# STORMWATER MANAGEMENT AND MASTER PLAN

**Village of Pinehurst**

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**Village of Pinehurst, Moore County, North Carolina**

Prepared by:

**MCGILL ASSOCIATES PA**

5400 Trinity Road, Suite 107
Raleigh, NC 27607
mcgillassociates.com

Prepared for:

**VILLAGE OF PINEHURST**

395 Magnolia Rd – Pinehurst, North Carolina 28374

# STORMWATER MANAGEMENT AND MASTER PLAN

**Village of Pinehurst, Moore County, North Carolina**

This report has been prepared for Village of Pinehurst under the supervision of:


**Michael Hanson**

030624

NORTH CAROLINA PROFESSIONAL SEAL 030624 ENGINEER MICHAEL A. HANSON

Michael A Hanson

Digitally Signed by Michael A Hanson
Date: 2023.12.19 16:52:37 -05'00'

**McGill Associates PA**
Firm License No.: C-0459

5400 Trinity Road, Suite 107
Raleigh, NC 27607

Phone: (919) 378-9111
mcgillassociates.com

December 19, 2023

Village of Pinehurst
Mike Apke, PE
Village of Pinehurst
395 Magnolia Rd – Pinehurst, North Carolina 28374

Transmitted via email: Client email

Re: Stormwater Management and Master Plan
Village of Pinehurst, Moore County, North Carolina

Dear Mr. Apke:

McGill Associates PA is pleased to submit the subject report to your attention in accordance with our Task Orders dated October 26th, 2021, and August 18th, 2022.

Sincerely,
**MCGILL ASSOCIATES, P.A.**

**MICHAEL HANSON**
Principal/Director of Water Resources

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***Introduction/Scope of Work***

The Village of Pinehurst (VOP) has engaged McGill Associates (McGill) to prepare this Stormwater Management and Master Plan (SWMMP). The primary purposes of this project were to identify effective stormwater management strategies, evaluate supporting programs and future funding mechanisms, and develop a plan to guide Village staff in addressing the future of stormwater management in Pinehurst.

The VOP's 2019 Comprehensive Plan identified the expansion and enhancement of stormwater management efforts as a "Strategic Opportunity" and included several recommendations related to stormwater, including:

1. Prepare a comprehensive Stormwater Master Plan to identify effective stormwater management strategies.
2. Evaluate creating a local stormwater utility for planning, programming, and coordinating future stormwater infrastructure within the community.
3. Develop and implement rules for post-construction stormwater maintenance requirements.

This plan has attempted to address all three (3) Comprehensive Plan recommendations related to stormwater. McGill performed the majority of the work for Recommendations 1 and 3 above, while Village staff led the evaluation of creating the local stormwater utility after reviewing McGill's recommendations in this Plan. The results of the Village staff's evaluation have been incorporated into this Executive Summary.

McGill's scope of work on this project included:

- Review existing VOP policies, ordinances, regulations, etc. related to stormwater management, including the current 10-Year Design Storm and Return Frequency,
- Gather sample ordinances and policies from additional communities, compare the samples to the VOP's documents, and discuss pros and cons of implementing new measures within the VOP,

- Review previous “MyVOP” Work Order tickets to note stormwater trends and issues in the area,
- Review options/potential restrictions for regulating stormwater discharges from existing developed and proposed development lots in single-family residential areas,
- Assist with Public Engagement,
- Provide recommendations for implementing standards for post-construction maintenance of Stormwater Control Measures (SCMs),
- Assist with evaluating and providing recommended solutions in various “problem areas” identified by VOP staff (Note that McGill performed evaluations in seven (7) separate areas, and Village staff evaluated one (1) area (Blake Boulevard)),
- Determine project future funding needs and identify projects that may qualify for grant funding,
- Evaluate advantages, disadvantages, and the feasibility of establishing a delegated erosion control program in lieu of using the North Carolina Department of Environmental Quality (NCDEQ) for these services,
- Summarize the results of the work in a written document that is signed and sealed by a licensed North Carolina Professional Engineer, and
- Present the Plan’s key recommendations to Village Council.

## ***Stormwater Rules and Management Responsibilities***

For the purposes of this Plan, stormwater is defined as water that naturally accumulates as a result of rain or snow. Pinehurst’s sandy soil allows a significant amount of stormwater to infiltrate into the ground, which helps to recharge the underground aquifer that supplies the Village with drinking water.

Stormwater that does not infiltrate typically “runs off” across land or other impervious surfaces like rooftops, streets, parking lots, etc. At times, heavy rain can result in localized flooding of streets, yards, or even basements and crawlspaces in low lying areas.

In 1977, the North Carolina Supreme Court adopted the "Rule of Reasonable Use", which is based on the premise that water naturally flows downhill. Other provisions of this rule include:

- Private landowners have the legal right to make reasonable use of their land,
- Property owners are ultimately responsible for managing stormwater across their land,
- Persons on lower estates must receive and pass water from higher estates, and
- Disputes between private landowners can be resolved in civil court actions.

As a property owner, the Village is subject to the same rules and regulations as private property owners. Current policies indicate that the VOP only maintains pipes, swales, and other stormwater measures that are on Village property or within Village right-of-way. Maintenance of stormwater measures on private property is the responsibility of the property owner unless an easement has been offered to and accepted by the Village. It has been McGill's experience in working with communities across North Carolina that many municipalities have similar policies to only maintain infrastructure on public property. The exception being some communities that have stormwater utilities which have extended services, in part or whole, on to private property with the intent to provide more equitable benefits to all rate payers.

## ***Existing Documents***

The VOP has adopted and/or prepared several documents that summarize the various rules and regulations related to stormwater, including:

- *Engineering Standards and Specifications Manual (referred to as the "ESSM," originally adopted by Village Council in August 2004, most recently updated in December 2015).*
- *Storm Drainage Policy and Procedures (adopted by Village Council in October 2004).*

- *Pinehurst Development Ordinance (referred to as the "PDO," adopted by Village Council in 2014, most recent revision was May 2023).*
- *Stormwater Pamphlet (Developed by staff in April 2021, frequently provided to residents that have questions related to stormwater rules and regulations).*
- *Flood Damage Prevention Ordinance (primarily deals with development within the designated floodplain, approved in September 2014).*

In addition to the documents noted above, the Village's ESSM references NCDEQ's Stormwater Design Manual, which provides guidance, minimum design criteria, and recommendations related to SCM design. The NCDEQ manual is referenced by developers, engineers, and Village staff when designing and constructing various types of stormwater measures.

As part of this project, McGill has provided VOP staff with a listing of recommended changes to the ESSM, Policy and Procedures document, and PDO related to stormwater. VOP staff's recommended changes to these documents will be brought to the Village Council for review and approval at a later date.

## ***Public Engagement***

McGill also worked closely with VOP staff to develop and implement a public engagement strategy that offered residents various opportunities to provide input into this Plan and to specifically note locations of stormwater issues within the community. These included:

- A public input meeting was held in March 2022 at Village Hall. VOP and McGill staff collaborated on a presentation and attendees were then given the opportunity to ask questions and provide input.
- VOP staff set up a portal on the Engage Pinehurst website, which gave residents the ability to provide comments and note specific areas with stormwater concerns. A video of the public input meeting was also made available on the website.
- Social media posts and newsletter articles were provided to residents notifying them of the Plan and the various ways to provide input.

- MyVOP continues to serve as a 24/7 option for the public to communicate stormwater issues and complaints directly to VOP staff. For context, VOP staff received 126 MyVOP stormwater requests in FY23. These included requests submitted by the public and work order tickets entered into MyVOP by Village staff.

## ***Recommendations***

After completing our requested scope of services, McGill is pleased to provide the following recommendations to the VOP related to stormwater:

### 1. Implement specific post-construction maintenance requirements and inspection guidelines for Stormwater Control Measures

As previously noted, the development and implementation of rules for post-construction stormwater maintenance was a specific recommendation in the VOP's 2019 Comprehensive Plan. The Village's ESSM states that storm drainage systems located on private property shall be maintained by the property owner, but the VOP currently lacks specific criteria or regulations to ensure that the systems are being adequately maintained, except for a statement in the ESSM that all stormwater management facilities shall be "properly maintained" by the property owner.

As a first step, McGill recommends that the VOP develop a Stormwater Operation and Maintenance (O&M) Agreement that would be executed by the VOP and property owners with SCMs prior to the issuance of a Certificate of Occupancy (CO). This procedure would be required for all SCMs meeting Village and State standards, and sample Agreements used by other municipalities have been provided to Village staff for review. These Agreements typically require property owners to acknowledge sole acceptance of maintenance responsibilities and grant the applicable municipality access to inspect the SCM as needed.

Some Agreements require property owners to provide annual SCM inspection reports to the municipality, and some have historically required owners to provide financial

securities to ensure perpetual maintenance. However, the recently passed House Bill 488 states that local governments are now "prohibited from adopting any regulation that requires an owner of a privately owned and maintained stormwater control project to make payments to a local government for the purpose of ensuring assets are available for maintenance, repair, replacement, and reconstruction costs" of the stormwater control project.

In addition to sample O&M Agreements, McGill has provided Village staff with recommended maintenance standards, inspection criteria, and sample inspection forms for SCMs. The VOP is encouraged to utilize these documents to develop similar documents that meet the needs and goals of the Village, while also complying with current North Carolina regulations.

## 2. Develop a Stormwater Development Manual

McGill recommends that the VOP combine the stormwater rules, regulations, and requirements that are currently spread throughout numerous documents (ESSM, Policy and Procedures, PDO, etc.) into one complete document. This would consolidate guidance for developers and engineers in lieu of having to reference multiple documents for the Village standards. McGill also recommends that the Development Manual include specific criteria and procedures for the protection of downstream properties.

As previously noted, McGill has provided a listing of recommended changes to the ESSM, PDO, Policy and Procedures, etc. to Village staff, and we recommend that these changes be incorporated into the new Stormwater Development Manual.

## 3. Sustain the current 10-year storm pre-post discharge rate criterion and add a 2-year storm volume criterion

The ESSM currently requires stormwater management facilities to be designed such that the post-development runoff rate does not exceed the pre-development runoff rate during a 10-year storm event. In our experience, the 10-year pre-post criterion is the most

prevalent in North Carolina among those communities with higher standards, and this exceeds the State's minimum requirement of a 1-year, 24-hour storm event.

We understand that the VOP's historic stormwater issues have primarily been in the areas of uncontrolled runoff from highly impervious redevelopment and increased downstream flooding over time. As such, simply raising the 10-year criterion to a higher criterion (such as the 25-year storm) will likely not eliminate these issues and could make them worse by allowing higher discharges during smaller events.

In lieu of changing the 10-year pre-post rate requirement, McGill recommends the addition of a 2-year pre-post volume requirement to complement the 10-year rate requirement. Capturing the volume from the 2-year event would result in only an incremental increase in the volume currently detained under the existing rule thereby minimizing additional costs to developers, but the retention and infiltration of this volume on site will significantly reduce runoff seen by adjacent downstream properties during frequent low-volume storm events. This approach takes advantage of Pinehurst's high infiltration sandy soils and also serves to promote recharge of the groundwater aquifer, a primary source of drinking water in the area.

In addition, McGill notes that the current ESSM does not clearly clarify the duration of the 10-year storm event to be used (5-minute event, 6-hour event, 24-hour event, etc.). We therefore also recommend that the VOP clarify the ESSM (and/or future Stormwater Development Manual) to follow the NCDEQ Stormwater Design Manual, which requires a 24-hour duration for the design storm return period.

4. **Consider developing a more proactive inlet, swale, and pipe cleaning program**

In reviewing MyVOP work order requests from FY18 to FY22 (a total of 741 requests), the most common word provided in the requests was "clean." Requests are commonly submitted by both VOP staff and the public to clean debris out of pipes, swales, inlets, and other areas. This appears to be a common occurrence in Pinehurst due to the large

number of trees and other vegetation, and the presence of pine straw, leaves, and other natural debris that can enter and clog stormwater management systems.

While VOP staff appears to be proactive with submitting work orders for items that need to be cleaned, McGill recommends that the Village consider implementing an even more proactive cleaning program. Our recommendation is to consider cleaning 20% of pipes, swales, and inlets on an annual basis, whereby the entire Village is cleaned within a typical 5-year CIP period. The Village could be divided by land areas or drainage basins, with a routine schedule developed for cleaning 20% each year.

Development and implementation of such a program would require a significant amount of staff time to inspect infrastructure, determine the cleaning needs, and coordinate the work with either VOP Streets and Grounds crews or contractors as required. However, this would likely result in an increased performance of the Village's infrastructure and fewer calls and MyVOP work requests developed for cleaning stormwater items.

### 5. Fund a dedicated stormwater staff person

Implementation of the recommendations in this Plan will require a significant amount of time to pursue and incorporate into the Village's existing operations. Based on McGill's discussions with VOP staff members, heavy workloads likely prohibit existing staff from taking on most of these additional tasks, and McGill recommends that the Village fund one (1) additional dedicated stormwater staff person to oversee stormwater management in Pinehurst.

Village staff have included the addition of a Stormwater Technician into the 5-year staffing plan and plans to generate a job description based on the tasks to be performed. Some recommendations in this Plan (such as the development of the Stormwater Development Manual) may also require assistance from a consultant, and the Stormwater Technician can also be responsible for helping to oversee the consultant's work.

6. **Consider establishing a threshold of 2,000 SF added BUA for residential stormwater controls**

One of VOP's historic stormwater issues has been in the areas of uncontrolled runoff from highly impervious redevelopment, increased downstream flooding over time, and runoff issues between neighboring properties. A recommendation for future consideration and possible future implementation is to establish a threshold of 2,000 square feet (sf) or greater additional built-upon area (BUA) for any single family residential (SFR) lot expansion or redevelopment to require a consultation with the VOP for consideration of stormwater controls to address onsite grading and drainage. As a compliance option the Village could also tie this requirement to zoning approval to promote awareness early in the design process.

7. **Do not pursue a local erosion control program at this time**

Projects that disturb more than one (1) acre of land are currently required to be submitted to NCDEQ for review and issuance of an Erosion and Sedimentation Control Permit. Local governments have the option to create local ordinances with supporting documentation to establish and enforce a self-delegated program in lieu of utilizing NCDEQ for these services.

Local governments with self-delegated authority are required to administer and enforce North Carolina's Sedimentation Pollution Control Act of 1973 and must adhere to mandatory standards, including rendering decisions on initial plans within 30 calendar days of receipt, rendering decisions on revised plans within 15 calendar days of receipt, and only approving plans after determining it complies with all applicable State and local regulations for erosion and sediment control. Monthly activity reports and any issued Notices of Violation are required to be provided to NCDEQ.

A self-delegated program in Pinehurst would require at least one full-time employee to oversee the implementation, set up standard operating procedures, and subsequently conduct reviews, inspections, and the mandatory reporting. From our experience, fees collected from permits are typically not sufficient to offset the cost of administering the

program, and the recent passing of HB 488 further limits fees that local governments can charge for review of plans and related activities. The VOP does not currently pay a direct fee to NCDEQ to provide these services.

No concerns over the Village's current practice to utilize NCDEQ for erosion control reviews exceeding one (1) acre were prevalent during the preparation of this Plan, and McGill therefore recommends that the VOP continue to utilize NCDEQ for these services in lieu of pursuing a local program. This should also be periodically re-evaluated in the future if a need to develop a local program arises.

### 8. Do not pursue a local stormwater utility at this time (staff recommendation)

As previously noted, the evaluation of creating a local stormwater utility for planning, programming, and coordinating future stormwater infrastructure within the community was a specific recommendation in the VOP's 2019 Comprehensive Plan. Stormwater utilities are generally set up to provide additional revenue sources to local governments to fund stormwater projects and programs, often to address unfunded mandates like becoming an NPDES MS4 community. Rates are adopted by the local government, which are typically paid monthly (via utility bills) or as a separate line item on an annual property tax bill.

The VOP has allocated $460,000 per year for stormwater capital projects in the 5-year CIP ($2.3 million total), which McGill believes is sufficient to meet the current needs of the Village. VOP staff does not recommend pursuing a stormwater utility at this time; however, the option remains available for the future and can be re-evaluated by staff as needed. McGill does recommend that the Village pursue opportunities for stormwater grants when feasible, and a listing of potential funding sources has been provided in the full SWMMP.

## Drainage Problem Areas Solutions

Finally, McGill performed engineering analyses of various problem areas as requested by Village staff, and our summary of these areas is as follows.

***Chinquapin and Magnolia Road***

***Summary of Issue:*** *Flooding in the public right-of-way and parking areas.*

***Public Benefit:*** *Yes, due to flooding in public areas.*

***Recommended Solution****: Install new piping on Chinquapin and Magnolia Road.*

***Gun Club Drive***

***Summary of Issue:*** *Flooding primarily on private property.*

***Public Benefit:*** *Limited, flooding occurred in the right-of-way on one documented occurrence, but this appears to have been due to a pipe being clogged with debris.*

***Proposed Solution:*** *Install an additional pipe beneath Gun Club Drive.*

***Palmetto and Cherokee Road***

***Summary of Issue:*** *Flooding in the roadway and right-of-way.*

***Public Benefit:*** *Yes, due to flooding in the right-of-way.*

***Proposed Solution:*** *Public-private partnership with downstream property owners to clear an existing drainage swale that has become inundated with vegetation over time.*

***Salem Drive and York Place***

***Summary of Issue:*** *Road and Right-of-Way flooding.*

***Public Benefit:*** *Yes, due to road and right-of-way flooding.*

***Proposed Solution:*** *New piping and boxes within the right-of-way and possibly private property, which would require easements to be obtained.*

***Belair Court and Thunderbird Circle***

***Summary of Issue:*** *Property owner's complaints about flooding on private property.*

***Public Benefit:*** *No clear public benefit since issues are on private property.*

***Proposed Solution:*** *Piping/swales on private property.*

***Starlit Lane***

***Summary of Issue:*** *Property owner's complaints about flooding on private property and improper grading by the homebuilder.*

***Public Benefit:*** *No clear public benefit since issues are on private property.*

***Proposed Solution:*** *Piping/swales on private property.*

***Blake Boulevard***

***Summary of Issue:*** *Flooding within the roadway and right-of-way.*

***Public Benefit:*** *Yes, due to flooding in the roadway and right-of-way.*

***Proposed Solution:*** *Evaluate existing pipes via video inspection and topographical survey. Clean, repair, and replace pipes as necessary.*

# 1. INTRODUCTION

The Village of Pinehurst (VOP) engaged McGill to identify effective stormwater management strategies and develop supporting programs and funding mechanisms. The project was divided into phases. Phase 1 included updating VOP's stormwater program policies, standards, ordinances, and regulations; reviewing historical MyVOP stormwater work orders and complaints to identify trends; evaluating the current 10-year design storm standard and the potential for implementing measures on single family residential lots, developing, and executing a related public engagement strategy; and developing post-construction stormwater maintenance requirements. Phase 2, included developing conceptual plans and cost estimates to address stormwater system deficiencies, determining whether funding levels in the current 5-year Capital Improvement Plan (CIP) are adequate and evaluating funding sources, including the creation of a local erosion control program. All phases of the project are summarized in this comprehensive Stormwater Management and Master Plan (SWMMP).

# 2. MEETINGS

McGill coordinated Project Oversight Group (POG) and VOP Staff Meetings to provide regular coordination and communication with VOP staff and the POG throughout the course of the project via a kick-off meeting on November 30, 2021, and two (2) additional coordination meetings on February 3, 2022, and August 03, 2022. Coordination included obtaining VOP reference materials, further defining the goals of the SWMMP and discussions with staff to determine what is working in their current stormwater program and what is not adequate at identifying opportunities for improvement. Progress tracking was accomplished by providing digital copies of minutes, emails and teleconferences.

# 3. DOCUMENT REVIEW

## 3.1 POLICIES, STANDARDS, AND ORDINANCES INFORMATION

McGill reviewed current stormwater program policies, standards, ordinances, and regulations in the Pinehurst Development Ordinance (PDO), Engineering Standards and Specifications Manual (ESSM), Comprehensive Plan, and Storm Drainage pamphlet to

develop a complete understanding of the current stormwater program goals and objectives as well as to understand VOP concerns and challenges.

McGill gathered sample stormwater ordinances and policies from similar sized North Carolina communities selected by VOP which included Southern Pines, Chapel Hill, Davidson, Cary, Holly Springs, Hendersonville, and Hope Mills. Program data was gathered from these communities for review, and comparison of the essential elements of a comprehensive Stormwater Program. A matrix was developed highlighting the major elements of each community's stormwater program (see Table 1). The table provides an easy comparison of post-construction stormwater management program elements through the individual community ordinances. Reference documents containing information about community stormwater programs were typically found on the community's website or in the NCDEQ Interactive Stormwater Map.

| Entity | NPDES Phase II | Post-Construction Stormwater Management | | | Pre – Post Attenuation | | | |
|---|---|---|---|---|---|---|---|---|
| | | Stormwater Quality Treatment | Stormwater Quantity Control | Required Buffer Zone (Neuse or WSW) | 1-yr (State Minimum) | 2-yr | 10-yr | 25-yr |
| **Pinehurst** | No | Density restrictions in WSW, High Density - 1" rainfall or volume match, 10/70 rule in critical areas | 10-yr pre-post runoff | 30' buffer is required around all bodies of water | No | No | Yes | Yes, in HQW areas[1] |
| **Cary (Neuse River Basin)** | Yes | Yes, NSW Strategy (Nitrogen) | 1-yr pre-post runoff | Cape Fear Basin/Jordan Lake Watershed:<br>100' buffer (on quad map)<br>50' buffer (on SCS maps only) Neuse River Basin:<br>50' added to NR Riparian Buffer | Yes, exemption under 10% net increase in peak flow | No | No | No |
| **Chapel Hill** | Yes | First 1" rainfall or 85% TSS removal from new development. | 2-yr Pre-Post volume and 1-yr, 2-yr and 25-yr Pre-Post runoff | Trout waters=25'<br>Jordan Lake Watershed:<br>Zone 1=30', Zone 2=50' | Yes | Yes | No | Yes |
| **Davidson** | Yes | Treat first 1" rainfall, 85% TSS removal and 70% P removal | <12% BUA = 10-yr and 25-yr, 6-hr storms | 30-foot buffer <= to 50-ac watershed and 100-foot buffer > 50-ac watershed, including<br>30-foot streamside,<br>45-foot managed use and<br>25-foot upland. | No | No | Yes, 6-hr intensity | Yes, 6-hr intensity |
| **Hendersonville** | Yes | Runoff volume from the disturbed area 1-yr/1-hr or Pre-Post 1-yr. (Min 85% TSS) | Pre-Post 2-yr and 10-yr with the ability to pass the 25-year, 24-hour storm. | Minimum of 30' vegetative buffer | No | Yes | Yes | No |
| **Holly Springs** | Yes | Pre-Post 1-yr. (Min 85% TSS, TN per Neuse Rules) | 1-yr and 10-yr pre-post runoff; 25-yr w/quantity problems | Neuse: 100 foot; 50' buffer (on SCS maps only – State)<br>Cape Fear River Basin Buffer: 30 foot;<br>Bass Lake Buffer: 100 foot. | Yes | No | Yes | No |
| **Hope Mills** | Yes | Runoff volume from the disturbed area 1-yr/1-hr or Pre-Post 1-yr. (Min 85% TSS) | 1-yr pre-post runoff | None | Yes | No | No | No |
| **Southern Pines** | No | Min 80% TSS, Density restrictions in WSW, High Density - 1" rainfall or volume match, 10/70 in critical areas | 10-yr pre-post runoff | Minimum of 30' vegetative buffer and zoning setbacks | No | No | Yes | Yes, in HQW areas |

**Table 1 – Benchmark Stormwater Programs (1 of 2)**

[1] for Erosion Control purposes

| Entity | SCM Maintenance Guidelines | SCM Inspection (Interval/Enforcement) | Stormwater Development Manual | Stormwater Standards & Design Manual | Downstream Impact Analysis | Notes |
|---|---|---|---|---|---|---|
| **Pinehurst** | Yes, In WSW[2] | Yes (No/Yes)[3] | No | ESSM | Yes | |
| **Cary** | Yes | Yes | No | Yes, Standard Engineering Details and Specifications Manual | 2, 5, 10, and 100-year | Swift Creek Management Plan |
| **Chapel Hill** | Yes | Yes | No | Town of Chapel Hill Design Manual and Standard Details and NC DEQ BMP Manual | No | |
| **Davidson** | Yes | Yes | Charlotte-Mecklenburg Storm Water Design Manual | Charlotte/Mecklenburg Land Development Standards Manual | Yes over 12% BUA (up to 10, 25, 50 or 100-yr, 6-hr) | |
| **Hendersonville** | Yes | Yes | Yes | No | No | amount of a maintenance performance security shall be the present value of an annuity of perpetual duration based on a reasonable estimate of the annual cost of inspection, operation, and maintenance of the BMPs |
| **Holly Springs** | Yes | Yes | No | No | control downstream channel and bank erosion | May require H&H modeling upstream or downstream of existing or potential drainage problems and/or flooding problems |
| **Hope Mills** | Yes | Yes (No/Yes) | Yes | Yes | No | |
| **Southern Pines** | Yes | Yes (No/Yes) | No | No | No | |

**Table Benchmark Stormwater Programs (2 of 2)**

[2] SCM Maintenance Guidelines found under ESSM: E&SC Maintenance (pg. 15) and Storm Drainage Maintenance Agreement Responsibility Statement (pg. 59)

[3] Read, SCM Inspections: Yes, Interval: No, Enforcement: Yes

### 3.1.1 NPDES PROGRAM

The EPA Stormwater Phase II Final Rule is based on the passage of the Clean Water Act (CWA) of 1974. Since then, the quality of our Nation's waters has improved dramatically due to many different federal programs including Phase I of the National Pollutant Discharge Elimination System (NPDES) permit which was promulgated in 1990. Phase I relies on coverage to address stormwater runoff from: (1) "medium" and "large" municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or greater, (2) construction activity disturbing 5 acres of land or greater, and (3) ten categories of industrial activity. Phase II was intended to further reduce adverse impacts to water quality and aquatic habitat by instituting the use of controls on the unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation, such as the environmental problems associated with discharges from MS4s in urbanized areas and discharges resulting from small scale construction activity. The Phase II program expands the Phase I program by lowering the thresholds for inclusion for qualifiers (1) and (2) above and requiring additional operators of MS4s in urbanized areas and operators of small construction sites, through the use of NPDES permits, to implement programs and practices to control polluted stormwater runoff. In the last round of Phase II permitting EPA included operators of small MS4s located in "urbanized areas" as delineated by the Bureau of the Census.

The Village initially fell within this threshold. However, the permitting authorities may waive "automatically designated" Phase II dischargers if the dischargers meet the necessary criteria. Upon request the NCDENR excluded VOP from the Phase II program based on the primarily built-out nature of the community and the programs already in place within the VOP. Table 1 above lists many of the program requirements of Phase II communities. Keep in mind that these requirements are mandatory and through a 5-year revolving permit EPA and its designated authority in North Carolina NCDENR compel compliance. The VOP may choose to implement any of these standards on its own should they so choose.

### 3.1.2 INFRASTRUCTURE MAINTENANCE

MyVOP requests are discussed in Section 3.2 below. The most prevalent word used, by far, during the reviewed period is “Clean”. Based on this VOP may consider implementing a more proactive program for cleaning inlets, pipes, swales, etc. rather than being more reactive when work orders or complaints are received. As many of the benchmark communities have a SWU they typically include funding of comprehensive stormwater maintenance programs in their fees. A more manageable way for VOP to address this concern may be to implement a program where say 20% of the system is proactively cleaned on an annual basis with a goal of reaching the entire Village within a typical 5-year capital plan period.

### 3.1.3 PRIVATE INFRASTRUCTURE MAINTENANCE

Table 1 specifically notes the policies of comparable communities regarding infrastructure maintenance on private property. While not many communities publish these policies it has been our experience having worked with communities across NC that most only maintain what is in their specific right-of-way similar to VOP. Municipalities that do maintain on private property are dependent upon easements or rights of entry granted by the private property owners. Again, in our experience this type of acceptance of expanded responsibility is more common to communities such as Charlotte, Raleigh, Greensboro and others with robust Stormwater Utility programs. These policies are often a Board response to residence outside those areas directly benefitting from SWU funded CIPs. Shared cost or outright acceptance of stormwater systems on private property provides more equity for SWU fees paid by all residents.

Based on the information presented above and discussions with VOP staff, McGill offers the following observations about the benchmark programs. Warranted recommendations for VOP implementation to address historical VOP concerns are also included.

1. Typically, water quality criteria are only included in Phase II communities in NC. That is the case for the selected benchmark communities with only Southern Pines, a non-NPDES community, not having a jurisdiction wide water quality

criterion. As this is not an identified issue for VOP we do not recommend addition of water quality criterion at this time.

2. Two of the seven benchmark communities only require the NC State Standard of 1-year/24-hour pre-post discharge (See 15A NCAC 02H .1020 UNIVERSAL STORMWATER MANAGEMENT PROGRAM (m (2))). Three others are the same as VOP at 10-year with the last two requiring 25-year pre-post runoff controls. In our experience, the 10-year pre-post criterion is the most prevalent in NC of those communities with higher standards. Further discussion of the pros and cons of requiring a 25-year pre-post runoff controls is provided in Section 5.
3. Three of the seven have community wide buffers similar to VOP. The others all enforce watershed specific buffers only. No change is recommended.
4. All seven benchmark communities have SCM maintenance and inspection guidelines. We recommend VOP implement specific SCM Maintenance inspection guidelines. Sample Operation and Maintenance Agreements, recommended Maintenance Standards, Inspection Criteria, and Sample Inspection Forms have been provided to the Village Staff as a part of this project.
5. Three communities have a Stormwater Development Manual (SDM) and control downstream impacts, while four communities have Standard and Design Manuals. The current VOP ESSM is a Standard and Design Manual. We recommend VOP implement a Stormwater Development Manual that may serve to consolidate guidance for developers as the SDM would combine the ESSM with the VOPs Storm Drainage Policy and Procedures document. Additionally, the SDM would adopt specific criteria and procedures for protection of downstream properties.

Recommendations with this document include the addition of many new aspects to the Village's Stormwater Program. These include keeping up with inspection reports, performing inspections, approving O&M agreements, using the performance security to repair SCMs as needed, coordinating sign locations, etc. In most of the benchmark communities with a SWU these duties fall to one or more dedicated stormwater staff,

typically a Stormwater Administrator. In smaller programs an existing Engineering Manager or Public Works Director could do these tasks. Given the current responsibilities of existing VOP staff we recommend adding a dedicated Stormwater Administrator position to manage VOP's expanding Stormwater Program. The Stormwater Administrator position and a description of the position's role and responsibilities could be added under PDO Section 3.7 Village Staff and Departments.

## 3.2 MYVOP INFORMATION

The Village's MyVOP system allows work orders to be developed and questions asked directly to VOP staff. McGill reviewed FY18-FY22 MyVOP information with the intent to determine trends and issues at the forefront of Pinehurst residents' minds related to stormwater.

McGill compared the number of complaints vs. the number of work requests in the MyVOP system. This allowed McGill to view the complaints that did not need to be addressed by the Village and the ones that may have requested work. Then, the work requests were split into requests that required work or "projects" and those that did not. The results of this are shown below.

| Call Type | Number of Call Type | Percentage of Total Calls |
|---|---|---|
| Complaints | 55 | 7% |
| Work Requests | 671 | 91% |
| Other | 15 | 2% |
| **Total Number of Calls** | **741** | **100%** |
| *Number of Projects from Work Requests* | *114* | *15%* |

McGill also wanted to view how many times certain words and phrases were documented in the calls that requested work. These occurrences showed what people were calling about and what the most common issues were. The results are shown below.

| Keyword | Number of Occurrences | Percentage of Calls that Used These Keywords |
|---|---|---|
| Flood | 56 | 8% |
| Flooding | 35 | 5% |
| Heavy Rain | 20 | 3% |
| Standing Water | 26 | 4% |

| | | |
|---|---|---|
| Erosion | 34 | 5% |
| Clean | 125 | 19% |
| Clear | 25 | 4% |
| **Total Number of Work Requests** | **671** | **100%** |

Likewise, it may be of interest to identify occurrences of flooding issues specific to yards or homes vs. Right-of-Way (R/W) issues in streets, gutters, or inlets. However, without the context of historical knowledge, it may be difficult to discern this information from the raw data based on keywords alone. VOP may want to pursue this or other queries through future data analysis.

## 4. REVIEW OF MODEL ORDINANCES

McGill gathered sample stormwater ordinances and policies from similar sized North Carolina communities selected by VOP which included Southern Pines, Chapel Hill, Davidson, Cary, Holly Springs, Hendersonville, and Hope Mills. Program data was gathered from these communities for review, and comparison of the essential elements of the Stormwater Utility data (e.g., rate structure, credit program, billing process and funded stormwater program elements), where available. A matrix was developed highlighting the major elements of the stormwater utility program of each community including rate structure, credit/exemption programs, billing process, and funded stormwater elements. The documents referenced in the table are typically found on the community website.

| Entity | Rate Structure | Credit Program | Exemptions Program | Billing Process | Funded Stormwater Program Elements |
|---|---|---|---|---|---|
| **Pinehurst** | N/A | N/A | N/A | N/A | N/A |
| **Cary** | N/A | N/A | N/A | N/A | N/A |
| **Chapel Hill** | ERU = $34.97 / 1,000 SF | No | 1) NCDOT and Chapel Hill Public road R/W<br>2) Railroad R/W | Paid online annually w/ property tax | meet Town's requirements under the NPDES – Phase II. |
| **Davidson** | Tier 1: $22.68 < 2,000 SF<br>Tier 2: $30.66 for 2,000-2,999<br>Tier 3: $41.64 for 3,000-4,999<br>Tier 4: $74.28 > 5,000<br>All others $69.17 per acre of impervious surface. | a) peak discharge reduction, 40 percent<br>b) total runoff volume reduction, 60 percent; 100-percent credit = 0 fee | 1) Undeveloped land<br>2) NCDOT or City public road R/W | CMU dedicated billing system<br>Residential - bi-annually.<br>Commercial - monthly | construction, operation, and maintenance of the SW system. |
| **Hendersonville** | Flat $5.00 / per dwelling unit (3000 SF)<br>All others = ERU | Evaluated on a Case-by-Case basis | N/A | Monthly | Operating and maintaining the City's SW infrastructure, compliance w/ state and federal SW regulations, and improving SW quality. |
| **Holly Springs** | SFR = $5.20<br>NSFR Tier 1: $15.60 <= 8K SF imp.<br>Tier 2: $72.80<= 40K SF imp.<br>Tier 3: $182.00<= 100K SF imp. | (NSFR) reduction up to 25% of fee for SW treatment above the minimum design requirement. | 1) Undeveloped land & lots < 600 SF of imp.<br>2) Owned and operated by the town;<br>3) Railroad R/W | Monthly fee on water bill | The Town's stormwater program is aimed at reducing flooding to protect infrastructure, such as roadways, water and sewer lines, and properties. |
| **Hope Mills** | $4 / ERU (SFR, ERU =: 2,266 SF imp.)<br>$6 / ERU (NSFR) | N/A | 1) NCDOT improved public road R/W<br>2) Town improved public road R/W | Included with annual property tax bill | Improve water quality and water quantity issues, reduce the pollution caused by stormwater runoff and implement stormwater education and involvement programs. |
| **Southern Pines** | N/A | N/A | N/A | N/A | N/A |

**Table 2 – Benchmark Stormwater Utilities**

# 5. REVIEW OF DESIGN STORM AND RETURN FREQUENCY

Based on the results of Sections 3.1 and 3.2 above, McGill compared flood complaints logged in MyVOP during storm events to the 10-year design storm standard and assessed if the 10-year level of service is reasonable for the community or if modifications are warranted. McGill explored various options to achieve enhanced standards, reviewed findings with VOP staff and provided recommendations to address historical VOP concerns.

McGill measured rainfall data to see how different rain events affected the number of calls, McGill downloaded rainfall gauge data from the NC State Climate Office. The rainfall gauge is located at Moore County Airport in close proximity to the Village. There were three events analyzed for this comparison. The first were those that had less than 1" of rainfall. The next two were two- and ten-year rainfall events as defined by NOAA. During the analyzed time period from July 2017 to November 2020 there were no events that met the minimum threshold for two- or ten-year events. The largest rainfall event during the analyzed time period was Hurricane Florence during September 2018. While there was significant cumulative rainfall over several days, this event did not exceed the 2-year/6-hour -, 2-year/24-hour -, 10-year/6-hour -, nor the 10-year/24-hour storm. The 10-year/6-hour storm and 10-year/24-hour storm are the VOP and general industry standards, respectively. There were many instances of rainfall measured under 1". McGill logged all calls made one or three days following the events. The results show that 447 out of 741 or roughly 60% of calls were made during this window of time.

In our experience, the 10-year pre-post criterion is the most prevalent in NC of those communities with higher standards. While two of the benchmark communities do require 25-year pre-post runoff controls, these are in more urbanized communities of Chapel Hill and Davidson (part of Charlotte/Mecklenburg Stormwater) which tend toward more restrictive stormwater management programs as part of their overall growth management approach.

As we understand VOP's historic stormwater issues have primarily been in the areas of uncontrolled runoff from highly impervious redevelopment and increased downstream flooding over time. Simply raising the current 10-year discharge criterion to 25-year

likely will not eliminate these issues and could make them worse by allowing higher volume discharge for smaller events. A better approach would be to require an evaluation of discharges across a range of common flow events. It is notable that both Chapel Hill and Davidson use this approach. This provides for a check on peak discharge say at the 1-year, 2-year, and 10-year event thereby covering a range of common storm events. Another way to achieve similar results would be to require a volume check in addition to peak flow criterion, which is what Chapel Hill uses. This can also be achieved by requiring a water quality design criterion in addition to peak discharge.

While McGill recommends VOP keep the 10-year return period for design storms, design storm duration for the pre-post criterion should be updated. The Village ESSM currently states that "general design [of stormwater management facilities] shall follow the standards set forth in the Publication Elements of Urban Stormwater Design by H. Rooney Malcolm, PhD., P.E.", which itself states "[i]t is usually satisfactory to include under the hydrograph the volume of runoff from the six-hour precipitation of the return period of interest", i.e., the 6-hour storm. McGill recommends the Village instead follows NCDEQ Stormwater Design Manual (See References) which requires a 24-hour storm duration for the design storm return period.

Discharge volume, peak flow, and water quality criterions need to be balanced against the common developer's complaint of making stormwater management more expensive to permit and implement on the site. Given all of the above discussion we recommend VOP keep the 10-year pre-post discharge criterion, update design standards to match NCDEQ design standards rather than those set forth in Elements of Urban Stormwater Design and add a 2 -year pre-post volume criterion for new development. This criterion would require the retention and infiltration of the 2-year pre-post volume difference on site. This will result in only a moderate (10-20%) increase in typical pond volume due to the predominance of permeable soils in the sandhills region, should reduce downstream discharges in smaller, more frequent events and will start the process of requiring on-site retention limiting downstream impacts. Future consideration can be given to adding

another volume or discharge criterion should continued development pressures warrant this action.

# 6. PRE / POST FOR RESIDENTIAL DEVELOPMENT

An important part of the SWMP considerations is the potential for controlling stormwater discharge from proposed development and redevelopment of lots in single-family residential areas. McGill gathered information on the benefits, limitations, and available model policies for regulating runoff from single-family residential lots from the communities noted in Task 3 and NCDEQ for evaluation.

## 6.1 NEED AND PURPOSE

Pre/post stormwater controls are required for residential subdivisions and commercial development. However, they are currently not required as a means to control stormwater discharges from proposed redevelopment on existing residential lots and infill lots within existing residential subdivision projects constructed prior to the requirement for stormwater controls.

The VOP has witnessed accounts of stormwater issues on properties adjacent to lots which become developed with a large percentage of impervious area (otherwise known as built upon area or BUA). The change in ground cover from pervious to a high percentage of impervious, leaves the potential for higher volumes of uncontrolled stormwater being discharged offsite, higher rates of stormwater discharge which can become more erosive, nuisance flooding of adjacent lots and the potential for stormwater to carry higher pollutant loads offsite.

Regard was given to controlling the post development runoff on high BUA lots to be closer to pre-development runoff rates and improving water quality. Incorporating stormwater control measures at the development stage of a high BUA single-family property has the potential to lessen problematic stormwater issues. Criteria could be developed to identify when stormwater controls are appropriate for development of high BUA single-family lots.

## 6.2 FACTORS AND TYPES OF RESIDENTIAL STORMWATER CONTROLS

Factors considered for the types of residential stormwater controls included:

a. Costs
b. Effectiveness
c. Required area
d. Ease of Installation
e. Ease of Maintenance and O&M Agreements
f. Aesthetics

Stormwater management control measures (SCM) considered for use for single-family residences should be low cost, compact, and require minimal maintenance to not overburden the typical single-family homeowner and encourage compliance. Likewise, consideration should be given to SCM types that infiltrate, filter, store and/or aid in evapotranspiration of stormwater (similar to Low Impact Design or LID) for similar reasons. These types of SCM may include:

a. Rain Gardens – or bioretention area at the low area of the yard to store and infiltrate water. Underdrains can be used where existing soils have low infiltration rates.
b. Dry wells – perforated tank set in gravel bedding to allow for subgrade infiltration and reduction in runoff.
c. Cisterns or Rain Barrels – for water capture, can be used later for watering, may decrease water bill.
d. Permeable Pavement – reducing runoff from driveways and patios and promote infiltration.
e. Disconnected Impervious - roof downspouts directed to the property's large grassed or planted areas promoting infiltration, reducing runoff and lawn and garden watering.
f. Planned landscaping – minimize severe slopes, use of native planting, plant shrubbery and trees along ditches, creeks, or ponds to create buffers and promote infiltration.
g. Green roofs – Absorbs rainfall, reduces runoff.

h. Modified French Drains – temporary storage, promote infiltration and reduce runoff.

SCM design, maintenance, and operational standards and requirements should be included in the Stormwater Design Manual recommended in Section 3.1. O&M agreements should be required in the SDM (See 15A NCAC 02H .1050 MDC FOR ALL STORMWATER CONTROL MEASURES (11 and 12)). Additionally, the SDM should adopt specific criteria and procedures for protection of downstream properties.

## 6.3 BENEFITS OF RESIDENTIAL STORMWATER CONTROLS

When homeowners are responsible for controlling stormwater runoff from and across their personal property, awareness of the importance and the part they play in management of stormwater is enhanced. Installation and proper maintenance of stormwater runoff controls lead to reduction of stormwater runoff onto neighboring properties lessening issues which arise such as soil erosion, flooding, and pollutants in the watershed. (Reference “NCDEQ Guide: Improving WQ In Your Own Backyard”).

Families and property owners responsible for their own stormwater management are more likely to perform additional activities to enhance water quality such as reducing the use of pesticides and fertilizers, composting, sweeping driveways into grassed areas instead of street gutters, and reducing detergents when performing outdoor car or house washing.

Improving the VOP’s stormwater program to include criteria for single-family residential (SFR) lots could help to eliminate runoff issues between neighboring properties and improve the environmental health of public streams. It would also offer a great educational component to add to the Village’s stormwater program.

Many of the residential stormwater complaints the Village receives are due to lack of education and knowledge on stormwater rules and regulations. Many residents believe the Village is responsible for managing all stormwater in Pinehurst. Per The Civil Law Rule, i.e., “rule of reasonable use,” owners of lower land are obligated to receive and

manage the natural flow of surface water from higher lands across their property. To address this the Village discussed the limitations of its Legal authority and the “rule of reasonable use” during a Public Meeting (See Section 7). The Village has also created a storm drainage pamphlet, clarified the “rule or reasonable use” and stormwater regulations on their website, and published several social media posts on the topic to educate the public about the rules, regulations, and their responsibilities related to stormwater. Requiring O&M agreements in the SDM would further educate residents on these rules, regulations, and responsibilities.

## 6.4 LIMITATIONS OF RESIDENTIAL STORMWATER CONTROLS

A residential stormwater program to implement runoff controls for SFR lots would need to be tied to the Village’s stormwater program and conditions of the permitting process. Legal authority would need to be established for enforcement of the program in the Code of Ordinance.

To remain effective, SCMs need to be maintained. It would be up to the property owners to ensure the operation and maintenance of their controls. Consideration may be needed for inspections and enforcement when not in compliance similar to other SCMs. Dedicated right of entry or easements should also be considered, especially when residential SCMs tie into public right of ways or drainage systems.

## 6.5 LEGAL AUTHORITY

Legal authority could be accomplished through an addendum to the Village’s written Code of Ordinance and incorporation into existing VOP stormwater programs. SFR stormwater control elements may include:

a. How will the program be implemented? Will it be part of the stormwater plan review and permitting process? Will it be tied to zoning, building permits and/or acquirement of the certificate of occupancy?
b. Deed verbiage for perpetual maintenance of controls.

c. Establishment of operation and maintenance agreements or maintenance covenants, inspection criteria and frequency and enforcement mechanisms for lack of compliance?
d. Establish thresholds such as the addition of 5,000 sf of new BUA. What would be the exceptions, for instance, less than 20,000 SF lots, land disturbance of less than 10,000 SF? Would it be based on the total impervious area for a lot or existing with the proposed exceeding a certain threshold? Would there be a grandfathering period?
e. What will be required of the homeowner to receive approval? Would calculations or certifications by engineers be required? What would the performance standards be (pre/post requirements)?
f. Would VOP provide details of approved SCM or reference others such as NCDEQ?
g. Would sizing requirements be required from the homeowner or provided for by the VOP?

## 6.6 OTHER PROGRAMS IN NORTH CAROLINA

Several municipalities in North Carolina have established Stormwater Programs which have included residential stormwater management requirements. Programs from the VOP benchmark municipalities are summarized below:

a. *Chapel Hill* – Exempt activities: Individual single-family and two-family development and redevelopments that do not disturb more than twenty thousand (20,000) square feet of land area, including cumulative disturbance since the adoption of the Land Use Management Ordinance on January 27, 2003, provided they are not part of a larger common plan of development. Individual single-family and two-family residential construction that are exempt from stormwater performance criteria under subsection 5.4.2(b)(2) above shall discharge runoff in a non-erosive and diffuse manner using techniques approved by the Town Manager. Discharge system/techniques shall be in accordance with the standards established in the Town's Design Manual.

b. *Davidson* – Exempt: Residential development that cumulatively disturbs less than on acre and cumulatively creates less than 24 percent BUA based on lot size, or the lot is less than 20,000 sf (and not part of a larger development).

Based on the information presented above and discussions with VOP staff, we recommend the following immediate actions to address historical VOP concerns.

1. Establish design criteria through development of a Stormwater Design Manual or by ordinance to guide design, identify exception policies and provide a reference list of acceptable SCMs.

2. Develop O&M Agreement based on above recommended for other SCMs. Establish accompanying inspection criteria and frequency and enforcement mechanisms for lack of compliance. Require O&M Agreements in the SDM.

3. Tie execution of O&M Agreement and deed verbiage for perpetual maintenance of controls to Certificate of Occupancy.

As discussed in section 5, we understand VOP's historic stormwater issues have primarily been in the areas of uncontrolled runoff from highly impervious redevelopment, increased downstream flooding over time, and runoff issues between neighboring properties. Should continued development pressures increase stormwater issues and warrant further action, we additionally recommend the following actions for possible future implementation.

1. Establish a threshold of 2,000 sf or greater additional BUA for any SFR lot expansion or redevelopment to require a consultation with the VOP for consideration of stormwater controls.
2. Establish such SFR lot expansion or redevelopment to require a consultation with the VOP for onsite grading and drainage.
3. Tie this requirement to zoning approval to promote awareness early in the design process.

# 7. PUBLIC ENGAGEMENT

## 7.1 PUBLIC MEETING

VOP requested McGill assist with coordination of a Public Meeting where a summary of the SWMMP development process could be provided, and the public could be engaged regarding identification of stormwater related issues or concerns that have not been addressed by the VOP. The VOP staff also used a mirrored segment on the EngagePinehurst website to obtain public feedback.

The meeting was scheduled for Wednesday, March 23rd, 2022, in the Assembly Hall. The meeting provided an opportunity for in-person or virtual participation via the VOP's IT.

The presentation generally included the following:

1. SWMMP overview and education,
2. Legal Authority limitations ("rule of reasonable use"),
3. Past project successes (case studies on addressing SW problems in VOP),
4. Suggested changes to policy and procedures
5. New SW pamphlet and maps on the wall for complaints.

