2006 Fish Survey in Recently Dewatered Western Irrigation District Canals

Prepared for:

Western Irrigation District
Strathmore, Alberta
T1P 1C1

Prepared by:

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LETTER OF TRANSMITTAL

Date: December 15, 2006

To: Mr. Jim Webber, General Manager
Western Irrigation District
201 Pine Road
Strathmore, Alberta
T1P 1C1

Re: 2006 Fish Survey in Recently Dewatered Western Irrigation District Irrigation Canals

Attention: Mr. Webber

Aquality Environmental Consulting Ltd. is pleased to present the following survey of fish in WID Canals A and B downstream of Chestermere Lake following the 2006 fall dewatering. Fewer fish were captured this year, but the mean size of fish captured was greater than fish captured in 2005. Recommendations to minimize fish entrapment in the WID canal system have been developed and presented in this report.

Should you have any questions or comments regarding this report, please contact our office at (780) 433-9414.

Regards,

AQUALITY ENVIRONMENTAL CONSULTING LTD.

Per:____
Jay S. White, M.Sc., P.Biol.
Principal

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1.0 Executive Summary

Headwater canals within the Western Irrigation District irrigation system were sampled for fish by *Aqua*lity Environmental Consulting Ltd. on October 2 and 3, 2006 following the annual fall canal dewatering. The purpose of this work was to (i) identify the species of fish subject to irrigation canal entrainment, (ii) quantify fish from pre-selected pools, (iii) comment on the condition of fish, (iv) comment on the significance of the number of fish collected, and (v) suggest potential remediation measures to minimize fish loss.

Ten sites along canal A and B were inspected downstream of Chestermere Lake including two new sites and eight sites that were sampled in previous years. Fish were collected from six historical sites but were not found at either of the two new survey sites, nor at two sites sampled in previous years. Northern Pike (*Esox lucius*) was the most abundant fish species found in the canal system, followed by Lake Whitefish (*Coregonus clupeaformis*), and Yellow Perch (*Perca flavescens*). Other fish found in the survey included White Sucker (*Catostomus commersoni*), Rainbow Trout (*Oncorhynchus mykiss*), and Brown Trout (*Salmo trutta*). There was a noted lack of the freshwater shrimp *Gammarus* present, considering the abundance noted in previous years.

The majority of fish collected were in good health, with no apparent lesions or ectoparasites. The number of fish collected decreased by threefold in 2006 from 2005 and species diversity has also continued to decline from previous years. Fish sizes (fork length) increased in 2006 to an average size of 34 cm in comparison to 2005, when the average fork length was 25 cm. Continued sampling and expanding the sampling sites to lower reaches of the canal system will be required to determine if the amounts of fish collected accurately represent the numbers and species of fish trapped in the system. Further study will also be required to determine if fish loss in the canals have a significant impact on local populations. Some suggested solutions to minimize fish entrapment in the WID canal system are to:

- (i) exclude fish from entering into the canal works,
- (ii) coordinate operation of internal WID infrastructure to minimize fish stranding,
- (iii) eliminate deep pool habitat within the canal system that fish find favorable,
- (iv) rescue fish from concentrated, predictable locations for re-release back into the Bow River following fall dewatering,
- (v) provide a flushing process to herd the fish into deeper water bodies, or
- (vi) continue to monitor and report on the status quo.

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2.0 Introduction

The Western Irrigation District (WID) has been providing water to agricultural operators in southern Alberta since 1907. Water is withdrawn through a diversion structure on the Bow River immediately downstream of the confluence of the Bow River and Nose Creek. The Bow River, the WID water source, is world-renowned for its blue-ribbon trout fishery, and boasts over 3000 trout per mile of river (McLennan 1998). The growth of the Bow fishery began with Rainbow Trout stocking efforts in the mid-1920's, which parallels the timelines of irrigation growth. Several species of fish make their way into the WID canal system through the diversion. Diverted waters flow through the Canals eastward to Chestermere Lake, then flow southeast to Langdon, Strathmore and Gleichen, and north and east toward Standard and Rockyford. It is not currently known how many fish make their way into the WID diversion or how many of these become trapped within the WID irrigation canal system.

