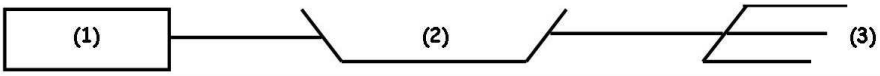
Project Design

A constructed wetland is composed of three independent stages for treatment of sewage:

1. **Septic Tank→** This is an underground storage tank that separates the solid waste from the liquid effluent. The separation is a slow process, occurring over a period of 2-4 days.
2. **Wetland Cell→** The effluent now enters the wetland cell where plant roots and aquatic microbes absorb the nutrients dissolved in the wastewater.
3. **Absorption Field→** The "clean" water is now released into a field and, consequently, into the local watershed.

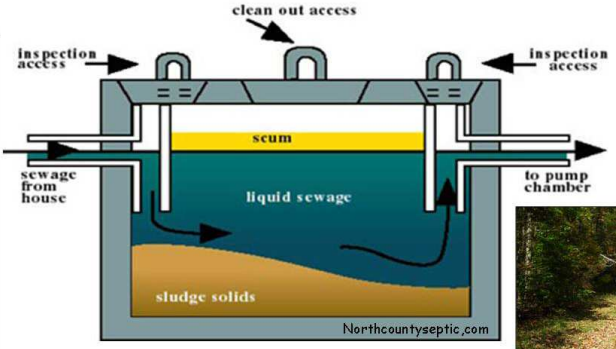


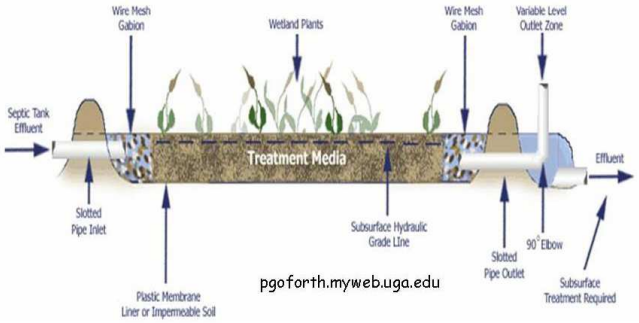
Septic Tank

After analyzing expected flow rates, the size of the septic system was determined to be 15,000 gals for a retention time of 3.3 days; allowing for future property expansion of up to 6000 gpd.

The tank was chosen from Hartford Concrete Products, located in Hartford, Indiana to minimize shipping and construction costs.

The location for installation of the tank was selected close to the pre-existing service road, allowing for easy access for construction and maintenance.





Wetland Cell

For each 1 gpd of flow expected, 1 square foot of wetland area is needed. However, since flow varies throughout the year it may be possible to reduce the size of the wetland cell. To increase detention time in the wetland, the cells should have a length-to-width ratio of 2:1 or less. The wetland will be comprised of two cells placed side-by-side, each with dimensions of 64' X 32' for a total area of 4096 square feet.

Location for the wetland was chosen to the south of the service road for topographical and accessibility reasons.

The cells will be surrounded by an 18" berm to protect the wetland from flooding and an 8' deer fence to keep away pests.

Plants will include: great spike rush, water iris, prairie cord grass, hard-stemmed bulrush, and New England aster.

Absorption Field

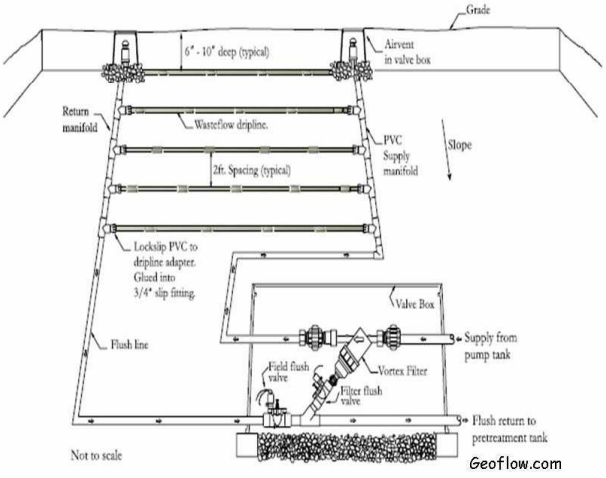
Based on the maximum flow of 4500 gpd and soil properties the area needed for the absorption field is 11,250 ft2 or 150' x 75'. The grid is set-up with 2 ft. of spacing between drip lines and 2 ft between emitters. Ultimately, there will be 5,625 lineal ft. of drip line rated at .5 gph and 300 ft of 3" PVC pipe for supply and return manifolds.

