Welcome!

Storm Water Infiltration Workshop

Waukesha - March 14, 2007

Sponsored by Waukesha County Land Resources Division, in cooperation with:

- SE Fox Basin Partnership
- University of Wisconsin – Extension
- Upper Fox MS4 Storm Water Permit Group

Workshop Agenda

- Ordinance & Soils Overview (8:00-8:45)
- Rain Gardens (8:45-9:15)
- Bioretention (9:15-10:00)
- Break (10:00 - 10:15)
- Infiltration Basin/Trench (10:15 – 11:15)
- Plants are Key (11:15 - 12:00)
- Implementation Roundtable (12:00 - 12:30)
- Open Displays & Lunch (12:30-1:30)

Workshop Format

- Fast paced
- Skim over the basics
- Focus on implementation experiences
- Time for questions after each section

Presentation Outline

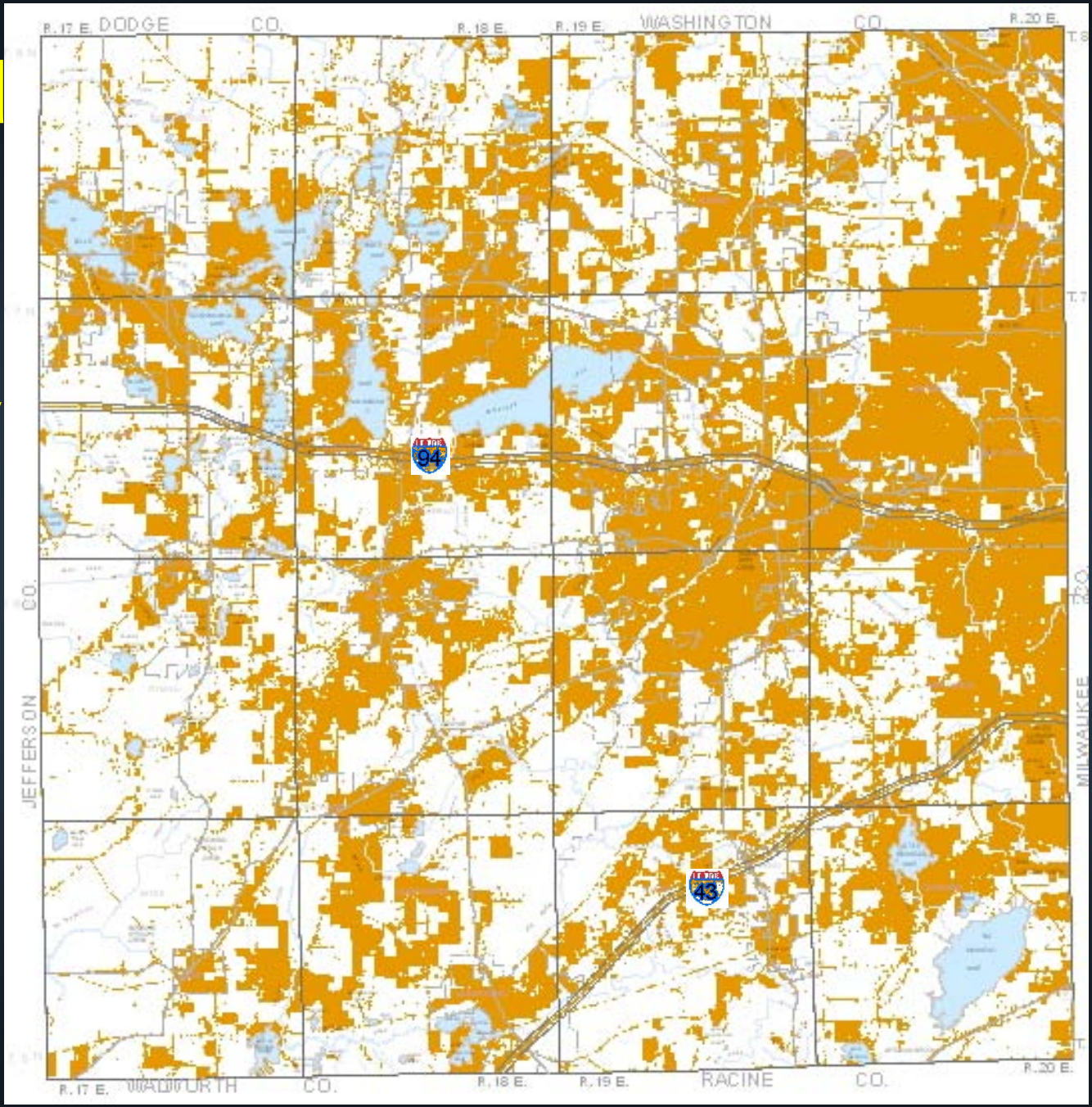
- Background information
- Ordinance infiltration requirements
- Soils challenges, requirements & resources
- Basement flooding prevention
- BMP maintenance agreements
- Wrap-up (recommended process)

Ordinance & Soils Overview

Perry Lindquist, Land Resources Manager
Waukesha County Department of Parks and Land Use

Developed Lands 2005

Waukesha County

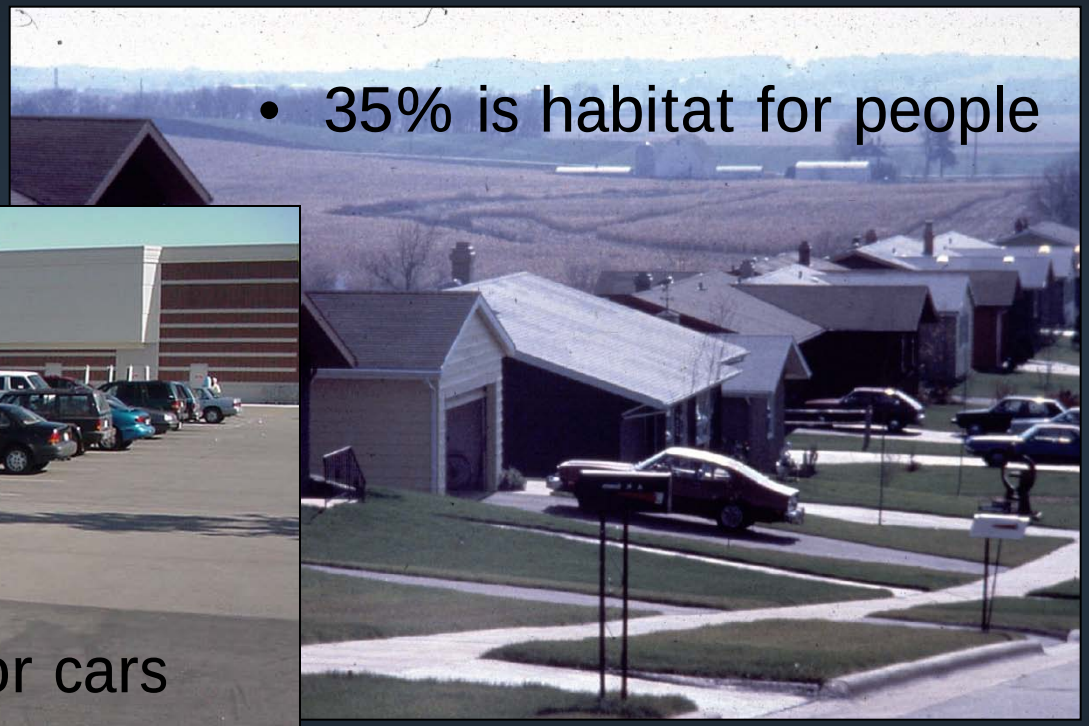


- Lawn grass is #1 crop
- Convert 4+ sq. mi./year

The “Hard” Facts

(Impervious Cover)

- 1/2 acre per person

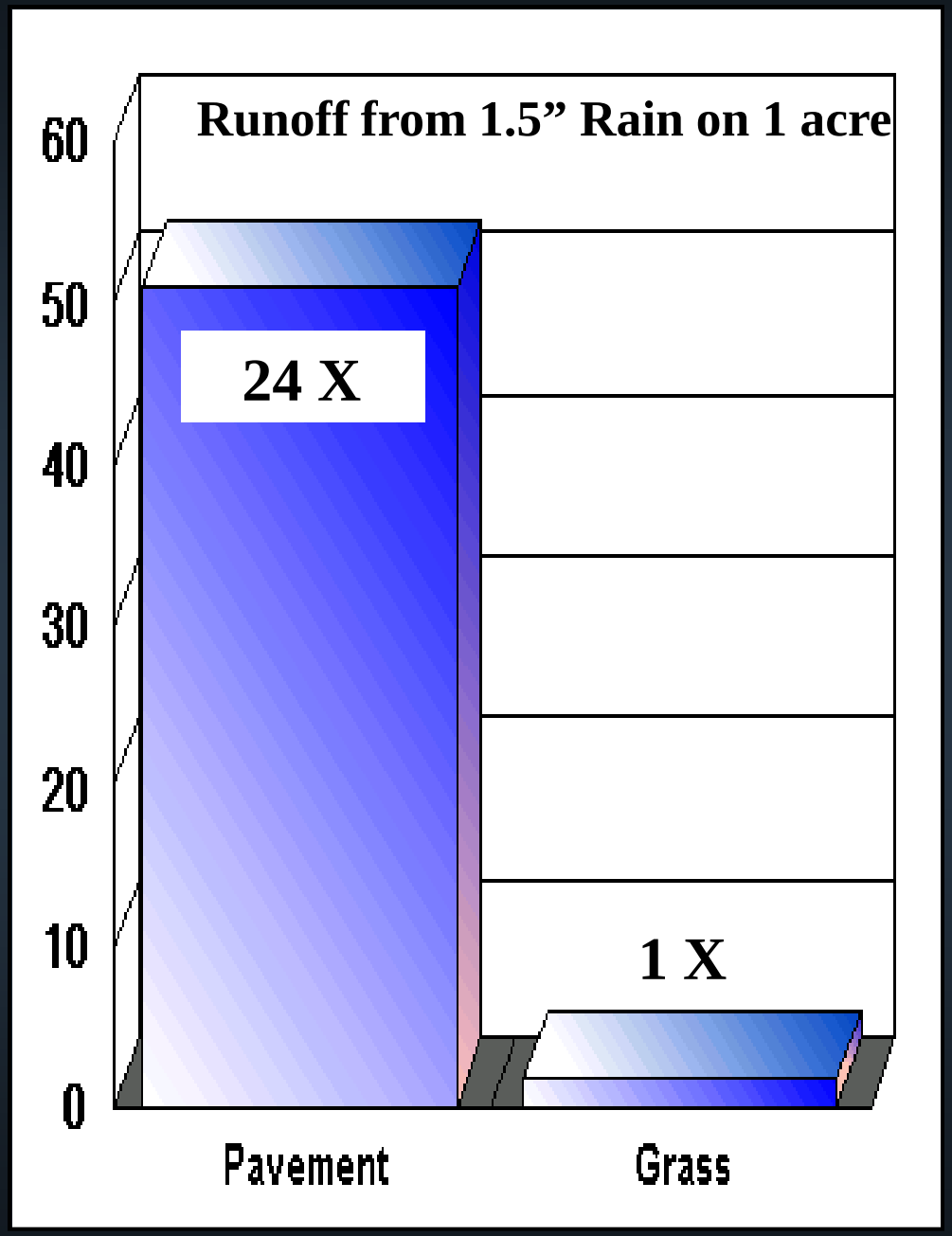


- 35% is habitat for people

- 65% is habitat for cars
- 10 parking spaces per car

Impervious Beginnings

- Rooftops
- Pavement
- No infiltration



The Underground Connection

Out of site…

…out of mind

The “Disappearing” Stream

- Less infiltration
- Loss of base flow

The “Growing” Stream

- Larger volumes of runoff
- Faster flows
- Occurring more often

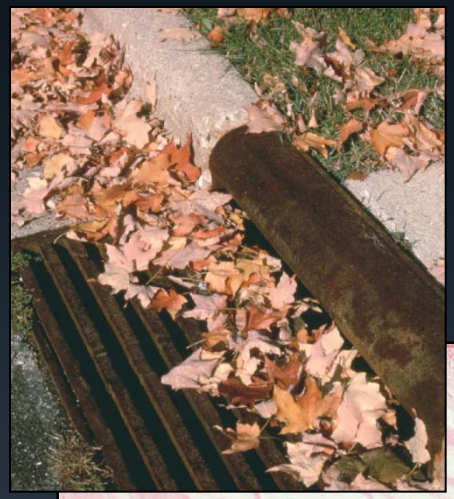
Agricultural Impacts

- Eroding channels

- Chronic wetness

The Dirty Facts

- Human contact? (bacteria)
- More oil than tanker spills
- Drinking water?