To gain some understanding of the magnitude of potential impact to fish due to the autumnal dewatering process, the WID hired *Aqua*lity Environmental Consulting Ltd. (*Aqua*lity) to identify and quantify fish stranded following the normal seasonal (fall) dewatering (i.e. when diversion activities cease and canals are allowed to run dry) in October of 2006. Canal dewatering typically occurs around the Canadian Thanksgiving weekend in October, and draining of the canals can take up to a week. The majority of fish inhabiting the canals are assumed to move to the safety of deeper waters or reservoirs within the canal system such as Chestermere Lake, Langdon Reservoir and Bruce Lakes during the dewatering process. However, some fish do remain behind in the deeper pools within the canals. The purpose of this work was to: (i) identify the species of fish encountered, (ii) quantify the number of fish encountered, (iii) comment on the condition of stranded fish, (iv) comment on the significance of the amounts of fish stranded, and (v) suggest potential remediation measures. *Aqua*lity has collected fish sampling data annually from 2002 – 2005 for the WID, so efforts to understand changes in fish populations over the years through comparison of data from common sites will be made.

3.0 Methods

3.1 Overview of Sampling Methods

Headwater canals within the Western Irrigation District were sampled by Aquality Environmental Consulting Ltd. on October 2 and 3, 2006 following the fall canal dewatering. Fish capture was authorized by Fish Research License No. 06-1515FR. Sites immediately downstream of Chestermere Lake were selected along canals A and B. These sites have been identified with the aid of WID operations staff, based on their observation, as well as on sampling data from previous years. Two additional sites were included in this year's survey based on the presence of deep enough water to hold fish at these sites. Deep water was typically found immediately downstream of large drop-structures where a plunge pool was an integral part of energy dissipation. Collected fish were released back into Chestermere Lake, where deeper water will provide a better chance for winter survival (Figure 1).

Pocket seine nets and block nets (50' long by 4' deep, mesh size approximately 1/8") were used to block downstream passage of fish (where necessary), while pools were seined with a smaller (4'x 4' x 4', mesh size approximately 1/8") two-man pocket seine net. Seine net hauls were made through the sites until fish were no longer collected. Seining was effective at sites that were less than 1m deep, and less effective at increasingly deeper sites and sites with large rocks. A variable mesh gill net (mesh size approximately 6" to ½") was used at the deepest sites that were inaccessible by seine net.

