APPENDIX N

Fish Habitat Framework

APPENDIX N

Terry Fox Drive Extension – Part B

Aquatic Effects Assessment

The Terry Fox Drive roadway extension will cross or interact with the following watercourses within the Carp River and Shirley's Brook watersheds moving up-chainage from Richardson's Side Road, north east towards Second Line.

- Habitat A: Carp Tributary #1 – three box culverts to equilibrate flood-flows - avg. 70 m
- Habitat B: Carp Tributary #2 - one box culvert to carry seasonal flows – 86 m
- Habitat C: West Shirley's Brook – one arch culvert for year round steam flow – 45m
- Habitat D: Tributary to E. Shirley's Brook – combined hydraulic/wildlife culvert- 60m
- Habitat E: 190 m removal of East Shirley's Brook by roadbed
- Habitat F: East Shirley's Brook - one box culvert to carry year round flows – 45m

Step 1. Identify Relevant Activities

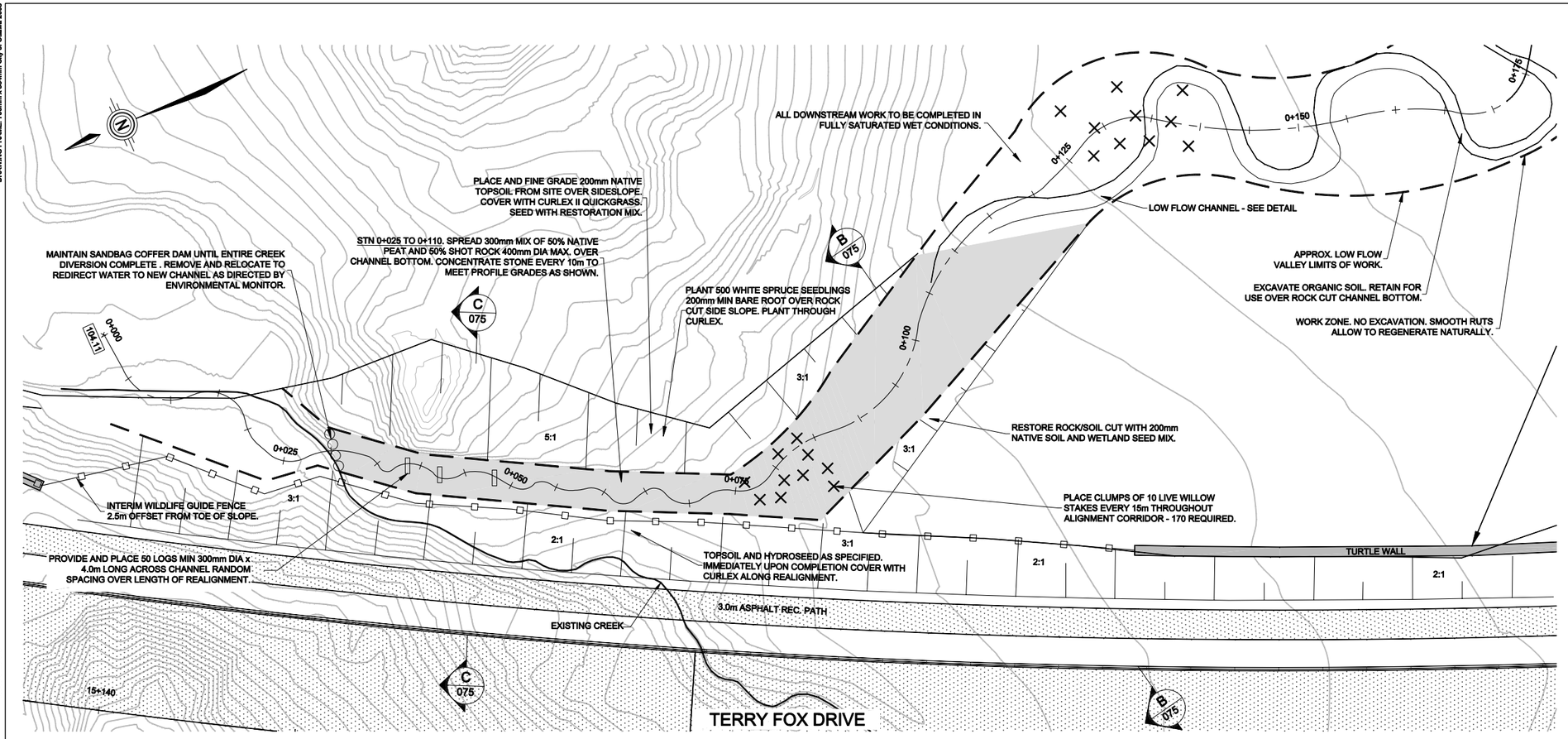
Table N1. Proposed stream crossing structure and the potential pathways that may negatively effect habitats.

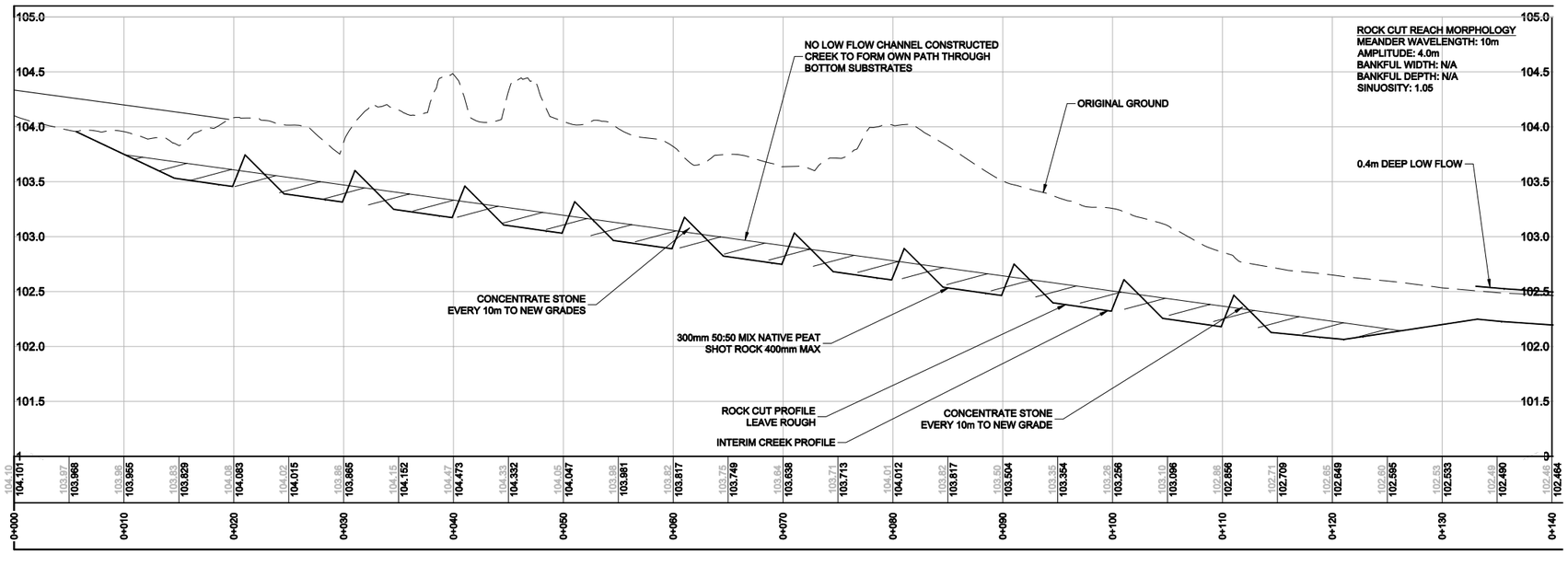
Proposed Development	Habitat Affected	Potential POEs	
		Inwater	Land
New stream crossing involving excavation of the channel for installation of the structure	A, B, D, F	• Industrial Equipment • Water Extraction • Water Flow • Structure Removal • Placement of Material • Dredging • Debris • Fish Passage	• Vegetation Clearing • Excavation • Industrial Equipment • Grading • Riparian Planting
2. New open-bottom arch culvert stream crossing with some excavation of the channel. Temporary lined channel installed around work area. Footings placed outside of the natural channel width allows 'natural' riverstone	C	• Industrial Equipment • Water Extraction • Water Flow • Structure Removal • Placement of Material • Dredging • Debris • Fish Passage	• Vegetation Clearing • Excavation • Industrial Equipment • Grading • Riparian Planting

bottom with meandering channel.			
Permanent enclosure of 190 m segment of East Shirley's Brook as is lies directly underneath road alignment.	E	• Industrial Equipment • Water Extraction • Water Flow • Structure Removal • Placement of Material • Dredging • Debris • Fish Passage	• Vegetation Clearing • Excavation • Industrial Equipment • Grading

