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A Reference Guide for Coordinating a Wetland Restoration Program

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1. Objectives

The purpose of this report is to assist technical staff with the coordination of a wetland restoration program in the Ausable Bayfield Watershed and surrounding areas.

This report includes the basic information related to project outreach, financial opportunities, technical processes and requirements, regulations, and the maintenance and monitoring of wetland projects through a conservation authority perspective. Other organizations and agencies may find this document helpful if restoring wetlands, or completing other stewardship projects, or working with a Conservation Authority. When reviewing the project components section of this document, it is important to remember that each individual wetland project is unique and requires creativity to generate the most sustainable solution.

2. Wetlands 101

Wetlands are areas of land covered in water for part or all of the year with the following characteristics: a water source, poorly-drained soils and wetland vegetation (Ducks Unlimited Canada, No date, Wetlands Fact sheet #1). These ecosystems provide biological, ecological and hydrologic functions (Heimlich et al. 1998). Wetlands provide the most economical water management system. As well, wetlands provide society with water filtration of nutrients and pollutants. Wetlands provide water storage. This storage is important to:

- maintain soil moisture during times of drought for better crop production
- reduce downstream flooding, soil erosion and surface drain maintenance
- regulate ground water recharge
- improve water quality by filtering suspended sediments and pollutants

Permanent and seasonal wetlands are important breeding habitat for wildlife and waterfowl and therefore wetlands also provide recreation such as hunting, fishing and landscape aesthetics.

Wetlands act as a natural filter, removing pollutants and recycling nutrients and energy. Nutrients in wetlands are moved or retained through absorption into sediments, uptake by plants and deposition of detritus (organic matter and chemical precipitation) (Heimlich et al. 1998). Wetlands can remove contaminates from the environment and retain up to 87 percent nitrate, up to 95 percent ammonium, and up to 94 percent phosphorus (Ducks Unlimited Canada, April 2006, Natural Values). The transport of suspended sediment is also reduced by up to 98 percent (Ducks Unlimited Canada, April 2006, Natural Values). Wetlands filter up to 99 percent coliforms (in constructed wetlands) (Ducks Unlimited Canada, April 2006, Natural Values). Invertebrates feed on various microbes and bacteria, at the bottom of a very complex food chain (Ducks Unlimited Canada, No date, b). The invertebrates are very important in feeding the top predators, fish and waterfowl.

Wetlands reduce flooding by storing water temporarily like a sponge and slowly releasing the water, reducing the peak flows and resulting in less soil erosion (Ducks Unlimited Canada, No date, Wetlands Fact sheet #1 and Heimlich et al. 1998). As the wetland releases the water slowly, it seeps into the groundwater to replenish it. Water tables are often close to the surface in wetlands, resulting in fluctuating recharge or discharges of groundwater supplies (Heimlich et al. 1998).

Wetlands are critical to the animals, organisms and plant species that use these areas for food, water, breeding, nesting grounds, resting areas and shelter (Ducks Unlimited Canada, No date, a). More than 40 percent of the world's species are found in freshwater wetlands that cover only one percent of the Earth's surface (Ducks Unlimited, No date, a).

Direct impacts such as drainage, clearing and filling of wetlands to obtain usable urban, agricultural and industrial land have and continue to result in a considerable loss of wetlands (Wright et al. 2006).

Additional Resources:

- What are wetlands? (MNR)
- Why are Wetlands Important? (MNR)

3. Program Elements

3.a Outreach

The following is a list of media formats that have and can be used to contact and educate landowners about wetlands and related stewardship initiatives:

- Letters to landowners (targeted 2acre+ properties in areas where funding is available),
- Brochures,
- Newsletters,
- Surveys,
- Media releases,
- Presentations to the public,
- 'The Wonder of Wetlands' Posters for public events, and
- Webpage: http://www.abca.on.ca/page.php?page=Wetlands

3.b Funding

Outlined below is a list and brief description of potential funding sources for wetland projects:
- It would be nice to create a table which outlines all of the following funding sources and their requirements (e.g. amounts, requirements/ deliverables, what they cover (i.e. salaries, construction, etc.), deadlines, contacts, area, etc.)

- Canada-Ontario Agreement (COA) – Ontario Ministry of Natural Resources (MNR)
  - COA- Huron County
  - COA- Middlesex County

Resource: http://www.mnr.gov.on.ca/en/Business/GreatLakes/2ColumnSubPage/STEL02_173911.html

- Huron Clean Water Project

Resource: http://www.huroncounty.ca/plandev/water.php
Brochure: http://www.huroncounty.ca/plandev/downloads/HuronCleanWater_brochure11.pdf

- Habitat Stewardship Program (HSP) for Species at Risk- Environment Canada

Discuss funding – HSP – go through Kate at ABCA and have her or Ian present projects to Board at regular board meetings
Resource: http://www.ec.gc.ca/hsp-pih/default.asp?lang=En

- Ducks Unlimited Canada

- Community Fisheries and Wildlife Involvement Program (CFWIP) - MNR

Appendix xx. CFWIP Application Form
Resource: http://www.mnr.gov.on.ca/en/Business/LetsFish/2ColumnSubPage/STEL02_166030.html

- Canada-Ontario Environmental Farm Plan (EFP) - Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)

Resource: http://www.omafra.gov.on.ca/english/environment/efp/efp.htm

- Ontario Species at Risk (SAR) Stewardship Program - MNR

Resource: http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/STEL01_131229.html
Guidelines:
http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@species/documents/document/stdprod_078888.pdf
Application Form: http://www.forms.ssb.gov.on.ca/mbs/ssb/forms/ssbforms.nsf/GetFileAttach/018-FW1075E~1/$File/FW1075E%20Application.doc

- Erb Family Foundation

Resource: http://www.erbff.org/

- RBC Bluewater Project

Resource: http://www.rbc.com/community-sustainability/environment/rbc-blue-water/index.html

- Ontario Trillium Foundation

Resource: http://www.trilliumfoundation.org/en/index.asp

- Ontario Power Generation

Resource: http://www.opg.com/community/activities/index.asp

- Management of Abandoned Aggregates Program - MNR

If property contains an abandoned commercially used gravel pit(s) or quarry(s), it may be eligible for the Management of Abandoned Aggregates Program: Resource:
http://www.mnr.gov.on.ca/en/Business/Aggregates/2ColumnSubPage/263752.html

3.c Organization

Listed below are items to record, update, and keep track of while coordinating a wetland initiative program:

- Outreach Material (e.g. Mailing lists, newsletters, webpage)
- Landowner Contact Information, site visits, dates, comments whether the site qualifies
- Project Photos
- Project Designs
- Tenders for contractors
- Permits
- Maps
- Academia (e.g. public fact sheets, journal articles, other literature)
- Workshops/Conferences
- Budgets
- Funding
- Summary of number of projects, location, cost, status of project, completion dates, deliverables (e.g. number of acres restored or retired, number of trees planted, number of meters of watercourse buffered)

It may be useful to organize the information listed above both annually and by location (e.g. by County; Huron and Middlesex).

3.d Partners

It may be important have lots of partnerships and collaboration efforts with other organizations, agencies, and individuals for information sharing and for funding applications to demonstrate that more can be accomplished with working together towards the same initiative. Partners may include: Ducks Unlimited Canada (DUC), Environment Canada (EC), Farmers and Farmer groups, Friends of groups, groups of landowners, Lions Clubs, local community groups, Ministry of Natural Resources (MNR), Ministry of the Environment (MOE), Municipality, Ontario Ministry of Agriculture and Food and Rural Affairs (OMAFRA), Schools, Scouts, Stewardship Councils (SC).

Please refer to Appendix xx Partner Roles and Responsibilities

Duck's Unlimited Canada (DUC) can provide:

- available funding to the partners if it fits criteria. DUC's cost share for southern Ontario is up to 25% of construction costs to a maximum $5,000
- provide contacts of interested landowners
- advice/guidance on design, land surveys. It is best to arrange multiple site visits per day to show DUC staff and other funding partners
- assistance with sourcing experienced contractors
- advice/assistance in applying for permits
- assistance with our DUC Conservation Agreement
- identify potential opportunities through targeted Geographic Information Systems (GIS) and in priority areas

Projects are funded by DUC on a first come first served basis

Be sure to send Darrel a list with project information for him to compose the MOA's (Memorandum of Agreement) for each project

3.e Focus on: wetlands, riparian and wetland buffers

Why wetlands?

- maintains and increases biodiversity
- reduces flooding
- provides habitat for many flora and fauna species
- conserves and improves water quality
- provides recreational and research opportunities
- provides many environmental goods and services to society

Program deliverables:

Enhancing Floodplain Habitat

Floodplains, valley areas, wetlands, seasonal wetlands, oxbows and woodland swamps, etc., enhancements using small, low-cost water impoundment structures

Wetland Creation

One focus of this program is also to create surface water wetlands (where there is no evidence of groundwater). This is because there are many risks and regulations associated with working near

groundwater sensitive areas. Evidence of Groundwater can include seeps, springs, and/or a high water table.

a) Small impoundments or berms in areas to restrict water flowing out of shallow, low-lying areas, creating a half to one acre sized wetland
b) Excavated wetlands- movement of earth to create a water retention area

Creating Conservation Buffers

a) Creation of small areas or strips of permanent vegetation, designed to filter pollutants and excess nutrients and provide buffer between agriculture land and watercourse, habitat and a corridor for wildlife.

Livestock Exclusion Fencing

Includes fencing livestock out of watercourses and natural water sources, create low-water crossings for livestock and farm equipment over watercourses and wet areas and creating an alternative water source for drinking water for livestock instead of drinking from natural water sources (creeks, rivers, ponds).

4. Project Components

4.a Getting projects

Landowners can learn about the wetland program through referrals, word of mouth, and advertising through media formats outlined in *Section 3.a Outreach*. Interested landowners will contact you by phone or email.

When contacted by an interested landowner, you may want to collect the information listed below. This information will make it easier to gather sufficient background data and will help you prepare for the initial site visit.

- First and Last Name
- Contact Information- Phone number and email and best method/time to contact them
- Address
- Lot and concession
- Brief description of the property
    - e.g. location, size of farm, annual water accumulation (spring, summer, fall), infiltration (how long the water sits on the landscape or how quickly it drains away), land use (pasture, meadow, crop, forest, retired farm field), unique features, soil types, any natural low basin areas or is the land flat, surrounding areas, nearest areas of human disturbance
- General idea of the kind of project the landowner had in mind or goals they are trying to achieve

During the initial conversation, after gathering the information (listed above), close with letting the landowner know that you will follow-up and contact them in the near future to discuss the potential project further and to arrange a site visit. It is recommended to try and arrange site visits with everyone, as some properties have potential that you might not see from the air photo or from information from the landowner. It is also valuable to coordinate site visits with other staff and partners to reduce the number of site visits needed with the landowner. And to meet with regulation staff prior and after the site visit for consultation if in regulated areas or if area involves significant natural features.

