

## **APPENDIX 6**

### **WORK DONE AFTER PRELIMINARY REPORT START UP**

## APPENDIX 6

### WORK DONE TO ADDRESS THE PROBLEM AS PART OF THIS PRELIMINARY REPORT PROCESS (AND IN ACCORDANCE WITH THE RECOMMENDATIONS OF THE SCOPING REPORT)

#### **6.1 Further Water Level and Soil Determination Work Downstream of the Current Swaley Outlet**

As part of the Scoping Study work, elevations were secured at, and downstream (for a short distance) of, the Swaley Drain outlet and also at and in the area of the Nottawasaga River, the Muskrat Creek remnants near the River and the Downey Drain.

However, subsequent to the appointment to prepare a Preliminary Report, the Engineer not only authorized the Natural Environment Report work but also commenced work that could lead to having a contractor go for one day downstream of the current Swaley Drain outlet to do some test holes<sup>1</sup> to determine both the soils and to better confirm the elevations/depths of the waters in the wetlands, generally along what was the route of the Muskrat Creek remnants. Communication occurred with both the NVCA and the MNRF regarding the approval to do such investigation work and it was determined that the NVCA would require that a permit be issued for this investigative work. (MNRF expressed no concerns with the trial work.) Application work was then undertaken by the Engineer and by the Environmental Consultant to secure such NVCA permit, but the permit could not be obtained prior to the spring thaws (in 2019). As a result, the work did not proceed because of the concern of damage to fields along the access route due to thawing conditions.

As a result, the Engineer's staff had to, at an appropriate frozen time prior to the thaw (at the same 2019 period), proceed further into the wetlands on foot using snow shoes, and were able to go approximately 750m downstream of the existing Swaley terminus (on the diagonal route) to a location which would be approximately 400m north of the line between the NVCA property and the MNRF property in Lot 9, Concession 11, which would also be approximately 400m north of the original downstream route of the Swaley Drain, to determine the water levels. It was determined that water levels at a distance of 300m north of this line were 390mm± lower than the levels in the Swaley Drain at its existing outlet and equal to the elevation of the tile outlet invert on the Gilroy property. The water levels at the 400m

---

<sup>1</sup> It was believed the Contractor would be able to do this using mats. However, it was later found the Contractor would have been unable to use mats due to the increasing depth of the wetland water.

northerly location would be an additional 70mm (3") lower and thus 460mm below the current level of the Swaley Drain, and 100mm below the invert of the Gilroy tile outlet invert. The 100mm would allow for some gradient in a new water level and it was concluded work could commence at the area and give a sufficiently lower Swaley water level.

Also at the time of this survey, additional survey work was done upstream of George Johnston Road, specifically to determine the elevation of other tiles that outletted into the Swaley channel. The tile outlets surveyed were on the Camack property near the line between Lots 9 & 10, Concession 9. Here it was determined that the three tiles observed were also below the levels of the Swaley Drain. (See **Drawing 5** of this Report.)

It was evident however that if the Swaley Drain water levels could be lowered at the location of the Gilroy invert, and if the water levels then followed the grade of the Swaley Drain channel, that the levels could be similarly dropped in the area of the Camack outlets also.

One 1m deep test hole was dug, at this time, by the surveyors adjacent to the current outlet of the Swaley Drain. The ground level at the top of the test hole, which was also on the top of the bank of the channel, was closely equal to the level of the water in the adjacent channel. It was found there was approximately 0.5m of mixed soils overlying 0.5m of loamy soils. It was felt the 0.5m of mixed soils is actually a mixture of sediments, old and original topsoils and excavated materials (and thus in part at least is the old spoil bank). It was concluded that the channel itself had been excavated one half metre mostly into the native loamy soils.

The surveyors noted that the native loamy soils had a significant clay content.

