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Technical Memorandum

To: *City of Franklin IWRP Team*

From: *CDM*

Date: *December 8, 2011*

Subject: *Integrated Water Resources Plan – Green Infrastructure and Low Impact Development Techniques and Opportunities*

1.0 Introduction

Green Infrastructure and/or Low Impact Development (LID) techniques are terms used to describe an array of management practices, products, and/or technologies that use natural systems and/or engineered systems to capture, manage, and reduce stormwater runoff volumes and enhance overall environmental quality. As a general principal, Green Infrastructure techniques use soils and vegetation to infiltrate, evapotranspirate, and/or recycle stormwater runoff. This approach is an enhancement of traditional stormwater controls to add more sustainable and cost effective solutions. When used as components of a stormwater management system, green practices such as green roofs, porous pavement, rain gardens, vegetated swales, and stream-riparian buffers can produce a variety of hydrologic and environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help control flooding and erosion, maintain and improve water quality, maintain baseflows and stream temperatures, promote healthy aquatic habitat and riparian corridors, filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic benefits.

The Environmental Protection Agency (EPA) has made Green Infrastructure a key Administration priority, as stated in the "Strategic Agenda to Protect Waters and Build More Livable Communities through Green Infrastructure (EPA, 2011). Key policies and regulatory guidance were also provided by EPA in a guidance document developed to assist NPDES permit writers in developing municipal separate storm sewer system (MS4) stormwater permit language (EPA, 2010). The State of Tennessee has incorporated much of the guidance regarding green infrastructure into local MS4 permits.

For example, the City's current MS4 permit requires the following under Section 4.2.5.2:

> *Site design standards for all new and redevelopment require, in combination or alone, management measures that are designed, built and maintained to infiltrate, evapotranspire, harvest and/or use, at a minimum, the first inch of every rainfall event preceded by 72 hours of no measurable precipitation. This first inch of rainfall must be 100% managed with no storm water runoff being discharged to surface waters.*

This represents a shift by the State of Tennessee towards green infrastructure and low impact development practices. The City of Franklin has already incorporated the permit language into the local stormwater management ordinance, which becomes effective in July 2013. As such, the City wishes to evaluate the potential benefits of a green infrastructure program in relation to the Franklin IWRP project.

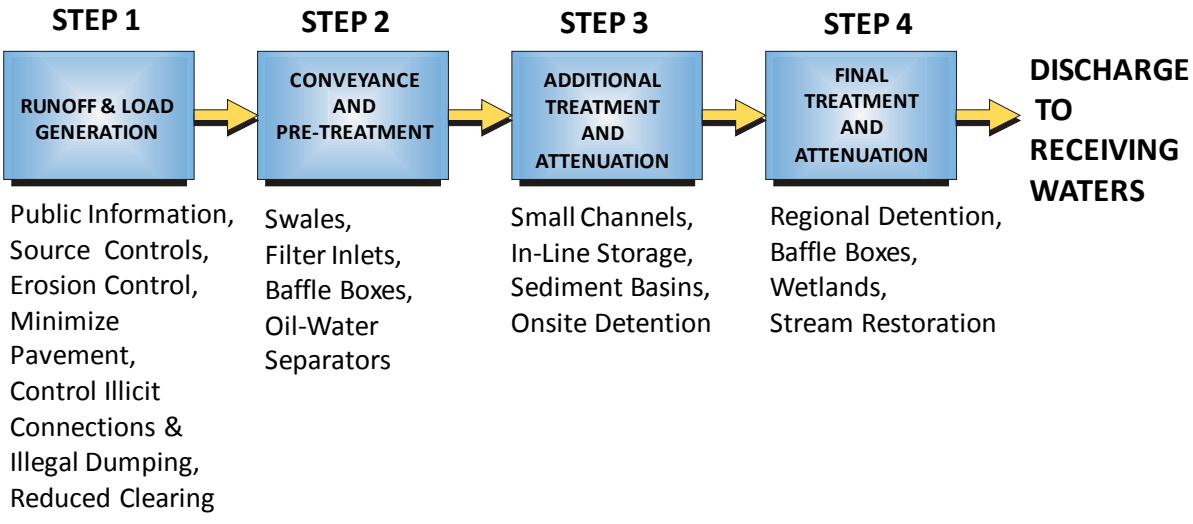
2.0 Data Collection

The City's current ordinance for stormwater management promotes the concept of the BMP Treatment Train, which is defined in the City's Stormwater Management Ordinance as:

