# Bow Basin Watershed Management Plan

# Phase One: Water Quality

**Final Version 1.0 September 10, 2008**

**Prepared by the Bow Basin Watershed Management Plan Steering Committee**

**Bow Basin Watershed Management Plan:**
**Phase One – Water Quality**

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## COMMENTS FROM THE BOW RIVER BASIN COUNCIL

The success of the Province of Alberta's Water for Life strategy depends upon collaborative partnerships to develop a new vision of sustainable watersheds. In delivering these Water Quality Objectives, our Steering and Technical Committees have achieved an unprecedented breakthrough in shared-governance and shared-vision for our precious lifeline.

Albertans are the protectors of source waters to the Mackenzie Delta, Hudson's Bay and Gulf of Mexico. Millions of downstream neighbours and countless ecosystems rely, in part, on our vision and our commitment to collective interest. While we have always strived to do well, this Plan now articulates our desire to do even better.

Our team members overcame many barriers. The complexity of issues, depth of commitment and diversity of opinions can make it difficult to strike a balance between ecological integrity, economic prosperity and security of supply. While much of the document is gleaned from standards and objectives from around the world, innovative approaches and original concepts were developed to address the breadth of qualities that constitute a healthy river system. The team's scientific rigor, combined with originality of thought, has created a world-class product from one of the most talented group of volunteers ever assembled.

For more than two years, stakeholders from across our watershed have worked tirelessly to develop a collaborative and community-led vision for our river. Their goal has been simple: to create a legacy for many generations to come, who will benefit from our focus on the future. All they ask for in return is your help in achieving our vision to be the best-managed watershed in the world.

We encourage you to join us as we now work to turn our objectives into reality.

**Bill Berzins**
**Chairman of the Bow River Basin Council**

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The Provincial Government developed the Water for Life Strategy, accompanied by the Framework. This called for a partnership. We have delivered!

The members of the Steering Committee (SC) have donated two years of their time to this important task: to protect the water quality of this watershed. They each represent segments of users and/or decision-makers in the Bow River basin and have regularly communicated with their segments in order to bring those views to the SC table.

The SC furthered its partnership efforts for the Province by striking a Joint Technical Committee. This team of experts donated thousands of hours to collate existing

scientific information in order to set the recommendations for water quality, not only for the Bow River mainstem, but also for the Elbow River and Nose Creek sub-basins.

I thank each and every one of those volunteers who made this Watershed Management Plan possible. I believe they must have been inspired by the following quote:

> *"If you want to move people, it has to be toward a vision that gets them something they desire. It has to be presented in a compelling way that they feel inspired to follow"* (Martin Luther King).

**Gloria Wilkinson**
**Bow Basin Watershed Management Plan Steering Committee Chair**

# ACKNOWLEDGEMENTS

The Bow River Basin Council would like to acknowledge members of the Steering Committee and the Technical Committee for their significant contribution in the development of the Bow Basin Watershed Management Plan.

| Steering Committee | Technical Committee |
|---|---|
| Gloria Wilkinson (Chair) – Elbow River Watershed Partnership<br>Gary Kindrat (Past Chair) – Ducks Unlimited/Calgary Airport Authority | Al Sosiak (B.Sc., M.Sc., P. Biol.) (Chair) – Senior Limnologist, Alberta Environment |
| Chris Vermeeren (Vice-Chair) – downstream municipalities | Sheena Majewski (Vice-Chair) – Fisheries and Oceans Canada |
| Bill Berzins – BRBC Chair | Cathy Ryan (PhD, P. Eng, P. Geol.) Associate Professor, Dept of Geoscience, University of Calgary |
| Hugh Pepper – M.D. Bighorn , upstream municipalities | Earl Wilson, P.Eng. General Manager of Eastern Irrigation District. |
| James Guthrie - Industry | Francine Forrest (M.Sc., P. Biol.) – Water quality specialist, Alberta Agriculture and Food (replaced former member Joanne Little) |
| John Groeneveld – Alberta Wilderness Association | Gerald R. Ontkean (M.Sc., P.Ag.) - Soil and Water Specialist, Alberta Agriculture and Food |
| Lydia Hill – Observer for the Stoney Nakoda First Nation | Jamie Dixon (M.Sc., P.Biol.) - Watershed Biologist, City of Calgary Water Resources, Water Quality Services |
| Mark Bennett – Executive Director, BRBC | John Jagorinec (B.Sc., P.Chem.)- Senior Water Quality & Regulatory Analyst, City of Calgary, Water Resources, Strategic Services |
| Richard Phillips – irrigation districts | J.P. Bechtold (M.A.Sc., P.Biol.) – Senior Water Quality Specialist, Golder Associates Ltd. |
| Rick Blackwood - Sustainable Resource Development | Matthew Coombs (M.Sc.) - Environmental Indicators Specialist, Alberta Environment |
| Rob Wolfe and Francine Forrest - Alberta Environment | Richard Barss (MEDes, B.Sc. Geol.) - Land use planner, Municipal District of Rocky View |
| Roger Hohm – Alberta Agriculture and Rural Development (replacing former member Wally Chinn) | Sheena Majewski (M.Sc.) - Fish Habitat Biologist / Biologiste, Habitat du Poisson, Fish Habitat Management, Western Arctic Area |
| Sheena Majewski – Fisheries and Oceans Canada | Shelley Humphries (M.Sc.) - Aquatic Specialist, Lake Louise, Yoho and Kootenay Field Unit, Parks Canada |
| Shirley Pickering – Highwood Water Management Plan Public Advisory Committee (Chair) | Travis Ripley (M.Sc. , P. Biol.) - Fish and Wildlife Program Manager, Alberta Sustainable Resource Development, Southern Rockies Area, Fisheries, |
| Sheikh Javed Ahmed – M.D. Rocky View | Angus Chu - (alternate) University of Calgary |
| Shawn Quinn – Alberta Infrastructure and Transportation | Brian Hills - (alternate) Alberta Environment |
| Tracy Scott – Ducks Unlimited | Charlie Pacas - (alternate) Parks Canada |
| Yin Deong – City of Calgary (replacing former member Paul Fesko) | Dave Evans - (alternate) Fisheries and Oceans Canada |

Special thanks to the Bow River Basin Council Board of Directors (Bill Berzins, Gloria Wilkinson, Earl Wilson, Zennon Zalusky, Maureen Bell, Norm Carlson, Danielle Droitsch, Karen Natsukoshi, Richard Phillips, Dr. Cathy Ryan, Heather Sinton, Chris Vermeeren), Mark Bennett (BRBC Executive Director), Mike Murray (BRBC administration and workshop coordination), Barry Kobryn (BRBC Project Manager), Claudette Lacombe (publishing), Steve Meadows, Fay Westcott, Patsy Cross (for their initial participation with Technical Committee), Loretta Holloway, and Willis Fox (initial observers on the Technical Committee). Additional appreciation goes to Patricia Chambers, N. E. Glozier, L. Levesque, E. Wallace, K. Pippy (Environment Canada) and Dr. Hans Schreier (University of British Columbia) for their peer review of the technical document. Under the Water for Life Strategy, Alberta Environment was a true partner in ensuring that a project coordinator was assigned to the SC and in providing scientific expertise to the TC.

Many other individuals also participated through e-mail, collaboration meetings or open houses; your comments and suggestions are greatly appreciated.

# EXECUTIVE SUMMARY

In 2005 the Bow River Basin Council (BRBC) recognized the need to develop a watershed management plan to align resource decisions across sectors and jurisdictions. Based on an assessment of outcomes, planning priorities, and available resources, Phase One of the Bow Basin Watershed Management Plan (BBWMP) focuses on surface water quality. The Plan was developed using an environmental performance management system to achieve surface water quality outcomes with associated timelines for management actions, research, monitoring and evaluation. The Plan contains reach-specific water quality objectives, targets, warning levels, and baseline water quality data. This Plan serves as a decision support tool.

Under the direction of the BBWMP Steering Committee (SC), the BBWMP Technical Committee (TC) created reach-specific objectives for indicators in the Bow River mainstem and the Elbow River and Nose Creek sub-basins. These reach-specific water quality objectives were established with the goal of maintaining or improving current water quality conditions in all reaches, while considering their unique natural features and user needs. Common biological, physical and chemical indicators of water quality were selected by reviewing available guidelines or criteria relevant to the selected water quality indicators to protect the desired outcomes. Many factors were considered in deciding whether to modify or adopt the available guidelines and criteria and the rationale is described for each recommended objective. See the TC document (BRBC 2008) for more details on this technical approach.

Based on the objectives set, the TC created a list of recommendations for the SC, which are grouped as either: 1) performance indicators, to evaluate the progress of maintaining water quality through the management actions taken; or 2) management actions, work budgeted and delivered to achieve the desired water quality outcomes. The recommendations apply to the overall Bow River basin, with additional recommendations made to specific reaches within the Bow River mainstem and the Elbow River and Nose Creek sub-basins.

Each recommendation suggests a logical decision-maker for the action recommended. All the recommendations in the plan are important; however, the short- term recommendations that received the highest priority by the TC, based on available science, were as follows:

- Monitor and report wastewater loadings from all licensed municipal and industrial sources throughout the Bow River basin (and the various sub-basins).
- Strive to use the best available municipal wastewater and stormwater treatment technologies (and other methods to achieve similar means).
- Uphold the principle of minimizing the quantity and/or toxicity of active ingredients when municipalities apply pesticides and herbicides on the lands they manage.
- Adopt riparian setbacks for municipalities.

- Educate municipalities and developers on the principles of low impact development and encourage developers to use these practices in their overall designs.

- Conduct further research on dissolved oxygen to determine:

  - The cause of low nocturnal dissolved oxygen levels in the Bow River, downstream of Calgary, during the spring and summer.

  - The relative roles of nitrogen (N) and/or phosphorus (P) as the limiting nutrient for aquatic plant growth, which then contributes to low dissolved oxygen levels.

  - Additional monitoring, model refinement and research on total dissolved phosphorus (TDP) and dissolved oxygen (DO) in the Bow River Central to ensure that 15 ug/L TDP is sufficient to prevent DO from falling below 5 mg/L.

  - The level of spawning success in relation to interstitial oxygen levels.

- Coordinate a workshop to develop strategies for enhanced alignment of monitoring programs within the Bow River basin (including review of locations, standardization of methods and data, and enhanced provision of publicly-accessible real-time data).

- Continue to educate producers on manure application and setback distances with respect to water bodies as outlined by the *Agriculture Operations Practices Act*, and continue research into the effectiveness of different application techniques to reduce manure runoff into receiving water bodies.

- Implement significant stormwater quality upgrades / improvements within Calgary.

- Develop water conservation and efficiency targets for all municipalities and irrigation districts within the Bow River basin.

- Continue to conduct the water quality monitoring program for the representative stormwater outfalls in Calgary in support of the Total Loading Management Plan, including the verification and improvement of the total suspended solid (TSS) loading estimates. Expand the plan to estimate loadings from the pertinent storm outfalls in the Elbow Central reach.

- Carefully consider land use on the alluvial aquifer in the Elbow River sub-basin in the context of downstream river water uses with appropriate groundwater assessments done prior to any development. Groundwater assessments may lead to some additional monitoring.

The BBWMP is a living document. The BBWMP recommends updates are considered on a case-by-case basis by the BRBC Board of Directors. New phases of integrated watershed management planning will be considered by the BRBC at the 2008 board retreat.

## SIGNATORY PAGE

The Board of the Directors of the Bow River Basin Council approved this document on May 16, 2008.

The following is a list of organisations that agree to use this as a decision support tool to work with the Bow River Basin Council in developing their implementation strategies toward realizing the outcomes of the Bow Basin Watershed Management Plan, Phase One, June, 2008.

| Decision-makers | Date and Signature |
|---|---|
| **Alberta Environment**<br>❑ Jay Litke, Southern Region Regional Director | "Alberta Environment gives its support to the *BBWMP, Phase One: Water Quality*, and recognizes the Plan as a n example of a Watershed Management Plan as described in the Draft: A Framework for Watershed Management Planning Version 2: May 13, 2008.<br>Alberta Environment will use the Plan as a decision support tool. The Department is currently reviewing the recommendations under the Plan to AENV and will be discussing those recommendations with First Nations." (Sept 4, 2008) |
| **Alberta Sustainable Resource Development**<br>❑ Rick Blackwood, Area Manager, Southern Rockies Area | Please be advised that Alberta Sustainable Resource Development supports the Bow Basin Watershed Management Plan: Phase One: Water Quality and will use the plan as a decision support tool. (Sept. 10, 2008) |
| **Alberta Tourism, Parks and Recreation**<br>❑ Dave Nielsen, Regional Director, Kananaskis Country | Please be advised that Alberta Tourism Parks and Recreation supports the Bow Basin Watershed Management Plan: Phase One: Water Quality and will use the plan as a decision support tool. (Sept 4, 2008) |
| **Bow River Irrigation District**<br>❑ Richard Phillips, General Manager | Motion to indicate acceptance and support of the plan. (Passed by Board of Directors, May 26, 2008 as per e-mail from Richard Phillips, May 27, 2008.) |
| **Calgary Health Region**<br>❑ Norm Carlson, Manager, Environmental Health North, Calgary Health Region |  <br>(July 21, 2008) |
| **City of Airdrie**<br>❑ Linda Bruce, Mayor | "At its regular meeting of March 17, 2008, Council accepted in principle the recommendations as outlined in the Water Quality Objectives and Indicators Executive Summary regarding the Bow Basin Watershed Management Plan." (E-mail received from Tricia White on June 12, 2008.) |

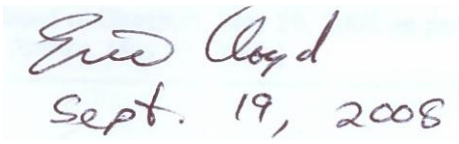
| Decision-makers | Date and Signature |
|---|---|
| **City of Brooks**<br>❑ Amanda D. Peterson, Executive Assistant | "I am pleased to advise that, on June 9th, 2008, during the Regular Council Meeting, the Motion that Council approve the Bow Basin Watershed Management Plan – Phase 1 Water Quality Report was carried." (Letter received by Mark Bennett dated June 13, 2008.) |
| **City of Calgary**<br>❑ Yin Deong, Senior Strategic Planning Engineer, Strategic Services, Water Resources | City Council accepted SPC on Utilities and Environment recommendations:<br>1. Approve the Bow Basin Watershed Management Plan (BBWMP) – Phase One (Attachment) as a guidance document and planning tool;<br>2. Direct Administration to collaborate with other stakeholders in the implementation of the BBWMP, taking into consideration the Triple Bottom Line Policy.<br>3. Direct Administration to work with the Plan It Calgary team to identify impacts of Watershed Management Plans (WMPs) on land use and mobility; and<br>4. Direct Administration to report back by December 2009 with an implementation plan addressing the impacts of WMPs on land use and mobility, and progress on the implementation of the BBWMP. (Sept 8, 2008) |
| **Country of Newell No. 4**<br>❑ Kevin Stephenson, Chief Administrative Officer | "MOVED BY COUNCILLOR R. ANDREWS that the County of Newell No. 4 support the Bow Basin Watershed Management Plan: Phase 1." (Motion carried by Council, May 22, 2008. E-mail from Ariana Clapton, June 05, 2008.) |
| **Eastern Irrigation District**<br>❑ Earl Wilson, General Manager | Mess 10:20 July 3. Gloria chatted with Earl and EID has approved the BBWMP. He will now send me an electronic signature. |
| **Environment Canada**<br>❑ Patricia Chambers (Ontario Office), N. Glozier, L. Levesque, E. Wallace, K. Pippy | The Technical Committee report (BRBC 2008) was peer-reviewed by Environment Canada. |
| **Improvement District #9 (Banff)**<br>❑ Rick Grimson, Improvement District Manager (Municipal Advisor, Alberta Municipal Affairs) | I.D. #9 Council does not need to be a signatory to the BBWMP, even though it supports the work, because they receive their water authorization through Parks Canada. (Received via e-mail from Rick Grimson on June 12, 2008.) |
| **Kananaskis Improvement District**<br>❑ Mike Benny, Administrator | "Move that KID accept the BBWMP as information and that wherever possible and within its mandate, Council support "in principle" and practice the goals, objectives and recommendations of the BBWMP." Moved by Ken Kelly, seconded Craig Reid – carried unanimously 080108 |

| Decision-makers | Date and Signature |
|---|---|
| **Municipal District of Bighorn**<br>❑ Martin Buckley, Chief Administrative Officer | "Moved by Councillor Hugh Pepper that Council express support for the Bow Basin Watershed Management Plan – Phase One Water Quality report (version 11.0, dated March 3, 2008) and that the Province provide adequate funding for the implementation of any or all of the recommendations of the report." (Carried unanimously by Council, May 13, 2008. Received via letter from Martin Buckley dated May 21, 2008.) |
| **Municipal District of Foothills**<br>❑ Harry Riva Cambrin, Chief Administrative Officer | "Further to a meeting held on June 19, 2008, Council passed the following resolution: "Moved by Councilor Spilak that Council accept and support the Bow Basin Watershed Management Plan- Phase One Water Quality report." " (July 3, 2008) |
| **Municipal District of Rocky View**<br>❑ Sheikh Ahmed, Watershed Management Specialist now employed at City, need a replacement | "That Infrastructures and Operations Committee of the MD's Council receive the BBWMP report for information and direct administration to conduct a review of the final document and bring recommendations back to the Council – with the view of being a member of the BRBC BBWMP implementation team." (May 20/08) |
| **Parks Canada, Banff Field Unit**<br>❑ Kevin Van Tighem, Superintendent | "I will sign off on this plan in my capacity." (Received via e-mail to Gloria Wilkinson on July 3, 2008.)<br>  |
| **Parks Canada, Lake Louise, Yoho and Kootenay Field Unit**<br>❑ Caroline Marion, Acting Superintendent |  |
| **Town of Banff**<br>❑ Evelyne Labelle, Manger of Engineering | 'Moved by Councillor Taylor to endorse the Bow River Basin Council's "Bow Basin Watershed Management Plan, Phase One: Water Quality." ' (Carried by Council, May 26, 2008. E-mail from Chad Townsend, May 29, 2008.) |
| **Town of Black Diamond**<br>❑ Rollie Magee, Mayor | "…that Council agree to recognize the efforts and the strategy of the Bow River Basin Council and accept its Bow Basin Watershed Management Plan Phase One…" (July 16, 2008) |
| **Town of Canmore**<br>❑ Lisa de Soto, Senior Manager, Public Works | "Moved by Mayor Casey that Council support the Bow Basin Watershed Management Plan, Phase One: Water Quality." (Carried unanimously by Council, May 20, 2008. E-mail for Lisa De Soto dated May 23, 2008.) |

| Decision-makers | Date and Signature |
|---|---|
| **Town of Chestermere**<br>❑ Terry Hurlbut, Chief Administrative Officer | "That Council provide a letter of support for the Bow Basin Watershed Management Plan Phase One: Water Quality draft version 16.0 dated May 15, 2008." (Motion made by Council, May 20, 2008. E-mail from Tracy Anderson for Terry Hurlbut, May 28, 2008.) |
| **Town of Cochrane**<br>❑ Truper McBride, Mayor | "On behalf of the Town of Cochrane, I am writing to express our ongoing support for the impressive work of the Bow River Basin Council (BRBC) on watershed management planning, specifically the *Bow Basin Watershed Management Plan, Phase One: Water Quality.*". (Letter received by Mark Bennett dated June 20, 2008.) |
| **Town of Crossfield**<br>❑ Cheryl Skelly, Chief Administrative Officer | "MOVED by Councillor Norma Lang that Administration forward a letter stating that Crossfield is participating under the Nose Creek Water Management Plan as well as working with the Calgary Regional Partnership and supporting the Provincial Land Use Framework." (CARRIED by Council, June 3, 2008. Received letter attached in e-mail from Meryl Jarvis, June 05, 2008.) |
| **Town of High River**<br>❑ Sharon Doll, Executive Secretary | RESOLUTION #282/2008<br><br>Councilor Moore moved that Council authorize the Mayor and Town Manager to sign approval of the Bow Basin Watershed Management Plan on behalf of the Town of High River.<br>Carried. (May 15, 2008) |
| **Town of Okotoks**<br>❑ Linda Turnbull, Municipal Secretary | "Moved by Councillor Robertson that the Bow River Basin Council be advised that Council supports the Bow Basin Watershed Management Plan – Phase One Water Quality report (version 19.0, dated June 12, 2008)" (August 11, 2008) |
| **Town of Strathmore**<br>❑ Lois Wegener, Councillor | "Moved by Councillor L. Wegener that Council supports the Bow Basin Watershed Management Plan and that the Mayor be authorized to sign the Plan on behalf of the Town." (October 8th, 2008) |
| **Town of Vauxhall**<br>❑ John Maine, Chief Administrative Officer | "Moved by Councillor Hagen to endorse the Bow River Basin Council's "Bow Basin Watershed Management Plan, Phase One: Water Quality" (July 21, 2008) |
| **TransAlta**<br>❑ Michael Kelly, Director, Water Resource Development |  |
| **Western Irrigation District**<br>❑ Jim Webber, General Manager | "The WID is pleased to endorse the BBWMP Phase 1…Please accept this letter as my endorsement for the signatory page." (Letter received by Mark Bennett dated July 8, 2008.) |

| Decision-makers | Date and Signature |
|---|---|
| **Wheatland County**<br>❑ Glenn Koester, Chairman Agricultural Services Board | The Wheatland County Agricultural Service Board has made a motion to agree in principle with phase one of the Bow Basin Watershed Management Plan." (October 6, 2008) |

The following organisations have voluntarily expressed support for this Plan.

| Supporting Agency/Organisation | Date and Signature |
|---|---|
| **Alberta Conservation Association**<br>❑ Peter K.M. Aku, Senior Scientist, Manager of Fisheries & Aquatic Programs | "The ACA supports the Bow Basin Watershed Management Plan in principle, and views it as a vital and living decision tool that would guide efforts at ensuring a healthy and sustainable river system." (E-mail from Peter Aku, May 28, 2008.) |
| **Alberta Low Impact Development Partnership**<br>❑ Liliana Bozic, P.Eng., Director and Vice-Chair | "The ALIDP supports the Bow Basin Watershed Management Plan as it raises awareness of the impacts of urban development on the watershed health and river water quality." (August 1, 2008) |
| **Alberta Wilderness Association**<br>❑ Carolyn Campbell, Conservation Specialist | "The Alberta Wilderness Association hereby gives its support to the *Bow Basin Watershed Management Plan, Phase One: Water Quality*." (Excerpt from letter from Carolyn Campbell dated May 27, 2008 attached to e-mail dated may 27, 2008.) |
| **Bow Riverkeeper**<br>❑ Danielle Droitsch, Executive Director<br>❑ Meghan Beveridge, Policy Associate | As a key stakeholder in the Bow River watershed, we commend Bow River Basin Council's success in stewarding the completion of the *Bow Basin Watershed Management Plan Phase One: Water Quality* (*BBWMP*). This is a comprehensive and progressive document that will contribute to the health of the Bow watershed. (March 26, 2008) |
| **Bragg Creek Environmental Coalition Foundation**<br>❑ Eric Lloyd, Chair |  |
| **Cows and Fish**<br>❑ Norine Ambrose, Program Manager Cows & Fish AB Riparian Habitat Management Society | "We support the concept of the Bow Basin Watershed Management Plan as a framework for taking regional action to improve the health of the watershed and encourage ongoing integration of evaluation and implementation results within the plan, as it evolves and progresses." (Aug 20, 2008) |

| Supporting Agency/Organisation | Date and Signature |
|---|---|
| **Department of Fisheries and Oceans**<br>❑ Richard Orr, Senior Habitat Biologist Calgary Office– Alberta District | "DFO is supportive of this planning initiative and congratulates the committee on achieving this milestone. We are pleased to have been involved in this process to date however, in view of our primary role as a regulator pursuant to the *Fisheries Act* and the *Species at Risk Act*, we are unable to provide formal approval for watershed management plans. We appreciate the opportunity for involvement in the process to date and hope to continue to be involved in future." (July 11, 2008) |
| **Elbow River Watershed Partnership**<br>❑ Gloria Wilkinson, Steering Committee Chair |  |

