Mission Valley Power Agricultural Measures

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Bonneville Power Administration

Mission Valley Power Irrigation Workshop

Agricultural

- Agricultural
  - Variable Frequency Drive (VFD) for **centrifugal/turbine/submersible** agricultural pumps (New or Existing installations).
  - Agricultural pump efficiency upgrade (New pumps).
  - Sprinkler irrigation hardware maintenance and conversions
  - Green motors

VFD for Centrifugal Agricultural Pumps

(New or Existing Installations)

- Pre-Condition:
  - Pre-Approval with Mission Valley Power required prior to purchase of equipment.
  - A fixed speed centrifugal pump ranging from 20 to 1000 horsepower.
  - Eligible installations are limited to pumps with at least 20% variation in head.
  - Pump manufacturer’s performance curve if available.
- Post-Condition:
  - A new (not rebuilt) VFD that meets the 20% variation in head.
  - BPA recommends IEEE 519 standard is met. (Electrical harmonic mitigation)
  - Pump manufacturer’s performance curve (if new pump is installed)
  - Invoice
- Rebate:
  - $70/horsepower

VFD for Turbine/Submersible Agricultural Pumps

(New or Existing Installations)

- Pre-Condition:
  - Pre-Approval with Mission Valley Power required prior to purchase of equipment.
  - A fixed speed turbine/submersible pump ranging from 20 to 1000 horsepower.
  - Eligible installations are limited to pumps with at least 20% variation in flow rate or 10% variation in head.
  - Pump manufacturer's performance curve
- Post-Condition:
  - A new (not rebuilt) VFD that meets the 20% variation in flow or 10% variation in head.
  - BPA recommends IEEE 519 standard is met. (Electrical harmonic mitigation)
  - Pump manufacturer's performance curve (if new pump is installed)
  - Invoice
- Rebate:
  - $100/horsepower

Agricultural New Pump Upgrade

- Pre-Condition
  - Pre-Approval with Mission Valley Power required prior to purchase of equipment.
  - **Existing** submersible, centrifugal or turbine pump
  - Pump ranges from 20 to 500 horsepower.

- Post-Condition
  - New replacement pump. New motor not required.
  - New pump must be the same or lower horsepower as the existing horsepower unless a VFD is installed.
  - A change from a turbine pump to a centrifugal pump or centrifugal to a turbine is allowable.

  Note: Rebuilt pump or simply new impeller(s) using the existing bowls/volute does not qualify for the rebate.

- Rebate Payment
  - $70/hp

Sprinkler Hardware Conversion Rebates

- Pre-Condition
  - Pre-Approval with Mission Valley Power required prior to purchase of hardware.
  - Applies to both new and existing systems.
  - Pivot or Lateral Move with MESA (Rotators/I-Wobs/Orbitors/Sprays, etc.) or high pressure impact sprinklers.
  - Minimum pressure to critical sprinkler is at least 35 psi.

- Post-Condition
  - Pivot or Lateral Move with LESA / LEPA / MDI package
- Rebate Payment
  - $18.00/drop

- Note: Wheel Line conversions to pivot do not qualify for the rebate. This is considered a custom project.

Sprinkler Hardware Conversion Rebates

- Pre-Condition
  - Pre-Approval with Mission Valley Power required prior to purchase of hardware.
  - Wheel line or hand line with high pressure impact sprinklers.
- Post-Condition
  - Wheel line or hand line with a pressure regulator, rotating type sprinkler and new nozzle; or rotating type sprinkler with a flow control nozzle.
- Rebate Payment
  - $16.00/sprinkler head

Sprinkler Hardware Rebates

- Pre-Condition
  - Pump is served by Mission Valley Power.
  - Leaky high pressure wheel lines, hand lines, pivots or lateral moves
- Post-Condition
  - Non-leaky pivots, lateral moves, wheel lines or hand lines
- Rebate Payment
  - Replace or rebuild impact sprinklers — $1.00/sprinkler
  - Replace leaky pipe section gaskets — $4.00/gasket

Sprinkler Hardware Rebates

- Pre-Condition
  - Pump is served by Mission Valley Power.
  - Leaky wheel lines
- Post-Condition
  - Non-leaky wheel lines
- Rebate Payment
  - Replace Thunderbird wheel line hubs — $4.00/hub
  - Replace or rebuild wheel line levelers — $1.00/leveler

Green Motors

- A service offered by Green Motor Service Centers.
- When a motor **fails**, an operator has three choices:
  - Rewind to a lower efficiency (typical practice).
  - Rewind and maintain the original efficiency (Green Motor).
  - Replace with a new motor.
- Typically need to request a green rewind to get one.

Green Motors

- The preferred benefit:
  - Reliability (95 percent)—all about temperature
    - For every 10º C (50º F) rise in the windings above design temperature, not 40º C (104º F) ambient, the useful life is reduced by 50 percent.
    - Longer bearing life.
    - Longer insulation life.

    —OR—
  - Efficiency: (5 percent)
    - Anything done to a motor to reduce temperature typically increases efficiency.

Green Motors

- Local Accredited EASA (Electrical Apparatus Service Association) Service Centers:
  - **See the Green Motors website**
  - **None in Montana**
  - **Closest is the Spokane Valley**

Pumps and What Causes Them to Wear

End-Suction Centrifugal Pump

- In Agriculture, Typically Used as a Either the Primary Pump or a Booster Pump
- High Efficiency
- May Require Priming

Pumps and What Causes Them to Wear

Split-Case Centrifugal Pump

- In Agriculture, Typically Used Only as a Booster Pump
- High Efficiency
- Suction Head

Pumps and What Causes Them to Wear (Continued)

