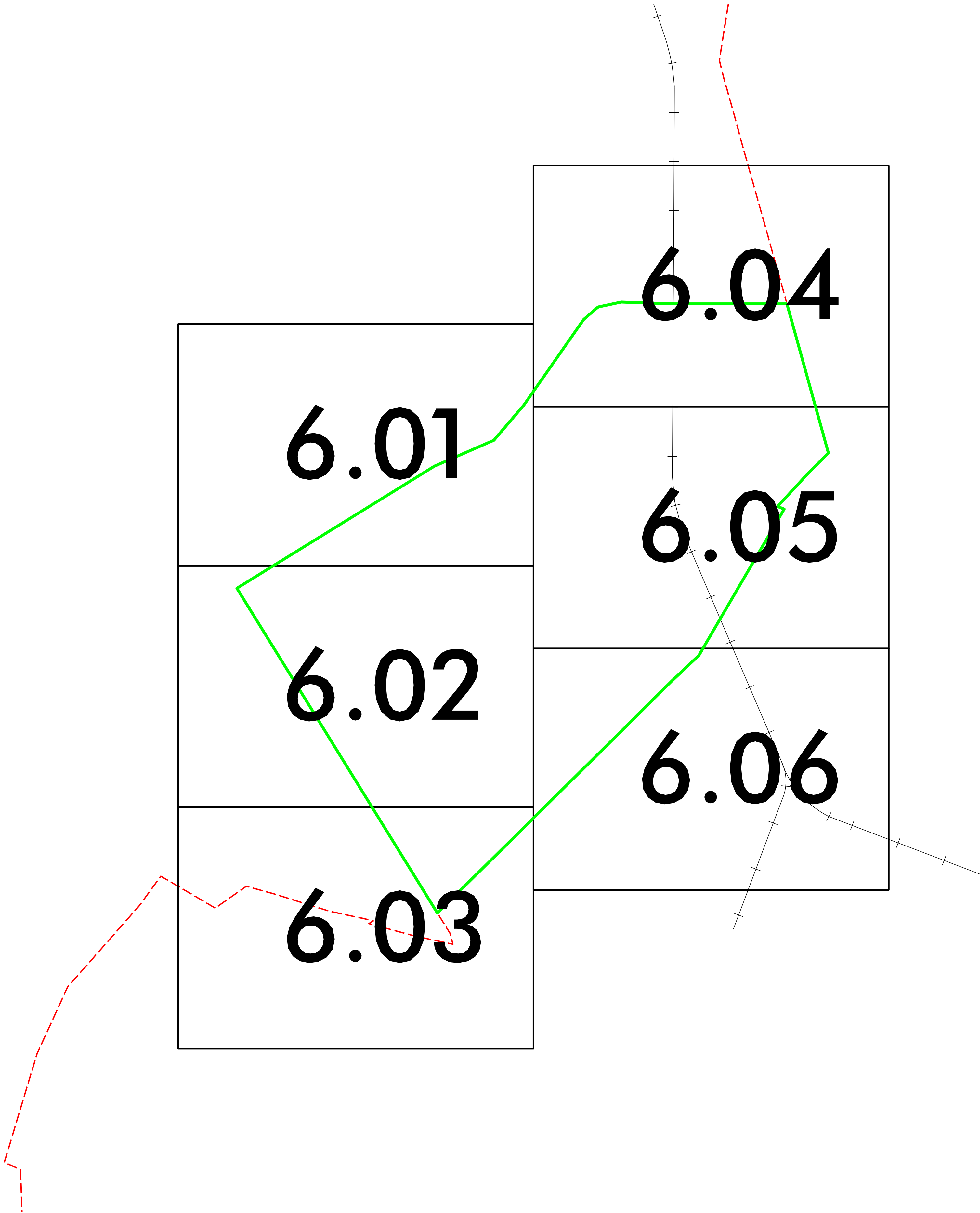
C5.11

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6/8/2020
Boiling_Spring_Hyd_Storm_Mgmt_P6_PSH_C600.dgn
lhp:vel



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DRAWING NAME:	
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SHEET NO.	

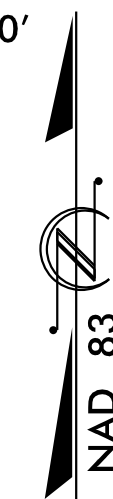
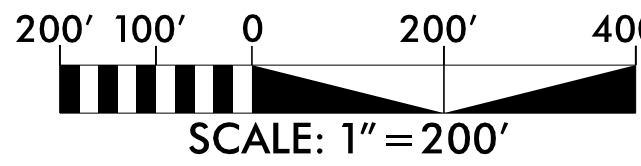
STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC
PHASE 6 – PLAN SHEET LAYOUT

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TEL: 919.852.2243
ENG FIRM LICENSE NO. C-680

