



Final Draft

Nose Creek Watershed Water Management Plan

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Prepared for:

The Nose Creek Watershed Partnership

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EXECUTIVE SUMMARY

The Nose Creek Watershed Partnership initiated the development of an authorized Water Management Plan to help protect riparian areas and improve water quality in the Nose Creek watershed. The authority to undertake a Water Management Plan is provided in the *Water Act* and partly in the *Municipal Government Act*.

In 2003, the Terms of Reference for the Nose Creek Water Management Plan was developed in collaboration with Alberta Environment. It outlines three main objectives, including the development of water conservation objectives and identification of the matters and factors that should be considered by Alberta Environment and other resource managers when considering applications for approval or licences. The Partnership hosted public open houses to solicit input into the Water Management Plan and, during this consultation process, it was clear that the Plan should be based on sound science and address concerns of poor water quality and loss of riparian function.

In addition to public consultation, the Partnership commissioned a number of studies, some prior to 2003, that support the recommendations provided in the Water Management Plan. These studies included water quality monitoring (Cross 1999, 2002), groundwater investigations (Hayashi 2004), instream flow needs investigations (Westhoff Engineering Resources 2004, 2005), and riparian health assessments (Cows and Fish 2001). The Water Management Plan is the culmination of research, legislation and recommendations that have been made to the Nose Creek Watershed Partnership.

Water conservation objectives were recommended based on input from stakeholders and the results of the Instream Flow Needs Study (WER 2005). A major finding in the Instream Flow Needs Study was that the current permissible release rate for stormwater management is nearly twice that of predevelopment conditions. An integrated approach to stormwater management is recommended.

More sustainable stormwater management practices may be achieved through the implementation of a maximum allowable release rates and runoff volume control targets. Implementing Low Impact Development practices will be necessary to reduce runoff volumes and meet targets.

In addition to stormwater management, riparian protection recommendations are provided in the Water Management Plan. These recommendations incorporate the 1:100 year floodplain, escarpments and meander belt widths to achieve an appropriate setback for intermittent and perennial watercourses. The setbacks are variable in width according to site-specific land forms as delineated on the Riparian Area Management Map. Setbacks are recommended for urban, country-residential and agricultural landscapes.

Implementing the stormwater and riparian protection measures will result in improved water quality. Additional recommendations for water quality protection include source water protection measures, a “no net loss” of channel length to deter further channelization of the watercourses in the watershed, and protection for natural features. Natural features include maintenance of native vegetation on critical slope areas ($\geq 15\%$) to stabilize soils and filter surface runoff water. Recommendations preserve vegetative cover during construction phases of development and discourage development from occurring in gullies, ravines and coulees. A long-term water quality monitoring program is recommended as part of the Implementation Action Plan to better understand land use changes in the Nose Creek watershed, identify future concerns and as a tool to measure the success of the Water Management Plan in future years.

Where adverse impacts on riparian areas are unavoidable, compensation is recommended. Compensation may only be applied after efforts have been made to avoid the impact through project relocation or redesign. Compensation can be achieved in different ways: by restoring riparian function at or near the site of impact, or restoring function away from the site on the same watercourse. Appropriate mitigation and restoration techniques are provided.

In addition, the reclassification of the present rating of Nose Creek and West Nose Creek is recommended as defined by the Code of Practice for Pipelines and Telecommunication Lines Crossing a Waterbody. The current Class rating is "D" and does not reflect the importance of either Creek to potential fisheries. Reclassification of the creeks to Class "C" will introduce timing restrictions on activity (but not prevent activity) proposed on the Creek. This will provide some protection for water quality and aquatic life.

Finally, consideration of cumulative effects of activity in the Nose Creek watershed is recommended. Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future human actions. Cumulative effects on the landscape go beyond political boundaries and demonstrate the true impact of human activity on our natural environment. Recommendations are made to address cumulative effects during the application review process.

An Implementation Action Plan is provided to guide the implementation of the recommendations in the Water Management Plan. The Short Term, Medium Term and Long Term actions recommended for each jurisdiction are defined.

The recommendations provided in the Nose Creek Water Management Plan aim to protect riparian areas and improve water quality by providing consistency to governing jurisdictions managing natural resources in the watershed. The recommendations serve as a guidance document and planning tool that may be supported and implemented by everyone living and working in the watershed. Annual review of the Water Management Plan will insure that these goals are being achieved.

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1.0 BACKGROUND

The Nose Creek watershed is under pressure from the cumulative effects of increasing residential and commercial development, industrial growth, stormwater discharge, agricultural activity and channelization in the watershed. Urban and rural land use, namely development and agricultural activity, have resulted in degraded water quality, loss and degradation of riparian areas, an overall reduction in channel length and an increase in water flows above natural in urban areas during certain times of the year. The Nose Creek Watershed Partnership was formed to protect riparian areas and improve water quality in the Nose Creek watershed. The Partnership consists of the M.D. of Rocky View, City of Calgary, City of Airdrie, Town of Crossfield, the Calgary Airport Authority and the Bow River Basin Council, with technical assistance provided by Alberta Environment, Ducks Unlimited and Fisheries and Oceans Canada.

The different watershed management policies adopted by various regulating authorities and land managers in the Nose Creek watershed have resulted in inconsistencies in the level of protection of the Creek. A clear example is legislation related to riparian area setbacks. Setbacks vary from 6 m (*Municipal Government Act*), to a minimum of 15 m (City of Airdrie, Landuse Bylaw), to 30 m for undeveloped land within the City of Calgary (City of Calgary, Landuse Bylaw). No riparian setback widths are identified in the *Public Lands Act*, the *Water Act* or in the *Environmental Protection and Enhancement Act*. Clarification and consistency is necessary to protect riparian areas in the Nose Creek watershed.

Capacity for water management has been improving since 1998 when the *Water Act* was amended by the provincial government to ensure sustainable water management and a healthy aquatic environment. *The Framework for Water Management Planning (Framework)* was developed by Alberta Environment as a guideline for management planning. A requirement of the *Water Act* and a major component of the *Framework* is the *Strategy for the Protection of the Aquatic Environment (Strategy)*. The Strategy outlines the Alberta government's dedication to protecting, maintaining and improving the condition of the aquatic environment.

Within the *Strategy*, the Alberta government encourages cooperation among stakeholders through the development of a Water Management Plan (WMP), a plan with respect to conservation and management of water. In 2002, the Nose Creek Watershed Partnership began consultation with Alberta Environment and in the spring of 2003, the Terms of Reference that guided the development of the authorized Water Management Plan was issued (Appendix A).

The Partnership commissioned several studies since 1998 to gain greater understanding of the watershed and to support recommendations made in the Water Management Plan. These studies included water quality monitoring (Madawaska Consulting 1998-2000), groundwater investigations (Hayashi 2004), instream flow needs investigations (Westhoff Engineering Resources 2004, 2005), and riparian health assessments (Cows and Fish 2001). The Water Management Plan is the culmination of research, legislation and recommendations that have been made to the Nose Creek Watershed Partnership.

The Nose Creek Watershed Water Management Plan will provide broad guidance for water management and set out clear, strategic direction that will result in consistent, specific actions for improved riparian function and water quality protection in the Watershed. The Water Management Plan:

- 1) Recommends water conservation objectives (WCOs) for Nose Creek and West Nose Creek,
- 2) Specifies matters and factors that may be considered by Alberta Environment and other decision makers in deciding whether to issue an approval, preliminary certificate or licence, or approve a transfer of an allocation of water under a licence, and

- 3) Builds upon and/or refine the requirements specified in strategic, broad-scale planning documents.

2.0 STATEMENT OF ISSUES

Riparian health and function and water quality have been compromised¹ in the Nose Creek Watershed due to:

- elevated flows resulting in streambank erosion²,
- encroachment by development and agricultural activity (i.e. infilling, channelization, grazing), and
- alteration and/or elimination of the native plant community and natural features that protect water quality.

3.0 GOALS AND POLICY STATEMENTS

3.1 Goals: Protect Riparian Areas and Improve Water Quality

Riparian health and function, and provision of quality water are a priority for governing jurisdictions in the Nose Creek watershed.

Governing jurisdictions recognize the linkage among land use, riparian health and water quality in the Nose Creek watershed.

Riparian areas in the Nose Creek watershed deliver ecological goods and services by providing streambank stability, flood reduction, pollution control, water quality benefits and wildlife habitat.

Good water quality in the Nose Creek watershed sustains healthy aquatic ecosystems, human populations, and the economy.

3.2 Policy Statements

- A.** Water Conservation Objectives should be implemented to maintain the quantity and quality of water for the management and protection of Nose Creek and West Nose Creek.
- B.** Integrated stormwater management practices should be implemented to improve stormwater quality, preserve the natural hydrology of the watershed and to mitigate the negative impacts of urban development.
- C.** Science-based riparian setbacks should be implemented to protect riparian functions in the Nose Creek watershed.
- D.** Source water protection measures should be used to maintain source water quality and quantity for downstream users and the aquatic environment.
- E.** Other watershed protection measures should be implemented to address channelization and cumulative effects in the Nose Creek watershed.

¹ Cows and Fish 2001; Cross 1999, 2002

² WER 2002; WER 2005

3.3 Tools to Achieve the Goals of the Water Management Plan

- Water Conservation Objective (WCO),
- Reduced Maximum Allowable Release Rates,
- Staged implementation of Runoff Volume Control Targets,
- Low Impact Development strategies,
- A Riparian Area Management Map defining site-specific setback criteria,
- Implementation of agricultural Best Management Practices,
- Mitigation of impact, compensation for loss and restoration of natural system function, and
- Cumulative effects assessment.

4.0 AUTHORITY

The Nose Creek Watershed Water Management Plan has been prepared under the direction of the Nose Creek Watershed Partnership and in collaboration with Alberta Environment and other watershed stakeholders. Provincial authority to develop and implement recommendations in the Water Management Plan is provided in the *Water Act*³ and some Municipal authority is provided partly by the *Municipal Government Act*⁴. Recommendations are consistent with existing Provincial and Municipal Policies and Guidelines⁵.

Following the authorization of the Water Management Plan by Alberta Environment and approval by the Municipal Councils of Airdrie, Calgary and the M.D. of Rocky View, use by provincial and municipal jurisdictions in existing plans or as stand-alone policies is strongly encouraged. The recommendations in the Water Management Plan apply only to those portions of the jurisdiction located within the boundaries of the Nose Creek Watershed.

5.0 PUBLIC CONSULTATION PROCESS

The Nose Creek Watershed Partnership consulted with the public in accordance with the *Framework*⁶ to ensure the long-term viability of the Nose Creek Watershed Water Management Plan. Throughout the consultation process, the public provided valuable insight, ideas and advice that was considered by the Technical Committee and incorporated into the Water Management Plan where possible. Methods of consultation included focus group meetings, open houses, newspaper releases, public presentations and reports to Council. Activity days, such as the Annual Nose Creek Clean-Up and a Bioengineering Workshop were also scheduled with watershed partners to reach a wider audience.

The 2004 focus group meetings were attended by representatives from regulatory agencies, environmental groups, and the agricultural and development industry (Appendix B). Two Open Houses, one in Calgary and the other in the M.D. of Rocky View, were held in the spring and the fall of 2005 to provide progress updates to urban and rural watershed stakeholders and to solicit input (Appendix B). In total, approximately 100 people attended each series of Open Houses. Meetings were also held with specific interest groups following the release of the draft Water Management Plan in November 2005.

³ *Water Act* Section 9(1)(2)

⁴ *Municipal Government Act* 60(1) Section 617

⁵ Government of Alberta - Framework for Water Management Planning, Government of Alberta – Water for Life Strategy, City of Calgary/MD of RockyView - Intermunicipal Development Plan, MD of Rocky View/City of Airdrie Intermunicipal Development Plan

⁶ Framework for Water Management Planning, Government of Alberta

6.0 GEOGRAPHICAL EXTENT

Nose Creek originates near the northern boundary of the M.D. of Rocky View and the Town of Crossfield, and flows south through the City of Airdrie, joining the Bow River in the City of Calgary near the Calgary Zoo (Fig. 6.1). The watershed drains a gross area of 989 km² and an effective area of 743 km². Nose Creek is fed by numerous intermittent streams; the most notable is McPherson Coulee. The main, permanent tributary to Nose Creek is West Nose Creek.

The mainstem of West Nose Creek is about 65 km in length and has a gross watershed area of 325 km² and effective watershed area of 217 km². West Nose Creek encompasses about 33% of the entire Nose Creek Watershed area. The creek originates in the M.D. of Rocky View, northwest of Calgary. West Nose Creek joins Nose Creek near Deerfoot Trail (Hwy 2), directly west of the Calgary International Airport.

