

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

PUMPING PLANT

(Number)

CODE 533

DEFINITION

A facility that delivers water at a designed pressure and flow rate. Includes the required pump(s), associated power unit(s), plumbing, appurtenances, and may include on-site fuel or energy source(s), and protective structures.

PURPOSES

This practice may be applied as a part of a resource management system to achieve one or more of the following:

- Delivery of water for irrigation, watering facilities, wetlands, or fire protection
- Removal of excessive subsurface or surface water
- Provide efficient use of water on irrigated land
- Transfer of animal waste as part of a manure transfer system
- Improvement of air quality
- Reduce energy use

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where conservation objectives require the addition of energy to pressurize and transfer water to provide water supply for irrigation, recreation, livestock, or wildlife; maintain critical water levels in soils, wetlands, or reservoirs; transfer wastewater; or remove surface runoff or groundwater.

CRITERIA

General Criteria Applicable to All Purposes

Use of this standard will comply with all applicable federal, state, and local laws and regulations.

The efficiency of units, type of power, quality of building, automation features, and other accessories installed will be in keeping with the economic and environmental value of the system to accomplish the conservation objectives.

Criteria for the design of components not addressed in Natural Resources Conservation Service (NRCS) practice standards will be consistent with sound engineering principles and according to the manufacturer's recommendations.

Pump requirements. Design flow rate, range of operating heads, and pump type will meet the requirements of the application.

Pumps used for the transfer of wastewater or manure will be sized to transfer material at the required system head and flow rate determined by the waste management plan.

Selection of pump type and materials will be based on the physical and chemical qualities of material being pumped and the manufacturer's recommendations.

Power units. Pump power units will be selected based on the availability and cost of power, operating conditions, need for automation, and other site specific objectives. Power units will match the pump requirements

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service State Office, or download it from the Field Office Technical Guide for your State.

and be capable of operating efficiently and effectively within the planned range of conditions. The power unit will be sized to meet the horsepower requirements of the pump, including efficiency, service factor, and environmental conditions.

Electric power units may include line power, photovoltaic panels, and wind or water powered turbines.

Electrical wiring will meet the requirements of the National Electrical Code.

Variable Frequency Drives. The owner will inform the electric power provider that a Variable Frequency Drive will be installed prior to installation, and be responsible for following requirements of the electric power provider.

The Variable Frequency Drive will be protected against overheating.

The Variable Frequency Drive control panel will provide the read out display of flow rate or pressure.

Photovoltaic (Solar) panels. The photovoltaic array will be sized based on average data for the location and the time of year pumping occurs, according to manufacturer's recommendations. The photovoltaic array will provide the power necessary to operate the pump at the design flow rate with the appropriate service factor, considering a minimum panel degradation of 10 years. Fixed arrays will be oriented to receive maximum sunlight. Panel tilt angle will be based on the location latitude and time of year for power requirements. Panels will be mounted securely to resist movement by environmental factors.

Windmills. Pumping units will be sized according to pumping lifts and capacities, as specified by the manufacturer. The diameter of the mill will be based on the stroke length and the average wind speed. Towers will be proportioned to the mill diameter, with adequate height for efficient and safe operation.

Water powered pumps (hydraulic rams). Pumping units will be sized according to flow rate, lift, fall, and efficiency. Bypass water will be returned to the stream or storage facility, without erosion or impairment to water quality.

Suction and discharge pipes. To prevent cavitation, suction and discharge pipes will be designed to account for suction lift, net positive suction head, pipe diameter and length, minor losses, temperature, and altitude. The size of suction and discharge pipes will be based on hydraulic analysis, operating costs, and compatibility with other system components.

Appurtenances such as gate valves, check valves, pressure reducing valves, pressure gages, pipe connections, and other protective devices will be included to meet the requirements of the application.

Screens, filters, trash racks, or other devices will be installed as needed to prevent the intake of sand, gravel, debris, or other objectionable material into the pump. Intake screens will be designed according to applicable Federal and State guidelines to avoid entrainment or trapping of aquatic organisms.

Backflow prevention devices will be included according to Federal, State, and Local laws to prevent contamination of water sources connected to the pumping plant.

Building and accessories. The design of the pumping plant and associated housing, if required, will consider accessibility for equipment maintenance and repairs, and the need for protecting equipment from the elements, vandalism, and fire. The appearance of the plant will be compatible with the surrounding environment, as applicable.

