An aerial photograph of a watershed area. A river flows through the center, surrounded by green fields and residential developments. The background shows more green hills and a road. The text is overlaid on the image.

Post-Construction Stormwater Management: Building Green Programs

September 5, 2007

David J. Hirschman
Center for Watershed Protection

Nikos Singelis
Environmental Protection Agency

Jay Riggs
Washington Conservation District

Presentation Outline

◆ Post-Construction Guidance Manual & Tools

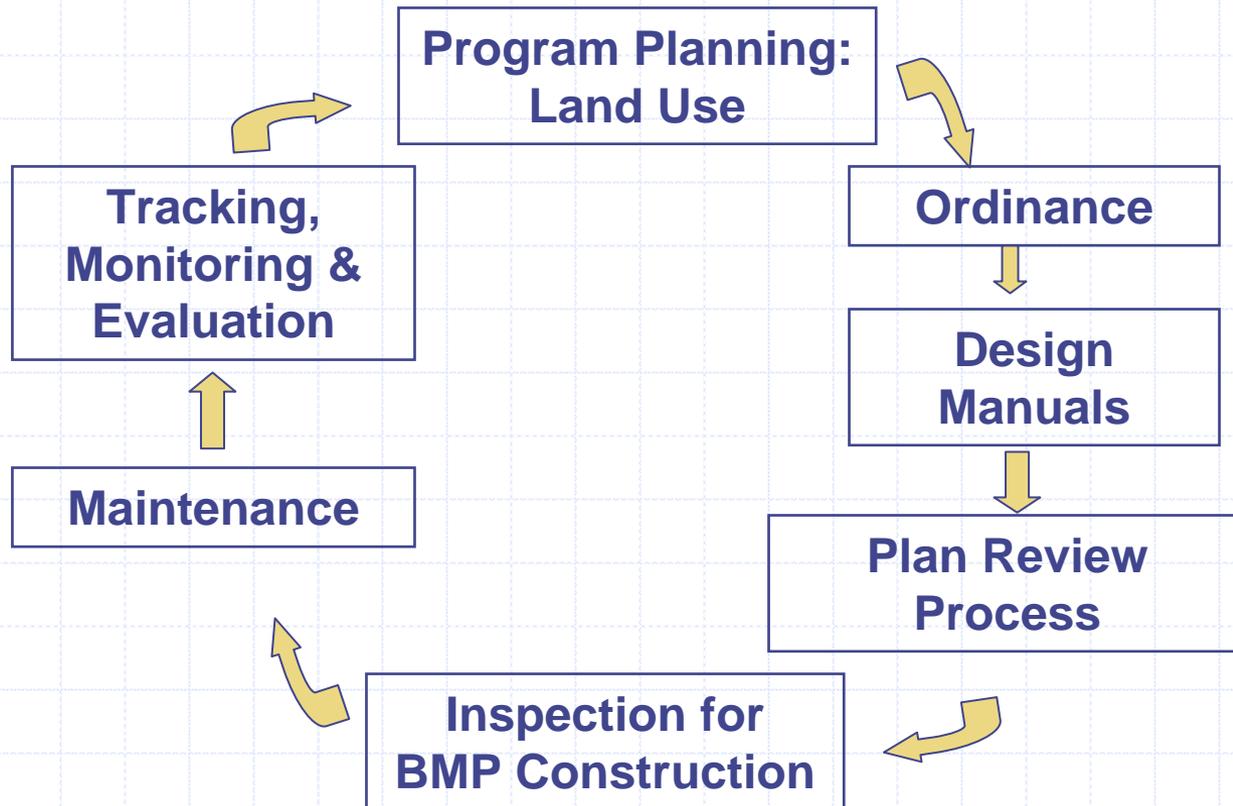
◆ Program Elements

- Land Use as First BMP
- Ordinance
- Design Manuals
- **Case Study: Innovative Stormwater in the Twin Cities**
- Inspection During Construction
- Maintenance

Phase II Minimum Measures

- ◆ Public Education & Outreach
- ◆ Public Participation
- ◆ Illicit Discharge Detection & Elimination
- ◆ Construction Site Runoff Control
- ◆ **Post-Construction Runoff Control**
- ◆ Pollution Prevention & Good Housekeeping

Overview of Post-Construction Guidance



Post-Construction Program: **DRAFT Tools**

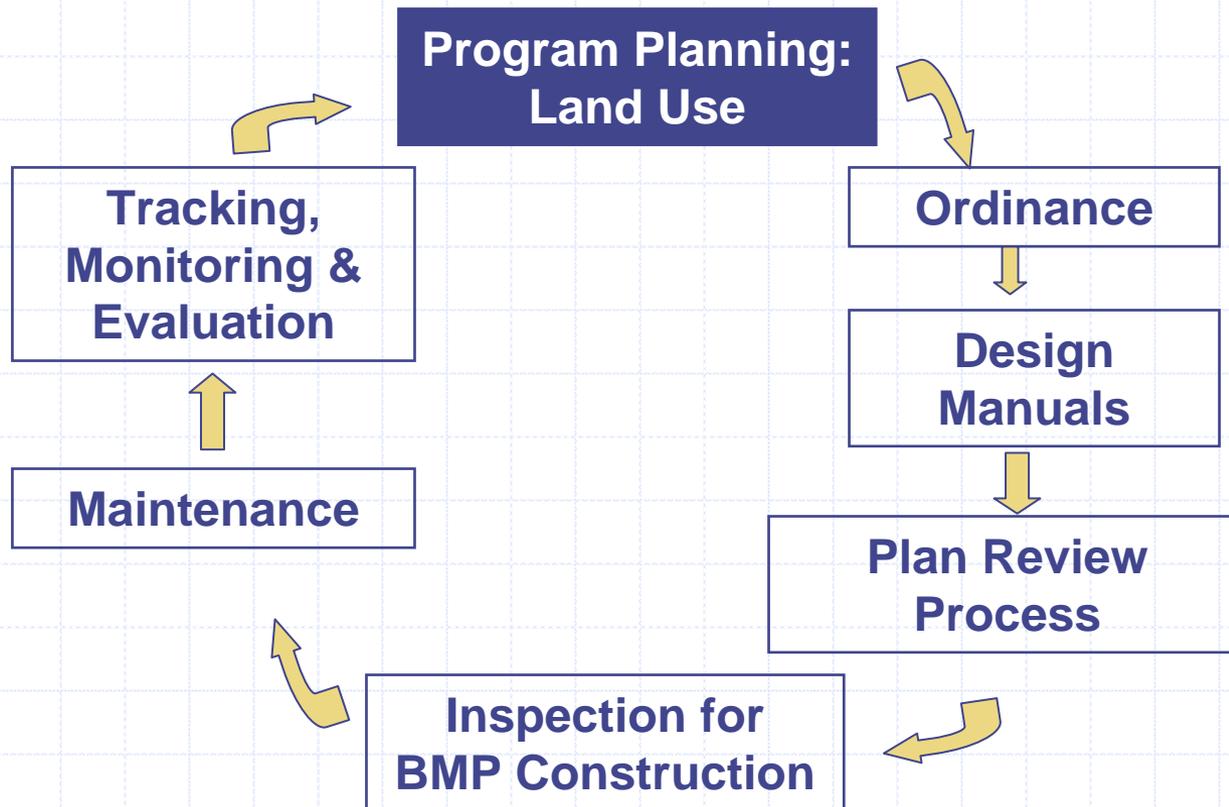
- ◆ Program Self-Audit
- ◆ Post-Construction Model Ordinance
- ◆ Codes & Ordinance Worksheet
- ◆ Stormwater Manual Builder
- ◆ Checklists
- ◆ Performance Bond Tool

Download at:

<http://www.cwp.org/webcast/postconstruction.htm>



Post-Construction Guidance

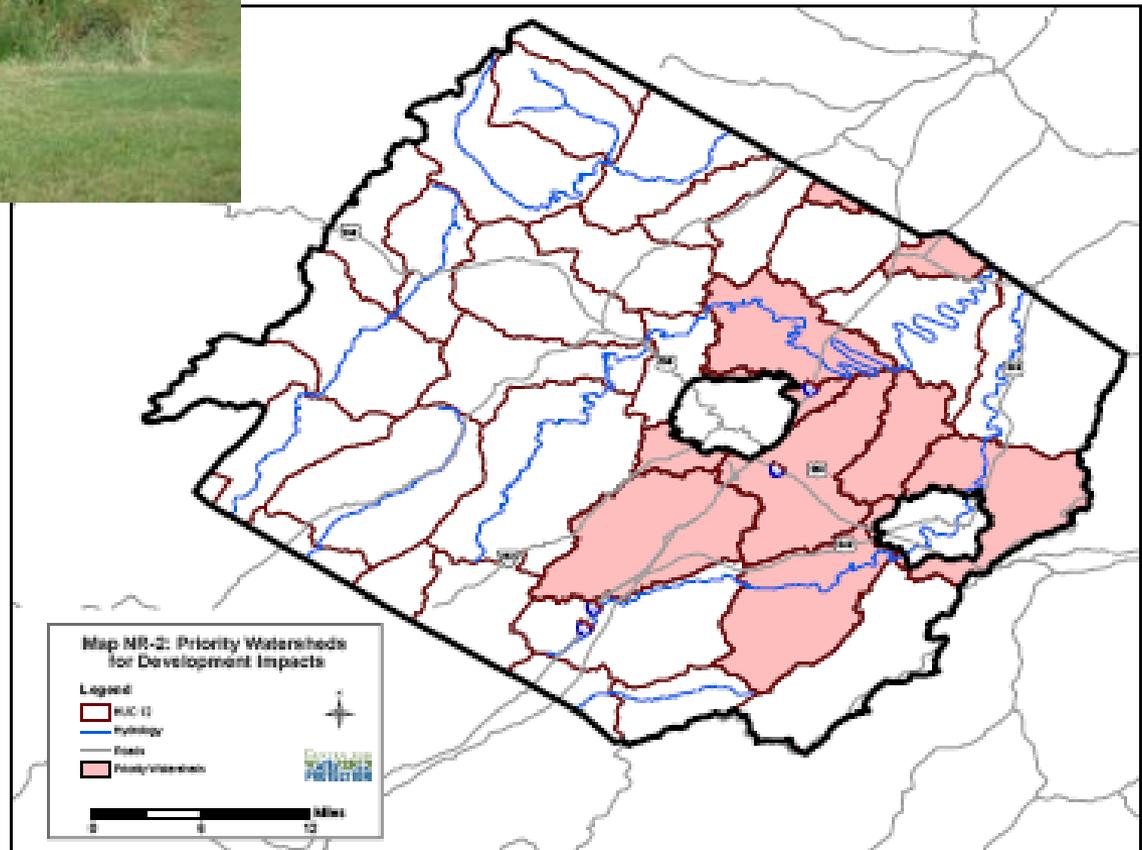


Why Should Stormwater Managers Care. . .



...What the Comprehensive Plan says?

Land Use As the First BMP!



Zoning & Impervious Cover

Zoning Regulates

- Separate Uses
- Parking MINIMUMS
- Setbacks
- Height
- Lot Coverage

Spread-Out
Development

=

More Impervious & More Runoff



Development Should Be Targeted to Some Areas. . .



Transit Hubs



Underutilized Commercial

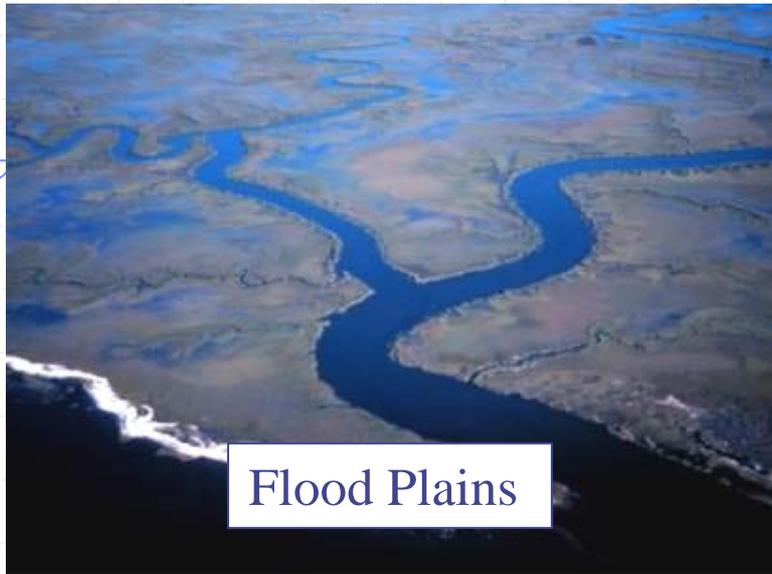


Redevelopment Site

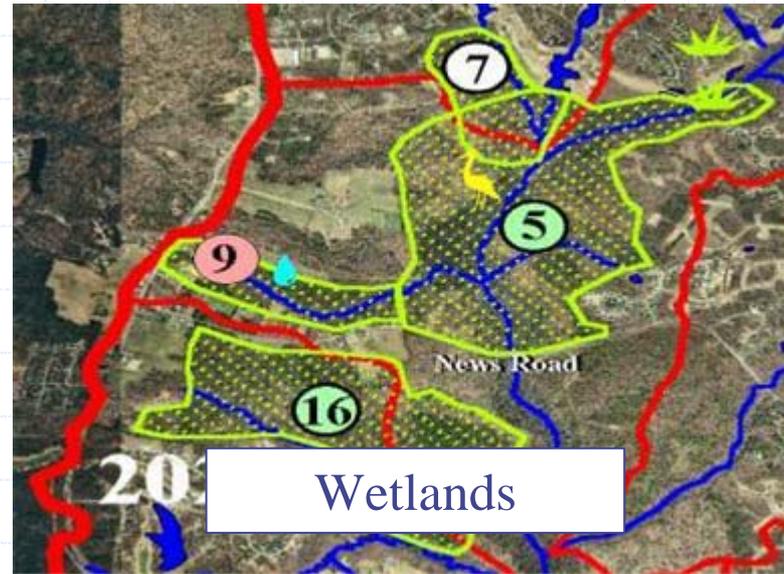


Utility Corridors

. . .And Avoided in Others



Flood Plains



Wetlands



Sensitive Lakes



Drinking Water Source Areas

Encouraging Development Where We **DO** Want It. . .

- ◆ Infill & Redevelopment Incentives
- ◆ Flexible Setbacks & Lot Coverage
- ◆ Redevelopment Stormwater Criteria
- ◆ Fee-in-Lieu Program for Watershed Projects
- ◆ Utility Planning

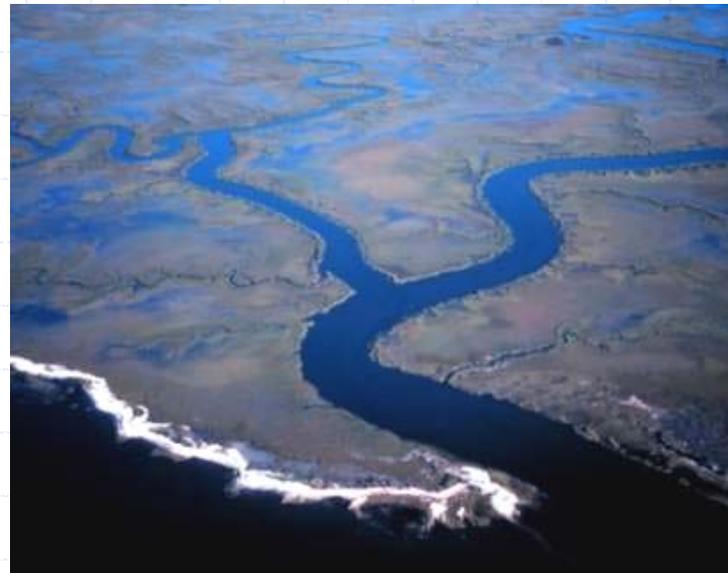


Discouraging The Wrong Type of Development Where We **DON'T** Want It. . .

- ◆ Overlay Zoning
- ◆ Performance Standards
- ◆ Special Stormwater Criteria (Buffers, Infiltration)
- ◆ Conservation Easements
- ◆ Utility Restrictions



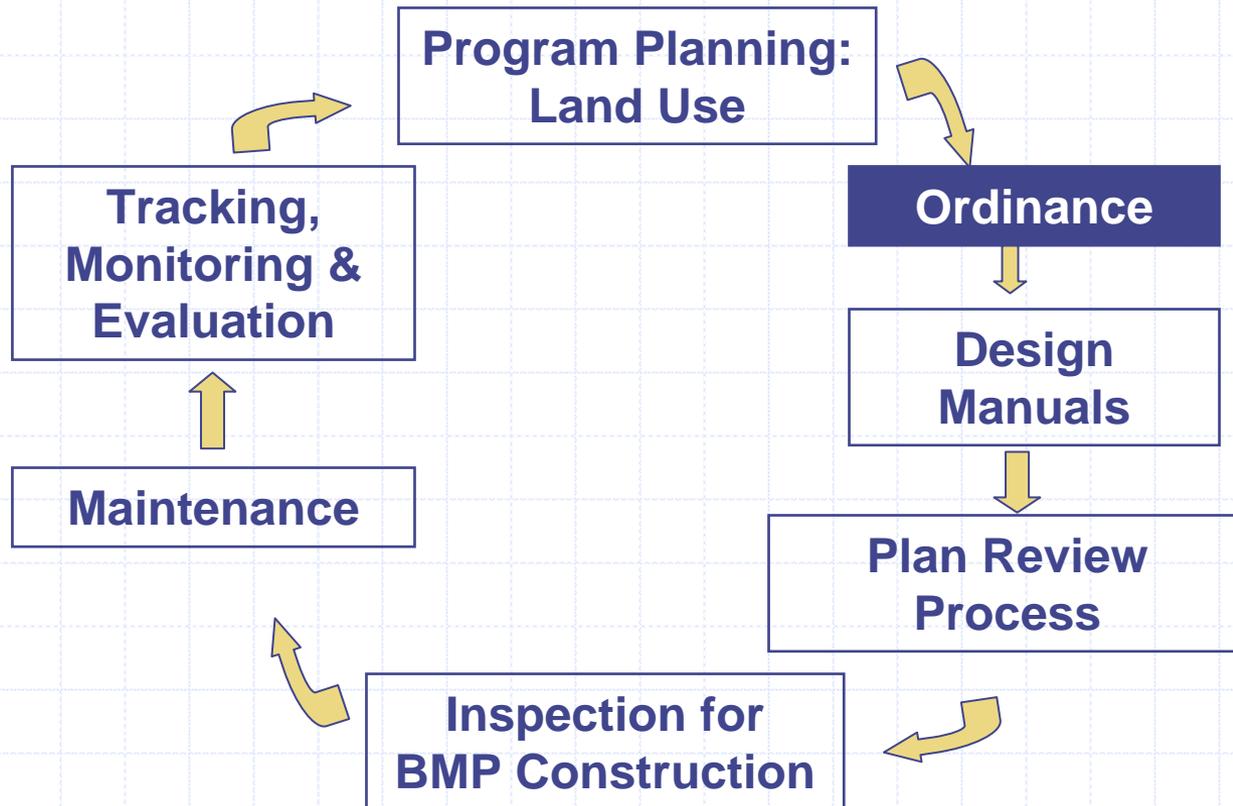
GOAL:
**Comprehensive
Plan & Stormwater
Program Should
Send the Same
Signal**



