

# MICHIGAN'S STORMWATER STANDARDS

new requirements for development and redevelopment

*presented by:*

CARA DECKER, GRAND VALLEY METRO COUNCIL  
BRAD BOOMSTRA, PE, KENT COUNTY DRAIN OFFICE  
BOB HOEKSEMA, PhD, FISHBECK

# STORMWATER REGULATIONS



Clean Water Act



National Pollutant Discharge  
Elimination System (NPDES)

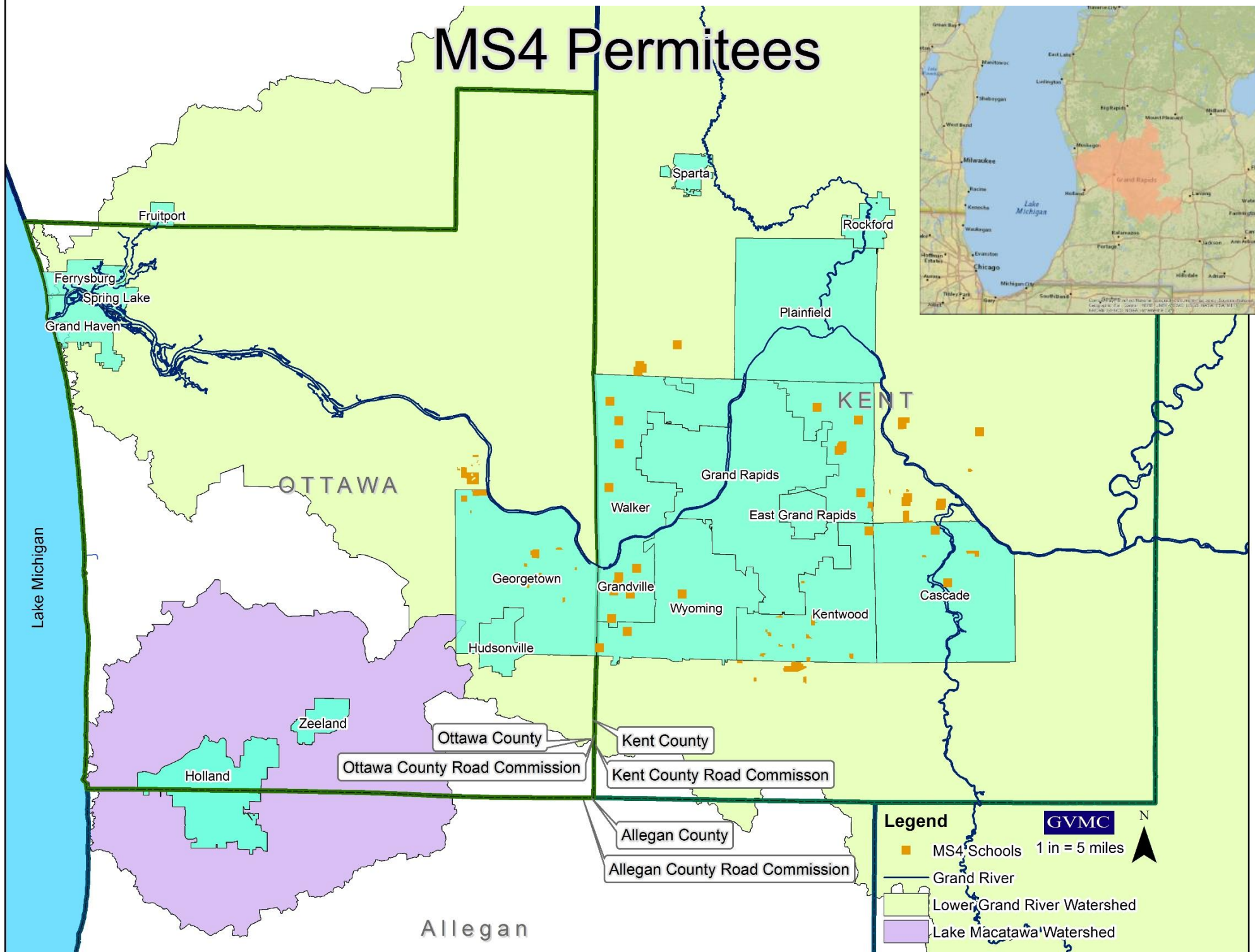


Municipal Separate Storm  
Sewer System (MS4)







