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RECARGA: Infiltration Modeling

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Outline

- Regulatory Drivers
- RECARGA Overview
- Design Example





Low Impact Design

- LID Goals
 - Impact avoidance
 - Impact minimization
 - Sustainability (triple bottom line)
- Stormwater Goals
 - Control Rate
 - Control Quality
 - Control Volume





Regulatory Drivers

- Regulations drive our design
- Rate control
 - Common design element
 - Post dev. design flow varies
- Quality and volume control
 - Qualitative in many cases
 - Quantitative standards evolving
 - IL state examples





Regulatory Drivers

- Chicago district for 404 permits
- IEPA Water quality
- USFWS Habitat impacts
 - Water level fluctuations
 - Velocity increases
 - Requesting use of RECARGA to evaluate pre vs post infiltration



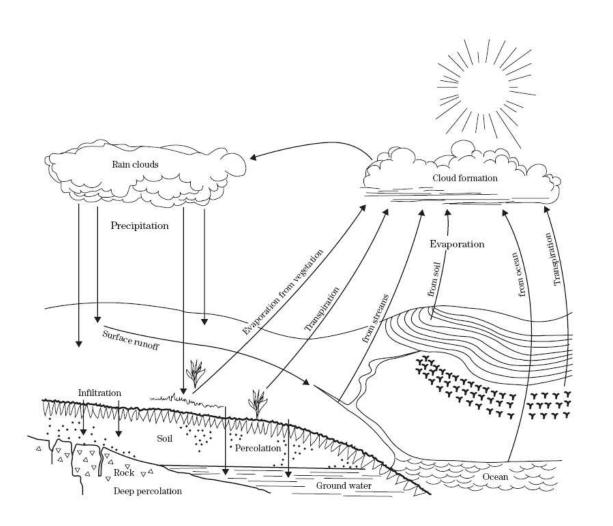


RECARGA Overview

- Bioretention design tool
 - Ponding duration
 - Overtopping frequency
 - Runoff volume
- Infiltration analysis
- Compare pre vs post infiltration