The Evolution of a Stream

Rural ……. Urban

The Stream Evolution Up Close

Research shows:

10% Impervious:
Stream is hurting

25% Impervious:
Stream is dead

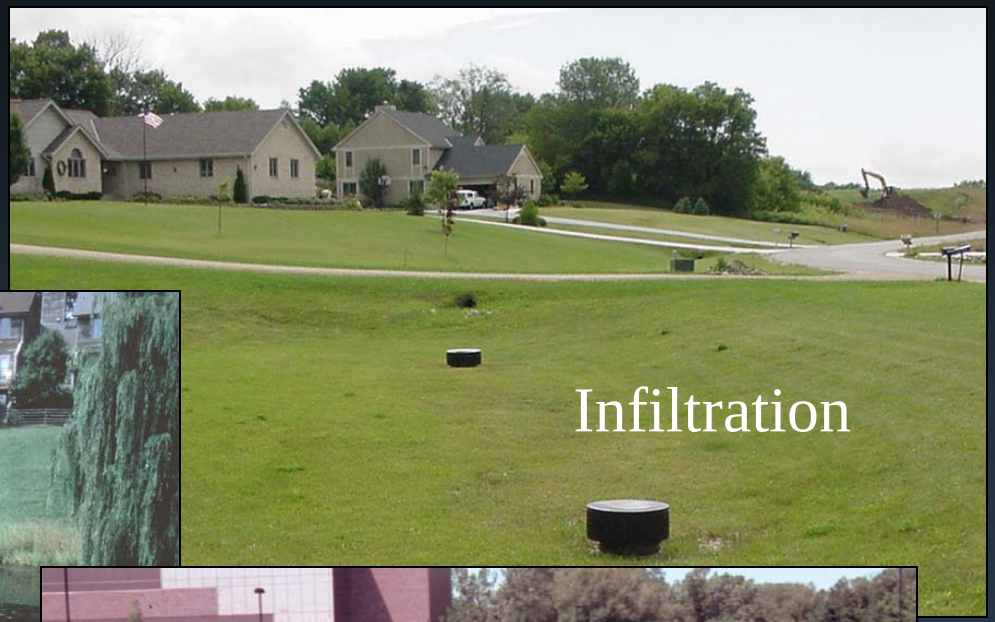
Dead – with or without “buffer”

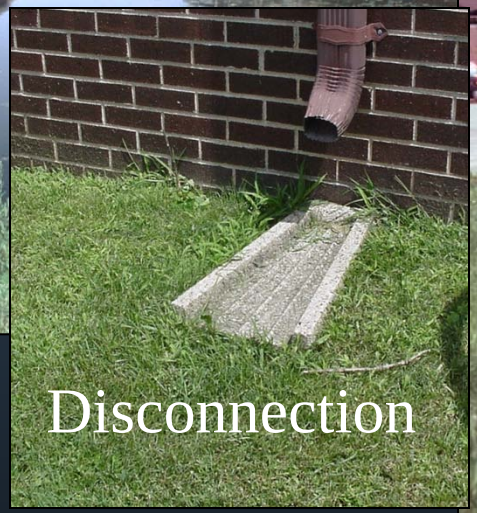
Solutions

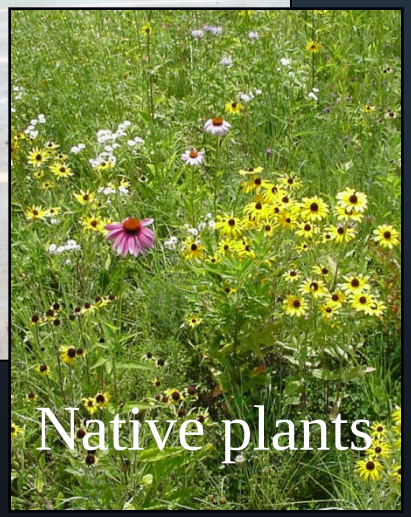
- Land use planning
  - Cluster development/preserve natural areas & environmental corridors
  - Reserve space for storm water mgt.
- Storm water management
  - Peak flows (1970-80's)
  - Water quality (1990's)
  - Runoff volumes/infiltration (2000's)
- Infiltration is a paradigm shift - not just reserving the low point for storm water

Storm Water Mgt.

"Treatment Train"







Infiltration is a piece of the puzzle

Customize Plans to Site

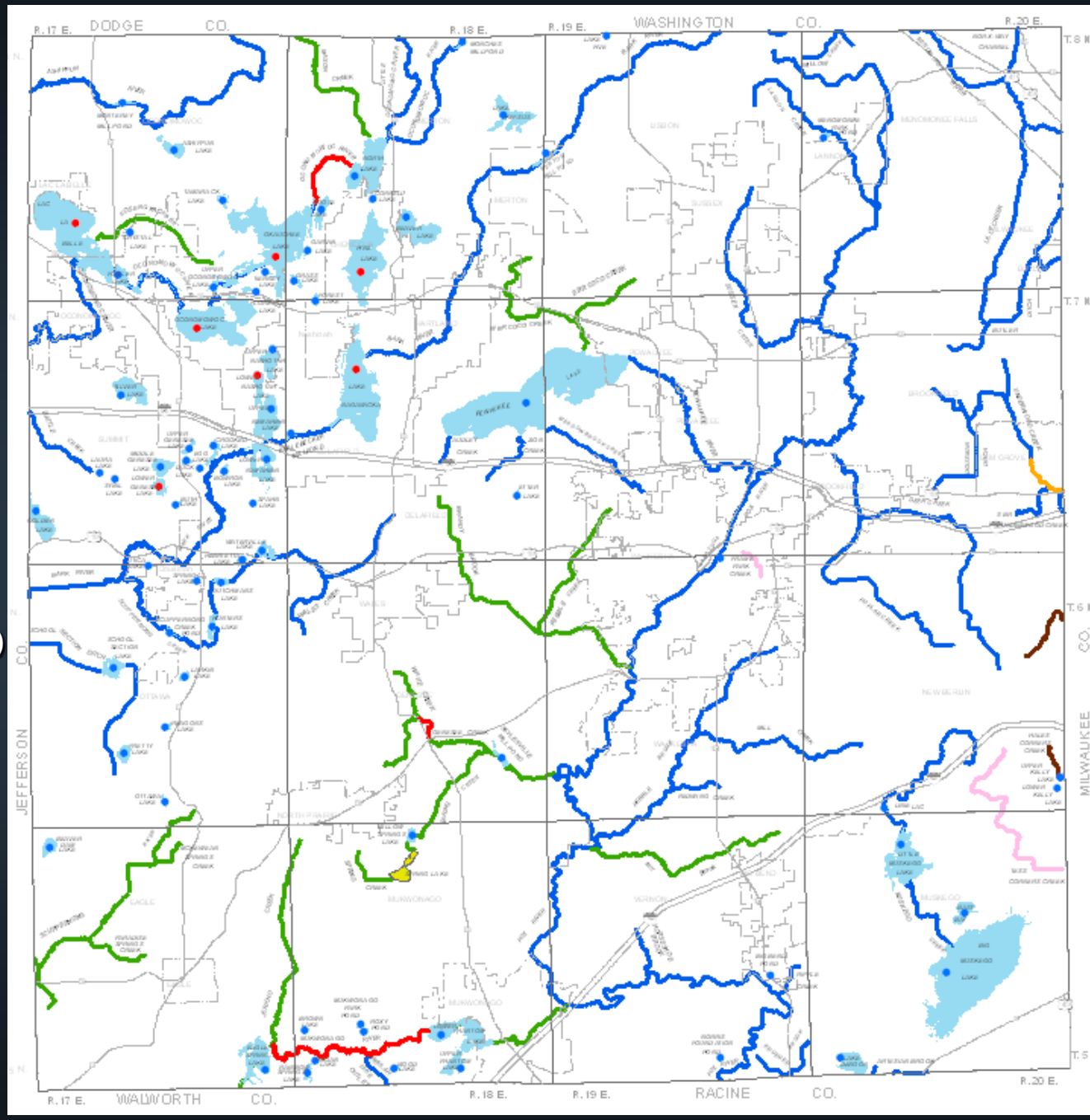
- Consider:
  - Predevelopment discharge points
  - Potential downstream property impacts
  - Adequacy of drainage facilities
  - Receiving water resources
- Meet with regulator to agree on goals before spending a lot of design time

Water Resource Classifications

Waukesha County

Legend

- Lake Supports Cold Water Species (7)
- Lake Supports Fish and Aquatic Life (73)
- Outstanding Resource Water (1-Spring Lake)
- Warm Water Streams (40)
- Cold Water Streams (10)
- Exceptional Resource Waters (3)
- Limited Forage Fish (1)
- Limited Aquatic Life (2)
- Special Variance Waters (1)



Storm Water Infiltration Law

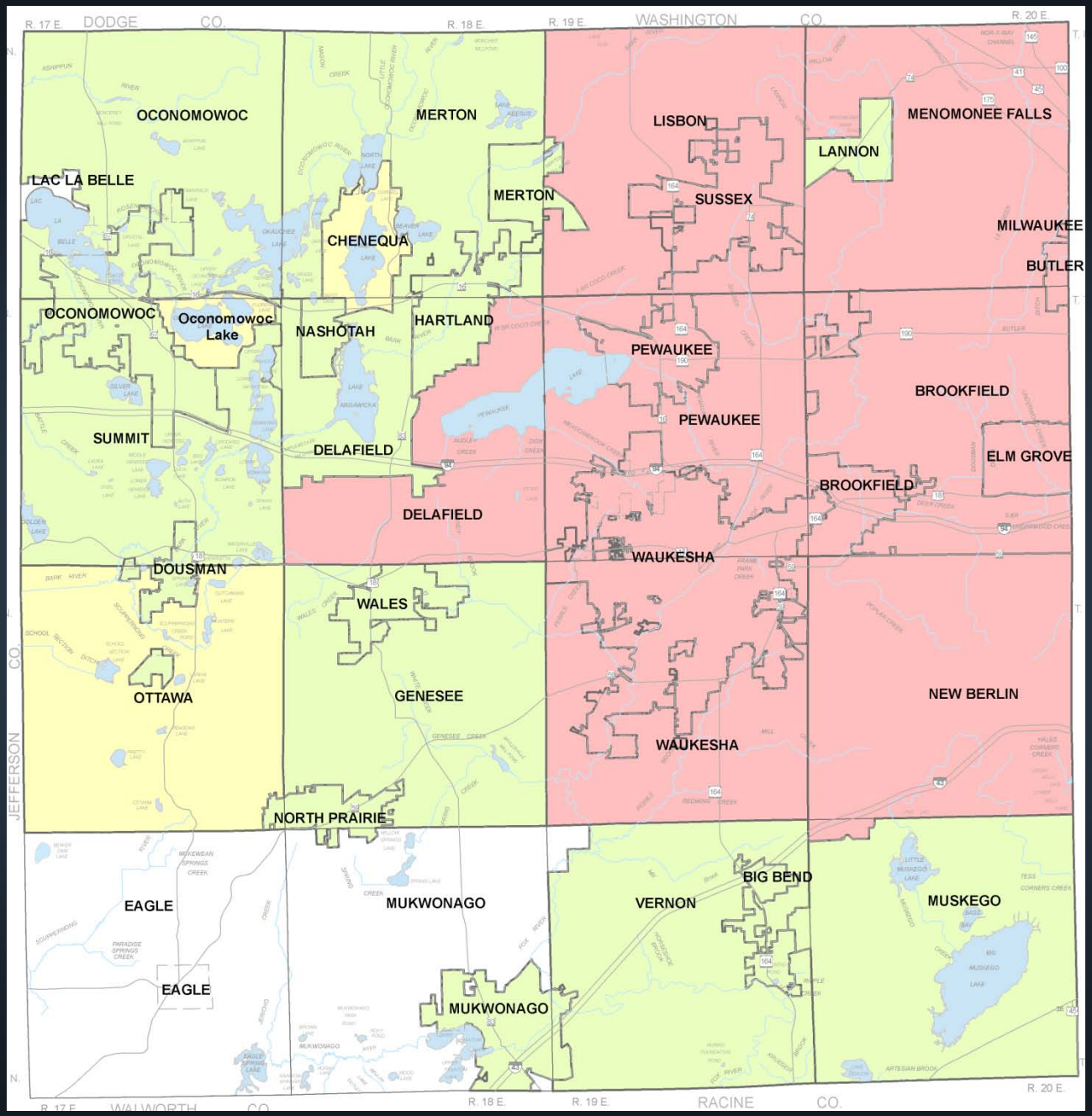
- NR 151- Runoff Management (2002)
  - 1997 legis./NPS performance stds. (ag & urban)
  - Included minimum infiltration standards
- NR 216 – Storm Water Discharge Permits (2004) - Phase II
  - 1987 Clean Water Act revision/EPA mandate
  - Incorporated infiltration standards into:
    - Community permits (MS4's)
    - Construction site permits (>1 acre)
  - Requires MS4 ordinances to address