Vertical Turbine Pump

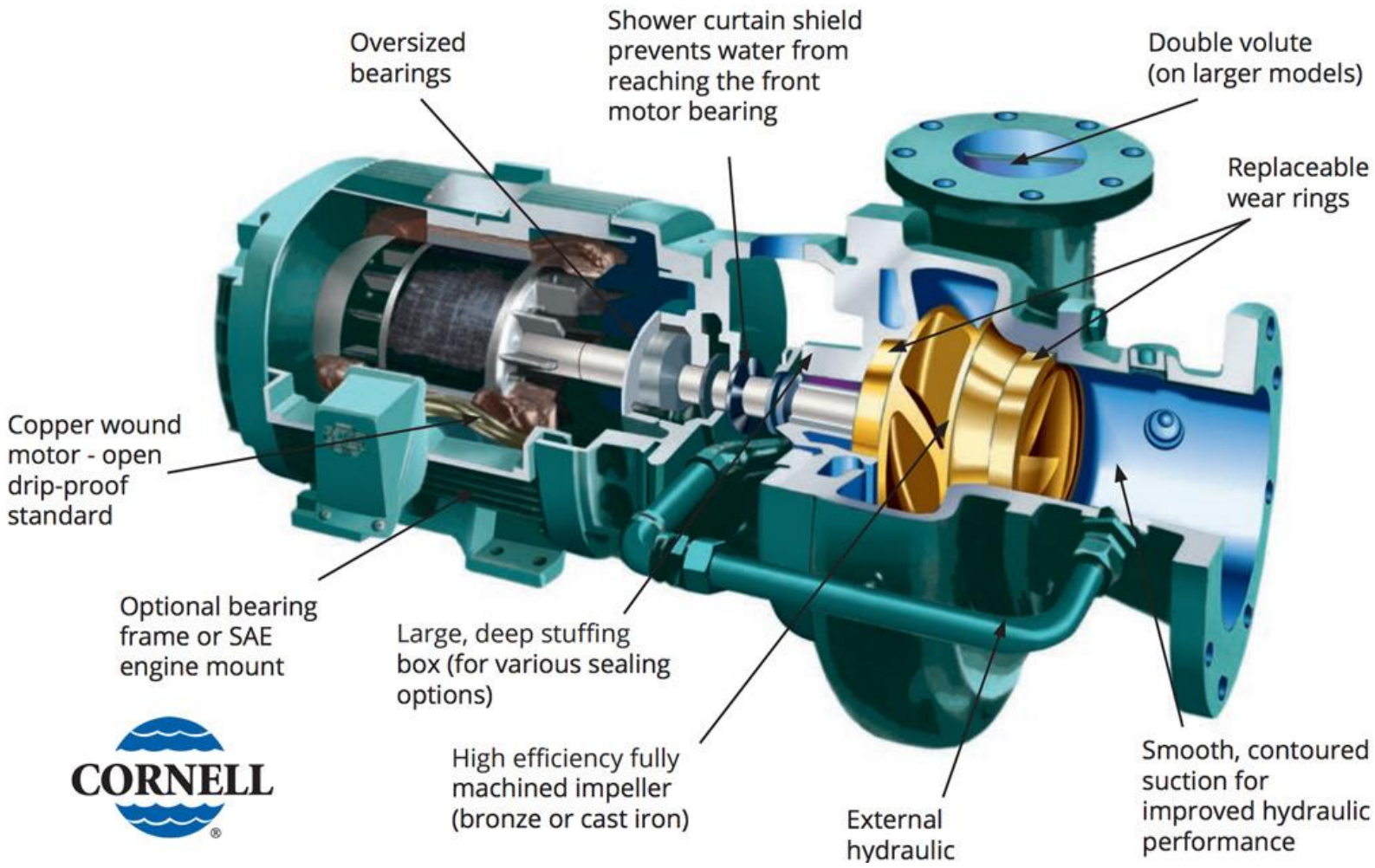
- Most Versatile Pump
- In Agriculture, Can be Used as the Primary Pump or Booster Pump
- Surface Water or Deep Well Water Pumping
- Can be High Efficiency

Pumps and What Causes Them to Wear (Continued)

Causes of Pump Wear

- Grit and Sediment entrained in the water
- Cavitation
  - High suction lift
  - Plugged intake
  - Improper intake design
  - Pumping more water than designed for the pump
  - Pumping air bubbles

