# Post-Construction Ordinance Case Study Analysis for the Phase II Jurisdictions in Mecklenburg County, North Carolina


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# EXECUTIVE SUMMARY

In response to the Clean Water Act provisions, the State of North Carolina issued a National Pollutant Discharge Elimination System permit to all the Phase II jurisdictions in Mecklenburg County including Mecklenburg County and the Towns of Davidson, Cornelius, Huntersville, Matthews, Mint Hill, and Pineville (co-permittees). One of the requirements of the permit is the development and implementation of a Post-Construction Site Runoff Controls Program by June 30, 2007.

The co-permittees decided to develop a Post-Construction Ordinance using a stakeholders' group process that could then be implemented by each Phase II jurisdiction to meet the requirements of the permit. The group began meeting in April 2004 and the ordinance language and the accompanying Post-Construction Stakeholders' Group Final Report was completed in September 2005. The report indicated that implementation of the Post-Construction Ordinance will cost an estimated $16,000 to $33,000 per acre for the majority of land uses in Mecklenburg County.

Staff from the Phase II Jurisdictions requested additional information on how the ordinance would affect development if applied to several existing sites. MCWQP conducted case studies on eight (8) sites selected by the Phase II jurisdictions and showed how the site layout and estimated development costs would change under the ordinance. Four (4) of the sites were residential subdivisions and four (4) of the sites were commercial / industrial sites. One of the case studies (a residential subdivision located in Mint Hill) was evaluated based upon the draft Mint Hill Post-Construction Ordinance dated February 23, 2007, which contains additional requirements to protect the Carolina Heelsplitter mussel, a Federal Endangered Species.

The results of the case study analyses showed that the effect of the Post-Construction Ordinance on development was specific for each case study depending mainly on the presence of intermittent and perennial streams, undisturbed areas, and the presence of existing storm water control structures required by other existing ordinances such as Detention Ordinances and Watershed Protection Ordinances.

The estimated costs to comply with the ordinance for residential development ranged from $3,800 to $32,500 on a per acre basis, and ranged from $3,700 to $24,500 on a per lot basis. The average costs were estimated at $15,900 per acre and $10,200 per lot for residential development.

The estimated costs to comply with the ordinance for commercial / industrial development ranged from $0 to $25,200 on a per acre basis. The average cost of compliance was estimated at $10,000 per acre for commercial / industrial development.

## 1.0 INTRODUCTION

In July 2005, the State of North Carolina issued a National Pollutant Discharge Elimination System (NPDES) permit to all the Phase II jurisdictions in Mecklenburg County including Mecklenburg County and the Towns of Davidson, Cornelius, Huntersville, Matthews, Mint Hill, and Pineville (co-permittees) under the provisions of the Clean Water Act. The NPDES permit required the co-permittees to develop and implement six (6) programs for demonstrating compliance with the permit. The co-permittees had implemented five (5) of the six (6) programs and were involved in a stakeholders process for developing a Post-Construction Controls Ordinance to meet the requirements of the final program, Post-Construction Site Runoff Controls, which is required to be implemented by June 30, 2007.

The Post-Construction Stakeholders' Group completed its goal in September 2005 with consensus being reached on a Post-Construction Storm Water Ordinance and a final report issued to the group documenting the ordinance development process and the summary of costs for implementing the ordinance. In the final report, the consultant estimated that the costs to implement the Post-Construction ordinance would range from $16,000 to $33,000 per acre for the majority of land uses in Mecklenburg County.

To implement the ordinance, each of the seven (7) co-permittees needed to adopt the ordinance within their respective jurisdictions. Staff from the various jurisdictions expressed interest in further understanding how the new ordinance would affect development and requested that the Mecklenburg County Water Quality Program (MCWQP) demonstrate how development (and development costs) would change if the Post-Construction Ordinance were applied to several actual subdivisions. To illustrate typical changes, eight (8) subdivisions were selected and "retrofitted" with undisturbed open space, stream buffers, and water quality and quantity best management practices (BMPs) required by the Post-Construction Ordinance. One of the residential case studies (a subdivision located in Mint Hill) was evaluated based upon the draft Mint Hill Post-Construction Ordinance dated February 23, 2007, which contains additional requirements to protect the Carolina Heelsplitter mussel, a Federal Endangered Species. The results of the analyses contained in this report were presented to each jurisdiction. This report provides written documentation for the eight (8) case studies and the results of the analyses.

Note that each case study in this report was evaluated as a retrofit design of an existing development. For most designers, designing a subdivision using a "greenfield" site knowing all the initial design parameters (such as open space, buffers, and structural best management practices) is preferable to trying to "fit in" elements after the layout and design are complete. Redesigning each of these sites from the "greenfield" stage of site design was not part of the scope of this report; however, MCWQP recognizes that incorporating the Post-Construction elements in the beginning stages of site design would likely be more cost effective. In addition, costs associated with maintenance of the structural best management practices was not included as part of the scope of this report.

## 2.0 PURPOSE

The purpose of this report is to provide staff and elected officials written documentation on the effects the Post-Construction Ordinance could have on actual sites within the seven (7) jurisdictions. Additionally, this report will assist staff and elected officials in understanding the requirements and the estimated costs of implementing the Post-Construction Ordinance.

## 3.0 SUBDIVISION ANALYSES

Each Town was asked to recommend subdivisions for case study under the Post-Construction Ordinance. The subdivisions were a mix of residential, commercial, and industrial. The following table summarizes the subdivisions that were used as case studies:

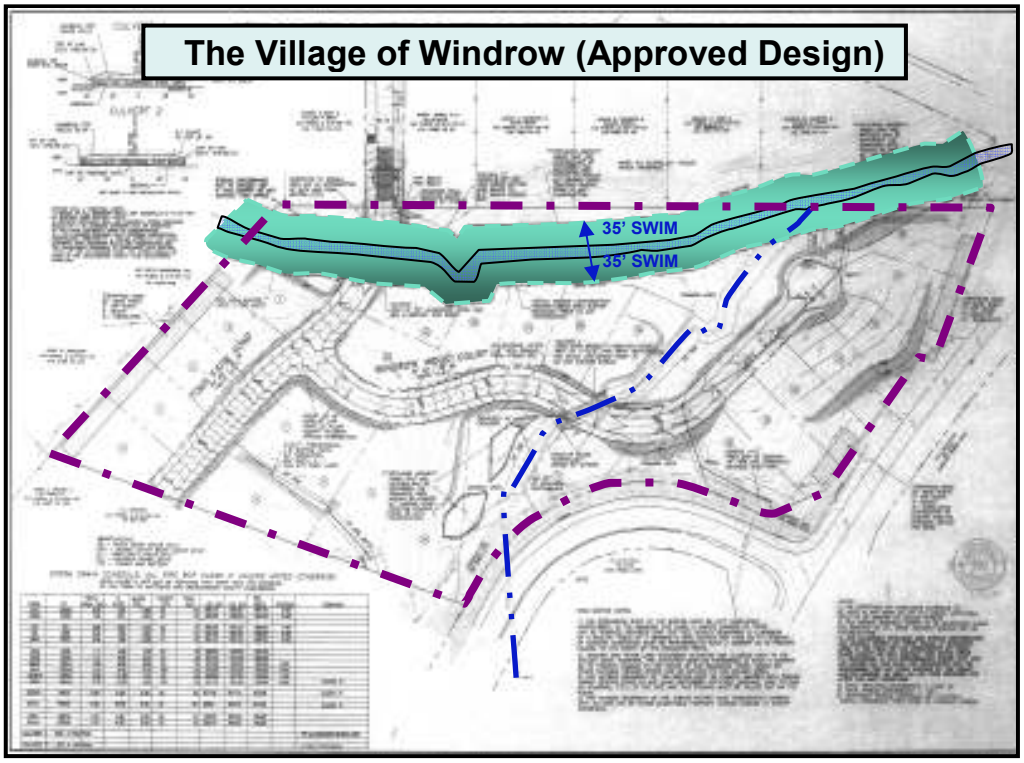
| Subdivision | Jurisdiction |
|---|---|
| The Village at Windrow | Matthews |
| The Traditions | Pineville |
| The Woodlands | Davidson |
| Matthews Professional Center | Matthews |
| Fairington Oaks | Mint Hill |
| Mercedes Benz | Pineville |
| Ingersoll Rand | Davidson |
| Waltrip Racing World | Cornelius |

The following sections of this report provide development details for each of these subdivisions including:

- Existing development layout as approved by the jurisdiction,
- Existing conditions of development including acreage, density, imperviousness, applicable SWIM and or Watershed buffers,
- Applicability of each key development standard for compliance with the Post-Construction Ordinance,
- Revised development layout showing the modified design for compliance with the Post-Construction Ordinance, and
- Estimated costs to comply with the Post-Construction Ordinance.

### 3.1 The Village at Windrow

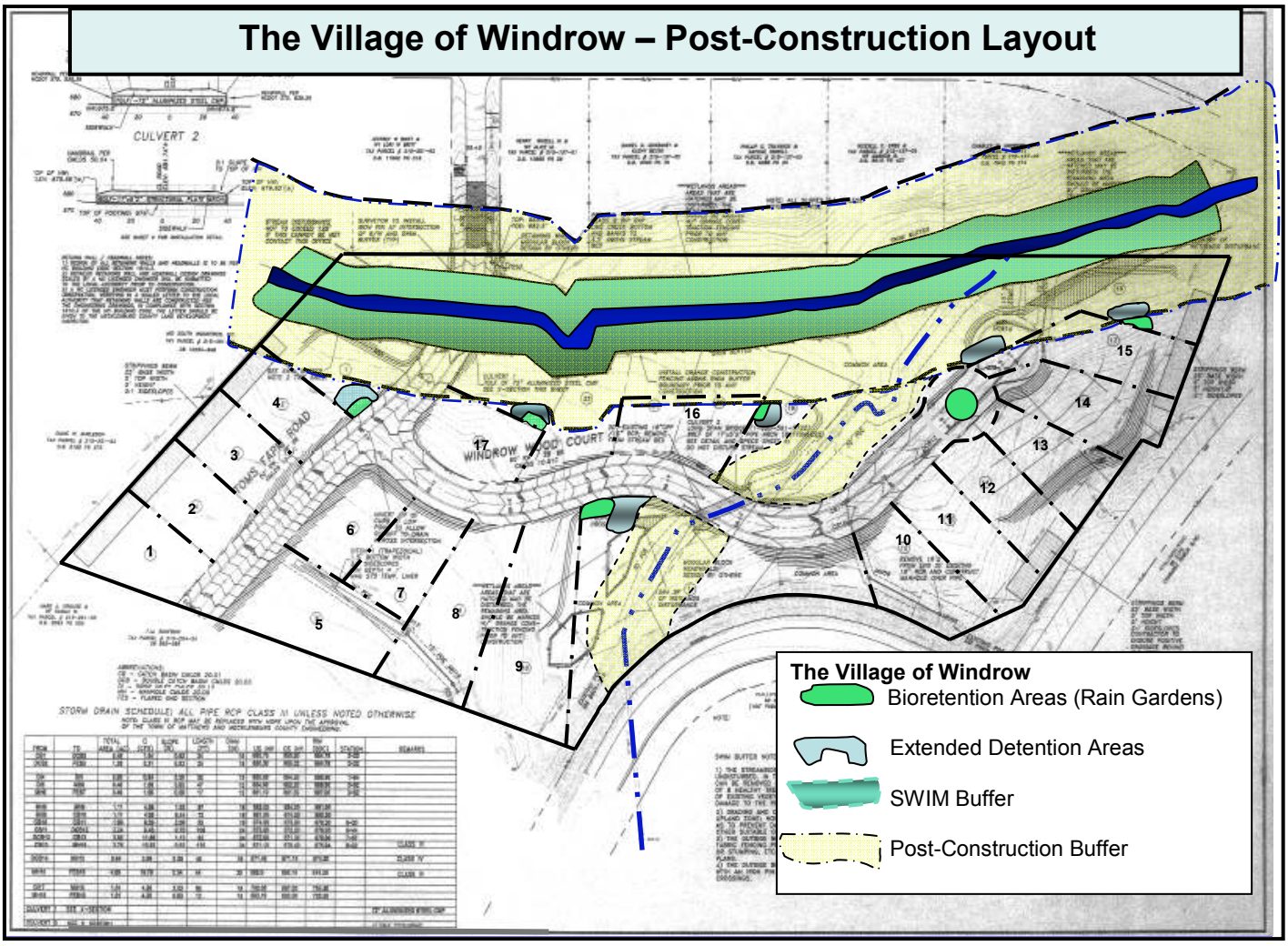
The Town of Matthews selected The Village at Window subdivision for analysis, which consists of 24 single-family residential lots located on 12.8 acres of land, with 21% built-upon area. The average cost of a home in this development is approximately $300,000. This development is located within the Yadkin-Southeast Catawba district of the Post-Construction Ordinance. One perennial stream and one intermittent stream are located within the development. The perennial stream is currently subject to the SWIM ordinance which requires a 35-ft buffer on either side of the stream (see figure below):




