Virtual workshop series: Water quality impacts of livestock operations and grazing management

Natural Resources PFT

Kansas Center for Agricultural Resources and the Environment (KCARE)

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Water quality impacts of livestock operations and grazing management

- Offered as a Professional Development Event in PEARS for county extension agents
- Date/Time: May 5 to May 13, 8:30 am to 9:30 am
- **Zoom Meeting ID: 952 6066 1935**

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Schedule

- Day 4: Livestock watering systems
  - Tuesday, 5/12, 8:30-9:30 a.m.
  - Presenters: KCARE watershed specialists Herschel George and Will Boyer
- Day 5: Electric fence systems
  - Wednesday, 5/13, 8:30-9:30 a.m.
  - Presenter: Rod Schaub, Frontier Extension District Agent

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Today's format

- If you haven't already, **please mute** your microphones.
- Speakers will present for 30-40 minutes
- Panelists will join the discussion at the end
- Please ask questions through the **chat** function (located at the lower part of your screen).
- Although our "end time" is posted for 9:30 a.m., participants are welcome to remain longer if they want to discuss the topic further.

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Water quality impacts of livestock operations and grazing management

Livestock Watering Systems

Tuesday, May 12

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Speakers

Will Boyer

KCARE Watershed Specialist, NE Kansas

Herschel George

KCARE Watershed Specialist, retired

Panelists

Brian Rees, Lyon County Extension Agent; **Carl Garten**, retired Central Kansas Extension District Agent

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Livestock Watering Systems

Herschel George and Will Boyer, Extension Watershed Specialists

May 12, 2020

Items we plan to discuss

- Installing a line through a pond (that is full of water)
- Tire tanks
- Solar water pumps
  - Surface water pumps
    - Positive displacement pumps
    - Submersible centrifugal pumps
- Winterizing watering systems
  - Releasing water on the surface
  - Air Bubblers
  - Heat tape

Line Through the pond dam

Installing a Pipeline through a pond dam

(that is full of water, without losing more than 100 gal. of water)

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Southeast Kansas Watershed Specialist
674 Musket Rd.
Uniontown, KS 66779
cell: 913-294-6021
Hgeorge@ksu.edu

I have helped a number of producers install lines through their ponds. The process is normally in preparation to install livestock watering tanks and exclusion fences.

The first step is to **test the depth** of the pond itself to see if it justifies the time and cost to develop the pond.

Second, is to **measure the elevations** of the water surface, primary spillway and emergency spillways. Compare those elevations with the possible site for a waterer below the pond. (I use a 6 ft.differential as a standard, but have put lines through ponds with as little as 4 ft. difference)

Find a contractor with **equipment that is large** enough to do the job. The mini-excavators are most often not large enough because the slope of the bottom of the pond is too flat. Large track-hoes are most frequently what we use. However Back-hoe tractors were what we used when we started.

If the decision is to develop the pond, first **prepare a riser** (with holes) to be slid into the deepest part of the pond (leaving room for sediment accumulation below the lowest holes in the riser). Typically, the riser is made of the same PVC pipeline as the remainder of the pipe (1 ½ or 2 Inch). Often I make the riser 6 ft. long, placing 3/8 inch holes every 2 inches through both sides of the pipe from the top to about 2 ft. from the bottom. Then the pipe can be rotated 90 degrees and another set of holes are put into the pipeline between the other set of holes. The 2 ft. length "feet" are glued into the opposite ends on one of the PVC tees. A short piece of PVC pipe (3 inch) is glued into the third leg of the tee. The bottom end of the riser pipe can be glued into the third leg of the other PVC tee. The riser tee and the foot tee can be glued together so the riser will set vertical, check it for close to plumb.

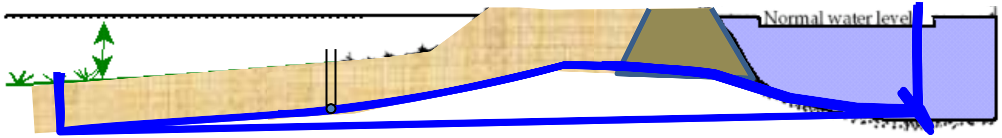
(NOTE: drill a 3/8 hole in the top of each foot to allow water to enter the riser system, without it the pipe is difficult to sink into the water.)