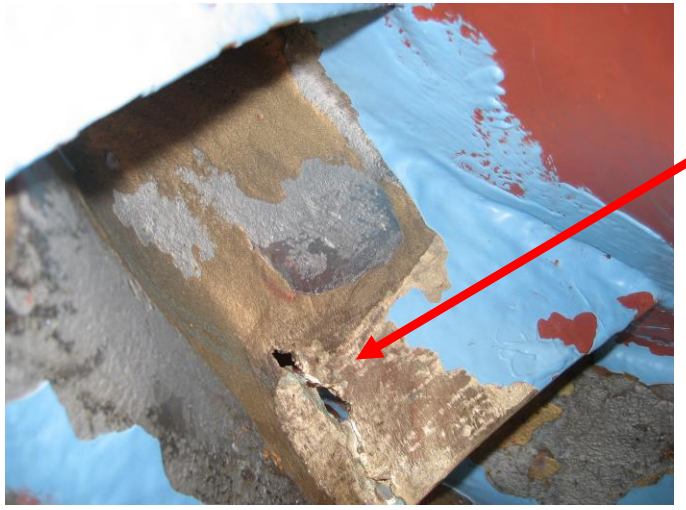
Pumps and What Causes Them to Wear



Pumps and What Causes Them to Wear (Continued)_

A Look at Cavitation Effects

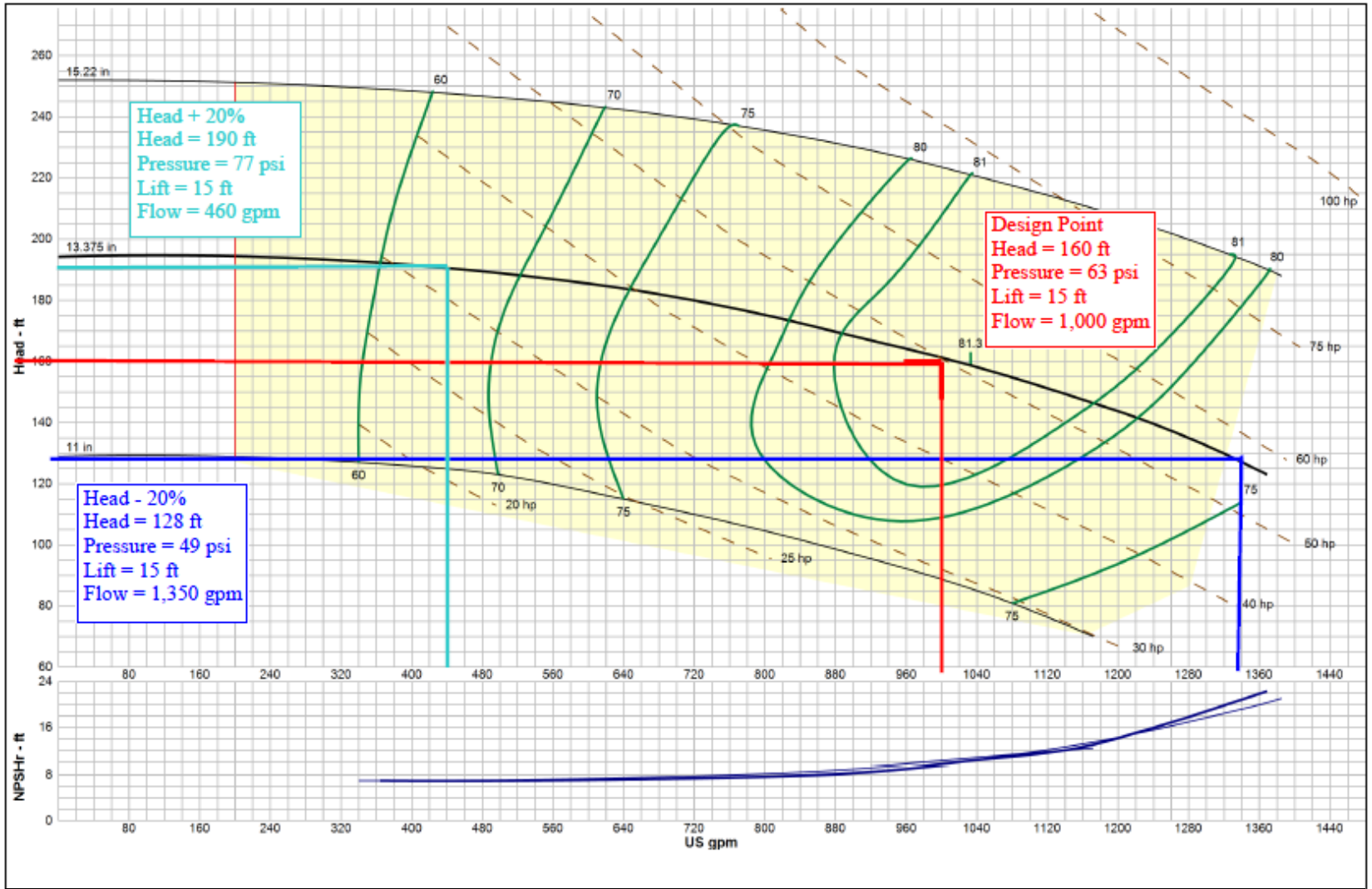
Pumps and What Causes Them to Wear



Cavitation Damage to Impeller

Pumps and What Causes Them to Wear

Cavitation Example Centrifugal Pump Curve



Pumps and What Causes Them to Wear
Cavitation Example Centrifugal Pump Curve

- **Cavitation is dependent on the Net Positive Suction Head Available as compared to the Net Positive Suction Head Required.**
- **The Net Positive Suction Head Available must be greater than the Net Positive Suction Head Required.**

NPSHA (ft) = 34.0 feet – Site Elevation (ft)/1000 – $V^2/2g$ – Suction Lift (ft) – Suction Friction Loss (ft)

where: V = Suction pipe flow velocity (ft/sec)
g = Acceleration of gravity (32.2 ft/sec^2)

Example from Pump Curve
8” Suction pipe
Operating Conditions:

Friction loss includes suction pipe and foot valve
Velocity (ft/sec) = 0.408 x GPM/Dia (in)^2

	Condition 1	**Condition 2**	**Condition 3**
Flow Rate:	440 gpm	1000 gpm	1340 gpm
Elevation:	3500 ft	3500 ft	3500 ft
Lift:	5 ft	5 ft	5 ft
NPSHR:	7 ft	10 ft	20 ft
Velocity:	2.81 ft/sec	6.38 ft/sec	8.54 ft/sec
Friction Loss:	0.78 ft	4.02 ft	7.2 ft
NPSHA:	24.60 ft	20.85 ft	17.17 ft

Indicates Cavitation Will Occur

Pumps and What Causes Them to Wear

Ways to Minimize Cavitation Damage:

- Reduce friction losses on the intake side of the pump
- Reduce the suction lift
- Reduce flow from pump

LESA/LEPA/MDI

Low Pressure Technologies for Center Pivots and Lateral Moves

- LESA – Low Elevation Spray Application
- LEPA – Low Energy Precision Application
- MDI – Mobile Drip Irrigation

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LESA

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Dragon Line
A Form of MDI

LESA/LEPA/MDI

LEPA

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Truss Bar Clip

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Ram's Head T

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Angled Hoses Dropping 12” to 18” from Ground