# ABBREVIATIONS AND GLOSSARY

| Term | Abbreviation | Description or Definition |
|---|---|---|
| Alluvial aquifer | | Subsurface geological unit along a river or stream that is hydraulically connected to the surface waterbody. This is an unconfined aquifer but not all unconfined aquifers are in alluvial deposits. |
| Alberta Agriculture and Rural Development | AA&RD | |
| Alberta Conservation Association | ACA | ACA conserves, protects and enhances fish, wildlife and habitat for all Albertan's to enjoy, value and use. |
| Alberta Environment | AENV | Alberta Environment's mission is to assure the effective stewardship of Alberta's environmental systems to sustain a high quality of life. |
| Alberta Low Impact Development Partnership | ALIDP | |
| Alberta Sustainable Resource Development | ASRD | ASRD encourages balanced and responsible use of Alberta's natural resources through the application of leading practices in management, science, and stewardship. |
| Alberta Transportation | AT | |
| Anthropogenic | | Modification to the environment by human activities. |
| Aquatic plants outcome | AQPT | Surface water quality where water withdrawal systems are protected from high levels of algal and macrophyte biomass. |
| Bow Basin Watershed Management Plan | BBWMP | In general, this will be the name of the integrated watershed management plan for the Bow River basin, being developed in phases by the BRBC. In this context, most references are to this first phase of the Plan. |
| Bow River Basin Council | BRBC | The Bow River Basin Council is a multi-stakeholder, charitable organization dedicated to conducting activities for the improvement and protection of the waters of the Bow River Basin. |
| BRBC Board of Directors | BoD | |
| Buffer | | A transitional area between two different land types or uses (e.g., a riparian buffer zone provides a transition between the river and the upland area). |
| Calgary Health Region | CHR | |
| Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment (CCME 1999) | CCME | A document that compiles surface water quality guidelines for use in Canada. |
| Cold-Water Ecosystem Outcome | CDWE | Surface water quality that maintains the existing cold-water aquatic ecosystem fauna structure and abundance (e.g., healthy trout populations and benthic invertebrates). Based on American Fisheries Society classification system. |

| Term | Abbreviation | Description or Definition |
|---|---|---|
| Cool-water ecosystem outcome | CLWE | Surface water quality that maintains the existing cool-water aquatic ecosystem fauna structure and abundance (e.g., healthy walleye populations and benthic invertebrates). Based on American Fisheries Society classification system. |
| Dissolved oxygen | DO | |
| Ducks Unlimited Canada | DUC | |
| Environment Canada | EC | |
| Green Area | | Forest lands in the province of Alberta not available for agricultural development other than grazing. Provincial public lands are managed for multiple uses including forest production, water, recreation, fish and wildlife, grazing and industrial development. |
| Irrigation outcome | IRR | Surface water quality that is appropriate for the irrigation of crops. |
| Livestock outcome | LIV | Surface water quality that is appropriate for livestock watering. |
| Mixing zone | | The regulatory mixing zone is rectangular in shape. It has a width equal to half the river width, and a length equal to 10 x the river width. The definition originates from Alberta Environment's Water Quality Effluent Procedures Manual (AENV 1995). |
| National Recommended Water Quality Criteria, United States Environmental Protection Agency (US EPA 1996) | US EPA | A document that compiles surface water quality criteria (equivalent to Canadian guidelines) for use in the United States. |
| Natural Resources Conservation Board | NRCB | |
| Nitrogen | N | |
| Nose Creek Watershed Partnership | NCWP | |
| Nuisance growth | | The biomass of native or non-native aquatic plant species that threatens the diversity or abundance of native aquatic species; commercial, agricultural, aquacultural or recreational activity; or the ecological stability of impacted waters. |
| Oligotrophic | | Waterbodies which are nutrient poor and contain little aquatic plant or animal life. |
| Parks Canada | PC | |
| Phosphorus | P | |
| Periphyton | | Refers to algal and other plant growth attached to rocks or other underwater surfaces. The amount of chlorophyll a in a rock scraping is commonly used as an indicator of periphyton growth |
| Provisional objective | | Objective used when there is not enough data or understanding of the data to set an objective. |
| Reach | | A relatively uniform section of a river or creek. |
| Recreation outcome | REC | Surface water quality where total body contact recreation is safe (e.g., high coliforms from storm events). |

| Term | Abbreviation | Description or Definition |
|---|---|---|
| Riparian areas | | The lands adjacent to streams, rivers, lakes and wetlands where the vegetation, soils and alluvial aquifers are strongly influenced by the presence of surface water. They are part of healthy, functioning landscapes and form part of the extensive drainage network within every watershed. |
| Severity of Effects Value | SEV | Index score provided by Newcombe and Jensen 1996 that relates suspended sediment to fish stress and habitat degradation. |
| Steering Committee | SC | Steering Committee for this phase of the Bow Basin Watershed Management Plan |
| Surface Water Quality outcome | HC | Maintain or enhance surface water quality (and linked alluvial aquifers) for human consumption. |
| Surface Water Quality Guidelines for Use in Alberta (AENV 1999) | SWQG | An AENV document that compiles surface water quality guidelines for use in Alberta. |
| Technical Committee | TC | Technical Committee for this phase of the Bow Basin Watershed Management Plan |
| Terms of Reference | ToR | Specifically referring to the Terms of Reference for Phase One of the BBWMP, unless otherwise noted |
| Threshold | | A value that is not to be exceeded. |
| Target | | A target is a numerically defined desired condition for a given indicator. |
| Total Dissolved Phosphorus | TDP | |
| Total Loading Management Plan | | The "Calgary Total Loading Management Plan" is a living process the City of Calgary will use to manage pollutant loadings from Calgary's wastewater and stormwater such that they will not have significant adverse impacts on the Bow River. To date, it has addressed loadings of phosphorus, TSS, CBOD, and nitrogen, with a focus on management actions for phosphorus and TSS. |
| Total Suspended Solids | TSS | |
| Trophic state | | The total weight of living biological material (biomass) in a waterbody at a specific location and time. Trophic state includes the biological response to forcing factors such as nutrient additions along with the modifying factors such as season, grazing, mixing depth, etc. The trophic state indices can use algal biomass as the basis for trophic state classification. Three variables, chlorophyll pigments, Secci depth and total phosphorus, independently estimate algal biomass (Carlson and Simpson 1996). |
| University of Alberta | U of A | |
| University of Calgary | U of C | |
| Water quality | | Water quality is the suitability of water for designated uses, based on scientific guidelines (e.g. to protect aquatic life, drinking water, irrigation use, industrial use, direct contact recreation, etc.). |

| Term | Abbreviation | Description or Definition |
|---|---|---|
| Warning Level | | A warning level acts as a planning trigger for certain management actions to occur. |
| Water Quality Guideline | WQG | |
| Water Quality Objectives | WQOs | Water quality objectives are minimum or maximum values adapted to protect the most sensitive designated water uses at a specific location with an adequate degree of safety, taking local circumstances and naturally occurring water quality fluctuations into account. |
| Wetlands | | Land having water at, near, or above the land surface or which is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained (hydric) soils, hydrophytic vegetation, and various kinds of biological activity that are adapted to the wet environment. Degraded wetlands may not show all of these characteristics, but remain important. |
| White Area | | The White Area is the region of Alberta settled initially, as well as the settled part of the Peace River Region, and comprises nearly 40% of the total area of Alberta. Available public lands in the White Area, suitable for the proposed use and not required for conservation, recreation uses, fish and wildlife habitat, etc., may be applied for pursuant to the Public Lands Act. |

## HOW TO USE THIS REPORT

Because there are many acronyms and technical terms in this report, it is recommended that the reader review the glossary prior to reading the document. Following is an explanation of how the Plan is organized, including a summary of the information that can be found in each chapter.

Section 1: Provides a description of the vision of the BBWMP, scope of this phase of the watershed management plan, background information, planning approach and the desired water quality outcomes.

Section 2: Briefly discusses the desired water quality outcomes and related water quality objectives.

Section 3: Includes recommendations on how to measure and achieve the desired water quality outcomes. These recommendations are summarized in a table which indicates proposed Decision-makers and associated timelines.

Section 4: Describes the engagement strategy used during the plan development and into the implementation.

Section 5: Provides recommendations to the BRBC for future work.

Appendix A: Includes a table of reach-specific water quality objectives for the identified Bow River mainstem reaches, Elbow Upper and Lower reaches and Nose Creek. These objectives will serve as performance indicators to work towards the reach-specific desired water quality outcomes.

Appendix B: Includes linkages with provincial, regional and Bow River basin initiatives.

Appendix C: Provides a list of legislation and policy involved in water and watershed management.

Appendix D: Includes a list of municipalities in the Bow River basin.

Appendix E: Includes a summary of engagement actions.

Appendix F: Contains the communication protocol developed for work with First Nations partners.

Additional technical information on the creation of the water quality objectives can be found in the supporting document: *Bow Basin Watershed Water Quality Objectives and Indicators* (BRBC 2008) as well as within the associated tables of historic water quality data, included in this document as Appendix A.

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# 1 INTRODUCTION

Managing and protecting water supplies, water quality, and aquatic and riparian ecosystems within watersheds is a complex task. Multi-jurisdictional land development decisions (federal, provincial, municipal, First Nations) covering a multiplicity of uses (e.g., agricultural, residential, recreational, and industrial) add to this complexity. Recognizing this complexity and the need for a management tool that would align resource decisions across sectors and jurisdictions, the Bow River Basin Council (BRBC) initiated the development of the Bow River Basin Watershed Management Plan (BRWMP) in 2005, in collaboration with partners and stakeholders.

The purpose of the BBWMP, Phase One, is to serve as a decision-support tool to decision makers. Successful implementation of the recommendations is a shared responsibility of the BRBC and levels of government, including First Nations.

Under the direction of the BRBC, the BBWMP Steering Committee (SC) developed the terms of reference and set up a BBWMP joint Technical Committee (TC) in March of 2006. The goal was to provide scientific and technical expertise that would lead to the development of reach-specific water quality objectives and indicators for the Bow River basin. The SC provided the overall direction for the plan and was comprised of members representing different constituencies. Throughout the plan development, the SC used a consensus based shared-governance approach. Linkages with other planning and policy initiatives were also considered throughout the process to ensure the plan was integrating with other initiatives (Appendix B).

## 1.1 Vision

The vision of the plan, adapted since the terms of reference, is to:

- Protect and enhance water quality in the watershed.
- Recommend changes that will affect education and awareness programs, public policy, practice and regulation.

Serve as a catalyst for proactive action by land, water and resource decision-makers.

## 1.2 Goals and Objectives

Based on the BRBC's assessment of desired outcomes and planning priorities, Phase One of the BBWMP focuses on surface water quality, including water connected through the alluvial aquifer. However, due to linkages between water quality and other ecosystem components, recommendations include management actions which can affect, improve or protect water quality, such as implementing stormwater upgrades or maintaining setback distances to reduce runoff.

The overall goals of the BBWMP are to:

- Meet the reach-specific water quality outcomes within the Bow River basin.
- Monitor and evaluate whether the associated indicators are reaching their objectives.
- Make some key recommendations to improve future management.

The specific objectives of the BBWMP were to:

- Create reach-specific water quality objectives (WQOs) and targets within the Bow River basin (Figure 2).
- Make recommendations on a) monitoring and evaluation and b) management actions required to achieve the desired water quality objectives. Recommendations identify timelines and decision-makers for their implementation in order to create accountability.

It is anticipated that the WQOs will be used in performance monitoring of future reporting and will be considered for decisions that have the potential to impact water quality. Decision-makers are required to report back annually to the BRBC on their implementation of the recommendations.

## 1.3 Sequence of Work

- Provincial initiative: Water for Life Strategy (November 2003)
- BRBC motion: to establish a SC to develop a watershed management plan under the Water for Life Framework (September 2005)
- Terms of Reference (ToR) written and approved in principal by BRBC Board of Directors (BoD) (January 2006), key decision-makers, including the Director of Alberta Environment (AENV) (February 2007)
- SC established TC to use collated science to set water quality indicators and objectives, and made recommendations on how to achieve the objectives (March 2006)
- Key technical components incorporated into a watershed management plan by SC (November 2007)
- Phase 1 BBWMP approved by BRBC BoD May 16, 2008, decision-makers (various dates), and the Director of AENV (September 3, 2008).

## 1.4 Authority

The watershed management plan has been led by the BRBC through a BBWMP steering committee using a shared-governance approach which has involved key partners within the watershed. Using this shared-governance process, the decision-makers will continue to work together toward implementing the plan and achieving the plan's outcomes and goals. Government agencies will also help enforce and implement the plan's goals through legislation and policy related to water and watershed management (Appendix C).

## 1.5 Description of Issues

The Bow River basin reflects the cumulative effects of a multitude of activities on its water quality and aquatic ecosystems. Over the years, a number of issues and concerns have been identified in the Bow River basin by public groups and government study teams. The 2005 State of the Bow River Basin report, Nurture*, Renew, Protect* (BRBC 2005) provides a comprehensive overview of the successes and challenges that the basin is facing.

Current activities and development in the watershed include, but are not limited to, the following competing demands:

- **Recreation:** camping, hiking, cross-country and alpine skiing, equestrian activities, mountain biking, off-highway vehicle use, fishing, canoeing, kayaking, and golfing
- **Industrial:** logging, oil and gas field development, snow-making for ski hills, hydroelectric generation
- **Agricultural:** ranching, dairy, grazing leases, forage crops, confined feedlot operations, irrigation diversions
- **Human:** drinking water, parks (natural environment, regional, community etc.), residential, commercial, institutional

These competing uses create a number of recognized issues:
Wetland and riparian areas have been lost to development. Wetland and riparian areas provide habitat for local wildlife, migratory birds and aquatic species. In addition to habitat, these areas also provide protection during floods, water storage to offset droughts, groundwater recharge, and improve water quality for receiving water bodies.

At certain times, there are insufficient flows to meet all the demands of the river, especially in the lower reaches of the Bow River, resulting in the degradation of aquatic and riparian habitat.

Climate change and glacial retreat add uncertainty to the quantity of flows. Since water quantity affects the dilution and the assimilative capacity of the river, impacts on water quality are also uncertain.

Several sub-basins within the Bow River basin are experiencing localized pressures and water quality is deteriorating. For example, water quality in the Elbow River has been deteriorating in recent years, and concentrations of dissolved phosphorous, turbidity, nitrites/nitrates, total suspended solids, and coliform bacteria have increased (AENV 2004). The Nose Creek watershed is experiencing water quality impacts from the cumulative effects of increasing residential and commercial development, transportation infrastructure, industrial growth, storm water discharge, agriculture activities and channelization occurring in the basin (NCWP 2006).

Crown lands (Green Area) in the headwaters of the Eastern Slopes, including the headwaters of the Bow River basin, are critically important as watershed recharge areas and contain significant riparian areas and fish habitat (AENV 1984). Risks to water quality and quantity from urban development in the headwaters (e.g., Lake Louise and Banff), recreational development (e.g., ski hills and golf courses), and the loss of forested areas in the headwaters need to be considered.

## 1.6 Geographic Area

Figure 1 illustrates the location of the defined reaches along with monitoring sites used to represent the cumulative natural and anthropogenic impacts within each reach.

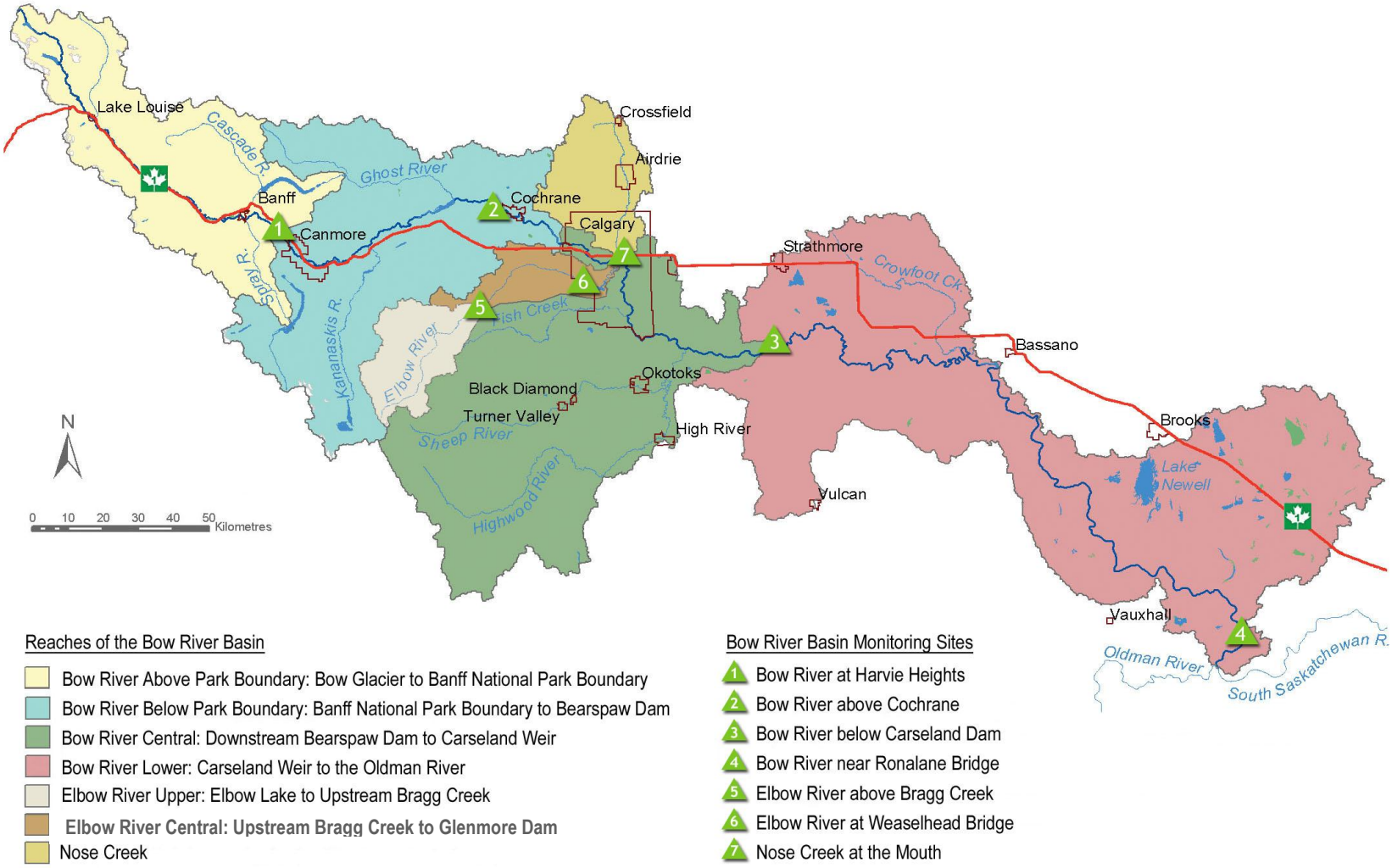


**Figure 1: Map of the Bow River Basin and Water Quality Monitoring Sites**

Note: Monitoring sites correspond only to those referenced in Appendix A, excerpted from the TC report.

## 1.7 Planning Approach

The BBWMP is guided by the existing provincial Framework for Water Management Planning (AENV 2000) and the Shared Governance Model and Watershed Management Planning Framework (AWC 2007). Watershed management planning advocates sustainable water management by addressing the challenges of integrated resource management at the watershed scale in pursuit of the Water for Life goals (AWC 2007). The BBWMP has used consensus-based decision making, outcome-based planning and adaptive management. The plan is based on a five-step environmental performance management system involving outcomes, indicators, targets, strategies for implementation, and associated timelines for management actions, monitoring, and evaluation (Figure 2). A collaborative effort is expected from all partners/decision-makers to implement and achieve the collective desired outcomes of the plan.

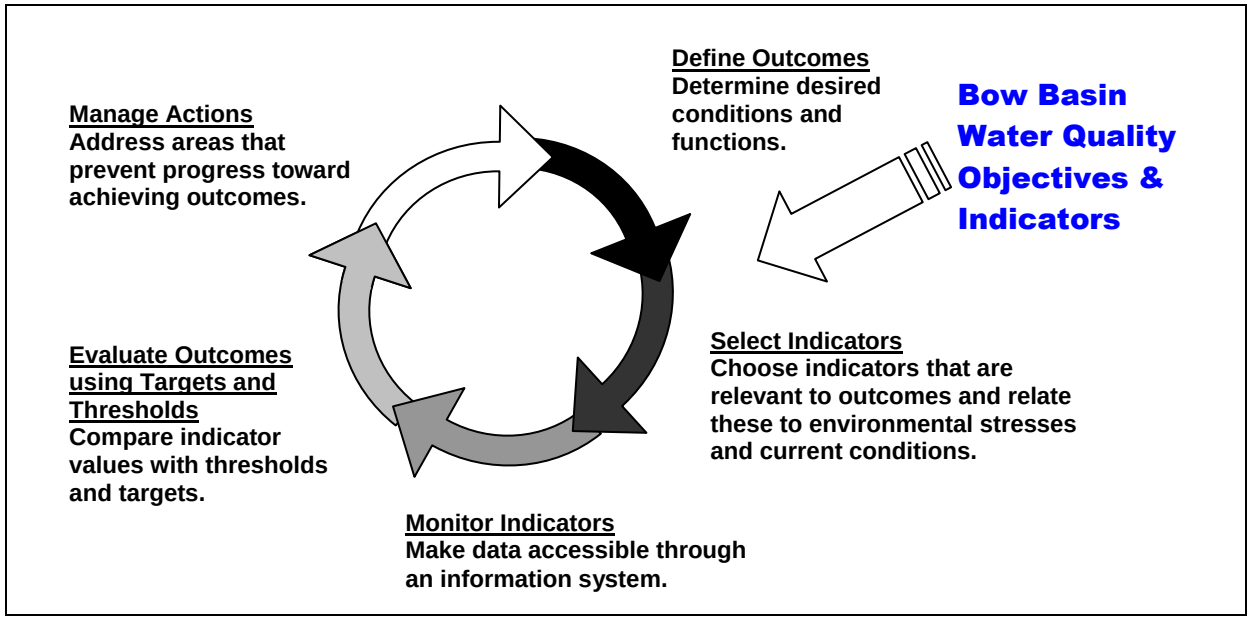


**Figure 2: Environmental Performance Management System Diagram**

## 1.8 Outcomes

For planning purposes, "outcomes" are the desired endpoints that should guide the development and implementation of the BBWMP's recommendations. The outcomes established by the BBWMP contribute to those outlined in the Province's Water for Life strategy, in addition to another seven desired outcomes of the Bow River Basin Council.

### 1.8.1 Provincial Scale – Water for Life Outcomes

- Safe, secure, drinking water supply
- Healthy aquatic ecosystems

- Reliable, quality water supplies for a sustainable economy

### 1.8.2 Bow Basin Desired Outcomes

- Surface water quality meets requirements of the aquatic ecosystem and human uses
- Riparian and wetlands systems are intact, restored, healthy and valued
- Rivers and streams are free of “nuisance” growth of aquatic vegetation
- Human influences are mitigated where these influences could negatively affect aquatic ecosystems
- Aquatic and riparian ecosystems are protected during all flow periods but particularly during critical high and low flow periods
- Source waters throughout the Bow River basin are protected for all uses
- The public understands and values the Bow River basin for its ecological, economic, cultural and spiritual values

### 1.8.3 Reach-Specific Desired Outcomes

It is recognized that each reach in the Bow River will have differing natural/existing conditions. Therefore the desired outcomes are also reach-specific to ensure that the objectives and targets are reasonably achievable.

The water quantity, quality and aquatic ecosystems of the Bow River experiences both natural and anthropogenic changes from its headwaters in the mountains to its confluence with the Oldman River in the grasslands. The Bow originates at Bow Glacier in the Rocky Mountains and flows for a length of about 625 km, passing through subalpine forests, aspen parklands, and mixed grassland natural regions. The variation in climate and vegetation leads to longitudinal zonation in the physical, chemical and biological characteristics of the river (Culp et al. 1992).

The Bow River basin is the most highly populated river basin in Alberta and supplies water to more than a million people. From its headwaters to its mouth, the Bow River also provides water for aquatic life, hydroelectric generation, irrigation, industry, agriculture, wastewater assimilation and recreational purposes. Hydroelectric facilities, water withdrawals, and irrigation diversions all contribute to alter the natural river flows. River flows, especially low summer flows in the lower reaches, greatly influence water quality, as do the eleven reservoirs which retain sediments and contaminants. The BRBC’s *State of the Bow River Basin – 2005 Report* (BRBC 2005) contains detailed descriptions of the physical and human geography and water issues of each of the major reaches of the Bow River.

Desired water quality outcomes were developed for four reaches within the Bow River mainstem[1] and two of its more important tributaries:

- Bow River above Park Boundary (Bow Glacier to above Canmore)
- Bow River below Park Boundary (Canmore to upstream of the Bearspaw Dam)
- Bow River Central (downstream of the Bearspaw Dam to upstream of the Carseland Weir)
- Bow River Lower (downstream of the Carseland Weir to the confluence with the Oldman River)
- Elbow River Upper (Elbow Lake to upstream of Bragg Creek)
- Elbow River Central (Bragg Creek to the Glenmore Dam)
- Nose Creek

The reaches which are the focus of this phase were selected as those with the most urgent water issues in the basin based on the collective experience of the Technical Committee. Specific attention was given to reaches within the City of Calgary and its immediate area because of the impacts that extend downstream. The section of the river below Bassano was also given specific attention. Additionally, desired water quality outcomes were created for the mainstem of the Elbow River, which was divided into two reaches, and for Nose Creek. The reach-specific desired outcomes were based on the Technical Committee's combined knowledge of the Bow River's natural zonation characteristics, along with the existing demands for human consumption, recreation, irrigation, livestock watering and healthy aquatic ecosystems.

