Final Report:

Fish Population and Water Quality Monitoring

Hardisty Creek Restoration Project

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March 23, 2009

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Foothills Research Institute's core study area is located in west-central Alberta, with an administrative office in the resource community of Hinton, approximately three hours west of Edmonton.

The area covers 2.75 million hectares (27,500 square kilometres), and includes Jasper National Park of Canada, Willmore Wilderness Park, William A. Switzer Provincial Park and the Forest Management Area of Hinton Wood Products, A Division of West Fraser Mills Ltd. It also includes some provincial management units and the Hinton Training Centre's Cache Percotte Training Forest. Within its boundaries are three forest types – boreal, montane, and sub-alpine – and many forest uses including timber, petroleum and coal extraction, tourism and recreation.

The Foothills Research Institute Fish and Watershed Program partners include Alberta Sustainable Resource Development, Hinton Wood Products – a division of West Fraser Mills Ltd., Canadian Natural Resources Ltd., ConocoPhillips Canada, Encana Corporation, Petro-Canada, and Talisman Energy Inc.

Abstract

This project summarizes an evaluation of the biological response following various restoration projects completed between 2003 and 2007, as well as a storm water quality assessment in Hardisty Creek. Hardisty Creek watershed is located in Alberta's Upper Foothills natural sub-region. The forested headwaters are provincial lands and include parts of the Cache Percotte Forest managed by Alberta Sustainable Resource Development and the Forest Management Agreement area held by Hinton Wood Products. The lower watershed lies within the Town of Hinton. The fish inventory for monitoring purposes was initiated in 2005 and in 2008 the study area expanded to include seven locations. 2008 was the first year of water quality assessments.

When this community-based restoration effort started in 2003, there were records of rainbow trout and brook trout inhabiting Hardisty Creek within the Town of Hinton. Between 2005 and 2008, four additional fish species were captured including bull trout, mountain whitefish, northern pike and longnose dace. This increase in fish species diversity followed completion of the fish migration barrier removal and habitat restoration projects. In the reaches upstream from the fish passage remediation projects, fish abundance was the highest in 2007 for brook trout, bull trout, mountain whitefish, and rainbow trout. In 2008, some erosion at the Kinsmen Park fish passage project occurred and this may have reduced the productive capacity in downstream areas and prevented migration of some fish. The Town of Hinton initiated plans to complete necessary maintenance activities at the site in 2009.

The storm water quality monitoring project identified a number of areas of concern and ranked them in order of priority for action. Water quality at the point where Hardisty Creek leaves the provincial lands and enters the Town of Hinton was good, but decreased due to the quality of storm water runoff in town. Sedimentation of Hardisty Creek occurs as a result of erosion of recently developed lands. Addressing this issue will be difficult for two reasons. First, the soil covering most of the eroding areas within the Town of Hinton has a high erosion hazard and is prone to water erosion following the removal of vegetation. Second, multiple land owners, including the Town of Hinton and small businesses, hold the property rights for the areas of concern. Many of the industrial properties either have bare soil or extensive gravel areas, both of which are sources of sediment. Ideally these areas would be stabilized by grass, pavement, or a properly engineered surface. Developing and implementing erosion control plans in these areas will be an expensive endeavor. Land owners are not aware of the problem / requirements and have not budgeted to address the problem in the short-term. Therefore, a well coordinated long-term effort with input from regulators, land owners, and some form of financial support has the best chance of reducing pollution into Hardisty Creek. Modifying Town of Hinton policy for new developments will also help to conserve water quality and reduce pollution.

Acknowledgements

This project was funded by the Alberta Stewardship Network and Foothills Research Institute partners including Canadian Natural Resources Ltd., Conoco-Phillips Canada, Encana Corporation, Hinton Wood Products – a division of West Fraser Mills Ltd. (Hinton Wood Products), Petro-Canada, and Talisman Energy Inc.

Members of the Hardisty Creek Restoration Project steering committee, including representatives from HWP and the Town of Hinton, agreed that this was a worthwhile project to pursue. Jean Anne Fraser and Jamal Nasrabadi from the Town of Hinton provided digital data including storm sewer lines and manholes that was essential for identifying sample locations. Other Town of Hinton employees including Ken McLeod, Crystal Kereliuk, and Stephen Hanus attended meetings to review interim findings.

Employees of the Foothills Research Institute (FRI) including Ngaio Baril, Candace Flynn, Stephen Haslett, and Donald Lougheed completed the electro-fishing. Stephen Haslett and Donald Lougheed also worked on the Storm Water Assessment Team (SWAT), completing their work during periods of heavy rain in good spirits. Julie Duval - FRI GIS specialist, prepared maps for the field surveys. Karen Nikaruk provided valuable comments during an editorial review of this report.

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1. Introduction

The Hardisty Creek Restoration Project (HCRP) was started in 2002 through a partnership between the Foothills Research Institute and the West Athabasca Bioregional Society. The goals of the project were to complete watershed restoration and education activities in Hardisty Creek within the Town of Hinton. Our strategy included:

1) building an engaged partnership of all stakeholders;
2) fostering community involvement;
3) setting priorities for restoration; and
4) demonstrating innovative restoration practices.

Since 2002, stakeholders have completed fish passage restoration at three crossings and restored habitat within a 300 m section of stream in a public park (Figure 1). Fish passage restoration plans have been developed for the remaining crossings of concern and repairs have been scheduled. Numerous education events for the general public, school groups, youth groups and professionals have contributed to the success and recognition that the project has received at the regional, provincial and national levels (e.g. http://www.whc.org/EN/stewardship/2007FSRPAwardRecipients.htm).

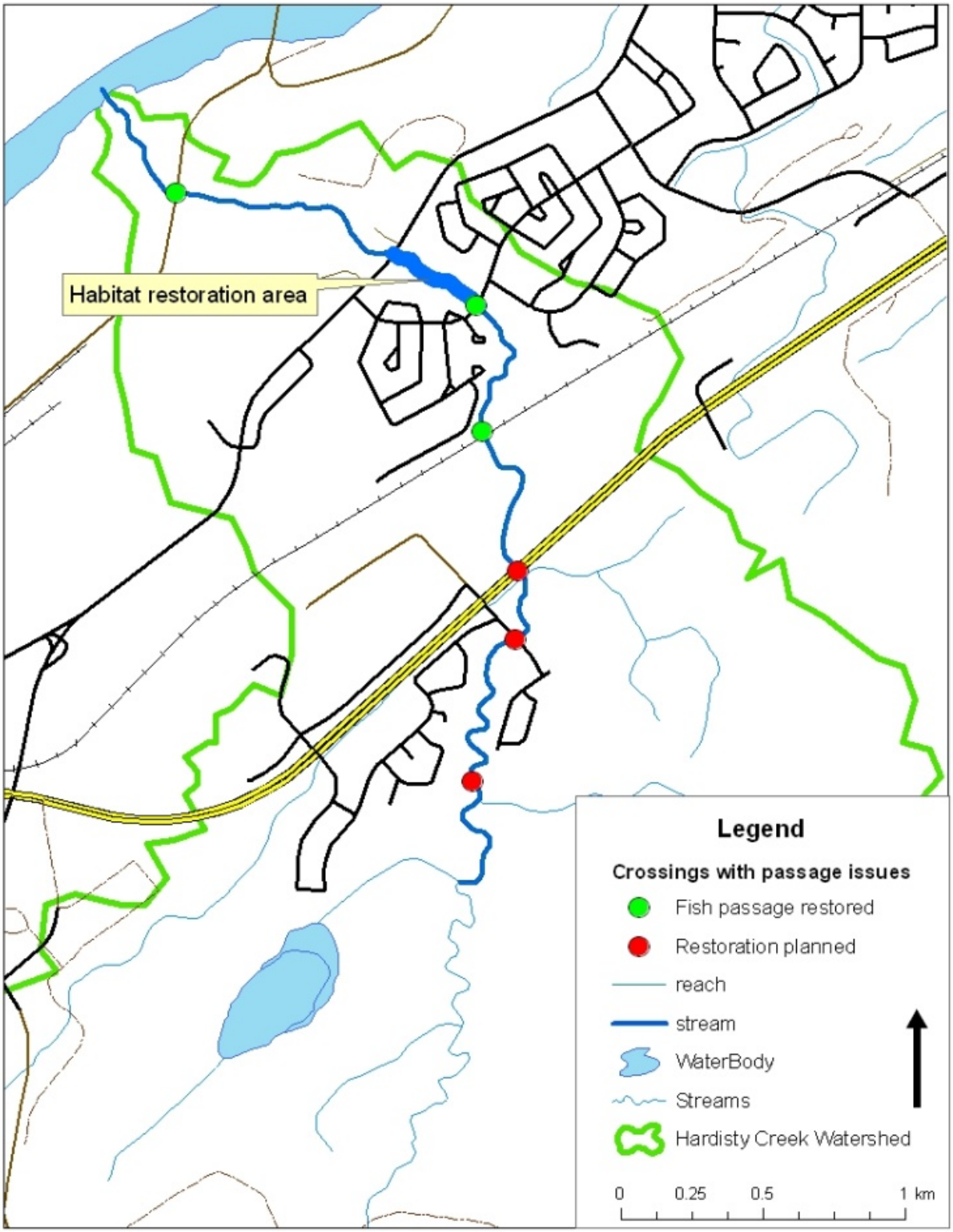

Figure 1. Map of Hardisty Creek within the Town of Hinton showing stream crossings of concern and fish habitat restoration reach.

Stream restoration is a new discipline that blends the sciences of aquatic biology and water resources engineering. Restoring impacted aquatic systems is not a profit-generating pursuit and innovative approaches are required to meet objectives with financial constraints. Monitoring the effectiveness of any project is important for three reasons. First, monitoring can help to identify required maintenance activities. Second, advancing the new discipline of stream restoration requires evaluations to confirm the techniques work and those that don't. Third, streams are complex ecosystems that can experience a variety of impacts including: (1) fish passage obstruction, (2) habitat loss, (3) sedimentation, (4) over-harvest from legal and illegal angling, and (5) competition from non-native fish. To be successful in the long-term, the biologist must rank these factors in order of importance and encourage managers to allocate their limited resources accordingly. The magnitude of these individual impacts can change over time, and ideally a biologist will complete annual evaluations and inform stakeholders on where available resources should be best allocated.

The purposes of this monitoring project were:

1) to complete fish population monitoring , evaluate biological responses to recently completed restoration activities (Figure 1, Kinsmen Park plus Crossings 1,2, and 3) and to provide baseline data prior to planned fish passage restoration activities (Figure 1, Crossings 4,5 and 6);
2) to complete an evaluation of the risk to aquatic life originating from upland erosion and subsequent stream sedimentation in Hardisty Creek;
3) to educate land managers on the connections between erosion control planning and aquatic health within the Hardisty Creek watershed and;
4) in a timely manner, inform land management partners of the HCRP of sites where upland erosion is contributing to polluting Hardisty Creek so that they can initiate remediation planning.

The following two subsections provide fish passage and erosion control considerations. This information is specifically provided to assist land managers on the HCRP who may be tasked with resourcing any remediation measures.