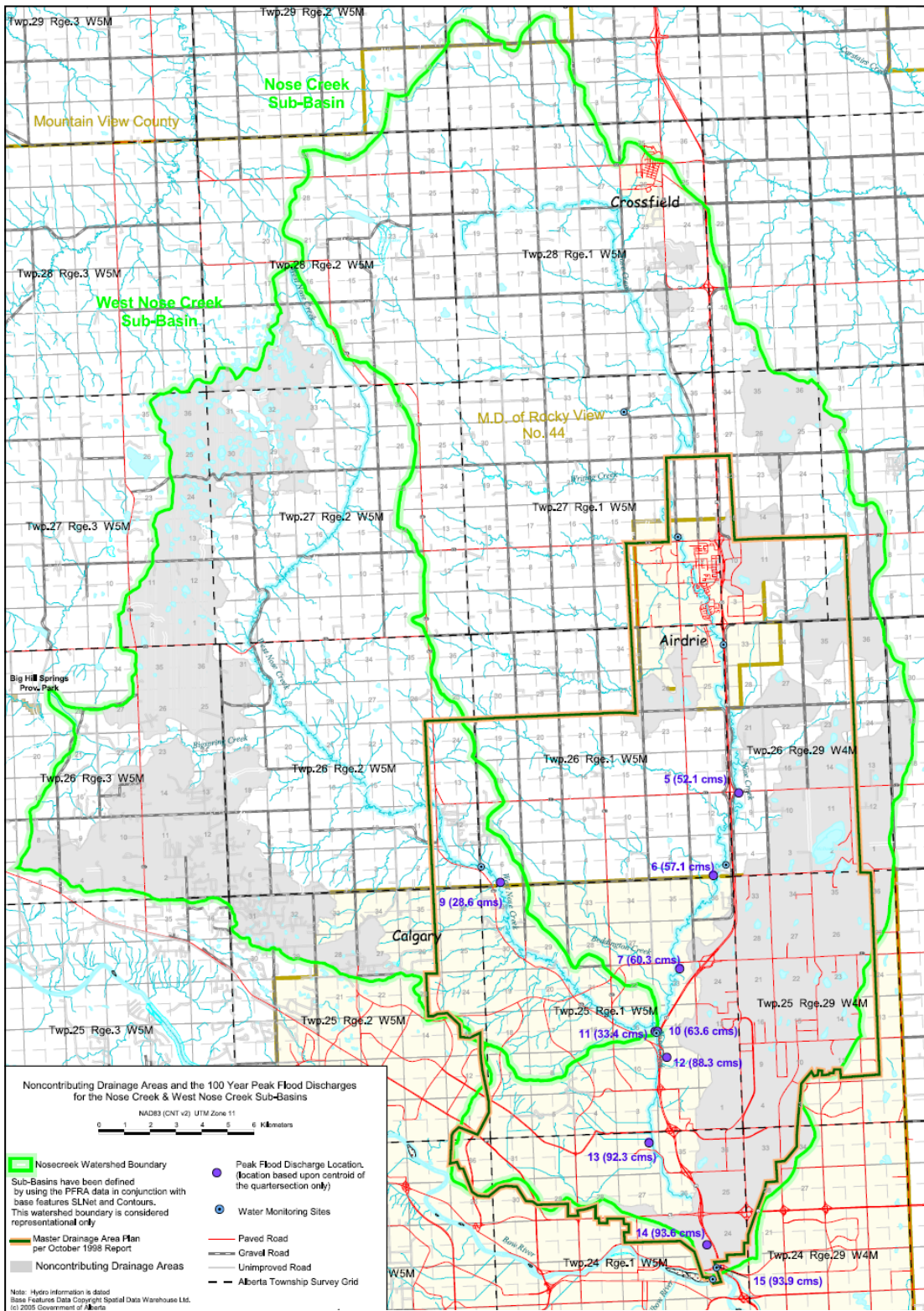


Figure 6.1. Map of the Nose Creek watershed. Areas shaded in grey represent areas in the watershed that are drained internally and do not contribute overland flow to Nose Creek and West Nose Creek (Sustainable Resource Development 2005).

7.0 Timeline and Schedule for Review⁷

| | | |
|-------------------------|---|-----------------------------------|
| Plan Development | <p>Data and Information collection Collect, review and organize relevant data. Identify data gaps and collection methods.</p> | 2000 – July 2005 |
| | <p>Synthesis and Analysis Interpret, analyze and synthesize findings ready for drafting. On-going press releases, newspaper/newsletter articles, website updates.</p> | |
| | <p>Draft Water Management Plan Develop draft Water Management Plan addressing objectives 1-3. Open House #2 to inform public. Press releases, newsletters etc. to public. Synthesize feedback to finalize plan.</p> | |
| | <p>Draft Implementation Strategy and Finalize Water Management Plan</p> | |
| Plan Approvals | <p>Seek Approvals Submit draft Water Management Plan to Nose Creek Partnership for approval and recommendation to municipal Councils. Submit to municipal Councils for approval. Submit to AENV Director responsible for water management for authorization. Open House #3 to inform public and key groups. Press releases, newsletters etc. to public.</p> | November 2006 – March 2007 |
| The Next Step | <p>Implement Recommendations Recommendations implemented into municipal and provincial plans, policies and bylaws. Effort made to fill data gaps identified in the development of the Plan.</p> <p>Schedule for Review Annual review will ensure the Plan remains current and enable the Partnership to evaluate whether the desired results of the Water Management Plan are being achieved.</p> <p>Amendments and Future Phases Amendments may be made by consensus of the Nose Creek Watershed Partnership.</p> | June 2007 and Beyond |

⁷ Revised from the Terms of Reference (Appendix A).

8.0 NOSE CREEK WATERSHED WATER MANAGEMENT PLAN RECOMMENDATIONS AND IMPLEMENTATION ACTION PLAN

The Recommendations in the Nose Creek Watershed Water Management Plan are summarized under the following headings:

- General Implementation Actions for the Nose Creek Watershed Partnership
- Water Conservation Objectives
- Integrated Stormwater Management
 - Maximum Allowable Release Rate
 - Runoff Volume Control Target
 - Internal Drainage Area
 - Low Impact Development
- Protection of Natural Features
 - Natural Hydrology
 - Escarpments
 - Valued Natural Features
 - Sediment and Erosion
- Riparian Protection
 - Setbacks
 - Restricted and Permitted Activity
 - Agricultural Lands
- Water Quality Protection
 - Class Structure
 - Source Water Protection
 - Channelization
- Mitigation, Compensation and Restoration
- Cumulative Effects

Background information related to the development of the Nose Creek Watershed Water Management Plan recommendations is provided in the Background Document (Appendix C). An Implementation Action Plan follows each set of recommendations to provide some guidance on the necessary steps to achieve the objectives of the Water Management Plan. The Action Plan identifies jurisdiction responsibility for responding to the recommendations, identifies future work required to support the Water Management Plan. A budget is provided at the end of the document, describing projected costs and priorities for completion.

8.1 General Implementation Actions for the Nose Creek Watershed Partnership

| TIMELINES | ACTIONS |
|---------------------------------|--|
| Short Term (2007-08) | <p>Adoption and Administration</p> <p>The key policy recommendations in the draft Nose Creek Watershed Water Management Plan should be adopted by each municipal Council and authorized by Alberta Environment to enable the incorporation of the recommendations into other policies and processes.</p> <p>Incorporate the recommendations into policies, procedures and into all aspects of planning and development standards and guidelines, including Municipal Development Plans, Regional Policy Plans, Area Structure Plans, Outline Plans, Redevelopment Plans and as conditions in review processes.</p> <p>An Inter-municipal Watershed Team should be formed as an Administrative Group assigned to work together to aid with implementation. This may be the Nose Creek Watershed Partnership's Technical Committee, but should be expanded to include more departments and sections within each jurisdiction.</p> |

| TIMELINES | ACTIONS |
|-----------|---------|
|-----------|---------|

**Short Term
(2007-08)**

Annual Review of the Nose Creek Water Management Plan

Annual review of the Implementation Strategy will ensure the Water Management Plan remains current and enable the Partnership to evaluate whether the desired results of the Plan are being achieved. The Water Management Plan should also remain adaptive and flexible to respond to new information as it becomes available.

Communication

Internal sections or departments within each jurisdiction should form working groups that meet following a Partnership or Technical Committee meeting, to address meeting outcomes and the action items in the Implementation Strategy. This includes one representative from each section or department. The representative should remain in their role for at least one year.

The NCWP Communication Team should be reinstated to help with internal communication and to develop the necessary supporting information that will be required to implement the WMP. Communication tools include website, newsletters, workshops, newspapers, Field Days and Demonstrations, survey and signage.

The Nose Creek Watershed Partnership website should be redesigned to make it more useable. Information relating to each of the WMP areas should be posted and the site should be updated regularly, at least quarterly.

Education and Outreach

Education materials should be developed to address target audiences, including:

- General Public and Council Members
- Developers and Department/Section staff within each Provincial and Municipal Jurisdiction (e.g. Enforcement, Planning, Permits)

Topics that should be covered in a series of factsheets include:

- integrated stormwater management (including reference to WCOs, hydrology, water quality and streambank erosion)
- low impact development (conservation development, highlight community projects)
- riparian function and value
- water quality and streambank erosion

Develop "Creek Clean Up in a Box" for local groups and organizations to use in a clean up program.

Performance Monitoring and Evaluation

Partnership should document general community awareness regarding the sensitive nature of Nose Creek and West Nose Creek.

A monitoring program and appropriate budgets should be developed through working teams assigned to each indicator (e.g. water quantity and quality, streambank erosion) to measure the success of the plan.

**Medium Term
(2009-10)**

Increase Enforcement Capacity

A coordinated effort among jurisdictions should be made in the Nose Creek watershed to address specific goals of the Nose Creek Watershed Water Management Plan. Information packages should be created for each Compliance Inspector of Alberta Environment or municipal Bylaw Officer within each jurisdiction. AENV education staff (Community Relations Officers) may be able to assist with the preparation of these packages. Currently, AENV Compliance staff conducts educational sweeps which the municipal Bylaw officers may be able to assist with in a coordinated manner. The educational sweep could begin with sediment and erosion control measures in Year 1, and a program could be developed for following years.

**Long Term
(2011 +)**

Review Enforcement Capacity

Develop and initiate programs to address and enforce the principles within the Nose Creek Water Management Plan.

8.2 Water Conservation Objectives

8.2.1 Background

Water conservation objectives (WCOs) and Instream Flow Needs (IFNs) are two tools used to identify and maintain appropriate water volumes in a waterbody. Water conservation objectives pertain to the amount and quality of water established by the Director (an Alberta Environment staff with delegated authority) to be necessary for:

- the protection of a natural water body or its aquatic environment, or any part of them,
- the protection of tourism, recreational, transportation or waste assimilation uses of water, or
- the management of fish and wildlife.

Principle

Stream flows and water quality in the Nose Creek watershed are managed and protected to meet instream needs and socio-economic factors.

Water conservation objectives may include water necessary for the rate of flow of water or water level requirements. Instream needs are defined as the quantity and quality of water required to satisfy hydrological process demands instream and to protect river ecology and riparian environments. Instream needs include fish habitat, water quality, riparian vegetation, channel structure, human safety and recreational uses. Instream flow needs differ from water conservation objectives in that they are strictly a scientific assessment. Water conservation objectives, on the other hand, refer to the quantity of water that should be present in a stream to meet instream needs and socio-economic factors.

The process of identifying water conservation objectives allows water users to work out mutually agreed targets for management and protection of streams and their ecosystems. As well, regulators can be more confident that the water conservation objectives are effective and achievable since the objectives are based on a consensus of water users developed through an open process using scientific information.

8.2.2 Recommendation for Water Conservation Objectives

- 1 a. *The water conservation objective (WCO) should be 45% of the natural flow, or the existing instream objective plus 10%, whichever is greater at any point in time.⁸ Based on the current instream objectives in the Nose Creek watershed, the WCO for Nose Creek should be 0.094 cms (3.3 cfs) and 0.062 cms (2.2 cfs) for West Nose Creek and McPherson Coulee or 45% of the natural flow, whichever is greater at any point in time.⁹*

⁸ Consistent with the water conservation objective recommendation in the South Saskatchewan River Basin Water Management Plan (Alberta) for tributaries in the Bow River sub-basin, AENV (2006).

⁹ The instream objective currently used by Alberta Environment for Nose Creek is 0.085 cms (3 cfs) and 0.057 cms (2 cfs) for West Nose Creek and McPherson Coulee.

