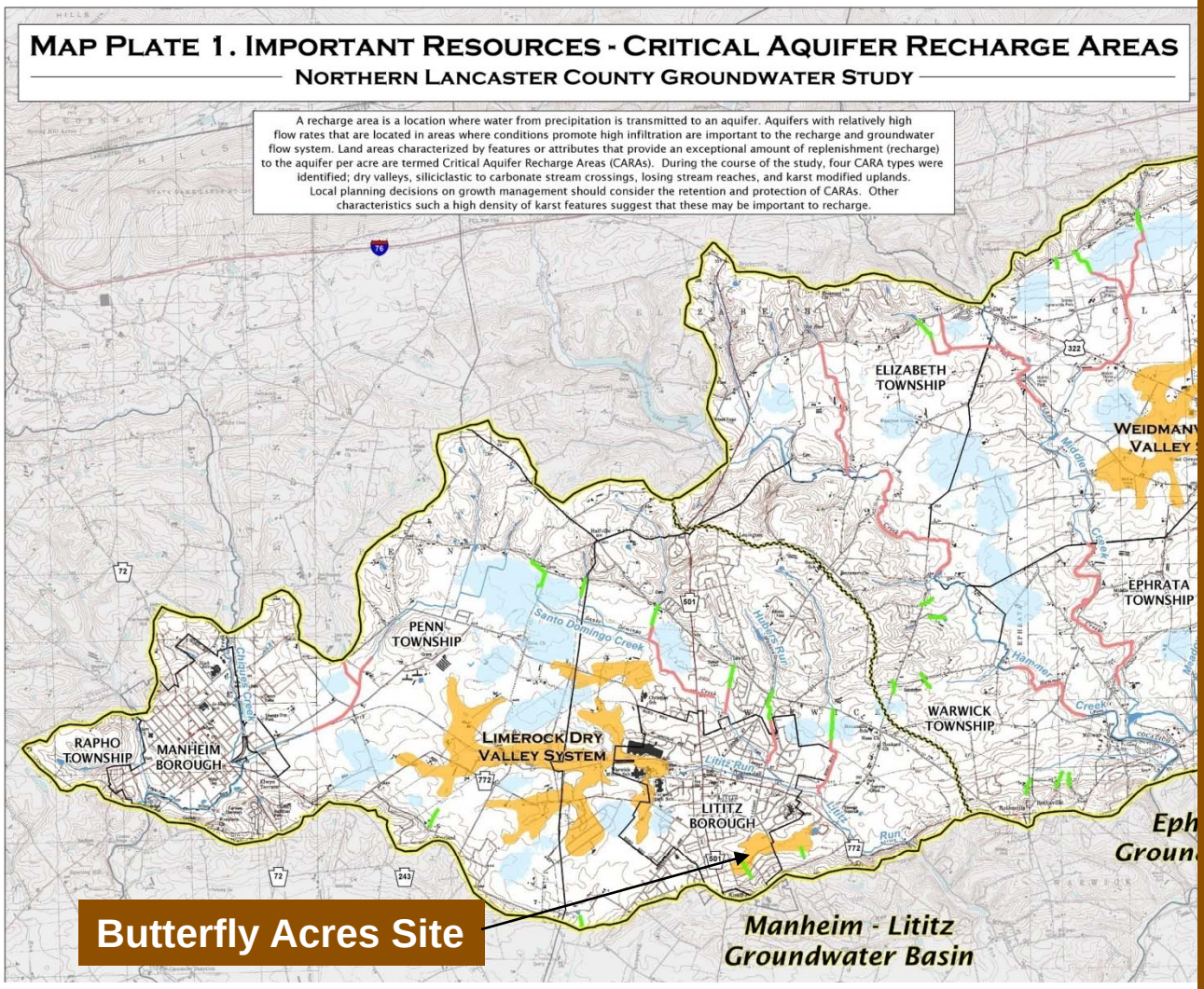
Lean “E”

The Challenges to Incorporate Reduced Water into Lean Mfg

Butterfly Acres Drainage Swale

SRBC Groundwater Study



- Study occurred simultaneously with the initial restoration attempt
- Lititz/Manheim Aquifer is identified as "potentially stressed" …. one of only nine (9) locations in PA
- Identified Butterfly Acres as a CARA - an opportunity to provide measurable and significant recharge to the groundwater stores.
- Prompted further field investigation

