Environmental Studies of the Halfway River System Nova Scotia

Supplemental Report
to
Minas Basin Pulp and Power
Company Limited

Prepared by
Graham R. Daborn, Michael Brylinsky
and Jonathan Lowe

1 November 2001

Acadia Centre for Estuarine Research
Publication No. 64

ACADIA ESTUARINE CENTRE FOR RESEARCH

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Executive Summary

Field investigations of the Halfway River streams and impoundments were conducted by personnel from the Acadia Centre for Estuarine Research and East Coast Aquatics between 20 October and 9 November 2001. Surveys of fish were carried out in streams and the two impoundments in the watershed, and water samples obtained for water quality analysis.

Impoundments exhibited little evidence of stratification, although oxygen levels were below saturation, especially in the Upper Impoundment, which had shown severe oxygen depletion in the hypolimnion during summer. Water was circumneutral (pH 6.8-6.9), and low in alkalinity.

Streams of the Halfway River system were also close to neutral (pH 6.8-7.2), with low alkalinity, conductivity and hardness. Two sample sites exhibited lower pH (4.8—4.9) because of water draining from upstream bogs; these waters are also more highly coloured as a result of dissolved organics. Nitrogen and phosphate levels were below the limit of detection in all waters.

Gill net collections in the two impoundments yielded 6 species, including brook trout (*Salvelinus fontinalis)*, white sucker (*Catostomus commersoni)* and creek chub (*Semotilus atromaculatus)*. As in summer, brook trout were only encountered in the Upper Impoundment, despite the depressed oxygen levels.

Six species were captured in streams by electrofishing. Brook trout dominated the catches at sites HW1-4 and 8 in the upper half of the watershed, but at more downstream sites the fauna was dominated by coarse fish, including creek chub, ninespine stickleback (*Pungitius pungitius*), common shiner (*Notropis cornutus*), and eel (*Anguilla rostrata*). Densities were similar to summer collections, ranging from 19 to 55 fish per habitat unit.

Information on fish habitat indicates that upper portions of the system support a good population of brook trout, but not in reaches below the impoundments.

A revised management strategy for archaeological resources is presented.

A list of corrections or amendments for the previous Final Report is given in an appendix.

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ACADIA ESTUARINE CENTRE FOR RESEARCH

Environmental Studies of the Halfway River System, Nova Scotia

Supplemental Report

1 November 2001

1.0 Introduction

During May through early November 2001 the Acadia Centre for Estuarine Research (ACER) conducted environmental studies of the Halfway River system. The work was carried out in response to Terms of Reference dated 15 February 2001 provided by the Nova Scotia Department of Environment and Labour for Renewal of Water Licenses for the Halfway River system.

Environmental surveys of the Halfway River system were primarily organised around three field campaigns scheduled for late May, July and October-November 2001, respectively. The first campaign was conducted between 22 May and 1 June; the second field campaign took place between 16 and 23 July. Field measurements, observations and collections were also made on many other days to ensure comprehensiveness of the studies. In late August an additional survey was conducted to assess water flow and fish habitat conditions during the usual low water season. The third field campaign was delayed by weather and permitting difficulties, and was finally conducted between 20 October and 9 November 2001.

The present report presents data primarily from the final field campaign.

Following completion of the Final Report (Daborn *et al.* 2001) in September, suggestions for modification of the proposed Management Strategy for Archaeological Resources were received from personnel at the Nova Scotia Museum. These modifications are incorporated into a revised version of the Management Strategy, presented here in Section 3.8.

Appendix 3.0.1 in this Supplemental Report contains a list of editorial and other corrections to be applied to the Final Report (Daborn et al. 2001).

2.0 Personnel.

The study was coordinated by Dr. Graham R. Daborn, Director of the Acadia Centre for Estuarine Research. The field research team was composed of the following personnel:

Dr. Michael Brylinsky –Honorary Research Associate, ACER
Mr. Michael Parker (B.Sc. Biol) – President, East Coast Aquatics
Ms. Dawn MacNeill (B.Sc.H. Environmental Science. 2001)
Ms. Susan Snyder (B.Sc.H. Environmental Science – in progress)
Mr. Leon deVreede (B.Sc. Environmental Science – in progress)
Ms. Marla MacAulay (B.Sc Biology – in progress).
Ms. Kathleen Martin (B.Sc. Environmental Science – in progress)
Mr. Jonathan Lowe (M.Sc. Biology – in progress)
Dr. Trefor Reynoldson , National Water Research Institute and ACER
Mr. Douglas Parker – Bridgetown

We acknowledge the support and assistance of numerous people from Minas Basin Pulp and Power Company Limited, especially Bruce MacDonald and Terry Gerhardt.

3.0 Environmental Studies of the Halfway River System

3.0.1. Field Operations.

Field work on the Halfway River was conducted from Acadia University. Access to the Lower (Front) Impoundment was obtained courtesy of Mr. John Tracey.

Two separate teams were organised, one dealing primarily with stream studies, and the other with impoundments. Although in some respects the results involve overlapping information, this Supplemental Report presents information on lentic (i.e. impoundments) and lotic (flowing waters) habitats separately under each of the above headings.

Dr. Michael Brylinsky supervised the work on the impoundments. Dr. Graham Daborn supervised the stream work, which was coordinated by Ms. Dawn MacNeill. Mr. Michael Parker conducted the electrofishing surveys, and provided identification of fish captured.

3.0.2 Laboratory Operations

Water samples for complete analysis were collected and sent to PSC Analytical Services of Bedford, N.S. Analyses of other water and invertebrate samples were conducted at the Acadia Centre for Estuarine Research (ACER) using standard methods for the examination of water and wastewater.

3.2 Water Quality of the Halfway River System

3.2.1. Introduction

Methods, equipment and sample locations used during the fall campaign were as described in the Final Report of the Halfway River project (Daborn *et al.* 2001).

3.2.2. Results: Impoundments

Results of all chemical analyses carried out by PSC Analytical Services on samples from the Halfway River impoundments are contained in Appendix 3.2.1. A summary of water quality measurements from the Halfway River impoundments is presented in Table 3.2.1:

Table 3.2.1. Summary of selected water quality parameters.

SITE	Date	Sample Depth (m)	Temperature (Celsius)	Conductivity (uS/cm)	Total Hardness (mg/l)	pH	Alkalinity (mg/l)	Chlorophyll a (ug/l)	Pheophytin (ug/l)	SPM (mg/l)	Secchi Depth (m)	Turbidity (NTUs)	Color (TCUs)	Dissolved Oxygen (mg/l)	DO Saturation (%)
Lower Impoundment	18 Oct	1	12.5	62	21.6	6.9	14	n.a	n.a	3.4	-	4.2	23	9.5	85
Lower Impoundment	18 Oct	6	12	-	-	-	-	n.a	n.a	5.0	-	-	-	8.5	80
Upper Impoundment	18 Oct	1	13.5	66	21.4	6.8	13	n.a	n.a	4.2	-	4.2	22	7.0	64
Upper Impoundment	18 Oct	8	11.5	-	-	-	-	n.a	n.a	5.2	-	-	-	7.0	66

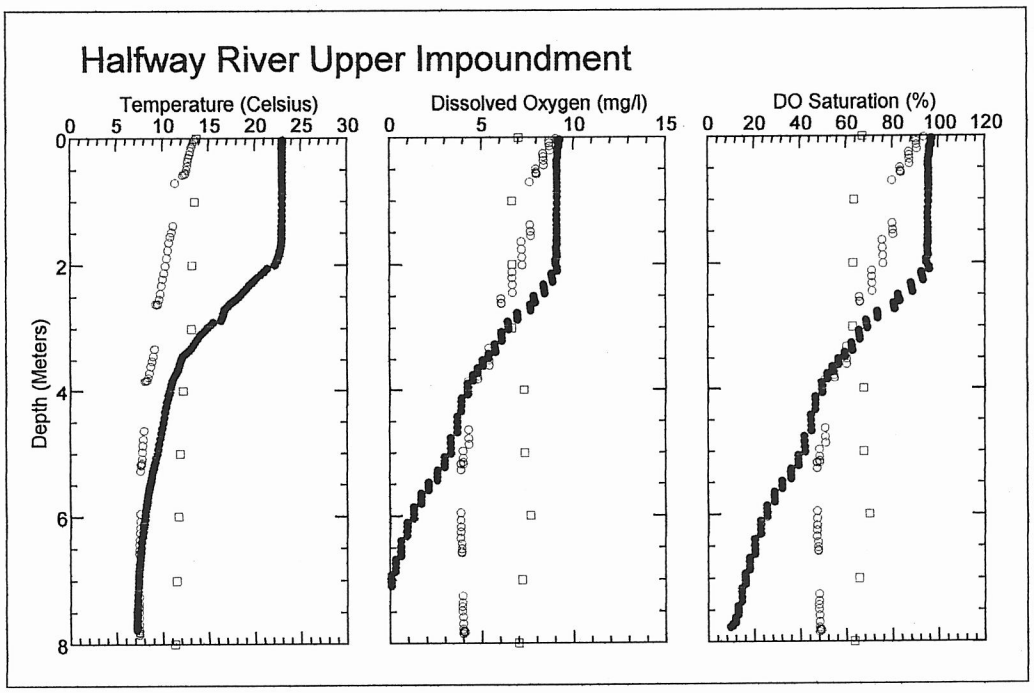
Results are comparable to those obtained during July. Water in the two impoundments is circumneutral (pH 6.8-6.9), moderately well-buffered (alkalinity 13-14 mg.L-1), lightly coloured, but somewhat turbid at the time of collection. Higher turbidity is probably related to recent rainfall and inflow into the impoundments. Orthophosphate and forms of nitrogen were below the limits of detection, as in previous months. The relatively high

chloride ion concentrations are typical of local stream and lake systems that are influenced by their proximity to marine environments.

