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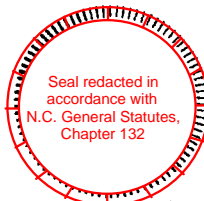
N-33-16

STORMWATER OPERATIONS AND MAINTENANCE
MANUAL

WYNDCREST SUBDIVISION
S-17-14

Prepared by:

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License Number C-0465



Chris Riddle
4/16/16

shelf that extends just above and just below the normal pool level. The wetland plants must be maintained throughout the life of the device.

A design summary and construction details the wet pond is included in the Appendix.

3. INSPECTION/MAINTENANCE

The wet pond, level spreader, and vegetated filter strip should be inspected at least every 30 days, or following rainfall events greater than 1.0" in accumulation over 24 hours. The area around the draw down pipe and riser structure should be cleared of all debris and trash. The orifice at the base of the draw down pipe should be cleared of all obstructions. Mow the grass on the slopes of the device as required.

Incorporated into this Operations and Maintenance Manual are the Wet Detention Basin Operation and Maintenance Agreement (Form SW401) and Filter Strip, Restored Riparian Buffer and Level Spreader Operation and Maintenance Agreement (Form SWU401) developed by the North Carolina Department of Environmental Quality. These forms shall be used as a guide for inspections and actions to be taken to maintain the wet pond, level spreader and vegetated filter strip. The forms are included in the Appendix.

If the Homeowners Association is unsure as to the stability of the Stormwater Control Measures, consult a qualified registered professional engineer.

4. ANNUAL INSPECTION

Inspection of the wet pond, level spreader, and vegetated filter strip by a qualified registered professional engineer is required annually by the City of Raleigh. Each year a report must be filed with the Stormwater Division of the Public Works Department. Each year inspections shall conform to City of Raleigh Unified Development Ordinance (UDO) Section 9.2.2(D). Form 501 should be filed with the City annually. See Appendix.

5. MAJOR REPAIR

Major repairs to the wet pond, level spreader, and vegetated filter strip should be undertaken at the direction of a qualified registered professional engineer. Major repairs include any repairs the cost of which exceeds one-third of the replacement cost of the wet pond, level spreader, and vegetated filter strip. Major repairs would include repair of leakage of the pond dike or riser structure or piping; pipe failure due to leaks, cracks, settlement, or other causes; replacement of the riser structure or piping.

Attached in the Appendix are copies of construction details, drawings of the design of the wet pond, level spreader, and filter strip.

6. RECORD KEEPING

The Homeowners Association shall be required to keep records in accordance with the City of Raleigh City Code. Attached are a checklist and an inspection log for use by the Homeowners Association. The Homeowners Association shall maintain copies of inspections, correspondence, and reports by a professional engineer regarding the Stormwater Control Measures.

7. ESTIMATED ANNUAL BUDGET

The following is a cost estimate for annual maintenance of the Stormwater Control Measures in Wyndcrest Subdivision:

Estimated Annual Inspection and Maintenance Costs (2016)

<u>Item</u>	<u>Estimated Cost</u>
1. Annual Inspection by Registered Professional (not including consulting, redesign or construction supervision)	\$400.00
2. Mowing (\$75.00/trip X 5 trips/year)	\$375.00
3. Litter, debris, and sediment removal	\$100.00
4. Wetland Plant Replacement and Seeding	\$100.00
5. Minor Outlet Structure repairs	\$50.00
6. Liability Insurance Premiums	\$300.00
Total Estimated Annual Maintenance cost of Stormwater Control Measures in Wyndcrest Subdivision	\$1,325.00

These are budget estimates that must be adjusted as required by the Homeowners Association based on the actual costs incurred.

Estimated Construction Costs for Stormwater Control Device (2016)

The following are estimated construction costs for the Stormwater Control Measures in The Wyndcrest Subdivision.

