Pump Lake Drain Guidance

All dams regulated by the Division of Water Resources are required to have a lake drain unless specifically exempted by the Chief in accordance with Ohio Administrative Rule 1501:21-13-06. For certain small, low hazard dams, a pump system may be sufficient to meet this requirement. Pump lake drain systems can be owned or rented as needed. These systems MUST be detailed in an approved Operation, Maintenance, and Inspection (OMI) Manual before the system will be approved as an acceptable lake drain device. This guidance document will help you: 1.) determine if your dam is eligible for a pump lake drain system, 2.) properly size the system, and 3.) write a proper lake drain section in your OMI.

1. **Is my dam eligible to use a pump lake drain system?** Dams on large drainage basins or with large storage volumes are likely not eligible due to the high capacity required to lower those types of reservoirs. Class III dams with a drainage area less than 1 square mile (640 acres) and a normal pool surface area less than 12 acres are eligible. For dams that do not fall under those requirements, please refer to your latest inspection report or contact the Dam Safety Program to determine if your dam is eligible.

2. **How big of a pump do I need?** The two most important pieces of required information to size a pump are the needed flow capacity and head. Flow capacity is the amount of water that needs to be moved in a set period of time and head is the height that the water must be lifted. In most cases the water will need to be pumped from the reservoir over the dam embankment; therefore, the maximum required head will be roughly the height of the dam. Required flow capacity is calculated based on the size of the reservoir, size of the drainage basin, and situation (emergency vs. normal). A calculation sheet and example have been provided along with this document to help you determine your required capacity. Once these calculations are complete, they should be compared to pump rating curves provided by the pump manufacturers. If you are planning on renting the pump, the supplier will be able to help you determine which pump will meet your calculated head and flow capacity. You may want to specify different sizes for emergency and non-emergency.

3. **Other factors?** The layout of the pump and piping is also important. It will be necessary to have a sufficient amount of pipe to link the water reservoir to the pump (suction pipe) and the pump to the proper outlet area (discharge pipe). The pump must not outlet onto the embankment or toe of the dam. Ideally, the pump will outlet into the principal spillway outlet channel to reduce erosion and potential downstream flooding. The set up location of the pump will determine the amount of suction piping and discharge piping necessary for the site.

   One final consideration is the cost to rent or buy a pump of sufficient size versus the cost to design and install a permanent lake drain. Pumps generally are quite expensive and are significantly higher maintenance than a normal lake drain. If planning to rent a pump, keep in mind that the pump will likely be needed for weeks at a time. It may be the case that it is cheaper to install a permanent lake drain than to rent a pump even once.

4. **What do I include in the OMI?** The OMI must include at least the following:

Owned

- Pump size/capacity
- Pump storage location
- Piping size and location
- How to move pump into position
- Where to set up and outlet pump
- How the pump is powered
- Plan to verify pump operation (at least yearly)
- Other important information

Rented

- Suppliers name (preferably more than 1) and phone # (24-hr if possible) (must be verified yearly)
- Pump sizes/capacities
- How to get pump on site
- Amount of time to get pump on site and operational.
- Where to set up and outlet pump
- How the pump is powered
- Other important information

Calculation Sheet

Normal Pool Area* = _____ acres (A)
Drainage Basin Area* = _____ acres (B)

1.) Find volume needed to be removed in order to lower pool by 1 ft.

Normal Pool (acres) x 1 (ft.) = Volume required to lower 1 ft. (acre-ft.)

(A)_____ acres x 1 ft. = _____ acre-ft. (C) → Convert to gal

(C)_____acre-ft. x 325,851 gal/acre-ft. = _____ gal (D)

2.) Find flow rate needed to lower pool 1 ft. in a set time period. The time period is typically 7 days for routine situations and 3.5 days for emergencies.

Volume required to lower 1 ft. (gal) / Time to lower (min) = Lowering Flowrate (gpm)

7 days = 10,080 min 3.5 days = 5,040 min

(D)_____ gal / 5,040 min = _____ gpm for emergencies (E)

(D)_____ gal / 10,080 min = _____ gpm for non-emergencies (F)

3.) Find baseflow. Baseflow is the amount of flow in the stream on a normal sunny day. The rule of thumb for Ohio is typically 0.7 gal per min for each acre of drainage basin.

Drainage Area (acres) x 0.7 (gpm/acre) = Baseflow (gpm)

(B)_____ acres x 0.7 gpm/acre = _____ gpm (G)

4.) Combine lowering flowrate and baseflow to find total required flowrate.

Lowering flowrate (gpm) + Baseflow (gpm) = **Total Required Flowrate (gpm)**

(E)_____ gpm + (G)_____ gpm = _____ **gpm for emergencies**

(F)_____ gpm + (G)_____ gpm = _____ **gpm for non-emergencies**

Dam Height* (Max. Head) = _____ ft.

* - can be found on the Dam Inventory Sheet in your latest Inspection Report

Example Calculation

Normal Pool Area* = 6.2 acres (A)
Drainage Basin Area* = 324 acres (B)

1.) Find volume needed to be removed in order to lower pool by 1 ft.