The system will run for 12 dosing periods per day comprising of 15 minutes per dosing cycle at the maximum flow rate. The total volume per dose is 375 gallons. All cycles and system operation will be automated using a PLC controller and solenoid operated flush valves.

External components consist of a 500 gal effluent tank, Gould Model We20H effluent pump (53 gpm, 34 psi) and an emergency holding pond already existing on the property.

System can be installed using any of the conventional methods of sub-surface drainage systems.

All of the design specifications and parameters for this absorption field comply with Indiana State Department of Health regulations concerning drip irrigation systems.

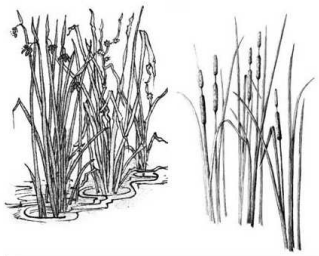


PURDUE UNIVERSITY

Constructed Wetland: Lutheran Hills Camp.
Captain Planet Engineers: Sean Kimmel, Joseph Mallory, Carly Sheets

April 19th, 2007

Constructed Wetland for Wastewater Treatment



Captain Planet Engineers

Team Members

Sean Kimmel, ABE

Joseph Mallory, ABE

Carly Sheets, ABE

Course Adviser:
Dr. Joseph Irudayaraj, ABE

Academic Advisers:
Dr. Don Jones, ABE
Dr. Jane Frankenberger, ABE

Sponsor:
Mr. David Deckard

Project Background

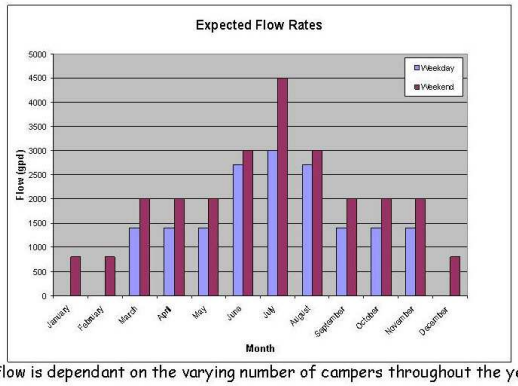
Problem Statement:

• The Lutheran Hills Camp, located in Brown County, Indiana, is currently treats its wastewater with an antiquated treatment system that is costly and time consuming. The property owner would like to replace this system with a "self-managing" natural alternative. Additionally, the property owner expressed future expansion interest, and consequently would like the new system to be able to handle flow increase. The team has been given a budget of $250,000, available through state grant funding.

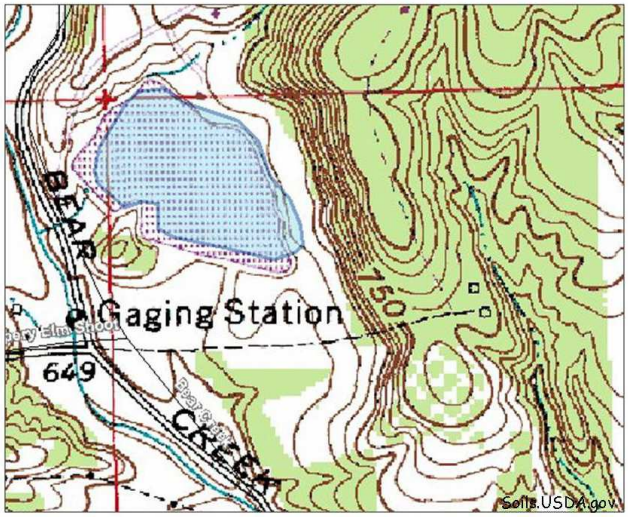
Objectives:

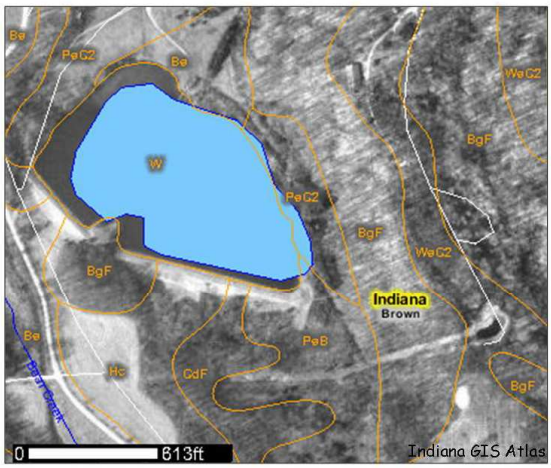
• To construct a wetland capable of replacing the existing wastewater treatment system at the Lutheran Hills Camp.

