Memorandum

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Prepared for:	Montgomery County Planning Department
Project Title:	**Ten Mile Creek Watershed Environmental Analysis for the Clarksburg Master Plan Limited Amendment**
Subject:	Hydrology and Hydraulics Analysis – Computations and Model Output for Existing Conditions and Four Development Scenarios
Date:	June 12, 2013
To:	Mary Dolan and Valdis Lazdins, Montgomery County Planning Department
From:	Biohabitats and Brown and Caldwell, a Joint Venture

Section 1: Introduction

One of the chief means by which development can impact a stream is by hydrologic alteration. In the absence of stormwater controls, an increase in impervious cover can lead to higher peak streamflows and current velocities. This in turn can lead to increased erosion and sedimentation both on the land surface and within the stream system, and subsequent impacts to biota. One of the major goals of environmental site design (ESD) is to maintain natural hydrology and prevent adverse hydrologic and hydraulic (H&H) impacts. This technical memorandum presents the methods and preliminary results of a planning-level modeling analysis to evaluate the potential H&H effects of the Clarksburg Master Plan on Ten Mile Creek prepared as part of an environmental analysis being conducted for the Maryland-National Capital Park and Planning Commission (M-NCPPC) Montgomery County Planning Department by Biohabitats and Brown and Caldwell, a Joint Venture, with support from the Center for Watershed Protection. The work was authorized under Change Order 2 to Purchase Order No. PQ008435 with notice to proceed (NTP) issued May 14, 2013, and the analysis was completed in collaboration with Montgomery County Department of Environmental Protection (DEP) and Montgomery County Department of Permitting Services (DPS).

The sections below provide descriptions of the computations and detailed output for analyses conducted for the Existing Conditions and four development scenarios requested by the Planning Department in May 2013. This work was in addition to prior analyses conducted in March 2013 of Existing Conditions and development proposed under the 1994 Master Plan[1].

For the May 2013 analyses, the Planning Department crafted four scenarios for future development within the watershed. Five watershed scenarios were analyzed, including:

- Scenario 1: Existing Conditions – The baseline for these analyses is existing conditions within the watershed. This includes current land use, land cover and watershed infrastructure.
- Scenario 2: 1994 Plan – The 1994 Clarksburg Master Plan recommendations for density and land use in Stage 4, assuming full Environmental Site Design for the developable and redevelopable properties.
- Scenario 3: Reduced Footprint, Same Yield – The same as Scenario 1 with a reduced footprint for the Pulte properties. Assumes a different unit mix that would allow approximately the same number of units permitted by the 1994 Plan.
- Scenario 4: Reduced Footprint Lower Yield – The same as Scenario 2 with the same unit mix as recommended in the 1994 Plan for the Pulte property, resulting in fewer potential units on Pulte.
- Scenario 5: 7% Watershed Imperviousness – The same as Scenario 3 with reduced yield on Miles/Coppola, Egan, and the County properties.

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[1] Prior work was documented in Technical Memorandum 1: *Preliminary Results of the Hydrology and Hydraulics Analysis*, dated April 2, 2013; Amendment A to Technical Memorandum 1: *Revised Environmental Site Design Modeling Scenario*, dated April 3, 2013; and an additional documentation in Memorandum: *Hydrology and Hydraulics Analysis – Computations and Model Output for Existing Conditions and 1994 Master Plan Model Scenarios*, dated April 11, 2013.

Section 2 describes the methodology used to model these development scenarios, Section 3 discusses results and findings of the H&H analysis, and model output data are tabulated in Appendix A. Additional supporting documents are provided in Appendices B through D.

Section 2: Methods

The primary tool used for the analysis was XP-SWMM 2012, a commercial modeling package developed by XP Solutions. XP-SWMM is a dynamic rainfall-runoff model that was originally developed as a graphical user interface to the USEPA Stormwater Water Management Model (EPA SWMM). For this project, the model is being used to predict H&H impacts to Ten Mile Creek that would result from the completion of the Clarksburg Master Plan implemented with full ESD in accordance with State and County regulations.

2.1 Model Set-Up and Base Conditions Scenario

XP-SWMM offers several options for the simulation of rainfall-runoff. For this project, the SWMM Runoff Non-Linear Reservoir method was selected because it provides the most flexibility for simulating ESD practices. The model was set up to simulate a 1-year, 24-hour storm (2.6 inches) and a 2-year, 24-hour storm (3.2 inches) and assuming an SCS Type II distribution. The 1-yr and 2-yr storm events were chosen to analyze the effects of development on the existing stream condition due to the ability of these storm events to influence the shape and form of natural channels. The model domain consists of the Ten Mile Creek watershed upstream of Little Seneca Lake. The watershed was conceptually divided into 16 runoff nodes that represent areas draining to Ten Mile Creek. The runoff nodes are listed in ascending order starting from the most downstream node. The main Ten Mile Creek itself was represented in the model as 30 hydraulic links, parameterized as natural channels using cross-sectional survey data provided by the County. Links are labeled according to their upstream node and have the prefix 'LN', for example link LN102 conveys flows from node 102 to node 101. A link node diagram of the study area is provided in Appendix A.

The model set up described above is similar to the structure used in the prior analyses, which were documented in the April 2013 memoranda mentioned above. However, several refinements were made prior to evaluating the May 2013 scenarios. These included:

- Creation of new subcatchment areas representing drainage to conventional BMPs to model existing stormwater BMPs explicitly. This was a change from prior model runs which had modeled existing stormwater BMPs implicitly by increasing the subcatchment width to represent increased time of concentrations and peak discharge lags associated with existing stormwater management facilities.
- Addition of 5 runoff nodes and 13 hydraulic links to incorporate the additional catchments (as compared to 11 nodes and 17 links used in the prior analyses).
- Adjustments to the model structure to prevent water loss from the system during flooding. These included adjustments of model node cross-sections and allowance of ponding at all model nodes.

BMPs providing stormwater management within the Ten Mile Creek study area were identified through review of Montgomery County GIS data, and are listed below. The existing BMPs modeled in the revised May 2013 existing conditions scenario are listed in Table 1.

Table 1 – Existing BMPs Included in Model					
Asset Number	Structure Type	Property Name	Drainage Area	Data Source	Sub - Watershed
11512	PDWTED	Gateway 270 Corporate Park	34.5	DEP BMP Database	206
N/A	PDWTED	SHA MD121/I-270 Southbound	7.6	MDE Storm Print	206
13700	SF	High Point Farm (MD355)	14.6	DEP BMP Database	201
UNK	SF[2]	Clarksburg Detention Facility	35	Montgomery Co DEP	201

GIS analysis was conducted to determine the acres of impervious surfaces draining to each type of BMP. The existing Wet Pond BMP (Asset 11512) was modeled by limiting the discharge of the Channel Protection Volume (CPv) to ensure a 24-hour detention in accordance with the requirements of the Maryland Stormwater Design Manual. Asset 13700 at High Point Farm and the existing BMPs at the Detention Center were modeled as surface sand filters using cross section information from as-built records.

Pre-treatment, water quality and structures treating less than five acres were excluded due to assumed negligible hydrologic impact. The excluded practices are listed in Table 2.

Table 2 – Existing BMPs Excluded from the Model					
Asset Number	Structure Type	Property Name	Drainage Area	Data Source	Sub - Watershed
Basin3	PDWTED	Stringtown Road Extension & Gateway Commons	12.9	Montgomery Co DEP[3]	206
10387	INF	Garden of Remembrance Cemetery	3.9	DEP BMP Database*	201
11212	PDQNED	Little Bennett Regional Park	3.7	DEP BMP Database	201
12412	SF	Little Bennett Regional Park	3.2	DEP BMP Database*	206
UNK	BR	Woodcrest Phase 5	1.1	DEP BMP Database*	206
10337	IT	Clarksburg Nursery	6.1	DEP BMP Database*	206
14407	BR	Clarksburg Ridge HOA	0.9	DEP BMP Database*	206
14406	SF	Clarksburg Ridge HOA	0.6	DEP BMP Database*	206
12742	UG	Clarksburg Elementary School	3.8	DEP BMP Database	206
10701	INFU	Clarksburg Elementary School	0.3	DEP BMP Database*	206
UNK	DW	Huffman Property Single Family Residence	0.09	DEP BMP Database*	204
UNK	DW	Branch Hill Single Family Residence	0.03	DEP BMP Database*	204

*Water quality BMP

[2] Per as-built data, Detention Center SWM provided by sand filters and a dry pond.

[3] Montgomery County Department of Environmental Protection (DEP) (2012). Per 2010 Special Protection area program annual report, sediment control structure not yet converted to a SWM facility, considered part of 11512 drainage area.

The approach described above was used to create a revised "base conditions" model scenario to represent the Ten Mile Creek watershed under existing conditions, prior to development described in the Master Plan and the other development scenarios provided by the Planning Department.

To characterize the runoff characteristics of each subwatershed, each runoff node was assigned acreages of pervious and impervious land based on available GIS data. Infiltration on pervious land covers was modeled using the SCS Curve Number method. Composite curve numbers were calculated for each runoff nodes based on land use and hydrologic soil group (HSG). The methods for developing the composite curve numbers are described in Appendix C.

2.2 Development Scenarios

To represent the development scenarios, the base conditions model was altered in two manners. First, the runoff nodes were parameterized to represent the land use and land cover conditions proposed in the development scenarios provided by the Planning Department. This step required GIS-based analysis and additional calculations to quantify how the proposed development (including a new utility easement and highway interchange) would change the existing land cover and alter the existing composite curve numbers. To account for construction impacts on soil, it was assumed that the hydrologic soil groups (HSGs) of disturbed areas would be reduced by one category (e.g., B soils became C soils; C soils became D soils). It was further assumed that development would be in compliance with County topsoiling requirements; therefore curve numbers were adjusted by taking an average of the curve numbers obtained from the existing HSGs and the reduced HSGs described above. Additional changes to land use and land cover conditions were made outside the Planning Department's development limits of disturbance (LODs) that occurred within the Special Protection Area (SPA). These changes reflect the assumption that existing pasture and cropland between the limits of disturbance and the stream would be replanted as forest. However, due to the time required to generate forest growth, the pasture and cropland polygons were modeled using a runoff curve number representing meadow in good condition. After GIS analysis of the land use changes associated with each of the development scenarios, composite curve numbers were calculated for each model subcatchment area. Additional description of the runoff curve numbers used for the development scenarios is provided in Appendix C.

Secondly, the base scenario model was altered to conceptually direct runoff from new development to treatment practices. For the purposes of this screening-level analysis, with the exception of the proposed I-270 widening discussed below, all development was assumed to be treated using micro-bioretention as a representative ESD practice. The required area and storage volume of micro-bioretention was calculated based on the new impervious surface of each subwatershed, using the procedures of the Maryland Stormwater Design Manual and guidelines provided by Montgomery County DEP. Each micro-bioretention filter was modeled with 9-inches of storage above the filter media, with a decaying infiltration rate to model the available storage within the soil media as if it were initially dry with a constant infiltration rate. The Horton method was utilized in XP-SWMM to represent both the decaying infiltration of the ponded area and the constant infiltration from the soil media. A maximum infiltration rate of 2 in/hour and a minimum (asymptotic) infiltration rate of 0.25 in/hour with a decaying rate of 0.0015/sec were utilized in the model to represent the decaying infiltration rate. A constant infiltration rate of 0.05[4] inch per hour was used to represent the infiltration from the soil media.

The available storage within the soil media was computed by assuming that the soil media cross section would be 3-ft deep with a 40% void ratio. This depth of storage was combined with the assumed 3-inch thick stone reservoir, also with a 40% void ratio, to arrive at the total storage available within the conceptualized micro-bioretention cross section. The micro-bioretention filters were also assumed to have underdrains that would be placed above the level of the stone reservoir and discharge to surface water.

Although design standards allow larger micro-bioretention storage volumes than those used for in the H&H modeling analyses, constructed practices cannot be assumed to function at maximum design performance at all locations throughout the development, or at all times through a range of storm events. Therefore, the parameters selected for modeling represent a more moderate level of performance which allows for a margin of safety appropriate for this planning-level analysis.

In addition to the conceptual ESD practices, the development scenario model structure included a new subcatchment to represent the drainage from the new impervious surface proposed as part of I-270 widening, which was modeled with conventional stormwater management to control the required volumes. These model parameters were developed for the May model scenarios in conjunction with the Planning Department, Montgomery County Department of Environmental Protection (DEP) and Montgomery County Department of Permitting Services (DPS) based on feedback received after presentation of the earlier model results documented in the April 2013 memoranda mentioned above.

For each development scenario, each of the subwatersheds within the Ten Mile Creek Study Area was represented in the model by five individual subcatchments. As described in more detail in Appendix C, GIS files provided by the Planning Department were utilized to determine the composite runoff curve number for each of the subcatchments based on land use and hydrologic soil groups (HSG). Subcatchments #1 and #3 were the primary subcatchments utilizing curve numbers for the model analysis to represent the infiltration capacity of the soils. Within each subwatershed, subcatchment #1 was used to represent all the land outside the proposed development area as defined by the LOD provided by the Planning Department. A composite curve number was computed for subcatchment #1 based on the existing land use and underlying soil types. Subcatchments #2 and #3 were used to represent the impervious and pervious portions of the proposed development, respectively. Subcatchment #2 was used to combine all of the impervious areas of the proposed development, and was assigned a curve number of 98. A composite curve number was computed for subcatchment #3 based on the proposed pervious land uses and underlying soil types. Summaries of the curve numbers used for the model runs are provided in Appendix C.

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[4] Changed from the (0.025"/hr rate specified in the Statement of Work SOW during the MNCPPC weekly check-in call on 5/6/13.

The XP-SWMM Runoff Non-Linear Reservoir method was used to simulate the runoff from subcatchments #2 and #3 and route the runoff through the modeled ESD practices, which were represented in the model as subcatchments #4 and #5. Subcatchment #4 represented the available storage for ponding above the soil media for the conceptualized micro-bioretention cross section, and subcatchment #5 represented the available storage in the soil media and conceptualized stone reservoir at the base. The required areas and storage volumes of micro-bioretention practices were calculated based on the new impervious surface areas of each subwatershed, using the procedures outlined in Chapter 5 of the Maryland Stormwater Design Manual (including the target rainfalls values listed in Table 5.3) and the micro-bioretention guidelines provided by Montgomery County DPS. The analysis assumed that the rainfall targets will be met and Channel Protection Volume (CPv) requirements will be satisfied, therefore negating the need for any additional stormwater management practices for the development areas routed to ESD practices.

