Greenville
NORTH CAROLINA
PUBLIC WORKS

March 10, 2017

RE: 2017 Stormwater Advisory Committee (SWAC)

Dear SWAC Member:

The second meeting is scheduled for Thursday, March 16, 2017, beginning at 3 p.m. and lasting approximately two hours, see the attached agenda (Attachment A). The meeting will be held in the Public Works Main Conference Room located at 1500 Beatty Street. Light refreshments will be provided.

This meeting will focus on the 25-year detention requirement recommended by the consultants as part of the Watershed Master Plans. We have provided the attached background information for your review prior to the meeting.

- Summary of SWAC Meeting #1, February 3, 2017 (Attachment B)
- Summary of other municipalities' detention requirements (Attachment C)
- 25-year detention recommendation from each watershed (Attachment D-J)
- Memo to development community (Attachment K)

Thank you for being a part of this process. We look forward to working with you and appreciate the time you are willing to commit to this Committee. If you have any questions prior to the March 16th meeting, please do not hesitate to call Ms. Lisa Kirby at 329-4467.

Best regards,

Kevin Mulligan, PE
Director of Public Works

Attachments

ATTACHMENT A

STORMWATER ADVISORY COMMITTEE (SWAC)

Meeting #2 – Stormwater Detention
March 16, 2017 @ 3:00 P.M.

PUBLIC WORKS DEPARTMENT
CONFERENCE ROOM
1500 BEATTY STREET

"Come with an open mind, a willingness to hear all opinions or ideas,
and be a champion for sustainable stormwater management in Greenville."

1. Storm Hydrology
2. 2013 Stormwater Management Ordinance
3. Summary of Other Municipalities' Requirements
4. Watershed Master Plan – 25-year Detention Analysis
5. Memo to Development Community
6. Discussion
7. Closing Remarks

ATTACHMENT B – Summary from 2/3/17

City of Greenville
Stormwater Advisory Committee Meeting
February 3, 2017 11:00am – 1:00pm
Public Works Conference Room

Advisory Members Present:

Jeff Aldridge	Donnie Brewer	Drake Brinkley
Michelle Clements	Lisa Sasser	Leroy Smith
Joni Torres	Beth Ward	Landon Weaver

Staff Present:

Kevin Mulligan	Lisa Kirby	Daryl Norris
Ronnie Donley	Amanda Braddy	

1. Welcome/Introductions

Mr. Mulligan welcomed all present and asked that everyone give an introduction of themselves.

2. Background Information on the development of the City's Stormwater Utility and Stormwater Management Program/Ordinance

Ms. Kirby gave a PowerPoint presentation on the history of the City's Stormwater Utility and Stormwater Management Program and Ordinance.

During the ordinance review of the presentation, Mr. Brewer stated he believed the initial Stormwater Utility fee was initiated in 2000 when the Ogden Reports were reviewed. Mrs. Kirby stated the fee was adopted by City Council in 2003 and began in July 2003.

Ms. Ward questioned where the City of Greenville was in comparison to other cities in regards to Stormwater fees and maintaining Stormwater infrastructure. Ms. Kirby stated as the various topics are presented, comparisons with other municipalities would be provided.

3. Summary of the Current Stormwater Management Program

Mr. Norris gave a PowerPoint presentation on the City's current Stormwater Management Program.

Mr. Brewer asked about piping during the Conditions of Participation portion of the presentation. Mr. Brewer asked if there was a minimum size requirement for pipe installation of a ditch. Mr. Norris replied there was a minimum size of 15 inches and the pipe also had to convey public water.

4. Summary of the Watershed Master Plans

Ms. Kirby gave a PowerPoint presentation on the Watershed Master Plans.

5. Goals & Objectives for the Committee

Mr. Mulligan stated some of the goals & objectives for the Committee are to establish extent of service; level of service; determining future rate structures; and prioritizing capital projects.

6. Questions & Comments

Mr. Mulligan asked if there were any questions or comments about the information presented. There were no questions or additional comments.

7. Closing Remarks

Mr. Mulligan thanked everyone for their involvement in working with the City on this project and stated a poll for the next meeting date will be sent to members.

ATTACHMENT C – Summary of Other Municipalities' Requirements

			Peak Flow Regulation (X yr/24hr storm)				
Rank	**Municipality**	**Regulations**	**1**	**2**	**5**	**10**	**25**
2	Raleigh	Neuse, Falls, Water Supply, Phase 1		No Increase			
5	Durham	Neuse, Falls, Water Supply, Phase 1	No Increase	May require address impact	May require address impact	May require address impact	May require address impact
6	Fayetteville	Water Supply, Phase I	No Increase			No Increase	May require
8	Wilmington	Phase 2, CAMA	No Increase	No Increase		No Increase	No Increase
10	Greenville	Tar-Pam, Water Supply, Phase 2	No Increase		No Increase	No Increase	May require
14	Jacksonville	Phase 2, CAMA				No Increase	
15	Rocky Mount	TarPam, Phase 2, Water Supply	No Increase			No Increase	No Increase
18	Wilson	Neuse, Water Supply	20% reduction	20% reduction		10% reduction	10% reduction

4.3 25-YEAR DETENTION ANALYSIS

In 2014, the City of Greenville enacted legislation requiring attenuation for new development and re-development for the one-year, five-year, and ten-year, 24-hour storm events. In addition, Section 9-9-10 of Ordinance No. 13-054 states the following:

"New development and redevelopment, as described in section 9-9-3, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event."

As part of the Hardee Creek Master Plan, an analysis was completed to determine if there are areas within the watershed and the ETJ that should be considered "well documented water quantity problems" requiring detention for the 25-year, 24-hour storm event. Areas may be defined as well documented water quantity problems if either of the following is true:

- Structural flooding has been historically noted by property owners during storms considered smaller than the design event and this structural flooding has been corroborated by either high water marks, City staff input, or model results.
- Model results indicate structural flooding or roadway overtopping during storms smaller than the design storm and models results are corroborated by City staff input.

Portions of the watershed draining to the "well documented water quantity problems" may be considered for 25-year detention if any of the following are true:

- Future condition flows are 10% or greater than existing flows for a given subwatershed upstream of the water quantity problem.
- Proposed capital projects are not deemed to be feasible or cost effective for providing the required level of service for these water quantity problems based on future land use conditions.
- Cost differential between designing for existing conditions and future conditions is deemed to be significant and/or a significant number of structures would become floodprone during the 25-year design storm based on future conditions flows when compared to existing conditions flows.

It is assumed that for this analysis, systems with a 10-year level of service design would not be considered for the 25-year detention since the 10-year detention requirements would result in little to no increase in peak flows for the design event. Typically, this would include most secondary systems, although secondary systems with significant documented water quantity problems that also includes infrastructure requiring a level of service greater than a 10-year event may be evaluated for the 25-year detention requirement.