• Adequately treat and discharge wastewater effluent ranging from 0 gallons per day (gpd) in the winter to 4500 gpd in the summer using aquatic plants and symbiotic microbes.



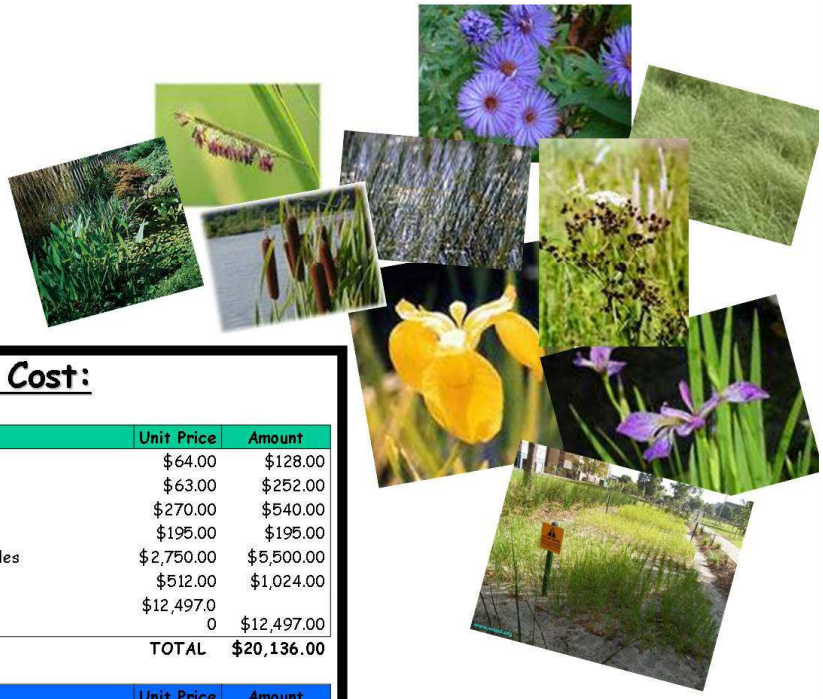
Flow is dependant on the varying number of campers throughout the year.





Map Unit Symbol	Be	BgF	CdF	Hc	PeB	PeC2	W	WeC2
Map Unit Name	Beanblossom channery silt loam, occasionally flooded	Berks-Trevlac-Wellson complex, 20-70% slopes	Chetwynd loam, 20-50% slopes	Haymond silt loam, frequently flooded	Pekin silt loam, 2-6% slopes	Pekin silt loam, 6-12% slopes, eroded	Water	Wellston-Gilpin silt loams, 6-20% slopes, eroded
Absorption Field Rating	Very Limited	Very Limited	Very Limited	Very Limited	Very Limited	Very Limited	Null	Very Limited

Project Summary



Materials and Cost:

Septic Tank: 15,000gal Hartford Concrete Products

Qty	Description	Unit Price	Amount
2 ea.	Waste Water Grade Ring, 6"x20" ID for 20" F&C	$64.00	$128.00
4 ea.	Waste Water ST Riser, 6" Round w/o Ins	$63.00	$252.00
2 ea.	Frame and Cover, 20.5" Watertight M.D. HCP	$270.00	$540.00
1 ea.	Septic Filter	$195.00	$195.00
2 ea.	On-site crane: off-load and set into preexcavated holes	$2,750.00	$5,500.00
2 ea.	Delivery (taxable), from Hartford City, IN	$512.00	$1,024.00
1 ea.	Tank: WW ST 15,000 gal 1/C Bottom and Top HS20	$12,497.00	$12,497.00
		TOTAL	$20,136.00

Wetland Cell: 64' x 64'