When the surveyors walked out on ice to obtain water levels further into the wetlands, they noted their probe easily penetrated the grass masses submerged in the wetland waters and did reach a firmer bottom through the grasses (and organics if any) at depths of 500/600mm± increasing to 1100/1200mm± below water surface (as shown on the drawings).

All firm ground elevations secured in the wetlands related well to each other and to the firm ground at the Swaley outlet. The elevations had a slight downwards gradient into the wetlands as could be expected. It became evident that the area of significant wetland grasses (augmented it is suspected by sediments) downstream of the

existing outlet over a diagonal length of 750m± are what is causing the water levels to rise, reasonably abruptly, in the area and thus what is causing the greatest impact on the Swaley channel.

## **6.2 Summarization of Results of Water Level Determinations in the River, the Muskrat Remnants, the Downey Drain and the Swaley Drain**

As indicated in Section 6.1, elevations have been secured by the Engineer's staff at both the Swaley outlet study area and also at the Muskrat Creek outlet study area.

A summary of the various elevations (primarily water level elevations), determined by the Engineer's staff (prior to and after the Scoping Report Studies) and/or, to a small part, determined by the Engineer's review of profile drawings made available and/or, to a small part, determined by drone elevation surveys commissioned as part of the Scoping Study is herein set out such indicates the following:

- Water level in Nottawasaga River at Downey outlet (Point A)<sup>2</sup>180.84/180.92
- Water level in Nottawasaga River at what should be the Muskrat outlet (Point B) 181.24
- Distance between these two River locations along the river course (i.e. Points A to B) 2,000m (2 km±)
- Levee elevation at Point B (adjacent to historic Muskrat outlet) 182.24
- Water level of wetlands above Muskrat remnants 200m± east of Point B (new Point C) 181.32
- Wetlands water level 200m± east of Point C at a pool area above the Muskrat remnants and which pool is 300 to 400m± southeast of Downey (Point D) 181.36 to 181.40
- Water level in Downey Drain 400m north of Point D and 800m± upstream of Point A in the River (Point E) 181.08
- Bank elevation of Downey Drain adjacent to Point E (Point E1) 181.24

---

<sup>2</sup> See **Drawings 4 and 11A** for location of these "Points"

-	Water level of the wetlands approximately 100m south of Point E (partway between Downey and Muskrat) (Point F) (note: almost same as level at Point E)	181.09
-	Water level in Downey where Coleman ditch connects (a further 1500m± upstream of Point E based on averaging data reviewed (Point G)	181.15±
-	Water level of wetlands near Muskrat Creek remnants at a point 400m± north of original route of Swaley Drain (new Point H). (This is where new outlet work for Swaley is recommended to commence) (This is also Point 5 on some drawings.)	182.43
-	Water level of wetlands near Muskrat Creek remnants where Swaley is shown joined by 1954 aerials (Point I)	182.59
-	Water level at Swaley (and thus of wetlands) where it presently terminates/commences 550m east of Point I (Point J)	182.89
-	Water level difference between Swaley outlet and Downey Drain to the north, Points G to J (a distance of 2500m±):	
	a) Based on Drone Survey	1.7m
	b) Based on Betts OLS survey in 2013	1.6m
-	Water level in Swaley at Gilroy's tile outlet which is 900m east of Point J (water gradient would be 0.013%±) (Point K)	183.0±
-	Gilroy's tile outlet invert (Point L)	182.53
-	Water level at George Johnston Road (Point M) (Water level gradient between Points K and M would be 0.019%) <sup>3</sup>	183.3±
-	Water level at Camack's tile outlet (Point N) (approximately 1100m east of Point M – water level gradient 0.06%)	184.0±
-	Water level in Willow Creek at George Johnston Road (Point O) which is 80m± south of Point M	184.0

<sup>3</sup> Note: A pipe believed to be serving lands to the south of Willow Creek was found at an invert elevation of 200mm± below this water level on the east side of the road.