Step 2. Assess the Mitigation Measures and Residual Effects

- Warm water restrictive window Mar 15 to June 30 will be respected. No in-water work during this period.
- Temporary CSP culverts will be placed under a gravel access at each watercourse crossing until the permanent structures are in place; this applies to all habitats.
- Habitat C on West Shirley's Brook will require a temporary lined diversion because the 4.3 m wide arch culvert cannot be built safely without disturbing the watercourse.
- Habitat F on East Shirley's Brook will require a temporary lined diversion because of the adjacent wetland (PSW#3), so that water levels will not be disrupted in the wetland during construction.
- During culvert installations after June 30, watercourses are to be coffer-dammed and periodic flows pumped around the excavations while the pre-cast sections are positioned. Blasting using explosives will be required for Habitats B & F only.
- Arch culvert C will be placed with an open bottom, with foundations placed either side of the watercourse. To work safely on the foundations a diversion will be required to allow excavations below the existing creek. A new meandering low flow channel will be defined within the culvert using riverstone over rip rap.





TERRY FOX DRIVE

RICHARDSON SIDEROAD TO SECOND LINE ROAD

PHASE TWO

SHIRLEY'S BROOK CREEK DIVERSION STA. 0+000 TO STA. 0+180

R.HOLDER, P.ENG. *Manager-Construction Services West*	S.STODDARD, P.ENG. *Senior Project Engineer*

LICENSED PROFESSIONAL ENGINEER — March 23/10 — B.G. HUSTON — 21065503 — PROVINCE OF ONTARIO

ASSOCIATION OF PROFESSIONAL BIOLOGISTS OF ONTARIO — Shawn R. Taylor — P.Eff. — APB

NOTE:
The location of utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned. The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage.

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REVISIONS	No.	Description	By	Date (dd/mm/yy)
	1	ADDENDUM 2	M.J.F.	23-03-10

NOTE:
CONSTRUCTION OF CLEARLY-DEFINED LOW FLOW CHANNEL NOT REQUIRED 0+000 TO 0+110.

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Contract No. ISB09-5123	Dwg. No. 073
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Asset No.	
Asset Group	
Des. S.R.T.	Chk'd. B.G.H.
Dwn. C.G.P.	Chk'd. B.G.H.
Utility Circ. No.	Index No.
Const. Inspector	

Scale:
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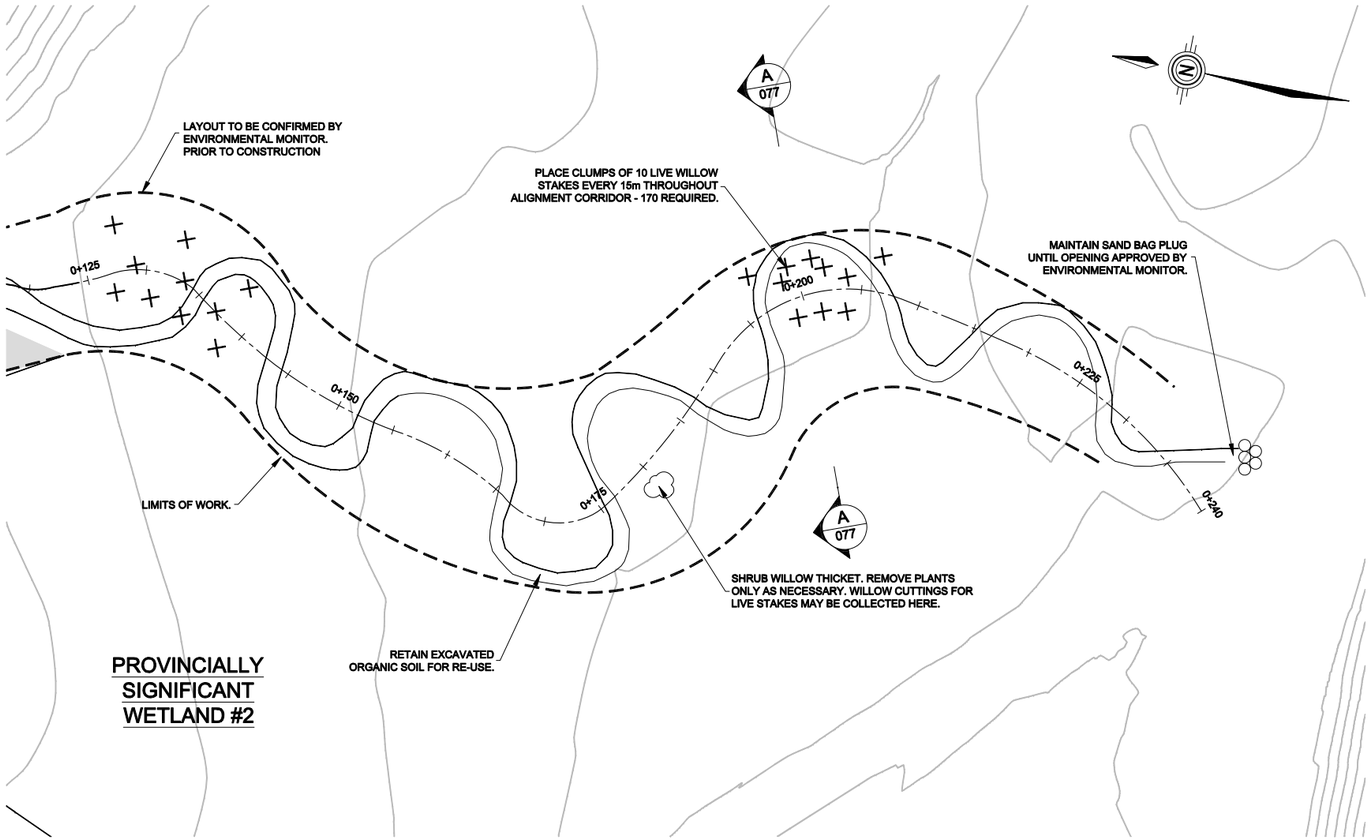
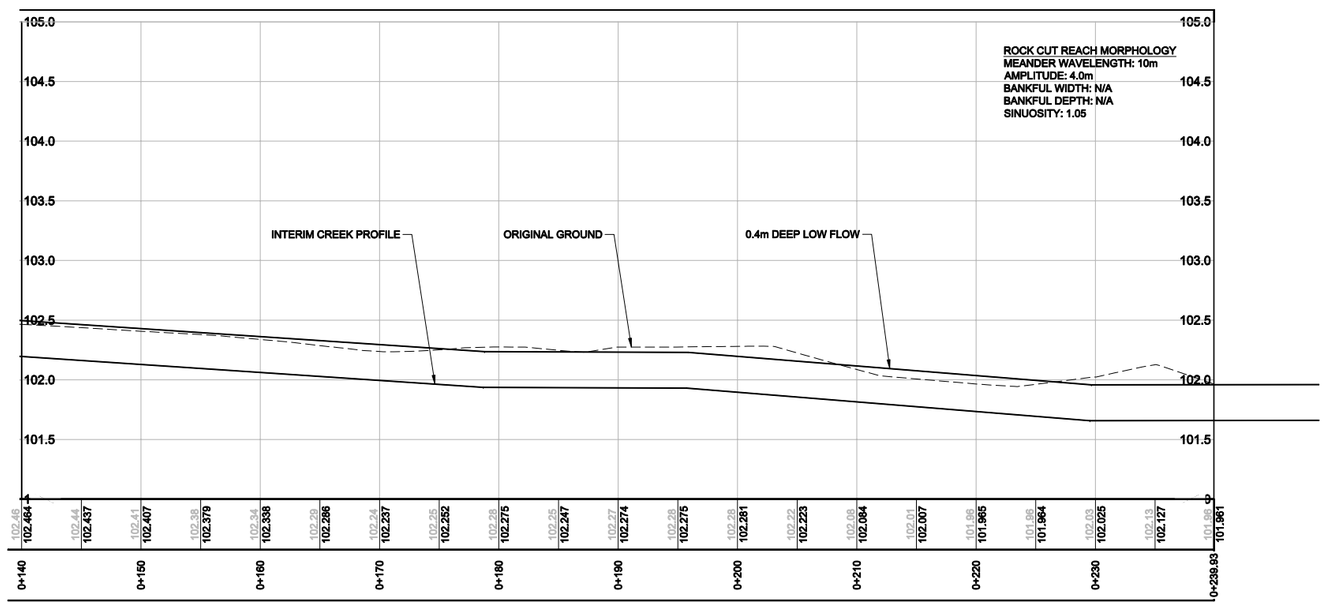
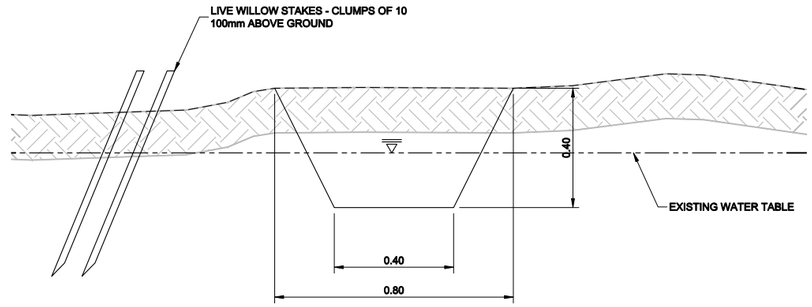
VERTICAL 0m 0.5 1