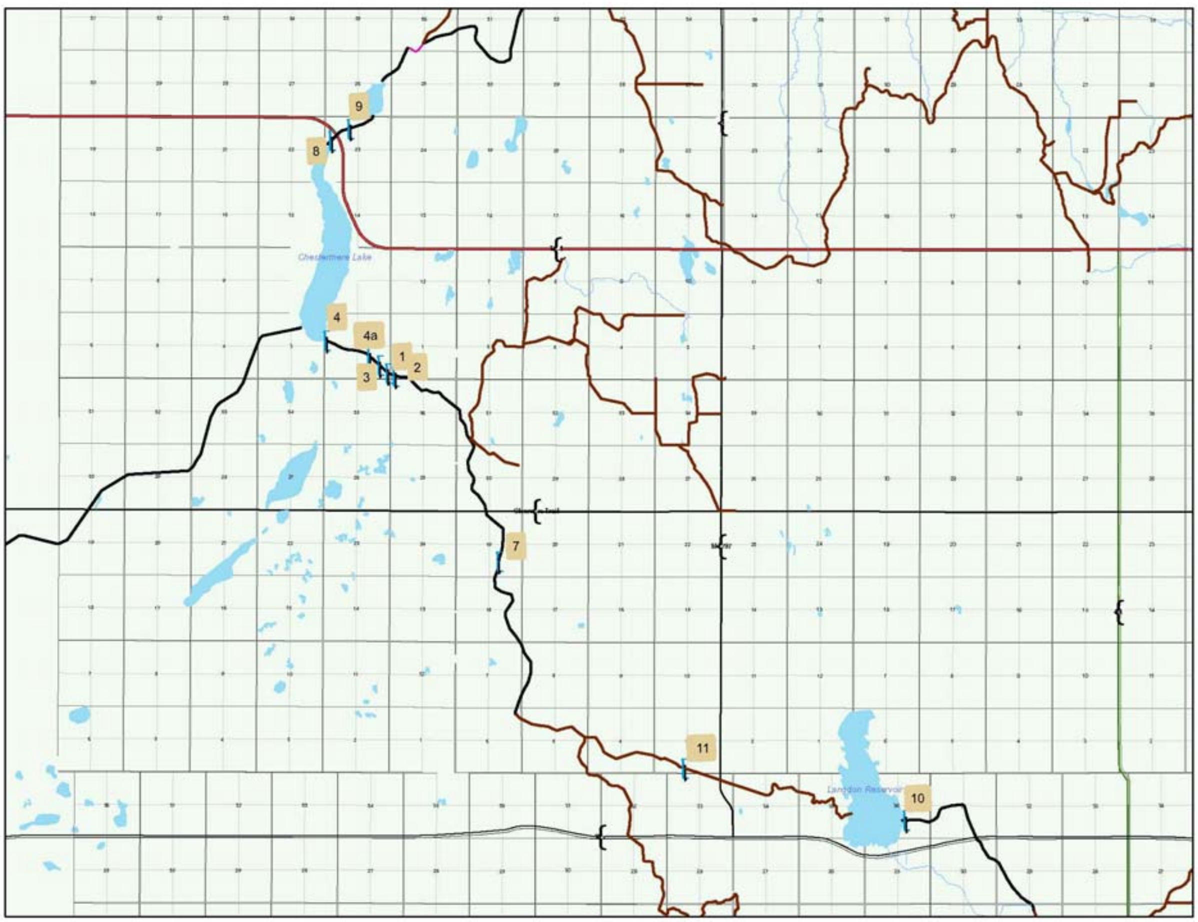

Figure 1: Locations of Sites sampled by *Aqua*lity on October 2 and 3, 2006 along the dewatered WID canal.

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Figure 2: Western Irrigation District staff (Wes Sproule) live-releasing fish into Chestermere Lake after capture and measurement.

Figure 3: Western Irrigation District staff (Dwight Gittel, left and Wes Sproule) measuring captured fish prior to live-release into Chestermere Lake.

3.2 Detailed Site Descriptions

Site 1: Site 1, a long-term monitoring site, is located under the railway crossing bridge at SE-2-24-28-W4 (Figure 1). Seine samplings at this site were limited to upstream of the deepest waters, where nets were effective and could touch bottom. The large, deep pool under the railway tracks, however, was inaccessible to seine netting. Gill nets were therefore used under the railway crossing bridge, and fish were removed from the nets immediately to minimize fish mortality. To maximize recovery efforts, one large mesh gill net was left in place overnight.

Site 2: Site 2 is located at SE-2-24-28-W4 (Figure 1). Seine sampling was attempted downstream of Site 1, in a 40 m-long haul of the canal.

Site 3: Site 3 is located at SE-2-24-28-W4 (Figure 1). Seine sampling was attempted upstream of Site 1, in a 40 m-long haul of the canal.

Site 4: Site 4 is located within NW-2-24-28-W4 (Figure 1). In January 2005, Canal A headgates were replaced with automated gates. A small, shallow, isolated pool located downstream from the headgates was seined repeatedly.

Site 4a: Site 4a is located within SE-2-24-28-W4 (Figure 1) and was a new site in 2005. A measuring flume in canal A located between Site 1 and Site 4 was constructed in the winter of 2004-2005. The upstream side of the flume (approximately 50m) was seined on both October 2 and October 3. Heavy weed growth made it difficult for the seine to reach the bottom of the canal. A gate located on the new flume allows upstream water to pass through the flume during dewatering of the canal.

Site 7: Samplings were taken 6 km downstream of canal A headgates at drop structure 1, 1 km south of Glenmore Trail. The pool was not isolated and the water depth was 1-1.5 m throughout. This location is SE-19-23-27-W4 (Figure 1).

