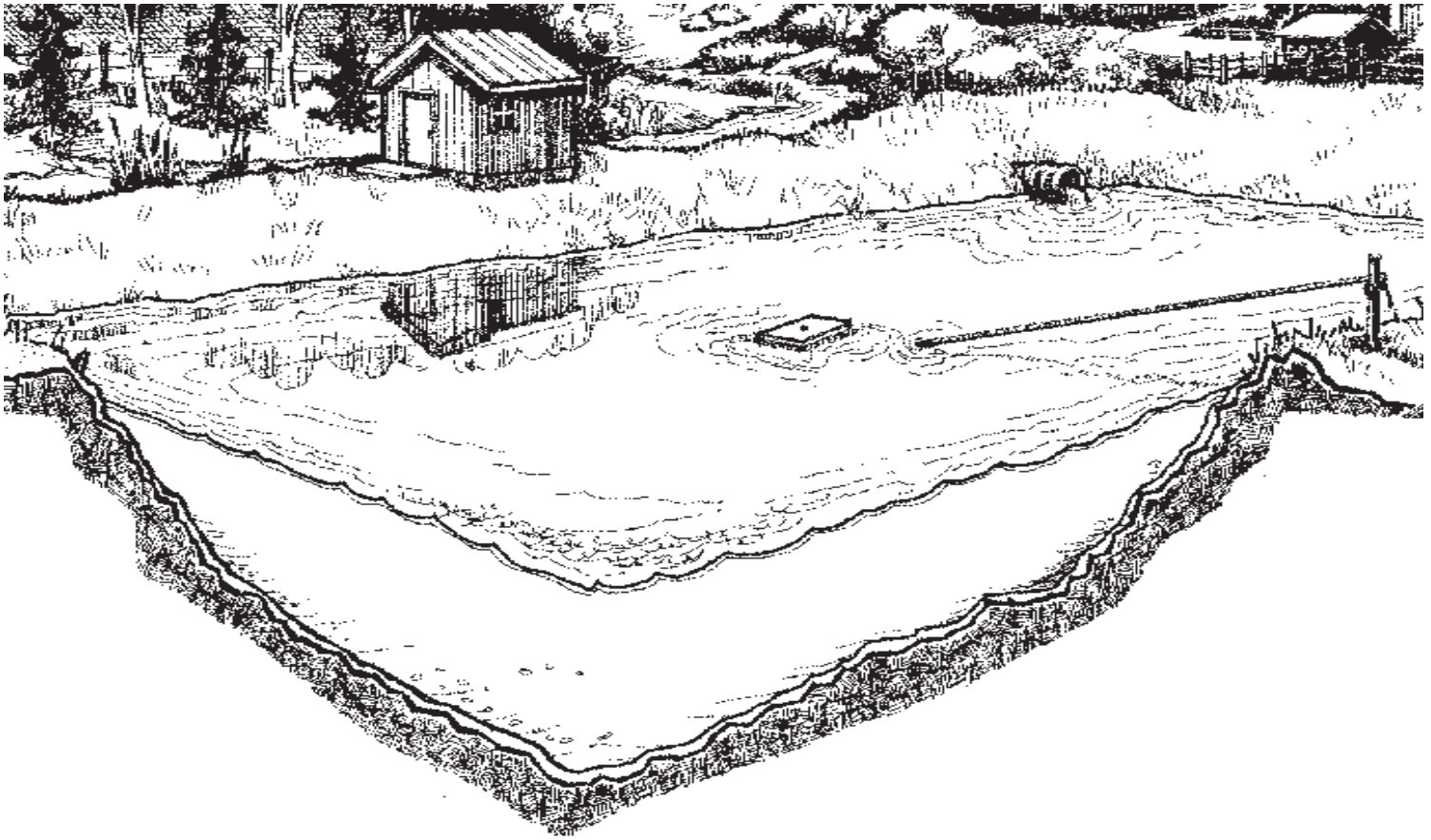
Dugout Management



The goal of dugout management is to protect and improve water quality. Some of the strategies for doing this through dugout location and design have been discussed in Module 3 – Planning. This module provides suggestions for preserving and enhancing water quality in existing dugouts. The cost and effort to properly manage a dugout is generally small and most often rapidly recovered in the form of improvements in water quality. Improving water quality reduces treatment costs, improves productivity of livestock, and generally improves the quality of rural life.