SECTION A-A - TYPICAL BEAT CUT SECTION WITH WILLOW STAKES
N.T.S.

TERRY FOX DRIVE
RICHARDSON SIDEROAD TO SECOND LINE ROAD
PHASE TWO

SHIRLEY'S BROOK CREEK DIVERSION
STA. 0+180 TO STA. 0+248.72

R.HOLDER, P.ENG. *Manager-Construction Services West*	S.STODDARD, P.ENG. *Senior Project Engineer*

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Contract No. ISB09-5123	Dwg. No. 074
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Asset No.	
Asset Group	
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Dwn. C.G.P.	Chk'd. B.G.H.
Utility Circ. No.	Index No.
Const. Inspector	

Scale: HORIZONTAL 0m 0m VERTICAL

LICENSED PROFESSIONAL ENGINEER B.G. HUSTON 21065503 PROVINCE OF ONTARIO

ASSOCIATION OF PROFESSIONAL BIOLOGISTS OF ONTARIO Shawn R. Taylor P.Biol. #961 APB

NOTE:
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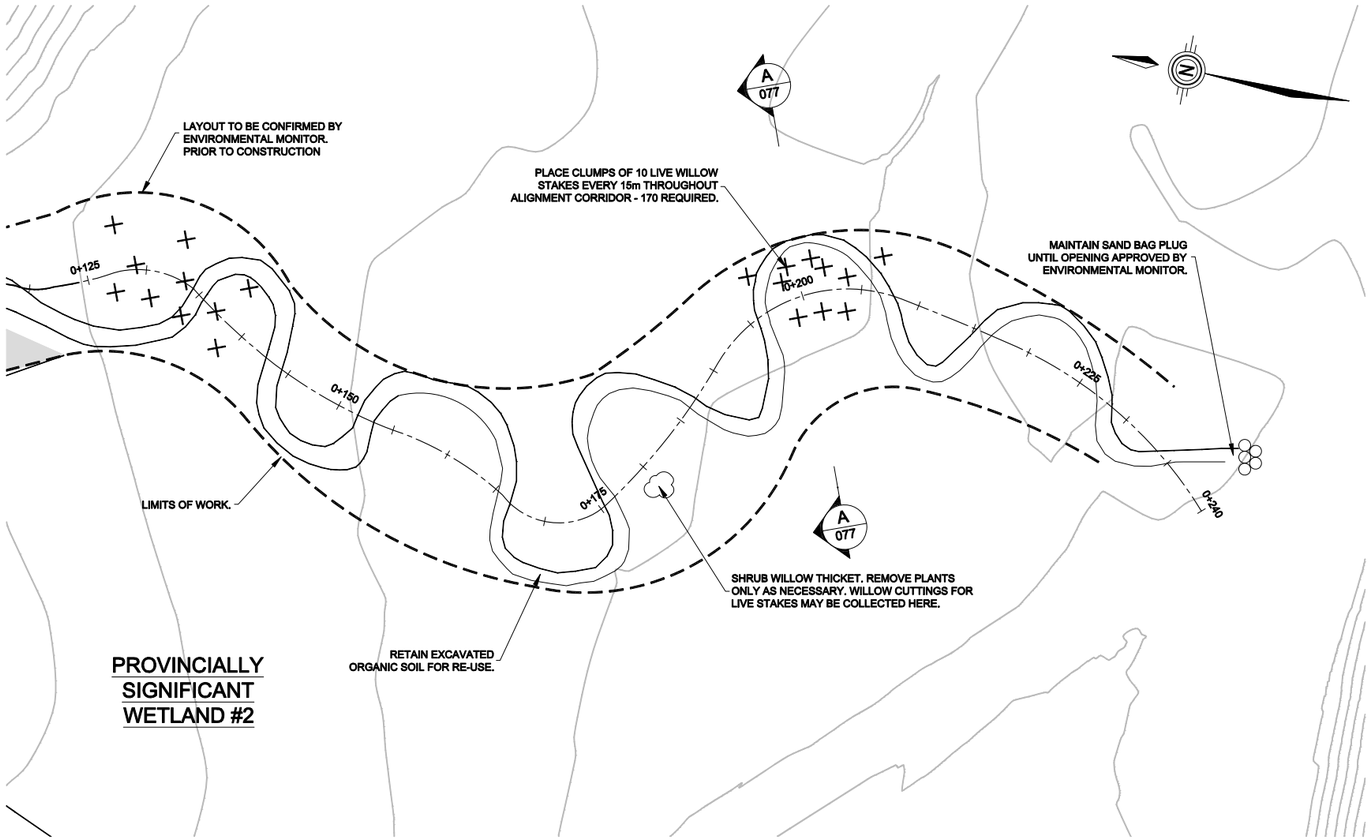
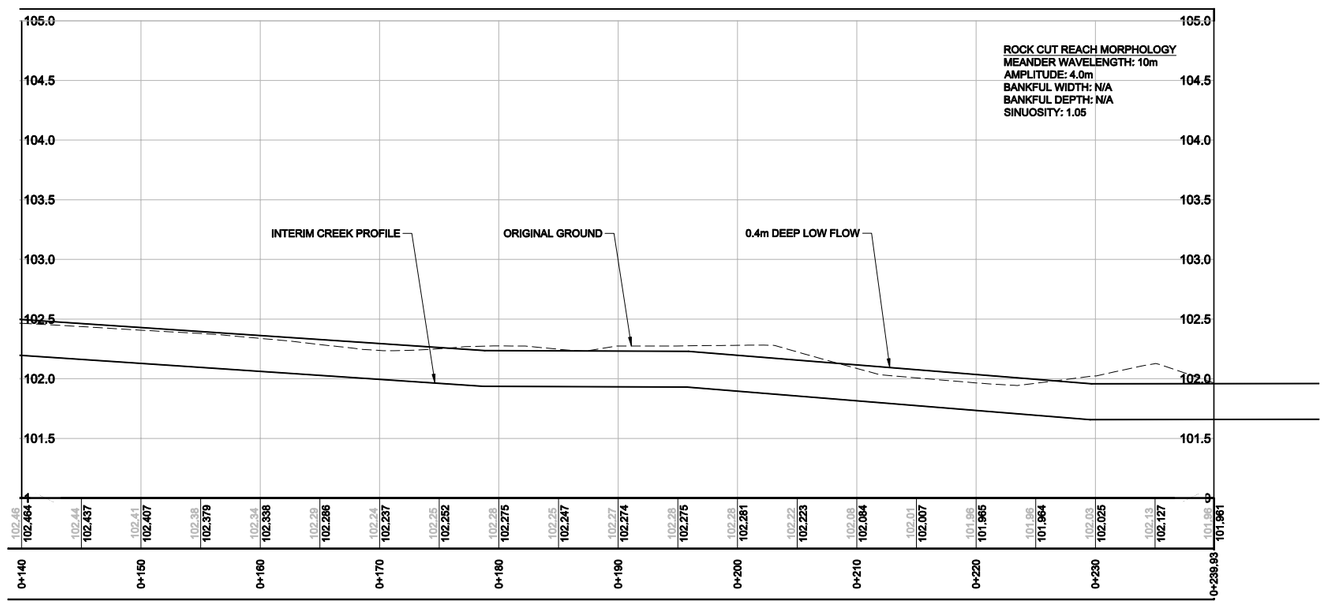
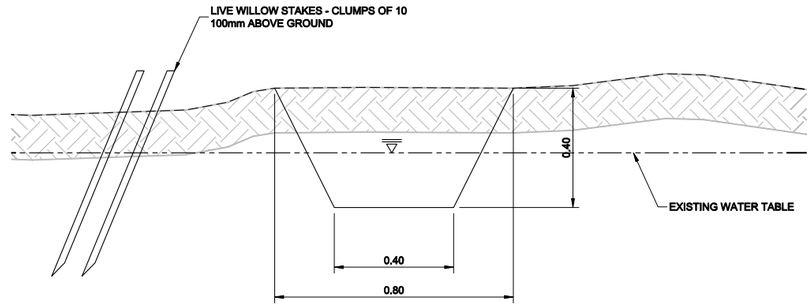
REVISIONS	No.	Description	By	Date (dd/mm/yy)
	1	ADDENDUM 2	M.J.F.	23-03-10