As noted in Section 3.1 the crossings at Portertown Road and East 10th Street do not meet the required level of service based on model results. However, based on interviews with City staff and resident feedback these crossings were not considered well documented water quantity

problems as a history of overtopping at these crossings has not been observed. Additionally, the future 25-year flows within the primary streams are a maximum of 8% higher than existing flows throughout Hardee Creek. There are isolated subwatersheds with increases greater than 10% for the future conditions 25-year flows; however, these increases do not result in substantially higher flows within the streams as noted above and do not drain to existing floodprone areas. Subwatersheds HC-7b and HC-9 have the highest increases in 25-year future flows, approximately 25 to 30% higher than existing. Subwatershed HC-7b drains to Hardee Creek north (downstream) of the railroad. As shown in Figure 3-1, the floodprone area north of the railroad has few structures at risk of flooding as the majority of the land use is the golf course. Requiring 25-year detention in Subwatershed HC-7b would not impact flooding of roads or structures. Subwatershed HC-9 is located downstream of 10th Street in undeveloped areas. Any development in this portion of the watershed would have limited impact on flooding due to the timing difference of peak flows from Hardee Creek when compared to the Tar River. Future development plans in these subbasins include conversion of agricultural and open space into commercial, office/institutional, and low density residential land use.

Since the East 10th Street culvert improvements are required to provide a 50-year level of service, it is assumed that 25-year detention upstream of the culvert would not result in substantial cost savings when designing a 50-year level of service. The length of the proposed Portertown Road floodplain benching could potentially be reduced by approximately 900 linear feet if 25-year detention was required in the areas upstream of the proposed project, which would result in an estimated cost savings of $920,000. However, as noted below because the Portertown Road area is not considered an area of repetitive flooding or damages, requiring 25-year detention upstream of the project area is not recommended.

There have been documented quantity issues for the dam associated with Lake Glenwood near the intersection of Leon Drive and Eastern Pines Road. This area is outside of the existing City limits, although it is within the City ETJ and there are areas draining to the Lake within the City's ETJ. Projected increases for future flows for the 25-year storm event for the two subwatersheds draining to Lake Glenwood are 3% and 6%. Since the projected increases are below the 10% threshold it is not likely that the 25-year detention requirement would provide substantial additional protection for the dam. It is recommended that the City carefully consider any re-zoning applications and/or annexation requests in the ETJ draining to Lake Glenwood to determine if a change from the projected zoning would change the projected future flows and thereby possibly necessitate detention for the 25-year storm event.

In summary based on an analysis of the Hardee Creek watershed evaluating feedback from the public, City staff, model results, and anticipated future development, there are no recommendations for requiring 25-year detention for future development in the watershed.

4.3 High Risk Areas for 25-year Detention

In 2014, the City of Greenville enacted legislation requiring attenuation for new development and re-development for the one-year, five-year, and ten-year, 24-hour storm events. In addition, Section 9-9-10 of Ordinance No. 13-054 states the following:
"New development and redevelopment, as described in section 9-9-3, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event."

As part of the Parkers Creek/Johnsons Mill Run (PC/JMR) Watershed Master Plan, an analysis was completed to determine if there are areas within the watershed and the ETJ that should be considered "well documented water quantity problems" requiring detention for the 25-year, 24-hour storm event. Areas may be defined as well documented water quantity problems if either of the following is true:

- Structural flooding has been historically noted by property owners during storms considered smaller than the design event and this structural flooding has been corroborated by either high water marks, City staff input, or model results.
- Model results indicate structural flooding or roadway overtopping during storms smaller than the design storm and models results are corroborated by City staff input.

Portions of the watershed draining to the "well documented water quantity problems" may be considered for 25-year detention if any of the following are true:

- Future condition flows are 10% or greater than existing flows for a given subwatershed upstream of the water quantity problem.
- Proposed capital projects are not deemed to be feasible or cost effective for providing the required level of service for these water quantity problems based on future land use conditions.
- Cost differential between designing for existing conditions and future conditions is deemed to be significant and/or a significant number of structures would become floodprone during the 25-year design storm based on future conditions flows when compared to existing conditions flows.

It is assumed that for this analysis, systems with a 10-year level of service design would not be considered for the 25-year detention since the 10-year detention requirements would result in little to no increase in peak flows for the design event. Typically, this would include most secondary systems, although secondary systems with significant documented water quantity problems that also includes infrastructure requiring a level of service greater than a 10-year event may be evaluated for the 25-year detention requirement.

4.3.1 Evaluation

As noted in Section 3.1 crossings at N. Greene Road and Memorial on Parkers Creek laterals do not meet the required level of service (LOS) based on model results. Another crossing on

Parkers Creek outside the City limits at Staton Road also does not currently meet the LOS. However, based on interviews with City staff and resident feedback these crossings are not considered well-documented water quantity problems as a history of overtopping at these crossings has not been observed. The future 25-year flows within the primary streams are a maximum of 17% higher than existing flows just upstream of the Memorial Drive crossing. However, since the N. Greene Road and Memorial Drive culvert improvements are required to provide a 50-year level of service, it is assumed that 25-year detention upstream of the culvert would not result in substantial cost savings when designing to a 50-year level of service. These crossings on Parkers Creek and its laterals are already subject to flooding for less than the design storm, requiring 25-year detention upstream of the project area is not recommended.

It is recommended that the City carefully consider any re-zoning applications and/or annexation requests in the ETJ draining to Parkers Creek to determine if a change from the projected zoning would change the projected future flows and thereby possibly necessitate detention for the 25-year storm event.

4.3.2 Results

In summary, based on an analysis of the PC/JMR watershed evaluating feedback from the public, City staff, model results, and anticipated future development, there are no recommendations for requiring 25-year detention for future development in the PC/JMR watershed.

4.3 25-YEAR DETENTION ANALYSIS

In 2014, the City of Greenville enacted legislation requiring attenuation for new development and re-development for the one-year, five-year, and ten-year, 24-hour storm events. In addition, Section 9-9-10 of Ordinance No. 13-054 states the following:

"New development and redevelopment, as described in section 9-9-3, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event."

As part of the Swift Creek Master Plan, an analysis was completed to determine if there are areas within the watershed and the ETJ that should be considered "well documented water quantity problems" requiring detention for the 25-year, 24-hour storm event. Areas may be defined as well documented water quantity problems if either of the following is true:

- Structural flooding has been historically noted by property owners during storms considered smaller than the design event and this structural flooding has been corroborated by either high water marks, City staff input, or model results.
- Model results indicate structural flooding or roadway overtopping during storms smaller than the design storm and models results are corroborated by City staff input.

Portions of the watershed draining to the "well documented water quantity problems" may be considered for 25-year detention if any of the following are true:

- Future condition flows are 10% or greater than existing flows for a given subwatershed upstream of the water quantity problem.
- Proposed capital projects are not deemed to be feasible or cost effective for providing the required level of service for these water quantity problems based on future land use conditions.
- Cost differential between designing for existing conditions and future conditions is deemed to be significant and/or a significant number of structures would become floodprone during the 25-year design storm based on future conditions flows when compared to existing conditions flows.

It is assumed that for this analysis, systems with a 10-year level of service design would not be considered for the 25-year detention since the 10-year detention requirements would result in little to no increase in peak flows for the design event. Most secondary systems have a 10-year level of service, although secondary systems with significant documented water quantity problems that also include infrastructure requiring a level of service greater than a 10-year event may be evaluated for the 25-year detention requirement. There are no secondary systems for this evaluation of Swift Creek watershed that require more than 10-year level of service, therefore were not included in the 25-year detention requirement.