Waukesha County Municipalities with MS4 Permits

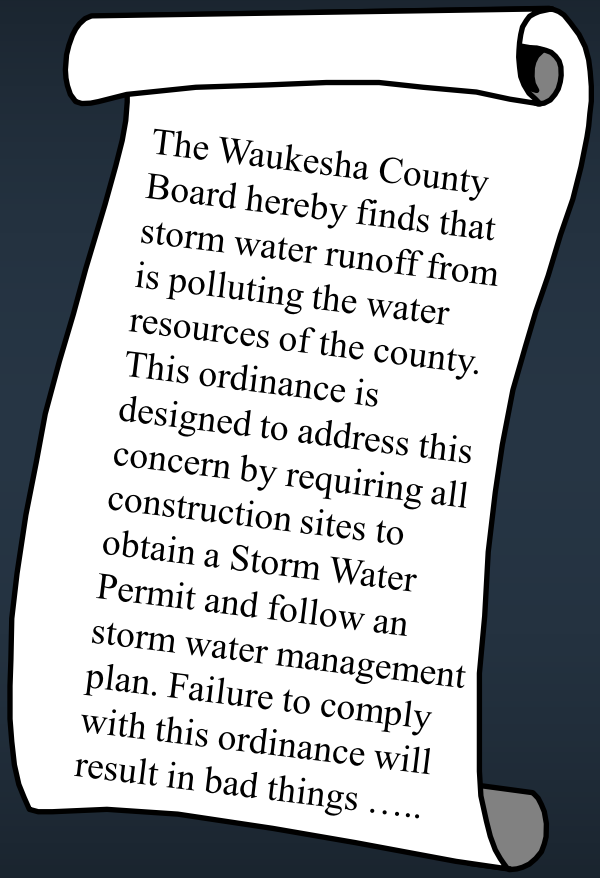
Legend

- Phase I (13)
- Phase II (18)*
- Exempted (3)
- Not required (4)

** Includes Waukesha Co.*



Storm Water Ordinances



Infiltration Requirements

- Guiding principles - to the "*maximum extent practicable*":
  - Minimize soil compaction & maintain predevelopment groundwater recharge areas (compensation)
  - Minimize impervious surfaces & drain them to vegetated areas for filtering and infiltration
  - Emphasize vegetated swales, warm season & wetland plantings & low flow velocities
  - Different strategies for "clean" versus "dirty" runoff
  - Distribute storm water bioretention and infiltration BMPs throughout the site plan for large developments

Infiltration Requirements

- New residential:
  - **25%** of the 2-year, 24-hour storm, or
  - 90% predevelopment infiltration volume
- New non-residential:
  - **10%** of the 2-year, 24-hour storm, or
  - 60% predevelopment infiltration volume

Filtering layer

- Minimum soil filtering/distance to bedrock or seasonal high groundwater:
  - 5 feet with 10% fines (#200 sieve)
    - Comm., industrial, parking lots, arterials, etc.
  - 3 feet with 20% fines (#200 sieve)
    - All other areas except roof runoff
  - Another medium with an equivalent level of protection, as determined by the LRD
- Does not apply to roof runoff

Pretreatment

- Parking lot & road runoff from commercial, industrial and institutional areas to prevent:
  - System clogging
  - Groundwater contamination
- Options (not limited to):
  - Oil & grease separators
  - Bioretention
  - Filtration swales/strips
- May infiltrate higher ratio of “clean water”

Do NOT Infiltrate

- Runoff from:
  - Outdoor material storage facilities and loading docks for tier 1 & 2 industrial facilities
  - Vehicle fueling & maintenance areas, not including roof canopies
- Near karst (bedrock) features that may serve as a conduit to groundwater
- Within 400 feet of municipal wells or 100 feet of private wells

Note: “Injection wells” must follow NR 815

Infiltration Rules of Thumb/Policies

- If first ½ inch of runoff is infiltrated, water quality and infiltration standards are both met
  - May need pretreatment
- Compensate for filling of internally drained areas, depressions
- Count only dead storage volume
- Do not accept SLAMM to verify infiltration compliance
  - Too much abuse
  - May contradict guiding principles
  - Not necessary – use the 10-25% rules (2-year storm)

Infiltration Credits

- Storage on green roofs
- Capture/reuse of runoff
  - Irrigation, etc.

Infiltration Exemptions

- Frozen soils
- “If soils have a measured infiltration rate of less than 0.6 inches per hour and the LRD determines it would be impracticable to modify existing soil conditions”
  - “Measured” by soil investigations or double-ring infiltrometer
  - May remove limiting layer in all or part of the BMP

Exemption Requests Must Use:

- NRCS Soil Survey rates

  <u>or</u>

- On-site testing

NRCS Rates

		Rate	Infiltratior
	Sand and gravel	>20.0	Exessively
	Sand	>20.0	Exessively
	Fine sand	>20.0	Exessively
	Gravelly loam	6.3-20.0	Very High
	Loamy sand	6.3-20.0	Very High
	Muck	2.0-6.3	High
	Muck and peat	2.0-6.3	High
	Sandy loam	2.0-6.3	High
	Silt and fine sand	0.63-2.0	Moderate
	Silt loam	0.63-2.0	Moderate
	Silty clay loam	0.63-2.0	Moderate
	Loam	0.63-2.0	Moderate
	Clay loam	0.63-2.0	Moderate
	Sandy clay loam	0.63-2.0	Moderate
	Marl	0.63-2.0	Moderate
	Sedimentary peat	0.20-0.63	Low
	Silty clay	0.06-0.20	Low
	Clay	0.06-0.20	Low
	Dolomite	NA	Low

NOT DNR "Design Rates"

Site evaluation Standard 1002

Table 2: Design Infiltration Rates for Soil Textures Receiving Stormwater

Soil Texture[1]	Design Infiltration Rate Without Measurement inches/hour[2]
Coarse sand or coarser	3.60
Loamy coarse sand	3.60
Sand	3.60
Loamy sand	1.63
Sandy loam	0.50
Loam	0.24
Silt loam	0.13
Sandy clay loam	0.11
Clay loam	0.03
Silty Clay loam	0.04[3]
Sandy clay	0.04
Silty clay	0.07
Clay	0.07

[1]Use sandy loam design infiltration rates for fine sand, loamy fine sand, very fine sand, and loamy fine sand soil textures.

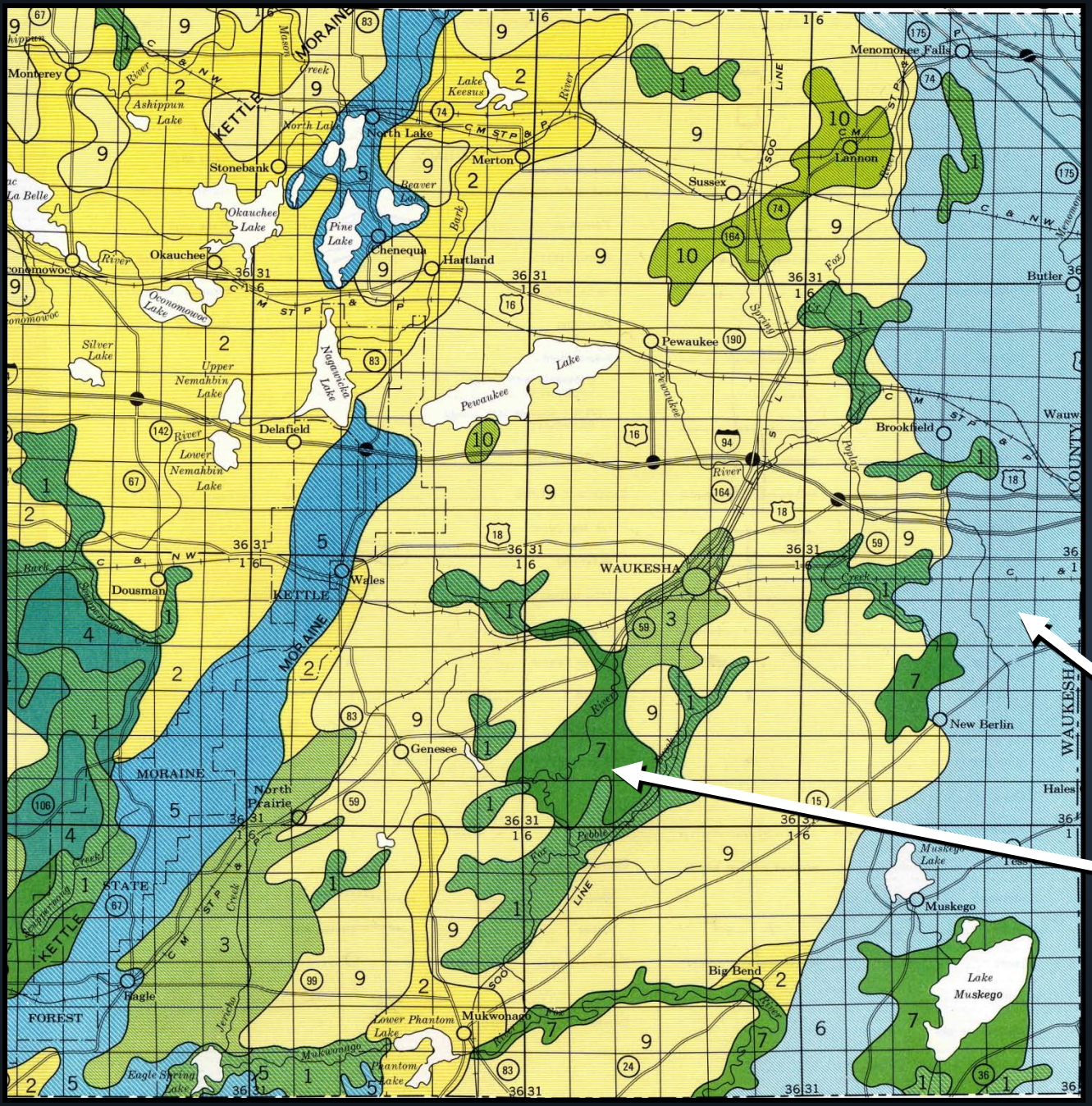
[2] Infiltration rates represent the lowest value for each textural class presented in Table 2 of Rawls, 1998.

[3] Infiltration rate is an average based on Rawls, 1982 and Clapp & Hornberger, 1978.

Table 3: Total Correction Factors Divided into Measured Infiltration Rates

Ratio of Design Infiltration Rates[1]	Correction Factor
1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

[1]Ratio is determined by dividing the design infiltration rate (Table 2) for the textural classification at the bottom of the infiltration device by the design infiltration rate (Table 2) for the textural classification of the least permeable soil horizon. The least permeable soil horizon used for the ratio should be within five feet of the bottom of the device or to the depth of the limiting layer.