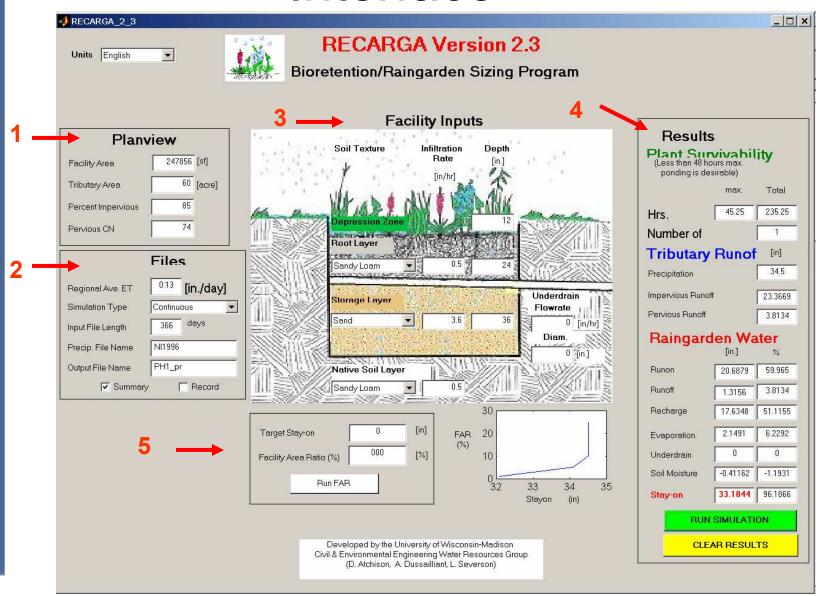
United States Department of Agriculture

Natural Resources Conservation Service





Interface







RECARGA

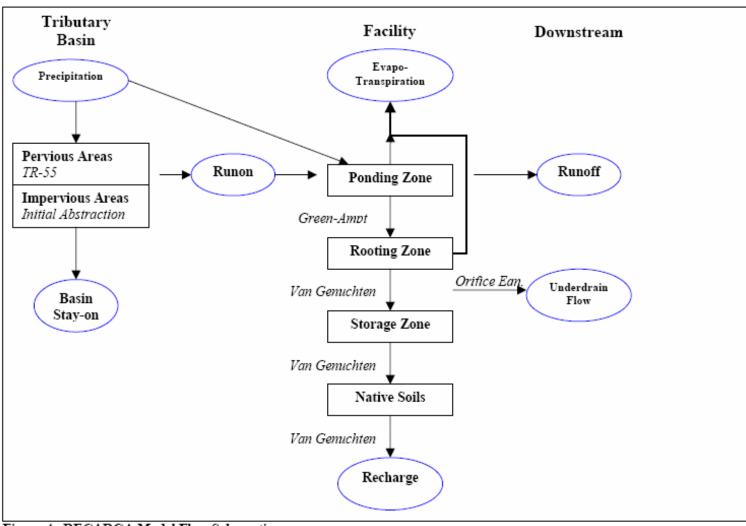


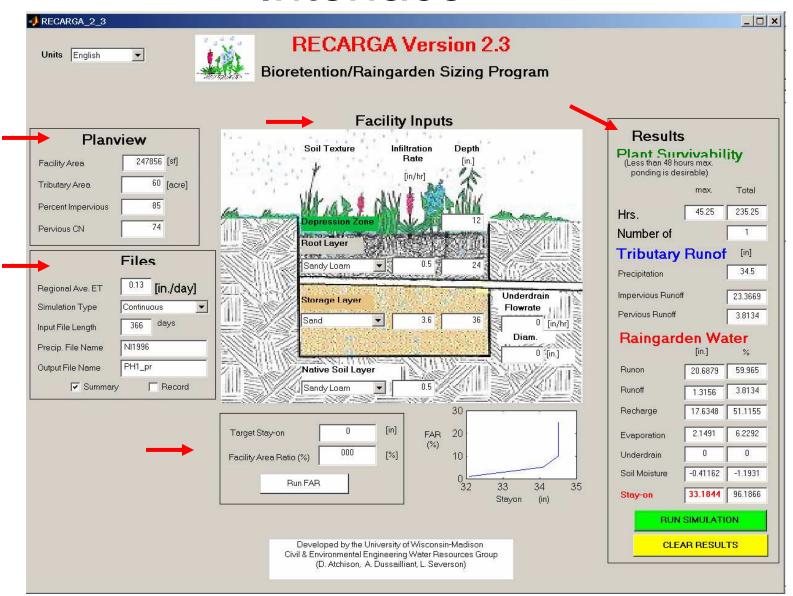
Figure 4. RECARGA Model Flow Schematic

RECARGA User's Manual, UW Madison





Interface



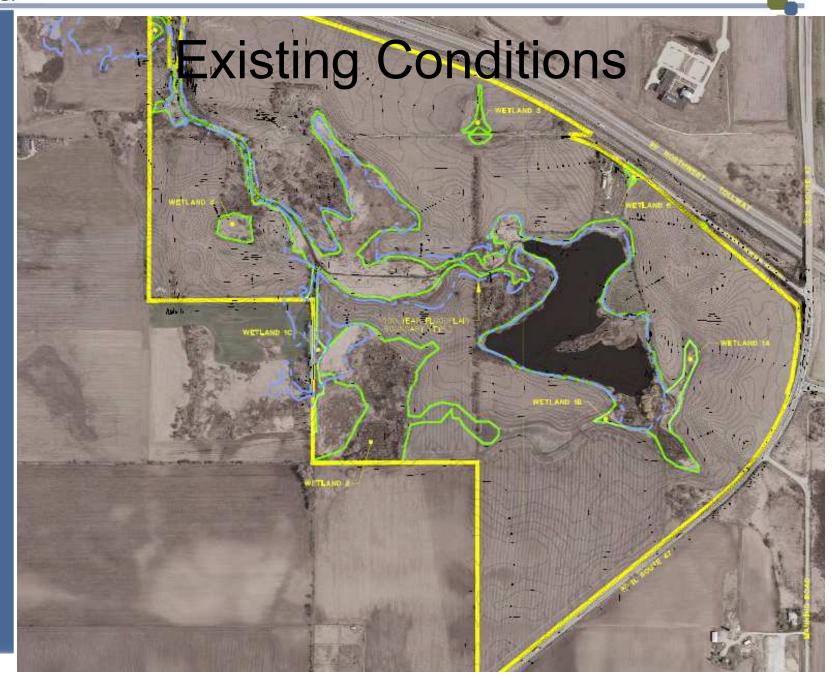




Design Example

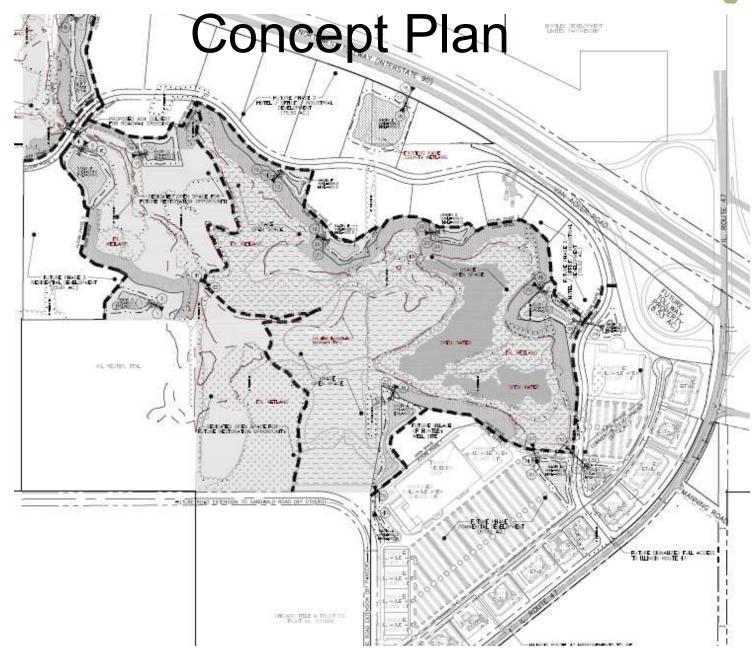
- Existing conditions
- Concept plan
- Project overview
- RECARGA Analysis















Preliminary BMP plan







Project Overview

- Pre application meeting with agencies
 - Reviewed concept plan
 - Reviewed mitigation approach
- Meeting proved critical
 - Insight into public notice comments
 - Target Resource protection infiltration
 - Specific request for RECARGA
 - Looked to Wisconsin DNR regs for guidance





Project Overview

- WDNR Guidance
 - NR 151 (Wis. Adm. Code)
 - Exemption & exclusions
 - RECARGA users manual
- Site Evaluation
 - Initial Screening
 - Field verification
 - Evaluation of specific infiltration area
 - Soil and site evaluation reporting





MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

Blowout \odot

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Special Line Features

20 Gully

Short Steep Slope

Political Features





Streams and Canals

Transportation



Interstate Highways



US Routes Major Roads



Local Roads



USDA United States Department of Agriculture



Natural Resources Conservation Service







Soils

			Physical Soil Properties– Kane County, Illinois					
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct
103A— Houghton muck, 0 to 2 percent slopes								
Houghton	0-11	_	_	-	0.20-0.35	1.41-42.34	0.35-0.45	_
	11-60	_	_	_	0.15-0.25	1.41-42.34	0.35-0.45	_
125A—Selma loam, 0 to 2 percent slopes								
Selma	0-23	30-50	28-50	10-27	1.30-1.50	4.23-14.11	0.14-0.18	0.0-2.9
	23-28	30-50	28-50	20-27	1.35-1.55	4.23-14.11	0.10-0.15	0.0-2.9
	28-41	15-30	50-65	20-27	1.40-1.60	4.23-14.11	0.10-0.17	0.0-2.9
	41-53	55-75	10-45	5-20	1.45-1.65	14.11-42.34	0.09-0.13	0.0-2.9
	53-60	65-80	10-25	5-15	1.45-1.65	14.11-42.34	0.07-0.10	0.0-2.9
149A—Brenton silt loam, 0 to 2 percent slopes								
Brenton	0-13	0-15	58-80	20-27	1.25-1.45	4.23-14.11	0.22-0.26	0.0-2.9
	13-35	0-15	50-75	25-35	1.30-1.55	4.23-14.11	0.18-0.20	3.0-5.9
	35-43	15-60	10-67	18-30	1.40-1.60	4.23-14.11	0.15-0.19	3.0-5.9
	43-60	15-85	0-80	5-30	1.50-1.70	4.23-42.34	0.11-0.20	0.0-2.9





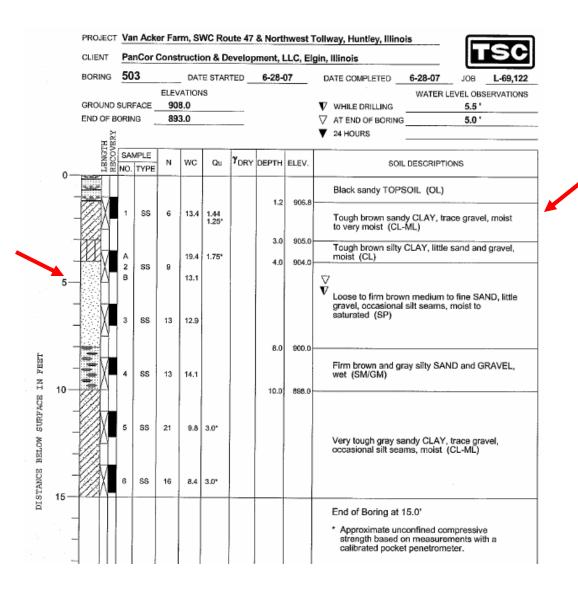
Soils

	Physical Soil Properties - Kane Cou							unty, Illinois
Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility
	In	Pct	Pct	Pct	g/cc	micro m/sec	In/In	Pct
570B— Martinsville silt loam, 2 to 4 percent slopes								
Martinsville	0-5	12-35	50-78	10-20	1.30-1.45	4.23-14.11	0.20-0.24	0.0-2.9
	5-12	30-60	20-50	8-20	1.35-1.50	4.23-14.11	0.19-0.23	0.0-2.9
	12-38	12-50	17-68	20-33	1.40-1.60	4.23-14.11	0.16-0.20	3.0-5.9
	38-53	20-60	15-65	15-25	1.40-1.60	4.23-14.11	0.12-0.17	0.0-2.9
	53-60	20-90	0-75	5-20	1.50-1.70	4.23-42.34	0.08-0.17	0.0-2.9





Soil Borings







Infiltration Analysis

- Compare Pre vs Post "Stay on"
- Existing stay on
- Target stay on
 - USFWS suggested 90%
 - WI DNR
 - 60% for commercial
 - 90% residential
 - Also provides exclusions and exemptions

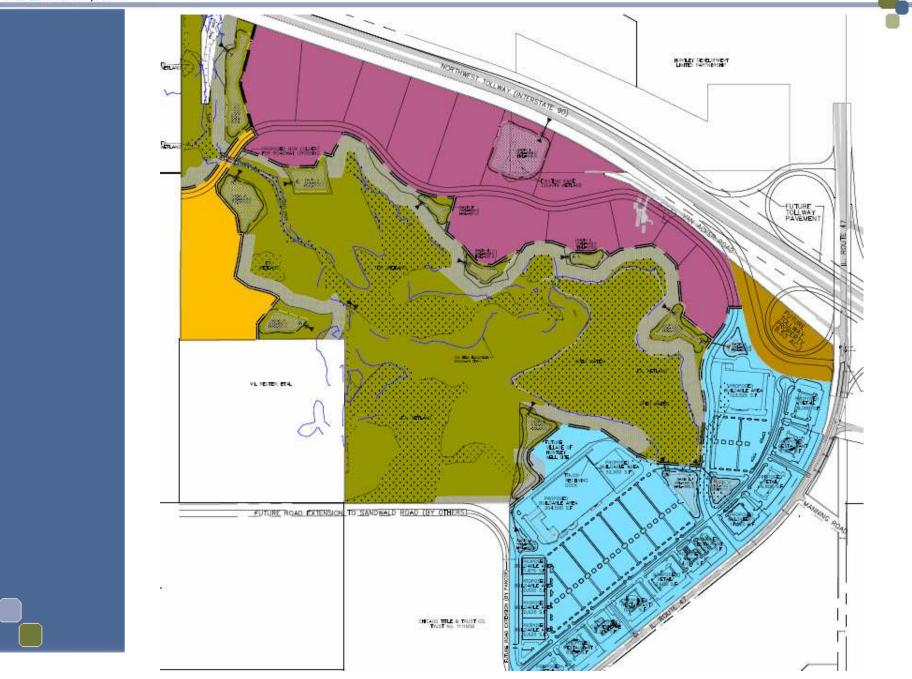




Infiltration Analysis

- Divided site into three zones
- Analyzed each zone
 - Determined existing condition stay on
 - Determined target stay on
 - Analyzed proposed BMPs
 - Compared pre to post stay on
 - Final design of BMPs