The required areas of ESD practices for each development were then calculated using Montgomery County's micro-bioretention guidelines, and the ESD areas for all developments proposed within the subwatershed were summed and entered into the model. The ESD calculations are provided in Appendix D.

Due to the limited amount of space within the I-270 Right-of-Way, the increase in impervious area associated with the proposed I-270 widening was assumed to be treated with a conventional stormwater treatment practice in the model. A wet pond was represented in the model as a storage node with its discharge limited to the required Channel Protection storage volume in accordance with Appendix D.11.1 of the Maryland Stormwater Design Manual.

Section 3: H&H Model Results and Findings

The model provided estimates of relative changes in total streamflow volume, peak streamflow and streamflow velocity predicted to occur as a result of differences between existing land cover compared to each development scenario. Results are tabulated in Appendix A. Major findings include:

- For all development scenarios, the modeling results indicate that the development proposed for the Ten Mile Creek study area will impact hydrology in all of the modeled subwatersheds to a varying degree, with the exception of LSTM204, which was not predicted to be impacted. Streamflow changes shown in the modeling results will occur in some tributaries directly as a result of land cover changes within the subwatershed, or in some downstream locations indirectly as a result of flow changes from upstream development.

- The subwatersheds predicted to be most impacted from the 1994 Master Plan development modeled in Scenario 2 include LSTM110, LSTM111 and LSTM206, with increased streamflow volumes and peak flows also noted at downstream points LSTM202, LSTM302, LSTM303B and the study outlet point at LSTM304.

- The subwatersheds which showed most improvement from the reduced footprints modeled in Scenario 3 (compared to Scenario 2) were LSTM110 and LSTM111. Improvements were also seen at downstream points LSTM303B and the study area outlet at LSTM304.
- In most subwatersheds, the differences between the development proposed under Scenario 3 versus Scenario 4 were too small to result in any significant model response. However, additional improvements were seen as a result of the reduced imperviousness modeled in Scenario 5, with the greatest benefits predicted in LSTM110, LSTM111 and LSTM206. Improvements were also seen in LSTM201 and at the downstream modeling points at LSTM202, LSTM203, LSTM302, LSTM303B and the study outlet point at LSTM304.

Conclusions and Recommendations

The H&H model was used as one of several planning-level tools in the environmental analysis of the Ten Mile Creek Watershed conducted in support of the Clarksburg Master Plan Limited Amendment. The purpose of the analysis was to compare the results of different scenarios within each modeled subwatershed, and not for precise predictions of future health of Ten Mile Creek. There are no models that can determine the impacts of development with proposed Environmental Site Design (ESD) practices on the biological and ecosystem health of a receiving stream, and the model used for this analysis was not calibrated to the downstream gauge so does not produce absolute value of the modeled parameters. Rather, the model was used in this study to estimate relative discharge to the model nodes to as one means of predicting the potential watershed impacts resulting from changes between existing conditions and the modeled development scenarios.

The model responses represented the total change occurring in each subwatershed as a result of each development scenario, including new impervious acres, reductions in existing forest cover and other existing land use acreage, post-development runoff curve numbers, and the total area of ESD practices required by the Maryland Stormwater Design Manual to manage runoff from the total acres of new development. The H&H analysis was conducted at a scale that necessitated relatively large subcatchment areas, and the configuration of new development within the Planning Department's LODs was not spatially represented in the model, nor were the ESD structures, which in practice will be required to be distributed throughout the development per Montgomery County and Maryland design requirements. A more detailed assessment conducted at a smaller subcatchment scale to reflect proposed development configuration and site-specific ESD techniques may be better able to simulate the extent of stream response to proposed developments, however, the results of the planning scale analysis indicate that ESD will not fully mitigate the impacts of development on the hydrology in the Ten Mile Creek watershed.

Given the level of development proposed and the strong correlation between the extent of development and model responses, increases in stormwater runoff volume and peak flow can be expected in all development scenarios despite the application of ESD practices (Center for Watershed Protection, 2013). Literature review of case studies and monitoring to document the effectiveness of ESD and similar low impact development (LID) strategies are limited and don't appear to exist at a watershed scale of analysis. Where case studies do exist at a subdivision scale, there is no conclusive evidence that ESD fully protects stream health.

So although ESD may be able to mitigate the impacts of development to some degree, the findings of the analysis indicate that additional development within the Ten Mile Creek watershed will have a negative impact on stream hydrology. In order to minimize impacts to Ten Mile Creek, it is recommended that disturbance of natural resources throughout the Ten Mile Creek study area be minimized, especially forest cover in the headwater areas, and that existing conditions in the high quality headwater subwatersheds of LSTM110 and LSTM111 be preserved. If development occurs in these subwatersheds, the limits of disturbance should be minimized, such as the LODs represented in Scenarios 3, 4 and 5.

In addition, within any developed areas, it is recommended that site planning techniques be employed as the first measure of Environmental Site Design to preserve and protect natural resources; conserve natural drainage patterns; minimize impervious areas; cluster development; and limit soil disturbance, mass grading and compaction. Required volumes should be controlled with ESD treatment practices selected to achieve the greatest watershed benefits based on evaluation of site-specific and subwatershed-specific considerations.

Appendix A –

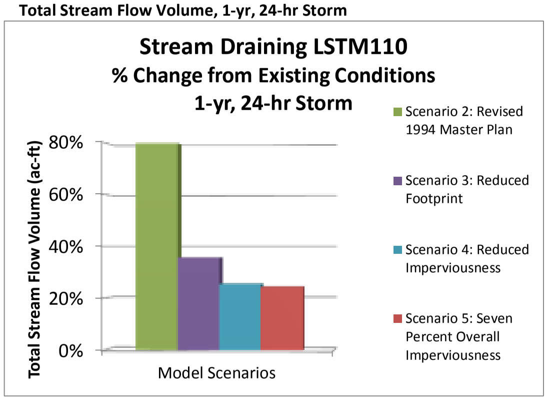
Model Results

LSTM110			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	5.5	**9.9**	4.4	80%	**7.5**	2.0	36%	**6.9**	1.4	25%	**6.8**	1.3	24%
		Peak Stream Flow (cfs)	12.2	**54.7**	42.6	350%	**47.2**	35.1	289%	**41.8**	29.7	244%	**40.4**	28.2	232%
		Stream Flow Velocity (fps)	1.8	**2.8**	1.1	62%	**2.9**	1.1	63%	**2.8**	1.0	57%	**2.7**	1.0	56%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	10.1	**15.7**	5.7	56%	**12.4**	2.3	23%	**11.6**	1.6	15%	**11.6**	1.5	15%
		Peak Stream Flow (cfs)	15.5	**95.2**	79.8	516%	**80.5**	65.0	420%	**72.9**	57.4	371%	**70.8**	55.3	357%
		Stream Flow Velocity (fps)	1.9	**3.4**	1.5	78%	**3.2**	1.3	67%	**3.0**	1.2	61%	**3.0**	1.1	60%

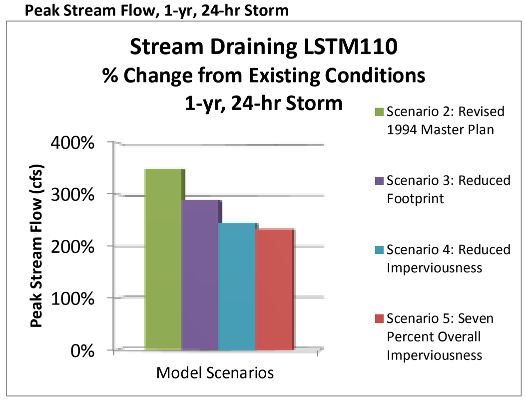
drains to link 71

Change compared to Existing Conditions

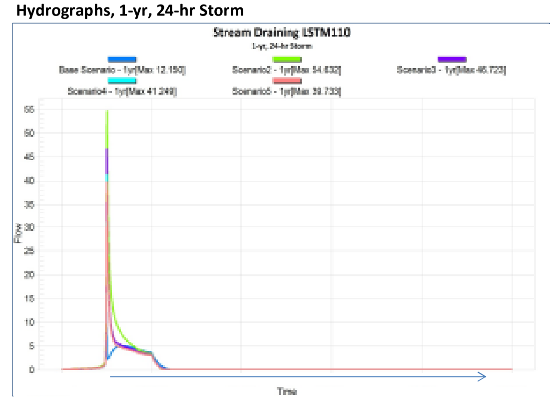
Total Stream Flow Volume, 1-yr, 24-hr Storm



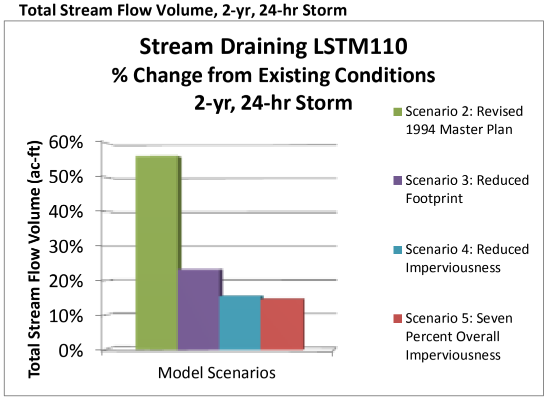
Peak Stream Flow, 1-yr, 24-hr Storm



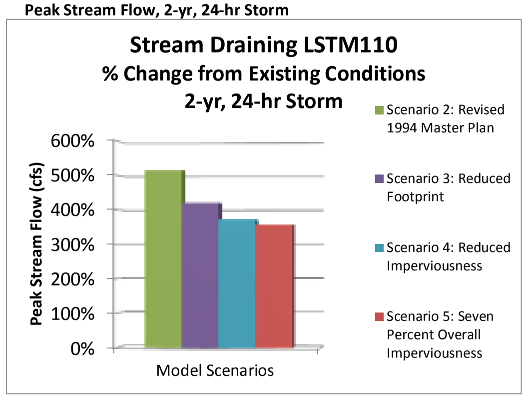
Hydrographs, 1-yr, 24-hr Storm



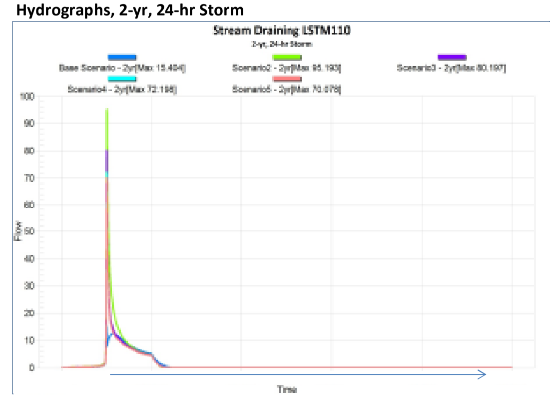
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm



LSTM111			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	3.472	**5.0**	1.5	43%	**4.4**	0.9	26%	**4.2**	0.7	21%	**4.1**	0.7	19%
		Peak Stream Flow (cfs)	3.9360	**33.1**	29.2	741%	**33.0**	29.1	739%	**29.3**	25.3	644%	**27.8**	23.8	605%
		Stream Flow Velocity (fps)	0.7	**1.8**	1.1	151%	**1.8**	1.1	155%	**1.7**	1.0	141%	**1.7**	1.0	137%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	6.0	**7.9**	1.8	30%	**7.0**	1.0	17%	**6.8**	0.8	13%	**6.8**	0.7	12%
		Peak Stream Flow (cfs)	9.5	**56.9**	47.4	497%	**55.8**	46.2	485%	**49.7**	40.2	421%	**47.7**	38.2	400%
		Stream Flow Velocity (fps)	0.9	**2.1**	1.3	145%	**2.1**	1.3	145%	**2.0**	1.2	132%	**2.0**	1.1	130%

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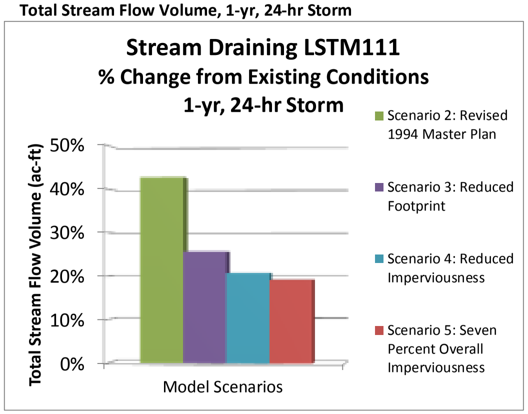
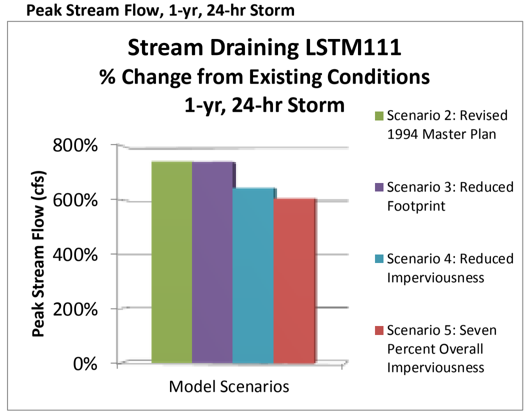
Change compared to Existing Conditions

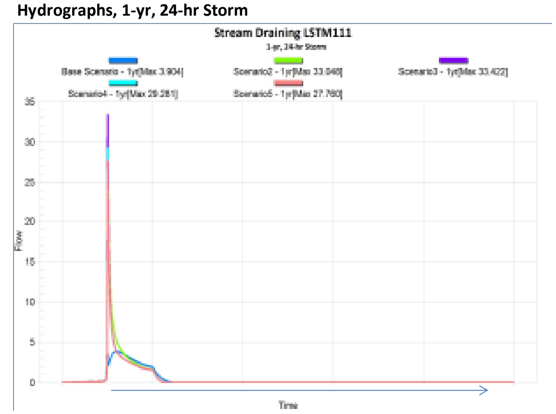
Total Stream Flow Volume, 1-yr, 24-hr Storm