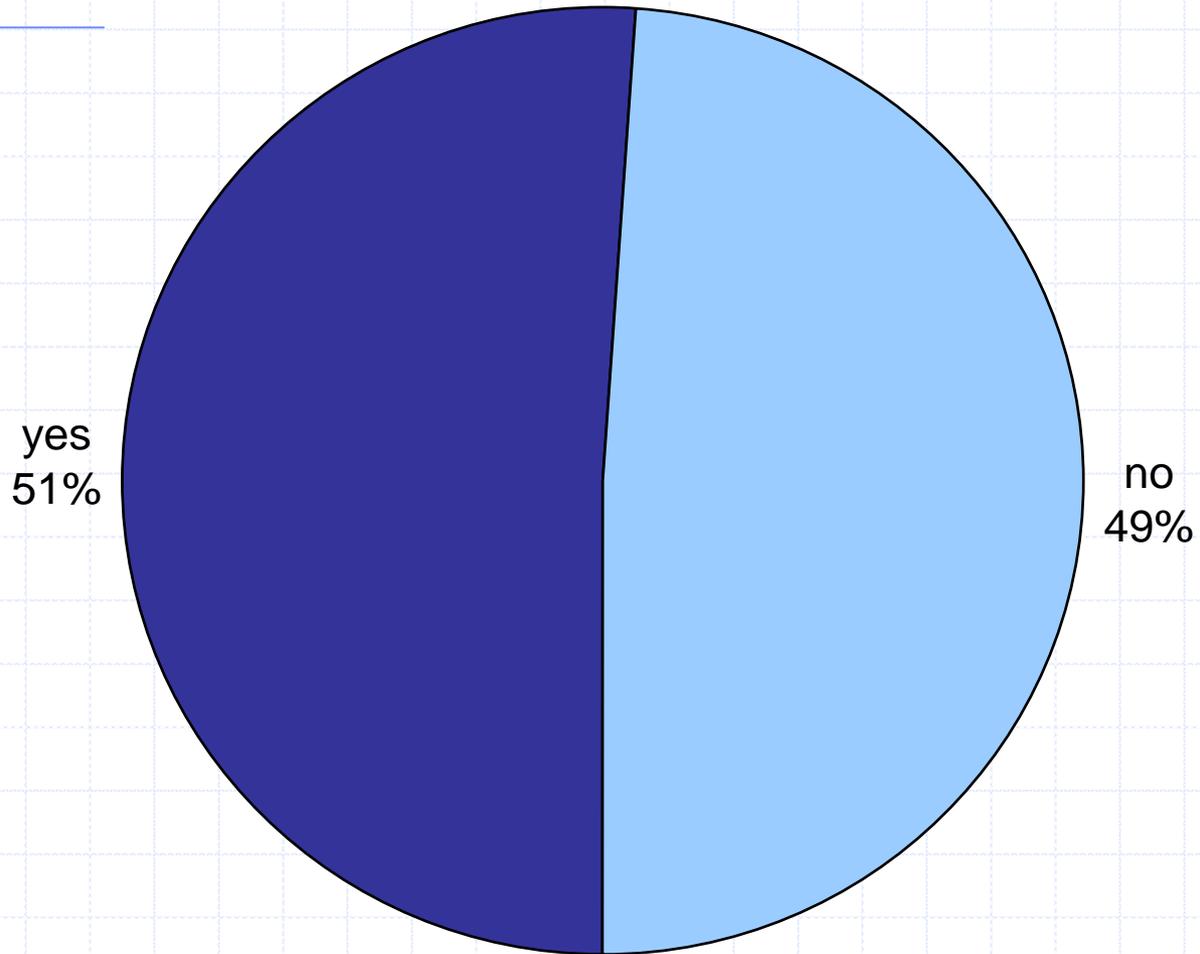
Linking Stormwater & Land Use (Ch. 2)

- ◆ **Work With Land Use Planners**
 - Comprehensive Plans
- ◆ **Evaluate Existing Codes**
 - Zoning
 - Subdivision
 - Utility
- ◆ **Use Watersheds for Integrated Planning**

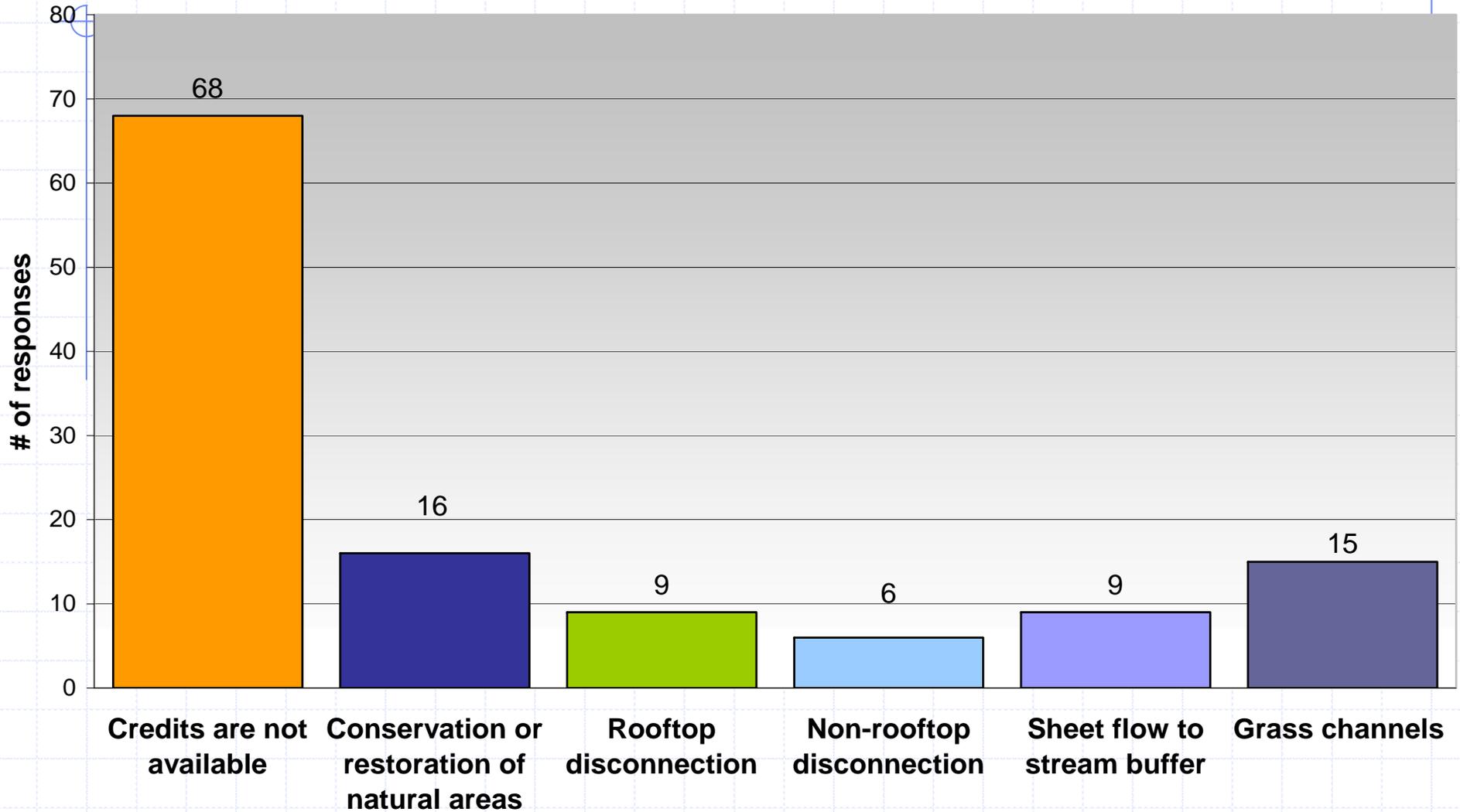
Overview of Post-Construction Guidance



Have you adopted an ordinance that has post-construction stormwater management requirements?



Does Your Program Allow Stormwater Credits for LID & Site Design Techniques



Site-Based LID Credit Systems: Replace or Reduce Structural BMPs

- ◆ Riparian Protection & Restoration
- ◆ Natural Area/Wetland/Forest Conservation & Restoration
- ◆ Impervious Disconnection
 - Rain gardens
 - Rain barrels & cisterns
 - Grass swales
 - Infiltration
- ◆ Pervious Parking
- ◆ Green Roof

Post-Construction Ordinance: (Ch. 3)

- ◆ Establish Stormwater Criteria
- ◆ Authorize LID, Provide Credits
- ◆ Assign Maintenance Responsibility
- ◆ Require Maintenance Agreement or Covenant
- ◆ Establish Enforcement Procedures

Post-Construction Model Ordinance

◆ Three Levels of Code Language

- Fundamental
- Enhancements
- Advanced Program

◆ Stormwater Criteria

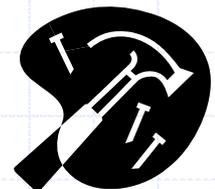
◆ Plan Review

◆ Inspection & Maintenance

◆ Enforcement

Download at:

<http://www.cwp.org/webcast/postconstruction.htm>



What About Other Codes?

Ensure That Other Local Codes (Zoning, Subdivision) Allow For:

- **Open space, conservation design**
- **Reduction of impervious cover in streets & parking**
- **Open section roads, natural drainage swales**
- **Infill & redevelopment**

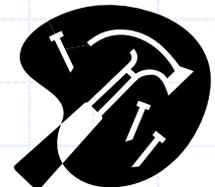
POST-CONSTRUCTION TOOL #4

Codes & Ordinance Worksheet (COW)

- ◆ Evaluate existing codes to reduce impervious cover by design
- ◆ 22 Questions
 - Streets & Parking Lots
 - Lot Layout
 - Natural Areas

Download at:

<http://www.cwp.org/webcast/postconstruction.htm>





Driveways



Parking Lots



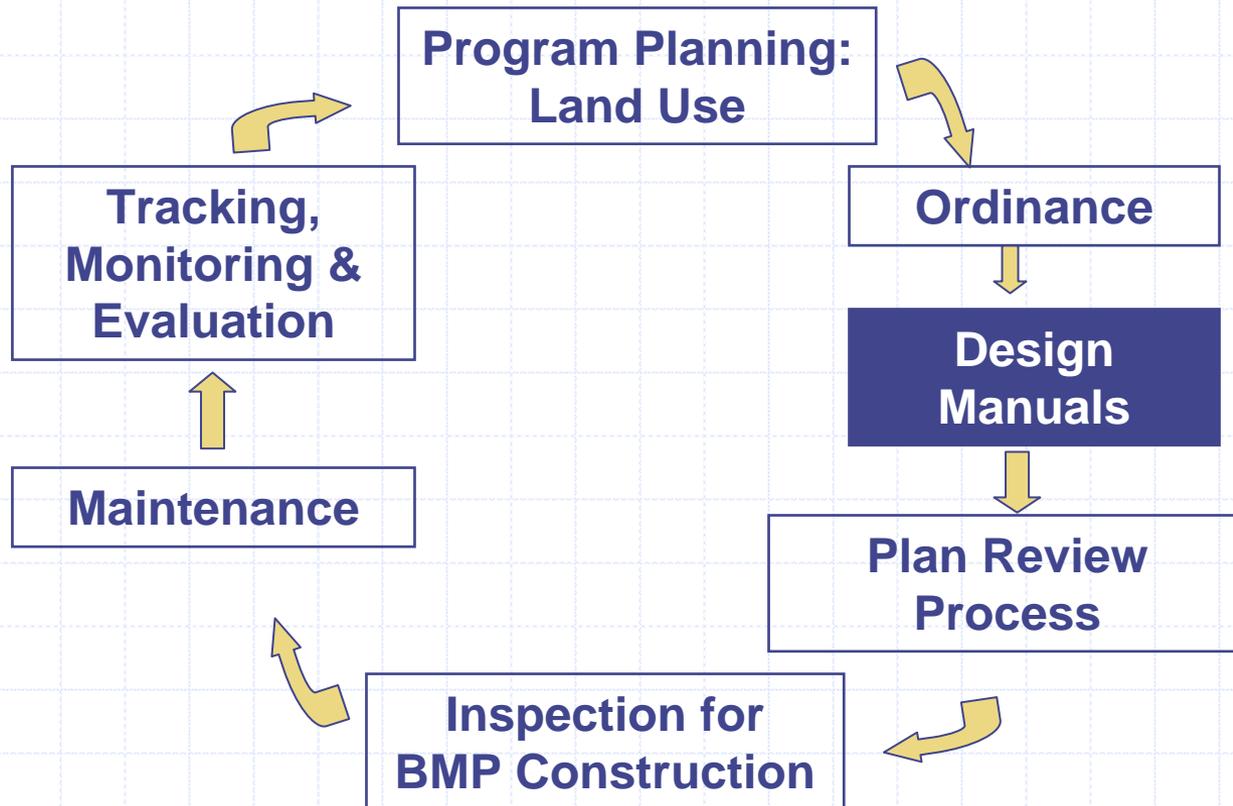
Streets

2. 2. 2002



Question & Answer Break

Overview of Post-Construction Guidance



Effective Manuals Have 2 Parts:

Design Manual	Policy and Procedures Manual
<p>Guidance for selecting & designing stormwater BMPs at development sites</p> <p>Used by design professionals and plan reviewers</p> <p>Can be an existing state or regional manual</p>	<p>Policies and procedures to support the local plan review process</p> <p>Used by plan reviewers, design professionals and administrative staff</p> <p>Should be prepared at the local level</p>

A Good **Design** Manual Should Include. . .

- ◆ Unified Stormwater Sizing Criteria
- ◆ Special Criteria for Sensitive Receiving Waters
- ◆ Special Criteria for Stormwater Hotspots
- ◆ List of Acceptable Stormwater BMPs
- ◆ Detailed Stormwater BMP Design Guidance
- ◆ Maintenance Reduction Design Features
- ◆ Stormwater Credits or LID Incentives

A Good **Policy** Manual Should Include. . .

- ◆ Acceptable Models & Procedures
- ◆ Template for Maintenance Agreement
- ◆ Template for Drainage & Access Easements
- ◆ Sample O&M Plans
- ◆ Criteria for Acceptance of Proprietary Devices

**Stormwater
Credit System to
Make LID A
Realistic Option
and Allow
Impervious Cover
to be Reduced
Through Site
Design**



Surface Impervious Cover Disconnection Credit Example



Chapter 11
Applying Stormwater Credits to Development Sites

$$V_{req} \text{ Before Credit} = [0.5 \text{ inches} + 1.9 \text{ acres}] \times \frac{1}{12}$$

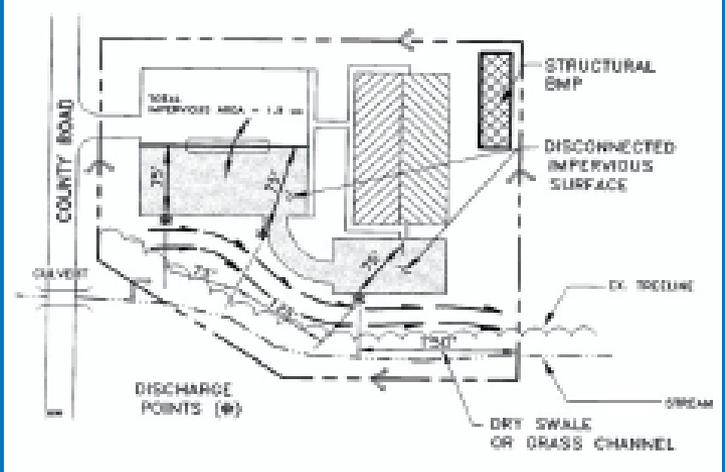
$$= 0.079 \text{ acre-foot}$$

$$V_{req} \text{ After Credit} = [0.5 \text{ inches} + (1.9 \text{ acres} - 0.52 \text{ acres})] \times \frac{1}{12}$$

$$= 0.066 \text{ acre-foot}$$

In this example, the surface impervious cover credit reduced the size of the planned bioretention area for the site by about 16.5% (.013 acre-foot).

Figure 11.3. Application of Surface Impervious Cover Disconnection Credit to a Hypothetical Development (Shaded Areas are Deducted from Total Site Area.)



Most Manuals Do Not Include Maintenance Reduction Design Features



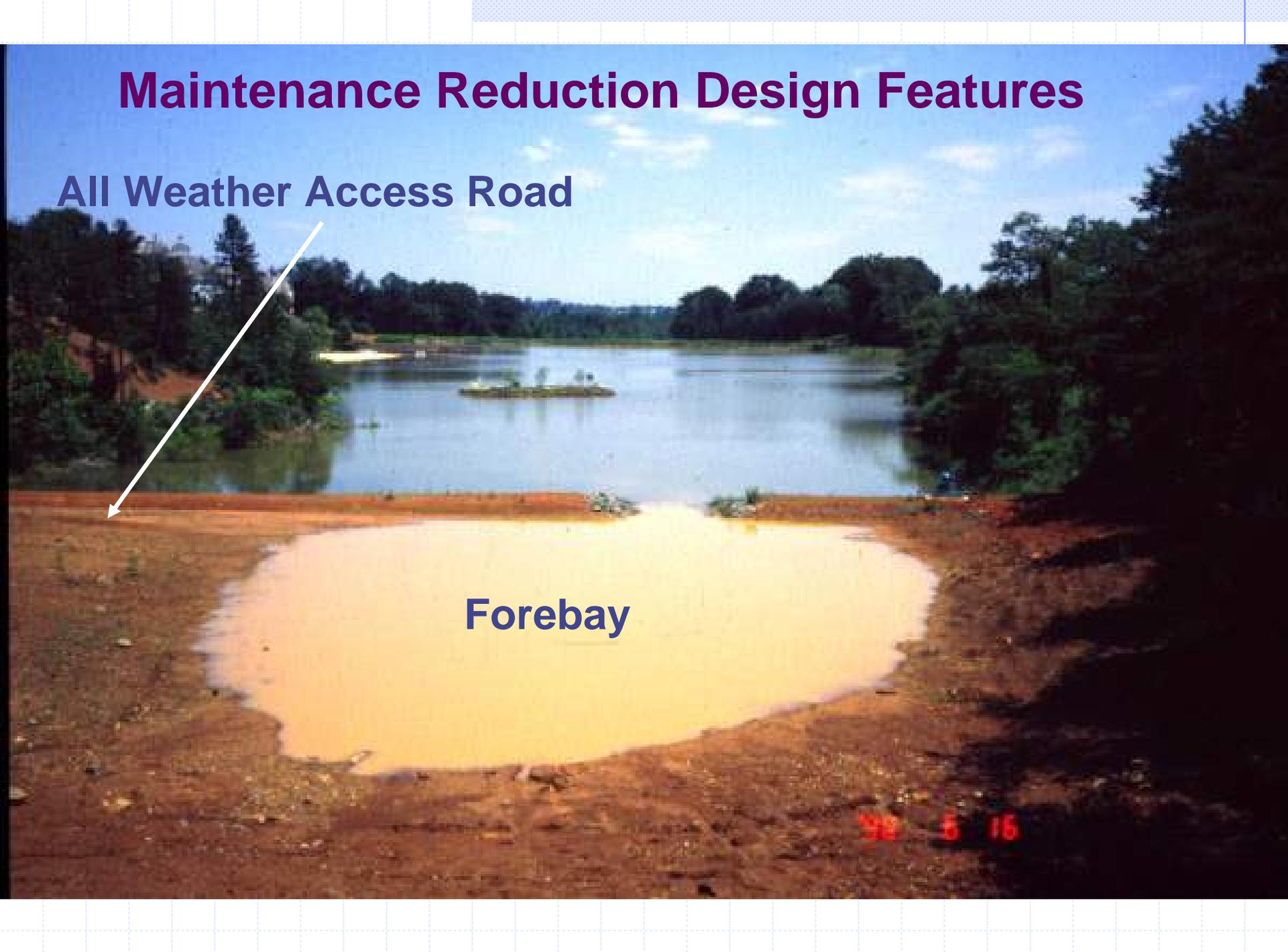
Maintenance Reduction Design Features

All Weather Access Road



Forebay

98 5 16



Developing Stormwater Manuals (Ch. 4)

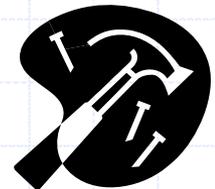
- ◆ Reference Existing State or Regional Manual
- ◆ Provide Credits for LID & Pollution Prevention
- ◆ Develop BMP Specs & Typical Designs –
Include Maintenance Reduction Features
- ◆ Provide Training to Design Consultants & Plan Reviewers

Design Manual Builder

- ◆ Review of State & Local Manuals
- ◆ Best of the Best in 50 categories
 - BMPs
 - Programmatic Issues: maintenance agreements, easements, LID credits, etc.