Slide the riser into position with a line coming to shore where the line is to go through the pond dam. Typically, I use a 2-inch "bell end" PVC pipe for this portion of the pipeline system. The final joint of pipe is ideally "gasket fit" pipe with the bell end toward the shore. These pipelines can be 40, 60 or 80 ft. long in order to get the riser into the deepest portion of the pond. The pipeline can be caused to float so it can be floated over the trench by pulling the pipeline onto the shore about ½ length of the pipeline and inserting the plug (tapered end of gasketed pipe with cap) and then pushing the riser back into place.

The **freeboard of the pond is removed** down to about 2 inches above the pond water level. The slot through the freeboard of the pond dam needs to be wide enough that the excavator can rotate without hitting on any soil.

A trench is created from 'as far out into the pond water' the contractor can reach, to the shore, plus a few feet into the dam itself. It is ideal if the trench can be 3 to 4 ft. deep as it reaches the shoreline and the trench segment into the dam. The end of the trench in the dam should be as vertical as possible.
When the trench is clean of clods and mud **Align the pipeline and riser over the trench**. A rope or strap is placed around the pipe to insure that we can find the pipe in the trench later.
When the pipeline aligns with the underwater trench, remove the plug from the end of the pipeline, the pipeline will slowly fill with water, replace the plug in the end of the pipeline one last time, (it will be difficult to drive in as it the pipeline is now full of water) and sink it into place at the bottom of the trench. A 2x4 with two 16d nails placed in one end spaced to straddle the pipeline is a good tool to guide the pipeline to the bottom and hold it in place while the contractor begins to build the seal and coffer dam.

Installing a line through a pond dam



Line Through the Pond Dam

- Most often takes 4 hour of excavator time
- Normally the line into pond is 30 to 50 ft. from shore
- 2 inch PVC
  - Glued joint in water
  - Gasketed pipe through the dam
    - At least at the major connection.

Tire Tanks

Tire Tank Installation Guidelines:

(Prepared by Herschel George - K-State watershed specialist)

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1. **Choose size of tire and type of opening.**
   - Small circles for drinking
   - Whole tire (I really like 30.5x32 (combine tires) and 48x31x20 (front tire on fertilizer trucks.) or heavy equipment tires that have height available for at least 18 of water above the lower tire bead.
   - Half tire (the large mining tires that are cut like a bagel, up to 13 ft. diameter)

2. **Cut tire opening.**
   - Tools
     - Tire chalk
     - Reciprocating saw with metal cutting blade with 5 to 6 tpi (teeth per inch).
     - Special cleaning and lubricating fluid (I use a mixture of Dawn dishwater soap and water)
   - Mark the desired cut line with tire chalk
   - Cut tire and remove the center

3. **Select site for tank.**
   - When placing the tank below a pond, it is ideal the site will have at least 6 ft. difference between water level in pond (bottom of the primary spillway pipe) and soil line where the bottom of the tank will set. About 4 ft. is the minimum.
   - Ideal to have overflow line that drains to daylight

4. **Plumb water lines to and from proposed site**
   - Ideal to have 1 ½ or 2 inch waterline to and from the waterer.
   - Ideal to have flexible connector or a "swing joint" on the incoming lines below the tank.
   - Ideal to have Brass (or Galvanized) nipple coming into tank to connect to float valve
   - Plumb intake line so bottom of threads on the metal pipe is even with top of concrete line (top of bead inside the tank).
     - Lightly thread a PVC female adapter onto the top of the pipe nipple with about 1 ft. of pipe in it to prevent concrete from getting into the nipple or threads and to allow you to maintain as perfectly vertical as possible pipe placement. Do not glue these pieces; they will be removed when concrete is cured.
   - Plumb the drain and overflow so the top of the PVC collar connector is installed to be just flush with the top of the concrete (even with the top of bead inside of the tank).
     - Lightly place a 1 ft or longer piece of spare pipe into connector, but do not glue it! This is to protect the pipe from being filled with concrete and to allow you to maintain the pipe as vertical as possible. This will be removed after the concrete in cured.
5. **Firm, tamp and fill center of tank** so there are 4 to 6 inches of space left for the concrete. There can be greater space, but it requires more concrete.