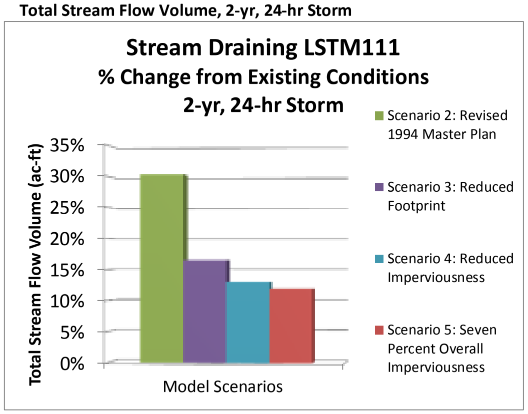
Peak Stream Flow, 1-yr, 24-hr Storm



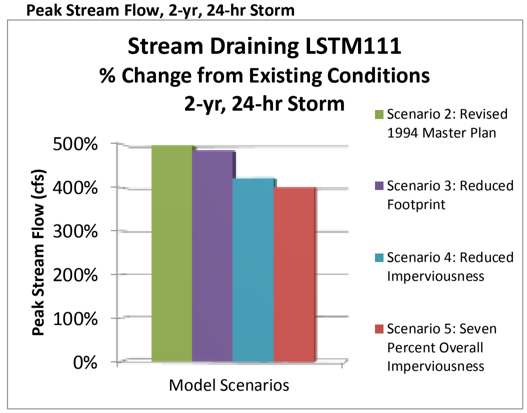
Hydrographs, 1-yr, 24-hr Storm



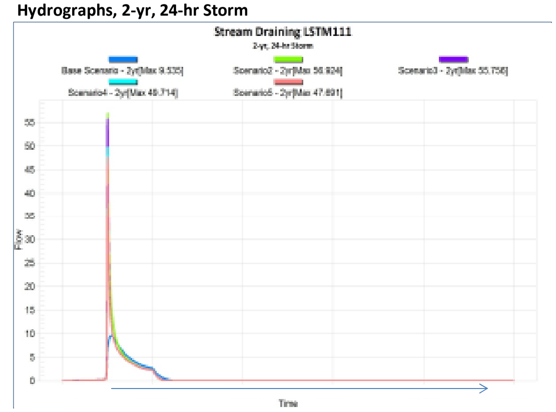
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

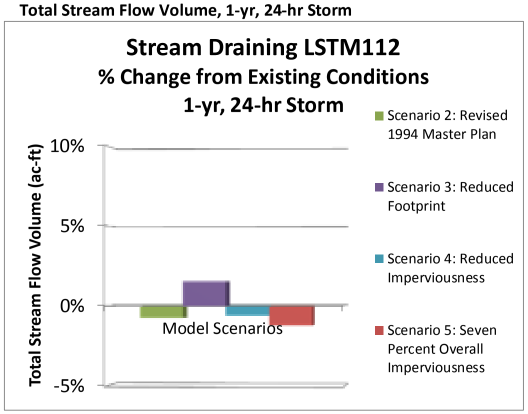


LSTM112			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	**Total Stream Flow Volume (ac-ft)**	5.7	**5.7**	0.0	-1%	**5.8**	0.1	2%	**5.7**	0.0	-1%	**5.7**	-0.1	-1%
		Peak Stream Flow (cfs)	17.3	**32.9**	15.5	90%	**34.4**	17.1	98%	**32.7**	15.4	89%	**32.1**	14.8	85%
		Stream Flow Velocity (fps)	1.9	**2.2**	0.3	14%	**2.2**	0.3	14%	**2.1**	0.2	12%	**2.1**	0.2	11%
	2-yr, 24-hr Storm	**Total Stream Flow Volume (ac-ft)**	10.5	**10.3**	-0.2	-2%	**10.5**	0.0	0%	**10.3**	-0.2	-2%	**10.2**	-0.3	-3%
		Peak Stream Flow (cfs)	21.8	**53.0**	31.2	143%	**57.4**	35.6	163%	**53.4**	31.6	145%	**52.2**	30.4	139%
		Stream Flow Velocity (fps)	2.1	**2.1**	0.1	3%	**2.1**	0.1	3%	**2.2**	0.1	5%	**2.2**	0.2	7%

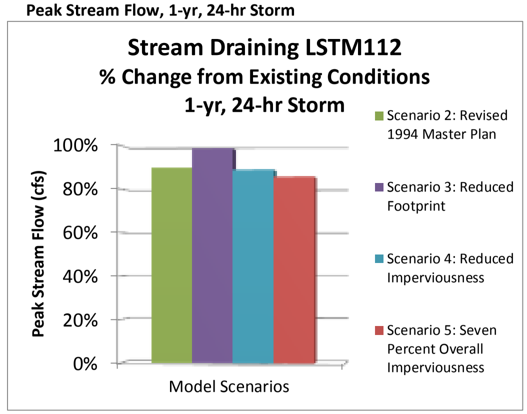
drains to link 21

Change compared to Existing Conditions

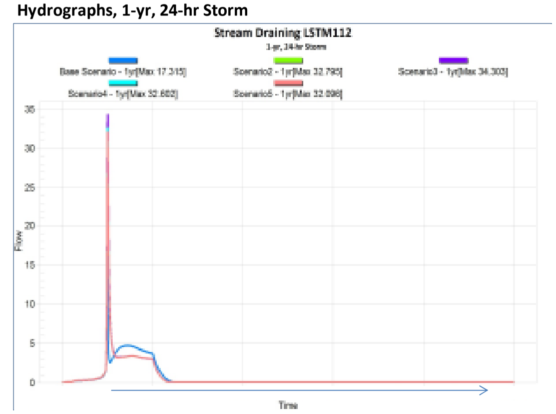
Total Stream Flow Volume, 1-yr, 24-hr Storm



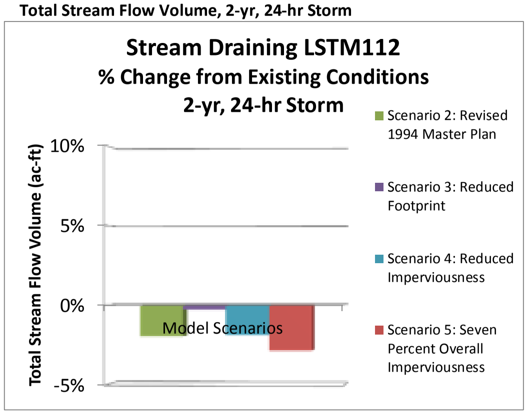
Peak Stream Flow, 1-yr, 24-hr Storm



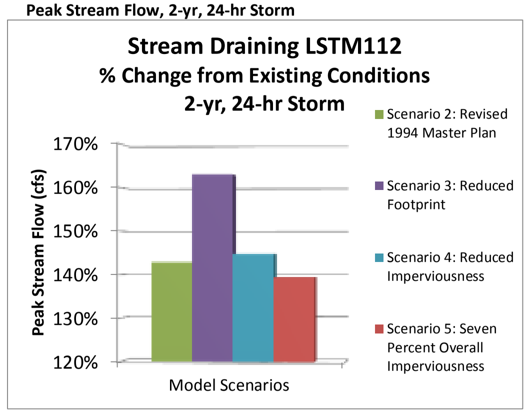
Hydrographs, 1-yr, 24-hr Storm



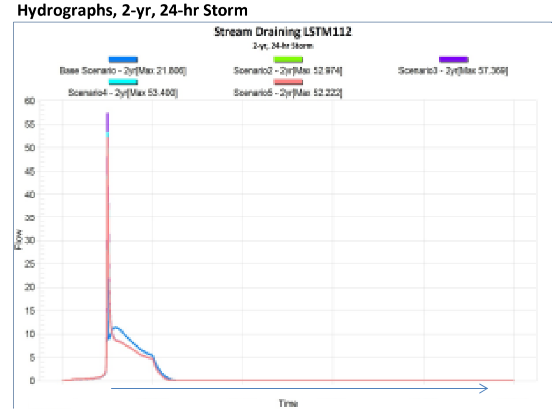
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

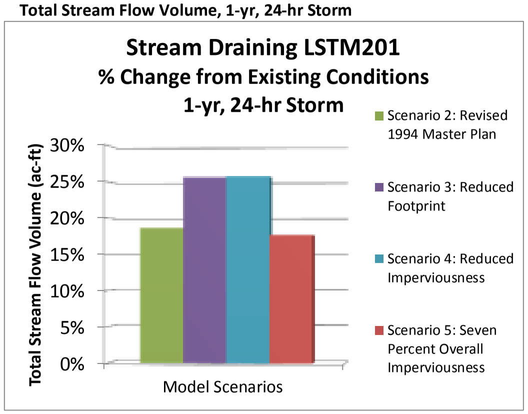


LSTM201			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	17.2	**20.5**	3.2	19%	**21.7**	4.4	26%	**21.7**	4.4	26%	**20.3**	3.0	18%
		Peak Stream Flow (cfs)	53.5	**68.7**	15.2	28%	**69.3**	15.8	30%	**69.4**	16.0	30%	**57.1**	3.6	7%
		Stream Flow Velocity (fps)	1.7	**1.8**	0.2	10%	**1.8**	0.2	10%	**1.8**	0.2	10%	**1.7**	0.0	1%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	30.7	**34.9**	4.3	14%	**36.7**	6.1	20%	**36.7**	6.1	20%	**35.0**	4.3	14%
		Peak Stream Flow (cfs)	66.9	**116.9**	50.0	75%	**118.9**	52.0	78%	**119.1**	52.2	78%	**95.1**	28.2	42%
		Stream Flow Velocity (fps)	1.8	**2.3**	0.5	25%	**2.3**	0.5	26%	**2.3**	0.5	26%	**2.1**	0.2	13%

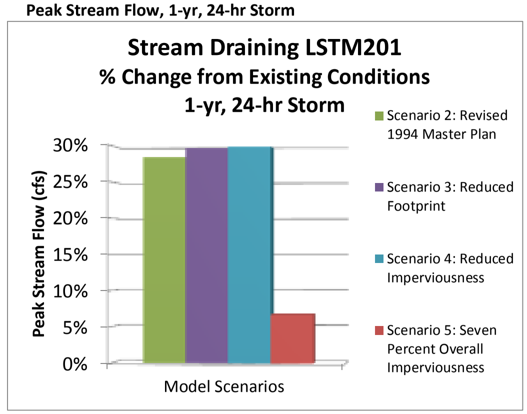
drains to link 110

Change compared to Existing Conditions

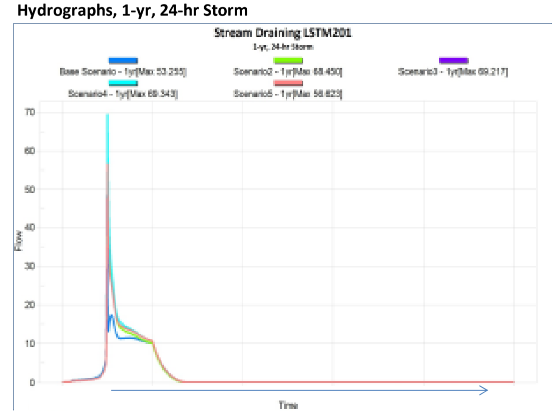
Total Stream Flow Volume, 1-yr, 24-hr Storm



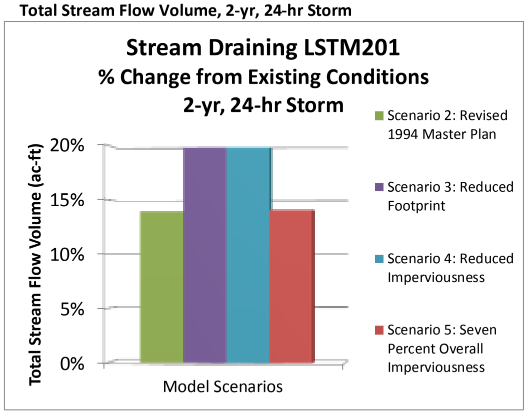
Peak Stream Flow, 1-yr, 24-hr Storm



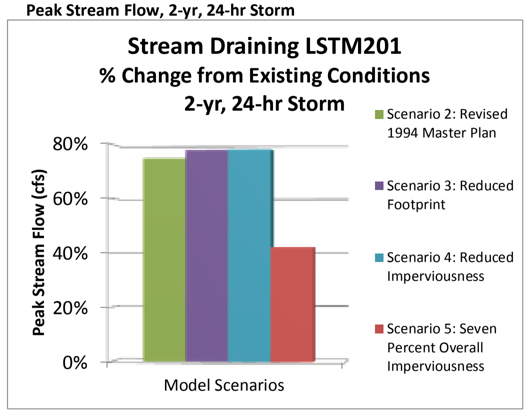
Hydrographs, 1-yr, 24-hr Storm



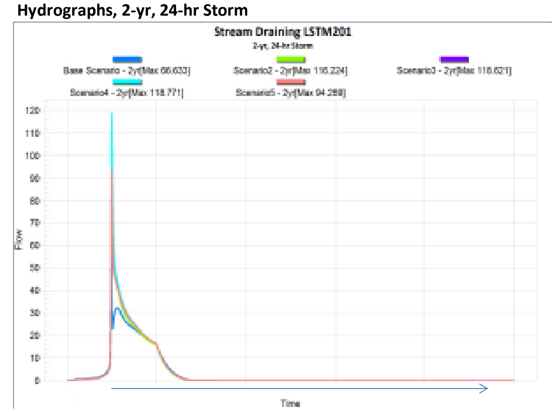
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