Phase 1 and Phase 2

# MS4 Permitees



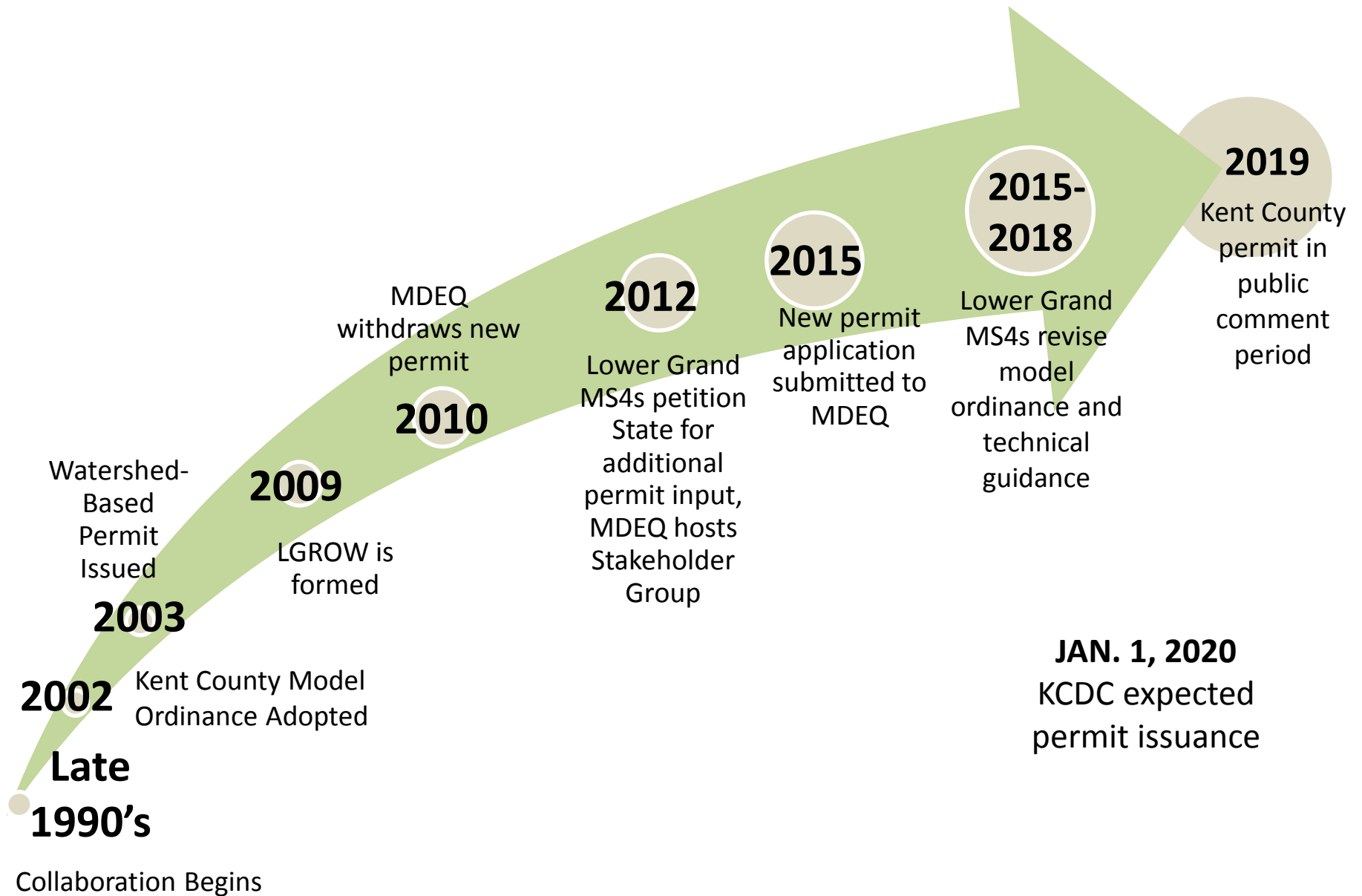
## Legend

-  MS4 Schools 1 in = 5 miles
-  Grand River
-  Lower Grand River Watershed
-  Lake Macatawa Watershed