<u>Wet Pond</u>	<u>Estimated Construction Costs (2016)</u>
Grading	\$30,000.00
Riser Structure & Trash Rack	\$6,000.00
36-inch RCP, Anti-seepage, & Rip Rap	\$10,700.00
Draw Down Pipe	\$3,100.00
Wetland Plants	\$1,750.00
Seeding	\$1,400.00
Miscellaneous	\$200.00
Total Estimated Construction Cost	\$53,150.00

Required 24% Contribution Payment = $0.24 \times 53,150.00 = \$12,756.00$

Level Spreader and Veg. Filter Strip Estimated Construction Costs (2016)

Level Spreader and vegetated filter strip	\$1,000.00
Seeding	\$100.00
Total Estimated Construction Cost	\$1,100.00

Required 24% Contribution Payment = $0.24 \times 1,100.00 = \$264.00$

APPENDIX

Stormwater Control Measures Maintenance Log

Wyndcrest Subdivision

Raleigh, NC

1. Inspector/Maintenance Supervisor _____

2. Is this maintenance at the direction of a registered professional engineer?

_____ yes _____ no

If yes, attach engineer's report.

Name of engineer _____

Telephone Number _____

3. Generally describe maintenance to be undertaken and reason for maintenance:

4. Date Started _____

Date Completed _____

5. Additional Comments:

Wyndcrest Subdivision

Wet Pond, Level Spreader, and Vegetated Filter Strip Design Summary

Wet Pond

Bottom Elevation (pond and forebay)	409.00
Sediment Removal Elevation	410.00
Bottom of Wetland Shelf	416.00
Normal Pool Level	416.50
Top of Wetland Shelf	417.00
Top of Dike	420.50

Riser Structure

Top Elevation	418.40
Invert out (36" @1.54%)	413.25
Invert out (6" to level spreader @1.00%)	413.30
Top of Weir Wall	414.50

Total Length 36" Pipe	88 ft.
Approximate Volume of Storage During 2-year Storm(El 418.06)	22,170 cu. ft.
Approximate Volume of Storage During 10-year Storm(El 418.43)	28,120 cu. ft.
Q-2 Discharge (Inflow = 53.5 cfs)	0.14 cu. ft./sec.
Q-10 Discharge (Inflow = 67.9 cfs)	0.23 cu. ft./sec.

Level Spreader and Vegetated Filter Strip

Length of Level Spreader	10 feet
Top of Level Spreader	413.00
Vegetated Filter Strip Width	10 feet
Vegetated Filter Strip Length	30 feet
Fescue Ground Cover	
Vegetated Filter Strip Slope	1.5%

Permit Number: _____
(to be provided by DWQ)
 Drainage Area Number: _____

Wet Detention Basin Operation and Maintenance Agreement

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

The wet detention basin system is defined as the wet detention basin, pretreatment including forebays and the vegetated filter if one is provided.

This system *(check one)*:

does does not incorporate a vegetated filter at the outlet.

This system *(check one)*:

does does not incorporate pretreatment other than a forebay.

Important maintenance procedures:

- Immediately after the wet detention basin is established, the plants on the vegetated shelf and perimeter of the basin should be watered twice weekly if needed, until the plants become established (commonly six weeks).
- No portion of the wet detention pond should be fertilized after the first initial fertilization that is required to establish the plants on the vegetated shelf.
- Stable groundcover should be maintained in the drainage area to reduce the sediment load to the wet detention basin.
- If the basin must be drained for an emergency or to perform maintenance, the flushing of sediment through the emergency drain should be minimized to the maximum extent practical.
- Once a year, a dam safety expert should inspect the embankment.

After the wet detention pond is established, it should be inspected once a month and within 24 hours after every storm event greater than 1.0 inches (or 1.5 inches if in a Coastal County). Records of operation and maintenance should be kept in a known set location and must be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire BMP	Trash/debris is present.	Remove the trash/debris.
The perimeter of the wet detention basin	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Vegetation is too short or too long.	Maintain vegetation at a height of approximately six inches.

