

Irrigation: Trials and Tribulations of Establishing Irrigation

Principal Investigator: Jon Leuck, Superintendent Pinney
Purdue Agricultural Center, Purdue University.

Co-Principal Investigator: Steve Hawkins, Assistant Director
Purdue Agricultural Centers & Coordinator of Building
Projects Purdue College of Agriculture, Purdue University



DANGER
HIGH
VOLTAGE



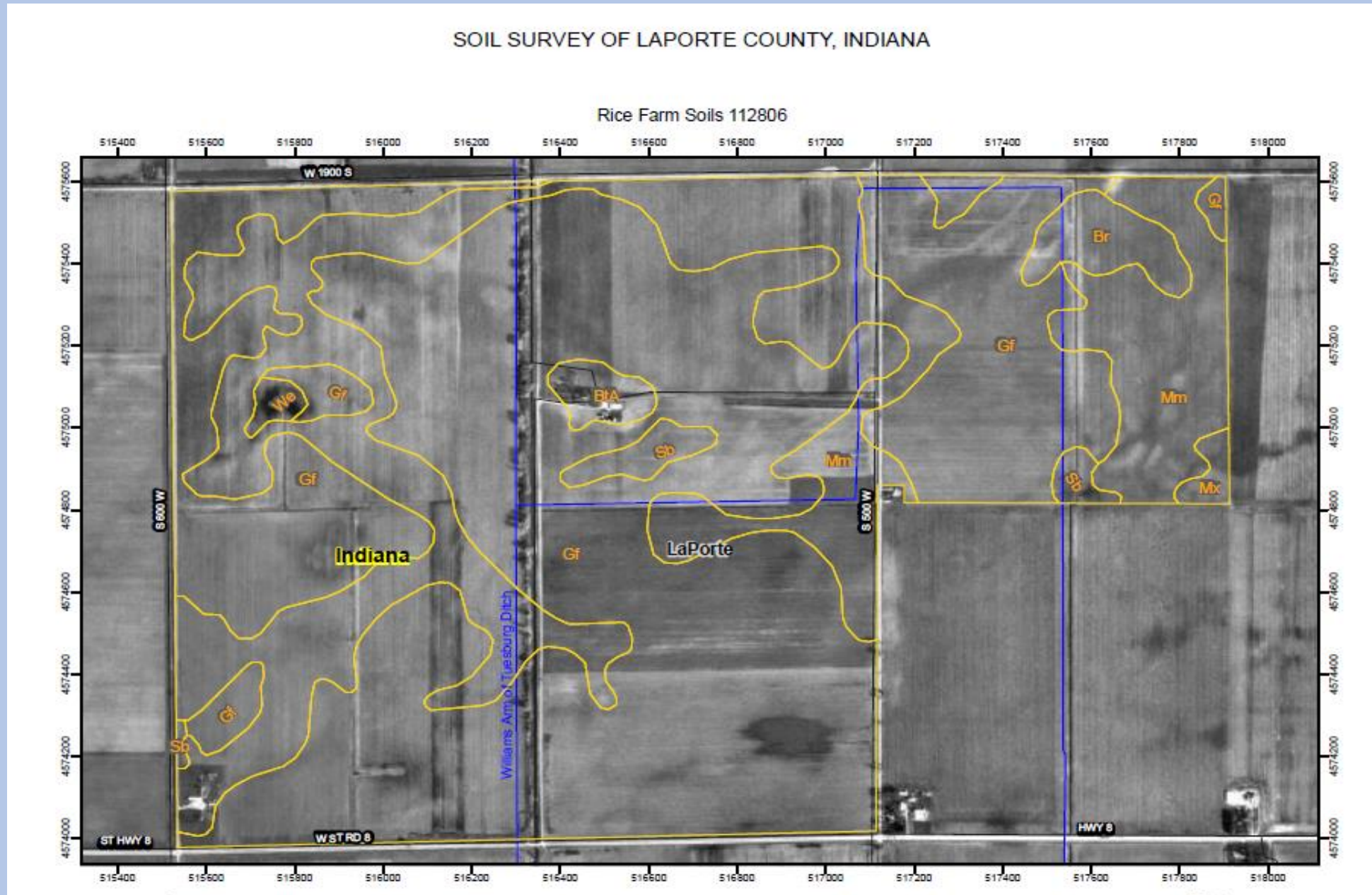
Initial Discussion Phase

- Research land is needed with irrigation, especially after 2012 drought
- Land availability
- Decide on a possible location
- Water seems abundant
- Need to look at soil profile and types
- Check local well log records
- A test well should be done to decide on yield first
- How large of a system or irrigator is desired – Formula: 6 gallons per acre x 142 acres = 852 gallons per minute well capacity
- Power sources available/expense – diesel versus electric