It is important to remember, that the value of wetland functions has increased in society with greater scientific understanding. However, owners of wetlands may only be able to directly profit from the land by altering or draining these areas. As cost recovery can only be applied at the individual scale, it is important to consider the interests and needs of individual landowners.

4.b Prep for initial site visit

From the information obtained from the landowner (*Refer to Section 4.a Getting Projects*), retrieve aerial photographs of the site using GeoPortal or GIS, Google maps, etc. Many variables can be reviewed quickly by looking at the site using aerial photographs.

Using aerial photographs, try and find as much of the information (below) as you can about the site:

- Historical air photo (past infrastructure or land use, landscape, water flows and wet areas)
- Contour lines (landscape's grade (i.e. how steep are the slopes), and what the approximate size of land is for the project and the watershed size that drains into the area the landowner wants to look at).
- Environmentally Significant Areas (ESA's) or Provincially Significant Wetlands (PSW's) or other natural heritage features
- Species At Risk information
- Conservation Authority regulated areas (e.g. Floodplains) Consult with regulation staff
- Wetland features
- Tiles – old, new, material, size (4inch, 6inch headers), location of watercourse or drain that the tiles flow into
- Indication of soil erosion – rills in field, lack of topsoil on field, flooding, stones washed up on floodplain area – overland flooding or concentrated
- Creek names
- Drain Classifications – coldwater, warm water (Do not have warm water wetlands overflowing into cold water creeks – use bottom draw water control structure)
- Soils – type and infiltration
- Source water protection areas

It is recommended to print the aerial photos and close ups of areas, to use during site visits for notes. Some important variables to consider when preparing for your site visit and brainstorming potential projects include:

- Watershed
    - Size
    - Location
- Inlet and Outlet Location
- Grade of Draw
- Existing Tile Location
- Crop Type and harvest time
- Property Line
    - Uncontrolled ownership

Useful internet mapping sites for wetlands:

- Conservation Authorities internal mapping sites (GIS and Geoportal)
- Rural Drainage Mapping for approximate Agricultural Tile Drainage (random or systematic) or for sites outside of our watershed: http://www.lio.ontario.ca/imf-ows/imf.jsp?site=aia_en

- I also use Source water protection Geoportal for soils and for areas in Huron County outside of our watershed, but some information is limited.

- Middlesex County Soil Maps (click on map to download and zoom in): http://sis.agr.gc.ca/cansis/publications/surveys/on/on56/index.html

- Huron County Soil Maps: http://sis.agr.gc.ca/cansis/publications/surveys/on/on13/index.html

- There is also the MNR make a map site and is very similar to top map site: http://www.lio.ontario.ca/imf-ows/imf.jsp?site=makeamap_

- Google maps

4.c Initial site visit

Conducting an initial site visit is an essential step to assess the potential for wetland project opportunities on a particular property. When conducting site visits, there are many criteria to investigate including soil types, water movement, the surrounding environment, land uses, water issues, and the existing wildlife habitat. See *Appendix xx. Wetland Criteria for Site Visits*, for a more detailed list of questions for gathering appropriate information during the first site visit.

Site visits can be conducted any time of the year; however after a heavy rainfall or during the spring runoff is the best time to get an idea of where water flows and lies on the landscape (Ducks Unlimited Canada, 2010) and how long it remains wet. The site can look very different depending on the season and the recent weather conditions.

It is important to remember to take detailed notes, and photographs of the site for your records. Remember to discuss with the landowner about potential project costs. How much money, if any, are they able to put towards their project? This is a risk management item, just in case funding does not get approved, or unexpected costs arise.

It is also recommended not to commit to any project design or details during your first visit to the property. Permits, funding, and consulted site design still need to be accomplished before any commitment is made.
There are many factors that may influence the future design of a project, and it may take a bit of time to assess, access funding, and process your initial findings.

One site visit might also not be enough. More information and expertise may be needed in order to move forward with the project planning process. For example, you may want to visit the site again with a contractor, DUC representative, regulations staff, or have a vegetation survey conducted.

The landowners you are visiting are volunteering their time and land for projects, and so it is important to engage them in the process and ask for their opinions and ideas for you to take into consideration. They also will have information and experiences to share with you about their property, and can be very helpful when trying to answer the *Wetland Criteria for Site Visits* list (Appendix xx.).

Lastly, based on your assessment, not all projects will fit into your wetland restoration program. After the information gathering process, if it is determined that a wetland cannot be constructed, there still may be other stewardship opportunities (tree planting, BMP's) on the property to consider. If applicable, refer the landowner to a more appropriate contact, partner, and/or program (Ducks Unlimited, 2010).

4.d Survey

The reason for surveying is to determine the various slopes (inclines and declines) and distances across the landscape. It is used to show the high and low areas, it will highlight draws (a low gully where the water tends to travel), and existing areas where the water might already collect and pool.

What you need in order to survey is listed in *Appendix xx. Wetland Survey Field Equipment List*.

The process of how to survey using the ABCA's total station equipment is described in *Appendix xx. Total Station Set-Up and Download Instructions*. Some additional useful tips to consider while surveying include:

- Requires at least two people: one to stand near total station and one to carry the rod
- It is ideal to have the total station set up in only one location. The goal is to try and find a location on the landscape that will be able to pick up the rod's signal from every point. Usually this location is at a higher elevation point (as the rod has a length of 2.5m) and you are able to travel up to 2.5m down the grade from the benchmark.
- Areas to take survey points from include:
    - water draws (survey along the draw and take cross sections)
    - around proposed wetland area with some cross sections
    - along area where there is a berm being considered with a few cross sections (every 5- 10 m)
    - lowest area where you would not want to flood past (e.g. neighbours field, edge of property)

Personnel that have experience and can assist with surveying include Ducks Unlimited Canada staff, a representative from the local conservation authority, or tender out this task to contractors.

Additional Resource: "Using a Total Station in surveying technology"
http://totalstation.org/surveyingtechnology.php

4.e Site design

Appendix xx. Wetland Restoration Design Example

A design should include a rough sketch of the wetland from overhead, the position of the inlet (where the water flows in) and outlet (where the water flows out) and depth of basin. The design you pick for your wetland will depend on a number of factors including:

- Site history- are you restoring a drained wetland or creating a new one?
- Slope across the site
- Size of proposed wetland
- Water depth (permanent vs. non-permanent wetland)
- Amount of water flowing into your wetland (catchment area= area that provides surface runoff into your wetland) The amount of water entering your wetland will determine how long it will take to fill, how long it stays flooded (soils and infiltration) and what sort of spillway you need to release excess water (stone, grassed waterway, use of rip rap, erosion mat).
- Use of water control structures
- Your budget
- Additional costs (Table xx)

If you are creating a wetland, the first major decision you have to make is whether to dig (excavate) or create a berm (impound). This is determined by the slope (see figure xx.) Excavating is usually more expensive (cost/hectare) than building a berm and also leaves you with a lot of dirt (spoils) to spread and tie into the landscape and making it look natural.

Moderate Slope: Constructing small berms to create or restore wetlands; Blocking Drainage Ditches to restore drained wetlands
Little or no Slope: Excavation to create wetlands; cutting buried field tiles
Choosing the proper technique:

- Where there is little or no drop, excavation (digging) is usually recommended because there is not enough slope to contain the water on the site. (0-2 feet drop across 100 yards slope)

- This range is ideal for impoundment (berming). This method creates a wetland by holding back water with an earthen barrier. Maximum area vs. cost (2-4 foot drop across 100 yards slope) May need basin area to hold water or more excavation is required.
- Excavation or impoundment on steep slope is generally not recommended due to high construction costs and lower wildlife values (Over 4 feet drop across 100 yards slope = too steep) Will not store much water as it will be really steep, small wetlands, more risk for erosion because water is moving faster in concentrated areas. May have to do a series of step pools and it may not be worth the cost for the small size of the wetlands.

Source:
Ducks Unlimited Canada. No date. Wetlands on My Lands?

Wetland Project Sequencing

A. <u>Develop Project Concept</u>

- with landowner input: develop simple concept plan for wetland project (GIS mapping if possible), include size, location, other stewardship elements etc.
- you or landowner to pre-consult with CA planner and ecologist to determine regulatory limitations. This may change concept, location, or eliminate project. A site visit with CA staff is usually very helpful at this time
- consider other regulatory: MNR, MOE, NEC, DFE etc. Consult if necessary

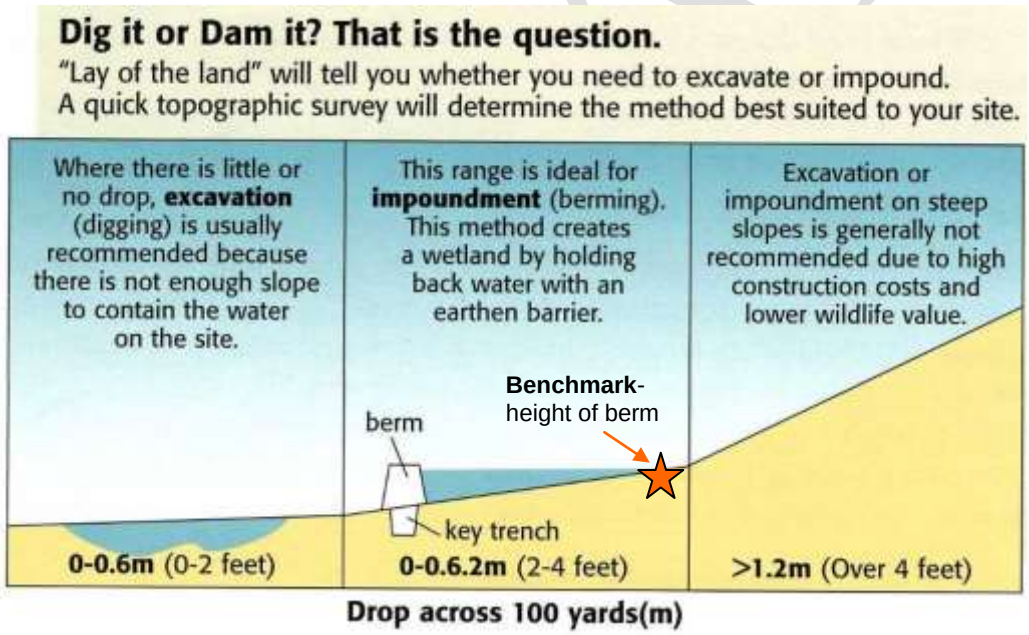


Figure xx. Choosing a wetland design based on the slope conditions *(DUC, 2010).*

Landowner Verification

It is important to discuss and verify the project design with the landowner. There may be some needed negotiation or modifications to the project concept if necessary (Ducks Unlimited Canada, 2010). This is a good opportunity to have the landowner sign any necessary agreements and permits for the project to

move forward (i.e. documents associated with funding such as Ducks Unlimited Canada or Huron Clean Water, and a possible landowner agreement, Appendix xx.).

B. Finalize Project Design
- complete topographic survey if necessary (usually for impoundments/bermed wetlands)
- complete final site plan (GIS if possible)
- secure contractor/material quotes to determine funding needs
- have landowner sign program agreement to secure his commitment and allocate your funding
- seek additional partner funding if necessary, determine landowner contribution (cash and in-kind)

Ducks Unlimited Canada. 2010. Duck's Unlimited Canada's Partner Workshop: The Why and How of Wetlands.