1.1 Overview of biological and legal considerations for fish passage in Hardisty Creek

Like many clear running streams in the Foothills, Hardisty Creek supports a variety of fish species. Many of these fishes also spend part of their life cycle in the Athabasca River.

In North America, rainbow trout are native to only three watersheds (Athabasca, Peace and Liard) east of the Rocky Mountains [4]. Due to this distinction, the rainbow trout in Hardisty Creek are part of a population that meets the criteria for listing under Canada's Species at Risk Act. Rainbow trout have survived in the upper Hardisty Creek watershed despite the migration barriers (e.g. Crossing 3) that have persisted for more than half a century. This group is a "resident" population and such fish rarely grow to more than 25 cm in length. Although out-migration from this population likely occurs, enough individuals have completed all life cycle stages in the upper watershed to sustain the population. These resident fish would migrate throughout the upper Hardisty Creek to find suitable spawning, over-

wintering and juvenile habitat. Other rainbow trout spend part of their life cycle in large rivers but use clear running tributary streams for spawning and juvenile life stages. Fish from these "migratory" populations can grow to larger than 25 cm in length. Ensuring that rainbow trout have access to their entire historic range is a primary consideration in sustaining these populations.

Bull trout are recognized as a "Species of Special Concern" in Alberta. Bull trout also form resident and migratory populations. During the summer months, while the Athabasca River is high and turbid due to glacial runoff, the clear tributary streams that support aquatic insects and small fish may provide feeding areas for migratory bull trout. Fish larger than 25 cm in length are generally considered to be adults from migratory populations. Prior to the initiation of this project, bull trout were not found in Hardisty Creek during fish population surveys in the lower or upper watershed. However, anglers occasionally caught large bull trout in Hardisty Creek a number of decades ago, indicating some use of the stream by migratory populations. Interest in sport fishing dropped off over time as habitat quality and populations decreased. At an early meeting of the HCRP steering committee, the group decided that re-establishing bull trout within Hardisty Creek was an unrealistic goal.

Mountain whitefish do not use Foothills streams as extensively as rainbow trout or bull trout. They tend to migrate upstream from larger rivers into the lower reaches of streams for spawning and juvenile life stages. During these times, they may be an important food source for bull trout. Prior to the start of this project, there were no records of mountain whitefish in Hardisty Creek. Establishment of a mountain whitefish population within the lower reaches of Hardisty Creek would be an indicator of good aquatic ecosystem health.

Maintaining unobstructed fish passage has been a requirement under the Federal Fisheries Act for decades, however compliance with this legislation has not always been enforced. As a result, migration barriers occur at many road and rail stream crossings in Canada. Other provincial statutes also contain requirements to maintain fish passage. As a general trend, government efforts to achieve compliance with these Acts are increasing.

1.2 Overview of biological and legal considerations for erosion control in the Hardisty Creek watershed

Extensive reviews of the effects of sediment on streams and stream dwelling organisms have been completed [5]. Significant effects on fish include reduced feeding capacity, reduced egg survival, gill abrasion, and relocation to clean waters. These effects have long been recognized and are well integrated into federal and provincial legislation. Although it is illegal to allow sediment to enter a stream, routine checks by regulators to determine effectiveness of erosion control plans and other storm water management practices have not been conducted in Hardisty Creek.

1.3 Study area

The study area corresponds to Hardisty Creek watershed boundary (Figure 2). The project focuses on fish passage and water quality impacts that have occurred due to development in the lower watershed. The soils of the lower watershed are formed in a wind-deposited (aeolian) layer of silt and clay. The material is swept from the bed of Brule Lake by winds during periods of low water and deposited in

downwind areas. This material has a high surface erosion hazard once the vegetation has been removed [1] and will require special attention if erosion control plans are to succeed.

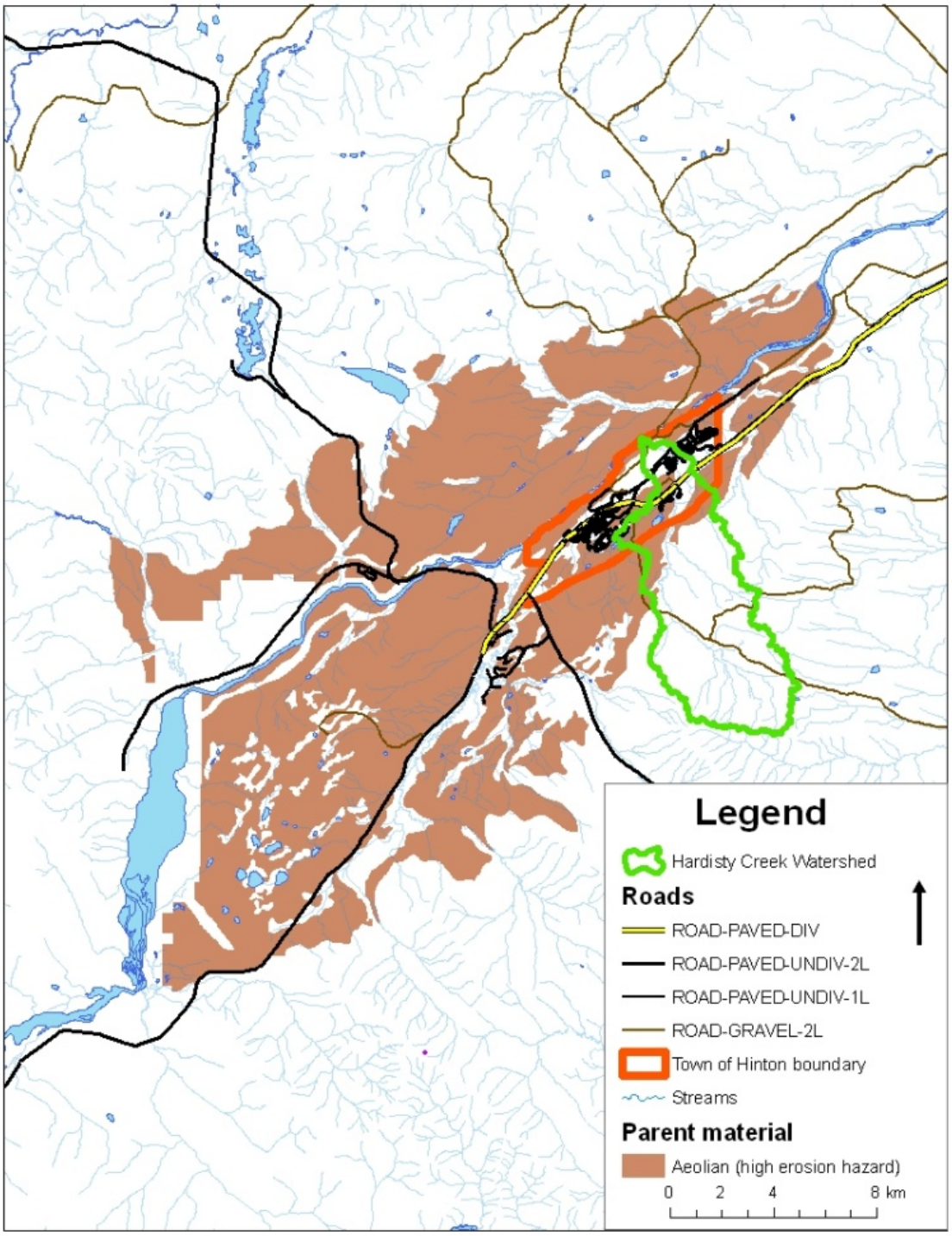

Figure 2. Map of study area including Hardisty Creek watershed, Town of Hinton boundary and the extent of high erosion hazard aeolian soils in the vicinity.

2. Methods

2.1 Fish population monitoring

Within Hardisty Creek, fish species distributions and their relative abundance was determined in consideration of the completed and planned restoration activities. The study area was divided into eight different reaches within the Town of Hinton (Figure 4). The boundaries between these stream segments corresponded to migration barriers and major changes in land-use. Backpack electro-fishing surveys were completed in reaches of interest using the Foothills Research Institute methodology [2]. The area of interest expanded annually as the monitoring project developed.

2.2 Water quality monitoring

Ongoing land management activities were assessed to determine if they present risks to water quality in Hardisty Creek. If water quality was comprised, locations of source areas of pollutants were to be determined. Sediment (defined as soil particles carried by water) was the target pollutant. Sediment is the pollutant of greatest concern to stream health in the United States, [5] and it was also the focus of this study.

A sediment source survey of areas of the watershed upstream from the Town of Hinton was completed using digital orthophotos. Within the Town of Hinton, each storm sewer outfall was considered a potential sediment input location and the uplands draining into the respective storm sewer drain network were considered a source area. The Town of Hinton provided digital maps of their storm sewer line and storm sewer manholes to assist in the identification of 13 unique sample sites (Figure 3). These sites were located at easy access points (Site #1, 4, and 5) and at points where storm water flows into Hardisty Creek. At storm water input sites, samples were taken from:

a. Hardisty Creek upstream of the storm water input,
b. the storm water itself, above the point where it flowed into Hardisty Creek, and
c. Hardisty Creek downstream of the point where storm water was completely mixed.

Water quality was sampled with a “turbidity tube”. The transparent tube was held vertically and filled to a depth of 120 cm. The technician looked down into the open end of the tube. Water was slowly drained using a value in the bottom of the tube until the black and white target in the bottom of the tube was visible to the technician. This water depth was recorded (0.1 cm). In the office, this depth measure was converted to Nephelometric Turbidity Units (NTU) using a formula developed from published conversion data[3]:

Turbidity (NTU) = 3948.5 * Turbidity tube depth (cm) ^-1.499

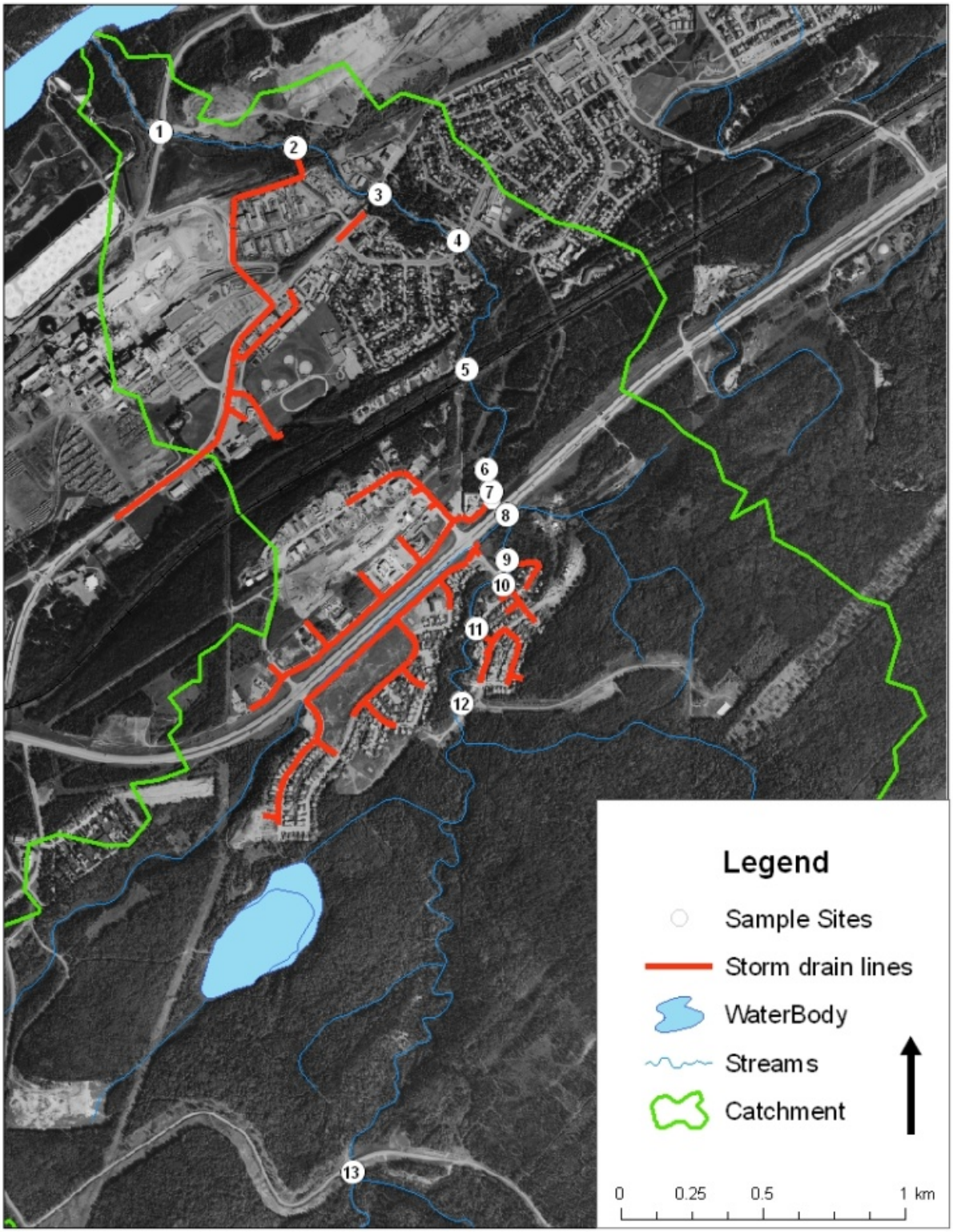

Figure 3. Water quality sampling locations.

3. Results and Discussion

3.1 Fish population monitoring

When this community-based restoration effort started in 2003, there were records of rainbow trout and brook trout inhabiting Hardisty Creek within the Town of Hinton. Between 2005 and 2008, four additional fish species were captured including bull trout, mountain whitefish, northern pike and longnose dace (Figure 4). This increase in fish species diversity followed completion of three fish migration barrier removal projects and one habitat restoration project (Figure 1).

The two reaches with the highest brook trout abundance were Reach 6 in 2007 (44 fish/km) and Reach 3 in 2005 (27 fish/km) (Figure 5). Fish migration barriers were present at the upstream end of these reaches at the time of these surveys, possibly indicating the upstream limit of brook trout migration. These findings suggest that fish migration removal may result in increasing brook trout migration into upstream areas.

The reach with the highest bull trout abundance was Reach 3 in 2005 (45 fish/km) (Figure 5). This survey was completed in the late fall following the replacement of the culverts nearest the mouth of Hardisty Creek by HWP. Overall relative abundance decreased from 2007 to 2008. Factors that could have contributed to the change may include erosion at the #2 fish passage remediation site at Hardisty Ave. The erosion may have reduced the effectiveness of the fish passage remedial measures. The material that was eroded from the site was deposited in downstream areas where it reduced pool depth and access to stream side large woody debris – both important bull trout cover features. In 2008, the Town of Hinton initiated plans to complete necessary maintenance activities at the site in 2009. In 2007, bull trout were captured upstream from two of the culverts that were rated as impassible to fish and a large char (>30cm) was observed during electro fishing in the most upstream reach – suggesting that bull trout may have also been able to negotiate the highest culvert, which was rated as a migration barrier.

Juvenile mountain whitefish were captured in great abundance (500 fish/km) in the late fall of 2005 (Figure 6). In 2007, juvenile mountain whitefish were captured upstream of the fish passage restoration structure at the CN crossing and also upstream of the fish migration barrier at Hwy 16. These results indicate that at certain flows mountain whitefish can navigate through sites that present gradient and velocity barriers according to fish passage design criteria. Meeting all fish passage design criteria at existing crossings can be financially restrictive, and these findings indicate that projects that meet relaxed criteria may be of some benefit for re-establishment of native fish. A detailed study of fish migration patterns and stream velocities in locations such as Hardisty Creek may provide knowledge to supplement the laboratory based studies that are currently used to set fish passage design criteria.

Rainbow trout relative abundance peaked in 2007 throughout most study area reaches (Figure 6). Fish size suggests that migratory rainbow trout from the Athabasca River may be using Hardisty Creek seasonally (e.g. 350 mm fish captured in Reach 4, July 29, 2008).

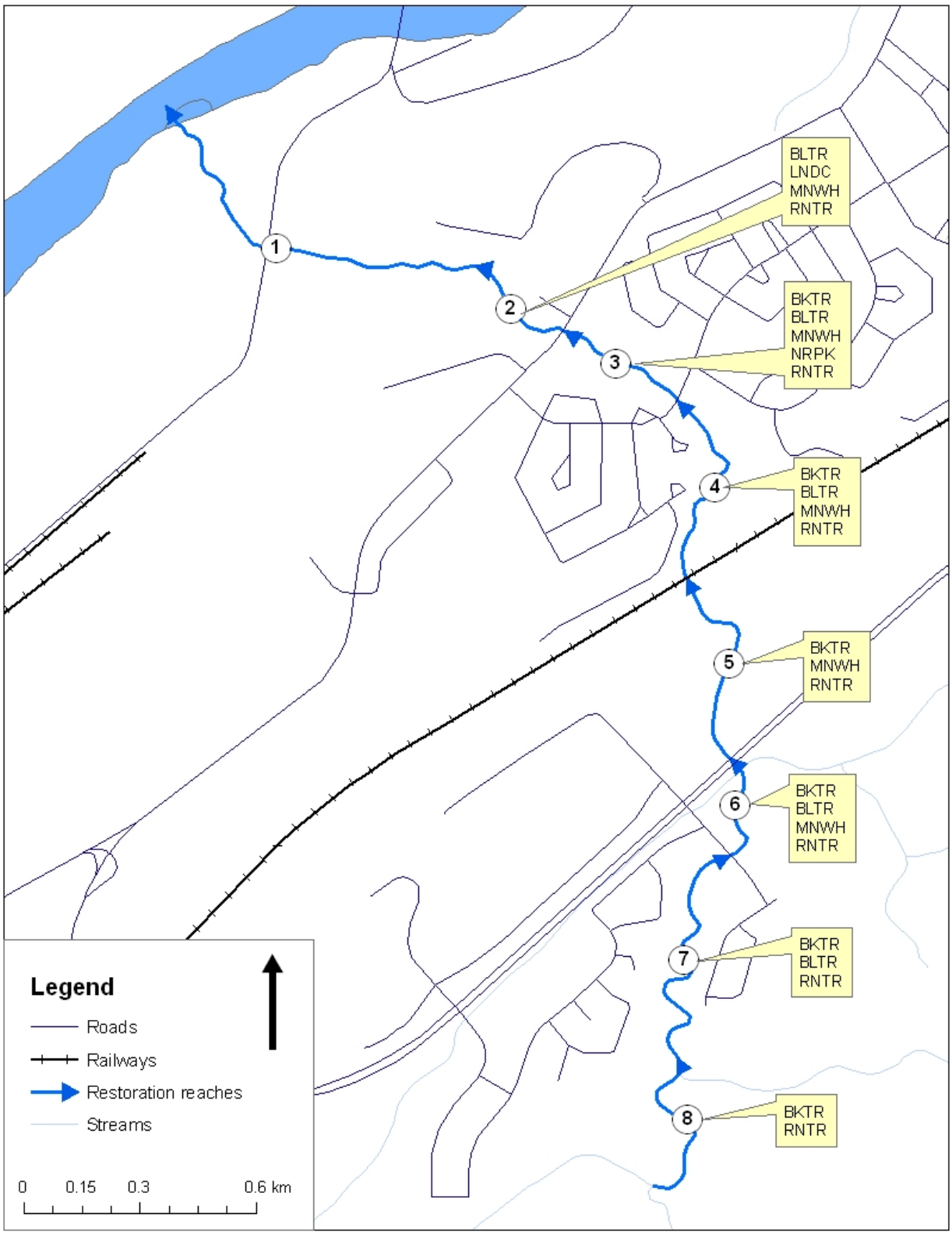

Figure 4. Map of all fish species captured from 2004-2008 by stream reach in Hardisty Creek (BKTR = brook trout, BLTR = bull trout, LNDC = longnose dace, MNWH = mountain whitefish, NRPK = northern pike, RNTR = rainbow trout).