Generalized Soils of Waukesha County

High clay soils

High water table soils

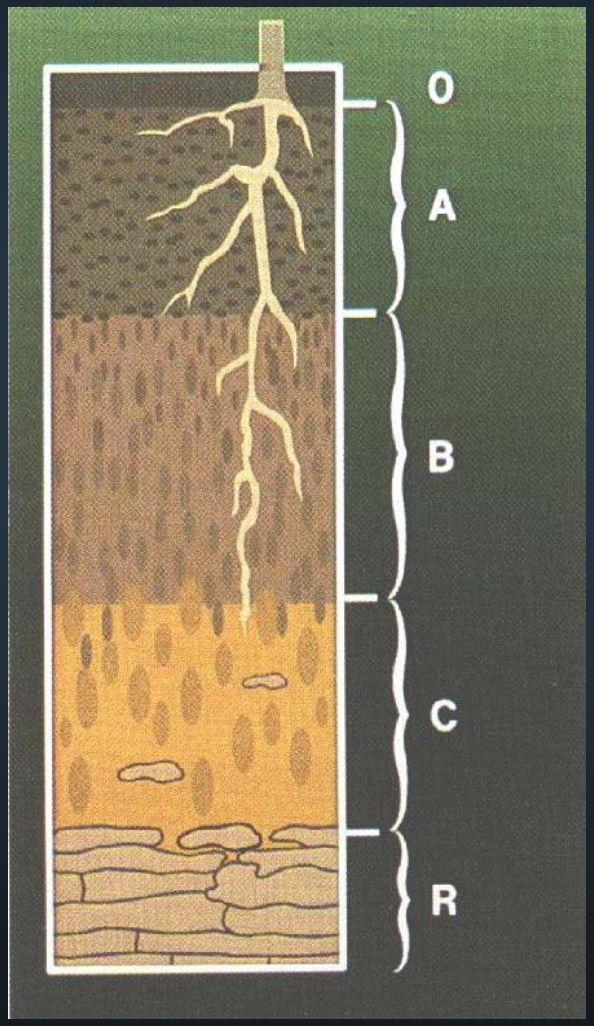
Technical Exemption Process

- No self-proclaimed exemptions
- Must submit written exemption request
  - Explanation, soils data, maps, calculations, etc.
- Determination by LRD in accordance with ordinance criteria
  - “Impractical” due to site conditions…beyond the control of the applicant (site plan not an excuse)
- Can appeal LRD determination and ask for variance (Planning Commission decision)

Top 3 Infiltration Challenges

1. Soils
2. Soils!
3. Soils!!

Site planning, BMP location, design & construction, basement location & design, coordination with septic planning, etc.



Soils Challenges

- Get soil profile evaluations <u>early!</u>
  - Required for “Preliminary Review Letter” process
    - Applies to all new preliminary plats, CSMs, etc. (add ½ ac. Impervious)
  - Determines BMP feasibility and flags site plan problems early

DNR Technical Standard 1002

Site Evaluation for Storm Water Infiltration

- Specifies min. no. of pits, depth, etc. for each BMP type

Table 1: Evaluation Requirements Specific to Proposed Infiltration Devices

Infiltration Device	Tests Required[1]	Minimum Number of Borings/Pits Required	Minimum Drill/Test Depth Required Below the Bottom of the Infiltration System
Irrigation Systems[2]	Pits or borings	NA[2]	5 feet or depth to *limiting layer*, whichever is less.
Rain Garden[2]	Pits or Borings	NA[2]	5 feet or depth to limiting layer, whichever is less.
Infiltration Trenches (≤ 2000 sq feet impervious drainage area)	Pits or borings	1 test/100 linear feet of trench with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer, whichever is less.
Infiltration Trenches (> 2000 sq ft of impervious drainage area)	• Pits or borings • Mounding potential	1 pit required and an additional 1 pit or boring/100 linear feet of trench, and sufficient to determine variability	Pits to 5 feet or depth to limiting layer Borings to 15 feet or depth to limiting layer
Bioretention Systems	• Pits or borings • Mounding potential	1 test/50 linear feet of device with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
Infiltration Grassed Swales	Pits or borings	1 test/1000 linear feet of swale with a minimum of 2, and sufficient to determine variability	5 feet or depth to limiting layer
Surface *Infiltration Basins*	• Pits or borings • Mounding potential	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer
Subsurface Dispersal Systems greater than 15 feet in width.	• Pits or borings • Mounding potential	2 pits required per infiltration area with an additional 1 pit or boring for every 10,000 square feet of infiltration area, and sufficient to determine variability	Pits to 10 feet or depth to limiting layer Borings to 20 feet or depth to limiting layer

[1]Continuous soil borings shall be taken using a bucket auger, probe, split-spoon sampler, or shelby tube. Samples shall have a minimum 2-inch diameter. Soil pits must be of adequate size, depth and construction to allow a person to enter and exit the pit and complete a morphological soil profile description.

[2]Information from Step B is adequate to design rain gardens and irrigation systems.

DNR Technical Standard 1002

Four step soil evaluation process

1. Initial screening (maps, etc.)
2. Field verification (soil pits)
3. Evaluation of specific infiltration areas
   - Using design or measured infiltration rates
4. Soil & site evaluation report

Site Screening/County GIS Tools

- Soil maps
- Soils database (interactive)
- Soil interpretive maps

} Being updated (soon!)

“Waukesha County GIS”

http://maps.waukeshacounty.gov/imf/imfIdentifyDefault.jsp?loi...

http://maps.waukeshacounty.gov/imf/imfIdentifyDefault.jsp?loid=351356&lyr=70&x1=245899

Google Go Settings

Norton Fraud monitoring is on Options

Coordinate Position

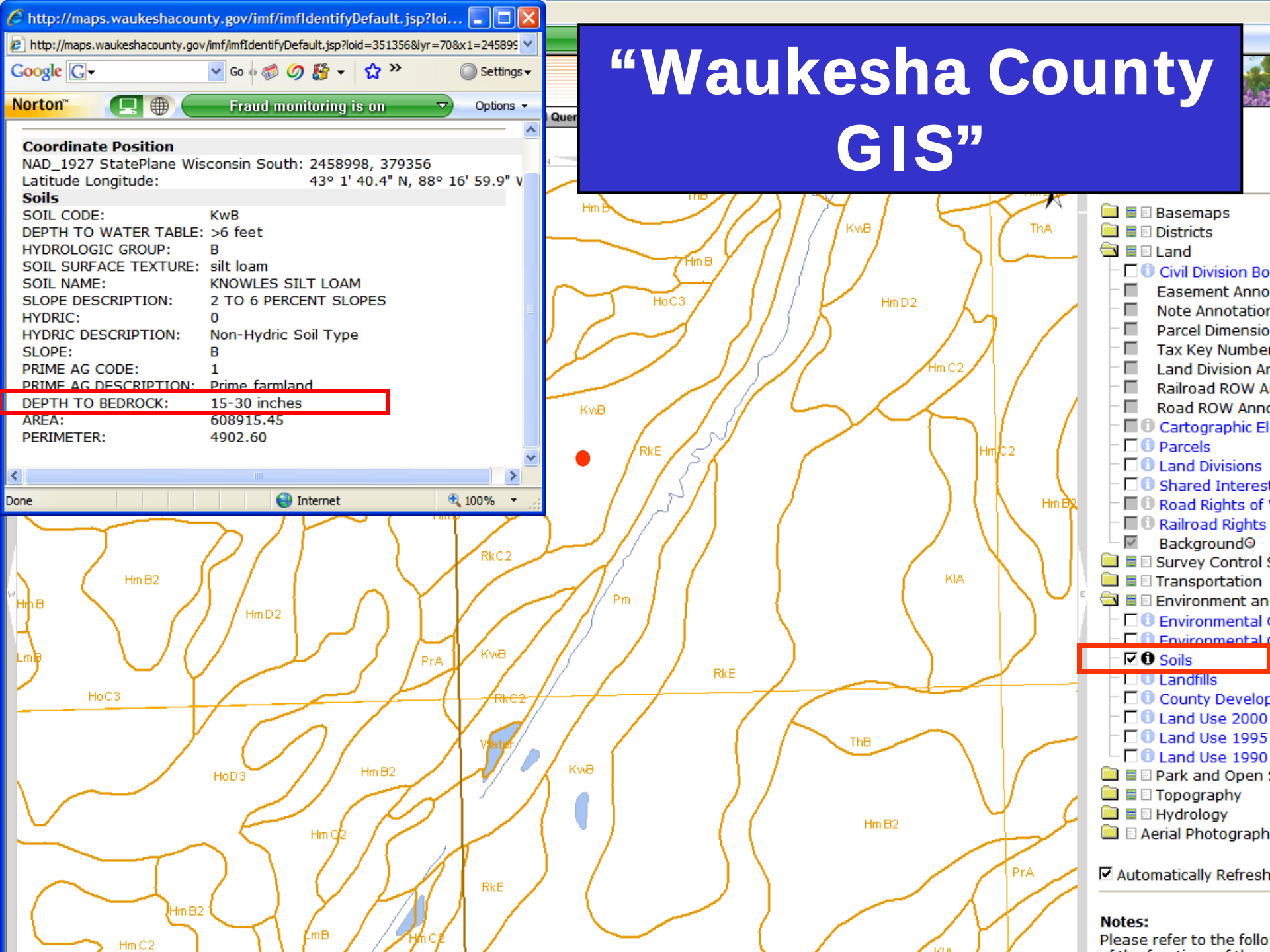
NAD_1927 StatePlane Wisconsin South: 2458998, 379356

Latitude Longitude: 43° 1' 40.4" N, 88° 16' 59.9" W

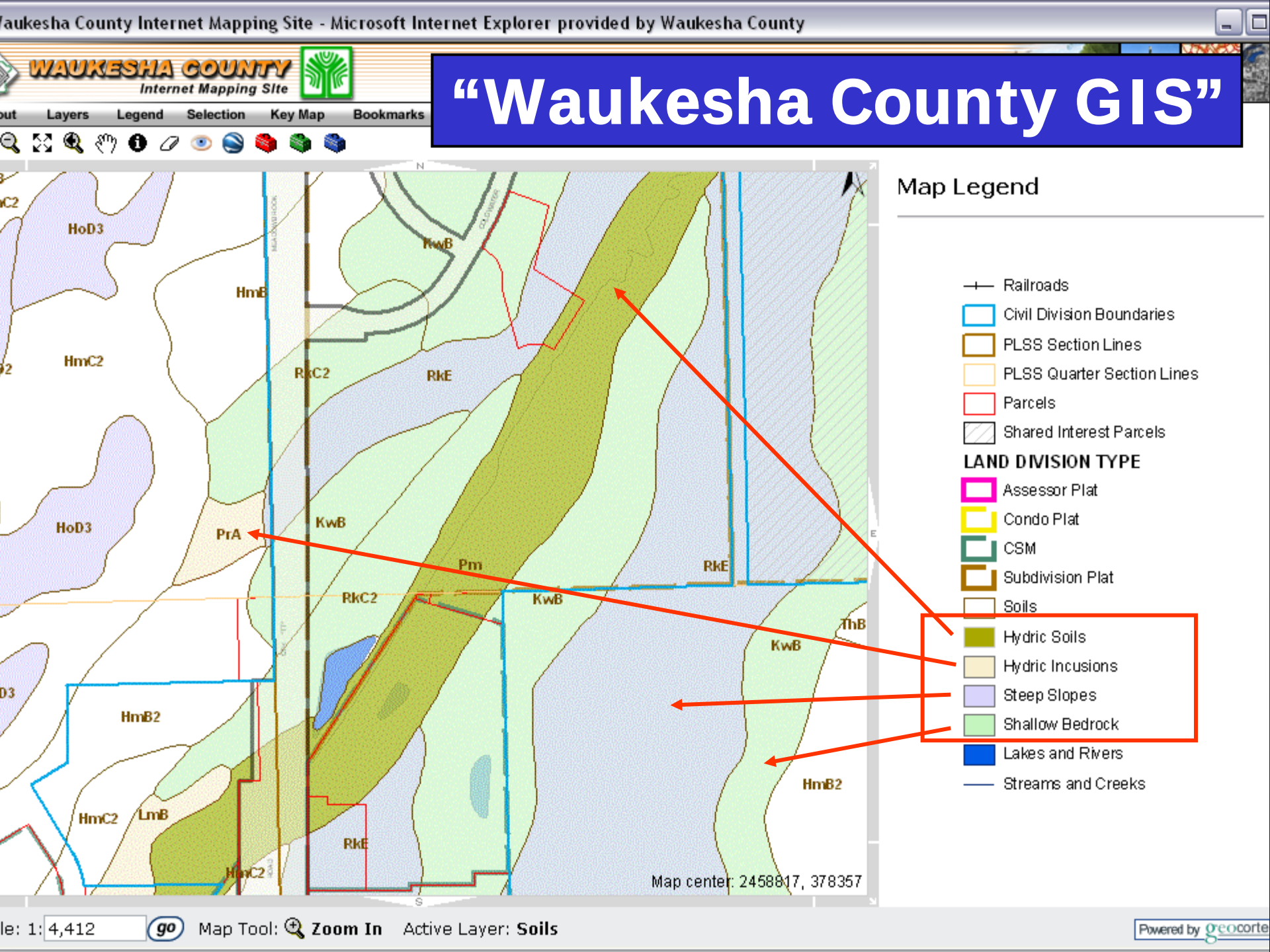
Soils

SOIL CODE:	KwB
DEPTH TO WATER TABLE:	>6 feet
HYDROLOGIC GROUP:	B
SOIL SURFACE TEXTURE:	silt loam
SOIL NAME:	KNOWLES SILT LOAM
SLOPE DESCRIPTION:	2 TO 6 PERCENT SLOPES
HYDRIC:	0
HYDRIC DESCRIPTION:	Non-Hydric Soil Type
SLOPE:	B
PRIME AG CODE:	1
PRIME AG DESCRIPTION:	Prime farmland
DEPTH TO BEDROCK:	15-30 inches
AREA:	608915.45
PERIMETER:	4902.60