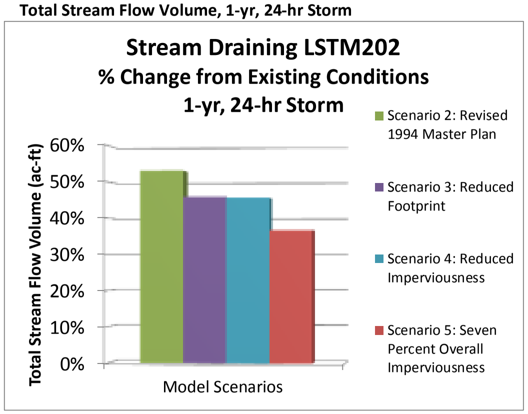


LSTM202			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	24.6	**37.6**	13.0	53%	**35.8**	11.3	46%	**35.8**	11.2	46%	**33.6**	9.0	37%
		Peak Stream Flow (cfs)	98.3	**137.9**	39.6	40%	**141.8**	43.5	44%	**140.4**	42.1	43%	**122.4**	24.1	25%
		Stream Flow Velocity (fps)	2.5	**2.7**	0.2	8%	**2.8**	0.2	9%	**2.7**	0.2	9%	**2.7**	0.2	8%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	39.2	**56.2**	17.0	43%	**53.7**	14.4	37%	**53.6**	14.4	37%	**50.7**	11.5	29%
		Peak Stream Flow (cfs)	127.0	**229.5**	102.5	81%	**227.3**	100.3	79%	**225.6**	98.6	78%	**195.1**	68.0	54%
		Stream Flow Velocity (fps)	2.7	**3.2**	0.5	16%	**3.2**	0.4	16%	**3.2**	0.4	15%	**3.0**	0.3	10%

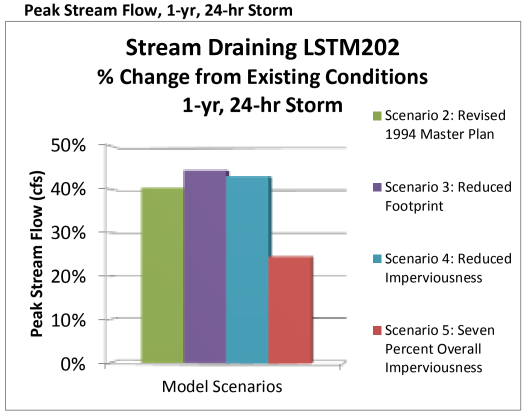
drains to link 101

Change compared to Existing Conditions

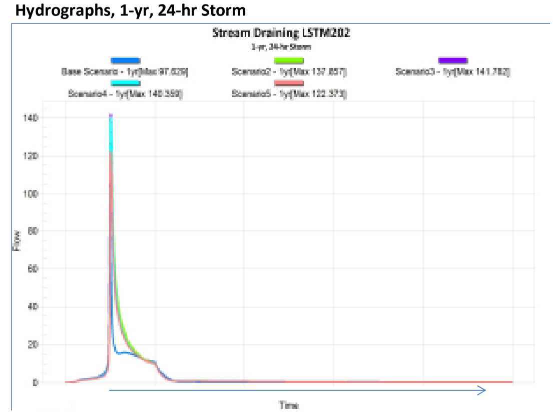
Total Stream Flow Volume, 1-yr, 24-hr Storm



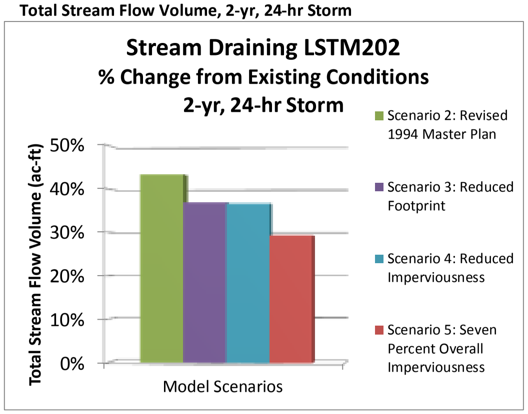
Peak Stream Flow, 1-yr, 24-hr Storm



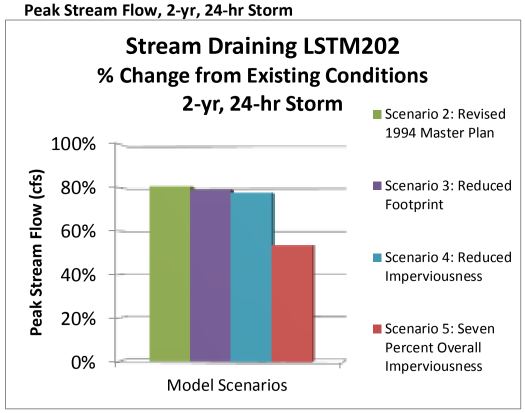
Hydrographs, 1-yr, 24-hr Storm



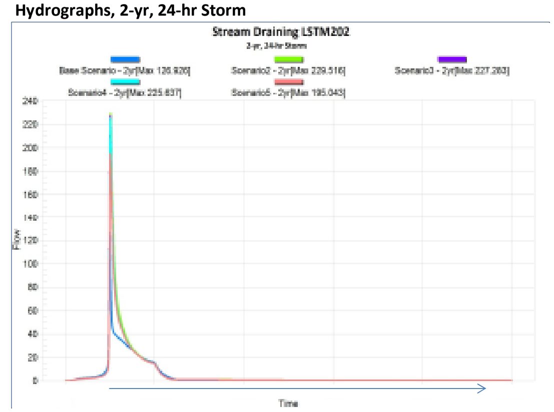
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

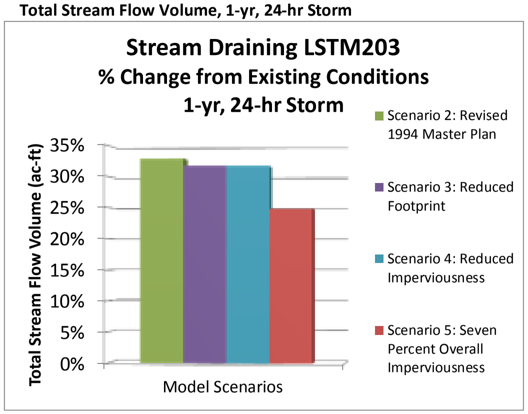


LSTM203			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	**Total Stream Flow Volume (ac-ft)**	53.7	**71.3**	17.7	33%	**70.7**	17.0	32%	**70.6**	17.0	32%	**67.0**	13.3	25%
		Peak Stream Flow (cfs)	115.7	**196.9**	81.2	70%	**196.5**	80.8	70%	**196.1**	80.4	69%	**161.6**	45.9	40%
		Stream Flow Velocity (fps)	2.1	**2.5**	0.4	20%	**2.5**	0.5	22%	**2.5**	0.4	21%	**2.3**	0.3	13%
	2-yr, 24-hr Storm	**Total Stream Flow Volume (ac-ft)**	92.2	**115.5**	23.3	25%	**114.7**	22.5	24%	**114.6**	22.4	24%	**109.8**	17.6	19%
		Peak Stream Flow (cfs)	167.1	**323.8**	156.7	94%	**326.1**	159.0	95%	**324.5**	157.4	94%	**272.6**	105.5	63%
		Stream Flow Velocity (fps)	2.4	**2.9**	0.5	23%	**2.9**	0.5	23%	**2.9**	0.5	23%	**2.8**	0.4	19%

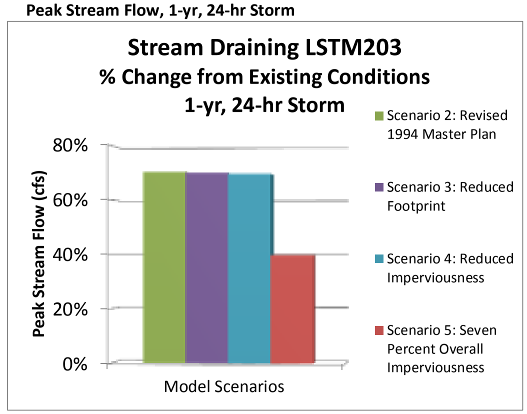
drains to link 90

Change compared to Existing Conditions

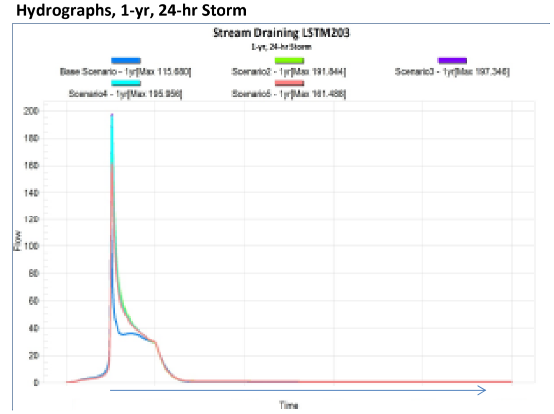
Total Stream Flow Volume, 1-yr, 24-hr Storm



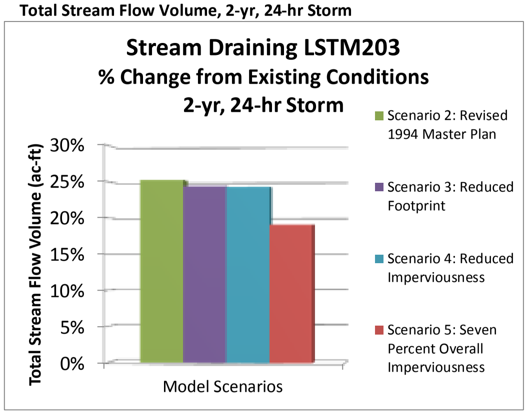
Peak Stream Flow, 1-yr, 24-hr Storm



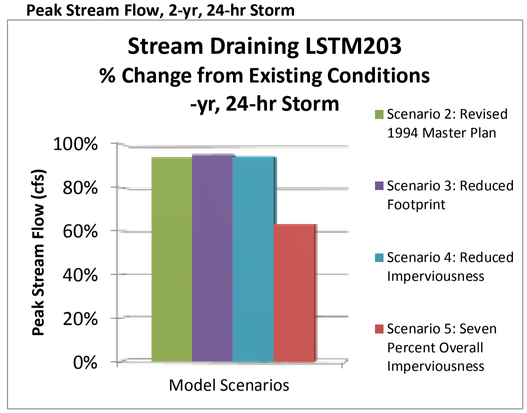
Hydrographs, 1-yr, 24-hr Storm



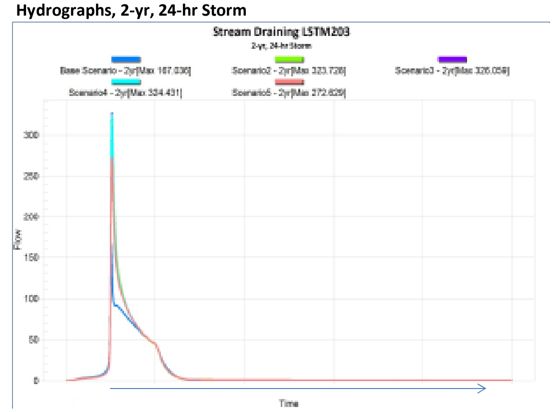
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

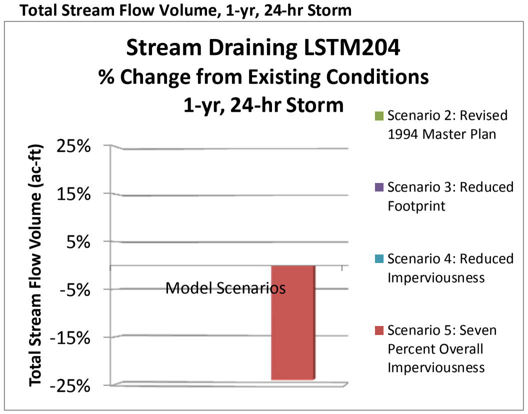


LSTM204			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	15.9	15.9	0.0	0%	**15.9**	0.0	0%	**15.9**	0.0	0%	**12.1**	-3.8	-24%
		Peak Stream Flow (cfs)	47.4	**47.7**	0.3	1%	**47.5**	0.2	0%	**47.5**	0.1	0%	**46.4**	-0.9	-2%
		Stream Flow Velocity (fps)	2.6	**2.7**	0.0	2%	**2.6**	0.0	0%	**2.6**	0.0	0%	**2.6**	0.0	-1%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	28.6	**28.6**	0.0	0%	**28.6**	0.0	0%	**28.6**	0.0	0%	**23.0**	-5.6	-20%
		Peak Stream Flow (cfs)	60.3	**61.5**	1.2	2%	**61.6**	1.3	2%	**61.5**	1.2	2%	**58.4**	-1.9	-3%
		Stream Flow Velocity (fps)	2.7	**2.5**	-0.2	-6%	**2.5**	-0.2	-6%	**2.5**	-0.1	-5%	**2.5**	-0.2	-6%

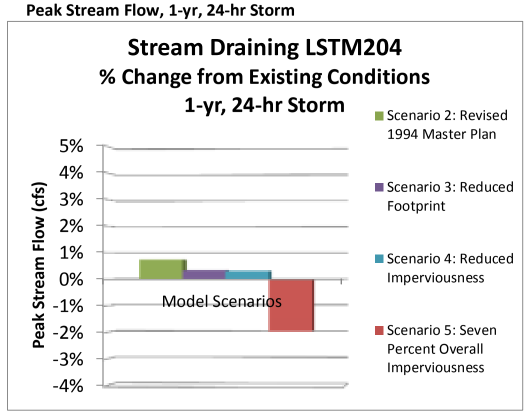
drains to link 041

Change compared to Existing Conditions

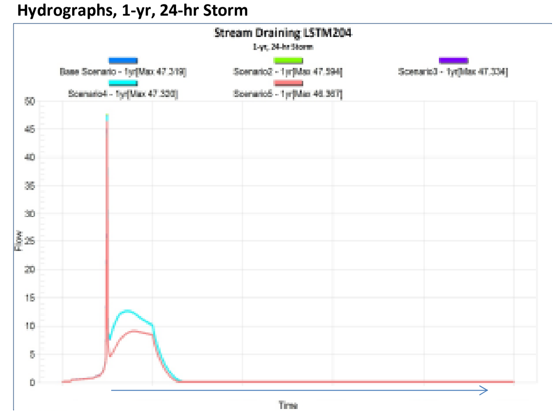
Total Stream Flow Volume, 1-yr, 24-hr Storm