**GVMC**



# 20 Years of Collaboration





# Regional Work

- Regional Framework
- Regulatory Authority
- Basic Design Standards
- Operation & Maintenance Requirements

## PROPOSED MODEL STORMWATER ORDINANCE

FOR LOCAL GOVERNMENTS  
WITHIN THE LOWER GRAND RIVER  
WATERSHED

2019

[LOCAL GOVERNMENT]

Prepared by the Stormwater Ordinance Committee of the  
Lower Grand River Watershed

**GVMC**

# STORMWATER STANDARDS MANUAL

## KENT COUNTY DRAIN COMMISSIONER

### SITE DEVELOPMENT RULES

Procedures and Design Standards for Stormwater Management



Ken Yonker  
Kent County Drain Commissioner  
1500 Scribner Avenue, NW  
Grand Rapids, MI 49504

March 2018

## Stormwater Standards Manual

Procedures & Design Criteria for  
Stormwater Management



CITY of WALKER  
4243 Remembrance Road Northwest, County of Kent  
Walker, MI

# WATER QUALITY



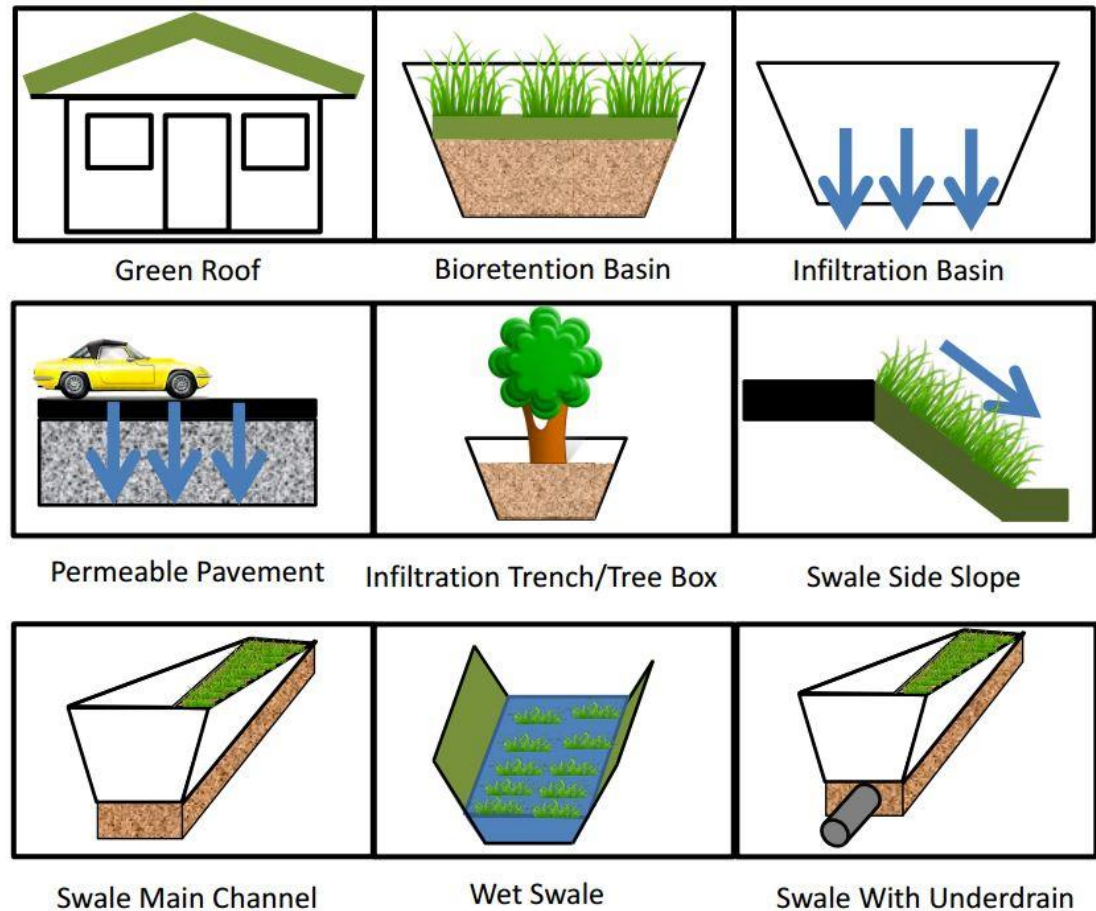
- Total Suspended Solids (TSS)
- Treat the first inch of rain (first flush)
- Reduce TSS 80% or below 80 mg/L