Done Internet 100%



"Waukesha County GIS"

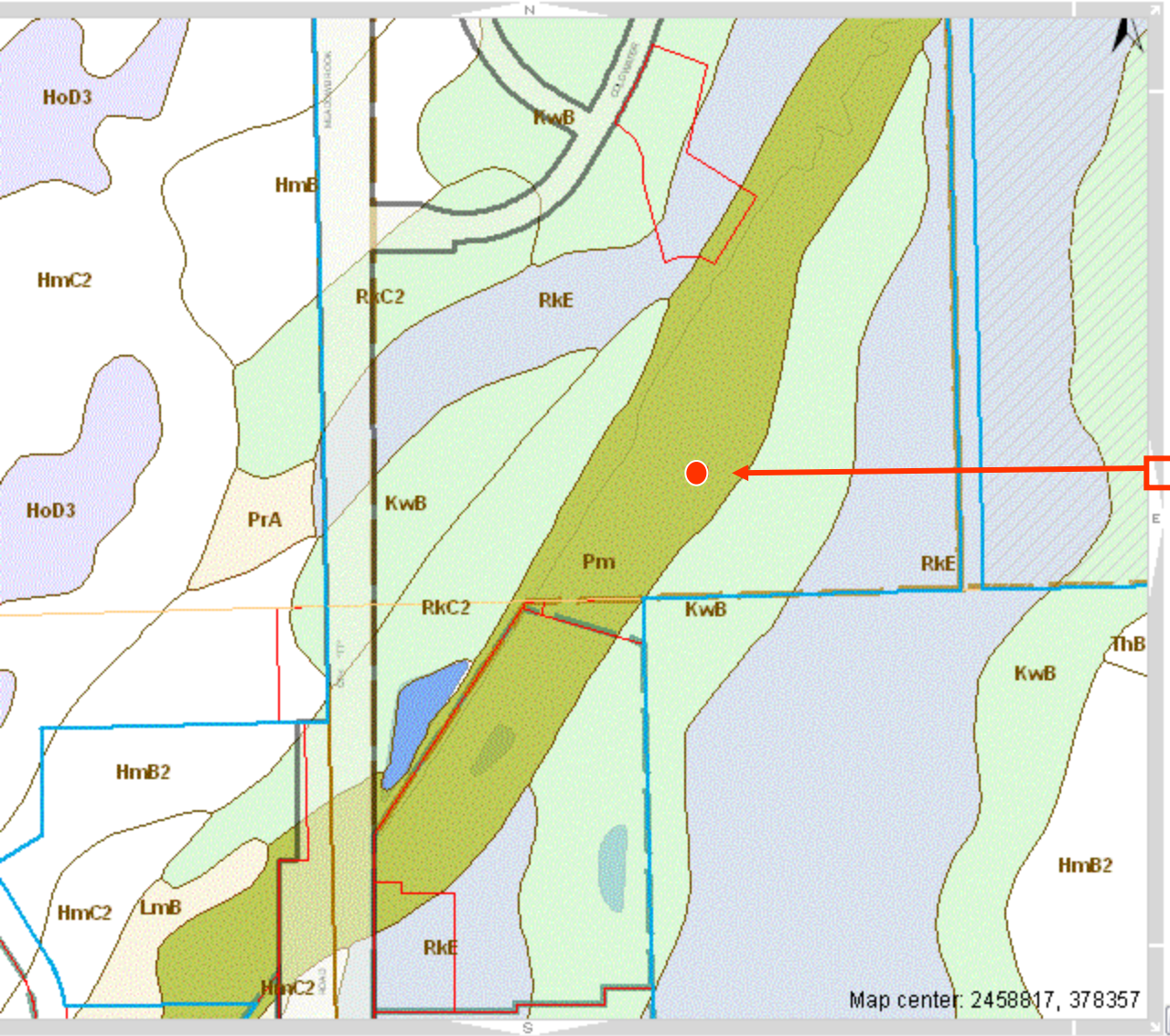


esha County Internet Mapping Site - Microsoft Internet Explorer provided by Waukesha County

WAUKESHA COUNTY
Internet Mapping Site

"Waukesha County GIS"

Layers Legend Selection Key Map Bookmarks Print



Identify Results

Coordinate Position

NAD_1927 StatePlane Wisconsin South: 24591
Latitude Longitude: 43° 1'

Soils

MAP_SYMBOL:	Pm
SOIL_NAME:	Pella silt loam, moderately shallow variant
SOIL_SERIES:	Pella
SURFACE_TEXTURE:	Silt Loam
SLOPE:	A
SLOPE_PERCENT:	0-2
DEPTH_TO_WATER_TABLE:	0
PERM_AT_4_FT_DEPTH:	0-0.6
HYDRIC_CODE:	Hydric
FLOODING_FREQUENCY:	None
PONDING_FREQUENCY:	Frequent
DEPTH_TO_BEDROCK:	20-40
PRIME_AG_SOIL:	Prime If Drained
LAND_CAPABILITY_CLASS:	2w
PERCENT_OF_COUNTY:	0.17
SOIL_RANKING:	87
SOIL_DESCRIPTION:	Poorly drained soil formed in silty deposits over dolomite bedrock
DRAINAGE_CLASS:	Poorly Drained

4,412 go Map Tool: Identify Active Layer: Soils

Powered by geocortex

Infiltration Potential

Town of Genesee

Legend

- Low (exempt)
- Moderate
- High
- Very high
- Excessively high

Field Verification (Comm 85)

- Standardized form and process
  - USDA-NRCS system
- Documentation of seasonal high groundwater based on soils
  - Cannot do by borings or “water fill”

Wisconsin Department of Commerce
Division of Safety and Buildings

SOIL EVALUATION - STORM
In accordance with Comm 82.365 & 85, Wis. Adm. Code

Page ____ of ____

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s. 15.04 (1) (m)).

County
Parcel I.D.
Reviewed by | Date

Property Owner
Property Location
Govt. Lot | 1/4 | 1/4 S | T | N R | E (or) W
Property Owner's Mailing Address
Lot # | Block # | Subd. Name or CSM#
City | State | Zip Code | Phone Number ( )
☐ City ☐ Village ☐ Town | Nearest Road

Drainage area _____ ☐ sq. ft. ☐ acres
Optional:
Test Site Suitable for (check all that apply)
☐ Irrigation ☐ Bioretention trench ☐ Trench(es)
☐ Rain garden ☐ Grassed swale ☐ Reuse
☐ Infiltration trench ☐ SDS (> 15' wide) ☐ Other _____

Hydraulic Application Test Method:
☐ Morphological Evaluation
☐ Double-Ring Infiltrometer
☐ Other (specify) _____

Obs. # ☐ Boring ☐ Pit Ground surface elev. _____ ft. Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

Obs. # ☐ Boring ☐ Pit Ground surface elev. _____ ft. Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate Inches/Hr

CST/PSS Name (Please Print) | Signature | CST/PSS Number
Address | Date Evaluation Conducted | Telephone Number

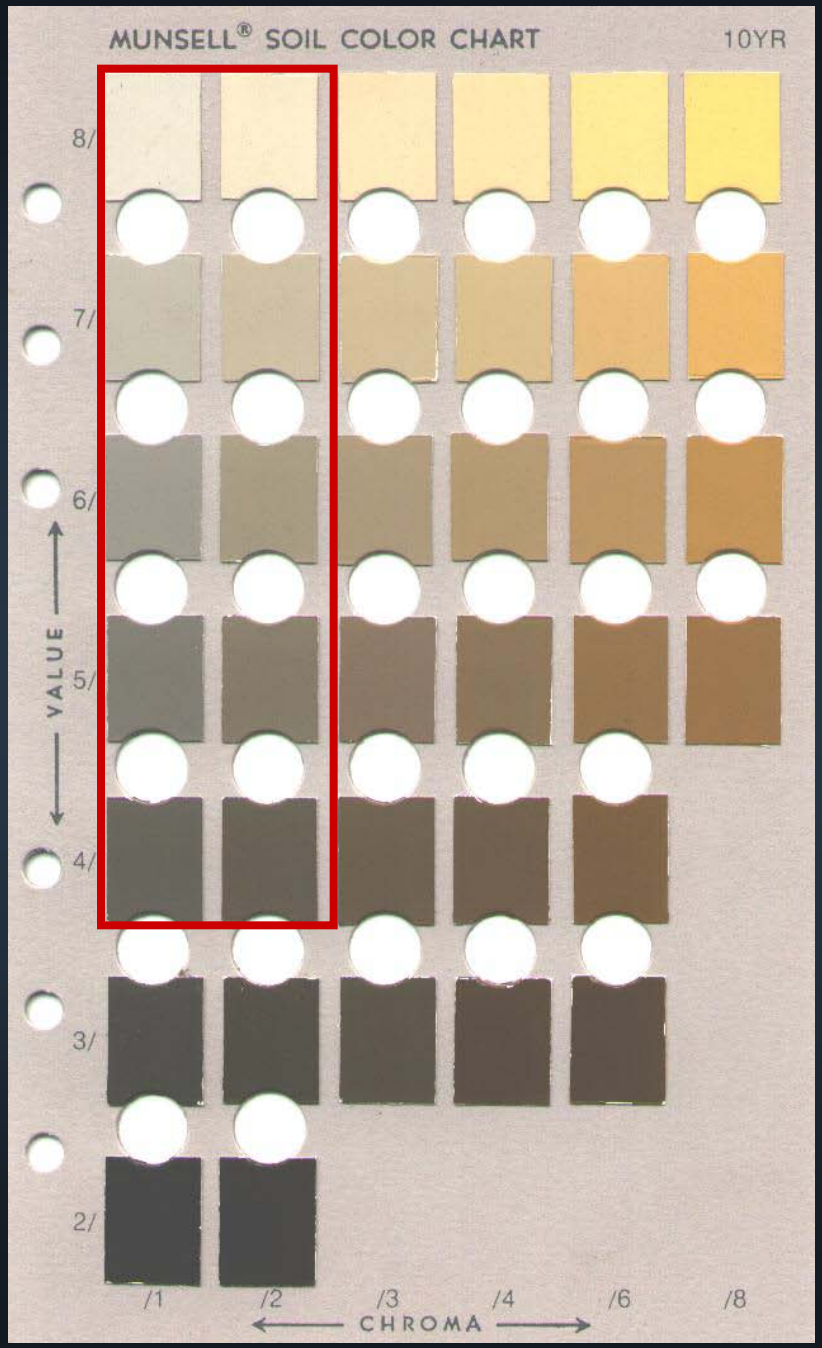
SBD-10793 (R.1/05)

Soil Mottling *(Redoximorphic Features)*

Low Chroma Colors = Wet

Value $\geq$4

Chroma <3



Gley Colors – Very Wet!