C6.00

6/8/2020
Boiling Spring Hyd. Storm Mgmt. P6_PSH_C601.dgn
hbarveit



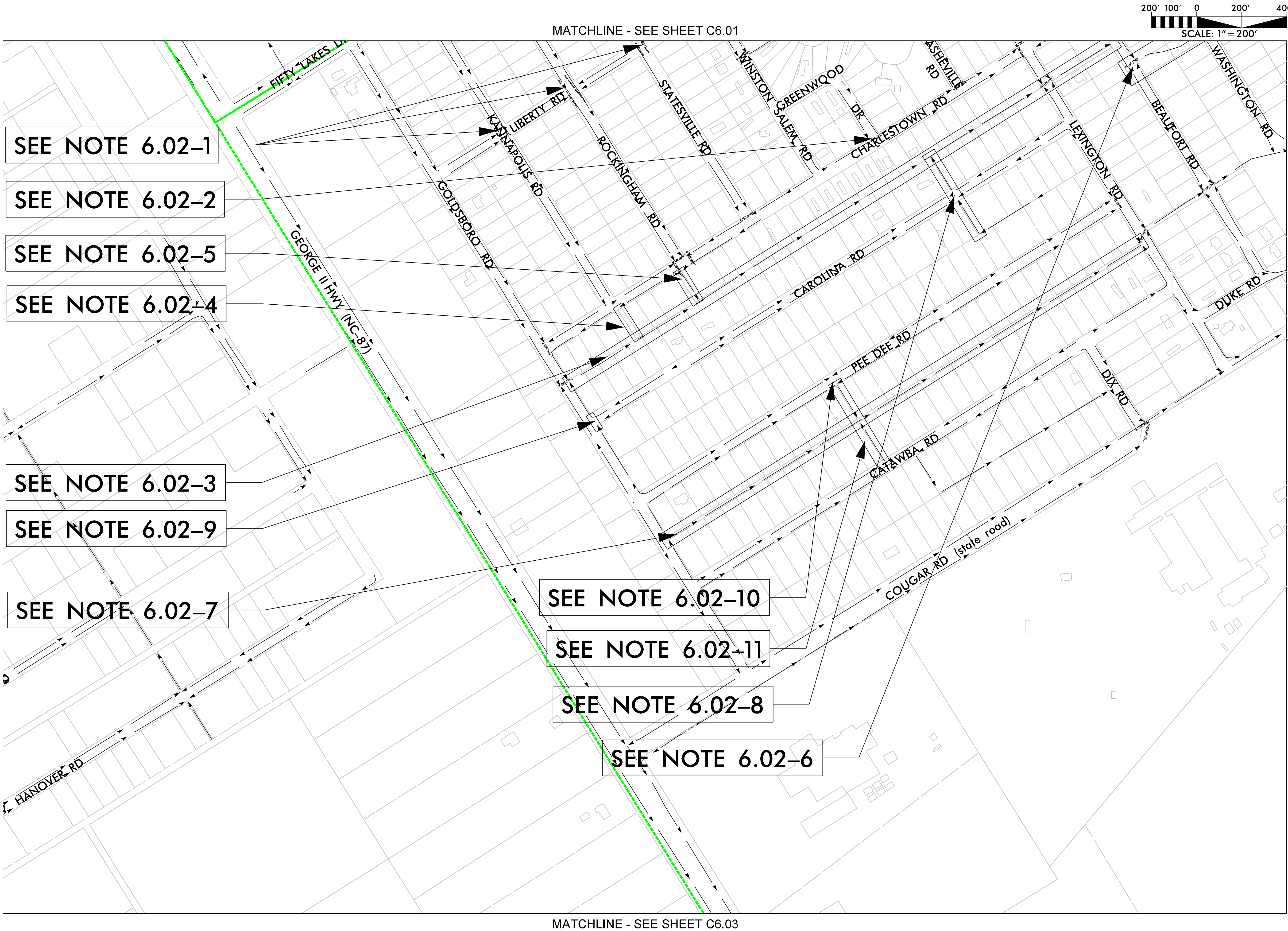
MATCHLINE -
SEE SHEET C6.04

MATCHLINE - SEE SHEET C6.05

MATCHLINE - SEE SHEET C6.02

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PHASE 6	
PROJECT # :	
DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	
SHEET NO.	C6.01

6/8/2020
Boiling Spring Hyd. Strm. Mgmt. P6_PSH_C602.dgn
lbarve



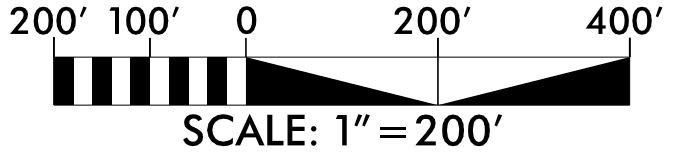
MATCHLINE - SEE SHEET C6.06

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STORMWATER MANAGEMENT MASTER PLAN CITY OF BOILING SPRING LAKES, NC	
PHASE 6	
PROJECT # :	
DRAWING NAME:	
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REVISIONS:	
SHEET NO.	C6.02

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6/8/2020
Boiling_Spring_Hyd_Storm_Mgmt_P6_PSH_C603.dgn
lhb\vel

MATCHLINE - SEE SHEET C6.02



MATCHLINE -
SEE SHEET C6.06

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DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	C6.03
SHEET NO.	

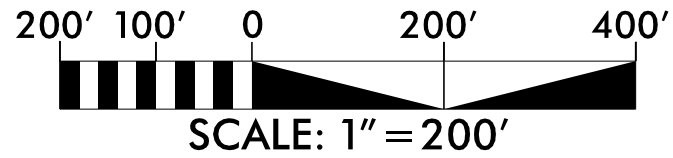
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6/8/2020
Boiling Spring Hyd. Storm Mgmt. P6_PSH_C604.dgn
lbarve

MATCHLINE - SEE SHEET C6.01



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CITY OF BOILING SPRING LAKES, NC

PHASE 6

PROJECT # :

DRAWING NAME:

DATE:

DRAWN BY:

REVIEWED BY:

REVISIONS:

SHEET NO.