Temperature, Dissolved Oxygen and Percent DO Saturation Depth Profiles

Water temperature depth profiles for both the Upper and Lower Halfway impoundments are shown in Figures 3.3.1 and 3.3.2. The figures include spring and summer profiles for comparison.

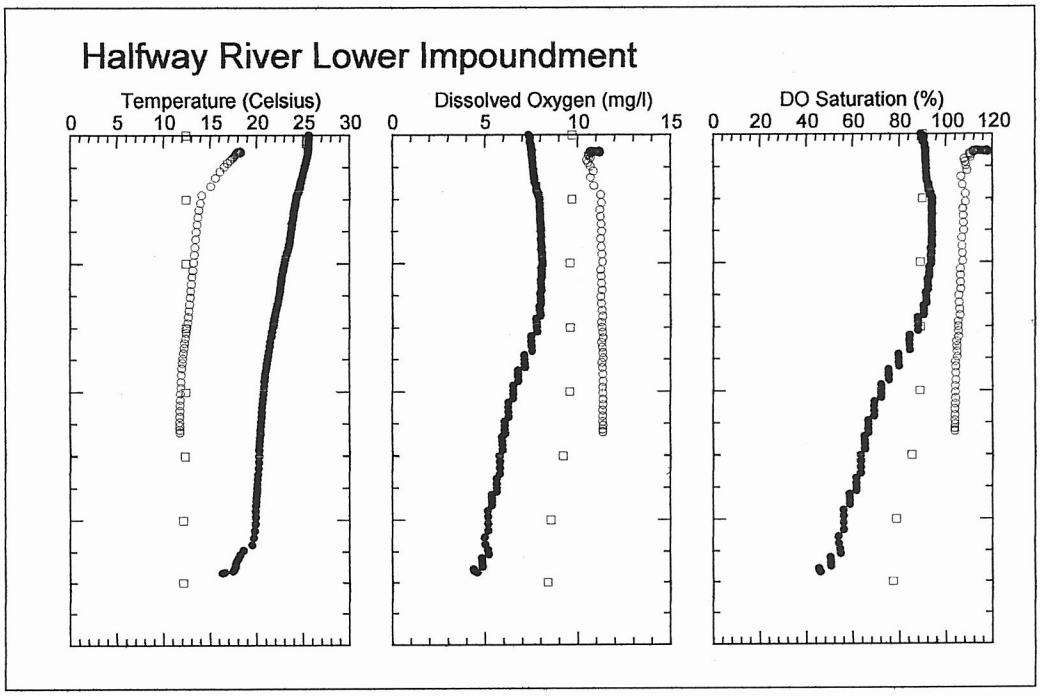
Figure 3.3.1. Temperature, dissolved oxygen and percent dissolved oxygen depth profiles for the Upper Impoundment during spring (o), summer (●), and fall (□), 2001.



Profiles indicate that both impoundments were nearly completely destratified by the time of the fall survey (18-19 October). Water temperatures were about 12-13 C. Percent dissolved oxygen saturation levels were uniform from surface to bottom in both impoundments, but the Upper Impoundment had considerably lower saturation values (60-65%) than did the Lower Impoundment (>80%). The difference is probably a result of the significant depletion of dissolved oxygen that occurred during summer in the Upper Impoundment, and the fact that a complete overturn is required before the entire

water column becomes fully saturated with dissolved oxygen. Usually, overturn of the water column occurs as surface temperatures and densities fall to those of deeper water; bottom water temperatures during summer stratification in the Upper Impoundment were 8-10 C.

Figure 3.3.2. Temperature, dissolved oxygen and percent dissolved oxygen depth profiles for the Lower Impoundment during spring (o), summer (●), and fall (□), 2001.



3.2.3. Results: Streams.

Water samples were taken at all electrofishing stations (identified as HW1 to HW8). Results of all water chemistry analyses carried out by PSC Analytical Services are contained in Appendix 3.2.2.

As in previous surveys, water at most stations on the main stem and tributaries of the Halfway River (except HW2 and HW4) was lightly coloured, and nearly neutral (pH 6.8-7.2) despite relatively low alkalinity (< 6 mg.L^{-1}). Alkalinity increases considerably

downstream of the impoundments, and the pH rises accordingly. Nitrogen and orthophosphate concentrations were below the limit of detection. Sites HW2 and HW4 are, in contrast, quite highly stained and acidic (pH 4.8-4.9), with relatively high dissolved organic carbon. These results are typical of water issuing from upstream bogs.

3.3 Fish Surveys of the Halfway River System

3.3.1 Introduction

Surveys of fish populations were conducted both within the two impoundments of the Halfway River system, and at seven sites on the River and tributaries selected for the summer field campaign. Methods were as described in Daborn *et al.* (2001).

3.3.2 Results.

A. Fish Surveys of the Upper and Lower Halfway River Impoundments.

Locations of gill net and minnow trap surveys of the two impoundments are as shown in Table 3.3.1 and Figure 3.3.1 of the Final Report (Daborn *et al.* 2001).

Table 3.3.1. Summary of fish collections in Halfway River impoundments, Fall 2001.

Site	Date	Method		Location		Total Number Fish Collected	Total Number Species Collected	Number of Each Species							
		Gill Net	Minnow Trap	Northing	Easting			*S. fontinalis*	*C. commersoni*	*A. rostrata*	*F. diaphanus*	*G. aculeatus*	*N. crysoleucas*	*S. atromaculatus*	*P. pungitius*
Lower	19/20 Oct	x		4988562	405452	14	2		13	1					
"	"		x	4988599	404863	7	2		2					5	
"	"		x	4988599	404863	3	1			3					
"	"		x	4988599	404863	1	1			1					
Upper	18/19 Oct	x		4987834	403765	16	1		16						
"	"		x	4987834	403765	2	2	1	1						
"	"		x	4987834	403765	5	2		3			2			
"	"		x	4987834	403765	6	3		1			3			2

Fish collections correspond to earlier surveys, although only 6 species were collected in gill nets and minnow traps. Neither banded killifish nor golden shiner were captured during the fall sets, but the three-spined stickleback (*G. aculeatus)* was collected this time from the Upper Impoundment, although it was previously recorded only from the Lower.

As in summer, collections in the Upper and Lower Impoundments were dominated by white sucker, whereas creek chub were most abundant in the Lower Impoundment. One brook trout was captured in the Upper, and none in the Lower Impoundment. It is notable that trout only seem to be present in the Upper Impoundment, given the tendency of that impoundment to become devoid of oxygen.

B. Fish Surveys of the Halfway River Streams.

Semiquantitative fish collections were made at seven sites (HW1-6 and HW8) between 28 and 30 October 2001. Location of sites is given in Table 3.3.4 and Figure 3.3.4 of the Final Report (Daborn *et al.* 2001), together with descriptions of fish habitat in the vicinity of the electrofishing sites.

Species captured included brook trout (*Salvelinus fontinalis*), white sucker (*Catostomus commersoni*), creek chub (*Semotilus atromaculatus*), ninespine stickleback (*Pungitius pungitius*), common shiner (*Notropis cornutus*), and eel (*Anguilla rostrata*). We were unable to confirm the presence of blacknose dace (*Rhinichthyes atratulus)* in the Halfway River. It is probable that the earlier tentative record was a misidentification.

A summary of the electrofishing results is shown in Table 3.3.2; more detailed results, including length and weight measurements, are included as Appendix 3.3.2.

A total of 358 fish were turned during 14 passes at the seven sites. More than half of these (198, ~55%) were brook trout, and one quarter (90, ~25%) were creek chub. Brook trout were taken at all sites except for HW2 (which yielded no fish at all after 1 pass), and were the most abundant species in the upper portion of the Halfway system (sites 1-4). None of the brook trout captured by electrofishing was in spawning condition. Relatively few eels were caught except at HW6A, where a large number (estimated in excess of 60) were encountered in a relatively deep hole.

Table 3.3.2. Summary of electrofishing results, Halfway River system, October 2001.

Site	Pass	Total No. Fish	# Trout	# Suckers	# C. chub	# Eel	# 9-Spine	# C. shiner	Area Sampled sq.m	Fish per Habitat unit (100 sq.m)
HW1	1	42	36	5	1					
	2	20	16	4						
	3	11	8	2		1				
	Totals	**73**	**60**	**11**	**1**	**1**			**288**	**25.35**
HW2	1	0								
HW3	1	18	18							
	2	9	9							
	Totals	**27**	**27**						**140**	**19.29**
HW4	1	63	32	9	24					
	2	31	12	5	13	1				
	Totals	**94**	**44**	**14**	**37**	**1**			**330**	**28.48**
HW5	1	46	13	12	19		2			
	2	23	4	1	10		8			
	3	17	2	3	4		8			
	Totals	**86**	**19**	**16**	**33**		**18**		**158**	**54.43**
HW6A	1	**25+**		6	19	*60+*			n.a	
HW8	1	40	36	1				3	n.a	
	2	13	12					1		
	Totals	**53**	**48**	**1**				**4**		

Brook trout were the only fish caught in Gold Brook (Site HW3) in all three surveys. This brook, which has good riparian cover and cool water temperatures in summer, appears to be an important habitat for young trout in all seasons, despite its intermittent nature. The very high number of trout caught in July at HW3 undoubtedly reflects low water levels which concentrated fish into areas with sufficient depth; this stream was dry at the surface downstream of the survey reach during the July sampling, and other trout trapped in an isolated pool (not included in the above counts) were recovered and released into the lower stream (Daborn *et al.* 2001).