- Fall/rise in Swaley Drain channel bottom from Line 9 (which is near Point N) to Lot 3-4 Line, Concession 8 based on 1930 profile on file and which is a distance of 4400mm± upstream (gradient is 0.10%) 4.4m
- Water level drop in Willow Creek from Point O at George Johnston Road to Point B near where Willow would outlet in River over a length of 13± km following the creek course (which would give a gradient of 0.02%±) 2.76m
- Rise in wetlands water level along Muskrat remnants from east of River (Point C) to where new Swaley outlet is recommended to commence (Point H) over a creek remnant course length of 5 km± which would give a gradient of 0.02%± (182.43 – 181.32) 1.11m

### **6.3 Completion of Natural Environment Report**

The most significant step that the Engineer took after the appointment to do the Preliminary Report was to authorize the preparation of the requested environmental study. This work was authorized in March/April 2018. The Report on the Study was entitled Natural Environment Report and was submitted on May 27, 2020. It is enclosed as a link in **Appendix 7** to this Report.

From a review of the Natural Environment Report (referred to as the NER), it is evident that:

- a) There were two study areas reviewed by the NER. The first area would be what is called the Swaley outlet area and the second is the Muskrat outlet area. The Swaley outlet area of course is where this Preliminary Report has discussed that there should be in the magnitude of 950m of extension of the Swaley Drain downstream of its existing outlet if following the historic routes. The Muskrat outlet area is the study area identified by this Preliminary Report at the end of the original Muskrat Creek if it were fully existent at the Nottawasaga River or if it were better connected north to the Downey Drain.
- b) The NER reviewed, in each study area, species habitat, vegetation, and wildlife. Included wildlife were turtles, birds, fish, snakes and anurans (frogs, toads).

- c) The primary duration of the NER's field work was from May 2017 to October 2018. Some follow up field work occurred in the spring of 2019.
- d) The findings of the NER with respect to fish and fish habitat are set out below.
  - i) All in-water improvements should be completed during the winter months when the site is frozen since the timing would minimize the potential for impacts to fish and fish habitat and avoid sensitive times of the year, e.g. spawning.
  - ii) Disturbance and removal of riparian vegetation along an access route should be minimized. All temporarily disturbed areas should be reinstated to original condition or better.
  - iii) Best management practices should be utilized with all the machinery operating within the study area to ensure that material and equipment tracks, etc. are free of invasive species, e.g. phragmites, etc.
  - iv) Machinery should arrive on site in a clean condition and should be checked and maintained free of fluid leaks.
  - v) Machinery should be refueled, washed and serviced a minimum of 30 metres from wetlands that exist near the working area on the boundary of adjacent lands.
  - vi) All fuel and other potentially deleterious substances should be located a minimum of 30m from the wetlands and drainage features. Storage of fuels and chemicals on site should be minimized and spill management plans and the associated spill response equipment should always be available on site for implementation in the event of a spill of a deleterious material.
  - vii) Where applicable, temporary storage locations of aggregate fill material should be located no less than 30m from wetlands and materials should be contained by heavy duty sediment fencing.
  - vii) Where applicable, off-loading of construction and aggregate fill materials should be completed during fair weather conditions.
  - ix) Where applicable, any stockpiled aggregate fill material should be piled in low piles and stabilized as quickly as possible, e.g. erosion prone areas

should be covered with geotextiles, to minimize potential for runoff and wind erosion.