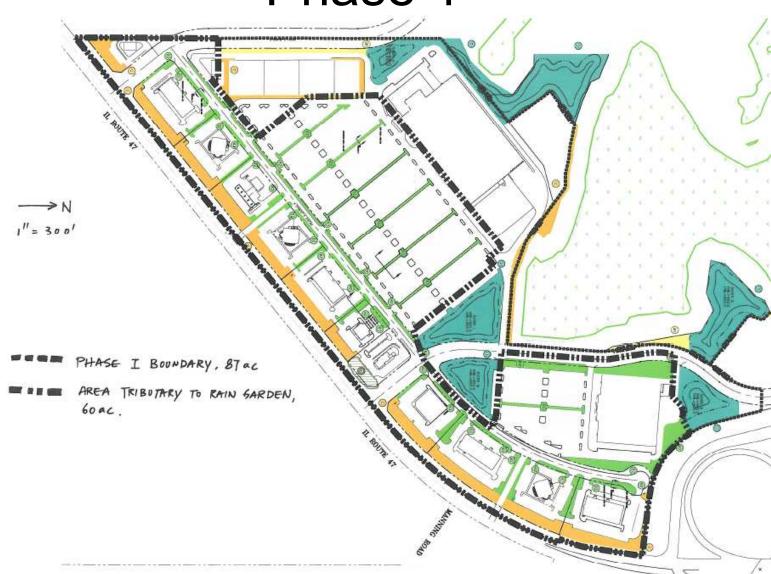








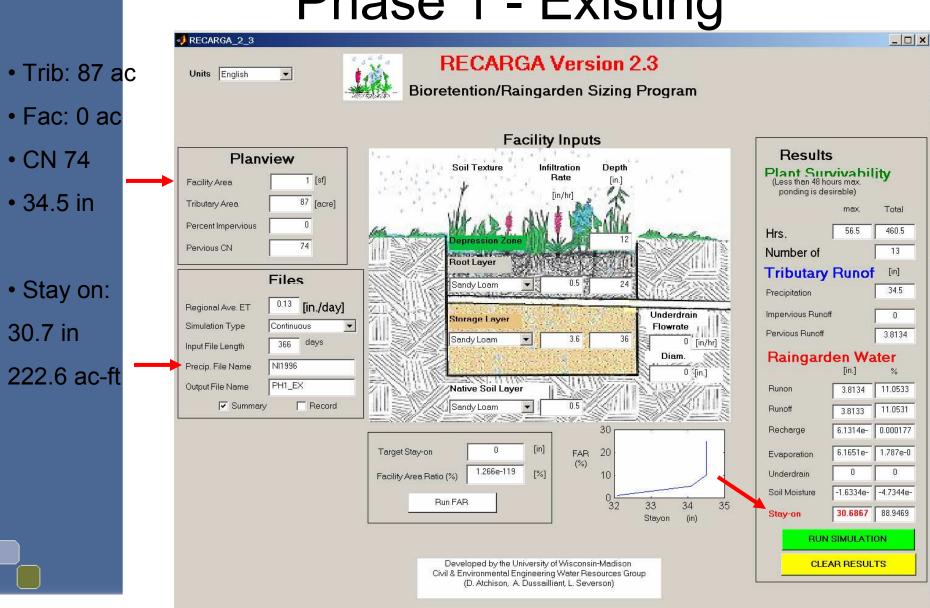
Phase 1







Phase 1 - Existing







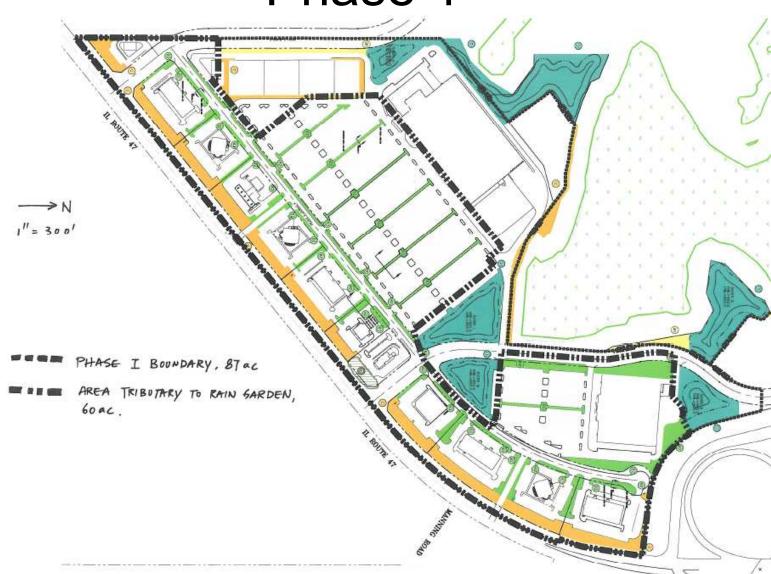
Phase 1: Target stay on

- Target stay on
 - -60%
 - 18.4 in
 - 133.6 ac-ft
 - -90%
 - 27.6 in
 - 200.3 ac-ft