In general, fish densities were comparable to or greater than those recorded at these sites during the two earlier campaigns, as shown in Table 3.3.3:

Table 3.3.3. Fish Densities at Halfway River sites, 2001.

Site	Fish per Habitat Unit (100 sq.m)			Trout per Habitat Unit (100 sq.m)		
	May	July	**Oct**	May	July	**Oct**
HW1	13.18	15.61	**25.35**	9.02	7.63	**20.83**
HW2	5.33	0.00	**0.00**	3.33	0.00	**0.00**
HW3	7.86	62.14	**19.29**	7.86	62.14	**19.29**
HW4	7.87	29.97	**28.48**	4.54	24.22	**13.33**
HW5	129.52	37.46	**54.43**	3.17	1.90	**12.03**
HW7	16.83	-	-	0.71	-	-

Length frequency distributions for brook trout and creek chub are shown in Figures 3.3.3 and 3.3.4. Most of the trout were less than 8 cm in fork length (Figure 3.3.3), representing young of the year. The length-weight relationship is shown in Figure 3.3.5

Figure 3.3.3 Halfway River Brook Trout: Length Frequency, Oct. 2001

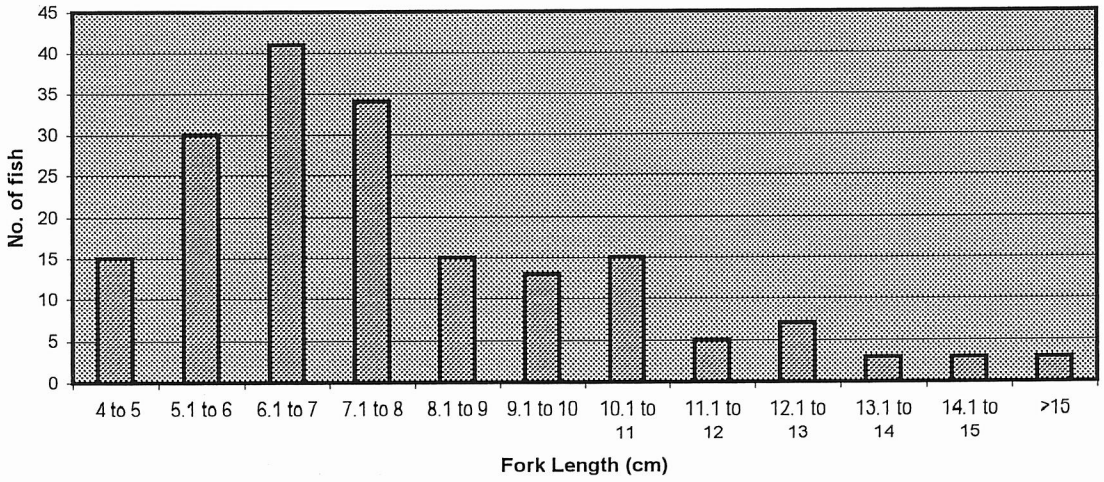


Figure 3.3.4. Halfway River Creek Chub: Length Frequency, Oct. 2001

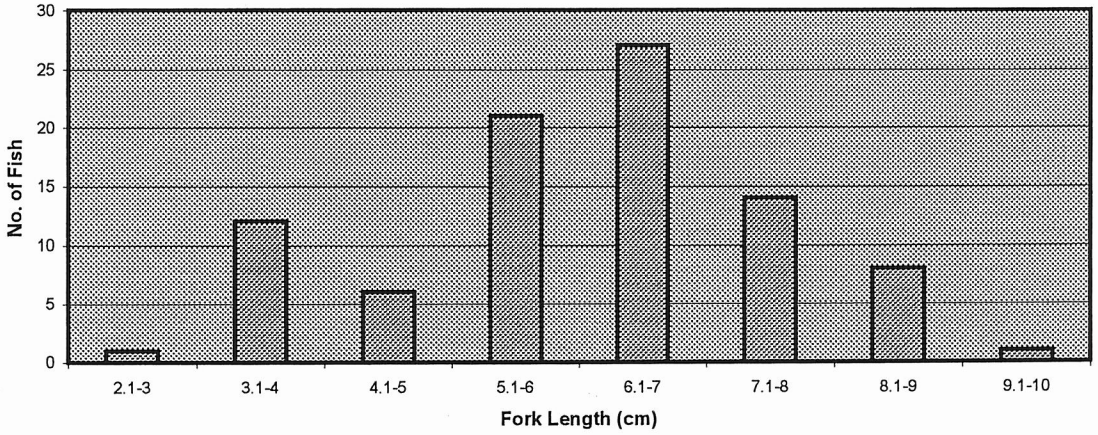
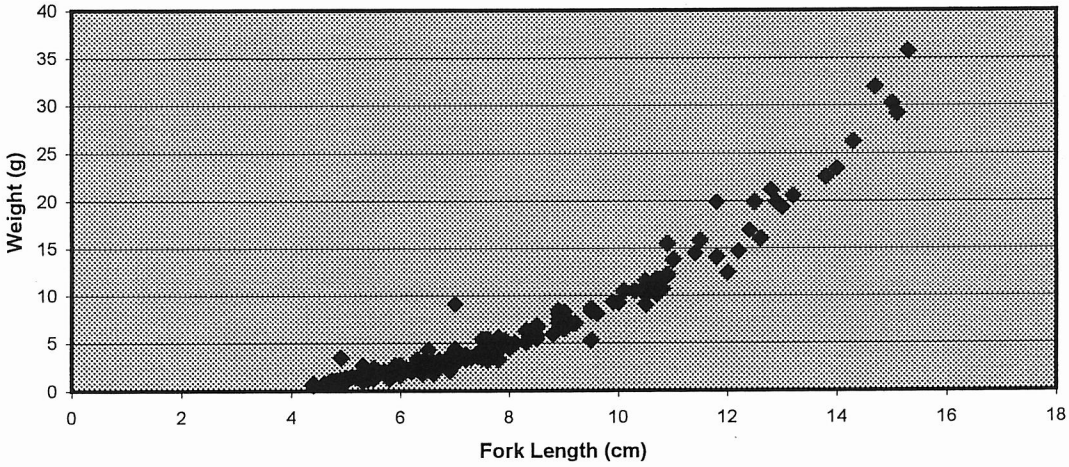


Figure 3.3.5. Halfway Brook Trout Length:Weight relationship, Oct. 2001



3.3.3 Summary.

Fall gill net and minnow trap collections in the two Halfway River impoundments yielded 6 of the same species recorded earlier. Once again, brook trout were only encountered in the Upper Impoundment, despite the undersaturation of oxygen in much of the water column, and the previous anoxia developed during the summer. It is apparent that the Lower Impoundment is, like the lower stretches of the river itself, dominated by coarse fish such as suckers and minnows.

The electrofishing surveys yielded the same species recorded during spring and summer collections. The conclusions tentatively reached in the Final Report are confirmed. The upper half of the Halfway River system supports a good population of brook trout, with numbers ranging from 5-25 per habitat unit on all sample dates. The lower portion of the Halfway River system, in contrast, is dominated by coarse fish, especially suckers, creek chub and eels. This reflects the generally degraded nature of the lower river, which is broad and shallow, with limited riparian or instream cover.

The value of the fish densities reported here, however, is limited because of the intermittent nature of many of the streams sampled.

3.4 Shoreline and Littoral Zone Vegetation Surveys.

These surveys were completed in August and reported previously. No additional observations or records have been obtained for the Halfway River since that time.

3.5 Qualitative Fish Habitat Surveys

Qualitative surveys of the streams in the vicinity of sample sites were described in the previous Final Report (Daborn *et al.* 2001).

During the fall survey, water depths at most stations were little more than during the summer low water periods, and velocities below the sensitivity of the flow meter, as a result of the mild and dry weather during September and October. Consequently, stream conditions had still not returned to the depths and flows that would be expected of a typical fall season.

In general, substrate characteristics remained the same as during summer surveys, however, in some locations leaf fall had commenced, leading to build up of leaf detritus in isolated patches. Leaf packs were especially common and larger at sites HW 1, 2, 4 and 8, but small or absent at HW 3, 5, and 6A.

In general, the Halfway River watershed can be classified as a Category 4 system, from the viewpoint of acidification (DFO. 2000). At all sites, pH values exceeded 5.4 from May through October, and were commonly greater than 6 at most sites. Although the system exhibits little buffering capacity, current inputs of acidity represent no threat to salmonid populations.

Except for their intermittent nature, the tributaries and main stem of the Halfway River provide fair habitat throughout, and good to excellent salmonid habitat in the upper half of the system. Low numbers or absence of trout in the lower portions of the system reflect physical degradation, especially overwidening and lack of suitable cover. There is

potential for rehabilitation of these lower reaches using standard techniques (cf. Newbury and Gaboury, 1993).

3.6 Macroinvertebrates

Macroinvertebrate samples have been taken wherever feasible, using a Surber sampler or D-net. Because of the quantity of detritus involved in many samples, analysis is a slow process, and is continuing.

Dominant species of the fall samples were mayflies (Ephemeroptera), dragonflies (Odonata), stoneflies (Plecoptera) and caddisflies (Trichoptera). The forms are indicative of clean water habitats.