As noted in Section 3.1, documented flooding issues are located along Swift Creek Unnamed Tributary 1 and Gum Swamp in the vicinity of Thomas Langston Road and Frog Level Road. In addition to the documented flooding issues, model results show a number of homes and buildings at risk of flooding during the 25-year storm event. Large portions of the Swift Creek watershed remain undeveloped and could potentially cause increased flows greater than 10% higher than the current existing flows. These areas are shown in Figure 4-4.

For the purposes of evaluating if 25-year detention is appropriate, the Swift Creek watershed is divided into three (3) distinct areas based on the drainage feature that conveys runoff from that area. Then the entire Swift Creek watershed needs to be evaluated to limit increases in runoff from the south end of the City limits entering neighboring communities.

- Swift Creek Main Stem – While there were no documented reports of flooding along Swift Creek Main Stem, floodprone areas identified through modeling efforts are predominantly located upstream of Thomas Langston Drive and downstream of Sterling Trace Drive. As shown in Figure 4-4, there are extensive undeveloped areas that if developed, would significantly increase the 25-year flows. Project increases in flows during the 25-year storm could range from 10 to 20 percent in the Swift Creek Main Stem watershed. If 25-year detention was required for new development in the highlighted drainage basins, then the City could move forward with the proposed Alternative 2 options at Thomas Langston Road and Sterling Trace Drive without having to implement the Megan Drive detention pond. Assuming the City would have proceeded with Alternative #1, the projected savings by requiring the 25-year detention for the City would be approximately $930,000 in the Swift Creek Main Stem watershed.

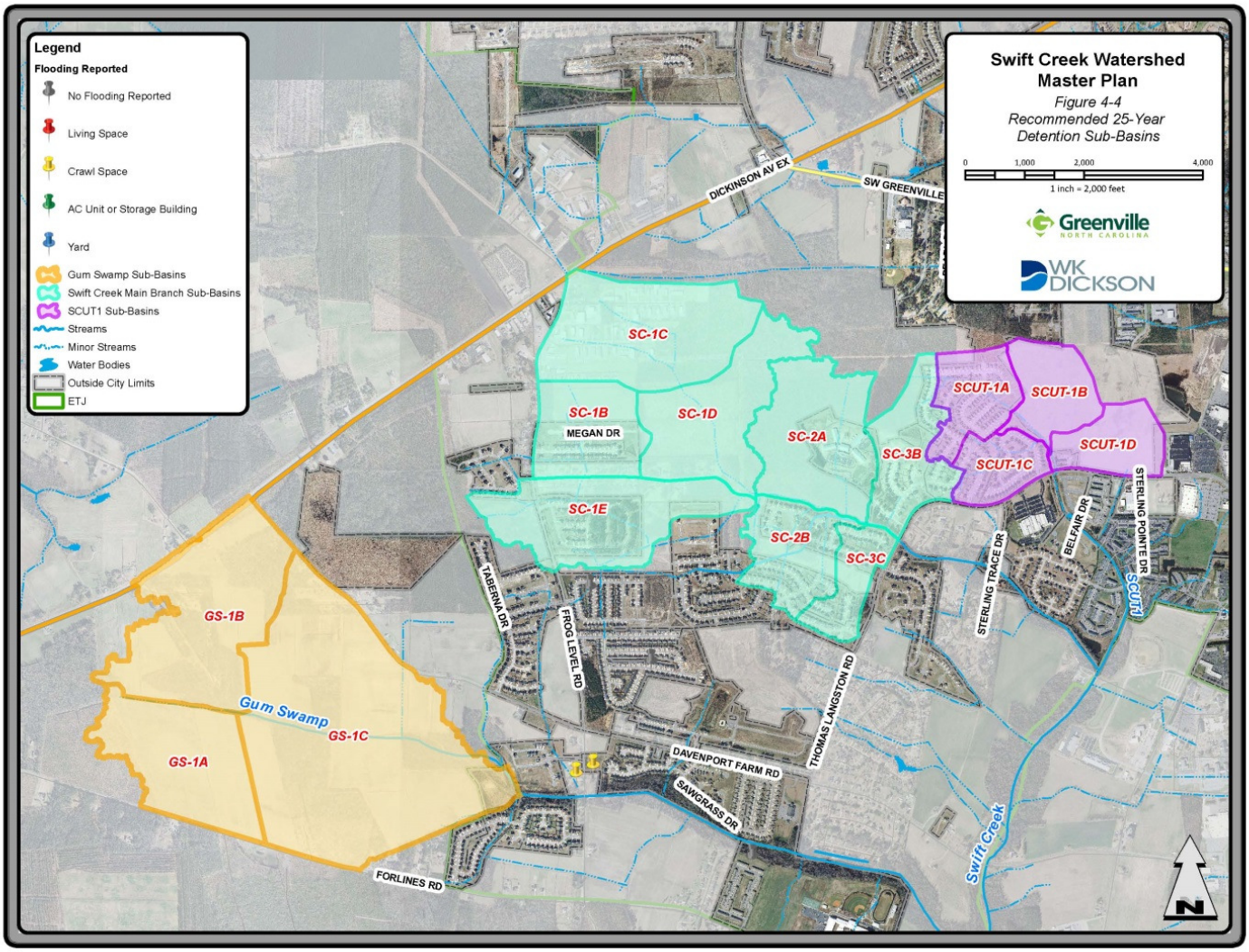
- Swift Creek Unnamed Tributary 1 – Documented reports of flooding along Swift Creek Main Unnamed Tributary 1 are predominantly located upstream of Thomas Langston Drive although modeling results also indicate floodprone areas in the vicinity of Belfair Drive and Sterling Pointe Drive. As shown in Figure 4-4, there are extensive undeveloped areas that if developed, would significantly increase the 25-year flows. Project increases in flows during the 25-year storm could range from 2 to 12 percent in the Swift Creek Unnamed Tributary 1 watershed. If 25-year detention was required for new development in the highlighted drainage basins then, the proposed culvert sizes at Sterling Pointe Drive and Belfair Drive could be slightly reduced, although the cost savings would not be significant.

- Gum Swamp – Documented reports of flooding along Gum Swamp are predominantly located upstream of Frog Level Road and along Sebring Drive and Sawgrass Drive downstream of Frog Level Road. As shown in Figure 4-4, there are extensive undeveloped areas that if developed, would significantly increase the 25-year flows. Project increases in flows during the 25-year storm could range from 6 to 11 percent in the Gum Swamp watershed. If 25-year detention was required for new development in the highlighted drainage basins then, the proposed culvert size at Frog Level Road and

extents of floodplain benching could be slightly reduced, although the cost savings would not be significant.

- Overall Swift Creek watershed – Changes in land use (future build-out conditions) and increasing culvert capacity will increase the 25-year flow at the outlet of the study area (City limits) by approximately 6%. Downstream communities including Ayden and Pitt County already experience flooding along Swift Creek in existing conditions, so any increase in flows could potentially increase the duration, severity, and frequency of flooding, although the limits of this study do not evaluate these potential impacts downstream of the City limits. If 25-year detention was required in the highlighted areas in Figure 4-14, the increase in the 25-year flow would be reduced to 1.2%. Therefore, the City could significantly reduce the size of the Pitt County Community College Regional Detention Area described in Section 4.1.4 to effectively ensure no net increase in the 25-year peak flow at the limits of the study for Alternative #1. The size of the detention area could be reduced to twenty acres which would result in a cost savings of $6,850,000.