Permit Number: _____
(to be provided by DWQ)
 Drainage Area Number: _____

BMP element:	Potential problem:	How I will remediate the problem:
The inlet device: pipe or swale	The pipe is clogged.	Unclog the pipe. Dispose of the sediment off-site.
	The pipe is cracked or otherwise damaged.	Replace the pipe.
	Erosion is occurring in the swale.	Regrade the swale if necessary to smooth it over and provide erosion control devices such as reinforced turf matting or riprap to avoid future problems with erosion.
The forebay	Sediment has accumulated to a depth greater than the original design depth for sediment storage.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Erosion has occurred.	Provide additional erosion protection such as reinforced turf matting or riprap if needed to prevent future erosion problems.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The vegetated shelf	Best professional practices show that pruning is needed to maintain optimal plant health.	Prune according to best professional practices
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application to establish the ground cover if a soil test indicates it is necessary.
	Weeds are present.	Remove the weeds, preferably by hand. If pesticide is used, wipe it on the plants rather than spraying.
The main treatment area	Sediment has accumulated to a depth greater than the original design sediment storage depth.	Search for the source of the sediment and remedy the problem if possible. Remove the sediment and dispose of it in a location where it will not cause impacts to streams or the BMP.
	Algal growth covers over 50% of the area.	Consult a professional to remove and control the algal growth.
	Cattails, phragmites or other invasive plants cover 50% of the basin surface.	Remove the plants by wiping them with pesticide (do not spray).

Permit Number: _____
 (to be provided by DWQ)
 Drainage Area Number: _____

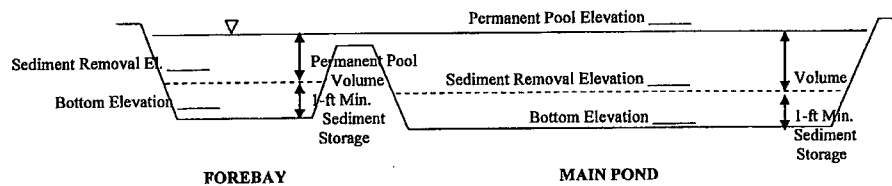
BMP element:	Potential problem:	How I will remediate the problem:
The embankment	Shrubs have started to grow on the embankment.	Remove shrubs immediately.
	Evidence of muskrat or beaver activity is present.	Use traps to remove muskrats and consult a professional to remove beavers.
	A tree has started to grow on the embankment.	Consult a dam safety specialist to remove the tree.
	An annual inspection by an appropriate professional shows that the embankment needs repair. (if applicable)	Make all needed repairs.
The outlet device	Clogging has occurred.	Clean out the outlet device. Dispose of the sediment off-site.
	The outlet device is damaged.	Repair or replace the outlet device.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the local NC Division of Water Quality Regional Office, or the 401 Oversight Unit at 919-733-1786.

The measuring device used to determine the sediment elevation shall be such that it will give an accurate depth reading and not readily penetrate into accumulated sediments.

When the permanent pool depth reads _____ feet in the main pond, the sediment shall be removed.

When the permanent pool depth reads _____ feet in the forebay, the sediment shall be removed.

BASIN DIAGRAM
 (fill in the blanks)



Permit Number: _____
 (to be provided by DWQ)
 Drainage Area Number: _____

Filter Strip, Restored Riparian Buffer and Level Spreader Operation and Maintenance Agreement

I will keep a maintenance record on this BMP. This maintenance record will be kept in a log in a known set location. Any deficient BMP elements noted in the inspection will be corrected, repaired or replaced immediately. These deficiencies can affect the integrity of structures, safety of the public, and the removal efficiency of the BMP.

Important maintenance procedures:

- Immediately after the filter strip is established, any newly planted vegetation will be watered twice weekly if needed until the plants become established (commonly six weeks).
- Once a year, the filter strip will be reseeded to maintain a dense growth of vegetation
- Stable groundcover will be maintained in the drainage area to reduce the sediment load to the vegetation.
- Two to three times a year, grass filter strips will be mowed and the clippings harvested to promote the growth of thick vegetation with optimum pollutant removal efficiency. Turf grass should not be cut shorter than 3 to 5 inches and may be allowed to grow as tall as 12 inches depending on aesthetic requirements (NIPC, 1993). Forested filter strips do not require this type of maintenance.
- Once a year, the soil will be aerated if necessary.
- Once a year, soil pH will be tested and lime will be added if necessary.