Understanding where it all goes – Inputs vs. Outputs

Water Inputs

- **Raw Materials in products**
- **Cooling water**
- **Production of high purity water**
- **Cleaning**
- **Once through cooling**

Products

Water Outputs:

- **Concentrate from production of high purity water**
- **Boiler blow down**
- **Cooling tower blow down**
- **Cleaning wastewater**
- **Once through cooling**
- **Belt washer discharge**

Water Inputs:

- **Cooling water**
- **Boiler make up**
- **Cooling tower make-up**
- **Once through cooling**
- **Belt washing**

Support Services

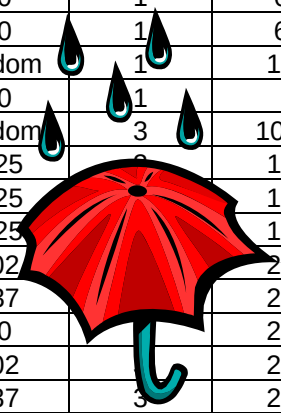
Understanding where it all goes – mass balancing

- **Annual detailed review of all site water, wastewater and stormwater uses:**
  - Account for water used in products;
  - Account for water that is evaporated;
  - Account for water used for landscaping;
  - Account for miscellaneous cooling water;
  - Account for sanitary flows;
  - Account for water used in cleaning;
  - Account for offsite stormwater

- **Daily reporting/tracking of water use and wastewater discharge:**
  - Trend analysis
  - Cost accounting
  - Knowing if the flows make “sense”
- **Tracking of production:**
  - Daily
  - Comparison to consumptive water use to see if something doesn’t appear right

Understanding where it all goes – mass balancing

Area	Location	Operation	Water Flow (gpm)	Duration (min)	Shifts	Avg GPD
Chem Weigh	First Floor	Booth Cleaning	50	50	3	4500
Pallet Washer	First Floor	Pallet Cleaning	30	30	3	1800
Mouthwash Batch Mfg	First Floor	Tank Cleaning	200	10	1	100
CALM Mfg.	First Floor	System Cleaning	5	120	1	60
Caramel Htg	First Floor	Heat up Caramel				
Mouthwash Pkg.	First Floor	Conveyor Lube	4	30	3	5760
Mouthwash Pkg.	First Floor	CIP	10	30	3	170
Mouthwash Pkg.	First Floor	CIP	14	30	3	5930
Upper Respiratory Mfg.	Second Floor	Tank Cleaning	100	30	2	2045
Neo/Poly Mfg.	Second Floor	Tank Cleaning	100	30	2	400
Lubriderm Mfg.	Second Floor	Tank Cleaning	100	30	2	1820
Liquids Pkg.	Second Floor	CIP Cleaning	100	120 to 180	2	570
Parke Davis	First Floor	Room Cleaning	10	30	1	1500
Parke Davis	First Floor	50 CF PK Blender	80	2	1	65
Parke Davis	First Floor	75 CF PK Blender	80	3	1	10
Parke Davis	First Floor	35CF PK Blender	80	2	1	65
Parke Davis	First Floor	600-L Gral Kettle	300	0.5	1	12
Parke Davis	First Floor	Film Coating	10	2	1	15
Parke Davis	First Floor	Coating Solution Prep	10	30	1	300
Parke Davis	First Floor	Parts washer	10	60	1	600
Parke Davis	First Floor	Drum washer	10	60	1	600
Parke Davis	First Floor	Sinks	20	random	1	1000
Parke Davis	First Floor	Lab Coat Washer	15	60	1	5
QC/Micro labs	Second Floor	Lab Sinks	5 to 25	random	3	10,000
Boiler #1	West Boiler Room	Blowdown	2	0.25	[illegible]	1239
Boiler #2	West Boiler Room	Blowdown	2	0.25	[illegible]	1239
Boiler #3	West Boiler Room	Blowdown	2	0.25	[illegible]	1239
Impulse Softeners	Middle Boiler Room	Brine Cycle	4.4	102	[illegible]	2301
Impulse Softeners	Middle Boiler Room	Slow Rinse	4.4	137	[illegible]	2301
Impulse Softeners	Middle Boiler Room	Fast Rinse	125	10	[illegible]	2301
Back-up Softeners	West Boiler Room	Brine Cycle	4.4	102	[illegible]	2301
Back-up Softeners	Middle Boiler Room	Slow Rinse	4.4	137	3	2301