Based on the analysis summarized above it is recommended that 25-year detention for the highlighted areas within the Swift Creek Main Branch Watershed be required and it is recommended that the City consider requiring 25-year detention for the highlighted areas in Swift Creek Unnamed Tributary 1 and Gum Swamp.


Legend
Flooding Reported
No Flooding Reported
Living Space
Crawl Space
AC Unit or Storage Building
Yard
Gum Swamp Sub-Basins
Swift Creek Main Branch Sub-Basins
SCUT1 Sub-Basins
Streams
Minor Streams
Water Bodies
Outside City Limits
ETJ
Swift Creek Watershed Master Plan
Figure 4-4
Recommended 25-Year Detention Sub-Basins
0
1,000
2,000
4,000
1 inch = 2,000 feet
Greenville
NORTH CAROLINA
WK DICKSON
SC-1C
SC-1B
SC-1D
SC-2A
SC-3B
SC-1E
SC-2B
SC-3C
SCUT-1A
SCUT-1B
SCUT-1C
SCUT-1D
GS-1B
GS-1C
GS-1A
Gum Swamp
MEGAN DR
DICKINSON AV EX
SW GREENVILLE
TABERNA DR
FROG LEVEL RD
THOMAS LANGSTON RD
STERLING TRACE DR
BELFAIR DR
STERLING POINTE DR
SCUT1
DAVENPORT FARM RD
SAWGRASS DR
FORLINES RD
Swift Creek
N

4.3 25-YEAR DETENTION ANALYSIS

In 2014, the City of Greenville enacted legislation requiring attenuation for new development and re-development for the one-year, five-year, and ten-year, 24-hour storm events. In addition, Section 9-9-10 of Ordinance No. 13-054 states the following:

"New development and redevelopment, as described in section 9-9-3, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event."

As part of the Fork Swamp Master Plan, an analysis was completed to determine if there are areas within the watershed and the ETJ that should be considered "well documented water quantity problems" requiring detention for the 25-year, 24-hour storm event. Areas may be defined as well documented water quantity problems if either of the following is true:

- Structural flooding has been historically noted by property owners during storms considered smaller than the design event and this structural flooding has been corroborated by either high water marks, City staff input, or model results.
- Model results indicate structural flooding or roadway overtopping during storms smaller than the design storm and model results are corroborated by City staff input.

Portions of the watershed draining to the "well documented water quantity problems" may be considered for 25-year detention if any of the following are true:

- Future condition flows are 10% or greater than existing flows for a given subwatershed upstream of the water quantity problem.
- Proposed capital projects are not deemed to be feasible or cost effective for providing the required level of service for these water quantity problems based on future land use conditions.
- Cost differential between designing for existing conditions and future conditions is deemed to be significant and/or a significant number of structures would become floodprone during the 25-year design storm based on future conditions flows when compared to existing conditions flows.

It is assumed that for this analysis, systems with a 10-year level of service design would not be considered for the 25-year detention since the existing 10-year detention requirements would result in little to no increase in peak flows for the design event. The secondary systems evaluated in Fork Swamp watershed only required a 10-year level of service, therefore requiring upstream 25-year detention would not impact the design of a system that only needs to meet a 10-year design storm.

As noted in Section 3.1, documented flooding issues are located along Fork Swamp Main Branch, Unnamed Tributary 3, and Unnamed Tributary 1 including the area between Baywood

Lane and Treetops Circle along Fork Swamp Main Branch, the area between Corey Road and Trafalgar Drive along Unnamed Tributary 1, and the area between East Fire Tower Road and County Home Road along Unnamed Tributary 3. Large portions of the Fork Swamp watershed are already fully developed, however there are some areas of the watershed where the future conditions 25-year flows could be greater than 10% higher than the current existing flows. These areas are shown in Figure 4-14.

For the purposes of evaluating if 25-year detention is appropriate, the Fork Swamp watershed is divided into four (4) distinct areas based on the drainage feature that conveys runoff from that area. Then the entire Fork Swamp watershed needs to be evaluated to limit increases in runoff from the south end of the City limits entering neighboring communities.

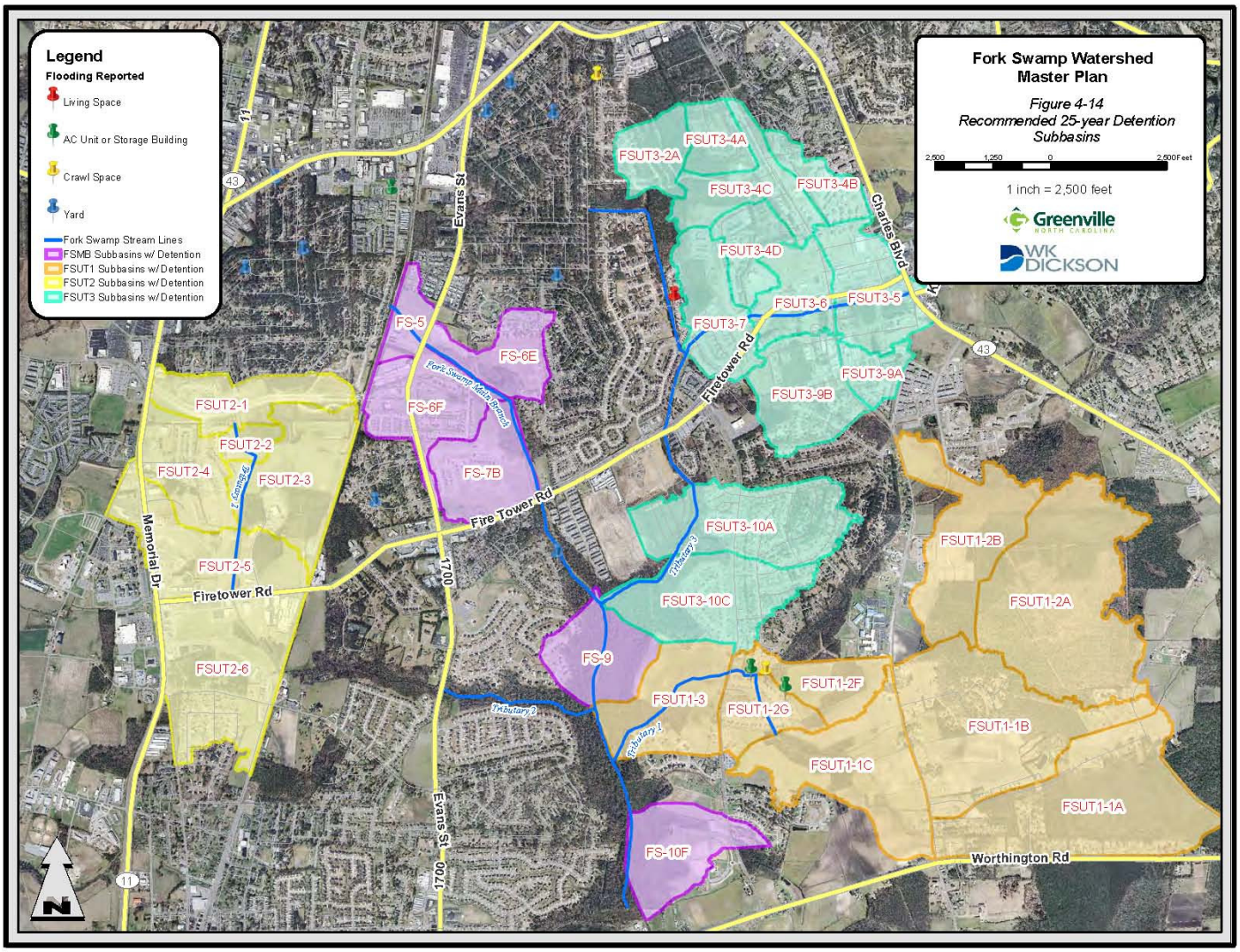
- Fork Swamp Main Stem – Flooding issues along the Fork Swamp Main Stem are predominantly located in the upstream portion of the watershed from the vicinity of East Fire Tower Road up through Baywood Lane and the Westhaven subdivision. The contributing drainage area to these locations is fully developed with the exception of some areas along Evans Road and north of East Fire Tower Road. Requiring 25-year detention in these areas will not substantially impact the proposed capital projects along Fork Swamp Main Stem however since existing flooding problems have been documented in these areas, it is recommended that the highlighted drainage basins shown in the Figure 4-14 within the Fork Swamp Main Stem drainage area require 25-year detention.