After the filter strip is established, it will be inspected quarterly and within 24 hours after every storm event greater than 1.0 inch (or 1.5 inches if in a Coastal County). Records of operation and maintenance will be kept in a known set location and will be available upon request.

Inspection activities shall be performed as follows. Any problems that are found shall be repaired immediately.

BMP element:	Potential problem:	How I will remediate the problem:
The entire filter strip system	Trash/debris is present.	Remove the trash/debris.
The flow splitter device (if applicable)	The flow splitter device is clogged.	Unclog the conveyance and dispose of any sediment off-site.
	The flow splitter device is damaged.	Make any necessary repairs or replace if damage is too large for repair.

BMP element:	Potential problem:	How I will remediate the problem:
The swale and the level lip	The swale is clogged with sediment.	Remove the sediment and dispose of it off-site.
	The level lip is cracked, settled, undercut, eroded or otherwise damaged.	Repair or replace lip.
	There is erosion around the end of the level spreader that shows stormwater has bypassed it.	Regrade the soil to create a berm that is higher than the level lip, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Trees or shrubs have begun to grow on the swale or just downslope of the level lip.	Remove them.
The bypass channel	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then reestablish proper erosion control.
	Turf reinforcement is damaged or riprap is rolling downhill.	Study the site to see if a larger bypass channel is needed (enlarge if necessary). After this, reestablish the erosion control material.
The filter strip	Grass is too short or too long (if applicable).	Maintain grass at a height of approximately three to six inches.
	Areas of bare soil and/or erosive gullies have formed.	Regrade the soil if necessary to remove the gully, and then plant a ground cover and water until it is established. Provide lime and a one-time fertilizer application.
	Sediment is building up on the filter strip.	Remove the sediment and restabilize the soil with vegetation if necessary. Provide lime and a one-time fertilizer application.
	Plants are desiccated.	Provide additional irrigation and fertilizer as needed.
	Plants are dead, diseased or dying.	Determine the source of the problem: soils, hydrology, disease, etc. Remedy the problem and replace plants. Provide a one-time fertilizer application.
	Nuisance vegetation is choking out desirable species.	Remove vegetation by hand if possible. If pesticide is used, do not allow it to get into the receiving water.
The receiving water	Erosion or other signs of damage have occurred at the outlet.	Contact the NC Division of Water Quality local Regional Office, or the 401 Oversight Unit at 919-733-1786.



City of Raleigh Public Works
Stormwater SCM Annual
Inspection Summary

For City Staff Use:
Date Received:
Date Accepted:
By:
Next Report Due:

Section A- Project Information

Project Name	Permit Number
Project Address	N-
City	State Zip

Section B- Property Information

Property Owner's Name
Property Owner's Address
City State Zip Phone
Recorded book and page of lot of each required stormwater control facility and required open space areas

Section C- SCM Information

Additional pages are necessary to complete this stormwater SCM annual inspection report. The following items are to be included for each SCM, initial by each item:

- Narrative of general site condition
- SCM Type -- **Circle Device(s)**- (Wet Pond, Dry Pond, Wetland, UG Detention, Sand Filter, WQ Swale, Vegetative Filter Strip, Level Spreader, Bioretention, Permeable Pavement, Infiltration, PPUOS, Other: _____)
- Disclosure of completed repairs
- Site specific inspection charts/logs from the approved maintenance manual
- Photograph (in color) of SCM inspected

Submittals may be in the form of an electronic copy emailed to scminspections@raleighnc.gov. Submit the report as one single PDF file. Confirmation will be sent out within 5 days of receipt. If there is no contact from city staff by the 5th day please contact to be sure the City of Raleigh received the inspection.

Paper copies are no longer required.