# WATER QUALITY

Treatment may be provided through:

- Settling Ponds
- Filtration
- Infiltration
- Absorption
- Chemical/mechanical treatment





# CHANNEL PROTECTION



- Large volumes of stormwater over extended periods can lead to channel erosion
- Retain new or additional runoff onsite from the 2-year, 24 hour event
- Infiltrate ALL of that water into the ground

In the Lower Grand River Watershed:

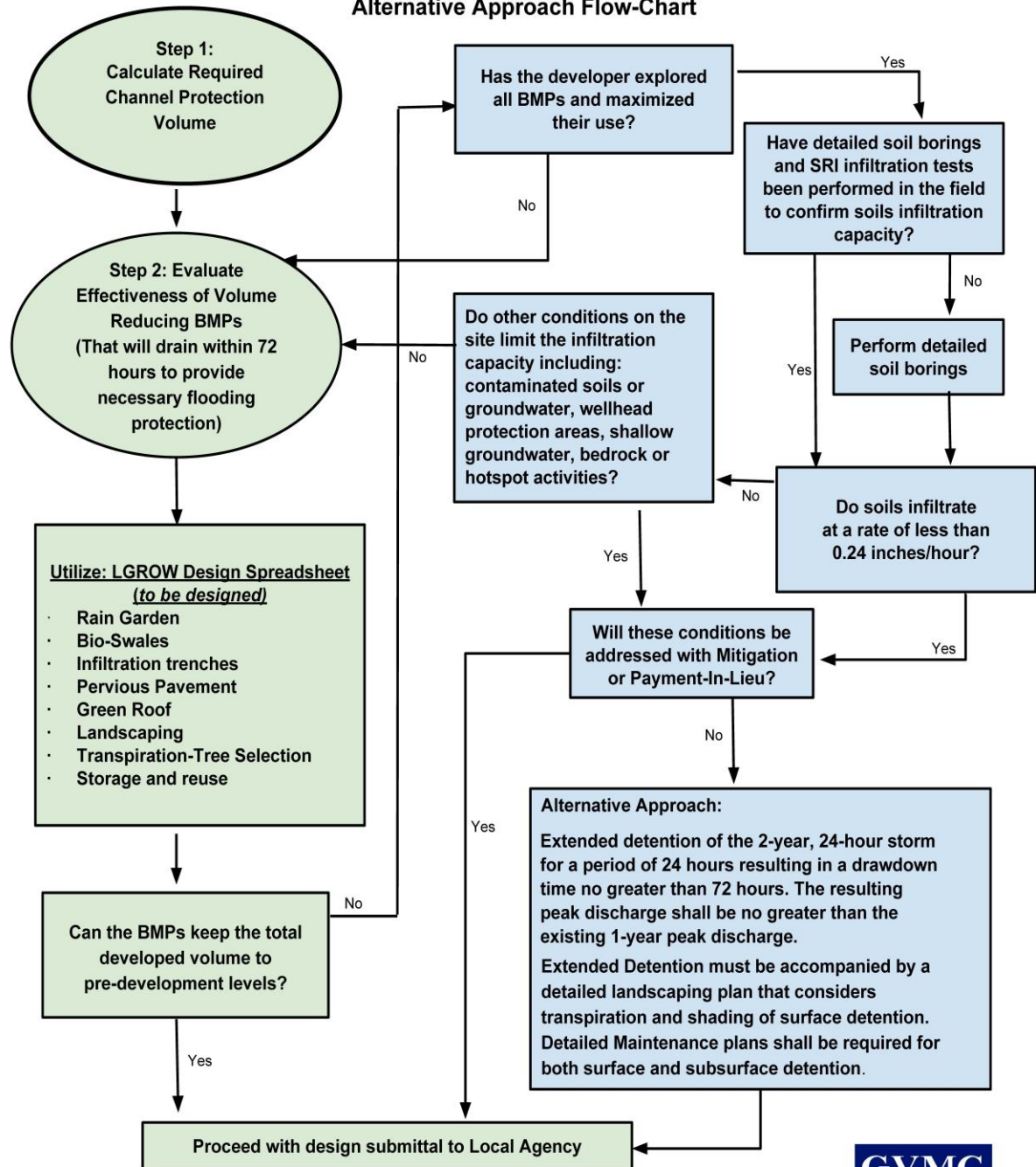
**Pre-development = the last land use prior to the planned new development or redevelopment**