Understanding where it all goes – mass balancing

RECORD OF TOTAL DAILY CONSUMPTIVE WATER USE

Project Name: McNeil Inc.-20050906

Name(s) of Source(s): Lititz Borough Municipal Water Authority

Report Period: Oct - Dec 2009 **Prepared By:** **Signature & Date:**

Mon./Day Oct '09	Water Inflow	Metered Stormwater	Daily Metered Outflow	Total CU (Gallons)	Payable CU (Gallons)	Mon./Day Nov '09	Water Inflow	Metered Stormwater	Daily Metered Outflow	Total CU (Gallons)	Payable CU (Gallons)	Mon./Day Dec '09	Water Inflow	Metered Stormwater	Daily Metered Outflow	Total CU (Gallons)	Payable CU (Gallons)
	Gallons	Gallons	Gallons				Gallons	Gallons	Gallons				Gallons	Gallons	Gallons		
1	184800	0	163,900	20,900	0	**1**	156,000	4600	87,700	72,900	35,900	**1**	316000	0	142000	174,000	137,000
2	210600	0	149,200	61,400	24,400	**2**	286,200	0	141,300	144,900	107,900	**2**	322000	11400	145800	187,600	150,600
3	224800	0	85,900	138,900	101,900	**3**	251,700	0	148,200	103,500	66,500	**3**	282000	7800	155300	134,500	97,500
4	238400	0	98,100	140,300	103,300	**4**	260,700	0	154,000	106,700	69,700	**4**	363000	0	132000	231,000	194,000
5	271900	0	85,800	186,100	149,100	**5**	264,700	0	139,200	125,500	88,500	**5**	289000	2900	142300	149,600	112,600
6	299000	0	149,200	149,800	112,800	**6**	303,900	0	161,500	142,400	105,400	**6**	331000	3400	133200	201,200	164,200
7	322900	0	155,400	167,500	130,500	**7**	295,700	0	89,500	206,200	169,200	**7**	275000	0	144500	130,500	93,500
8	346900	0	134,600	212,300	175,300	**8**	296,000	0	84,200	211,800	174,800	**8**	302500	0	167900	134,600	97,600
9	371800	5300	177,200	199,900	162,900	**9**	284,800	0	147,300	137,500	100,500	**9**	310300	33500	177600	166,200	129,200
10	381800	0	155,400	226,400	189,400	**10**	262,250	0	170,200	92,050	55,050	**10**	300800	0	169200	131,600	94,600
11	393500	0	152,100	241,400	204,400	**11**	360,300	1100	183,300	178,100	141,100	**11**	352700	0	198200	154,500	117,500
12	417900	0	177,500	240,400	203,400	**12**	305,200	0	152,900	152,300	115,300	**12**	349600	0	183400	166,200	129,200
13	332900	0	156,100	176,800	139,800	**13**	352,000	0	148,200	203,800	166,800	**13**	334500	0	155400	179,100	142,100
14	270200	0	89,700	180,500	143,500	**14**	315,700	0	74,200	241,500	204,500	**14**	327300	0	147400	179,900	142,900
15	337000	13700	104,400	246,300	209,300	**15**	297,000	0	76,400	220,600	183,600	**15**	330000	0	159600	170,400	133,400
16	280000	14300	203,700	90,600	53,600	**16**	331,300	0	146,000	185,300	148,300	**16**	360100	0	145100	215,000	178,000
17	379000	21500	113,400	287,100	250,100	**17**	332,300	0	175,200	157,100	120,100	**17**	241000	0	143700	97,300	60,300
18	250000	6700	168,000	88,700	51,700	**18**	302,150	0	171,800	130,350	93,350	**18**	180200	0	148700	31,500	0
19	263000	0	132,400	130,600	93,600	**19**	246,510	6500	155,100	97,910	60,910	**19**	184200	0	81400	102,800	65,800
20	222000	0	188,600	33,400	0	**20**	251,920	4000	132,100	123,820	86,820	**20**	180300	0	75700	104,600	67,600
21	337000	0	155,400	181,600	144,600	**21**	332,800	0	95,600	237,200	200,200	**21**	173300	5900	126700	52,500	15,500
22	419000	0	188,200	230,800	193,800	**22**	311,400	0	99,300	212,100	175,100	**22**	282800	1100	155800	128,100	91,100
23	257000	7800	119,800	145,000	108,000	**23**	268,600	1100	120,600	149,100	112,100	**23**	239000	0	139600	99,400	62,400
24	300000	19100	212,100	107,000	70,000	**24**	268,400	4800	78,700	194,500	157,500	**24**	215200	20400	117500	118,100	81,100
25	335000	0	146,800	188,200	151,200	**25**	254,700	2700	135,000	122,400	85,400	**25**	112600	0	96900	15,700	0
26	169000	0	111,400	57,600	20,600	**26**	193,400	0	82,900	110,500	73,500	**26**	93800	0	62800	31,000	0
27	335000	11800	135,600	211,200	174,200	**27**	197,000	0	72,800	124,200	87,200	**27**	103600	0	84000	19,600	0
28	273000	12000	170,700	114,300	77,300	**28**	218,100	0	77,800	140,300	103,300	**28**	131600	0	88700	42,900	5,900
29	360000	0	155,300	204,700	167,700	**29**	209,900	0	80,100	129,800	92,800	**29**	131000	0	92100	38,900	1,900
30	210000	0	150,800	59,200	22,200	**30**	201,500	3200	148,900	55,800	18,800	**30**	143000	0	77,000	66,000	29,000
31	187200	2500	69,400	120,300	83,300	**31**					0	**31**	146,800	0	67,800	79,000	42,000
Totals:	9180600	114,700	4,456,100	4,839,200	3,711,900	**Totals:**	8,212,130	28,000	3,730,000	4,510,130	3,400,130	**Totals:**	7,557,400	86,400	4,057,300	3,733,300	2,636,500