## 7.2 STORMWATER SATISFACTION SURVEY

As a part of the VOP annual community survey, residents were asked their levels of stormwater satisfaction. FY22 survey information was reviewed with the intent to determine dissatisfied areas and trends in historic resident satisfaction. The number of responses and their breakdown by neighborhood are shown below.

| Pinehurst #6 | Pinehurst Trace | Pinehurst #7 | Morganton/ Monticello Rd | Lake Pinehurst | Pinewild | Old Town/ Linden | Village Acres | Total |
|---|---|---|---|---|---|---|---|---|
| 155 | 39 | 45 | 76 | 223 | 83 | 108 | 80 | 809 |
| 19% | 5% | 6% | 9% | 28% | 10% | 13% | 10% | |

Results of the FY22 survey satisfaction percentages are given below.

| | Pinehurst #6 | Pinehurst Trace | Pinehurst #7 | Morganton/ Monticello Rd | Lake Pinehurst | Pinewild | Old Town/ Linden | Village Acres |
|---|---|---|---|---|---|---|---|---|
| Satisfied | 69.06% | 52.94% | 68.57% | 50.75% | 61.88% | 72.97% | 62.38% | 73.24% |
| Neutral | 21.58% | 23.53% | 14.29% | 19.40% | 16.83% | 18.92% | 17.82% | 12.68% |
| Dissatisfied | 9.35% | 23.53% | 17.14% | 29.85% | 21.29% | 8.11% | 19.80% | 14.08% |

Results of the FY22 survey were compared to previous years to understand historic residential stormwater satisfaction percentages and trends. “Satisfaction” included satisfied and neutral responses, i.e., all residents who were not dissatisfied. Results are given below.

| | FY 18 | FY 19 | FY20 | FY21 | FY22 |
|---|---|---|---|---|---|
| Pinehurst #6 | 87% | 81% | 88% | 84.38% | 90.65% |
| Pinehurst Trace | 92% | 81% | 74% | 87.10% | 76.47% |
| Pinehurst #7 | 86% | 96% | 97% | 96.77% | 82.86% |
| Morganton/Monticello | 78% | 70% | 80% | 74.60% | 70.15% |
| Lake Pinehurst | 76% | 76% | 80% | 78.92% | 78.71% |
| Pinewild | 90% | 80% | 94% | 89.04% | 91.89% |
| Old Town/Linden | 82% | 73% | 82% | 82.18% | 80.20% |
| Village Acres | 80% | 76% | 80% | 82.76% | 85.92% |

While the Village tends to receive the most complaints regarding stormwater from the Lake Pinehurst area, the Morganton/Monticello Area is historically the most dissatisfied neighborhood.

## 8. POST-CONSTRUCTION STORMWATER MAINTENANCE

McGill identified options for post-construction stormwater maintenance based on typical NPDES Phase 2 program requirements and discussed with VOP staff. These included maintenance agreements, compliance inspections, and enforcement of post-construction stormwater maintenance requirements.

Similar to the recommendation for SFR SCMs we recommend the following:

1. Develop O&M Agreement based on above recommended for other SCMs. Establish accompanying inspection criteria, frequency, and enforcement mechanisms for lack of compliance.

2. Tie execution of O&M Agreement and deed verbiage for perpetual maintenance of controls to Certificate of Occupancy.

Village staff or a consultant would be responsible for developing O&M agreements, establishing inspection criteria and frequency, and establishing enforcement mechanisms. After the program is developed Village staff or a consultant would be responsible for administering the program, performing inspections, and enforcement. The time commitment of the Village staff or consultant would depend on the frequency and number of SCM inspections; however, it can be assumed annual inspections require 2 field hours and 1 office hour per SCM, in addition to administration and tracking. The City of Oxford budgets $20,000 per year for 15 SCMs plus 2 to 3 new SCMs each year.

Typically, existing SCMs are grandfathered into such programs and do not require new Agreements.

## 9. DRAINAGE PROBLEM AREA SOLUTIONS

Six problem areas reported to Village staff with stormwater system deficiencies were chosen for storm system improvement. For each location, the existing stormwater system was evaluated, and conceptual plans and cost estimates developed to address system deficiencies.

Problem areas evaluated by McGill included:

1. Belair Court and Thunderbird Circle (Appendix 1)
2. Chinquapin Road and Magnolia Road (Appendix 2)
3. Gun Club Drive and Garner Lane (Appendix 3)
4. Palmetto Road and Cherokee Road (Appendix 4)
5. Starlit Lane (Appendix 5)
6. York Place (Appendix 6)

In addition, Village staff evaluated a seventh problem area on Black Boulevard. The Villages Evaluation has been incorporated into this SWMMP (Appendix 7).

Details on existing system conditions, calculations, conceptual plans, and cost estimates for each location can be found in the appendices listed above. McGill visited each site with Village staff to review topography and existing infrastructure in the area, discussed the reported problems and issues, and evaluated solutions to reasonably improve recurring nuisance flooding. Conceptual evaluations were based on Village provided GIS data supplemented with information from past McGill projects in the areas.

## 10. FUNDING LEVELS AND SOURCES

The Village of Pinehurst has $460,000 in the FY24 budget dedicated for stormwater projects. This same amount is forecasted annually for inclusion in the budget based on the current 5-year Capital Improvement Plan. This amount is sufficient to complete all five projects discussed in this Report in the next two years. Therefore, the current CIP budget is sufficient to meet the needs of the Village.

Even though the current CIP budget may be sufficient, it is always good practice to consider what potential may also exist for acquisition of grant funding.

There are primarily two different types of grant programs available to fund stormwater and flood improvements. The first group available to areas that are economically challenged are likely not viable for the Village given its current demographics. These include:

- EDA Public Works and Economic Adjustment Assistance Program

  The Economic Adjustment Assistance (EAA) (PDF) program is EDA's most flexible program; it provides a wide range of technical, planning, and public works and infrastructure assistance in regions experiencing adverse economic changes that may occur suddenly or over time. These adverse economic impacts may result from a steep decline in manufacturing employment following a plant closure, changing trade patterns, catastrophic natural disaster, a military base closure, or environmental changes and regulations.

- DWI Local Assistance for Stormwater Infrastructure Investments (LASII)

McGill is well acquainted with the LASII application process and determined as part of the inaugural round of applications in fall of 2022 that the Village of Pinehurst cannot participate in this grant program for the reasons noted below.

The criteria to apply is two-fold. The applicant must show eligibility and then have a "high" scoring project to get funded. Eligibility is based on the NC DWI LGU Indicator Calculator for Stormwater Funding Eligibility tool from NCDEQ. There are two types of applications including one for Stormwater Construction (LASII) and one for Stormwater Planning Grants (LASII). For either an applicant must demonstrate eligibility by meeting either of the two criteria below (Criterion 1 or Criterion 2):

I. Criterion 1: At least one (1) of the five (5) five Local Government Unit (LGU) Indicators for the applicant are worse than the state benchmarks - **Pinehurst does not score "Worse than State Benchmark" in any of the 5 categories.**

II. Criterion 2: The City or County as a whole does not meet Criterion 1 but is applying for stormwater projects that primarily benefit disadvantaged areas within the City's or County's jurisdiction. To be eligible, 75 percent or more of the project construction costs (as delineated in the Project Budget) must be used to directly benefit disadvantaged areas.- Per the NCDEQ Community Mapping System (https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=1eb0fbe2bcfb4cccb3cc212af8a0b8c8) - **Pinehurst has no disadvantaged areas**.

The second group of grants are not restricted by economic need. These may be considered viable to partially or completely offset the stormwater project costs. However, each program may have other constraints that make it more or less viable and should be reviewed in detail on a project-by-project basis.

- FEMA Building Resilient Infrastructure and Communities (BRIC) Program

The BRIC grant program give states, local communities, tribes and territories funding to address future risks to natural disasters, including ones involving: wildfires, drought, hurricanes, earthquakes, extreme heat, and flooding. Addressing these risks helps make communities more resilient. BRIC funds may be used for:

- Capability and capacity building (C&CB) activities
- Mitigation projects
- Management costs

Existing project types detailed in the Hazard Mitigation Assistance Guidance for the Pre-Disaster Mitigation grant program are eligible under the BRIC program.

Projects must:

- Be cost-effective
- Reduce or eliminate risk and damage from future natural hazards
- Meet either of the two latest published editions of relevant consensus-based codes, specifications, and standards
- Align with the applicable hazard mitigation plan (HMP)
- Meet all Environmental and Historic Preservation (EHP) requirements

BRIC applications periods are announced annually by each state. The federal application period typically opens in September and closes in January of each year. However, a state sponsor is required for consideration at the federal level. In North Carolina this is the State Hazard Mitigation Officer - Steve McGugan in NCDPS Steve.McGugan@ncdps.gov. NC fixed sub-application deadlines are announced each year.

- CWMTF Innovative Stormwater Grant

  The North Carolina Clean Water Management Trust Fund (CWMTF) may fund projects employing innovative technologies, applications, strategies, or approaches for managing stormwater for protecting and improving the quality of water in North Carolina. CWMTF defines “innovative stormwater projects” as projects that:

  1) bring something new or different to practices in stormwater-quality management,
  2) build on experience and current practices, and
  3) advance practices in stormwater-quality management regionally or statewide.

  Innovative stormwater projects will focus on developing and applying new information. These projects will emphasize developing representative and defensible monitoring data and cost data, evaluating system effectiveness and performance in field applications, evaluating economic and social benefits, and disseminating findings and results.

- CWMTF Planning Grant

  NCLWF (North Carolina Land and Water Fund) may fund planning efforts that develop potential projects with one or more of the following goals:

  - Enhance or restore degraded waters,
  - Protect unpolluted waters,
  - Contribute toward a network of riparian buffers and greenways for environmental, educational, and recreational benefits,
  - Provide buffers around military bases to protect the military mission,

- Acquire land that represents the ecological diversity of North Carolina,
- Acquire land that contributes to the development of a balanced State program of historic properties, or
- Facilitate innovative efforts to improve stormwater treatment.

The North Carolina Land and Water Fund has one grant cycle per year. The application forms are available in early December. The application deadline is midnight on February 15, and final award decisions are made in the fall.

- Golden Leaf Foundation Flood Recovery

This program is focused on mitigating the causes of flooding. The program funds construction of new or improvement of existing publicly owned stormwater infrastructure, including natural drainage infrastructure and flood control equipment, repair of existing stormwater infrastructure damaged or destroyed by flooding, which must include improvements to mitigate against future flooding and engineering expenses related to planning and development of flood mitigation solutions.

Characteristics of competitive proposals include:

- Efforts to mitigate against frequent flooding, including hazards with a frequency beyond a hurricane or other named storm.
- Clear benefit for residents, businesses, and other entities within a community with priority on those where flooding poses a risk for life, health, and safety.
- A demonstrated likelihood of success and feasibility demonstrated by engineering reports and analysis by professional engineers.

- A current (within the last six months) estimate of probable cost or other similar document
- Linked to a comprehensive stormwater assessment or planning effort with community support.
- Sustainable outcomes that can be maintained following use of funds.
- For applications to support planning efforts, a reasonable strategy for implementation.

The Golden LEAF Board of Directors decides whether or not to fund each proposal. The Board considers new applications at each quarterly meeting. Applications typically need to be submitted no less than 1 month prior to the meeting to be considered.

## 11. LOCAL EROSION AND SEDIMENTATION CONTROL PROGRAM

VOP requested McGill evaluate the option of implementing the Sediment Pollution Control Act (SPCA) as a delegated local program. Currently, projects within the jurisdiction of the Village that meet land disturbance thresholds are required to submit an erosion and sedimentation control (E&SC) plan for approval by the North Carolina Department of Environmental Quality (NCDEQ) Division of Energy, Mineral, and Land Resources (DEMLR). The NC Sedimentation Control Commission (SCC) may delegate authority to implement the SPCA to local governments that adopt a local qualifying E&SC ordinance in compliance with North Carolina state requirements. In lieu of utilizing NCDEQ for these services, VOP wishes to evaluate establishing a delegated local E&SC review and inspection program.

Details on the evaluation of an In-house Erosion and Sedimentation Control Program and guidance on program and ordinance development are provided in Appendix 8.

In summary, local E&SC ordinances must meet or exceed state requirements and the SPCA. Local ordinances are to be developed based on the Model Local Ordinance provided by DEMLR (Exhibit B, Appendix 8), and adjusted to comply with House Bill

488, discussed at the end of this section. The ordinance must be submitted for review by the State Sediment Specialist, Assistant Sediment Specialist, and DEQ Attorney. The Village must adopt the ordinance before seeking formal approval from the SCC. Once the Village has formally adopted the ordinance, a delegation request can be submitted to the Assistant Sediment Specialist. The SCC will review the delegation request and notify the Village of its approval or disapproval.

The local E&SC review and inspection program budget should be adequate for staffing and equipment needs. Having a self-funded program may be difficult to achieve. Fees collected from the permits are not typically sufficient to offset the cost of administering the program using the State's standard. The staffing plan should be sufficient to support engineering plan reviews and site inspections of active projects considering historical development trends, i.e., about two times per month. The program would require at least one full-time employee in the Village to oversee the implementation, set up standard operating procedures, and subsequently conduct reviews, inspections, and reporting. The inventory of program equipment should also be sufficient to support the frequency of site inspection.

The North Carolina House is currently considering HB 579 that relates to delegated E&SC Programs. Upon brief review of the proposal, it would seem to have minimal impact on the framework of the Village's potential program as it would essentially follow the State rules, but if it became law, it may limit the Village's ability to address the earlier comment on fees as it would restrict the maximum fee for the program to the State standard.

House Bill 488 was signed into law on August 18th, 2023, and relates to the North Carolina State Building Code and Land Development Regulations. Section 10 of the bill limits the allowable fees for local sedimentation and erosion control programs. Were a local E&SC program to be developed, fees must be in compliance with this section. Additionally, HB 488 section 13a changes the previous law regarding financial arrangements for the maintenance and replacement of private SCMs.

No concerns over the Village's current practice to utilize NCDEQ for erosion control reviews exceeding one (1) acre were prevalent during the preparation of this Plan. Due to this and the limit placed on allowable fees for local sedimentation and erosion control programs by HB488, McGill recommends that the VOP continue to utilize NCDEQ for these services in lieu of pursuing a local program. This should be periodically re-evaluated in the future if a need to develop a local program arises.

## REFERENCES

NCDEQ Guide: Improving WQ In Your Own Backyard

NCDEQ Stormwater Design Manual

# GLOSSARY

BMP: Best Management Practice

BUA: Built Upon Area

CIP: Capital Improvement Plan

CMU: Charlotte Mecklenburg Utilities

ERU: Equivalent Residential Unit

E&SC: Erosion and Sedimentation Control

ESSM: Engineering Standards and Specifications Manual

H&H Modeling: Hydrologic and Hydraulic Modeling

HQW: High Quality Waters

N: Nitrogen

NPDES: National Pollutant Discharge Elimination System

NR: Neuse River

NSFR: Non-Single Family Residential

NSW: Nutrient Sensitive Water

O&M: Operation and Maintenance

P: Phosphorus

PDO: Pinehurst Development Ordinance

POG: Project Oversite Group

R/W: Right-of-way

SCM: Stormwater Management Control Measure

SDM: Stormwater Design Manual

SF: Square Foot ($ft^2$)

SFR: Single Family Residential

SW: Stormwater

TN: Total Nitrogen

TSS: Total Suspended Solids

WSW: Water Supply Watershed

# APPENDIX 1

## Belair Court and Thunderbird Circle
## Storm System Improvement

# TECHNICAL MEMORANDUM

**Date:** July 11, 2023

**Prepared for:** Mike Apke, PE
Public Services Director, Village of Pinehurst

**Prepared by:** Michael Hanson, PE, Director of Water Resources
McGill Associates, P.A., Firm License No. C-0459

**Subject:** Village of Pinehurst Stormwater Masterplan- Phase 2
Belair Court and Thunderbird Circle Storm System Improvement

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The purpose of this memorandum is to provide supporting computations and recommendations for the sizing of the pipe network needed to maintain water flow through the system at Belair Court and Thunderbird Circle up to the 10-year storm event. The project includes the assessment of the storm sewer network on Thunderbird Circle and proposes potential improvements to mitigate recuring nuisance flooding.

Existing stormwater system data was provided by the Village. Before entering the existing stormwater system, stormwater flows overland from the Resort of Pinehurst golf course (Resort) to the existing stormwater catch basin in front of 2 Thunderbird Circle via low elevation areas. Grading in the area directs stormwater to flow into the property and along the residence of 2 Thunderbird Circle before entering the existing catch basin. During heavy rains, the Resort's Pond located directly upstream of 2 Thunderbird Circle has overflowed, with water entering the property of 2 Thunderbird Circle. The resident of 2 Thunderbird Circle has contacted the Village about stormwater entering their property from the Resort and related issues. The existing system continues from 2 Thunderbird Circle with an 18-inch reinforced pipe (RCP) running southeast across Thunderbird Circle to a catch basin adjacent to 1 Thunderbird Circle. An additional 18-inch RCP runs southwest across Thunderbird Circle that outfalls to a channel along the properties at 36 and 34 Thunderbird Circle and then into the Resort. Flow continues downstream through the low elevation areas that straddle the Resort and adjacent properties, particularly impacting the backyard of the house located at 5 Belair Court causing nuisance flooding and erosion (Figure 1). After heavy storms on May 29, 2020, the resident of 5 Belair

Court notified the Village that the stream located behind their residence “ha[d] overflowed its banks as water deluge[d] in from all sides”. While the issue occurred on private property, the Village agreed to evaluate upstream areas to determine whether improvements within the Village Right-of-Way could help mitigate the situation. Additionally, the Village is considering, but has not implemented, improvements to the existing storm pipes in the Right-of-Way between 1 and 2 Thunderbird Circle. Such improvements would not reduce the quantity of stormwater flowing downstream.

The contributing drainage area was obtained from Streamstats and edited in ArcMap based on engineering judgment (Figure 1). The rational method (CiA) was used to compute peak flow for the design storm (Table 1). Rainfall Intensities for the 5- and 10-year events were obtained from NOAA Atlas 14 (Table 1 and Exhibit A).

| Table 1 Storm Event Return Period | Flow Basin 1 (cfs) | Flow Basin 1& 2 (cfs) | Precipitation Intensity, 5 min Storm (in/hr) |
|---|---|---|---|
| **5-year** | 18.2 | 27.5 | 7.26 |
| **10-year** | 20.1 | 30.3 | 8.00 |

McGill evaluated the level of service of the existing pipe network beneath Thunderbird Circle and found that the existing system is adequately sized to pass the 10-year storm event (Exhibit B), therefore there is no need to install a Pond upstream of 2 Thunderbird Circle for stormwater detention. Although there are no apparent public benefits, installing a catch basin to collect runoff from the channel between 36 and 34 Thunderbird Circle and redirecting it to the Pond via a 24-inch RCP under the golf cart path would reduce the frequency and intensity of nuisance flooding for properties at the downstream end of Belair Court (Figure 2). The existing channel would need minimal grading to better define the flow path. Additionally, the golf cart path would need to be raised, requiring easements on private property and an agreement with Pinehurst Resort to accept discharge into their system, the Pond.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $63,000 and $100,000. See Exhibit C for Cost Estimate breakdown. All

improvements noted are located entirely on private property and serve no public benefit. Per the Village of Pinehurst Storm Drainage Policy and Procedures Document, the Village would not participate in the cost of the project. Homeowners in the area should work directly with the Resort to determine a solution. Regarding complaints from the resident of 2 Thunderbird Circle, after discussion between the Village, the Resort, and the resident, the Resort indicated they would consider implementing grading work on the golf course property to redirect stormwater flow into the wooded area between 35 Thunderbird and 2 Thunderbird Circle. At this time, the Resort has not proceeded with such grading work.

Enclosures:

Figure 1: Existing Conditions Map

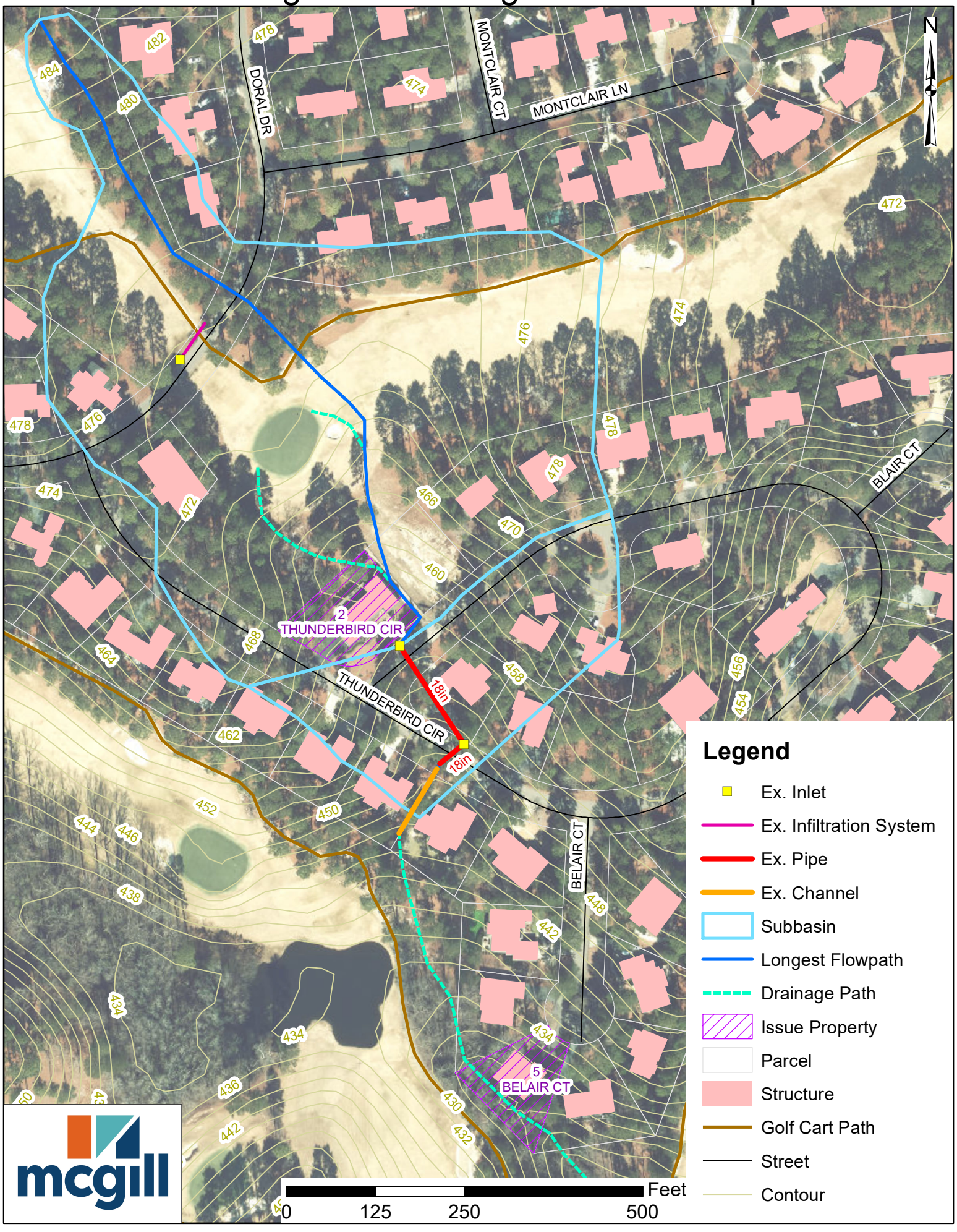
Figure 2: Concept Plan

Exhibit A: NOAA Atlas 14 and Rational Method Calculations

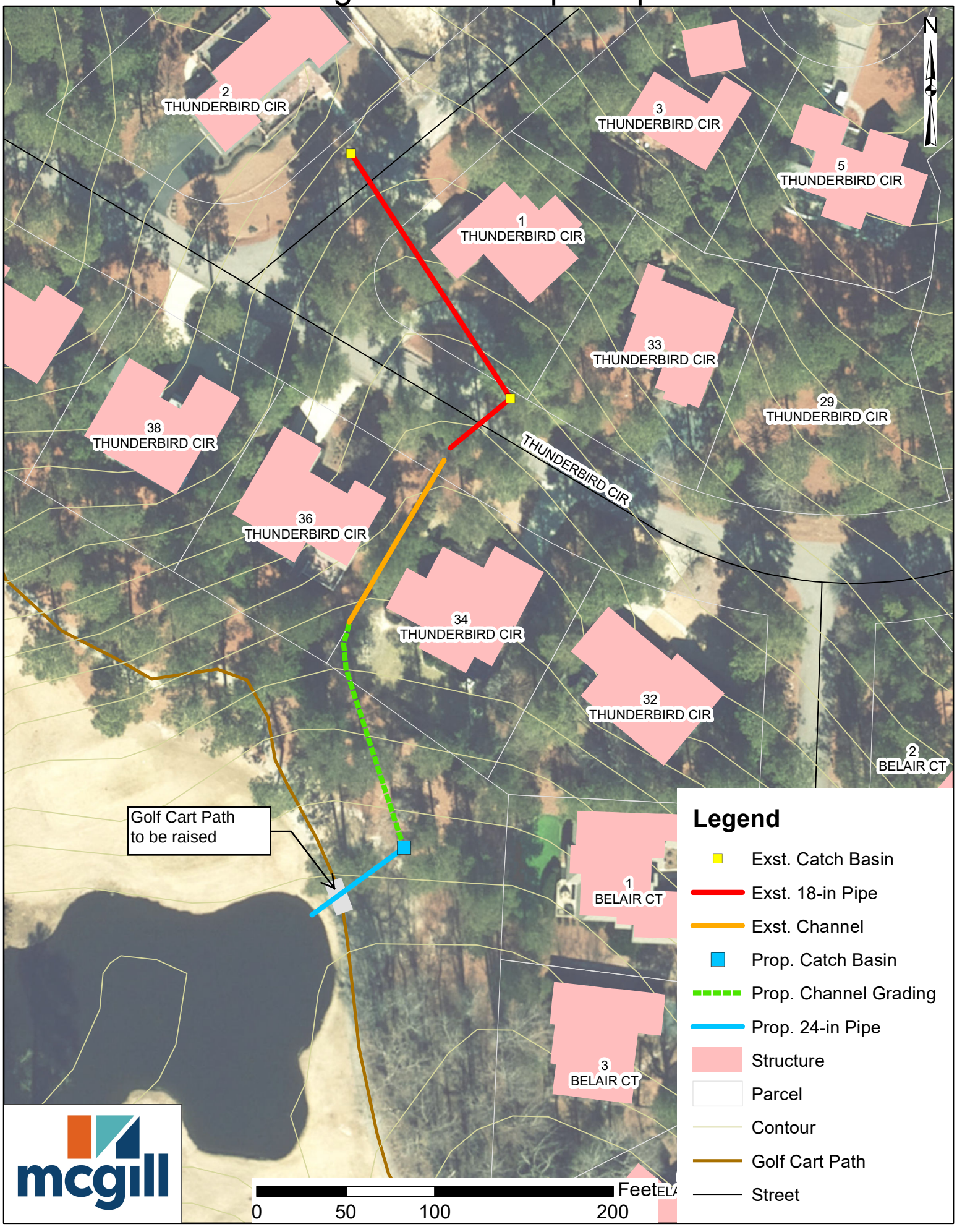
Exhibit B: Pipe Sizing Calculations

Exhibit C: Cost Estimate

# Figure 1: Existing Conditions Map



# Figure 2: Concept Map



# Exhibit A:

## NOAA Atlas 14 and Rational Method Calculations

**NOAA Atlas 14, Volume 2, Version 3**
**Location name: Pinehurst, North Carolina, USA***
**Latitude: 35.1774°, Longitude: -79.4573°**
**Elevation: 426.04 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **5.29** (4.81-5.84) | **6.25** (5.69-6.91) | **7.26** (6.60-8.03) | **8.00** (7.25-8.82) | **8.84** (7.98-9.74) | **9.44** (8.50-10.4) | **10.00** (8.94-11.0) | **10.5** (9.34-11.5) | **11.1** (9.77-12.2) | **11.5** (10.1-12.7) |
| 10-min | **4.22** (3.85-4.67) | **5.00** (4.55-5.53) | **5.82** (5.29-6.43) | **6.40** (5.80-7.06) | **7.05** (6.36-7.76) | **7.52** (6.77-8.27) | **7.94** (7.10-8.74) | **8.32** (7.40-9.16) | **8.76** (7.73-9.64) | **9.07** (7.94-9.99) |
| 15-min | **3.52** (3.20-3.89) | **4.19** (3.81-4.63) | **4.90** (4.46-5.42) | **5.40** (4.89-5.95) | **5.96** (5.38-6.56) | **6.35** (5.71-6.98) | **6.70** (5.99-7.36) | **7.00** (6.23-7.70) | **7.35** (6.48-8.09) | **7.59** (6.64-8.36) |
| 30-min | **2.41** (2.20-2.67) | **2.89** (2.63-3.20) | **3.49** (3.17-3.85) | **3.91** (3.54-4.31) | **4.41** (3.98-4.86) | **4.78** (4.30-5.26) | **5.13** (4.59-5.64) | **5.45** (4.85-5.99) | **5.85** (5.16-6.44) | **6.15** (5.38-6.77) |
| 60-min | **1.50** (1.37-1.66) | **1.82** (1.65-2.01) | **2.23** (2.03-2.47) | **2.55** (2.31-2.81) | **2.94** (2.65-3.24) | **3.24** (2.91-3.56) | **3.53** (3.16-3.88) | **3.82** (3.40-4.20) | **4.20** (3.70-4.62) | **4.49** (3.93-4.94) |
| 2-hr | **0.883** (0.798-0.984) | **1.07** (0.968-1.19) | **1.33** (1.21-1.48) | **1.53** (1.38-1.70) | **1.79** (1.61-1.99) | **1.99** (1.78-2.21) | **2.19** (1.95-2.43) | **2.39** (2.11-2.66) | **2.66** (2.32-2.95) | **2.86** (2.48-3.18) |
| 3-hr | **0.623** (0.565-0.693) | **0.754** (0.685-0.840) | **0.945** (0.857-1.05) | **1.09** (0.989-1.22) | **1.29** (1.16-1.44) | **1.45** (1.30-1.61) | **1.62** (1.43-1.79) | **1.78** (1.57-1.97) | **2.01** (1.75-2.23) | **2.20** (1.89-2.44) |
| 6-hr | **0.372** (0.339-0.412) | **0.451** (0.410-0.498) | **0.565** (0.514-0.624) | **0.655** (0.593-0.723) | **0.779** (0.700-0.857) | **0.877** (0.783-0.965) | **0.979** (0.867-1.08) | **1.09** (0.952-1.19) | **1.23** (1.07-1.35) | **1.35** (1.15-1.48) |
| 12-hr | **0.219** (0.199-0.242) | **0.265** (0.241-0.293) | **0.334** (0.303-0.369) | **0.389** (0.352-0.430) | **0.466** (0.418-0.513) | **0.529** (0.471-0.580) | **0.594** (0.524-0.651) | **0.663** (0.579-0.726) | **0.760** (0.653-0.832) | **0.839** (0.710-0.918) |
| 24-hr | **0.129** (0.119-0.140) | **0.155** (0.144-0.169) | **0.195** (0.181-0.212) | **0.227** (0.209-0.246) | **0.270** (0.248-0.293) | **0.304** (0.279-0.330) | **0.340** (0.311-0.368) | **0.376** (0.343-0.407) | **0.426** (0.387-0.461) | **0.465** (0.421-0.504) |
| 2-day | **0.075** (0.070-0.081) | **0.090** (0.084-0.098) | **0.113** (0.105-0.122) | **0.131** (0.121-0.141) | **0.155** (0.143-0.167) | **0.174** (0.160-0.187) | **0.193** (0.178-0.209) | **0.214** (0.195-0.231) | **0.241** (0.220-0.261) | **0.263** (0.239-0.285) |
| 3-day | **0.053** (0.049-0.057) | **0.064** (0.059-0.069) | **0.079** (0.074-0.085) | **0.091** (0.085-0.098) | **0.108** (0.100-0.116) | **0.121** (0.112-0.130) | **0.135** (0.124-0.145) | **0.149** (0.137-0.160) | **0.168** (0.153-0.181) | **0.183** (0.167-0.197) |
| 4-day | **0.042** (0.039-0.045) | **0.050** (0.047-0.054) | **0.062** (0.058-0.067) | **0.072** (0.067-0.077) | **0.085** (0.079-0.091) | **0.095** (0.088-0.102) | **0.106** (0.097-0.113) | **0.116** (0.107-0.125) | **0.131** (0.120-0.141) | **0.143** (0.131-0.154) |
| 7-day | **0.028** (0.026-0.030) | **0.033** (0.031-0.035) | **0.040** (0.038-0.043) | **0.046** (0.043-0.049) | **0.054** (0.050-0.058) | **0.061** (0.056-0.065) | **0.067** (0.062-0.072) | **0.074** (0.068-0.079) | **0.083** (0.076-0.089) | **0.090** (0.082-0.097) |
| 10-day | **0.022** (0.021-0.024) | **0.026** (0.025-0.028) | **0.032** (0.030-0.034) | **0.036** (0.034-0.038) | **0.042** (0.039-0.044) | **0.046** (0.043-0.049) | **0.051** (0.047-0.054) | **0.055** (0.051-0.059) | **0.062** (0.057-0.066) | **0.066** (0.061-0.071) |
| 20-day | **0.015** (0.014-0.016) | **0.018** (0.017-0.019) | **0.021** (0.020-0.022) | **0.023** (0.022-0.025) | **0.027** (0.025-0.028) | **0.029** (0.028-0.031) | **0.032** (0.030-0.034) | **0.035** (0.033-0.037) | **0.039** (0.036-0.041) | **0.042** (0.038-0.044) |
| 30-day | **0.012** (0.012-0.013) | **0.015** (0.014-0.015) | **0.017** (0.016-0.018) | **0.019** (0.018-0.020) | **0.021** (0.020-0.022) | **0.023** (0.022-0.024) | **0.025** (0.023-0.026) | **0.027** (0.025-0.028) | **0.029** (0.027-0.031) | **0.031** (0.029-0.033) |
| 45-day | **0.010** (0.010-0.011) | **0.012** (0.012-0.013) | **0.014** (0.013-0.015) | **0.015** (0.015-0.016) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.020** (0.019-0.021) | **0.021** (0.020-0.022) | **0.023** (0.021-0.024) | **0.024** (0.022-0.025) |
| 60-day | **0.009** (0.009-0.010) | **0.011** (0.010-0.012) | **0.012** (0.012-0.013) | **0.014** (0.013-0.014) | **0.015** (0.014-0.016) | **0.016** (0.015-0.017) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.019** (0.018-0.021) | **0.020** (0.019-0.022) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical

## Rational Method- C Value, Subbasin 1

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subbasin | Land Use | Area (sft) | C | C*Area |
| 1 | Woodlands | 124885 | 0.15 | 18732.75 |
| 1 | Lawn, sandy soil, flat | 142299 | 0.10 | 14229.9 |
| 1 | Street, Asphalt | 38505 | 0.80 | 30804 |
| 1 | Residential | 113566 | 0.40 | 45426.4 |
| | | Total Area | | Weighted C |
| | | 419255 | | 0.26 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| Agricultural land: | 0.30-0.60 |
| Bare packed soil | 0.20-0.50 |
| Smooth | 0.20-0.40 |
| Rough | 0.10-0.25 |
| Cultivated rows | |
| Heavy soil no crop | 0.15-0.45 |
| Heavy soil with crop | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Subbasin 1

Time of Concentration

$$t_c = kL^{0.77}s^{-0.385}$$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| channel slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 1062 | 0.0282 | 7 |

*Use 5 min Storm

| | start elev ft | end elev ft | L ft | s ft/ft |
|---|---|---|---|---|
| Longest Flow Path | 487 | 457 | 1062 | 0.0282 |

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.26 | | |
| i | 7.26 | in/hr | (5min/5 yr) |
| A | 419255 | ft2 | |
| | 9.6 | acres | |

| | | |
|---|---|---|
| Q | 18.2 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.26 | | |
| i | 8.00 | in/hr | (5min/10 yr) |
| A | 419255 | ft2 | |
| | 9.6 | acres | |

| | | |
|---|---|---|
| Q | 20.1 | cfs |

## Rational Method- C Value, Subbasin 1 & 2

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subbasin | Land Use | Area (sft) | C | C*Area |
| 1 | Woodlands | 124885 | 0.15 | 18732.75 |
| 1 | Lawn, sandy soil, flat | 142299 | 0.10 | 14229.9 |
| 1 | Street, Asphalt | 38505 | 0.80 | 30804 |
| 1 | Residential | 113566 | 0.40 | 45426.4 |
| 2 | Street, Asphalt | 43893 | 0.80 | 35114.4 |
| 2 | Residential | 51917 | 0.40 | 20766.8 |
| | | Total Area | | Weighted C |
| | | 515065 | | 0.32 |

| Land Use | C | Land Use | C |
|---|---|---|---|
| Business: | | Lawns: | |
| Downtown areas | 0.70-0.95 | Sandy soil, flat, 2% | 0.05-0.10 |
| Neighborhood areas | 0.50-0.70 | Sandy soil, ave., 2-7% | 0.10-0.15 |
| Residential: | | Sandy soil, steep, 7% | 0.15-0.20 |
| Single-family areas | 0.30-0.50 | Heavy soil, flat, 2% | 0.13-0.17 |
| Multi units, detached | 0.40-0.60 | Heavy soil, ave., 2-7% | 0.18-0.22 |
| Multi units, Attached | 0.60-0.75 | Heavy soil, steep, 7% | 0.25-0.35 |
| Suburban | 0.25-0.40 | | 0.30-0.60 |
| Industrial: | | Agricultural land: | 0.20-0.50 |
| Light areas | 0.50-0.80 | Bare packed soil | 0.30-0.60 |
| Heavy areas | 0.60-0.90 | Smooth | 0.20-0.50 |
| Parks, cemeteries | 0.10-0.25 | Rough | 0.20-0.40 |
| Playgrounds | 0.20-0.35 | Cultivated rows | 0.10-0.25 |
| Railroad yard areas | 0.20-0.40 | Heavy soil no crop | 0.15-0.45 |
| Unimproved areas | 0.10-0.30 | Heavy soil with crop | 0.05-0.25 |
| Streets: | | Sandy soil no crop | 0.05-0.25 |
| Asphalt | 0.70-0.95 | Sandy soil with crop | 0.10-0.25 |
| Concrete | 0.80-0.95 | Pasture | |
| Brick | 0.70-0.85 | Heavy soil | 0.15-0.45 |
| Drives and walks | 0.75-0.85 | Sandy soil | 0.05-0.25 |
| Roofs | 0.75-0.85 | Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Subbasin 1 & 2

Time of Concentration

$$t_c = kL^{0.77}s^{-0.385}$$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| channel slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 1336 | 0.0329 | 7 |

*Use 5 min Storm

| | start elev ft | end elev ft | L ft | s ft/ft |
|---|---|---|---|---|
| Longest Flow Path | 487 | 443 | 1336 | 0.0329 |

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.32 | | |
| i | 7.26 | in/hr | (5min/5 yr) |
| A | 515065 | ft2 | |
| | 11.8 | acres | |

| | | |
|---|---|---|
| Q | 27.5 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.32 | | |
| i | 8.00 | in/hr | (5min/10 yr) |
| A | 515065 | ft2 | |
| | 11.8 | acres | |

| | | |
|---|---|---|
| Q | 30.3 | cfs |

# Exhibit B:

## Pipe Sizing Calculations

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

| Pipe | Q (cfs), 10yr | n | slope (ft/ft)* | D (ft) | D (in) | Pipe size, D (in) | Exst Conds D (in) |
|---|---|---|---|---|---|---|---|
| Exst. Pipe from 2 Thunderbird Cir. | 20.1 | 0.013 | 0.051 | 1.41 | 16.96 | 18 | 18 |

*Stormwater Junction elevations from Village of Pinehurst used for slope

| | | | | | | |
|---|---|---|---|---|---|---|
| Prop. CB to Pond | 30.3 | 0.013 | 0.05 | 1.65 | 19.85 | 24 |

# Exhibit C:

## Cost Estimate

# Belair Court and Thunderbird Circle Improvements

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 10,000 | $ 10,000 |
| 2 | CONSTRUCTION SURVEYING | 1 | LS | $ 1,500 | $ 1,500 |
| 3 | EROSION CONTROL | 1 | LS | $ 3,000 | $ 3,000 |
| 4 | DEMOLITON | 1 | LS | $ 4,000 | $ 4,000 |
| 5 | 24" RCP CULVERT | 64 | LF | $ 95.13 | $ 7,000 |
| 6 | DRAINAGE STRUCTURES | 1 | EA | $ 8,000 | $ 8,000 |
| 7 | CHANNEL IMPROVEMENT | 1 | LS | $ 2,000.00 | $ 2,000 |
| 8 | RESTORE VEGETATED AREAS | 413 | SY | $ 20.00 | $ 9,000 |
| 9 | RESTORE GOLF CART PATH | 11 | SY | $ 650 | $ 8,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | **Subtotal** | **$ 53,000** |
| | *Contingencies (35%)* | | | | $ 19,000 |
| | *Price Escalation Factor (15%)* | | | | $ 8,000 |

**Estimated Construction Cost Range: $53,000 to $80,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range): $10,000 to $20,000**

**Total Estimated Project Cost Range: $63,000 to $100,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# APPENDIX 2

## Chinquapin Road and Magnolia Road
## Storm System Improvement

# TECHNICAL MEMORANDUM

**Date:** July 06, 2023

**Prepared for:** Mike Apke, PE
Public Services Director, Village of Pinehurst

**Prepared by:** Michael Hanson, PE, Director of Water Resources
McGill Associates, P.A., Firm License No. C-0459

**Subject:** Village of Pinehurst Stormwater Masterplan- Phase 2
Chinquapin and Magnolia Road Storm System Improvement

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The purpose of this memorandum is to provide recommendations for improvements needed to reduce flooding along and around Chinquapin Road and to maintain water flow through the proposed storm system up to the 10-year storm event.

Existing stormwater system data was provided by the Village and was supplemented using survey from previous McGill projects in the surrounding area. Two main components of the existing stormwater system are present surrounding Chinquapin Road. The first, south of Chinquapin Road, is a 15-inch piping system starting on the west side of Cherokee Road and extends east across Village Green Road West, where it outlets to a dry detention pond at the Village Green Parking Lot. The second, north of Chinquapin Road, is a 15-inch piping system starting at the south side of the Magnolia Road, Chinquapin Road, and Dogwood Road Intersection and extends north to McCaskill Road. See Figure 1 for the Existing Conditions Map.

In total four alternatives were evaluated for the storm system improvements.

Previous Alternatives (1A, 1B, 2)

Three alternatives were previously recommended. All three involved routing flow southwest of Chinquapin Road to a detention pond at the parking lot on Village Green West. Alternative 1A consisted of routing flow through the alley between Chinquapin Road and Cherokee Road and required an expansion of the capacity of the detention pond and its outlet. Alternative 1B consisted of the same flow routing path but included installing permeable pavers on both sides

of Chinquapin Road and required only the addition of a secondary outlet to the detention pond. Alternative 2 routed flow through the Chinquapin Road and Cherokee Road Intersection, rather than the alley. This alternative required the same pond and outlet expansion as Alternative 1A. These alternatives were deemed unfeasible by the Village due to their cost and requirements for major easement acquisition.

Alternative 3

The proposed improvement to accommodate the 10-year storm consist of installing piping and inlets through the Chinquapin Road and Magnolia Road Intersection, then along the west side of Magnolia Rd, until the proposed system ties to the existing 15-inch stormwater system at the Magnolia Road, Chinquapin Road, and Dogwood Road Intersection. The drainage area south of Chinquapin Road naturally drains southeast, through the existing stormwater system at Chinquapin and Cherokee Road, eventually draining into Watson Lake. The proposed improvements partially reroutes flow from this area towards the north, where flow naturally drains northeast to Thagards Lake in Whispering Pines. The proposed storm system improvements are included in the Chinquapin Road and Magnolia Road Intersection Improvements Project. Please see information related to the Intersection Improvements Project for details on design and calculations. See Figure 2 for a general Concept Map.

The estimated cost of the proposed improvements ranges between $403,000 and $628,000. See Exhibit A for cost estimate breakdown. This is a preliminary cost estimate, final cost estimate provided for the Chinquapin Road and Magnolia Road Intersection Improvements Project.

The existing system on Magnolia Road primarily consists of 15-inch RCPs and is undersized in its current condition. While Village of Pinehurst Ordinances require storm sewer systems to be adequately sized to pass the 10-year storm, the initial 15-inch pipe in the system does not even pass the 1-year flow. In-depth analysis and recommendations for improvements of the existing Magnolia Road system are not part of this project.

Conclusion

Due to the large easement acquisition necessary for Alternatives 1A-2, the Village of Pinehurst requested that a storm system be designed that routes flow north from Chinquapin Road to the existing system on Magnolia Road within the Right-of-Way. Alternate 3 achieves this. However,

the Magnolia Road system is undersized in its existing condition, and routing additional flow to the system without increasing the system's capacity may lead to flooding issues downstream. It is recommended that an in-depth analysis of the Magnolia Road system is completed, and the system sized to adequately pass the 10-year storm under the proposed conditions.

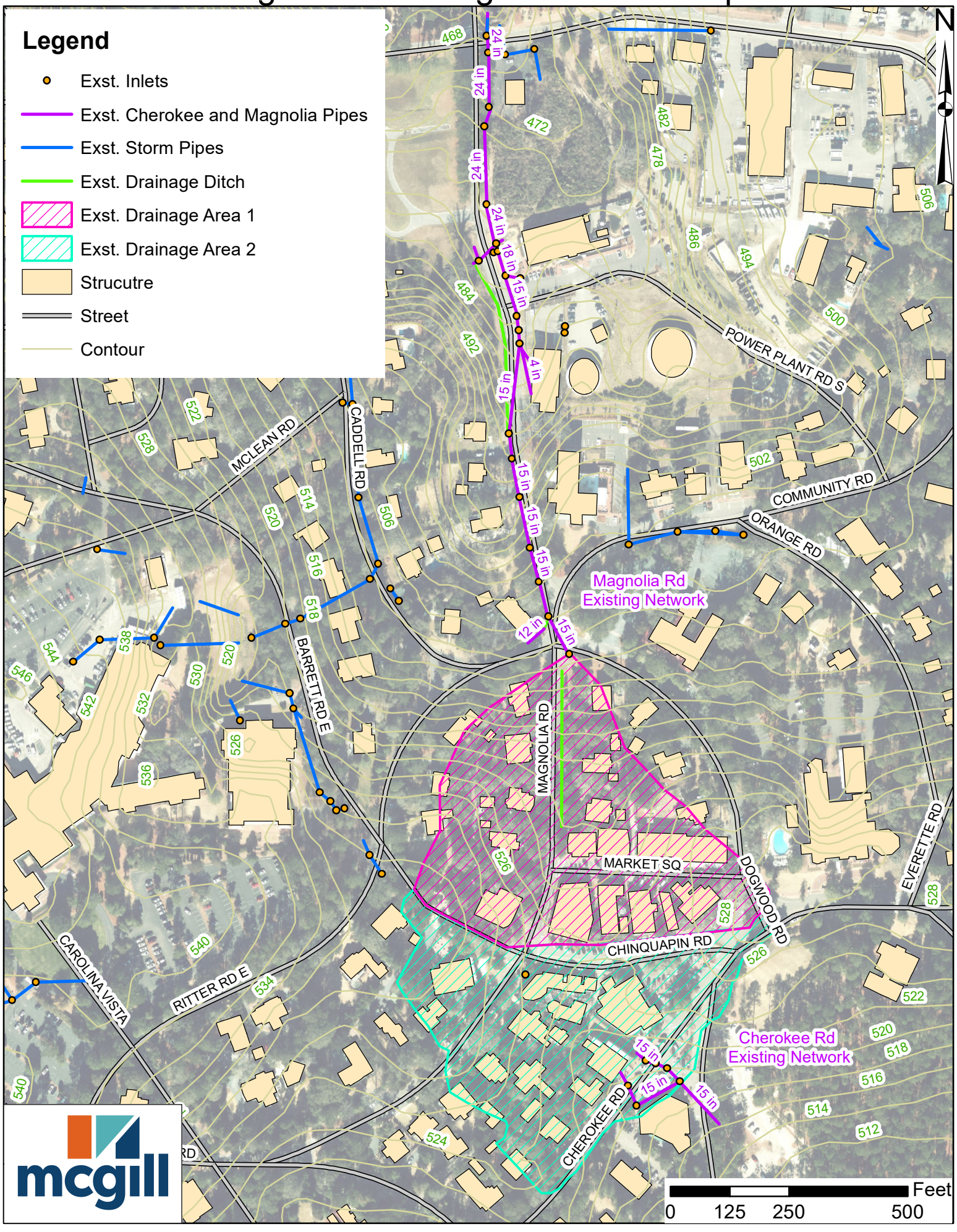
Enclosure:

Figure 1: Existing Conditions Map

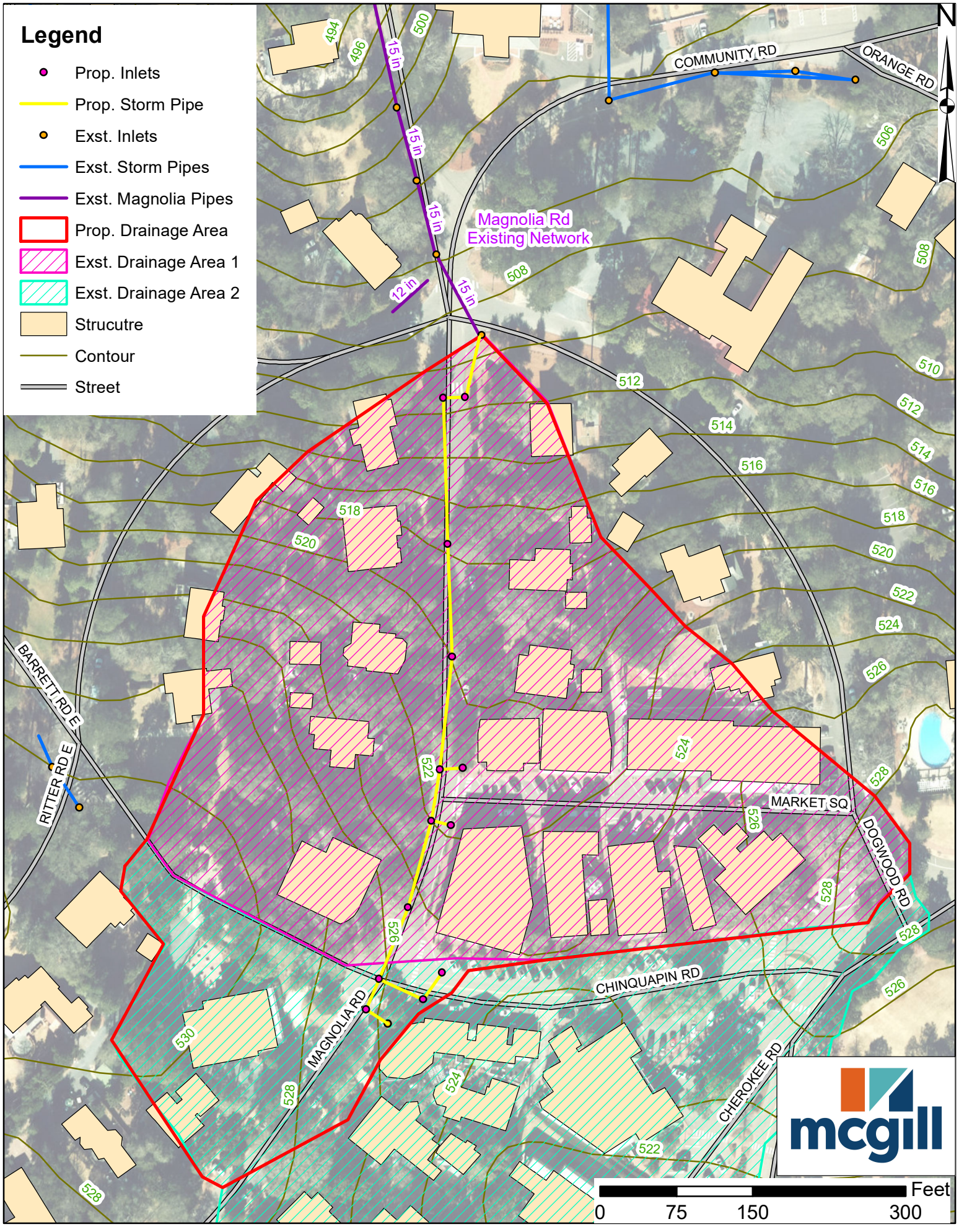
Figure 2: Concept Map

Exhibit A: Cost Estimate

# Figure 1: Existing Conditions Map



# Figure 2: Concept Map



# Exhibit A

## Cost Estimate

# Alternative 3 - Pipes and Inlets Along Magnolia Road

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 17,000 | $ 17,000 |
| 2 | MAINTENANCE OF TRAFFIC | 1 | LS | $ 16,000 | $ 16,000 |
| 3 | CONSTRUCTION SURVEYING | 1 | LS | $ 3,000 | $ 3,000 |
| 4 | EROSION CONTROL | 1 | LS | $ 10,000 | $ 10,000 |
| 5 | DEMOLITON | 1 | LS | $ 28,000 | $ 28,000 |
| 6 | 15" RCP CULVERT | 334 | LF | $ 66.92 | $ 23,000 |
| 7 | 18" RCP CULVERT | 70 | LF | $ 85.45 | $ 6,000 |
| 8 | 24" RCP CULVERT | 365 | LF | $ 95.13 | $ 35,000 |
| 9 | 30" RCP CULVERT | 83 | LF | $ 144.31 | $ 12,000 |
| 10 | DRAINAGE STRUCTURES | 13 | EA | $ 8,000 | $ 104,000 |
| 11 | RESTORE ASPHALT PAVEMENT | 1,117 | SY | $ 45 | $ 51,000 |
| 12 | RESTORE SIDEWALKS | 61 | SY | $ 40 | $ 3,000 |
| 13 | RESTORE VEGETATED AREAS | 49 | SY | $ 20 | $ 1,000 |
| 14 | REMOVE AND REPLACE DRIVEWAY | 40 | SY | $ 100 | $ 4,000 |
| 15 | UTILITIES | 1 | LS | $ 35,000 | $ 35,000 |
| | | | | | |
| | | | | **Subtotal** | **$ 348,000** |
| | *Contingencies (35%)* | | | | $ 122,000 |
| | *Price Escalation Factor (15%)* | | | | $ 53,000 |

**Estimated Construction Cost Range: $348,000 to $523,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range):**

**Total Estimated Project Cost Range: $403,000 to $628,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# APPENDIX 3

## Gun Club Drive and Garner Lane
## Storm System Improvement

# TECHNICAL MEMORANDUM

**Date:** July 14, 2023

**Prepared for:** Mike Apke, PE
Public Services Director, Village of Pinehurst

**Prepared by:** Michael Hanson, PE, Principal/Director of Water Resources
McGill Associates, P.A., Firm License No. C-0459

**Subject:** Village of Pinehurst Stormwater Masterplan- Phase 2
Gun Club Drive and Garner Lane Storm System Improvement

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The purpose of this memorandum is to provide recommendations and supporting computations for the sizing and number of culverts needed to maintain water flow through the culvert system on Gun Club Drive up to the 10-year storm event. The project includes analysis of and improvements to Gun Club Drive. McGill evaluated the level of service of the existing culverts beneath Gun Club Drive and found that the existing system is undersized to handle the 10-year storm event (Exhibit B).