Site 8: Site 8 is located in NW-23-24-28-W4 (Figure 1). Samplings were taken immediately downstream of canal B headgates before the canal is piped under Highway 1. The deepest pool was found below a large culvert draining into the canal on the south side. The pool was not isolated, and the water depth was 1-2 m throughout. Large rocks on the canal bottom may have prevented thoroughly sampling of this site.

Site 9: This site is situated in NW 23-24-28-W4 and was a new sites in 2005 (Figure 1). It is located on the east side of the TransCanada Highway as water exits the culvert which separates sites 8 and 9. The water depth was 1-2 m with large angular rocks lining the bottom of the canal. The sampling site was not an isolated pond but rather a continuous water body that connected to McElroy Slough. A variable mesh size gill net was use to sample the pool created by water exiting the culverts. Staff entered the canal downstream of the sampling site and walked towards the gill net in an attempt to herd fish into it.

Site 10: This site was new in 2006 and is located in SE 36-22-27-W4 on the east side of Langdon or #2 Reservoir at the outfall (Figure 1).

Site 11: This site was a new site in 2006 and is located at SW 3-23-27-W4 at the Canal A Power Drop #2 (Figure 1). It is situated west of Hwy 791 in Canal A which crosses Hwy 791.

4.0 Results

4.1 Results Summary

Ten sites along canal A and B were inspected downstream of Chestermere Lake on October 2 and 3, 2006, consisting of nine holding locations (pools) and one continuous conduit to a slough (Figure 1). Sites were visited by Jay White, Brian Sander, Wes Sproule and Dwight Gittel. The ten sites sampled in 2006 included two new sites and eight sites that were sampled in previous years. The new sites included one located at the Langdon or #2 Reservoir outfall (SE 36-22-27-W4) and another at the Power Drop structure #2 in Canal A (SW 3-23-27-W4). Sampling at pre-existing sites involved the same methodology as in previous years.

A results summary of fish numbers collected appears in Table 1. Fish were collected from six of the ten sites visited. Four sites immediately downstream of Chestermere Lake (Sites 1, 4, 4a and 8) contained the majority of fish found on Canals A and B. The number of fish collected decreased by threefold in 2006 from 2005 and species diversity has continued to decline from previous years. Conversely, fish sizes (fork length) increased in 2006 to an average size of 34cm in comparison to 2005, when the average fish fork length was 25cm.

When comparing two sites with fish in both years (Sites 1 and 8), there were 49% percent fewer fish collected in 2006 than in 2005 (Figure 5). Spottail Shiners, Spoonhead Sculpin and Burbot were not collected this year, although these species have been present in previous years. There was a notable lack of the freshwater shrimp *Gammarus* present, considering the high abundances noted in previous years.

Table 1: Numbers of fish seined by *Aqua*lity on October 2 and 3, 2006 along eight dewatered WID canal headwater sites.

Site #	Northern Pike	Lake Whitefish	White Sucker	Rainbow Trout	Brown Trout	Yellow Perch
1	3	8	1	0	0	1
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	2	8	0	0	2	0
4a	12	4	2	0	0	6
7	2	0	0	0	0	0
8	10	0	0	1	0	0
9	4	0	2	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0

4.2 Summary of fish collections

Six sites along the upper headwaters of the Western Irrigation District canal system downstream of Chestermere Lake were inhabited by fish. Fish species collected (in order of abundance) were: Northern Pike (*Esox lucius*); Lake Whitefish (*Coregonus clupeaformis*); Yellow Perch (*Perca flavescens*); White Sucker (*Catostomus commersoni*); Brown Trout (*Salmo trutta*); and Rainbow Trout (*Oncorhynchus mykiss*). Burbot *(Lota lota*); Spoonhead Sculpin (*Cottus ricei*); and Spottail Shiners (*Notropis hudsonius*) were absent in the 2006 survey. There were 49% fewer fish collected in 2006 when compared to 2005, however, the average fish size was larger. Most fish collected were in good condition, and had no obvious lesions or ectoparasites. Site 4a yielded the highest abundance of fish.