8.2.3 Implementation Action Plan for Water Conservation Objective

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|-------------------------------|--------------------|---|---|--|
| Water Conservation Objectives | NCWP | <p>Performance Monitoring</p> <p>Create a Working Team to develop a Water Monitoring Program Proposal to:</p> <ul style="list-style-type: none"> - Identify sites for long-term stream flow and water quality gauges - Evaluate the need to expand the dissolved oxygen and temperature monitoring and frequency to allow for improved analysis. - Draft fisheries, invertebrate and other habitat indicator monitoring criteria for performance monitoring. - Identify funding sources for water quantity and quality monitoring. | <p>Performance Monitoring</p> <p>Install sites for long-term stream flow and water quality gauges.</p> <p>Implement fisheries, invertebrate and other habitat indicator stations to monitor the long-term quality of the creeks.</p> <p>Refine WCO</p> <p>Explore low flow WCOs based on the Alberta Desktop Method, rather than the Tennant Tessman Method.</p> <p>Refine IFN</p> <p>Review provincial and federal guidelines to establish IFNs for other water quality parameters such as coliforms, pesticides, metals and sediments (i.e. Water Quality Objectives).</p> | <p>Performance Monitoring</p> <p>Continue long-term performance monitoring of indicators.</p> <p>Refine Hydrologic Models</p> <p>Update the hydrologic analysis of the entire watershed, including high-flow IFNs and permissible release rates for urbanizing areas. Update IFNs and flow duration curves accordingly.</p> <p>Compare frequency duration curves for stream gauges in urbanizing areas to evaluate if runoff volume control benefits are achieved.</p> |
| | AENV ¹⁰ | <p>Adopt the WCO</p> <p>The Director considers the WCO in making decisions on applications for licenses, preliminary certificates, approvals, or transfers of an allocation of water.</p> <p>Technical Support</p> <p>Provide Partnership with detailed water licence withdrawal</p> | <p>Performance Monitoring</p> <p>Require monitoring and reporting on old licenses, including water transfers and temporary transfers.</p> <p>Develop a program regarding unauthorized water use and diversions.</p> <p>Identify and cancel licenses that are not in good standing (joint Approvals and Compliance initiative).</p> | <p>Refine WCO</p> <p>Review the WCO based on future performance monitoring.</p> <p>Technical Support</p> <p>Provide technical support to the NCWP for performance monitoring (e.g. flow monitoring, water quality monitoring, monitoring program development).</p> |

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|--------------------------------------|---------------------------------|--|--|---|
| Water Conservation Objectives | AENV⁸ | <p>information (i.e. actual amounts withdrawn, timing of withdrawals) for use in future studies.</p> <p>Technical Support</p> <p>Provide technical support to the NCWP for performance monitoring (e.g. flow monitoring, water quality monitoring, monitoring program development).</p> | <p>Technical Support</p> <p>Provide available reporting data and information to the NCWP to help establish IFNs for water quality parameters and Water Conservation Objectives.</p> <p>Provide technical support to the NCWP for performance monitoring (e.g. flow monitoring, water quality monitoring, monitoring program development).</p> | |
| | Municipalities | <p>Performance Monitoring</p> <p>Municipalities continue with the existing flow and water quality monitoring along Nose Creek and West Nose Creek.</p> <p>Municipalities Partner with Water Monitoring Working Team to develop a stormwater impact monitoring program proposal.</p> | <p>Performance Monitoring</p> <p>Municipalities continue to participate in development and implementation of the stormwater impact monitoring program.</p> | <p>Performance Monitoring</p> <p>Municipalities continue to participate in development and implementation of a stormwater impact monitoring program.</p> |
| | Fisheries and Oceans/SRD | | <p>Technical Support</p> <p>Review fisheries impacts to establish what degree of volume control is appropriate.</p> | |

¹⁰Guiding Legislation and Policy: *Water Act* – Section 15

8.3 Integrated Stormwater Management

8.3.1 Background

High rates and volumes of stormwater discharge, due largely to urban growth and country residential developments, are affecting the health of Nose Creek, West Nose Creek and their tributaries. Typical land development practices can generate 5 to 100 times more runoff compared to predevelopment conditions. Increased stormwater flows are caused by greater impervious coverage, grading and compaction of subsoils, draining or infilling of depressional or wetland areas, and elimination of native vegetation. Increased stormwater runoff causes channel erosion, higher pollutant loads, deterioration of receiving stream water quality and adverse impacts on aquatic species.

Low-impact development strategies can reduce stormwater runoff volume. A development is considered 'low impact' when the post-development runoff conditions mimic the pre-development rates and volumes for smaller storm events and severe, infrequent events. This is typically achieved through reduction in the level of imperviousness and integration of best management practices (BMPs) in subdivision design, including "green infrastructure" features, and stormwater reuse. In some cases, precipitation captured at the source can be returned to the original, natural hydrologic pathways through infiltration and evapotranspiration.

Properly sized and designed structural BMPs used to satisfy runoff volume control recommendations may also serve as water quality treatment BMPs (e.g. bioretention areas, cisterns and rain barrels). The use of BMPs can simultaneously contribute to runoff volume control and attainment of water quality volume objectives.

8.3.2 Recommendations for Integrated Stormwater Management

Maximum Allowable Release Rate

2. *To achieve intermediate and high flow instream objectives, the current Maximum Allowable Release Rate of 2.6 l/s/ha for the 1:100 year return period should be reduced to 0.99 L/s/ha on West Nose Creek and to 1.257 L/s/ha on Nose Creek for the period April through October, based on gross catchment area.¹¹*

Principles

Stream flows in the Nose Creek Watershed are managed to reduce streambank erosion, preserve riparian areas and protect infrastructure and public safety in the Nose Creek Watershed.

An Integrated Stormwater Management Program in the watershed that will achieve the WCO for minimum flows and the Maximum Allowable Discharge Volume for intermediate and high flows.

The continued hydrological function of internal drainage areas in the eastern and western most areas of the watershed and within intermittent and perennial tributaries of Nose Creek and West Nose Creek.

To approach predevelopment hydrographs in developed and developing areas of the Nose Creek watershed by methods other than detention.

¹¹ Appendix D - Nose Creek Basin IFN Study, Table 8 (WER 2005)

Runoff Volume Control Target

Runoff Volume Control Targets are necessary to preserve the natural hydrological runoff volume in Nose Creek and West Nose Creek. Predevelopment runoff volumes for Nose Creek and West Nose Creek amounted to about 6.1 mm and 9.6 mm (April-October), respectively. Average precipitation at the Calgary International Airport for the period April through October is about 350 mm (based on Environment Canada's climate normals). Predevelopment runoff volumes, therefore, represented about 2% of total rainfall volumes (April-October).

- 3 a. *To meet the Maximum Allowable Discharge Volume for typical residential, industrial, commercial and institutional developments, interim Runoff Volume Control Targets of 90 mm on the Nose Creek main stem and 90 mm on West Nose Creek should be implemented in 2007 and reduced according to the schedule in Table 8.1. This represents about a 75% on-site capture of average annual rainfall (April to October). For a dry year, the runoff volume to Nose Creek and/or West Nose Creek is expected to be less, while for a wet year, the runoff volume may be higher, as long as the long-term median equals the above targets.*
- 3 b. *For country residential developments and low density industrial, commercial and institutional developments, interim Runoff Volume Control Targets of 50 mm on the Nose Creek main stem and 50 mm on West Nose Creek should be implemented in 2007 and reduced according to the schedule in Table 8.1.*

Implications: For the areas upstream of the current City of Calgary limits, this target will likely result in a near doubling of stream width, lower habitat suitability for aquatic life, unstable stream banks, degraded riparian areas and limited protection for existing infrastructure. The impacts will be greater within Calgary as existing communities currently have no runoff volume controls in place. The intent is to reduce the interim Runoff Volume Control Targets to more sustainable volumes as more information regarding Low Impact Development BMPs becomes available.¹²

- 3 c. *It is understood that the new approach to stormwater management will take time to implement fully. A staged implementation plan should be encouraged with ultimate targets achieved in 2017 (Table 8.1).*

Table 8.1. Implementation schedule for reduction in Runoff Volume Control Targets.

| Date of Implementation | Runoff Volume Control Targets | | | |
|--------------------------------|-------------------------------|----------|----------|----------|
| | 2007 | Jan 2010 | Jan 2013 | Jan 2017 |
| Nose Creek main stem Target | 90 mm (50 mm) ^z | 30 mm | 16 mm | 11 mm |
| West Nose Creek Target | 90 mm (50 mm) | 50 mm | 26 mm | 17 mm |
| % Precipitation Volume Capture | 75%-85% | 85-90% | 93-95% | 95-97% |
| % Increase in Channel Width | ~ 100-200 % | ~100% | ~50% | 0-25% |
| Target Impacts on Creeks | High | High | Moderate | Low |

^z The 50 mm Runoff Volume Control Target should be applicable to country residential developments and low density industrial, commercial and institutional developments from 2007 to Jan 2010.

- 3 d. *The targets should be effective two months after the date of approval of the Nose Creek Watershed Water Management Plan by individual municipal jurisdictions. The target should apply to all new developments without a previously approved Staged Master Drainage Plan (for the catchment area draining to a stormwater pond or constructed wetland). Staged Master Drainage Plans should be submitted in conjunction with Outline Plan submissions (or equivalent within each jurisdiction).*

¹² Appendix D - Technical Memorandum Runoff Volume Evaluation (WER 2006).

Internal Drainage Areas

- 4 a.** *Due to the importance of internal drainage to the hydrological regime (i.e. groundwater recharge and evapotranspiration) in the western portion of West Nose Creek, and the eastern portion of Nose Creek, (Figure 6.1, page 5), direct drainage should not be permitted to West Nose Creek, Nose Creek or an associated tributary. These areas should remain isolated from the effective watershed area. Existing wetland policies should be considered during stormwater management planning.*
- 4 b.** *For extreme events, where precipitation exceeds local infiltration capacity, runoff may be directed toward the Creeks via conveyance methods designed to promote retention and infiltration, provided that the Runoff Volume Control Target has been achieved.*

Low Impact Development

- 5 a.** *Low impact development practices should be incorporated, wherever feasible, for all new developments and/or areas of redevelopment according to best available science in order to meet the Runoff Volume Control Target.¹³*
- 5 b.** *Targets for Low Impact Development should include, but not be limited to:*
- *a reduction in hard surface area*
 - *green roof systems*
 - *stormwater capture and re-use*
 - *absorbent landscaping*
 - *adoption of compact development forms and alternative site development standards.¹¹*

¹³ Appendix E provides a summary of Low Impact Development options.

8.3.3 Implementation Action Plan for Integrated Stormwater Management

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|--|--------------------|--|--|---|
| <p>Integrated Stormwater Management</p> | <p>NCWP</p> | <p>Education and Training</p> <p>Organize a two-day training workshop for governing jurisdictions to review Integrated Stormwater Management, hydrological water balance modeling, and Low Impact Development principles and practices.</p> <p>Develop factsheets related to Integrated Stormwater Management, hydrology and BMPs for use by the general public, members of Council and for landowners and internal department members.</p> <p>Request assistance from Trout Unlimited Canada to initiate the Yellow Fish Road Program, with support provided by education staff within each jurisdiction.</p> <p>Demonstration Projects</p> <p>Identify landowners/developers willing to participate in Low Impact Development subdivision designs and other BMP projects</p> <p>Initiate source control pilot projects to evaluate the applicability and effectiveness of different BMPs in the Nose Creek watershed (WER 2005). Project planning should be done in partnership to encourage all jurisdictions to be part of a larger initiative.</p> <p>Performance Monitoring and Indicators</p> <p>Conduct benchmark photography along select reaches of Nose Creek and its tributaries to provide visual assessment of changes to the creeks.</p> | <p>Runoff Volume Control Target</p> <p>The Partnership should further refine the Runoff Volume Control Target using precipitation data from at least a 30-40 year period, modeling and monitoring data generated from BMP projects.</p> <p>Demonstration Projects</p> <p>Continue to initiate source control pilot projects to evaluate the applicability and effectiveness of different BMPs in the Nose Creek watershed</p> <p>Performance Monitoring</p> <p>Monitoring of stream erosion and biometrics as well as additional research into Low Impact Development strategies should be conducted to examine whether these targets need to be refined (e.g. relaxed or tightened).</p> <p>Approach the University of Calgary to initiate erosion monitoring program to:</p> <ul style="list-style-type: none"> - better understand erosion processes and channel migration and to refine the present method of delineating meander belt needs. <p>Install reference sites to monitor long-term erosion by means of an annual or bi-annual comparison of surveyed cross-sections and possibly longitudinal profiles.</p> | <p>Erosion Monitoring</p> <p>The results of long-term erosion monitoring should be assessed for trends in erosion and channel enlargement.</p> <p>Improve Existing Infrastructure</p> <p>Partnership to develop a proposal to evaluate options to improve the operation of existing drainage systems within the Nose Creek watershed.</p> |

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---|--------------------------|--|---|--|
| Integrated Stormwater Management | AENV¹⁴ | <p>Education and Training</p> <p>Alberta Environment to build capacity for provincial staff to develop expertise on water balance modeling that considers implementation of Low Impact Development in site designs (reduction in hard surface area, green roof systems, stormwater capture and reuse, infiltration gardens) to achieve Runoff Volume Control Targets.</p> <p>Increased Enforcement and Capacity</p> <p>Work with municipalities to review and make recommendations to amend existing regulations.</p> <p>(No person responsible for a storm drainage system should use or permit the use of a substance into the storm drainage system in an amount, concentration or level or at a rate of release that may impair the quality of storm drainage (AR 119/93).</p> <p>Amend Policy/Legislation and Procedure</p> <p>Provide input for factsheet development.</p> <p>Update the Stormwater Management Guidelines and the Standards and Guidelines for Municipal Waterworks and Storm Drainage Systems to incorporate Low Impact Development practices.</p> | <p>Amend Policy/Legislation and Procedure</p> <p>Amend regulation (AR119/93).</p> <p>Manuals and guidelines should be developed and updated to reflect the new approach and terminology used for Integrated Stormwater Management (ISM).</p> <p>Develop a policy manual for Low Impact Development site designs.</p> | <p>Education and Training</p> <p>Review Manuals and Guidelines to remain current with advancing science and technology.</p> |

¹⁴ Guiding Legislation and Policy: *EPEA* Revised Statutes of Alberta 2000 Chapter E-12 Part 2-Division 2 (Approvals, Registration and Certificates); Activities Designation Regulation AR 276/2003 Schedule 2, Division 2 (Substance Release – construction, operation or reclamation of a storm drainage system); Wastewater and Storm Drainage Regulation AR 119/1993 Sections 5-6.1(3) (Design standards, extension of collection system, storm treatment facilities); Approvals and Registrations Procedure Regulation AR 113/93 Section 3(1)(2) (Requirements of Application), Sections 4, 5, and 6 (application completion, review and scope of review); Standards and Guidelines of Municipal Waterworks and Storm Drainage Systems (January 2006); Water for Life Strategy.