The existing stormwater system data was provided by the Village and supplemented using information from previous McGill Projects in the surrounding area. The existing stormwater system, from upstream to downstream, consists primarily of a 15-inch piping network along Long Leaf Drive West and driveway culverts under the west side of Gun Club Drive. At the Remington Lane and Gun Club Drive Intersection a 36-inch piping network runs along Gun Club Drive to tie to dual 24-inch RCP culverts beneath Gun Club Drive. The culverts discharge to 410 Gun Club Drive, where stormwater flows overland via low-lying elevations across 420 Gun Club Drive to dual 24-inch RCP culverts beneath Garner Lane (Figure 1). From the culverts on Garner Lane, stormwater flows overland via low-lying elevations towards the north to the west fork of the Pinehurst Resort Pond on Lake View Drive East.

All contributing drainage areas were obtained from StreamStats and edited via knowledge of the surrounding storm drainage systems in ArcMap. The rational method (CiA) was used to

compute peak flow for the design storm. Rainfall Intensities for the 5- and 10-year events were obtained from NOAA Atlas 14 (Table 1 and Exhibit B).

| Table 1<br>Storm Event<br>Return Period | Flow<br>(cfs) | Precipitation<br>Intensity, 10 min<br>Storm (in/hr) |
|---|---|---|
| **5-year** | 52.36 | 5.82 |
| **10-year** | 57.85 | 6.40 |

Culvert hydraulics for the existing Gun Club Drive system were computed using HY-8 (Exhibit C). The existing dual 24-inch RCP culverts beneath Gun Club Drive are undersized for the 10-year storm event.

Complaints from residents in the area include the overtopping of the Gun Club Drive roadway and heavy flow across properties. During heavy rain on May 29, 2020, the Village was notified that stormwater overtopped the headwall of the Gun Club Drive dual 24-inch culverts and was flowing across Gun Club Drive. Roadway overtopping was determined to be the result of debris build-up in one of the 24-inch pipes, which reduced capacity. The Village jetted out the pipe and have not had roadway overtopping issues since. Although roadway overtopping has not been an issue, the 10-year peak flow exceeds the capacity of the existing dual 24-inch culverts at Gun Club Drive and capacity should be increased to pass the 10-year storm.

The owners of 410 and 420 Gun Club Drive have both complained to the Village about the amount of stormwater that flows onto their properties from the Gun Club Drive dual 24-inch culverts. The previous owner at 410 complained that four different homebuilders had conditionally purchased the lot and then backed out due to the drainage issues. According to Moore County GIS, the lot sold for $18,000 in September 2022. The current intentions of the owner are unknown. The owner of 420 Gun Club Drive has also complained to the Village about drainage issues since at least 2016 per the MyVOP work order system. The current owner referred to the property as a “dumping ground for city water”, and the property is currently listed for sale. The Village has consistently explained to residents at both properties that their land is located at the bottom of a large drainage basin (approx. 40 Ac) and that State law requires them

to accept and manage stormwater from upstream across their properties per The Reasonable Use Rule, which obligates owners of lower land to receive the natural flow of surface water from higher lands.

Three alternatives were evaluated for the storm system improvements. Concept Plans for each alternative can be found in Exhibit A. Peak Flow Calculations for each Alternative can be found in Exhibit B. Pipe Sizing calculations for each alternative can be found in Exhibit C. Cost estimate breakdowns for each alternative can be found in Exhibit D.

Alternative 1A

The proposed improvements to accommodate the 10-year storm event consists of installing a third 24-inch RCP culvert beneath Gun Club Drive and installing a 257 LF drainage ditch across the 410 and 420 Gun Club Drive and 20 Garner Lane properties. 410 Gun Club Drive, a vacant lot, is to be purchased by Village of Pinehurst to utilize the most direct flow path. Easements will be required for 420 Gun Club Drive and 20 Garner Lane. Additionally, a 36-inch RCP culvert is to be installed across Garner Lane in addition to the existing dual culverts. The proposed additional culvert for Garner Lane is one size larger than the proposed additional culvert for Gun Club Drive to accommodate for the larger drainage area to this downstream location. Riprap aprons are to be installed at each proposed culvert outlet. As there is no stormwater infrastructure from Garner Lane to the Pinehurst Resort Pond on Lake View Drive East, no downstream impacts are expected.

There is no survey available for the Garner Lane area and the Village GIS database does not provide reasonable invert elevations for existing stormwater infrastructure. Pipe slopes were assumed to be between 0.5% and 2% and capacities calculated for several slopes. McGill evaluated the level of service of the existing dual 24-inch RCP culverts beneath Garner Lane and found that the existing system is likely undersized to handle the existing 10-year storm event (Exhibit B). If Alternative 1A is selected, a 36-inch RCP culvert is to be installed in addition to the existing dual 24-inch RCP culverts. See Exhibit C for all Pipe Capacity and Sizing Calculations.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $112,000 and $176,000. See Exhibit D for cost estimate breakdown. The property of 420 Gun Club Drive sold in August 2023 for $425,000 (per Zillow), and has a total value of  338,7900$ (per Moore County GIS).  The existing residence would

need to be demolished to to make use of the property for the Village. While not currently for sale, the lot of 410 Gun Club Drive has a total value of only 30,000$ and is vacant, requiring less capital and work for the Village to make use of the property.

Alternative 1B

The proposed improvements to accommodate the 10-year storm event consists of installing a third 24-inch RCP culvert beneath Gun Club Drive and purchasing the 410 Gun Club Drive property to install an approx. 840 $ft^3$ detention basin and 30-inch RCP outlet pipe to connect to the existing Garner Lane culverts. An 82 LF drainage ditch is to run from the Gun Club Drive culverts to the proposed detention basin. The detention basin outlet pipe is sized so that the flow from the 10-year storm to the existing Garner Lane culverts does not exceed the culverts existing capacity. Due to reduced flow no work will be needed on the Garner Lane culverts. Riprap aprons are to be installed at all proposed pipe outlets. Easements will be required for 420 Gun Club Drive and 20 Garner Lane.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $115,000 and $180,000. See Exhibit D for cost estimate breakdown.

Alternative 2

The proposed improvements to reduce water flow through the culvert system on Gun Club Drive consist of partially rerouting flow from Gun Club Drive east toward the floodplain on Love Lane.

This area is located within the floodplain of Rattlesnake Creek and is defined as delineated by the National Flood Insurance Program on map panel 8563 of the Flood Insurance Rate Map (FIRM) for the Village of Pinehurst, North Carolina, Community number 370463, with an effective date of October 17, 2006 (Figure 2). The existing system surrounding Love Lane consists primarily of driveway culverts on the east side of Gun Club Drive. At 344 Gun Club Drive a concrete pipe discharges stormwater from the Gun Club Right-of-Way to the middle of the property. Stormwater flows overland via low-lying elevations across 344 Gun Club Drive and 5 Love Lane to a 24-inch RCP culvert beneath Love Lane. Stormwater again flows overland via low-lying elevations across 6 and 4 Love Lane to discharge to Rattlesnake Creek.

At Spring Lake Drive Rattlesnake Creek enters dual 48-inch RCP culverts (Figure 3). From Spring Lake Drive Rattlesnake Creek flows north to the east fork of the Pinehurst Resort Pond. The proposed storm system includes installing a piped stormwater network running east from the Gun Club Drive and Remington Lane Intersection to eventually outlet to Rattlesnake Creek at 6 Love Lane. An 18-inch RCP cross culvert is to be tied to the existing junction box at the Gun Club Drive and Remington Lane Intersection to run east beneath Gun Club Drive. To correct erosion issues in front of 344 Gun Club Drive a Yard Inlet and 24-inch RCP is to be installed. A 30-inch RCP is to run along the property lines of 344 and 346 Gun Club Drive and 3 and 5 Love Lane. All four lots are vacant. Easements will be required for all four lots. The existing 24-inch RCP across Love Lane is to be upsized to a 30-inch RCP. A final 30-inch RCP is to run across 6 Love Lane, a Village owned property, and outlet to Rattlesnake Creek. The Spring Lake Drive dual 48-inch RCP culverts are to be upsized to dual 54-inch RCP culverts. Riprap aprons are to be installed at all proposed pipe outlets. As there is no stormwater infrastructure from Spring Lake Drive to the Pinehurst Resort Pond, no downstream impacts are expected.

There is no survey available for the Love Lane area and the Village GIS database does not provide reasonable invert elevations for existing stormwater infrastructure. Pipe slopes were assumed to be between 0.5% and 2% and capacities calculated for several slopes. McGill evaluated the level of service of the existing dual 48-inch RCP culverts beneath Spring Lake Drive and found that the existing system is likely undersized to handle the existing 10-year storm event (Exhibit B). The Spring Lake Drive culverts are at the bottom of a very large watershed (approx. 170 Ac) (Figure 3). Routing additional flow to the already undersized existing culverts will exacerbate flooding issues in the area and is not good practice. If Alternative 2 is selected, the Spring Lake Drive culverts will need to be upsized to dual 54-inch RCP culverts.

McGill evaluated the level of service of the existing 24-inch RCP culvert beneath Love Lane and found that the existing system is likely undersized to handle the existing 10-year storm event (Exhibit B). If Alternative 2 is selected, the Love Lane culvert will need to be upsized to a 30-inch RCP culvert.

The proposed Gun Club Drive cross culvert is sized to pass 14.3 cfs, to re-route enough flow from the Gun Club Drive system as to not exceed the existing capacity of the Gun Club Drive

culverts during the 10-year storm event. Other pipes in the proposed system were sized to pass the existing 10-year storm event and the Gun Club Drive re-routed flow. See Exhibit C for all Pipe Capacity and Sizing Calculations. Due to reduced flow, no work will be needed on the Gun Club Drive or Garner Lane culverts.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $274,000 and $427,000. See Exhibit D for cost estimate breakdown.

Conclusion

Alternative 2 is the least cost-effective option. As the proposed work includes work in a floodplain, a Floodplain Development Permit may be required. Due to the extensive work proposed in Alternative 2 and its high cost, this alternative is not recommended.

Alternative 1A and 1B both include purchasing the lot 410 Gun Club Drive. Current intentions of the property owner are unknown, and the Village will need to discuss purchasing the property with the current owner. Alternative 1A is more cost effective than Alternative 1B, for this reason Alternative 1A is recommended.

Enclosures:

Figure 1: Existing Conditions Map, Gun Club Drive

Figure 2: FIRM Panel

Figure 3: Existing Conditions Map, Love Lane

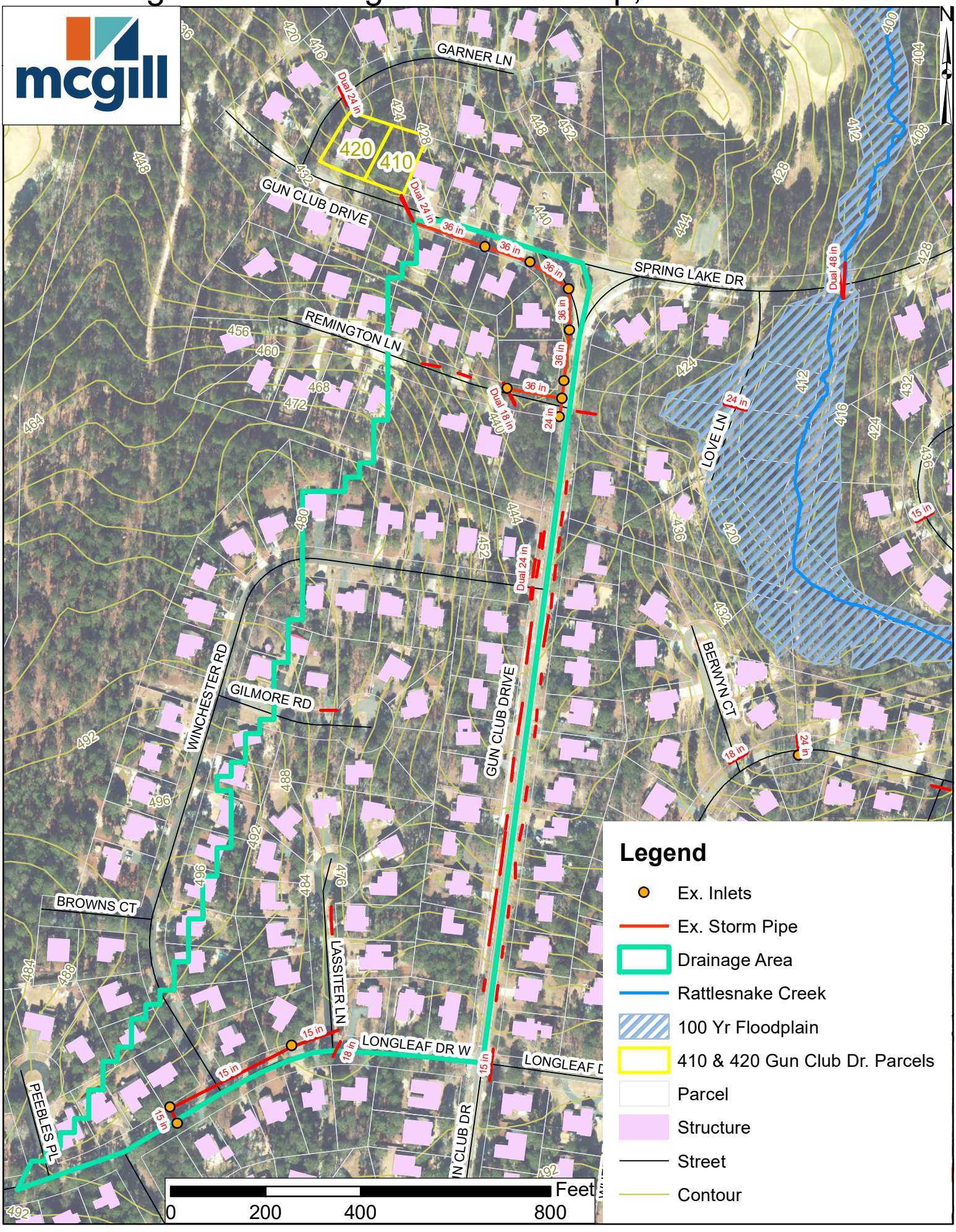
Exhibit A: Concept Maps (1A, 1B, 2)

Exhibit B: NOAA Atlas 14 and Rational Method Calculations

Exhibit C: HY-8 Model and Crossing Analysis
Pipe Capacity Calculations
Detention Basin Calculations

Exhibit D: Cost Estimate

# Figure 1: Existing Conditions Map, Gun Club Drive




This digital Flood Insurance Rate Map (FIRM) was produced through a unique cooperative partnership between the State of North Carolina and the Federal Emergency Management Agency (FEMA). The State of North Carolina has implemented a long term approach to floodplain management to decrease the costs associated with flooding. This is demonstrated by the State's commitment to map flood hazard areas at the local level. As a part of this effort, the State of North Carolina has joined in a Cooperating Technical State agreement with FEMA to produce and maintain this digital FIRM.

## FLOOD HAZARD INFORMATION

**SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP**

**THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT HTTP://FRIS.NC.GOV/FRIS**

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% Annual Chance Flood with Average Depth Less Than One Foot or With Drainage Areas of Less Than One Square Mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes *Zone X*

**OTHER AREAS**
- Areas Determined to be Outside the 0.2% Annual Chance Floodplain *Zone X*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall

**OTHER FEATURES**
- BM5510 North Carolina Geodetic Survey bench mark
- BM5510 National Geodetic Survey bench mark
- BM5510 Contractor Est. NCFMP Survey bench mark
- 012 18.2 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- Limit of Study
- Jurisdiction Boundary

## NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. An accompanying Flood Insurance Study report, Letter of Map Revision (LOMR) or Letter of Map Amendment (LOMA) revising portions of this panel, and digital versions of this FIRM may be available. Visit the North Carolina Floodplain Mapping Program website at http://www.ncfloodmaps.com, or contact the FEMA Map Service Center.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided in digital format by the North Carolina Floodplain Mapping Program (NCFMP). The source of this information can be determined from the metadata available in the digital FLOOD database and in the Technical Support Data Notebook (TSDN).

ACCREDITED LEVEE NOTES TO USERS: If an accredited levee note appears on this panel check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

PROVISIONALLY ACCREDITED LEVEE NOTES TO USERS: If a Provisionally Accredited Levee (PAL) note appears on this panel, check with your local community to obtain more information, such as the estimated level of protection provided (which may exceed the 1-percent-annual-chance level) and Emergency Action Plan, on the levee system(s) shown as providing protection. To maintain accreditation, the levee owner or community is required to submit the data and documentation necessary to comply with Section 65.10 of the NFIP regulations. If the community or owner does not provide the necessary data and documentation or if the data and documentation provided indicates the levee system does not comply with Section 65.10 requirements, FEMA will revise the flood hazard and risk information for this area to reflect de-accreditation of the levee system. To mitigate flood risk in residual risk areas, property owners and residents are encouraged to consider flood insurance and floodproofing or other protective measures. For more information on flood insurance, interested parties should visit the FEMA Website at http://www.fema.gov/business/nfip/index.shtm.

LIMIT OF MODERATE WAVE ACTION NOTES TO USERS: For some coastal flooding zones the AE Zone category has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

Limit of Moderate Wave Action (LiMWA)

### COASTAL BARRIER RESOURCES SYSTEM (CBRS) NOTE

This map may include approximate boundaries of the CBRS for informational purposes only. Flood insurance is not available within CBRS areas for structures that are newly built or substantially improved on or after the date(s) indicated on the map. For more information see http://www.fws.gov/habitatconservation/coastal_barrier.html, the FIS Report, or call the U.S. Fish and Wildlife Service Customer Service Center at 1-800-344-WILD.

CBRS Area

Otherwise Protected Area

## SCALE

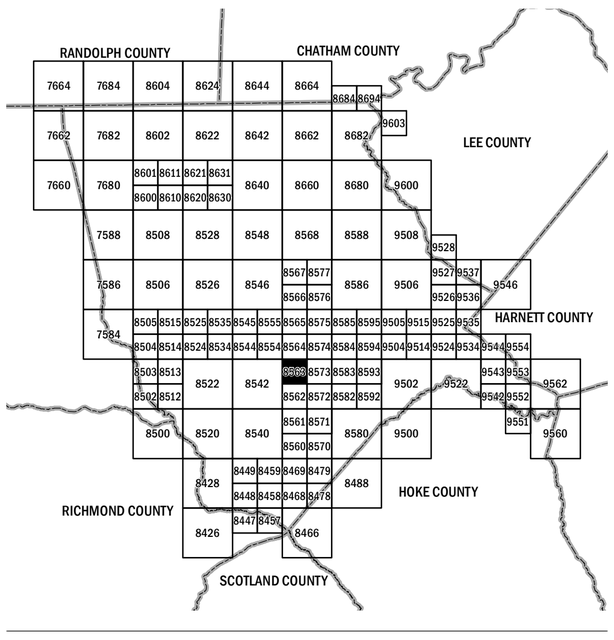
Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

## PANEL LOCATOR







NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

# NORTH CAROLINA

PANEL 8563

FEMA

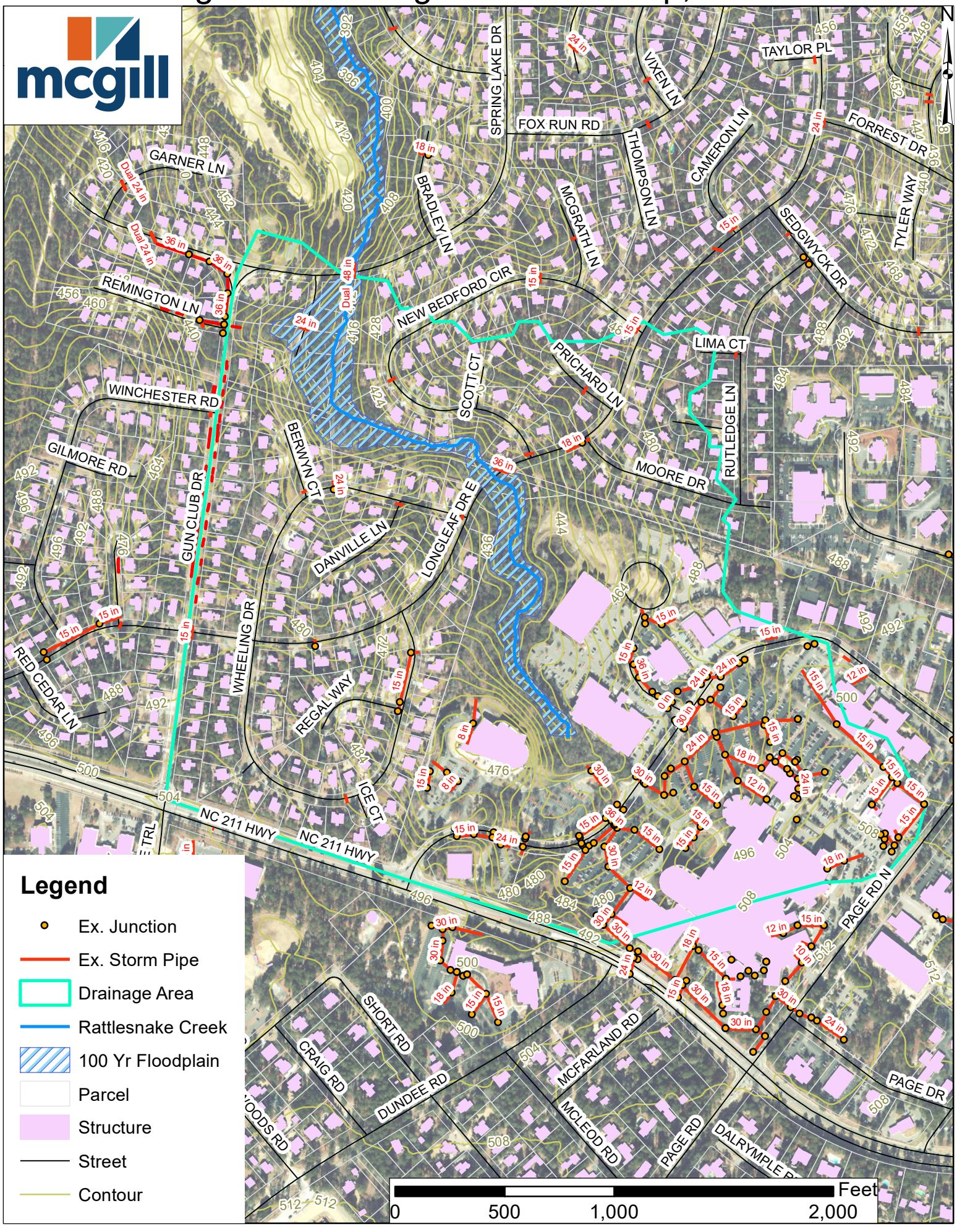
Panel Contains:

| COMMUNITY | CID | PANEL | SUFFIX |
|---|---|---|---|
| MOORE COUNTY | 370164 | 8563 | J |
| PINEHURST, VILLAGE OF | 370463 | 8563 | J |
| SOUTHERN PINES, TOWN OF | 370338 | 8563 | J |

MAP NUMBER
3710856300J

MAP REVISED
10/17/06

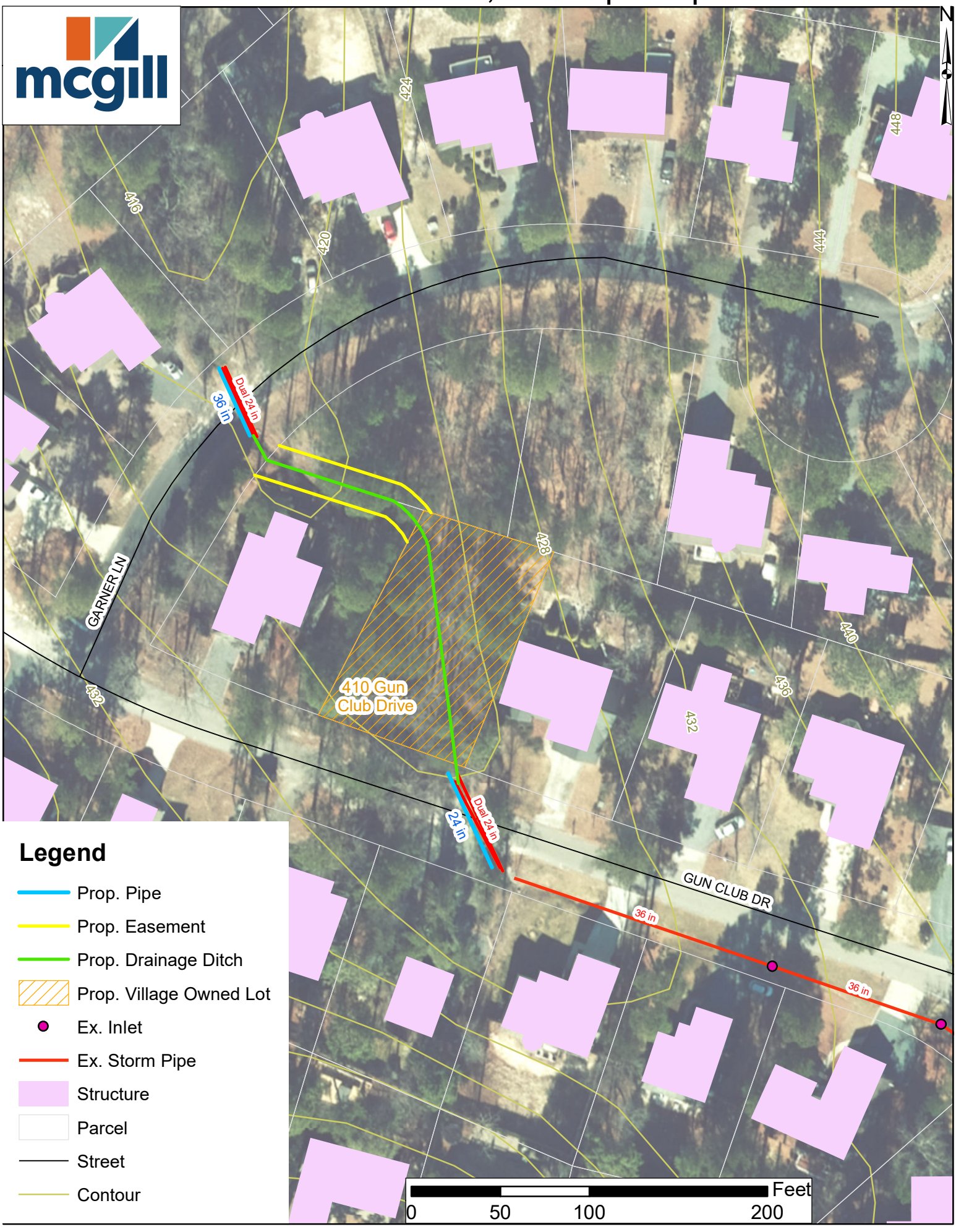
# Figure 3: Existing Conditions Map, Love Lane



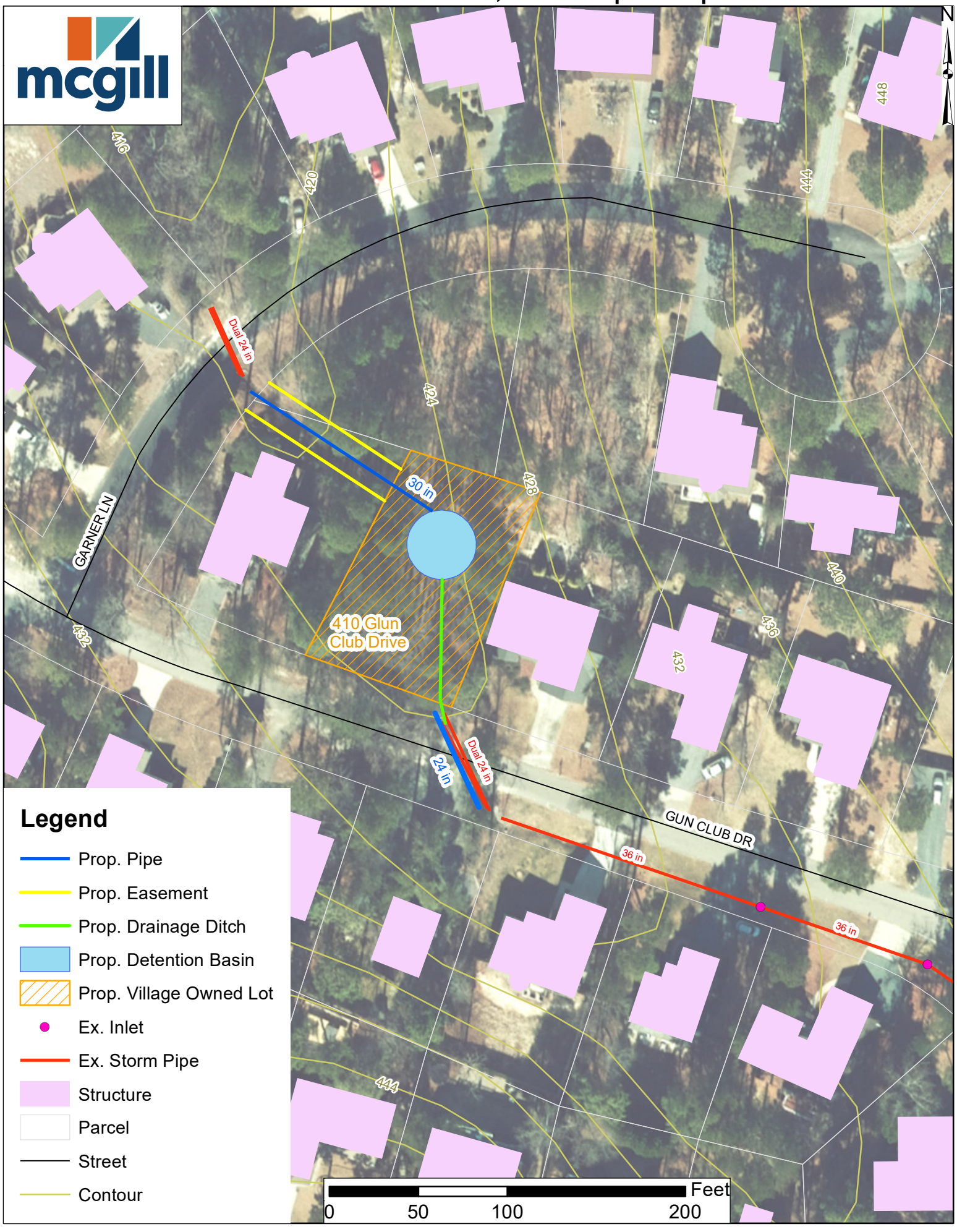
# Exhibit A

## Concept Maps

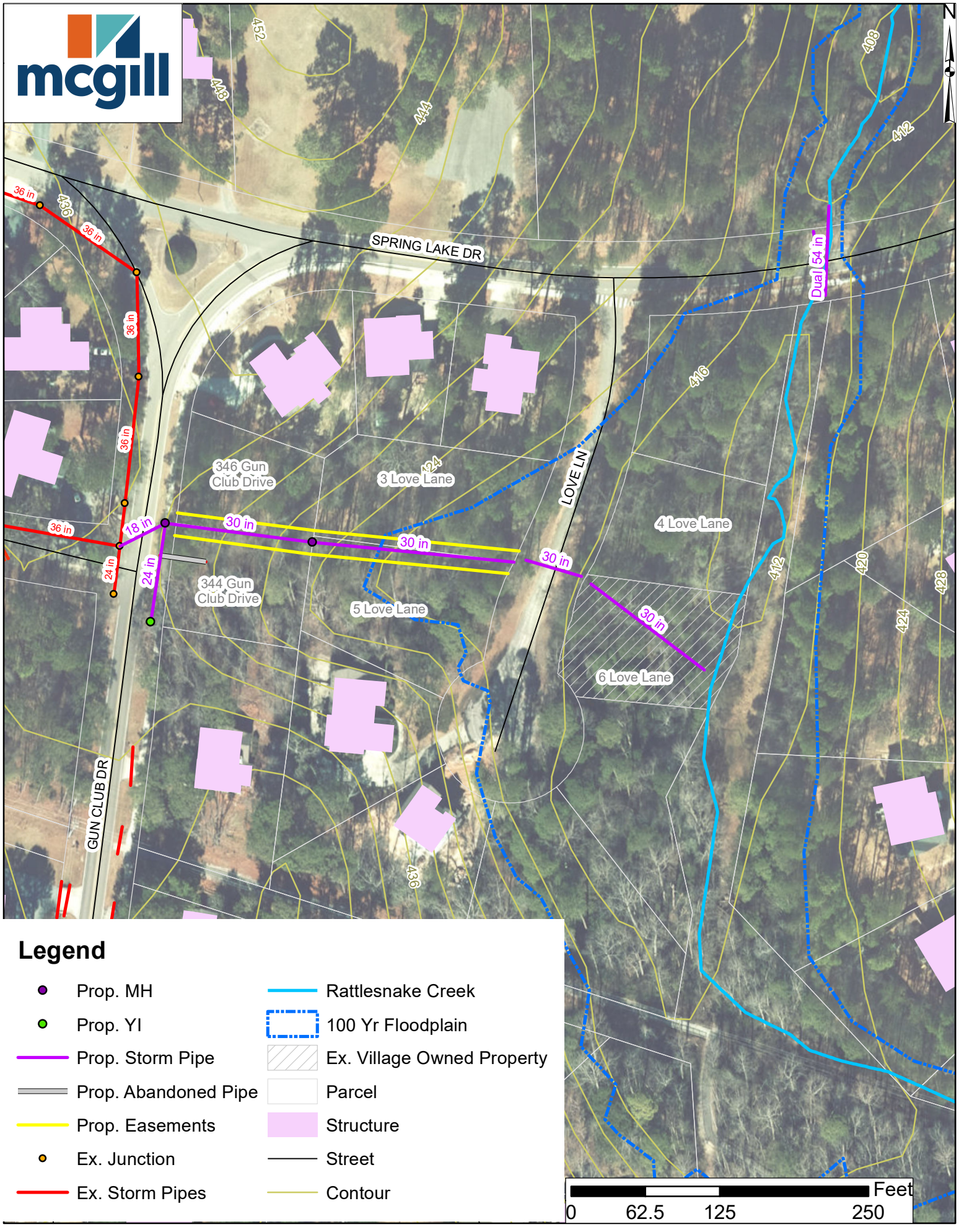
# Alternative 1A, Concept Map



# Alternative 1B, Concept Map



# Alternative 2, Concept Map



# Exhibit B

## NOAA Atlas 14 & Rational Method Calculations

**NOAA Atlas 14, Volume 2, Version 3**
**Location name: Pinehurst, North Carolina, USA***
**Latitude: 35.2137°, Longitude: -79.4655°**
**Elevation: 423.69 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **5.29** (4.82-5.86) | **6.26** (5.69-6.92) | **7.27** (6.60-8.04) | **8.00** (7.25-8.83) | **8.83** (7.96-9.73) | **9.41** (8.46-10.4) | **9.95** (8.89-11.0) | **10.4** (9.28-11.5) | **11.0** (9.67-12.1) | **11.4** (9.96-12.6) |
| 10-min | **4.23** (3.85-4.67) | **5.00** (4.55-5.54) | **5.82** (5.29-6.44) | **6.40** (5.80-7.06) | **7.04** (6.34-7.76) | **7.49** (6.74-8.26) | **7.90** (7.07-8.71) | **8.26** (7.35-9.11) | **8.68** (7.65-9.57) | **8.97** (7.84-9.89) |
| 15-min | **3.52** (3.21-3.90) | **4.20** (3.82-4.64) | **4.91** (4.46-5.43) | **5.39** (4.89-5.95) | **5.95** (5.36-6.56) | **6.33** (5.69-6.97) | **6.66** (5.96-7.34) | **6.95** (6.18-7.66) | **7.28** (6.42-8.03) | **7.50** (6.56-8.28) |
| 30-min | **2.42** (2.20-2.67) | **2.90** (2.63-3.21) | **3.49** (3.17-3.86) | **3.91** (3.54-4.31) | **4.41** (3.97-4.86) | **4.76** (4.28-5.25) | **5.10** (4.56-5.62) | **5.41** (4.81-5.96) | **5.80** (5.11-6.39) | **6.08** (5.31-6.70) |
| 60-min | **1.51** (1.37-1.67) | **1.82** (1.65-2.01) | **2.24** (2.03-2.47) | **2.54** (2.31-2.81) | **2.93** (2.64-3.23) | **3.23** (2.90-3.56) | **3.51** (3.14-3.87) | **3.79** (3.38-4.18) | **4.16** (3.66-4.58) | **4.44** (3.88-4.89) |
| 2-hr | **0.885** (0.800-0.986) | **1.07** (0.970-1.20) | **1.34** (1.21-1.49) | **1.53** (1.38-1.71) | **1.79** (1.60-1.99) | **1.99** (1.77-2.21) | **2.18** (1.93-2.42) | **2.37** (2.09-2.64) | **2.63** (2.29-2.92) | **2.83** (2.44-3.14) |
| 3-hr | **0.624** (0.566-0.695) | **0.756** (0.687-0.842) | **0.946** (0.858-1.05) | **1.09** (0.989-1.22) | **1.29** (1.16-1.43) | **1.45** (1.29-1.61) | **1.61** (1.42-1.78) | **1.77** (1.55-1.96) | **1.99** (1.73-2.21) | **2.17** (1.86-2.40) |
| 6-hr | **0.374** (0.340-0.413) | **0.452** (0.412-0.500) | **0.566** (0.515-0.625) | **0.656** (0.594-0.723) | **0.778** (0.699-0.855) | **0.875** (0.781-0.961) | **0.975** (0.863-1.07) | **1.08** (0.945-1.18) | **1.22** (1.06-1.34) | **1.33** (1.14-1.46) |
| 12-hr | **0.219** (0.200-0.243) | **0.266** (0.242-0.294) | **0.334** (0.304-0.370) | **0.390** (0.352-0.430) | **0.465** (0.418-0.512) | **0.527** (0.470-0.578) | **0.591** (0.522-0.647) | **0.659** (0.575-0.721) | **0.753** (0.648-0.824) | **0.830** (0.703-0.908) |
| 24-hr | **0.129** (0.119-0.140) | **0.156** (0.144-0.169) | **0.196** (0.181-0.212) | **0.227** (0.209-0.247) | **0.270** (0.248-0.293) | **0.304** (0.279-0.330) | **0.340** (0.310-0.368) | **0.376** (0.343-0.407) | **0.425** (0.386-0.461) | **0.465** (0.421-0.503) |
| 2-day | **0.075** (0.070-0.081) | **0.090** (0.084-0.098) | **0.113** (0.105-0.122) | **0.131** (0.121-0.141) | **0.155** (0.143-0.167) | **0.174** (0.160-0.188) | **0.194** (0.178-0.209) | **0.214** (0.195-0.231) | **0.241** (0.220-0.261) | **0.263** (0.239-0.285) |
| 3-day | **0.053** (0.049-0.057) | **0.064** (0.060-0.069) | **0.079** (0.074-0.085) | **0.092** (0.085-0.098) | **0.108** (0.100-0.116) | **0.121** (0.112-0.130) | **0.135** (0.124-0.145) | **0.149** (0.137-0.160) | **0.168** (0.154-0.181) | **0.183** (0.167-0.198) |
| 4-day | **0.042** (0.039-0.045) | **0.051** (0.047-0.054) | **0.063** (0.058-0.067) | **0.072** (0.067-0.077) | **0.085** (0.079-0.091) | **0.095** (0.088-0.102) | **0.106** (0.098-0.113) | **0.117** (0.107-0.125) | **0.131** (0.120-0.141) | **0.143** (0.131-0.154) |
| 7-day | **0.028** (0.026-0.030) | **0.033** (0.031-0.035) | **0.040** (0.038-0.043) | **0.046** (0.043-0.049) | **0.054** (0.050-0.058) | **0.061** (0.056-0.065) | **0.067** (0.062-0.072) | **0.074** (0.068-0.079) | **0.083** (0.076-0.089) | **0.090** (0.082-0.097) |
| 10-day | **0.022** (0.021-0.024) | **0.026** (0.025-0.028) | **0.032** (0.030-0.034) | **0.036** (0.034-0.038) | **0.042** (0.039-0.044) | **0.046** (0.043-0.049) | **0.051** (0.047-0.054) | **0.055** (0.051-0.059) | **0.062** (0.057-0.066) | **0.066** (0.061-0.071) |
| 20-day | **0.015** (0.014-0.016) | **0.018** (0.017-0.019) | **0.021** (0.020-0.022) | **0.023** (0.022-0.025) | **0.027** (0.025-0.028) | **0.030** (0.028-0.031) | **0.032** (0.030-0.034) | **0.035** (0.033-0.037) | **0.039** (0.036-0.041) | **0.042** (0.038-0.044) |
| 30-day | **0.012** (0.012-0.013) | **0.015** (0.014-0.015) | **0.017** (0.016-0.018) | **0.019** (0.018-0.020) | **0.021** (0.020-0.022) | **0.023** (0.022-0.024) | **0.025** (0.023-0.026) | **0.027** (0.025-0.028) | **0.029** (0.027-0.031) | **0.031** (0.029-0.033) |
| 45-day | **0.010** (0.010-0.011) | **0.012** (0.012-0.013) | **0.014** (0.013-0.015) | **0.015** (0.015-0.016) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.020** (0.019-0.021) | **0.021** (0.020-0.022) | **0.023** (0.021-0.024) | **0.024** (0.022-0.025) |
| 60-day | **0.009** (0.009-0.010) | **0.011** (0.010-0.012) | **0.012** (0.012-0.013) | **0.014** (0.013-0.014) | **0.015** (0.014-0.016) | **0.016** (0.015-0.017) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.019** (0.018-0.021) | **0.020** (0.019-0.022) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

## PF graphical

## Rational Method- C Value, Existing Conditions, Gun Club Drive

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | C | Weighted C |
| | Single Family | 979816 | 0.4 | 0.40 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | |
| Heavy soil with crop | 0.15-0.45 |
| | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Existing Conditions, Gun Club Drive

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 2701 | 0.060 | 10 |

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 5.82 | in/hr | (10min/5 yr) |
| A | 979816 | ft2 | |
| | 22.5 | acres | |

| | | |
|---|---|---|
| Q | 52.36 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 6.4 | in/hr | (10min/10 yr) |
| A | 979816 | ft2 | |
| | 22.5 | acres | |

| | | |
|---|---|---|
| Q | 57.58 | cfs |

## Rational Method- C Value, Existing Conditions, Garner Lane

| Weighted Runoff Coefficient | | | | | |
|---|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | % of Area | C | C*A |
| 1 | Single Family | 1628900 | 87% | 0.4 | 651560.00 |
| 2 | Forest | 247346 | 13% | 0.1 | 24734.60 |
| TOTAL | Mixed | 1876246 | 100% | 0.36 | |

| Land Use | C | Land Use | C |
|---|---|---|---|
| Business: | | Lawns: | |
| Downtown areas | 0.70-0.95 | Sandy soil, flat, 2% | 0.05-0.10 |
| Neighborhood areas | 0.50-0.70 | Sandy soil, ave., 2-7% | 0.10-0.15 |
| Residential: | | Sandy soil, steep, 7% | 0.15-0.20 |
| Single-family areas | 0.30-0.50 | Heavy soil, flat, 2% | 0.13-0.17 |
| Multi units, detached | 0.40-0.60 | Heavy soil, ave., 2-7% | 0.18-0.22 |
| Multi units, Attached | 0.60-0.75 | Heavy soil, steep, 7% | 0.25-0.35 |
| Suburban | 0.25-0.40 | | 0.30-0.60 |
| Industrial: | | Agricultural land: | 0.20-0.50 |
| Light areas | 0.50-0.80 | Bare packed soil | 0.30-0.60 |
| Heavy areas | 0.60-0.90 | Smooth | 0.20-0.50 |
| Parks, cemeteries | 0.10-0.25 | Rough | 0.20-0.40 |
| Playgrounds | 0.20-0.35 | Cultivated rows | 0.10-0.25 |
| Railroad yard areas | 0.20-0.40 | Heavy soil no crop | 0.15-0.45 |
| Unimproved areas | 0.10-0.30 | Heavy soil with crop | 0.05-0.25 |
| Streets: | | Sandy soil no crop | 0.05-0.25 |
| Asphalt | 0.70-0.95 | Sandy soil with crop | 0.10-0.25 |
| Concrete | 0.80-0.95 | Pasture | |
| Brick | 0.70-0.85 | Heavy soil | 0.15-0.45 |
| Drives and walks | 0.75-0.85 | Sandy soil | 0.05-0.25 |
| Roofs | 0.75-0.85 | Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Existing Conditions, Garner Lane

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 3102 | 0.024 | 16 |

*Use 15 min Storm

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.36 | | |
| i | 4.91 | in/hr | (15min/5 yr) |
| A | 1876246 | ft2 | |
| | 43.1 | acres | |

Q = 76.23 cfs

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.36 | | |
| i | 5.39 | in/hr | (15min/10 yr) |
| A | 1876246 | ft2 | |
| | 43.1 | acres | |