- e) With respect to endangered species and to limited and threatened species, the NER recommends that project details be submitted to the Ministry of Environment, Conservation and Parks (MECP) for review to ensure compliance with provincial Endangered Species Act.
- f) With respect to Blandings and Spotted Turtles, the NER recommends that:
  - i) All improvements to the drains be completed during the winter months, i.e. November 1 to March 31.
  - ii) Prior to commencing work the MECP be contacted to obtain direction on how to proceed in the unlikely event that a Blandings Turtle or a Spotted Turtle are encountered during the completion of the excavation for the drainage works.
- g) With respect to Bobolinks, the NER recommended that all improvements to the drains be completed during the winter months, i.e. November 1 to March 31, and that movement of heavy equipment through the agricultural community to the improvement areas only occur during that time period.
- h) With respect to Least Bittern, the NER recommends that all improvements to the drains be completed during the winter months, i.e. November 1 to March 31.
- i) With respect to Little Brown and Northern Long-Eared Bats, the NER acknowledged that these species are apt to be found on this project only in the trees along the Nottawasaga River at the Muskrat outlet area. The NER indicates that there is a low likelihood of their habitats being negatively impacted by the proposed drainage improvement works and that if the work is undertaken during the winter months, it will avoid damage to these species and their habitats. However, elsewhere the NER recommends that if at all possible, work at the Muskrat area involving a connection to the river through the wooded area be delayed and/or avoided.
- k) With respect to Lake Sturgeon, the NER notes these could be/would be encountered if work were done at the Muskrat outlet area by any connection to the river. The NER recommends that if work is considered at all at the River:
  - i) All improvements to the drainage works be completed during the winter months, i.e. November 1 to March 31.

- ii) Prior to commencing work to remove the levee (sediment berm) along the river, suitable sediment control measures, e.g. marine silt fence, cofferdams, sheet piles, be installed in the river to ensure that sediment is not able to migrate downstream.
- iii) Detailed design and phasing of the removal of any sediment berm be submitted to DFO, MNRF and MECP for review prior to commencing of any associated work.

However, as already indicated previously the NER discourages any work that may involve work into the Nottawasaga River (This Preliminary Report does now recommend that no work be done in or near the River).

- l) With respect to the Provincially Significant Wetland itself, the NER recommends:
  - i) Vegetation removal and disturbance outside of the proposed drain improvement areas should be minimized to the extent possible.
  - ii) All necessary vegetation removal (e.g. tree/shrub clearing, etc.) within the proposed excavation area should be completed outside of the primary breeding bird nesting window (i.e. should not be undertaken between April 1 and August 31).
- m) With respect to the fact the wetlands are an Area of Natural and Scientific Interest (ANSI), the NER acknowledges that all work completed will be in an area that is identified as provincially significant ANSI. It suggests that if the listed previous recommendations are implemented, the negative impacts to the ANSI area will be minimized.
- n) The NER also talks about the applicability of the Federal Fisheries Act, the Federal Migratory Birds Convention Act, and the Provincial Endangered Species Act. It suggests that if all the recommendations that are discussed under specific topics, and as repeated herein, are followed, the provisions of the Acts should not be compromised. The NER sets out specific steps to be followed re each listed Act.

The Natural Environment Report (NER) concludes by saying:

*“Based upon the findings presented in this report and contingent upon the implementation of the recommendations made herein, it is our conclusion that the proposed drainage improvement activities permissible will have a low likelihood of negatively impacting any significant natural heritage features and functions, and that negative impacts on the natural environment can be*

*acceptably minimized. We advise that the recommendations in this report be incorporated into the design and phasing of the proposed drainage works. Additionally, as outlined in Section 5, given the location of the proposed drainage works and the surrounding natural heritage features, RiverStone recommends that this project be submitted to DFO, MECP, and MNRF to ensure compliance with the applicable legislation.”*

#### **6.4 Obtaining and Considering an Experienced Wetlands Contractor’s Input**

Many sections of this Preliminary Report describe the significance of the wetlands area. Construction methods employed should minimize damage to the wetlands.

A challenge of this project has been to identify means to safely excavate a shallow channel in the firmer grounds/wetlands floor where 600 to 1200mm± depths of wetland waters and grasses lying above the firmer bottom will be encountered<sup>4</sup>.