Retrofitting the original site design with the requirements of the Post-Construction Ordinance required the extension of the buffers on the perennial stream from 35-ft to 100-ft, the addition of 50-ft buffers on the intermittent stream, and the addition of structural best management practices (BMPs) that would remove 85% of total suspended solids (TSS) and 70% of total phosphorus (TP) from runoff from the first one (1) inch of rainfall. The open space requirements for the development were met with the increased buffers on the streams.

The increased buffers resulted in a loss of eight (8) lots; however by modifying the layout slightly, one (1) additional lot was gained for a net loss of seven (7) lots. The BMPs selected to provide the

required TSS and TP removal were bioretention areas (or rain gardens). Dry detention basins were used to provide volume and peak control (refer to the figure below):

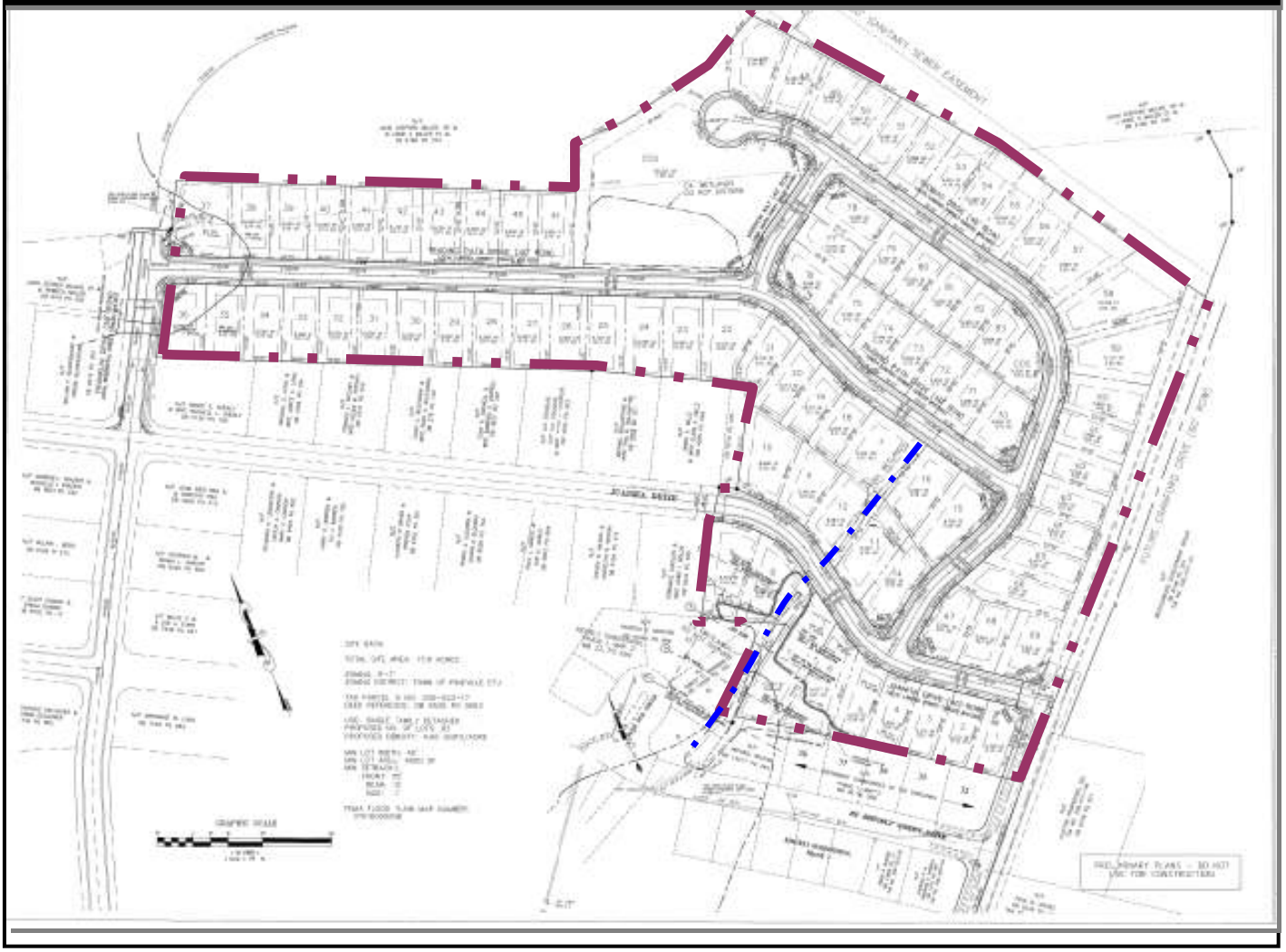



The costs for retrofitting this development with BMPs to comply with the Post-Construction Ordinance were estimated using unit costs received from contractors in March 2006 for retrofitting BMPs at Fairview Park in Mint Hill and The Shops at Freedom Drive. The value (cost) of the lots lost to the increased stream buffers was estimated by assuming that a builder's loss would be equivalent to the lost profit from each lot, which was estimated as 15% of the sales cost per home. The costs also include design and installation of water quality BMPs. The estimated costs to comply with the Post-Construction Ordinance are summarized on Table 1 (attached at the end of the report).

## 3.2 The Traditions

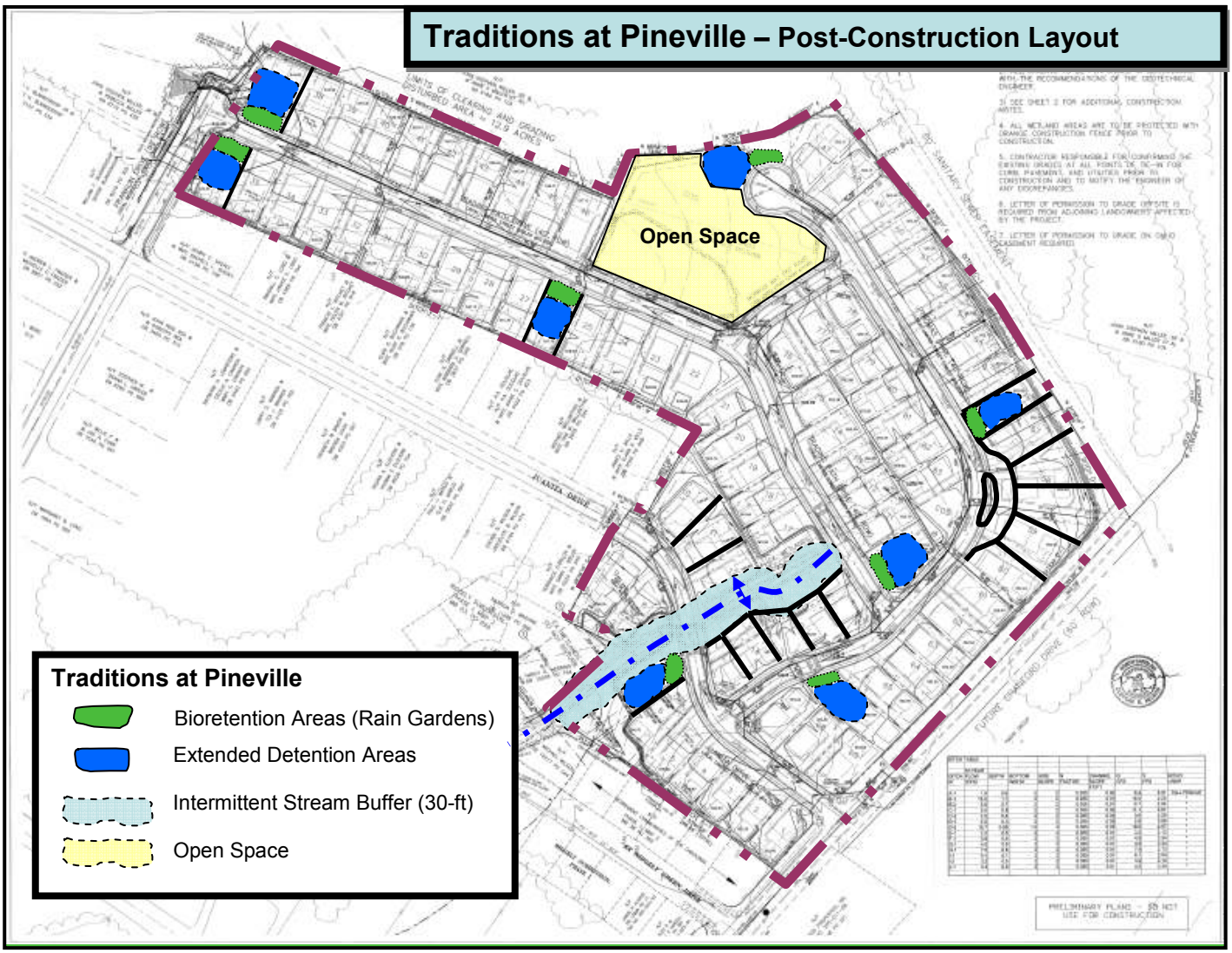
The Town of Pineville selected The Traditions subdivision for analysis. This development consists of 83 single-family residential lots located on 17.8 acres of land, with 56% built-upon area. The average cost of a home in this development is approximately $200,000. This development is located within the Central Catawba district of the Post-Construction Ordinance. One perennial stream and one intermittent stream are located within the development. The intermittent stream located on-site is not currently subject to any SWIM ordinance requirements (see figure below):

**Traditions at Pineville (Approved Design)**



Retrofitting the original site design with the requirements of the Post-Construction ordinance required the addition of 50-ft buffers on the intermittent stream, and the addition of structural BMPs that would remove 85% of TSS and 70% of TP from runoff from the first one (1) inch of rainfall. The open space requirements for the development were met with the existing open space and buffers on the stream.