6. **Level and set tire into site.**
   - The tank should set on a slightly elevated area.
   - Ideal to have geotextile under the tank and gravel to extend the life of the gravel from sinking into mud
   - Firm and tamp any gravel base under tank.
   - Level tank site !!!!. 1 inch out of level is noticeable when tank is full.

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Tire waterers

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Tire waterers

Tire waterers

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Gravity Flow systems
Stock Water Control valve

Pressure water systems
Jobe valve

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Solar Water Pump

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Solar Water Pumping

Solar water pumping is the process of pumping water with the use of power generated by sunlight. Solar pumping systems are reliable stand-alone systems that require no fuel and very little attention. Solar panels generate maximum power in full sun conditions when larger quantities of water are typically needed.

Panels-

This demonstration unit has two 85 Watt panels convert the solar energy into electrical energy. In this system it is the only energy. No batteries are attached. They normally carry a 25 year warranty.

Sun Tracker-

Some system uses a tracker to follow the sun to increase the solar panel efficiency. The system I have used have passive tracking, meaning they take no power from the system, it operate from the heat of the sun striking the frame members. The frame member is warmed causing the Freon inside to move from one cylinder to the other as it follows the suns heat. The tracker allows the system to pump an estimated 30-40% more water during the summer. Most likely it increases the pumping in the early parts of the morning and the late afternoon. Currently we are not using a tracker. They cost about $500-600.
The trackers come with a 10 year warranty.
This system we demonstrate here uses panels with more wattage and does not use the tracker.

Controller -

This electronic "magic" box converts the variable energy from the solar panel to the constant voltage for the pump. The controller include a pump speed control circuit, a remote switch circuit, a sensor-less low water cut-off circuit, an electronic circuit breaker and indicator lights.

Pump -

This is the part that does the actual pumping of the water. It is a diaphragm pump. This means the pump works on a positive displacement process. The pump has the capacity to pump water to greater height (greater head) without much decrease in volume. Pumping to greater height does require more energy from the solar panel. This pump has the capacity to pump to 100 ft of head (43 psi).

Do I need a water storage tank?

Storing water in a cistern or tank has many advantages. It's less expensive, more trouble-free and more efficient than storing power in batteries. Since water is always a critical issue, we recommend the tank should be able to store a minimum 3 to 6 days worth of water or whatever you think your needs may be during cloudy weather or in case of a system failure.

Generally speaking, animals, plants and humans use less water on cloudy days. Conversely, the sunniest days are when we consume the most water and when the solar panels are providing the pump with the most power.

Should I use batteries in my solar pumping system?

While batteries may seem like a good idea, they have a number of disadvantages in pumping systems. First, they reduce the efficiency of the overall system. Second, they are another source of problems and maintenance. Third, they add cost to the system.

Solar Pump System suppliers indicate livestock producers should "Store water and not power when possible and you will have much better performance and reliability with your solar pumping system."

Solar Pump System costs

For demonstration unit

Photovoltaic Panels $444
2 - 85 watt panels
Fixed Rack $237
FX2-44L
Controller $289
PCA 30-M1D SolarJack
Pump Wire $165
10-2 w/grn.
100 ft x $1.63/ft $42
MC4 interconnect
Pump $1,025
Sun Pumps SDS-Q-130
Freight to Eastern Kansas <u>about $155</u>
Prices - July 19, 2016 **$2,357**

Sunpumps: (diaphragm pump, brass and stainless steel, with brushes, design for shallow well), (air filled motor cavity), (DC power only).
Grundfos: Sqflex pumps, CU200 controller, Pole Mount ,Solar Panels,
(Helical rotor pump, stainless steel, brushless, design for deep wells), (oil filled motor cavity for lubrication and heat dissipation), (AC or DC powered)
Bison: BSP pump, SPC Controller, Pole Mount, Solar Panels,
(Helical rotor pump, stainless steel, brushless, design for deep wells), (oil filled motor cavity for lubrication and heat dissipation), (AC or DC powered)

How much water can a solar pump supply?

These Sunpumps can pump at the rate 4 to 5 gallon per minute in full sun for about 2000 gallon per day. The maximum head of water = 100 ft (or 43 psi), (a slower rate pump can pump up to 200 ft head (or 86 psi)).

The Grunfos and Bison pumps can pump similar gallons with the same wattage of panels, these pumps have the capability to pump 300+ ft head..