Inspect dugouts weekly during April to September and monthly during October to March.

At a minimum, dugouts need to be inspected weekly during April to September and monthly from October to March. Early detection of problems allows corrective action before water quality deteriorates significantly. When inspecting, look for:

- any peculiar signs of animal entry
- signs of failure of the aeration systems
- incorrect positioning of the water intake
- algae growth or blooms, and increased plant growth
- damage to grass buffer areas and diking
- signs of contaminated runoff.

Keep a record of your inspections. This will enable you to document and analyze both short-term and long-term occurrences. The example in Figure 8-1 Dugout Maintenance Schedule shows a filled out Dugout Maintenance Schedule. Review the example to see the type of information recorded. Use the blank form located in the pocket at the rear of the manual to record dugout inspections.

Figure 8-1 Dugout Maintenance Schedule

Dugout Maintenance Schedule

Year: 2000 - 2001 Dugout No.: 1 Legal Land Description: *NW 30-50-30-W4*

Season	Date	Water Level	Comments (runoff, water quality, treatment, and maintenance)
Spring	*March 25*	*4 ft. from full*	*- very little runoff; only added 2 ft. of water* *- increase in sediment in water* *- checked aeration pump*
Summer	*June 15*	*5 ft. from full*	*- water clarity decreased because of cyanobacteria growth* *- treated dugout with 4 litres of copper algecide to control cyanobacteria*
	July 17	*6 ft. from full*	*- spot treated water weeds around dugout edge with 1/2 litre of Reward (diquat)*
	Aug 12	*7 ft. from full*	*- water clarity decreased* *- re-treated for cyanobacteria with 4 litres of copper algaecide*
Fall	*Oct 5*	*7.5 ft. from full*	*- approximately a 10 ft. depth of water left in dugout which will be adequate for winter use* *- pulled floating intake to bank and cleaned perforations* *- thoroughly checked dugout aeration pump diaphragm, and checked valves in preparation for winter* *- ensured runoff control gate opens and closes in preparation for next spring's runoff*
Winter	*Jan 15*	*10 ft. from full*	*- about a 5 ft. depth of water below ice* *- checked aeration pump*
	Mar 1	*11.5 ft. from full*	*- open runoff control gate prior to spring runoff*

Summary of comments for the year and proposed improvements/changes

- Water levels were very low because of the lack of spring runoff and high evaporation losses.

- Try to increase runoff into dugout with additional snow fencing and make plans for new shelterbelt.

- Need to clean air diffuser as it seems to be restricting air flow into the dugout.

Dugout Management Practices

There are a great number of dugout management practices. Many are known to be highly effective, while others are still in the experimental stages. Some techniques do not require special or highly processed products or services or a high level of knowledge. Other treatments involve chemicals available in commercial products. This module outlines some of these practices, including their strengths and weaknesses.

Established Practices

The practices presented in this module are well-established methods of greatly improving dugout water quality.

Continuous Aeration

Continuous injection of supplementary oxygen is the single most effective practice for maintaining and improving water quality. Aeration is discussed further on page 52 in Module 5 – Operating Systems, Dugout Aeration Systems.

Floating Intake

Research shows that water in the top four or five feet of a dugout is of higher quality than water at the bottom and edges. The reason for this difference in quality is that the algae and plants that grow in dugouts eventually die and decay at the bottom and edges, resulting in black, smelly water conditions. Floating intakes draw better quality water from near the dugout water surface.

Sediment Removal

Excavation of accumulated sediment from a dugout, every five to ten years, is an effective technique for improving water quality and extending the life of a dugout. Unfortunately, it is costly, and in some cases excavation may exceed the cost of new dugout construction. Make careful cost estimates prior to deciding to clean out a dugout. Where two or more dugouts exist, divert all runoff away from the dugout to be excavated. Let the dugout dry up during summer, and excavate the sediment in early fall. Where only one dugout exists, the only way to excavate sediment under water is with a dragline or hydraulic backhoe. After excavation under water, expect the water to have high turbidity for up to several weeks or perhaps months. One option might be to pump the water to another location while the dugout is cleaned out and then pump the water back in.