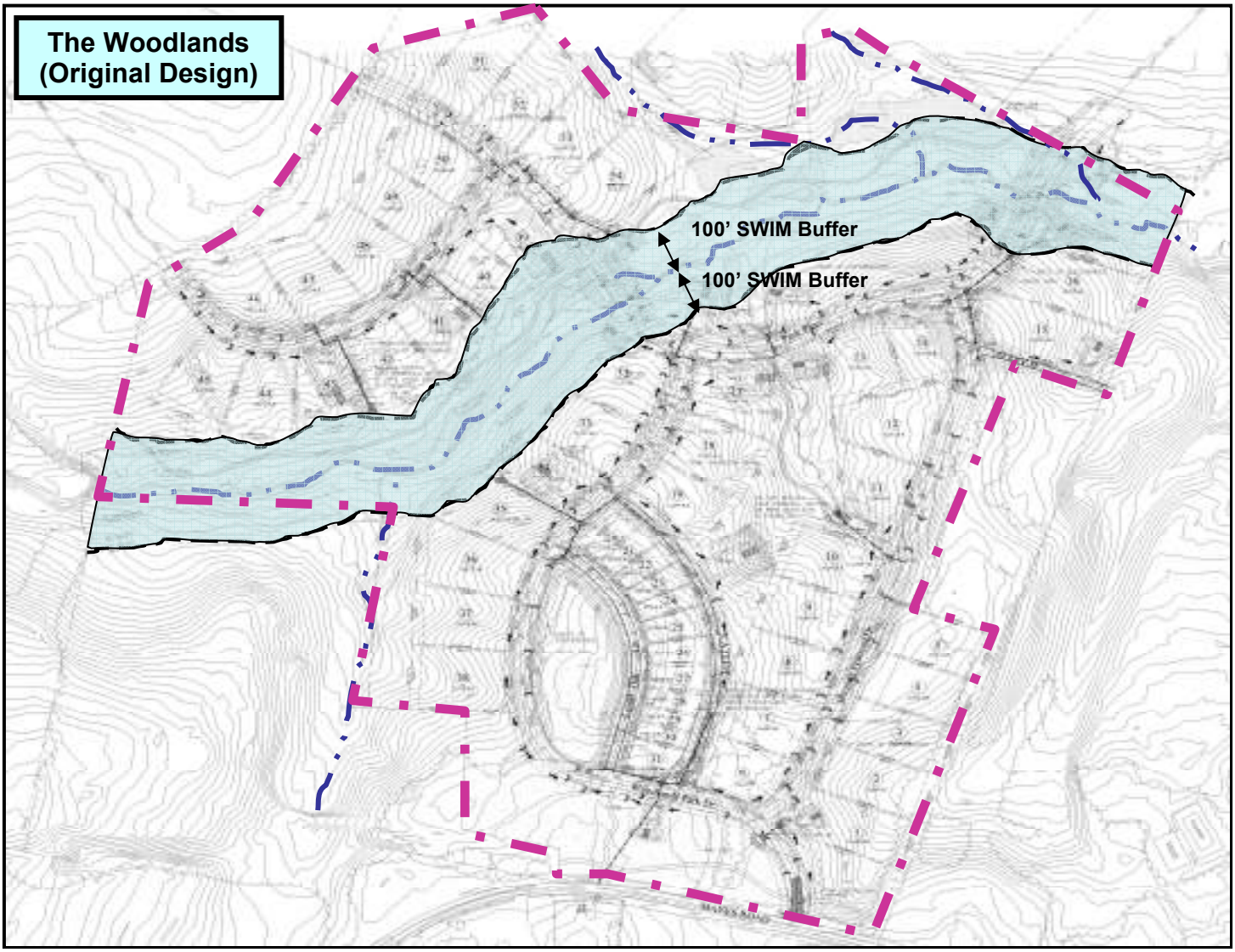
The increased buffers resulted in a loss of ten (10) lots from the original design; however by modifying the layout slightly, five (5) lots were gained for a net loss of five (5) lots. The BMPs selected to provide the required TSS and TP removal were bioretention areas (or rain gardens). Dry detention basins were selected to provide volume and peak control (refer to the figure below):




The costs for retrofitting this development with BMPs to comply with the Post-Construction Ordinance were estimated using unit costs received from contractors in March 2006 for retrofitting BMPs at Fairview Park in Mint Hill and The Shops at Freedom Drive. The value (cost) of the lots lost to the increased stream buffers was estimated by assuming that a builder's loss would be equivalent to the lost profit from each lot, which was estimated as 15% of the sales cost per home. The costs also include design and installation of water quality BMPs. The estimated costs to comply with the Post-Construction Ordinance are summarized on Table 1 (attached at the end of the report).

## 3.3 The Woodlands

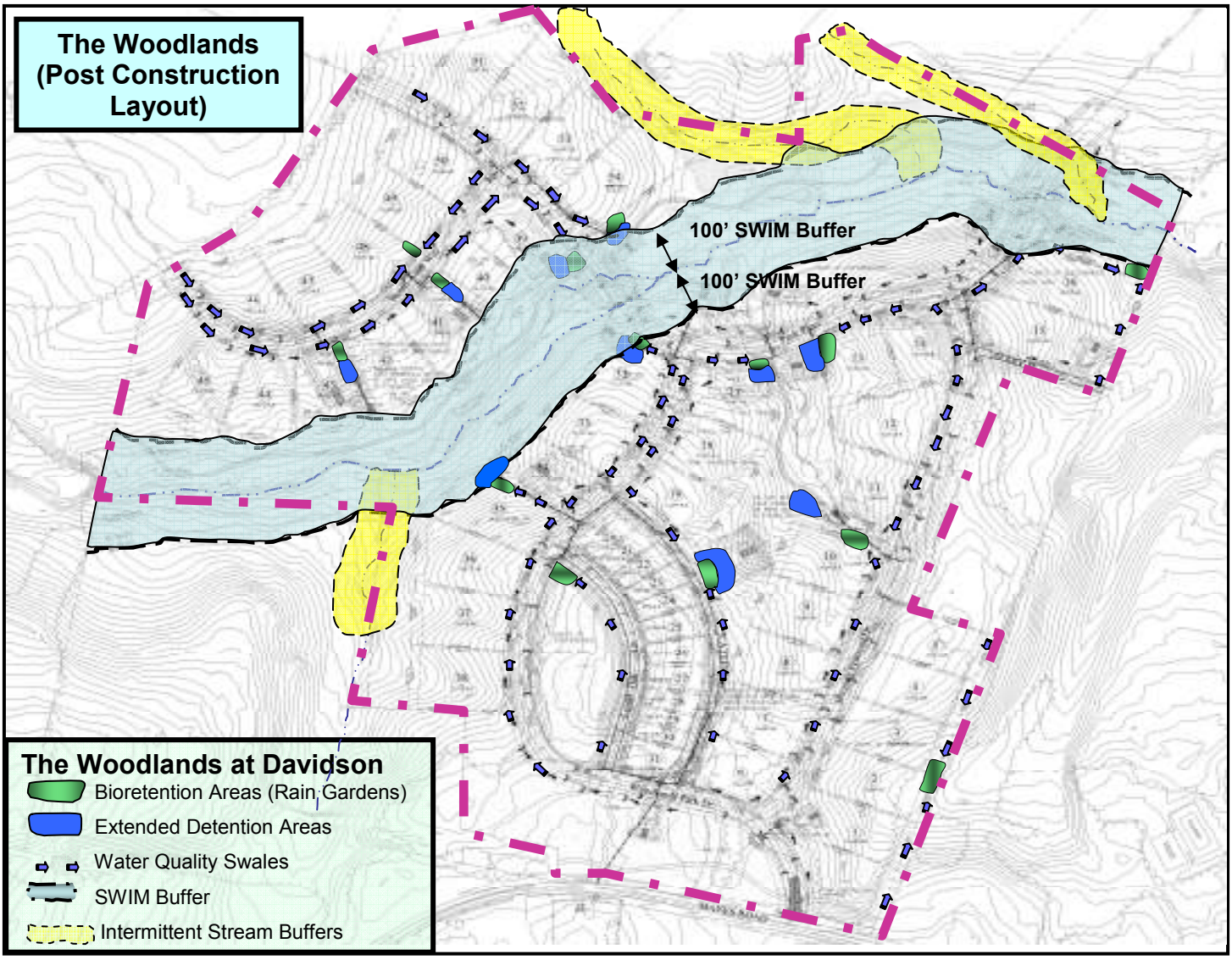
The Town of Davidson selected The Traditions subdivision for analysis. This development consists of 42 single-family residential detached lots and 12 single-family residential attached lots (a total of 54 lots) located on 63 acres of land, with 23% built-upon area. The average cost of a single-family detached home in this development is approximately $500,000 and the average cost of an attached home is approximately $200,000. This development is located within the Yadkin-Southeast Catawba district of the Post-Construction Ordinance. One (1) perennial stream and three (3) intermittent streams are located within the development. Storm water conveyance from the streets was managed using v-type ditches. The perennial stream located on-site is currently subject to the SWIM ordinance which requires a 100-foot buffer on either side of the stream (see figure below):




Retrofitting the original site design with the requirements of the Post-Construction ordinance required the addition of 50-ft buffers on the intermittent stream and the addition of structural BMPs that would

remove 85% of TSS and 70% of TP from runoff from the first one (1) inch of rainfall. The open space requirements for the development were met with the existing buffers on the perennial stream.

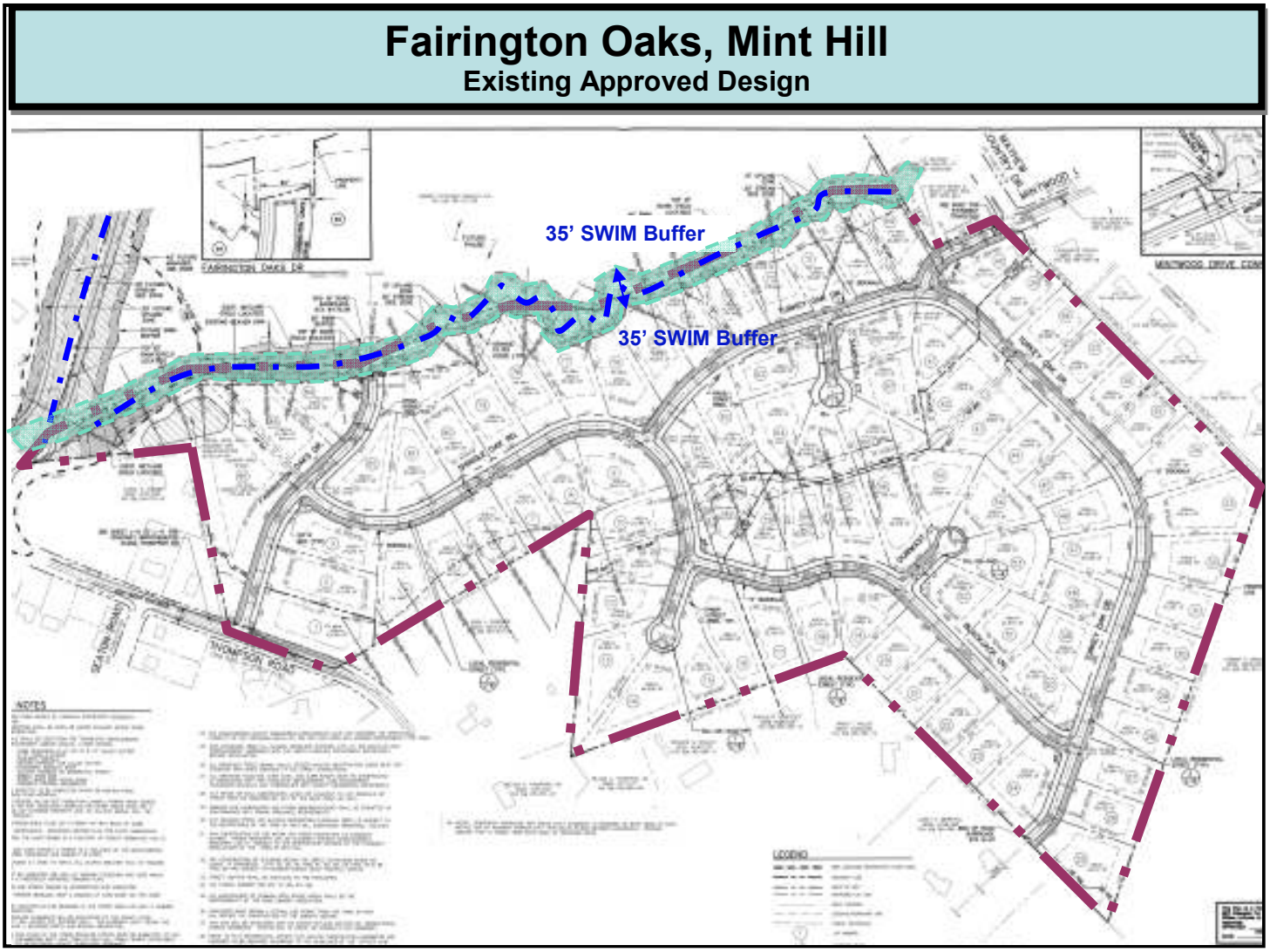
The addition of 50-foot buffers on the three intermittent streams did not affect the development layout as the existing lots were originally designed to protect these natural drainage features. The BMPs selected to provide the required TSS and TP removal were bioretention areas (or rain gardens) and water quality swales. Dry detention basins were selected to provide volume and peak control (refer to the figure below):




The costs for retrofitting this development with BMPs to comply with the Post-Construction Ordinance were estimated using unit costs received from contractors in March 2006 for retrofitting BMPs at Fairview Park in Mint Hill and The Shops at Freedom Drive. The costs include design and installation of water quality BMPs. The estimated costs to comply with the Post-Construction Ordinance are summarized on Table 1 (attached at the end of the report).