Construction of Surface Water Wetlands
- wetlands designed to hold rainfall and runoff are shallow depressions consisting of compacted soils that are high in clay.
- The following soil textures can be used to form a wetland that will hold runoff:
    - silty-clay; silty-clay-loam; sandy-clay; sandy-clay-loam; clay loam; and clay
- not being able to dig a test hole because of too much rock indicates that soils are quite permeable and not suited for building a surface water wetland
- In areas where rainfall exceeds evaporation, a wetland that does not have a watershed can be successfully built, as long as soils are high in clay, and can be compacted to prevent water from seeping into the ground
- logs placed in wetlands provide sites for turtles and snakes to bask, perches for birds to hunt from and to rest on, and moist protective cover under which salamanders will lay their eggs (Biebighauser, 2011),

(Biebighauser, 2011), T.R. 2011. Wetland Restoration and Construction, A Technical Guide. Upper Susquehanna Coalition. China.

Table xx. Additional Cost Considerations (DUC, 2010)

Item	Description	Cost
Rip Rap Spillways	Purchase and place materials	$800 - $1,500
Rip Rap protection	Around Water control structure control and outlet	$800 - $1,500
Clearing and Grubbing	Removal of trees and woody material from work area	$200 -$1,000
Silt Control	Purchase and installation of silt fencing/ straw bales	$50 - $100+
Seeding	Purchase seed and place	$100 - $400+
Control	Debris protection	$200 - $1,000
Signage	Gate Post, 3'x'5, 4'x8'	$50 - $1,500
Construction Supervision	If necessary; varies by project type	$500 - $2,500
Conservation Authority (CA) permit fees	Varies by CA, some will reduce fees for conservation projects	~ $75
Access	Consider length and quality, is brushing required	

	for equipment access etc	
Timing	The drier, the better costs	
HST	13% is an additional cost to consider	

Listed below are calculations, conversions, and conversion tools, which can be helpful throughout the project design process.
Calculations:

- Volume = length x width x height

Conversions:

- 1,000 L = 1 m^3
- 1 acre= 4,046.856 m^2
- 1 hec = 2.47105 acres
- Meters to acres: http://www.metric-conversions.org/area/square-meters-to-acres.htm
- Hectares to acres: http://www.metric-conversions.org/area/hectares-to-acres.htm

i. Berms

Background
A berm is a man-made mound of dirt used to hold back (impound) water behind it (Ducks Unlimited Canada. No date). Berms are commonly the most cost-effective and successful way to create or restore a wetland, and are optimally used when the slope across your site is between 0.6- 12m (Figure xx). To create a wetland, you must place your berm in the path of surface flows at the lowest point around your wetland (Ducks Unlimited Canada. No date).

The simplest type of berm, a fixed level berm, is one that does not allow changes to the water level in the wetland (Ducks Unlimited Canada. No date). The water level builds up behind the berm until it flows out of the spillway. This type of berm is recommended when inflows are not large or where small (<1 ha or 2.5 acres) wetlands are being created. Larger wetlands may require additional water control structures such as hickenbottoms or Water control structures that are incorporated into new or existing drainage systems. These control structures are discussed in greater detail in Section 4.e.iv.

Berm design: (Biebighauser, 2011).
Generally, the more gradual the slopes and wider the top of the dam, the better it will blend with its surroundings. Other advantages include reduced maintenance costs associated with muskrats and beaver tunnelling, less potential for flood damage, few leaks from tree roots and greater plant diversity (Biebighauser, 2011).

- To determine how high the dam ought to be, it is necessary to measure the slope on the area where the wetland is to be restored. The height of the dam should be equal to the difference in elevation between the highest desired water level and lower edge of the work area.
- Building one high dam is generally more expensive than building several low dams. There are other advantages to building a series of low dams instead of one high dam, which include creating more naturally-appearing wetlands, having the ability to manage a series of wetlands at various depths.
- wetlands with low dams and shallow depth contain greater diversity of plants and animals than deep wetlands with high dams.
- Keep the maximum height if the dam below the elevation of neighbouring property.

Site preparation: (Biebighauser, 2011).

- the first step to restoring a wetland involves removing trees, shrubs, grasses, and topsoil from the area where the dam will be located, and the area in front of the dam where the soil will be removed to build the dam.
- Save the vegetation and topsoil for later spreading over disturbed soils by placing it in piles along the upper edge of the work area.
- The upper layer, containing a majority of organic material, is saved in piles, while the lower area, containing more mineral soil, is heaped in a row along the lower edge of the work area for use in shaping the backside of the dam
- It is important to remove all topsoil from the dam location and the area in front of the dam where soil will be taken to build the dam.
- Topsoil contains roots and leaves that will cause leaking if left under the dam.

Construction

- Survey the site to define the wetland area
- Stake out wetland boundary as determined by site survey
- The best time to construct a berm is during the driest part of the year (usually late summer or early fall).
- Topsoil Removal
    - Remove topsoil from the area where the berm is to be built and stockpile (this can be used to cover the berm later)
    - Clear away the topsoil from the berm location to ensure there is a good seal between the berm and native soil
- "Key" the berm.
    - "Key" the berm. This layer of compacted impermeable soil beneath the berm which acts as a barrier to water movement under the berm. A small bulldozer or tractor with a bucket can do this job. The key should be approx. 60 cm (2ft) wide by 60 cm (2ft) deep. Male sure the soils in the key have a high clay content to prevent water seepage. If you don't complete this step your berm will probably wash away within a short period of time
    - The "key trench" runs underneath the length of the berm and is backfilled with clay soil to ensure water does not seep through the berm.
- Construct the berm.
    - Construct the berm using impermeable soils from the proposed wetland area
    - Minimum berm height should be at least 60 cm (2ft) above the maximum proposed water level in the wetland. You should construct the berm with a minimum 3m (10ft) wide top. This will allow you to drive a vehicle or tractor across the berm if required. Make the berm with a series of soil layers 20cm (8in) thick or less.
    - The material to be used to construct the berm must be a minimum 10% clay and be free of stones and debris
    - Topsoil should be scraped away from the berm location, stockpiled and replaced following construction completion
    - Berm to be dressed with a minimum 20 mm top soil to facilitate vegetative growth
    - Actual berm construction should consist of 150 mm layers, placed and compacted progressively until the desired elevation is reached
    - Allowance should be given for freeboard and settlement
    - Compact each layer with a pass of a bulldozer or tractor, Make the side slopes gradual to prevent erosion (30cm (1ft) vertical for every 100cm (3ft) horizontal)
- Spillway (See Section iv. For more information about spillways and additional water control structures)
    - If your berm is over 1 m (3ft) high then you will need a spillway or overflow to
    - accommodate high water flows. The spillway sets the maximum water level in your wetland and should be about 60cm (2ft) below the top of the berm. Locate the spillway on

either end of the dam on undisturbed ground and cover it with rip rap to reduce the potential for erosion problems

- Finishing touches.
  - Spread excess topsoil over the berm to create a good seedbed.
  - Seed the berm with a forage mix that will establish easily to reduce erosion. Any left over topsoil can be graded back from the site at a gentle slope being careful not to create a donut around the wetland which will block surface flow.

(Ducks Unlimited Canada No date).

ii. Excavations

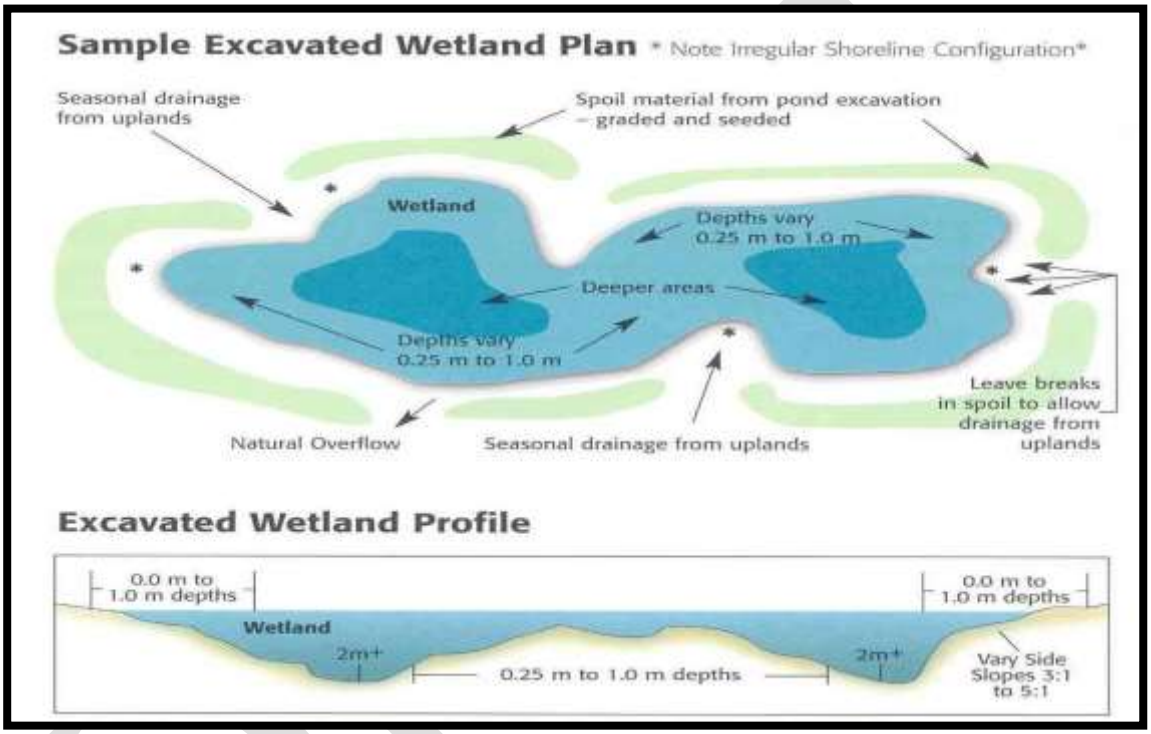


Figure xx. An example of an excavated wetland plan (DUC).