Q = 83.68 cfs

## Rational Method- C Value, Alternative 2, Proposed Pipe 2 (DA1)

| Weighted Runoff Coefficient | | | | | |
|---|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | % of Area | C | C*A |
| | Single Family | 438132 | 100% | 0.4 | 175252.80 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | |
| Heavy soil with crop | 0.15-0.45 |
| | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Alt 2, Proposed Pipe 2 (DA1)

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 2532.02 | 0.033570035 | 12 |

*Use 10 min Storm

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | |
|---|---|---|
| C | 0.40 | |
| i | 5.82 | in/hr |
| A | 438132 | ft2 |
| | 10.05812672 | acres |

(10min/5 yr)

Q = 23.42 cfs

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | |
|---|---|---|
| C | 0.40 | |
| i | 6.4 | in/hr |
| A | 438132 | ft2 |
| | 10.058127 | acres |

(10min/10 yr)

Q = 25.75 cfs

## Rational Method- C Value, Existing Conditions, Love Lane (DA2)

| Weighted Runoff Coefficient | | | | | |
|---|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | % of Area | C | C*A |
| | Single Family | 578482 | 100% | 0.4 | 231392.80 |

| Land Use | C | Land Use | C |
|---|---|---|---|
| Business: | | Lawns: | |
| Downtown areas | 0.70-0.95 | Sandy soil, flat, 2% | 0.05-0.10 |
| Neighborhood areas | 0.50-0.70 | Sandy soil, ave., 2-7% | 0.10-0.15 |
| Residential: | | Sandy soil, steep, 7% | 0.15-0.20 |
| Single-family areas | 0.30-0.50 | Heavy soil, flat, 2% | 0.13-0.17 |
| Multi units, detached | 0.40-0.60 | Heavy soil, ave., 2-7% | 0.18-0.22 |
| Multi units, Attached | 0.60-0.75 | Heavy soil, steep, 7% | 0.25-0.35 |
| Suburban | 0.25-0.40 | | 0.30-0.60 |
| Industrial: | | | 0.20-0.50 |
| Light areas | 0.50-0.80 | Agricultural land: | |
| Heavy areas | 0.60-0.90 | Bare packed soil | 0.30-0.60 |
| Parks, cemeteries | 0.10-0.25 | Smooth | 0.20-0.50 |
| Playgrounds | 0.20-0.35 | Rough | 0.20-0.40 |
| Railroad yard areas | 0.20-0.40 | Cultivated rows | 0.10-0.25 |
| Unimproved areas | 0.10-0.30 | Heavy soil no crop | |
| Streets: | | Heavy soil with crop | 0.15-0.45 |
| Asphalt | 0.70-0.95 | Sandy soil no crop | 0.05-0.25 |
| Concrete | 0.80-0.95 | Sandy soil with crop | 0.05-0.25 |
| Brick | 0.70-0.85 | Pasture | 0.10-0.25 |
| Drives and walks | 0.75-0.85 | Heavy soil | 0.15-0.45 |
| Roofs | 0.75-0.85 | Sandy soil | 0.05-0.25 |
| | | Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Existing Conditions, Love Lane (DA2)

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 2483.32 | 0.033020312 | 12 |

*use 10 min Storm

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 5.82 | in/hr | (10min/5 yr) |
| A | 578482 | ft2 | |
| | 13.28011938 | acres | |

| | | |
|---|---|---|
| Q | 30.92 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 6.4 | in/hr | (10min/10 yr) |
| A | 578482 | ft2 | |
| | 13.28011938 | acres | |

| | | |
|---|---|---|
| Q | 34.00 | cfs |

## Rational Method- C Value, Alternative 2, Proposed Pipe 6 (DA3)

| Weighted Runoff Coefficient | | | | | |
|---|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | % of Area | C | C*A |
| | Single Family | 606242 | 100% | 0.4 | 242496.80 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | |
| Heavy soil with crop | 0.15-0.45 |
| | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Alternative 2, Proposed Pipe 6 (DA3)

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 2532.02 | 0.033570035 | 12 |

* use 10 min Storm

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 5.82 | in/hr | (10min/5 yr) |
| A | 606242 | ft2 | |
| | 13.91740129 | acres | |

| | | |
|---|---|---|
| Q | 32.40 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 6.4 | in/hr | (10min/10 yr) |
| A | 606242 | ft2 | |
| | 13.917401 | acres | |

| | | |
|---|---|---|
| Q | 35.63 | cfs |

## Rational Method- C Value, Existing Conditions, Spring Lake Drive (DA4)

| Weighted Runoff Coefficient | | | | | |
|---|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | % of Area | C | C*A |
| 1 | Single Family | 4393740 | 60% | 0.4 | 1757496.00 |
| 2 | Light Industry | 2937710 | 40% | 0.65 | 1909511.50 |
| TOTAL | Mixed Use | 7331450 | 100% | 0.50 | |

| Land Use | C | Land Use | C |
|---|---|---|---|
| Business: | | Lawns: | |
| Downtown areas | 0.70-0.95 | Sandy soil, flat, 2% | 0.05-0.10 |
| Neighborhood areas | 0.50-0.70 | Sandy soil, ave., 2-7% | 0.10-0.15 |
| Residential: | | Sandy soil, steep, 7% | 0.15-0.20 |
| Single-family areas | 0.30-0.50 | Heavy soil, flat, 2% | 0.13-0.17 |
| Multi units, detached | 0.40-0.60 | Heavy soil, ave., 2-7% | 0.18-0.22 |
| Multi units, Attached | 0.60-0.75 | Heavy soil, steep, 7% | 0.25-0.35 |
| Suburban | 0.25-0.40 | | 0.30-0.60 |
| Industrial: | | Agricultural land: | 0.20-0.50 |
| Light areas | 0.50-0.80 | Bare packed soil | |
| Heavy areas | 0.60-0.90 | Smooth | 0.30-0.60 |
| Parks, cemeteries | 0.10-0.25 | Rough | 0.20-0.50 |
| Playgrounds | 0.20-0.35 | Cultivated rows | 0.20-0.40 |
| Railroad yard areas | 0.20-0.40 | Heavy soil no crop | 0.10-0.25 |
| Unimproved areas | 0.10-0.30 | Heavy soil with crop | 0.15-0.45 |
| Streets: | | Sandy soil no crop | 0.05-0.25 |
| Asphalt | 0.70-0.95 | Sandy soil with crop | 0.05-0.25 |
| Concrete | 0.80-0.95 | | 0.10-0.25 |
| Brick | 0.70-0.85 | Pasture | |
| Drives and walks | 0.75-0.85 | Heavy soil | 0.15-0.45 |
| Roofs | 0.75-0.85 | Sandy soil | 0.05-0.25 |
| | | Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Existing Conditions, Spring Lake Drive (DA4)

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 4850.78 | 0.021233698 | 24 |

*Use 15 min Storm

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.50 | | (15min/5 yr) |
| i | 4.91 | in/hr | |
| A | 7331450 | ft2 | |
| | 168.306933 | acres | |

| | | |
|---|---|---|
| Q | 413.34 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.50 | | |
| i | 5.39 | in/hr | (15min/10 yr) |
| A | 7331450 | ft2 | |
| | 168.306933 | acres | |

| | | |
|---|---|---|
| Q | 453.75 | cfs |

# Exhibit C

## HY-8 Model & Crossing Analysis
## and
## Pipe Sizing Calculations

# HY-8 Culvert Analysis Report

## Site Data - Culvert Existing

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 422.50 ft

Outlet Station: 60.00 ft

Outlet Elevation: 422.00 ft

Number of Barrels: 2

## Culvert Data Summary - Culvert Existing

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

## Table 1 - Culvert Summary Table: Culvert Existing

| Discharge Names | Total Discharge (cfs) | Culvert Discharge (cfs) | Headwater Elevation (ft) | Inlet Control Depth (ft) | Outlet Control Depth (ft) | Flow Type | Normal Depth (ft) | Critical Depth (ft) | Outlet Depth (ft) | Tailwater Depth (ft) | Outlet Velocity (ft/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 year | 52.36 | 42.76 | 425.66 | 3.160 | 2.860 | 5-S2n | 1.522 | 1.653 | 1.568 | 1.256 | 7.886 |
| 10 year | 57.58 | 43.34 | 425.71 | 3.209 | 2.906 | 5-S2n | 1.542 | 1.663 | 1.587 | 1.321 | 7.896 |

**********

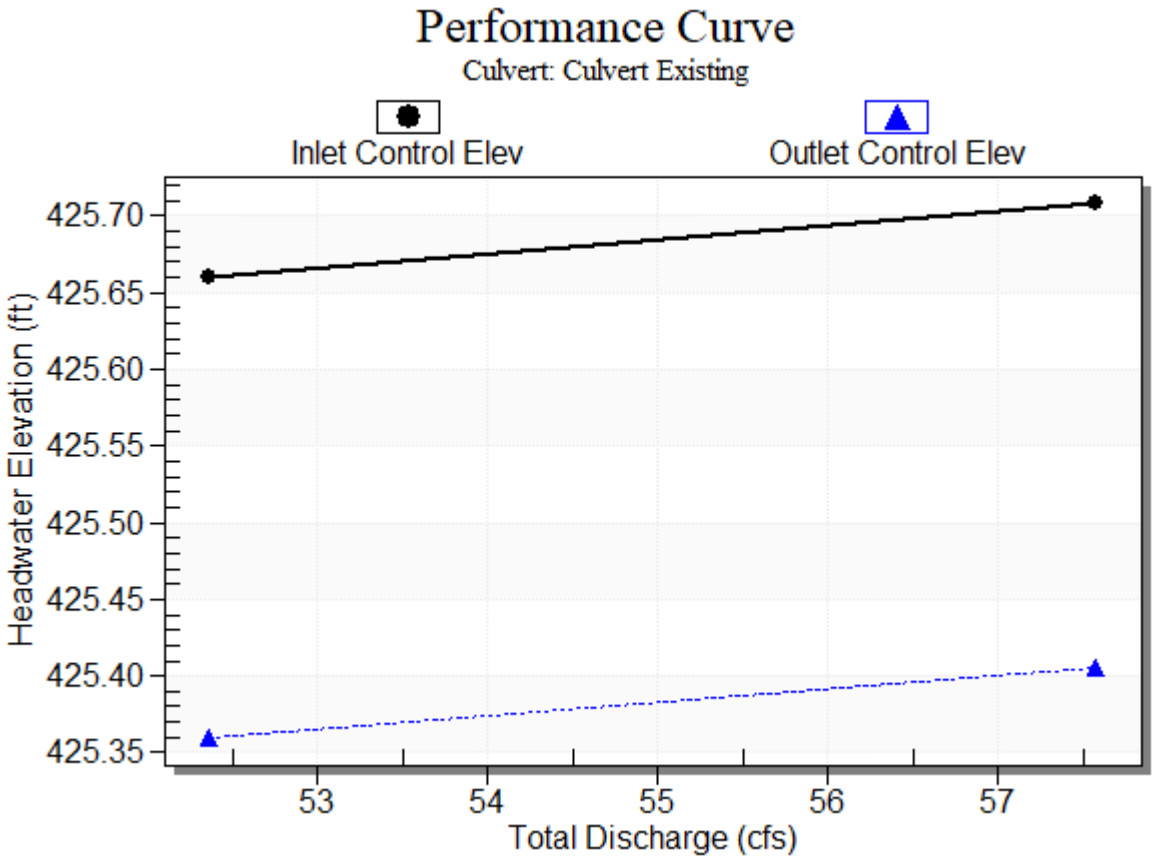
Straight Culvert

Inlet Elevation (invert): 422.50 ft,  Outlet Elevation (invert): 422.00 ft

Culvert Length: 60.00 ft,  Culvert Slope: 0.0083

**********

**Culvert Performance Curve Plot: Culvert Existing**



**Water Surface Profile Plot for Culvert: Culvert Existing**

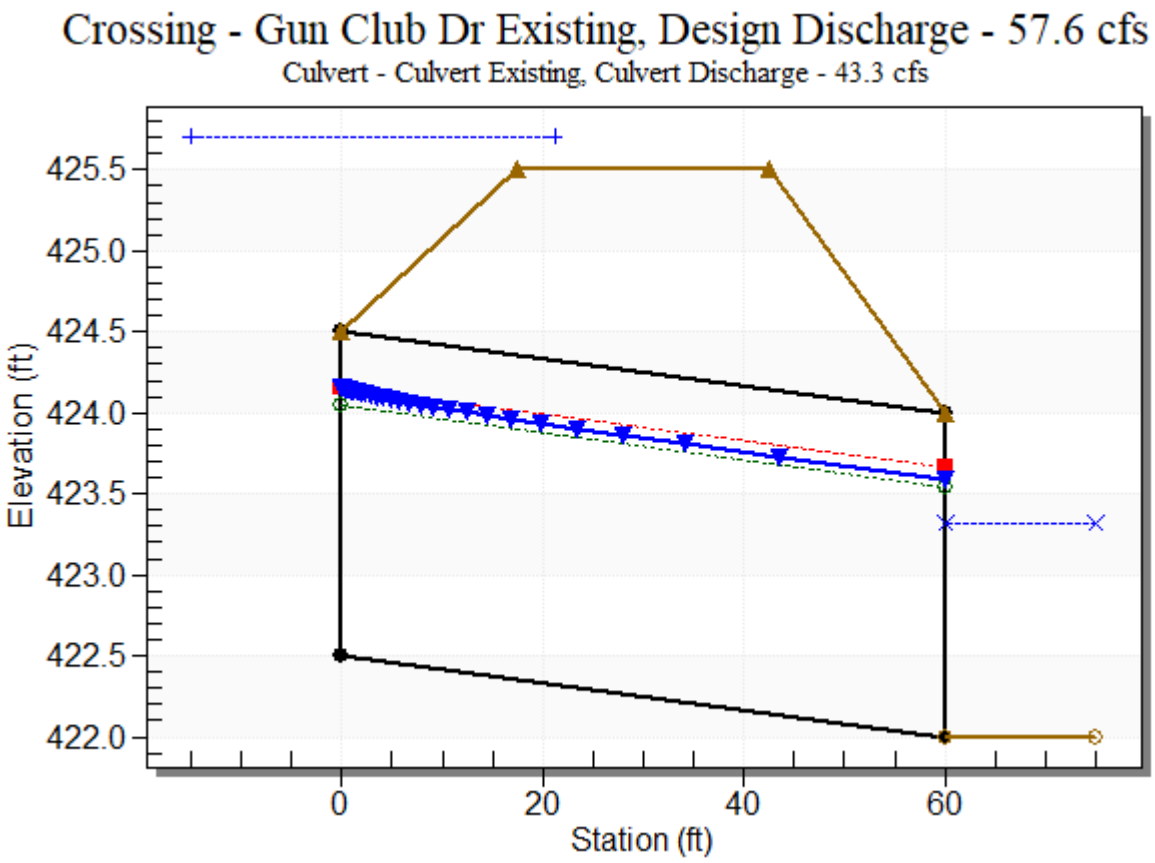


**Table 2 - Downstream Channel Rating Curve (Crossing: Gun Club Dr Existing)**

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) | Velocity (ft/s) | Shear (psf) | Froude Number |
|---|---|---|---|---|---|
| 52.36 | 423.26 | 1.26 | 5.55 | 1.57 | 1.01 |
| 57.58 | 423.32 | 1.32 | 5.70 | 1.65 | 1.01 |

## Tailwater Channel Data - Gun Club Dr Existing

Tailwater Channel Option:  Trapezoidal Channel

Bottom Width:  5.00 ft

Side Slope (H:V):  2.00 (_:1)

Channel Slope:  0.0200

Channel Manning's n:  0.0350

Channel Invert Elevation:  422.00 ft

## Roadway Data for Crossing: Gun Club Dr Existing

Roadway Profile Shape:  Constant Roadway Elevation

Crest Length:  50.00 ft

Crest Elevation:  425.50 ft

Roadway Surface:  Paved

Roadway Top Width:  25.00 ft

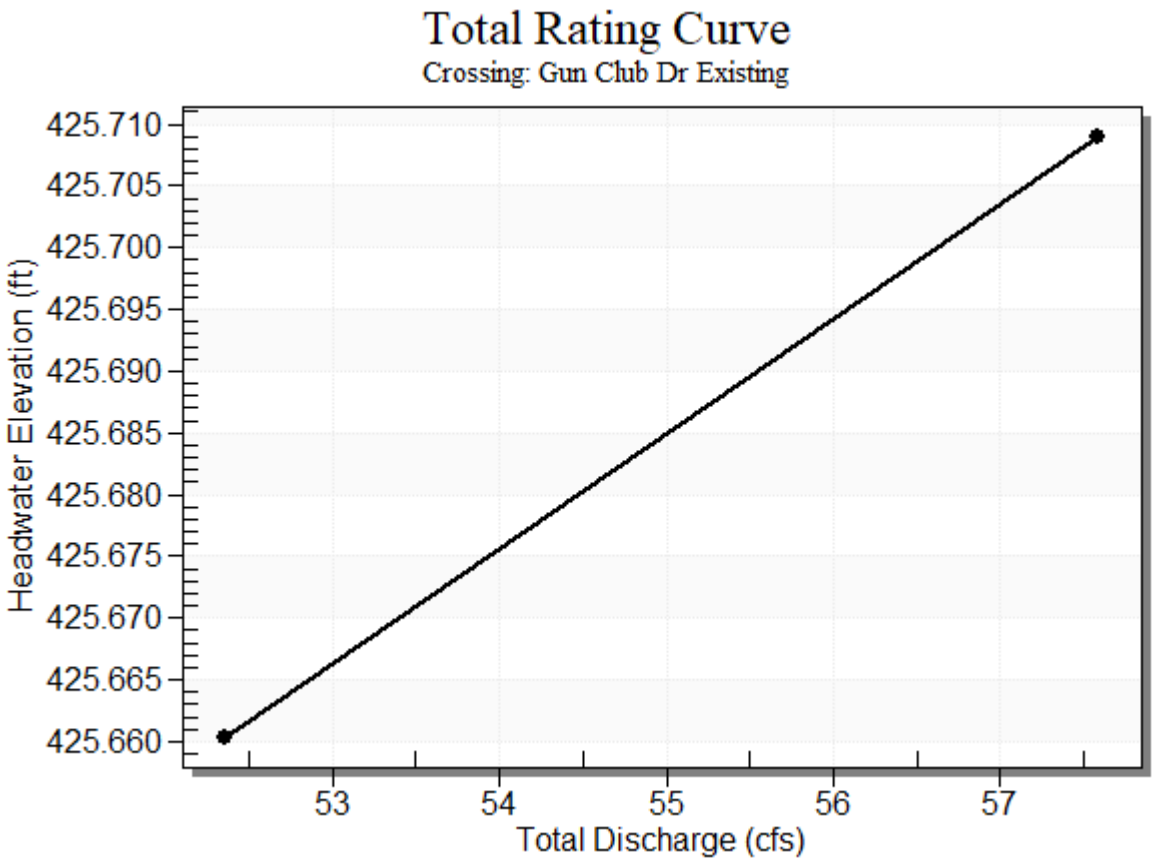
## Crossing Discharge Data

Discharge Selection Method: Recurrence

## Table 3 - Summary of Culvert Flows at Crossing: Gun Club Dr Existing

| Headwater Elevation (ft) | Discharge Names | Total Discharge (cfs) | Culvert Existing Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|---|---|---|---|---|---|
| 425.66 | 5 year | 52.36 | 42.76 | 9.48 | 9 |
| 425.71 | 10 year | 57.58 | 43.34 | 14.17 | 4 |
| 425.50 | Overtopping | 40.82 | 40.82 | 0.00 | Overtopping |

**Rating Curve Plot for Crossing: Gun Club Dr Existing**



# HY-8 Culvert Analysis Report

## Site Data - Culvert Proposed

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 422.50 ft

Outlet Station: 60.00 ft

Outlet Elevation: 422.00 ft

Number of Barrels: 3

## Culvert Data Summary - Culvert Proposed

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

## Table 1 - Culvert Summary Table: Culvert Proposed

| Discharge Names | Total Discharge (cfs) | Culvert Discharge (cfs) | Headwater Elevation (ft) | Inlet Control Depth (ft) | Outlet Control Depth (ft) | Flow Type | Normal Depth (ft) | Critical Depth (ft) | Outlet Depth (ft) | Tailwater Depth (ft) | Outlet Velocity (ft/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 year | 52.36 | 52.36 | 425.06 | 2.563 | 2.273 | 5-S2n | 1.293 | 1.504 | 1.343 | 1.158 | 7.558 |
| 10 year | 57.58 | 57.58 | 425.31 | 2.812 | 2.522 | 5-S2n | 1.388 | 1.574 | 1.437 | 1.220 | 7.728 |

**********

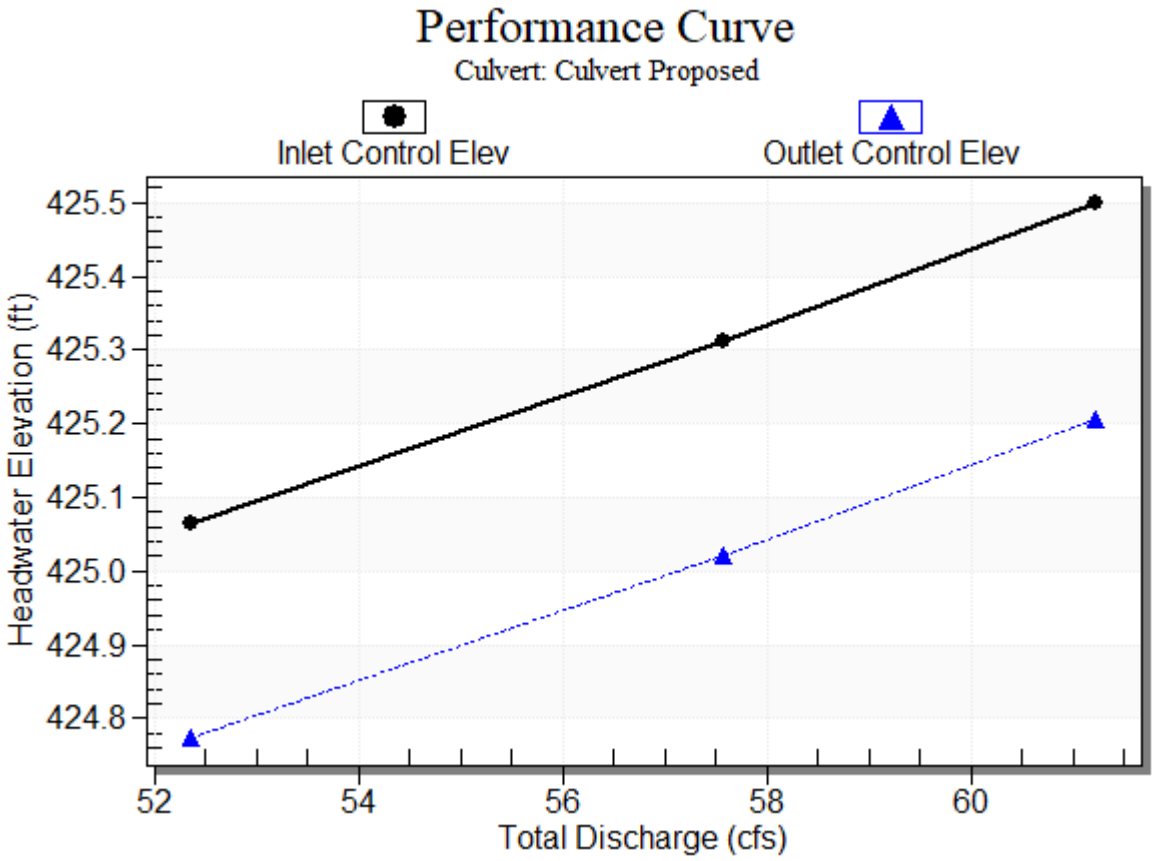
Straight Culvert

Inlet Elevation (invert): 422.50 ft,  Outlet Elevation (invert): 422.00 ft

Culvert Length: 60.00 ft,  Culvert Slope: 0.0083

**********

**Culvert Performance Curve Plot: Culvert Proposed**



**Water Surface Profile Plot for Culvert: Culvert Proposed**

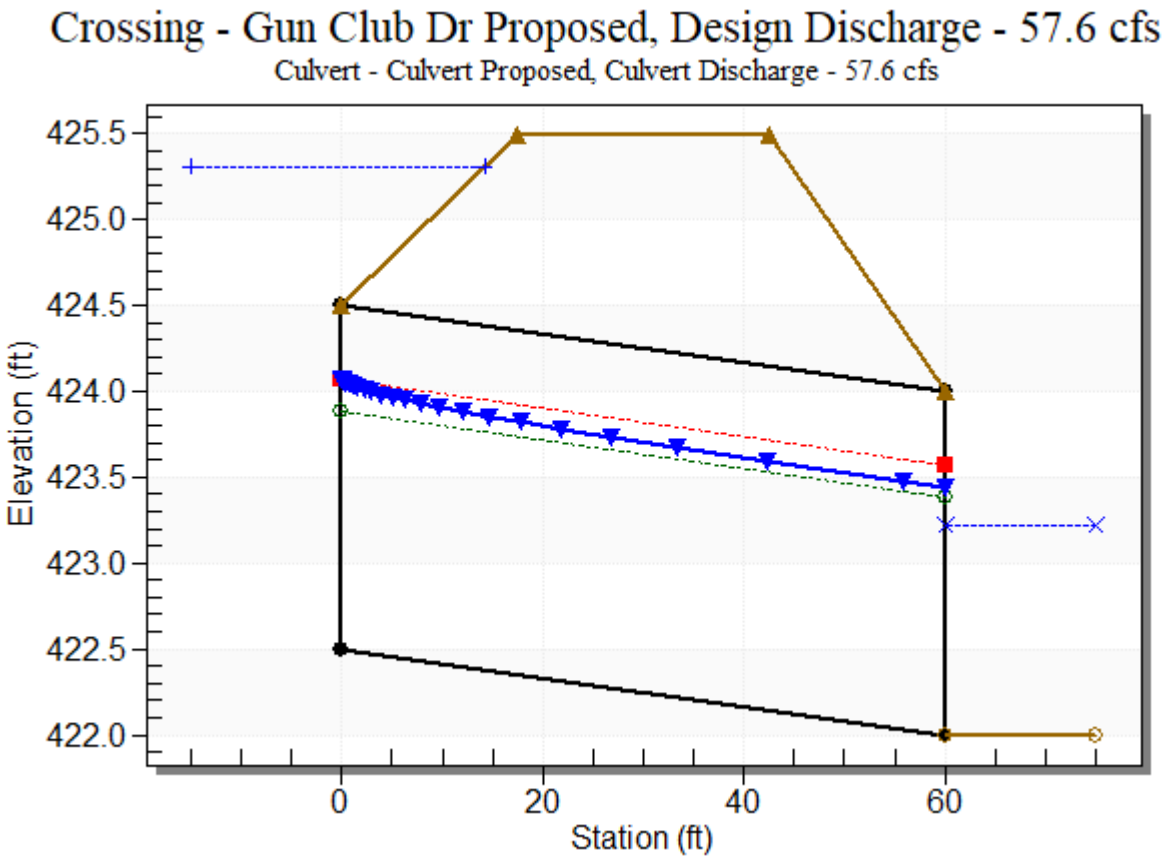


**Table 2 - Downstream Channel Rating Curve (Crossing: Gun Club Dr Proposed)**

| Flow (cfs) | Water Surface Elev (ft) | Depth (ft) | Velocity (ft/s) | Shear (psf) | Froude Number |
|---|---|---|---|---|---|
| 52.36 | 423.16 | 1.16 | 5.44 | 1.45 | 1.01 |
| 57.58 | 423.22 | 1.22 | 5.59 | 1.52 | 1.01 |

## Tailwater Channel Data - Gun Club Dr Proposed

Tailwater Channel Option:  Trapezoidal Channel

Bottom Width:  6.00 ft

Side Slope (H:V):  2.00 (_:1)

Channel Slope:  0.0200

Channel Manning's n:  0.0350

Channel Invert Elevation:  422.00 ft

## Roadway Data for Crossing: Gun Club Dr Proposed

Roadway Profile Shape:  Constant Roadway Elevation

Crest Length:  50.00 ft

Crest Elevation:  425.50 ft

Roadway Surface:  Paved

Roadway Top Width:  25.00 ft

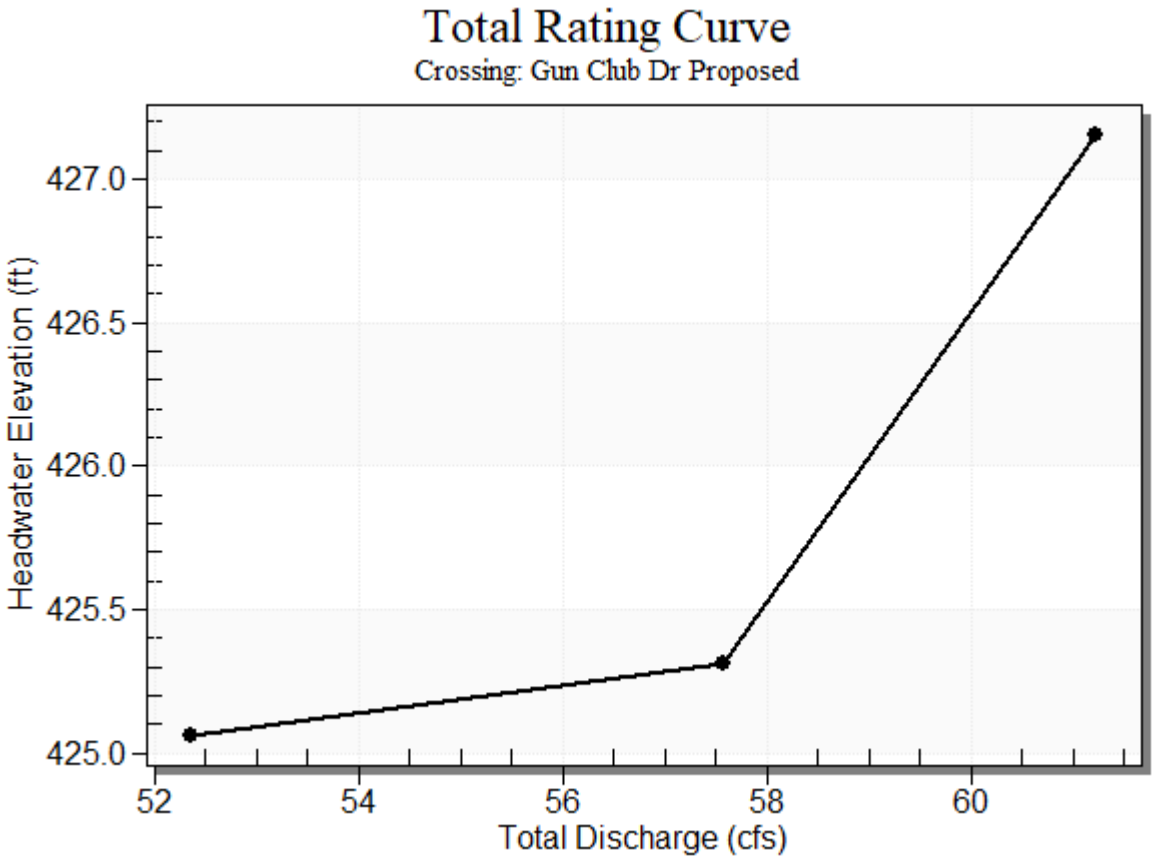
## Crossing Discharge Data

Discharge Selection Method: Recurrence

## Table 3 - Summary of Culvert Flows at Crossing: Gun Club Dr Proposed

| Headwater Elevation (ft) | Discharge Names | Total Discharge (cfs) | Culvert Proposed Discharge (cfs) | Roadway Discharge (cfs) | Iterations |
|---|---|---|---|---|---|
| 425.06 | 5 year | 52.36 | 52.36 | 0.00 | 1 |
| 425.31 | 10 year | 57.58 | 57.58 | 0.00 | 1 |
| 425.50 | Overtopping | 61.22 | 61.22 | 0.00 | Overtopping |

**Rating Curve Plot for Crossing: Gun Club Dr Proposed**



# Pipe Sizing Calculations, Alternative 1A, Garner Lane Existing and Proposed Culvert

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

**Ex Flow**

| | n | slope (ft/ft) | D (ft) | D (in) | Single Barrel Capacity (cfs) | Double Barrel Capacity (cfs) | 10 yr Peak Flow (cfs) |
|---|---|---|---|---|---|---|---|
| **Ex Pipe** | 0.013 | 0.005 | 2 | 24 | 15.92 | 31.85 | 83.68 |
| | 0.013 | 0.01 | 2 | 24 | 22.52 | 45.04 | 83.68 |
| | 0.013 | 0.02 | 2 | 24 | 31.85 | 63.70 | 83.68 |

**Ex Flow**

| | n | slope (ft/ft) | D (ft) | D (in) | Single Barrel Capacity (cfs) | Capacity for All Culverts (cfs) | 10 yr Peak Flow (cfs) |
|---|---|---|---|---|---|---|---|
| **Prop Additional Pipe** | 0.013 | 0.0100 | 3 | 36 | 66.48569753 | 111.53 | 83.68 |

# Detention Basin Sizing Calulations, Alternative 1B

| Weighted Curve Number | | | | | |
|---|---|---|---|---|---|
| Subcatchmnet | Land Use | SHG | Area (sft) | % of Area | CN |
| 1 | 1/3 Ac Parcels | Mixed | 1608284 | 86% | 65 |
| | | A | 1101010 | 59% | 57 |
| | | C | 507274 | 27% | 81 |
| 2 | Woods (Fair) | Mixed | 267963 | 14% | 55 |
| | | A | 129265 | 7% | 36 |
| | | C | 138698 | 7% | 73 |
| TOTAL | | | 1876246 | 100% | 63 |

## NRCS Curve Number- Runoff Volume (cft)

| | | |
|---|---|---|
| Runoff Volume | Q | cft |
| Runoff Depth | Q* | in |
| Curve Number | CN | |
| Rainfall Depth | P | in |

| | | |
|---|---|---|
| CN | 63.00 | |
| S | 5.87 | |
| P | 1 | in |
| Q* | 0.005349958 | in |
| Q | 836.48653 | cft |

for non Coastal Counties

**Discrete NRCS Curve Number Method for Runoff Depth**

$$S = \frac{1000}{CN} - 10$$

Where: S = Maximum retention after rainfall begins (in)
CN = Curve number (unitless)

$$Q^* = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Where: Q* = Runoff depth (in)
P = Rainfall depth (in)

## Basin Dimensions

| | | |
|---|---|---|
| Depth | 3 | ft |
| Pond Diameter | 18.9 | ft |
| Volume | 841.7 | cft |

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46 D^{2.67} \sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{S}}\right)^{1/2.67}$$

| | n | slope (ft/ft) | D (ft) | D (in) | Pipe Capacity (cfs) |
|---|---|---|---|---|---|
| **Outlet Pipe** | 0.013 | 0.005 | 2.5 | 30 | 28.89 |

| | n | slope (ft/ft) | D (ft) | D (in) | Single Barrel Capacity (cfs) | Double Barrel Capacity (cfs) | Flow from Detention Basin (cfs) |
|---|---|---|---|---|---|---|---|
| **Ex Garner Lane Culverts** | 0.013 | 0.005 | 2 | 24 | 15.92 | 31.85 | 28.89 |
| | 0.013 | 0.01 | 2 | 24 | 22.52 | 45.04 | 28.89 |
| | 0.013 | 0.02 | 2 | 24 | 31.85 | 63.70 | 28.89 |

# Pipe Sizing Calculations, Alternative 2, Love Lane Existing Culvert and Proposed Network

Gun Club

| | Capacity (cfs) | q10 (cfs) | Difference (Cfs) |
|---|---|---|---|
| Ex. Dual 24in Culvert | 43.3 | 57.58 | 14.28 |

To be re-routed to Love Ln System

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

**Ex Flow**

| | Loc | n | slope (ft/ft) | D (ft) | D (in) | Culvert Capacity (cfs) | Ex 10 yr storm (cfs) |
|---|---|---|---|---|---|---|---|
| **Ex Pipe** | across Love Ln | 0.013 | 0.02 | 2 | 24 | 31.85 | 34.00 |
| | across Love Ln | 0.013 | 0.01 | 2 | 24 | 22.52 | 34.00 |
| | across Love Ln | 0.013 | 0.005 | 2 | 24 | 15.92 | 34.00 |

DA2 q10 Flow

**Prop Flow**

| | Loc | n | slope (ft/ft) | D (ft) | D (in) | Culvert Capacity (cfs) | Prop Flow (cfs) |
|---|---|---|---|---|---|---|---|
| Prop Pipe 1 | Across Gun Club Dr | 0.013 | 0.0187 | 1.5 | 18 | 14.29 | 14.28 |
| | | | | | | | Re-routed Flow |
| Prop Pipe 2 | In front of 344 Gun Club Dr | 0.013 | 0.0131 | 2 | 24 | 25.78 | 25.75 |
| | | | | | | | DA1 q10 Flow |
| Prop Pipe 3 | Across 334/346 Gun Club Dr | 0.013 | 0.0097 | 2.5 | 30 | 40.24 | 40.06 |
| | | | | | | | DA1 q10 Flow + Re-Routed Flow |
| Prop Pipe 4 | Across 5/3 Love Ln | 0.013 | 0.0097 | 2.5 | 30 | 40.24 | 40.24 |
| | | | | | | | Pipe 3 Flow |
| Prop Pipe 5 (replacement) | Across Love Ln | 0.013 | 0.014 | 2.5 | 30 | 48.35 | 48.28 |
| | | | | | | | DA2 q10 Flow + Re-Routed Flow |
| Prop Pipe 6 | Across 6/2 Love Ln | 0.013 | 0.015 | 2.5 | 30 | 50.04 | 49.91 |
| | | | | | | | DA3 q10 Flow + Re-Routed Flow |

# Pipe Sizing Calculations, Alternative 2, Spring Lake Drive Dual Culverts

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

Gun Club

| | Capacity (cfs) | q10 (cfs) | Difference (Cfs) |
|---|---|---|---|
| Ex. Dual 24in Culvert | 43.3 | 57.58 | 14.28 |

To be re-routed to Love Ln System

**Ex Flow**

| | n | slope (ft/ft) | D (ft) | D (in) | Single Barrel Capacity (cfs) | Double Barrel Capacity (cfs) | Ex 10 yr Peak Flow (cfs) |
|---|---|---|---|---|---|---|---|
| **Ex Pipe** | 0.013 | 0.005 | 4 | 48 | 101.34 | 202.69 | 453.75 |
| | 0.013 | 0.01 | 4 | 48 | 143.32 | 286.65 | 453.75 |
| | 0.013 | 0.02 | 4 | 48 | 202.69 | 405.38 | 453.75 |

DA4 q10 Flow

**Prop Flow**

| | n | slope (ft/ft) | D (ft) | D (in) | Single Barrel Capacity (cfs) | Double Barrel Capacity (cfs) | Prop Flow (cfs) |
|---|---|---|---|---|---|---|---|
| **Prop Pipe** | 0.013 | 0.0143 | 4.5 | 54 | 234.7253038 | 469.45 | 468.03 |

DA4 q10 Flow + Re-Routed Flow

# Exhibit D

## Cost Estimate

# Gun Club Dr Storm Imporvements, Alternative 1A

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 10,000 | $ 10,000 |
| 2 | MAINTENANCE OF TRAFFIC | 1 | LS | $ 5,000 | $ 5,000 |
| 3 | CONSTRUCTION SURVEYING | 1 | LS | $ 2,000 | $ 2,000 |
| 4 | EROSION CONTROL | 1 | LS | $ 3,000 | $ 3,000 |
| 5 | DEMOLITON | 1 | LS | $ 5,000 | $ 5,000 |
| 6 | PURCHASE OF LOT (410 GUN CLUB DRIVE) | 1 | LS | $ 30,000 | $ 30,000 |
| 7 | 24" RCP CULVERT | 60 | LF | $ 95.13 | $ 6,000 |
| 8 | 36" RCP CULVERT | 43 | LF | $ 185.64 | $ 8,000 |
| 9 | CHANNEL EXCAVATION | 257 | LF | $ 10.00 | $ 3,000 |
| 10 | TREE REMOVAL | 20 | EA | $ 500.00 | $ 10,000 |
| 11 | RESTORE ASPHALT PAVEMENT | 229 | SY | $ 45.00 | $ 11,000 |
| 12 | CLASS B RIPRAP | 36 | TN | $ 70.00 | $ 3,000 |
| 13 | GEOTEXTILE FABRIC | 98 | SY | $ 5.00 | $ 1,000 |
| | | | | | |
| | | | | | |
| | | | | **Subtotal** | **$ 97,000** |
| | *Contingencies (35%)* | | | | $ 34,000 |
| | *Price Escalation Factor (15%)* | | | | $ 15,000 |

**Estimated Construction Cost Range: $97,000 to $146,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range): $15,000 to $30,000**

**Total Estimated Project Cost Range: $112,000 to $176,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# Gun Club Dr Storm Imporvements, Alternative 1B

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 10,000 | $ 10,000 |
| 2 | MAINTENANCE OF TRAFFIC | 1 | LS | $ 5,000 | $ 5,000 |
| 3 | CONSTRUCTION SURVEYING | 1 | LS | $ 2,000 | $ 2,000 |
| 4 | EROSION CONTROL | 1 | LS | $ 3,000 | $ 3,000 |
| 5 | DEMOLITON | 1 | LS | $ 5,000 | $ 5,000 |
| 6 | PURCHASE OF LOT 410 GUN CLUB DRIVE | 1 | LS | $ 30,000 | $ 30,000 |
| 7 | 24" RCP CULVERT | 60 | LF | $ 95.13 | $ 6,000 |
| 8 | 30" RCP | 123 | LF | $ 144.31 | $ 18,000 |
| 9 | DETENTION BASIN EXCAVATION | 94 | YD3 | $ 10.00 | $ 1,000 |
| 10 | CHANNEL EXCAVATION | 81 | LF | $ 10.00 | $ 1,000 |
| 11 | TREE REMOVAL | 20 | EA | $ 500.00 | $ 10,000 |
| 12 | RESTORE ASPHALT PAVEMENT | 133 | SY | $ 45.00 | $ 6,000 |
| 13 | CLASS B RIPRAP | 23 | TN | $ 70.00 | $ 2,000 |
| 14 | GEOTEXTILE FABRIC | 63 | SY | $ 5.00 | $ 1,000 |
| | | | | | |
| | | | | **Subtotal** | **$ 100,000** |
| | *Contingencies (35%)* | | | | $ 35,000 |
| | *Price Escalation Factor (15%)* | | | | $ 15,000 |

**Estimated Construction Cost Range: $100,000 to $150,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range): $15,000 to $30,000**

**Total Estimated Project Cost Range: $115,000 to $180,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# Gun Club Dr Storm Imporvements, Alternative 2

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 12,000 | $ 12,000 |
| 2 | MAINTENANCE OF TRAFFIC | 1 | LS | $ 11,000 | $ 11,000 |
| 3 | CONSTRUCTION SURVEYING | 1 | LS | $ 2,000 | $ 2,000 |
| 4 | EROSION CONTROL | 1 | LS | $ 7,000 | $ 7,000 |
| 5 | DEMOLITON | 1 | LS | $ 18,000 | $ 18,000 |
| 6 | 18" RCP CULVERT | 43 | LF | $ 85.45 | $ 4,000 |
| 7 | 24" RCP CULVERT | 84 | LF | $ 95.13 | $ 8,000 |
| 8 | 30" RCP CULVERT | 464 | LF | $ 144.31 | $ 67,000 |
| 9 | 54" RCP CULVERT | 140 | LF | $ 369.69 | $ 52,000 |
| 10 | DRAINAGE STRUCTURES | 3 | EA | $ 8,000.00 | $ 24,000 |
| 11 | TREE REMOVAL | 30 | EA | $ 500.00 | $ 15,000 |
| 12 | RESTORE ASPHALT PAVEMENT | 162 | SY | $ 45.00 | $ 8,000 |
| 13 | CLASS 1 RIPRAP | 33 | TN | $ 80.00 | $ 3,000 |
| 13 | CLASS B RIPRAP | 21 | TN | $ 70.00 | $ 2,000 |
| 14 | GEOTEXTILE FABRIC | 120 | SY | $ 5.00 | $ 1,000 |
| | | | | | |
| | | | | **Subtotal** | **$ 234,000** |
| | *Contingencies (35%)* | | | | $ 82,000 |
| | *Price Escalation Factor (15%)* | | | | $ 36,000 |

**Estimated Construction Cost Range: $234,000 to $352,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range):**

**Total Estimated Project Cost Range: $274,000 to $427,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# APPENDIX 4

## Palmetto Road and Cherokee Road
## Storm System Improvement

# TECHNICAL MEMORANDUM

**Date:** May 10, 2023

**Prepared for:** Mike Apke, PE
Public Services Director, Village of Pinehurst

**Prepared by:** Dori Sabeh, PE, GISP, Director of Water Resources
McGill Associates, P.A., Firm License No. C-0459

**Subject:** Village of Pinehurst Stormwater Masterplan- Phase 2
Palmetto Road and Cherokee Road Storm System Improvement

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The purpose of this memorandum is to provide recommendations for improvements to the storm drainage system needed to reduce flooding along the swales connecting Everette Road, Cherokee Road, and Midland Road.

The existing system, described from upstream to downstream, consists of a Stormwater Control Measure (SCM) at the Community Presbyterian Church parking lot adjacent to Fields Road, connecting at Everette Road to a system of roadside ditches, pipes, slab top inlets, and catch basins. The runoff discharges into a swale that runs southeast from Everette Road to Cherokee Road and then to Midland Road via the Spur Road. Right-of-Way (ROW) adjacent to 54 Everett Road. As of October 1992, the Spur Road ROW from Everette Road to Cherokee Road became the private property of the adjacent property owners. Drainage is piped under Cherokee Road, where it discharges into the swale leading to Midland Road. A slab top inlet is set on the north side of Cherokee Road. Here, the Village experiences significant road and ROW flooding during heavy rain events along Cherokee Road that additionally impacts the private property at 255 Cherokee Road. An 18-inch culvert beneath Midland Road then freely discharges onto the golf course (Figure 1).

Previous upstream public infrastructure improvements included adding the drainage ditch, pipe, slab top inlet, and catch basin system on Everette Road. The Village inquired if this addition resulted in adverse impacts to the private swale south of Everette Road. The drainage area contributing runoff to the swale was delineated using LiDAR data that predated the public

infrastructure improvements. The improvements are located within the drainage area contributing runoff into the swale between Everette Road and Cherokee Road and therefore are not contributing additional flow to the swale. The role of the improvements is limited to conveying the existing flow through a closed pipe system instead of overland flow. Therefore, no adverse impacts are introduced by the improvements.

There is uncertainty if the SCM located within the Community Presbyterian Church parking lot is consistent with permitting. It is recommended that the Village investigate further.

The swale from Everett Road to Cherokee Road is a shallow irregular channel with sparse vegetation. While ponding and erosion are prevalent, the swale is entirely on private property and improvements are not warranted to provide public benefit.

The swale from Cherokee Road to Midland Road is heavily vegetated, resulting in reduced conveyance capacity of the swale. During rain events, the Village observed flooding along Cherokee Road backing up to private properties. The photo below is taken from a video provided by the Village for flooding along Cherokee Road and the property at 255 Cherokee Road during a heavy rain event in February 2020.

Clearing the swale is beneficial to improve conveyance within the swale and alleviate upstream flooding along Cherokee Road. However, the swale is located within private properties and maintenance activities cannot be performed by the Village without an easement. The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $30,000 and $48,000. See Exhibit A for cost estimate breakdown.