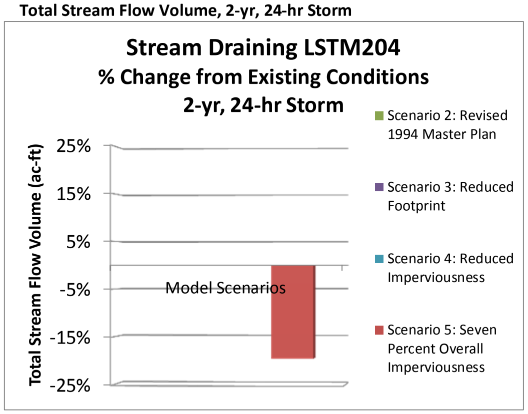
Peak Stream Flow, 1-yr, 24-hr Storm



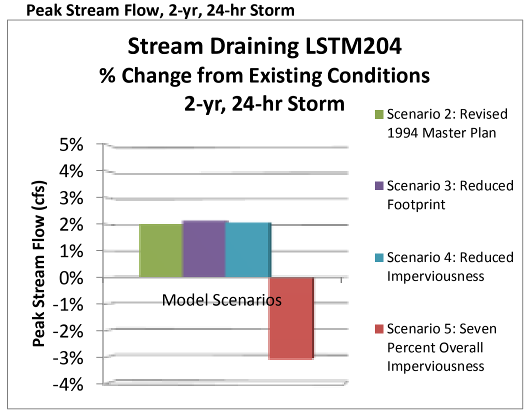
Hydrographs, 1-yr, 24-hr Storm



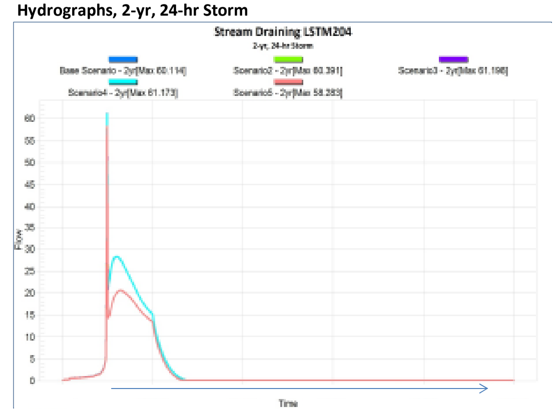
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

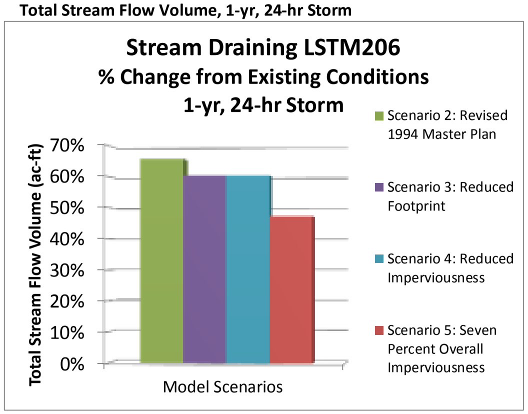


LSTM206			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	16.5	**27.3**	10.8	66%	**26.4**	9.9	60%	**26.4**	9.9	60%	**24.3**	7.8	47%
		Peak Stream Flow (cfs)	87.2	**98.4**	11.2	13%	**99.9**	12.7	15%	**99.9**	12.8	15%	**82.6**	-4.6	-5%
		Stream Flow Velocity (fps)	2.5	**2.6**	0.1	3%	**2.6**	0.1	4%	**2.6**	0.1	4%	**2.5**	0.0	-2%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	25.2	**39.5**	14.3	57%	**38.2**	13.0	52%	**38.2**	13.1	52%	**35.5**	10.3	41%
		Peak Stream Flow (cfs)	108.0	**161.1**	53.1	49%	**160.9**	52.9	49%	**161.0**	53.0	49%	**130.0**	22.0	20%
		Stream Flow Velocity (fps)	2.7	**2.8**	0.1	4%	**2.8**	0.1	4%	**2.8**	0.1	4%	**2.7**	0.0	-1%

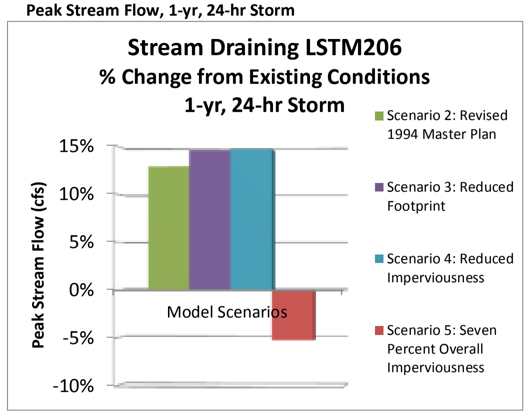
drains to link 102

Change compared to Existing Conditions

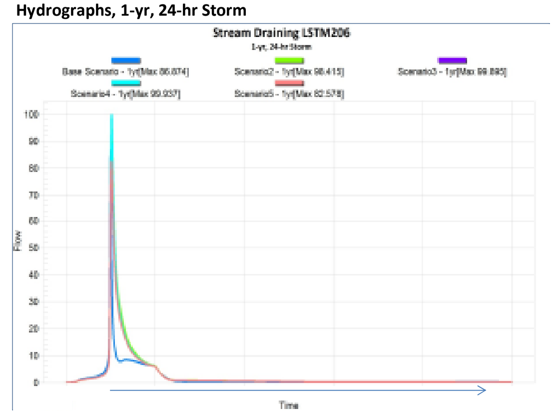
Total Stream Flow Volume, 1-yr, 24-hr Storm



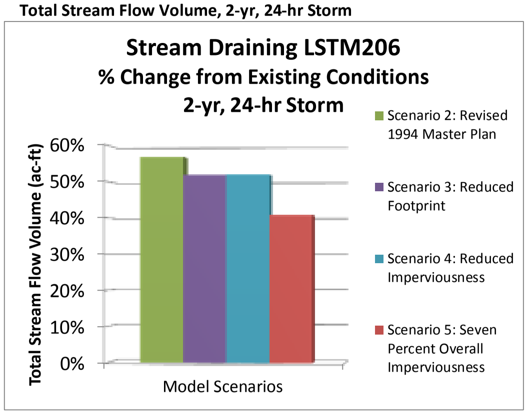
Peak Stream Flow, 1-yr, 24-hr Storm



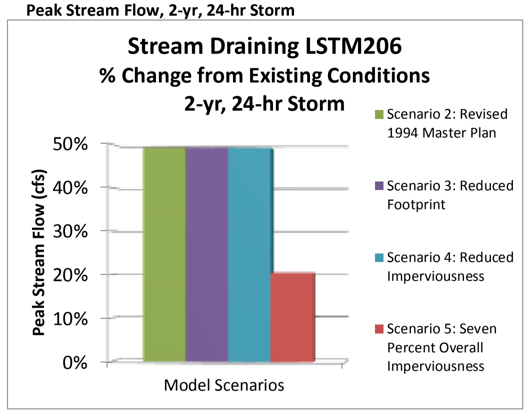
Hydrographs, 1-yr, 24-hr Storm



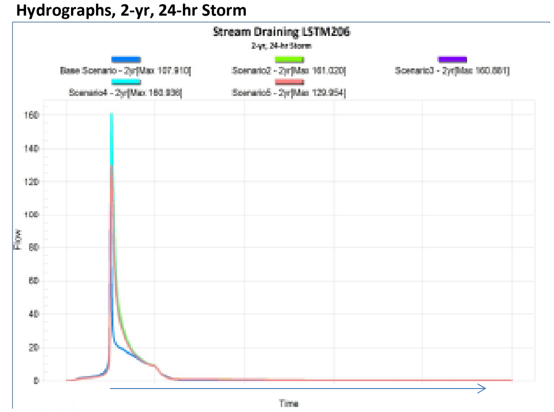
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

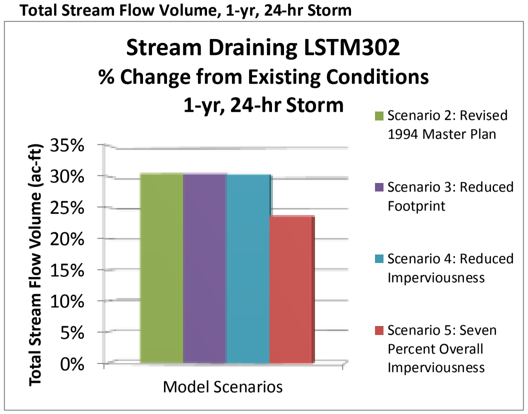


LSTM302			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	56.3	**73.5**	17.2	30%	**73.5**	17.1	30%	**73.4**	17.1	30%	**69.7**	13.3	24%
		Peak Stream Flow (cfs)	112.5	**190.3**	77.8	69%	**195.7**	83.1	74%	**194.5**	81.9	73%	**160.7**	48.1	43%
		Stream Flow Velocity (fps)	1.5	**1.8**	0.3	21%	**1.8**	0.3	23%	**1.8**	0.3	22%	**1.7**	0.2	14%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	96.9	**119.5**	22.5	23%	**119.5**	22.6	23%	**119.5**	22.5	23%	**114.6**	17.7	18%
		Peak Stream Flow (cfs)	167.2	**322.5**	155.3	93%	**326.7**	159.5	95%	**325.3**	158.1	95%	**274.4**	107.2	64%
		Stream Flow Velocity (fps)	1.7	**2.1**	0.4	21%	**2.1**	0.4	22%	**2.1**	0.4	22%	**2.0**	0.3	18%

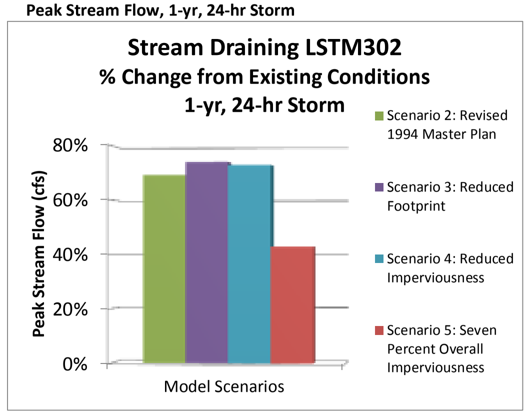
drains to link 80

Change compared to Existing Conditions

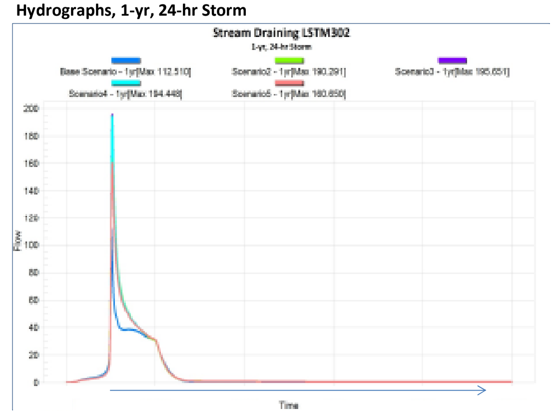
Total Stream Flow Volume, 1-yr, 24-hr Storm



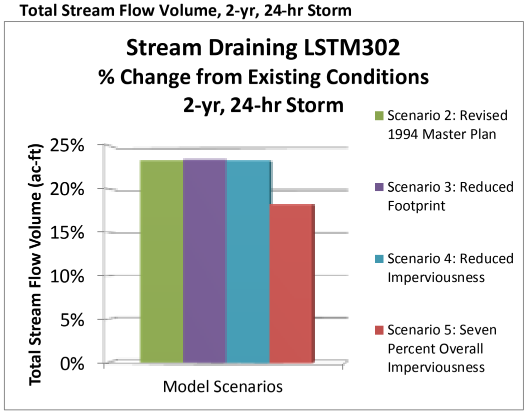
Peak Stream Flow, 1-yr, 24-hr Storm



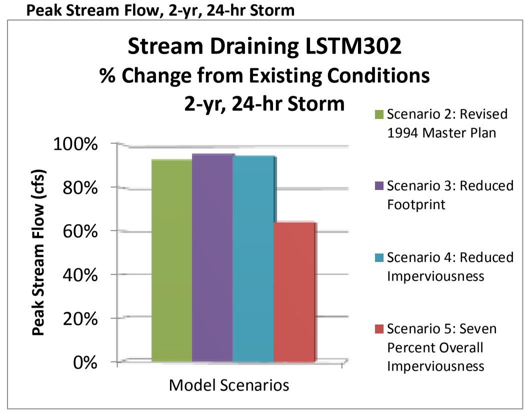
Hydrographs, 1-yr, 24-hr Storm



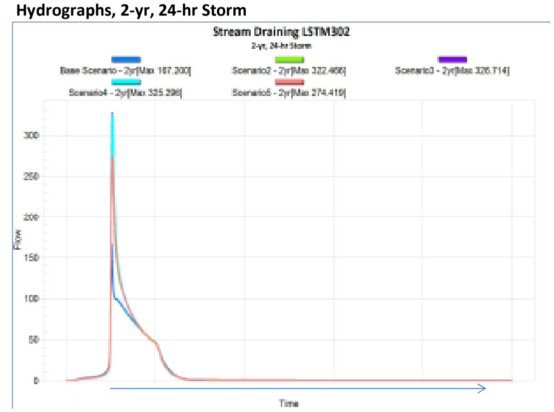
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

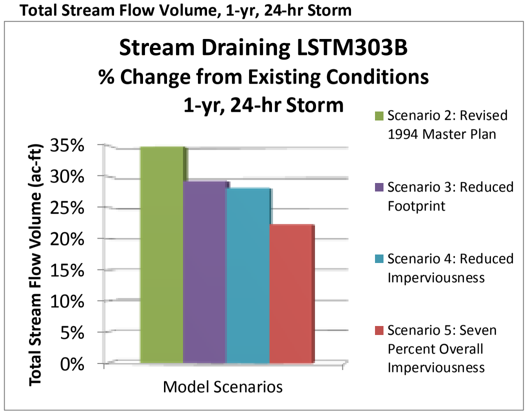


LSTM303B			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	68.1	**91.9**	23.8	35%	**88.1**	19.9	29%	**87.3**	19.2	28%	**83.3**	15.2	22%
		Peak Stream Flow (cfs)	107.5	**231.6**	124.1	115%	**222.2**	114.7	107%	**216.8**	109.3	102%	**183.7**	76.2	71%
		Stream Flow Velocity (fps)	2.0	**2.4**	0.4	18%	**2.4**	0.3	17%	**2.3**	0.3	15%	**2.3**	0.3	14%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	118.4	**149.2**	30.8	26%	**144.2**	25.8	22%	**143.1**	24.7	21%	**138.0**	19.6	17%
		Peak Stream Flow (cfs)	176.2	**402.7**	226.5	129%	**381.8**	205.6	117%	**376.6**	200.4	114%	**328.9**	152.6	87%
		Stream Flow Velocity (fps)	2.3	**2.9**	0.6	27%	**2.9**	0.6	25%	**2.9**	0.6	24%	**2.7**	0.4	18%