Wetland Depths = ~ 4-5ft (1.2-1.5m) sometimes deeper in the middle. Edges shallow for wildlife access.
Suitable Sites for Small Excavated Wetlands

- where there is adequate water/watershed area
- away from dwellings
- away from human or domestic disturbances
- poorly drained, damp or wet depressions (NOT in high quality wetlands)
- rehabilitation of old farm pond
- municipal drains
- regulated areas: floodplains, wetlands…. Yes but discuss regulations first. Possible wetland sites may be ones degraded by sediment infilling from past agricultural use of uplands

Unsuitable Sites for Small Excavated Wetlands

- within an existing identified watercourse (intermittent or permanent)
- healthy, functioning wetlands (with diverse wetland vegetation)

- identified hazard lands (steep slopes, erosion concerns)

Characteristics of Small Excavated Wetlands
- shallow with variable depths (0.3 to 1m max.)
- irregular shoreline (maximize edge)
- gentle side slopes (3:1 wetland to upland ratio, 10m or >)
- secluded location to reduce wildlife disturbance
- small in size (1 acre or less)

Wetland excavation: Average 0.7m deep with 3:1 slope (shallow and deep areas)

Excavation Steps:

Stake out wetland edges- remember to make the wetland irregular in shape with many bends in the shoreline to mimic a natural wetland

Strip off any organic soils from the site and set aside. This soil can be placed back in the bottom of the wetland after excavation to provide a good seed bank and growing substrate for native wetland plants

Excavate the wetland with an undulating bottom to encourage various types of vegetation. Wetland vegetation provides wildlife habitat and will keep your pond healthy but you may want to excavate some deeper pockets that will remain free of vegetation. This will provide diversity to your wetland and allow you to add some native fish or use one end of the wetland for recreation. You must also consider what you are going to do with the dirt (or "spoil")

iii. Spoils

Spoils are left over soil from the constructed project
- hills and mounds of soil which are reconstructed surrounding the new wetland
- grades of spoils should be at a minimum grade of 3:1 (5:1 is even better)
- size depends on volume of topsoil being excavated

Dealing with Spoil Material
- material spread out around edges (most expensive)
- material placed in trimmed pikes (least expensive)

Basin Size vs. Volume
- equipment can move 500m3/day
- 0.1 ha (0.25 ac)
    - Size 32x32m (105 ft x 105 ft)
    - Approximate Volume: 650 m3 (850 yds)
    - 1.5days
    - 48 trucks?
    - $1,000/day + transport + extra incidentals
- 0.2 ha (0.50 ac)
    - Size 45x45m (148x 148ft)
    - Approximate volume: 1,400 m3 (1830 yards)
    - 3.5 days
    - 102 trucks
    - $5,000
- 0.3 ha (0.75 ac)
    - Size 55mx55m (180x180 ft)
    - Appropriate volume: 2250m3 (2945yd3)
    - 5 days

Spoil Material Placed Adjacent to Wetlands in Trimmed Piles (most economical)

- trimmed spoil piles: height around 4' and sloped
- excavator can work all around pond reducing the amount of double handling the material which will increase the costs

Spoil Material Spread Out around wetland (expensive and requires more land to spread material)

- excavator pulls out material while dozer places around pond

Spoil Material outside floodplain adjacent to wetland (most economical if excavator and dozer can work to place material adjacent – again more economical if spoil can be placed in trim piles rather than spread over upland)

Spoil Material Outside floodplain haul operation (most expensive)

iv. Water Control Structures

A water control structure…There are a few water control design structures to choose from. It is important to consider the watershed size and the volume of water that could potentially come into the wetland system, when deciding which control structure is best to include in your wetland design. Watershed Sizing

- Important consideration in sizing controls
- Water control structures have limited capacity and used to vary wetland water levels
- Rip Rap spillway required – width depends on watershed size/ design flow

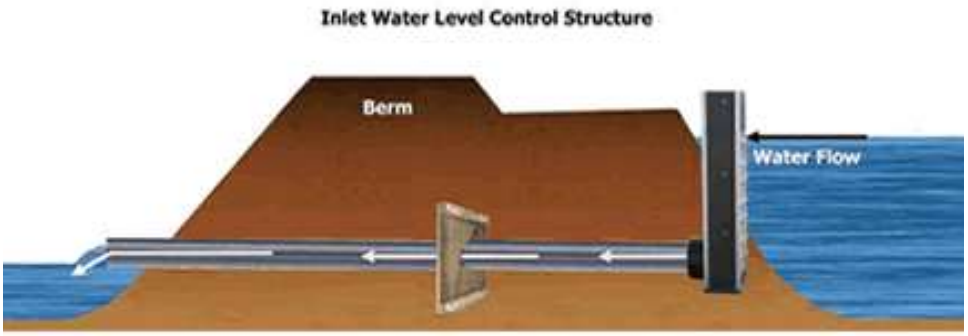
- Installing a water control structure and drainpipe in a wetland provides flexibility in how the wetland can be managed. Being able to adjust water levels can be critical for establishing and maintaining plants, and for controlling unwanted plant and animal species.

- A disadvantage to installing a water control structure is that it adds something that will itself have to be maintained in the future. If one's goal is to restore a wetland that will require no maintenance in the future, it is best to design the wetland so it will meet objectives without installing a water control structure or drainpipe.

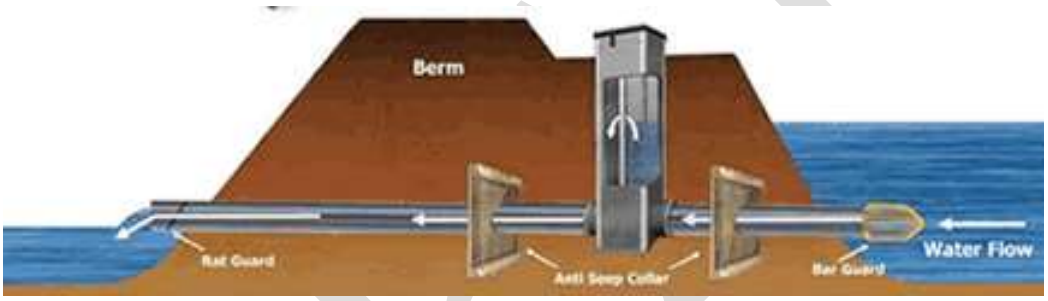
Variable Level Control Structure= a spillway with the capability to change upstream water levels by inserting or removing a series of stop logs or boards

Water control structure

Inlet Style Water control structure – surface draw Harder to backfill around Prefer Inline style



Inline Style Water control structure – bottom draw comes in variable sizes and pipe diameters



Anti-seep collar seen above is a membrane device which prevents water from running over the tile and seeping and cutting into the berm.

Control Consideration:
Inlet style Water control structure – surface draw

- harder to backfill around
- preference for inline style

- www.agridrain.com

Inline Style Water control structure- bottom draw

- Comes in variable sizes and pipe diameters

Grass Spillway

Spillway= a channel or passageway around a berm through which excess water is released

- it is important to direct how waters leave the wetland to prevent damage and erosion
- The spillway is a safeguard, like an overflow drain on a bathtub
- The entrance of the spillway is set at an elevation lower than the top of the dam
- A spillway is usually located at one end of the dam, where it ties to higher ground
- The spillway is created after the dam is built, to ensure its entrance is lower than the top of the finished dam.
- The entrance of the spillway should be set from 6-12 inches below the top of the dam.
- Since few earthen dams are built perfectly level, it is always a good idea to use a survey rod and level to check elevations along the top of the dam before creating the spillway
- It is important to be on-site when constructing the spillway to ensure that it is in the best location, has the correct elevation, and a gradual slope, as wetland failure can result from improper construction of the spillway
- Rock may be needed when waters flow down a spillway over steep ground or across soil not protected by vegetation
- Rock is also needed when the spillway is expected to carry water on a regular basis

Rock Spillway

Filter cloth usually comes into play with riprap. Otherwise you might consider straw matting spread over the spillway after seeding. It holds the seed and moisture in place and really promotes it grassing up in a hurry.

Rip Rap= A layer of coarsely broken rock (10-30 cm in diameter) placed on soil to reduce erosion by running water

Hickenbottoms

Definition
Usage
Installation methods
Maintenance?

Resources:
Inlet/Intake Products Catalogue:
http://www.hickenbottominc.com/downloads/catalogs/Hickenbottom_Inc_Inlet-Intake_Catalog_(v3).pdf
Website: http://www.hickenbottominc.com/

v. Tiles

Tile drainage= land drainage by series of buried tiles or perforated pipes laid at specific depth, grade and spacing

"Cutting" Buried Drainage Tiles
If a field has been tile drained, it is possible that there were wetlands in the field before the tiles were installed. In agricultural fields that have been retired from production, it can be a simple matter to restore wetlands that used to occupy the field by breaking or "cutting" the buried field tiles and blocking them so that water no longer can drain into them. This work almost always requires a back-hoe or high-hoe. A site inspection in the early spring can help you find the low areas in the field that will most likely to hold water. The most difficult part will be to determine where the buried tiles are located but a tile contractor or experienced high-hoe operator can help you out. In order for this technique to work properly, at least 2m (6ft) of tile should be removed and the resulting trench fill with compacted soil.

vi. Vegetation

Seeds
After wetland construction is completed, it is important to cover all bare, exposed and disturbed soils with vegetation. This seed cover will protect the newly made wetlands and heir surrounding areas from eroding and/or washing away, and therefore improving the water quality within the wetland and if applicable further down the system.
Contractors are responsible for buying the seed mixture and seeding the construction area. The areas should be seeded with a grass mixture identical to the following DUC mixture:

- 12% Coated Birdsfoot Trefoil
- 20% double cut Red Clover
- 26% Creeping red fescue

- 10% Annual Rye Grass
- 25% Kentucky Bluegrass
- 7% White Clover

Always allow landowner to review the vegetation list (above). Certain farming practices, surrounding land uses or allergies may eliminate certain species from your list.

If the construction takes place after the early October, it is advised that the contractors add a layer of straw on top of the seed. This straw will prevent erosion, and will retain moisture in the soil needed for seed germination growth *(Biebighauser, 2011).* It is better to use straw instead of hay, as straw contains fewer weeds and is much easier to spread *(Biebighauser, 2011).*

Lastly, the entire area should be seeded a second time by the project lead with the DUC-like mixture. This will ensure that grass seed is distributed and it will establish as soon as possible. This can be done soon after contractor spreads seed or the following spring season if the project is completed in the late Fall.

- vegetation should be planted on exposed soils as soon as possible after construction to protect wetlands from being damaged by heavy rain.
- a layer of straw protects soils from washing, and helps to retain moisture in the soil needed for seed germination and growth
- a layer of straw makes it possible for seed to develop and grow in late summer, even under drought conditions. Straw contains few, if any, weeds, and is much easier to spread than hay.

Aquatic Plants

Planting native aquatic plants within a constructed wetland can speed up the process of creating a natural habitat. It can also prevent non-native species from growing in the disturbed area.

Choosing which plants to include

Water Depth and Wetland Plants

- water depth will determine what vegetation and how much of it will grow in your wetland
- wetland plants form the base of the wetland food chain, provide habitat for wildlife and help keep your wetland healthy
- emergent vegetation will grow in water depths of 1m or less
- it is advisable to design your small wetland so that approximately 25% of the surface area is 1m or more in depth to ensure an ideal mixture of vegetation and open water areas.