SECTION A-A - TYPICAL BEAT CUT SECTION WITH WILLOW STAKES
N.T.S.

TERRY FOX DRIVE
RICHARDSON SIDEROAD TO SECOND LINE ROAD
PHASE TWO

SHIRLEY'S BROOK CREEK DIVERSION
STA. 0+180 TO STA. 0+248.72

R.HOLDER, P.ENG.
Manager-Construction Services West

S.STODDARD, P.ENG.
Senior Project Engineer

Ottawa

Contract No. ISB09-5123	Dwg. No. 074
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Asset No.	
Asset Group	
Des. S.R.T.	Chk'd. B.G.H.
Dwn. C.G.P.	Chk'd. B.G.H.
Utility Circ. No.	Index No.
Const. Inspector	

Scale:
HORIZONTAL
0m
0m
VERTICAL

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DILLON CONSULTING

REVISIONS

No.	Description	By	Date (dd/mm/yy)
1	ADDENDUM 2	M.J.F.	23-03-10

Table N.2 Cause and Effect Relationships of Stressors and the Proposed offsetting Mitigation Measures.

Habitat	Type of Fishery Directly Supported	Type of Work / Undertaking	Effected Habitat	Potential Pathways of Effect	Potential Impact (stressor from PoE)	Mitigation Measures	Negative Residual Effects		
							Describe	Scale (Low, Medium, High)	Comments (rationale for scale)
Habitat A: Carp Tributary #1 (Culverts CV3a,b,c)	Warm water fish	Three box culverts to equilibrate flood-flows - avg. 70 m	**In-water POE**	Flow Management: Maintain Fish Passage, & Flow diversion	Change in migration /access to habitats	-Operational constraint for timing of in-water works (O-TW) to protect sensitive life stages/processes of fish; in-water works to take place between March 15 – June 30	-minor disruption to habitat access	Low	-In-water work to take place outside of sensitive spring window. - No fish were observed in this habitat during surveys.
Habitat B: Carp Tributary #2 (CV4)	Warmwater fish	One box culvert to carry seasonal flows – 86 m			Diversion channels	-Management of temporary flow (M-TF) by isolating temporary in-water work and maintain clean flow around the work zone (e.g., using coffer dam)	-none	Low	-clean flow to be maintained around or through work zone
Habitat D: Tributary #1 to E. Shirley's Brook (TCV2)	Warmwater fish	Combined hydraulic/wildlife culvert-60m			Flow alteration	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-drainage system to be designed to minimize impacts to the water courses and upstream wetland
Habitat F: East Shirley's Brook (CV6)	Warmwater fish	Combined hydraulic / wildlife box culvert to carry year round flows – 45m		Industrial Equipment	Use of Mobile Industrial Equipment / bank stability/ erosion potential	-Operational constraint for timing of in-water works (O-TW) to protect sensitive life stages/processes of fish; in-water works to take place between March 15 – June 30 -Operational constraint for access (O-Acc) to protect riparian vegetation and minimize bank erosion - refuel in designated areas, maintain clean, grease free machinery	-minimal, localized and temporary disturbance to areas adjacent to watercourse	Low	-disruption will be minimal and mitigated by re-seeding / re-vegetation and erosion / sediment controls
					Use of Immobile Industrial Equipment / Equipment Leaks	-Management of equipment (M-Eqp) by operating and maintaining in a manner that prevents entry of deleterious substances into any waterbody - refuel in designated areas, -ensure any equipment entering the waterbody is free of leaks and externally cleaned/degreased -have Spills Management Plan (M-Spl) on site	-none	Low	-with mitigation measures, no residual effect is expected
				Change in timing duration and frequency of flow.	Change in migration /access to habitats	-Operational constraint for timing of in-water works (O-TW) to protect sensitive life stages/processes of fish; in-water works to take place between March 15 – June 30	-minor disruption to habitat access	Low	-in-water work to take place outside of sensitive spring window - No fish were observed in this habitat during surveys
					Change in Land Drainage Patterns	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-drainage system to be designed to minimize waterbody impacts
				Placing materials or structure in the water	Partial construction of flow	-Design of culvert (D-C) extension to prevent barriers to fish movement and maintain bankfull channel and habitat functions to the extent possible -Management of temporary flow (M-TF) to maintain clean flow around or through the work area	-none	Low	-minor culvert extensions to be designed to match the size/type of existing open footing culvert -clean flow to be maintained around or through the site -fish not observed during surveys of this habitat.
				Dredging	Removal of In-stream Organic Structure	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of native riparian and aquatic vegetation	Low	-loss of in-stream vegetation will be minor -fish not observed during surveys of this habitat.
				Structure Removal	Change in habitat cover and structure	-riparian vegetation plantings (R-Veg) or re-seeding as necessary - avoid excessive clearing of limbs, stumps and large woody debris from watercourse	-loss of native riparian and aquatic vegetation	Low	-loss of in-stream vegetation will be minor