A comparative study of the sampling techniques required by the Terms of Reference, with a sweep technique recommended by the National Water Research Institute (Environment Canada), has been initiated by Dr. Trefor Reynoldson at the sample sites on the Halfway River. The purpose is to determine whether the sweep technique, which is being used by NWRI for a national biomonitoring program for Canadian rivers, provides the same or better information than the Surber and D-net techniques previously selected.

3.7 Species at Risk

No further records have been identified.

3.8 Archaeological Assessment

3.8.1 Introduction.

A Management Strategy for Archaeological Resources of the Halfway River was prepared during July and August by Fundy Environmental and Educational Consultants of Wolfville, NS. This strategy was discussed and supported by Minas Basin Pulp and Power Company Limited, and included in the Final Report prepared in September 2001 (Daborn *et al.* 2001). As the Final Report was in print, some suggested amendments were received from Dr. David Christianson and Mr. Stephen Powell of the Nova Scotia Museum. The essence of the changes was to place greater decision-making responsibility upon qualified archaeological consultants, who would be answerable to the Company, rather than upon Museum personnel who might be involved in site investigation and planning. For clarity, the Management Strategy is reproduced below, with the suggested amendments indicated by underlining.

3.8.2. Management Strategy for Archaeological Resources of the Halfway River, N.S. (Amended October 2001).

The following Management Strategy outlines the plans of Minas Basin Pulp and Power Company Limited for management of archaeological and historical resources that may be encountered in the Halfway River system in areas that are affected by management of the water resources. These areas consist principally of the Front (Lower) and Back (Upper) Impoundments, including the land covered by water and the adjacent riparian zone, and access roads or paths to control facilities.

1. Inventory of Known Archaeological and Historic Resources.

At the present time, there are no records held by the Nova Scotia Museum in the Maritime Archaeological Resource Inventory of any archaeological or historical sites in the Halfway River watershed. Information may be in the possession of individuals who

have been involved in the collection of artefacts in the watershed; however, such information has not so far been provided to the Company.

2. Procedure for Survey of Archaeological or Historical Resources.

The Company undertakes to consider the spirit and requirements of the *Special Places Protection Act* in relation to archaeological and historical resources that are discovered as a result of

a) normal operations;

b) special investigations conducted at times of planned exceptional lowering of water levels in the Halfway River impoundments; and

c) prior to any new work that has the potential for affecting or detecting archaeological or historical resources.

In the event that water levels must be dropped to levels below the normal operating levels for maintenance or repair purposes, the Company will initiate procedures for a more comprehensive survey, the extent of which will depend upon initial results, and on the expected period of low water levels. Because of the long establishment of the two impoundments, sediment accumulation on the bottom in deeper portions may prevent ready observation of artefacts *in situ*, and thus the expected area of investigation will include the swash zone within a few feet (vertically) of the normal lowest water level; subsurface shovel testing may also be conducted on levels areas or terraces just above the swash zone if the consultant archaeologist determines that these are areas of high potential.

Procedures to be followed in such a survey are indicated below.

Procedures for Site Investigation.

A. Contract with a qualified professional archaeologist to plan and supervise the survey.

B. Complete an application for a Heritage Research Permit through the Nova Scotia Museum.

C. Invite the Curator of Archaeology or his/her designate to participate in planning and fieldwork.

D. Form a Site Investigation Team consisting of the Consultant Archaeologist, the Curator of Archaeology (or designate), at least one company official, and such other persons as the Company shall determine.

E. Compile and examine aerial photographs, and any historic maps held in the Provincial Archives of Nova Scotia, relating to the study area.

F. Conduct an Initial Pedestrian Survey of the site. The survey will be under the direction of the Consultant Archaeologist holding a Heritage Research Permit issued by the Nova Scotia Museum.

G. Location of all artefacts and suspected sites of archaeological or historical significance will be recorded as precisely as possible, using Global Positioning System (GPS) techniques and/or measured distances and directions from permanent anthropogenic, geological or geographic features.

H. Following the Initial Survey, any decisions to be made regarding collection of surface artefacts or further site investigation will be the responsibility of the Consultant Archaeologist and the Curator of Archaeology (or designate).

I. Sites containing rich assemblages of artefacts or indicators of undisturbed archaeological resources will be properly mapped prior to removal of any artefacts. Photographs of *in situ* condition and context will accompany documentation of collections or other records wherever feasible.

3. Procedure for Notification of Discovery.

The Company will establish a policy to ensure appropriate notification of discovery in the event that archaeological or historical resources are discovered during routine operations. The essence of this policy is as follows.

a. Any employee of Minas Basin Pulp and Power Company Limited encountering potential indicators of previously unknown archaeological or historical resources on land owned or managed by the Company along the shoreline of the impoundments will inform their immediate supervisor, providing information on the location and nature of the indicator(s).

b. The Supervisor will forward this report to the Electrical/Project Engineer of the Company, who will advise the following company officials:

1) The President and Chief Operating Officer;
2) The General Manager
3) The Operator, Halfway Dams.

4. The General Manager will advise the Curator of Archaeology at the Nova Scotia Museum of the discovery, providing such information as exists. Further official reporting action will be the responsibility of the Curator of Archaeology, and may include notifying the Advisory Committee on Protection of Special Places.

5. Responses following Discovery.

Following the discovery of new archaeological or historical resources in association with the impoundments owned or managed by the Company, the Company will attempt an

initial determination of the condition and degree of vulnerability of the resources to continued company operations. This determination may be made with the assistance of the Curator of Archaeology (or designate) and/or a Consultant Archaeologist engaged for the purpose.

The Company will be diligent in keeping the nature and location of the discovery confidential until all appropriate notifications have been made. No public announcement will be made without the prior approval of the Curator of Archaeology (or designate), and will only be made if it is conformable with the spirit and letter of the *Special Places Protection Act*.

If it is determined that the newly discovered resources are at risk of destruction or serious damage from continued company activities (e.g. if the discovery is associated with excavation or other earthworks), such activity shall stop for a reasonable time to permit a more careful evaluation of:

i. the nature of the discovery;
ii. the extent of risk associated with continued Company activities;
iii. the extent of risk associated with no action for protection or removal of the resource; and
iv. appropriate measures to be taken for documentation and protection of the resource.

If, on the other hand, it is determined that normal operations, once resumed, render no new threat to the resource, the Company will continue activities and reserve further study or documentation of the resource until more convenient opportunity. This response would be appropriate where the discovery is associated with temporary change in water levels such that returning the system to normal operating levels would act to preserve the resource.

3.9 Bibliography

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3.9.1 Appendices

Appendix 3.0.1. Corrigenda for: Daborn, G.R., M. Brylinsky and R. Newell. 2001. Environmental studies of the Halfway River system, Nova Scotia. Final Report. ACER Publication No. 62. 127p.

Page	Para.	Line	
ii	3.4.2. 3.4.3.		Lower (Front) Impoundment Upper (Back) Impoundment
8	5	7	... Upper Impoundment ..."
11	2	1	50 µS/cm
13	4	2	"... which will bind with available anions..."
14	2	5	"... conductivity was higher at all stations..."
16/17	4/1	last/first	"... watershed were low (Figure 3.2.4). Highest values were obtained at HW5 and HW7, both of which are strongly influenced by nearby roads."
18	1	3	"brook trout"
21	Table 3.3.2.		Heading: *F. diaphanus; N. crysoleucas; S. atromaculatus; P. pungitius.*
22	Table 3.3.2. (continued)		Heading: *F. diaphanus; N. crysoleucas; S. atromaculatus; P. pungitius.*
22/23	2/1	last/first	"... less than 50 percent, the level considered to be the lower tolerance limit for most aquatic organisms. For brook trout that inhabit the Upper Impoundment during the spring, there must obviously be a summer refuge, most likely located upstream of the Upper Impoundment.
23	2	1	"... from the Upper Impoundment..."
27/28	2/1	last/first	"... May collections, 1 of 332 fish died as a result..."
36	1	3	"...*pungitius*..."

Appendix 3.0.1. Corrigenda for: Daborn, G.R., M. Brylinsky and R. Newell. 2001. Environmental studies of the Halfway River system, Nova Scotia. Final Report. ACER Publication No. 62. 127p. (continued).

Page	Para.	Line	
43	2	heading	"3.4.2. Lower (Front) Impoundment, Halfway River."
44	5	heading	"3.4.3. Upper (Back) Impoundment, Halfway River."
44	5	1	"... Upper Impoundment ..."
44	5	2/3	"... Lower Impoundment..." — "...Upper Impoundment ..."
45	4	9	"... *Calamagrostis canadensis* ... "
48	4	5	"... distance in Figure 3.5.1)..."

108 Appendix 3.3.2 line 43 HW5

Appendix 3.2.1. Water quality of the Halfway River impoundments, fall 2001.