Purdue University Rice Farm Aerial Map



Soil Survey of Purdue University Rice Farm



Rice Farm Soil Summary

Soil Survey of LaPorte County, Indiana

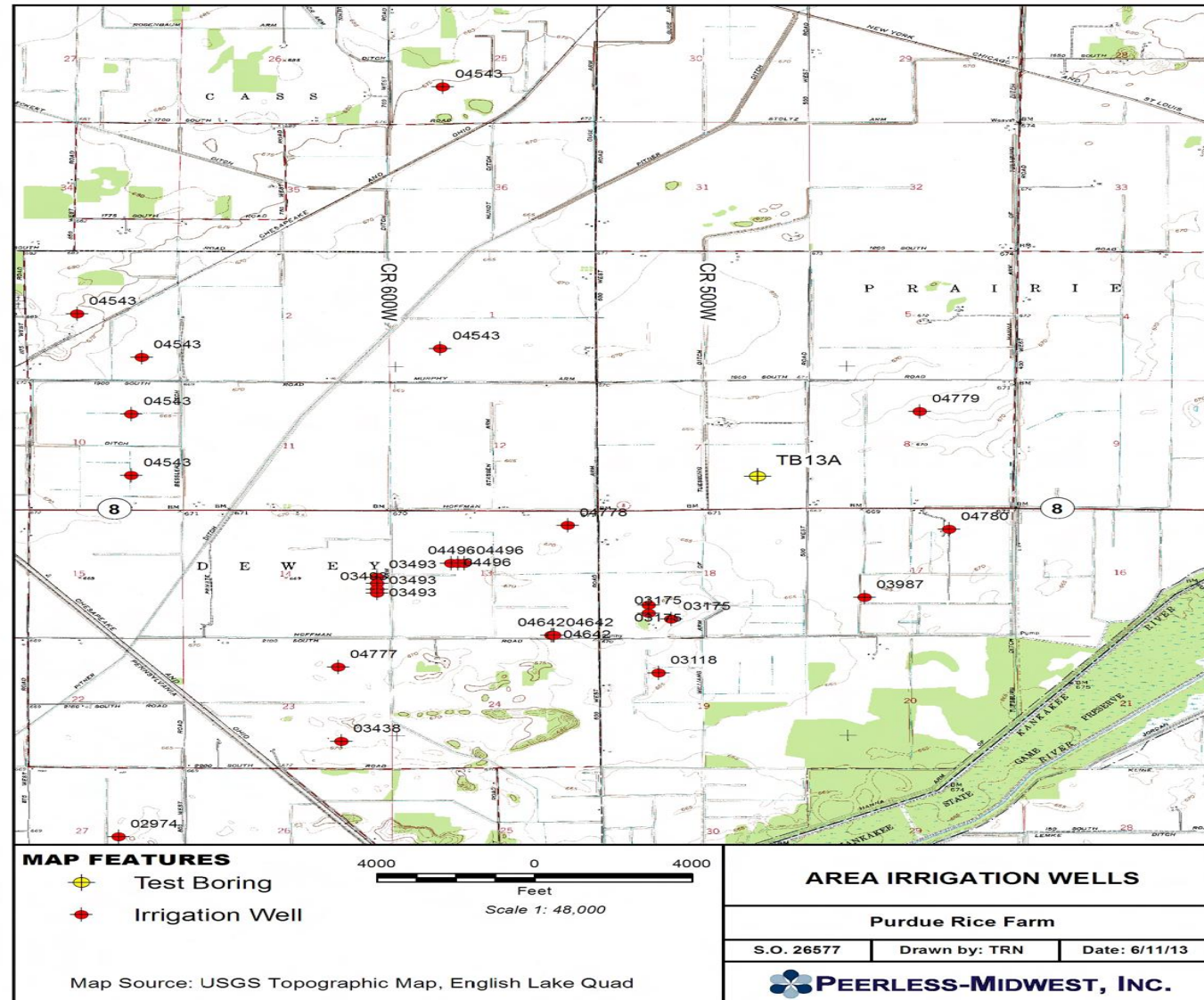
Rice Farm Soils 112806

Map Unit Legend Summary

LaPorte County, Indiana

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Br	Bourbon sandy loam	13.9	1.7
BtA	Brems fine sand, 0 to 3 percent slopes	7.2	0.9
Gf	Gilford fine sandy loam	528.5	66.1
Mm	Maumee loamy fine sand	232.8	29.1
Mx	Morocco loamy fine sand	3.5	0.4
Sb	Sebewa loam, shaly sand substratum	10.5	1.3
We	Warners silt loam	3.0	0.4

Neighboring Well Locations



26577_PurdueRiceFarm_HiCapWells_Fig2

FIGURE 2

Surrounding Well Logs

Indiana Department of Natural Resources

Page 1 of 1

Record of Water Well

Indiana Department of Natural Resources

Reference Number 96684	Driving directions to well		Date completed May 27, 1993
Owner-Contractor	Name	Address	Telephone
Owner	JOHN GORSKI	LACROSSE, IN	
Driller	JOE BROWN	RR 1 BOX 198, KNOX IN	
Operator	JOE BROWN	License: 130	
Construction Details			
Well	Use: Industry	Drilling method: Rotary	Pump type:
	Depth: 57.0	Pump setting depth: 35.0	Water quality: CLEAR
Casing	Length: 37.0	Material: STEEL	Diameter: 12.0
Screen	Length: 20.0	Material: 5.5	Diameter: 10.75 Slot size: .045
Well Capacity Test	Type of test:	Test rate: 800.0 gpm for 2.0 hrs.	BailTest rate: gpm for hrs.
	Drawdown: 30.0 ft.	Static water level: 5.0 ft.	Bailer Drawdown ft.
Grouting Information	Material: BEN		Depth: from 0.0 to 30.0
	Installation Method: TREMISE		Number of bags used: 12.0
Well Abandonment	Sealing material:		Depth: from to
	Installation Method:		Number of bags used:
Administrative	County: LAPORTE		Township: 33N Range: 3W
	Section: SW of the NE of the SW of Section 17		Topo map: ENGLISH LAKE
	Grant Number:		
	Field located by: BH		on: Aug 08, 1994
	Courthouse location by:		on:
	Location accepted w/o verification by:		on:
	Subdivision name:		Lot number:
	Ft W of EL:	Ft N of SL: 1400.0	Ft E of WL: 1400.0 Ft S of NL:
	Ground elevation: 666.0	Depth to bedrock: 75.0	Bedrock elevation: 591.0 Aquifer elevation: 609.0
	UTM Easting: 517564.7		UTM Northing: 4572626.0
Well Log	Top	Bottom	Formation
	0.0	36.0	SAND
	36.0	57.0	SMALL GRAVEL
	57.0	75.0	FINE SAND
	75.0	75.0	SHALE
Comments	MC; VERIFIED BY DIRECTIONS, WELL 1400 FT N OF 2100S		

Bidding Out The Well Work

- We are a public entity and must follow codes, processes, inspections, and competitive bidding
- Ultimately this raises the cost but at the same time is supposed to lower the risk
- We can use this to our advantage to build low maintenance and low start up costs
- Consequently we tend to build more robust systems but this can be beneficial in the long run
- Our bid package asked for the test well, production well, and electric

Bids Are Returned

**RICE FARM IRRIGATION WELL INSTALLATION - 2013
PURDUE UNIVERSITY WEST LAFAYETTE CAMPUS
SMALL PUBLIC WORKS
FEBRUARY 1, 2013**

BIDDERS	Layne Christensen Company	Resource Construction, Inc.		
	Beecher, IL	Indianapolis, IN		
COMPLETE CONSTRUCTION				
Base Bid	\$313,609.00	\$335,507.00		

- Bids returned are rejected due to extreme cost
- Union Labor and Prevailing Wage requirements, the test well, the scope of the electrical work, quality of materials requested, and the schedule of work anticipating overtime labor increased the final bid results.