Below is a list of the dealers that I know of for the eastern Kansas area:

Sun Pumps	Safford, Arizona	(Jim Allen)	800-370-8115	www.sunpumps.com
Panhandle Sales & Service	Beaver, Oklahoma (Brandy Nelson) 580-525-1919		580-646-0911	www.solarwellpumps.com
Solar Water Technologies Inc.	317 S Sindny Baker St, Kerrville, TX		800-952-7221	www.solarwater.com
Robinson Solar System	207 West Main, Canton, OK		866-519-7892	www.solarpumps.com
Oak Grove Fabrications	RR1 Box 69, 15221 Schmedemann Rd , Alta Vista, KS		785-499-5311	
Lyman Inc.	Medicine Lodge, Kansas (Dean)		620-886-5731	
Preferred Pump	1441 N. Wabash, Wichita, KS	(John Blaine)	888-669-9897	620-960-7344 (mobile)

Solar Pumping System options

When wishing to have a **pressurized water system,**
I have found the following item effective:
2 gal pressure tank ($50)
Pressure switch (preset at 15-30 psi. or less) ($25),
Pressure Gauge ($7),
check valve ($7)
(with all other connections and adapters ,
the system will cost about $100 total)

Any **float valve** can work.
I have found the Hudson float valve effective ($30)

When wanting to store energy to be used at nights or cloudy weather, batteries are required.

This system requires 24 Volt DC.
Use 2-12 Volt Marine-type **deep cycle** batteries
I believe we should include a **charge regulator** when using storage batteries.
I have used a **Morningstar SS-10L-24V ($85)**

Herschel George, K-State Watershed Specialist, Southeast Kansas, 913-294-6021 Hgeorge@ksu.edu


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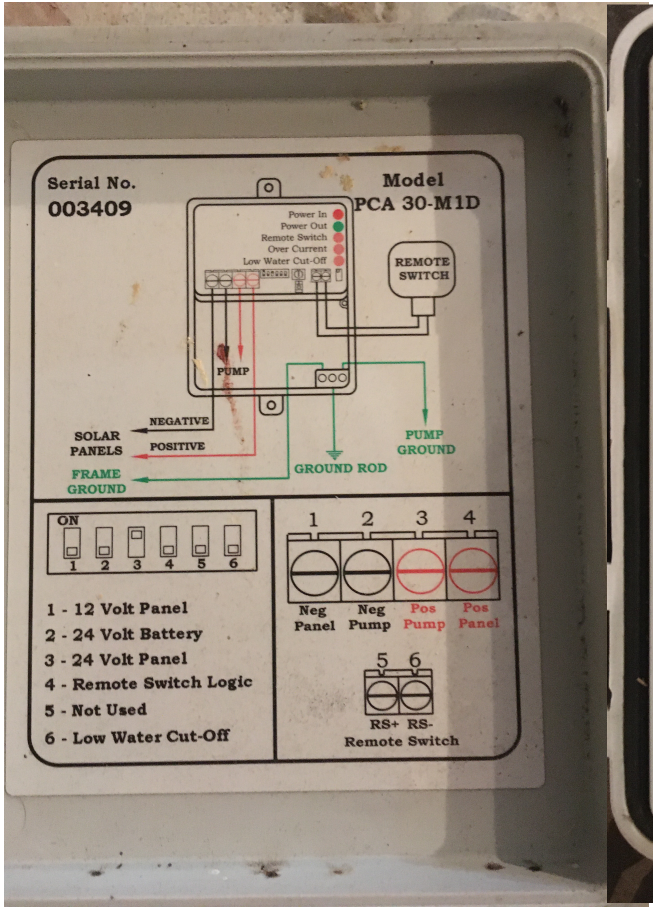
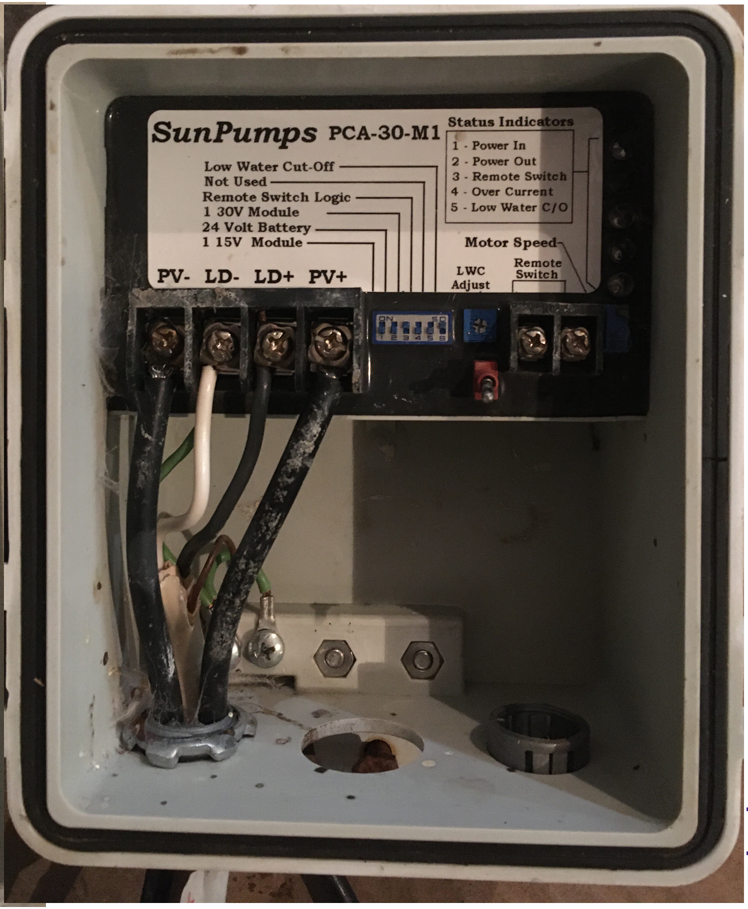
SunPump Solar Pump Controller