Understanding where it all goes – opportunities for reduction

- **Methods for review of sources for potential reductions and develop options;**
  - Site energy reduction team
  - Environmental assessments conducted on all new products and product changes
  - Management of Change process
  - ISO 14001 significant aspect analysis, objectives and targets
  - Onsite AND offsite

Understanding where it all goes – opportunities for reduction

- **Example review of sources for potential reductions and develop options;**
  - Reduce once through cooling through the conversion to chilled water systems, caveat – energy impact evaluation first completed before making the change;
  - Reduce stormwater discharges from site, increase groundwater discharges – modify stormwater swales and develop new best management practices;
  - Reuse of wastewater – purified waster system concentrate discharges used in boilers and cooling towers;
  - Eliminate landscaping irrigation systems;
  - Reduce water discharges through “pigging” of lines vs. water flush;
  - Reduce water through use of high pressure spray balls and improved cleaners

Understanding where it all goes – opportunities for reduction

- **Daily reporting/tracking of water use and wastewater discharge**:
  - Trend analysis
  - Knowing if the flows make "sense":
    - Offsite stormwater flows make up only 17% of total offsite flow;
    - Opportunity to "reclaim" water for
    - groundwater recharge
  - Daily
  - Comparison to consumptive water use to see if something doesn't appear right
    - Found a 1,000,000 gpd+ leak because of tracking mechanisms that were in place
  - Develop offsite opportunities for water restoration and recharging