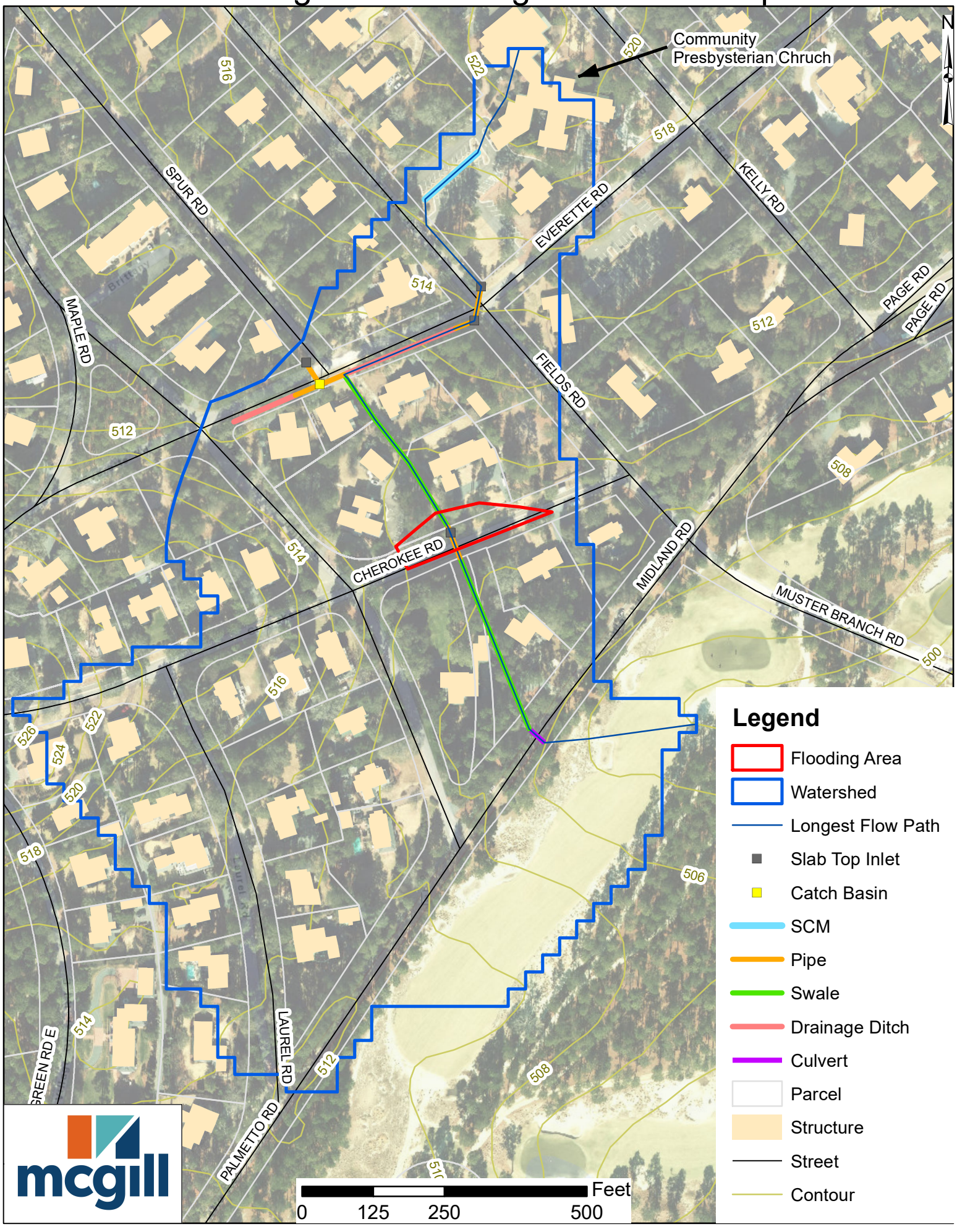
Due to the obvious public benefit for maintaining the swale, it is recommended that the Village enters into a cost share agreement with the property owners south of Cherokee Road to maintain the swale. It is also recommended for the Village to obtain drainage easements or agreements from the property owners along the channel.

Enclosures:

Figure 1: Existing Conditions Map

Exhibit A: Cost Estimate

# Figure 1: Existing Conditions Map



# Exhibit A

## Cost Estimate

# Palmetto Road and Cherokee Road Storm System Improvements

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 3,000 | $ 3,000 |
| 2 | CLEARING OF SWALE | 325 | LF | $ 65.00 | $ 22,000 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | **Subtotal** | **$ 25,000** |
| | *Contingencies (35%)* | | | | $ 9,000 |
| | *Price Escalation Factor (15%)* | | | | $ 4,000 |

**Estimated Construction Cost Range: $25,000 to $38,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range): $5,000 to $10,000**

**Total Estimated Project Cost Range: $30,000 to $48,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# APPENDIX 5

## Starlit Lane
## Storm System Improvement

# TECHNICAL MEMORANDUM

**Date:** May 10, 2023

**Prepared for:** Mike Apke, PE
Public Services Director, Village of Pinehurst

**Prepared by:** Dori Sabeh, PE, GISP, Director of Water Resources
McGill Associates, P.A., Firm License No. C-0459

**Subject:** Village of Pinehurst Stormwater Masterplan- Phase 2
Starlit Lane Storm System Improvement

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The purpose of this memorandum is to provide supporting computations and recommendations for the sizing of the pipe network needed to maintain water flow through the system at Starlit Lane up to the 10-year storm event. The project includes proposed potential improvements to mitigate recuring flooding within the lots located between 10 Starlit Lane and 16 Starlit Lane, with the lot at 16 Starlit Lane experiencing the most flooding.

Although no flooding is experienced within the Starlit Lane Right-of-Way, this area is being evaluated because the Village received numerous complaints from residents about inappropriate grading of their property by the builder. Information provided by the Village indicates that the residents contacted the builder to remedy the lot grading. The builder installed a swale along the south property lines of the four lots as part of the adjacent Floyd Way Subdivision but did not agree to adjust lot grading. The purpose of this evaluation is to check if there is public benefit for a retrofit in the area.

Existing stormwater system data were provided by the Village. The overall drainage pattern in the area consists of sheet flow from a drainage basin starting upstream of 10 Starlit Lane on the west side to west of Shamrock Way on the east side with the low-lying area located between lots 14 and 16 Starlit Lane (Figure 1). One Drainage Inlet and two 15-inch pipes that cross Shamrock Way and Starlit Lane outfall to a swale along the east side of 16 Starlit Lane. A swale downstream of properties 10 through 16 Starlit Lane was installed as part of the Floyd

Way Subdivision. Both the swales on the east side of 16 Starlit Lane and the Floyd Way Subdivision swale are located on private properties and not maintained by the Village.


The natural pathway of the swale on the east side of 16 Starlit Lane to reach the low-lying area is through the backyard of the property. A video taken by the resident at 16 Starlit Lane during a rainfall event and shared by the Village shows that the privacy fence installed across the swale appears to be impeding flow from reaching the low-lying area and/or the added swale along the Floyd Way Subdivision (screen capture on the right). The property owner could consider reshaping the fence to remove the flow obstruction. For the flow through the backyard, the property owner could consider continuing the existing swale on the east side to connect with the Floyd Way Subdivision swale or installing a pipe if topography allows it. A detailed lot drainage evaluation is not part of this study. The owner should consult with a professional for implementation of a retrofit. It is not known if the fence was installed by the builder or the property owner, and no records were available for McGill related to the review of the development plans by the Village.

The Village further requested evaluating the feasibility of capturing flow in the upstream portion of the drainage basin to route it to the swale in the Floyd Way Subdivision. Two alternatives were evaluated.

The contributing drainage area was delineated in ArcMap based on available LiDAR (Figure 2 and 3). The rational method (CiA) was used to compute peak flow for the design storm (Table 1). Rainfall Intensities for the 5- and 10-year events were obtained from NOAA Atlas 14 (Table 1 and Exhibit A).

| Table 1 Storm Event Return Period | Flow Basin 1 (cfs) | Flow Basin 2 (cfs) | Precipitation Intensity, 5 min Storm (in/hr) |
|---|---|---|---|
| **5-year** | 1.66 | 2.38 | 7.26 |
| **10-year** | 1.82 | 2.62 | 7.99 |

Alternative 1

The proposed improvements consist of installing two drainage inlets on either side of the road adjacent to 12 Starlit Lane, and 208 LF of 15-inch reinforced concrete pipe (RCP) to be tied to the existing swale at the rear of the Starlit Lane properties. See Figure 2 for Concept Plan. The village discussed with the owner of 10 Starlit Lane if installing a swale is possible instead of a pipe to reduce cost, but the property owner was not agreeable to this option because he wants to extend his fence to the property line. See Exhibit B for Pipe Sizing Calculations. Per Village of Pinehurst Engineering Standards & Specifications Manual: Section 5.02b, the allowable minimum storm sewer RCP diameter is 15-inches.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $60,000 and $96,000. See Exhibit C for Cost Estimate breakdown.

Alternative 2

The proposed improvements consist of installing two swales, a 15-inch RCP driveway culvert at 12 Starlit Lane, two drainage inlets on either side of Starlit Lane, and 208 LF of 15-inch RCP to be tied to the existing swale at the rear of the Starlit Lane properties. See Figure 3 for Concept Plan. See Exhibit B for Pipe Sizing Calculations.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $92,000 and $141,000. See Exhibit C for Cost Estimate breakdown.

Conclusion

Alternative 1 is the most cost effective but will provide limited improvements for residents of Starlit Lane as the system is placed at the upstream end of the drainage area and much of the flow will not be intercepted by the proposed system. While less cost efficient, the advantage of

Alternative 2 is that it will intercept and route more flow than Alternative 1 providing more tangible improvements to residents. Therefore, Alternative 2 is recommended. For the property at 16 Starlit Lane, internal lot adjustments are needed to ensure positive outfall of the flow from the existing swale on the east side of the property. Overall, the evaluated problems and solutions within this area are mainly private drainage improvements and are not warranted for overall public benefits.

Enclosures:

Figure 1: Existing Conditions Map

Figure 2: Alternative 1, Concept Plan

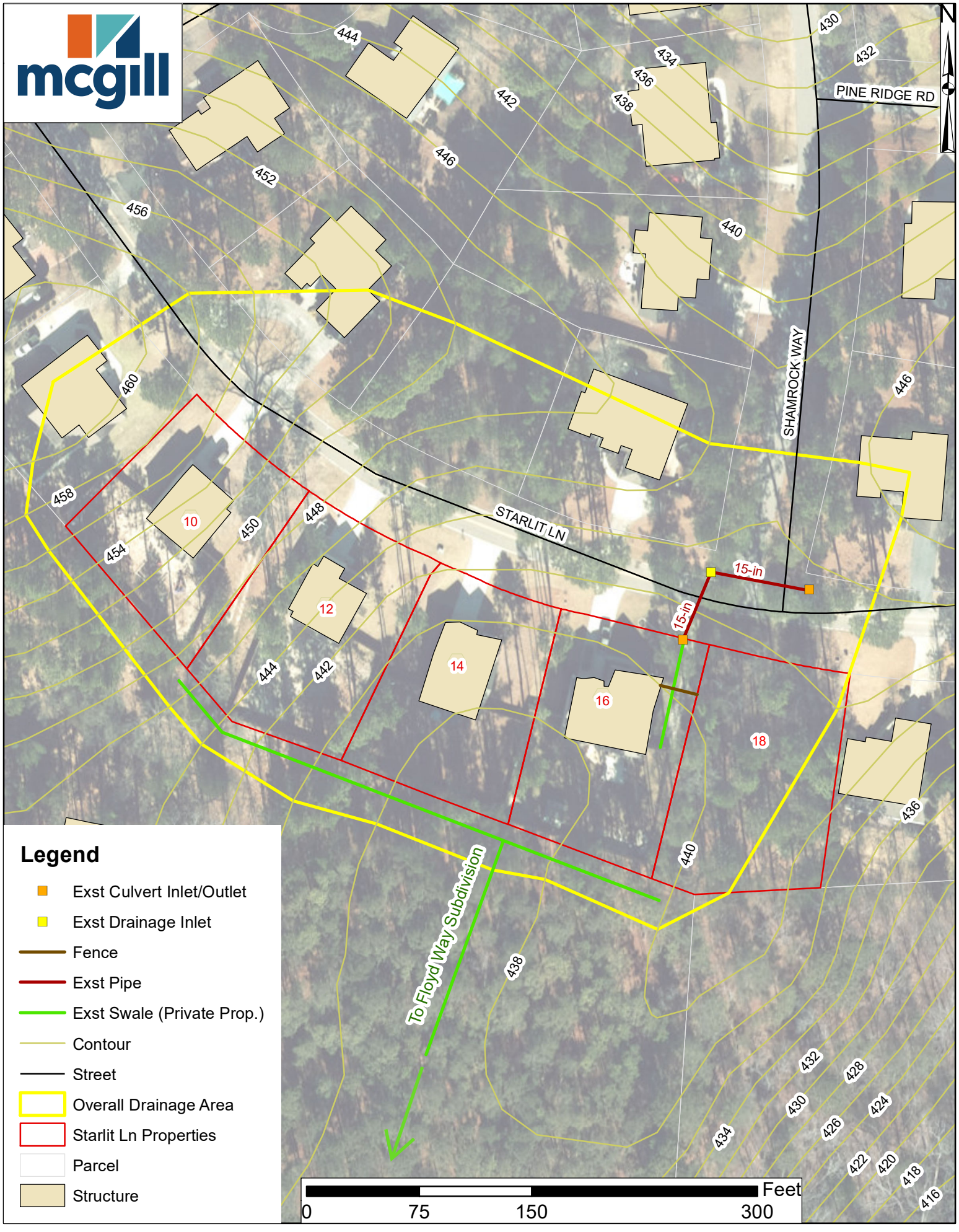
Figure 3: Alternative 2, Concept Plan

Exhibit A: NOAA Atlas 14 and Rational Method Calculations

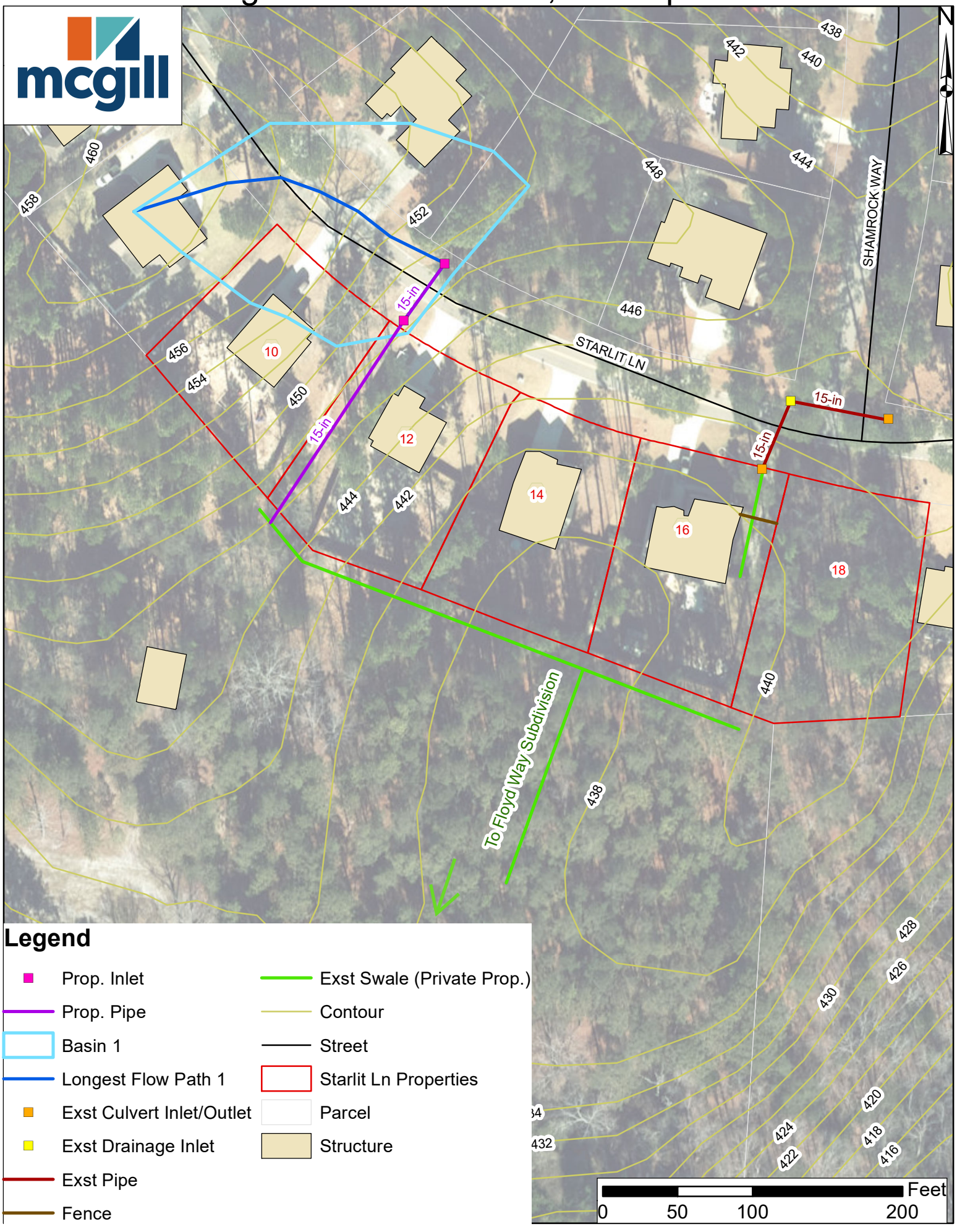
Exhibit B: Pipe Sizing Calculations

Exhibit C: Cost Estimate

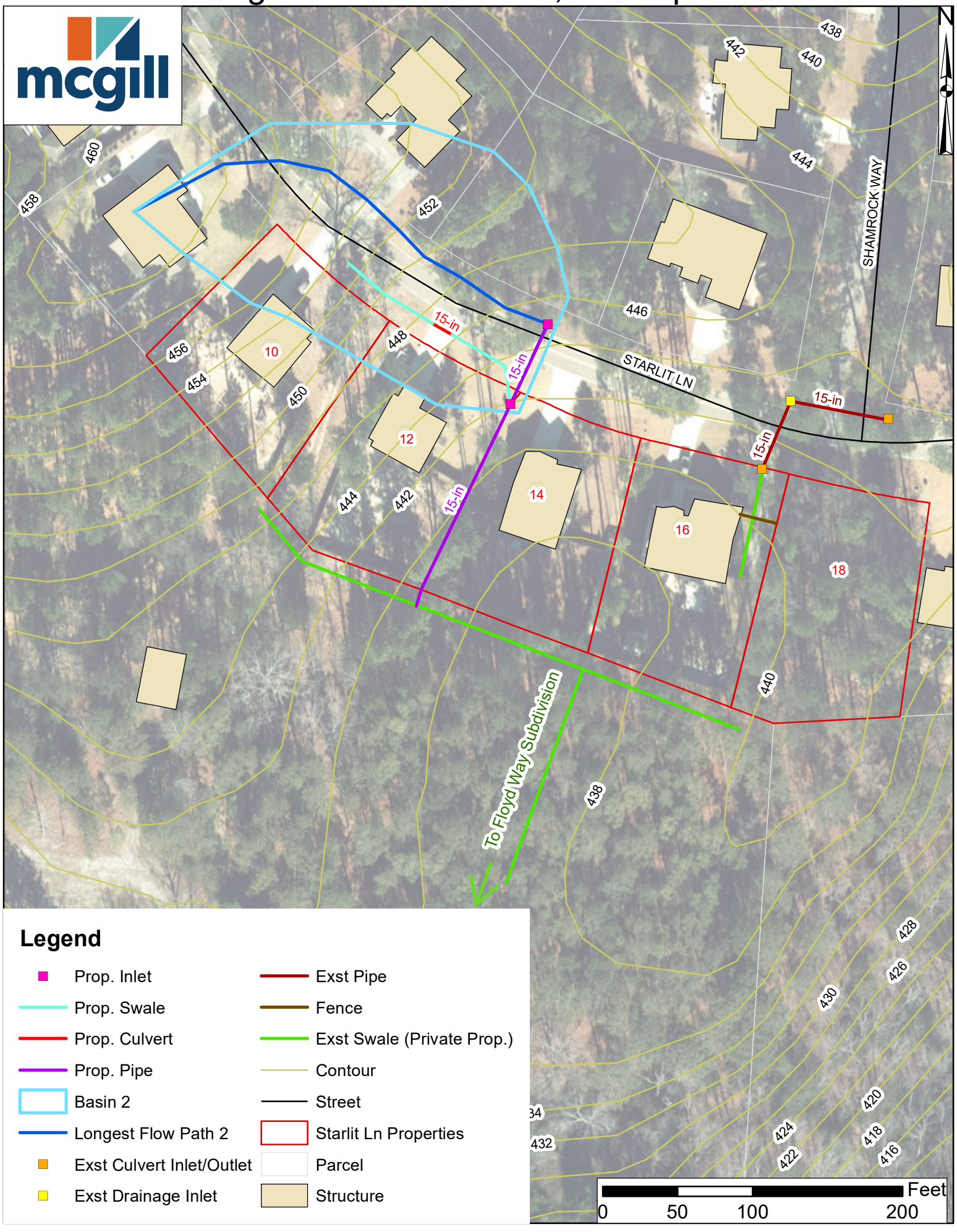
# Figure 1: Existing Conditions Map



# Figure 2: Alternative 1, Concept Plan



# Figure 3: Alternative 2, Concept Plan



# Exhibit A

## NOAA Atlas 14 and
## Rational Method Calculations

**NOAA Atlas 14, Volume 2, Version 3**
**Location name: Pinehurst, North Carolina, USA***
**Latitude: 35.1672°, Longitude: -79.4856°**
**Elevation: 458.95 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **5.28** (4.81-5.83) | **6.25** (5.69-6.90) | **7.26** (6.60-8.02) | **7.99** (7.25-8.81) | **8.84** (7.98-9.73) | **9.43** (8.50-10.4) | **9.98** (8.94-11.0) | **10.5** (9.34-11.5) | **11.1** (9.76-12.2) | **11.5** (10.1-12.7) |
| 10-min | **4.22** (3.85-4.66) | **5.00** (4.55-5.52) | **5.81** (5.28-6.42) | **6.40** (5.80-7.04) | **7.04** (6.35-7.75) | **7.51** (6.76-8.26) | **7.93** (7.10-8.72) | **8.30** (7.40-9.13) | **8.75** (7.72-9.62) | **9.05** (7.93-9.97) |
| 15-min | **3.52** (3.20-3.88) | **4.19** (3.81-4.63) | **4.90** (4.45-5.42) | **5.39** (4.89-5.94) | **5.95** (5.37-6.55) | **6.34** (5.71-6.97) | **6.68** (5.98-7.35) | **6.98** (6.22-7.68) | **7.34** (6.47-8.08) | **7.58** (6.64-8.34) |
| 30-min | **2.41** (2.20-2.66) | **2.89** (2.63-3.20) | **3.48** (3.16-3.85) | **3.91** (3.54-4.30) | **4.41** (3.98-4.85) | **4.77** (4.30-5.25) | **5.12** (4.58-5.63) | **5.44** (4.84-5.98) | **5.84** (5.15-6.43) | **6.13** (5.37-6.76) |
| 60-min | **1.50** (1.37-1.66) | **1.81** (1.65-2.01) | **2.23** (2.03-2.47) | **2.54** (2.31-2.80) | **2.94** (2.65-3.23) | **3.24** (2.91-3.56) | **3.53** (3.16-3.88) | **3.81** (3.40-4.19) | **4.19** (3.70-4.61) | **4.48** (3.92-4.93) |
| 2-hr | **0.882** (0.798-0.982) | **1.07** (0.968-1.19) | **1.33** (1.21-1.48) | **1.53** (1.38-1.70) | **1.79** (1.61-1.99) | **1.99** (1.78-2.21) | **2.19** (1.94-2.43) | **2.39** (2.10-2.65) | **2.65** (2.31-2.94) | **2.86** (2.47-3.17) |
| 3-hr | **0.622** (0.564-0.692) | **0.754** (0.684-0.839) | **0.944** (0.856-1.05) | **1.09** (0.988-1.21) | **1.29** (1.16-1.43) | **1.45** (1.30-1.61) | **1.61** (1.43-1.78) | **1.78** (1.56-1.97) | **2.01** (1.75-2.22) | **2.19** (1.88-2.42) |
| 6-hr | **0.372** (0.339-0.412) | **0.450** (0.410-0.498) | **0.565** (0.514-0.624) | **0.655** (0.593-0.722) | **0.778** (0.699-0.856) | **0.876** (0.782-0.963) | **0.978** (0.866-1.07) | **1.08** (0.950-1.19) | **1.23** (1.06-1.35) | **1.35** (1.15-1.48) |
| 12-hr | **0.219** (0.199-0.242) | **0.265** (0.241-0.293) | **0.334** (0.303-0.369) | **0.389** (0.352-0.429) | **0.466** (0.418-0.512) | **0.528** (0.470-0.579) | **0.593** (0.523-0.649) | **0.662** (0.578-0.725) | **0.759** (0.652-0.830) | **0.837** (0.709-0.915) |
| 24-hr | **0.129** (0.119-0.140) | **0.155** (0.143-0.169) | **0.195** (0.180-0.212) | **0.227** (0.209-0.246) | **0.270** (0.248-0.293) | **0.304** (0.279-0.330) | **0.339** (0.310-0.368) | **0.376** (0.342-0.407) | **0.426** (0.386-0.461) | **0.465** (0.421-0.504) |
| 2-day | **0.075** (0.069-0.081) | **0.090** (0.084-0.097) | **0.113** (0.104-0.122) | **0.130** (0.121-0.141) | **0.154** (0.142-0.167) | **0.174** (0.160-0.187) | **0.193** (0.177-0.209) | **0.213** (0.195-0.231) | **0.241** (0.219-0.261) | **0.263** (0.239-0.285) |
| 3-day | **0.053** (0.049-0.057) | **0.064** (0.059-0.068) | **0.079** (0.074-0.085) | **0.091** (0.085-0.098) | **0.108** (0.100-0.116) | **0.121** (0.112-0.130) | **0.135** (0.124-0.145) | **0.149** (0.136-0.160) | **0.168** (0.153-0.181) | **0.183** (0.166-0.197) |
| 4-day | **0.042** (0.039-0.045) | **0.050** (0.047-0.054) | **0.062** (0.058-0.067) | **0.072** (0.067-0.077) | **0.085** (0.079-0.091) | **0.095** (0.088-0.101) | **0.105** (0.097-0.113) | **0.116** (0.107-0.125) | **0.131** (0.120-0.141) | **0.143** (0.130-0.153) |
| 7-day | **0.028** (0.026-0.030) | **0.033** (0.031-0.035) | **0.040** (0.038-0.043) | **0.046** (0.043-0.049) | **0.054** (0.050-0.058) | **0.060** (0.056-0.065) | **0.067** (0.062-0.072) | **0.074** (0.068-0.079) | **0.083** (0.076-0.089) | **0.090** (0.082-0.097) |
| 10-day | **0.022** (0.021-0.024) | **0.026** (0.025-0.028) | **0.032** (0.030-0.034) | **0.036** (0.034-0.038) | **0.042** (0.039-0.044) | **0.046** (0.043-0.049) | **0.051** (0.047-0.054) | **0.055** (0.051-0.059) | **0.061** (0.057-0.066) | **0.066** (0.061-0.071) |
| 20-day | **0.015** (0.014-0.016) | **0.018** (0.017-0.019) | **0.021** (0.020-0.022) | **0.023** (0.022-0.025) | **0.027** (0.025-0.028) | **0.029** (0.028-0.031) | **0.032** (0.030-0.034) | **0.035** (0.033-0.037) | **0.039** (0.036-0.041) | **0.041** (0.038-0.044) |
| 30-day | **0.012** (0.012-0.013) | **0.015** (0.014-0.015) | **0.017** (0.016-0.018) | **0.019** (0.018-0.020) | **0.021** (0.020-0.022) | **0.023** (0.022-0.024) | **0.025** (0.023-0.026) | **0.027** (0.025-0.028) | **0.029** (0.027-0.031) | **0.031** (0.029-0.033) |
| 45-day | **0.010** (0.010-0.011) | **0.012** (0.012-0.013) | **0.014** (0.013-0.015) | **0.015** (0.015-0.016) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.020** (0.019-0.021) | **0.021** (0.020-0.022) | **0.023** (0.021-0.024) | **0.024** (0.022-0.025) |
| 60-day | **0.009** (0.009-0.010) | **0.011** (0.010-0.012) | **0.012** (0.012-0.013) | **0.014** (0.013-0.014) | **0.015** (0.014-0.016) | **0.016** (0.015-0.017) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.019** (0.018-0.021) | **0.020** (0.019-0.022) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical

## Rational Method- C Value, Subbasin A

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subbasin | Land Use | Area (sft) | C | C*Area |
| A | Residential | 24845 | 0.40 | 9938 |
| | | Total Area | | Weighted C |
| | | 24845 | | 0.40 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | |
| Heavy soil with crop | 0.15-0.45 |
| | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Subbasin A

Time of Concentration

$$t_c = kL^{0.77}s^{-0.385}$$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| channel slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| A | 0.0078 | 272 | 0.0478 | 2 |

*Use 5 min Storm

| | start elev ft | end elev ft | L ft | s ft/ft |
|---|---|---|---|---|
| Longest Flow Path | 461 | 448 | 272 | 0.0478 |

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 7.26 | in/hr | (5min/5 yr) |
| A | 24845 | ft2 | |
| | 0.57 | acres | |

| | | |
|---|---|---|
| Q | 1.7 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 7.99 | in/hr | (5min/10 yr) |
| A | 24845 | ft2 | |
| | 0.57 | acres | |

| | | |
|---|---|---|
| Q | 1.8 | cfs |

## Rational Method- C Value, Subbasin B

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subbasin | Land Use | Area (sft) | C | C*Area |
| B | Residential | 35669 | 0.40 | 14267.6 |
| | | Total Area | | Weighted C |
| | | 35669 | | 0.40 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | |
| Heavy soil with crop | 0.15-0.45 |
| | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Rational Method - Peak Runoff, Subbasin B

Time of Concentration

$$t_c = kL^{0.77}s^{-0.385}$$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| channel slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| B | 0.0078 | 378 | 0.0503 | 2 |

*Use 5 min Storm

| | start elev ft | end elev ft | L ft | s ft/ft |
|---|---|---|---|---|
| Longest Flow Path | 461 | 442 | 378 | 0.0503 |

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 7.26 | in/hr | (5min/5 yr) |
| A | 35669 | ft2 | |
| | 0.8 | acres | |

| | | |
|---|---|---|
| Q | 2.4 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.40 | | |
| i | 7.99 | in/hr | (5min/10 yr) |
| A | 35669 | ft2 | |
| | 0.8 | acres | |

| | | |
|---|---|---|
| Q | 2.6 | cfs |

# Exhibit B

## Pipe Sizing Calculations

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

| Pipe | Q (cfs), 10yr | n | slope (ft/ft) | D (ft) | D (in) | Pipe size, D (in) |
|---|---|---|---|---|---|---|
| Alt 1 | 1.8 | 0.013 | 0.02 | 0.69 | 8.26 | 15 |
| Alt 2 | 2.6 | 0.013 | 0.02 | 0.78 | 9.40 | 15 |

# Exhibit C

## Cost Estimate

# Starlit Ln Storm System Improvements, Alternative 1

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 5,000 | $ 5,000 |
| 2 | CONSTRUCTION SURVEYING | 1 | LS | $ 2,000 | $ 2,000 |
| 3 | EROSION CONTROL | 1 | LS | $ 2,000 | $ 2,000 |
| 4 | DEMOLITON | 1 | LS | $ 3,000 | $ 3,000 |
| 5 | 15" RCP CULVERT | 208 | LF | $ 70.00 | $ 15,000 |
| 6 | DRAINAGE STRUCTURES | 2 | EA | $ 8,000 | $ 16,000 |
| 7 | RESTORATION OF SURFACES | 1 | LS | $ 4,000 | $ 4,000 |
| 8 | CLASS B RIPRAP | 1 | TN | $ 70.00 | $ 1,000 |
| 9 | GEOTEXTILE FABRIC | 5 | SY | $ 10.00 | $ 1,000 |
| 10 | NCDOT #57 STONE | 1 | TN | $ 70.00 | $ 1,000 |
| | | | | | |
| | | | | | |
| | | | | **Subtotal** | **$ 50,000** |
| | *Contingencies (35%)* | | | | $ 18,000 |
| | *Price Escalation Factor (15%)* | | | | $ 8,000 |

**Estimated Construction Cost Range: $50,000 to $76,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range): $10,000 to $20,000**

**Total Estimated Project Cost Range: $60,000 to $96,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# Starlit Ln Storm System Improvements, Alternative 2

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 10,000 | $ 10,000 |
| 2 | CONSTRUCTION SURVEYING | 1 | LS | $ 2,000 | $ 2,000 |
| 3 | EROSION CONTROL | 1 | LS | $ 2,000 | $ 2,000 |
| 4 | DEMOLITON | 1 | LS | $ 6,000 | $ 6,000 |
| 5 | 15" RCP CULVERT | 208 | LF | $ 70.00 | $ 15,000 |
| 6 | DRAINAGE STRUCTURES | 2 | EA | $ 8,000 | $ 16,000 |
| 7 | DRAINAGE DITCH EXCAVATION | 136 | LF | $ 10.00 | $ 2,000 |
| 8 | GEOTEXTILE FABRIC | 5 | SY | $ 10.00 | $ 1,000 |
| 9 | CLASS B RIPRAP | 1 | TN | $ 70.00 | $ 1,000 |
| 10 | NCDOT #57 STONE | 11 | TN | $ 70.00 | $ 1,000 |
| 11 | UTILITIES | 1 | LS | $ 5,000 | $ 5,000 |
| 12 | ORNAMENTAL WOOD FENCE | 70 | LF | $ 40.00 | $ 3,000 |
| 13 | RESTORE VEGETATED AREAS | 233 | SY | $ 20.00 | $ 5,000 |
| 14 | REMOVE AND REPLACE DRIVEWAY | 33 | SY | $ 100.00 | $ 4,000 |
| 15 | RESTORATION OF SURFACES | 1 | LS | $ 4,000 | $ 4,000 |
| | | | | | |
| | | | | **Subtotal** | **$ 77,000** |
| | *Contingencies (35%)* | | | | $ 27,000 |
| | *Price Escalation Factor (15%)* | | | | $ 12,000 |

**Estimated Construction Cost Range: $77,000 to $116,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range):**

**Total Estimated Project Cost Range: $92,000 to $141,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# APPENDIX 6

## York Place
## Storm System Improvement

# TECHNICAL MEMORANDUM

**Date:** May 18, 2023

**Prepared for:** Mike Apke, PE
Public Services Director, Village of Pinehurst

**Prepared by:** Dori Sabeh, PE, GISP, Director of Water Resources
McGill Associates, P.A., Firm License No. C-0459

**Subject:** Village of Pinehurst Stormwater Masterplan- Phase 2
York Place Storm System Improvement

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The purpose of this memorandum is to provide supporting computations and recommendations for the sizing of the pipe network needed to maintain water flow through the system at Salem Drive and York Place up to the 10-year storm event and to reduce ponding on the east side of York Place. The project includes proposed potential improvements to mitigate recuring flooding at the cul-de-sac of York Place (Figure 1).

The natural drainage path for runoff in this area is through the property at 6 York Place toward Salem Drive and ultimately into Aberdeen Creek (Figure 1). Based on the existing stormwater system data provided by the Village and data collated from the “Storm Drainage Improvements for Salem Drive” Project, there is no existing infrastructure to accommodate the runoff. The existing stormwater system is limited to two catch basins along Salem Drive that connect to the drainage pipes along Morganton Road and discharge into a tributary of Aberdeen Creek at Watson Lake. Flooding in this area is due to lack of positive outfall of runoff water that accumulates from the intersection of York Place and Salem Drive down to the cul-de-sac.

Two alternatives are available for alleviating flooding in the area:

Alternative 1: Route the runoff through the Morganton Road drainage network.

The contributing drainage area was delineated in ArcMap based on available LiDAR (Figure 2). The rational method (CiA) was used to compute peak flow for the design storm (Table 1).

Rainfall Intensities for the 5- and 10-year events were obtained from NOAA Atlas 14 (Table 1 and Exhibit A).

| Table 1, Alt 1<br>Storm Event Return Period | Precipitation Intensity, 5 min Storm<br>(in/hr) | Flow, Exst. Drainage Area<br>(cfs) | Precipitation Intensity, 10 min Storm<br>(in/hr) | Flow, Prop. Drainage Area<br>(cfs) |
|---|---|---|---|---|
| **1-year** | 5.29 | 3.03 | 4.23 | 8.27 |
| **2-year** | 6.26 | 3.58 | 5.00 | 9.78 |
| **5-year** | 7.27 | 4.16 | 5.82 | 11.38 |
| **10-year** | 8.00 | 4.57 | 6.40 | 12.51 |

The proposed improvements consist of installing a 364 LF swale within the York Place Right-of-Way (ROW), two 15-inch reinforced concrete Driveway Culverts, one Drainage Inlet, and 124 LF of 15-inch reinforced concrete pipe (RCP) within the Salem Drive ROW. The proposed swale would be placed against grade (about 1 to 2 feet elevation change based on survey spot elevations provided by the Village (Exhibit B). The proposed pipe will tie to an existing Catch Basin along Salem Drive. The receiving pipe network along Morganton Road consists of 15" RCPs with a limiting capacity of 3.15 cfs (15" RCP at 0.24%) (Exhibit C) and is sized for the 1-year storm event under existing conditions. The connection of the proposed system to the existing Salem Drive and Morganton Road system will likely result in drainage and flooding issues downstream at the Salem Drive ROW and properties along the existing Salem Drive and Morganton Road system . Additionally, drainage at York Place will not meet the Village's level of service as the undersized pipes will be at full capacity during storm events and will not be able to accommodate additional flow. It shall be noted that the proposed swale will provide storage and attenuation. However, a dynamic model of the entire system is required to quantify such benefits, which is beyond the scope of this evaluation. See Exhibit C for Pipe Sizing Calculations. See Figure 2 for Alternative 1 Concept Plan.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $84,000 and $130,000. See Exhibit D for Cost Estimate breakdown.

Alternative 2: Provide positive outfall along the natural drainage path.

The contributing drainage area was delineated in ArcMap based on available LiDAR (Figure 3). The rational method (CiA) was used to compute peak flow for the design storm (Table 2). Rainfall Intensities for the 5- and 10-year events were obtained from NOAA Atlas 14 (Table 2 and Exhibit A).

| **Table 2, Alt 2**<br>**Storm Event Return Period** | **Precipitation Intensity, 5 min Storm**<br>**(in/hr)** | **Flow, Prop. Drainage Area**<br>**(cfs)** |
|---|---|---|
| **1-year** | 5.29 | 7.29 |
| **2-year** | 6.26 | 8.63 |
| **5-year** | 7.27 | 10.02 |
| **10-year** | 8.00 | 11.03 |

The proposed improvements consist of installing, one Drainage Inlet, four Storm Manholes, and 597 LF 18-inch RCP from York Place across Amboy Place to Salem Drive. The proposed pipe will tie to an existing degraded swale along 125 Salem Drive. The existing swale is to be restored and channelized. This alternative requires substantial easement acquisition along five properties (Figure 3). There is limited space (15 ft) between the houses at 120 Salem Drive and 130 Salem Drive, causing constructability constraints.

The estimated project cost for the proposed improvements, not including easement acquisition, ranges between $159,000 and $247,000. See Exhibit C for Cost Estimate breakdown.

Conclusion

Alternative 2 has the advantage of maintaining the existing drainage patterns whereas Alternative 1 routes flows from Aberdeen Creek into a tributary of Aberdeen Creek through the Country Club of North Carolina (CCNC), but will likely result in continued flooding. Ultimately both creeks converge at Watson Lake within the CCNC. Alternative 2, however, requires

substantial capital budget and easement acquisition for implementation. If property owners are amenable to donate easements to the Village and capital funding can be secured, Alternative 2 is recommended.

Enclosures:

Figure 1: Existing Conditions Map

Figure 2: Alternative 1, Concept Plan

Figure 3: Alternative 2, Concept Plan

Exhibit A: NOAA Atlas 14 and Rational Method Calculations

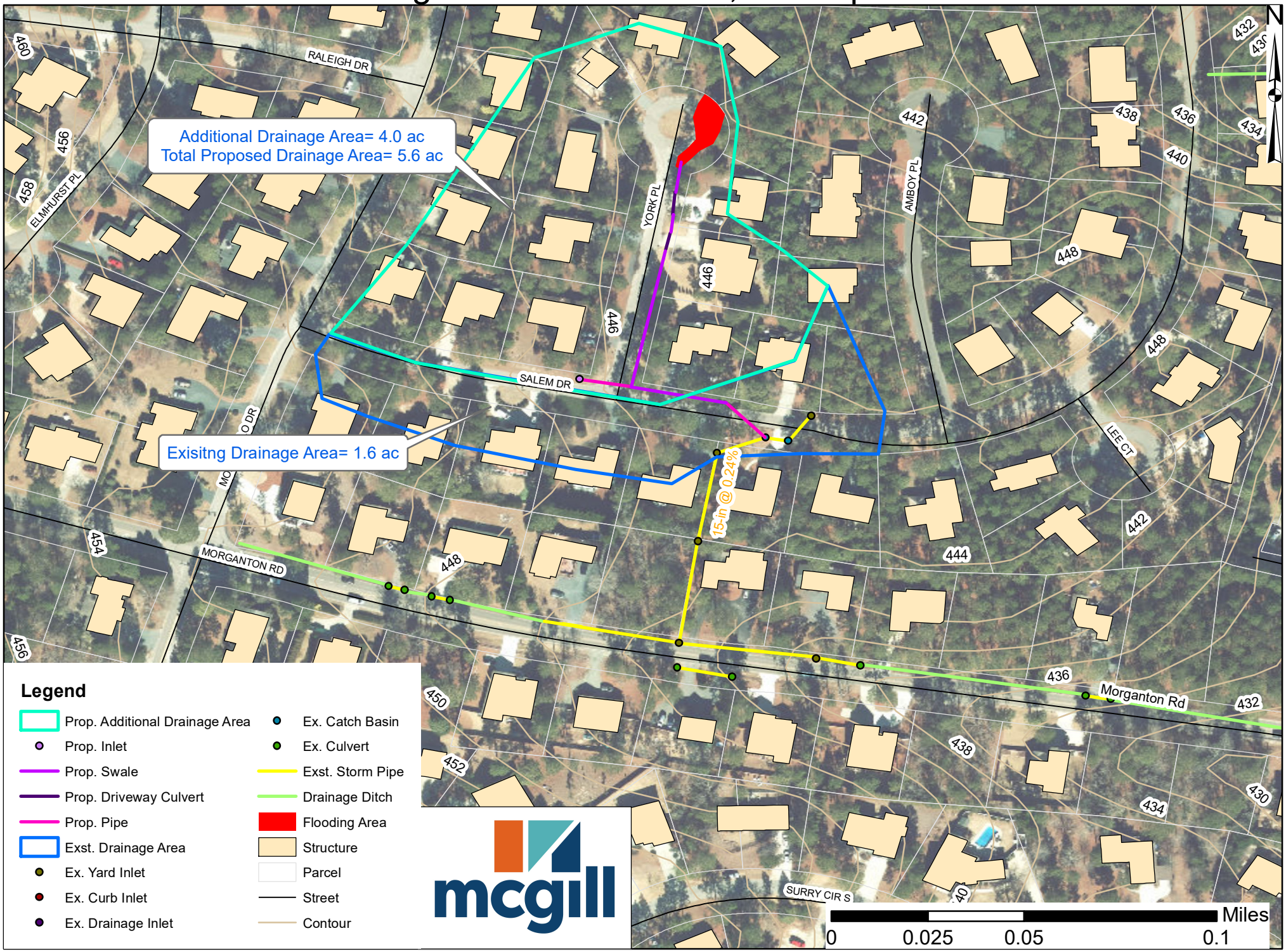
Exhibit B: Topographic and Drainage Data

Exhibit C: Pipe Sizing Calculations

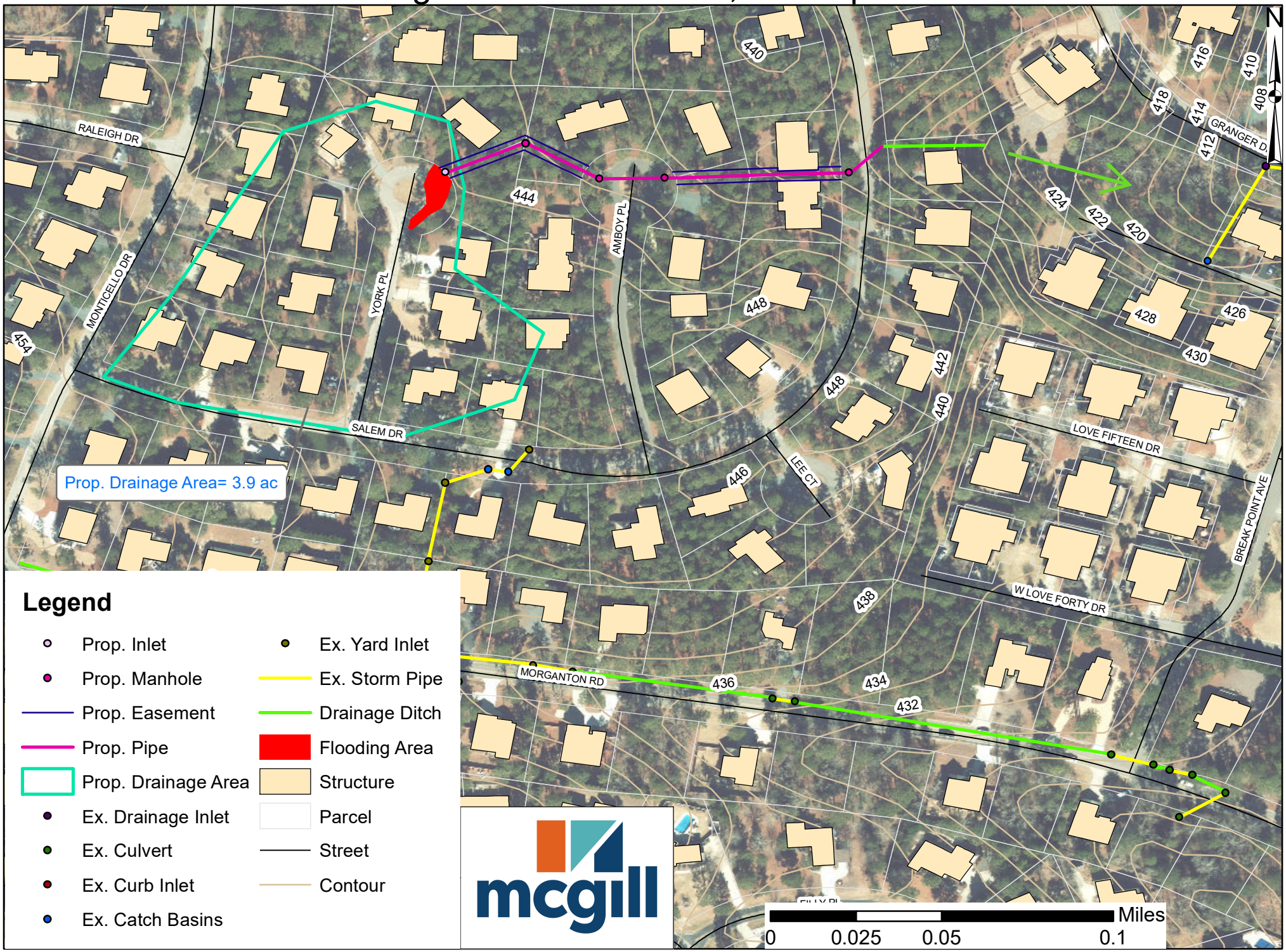
Exhibit D: Cost Estimate

# Figure 1: Existing Conditions Map

# Figure 2: Alternative 1, Concept Plan



# Figure 3: Alternative 2, Concept Plan



# Exhibit A

## NOAA Atlas 14 and
## Rational Method Calculations

**NOAA Atlas 14, Volume 2, Version 3**
**Location name: Pinehurst, North Carolina, USA***
**Latitude: 35.2137°, Longitude: -79.4655°**
**Elevation: 423.69 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **5.29** (4.82-5.86) | **6.26** (5.69-6.92) | **7.27** (6.60-8.04) | **8.00** (7.25-8.83) | **8.83** (7.96-9.73) | **9.41** (8.46-10.4) | **9.95** (8.89-11.0) | **10.4** (9.28-11.5) | **11.0** (9.67-12.1) | **11.4** (9.96-12.6) |
| 10-min | **4.23** (3.85-4.67) | **5.00** (4.55-5.54) | **5.82** (5.29-6.44) | **6.40** (5.80-7.06) | **7.04** (6.34-7.76) | **7.49** (6.74-8.26) | **7.90** (7.07-8.71) | **8.26** (7.35-9.11) | **8.68** (7.65-9.57) | **8.97** (7.84-9.89) |
| 15-min | **3.52** (3.21-3.90) | **4.20** (3.82-4.64) | **4.91** (4.46-5.43) | **5.39** (4.89-5.95) | **5.95** (5.36-6.56) | **6.33** (5.69-6.97) | **6.66** (5.96-7.34) | **6.95** (6.18-7.66) | **7.28** (6.42-8.03) | **7.50** (6.56-8.28) |
| 30-min | **2.42** (2.20-2.67) | **2.90** (2.63-3.21) | **3.49** (3.17-3.86) | **3.91** (3.54-4.31) | **4.41** (3.97-4.86) | **4.76** (4.28-5.25) | **5.10** (4.56-5.62) | **5.41** (4.81-5.96) | **5.80** (5.11-6.39) | **6.08** (5.31-6.70) |
| 60-min | **1.51** (1.37-1.67) | **1.82** (1.65-2.01) | **2.24** (2.03-2.47) | **2.54** (2.31-2.81) | **2.93** (2.64-3.23) | **3.23** (2.90-3.56) | **3.51** (3.14-3.87) | **3.79** (3.38-4.18) | **4.16** (3.66-4.58) | **4.44** (3.88-4.89) |
| 2-hr | **0.885** (0.800-0.986) | **1.07** (0.970-1.20) | **1.34** (1.21-1.49) | **1.53** (1.38-1.71) | **1.79** (1.60-1.99) | **1.99** (1.77-2.21) | **2.18** (1.93-2.42) | **2.37** (2.09-2.64) | **2.63** (2.29-2.92) | **2.83** (2.44-3.14) |
| 3-hr | **0.624** (0.566-0.695) | **0.756** (0.687-0.842) | **0.946** (0.858-1.05) | **1.09** (0.989-1.22) | **1.29** (1.16-1.43) | **1.45** (1.29-1.61) | **1.61** (1.42-1.78) | **1.77** (1.55-1.96) | **1.99** (1.73-2.21) | **2.17** (1.86-2.40) |
| 6-hr | **0.374** (0.340-0.413) | **0.452** (0.412-0.500) | **0.566** (0.515-0.625) | **0.656** (0.594-0.723) | **0.778** (0.699-0.855) | **0.875** (0.781-0.961) | **0.975** (0.863-1.07) | **1.08** (0.945-1.18) | **1.22** (1.06-1.34) | **1.33** (1.14-1.46) |
| 12-hr | **0.219** (0.200-0.243) | **0.266** (0.242-0.294) | **0.334** (0.304-0.370) | **0.390** (0.352-0.430) | **0.465** (0.418-0.512) | **0.527** (0.470-0.578) | **0.591** (0.522-0.647) | **0.659** (0.575-0.721) | **0.753** (0.648-0.824) | **0.830** (0.703-0.908) |
| 24-hr | **0.129** (0.119-0.140) | **0.156** (0.144-0.169) | **0.196** (0.181-0.212) | **0.227** (0.209-0.247) | **0.270** (0.248-0.293) | **0.304** (0.279-0.330) | **0.340** (0.310-0.368) | **0.376** (0.343-0.407) | **0.425** (0.386-0.461) | **0.465** (0.421-0.503) |
| 2-day | **0.075** (0.070-0.081) | **0.090** (0.084-0.098) | **0.113** (0.105-0.122) | **0.131** (0.121-0.141) | **0.155** (0.143-0.167) | **0.174** (0.160-0.188) | **0.194** (0.178-0.209) | **0.214** (0.195-0.231) | **0.241** (0.220-0.261) | **0.263** (0.239-0.285) |
| 3-day | **0.053** (0.049-0.057) | **0.064** (0.060-0.069) | **0.079** (0.074-0.085) | **0.092** (0.085-0.098) | **0.108** (0.100-0.116) | **0.121** (0.112-0.130) | **0.135** (0.124-0.145) | **0.149** (0.137-0.160) | **0.168** (0.154-0.181) | **0.183** (0.167-0.198) |
| 4-day | **0.042** (0.039-0.045) | **0.051** (0.047-0.054) | **0.063** (0.058-0.067) | **0.072** (0.067-0.077) | **0.085** (0.079-0.091) | **0.095** (0.088-0.102) | **0.106** (0.098-0.113) | **0.117** (0.107-0.125) | **0.131** (0.120-0.141) | **0.143** (0.131-0.154) |
| 7-day | **0.028** (0.026-0.030) | **0.033** (0.031-0.035) | **0.040** (0.038-0.043) | **0.046** (0.043-0.049) | **0.054** (0.050-0.058) | **0.061** (0.056-0.065) | **0.067** (0.062-0.072) | **0.074** (0.068-0.079) | **0.083** (0.076-0.089) | **0.090** (0.082-0.097) |
| 10-day | **0.022** (0.021-0.024) | **0.026** (0.025-0.028) | **0.032** (0.030-0.034) | **0.036** (0.034-0.038) | **0.042** (0.039-0.044) | **0.046** (0.043-0.049) | **0.051** (0.047-0.054) | **0.055** (0.051-0.059) | **0.062** (0.057-0.066) | **0.066** (0.061-0.071) |
| 20-day | **0.015** (0.014-0.016) | **0.018** (0.017-0.019) | **0.021** (0.020-0.022) | **0.023** (0.022-0.025) | **0.027** (0.025-0.028) | **0.030** (0.028-0.031) | **0.032** (0.030-0.034) | **0.035** (0.033-0.037) | **0.039** (0.036-0.041) | **0.042** (0.038-0.044) |
| 30-day | **0.012** (0.012-0.013) | **0.015** (0.014-0.015) | **0.017** (0.016-0.018) | **0.019** (0.018-0.020) | **0.021** (0.020-0.022) | **0.023** (0.022-0.024) | **0.025** (0.023-0.026) | **0.027** (0.025-0.028) | **0.029** (0.027-0.031) | **0.031** (0.029-0.033) |
| 45-day | **0.010** (0.010-0.011) | **0.012** (0.012-0.013) | **0.014** (0.013-0.015) | **0.015** (0.015-0.016) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.020** (0.019-0.021) | **0.021** (0.020-0.022) | **0.023** (0.021-0.024) | **0.024** (0.022-0.025) |
| 60-day | **0.009** (0.009-0.010) | **0.011** (0.010-0.012) | **0.012** (0.012-0.013) | **0.014** (0.013-0.014) | **0.015** (0.014-0.016) | **0.016** (0.015-0.017) | **0.017** (0.016-0.018) | **0.018** (0.017-0.019) | **0.019** (0.018-0.021) | **0.020** (0.019-0.022) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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## PF graphical