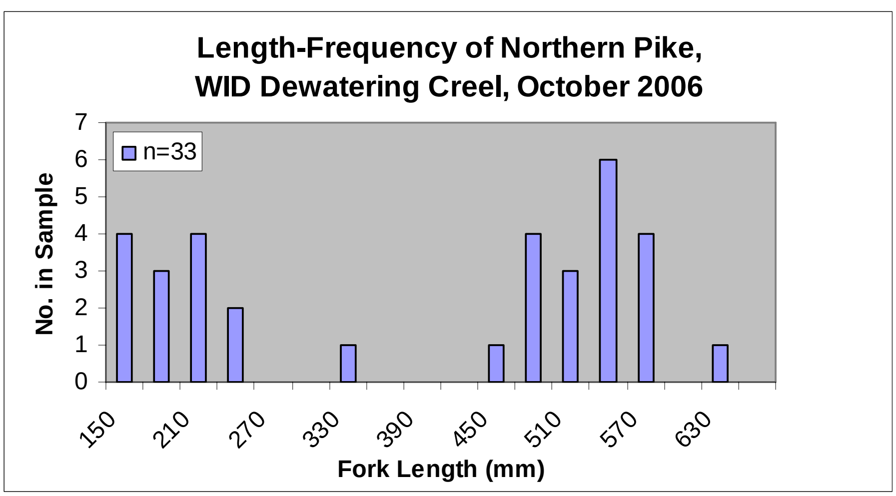
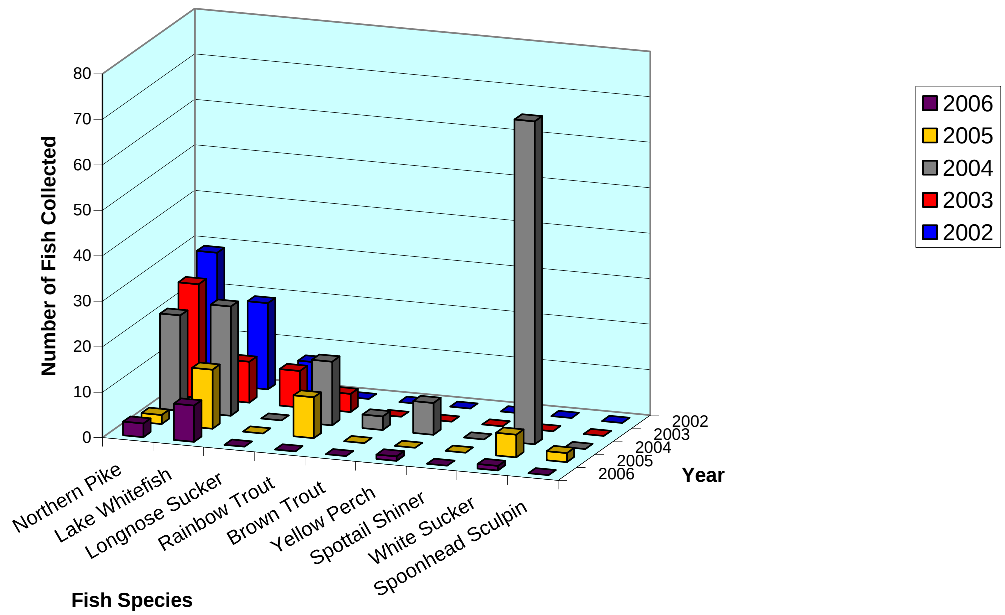


Figure 4: Length-Frequency Histogram of Northern Pike captured in 2006 at all sites.