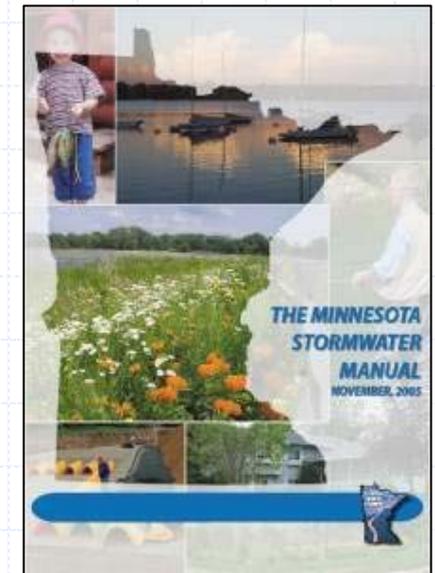
Download at:

<http://www.cwp.org/webcast/postconstruction.htm>



Web Links to Best Resources

Detailed BMP Design/Performance Specifications			
Bioretention	Prince George's Co, MD	Bioretention Manual	http://www.goprincegeorgescounty.com/Government/AgencyIndex/DER/ESD/Bioretention/bioretention.asp?nivel=f
	Lake Co, OH	Bioretention Guidance	http://www2.lakecountyohio.org/smd/Forms.htm
	Washington	Low Impact Development Technical Guidance Manual for Puget Sound	http://www.psat.wa.gov/Publications/LID_tech_manual05/id_index.htm
	Wisconsin	Stormwater Management Technical Standards	http://www.dnr.state.wi.us/org/water/wm/nps/stormwater/techstds.htm#Post



INNOVATIVE STORMWATER MANAGEMENT IN THE TWIN CITIES

*Jay Riggs, District Manager
Washington Conservation District
Stillwater, Minnesota*

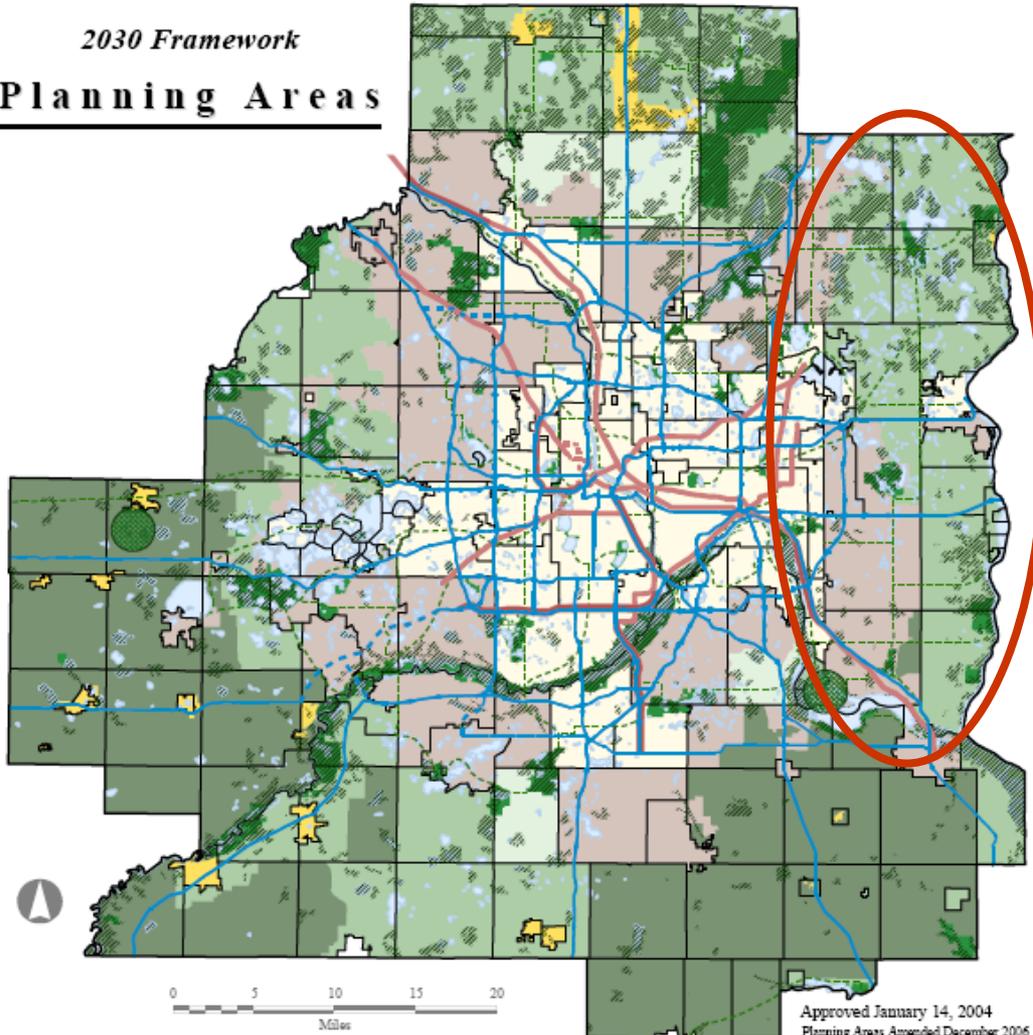


**WASHINGTON
CONSERVATION
DISTRICT**

1380 W FRONTAGE RD
HIGHWAY 36
STILLWATER, MN 55082

651-275-1136 [PHONE]
651-275-1254 [FAX]
WWW.MNWCD.ORG

Planning Areas

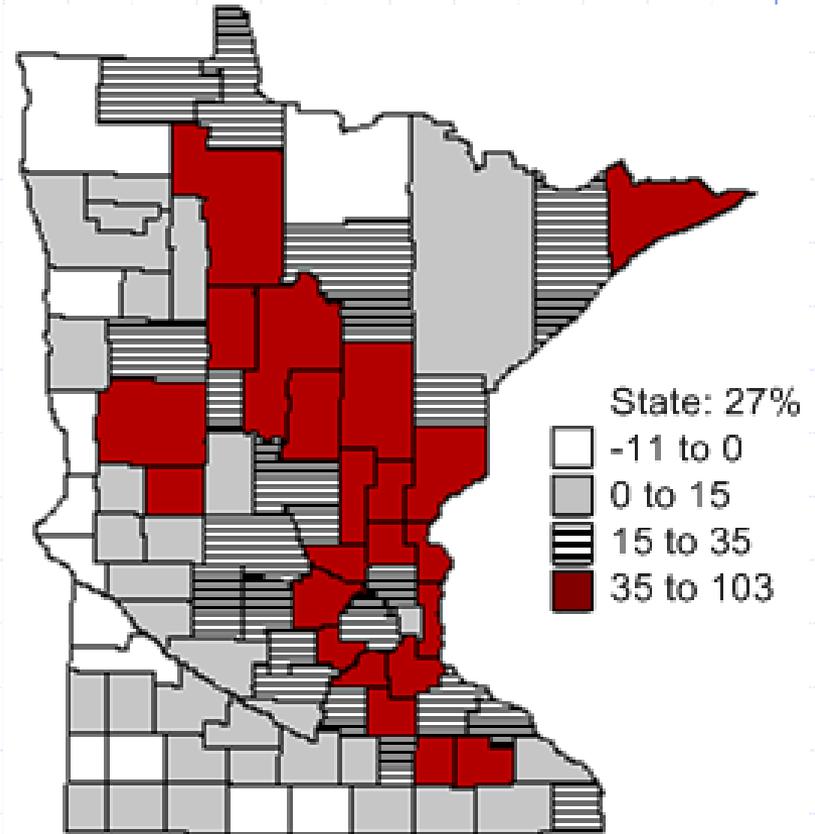


Approved January 14, 2004
Planning Areas Amended December 2006

NOTE: Please refer to the Comprehensive Plans Composite map or the Regional Systems maps for the most recent information. These maps are available at the Metropolitan Council Data Center (651) 602-1140.

Geographic Planning Areas		Additional Information	
Urban Planning Areas	Rural Planning Areas	Regional Natural Resource Areas (includes Terrestrial and Wetland Areas) SOURCE: Metro DNR in coordination with the Metropolitan Council	Regional Trail
Developing Area	Rural Center	Regional Park	Transit 2025 Corridor
Developed Area	Agricultural	Proposed Regional Park	Principal Arterial
	Diversified Rural		Open Water
	Rural Residential		

Projected Population Growth Rate 2000 to 2030



State: 27%

- 11 to 0
- 0 to 15
- 15 to 35
- 35 to 103

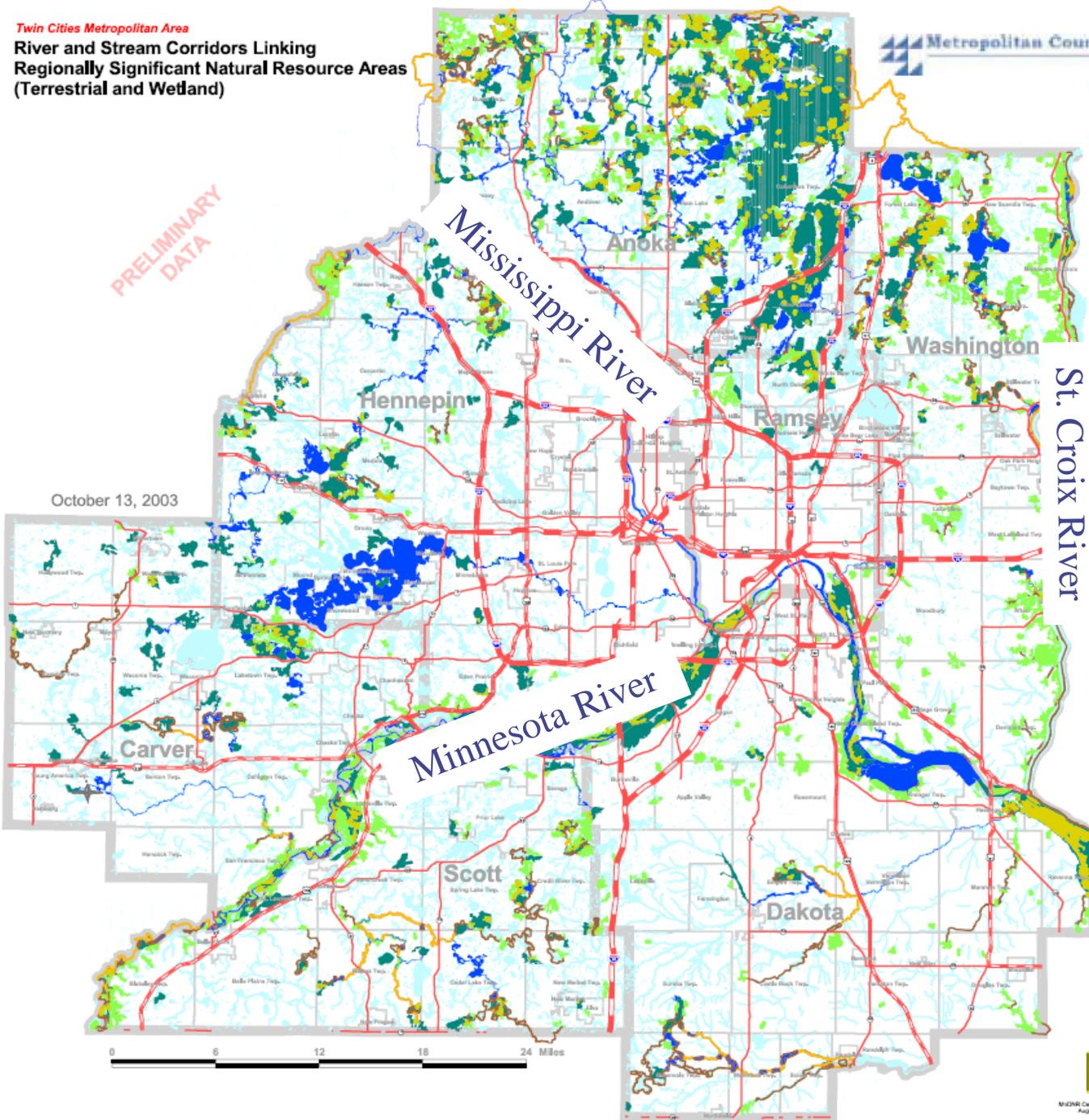
Source: Minnesota State Demographic Center

Twin Cities Metropolitan Area

River and Stream Corridors Linking Regionally Significant Natural Resource Areas (Terrestrial and Wetland)



PRELIMINARY DATA



Land of 10,000 Lakes is Land of . . .