Measured Infiltration Rates
(double-ring infiltrometer)

- May reduce the BMP size
  - Apply correction factor in standard
- Do correct elevation
- May require for final certification in the future

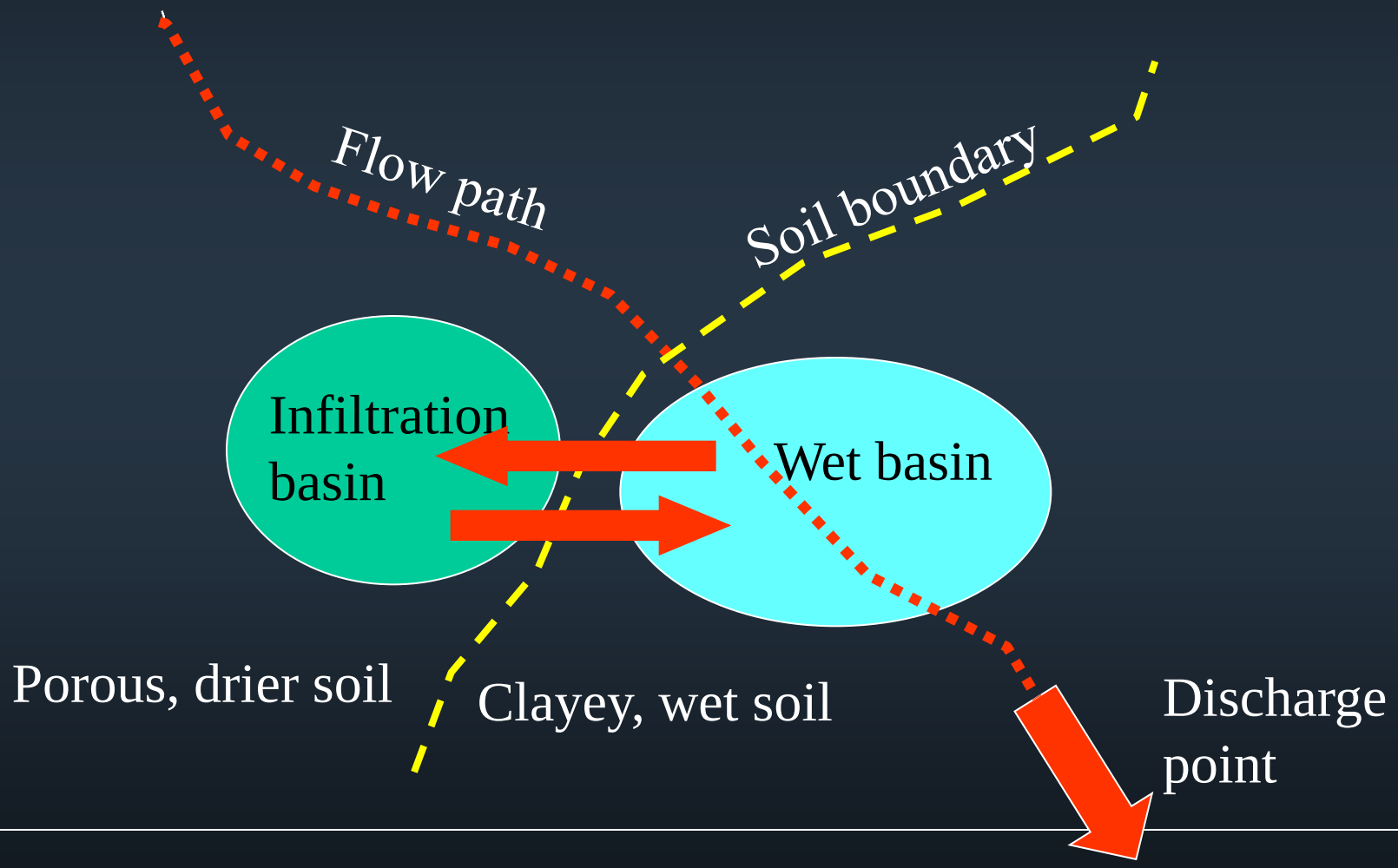
Soil Evaluation Report

- Summarize and interpret soils data
- For the designer, not the regulator
  - Incorporate into site plan/BMP design
  - Regulator is just checking for consistency
- Who can sign it?
  - DNR: a Professional Soil Scientist or other licensed professional acceptable to the regulator
  - COMM: Certified Soil Tester or PSS
  - County: Depends on soils/proposal

Other Soils Challenges

- Best soils are in the wrong location
  - Change site plan
  - Engineer soils to remove limiting layer
  - Reverse BMP flows to drain back to good soils

Example Flow Reversal



Other Soils Challenges

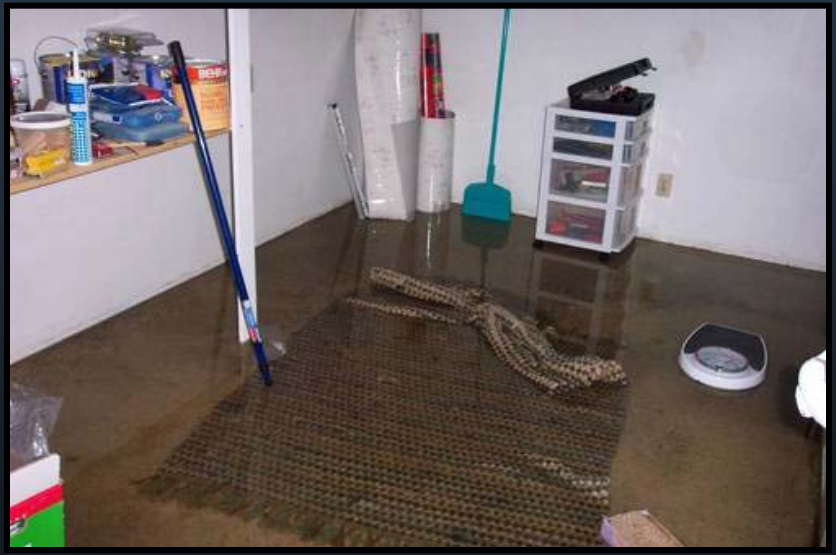
- Sedimentation of infiltration BMPs during site development phase
  - Careful planning/good communication & oversight during construction
- Sedimentation from home construction?
  - Who is responsible for damage after permit termination for the development?

Other Soils Challenges

- Planning is key, or you will spend a lot of time doing multiple soil investigations to meet various ordinance requirements
  - Septic,
  - Sewer, utilities, etc. (dewatering)
  - Storm water BMP design
  - Basement separation from groundwater
- Must be deep enough/in the right places

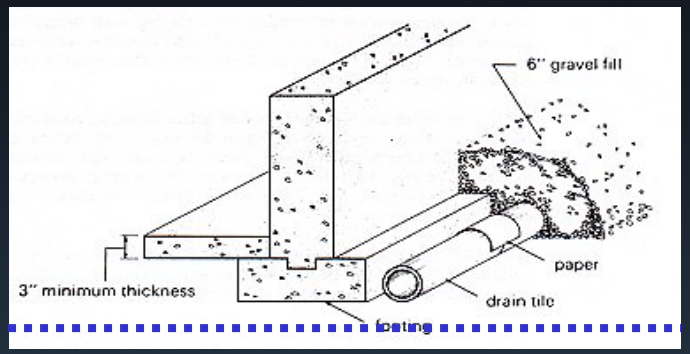
Basement Flooding

- Is preventable, but previous “warnings” did not work
- More of a problem as exposed basements have become more popular & expensive
  - Should not rely on a sump pump/electricity
  - Flooding can be from groundwater seepage or surface runoff – or both
  - Insurance exclusions



Basement Restrictions

Water table



- Basement floors must be a minimum of 1 foot above seasonal high groundwater
  - Soil pits required (no augers per COMM 85)
  - Within 50 feet of proposed basement
  - Soil report by CST or PSS
  - Limiting elevation must be recorded on deed
- Triggers
  - 8 feet vertical to water (wetland, stream, lake, etc.)
  - Poorly drained or worse soil classification (GIS)
  - Other soils investigations, etc.

Rain on Frozen Ground

Flooding from Surface Runoff

Exposed Structure Restrictions

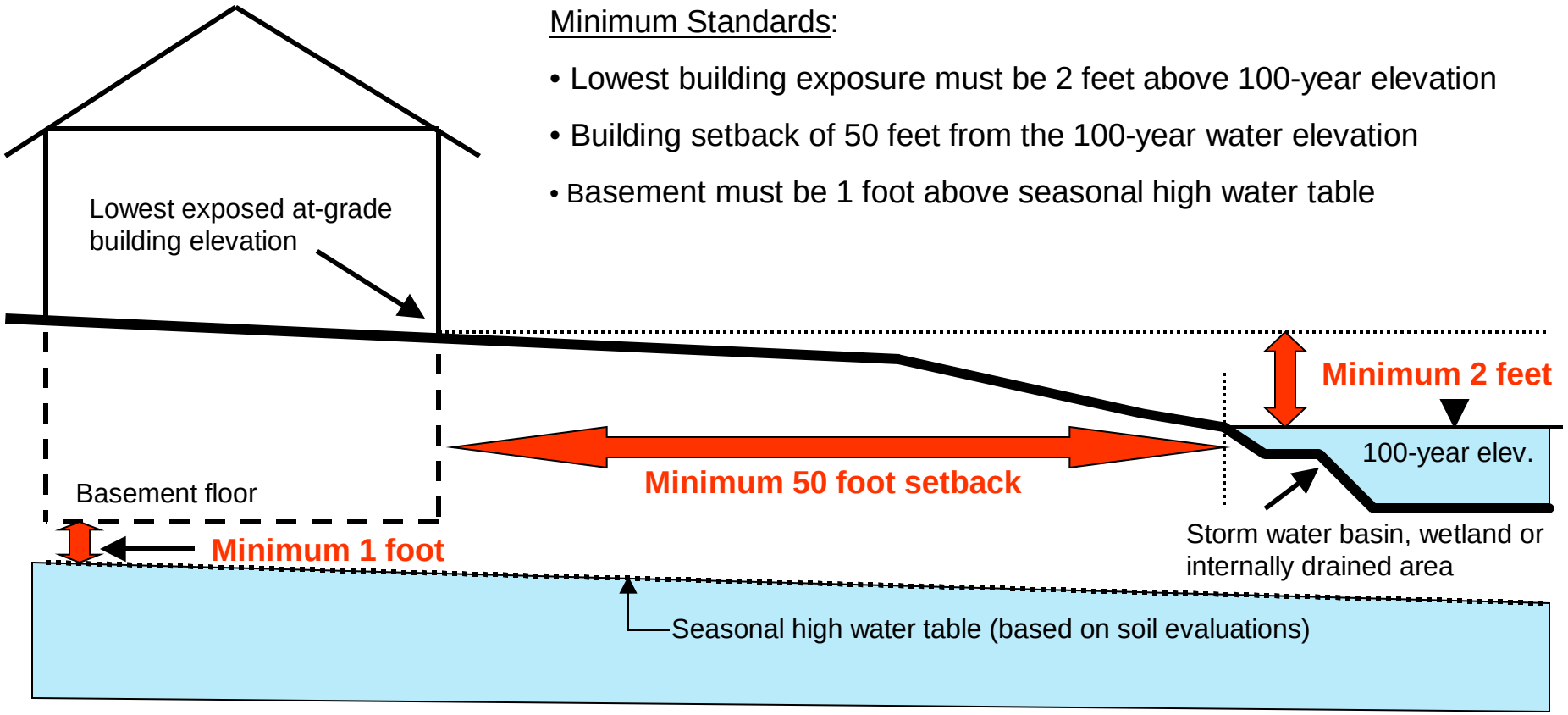
- Lowest elevation of the exposed structure must be min. 2 feet above peak surface water elevation and setback min. 50 feet
  - Based on 100-year 24-hour rain event (1%)
  - Assume frozen ground (no infiltration in basin and watershed RCN of 98)
  - Limiting elevation must be recorded

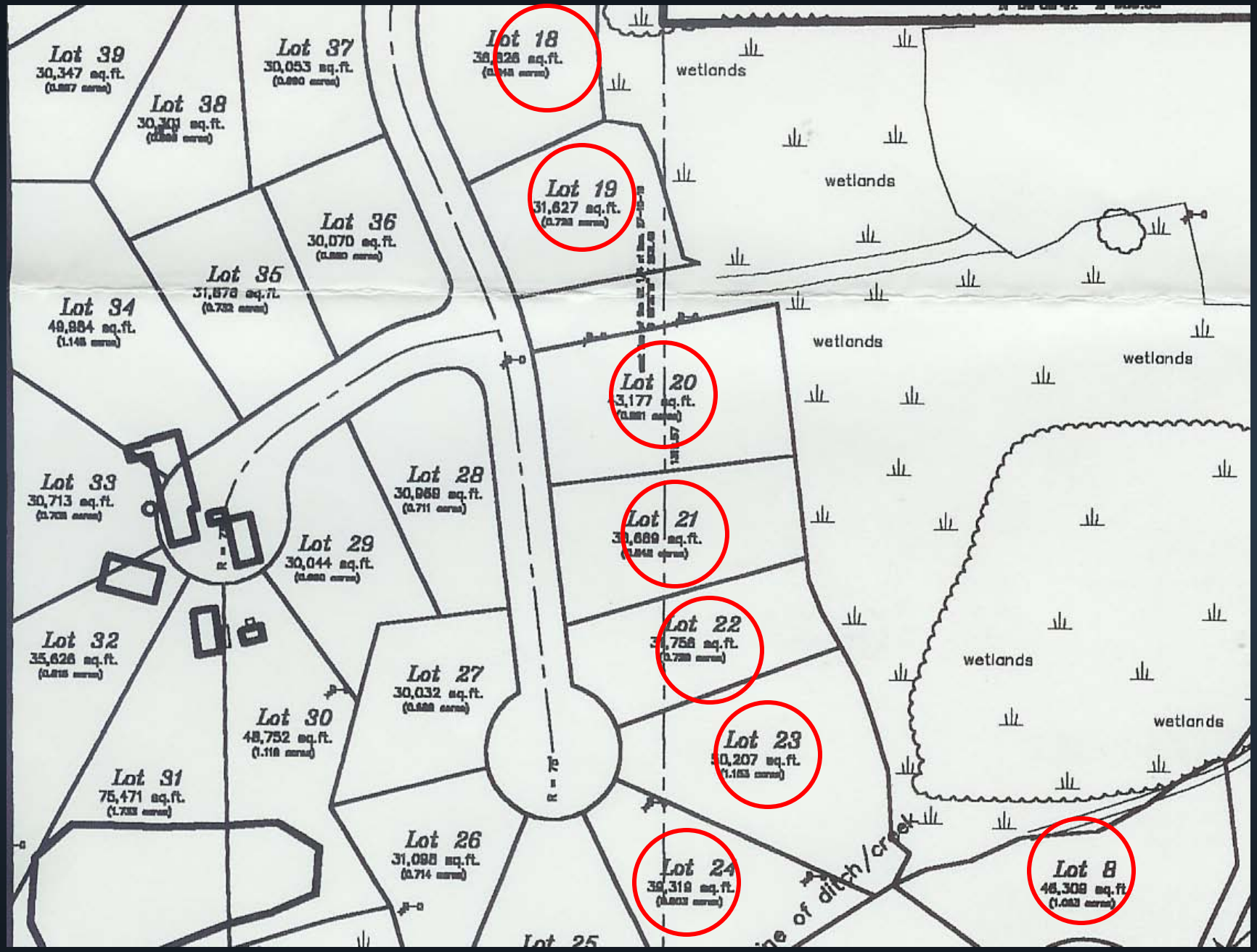
Minimum Site Drainage Standards

Waukesha County Storm Water Ordinance

<u>Minimum Standards</u>:

- Lowest building exposure must be 2 feet above 100-year elevation
- Building setback of 50 feet from the 100-year water elevation
- Basement must be 1 foot above seasonal high water table




Lot 39
30,347 sq.ft.
Lot 38
Lot 37
30,053 sq.ft.
Lot 18
Lot 19
31,627 sq.ft.
Lot 36
30,070 sq.ft.
Lot 35
Lot 34
49,884 sq.ft.
Lot 20
Lot 33
30,713 sq.ft.
Lot 28
30,969 sq.ft.
Lot 29
30,044 sq.ft.
Lot 21
Lot 22
Lot 32
35,626 sq.ft.
Lot 27
30,032 sq.ft.
Lot 30
48,752 sq.ft.
Lot 23
Lot 31
75,471 sq.ft.
Lot 26
31,098 sq.ft.
Lot 24
Lot 8
46,309 sq.ft.
Lot 25
wetlands
wetlands
wetlands
wetlands
wetlands
wetlands

Too close for comfort?
(surface & groundwater)

Groundwater – what a difference a foot makes!

Coordinate with utilities

Storm Water Mgt. Practice Maintenance Agreement

- An important reference <u>when</u> (not if) maintenance is needed

BMP Maintenance Agreements

- Required at time of plat/CSM for any BMP used to meet ordinance
  - Assessment process requires joint ownership / shared runoff
  - Requires drainage and access easements
- Municipality must enforce
- Process depends if ownership is transferred or not

Certification of Compliance

- What is it?
  - Memo from LRD prior to recording a final plat/CSM stating that it complies with storm water ordinance
- Why?
  - Prevents errors/omissions/miscommunication during recording plat/CSM
  - Allows enforcement of site restrictions and BMP maintenance agreements in the future

Maintenance Agreement Exhibits:

A – Legal Description
B – BMP Locations
C – Maintenance Plan

Up front

D – Design Documentation
E – As-built Survey
F – Construction Verification
G – Permit Termination

Addendum

Watershed Data Summary (D)

Example Data Summary Sheet for Stormwater Management Plan

Project Name: Rolling Acres **Project Size:** 110 Acres **Project type:** Residential Subdivision **No. of Lots:** 180
Number of Runoff Discharge Points: 3 **Watershed (ultimate discharge)**: Pewaukee Lake (via unnamed tributary)
Watershed Area (including off-site runoff traveling through project area): 140 acres (30 acres off-site)
Public Land Survey Location: SE1/4, Section 32, T8N R19E (Pewaukee Township)

Summary Data Elements	Subwatershed A		Subwatershed B		Subwatershed C	
	Pre-develop	Post-develop	Pre-develop	Post-develop	Pre-develop	Post-develop
Watershed Areas ***(in acres) (see attached map)***	100 acres	120 acres	20	10	20	10
Average Watershed Slopes (%)	2-8%	2-8%	3-6%	3-6%	6-8%	6-8%
Land Uses ***(% of each) (see attached map)***	75 ac. cropland 15 ac. brush 10 ac. woodland	110 ac. ½ ac. lots 5ac. brush 5 ac. woodlands	100% cropland	100% ½ ac. lots	100% Woodland	100% ½ acre lots
Runoff Curve Numbers	68 x 75ac.= 5100 30 x 25ac.= 750 *Net 5850\100 ac.* RCN = 59	70 x 110 ac.= 7700 10 x 10 ac.= 100 Net 7800\120ac RCN = 65	RCN = 68 (state standard)	RCN = 70	RCN = 30	RCN = 70
Conveyance Systems Types	Grass waterway	50% grass swale 50% storm sewer	100% bare channel	100% grass swale	100% natural channel	100% storm sewer
Summary of Average Conveyance System Data	8’ bottom/4:1 ss 2’ depth/3% grade	2’ depth swale/3% 30” r/c sewer/2% (see calcs.)	15’ (w) top 1’ (d) parabolic 2% grade	2’ deep standard road ditch 2% grade	15’ top (w) 1’ (d) parabolic 4% grade	2’ deep standard road ditch 4% grade

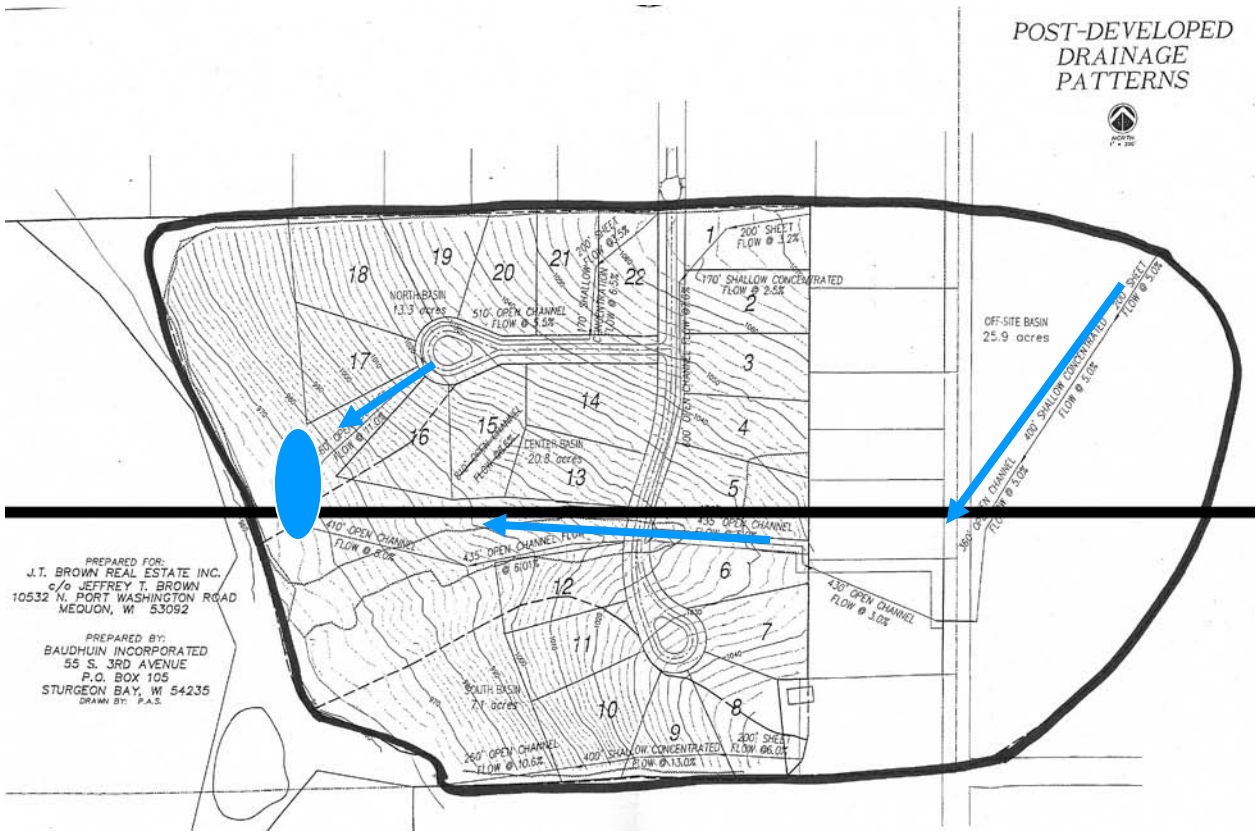
Watershed Map (D)

Should be no bigger than 11” x 17”

Exhibit D (continued)

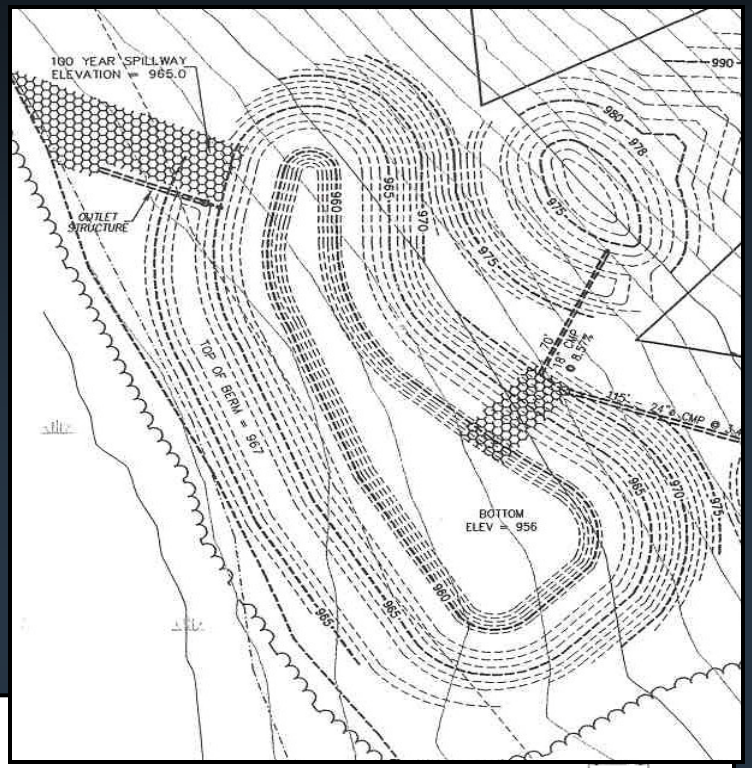
Watershed Map. The watershed map shown below was used to determine the post-development data contained in this exhibit. The post-developed watershed areas are the same as the pre-development watershed areas for this project.

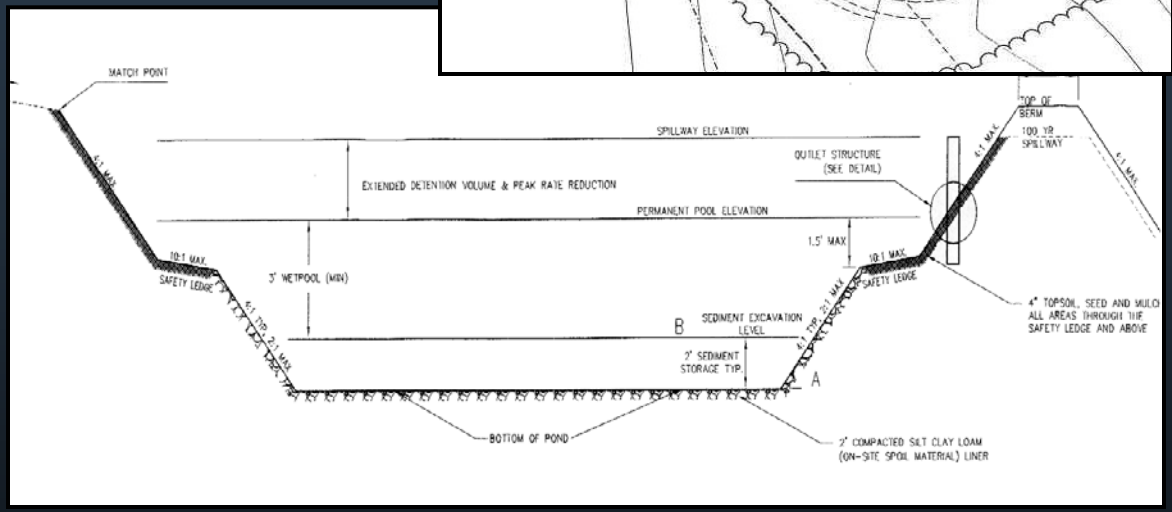
[Map scale must be sufficiently large enough to show necessary details, but page size should not exceed 11” x 17”.]