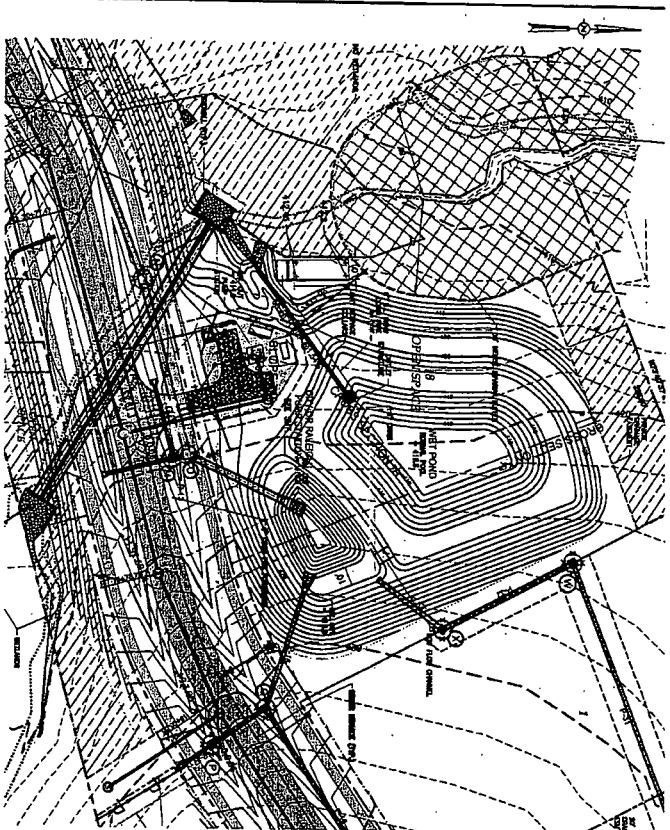
Section D- Surveyor, Engineer, or Landscape Architect Certification

I, _____ as a duly registered _____ in the State of North Carolina attest that on _____, 20____ a thorough inspection of all required stormwater control facilities including open space areas associated with this site are performing properly and are in compliance with the approved stormwater control plan, the applicable maintenance manual required by Unified Development Ordinance (UDO) Sect 9.2.2(D) and the Raleigh Stormwater Control and Watercourse Buffer Manual. No sampling of pollutant loading is required as part of the inspection. All information provided is correct to the best of my knowledge. It is a violation of UDO 9.2.5(F) to falsify this certification. A civil penalty for falsifying this certification shall be assessed by the City of Raleigh in the amount of \$3000.00.

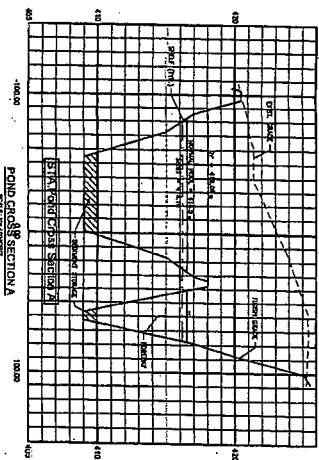
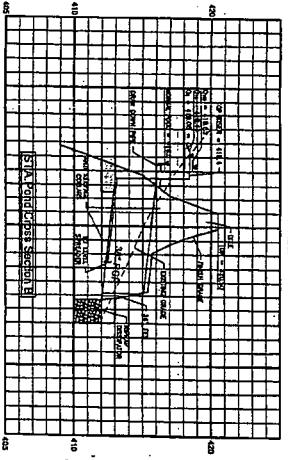
Certifier's Name	License Number	Place Seal Here
Title	Company Name	
Address	City State Zip	
Signature	Date Telephone	

Annual Inspection Reports: Per Unified Development Ordinance 9.2.2(H) An original inspection report of all required stormwater SCMs, including open spaces, shall be filed with the City; due on the anniversary of the initial as-built certification date. Annual inspection reports shall be accompanied by City provided 'Stormwater SCM Annual Inspection Report Summary' Form 501.