Bidding the Test Well, Production Well, and Electrical Work Separately

PURCHASE ORDER: 30670913
Order Date: 04/09/2013

MUST BE SHOWN ON ALL PACKAGES, FREIGHT BILL,
PACKING SLIPS AND INVOICES



For questions on the order, please contact:
Requester Name: Judith H Clare
Email: jclare@purdue.edu
Phone: 765-494-0398
Fax: 765-496-1579

Supplier:

Peerless-Midwest Inc
55860 Russell Industrial Pkwy
Mishawaka, IN 46545-7599US
Phone: 574-254-9050 Ext:
Fax: 1-574-254-9650
Contact:

Ship To:

Purdue University - West Lafayette Campus
Judith H Clare
Rice Farm

RICE
19955 S 600 W
LaCrosse, IN 46348US
Campus Deliver To: Mark Townsend,
765-496-2563/ Rice Farm

Bill To:

Purdue University
Freehafer Hall of Admin. Services
Accounts Payable Dept
401 South Grant Street
West Lafayette, IN 47907-2024US
Phone: 765-494-7370 Ext:
Fax: 765-494-1379

Incoterm: Shipping Point

Payment Terms: Net 30 - No Discount; 30 days from Document Date

Line	Item Description	Part Number	Qty	Unit	Unit Price	Extended Amount	Need by Date
1	Test Well Drilling For Purdue Rice Farm location Well as per specifications of Purdue RFQ A-1814 Pricing per your quotation #PU- 01 dated 4/4/13 by Tim Hill and our reference A-1814 For questions regarding this order, and to schedule, please contact Project Manager Mark Townsend, 765-496-2563.		1	LO	4,200.00	4,200.00	05/17/2013
					Total	\$ 4,200.00	

If you have general Procurement questions, please contact:
Purchasing Department Email: pshep@purdue.edu
Phone: (765) 494-7279 Fax: (765) 494-6609

State Law requires that Purdue University submit Seller information to the Indiana Department of Revenue for sales tax clearance purposes. Sellers having no nexus in Indiana are not required to register. Amended 7/1/2007. See terms and conditions.

Test Well Drilling



Test Well Sieve Results

Alloy Machine Works, Inc.
18102 E. Hardy Rd.
Houston, TX 77073

Date Run:
6/11/2013

Ph (800) 577-5068
Ph (281) 233-0214
Fax (281) 233-0487

Sold To: Peerless Midwest
Address: 55860 Russell Industrial Pk
City, St Zip: Mishawaka, IN

Ship To: Peerless Midwest
Address: 55860 Russell Industrial P
CSZ: Mishawaka, IN
Contact:
Phone:
Fax:

Driller:
Engineer:
Well: Purdue Rice Farm

U.S. SIEVE NO.	SLOT OPENING INCHES	WEIGHT RETAINED	PERCENT RETAINED	CUMULATIVE RETENTION
3.5	0.223	0	0%	0%
4	0.187	6	6%	6%
6	0.132	2	2%	8%
8	0.094	1	1%	9%
12	0.066	5	5%	14%
16	0.047	15	15%	29%
20	0.033	32	32%	61%
30	0.023	22	22%	83%
40	0.016	9	9%	92%
50	0.012	8	8%	100%
70	0.008	0	0%	100%
100	0.006	0	0%	100%
120	0.0049	0	0%	100%
140	0.0041	0	0%	100%
170	0.0035	0	0%	100%
200	0.0029	0	0%	100%
PAN	0	0	0%	100%
TOTAL		100		