Planting instructions: Mary Gartshore has mentioned 1-10 plants per meter squared.
I think 1 or 2 is enough/m2

Table xx. Common Native Aquatic Plants to Order and Plant in areas surrounding Wetlands

Common Name	Scientific Name	Preferred Environment: Dry (D), Medium (M), Wet (W)	Colour
Canada Anemone	*Anemone canadensis*	W	white flower
Swamp Milkweed	*Asclepias incarnata*	M	pink flower
Heath Aster	*Aster ericoides*	D	white flower
Smooth Aster	*Aster laevis*	D	purple flowers
New England Aster	*Aster novae-angliae*	M	purple flowers
Frost Aster	*Aster pilosus*	M	white flower
Purple-stemmed Aster	*Aster puniceus*	W	purple flowers
Flat-topped Aster	*Aster umbellatus*	M	white flower

Common Name	Scientific Name	Preferred Environment: Dry (D), Medium (M), Wet (W)	Colour
Arrow-leaved Aster	*Aster urophyllus*	M	white flower
Fringed Brome	*Bromus ciliatus*	W	grass
Canada Bluejoint	*Calamagrostis canadensis*	W	grass
Fringed Sedge	*Carex crinita*	W	green
Porcupine Sedge	*Carex hystricina*	W	green
Hop Sedge	*Carex lupulinus*	W	green
Fox Sedge	*Carex vulpinoidea*	W	brown
Canada Wild Rye	*Elymus canadensis*		grass
Joe-Pye-Weed	*Eupatorium maculatum*	W	pink/purple flowers
Boneset	*Eupatorium perfoliatum*	W	white flower
Wood Strawberry	*Fragaria vesca*	M	yellow flower
Wild Strawberry	*Fragaria virginiana*	D	white flower
Sweet Ox-eye	*Heliopsis helianthoides*	M	yellow flower
Blue Flag Iris	*Iris versicolor*	W	blue flower
Great Lobelia	*Lobelia siphilitica*	W	blue flowers
Monkey Flower	*Mimulus ringens*	W	purple flowers
Wild Bergamot	*Monarda fistulosa*	D	purple flowers
Evening Primrose	*Oenothera biennis*	D	yellow flower
Hairy Beardtongue	*Penstemon hirsutus*	D	purple flowers
Virginia Mountain Mint	*Pycnanthemum virginianum*	D	white flower
Brown-eyed Susan	*Rudbeckia hirta*	D	yellow flower
Green-headed Coneflower	*Rudbeckia laciniata*	W	yellow flower
Dark Green Bulrush	*Scirpus atrovirens*	W	green
Grey Goldenrod	*Solidago nemoralis*	D	yellow flower
Rough-leaved Goldenrod	*Solidago patula*	W	yellow
Tall Meadowrue	*Thalictrum pubens*	W	white flower
Blue Vervain	*Verbena hastata*	W	blue flower

Resources:
St. Williams Nursery & Ecology Centre. 2012. http://www.stwilliamsnursery.com/. Retrieved: February 22, 2012.

Wetland buffers, fencing, plantings
- DUC will provide funding (as per cost-share) for the establishment of permanent wetland buffers
- Minimum 10m wide and delineated by posts
- Funding can go towards purchase of materials, installation, and limited buffer plantings

Group Plantings
Huron County- Jacqui Laporte (OMAFRA) is a great person to contact for organizing groups to plant aquatics. She is always looking for opportunities.
ABCA- Contact ABCA education staff

vii. Nest boxes

- installed by Darrell Randall (DUC) or by landowner
- bat boxes
- wood duck boxes
- mallard boxes

- blue bird boxes

Nest Boxes

- DUC can provide nest boxes and reporting cards
- Landowner or other partner to install and maintain
- Annual monitoring info to be sent to DUC for on-going study

4.f Permits

Each of the permits described in more detail below, are associated with the construction of wetlands. Deciding which permits need to be submitted, is dependant on where the project is taking place and which organizing partners are involved. Some locations (e.g. floodplains) and some project partners (e.g. Duck's Unlimited Canada) require certain permits to be submitted for approval before the work is completed. For example, an Environmental Assessment and Permit to Take Water must be completed when planning to receive funding from DUC.

Each permit is submitted by the landowner; however due to the information needed to complete these permits, most of the time they are completed by the program administer and submitted on behalf of the landowner, with their consent (Appendix xx- Landowner Authorization Form).

Conservation Authority (CA) Permits

Conservation authority (CA) permits are usually required when projects are designed within a floodplain or near a naturally significant area. Contact the local conservation authority's regulations officer to confirm whether or not a permit is required. It is also important to keep in mind that sometimes permits are conditionally accepted and require specific design elements (e.g. berm height and size). The CA regulations officer may also require a few site visits (before and after) to determine whether or not the design conditions were met and whether or not to grant a permit.

A CA permit costs approximately $175.00 to be processed. This cost is usually absorbed by the wetlands program and is covered either by the MNR's Canada-Ontario Agreement (COA) funding, or it could be incorporated into the construction costs when funded by other funding programs.

Contacts:

ABCA watershed: Andrew Bicknell, ABCA Regulations Coordinator/Officer (abicknell@abca.on.ca)

External (Huron and Middlesex Stewardship Council's area, outside the ABCA watershed): have Stewardship council representative call the local CA

Permits to Take Water (PTTW) - Ontario Ministry of Environment (MOE)

A permit to take water (PTTW) is a regulation from the Ontario Ministry of Environment (MOE). It is required when a wetland is anticipated to store above 50,000 L of water/day. This translates to a small size (50m3) wetland which requires a PTTW.

Have landowner sign completed PTTW application, and landowner authorization form and provide a photocopy of driver's license. Scan all signed documents and save a copy for your files. Mail the original application to the Toronto MOE office (address on first page of PTTW application form).

The MOE will post information on the Environmental Bill of Rights (EBR) Registry for 30 days. Check the EBR site and search for landowners name to find the Ministry Reference Number. Record the Ministry Reference Number (PTTW number for that application) for your files along with the date that will complete the EBR posting (potential permit date issued soon after that). The permits are good for 10 years. The Toronto MOE office will submit the permits to the local London MOE office to complete the permitting process. As long as the PTTW is a conservation or wetland project, there will be no fee.

Reporting of water takings will need to be completed each year and are due March 31 of each year. Landowners will receive a letter with the password and instructions on how to enter the numbers and can call MOE for guidance. Ducks Unlimited Canada have discussed with MOE about allowing landowners to record 'zero water taken' each month if they don't know how to calculate the numbers, as the typical water taking is '0'. Ross Wilson of ABCA can help with calculating numbers if required, as he has set up a spreadsheet to calculate rainfall and evaporation over the year and how much water would be required to fill the wetland if evaporation occurs.

I provide a copy of the PTTW application on a CD with some photos of the project and provide to the landowner for future reference.

There is also a draft risk assessment tabulation guide that partners (MOE, DUC, Stewardship Ontario, Conservation Authorities, Stewardship Coordinators and other partners creating wetlands) have come up with to help guide what risk level it is for MOE and what category the wetland would fall under for the conservation partners applying for the PTTW application. It is still in review and has not been accepted yet, but eventually when it is accepted; it will allow us to apply for category 1 and category 2 permits instead of just getting lumped into category 3 permits.

A permit to take water (PTTW) is a regulation from the Ontario Ministry of Environment (MOE). It is required when - required when wetland stores above 50,000 L of water/day
- 1,000L= 1m3, therefore 50,000L = 50 m3 = size of wetland which requires PTTW completion
- information required for category 2 or 3
Items to Include in Application:

- Cover letter
- Application for PTTW
- Landowner Authorization Form
- Water Conservation Schedule
- Schedule 3- Qualified person certification
- Category 2 or 3 Surface water takings (found in Appendix E of the PTTW Guide)
- Proof of Legal Name
- Wetland Design and Maps
- Water Usage Discussion/ Project Description
- Water Needs Discussion

Note: Hydrology reports have been required in the past for category 3, but are not necessary because the rest of the report should already include sufficient information
Helpful tips: Water Taking Volumes- calculations section

- max # days/year always = 365/year
- typical volume/day = always 0
- also include source water calculations
- may wish to have pre-consultation meeting with London MOE staff to discuss projects and reporting process

Permit to Take Water: PTTW

- reason for PTTW program: conservation of Ontario water resources
- regulation of PTTW through the MOE (OWRA)
- PTTW is currently required for wetland restoration projects
- A risk0based assessment system is applied to applications
- Each category (1,2 and 3) has unique requirements for submission
- For DUC projects, MOE classifies projects according to volume of proposed wetland
    - Category 1: less than 1500m3
    - Category 3: more than 1500m3

Additional Resources:

MOE PTTW website and general information:
http://www.ene.gov.on.ca/environment/en/industry/assessment_and_approvals/water_taking/STDPROD_075554.html

Guide to Permit to Take Water Application Form:
http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079452.pdf

Includes Schedule 1 Water Conservation Measures (pg 57-58 of Appendix E) and Schedule 3 Certified Person Certification for Category 2 Surface Water Takings (pg 63-64 of Appendix F).

Application for Permit to Take Water:
http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079451.pdf

Environmental Assessment- Ontario Ministry of Environment

Tree cutting by-laws- Local Municipalities

C. - Permits

- landowner will apply for/retain all required permits

Possible Permits/ Review Required

- Conservation Authority
    - Interference with wetlands, floodplain regulations, etc.
- Ministry of the Environment
    - Permit to Take Water (PTTW)
- Ministry of Natural Resources
    - MNR permits for LRIA, SAR
- Department of Fisheries and Oceans
    - If there is a concern for fish habitat
- Tree Cutting By-laws
    - Check with local municipalities
- EA Screening
    - If provincial partner funds involved

4.g Tendering

As stated in the Ausable Bayfield Conservation Authority Human Resources Personnel Regulations document (2010), it is required for ABCA staff to tender for three telephone quotations for any material or equipment purchases, rentals, and/or services over $3,000. At least three written quotations are required

for any material or equipment purchases, rentals or services which are greater than $7,500.00. All quotations are to be submitted to the Financial Services Coordinator to be retained for audit purposes. For contracts over $3,000.00, the lowest quotation will be accepted. Where other than the lowest tender is to be accepted, ABCA staff needs to submit a report to the ABC Board with explanation and details.

I came across some prices from a contractor and other little details that might help:

$150 to $155/hr x 10hrs/day

$5,000/acre okay for berms but more for excavation.

Ask other ABCA staff who a good contractor is
If landowner is paying up front for costs, they do not require three quotes (they may want a specific contactor
Ask contractor to order water control structure and place water control structure dimensions in tender.
Alec or Tom will need to sign off on tenders
Tracey can create elevations map
- give tenders at least 2 week's notice after delivery (depending in type of delivery e.g. fax, mail, email)
- give contractors a call to let them know it's been sent
-should always request written quotes for records

Appendix xx. Tender Proposal Example

How much will this cost?