No matter the depths, excavation in the wetlands waters will have to be specialized. There are three possibilities. The one option is to use a standard excavator working on moveable thick wood beam platforms (matted construction). Another is by use of high float excavators with high and wide tracks (“Swamp Buggies” or equivalent) as used in the wetlands areas of the southern American states. Another is by use of an excavator sitting on a barge provided water levels are in the area of one metre in depth.

The least expensive method is with standard excavators on mats. To work in 500mm of water and grasses is possible with mats but working on mats in depths of water in excess of 500mm could not be satisfactorily completed.

Mats, if used, would sit on the top of the firmer soils and since such mats are in the range of 300mm in thickness, some of the excavator tracks would be in water but the mats could be visible and moveable. This type of construction is not uncommon and occurred successfully in sections of the Holland Marsh project (with which this Engineer was involved) where shallow depths of water and soft soils were encountered.

If an option is used with what is known as high float excavators with wide and high tracks, the use of matting can be avoided. Excavation would be as done by any

---

<sup>4</sup> *Depths to be encountered at the Swaley outlet study area will vary from 500 to 600mm minimum and up to 1100 to 1200mm maximum. However, depths at the Muskrat study area should be 500mm or slightly lower.*

excavator. These excavators however have rarely been available locally and presently none are believed to be available in Ontario. If such existed, the cost to use such could be competitive to barge work and working widths might be slightly narrower.

If barge methods are used, the barge would be brought in by flat bed trucks in two or three sections and then assembled. It would have to be skidded to where the work would commence, then a pool area deep enough would be excavated and the barge would be pushed into the pool. The barge would have to be wide enough for stability for the excavator to be used, and would be equipped with legs or pods that are lowered for stability as the excavator moved onto the barge. The barge would be moved by push movements of the bucket of the excavator sitting on the barge. The pool area would have to be sufficiently deep that there would be a sufficient depth of water in it after all the lowering of the wetlands occurred.

To discuss the applicability of these methods to this project the contractor who completed the lengthy Holland Marsh Canal project (and spin off projects) between 2010 and the present was spoken to. This contractor both reviewed the site plus met with the Engineer, the environmental consultant and the Township Drainage Superintendent.

This contractor has equipment that includes standard excavators, long reach excavators, and barges (He unfortunately does not have, at this time, access to a high float excavator).

This contractor;

- a) Confirmed that matted type of construction should only be done where wetland water depths are in the range of 500mm deep or less.
- b) Advised that if a high float excavator were desired, it would have to be rented from a US location.
- c) Suggested that the optimum method of doing the work at the Swaley outlet area would be by barge methods due to the depth of waters.
- d) Stated that water depths should be in the magnitude of one metre to allow the barge to launch and move (construction of a pool area adjacent to the existing Swaley outlet where wetland waters are shallower would allow barge methods

to be used throughout at the Swaley end) and then return in sufficient water after levels are lowered.

- e) Confirmed the work described could be done in early winter but should not be undertaken when significant ice exists.
- f) Advised that a barge with a width of 10 metres $\pm$  (30 feet $\pm$ ) would be necessary for stability with a long reach excavator. A minimum depth of water would be 900mm to 1000mm. He later advised a 6m barge could be used if a smaller excavator were also used and the minimum depth of water could be 800mm to 900mm.
- g) Confirmed that requirements of the environmental consultant could be satisfied by barge work (and by matted construction in shallow areas).
- h) Advised that the barge would be floated from the pool area launch site, with removal of grasses as necessary, to the downstream starting point (950m $\pm$  downstream of the existing Swaley end following the historic route (or 750m $\pm$  on the diagonal route)) and then the full removal of grasses in the 6 $\pm$  or 10 $\pm$  metre width and the shallow 6m $\pm$  wide channel at the wetlands floor would be excavated out as the barge returned back to the existing Swaley outlet from where it was launched.
- i) Confirmed that moving equipment in and out on access routes after harvesting and before the full onset of winter would be possible whenever it was desired to do such.