Butterfly Acres Drainage Swale

Site Investigations

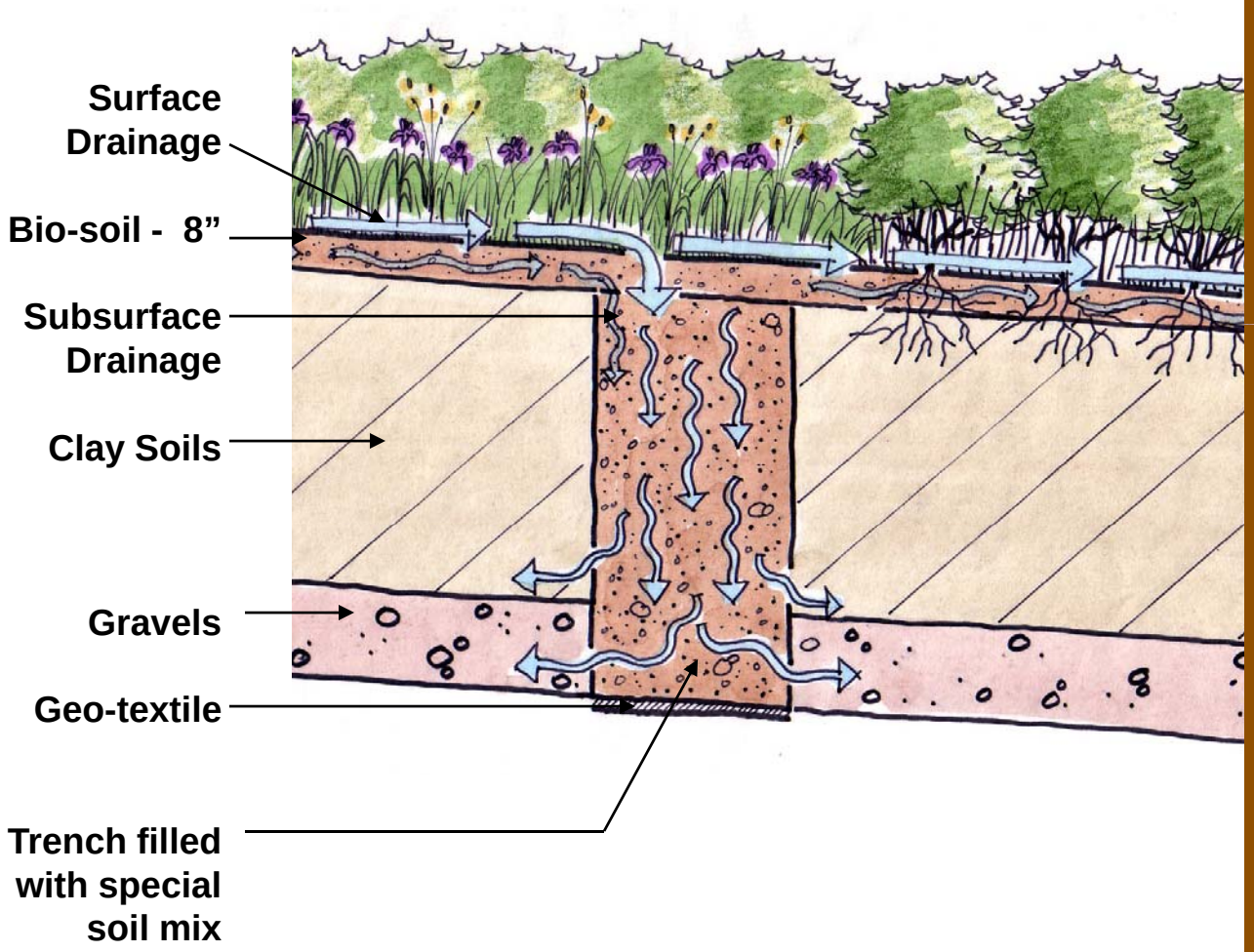
We GeoProbed Machine to drill soil cores at 10 locations along the swale.

These cores ranged in depth from 8 to 28 feet deep, and were about 2 inches in diameter.

This provided a view of the layering of soil types in the swale.

Butterfly Acres Drainage Swale

Strategy for Proposed Improvements

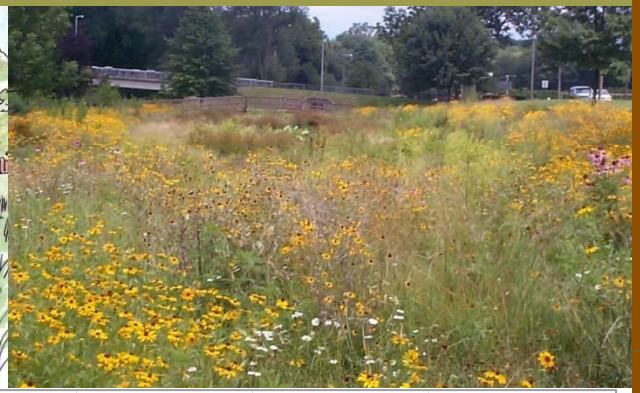


Section View – Proposed Restoration

- trenches are located strategically to take pressure off existing structures and to minimize the potential for sinkhole formation
- clay layer will remain below the new topsoil layer
- trees are planted to provide root zone conduits for water
- standing water will be minimized