Habitat	Type of Fishery Directly Supported	Type of Work / Undertaking	Effected Habitat	Potential Pathways of Effect	Potential Impact (stressor from PoE)	Mitigation Measures	Negative Residual Effects		
							Describe	Scale (Low, Medium, High)	Comments (rationale for scale)
				Debris	Suspension of sediment	-Management – work site containment (M-WSCon) to isolate above water work and prevent entry of deleterious materials to the waterbody	-none	Low	-use of Standard Special Provisions to protect adjacent watercourse
Habitat A: Carp Tributary #1 (Culverts CV3a,b,c)	Warm water fish	Three box culverts to equilibrate flood-flows - avg. 70 m	**Land Based POE**	Vegetation Clearing	Loss of Bank Stability and Exposed Soils	-No shade now occurring at this site other than cover from low lying sedges and rushes -Management – erosion and sediment controls (M-ESC) such as silt fence, armour stone guidewall, and/or rock rip rap	-none	Low	-vegetation removal to be minor and localized to permit the construction of minor culvert extensions -fish not observed during surveys of this habitat.
Habitat B: Carp Tributary #2 (CV4)	Warmwater fish	One box culvert to carry seasonal flows – 86 m			Removal of In-stream Organic Structure	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of native riparian and aquatic vegetation	Low	-loss of in-stream vegetation will be minor
Habitat D: Tributary #1 to E. Shirley's Brook (TCV2)	Warmwater fish	Combined hydraulic/wildlife culvert-60m			Alteration of Riparian Vegetation	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of riparian vegetation within small area	Low	-loss of riparian vegetation will be minor and will be mitigated with plantings or re-seeding along proposed enhanced swales as necessary
Habitat F: East Shirley's Brook (CV6)	Warmwater fish	Combined hydraulic / wildlife box culvert to carry year round flows – 45m		Excavation	Change in Land Drainage Patterns	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-drainage system to be designed to minimize waterbody impacts
				Industrial Equipment	Use of Mobile Industrial Equipment / bank stability/ erosion potential	-Operational constraint for timing of in-water works (O-TW) to protect sensitive life stages/processes of fish; in-water works to take place between March 15 – June 30 -Operational constraint for access (O-Acc) to protect riparian vegetation and minimize bank erosion refuel in designated areas, maintain clean, grease free machinery	-minimal, localized and temporary disturbance to areas adjacent to watercourse	Low	-disruption will be minimal and mitigated by re-seeding / re-vegetation and erosion / sediment controls
				Riparian planting	Change in habitat cover and structure	-riparian vegetation plantings (R-Veg) or re-seeding as necessary - willow cuttings placed into top of guide wall to stabilize, provide shade and overhead cover	-small loss of riparian vegetation	Low	-loss of in-stream vegetation will be minor.
					Change in habitat cover and structure	-riparian vegetation plantings (R-Veg) or re-seeding as necessary	-small loss of riparian vegetation	Low	-loss of in-stream vegetation will be minor due to recent clean-out activities
					Introduction of Alien plant species	- replanted species to be locally sourced and or salvaged from site.	-none	Low	-limited risk of introduction of alien plan species due to locally sourced vegetation.
				Grading	Organic soils removed to prepare firm bottom. Reuse organic soils in constructed wetland to initiate growth of beneficial microorganisms.	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of riparian and terrestrial vegetation within small area	Low	-loss of in-stream vegetation will be minor -fish not observed during surveys of this habitat.

Habitat	Type of Fishery Directly Supported	Type of Work / Undertaking	Effected Habitat	Potential Pathways of Effect	Potential Impact (stressor from PoE)	Mitigation Measures	Negative Residual Effects		
							Describe	Scale (Low, Medium, High)	Comments (rationale for scale)
Habitat C: West Shirley's Brook (CV6)	Warmwater fish	One arch culvert for year round steam flow – 4.3 m X 45m long	**In-water POE**	Dredging (Organic topsoil stripping in PSW #1 and excavations to place footings)	Removal of In-stream Organic Structure	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of native riparian and aquatic vegetation	Medium	-loss of in-stream vegetation will be moderate
					Change in habitat cover and structure	-riparian vegetation plantings (R-Veg) or re-seeding as necessary	-moderate loss of native riparian and aquatic vegetation	Medium	-moderate loss of in-stream vegetation will be minor due to recent clean-out activities
					Suspension of sediment	-Management – work site containment (M-WSCon) to isolate above water work and prevent entry of deleterious materials to the waterbody	-none	Low	-use of Standard Special Provisions to protect adjacent watercourse and wetland
				Flow Management to minimize sedimentation impacts.	Suspension of sediment	-Management – work site containment (M-WSCon) to isolate above water work and prevent entry of deleterious materials to the waterbody	-none	Low	-use of Standard Special Provisions to protect adjacent watercourse
				Change in timing duration and frequency of flow (Dewatering)	Flow alteration	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-drainage system to be designed to minimize waterbody impacts
				Maintain fish passage with lined channel	Flow alteration	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr) - Manage sediment in runoff at dewatering pads	-none	Low	-drainage system to be designed to minimize waterbody impacts
					Diversion channels	- Coir-lined diversion with temporary crossing Management of temporary flow (M-TF) by isolating temporary in-water work and maintain clean flow around the work zone (e.g., using coffer dam or earthen dyking with silt fencing)	-none	Low	-clean flow to be maintained around or through work zone
				Place Materials : River stone to define meandering low flow channel	Partial construction of flow	-Riverstone meander included in design of culvert (D-C) to facilitate low flow fish movement and maintain bankfull channel and habitat functions to the extent possible -Management of temporary flow (M-TF) to maintain clean flow around or through the work area	-none	Low	- riverstone meander designed to match existing and anticipated low flow through culvert -clean flow to be maintained around or through the site
				Structure removal	Change in habitat cover and structure	-avoid excessive clearing of limbs, stumps and large woody debris from watercourse -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of aquatic and riparian vegetation within small area	Low	-loss of in-stream vegetation will be minor
Habitat C: West Shirley's Brook (CV6)	Warmwater fish	One arch culvert for year round steam flow – 4.3 m X 45m long	**Land Based POE**	Vegetation Clearing	Alteration of Riparian Vegetation	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of riparian vegetation within small area	Medium	-loss of riparian vegetation will be moderate and will be mitigated with plantings or re-seeding as necessary
				Industrial Equipment: Grading	Use of Mobile Industrial	-Operational constraint for timing of in-water works (O-TW) to protect sensitive life	-minimal, localized and	Low	-disruption will be minimal and mitigated by re-seeding / re-

Habitat	Type of Fishery Directly Supported	Type of Work / Undertaking	Effected Habitat	Potential Pathways of Effect	Potential Impact (stressor from PoE)	Mitigation Measures	Negative Residual Effects		
							Describe	Scale (Low, Medium, High)	Comments (rationale for scale)
				Excavation and Placement of Granular Fill	Equipment / bank stability/ erosion potential	stages/processes of fish; in-water works to take place between March 15 – June 30 -Operational constraint for access (O-Acc) to protect riparian vegetation and minimize bank erosion - refuel in designated areas, maintain clean, grease free machinery	temporary disturbance to areas adjacent to watercourse		vegetation and erosion / sediment controls
					Use of Immobile Industrial Equipment / Equipment Leaks	-Management of equipment (M-Eqp) by operating and maintaining in a manner that prevents entry of deleterious substances into any waterbody -ensure any equipment entering the waterbody is free of leaks and externally cleaned/degreased -have Spills Management Plan (M-Spl) on site -dewatering to specialized pad that minimizes bank erosion -refuel in designated areas, maintain clean, grease free machinery	-none	Low	-with mitigation measures, no residual effect is expected
					Suspension of sediment	-Management – work site containment (M-WSCon) to isolate above water work and prevent entry of deleterious materials to the waterbody	-none	Low	-use of Standard Special Provisions to protect adjacent watercourse
					Flow alteration	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-drainage system to be designed to minimize waterbody impacts
				Manage excess water from wetland	Excessive velocities during dewatering	-dewater to specialized pads -surround area with dyking to reduce dewatering needs - install lined channel to flume clean water through site. - strip organics and place granular fill in one smooth continuous operation to minimize area open to water flows	- potential to pump water at greater rate than downstream channel can handle	Medium	- Permit to Take Water (MOE) to specify pumping rates. Discharge points, intake- - short term impacts that can be managed and mitigated - impact not significant with mitigation
				Riparian Planting	Change in habitat cover and structure	-riparian vegetation plantings (R-Veg) or re-seeding as necessary	-small loss of riparian vegetation	Low	-loss of wetland vegetation will be moderate as the swamp forest has little undergrowth
					Introduction of alien plant species	- replanted species to be locally sourced and or salvaged from site.	-none	Low	-limited risk of introduction of alien plan species due to locally sourced vegetation. And reuse of existing native soils.
Habitat E: 190 m removal of East Shirley's Brook by roadbed	Warmwater fish	Permanent enclosure of 190 m segment of East Shirley's Brook as is lies directly underneath road alignment. (250 m creek relocation to offset 190m enclosure of creek and loss of habitat)	**In-water POE**	Stripping Organic Soils of PSW#2	Removal of In-stream Organic Structure	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-loss of riparian and aquatic vegetation within small area	High	-loss of in-stream vegetation will be moderate to high
					Change in habitat cover and structure	- channel to be cleaned and filled with granular as part of future road base.	-Medium loss of riparian	High	-channel to be enclosed