- Fork Swamp Tributary 1 – Repetitive flooding has been reported within the Farrington subdivision specifically on Trafalgar Drive along Fork Swamp Tributary 1. Each of the highlighted areas shown in Figure 4-14 have the potential for the 25-year flows to increase by greater than 10% due to the potential future development in these areas. The future condition land use was based on existing zoning. The City should carefully consider rezoning requests within the Fork Swamp Tributary 1 watershed based on the existing known flooding issues. If 25-year detention is required in the proposed areas, the recommended culvert sizes at Trafalgar Drive can be decreased, although the cost savings would not be substantial. However, the severity, frequency, and duration of flooding would be reduced, which would in return provide savings to the property owners.

- Fork Swamp Tributary 2 – The highlighted areas shown in the western portion of the watershed in Figure 4-14 all have the potential for future development that would result in increases greater than 10% in the 25-year peak development flows. While floodprone areas were not identified within the City limits in Tributary 2, the crossing at Old Tar Road downstream outside of the City's jurisdiction is floodprone. Furthermore, 25-year detention in these areas would reduce the increase in runoff at the City boundary under future development conditions.

- Fork Swamp Tributary 3 – The majority of the culvert crossings along Fork Swamp Tributary 3 do not meet the desired level of service for existing conditions and in several locations there is a limited natural floodplain. Furthermore, significant stream erosion has already occurred throughout Tributary 3. The areas shown in Figure 4-14 should be considered for 25-year detention to minimize the size of the culvert improvements to the extent possible. While 25-year detention will not eliminate the need for culvert improvements in the area, the size of the culverts could be reduced in some areas which is particularly valuable given the tight constraints. The areas highlighted in Figure 4-14 have the potential for increasing the 25-year flows greater than 10% in future conditions when compared to existing.

- Overall Fork Swamp watershed – Changes in land use (future build-out conditions) and increasing culvert capacity will increase the 25-year flow at the outlet of the study area (City limits) by approximately 8%, resulting in a 0.22-foot increase in WSEL at the outlet. Downstream communities including Winterville and Pitt County already experience flooding along Fork Swamp in existing conditions, so any increase in flows could potentially increase the duration, severity, and frequency of flooding, although the limits of this study do not evaluate these potential impacts downstream of the City limits. If 25-year detention was required in the highlighted areas in Figure 4-14, the increase in the 25-year flow would be reduced to 1.1%, a reduction in WSEL of 0.17 foot. Therefore, the City could significantly reduce the size of the Corey Road Regional Detention Area described in Section 4.1.6 to effectively ensure no net increase in the 25-year peak flow at the limits of the study. The size of the detention area could be reduced to eight (8) acres which would reduce the cost to $2,670,000, which is approximately $5 million less than the original cost of $7 million.


Legend
Flooding Reported
Living Space
AC Unit or Storage Building
Crawl Space
Yard
Fork Swamp Stream Lines
FSMB Subbasins w/ Detention
FSUT1 Subbasins w/ Detention
FSUT2 Subbasins w/ Detention
FSUT3 Subbasins w/ Detention
Fork Swamp Watershed Master Plan
Figure 4-14
Recommended 25-year Detention Subbasins
2,500 1,250 0 2,500 Feet
1 inch = 2,500 feet
Greenville NORTH CAROLINA
WK DICKSON
FSUT3-2A
FSUT3-4A
FSUT3-4C
FSUT3-4B
FSUT3-4D
FSUT3-6
FSUT3-5
FSUT3-7
FSUT3-9A
FSUT3-9B
FS-5
FS-6E
FS-6F
FS-7B
FSUT2-1
FSUT2-2
FSUT2-3
FSUT2-4
FSUT2-5
FSUT2-6
FSUT3-10A
FSUT3-10C
FS-9
FSUT1-3
FSUT1-2F
FSUT1-2G
FSUT1-2B
FSUT1-2A
FSUT1-1B
FSUT1-1C
FSUT1-1A
FS-10F
Fork Swamp North Branch
Tributary 3
Tributary 2
Tributary 1
Evans St
Memorial Dr
Fire Tower Rd
Firetower Rd
Charles Blvd
Worthington Rd
1700
1720
11
43
N

4.3 25-Year Special Risk Areas

In 2014, the City of Greenville passed an ordinance requiring attenuation for new development and re-development for the one-year, five-year, and ten-year, 24-hour storm events. In addition, Section 9-9-10 of Ordinance No. 13-054 states the following:

> *"New development and redevelopment, as described in section 9-9-3, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event."*

As part of the GMR WSMP, an analysis was completed to determine if areas within the watershed should be considered to have "well documented water quantity problems". Areas may be defined, as "well documented water quantity problems" if either of the following is true:

- Structural flooding has been historically noted by property owners during storms considered smaller than the design event and this structural flooding has been corroborated by either high water marks, City staff input, or model results.
- Model results indicate structural flooding or roadway overtopping during storms smaller than the design storm and models results are corroborated by City staff input.

Portions of the watershed draining to the "well documented water quantity problems" may be considered for 25-year detention if any of the following are true:

- Future condition flows are 10% or greater than existing flows for a given subwatershed upstream of the water quantity problem.
- Proposed capital projects are not deemed to be feasible or cost effective for providing the required level of service for these water quantity problems based on future land-use conditions.
- Cost differential between designing for existing conditions and future conditions is deemed to be significant and/or a significant number of structures become floodprone during the 25-year design storm based on future conditions flows when compared to existing conditions flows.