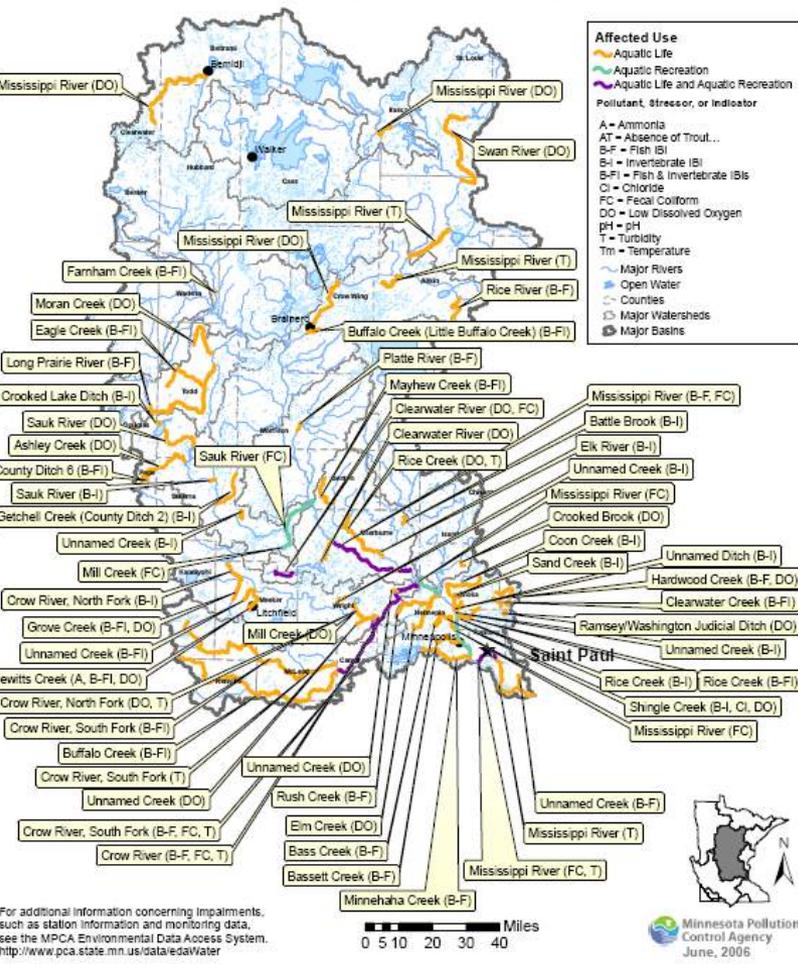


MDNR Central Region August 21, 2002

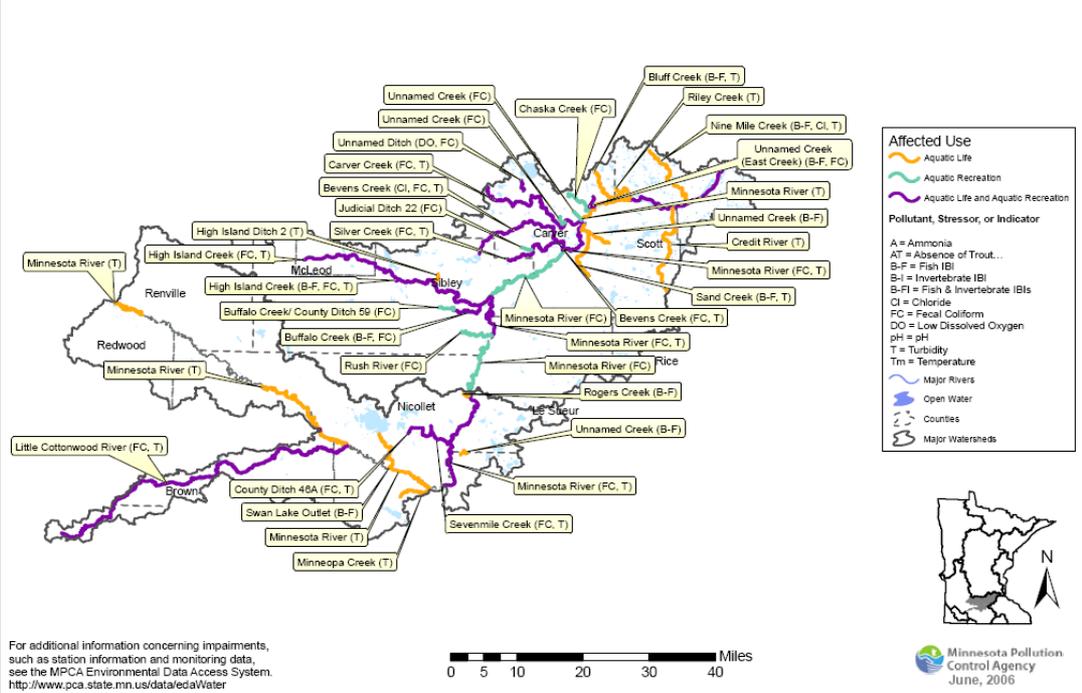
Impaired Waters in Minnesota

2,250 impairments on 284 rivers and 1,013 lakes

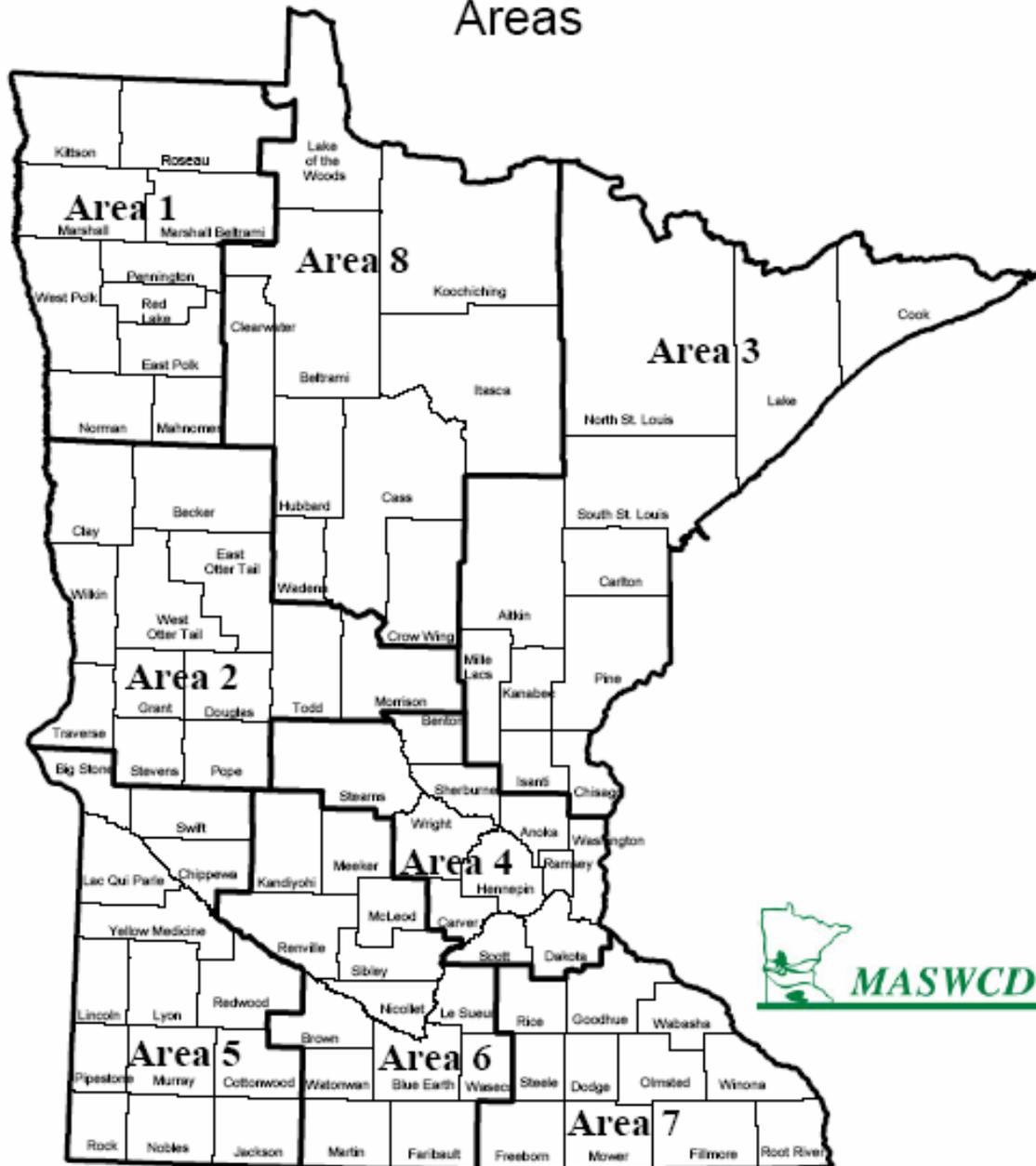
Upper Mississippi River Basin: Conventional Parameters
2006 Impaired Waters Requiring a TMDL
(per Section 303 (d) Clean Water Act)



Lower Minnesota River Basin: Conventional Parameters
2006 Impaired Waters Requiring a TMDL
(per Section 303 (d) Clean Water Act)



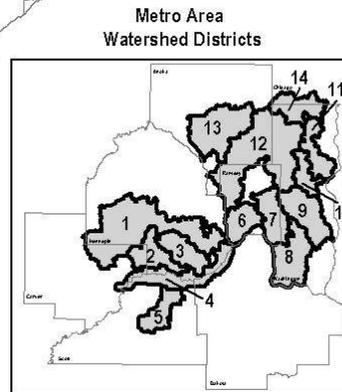
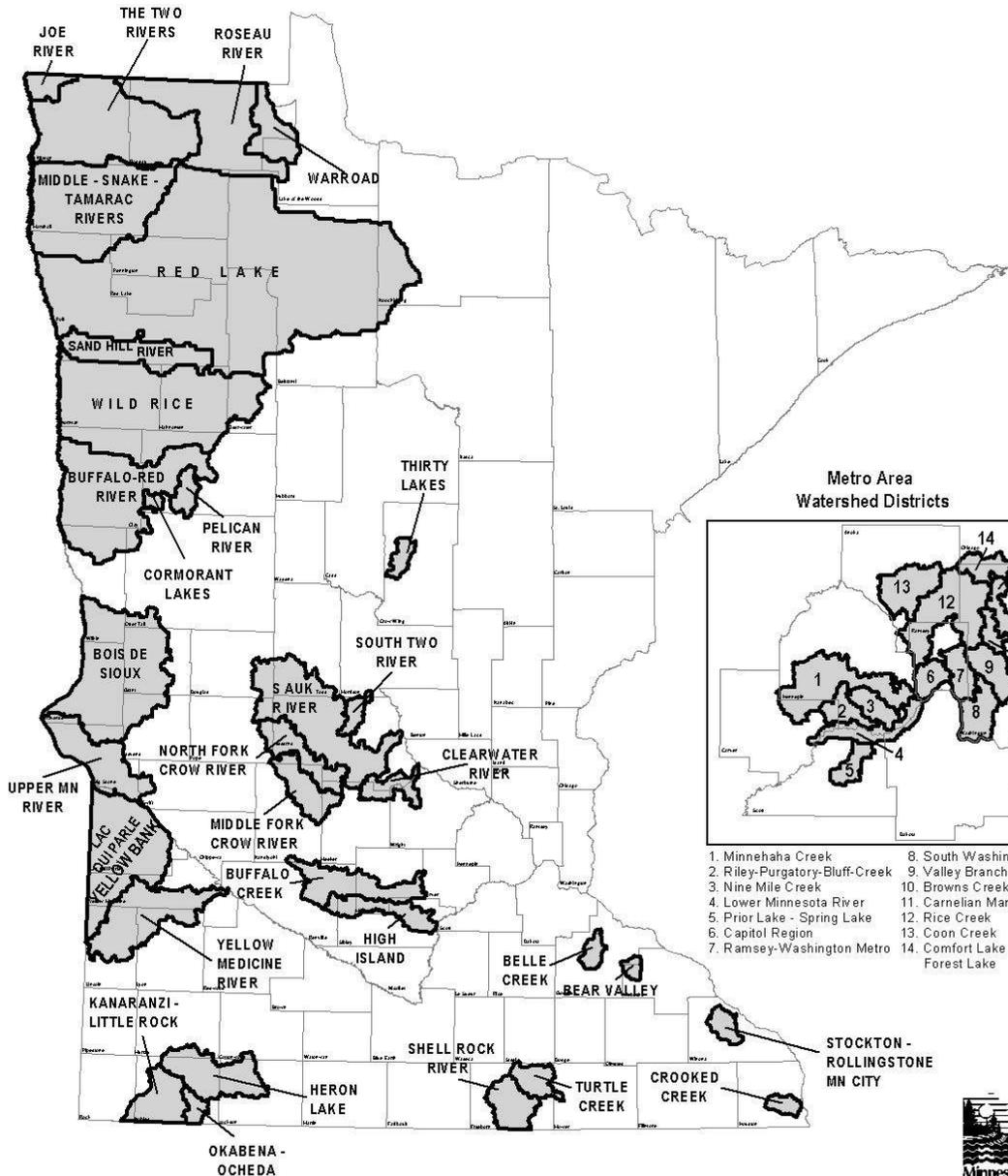
Minnesota Association of Soil & Water Conservation Districts Areas



*91 Conservation
Districts in the State
of MN*

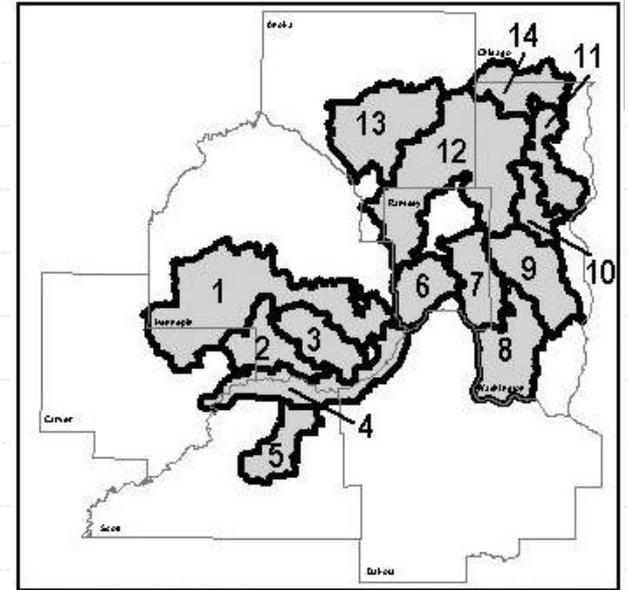


Minnesota Association of Watershed Districts MAWD



1. Minnehaha Creek
2. Riley-Purgatory-Bluff-Creek
3. Nine Mile Creek
4. Lower Minnesota River
5. Prior Lake - Spring Lake
6. Capitol Region
7. Ramsey-Washington Metro
8. South Washington
9. Valley Branch
10. Browns Creek
11. Carnelian Marine
12. Rice Creek
13. Coon Creek
14. Comfort Lake - Forest Lake

45 Watershed Districts in the State of MN



The entire metro has watershed plans

Example Projects

Maplewood Raingardens

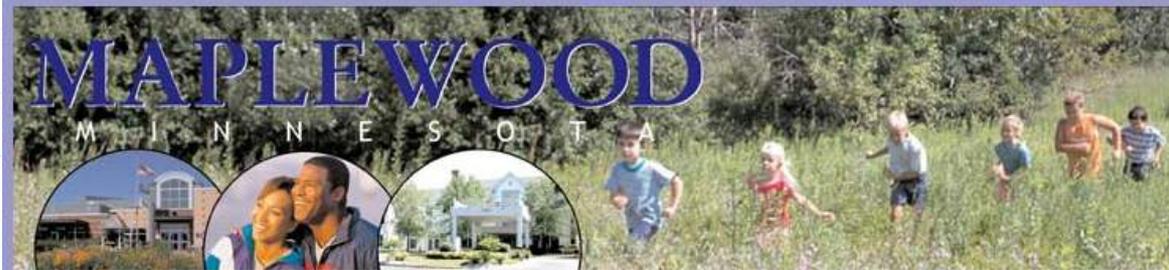
Fairway Villas

Burnsville Raingardens

*Washington County Big
Marine Park*

Major Factors
Contributing to
Implementation of
LID Practices

Maplewood Raingardens



[Home](#)

[Email Updates](#)

[City Council](#)

[City Departments](#)

[City Manager's Office](#)

[Community Development](#)

[Emergency Management](#)

[Finance](#)

[Fire](#)

[Human Resources](#)

[Information Technology](#)

[Park & Recreation](#)

[Police Department](#)

[Public Works](#)

[Engineering Division](#)

Rainwater Gardens



Prairie Garden in Maplewood



[Sign up for Rainwater Gardens e-mail updates](#)

A rainwater garden is a relatively small area of plantings near the drain spout of a building or a paved area. Rainwater is routed to the garden and filtered naturally by the plants and soils of the garden. Minnesota is fortunate to have an abundance of lakes.

History of Rainwater Gardens

1996-1997

Birmingham Pilot

The Birmingham Pilot Project was a partnership between the City of Maplewood, U of M, Department of Landscape Architecture, and the Ramsey Washington Metro Watershed District. Maplewood City Engineer Ken Haider, Watershed District Director Cliff Aichinger, and Professor Joan Iverson Nassauer from the University were the visionaries for this work. The project was

www.ci.maplewood.mn.us

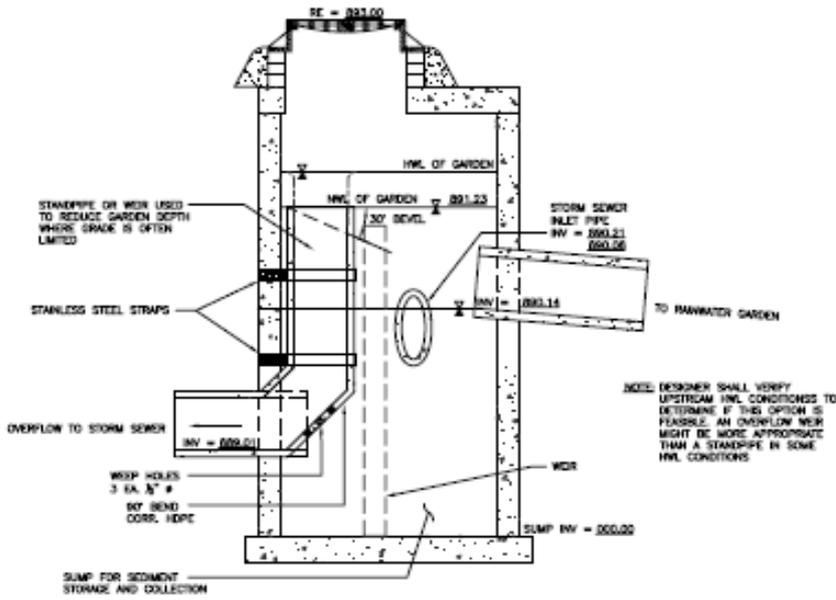
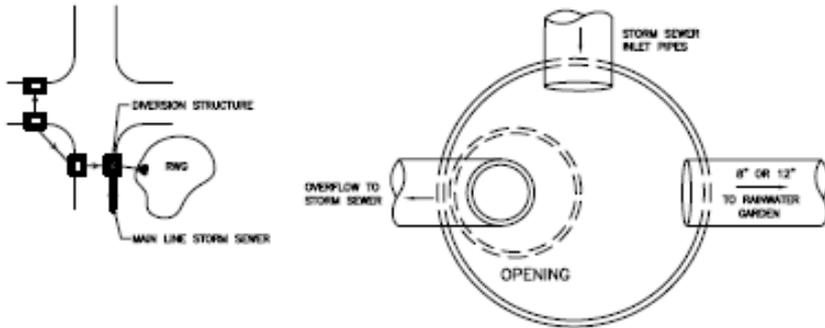
Maplewood Raingardens



Maplewood Raingardens

EXAMPLE:

PLAN OF TOP SLAB



DESIGN: CMC	DATE: 7-02
DRAWN: EMS	FILENAME: P:\WORKS\240 (PLATES, DINGS, STANDPIPE)
REVISIONS	

CITY OF MAPLEWOOD—ENGINEERING DEPT.
FIRST FLUSH/LOW FLOW RATE DIVERSION STRUCTURE

PLATE NO.
S2

Maplewood Raingardens

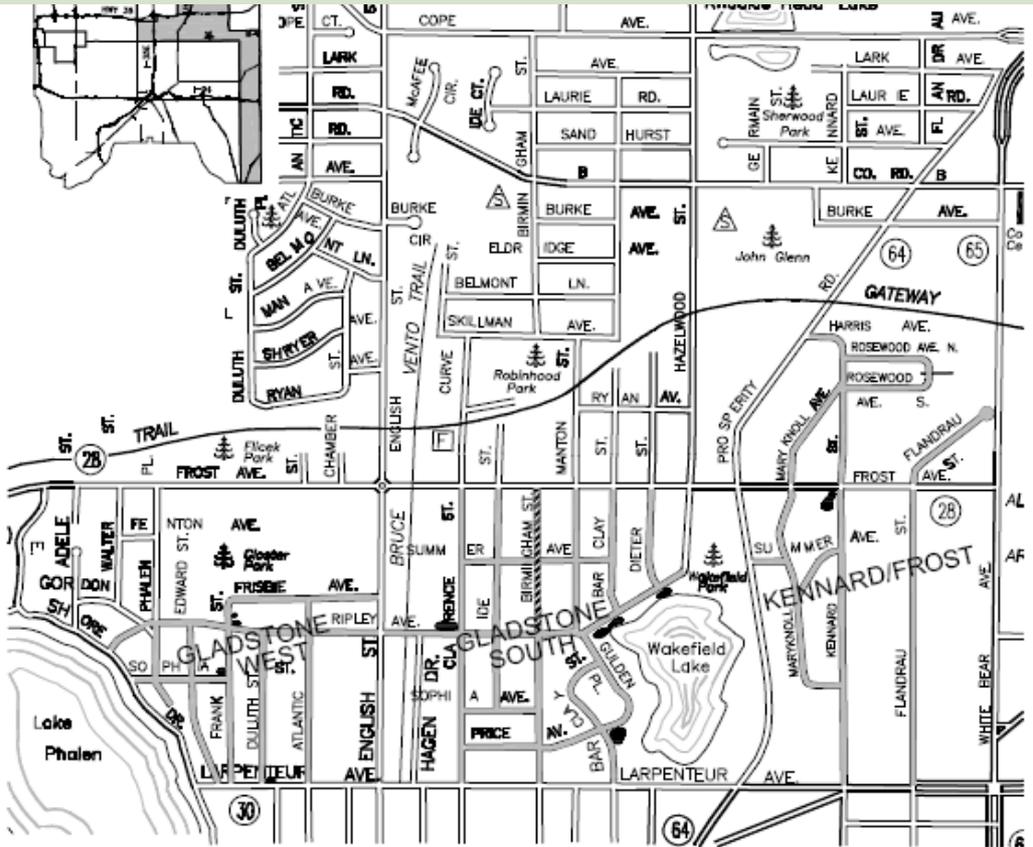
Major Factors

Existing rural x-section

High cost of curb and pipes

Innovative staff

Grant available



● CITY RAINWATER GARDENS

no scale

RAINWATER GARDEN LOCATION MAP

GLADSTONE WEST, GLADSTONE SOUTH, KENNARD-FROST

Hundreds of
raingardens have
been installed in the
City

Fairway Villas

GENERAL NOTES

THE CURRENT EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" COVERS EXCEPT AS MODIFIED BY THE CITY OF STILLWATER CODES, ORDINANCES, STANDARDS AND SPECIFICATIONS.

FURNISH, INSTALL, INSPECT, MAINTAIN AND REMOVE ALL NECESSARY TRAFFIC CONTROL DEVICES. ALL TRAFFIC CONTROL DEVICES AND SIGNS SHALL CONFORM TO ALL LOCAL, COUNTY AND STATE TRAFFIC CONTROL CODES, ORDINANCES, STANDARDS AND SPECIFICATIONS.