LESA/LEPA/MDI

Demonstration Pivot

LESA/LEPA/MDI

Installation of Soil Moisture Sensors

LESA/LEPA/MDI Demonstration Program

Installation of Soil Moisture Sensors

LESA/LEPA/MDI Demonstration Program

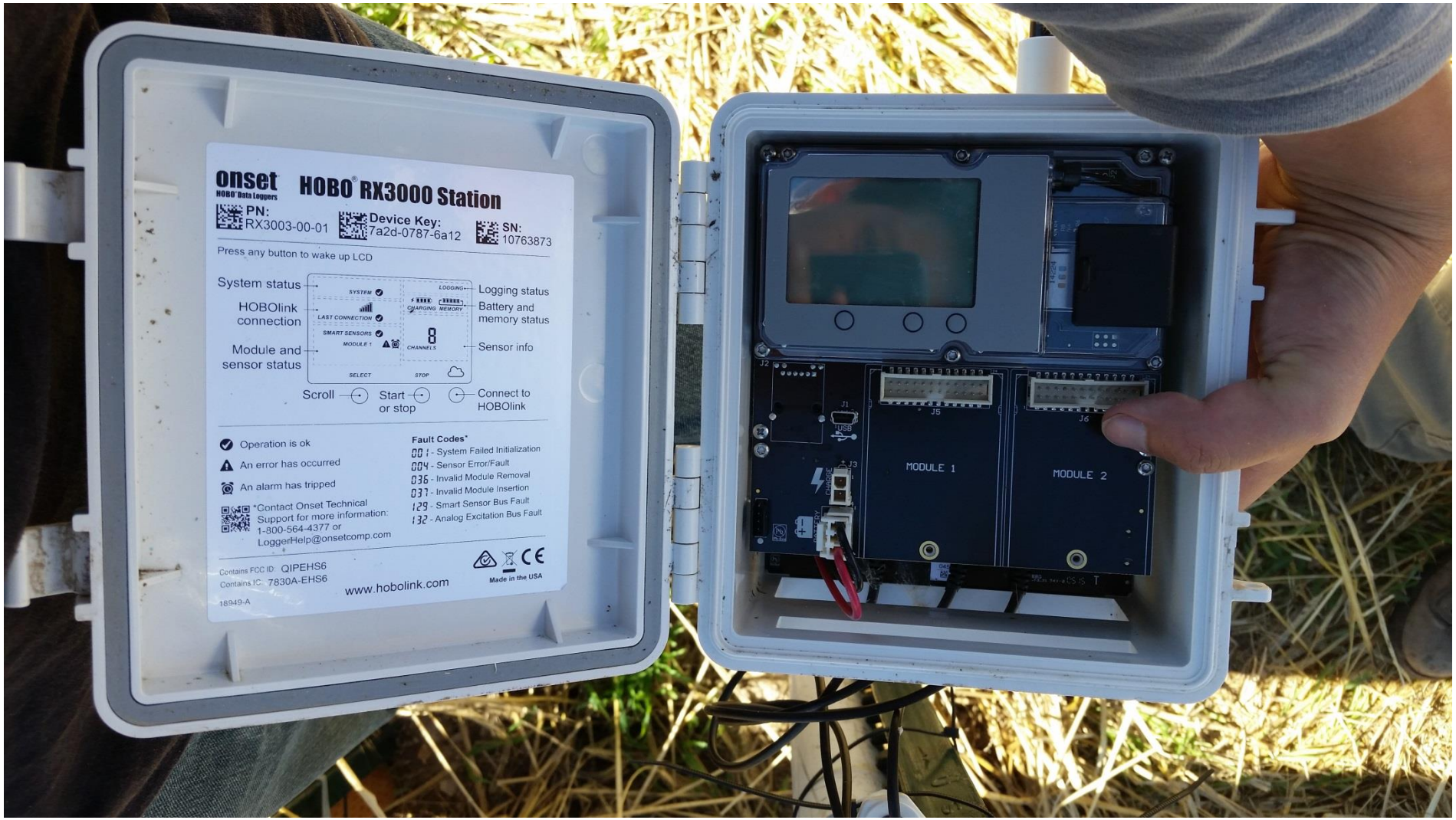
Installation of Soil Moisture Sensors

LESA/LEPA/MDI Demonstration Program

Setting up the Soil Moisture Loggers

LESA/LEPA/MDI

Data Logger

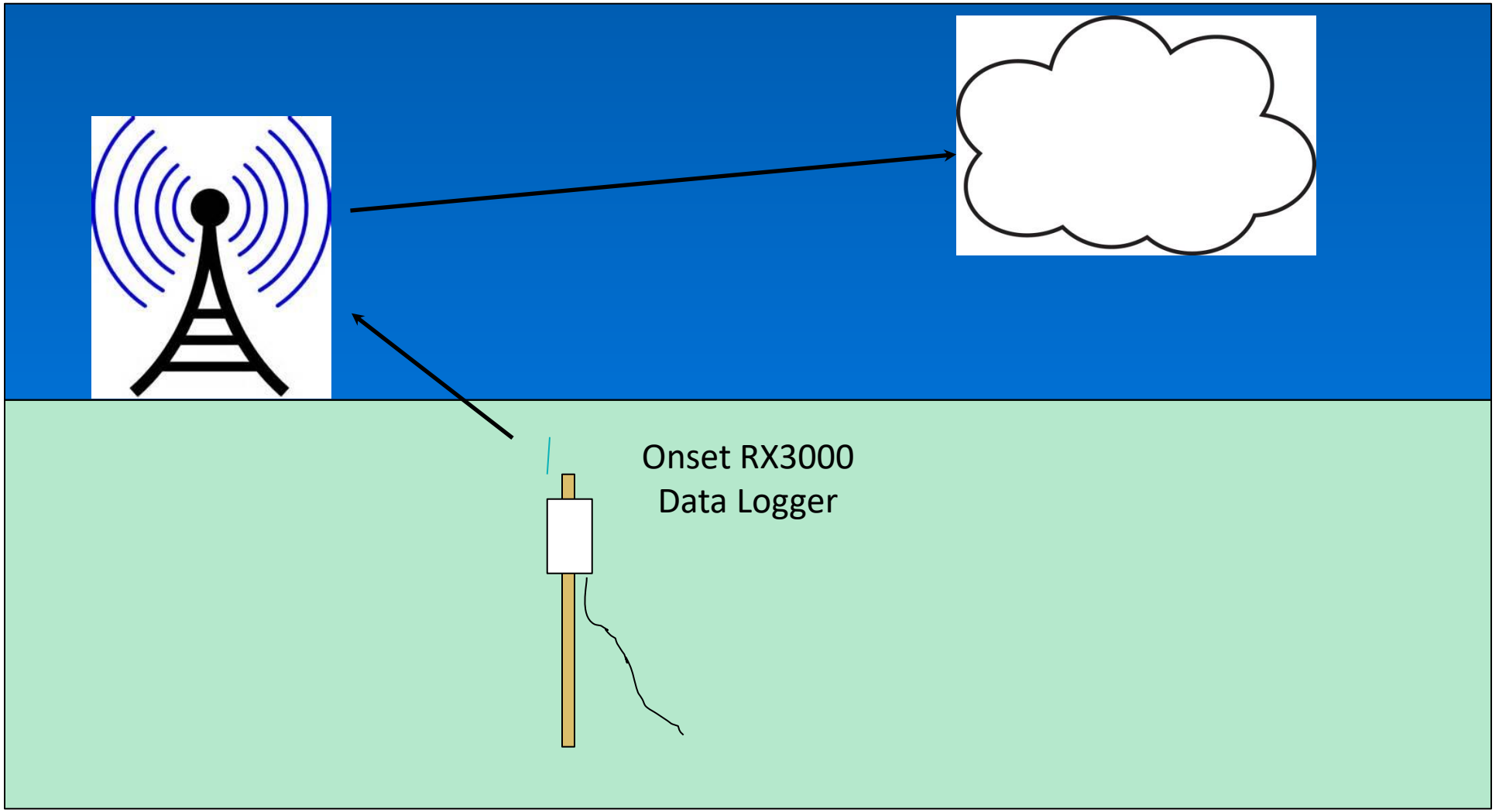


LESA/LEPA/MDI Demonstration Program

Logger Connected to Installed Soil Moisture Sensors.