As discussed in **Section 3.1.2**, a number of crossings did not meet the desired LOS based upon the existing conditions model results, which have been corroborated by City staff (therefore constituting a "well documented water quantity problem"). **Table 3-5** identifies crossings analyzed within the watershed and their existing LOS. As shown in the table, of 33 crossings evaluated, 14 (42%) exhibited substandard performance in the existing condition. Several of the crossings are located along GMR proper, in the lower portions of the watershed, and downstream of all undeveloped areas within the watershed (i.e. South Elm Street, College Hill Drive, Rock Spring Road, etc.). As discussed in **Section 4.1.5**, and shown in **Table 4-2** and **Table 4-3**, meeting the required level of service at these locations is not feasible, however a reduced level of service is

proposed. Additionally, three other crossings (East 14th Street, Charles Boulevard, and Evans Street) along GMR exhibit such severe LOS violations that no feasible solutions exist, even for a reduced LOS. For those crossings, future development within the watershed will continue to degrade their performance beyond current conditions. For all crossings along GMR which exhibit level of service violations, either a reduced LOS is proposed or there is no feasible solution, therefore undeveloped areas upstream of these crossings (which includes all undeveloped area within the watershed) are recommended to be designated 25-year special risk based on criteria #2, above.

Most of the undeveloped area within the GMR watershed is located to the west of Memorial Drive. **Table 4-12** shows the crossings on GMR which do not meet the required level of service and compares the existing flows to the future flows (25-year event). In all cases, future flows are increased by greater than 10% over existing flows, which triggers criteria #1, above, and designates undeveloped areas upstream of these crossings (which includes *all* undeveloped area within the watershed) as 25-year special risk properties.

Table 4-12: GMR Known Water Quantity Problem Crossing Flow Comparisons

Crossing	Existing 25-year Flow (cfs)	Future 25-year Flow (cfs)	% Change
Evans Street	2,311	3,929	+70%
Charles Boulevard	3,001	4,117	+37%
14th Street	2,755	4,058	+47%
Rock Spring Road	2,783	4,091	+47%
College Hill Drive	2,783	4,106	+48%
Elm Street	2,746	4,117	+50%

Finally, future conditions flows (and the associated expansion of the floodplain) for the 25-year event result in 142 additional structures being classified as "floodprone" (note that this analysis focuses on Greens Mill Run, as all undeveloped areas ultimately flow into GMR, thus if GMR meets the 25-year special risk criteria, the entire watershed does as well).

Implementation of the 25-year Special Risk Area throughout the GMR watershed aids in reducing the frequency of flooding along the Primary System streams and negate the need to implement future capital improvement projects at several roadway crossings. The hydraulic model was analyzed to identify crossings meeting the desired 25-year LOS under existing land-use conditions, but in violation under future land-use conditions. Crossings that showed this change were those that may benefit from the special risk designation. This analysis focused on crossings along streams that may be influenced by 25-year detention, including GMR, the Unnamed Tributary to GMR, and North Fork GMR. These streams are located within or downstream of large undeveloped areas and will experience the effects of detention requirements. The Reedy Branch and Fornes Run watersheds are nearly fully developed, thus have little opportunity for implementation of 25-year detention and thus little impact on flows in these two streams.

This analysis identified three crossings: Hooker Road on GMR, Dalebrook Circle on Fornes Run, and Williams Road on the Unnamed Tributary to GMR. The estimated cost to address potential future LOS violations at these crossings, should the 25-year Special Risk designation not be implemented, is approximately $3,430,000.

Comparatively small savings will be realized at locations where this WSMP already proposes alternatives due to LOS violations under existing conditions. At most, requiring 25-year detention will make those improvements incrementally smaller, resulting in small decreases in cost associated with the projects at those locations. These locations were not considered in this analysis due to the small effects of 25-year detention on the proposed infrastructure.

Based on the above discussion and justification, it is recommended that the entire Greens Mill Run watershed be classified as Special Risk, requiring 25-year detention for all new development. There may be cases along the fringes of the watershed boundary identified as part of this WSMP where certain properties do not drain to GMR; in those special cases if the property owner can demonstrate with certainty that the property in question does not drain to GMR, City staff may decide to only require the minimum 10-year detention, subject to determinations made in other WSMPs.

4.4 Regional Detention Facilities

Based on established criteria, this WSMP document recommends that all undeveloped areas within GMR be designated as 25-year Special Risk, meaning that future development will be required to provide detention facilities that attenuate peak flows up to the 25-year storm. If the City implements this recommendation, each new development will be required to provide its own detention up to the 25-year storm. On this basis, no regional detention facilities were investigated.

The proposed improvements include upsizing and additional barrel segments of pipe through 117 N Elm Street and upsizing through Wilson Acres apartment complex at 1806 E 1st Street. There will be potential impacts to the parking lots, landscaping, and/or fencing at the following private properties:

- 117 N Elm Street;
- 1806 E 1st Street;

Small segments of the project are located in the E 1st Street right-of-way as well as the E 3rd Street right-of-way and the E 4th Street right-of-way. The curb and gutter along these roadways will need to removed and replaced. Gas lines, sanitary sewer lines, and water lines were also identified as a potential site restrictions and utility conflicts in the project area.

4.3 High Risk Areas for 25-year Detention

In 2014, the City of Greenville enacted legislation requiring attenuation for new development and re-development for the one-year, five-year, and ten-year, 24-hour storm events. In addition, Section 9-9-10 of Ordinance No. 13-054 states the following:
"New development and redevelopment, as described in section 9-9-3, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event."
As part of the Parkers Creek/Johnsons Mill Run (PC/JMR) Watershed Master Plan, an analysis was completed to determine if there are areas within the watershed and the ETJ that should be considered "well documented water quantity problems" requiring detention for the 25-year, 24-hour storm event. Areas may be defined as well documented water quantity problems if either of the following is true:

- Structural flooding has been historically noted by property owners during storms considered smaller than the design event and this structural flooding has been corroborated by either high water marks, City staff input, or model results.
- Model results indicate structural flooding or roadway overtopping during storms smaller than the design storm and models results are corroborated by City staff input.

Portions of the watershed draining to the "well documented water quantity problems" may be considered for 25-year detention if any of the following are true:

- Future condition flows are 10% or greater than existing flows for a given subwatershed upstream of the water quantity problem.
- Proposed capital projects are not deemed to be feasible or cost effective for providing the required level of service for these water quantity problems based on future land use conditions.
- Cost differential between designing for existing conditions and future conditions is deemed to be significant and/or a significant number of structures would become floodprone during the 25-year design storm based on future conditions flows when compared to existing conditions flows.

It is assumed that for this analysis, systems with a 10-year level of service design would not

be considered for the 25-year detention since the 10-year detention requirements would result in little to no increase in peak flows for the design event. Typically, this would include most secondary systems, although secondary systems with significant documented water quantity problems that also includes infrastructure requiring a level of service greater than a 10-year event may be evaluated for the 25-year detention requirement.

4.3.1 Evaluation

As noted in Section 3.1 crossings at W. 5th Street on Schoolhouse Branch do not meet the required level of service (LOS) based on model results. However, based on interviews with City staff and resident feedback these crossings are not considered well-documented water quantity problems as a history of overtopping at these crossings has not been observed. The future 25-year flows within the primary streams are a maximum of 17% higher than existing flows just upstream of the 5th Street crossing. However, since the W. 5th Street culvert improvements are required to provide a 50-year level of service, it is assumed that 25-year detention upstream of the culvert would not result in substantial cost savings when designing to a 50-year level of service. These crossings on Schoolhouse Branch are already subject to flooding for less than the design storm, requiring 25-year detention upstream of the project area is not recommended.