Remarks

Depth (Beginning) 34 Depth (Ending) 39

Uniformity Coefficient D60/D10 = 2.4031

D60 = 0.0422 D10 = 0.0176

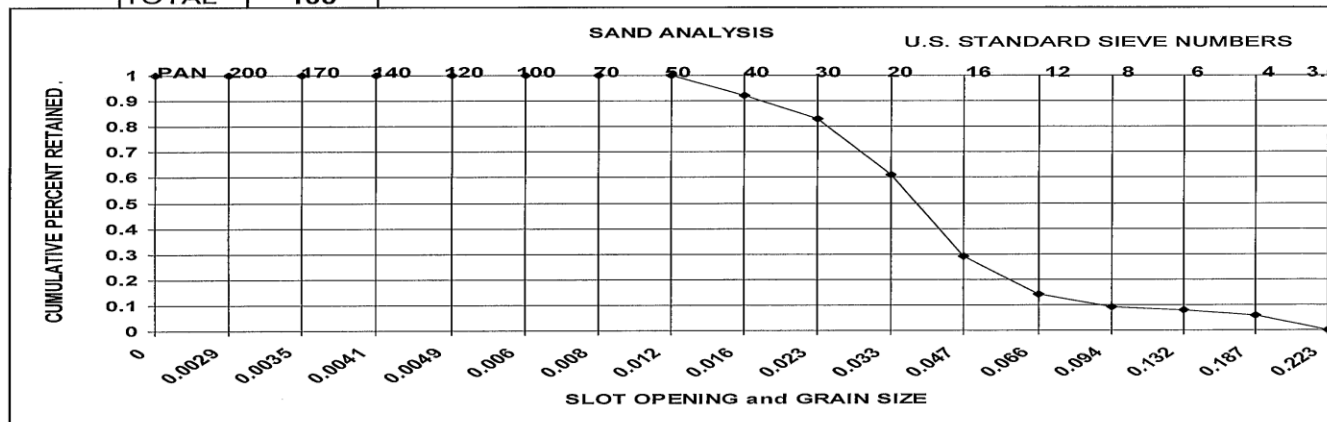
50% Point 0.0378 5*50% Pt 0.1891

Median Gravel Size 0.1891

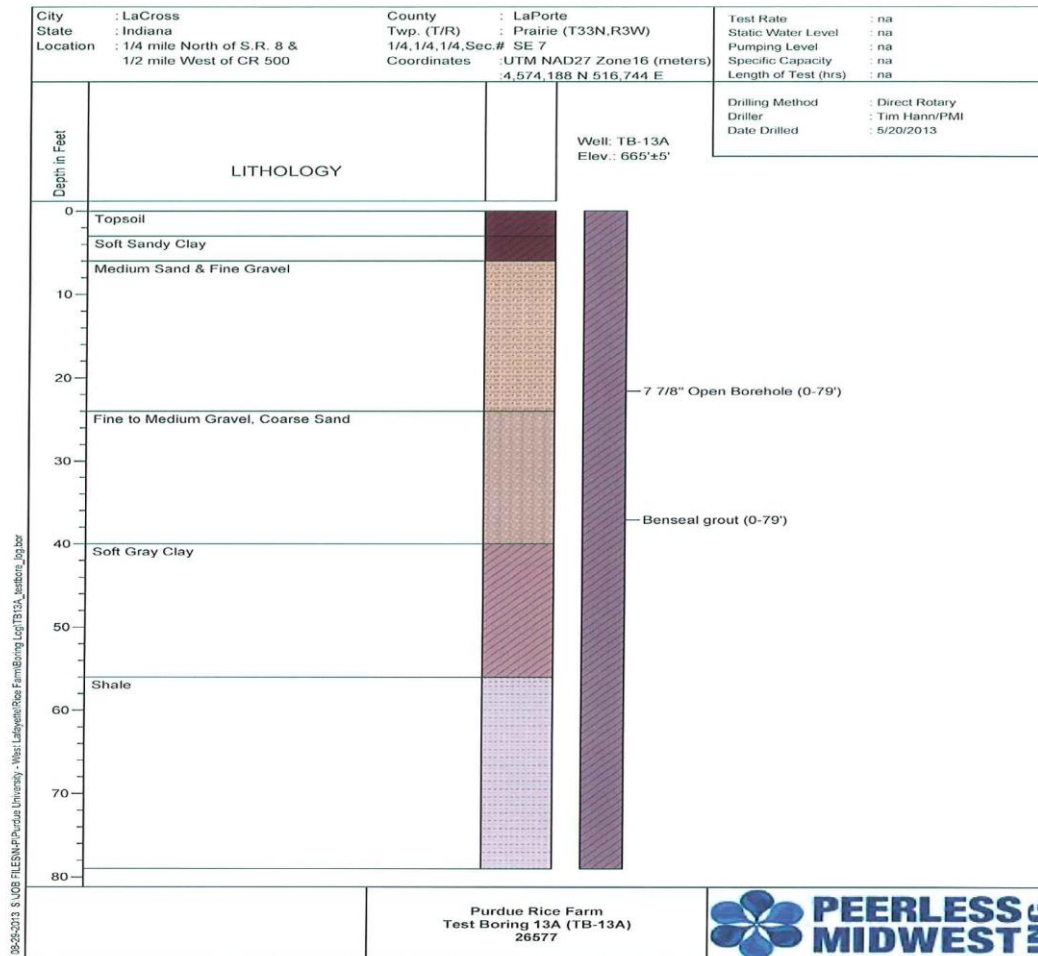
Calculated Gravel Pack $\frac{x6}{0.227}$ $\frac{x4}{0.151}$