Vegetation Control

Routine maintenance of the area around a dugout is important for maintaining water quality. Grassed buffers and runways surrounding dugouts should be mowed regularly. This prevents long grass from lying down and becoming ineffective as a sediment trap. Proper setback of shelterbelts ensures that the amount of fallen leaves entering the water is at a minimum. Steep end-slopes reduce the amount of emergent plants that can grow in the dugout. If possible, aquatic plants should be removed from the dugout before they die and decompose. Shrubs and trees will take root on the banks of the dugout. Left alone, they can grow quite large and contribute significant amounts of vegetation to the water in the fall. Annual cutting and removing of willows and volunteer saplings every fall can make a significant contribution to protecting dugout water.

Removal of Animals

Animals such as salamanders, also called mud puppies, and muskrats can create problems in a dugout by burrowing, house building, and foraging for plant roots. This disturbs the sediments and keeps the water constantly turbid. The most effective way to remove muskrats is through trapping or hunting. Specially designed fencing can be used to keep them out in the first place.

Copper Sulphate

Copper sulphate, also known as **bluestone**, is perhaps the most common chemical that was historically used to treat dugouts as shown in Figure 8-2 Bluestone Treatment. It is also the least understood. Copper is an essential element for both plants and animals, but at high concentrations, it can be toxic. All herbicides and pesticides are regulated in Canada by the Canada Pest Management Regulatory Agency and must be licensed for use. This includes any products that are used to treat dugouts. Various companies have registered copper sulphate (products) with the Canada Pest Management Regulatory Agency (CPMRA) in the past but have allowed the 5 year licences to expire; therefore it is important to check with CPMRA to determine which products are currently legal to sell in Canada. Most licensed products that have copper in their ingredients come in a liquid form. It is important to read and follow the directions of a licensed product to avoid environmental contamination and maximize effectiveness. Copper treatments can be very effective at controlling cyanobacteria. However, copper treatments are most effective when done in early summer before large populations develop.

Don't overdose! *Copper is not effective on green algae!*

Copper may also kill beneficial organisms, like zooplankton, which feed on some algae species. Overuse and repeated treatments can also cause a buildup of copper in the sediments of a dugout. This can harm or kill beneficial organisms and disrupt the normal biology of the dugout. In fact, a single overdose can also cause a man-made green algae bloom.

Health Canada recommends that the concentration of copper in drinking water for humans not exceed 1 mg/L copper. However, this is far below what would be a toxic level.

Copper treatments should therefore be done very selectively. It is not reasonable to expect dugouts to be completely free of green or brown algae, nor free of aquatic plants. The primary target organism of a copper treatment is cyanobacteria. If copper is applied during an algae bloom, there may be an immediate release of large quantities of toxin. Because of the toxins produced, it is recommended that you wait a minimum of 14 days before the water is used for human or animal consumption. This should allow toxin levels to dissipate. Continuous diffused aeration during this period may also help degrade toxins.

Figure 8-2 Bluestone Treatment

Copper is found in a variety of products. The active ingredient is always the copper element (Cu) itself. Contact the Canada Pest Management Regulatory Agency for the copper products currently registered for the control of algae in dugouts.

More information on copper products and procedures for treating dugouts is provided on page 128 in Appendix 3 Using Copper Products to Control Cyanobacteria.

Figure 8-3 Coagulation Cell

The coagulation process is outlined in Module 7 – Water Treatment for Domestic Water Supplies.

Coagulation

As opposed to treating the entire dugout, it is more economical to treat the small volume of water required for high quality use in a specially constructed treatment cell, separate from the dugout as shown in Figure 8-3 Coagulation Cell. However, coagulation chemicals have successfully treated entire dugouts and have remediated flood affected turbid dugouts. The addition of powdered activated carbon has proven to be helpful for increased removal of dissolved organic matter, taste, and odour compounds. If a dugout is coagulated regularly, chemical residues should be monitored.

Herbicides

Some herbicides are registered for use by the Canada Pest Management Regulatory Agency to control aquatic weeds and algae. These compounds may only be used on privately owned reservoirs where water does not flow into other water bodies, as shown in Figure 8-4 Herbicide Treatment. Always follow label directions, and use safe handling practices to protect yourself from the product. In order to calculate the proper dosage, you must accurately estimate the existing volume of water in the dugout to be treated.