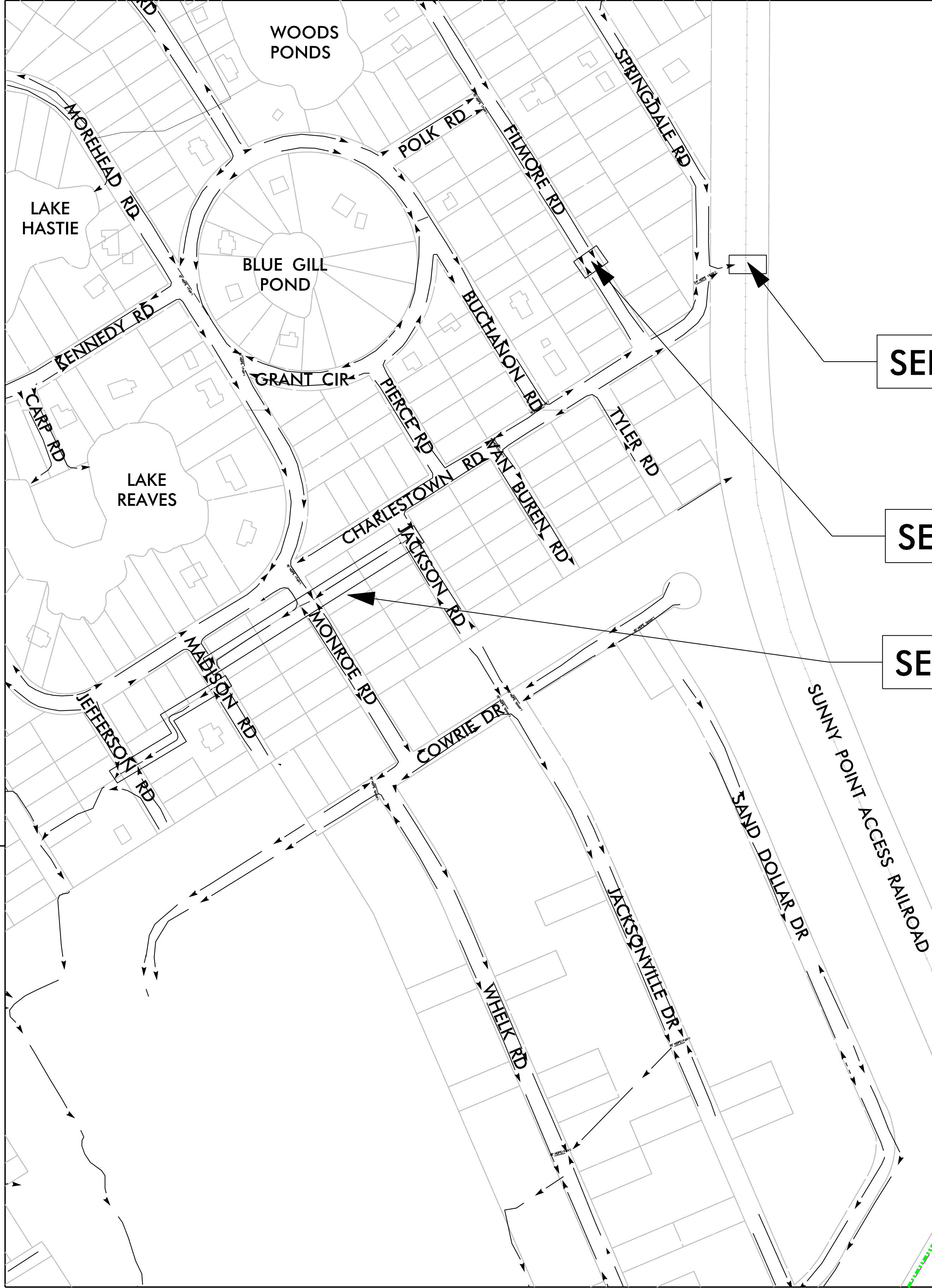
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MATCHLINE - SEE SHEET C6.05

6/8/2020
Boiling-Spring-Hyd-Sturm_Mgmt_P6_PSH_C6.05.dgn
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MATCHLINE - SEE SHEET C6.01

MATCHLINE - SEE SHEET C6.02



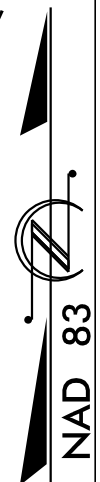
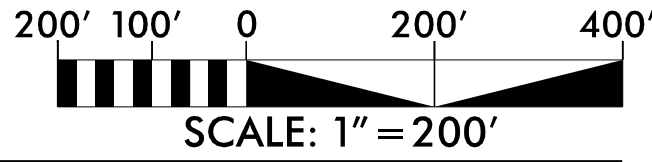
MATCHLINE - SEE SHEET C6.04

MATCHLINE - SEE SHEET C6.06

SEE NOTE 6.05-3

SEE NOTE 6.05-2

SEE NOTE 6.05-1



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DRAWING NAME:
DATE:
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REVIEWED BY:
REVISIONS:

STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

SHEET NO.
C6.05

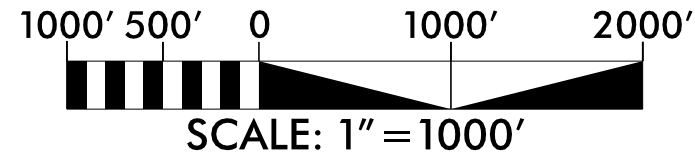
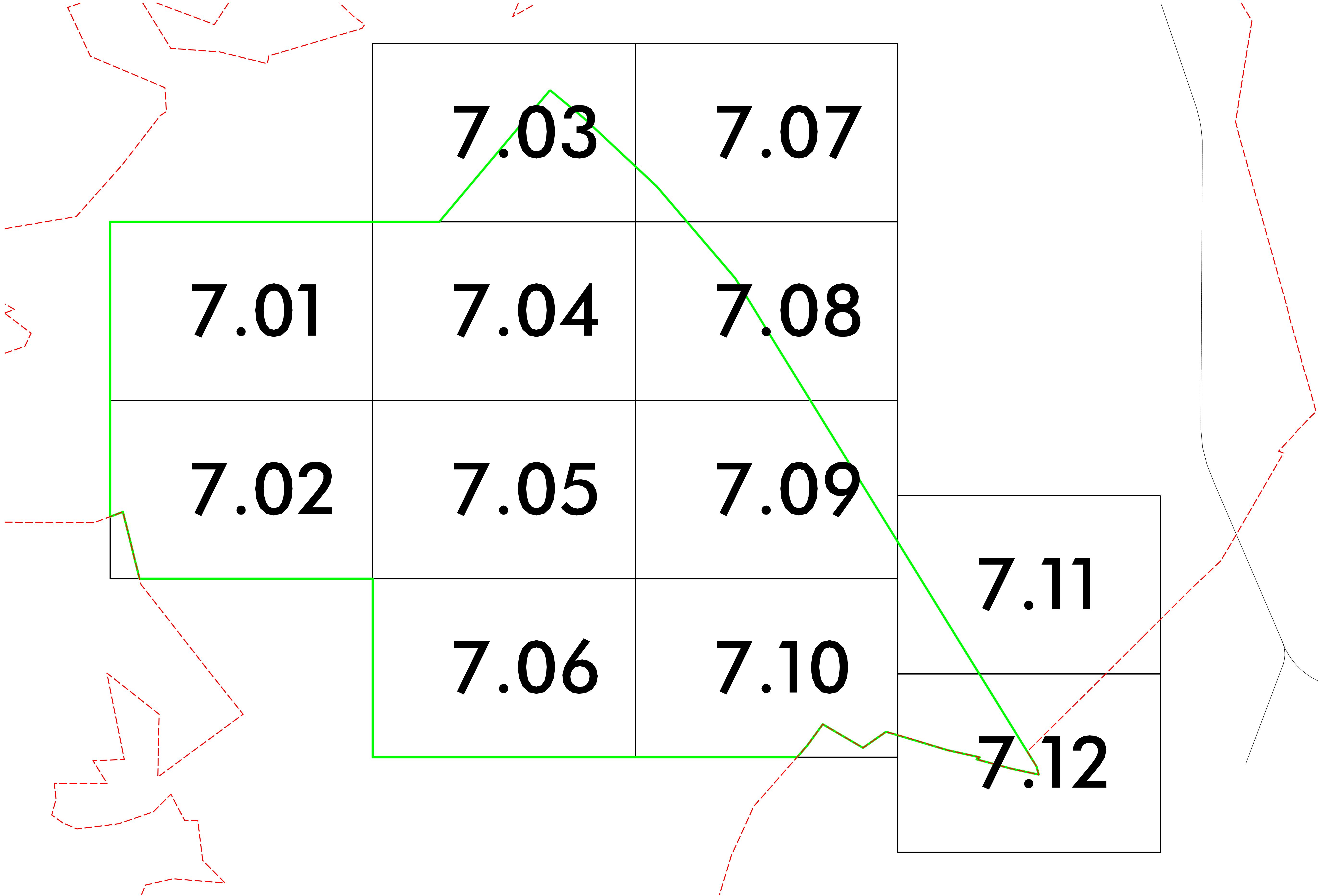
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6/8/2020
Boiling_Spring_Hyd_Storm_Mgmt_P6_PSH_C606.dgn
lbarrett



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PROJECT # :	
DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	
SHEET NO.	
C6.06	
STORMWATER MANAGEMENT MASTER PLAN CITY OF BOILING SPRING LAKES, NC	
PHASE 6	
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5/6/2021
Boiling-Spring-Hyd-Storm-Mgmt-P7_PSH_C700.dgn
belam



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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PHASE 7 – PLAN SHEET LAYOUT

PROJECT # :

DRAWING NAME:

DATE:

DRAWN BY:

REVIEWED BY:

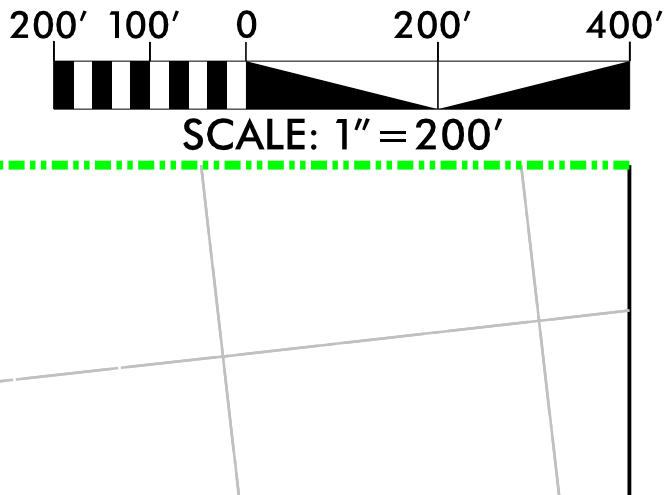
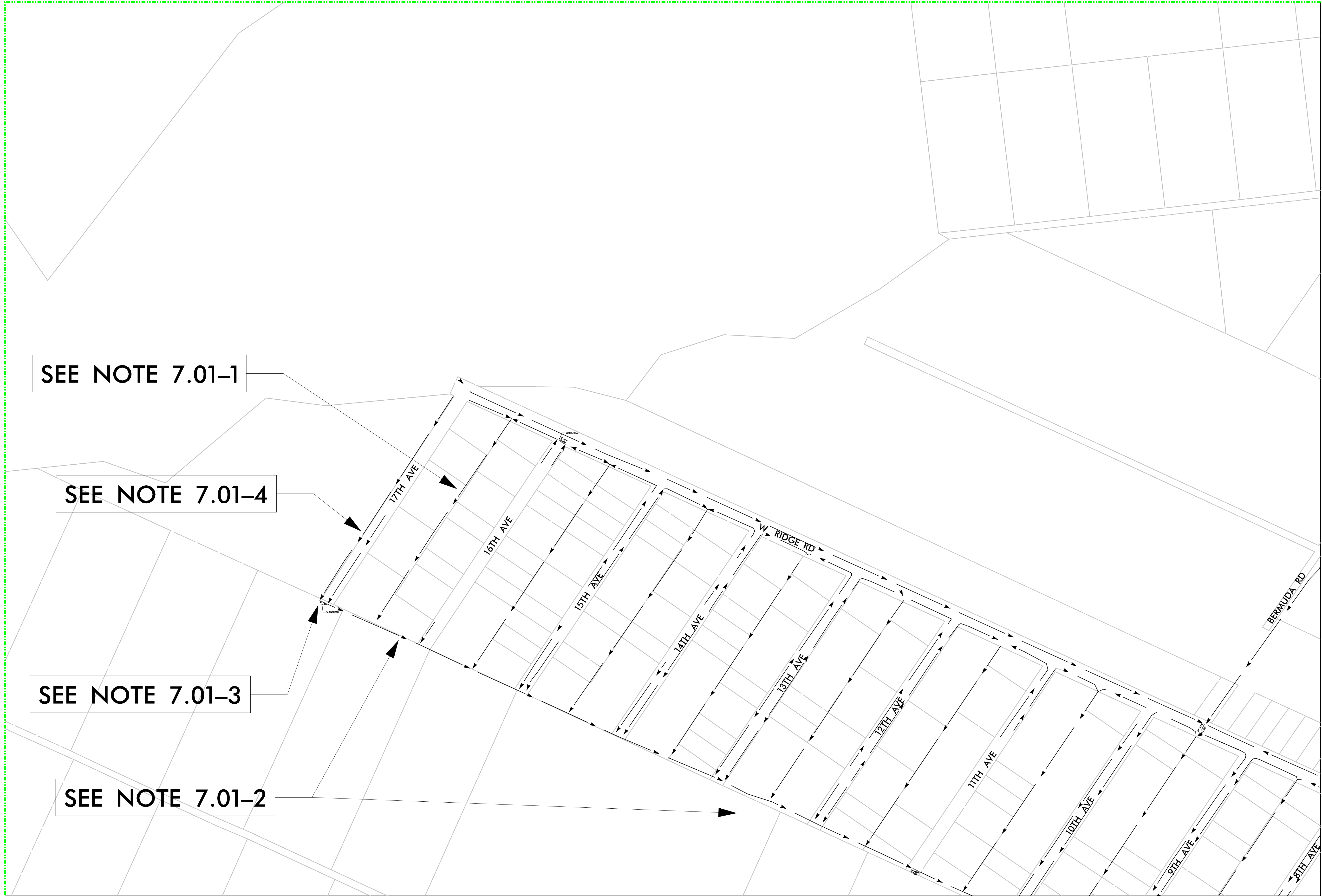
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74.00