Site 1 Comparison of Species Collected 2002-2006



Site 8 Comparison of Species Collected 2002-2006

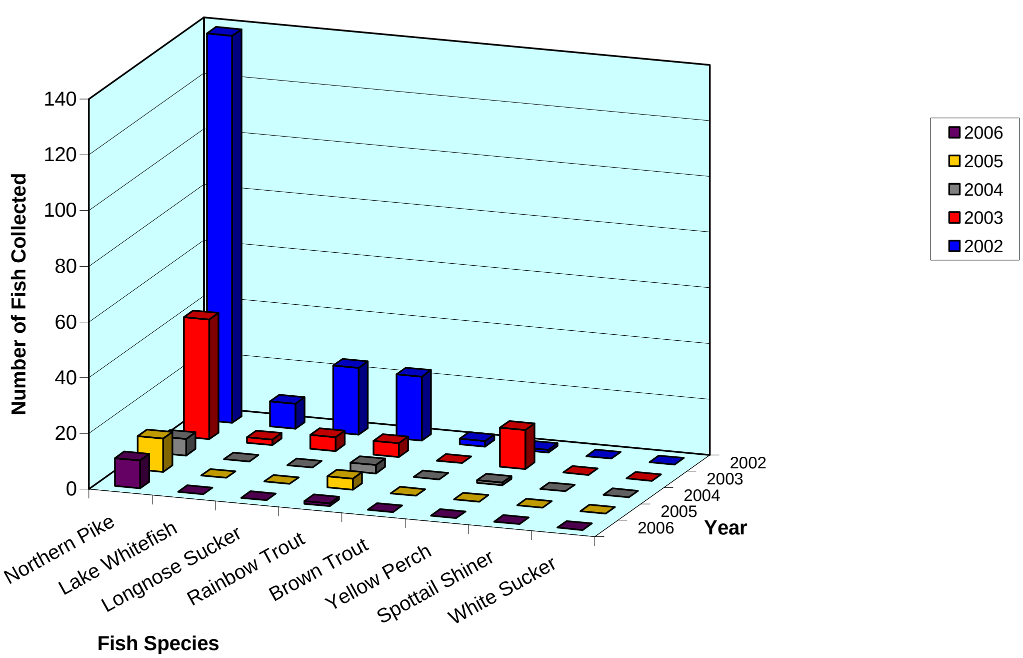


Figure 5: Numbers and species of fish collected annually at Site 1 (top) and Site 8 (bottom).

Length-frequency histograms of Northern Pike and Lake Whitefish appear to show bimodal size-class population distribution, although sample sizes are relatively small (Figures 4 and 6). There appears to be a normally distributed juvenile population of Northern Pike (i.e. fish < 340 mm) as well as a distinct normally distributed mature population (i.e. fish > 450 mm). Further study of the fish populations within the canal and their age-class distribution is required to gain a better understanding of how old or large fish are when they enter the canal and how long they remain entrained within the canal system.

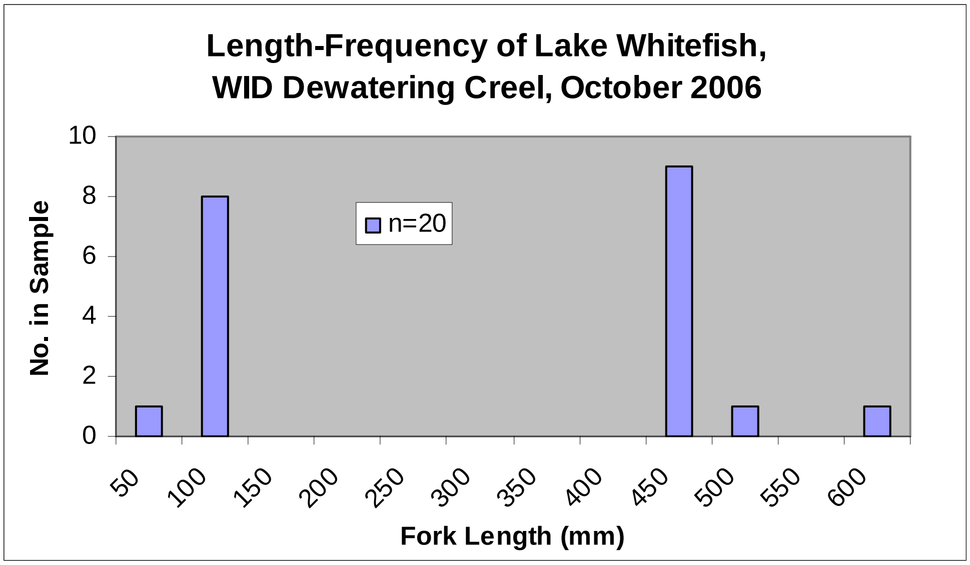


Figure 6: Length-Frequency Histogram of Lake Whitefish captured in 2006 at all sites.