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Hudson Valve

(Sets on top of tank)

Jobe Valve

Sets in bottom of tank
(with bobber on a string on surface)

So I do not forget,
most of the things Will and I will discuss are available for demonstration (within reason)

Surface Water Pumping Systems for Livestock Grazing

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Watering livestock in remote locations for the purpose of grazing pasture and forage-based cover crops can be a challenge. In most situations in eastern Kansas, the water source is a pond, a stream or a shallow hand-dug well. The greatest need for water is during the warm months of the grass-growing season. There is also interest in water systems that can tolerate freezing weather.

This publication describes two systems which use a 100-watt solar panel with a charge controller. Solar panels connected to a voltage controller and a deep cycle marine-type battery provide the power for the pump systems (**Figure 1**). Some solar panels are not equipped with a mounting rack. A mounting rack can be constructed from angle iron and 2-inch pipe so that the solar panels can be mounted on a steel post at 45 degrees in winter or horizontally during the summer months.

Producers are encouraged to use the power/load output portion of the charge controller to power the pump rather than connecting directly to the battery. The advantage of this configuration is that the charge controller will stop the pump if the battery level drops below 10.5 volts. Running the system at lower voltages can damage the battery or pump. Directly connecting to a battery also can deplete the battery of charge in the case of a broken water line or overflowing tank.

Throughout this publication, there are links to specific products. However, these links do not constitute product or company endorsements; they are only suggestions or examples of how to create pumping systems.

System Type One:

The pump is operated on the soil surface above the surface level of the water. A positive displacement SEAFLO Model 55 or similar pump can be used. The system requires a "Deep Cycle" marine-type battery, which is available from most battery supply outlets. In a test using the SeaFlo pump, the deep cycle battery pumped 2400 gallons over 10 hours, reducing the battery from 12.5 volts to 10.75 volts which causes the charge controller to shut the system off. The pump test was conducted with 6 ft. head or lift.

This pump type has an improved pressure switch system, as well as other benefits. These include:

- ability to pump 5 gal per min
- built-in pressure shut-off system
- ability to pump 100 feet in elevation
- rated for continuous duty

Figure 1. Various systems for use with surface water pumping.

- carries a 4-year warranty
- uses ½ inch NPT fittings

If a tiny leak in a hose or connection occurs, the pump will chatter (come on and off frequently). To combat this, adding an accumulation (pressure) tank will allow some leakage to occur before the pump start/stop/start/stop cycle. SEAFLO manufactures an accumulation tank, SEAFLO model SFAT-075-125-01. A larger accumulator tank allows for greater leakage before the start/stop cycle. Initial systems used the Eastman 2 Gallon Expansion Tank. The SeaFlo accumulator is also recommended.