# Alternative Approach

to volume restrictions...

If the developer explores every available alternative and poor soils won't allow a reasonable solution that includes extensive Low Impact Development (LID) techniques, "extended detention" may be used to address the 2 year storm volume increase. This must be the last option, not the first option.

## Alternative Approach Flow-Chart



- Utilize: LGROW Design Spreadsheet (to be designed)**
- Rain Garden
  - Bio-Swales
  - Infiltration trenches
  - Pervious Pavement
  - Green Roof
  - Landscaping
  - Transpiration-Tree Selection
  - Storage and reuse

**Alternative Approach:**  
Extended detention of the 2-year, 24-hour storm for a period of 24 hours resulting in a drawdown time no greater than 72 hours. The resulting peak discharge shall be no greater than the existing 1-year peak discharge.  
Extended Detention must be accompanied by a detailed landscaping plan that considers transpiration and shading of surface detention. Detailed Maintenance plans shall be required for both surface and subsurface detention.

# QUESTIONS?

Cara Decker

[cara.decker@gvmc.org](mailto:cara.decker@gvmc.org)

Brad Boomstra

[brad.boomstra@kentcountymi.gov](mailto:brad.boomstra@kentcountymi.gov)

Bob Hoeksema

[rjhoeksema@fishbeck.com](mailto:rjhoeksema@fishbeck.com)



## LGROW Design Spreadsheet - Details

- Developed for GVMC by Fishbeck
- Tailored to specific requirements of each MS4 permittee
- Kent County version available on LGROW website
- Tutorial and completed site example on LGROW website
- [www.lgrow.org/ms4](http://www.lgrow.org/ms4)

**Design Spreadsheet: Municipality of XYZ**

**Site Summary**

Version 3.1

- 1) After opening the spreadsheet you will need to enable the use of an embedded macro. Look for security warning above and click "Enable Content."
- 2) Data is entered in yellow cells. Green cells allow selection of items from pull down menus or buttons.
- 3) Comments are indicated by red triangles in cells. Further direction is provided in the LGROW Design Spreadsheet Tutorial.
- 4) The spreadsheet can be used to model a single discharge point from the site including structural BMPs in series or parallel.

**Project Description**

Development Name	Case Study No. 1	
Location	Urban Township	
Address		
Developer/Owner	John Doe	
Engineering Firm	Doe Engineering & Surveying, Inc.	
Engineer	RJH	
Date		

	Select if Yes	Notes
Drainage District	<input checked="" type="checkbox"/>	County Drain No. 1; detention basin discharges to drain located on east side of property
Watershed Policy	<input type="checkbox"/>	
Redevelopment	<input type="checkbox"/>	
MS4	<input checked="" type="checkbox"/>	Site located in MS4 urbanized area; disturbance > 1 acre; discharge to waters of the state
Hotspot	<input type="checkbox"/>	

Summary | Sub1 | Sub2 | Sub3 | Sub4 | Sub5 | Sub6 | Sub7 | Sub8 | Sub9 | Sub10 | Tc | Flood Control | Documentation | Settings | +



## Purpose of spreadsheet

- Document site characteristics
- Calculate key quantities following methodologies outlined in the new standards
  - Channel Protection Volume
  - Extended Detention Volume
  - Water Quality Volume
  - TSS Removal Efficiency
  - Flood Protection Volume
- Show that design meets standards
- Provides a method for submitting calculations for review

The spreadsheet does not do detailed BMP design. The guidelines provide detailed criteria for BMP design.