LESA/LEPA/MDI

Cell Phone Transmission of Data



LESA/LEPA/MDI

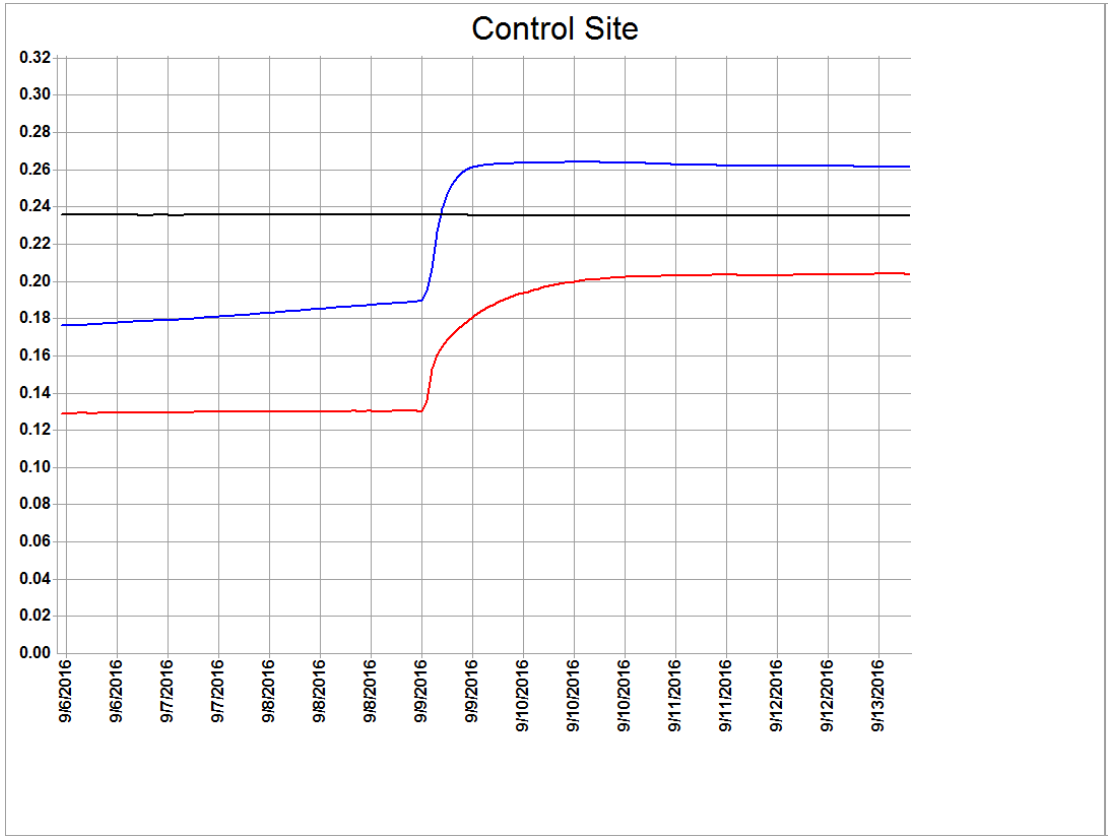
Recording Crop Progress

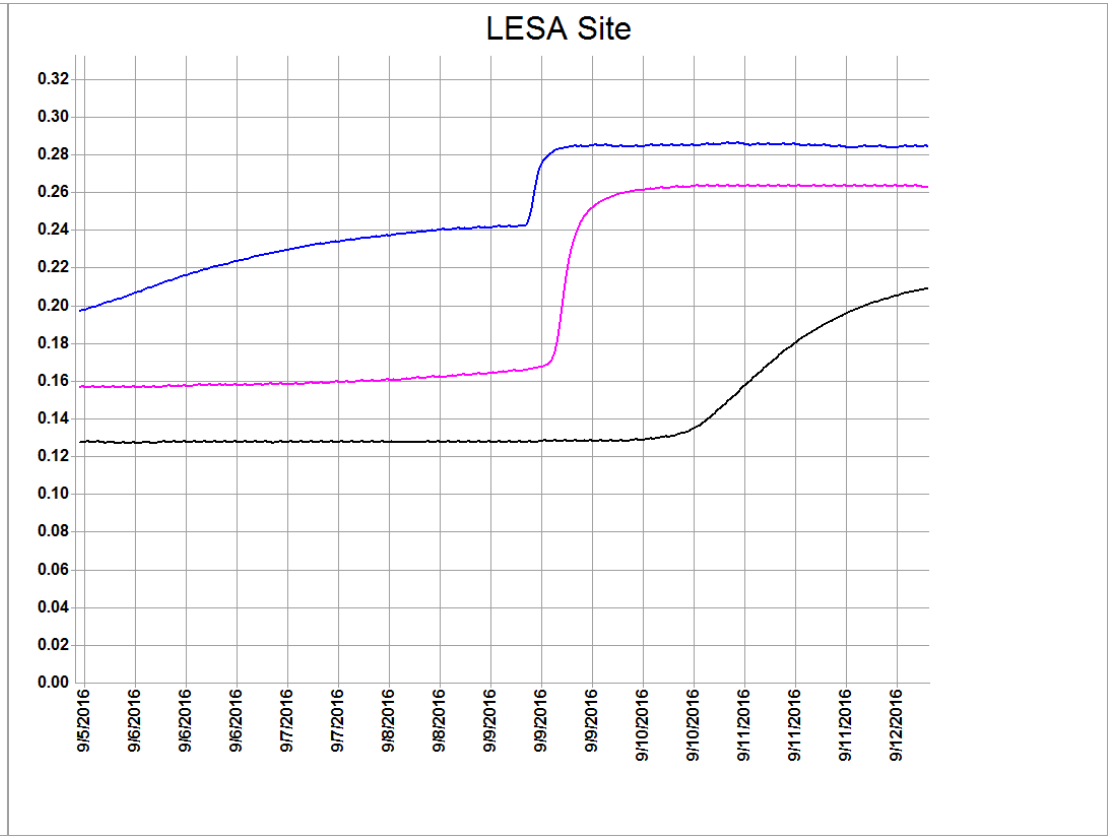
LESA 8/3/2016

Control 8/3/2016

LESA/LEPA/MDI

Data





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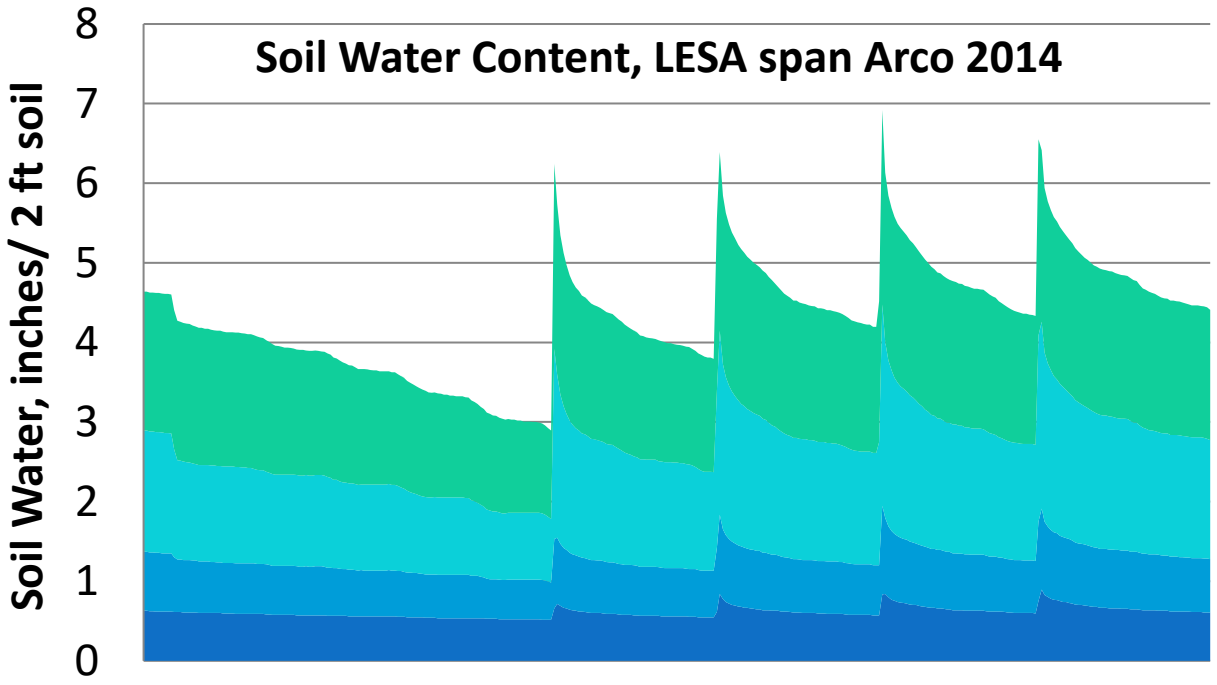
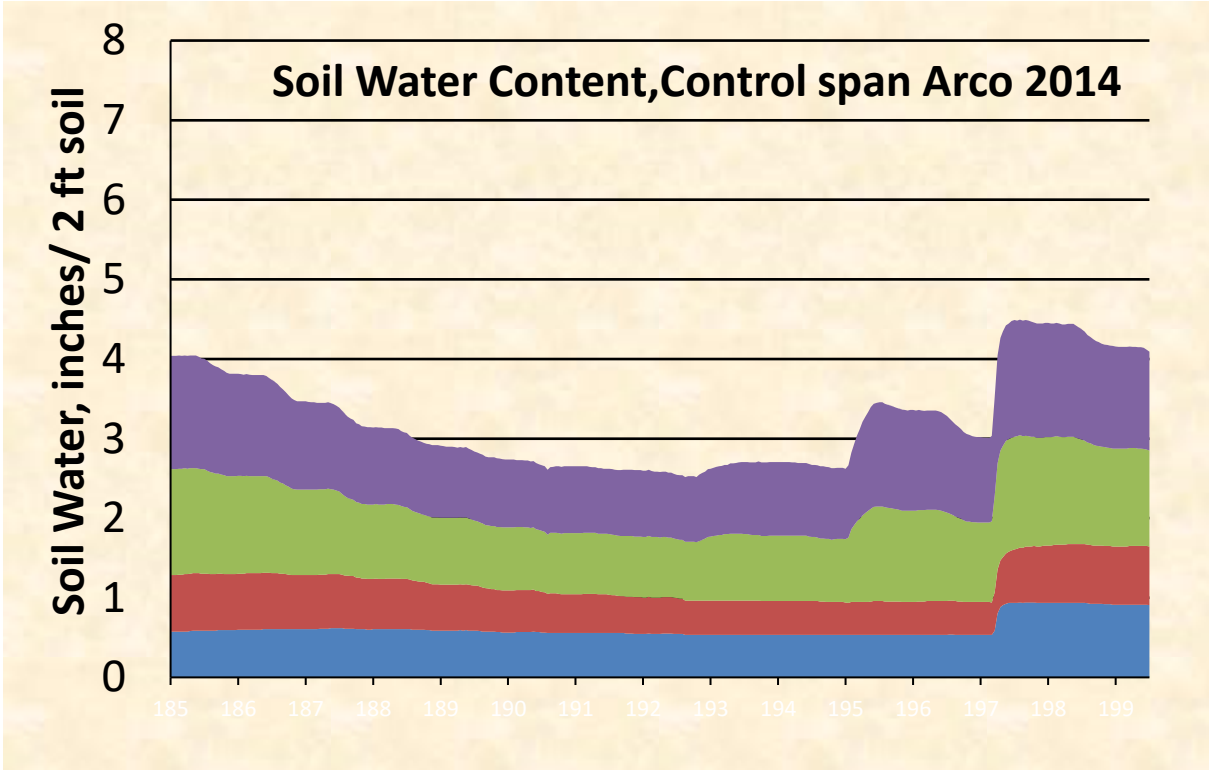