This Preliminary Report therefore would recommend that the work be done by matted methods where wetlands waters are 500mm deep or less and by barge methods where depths are in excess of 500mm. If high float excavators do become available such could be considered in any area. Since all of the work at the Swaley end would be in depths greater than 500mm, barge methods should be employed there. However, at the Muskrat outlet area with depths around 500mm, matted construction could be employed if work were to be done at that location.<sup>5</sup>

---

<sup>5</sup> Would no longer be any shallow water levels encountered, since work at Muskrat end is no longer considered.

### **6.5 Considering How the Excavated Materials Could Be Disposed Of**

This Preliminary Report recommends that, the half metre depth of excavated loam soils, once excavated, be cast/spread adjacent to the new channel. If the soils are cast/spread in narrow widths like a submerged berm as found now at the existing end of the Swaley, the width of adjacent grasses damaged can be minimized. If the materials are cast as wide as possible and as thin as possible, the short and long term damage to the adjacent wetland grasses may be avoided.

*<sup>6</sup>If a 10m wide barge was used, then in the area that is overdug to allow launching and return of the barge (the easterly 250 metres of work where wetland water depths will be less than 900mm), significantly more excavation will be necessary. At this launching area the excavation could vary from 10 m<sup>3</sup>/m to 13 m<sup>3</sup>/m versus 3m<sup>3</sup>/m downstream. It would be recommended that a portion of this additional excavation be used to construct a maintenance berm alongside the new overdug area. The berm could be 6m wide and if 1.0m in depth would be 0.3m above lowered wetlands levels. Approximately one third of the excavation could be used in a berm beside the launching area.*

*This maintenance berm would then be like the berm that exists alongside the existing Swaley and would allow the launching area that is excavated to be maintained like a sediment pool with an excavation working beside it.*

*The launching pool area in addition to serving as a possible sediment collection area could also serve as an area of habitat diversity with its additional depth and width.*

*The balance of the excavation from the launching pool area could be levelled above the existing maintenance berm alongside the Swaley heading east for 250 metres± to George Johnston Road or could be loaded and hauled off site or a combination of disposal could be pursued.*

If a 6m wide barge is used, as now proposed, the over-excavation required to launch and return the barge would be lesser in length and depth. Disposal of excavated materials would then be done on either side of the barge path over the full length of travel.

---

<sup>6</sup> These 4 paragraphs in italics re substantially more excavation at the barge launching area and the need to create a maintenance berm and to level some materials upstream is no longer recommended since use of a 6m barge and lesser depths of the launching pool are now recommended. These notes would only apply if a 10m wide barge was used.

## **6.6 Further Analyses of Work to Be Recommended at Both Swaley Outlet Study Area (and Muskrat Outlet Study Area had it been part of this Report)**

### **6.6.1 Swaley Outlet Area**

**Drawings 2, 4 and 5** show the work possible following the historic route. Here the clearing of the wetland grasses should be to a 6m width to allow barge work and then the channel to be excavated (at the top of firmer ground/floor of the wetlands) should be 6m± wide (top width) with greater depth for 175m± downstream of the existing Swaley where wetland water depths will be less than 800mm± once lowered (the deeper pool area). Where wetland waters are/will be in excess of 800mm± over the remaining 725m±, only the 500mm deep parabolic excavation is necessary. When finished, the channel itself would not be visible but there would be a 6m± width minimum with no grasses. The excavated material (spoil) would be cast in with the adjacent grasses and would temporarily cover some of the adjacent grasses outside of the 6± metre width. No material is recommended to be cast within 2 to 3m of the 6m± clearing width since such could increase future maintenance need.

At this Swaley end it would be recommended the new channel (if following the historic route) come off the west side of the existing channel near the north limits of Lot 10. It could be considered as an ancillary or relief drain with the main channel continuing into Lot 9 as it does now.

If it were to follow the diagonal route, it would continue as an extension to the existing channel in a northwesterly direction.