The upper Bow River (above the Banff National Park boundary) and upper Elbow River (above Bragg Creek) are typically low in nutrients and classified as oligotrophic. These headwater reaches are associated with cold-water aquatic life that is more sensitive to poor water quality than the aquatic organisms found further downstream. The upper reaches also provide outstanding raw water quality for a majority of the basin's population. Overall the water quality is considered 'excellent' in the upper reaches of the Bow River (NSC 2007).

The Bow River Central reach provides water for irrigation (via the Western Irrigation District and Bow River Irrigation District) and dilution effects for contaminants from urban runoff, municipal discharges from Calgary and tributary inputs. Water quality is summarized as 'good' with occasional instances of dissolved oxygen levels dropping

[1] BBWMP reaches can be compared to the reaches within the 2005 Report on the State of the Bow Basin. BBWMP reaches labelled as "Bow River Above Park Boundary" includes Reaches 1 & 2 in the State of the Basin report, "Bow River Below Park Boundary" is identical to Reach 3 in the report, "Bow River Central" includes Reaches 4, 5, & 6, and "Bow River Lower" includes Reaches 7 & 8 in the State of the Basin report.

below provincial guidelines (NSC 2007). Just below Calgary, the Bow River supports a world-class sport fishery in a cold-water aquatic ecosystem.

### Table 1: Summary of Reach-Specific Desired Outcomes

| Reach-Specific Outcomes | River and Reach | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bow River Above Park Boundary – Bow Glacier to Above Canmore | Bow River Below Park Boundary – Canmore to Upstream Bearspaw Dam | Bow River Central – Downstream Bearspaw Dam to Carseland Weir | Bow River Lower – Carseland Weir to Oldman River | Elbow River Upper – Elbow Lake to Upstream Bragg Creek | Elbow River Central – Upstream Bragg Creek to Glenmore Dam | Nose Creek |
| Maintain or enhance surface water quality (and linked alluvial aquifers) for **human consumption** (HC) | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | |
| Surface water quality that is appropriate for **irrigation** of crops (IRR) | | ☑ | ☑ | ☑ | | ☑ | ☑ |
| Surface water quality that is appropriate for **livestock** watering (LIV) | | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ |
| Surface water quality where water withdrawal systems are protected from high levels of **algae and/or macrophytes** (AQPT) | | ☑ | ☑ | ☑ | | ☑ | ☑ |
| Surface water quality that maintains the existing **cold-water aquatic ecosystem** fauna and abundance (e.g., healthy trout populations and benthic invertebrates) (CDWE) | ☑ | ☑ | ☑ | | ☑ | ☑ | |
| Surface water quality that maintains the existing **cool-water aquatic ecosystem** fauna structure and abundance (e.g., healthy pike populations and benthic invertebrates) (CLWE) | | | | ☑ | | | ☑ |
| Surface water quality where body **contact recreation** is safe (REC) | ☑ | ☑ | ☑ | ☑ | ☑ | ☑ | |

Refer to the glossary for definitions of terms.

The reach of the Elbow River, below the Glenmore Dam, is a relatively short and highly urbanized reach with some unique characteristics. It may not be appropriate for the purposes of this planning exercise to treat it the same as the Bow River Central, with

the application of the same WQOs. Due to constraints on time and resources it didn't receive specific attention in this phase. At such time as Water Quality is reviewed in future phases, the Lower Elbow is certainly deserving of inclusion.

In the Lower Bow River reach, the river supplies water for the Eastern Irrigation District, raw water for production of potable water for municipalities, and supports a cool-water aquatic ecosystem. Water quality in this reach is also currently considered 'good' with few exceedances of provincial guidelines (NSC 2007).

## 1.9 Background on Water Quality Objectives

Water Quality Objectives (WQOs) are criteria developed to protect the most sensitive designated water uses at a specific location with an adequate degree of safety, taking local circumstances and naturally occurring water quality fluctuations into account. Within a given water body, each objective may be based on the protection of a different water use depending on the water uses that are most sensitive to the characteristics of concern in that water body (BC 2001).

WQOs currently have no legal standing, but can be recognized and used as a guide for regulatory authorities, and as a means of supporting and maintaining designated water uses. While WQOs acknowledge that healthy aquatic ecosystems can tolerate some stress and can recover, it is accepted policy that degradation of existing water quality in important water bodies should be avoided (Sask 2006).

- **Water Quality Guideline (WQG):** Numerical concentration limit or narrative statement recommended to support and maintain a designated water use. (CCME 1996). (e.g. Surface Water Guidelines for Use in Alberta (AEP1999).
- **Water Quality Objective (WQO):** Numerical concentration limit or narrative statement which has been established to support and protect a designated water use at a specific site (CCME 1996).
- WQOs are typically based on generic WQGs, which may be modified to account for local environmental conditions or other factors. In general, WQOs are prepared only for those water bodies and water quality variables that may be significantly affected by human activities, either now or in the future (CCME 1996).

WQOs are important tools which, when used in a framework of municipal, provincial and federal environmental assessment, support the management, protection and enhancement of the surface water resources of the province. Those charged with developing objectives (federal, provincial and territorial governments, plus water management agencies [such as the Prairie Provinces Water Board]) must decide what uses are to be protected, gather the necessary information, formulate the objectives, and present them for approval to the appropriate jurisdiction (Sask 2006).

In order for the WQOs to be meaningful in the longer term, they need to be based on a sound understanding of:

- Current conditions and anticipated future conditions for a given reach or tributary

- Broader issues as they relate to potential effects on watershed quality (e.g., impacts from changes to other ecosystem components such as water quantity and riparian areas)

Ongoing, routine revisions to the surface WQOs are necessary to incorporate new scientific findings and emerging approaches to enhance environmental protection.

Reach-specific WQOs were developed for several reaches of the Bow River, Elbow River and Nose Creek. These WQOs can be found in Appendix A, along with targets (i.e., interim values to strive for) and warning levels (i.e., planning triggers for certain management actions to occur). Associated timelines for implementing management actions, monitoring and evaluation were also created. Refer to the Technical Committee document (BRBC 2008) for information on objectives development.

It is expected that these WQOs will also be used as 1) performance indicators for future watershed reporting, and 2) be considered by decision-makers for decisions that have the potential to impact water quality within the Bow River basin. WQOs for Nose Creek will be considered by the Nose Creek Watershed Partnership[2] in their current and/or future planning initiatives. WQOs for the Elbow River mainstem will be considered as part of the *Elbow River Basin Water Management Plan*[3].

[2] The Nose Creek Watershed Partnership website is located at www.nosecreekpartnership.com.
[3] The Elbow River Watershed Partnership website is located at www.erwp.org

# 2 Water Quality Objectives and Indicators

The Technical Committee, based on their collective experience in the Bow River basin, selected seventeen physical, chemical and biological parameters as appropriate indicators of water quality. These indicators are important for assessing water quality for human consumption (HC), irrigation (IRR), and livestock watering (LIV), healthy aquatic ecosystems (AQPT, CDWE, CDWT), and recreational (REC) purposes (see Table 1). These indicators also link back to the reach desired outcomes, as described in Section 1.8.3. While other indicators were considered (e.g., benthic invertebrates), it was decided that further research was needed prior to setting reach-specific objectives or targets for these indicators.

The Technical Committee then set water quality objectives, targets and/or warning levels for the indicators as warranted achieving the goal of maintaining or improving current water quality conditions for each of the reaches. These were developed in conjunction with data on the existing conditions of each reach for the Bow River mainstem, Elbow River and Nose Creek and are summarised in Appendix A, excerpted for the Technical Committee document (BRBC 2008). Appendix A also provides an estimate of baseline water quality conditions for each reach, including median and percentile values and the associated sampling information. Numbers in the last column correspond to recommendations listed in Table 2. Refer to the Glossary for a definition of terms and acronyms and to the Technical Committee document (BRBC 2008) for a list of the existing water quality indicators and guidelines.

In an attempt to maintain or improve water quality in the downstream reaches, there are generally stricter water quality objectives in the headwater reaches relative to existing provincial and federal guidelines. These requirements in the headwaters were set because of (a) the limited assimilative capacity of the river, (b) the greater contributing nutrient loading downstream and, (c) cumulative effects. The Upper Elbow River and Upper Bow River are relatively pristine headwater reaches. These reaches are associated with cold-water aquatic life, which are more sensitive to poor water quality than the aquatic life found further downstream. As major sources of drinking water to all downstream users, the headwaters of the Elbow River and Bow River are considered areas of high importance from both a water quality and quantity perspective and need to be managed accordingly. For the above reasons, this plan recommends that all agencies involved in the management of the Upper Elbow River and Bow River above the National Park Boundary ensure that there is no long-term, anthropogenic degradation of water quality in these reaches.

# 3 Recommendations

The SC has accepted the following recommendations from the Bow Basin Watershed Water Quality Objectives and Indicators Technical Committee document (2008) with some minor modifications to timelines based on decision-maker input (Table 2).

Recommendations are grouped by themes:

- Theme 1: performance indicators, necessary to evaluate the success of the water quality outcomes, have been established for both
  - Theme 1A: water quality, and
  - Theme 1B: aquatic ecosystem health.
- Theme 2: management actions to support the reach-specific WQOs and associated water quality outcomes, including:
  - Theme 2A: those for water quantity,
  - Theme 2B: stormwater and wastewater loading,
  - Theme 2C: pesticide use,
  - Theme 2D: land use planning,
  - Theme 2E: source water protection, and
  - Theme 2F: riparian and wetland characterization and protection.

Recommendations are then categorized by the type of activity needed in order for the outcomes to be successful:

- research,
- education,
- planning,
- monitoring and evaluation,
- indicator/objective or target development,
- practice change,
- modelling, and
- reporting.

The recommendations have been applied to: the overall Bow River basin or to specific reaches within the Bow River mainstem, or Nose Creek or Elbow River sub-basins.

Proposed timelines and decision-makers have been assigned to each of the recommendations. An annual progress report to the BRBC is recommended to track progress and maintain accountability.

The short- term recommendations that were identified by the TC as being of highest priority based on available science were as follows:

- Monitor and report wastewater loadings from all licensed municipal and industrial sources throughout the Bow River basin (and the various sub-basins). (See #28 in Table 2)

- Strive to use the best available municipal wastewater and stormwater treatment technologies (and other methods to achieve similar means). (See #29)

- Uphold the principle of minimizing the quantity and/or toxicity of active ingredients when municipalities apply pesticides and herbicides on the lands they manage. (See #41)

- Adopt riparian setbacks for municipalities. (See #49)

- Educate municipalities and developers on the principles of low impact development and encourage developers to use these practices in their overall designs. (See #45)

- Conduct further research on dissolved oxygen to determine (See #7):

    - The cause of low nocturnal dissolved oxygen levels in the Bow River downstream of Calgary during the spring and summer.

    - The relative roles of nitrogen (N) and/or phosphorus (P) as the limiting nutrient for aquatic plant growth, which then contributes to low dissolved oxygen levels.

    - Additional monitoring, model refinement and research on total dissolved phosphorus (TDP) and dissolved oxygen (DO) in the Bow River Central to ensure that 15 ug/L TDP is sufficient to prevent DO from falling below 5 mg/L.

    - The level of spawning success in relation to interstitial oxygen levels.

- Coordinate a workshop to develop strategies for enhanced alignment of monitoring programs within the Bow River basin (including review of locations, standardization of methods and data, and enhanced provision of publicly-accessible real-time data). (See #1)

- Continue to educate producers on manure application and setback distances with respect to water bodies as outlined by the *Agriculture Operations Practices Act*, and continue research into the effectiveness of different application techniques to reduce manure runoff into receiving water bodies. (See #46)

- Implement significant stormwater quality upgrades / improvements within Calgary. (See #33)

- Develop water conservation and efficiency targets for all municipalities and irrigation districts within the Bow River basin. (See #22)

- Continue to conduct the water quality monitoring program for the representative stormwater outfalls in Calgary in support of the Total Loading Management Plan, including the verification and improvement of the total suspended solid (TSS) loading estimates. Expand the plan to estimate loadings from the pertinent storm outfalls in the Elbow Central reach. (#31)

- Carefully consider land use on the alluvial aquifer in the Elbow River sub-basin in the context of downstream river water uses with appropriate groundwater assessments done prior to any development. Groundwater assessments may lead to some additional monitoring. (See #56)

These high priority recommendations are identified in **bold face** in Table 2.

The recommendations are numbered and the water quality objectives in Appendix A are cross-referenced back to the recommendations.

## Table 2: Summary of Performance Monitoring and Management Recommendations

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 1 | 1a water quality performance indicators | Monitoring and evaluation | Coordinated Monitoring | Overall Bow Basin | **Coordinate a workshop to develop strategies for enhanced coordination of monitoring programs within the Bow Basin.** | BRBC | Short-Term (2008-2010) |
| 2 | 1a water quality performance indicators | Reporting | Real-Time Monitoring | Overall Bow Basin | Expand real-time monitoring for both flow and water quality and make data "publicly accessible". | Calgary*, AENV, EC, BRBC, | Medium-Term (2011-2012) |
| 3 | 1a water quality performance indicators | Research | Giardia | Overall Bow Basin | Further research and monitoring to develop a long-term target for Giardia, and to determine natural and anthropogenic sources. | Research communities | Long-Term (2012-2013) |
| 4 | 1a water quality performance indicators | Indicator development | Cryptosporidium | Overall Bow Basin | Develop a report to review Cryptosporidium data and monitoring methodologies. | Research communities, Calgary, U of C, CHR, AENV and EC | Medium-Term (2011-2012) |
| 5 | 1a water quality performance indicators | Monitoring and target development | Pathogens E.coli | Bow above park boundary | Include E. coli in surface water quality monitoring to determine an appropriate target. | PC and EC | Medium-Term (2011-2012) |
| 6 | 1a water quality performance indicators | Monitoring and evaluation | Spawning and Dissolved Oxygen Levels | Bow River Central | Evaluate wastewater treatment methods and/or other options to improve river DO levels particularly during trout spawning and incubation. | Calgary | Medium-Term (2011-2012) |
| 7 | 1a water quality performance indicators | Research and monitoring | Research and monitoring on Dissolved Oxygen | Bow River Central | **Further research on dissolved oxygen to determine the following:**<br>**- cause of low nocturnal dissolved oxygen levels in the Bow River downstream from Calgary in the spring and summer;**<br>**- whether N and/or P is the limiting nutrient for aquatic plant growth which contributes to low dissolved oxygen levels;**<br>**- additional monitoring, model refinement and research to ensure that 0.015 mg/L TDP is sufficient to prevent DO from falling below 5 mg/L**<br>**- spawning success in relation to interstitial oxygen levels.** | Research communities, Calgary, AENV, ASRD | Short-Term (2008-2010) |
| 8 | 1a water quality performance indicators | Education | Pathogens (E. coli) and Education | Bow River Central | Increase education programs about the risks associated with body contact recreation. | Calgary*, CHR, Bow River Central Municipalities, AENV | Short Term (2008-2010) |

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 9 | 1a water quality performance indicators | Research | Total Organic Carbon Thresholds and Exceedance Options | Bow River Central and Elbow River Central | Further research to better define thresholds for total organic carbon to set treatment and source control options if necessary. | Calgary, U of C, AENV and EC | Medium-Term (2011-2012) |
| 10 | 1a water quality performance indicators | Indicator development and research | Total Suspended Solids WQO and research | Nose Creek | Develop a total suspended solids WQO and conduct research to identify the anthropogenic causes of total suspended solids relative to natural sources. | NCWP | Long-term (2012-2013) |
| 11 | 1a water quality performance indicators | Monitoring and evaluation | Dissolved Oxygen Monitoring | Nose Creek | Enhance monitoring of DO to better characterize and understand low nocturnal DO concentrations. | AENV, Calgary, NCWP | Short-Term (2008-2010) |
| 12 | 1b. Aquatic ecosystem performance indicators | Indicator development | Benthic Invertebrate Research and Index of Biotic Integrity | Overall Bow Basin | Complete benthic invertebrate study for sites upstream and downstream of Calgary. Develop an index to assess benthic invertebrate response to water quality and assess overall aquatic ecosystem health. | Calgary*, EC, AENV, ASRD, ACA, PC, Research communities | Medium – Term (2011- 2012) |
| 13 | 1b. Aquatic ecosystem performance indicators | Indicator development | Fish community Index | Overall Bow Basin | Fisheries Management will continue to refine the fish IBI (Index of biotic integrity) for use as an index to assess fish community response to water quality. | ASRD* | Medium-Term (2011-2012) |
| 14 | 1b. Aquatic ecosystem performance indicators | Research | Macrophyte, Periphyton and Fish Research | Overall Bow Basin | Further research is required to link adverse human use impacts to macrophyte growth. Research is needed to determine acceptable periphyton levels with respect to water quality and still provide benefits for fish growth. | Research communities | Medium-Term (2011-2012) |
| 15 | 1b. Aquatic ecosystem performance indicators | Research | Didymosphenia Research | Bow River Above Park Boundary, Bow River Below Park Boundary | Research is required to determine how Didymosphenia geminata is proliferating and what can be done to contain its growth. | Research communities, EC | Short-Term (2008-2010) |
| 16 | 1b. Aquatic ecosystem performance indicators | Research | Water Temperature & Cutthroat Trout | Bow River Below Park Boundary | Research to help determine if water temperatures are sufficiently warm for cutthroat trout spawning in the spring. | PC, ASRD, Trout Unlimited | Short-Term (2008-2010) |
| 17 | 1b. Aquatic ecosystem performance indicators | Monitoring and evaluation | Water Temperature and Dissolved Oxygen & Mountain Whitefish | Bow River Central | Establish thresholds for acute and chronic temperature and dissolved oxygen effects on mountain whitefish. | Research communities, ASRD | Short-Term (2008-2010) |

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 18 | 1b. Aquatic ecosystem performance indicators | Research | Total Suspended Solids – Particle Size & Fish | Bow River Central | Further research on the effects of smaller particle sizes (e.g., in storm water) on fish health and spawning. | Research communities, other academic agencies | Long-Term (2013-2014) |
| 19 | 1b. Aquatic ecosystem performance indicators | Monitoring and evaluation | Periphyton Biomass | Nose Creek | Future water quality monitoring should include the collection of periphyton biomass (as chlorophyll a). | AENV | Short-Term (2008-2010) |
| 20 | 2a. Water quantity management in relation to water quality | Modelling and research | Water Balance Schematics | Overall Bow Basin | Develop water balance schematics, including groundwater, for the basin and all key reaches defined in this document. | AENV, ASRD | Medium-Term (2011-2012) |
| 21 | 2a. Water quantity management in relation to water quality | Indicator development | Flow Deviations | Overall Bow Basin | Further work is needed to develop an appropriate method to evaluate the deviation of recorded flows from naturalized flow regimes and three flow regime benchmarks[4] (AENV 2006a, Clipperton et al 2003) that have been set in the Bow Basin to meet the needs of the aquatic environment and consumptive water users. | AENV, ASRD, EC* | Short-term (2008-2010) |
| 22 | 2a. Water quantity management in relation to water quality | Indicator development | Water Conservation | Overall Bow Basin | **Develop water conservation, efficiency, productivity targets and programs to meet targets for all municipalities and irrigation districts within the Bow Basin.** | Bow Municipalities | Short-Term (2008-2010) |
| 23 | 2a. Water quantity management in relation to water quality | Reporting | Water Use Data | Overall Bow Basin | Provide readily, accessible water use data for all major licensed water users in the Bow Basin (i.e. IDs, municipalities, and industry) and strive for enhanced recording of use for all other licence users. | AENV | Medium-Term (2011-2012) |
| 24 | 2a. Water quantity management in relation to water quality | Modelling | Coupled-water quantity and quality modelling | Bow River Central, Bow River Lower | Modelling work is required to understand the effects of flow alterations (i.e. upstream hydroelectric dams and irrigation diversions) on the assimilation capacity of the river to wastewater loadings and on ambient water quality. | Research communities, hydroelectric and irrigation groups | Medium-Term (2011-2012) |

[4] The three flow benchmarks that have been set for the Bow Basin are: i) the Instream Flow Need values determined using the Instream Flow Incremental Methodology, ii) the Water Conservation Objectives established under the approved Water Management Plan for the South Saskatchewan River, and (iii) the Instream Objectives established under the Water Act and used as regulatory restrictions on existing water licences for dams and diversions.

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 25 | 2a. Water quantity management in relation to water quality | Modelling | Headwater runoff modelling | Bow River Upper, Bow River Below Park Boundary, Elbow River Upper | Evaluate the potential landcover scenarios in the headwaters of the Bow Basin using existing runoff models in response to different levels of forest disturbance (e.g. forestry, fire and mountain pine beetle). Investigate the relative risks using more extreme flow events, changes in annual water supplies, and changes to erosion and sediment loading. | ASRD, U of A | Medium-Term (2011-2012) |
| 26 | 2a. Water quantity management in relation to water quality | Research | Peak and Base Flows | Nose Creek | Further research is needed to compare the frequency and magnitude of base and peak flows. Storm events should remain within the range of pre-developments conditions (pre-1970). | NCWP | Short-Term (2008-2010) |
| 27 | 2b. Storm water and wastewater management | Modelling | Water Quality Modelling | Overall Bow Basin | Expanded water quality modelling for both NPS and PS pollution entering the Bow River and key tributaries. | Calgary, Research communities , AA&RD, & AENV* | Medium-Term (2011-2012) |
| 28 | 2b. Storm water and wastewater management | Monitoring and reporting | Wastewater Monitoring and Reporting | Overall Bow Basin | **Wastewater loadings from all licensed municipal and industrial sources throughout the Bow Basin should be monitored and reported for the various sub-basins.** | AENV, Bow Municipalities and industries with discharges to the river | Medium-Term (2011-2012) |
| 29 | 2b. Storm water and wastewater management | BMP implementation | Wastewater and Stormwater Treatment | Overall Bow Basin | **Municipalities must evaluate and implement the best treatment wastewater and stormwater options or technologies to protect the river water quality.** | Bow Municipalities AENV (lead), AT | Medium- Term (2011-2012) |
| 30 | 2b. Storm water and wastewater management | BMP implementation | Total Suspended Solids and Source Control Practices | Bow River Central | Develop design guidelines for source control practices (i.e., BMPs). | Calgary* | Medium-Term (2011-2012) |
| 31 | 2b. Storm water and wastewater management | Monitoring and modelling | Storm water Monitoring | Bow River Central, Elbow River Central | **Continue to conduct the water quality monitoring program for the representative storm water outfalls in Calgary in support of the Total Loading Management Plan (CoC 2005). Work on verifying and improving the storm water total suspended solid loading estimates. Expand the model to estimate loadings from the pertinent storm outfalls in the Elbow Central reach (both Elbow and Glenmore outfalls).** | Calgary* | Short-Term (2008-2010) |
| 32 | 2b. Storm water and wastewater management | Objective development | Pathogen (E. coli) Source Tracking | Bow River Central, Elbow River Central | Further source tracking within the City of Calgary (including evaluation of risks) is required prior to setting WQOs and warning levels. | Calgary, U of C, CHR, AENV and EC | Medium Term (2011-2012) |

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 33 | 2b. Storm water and wastewater management | BMP implementation | Stormwater Improvements | Bow River Central, Elbow River Central | **Implement significant stormwater quality upgrades / improvements within Calgary.** | City of Calgary* | Short to Long-Term (2008–2014) |
| 34 | 2b. Storm water and wastewater management | Research | Pathogenic Speciation and WQOs (Total Coliforms) | Elbow River Central | Need to determine the species composition of pathogens and other organisms when counts exceed 20,000 coliforms/100 mL at the intake for Glenmore Water Treatment Plant. Once the pathogenic speciation work has been completed, further work will be required to refine the WQO. | Calgary, BRBC, CHR, AENV, EC and U of C | Medium-Term (2011-2012) |
| 35 | 2b. Storm water and wastewater management | Research | Nitrate Research | Elbow River Central, Elbow River Upper, Bow River Above Park Boundary | Further research to determine if increased nitrate in the headwaters and foothills is from natural sources, local anthropogenic changes or long-range transport. | Research communities, other academic agencies | Medium-Term (2011-2012) |
| 36 | 2b. Storm water and wastewater management | Research | Total Phosphorus Reductions | Nose Creek | Conduct research into the primary productivity of Nose Creek with the intent to reduce total phosphorus and total dissolved phosphorus. | NCWP (lead), Research communities | Medium-Term (2011-2012) |
| 37 | 2c. Pesticide management | Education | Pesticide Use and Education | Overall Bow Basin | Develop education programs to encourage a reduction in urban pesticide applications. | Bow Municipalities | Medium-Term (2011-2012) |
| 38 | 2c. Pesticide management | Indicator development | Pesticide Index | Overall Bow Basin | Once completed, the new 1) Alberta pesticide index (based on thresholds of observable effects limits developed by A-M. Anderson, AENV) and the new 2) European Union Water Framework Directive pesticide index be reviewed as alternatives to the existing recommended WQO. | BRBC's Knowledge Data and Research team | Short-Term (2008-2010) |
| 39 | 2c. Pesticide management | Monitoring and evaluation | Pesticide Monitoring | Overall Bow Basin | Agencies monitor pesticide concentrations in long-term monitoring programs. Parks Canada will consider adding pesticide monitoring to their existing agreement with Environment Canada. The monitoring programs should be coordinated and consistent with the sampling methodologies utilized by AENV (e.g., frequency, variables tested, etc.) | AENV*, Calgary, EC, PC | Long-Term (2013-2014) |
| 40 | 2c. Pesticide management | BMP implementation | Topsoil Thickness in New Developments | Overall Bow Basin | Require developers to provide thicker topsoil layers for all landscaped areas within new developments, to minimize the use and resulting impacts of urban pesticide applications and will increase water retention. | Bow Municipalities | Medium-Term (2011-2012) |