THE EXISTING UTILITY INFORMATION SHOWN ON THESE DRAWINGS IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE. CONTACT OWNER STATE ONE CALL (855-464-6862) FOR THE LOCATION OF ALL UNDERGROUND WIRING, CABLES, CONDUITS, PIPES, MANHOLES, MANIFOLDS, OR OTHER BURIED STRUCTURES BEFORE DIGGING. REPAIR ANY OF THE ABOVE WHICH ARE REMOVED OR DAMAGED DURING CONSTRUCTION AT NO COST TO THE OWNER.

THE EXACT LOCATION OF ALL UTILITIES AND UTILITY CONNECTIONS MUST BE VERIFIED PRIOR TO COMMENCING WORK. LOCATE, FIELD VERIFY AND PROTECT ALL EXISTING UTILITIES AND TOPOGRAPHIC FEATURES PRIOR TO START OF SITE CONSTRUCTION. IMMEDIATELY NOTIFY THE ENGINEER OF ANY DISCREPANCIES OR VARIATIONS FROM THE PLAN.

SECURE ALL NECESSARY PERMITS AND NOTIFY ALL UTILITY COMPANIES WITH UTILITIES ON SITE PRIOR TO THE CONSTRUCTION OF THE PROJECT. ADHERE TO ALL APPLICABLE LOCAL, STATE, AND/OR FEDERAL LAWS FOR ANY COST INCURRED DUE TO THE DAMAGE OF SUD UTILITIES.

EXISTING SURVEY AND TOPOGRAPHIC INFORMATION PROVIDED CONFORMS TO LAND SURVEYING. HUMPHREY ENGINEERING INC. IS NOT RESPONSIBLE FOR THE ACCURACY OF INFORMATION PROVIDED BY OTHERS.

LEGEND

- | | | | |
|---|--------------------------------|-----|-----------------------------|
| — | EX. HOOD CONTOURS | HP | HIGH POINT |
| — | EX. INTERMEDIATE CONTOURS | LP | LOW POINT |
| — | PROPOSED HOOD CONTOURS | HNE | 100-YR RAIN WATER ELEVATION |
| — | PROPOSED INTERMEDIATE CONTOURS | TNE | TOP OF WALL ELEVATION |
| — | TRIO LINE | BNE | BOTTOM OF WALL ELEVATION |
| — | WEIRAGE | MFE | MAIN FLOOR ELEVATION |
| — | OVERHEAD ELECTRIC | GFE | GROUND FLOOR ELEVATION |
| — | FENCE | TLS | TOP LINER SLAB |
| — | OVERHEAD SCREEN | LSE | LOWEST FINISH ELEVATION |
| — | GRAVELLE GRASS | NHL | NORMAL WATER LEVEL |
| — | RETAINED WALL | NSL | NO. 8999.0 |

GRADING LIMITS

GRADING NOTES

USE ONLY DUMPED MATERIAL AS APPROVED BY THE ENGINEER FOR BUILDING PAD AND STREET CONSTRUCTION. REMOVE UNSUITABLE AND UNSTABLE MATERIALS INCLUDING BUT NOT LIMITED TO TOPSOIL, GRADING MATERIAL, AND CERES FROM THE BUILDING PAD AND STREET AREAS. COMPACT THE UPPER 3 FEET OF EMBANKMENT IN THE STREET TO 100% OF THE STANDARD PROCTOR DENSITY. COMPACT STREET EMBANKMENTS BELOW THE UPPER 3 FEET AND BUILDING FOUNDATIONS TO NO LESS THAN 90% OF THE STANDARD PROCTOR DENSITY.

BACKFILL ALL BELOW GRADE EXCAVATIONS IMMEDIATELY UPON REMOVAL OF THE UNSUITABLE SOILS. BACKFILL EXCAVATIONS ADJACENT TO EXISTING PAVEMENTS PROMPTLY TO AVOID UNDERMINING OF THE EXISTING PAVEMENT.

SAVEGRASS AND PROVIDE A MINIMUM DEPTH OF 4 INCHES OF TOPSOIL TO ALL AREAS DISTURBED BY CONSTRUCTION.

CONTRACTOR IS RESPONSIBLE FOR ALL HORIZONTAL AND VERTICAL CONTROL ONCE THE ALIGNMENT HAS BEEN ESTABLISHED BY THE SURVEYOR. ADDITIONAL COST FOR SETBACKS AND/OR REPLACING DAMAGED STAKES IS THE RESPONSIBILITY OF THE CONTRACTOR.

PROVIDE ALL SOIL TESTING AT INTERVALS NO LESS THAN EVERY 500' AND ADDITIONAL TESTING DEEMED NECESSARY BY THE CITY OR ENGINEER WITH NO ADDITIONAL COMPENSATION.

THE SPECIFIED DENSITY METHOD OF COMPACTION IS REQUIRED FOR ALL PORTIONS OF PERMANENT CONSTRUCTION. STANDARD COMPACTION IS REQUIRED FOR ANY TEMPORARY CONSTRUCTION.

DISPOSE OF ALL EXCESS MATERIAL, STUMMUS, BUFFALOING, CONCRETE ITEMS, REMOVED UTILITY ITEMS AND OTHER UNDESIRABLE WASTE OFF-SITE OF THE CONSTRUCTION SITE IN ACCORDANCE WITH ALL APPLICABLE LAWS AND REGULATIONS, UNLESS OTHERWISE SPECIFIED.

PROVIDED SPOT ELEVATIONS AND CONTOURS ARE TO FINISHED GRADE, PAVEMENT SURFACE OR CURB FLOW LINE, UNLESS OTHERWISE SPECIFIED.

NOTIFY THE CITY OF STILLWATER, PUBLIC WORKS DEPARTMENT, 48 HOURS IN ADVANCE OF WORKING WITHIN THE RIGHT OF WAY. CITY OF STILLWATER INSPECTORS MUST OBSERVE ALL WORK COMPLETED, INCLUDING THE REMOVAL OF EXISTING CURBS & GUTTER, EXCAVATION OF TRENCHES, PLACEMENT OF STORM SWAY, CONNECTIONS TO EXISTING UTILITY LINES, BACKFILLING AND REPLACEMENT OF DISTURBED PAVEMENT AND/OR CONCRETE CURBS AND GUTTERS.

COMPLETE ALL PROPOSED STREET CONSTRUCTION USING APPROVED MATERIALS, METHODS OF PLACEMENT AND TESTING AS REQUIRED BY ALL GOVERNING SPECIFICATIONS.

CARE MUST BE TAKEN DURING CONSTRUCTION AND EXCAVATION TO PROTECT ALL SURVEY MONUMENTS AND/OR PROPERTY IRONS ON AND ADJACENT TO THIS SITE.

REPAIR ALL DAMAGE TO EXISTING FACILITIES RESULTING FROM CONSTRUCTION ACTIVITIES AT NO COST TO THE OWNER.

PROVIDE A SMOOTH AND THOROUGH TRANSITION BETWEEN PROPOSED SITE GRADES AND DRAINAGE AND EXISTING SURROUNDING SITE GRADES AND DRAINAGEWAYS.

R/RAP SHALL BE 0.50" ± 12", UNLESS OTHERWISE SPECIFIED.

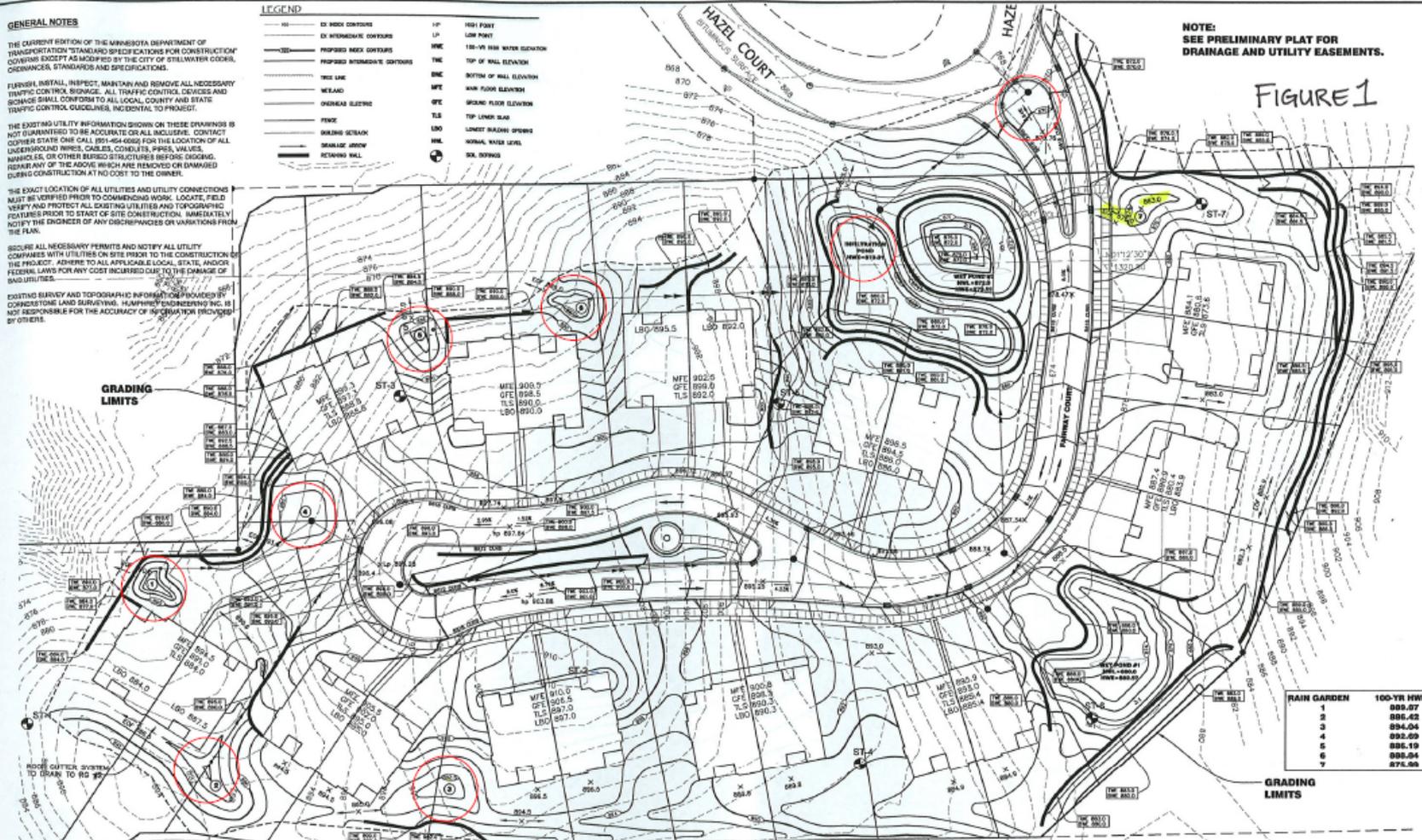
ALL CURB AND GUTTER SHALL BE CONCRETE 8" MIN, UNLESS OTHERWISE SPECIFIED. SEE DETAIL.

WRITE IN DIMENSIONS PREVAIL OVER SCALED DIMENSIONS.

2" VERTICAL CONTOUR INTERVAL, N.O.D. VERTICAL DATUM.

NOTE: SEE PRELIMINARY PLAN FOR DRAINAGE AND UTILITY EASEMENTS.

FIGURE 1



RAIN GARDEN	100-YR HWE
1	899.07
2	895.42
3	894.00
4	892.69
5	891.19
6	888.54
7	875.59



PROJECT OWNER:
Lynskey & Clark Companies
 PO BOX 26
 118 SOUTH MAIN
 STILLWATER, MN 55082

DESIGNED BY:
HUMPHREY ENGINEERING
 2311 ONYX ROAD • FALCON WJ 54016
 715.931.0215 • 866.299.0020 • FAX 715.931.0220
 www.humphreyengineering.com

ENGINEERED BY:
HUMPHREY ENGINEERING
 Engineers - Land Surveyors - Planners
 2311 ONYX ROAD • FALCON WJ 54016
 715.931.0215 • 866.299.0020 • FAX 715.931.0220
 www.humphreyengineering.com

PROJECT NAME: FAIRWAY VILLAS
 SHEET NO.: 12.15.05

PROJ. NO.: 461-001
 DRAWN BY: JCH
 CHECKED BY: TON
 DATE: 12.15.05
 SHEET NO.: C2.2

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Fairway Villas

GENERAL NOTES

THE CURRENT EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" GOVERNS EXCEPT AS MODIFIED BY THE CITY OF STILLWATER CODES, ORDINANCES, STANDARDS AND SPECIFICATIONS.

FURNISH, INSTALL, INSPECT, MAINTAIN AND REMOVE ALL NECESSARY TRAFFIC CONTROL SIGNAGE. ALL TRAFFIC CONTROL DEVICES AND SIGNAGE SHALL CONFORM TO ALL LOCAL, COUNTY AND STATE TRAFFIC CONTROL CODES, ORDINANCES, STANDARDS AND SPECIFICATIONS.

THE EXISTING UTILITY INFORMATION SHOWN ON THESE DRAWINGS IS NOT GUARANTEED TO BE ACCURATE OR ALL INCLUSIVE. CONTACT OWNER STATE ONE CALL (855-464-6862) FOR THE LOCATION OF ALL UNDERGROUND WIRING, CABLES, CONDUITS, PIPES, MANHOLES, MANIFOLDS, OR OTHER BURIED STRUCTURES BEFORE DIGGING. REPAIR ANY OF THE ABOVE WHICH ARE REMOVED OR DAMAGED DURING CONSTRUCTION AT NO COST TO THE OWNER.

THE EXACT LOCATION OF ALL UTILITIES AND UTILITY CONNECTIONS MUST BE VERIFIED PRIOR TO COMMENCING WORK. LOCATE, FIELD VERIFY AND PROTECT ALL EXISTING UTILITIES AND TOPOGRAPHIC FEATURES PRIOR TO START OF SITE CONSTRUCTION. IMMEDIATELY NOTIFY THE ENGINEER OF ANY DISCREPANCIES OR VARIATIONS FROM THE PLAN.

SECURE ALL NECESSARY PERMITS AND NOTIFY ALL UTILITY COMPANIES WITH UTILITIES ON SITE PRIOR TO THE CONSTRUCTION OF THE PROJECT. ADHERE TO ALL APPLICABLE LOCAL, STATE, AND/OR FEDERAL LAWS FOR ANY COST INCURRED DUE TO THE DAMAGE OF SUD UTILITIES.

EXISTING SURVEY AND TOPOGRAPHIC INFORMATION PROVIDED CONFORMS TO LAND SURVEYING. HAMPHREY ENGINEERING INC. IS NOT RESPONSIBLE FOR THE ACCURACY OF INFORMATION PROVIDED BY OTHERS.

LEGEND

- | | | | |
|------|---------------------------|------|-----------------------------|
| — 00 | EX. HOOD CONTOURS | HP | HIGH POINT |
| — 01 | EX. INTERMEDIATE CONTOURS | LP | LOW POINT |
| — 02 | EX. BENCH CONTOURS | HWE | 100-YR HAZ. WATER ELEVATION |
| — 03 | PROPOSED BENCH CONTOURS | TME | TOP OF WALL ELEVATION |
| — 04 | TRIO LINE | BME | BOTTOM OF WALL ELEVATION |
| — 05 | WEIRAGE | MFE | MAIN FLOOR ELEVATION |
| — 06 | OVERHEAD ELECTRIC | GFE | GROUND FLOOR ELEVATION |
| — 07 | FENCE | TLS | TOP LINER SLAB |
| — 08 | DRAINAGE SWOOSH | ULES | UNDERST. SLAB ON GROUND |
| — 09 | GRAVELLY GROUND | MHL | NORMAL WATER LEVEL |
| — 10 | RETAINED WALL | DL | DOOR |

GRADING LIMITS

GRADING NOTES

USE ONLY SUITABLE MATERIAL AS APPROVED BY THE ENGINEER FOR BUILDING PAD AND STREET CONSTRUCTION. REMOVE UNSUITABLE AND UNSTABLE MATERIALS INCLUDING BUT NOT LIMITED TO TOPSOIL, GRADING MATERIAL, AND CERES FROM THE BUILDING PAD AND STREET AREAS. COMPACT THE UPPER 3 FEET OF EMBANKMENT AT THE STREET TO 100% OF THE STANDARD PROCTOR DENSITY. COMPACT STREET EMBANKMENTS BELOW THE UPPER 3 FEET AND BUILDING FOUNDATIONS TO NO LESS THAN 5% OF THE STANDARD PROCTOR DENSITY.

BACKFILL ALL BELOW GRADE EXCAVATIONS IMMEDIATELY UPON REMOVAL OF THE UNSUITABLE SOILS. BACKFILL EXCAVATIONS ADJACENT TO EXISTING PAVEMENTS PROMPTLY TO AVOID UNDERMINING OF THE EXISTING PAVEMENT.

SAVAGE AND PROVIDE A MINIMUM DEPTH OF 4 INCHES OF TOPSOIL TO ALL AREAS DISTURBED BY CONSTRUCTION.

CONTRACTOR IS RESPONSIBLE FOR ALL HORIZONTAL AND VERTICAL CONTROL ONCE THE ALIGNMENT HAS BEEN ESTABLISHED BY THE SURVEYOR. ADDITIONAL COST FOR SETTING AND/OR REPLACING DAMAGED STAKES IS THE RESPONSIBILITY OF THE CONTRACTOR.

PROVIDE ALL SOIL TESTING AT INTERVALS NO LESS THAN EVERY 500' AND ADDITIONAL TESTING DEEMED NECESSARY BY THE CITY OR ENGINEER WITH NO ADDITIONAL COMPENSATION.

THE SPECIFIED DENSITY METHOD OF COMPACTION IS REQUIRED FOR ALL PORTIONS OF PERMANENT CONSTRUCTION. STANDARD COMPACTION IS REQUIRED FOR ANY TEMPORARY CONSTRUCTION.

DISPOSE OF ALL EXCESS MATERIAL, REFUSABLE SURFACING, CONCRETE ITEMS, REMOVED UTILITY ITEMS AND OTHER UNDESIRABLE WASTE OFF-SITE OF THE CONSTRUCTION SITE IN ACCORDANCE WITH ALL APPLICABLE LAWS AND REGULATIONS, UNLESS OTHERWISE SPECIFIED.

PROPOSED SPOT ELEVATIONS AND CONTOURS ARE TO FINISHED GRADE, PAVEMENT SURFACE OR CURB FLOW LINE, UNLESS OTHERWISE SPECIFIED.

NOTIFY THE CITY OF STILLWATER, PUBLIC WORKS DEPARTMENT, 48 HOURS IN ADVANCE OF WORKING WITHIN THE RIGHT OF WAY. CITY OF STILLWATER INSPECTORS MUST OBSERVE ALL WORK COMPLETED, INCLUDING THE REMOVAL OF EXISTING CURBS & GUTTER, EXCAVATION OF TRENCHES, PLACEMENT OF STORM SWAY, CONNECTIONS TO EXISTING UTILITY LINES, BACKFILLING AND REPLACEMENT OF DISTURBED PAVEMENT AND/OR CONCRETE CURBS AND GUTTERS.