It is recommended that the City carefully consider any re-zoning applications and/or annexation requests in the ETJ draining to Parkers Creek to determine if a change from the projected zoning would change the projected future flows and thereby possibly necessitate detention for the 25-year storm event.

4.3.2 Results

In summary, based on an analysis of the PC/JMR watershed evaluating feedback from the public, City staff, model results, and anticipated future development, there are no recommendations for requiring 25-year detention for future development in the PC/JMR watershed.

4.3 25-YEAR DETENTION ANALYSIS

In 2014, the City of Greenville enacted legislation requiring attenuation for new development and re-development for the one-year, five-year, and ten-year, 24-hour storm events. In addition, Section 9-9-10 of Ordinance No. 13-054 states the following:

"New development and redevelopment, as described in section 9-9-3, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event."

As part of the Swift Creek Master Plan, an analysis was completed to determine if there are areas within the watershed and the ETJ that should be considered "well documented water quantity problems" requiring detention for the 25-year, 24-hour storm event. Areas may be defined as well documented water quantity problems if either of the following is true:

- Structural flooding has been historically noted by property owners during storms considered smaller than the design event and this structural flooding has been corroborated by either high water marks, City staff input, or model results.
- Model results indicate structural flooding or roadway overtopping during storms smaller than the design storm and models results are corroborated by City staff input.

Portions of the watershed draining to the "well documented water quantity problems" may be considered for 25-year detention if any of the following are true:

- Future condition flows are 10% or greater than existing flows for a given subwatershed upstream of the water quantity problem.
- Proposed capital projects are not deemed to be feasible or cost effective for providing the required level of service for these water quantity problems based on future land use conditions.
- Cost differential between designing for existing conditions and future conditions is deemed to be significant and/or a significant number of structures would become floodprone during the 25-year design storm based on future conditions flows when compared to existing conditions flows.

It is assumed that for this analysis, systems with a 10-year level of service design would not be considered for the 25-year detention since the 10-year detention requirements would result in little to no increase in peak flows for the design event. Most secondary systems have a 10-year level of service, although secondary systems with significant documented water quantity problems that also include infrastructure requiring a level of service greater than a 10-year event may be evaluated for the 25-year detention requirement. There are no secondary systems for this evaluation of Swift Creek watershed that require more than 10-year level of service, therefore were not included in the 25-year detention requirement.

As noted in Section 3.1, documented flooding issues are located along Swift Creek Unnamed Tributary 1 and Gum Swamp in the vicinity of Thomas Langston Road and Frog Level Road. In addition to the documented flooding issues, model results show a number of homes and buildings at risk of flooding during the 25-year storm event. Large portions of the Swift Creek watershed remain undeveloped and could potentially cause increased flows greater than 10% higher than the current existing flows. These areas are shown in Figure 4-4.

For the purposes of evaluating if 25-year detention is appropriate, the Swift Creek watershed is divided into three (3) distinct areas based on the drainage feature that conveys runoff from that area. Then the entire Swift Creek watershed needs to be evaluated to limit increases in runoff from the south end of the City limits entering neighboring communities.

- Swift Creek Main Stem – While there were no documented reports of flooding along Swift Creek Main Stem, floodprone areas identified through modeling efforts are predominantly located upstream of Thomas Langston Drive and downstream of Sterling Trace Drive. As shown in Figure 4-4, there are extensive undeveloped areas that if developed, would significantly increase the 25-year flows. Project increases in flows during the 25-year storm could range from 10 to 20 percent in the Swift Creek Main Stem watershed. If 25-year detention was required for new development in the highlighted drainage basins, then the City could move forward with the proposed Alternative 2 options at Thomas Langston Road and Sterling Trace Drive without having to implement the Megan Drive detention pond. Assuming the City would have proceeded with Alternative #1, the projected savings by requiring the 25-year detention for the City would be approximately $930,000 in the Swift Creek Main Stem watershed.

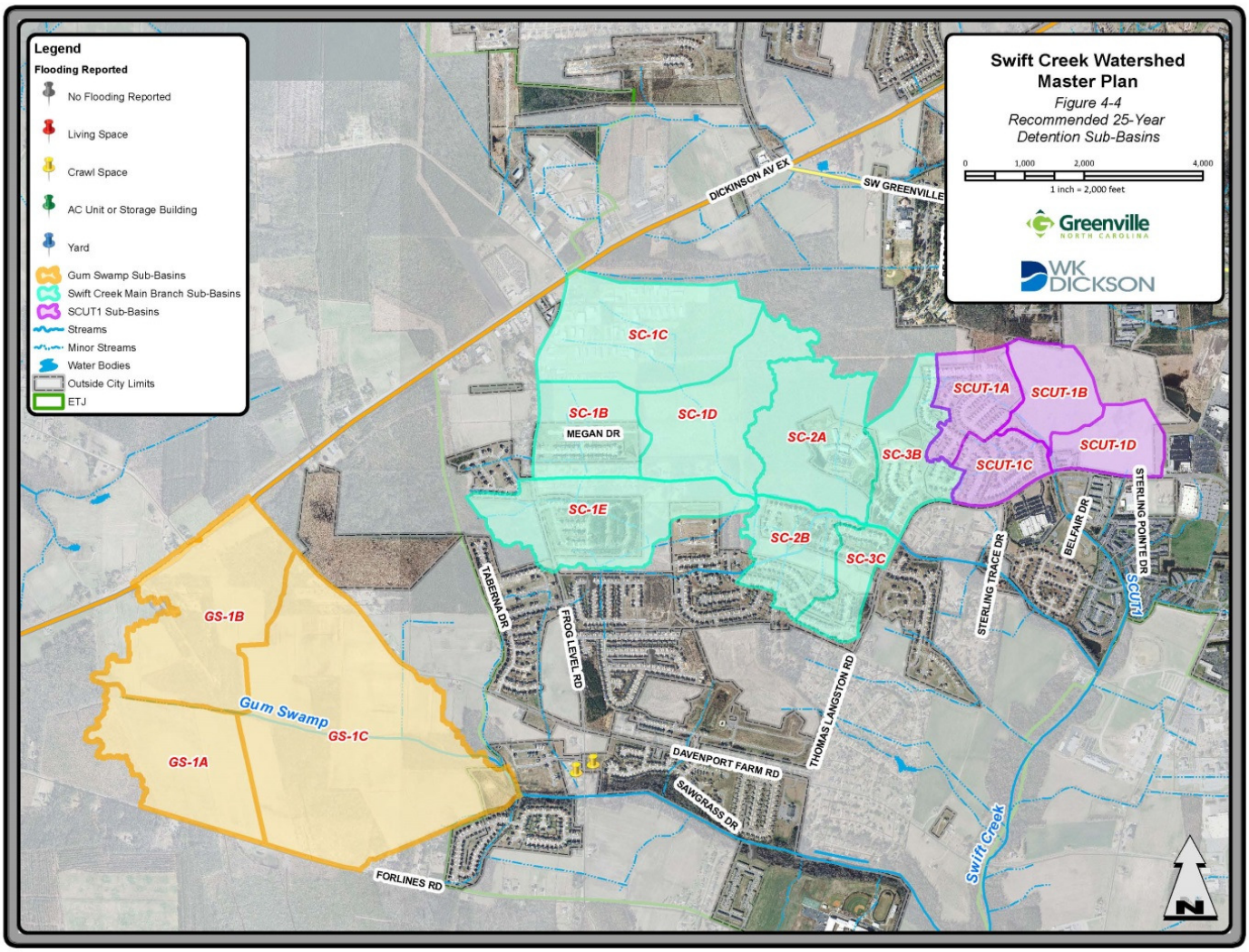
- Swift Creek Unnamed Tributary 1 – Documented reports of flooding along Swift Creek Main Unnamed Tributary 1 are predominantly located upstream of Thomas Langston Drive although modeling results also indicate floodprone areas in the vicinity of Belfair Drive and Sterling Pointe Drive. As shown in Figure 4-4, there are extensive undeveloped areas that if developed, would significantly increase the 25-year flows. Project increases in flows during the 25-year storm could range from 2 to 12 percent in the Swift Creek Unnamed Tributary 1 watershed. If 25-year detention was required for new development in the highlighted drainage basins then, the proposed culvert sizes at Sterling Pointe Drive and Belfair Drive could be slightly reduced, although the cost savings would not be significant.