University of Idaho Extension

LESA/LEPA/MDI

Installation of Netafim PMDI

LESA/LEPA/MDI

Netafim PMDI

LESA/LEPA/MDI

LESA/LEPA/MDI

LEPA Sprinkler

LESA/LEPA/MDI Demonstration Conclusions

Benefits

- Water savings using LESA is about 10% while water Savings for MDI can be as high as 20%
- LESA may operate effectively using 6 psi pressure regulators.
- Reduced disease pressure in small grains.
- Higher application uniformity.
- Higher yields and crop quality*.
- Significant energy savings*.

* Several factors can affect this.

LESA/LEPA/MDI

LESA/MDI Drawbacks:

- Livestock and wildlife may damage drops – recommend securing hoses high up on the pivot during the winter.
- High winds can tangle MDI hoses.
- LESA works best on flat terrain.
- LESA requires double to triple the number of drops compared to MESA.
- MID requires spacing between 2 and 3 feet
- Cost for a LESA package may cost between $10,000 and $15,000.
- Cost for a MDI package may cost between $20,000 and $30,000.
- Having clean water is critical.
- Runoff

VFDs and When to Use Them

Facts about Electric Induction Motors

- **Unlike gasoline/diesel/propane/NG engines, induction motors are essentially constant speed.**
- **The shaft rotational speed (RPM) of an electric motor = 120 x Frequency (Hertz)/# Poles**
- **The most common induction motors used for irrigation pumps have either 2 pole or 4 pole motors – This equates to 3600 RPM or 1800 RPM.**
- **A variable frequency drive varies the input frequency to the motor, thus changing the speed.**

VFDs and When to Use Them

New 500 hp well pump and VFD

VFDs and When to Use Them

Inside a VFD panel

VFDs and When to Use Them

Advantages of VFDs

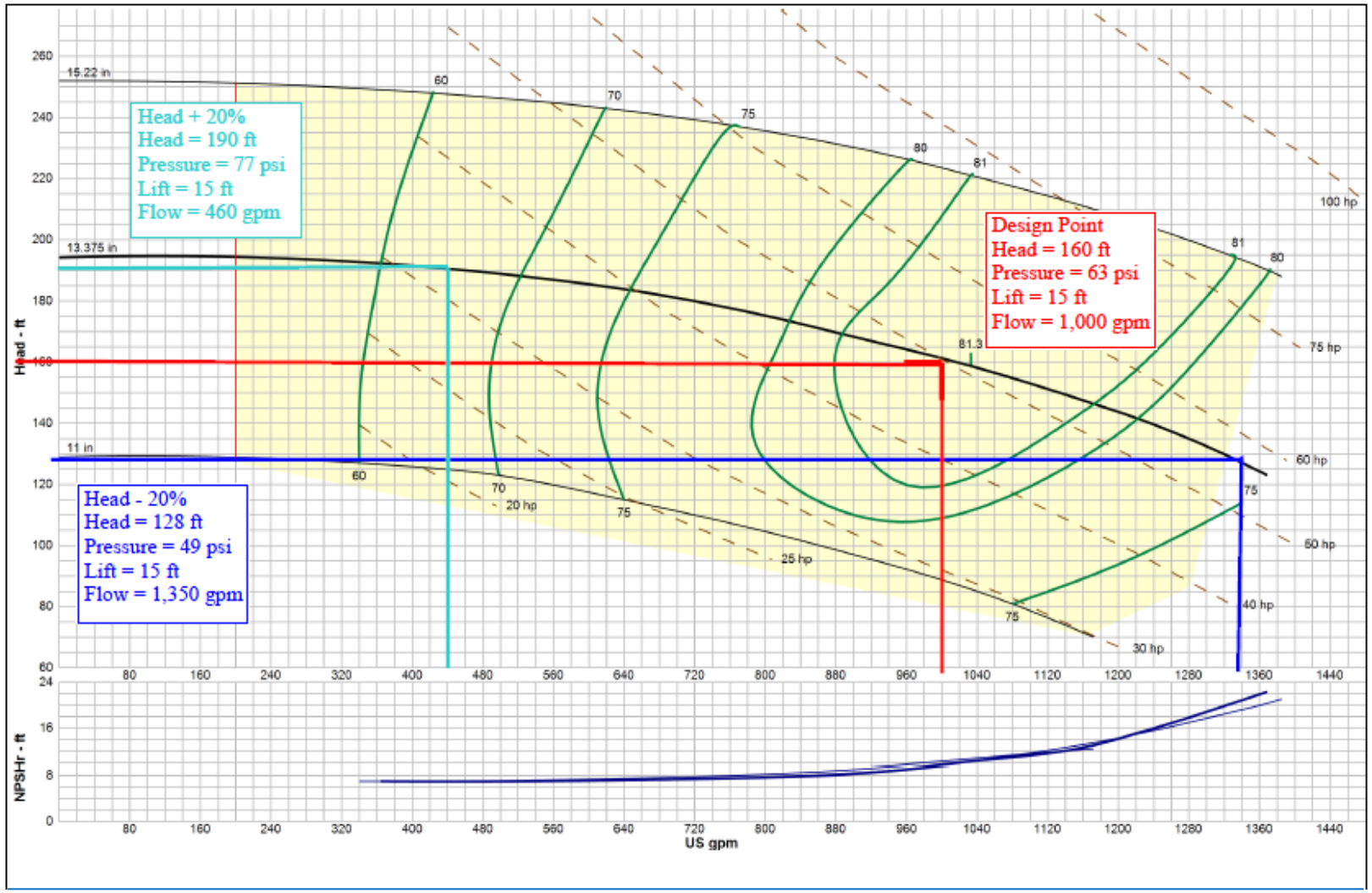
- Can maintain the same pressure to the irrigation system regardless of flow.
- Can result in energy savings by not over-pressurizing system.
- Inherently provides soft start capabilities.