## 3.4 Fairington Oaks

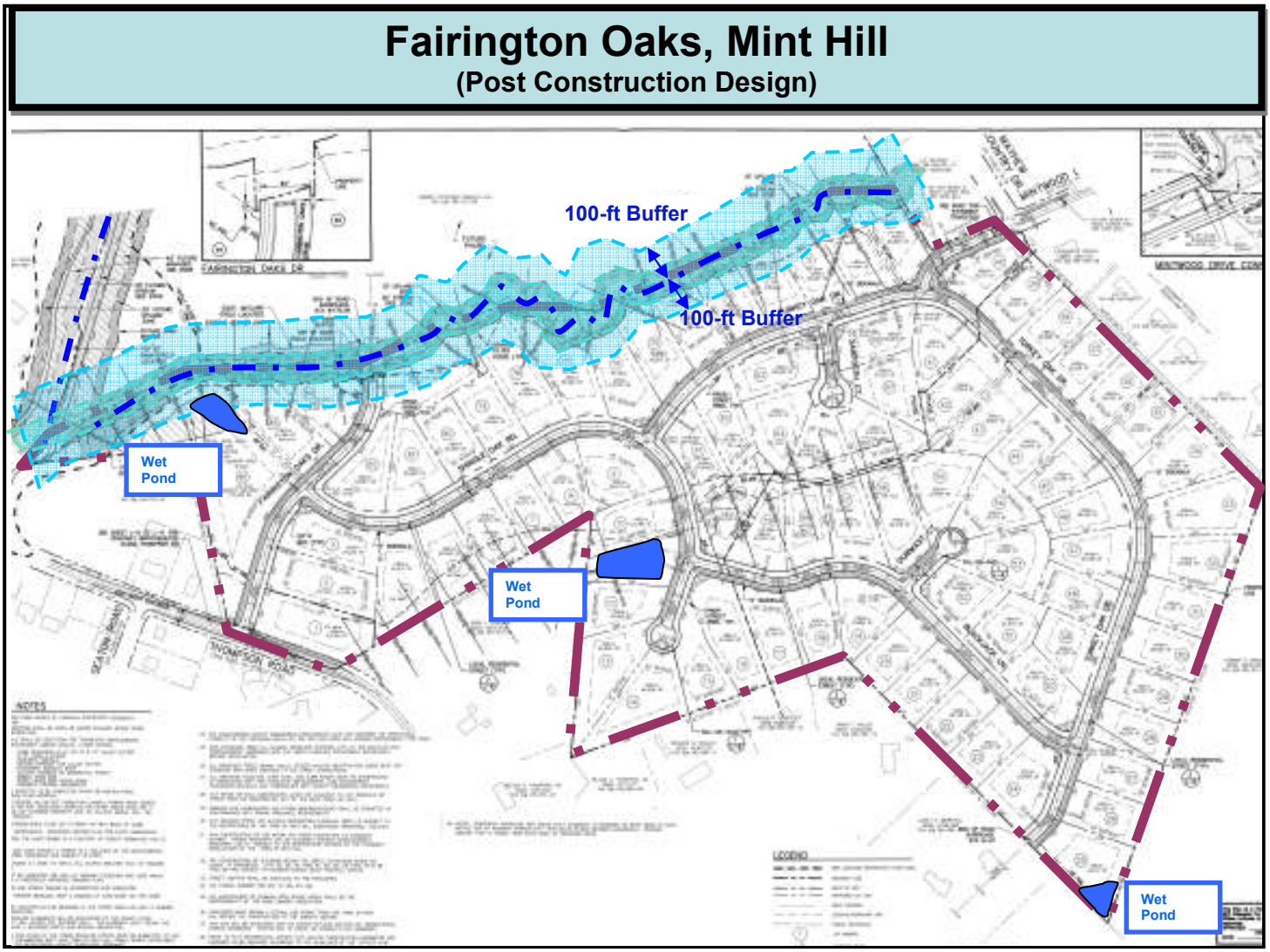
The Town of Mint Hill selected Fairington Oaks subdivision for analysis. This development consists of 85 single-family residential detached lots located on 83.2 acres of land, with 18% built-upon area. The average cost of a single-family detached home in this development is approximately $420,000. This development is located within the Goose Creek district of the Mint Hill Post-Construction Ordinance. One (1) intermittent stream (as defined by USGS Quadrangle maps) is located within the development. The intermittent stream located on-site is currently subject to the SWIM ordinance which requires a 35-foot buffer on either side of the stream (see figure below):




Retrofitting the original site design with the requirements of the Mint Hill Post-Construction ordinance required the addition of a 100-ft buffer on the intermittent stream and the addition of structural BMPs that would remove 85% of TSS from runoff from the difference between the pre-development and post-development conditions for the 1-yr 24-hr storm. Since the development is composed of less

than 20% built-upon area, there are no open space requirements for the development. The proposed Mint Hill Post-Construction Ordinance exempts development with less than 20% built-upon area from the open space requirements.

The addition of the 100-foot buffer on the intermittent stream did not affect the development layout as the existing lots were designed with adequate buildable area outside of the buffer area. The BMPs selected to provide the required TSS removal, volume control, and peak control were wet ponds. The addition of wet ponds resulted in a loss of one (1) lot from the original design. Based upon the site topography, three (3) wet ponds were located throughout the development to provide storm water treatment and control (refer to the figure below):

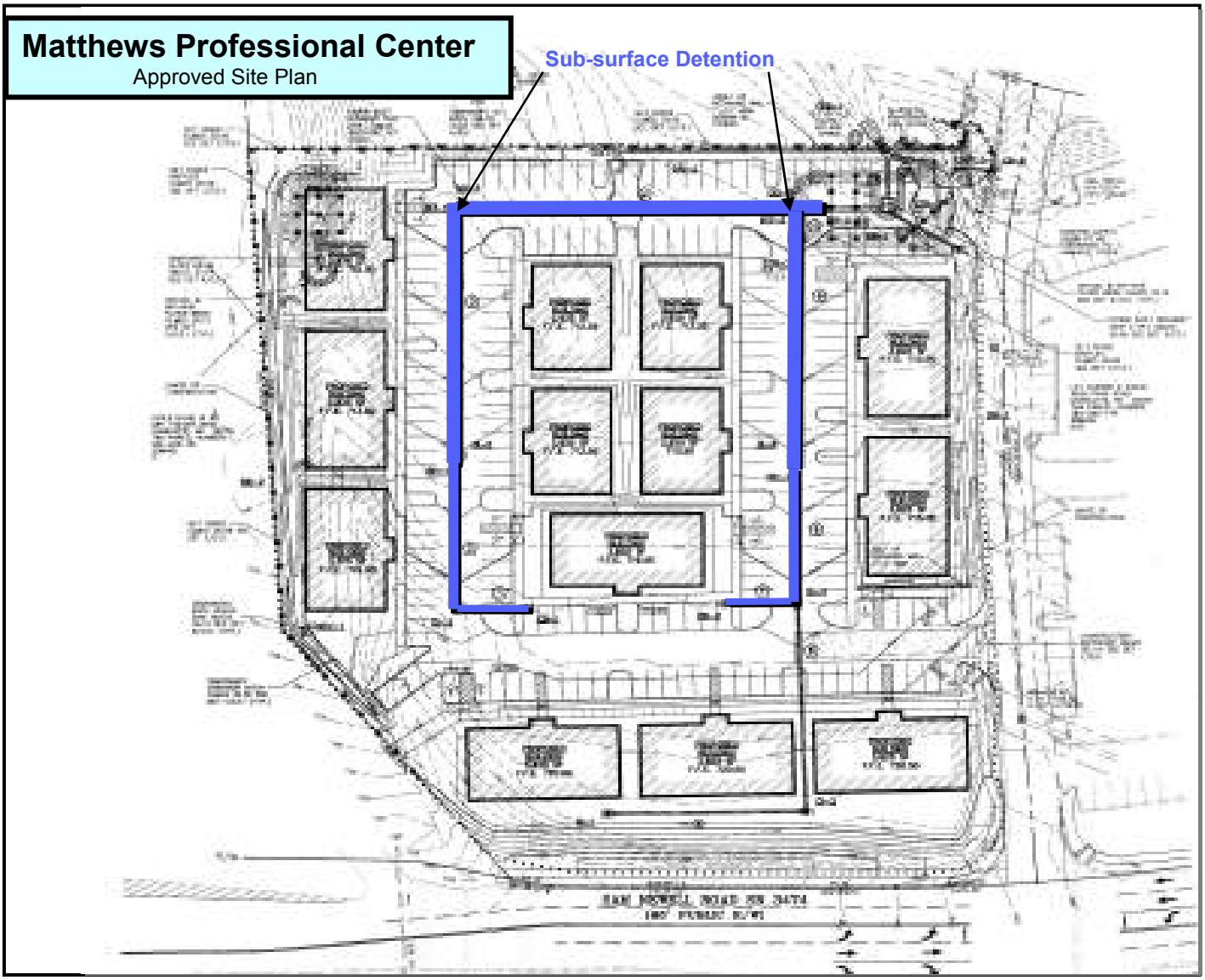



The costs for retrofitting this development with BMPs to comply with the Mint Hill Post-Construction Ordinance were estimated using the North Carolina State University (NCSU) publication entitled *The Economics of Structural Stormwater BMPs in North Carolina,* dated May 2003. The costs include design and installation of water quality BMPs. The value (cost) of the one lost lot was estimated by

assuming that a builder's loss would be equivalent to the lost profit from one lot, which was estimated as 15% of the sales cost per home. The estimated costs are summarized on Table 1 (attached at the end of the report).