Phase 1







Phase 1 – BMP area

• Trib: 60 ac

• Fac: 5.7 ac

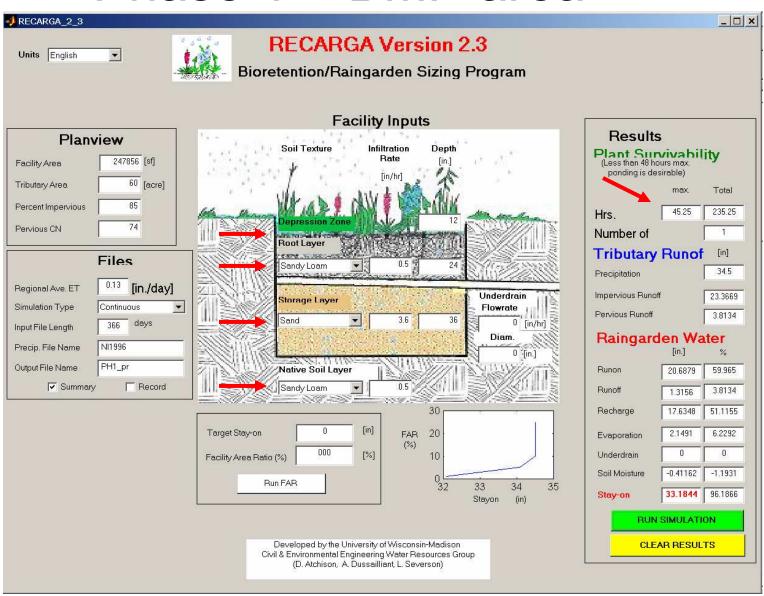
• Imp: 85 %

• 34.5 in

• Stay on:

33.2 in

166.0 ac-ft





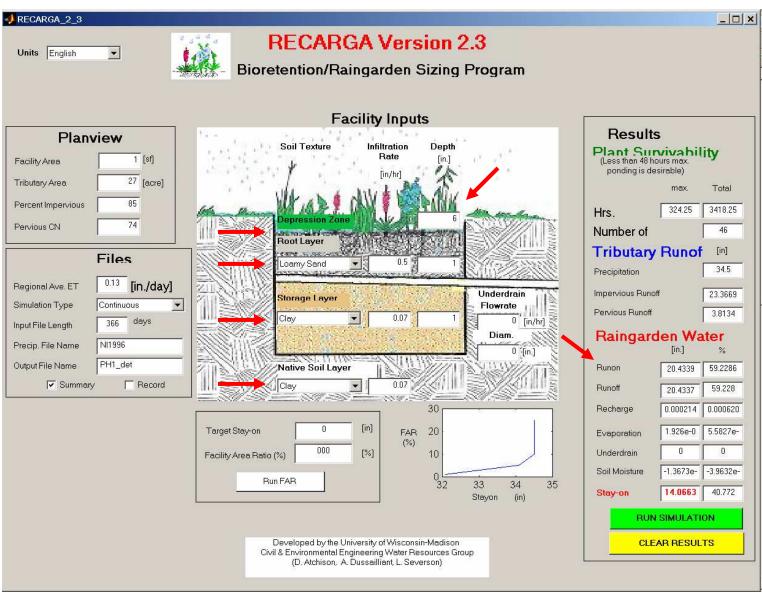


Phase 1 – Detention area

- Trib: 27 ac
- Fac: 0 ac
- HSG: B
- 85 %
- 34.5 in
- Stay on:

14.1 in

31.7 ac-ft







Phase 1

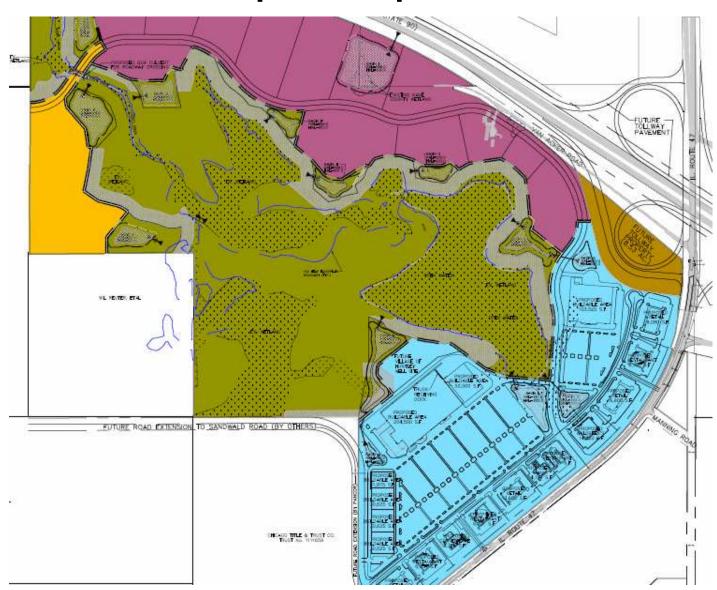
		Ex stayon (ac-ft)	Target stayon (ac-ft)	Pr stayon (ac-ft)
BMP	area	_	_	166.0
Det. a	rea	_	_	31.7
		222.6	200.3	197.7

2.6 ac-ft short for this analysis





Open Space







Open Space

- 56 acres to be restored in Phase 1
- Currently farmed row crops
- Restored to upland prairie
- Determine increased stay on due to reduction in CN: 74 to 58





Open Space - Existing

• Trib: 57 ac

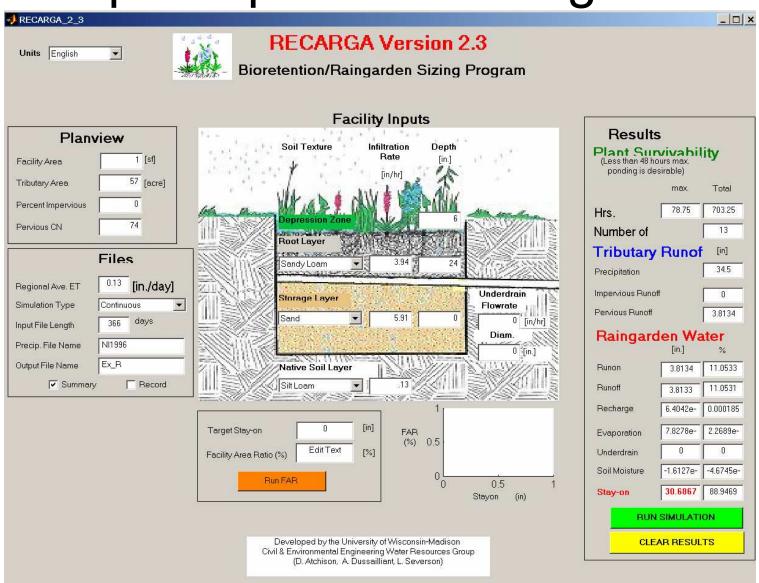
Fac: 0 ac

CN 74

Stay on:

30.7 in

145.8 ac-ft







Open Space - Restored

• Trib: 57 ac

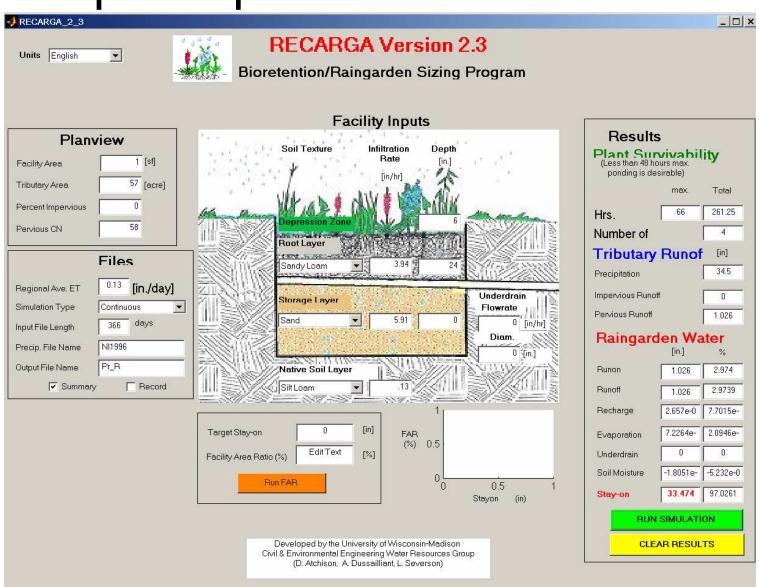
Fac: 0 ac

• CN 58

Stay on:

33.5 in

159.1 ac-ft







Open Space

	Area (ac)	Stayon (in)	Stayon (ac-ft)
Farm	57	30.7	145.8
Prairie	57	33.5	159.1

Increased stay on: 13.3 ac-ft





Phase 1

		Ex stayon (ac-ft)	Target stayon (ac-ft)	Pr stayon (ac-ft)
BMP	area	_	_	166.0
Det. a	rea	_	_	31.7
Open	Space	_	_	13.3
		222.6	200.3	211.0





Phase 2

- Phase 2
 - Future phase
 - No set site plan
 - Meet 90% stay on
- RECARGA analysis
 - Existing stay on
 - FAR (facility area ratio) analysis





Phase 2 - Existing

• Trib: 76 ac

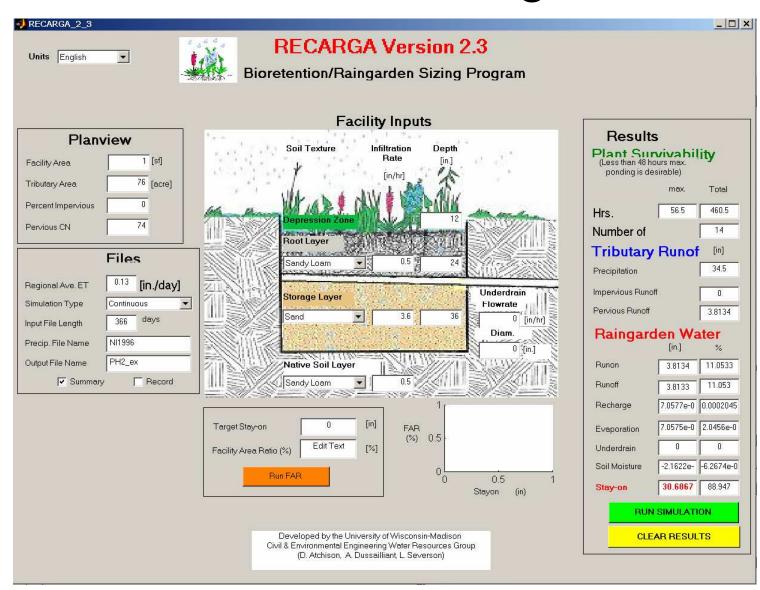
Fac: 0 ac

• CN 74

Stay on:

30.7 in

194.4 ac-ft







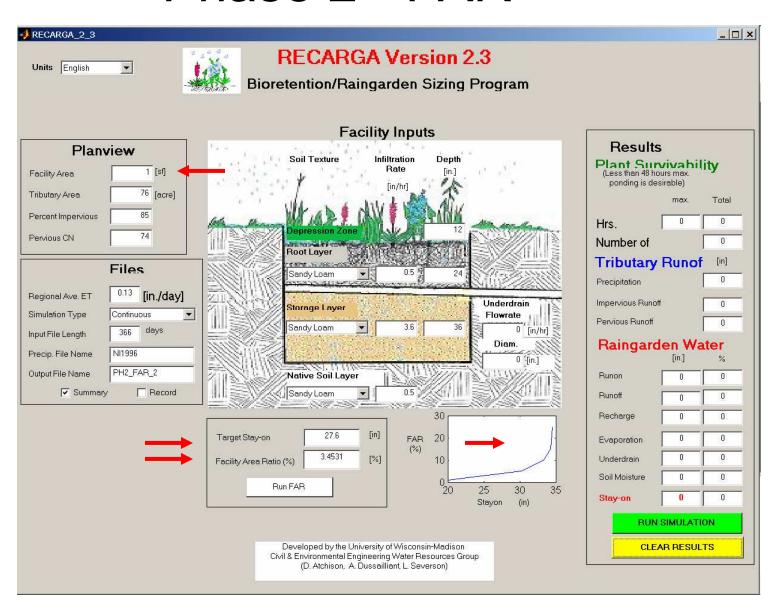
Phase 2 - FAR

• Trib: 76 ac

• Stay on:

Target: 27.6 in

FAR: 3.45%







Phase 2

- Existing
 - -76 ac
 - Stay on: 30.7 in
- Proposed
 - Target: 27.6 in
 - Facility Area Ratio: 3.45% (2.6 ac)
 - WDNR limit: 2%





Summary of Results

- Preliminary analysis meets target "Stay on"
- Need to evaluate specific location of each bio-infiltration device
 - Soils
 - Drainage area
- Modify to meet target ponding duration





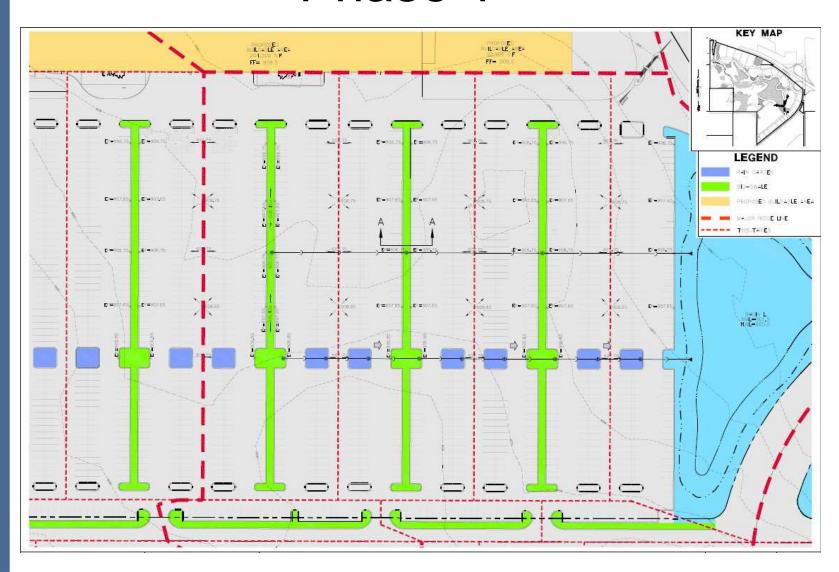
Final Design

- Phase 1 BMPs location specific design
- Refine bio-infiltration facility
 - Boring logs
 - Review ponding duration
 - Under drain design