## Alt 1 Rational Method-Exst. C Value

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | C | Weighted C |
| 1 | Single Family | 71173.3 | 0.35 | 0.35 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | |
| Heavy soil with crop | 0.15-0.45 |
| | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Alt 1 Rational Method - Peak Runoff Existing Conditions

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 477 | 0.017 | 4 |

*Use 5 min Storm

**1 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 5.29 | in/hr | (5min/1yr) |
| A | 71173.3 | ft2 | |
| | 1.63 | acres | |

| | | |
|---|---|---|
| Q | 3.03 | cfs |

**2 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 6.26 | in/hr | (5min/2 yr) |
| A | 71173.3 | ft2 | |
| | 1.63 | acres | |

| | | |
|---|---|---|
| Q | 3.58 | cfs |

# Alt 1 Rational Method - Peak Runoff Existing Conditions

**5 year**

| Q = CiA | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 7.27 | in/hr | (5min/5yr) |
| A | 71173.3 | ft2 | |
| | 1.63 | acres | |

| | | |
|---|---|---|
| Q | 4.16 | cfs |

**10 year**

| Q = CiA | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 8 | in/hr | (5min/10 yr) |
| A | 71173.3 | ft2 | |
| | 1.63 | acres | |

| | | |
|---|---|---|
| Q | 4.57 | cfs |

## Alt 1 Rational Method-Prop. C Value

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | C | Weighted C |
| 1 | Single Family | 243352 | 0.35 | 0.35 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | |
| Heavy soil with crop | 0.15-0.45 |
| | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Alt 1 Rational Method - Peak Runoff Proposed Conditions

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 1177.76 | 0.008 | 11 |

*use 10 min Storm

**5 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 4.23 | in/hr | (10min/1 yr) |
| A | 243352 | ft2 | |
| | 5.59 | acres | |

| | | |
|---|---|---|
| Q | 8.27 | cfs |

**10 year**

Q = CiA

| | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 5 | in/hr | (10min/2 yr) |
| A | 243352 | ft2 | |
| | 5.59 | acres | |

| | | |
|---|---|---|
| Q | 9.78 | cfs |

# Alt 1 Rational Method - Peak Runoff Existing Conditions

**5 year**

| Q = CiA | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 5.82 | in/hr | (10min/5yr) |
| A | 243352 | ft2 | |
| | 5.59 | acres | |

| | | |
|---|---|---|
| Q | 11.38 | cfs |

**10 year**

| Q = CiA | | |
|---|---|---|
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 6.4 | in/hr | (10min/10 yr) |
| A | 243352 | ft2 | |
| | 5.59 | acres | |

| | | |
|---|---|---|
| Q | 12.51 | cfs |

# Alt 2 Rational Method- Prop. C Value

| Weighted Runoff Coefficient | | | | |
|---|---|---|---|---|
| Subcatchmnet | Land Use | Area (sft) | C | Weighted C |
| 1 | Single Family | 171520 | 0.35 | 0.35 |

| Land Use | C |
|---|---|
| Business: | |
| Downtown areas | 0.70-0.95 |
| Neighborhood areas | 0.50-0.70 |
| Residential: | |
| Single-family areas | 0.30-0.50 |
| Multi units, detached | 0.40-0.60 |
| Multi units, Attached | 0.60-0.75 |
| Suburban | 0.25-0.40 |
| Industrial: | |
| Light areas | 0.50-0.80 |
| Heavy areas | 0.60-0.90 |
| Parks, cemeteries | 0.10-0.25 |
| Playgrounds | 0.20-0.35 |
| Railroad yard areas | 0.20-0.40 |
| Unimproved areas | 0.10-0.30 |
| Streets: | |
| Asphalt | 0.70-0.95 |
| Concrete | 0.80-0.95 |
| Brick | 0.70-0.85 |
| Drives and walks | 0.75-0.85 |
| Roofs | 0.75-0.85 |

| Land Use | C |
|---|---|
| Lawns: | |
| Sandy soil, flat, 2% | 0.05-0.10 |
| Sandy soil, ave., 2-7% | 0.10-0.15 |
| Sandy soil, steep, 7% | 0.15-0.20 |
| Heavy soil, flat, 2% | 0.13-0.17 |
| Heavy soil, ave., 2-7% | 0.18-0.22 |
| Heavy soil, steep, 7% | 0.25-0.35 |
| | 0.30-0.60 |
| | 0.20-0.50 |
| Agricultural land: | |
| Bare packed soil | 0.30-0.60 |
| Smooth | 0.20-0.50 |
| Rough | 0.20-0.40 |
| Cultivated rows | 0.10-0.25 |
| Heavy soil no crop | 0.15-0.45 |
| Heavy soil with crop | 0.05-0.25 |
| Sandy soil no crop | 0.05-0.25 |
| Sandy soil with crop | 0.10-0.25 |
| Pasture | |
| Heavy soil | 0.15-0.45 |
| Sandy soil | 0.05-0.25 |
| Woodlands | 0.05-0.25 |

**NOTE:** The designer must use judgement to select the appropriate C value within the range for the appropriate land use. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have lowest C values. Smaller areas with slowly permeable soils, steep slopes, and sparse vegetation should be assigned highest C values.

Source: American Society of Civil Engineers

# Alt 2 Rational Method - Peak Runoff Prop. Conditions

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| Watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 559.981 | 0.013 | 6 |

*Use 5 min Storm

**5 year**

| | | |
|---|---|---|
| Q = CiA | | |
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 7.27 | in/hr | (5min/5 yr) |
| A | 171520 | ft2 | |
| | 3.94 | acres | |

| | | |
|---|---|---|
| Q | 10.02 | cfs |

**10 year**

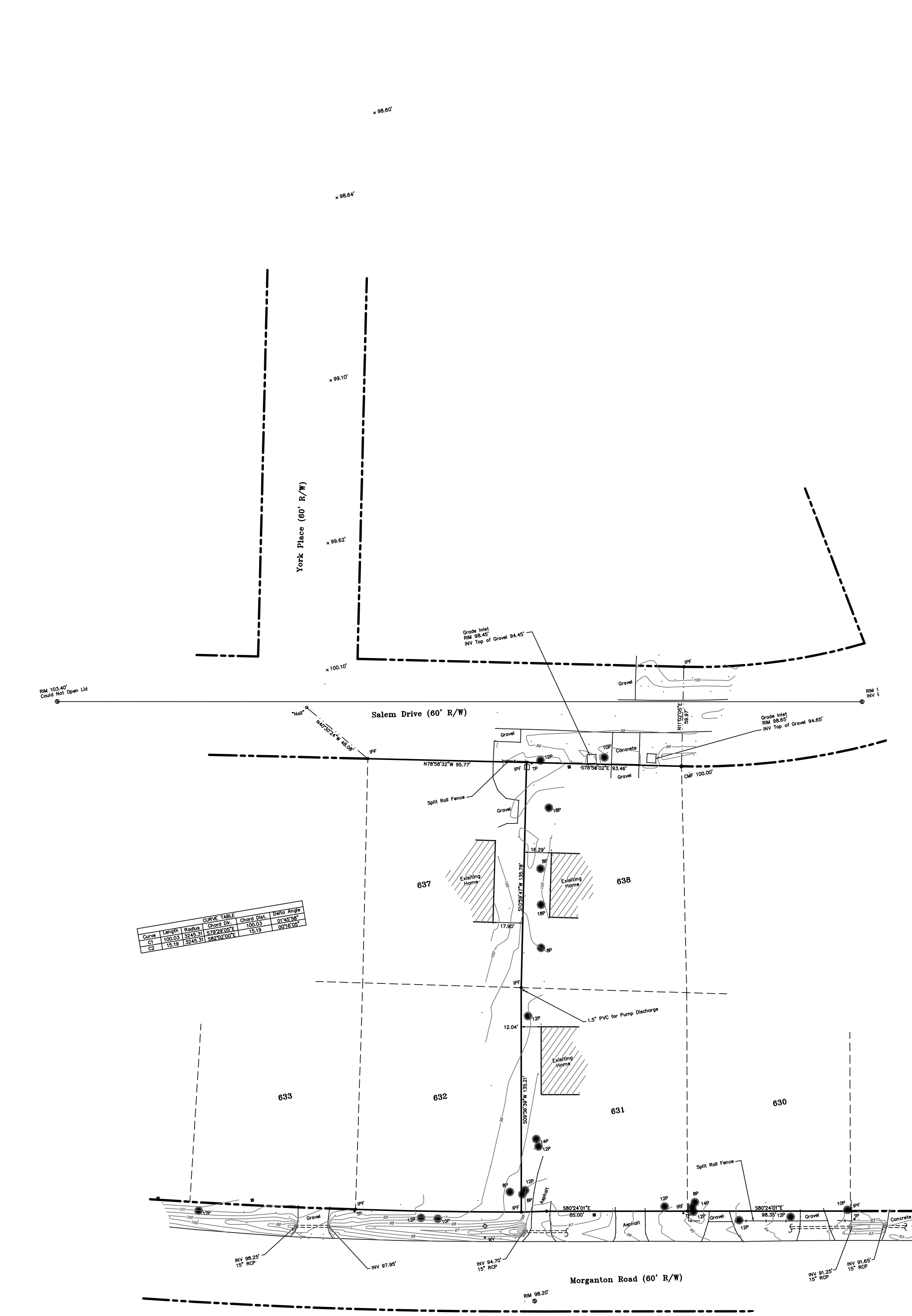
| | | |
|---|---|---|
| Q = CiA | | |
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 8 | in/hr | (5min/10 yr) |
| A | 171520 | ft2 | |
| | 3.94 | acres | |

| | | |
|---|---|---|
| Q | 11.03 | cfs |

# Exhibit B

Topographic and
Drainage Data



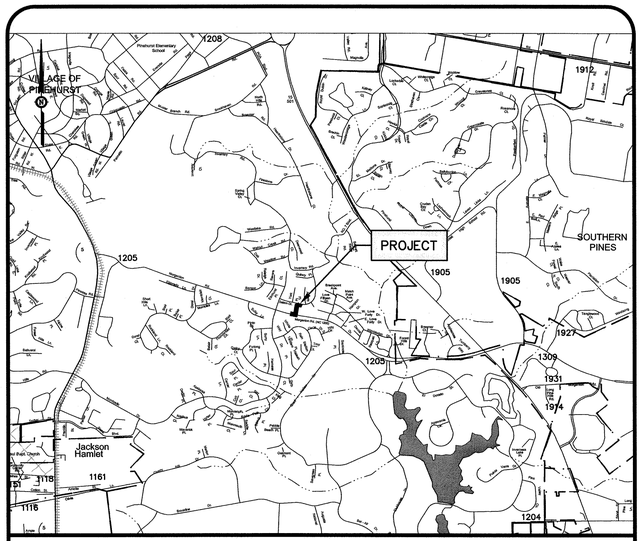

| CURVE TABLE | | | | | |
|---|---|---|---|---|---|
| Curve | Length | Radius | Chord Dir. | Chord Dist. | Delta Angle |
| C1 | 100.03 | 3245.31 | S79°29'05"E | 100.03 | 01°45'58" |
| C2 | 15.19 | 3245.31 | S82°02'00"E | 15.19 | 00°16'05" |

# STORM DRAINAGE IMPROVEMENTS
# FOR
# SALEM DRIVE

## PINEHURST, NORTH CAROLINA

### SCHEDULE OF DRAWINGS






VICINITY MAP


McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
5 REGIONAL CIRCLE, SUITE A PINEHURST, NC 28374 PH. (910) 295-3159 FIRM LICENSE # C-0459


SEAL 027788 ENGINEER BILLY J. ROARK PROFESSIONAL CAROLINA

8/19/15

AUGUST, 2015

**INFRASTRUCTURE INSPECTION NOTICE TO CONTRACTOR**

This is to advise you that the Village of Pinehurst is now requiring a **minimum** of Forty-eight (48) hours of notice when requesting an Engineering Inspection. Inspection requests may be made by calling the Engineering Department at 295-1900. *Items requiring an Engineering Inspection include, but are not limited to:*

1. Subgrade inspection/proof rolling (streets, sidewalks, firelanes, etc.) Density tests from an approved geotechnical engineering firm may be required.
2. Placement and inspection of base course materials including proof-rolling. Density tests from a Village-approved geotechnical engineering firm may be required/accepted by the Village.
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## LEGEND

- EXISTING IRON STAKE
- EXISTING CONCRETE MONUMENT
- SET CONCRETE MONUMENT
- SET IRON STAKE
- SQUARE FOOTAGE
- POWER SERVICE STUB
- SEWER SERVICE STUB
- TELEPHONE SERVICE STUB
- CABLE TV SERVICE STUB
- WATER METER
- FIRE HYDRANT
- UTILITY POLE
- BURIED PROPANE TANK
- SANITARY SEWER MANHOLE
- FENCE
- OVERHEAD ELECTRICAL LINE
- SILT FENCE

**DEVELOPMENT DATA BLOCK**

CONTACT PERSON:
RALPH BOWEN
THE VILLAGE OF PINEHURST
395 MAGNOLIA ROAD
PINEHURST, NORTH CAROLINA 28374
PHONE (910) 295-1900

ENGINEER:
BILLY J. ROARK, PE
MCGILL ASSOCIATES
5 REGIONAL CIRCLE, SUITE A
PINEHURST, NORTH CAROLINA 28374
PHONE (910) 295-3159 FAX (910) 295-3647

SURVEY INFORMATION BY:


RYAN McBRYDE
LAND SURVEYING • PLANNING
P.O. Box 1013
105-A Parkway Dr.
Aberdeen, NC 28315
Phone/Fax (910) 944-2410


## GENERAL CONSTRUCTION NOTES

1. CONTRACTOR SHALL REPAIR ALL DISTURBED AREAS TO EQUAL OR BETTER CONDITION THAN THE ORIGINAL SITE, OR AS NOTED.
2. LOCATIONS OF EXISTING UTILITIES AS SHOWN ARE APPROXIMATE ONLY. EXACT LOCATIONS ARE TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR. AT LEAST THREE DAYS PRIOR TO CONSTRUCTION, CONTRACTOR MUST NOTIFY EXISTING UTILITY OWNERS. CALL BEFORE YOU DIG. NORTH CAROLINA ONE CALL (1-800-632-4949).
3. CONTRACTOR MUST PROVIDE EROSION CONTROL DEVICES TO CONTROL RUNOFF FROM THE CONSTRUCTION SITE. CONTRACTOR WILL BE RESPONSIBLE FOR ANY FINES THAT MAY BE LEVIED DUE TO POLLUTION CREATED DURING CONSTRUCTION.
4. CONTRACTOR SHALL FOLLOW ALL FEDERAL, STATE AND LOCAL HEALTH AND SAFETY REGULATIONS PERTAINING TO CONSTRUCTION OPERATIONS.
5. ALL WORK SHALL BE COMPLETED WITHIN VILLAGE OF PINEHURST PROPERTY UNLESS OTHERWISE SHOWN.
6. ALL MATERIALS USED SHALL CONFORM TO VILLAGE OF PINEHURST STANDARDS.

GROUND STABILIZATION*

| SITE AREA DESCRIPTION | STABILIZATION TIME FRAME | STABILIZATION TIME FRAME EXCEPTIONS |
|---|---|---|
| • PERIMETER DIKES, SWALES, DITCHES, AND SLOPES | 7 DAYS | NONE |
| • HIGH QUALITY WATER (HQW) ZONES | 7 DAYS | NONE |
| • SLOPES STEEPER THAN 3:1 | 7 DAYS | IF SLOPES ARE 10' OR LESS IN LENGTH AND ARE NOT STEEP THAN 2:1, 14 DAYS ARE ALLOWED |
| • SLOPES 3:1 OR FLATTER | 14 DAYS | 7-DAYS FOR SLOPES GREATER THAN 50 FEET IN LENGTH |
| • ALL OTHER AREAS WITH SLOPES FLATTER THAN 4:1 | 14 DAYS | NONE (EXCEPT FOR PERIMETERS AND HQW ZONES) |

* "EXTENSIONS OF TIME MAY BE APPROVED BY THE PERMITTING AUTHORITY BASED ON WEATHER OR OTHER SITE-SPECIFIC CONDITIONS THAT MAKE COMPLIANCE INPRACTICABLE" (SECTION II.B(2)(b))

NOTE:
PERMANENT GROUND COVER FOR ALL DISTURBED AREAS SHALL BE ESTABLISHED WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER IS SHORTER) FOLLOWING COMPLETION OF CONSTRUCTION.

NOTE:
THE PROPOSED IMPROVEMENTS ARE NOT LOCATED IN EXISTING FLOODPLAIN, FLOODWAY, OR WETLAND AREAS.

**INFRASTRUCTURE INSPECTION NOTICE TO CONTRACTOR**

This is to advise you that the Village of Pinehurst is now requiring a **minimum** of Forty-eight (48) hours of notice when requesting an Engineering Inspection. Inspection requests may be made by calling the Engineering Department at 295-1900. *Items requiring an Engineering Inspection include, but are not limited to:*

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BEFORE YOU DIG!
CALL 1-800-632-4949
N.C. ONE-CALL CENTER
IT'S THE LAW!

| NO. | DATE | BY | REVISION DESCRIPTION |
|---|---|---|---|
| | | | |
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| | | | |


McGILL ASSOCIATES
ENGINEERING·PLANNING·FINANCE
5 REGIONAL CIRCLE, SUITE A · PINEHURST, NC 28374 · PH. (910) 295-3159 · FIRM LICENSE # C-0459


NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 027788 BILLY J. ROARK

STORM DRAINAGE IMPROVEMENTS FOR

# SALEM DRIVE

PINEHURST, NORTH CAROLINA

JOB NO.: 14.04028
DATE: JANUARY, 2015
DESIGNED BY: EWC
CADD BY: EWC
DESIGN REVIEW: ____
CONST. REVIEW: ____
14.04028 Drainage Plan.dwg

GENERAL NOTES AND LEGEND

SHEET
G-002

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# PLAN

GRAPHIC SCALE 50 0 25 50 100 150 — 1 INCH = 50 FEET

| CURVE TABLE | | | | | |
|---|---|---|---|---|---|
| Curve | Length | Radius | Chord Dir. | Chord Dist. | Delta Angle |
| C1 | 100.03 | 3245.31 | S79°29'05"E | 100.03 | 01°45'58" |
| C2 | 15.19 | 3245.31 | S82°02'00"E | 15.19 | 00°16'05" |

EXISTING SSMH
RIM: 103.40

"Nail"

N40°30'24"W 49.08'

IPF

N78°58'32"W 95.77'

IPF

IPF

S78°48'02"E 99.46'

CMF 100.00'

EXISTING SSMH
RIM: 98.80
INV: 94.10

Salem Drive (60' R/W)

York Place (60' R/W)

Amboy Place (60' R/W)

STA. 13+07.56 SD-1
EXISTING BOX TO REMAIN.
REPLACE EXISTING COVER
WITH NEW CONCRETE COVER
WITH MANHOLE LID
RIM: 98.45
INV: 95.45
TOP OF GRAVEL: 94.45

EXISTING TREE
TO BE REMOVED

PROPOSED PATCH EXISTING
ROAD. SEE DETAIL

EXISTING 8" WATER LINE

EXISTING FENCE
TO REMAIN

EXISTING POWER
BOX TO REMAIN

Existing Home

Existing Home

Existing Home

Gravel

Concrete

Asphalt

WALENTY AND CAROL JANOWICZ
DB: 4458, PG: 240
LOT: 636

ROBERT HERBERT
DB: 2009E, PG: 24
LOT: 637

JAMES PATE, III
AND MELINDA PATE
DB: 4378, PG: 468
LOT: 638

ALFRED DICK AND
PATRICIA MORATH
DB: 2007E, PG: 475
LOT 639

MARTY BIBLE
DB: 4340, PG: 398
LOT: 633

GARNETTE AND HARVEY DUPONT
DB: 4456, PG: 285
LOT: 632

DAVID AND SHEILA
WILLIAMS
DB: 2017, PG: 430
LOT: 631

JOHN SHANNON
DB: 1709, PG: 263
LOT: 630

EXISTING 1.5" PVC
FOR PUMP DISCHARGE
CONNECT TO NEW YI #2

PROPOSED 10'
STORM EASEMENT

PROPOSED PATCH EXISTING
CONCRETE DRIVEWAY, SEE DETAIL

STA. 12+62.22 SD-1
CONNECT NEW PIPE TO EXISTING
CONCRETE BOX. EXISTING BOX TO
REMAIN. REPLACE EXISTING COVER
WITH CONCRETE MANHOLE LID
RIM: 98.65
INV: 95.65
TOP OF GRAVEL: 94.65

EXISTING 5' SIDE YARD
DRAINAGE UTILITY
EASEMENT (TYP.)

S05°38'36"W 135.21'

S10°59'47"W 138.78'

PROPOSED FES
STA. 11+38.90 SD-2
N: 3820.30
E: 3403.68

EXISTING TREE
TO BE REMOVED

139 LF 15" RCP

S80°24'01"E
85.00'

S80°24'01"E
98.35'

PROPOSED YI #5
INSTALLED ON EXISTING 15" RCP
CONTRACTOR SHALL VERIFY
LOCATION AND DEPTH
PRIOR TO CONSTRUCTION
N: 3770.52
E: 3689.13

EXISTING 151 LF
15" RCP STORM
PIPE TO REMAIN

EXISTING 48 LF
15" RCP STORM
PIPE TO REMAIN

EXISTING STORM
PIPE OUTLET
INV: 91.25

EXISTING 15" RCP
STORM PIPE
INV: 91.65

EXISTING 21 LF 15" RCP
STORM PIPE TO BE
REMOVED AND REPLACED
EXISTING INV. IN: 98.26
EXISTING INV. OUT: 97.96

EXISTING SSMH
RIM: 98.20

EXISTING 6" WATER LINE

11+38.90

11+00

10+00

Morganton Road
S.R. 1205
(60' R/W)

BEFORE YOU DIG!
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NC ONE-CALL CENTER
IT'S THE LAW!

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| NO. | DATE | BY | REVISION DESCRIPTION |
|---|---|---|---|
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McGill ASSOCIATES
ENGINEERING-PLANNING-FINANCE
5 REGIONAL CIRCLE, SUITE A PINEHURST, NC 28374 PH: (910) 295-3159 FIRM LICENSE # C-459

SEAL 027788 — BILLY J. MCGILL, JR. — PROFESSIONAL ENGINEER

STORM DRAINAGE IMPROVEMENTS
FOR

# SALEM DRIVE

PINEHURST, NORTH CAROLINA

JOB NO.: 14.04028
DATE: JANUARY, 2015
DESIGNED BY: EWC
CADD BY: EWC
DESIGN REVIEW: ____
CONST. REVIEW: ____

14.04028 Drainage Plan.dwg

EXISTING CONDITIONS AND DEMOLITION PLAN

SHEET
CE-101

Z:\Vol1\Drawings\2014\14.04028Salem Drainage\Design\Civil\Drawings\14.04028 Drainage Plan.dwg 8/19/2015 10:17 AM BILL.ROARK

# PLAN

GRAPHIC SCALE 30 0 15 30 60 90 — 1 INCH = 30 FEET

BEFORE YOU DIG! CALL 1-800-632-4949 NC ONE-CALL CENTER IT'S THE LAW!

PROPOSED FES
STA. 11+38.90 SD-2
N: 3820.30
E: 3403.68

EXISTING 21 LF 15" RCP STORM PIPE TO BE REMOVED AND REPLACED
EXISTING INV. IN: 98.26
EXISTING INV. OUT: 97.96

PROPOSED YI #1
STA 10+00.00 SD-1
STA. 10+00.00 SD-2
N: 3793.72
E: 3540.02
CONNECT TO EXISTING 15" RCP
ELEV. 94.70

EXISTING TREE TO BE REMOVED

EXISTING 1.5" PVC FOR PUMP DISCHARGE CONNECT TO NEW YI #2

EXISTING 5' SIDE YARD DRAINAGE UTILITY EASEMENT (TYP.)

EXISTING SSMH RIM: 98.20

EXISTING 6" WATER LINE

EXISTING 151 LF 15" RCP STORM PIPE TO REMAIN

EXISTING FENCE TO REMAIN

EXISTING 48 LF 15" RCP STORM PIPE TO REMAIN

PROPOSED YI #5
INSTALLED ON EXISTING 15" RCP
CONTRACTOR SHALL VERIFY LOCATION AND DEPTH PRIOR TO CONSTRUCTION
N: 3770.52
E: 3689.13

PROPOSED YI #2
STA 11+47.11 SD-1
N: 3938.77
E: 3564.58

PROPOSED YI #3
STA 12+61.22 SD-1
N: 4050.76
E: 3586.42

PROPOSED 10' STORM EASEMENT

PROPOSED PATCH EXISTING CONCRETE DRIVEWAY, SEE DETAIL

STA. 12+62.22 SD-1
CONNECT NEW PIPE TO EXISTING CONCRETE BOX. EXISTING BOX TO REMAIN. REPLACE EXISTING COVER WITH CONCRETE MANHOLE LID
RIM: 98.65
INV: 95.65
TOP OF GRAVEL: 94.65

STA. 13+07.56 SD-1
EXISTING BOX TO REMAIN. REPLACE EXISTING COVER WITH NEW CONCRETE COVER WITH MANHOLE LID
RIM: 98.45
INV: 95.45
TOP OF GRAVEL: 94.45

EXISTING TREE TO BE REMOVED

36 LF 15" RCP

PROPOSED PATCH EXISTING ROAD. SEE DETAIL

PROPOSED YI #4
STA 13+85.02 SD-1
N: 4097.98
E: 3685.67

41 LF 15" RCP

EXISTING 8" WATER LINE

MARTY BIBLE DB: 4340, PG: 398 LOT: 633

WALENTY AND CAROL JANOWICZ DB: 4283, PG: 240 LOT: 636

GARNETTE AND HARVEY DUPONT DB: 495, PG: 256 LOT: 632

ROBERT HERBERT DB: 2009E, PG: 24 LOT: 637

DAVID AND SHEILA WILLIAMS DB: 2517, PG: 430 LOT 631

JAMES PATE, III AND MELINDA PATE DB: 4378, PG: 468 LOT: 638

JOHN SHANNON DB: 1122, PG: 263 LOT 630

ALFRED DICK AND PATRICIA MCGRATH DB: 2053, PG: 475 LOT 639

Morganton Road S.R. 1205 (60' R/W)

Salem Drive (60' R/W)

York Place (60' R/W)

147 LF 15" RCP

114 LF 15" RCP

46 LF 15" RCP

139 LF 15" RCP

## INFRASTRUCTURE INSPECTION NOTICE TO CONTRACTOR

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| NO. | DATE | BY | REVISION DESCRIPTION |
|---|---|---|---|
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# PROFILE

SCALE: HORIZ. 1"= 30'
VERT. 1"= 3'

## LINE SD-1

EXISTING GROUND
EXISTING 8" WATER LINE (FIELD VERIFY)
EXISTING 8" SEWER LINE
MIN. 6" CLEAR
147 LF 15" RCP @ 0.25%
114 LF 15" RCP @ 0.24%
41 LF 15" RCP @ 5.25%
36 LF 15" RCP @ 0.56%
46 LF 15" RCP @ 0.24%

PROPOSED YI #1
STA. 10+00.00 SD-1
TOP ELEV. 97.56
INV. IN: 94.70
INV. IN: 94.70
INV. OUT: 94.70

PROPOSED YI #2
STA. 11+47.11 SD-1
TOP ELEV. 99.22
INV. IN: 95.37
INV. OUT: 95.07

PROPOSED YI #3
STA. 12+61.22 SD-1
TOP ELEV. 99.50
INV. IN: 95.34
INV. OUT: 95.34

EXISTING BOX TO REMAIN
STA. 13+07.56 SD-1
TOP ELEV. 98.50
INV. IN: 95.45
INV. OUT: 95.45
TOP OF GRAVEL: 94.45

EXISTING BOX TO REMAIN
STA. 13+43.55 SD-1
TOP ELEV. 98.68
INV. IN: 95.65
INV. OUT: 95.65
TOP OF GRAVEL: 94.65

PROPOSED YI #4
STA. 13+85.02 SD-1
TOP ELEV. 99.50
INV. OUT: 97.83

## LINE SD-2

FINISHED GRADE
EXISTING GROUND
139 LF 15" RCP @ 2.56%

PROPOSED YI #1
STA. 10+00.00 SD-2
STA. 10+00.00 SD-1
TOP ELEV. 97.56
INV. IN: 94.70
INV. IN: 94.70
INV. OUT: 94.70

PROPOSED FES
STA. 11+38.90 SD-2
INV. IN: 98.26

McGill Associates
Engineering · Planning · Finance
5 Regional Circle, Suite A Pinehurst, NC 28374 PH. (910) 295-5159 Firm License # C-0459

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 027788 BILLY A. ROARK

STORM DRAINAGE IMPROVEMENTS FOR

# SALEM DRIVE

PINEHURST, NORTH CAROLINA

JOB NO.: 14.04028
DATE: FEBRUARY, 2015
DESIGNED BY: MSA
CADD BY: EWC
DESIGN REVIEW: ____
CONST. REVIEW: ____
FILE NAME: 14.04028 Drainage Plan.dwg

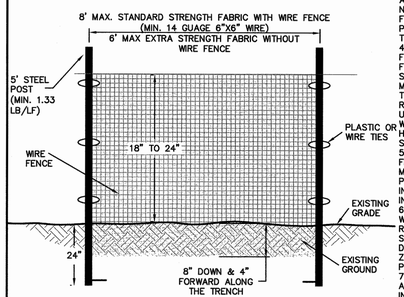
PROPOSED STORM DRAINAGE PLAN AND PROFILE

SHEET C-101

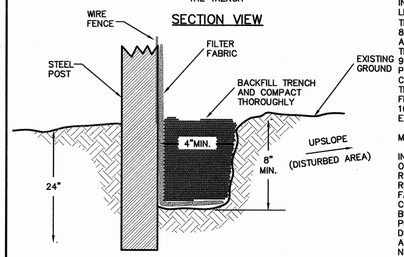
Z:\1c01\Drawings\2014\14.04028\Salem Drainage\Design\Civil\Drawings\14.04028 Drainage Plan.dwg 8/19/2015 10:17 AM BILL ROARK

NOTES:

1. FILTER BARRIERS SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND DAILY DURING PROLONGED RAINFALL. REPAIR SHALL BE MADE AS NECESSARY.
2. FABRIC SHALL BE REPLACED PROMPTLY IF FOUND TO BE IN DISREPAIR.
3. SEDIMENT DEPOSITS SHALL BE REMOVED AFTER EACH STORM EVENT AND WHEN DEPOSITS REACH APPROXIMATELY 1/3 HEIGHT OF BARRIER.
4. REFERENCE NCDENR LAND QUALITY SECTION DESIGN MANUAL: 6.62.




SECTION VIEW




| SLOPE | SLOPE LENGTH(FT) | MAXIMUM AREA(SQFT) |
|---|---|---|
| <2% | 100 | 10,000 |
| 2 TO 5% | 75 | 7,500 |
| 5 TO 10% | 50 | 5,000 |
| 10 TO 20% | 25 | 2,500 |
| >20% | 15 | 1,500 |

CONSTRUCTION SPECIFICATIONS

1. CONSTRUCT THE SEDIMENT BARRIER OF STANDARD STRENGTH OR EXTRA STRENGTH SYNTHETIC FILTER FABRICS.
2. ENSURE THAT THE HEIGHT OF THE SEDIMENT FENCE DOES NOT EXCEED 24 INCHES ABOVE THE GROUND SURFACE. (HIGHER FENCES MAY IMPOUND VOLUMES OF WATER SUFFICIENT TO CAUSE FAILURE OF THE STRUCTURE.)
3. CONSTRUCT THE FILTER FABRIC FROM A CONTINUOUS ROLL CUT TO THE LENGTH OF THE BARRIER TO AVOID JOINTS. WHEN JOINTS ARE NECESSARY, SECURELY FASTEN THE FILTER CLOTH ONLY AT A SUPPORT POST WITH 4 FEET MINIMUM OVERLAP TO THE NEXT POST.
4. SUPPORT STANDARD STRENGTH FILTER FABRIC BY WIRE MESH FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS. EXTEND THE WIRE MESH SUPPORT TO THE BOTTOM OF THE TRENCH. FASTEN THE WIRE REINFORCEMENT, THEN FABRIC ON THE UPSLOPE SIDE OF THE FENCE POST. WIRE OR PLASTIC ZIP TIES SHOULD HAVE MINIMUM 50 POUND TENSILE STRENGTH.
5. WHEN A WIRE MESH SUPPORT FENCE IS USED, SPACE POSTS A MAXIMUM OF 8 FEET APART. SUPPORT POSTS SHOULD BE DRIVEN SECURELY INTO THE GROUND A MINIMUM OF 24 INCHES.
6. EXTRA STRENGTH FILTER FABRIC WITH 6 FEET POST SPACING DOES NOT REQUIRE WIRE MESH SUPPORT FENCE. SECURELY FASTEN THE FILTER FABRIC DIRECTLY TO POSTS. WIRE OR PLASTIC ZIP TIES SHOULD HAVE MINIMUM 50 POUND TENSILE STRENGTH.
7. EXCAVATE A TRENCH APPROXIMATELY 4 INCHES WIDE AND 8 INCHES DEEP ALONG THE PROPOSED LINE OF POSTS AND UPSLOPE FROM THE BARRIER (FIGURE 6.62A).
8. PLACE 12 INCHES OF THE FABRIC ALONG THE BOTTOM AND SIDE OF THE TRENCH.
9. BACKFILL THE TRENCH WITH SOIL PLACED OVER THE FILTER FABRIC AND COMPACT. THOROUGH COMPACTION OF THE BACKFILL IS CRITICAL TO SILT FENCE PERFORMANCE.
10. DO NOT ATTACH FILTER FABRIC TO EXISTING TREES.

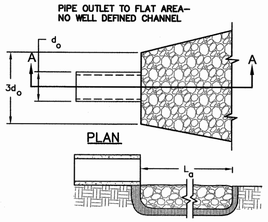
MAINTENANCE

INSPECT SEDIMENT FENCES AT LEAST ONCE A WEEK AND AFTER EACH RAINFALL. MAKE ANY REQUIRED REPAIRS IMMEDIATELY. SHOULD THE FABRIC OF A SEDIMENT FENCE COLLAPSE, TEAR, DECOMPOSE OR BECOME INEFFECTIVE, REPLACE IT PROMPTLY. REMOVE SEDIMENT DEPOSITS AS NECESSARY TO PROVIDE ADEQUATE STORAGE VOLUME FOR THE NEXT RAIN AND TO REDUCE PRESSURE ON THE FENCE. TAKE CARE TO AVOID UNDERMINING THE FENCE DURING CLEANOUT. REMOVE ALL FENCING MATERIALS AND UNSTABLE SEDIMENT DEPOSITS AND BRING THE AREA TO GRADE AND STABILIZE IT AFTER THE CONTRIBUTING DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.

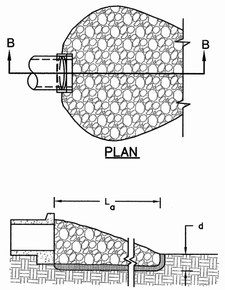
## SEDIMENTATION/SILT FENCE

NOT TO SCALE

PIPE OUTLET TO FLAT AREA– NO WELL DEFINED CHANNEL




PIPE OUTLET TO WELL–DEFINED CHANNEL




NOTES

1. La IS THE LENGTH OF THE RIPRAP APRON
2. $d_{50}$ = 1.5 TIMES THE MAXIMUM STONE DIAMETER BUT NOT LESS THAN 6".
3. IN A WELL–DEFINED CHANNEL EXTEND THE APRON UP THE CHANNEL BANKS TO AN ELEVATION OF 6" ABOVE THE MAXIMUM TAILWATER DEPTH OR TO THE TOP OF THE BANK, WHICHEVER IS LESS.
4. FILTER FABRIC SHOULD BE INSTALLED BETWEEN THE RIPRAP AND SOIL FOUNDATION.
5. REFERENCE NCDENR LAND QUALITY SECTION DESIGN MANUAL: 6.41.

CONSTRUCTION SPECIFICATIONS

1. ENSURE THAT THE SUBGRADE FOR THE FILTER AND RIPRAP FOLLOWS THE REQUIRED LINES AND GRADES SHOWN IN THE PLAN. COMPACT ANY FILL REQUIRED IN THE SUBGRADE TO THE DENSITY OF THE SURROUNDING UNDISTURBED MATERIAL. LOW AREAS IN THE SUBGRADE ON UNDISTURBED SOIL MAY ALSO BE FILLED BY INCREASING THE RIPRAP THICKNESS.
2. THE RIPRAP AND GRAVEL FILTER MUST CONFORM TO THE SPECIFIED GRADING LIMITS SHOWN ON THE PLANS.
3. FILTER CLOTH, WHEN USED, MUST MEET DESIGN REQUIREMENTS AND BE PROPERLY PROTECTED FROM PUNCHING OR TEARING DURING INSTALLATION. REPAIR ANY DAMAGE BY REMOVING THE RIPRAP AND PLACING ANOTHER PIECE OF FILTER CLOTH OVER THE DAMAGED AREA. ALL CONNECTING JOINTS SHOULD OVERLAP SO THE TOP LAYER IS ABOVE THE DOWNSTREAM LAYER A MINIMUM OF 1 FOOT. IF THE DAMAGE IS EXTENSIVE, REPLACE THE ENTIRE FILTER CLOTH.
4. RIPRAP MAY BE PLACED BY EQUIPMENT, BUT TAKE CARE TO AVOID DAMAGING THE FILTER.
5. THE MINIMUM THICKNESS OF THE RIPRAP SHOULD BE 1.5 TIMES THE MAXIMUM STONE DIAMETER.
6. RIPRAP MAY BE FIELD STONE OR ROUGH QUARRY STONE. IT SHOULD BE HARD, ANGULAR, HIGHLY WEATHER–RESISTANT AND WELL GRADED.
7. CONSTRUCT THE APRON ON ZERO GRADE WITH NO OVERFILL AT THE END. MAKE THE TOP OF THE RIPRAP AT THE DOWNSTREAM END LEVEL WITH THE RECEIVING AREA OR SLIGHTLY BELOW IT.
8. ENSURE THAT THE APRON IS PROPERLY ALIGNED WITH THE RECEIVING STREAM AND PREFERABLY STRAIGHT THROUGHOUT ITS LENGTH. IF A CURVE IS NEEDED TO FIT SITE CONDITIONS, PLACE IT IN THE UPPER SECTION OF THE APRON.
9. IMMEDIATELY AFTER CONSTRUCTION, STABILIZE ALL DISTURBED AREAS WITH VEGETATION (PRACTICES 6.10, TEMPORARY SEEDING, AND 6.11, PERMANENT SEEDING).

MAINTENANCE

INSPECT RIPRAP OUTLET STRUCTURES WEEKLY AND AFTER SIGNIFICANT (1/2 INCH OR GREATER) RAINFALL EVENTS TO SEE IF ANY EROSION AROUND OR BELOW THE RIPRAP HAS TAKEN PLACE, OR IF STONES HAVE BEEN DISLODGED. IMMEDIATELY MAKE ALL NEEDED REPAIRS TO PREVENT FURTHER DAMAGE.

RIPRAP APRON SIZING (PER FIG. 8.06a)

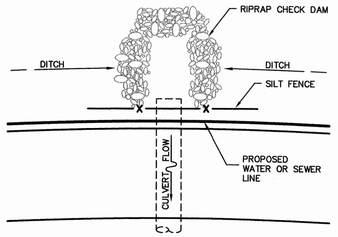
| OUTLET No. | PIPE DIAMETER (Do) | 3 x Do | APRON LENGTH (La) | APRON WIDTH (W=Do+La) | RIPRAP SIZE ($d_{50}$xTHICKNESS) |
|---|---|---|---|---|---|
| ALL PIPES | 24" | 6' | 10' | 12 | 8" |

## OUTLET PROTECTION

NOT TO SCALE

CONSTRUCTION SPECIFICATIONS

1. CLEAR THE AREA OF ALL DEBRIS THAT MIGHT HINDER EXCAVATION AND DISPOSAL OF SPOIL.
2. INSTALL THE CLASS B OR CLASS I RIPRAP IN A SEMI–CIRCLE AROUND THE PIPE INLET. THE STONE SHOULD BE BUILT UP HIGHER ON EACH END WHERE IT TIES INTO THE EMBANKMENT. THE MINIMUM CREST WIDTH OF THE RIPRAP SHOULD BE 3 FEET, WITH A MINIMUM BOTTOM WIDTH OF 11 FEET. THE MINIMUM HEIGHT SHOULD BE 2 FEET, BUT ALSO 1 FOOT LOWER THAN THE SHOULDER OF THE EMBANKMENT OR DIVERSIONS.
3. A 1 FOOT THICK LAYER OF NC DOT #5 OR #57 STONE SHOULD BE PLACED ON THE OUTSIDE SLOPE OF THE RIPRAP.
4. THE SEDIMENT STORAGE AREA SHOULD BE EXCAVATED AROUND THE OUTSIDE OF THE STONE HORSESHOE 18 INCHES BELOW NATURAL GRADE.
5. WHEN THE CONTRIBUTING DRAINAGE AREA HAS BEEN STABILIZED, FILL DEPRESSION AND ESTABLISH FINAL GRADING ELEVATIONS, COMPACT AREA PROPERLY, AND STABILIZE WITH GROUND COVER.

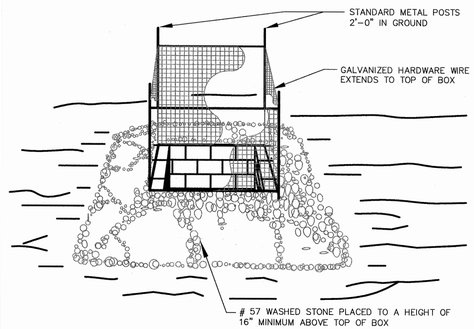



MAINTENANCE

INSPECT ROCK PIPE INLET PROTECTION AT LEAST WEEKLY AND AFTER EACH SIGNIFICANT (½ INCH OR GREATER) RAINFALL EVENT AND REPAIR IMMEDIATELY. REMOVE SEDIMENT AND RESTORE THE SEDIMENT STORAGE AREA TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO ONE–HALF THE DESIGN DEPTH OF THE TRAP. PLACE THE SEDIMENT THAT IS REMOVED IN THE DESIGNATED DISPOSAL AREA AND REPLACE THE CONTAMINATED PART OF THE GRAVEL FACING. CHECK THE STRUCTURE FOR DAMAGE. ANY RIPRAP DISPLACED FROM THE STONE HORSESHOE MUST BE REPLACED IMMEDIATELY. AFTER ALL THE SEDIMENT–PRODUCING AREAS HAVE BEEN PERMANENTLY STABILIZED, REMOVE THE STRUCTURE AND ALL THE UNSTABLE SEDIMENT. SMOOTH THE AREA TO BLEND WITH THE ADJOINING AREAS AND PROVIDE PERMANENT GROUND COVER

## EXISTING CULVERT PROTECTION

NOT TO SCALE




CONSTRUCTION SPECIFICATIONS

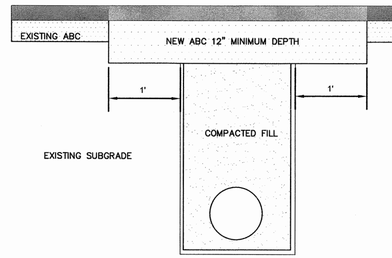
1. UNIFORMLY GRADE A SHALLOW DEPRESSION APPROACHING THE INLET.
2. DRIVE 5–FOOT STEEL POSTS 2 FEET INTO THE GROUND SURROUNDING THE INLET. SPACE POSTS EVENLY AROUND THE PERIMETER OF THE INLET, A AXIMUM OF 4 FEET APART.
3. SURROUND THE POSTS WITH WIRE MESH HARDWARE CLOTH. SECURE THE WIRE MESH TO THE STEEL POSTS AT THE TOP, MIDDLE, AND BOTTOM. PLACING A 2–FOOT FLAP OF THE WIRE MESH UNDER THE GRAVEL FOR ANCHORING IS RECOMMENDED.
4. PLACE CLEAN GRAVEL (NC DOT #5 OR #57 STONE) ON A 2:1 SLOPE WITH A HEIGHT OF 16 INCHES AROUND THE WIRE, AND SMOOTH TO AN EVEN GRADE.
5. ONCE THE CONTRIBUTING DRAINAGE AREA HAS BEEN STABILIZED, REMOVE ACCUMULATED SEDIMENT, AND ESTABLISH FINAL GRADING ELEVATIONS.
6. COMPACT THE AREA PROPERLY AND STABILIZED IT WITH GROUNDCOVER.

MAINTENANCE: INSPECT THE BARRIER AT LEAST WEEKLY AND AFTER EACH SIGNIFICANT (1/2 INCH OR GREATER) RAINFALL AND MAKE REPAIRS AS NEEDED. REMOVE SEDIMENT AS NECESSARY TO PROVIDE ADEQUATE STORAGE VOLUME FOR SUBSEQUENT RAINS. WHEN THE CONTRIBUTING DRAINAGE AREA HAS BEEN ADEQUATELY STABILIZED, REMOVE ALL MATERIALS AND ANY UNSTABLE SOIL, AND EITHER SALVAGE OR DISPOSE OF IT PROPERLY. BRING THE DISTURBED AREA TO PROPER GRADE, THEN SMOOTH AND COMPACT IT. APPROPRIATELY STABILIZE ALL BARE AREAS AROUND THE INLET.