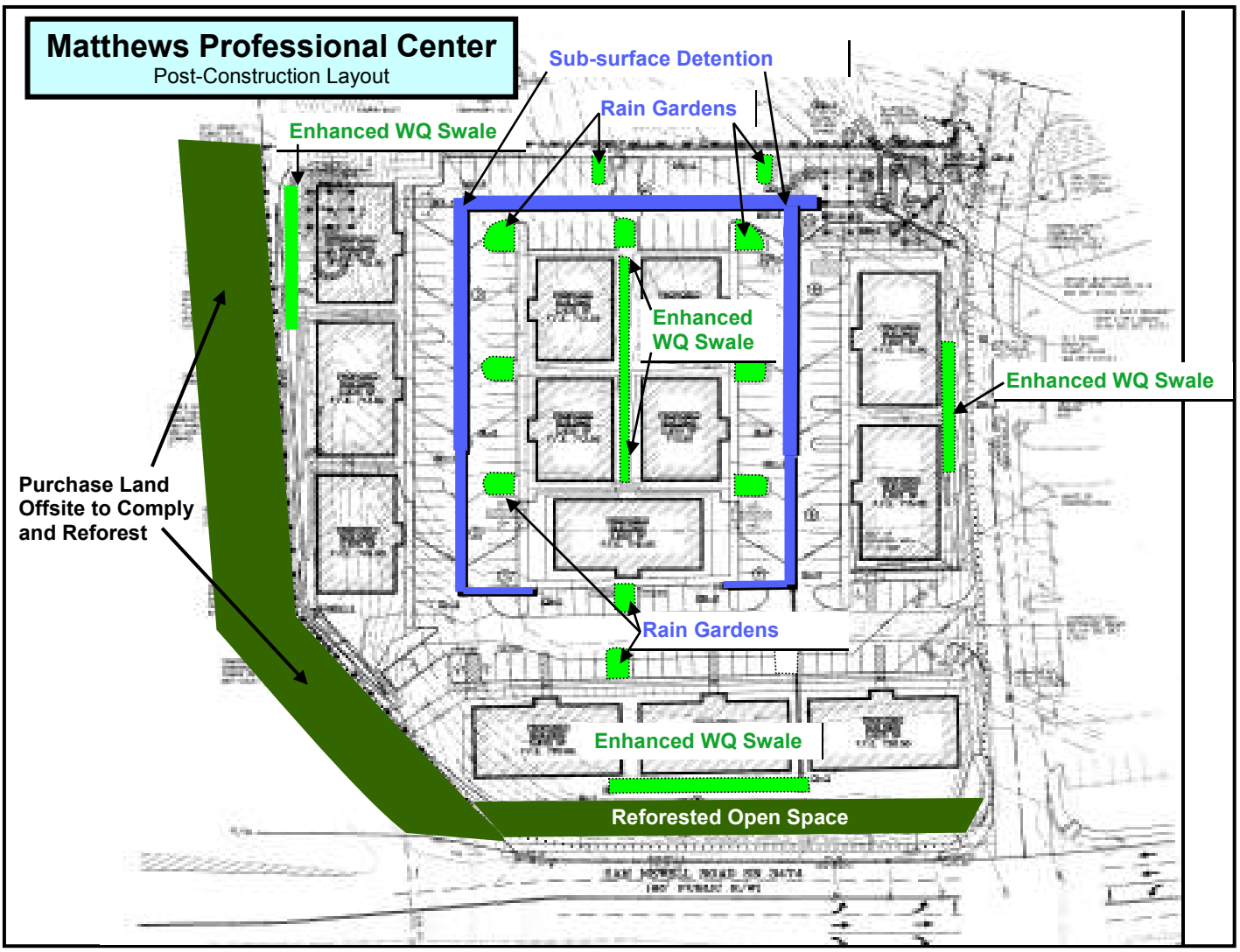
### 3.5 Matthews Professional Center

The Town of Matthews selected The Matthews Professional Center property for analysis. This development consists of thirteen (13) office buildings located on 3.97 acres of land, with 65.8% built-upon area. The development had provided sub-surface detention of storm water to control runoff volume and peak flow according to existing development regulations. This development is located within the Central Catawba district of the Post-Construction Ordinance (refer to the figure below):




Retrofitting the original site design with the requirements of the Post-Construction ordinance required modifications to meet the open space requirements and the TSS and TP treatment. Since the

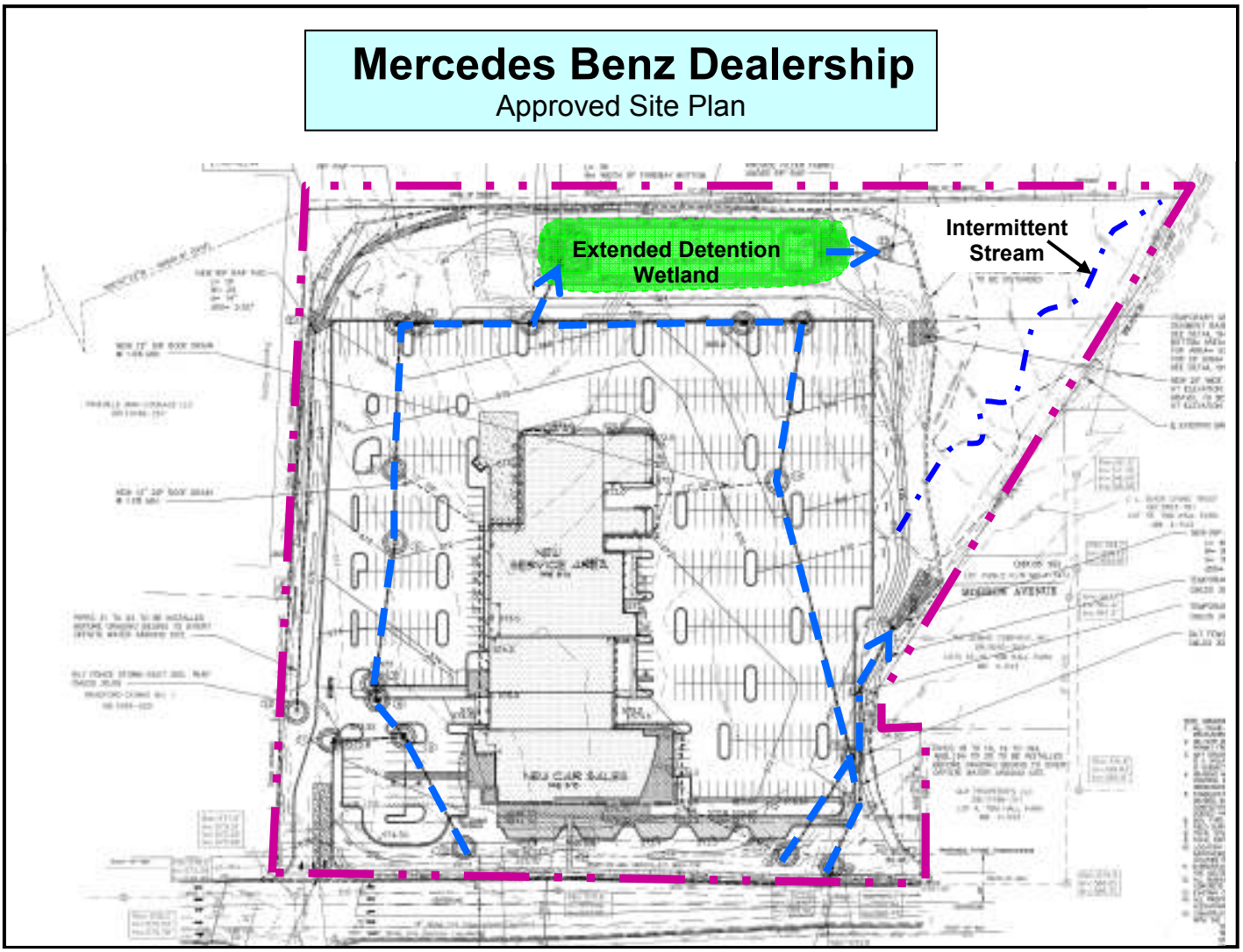
property had no undisturbed open space, the open space required by the ordinance (10%) had to be increased by 50% for a total of 15% open space (or 0.6 acres). To retrofit this development to comply with the open space requirements, an additional 0.44 acres of adjoining property needed to be purchased. Since the adjoining property contained no trees, trees would need to be planted for qualification as open space. The development already provided water quantity control (through sub-surface detention) but was required to add structural BMPs that would remove 85% of TSS from runoff from the first one (1) inch of rainfall. The BMPs selected to provide the required TSS removal were bioretention areas (or rain gardens) and enhanced water quality swales. The retrofitted development layout is shown below:




The costs for retrofitting this development with BMPs to comply with the Post-Construction ordinance were estimated using unit costs received from contractors in March 2006 for retrofitting BMPs at Fairview Park in Mint Hill and The Shops at Freedom Drive. The costs include design and installation of water quality BMPs, purchase of additional property, and re-forestation of open space areas. The estimated costs to comply with the Post-Construction Ordinance are summarized on Table 2 (attached at the end of the report).

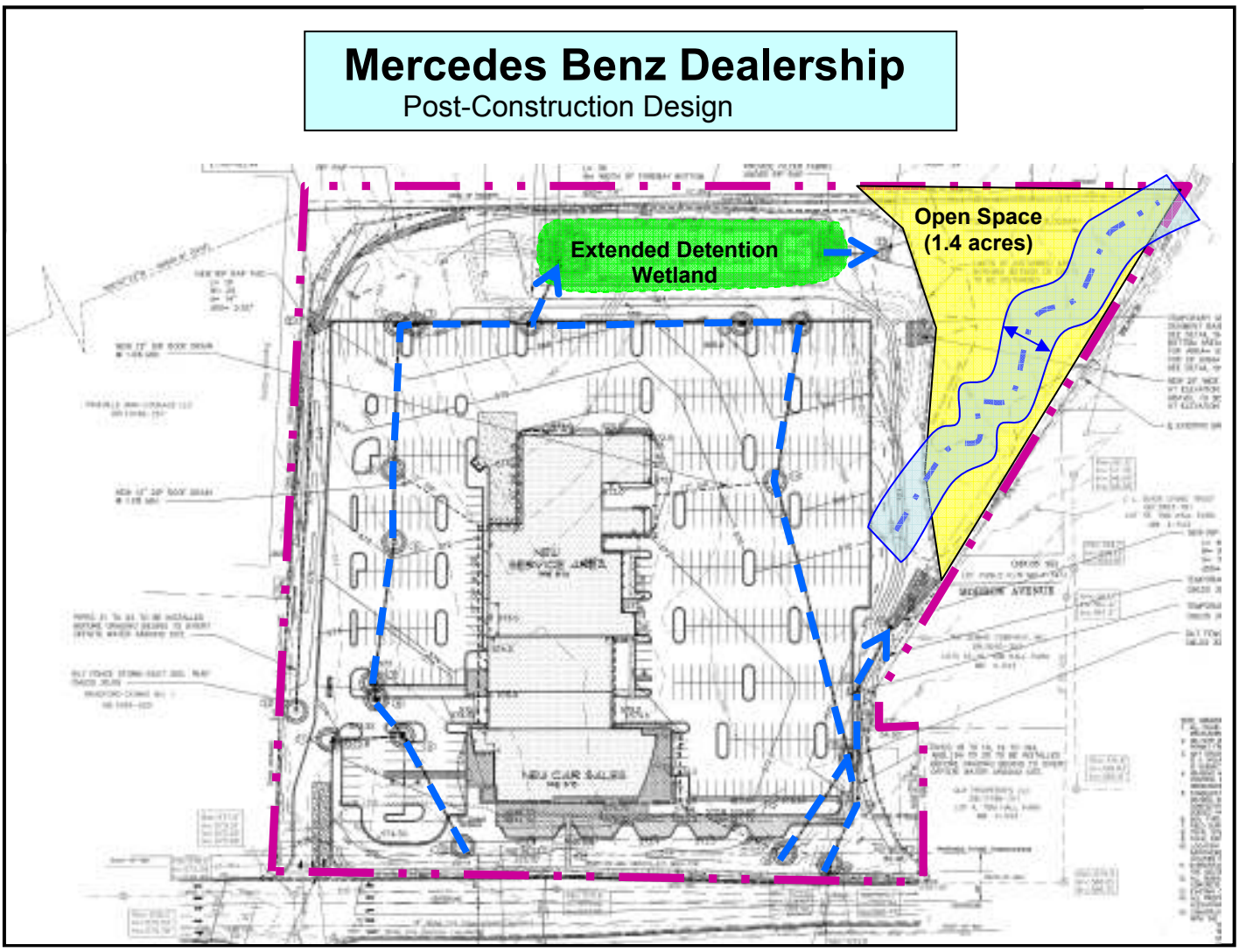
## 3.6 Mercedes Benz

The Town of Pineville selected the Mercedes Benz car dealership for analysis. This development consists of one (1) building located on 11.4 acres of land, with 57% built-upon area. The development had a constructed wetland to provide sub-surface detention of storm water to control runoff volume and peak flow according to existing development regulations and to provide water quality treatment according to the request of the Town. This development is located within the Central Catawba district of the Post-Construction Ordinance (refer to figure below):