Parameter	Units	Lower Halfway Impoundment	Upper Halfway Impoundment
Sodium	mg/L	4.5	4.6
Potassium	mg/L	0.8	0.7
Calcium	mg/L	5.2	5.1
Magnesium	mg/L	2.1	2.1
Alkalinity (as CaCO3)	mg/L	14	13
Sulfate	mg/L	5	6
Chloride	mg/L	5.9	6.8
Reactive Silica (as SiO2)	mg/L	4.7	4.8
Ortho Phosphate (as P)	mg/L	< 0.01	< 0.01
Nitrate + Nitrite (as N)	mg/L	< 0.05	< 0.05
Ammonia (as N)	mg/L	0.07	0.08
Iron	mg/L	0.4	0.56
Manganese	mg/L	0.2	0.24
Copper	mg/L	< 0.01	< 0.01
Zinc	mg/L	< 0.05	< 0.05
Color	TCU	23	22
Turbidity	NTU	4.2	4.2
Conductivity (RCAp)	uS/cm	62	66
pH	Units	6.9	6.8
Hardness (as CaCO3)	mg/L	21.6	21.4
Bicarbonate (as CaCO3)	mg/L	14	13
Carbonate (as CaCO3)	mg/L	< 1	< 1
TDS (Calculated)	mg/L	37	38
Cation Sum	meq/L	0.65	0.65
Anion Sum	meq/L	0.55	0.58
Total Org. Carbon (by UV)	mg/L	3.2	3.6

Appendix 3.2.2. Water quality of the Halfway River streams, fall 2001.

Parameters	Units	HW1	HW2	HW3	HW4	HW5	HW6	HW8
Sodium	mg/L	5.7	4.2	3.8	3.4	8.1	5.5	7.7
Potassium	mg/L	1	0.1	0.6	0.3	0.7	0.8	0.8
Calcium	mg/L	6.9	4.3	4.4	2	6.6	5.5	5.8
Magnesium	mg/L	3.6	3	2.7	1.2	3.5	2.4	3
Alkalinity (as CaCO3)	mg/L	4	1	5	< 1	20	13	6
Sulfate	mg/L	18	11	11	< 2	8	6	12
Chloride	mg/L	17.1	9.3	5.9	4.7	11.4	8	12.2
Reactive Silica (as SiO2)	mg/L	6.4	6.7	5.6	5.6	5.6	5.1	6.2
Ortho Phosphate (as P)	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Nitrate + Nitrite (as N)	mg/L	0.13	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.1
Ammonia (as N)	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Iron	mg/L	0.26	0.65	0.11	0.25	0.36	0.32	0.16
Manganese	mg/L	0.12	0.11	0.01	0.08	0.16	0.08	0.05
Copper	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zinc	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Color	TCU	18	76	24	91	17	28	19
Turbidity	NTU	0.7	1.2	0.3	0.8	0.6	2.1	0.5
Conductivity (RCAp)	uS/cm	112	72	60	38	95	69	88
pH	Units	6.7	4.8	6.7	4.9	7.2	7.2	6.7
Hardness (as CaCO3)	mg/L	32	23.1	22.1	9.9	30.9	23.6	26.8
Bicarbonate (as CaCO3)	mg/L	4	< 1	5	< 1	20	13	6
Carbonate (as CaCO3)	mg/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1
TDS (Calculated)	mg/L	62	39	37	20	56	41	52
Cation Sum	meq/L	0.92	0.67	0.63	0.37	0.99	0.74	0.9
Anion Sum	meq/L	0.95	0.51	0.5	0.2	0.89	0.61	0.72
Ion Balance	%	1.5	12.8	11.3	30.4	5.3	8.99	10.8
Total Org. Carbon (by UV)	mg/L	2.8	15.2	4.1	15.2	1.9	4.8	2.6

Appendix 3.3.1. Database of fish collected from the Upper and Lower Impoundments of the Halfway River system, October 2001.

Site	Collection Method	Collection Date	*Species*	Fork Length (cm)	Total Length (cm)	Weight (g)
Lower	Gill Net	19/20 Oct	*C. commersoni*	21.0	23.0	
Lower	Gill Net	19/20 Oct	*C. commersoni*	11.5	12.2	
Lower	Gill Net	19/20 Oct	*C. commersoni*	Predated		
Lower	Gill Net	19/20 Oct	*C. commersoni*	Predated		
Lower	Gill Net	19/20 Oct	*C. commersoni*	Predated		
Lower	Gill Net	19/20 Oct	*C. commersoni*	Predated		
Lower	Gill Net	19/20 Oct	*C. commersoni*	Predated		
Lower	Gill Net	19/20 Oct	*C. commersoni*	Predated		
Lower	Minnow Trap	19/20 Oct	*A. rostrata*		49.0	
Lower	Minnow Trap	19/20 Oct	*A. rostrata*		50.0	
Lower	Minnow Trap	19/20 Oct	*A. rostrata*		52.0	
Lower	Minnow Trap	19/20 Oct	*A. rostrata*		29.0	
Lower	Minnow Trap	19/20 Oct	*S. atromaculatus*			
Lower	Minnow Trap	19/20 Oct	*S. atromaculatus*			
Lower	Minnow Trap	19/20 Oct	*S. atromaculatus*			
Lower	Minnow Trap	19/20 Oct	*S. atromaculatus*			
Lower	Minnow Trap	19/20 Oct	*S. atromaculatus*			
Upper	Minnow Trap	18/19 Oct	*S. fontinalis*	6.5	7.0	
Upper	Minnow Trap	18/19 Oct	*G. aculeatus*			
Upper	Minnow Trap	18/19 Oct	*G. aculeatus*			
Upper	Minnow Trap	18/19 Oct	*G. aculeatus*			
Upper	Minnow Trap	18/19 Oct	*G. aculeatus*			
Upper	Minnow Trap	18/19 Oct	*G. aculeatus*			
Upper	Minnow Trap	18/19 Oct	*S. atromaculatus*			
Upper	Minnow Trap	18/19 Oct	*C. commersoni*		>10	
Upper	Minnow Trap	18/19 Oct	*C. commersoni*		>10	
Upper	Minnow Trap	18/19 Oct	*C. commersoni*		>10	
Upper	Minnow Trap	18/19 Oct	*C. commersoni*		>10	
Upper	Minnow Trap	18/19 Oct	*C. commersoni*		>10	
Upper	Gill Net	18/19 Oct	*C. commersoni*	22.0	23.5	
Upper	Gill Net	18/19 Oct	*C. commersoni*	28.0	30.2	
Upper	Gill Net	18/19 Oct	*C. commersoni*	24.4	26.5	
Upper	Gill Net	18/19 Oct	*C. commersoni*	Predated		
Upper	Gill Net	18/19 Oct	*C. commersoni*	Predated		
Upper	Gill Net	18/19 Oct	*C. commersoni*	Predated		
Upper	Gill Net	18/19 Oct	*C. commersoni*	Predated		
Upper	Gill Net	18/19 Oct	*C. commersoni*	Predated		
Upper	Gill Net	18/19 Oct	*C. commersoni*	Predated		
Upper	Gill Net	18/19 Oct	*C. commersoni*	31.0	33.5	
Upper	Gill Net	18/19 Oct	*C. commersoni*	23.1	25.2	
Upper	Gill Net	18/19 Oct	*C. commersoni*	41.5	44.5	
Upper	Gill Net	18/19 Oct	*C. commersoni*	34.5	36.5	
Upper	Gill Net	18/19 Oct	*C. commersoni*	22.5	24.5	
Upper	Gill Net	18/19 Oct	*C. commersoni*	32.3	35.0	
Upper	Gill Net	18/19 Oct	*C. commersoni*	30.0	32.5	

Appendix 3.3.2. Electrofishing data for Halfway River sites, October 28-30, 2001.

Site	Date	MT	P	Species	otal L (cm	Weight (g)	Fork L (cm)	Comments
HW1	28-Oct	EF	1	Brook Trout	6.2	2.7	6	
HW1	28-Oct	EF	1	Brook Trout	7.9	5.4	7.5	
HW1	28-Oct	EF	1	Brook Trout	8.9	5.4	8.5	
HW1	28-Oct	EF	1	Brook Trout	12.2	15.8	11.5	
HW1	28-Oct	EF	1	Brook Trout	10.4	9.3	9.9	
HW1	28-Oct	EF	1	Brook Trout	9.4	6.8	9	
HW1	28-Oct	EF	1	Brook Trout	6.7	2.5	6.3	
HW1	28-Oct	EF	1	Brook Trout	7.5	3.3	7	
HW1	28-Oct	EF	1	Brook Trout	12.4	12.5	12	
HW1	28-Oct	EF	1	Brook Trout	15.6	35.7	15.3	
HW1	28-Oct	EF	1	Brook Trout	9.9	5.3	9.5	
HW1	28-Oct	EF	1	Brook Trout	11	10.5	10.3	
HW1	28-Oct	EF	1	Brook Trout	8	3.2	7.6	
HW1	28-Oct	EF	1	Brook Trout	12.6	14.7	12.2	
HW1	28-Oct	EF	1	Brook Trout	6.2	2	6	
HW1	28-Oct	EF	1	Brook Trout	10	8.3	9	
HW1	28-Oct	EF	1	Brook Trout	7.3	2.8	7	
HW1	28-Oct	EF	1	Brook Trout	10.9	9	10.5	
HW1	28-Oct	EF	1	Brook Trout	6.5	2.1	6.2	
HW1	28-Oct	EF	1	Brook Trout	13.4	19.8	12.9	
HW1	28-Oct	EF	1	Brook Trout	6.8	3.4	6.5	
HW1	28-Oct	EF	1	Brook Trout	6.4	2.3	6.1	
HW1	28-Oct	EF	1	Brook Trout	11.1	11.6	10.5	
HW1	28-Oct	EF	1	Brook Trout	10	8.6	9.5	
HW1	28-Oct	EF	1	Brook Trout	13.7	20.5	13.2	
HW1	28-Oct	EF	1	Brook Trout	6.7	4.3	6.5	
HW1	28-Oct	EF	1	Brook Trout	7.7	3.7	7.4	
HW1	28-Oct	EF	1	Brook Trout	7.8	4.4	7.5	
HW1	28-Oct	EF	1	Brook Trout	8.3	5.3	7.9	
HW1	28-Oct	EF	1	Brook Trout	10.4	9.2	10	
HW1	28-Oct	EF	1	Brook Trout	6.2	1.7	6	
HW1	28-Oct	EF	1	Brook Trout	10.1	8.1	9.6	
HW1	28-Oct	EF	1	Brook Trout	7.4	3.7	7.2	
HW1	28-Oct	EF	1	Brook Trout	9.2	8.4	8.9	
HW1	28-Oct	EF	1	Brook Trout	7.6	3.9	7.4	
HW1	28-Oct	EF	1	Brook Trout	7.3	4.4	7	
HW1	28-Oct	EF	1	Creek chub	4.4	0.7	4	
HW1	28-Oct	EF	1	Sucker	13.4	23	12.7	
HW1	28-Oct	EF	1	Sucker	5.2	1.7	4.8	
HW1	28-Oct	EF	1	Sucker	4	0.8	3.8	
HW1	28-Oct	EF	1	Sucker	4.1	0.5	3.9	
HW1	28-Oct	EF	1	Sucker	11.5	15.4	11	Total Pass1=42