> *"A technique for progressively selecting various Stormwater management practices to address water quality, by which groups of practices may be used to achieve a treatment goal while optimizing effectiveness, maintenance needs and space.*

The goal of the BMP Treatment Train, which is depicted in Figure 1, is treatment for the runoff resulting from a rainfall depth of 1.1 inches. Treatment at this level is predicted to achieve a goal of ninety percent (90%) capture of the average annual rainfall volume.

Figure 1 – BMP Treatment Train

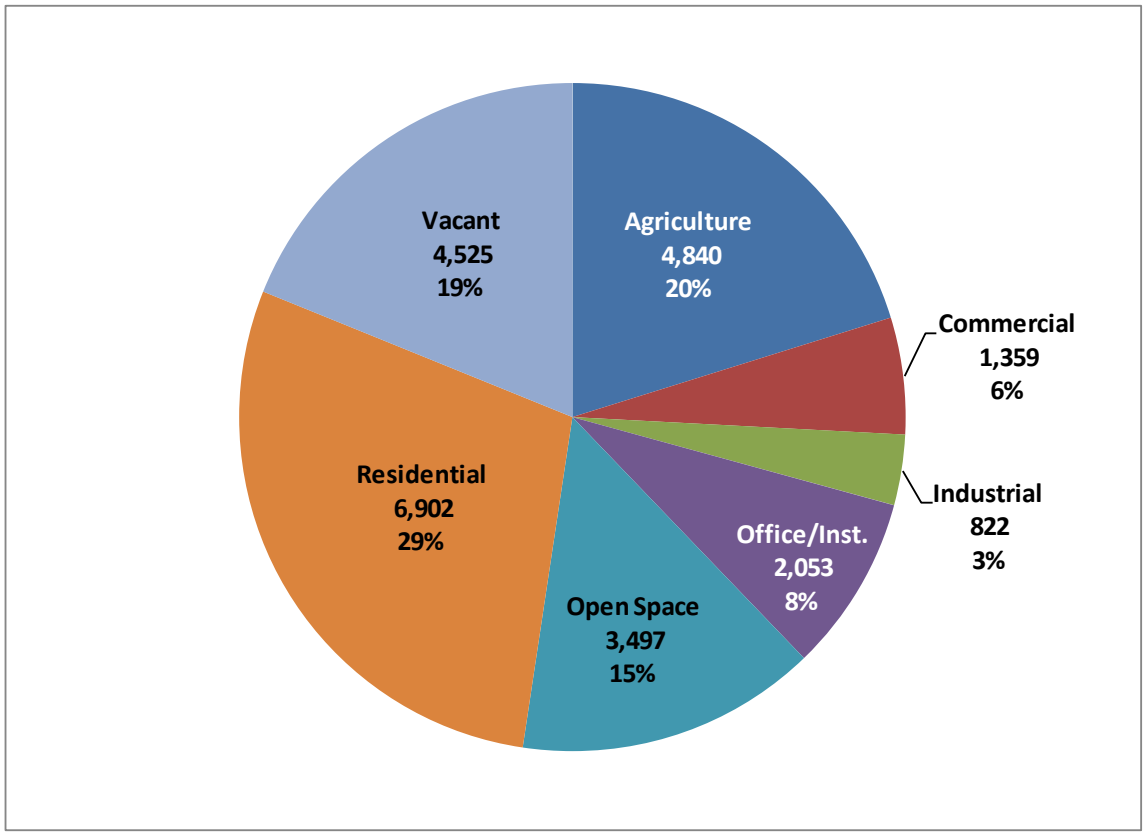


While the present approach used by Franklin is effective at meeting the City's goals, the current ordinance does not achieve the new regulatory standard set forth in the NPDES Phase II MS4 permit. The primary difference is the current ordinance requires only "capture and treatment" of the first 1.1 inches of rainfall while the NPDES Permit requires "capture and/or reuse" of the first inch. This memorandum presents an approach to approximate the additional benefits in pollutant reduction gained by moving to the new standard.