For those producers who want a "plug and pump" system, the SEAFLO 55-Series Water Pump and Accumulator Tank System is available. This system has a built-in pressure gauge and mounting surfaces. A protein tub or other enclosure can be used to cover this system.

Adding a float valve to turn the pump on and off completes the system. Hudson, Jobe and Apex valves are examples of float valves which have a diaphragm shutoff system that causes them to shut off completely when full level occurs. Other float systems reduce the flow as the tank approaches full. The Hudson valves work from the surface of the water, while the Jobe or Apex valves are set in the bottom of the stock tank.

Garden hose and hose connections can be used on these systems, but the intake hose must be rigid enough to avoid vacuum closure during pumping. If garden hose is used as the intake line, heavy duty ¾ inch hose is recommended. An alternative is HDPE (High density Polyethylene Pipe) or PVC pipe for the intake. Either type of pipe or garden hose can be used for the discharge (pressure) lines.

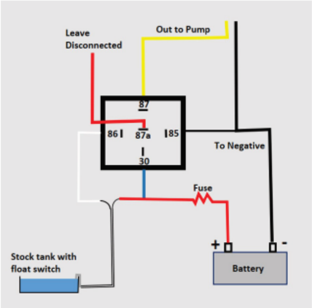

Figure 2. Wiring diagram for a float system.

System Type Two:

The second pump system is a 12-Volt Submersible Water Pump, similar to a submersible sump pump. This system connects to a deep cycle battery and a 100-watt solar panel with charge controller. This pump is a centrifugal pump with no check valves and has good flow rate. It is limited to a maximum lift of 8 meters (26 ft.) and has no switch to turn the pump on/off. This system requires an electrical switch for an automatic system.

This pump type can handle more debris, such as algae or dirt in the water, which makes it a good choice for pumping from ponds, streams, or shallow wells to nearby cattle. The pump's drain back characteristic can assist to freeze-proof the pump. The electric 2-wire sensor switch is recommended during winter freezing conditions.

The 12-volt systems have a higher amperage draw than the 24-volt systems on other solar pump systems. A relay or continuous duty solenoid is necessary to prevent burning out the lower amperage electrical switches. An Advanced Systems ALC 1275 switch uses two sensor wires to control the switch and pump. This switch has an 8-second time delay when powering the pump on and off, so it does not chatter (turn on and off in quick succession) when the wind blows the water waves in the stock tank against the sensor wires. This switch is rated for an output of 7 amps; a continuous duty solenoid or switch relay must be used to prevent electrical burn out.

A relay switch connected to an electric float switch will also operate the electric circuit. The float system may be preferred because there are no probes to clean or adjust. When selecting a relay, select a holder (or pigtail), as shown in this 100 Amp relay. Relays can be purchased without the holders and in various amperages, so select a relay with sufficient amperage capacity. The small stainless electric float switch has been reliable in field tests. The small wires of the float will carry 1 amp, therefore a relay or solenoid is needed to carry the amperage load of the pump (**Figure 2**). A simple system would be the pump wired to a tethered (normally closed) float switch that could be anchored to the side of the stock tank.

Pump systems can use a quick connect, flat 12-gauge 2-pin plug (similar to 4-wheeler sprayer systems) available from local automotive repair shops. Whenever possible, purchase the 12-gauge wire and hardwire the system so only the pump has a connection plug to the power supply.

Authors

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An electronic version of this pump system publication is available at *https://www.kcare.k-state.edu/pubs/index.html.*

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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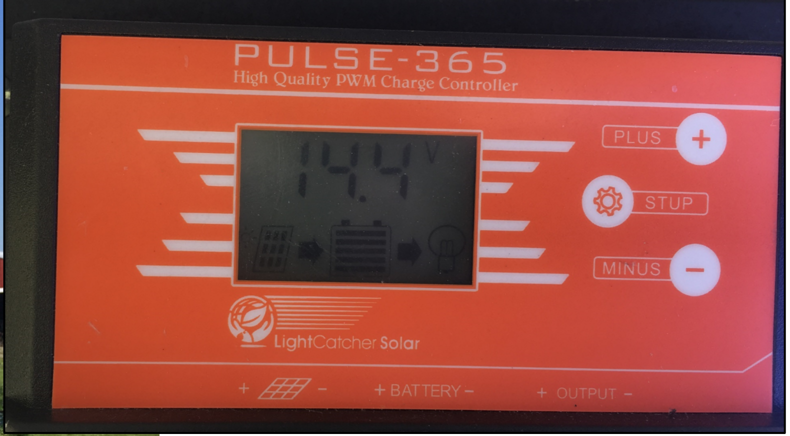
Solar Surface Water Pump