Figure 8-4 Herbicide Treatment

Colourants

Colourants, known as pond dyes, were developed for golf courses to limit aquatic growth. They accomplish this by blocking ultraviolet light that aquatic plants use for photosynthesis. These products have been shown to have some beneficial effects for farm dugouts. Some dugout owners have reported some improvement of water quality due to reduced aquatic growth. It should be noted that these products will not compensate for poor dugout management and maintenance practices as previously discussed. Several companies have licensed these products through the Canada Pest Management Regulatory Agency (PMRA). Only colourant products licensed by Canada PMRA should be used.

Dugout Covers

Floating synthetic plastic dugout covers, as shown in Figure 8-5 Dugout Cover, have been used experimentally on dugouts to prevent algae and plant growth by limiting light penetration into the water and to minimize evaporative losses. Plastic tarp-like covers are floated on top of the water and anchored to the banks at several points. Since the water level in the dugout will vary during the year, the anchor straps must be left slack or adjusted on a regular basis to allow for fluctuating water levels. Individuals who have used dugout covers have reported a significant reduction of evaporative losses in periods of drought.

Figure 8-5 Dugout Cover

Dugout covers have been used experimentally to prevent algae and plant growth.

Supplemental diffused aeration is essential to maintain oxygen levels in a covered dugout. Well-designed covers are perforated with special slits to release any accumulated air from the aeration system that collects underneath the tarp. Due to the nature of these slits, they allow the release of air while preventing the passage of light through the perforations. Dugout covers have a life expectancy of only three to five years due to degradation by ultraviolet light, but problems can arise sooner from wind and ice damage. If tarp anchors are not properly adjusted, wind can destroy a dugout cover.

Disinfectants

Disinfectants are not registered for use in dugouts.

Disinfectants are chemicals containing concentrated oxidants, such as chlorine, hydrogen peroxide, and ozone. They are effective at killing microorganisms when:

- the water is clean enough
- the dosage is strong enough
- the contact time is long enough.

However, disinfectants are non-selective and will kill off many beneficial organisms. Disinfectants can also create by-products that are potentially harmful to humans and should not be used in dugouts. Accordingly, they are not registered for use in dugouts.

Plants

Plants have been used experimentally to improve water quality. Some species of aquatic plants may improve summer water quality by taking up nitrogen and phosphorus. With the fertility of the water reduced, the growth of unwanted algae species may be suppressed. Rooted plants such as cattails can serve this purpose. However, in order to maintain the water quality, the plants must be removed in the fall. If not removed, the plants will eventually die off, and plant nutrients will be returned to the water.

Because bottom-rooted plants can be difficult to harvest, there is interest in using floating plants to improve water quality. Duckweed is a floating, native plant that is able to take up large amounts of phosphorus from water but must be constantly harvested and removed from the dugout. It only survives in relatively sheltered locations and often blows to the downwind side of a water body. Water hyacinth is a floating, tropical plant that has only been used experimentally on Canadian dugouts to reduce algae problems. Both duckweed and water hyacinth can be harvested using a floating boom, as shown in the Figure 8-6 Harvesting Duckweed.

Figure 8-6 Harvesting Duckweed

Harvesting can be accomplished by dragging a floating timber boom across the dugout to the opposite shore and removing the plants.

Fish

Fish are sometimes added to dugouts to improve water quality by eating aquatic plants. However, they may often compound dugout, water quality problems by increasing turbidity, increasing dissolved nutrients, and making it difficult to use other chemical methods of algae and plant control.

For the same reasons that plants should be removed from a dugout, fish should be harvested before they die and decompose. Grass carp or *Tilapia* are effective at removing plants in dugouts but because of concern about the possibility of escape into the wild, their use is not permitted in some provinces. Check with provincial authorities before considering the addition of fish to a dugout. Some fish, notably rainbow trout, can actually degrade water quality by eating phytoplankton and adding excrement to the water.

Miscellaneous Biological and Chemical Products

There are a number of products now available on the market that are advertised as having the ability to improve water quality. Many of these products have been developed for non-consumptive ponds such as golf courses, ornamental ponds, and zoo ponds. The range of products includes various type of bacteria and chemical toxins. Check for registration with the Canada Pest Management Regulatory Agency of Health Canada and, if registered, check the registration/certification information for any specified water use limitations.

Many of these products are **not** registered by the Canada Pest Management Regulatory Agency for application to dugouts or farm ponds used for consumptive purposes and, therefore, should not be used. Until research proves the effectiveness and safety of these chemicals in dugouts, their use is not recommended.