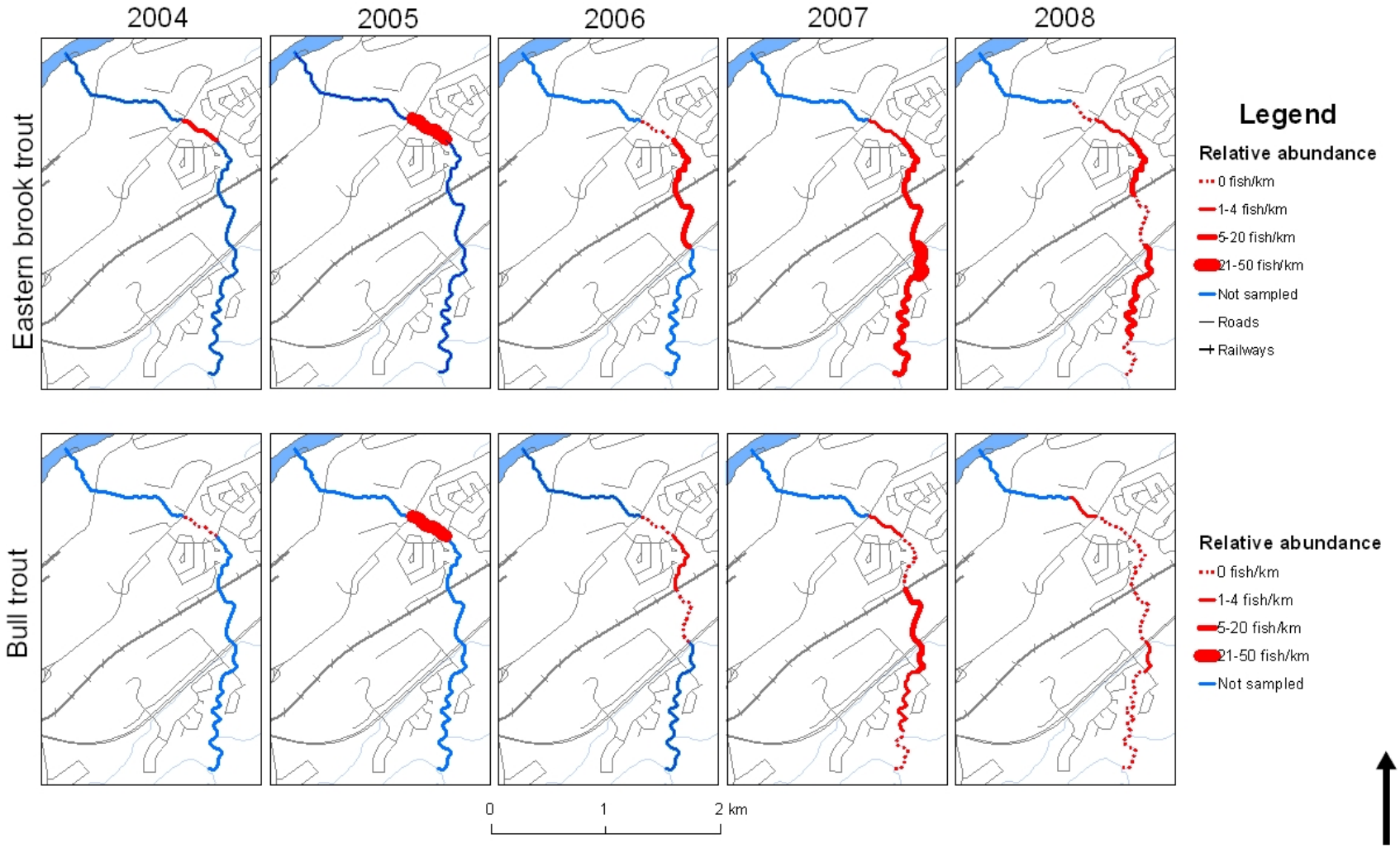

Figure 5. Relative abundance of brook trout and bull trout from 2004 to 2008 in Hardisty Creek within Town of Hinton.

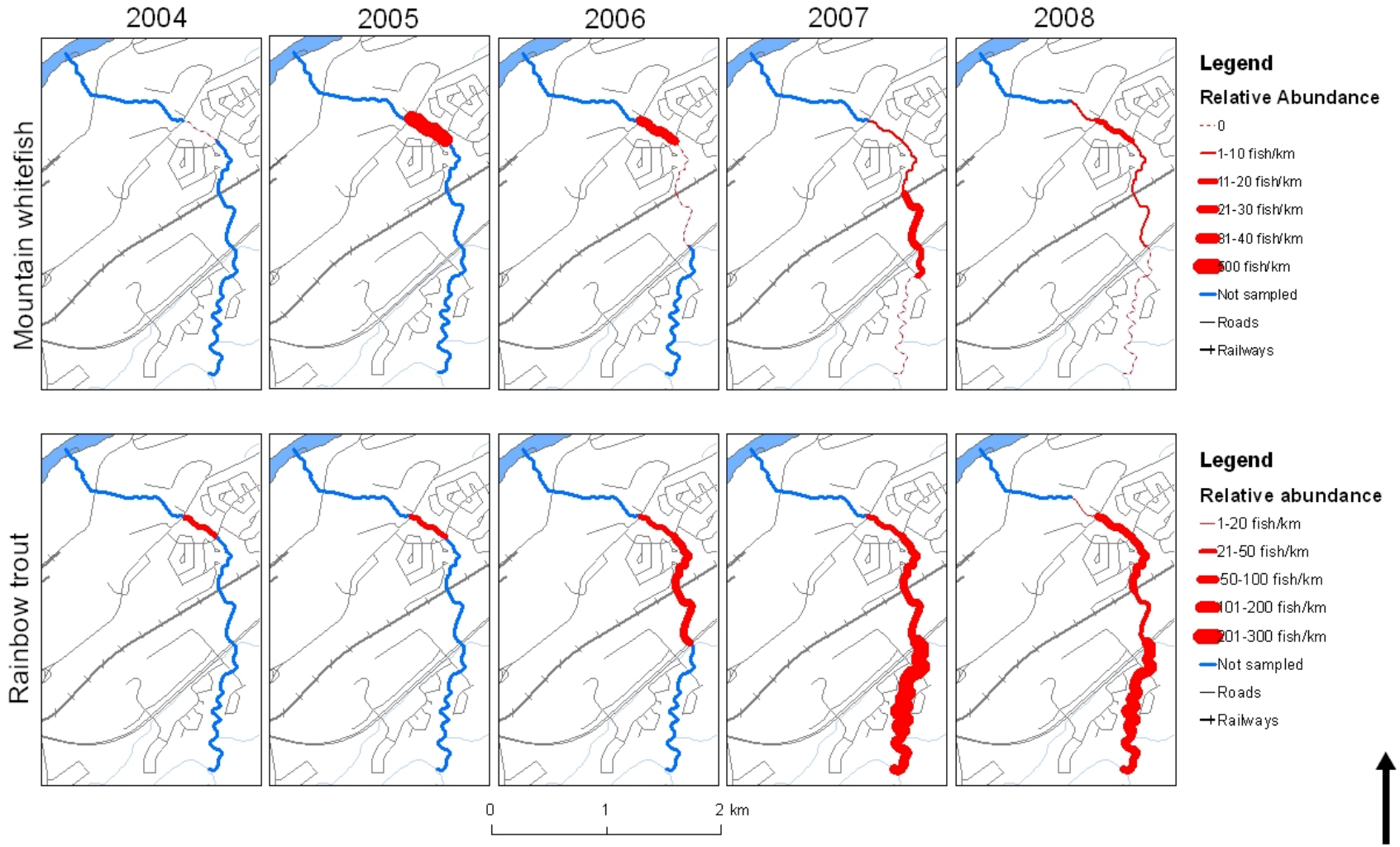

Figure 6. Relative abundance of mountain whitefish and rainbow trout from 2004 to 2008 in Hardisty Creek within Town of Hinton.

3.2 Water quality monitoring

Baseline water quality data was collected at all 13 sites (Figure 3) on June 6, 2008 and clear water was observed at all locations (Appendix 4). All sites were visited again on June 11, 2008 during a period of heavy rain. Water quality was excellent at the location where Hardisty Creek enters the Town of Hinton (Figure 7), but decreased downstream of four different storm sewer outfalls (Sample site #'s 11, 6, 3, and 2 - Figure 3). Turbidity recovered in a downstream direction from each of the sites; however turbidity exceeded 10 NTU in a number of reaches that include approximately 1 km of Hardisty Creek within the Town of Hinton. The storm outfalls were ranked in order of priority based on the change in Hardisty Creek water quality downstream of the input and the turbidity level observed at the outfall (Table 1).

Table 1. Prioritization of storm sewer outfalls based on severity of sedimentation.

Priority	Sample Site #	Sediment source area location	Turbidity at outfall	Turbidity at Hardisty Creek	Comments
1.	6	Recently constructed light industrial development off Felaber Road and Steele Cresent with paved roads. Source areas are properties cleared for storage, parking etc.	2149 NTU	29 NTU	Sedimentation of stream bed downstream of site noted. At the outlet, the concrete drain pipe was up to ½ full with sediment. Follow-up sampling at manholes in July indicated widespread erosion throughout drainage area.
2.	2	Old industrial area off Hampshire Road with gravel roads.	1062 NTU	11 NTU	Unable to locate storm sewer manholes during field visit.
3.	11	Storm sewer drains off Bradwell Street and Sitar Cresent.	108 NTU	93 NTU	High turbidity values recovered quickly downstream.
4.	3	Storm sewer drains on south side of Switzer Drive near 7-11.	353 NTU	24 NTU	Sediment source may be ditch runoff from paved road. Options for remediation limited.
5.	9	Storm sewer drains from Bradwell Street and Appleyard Cove.	388 NTU	3 NTU	Low volume of water from storm sewer enters Hardisty Creek. Improvements expected over time as landscaping in new residential development is completed.

The focus of the project shifted after the June 11 rain event. First, sediment source surveys were completed for the two top priority areas. The field crew was unable to find the mapped storm sewer manholes in public land in the Hampshire Road area, so the Felaber Road area became the area of interest.

Sedimentation of Hardisty Creek occurs as a result of erosion of recently developed lands. Addressing this issue will be difficult for two reasons. First, the soil covering most of the eroding areas within the Town of Hinton has a high erosion hazard and is prone to water erosion following the removal of vegetation. Second, multiple land owners, including the Town of Hinton and small businesses, hold the property rights for the areas of concern. Many of the industrial properties either have bare soil or extensive gravel areas, both of which are sources of sediment. Ideally these areas would be stabilized by grass, pavement, or a properly engineered surface. Developing and implementing erosion control plans in these areas will be an expensive endeavor. Land owners are not aware of the problem / requirements and have not budgeted to address the problem in the short-term. Therefore, a well coordinated long-term effort with input from regulators, land owners, and some form of financial support has the best chance of reducing pollution into Hardisty Creek. Modifying Town of Hinton policy for new developments will also help to conserve water quality and reduce pollution. If such changes are made, the Town of Hinton would be a leader in environmental policy among Alberta's rural municipalities.