### **6.6.2 Muskrat Outlet Study Area (No Longer Applicable)**

**This Section 6.6.2 was initially written prior to completion of the NER and its review by NVCA. It has been since edited and is now redundant. This section should therefore be considered as background information only.** If ever any work was found necessary at this study area only a short connection to the Downey should be pursued. Any connection to the River should not be pursued. Brushing of the Downey Drain channel as a Township Drainage Superintendent project is recognized by this Preliminary Report and is felt necessary to be done now.

At the Muskrat outlet area, it is evident from a review of the elevations secured by the Engineer's survey staff as presented in the **Appendix Section 6.1** and by **Drawings 11A, 12A and 13A**, that the wetland waters above the Muskrat Creek remnants, in

the existing conditions, are believed to overflow to the Downey Drain rather than to the River. It is known that the River connection/outlet that once existed for the Muskrat ("the cut") is now filled in.

The wetlands water level at the Muskrat remnants at a location which extends from 300mm to 400m± south of the Downey and from 200mm to 400m± east of the River is 300mm± above the Downey levels and only 150mm± above the River levels.

Drawings and text herein show and describe the two possible options in reconnecting the Muskrat to the River and also in better connecting to the Downey.

As is noted, a connection to the River or to the Downey is no longer being considered by this Preliminary Report. As a result, the following text in italics is for information only.

*There is no high wooded bank along the south side of the Downey Drain as there is along the east side of the River. At the River the high bank area exists 850mm± higher than the wetland waters in the more prominent area of the Muskrat remnants and 1000mm± higher than the River levels (where measured in the northwest corner of Lot 6, Concession 12). At the Downey, by comparison, there is a level area where wetland waters overflow naturally to the Downey.*

*As **Drawing 11A** enclosed shows, the route to the Downey, if done, would stay out of the bush area and could be 275m in length and would be consistent throughout and similar to the Swaley outlet extension work but in shallower wetlands water.*

*Two options are shown for the route to the River (also see **Drawing 11A**) (Both should now be ignored). The first of these sub-options (Option I) would intercept the water levels of the wetlands at the edge of the wooded area, while sub-option II would start more at the historic/more prominent pool area of Muskrat remnants itself and closer to where the route to the Downey would start.*

*In either route that starts at the deeper/pool area of the Muskrat (Route 1 to the Downey and Route 2 Option II to the River), the new channel bottom would start at elevation 180.7 to 180.8 (which is believed to be the firmer bottom elevation of the Muskrat remnants) and would slope down at minimal grade to either the River or Downey. However, at least a 10m wide bank should remain between the new channel work and the edge of either the River or Downey.*

*At the River, the top of this 10-metre wide bank is shown to be 50mm above river level (181.29), meaning the higher part of the bank or the levee would have to be cut by 1± metre. The new submerged channel would then either be elevation 180.7 (Sub-option I) or 180.6 (Sub-option II) east of this cut in the riverside levee. The firmer grounds along the route to the River in the wetlands vary from 180.7 to 181.1 and in the wooded area from 181.7 to 182.2.*

*The 10m± wide bank that would remain on the south side of the Downey would be at 181.13± elevation (50mm± higher than the Downey water elevation) and then south of this bank the new wetland grass removal and channel would join up and be at bottom elevation 180.6. The firmer ground elevations south of the Downey vary from 181.1 at the Downey to 180.7 where work would stop near Muskrat remnants.*

*At the Downey, by cutting the bank of the Downey to elevation 181.13± and by doing the work described over 275m to the south, the result would be that the wetlands level at the Muskrat remnants is not lowered any more than 120mm± below River levels in this area and would remain 50mm higher than the Downey level (if wetland levels were flat).*

*For part of the (studied Option II) route to the River and for all of the route to the Downey, the channel would be in wetlands and would have a 4.5m top width at the firm ground elevation with a parabolic shape. This would involve 1.2m<sup>3</sup>/m to 1.8m<sup>3</sup>/m of excavation. The narrower width is possible through use of matted construction versus barge methods.*