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 41 | 2c. Pesticide management | BMP implementation | Pesticide Use | Overall Bow Basin | **Municipalities to uphold the principle of minimizing the quantity and/or toxicity of active ingredients when applying pesticides on the land they manage. It is recognized that the management of invasive species may require aggressive control measures.** | Bow Municipalities, landowners | Short-Term (2008-2010) |
| 42 | 2c. Pesticide management | Reporting and evaluation | Pesticide Surveys for Bow Basin | Overall Bow Basin | Continue to survey pesticide sales every five years and break information down by major river basins including the Bow Basin. Data on pesticide sales can contribute important information for a variety of monitoring and research needs, such as the relationship between pesticide use and their persistence in the environment. | AENV* | Short-Term (2008-2010) |
| 43 | 2c. Pesticide management | Education | Pesticide Applications and Buffer Areas | Bow River Central & Elbow River Central | Continue to support pesticide use education programs and BMP extension materials. Producers and commercial applicators must continue to follow product label application specifications if spraying on cultivated land. If no specifications are provided on the label, the provisions contained in the fact sheet "Pesticide Use In or Near Water" should be followed.<br><br>(http://environment.gov.ab.ca/info/library/7459.pdf | AA&RD, BRBC Legislation & Policy Committee, Bow Municipalities | Short-Term (2008-2010) |
| 44 | 2c. Pesticide management | Reporting | Pesticide Use and Sales in Calgary | Bow River Central & Elbow River Central, Nose Creek | Continue to prepare annual surveys of urban domestic pesticide sales and actual use by golf course and landscape companies beyond 2008. | Calgary* | Short-Term (2008-2010) |
| 45 | 2d. Land use management in relation to water quality | Education | Low Impact Development Education | Overall Bow Basin | **Take a lead role in helping to educate municipalities and developers on the basic principles of low impact development and encourage developers to utilize these practices in the overall design.** | ALIDP, Bow Municipalities | Short-Term (2008-2010) |
| 46 | 2d. Land use management in relation to water quality | Education | Manure Application & Setbacks | Overall Bow Basin | **Continue to educate producers on manure application and setback distances with respect to water bodies as outlined by the Agriculture Operations Practices Act. Research the effectiveness of different application techniques to reduce runoff of manure into receiving water bodies.** | AA&RD*, NRCB* Bow Municipalities | Short-Term (2008-2010) |

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 47 | 2d. Land use management in relation to water quality | BMP implementation | Cattle Grazing in Riparian Areas | Overall Bow Basin | Encourage landowners to implement grazing strategies to reduce the degree and impact of cattle grazing on riparian habitat along rivers and creeks (for grasslands, forested areas and protected areas). | Cows & Fish*, ASRD, Alberta Environmental Farm Plan Company, AA&RD, Bow Municipalities | Short-Term (2008-2010) |
| 48 | 2d. Land use management in relation to water quality | BMP implementation | Low Impact Development and Municipal Approvals | Overall Bow Basin | Incorporate elements of low impact development Best Management Practices and performance monitoring into the overall development design of new residential and commercial developments. | Bow Municipalities, landowners | Short-Term (2008-2010) |
| 49 | 2d. Land use management in relation to water quality | BMP implementation | Riparian Buffer Zone Protection | Overall Bow Basin | **Adopt riparian setbacks (e.g. City of Calgary setback policy (COC 2007); Nose Creek Watershed Management Plan (NCWP 2006) in all new developments.** | Bow Municipalities | Short-Term (2008-2010) |
| 50 | 2d. Land use management in relation to water quality | BMP implementation | Soil Erosion | Overall Bow Basin | Include erosion and sediment control measures for construction sites in all development plans submitted to municipalities or management agencies (e.g. Alberta Transportation) e.g. The City of Calgary's erosion and sediment control manuals. A requirement for an inspection of the development site by a professional should be included. | Bow Municipalities | Short-Term (2008-2010) |
| 51 | 2d. Land use management in relation to water quality | Target development | Runoff, Erosion & Effective Impervious Areas | Overall Bow Basin | Review the 1) effective impervious area targets, 2) reach-specific runoff volume targets, and 3) erosion control targets for all new developments; to meet water quality objectives. | Bow Municipalities, AENV | Medium-Term (2011-2012) |
| 52 | 2d. Land use management in relation to water quality | Target development | Runoff and Soil Erosion | Bow River Upper, Bow River Below Park Boundary and Elbow River Upper | Review the effectiveness of existing forestry guidelines (e.g., stream crossings, riparian protection, road maintenance) on water quality. Erosion control targets should be developed and implemented for reaches without a target. | ASRD | Short-Term (2008-2010) |
| 53 | 2d. Land use management in relation to water quality | Indicator development | Effective Impervious Areas | Bow River Central & Elbow River Central | Develop effective impervious area targets for all new developments based on the overall goal of trying to achieve pre-development rates & volumes entering the streams or rivers. | Calgary and M.D. of Rocky View, Airdrie, Strathmore, AENV, other municipalities in the reaches | Short-Term (2008-2010) |

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 54 | 2d. Land use management in relation to water quality | BMP implementation | Soil Erosion | Elbow River Upper, Bow River Upper | Continue efforts to reduce erosion from trails, recreation sites or other activities. Erosion and sediment control plans must be developed and implemented for construction sites with any connection to surface water. A requirement for environmental inspection of the development site during (and following) construction (by a qualified professional) should be included. | ASRD*; Alberta Tourism, Parks & Recreation* | Short-Term (2008-2010) |
| 55 | 2d. Land use management in relation to water quality | Target development | Runoff & Effective Impervious Areas | Nose Creek | Enhanced stream and storm water flow monitoring at various points throughout the system is needed to assist in the identification of the impervious and runoff targets. | Calgary, NCWP, AENV | Short-Term (2008-2010) |
| 56 | 2e. Source water protection | Planning | Alluvial Aquifer | Elbow River Central | **Land use on alluvial aquifer lands overlying groundwater under the direct influence of surface water (GUDI) has the potential to affect both groundwater and surface water quality. Carefully consider land use in the context of downstream river water uses with appropriate groundwater assessments done prior to development, if any. Groundwater assessments may lead to some additional monitoring.** | MD of Rocky View, Tsuu T'ina , City of Calgary | Short-Term (2008-2010) |
| 57 | 2f. Wetland & riparian characterization and protection | Objective and indicator development | Wetland and Riparian Health Inventory & Classification | Overall Bow Basin | A comprehensive wetland and riparian inventory which includes drained and altered wetland and developed and degraded riparian areas is critical for source water protection. The inventories to classify wetland and riparian areas at appropriate resolution/scale and according to their existing vegetation, the vegetation potential and the type and intensity of land use occurring within them. Priorization by geographic area (e.g., White/Settled area vs. Green/Forested area, heavily populated versus lightly populated areas). Reassess objectives and indicators of wetland and riparian health that relate to water quality when this is complete. | AENV, DUC, ASRD Cows and Fish* | Short-Term (2008-2010) |
| 58 | 2f. Wetland & riparian characterization and protection | Objective & Indicator development | Wetland Coverage | Overall Bow Basin | The comprehensive wetland inventory capturing historic wetland loss and alteration should be used as an indicator for future state of watershed reporting and planning and the setting of wetland conservation and restoration goals. | BRBC<br>AENV, DUC | Short-Term (2008-2010) |

| # | Theme | Activity | Proposed Indicator or Topic Area | River or Reach | Recommendations | Decision-makers | Implementation Timeline |
|---|---|---|---|---|---|---|---|
| The recommendation numbers in the leftmost column are referenced in Appendix A for each water quality objective.<br>*Asterisked Recommendations: Projects that are either in progress or are planned subject to budgetary approval.<br>**Bold Recommendations:** Identified by the Technical Committee as being the highest priority based on science for short-term implementation. | | | | | | | |
| 59 | 2f. Wetland & riparian characterization and protection | Planning | Wetland and Riparian Restoration & Planning | Overall Bow Basin | Develop a wetland management plan and riparian management plan, based on comprehensive wetland and riparian inventories. | DUC, AENV, Bow Municipalities, BRBC, ASRD | Medium-Term (2011-2012) |
| 60 | 2f. Wetland & riparian characterization and protection | Research | Wetlands and Storm water | Overall Bow Basin | Further research to determine the practicality of using existing undisturbed wetlands for storm water treatment purposes. | U of C* | Long-Term (2013-2014) |
| 61 | 2f. Wetland & riparian characterization and protection | Research | Wetlands and Water Quality | Overall Bow Basin | Further research into wetland function and which include investigating groundwater recharge and surface water quantity relationships in wetland function. | DUC*, AENV | Medium-Term (2011-2012) |

# 4 Engagement

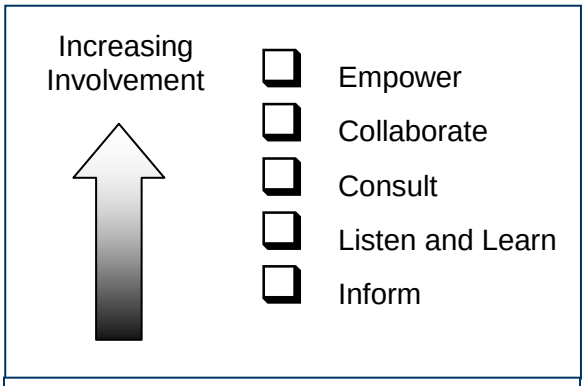


**Figure 3: Levels of Engagement (based on The City of Calgary's *engage!* Framework and Tools)**

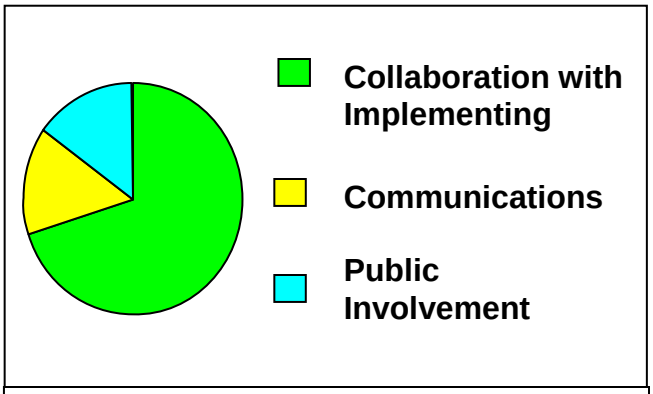


**Figure 4: The Focus of Engagement for Phase One BBWMP**

Engagement describes the means by which the sectors of our stakeholders and the public (Figure 3) were included throughout the development of the Terms of Reference and the Watershed Management Plan. A summary of engagement actions is included as Appendix E.

## 4.1 Collaboration

Collaboration with the decision-makers was identified by the SC as the major focus of engagement efforts for the Phase One Plan. This collaboration included a number of approaches:

- The Steering Committee (SC) was comprised of members who represented different constituencies and who have kept their constituents informed through a formal quarterly report-back during the development of the draft plan.

- The completed TC document was first released to the SC for their feedback. The TC draft was then released to decision-makers (November 2007). The draft was then released to BRBC members for feedback in December of 2007. The TC document (BRBC 2008) has been approved and signed off by the BRBC BoD. Presentations by the SC Chair were arranged with the Councils from most of the municipalities within the basin (Appendix E).

- The Steering Committee produced this document. Feedback was received with a consistent theme of assistance needed with implementation of this Plan. The BRBC approved creating an Implementation Committee in 2008.

- Note that decision-makers were given the opportunity to modify implementation timelines in order to meet the water quality objectives in the recommendations, with a deadline of January 15, 2008.

- The final draft of this document was created in September, 2008, after considering the results of the engagement process. The plan was signed (September 4, 2008) by the Director of Alberta Environment, Indicating support of the Water Quality Objectives.

## 4.2 Communications

Communications in Figure 4 refers to information updates on the Draft Plan which were focused toward the membership of the BRBC. The BRBC is comprised of 203 members representing 96 organisations from the industrial, commercial, municipal government, non-profit group, academic, and regulatory sectors; First Nations; and 61 individual public members. BRBC members were kept informed of progress and content within the BBWMP through:

- Regular reports at each Quarterly BRBC Educational Forum

- Quarterly reports in the BRBC newsletter, *Preserving Our Lifeline*

## 4.3 Public Involvement

- Public involvement is key to successful watershed management. Ultimately, individual actions and attitudes will provide the long-term sustainability and effort needed in achieving the objectives of the Watershed Management Plan.

- Most of the Phase One recommendations are related to actions to be implemented by decision-makers (e.g., government agencies, municipalities). Decision-makers generally liaise with individuals during the implementation of the recommended actions. As a result, the communications focus for the BBWMP Steering Committee effort was to provide a broad introduction of the plan to the general public:

- The public was notified of the release of the Draft Plan by a paid Public Notice published in regional newspapers throughout the Bow River basin (Government of Alberta list used for advertising the Land Use Framework review).

- A copy of the plan was available to view or download from the BRBC website (and remains on the site www.brbc.ab.ca).

- A web-based survey was provided to receive further comments.

- Public service announcements were made available to the regional media.

- Four public open houses were held geographically along several municipalities along the Bow River with a 30-day comment period allowed. Those meetings were each 7 – 9 p.m., with a formal presentation at 7:30. Attendance was: Calgary, Mar. 4/08 – 6; Strathmore, Mar.5/08– 3; Canmore, Mar. 6/08 – 3; Brooks, Mar. 10/08 – 15.

- Lessons learned to increase public involvement:

- Involve the local education system, as this is one of the most effective ways of communicating information to the public. Children learn about the issues and carry the information with them for life. They also bring the information home to their parents.

- The Education and Communications Committee of the BRBC has initiated an effort to roll out the classroom education package developed to complement the "Bow River Basin Waterscape"[5] poster to junior high schools throughout the basin. To date, it has been very well received by teachers in Calgary.

## 4.4 First Nations Communications

A communications protocol (Appendix F) was established to ensure there was communication with First Nations in the Basin. Specific communications are also included in Appendix E.

## 4.5 Response to Stakeholder Feedback

Major release dates and comment deadlines can be summarised as follows:

- November 21, 2007 – Technical committee document released to decision-makers

- December 12, 2007 – Technical committee document released to BRBC members

- January 15, 2008 – Deadline for comments form decision-makers and BRBC members

- March 04 -10, 2008 – Public open houses

- March 06, 2007 – Draft of Steering Committee Phase One Plan posted in public area on BRBC website.

- March 26, 2007 – Deadline for public comment.

In practice, comments were often received beyond the targeted deadlines and were considered up to the time when the final draft was produced.

Comments and suggestions from all engagement efforts have been compiled and considered in the finalization of the plan. A detailed summary of comments with responses has been compiled and is available from the BRBC upon request.

[5] The Bow River Waterscape Poster was developed by the Geological Survey of Canada in partnership with the following agencies: The Bow River Basin Council, Alberta Environment, Climate Change Central, Calgary Roman Catholic School District No. 1, The Calgary Board of Education and the City of Calgary with participation of individuals from Parks Canada, the University of Calgary, Telus World of Science, the Prairie Farm Rehabilitation Administration and the SEEDS Foundation. The City of Calgary worked with a group of elementary and junior high teachers from Calgary schools to create a series of interactive activities to accompany the poster.

A full documentation of the consultation comments is available from the BRBC upon request.

# 5 Recommendations to the BRBC BoD

In order to ensure effective implementation and improvement of this Plan, it is recommended that the BRBC Board of Directors (BoD) take responsibility for the following.

## 5.1 Plan Implementation

- Form an Implementation Committee to align implementation efforts of decision-makers (this recommendation was adopted by motion of the BRBC BoD in November 2007)
- Create tools to help develop implementation plans
- Use the water quality objectives and indicators in all decision-making processes when the decision could impact the protection, restoration, and/or maintenance of the water quality in the Bow River basin
- Consider the social and economic implications and benefits of the plan during implementation of the recommendations
- Take on responsibility for tracking the overall implementation of the BBWMP through annual progress reporting
- If requested, each "decision-maker" will be assisted to: 1) develop an implementation plan for their specific recommendations shortly after final plan approval and 2) prepare a summary of progress report for submission to the BRBC BoD on an annual basis.
- To assist the agencies in their annual reporting, prepare a standard reporting template for both the implementation plan and progress report. The template design will allow for clear and easy completion of the implementation plan and progress report.
- Recommend the Implementation Committee increase the public involvement segment.

## 5.2 Review and Amendments

- Water quality data for each reach should be reported and reviewed on a regular basis and used as performance measurements of implementation for recommendations in this phase of the watershed management plan.

- The BBWMP is a living document. As new information becomes available, updates to the existing version of the BBWMP should be considered on a case-by-case basis by the BRBC BoD

- All future phases of the plan should work towards building a comprehensive integrated watershed management plan.

# 6 References and Bibliography (BBWMP and Appendix A)

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# APPENDIX A: WATER QUALITY OBJECTIVES[6]

## Water quality objectives, warning levels and targets by reach (from Technical committee document Bow Basin Watershed Water Quality Objectives and Indicators document v. 10, 2008).

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Attached Algae (Periphyton) Biomass –defined as chlor a | Bow River Above Park Boundary | ❑ WQO: 47 mg/$m^2$ maximum value during open water season | Harvie Heights<br>Fall measurements (Sept – Oct)<br>1999-2006<br>30<br>$(243)^{max}$<br>$(197.6)^{90}$- includes data prior to treatment plant upgrades<br><br>2002-2006<br>9<br>$(44)^{max}$<br>$(32.9)^{90}$ | ❑ Objective supports the Park Canada mandate to maintain near pristine conditions in park areas.<br>❑ Objective is an experimentally derived value based on data from 1998-2006 upstream of the Banff town site (Bowman 2006). This is the value that represents the transition from good to fair rankings according to Parks Canada (Bowman 2003).<br>❑ Decline in algal growth with recent wastewater treatment upgrades.<br>❑ Objective may not be met in some locations due to recent occurrence of invasive strain of Didymosphenia geminata. Research recommended on reasons for its recent occurrence and growth. | 14, 15 |
| Dissolved Oxygen | Bow River Above Park Boundary | ❑ WQO: CCME with protection of spawning and incubation. (CCME 1999)<br>o 9.5 mg/L for spawning and incubation<br>o 6.5 mg/L for acute daily minimum. | Year round<br>Upstream Lake Louise<br>1973-2002<br>Monthly :<br>11.5<br>$(9.5)^{10}$ | ❑ CCME provides a high-level of protection for saturated conditions. | 2 |
| Macrophytes | Bow River Above Park Boundary | ❑ WQO: No macrophyte biomass that adversely affects users. | Insufficient data, rare or absent | ❑ Numerical relationships between biomass and DO are poorly understood and need to be established. For example, higher macrophytes biomass may naturally occur in standing or slower moving water. | 14 |

[6] The body of this table is taken verbatim from the TC report (BRBC 2008), except for corrections of minor typographical or logistical errors.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Nitrate (nitrate + nitrite (as N)) | Bow River Above Park Boundary | ❑ WQO: 0.13 mg/L during growing season | Year round<br>Harvie Heights<br>73-02<br>monthly<br>0.08<br>$(0.13)^{90}$ | ❑ 0.13 is based on 90th percentile from the 1983 to 2002 at the downstream monitoring station.<br>❑ Trying to maintain this reach at its current trophic state. | 27, 35 |
| Pathogens as indicated by E. coli | Bow River Above Park Boundary | ❑ WQO: Not recommended at this time. | Insufficient data | ❑ Not currently measured. | 5, 28 |
| Pathogens as indicated by Total Coliforms | Bow River Above Park Boundary | ❑ WQO: Should not exceed 20,000 counts (total coliforms) per 100 mL at intake for drinking water treatment plant | Year Round<br>Coliforms/100 mL<br>Harvie Heights<br>73-02<br>monthly<br>13 per 100 mL<br>$(310)^{90}$ | ❑ The instantaneous objective of <20,000 counts/100 mL is based on conventional water treatment plant's ability to remove contaminants if pre-disinfection is present (US EPA 1991).<br>❑ Protects human health by ensuring that municipal water treatment plants can remove pathogens (e.g., bacteria, protozoa, and viruses) from raw water. | 28 |
| Pathogens – Giardia | Bow River Above Park Boundary | ❑ WQO: Not set for this reach. However, Giardia is an important issue, and agencies should continue to monitor for Giardia and attempt to identify sources. | Insufficient data | ❑ Insufficient data to make an objective, as it is not currently monitored.<br>❑ Groundwater is currently being used as the drinking water source for this reach.<br>❑ Wildlife are the prime vectors of Giardia transmission in this reach. | 3 |
| Pesticides and Degradation Products | Bow River Above Park Boundary | ❑ WQO: Should not exceed the lower of:<br>o < 1/10 of federal drinking water guidelines or<br>o < CCME guidelines for aquatic life in the river (provisional objective) (CCME 1999) | Insufficient data | ❑ Provisional objective was set as there is currently no ongoing monitoring available at this time to set an objective.<br>❑ No current use of surface water for municipal water supplies however drinking objective included to consider to protect downstream users | 37, 38, 39, 41, 42 |
| Total Ammonia | Bow River Above Park Boundary | ❑ WQO: Should not exceed CCME guideline for protection of aquatic life (CCME 1999). To apply outside mixing zone (AENV 1995). | Year Round<br>Harvie Heights<br>87-02<br>monthly<br>0.011<br>$(0.044)^{90}$ | ❑ Designed to protect aquatic life and considers the influence of both temperature and pH on the toxicity of ammonia. | 27, 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Dissolved Phosphorus | Bow River Above Park Boundary | ❑ WQO: 0.005 mg/L TDP | Year round<br>Harvie Heights<br>73-02<br>monthly<br>0.006<br>$(0.016)^{90}$ | ❑ Based on trying to maintain or improve the existing water quality.<br>❑ Recent (2002 – 2003) water treatment improvements have decreased TDP concentrations at Harvie Height's site to below 0.005 mg/L (Humphries pers. comm..).<br>❑ It is expected that recent treatment plant upgrades will allow this water quality objective to be met. | 27, 28 |
| Total Phosphorus | Bow River Above Park Boundary | ❑ WQO: 0.012 mg/L TP | Year round<br>Harvie Heights<br>73-02<br>monthly<br>0.012<br>$(0.025)^{90}$ | ❑ Based on trying to maintain or improve the existing water quality in the mountain parks to a natural state, protected under federal legislation.<br>❑ Values may be exceeded during freshet conditions.<br>❑ Recent upgrades to the WWTPs (post 2002) have improved receiving water quality. | 27, 28 |
| Total Suspended Solids | Bow River Above Park Boundary | ❑ WQO: CCME (CCME 1999) | Year Round<br>Harvie Heights<br>73-02<br>monthly<br>2.0<br>$(11.2)^{90}$ | ❑ To maintain existing water quality for aquatic life. | 27, 52, 54 |
| Water Temperature | Bow River Above Park Boundary | ❑ WQO: Should not exceed 18°C at any time or a 7-day mean of 15°C (added) | Year Round, °C<br>Harvie Heights<br>73-02<br>monthly<br>5.0<br>$(11.0)^{90}$<br>$(16.3)^{max}$ | ❑ To protect most sensitive native fish, namely bull trout<br>❑ 7-day mean based on Taylor & Barton 1992. | 2, 27 |
| Riparian Condition7 | Bow River Above Park Boundary | ❑ TARGET: maintaining a "healthy" rating using Cows and Fish rating system. | | ❑ Based on the best available data, targets were set at one level higher than initial conditions measured using the Cows and Fish Riparian Health Inventory rating system (Fitch and Ambrose 2003) (e.g., "unhealthy" ➔ "healthy with problems" ➔ "healthy"). If the river and/or reach previously rated as "healthy", the target remained as "healthy". In all cases, the long-term goal is "healthy". | 45, 47, 49, 57, 59 |