- the cost of your wetland project depends on many factors including: type of equipment used, ease of access, soil moisture content, size, and spoil placement method.
- Try to create your wetland during the drier times of the year when the equipment can work more efficiently
- Get 3 quotes from experienced contractors to undertake the work
- Layout the wetland (flag the areas off) and obtain your quote for the complete job or priced hourly
- Ensure your contractors understand what you want to achieve so they are all quoting the same amount of work. This way you avoid increased cost later. If they have underestimated the work

Recommended Equipment

- track excavator ($95-115/hour) plus float
- Dozer & Track excavator (dozer $65-95/hour)
- Dragline/ Mats ($110-150/hr)

Not recommended

- rubber tired loader and backhoe (very limited reach and bucket capacity)
- skid steer loader

When xx out tenders, give contractors at least 2 week's notice after delivery (depending in type of delivery e.g. fax, mail, email)
- give contractors a call to let them know it's been sent
-should always request written quotes for records

The equipment used for constructing wetlands is listed in *table xx*. The most common equipment used for building wetlands are the dozer and excavator. These two machines are most effective when they are

mounted on tracks instead of tires, because this prevents them from getting easily stuck in the wet soils (Biebighauser, T.R. 2011). The dozer can be used for scraping, moving, shaping, packing, and spreading soils, and the excavator is useful for digging, sorting soils, and placing wood and rock (Biebighauser, T.R. 2011).

Table xx. Common Equipment used for Building Wetlands

Machine	Activities Description	Photo
Excavator	- toppling trees on the worksite - digging ditches to drain worksite prior to construction - removing and sorting gravel and clay layers for dam construction - removing buried drainage structures - planting large snags or trees - loading tucks with soil and rock	
Dozer	- moving toppled trees - scraping and moving topsoil - filling and packing the dam - building, shaping, and packing the dam - shaping the wetland pool area - replacing topsoil when completed	
Backhoe	- repairing muskrat and beaver damage caused to dams - moving small quantities of soil	
Tack-steer	- moving small quantities of soil	
Scraper	- moving large quantities of soil over long distances - compacting dams - levelling large areas	

Information from the above table was provided by:

- Biebighauser, T.R. 2011. Wetland Restoration and Construction, A Technical Guide. Upper Susquehanna Coalition. China.
- Photo Sources:
  - *Excavator:* http://www.theconstructionmachinery.com/gifs/excavator1.jpg
  - *Dozer:* http://www.deere.com/common/media/images/product/crawler_dozers/650j/JD401523_ce_642X462.png
  - *Backhoe*: http://image.made-in-china.com/4f0j00rMATaElYvRcn/Backhoe-Loader-LGB680-59KW-.jpg
  - *Track-steer*: http://images1.hellotrade.com/data2/DI/CK/MY-2198627/bobcat-skid-steer-loader-track-loader-250x250.jpg
  - *Scraper:* http://www.miniature-construction-world.co.uk/gallery/historic/cat666/IMG_2785.jpg

4.h Onsite supervision

D. Construction/Completion

- Consider time of year, weather, permit timing windows etc. to begin when conditions are favourable

- You or landowner arranges contractor beginning the work
- Supervise construction to ensure compliance with plan. Some on-site adjustments may be necessary at construction
- Ensure adherence to permit conditions, E&S plan, etc.
- Upon completion, seeding of all disturbed areas to reduce erosion potential. Other plantings can now occur.
- Complete other planned stewardship activities as time/season permits: nest boxes, trees and shrubs plantings, fencing, etc.
- Monitor to ensure success

- Wetland construction projects can generate large piles of topsoil. Deciding what to do with it can affect the success and cost of a wetland project.
- Spreading a loose layer of topsoil over the finished wetland will improve conditions for the growth of plants compared to leaving compacted minerals on the bottom.
- Topsoil can also contain seeds of wetland plants that have lain dormant for years, and with inundation, these seeds may germinate and grow in the restored wetland

Obtaining Compaction:
- Constructed surface water wetlands can fail to hold water if soils are not compacted during construction. There are a number of ways to determine if soils are being compacted when constructing a wetland:
    - a hard ball can be formed by hand that will not break apart when dropped
    - a thin ribbon or tube of earth can be formed by hand without adding water
    - equipment tracks and vehicle tires will stay on top of the soil and not sink after repeated passes
    - it is difficult to dig a hole by hand with a shovel
    - soils have a smooth, hard surface when cut with a dozer blade, not tearing apart or appearing grainy
- suitable compaction can generally be obtained by requiring the tracked dozer or excavator to travel over each layer of soil 4x or more as it is spread in layers of no more than 6 inches thick before being compacted.

4.i Long-term care and Maintenance

Other Wetland Enhancements
- establish a buffer around your wetland (10m or >) but any buffer is better than no buffer
- exclusion fencing for livestock
- install nest boxes to increase cavity nesting for wood ducks, hooded mergansers, screech owls, tree swallows and other wildlife
- plant native trees and shrubs to increase wildlife cover, food availability
- place a few thick branches or logs into your wetland to provide baking areas for waterfowl, frogs, and turtles

Management considerations
- excavated wetlands will mature completely in 305 years without active planning but planting will speed up this process substantially.
- Placing topsoil back into excavation will provide productive soil horizon and possible seed bank for submergent and emergent vegetation growth
- Maintaining wetland buffers will reduce erosion and sediment inputs into the wetland. This will reduce the need for disturbance/sediment removal costs in the future

- Monitor vegetation response to available water and created depths. Adjustments and/or additional management may be required to optimize conditions
- If constructed properly, these sites are relatively maintenance free.
- Maintenance of PTTW is an ongoing consideration for landowners/ implementers to be aware of.

- Muskrat holes in berms… prevented by chicken wire

See Appendix xx. Wetland Inspection Form

- ask landowners to take photos of flooding events and year round

Upon completion of project, the landowner receives a CD which includes the permits, photos and site map of their wetland project

4.j Timeline

The entire project process can take six months to one year to complete. The project timeline is dependant on the wetland project type, permitting and requirements, available funding, landowner funds, weather, and time available to implement. Table xx lists optimal times throughout the year to complete specific tasks related to completing a wetland project.

Table xx. Wetland Project Activity Timeline

Activity	**Optimal Time for Completion**	**Notes**
Outreach	Ongoing	
Prep for Initial Site Visit	Ongoing	Soon after contact from landowner
Initial Site Visit	Spring- Fall	Can be completed in winter, but may be difficult to access and properly investigate area (e.g. catchment area, vegetation etc.)
Survey	Early Spring, late Fall	Best when limited ground vegetation and tree cover
Site design	Ongoing	
Construction	Spring (if dry) Late summer- Fall	Ground must be hard enough for construction vehicles
Planting	Spring (April-May) Late summer (August-September)	
Nest boxes	Anytime	Depends on type- Winter (January- February)
Permits	Ongoing	Before construction phase
Tenders	Ongoing	Best time to contact is early spring march-April
Onsite Supervision	Spring Late summer- Fall	Related to Construction
Inspection	Ongoing	A few times up to a year after construction - After flooding in the Spring or heavy rainfall - It is optimal to visit the site during all of the seasons within the first year (view vegetation, berm, spillways, water levels, etc.)

5. Valuable Knowledge

5.1 Wetland vegetation ID

(websites, native nurseries, Sarah Fleishhauers CD with plants and info on wildlife)
Source: Wetland Habitat Management: A guide for landowners. DU

Beggar Ticks – *Bidens frondosa*

Resources:
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The Lake Huron Centre for Coastal Conservation, 1998-2012. Common Reed (Phragmites australis) http://lakehuron.ca/index.php?page=common-reed. Retrieved: February 22, 2012.

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Ontario ministry of agriculture, food, and Rural affairs. 2011. Ontario Weeds: Common reed. http://www.omafra.gov.on.ca/english/crops/facts/ontweeds/common_reed.htm. Retrieved: February 22, 2012.

5.2 Common Wildlife ID

Most common waterfowl species breeding in Southern Ontario
- Mallard
- Canada Geese
- Wood Duck
- Blue-winged Teal
- Black

Waterfowl Breeding Habitats
- Spring Pairing
- Nesting
- Brood Rearing
- Food, water, cover, space

Toads, frogs, salamanders, turtles, wood ducks, Canada geese, shorebirds, bats, dragonflies, muskrats, crayfish,

Muskrats

Beavers

There is no provincial policy governing the handling of problem beaver situations in Ontario. It is the responsibility of each MNR district to deal with beaver problems based on local conditions and within laws regulating fur bearer management (D'Eon, Robert G. et al. 1995.).

It is therefore very important that the landowner contact their local MNR office to find out what the procedure is for dealing with problem beavers on their property.
Generally, MNR will only take action on a beaver problem if it occurs on Crown land, or when beaver activity on private land affects adjacent Crown land, MNR staff will also provide advice to private land owners.

Under the Ontario Game and fish Act, any person may, on their own property, remove a beaver or dam in defence or preservation of property. These land owners can use any available method to deal with problem beavers, with the exception that only a licensed trapper can remove a beaver with a trap or snare. Landowners may be liable for any downstream damages caused by removing beaver dams. All costs are the responsibility of the landowner ($30-$150 per beaver payable to trapper). All water control devices, culvert modifications, beaver control programs, preventative measures are the responsibility of interested parties.

Heavy wire mesh (less than 2.5 cm mesh) or tar paper, wrapped around the trunk of a tree from the ground to 1 m, can be very effective in keeping beavers from gnawing trees. For a large number of trees, fencing can be used to protect the entire area. Wire fences (0.5 m high), and single0strand electric fencing can be used.
Trapping or snaring beavers must be done by a licensed trapper. Shooting beavers may be done by non-trappers on their own property or if permitted by MNR. Shooting at water surfaces poses dangers due to ricochet and may only result in injuring the animal.

If you plan to remove the dam, you should also remove the beaver.

Source:
D'Eon, R.G., Lapointe, R., Bosnick, N., Davies, J.C., MacLean, B., Watt, W.R., and Wilson, R.G. 1995. The Beaver Handbook: A Guide to Understanding and Coping with Beaver Activity. Northeast Science & Technology.

Species at Risk in Area (COESWIC) - Committee on the Status of Endangered Wildlife in Canada
Reptiles:
Five-lined Skink
Spotted Turtle
Lake Erie Watersnake
Eastern Hog-nosed Snake
Queen Snake
Spiny Softshell
Stinkpot
Blanding's Turtle
Wood Turtle
Milksnake
Eastern Ribbonsnake
Northern Map Turtle
Snapping Turtle

Glossary

Area of Natural and Scientific Interest (ANSI)
Area of land and water containing natural landscapes or features that have been identified as having life science or earth science values related to protection, science or earth science values related to protection, scientific study or education.

Berm
A small man-made mound of earth used to hold back (impound) water behind it

Beneficial Management Practices (BMPs)
A proven, practical and affordable approach to conserving soil, water and other natural resources in rural areas.

Draw
A gully shallower than a ravine, where the water tends to travel
Source: http://www.merriam-webster.com/dictionary/draw

Environmental Farm Plan (EFP)
Environmental Farm Plans are assessments voluntarily prepared by farmers in order to highlight their farm's environmental strengths, identify areas of environmental concern, and set realistic action plans with time tables to improve environmental conditions. Environmental cost share programs are available to assist in implementing projects.

Environmentally Significant Area (ESA)
ABCA defines Environmentally Significant Areas as areas of woodlots that contain some wetland features that play an important role in supporting significant plant or animal species and/or serving hydrological functions. A site may also be significant if it supports a remnant or a threatened species of flora or fauna.