Pumps will be securely mounted on a solid foundation such as pilings or concrete. Foundations will be designed to safely support the loads imposed by the pumping plant and appurtenances. Sheet piling or other measures will be used, as required, to prevent piping beneath the foundation.

Where buildings are necessary to protect the pumping plant, provisions will be included for adequate ventilation and accessibility for equipment maintenance, repairs, or removal.

Suction bays or sumps will be designed to prevent the introduction of air at the intake. Trash racks will be provided, as needed, to exclude debris and trash from the pump.

The discharge bay or the connection to the distribution system will meet all hydraulic and structural requirements.

Structures and equipment will be designed to provide adequate safety features to protect operators, workers, and the public from potential injury. Drive shaft covers will be required on all exposed rotating shafts.

Additional Criteria Applicable to Providing the Efficient Use of Water on Irrigated Land

Provisions for the connection of flow and pressure measurement devices will be included in power plant system design.

Additional Criteria Applicable to the Improvement of Energy Use Efficiency

For fossil fuel or electrical grid power sources, pumping plant installations will meet or exceed the Nebraska Pumping Plant Performance Criteria. Refer to the NRCS National Engineering Handbook, Part 652, National Irrigation Guide, Table 12-2.

Additional Criteria Applicable to the Improvement of Air Quality

Replacement pumping plants will have lower total emissions of oxides of nitrogen and fine particulate matter compared to the unit being replaced.

New, replacement, or retrofitted pumping equipment will use a non-combustion power source, or cleaner-burning technologies or fuels.

CONSIDERATIONS

When planning this practice, the following should be considered as applicable:

- The removal of surface water by a pumping plant can affect downstream flows or aquifer recharge volumes. Consider the potential long term impacts downstream of the pumping plant.
- If using a pumping plant to remove surface water or ground water flowing into a wetland, consider the potential impacts on existing wetland hydrology.
- The operation and maintenance of a pumping plant can involve the use of fuels and lubricants that when spilled may

adversely affect surface or ground water quality. Consider measures to protect the environment from potential spills. In some cases, secondary containment of spilled fuel may be required by Federal and State laws or regulations.

- Pumping plants are often constructed in flood-prone areas or can be subject to other unexpected natural events. Consider how the pumping plant may be protected from extreme natural events and the consequences of damage or failure.
- Include protective sensors to detect low or stopped flow, or pressures that are too high or too low.
- The visual appearance of buildings or structures associated with the pumping plant should be compatible with the surrounding environment.
- When installing new or replacing existing combustion equipment, non-combustion and renewable energy sources, such as solar, wind, and water, should be considered.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing pumping plants will be in accordance with this standard and describe the requirements for properly installing the practice to achieve its intended purpose. As a minimum, the plans and specifications will include the following:

- A plan view showing the location of the pumping plant in relationship to other structures or natural features.
- Detail drawings of the pumping plant and appurtenances, such as piping, inlet and outlet connections, mounting, foundations, and other structural components.
- Written specifications that describe the site specific details of installation.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan specific to the pumping plant being installed will be prepared for use by the owner and responsible operator. The plan will provide specific instructions for operating and maintaining facilities to ensure the pumping plant functions

properly as designed. As a minimum, the plan will address the following:

- Inspection or testing of all pumping plant components and appurtenances.
- Proper start-up and shut-down procedures for the operation of the pumping plant.
- Routine maintenance of all mechanical components (power unit, pump, drive train, etc.) in accordance with the manufacturer's recommendations.
- Procedures to protect the system from damage due to freezing temperatures.
- When applicable, procedures to frequently check the power unit, fuel storage facilities, and fuel lines for leaks and repair as needed.
- Periodic checks and removal of debris as necessary from trash racks and structures to assure adequate flow capacity reaching the pumping plant intake.
- Periodic removal of sediment in suction bays to maintain design capacity and efficiency.
- Inspection and maintenance of anti-siphon devices, if applicable.
- Routine test and inspection of all automated components of the pumping plant to assure the proper functioning as designed.
- Inspection and maintenance of secondary containment facilities, if applicable.
- Periodic inspection of all safety features to ensure proper placement and function.
- Prior to retrofitting any electrically powered equipment, electrical service must be disconnected and the absence of stray electrical current verified.

REFERENCES

NRCS National Engineering Handbook, Part 652, National Irrigation Guide.