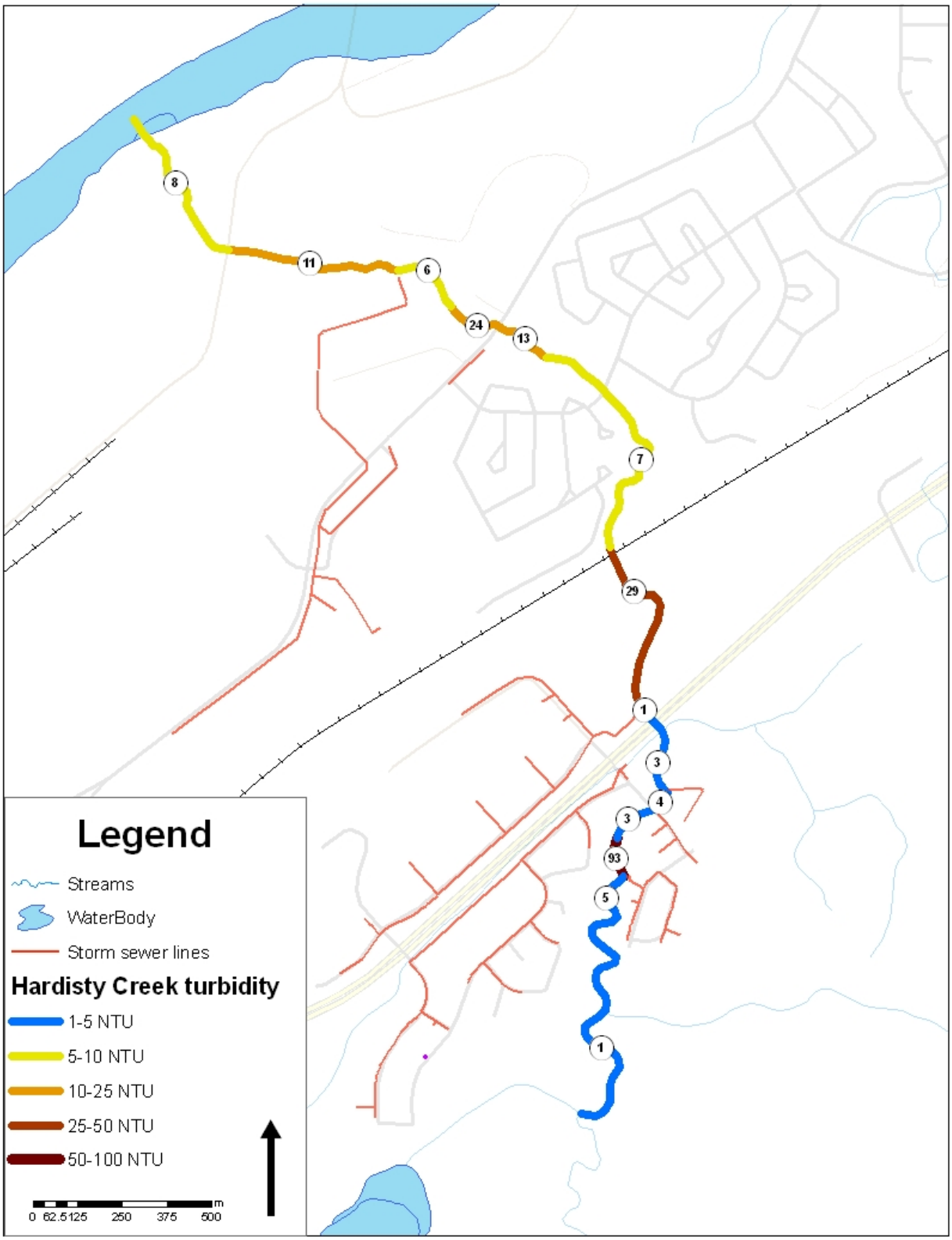

Figure 7. Turbidity measured in Nephelometric Turbidity Units (NTU) in Hardisty Creek within Town of Hinton by reach on June 11, 2008. Labels show measured value.

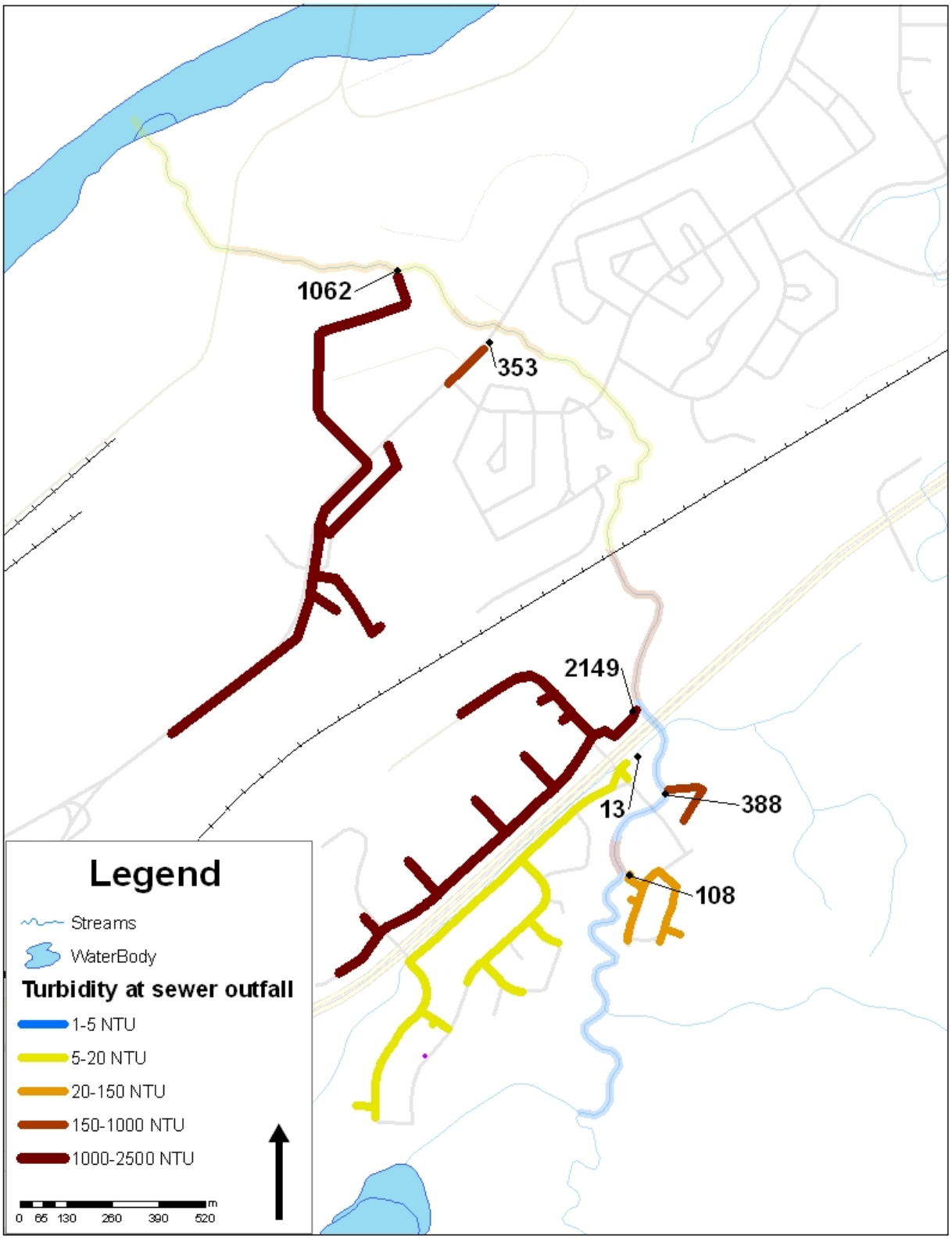

Figure 8 . Turbidity measured in Nephelometric Turbidity Units (NTU) at storm sewer outfalls into Hardisty Creek within Town of Hinton on June 11, 2008. Labels show measured value.

4. Conclusions

Since 2003, stakeholders in the Hardisty Creek project have completed a number of capital projects. As a result, the first goal of this monitoring project was to document changes in the Hardisty Creek fish community following these investments. Between 2003 and 2008, the stakeholders focused on fish passage and fish habitat restoration. However, in 2007 water quality was identified as a potential factor affecting the health of the aquatic ecosystem. In response, the second goal of this project was to locate any actively eroding upland sites that are contributing sediment to Hardisty Creek and to rank them in order of severity.

Fish species diversity and fish abundance have increased following completion of capital projects. The new bridge near the mouth of Hardisty Creek has allowed fish to inhabit sections of Hardisty Creek within the Town of Hinton. This major investment by Hinton Wood Products is a demonstration of the best fish passage remediation technique available – complete restoration of the natural stream bed through culvert removal. Bull trout and mountain whitefish have been recorded at varying levels of abundance in upstream areas following this project. Incidental catches of northern pike and longnose dace can also be attributed to this project.

A replacement of the Town of Hinton culvert at Hardisty Avenue was not feasible due to buried municipal infrastructure and the four-lane width of the road – costs for a bridge at this location were prohibitive and an innovative fix was attempted in 2005. Performance in terms of fish passage exceeded expectations in 2006 and 2007. However erosion of the structure in 2008 may be contributing to reduced fish use in upstream and downstream areas. An engineer's review of the structure is recommended to determine measures to re-stabalize the site and also to determine if similar innovations are appropriate for other upstream areas.

The CN crossing obstructed fish passage prior to 2003 when an innovative repair was completed. This sites has remained stable across a range of flows over a five-year period and has exceeded performance in terms of fish passage. This site could be considered a template for future projects in upstream areas.

The Highway 16 crossing was rated as a complete barrier to fish migration. Unfortunately the proposed repair plan was determined to be cost prohibitive (personal communication 2008, Dana Becker – Alberta Transportation). However, bull trout and juvenile mountain whitefish have been captured upstream of this structure. This indicates that the environmental performance of the existing structure is better than our evaluations indicated. Projects that improve fish passage at the culvert outfall may provide further benefits.

In summary, the fish passage projects completed prior to 2008 exceeded performance expectations, but stability of the innovative project at Hardisty Avenue remains an issue.

Our water quality monitoring project employed simple low cost techniques to identify two areas of concern within the Town of Hinton. Completing erosion control plans is the next step recommended for

these areas. Through their participation in this project, the Town of Hinton has demonstrated a level of leadership in environmental stewardship that is unique among rural municipalities in Alberta. They supported this project, have conducted a review of their erosion control requirements within their land development policy, and display an interest to move ahead with the next steps.

All stakeholders in the Hardisty Creek project were pleased with the progress made between 2003 and 2008 towards the completion of our multi-year plan to restore fish passage and habitat in Hardisty Creek. In 2008, we introduced a new element to watershed restoration – storm water runoff. This was not easy because the group thought that the project was just about done. Now we have another 5 years of work. Participants are starting to realize that watershed stewardship is a life-long endeavor.

5. Literature Cited

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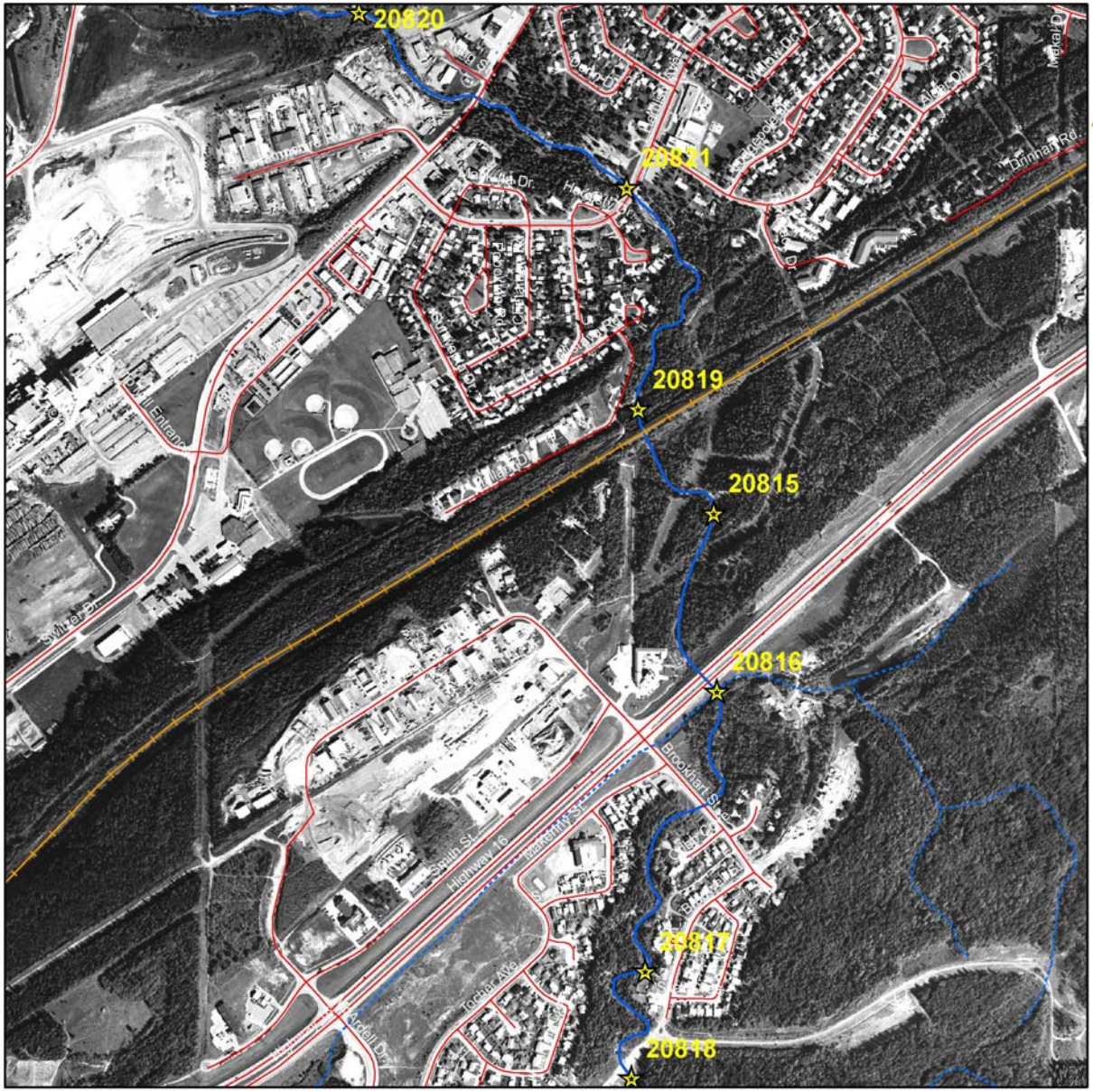
Appendix 1: Fish Inventory Summary Reports