- Gum Swamp – Documented reports of flooding along Gum Swamp are predominantly located upstream of Frog Level Road and along Sebring Drive and Sawgrass Drive downstream of Frog Level Road. As shown in Figure 4-4, there are extensive undeveloped areas that if developed, would significantly increase the 25-year flows. Project increases in flows during the 25-year storm could range from 6 to 11 percent in the Gum Swamp watershed. If 25-year detention was required for new development in the highlighted drainage basins then, the proposed culvert size at Frog Level Road and

extents of floodplain benching could be slightly reduced, although the cost savings would not be significant.

- Overall Swift Creek watershed – Changes in land use (future build-out conditions) and increasing culvert capacity will increase the 25-year flow at the outlet of the study area (City limits) by approximately 6%. Downstream communities including Ayden and Pitt County already experience flooding along Swift Creek in existing conditions, so any increase in flows could potentially increase the duration, severity, and frequency of flooding, although the limits of this study do not evaluate these potential impacts downstream of the City limits. If 25-year detention was required in the highlighted areas in Figure 4-14, the increase in the 25-year flow would be reduced to 1.2%. Therefore, the City could significantly reduce the size of the Pitt County Community College Regional Detention Area described in Section 4.1.4 to effectively ensure no net increase in the 25-year peak flow at the limits of the study for Alternative #1. The size of the detention area could be reduced to twenty acres which would result in a cost savings of $6,850,000.

Based on the analysis summarized above it is recommended that 25-year detention for the highlighted areas within the Swift Creek Main Branch Watershed be required and it is recommended that the City consider requiring 25-year detention for the highlighted areas in Swift Creek Unnamed Tributary 1 and Gum Swamp.


Legend
Flooding Reported
No Flooding Reported
Living Space
Crawl Space
AC Unit or Storage Building
Yard
Gum Swamp Sub-Basins
Swift Creek Main Branch Sub-Basins
SCUT1 Sub-Basins
Streams
Minor Streams
Water Bodies
Outside City Limits
ETJ
Swift Creek Watershed Master Plan
Figure 4-4
Recommended 25-Year Detention Sub-Basins
0
1,000
2,000
4,000
1 inch = 2,000 feet
Greenville
NORTH CAROLINA
WK DICKSON
SC-1C
SC-1B
SC-1D
SC-2A
SC-3B
SC-1E
SC-2B
SC-3C
SCUT-1A
SCUT-1B
SCUT-1C
SCUT-1D
GS-1B
GS-1C
GS-1A
Gum Swamp
MEGAN DR
TABERNA DR
FROG LEVEL RD
DAVENPORT FARM RD
SAWGRASS DR
FORLINES RD
THOMAS LANGSTON RD
STERLING TRACE DR
BELFAIR DR
STERLING POINTE DR
SCUT1
Swift Creek
DICKINSON AV EX
SW GREENVILLE
N

ATTACHMENT K – Memo to Development Community

MEMORANDUM

TO: Public Works Department, Engineering Division

FROM: Scott P. M. Godefroy, P.E., City Engineer

DATE: February 21, 2017

SUBJECT: Clarification of Stormwater Detention Ordinance

The completion of the watershed master plans has demonstrated the importance of appropriate stormwater controls for new and redevelopment. This memo serves to identify and clarify the implementation of the peak flow attenuation requirements within the stormwater ordinance. The ordinance states:

> SEC. 9-9-10 ATTENUATION REQUIREMENTS.
> (A) At a minimum, new development and redevelopment as described in section 9-9-3 shall not result in a net increase in peak flow leaving the site from pre-development conditions for the one-year, five-year and ten-year, 24-hour storm events.
> (B) New development and redevelopment, as described in § 9-9-3**, in areas at special risk with well documented water quantity problems as determined by the City Engineer, shall not result in a net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event**.
> (Ord. No. 04-112, passed 9-9-2004; Ord. No. 13-054, § 2, passed 10-10-2013)

> SEC. 9-9-11 EXCEPTIONS TO PEAK FLOW REQUIREMENT.
> Peak flow control is not required for developments that meet one or more of the following requirements:
> (A) The increase in peak flow between pre- and post-development conditions does not exceed 10% (note that this exemption makes it easier to conduct redevelopment activities); or
> (B) **The development occurs in a part of a drainage basin where stormwater detention can aggravate local flooding problems as determined by the city.** (Ord. No. 04-112, passed 9-9-2004)

THERFORE BE ADVISED effective for all plans submitted after the date of this memorandum:

The watershed master plans have documented water quantity problems in the following areas and detention of the 25-year, 24-hour storm events are now required for new and redevelopment per Sec 9-9-10B:

- Entire Greens Mill Run Watershed (source to Tar River)
- Entire Meetinghouse Branch Watershed (source to Tar River)
- Fork Swamp Watershed (Highlighted areas shown on Figure 4-14 of the master plan)
- Swift Creek Watershed (Highlighted areas shown on Figure 4-4 of the master plan)

The application of the exemption in Sec 9-9-11B is to be determined on a selective case by case basis by the City Engineer and based upon documented existing local flooding problems. Stormwater detention from a site that may cause a slight rise in peak flows for the overall watershed or drainage basin does not constitute, in and of itself, an aggravation of local flooding problems. This exemption would, therefore, not apply unless other evidence of increased flooding is applicable.

Vesting of valid previously approved developments remain per Sections 9-4-34 & 9-5-43:

- New and redevelopment sites that are final platted as part of an approved development plan before September 10, 2004 which drain directly (contiguously) to a mapped floodway are deemed exempt from detention requirements.
- Development on final platted lots within valid previously approved preliminary plans which address stormwater requirements and are demonstrated upon the plat, are vested and not subject to additional detention requirements.

Thank you for your attention in this matter,

Scott P. M. Godefroy, P.E.
City Engineer

Cc Kevin Mulligan – Public Works Director, City of Greenville
Lisa Kirby, PE, CFM – Senior Engineer, City of Greenville Public Works
Daryl Norris, PE, CFM – Civil Engineer II, City of Greenville Public Works