## Calculation Guidance and Validation

- Help with calculations: Stormwater Standards Manual and Documentation tab in spreadsheet
- Help with selections in spreadsheet: Internal notes

A Area of BMP [sqft]	V Available Water Volume [cft]	i Design Infiltration Rate [in/hr]
2,300	3,220	2.74

Enter the design infiltration rate from either:

1. Field permeability tests.
2. Table of design infiltration rates by USDA soil texture class (refer to Documentation tab).
3. Infiltration rate calculator for BMP media.

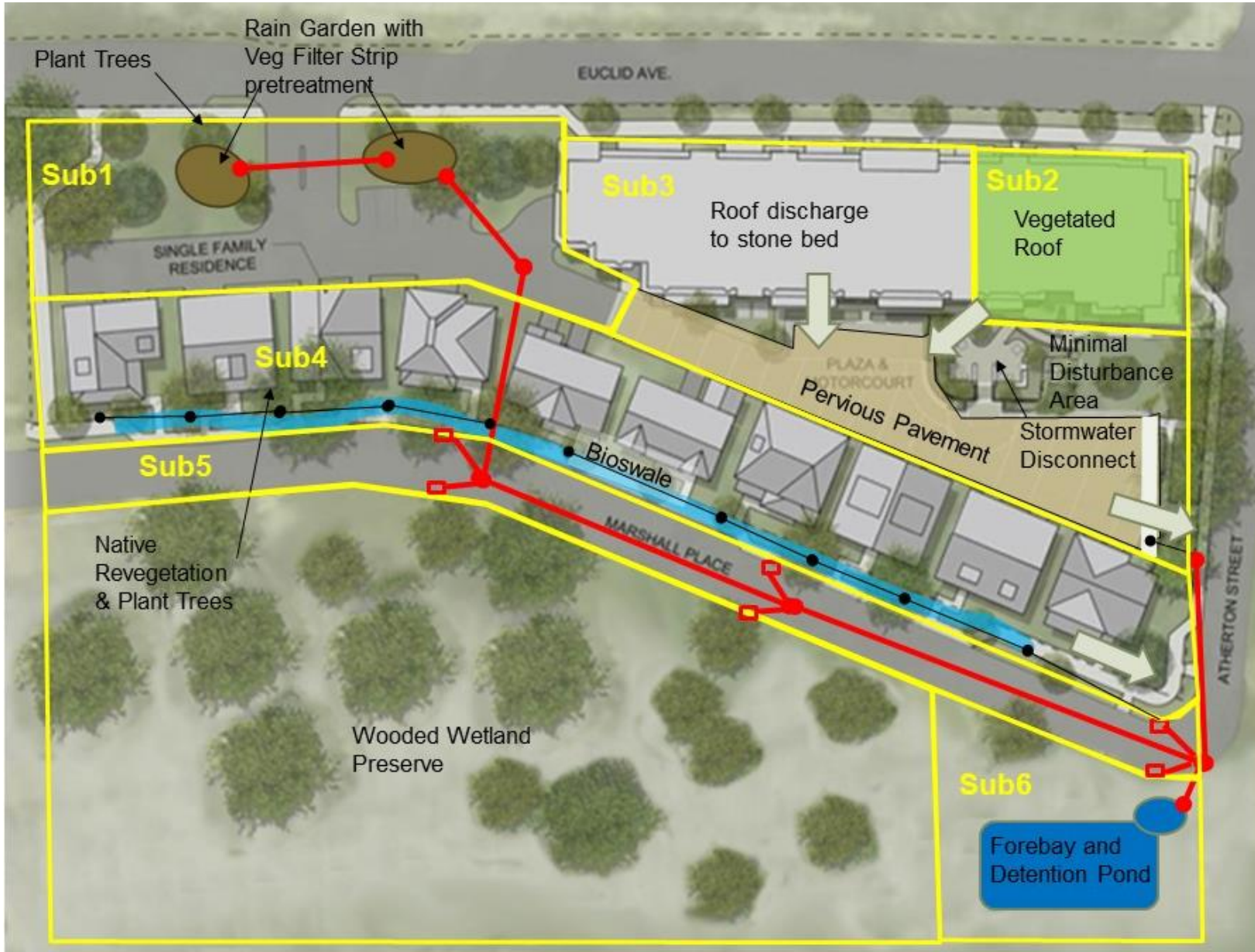
This should be the lesser of the underlying soil or the filter media.