The original site design did not require modifications to meet the requirements of the Post-Construction Ordinance. The Post-Construction Ordinance does require a 30-ft buffer (no build zone) on the intermittent stream, but since no building was proposed in this area, the buffer did not affect the layout of the dealership. The open space requirement was met with the open space provided in the original design. The constructed wetland would meet the water quality and quantity treatment

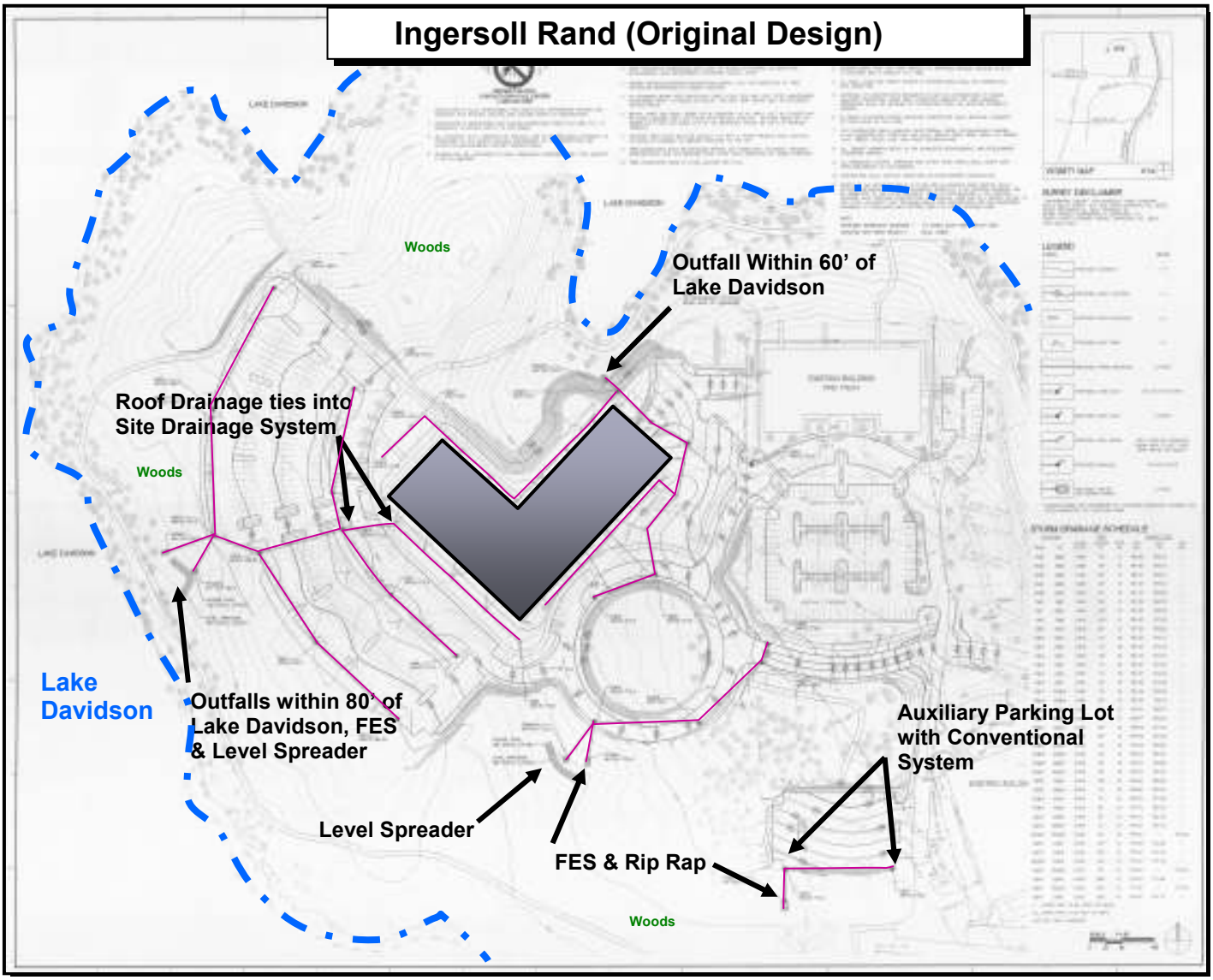
requirements with little modification, if any. The development layout showing the open space and stream buffer is shown below:




Since the original design for the Mercedes Benz site met the requirements of the Post-Construction Ordinance, no modifications or additional costs were required to comply with the ordinance.

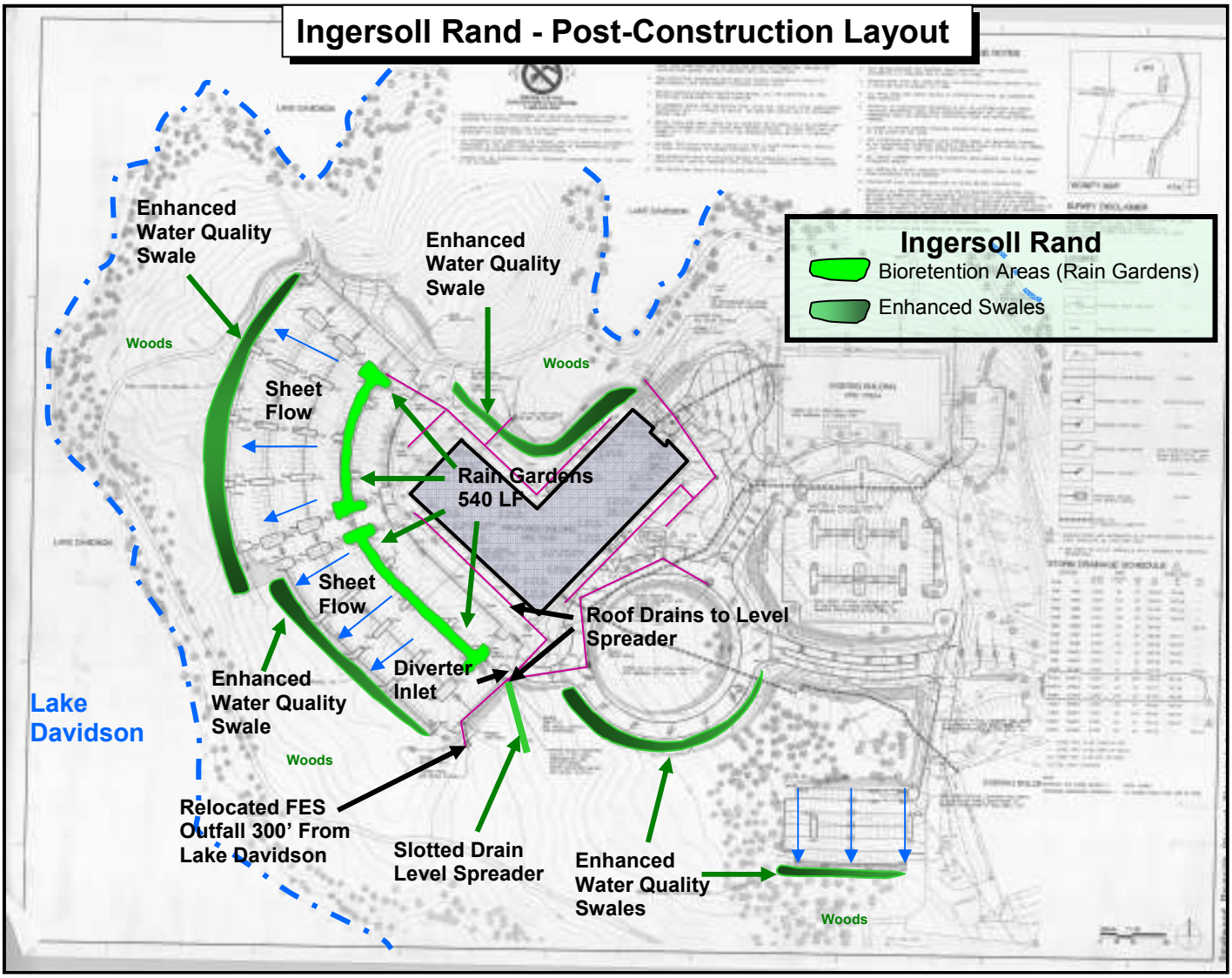
## 3.7 Ingersoll Rand

The Town of Davidson selected an expansion project for Ingersoll Rand for analysis. This development consisted of a 66,000 square foot building addition and parking lot addition located on 30 acres of land, with 23% built-upon area. The original development had a network of underground storm drain piping leading to level spreaders that allowed storm water to flow across buffers prior to entering Lake Davidson. After receiving the original design for the expansion, the Town of Davidson asked Ingersoll Rand to consult with MCWQP to determine if there were alternatives to improve water quality of runoff. This development is located within the Western Catawba district of the Post-Construction Ordinance (refer to figure below):




Retrofitting the original site design with the requirements of the Post-Construction ordinance required modifications to meet the TSS and TP treatment requirements. Since the development is located on Lake Davidson, no water quantity volume or peak control is required. The development was required