foothills RESEARCH INSTITUTE
research growing into practice.

2008 Operational Inventory
Hardisty Creek

Legend

- Inventory Sites
- Railways
- Roads

1:10,000

N

November 5, 2008
Map created by Ngaio Baril
On behalf of the Fish and
Watershed Program
Foothills Research Institute

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20815

Waterbody: **HARDISTY CREEK**
FMA Compartment: TOWN OF HINTON-
Legal Description: **SE-24-51-25-W5**
UTM: 463518 E 5918316 N NAD83

Elevation: 1015 mASL
Crossing Type: Culvert
Hang Height: 11 cm

Location ID: **10718**
Date/Time: **28-Jul-08**
Previous Visit: **n/a**
Crew: Flynn, Baril, Volunteer

STREAM CLASSIFICATION:

1994 Alberta Government Watercourse Classification:
Permanent (flows year round)

****PROBABILITY OF FISH CAPTURE:

Drainage Area:	Reach - any species:	Basin - bull trout:
37.701 km^2	H	NA

Bank Full Width:	Flood Prone Area Width:	Substrate	Sinuosity	Braided	Rosgen Class	Field Gradient	GIS Gradient
6.5 m	14.5 m	Cobble	Low	No	C3	2-3 %	2 %

*HABITAT DATA: Field Estimates

Available Cover Composition
Surface Turbulence : 72 %
Instream Debris : 3 %
Terrestrial Canopy : 16 %
Undercuts : 2 %

Habitat Potential
Spawning : High
Rearing : High
Overwintering : High

**Substrate Composition
Fines: 12.00 %
SmGr: 17.00 %
LgGr: 18.00 %
SmCo: 18.00 %
LgCo: 21.00 %
Boulder: 14.00 %
Bedrock: 0.00 %

Observations
Beaver Activity: No
Stream Stage: Mod

Bank Stability
Left: Stable
Right: Stable

Field Measurements
Mean Depth: 0.2 m
Mean Wetted Width: 4.8 m
Mean Rooted Width: 6.6 m

Temp Air (°C) : 9 @ 8:11
Temp Water (°C): 9
Turbidity: Clear

***Pool Measurements**
Pool Frequency:
Residual Pool Depth: cm

*Methods for field data collection found in : Johnson, C.F. and L.Lech. 1996. Alberta Forest Resource Improvement Program 1995 Annual Report. Operational Fisheries and Stream Inventory. Hinton, AB.

**Substrate Composition: Fines: < 2 mm Small Gravel: 2-16 mm Large Gravel: 16-64 mm Small Cobble: 64-128mm Large Cobble: 128-256 mm Boulder: > 256 mm

***Pool frequency units equal the number of mean rooted channel widths between pools. A commonly noted spacing for pools is 5-7 channel widths.

****Methods and evaluation of RSF models found in: McCleary and Hassan. (In press).

FISH DATA:

Capture Method:	Length of site:	Effort:	Water Conductivity:
Electro-fishing	300 m	667 seconds	396 µS/cm

Species:	Number Caught:	Min Fork Length: (mm)	Max Fork Length: (mm)	Mean Fork Length: (mm)
MNWH	1	99	99	99
RNTR	14	67	245	123

COMMENTS:

Fish: EF: D/S of crossing. One Rainbow trout exceeded the capacity of the scale (200g).

General: Electrofished up to the Highway 16 cement culvert. Photos taken after the electrofishing, October 22, 2008. Don Lougheed and Steve Haslet volunteered.

POTENTIAL OBSTRUCTIONS:

Type	Location	Height
HangCulvrt	Distance = 300 m	0.11 m

Downstream from reach end.

Hanging culverts at reach end.

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20816

Waterbody: **HARDISTY CREEK**
FMA Compartment: TOWN OF HINTON-
Legal Description: **NE-13-51-25-W5**
UTM: 463524 E 5917975 N NAD83

Elevation: 1025 mASL
Crossing Type: Culvert
Hang Height: 59 cm

Location ID: **10719**
Date/Time: **28-Jul-08**
Previous Visit: **n/a**
Crew: Baril Flynn Volunteer

STREAM CLASSIFICATION:

1994 Alberta Government Watercourse Classification:
Permanent (flows year round)

****PROBABILITY OF FISH CAPTURE:

Drainage Area:	Reach - any species:	Basin - bull trout:
34.54 km^2	H	L

Bank Full Width:	Flood Prone Area Width:	Substrate	Sinuosity	Braided	Rosgen Class	Field Gradient	GIS Gradient
6 m	m	Cobble	Low	No	C3	2-3 %	2 %

*HABITAT DATA: Field Estimates

Available Cover Composition
Surface Turbulence : 73 %
Instream Debris : 5 %
Terrestrial Canopy : 25 %
Undercuts : 14 %

Habitat Potential
Spawning : High
Rearing : High
Overwintering : High

Substrate Composition

Fines:	5.00 %
SmGr:	7.50 %
LgGr:	12.50 %
SmCo:	16.25 %
LgCo:	53.75 %
Boulder:	5.00 %
Bedrock:	0.00 %

Observations
Beaver Activity: No
Stream Stage: Mod

Bank Stability
Left: Slightly Unstable
Right: Slightly Unstable

Field Measurements
Mean Depth: 0.2 m
Mean Wetted Width: 4.7 m
Mean Rooted Width: 7.7 m

Temp Air (°C) : 17 @ 10:06
Temp Water (°C): 10
Turbidity: Clear

***Pool Measurements**
Pool Frequency: 9.0
Residual Pool Depth: 43.0 cm

*Methods for field data collection found in : Johnson, C.F. and L.Lech. 1996. Alberta Forest Resource Improvement Program 1995 Annual Report. Operational Fisheries and Stream Inventory. Hinton, AB.

**Substrate Composition: Fines: < 2 mm Small Gravel: 2-16 mm Large Gravel: 16-64 mm Small Cobble: 64-128mm Large Cobble: 128-256 mm Boulder: > 256 mm

***Pool frequency units equal the number of mean rooted channel widths between pools. A commonly noted spacing for pools is 5-7 channel widths.

****Methods and evaluation of RSF models found in: McCleary and Hassan. (In press).

FISH DATA:

Capture Method:	Length of site:	Effort:	Water Conductivity:
Electro-fishing	238 m	622 seconds	398 µS/cm

Species:	Number Caught:	Min Fork Length: (mm)	Max Fork Length: (mm)	Mean Fork Length: (mm)
BKTR	2	120	199	160
BLTR	1	134	134	134
RNTR	33	13	247	111

COMMENTS:

Fish: EF: D/S of crossing.

General: Electrofished upstream of Highway 16 to hanging culvert at Brookhart Street. Note the reduced reach length. Don Lougheed and Steve Haslet volunteered.

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20816

POTENTIAL OBSTRUCTIONS:

Type	Location	Height
HangCulvrt	Distance = 238 m	0.59 m

Upstream from T4.

Upstream from T3.

Rainbow trout.

Downstream from T4.

Downstream from T3.

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20817

Waterbody: **HARDISTY CREEK**
FMA Compartment: TOWN OF HINTON-
Legal Description: **NE-13-51-25-W5**
UTM: 463387 E 5917439 N NAD83

Elevation: 1037 mASL
Crossing Type: Culvert
Hang Height: 21 cm

Location ID: **10720**
Date/Time: **28-Jul-08**
Previous Visit: **n/a**
Crew: Flynn, Baril, Volunteer

STREAM CLASSIFICATION:

1994 Alberta Government Watercourse Classification:
Permanent (flows year round)

****PROBABILITY OF FISH CAPTURE:

Drainage Area:	Reach - any species:	Basin - bull trout:
34.54 km^2	H	NA

Bank Full Width:	Flood Prone Area Width:	Substrate	Sinuosity	Braided	Rosgen Class	Field Gradient	GIS Gradient
7.3 m	15.3 m	Cobble	Low	No	C3	2-3 %	2 %

*HABITAT DATA: Field Estimates

Available Cover Composition
Surface Turbulence : 69 %
Instream Debris : 6 %
Terrestrial Canopy : 6 %
Undercuts : 15 %

Habitat Potential
Spawning : High
Rearing : High
Overwintering : High

**Substrate Composition
Fines: 5.00 %
SmGr: 8.00 %
LgGr: 11.00 %
SmCo: 32.00 %
LgCo: 38.00 %
Boulder: 6.00 %
Bedrock: 0.00 %

Observations
Beaver Activity: No
Stream Stage: Mod

Bank Stability
Left: Stable
Right: Stable

Field Measurements
Mean Depth: 0.2 m
Mean Wetted Width: 5.0 m
Mean Rooted Width: 6.3 m

Temp Air (°C) : 17 @ 13:56
Temp Water (°C): 12
Turbidity: Clear

***Pool Measurements**
Pool Frequency: 35.5
Residual Pool Depth: 45.0 cm

*Methods for field data collection found in : Johnson, C.F. and L.Lech. 1996. Alberta Forest Resource Improvement Program 1995 Annual Report. Operational Fisheries and Stream Inventory. Hinton, AB.

**Substrate Composition: Fines: < 2 mm Small Gravel: 2-16 mm Large Gravel: 16-64 mm Small Cobble: 64-128mm Large Cobble: 128-256 mm Boulder: > 256 mm

***Pool frequency units equal the number of mean rooted channel widths between pools. A commonly noted spacing for pools is 5-7 channel widths.

