Water Supply
FACTSHEET

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

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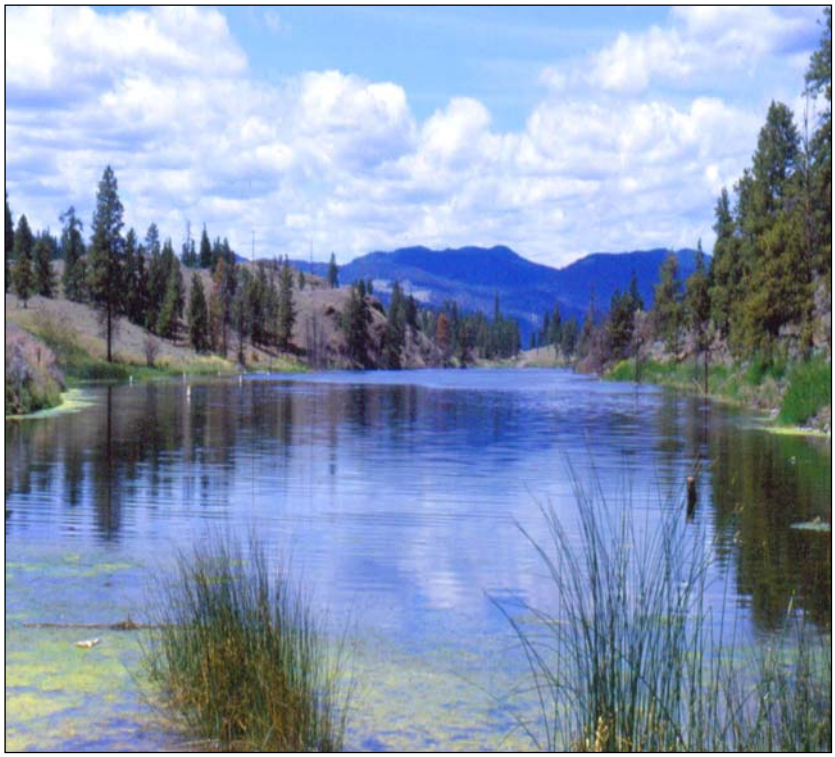
FARM WATER STORAGE

Farmers in British Columbia often need storage facilities to supply farmstead water or to back up irrigation licences from streams or rivers. Storages can be in the form of small dugouts or reservoirs that are impounded behind licensed dams.



Dugouts are often the sole source of water for the farm. The factsheet number 504.000-1 ***Farm Water Supply***, provides information on determining how much water is required for the farmstead. Larger storages such as reservoirs are often used for irrigation and can be used to augment stream or groundwater supplies. Where stored water is the only source during the growing season the storage facility must be large enough to provide the crop's water requirement for the entire season.

A water storage licence is required for any water storage facility, whether it is a dam or a dugout. In some regions dugouts do not need to be licenced if the water collected in the dugout is runoff coming only from the farm. If the dugout is storing water that is diverted from a watercourse a licence is required.
The maximum amount of water stored in the reservoir should match the quantity stated on the water licence. To obtain a licence for a large reservoir the size of the storage area and the volume of water stored must be determined.

EARTHEN DAMS

If one is considering building a small earth dam to store water for irrigation, there are a number of steps which should be considered before any action is undertaken.

Feasibility

The feasibility of the entire project must be evaluated. Will the expected benefits from the irrigation be greater than the costs of the storage structure, the conveyance of the water from the reservoir to the fields and the on-farm irrigation system?

Information on irrigation costs and benefits and dam construction criteria are available from the BC Ministry of Agriculture, Food and Fisheries that may be of assistance.

Site Selection

There are four major elements of the reservoir storage system which must be considered:

1. the dam
2. the spillway
3. the reservoir
4. the outlet control structure

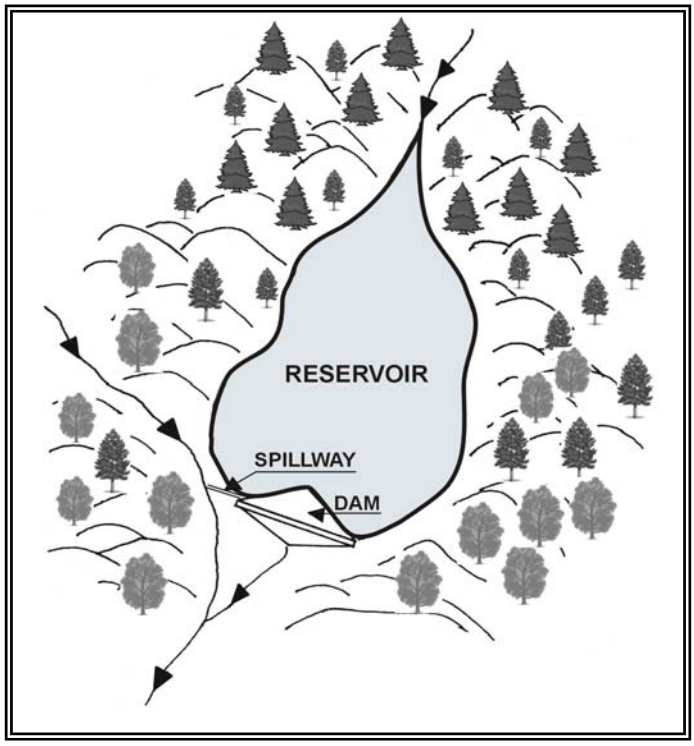


Figure 1 Components of an earthen dam water storage

These elements must all function properly to ensure that the structure is safe. Quite often it is difficult to find a site where the conditions are ideal for all three components. The final site selected will almost always be a compromise. The following items should be considered for each component.

The Dam

- Dam should be designed by a professional engineer
- Avoid unstable soils conditions.
- The dam length should be as short as possible (a longer dam is usually more expensive per unit of stored water).

- Consider the difference in elevation between the dam and the area where the water is to be used; will gravity supply be sufficient or will pumping be required?
- Proximity to material suitable for construction (material should not be removed from the reservoir site if the underlying material will allow seepage).
- Accessibility of dam site; road construction may be costly.
- Consider the risk to transportation corridors, homes and other entities down stream from the dam. Are there steps that can be taken to reduce the damage in the event of dam failure?

The Reservoir

- Is the reservoir storage volume adequate for existing and future requirements? (see section on storage capacity)
- Will the watershed supply enough rainfall or snow melt to meet expected needs?
- Are the soil conditions adequate to prevent excessive seepage from the bottom and sides of the reservoir?
- Does the reservoir area need to be cleared and if so what are the costs?

The Outlet Control Structure

- The outlet control structure should be installed on the upstream side of the dam so that the outlet pipe is not full of water to prevent freezing during the winter. Is the outlet control structure easily accessible.?
- The outlet control pipe should have cutoff collars to prevent seepage traveling through the dam along the pipe.
- For earthen dams the pipe should be encased in concrete.

The Spillway

- A shallow wider spillway is better than a deep, narrow one.
- Spillways should be constructed around the dam whenever possible. Spillways over the dam should only be used as a last option. They are difficult to build and are costly as they must be made of concrete.
- The spillway should be built away from the dam whenever possible and should be built in undisturbed ground which will not wash easily.
- The spillways must have sufficient capacity to carry major storm events to prevent overtopping of the dam structure.

DUGOUTS

In choosing a dugout location, the following points should be considered (adapted from *Dugout for Farm Water Supplies*, Alberta Agriculture):

Nature of drainage area

- Hayland and woodland usually provide the best drainage areas.
- Water draining in from other areas may be high in impurities, such as mud, silt, fertilizer, herbicides and manure.

Dugout site

- If the dugout is taking water from a watercourse, regulate the flow into the dugout. This will reduce siltation and maintain good water quality.
- Keep in mind the best quality water is the water from the first snow melt.
- A culvert with a simple, economical water control gate can be used to direct undesirable runoff away from the dugout.
- A water licence is required to divert water from a water course.

Topography

- In order to reduce evaporation and other losses, a dugout should be located in a natural depression.
- Natural depressions tend to accumulate more snow and water in winter.

Soil Texture and Water Table

- A dugout can be constructed in almost any texture of soil.
- Dugouts located in clay soils will be watertight.
- Dugouts located in coarser silts and sands will leak and will require sealing to prevent excessive seepage.
- Test holes should be dug at the four corners and centre of the site, to approximately 1.5 m below the proposed dugout bottom, to determine the texture of the soil. The test holes will also identify areas with a high water table. If a high water table exists another site may be chosen or a special piece of equipment such as a dragline or large backhoe may be required for construction.

Distances

- A dugout should be as close to the intended point of use as possible. This will minimize the cost of piping, power and pumping equipment.
- A dugout must be located a certain distance away from sources of contamination. Common sense should be used in locating the dugout away from sources of contamination.

STORAGE CAPACITY OF THE RESERVOIR OR DUGOUT

To ensure that your proposed dam or dugout will store enough water to meet your needs, the capacity of the reservoir will have to be determined.

Storage Capacity

The storage area of a dugout with known depth, width and length can be determined using the following equation.