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---|------------------------------------|---|---|--|
| Integrated Stormwater Management | Municipalities¹⁵ | <p>Runoff Volume Control Target</p> <p>The interim Runoff Volume Control Target of 90 mm for typical residential and industrial areas should be implemented in Stormwater Management Plans submitted to Municipalities with development proposals and applications.</p> <p>The interim Runoff Volume Control Target of 50 mm should be implemented for country residential developments and low density commercial and industrial developments in Stormwater Management Plans submitted to Municipalities with development proposals and applications.</p> <p>Enforce bylaws.</p> <p>Develop Low Impact Development Specifications</p> <p>Design standards, construction specifications and maintenance procedures should be developed for Low Impact Development.</p> <p>Require that absorbent landscaping (e.g., increase in minimum soil depths to 300 mm), green roofs, rainwater capture and reuse, reuse of stormwater in wetponds for irrigation, porous pavements and reduction of impervious areas be incorporated in all new developments where possible.</p> | <p>Amend Policy/Legislation and Procedures¹⁶</p> <p>Manuals and guidelines (e.g. City of Calgary's Stormwater Design Manual) should be updated within all jurisdictions to reflect the new approach and terminology used for Integrated Stormwater Management (ISM).</p> <p>Amend existing policies, guidelines and procedures to include integrated stormwater management recommendations as minimum standards and allow for more flexibility and better regulatory control by departmental staff. Amendments should take effect for all new developments, with existing approvals grandfathered.</p> <p>Municipalities to set date (e.g. 2020), as target for all subdivisions and developments to meet minimum standards for Low Impact Development and landscaping as a condition on development agreements.</p> <p>Runoff Volume Control Target</p> <p>In January, 2010, the interim Runoff Volume Control Target should be reduced according to the schedule in Table 8.1.</p> <p>Performance Monitoring - BMPs</p> <p>Annually document occurrence (e.g. number and type) of Low Impact Development BMPs in each jurisdiction.</p> | <p>Performance Monitoring - BMPs</p> <p>Document occurrence (e.g. number and type) of Low Impact Development BMPs in use within each jurisdiction annually.</p> |

¹⁵ Guiding Legislation and Policy: City of Calgary: *MGA (Municipal Government Act)*, Intermunicipal Development Plan (IDP) (Calgary/MD of Rocky View Section 2.8.2), Municipal Development Plan (Section 2-1.2), Land Use Bylaws (LUBs), Drainage Bylaw 26M98; Streets Bylaw 20M88; City of Calgary Stormwater Design Manual; City of Calgary's

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---|-----------------------|--|-----------------------|-------------------|
| Integrated Stormwater Management | Municipalities | <p>Internal Policy Review</p> <p>Municipalities to conduct internal review of existing policies and legislation to identify changes required to implement Low Impact Development practices.</p> <p>Amend Policy/Legislation and Procedures¹⁷</p> <p>Require a Stormwater Management Plan for all new developments at the early Concept or Outline Plan stage of development approval.</p> <p>Build Capacity and Expertise</p> <p>Promote Low Impact Development and allow time for local consultants and contractors to build expertise in low impact design and construction to reduce risks.</p> <p>Municipalities should document occurrence (e.g. number and type) of Low Impact Development BMPs in use within their jurisdiction and feature projects in newsletters and at conferences.</p> <p>With support from the Nose Creek Watershed</p> | | |

Environmental Policy; City of Airdrie: MGA, MDP (Section 5B.5, Section 9D.5), LUBs; Town of Crossfield – MGA, MDP, LUBs; MD of Rocky View: MGA, IDP (Calgary/MD of Rocky View Section 2.8.2), MDP (Section 8.0 c, Section 9.5), LUBs (Section 20.1, Section 31.1).

¹⁶ Recommendations should be incorporated into Municipal Development Plans (MDPs), Regional Policy Plans, Area Structure Plans (ASPs), Outline Plans, Concept Plans, Redevelopment Plans, Servicing Standards (SS), Development Permits (DPs) and Development Agreements (DAs).

¹⁷ Recommendations should be incorporated into Municipal Development Plans (MDPs), Regional Policy Plans, Area Structure Plans (ASPs), Outline Plans, Concept Plans, Redevelopment Plans, Servicing Standards (SS), Development Permits (DPs) and Development Agreements (DAs).

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---|-----------------------|--|---|--|
| Integrated Stormwater Management | Municipalities | <p>Partnership and Alberta Low Impact Development Partnership, develop a plan to implement Low Impact Development research to increase confidence among landowners.</p> <p>Education and Training</p> <p>Conduct training for municipal staff to build capacity in water balance modeling that considers implementation of Low Impact Development in site designs (e.g. reduction in hard surface area, stormwater capture and reuse) to achieve Runoff Volume Control Targets.</p> <p>Amend Policy/Legislation and Procedures</p> <p>Absorbent landscaping (e.g. greater soil depths), green roofs and stormwater capture and reuse should be incorporated into new developments (Land Use Bylaws).</p> | | |
| | Landowners | <p>Runoff Volume Control Target</p> <p>The interim Runoff Volume Control Target of 90 mm for typical residential and industrial areas should be implemented in Stormwater Management Plans.</p> <p>The interim Runoff Volume Control Target of 50 mm should be implemented for country residential developments and low density commercial and industrial developments in Stormwater Management Plans.</p> <p>Source control BMPs in new developments to reduce runoff volumes should be implemented.</p> | <p>Education and Training</p> <p>Expertise in water balance modeling that considers implementation of Low Impact Development in site designs (reduction in hard surface area, green roof systems, stormwater capture and reuse, bioretention) should be developed to achieve Runoff Volume Control Targets.</p> <p>Runoff Volume Control Target</p> <p>In January, 2010, the interim Runoff Volume Control Target should be</p> | <p>Runoff Volume Control Target</p> <p>Preparations should be made for reductions in the Runoff Volume Control Target in 2013 and 2017.</p> |

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|--|--------------------------|---|--|-------------------|
| <p>Integrated Stormwater Management</p> | <p>Landowners</p> | <p>The Runoff Volume Control Target is achievable by incorporating:</p> <ul style="list-style-type: none"> - 300 mm thick absorbent landscaping, - green roofs for multi-family homes and commercial areas, - stormwater capture and reuse in multi-family and commercial areas, and - irrigation of stormwater accumulated in wetponds for MR and ER, - porous pavements, and - reduction of impervious areas. <p>Soil characteristics, subsurface conditions, topography, existing drainage patterns, economics and advantages/disadvantages of techniques should be included in the development of source control BMPs.</p> <p>Internal Drainage Areas</p> <p>Development that will occur in these areas of the watershed should incorporate the recommended Runoff Volume Control Targets to promote on-site retention and infiltration of stormwater according to best available science.</p> | <p>reduced according to the schedule in Table 8.1.</p> | |

8.4 Protection of Natural Features

8.4.1 Background

Valued natural features in the Nose Creek watershed include native vegetation, riparian areas, coulees, valleys, wetlands and escarpments. Native vegetation in natural areas controls erosion by protecting the surface of the soil from rainfall, slowing the velocity of runoff, maintaining the soil's absorption capacity, and holding soil particles in place. While natural features assist in regulating runoff quality and quantity, these areas also serve as critical habitats for wildlife in urban areas. Preserved coulees, wetlands and escarpments are travel corridors for wildlife. Preserving natural features serves to promote healthy watersheds, biodiversity and sustainable ecosystems.

Principles

Preservation of natural features in the watershed promotes healthy ecosystems through the provision of wildlife habitat, runoff control, water quality protection, and soil stabilization.

8.4.2 Recommendations to Protect Natural Features

Natural Hydrology

- 6 a. *To preserve existing topography and natural hydrology, buildings and roads should be strategically located to reduce the area disturbed by cutting and filling and minimize the amount of surface area susceptible to erosion.*
- 6 b. *Natural drainage swales should be used to convey runoff from new developments to the receiving waters at an appropriate volume and rate so as not to alter the native vegetation community or induce soil erosion.*

Escarpments

- 7 a. *Stripping, grading or filling of escarpment areas should not be permitted for new developments.*
- 7 b. *On lands subject to development, regardless of proximity to the creeks, escarpments equal to or greater than 15% slope should be designated as Environmental Reserve and retained as natural area as identified on the Riparian Area Management Map.*
- 7 c. *Where land is situated adjacent to or includes the banks of any watercourse, including coulees, ravines, gullies, valleys and where the slope of the bank adjacent to any watercourse is in excess of 15%, buildings or other structures should not be permitted:*
 - *Where the height of bank is less than 6 m, within 12 m from the top of the bank,*
 - *Where the height of bank is between 6 m and 23 m, within a distance that is two times the height of bank, from the top of the bank,*
 - *Where the height of bank is more than 23 m, within 46 m from the top of the bank.*¹⁸

Valued Natural Features

- 8 a. *Wherever possible, stripping, grading and/or filling should be minimized to preserve valued ecosystem components (e.g. riparian areas, escarpments, wetlands).*

¹⁸ M.D. of Rocky View Land Use Bylaw Section 34 (a).

- 8 b.** *Wetlands should be retained in the watershed using a minimum 30 m setback. This is an interim recommendation that will be refined once the wetland inventory is complete.*
- 8 c.** *Where possible on all new developments and areas designated for redevelopment, existing vegetation should be maintained and stripped areas should be re-vegetated as soon as feasible.*

Sediment and Erosion

- 9 a.** *Sediment and erosion control measures (BMPs) should be implemented, monitored and maintained on construction sites to prevent water quality degradation according to the City of Calgary's Sediment and Erosion Control Manual. This manual should be updated to reflect the importance of maintaining natural vegetative cover and avoiding critical slope areas.*

8.4.3 Implementation Action Plan to Protect Natural Features

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term to Long Term (2009-11+) |
|-----------------------------|------------------------------|---|--|
| Natural Features Protection | NCWP | <p>Education and Training</p> <p>The Partnership should host a Sediment and Erosion Control workshop for the jurisdictions in the Nose Creek Watershed.</p> | |
| | AENV ¹⁹ | <p>Consider the Nose Creek Watershed Water Management Plan</p> <p>AENV to consider the Nose Creek Watershed Water Management Plan in its decision-making where legislation applies.</p> <p>Review the <i>Water Act</i> to include the protection of natural features.</p> | |
| | Municipalities ²⁰ | <p>Natural Capital Inventory</p> <p>Complete Natural Capital Inventory:</p> <ul style="list-style-type: none"> - Wetlands (location, number and size classified according to Stewart and Kantrud) - springs - areas with significant vegetation, including unique landforms and significant species, - wildlife corridors - recharge areas, and - areas susceptible to bank instability and erosion. <p>This inventory could build on some of the work that has been completed by Westhoff Engineering Resources, Inc.</p> <p>Amend Policy/Legislation and Procedures</p> <p>A reclamation plan should be submitted by developers at time of application that includes timelines for completion. An abandoned project area that was subjected to stripping and grading should be reclaimed within 60 days of notification.</p> <p>Inclusion of sediment and erosion control measures for construction</p> | <p>Natural Capital Inventory</p> <p>Natural capital inventory could be monitored through time and reported as cumulative effects.</p> <p>Amend Policy/Legislation and Procedures</p> <p>Require that sediment control measures for construction sites are included in all development plans submitted to municipalities or provincial departments.</p> <p>Improved Enforcement Capacity</p> <p>Design a program within each jurisdiction to encourage departments to participate in enforcement of sediment and erosion control. An example may be departments that operate outside in the watershed (e.g. Parks or Public Works staff) may be able to identify violations.</p> |

¹⁹ Guiding Legislation and Policy: *Environmental Protection and Enhancement Act* – Section 122(1) 7c, 7c, 7e; Water for Life Strategy; Southern Region Strategy.

²⁰ Guiding Legislation and Policy: City of Calgary – MGA, IDP (Calgary/MD of Rocky View Section 2.6), MDP (Section 2-1.4), Urban Parks Master Plan, LUBs; City of Airdrie – MGA, IDP (Airdrie/MD of Rocky View Section 2.6), MDP (Section 7H.16, Section 8A.1), LUBs; Town of Crossfield – MGA, MDP, LUBs; MD of Rocky View – MGA,, IDP (Airdrie/MD of Rocky View Section 2.6; Calgary/MD of Rocky View Section 2.6), MDP (Section 8.0 c), LUBs (Section 20.1).