****Methods and evaluation of RSF models found in: McCleary and Hassan. (In press).

FISH DATA:

Capture Method:	Length of site:	Effort:	Water Conductivity:
Electro-fishing	300 m	726 seconds	365 µS/cm

Species:	Number Caught:	Min Fork Length: (mm)	Max Fork Length: (mm)	Mean Fork Length: (mm)
BKTR	2	183	197	190
RNTR	34	56	213	101

COMMENTS:

Fish: EF: D/S of crossing.

General: Electrofished up to the Bradwell Street hanging culverts. Don Lougheed and Steve Haslet volunteered.

POTENTIAL OBSTRUCTIONS:

Type	Location	Height
HangCulvrt	Distance = 300 m	0.21 m

Upstream from T3.

Downstream from T3.

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20818

Waterbody: **HARDISTY CREEK**
FMA Compartment: TOWN OF HINTON-
Legal Description: **SW-13-51-25-W5**
UTM: 463361 E 5917234 N NAD83

Elevation: 1046 mASL
Crossing Type: Culvert
Hang Height: 21 cm

Location ID: **10721**
Date/Time: **29-Jul-08**
Previous Visit: **n/a**
Crew: Baril Flynn

STREAM CLASSIFICATION:

1994 Alberta Government Watercourse Classification:
Permanent (flows year round)

****PROBABILITY OF FISH CAPTURE:

Drainage Area:	Reach - any species:	Basin - bull trout:
34.54 km^2	H	NA

Bank Full Width:	Flood Prone Area Width:	Substrate	Sinuosity	Braided	Rosgen Class	Field Gradient	GIS Gradient
8.9 m	13.7 m	Cobble	Mod	No	C3	1-2 %	2 %

*HABITAT DATA: Field Estimates

Available Cover Composition
Surface Turbulence : 85 %
Instream Debris : 7 %
Terrestrial Canopy : 42 %
Undercuts : 2 %

Habitat Potential
Spawning : High
Rearing : High
Overwintering : High

Substrate Composition

Fines:	3.00 %
SmGr:	17.00 %
LgGr:	15.00 %
SmCo:	18.00 %
LgCo:	31.00 %
Boulder:	16.00 %
Bedrock:	0.00 %

Observations
Beaver Activity: No
Stream Stage: Mod

Bank Stability
Left: Stable
Right: Stable

Field Measurements
Mean Depth: 0.2 m
Mean Wetted Width: 5.1 m
Mean Rooted Width: 6.5 m

Temp Air (°C) : 13 @ 7:47
Temp Water (°C): 9
Turbidity: Clear

***Pool Measurements**
Pool Frequency: 15.3
Residual Pool Depth: 46.3 cm

*Methods for field data collection found in : Johnson, C.F. and L.Lech. 1996. Alberta Forest Resource Improvement Program 1995 Annual Report. Operational Fisheries and Stream Inventory. Hinton, AB.

**Substrate Composition: Fines: < 2 mm Small Gravel: 2-16 mm Large Gravel: 16-64 mm Small Cobble: 64-128mm Large Cobble: 128-256 mm Boulder: > 256 mm

***Pool frequency units equal the number of mean rooted channel widths between pools. A commonly noted spacing for pools is 5-7 channel widths.

****Methods and evaluation of RSF models found in: McCleary and Hassan. (In press).

FISH DATA:

Capture Method:	Length of site:	Effort:	Water Conductivity:
Electro-fishing	300 m	756 seconds	368 µS/cm

Species:	Number Caught:	Min Fork Length: (mm)	Max Fork Length: (mm)	Mean Fork Length: (mm)
RNTR	29	54	211	104

COMMENTS:

Fish: EF: U/S of crossing.

General: Electrofished upstream of the Bradwell Street hanging culverts. Don Lougheed and Steve Haslet volunteered.

POTENTIAL OBSTRUCTIONS:

Type	Location	Height
HangCulvrt	Distance = 0 m	0.21 m
LogJam	Distance = 300 m	0.42 m

Upstream from reach end.

Downstream from reach end.

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20819

Waterbody: **HARDISTY CREEK**
FMA Compartment: TOWN OF HINTON-
Legal Description: **SE-24-51-25-W5**
UTM: 463374 E 5918516 N NAD83

Elevation: 1011 mASL
Crossing Type: Culvert
Hang Height: 999 cm

Location ID: **10722**
Date/Time: **29-Jul-08**
Previous Visit: **n/a**
Crew: Flynn, Baril

STREAM CLASSIFICATION:

1994 Alberta Government Watercourse Classification:
Permanent (flows year round)

****PROBABILITY OF FISH CAPTURE:

Drainage Area:	Reach - any species:	Basin - bull trout:
38.526 km^2	H	NA

Bank Full Width:	Flood Prone Area Width:	Substrate	Sinuosity	Braided	Rosgen Class	Field Gradient	GIS Gradient
7.9 m	12.1 m	Cobble	Low	No	C3	2-3 %	2 %

*HABITAT DATA: Field Estimates

Available Cover Composition
Surface Turbulence : 77 %
Instream Debris : 8 %
Terrestrial Canopy : 18 %
Undercuts : 18 %

Habitat Potential
Spawning : High
Rearing : High
Overwintering : High

Substrate Composition
Fines: 13.00 %
SmGr: 9.00 %
LgGr: 14.00 %
SmCo: 34.00 %
LgCo: 20.00 %
Boulder: 10.00 %
Bedrock: 0.00 %

Observations
Beaver Activity: No
Stream Stage: Mod

Bank Stability
Left: Stable
Right: Slightly Unstable

Field Measurements
Mean Depth: 0.2 m
Mean Wetted Width: 6.5 m
Mean Rooted Width: 7.5 m

Temp Air (°C) : 13 @ 10:47
Temp Water (°C): 11
Turbidity: Clear

***Pool Measurements**
Pool Frequency: 13.6
Residual Pool Depth: 38.5 cm

*Methods for field data collection found in : Johnson, C.F. and L.Lech. 1996. Alberta Forest Resource Improvement Program 1995 Annual Report. Operational Fisheries and Stream Inventory. Hinton, AB.

**Substrate Composition: Fines: < 2 mm Small Gravel: 2-16 mm Large Gravel: 16-64 mm Small Cobble: 64-128mm Large Cobble: 128-256 mm Boulder: > 256 mm

***Pool frequency units equal the number of mean rooted channel widths between pools. A commonly noted spacing for pools is 5-7 channel widths.

****Methods and evaluation of RSF models found in: McCleary and Hassan. (In press).

FISH DATA:

Capture Method:	Length of site:	Effort:	Water Conductivity:
Electro-fishing	300 m	740 seconds	401 µS/cm

Species:	Number Caught:	Min Fork Length: (mm)	Max Fork Length: (mm)	Mean Fork Length: (mm)
BKTR	4	118	247	161
MNWH	2	103	126	115
RNTR	24	80	350	139

COMMENTS:

Fish: EF: D/S of crossing.

General: Electrofished up to the CN railway crossing.

POTENTIAL OBSTRUCTIONS:

Upstream from T1.

Rainbow trout.

Downstream from T4.

Brook trout.

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20820

Waterbody: **HARDISTY CREEK**
FMA Compartment: TOWN OF HINTON-
Legal Description: **NW-24-51-25-W5**
UTM: 462840 E 5919276 N NAD83

Elevation: 982 mASL
Crossing Type: Bridge
Hang Height: n/a cm

Location ID: **10723**
Date/Time: **29-Jul-08**
Previous Visit: **n/a**
Crew: Baril Flynn

STREAM CLASSIFICATION:

1994 Alberta Government Watercourse Classification:
Permanent (flows year round)

****PROBABILITY OF FISH CAPTURE:

Drainage Area:	Reach - any species:	Basin - bull trout:
39.67 km^2	H	NA

Bank Full Width:	Flood Prone Area Width:	Substrate	Sinuosity	Braided	Rosgen Class	Field Gradient	GIS Gradient
6.9 m	8.8 m	Cobble	Mod	No	C3	1-2 %	2 %

*HABITAT DATA:

Field Estimates

Available Cover Composition
Surface Turbulence : 85 %
Instream Debris : 0 %
Terrestrial Canopy : 5 %
Undercuts : 0 %

Habitat Potential
Spawning : Mod
Rearing : High
Overwintering : High

Substrate Composition

Fines:	9.00 %
SmGr:	18.00 %
LgGr:	5.00 %
SmCo:	15.00 %
LgCo:	45.00 %
Boulder:	8.00 %
Bedrock:	0.00 %

Observations
Beaver Activity: No
Stream Stage: Mod

Bank Stability
Left: Stable
Right: Stable

Field Measurements
Mean Depth: 0.2 m
Mean Wetted Width: 5.0 m
Mean Rooted Width: 6.8 m

Temp Air (°C) : 16 @ 14:31
Temp Water (°C): 13
Turbidity: Clear

***Pool Measurements**
Pool Frequency: 41.9
Residual Pool Depth: 41.0 cm

*Methods for field data collection found in : Johnson, C.F. and L.Lech. 1996. Alberta Forest Resource Improvement Program 1995 Annual Report. Operational Fisheries and Stream Inventory. Hinton, AB.

**Substrate Composition: Fines: < 2 mm Small Gravel: 2-16 mm Large Gravel: 16-64 mm Small Cobble: 64-128mm Large Cobble: 128-256 mm Boulder: > 256 mm

***Pool frequency units equal the number of mean rooted channel widths between pools. A commonly noted spacing for pools is 5-7 channel widths.

****Methods and evaluation of RSF models found in: McCleary and Hassan. (In press).

FISH DATA:

Capture Method:	Length of site:	Effort:	Water Conductivity:
Electro-fishing	300 m	897 seconds	400 µS/cm

Species:	Number Caught:	Min Fork Length: (mm)	Max Fork Length: (mm)	Mean Fork Length: (mm)
BLTR	1	143	143	143
LNDC	1	101	101	101
MNWH	1	57	57	57
RNTR	5	86	155	109

COMMENTS:

Fish: EF: D/S of crossing.

General: Electrofished up to the Switzer Drive bridge. Creek runs through the industrial area of Hinton.

POTENTIAL OBSTRUCTIONS:

Upstream from T2.

Downstream from T2.

