

Use Your Records to Locate Inefficient Pumping Plants

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The average pumping plant in Nebraska is using between 25% and 30% more energy than necessary for the useful work it is performing. Some pumping plants, however, are very efficient and others are quite bad.

The reason so many inefficient pumping plants are allowed to operate is because the operator doesn't realize how poorly the pumping plant is performing. When comparing one pumping plant to another, there are almost always differences in the amount of water pumped over time and/or differences in the height the pump must lift water to reach the soil surface and/or differences in the system pressure the pump must build.

A tool developed by the University of Nebraska, known as the Nebraska Pumping Plant Performance Criteria (NPC)



(Table 1), makes it possible to determine the performance of any pumping plant regardless of the pumping situation so long as the operator has been keeping a record of water pumped and energy consumed over time and they have an estimate of the average pumping water level and system pressure during the same period of time.

The five-step procedure at right not only results in a relative performance rating, it provides the potential estimated energy savings possible if an inefficient pumping plant were repaired or replaced.

Table 1. The Nebraska Pumping Plant Performance Criteria (NPC)

ENERGY SOURCE	HP-H / ENERGY UNIT	WHP-H/ ENERGY UNIT	ENERGY UNITS
Diesel	16.66	12.5	Gallons
Gasoline	11.50	8.66	Gallons
Propane	9.20	6.89	Gallons
Natural Gas(mcf)	82.2	61.7	MCF
Natural Gas (Therm)	8.9	6.67	Therm
Electricity	Electricity	1.18	0.885

Online Workbook

UNL Extension Educator Tom Dorn has created an Excel workbook to simplify the calculations. The workbook can be run online in most Internet browsers or downloaded to a user's computer and opened in Excel. Go to <http://lanaster.unl.edu/ag/crops/irrigate.shtml> – scroll down, then click on Long Term Pump.xls

Step 1. Calculate the water horsepower output of the pumping plant.
whp-h = acre-inches^f pumped x total head (feet) / 8.75 whp-h / ac-in x ft

Where:

- whp-h = water horsepower hours
- acre-inches = volume of water necessary to cover an acre one inch deep = 27,154 gallons.
- total head (feet) = lift (feet) + system pressure (feet)
- lift = distance (feet) from the water level inside the well casing to the discharge head while pumping.
- system pressure (feet) = psi x 2.31 ft/psi

Step 2. Performance = whp-h / fuel used for the test period

Step 3. Performance rating = (performance / NPC for the energy source) x 100%

Step 4. Potential fuel savings = ((100% - % NPC) / 100) x fuel used for the test period

Step 5. Potential dollar savings = fuel savings x fuel price

^f Conversion to acre-inches

- If the water meter totalizer registers in gallons, divide gallons by 27,154.
- If the water meter totalizer registers in acre-feet, multiply acre-feet by 12.
- If the water meter totalizer registers in cubic feet, divide cubic feet by 3,630.

- Example:**
- Test period: entire irrigation season
 - System: center pivot sprinkler system with a diesel engine.
 - Pumping water level: 140 feet
 - Pressure at the discharge head: 40 psi
 - Acre-inches of water pumped (from water meter): 1,415
 - Total fuel used for test period = 3,571 gallons of diesel
 - Diesel fuel price: \$2.20/gallon

Step 1. whp-h = acre-inches^f pumped x total head (ft) / 8.75
= 1,415 x (140 + [40 x 2.31]) / 8.75
= 1,415 x (140 + 92.4) / 8.75
= 1,415 x (232.4) / 8.75
= 37,518 whp-h

Step 2. Performance = whp-h for the test period / fuel used for the test period
= 37,518 whp-h / 3,571 gallons
= 10.5 whp-h / gallon

Step 3. Performance rating = (performance/ NPC for the energy source) x 100%
= (10.5 whp-h / gallon / 12.5 whp-h / gallon of diesel) x 100%
= 84%

Step 4. Potential fuel savings = ((100% - %NPC) / 100) x fuel used for the test period
= ((100% - 84%) / 100) x 3,571 gallons of diesel
= 0.16 x 3,571 gallons
= 571 gallons

Step 5. Potential Dollar Savings = Fuel savings x Fuel price
= 571 gallons x \$2.20 per gallon
= \$1,256.20

May is Time to Control Leafy Spurge

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In my travels around the county, I have seen many patches of Leafy spurge. Leafy spurge is a noxious weed according to the Nebraska Seed Law and the Nebraska Noxious Weed Law. Leafy spurge is found primarily on untilled land such as pastures, range, roadsides, woodlands and farmsteads. It is mildly poisonous to cattle and can effectively ruin the carrying capacity of patches where it is growing because cattle soon learn to avoid grazing near it.

Identification

Leafy spurge is a persistent, deep-rooted perennial which reproduces by seeds and roots. Leafy spurge has a somewhat woody crown below the soil



Figure 1 — lateral, secondary roots



Figure 2 — yellow bract appearance

surface. Each crown area produces several upright stems giving the plant a clump-like appearance. In addition, new stems arise from buds on lateral, secondary roots. See Figure 1. Stem growth starts in April, making leafy spurge an early, vigorous competitor with forage and pasture plants. The plant bears numerous linear-shaped leaves with smooth margins. Leaves have a bluish-green color but turn yellowish or

reddish-orange in late summer. Leafy spurge produces a flat-topped cluster of yellowish-green, petal-like structures called bracts, which bear the true spurge flowers. The showy, yellow bracts appear in May and give the plant a "blooming" appearance. See Figure 2. The true spurge flowers, however, develop about 10 days later and have small, green bracts. See Figure 3. The distinction between yellow bract appearance and true flowering is important for timing herbicide applications. Spring-applied herbicides are more effective when applied on plants with developing true flowers.



Montana State University Archives, Montana State University, www.ipmimages.org



Figure 3 — true flowering

Seeds are borne in pods which contain three gray-brown, sometimes speckled, oblong, smooth seeds. At maturity, pods pop open, throwing seeds up to 15 feet from the parent plant. About 140 seeds are produced per stem and seeds may remain viable in the soil for up to eight years. Leafy spurge peak germination time is late April to early May. New seedlings develop throughout the summer but usually do not flower during the first year. Leafy spurge seedlings can vegetatively reproduce from root buds within 7–10 weeks after germination.

Control

Chemical control recommendations listed in UNL

Extension publication 2007 *Guide for Weed Management* (EC 07-130) include:

- 2,4-D (4L) at 2 quart per acre at flower bud stage (for suppression of seed production - annual treatments necessary).
- Grazon P+D at 2 quart per acre at flower bud stage (for suppression of seed production and gradual stand reduction over several years).
- Tordon 22K at 1- 2 quart per acre (retreatment necessary for several years).
- Overdrive + Tordon at 4 ounces + 16 ounces per acre. Spot treatment of seedlings and shoots emerging from deep root buds will be necessary for many years after a stand appears to be controlled. Always follow label directions.