5.0 Conclusions and Recommendations

5.1 Significance of findings

Assuming that all of the fish collected in this survey would die throughout the winter months if left in the canal, it is likely that the species and proportions of fish collected in this survey represent the species and proportions of fish removed from the system yearly (i.e. mostly White Sucker, Northern Pike, Lake Whitefish and to a much lesser extent Rainbow Trout, Brown Trout Yellow Perch, Spoonhead Sculpin and Burbot). Five years of data collection is beginning to reveal that distribution of the fish is highly variable from site to site and from year to year. The species of fish collected remains reasonably consistent, although three species that have been present in previous years, were not found this year. Expanding the program to include additional sampling sites further downstream in the canal system would test the assumption that fish distribution and species composition is similar throughout the system. Overall numbers of fish collected in 2006 declined at all sites which had fish in both years, with the exception of Site 9, where one more fish was collected in 2006 than in 2005.

Repeated seine samplings of isolated pools < 1m deep were quite effective in removing fish, however deeper sites were less effectively sampled. It is quite possible that the majority of fish that are stranded in the WID canals are in the deeper pools that were the most difficult to sample. If this is true, then the number of fish trapped in deeper pools may be underestimated. Some of the deep pools may provide for winter survival for some species, and so we cannot confirm that all fish trapped in these pools are lost to incidental take (i.e.death or injury). Salvage licences from Sustainable Resource Development allow fish harvesting on some canal waters, which provides the local community with fish for a food source. Although the irrigation system lands are on private property, the sites are remote and the public are not bound to inform the WID of their fish salvaging activities.

To properly determine how many fish may be trapped in WID canals, future studies should identify how many deep pools exist in canals A, B, and C, and should quantify how many fish there are on average within each pool (by performing mark-recapture studies within these pools). With this information, the number of fish stranded in deep pools of the WID system could be more accurately quantified. Backpack electroshocking and boat electroshocking could be considered for future sampling undertakings. The estimated total number of fish trapped along the entire canal network could then be compared to the source populations. To assess whether or not the loss of fish would have a significant impact on the population, each species will have to be addressed individually.

The Northern Pike collected in this study are likely to have originated from Chestermere Lake, which has an established pike fishery (Council 2001). This may explain why we see large numbers of small pike downstream of the lake. As well, due to the multiple age-classes of pike in Chestermere Lake (Council 2001), we can assume that pike safely overwinter there. Because pike find shallow water to be suitable habitat, they will tend to remain in the canals as they are dewatered. Therefore, this species will likely be the most abundant following canal dewatering, and potentially be the species most adversely affected. By not including a measure of the abundance of these fish throughout the canal system, we are likely to underestimate pike stranding. In this case, the underestimate is potentially very high because there are very long stretches of shallow water. Although pike were not caught at every site in this study, there existed suitable habitat for pike at every site visited.

The trout species collected in this study are likely to have originated from the Bow River, entering the canal at the WID headworks diversion. The Bow River contains a managed trout

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fishery, with different regulations for eight different sections of the River (Alberta Sustainable Resource Development 2006). There are specific regulations for catch limits specified for all trout species. The loss of the small number of fish identified in this survey are likely negligible when compared to the larger Bow River fishery. As well, the impacted fish populations were limited to a few localized deep pockets downstream of Chestermere Lake. The age of the trout observed (most were mature fish, 2 to 3 years of age) also raises the question of long-term trout survival within the system. We cannot assume that all fish collected in our study were not in the canal system last year. The apparent lack of smaller, younger trout may be attributed to the abundance of pike preying on these fish throughout the canal system. The presence of young Yellow Perch suggests the conditions in Chestermere Lake are favorable for Perch recruitment.