[7] Healthy riparian condition filters nutrients and minimizes the runoff of sediments into receiving water bodies.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Soil Erosion8 | Bow River Above Park Boundary | ❑ TARGET: The erosion and sediment control (ESC) plan should be designed with a T-value or maximum soil erosion rate target of 2t/ha/yr where disturbed land has direct connection to a water body (no buffer, no interception). Applies to all construction sites and endures for the life of the project (during and post construction phases). | | ❑ For new developments that are permitted within the defined boundaries, Operating Ground Rules are in place to minimize erosion and sedimentation (ASRD).<br>❑ An erosion and sediment control plan (ESC) must be developed, implemented and monitored for construction sites with any direct connection to surface water.<br>❑ An ESC plan should be prepared by a qualified professional (a professional certification that includes erosion and sediment control as a field of expertise).<br>❑ Based on methods described in Wall et al 2002. | 49, 50, 51 |
| Attached Algae (Periphyton) Biomass –defined as chlor a | Bow River Below Park Boundary | ❑ WQO: 150 mg/m$^2$ maximum value during open water season | Open Water Cochrane monthly 1995-2006 21 $(83)^{90}$ $(154.3)^{max}$ | ❑ A literature review over many regions determined that periphyton concentrations above 150 mg/m2 are associated with adverse impacts on users (Welch et al 1998). | 15 |
| Dissolved Oxygen | Bow River Below Park Boundary | ❑ WQO: CCME with protection of spawning and incubation (CCME 1999).<br>○ 9.5 mg/L for spawning and incubation<br>○ 6.5 mg/L for acute daily minimum. | Open Water Cochrane, 87-06 Monthly: 10.2 (8.9510) $(7.61)^{min}$ | ❑ CCME provides a high-level of protection for saturated conditions. | 2, 27, 28 |
| Macrophytes | Bow River Below Park Boundary | ❑ WQO: No macrophyte biomass that adversely affects users. | Insufficient data | ❑ Numerical relationships between biomass and DO are poorly understood and need to be established. For example, higher macrophytes biomass may naturally occur in standing or slower moving water. | 14 |

[8]Erosion is caused when soil particles are dislodged and transported by water falling on or running across bare soil or vegetated areas that are unable to resist the force of the flowing and falling water. If eroded material is transported to water bodies sedimentation occurs which reduces water quality after and during storm events.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Nitrate (nitrate + nitrite (as N)) | Bow River Below Park Boundary | ❑ WQO: 0.267 mg/L<br>❑ WARNING LEVEL: 0.163 mg/L<br>❑ WQOs, warning levels and targets for nitrate apply during the growing / open water season. | Open water<br>Cochrane<br>87-06<br>monthly<br>0.067<br>$(0.112)^{90}$ | ❑ The value of 0.267 mg/L was obtained from Sosiak 2004 as the nitrate + nitrite level that corresponds to nuisance growth of periphyton in the Bow River basin.<br>❑ The warning level was developed based on the $90^{th}$ percentile level for the period 1987 – 2006. | 27, 28 |
| Pathogens as indicated by E. coli | Bow River Below Park Boundary | ❑ WQO: Meet recreational guideline – no single value to exceed 400 *E.coli*/100 mL or <200 *E. coli*/100 mL (geometric mean 5 samples/30 d). | Year Round<br>coliforms/100 mL<br>Cochrane<br>94-06<br>monthly<br>1 per 100 mL<br>$(14)^{90}$ | ❑ 400 E. coli/100 mL is the CCME re-sampling guideline. (CCME 1999) | 28 |
| Pathogens as indicated by fecal coliforms | Bow River Below Park Boundary | ❑ WQO: Meet 100 fecal coliforms/100 mL (no single value to exceed objective) at the point of withdrawal. | Year Round<br>Coliforms/100 mL<br>Cochrane<br>91-05<br>monthly<br>2 per 100 mL<br>$(20)^{90}$ | ❑ Irrigation guidelines set by CCME. (CCME 1999)<br>❑ It is recognized, that the WQO values may be briefly exceeded for short periods of time during storm events.<br>❑ The intention though, is to maintain in-stream concentrations at or below current levels. | 28 |
| Pathogens as indicated by Total Coliforms | Bow River Below Park Boundary | ❑ WQO: Should not exceed 20,000 counts (total coliforms) per 100 mL at intake for drinking water treatment plant. | Year Round<br>Cochrane<br>00-06<br>monthly<br>66 per 100 mL<br>$(435)^{90}$ | ❑ The instantaneous objective of <20,000 counts/100 mL is based on conventional water treatment plant's ability to remove contaminants if pre-disinfection is present (US EPA 1991).<br>❑ Protects human health by ensuring that municipal water treatment plants can remove pathogens (e.g., bacteria, protozoa, and viruses) from raw water. | 28 |
| Pathogens – Giardia | Bow River Below Park Boundary | ❑ WQO: Should not exceed 100 cysts per 100L (instantaneous) for the Bearspaw Water Treatment Plant. | Insufficient data | ❑ This is the level above which will require in excess of 5-log reduction at the Bearspaw Water Treatment Plant (AENV 2006b).<br>❑ Higher levels of Giardia require new water treatment processes for small water supply systems in the Basin. Over time, as approvals come up for renewal, small water supply systems may be required to upgrade to treat higher levels of Giardia. | 3 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Pesticides and Degradation Products | Bow River Below Park Boundary | ❑ WQO: Should not exceed the lower of:<br>○ < 1/10 of federal drinking water guidelines or<br>○ < CCME guidelines for aquatic life in the river (CCME 1999). | Data not readily available | ❑ Provisional objective as there is currently no ongoing monitoring available at this time to set an objective.<br>❑ Protects drinking water and aquatic ecosystems.<br>❑ <1/10 of federal drinking water guidelines used to provide a safety margin to protect against compounds for which there is no treatment. | 37, 38, 39, 41, 42 |
| Total Ammonia | Bow River Below Park Boundary | ❑ WQO: Should not exceed 0.04 mg/L in the river for municipal water supply, and should not exceed CCME guideline for protection of aquatic life (CCME 1999). To apply outside mixing zone (AENV 1995). | Open water<br>Cochrane<br>87-06<br>monthly<br>0.010<br>$(0.020)^{90}$ | ❑ Protects municipal water supply from unacceptable chlorine demand.<br>❑ Based on experience at Glenmore Water Treatment Plant.<br>❑ This is more restrictive than the current CCME guideline.<br>❑ Designed to protect aquatic life and takes into account the influence of both temperature and pH on the toxicity of ammonia. | 27, 28 |
| Total Dissolved Phosphorus | Bow River Below Park Boundary | ❑ WQO: 0.005 mg/L TDP during the growing season for aquatic plant | Open Water<br>Cochrane<br>87-06<br>monthly<br>0.002<br>$(0.005)^{90}$ | ❑ Based on trying to maintain or improve the existing water quality.<br>❑ Objective is the 90 percentile (1987-2006) open water concentrations in the Bow River at Cochrane. | 27, 28 |
| Total Organic Carbon | Bow River Below Park Boundary | ❑ WQO: Should not exceed 3.0 mg/L (instantaneous). | Year Round<br>Cochrane<br>00-06<br>Monthly<br>0.82<br>$(1.51)^{90}$ | ❑ Value excludes periods of snowmelt runoff, mountain runoff, and significant precipitation events.<br>❑ TOC is generally lower in these upper reaches.<br>❑ Increasing TOC levels in the source water has affected the treatment process of water at many surface water treatment plans. TOC >3 mg/L result in increased coagulant and chlorine demands, and gets worse as TOC levels get higher. (UEWG 1999) | |
| Total Phosphorus | Bow River Below Park Boundary | ❑ WQO: 0.014 mg/L TP | Open Water<br>Cochrane<br>87-06<br>Monthly<br>0.004<br>$(0.014)^{90}$ | ❑ Based on trying to maintain or improve the existing water quality.<br>❑ Objective is the $90^{th}$ percentile (1987-2006) open water concentrations in the Bow River at Cochrane. | 27, 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Suspended Solids | Bow River Below Park Boundary | ❑ WQO: CCME (CCME 1999) | Year Round<br>Cochrane<br>87-06<br>monthly<br>1.0<br>$(6.0)^{90}$ | ❑ To maintain existing water quality for aquatic life. | 27, 50, 52, 54 |
| Water Temperature | Bow River Below Park Boundary | ❑ WQO: Should not exceed 22°C at any time or a 7-day mean of 18°C. | Open Water<br>Cochrane<br>87-06<br>monthly<br>10.4<br>$(15.07)^{90}$<br>$(18.02)^{max}$ | ❑ To protect most sensitive native fish, namely mountain whitefish.<br>❑ Maximum values are based on Taylor & Barton 1992. | 2, 16, 27 |
| Riparian Condition[m] | Bow River Below Park Boundary | ❑ TARGET: Maintaining a "healthy" rating using Cows and Fish rating system. | | ❑ Based on the best available data, targets were set at one level higher than initial conditions measured using the Cows and Fish Riparian Health Inventory rating system (Fitch and Ambrose 2003) (e.g., "unhealthy" ➔ "healthy with problems" ➔ "healthy"). If the river and/or reach previously rated as "healthy", the target remained as "healthy". In all cases, the long-term goal is "healthy". | 45, 47, 49, 57, 59 |
| Soil Erosion[n] | Bow River Below Park Boundary | ❑ TARGET: An erosion and sediment control (ESC) plan should be designed with a T-value or maximum soil erosion rate target of 2t/ha/yr where disturbed land has direct connection to a water body (no buffer, no interception). Applies to all construction sites and endures for the life of the project (during and post construction phases). | | ❑ For new developments that are permitted within the defined boundaries, Operating Ground Rules are in place to minimize erosion and sedimentation (ASRD).<br>❑ An erosion and sediment control plan (ESC) must be developed, implemented and monitored for construction sites with any direct connection to surface water.<br>❑ An ESC plan should be prepared by a qualified professional (a professional certification that includes erosion and sediment control as a field of expertise).<br>❑ Based on methods described in Wall et al 2002. | 45, 48, 50, 51, 52 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Attached Algae (Periphyton) Biomass-defined as chlor a | Bow River Central | ❑ WQO: No periphytic algal biomass that adversely affects users.<br>❑ Target: 150 mg/$m^2$ maximum value during open water season | Open Water<br>Carseland<br>87-98<br>monthly<br>205<br>$(469)^{90}$<br>$(682)^{max}$<br><br>99-06<br>monthly<br>121<br>$(242)^{90}$<br>$(432)^{max}$ | ❑ A literature review over many regions determined that periphyton concentrations above 150 mg/m2 are associated with adverse impacts on users (Welch et al 1998).<br>❑ Currently exceeded around Stier's ranch.<br>❑ Last 6 years there have been declines in periphyton biomass therefore this target was considered appropriate. | 14 |
| Dissolved Oxygen | Bow River Central | ❑ WQO: 5.0 mg/L (acute daily minimum), 6.5 chronic (7 day running average)<br>❑ WARNING LEVEL: 5.5 mg/L (acute daily minimum)<br>❑ TARGET: 6.0 mg/L (acute daily minimum), 8.0 mg/L[9] (acute daily minimum) for spawning and incubation from October to end of May from WID Weir to Hwy 22, 9.5 mg/L upstream of WID Weir from Oct. to end of June. | Open Water<br>Monthly<br>Carseland<br><br>87-05:<br>10.1<br>$(9.0)^{10}$<br>$(7.7)^{min}$<br><br>Hourly<br>Above Highwood<br>2006:<br>8.49<br>$(5.53)^{10}$<br>$(4.08)^{min}$ | ❑ 5.0 mg/L is the Alberta guideline, which provides a threshold for aquatic effects and a margin of safety.<br>❑ 5.5 mg/L is the warning level used for the Highwood River.<br>❑ The Calgary Total Loading Management Plan adopted a trigger value of 340 kg/day for total phosphorus (CoC 2005). It is based on maintaining the surface water quality guideline of 5.0 mg/L dissolved oxygen as a cross-sectional average across the Bow River just upstream of the confluence of the Highwood River at a frequency of compliance of 99.91%.<br>❑ 8.0 mg/L is to protect brown trout spawning in this reach [5 mg/L + 3 mg/L (safety margin (CCME 1999)]<br>❑ 9.5 mg/L to protect rainbow trout spawning in this reach.<br>❑ During spawning periods, there is a recognized need to have a higher level of DO in the water column to ensure 5.0 mg/L within gravel for eggs and incubation. | 2, 6, 7, 17, 24, 27, 28 |

[m] Healthy riparian condition filters nutrients and minimizes the runoff of sediments into receiving water bodies.
[n] Erosion is caused when soil particles are dislodged by water falling on or running across bare soil or vegetated areas that are unable to handle the force of the flowing water. Receiving water bodies adjacent to eroded stream banks tend to have poor water quality after storm events.
[9] Based on brown trout population.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Macrophytes | Bow River Central | ❑ WQO: No macrophyte biomass that adversely affects users. | AENV Macrophyte sites, M1-M8, g/m2<br>1979-1996:<br>Median: 503<br>Range: 0-3897<br>2006:<br>Median: 71.0<br>Range: 0-1273 | ❑ Numerical relationships between biomass and DO are poorly understood and need to be established. For example, higher macrophytes biomass may naturally occur in standing or slower moving water.<br>❑ Trying to relate measured macrophyte biomass in this reach to problems in irrigation district canals. | 14 |
| Nitrate (nitrate + nitrite (as N)) | Bow River Central | ❑ WQO: 1.5 mg/L<br>❑ WARNING LEVEL: Need to better understand the limiting factor for macrophytes and periphyton growth before assigning a warning limit.<br>❑ TARGET: Eliminate levels that cause nuisance aquatic plant growth.<br>❑ WQOs, warning levels and targets for nitrate apply during the growing / open water season. | Open Water<br>Carseland<br>87-05<br>monthly<br>0.622<br>(1.146)$^{90}$ | ❑ WQO of 1.5 mg/L nitrate was the concentration in the City of Calgary Total Loading Management model (Golder 2007) that corresponded to 5 mg/L DO for the period April to Sept 30.<br>❑ Nitrate + nitrite levels will be typically well below this objective except for occasional outliers during the open water season and levels may be exceeded during the winter.<br>❑ The model assumes that some form of nitrification is occurring at the Fish Creek WWTP. This objective may need to be revisited as improvements around the WWTP occur over time and as findings from related research recommendations become available. | 6, 7, 24, 27, 28, 29, 31 |
| Pathogens as indicated by E. coli | Bow River Central | ❑ WQO: Further research required.<br>❑ TARGET: Meet recreational guideline (<200 *E. coli* per 100 mL (geometric mean 5 samples /30 d). | Year Round<br>Carseland<br>94-05<br>monthly<br>23 per 100 mL<br>(205)$^{90}$ | ❑ Pathogen indicator loads are significant.<br>❑ It is recognized that E. coli in the Bow Central can be above recreational guidelines following storm events.<br>❑ Further research required to establish warning level. | 8, 28, 32 |
| Pathogens as indicated by fecal coliforms | Bow River Central | ❑ WQO: Meet 100 fecal coliforms per 100 mL (no single value to exceed objective) at the point of withdrawal | Year Round<br>Carseland<br>87-05<br>monthly<br>91 per 100 mL<br>(590)$^{90}$ | ❑ Irrigation guidelines set by CCME (CCME 1999).<br>❑ The WQO values can be briefly exceeded for short periods of time during storm events.<br>❑ Fecal coliforms at this site have declined greatly (medians<62) since disinfection installed at both Calgary wastewater treatment plants in 1997. | 8, 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Pathogens as indicated by Total Coliforms | Bow River Central | ❑ WQO: Should not exceed 20,000 counts (total coliforms) per 100 mL at intake for drinking water treatment plant. | Year Round<br>Carseland<br>87-94<br>monthly<br>870 per 100 mL (2900)[90] | ❑ The instantaneous objective of <20,000 counts/100 mL is based on conventional water treatment plant's ability to remove contaminants if pre-disinfection is present (US EPA 1991).<br>❑ Protects human health by ensuring that municipal water treatment plants can remove pathogens (e.g., bacteria, protozoa, and viruses) from raw water.<br>❑ Total coliforms are not typically monitored here. | 8, 28 |
| Pathogens – Giardia | Bow River Central | ❑ WQO: Should not exceed 100 cysts per 100L (instantaneous) for the Bearspaw Water Treatment Plant. | Insufficient data | ❑ This is the level above which will require in excess of 5-log reduction at the Bearspaw Water Treatment Plant (AENV 2006b).<br>❑ Higher levels of Giardia require new water treatment processes for small water supply systems in the Basin. Over time, as approvals come up for renewal, small water supply systems may be required to upgrade to treat higher levels of Giardia. | 3, 8, 28 |
| Pesticides and Degradation Products | Bow River Central | ❑ WQO: Should not exceed the lower of:<br>○ < 1/10 of federal drinking water guidelines or<br>○ < CCME guidelines for aquatic life in the river (CCME 1999). | Breakdown of data by reach not available (Anderson 2005)[10] | ❑ Protects drinking water and aquatic ecosystems.<br>❑ <1/10 of federal drinking water guidelines used to provide a safety margin to protect against compounds for which there is no treatment. | 31, 37, 38, 39, 41, 43, 44 |
| Total Ammonia | Bow River Central | ❑ WQO: The lower of US EPA or 0.2 mg/L ammonia during the growing season for growth of aquatic vegetation. To apply outside mixing zone (AENV 1995).<br>❑ TARGET: CCME (CCME 1999) | Open Water<br>Carseland<br>87-05<br>monthly<br>0.040 (0.160)[90] | ❑ 0.2 mg/L total ammonia was a fully-mixed concentration in the City of Calgary Management model (Golder 2007) that corresponded to 5 mg/L DO.<br>❑ The model assumes that some form of nitrification is occurring at the Fish Creek WWTP. This objective may need to be revisited as improvements around the WWTP occur over time and as findings from related research recommendations become available.<br>❑ Objectives are based on toxicity thresholds and aquatic plant growth. | 7, 24, 27, 28, 31 |

[10] Over entire Bow basin, (Anderson 2005; Table 4c) found 180 of 406 samples exceeded irrigation guidelines (mainly Dicamba and MCPA), 12 of 406 samples (mainly, 2,4-D and chlorpyrifos-ethyl exceeded aquatic life guidelines, and no exceedance of guidelines for drinking water or livestock watering.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Dissolved Phosphorus | Bow River Central | ❑ WQO: 0.015 mg/L TDP during the growing season for aquatic plants<br>❑ Provisional objective: 0.054 mg/L for winter season | Open Water<br>Carseland<br>83-05<br>monthly<br>0.016 mg/L<br>$(0.037)^{90}$<br><br>With Enhanced P Removal<br>monthly<br>2004: 0.008<br>2005: 0.006<br><br>Winter season<br>84-06<br>0.032<br>$(0.054)^{90}$ | ❑ Objective based on protecting DO and nuisance aquatic plants.<br>❑ Cross-sectional average TDP concentration that maintained DO levels above 5.0 mg/L in City of Calgary Total Loading Management model (Golder 2007) using data from the April to Sept time period.<br>❑ Provisional objective is the $90^{th}$ percentile based on historical data.<br>❑ Lower [TDP] have been observed with recent wastewater treatment upgrades. | 7, 24, 27, 28, 31 |
| Total Organic Carbon | Bow River Central | ❑ WQO: Should not exceed 5.0 mg/L (instantaneous)<br>❑ TARGET: Should not exceed 3.0 mg/L (instantaneous). | Year Round<br>Carseland<br>87-05<br>monthly<br>1.90<br>$(3.11)^{90}$ | ❑ Increasing TOC levels in the source water has affected the treatment process of water at many surface water treatment plans. TOC >3 mg/L result in increased coagulant and chlorine demands, and gets worse as TOC levels get higher (UEWG 1999).<br>❑ Values exclude periods of snowmelt runoff, mountain runoff, and significant precipitation events. | 9 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Phosphorus | Bow River Central | ❑ WQO: 0.028 mg/L<br>❑ TARGET: Eliminate levels that cause nuisance aquatic plant growth.<br>❑ Provisional WQO: 0.075 mg/L during winter season | Open Water<br>Carseland<br>83-05<br>monthly<br>0.038<br>$(0.095)^{90}$<br><br>With Enhanced P Removal<br>monthly<br>2004: 0.023<br>2005: 0.021<br><br>Winter season<br>Carseland<br>84-06<br>0.052<br>$(0.075)^{90}$ | ❑ Objective is based on protecting DO and the target relates to controlling the growth of aquatic plant growth. The TP objective was inferred from the TDP objective using observed TP:TDP ratios.<br>❑ Based on TLM model (Golder 2007) using an average TDP concentration during Apr. to Sept. that maintained DO above 5.0 mg/L and a TDP:TP ratio of approx. 55%.<br>❑ Although there is currently no CCME guideline for phosphorus, the Bow River water quality objective is in the middle of the "trigger range" of TP concentration (0.020-0.035 mg/L) that CCME 2004 recommends for mesotrophic rivers (those with moderate levels of productivity), above which management action and investigation is required. It is also within the range of TP levels (0.018 – 0.030 mg/L) that corresponded to nuisance growth of periphyton in studies reviewed in Sosiak 2004.<br>❑ The WQO may be exceeded during storm events due to particulate phosphorus.<br>❑ With the addition of alum treatment, concentrations have declined in the last couple of years.<br>❑ Provisional objective is the $90^{th}$ percentile based on historical data | 7, 24, 27, 28, 31 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Suspended Solids | Bow River Central | WQO: If the background[11] concentration is:<br>○ < 25 mg/L conditions must not exceed an SEV value of 6<br>○ > 25 mg/L conditions must not exceed an SEV value of 7- (CCME 2002, Caux et al 1997)<br>○ >250 mg/L (CCME 2002) applies (conditions should not increase more than 10% above background levels when background is >250 mg/L)<br>❑ Calculation of the SEV value must be taken from fully mixed zone.<br>❑ WARNING LEVEL: Visible plume entering river during base river flow.<br>❑ TARGET: CCME (CCME 1999), increase compliance frequency with objectives | Year Round<br>Carseland<br>87-05<br>monthly<br>5.0<br>$(26.9)^{90}$ | ❑ There are different objectives to consider natural and anthropogenic TSS variation along the river.<br>❑ When the background is less than <250 mg/L, the objectives are based on SEV values derived from Newcombe and Jensen 1996. The approach relates the biological fish response to duration of exposure and suspended sediment concentration. The SEV values selected ensures that only a moderate level of physiological stress is endured by fish in this reach during 1 and 7 day exposure periods.<br>❑ SEV objectives are based on ASRD and DFOs' mandates which strive to ensure that fish and their habitats support success in all life stages. SEV exposure periods for 1 and 7 days were used to protect fish during storm events.<br>❑ It is recognized that the objectives may be temporarily exceeded during spring freshet and storm events.<br>❑ Warning narrative similar to what is used by the City of Calgary. | 18, 27, 28, 30, 31, 33, 50, 52, 53 |
| Water Temperature | Bow River Central | ❑ WQO: Should not exceed 24°C at any time. | Open Water<br>Carseland Above Highwood<br>87-05: Monthly 2006: hourly<br>12.4 17.37<br>$(17.1)^{90}$ $(19.81)^{90}$<br>$(20.2)^{max}$ $22.49^{max}$ | ❑ 24°C was used in the Highwood Water Management Plan.<br>❑ Temperatures above 26°C can be lethal to rainbow trout (Hokanson et al 1977).<br>❑ Need to also consider the interplay between oxygen & temperature. | 2, 7, 17, 24, 27 |