Habitat	Type of Fishery Directly Supported	Type of Work / Undertaking	Effected Habitat	Potential Pathways of Effect	Potential Impact (stressor from PoE)	Mitigation Measures	Negative Residual Effects		
							Describe	Scale (Low, Medium, High)	Comments (rationale for scale)
							and aquatic vegetation		
				Flow Management to minimize sedimentation impacts	Suspension of sediment	-silt fencing installed both sides until the new creek s ready to be opened. complete offsetting realignment first; Most work to be done in dry by maintaining existing watercourse, minor inwater works to make connections at either end -Management – work site containment (M-WSCon) to isolate above water work and prevent entry of deleterious materials to the waterbody	-none	Low	-use of Standard Special Provisions to protect adjacent watercourse - no significant impacts as most work is completed in the dry
Habitat E: 190 m removal of East Shirley's Brook by roadbed	Warmwater fish	Permanent enclosure of 190 m segment of East Shirley's Brook as is lies directly underneath road alignment.	**In-water POE**		Change in migration /access to habitats	-Operational constraint for timing of in-water works (O-TW) to protect sensitive life stages/processes of fish; in-water works to take place between March 15 – June 30	-minor disruption to habitat access	Low	-in-water work to take place outside of sensitive spring window
					Flow alteration	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-drainage system has been designed to minimize waterbody impacts
				Fish Passage Issues	Diversion channels	-No diversion channels to be used here. Existing channel to remain open until offsetting channel is completed and stabilized. Management of temporary flow (M-TF) by isolating temporary in-water work and maintain clean flow around the work zone (e.g., using sheet piling) ; in-water works to take place between March 15 – June 30	-none	Low	-clean flow to be maintained around or through work zone
					Flow alteration	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-drainage system to be designed to minimize waterbody impacts
				Excavate low flow channel in PSW#2	Removal of In-stream Organic Structure	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation	-minor loss of riparian vegetation	Low	-loss of in-stream vegetation will be minor due to methods used - organic soils and vegetative rootzone reused in new channel bottom
					Suspension of sediment	-Management – work site containment (M-WSCon) to isolate above water work and prevent entry of deleterious materials to the waterbody -potentially some sediment released during changeover operations – this can be managed by working from downstream to upstream	none	Low	-use of Standard Special Provisions to protect adjacent watercourse
Habitat E: 190 m removal of East Shirley's Brook by roadbed	Warmwater fish	Permanent enclosure of 190 m segment of East Shirley's Brook as is lies directly underneath road alignment.	**Land-based POE**	Vegetation Clearing	Bank Stability and Exposed Soils	-Management – erosion and sediment controls (M-ESC) such as silt fence and/or rock rip rap	-none	High	-vegetation removal to be significant
					Removal of In-stream Organic Structure	-Management of vegetation (M-Veg) by minimizing clearing and protecting retained vegetation -riparian vegetation plantings (R-Veg) or re-seeding as necessary	-bedrock area, forested, few riparian plants	High	-100% loss of in-stream vegetation will
				Loss of Shade Sediment Runoff	Bank Stability and Exposed Soils	-Management – erosion and sediment controls (M-ESC) such as silt fence and/or rock rip rap.	-none	High	-vegetation removal to be significant and localized to permit the road

Habitat	Type of Fishery Directly Supported	Type of Work / Undertaking	Effected Habitat	Potential Pathways of Effect	Potential Impact (stressor from PoE)	Mitigation Measures	Negative Residual Effects		
							Describe	Scale (Low, Medium, High)	Comments (rationale for scale)
									construction.
				Heavy Equipment & Explosives	Use of Mobile Industrial Equipment / bank stability/ erosion potential Explosives will be used for rock cut section	-Operational constraint for timing of in-water works (O-TW) to protect sensitive life stages/processes of fish; in-water works to take place between March 15 – June 30 -Operational constraint for access (O-Acc) to protect riparian vegetation and minimize bank erosion - follow DFO guidelines for use of explosives around waterbodies	-minimal, localized and temporary disturbance to areas adjacent to watercourse	High	-explosive use throughout road project will be significant - use of low residue explosives has been specified for use around watercourses.
					Use of Immobile Industrial Equipment / Equipment Leaks	-Management of equipment (M-Eqp) by operating and maintaining in a manner that prevents entry of deleterious substances into any waterbody -ensure any equipment entering the waterbody is free of leaks and externally cleaned/degreased -have Spills Management Plan (M-Spl) on site	-no dewatering is expected	Low	-with mitigation measures, no residual effect is expected
				Grading Excavation of bedrock Placement of Granular Fill. Placement of organic soils in open channel.	Bank Stability and Exposed Soils / Increased Erosion Potential	-fill to be placed in channel to enclose the watercourse	- channel eliminated	High	-enclosure of creek
					Change in Land Drainage Patterns	-design drainage system to minimize changes in drainage to or from the waterbody (D-Dr)	-none	Low	-the realignment drainage system has been designed to minimize impacts to PSW #2 and this watercourse
					Partial construction of flow	- reuse organic soils as soon as possible after stripping to maintain viability of the seed bank	-none	Medium	-reuse of organic soils, seedbank and existing root masses will speed regeneration in the new channel

Expected Residual Effects

- Habitats A, B & D are ephemeral, small tributaries that seldom carry flow after the spring freshet. By embedding the base 30 cm below the creek grade, water is likely to pool beneath the culvert and remain there during drought or hot conditions. The cool culvert pools can become a refuge for small fish species and some amphibians to survive the drought period.
- Removal of instream woody structural cover material, stream bank vegetation and allocthanous inputs will occur within the footprint of the new culverts (i.e. 45-77 m in range).
- Potential increase in solar inputs and loss of allocthanous inputs along an additional 5-10 meters of stream on either end of the culvert. This will be partially offset as the vegetation of the edge management zone re-colonizes.
- Changes in stream bank composition from vegetation to exposed bedrock along 130 metres of the East Shirley's Brook realignment. By using native organic soils from teh wetland and locally collected willow cuttings, this riparian zone will regrow rapidly in 3-5 years.
- Fish will be able to migrate immediately after construction if there is enough waterflow – the resident fish species migrate short distances during storm events, so migration is not a concern.

We expect that additional mitigation measures made in the field during construction will reduce the residual effects even further:

- The re-colonization of vegetation around either end of the culverts will be expedited through seeding and the planting of shrubs.
- Solar inputs could be reduced by retaining vegetation on the shade producing side of the stream.
- The impact to streambank vegetation will be reduced by limiting the amount of rip rap and preventing unnecessary vegetation removal at the waters edge.