COMPLETE ALL PROPOSED STREET CONSTRUCTION USING APPROVED MATERIALS, METHODS OF PLACEMENT AND TESTING AS REQUIRED BY ALL GOVERNING SPECIFICATIONS.

CARE MUST BE TAKEN DURING CONSTRUCTION AND EXCAVATION TO PROTECT ALL SURVEY MONUMENTS AND/OR PROPERTY IRONS ON AND ADJACENT TO THIS SITE.

Major Factors
Trout Stream
Watershed rules
Variance request
Committed
watershed board

RAIN GARDEN	100-YR HWE
1	889.87
2	885.48
3	894.06
4	892.69
5	886.19
6	888.54
7	875.56

GRADING LIMITS



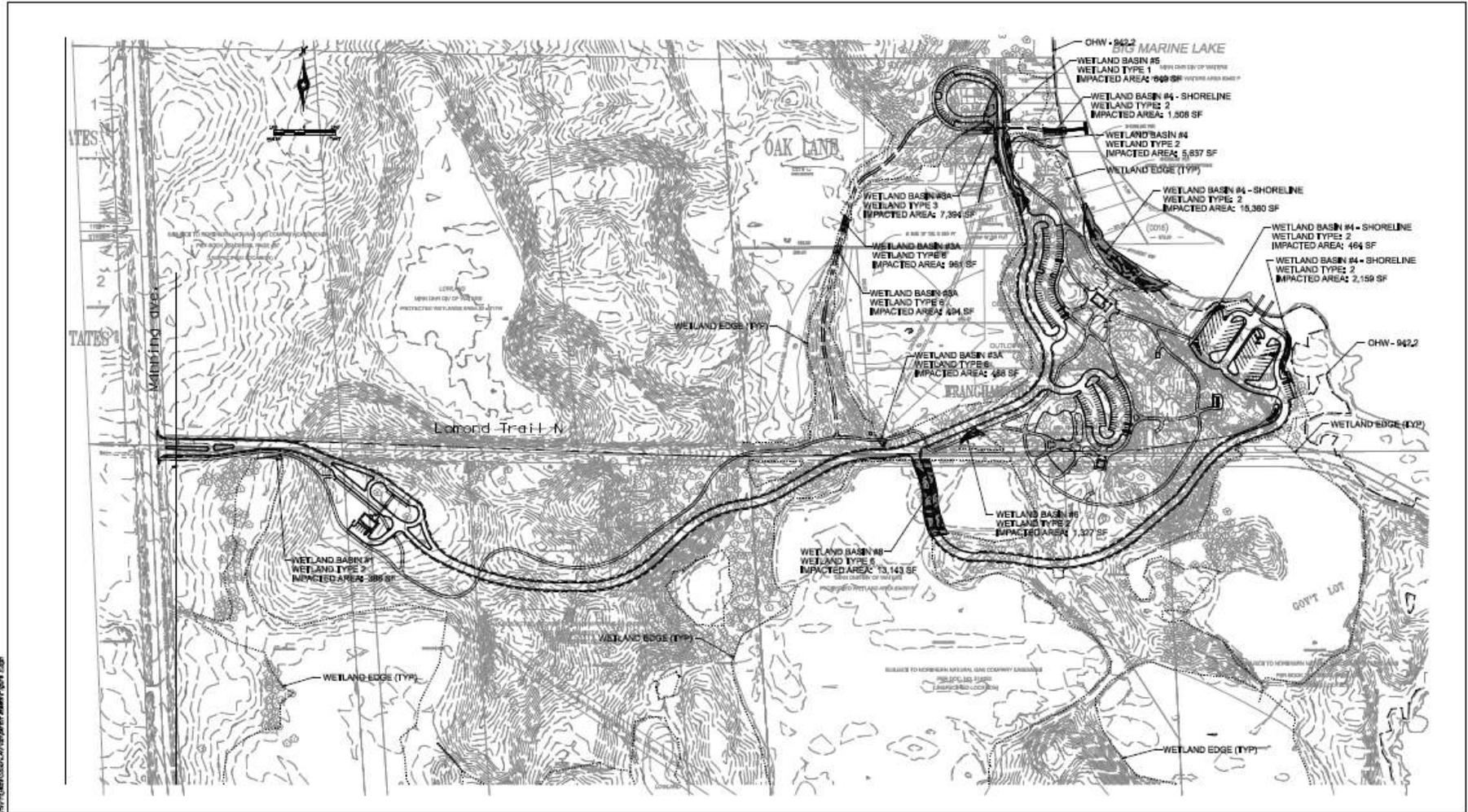
PROJECT NAME: FAIRWAY VILLAS
SITE IMPROVEMENTS
STILLWATER, MINNESOTA
SHEET TITLE: GRADING PLAN

PROPOSED	DATE	DESCRIPTION
REV. 1	10.15.20	ADD GRADING
REV. 2	10.15.20	REVISED GRADING
REV. 3	12.15.20	REVISED GRADING

PROJECT NO: 461-001
DRAWN BY: JCH
CHECKED BY: TON
DATE: 12.15.20
SHEET NO:

C2.2

Big Marine Park



PROJECT AREA
 BIG MARINE PARK RESERVE - PHASE 1 DEVELOPMENT
 Washington County Parks

Figure 2

Big Marine Park

GRADING NOTES:

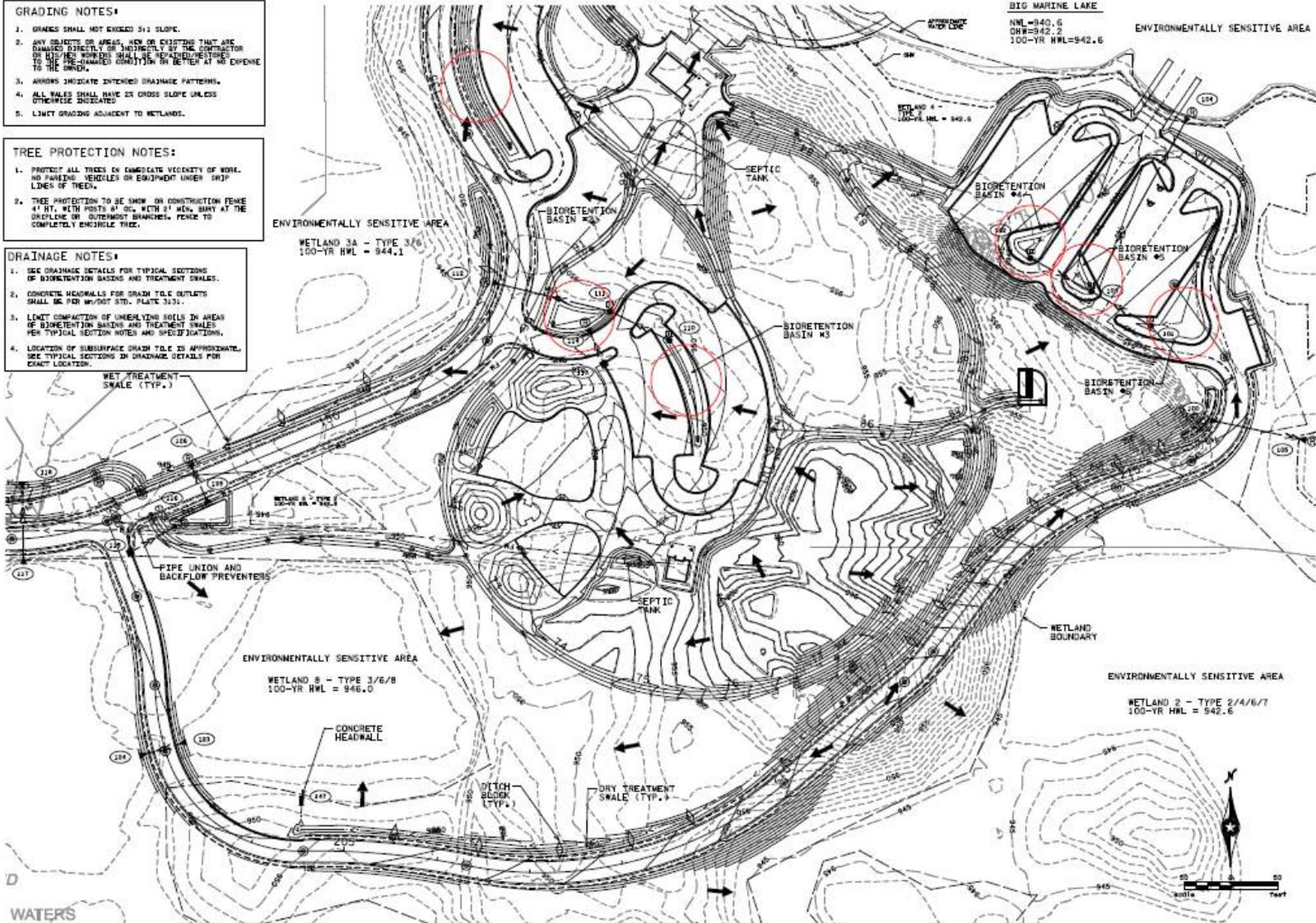
1. GRADES SHALL NOT EXCEED 3:1 SLOPE.
2. ANY OBJECTS OR AREAS, NEW OR EXISTING THAT ARE DAMAGED DIRECTLY OR INDIRECTLY BY THE CONTRACTOR OR HIS/HERS WORKERS SHALL BE REPAIRED/RESTORED TO THE PRE-DAMAGED CONDITION OR BETTER AT NO EXPENSE TO THE OWNER.
3. ARROWS INDICATE INTENDED DRAINAGE PATTERNS.
4. ALL WALES SHALL HAVE 2% CROSS SLOPE UNLESS OTHERWISE INDICATED.
5. LIMIT GRADING ADJACENT TO WETLANDS.

TREE PROTECTION NOTES:

1. PROTECT ALL TREES ON EXISTING VEGETATION OF WORK. NO PARKING, VEHICLES OR EQUIPMENT UNDER SHIP LINES OF TREES.
2. TREE PROTECTION TO BE SHOWN ON CONSTRUCTION FENCE 4' HT. WITH POSTS AT 60' WITH 2' HIGH, BURY AT THE DISCIPLINE OR OUTERMOST BRANCHES. FENCE TO COMPLETELY ENCLOSE TREE.

DRAINAGE NOTES:

1. USE DRAINAGE DETAILS FOR TYPICAL SECTIONS OF BIORETENTION BASINS AND TREATMENT SWALES.
2. CONCRETE HEADWALLS FOR DRAIN TILE OUTLETS SHALL BE PER W/WOOD STD. PLATE 333.
3. LIMIT CONSTRUCTION OF UNEVALUATED SOILS IN AREAS OF BIORETENTION BASINS AND TREATMENT SWALES PER TYPICAL SECTION NOTES AND SPECIFICATIONS.
4. LOCATION OF SUBSURFACE DRAIN TILE IS APPROXIMATE. SEE TYPICAL SECTIONS IN DRAINAGE DETAILS FOR EXACT LOCATION.



SRE
 CONSULTING
 GROUP, INC

DRAWN BY _____

DESIGNED BY _____

CHECKED BY _____

DATE _____

SCALE _____

NO.	DATE	BY	GRID	APPR.

Print Name _____

Date _____

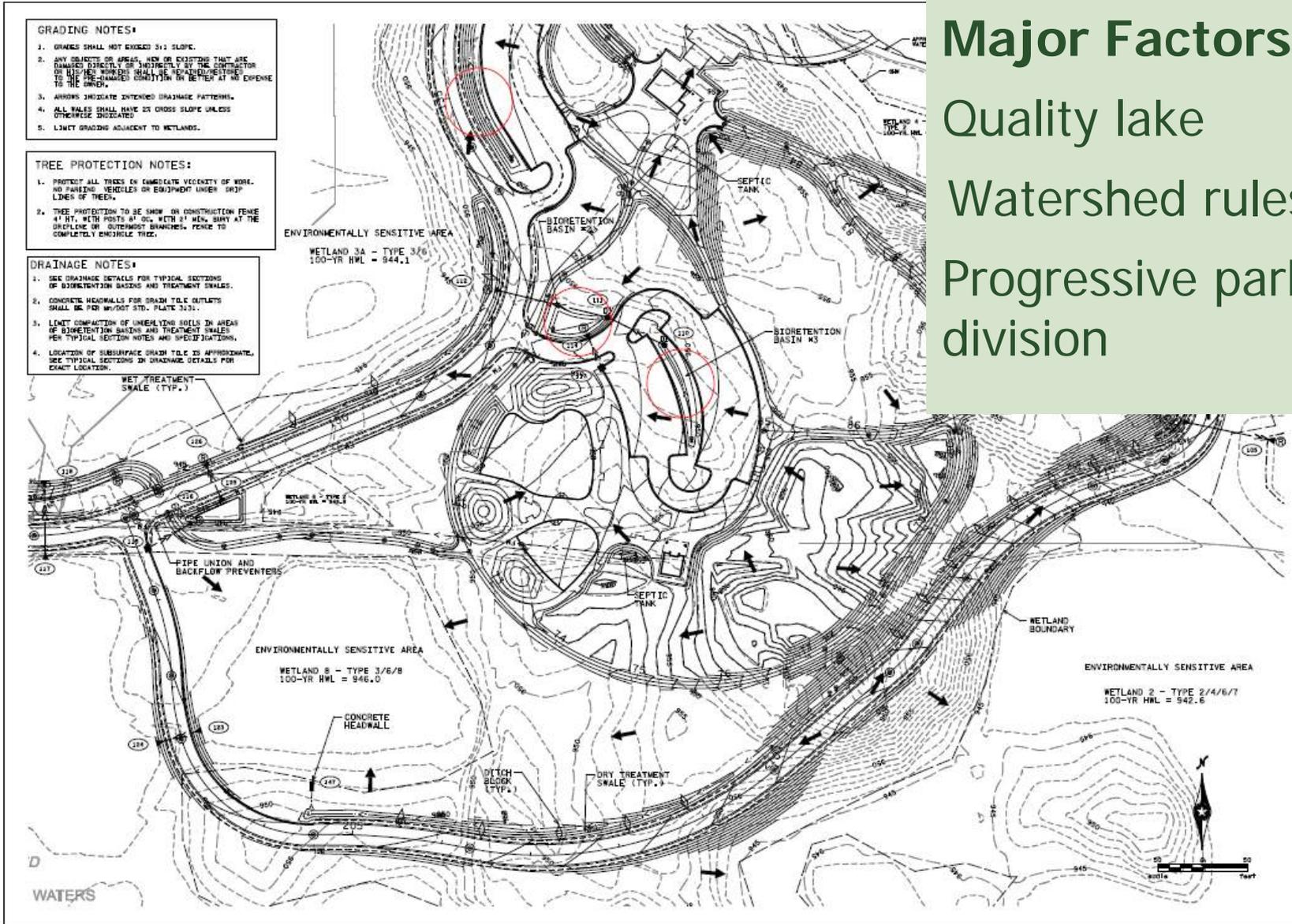
License # _____

BIG MARINE PARK RESERVE
PHASE 1 SITE IMPROVEMENTS
 Washington County Parks
OVERALL GRADING & UTILITIES PLAN

LAYERS & AN UNUSUAL VISIONS, INC.
 11415 15th SW
 3/2/2007

Big Marine Park

Major Factors
 Quality lake
 Watershed rules
 Progressive park
 division



- GRADING NOTES:**
1. GRADINGS SHALL NOT EXCEED 3:1 SLOPE.
 2. ANY OBJECTS OR AREAS, NEW OR EXISTING THAT ARE DAMAGED DIRECTLY OR INDIRECTLY BY THE CONTRACTOR OR HIS/HER SUBS CONTRACTORS SHALL BE REPAIRED/RESTORED TO THE PRE-DAMAGED CONDITION OR BETTER AT HIS/HERS EXPENSE TO THE OWNER.
 3. ARROWS INDICATE INTENDED DRAINAGE PATTERNS.
 4. ALL WALES SHALL HAVE 2% CROSS SLOPE UNLESS OTHERWISE INDICATED.
 5. LIMIT GRADING ADJACENT TO WETLANDS.

- TREE PROTECTION NOTES:**
1. PROTECT ALL TREES ON EXISTING VEGETATION OF WORK. NO PARKING, VEHICLES OR EQUIPMENT UNDER SHIP LINES OF TREES.
 2. TREE PROTECTION TO BE SHOWN ON CONSTRUCTION FENCE 4' HT. WITH POSTS AT 60' WITH 2' HIGH BARS AT THE OUTLINE OR OUTSIDING BRANCHES. FENCE TO COMPLETELY ENCLOSE TREE.

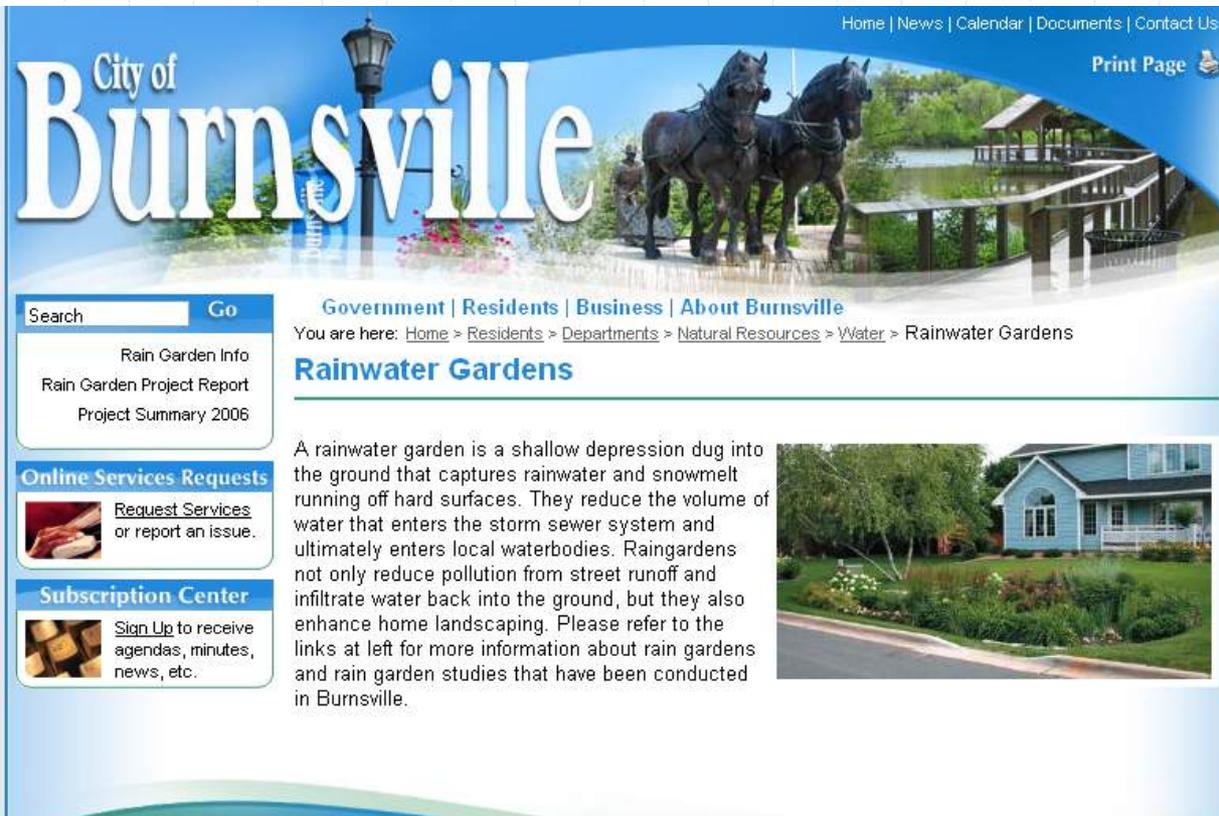
- DRAINAGE NOTES:**
1. SEE DRAINAGE DETAILS FOR TYPICAL SECTIONS OF BIORETENTION BASINS AND TREATMENT SWALES.
 2. CONCRETE HEADWALLS FOR DRAIN TILE OUTLETS SHALL BE PER MW/DOE STD. PLATE 3231.
 3. LIMIT COMPACTION OF UNDERLYING SOILS IN AREAS OF BIORETENTION BASINS AND TREATMENT SWALES PER TYPICAL SECTION NOTES AND SPECIFICATIONS.
 4. LOCATION OF SURFACE DRAIN TILE IS APPROXIMATE. SEE TYPICAL SECTIONS IN DRAINAGE DETAILS FOR EXACT LOCATION.