[11] Two general approaches are considered acceptable to define background concentrations of water quality variables which involve (CCME 2002 pg20- Site-specific guidance): -Utilization of historically-collected water quality data for site (i.e., prior to the commencement of activities that could have substantially altered water quality conditions); or -Monitoring contemporary water quality conditions at one or more stations located upstream of contaminant sources.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Riparian Condition | Bow River Central | ❑ TARGET: a "healthy" rating using Cows and Fish rating system | | ❑ Based on the best available data, targets were set at one level higher than initial conditions measured using the Cows and Fish Riparian Health Inventory rating system (Fitch and Ambrose 2003) (e.g., "unhealthy" ➔ "healthy with problems" ➔ "healthy"). If the river and/or reach previously rated as "healthy", the target remained as "healthy". In all cases, the long-term goal is "healthy". | 45, 47, 49, 57, 59 |
| Soil Erosion | Bow River Central | ❑ TARGET: An erosion and sediment control (ESC) plan should be designed with a T-value or maximum soil erosion rate target of 2t/ha/yr where disturbed land has direct connection to a water body (no buffer, no interception). Applies to all construction sites and endures for the life of the project (during and post construction phases). | | ❑ An erosion and sediment control plan (ESC) must be developed, implemented and monitored for construction sites with any direct connection to surface water.<br>❑ An ESC plan should be prepared by a qualified professional (a professional certification that includes erosion and sediment control as a field of expertise).<br>❑ Based on methods described in Wall et al 2002. | 30, 31, 45, 47, 50, 51, 52 |
| Attached Algae (Periphyton) Biomass-defined as chlor a | Bow River Lower | ❑ WQO: No periphytic algal biomass that adversely affects users.<br>❑ Target: 150 mg/$m^2$ maximum value during open water season | Open Water<br>Ronalane<br>87-05<br>monthly<br>53<br>$(109)^{90}$<br>$(493)^{max}$<br>last exceeded 150 mg/m2 in 1987 | ❑ A literature review over many regions determined that periphyton concentrations above 150 mg/m2 are associated with adverse impacts on users (Welch et al 1998). | 14 |
| Dissolved Oxygen | Bow River Lower | ❑ WQO 5.0 mg/L (acute daily minimum), 6.5 chronic (7 day running average) | Open Water<br>Ronalane<br>87-05 2000<br>monthly hourly<br>10.1 8.79<br>$(8.0)^{10}$ $(6.93)^{10}$<br>$(3.7)^{min}$ $(5.75)^{min}$ | ❑ These values support the species of concern (e.g., sturgeon) and the main sport fish (e.g. Walleye, Northern pike). | 2, 24, 27, 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Macrophytes | Bow River Lower | ❑ WQO: No macrophyte biomass that adversely affects users. | Peak macrophyte biomass of 105 g/m$^2$ below Bassano Dam during 1994-97 synoptic surveys (WRS 2004) | ❑ Numerical relationships between biomass and DO are poorly understood and need to be established. For example, higher macrophytes biomass may naturally occur in standing or slower moving water.<br>❑ Trying to relate measured macrophyte biomass in this reach to problems in irrigation district canals. | 14 |
| Nitrate (nitrate + nitrite (as N)) | Bow River Lower | ❑ WQO: 1.5 mg/L<br>❑ WARNING LEVEL: Need to better understand the limiting factor for macrophytes and periphyton growth before assigning a warning limit.<br>❑ TARGET: Eliminate levels that cause nuisance aquatic plant growth.<br>❑ WQOs, warning levels and targets for nitrate apply during the growing / open water season. | Open Water<br>Ronalane<br>87-05<br>monthly<br>0.166<br>(0.596)$^{90}$ | ❑ WQO of 1.5 mg/L nitrate was the concentration in the City of Calgary Total Loading Management model (Golder 2007) that corresponded to 5 mg/L DO for the period April to Sept 30.<br>❑ Although the City of Calgary model was not designed for this reach, it is assumed that the model's predicted limit is appropriate and it has been applied to this reach as well.<br>❑ Nitrate + nitrite levels will be typically well below this objective except for occasional outliers during the open water season and levels may be exceeded during the winter.<br>❑ The model assumes that some form of nitrification is occurring at the Fish Creek WWTP. This objective may need to be revisited as improvements around the WWTP occur over time and as findings from related research recommendations become available. | 24, 27, 28 |
| Pathogens as indicated by E. coli | Bow River Lower | ❑ WQO: Meet recreational guideline – no single value to exceed 400 *E.coli*/ per 100 mL or (<200 *E. coli* per 100 mL (geometric mean 5 samples /30 d). | Year Round<br>Ronalane<br>94-05<br>monthly<br>6 per 100 mL<br>(43)$^{9}$0 | ❑ 400 E. coli/100 mL is the re-sampling guideline (CCME 1999). | 28 |
| Pathogens as indicated by fecal coliforms | Bow River Lower | ❑ WQO: Meet 100 fecal coliforms per 100 mL (no single value to exceed objective) at the point of withdrawal. | Year Round<br>Ronalane<br>87-05<br>monthly<br>10 per 100 mL<br>(109)$^{90}$ | ❑ Irrigation guidelines set by CCME (CCME 1999).<br>❑ The WQO values can be briefly exceeded for short periods of time during storm events. | 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Pathogens as indicated by Total Coliforms | Bow River Lower | ❑ WQO: Should not exceed 20,000 counts (total coliforms) per 100 mL at intake for drinking water treatment plant. | Year Round<br>Ronalane<br>87-94<br>monthly<br>66 per 100 mL<br>(580)[90] | ❑ The instantaneous objective of <20,000 counts/100 mL is based on conventional water treatment plant's ability to remove contaminants if pre-disinfection is present (US EPA 1991).<br>❑ Protects human health by ensuring that municipal water treatment plants can remove pathogens (e.g., bacteria, protozoa, and viruses) from raw water.<br>❑ Total coliforms are not typically monitored here. | 28 |
| Pathogens – Giardia | Bow River Lower | ❑ WQO: Not set for this reach. However, Giardia is an important issue, and agencies should continue to monitor for Giardia and attempt to identify and reduce sources. | Insufficient data | ❑ Insufficient data to make recommendation. We need to first determine Giardia counts in surface water reaches that can be effectively treated by different methods.<br>❑ Higher levels of Giardia require new water treatment processes for small water supply systems in the Basin. Over time, as approvals come up for renewal, small water supply systems may be required to upgrade to treat higher levels of Giardia. | 3 |
| Pesticides and Degradation Products | Bow River Lower | ❑ WQO: Should not exceed the lower of:<br>o < 1/10 of federal drinking water guidelines or<br>o < CCME guidelines for aquatic life in the river (CCME 1999). | Breakdown of data by reach not available (Anderson 2005)[12]. | ❑ Protects drinking water and aquatic ecosystems.<br>❑ <1/10 of federal drinking water guidelines used to provide a safety margin to protect against compounds for which there is no treatment. | 37, 38, 39, 41, 42 |
| Total Ammonia | Bow River Lower | ❑ WQO: The lower of US EPA or 0.2 mg/L ammonia during the growing season for growth of aquatic vegetation. To apply outside mixing zones (AENV 1995).<br>❑ TARGET: CCME (CCME 1999) | Open Water<br>Ronalane<br>87-05<br>monthly<br>0.010<br>(0.072)[90] | ❑ 0.2 mg/L total ammonia was a fully-mixed concentration in the City of Calgary Total Loading Management model (Golder 2007) that corresponded to 5 mg/L DO.<br>❑ Although the City of Calgary model was not designed for this reach, the model predicted limit is appropriate and has been applied to this reach as well.<br>❑ The model assumes that some form of nitrification is occurring at the Fish Creek WWTP. This objective may need to be revisited as improvements around the WWTP occur over time and as findings from related research recommendations become available.<br>❑ Objectives are based on toxicity thresholds and aquatic plant growth. | 24, 27, 28 |

[12] Over entire Bow basin, (Anderson 2005; Table 4c) found 180 of 406 samples exceeded irrigation guidelines (mainly Dicamba and MCPA), 12 of 406 samples (mainly 2,4-D and chlorpyrifos-ethyl exceeded aquatic life guidelines, and no exceedance of guidelines for drinking water or livestock watering.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Dissolved Phosphorus | Bow River Lower | ❑ WQO: 0.015 mg/L TDP during the growing season for aquatic plants<br>❑ Provisional objective: 0.025 mg/L for winter season | Open Water<br>Ronalane<br>83-05<br>monthly<br>0.007 mg/L<br>$(0.017)^{90}$<br><br>Winter season<br>84-05<br>0.007<br>$^{(0.025)}90$ | ❑ Objective is based on protecting DO and reducing nuisance aquatic plant growth.<br>❑ Although the City of Calgary model (Golder 2007) was not designed for this reach, the model's predicted limit is appropriate and has been applied to this reach as well using ave. conc. During Apr. to Sept.<br>❑ Based on TLM model (Golder 2007) using an average TDP concentration during Apr. to Sept. that maintained DO above 5.0 mg/L and a TDP:TP ratio of approx. 55%.<br>❑ Provisional objective is the 90$^{th}$ percentile based on historical data. | 24, 27, 28 |
| Total Organic Carbon | Bow River Lower | ❑ WQO: Should not exceed 5.0 mg/L (instantaneous)<br>❑ TARGET: Should not exceed 3.0 mg/L (instantaneous). | Year Round<br>Ronalane<br>87-05<br>monthly<br>2.55<br>$(4.20)^{90}$ | ❑ Increasing TOC levels in the source water has affected the treatment process of water at many surface water treatment plans. TOC >3 mg/L result in increased coagulant and chlorine demands, and gets worse as TOC levels get higher. (UEWG 1999)<br>❑ Values exclude periods of snowmelt runoff, mountain runoff, and significant precipitation events. | |
| Total Phosphorus | Bow River Lower | ❑ WQO: No recommendation for TP. TDP is believed to be the better WQO for this reach.<br>❑ TARGET: Eliminate levels that cause nuisance aquatic plant growth. | Open Water<br>Ronalane<br>83-05<br>monthly<br>0.027<br>$(0.095)^{90}$<br><br>With Enhanced P Removal<br>monthly<br>2004: 0.031<br>2005: 0.019<br><br>Winter season<br>1984-2006<br>0.020<br>$(0.041)^{90}$ | ❑ Total phosphorus in this reach is predominantly particulate phosphorus which can increase above this level with concurrent algae production. For this reason, total dissolved phosphorus is the better indicator for this reach. | 24, 27, 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Suspended Solids | Bow River Lower | ❑ WQO: If the background13 concentration is:<br>o <25 mg/L conditions must not exceed an SEV value of 6<br>o > 25 mg/L conditions must not exceed an SEV value of 7- (CCME 2002, et al 1997)<br>o >250 mg/L (CCME 2002) applies (conditions should not increase more than 10% above background levels when background is >250 mg/L)<br>❑ Calculation of the SEV value must be taken from fully mixed zone.<br>❑ WARNING LEVEL: Visible plume entering river during base river flow.<br>❑ TARGET: CCME (CCME 1999), increase compliance frequency with objectives | Year Round<br>Ronalane<br>87-05<br>monthly<br>9.6<br>$(80.0)^{90}$ | ❑ There are different objectives to consider natural and anthropogenic TSS variation along the river.<br>❑ When the background is less than <250 mg/L, the objectives are based on SEV values derived from Newcombe and Jensen 1996. The approach relates the biological fish response to duration of exposure and suspended sediment concentration. The SEV values selected ensures that only a moderate level of physiological stress is endured by fish in this reach during 1 and 7 day exposure periods.<br>❑ SEV objectives are based on ASRD and DFOs' mandates which strive to ensure that fish and their habitats support success in all life stages. SEV exposure periods for 1 and 7 days were used to protect fish during storm events.<br>❑ It is recognized that the objectives may be temporarily exceeded during spring freshet and storm events.<br>❑ Warning narrative similar to what is used by the City of Calgary. | 27, 50 |

[13] Two general approaches are considered acceptable to define background concentrations of water quality variables which involve (CCME 2002 pg20- Site-specific guidance): -Utilization of historically-collected water quality data for site (i.e., prior to the commencement of activities that could have substantially altered water quality conditions); or -Monitoring contemporary water quality conditions at one or more stations located upstream of contaminant sources.

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Water Temperature | Bow River Lower | ❑ WQO: Should not exceed 29°C at any time or a 7-day mean of 24°C.<br>❑ WARNING LEVEL: ABOVE BASSANO DAM: A warning level of 24°C should be used as a signal to stop all angling until such time as temperatures fall below 24°C for a period of 2 consecutive days. | Open Water<br>Ronalane Bow City<br>87-05 1998<br>Monthly Hourly<br>15.7 20.38<br>$(20.9)^{90}$ $(23.97)^{90}$<br>$(25.9)^{max}$ $(28.8)^{max}$ | ❑ Lake Sturgeon occur in this reach and are considered a species of concern in Alberta.<br>❑ Objective is based on Taylor and Barton 1992. | 2, 24, 27 |
| Riparian Condition | Bow River Lower | ❑ TARGET ABOVE BASSANO DAM: a "healthy" rating using the Cows and Fish rating system<br>❑ TARGET BELOW BASSANO DAM: a "healthy with problems" rating using the Cows and Fish rating system | | ❑ Based on the best available data, targets were set at one level higher than initial conditions measured using the Cows and Fish Riparian Health Inventory rating system (Fitch and Ambrose 2003) (e.g., "unhealthy" ➔ "healthy with problems" ➔ "healthy"). If the river and/or reach previously rated as "healthy", the target remained as "healthy". In all cases, the long-term goal is "healthy". | 45, 47, 49, 57, 59 |
| Soil Erosion | Bow River Lower | ❑ TARGET: An erosion and sediment control (ESC) plan should be designed with a T-value or maximum soil erosion rate target of 2t/ha/yr where disturbed land has direct connection to a water body (no buffer, no interception). Applies to all construction sites and endures for the life of the project (during and post construction phases). | | ❑ An erosion and sediment control plan (ESC) must be developed, implemented and monitored for construction sites with any direct connection to surface water.<br>❑ An ESC plan should be prepared by a qualified professional (a professional certification that includes erosion and sediment control as a field of expertise).<br>❑ Based on methods described in Wall et al 2002. | 45, 48, 50, 51 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Attached Algae (Periphyton) Biomass-defined as chlor a | Elbow River Central | ❑ WQO: 150 mg/m$^2$ maximum value during open water season | Open Water<br>Sarcee Bridge<br>88-89<br>monthly<br>105.1<br>(143.1)$^{75}$<br>(174.4)$^{max}$<br>Not currently monitored | ❑ A literature review over many regions determined that periphyton concentrations above 150 mg/m2 are associated with adverse impacts on users (Welch et al 1998). | 14 |
| Dissolved Oxygen | Elbow River Central | ❑ WQO: CCME (CCME 1999) with protection of spawning and incubation .<br>○ 9.5 mg/L for spawning and incubation<br>○ 6.5 mg/L for acute daily minimum. | Open Water<br>Weaselhead<br>00-06<br>monthly<br>9.7<br>(8.5)$^{10}$<br>(7.0)$^{min}$ | ❑ CCME minimum for adult and juvenile cold-water fish<br>❑ Requires fishery inventory to determine spawning areas. | 2, 28 |
| Nitrate (nitrate + nitrite (as N)) | Elbow River Central | ❑ WQO: 0.267 mg/L<br>❑ WARNING LEVEL: 0.132 mg/L<br>❑ WQOs, warning levels and targets for nitrate apply during the growing / open water season. | Open Water<br>Weaselhead<br>97-06<br>monthly<br>0.065<br>(0.129)$^{90}$ | ❑ Protects against stimulation of excessive algal growth to protect municipal water supplies.<br>❑ Nitrogen may be entering the reach as a result of long-range transport.<br>❑ The value of 0.267 mg/L was obtained from Sosiak 2004 as the nitrate + nitrite level that corresponds to nuisance growth of periphyton.<br>❑ The warning level was developed based on the 90$^{th}$ percentile level for the period 1992 – 2006. | 27, 28, 35 |
| Pathogens as indicated by E. coli | Elbow River Central | ❑ WQO: Meet recreational guideline – no single value to exceed 400 *E.coli* per 100 mL or (<200 *E. coli* per 100 mL (geometric mean 5 samples /30 d). | Open water14<br>Weaselhead<br>94-06<br>monthly<br>28 per 100 mL<br>(167)$^{90}$ | ❑ 400 E. coli/100 mL is the CCME re-sampling guideline (CCME 1999). | 28, 32 |
| Pathogens as indicated by fecal coliforms | Elbow River Central | ❑ WQO: Meet 100 fecal coliforms per 100 mL (no single value to exceed objective) at the point of withdrawal. | No baseline data currently available | ❑ Irrigation guidelines set by CCME (CCME 1999).<br>❑ The WQO values can be briefly exceeded for short periods of time during storm events. | 28 |

[14] Most available data from April-September, although some years include March, October and November data

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Pathogens as indicated by Total Coliforms | Elbow River Central | ❑ WQO: Should not exceed 20,000 counts (total coliforms) per 100 mL at intake for drinking water treatment plant. | Open water[15]<br>Weaselhead<br>93-06<br>monthly<br>444 per 100 mL<br>(2420)$^{90}$ | ❑ The instantaneous objective of <20,000 counts/100 mL is based on conventional water treatment plant's ability to remove contaminants if pre-disinfection is present (US EPA 1991).<br>❑ Protects human health by ensuring that municipal water treatment plants can remove pathogens (e.g., bacteria, protozoa, and viruses) from raw water. | 28, 34 |
| Pathogens – Giardia | Elbow River Central | ❑ WQO: Should not exceed 100 cysts per 100 L (instantaneous) at the intake for Glenmore Water Treatment Plant. | Year Round cysts/100 L<br><br>Weaselhead<br>97-05<br>24<br>(172)$^{90}$ | ❑ This is the level above which will require in excess of 5-log reduction at the Glenmore Water Treatment Plant (AENV 2006b).<br>❑ Giardia is more of a concern on the Elbow than the Bow, as levels are typically higher on the Elbow River. For this reason, the treatment facility has a clearwell to increase the chlorine contact time.<br>❑ Higher levels of Giardia require new water treatment processes for small water supply systems in the Basin. Over time, as approvals come up for renewal, small water supply systems may be required to upgrade to treat higher levels of Giardia. | 3, 28 |
| Pesticides and Degradation Products | Elbow River Central | ❑ WQO: Should not exceed the lower of:<br>o < 1/10 of federal drinking water guidelines or<br>o < CCME guidelines for aquatic life in the river (CCME 1999). | Insufficient data | ❑ Provisional objective as there is currently no ongoing monitoring available at this time to set an objective.<br>❑ Protects drinking water and aquatic ecosystems.<br>❑ <1/10 of federal drinking water guidelines used to provide a safety margin to protect against compounds for which there is no treatment. | 31, 37, 38, 39, 41, 42, 44 |
| Total Ammonia | Elbow River Central | ❑ WQO: Should not exceed 0.04 mg/L in the river for municipal water supply, and should not exceed CCME guideline for protection of aquatic life (CCME 1999). To apply outside mixing zones. | Open Water<br>Weaselhead<br>97-06<br>monthly<br>0.010<br>(0.020)$^{90}$ | ❑ Protects municipal water supply from unacceptable chlorine demand.<br>❑ Based on experience at Glenmore Water Treatment Plant.<br>❑ This is more restrictive than the current CCME guideline.<br>❑ Designed to protect aquatic life and takes into account the influence of both temperature and pH on the toxicity of ammonia.<br>❑ This objective does not represent a value to protect the river against excessive growth of aquatic plants. | 27, 28 |

[15] Mostly April-September, although some years include March, October and November dates

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Dissolved Phosphorus | Elbow River Central | ❑ WQO: 0.009 mg/L TDP<br>❑ TARGET: Eliminate levels that cause nuisance aquatic plant growth. | Open Water<br>Weaselhead<br>93-06<br>monthly<br>0.002<br>$(0.009)^{90}$ | ❑ Based on 90th percentile (1993-2006) for all available data from March to November at the Elbow River at Weaselhead. | 27, 28 |
| Total Organic Carbon | Elbow River Central | ❑ WQO: Should not exceed 5.0 mg/L (instantaneous).<br>❑ TARGET: Should not exceed 3.0 mg/L (instantaneous). | Open Water16<br>Weaselhead<br>93-06<br>monthly<br>1.41<br>$(3.97)^{90}$ | ❑ Values exclude periods of snowmelt runoff, mountain runoff, and significant precipitation events. | 9 |
| Total Phosphorus | Elbow River Central | ❑ WQO: No recommendation for TP. TDP is believed to be the better WQO for this reach.<br>❑ TARGET: Eliminate levels that cause nuisance aquatic plant growth. | Open Water<br>Weaselhead<br>93-06<br>monthly<br>0.011<br>$(0.089)^{90}$ | ❑ Total phosphorus in this reach is predominantly particulate phosphorus which can increase above this level without concurrent algae production. For this reason, total dissolved phosphorus is the better indicator for this reach. | 27, 28 |

[16] Include some March and November data

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Suspended Solids | Elbow River Central | WQO: If the background[17] concentration is:<br>o < 25 mg/L conditions must not exceed an SEV value of 6<br>o > 25 mg/L conditions must not exceed an SEV value of 7- (CCME 2002, Caux et al 1997)<br>o > 250 mg/L (CCME 2002) applies (conditions should not increase more than 10% above background levels when background is >250 mg/L)<br>❑ Calculation of the SEV value must be taken from fully mixed zone.<br>❑ WARNING LEVEL: Visible plume entering river during base river flow.<br>❑ TARGET: CCME (CCME 1999), increase compliance frequency with objectives | Open water18<br>Weaselhead<br>98-06<br>monthly<br>8.1<br>$(62.0)^{90}$ | ❑ Trend analysis has indicated that levels of suspended solids are increasing.<br>❑ There are different objectives to consider natural and anthropogenic TSS variation along the river.<br>❑ When the background is less than <250 mg/L, the objectives are based on SEV values derived from Newcombe and Jensen 1996. The approach relates the biological fish response to duration of exposure and suspended sediment concentration. The SEV values selected ensures that only a moderate level of physiological stress is endured by fish in this reach during 1 and 7 day exposure periods.<br>❑ SEV objectives are based on ASRD and DFOs' mandates which strive to ensure that fish and their habitats support success in all life stages. SEV exposure periods for 1 and 7 days were used to protect fish during storm events.<br>❑ It is recognized that the objectives may be temporarily exceeded during spring freshet and storm events. | 27, 28, 31, 33, 50, 53 |
| Water Temperature | Elbow River Central | ❑ WQO: Should not exceed 18°C at any time or a 7-day mean of 18°C. | Open Water<br>Weaselhead<br>98-06<br>monthly<br>9.9<br>$(14.5)^{90}$<br>$(17.2)^{max}$ | ❑ 18°C is above the recorded maximum<br>❑ To protect most sensitive native fish, namely white fish.<br>❑ Chronic maximum based on Taylor & Barton 1992. | 2, 27 |

[17] Two general approaches are considered acceptable to define background concentrations of water quality variables which involve (CCME 2002 pg20- Site-specific guidance): -Utilization of historically-collected water quality data for site (i.e., prior to the commencement of activities that could have substantially altered water quality conditions); or -Monitoring contemporary water quality conditions at one or more stations located upstream of contaminant sources.