FOOTHILLS RESEARCH INSTITUTE - Survey Summary

Site ID: 20821

Waterbody: **HARDISTY CREEK**
FMA Compartment: TOWN OF HINTON-
Legal Description: **NW-24-51-25-W5**
UTM: 463352 E 5918940 N NAD83

Elevation: 996 mASL
Crossing Type: Culvert
Hang Height: 999 cm

Location ID: **10724**
Date/Time: **31-Jul-08**
Previous Visit: **n/a**
Crew: Flynn, Baril, Volunteer

STREAM CLASSIFICATION:

1994 Alberta Government Watercourse Classification:
Permanent (flows year round)

****PROBABILITY OF FISH CAPTURE:

Drainage Area:	Reach - any species:	Basin - bull trout:
38.526 km^2	H	NA

Bank Full Width:	Flood Prone Area Width:	Substrate	Sinuosity	Braided	Rosgen Class	Field Gradient	GIS Gradient
8.9 m	14.9 m	Cobble	Low	No	B3	1-2 %	2 %

*HABITAT DATA: Field Estimates

Available Cover Composition
Surface Turbulence : 84 %
Instream Debris : 4 %
Terrestrial Canopy : 8 %
Undercuts : 5 %

Habitat Potential
Spawning : High
Rearing : High
Overwintering : High

Substrate Composition

Fines:	18.00 %
SmGr:	16.00 %
LgGr:	24.00 %
SmCo:	22.00 %
LgCo:	14.00 %
Boulder:	6.00 %
Bedrock:	0.00 %

Observations
Beaver Activity: No
Stream Stage: Mod

Bank Stability
Left: Stable
Right: Stable

Field Measurements
Mean Depth: 0.2 m
Mean Wetted Width: 7.5 m
Mean Rooted Width: 11.2 m

Temp Air (°C) : @ 0:00
Temp Water (°C): 8
Turbidity: Clear

***Pool Measurements**
Pool Frequency: 1.8
Residual Pool Depth: 43.0 cm

*Methods for field data collection found in : Johnson, C.F. and L.Lech. 1996. Alberta Forest Resource Improvement Program 1995 Annual Report. Operational Fisheries and Stream Inventory. Hinton, AB.

**Substrate Composition: Fines: < 2 mm Small Gravel: 2-16 mm Large Gravel: 16-64 mm Small Cobble: 64-128mm Large Cobble: 128-256 mm Boulder: > 256 mm

***Pool frequency units equal the number of mean rooted channel widths between pools. A commonly noted spacing for pools is 5-7 channel widths.

****Methods and evaluation of RSF models found in: McCleary and Hassan. (In press).

FISH DATA:

Capture Method:	Length of site:	Effort:	Water Conductivity:
Electro-fishing	300 m	1025 seconds	414 µS/cm

Species:	Number Caught:	Min Fork Length: (mm)	Max Fork Length: (mm)	Mean Fork Length: (mm)
BKTR	1	141	141	141
MNWH	4	63	228	145
NRPK	1	106	106	106
RNTR	25	84	608	135

COMMENTS:

Fish: EF: D/S of crossing.

General: Electrofished up to the Hardisty Avenue culverts with the Junior Forest Rangers.

POTENTIAL OBSTRUCTIONS:

Upstream from T4.

Downstream from T4.

Appendix 2: Memo to Town of Hinton Regarding Erosion Control Plans

TO: JEAN ANNE FRASER – DIRECOTR OF PLANNING AND TECHNICAL SERVICES, AND JAMAL NASRABADI, TECHNICAL SERVICES MANAGER, TOWN OF HINTON

FROM: RICHARD MCCLEARY, FISH AND WATERSHED PROGRAM MANAGER, FOOTHILLS RESEARCH INSTITUTE

SUBJECT: EROSION CONTROL PLANS AND DEVELOPMENT PLANS WITHIN THE TOWN OF HINTON

DATE: NOVEMBER 19, 2008

CC: STEPHEN HANUS, CRYSTAL KERELIUK, JEAN ANNE FRASER

Hello Jean Anne and Jamal,

Thanks again for your support of the Hardisty Creek Restoration Project last April by arranging the provision of the Town of Hinton storm sewer drain locations. The objective of our project was to determine if any turbid water was entering Hardisty Creek during summer rain storms from adjacent lands. Our project area included the Town of Hinton and the upstream provincial forest lands. The Hardisty Creek Restoration Project has received local, provincial and national recognition for the efforts of our partners to restore fish migration, fish habitat and educate the public. Now that the fish have returned, it is important to conserve the natural water quality within the stream. Turbid water was observed in the Kinsmen Park section of Hardisty Creek during the early onset of a 2007 summer storm. This prompted our 2008 water quality monitoring project, supported by the Alberta Stewardship Network. The Town of Hinton involvement from the onset is an important part of the project as the intent is to help our partners become the best possible stewards of the land they manage. Early detection and correction of environmental outages is part of our plan. The purpose of this document is to share the findings from our field investigations and to begin to work with the Town of Hinton to develop a plan to address erosion and sedimentation issues over the long term and short term.

Several sources of turbid water within the Town of Hinton were identified during a rainstorm on June 6, 2008. The results and photos from our field work are presented in the attached Powerpoint presentation. The project interim report to the Alberta Stewardship Network is also attached. The light industrial park off of Felaber Road was the area of highest concern. To date, the results have been reviewed with Ken McLeod, Stephen Hanus and Crystal Kerekiuk. These discussions have highlighted three types of action that are required to restore natural water quality in Hardisty Creek within the Town of Hinton.

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foothillsresearchinstitute.ca

First, over the long term, to avoid water quality issues from arising, it would be ideal if a requirement for erosion control plans and effectiveness monitoring within new land developments was included at the Master Plan level. This is something that Crystal suggested you may be able to guide.

Second, over the short-term, there is a need to stabilize sites that are actively eroding and contributing sediment into the waterways. This is a challenge because the erosion is widespread across most of the properties in the Felaber Road area. Resolving this issue will require coordination, education, and motivation. The Town of Hinton could request assistance from the other members of the project steering committee for this task.

This leads to the third action – reporting. Can I suggest that the Town of Hinton report the current situation to the provincial and federal authorities and request their input on reasonable timelines for implementing remediation? Sedimentation arising from land development is not a problem unique to Hinton. According to the American Fisheries Society, sedimentation arising from land development is a major problem for fish conservation across North America. Our authorities have endorsed the stewardship approach and I believe they will help the Town of Hinton to obtain the required resources to address this issue, rather than take an enforcement approach. The Department of Fisheries and Oceans sit on the Hardisty Creek Steering Committee and they adopted the stewardship approach for addressing fish passage issues.

Stephen and Crystal agreed that this challenge is an opportunity for the Town of Hinton to demonstrate its environmental leadership among small municipalities. The Alberta Stewardship Network will be issuing a call for proposals for 2009 and they may be interested in supporting the coordination and education components required to address the existing water quality issues.

I look forward to continuing to assist the Town of Hinton to achieve your land stewardship goals. I am currently looking into the approaches that other small municipalities use to address similar concerns and will provide any relevant findings to Crystal. Feel free to contact me with any questions.

Best regards,

Richard McCleary, M.Sc., P.Bio.

Fish and Watershed Program Manager, Foothills Research Institute

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Appendix 3: Suspended Sediment Report

Site #2

Pre-event– June 6/08

Site #2 is located behind the industrial park off Switzer Dr., NW of The Brick. Source water was clear when the site was first visited (pre-event), with all T-tube readings being 120+ cm's. The source water sampled post-storm event was substantially more turbid, as can be seen in the chart below

Post-event– June 11/08

Section	Turbidity cm	Ntu's
a	49.8	11.24
b	2.4	1061.98
c	77.4	5.80

Site #3

Pre-event– June 6/08

Site #3 is located immediately upstream of the bridge where Switzer Drive crosses Hardisty Creek. The input channel appears to be dry until a storm event, at which point the runoff picks up sediment from a nearby wooded area before entering the creek.

Post-event– June 11/08

Section	cm	Turbidity Ntu's
a	30	24.03
b	5	353.16
c	46.2	12.57

Site #4

Pre-event– June 6/08

Site #4 is located immediately upstream of the Kinsmen Park, across the street from Crescent Valley School. It was thought that the steep dirt slope behind the culvert would serve as a significant source of sediment input, but the results and observation during the storm event disprove this.

Post-event– June 11/08

Section	Turbidity cm	Ntu's
a	69.00	6.89
b	N.A	N.A
c	N.A	N.A

Site #5

Pre-event– June 6/08

Site #5 is located at the railroad culvert off Hallam Drive. It was sampled for the same reasons as Site #4, with the same results. This site is not a significant source of sediment input.

Post-event– June 11/08

Section	Turbidity cm	Ntu's
a	70.5	6.67
b	N.A	N.A
c	N.A	N.A

Site #6

Pre-event– June 6/08

Site #6 is located beside the Lakeview Inn, just off Hwy. 16 westbound. The site proved to be one of the highest sources of sediment pollution during the storm event, likely due to runoff collected from the nearby industrial park. The turbidity was accompanied by a strong chemical odor, suggesting improper disposal of chemicals into a nearby storm drain.

Post-event– June 11/08

Section	cm	Turbidity Ntu's
a	26.2	29.44
b	1.5	2149.29
c	120	3.00

Site #7

Pre-event– June 6/08

Site #7 is located immediately upstream of Site #6, and is the outlet for runoff from the ditch beside the highway. The water was very clear, even during the storm event, suggesting the channel was properly constructed to allow for sediment to settle before entering the stream

Post-event– June 11/08

Section	cm	Turbidity Ntu's
a	120	3.00
b	120	3.00
c	120	3.00

Site #8

Pre-event– June 6/08

Site #8 is located across the highway from sites #6 and 7. It is an area of fairly rapid flow, and the creek appeared to dilute the input water almost immediately, with no quantifiable difference in turbidity between the upstream and downstream samples.

Post-event– June 11/08

Section	Turbidity cm	Ntu's
a	120	3.0
b	46.3	12.53
c	120	3.0

Site #9

Pre-event– June 6/08

Site #9's input rate was extremely low, being comprised of the runoff from Appleyard Cove, located just south of the culvert. The turbidity of the input water was high, but the low injection rate coupled with the high flow of the stream at that point leads to fairly rapid dilution, and thus only a small impact on overall turbidity

Post-event– June 11/08

Section	cm	Turbidity Ntu's
a	97.0	4.13
b	4.7	387.51
c	120.0	3.00

Site #10

Pre-event– June 6/08

Site #10 is located approx. 100m upstream of site #9, just beside two large culverts. It was not flowing on either of the visits to it, so samples were not taken, and the input is assumed negligible.

Post-event– June 11/08

Section	cm	Turbidity Ntu's
a	N.A	N.A
b	N.A	N.A
c	N.A	N.A

Site #11

Pre-event– June 6/08

Site #11 is located behind Gitzel Cove in the Thompson Lake subdivision.

Post-event– June 11/08

Section	cm	Turbidity Ntu's
a	12.2	92.66
b	11	108.23
c	86.4	4.92

Site #12

Pre-event– June 6/08

Site #12 is located at the south-west end of Thompson Lake subdivision, when a creek flowing from the north merges with Hardisty. The water coming from the second creek is very clean, and does not chance the turbidity levels at all.

Post-event– June 11/08

Section	Turbidity cm	Ntu's
a	95.8	4.21
b	120	3.00
c	95.8	4.21

Site #13

Pre-event– June 6/08

Site #13 is located on the Cache Percotte road, south of Hinton. This site was sampled to observe the state of the creek before it reaches town limits. The water was very clear.

Post-event– June 11/08

Section	cm	Turbidity Ntu's
a	120+	<3.00
b	120+	<3.00
c	120+	<3.00