Estimated Capacity [acre-ft] = Average Length [ft] x Average Width [ft] x Average Depth [ft] x 0.000023

The metric equivalent of the above equation is shown below.

Estimated Capacity [acre-ft] = Average Length [m] x Average Width [m] x Average Depth [m] x 0.00081

For odd shaped storages a widely accepted formula assumes that the average depth of a reservoir or dugout is one third of the maximum depth. Therefore, the estimated capacity of the reservoir becomes:

$$\text{Estimated Capacity (ac.-ft.)} = \text{Surface Area (acres)} \times \frac{\text{Max. Depth (ft)}}{3}$$

To determine the area of an odd shaped water storage use the information below.

Area of Proposed Reservoir

The following procedure may be used to estimate the storage capacity of the reservoir.

Start at the crest of the proposed spillway, and use a hand-held or surveyor's level to outline the reservoir with stakes. The stakes should be at intervals of no more than 100 feet (33m)

Use the line between the stakes at either end of the proposed dam as a base, and lay out lines parallel to this base, see Figure 2. This will result in a series of strips and one triangle.

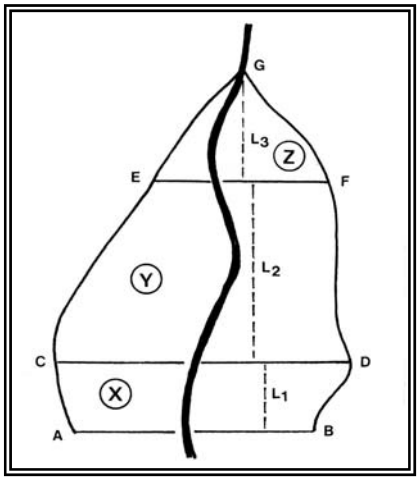


Figure 2 Storage Example

Note: *all measurements are assumed to be in feet*
To convert from metric: 1 foot = 0.3048 meters

The areas of these units may be computed as follows:

For area **trapezoidal area** X:

- measure lines AB, CD, and L_1
- then calculate area X

$$\text{Area X (ft}^2\text{)} = \frac{(\text{length AB} + \text{length CD}) \times \text{length } L_1}{2}$$

For trapezoidal area Y:

$$\text{Area Y (ft}^2\text{)} = \frac{(\text{length CD} + \text{length EF}) \times \text{length } L_2}{2}$$

For the **triangular area** Z:

- measure lines EF, CD, and L_3
- then calculate area Z

$$\text{Area Z (ft}^2\text{)} = \frac{\text{length EF} \times \text{length } L_3}{2}$$

Adding together the areas of the strips and of the triangle will give the total area in square feet.

To determine the area in acres divide by 43,560 the number of square feet in an acre.

$$\text{Total Area (acre-ft)} = \frac{\text{Area X} + \text{Area Y} + \text{Area Z}}{43{,}560}$$

REGULATIONS

To legally impound water for later use in British Columbia requires a water storage licence and a water use licence. Application forms for such licences may be obtained from any **Land and Water BC (LWBC)** office.

Therefore if a suitable site has been found, and the feasibility of the project has been considered, the next step would be to make application for a licence to store water.

Upon receiving the application, **LWBC** personnel will make a field inspection of the proposed site. Depending on the storage size, amount of water to be stored, and the potential damage that might occur if the structure failed, a plan of the proposed structure may be required. **LWBC** personnel will then make recommendations based on the plan. If the structure is quite large, an engineered design, done by a consulting engineer, will likely be required.

It states in the ***Water Act*** of this Province, "Every licensee.....shall exercise reasonable care to avoid damaging any land, works, trees, or other property, and shall make full compensation to the owners for any damage or loss resulting from the construction, maintenance, use or operation of the licensee's works."

The works are the responsibility of the licensee, and as a dam failure can be extremely costly, it does not pay to attempt to cut corners. A properly engineered design, although it may appear to be costly at first, may well be much cheaper in the long run. This is particularly true in situations where the potential for considerable downstream damage exists.

LAND AND WATER B.C. OFFICES

Surrey	(604) 586-4400
Squamish	(604) 898-2128
Prince George	(250) 565-6779
Fort St. John	(250) 787-3411
Smithers	(250) 847-7334
Williams Lake	(250) 398-4574
Kamloops	(250) 377-7000
Pentiction	(250) 490-8200
Nanaimo	(250) 741-5669

For further information on related topics, please visit our website

Resource Management Branch

www.agf.gov.bc.ca/resmgmt

Linking to our

Publications and Conceptual Plans

FOR FURTHER INFORMATION CONTACT

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RESOURCE MANAGEMENT BRANCH

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