Wildflowers

Zone I – Channel Bottom



Botanical	Common	Size	Color	Time
Zizia aureus	Golden Alexanders	1-3'	yellow	M-JU
Acorus catamus	Sweet Flag	2-3'	green	M-JL
Iris versicolor	Blue Flag	1-3'	blue	M-JU
Spigella marilandica	Indian Pink	1-2'	red	M-JU
Vernonia novenboracensis	New York Ironweed	4-8'	purple	JU-A
Lobelia cardinalis	Cardinal flower	2-4'	red	JU-A
Lobelia siphilitica	Great blue lobelia	2-3'	blue	AU-S
Eupatorium purpureum	Boneset	3-4'	white	JU-S
Solidago graminifolia	Grass-leaved goldenrod	3-4'	yellow	S-O
Aster novi-beigii	New York Aster	2-5'	violet	A-O
Aster novae-angiliae "Alma Potschke"	New England Aster	3-4'	pink	A-O

Aesthetic

Consistent Rush and sedge mix with Bent Grass groundcover

Add seasonal interest wildflowers in drifts with same species

Add tree and shrub "clusters" to define views

Function

Grass bottom mix provides stabilizing cover

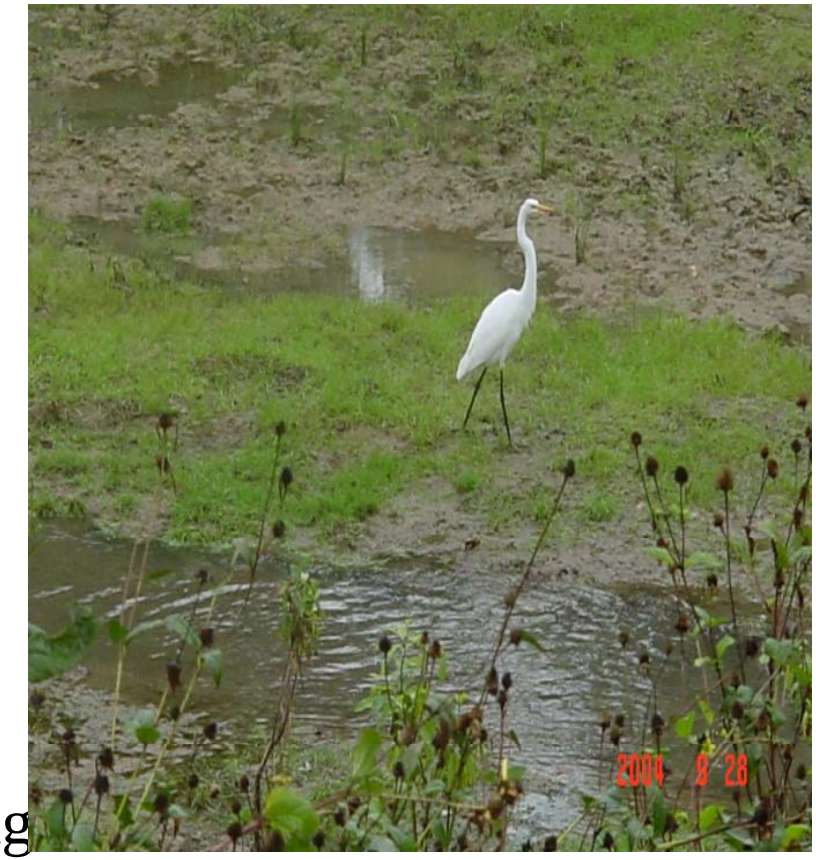
Wildflowers provide diversity for wildlife and additional root mass

Shrubs and trees provide root conduits through clay soils and stabilization in heavy flows

Other Thoughts

•Water projects have low IRRs compared to other environmental projects, e.g. energy, waste;
•“Bundle” projects, i.e. don’t always shoot for the highest IRR. Temper a high IRR project with low IRR work, that way can get the best of both worlds;
•“Market” the project. Use other approaches and supporting documentation to sell the project.
•Annual water use surveys (inputs and outputs) are a <u>must</u> as technology, grant monies, etc. are always changing and evolving;
•Keep the community appraised or at least the local municipality. A reduction in wastewater discharge is a great thing, but if a community depends on the revenue for their budgets they should have advance notice of project work so that they can plan ahead.

Results



- Water Use:
  - 2005 273,000 gpd
  - 2009 266,000 gpd
- Wastewater Discharge Reduction:
  - 2006 174,000 gpd
  - 2009 137,000 gpd
- Restoration:
  - 25+ acres
  - Increase groundwater recharge (quantification of results still being finalized)
  - Nutrient reductions: sediment, nitrogen and phosphorus