Print Name _____
 Date: 1/17/17
 License # _____

BIG MARINE PARK RESERVE
 PHASE 1 SITE IMPROVEMENTS
 Washington County Parks
OVERALL GRADING & UTILITIES PLAN

LAYERS & AN UNUSUAL VISION/DESIGN, INC.
 11415 15th SW
 SEASIDE, WA 98148
 3/2/2017

Burnsville Raingarden Retrofit



The screenshot shows the City of Burnsville website. At the top, there is a navigation bar with links for Home, News, Calendar, Documents, and Contact Us. The main header features the City of Burnsville logo and a large image of a park with horses. Below the header, there is a search bar and a list of online services requests. The main content area is titled "Rainwater Gardens" and includes a breadcrumb trail: Home > Residents > Departments > Natural Resources > Water > Rainwater Gardens. A paragraph explains that a rainwater garden is a shallow depression dug into the ground that captures rainwater and snowmelt running off hard surfaces. To the right of the text is a photograph of a rainwater garden installed in a residential yard next to a blue house.

Home | News | Calendar | Documents | Contact Us

City of Burnsville

Print Page

Search Go

Rain Garden Info
Rain Garden Project Report
Project Summary 2006

Online Services Requests

[Request Services](#)
or report an issue.

Subscription Center

[Sign Up](#) to receive
agendas, minutes,
news, etc.

[Government](#) | [Residents](#) | [Business](#) | [About Burnsville](#)

You are here: [Home](#) > [Residents](#) > [Departments](#) > [Natural Resources](#) > [Water](#) > [Rainwater Gardens](#)

Rainwater Gardens

A rainwater garden is a shallow depression dug into the ground that captures rainwater and snowmelt running off hard surfaces. They reduce the volume of water that enters the storm sewer system and ultimately enters local waterbodies. Raingardens not only reduce pollution from street runoff and infiltrate water back into the ground, but they also enhance home landscaping. Please refer to the links at left for more information about rain gardens and rain garden studies that have been conducted in Burnsville.



www.ci.burnsville.mn.us

Burnsville Raingarden Retrofit

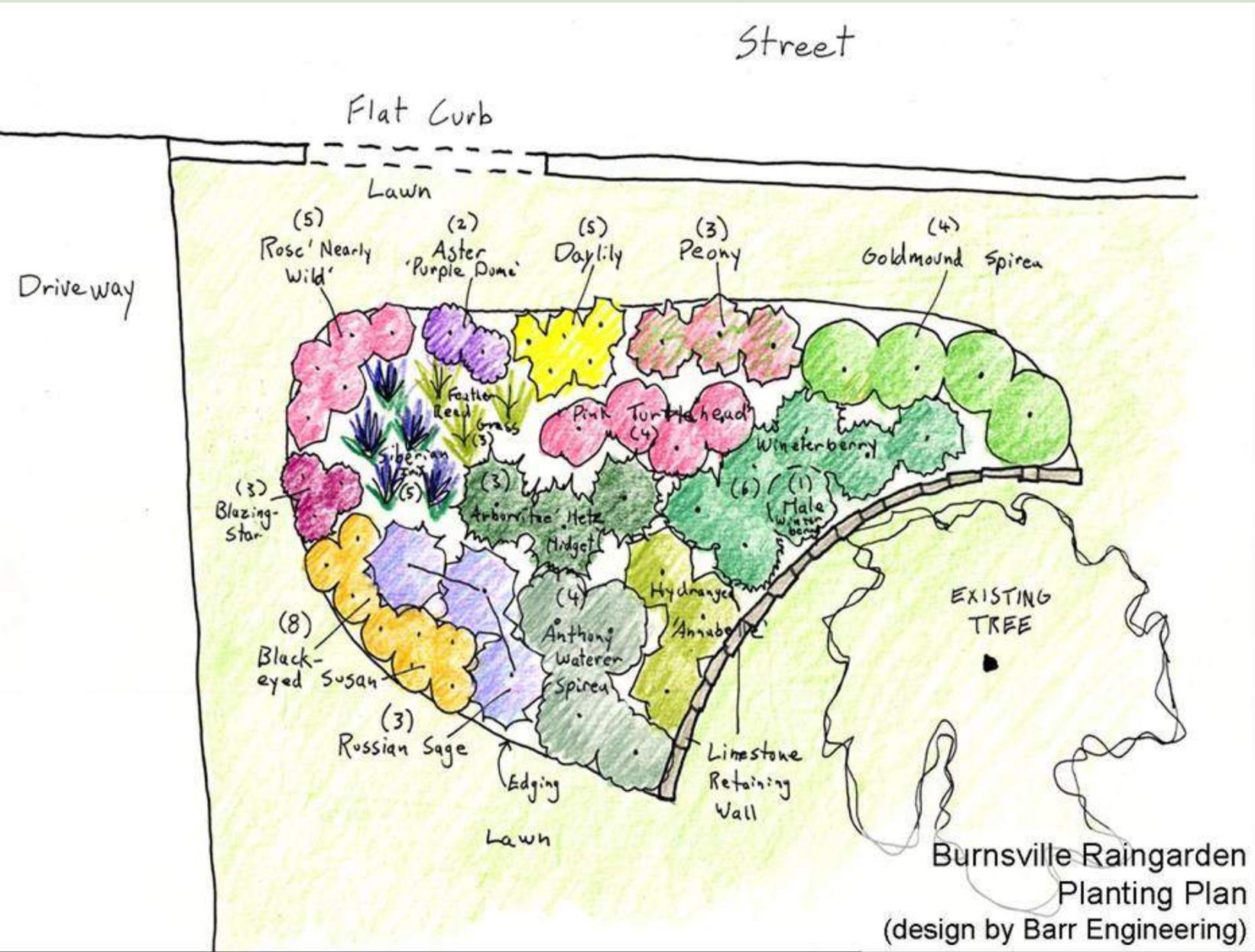


Burnsville – Rushmore Street

5.3 acres – 25 homes – 17 raingardens

Designed by: Barr Engineering

Burnsville Raingarden Retrofit



Burnsville Raingarden Retrofit





**City of Burnsville
Designed by: Barr Engineering**

Burnsville Raingarden Retrofit



City of Burnsville
Designed by: Barr Engineering

8. 2. 2004

Burnsville Raingarden Retrofit



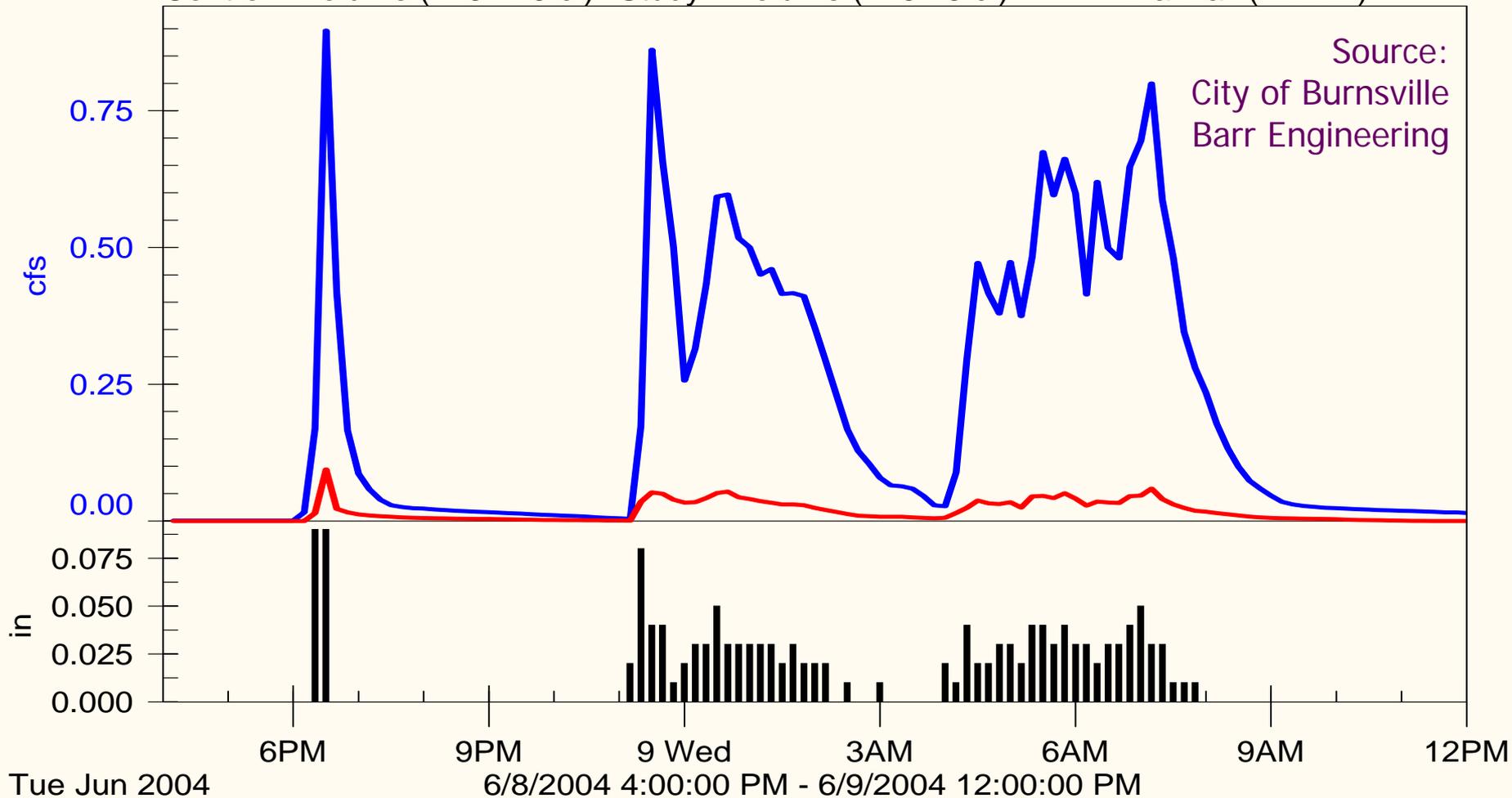
FEB 8 2005

Post-Construction Runoff

1.44 inches in 9 hours

Post-Construction Runoff - June 8, 2004

Control - Volume (14371.5 cf) Study - Volume (1164.3 cf) Rainfall (1.44 in)



Burnsville Raingarden Retrofit

Major Factors
Impaired TMDL Lake
Grant available
Research need
Motivated staff



Example Projects

Maplewood Raingardens

Fairway Villas

Burnsville Raingardens

*Washington County Big
Marine Park*

And more . . .

Major Factors

Innovative Staff

Innovative Developer

Impaired Waters

Watershed Rules

Grants

INNOVATIVE STORMWATER MANAGEMENT IN THE TWIN CITIES

*Jay Riggs, District Manager
Washington Conservation District
Stillwater, Minnesota*



**WASHINGTON
CONSERVATION
DISTRICT**

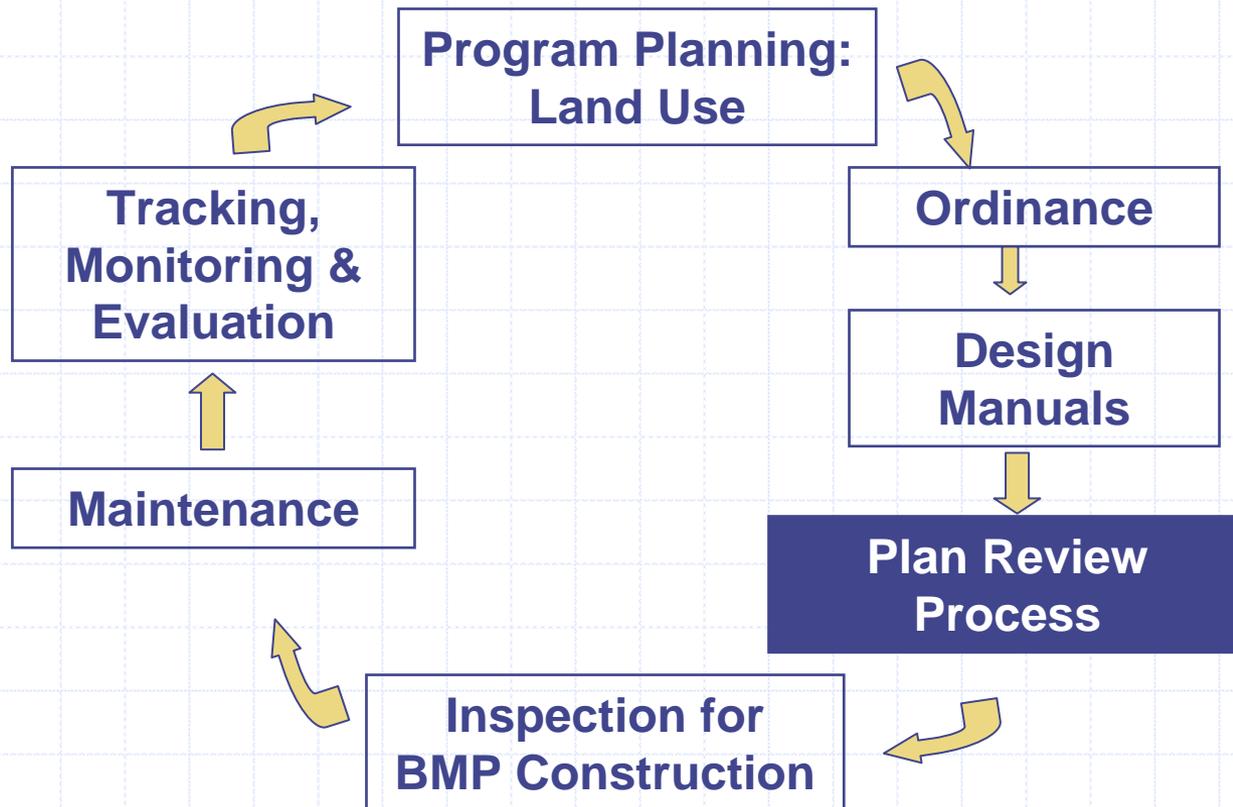
1380 W FRONTAGE RD
HIGHWAY 36
STILLWATER, MN 55082

651-275-1136 [PHONE]
651-275-1254 [FAX]
WWW.MNWCD.ORG



Question & Answer Break

Overview of Post-Construction Guidance



Plan Review



- Introduce LID Early in Site Planning Process
- Last, Best Chance To Ensure Maintenance:
 - Agreements
 - Easements
 - Performance Bond

The Stormwater Plan Review Process (Ch. 5)

- ◆ Integrate With Other Local Reviews
- ◆ Expect Each Reviewer to Review 70 to 100 plans per year
- ◆ Use Pre-Submittal Meetings & Concept Plans to Allow Early Consideration of Stormwater & LID
- ◆ Consider Use of Consultant Reviewers

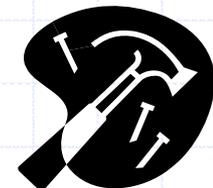
POST-CONSTRUCTION TOOL #6

Stormwater Plan Checklists

<i>D. Installation</i>				
S = Satisfactory U = Unsatisfactory N/A = Not Applicable				
Item	S	U	N/A	Comments
1. Pretreatment facility installed correctly				
a. Location, size and depth of facility are correct				
2. Inlet(s) and inlet protection installed according to plans				
3. Liner installed correctly				
4. Riser/outlet structure installed correctly				
a. Location, dimensions and type of riser are correct				Type of riser:
b. Riser located within embankment				
c. Riser base excavated or formed on stable subgrade				
d. Riser base set to design elevation				
e. Riser equipped with removable trash rack				
f. Location, dimensions and type of low flow orifice are correct				
g. Low flow orifice installed correctly and adequately protected from clogging				
h. Pond drain system installed correctly				
i. Pond drain equipped with adjustable control valve				

Download at:

<http://www.cwp.org/webcast/postconstruction.htm>

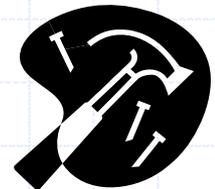


Performance Bond Tool

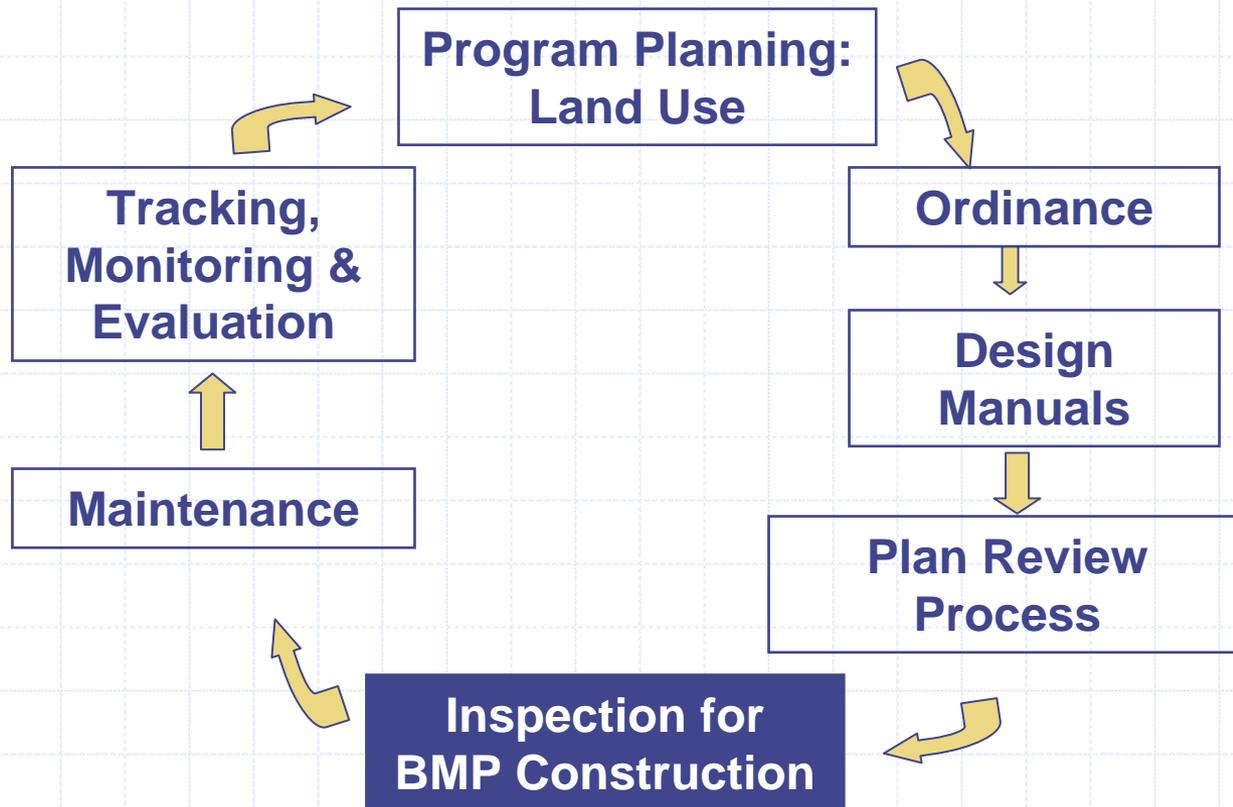
- ◆ Bond Instructions
- ◆ Sample Forms
- ◆ Performance Bond Estimator Tool
(Spreadsheet)