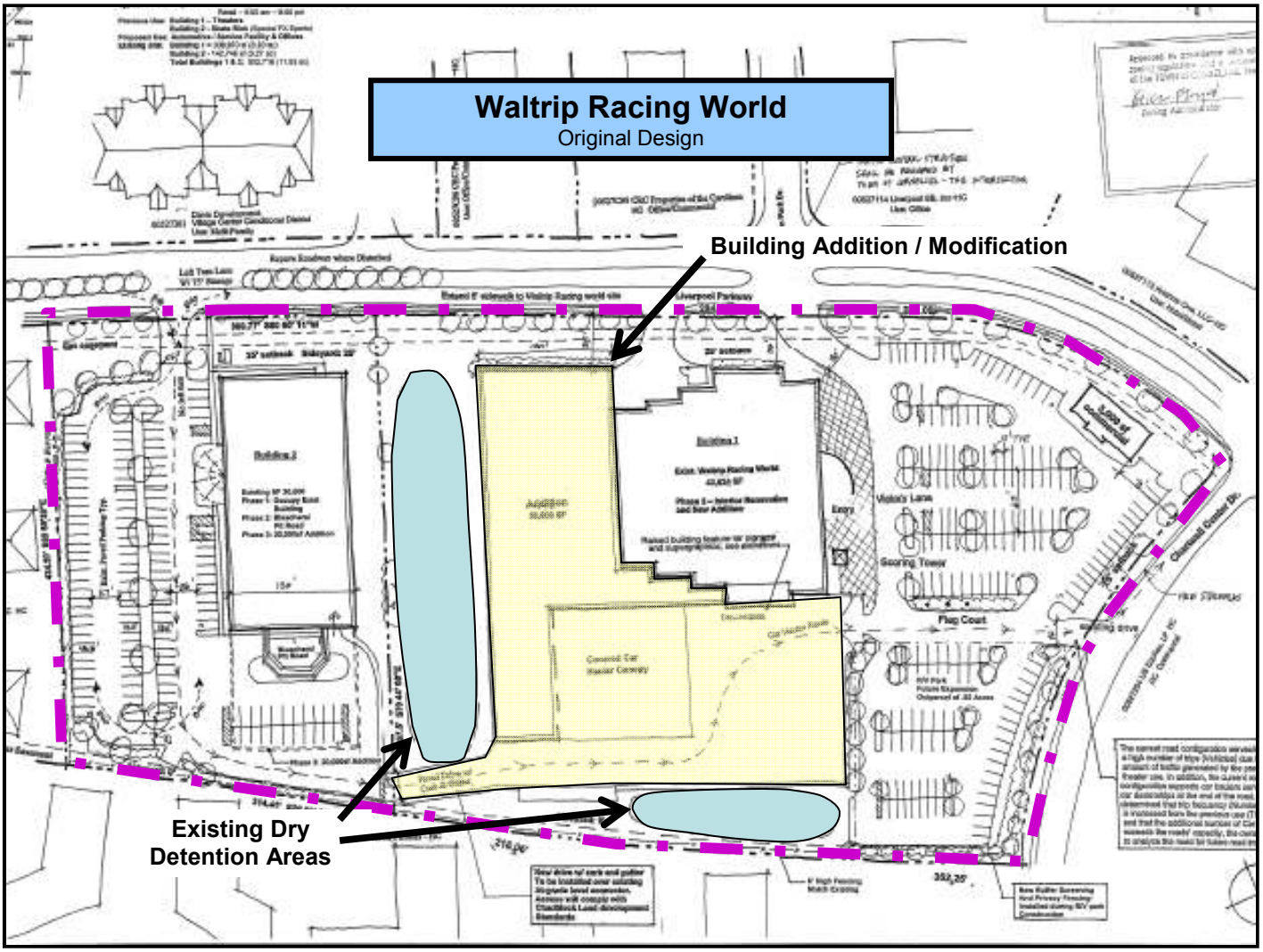
to add structural BMPs that would remove 85% of TSS and remove 70% of TP from runoff from the first one (1) inch of rainfall. The BMPs selected to provide the required TSS and TP removal were bioretention areas (or rain gardens), enhanced water quality swales, and natural buffers. By adding bioretention areas and swales that accept surface runoff, 73% of the original underground storm drain system was eliminated. The retrofitted development layout is shown below:




The costs for retrofitting this development with BMPs to comply with the Post-Construction ordinance were estimated using unit costs received from contractors in March 2006 for retrofitting BMPs at Fairview Park in Mint Hill and The Shops at Freedom Drive. In addition, unit costs for the designed storm water drainage system were provided by Ingersoll Rand for estimating reduction in drainage system costs. The "net" Post-Construction costs summarized on Table 2 include design and installation of water quality BMPs and drainage systems ($136,800) minus the cost from the originally-designed storm water drainage system ($119,650).

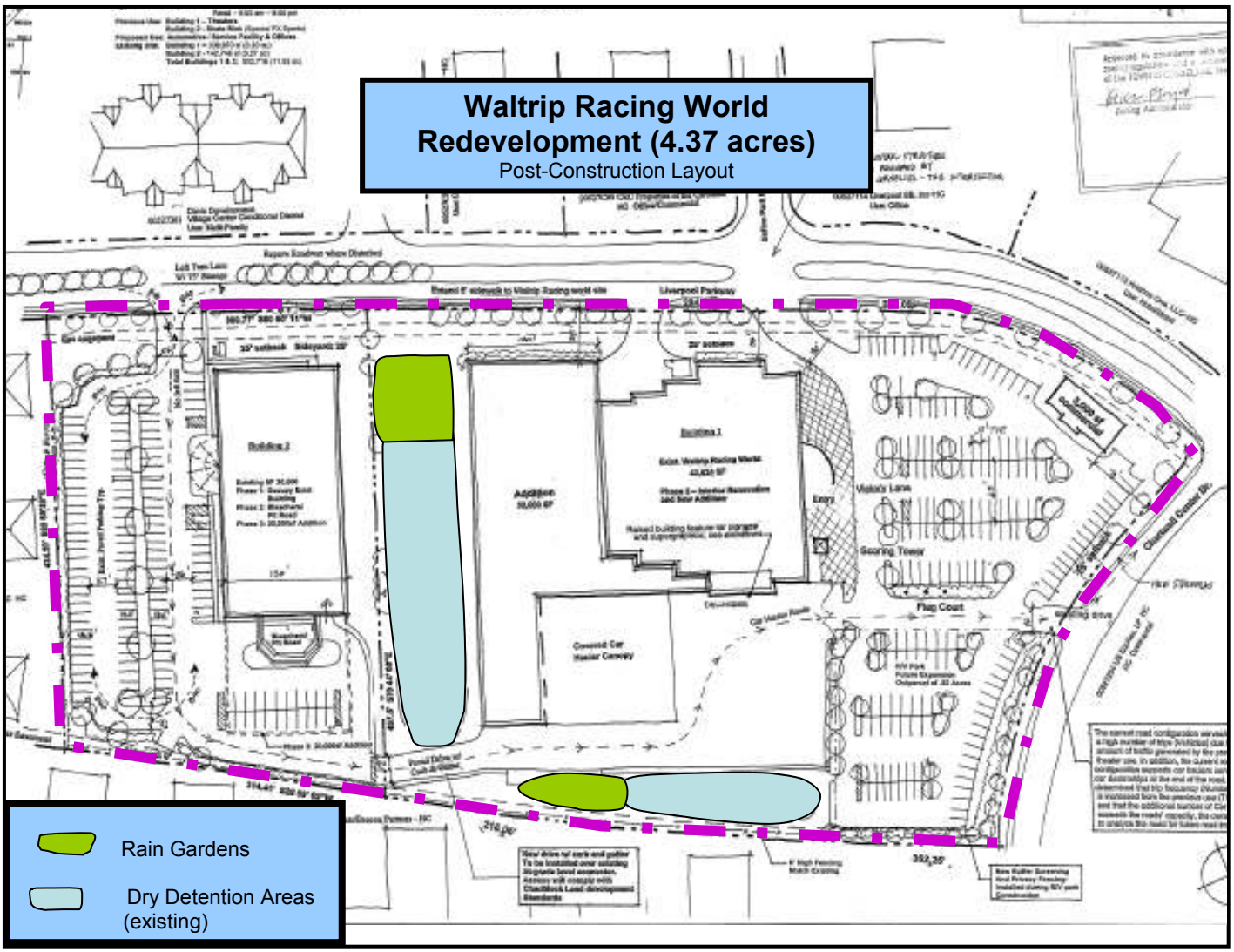
## 3.8 Waltrip Racing World

The Town of Cornelius selected a redevelopment project, Waltrip Racing World, for analysis using the Post-Construction Ordinance. Prior to redevelopment, the site consisted of 11.5 acres of property with a 75% built-upon area and no streams. This redevelopment consisted of a 58,000 square foot building addition and parking lot modification on the site. The redeveloped portion of the property consisted of 4.37 acres. The development had two (2) dry detention basins to provide detention of storm water to control runoff volume and peak flow according to existing development regulations. This development is located within the Western Catawba district of the Post-Construction Ordinance (refer to the figure below):



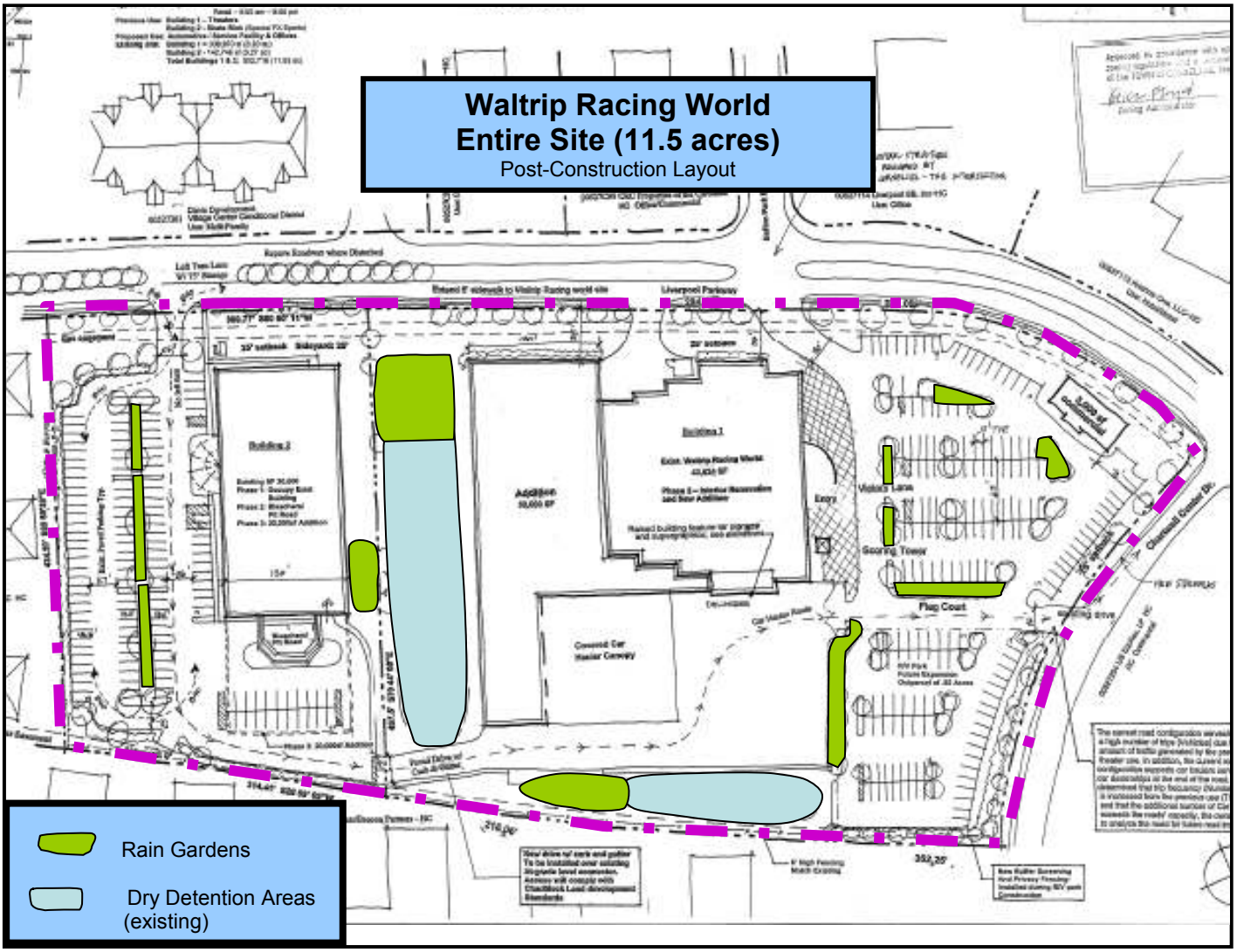

Retrofitting the original site design with the requirements of the Post-Construction Ordinance required modifications to meet the TSS and TP treatment requirements. For compliance, the redeveloped area (4.37 acres) required the addition of structural BMPs that would remove 85% of TSS and

remove 70% of TP from runoff from the first one (1) inch of rainfall. The BMPs selected to provide the required TSS and TP removal were bioretention areas (or rain gardens). The development already met the storm water volume and peak control requirements and open space requirements do not apply to redevelopments. The retrofitted layout for the redeveloped area is shown below:




Alternatively, the original site design was analyzed assuming the entire site (11.5 acres) was redeveloped and was required to meet the requirements of the Post-Construction Ordinance. The original design required similar modifications to meet the TSS and TP treatment requirements. The development was required to add structural BMPs that would remove 85% of TSS and remove 70% of TP from runoff from the first one (1) inch of rainfall. The BMPs selected to provide the required TSS and TP removal were bioretention areas (or rain gardens). The development already met the

storm water volume and peak control requirements and open space requirements do not apply to redevelopments. The retrofitted layout for the redeveloped area is shown below:




The costs for retrofitting this development with BMPs to comply with the Post-Construction Ordinance were estimated using unit costs received from contractors in March 2006 for retrofitting BMPs at Fairview Park in Mint Hill and The Shops at Freedom Drive. The costs include design and installation of water quality BMPs. The estimated costs to comply with the Post-Construction Ordinance for both the redeveloped area and the entire site are summarized on Table 2.