Appendix 3.3.2. Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW1	28-Oct	EF	2	Brook Trout	7.4	3.4	7	
HW1	28-Oct	EF	2	Brook Trout	11	10	10.5	
HW1	28-Oct	EF	2	Brook Trout	11.7	13.8	11	
HW1	28-Oct	EF	2	Brook Trout	5.8	1.5	5.5	
HW1	28-Oct	EF	2	Brook Trout	8.4	4.8	7.9	
HW1	28-Oct	EF	2	Brook Trout	7.3	3.5	4.9	
HW1	28-Oct	EF	2	Brook Trout	7.3	2.1	6.9	
HW1	28-Oct	EF	2	Brook Trout	5.8	1.3	5.5	
HW1	28-Oct	EF	2	Brook Trout	11.2	10.7	10.8	
HW1	28-Oct	EF	2	Brook Trout	14.4	22.5	13.8	
HW1	28-Oct	EF	2	Brook Trout	11.4	12.3	10.9	
HW1	28-Oct	EF	2	Brook Trout	9.3	5.9	8.8	
HW1	28-Oct	EF	2	Brook Trout	9.3	7.5	8.9	
HW1	28-Oct	EF	2	Brook Trout	7.4	9.1	7	
HW1	28-Oct	EF	2	Brook Trout	14.6	23.4	14	
HW1	28-Oct	EF	2	Brook Trout	5.7	1.7	5.4	
HW1	28-Oct	EF	2	Sucker	7.4	3.7	7	
HW1	28-Oct	EF	2	Sucker	10.7	13.1	10.2	
HW1	28-Oct	EF	2	Sucker	13.2	22.1	12.5	
HW1	28-Oct	EF	2	Sucker	19.1	65.1	18.2	Total Pass2=20
HW1	28-Oct	EF	3	Brook Trout	6.2	1.9	6	
HW1	28-Oct	EF	3	Brook Trout	9.4	7.7	9	
HW1	28-Oct	EF	3	Brook Trout	6.7	2.8	6.5	
HW1	28-Oct	EF	3	Brook Trout	7.1	2.6	6.7	
HW1	28-Oct	EF	3	Brook Trout	6.7	3	6.4	
HW1	28-Oct	EF	3	Brook Trout	6.6	2.8	6.3	
HW1	28-Oct	EF	3	Brook Trout	6.1	1.7	5.8	
HW1	28-Oct	EF	3	Brook Trout	5.1	1	4.9	
HW1	28-Oct	EF	3	Eel	13.5	3.1		
HW1	28-Oct	EF	3	Sucker	12.3	21.6	11.5	
HW1	28-Oct	EF	3	Sucker	18.7	70.4	17.5	Total Pass3=11
HW2	28-Oct	EF	1					No Fish
HW3	28-Oct	EF	1	Brook Trout	15.3	31.9	14.7	
HW3	28-Oct	EF	1	Brook Trout	13	16	12.6	
HW3	28-Oct	EF	1	Brook Trout	5.5	1.6	5.3	
HW3	28-Oct	EF	1	Brook Trout	5.5	1	5.3	
HW3	28-Oct	EF	1	Brook Trout	6.2	1.8	5.9	
HW3	28-Oct	EF	1	Brook Trout	5.2	1	5	
HW3	28-Oct	EF	1	Brook Trout	9.8	8.3	9.5	
HW3	28-Oct	EF	1	Brook Trout	8.8	5.4	8.5	
HW3	28-Oct	EF	1	Brook Trout	5.2	1	5	

Appendix 3.3.2. Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW3	28-Oct	EF	1	Brook Trout	5.6	1.4	5.3	
HW3	28-Oct	EF	1	Brook Trout	9.4	8.1	8.9	
HW3	28-Oct	EF	1	Brook Trout	6.5	3.3	6.3	
HW3	28-Oct	EF	1	Brook Trout	6.9	2.7	6.6	
HW3	28-Oct	EF	1	Brook Trout	4.9	0.8	4.7	
HW3	28-Oct	EF	1	Brook Trout	5.9	1.8	5.7	
HW3	28-Oct	EF	1	Brook Trout	5.3	1.1	5	
HW3	28-Oct	EF	1	Brook Trout	6	1.8	5.7	
HW3	28-Oct	EF	1	Brook Trout	5.4	1.5	5.2	Total Pass1=18
HW3	28-Oct	EF	2	Brook Trout	11.5	15.5	10.9	
HW3	28-Oct	EF	2	Brook Trout	12.9	19.8	12.5	
HW3	28-Oct	EF	2	Brook Trout	8.1	3.7	7.7	
HW3	28-Oct	EF	2	Brook Trout	11	10.1	10.5	
HW3	28-Oct	EF	2	Brook Trout	5.4	1.5	5.1	
HW3	28-Oct	EF	2	Brook Trout	5.2	1.4	5	
HW3	28-Oct	EF	2	Brook Trout	4.9	0.9	4.7	
HW3	28-Oct	EF	2	Brook Trout	4.8	1	4.7	
HW3	28-Oct	EF	2	Brook Trout	4.6	0.8	4.4	Total Pass2=9
HW4	30-Oct	EF	1	Brook Trout	5.6	1.6	5.4	
HW4	30-Oct	EF	1	Brook Trout	9.5	7.3	9.1	
HW4	30-Oct	EF	1	Brook Trout	6.6	2.1	6.2	
HW4	30-Oct	EF	1	Brook Trout	5.6	1.5	5.4	
HW4	30-Oct	EF	1	Brook Trout	7.9	4.4	7.5	
HW4	30-Oct	EF	1	Brook Trout	5.3	1.2	4.9	
HW4	30-Oct	EF	1	Brook Trout	6.1	1.3	5.8	
HW4	30-Oct	EF	1	Brook Trout	6.8	2.7	6.5	
HW4	30-Oct	EF	1	Brook Trout	6.4	2.2	6.1	
HW4	30-Oct	EF	1	Brook Trout	7	3	6.6	
HW4	30-Oct	EF	1	Brook Trout	7.5	3.3	7.2	
HW4	30-Oct	EF	1	Brook Trout	11.2	12.1	10.9	
HW4	30-Oct	EF	1	Brook Trout	11	11.8	10.7	
HW4	30-Oct	EF	1	Brook Trout	6.5	2.3	6.2	
HW4	30-Oct	EF	1	Brook Trout	9.5	7.1	9.2	
HW4	30-Oct	EF	1	Brook Trout	10.9	10.8	10.5	
HW4	30-Oct	EF	1	Brook Trout	11	11	10.5	
HW4	30-Oct	EF	1	Brook Trout	5.9	2.4	5.5	
HW4	30-Oct	EF	1	Brook Trout	7.5	3.8	7.2	
HW4	30-Oct	EF	1	Brook Trout	9.3	7.1	9	
HW4	30-Oct	EF	1	Brook Trout	6.8	1.8	6.6	
HW4	30-Oct	EF	1	Brook Trout	7.6	3.9	7.4	
HW4	30-Oct	EF	1	Brook Trout	7.1	2.7	6.7	