[18] Available data is mostly from April-Sept, although some years include March, October and November dates

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Riparian Condition | Elbow River Central | ❑ TARGET: maintaining a "healthy" rating using Cows and Fish rating system. | | ❑ Based on the best available data, targets were set at one level higher than initial conditions measured using the Cows and Fish Riparian Health Inventory rating system (Fitch and Ambrose 2003) (e.g., "unhealthy" ➔ "healthy with problems" ➔ "healthy"). If the river and/or reach previously rated as "healthy", the target remained as "healthy". In all cases, the long-term goal is "healthy". | 45, 47, 49, 56, 57, 59 |
| Soil Erosion | Elbow River Central | ❑ TARGET: An erosion and sediment control (ESC) plan should be designed with a T-value or maximum soil erosion rate target of 2t/ha/yr where disturbed land has direct connection to a water body (no buffer, no interception). Applies to all construction sites and endures for the life of the project (during and post construction phases). | | ❑ An erosion and sediment control plan (ESC) must be developed, implemented and monitored for construction sites with any direct connection to surface water.<br>❑ An ESC plan should be prepared by a qualified professional (a professional certification that includes erosion and sediment control as a field of expertise).<br>❑ Based on methods described in Wall et al 2002. | 27, 28, 29, 45, 48, 50, 51 |
| Attached Algae (Periphyton) Biomass-defined as chlor a | Elbow River Upper | ❑ WQO: 150 mg/m$^2$ maximum value during open water season<br>❑ Target: 47 mg/m$^2$ maximum | Open Water<br>Downstream Bragg Creek<br>88-89<br>monthly<br>14.8<br>$(21.5)^{75}$<br>$(61.1)^{max}$ | ❑ Target is an experimentally derived value based on 10 years of monitoring data for the Bow River near the Town of Banff. It is the value that represents the transition from good to fair rankings. In the absence of reach specific data for the Elbow, the upper Bow objective was considered a reasonable target.<br>❑ A literature review over many regions determined that periphyton concentrations above 150 mg/m2 are associated with adverse impacts on users (Welch et al 1998).<br>❑ Not currently monitored and no historic data in this reach, very sparse. | 14 |
| Dissolved Oxygen | Elbow River Upper | ❑ WQO: CCME (CCME 1999) with protection of spawning and incubation.<br>o 9.5 mg/L for spawning and incubation<br>o 6.5 mg/L for acute daily minimum. | Open Water<br>Above Bragg Ck.<br>00-06<br>monthly<br>10.6<br>$(9.4)^{10}$<br>$(8.1)^{min}$ | ❑ CCME provides a high-level of protection for saturated conditions. | 2 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Nitrate (nitrate + nitrite (as N)) | Elbow River Upper | ❑ WQO: 0.13 mg/L during the open water season | Open Water<br>Above Bragg Ck<br>99-06<br>monthly<br>0.083<br>(0.118)$^{90}$ | ❑ Trying to maintain this reach at its current trophic state.<br>❑ 90$^{th}$ percentile for Elbow River above Bragg Creek = 0.125 mg/L (1999 -2006). | 27, 35 |
| Pathogens as indicated by E. coli | Elbow River Upper | ❑ WQO: Meet recreational guideline – no single value to exceed 400 *E.coli* per 100 mL or (<200 *E. coli* per 100 mL (geometric mean 5 samples /30 d). | Year Round[19]<br>Above Bragg Ck.<br>98-06<br>monthly<br>4 per 100 mL<br>(22)$^{90}$ | ❑ 400 E. coli/100 mL is the CCME re-sampling guideline (CCME 1999). | 28 |
| Pathogens as indicated by Total Coliforms | Elbow River Upper | ❑ WQO: Should not exceed 20,000 total coliforms per 100 mL at intake for drinking water treatment plant. | Year Round[20]<br>Above Bragg Ck.<br>98-06<br>monthly<br>68 per 100 mL<br>(249)$^{90}$ | ❑ The instantaneous objective of <20,000 counts/100 mL is based on conventional water treatment plant's ability to remove contaminants if pre-disinfection is present (US EPA 1991).<br>❑ Protects human health by ensuring that municipal water treatment plants can remove pathogens (e.g., bacteria, protozoa, and viruses) from raw water. | 28, 34 |
| Pathogens – Giardia | Elbow River Upper | ❑ WQO: Not set for this reach. However, Giardia is an important issue, and agencies should continue to monitor for Giardia and attempt to identify and reduce sources. | Insufficient data | ❑ Insufficient data to make recommendation. We need to first determine Giardia counts in surface water reaches that can be effectively treated by different methods.<br>❑ Wildlife are the prime vectors of Giardia transmission in this reach. | 3 |
| Pesticides and Degradation Products | Elbow River Upper | ❑ WQO: Should not exceed the lower of:<br>o < 1/10 of federal drinking water guidelines or<br>o < CCME guidelines for aquatic life in the river (CCME 1999). (provisional objective) | Insufficient data | ❑ Provisional objective as there is currently no ongoing monitoring available at this time to set an objective.<br>❑ <1/10 of federal drinking water guidelines used to provide a safety margin to protect against compounds for which there is no treatment.<br>❑ Protects drinking water and aquatic ecosystems. | 37, 38, 39, 41, 42 |

[19] Not entirely year round historical data, year round data for 2004-2006
[20] Not entirely year round for all years in the period of record (2004-2006)

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Ammonia | Elbow River Upper | ❑ WQO: Should not exceed CCME guideline for protection of aquatic life (CCME 1999). To apply outside mixing zone (AENV 1995). | Open Water<br>Above Bragg Ck.<br>00-06<br>monthly<br>0.010<br>$(0.020)^{90}$ | ❑ Designed to protect aquatic life and takes into account the influence of both temperature and pH on the toxicity of ammonia.<br>❑ Historical total ammonia values have not exceeded 0.02 mg/L in 7 years of data. | 27, 28 |
| Total Dissolved Phosphorus | Elbow River Upper | ❑ WQO:0.006 mg/L TDP | Open Water<br>Above Bragg Ck.<br>00-06<br>monthly<br>0.001<br>$(0.006)^{90}$ | ❑ Based on year-round historical data at Elbow River above Bragg Creek using 90$^{th}$ percentile (2000-2006). | 28 |
| Total Organic Carbon | Elbow River Upper | ❑ WQO: Should not exceed 5.0 mg/L (instantaneous).<br>❑ TARGET: Should not exceed 3.0 mg/L (instantaneous). | Open Water21<br>Above Bragg Ck.<br>00-06<br>monthly<br>0.960<br>$(3.76)^{90}$ | ❑ Values exclude periods of snowmelt runoff, mountain runoff, and significant precipitation events. | |
| Total Phosphorus | Elbow River Upper | ❑ WQO: 0.019 mg/L TP | Open Water<br>Above Bragg Ck.<br>99-06<br>monthly<br>0.003<br>$(0.019)^{90}$ | ❑ Based on historical data at Elbow River above Bragg Creek using 90$^{th}$ percentile. | 28 |
| Total Suspended Solids | Elbow River Upper | ❑ WQO: CCME (CCME 1999) | Year Round22<br>Above Bragg Ck.<br>01-06<br>monthly<br>1.0<br>$(16.7)^{90}$ | ❑ To maintain existing water quality for the protection of aquatic life. | 27, 50, 52, 54 |

[m] Healthy riparian condition filters nutrients and minimizes the runoff of sediments into receiving water bodies.
[21] Include some March and November data
[22] Data record is not entirely year round for all years is for 2004-2006 data

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Water Temperature | Elbow River Upper | ❑ WQO: Should not exceed 18°C at any time or a 7-day mean of 15°C. | Open Water<br>Above Bragg Ck<br>98-06<br>monthly<br>8.8<br>$(11.3)^{90}$<br>$(14.0)^{max}$ | ❑ 14°C is the recorded maximum in the Elbow River above Bragg Creek.<br>❑ To protect most sensitive native fish, namely bull trout<br>❑ Chronic maximum based on Taylor & Barton 1992. | 2, 27 |
| Riparian Condition | Elbow River Upper | ❑ TARGET: maintaining a "healthy" rating using Cows and Fish rating system. | | ❑ Based on the best available data, targets were set at one level higher than initial conditions measured using the Cows and Fish Riparian Health Inventory rating system (Fitch and Ambrose 2003) (e.g., "unhealthy" ➔ "healthy with problems" ➔ "healthy"). If the river and/or reach previously rated as "healthy", the target remained as "healthy". In all cases, the long-term goal is "healthy". | 45, 47, 49, 57, 59 |
| Soil Erosion | Elbow River Upper | ❑ TARGET: An erosion and sediment control (ESC) plan should be designed with a T-value or maximum soil erosion rate target of 2t/ha/yr where disturbed land has direct connection to a water body (no buffer, no interception). Applies to all construction sites and endures for the life of the project (during and post construction phases). | | ❑ For new developments that are permitted within the defined boundaries, Operating Ground Rules are in place to minimize erosion and sedimentation (ASRD).<br>❑ An erosion and sediment control plan (ESC) must be developed, implemented and monitored for construction sites with any direct connection to surface water.<br>❑ An ESC plan should be prepared by a qualified professional (a professional certification that includes erosion and sediment control as a field of expertise).<br>❑ Based on methods described in Wall et al 2002. | 45, 50, 51, 52, 54 |
| Attached Algae (Periphyton) Biomass-defined as chlor a | Nose Creek | ❑ WQO: No periphytic algal biomass that adversely affects users.<br>❑ Target: 150 mg/$m^2$ maximum value during open water season | Open Water<br>Downstream Airdrie<br>99-01<br>monthly<br>48<br>$(136)^{90}$<br>$(257.2)^{max}$ | ❑ Creeks may be light-limited so the amount of periphyton is highly variable depending on location.<br>❑ A literature review over many regions determined that periphyton concentrations above 150 mg/m2 are associated with adverse impacts on users (Welch et al 1998).<br>❑ Not currently monitored. | 19 |
| Dissolved Oxygen | Nose Creek | ❑ WQO: Not recommended at this time.<br>❑ TARGET: 5.0 mg/L (acute daily minimum), 6.5 chronic (7-day running average). | Open Water At Mouth 95-06 7.1 $(4.8)^{10}$ $(2.3)^{min}$<br>Open Water At Mouth 2004 6.6 $(4.52)^{10}$ $(2.21)^{min}$ | ❑ Action and more research is required before setting a WQO.<br>❑ DO is currently going well below 5.0, at both the mouth and the City of Calgary limit (can go as low as 3.0 mg/L). | 2, 11, 27, 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Nitrate (nitrate + nitrite (as N) | Nose Creek | ❑ WQO: 1.5 mg/L<br>❑ TARGET: Eliminate levels that cause nuisance aquatic plant growth.<br>❑ WARNING LEVEL: Need to better understand the limiting factor for macrophytes and periphyton growth before assigning a warning level.<br>❑ All apply during the growing season. | Open water<br>At the Mouth<br>95-06<br>monthly<br>0.500 as nitrate<br>$(1.408)^{90}$ as nitrate | ❑ Although exceeded at times, the WQO is reasonable and will be a catalyst for action.<br>❑ WQO of 1.5 mg/L nitrate was the concentration in the City of Calgary Total Loading Management that corresponded to 5 mg/L DO for the period April to Sept 30 (Golder 2007).<br>❑ Although the City of Calgary model was not designed for Nose Creek, the model's predicted limit is appropriate and has been applied to this reach as well. | 27, 28 |
| Pathogens as indicated by fecal coliforms | Nose Creek | ❑ TARGET: Meet 100 fecal coliforms per100 mL (no single value to exceed objective) at the point of withdrawal | Year Round<br>At the Mouth<br>95-06<br>monthly<br>350 per 100 mL<br>$(2540)^{90}$ | ❑ Irrigation guidelines set by CCME (CCME 1999).<br>❑ The WQO values can be briefly exceeded for short periods of time during storm events.<br>❑ The challenge for Nose Creek is to determine what pathogen levels will be indicative of negative impacts to human health, stock health and pet health. | 28 |
| Pesticides and Degradation Products | Nose Creek | ❑ WQO: Not recommended at this time.<br>❑ TARGET: Should not exceed CCME guidelines for aquatic life in the river (CCME 1999). | 1999-2001 (Cross 2002): samples exceeding CCME irrigation<br>MCPA: 35%<br>Dicamba: 59%<br>(sensitive crops) | ❑ Guidelines are currently being exceeded. | 37, 38, 39, 41, 42, 44 |
| Total Ammonia | Nose Creek | ❑ WQO: US EPA during the growing season for growth of aquatic vegetation. To apply outside mixing zone (AENV 1995).<br>❑ TARGET: CCME (CCME 1999) | Open Water<br>At the Mouth<br>95-06<br>monthly<br>0.250<br>$(0.500)^{90}$ | ❑ Currently both the WQO and target are exceeded at times.<br>❑ Ammonia can be toxic to fish and other aquatic species. | 27, 28 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Total Dissolved Phosphorus | Nose Creek | ❑ WQO: To be developed. | Open Water<br>At the Mouth<br>99-06 (as DRP)<br>monthly<br>0.020<br>$(0.070)^{90}$ | ❑ Values fluctuate widely throughout the basin.<br>❑ Sources are likely urban storm water and agricultural runoff adjacent to the stream. | 27, 28, 36 |
| Total Phosphorus | Nose Creek | ❑ WQO: To be developed.<br>❑ TARGET: Reduction in number of exceedances of the SWQG. | Open water<br>At the Mouth<br>95-06<br>monthly<br>0.170<br>$(0.500)^{90}$ | ❑ The provincial guideline is frequently exceeded, with values fluctuating widely throughout the basin.<br>❑ West Nose is in better condition but is still two times higher than the SWQG.<br>❑ Sources are urban storm water and agricultural runoff adjacent to the stream. | 27, 28, 36 |
| Total Suspended Solids | Nose Creek | ❑ WQO: To be developed.<br>❑ TARGET: Maintain and then reduce TSS loadings from current levels. | Year Round<br>At the Mouth<br>95-06<br>monthly<br>19.0<br>$(62.1)^{90}$ | ❑ Highest levels are at the mouth and downstream of Airdrie probably resulting from urban runoff and urban flow alteration (higher flows).<br>❑ Nose Creek is a very turbid system with a mixture of natural sediments and those that result from human activities.<br>❑ Further work is required to determine what is natural and achievable. | 10, 27, 50, 55 |
| Water Temperature | Nose Creek | ❑ WQO: Should not exceed 29°C at any time or a 7-day mean of 24°C. | Open Water<br>At Mouth At Mouth<br>95-06 2004<br>Monthly hourly<br>13.10 16.57<br>$(18.91)^{90}$ $(20.94)^{90}$<br>$(20.50)^{max}$ $(26.2)^{max}$ | ❑ Objective is derived from Taylor and Barton 1992. | 2, 11, 27 |
| Riparian Condition | Nose Creek | ❑ TARGET FOR WEST NOSE CREEK: a "healthy" rating using the Cows and Fish rating system.<br>❑ TARGET FOR NOSE CREEK: a "healthy with problems" rating using the Cows and Fish rating system. | | ❑ Based on the best available data, targets were set at one level higher than initial conditions measured using the Cows and Fish Riparian Health Inventory rating system (Fitch and Ambrose 2003) (e.g., "unhealthy" ➔ "healthy with problems" ➔ "healthy"). If the river and/or reach previously rated as "healthy", the target remained as "healthy". In all cases, the long-term goal is "healthy".<br>❑ Also to follow riparian protection recommendations outlined in the Nose Creek Watershed Management Plan (NCWP 2006). | 45, 47, 49, 57, 59 |

| Proposed Indicator or Topic Area | Reach or River | WQOs, Warning Levels and Targets (Indicators with only targets are greyed) | Baseline Water Quality (median, percentiles), mg/L unless otherwise noted | Rationale | Related Recommendation Number in Table 2, BBWMP |
|---|---|---|---|---|---|
| Runoff, soil erosion and impervious areas | Nose Creek | ❑ TARGET: Impervious and runoff recommendations as detailed in the Nose Creek Watershed Water Management Plan[23]. | | ❑ To preserve the natural hydrological runoff volume to pre-development conditions (i.e., natural conditions).<br>❑ Based on the overall goal of trying to achieve pre-development rates & volumes entering the streams or rivers.<br>❑ An erosion and sediment control plan is required (encourage retrofitting where possible).<br>❑ Erosion control plan applies to any new development or construction site during and post construction. | 10, 26, 40, 45, 48, 50, 51, 55 |

[23] The Nose Creek Watershed Partnership website is located at www.nosecreekpartnership.com.

# Appendix B: Linkages of the BBWMP with Provincial, Regional and Bow River Basin Initiatives

## Provincial

### Water for Life: Alberta's Strategy for Sustainability

- The Alberta government has adopted a new approach to water management through Water for Life: Alberta's Strategy for Sustainability. Water for Life outlines key directions and priorities to guide future water management in Alberta. Water for Life is based on the following commitments to Albertans:
  - Albertans will be assured their drinking water is safe
  - Albertans will be assured that the province's aquatic ecosystems are maintained and protected
  - Albertans will be assured that water is managed effectively to support sustainable economic development
- The strategy also contains medium-term (2007-10) and long-term (2010-14) outcomes:
  - water management objectives and priorities for sustaining aquatic ecosystems are established through watershed plans
  - water is managed and allocated to sustain aquatic ecosystems and ensure their contribution to Alberta's natural capital and quality of life are maintained
  - water management objectives and priorities to support sustainable economic development are established through watershed plans
  - the overall efficiency and productivity of water use in Alberta has improved by 30 per cent from 2005 levels by 2015 (firm targets to be determined by the Alberta Water Council)
- While the Government of Alberta, led by Alberta Environment, will remain accountable and will continue to oversee water and watershed management activities in the province. Water for Life identifies three types of partnerships that are integral to achieving stewardship of our water resources:
  - provincial Water Advisory Council (Alberta Water Council)
  - Watershed Planning and Advisory Councils (WPACs)
  - Watershed Stewardship Groups (WSGs)

### Government of Alberta's First Nation Consultation Policy on Land Management and Resource Development

- The Government of Alberta is responsible for managing the development of its natural resources for the benefit of all Albertans. Alberta acknowledges that the existing Aboriginal and treaty rights of the Aboriginal peoples of Canada are recognized and affirmed by Section 35 of the Constitution Act (1982).

- Alberta will consult with First Nations where land management and resource development on provincial Crown land may infringe First Nation rights and traditional uses.

**Sustainable Resource and Environmental Management (SREM)**

- The SREM framework is designed to focus provincial government departments on delivering environmental outcomes through integrated policy making and performance measurement. SREM involves a tiered approach to achieving environmental outcomes (see table below). There is recognition in SREM that environmental quality can be achieved only if the cumulative effects of economic development can be effectively managed through long-term integrated actions. Assessment of the implications of economic development and growth strategies will assist with making appropriate decisions and achieving environmental outcomes.

| SREM Tier | Initiatives to Establish Environmental Outcomes |
|---|---|
| Provincial Scale: Vision & Mission | Government of Alberta and federal business plans; Water for Life; Alberta's Agri-Food Industry Growth Strategy; Economic Development Strategy; Canada and Alberta Biodiversity Strategies; Land Use Framework for Alberta; A Fish Conservation Strategy for Alberta; Municipal policies |
| Regional Scale: Priorities | Southern Alberta Landscapes: Eastern Slopes Policy |
| Sub-regional Scale: Objectives | Water management plans; Airshed management plans; Integrated Land Management program; Integrated Resource Management Plans; Access management plans; Municipal area structure plans; Species at Risk recovery plans; Best management practices; Inter-Municipal Partnership Strategies |
| Local Scale: Results | Regulatory approvals; Environmental Impact Assessment decisions; Local plans for parks, subdivisions, logging etc.; Total loading limits for individual streams; Local Cows & Fish initiatives; individual Environmental Farm Plans |

**The Shared Governance Model and Watershed Management Planning Framework, workshop discussion guide (draft- in progress)**

The document defines the shared- governance structure where provincial government and external parties collaboratively set goals, problem solve and share responsibility in the development and delivery of planning, programs or services, but government retains the legislative accountability.

The draft framework also recognizes the need to use consensus decision-making, outcome based planning and collaborative service delivery to achieve the Water for Life strategy goals. It has a broader focus than the framework for water management planning as it also addresses associated land use issues with a wider group of stakeholders through the partnership process.

### The Framework for Water Management Planning (under revision)

- The Framework for Water Management Planning outlines the planning direction for water management throughout the province. It is intended to provide consistent direction while at the same time allowing for enough flexibility to address different situations. It supports sustainable resource and environmental management, recognizes both short- and long-term needs and values for water, and considers local and regional perspectives.

- Central to the Framework is the Strategy for the Protection of the Aquatic Environment. This Strategy affirms the government's commitment to maintaining, and restoring and enhancing the aquatic ecosystem.

### A Fish Conservation Strategy for Alberta

- A Fish Conservation Strategy for Alberta outlines three provincial goals designed to sustain the abundance, distribution and diversity of fish populations at the carrying capacity of their habitats. The first goal (habitat maintenance) is to restore and maintain the productive capacity of fish habitat, and where possible, increase the amount of productive fish habitat. In this regard, the fish conservation strategy for Alberta endorses, as a working guideline, the federal Policy for the Management of Fish Habitat. The objective of that policy is to achieve a net gain of habitat for fish resources. (A Fish Conservation Strategy for Alberta – 2000-2005).

## REGIONAL

### A Policy for Resource Management of the Eastern Slopes

- This policy is intended to reflect the realities of the economic situation in Alberta and to provide for the maximum delivery of the full range of values and opportunities in the region while ensuring sustainability of the resource. Guidelines include:
  - the highest priority in the overall management of the Eastern Slopes is placed on watershed management. Recreation and tourism benefits from the private and public sectors are also extremely important
  - the natural resources of the Eastern Slopes will be developed, managed and protected in a manner consistent with principles of conservation and environmental protection

**Highwood Water Management Plan Phase One**

- The plan recommends the provision of the preferred scenario as the basis for development of a revised Highwood Diversion Plan. A series of contingent measures required for implementing the plan and verifying its performance are an inherent part of this recommendation.

**Kananaskis Country Sub-Regional Integrated Resource Plan (IRP)**

- This Plan presents the Government of Alberta's resource management policy for the public lands and resources within Kananaskis Country located southwest of Calgary. This IRP is linked to A Policy for Resource Management of the Eastern Slopes (Revised 1984) and the Recreation Policy of Kananaskis Country (1999). This Plan confirms the priorities for watershed protection and recreation development established in these two policies, while providing a guide for the management of such natural resources as timber, forage and natural gas (Kananaskis Country IRP – 1986).

**Kananaskis Country Recreation Policy (1999)**

- This policy guides future recreation/tourism development in Kananaskis Country by restricting size, location and number of future developments.

**Elbow Sheep Wildland Provincial Park Management Plan**

- This plan guides management of this protected area consistent with legislation and policies that are in effect. This plan provides a statement of management intent and objectives for the area. In addition, it identifies allowable public recreation activities and related facilities and provides guidelines for their future management.

**Forest Management Plans**

- Alberta Forest Management Planning Standard (June, 2005 and April, 1998 Versions) – These documents provide guidance to both the Crown and forest companies for the development and implementation of all forest management plans in the Province. These documents provide direction for the Crown and forest companies on the development of objectives and strategies for the conservation of soil and water resources.

- Alberta Timber Harvest Planning and Operating Ground Rules Framework for Renewal (December, 2005 Version) – This document provide the basis from which operating ground rules are developed for Crown Forest Management Units or for Forest Management Areas in the Province. Operating ground rules incorporate guidelines for the protection of water and watershed regarding timber and reforestation operations.

- 2004 Spray Lake Sawmills (1980) Ltd. Detailed Forest Management Plan (DFMP) (under revision) – Under their Forest Management Agreement, Spray Lake Sawmills is required to develop a long-range forest management plan that covers their Forest Management Area and the adjacent B9 Forest Management Unit. This DFMP sets out broad objectives and strategies based on sustainable forest management principles and practices. These objectives and strategies will provide guidance to the company in forest harvest planning and operations with the goal of a sustained yield of timber while recognizing other social and ecological values.

### Land Management Plans

- Forest Land Use Zones – A forest land use zone is an area of land to which legislative controls are applied to solve specific land use problems or conflicts. A forest land use zone can be used to: 1) protect areas containing sensitive resources such as wildlife and their habitats, vegetation, soils and watershed; and 2) separate or control conflicting recreational activities.

- McLean Creek Forest Land Use Zone – Off-Highway Vehicle – Operation of motor vehicles is permitted except as otherwise indicated by signs posted in the zone or by the written instructions of a forest officer.

- Sibbald Forest Land Use Zone – Snow Vehicle – Operation of snow vehicles is permitted except as otherwise indicated by signs posted in the zone or by the written instructions of a forest officer.

### CRP (Calgary Regional Partnership)

Land Use Plan – a land use plan is being formulated across 18 municipalities and one First Nation that considers economic development, regional servicing, water and ecology, regional transportation, development forms, climate change, agriculture, community services, and public health. Completion date is scheduled for spring 2009.

## BOW RIVER BASIN

### Fisheries Management Objectives for the upper Elbow River

- Upper Elbow River Fisheries Management Objectives Maintenance of water quality standards and establishment of instream flow need amounts to maintain optimal levels of fish production. Maintenance of an unobstructed channel above Glenmore Dam with adequate discharges to allow fish species unhindered movement upstream to spawn. Maintenance of aquatic habitat configuration (pools, riffles, refugia, substrate composition and bank stability) and riparian vegetation to sustain fish production.

**Ghost River Sub-Regional Integrated Resource Plan**

- This Plan presents the Government of Alberta's resource management policy for the public lands and resources within the Ghost and Waiparous areas located northwest of Calgary. The purpose of the plan was to provide enhanced management capabilities to the land manager (ASRD) so as to allow for the integration of recreational activities and the protection of ecological functioning. This IRP is linked to A Policy for Resource Management of the Eastern Slopes (Revised 1984). "The primary intent for resource management within the Ghost River Planning area is to allow for the development and use of the full range of available resources while minimizing adverse environmental impacts or watershed and renewable resources". (Ghost River IRP – 1988).

**Area Structure Plans**

- Examples include the Bearspaw Area Structure Plan, Central Springbank Area Structure Plan, North Springbank Area Structure Plan, Greater Bragg Creek ASP (under development), and Plan 8 Area Structure Plan (under development).

**Inter-municipal Development Plans**

- Examples include the Calgary/Rocky View Inter-municipal Development Plan, the Cochrane/Rocky View Inter-municipal Development Plan and the Calgary Regional Partnership Economic Development and Sustainability Growth Plan (under development).

**Watershed Stewardship Groups**

A number of local watershed protection groups/initiatives are currently active in the Bow Basin. These local initiatives can take many forms but are often characterized by private landowners working in partnership with local municipalities and other agencies. The focus of these initiatives is generally water quality and land use. These local groups are key to achieving long-term sustainable watershed management.

- Examples include Elbow River Watershed Partnership, Nose Creek Watershed Partnership, Frank Lake Water Quality Mitigation Initiative, Chestermere Lake Working Group, Grand Valley Creek Partnership, Calgary River Valleys Committee, Ghost Watershed Alliance, and the Waters of Wheatland.

**Municipal Development Plans and Land Use Bylaws (including Improvement Districts)**

- Municipal Development Plans and Land Use Bylaws help guide development towards reducing negative impacts on the environment, including the water resource. Several plans are either in place or underway (e.g., Calgary, Rocky View, Cochrane).