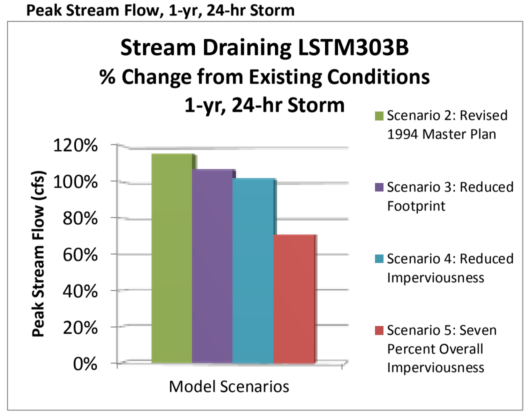
drains to link 50

Change compared to Existing Conditions

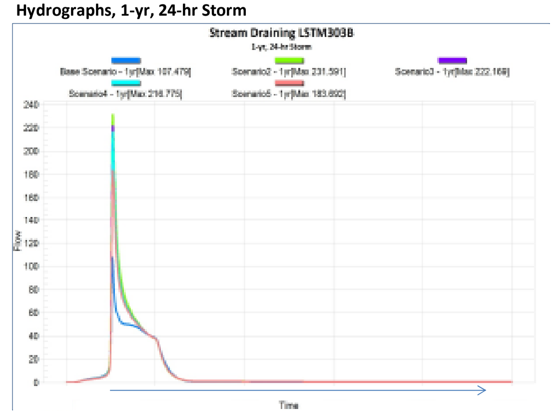
Total Stream Flow Volume, 1-yr, 24-hr Storm



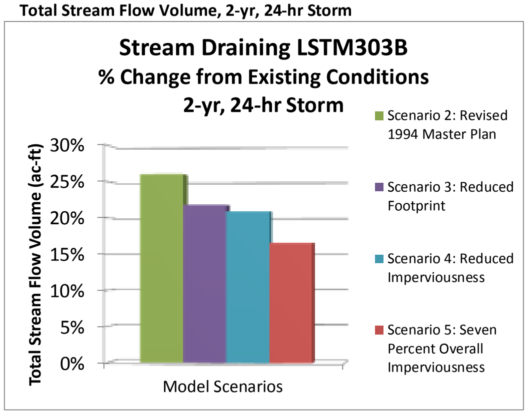
Peak Stream Flow, 1-yr, 24-hr Storm



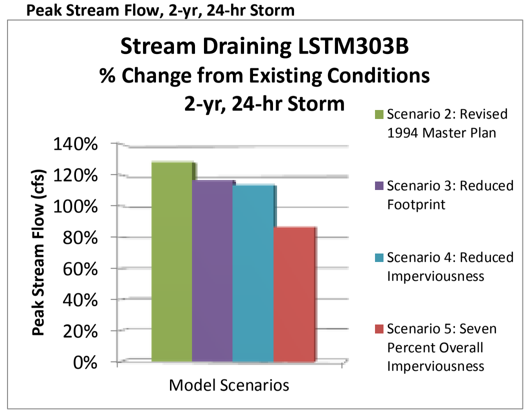
Hydrographs, 1-yr, 24-hr Storm



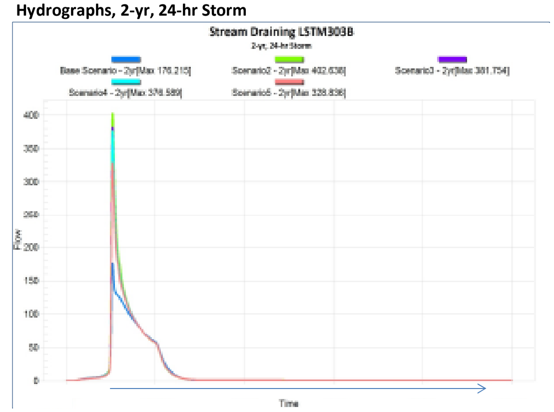
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm



Hydrographs, 2-yr, 24-hr Storm

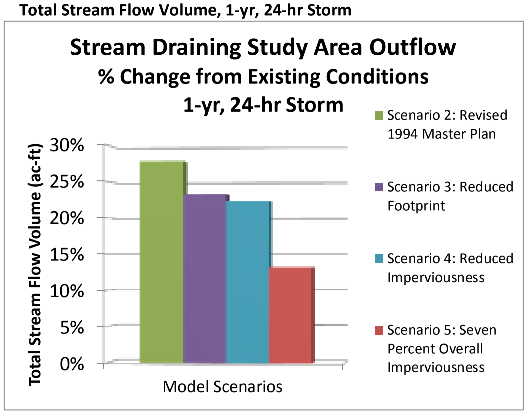


STUDY AREA OUTFLOW			Existing Conditions	Scenario 2: Revised 1994 Master Plan			Scenario 3: Reduced Footprint			Scenario 4: Reduced Imperviousness			Scenario 5: Seven Percent Overall Imperviousness		
Model Results	Storm Event:	Model Parameter:	Existing Conditions	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change	Developed Conditions	Net Impact (Change)	% Change
	1-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	85.6	**109.4**	23.8	28%	**105.5**	19.9	23%	**104.7**	19.1	22%	**96.9**	11.3	13%
		Peak Stream Flow (cfs)	109.4	**229.6**	120.2	110%	**219.0**	109.7	100%	**214.0**	104.6	96%	**182.6**	73.3	67%
		Stream Flow Velocity (fps)	2.2	**2.6**	0.4	20%	**2.6**	0.4	18%	**2.6**	0.4	18%	**2.6**	0.4	17%
	2-yr, 24-hr Storm	Total Stream Flow Volume (ac-ft)	149.9	**180.7**	30.8	21%	**175.5**	25.7	17%	**174.5**	24.6	16%	**163.7**	13.9	9%
		Peak Stream Flow (cfs)	194.2	**423.0**	228.8	118%	**398.8**	204.6	105%	**393.2**	199.0	102%	**335.4**	141.2	73%
		Stream Flow Velocity (fps)	2.6	**3.2**	0.6	25%	**3.2**	0.6	21%	**3.1**	0.5	20%	**2.9**	0.3	13%

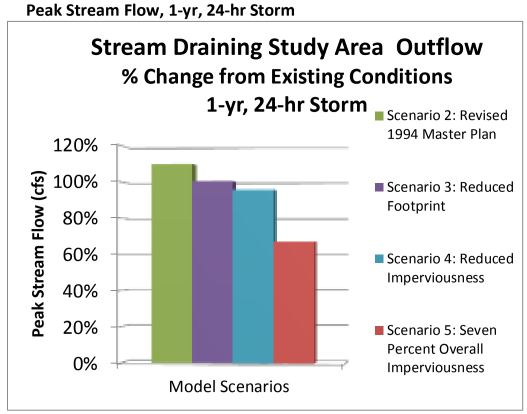
drains to link 30

Change compared to Existing Conditions

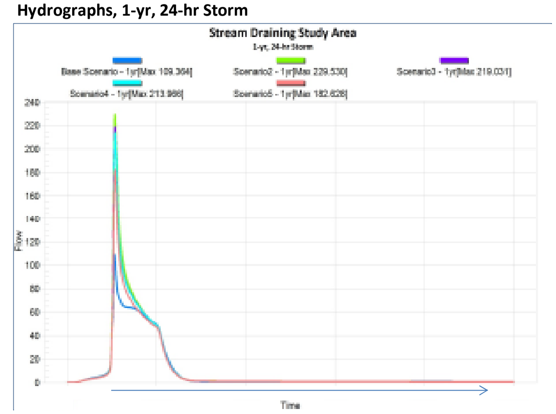
Total Stream Flow Volume, 1-yr, 24-hr Storm



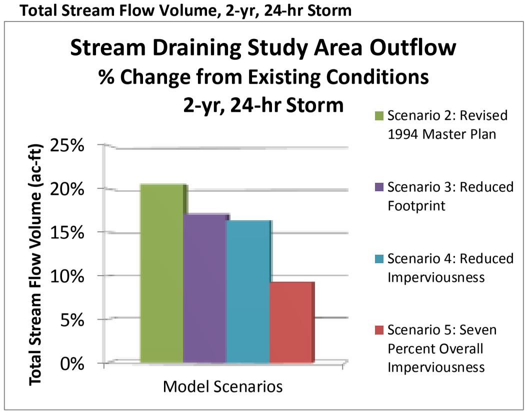
Peak Stream Flow, 1-yr, 24-hr Storm



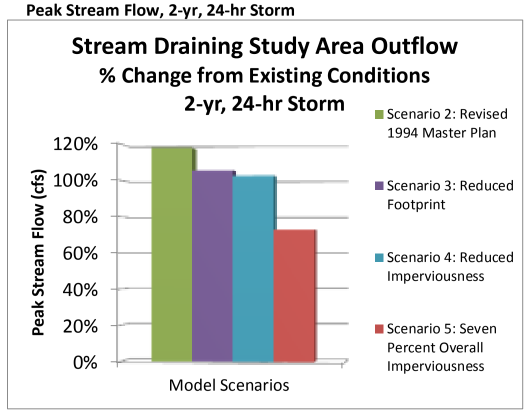
Hydrographs, 1-yr, 24-hr Storm



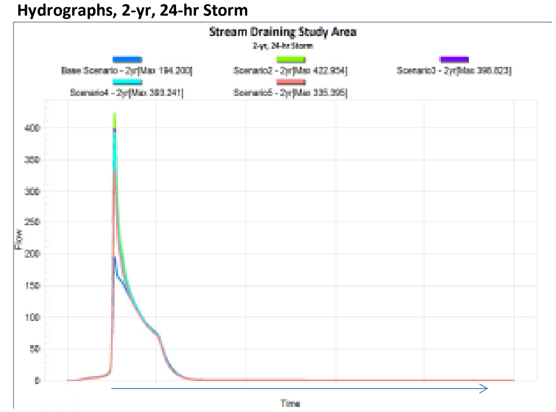
Total Stream Flow Volume, 2-yr, 24-hr Storm



Peak Stream Flow, 2-yr, 24-hr Storm

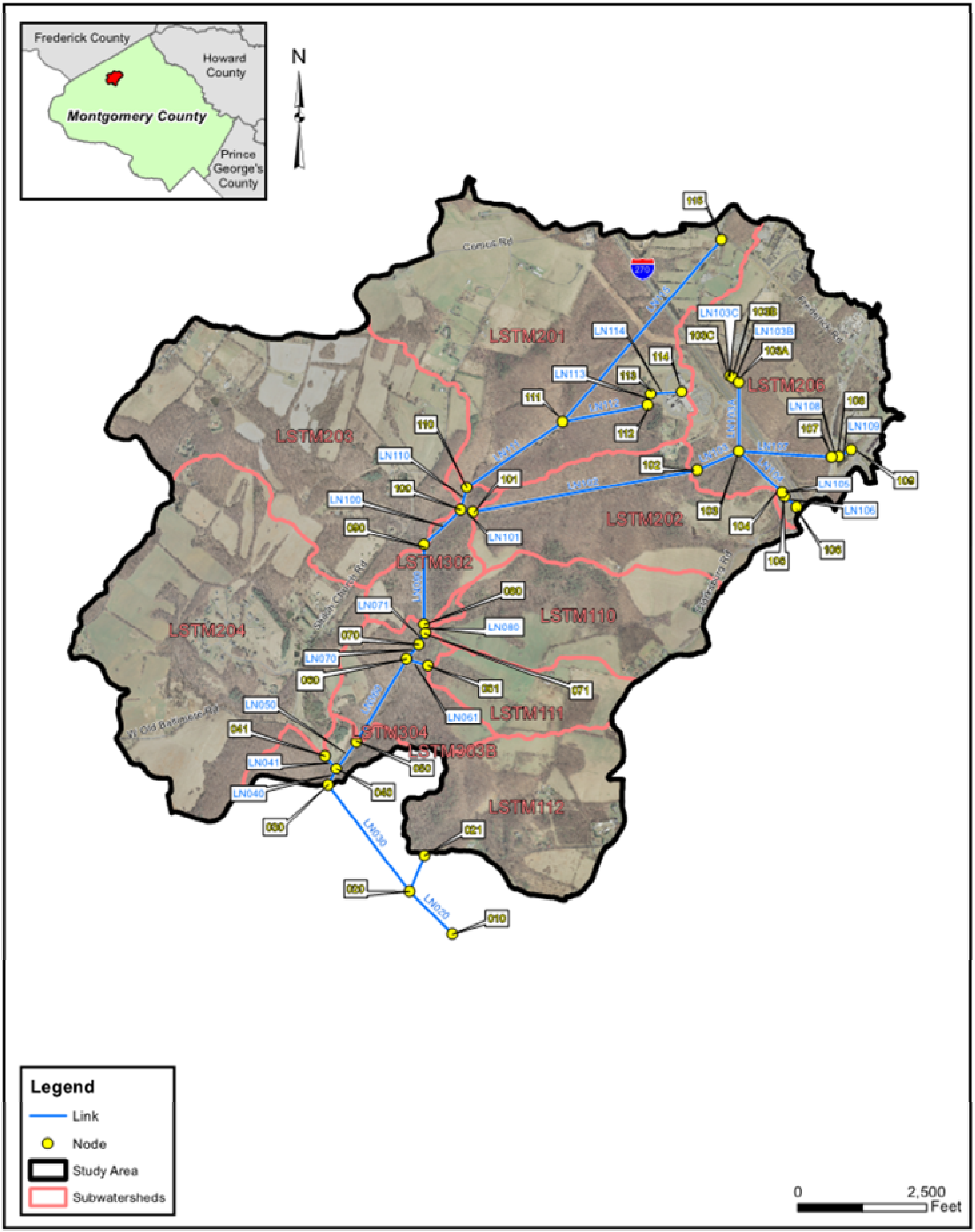


Hydrographs, 2-yr, 24-hr Storm



Appendix B –

Link Node Diagram



Ten Mile Creek

Clarksburg Master Plan Limited Amendment

SWMM Model Features

Appendix C –

Calculation of Runoff Curve Numbers

The XP-SWMM hydrologic model uses a standard Curve Number method as part of its calculation of runoff during storm events. Curve numbers correspond to runoff characteristics of different hydrologic soil groups and land cover types, with higher curve numbers corresponding to soil groups and land cover types that are less permeable and contribute more stormwater runoff. The process of generating composite curve numbers for each of the modeled subcatchments is described below.