Positive Displacement Pump

SeaFlo Brand



$125.00

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ALL NEW SEAFLO 55-Series Diaphragm Pump - 12V DC, 5.5 GPM, 60 PSI

4-Year Warranty!!

$117.00

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$29.99

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$199.00

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Intake System

- Portable
- Intake from shallow stream or pond
- Not sucking sludge and algae

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Output and shutoff

- Pressure switch in pump system
- Hose delivery line
- Hudson valve
  - Over the tank edge (top of tank)
- Jobe valve systems
  - Bottom of tank installation

Hudson Valve
(Over the tank edge (top of tank)

Jobe Valve
Bottom of tank installation
(with bobber on a string at surface)

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Solar Surface Water Pump

Submersible Centrifugal Pump

Sump Pump type

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PREMIUM 303
TRACTOR HYDRAULIC &
TRANSMISSION FLUID
DC submersible
water pump


PREMIUM 303
TRACTOR HYDRAULIC &
TRANSMISSION FLUID

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Winterizing tanks

With gravity flow

and

12 volt bubblers

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Winterizing tanks

With gravity flow

and

12 volt bubblers

Winter Solar Watering Challenges

Low-cost temporary/portable systems

- Cold temperatures
  - Freezing (especially night time)
    - From submersible pump to tank
    - Overflow line from the tank
    - Water level sensor in the tank
    - Drinking area in the tank
  - Reduced battery

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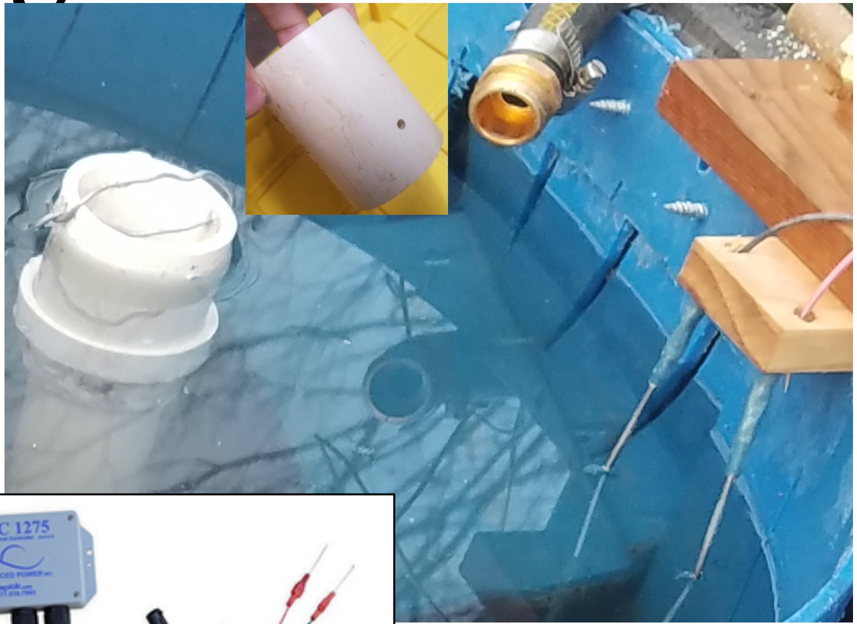
Winter Solar Watering Strategies

- Keep the Water Moving



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Winter Solar Watering Strategies