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term to Long Term (2009-11+) |
|-----------------------------|--------------|--|--|
| Natural Features Protection | | <p>sites should be included in all development plans submitted to municipalities or provincial departments.</p> <p>Education and Training</p> <p>Appropriate staff from each jurisdiction should attend a Sediment and Erosion Control course. A course is offered annually by the City of Calgary.</p> | |
| | Landowners | <p>Biophysical Assessments</p> <p>The developer, with the assistance of qualified environmental specialists, should identify native vegetation communities and appropriate runoff volume release rates for intermittent streams on all applications.</p> <p>Performance Monitoring and Maintenance</p> <p>Regular inspection and maintenance of erosion control BMPs should be conducted and all failing systems repaired as required.</p> | <p>Amend Policy/Legislation and Procedures</p> <p>From the base Nose Creek riparian map, the developer should provide site-specific detailed maps (a biophysical assessment) identifying, but not limited to, the following:</p> <ul style="list-style-type: none"> - Watercourses, lakes and other water bodies (e.g. creek/valley corridors, wetlands). - Areas of significant vegetation, including provincially, regionally and locally significant species. No earthworks should be permitted within 3 to 5 metres of the vegetation drip line to protect root systems. - Critical recharge areas. - Floodplain mapping (as provided by AENV) - Erosion areas susceptible to bank instability - Escarpment areas having slope of $\geq 15\%$. |

8.5 Riparian Protection

8.5.1 Background

A riparian area is the transition zone between aquatic and terrestrial ecosystems, where the presence of water supports the growth of water-tolerant vegetation and soils are modified due to temporary or permanent inundation.

As transition zones between the terrestrial and aquatic environment, riparian areas have a variety of functions. Riparian areas protect water quality by slowing the flow of water to facilitate the trapping of sediment (Cooper et al. 1987), nutrients (Gilliam 1994; Vought et al. 1994; Daniels and Gilliam 1996) and bacteria in soils and vegetation. Riparian vegetation is also a key component of streambank stability, as deep binding root mass holds soil together. The impact of stormwater runoff is also lessened by healthy riparian areas as flood water is absorbed in soils and released slowly throughout the remainder of the year. Overhanging riparian vegetation can moderate water temperature, making the creek more suitable for higher species of aquatic life. Finally, the riparian corridor maintains habitat diversity and allows for improved wildlife species distribution and diversity (Castelle et al. 1994). Generally, riparian areas are a small fraction of the landscape, comprising less than 2% of land area; their role, however, is essential to preserving the health of the Nose Creek Watershed.

Principles

Healthy riparian areas contribute to better water quality, stable stream banks, flood reduction and wildlife habitat in the Nose Creek Watershed.

8.5.2 Recommendations to Protect Riparian Areas

Setbacks

- 10 a.** *The riparian setback width should be determined on a site-specific basis by calculating the sum of three criteria: the 1:100 year floodplain width, the meander belt width (20x the bank full width) and the width of escarpments (lands having > 15% slope) that lie adjacent to the meander belt and/or floodplain as per the Riparian Area Management Map (Appendix G).*
- 10 b.** *The riparian setback should be applied to intermittent and perennial streams as identified on the Riparian Area Management Map (Appendix G).*
- 10 c.** *Where the slope of the bank adjacent to the watercourse is > 15%, an additional setback from the top of bank will be added to the riparian setback width to provide a stable slope allowance according to the following:*
- *Where the height of bank is less than 6 m, within 12 m from the top of the bank,*
 - *Where the height of bank is between 6 m and 23 m, within a distance that is two times the height of bank, from the top of bank,*
 - *Where the height of bank is more than 23 m, within 46 m from the top of the bank,²¹*
 - *The stable slope allowance also pertains to land situated adjacent to or including coulees, ravines, gullies, valleys and where the slope of the bank adjacent to any watercourse is in excess of 15%.*
- 10 d.** *Where the floodplain has not been defined, (i.e. for intermittent streams or perennial tributaries of Nose Creek or West Nose Creek), the meander belt width should be*

²¹ MD of Rocky View Land Use Bylaw Section 34 (a)

calculated and the resulting width used as the riparian setback to a minimum width of at least 15 m or as defined by each jurisdiction.

- 10 e.** *The Riparian Area Management Map should be used to identify riparian setbacks for planning purposes, but actual setbacks should be calculated in the field by qualified environmental specialists.*

Restricted and Permitted Activity

- 11 a.** *Except for permitted activities, no further development (including stormwater ponds) or site alteration should be permitted within the riparian setback, thus maintaining riparian areas in their natural state.*

- 11 b.** *Pathways in proximity of bridge crossings should be reviewed on a case by case basis to ensure continued provision of public safety.*

- 11 c.** *The following activities should be permitted in the riparian setback:*

- *existing uses, buildings and structures,*
- *existing agricultural operations, provided they comply with existing regulations (e.g. runoff regulations),*
- *existing parks and playgrounds,*
- *existing recreational facilities and associated surface parking,*
- *existing roads and pathways,*
- *public utility installations and facilities,*
- *natural areas,*
- *passive recreational uses (e.g. walking); pathways constructed from hard surfaces should be avoided where possible,*
- *maintenance and repair of existing infrastructure,*
- *approved water supply wells or wells and associated technology used for the purpose of livestock watering, and*
- *interpretive signage.²²*

- 11 d.** *Public access to Nose Creek, West Nose Creek and associated tributaries should be maintained in a manner that will not compromise riparian function or water quality. Appropriate measures to minimize impact should include:*

- *Construction of pathways consisting of impervious materials limited to above the 1:100 year floodplain.*
- *The use of bridges should be limited and avoided where the channel is highly active.*
- *Provision of signs in public areas that describe the ecological significance of riparian areas.*
- *Provision of bioengineered access points for dogs and signs that will educate dog owners of potential ecological impacts.*
- *Provision of garbage cans, bags and animal waste disposal areas in parks.*
- *Control of invasive weeds in riparian areas through the adoption of integrated pest management.*

Agricultural Lands

- 12 a.** *The application of manure and fertilizer on agricultural lands should be consistent with the standards outlined in the Agricultural Operations Practices Act (AOPA) for manure and fertilizer application on forages or direct seeded crops.²³*

²² Adapted from the Town Cochrane's Watershed Protection and Water Management Bylaw 2005

²³ Agricultural Operations Practices Act (AOPA)

- *Manure and fertilizer should be applied at an appropriate rate so as not to accumulate in the soil or leach into groundwater.*
 - *Regular soil testing should be conducted to prevent over application of fertilizer and manure.*
 - *Vegetative buffers should be established and protected adjacent to riparian areas at widths of 6 m on slopes less than 6%, and 30 m on slopes greater than 6%.*
 - *Vegetative buffer strips should be seeded using a mixture suitable for forage so to preserve the utility of the land for agriculture.*
 - *Vegetative buffer strips should be maintained by mowing, to not less than 15 cm in height. The forage produced may be used for livestock.*
- 12 b.** *Land that is marginally productive for annual crops should be converted into long-term forage production or retained in its natural state (e.g. ephemeral wetlands).*
- 12 c.** *Ephemeral wetlands should be retained to allow for the process of groundwater recharge and water quality protection.*
- 12 d.** *Riparian vegetation (trees, shrubs and grasses) should be maintained, protected, restored and/or enhanced.*
- 12 e.** *Grazing of livestock should be permitted in the riparian area if best management practices (BMPs) are implemented, including, but not limited to:*
- *Timing restrictions – Cattle should not be grazed in riparian areas during the spring thaw or when soils are moist. Most appropriate grazing periods are summer and/or winter.*
 - *Stocking rate – Cattle should be grazed at the appropriate stocking rate for pastures bisected by a watercourse.*
 - *Offstream watering – Where the sole source of livestock water is Nose Creek, West Nose Creek or a tributary of said Creeks, an offstream watering system should be used to protect riparian function.*
- 12 f.** *When timing restrictions and stocking rates cannot match a pasture's carrying capacity, temporary or permanent fencing should be used to protect water bodies.*
- 12 g.** *Tools, such as salt, artificial windbreaks, temporary or permanent fencing and water should be used to promote even distribution of grazing and manure throughout the entire pasture and discourage use around watercourses.*
- 12 h.** *Seasonal feeding and bedding sites should be located at least 30 m from a common body of water. Where sites are less than 30 m from a common body of water, a properly designed berm between the site and the water should be constructed to divert runoff away from the site. Accumulations of manure and bedding should be removed before runoff occurs. Berming upslope of the wintering site will also divert clean water run-on water away from the site and reduce the amount of manure runoff.*
- 12 i.** *Short-term storage of solid manure should be located:*
- *More than one metre above the water table,*
 - *Above the 1:25 year floodplain,*
 - *100 metres from springs or water wells, and*
 - *30 metres from a common body of water.²⁴*

²⁴ AOPA 2003

8.5.3 Implementation Action Plan for Riparian Protection

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|-------------------------|--------------------|---|---|---|
| Riparian Protection | NCWP | <p>Demonstration Project</p> <p>A landowner/developer should be identified who is willing to incorporate the riparian setback criteria into new development for demonstration.</p> <p>Strahler Order Coding</p> <p>Partnership to request that the Strahler Order Coding for the Nose Creek Watershed be completed that will identify and prioritize tributaries of Nose Creek and West Nose Creek.</p> | <p>Performance Monitoring - Riparian</p> <p>Cows and Fish should be contracted every three years to conduct a detailed Riparian Health Assessment.</p> | <p>Performance Monitoring - Riparian</p> <p>Continue with regular assessments of riparian areas every three years.</p> |
| | AENV ²⁵ | <p>Provincial Riparian Policy</p> <p>AENV should coordinate the development of a provincial riparian policy to complement efforts by other jurisdictions and organizations.</p> <p>General</p> <p>Any work within a water body requires an Approval under the <i>Water Act</i>. Wetland retention and compensation are considered in AENV's decisions.</p> | | |
| | SRD ²⁶ | <p>Internal Policy Review</p> <p>Sustainable Resource Development should review guiding legislation and policy regarding riparian areas and minimum setback requirements in support of municipalities.</p> | | |

²⁵ Guiding Legislation and Policy: *Water Act* Approvals (10 a, 10 b, 10 d, 10 e); Water for Life Strategy; Southern Region Strategy

²⁶ Guiding Legislation and Policy: *Public Lands Act* (Section 54(1)(e)), *Wildlife Act* (Section 36(1)), *Surveys Act*

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|-------------------------|---------------------------------|--|---|---|
| Riparian Protection | Municipal Affairs ²⁷ | <p>Internal Policy Review</p> <p>Municipal Affairs should review guiding legislation and policy regarding ER, MR and minimum riparian setback requirements in support of municipalities.</p> | | |
| | Municipalities ²⁸ | <p>Understand Implications</p> <p>Municipalities to look at the implication of the defined setback widths in the NCWMP on sections of Nose Creek and West Nose Creek to determine potential impacts to landowners. The setback distances should be measured in a horizontal direction outward from the ordinary high water mark for each designated watercourse. A minimum of two meander cycles, or generally a 200 m reach adjacent to the development, should be used as a representative reach to determine bank full width (Fitch et al. 2001).</p> <p>Alternative site design scenarios should be considered when exploring the riparian setback implications including density, flexible MR, and conservation development designs vs. conventional development.</p> <p>Internal Policy Review</p> <p>Municipalities ensure that Low Impact Development policies are amended and in place prior to amending riparian setback policies.</p> <p>Municipalities should review agricultural exemptions for building permits and refine as necessary.</p> | <p>Amend Policy/Legislation and Procedures²⁹</p> <p>Require development applications include documentation to show how the project considered riparian areas and water quality in the planning process.</p> <p>Amend policies, guidelines and other documents to include riparian setback criteria and other riparian protection recommendations by 2009.</p> <p>Integrate floodplain mapping, provided by Alberta Environment, into the Land Use Bylaw so it is available at the counter for review by landowners and developers.</p> <p>Education and Training</p> <p>Continue to host field days to highlight good management practices in the watershed. Involve Cows and Fish and</p> | <p>Internal Policy Review</p> <p>Review riparian setback policies to determine if meeting goals.</p> |

²⁷ Guiding Legislation and Policy: MGA (ER - Section 664(1) Subject to Section 663; MR – Section 666, Section 668)

²⁸ Guiding Legislation and Policy: City of Calgary – MGA, MDP, LUBs (Section 19.1, Parks and Pathways permitted uses), Calgary River Valleys Plan; City of Airdrie – MGA, IDP, Airdrie/MD of Rocky View (Section 2.6 c), MDP (Section 7H.4, Section 9D.5), LUBs (Section 12, Part III); Town of Crossfield – MGA, ASP, MDP, LUBs; MD of Rocky View – MGA, Airdrie/MD of Rocky View (Section 2.6 c), MDP Section 10.1 (ER), LUBs.

²⁹ Recommendations should be incorporated into Municipal Development Plans (MDPs), Regional Policy Plans, Area Structure Plans (ASPs), Outline Plans, Concept Plans, Redevelopment Plans, Servicing Standards (SS), Development Permits (DPs) and Development Agreements (DAs).