Curve numbers were be established from the United States Department of Agriculture's "Urban Hydrology for Small Watersheds, TR-55", tables 2-2a, 2-2b, and 2-2c. Land uses in the Ten Mile Creek study area were used to assign a representative TR-55 cover description then an associated curve number based on soil infiltration characteristics. The study area land use descriptions, representative TR-55 cover descriptions and curve numbers utilized in the model scenario are provided in Table C-1.

Table C-1: Runoff Curve Numbers

Land Cover Type		Curve Numbers for Hydrologic Soil Group			
Study Area Land Use	**Representative TR-55 Cover Description**	**A**	**B**	**C**	**D**
Impervious	Impervious	98	98	98	98
Wetlands	Impervious	98	98	98	98
Water	Impervious	98	98	98	98
Cropland	Small Grain, Good	63	75	83	87
Bare Ground	Fallow, Bare Soil	77	86	91	94
Large Lot Subdivision (ag)	Pasture, Grassland, Good Condition	39	61	74	80
Pasture	Pasture, Grassland, Good Condition	39	61	74	80
Large Lot Subdivision (forest)	Woods, Good	30	55	70	77
Forest	Woods, Good	30	55	70	77
Low Density Residential	Residential Districts, 2 acres	46	65	77	82
Medium Density Residential	Residential Districts, 1/2 acre	54	70	80	85
High Density Residential	Residential Districts 1/8 acre	77	85	90	92
Transportation Right of Way	Open Space, Good Condition	39	61	74	80
Utility Right of Way	Open Space, Good Condition	39	61	74	80
Institutional	Open Space, Fair Condition	49	69	79	84
Industrial	Industrial	81	88	91	93
Commercial	Commercial and Business	89	92	94	95
Land conversions outside SPA LODs[3]	Meadow	30	58	71	78
Land conversions inside Rural Parcel LODs[4]	Open Space, Good Condition	39	61	74	80

1. Representative TR-55 Cover Description and Curve Numbers synthesized from tables: 2-2a, 2-2b, and 2-2c from USDA NRCS "Urban Hydrology for Small Watersheds TR-55".
2. A hydrologic condition of "good" assumed for all appropriate cover descriptions
3. Conversions of unforested land to Meadow were processed between the stream and LODs in the SPA, as described in Section 2.
4. Conversions to of undeveloped and unforested land to Open Space were processed for development in the rural parcels.

For the base (existing conditions) model scenario, the overall runoff characteristics to each model node were characterized by calculating acreages for each combination of existing land use and HSG category based on unions of the GIS land cover, land use and hydrologic soil group (HSG) data provided for the study. Each of the resulting land use/HSG combinations was then assigned a TR-55 curve number from Table C-1, then the data polygons were combined through weighted averages to produce one composite curve number representing overall runoff characteristics for each subcatchment area. Data sources used for the analyses were provided by the Planning Department.

During development, heavy equipment used to grade land for construction compacts soils within the Limits of Disturbance (LOD), which increases the runoff from these areas along with the associated curve number. One method of modeling to account for the soil compaction that occurs during development is to assume that a soil moves from its original hydrologic soil group to the next less permeable soil group as a result of compaction.

In addition to state ESD requirements, Montgomery County requires a toposoiling or decompaction procedure for soils in grassed and landscaped (pervious) areas with the LOD. This procedure involves tillage to a depth from 8 to 10 inches, with 4 inches of topsoil added. A more rigorous procedure that involves a deeper tillage of 2 feet with organic material mixed in to amend the soil typically is sufficient to bring the soil approximately back to its original curve number. Because the County's requirements involve tillage to almost half the depth of the more rigorous procedure, and includes topsoil, a moderate assumption for the effect of the County's soil decompaction method is a final curve number halfway between the original soil curve number and the compacted soil curve number. This assumption was used to represent the County's soil decompaction requirements in the XP-SWMM hydrologic model.

For the May 2013 development scenarios, as described in Section 2, in each subwatershed, subcatchment #1 was used to represent all the land outside the proposed development area as defined by the LODs provided by the Planning Department. After separating out the areas within the development LODs, the composite curve number within subcatchment #1 was recalculated based on the remaining acreages of existing land use and underlying soil type combinations, using the same land use categories and associated TR-55 curve numbers as were used to calculate the CNs for the base (existing conditions) model scenario. Subcatchments #2 and #3 were used to represent the impervious and pervious portions of the new development, respectively. Subcatchment #2 was used to combine all of the impervious areas of the proposed development, and assigned a curve number of 98. A composite curve number was computed for subcatchment #3 based on the proposed pervious land uses after the conversion process described above, and the underlying soil types. The TR-55 curve numbers for existing soil HSG and the next less permeable HSG were averaged to represent each post-development pervious land use polygon. For example, a polygon converted to High Density Residential in a B soil HSG would be assigned a curve number of 87.5, or the average between the B soil CN of 85 and the C soil CN of 90.

The data used to generate the composite curve numbers for the development scenarios included the TR-55 curve numbers listed in Table C-1, along with existing land use data, the shapefiles representing proposed development parcels, and numerous other data files provided by the Planning Department. Table C-2 provides a summary of CNs calculated for each model scenario.

Table C-2: Composite Curve Numbers used for Model Scenarios										
	Scenario 1	Scenario 2		Scenario 3		Scenario 4		Scenario 5		
LSTM	Existing Conditons	SC1 - Undeveloped	SC3 - Developed Pervious	SC1 - Undeveloped	SC3 - Developed Pervious	SC1 - Undeveloped	SC3 - Developed Pervious	SC1 - Undeveloped	SC3 - Developed Pervious	
110	66	65	72	62	77	62	77	62	77	
111	69	64	75	63	78	63	78	63	78	
112	65	61	77	61	78	61	78	61	78	
201	66	66	71	66	71	66	71	60	69	
202	69	66	78	64	84	64	84	64	86	
203	66	66	79	66	79	66	79	66	79	
204	68	68	76	68	76	68	76	68	76	
206	65	67	69	65	72	65	72	65	72	
302	69	64	73	70	68	70	68	70	68	
303B	65	65	70	64	76	64	76	64	76	
304	67	67	NA	67	NA	67	NA	67	NA	
SC = Subcatchment		Scenarios 2-5 also included subcatchment 2 to represent all post-development impervious area, with a curve number of 98.								

Appendix D –

Environmental Site Design Calculations

SCENARIO 2

Sub Basin 110 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
110	Pulte Residential	B	85.43	3721209.64	55	55	33.02	0.34718	1.8	0.62	197736.68	101403.43	2.33	3.74
110	Pulte Residential	C	1.74	75796.38	70				1.6					
Sub Basin 111 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
111	Pulte Residential	B	42.76	1862633.22	55	55	33.02	0.34718	1.8	0.62	99376.13	50962.12	1.17	1.88
111	Pulte Residential	C	1.05	45620.54	70				1.6					
Sub Basin 112 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
112	Pulte Residential	B	21.73	946588.72	55	55	33.02	0.34718	1.8	0.62	49295.50	25279.74	0.58	0.93
Sub Basin 201 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
201	Egan/Mattlyn	B	35.04	1526330.654	55	55	50.15	0.50135	1.8	0.90	114798.84	58871.20	2.24	2.17
201	Egan/Mattlyn	C	0.00	198.9206325	70	55			1.8					
201	Developable Private Rural	B	20.35	886381.9597	55	56	43.00	0.437	1.8	0.79	60130.77	30836.29		1.14
201	Developable Private Rural	C	0.71	30944.87133	70	60			1.8					
201	I-270 Median	B	1.59	69112.15949	55	57	100.00	0.95	2.6	2.47	15312.54	7852.59		0.29
201	I-270 Median	D	0.12	5280.754543	77	77			2					
Sub Basin 202 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
202	MD 121	B	1.60	69683.28	55	55	100.00	0.95	2.6	2.47	14343.14	7355.46	1.94	0.27
202	Pulte Residential	B	31.96	1392109.30	55	55	33.02	0.34718	1.8	0.62	72978.93	37425.09		1.38
202	Pulte Residential	C	0.21	9256.57	70				1.6					
202	Pulte County Site	B	10.88	473781.66	55	65	41.56	0.42404	1.8	0.76	77399.12	39691.85		1.46
202	Pulte County Site	C	12.59	548274.12	70				1.8					
202	Pulte County Site	D	4.47	194796.67	77				1.6					
Sub Basin 203 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
203	Developable Private Rural	B	2.334415982	101687.16	55	#REF!	43.00	0.437	1.8	0.79	6665.59	3418.25	0.08	0.13
Sub Basin 204 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
204	Developable Private Rural	B	1.494632774	65106.20	55	#REF!	43.00	0.437	1.8	0.79	4267.71	2188.57	0.05	0.08
Sub Basin 206 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
206	Developable Private Rural	B	0.12	5343.57	55	55	43.00	0.437	1.8	0.79	350.27	179.63	5.87	0.01
206	Egan/Mattlyn	B	21.77	948405.34	55	55	50.15	0.50135	1.8	0.90	71322.45	36575.62		1.35
206	Fire Station	B	4.08	177846.53	55	55	37.00	0.383	1.8	0.69	10217.28	5239.63		0.19
206	Hammer Hill	B	1.34	58560.40	55	55	30.00	0.32	1.6	0.51	2498.58	1281.32		0.05
206	Historic Area Commercial	B	0.73	31706.23	55	55	80.00	0.77	2.2	1.69	4475.86	2295.31		0.08
206	Historic Property Vacant	B	4.38	190970.95	55	55	15.40	0.1886	1	0.19	3001.43	1539.19		0.06
206	Historic Property Vacant	D	0.08	3345.58	77									
206	MD 121	B	3.67	159854.42	55	56	100.00	0.95	2.6	2.47	32903.37	16873.52		0.62
206	MD 121	C	0.39	16896.48	70				2.2					
206	MD 121	D	0.01	501.97	77				2					
206	MD 355	B	28.61	1246204.78	55	60	30.40	0.3236	1.6	0.52	53769.58	27574.14		1.02
206	MD 355	C	2.87	125117.89	70				1.6					
206	MD 355	D	6.93	302056.71	77				1.2					
206	Miles Coppola	B	37.04	1613561.64	55	57	60.03	0.59027	2	1.18	181963.06	93314.39		3.44
206	Miles Coppola	C	4.75	207086.40	70				2					
206	Miles Coppola	D	0.67	28977.35	77				1.8					
206	Pulte County	B	5.64	245654.62	55	65	41.56	0.42404	1.8	0.76	49290.62	25277.24		0.93
206	Pulte County	C	12.15	529282.01	70				1.8					
206	I-270 Median	B	1.63	71154.70	55	57	100.00	0.95	2.6	2.47	16709.76	8569.11		0.32
206	I-270 Median	C	0.08	3524.98	70				2.2					
206	I-270 Median	D	0.15	6501.34	77				2					
206	Historic District Residential	B	5.88	256177.22	55	55	15.40	0.1886	1	0.19	4026.25	2064.74		
206	Towne Center Redev	B	17.55	764429.49	55	55	53.69	0.53321	2	1.07	67933.57	34837.73		
Sub Basin 302 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
302	Pulte Residential	B	5.08	221215.36	55	55	33.02	0.34718	1.8	0.62	11520.23	5907.81	0.14	0.22
302	Developable Private Rural	B	2.72	118680.56	55	55	43.00	0.437	1.8	0.79	7782.11	3990.83		0.15
302	Developable Private Rural	C	0.00	39.71	70									
Sub Basin 303B (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
303b	Developable Private Rural	B	3.18	138628.24	55	55	43.00	0.437	1.8	0.79	9120.25	4677.05	0.11	0.17
303b	Developable Private Rural	C	0.01	506.07	70									
303b	Pulte Residential	B	5.22	227379.34	55	55	33.02	0.34718	1.8	0.62	11953.26	6129.88		0.23
303b	Pulte Residential	C	0.05	2151.24	70				1.6					