Grade
The degree of inclination of a road or slope; *ex.* a sloping road
Source: http://www.merriam-webster.com/dictionary/grade

Groundwater
The water found underground in the soil, wells, porous rocks, and subsurface reservoirs and channels.

Habitat
Food, water, shelter, cover and other elements of the environment that living organisms need to survive.

Headwater Streams
Seemingly insignificant rivulets and seeps that upon convergence form recognizable streams.

Impoundment
A body of water held back by a berm

Non-Point Source
Non-point source pollution occurs when precipitation runs off fields, streets or backyards. As this runoff moves across the land surface, it picks up soil particles and pollutants.

Nutrients
Elements such as nitrogen and phosphorus, which stimulate growth of aquatic plants. The nutrients act as fertilizers and contribute to heavy weed growth and algal blooms.

Species at Risk
Species that are at risk of extinction, extirpation or endangerment globally or within a jurisdiction or region.

Substrate
Stream substrate is the material that is at the bottom of the stream

Watershed
A watershed is an area of land that is drained by a river or a stream, and its tributaries, to a body of water such as a lake or ocean. It is often referred to as a drainage area, basin or catchment area for a watercourse.

Wetland
Land seasonally or permanently flooded by shallow water as well as land where the water table is close to the surface; presence of abundant water causes poorly drained soils, favouring dominance of either water-loving or water tolerant plants. Wetlands are often areas with high biodiversity and may help to filter pollutants from water and provide species habitat.

Wetland – Locally Significant Wetland (LSW)
A wetland which provides functions or exhibits characteristics that are pertinent to planning decisions, but has not been classified by the Ontario Ministry of Natural Resources.

Wetland – Provincially Significant Wetland (PSW)
A wetland that has been identified and classified as provincially significant by the Ontario Ministry of Natural Resources in accordance with the Wetland Evaluation System. These wetlands may contain critical fish and wildlife habitat; provide a hydrologic role in the watershed; or have unique or provincially-significant features.

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Appendix C. Wetland Criteria Checklist for Site Visits

Healthy Headwaters Wetlands Initiative, c/o Ausable Bayfield Conservation Authority, 71108 Morrison Line, RR 3 Exeter, ON N0M 1S5 (519) 235-2610 1-888-286-2610 info@abca.on.ca

Wetland Criteria – what to look for during site visits

Hydrology:

Soils:

- **What is the soil type?** (e.g. clay, sand, gravel)
- **How much topsoil is there before you get to the subsoil?** (30 cm, 60 cm or more; digging deeper increases costs)

Water Source/ Path:

- **Where does the water come from?**
- **Is the source of water from springs or surface flow & flooding events?**
- **Is the wet area influenced by the river or stream or by surface over land flows**?
- **What is the approximate size of the watershed coming into the wet area?** (Look at topographic map to determine what side of the contour lines the water would flow and draw line around area of water that would flow into wet area).
- **Are any seeps (usually from groundwater) present?** (check hillsides, or ask landowner about constantly wet areas- year round)
- **Are there any iron precipitates at edge of hill or watercourse?** (If present, it can mean there is groundwater influence)
- **Where does the water outlet?**
- **Where does the water go?** (through soil, across driveway, immediately into river)

Surrounding environment:

- **Is there a river, creek, or drain nearby?** Find out the name, how much and when it floods
- **Are there nearby buildings, roads, and other infrastructure**?
- **If there are roads, how much higher is the driveway and road than the wet area**? (**Do they act as berms?)**
- **Are there any gravel pits in the area**?
- **Is the wet area tiled? Are there any holes with broken tiles?**
- **Are there any municipal drains running through or next to the wet area**?
- **What are the slopes of the land? Is land flat, rolling or hilly, steep?**
- **Look at all inflows, outflows, intermittent streams, or permanent water sources.**
- **Note if there are watercourses, forest, agriculture, pasture, or other land uses nearby.**

Water issues:

- **Are there any water quality issues**? (flooding, soil erosion, gullying…)
- **How long does the water sit/stay on the property (surface)**? (few days, weeks, months, all year)
- **Does the water kill the grass or crops in the wet area?**
- **Are there wetland plants present?**
- **What is the land use (pasture, rotational crops, natural)?**

Wildlife habitat:

- **What surrounding habitat (watercourse, forest, wetlands) is there for wildlife**? (for food, winter cover, resting, or nesting - e.g. winter wheat in or near wetlands for ducks to nest)
- **Are the crops in rotation? Till or no till**?
- **Are there horsetails or sedges in wet area**?
- **Is it dominantly grasses, sedges, shrubs, or trees, or a variety?**

- **Are there any natural areas that have lots of diversity of plants?** (1-3; 4-5; or 6+ dominant plant communities)
- **Is there any presence of frogs, birds, ducks, deer tracks**? **Note what wildlife you see or what has historically been seen**
- **Is the wet area fish habitat?**
- **Is the area a staging or resting area for waterfowl?**
- **What is the distance to the nearest buildings, roads or other?** (DUC requests minimum 400 ft away)
- **What kind of human disturbances are there around the site (gravel pits, hydro lines, houses, barns,…)?**

Landowner's Inputs

- **Is the landowner okay with semi-permanent wetland or do they want permanent wetland**? (This will depend on the area; if there are constant flows topping up the wetland or if it is more of a spring flooding event that dries up in the summer, may have wet woodlots nearby).
- **Does the landowner want a wetland right next to the creek or in floodplain?** You will have to check with the Conservation Authority staff about permits. (Typically they don't want you to remove fill from the floodplain or bring any material in).

Project Design

- **Would the project involve excavation only or creating a berm to hold back water**? (If excavation, get a quote from a contractor before committing in case prices are too high to be funded).
- **What kind of outlet would be necessary (overflow: grassed, rock and/or water control structure**)?
- **Would the project be up against a road**? Would need to involve the municipality and road works division for permission. Some don't like wetlands right next to the roads.

Appendix D. Wetland Survey Field Equipment List

Healthy Headwaters Wetlands Initiative, c/o Ausable Bayfield Conservation Authority, 71108 Morrison Line, RR 3 Exeter, ON N0M 1S5 (519) 235-2610 1-888-286-2610 info@abca.on.ca

Wetland Survey Field Equipment List

- Boots
- Total Station and Stand
- Rod & Prism
- Backpack
- Charged batteries for Total Station/Camera/two-way Radios
- Manual for Total Station
- Extra clothing
- Bag with water, camera, two-way radios
- Site directions and aerial photo maps
- Survey book or clipboard, pencils
- Camera
- 2-way Radios
- Food/Water
- Shovel
- Soil probe
- Wetland Forms
- Sun screen/sunglasses/hat
- Rain gear
- Field guides

Appendix xx. Wetland Restoration Design Example

Wetland Restoration Design Examples

Wetland: A

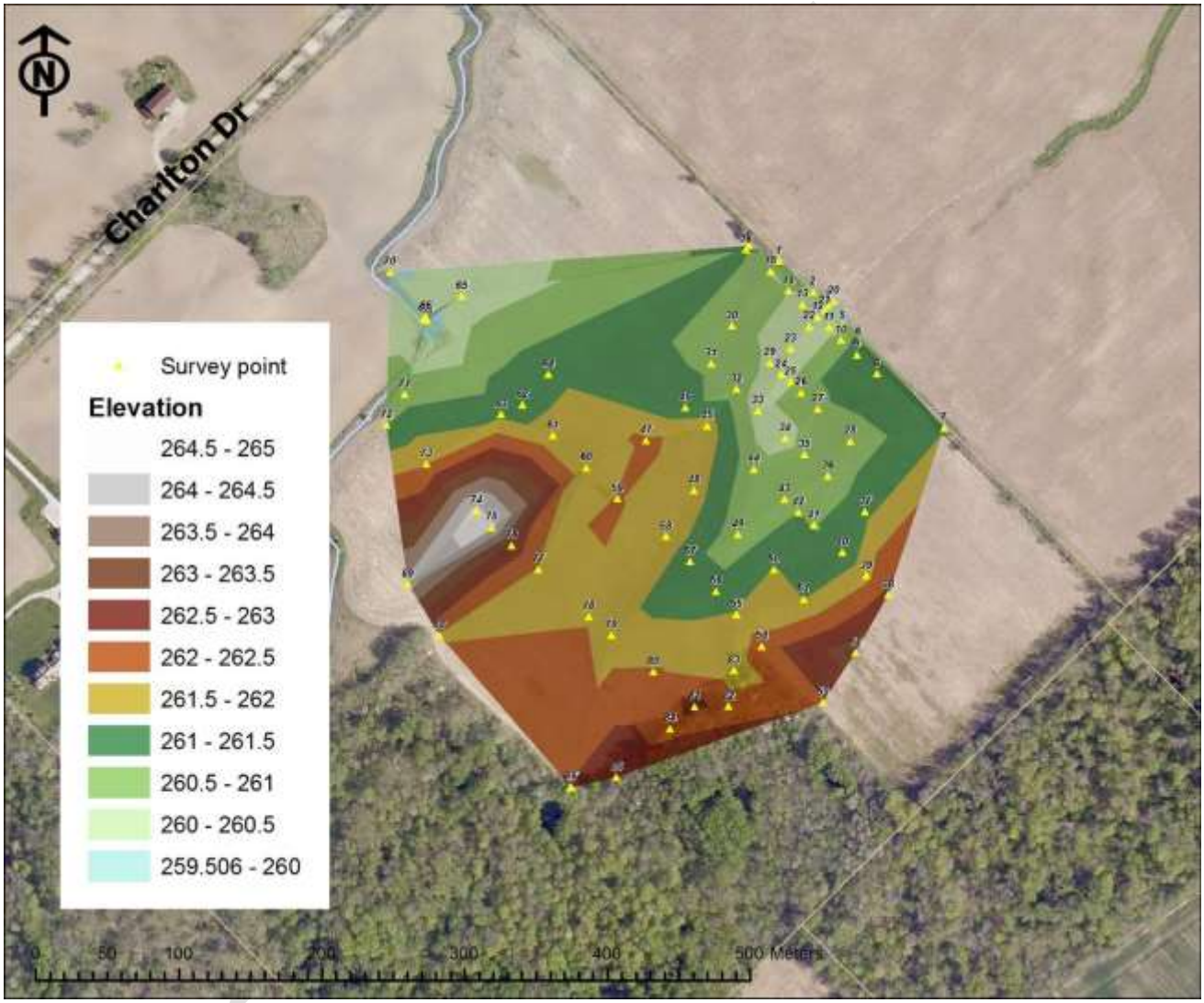


Figure 1: Elevation surveyed with Total Station, downloaded elevations and added to GIS aerial photography layer. GIS Specialist produced a digital elevation model of low and high areas on the landscape and added the survey point numbers. Areas in green are low basin areas with clay soils that would be easy to hold water if bermed along edge of field before flowing out to neighbours property.