VFDs and When to Use Them

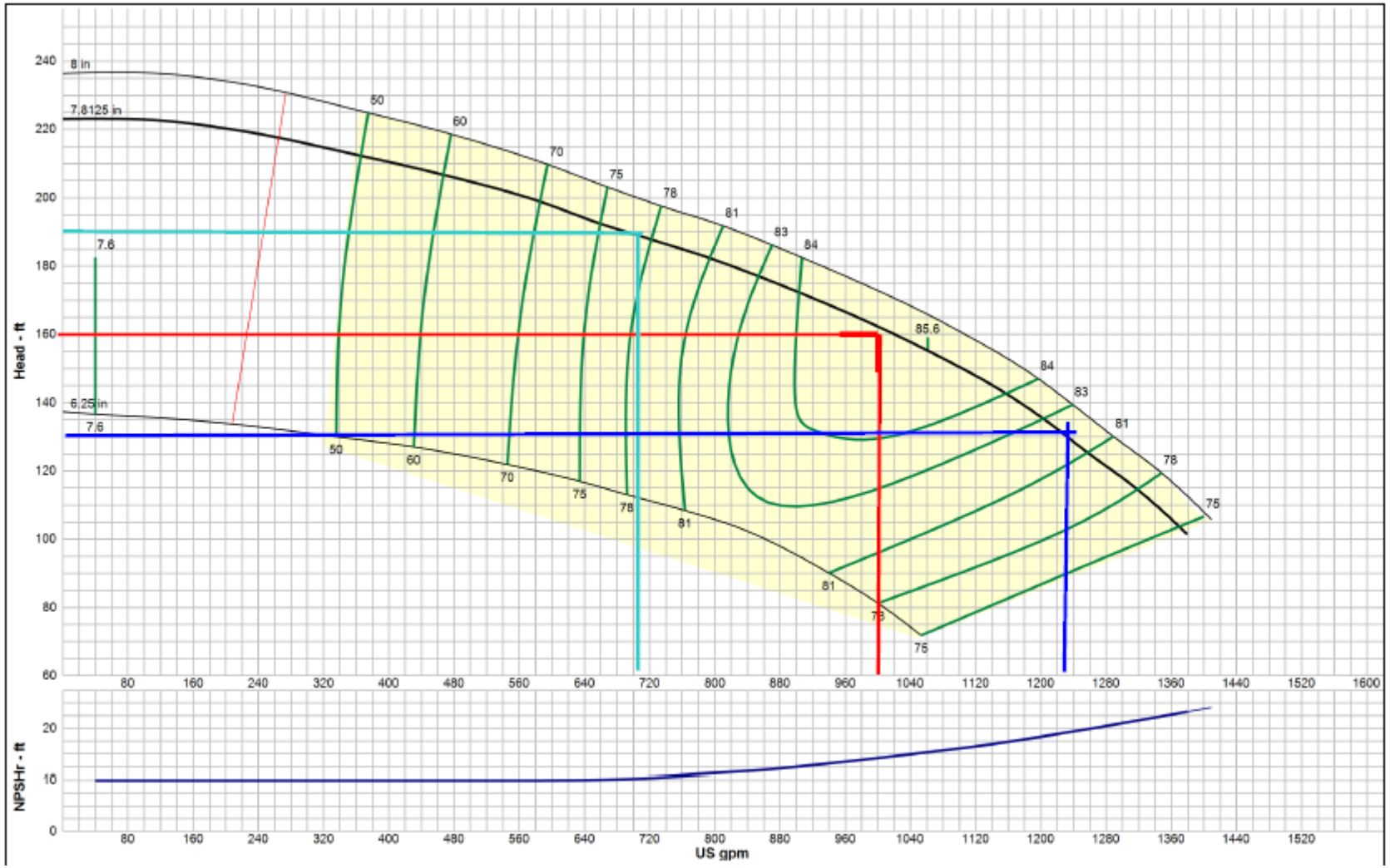
Disadvantages of VFDs

- Certain VFDs can generate harmonics on the power grid potentially causing electrical disturbances and interference.
- May require external cooling.
- Must be protected from dust and vermin.
- Electrical losses through the drive and possible filter. (Approximately 3% loss for each apparatus)