PO Box 590
One Exchange Plaza
Raleigh, NC 27602
Phone (919) 996-3940
www.raleighnc.gov

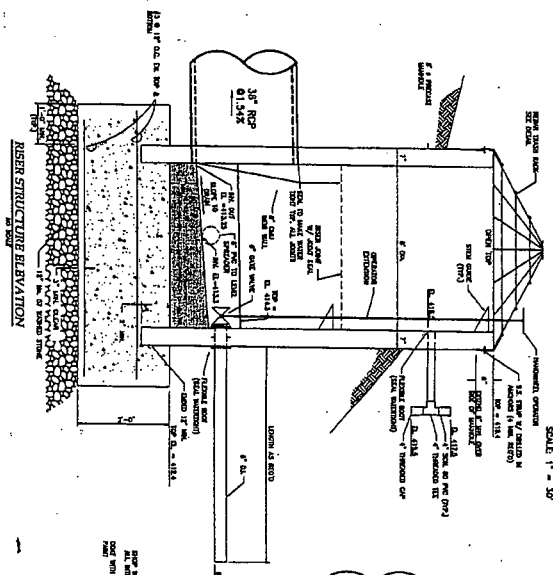


WET POND
SCALE 1" = 20'

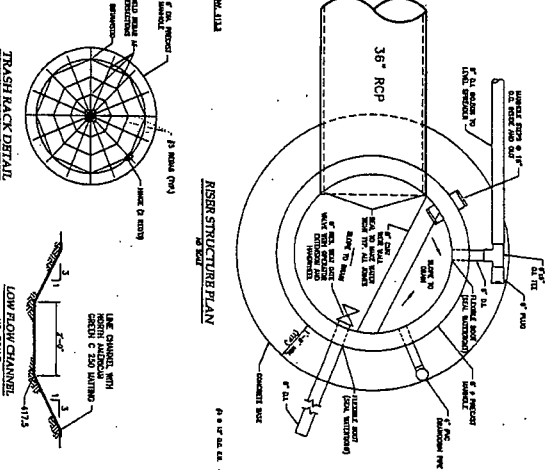


POND CROSS SECTION A
SCALE 1" = 2'

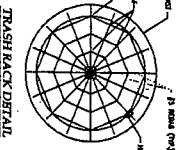
POND CROSS SECTION B
SCALE 1" = 2'



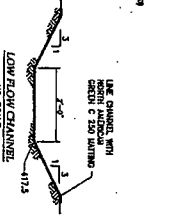
RIVER STRUCTURE ELEVATION
SCALE 1" = 2'



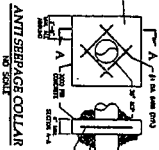
RIVER STRUCTURE PLAN
SCALE 1" = 2'



TRASH RACK DETAIL
SCALE 1" = 2'

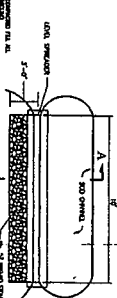


LOW FLOW CHANNEL
SCALE 1" = 2'

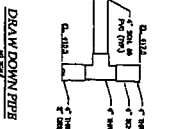


ANTI-SIPHONAGE COLLAR
SCALE 1" = 2'

TCA = THREE CONSERVATION AREA
FWP/D = FALLS WATERSHED
PROTECTION OVERLAY DISTRICT



LEVEL SPREADER DETAIL
SCALE 1" = 2'



DRAW DOWN PIPE
SCALE 1" = 2'

These drawings were prepared in accordance with the provisions of the North Carolina General Statutes, Chapter 152, and the rules and regulations of the North Carolina State Board of Engineering and Surveying. The Engineer is not responsible for the accuracy of the information provided by the client or for the consequences of any errors or omissions in the drawings. The Engineer is not responsible for the consequences of any errors or omissions in the drawings. The Engineer is not responsible for the consequences of any errors or omissions in the drawings.

DESIGNER	
Name	Adrienne Davis
Title	Senior Civil Engineer
Signature	[Signature]
Date	08/11/14

These drawings were prepared in accordance with the provisions of the North Carolina General Statutes, Chapter 152, and the rules and regulations of the North Carolina State Board of Engineering and Surveying. The Engineer is not responsible for the accuracy of the information provided by the client or for the consequences of any errors or omissions in the drawings. The Engineer is not responsible for the consequences of any errors or omissions in the drawings. The Engineer is not responsible for the consequences of any errors or omissions in the drawings.

Scale reduced in accordance with N.C. General Statutes Chapter 152