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|----------------------------|-----------------------|--|--|-------------------|
| Riparian Protection | Municipalities | <p>Education and Training</p> <p>Continue to encourage all producers in the watershed to participate in the Environmental Farm Plan Program.</p> <p>Municipalities to offer co-sponsored course to ensure that municipal staff have the expertise to review riparian setback and biophysical assessments submitted for approval.</p> | <p>Trout Unlimited Canada.</p> <p>Continue to provide land and water management support to producers in the watershed.</p> <p>Awareness and stewardship programs should be created to ensure the buffer is visible in the community. The following steps should be taken:</p> <ul style="list-style-type: none"> - Mark buffer boundaries with permanent signs that describe allowable uses, - Educate buffer owners about the benefits and uses of the buffer with pamphlets, creek walks and meetings with homeowners associations, - Ensure that new owners are fully informed about buffer limits/uses when property is sold or transferred, and - Conduct annual buffer walks to check on encroachment. | |
| | Landowners | <p>Amend Policy/Legislation and Procedures</p> <p>The land owner should consult a qualified environmental specialist to identify riparian setbacks on all site plans submitted to the appropriate jurisdiction for permitting. The site plan should be drawn to scale. A development permit should only be approved after the delineation of the riparian setback by the applicant has been conducted.</p> <p>The riparian setback zone should be clearly marked on-site with construction fencing prior to any soil disturbing or construction related activities. The delineation should be maintained throughout the activity period.</p> <p>Promote Local Stewardship</p> <p>Individual landowners should participate in riparian area awareness initiatives and strive to properly manage riparian areas.</p> | | |

8.6 Water Quality Protection

8.6.1 Creek Classification (Codes of Practice – *Water Act*)

8.6.1.1 Background

The class structure for water bodies in Alberta is outlined in the *Water Act* Codes of Practice. Currently, there are three Codes of Practice which apply to instream activities: “Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body”, “Code of Practice for Watercourse Crossings” and the “Code of Practice for Outfall Structures on Water Bodies”.³⁰

The class structure influences activities occurring in a water body, including the construction method, timing and conditions under which the pipeline, telecommunication line, bridge, culvert, ford or stormwater outfall is constructed. The class of a water body is determined based on the sensitivity of fish habitats and their known distribution. Class D is described as having low sensitivity since fish species as defined under the Code are not present. Class C is described as having moderately sensitive habitat areas that are sensitive enough to be potentially damaged by unconfined or unrestricted activities within a water body. Class C is further described as having broadly distributed habitats that support local fish species populations.

Restricted activity periods are time periods when works that disrupt the bed or banks of a water body are not permitted. Maps under the Code identify restricted activity periods for mapped Class A to Class C water bodies. Restricted activity periods do not exist for Class D water bodies.

At present, Nose Creek is classified as a Class D and has no timing restriction on activities that may disrupt the bed or banks of the creek, except for the reach 2 km upstream of the Bow River which is designated as Class C. By changing the Class of Nose and West Nose Creek from Class D to Class C, timing restrictions would be placed on an activity (i.e., construction) scheduled for the Creek and more strict conditions would apply to the activity, increasing the protection of aquatic health in the watershed.

8.6.1.2 Recommendation to Reclassify Creeks

13 a. *Nose Creek and West Nose Creek should be reclassified to a Class C water body, as defined by the Codes of Practice to reflect the sensitivity of the watershed’s aquatic and riparian environment, to improve water quality and promote public awareness and education.*

Principles

The importance of Nose Creek and West Nose Creek is acknowledged, and the Creeks, as habitat for fish and other aquatic and terrestrial life is valued.

Increased awareness among approval officers and industry when planning for development in the vicinity of Nose Creek or West Nose Creek.

³⁰ Appendix H contains the Code of Practice Map for the Calgary Management Area.

8.6.1.3 Implementation Action Plan for Reclassification of Creeks

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) |
|-------------------------|--------------------------|---|--|
| Class Structure | NCWP | <p>Fishery Inventory</p> <p>Partner with Fisheries and Oceans Canada, Trout Unlimited Canada and Sustainable Resource Development to conduct a comprehensive study that identifies the potential of Nose Creek and West Nose Creek as a fishery and determine the Creeks suitability and importance to maintaining a fishery in the Bow River.</p> | <p>Request Change to Classification of Nose Creek and West Nose Creek</p> <p>Partnership to prepare letter stating reasons for requested change in classification from Class "D" to Class "C".</p> <p>Partnership to contact Sustainable Resource Development (SRD) at (403) 362-1203 to change the fish habitat classification. SRD should be invited to a Technical Team meeting to discuss details. A letter stating reasons for the change should be provided to SRD at the meeting.</p> <p>SRD should submit classification change request to place Nose Creek on the map.</p> |
| | AENV³¹ | | <p>Change Classification of Nose Creek and West Nose Creek</p> <p>AENV should publish the revised Codes of Practice map, within a reasonable amount of time, once the classification change has been made.</p> |
| | SRD³² | | <p>Change Classification of Nose Creek and West Nose Creek</p> <p>Sustainable Resource Development should support the Nose Creek Watershed Partnership in their action to reclassify Nose Creek and West Nose Creek by providing appropriate fisheries information and submitting a class change request to Alberta Environment.</p> |

³¹ Guiding Legislation and Policy: *Water Act* - Codes of Practice

³² Guiding Legislation and Policy: *Wildlife Act*

8.6.2 Source Water Protection

8.6.2.1 Background

Source water is untreated water from streams, rivers, lakes, or underground aquifers which is used to supply private wells and public drinking water. Protection of these water sources is necessary to ensure they are available for future use, particularly in areas that are vulnerable to contamination due to geology, soils, hydrology, and land management practices. The health of individuals relying on a water supply is at risk if protection plans are not put in place. Preventing the contamination of source water is the first step to preventing waterborne illness. Water quality is compromised in various ways including point and non-point source pollution, water withdrawal that exceeds the rate of recharge, development, and agricultural practices. Economically, it is more cost-effective to prevent contamination than to improve water quality to drinking water standards after the source has been compromised.

Principles

Safe, secure drinking water supplies in rural and urban areas for future generations.

The areas identified on the watershed map (Figure 6.1, page 5), represent a starting point for source water protection initiatives. This area has unique drainage characteristics that make it important for groundwater recharge. Allowing rainfall to infiltrate replenishes groundwater and provides base flow to streams. This process maintains stream flow during drier summer months and maintains groundwater for drinking water purposes.

Groundwater studies in the Nose Creek watershed showed that infiltration capacity or groundwater recharge is a function of biophysical conditions including topography, soil, vegetation and geology. Hayashi (2004) divided the northern reaches of the West Nose Creek watershed into 8 sub-basins. They recorded change in base flow during one month in 2003. With no significant precipitation events occurring during the course of their study, they found that Big Spring Creek contributed 64% of the flow in West Nose Creek, while occupying only 15% of the area. The headwaters of the Big Spring Creek are comprised of a group of springs apparently discharging from the contact zone between the Paskapoo Formation and the overlying gravel layer. Best management practices (BMPs) for runoff volume control such as porous pavement and other infiltration structures should be implemented to maintain groundwater and base flows in this region.

8.6.2.2 Recommendations for Source Water Protection General

14. *A comprehensive source water protection plan should be developed that identifies the vulnerability of source water in the Nose Creek Watershed and the specific protection and management strategies required for high, medium and low risk areas.*

Education and Awareness

- 15 a. *Signs should be posted in the Source Water Protection Area to denote its significance to groundwater recharge and base flows in Nose Creek and West Nose Creek, and to indicate the sensitivity of the area in regard to local drinking water supplies.*
- 15 b. *Measures should be taken to protect groundwater supplies. Abandoned wells should be identified by each municipal jurisdiction and sealed by qualified professionals to prevent contamination of groundwater.*
- 15 c. *Landowners should adopt BMPs for source water protection including proper disposal of harmful materials and proper use of pesticides and fertilizers.*

8.6.2.3 Implementation Action Plan for Source Water Protection

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---------------------------------------|--------------------|---|---|--|
| <p>Source Water Protection</p> | <p>NCWP</p> | <p>Identify Priority Source Water Areas</p> <p>Identify priority source water protection areas in the watershed (e.g. the western and eastern fringe of the watershed).</p> <p>Prepare Source Water Protection Proposal</p> <p>Assemble meeting to discuss source water protection and prepare Project Proposal with:</p> <ul style="list-style-type: none"> - Alberta Health - Alberta Environment - University of Calgary - Alberta Ingenuity Centre for Water Research - Bow River Basin Council - PFRA <p>Identify Partner Lead to assist with the development of the source water protection plan for the Nose Creek Watershed.</p> <p>Develop Groundwater Map</p> <p>Develop a Nose Creek Watershed groundwater map showing:</p> <ul style="list-style-type: none"> - priority Source Water Protection Areas (high, medium and low risk areas) - groundwater flow pathways, - recharge areas, - location of springs and discharge areas, and - groundwater water quality. | <p>Develop Source Water Protection Plan</p> <p>Based on Groundwater Map and other reference material, develop comprehensive Source Water Protection Plan that identifies source water vulnerability and specific protection and management strategies for high, medium and low risk areas.</p> | <p>Education and Awareness</p> <p>Post signs in the Source Water Protection Area to denote its significance to groundwater recharge and base flows in Nose Creek and West Nose Creek, and to indicate the sensitivity of the area in regard to local drinking water supplies.</p> <p>Implement a Source Water Protection education program including:</p> <ul style="list-style-type: none"> - factsheets on source water protection in the Nose Creek watershed - signs denoting area's significance to groundwater recharge, base flows, and drinking water |

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|-------------------------|------------------------------|---|---|-------------------|
| Source Water Protection | AENV ³³ | <p>Technical Support</p> <p>Assist the Nose Creek Watershed Partnership with the development of a groundwater inventory map.</p> | <p>Addressing Abandoned Wells</p> <p>To protect groundwater supplies, abandoned wells should be identified and assessed by Alberta Environment.</p> <p>Alberta Environment should work with each municipal jurisdiction to develop a program to have qualified professionals seal abandoned wells to prevent contamination of groundwater. Potential partners in this program may include the Environmental Farm Plan Company, Alberta Agriculture, Food and Rural Development and the Prairie Farm Rehabilitation Administration.</p> <p>Technical Support</p> <p>Provide Technical groundwater support to the Nose Creek Watershed Partnership to assist with the development of a source water protection plan and identify appropriate tools for source water protection.</p> | |
| | Municipalities ³⁴ | | <p>Disposal of Harmful Materials</p> <p>Municipalities should develop programs to assist rate payers to properly dispose of harmful materials (e.g. pesticides and fertilizers).</p> | |
| | Landowners | <p>Landowners should adopt BMPs for source water protection including properly disposing of harmful materials and proper use of pesticides and fertilizers.</p> | | |

³³ Guiding Legislation and Policy: EPEA; Water for Life Strategy; Southern Region Strategy

³⁴ Guiding Legislation and Policy: City of Calgary – MGA, MDP (Section 2-1.2), LUBs ; City of Airdrie – MGA, MDP (Section 8A.1), LUBs; Town of Crossfield – MGA, MDP, LUBs; MD of Rocky View – MGA, MDP, LUBs

8.6.3 Channelization

8.6.3.1 Background

Channelization of Nose Creek and West Nose Creek has occurred numerous times in the past and has resulted in a substantial loss of overall creek length.

Channelization negatively impacts creek systems by simplifying habitat type, and changing flow levels and patterns that result in increased erosion of downstream banks and subsequent increased sediment loading (Alberta Transportation 2001). In addition, straightening creeks degrades riparian areas when flood waters can no longer reach the floodplain due to changes in natural hydrology. Loss of riparian function reduces the ability of a creek system to contribute to water quality improvements through natural processes of nutrient attenuation, sedimentation and biological uptake.

Currently it is permissible to have an overall shortening of a river or creek provided that the quantity of fish habitat meets or exceeds pre-construction conditions. This is generally achieved by improving the quality of fish habitat within the channelized reach (DFO 1998).

Principles

No further loss of channel length and associated ecological function in Nose Creek or West Nose Creek.