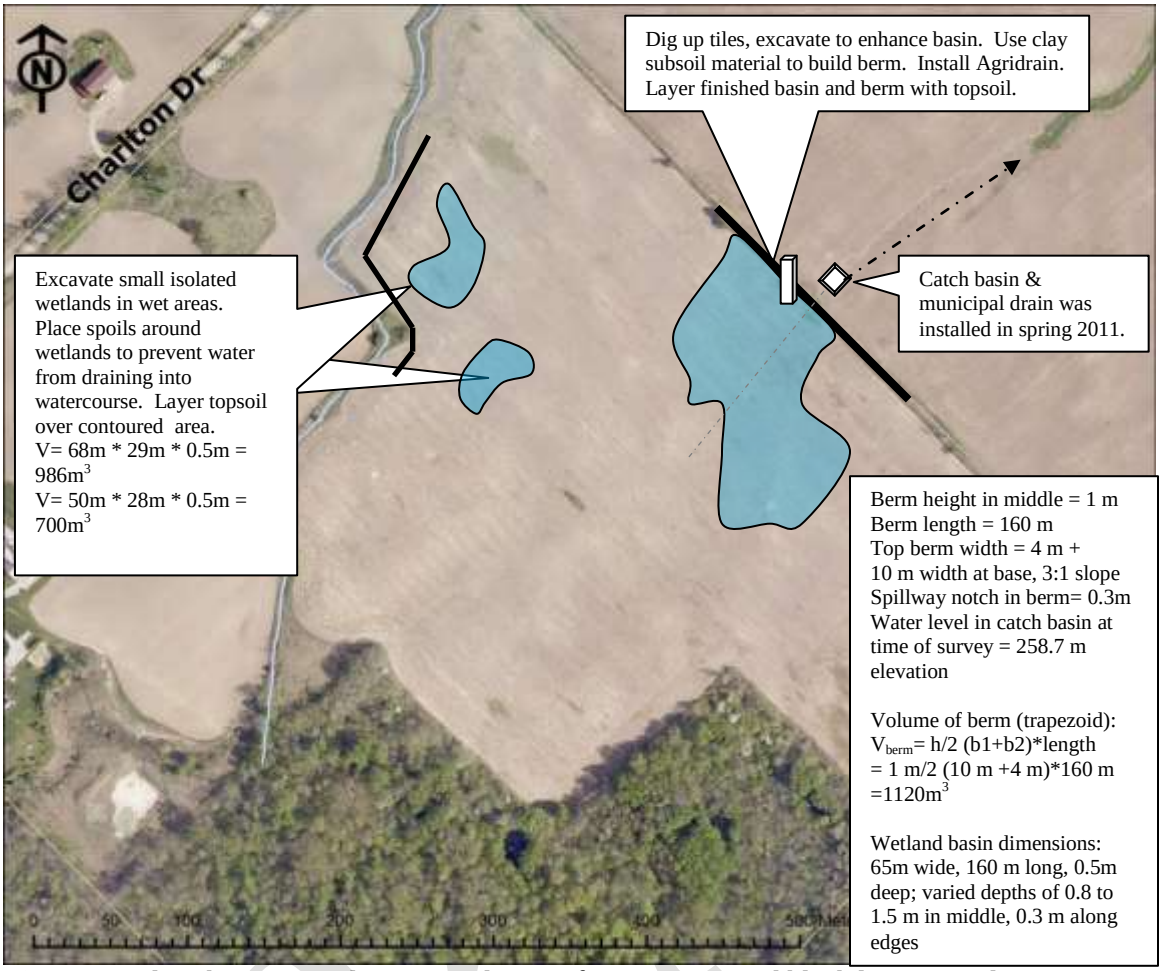


Figure 2: Blue shapes provide concept design of excavations and black lines provide approximate locations of berms and spoils. Remove topsoil, dig up tiles, excavate clay sub soils along edge of basin to create berm and widen the basin. Perform detailed contouring to enhance basin. Use clay sub soil material to build berm. Install Agridrain. Layer finished basin and berm with topsoil.

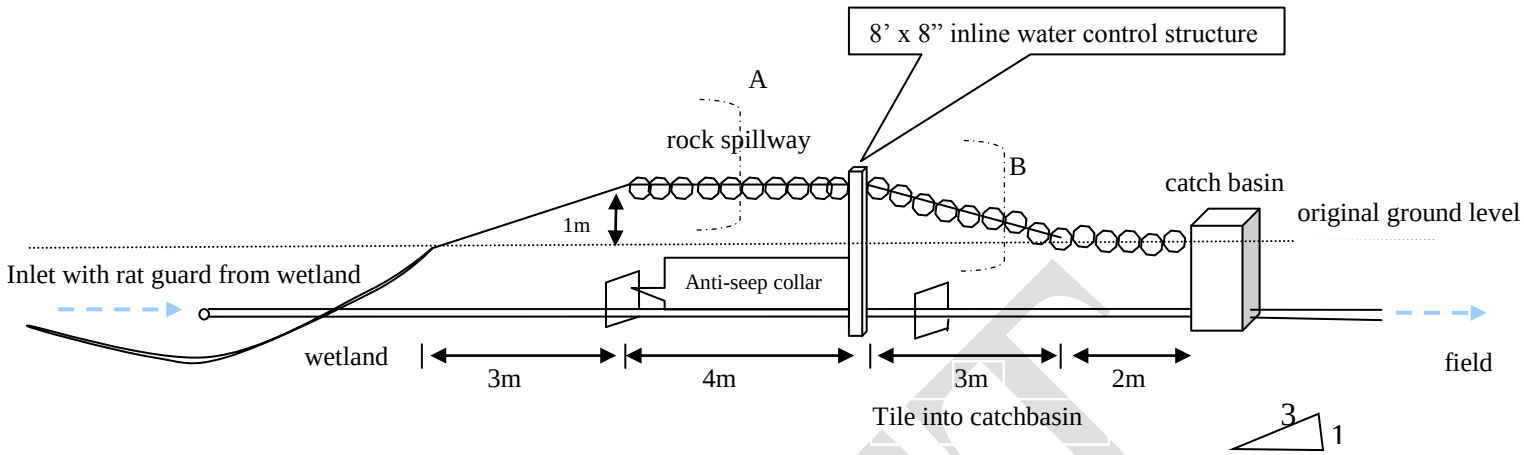
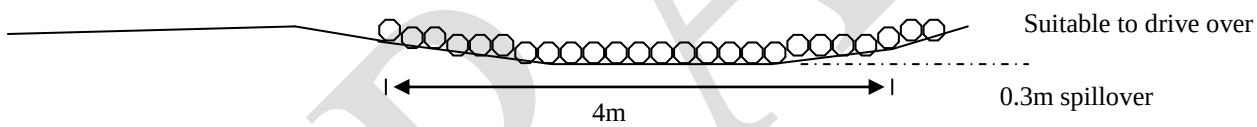


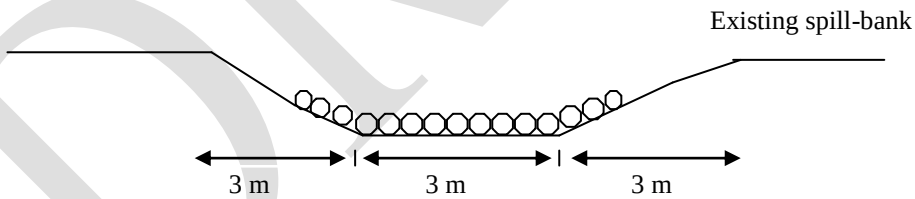
Figure 3: Berm cross-section at rock spillway with 8' x 8" inline water control structure with two anti-seep collars and one rat guard.

Rock spillway on one side of berm where it slopes and begins to meet the original ground elevation: 4m wide x 9m length downstream side of berm x 0.3m depth

Section A:



Section B:



Appendix xx. Wetlands under the Conservation Authorities Act

Conservation Authorities Act:

- "development" means
    - A) the construction, reconstruction, erection or placing of a building or structure of any kind
    - B) any change to a building or structure that would have the effect of altering the use or potential use of the building or structure or increasing the number of dwelling units in the building or structure
    - C) site grading, or
    - D) the temporary or permanent placing, dumping or removal of any material, originating on the site or elsewhere

Definition of Wetlands

- Wetlands are defined in the Conservation Authorities Act and means lands that
    - Is seasonally or permanently covered by shallow water or have a water table close or at the surface
    - Directly contributes to the hydrological function of a watershed through connection with a surface watercourse
    - Has hydric soils, the formation of which have been caused by the presence of abundant water
    - Has vegetation dominated by hydrophilic plants or water tolerant plants, the dominance of which has been favoured by the presence of abundant water
    - But does not include periodically soaked or wet land that is used for agricultural purposes and no longer exhibits wetland characteristics (CA Act, R.S.O. 1990, c.27, s 28, ss25)

Defining Areas of Interference

- Areas surrounding wetland where development could interfere with the hydrologic function of the wetland are called "Areas of Interference"
- These areas include lands that are 120 m from the boundaries of "Provincially Sig. Wetlands" and other wetlands greater or equal to 2ha (5acres).
- Regionally Significant Wetlands or wetlands smaller than 2ha are assigned a 30m (100ft) Area f Interference

Policies for Wetlands and Areas of Interference

- All wetlands and their associated areas of interference are regulated under the Development, Interference with Wetlands and Alteration to Shoreline and Watercourse Regulations (Ontario Regulation 150/6)
- Any development or interference within wetlands or development in areas of interference requires permission from the local CA

Policies for Wetlands and Areas of Interference

8.4.4 Development within a naturally occurring wetland may be permitted where the wetland is less than 0.5 ha, and it can be demonstrated that the wetland is not:

- part of a provincially significant wetland
- located within a floodplain or riparian community
- part of a Provincially or municipally designated natural feature, a significant woodland, or hazard land
- a bog or fen

- fish habitat
- significant wildlife habitat
- confirmed habitat for a Provincially or regionally significant species as determined by the Ministry of Natural Resources or as determined by the municipality
- Part of an ecologically functional corridor or linkage between larger wetlands or natural areas
- Part of groundwater recharge area, or
- A groundwater discharge areas associated with any of the above

8.4.5 Development within or Interference with an Anthropogenic wetland less than 2ha (5acres) may be permitted where it can be demonstrated that the wetland functions can be maintained or enhanced elsewhere within the subwatershed or planning area and the wetland is not

- part of a provincially significant wetland
- located within a floodplain or riparian community
- part of a Provincially or municipally designated natural feature, a significant woodland, or hazard land
- fish habitat
- significant wildlife habitat
- confirmed habitat for a Provincially or regionally significant species as determined by the Ministry of Natural Resources or as determined by the municipality
- Part of an ecologically functional corridor or linkage between larger wetlands or natural areas
- Part of groundwater recharge area, or
- A groundwater discharge areas associated with any of the above

8.4.13 Wetland Conservation Projects within wetlands and areas of interference may be permitted where an environmental Impact Study demonstrates how the hydrological functions will be protected, created, restored and/or enhanced

- Engage and consult with CA staff early on in your wetland restoration projects. Contact the Resource Planner or Ecologist to discuss your site, project objectives and design

Source:
Development, Interference with wetlands and alteration to shorelines and wetlands: Ontario Regulation 150/06. Robert Messier. GRCA. 2010. presentation