As-built Survey (E)

- Shows final construction details, elevations, etc.
- Referenced in construction verification
- Standards





Construction Verification (F)

- Shows compliance with approved plans
- Verifies proper oversight during construction

Exhibit F
Engineering/Construction Verification

DATE: 3-9-06

TO: Land Resources Division
Waukesha County Department of Parks and Land Use

FROM: Joe Engineer, P.E. – Engineering Specialists, Inc.

RE: Engineering/Construction Verification for the following project:

Project Name: Tree Line Estates Subdivision

Section 23, Town of Waukesha

Storm Water Permit #: 23158

Storm Water Management Practices: Wet Detention Basins A & B

This correspondence shall serve as verification that the storm water management practice design data presented in Exhibit D, and the "as-built" construction drawings presented in Exhibit E for the above-referenced project have been completed in accordance with all applicable state and local technical standards and in accordance with the Waukesha County Storm Water Management and Erosion Control Ordinance.

[Must include one of the following two statements:]
Any variations from the originally approved construction plans are noted in the Exhibit E. These variations are considered to be within the tolerances of standard construction techniques and do not affect the original design as presented in Exhibit D in any way.
[Note: The County may request additional documentation to support this statement depending on the extent of deviations from the approved plans.]

Or

Any design or construction changes from the originally approved construction plans are documented in Exhibits D and E and have been approved by Waukesha County.

[Note: If warm season and wetland planting verification is required, it may be included in this exhibit.]

(Signed P.E. stamp must be included)

Planting Verification

Critical for infiltration practices!

Planting Verification Letter
(minimum requirements)

DATE:

TO: Land Resources Division
Waukesha County Department of Parks and Land Use

FROM: (Landscape Architect or other qualified professional's name and qualification)

RE: Planting Verification for the following project:

Project Name: _____

Section _____, Town of _____

Permit # _____

This correspondence shall serve as verification that I have performed ___ transect surveys of the designated -warm season or wetland planting areas described in the approved plans for the storm water facilities for the above-referenced project and that the plantings have a minimum coverage of 70% and match the species descriptions on the plans. Copies of the transect survey results are attached, along with a location map.

(Signed L.A. stamp must be included, if applicable)

Permit Termination (G)

- Transfers BMP maintenance from permit holder to other entity (M.A.)
- After recording this, return the financial assurance & close project file

Exhibit G
Storm Water Permit Termination

Project Identifier: Highland Preserve Subdivision

Location: All that part of the Southwest Quarter (SW ¼) of Section 4, Township 8N, Range 19E (Town of Lisbon)

Storm Water Permit Holder's Name: _____

Storm Water Permit #: _____

Chapter 14 – Article VIII of the Waukesha County Code of Ordinances ("Storm Water Ordinance") requires that all newly constructed storm water management practices be maintained by the Storm Water Permit Holder until permit termination, after which maintenance responsibilities shall be transferred to the responsible party identified on the subdivision plat [or CSM] and referenced in this Maintenance Agreement.

Upon execution below, this exhibit shall serve to certify that the Storm Water Permit Holder has satisfied all requirements of the Storm Water Ordinance and that Waukesha County has terminated the Storm Water Permit for the property covered by this Maintenance Agreement.

Dated this ___ day of _____, 200_.

Waukesha County representative:

_____
(Signature)

_____

(Typed Name and Title)

Acknowledgements

State of Wisconsin
County of Waukesha

Personally came before me this ___ day of _____, 200_, the above named ___[Owners name]_____ to me known to be the person who executed the foregoing instrument and acknowledged the same.

_____.
[Name]
Notary Public, Waukesha County, WI
My commission expires: _____

Storm Water BMP GIS/Web Site

Data Summary Sheet for Wet Detention Basin Design

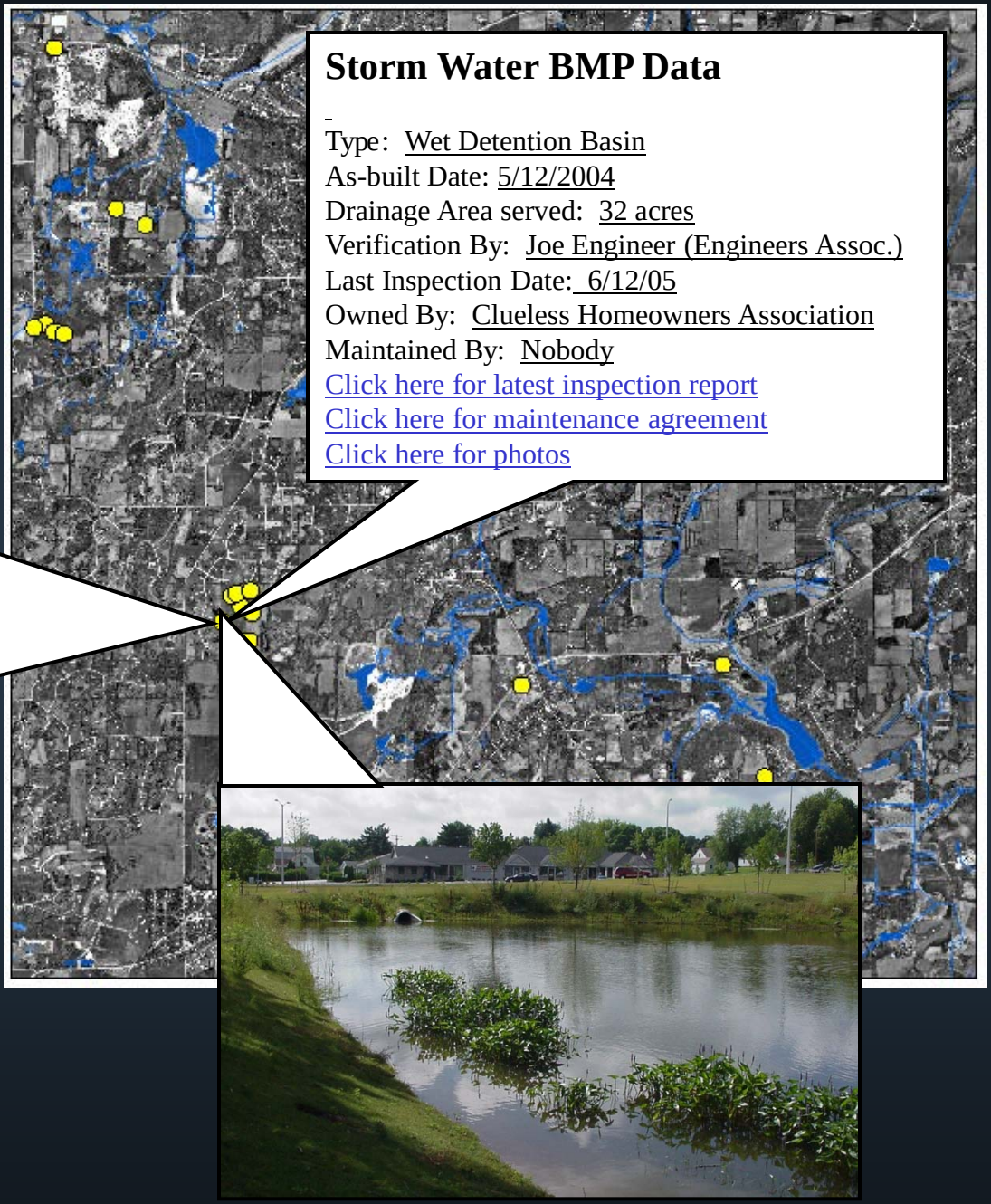
Design Element	Design Data
Site assessment data: (see attached maps)	
Contributing drainage area to basin (subwatershed A)	120 acres
Distance to nearest private well (including off-site wells)	> 100 feet
Distance to municipal well (including off-site wells)	> 1200 feet
Wellhead protection area involved?	No
Ground slope at site of proposed basin	average 3%
Any buried or overhead utilities in the area?	No
Proposed outfall conveyance system/discharge (w/ distances)	35 ft. to CTH "U" Road ditch 1000 ft. to wetland
Any downstream roads or other structures? (describe)	Yes – 36" cmp road culvert
Floodplain, shoreland or wetlands?	No
Soil investigation data (see attached map & soil logs):	
Number of soil investigations completed	3 (in basin area)
Do elevations of test holes extend 3 ft. below proposed bottom?	Yes (see map)
Average soil texture at pond bottom elevation (USDA)	Clay loam
Distance from pond bottom to bedrock	> 5 feet
Distance from pond bottom to seasonal water table	Pond bottom 2 below mottling No water observed in test holes
General basin design data (see attached detailed drawings):	
Permanent pool surface area	1.5 acres
Design permanent pool water surface elevation	elev. 900.0
Top of berm elevation (after settling) and width	elev. 905.0 / 10 feet wide
Length/width (dimensions/ratio)	445 ft. (L) x 145 ft. (W) = 3:1
Safety shelf design (length, grade, max. depth)	10 ft. @ 10% slope/1.5' deepest
Ave. water depth (minus safety shelf/sediment)	5 ft. (in center)
Sediment forebay size & depth	.16 acres (13% pool size)/5 feet
Sediment storage depth & design maintenance	2 ft. depth for forebay & pool 15 year maintenance schedule

Design Basin Inflow, Outflow & Storage Data
(see attached hydrographs and detail drawings)

Inflow Peak/Volume	Maximum Outflow Rate	Max. Water Elevation	Storage Volume at Max. Elev. (above perm. pool)	Outflow Control Structures*
1-yr./24 hr. (volume)	7 cfs (34 hr. drawdown)	901.3 ft.	2 acre feet	#1
24.3 cfs (Post 2-yr./24 hr. peak)	11 cfs	902.0 ft.	3.1 acre feet	#1 and #2
72 cfs (Post 10-yr./24 hr. peak)	35 cfs	903.0 ft.	4.5 acre feet	#3
171 cfs (Post 100-yr./24 hr. peak)	143 cfs	904.0 ft.	6.0 acre feet	#3 and #4

* The controlling elements are summarized below (See attached detail drawing of outlet structure):
#1 = 6 inch orifice in water level control weir plate – flow line elev. @ 900.0 (1.3 ft. max. head)
#2 = 2 foot wide rectangular weir – flow line elev. @ 901.3 (.7 ft. hydraulic head)
#3 = 30 inch diameter smooth wall pvc pipe – flow line elev. @ 900.0 (3.0 ft. max. hydraulic head)
#4 = 30 foot wide earthen/grass emergency spillway – flow line elev. @ 903.0 (1.0 ft. max. depth)

2/1/00 Waukesha Co. PLU



Storm Water BMP Data

Type: Wet Detention Basin
As-built Date: 5/12/2004
Drainage Area served: 32 acres
Verification By: Joe Engineer (Engineers Assoc.)
Last Inspection Date: 6/12/05
Owned By: Clueless Homeowners Association
Maintained By: Nobody
Click here for latest inspection report
Click here for maintenance agreement
Click here for photos

How to get plans approved in a timely manner?

Follow the checklists and get your soils work done early!

Recommended Process

1. Evaluate soils & topo maps/drainage/watersheds
   - ID limitations and opportunities for basements, infiltration, downstream water resources/property, etc.
2. Create concept site plan/plat and meet with regulators for guidance
   - ID soils/storm water issues and management goals
3. Complete on-site soil profile evaluations for septic, storm water and basements in key areas
   - Adjust plan and add more detail

Recommended Process (cont.)

4. Create preliminary site plan/plat and submit for “Preliminary Review Letter”
5. Complete additional soil evaluations or on-site testing if necessary for final design work
6. Prepare final site plan/plat/storm water plans/maintenance agreement & submit
   - Follow check lists
   - Address issues identified in the preliminary review

On the Web: www.waukeshacounty.gov
or Google: “Waukesha County Storm Water”

- Ordinance & forms
- Check lists (site plan/erosion/storm)
- Fee schedules
- Sample maintenance agreements
- Standard drawings
- Design tools

The End