8.6.3.2 Recommendations to Address Channelization

- 16 a.** *To prevent the further loss of channel length and associated ecological functions in Nose Creek and West Nose Creek, there should be no approval for development (e.g. road infrastructure) unless the following is demonstrated:*
- *“No net loss” of channel length in Nose Creek, West Nose Creek and associated tributaries.*
 - *No degradation of aquatic habitat or riparian areas in Nose Creek, West Nose Creek and associated tributaries.*
 - *Appropriate planning for upgrades to major infrastructure should be undertaken such that impacts to the Creeks are minimized and or mitigated to insure no net loss.*
- 16 b.** *Principles of “no net loss” and “no degradation” should be achieved through project relocation and redesign.*
- 16 c.** *Development applications should include documentation to show how the project considered riparian areas and water quality in the planning process.*

8.6.3.3 Implementation Action Plan for Channelization

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|-------------------------|------------------------------------|--|---|--|
| Channelization | NCWP | <p>Amend Policy/Legislation and Procedures</p> <p>During review of development applications and proposals, the Nose Creek Watershed Partnership should maintain their position of “no net loss” of channel length.</p> | <p>Performance Monitoring and Indicators – Channel Length</p> <p>The Nose Creek Watershed Partnership should determine historical channel lengths for Nose Creek and West Nose Creek and compare findings to present day conditions.</p> | <p>Performance Monitoring & Indicators – Channel Length</p> <p>The Nose Creek Watershed Partnership should update channel length estimates every three to five years.</p> |
| | AENV³⁵ | <p>Consider WMP</p> <p>The effects of channelization are taken into consideration during AENV’s review of <i>Water Act</i> applications. AENV should also consider the NCWMP during the review process.</p> | <p>Work with municipalities and landowners to reclaim channelized sections of the Nose and West Nose Creeks.</p> | |
| | Fisheries and Oceans Canada | <p>Consider WMP</p> <p>The effects of channelization are taken into consideration during Fisheries and Oceans Canada review of <i>Fisheries Act</i> applications. Fisheries and Oceans Canada should also consider the NCWMP during the review process.</p> | | |
| | Municipalities³⁶ | | <p>Amend Policy/Legislation & Procedures</p> <p>Municipalities should adopt the “No net loss” recommendations in policies.</p> | |

³⁵ Guiding Legislation and Policy : *Water Act* – Section 36 states that “no person may commence or continue an activity except pursuant to an approval unless it is otherwise authorized under this Act”; Water for Life Strategy; Southern Region Strategy

³⁶ Guiding legislation and policy: *MGA*

8.7 Mitigation, Compensation, Restoration

8.7.1 Background

Mitigation is defined as actions taken to lessen the actual or foreseen adverse environmental impact of a project or activity. Mitigation can further be described as those actions taken during the planning, design, construction and operation of a project that alleviate potential adverse effects (DFO 1986). Mitigation can consist of relocation, incorporation of design features that eliminate or reduce negative impacts, and construction BMPs and preventative measures. Fisheries and Oceans Canada considers mitigation as actions that avoid a harmful alteration, disruption or destruction of fish habitat (HADD), while Alberta Environment includes measures to restore the productive capacity at a crossing site, for example, to a level equal to or greater than that which existed prior to construction as mitigation (Alberta Transportation 2001).

Principles

A healthy, functioning aquatic ecosystem supports aquatic life and provides water quality benefits, stable stream banks, flood protection.

Compensation involves the replacement of damaged riparian areas with newly created riparian area and/or the restoration or enhancement of existing riparian areas. Stream meander restoration, the transformation of a straightened stream into a meandering one to reintroduce natural dynamics, improve channel stability, habitat quality, aesthetics, and other stream corridor functions or values may be considered as compensation.

Nose Creek and West Nose Creek are vulnerable to further degradation unless development and agricultural practices change and efforts are made to restore ecosystem function. Nose Creek has been impaired through channelization (loss of channel length) and loss of riparian function. Restoration of Nose Creek and West Nose Creek should be a priority as future land use decisions are being made and further alteration to the creeks is anticipated. Studies conducted by Cows and Fish (2001) indicate that the creeks will be highly responsive to any improvements made to grazing land management or development practices that reduce stormwater input and degradation of riparian areas.

8.7.2 Recommendations for Mitigation, Compensation and Restoration

Mitigation

- 17 a. *Development plans that may impact Nose Creek, West Nose Creek or an associated tributary must demonstrate why disturbance cannot be avoided through either relocation or redesign and how impacts will be mitigated.*
- 17 b. *BMPs should be prescribed during detailed design and used routinely when working in and around riparian areas and watercourses. Specific mitigation measures should be included in the detailed design, and account for construction and maintenance activities as well as the expected effects of the completed structure on riparian areas and water quality. Some appropriate mitigation measures are detailed in Appendix I.*

Compensation

- 18 a. *Compensation should only be considered when all other options (i.e., avoid and relocate) have been exhausted (Refer to Recommendation 17 a).*
- 18 b. *Depending on the severity of the disturbance, compensation may be achieved through:*
 - *Replacement of riparian area at or near the site,*

- *Enhancement or improvement of existing riparian area near the site or away from the site on the same watercourse, and*
- *Maintenance or restoration of hydraulic connectivity to allow interaction of water between the creek and abandoned channel reaches.*

Restoration

- 19 a.** *Effort should be made to partner with conservation groups, government agencies and watershed groups to restore the ecological function of Nose Creek, West Nose Creek and their tributaries.*
- 19 b.** *Restoration projects should be properly designed and allow the natural process of deposition and aggradation to occur in Nose Creek and West Nose Creek. Where ever possible, innovative bioengineering options should be employed to restore streambanks and reduce/prevent further occurrence of erosion (Appendix J).*
- 19 c.** *Priority sites that should be considered for restoration include:*
- *Areas that pose a safety hazard to the public due to accelerated erosion,*
 - *Areas where the hydraulic connectivity, that allows interaction of water between the stream and abandoned channel reaches, have been disconnected, and*
 - *Areas impacted by improper management of grazing lands.*
- 19 d.** *Reaches of the creek that have been channelized should be improved through the restoration of hydraulic connections where possible.*
- 19 e.** *Urban parks should be restored by replacing tame species with native species where possible and modifying park maintenance schedules, such as mowing timing and location (i.e., adhering to minimum setbacks).*

8.7.3 Implementation Action Plan for Mitigation, Compensation and Restoration

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---|--------------------|---|---|--|
| <p>Mitigation, Compensation, Restoration</p> | <p>NCWP</p> | <p>Define Restoration Goals</p> <p>Partnership to define restoration goals for Nose Creek, West Nose Creek and their tributaries.</p> <p>Partnership to use the existing Priority Reaches (delineated in Van Wyck 2003) as the basis for identifying restoration goals (Appendix K).</p> <p>Partnership to develop restoration goals with Trout Unlimited Canada, Ducks Unlimited, Fisheries and Oceans, Alberta Environment and others who have consistent goals.</p> <p>Priority sites that should be considered for restoration include:</p> <ul style="list-style-type: none"> - Areas that pose a safety hazard to the public due to accelerated erosion, - Areas where the hydraulic connectivity, that allows interaction of water between the stream and abandoned channel reaches, have been disconnected, and - Areas impacted by improper management of grazing lands. | <p>Compensation</p> <p>Wetland compensation should occur in accordance with Calgary’s Wetland Policy until the Nose Creek Watershed Wetland Inventory is complete and recommendations can be refined.</p> <p>Refine wetland recommendations in the Nose Creek Water Management Plan based on the outcome of the wetland inventory.</p> <p>Partnership to create a list of restoration plans/ studies that could be referred to for compensation purposes in consultation with the various jurisdictions, Trout Unlimited Canada and other non-government agencies.</p> <p>Education and Training</p> <p>Initiate restoration projects, including workshops and demonstration sites that can help educate industry and department staff.</p> <p>Develop Common Review Tools</p> <p>Develop common tools/standards for use by all jurisdictions that summarize minimum standards to consider during the application review process.</p> <p>Performance Monitoring and Evaluation - Water Quality</p> <p>Improved mitigation practices for work conducted within the vicinity of Nose Creek or West Nose Creek should result in better water quality in the long-term.</p> | <p>Education and Training</p> <p>Continue to initiate restoration projects, including workshops and demonstration sites that can help educate industry and department staff.</p> <p>Performance Monitoring and Evaluation – Restoration Projects</p> <p>Evaluate the success of restoration projects and report results to the public.</p> |

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---------------------------------------|------------------------------|---|--|---|
| Mitigation, Compensation, Restoration | AENV ³⁷ | <p>Amend Policy/Legislation and Procedures</p> <p>Compensation, mitigation and restoration are taken into consideration during AENV's review of <i>Water Act</i> applications. All restoration work requires an Approval under the <i>Water Act</i> if it is in a waterbody.</p> <p>Develop a riparian policy that incorporates mitigation, compensation and restoration requirements.</p> | <p>Internal Policy Review</p> <p>Identify the need for change in mitigation, compensation, and restoration policy, regulation and legislation.</p> <p>Amend Policy/Legislation and Procedures</p> <p>Amend policy and/or legislation to address mitigation, compensation and restoration as required.</p> | <p>Amend Policy/Legislation and Procedures</p> <p>Participate in initiatives to implement a riparian setback fund.</p> |
| | Municipalities ³⁸ | <p>Mitigation</p> <p>Municipalities should request that all plans submitted to jurisdictions must include mitigating factors.</p> <p>Restoration</p> <p>Park maintenance schedules, such as mowing, timing and location (i.e., adhering to minimum setbacks), should be modified.</p> | <p>Compensation</p> <p>All Municipalities should adopt the Calgary Wetland Policy as a minimum standard until policies are developed by each jurisdiction.</p> <p>Work with AENV on wetland compensation policies.</p> <p>Amend Policy/Legislation and Procedures³⁹</p> <p>Compensation policy/legislation should be amended to incorporate recommendations.</p> <p>BMPs should be prescribed during detailed design and used routinely when working in</p> | <p>Restoration</p> <p>Urban parks should be restored by replacing non-native species with native species where possible.</p> |

³⁷ Guiding Legislation and Policy: *Water Act* – Section 36 states that “no person may commence or continue an activity except pursuant to an approval unless it is otherwise authorized under this Act”; *Wetland Management in the Settled Area of Alberta – An Interim Policy* (Alberta Water Resources Commission, May 1993); *Wetland Restoration Program Water Act Approval Administrative Guide* (Alberta Environment/Ducks Unlimited Canada, May 2005); *Provincial Wetland Restoration/Compensation Guide* (Alberta Environment, November 2005); *Water for Life Strategy*; *Considers NCWMP*

³⁸ Guiding Legislation and Policy: City of Calgary - *Wetland Policy (Wetland Conservation Plan)*; *Parks Master Plans, MDP, LUBs*; City of Airdrie - *MDP (5B.7)*

³⁹ Recommendations should be incorporated into Municipal Development Plans (MDPs), Area Structure Plans (ASPs), Regional Policy Plans, Outline Plans, Concept Plans, Redevelopment Plans, Servicing Standards (SS), Development Permits (DPs) and Development Agreements (DAs).

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|---------------------------------------|----------------|----------------------|--|-------------------|
| Mitigation, Compensation, Restoration | Municipalities | | <p>and around riparian areas and watercourses.</p> <p>General mitigation measures should be included in the detailed design, and account for construction and maintenance activities as well as the expected effects of the completed structure on riparian areas and water quality. (Appendix D).</p> | |

8.8 Cumulative Effects

8.8.1 Background

In the Nose Creek watershed, there are about 118 stormwater outfalls that drain urban areas within the City of Airdrie and the City of Calgary. In addition, there are approximately 96 surface water licenses, 71 of which are direct withdrawals (62 for Nose Creek and 9 for West Nose Creek). All other licenses are direct withdrawals from Beddington Creek or Bigspring Creek. There are also numerous groundwater wells supplying rural homes. As the population continues to grow within the Nose Creek watershed, a thorough evaluation of cumulative effects will be necessary.

Principles

Better resource management decisions promote sustainable growth while preserving ecological function within the Nose Creek

Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future human actions (Hegmann et al. 1999). Cumulative effects on the landscape go beyond political boundaries and demonstrate the true impact of human activity on our natural environment.

Cumulative effects can occur when there is too much activity within a small area during a short timeframe. Hegmann et al. (1999) have termed this spatial and temporal crowding that can take place quickly or gradually before the effects are made apparent. Spatial crowding results in an overlap of effects among actions, while temporal crowding results when the environment has not been given time to recover. In some instances, actions induce further actions in a region that may add to the cumulative effects in the region. These actions are considered "reasonably-foreseeable". The most significant method by which cumulative effects occur may be by "nibbling loss" or by the gradual disturbance and loss of land and habitat (i.e. clearing of land for a new sub-division and roads into a forested area) (Hegmann et al. 1999). Regional "nibbling" effects usually cannot be addressed project-by-project, but rather, should be considered in regional plans, such as this Water Management Plan. These plans clearly establish regional thresholds of change that can be compared with specific actions. Project applications can at least be compared to restrictions or requirements under enforceable and applicable land use plans or policies.