- Keep the Water Moving

Air Bubblers

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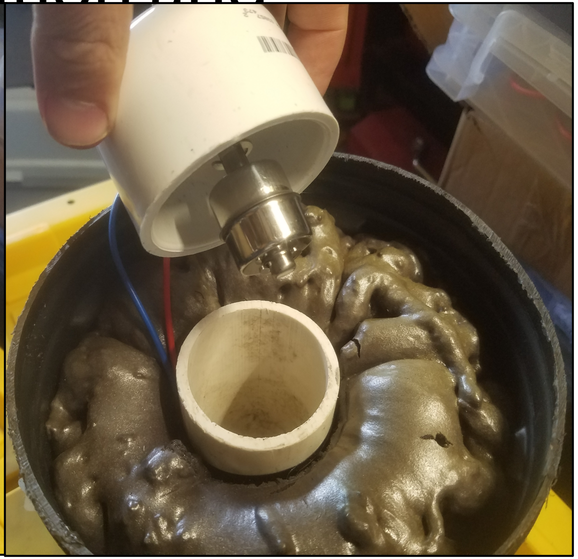
Winter Solar Watering Strategies

- Keep the Water Moving
- Use insulation to help prevent

Winter Solar Watering Strategies

- Keep the Water Moving
- Use insulation and



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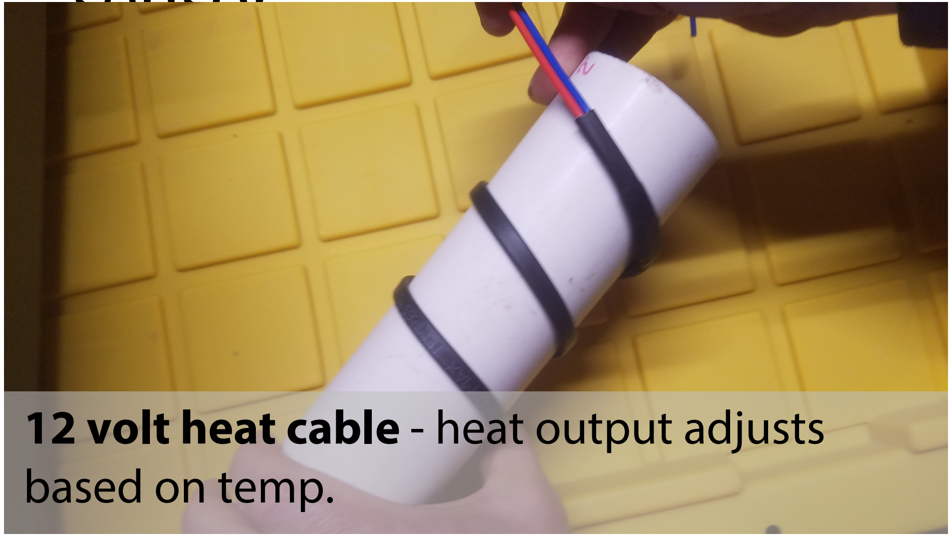
Winter Solar Watering Strategies

- Keep the Water Moving
- Heat water around the water level sensor



12 volt heat cable - heat output adjusts based on temp.

– current flows between wires through a carbon substance

½ M - .625 amps at 10 degrees C

Winter Solar Watering Strategies

- Keep the Water Moving
-

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Winter Solar Watering Strategies

- Keep the Water Moving
- Utilize insulation and heat
- H up
  b
  a

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Well Site in Leavenworth County

- Panel and Battery #1
  - Pumped when sensor didn't detect continuity
- Panel and Battery #2
  -

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Two Creek Sites in Clay County

2 setups: a) and b)

- Panel and Battery #1 - Pump
  a) 24/7, pump ran for a few seconds and rested for a few minutes

- Panel and Battery #2 – Ice control
  a) 3 bubblers in the tank

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Two Creek Sites in Clay County

2 setups: a) and b)

- Panel and Battery #1 - Pump
  a) 24/7, pump ran for a few seconds and rested for a few minutes
  b) Pumped when drinking, 2 bubblers
- Panel and Battery #2 – Ice control
  a) 3 bubblers in the tank

Resources:

- Virtual Workshop Series – Livestock Watering Systems
  - https://www.kcare.k-state.edu/training_events/virtual_training_home.html
- KCARE Publications page – Developing Livestock Water Resources
  - https://www.kcare.k-state.edu/pubs/index.html
- Animal Science Feed and Water page – Livestock Water Systems

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Water quality impacts of livestock operations and grazing management

Upcoming session: Wednesday, May 13, 8:30am

Topic: Electric fence systems

Presenters: Rod Schaub, Frontier Extension District Agent

Hosted by: Natural Resources PFT and KCARE

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