2.1 Estimate of Available Land for Development

Since the green infrastructure requirements apply to new development and redevelopment CDM estimated the approximate amount of land in Franklin still available for development. Using the City's most recent GIS data, CDM summarized the various land use types within the city limits, which is provided in Figure 2.

Figure 2 – Summary of Current Land Uses in Franklin



For the purposes of this analysis, CDM considered that Vacant (4,525 acres) and Agriculture (4,840 acres) lands would likely be available for future development. Consideration was given to the Open Space category, but it was expected that much of that land may be dedicated open space and therefore not available for development. Redevelopment potential was not considered in the analysis, but a similar BMP Treatment Train approach can be used for these retrofit cases. As shown, these evaluations result in a total of approximately 9,400 acres of land for use in the comparative analysis of traditional controls versus green infrastructure/LID controls.

3.0 Pollutant Loading Analysis

CDM performed a desktop pollutant loading analysis for three land use scenarios to determine the additional benefits gained by implementing a green infrastructure/LID development ordinance in Franklin. For consistency with previous pollutant loading analyses performed for this project, the EPA Spreadsheet Tool for Estimating Pollutant Load (STEPL) was used to generate desktop estimates of pollutant loads for each of the following three scenarios:

1. Build-Out with No Controls
2. Build-Out with Traditional BMP Controls (i.e. current ordinance)
3. Build-Out with GI/LID Controls (i.e. revised ordinance per NPDES requirements)

The STEPL tool uses a combination of annual rainfall estimates, land use information and event mean concentration (EMC) data to estimate annual pollutant loads. The spreadsheet tool used average annual rainfall data from the closest weather gage (Nashville BNA airport), which was estimated at approximately 59 inches annually.

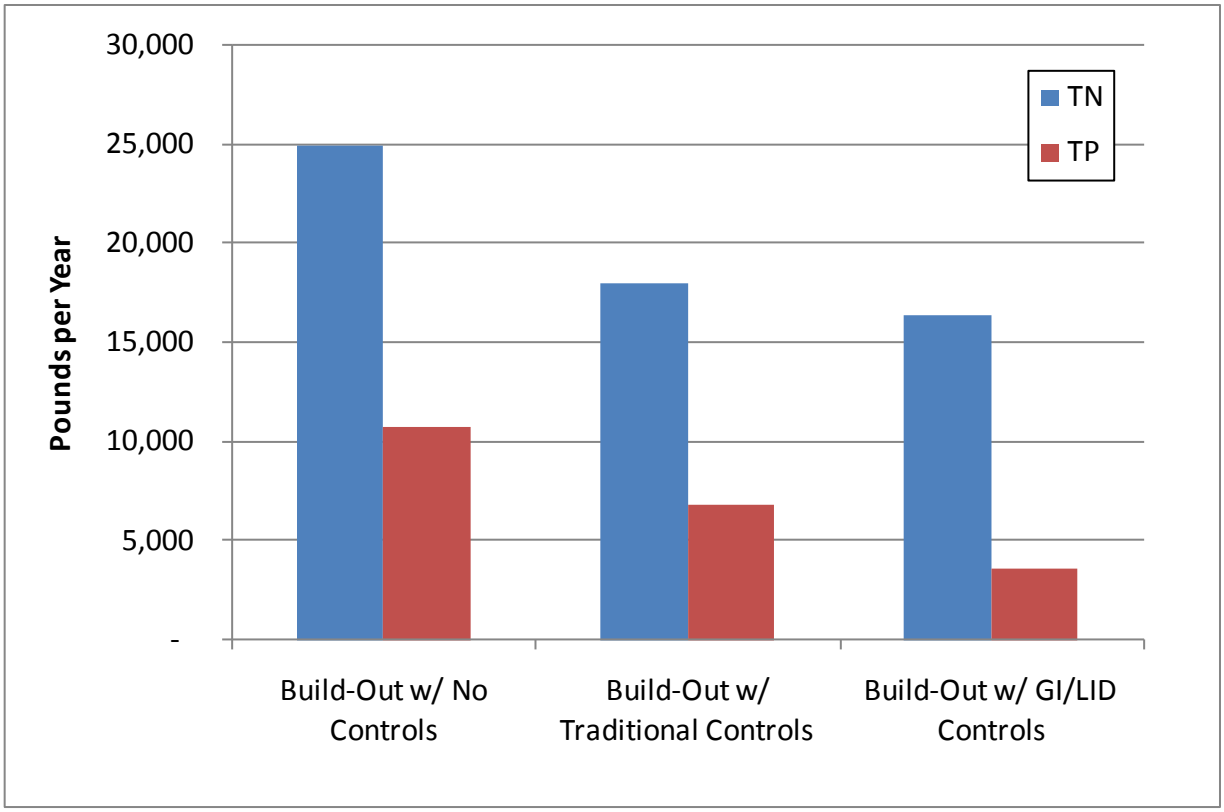
The land uses for each scenario were based on the data provide in Figure 2 above. For all three scenarios, the available 9,400 acres was evaluated using the same percent land use distribution that exists in the City today. The standard, default EMC values provided in the spreadsheet tool were applied to each land use to generate a pollutant loading. The EMC values were consistent with national averages and others used for this project. Table 1 provides a summary of the EMCs for the relevant pollutants of concern used in the spreadsheet tool. Total Nitrogen is represented by TN and Total Phosphorus is represented by TP.