Specific mitigation measures to be used while construction progresses will be compiled in the written specifications that govern the contractors work. These are as follows and as detailed in the CEAA screening report underculvert and stream realignment mitigation measures:

- Minimize the riparian area temporarily disturbed by access activities
- Install appropriate and effective sediment control measures before beginning the work. Ensure sediment control measures are inspected regularly during the course of the work and all necessary repairs are made if damage is discovered (i.e. you see silt or sediment entering the water outside of the work area).
- Stabilize any waste materials removed from the work site to prevent them from entering any water body (e.g., placing them above the High Water Mark). This could include covering spoil piles with biodegradable mats or tarps or planting them with grass or shrubs.
- Stockpiled or excavated materials should be stored on land above the high water level of any waterbody, and effectively contained/stabilized to prevent them from entering any waterbody.

- All disturbed areas should be stabilized and/or re-vegetated with deep rooted native plants upon completion of work and restored to a pre-disturbed state or better.
- Vegetate any disturbed areas by planting and seeding, preferably with native trees, shrubs, or grasses, and cover such areas with mulch to prevent erosion and to help seeds germinate. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring.
    - Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.
- Embed water crossings as appropriate to ensure fish passage and channel crossing stability – generally 30 cm below the stream natural invert elevation.
- If fish passage is required during low flows, ensure that a low flow channel is maintained through the crossing, even for bridges.
- Fish passage should be maintained through the water crossing at high and/or low flows, as dictated by the fisheries management objectives.
- The natural stream gradient should be maintained upstream, downstream and through the water crossing.
- Water depth within the water crossing should be not less than 20 cm or the same depth as the natural channel especially during low flows.
- Fish passage will be maintained during operation and life of the water crossing as per fisheries management objectives;
- Work during low flow conditions and avoid work during large precipitation/runoff events.
- Construction should be completed in the dry, when there is no flow in the channel, or by use of a by-pass channel, dam and pump or other construction techniques, unless it is determined that working in the wet is appropriate.
- Culvert inlets and outlets should be adequately protected to prevent erosion and scour of the bed and banks. Any materials installed for stabilization (e.g. rock rip-rap) should be clean and free of fine particulates and are not to be taken from below the high water mark or shoreline of any waterbody.
- When placing rock reinforcement/armouring to stabilize inlets and outlets, the following measures should be incorporated:
    - Place appropriately-sized, clean rocks into the eroding area.
    - Do not obtain rocks from below the ordinary high water mark of any water body.
    - Avoid the use of rock that is acid-generating. Also avoid the use of rock that fractures and breaks down quickly when exposed to the elements.

- Install rock at a similar slope to maintain a uniform stream bank and natural stream alignment.
- Ensure rock does not interfere with fish passage or constrict the channel width.

- If water is present in the creek at the time of construction, all instream works should occur in isolation of flows.
    - Coffer dams should be installed upstream and downstream of the work area. Earthen berms are not to be used as coffer dams for this purpose.
    - All materials associated with the coffer dams should be completely removed from the creek channel at the end of the project.
    - If flows are present, downstream flow will be maintained using a pump-around method, and if necessary, an energy dissipation pool consisting of riprap material will be created at the pumped water discharge site to avoid erosion.
    - Pump intakes should be screened according to *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO - March 1995. Available online at: http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/water-eau/pipe/index_e.asp).
    - Any fish that are stranded within the de-watered area should be removed and released downstream of the work area.

Temporary Isolation

- Install effective sediment and erosion control measures before starting work to prevent entry of sediment into the watercourse. Inspect them regularly during the course of construction to ensure they are functioning properly. Make all necessary repairs if any damage is discovered.
- Use coffer dams such as aqua-dams, sand bags, concrete blocks, steel or wood wall, clean rip-rap, sheet pile or other appropriate designs to separate the in-water work site from flowing water.
- Use clean, washed material to build the berm and face the berm with clean, washed granular material that is adequately sized (i.e., moderate sized rip-rap and not sand or gravel) to hold the berm in place during construction. Material to build the berms should not be taken from below the high water mark.
- Design coffer dams to accommodate any expected high flows of the watercourse during the construction period.
- Minimize flow constriction to maintain unobstructed fish passage and restore original flow as soon as work is completed.
- Before starting construction, salvage fish from behind the coffer dam and return them to the downstream portion of the watercourse.

- Remove accumulated sediment from behind the coffer dam before it is removed and ensure that the original bed of the watercourse is not excavated.
- All materials associated with the coffer dams should be completely removed from the creek channel at the end of the project.
- Restore the original channel bottom gradient and substrate after removing coffer dams.
- Treat water from dewatered areas or divert into a vegetated area or settling basin to remove suspended solids and prevent sediment and other deleterious substances from entering the watercourse.
- Gradually remove the coffer dam to equalize the water levels inside and outside the isolated areas and reduce the amount of suspended sediment that is carried downstream.

Machine operation

- Operate machinery in a manner that minimizes disturbance to the banks or bed of the waterbody (e.g. from above the high water mark, from a barge, on the ice).
- Operate machinery on land (above the HWM) and in a manner that minimizes disturbance to the banks of the water body.
    - Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks.
    - Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substances from entering the water.
    - Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.
    - Restore banks to original condition if any disturbance occurs.

Step 3. Risk Assessment

Risk Assessment is the process used by Practitioners to determine the level of risk that residual effects pose to fish and fish habitat. To assess risk, one must consider the outcome of the aquatic effects assessment (i.e. the **Scale of Negative Effect**) in the context of the fish and fish habitat being effected (i.e. the **Sensitivity of Fish and Fish Habitat**). The Risk Assessment Matrix incorporates these two factors in order to characterize the level of risk the development proposal poses to the productive capacity of fish habitat. The rationale used to locate the residual effects on the matrix forms the basis for decision-making.

Scale of Negative Effect

Scale of negative effect attributes are used to scale the residual effects on the y-axis of the risk assessment matrix. General qualifiers used to describe the attributes are described in Table 3.

Table 3: Attributes used to describe the scale of negative effects

Attribute	Description	Scale used to qualify the attributes (in increasing order)
1. Extent	Culverts in Habitats A,B, D and F will be standard box culverts averaging 61.5 m long by 1.2 m wide that cross the streams at right angles. The exception to this is Culvert CV4 on Habitat B which crosses at a skew, so the culvert is longer at 86 m. Crossings C & D are within PSW #1 & #2. Total extent of disturbances will be Habitat A: (0.4 m X 67 m X 2 channels) =53.6 m^2 Habitat B: (0.5 m X 86 m) =43 m^2 Habitat D : (0.2 m X 57 m) =11.4 m^2 Habitat F : (0.8 m X 61 m) = 48.8 m^2. The arch culvert and roadbed width on Habitat C has been shortened to 45 m to reduce the overall road footprint through wetland PSW#1. This crosses at a right angle. An enhanced swale will outlet to the creek, 25 m downstream of the culvert. No additional downstream effects are expected. Total extent of disturbances will be: Habitat C: (0.9 X 65 m) = 58.5 m^2 The 190 m segment (Habitat E) to be enclosed, is a narrow, previously ditched channel with some instream structure that enters PSW #2. No fish were found here. Configured in an 'L' shape, the road will impact the area surrounding the creek over an 80 m length of roadway. The compensating creek realignment will enter the wetland slightly further downstream so that new backwater conditions can be made to enhance the wetland. Total extent of disturbance will be: Habitat E: (0.8 m X 190 m) 152 m^2	Low: Short length compared to overall reach length (A,B, C, D, F) Medium: Medium length compared to overall reach (Habitat E) High: Total length of stream effected (Not in this project)
2. Duration	Culverts will become cluttered with woody debris and leaves within the first season and will be occupied by fish and benthic aquatic organisms within months of being constructed. Duration for all works is relatively short.	Low: short term (days) **Medium: Medium term (weeks-months).** High: (Months to years)
3. Intensity	Once recovered, there will be not be very much change from the current baseline conditions. Future developments may change that however. The spawning period for all species is being avoided. All resident species spawn in loose sand or on submerged vegetation, so the potential for sedimentation of spawning beds is negligible. Both systems are low productivity systems colonized only by small baitfish. Habitat will remain as productive as current conditions.	**Low: Habitat still suitable but not as productive** Medium: Habitat quality significantly reduced High: Habitat quality unusable

Sensitivity of Fish and Fish Habitat

The Sensitivity of Fish and Fish Habitat is represented by the x-axis of the Risk Assessment Matrix. The Shirley's Brook Watershed plan of 1999, identified essentially the same species composition as found in 2009 and reported in Chapter 8. No fish were found in the two Carp River tributaries, although the main river is considered to be a warm water system that supports Northern Pike among other valued fish species. In Shirley's Brook, the same three baitfish species (Central Mudminnow, Northern Redbelly Dace, Brook Stickleback) were found in all perennial stream habitats of both the east and west tributaries. These species were found in the associated wetlands as well, however water depth in April through PSW#2 was too shallow to support fish. These species are highly tolerant of shifting water quality conditions and are found ubiquitously throughout the Canadian Shield region.