- Tutorial and case study ([www.lgrow.org/ms4](http://www.lgrow.org/ms4))
- Most equations are simple allowing hand calculation check of results. Primary exception is detention flood control.
- Spreadsheet is complex. Many equations located in hidden areas.
- Use a simple test case to test calculations.

## Subcatchments

- A site might have distributed BMPs for channel protection (2-year event) and water quality (1-inch rain). Larger events (25- or 100-year) will discharge to flood control detention or retention pond.
- One spreadsheet is used for all areas draining to a single detention/retention pond.
- Subcatchments are defined by the BMPs:
  - Areas that drain to channel protection and/or water quality BMPs.
  - Areas that include the detention/retention pond and any pervious area surrounding it.
  - Any other areas ultimately draining to the detention/retention pond.

# LGROW Design Spreadsheet





## Spreadsheet tabs (15 visible)

- Summary: Site details and summary results
- Sub1 to Sub10: Channel protection and water quality calculations for each subcatchment
- Tc: Time-of-concentration calculations
- Flood Control: Flood control for the entire site (no subs).
- Documentation: Background for all calculations
- Settings: Settings selected by each MS4 permittee.

**Go to blank spreadsheet**

Summary | Sub1 | Sub2 | Sub3 | Sub4 | Sub5 | Sub6 | Sub7 | Sub8 | Sub9 | Sub10 | Tc | Flood Control | Documentation | Settings

**Channel protection** consists of retaining onsite the net increase in runoff volume between pre-development and post-development conditions for a 2-year, 24-hour storm using the Runoff Curve Number Method.

$$S = \frac{1000}{CN} - 10 \quad Q_v = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Each subcatchment is split into all combinations of land use and soil type (HSG). 2-year, 24-hour runoff volume is calculated from each for both existing and developed condition. The difference is the Channel Protection Volume.

**Water Quality.** Treatment of the runoff generated from 1-inch of rain over the developed portion of the site using the Small Storm Hydrology Method.

$$Vwq = ARv(1)(3630)$$

### Volumetric Runoff Coefficient, Rv

Directly Connected Impervious Area			Disturbed Pervious Area		
Flat Roofs/ Unpaved	Pitched Roofs	Paved	Sandy Soils (HSG A)	Silty Soils (HSG B)	Clayey Soils (HSG C&D)
0.815	0.965	0.980	0.035	0.120	0.2015

**Treatment:** Goal is to get 80% TSS removal via a combination of retentive and pass-through BMPs.

## Detention or Retention Volume for Flood Control

**Detention volume** is calculated via reservoir routing using the Modified Puls Method (see MDOT Drainage Manual). The goal is a target peak discharge for the flood control event. Runoff from upstream retentive BMPs is excluded from the inflow hydrograph. In Kent County the target discharge is 0.13 cfs/acre and the flood control event is 25-year.

**Retention volume** is computed as 85% of the difference between the runoff volume and the volume retained by upstream BMPs for the flood control event.

- Flood Control Volumes are computed for the entire site.
- Other methods are allowed in the standards.



## Example

**Area 1:** 4 acres, HSG B

Existing:

- All open space, fair condition

Developed:

- 1-acre flat roof
- 1.5-acre parking lot
- 0.5-acre native revegetation
- 1-acre open with rain garden/filter strip
- Rain garden sized for channel protection

**Area 2:** 1 acre, HSG D

Existing:

- All open space, fair condition

Developed:

- 0.5-acre paved
- 0.5-acre open, good condition
- No channel protection due to poor soils
- Some water quality treatment in catch basins.

**Detention:** 1 acre, HSG D

Existing:

- All open space, fair condition

Developed:

- Wet detention pond and sediment forebay sized for flood protection

**Go to spreadsheet**

# QUESTIONS?

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