Qty	Description	Unit Price	Amount
1 sq. ft.	Liner: 4500 sq ft. of 36 mil PPE liner	$0.75	$3,375.00
70 T.	Gravel: 1 ton of 1/2-1", cover 1.5' deep	$8.15	$570.50
24 T.	Gravel: 1 ton of 3/8", cover 0.5' deep	$9.00	$216.00
94 T.	Gravel: Shipping per ton from Martinsville, IN	$3.55	$333.70
8 T.	Sand: 1 ton, cover 2" deep	$15.55	$124.40
1 ea.	Sand: Shipping from Martinsville, IN	$78.00	$78.00
150 ea.	Plants: Great spike rush (Eleocharis palustris)	$1.25	$187.50
150 ea.	Plants: Prairie cord grass (Spartina pectinata)	$1.10	$165.00
150 ea.	Plants: Common rush (Juncus effusus)	$1.25	$187.50
150 ea.	Plants: River bulrush (Scirpus fluviatilis)	$1.50	$225.00
150 ea.	Plants: Hard-stemmed bulrush (Scirpus acutus)	$1.10	$165.00
150 ea.	Plants: Dark green rush (Scirpus atrovirens)	$1.10	$165.00
150 ea.	Plants: Water iris (Iris virginica)	$1.50	$225.00
150 ea.	Plants: New England aster (Aster novae-angliae)	$1.50	$225.00
150 ea.	Plants: Cardinal Flower (Lobelia cardinalis)	$1.10	$165.00
1 ea.	Plants: Shipping from Walkerton, IN	$250.00	$250.00
5 ea.	Fencing: pest fence for the 256' perimeter	$120.95	$604.75
1 ea.	Fencing: Shipping from Detroit, MI	$300.00	$300.00
		TOTAL	$7,562.35

Absorption Field: Drip Irragation System

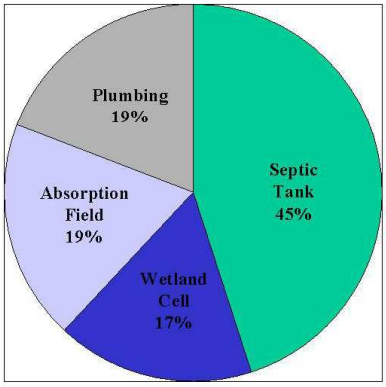
Qty	Description	Unit Price	Amount
5625 ft.	Dripline: Wasteflow PC 1/2 gph, 2' spacing	$0.59	$3,307.50
2 ea.	1" MPT air vent	$19.26	$38.52
2 ea.	Airvent Box	$9.63	$19.26
2 ea.	1.5" Solenoid valve	$160.50	$321.00
1 ea.	Headworks preassembled boxes, Ultra - 2" filter/no zone valves	$2,921.00	$2,921.00
1 ea.	Controller: PLC. Single zone. 115 V simplex pump. Automatic flush	$1,043.00	$1,043.00
150 ea.	Dripline fitting: Lockslip Adapter. 3/4" PVC slip to Wasteflow dripline	$1.02	$153.00
1 ea.	Pump: Gould model We20H	$150.00	$150.00
1 ea.	Pump tank: Plastic-Mart, 500 gallon	$525.00	$525.00
4 ea.	Floats	$5.00	$20.00
		TOTAL	$8,498.28

Plumbing: Connecting to the current WW line, and b/t systems

Qty	Description	Unit Price	Amount
1200 ft.	PVC mainline: Schedule 40, 2" diameter (feet)	$2.12	$2,544.00
130 ea.	PVC mainline: Schedule 40, 10' pipe, 4" diameter	$32.43	$4,215.90
300 ft.	PVC manifold (inches): Schedule 40, 3" diameter	$4.31	$1,293.00
25 ea.	PVC coupler: Schedule 40, 2" diameter	$2.08	$52.00
6 ea.	PVC coupler: Schedule 40, 3" diameter	$8.62	$51.72
2 ea.	PVC reducing coupling: Schedule 40, 6" to 4" diameter	$8.82	$17.64
1 ea.	PVC Wye: Schedule 40, 4" diameter	$9.92	$9.92
128 ea.	PVC gravity flow adapter: Schedule 40, 4" diameter	$2.94	$332.22
		TOTAL	$8,577.48
		GRAND TOTAL	$44,774.11

*NOTE
50 ft. b/t the septic tank and the existing wastewater line
350 ft. b/t the tank and the wetland
800 ft. b/t the wetland and the existing holding pond
1200 ft. b/t the holding pond and the drip irrigation system

Economic Pie Chart



Recommendations:

- *Education*

This system could be a great educational tool for the many campers that visit Lutheran Hills. We would like to recommend the addition of some placards throughout the system, or an information center, explaining purposes and use for the wetland, as well as the septic tank and drip irrigation system.

Acknowledgements:

Professor Don Jones, Professor Jane Frankenberger, Professor Brad Lee, Dr. Alfredo Garcia, Mr. Ed Miller, JFNew, Hartford Concrete Products, Rogers Construction Group, GeoFlow Subsurface Drip Systems

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