Download at:

<http://www.cwp.org/webcast/postconstruction.htm>



Overview of Post-Construction Guidance



Inspection Milestones



- ◆ Pre-construction
- ◆ Excavation
- ◆ Materials
- ◆ Final Stabilization
- ◆ As-Built Plans

Construction Sequence is Critical for Many BMPs





**Small Field
Problems Can Tank
a Good BMP**

Inspection of Stormwater BMPs During Construction (Ch. 6)

- ◆ Hold Pre-Construction Meetings
- ◆ Use Checklists
- ◆ Use Certified Contractors if Needed
- ◆ Require As-Built Plans
- ◆ **DOCUMENTATION!**
- ◆ Enforcement Procedures

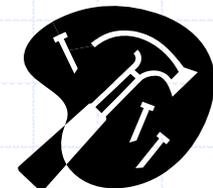
POST-CONSTRUCTION TOOL #6

BMP Construction Checklists

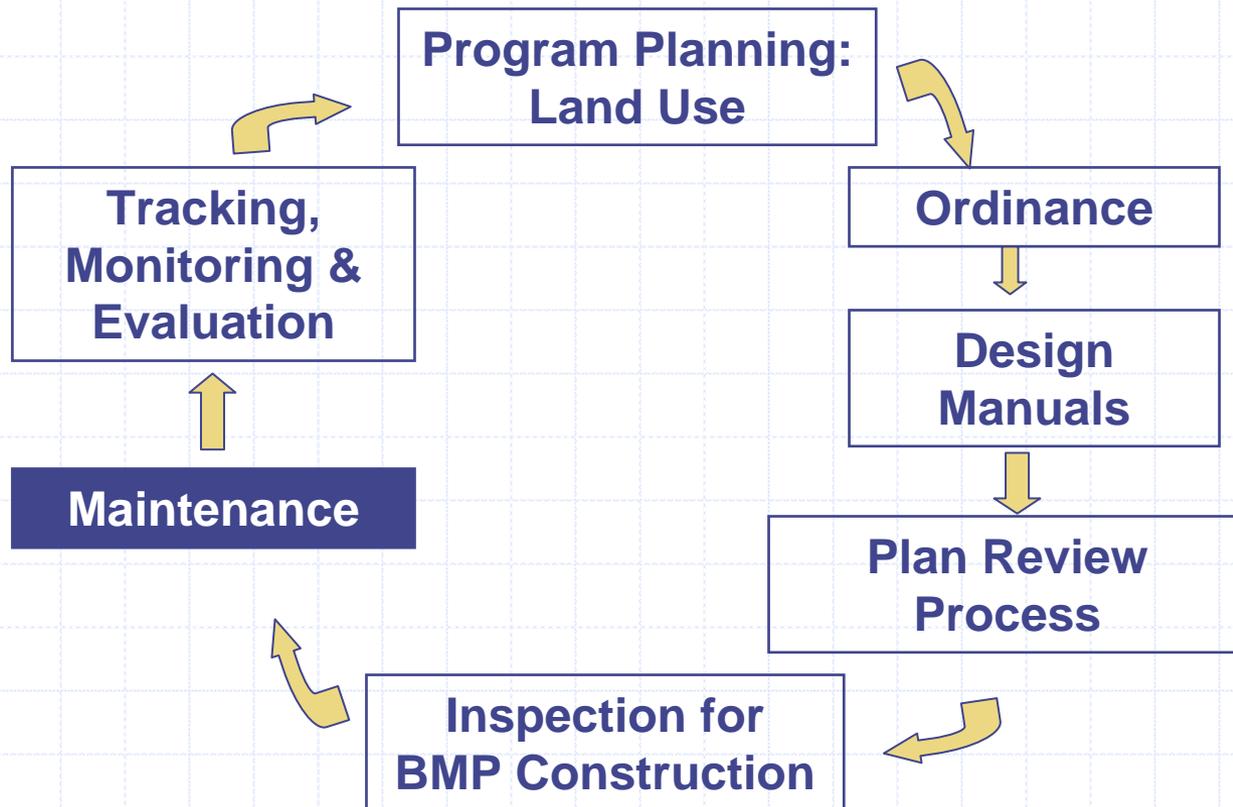
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Download at:

<http://www.cwp.org/webcast/postconstruction.htm>



Overview of Post-Construction Guidance





Stormwater is. . .

Infrastructure



Policy Options

Option 1 – Municipality Responsible for Public Facilities; Homeowners or Businesses Have Responsibility for Private Facilities

- Reduces costs
- Good option for small communities with limited staffing
- Community still responsible for education, tracking, and enforcement (e.g., regular inspections)

Policy Options

Option 2 – Community Has Full Responsibility

- Uncommon due to expense
- Avoids legal proceedings
- Better control
- Requires dedicated staff and funding

Policy Options

Option 3 – Community Has Responsibility for Public Facilities AND Some Private Facilities (e.g. runoff from public rights-of-way)

- Hybrid of Options 1 and 2
- Better control
- Requires dedicated staff and funding

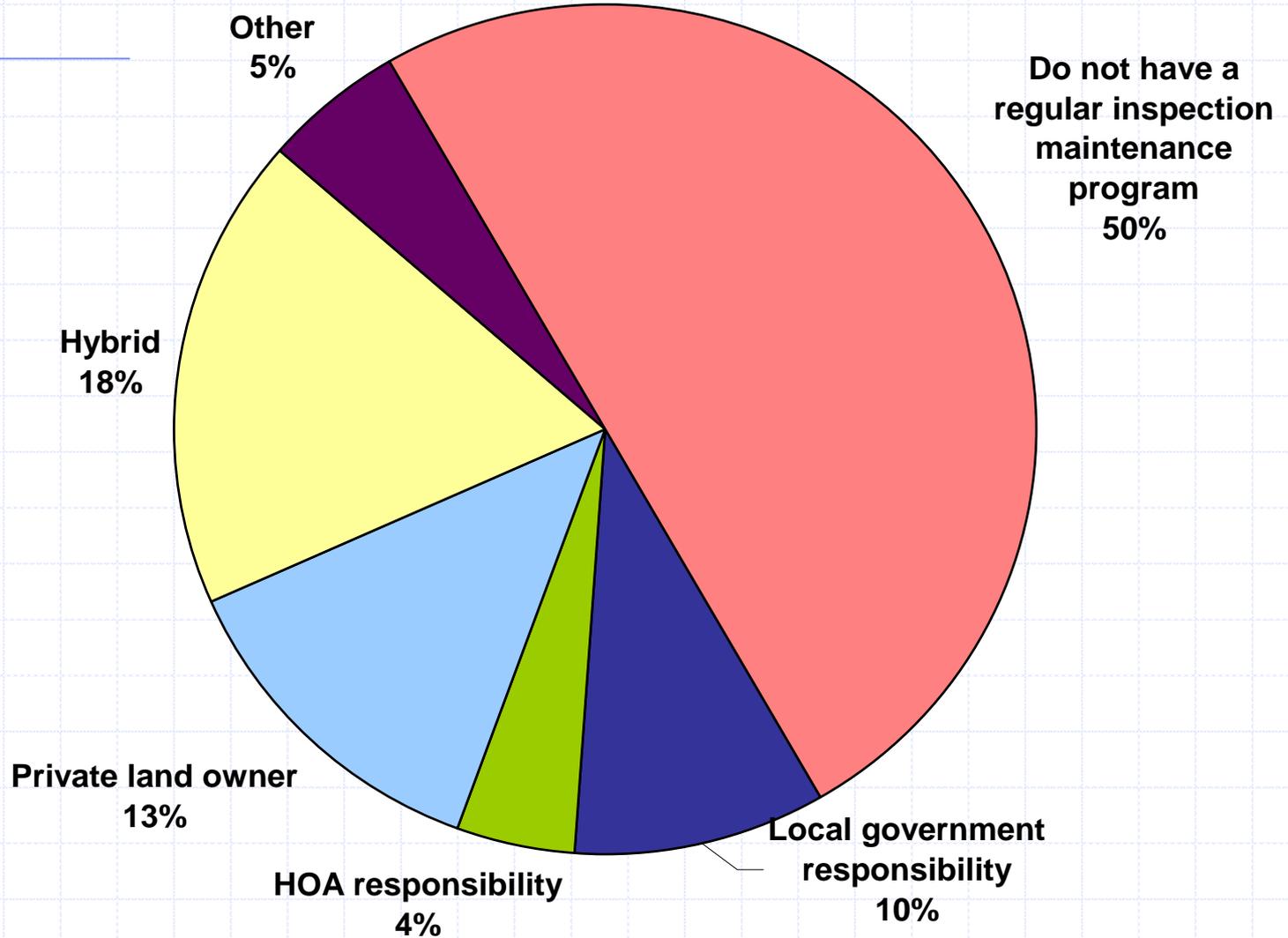
Selecting The “Right” BMPs: Green Infrastructure



- Low-Tech, Low-Maintenance
- Tied to Site Design & Natural Areas
- Approved Through Stormwater Credits

30 1:35 PM

Who is responsible for maintenance of post-construction stormwater facilities?



Education & Outreach to Responsible Parties

- ◆ Adopt-A-Pond
- ◆ Co-Inspections
- ◆ Publications, Mailings
- ◆ Technical Assistance



Stormwater Matters

A guide to help owners understand their stormwater facility maintenance responsibilities



Hogler, Manasco High School



ADOPT-A-POND PROGRAM DOCUMENT

March 2002 draft



Created by the
Center for Watershed Protection
8171 Main Street
Elkview City, MD 21041



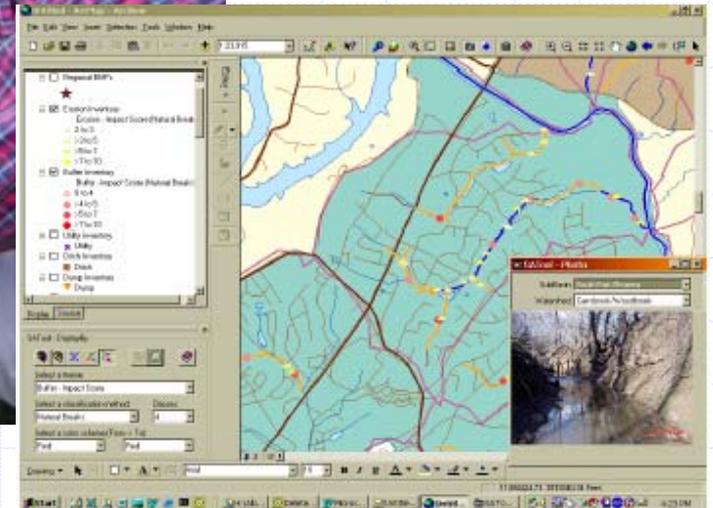
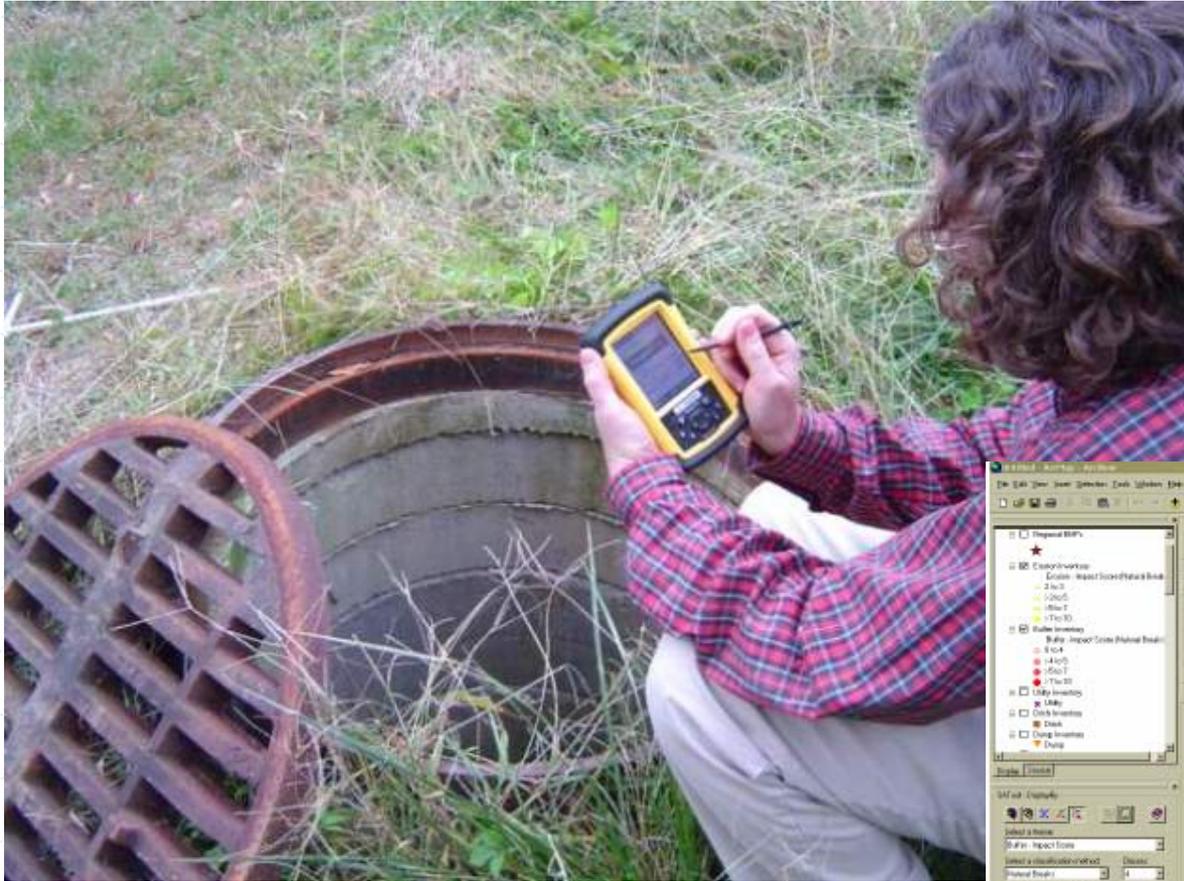
And the
Herring Run Watershed Association
4117 Maryland Rd.
Baltimore, MD 21214



For the
Baltimore County Department of Environmental
Protection and Resource Management (DEPRM)



GPS/GIS Tracking



Developing A Maintenance Program (Ch. 7)

- ◆ Make Policy Decisions
- ◆ Select the Right BMPs for Your Community
- ◆ Make Sure Agreements, Easements, Access are in Place
- ◆ Develop Tracking System
- ◆ Provide Education & Outreach to Responsible Parties

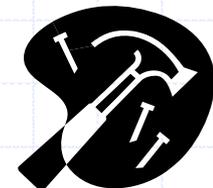
POST-CONSTRUCTION TOOL #6

Maintenance Checklists

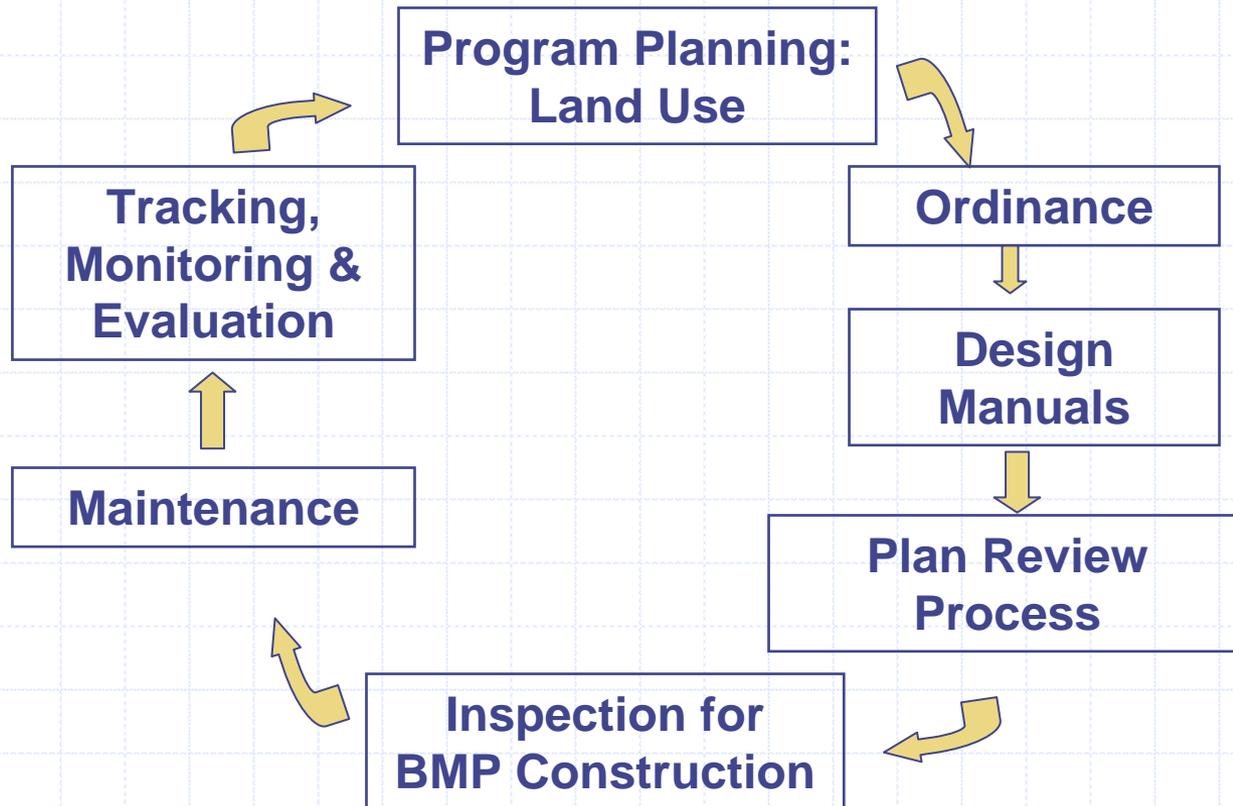
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Overview of Post-Construction Guidance





Question & Answer Break