## GRATED INLET PROTECTION

NOT TO SCALE

## ASPHALT PAVEMENT PATCH




NOTES:

1. THE PAVEMENT SHALL BE DEFINED BY A STRAIGHT EDGE, PREFERABLY A MACHINED SAW CUT: TACKED.
2. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH SUITABLE MATERIAL AND COMPACTED TO A DENSITY OF AT LEAST 95% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH AASHTO T–99 AS MODIFIED BY NCDOT.
3. THE FINAL 1' OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO A DENSITY EQUAL TO 100% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH AASHTO T–180 AS MODIFIED BY NCDOT. BITUMINOUS BASE OR BINDER MAY BE SUBSTITUTED IF APPROVED BY THE ENGINEER.
4. THE ENTIRE THICKNESS/VERTICAL EDGE OF THE CUT SHALL BE TACKED.
5. THE SAME DEPTH OF PAVEMENT MATERIAL WHICH EXISTS SHALL BE REINSTALLED, BUT IN NO CASE SHALL THE ASPHALT BE LESS THAN 2" THICK.
6. THE ASPHALT PAVEMENT MATERIAL SHALL BE INSTALLED AND COMPACTED THOROUGHLY TO ACHIEVE A SMOOTH LEVEL PATCH.

| REV | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|
| 1 | ISSUE FOR PUBLICATION | 03/04 | HJG |
| | | | |
| NOT TO SCALE | DWG NO. 3.06 | SHEET 1 OF 1 | |

ASPHALT PAVEMENT PATCH

**INFRASTRUCTURE INSPECTION NOTICE TO CONTRACTOR**

This is to advise you that the Village of Pinehurst is now requiring a **minimum** of Forty-eight (48) hours of notice when requesting an Engineering Inspection. Inspection requests may be made by calling the Engineering Department at 295-1900. *Items requiring an Engineering Inspection include, but are not limited to:*

1. Subgrade inspection/proof rolling (streets, sidewalks, firelanes, etc.) Density tests from an approved geotechnical engineering firm may be required.
2. Placement and inspection of base course materials including proof-rolling. Density tests from a Village-approved geotechnical engineering firm may be required/accepted by the Village.
3. Placement and compaction of pavement materials including concrete and asphalt surface courses. Includes stringlines/grade control, paving & rolling operations, material inspections.
4. Installation of water and sewer mains and services including pressure testing, pipe laying, chlorination of water mains, bacterial testing, mandrel pulls, etc. necessary to meet the Village's Utility ordinances. NOTE: The Contractor shall also contact Moore County Public Utilities Department Engineering Division at 947-6315 to schedule utility inspections as required by MCPUD.
5. Installation of formwork and placement of concrete (sidewalks, curb & gutter, etc.) within the public right of way.
6. Installation of storm drainage systems (pipes, trenches, catch basins, frames/grates, outlet protection. etc.)

**Failure to schedule the required inspections shall be grounds for rejection of all work not inspected and issuance of a stop-work order until the project is in compliance**

| NO. | DATE | BY | REVISION DESCRIPTION |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

BEFORE YOU DIG CALL 1-800-632-4949 N.C. ONE-CALL CENTER IT'S THE LAW!


McGILL ASSOCIATES
ENGINEERING·PLANNING·FINANCE
5 REGIONAL CIRCLE, SUITE A PINEHURST, NC 28374 PH. (910) 295-3159 FIRM LICENSE # C-0459


CAROLINA PROFESSIONAL ENGINEER SEAL 027788 WILLIAM J. ROARK

STORM DRAINAGE IMPROVEMENTS FOR

# SALEM DRIVE

PINEHURST, NORTH CAROLINA

JOB NO.: 14.04028
DATE: FEBRUARY 2015
DESIGNED BY: MSA
CADD BY: EWC
DESIGN REVIEW: ____
CONST. REVIEW: ____

14.04028 Drainage Plan.dwg

MISCELLANEOUS DETAILS

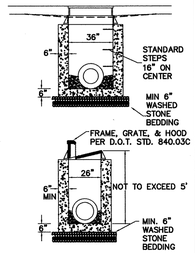
SHEET

C-501

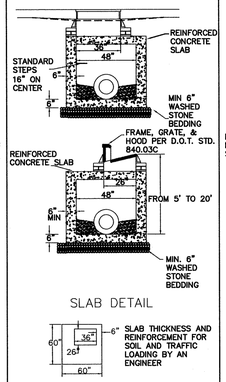
Z:\Vol1\Drawings\2014\14.04028\Salem Drainage\Design\Civil\Drawings\14.04028 Drainage Plan.dwg 8/19/2015 9:31 AM BILL ROARK

# PRECAST CONCRETE CATCH BASIN

## SHALLOW TYPE
(5 FEET OR LESS IN DEPTH)




## INTERMEDIATE TYPE (4'X4')
(5 FEET TO 20 FEET IN DEPTH)

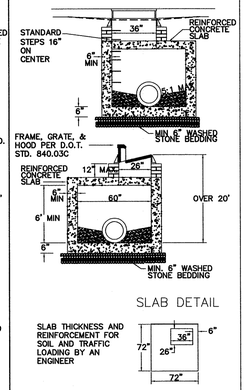



SLAB DETAIL




SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

## DEEP TYPE (5'X5')
(OVER 20 FEET IN DEPTH)




SLAB DETAIL




SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

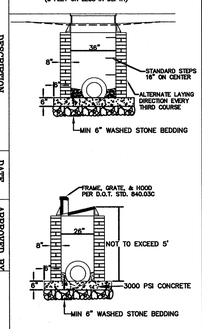
NOTES:

1. CONCRETE SHALL BE 4000 PSI MIN FOR ALL PRECAST CONCRETE CATCH BASINS.
2. PRECAST CONCRETE STRUCTURES MAY ONLY BE INSTALLED TO DEPTHS CERTIFIED AS ACCEPTABLE BY THE MANUFACTURER.
3. "WAFFLE" BOXES ARE ACCEPTABLE FOR SHALLOW TYPE CATCH BASINS.

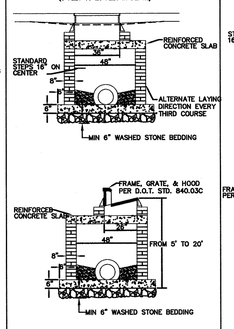
| REV | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|
| 1 | ISSUE FOR PUBLICATION | 06/04 | HJG |
| NOT TO SCALE | DWG NO. 5.03-A | SHEET 1 OF 1 | |

# CONCRETE BLOCK OR BRICK CATCH BASIN

## SHALLOW TYPE
(5 FEET OR LESS IN DEPTH)




## INTERMEDIATE TYPE (4'X4')
(5 FEET TO 20 FEET IN DEPTH)

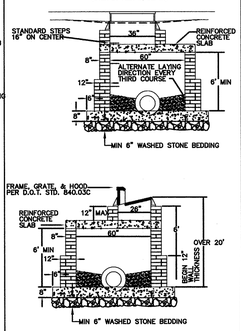



SLAB DETAIL




SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

## DEEP TYPE (5'X5')
(OVER 20 FEET IN DEPTH)




SLAB DETAIL



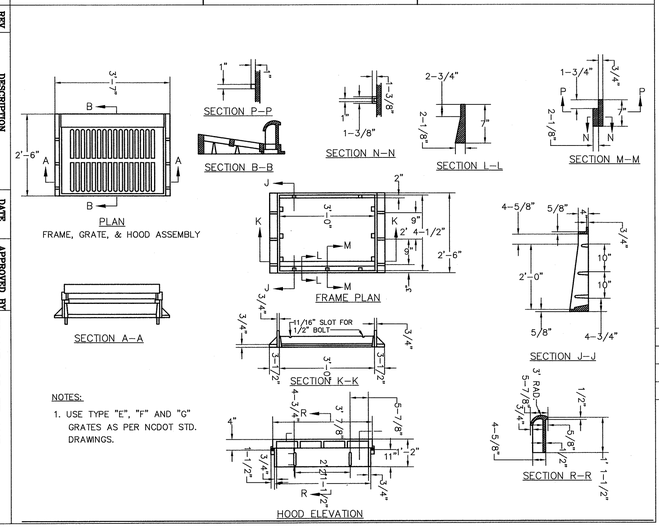

SLAB THICKNESS AND REINFORCEMENT FOR SOIL AND TRAFFIC LOADING BY AN ENGINEER

NOTES:

1. OVER 8' IN DEPTH, 12" WALL THICKNESS TO 6' FROM TOP OF WALL AND 8" BOTTOM SLAB SHALL BE USED.

| REV | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|
| 1 | ISSUE FOR PUBLICATION | 06/04 | HJG |
| NOT TO SCALE | DWG NO. 5.03-B | SHEET 1 OF 1 | |

# FRAME, GRATE AND HOOD FOR CATCH BASIN

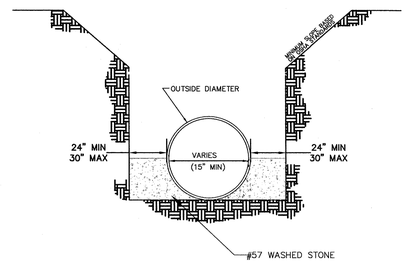



NOTES:

1. USE TYPE "E", "F" AND "G" GRATES AS PER NCDOT STD. DRAWINGS.

| REV | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|
| 1 | ISSUE FOR PUBLICATION | 06/04 | HJG |
| NOT TO SCALE | DWG NO. 5.04 | SHEET 1 OF 1 | |

# TRENCH DETAIL FOR STORM DRAIN PIPES

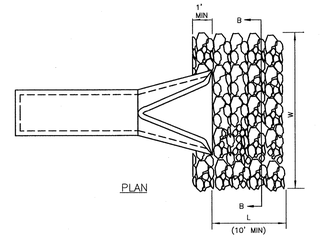



NOTES:

1. A MINIMUM OF 24" FROM OUTSIDE DIAMETER OF PIPE TO SIDE OF TRENCH MUST BE ALLOWED FOR COMPACTION OF FILL MATERIAL. BACKFILLING OF TRENCHES SHALL BE ACCOMPLISHED IMMEDIATELY AFTER THE PIPE IS LAID THE FILL AROUND THE PIPE SHALL BE PLACED IN LAYERS NOT TO EXCEED 6". UNDER NO CIRCUMSTANCES SHALL WATER BE PERMITTED TO RISE IN UNBACKFILLED TRENCHES AFTER THE PIPE HAS BEEN PLACED. COMPACTION REQUIREMENTS SHALL BE ATTAINED BY THE USE OF THE MECHANICAL TAMPS ONLY. EACH AND EVERY LAYER OF BACKFILL SHALL BE PLACED LOOSE AND THOROUGHLY COMPACTED INTO PLACE.
2. ALL BACKFILL MATERIAL SHALL HAVE AN IN PLACE COMPACTED DENSITY OF 95% OF STANDARD PROCTOR. THE FINAL 2' BELOW FINISHED GRADE SHALL BE 100%.
3. ALL TRENCHING OPERATIONS SHALL MEET OSHA STANDARDS.
4. BACKFILL MATERIAL BENEATH ROADWAY SHALL BE SELECT BACKFILL MATERIAL.
5. HAUNCHING SHALL BE WITH #57 OR #67 WASHED STONE UNLESS OTHERWISE APPROVED BY THE VILLAGE ENGINEER.

| REV | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|
| 1 | ISSUE FOR PUBLICATION | 06/04 | HJG |
| NOT TO SCALE | DWG NO. 5.08 | SHEET 1 OF 1 | |

# RIP-RAP APRON AT CULVERTS



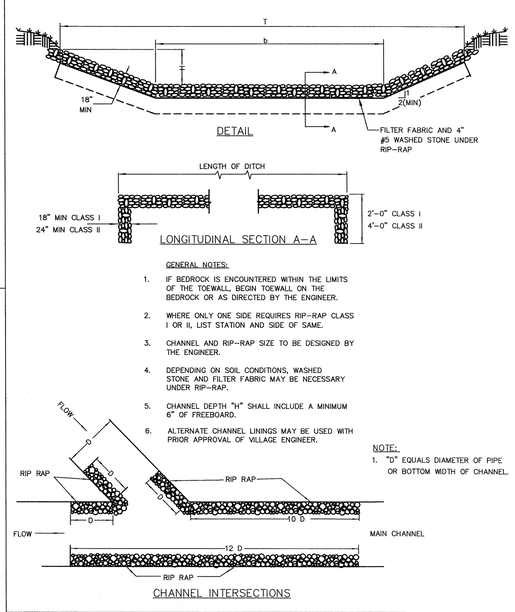

SECTION B-B

**NOTES:**

1. **CLASS OR MEDIAN SIZE OF RIP-RAP AND LENGTH, WIDTH AND DEPTH OF APRON TO BE DESIGNED BY THE ENGINEER.**
2. **NO BENDS OR CURVES IN THE HORIZONTAL ALIGNMENT OF THE APRON WILL BE PERMITTED.**
3. **RIP-RAP SHOULD EXTEND UP BOTH SIDES OF THE APRON AND AROUND THE END OF THE PIPE OR CULVERT AT THE DISCHARGE OUTLET AT A MAXIMUM SLOPE OF 3:1 AND A HEIGHT NOT LESS THAN TWO THIRDS THE PIPE DIAMETER OR CULVERT HEIGHT.**
4. **THERE SHALL BE NO OVERFLOW FROM THE END OF THE APRON TO THE SURFACE OF THE RECEIVING CHANNEL. THE AREA TO BE PAVED OR RIP-RAPPED SHALL BE UNDERCUT SO THAT THE INVERT OF THE APRON SHALL BE AT THE SAME GRADE (FLUSH) WITH THE SURFACE OF THE RECEIVING CHANNEL. THE APRON SHALL HAVE A CUTOFF OR TOE WALL AT THE DOWNSTREAM END.**
5. **THE WIDTH OF THE END OF THE APRON SHALL BE EQUAL TO THE BOTTOM WIDTH OF THE RECEIVING CHANNEL. MAXIMUM TAPER TO RECEIVING CHANNEL 5:1.**
6. **ALL SUBGRADE FOR STRUCTURE TO BE COMPACTED TO 95% OR GREATER.**
7. **THE PLACING OF FILL, EITHER LOOSE OR COMPACTED IN THE RECEIVING CHANNEL SHALL NOT BE ALLOWED.**

| REV | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|
| 1 | ISSUE FOR PUBLICATION | 06/04 | HJG |
| NOT TO SCALE | DWG NO. 5.07 | SHEET 1 OF 1 | |

# RIP-RAP LINED DITCHES




GENERAL NOTES:

1. IF BEDROCK IS ENCOUNTERED WITHIN THE LIMITS OF THE TOEWALL, BEGIN TOEWALL ON THE BEDROCK OR AS DIRECTED BY THE ENGINEER.
2. WHERE ONLY ONE SIDE REQUIRES RIP-RAP CLASS I OR II, LIST STATION AND SIDE OF SAME.
3. CHANNEL AND RIP-RAP SIZE TO BE DESIGNED BY THE ENGINEER.
4. DEPENDING ON SOIL CONDITIONS, WASHED STONE AND FILTER FABRIC MAY BE NECESSARY UNDER RIP-RAP.
5. CHANNEL DEPTH "H" SHALL INCLUDE A MINIMUM 6" OF FREEBOARD.
6. ALTERNATE CHANNEL LININGS MAY BE USED WITH PRIOR APPROVAL OF VILLAGE ENGINEER.

NOTE:
1. "D" EQUALS DIAMETER OF PIPE OR BOTTOM WIDTH OF CHANNEL.

| REV | DESCRIPTION | DATE | APPROVED BY |
|---|---|---|---|
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| NOT TO SCALE | DWG NO. 5.09 | SHEET 1 OF 1 | |

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BEFORE YOU DIG!
CALL 1-800-632-4949
N.C. ONE-CALL CENTER
IT'S THE LAW!

| NO. | DATE | BY | REVISION DESCRIPTION |
|---|---|---|---|
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McGill ASSOCIATES
ENGINEERING·PLANNING·FINANCE
5 REGIONAL CIRCLE, SUITE A PINEHURST, NC 28374 PH. (910) 295-5139 FIRM LICENSE # C-0459

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 027788 BILLY JOE ROARK

STORM DRAINAGE IMPROVEMENTS FOR

# SALEM DRIVE

PINEHURST, NORTH CAROLINA

JOB NO.: 14.04028
DATE: FEBRUARY, 2015
DESIGNED BY: MSA
CADD BY: EWC
DESIGN REVIEW: ____
CONST. REVIEW: ____
14.04028 Drainage Plan.dwg

MISCELLANEOUS DETAILS

SHEET
C-502

Z:\Vol1\Drawings\2014\14.04028\Salem Drainage\Design\Civil\Drawings\14.04028 Drainage Plan.dwg 8/19/2015 9:21 AM BILL ROARK

# Exhibit C

## Pipe Sizing Calculations

# Salem Dr Drainage, Existing Pipe Capacity

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

| Pipe | D (in) | D (ft) | n | ope (ft/f | Q (cfs) |
|---|---|---|---|---|---|
| 1 | 15.00 | 1.25 | 0.013 | 0.0525 | 14.71 |
| 2 | 15.00 | 1.25 | 0.013 | 0.0056 | 4.80 |
| 3 | 15.00 | 1.25 | 0.013 | 0.0024 | 3.15 |
| 4 | 15.00 | 1.25 | 0.013 | 0.0024 | 3.15 |
| 5 | 15.00 | 1.25 | 0.013 | 0.0025 | 3.21 |

# Alt1- Pipe Sizing Pipe 1

Weighted Runoff Coefficient

| Subcatchmnet | Land Use | Area (sft) | % of Area | C | Weighted C |
|---|---|---|---|---|---|
| 1 | Single Family | 14288.6 | 100% | 0.35 | 0.35 |

| | | |
|---|---|---|
| Q = CiA | | |
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 8 | in/hr (5 min, 10 yr) | |
| A | 14288.6 | ft2 | |
| | 0.33 | acres | |
| Q | 0.92 | cfs | |

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 282.467 | 0.014160946 | 3 |
| start elev | 451 | end elev | 447 | |

*Use 5 min Storm

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

| Q (cfs) | n | slope (ft/ft) | D (ft) | D (in) | Barrel Diameter (in) |
|---|---|---|---|---|---|
| 0.92 | 0.013 | 0.02 | 0.53 | 6.36 | 15 |

# Alt 1- flow to Swale

Weighted Runoff Coefficient

| Subcatchmnet | Land Use | Area (sft) | % of Area | C | Weighted C |
|---|---|---|---|---|---|
| 2 | Single Family | 160108 | 100% | 0.35 | 0.35 |

| | | |
|---|---|---|
| Q = CiA | | |
| Peak runoff | Q | cfs |
| Runoff coefficient | C | |
| Rainfall intensity | i | in/hr |
| watershed area | A | acres |

| | | | |
|---|---|---|---|
| C | 0.35 | | |
| i | 6.4 | in/hr (10 min, 10 yr) | |
| A | 160108 | ft2 | |
| | 3.68 | acres | |
| Q | 8.23 | cfs | |

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 944.315 | 0.006353812 | 11 |
| start elev | 451 | end elev | 445 | |

*Use 10 min Storm

Channel Sizing

| | | | |
|---|---|---|---|
| | Q (cfs) | 8.23 | |
| conversion factor | k | 1.49 | Imperial |
| Manning's n | n | 0.025 | Earthen Channel |
| slope | S (ft/ft) | 0.02 | |
| base width | b (ft) | 1 | |
| side slope | z | 3 | Trapezoidal Open Channel Design Calculations |
| channel depth | y (ft) | 0.67 | |
| top width | T (ft) | 5.0 | |
| area | A (ft^2) | 2.0167 | |
| wetted perimeter | p (ft) | 5.24 | |
| Hydraulic Radius | R (ft) | 0.39 | |
| flow velocity | V (ft/sec) | 4.46 | |
| | Q (cfs) | 9.00 | channel capacity |

$Q=VA \qquad V=\frac{k}{n}R^{2/3}S^{1/2} \qquad R=\frac{A}{P} \qquad A=\frac{y}{2}(b+T)$

$P=b+y\left(\sqrt{1+z_1^2}+\sqrt{1+z_2^2}\right) \qquad T=b+y(z_1+z_2)$

$F=V\sqrt{\frac{T}{gA\cos\theta}} \qquad \theta=Tan^{-1}(S)$

# Alt 1- Pipe Sizing Pipe 2

Weighted Runoff Coefficient

| Subcatchmnet | Land Use | Area (sft) | % of Area | C | Weighted C |
|---|---|---|---|---|---|
| 3 | Single Family | 174778 | 100% | 0.35 | 0.35 |

Q = CiA

| | | | | | |
|---|---|---|---|---|---|
| Peak runoff | Q | cfs | | | |
| Runoff coefficient | C | | C | 0.35 | |
| Rainfall intensity | i | in/hr | i | 6.4 | in/hr (10 min, 10 yr) |
| watershed area | A | acres | A | 174778 | ft2 |
| | | | | 4.01 | acres |
| | | | Q | 8.99 | cfs |

Time of Concentration

$t_c = kL^{0.77}s^{-0.385}$

| | | |
|---|---|---|
| time of concentration | tc | min |
| constant | k | |
| max flow length | L | ft |
| watershed slope | s | ft/ft |

| DA | k | L | s | tc |
|---|---|---|---|---|
| 1 | 0.0078 | 1002.6 | 0.00598444 | 11 |
| start elev | 451 | end elev | 445 | |

*Use 10 min Storm

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

| Q (cfs) | n | slope (ft/ft) | D (ft) | D (in) | Barrel Diameter (in) |
|---|---|---|---|---|---|
| 8.99 | 0.013 | 0.02 | 1.25 | 14.94 | 15 |

# Alt 2, Pipe Sizing

Manning's Full Flow Capacity Equation

$$Q = \frac{0.46D^{2.67}\sqrt{S}}{n}$$

Solved for D

$$D = \left(\frac{Qn}{0.46\sqrt{s}}\right)^{1/2.67}$$

| Pipe | Q (cfs) | n | slope (ft/ft) | D (ft) | D (in) | Pipe Diameter (in) |
|---|---|---|---|---|---|---|
| | 11.03 | 0.013 | 0.02 | 1.34 | 16.13 | 18 |

5 min/10 yr

# Exhibit D

## Cost Estimate

# York Pl Storm System Improvements, Alternative 1

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 5,000 | $ 5,000 |
| 2 | MAINTENANCE OF TRAFFIC | 1 | LS | $ 2,000 | $ 2,000 |
| 3 | CONSTRUCTION SURVEYING | 1 | LS | $ 2,000 | $ 2,000 |
| 4 | EROSION CONTROL | 1 | LS | $ 2,000 | $ 2,000 |
| 5 | DEMOLITON | 1 | LS | $ 6,000 | $ 6,000 |
| 6 | 15" RCP CULVERT | 388 | LF | $ 70.00 | $ 28,000 |
| 8 | DRAINAGE STRUCTURES | 1 | EA | $ 8,000 | $ 8,000 |
| 9 | UTILITIES | 1 | LS | $ 5,000 | $ 5,000 |
| 10 | RESTORE ASPHALT PAVEMENT | 144 | SY | $ 45.00 | $ 7,000 |
| 11 | SWALE, RESTORE VEGETATED SURFACE | 364 | LF | $ 10.00 | $ 4,000 |
| | | | | | |
| | | | | | |
| | | | | **Subtotal** | **$ 69,000** |
| | *Contingencies (35%)* | | | | $ 25,000 |
| | *Price Escalation Factor (15%)* | | | | $ 11,000 |

**Estimated Construction Cost Range: $69,000 to $105,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range): $15,000 to $25,000**

**Total Estimated Project Cost Range: $84,000 to $130,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# York Pl Storm System Improvements, Alternative 2

**Village of Pinehurst**

Concept-Level Opinion of Probable Construction Cost

| Item No. | Description | Quantity | Unit* | Unit Cost | Total Cost** |
|---|---|---|---|---|---|
| 1 | MOBILIZATION | 1 | LS | $ 5,000 | $ 5,000 |
| 2 | MAINTENANCE OF TRAFFIC | 1 | LS | $ 2,000 | $ 2,000 |
| 3 | CONSTRUCTION SURVEYING | 1 | LS | $ 2,000 | $ 2,000 |
| 4 | EROSION CONTROL | 1 | LS | $ 4,000 | $ 4,000 |
| 5 | DEMOLITON | 1 | LS | $ 11,000 | $ 11,000 |
| 6 | 18" RCP CULVERT | 597 | LF | $ 90.00 | $ 54,000 |
| 7 | DRAINAGE STRUCTURES | 5 | EA | $ 8,000 | $ 40,000 |
| 8 | UTILITIES | 1 | LS | $ 5,000 | $ 5,000 |
| 9 | RESTORE ASPHALT PAVEMENT | 200 | SY | $ 45.00 | $ 9,000 |
| 10 | RESTORE SWALE | 129 | LF | $ 10.00 | $ 2,000 |
| | | | | | |
| | | | | | |
| | | | | **Subtotal** | **$ 134,000** |
| | *Contingencies (35%)* | | | | $ 47,000 |
| | *Price Escalation Factor (15%)* | | | | $ 21,000 |

**Estimated Construction Cost Range: $134,000 to $202,000**

**Estimated Engineering, Surveying & Permitting Cost Range (15 to 20% of Estimated Construction Range): $25,000 to $45,000**

**Total Estimated Project Cost Range: $159,000 to $247,000**

* CY=Cubic Yard, EA=Each, LF=Linear Foot, LS=Lump Sum, SY=Square Yard

** Rounded up to the nearest $1000

# APPENDIX 7

## Blake Boulevard Stormwater Evaluation

**Memorandum**

To: Michael Hanson, P.E., Principal/Regional Manager
David Honeycutt, P.E., Principal/Pinehurst Office Manager

Cc: Kaija Beesley, Engineering Associate

From: Mike Apke, P.E., Public Services and Engineering Director

Date: November 14, 2023

Re: Blake Boulevard Stormwater Evaluation

Michael and David,

Pursuant to our recent discussions, Village of Pinehurst (VOP) staff has performed an initial evaluation of the existing storm drainage system on Blake Boulevard for inclusion in the VOP Stormwater Management and Master Plan. A summary of our evaluation and recommended plan of action is as follows:

**Existing Conditions**

1. An existing pond is located on private property near the intersection of Blake Boulevard (VOP street) and Dowd Circle (private road). The location of the pond is shown on the attached map.

2. An outlet structure within the pond allows it to drain when the water level reaches a certain elevation. An 18-inch overflow discharge pipe extends from the outlet structure to the east, which discharges onto private property near the intersection of Blake Boulevard and Monticello Drive (see attached map).

3. Historically, during heavy rain events, the property that contains the pond has experienced flooding, which at times has impacted an existing structure adjacent to the pond. Flooding has also occasionally extended into the Village's right-of-way and roadway on Blake Boulevard.

4. The 18-inch discharge pipe is reportedly a single-wall corrugated plastic pipe that was originally installed in the 1980s. Pinehurst Village Council accepted Blake Boulevard and its right-of-way for public use in September 1992. According to the Village's Stormwater Data map, the 18-inch pipe traverses both inside and outside of the public right-of-way; however, the map uses GIS property boundaries that may not be completely accurate.

5. The map also indicates that the 18-inch pipe curves in one area as Blake Boulevard curves towards Monticello Drive. The section that curves is also shown on the map to have more than 1,000 feet in length without any manholes, structures, or other access points. Village standards currently do not have a maximum length of pipe that can be installed without a structure; however, it is fairly common practice to install a structure every few hundred feet to provide access for inspections, cleaning, etc.

6. Village staff previously attempted to perform a video inspection of the 18-inch discharge pipe, but the Village's inspection camera was unable to pass through the pipe in several areas due to the presence of roots, debris, etc.

7. Based on Moore County GIS contours, the ground elevation gets higher as you travel east along Blake Boulevard. It is unclear whether the 18-inch discharge pipe follows the ground contours (which would presumably make it flow uphill) or whether the pipe grades allow the water to drain downhill.

8. Village staff observed that the pond was full of sediment and may need to be dredged out soon to improve the storage capacity within the pond.

9. It is currently unclear exactly what causes the area to flood, and further analysis is needed to determine the cause(s), which may include:

    a. Roots and/or other debris clogging the pipe and not allowing it to drain
    b. The pipe is too small and/or was installed at too flat of a grade to allow it to drain
    c. The pipe was installed at a negative grade that doesn't allow it to drain
    d. The inlet box is too small or gets blinded during heavy rains, not allowing it to drain

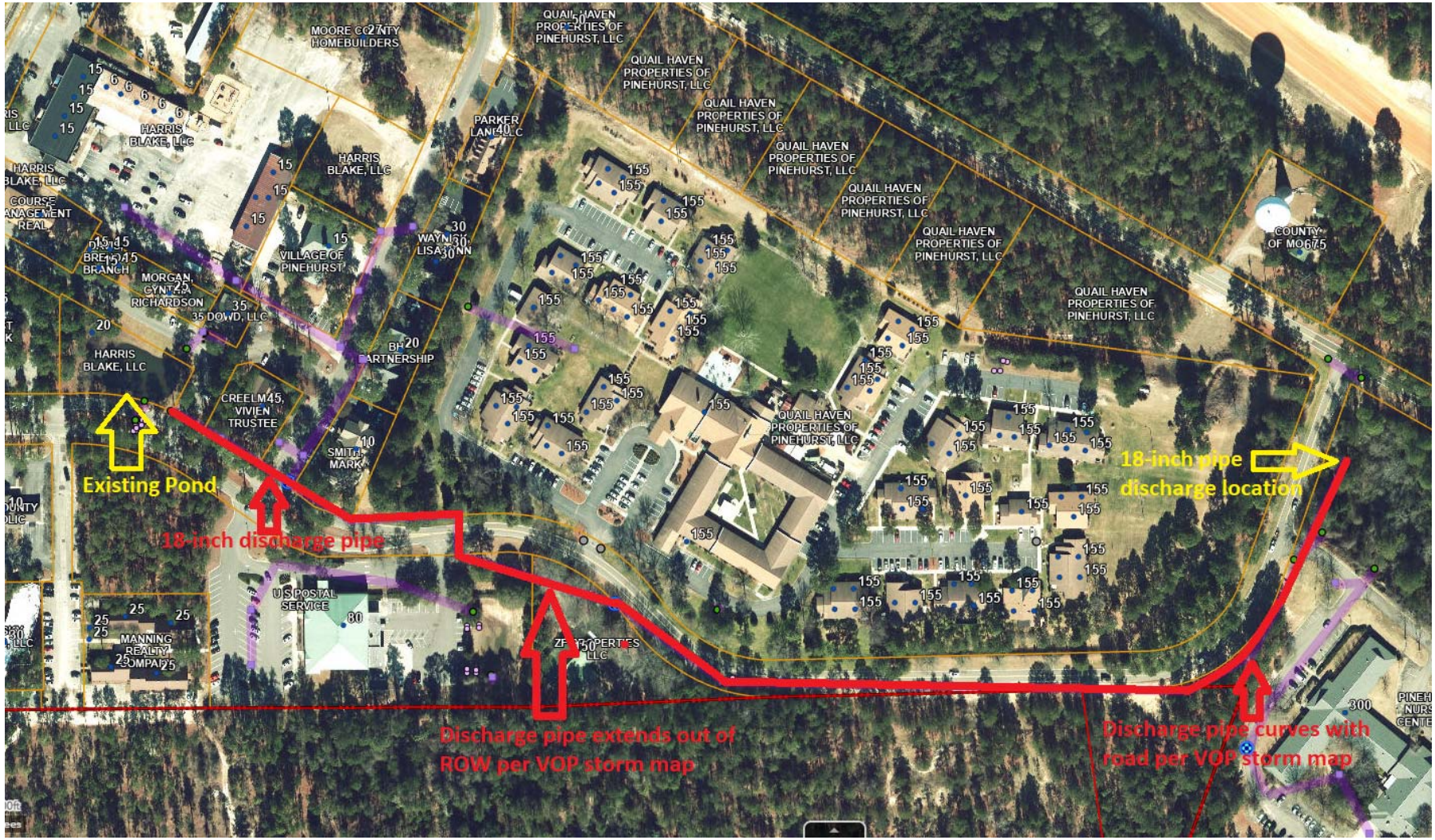
**Staff Recommendation**

Based on our evaluation, Village staff recommends the following process moving forward:

1. Retain a contractor to clean and perform a full camera inspection of the existing 18-inch discharge pipe. While Village staff's camera was unable to obtain information on the pipe, some contractors have more robust inspection and cleaning equipment that may be able to gather additional information.

2. Retain a licensed surveyor to conduct a topgraphical survey of the existing pipe. This should include the location and elevation of the pond's outlet structure, and the inverts of the existing 18-inch discharge pipe at all structure locations. This is needed to confirm whether the existing pipe was installed at a flat or negative grade. The survey should also attempt to identify the right-of-way locations along the route to determine areas where the pipe is located inside and outside of the VOP right-of-way.

3. Utilize the results from the camera inspection and the survey to determine next steps. If pipe segments need to be replaced, a consultant may need to be retained to prepare sealed engineering drawings prior to receiving bids from contractors.


Existing Pond
18-inch discharge pipe
Discharge pipe extends out of ROW per VOP storm map
Discharge pipe curves with road per VOP storm map
18-inch pipe discharge location
QUAIL HAVEN PROPERTIES OF PINEHURST, LLC
HARRIS BLAKE, LLC
VILLAGE OF PINEHURST
MOORE COUNTY HOMEBUILDERS
PARKER LAND
MORGAN, CYNTHIA RICHARDSON
DOWD, LLC
CREELMAN, VIVIEN TRUSTEE
SMITH, MARK
U S POSTAL SERVICE
MANNING REALTY COMPANY
COUNTY OF MOORE

# APPENDIX 8

## Evaluation of In-House Erosion and Sedimentation Control Program

# TECHNICAL MEMORANDUM

**Date:** September 11, 2023

**Prepared for:** Mike Apke, PE
Public Services Director, Village of Pinehurst

**Prepared by:** Michael Hanson, PE, Director of Water Resources
McGill Associates, P.A., Firm License No. C-0459

**Subject:** Pinehurst Stormwater Management and Master Plan
Evaluation of In-House Erosion and Sedimentation Control Program

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McGill Associates (McGill) has been retained by the Village of Pinehurst (Village) to evaluate the option of implementing the Sediment Pollution Control Act (SPCA) as a delegated local program. The purpose of this memo is to summarize the procedures and staffing needs required to establish a delegated local erosion and sediment control (E&SC) review and inspection program (Program) in lieu of utilizing North Carolina Department of Environmental Quality (NCDEQ) for these services.

## PROGRAM IMPLEMENTATION

The NCDEQ Division of Energy, Mineral, and Land Resources (DEMLR) website provides two step-by-step guides for planning and starting a local program which have been combined and summarized into the following guidance and can be found in full in Exhibit A.

Before beginning the planning process, the Village should determine the person or team (Village Representative) that will be responsible for developing the Program and ensure that they are familiar with State E&SC permit requirements. At least one Village Representative should be prepared to attend DEMLR meetings as needed to address any questions or concerns that arise during the development process. Attendance at these meetings and inclusion on meeting agendas should be planned and requested well ahead of time as DEMLR meetings only occur quarterly.

The Village Representative should become familiar with the Sedimentation Pollution Control Act of 1973 GS 113A and the Model Local Ordinance provided by DEMLR (Exhibit B) to fully understand the requirements and responsibilities of the Program. The Local Program Common

Responsibilities document provided by DEMLR can be found in Exhibit A and key Program responsibilities are summarized below:

1. Review plans within 30 calendar days for initial review and 15 calendar days for resubmittals.
2. Conduct site reviews and inspections as needed to ensure E&SC plans are being implemented properly and are working as intended.
3. Review and retain copies of inspection reports done by contractors, developers, etc. to ensure they are properly completed and documented.
4. Serve notices of violation (NOV) for land-disturbing activities failing to comply with the Sediment Act or local ordinance.
    a. Notify DEQ Regional Office of NOV issuance at the same time the violator is notified.
5. Report on all activities to DEMLR monthly.

The Village Representative can then use the Model Local Ordinance provided by DEMLR (Exhibit B) to develop a local ordinance for the Village. Local ordinance standards must equal or exceed those laid out in the SPCA and Section 7 of the Model Local Ordinance defines the control objectives that the ordinance must meet. Assistance with ordinance development is available from DEMLR's Land Quality division and legal review is available through the Attorney General's office. During this time, DEMLR recommends obtaining local input on the Program.

While developing the Village's ordinance, the Village Representative should also begin developing Program organization. A Program budget should be determined, taking into account staffing and equipment needs as well as fees to be collected from applicants, and permit application forms should be created. The staffing plan should be sufficient to support engineering plan reviews and site inspections of active projects considering historical development trends, i.e., about two times per month. The inventory of program equipment should also be sufficient to support this frequency of site inspection. During a review of similar communities with a Stormwater Utility Program, seven communities were reviewed (Southern Pines, Chapel Hill, Davidson, Cary, Holly Springs, Hendersonville, and Hope Mills). Three of these communities have a local program. Examples of existing program fees from these communities are summarized below and a complete listing can be found on the DEMLR website. House Bill 488 was signed into law on August 18th, 2023, and relates to the North

Carolina State Building Code and Land Development Regulations. Section 10 of the bill limits the allowable fees for the review of erosion and sedimentation control plans and related activities by local sedimentation and erosion control programs. The fees for a local sedimentation and erosion control program would need to be in compliance with this section.

| Local Program | Plan Review Fees and Permits | Revised or Resubmitted Plan Fee |
|---|---|---|
| **Town of Cary** | $500 per denuded acre.<br>Fee is due upon permit issuance. | No fee $0 |
| **Town of Holly Springs** | $300 per disturbed acre (covers 1st and 2nd review) | Subsequent plan reviews (per review after 2nd Review): $450 |
| **Town of Southern Pines** | Disturbances greater than 30,000 sq. ft.: $300 for the first acre and $150 per additional acre or part thereof. | $50 for each submittal after the 2nd review. Any substantial revision to a previously approved, active plan is $50 per acre or part thereof. |

Once the ordinance has been developed, the Village Representative will submit at least one copy of the ordinance for review by the State Sediment Specialist, Assistant Sediment Specialist, and DEQ Attorney. It is recommended to do this at least six months prior to the desired Program implementation date. While not required, DEMLR also recommends requesting an informal review of the ordinance by the NC Sedimentation Control Commission (SCC) at one of their regularly scheduled meetings.

The Village Representative will implement any feedback received from the State Sediment Specialist, Assistant Sediment Specialist, DEQ Attorney, and the SCC before submitting the revised ordinance to local government bodies for passage. The Village must adopt the ordinance before seeking formal approval from the SCC.

Once the Village has formally adopted the ordinance, a delegation request can be submitted to the Assistant Sediment Specialist. The SCC will review the delegation request within 90 days and notify the Village of its approval or disapproval. If the request is denied, the Village may make changes based on feedback from the SCC and resubmit.

In summary, the program would require at least one full-time employee in the Village to oversee the implementation, set up standard operating procedures, and subsequently conduct reviews, inspections, and reporting. Fees collected from the permits are not typically sufficient to offset the cost of administering the Program. Having a local program provides the Village control over the review process and timelines and allows the Village to set higher standards for erosion control. However, review times by the State are set to 30- and 15-days for initial and subsequent submittals, respectively, so limited advantage can be provided by the Village in terms of review time.

Enclosures:

Exhibit A: DEMLR Local E&SC Program Setup Guidelines

Exhibit B: Model Local Ordinance

# Exhibit A:

## DEMLR Local E&SC
## Program Setup Guidelines

# PROCEDURE FOR LOCAL PROGRAM DELEGATION

1. Establish grassroots effort to ascertain local interest in a local erosion and sediment control program.

2. Understand the responsibilities and obligations of Local Programs by reading the document titled "Responsibilities of Local E&SC Programs".

3. Obtain model ordinance from Land Quality Section website https://deq.nc.gov/about/divisions/energy-mineral-land-resources/erosion-sediment-control/local-government-programs

4. Create local ordinance and supporting documentation necessary to establish and enforce an erosion and sedimentation control program. Local ordinance standards must equal or exceed those in the Sedimentation Pollution Control Act of 1973, GS 113A. and must comply with House Bill 488

5. Two or more units of local government can establish a joint program and enter agreements that are necessary for the proper administration and enforcement of a local program.

6. Submit at least one copy of ordinance for review by the State Sediment Specialist, Assistant Sediment Specialist, and DEQ Attorney preferably six months before implementation. Mail any hard copies requested to the State Sediment Specialist, 1612 MSC, Raleigh, NC 27699-1612.

7. Submit ordinance to local government bodies for passage. Adopt ordinance locally before asking Sedimentation Control Commission (SCC) for delegation in writing. All ordinances must be adopted at the local level prior to seeking formal approval from the Commission. Additionally, it is recommended that you request an informal review of your ordinance by the SCC at one of their regularly scheduled meetings prior to local adoption.

8. Submit delegation request to the Assistant Sediment Specialist, 1612 MSC, Raleigh, NC 27699-1612. Joint programs must include a certified copy of the resolution stating the terms of agreement.

9. The SCC will review delegation request within 90 days and shall notify the petitioner that it has been approved, approved with modifications, or disapproved.

10. If the SCC determines a local program is failing to administer or enforce its approved local program, then the local program will be notified in writing specifying the deficiencies.

The North Carolina Sedimentation erosion control program

# Responsibilities of Local Erosion & Sedimentation Control Programs

Local governments (a.k.a. "Local Programs") with authority delegated to them by the Sedimentation Control Commission for administering and enforcing the state Sedimentation Pollution Control Act of 1973 ("Sediment Act") must adhere to the mandatory standards and other provisions of this law, including its exemptions and exclusions of power. Below are some common responsibilities under which Local Programs are expected to adhere to satisfy this state law and effectively manage their programs.

PLAN REVIEWS

1. **Plans are to be reviewed and a decision rendered to the applicant within 30 calendar days of receipt of a complete plan**. Unlike with other permits, there is no pausing this "review clock". A complete plan is defined as follows:
    a. An erosion and sediment control plan
    b. Calculations in support of the design, if applicable
    c. An authorized statement of financial responsibility
    d. A letter of consent or permission letter from the landowner for the land-disturbance, if the landowner and the Financially Responsible Person/Party are not the same entity
    e. Documentation of property ownership (e.g., deed)
    f. Fees paid in full
2. **Plans are to be reviewed and a decision rendered to the applicant within 15 calendar days of receipt of a revised plan**. There is no pausing this "review clock" once it has started.

*Reference: G.S. 113A-61(b)*

3. **Local Programs must require homebuilders to apply for an erosion and sediment control plan approval once their cumulative land-disturbance in a subdivision is planned to exceed one acre (or the Local Program's threshold for requiring a plan, whichever is less*).**
   Each homebuilder within a subdivision must have their own erosion and sediment control plan once their land disturbance exceeds or is reasonably expected to exceed one (1) acre within the subdivision. This is a per subdivision requirement, and not a per lot requirement. This is regardless of whether those lots are contiguous. The Sediment Act refers to the land-disturbing activity as that occurring on a tract of land. By definition, a "Tract" means all contiguous land and bodies of water being disturbed or to be disturbed as a unit, regardless of ownership. Thus, the subdivision is the Tract of land which is to be permitted. Individual lots are not tracts if they are within a subdivision.

   *Local Programs can require a plan when this exceedance equals something less than one acre.

*Reference: G.S. 113A-52 & 113A-57(4)*

4. **Local Programs are not to accept erosion control plans from publicly-funded projects**
   Local Programs are excluded from administering the Sediment Act (i.e., reviewing and monitoring projects) on the following types of land-disturbing activities:
   a. Those conducted by the state of North Carolina (e.g., NCDOT, public schools)
   b. Those conducted by the federal government (e.g., DOD)
   c. Those conducted by themselves or another Local Program (e.g., public schools)
   d. Those conducted by parties having the power of eminent domain (e.g., pipelines, railroads, public works projects)
   e. Those conducted for oil and gas exploration and development on a well pad site

   Broadly stated, this exclusion would apply to all publicly-funded projects, whether funded in whole or in part.

   *Reference: G.S. 113A-56(a) and MOA Part II.D.*

5. **Local Programs shall only approve a plan upon determining that it complies with all applicable state and local regulations for erosion and sediment control.**
   Projects that call for work within a jurisdictional waterbody or a riparian buffer may require a USACE 404 permit or a 401 Water Quality Certification from DEQ's Division of Water Resources (DWR). These permits or certifications should be sought when reviewing plans. These waterbodies and buffers should be clearly delineated on the plans, and the terms of the permit or certification should be considered when reviewing the plans. Because these permits and certifications may take longer than 30 days to be issued, Local Programs shall condition approval of plans upon compliance with these permits and certifications or with any federal or state water quality laws or rules. A Local Program shall disapprove an erosion and sediment control plan if implementation of the plan would result in a violation of the riparian buffer rules.

   *Reference: G.S. 113A-61(b) & (b1)*

6. **Waivers must be sought for desired land disturbances greater than 20 acres when in a High Quality Water Zone**
   Projects located within sensitive watersheds known as High Quality Waters (HQW), have more restrictive design standards. Uncovered areas involved with the land-disturbing activity inside HQW zones shall be limited to 20 acres within the boundaries of the tract. Larger areas may be uncovered within the boundaries of the tract with written approval of the DEQ-DEMLR Director upon providing engineering justification with a construction sequence that considers phasing, limiting exposure, weekly submitted self-inspection reports, a more conservative design than the 25-year storm, and other site-specific conditions as stipulated by the Director. The plans may have to be disapproved in the interim, if larger areas have been submitted for approval within the 15 or 30 day review period with no waiver granted.

   *Reference: 15A NCAC 04B .0124*

SITE MONITORING & COMPLIANCE

7. **Local Programs are to review documents provided on the project site.**
   Before construction begins, certificates or letters of plan approvals shall be posted at the primary entrance of the job site or other location that is observable to the public or inspectors. Local Program staff are to verify these postings with each visit.

   Contractors, developers, homebuilders, financially responsible parties, or their consultants are to conduct their own inspections after each phase of the plan (and weekly or within 24 hours of a precipitation event equal to or greater than 1 inch for projects covered under the NPDES NCG01 permit). The name, address, organization affiliation, telephone number, signature of the person conducting the inspection, and the date of the inspection shall be included, whether on a copy of the approved erosion and sedimentation control plan or an inspection report. If documentation of inspections occurs on a copy of the approved erosion and sedimentation control plan, then that plan shall be kept onsite. (NPDES inspection reports must be made available during normal business hours.) Local Program staff are to review self-inspection/self-monitoring records and ensure that inspections are being conducted, properly documented, and are accessible.

   *Reference: 15A NCAC 04B .0127 & .0131*

8. **Local Programs are to provide for inspections of land-disturbing activities at a frequency sufficient to ensure compliance with the Sediment Act and the local ordinance, and to determine whether the measures required in an erosion and sedimentation control plan are effective in controlling erosion and sedimentation resulting from the land-disturbing activity.**
   If it is determined that the party engaged in the land-disturbing activity has failed to comply with the Sediment Act or with the local government, the Program will immediately service a notice of violation upon the responsible party. The notice may be served by any means authorized under G.S. 1A-1, Rule 4.

   *Reference: G.S. 113A-61.1(a) & (c) and MOA Part III.D.1.*

ADMINISTRATION

9. **Local Programs are to report on their activities**

   Local Programs are to provide monthly activity reports to the DEQ, Division of Energy, Mineral & Land Resources (DEMLR), Land Quality Section on behalf of the Sedimentation Control Commission.

   *Reference: MOA Part III.B.1.*

10. **Local Programs are to notify the DEQ regional office of issuance of NOVs**

    Local Programs are to notify the appropriate DEQ regional office of issuance of Notices of Violation at the time the violator is notified.

    *Reference: MOA Part III.B.2.*

11. **Local Programs are to maintain current contact information on file with the Land Quality Section.**

    Local Programs are to notify the State Sedimentation Program Specialist or their assistant of at least one Program administrator. The name, address, phone number, and email address for a main contact is to be kept current with the state program. A list of all local program administrators will be maintained on the DEQ website.

    *Reference: MOA Part III.B.3.*

# Exhibit B:

## Model Local Ordinance

# MODEL LOCAL ORDINANCE

# SOIL EROSION and SEDIMENTATION CONTROL

Revised November 2021

SEDIMENTATION CONTROL COMMISSION

RALEIGH, NORTH CAROLINA

# TABLE OF CONTENTS

ORDINANCE NO._____

AN ORDINANCE TO PROVIDE FOR THE CONTROL OF SOIL EROSION AND SEDIMENTATION.

NOW, THEREFORE, BE IT ORDAINED by the (Governing Body) of the (City), (Town), (County) hereby adopts the following ordinance.

SECTION 1 Title

This ordinance may be cited as the (city), (town), (county) Soil Erosion and Sedimentation Control Ordinance.

SECTION 2 Purpose

This ordinance is adopted for the purposes of:

(a) regulating certain land-disturbing activity to control accelerated erosion and sedimentation in order to prevent the pollution of water and other damage to lakes, watercourses, and other public and private property by sedimentation; and

(b) establishing procedures through which these purposes can be fulfilled.

SECTION 3 Definitions

As used in this ordinance, unless the context clearly indicates otherwise, the following definitions apply:

(a) Accelerated Erosion - means any increase over the rate of natural erosion as a result of land-disturbing activity.

(b) Act - means the North Carolina Sedimentation Pollution Control Act of 1973 and all rules and orders adopted pursuant to it.

(c) Adequate Erosion Control Measure, Structure, or Device - means one which controls the soil material within the land area under responsible control of the Person conducting the land-disturbing activity.

(d) Affiliate – means a Person that directly, or indirectly through one or more intermediaries, controls, is controlled by, or is under common control of another Person.

(e) Approving Authority – means the Division or other State or a local government agency that has been delegated erosion and sedimentation plan review responsibilities in accordance with the provisions of the Act.