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sin 110 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
110	Pulte Residential	B	42.25	1840346.81	55	55	40.00	0.41	1.8	0.74	113190.21	58046.26	1.33	2.14
110	Pulte Residential	C	0.00	144.44	70				1.8					
sin 111 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
111	Pulte Residential	B	31.09	1354277.32	55	56	40.00	0.41	1.8	0.74	86354.70	44284.46	1.02	1.63
111	Pulte Residential	C	1.14	49864.11	70				1.8					
sin 112 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
112	Pulte Residential	B	21.56	939368.15	55	55	40.00	0.41	1.8	0.74	57771.14	29626.23	0.68	1.09
sin 201 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
201	Egan/Mattlyn	B	35.62	1551720.55	55	55	50.15	0.50135	1.8	0.90	116823.55	59909.51	2.26	2.21
201	Egan/Mattlyn	C	0.04	1732.45	70	55			1.8					
201	Developable Private Rural	B	20.35	886381.96	55	56	43.00	0.437	1.8	0.79	60130.77	30836.29		1.14
201	Developable Private Rural	C	0.71	30944.87	70	60			1.8					
201	I-270 Median	B	1.59	69112.46	55	57	100.00	0.95	2.6	2.47	15312.61	7852.62		0.29
201	I-270 Median	D	0.12	5280.80	77	77			2					
sin 202 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
202	MD 121	B	1.60	69683.18	55	55	100.00	0.95	2.6	2.47	14343.12	7355.45	1.52	0.27
202	Pulte Residential	B	18.87	822155.07	55	55	40.00	0.41	1.8	0.74	50706.65	26003.41		0.96
202	Pulte Residential	C	0.05	2343.38	70				1.8					
202	Pulte County Site	B	4.14	180370.12	55	69	41.56	0.42404	1.8	0.76	64188.57	32917.22		1.21
202	Pulte County Site	C	14.63	637345.77	70				1.8					
202	Pulte County Site	D	4.39	191443.21	77				1.6					
sin 203 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
203	Developable Private Rural	B	2.334415982	101687.16	55	55	43.00	0.437	1.8	0.79	6665.59	3418.25	0.08	0.13
203	Developable Private Rural	C	0	0.00	70		43.00		1.8					
sin 204 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
204	Developable Private Rural	B	1.494632774	65106.20	55	55	43.00	0.437	1.8	0.79	4267.71	2188.57	0.05	0.08
204	Developable Private Rural	C	0	0.00	70				1.8					
sin 206 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
206	Developable Private Rural	B	0.12	5343.57	55	55	43.00	0.437	1.8	0.79	350.27	179.63	5.52	0.01
206	Egan/Mattlyn	B	28.45	1239168.42	55	55	50.15	0.50135	1.8	0.90	93188.56	47789.01		1.76
206	Fire Station	B	4.08	177622.25	55	55	37.00	0.383	1.8	0.69	10204.40	5233.02		0.19
206	Hammer Hill	B	1.34	58560.43	55	55	30.00	0.32	1.6	0.51	2498.58	1281.32		0.05
206	Historic Area Commercial	B	0.73	31706.37	55	55	80.00	0.77	2.2	1.69	4475.88	2295.32		0.08
206	Historic Property Vacant	B	4.76	207264.60	55	55	15.40	0.1886	1	0.19	3257.51	1670.52		0.06
206	Historic Property Vacant	D	0.08	3354.65	77									
206	MD 121	B	3.67	159854.33	55	56	100.00	0.95	2.6	2.47	32903.35	16873.51		0.62
206	MD 121	C	0.39	16896.54	70				2.2					
206	MD 121	D	0.01	501.98	77				2					
206	MD 355	B	10.09	439324.87	55	59	30.40	0.3236	1.6	0.52	18955.40	9720.72		0.36
206	MD 355	C	0.97	42132.27	70				1.6					
206	MD 355	D	1.36	59175.37	77				1.2					
206	Miles Coppola	B	43.14	1879059.79	55	57	60.03	0.59027	2	1.18	209427.94	107398.94		3.96
206	Miles Coppola	C	4.97	216646.86	70				2					
206	Miles Coppola	D	0.76	33094.84	77				1.8					
206	Pulte County	B	1.48	64485.40	55	55	41.56	0.42404	1.8	0.76	4165.05	2135.92		0.08
206	Pulte County	C	0.02	996.68	70				1.8					
206	I-270 Median	B	1.63	71154.37	55	57	100.00	0.95	2.6	2.47	16709.69	8569.07		0.32
206	I-270 Median	C	0.08	3525.04	70				2.2					
206	I-270 Median	D	0.15	6501.28	77				2					
206	Historic District Residential	B	5.88	256177.17	55	55	15.40	0.1886	1	0.19	4026.25	2064.74		
206	Towne Center Redev	B	17.68	770193.16	55	55	53.69	0.53321	2	1.07	68445.78	35100.40		
sin 302 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
302	Developable Private Rural	B	2.72	118680.56	55	55	43.00	0.437	1.8	0.79	7782.11	3990.83	0.09	0.15
302	Developable Private Rural	C	0.00	39.71	70									
in 303B (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
303b	Developable Private Rural	B	3.18	138628.24	55	55	43.00	0.437	1.8	0.79	9120.25	4677.05	0.11	0.17
303b	Developable Private Rural	C	0.01	506.07	70									
sin 304 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
304	Developable Private Rural	B	0.00	0.00	55	NA	43.00	0.437	1.8	0.79	0.00	0.00	0.00	0.00
304	Developable Private Rural	C	0.00	0.00	70				1.8					

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in 110 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
110	Pulte Residential	B	42.25	1840346.81	55	55	33.02	0.35	1.8	0.62	95847.26	49152.44	1.13	1.81
110	Pulte Residential	C	0.00	144.44	70				1.8					
in 111 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
111	Pulte Residential	B	31.09	1354277.32	55	56	33.02	0.35	1.8	0.62	73123.47	37499.22	0.86	1.38
111	Pulte Residential	C	1.14	49864.11	70				1.6					
in 112 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
112	Pulte Residential	B	21.56	939368.15	55	55	33.02	0.35	1.8	0.62	48919.48	25086.91	0.58	0.92
in 201 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
201	Egan/Mattlyn	B	35.62	1551720.552	55	55	50.15	0.50	1.8	0.90	116823.55	59909.51	2.26	2.21
201	Egan/Mattlyn	C	0.04	1732.449268	70	55			1.8					
201	Developable Private Rural	B	20.35	886381.9597	55	56	43.00	0.44	1.8	0.79	60130.77	30836.29		1.14
201	Developable Private Rural	C	0.71	30944.87133	70	60			1.8					
201	I-270 Median	B	1.59	69112.46001	55	57	100.00	0.95	2.6	2.47	15312.61	7852.62		0.29
201	I-270 Median	D	0.12	5280.800442	77	77			2					
in 202 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
202	MD 121	B	1.60	69683.18	55	55	100.00	0.95	2.6	2.47	14343.12	7355.45	1.43	0.27
202	Pulte Residential	B	18.87	822155.07	55	55	33.02	0.35	1.8	0.62	42937.41	22019.18		0.81
202	Pulte Residential	C	0.05	2343.38	70				1.6					
202	Pulte County Site	B	4.14	180370.12	55	69	41.56	0.42	1.8	0.76	64188.57	32917.22		1.21
202	Pulte County Site	C	14.63	637345.77	70				1.8					
202	Pulte County Site	D	4.39	191443.21	77				1.6					
in 203 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
203	Developable Private Rural	B	2.334415982	101687.16	55	55	43.00	0.44	1.8	0.79	6665.59	3418.25	0.08	0.13
203	Developable Private Rural	C	0	0.00	70		43.00		1.8					
in 204 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
204	Developable Private Rural	B	1.494632774	65106.20	55	55	43.00	0.44	1.8	0.79	4267.71	2188.57	0.05	0.08
204	Developable Private Rural	C	0	0.00	70				1.8					
in 206 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
206	Developable Private Rural	B	0.12	5343.57	55	55	43.00	0.44	1.8	0.79	350.27	179.63	5.52	0.01
206	Egan/Mattlyn	B	28.45	1239168.42	55	55	50.15	0.50	1.8	0.90	93188.56	47789.01		1.76
206	Fire Station	B	4.08	177622.25	55	55	37.00	0.38	1.8	0.69	10204.40	5233.02		0.19
206	Hammer Hill	B	1.34	58560.43	55	55	30.00	0.32	1.6	0.51	2498.58	1281.32		0.05
206	Historic Area Commercial	B	0.73	31706.37	55	55	80.00	0.77	2.2	1.69	4475.88	2295.32		0.08
206	Historic Property Vacant	B	4.76	207264.60	55	55	15.40	0.19	1	0.19	3257.51	1670.52		0.06
206	Historic Property Vacant	D	0.08	3354.65	77									
206	MD 121	B	3.67	159854.33	55	56	100.00	0.95	2.6	2.47	32903.35	16873.51		0.62
206	MD 121	C	0.39	16896.54	70				2.2					
206	MD 121	D	0.01	501.98	77				2					
206	MD 355	B	10.09	439324.87	55	59	30.40	0.32	1.6	0.52	18955.40	9720.72		0.36
206	MD 355	C	0.97	42132.27	70				1.6					
206	MD 355	D	1.36	59175.37	77				1.2					
206	Miles Coppola	B	43.14	1879059.79	55	57	60.03	0.59	2	1.18	209427.94	107398.94		3.96
206	Miles Coppola	C	4.97	216646.86	70				2					
206	Miles Coppola	D	0.76	33094.84	77				1.8					
206	Pulte County	B	1.48	64485.40	55	55	41.56	0.42	1.8	0.76	4165.05	2135.92		0.08
206	Pulte County	C	0.02	996.68	70				1.8					
206	I-270 Median	B	1.63	71154.37	55	57	100.00	0.95	2.6	2.47	16709.69	8569.07		0.32
206	I-270 Median	C	0.08	3525.04	70				2.2					
206	I-270 Median	D	0.15	6501.28	77				2					
206	Historic District Residential	B	5.88	256177.17	55	55	15.40	0.19	1	0.19	4026.25	2064.74		
206	Towne Center Redev	B	17.68	770193.16	55	55	53.69	0.53	2	1.07	68445.78	35100.40		
in 302 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
302	Developable Private Rural	B	2.72	118680.56	55	55	43.00	0.44	1.8	0.79	7782.11	3990.83	0.09	0.15
302	Developable Private Rural	C	0.00	39.71	70									
n 303B (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
303b	Developable Private Rural	B	3.18	138628.24	55	55	43.00	0.44	1.8	0.79	9120.25	4677.05	0.11	0.17
303b	Developable Private Rural	C	0.01	506.07	70									
in 304 (1 yr 24 hr Storm)														
Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
304	Developable Private Rural	B	0.00	0.00	55	#DIV/0!	43.00	0.44	1.8	0.79	0.00	0.00	0.00	0.00
304	Developable Private Rural	C	0.00	0.00	70				1.8					

110 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
110	Pulte Residential	B	42.25	1840347	55	55	31.00	0.33	1.8	0.59	90828.24	46578.5861	1.069297202	1.72
110	Pulte Residential	C	0.00	144	70				1.8					

111 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
111	Pulte Residential	B	31.09	1354277	55	56	31.00	0.33	1.8	0.59	69294.38	35535.57914	0.815784645	1.31
111	Pulte Residential	C	1.14	49864	70				1.6					

112 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
112	Pulte Residential	B	21.56	939368	55	55	31.00	0.33	1.8	0.59	46357.82	23773.2402	0.545758499	0.88

201 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
201	Egan/Mattlyn	B	35.62	1551721	55	55	32.60	0.34	1.8	0.62	80018.36	41035.0585	1.54915207	1.51
201	Egan/Mattlyn	C	0.04	1732	70	55			1.8					
201	Developable Private Rural	B	12.50	544496	55	56	42.11	0.43	1.8	0.77	36257.10	18593.38375		0.69
201	Developable Private Rural	C	0.44	19009	70	58			1.8					
201	I-270 Median	B	1.59	69112	55	57	100.00	0.95	2.6	2.47	15312.61	7852.621936		0.29
201	I-270 Median	D	0.12	5281	77	77			2					

202 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
202	MD 121	B	1.60	69683	55	55	100.00	0.95	2.6	2.47	14343.12	7355.446956	0.73698304	0.27
202	Pulte Residential	B	18.87	822155	55	55	31.00	0.33	1.8	0.59	40689.00	20866.15311		0.77
202	Pulte Residential	C	0.05	2343	70				1.6					
202	Pulte County Site	B	4.14	180370	55	69	0.00	0.05	1.8	0.09	7568.69	3881.381144		0.14
202	Pulte County Site	C	14.63	637346	70				1.8					
202	Pulte County Site	D	4.39	191443	77				1.6					

203 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
203	Dev Private Rural	B	1.434009171	62465	55	55	42.11	0.43	1.8	0.77	4019.16	2061.106607	0.047316497	0.08
203	Dev Private Rural	C		0	70				1.8					

204 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
204	Developable Private Rural	B	0.918138464	39994	55	55	42.11	0.43	1.8	0.77	2573.31	1319.64376	0.030294852	0.05
204	Developable Private Rural	C		0	70				1.8					

206 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
206	Developable Private Rural	B	0.08	3283	55	55	42.11	0.43	1.8	0.77	211.20	108.3093172	4.518769634	0.00
206	Egan/Mattlyn	B	28.45	1239168	55	55	32.60	0.34	1.8	0.62	63829.57	32733.11051		1.21
206	Fire Station	B	4.08	177622	55	55	37.00	0.38	1.8	0.69	10204.40	5233.024801		0.19
206	Hammer Hill	B	1.34	58560	55	55	30.00	0.32	1.6	0.51	2498.58	1281.322159		0.05
206	Historic Area Commercial	B	0.73	31706	55	55	80.00	0.77	2.2	1.69	4475.88	2295.324061		0.08
206	Historic Property Vacant	B	4.76	207265	55	55	15.40	0.19	1	0.19	3257.51	1670.517229		0.06
206	Historic Property Vacant	D	0.08	3355	77									
206	MD 121	B	3.67	159854	55	56	100.00	0.95	2.6	2.47	32903.35	16873.51305		0.62
206	MD 121	C	0.39	16897	70				2.2					
206	MD 121	D	0.01	502	77				2					
206	MD 355	B	10.09	439325	55	59	48.39	0.49	1.6	0.78	28438.02	14583.59931		0.54
206	MD 355	C	0.97	42132	70				1.6					
206	MD 355	D	1.36	59175	77				1.2					
206	Miles Coppola	B	43.14	1879060	55	57	40.90	0.42	2	0.84	148341.98	76072.81206		2.80
206	Miles Coppola	C	4.97	216647	70				2					
206	Miles Coppola	D	0.76	33095	77				1.8					
206	Pulte County	B	1.48	64485	55	55	0.00	0.05	1.8	0.09	491.12	251.8541542		0.01
206	Pulte County	C	0.02	997	70				1.8					
206	I-270 Median	B	1.63	71154	55	57	100.00	0.95	2.6	2.47	16709.69	8569.073196		0.32
206	I-270 Median	C	0.08	3525	70				2.2					
206	I-270 Median	D	0.15	6501	77				2					
206	Historic District Residential	B	5.88	256177	55	55	15.40	0.19	1	0.19	4026.25	2064.744219		
206	Towne Center Redev	B	17.68	770193	55	55	53.69	0.53	2	1.07	68445.78	35100.40121		

302 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
302	Developable Private Rural	B	1.67	72904	55	55	42.11	0.43	1.8	0.77	4692.39	2406.352329	0.055242248	0.09
302	Developable Private Rural	C	0.00	24	70									

303B (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
303b	Developable Private Rural	B	1.95	85158	55	55	42.11	0.43	1.8	0.77	5499.25	2820.126414	0.064741194	0.10
303b	Developable Private Rural	C	0.01	311	70									

304 (1 yr 24 hr Storm)

Sub-Basin	Development	HSG	Area (Acres)	Area (ft2)	RCN	RCN*	Impervious (%)	Rv	Pe (in)	Qe (in)	ESDv (ft3)	Af (Mont Co) sf	Total Af (acres)Mont. Co	Af (Acres)
304	Developable Private Rural	B	0.00	0	55	#DIV/0!	42.11	0.43	1.8	0.77	0.00	0	0	0.00
304	Developable Private Rural	C	0.00	0	70				1.8					