Appendix 3.3.2. Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW4	30-Oct	EF	1	Brook Trout	7.4	3.5	7	
HW4	30-Oct	EF	1	Brook Trout	8.4	5	8.1	
HW4	30-Oct	EF	1	Brook Trout	6.6	1.8	6.4	
HW4	30-Oct	EF	1	Brook Trout	5.6	1.2	5.4	
HW4	30-Oct	EF	1	Brook Trout	5.7	1.7	5.5	
HW4	30-Oct	EF	1	Brook Trout	5	1.1	4.8	
HW4	30-Oct	EF	1	Brook Trout	4.8	0.8	4.6	
HW4	30-Oct	EF	1	Brook Trout	4.6	0.6	4.4	
HW4	30-Oct	EF	1	Brook Trout	5.6	1.9	5.4	
HW4	30-Oct	EF	1	Creek chub	8.4	5.1	8	
HW4	30-Oct	EF	1	Creek chub	8.7	6.4	8.3	
HW4	30-Oct	EF	1	Creek chub	5.9	1.6	5.4	
HW4	30-Oct	EF	1	Creek chub	5.9	1.8	5.5	
HW4	30-Oct	EF	1	Creek chub	7.2	3.6	6.7	
HW4	30-Oct	EF	1	Creek chub	7.8	5.2	7.4	
HW4	30-Oct	EF	1	Creek chub	5.8	1.9	5.4	
HW4	30-Oct	EF	1	Creek chub	6.8	2.6	6.3	
HW4	30-Oct	EF	1	Creek chub	5.8	1.7	5.4	
HW4	30-Oct	EF	1	Creek chub	5.4	1.3	4.9	
HW4	30-Oct	EF	1	Creek chub	7.4	3.5	6.8	
HW4	30-Oct	EF	1	Creek chub	7.2	3.1	6.7	
HW4	30-Oct	EF	1	Creek chub	7.1	3	6.7	
HW4	30-Oct	EF	1	Creek chub	7.7	4.8	7.3	
HW4	30-Oct	EF	1	Creek chub	8.5	5.8	8	
HW4	30-Oct	EF	1	Creek chub	9.1	7.1	8.6	
HW4	30-Oct	EF	1	Creek chub	6	1.9	5.6	
HW4	30-Oct	EF	1	Creek chub	6.8	3	6.2	
HW4	30-Oct	EF	1	Creek chub	7.3	4.5	6.8	
HW4	30-Oct	EF	1	Creek chub	8.9	6.5	8.4	
HW4	30-Oct	EF	1	Creek chub	6.9	3	6.4	
HW4	30-Oct	EF	1	Creek chub	7	3.5	6.6	
HW4	30-Oct	EF	1	Creek chub	6.4	2.6	5.9	
HW4	30-Oct	EF	1	Creek chub	7.9	4.2	7.4	
HW4	30-Oct	EF	1	Sucker	9.9	10.8	9.5	
HW4	30-Oct	EF	1	Sucker	8.9	7.7	8.5	
HW4	30-Oct	EF	1	Sucker	16.2	47	15.5	
HW4	30-Oct	EF	1	Sucker	10.9	14.6	10.5	
HW4	30-Oct	EF	1	Sucker	9.7	10	9.2	
HW4	30-Oct	EF	1	Sucker	9.2	8.3	8.7	
HW4	30-Oct	EF	1	Sucker	9.8	9.4	9.3	
HW4	30-Oct	EF	1	Sucker	8.6	6.2	8.3	
HW4	30-Oct	EF	1	Sucker	8.2	5.1	7.8	Total Pass1=63

Appendix 3.3.2 Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW4	30-Oct	EF	2	Brook Trout	14.8	26.2	14.3	
HW4	30-Oct	EF	2	Brook Trout	6.8	2.2	6.5	
HW4	30-Oct	EF	2	Brook Trout	5.9	2	5.6	
HW4	30-Oct	EF	2	Brook Trout	6.8	2.8	6.5	
HW4	30-Oct	EF	2	Brook Trout	13.6	19.3	13	
HW4	30-Oct	EF	2	Brook Trout	7.4	2.9	7	
HW4	30-Oct	EF	2	Brook Trout	10.1	8.6	9.5	
HW4	30-Oct	EF	2	Brook Trout	6.5	2.3	6.3	
HW4	30-Oct	EF	2	Brook Trout	7.1	2.3	6.6	
HW4	30-Oct	EF	2	Brook Trout	9.5	6.5	9	
HW4	30-Oct	EF	2	Brook Trout	6.5	2	6.2	
HW4	30-Oct	EF	2	Brook Trout	5.9	1.6	5.6	
HW4	30-Oct	EF	2	Creek chub	6.1	1.9	5.7	
HW4	30-Oct	EF	2	Creek chub	5.7	1.6	5.2	
HW4	30-Oct	EF	2	Creek chub	7.6	2.4	7	
HW4	30-Oct	EF	2	Creek chub	9.4	8.3	8.8	
HW4	30-Oct	EF	2	Creek chub	8.6	5.5	7.9	
HW4	30-Oct	EF	2	Creek chub	7.2	2.9	6.7	
HW4	30-Oct	EF	2	Creek chub	7.7	3.8	7.1	
HW4	30-Oct	EF	2	Creek chub	7.1	3.2	6.7	
HW4	30-Oct	EF	2	Creek chub	8.8	5.9	8.2	
HW4	30-Oct	EF	2	Creek chub	6.9	3.2	6.4	
HW4	30-Oct	EF	2	Creek chub	7.1	3.3	6.7	
HW4	30-Oct	EF	2	Creek chub	6	1.5	5.5	
HW4	30-Oct	EF	2	Creek chub	6.6	2.8	6.4	
HW4	30-Oct	EF	2	Eel	45	122		
HW4	30-Oct	EF	2	Sucker	15.7	44.1	14.7	
HW4	30-Oct	EF	2	Sucker	9.7	8.6	9.2	
HW4	30-Oct	EF	2	Sucker	9.6	8.9	9	
HW4	30-Oct	EF	2	Sucker	10.6	13	10	
HW4	30-Oct	EF	2	Sucker	7.7	4.6	7.3	Total Pass2=31
HW5	30-Oct	EF	1	9 Spine Stickleback	5.3	0.5		
HW5	30-Oct	EF	1	9 Spine Stickleback	4	0.3		
HW5	30-Oct	EF	1	Brook Trout	10.7	11.4	10.3	
HW5	30-Oct	EF	1	Brook Trout	13	16.9	12.4	
HW5	30-Oct	EF	1	Brook Trout	8.3	5.2	7.8	
HW5	30-Oct	EF	1	Brook Trout	8	5.4	7.6	
HW5	30-Oct	EF	1	Brook Trout	6.9	2.9	6.6	
HW5	30-Oct	EF	1	Brook Trout	8.3	5.6	7.8	
HW5	30-Oct	EF	1	Brook Trout	15.6	29.1	15.1	
HW5	30-Oct	EF	1	Brook Trout	8	3.3	7.8	

Appendix 3.3.2 Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW5	30-Oct	EF	1	Brook Trout	8.6	6.3	8.3	
HW5	30-Oct	EF	1	Brook Trout	7.6	3.5	7.3	
HW5	30-Oct	EF	1	Brook Trout	5.2	1.4	5	
HW5	30-Oct	EF	1	Brook Trout	7	3.2	6.7	
HW5	30-Oct	EF	1	Brook Trout	6.3	2.7	5.9	
HW5	30-Oct	EF	1	Creek chub	7.5	4.8	7	
HW5	30-Oct	EF	1	Creek chub	8.3	6.8	7.8	
HW5	30-Oct	EF	1	Creek chub	10.6	11.2	10	
HW5	30-Oct	EF	1	Creek chub	7.1	3.9	6.8	
HW5	30-Oct	EF	1	Creek chub	9.3	7.5	8.6	
HW5	30-Oct	EF	1	Creek chub	8.7	6.7	8.2	
HW5	30-Oct	EF	1	Creek chub	6.6	2.3	6.2	
HW5	30-Oct	EF	1	Creek chub	6.1	2	5.7	
HW5	30-Oct	EF	1	Creek chub	7.5	3.9	7	
HW5	30-Oct	EF	1	Creek chub	7.5	3.9	7	
HW5	30-Oct	EF	1	Creek chub	7.5	3.5	6.9	
HW5	30-Oct	EF	1	Creek chub	3.7	0.3	3.5	
HW5	30-Oct	EF	1	Creek chub	5.9	1.5	5.5	
HW5	30-Oct	EF	1	Creek chub	3.8	0.2	3.6	
HW5	30-Oct	EF	1	Creek chub	6.5	2.2	6.2	
HW5	30-Oct	EF	1	Creek chub	3.5	0.1	3.3	
HW5	30-Oct	EF	1	Creek chub	7.6	4.3	7.2	
HW5	30-Oct	EF	1	Creek chub	4.1	0.6	3.9	
HW5	30-Oct	EF	1	Creek chub	4.8	1.2	4.6	
HW5	30-Oct	EF	1	Sucker	4.6	0.5	4.4	
HW5	30-Oct	EF	1	Sucker	6.3	2.5	5.9	
HW5	30-Oct	EF	1	Sucker	6.5	2.8	6	
HW5	30-Oct	EF	1	Sucker	6.3	2.7	5.9	
HW5	30-Oct	EF	1	Sucker	5.3	1.8	4.9	
HW5	30-Oct	EF	1	Sucker	8.1	5.1	7.5	
HW5	30-Oct	EF	1	Sucker	6.5	2.6	6.2	
HW5	30-Oct	EF	1	Sucker	4.6	1.4	4.4	
HW5	30-Oct	EF	1	Sucker	6.8	3	6.4	
HW5	30-Oct	EF	1	Sucker	4.5	0.5	4.2	
HW5	30-Oct	EF	1	Sucker	5.4	1.8	5	
HW5	30-Oct	EF	1	Sucker	4.3	0.8	4.1	Total Pass1=46