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Boiling-Spring-Hyd-Storm-Mgmt_P7_PSH_C701.dgn
bclan



MATCHLINE – SEE SHEET C7.04

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STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

PHASE 7

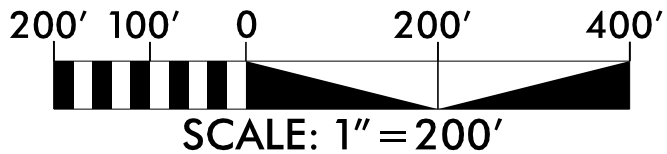
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C7.01

5/6/2021
Boiling-Spring-Hyd-Strm-Mgmt-P7_PSH-C702.dgn
bclm

MATCHLINE - SEE SHEET C7.01



NAD 83



SEE NOTE 7.02-1

WACCAMAW RD

W BOILING SPRING RD

MATCHLINE – SEE SHEET C7.05

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REVISIONS:
SHEET NO.

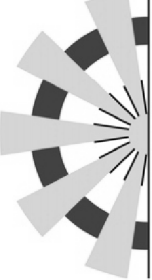
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STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

PHASE 7

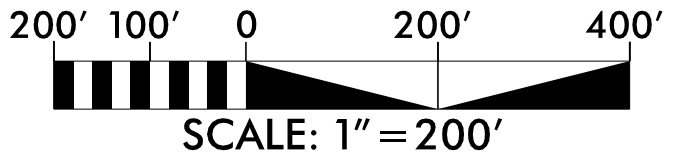
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5/6/2021
Boiling-Spring-Hyd-Strm-Mgmt_P7_PSH_C703.dgn
bclan

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MATCHLINE – SEE SHEET C7.07

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CITY OF BOILING SPRING LAKES, NC

PROJECT # :
DRAWING NAME:
DATE:
DRAWN BY:
REVIEWED BY:
REVISIONS:

SHEET NO.

C7.03

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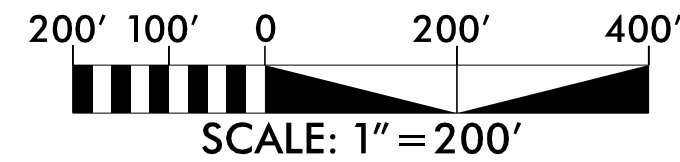
906 JONES FRANKLIN ROAD
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5/6/2021
Boiling-Spring-Hyd-Strm-Mgmt_P7_PSH-C704.dgn
bela

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MATCHLINE - SEE SHEET C7.03



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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PHASE 7

PROJECT # :

DRAWING NAME:

DATE:

DRAWN BY:

REVIEWED BY:

REVISIONS:

SHEET NO.