Calculated Slot Gravel
0.13625 (0.22688-0.15125)

Natural Development 40 % Retention
Slot Recommendation 0.0422



Test Well Results



Area Well Production

Table 1, Attachment C. Area Registered High Capacity Wells, Purdue Rice Farm, LaCrosse, Indiana.

IDNR Registration Number	Water Use	Facility Name	Well ID	UTM Easting	UTM Northing	Pump Rating (gpm)	Well Depth (Feet)	Well Diameter (inches)	Aquifer
04543	IR	Schafer Farms	1	511480	4576225	350	30	8	SG
04543	IR	Schafer Farms	2	511980	4575680	800	20	8	SD
04543	IR	Schafer Farms	3	514290	4575790	800	20	8	SG
04543	IR	Schafer Farms	4	511900	4574970	550	55	8	SH
04543	IR	Schafer Farms	5	514310	4579070	850	20	8	SG
04543	IR	Schafer Farms	6	511900	4574200	800	18	8	SG
04778	IR	Gorski, Carey	1	515275	4573575	700	34	12	SG
04779	IR	Gorski Brothers	1	518000	4575000	800	50	12	SG
04780	RU	Gorski Brothers Partnership	1	518225	4573525	200	43	6	SG
03987	IR	Gorski Brothers Partnership	1	517570	4572675	800	57	12	SG
04496	IR	Four Grand Farms LLC	1	514375	4573100	250	33	12	SG
04496	IR	Four Grand Farms LLC	2	514425	4573100	250	33	12	SG
04496	IR	Four Grand Farms LLC	3	514475	4573100	250	33	12	SG
03493	IR	Gorski Brothers Partnership	1	513800	4572925	300	37	8	SD
03493	IR	Gorski Brothers Partnership	2	513800	4572850	300	37	8	SD
03493	IR	Gorski Brothers Partnership	3	513800	4572775	300	37	8	SD
03493	IR	Gorski Brothers Partnership	4	513800	4572725	300	37	8	SD
04642	IR	Gorski, Carey	1	515150	4572200	170	40	6	SG
04642	IR	Gorski, Carey	2	515160	4572200	165	40	6	SG
04642	IR	Gorski, Carey	3	515170	4572200	165	40	6	SG
03175	IR	Gorski, John	1	515900	4572575	600	38	12	SG
03175	IR	Gorski, John	2	515900	4572475	400	38	8	SG
03175	IR	Gorski, John	3	516075	4572400	400	38	8	SG
04777	IR	Gorski, Brandon	1	513500	4571800	800	34	12	SG
03438	IR	Stoller, Duane	3	513525	4570870	600	40	6	SG
03118	IR	Scarborough, Linda	1	515980	4571725	700	45	12	SH
02974	IR	Swanson, David	1	511800	4569675	500	44	12	SG
Averages						485	37		

Table Notes:

Easting and Northing data presented as UTM, NAD 27, Zone 16 coordinates

IR - Irrigation

SG - Sand & Gravel

SD - Sand

SH - Shale

Test Well Conclusions

Conclusions and Recommendations

The conditions at the Site appear favorable for developing an irrigation groundwater supply from the surficial sand and gravel aquifer. However, it may require more than one well to achieve the desired 850 gpm supply. The average production from a 40 foot deep well in this aquifer is approximately 485 gpm (Attachment C).