5.2 Remediation options

There are several remediation options for the loss of fish in dewatered canals, if it is shown that the loss of these fish causes an adverse effect on fish populations. Remediation measures for Northern Pike will be much more difficult than for any other species, because they were found spread throughout the canal system. Coldwater trout species however, were found concentrated in more predictable locations (i.e. the deepest pools). Further, the source of the fish in the canal system is most likely from both outside the canal system (trout from the Bow River) and from within the system (Northern Pike and White Suckers from the reservoirs along the Canal).
The suggested solutions to minimize fish entrapment in the WID canal system are as follows:

(i) exclude fish from entering into the canal works, though a major Provincial investment may not be warranted based upon the apparent fish loss,
(ii) coordinate operation of internal WID infrastructure to minimize fish stranding,
(iii) eliminate deep pool habitat within the canal system that fish find favourable if the structural requirements allow,
(iv) rescue fish from concentrated, predictable locations for re-release back into the Bow River following fall dewatering if the fish can stand the stress of handling,
(v) provide a flushing process to herd the fish into deeper water bodies, or
(vi) continue to monitor and report on the status quo.

Fish exclusion structures would utilize physical or behavioral methods, as well as a combination of the two. While the most logical place for a fish exclusion structure is at the WID diversion structure at the Bow River, having exclusion screens at the outflows from Chestermere Lake may also be effective at keeping coldwater (trout) species out of the rest of the system. These screens may not be effective for young cool water (pike, perch and sucker) species, however. Directing entrained fish or fish that have been impeded by future screens to a return pipe (bypass) could convey the fish directly back to the Bow River.

At Site 4a, a gate located on the new flume allows upstream water to pass through the flume during dewatering of the canal. Operation of this gate needs to be timed so fish do not become trapped between the two structures (headgate & measuring flume) during dewatering. Water levels on the downstream side of the flume also need to be of sufficient depth to prevent fish from becoming stranded.

If deep pool habitats are eliminated below drop structures, it may encourage fish to move to safer deep waters during fall dewatering (i.e. within Chestermere Lake or Langdon Reservoir). Deeper pools could be filled in with rocks to decrease their depths and make them less favourable to fish. However, this cannot be considered at sites where the pool depth is an integral part of energy dissipation. Further, this may need to be reconsidered if it is shown that fish are overwintering in some of the deepest pools. If the majority of fish trapped in dewatered canals can be identified as originating from a few, predictable pools, then a local fish rescue operation may mitigate some fish losses. How such an arrangement would work on WID private lands, for an operation that is outside of its irrigation mandate, would require further discussion with interested partners.

Chemical astringents used for fish “herding” may be released into the canal head works at the start of the dewatering phase to move the fish downstream to deeper water bodies. This would work well for Site 8, as the McElroy slough is immediately downstream. This may also be an effective method to move fish from deeper pools to shallower locations downstream where they would be more easily captured.

Other possible methods of fish exclusion include electrical fish barriers and guidance systems. Submersed electrodes installed at the WID diversion weir could represent an impassible barricade for fish especially if the field pattern is such that the electric field lines run parallel to water flow. Guidance tools such as underwater flashing strobe lights can also deter some species and alter fish passage rates. Intense illumination has been shown to be a deterrent for both lake whitefish and rainbow trout, two species found to be entrained within the WID canal. A combination of these methods such as the use of strobe lights timed in unison with electric pulses could increase the effectiveness of these fish exclusion devices.

Continuing to monitor and report on the status quo is also an option. The number of fish captured in this study and assumed to be lost would not indicate a major problem. Accepting some amount of operational loss has been the practice for the last 90 years. However, the WID intends to continue monitoring fish populations within the canals and to observe year to year variance. The

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findings from this report and the previous four reports will provide a basis to measure future change and make management decisions.

6.0 References Cited

Alberta Sustainable Resource Development. 2006. Alberta Guide to Sportfishing Regulations. Alberta Sustainable Resource Development, Edmonton. 54 p.

Council, T.C. 2001. Investigations into Northern Pike (*Esox lucius*) status in prairie region reservoirs, Alberta. Alberta Conservation Association, Lethbridge, Alberta. 142 p.

McLennan, J. 1998. Blue Ribbon Bow. Johnson Gorman Publishers, Red Deer Alberta. 184 p.

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