C7.04

MATCHLINE – SEE SHEET C7.08

MATCHLINE - SEE SHEET C7.05

SEE NOTE 7.04-2

SEE NOTE 7.04-3

SEE NOTE 7.04-8

SEE NOTE 7.04-5

SEE NOTE 7.04-1

SEE NOTE 7.04-4

SEE NOTE 7.04-6

SEE NOTE 7.04-7

BERMUDA RD

GIBALTER RD

NDMAVNDY RD

BRITANNY RD

HOLIDAY RD

GREEN LAWN RD

W HAVEN RD

HAWTHORNE RD

HUNTERS RD

JASMINE RD

W BOILING SPRING RD

GREEN LAWN RD

SPARROW RD

BARCLAY RD

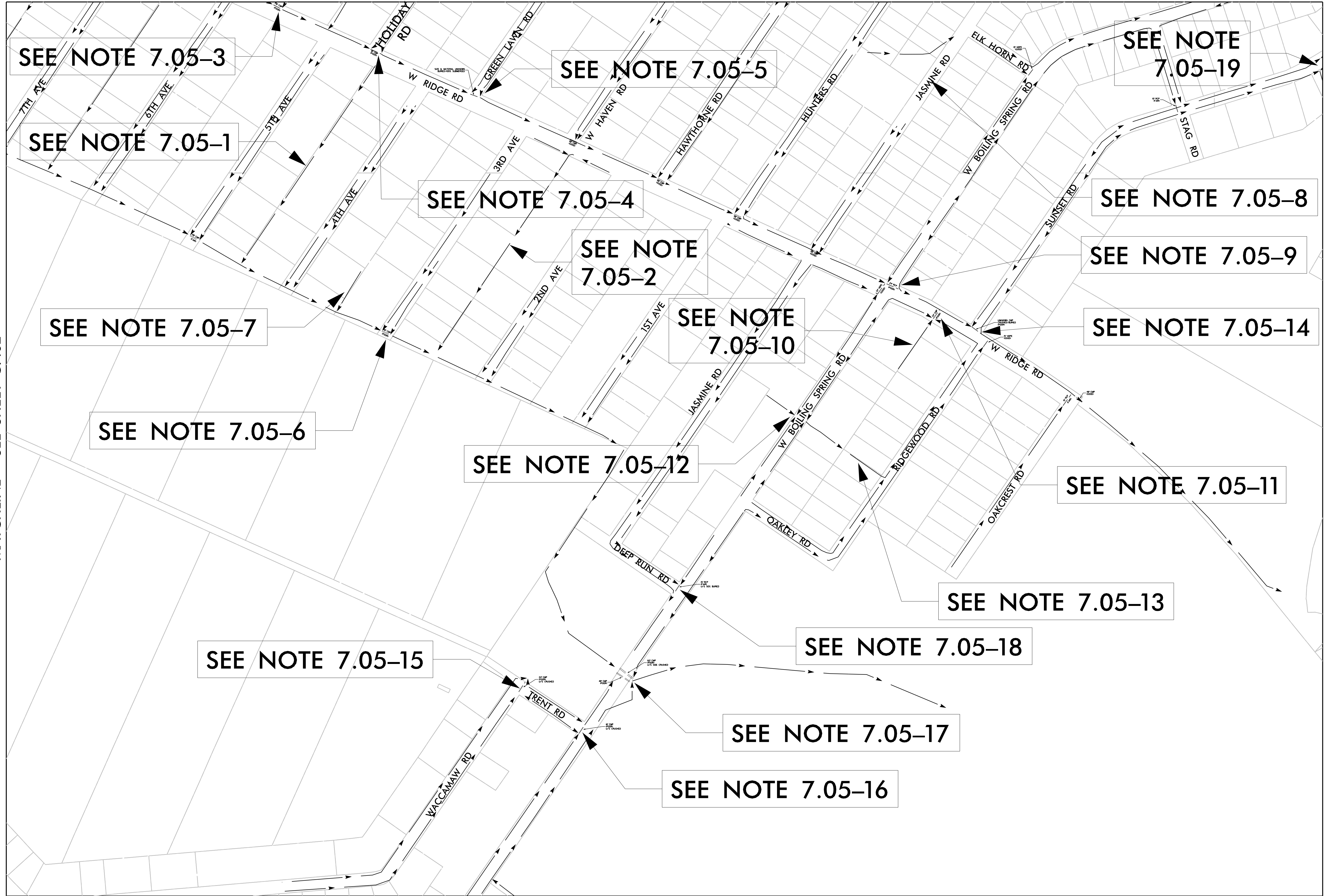
BLACKHAWK RD

BLUEBIRD RD

HUNTERS RD

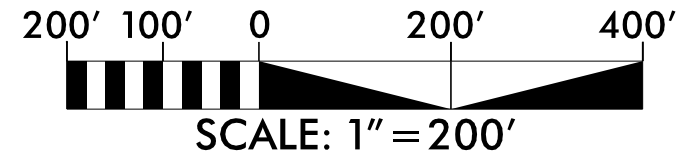
5/6/2021
Boiling-Spring-Hyd-Strm-Mgmt-P7_PSH-C705.dgn
bclan

MATCHLINE - SEE SHEET C7.02



MATCHLINE - SEE SHEET C7.04

MATCHLINE - SEE SHEET C7.06



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STORMWATER MANAGEMENT MASTER PLAN

CITY OF BOILING SPRING LAKES, NC

PHASE 7

PROJECT # :

DRAWING NAME:

DATE:

DRAWN BY:

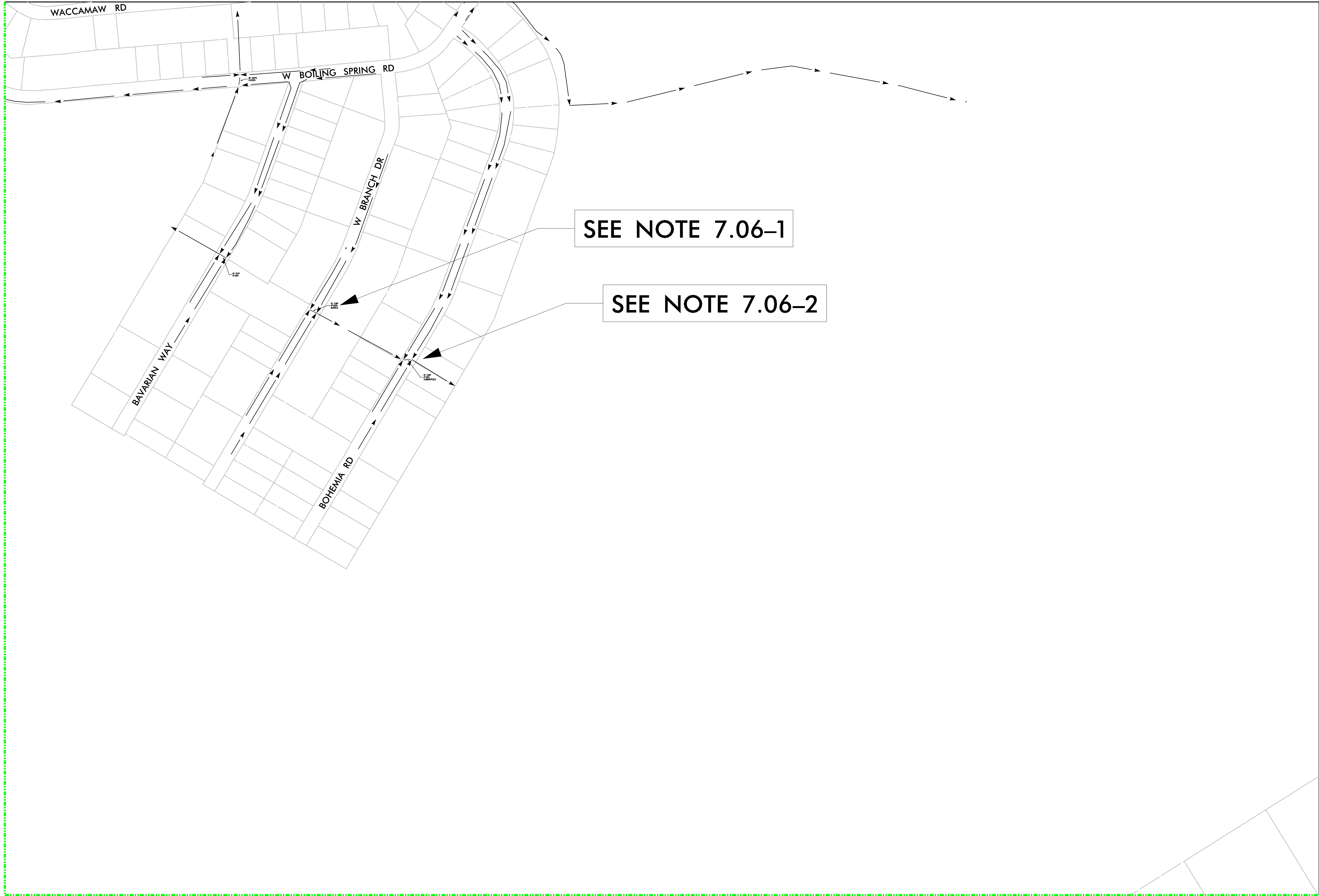
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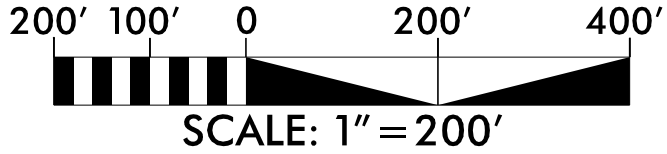
SHEET NO.

C7.05

5/6/2021
Boiling-Spring-Hyd-Strm-Mgmt-P7_PSH_C706.dgn
bela



MATCHLINE - SEE SHEET C7.05



MATCHLINE – SEE SHEET C7.10

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DRAWING NAME:	
DATE:	
DRAWN BY:	
REVIEWED BY:	
REVISIONS:	C7.06
SHEET NO.	

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MATCHLINE - SEE SHEET C7.08

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CITY OF BOILING SPRING LAKES, NC

PROJECT # :
DRAWING NAME:
DATE:
DRAWN BY:
REVIEWED BY:
REVISIONS:

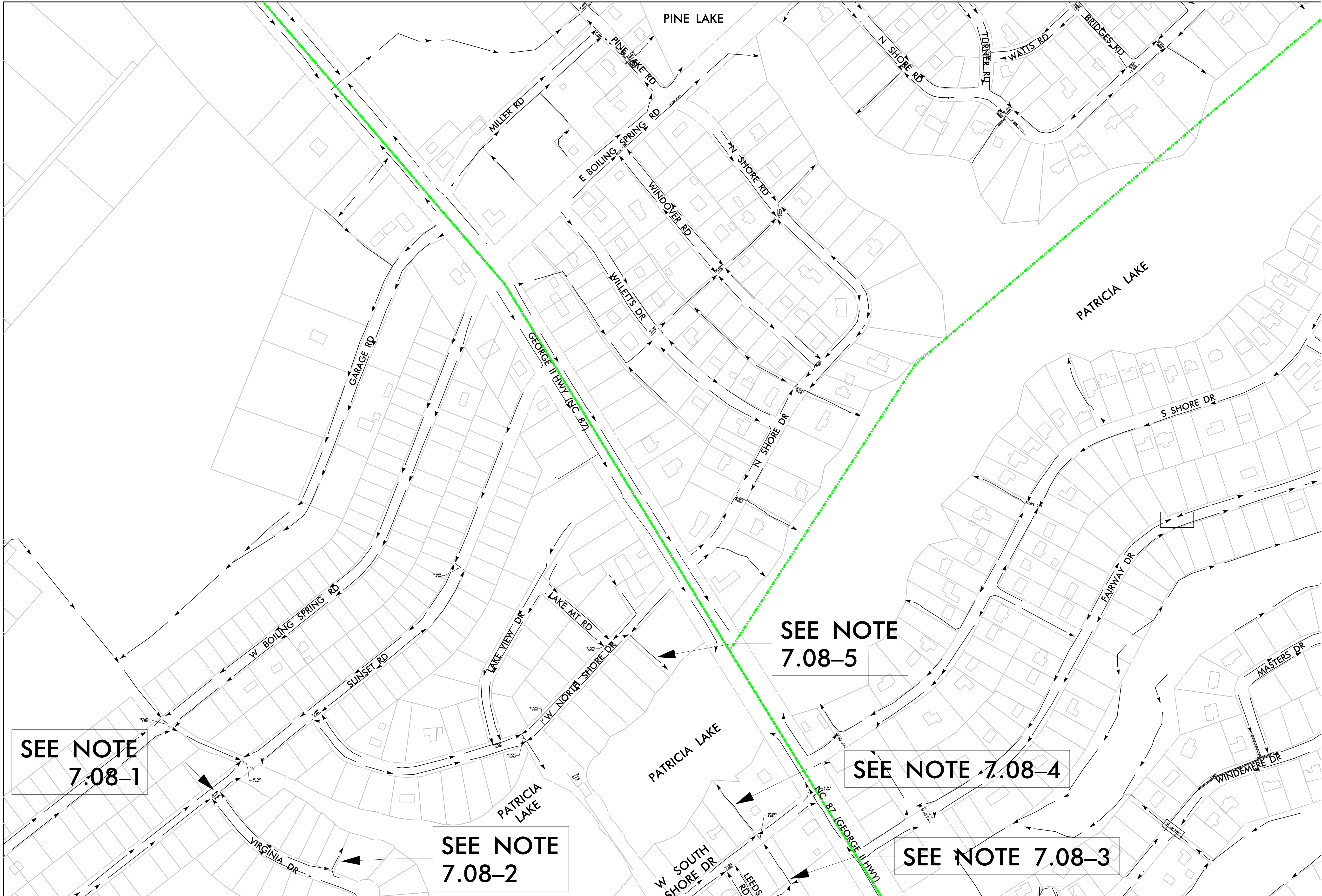
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C7.07