*However, for the River outlet work elevation where the channel has to pass through the wooded area to get to the River, the firm ground elevation varies from 181.7 to 182.2. With a required new channel bottom at 180.6 for sub-option II, the top of bank would average 10m wide to allow for 3:1 slopes and a 1.5m wide bottom.*

*With sub-option I through the bush for the route to the River, the average depth would reduce to 1.3m and the channel top could be close to 9.5m with a similar cross-section.*

*The material where excavated in the wetlands would be just cast/spread in the adjacent wetland vegetation grasses as done at the Swaley end. However, in the wooded area the materials would either have to be levelled or left in a berm like on a normal ditch. A significant additional width of clearing would be necessary just for disposal of excavated material.*

*If the optimum lowering of the Muskrat levels and if the minimal interference with the wetlands are desired, the Muskrat would be better connected to the Downey. The word "better" is used since it is the Engineer's finding that the outlet of the Muskrat waters now is already to the Downey Drain rather than to the River.*

*If a shallow channel were excavated over only the 275m length to the Downey, a maximum wetlands water lowering of 250mm± near the main Muskrat remnants could be provided. By comparison, if the high bank/levee along the River were removed and the Muskrat was newly connected to the River (by either of the sub-options shown), only a 100mm maximum lowering in the wetlands level of the Muskrat could be expected. As stated though, even if a better connection were made to the Downey the work would be done so only a 150mm maximum lowering of the wetlands levels occurs.*

To better connect the Muskrat to the Downey was considered as a "last resort" by the Natural Environment Report (NER). The NER however discouraged any new connection to the River for a variety of reasons. This Preliminary Report does not recommend either be pursued unless a new Report and proceedings were initiated in the future.

The concerns of a direct connection from the Muskrat to the River negatively altering the wetlands water level or vice versa from a hydrological perspective would be removed with a Downey connection. Indeed, the levels of the wetlands themselves could be lowered greater because of the lower level in the Downey and without working near the River.

Overall, the environmental advantages of better connecting the wetlands waters at the Muskrat to the Downey rather than to the River would be:

- a) Work at/in the River is avoided
- b) Work in the tree stand east of the River could be avoided
- c) Future maintenance of the connection could be more easily undertaken
- d) The possible negative hydrological effects of allowing the River to more easily flood/spill into the Muskrat would be avoided
- e) The length of the work could be shorter (depending on the sub-option taken to the River)
- f) The benefits to the remaining tree stands in the wetlands could be greater.

If a better connection were ever to be made to the Downey, there would be two possibilities. One possibility would be to lower the wetlands levels to the reasonable maximum allowed by the Downey which would be a lowering of 250mm± if wetlands levels were flat. This lowering would be 100mm± below the nearby River level and 50mm± above the Downey levels. The other possibility could be to lower the wetlands levels by only 150mm± which would then be 150mm± above Downey levels and at the same level as the adjacent River level.

Timing of any work at the Muskrat Study area was also initially considered. One thought was to do the Muskrat end first to hopefully cause a lowering at the Swaley end early to help in construction (This may not occur quickly or at all due to the substantial length of wetlands between the Muskrat and Swaley outlet areas and because of the existence of wetlands grasses over most of the route). Since barge methods are recommended at the Swaley end, the wetlands levels at the Muskrat outlet area should not be lowered first (Although as stated there may be no effect in any case). Overall the initial thoughts were to do work in the Muskrat outlet area only after the work at the Swaley outlet area.

The original thought was that only if the Swaley outlet area work were constructed by a high float excavator would there be merit in working at the Muskrat outlet area first with hope that any lowering would assist upstream work.

The final thoughts and recommendations re work at the Muskrat Study area (other than work to brush the Downey channel) is to avoid the area. Only if at some future time, a new Engineering Study was initiated and approved, should this area be reconsidered.