8.8.2 Recommendations for Cumulative Effects

20. *Within the Nose Creek watershed, the cumulative effects of all proposed projects should be identified, considering:*
- *The effects over a larger "regional" area that may cross jurisdictional boundaries, including effects due to natural disturbance affecting environmental components and human actions,*
 - *The effects during a longer period of time into the past and future (i.e. consider historical information and future projections),*
 - *The effects on valued ecosystem components (VECs), as identified by the Nose Creek Watershed Partnership, due to interactions with other actions, and not just the effects of the single action under review; Other past, existing and future, reasonably foreseeable actions; and*
 - *The project significance in consideration of other than just local, direct effects.*

8.8.3 Implementation Action Plan for Cumulative Effects

| Recommendation Category | Jurisdiction | Short Term (2007-08) | Medium Term (2009-10) | Long Term (2011+) |
|-------------------------|------------------------------|---|---|---|
| Cumulative Effects | NCWP | <p>Increase knowledge of Cumulative Effects in the watershed</p> <p>Partnership to approach the University of Calgary for possible collaboration as a Thesis project. May include the Mistaakis Institute for the Rockies as a potential partner.</p> | <p>Increase knowledge of Cumulative Effects in the watershed</p> <p>University student to begin work on Thesis project. Work to include GIS imagery as outlined below in Performance Monitoring and Indicators.</p> <p>Performance Monitoring and Evaluation - Land Use (Mapping Using GIS Imagery)</p> <p>The Nose Creek Watershed Partnership should document the:</p> <ul style="list-style-type: none"> - Changes in land use cover type - Changes in human footprint - Changes in amount of floodplain area (e.g. loss of area from filling/dyking, development) - Number of stormwater/wastewater outfalls - Number of stream crossings and other structures (e.g. weirs and on-stream impoundments) - Change in channel length - Study trends and recent urban sprawl in relation to future water requirements. | <p>Increase knowledge of Cumulative Effects in the watershed</p> <p>University student to begin work on Thesis project. Work to include GIS imagery as outlined below in Performance Monitoring and Indicators.</p> <p>Continuation of Thesis project and evaluation of results.</p> |
| | Municipalities ⁴⁰ | <p>Amend Policy/Legislation and Procedures</p> <p>Within the Nose Creek watershed, the cumulative effects of all proposed projects should be identified, considering:</p> <ul style="list-style-type: none"> - The effects over a larger “regional” area that may cross jurisdictional boundaries, including effects due to natural disturbance affecting environmental components and human actions, - The effects during a longer period of time into the past and future, - The effects on valued ecosystem components (VECs), as identified by the Nose Creek Watershed Partnership, due to interactions with other actions, and not just the effects of the single action under review; - Other past, existing and future, reasonably foreseeable actions; and - The project significance in consideration of other than just local, direct effects. | | |

⁴⁰ Guiding Legislation and Policy: City of Calgary – IDP; City of Airdrie – IDP; MDP (Section 8A.9); Town of Crossfield – IDP; MD of Rocky View - IDP

9.0 TENTATIVE BUDGET REQUIREMENTS

This tentative budget summarizes the cost associated with some of the Action Items required to move forward with implementation. In many cases, partnerships can be formed and grant money received from appropriate organizations. The funds allocated in this budget should be used to leverage additional funds. Actual budgets should be refined as each project develops.

| Item | Actions | Priority | Budget Requirements | | |
|--|---|----------|----------------------|---|----------------------|
| | | | 2007-08 | 2009-10 | 2011+ |
| Staffing | A coordinator or staff member should help oversee the implementation of the Nose Creek Watershed Water Management Plan. | High | 30 000.00 Inkind? | 30 000.00 Inkind? | 30 000.00 Inkind? |
| Education | Develop a factsheet series, specific to the Nose Creek watershed, suitable for industry use (e.g. developers, department staff) and for general public. | High | 15 000.00 | 5 000.00 | 5 000.00 |
| | Redesign website and review annually. | | 3 500.00 | 500.00 | 500.00 |
| | Host information workshops for department staff, landowners/developers and general public. Appropriate speakers should be found to address new topics (e.g. Water Balance Model). | | 5 000.00 | 5 000.00 | 5 000.00 |
| Natural Capital Inventory | Conduct social survey to identify valued ecosystems components to be preserved for future generations. | Medium | | | |
| | Complete wetland and natural capital inventory for remaining areas in the MD of Rocky View, Calgary, Airdrie and Crossfield. | | | 7 500.00 + Inkind | 7 500.00 + InKind |
| Source Water Protection | Prepare Source Water Protection Proposal to submit to potential project partners. | Medium | 1 500.00 | | |
| | Assemble meeting to discuss Source Water Protection Project Proposal with potential partners: - Alberta Health - Alberta Environment - University of Calgary - Alberta Ingenuity Centre for Water Research - Bow River Basin Council - PFRA | | | | |
| | Identify Partner Lead to assist with the implementation of the Source Water Protection Project for the Nose Creek Watershed. | | | | |
| | Develop a Nose Creek Watershed Groundwater Map showing: - priority Source Water Protection Areas (high, medium and low risk areas) - groundwater flow pathways, - recharge areas, - location of springs and - groundwater water quality | Medium | | 20 000.00 + InKind mapping from Partners | |
| Based on Groundwater Map, Develop comprehensive Source Water Protection Plan that identifies source water vulnerability and specific protection and management strategies for high, medium low risk areas. | | | | | |

| Item | Actions | Priority | Budget Requirements | | |
|--|--|----------|-----------------------|-----------------------|-----------------------|
| | | | 2007-08 | 2009-10 | 2011+ |
| Source Water Protection | Implement Source Water Protection education program including: <ul style="list-style-type: none"> - factsheets on Source Water Protection in the Nose Creek watershed - signs denoting area's significance to groundwater recharge, base flows, and drinking water - Abandoned well-sealing program with the Alberta Environmental Farm Plan Company | Low | | | 20 000.00 |
| Understanding Riparian Setback Implications | Complete review of riparian setback implications, including alternative site design scenarios. | High | 20 000.00 | | |
| Restoration | Initiate restoration project and BMP demonstration. | Low | | 15 000.00 | 15 000.00 |
| Performance Monitoring | Monitoring Program and Appropriate Budgets should be identified through working Teams assigned to each indicator (e.g. water quantity and quality, streambank erosion) | High | 30,000.00 + Inkind | 60 000.00 + Inkind | 60 000.00 + InKind |
| | Tentative Budget Requirements | | \$ 105 000.00 | \$ 143 000.00 | \$163 000.00 |

10.0 GLOSSARY

Accelerated erosion Rate of erosion that is much more rapid than normal, natural or geologic erosion, due primarily to human activities. (Armantrout 1998)

Baseflow Portion of the stream discharge that is derived from natural storage (i.e., outflow from groundwater, large lakes or swamps), or sources other than rainfall that creates surface runoff; discharge sustained in a stream channel, not a result of direct runoff and without regulation, diversion, or other human effects. Also referred to as sustaining, normal, dry-weather, ordinary or groundwater flow. (Armantrout 1998)

Buffer Vegetation strip maintained along a stream or lake to mitigate the impacts of actions on adjacent lands. Also called a buffer strip, leave strip or streamside management zone. (Armantrout 1998)

Channelization The mechanical alteration of a stream usually by deepening and straightening an existing stream channel or creating new channel to facilitate the movement of water. (Armantrout 1998)

Common Body of Water The bed and shore of an irrigation canal, drainage canal, reservoir, river, stream, creek, lake, marsh, slough or other exposed body of water (AOPA Standards and Administration Regulation, Section 1), not including:

- a) A water works system as defined by EPEA,
- b) A reservoir, lake, marsh or slough that is completely surrounded by private land controlled by the owner or operator and has no outflow going directly beyond the private land to a drainage canal, reservoir, river, permanent stream or creek, lake or potable water source that is being used for human or livestock consumption,
- c) An irrigation canal or a drainage canal that is completely surrounded by private land controlled by the owner or operator and has no outflow going directly beyond the private land,
- d) A roadside ditch,
- e) A wastewater system as defined by EPEA,
- f) A storm drainage system as defined by EPEA, or
- g) An ephemeral stream on private land controlled by the owner or operator that has no outflow going beyond the private land directly to a drainage canal, reservoir, river, permanent stream or creek, lake or potable water source that is being used for human or livestock consumption.

Cfs cubic feet per second

Cms cubic meters per second

Criteria Scientific data evaluated to derive recommended limits of parameters for water use.

Effective area That area where surface runoff water reaches Nose Creek, West Nose Creek or one of their tributaries

Ephemeral flow Streamflows in channels that are short lived or transitory and occur from precipitation, snow-melt, or short-term water releases. (Armantrout 1998)

Escarpment A steeply sloping area associated with a slope of 15% or greater that is separating two comparatively level or more gently sloping areas, and may contain isolated pockets of

lesser sloped terrain. Escarpments include ravines, gullies, coulees, side draws, and other similar features. (Adapted from the Town of Cochrane's Land Use Bylaw 1/99)

Evapotranspiration The combined action of evaporation (a physical process that converts liquid water to a gas) and transpiration (the loss of water vapor from plants). (Stevenson and Wyman 1991)

Flushing flow Artificial or natural discharge of sufficient magnitude and duration to scour and remove fine sediments from the stream bottom that helps to maintain the integrity of substrate composition and the form of the natural channel. (Armantrout 1998)

Gross area The area that makes up the entire Nose Creek watershed. Compare to "effective area".

Guidelines Recommended limits of parameters that will support and maintain a designated water use. They are given as numerical concentrations or narrative statements.

Hydraulic (s) The science concerned with water and other fluids at rest or in motion (Stevenson and Wyman 1991).

Hydrologic From the word hydrology. The study of the distribution, movement and chemical makeup of surface and underground waters (Stevenson and Wyman 1991).

Instream Flow Needs This is a scientifically determined amount of water, flow rate or water level that is required in a river or other body of water to sustain a healthy aquatic environment or to meet human needs such as recreation, waste assimilation, or aesthetics. An instream need is not necessarily the same as the natural flow. (SSRB WMP – Phase I)

Indefinite River/Stream A perennial or intermittent river/stream whose channel cannot be clearly distinguished. An indefinite river/stream is used when the actual channel is obscured by vegetation, high water, etc., and is most frequently found in forested areas, muskegs, bogs, wetlands, high water areas around perennial lakes and through intermittent lakes.

Intermittent flow Flows that occur at certain times of the year only when groundwater levels are adequate but may cease entirely in low water years or be reduced to a series of separated pools. (Armantrout 1998)

Intermittent River/Stream A natural linear hydrographic feature with shorelines that are an average of less than 20 m in width. The river/stream bed is often dry during certain times of the year due to climatic conditions and/or a limited area of drainage.

Intermittent Oxbow A crescent-shaped lake or pond by the side of a river, formed as a result of the cutting through of a meander neck, and silting of the backwater. Intermittent oxbows do not contain water during the dry periods of the year.

Meander belt The land area on either side of a watercourse representing the farthest potential limit of channel migration. Areas within the meander belt may someday be occupied by the watercourse; areas outside the meander belt will not. (Parish Geomorph 2004)

Meander belt-width Normal width or distance between tangents drawn on the convex sides of successive belts. (Armantrout 1998)

Morphology From the Greek morphe, meaning 'form', a prefix meaning pertaining to form or shape (Allaby 1994).

Natural Erosion Wearing away of the earth's surface by ice, water, wind, or other agents under natural environmental conditions. (Armantrout 1998)

Objectives Numerical concentrations or narrative statements that have been established to support and protect the designated uses of water at a specific site.

Peak flow Highest discharge recorded within a specified period of time that is often related to spring snowmelt, summer, fall, or winter flows. Also referred to as maximum flow. (Armantrout 1998)

Perennial Oxbow A crescent-shaped lake or pond by the side of a river, formed as a result of the cutting through of a meander neck, and the silting of the backwater. Perennial oxbows contain water during the whole year.

Perennial River/Stream A natural linear hydrographic feature with shorelines that are an average of 20 metres in width. The river/stream bed normally contains flowing water, except under drought conditions.

Riparian Area (1) Of, pertaining to, situated or dwelling on the margin of a river or other water body. (2) Also applies to banks on water bodies where sufficient soil moisture supports the growth of mesic vegetation that requires a moderate amount of moisture. (Armantrout 1998)

Riparian Vegetation Vegetation growing on or near the banks of a stream or other water body that is more dependent on water than vegetation that is found further up slope. (Armantrout 1998)

Runoff (1) Natural drainage of water away from an area. (2) Precipitation that flows overland before entering a defined stream channel. (Armantrout 1998)

Seasonal Feeding and Bedding Site An overwintering site where livestock are fed and sheltered.

Sedimentation (1) Action or process of forming and depositing sediments. (2) Deposition of suspended matter by gravity when water velocity cannot transport the bed load. (Armantrout 1998)

Standards Enforceable environmental control laws, set by a level of government. Standards are typically applied to effluent or emissions by industry to maintain a level of environmental quality.

Technical Committee The sub-committee appointed by the Nose Creek Watershed Partnership to undertake the drafting of the Nose Creek Watershed Water Management Plan. Members include representatives from the City of Airdrie, City of Calgary, MD of Rocky View, Bow River Basin Council, Town of Crossfield, Alberta Environment, Ducks Unlimited, Fisheries and Oceans Canada, and Alberta Transportation.

Unconfined watercourse Refers to a watercourse that is able to migrate freely on its floodplain in any direction. (Parish Geomorphic Ltd. 2004).

Water bodies Locations where water flows or is present year round or intermittently. They include lakes, wetlands, creeks and sloughs.

Water Conservation Objective The amount and quality of water established by the Director, based on information available to the Director, to be necessary for the (i) protection of a natural water body or its aquatic environment, or for the (ii) protection of tourism, recreational,

transportation or waste assimilation uses of water, or (iii) management of fish or wildlife, and may include water necessary for the rate of flow of water or water level requirements. (adapted from the *Water Act*)

Water Conservation Objectives (WCOs)

Water conservation objectives (WCOs) pertain to the amount and quality of water established by the Director (an Alberta Environment staff with delegated authority) to be necessary for the:

- protection of a natural water body or its aquatic environment, or any part of them,
- protection of tourism, recreational, transportation or waste assimilation uses of water, or
- management of fish and wildlife.

Water conservation objectives may also include water necessary for the rate of flow of water or water level requirements. Instream needs are defined as the quantity and quality of water required to satisfy hydrological process demands instream and to protect river ecology and riparian environments. Instream needs include fish habitat, water quality, riparian vegetation, channel structure, human safety and recreational uses. Instream flow needs differ from water conservation objectives in that they are strictly a scientific assessment. Water conservation objectives, on the other hand, refer to the quantity of water that should be present in a stream to meet instream needs and socio-economic factors.

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