Appendix 3.3.2 Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW5	30-Oct	EF	2	9 Spine Stickleback	4.3	0.5		
HW5	30-Oct	EF	2	9 Spine Stickleback	4.6	0.4		
HW5	30-Oct	EF	2	9 Spine Stickleback	4.3	0.4		
HW5	30-Oct	EF	2	9 Spine Stickleback				
HW5	30-Oct	EF	2	9 Spine Stickleback	3.2	0.5		
HW5	30-Oct	EF	2	9 Spine Stickleback	4	0.7		
HW5	30-Oct	EF	2	9 Spine Stickleback	4.6	0.6		
HW5	30-Oct	EF	2	9 Spine Stickleback	2.7	0.2		
HW5	30-Oct	EF	2	Brook Trout	6.3	2	6	
HW5	30-Oct	EF	2	Brook Trout	8.4	4.9	8	
HW5	30-Oct	EF	2	Brook Trout	10.7	10.5	10.1	
HW5	30-Oct	EF	2	Brook Trout	5.5	2.7	5.3	
HW5	30-Oct	EF	2	Creek chub	6.6	2.5	6.2	
HW5	30-Oct	EF	2	Creek chub	8	5.2	7.4	
HW5	30-Oct	EF	2	Creek chub	6.3	2.6	5.8	
HW5	30-Oct	EF	2	Creek chub	6.8	2.3	6.3	
HW5	30-Oct	EF	2	Creek chub	9	6.8	8.5	
HW5	30-Oct	EF	2	Creek chub	6.3	2.4	5.8	
HW5	30-Oct	EF	2	Creek chub	4	1	3.7	
HW5	30-Oct	EF	2	Creek chub	7.2	3.1	6.7	
HW5	30-Oct	EF	2	Creek chub	7.8	4.1	7.3	
HW5	30-Oct	EF	2	Creek chub	2.9	0.3	2.7	
HW5	30-Oct	EF	2	Sucker	4.6	0.5	4.4	Total Pass2=23
HW5	30-Oct	EF	3	9 Spine Stickleback	4.8	0.3		
HW5	30-Oct	EF	3	9 Spine Stickleback	3.2	0.1		
HW5	30-Oct	EF	3	9 Spine Stickleback	4.9	0.4		
HW5	30-Oct	EF	3	9 Spine Stickleback	3.4	0.5		
HW5	30-Oct	EF	3	9 Spine Stickleback	4.9	0.8		
HW5	30-Oct	EF	3	9 Spine Stickleback	3.9	0.1		
HW5	30-Oct	EF	3	9 Spine Stickleback	6.1	1.3		
HW5	30-Oct	EF	3	9 Spine Stickleback	4.9	1.2		
HW5	30-Oct	EF	3	Brook Trout	5.9	2.1	5.7	
HW5	30-Oct	EF	3	Brook Trout	7	3.1	6.7	
HW5	30-Oct	EF	3	Creek chub	8	4.4	7.5	
HW5	30-Oct	EF	3	Creek chub	5.7	1.7	5.4	
HW5	30-Oct	EF	3	Creek chub	6.1	1.2	5.7	
HW5	30-Oct	EF	3	Creek chub	4.4	0.6	4.1	
HW5	30-Oct	EF	3	Sucker	7.2	4.8	6.7	
HW5	30-Oct	EF	3	Sucker	7.2	4.6	6.8	
HW5	30-Oct	EF	3	Sucker	6.6	2.5	6.2	Total Pass3=17

Appendix 3.3.2. Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW6	30-Oct	EF	1	Creek chub	5.7	1.7	5.4	Estimated Count of Eels 60+
HW6	30-Oct	EF	1	Creek chub	6	2.1	5.6	
HW6	30-Oct	EF	1	Creek chub	4.3	1	3.8	
HW6	30-Oct	EF	1	Creek chub	5.9	2.1	5.5	
HW6	30-Oct	EF	1	Creek chub	7.4	4.5	6.9	
HW6	30-Oct	EF	1	Creek chub	6.1	2.8	5.6	
HW6	30-Oct	EF	1	Creek chub	5.3	1.8	4.9	
HW6	30-Oct	EF	1	Creek chub	3.7	0.5	3.5	
HW6	30-Oct	EF	1	Creek chub	3.7	0.8	3.5	
HW6	30-Oct	EF	1	Creek chub	5.6	1.6	5.3	
HW6	30-Oct	EF	1	Creek chub	4.9	1.2	4.6	
HW6	30-Oct	EF	1	Creek chub	5.3	1.2	4.9	
HW6	30-Oct	EF	1	Creek chub	7.6	3.4	7.1	
HW6	30-Oct	EF	1	Creek chub	7.9	4.6	7.4	
HW6	30-Oct	EF	1	Creek chub	5.9	1.5	5.5	
HW6	30-Oct	EF	1	Creek chub	6.7	2.8	6.3	
HW6	30-Oct	EF	1	Creek chub	4.3	0.6	3.9	
HW6	30-Oct	EF	1	Creek chub	3.5	0.4	3.3	
HW6	30-Oct	EF	1	Creek chub	3.6	0.5	3.4	
HW6	30-Oct	EF	1	Sucker	7.9	4.4	7.4	
HW6	30-Oct	EF	1	Sucker	9.3	8.3	8.7	
HW6	30-Oct	EF	1	Sucker	9	6.9	8.6	
HW6	30-Oct	EF	1	Sucker	8.6	6.6	8	
HW6	30-Oct	EF	1	Sucker	5.5	1.6	5.2	
HW6	30-Oct	EF	1	Sucker	6	2.2	5.5	Total Pass1=25
HW8	28-Oct	EF	1	Brook Trout	11.2	10.1	10.7	
HW8	28-Oct	EF	1	Brook Trout	8.4	4.5	8	
HW8	28-Oct	EF	1	Brook Trout	6.7	2.9	6.4	
HW8	28-Oct	EF	1	Brook Trout	8	3.4	7.5	
HW8	28-Oct	EF	1	Brook Trout	8.3	4.2	7.8	
HW8	28-Oct	EF	1	Brook Trout	7.9	3.8	7.5	
HW8	28-Oct	EF	1	Brook Trout	6.8	2.9	6.5	
HW8	28-Oct	EF	1	Brook Trout	6.5	2.3	6	
HW8	28-Oct	EF	1	Brook Trout	6.8	2.7	6.5	
HW8	28-Oct	EF	1	Brook Trout	7.3	3.4	7	
HW8	28-Oct	EF	1	Brook Trout	9	6.6	8.5	
HW8	28-Oct	EF	1	Brook Trout	8	4.4	7.7	
HW8	28-Oct	EF	1	Brook Trout	12.3	14.1	11.8	
HW8	28-Oct	EF	1	Brook Trout	13.4	21.1	12.8	
HW8	28-Oct	EF	1	Brook Trout	15.8	30.2	15	
HW8	28-Oct	EF	1	Brook Trout	9.1	5.8	8.5	

Appendix 3.3.2. Electrofishing data for Halfway River sites, October 28-30, 2001 (continued)

Site	Date	MTD	P	Species	Tot L (cm)	Weight (g)	Fork L (cm)	Comments
HW8	28-Oct	EF	1	Brook Trout	8.3	5.2	7.8	
HW8	28-Oct	EF	1	Brook Trout	9.4	7.1	8.9	
HW8	28-Oct	EF	1	Brook Trout	11.8	14.5	11.4	
HW8	28-Oct	EF	1	Brook Trout	12.5	19.8	11.8	
HW8	28-Oct	EF	1	Brook Trout	8.3	4.3	7.8	
HW8	28-Oct	EF	1	Brook Trout	6.7	2.3	6.4	
HW8	28-Oct	EF	1	Brook Trout	6.7	2.6	6.4	
HW8	28-Oct	EF	1	Brook Trout	7.1	2.8	6.7	
HW8	28-Oct	EF	1	Brook Trout	6	1.9	5.7	
HW8	28-Oct	EF	1	Brook Trout	9.1	6.8	8.5	
HW8	28-Oct	EF	1	Brook Trout	7.4	3.8	7	
HW8	28-Oct	EF	1	Brook Trout	7.4	3.6	6.9	
HW8	28-Oct	EF	1	Brook Trout	6.8	2.6	6.7	
HW8	28-Oct	EF	1	Brook Trout	6.9	2.5	6.7	
HW8	28-Oct	EF	1	Brook Trout	6.9	2.9	6.5	
HW8	28-Oct	EF	1	Brook Trout	7.4	4.2	7	
HW8	28-Oct	EF	1	Brook Trout	7	2.7	6.7	
HW8	28-Oct	EF	1	Brook Trout	6.7	2.6	6.3	
HW8	28-Oct	EF	1	Brook Trout	8.7	5.1	8.3	
HW8	28-Oct	EF	1	Brook Trout	6.5	2.1	6.2	
HW8	28-Oct	EF	1	C. shiner	7.4	4.5	7	
HW8	28-Oct	EF	1	C. shiner	6.9	3.3	6.2	
HW8	28-Oct	EF	1	C. shiner	6.8	3	6.4	
HW8	28-Oct	EF	1	Sucker	8.3	5.7	7.8	Total Pass1=40
HW8	28-Oct	EF	2	Brook Trout	5.3	1.5	5.1	
HW8	28-Oct	EF	2	Brook Trout	6.7	2.6	6.5	
HW8	28-Oct	EF	2	Brook Trout	7.3	3.1	7	
HW8	28-Oct	EF	2	Brook Trout	7.1	3.2	6.8	
HW8	28-Oct	EF	2	Brook Trout	11.7	14.2	11.5	
HW8	28-Oct	EF	2	Brook Trout	5.7	1.6	5.5	
HW8	28-Oct	EF	2	Brook Trout	7.8	4.4	7.5	
HW8	28-Oct	EF	2	Brook Trout	7.2	2.8	6.8	
HW8	28-Oct	EF	2	Brook Trout	6.6	3.2	6.3	
HW8	28-Oct	EF	2	Brook Trout	6.9	1.8	6.5	
HW8	28-Oct	EF	2	Brook Trout	8.8	5.4	8.1	
HW8	28-Oct	EF	2	Brook Trout	7.5	2.6	7	
HW8	28-Oct	EF	2	C. shiner	5.9	1.7	5.5	Total Pass2=13