## 4.0 RESULTS OF THE ANALYSES

The analyses showed that the effect of the Post-Construction Ordinance on development was specific for each case study depending mainly on the presence of intermittent and perennial streams,

undisturbed areas, and the presence of existing storm water control structures required by other existing ordinances such as Detention Ordinances and Watershed Protection Ordinances.

## 4.1 Residential Subdivision Case Studies

For all the residential subdivision case studies, no existing storm water control structures were required by other ordinances and all sites contained streams. All of the residential sites selected were considered high density under the Post-Construction Ordinance and thus required structural BMPs for storm water quality treatment. In addition, three (3) out of four (4) sites were impacted by the addition of or increase in stream buffer widths. Because the increased stream buffers provided undisturbed areas, the open space requirements were met. The estimated costs to comply with the ordinance for residential development ranged from $3,800 to $32,500 on a per acre basis, and ranged from $3,700 to $24,500 on a per lot basis. The average costs were estimated at $15,900 per acre and $10,200 per lot for residential development.

## 4.2 Commercial / Industrial Case Studies

The impacts of the ordinance on the commercial / industrial case studies were more variable because each site had different levels of existing controls. All of the sites met the storm water volume and peak control requirements of the Post-Construction Ordinance because of existing detention ordinances for commercial / industrial sites.

All of the commercial / industrial sites selected were considered high density under the Post-Construction Ordinance and thus required structural BMPs for storm water quality treatment. All of the sites with the exception of one had to add structural BMPs to provide water quality treatment. The one exception, the Mercedes Benz site, provided adequate storm water quality treatment of runoff using a structural BMP because the Town of Pineville requested water quality treatment, not because it was required by ordinance.

The impacts of stream buffers were minimal because only one site contained streams, and that one site (Mercedes Benz) had preserved the stream in the original design. Stream buffers are an element of the Post-Construction Ordinance that will have case-by-case effects on development.

All of the commercial / industrial sites except one met the open space requirements of the Post-Construction Ordinance. The one exception (Matthews Professional Center) had no undisturbed areas of the site and thus required the addition of lands to comply with this requirement.

The estimated costs to comply with the ordinance for commercial / industrial development ranged from $0 to $25,200 on a per acre basis. The average cost of compliance was estimated at $10,000 per acre for commercial / industrial development.

Table 1
Retro-Fit Cost Analysis Summary for Implementation of Post-Construction Controls Ordinance for Single-Family Residential Development in Mecklenburg County

| Subdivision Details | Key Development Standards | Provided in Original Design | Required by Post-Construction Ordinance | Total Cost of Improvements | Cost Per Acre | Cost Per Lot |
|---|---|---|---|---|---|---|
| The Village of Windrow<br>Single-Family Residential<br>$ 300,000 homes<br>24 lots original design<br>(17 lots after improvements)<br>12.82 total acres<br>21.31% Impervious<br>Yadkin-Southeast Catawba | Open Space | 21% (2.6 ac) | 25% (3.2 ac) | included below | included below | included below |
| | Buffers | Perennial: 35 ft<br>Intermittent: 0 ft | Perennial: 100 ft<br>Intermittent: 50 ft | $ 315,000 (1)<br>(loss of 7 lots) | $ 24,600 | $ 18,500 |
| | BMP(85% TSS) | No | Yes | $ 49,000 (2) | $ 3,800 (2) | $ 2,900 (2) |
| | BMP(70% TP) | No | Yes | included above | included above | included above |
| | Volume Control | No | 1-yr 24-hr storm | $ 52,000 (3) | $ 4,100 (3) | $ 3,100 (2) |
| | Peak Control | No | 10/25-yr,6-hr storm | included above | included above | included above |
| | | | **Total:** | **$ 416,000** | **$ 32,500** | **$ 24,500** |
| The Traditions<br>Single-Family Residential<br>$ 200,000 homes<br>83 lots original design<br>(78 lots after improvements)<br>17.8 acres<br>56% Impervious<br>Central Catawba | Open Space | 10% (1.8 ac.) | 10% (1.8 ac) | included below | included below | included below |
| | Buffers | Intermittent: 10 ft | Intermittent: 30 ft | $ 30,000<br>(loss of 1 lot) | $ 1,700 | $ 380 |
| | BMP(85% TSS) | No | Yes | $ 60,000 (2) | $ 3,400 (2) | $ 770 (2) |
| | BMP(70% TP) | No | No | -- | -- | -- |
| | Volume Control | No | 1-yr 24-hr storm | $ 270,000 (2) (3)<br>(loss of 4 lots) | $ 15,200 (2) (3) | $ 3,500 (2) (3) |
| | Peak Control | No | 10/25-yr,6-hr storm | included above | included above | included above |
| | | | **Total:** | **$ 360,000** | **$ 20,300** | **$ 4,600** |
| The Woodlands at Davidson<br>Single-Family Residential<br>$ 500,000 homes (42 each)<br>$ 200,000 homes (12 each)<br>54 lots, 62 acres<br>23% Impervious<br>Yadkin-Southeast Catawba | Open Space | 26% (16.4 ac) | 25% (15.6 ac.) | -- | -- | -- |
| | Buffers | Perennial: 100 ft<br>Intermittent: 0 ft | Perennial: 100 ft<br>Intermittent: 50 ft | -- | -- | -- |
| | BMP(85% TSS) | No | Yes | $ 217,600 (2) | $ 3,500 (2) | $ 4,000 (2) |
| | BMP (70% TP) | No | Yes | included above | included above | Included above |
| | Volume Control | No | 1-yr 24-hr storm | $ 202,400 (2) | $ 3,300 (2) | $ 3,800 (2) |
| | Peak Control | No | 10/25-yr,6-hr storm | included above | included above | included above |
| | | | **Total:** | **$ 420,000** | **$ 6,800** | **$ 7,800** |
| Fairington Oaks<br>Single-Family Residential<br>$ 420,000 homes<br>85 lots, 83.2 acres<br>18% Impervious<br>Goose Creek | Open Space | 3 % (2.3 ac) | No | -- | -- | -- |
| | Buffers | Intermittent: 35 ft | Intermittent:100 ft | -- | -- | -- |
| | BMP(85% TSS) | No | Yes | $ 313,000 (1) (3) (4)<br>(loss of 1 lot) | $ 3,800 (1) (3) (4) | $ 3,700 (1) (3) (4) |
| | BMP (70% TP) | No | No | -- | -- | -- |
| | Volume Control | No | 1-yr 24-hr storm | included above | included above | included above |
| | Peak Control | No | 10/25-yr,6-hr storm | included above | included above | included above |
| | | | **Total:** | **$ 313,000** | **$ 3,800** | **$ 3,700** |

(1) Cost associated with loss of lots based upon builder profit @ 15% of average home value.
(2) BMP costs based upon unit costs for BMP installation provided by recent bids (March 2006) for Fairview Park at Mint Hill and Shops at Freedom Drive.
(3) Cost includes BMP cost and cost associated with loss of lots
(4) BMP costs based upon North Carolina State University publication "The Economics of Structural Stormwater BMPs in North Carolina" dated May 2003.

Table 2
Retro-Fit Cost Analysis Summary for Implementation of Post-Construction Controls Ordinance for Commercial / Industrial Development in Mecklenburg County

| Subdivision Details | Key Development Standards | Provided in Original Design | Required by Post-Construction Ordinance | Total Cost of Improvements | Cost Per Acre |
|---|---|---|---|---|---|
| Matthews Professional Center<br>Commercial<br>3.97 acres<br>66% Impervious<br>Central Catawba | Open Space | No | 15% (0.6 ac) | $ 61,500 (1) | $ 15,500 (1) |
| | Buffers | No | No | -- | -- |
| | BMP(85% TSS) | No | Yes | $ 38,600 (2) | $ 9,700 (2) |
| | BMP(70% TP) | No | No | -- | -- |
| | Volume Control | Yes | Yes | -- | -- |
| | Peak Control | Yes | Yes | -- | -- |
| | | | **Total:** | **$ 100,100** | **$ 25,200** |
| Mercedes Benz<br>Commercial<br>11.4 acres<br>57% Impervious<br>Central Catawba | Open Space | 12% (1.4 ac) | 12% (1.4 ac) | -- | -- |
| | Buffers | Intermittent: 30 ft | Intermittent: 30 ft | -- | -- |
| | BMP(85% TSS) | Yes | Yes | -- | -- |
| | BMP(70% TP) | Yes | No | -- | -- |
| | Volume Control | Yes | Yes | -- | -- |
| | Peak Control | Yes | Yes | -- | -- |
| | | | **Total:** | **$ 0** | **$ 0** |
| Ingersoll Rand<br>Industrial<br>30 acres (expansion)<br>23%<br>Western Catawba | Open Space | 51% (15.2 ac) | 25% (7.5 ac.) | -- | -- |
| | Buffers | No | No | -- | -- |
| | BMP(85% TSS) | No | Yes | $ 17,200 (2) (3) | $ 570 (2) (3) |
| | BMP (70% TP) | No | Yes | included above | included above |
| | Volume Control | No | No | -- | -- |
| | Peak Control | No | No | -- | -- |
| | | | **Total:** | **$ 17,200** | **$ 570** |
| Waltrip Racing World<br>4.37 acres (redevelopment)<br>75% Impervious existing<br>Western Catawba | Open Space | No | No | -- | -- |
| | Buffers | No | No | -- | -- |
| | BMP(85% TSS) | No | Yes | $ 62,800 (2) | $ 14,400 (2) |
| | BMP (70% TP) | No | Yes | included above | included above |
| | Volume Control | Yes | Yes | -- | -- |
| | Peak Control | Yes | Yes | -- | -- |
| | | | **Total:** | **$ 62,800** | **$ 14,400** |
| Waltrip Racing World<br>11.5 acres (total site)<br>75% Impervious existing<br>Western Catawba | Open Space | No | No | -- | -- |
| | Buffers | No | No | -- | -- |
| | BMP(85% TSS) | No | Yes | $ 165,200 (2) | $ 14,400 (2) |
| | BMP (70% TP) | No | Yes | included above | included above |
| | Volume Control | Yes | Yes | -- | -- |
| | Peak Control | Yes | Yes | -- | -- |
| | | | **Total:** | **$ 165,200** | **$ 14,400** |

(1) Cost is based upon purchase of 0.44 acres of land valued at $130,000 per acre.

(2) BMP costs based upon unit costs for BMP installation provided by recent bids (March 2006) for Fairview Park at Mint Hill and Shops at Freedom Drive.

(3) BMP Costs were off-set by reduced storm drain system costs.