VFDs and When to Use Them
Example Centrifugal Pump Curve

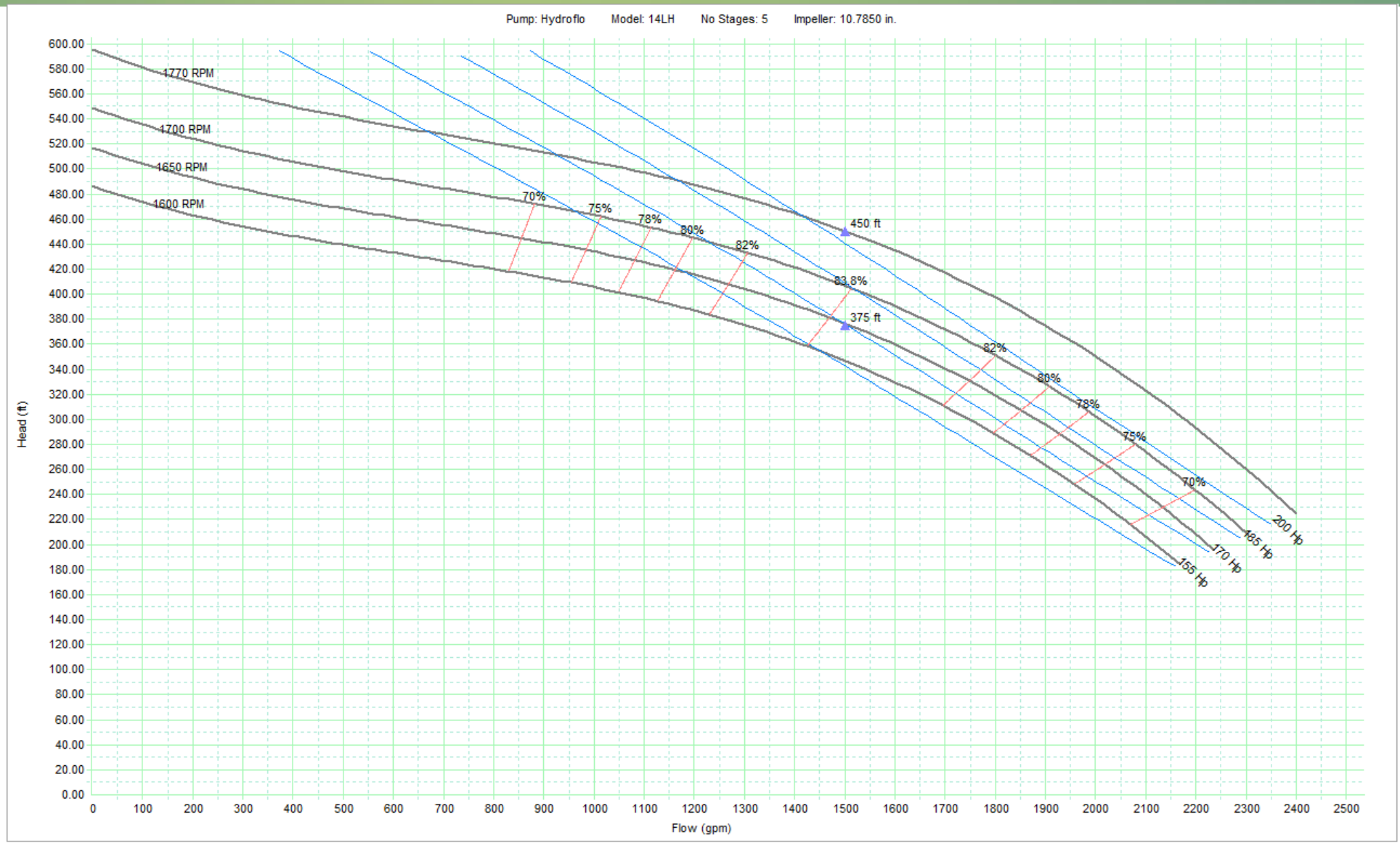


VFDs and When to Use Them
Example Turbine Pump Curve



VFDs and When to Use Them

Example VFD Analysis



VFDs and When to Use Them

Example VFD Analysis (Continued)

Variable Speed Analysis

Project No.: RRE-01-25

Pump Station No.: P1 **Pump No.:** 1 **Condition:** Existing

Pump Information

		Primary Model	
Pump Make:	Hydroflo	**Pump Model:**	14LH
Pump Type:	Vertical Turbine	**Impeller No:**	
Rated RPM:	1770	**Impeller Size:**	10.7850
Drive Eff.:	93.6%	**No. of Stages:**	5
Control:	Valve Control		

System Curve Data Points

Condition No.	Condition Description	Pump Operating Conditions Flow (gpm)	Head (ft)	Annual Hours Operation
1	Minimum Head	1,500	375.0	600
2	Maximum Head	1,500	450.0	600
		Totals:		1,200

System Curve Data Points

Condition No.	Pump Conditions w/Valve Control TDH (ft)	Brake Hp	Pump Eff. (%)	Plant Eff. (%)	kW Demand	kWh Usage	Pump Conditions w/VSD Control RPM	Brake Hp	Pump Eff. (%)	Plant Eff. (%)	kW Demand	kWh Usage
1	450.5	204.6	83.4	64.7	196.7	98,255	1,647	169.5	83.8	72.9	145.4	87,218
2	450.6	204.6	83.4	77.6	163.9	98,222	1,768	204.3	83.4	72.0	176.6	105,972

1.67% Savings

VFDs and When to Use Them

Example VFD Analysis (Continued)

Variable Speed Analysis

Page 5. 2

Project No.: LRE0123

Pump Station No.: P1 **Pump No.:** 1 **Condition:** Proposed

Pump Information

		Primary Model	
Pump Make:	Goulds	**Pump Model:**	12RJLO
Pump Type:	Vertical Turbine	**Impeller No:**	
Rated RPM:	1770	**Impeller Size:**	7.6250
Drive Eff.:	91.7%	**No. of Stages:**	4
Control:	Valve Control		

System Curve Data Points

Condition No.	Condition Description	Pump Operating Conditions Flow (gpm)	Head (ft)	Annual Hours Operation
1	All Sprinklers Operating	830	200.0	200
2	75% of Sprinklers Operating	623	200.0	200
3	50% of Sprinklers Operating	415	200.0	200
4	All Sprinklers Operating	830	150.0	200
5	75% of Sprinklers Operating	623	150.0	200
6	50% of Sprinklers Operating	415	150.0	200
		Totals:		1,200

Variable Speed Analysis

Page 5. 3

Project No.: LRE0123

Pump Station No.: P1 **Pump No.:** 1 **Condition:** Proposed

Pump Information

		Primary Model	
Pump Make:	Goulds	**Pump Model:**	12RJLO
Pump Type:	Vertical Turbine	**Impeller No:**	
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Condition No.	Pump Conditions w/Valve Control TDH (ft)	Brake Hp	Pump Eff. (%)	Plant Eff. (%)	kW Demand	kWh Usage	Pump Conditions w/VSD Control RPM	Brake Hp	Pump Eff. (%)	Plant Eff. (%)	kW Demand	kWh Usage
1	200.3	49.5	84.8	76.2	41.1	8,205	1,768	49.4	84.8	70.3	44.4	8,888
2	231.7	46.2	78.8	60.9	44.6	7,707	1,663	39.0	80.7	65.9	35.6	7,120
3	256.5	42.6	62.9	43.8	45.7	7,132	1,580	30.9	67.8	55.5	28.1	5,626
4	200.2	49.5	84.8	57.2	54.8	8,207	1,602	37.1	84.8	69.3	33.9	6,773
5	231.8	46.2	78.8	45.6	59.5	7,705	1,480	28.3	83.4	68.0	25.9	5,173
6	256.5	42.6	63.0	32.9	61.0	7,134	1,389	21.5	73.0	57.4	20.4	4,086
					Totals:	46,090						37,666

Total Energy Savings (kWh): 8,424

18% Savings

Contacts

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