General qualifiers used to describe fish and fish habitat attributes are summarized in Table 4.

Table 4: Sensitivity of Fish and Fish Habitat

Attribute	**Description**	**Scales for qualifying the attributes in freshwater ecosystems. These are ordered from low sensitivity to high sensitivity for each attribute.**
1. Species Sensitivity	The identified species (3) are not sensitive to changes in environmental conditions, such as suspended sediments, water temperature or salinity.	**Low: Species present are resilient to change and perturbation (e.g. many cyprinid species).** Medium: Species present are moderately resilient to change and perturbation (e.g. pike, walleye and some cyprinids) High: Species present are highly sensitive to perturbations (e.g. many salmonidae)
2. Species' Dependence on Habitat	Identified species found mostly in the wetland habitats and use the creeks primarily for seasonal migration. Almost no use by fish in the more ephemeral streams.	Low: No use by fish **Medium: Used as migratory corridor only; feeding, rearing**. High: Spawning habitat; habitat critical to survival of species
3. Rarity	Identified species are abundant and ubiquitous in the area.	**Low: Habitat/species is prevalent.** Medium: Habitat/Species has limited distribution confined to small areas High: Habitat/Species is rare e.g. Listed species under SARA.
4. Habitat Resiliency	The identified species are highly resilient to changes in their environment. They are commonly found in shallow ditches, wetlands and sometimes farm fields; anywhere they can shelter under some vegetation. All are warm water species. The Shirley's Brook upper watershed is stable and resistant to change due to the	**Thermal regime** Very Low: Thermal regime unsuitable for any fish species. **Low: Warm water thermal regime suitable for cyprinids.** Medium: Cool water systems; coldwater systems that can buffer temperature changes High: Cold water systems that cannot easily buffer temperature changes. **Physical characteristics:** **Low: System is stable and resilient to**

	large protected wetlands in the headwaters of the watershed. Habitats A & B are ephemeral. Habitat D is intermittent Habitats C, E & F are Permanent	**change and perturbation** High: System is unstable and resilient to change and perturbation **Flow regime** **Low: Ephemeral - systems contain water only for short period after rain event** Medium: Intermittent - system contains water periodically **High: Permanent - system contains water year round**

Step 4. Determine Level of Risk

The following table summarizes the two risk attributes, consolidating the six affected watercourse interactions into one summary risk assessment. From this table, the final risk assessment and HADD determination has been made.

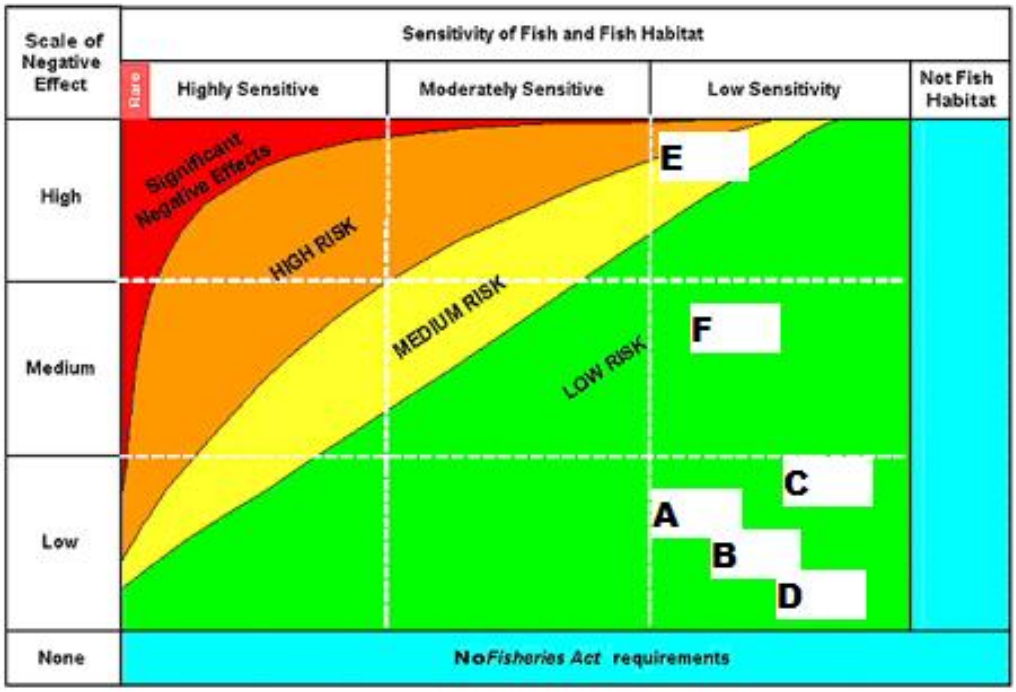
Table 5. Summary of Risk Attributes

Negative Effect Attributes	**Habitat A**	**Habitat B**	**Habitat C**	**Habitat D**	**Habitat E**	**Habitat F**
1. Extent	Low	Low	Low	Low	Medium	Low
2. Duration	Med	Low	Med	Low	High	Low
3. Intensity	Low	Low	Med	Low	Low	Low
Sensitivity Attributes						
1. Species Sensitivity	Low	Low	Low	Low	Low	Low
2. Species' Dependence on Habitat	Med	Med	Med	Med	Med	Med
3. Rarity	Low	Low	Low	Low	Low	Low
4. Resiliency Thermal	Low	Low	Low	Low	Low	Low
4. Resiliency Physical	Low	Low	Low	Low	Low	Low
4. Resiliency Flow	Low	Low	High	Med	High	High
X/Y Axis Rank	**L/L**	**L/L**	**M/L**	**L/L**	**H/L**	**L/L**

A red box labeled "Rare" located at the most highly sensitive end of the axis is meant to represent fish and fish habitats that are particularly rare and/or afforded special protection under the Species at Risk Act (SARA). No fish species at risk have been identified within the Terry Fox drive study area.

Categorizing risk involves using the analysis which was done for determining the Scale of Negative Effect (Step 3a) and the Sensitivity of Fish and Fish Habitat (Step 3b) to plot a point on the Risk Assessment Matrix. The Risk Assessment Matrix is divided into four categories of risk: Low Risk, Medium Risk, High Risk and Significant Negative Effects.

Risk Assessment Matrix Used for the Various Watercourse Crossings / Interactions used to Illustrate Various Categories of Risk



Step 5. HADD Determination

This step determines whether there will be a Harmful Alteration, Disruption or Destruction of Fish Habitat as defined by the Risk Management Framework.

Low Risk

Development proposals that are characterized as Low Risk are not likely to result in HADD, providing appropriate mitigation measures are applied. In general, based on this assessment, no HADD's will occur as a result of the crossing of watercourses. An appropriate management

option in this case would be to issue a 'No HADD Likely as Proposed' letter. Letters include a list of those mitigation measures that formed the basis of the decision, and direct proponents to the appropriate guidelines, or best management practices where applicable.

High Risk

Habitat E exhibits a high risk to the fish and fish habitats in East Shirley's Brook. The relocation of a 190 m piece of East Shirley's Brook will result in a HADD, and will require offsetting compensation through the construction of the 250 m creek realignment. An Authorization under Section 35(2) of the Fisheries Act will be required.