A 12 inch diameter production well completed at TB13A and designed with a partially penetrating screen installed at the base of the surficial sand and gravel aquifer will maximize the available drawdown at the Site. Assuming a static water level of approximately 5 feet bgl, and 10 feet of well screen installed from 30 to 40 feet bgl, an estimated safe available drawdown at this location (5 feet above the top of the screen) would be approximately 20 feet.

The sieve analysis results would suggest the outwash aquifer is poorly sorted with granular material ranging from fine sand to gravel. Based on the analysis, a production well completed adjacent to the TB13A location will support 0.120 inch slot size screen with a 1/4" by 1/8" Northern gravel pack. However, PMI experience shows outwash deposits can be highly stratified, meaning well sorted lenses of fine grained material can be present. To account for any fine-grained lenses and to reduce the potential for sand pumping in the production well, we recommend installing a more conservative screen design. For the production well design, we recommend installing 10 feet of 12 inch diameter, 0.080 slot screen with a Northern #2 (#6x#12) gravel pack. This design can provide up to 644 gpm at 0.1 feet per second entrance velocity.

Production Well Specifications

- **SPECIFICATIONS FOR IRRIGATION WELL AT PURDUE MARY S. RICE FARM**

- **Well:**

- Establishment of irrigation water well at the Purdue Mary S. Rice Farm in Laporte County, to supply water to an irrigation rig approximately 1,300 in length.
- 4 – 8 gallons per minute (gpm)/acre; 6 gallons per minute average watering 140 acres or 840 gallons per minute well.
- Option 1: Single well producing 900 gallons per minute.
- Option 2: Multiple wells tied together producing 900 gallons per minute.
- Variable Frequency Drive Submersible Pump (VFD) offers the soft start up and would be good to have in terms of energy usage and flexibility of future irrigation possibilities.
- Gear head or pump drive with appropriate horsepower to achieve desired gallons per minute.
- Gear head or pump drive will run from 3-phase electric power drive.

Production Well Specifications

- Well or wells will be located as close to the center of the pivot point as possible whether from option 1 or 2. The vendor will provide all equipment, materials and labor to install the new water well for irrigation purposes, producing 900 gallon per minute (gpm) at the Mary S. Rice Farm site.
- The well shall be drilled, developed and grouted per the Indiana Department of Natural Resources guidelines.
- Design and construction of this well are based on the American Society of Agricultural and Biological Engineers Standards.
- It is required that this well or wells be tested for output, flow, and pressure to determine gpm in relation to gpm required. In addition test will be used for particulate size to determine appropriate screen size. The wells shall have a continuous stainless steel screen, length determined by the well driller, with appropriate gravel pack.
- In the event the test well indicates the need for a sand separator system, a Lakos PPS separator for turbine pumps will be installed.
- Flanged outlet for irrigation vendor connection will be required.
- A gear head or pump drive such as a Johnson or a Randolph brand.

Bidding the Two Production Wells

RICE FARM IRRIGATION WATER WELL INSTALLATION - 2013 PURDUE UNIVERSITY WEST LAFAYETTE CAMPUS SMALL PUBLIC WORKS

BIDDERS	Layne Christensen Company	Dilden Brothers Inc.	Ortman Drilling & Water Services	Peerless Midwest, Inc.
	Beecher, IL	Lafayette, IN	Kokomo, IN	Mishawaka, IN
COMPLETE CONSTRUCTION				
Base Bid	\$238,825.00	\$112,772.00	\$69,850.00	\$87,758.00