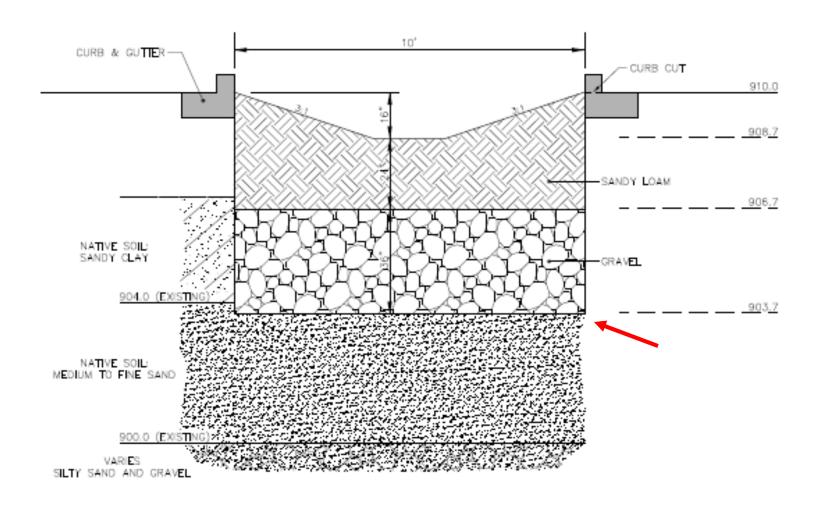
Phase 1







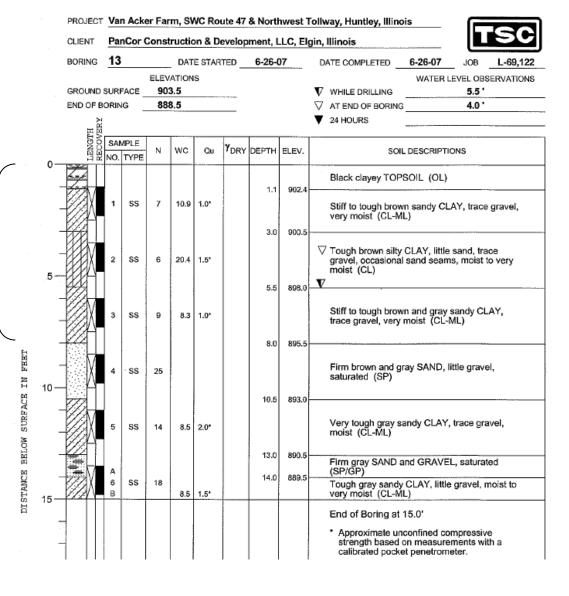
Preliminary cross-section







Borings

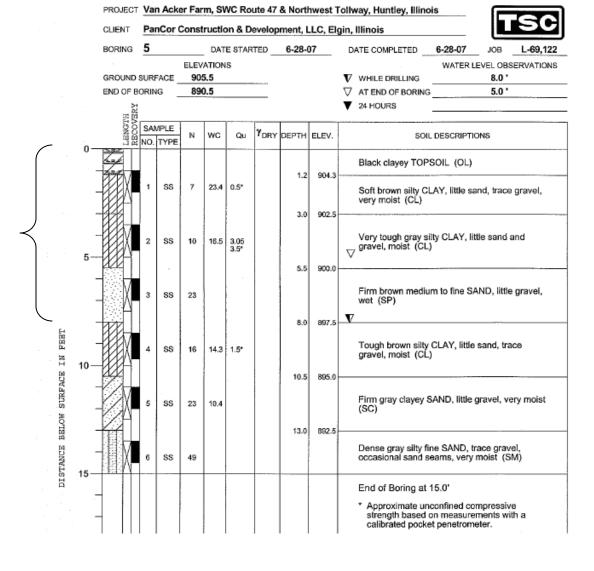


Several show confining layer





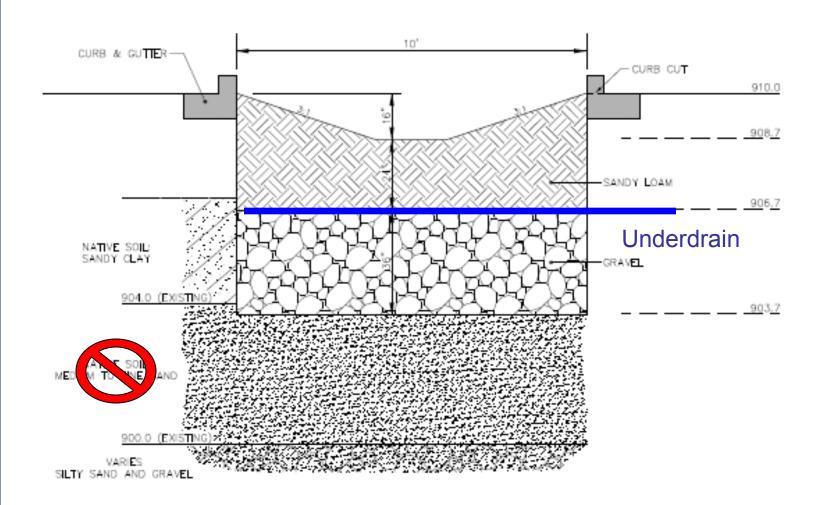
Borings



Several show confining layer











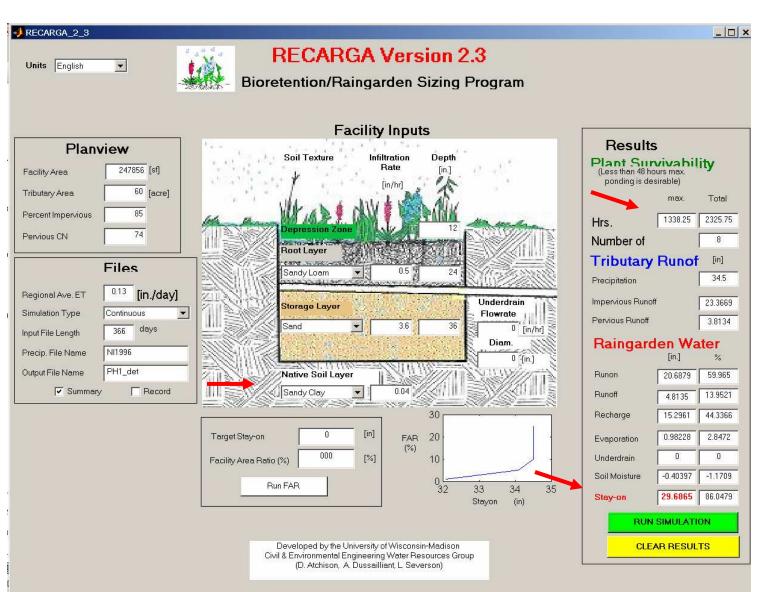
No Underdrain

Only change is native soil

Results:

Ponding:> 48hrs

Stayon: 29.7 in







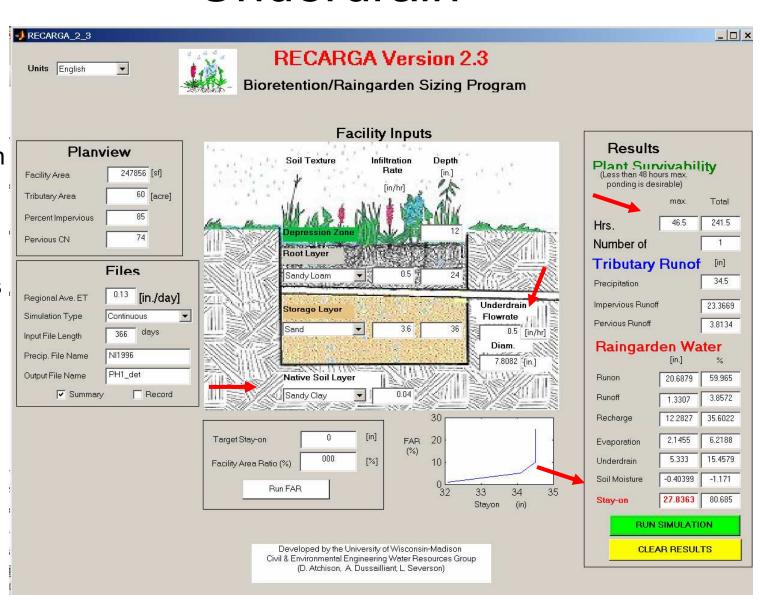
Underdrain

- Added underdrain
- Flow to replace loss of infiltration
- Results:

Ponding: < 48hrs

Stayon: 27.8 in

(reduced)







Summary

- RECARGA
 - Useful tool for impact analysis
 - Flexible user inputs
 - Powerful unique
 - Simple tool for final design analysis
 - Ponding duration
 - Vegetation survivability
 - Infiltration volume





Summary

- Accommodated site goals
- Not in strict accordance with WDNR
 - NR 151 Wis. Adm. code
 - Exclusions & exemptions
 - 0.6 in/hr
 - Area limitations
 - Percent goal
- Regulatory use needs clear standard
- Need to tailor site goals to site resources





Questions?