(f) Being Conducted - means a land-disturbing activity has been initiated and not deemed complete by the Approving Authority.

(g) Borrow - means fill material that is required for on-site construction that is obtained from other locations.

(h) Buffer Zone - means the strip of land adjacent to a lake or natural watercourse.

(i) Coastal Counties - means the following counties: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.

(j) Commission - means the North Carolina Sedimentation Control Commission.

(k) Completion of Construction or Development - means that no further land-disturbing activity is required on a phase of a project except that which is necessary for establishing a permanent ground cover.

(l) Department - means the North Carolina Department of Environmental Quality.

(m) Director - means the Director of the Division of Energy Mineral and Land Resources of the Department of Environmental Quality.

(n) Discharge Point or Point of Discharge - means that point where runoff leaves a tract of land where a land-disturbing activity has occurred or enters a lake or natural watercourse.

(o) District - means the _____ Soil and Water Conservation District created pursuant to Chapter 139, North Carolina General Statutes.

(p) Energy Dissipator - means a structure or a shaped channel section with mechanical armoring placed at the outlet of pipes or conduits to receive and break down the energy from high velocity flow.

(q) Erosion - means the wearing away of land surfaces by the action of wind, water, gravity, or any combination thereof.

(r) Ground Cover - means any natural vegetative growth or other material which renders the soil surface stable against accelerated erosion.

(s) High Quality Waters - means those classified as such in 15A NCAC 02B .0224, which is herein incorporated by reference including subsequent amendments and additions.

(t) High Quality Water (HQW) Zones –means, for the Coastal Counties, areas within 575 feet of High Quality Waters; and for the remainder of the state, areas within one mile and draining to HQW's.

(u) Lake or Natural Watercourse – means any stream, river, brook, swamp, sound, bay, creek, run, branch, canal, waterway, estuary, and any reservoir, lake or pond.

(v) Land-disturbing Activity - means any use of the land by any Person in residential, industrial, educational, institutional, or commercial development, highway and road construction and maintenance that results in a change in the natural cover or topography and that may cause or contribute to sedimentation.

(w) Local Government - means any county, incorporated village, town or city, or any combination of counties, incorporated villages, towns, and cities, acting through a joint program pursuant to the provisions of the Act.

(x) Natural Erosion - means the wearing away of the earth's surface by water, wind, or other natural agents under natural environmental conditions undisturbed by man.

(y) Parent – means an affiliate that directly, or indirectly through one or more intermediaries, controls another Person.

(z) Person - means any individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, interstate body, or other legal entity.

(aa) Person Conducting the Land-Disturbing Activity - means any Person who may be held responsible for violation unless expressly provided otherwise by this Ordinance, the Act, or any order adopted pursuant to this Ordinance or the Act.

(bb) Person Who Violates or Violator, as used in G.S. 113A-64, means: any landowner or other Person who has financial or operational control over the land-disturbing activity; or who has directly or indirectly allowed the activity, and who has failed to comply with any provision of the Act, the rules of this Chapter or any order or local ordinance adopted pursuant to the Act as it imposes a duty upon that Person.

(cc) Plan - means an erosion and sedimentation control plan.

(dd) Sediment - means solid particulate matter, both mineral and organic, that has been or is being transported by water, air, gravity, or ice from its site of origin.

(ee) Sedimentation - means the process by which sediment resulting from accelerated erosion has been or is being transported off the site of the land-disturbing activity or into a lake or natural watercourse.

(ff) Siltation - means sediment resulting from accelerated erosion which is settleable or removable by properly designed, constructed, and maintained control measures; and which has been transported from its point of origin within the site of a land-disturbing activity; and which has been deposited, or is in suspension in water.

(gg) Storm Drainage Facilities - means the system of inlets, conduits, channels, ditches and appurtenances which serve to collect and convey storm water through and from a given drainage area.

(hh) Stormwater Runoff - means the runoff of water resulting from precipitation in any form.

(ii) Subsidiary – means an affiliate that is directly, or indirectly through one or more intermediaries, controlled by another Person.

(jj) Ten-Year Storm - means a rainfall of an intensity that, based on historical data, is predicted by a method acceptable to the Approving Authority to be equaled or exceeded, on the average, once in ten years, and of a duration that will produce the maximum peak rate of runoff for the watershed of interest under average antecedent wetness conditions.

(kk) Tract - means all contiguous land and bodies of water being disturbed or to be disturbed as a unit, regardless of ownership.

(ll) Twenty-five Year Storm - means a rainfall of an intensity that, based on historical data, is predicted by a method acceptable to the Approving Authority to be equaled or exceeded, on the average, once in 25 years, and of a duration that will produce the maximum peak rate of runoff for the watershed of interest under average antecedent wetness conditions.

(mm) Uncovered - means the removal of ground cover from, on, or above the soil surface.

(nn) Undertaken - means the initiating of any activity, or phase of activity, which results or will result in a change in the ground cover or topography of a tract of land.

(oo) Velocity - means the speed of flow through a cross section perpendicular to the direction of the main channel at the peak flow of the storm of interest but not exceeding bank full flows.

(pp) Waste - means surplus materials resulting from on-site land-disturbing activities and being disposed of at other locations.

SECTION 4 Scope and Exclusions

(a) Geographical Scope of Regulated Land-Disturbing Activity. This ordinance shall apply to land-disturbing activity within the territorial jurisdiction of the (city), (town), (county) and to the extraterritorial jurisdiction of the (city), (town), (county) as allowed by agreement between local governments, the extent of annexation or other appropriate legal instrument or law.

(b) Exclusions from Regulated Land-Disturbing Activity. Notwithstanding the general applicability of this ordinance to all land-disturbing activity, this ordinance shall not apply to the following types of land-disturbing activity:

(1) Activities, including the production and activities relating or incidental to the production of crops, grains, fruits, vegetables, ornamental and flowering plants, dairy, livestock, poultry, and all other forms of agriculture undertaken on agricultural land for the production of plants and animals useful to man, including, but not limited to:

(i) forage and sod crops, grain and feed crops, tobacco, cotton, and peanuts.
(ii) dairy animals and dairy products.
(iii) poultry and poultry products.
(iv) livestock, including beef cattle, llamas, sheep, swine, horses, ponies, mules, and goats.
(v) bees and apiary products.
(vi) fur producing animals.
(vii) mulch, ornamental plants, and other horticultural products. For purposes of this section, "mulch" means substances composed primarily of plant remains or mixtures of such substances.

(2) An Activity undertaken on forestland for the production and harvesting of timber and timber products and conducted in accordance with standards defined by the Forest Practice Guidelines Related to Water Quality (Best Management Practices), as adopted by the North Carolina Department of Agriculture and Consumer Services. If land-disturbing activity undertaken on forestland for the production and harvesting of timber and timber products is not conducted in accordance with standards defined by the Forest Practice Guidelines Related to Water Quality, the provisions of this ordinance shall apply to such activity and any related land-disturbing activity on the tract.

(3) An activity for which a permit is required under the Mining Act of 1971, Article 7 of Chapter 74 of the General Statutes.

(4) A land-disturbing activity over which the State has exclusive regulatory jurisdiction as provided in G.S. 113A-56(a).

(5) An activity which is essential to protect human life during an emergency.

(6) Activities undertaken to restore the wetland functions of converted wetlands to provide compensatory mitigation to offset impacts permitted under Section 404 of the Clean Water Act.

(7) Activities undertaken pursuant to Natural Resources Conservation Service standards to restore the wetlands functions of converted wetlands as defined in Title 7 Code of Federal Regulations § 12.2

(c) Plan Approval Requirement for Land-Disturbing Activity. No Person shall undertake any land-disturbing activity subject to this ordinance without first obtaining a Plan approval from the (city)(town)(county).

(d) Protection of Property - Persons conducting land-disturbing activity shall take all reasonable measures to protect all public and private property from damage caused by such activity.

(e) More Restrictive Rules Shall Apply - Whenever conflicts exist between federal, state, or local laws, ordinance, or rules, the more restrictive provision shall apply.

(f) Plan Approval Exceptions. Notwithstanding the general requirement to obtain a Plan approval prior to undertaking land-disturbing activity, a Plan approval shall not be required for land-disturbing activity that does not exceed _____ acre in surface area. In determining the area, lands under one or diverse ownership being developed as a unit will be aggregated.

SECTION 5 Mandatory Standards for Land-Disturbing Activity

No land-disturbing activity subject to the control of this ordinance shall be undertaken except in accordance with the following mandatory standards:

(a) Buffer zone

(1) Standard Buffer. No land-disturbing activity during periods of construction or improvement to land shall be permitted in proximity to a lake or natural watercourse unless a buffer zone is provided along the margin of the watercourse of sufficient width to confine visible siltation within the twenty-five percent (25%) of the buffer zone nearest the land-disturbing activity.

(i) Projects On, Over or Under Water. This subdivision shall not apply to a land-disturbing activity in connection with the construction of facilities to be located on, over, or under a lake or natural watercourse.

(ii) Buffer Measurement. Unless otherwise provided, the width of a buffer zone is measured horizontally from the edge of the water to the nearest edge of the disturbed area, with the 25 percent of the strip nearer the land-disturbing activity containing natural or artificial means of confining visible siltation.

(2) Trout Buffer. Waters that have been classified as trout waters by the Environmental Management Commission shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent (25%) of the buffer zone nearest the land-disturbing activity, whichever is greater. Provided, however, that the Commission may approve plans which include land-disturbing activity along trout waters when the duration of said disturbance would be temporary and the extent of said disturbance would be minimal.

(i) Projects On, Over or Under Water. This subdivision shall not apply to a land-disturbing activity in connection with the construction of facilities to be located on, over, or under a lake or natural watercourse.

(ii) Trout Buffer Measurement. The 25-foot minimum width for an undisturbed buffer zone adjacent to designated trout waters shall be measured horizontally from the top of the bank to the nearest edge of the disturbed area.

(iii) Limit on Land Disturbance. Where a temporary and minimal disturbance has been permitted as an exception to the trout buffer, land-disturbing activities in the buffer zone adjacent to designated trout waters shall be limited to a maximum of ten percent (10%) of the total length of the buffer zone within the tract to be disturbed such that there is not more than 100 linear feet of disturbance in each 1000 linear feet of buffer zone. Larger areas may be disturbed with the written approval of the Director.

(iv) Limit on Temperature Fluctuations. No land-disturbing activity shall be undertaken within a buffer zone adjacent to designated trout waters that will cause adverse temperature fluctuations in the trout waters, as set forth in 15 NCAC 2B.0211 "Fresh Surface Water Classification and Standards."

(b) Graded Slopes and Fills. The angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion control devices or structures. In any event, slopes left exposed will, within 21 calendar days of completion of any phase of grading, be planted or otherwise provided with temporary or permanent ground cover, devices, or structures sufficient to restrain erosion. The angle for graded slopes and fills must be

demonstrated to be stable. Stable is the condition where the soil remains in its original configuration, with or without mechanical constraints.

(c) Fill Material. Materials being used as fill shall be consistent with those described in 15A NCAC 13B .0562 unless the site is permitted by the Department's Division of Waste Management to operate as a landfill. Not all materials described in Section .0562 may be suitable to meet geotechnical considerations of the fill activity and should be evaluated accordingly.

(d) Ground Cover. Whenever land-disturbing activity that will disturb more than _____ acre is undertaken on a tract, the Person conducting the land-disturbing activity shall install erosion and sedimentation control devices and practices that are sufficient to retain the sediment generated by the land disturbing activity within the boundaries of the tract during construction upon and development of said tract, and shall plant or otherwise provide a permanent ground cover sufficient to restrain erosion after completion of construction or development. Except as provided in Section 8(c)(4), provisions for a permanent ground cover sufficient to restrain erosion must be accomplished within 90 calendar days following completion of construction or development.

[NOTE: ONE ACRE OR LESS SHALL BE SPECIFIED IN THE ABOVE PARAGRAPH.]

(e) Prior Plan Approval. No Person shall initiate any land-disturbing activity that will disturb more than _____ acre on a tract unless, thirty (30) or more days prior to initiating the activity, a Plan for the activity is filed with and approved by the (city)(town)(county). An erosion and sedimentation control plan may be filed less than 30 days prior to initiation of a land-disturbing activity if the plan is submitted under an approved express permit program. The land-disturbing activity may be initiated and conducted in accordance with the plan once the plan has been approved.

[NOTE: ONE ACRE OR LESS SHALL BE SPECIFIED IN THE ABOVE PARAGRAPH. LOCAL PROGRAMS MAY HAVE PERMITS WHICH ALLOW FOR LAND DISTURBING ACTIVITIES TO BE INITIATED SUBSEQUENT TO BOTH A PLAN APPROVAL AND THE LOCAL PERMIT BEING ISSUED. IN THIS CASE, THE ABOVE SENTENCE WILL NEED TO BE REVISED OR EXPANDED.]

The (city)(town)(county) shall forward to the Director of the Division of Water Resources a copy of each Plan for a land-disturbing activity that involves the utilization of ditches for the purpose of de-watering or lowering the water table of the tract.

(f) The land-disturbing activity shall be conducted in accordance with the approved erosion and sedimentation control plan.

SECTION 6 Erosion and Sedimentation Control Plans

(a) Plan Submission. A Plan shall be prepared for all land-disturbing activities subject to this ordinance whenever the proposed activity will disturb more than _____ acre on a tract. The Plan shall be filed with the (city)(town)(county); a copy shall be simultaneously submitted to the ____ Soil and Water Conservation District at least 30 days prior to the commencement of the proposed activity.

[NOTE: ONE ACRE OR LESS SHALL BE SPECIFIED IN THE ABOVE PARAGRAPH. THE LAST SENTENCE IN PARAGRAPH (a) DEALING WITH PLAN SUBMISSIONS MAY BE DELETED IF SUBMISSIONS TO THE SOIL AND WATER CONSERVATION DISTRICTS ARE NOT REQUIRED UNDER PARAGRAPH (f) BELOW.]

(b) Financial Responsibility and Ownership. Plans may be disapproved unless accompanied by an authorized statement of financial responsibility and documentation of property ownership. This statement shall be signed by the Person financially responsible for the land-disturbing activity or his attorney in fact. The statement shall include the mailing and street addresses of the principal place of business of (1) the Person financially responsible, (2) the owner of the land, and (3) any registered agents. If the Person financially responsible is not a resident of North Carolina, a North Carolina agent must be designated in the statement for the purpose of receiving notice of compliance or non-compliance with the Plan, the Act, this ordinance, or rules or orders adopted or issued pursuant to this ordinance. Except as provided in subsections (c) or (k) of this section, if the applicant is not the owner of the land to be disturbed, the draft erosion and sedimentation control plan must include the owner's written consent for the applicant to submit a draft erosion and sedimentation control plan and to conduct the anticipated land-disturbing activity.

(c) If the applicant is not the owner of the land to be disturbed and the anticipated land-disturbing activity involves the construction of utility lines for the provision of water, sewer, gas, telecommunications, or electrical service, the draft erosion and sedimentation control plan may be submitted without the written consent of the owner of the land, so long as the owner of the land has been provided prior notice of the project.

(d) Environmental Policy Act Document. Any Plan submitted for a land-disturbing activity for which an environmental document is required by the North Carolina Environment Policy Act (G.S. §113A-1, et seq.) shall be deemed incomplete until a complete environmental document is available for review. The (city)(town)(county) shall promptly notify the Person submitting the Plan that the 30-day time limit for review of the Plan pursuant to this ordinance shall not begin until a complete environmental document is available for review.

(e) Content. The Plan required by this section shall contain architectural or engineering

drawings, maps, assumptions, calculations, and narrative statements as needed to adequately describe the proposed development of the tract and the measures planned to comply with the requirements of this ordinance. Plan content may vary to meet the needs of specific site requirements. Detailed guidelines for Plan preparation may be obtained from the (city)(town)(county) on request.

(f) Soil and Water Conservation District Comments. The District shall review the Plan and submit any comments and recommendations to the (city)(town)(county) within 20 days after the District received the Plan, or within any shorter period of time as may be agreed upon by the District and the (city)(town)(county). Failure of the District to submit its comments and recommendations within 20 days or within any agreed-upon shorter period of time shall not delay final action on the Plan.

[NOTE: PARAGRAPH (f) MAY BE DELETED WITH CONSENT FROM THE SEDIMENTATION CONTROL COMMISSION.]

(g) Timeline for Decisions on Plans. The (city)(town)(county) will review each complete Plan submitted to them and within 30 days of receipt thereof will notify the Person submitting the Plan that it has been approved, approved with modifications, or disapproved. Failure to approve, approve with modifications, or disapprove a complete Plan within 30 days of receipt shall be deemed approval. The (city)(town)(county) will review each revised Plan submitted to them and within 15 days of receipt thereof will notify the Person submitting the Plan that it has been approved, approved with modifications, or disapproved. Failure to approve, approve with modifications, or disapprove a revised Plan within 15 days of receipt shall be deemed approval.

(h) Approval. The (city)(town)(county) shall only approve a Plan upon determining that it complies with all applicable State and local regulations for erosion and sedimentation control. Approval assumes the applicant's compliance with the federal and state water quality laws, regulations and rules. The (city)(town)(county) shall condition approval of Plans upon the applicant's compliance with federal and state water quality laws, regulations and rules. The (city), (town), (county) may establish an expiration date, not to exceed three (3) years, for Plans approved under this ordinance whereby no land-disturbing activity has been undertaken.

(i) Disapproval for Content. The (city)(town)(county) may disapprove a Plan or draft Plan based on its content. A disapproval based upon a Plan's content must specifically state in writing the reasons for disapproval.

(j) Other Disapprovals. The (city)(town)(county) shall disapprove an erosion and sedimentation control plan if implementation of the plan would result in a violation of rules adopted by the Environmental Management Commission to protect riparian buffers along surface waters. The (city)(town)(county) may disapprove an erosion and sedimentation control plan or disapprove a transfer of a plan under subsection (k) of this section upon finding that an applicant

or a parent, subsidiary, or other affiliate of the applicant:

(1) Is conducting or has conducted land-disturbing activity without an approved plan, or has received notice of violation of a plan previously approved by the Commission or a local government pursuant to this Article and has not complied with the notice within the time specified in the notice.
(2) Has failed to pay a civil penalty assessed pursuant to this Article or a local ordinance adopted pursuant to this Article by the time the payment is due.
(3) Has been convicted of a misdemeanor pursuant to G.S. 113A-64(b) or any criminal provision of a local ordinance adopted pursuant to this Article.
(4) Has failed to substantially comply with State rules or local ordinances and regulations adopted pursuant to this Article.

In the event that an erosion and sedimentation control plan or a transfer of a plan is disapproved by the (city)(town)(county) pursuant to subsection (j) of this section, the local government shall so notify the Director of the Division of Energy, Mineral, and Land Resources within 10 days of the disapproval. The (city)(town)(county) shall advise the applicant or the proposed transferee and the Director in writing as to the specific reasons that the plan was disapproved. Notwithstanding the provisions of Section 16(a), the applicant may appeal the local government's disapproval of the plan directly to the Commission.

For purposes of this subsection, an applicant's record or the proposed transferee's record may be considered for only the two years prior to the application date.

(k) Transfer of Plans. The (city)(town)(county) administering an erosion and sedimentation control program may transfer an erosion and sedimentation control plan approved pursuant to this section without the consent of the plan holder to a successor-owner of the property on which the permitted activity is occurring or will occur as provided in this subsection.
(1) The (city)(town)(county) may transfer a plan if all of the following conditions are met:
(i) The successor-owner of the property submits to the local government a written request for the transfer of the plan and an authorized statement of financial responsibility and documentation of property ownership.
(ii) The (city)(town)(county) finds all of the following:
a. The plan holder is one of the following:
1. A natural person who is deceased.
2. A partnership, limited liability corporation, corporation, or any other business association that has been dissolved.
3. A Person who has been lawfully and finally divested of title to the property on which the permitted activity is

occurring or will occur.

4. A Person who has sold the property on which the permitted activity is occurring or will occur.

b. The successor-owner holds title to the property on which the permitted activity is occurring or will occur.

c. The successor-owner is the sole claimant of the right to engage in the permitted activity.

d. There will be no substantial change in the permitted activity.

(2) The plan holder shall comply with all terms and conditions of the plan until such time as the plan is transferred.

(3) The successor-owner shall comply with all terms and conditions of the plan once the plan has been transferred.

(4) Notwithstanding changes to law made after the original issuance of the plan, the (city)(town)(county) may not impose new or different terms and conditions in the plan without the prior express consent of the successor-owner. Nothing in this subsection shall prevent the (city)(town)(county) from requiring a revised plan pursuant to G.S. 113A-54.1(b).

(l) Notice of Activity Initiation. No Person may initiate a land-disturbing activity before notifying the agency that issued the Plan approval of the date that land-disturbing activity will begin.

(m) Preconstruction Conference. When deemed necessary by the Approving Authority, a preconstruction conference may be required and noted on the approved plan.

(n) Display of Plan Approval. A Plan approval issued under this Article shall be prominently displayed until all construction is complete, all temporary measures have been removed, all permanent sedimentation and erosion control measures are installed, and the site has been stabilized. A copy of the approved plan shall be kept on file at the job site.

(o) Required Revisions. After approving a Plan, if the (city)(town)(county), either upon review of such Plan or on inspection of the job site, determines that a significant risk of accelerated erosion or off-site sedimentation exists, the (city), (town), (county) shall require a revised Plan. Pending the preparation of the revised Plan, work shall cease or shall continue under conditions outlined by the appropriate authority. If following commencement of a land-disturbing activity pursuant to an approved Plan, the (city)(town)(county) determines that the Plan is inadequate to meet the requirements of this ordinance, the (city, (town), (county) may require any revision of the Plan that is necessary to comply with this ordinance.

(p) Amendment to a Plan. Applications for amendment of a Plan in written and/or graphic form may be made at any time under the same conditions as the original application. Until such time as said amendment is approved by the (city)(town)(county), the land-disturbing activity shall not proceed except in accordance with the Plan as originally approved.

(q) Failure to File a Plan. Any Person engaged in land-disturbing activity who fails to file a Plan in accordance with this ordinance, or who conducts a land-disturbing activity except in accordance with provisions of an approved Plan shall be deemed in violation of this ordinance.

(r) Self-Inspections. The landowner, the financially responsible party, or the landowner's or the financially responsible party's agent shall perform an inspection of the area covered by the plan after each phase of the plan has been completed and after establishment of temporary ground cover in accordance with G.S. 113A-57(2). In addition, weekly and rain-event self-inspections are required by federal regulations, that are implemented through the NPDES Construction General Permit No. NCG 010000. The Person who performs the inspection shall maintain and make available a record of the inspection at the site of the land-disturbing activity. The record shall set out any significant deviation from the approved erosion control plan, identify any measures that may be required to correct the deviation, and document the completion of those measures. The record shall be maintained until permanent ground cover has been established as required by the approved erosion and sedimentation control plan. The inspections required by this subsection shall be in addition to inspections required by G.S. 113A-61.1.

Where inspections are required by Section 6(r) of this Ordinance or G.S. 113A-54.1(e), the following apply:

(1) The inspection shall be performed during or after each of the following phases of the plan;
   (i) initial installation of erosion and sediment control measures;
   (ii) clearing and grubbing of existing ground cover;
   (iii) completion of any grading that requires ground cover;
   (iv) completion of all land-disturbing activity, construction, or development, including permanent ground cover establishment and removal of all temporary measures; and
   (v) transfer of ownership or control of the tract of land where the erosion and sedimentation control plan has been approved and work has begun. The new owner or Person in control shall conduct and document inspections until the project is permanently stabilized as set forth in Sub-Item (iii) of this Item.

(2) Documentation of self-inspections performed under Item (1) of this Rule shall include:
   (i) Visual verification of ground stabilization and other erosion control measures and practices as called for in the approved plan;
   (ii) Verification by measurement of settling basins, temporary construction entrances, energy dissipators, and traps.
   (iii) The name, address, organization affiliation, telephone number, and signature of the person conducting the inspection and the date of the inspection shall be included, whether on a copy of the approved erosion and sedimentation control plan or an inspection report. A

template for an example of an inspection and monitoring report is provided on the DEMLR website at: https://deq.nc.gov/about/divisions/energy-mineral-land-resources/erosion-sediment-control/forms. Any relevant licenses and certifications may also be included. Any documentation of inspections that occur on a copy of the approved erosion and sedimentation control plan shall occur on a single copy of the plan and that plan shall be made available on the site.

(iv) A record of any significant deviation from any erosion or sedimentation control measure from that on the approved plan. For the purpose of this Rule, a "significant deviation" means an omission, alternation, or relocation of an erosion or sedimentation control measure that prevents it from performing as intended. The record shall include measures required to correct the significant deviation, along with documentation of when those measures were taken. Deviations from the approved plan may also be recommended to enhance the intended performance of the sedimentation and erosion control measures.

Except as may be required under federal law, rule or regulation, no periodic self-inspections or rain gauge installation is required on individual residential lots where less than one acre is being disturbed on each lot.

SECTION 7 Basic Control Objectives

An erosion and sedimentation control Plan may be disapproved if the Plan fails to address the following control objectives:

(a) Identify Critical Areas - On-site areas which are subject to severe erosion, and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation, are to be identified and receive special attention.

(b) Limit Time of Exposure - All land-disturbing activities are to be planned and conducted to limit exposure to the shortest time specified in G.S. 113A-57, the rules of the aforementioned Chapter, or as directed by the Approving Authority.

(c) Limit Exposed Areas - All land-disturbing activity is to be planned and conducted to minimize the size of the area to be exposed at any one time.

(d) Control Surface Water - Surface water runoff originating upgrade of exposed areas should be controlled to reduce erosion and sediment loss during the period of exposure.

(e) Control Sedimentation - All land-disturbing activity is to be planned and conducted to prevent off-site sedimentation damage.

(f) Manage Stormwater Runoff - Plans shall be designed so that any increase in velocity of stormwater runoff resulting from a land-disturbing activity will not result in accelerated erosion of the receiving stormwater conveyance or at the point of discharge. Plans shall include measures to prevent accelerated erosion within the project boundary and at the point of discharge.

SECTION 8 Design and Performance Standards

(a) Except as provided in Section 8(b)(2) and Section 8(c)(1) of this ordinance, erosion and sedimentation control measures, structures, and devices shall be planned, designed, and constructed to provide protection from the calculated maximum peak rate of runoff from the ten-year storm. Runoff rates shall be calculated using the procedures in the latest edition of the United States Department of Agriculture (USDA), Natural Resources Conservation Service's "National Engineering Field Handbook", or other acceptable calculation procedures.

(b) HQW Zones. In High Quality Water (HQW) zones the following design standards shall apply:

(1) Limit on Uncovered Area. Uncovered areas in HQW zones shall be limited at any time to a maximum total area of twenty acres within the boundaries of the tract. Only the portion of the land-disturbing activity within a HQW zone shall be governed by this section. Larger areas may be uncovered within the boundaries of the tract with the written approval of the Director upon providing engineering justification with a construction sequence that considers phasing, limiting exposure, weekly submitted self-inspection reports, and a more conservative design than the Twenty-five Year Storm.

(2) Maximum Peak Rate of Runoff Protection. Erosion and sedimentation control measures, structures, and devices within HQW zones shall be planned, designed and constructed to provide protection from the runoff of the twenty-five year storm which produces the maximum peak rate of runoff as calculated according to procedures in the latest edition of the United States Department of Agriculture Natural Resources Conservation Service's "National Engineering Field Handbook" or according to procedures adopted by any other agency of this state or the United States or any generally recognized organization or association.

(3) Sediment Basin Design. Sediment basins within HQW zones shall be designed and constructed according to the following criteria:

(i) use a surface withdrawal mechanism, except when the basin drainage area is less than 1.0 acre;

(ii) have a minimum of 1800 cubic feet of storage area per acre of disturbed area;

(iii) have a minimum surface area of 325 square feet per cfs of the

Twenty-five Year Storm (Q25) peak flow;

(iv) have a minimum dewatering time of 48 hours;

(v) incorporate 3 baffles, unless the basin is less than 20 feet in length, in which case 2 baffles shall be sufficient.

Upon a written request of the applicant, the Director may allow alternative design and control measures in lieu of meeting the conditions required in subparagraphs (3)(ii) through (3)(v) of this sub-section if the applicant demonstrates that meeting all of those conditions will result in design or operational hardships and that the alternative measures will provide an equal or more effective level of erosion and sediment control on the site. Alternative measures may include quicker application of ground cover, use of sediment flocculants, and use of enhanced ground cover practices.

(4) Grade. Newly constructed open channels in HQW zones shall be designed and constructed with side slopes no steeper than two horizontal to one vertical if a vegetative cover is used for stabilization unless soil conditions permit a steeper slope or where the slopes are stabilized by using mechanical devices, structural devices or other forms of ditch liners proven as being effective in restraining accelerated erosion. In any event, the angle for side slopes shall be sufficient to restrain accelerated erosion.

(c) Design Standards for The Upper Neuse River Basin (Falls Lake Watershed)

In addition to any other requirements of State, federal, and local law, land-disturbing activity in the watershed of the drinking water supply reservoir that meets the applicability requirements of Session Law 2009-486, Section 3. (a), shall meet all of the following design standards for sedimentation and erosion control:

(1) Erosion and sedimentation control measures, structures, and devices shall be planned, designed, and constructed to provide protection from the runoff of the 25-year storm that produces the maximum peak rate of runoff as calculated according to procedures set out in the latest edition of the United States Department of Agriculture Natural Resources Conservation Service's "Engineering Field Handbook" found through nrcs.usda.gov or according to procedures adopted by any other agency of the State or the United States.

(2) Sediment basins shall be planned, designed, and constructed so that the basin will have a settling efficiency of at least 70 percent for the 40-micron size soil particle transported into the basin by the runoff of the two-year storm that produces the maximum peak rate of runoff as calculated according to procedures in the latest edition of the United States Department of Agriculture Natural Resources Conservation Service's "National Engineering Field Handbook" or according to procedures adopted by any other agency of the State or the United States.

(3) Newly constructed open channels shall be planned, designed, and constructed with side slopes no steeper than two horizontal to one vertical if a vegetative cover is used for stabilization unless soil conditions permit

steeper side slopes or where the side slopes are stabilized by using mechanical devices, structural devices, or other ditch liners sufficient to restrain accelerated erosion. The angle for side slopes shall be sufficient to restrain accelerated erosion, as determined by the Approving Authority, based on soil conditions.

(4) For an area of land-disturbing activity where grading activities have been completed, temporary or permanent ground cover sufficient to restrain erosion shall be provided as soon as practicable, but in no case later than seven calendar days after completion of grading. For an area of land-disturbing activity where grading activities have not been completed, temporary ground cover shall be provided as follows:

(i) For an area with no slope, temporary ground cover shall be provided for the area if it has not been disturbed for a period of 14 calendar days.

(ii) For an area of moderate slope, temporary ground cover shall be provided for the area if it has not been disturbed for a period of 10 calendar days. For purposes of this Item, "moderate slope" means an inclined area, the inclination of which is less than or equal to three units of horizontal distance to one unit of vertical distance.

(iii) For an area of steep slope, temporary ground cover shall be provided for the area if it has not been disturbed for a period of seven calendar days. For purposes of this Item, "steep slope" means an inclined area, the inclination of which is greater than three units of horizontal distance to one unit of vertical distance.

SECTION 9 Storm Water Outlet Protection

(a) Intent. Stream banks and channels downstream from any land disturbing activity shall be protected from increased degradation by accelerated erosion caused by increased velocity of runoff from the land disturbing activity.

(b) Performance standard. Persons shall conduct land-disturbing activity so that the post construction velocity of the 10-year storm runoff in the receiving watercourse to the discharge point does not exceed the greater of:

(1) the velocity established by the Maximum Permissible Velocities Table set out within this subsection; or

(2) the velocity of the ten-year storm runoff in the receiving watercourse prior to development.

If condition (1) or (2) of this Paragraph cannot be met, then the receiving watercourse to and including the discharge point shall be designed and constructed to withstand the expected velocity anywhere the velocity exceeds the “prior to development” velocity by 10%.

Maximum Permissible Velocities Table

The following is a table for maximum permissible velocity for storm water discharges in feet per second (F.P.S.) and meters per second (M.P.S.):

| Material | F.P.S. | M.P.S. |
|---|---|---|
| Fine sand (noncolloidal) | 2.5 | 0.8 |
| Sandy loam (noncolloidal) | 2.5 | 0.8 |
| Silt loam (noncolloidal) | 3.0 | 0.9 |
| Ordinary firm loam | 3.5 | 1.1 |
| Fine gravel | 5.0 | 1.5 |
| Stiff clay (very colloidal) | 5.0 | 1.5 |
| Graded, loam to cobbles (noncolloidal) | 5.0 | 1.5 |
| Graded, silt to cobbles (Colloidal) | 5.5 | 1.7 |
| Alluvial silts (noncolloidal) | 3.5 | 1.1 |
| Alluvial silts (colloidal) | 5.0 | 1.5 |
| Coarse gravel (noncolloidal) | 6.0 | 1.8 |
| Cobbles and shingles | 5.5 | 1.7 |
| Shales and hard pans | 6.0 | 1.8 |

Source - Adapted from recommendations by Special Committee on Irrigation Research, American Society of Civil Engineers, 1926, for channels with straight alignment. For sinuous channels, multiply allowable velocity by 0.95 for slightly sinuous, by 0.9 for moderately sinuous channels, and by 0.8 for highly sinuous channels.

(c) Acceptable Management Measures - Measures applied alone or in combination to satisfy the intent of this section are acceptable if there are no objectionable secondary consequences. The (city)(town)(county) recognizes that the management of storm water runoff to minimize or control downstream channel and bank erosion is a developing technology. Innovative techniques and ideas will be considered and may be used when shown to have the potential to produce successful results. Some alternatives, while not exhaustive, are to:

(1) Avoid increases in surface runoff volume and velocity by including measures to promote infiltration to compensate for increased runoff from areas rendered impervious;

(2) Avoid increases in storm water discharge velocities by using vegetated or

roughened swales and waterways in place of closed drains and high velocity paved sections:

(3) Provide energy dissipators at outlets of storm drainage facilities to reduce flow velocities to the point of discharge;

(4) Protect watercourses subject to accelerated erosion by improving cross sections and/or providing erosion-resistant lining; and

(5) Upgrade or replace the receiving device structure, or watercourse such that it will receive and conduct the flow to a point where it is no longer subject to degradation from the increased rate of flow or increased velocity.

(d) Exceptions - This rule shall not apply where it can be demonstrated to the (city), (town), (county) that storm water discharge velocities will not create an erosion problem in the receiving watercourse.

SECTION 10 Borrow and Waste Areas

If the same Person conducts the land-disturbing activity and any related borrow or waste activity, the related borrow or waste activity shall constitute part of the land-disturbing activity, unless the borrow or waste activity is regulated under the Mining Act of 1971, G.S. 74, Article 7, or is a landfill regulated by the Division of Waste Management. If the land-disturbing activity and any related borrow or waste activity are not conducted by the same Person, they shall be considered by the Approving Authority as separate land-disturbing activities.

SECTION 11 Access and Haul Roads

Temporary access and haul roads, other than public roads, constructed or used in connection with any land-disturbing activity shall be considered a part of such activity.

SECTION 12 Operations in Lakes or Natural Watercourses

Land disturbing activity in connection with construction in, on, over, or under a lake or natural watercourse shall minimize the extent and duration of disruption of the stream channel. Where relocation of a stream forms an essential part of the proposed activity, the relocation shall minimize changes in the stream flow characteristics.

SECTION 13 Responsibility for Maintenance

During the development of a site, the Person conducting the land-disturbing activity shall install and maintain all temporary and permanent erosion and sedimentation control measures as required by the approved plan or any provision of this Ordinance, the Act, or any order adopted pursuant to this ordinance or the Act. After site development, the landowner or Person in possession or control of the land shall install and/or maintain all necessary permanent erosion and sediment control measures, except those measures installed within a road or street right-of-way or easement accepted for maintenance by a governmental agency.

SECTION 14 Additional Measures

Whenever the (city)(town)(county), determines that accelerated erosion and sedimentation continues despite the installation of protective practices, they shall direct the Person conducting the land-disturbing activity to take additional protective action necessary to achieve compliance with the conditions specified in the Act or its rules.

SECTION 15 Fees

The (city)(town)(county), may establish a fee schedule for the review and approval of Plans.

[NOTE: THE LOCAL PROGRAM SHALL CONSIDER THE ADMINISTRATIVE AND PERSONNEL COSTS INCURRED FOR REVIEWING THE PLANS AND FOR COMPLIANCE RELATED ACTIVITES.]

[NOTE: Fees for Sedimentation and Erosion Control plan review by a local E&SC program must comply with House Bill 488 -FAMILY LOT IN A R MENT THAT IS LESS T T.]

SECTION 16 Plan Appeals

(a) Except as provided in Section 16(b) of this ordinance, the appeal of a disapproval or approval with modifications of a Plan shall governed by the following provisions:

(1) The disapproval or modification of any proposed Plan by the (city)(town)(county), shall entitle the Person submitting the Plan to a public hearing if such Person submits written demand for a hearing within 15 days after receipt of written notice of disapproval or modifications.

(2) A hearing held pursuant to this section shall be conducted by the (city)(town)(county), (appropriate local agency), within _____ days after the date of the appeal or request for a hearing.

(3) The agency conducting the hearings shall make recommendations to the governing body of the (city)(town)(county), within ____ days after the date of the hearing on any Plan.

(4) The Governing Body of the (city)(town)(county), will render its final decision on any Plan within ____ days of receipt of the recommendations from the agency conducting the hearing.

(5) If the (city)(town)(county) upholds the disapproval or modification of a proposed Plan following the hearing, the Person submitting the Plan shall then be entitled to appeal the (city)(town)(county)'s decision to the Commission as provided in G.S. 113A-61(c) and 15A NCAC 4B .0118(d)

[NOTE: THE APPEALS PROCEDURES ABOVE ARE INCLUDED ONLY TO ENSURE THAT EACH LOCAL ORDINANCE CONTAINS PROCEDURES FOR APPEALS. THE PROCEDURE SHOULD BE WRITTEN TO CONFORM TO APPLICABLE EXISTING PROCEDURES, OR AS CREATED FOR THE ADMINISTRATION OF THE ORDINANCE.]

(b) In the event that a Plan is disapproved pursuant to Section 6(j) of this ordinance, the applicant may appeal the (city)(town)(county)'s disapproval of the Plan directly to the Commission.

SECTION 17 Inspections and Investigations

(a) Inspection. Agents, officials, or other qualified persons authorized by the (city), (town), (county), will periodically inspect land-disturbing activities to ensure compliance with the Act, this ordinance, or rules or orders adopted or issued pursuant to this ordinance, and to determine whether the measures required in the Plan are effective in controlling erosion and sedimentation resulting from land-disturbing activity. Notice of the right to inspect shall be included in the certificate of approval of each Plan.

(b) Willful Resistance, Delay or Obstruction. No person shall willfully resist, delay, or obstruct an authorized representative, employee, or agent of the (city), (town), (county), while that person is inspecting or attempting to inspect a land-disturbing activity under this section.

(c) Notice of Violation. If the (city)(town)(county) determines that a Person engaged in land-disturbing activity has failed to comply with the Act, this ordinance, or rules, or orders adopted or issued pursuant to this ordinance, a notice of violation shall be served upon that Person. The notice may be served by any means authorized under GS 1A-1, Rule 4. The notice shall specify a date by which the

Person must comply with the Act, or this ordinance, or rules, or orders adopted pursuant to this ordinance, and inform the Person of the actions that need to be taken to comply with the Act, this ordinance, or rules or orders adopted pursuant to this ordinance. Any Person who fails to comply within the time specified is subject to additional civil and criminal penalties for a continuing violation as provided in G.S. 113A-64 and this ordinance. If the Person engaged in the land-disturbing activity has not received a previous notice of violation under this section, the (city)(town)(county) shall offer assistance in developing corrective measures. Assistance may be provided by referral to a technical assistance program on behalf of the Approving Authority, referral to a cooperative extension program, or by the provision of written materials such as Department guidance documents. The notice of violation may be served in the manner prescribed for service of process by G.S. 1A-1, Rule 4, and shall include information on how to obtain assistance in developing corrective measures.

(d) Investigation. The (city)(town)(county), shall have the power to conduct such investigation as it may reasonably deem necessary to carry out its duties as prescribed in this ordinance, and who presents appropriate credentials for this purpose to enter at reasonable times, any property, public or private, for the purpose of investigating and inspecting the sites of any land-disturbing activity.

(e) Statements and Reports. The (city)(town)(county), shall also have the power to require written statements, or filing of reports under oath, with respect to pertinent questions relating to land-disturbing activity.

SECTION 18 Penalties

(a) Civil Penalties

(1) Civil Penalty for a Violation. Any Person who violates any of the provisions of this ordinance, or rule or order adopted or issued pursuant to this ordinance, or who initiates or continues a land-disturbing activity for which a Plan is required except in accordance with the terms, conditions, and provisions of an approved Plan, is subject to a civil penalty. The maximum civil penalty amount that the (city)(town)(county) may assess per violation is five thousand dollars ($5,000.00). A civil penalty may be assessed from the date of the violation. Each day of a continuing violation shall constitute a separate violation. When the Person has not been assessed any civil penalty under this subsection for any previous violation, and that Person abated continuing environmental damage resulting from the violation within 180 days from the date of the notice of violation, the maximum cumulative total civil penalty assessed under this subsection for all violations associated with the land-disturbing activity for which the erosion and sedimentation control plan is required is twenty-five thousand dollars ($25,000).

[NOTE: UNDER G.S. §113A-61.1(d), DAMAGE OR DESTRUCTION OF A SILT FENCE OCCURRING DURING LAND-DISTURBING ACTIVITIES OR CONSTRUCTION ON A DEVELOPMENT PROJECT SHALL NOT BE ASSESSED A CIVIL PENALTY PROVIDED THAT THE SILT FENCE IS REPAIRED OR REPLACED WITHIN THE COMPLIANCE PERIOD/DEADLINE NOTED IN THE INSPECTION REPORT OR NOTICE OF VIOLATION. ENSURE VIOLATORS HAVE AN OPPORTUNITY TO CORRECT THESE VIOLATIONS. THIS STATUTE DOES NOT APPLY TO OFF-SITE SEDIMENT THAT OCCURS DUE TO THE SILT FENCE NOT BEING IN PLACE, BUT MERELY DAMAGE TO THE SILT FENCE ITSELF.]

(2) Civil Penalty Assessment Factors. The governing body of the (city)(town)(county) shall determine the amount of the civil penalty based upon the following factors:

(i) the degree and extent of harm caused by the violation,
(ii) the cost of rectifying the damage,
(iii) the amount of money the violator saved by noncompliance,
(iv) whether the violation was committed willfully, and
(v) the prior record of the violator in complying of failing to comply with this ordinance.

(3) Notice of Civil Penalty Assessment. The governing body of the (city)(town)(county) shall provide notice of the civil penalty amount and basis for assessment to the Person assessed. The notice of assessment shall be served by any means authorized under G.S. 1A-1, Rule 4. A notice of assessment by the (city)(town)(county) shall direct the violator to either pay the assessment, contest the assessment within 30 days by filing a petition for hearing with the (city)(town)(county) (as directed by procedures within the local ordinances or regulations adopted to establish and enforce the erosion and sedimentation control program), or file a request with the (city, town, county commission/board) for remission of the assessment within 30 days of receipt of the notice of assessment. A remission request must be accompanied by a waiver of the right to a contested case hearing pursuant to Chapter 150B of the North Carolina General Statutes and a stipulation of the facts on which the assessment was based.

(4) Final Decision: The final decision on contested assessments shall be made by the governing body of the (city)(town)(county) in accordance with (the local ordinances or regulations adopted to establish and enforce the erosion and sedimentation control program.)

(5) Appeal of Final Decision. Appeal of the final decision of the governing body of the (city)(town)(county) shall be to the Superior Court of the county where the violation occurred. Such appeals must be made within 30 days of the final decision of the governing body of the (city)(town)(county).

(6) Remission of Civil Penalties. A request for remission of a civil penalty imposed under G.S. 113A-64 may be filed with the (city, town, county commission/board) within 30 days of receipt of the notice of assessment. A remission request must be accompanied by a waiver of the right to a contested case hearing pursuant to Chapter 150B of the General Statutes and a stipulation of the facts on which the assessment was based. The following factors shall be considered in determining whether a civil penalty remission request will be approved:

(i) Whether one or more of the civil penalty assessment factors in G.S. 113A-64(a)(3) were wrongly applied to the detriment of the petitioner.
(ii) Whether the petitioner promptly abated continuing environmental damage resulting from the violation.
(iii) Whether the violation was inadvertent or a result of an accident.
(iv) Whether the petitioner had been assessed civil penalties for any previous violations.
(v) Whether payment of the civil penalty will prevent payment for necessary remedial actions or would otherwise create a significant financial hardship.
(vi) The assessed property tax valuation of the petitioner's property upon which the violation occurred, excluding the value of any structures located on the property.

[NOTE: THE PETITIONER HAS THE BURDEN OF PROVIDING INFORMATION CONCERNING THE FINANCIAL IMPACT OF A CIVIL PENALTY ON THE PETITIONER AND THE BURDEN OF SHOWING THE PETITIONER'S FINANCIAL HARDSHIP. THE CITY/TOWN/COUNTY COMMISSION OR BOARD MAY REMIT THE ENTIRE AMOUNT OF THE PENALTY ONLY WHEN THE PETITIONER HAS NOT BEEN ASSESSED CIVIL PENALTIES FOR PREVIOUS VIOLATIONS AND PAYMENT OF THE CIVIL PENALTY WILL PREVENT PAYMENT FOR NECESSARY REMEDIAL ACTIONS. THE CITY/TOWN/COUNTY COMMISSION OR BOARD MAY NOT IMPOSE A PENALTY UNDER THIS SECTION THAT IS IN EXCESS OF THE CIVIL PENALTY IMPOSED BY THE LOCAL PROGRAM.]

[NOTE: THE FOREGOING PROCEDURES ARE OFFERED AS GUIDANCE TO LOCAL GOVERNMENTS TO ENSURE THAT CIVIL PENALTIES ARE ACCOMPANIED BY REMISSION REQUESTS AND APPEAL PROCEDURES, INCLUDING HEARING OPPORTUNITIES. REFER TO THE REMISSION GUIDELINES FOR LOCAL GOVERNMENT EROSION AND SEDIMENT CONTROL PROGRAMS FOR THE FULL PROCEDURE.]

(7) Collection. If payment is not received within 30 days after it is due, the (city)(town)(county) may institute a civil action to recover the amount of the assessment. The civil action may be brought in the Superior Court of the county where the violation occurred, or the violator's residence or principal place of business is located. Such civil actions must be filed within three (3) years of the date the assessment was due. An assessment that is not contested and a remission that is not requested is due when the violator is served with a notice of assessment. An assessment that is contested or a remission that is requested is due at the conclusion of the administrative and judicial review of the assessment.

(8) Credit of Civil Penalties. The clear proceeds of civil penalties collected by the (city)(town)(county) under this subsection shall be remitted to the Civil Penalty and Forfeiture Fund in accordance with G.S. 115C-457.2. Penalties collected by the (city)(town)(county) may be diminished only by the actual costs of collection. The collection cost percentage to be used shall be established and approved by the North Carolina Office of State Budget and Management on an annual basis, based upon the computation of actual collection costs by the (city)(town)(county) for the prior fiscal year.

[IN ANY EVENT, THE COST PERCENTAGE SHALL NOT EXCEED TWENTY PERCENT (20%) OF PENALTIES COLLECTED.]

(b) Criminal Penalties. Any Person who knowingly or willfully violates any provision of this ordinance, or rule or order adopted or issued by the Commission or a local government, or who knowingly or willfully initiates or continues a land-disturbing activity for which a Plan is required except in accordance with the terms, conditions, and provisions of an approved Plan, shall be guilty of a Class 2 misdemeanor which may include a fine not to exceed $5,000 as provided in G.S. 113A-64.

SECTION 19 Injunctive Relief

(a) Violation of Local Program. Whenever the governing body has reasonable cause to believe that any Person is violating or threatening to violate any ordinance, rule, regulation or order adopted or issued by the (city)(town)(county), or any term, condition, or provision of an approved Plan, it may, either before or after the institution of any other action or proceeding authorized by this ordinance, institute a civil action in the name of the (city)(town)(county), for injunctive relief to restrain the violation or threatened violation. The action shall be brought in the superior court of the county in which the violation is occurring or is threatened.

(b) Abatement of Violation. Upon determination by a court that an alleged violation is occurring or is threatened, the court shall enter any order or judgment that is

necessary to abate the violation, to ensure that restoration is performed, or to prevent the threatened violation. The institution of an action for injunctive relief under this section shall not relieve any party to the proceedings from any civil or criminal penalty prescribed for violations of this ordinance.

SECTION 20 Restoration After Non-Compliance

The (city)(town)(county), may require a Person who engaged in a land-disturbing activity and failed to retain sediment generated by the activity, as required by G.S. 113A-57 (3), to restore the waters and land affected by the failure so as to minimize the detrimental effects of the resulting pollution by sedimentation. This authority is in addition to any other civil or criminal penalty or injunctive relief authorized under this ordinance.

SECTION 21 Severability

If any section or section or sections of this ordinance is/are held to be invalid or unenforceable, all other sections shall nevertheless continue in full force and effect.

SECTION 22 Effective Date

This ordinance becomes effective on _____.

[IN ESTABLISHING AN EFFECTIVE DATE, THE LOCAL GOVERNMENT SHOULD CONSIDER THE NEED FOR LEAD-TIME TO ORIENT AND EDUCATE THOSE AFFECTED BY FULL IMPLEMENTATION OF THE ORDINANCE.]