Efficiencies & Strategies In Irrigation

- The key is to pump only water that is Effective
- Uniform application of water – End gun stop adjustment, water supply over or under design, incorrect end gun orifice and sprinkler tips, leaks, plugs, and non turning sprinklers
- Preventing irrigation runoff – consider slope, heavy soils, pressure, sprinkler package, application rate, and compaction
- Do not over fill the soil profile
- Scheduling-water the crop when it needs it
- Use the least pressure or lift possible to Effectively deliver water
- Use the least cost energy source

Power Options to Run Your Irrigation System

Irrigation power cost vary:

- Power source – electric, diesel, or propane
- Power cost – electric was the most economical versus the higher cost of diesel fuel and most recently propane
- System pressure – Cost varies for all 3 power sources depending on the system pressure requirements. <35 psi, 35 – 95 psi, and >100 psi, electric power cost per acre inch was the better source of power
- On our system 3 phase electric was available and utilized

Bidding the Electrical Work

RICE FARM IRRIGATION WELL ELECTRICAL INSTALLATION - 2013 PURDUE UNIVERSITY WEST LAFAYETTE CAMPUS SMALL PUBLIC WORKS

BIDDERS	Martell Electric, LLC	Michiana Contracting, Inc.	
	South Bend, IN	Plymouth, IN	
COMPLETE CONSTRUCTION			
Base Bid	\$92,970.00	\$72,900.00	

Irrigation Rig System

- **SPECIFICATIONS FOR IRRIGATION SYSTEM AT PURDUE RICE FARM**
- **Vendors: Valley, Zimmatic, and Reinke**
- Galvanized pipe construction, non-towable irrigation system, stationary pivot with concrete pad, centered on a 160 acre field complete with installation and setup. 3 phase electric energy. This system will be a full circle coverage unit.
- Drive wheel application speed to allow for quickest application time. This would be useful in terms of research. The highest drive wheel application speed available.
- Standard system height, Heavy construction for durability.
- System to function uniformly with a Variable Frequency Drive pump. Well will be supplying 850 gallon per minute.

Irrigation Rig System

- Booster pump and end gun for maximum end gun watering.
- The 14.9 x 24 tire can be mounted on an 8" – 10" galvanized rim.
- End tower and pivot strobe light.
- Monitoring abilities that check rainfall, wind speed and offsite location positioning.
- As the well is developed and gallon per minute, flow and pressure are determined it will be at this time when a sprinkler and regulator package will be chosen, depending on well output results.
- Top of the pipe sprinklers. Sprinklers close to the towers or lower ends of the spans to be raised for reduced water contact, allowing for maximum sprinkler application.

Irrigation Rig System

- Installation of a blank spool for future installation of Chemigation/Fertigation injection valve will be provided and installed by irrigation vendor.
- Variable Rate Irrigation applied by speed control and appropriate control panel.
- Pressure, flow, voltage and temperature shut down parameters.
- Control panel to include cellular and internet connectivity, position, control of irrigation, chemigation, fertigation, end gun controlling, scheduling, programmability, for precision of application and efficiency. Including direction, pressure, voltage, temperature, flow sensor, and run time hours.
- Lightning and voltage protection.

Bid Process Summary

- Separating out the test well, production well, and electric seemed to be the most logical process to rebidding the work for a lower cost.
- However keeping the test well and production well together would be positive since they are so closely tied to one another.
- Coordination and communication with all the working parts: well drillers, electrical contractors, and irrigation system installers would have been beneficial for all those involved since only purchasing and physical facilities can execute contracts.
- By bidding the test and production wells together, acquiring the yield results, design and bidding the electric to the needs, and specifying the desired system requires all aspects to be working in unison.

Overall Project Summary

- Keep your main goal in perspective – for us it was to provide the basic potential for irrigation. In the beginning design it simple
- Do your homework to assess your irrigation potential. Look at well logs, soil structure, and utilize test well results
- Be flexible in your planning, specs, and design to allow for growth. All for the implementation of features such as injection, variable rate applications, and remote monitoring
- Bring all parties to the discussion table to ensure the best communication toward a continuing effort
- Always invest in safety

Questions?