Table 1 – EMC Values for Various Pollutants and Land Uses (mg/L)

Pollutant	Comm.	Indust.	Instit.	Trans.	Multi-Family	Single-Family	Open Space
TN	0.62	0.75	0.62	0.28	0.58	0.58	0.85
TP	0.23	0.27	0.23	0.25	0.31	0.31	0.33

Using the STEPL tool with the values defined in the above tables, CDM generated a total pollutant load for the Build-Out Scenario with No Controls. Next, CDM used the STEPL tool to apply traditional stormwater controls to the 9,400 acres. The "wet detention" scenario in STEPL was used for this analysis. Finally, CDM applied the LID/Bioretention BMP Tool in the STEPL model to represent the Green Infrastructure/LID scenario. Figure 3 summarizes the results of this analysis.

Figure 3 – Summary of Pollutant Loads for BMP Scenarios



4.0 Summary and Conclusions

While the scenario using traditional stormwater controls provides significant pollutant reduction over the Build-Out with No Controls scenario, the analysis shows that additional benefits will be gained when the City implements the green infrastructure/LID ordinance required by the NPDES Phase II MS4 permit. Table 2 summarizes the predicted pollutant load reductions for each scenario.

Table 2 – Pollutant Load Reductions for Each Scenario

Scenario	% TN Reduction	% TP Reduction
Build-Out w/ No Controls	--	--
Build-Out w/ Traditional Controls	28%	37%
Build-Out w/ GI/LID Controls	34%	66%

The potential reductions in TN will be consistent with the TMDL for the Harpeth which is based on low dissolved oxygen (DO). In addition to water quality and TMDLs, additional benefits of green or LID approaches are:

- Reduced clearing and use of native vegetation which requires less irrigation,
- Protection for riparian corridors and habitat
- Reduced stream erosion and sedimentation,
- Reduced flooding from less runoff generation and protection of floodplain with the riparian corridors,
- Maintenance of baseflow during dry weather conditions, and
- Direct use of runoff for irrigation of planted areas, which reduces potable water demand and generation of wastewater flows for treatment,

The pollutant load reductions estimated in this memorandum will be incorporated into the STELLA model as an alternative stormwater practice. The cost for this option is minimal to the City since the regulatory-required controls will be implemented through new development. The City's anticipated costs will be associated with plan review and enforcement activities. It has been estimated that approximately 0.5 FTEs will be required for this activity. Consistent with estimates on previous IWRP alternatives, the cost for 0.5 FTEs at a technician level is approximately $25,000 (including overhead).

5.0 References

Environmental Protection Agency (May 2010). MS4 Improvement Guide. Retrieved from: http://www.epa.gov/npdes/pubs/ms4permit_improvement_guide.pdf

Environmental Protection Agency (April 2011). A Strategic Agenda to Protect Waters and Build More Livable Communities Through Green Infrastructure. Retrieved from: http://www.epa.gov/npdes/pubs/gi_agenda_protectwaters.pdf

Environmental Protection Agency (November 2011). Managing Wet Weather with Green Infrastructure. Retrieved from: http://cfpub.epa.gov/npdes/home.cfm?program_id=298