**Management Plans for Parks and Protected Areas (National, Provincial and Municipal)**

- Parks Canada: As a strategic and long-term guide, a management plan establishes a vision looking 15 or more years into the future. Its primary goal is to ensure that there is a clearly defined direction for the maintenance or restoration of ecological integrity and, to guide appropriate use. Management plans outline how our natural heritage will be preserved in each park and protected area.

- Alberta Community Development: Management plans describe the type and extent of outdoor recreation and tourism opportunities, facilities, and services that will be permitted. These plans have the inherent effect of watershed protection. Several plans are either in place soon to be initiated

- Municipalities: Examples include Griffith Woods Natural Environment Management Plan, Nose Hill Management Plan, and Clearwater Park.

**Bow River Basin Watershed Management Plan**

The purpose of Phase One of the BBWMP is to maintain or enhance the water quality in the basin.

**Highwood Water Management Plan**

- The purpose of Phase One of the Highwood Management Plan is to deal with matters directly relevant to the Highwood Diversion Plan and information requirements of the Natural Resources Conservation Board/Canadian Environmental Assessment Agency Joint Review Panel. The overall goal is to achieve sustainable water management in the Highwood, Little Bow, and Mosquito Creek sub-basins. A Public Advisory Committee (PAC) was formed to advise on the development of the water management plan for the Highwood-Little Bow system.

**Nose Creek Water Management Plan**

- The Nose Creek Partnership has prepared a water management plan to help protect riparian areas and improve water quality in the Nose Creek watershed. The recommendations contained in the final draft plan are intended to provide municipal, provincial, and federal jurisdictions with a consistent and cross-jurisdictional approach to managing natural resources within the watershed.

**Little Bow River and Mosquito Creek Water Quality Protection Plan**

- The goal of this initiative is to prepare a Water Quality Protection Plan that will outline the activities in the Little Bow River Basin necessary to achieving a mesotrophic state of water quality in the reservoir.

### Elbow River Basin Water Management Plan

- The Partnership was formed in response to the deteriorating water quality in the Elbow River, the increasing urbanization of the Elbow watershed, and concern about relying solely on the government to protect the watershed. The Partnership is preparing a water management plan to address stakeholder concerns. The purpose of the Elbow River Basin Water Management Plan is to serve as a local decision-support tool and align land use management decisions across the watershed to meet the overall water quality objectives.

### Approved Water Management Plan for the South Saskatchewan River Basin in Alberta, August 2006

- As a result of the recommendations contained in the Approved Water Management Plan for the South Saskatchewan River Basin (SSRB), Alberta Environment has:
  - Established Water Conservation Objectives for the main rivers of the SSRB. The Water Conservation Objective for the Bow River provides direction that opportunities to restore flows should be taken if they arise.
  - Established a Crown Reservation for the Bow, Oldman and South Saskatchewan River sub-basins. The Crown Reservation restricts Alberta Environment to accepting applications for new allocations of water only for the purposes described in the Crown Reservation.
  - Created a special project to implement other recommendations of the plan.

### Range Management Plans

- Various range management plans are found in the Green Area throughout the Bow Basin, with potential implication to water quantity and quality. (The White Area is managed under private ownership.)

### Ghost-Waiparous Access Management Plan

- The purpose of this initiative was to develop an access management plan intended to provide opportunities for recreational use in the Ghost-Waiparous area while maintaining the area's natural resources. An Access Management Plan was released in May 2006.

## NATIONAL

### CCME Canada-wide Strategy for Managing Municipal Wastewater Effluents

- The CCME strategy is expected to contain elements of watershed management and an initiative to develop guidelines for monitoring of environmental impacts.

## Appendix C: Legislation and Policy Involving Water and Watershed Management

| Legislation and Policy | Intent |
|---|---|
| Federal *Fisheries Act*- Department of Fisheries and Oceans Canada | Regulates and enforces on harmful alteration, disruption and destruction of fish habitat in section 35. |
| Provincial *Water Act*- Alberta Environment (AENV) | Governs the diversion, allocation and use of water. Regulates and enforces actions that affect water and water use management, the aquatic environment, fish habitat protection practices, in stream construction practices, storm water manage. |
| Provincial *Environmental Protection and Enhancement Act* (EPEA) – AENV | Provides management of contaminated sites, storage tanks, landfill management practices and enforcement. |
| Provincial *Agricultural Operations Practices Act* (AOPA)-Natural Resources Conservation Board (NRCB) | Outlines manure management standards for all farming and ranching operations in Alberta. It also provides producers and other stakeholders with a process for siting new and expanding confined feeding operations (CFOs). |
| Provincial *Municipal Government Act* (MGA)- Municipal Affairs and Appended Regulations | Provides municipalities with authorities to regulate water on municipal lands, management of private land to control non-point sources, and authority to ensure that land use practices are compatible with the protection of aquatic environment. |
| Provincial *Public Lands Act*- Sustainable Resource Development (ASRD) | Regulates and enforces activities that affect Crown-owned uplands that may affect nearby water bodies. |
| Provincial *Safety Codes Act*- Municipal Affairs | Regulates and enforces septic system management practices, including installation of septic field and other subsurface disposal systems. |
| Regional *Health Authorities Act*- Alberta Health | RHA have the mandate to promote and protect the health of the population in the region and may respond to concerns that may adversely affect surface and groundwater. |
| Provincial *Wildlife Act*- ASRD | Regulates and enforces on protection of wetland-dependent and wetland associated wildlife and endangered species (including plants). |
| Provincial *Parks Act & Wilderness Areas, Ecological Reserve and* | Both Acts can be used to minimize the harmful effects of land use activities on water quality |

| | |
|---|---|
| *Natural Areas Act*- ASRD and Community Development | and aquatic resources in and adjacent to parks and other protected areas. |
| Land Use Bylaws (Municipal) | The bylaw that divides the municipality into land use districts and establishes procedures for processing and deciding upon development applications. It sets out rules that affect how each parcel of land can be used and developed and includes a zoning map. |
| Area Structure Plans (Municipal) | Adopted by Council as a bylaw pursuant to the Municipal Government Act that provides a framework for future subdivisions, development, and other land use practices of an area, usually surrounding a lake. |
| Municipal Development Plans | The plan adopted by Council as a municipal development plan pursuant to the Municipal Government Act. |

# Appendix D: List of Municipalities Located Within the Bow Basin

## Alphabetical Order:

| Municipalities | ToR Signatory | Reach identified in Phase One BBWMP (Figure 2). |
|---|---|---|
| City of Airdrie | | Nose Creek |
| City of Brooks | ✓ | Bow River Lower |
| City of Calgary | ✓ | Nose Creek and Bow River Central |
| County of Newell | ✓ | Bow River Lower |
| Improvement District #9 (Banff) | | Bow River Above Park Boundary |
| Kananaskis Improvement District | ✓ | Bow River Below Park Boundary and<br>Bow River Central |
| Municipal District of Bighorn | ✓ | Bow River Below Park Boundary |
| Municipal District of Foothills | ✓ | Bow River Central |
| Municipal District of Rocky View | ✓ | Bow River Below Park Boundary and<br>Nose Creek and<br>Bow River Central |
| Town of Banff | ✓ | Bow River Above Park Boundary |
| Town of Bassano | ✓ | Bow River Lower |
| Town of Black Diamond | | Bow River Central |
| Town of Canmore | ✓ | Bow River Below Park Boundary |
| Town of Chestermere | ✓ | Bow River Central |
| Town of Cochrane | ✓ | Bow River Below Park Boundary |
| Town of Crossfield | | Nose Creek |
| Town of High River | ✓ | Bow River Central |
| Town of Okotoks | ✓ | Bow River Central |
| Town of Strathmore | | Bow River Lower |
| Town of Turner Valley | ✓ | Bow River Central |
| Town of Vauxhall | ✓ | Bow River Lower |
| Village of Longview | | Bow River Central |
| Wheatland County | ✓ | Bow River Lower |

**Municipalities by Reach:**

| Reach identified in Phase One BBWMP (Figure 2). | Municipalities |
|---|---|
| Bow River Above Park Boundary | Improvement District #9 (Banff) |
| | Town of Banff |
| Bow River Below Park Boundary | Kananaskis Improvement District |
| | Municipal District of Bighorn |
| | Municipal District of Rocky View |
| | Town of Canmore |
| | Town of Cochrane |
| Bow River Central | City of Calgary |
| | Kananaskis Improvement District |
| | Municipal District of Foothills |
| | Municipal District of Rocky View |
| | Town of Black Diamond |
| | Town of Chestermere |
| | Town of High River |
| | Town of Okotoks |
| | Town of Turner Valley |
| | Village of Longview |
| Bow River Lower | City of Brooks |
| | County of Newell |
| | Town of Bassano |
| | Town of Strathmore |
| | Town of Vauxhall |
| | Wheatland County |
| Nose Creek | City of Airdrie |
| | City of Calgary |
| | Municipal District of Rocky View |
| | Town of Crossfield |

# Appendix E: Engagement Action Summary

## Bow Basin Watershed Management Plan, Phase One (BBWMP) Summary of Engagement, Communication, Public Involvement, and Collaboration Processes

**April 11, 2007- June 03, 2008**

| Process or Event, Lead Individual and Date | Details | Estimated # of Contacts | Involving Broader Public?[24] | Involving First Nations?[25] |
|---|---|---|---|---|
| Note: First Nations members who requested to be informed of developments in the plan were copied Steering Committee minutes and other communications. – ongoing | | | | YES |
| Monthly emails and phone messages to all FN contacts with no response under the agreed-to communication protocol – Gloria Wilkinson - ongoing | | | | YES |
| BRBC electronic newsletter, *News and Events* – weekly - ongoing | ❑ This newsletter is sent weekly to BRBC active participants[26] and often contains items relating to specific recommendations in the BBWMP | 200 | | |
| Bow River Watershed Science Forum - May 1, 2007 | ❑ BRBC members were invited to a day of presentations on science topics related to the watershed | 100 | | |
| Press Release – Terms of Reference – May 31, 2007 | ❑ BRBC issued a press release regarding the approval of the Terms of Reference for Phase One of the BBWMP dealing with water quality objectives by the BRBC BOD. | Potential circulation ~290,000 | YES | |
| Article in the Springbank Park for All Seasons' *Park Patter* newsletter – June 2007 | ❑ Content similar to press release regarding the approval of the Terms of Reference for Phase One of the BBWMP dealing with water quality objectives by the BRBC BOD. | Circulation 3235 | YES | |
| Thank-you letters – June, 2007 | ❑ Thank you letters or reminder letters were sent out to all signatories of the ToR from Mark Bennett on behalf of BOD and SC. | 38 | | |
| Meeting with Alberta Wilderness Association - Bill Berzins & Mark Bennett - June 12, 2007 | ❑ A number of concerns were discussed<br>❑ AWA followed up with letter presenting proposals | 10+ | | |

[24] Broader public involvement refers to individuals outside of the 150 members of the BRBC.
[25] First Nation's involvement refers to specific efforts made to target First Nations outside of the First Nation members that regularly attend BRBC meetings.
[26] BRBC membership consists of about 150 organisations, agencies, companies or individuals. Organisations, agencies and companies often will have more that one person involved. Thus, the number of "active participants" is greater than the membership.

| Process or Event, Lead Individual and Date | Details | Estimated # of Contacts | Involving Broader Public?[24] | Involving First Nations?[25] |
|---|---|---|---|---|
| Presentation - BRBC Quarterly Forum - Gloria Wilkinson - June 13, 2007 | ❑ Gloria provided an update on the development of phase one of the BBWMP | 65 | | |
| BBWMP Presentation to AENV BRBC Project Team - Rob Wolfe and Al Sosiak - June 25, 2007 () | ❑ Complete review of draft recommendations targeted at AENV. | 12 | | |
| Update letters to First Nations Chiefs and Councils – Gloria Wilkinson - July and August, 2007 | ❑ Gloria sent letters to each of Chief Adrian Stimson, Siksika; Chief Dixon, Stoney-Bearspaw; Chief Labelle, Stoney – Chiniki, Chief Poucette, Stoney Wesley, Chief Big Plume, Tsuu T'ina | 30 | | YES |
| Article in BRBC's newsletter *Preserving Our Lifeline* - Gloria Wilkinson - September, 2007 | ❑ Gloria reported on progress with the TC report and future plans. | 300 | YES | |
| Booth at City of Calgary's "Employee Conference" – Barry Kobryn -October 03, 2007 | ❑ Barry manned a booth providing general information on the BBWMP and some indications of how the Draft related to City of Calgary programs. | 50 | ? | |
| Presentation - BRBC Quarterly Forum - Gloria Wilkinson - September 12, 2007 | ❑ Gloria reported on progress with the TC report and future plans. | 65 | | |
| Watershed Management Workshop – BRBC – September 13, 2007 | ❑ BRBC enlisted Dr. Hans Schreier to run a workshop on watershed management | 40 | | |
| Technical peer review – September-October, 2007 | ❑ Dr. Hans Schreier and experts from Environment Canada reviewed and provided feedback on the Technical Committee (TC) report, which included both water quality objectives and recommendations | 6 | | |
| Notice of upcoming stormwater workshops - October 09, 2007 | ❑ Notice of 3 upcoming workshops on stormwater management sent to decision makers and BRBC members. | 52 | | |
| Presentation, Kananaskis Improvement District - Gloria Wilkinson – November 06, 2007 | ❑ Gloria presented an overview of phase one of the watershed plan to Council and answered questions<br>Subsequent motion endorsing the wmp. | 5 | | |
| Presentation, M.D. of Bighorn, - Gloria Wilkinson, November 13, 2007 | ❑ Gloria presented an overview of phase one of the watershed plan to Council and staff and answered questions | 12 | | |
| TC report released to "Leaders" for decision-makers - November 20, 2007 | ❑ Contacts for all organisations and agencies who would be involved in implementation of recommendations were sent an MSWord "working version" of the TC report. It was also sent to First Nation contacts in the basin. | 52 | | YES<br>(SC observers by copy) |
| TC Report distributed to First Nations - Gloria Wilkinson – November 21, 2007 | ❑ Gloria sent the TC report to contacts for all First Nations in the basin: via Stewart Breaker for Siksika, Bryce Starlight for Tsuu T'ina, and Loretta Holloway for all the Stoney Nakoda bands. | 25 | | YES |
| Article in BRBC's newsletter *Preserving Our Lifeline* – Gloria Wilkinson – December 2007 | ❑ Announcing the delivery of the TC report to the Board and describing next steps. | 300 | YES | |

| Process or Event, Lead Individual and Date | Details | Estimated # of Contacts | Involving Broader Public?[24] | Involving First Nations?[25] |
|---|---|---|---|---|
| Presentation, M.D. of Foothills, Gloria Wilkinson, December 11, 2007 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 20 | 20 audience | |
| Presentation to membership - BRBC Quarterly Forum, Gloria Wilkinson - December 12, 2007 (release to membership) | ❑ Gloria Wilkinson provided an overview of the draft TC report released to decision makers. | 65 | | |
| TC report provided on website to BRBC membership – December 13, 2007 | ❑ A PDF of the version released to decision-makers was posted in a non-public area of the website and BRBC active participants were sent a link by e-mail. | 200 | YES | YES |
| Presentation to AWNA - Bill Berzins – December 15, 2007 | ❑ Bill Berzins presented an overview on the BBWMP to the Air & Waste Management Association. | 60 | | |
| Presentation, Town of Strathmore - Gloria Wilkinson – January 09, 2008 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 10 | 6 audience | |
| Presentation, Town of High River - Gloria Wilkinson – January 14, 2008 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 12 | 15 audience | |
| Presentation, Town of Crossfield - Gloria Wilkinson – January 15, 2008 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 8 | | |
| Presentation, Town of Black Diamond - Gloria Wilkinson – January 16, 2008 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 9 | 8 audience | |
| Presentation, Town of Chestermere - Gloria Wilkinson –January 21, 2008 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 10 | 5 audience | |
| Extended Distribution - Chris Vermeeren – January 25, 2008 | ❑ Chris distributed the draft plan to Vulcan County, The Town of Vulcan and the Village of Duchess | 3 | | |
| Presentation, Town of Okotoks - Gloria Wilkinson – January 28, 2008 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 12 | 4 audience | |
| Article in the Springbank Park for All Seasons' *Park Patter* newsletter – Gloria Wilkinson - February 2008 | ❑ Update on progress with plan. | Circulation 3235 | YES | |
| Extended Distribution of draft plan - Chris Vermeeren – February 04, 2008 | ❑ Chris distributed the draft plan to he Village of Rosemary, The Village of Tilley, the Town of Vauxhall, and the M.D. of Taber. | 4 | | |
| Presentation to Nose Creek Watershed Partnership Technical Committee, Mark Bennett, Gloria Wilkinson – February 07, 2008 | ❑ Mark presented an overview of phase one of the plan to the Committee and answered questions | | | |
| Paid Newspaper Advertisement – weeks of February 18 & 25, 2008 | ❑ Forthcoming public release of the draft plan, web survey, and Open Houses advertised in regional newspapers | Total circulation ~258,000 | YES | YES |

| Process or Event, Lead Individual and Date | Details | Estimated # of Contacts | Involving Broader Public?[24] | Involving First Nations?[25] |
|---|---|---|---|---|
| "Leaders" and commenters sent copy of Newspaper Ad – February 19, 2008 | ❑ A copy of the newspaper advertisement was sent to "Possible Leaders of Implementation" so they would be aware of the posting of the SC version on the website and the open houses. | 56 | | |
| Presentation, Town of Banff - Mark Bennett – February 25, 2008 | ❑ Mark presented an overview of phase one of the plan to Council, staff and the gallery and answered questions | 20 | YES | |
| Press Release – Public release of Draft Plan – February 28, 2008 | ❑ BRBC distributed a press release on the forthcoming public release of the draft plan, web survey, and Open Houses | Potential circulation ~294,000 | | |
| Notice of City of Calgary Erosion and Sediment Control Conference sent to contacts for decision-makers – February 28, 2008 | ❑ Notice sent to contacts for decision-makers first and later to BRBC active participants. | 52 (~250 w/ BRBC active participants) | | |
| Article in the Springbank Park for All Seasons' *Park Patter* newsletter – Gloria Wilkinson – March, 2008 | ❑ Announcing the publication of the draft plan on the website and inviting readers to complete survey. | Circulation 3235 | YES | |
| Article in BRBC's newsletter *Preserving Our Lifeline* – Gloria Wilkinson - March 2008 | ❑ Announcing the publication of the draft plan on the website and inviting readers to complete survey. | 300 | YES | |
| Presentation to Alberta Sustainable Resource Development managers in Calgary, Gloria Wilkinson | ❑ Gloria presented an overview of phase one of the plan and answered questions | 10 | | |
| Open house, Calgary, Gloria Wilkinson – March 04, 2008 | ❑ Gloria presented an overview of phase one of the plan and answered questions | 6 | YES (limited) | |
| Open house, Strathmore - Barry Kobryn & Mark Bennett– March 05, 2008 | ❑ Barry presented an overview of phase one of the plan and answered questions<br>❑ Reporter who attended wrote article in Strathmore Standard March 12, 2008 | 3 (newspaper circ. 5503) | YES (limited) | |
| Draft plan posted in public area BRBC website – March 06, 2008 | ❑ Draft plan posted in public area BRBC website | 50 (assume = survey visits) | YES | Same opportunity |
| Survey - BBWMP Phase One Zoomerang Survey – March 06, 2008 | ❑ Survey was advertised in regional newspapers, noted at open houses and notice sent to BRBC membership | 50 visits 8 completes | YES | |
| Open house, Canmore- Gloria Wilkinson – March 06, 2008 | ❑ Gloria presented an overview of phase one of the plan and answered questions | 3 | YES (limited) | |
| Open house, Brooks - Chris Vermeeren & Barry Kobryn – March 10, 2008 | ❑ Barry presented an overview of phase one of the plan and answered questions | 15 | YES (limited) | |
| Presentation, Town of Cochrane- Gloria Wilkinson – March 10, 2008 | ❑ Gloria presented an overview of phase one of the plan to Council and staff and answered questions | 15 | 10 audience | |
| Presentation to membership - BRBC Quarterly Forum, Gloria Wilkinson – March 13, 2008 | ❑ Gloria Wilkinson presented an update on the collaboration and public involvement actions. | 65 | | |
| Final Technical Committee report posted on website – March 17, 2008 | ❑ Final Technical Committee report posted on website | ? | | |

| Process or Event, Lead Individual and Date | Details | Estimated # of Contacts | Involving Broader Public?[24] | Involving First Nations?[25] |
|---|---|---|---|---|
| Presentation, City of Airdrie - Mark Bennett – March 17, 2008 | ❑ Mark made two presentations and took questions:<br>o one to Council, staff, and the gallery, and<br>o a second to senior staff and management. | 35 + 20 | YES | |
| Presentation, City of Calgary - Gloria Wilkinson – March 24, 2008 | ❑ Gloria presented an overview of phase one of the plan to City water managers and answered questions | 8 | | |
| New contact established for Stoney Nakoda Nation – Gloria Wilkinson – April, 2008 | ❑ Peter Snow was established as the contact for the Stoney Nakoda Nation | | | |
| E-mail to Signatory contacts requesting sign off of plan – April 18, 2008 | ❑ Contacts were asked to move forward with obtaining signatures in their organisation. Presentation offered to assist. | 38 | | |
| Article in the Springbank Park for All Seasons' *Park Patter* newsletter – May 2008 | ❑ Providing summary of the various reviews and the describing next steps to complete plan. | Circulation 3235 | YES | |
| 2nd Annual BRBC Science Forum – May 12, 2008 | ❑ Presentations focusing on "Coordinating Bow River Monitoring and Data" | 100 | | |
| Presentation to Alberta Improvement District #9 council, Gloria Wilkinson – May 22, 2008 | ❑ Gloria presented an overview of phase one of the plan and answered questions | 6 | | |
| Article in BRBC's newsletter *Preserving Our Lifeline* – Gloria Wilkinson - June 2008 | ❑ Announcing the final stages and seeking of signatures for plan. | 300 | YES | |

# Appendix F: Communication Protocol for First Nations Participation

## Background

The Bow River Basin Council (BRBC) and Elbow River Watershed Partnership (ERWP) are pleased to work together with Treaty 7 First Nations to engage them in respective watershed management planning processes. The BRBC and ERWP are volunteer-driven organizations that work independently, yet cooperatively with government, to develop sustainable strategies to improve water quality, water quantity and ecological integrity for all residents of the Bow Basin. Both the BRBC and ERWP desire to become trusted neighbours to First Nations communities to the benefit of generations to come. Furthermore, both believe First Nations' knowledge, their approach to integrated stewardship and their relationship to the land/air/water further reinforce Watershed work as the groups advocate for better decision-making by all who manage air, land and water.

The benefits to First Nations of participating with these groups in the planning process are many.

Firstly, watershed groups commit to sharing their large body of knowledge around water in and around First Nations' lands. First Nations will gain access to watershed experts, associated project teams and general members so they can quickly mobilize information and ideas when addressing issues on and around First Nations' land.

Secondly, First Nations will have the opportunity to share their perspectives and values with influencers from other watershed communities. These are influencers who can take direct action to improve watershed conditions and carry traditional messages of stewardship and sustainability. Watershed groups believe that increased awareness within the general community of traditional, constitutional and Treaty rights and values will assist First Nations as they seek new relationships with local and provincial leaders.

Thirdly, First Nations will participate in a citizen-driven process that is truly unique in Canada - a commitment to sustainable decision-making that strives to strike a sustainable balance between quality of life, integrity of environment and economic prosperity.

Finally, First Nations can accomplish this without abrogating the rights they have; nor diminishing the obligation of governments to duly consult with First Nations. The BRBC and EWRP are simply neighbours working with neighbours to pursue a common good and a sustainable future.

## Next Steps

1. Cultural Awareness Training for Watershed Memberships: Watershed groups have much to learn about First Nations' traditional values, traditional rights, constitutional rights and the key principles embodied in the Treaty as understood by First Nations and passed down as traditional oral knowledge. Watershed groups will seek resources to support Cultural Awareness Workshops in which the Five First Nations most-affected by the Bow and Elbow Plans will educate group membership and Steering Committees on the issues of most importance to First Nations. Watershed groups would expect a minimum of five 1/2-day or 1-day sessions for our membership - but of course they will seek First Nations' guidance on the most efficient way of carrying this out. (First one has occurred with Tsuu T'ina, without funding)

2. Information Exchange with First Nations Communities: Watershed groups have much knowledge to share about the state of our watersheds and the challenges faced around water management, climate change and increasing demands. Repeated attempts will be made to seek funds to allow for delivering information through meetings, presentations and/or open-houses to the administrative, council, elder and youth groups at each Nation based on their individual requirements. Groups will bring in experts to share common knowledge for collective benefit. Presentations to Nations will be provided upon request on an "as-needed" basis.

May 26, 2008