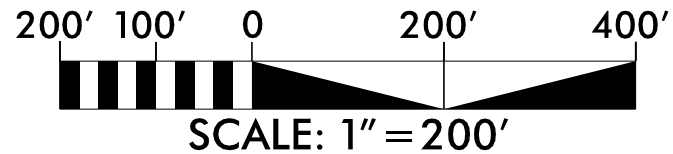
5/6/2021
Boiling-Spring-Hyd-Strm_Mgmt_P7_PSH-C707.dgn
belam

5/6/2021
Boiling-Spring-Hyd-Strm-Mgmt_P7_PSH-C708.dgn
belan

MATCHLINE - SEE SHEET C7.04



MATCHLINE - SEE SHEET C7.07



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PROJECT # :
DRAWING NAME:
DATE:
DRAWN BY:
REVIEWED BY:
REVISIONS:
SHEET NO.

C7.08

PHASE 7

SEE NOTE
7.08-1

SEE NOTE
7.08-2

SEE NOTE
7.08-5

SEE NOTE 7.08-4

SEE NOTE 7.08-3

MATCHLINE - SEE SHEET C7.09

5/6/2021
Boiling-Spring-Hyd-Storm-Mgmt-L_P7_PSH-C709.dgn
belan

MATCHLINE - SEE SHEET C7.05

MATCHLINE - SEE SHEET C7.08

200' 100' 0 200' 400'
SCALE: 1" = 200'

NAD 83

SEE NOTE
7.09-3

SEE NOTE
7.09-1

SEE NOTE
7.09-2

SEE NOTE
7.09-7

SEE NOTE
7.09-4

SEE NOTE 7.09-5

SEE NOTE 7.09-9

SEE NOTE 7.09-8

SEE NOTE
7.09-6

MATCHLINE - SEE SHEET C7.11

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SHEET NO.

STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

PHASE 7

SUNGATE DESIGN GROUP, P.A.

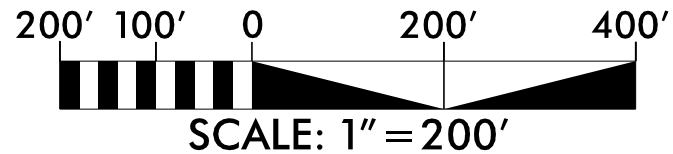
906 JONES FRANKLIN ROAD
FALLEN LEAF, NORTH CAROLINA 27606
TEL: 919.882.2341
ENG FIRM LICENSE NO. C-880



5/6/2021
Boiling-Spring-Hyd-Strm-Mgmt-P7_PSH-C710.dgn
bela

MATCHLINE – SEE SHEET C7.06

MATCHLINE - SEE SHEET C7.09



SEE NOTE 7.10-1

SEE NOTE 7.10-2

SEE NOTE 7.10-3

SEE NOTE 7.10-4

SAMPSON ST

CUMBERLAND ST

LEYOIR ST

COLUMBUS ST

PENDER ST

ROBERSON ST

BRUNSWICK ST

NEW HANOVER ST

CRAVEN ST

BETT LN

MATCHLINE – SEE SHEET C7.11

MATCHLINE – SEE SHEET C7.12

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SHEET NO.
C7.10

5/4/2021
Boiling-Spring-Hyd-Strm-Mgmt_P7_PSH_C711.dgn
bclan

MATCHLINE – SEE SHEET C7.09

MATCHLINE – SEE SHEET C7.10



MATCHLINE - SEE SHEET C7.12

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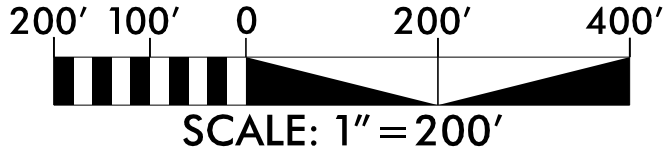
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5/4/2021
Boiling-Spring-Hyd-Storm-Mgmt_P7_PSH_C712.dgn
Belam

MATCHLINE – SEE SHEET C7.10

MATCHLINE - SEE SHEET C7.11



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SHEET NO.

C7.12

STORMWATER MANAGEMENT MASTER PLAN
CITY OF BOILING SPRING LAKES, NC

PHASE 7

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