Normal Pool (acres) x 1 (ft.) = Volume required to lower 1 ft. (acre-ft.)
(A) 6.2 acres x 1 ft. = 6.2 acre-ft. (C) → Convert to gal
(C) 6.2 acre-ft. x 325,851 gal/acre-ft. = 2,020,276.2 gal (D)

2.) Find flow rate needed to lower pool 1 ft. in a set time period. The time period is typically 7 days for routine situations and 3.5 days for emergencies.

Volume required to lower 1 ft. (gal) / Time to lower (min) = Lowering Flowrate (gpm)
7 days = 10,080 min 3.5 days = 5,040 min
(D) 2,020,276.2 gal / 5,040 min = 400.8 gpm for emergencies (E)
(D) 2,020,276.2 gal / 10,080 min = 200.4 gpm for non-emergencies (F)

3.) Find baseflow. Baseflow is the amount of flow in the stream on a normal sunny day. The rule of thumb for Ohio is typically 0.7 gal per min for each acre of drainage basin.

Drainage Area (acres) x 0.7 (gpm/acre) = Baseflow (gpm)
(B) 324 acres x 0.7 gpm/acre = 226.8 gpm (G)

4.) Combine lowering flowrate and baseflow to find total required flowrate.

Lowering flowrate (gpm) + Baseflow (gpm) = **Total Required Flowrate (gpm)**
(E) 400.8 gpm + (G) 226.8 gpm = **627.6 gpm for emergencies**
(F) 200.4 gpm + (G) 226.8 gpm = **427.2 gpm for non-emergencies**

Dam Height* (Max. Head) = 33.7 ft.

* - can be found on the Dam Inventory Sheet in your latest Inspection Report

Example OMI Section

For pump owned by Dam Owner:

4.0 Operation

4.1 Portable Lake Drain Pump
Example Lake Dam has a 4-inch, 1000 horsepower pump that will be used to lower the lake water level for maintenance and emergencies. The pump, suction/discharge hoses, and gasoline are stored in the storage shed located on the right abutment of the dam.

4.2 Pump Operation
The pump is heavy for a single person to lift and carry from the storage shed to the dam. A dolly is also located in the storage shed that can be used to move the pump to the dam. The pump should be placed on the crest of the dam so that the suction hose is far enough into the water to draw the water level down to the desired elevation and the discharge hose should reach far enough downstream to avoid any erosion of the downstream slope. Ideally, the pump should be placed near the spillway inlet, but discretion should be used depending on the location of any emergency condition. The pump should be monitored during operation to ensure that an adequate fuel level is maintained.

4.3 Pump Maintenance
The pump and hoses should be pulled from storage and inspected and all connections should be fully assembled to operate the pump at least once per year to ensure that the pump is still operable. Upon completion of inspection or operation, the pump should be disassembled, all components cleaned per the manufacturer's operation manual and all pump components returned and stored together in the storage shed.

Should the pump require additional maintenance beyond that listed above, the pump manufacturer's operation and maintenance manual should be consulted. If the maintenance problem cannot be resolved in the literature provided with the pump, the manufacturer should be contacted for additional support. The contact information for the manufacturer is listed below.

Best Pumps Co.
123 Suction Lane
Drawdown, OH 54321
1-800-123-4567

4.4 Safe Rate of Drawdown
A safe drawdown rate is one foot per week. However, in an emergency, the lake shall be lowered as fast as possible until the lake is at a safe elevation.

For Rental Pump:

4.0 Operation

4.1 Portable Lake Drain Pump
Example Lake Dam requires a 4-inch, 1000 horsepower pump in order to lower the lake water level for maintenance and emergencies. The pump and suction/discharge hoses can be rented from either of these 24-hour pump rental contacts:

Best Pump Rental Co.
123 Suction Lane
Drawdown, OH 54321
1-800-123-4567

Speedy Pump Rental Co.
321 Suction Lake
Drawdown, OH 54321
1-800-765-4321

Both rental companies are located within 10 minutes of the dam. The pump and hoses can be delivered to the site or transported in the back of a pickup truck. The gasoline for use in the pump is stored in the storage shed located on the right abutment of the dam.

4.2 Pump Operation

The pump is heavy for a single person to lift and carry into position. A dolly is also located in the storage shed that can be used to move the pump on the dam. The pump should be placed on the crest of the dam so that the suction hose is far enough into the water to draw the water level down to the desired elevation and the discharge hose should reach far enough downstream to avoid any erosion of the downstream slope. Ideally, the pump should be placed near the spillway inlet, but discretion should be used depending on the location of any emergency condition. The pump should be monitored during operation to ensure that an adequate fuel level is maintained.

4.3 Yearly Check-up

Yearly checks must be made to both rental companies to make sure that the correct size pump is still available for rent.

4.4 Safe Rate of Drawdown

A safe drawdown rate is one foot per week. However, in an emergency, the lake shall be lowered as fast as possible until the lake is at a safe elevation.