8.4 Water Management Planning Within WR6 (NR)

General guidance on water management planning for all water regions is provide in later sections of this document. Specific to WR6 (NR), the following recommendations are presented for consideration by RDN to improve the state of knowledge in the water region:

- At least one observation well should be installed in each mapped aquifer. Mapped aquifers that currently do not have MOE observation wells include Aquifer 164 and 165;
- Well owners should identify the MOE well plate and tag numbers for each of their active water wells. In this manner, water use and monitoring data can be easily cross-referenced with the BC MOE well records. These included North Cedar Water Works wells, RDN DeCourcy well(s), Nanaimo Airport wells, and Harmac supply wells;
- The significant recharge area map needs to be further updated by further processing of the NRCAN remote sensing data and by field verification;
- Further mapping of the groundwater surface water interactions is also required in Haslam Creek and the Nanaimo River to confirm the interactions between mapped aquifers 161 and 160. Waterline recommends specialized analysis (E.g.: isotopes[29], noble gases) of groundwater samples in this region to assist in determining groundwater age and origin. Thermal imaging of the river during high and low flows may help to quickly pinpoint areas where more detailed studies may be required;
- Reactivation of WSC surface water gauging station for Haslam Creek (08HB003) is recommended;
- Summer base flows (June to Sept) in Hokkenen Creek and Holden Creek should be collected as part of the Community Watershed Monitoring Network to gain a better understanding of summer base flows in smaller watersheds in the region; and
- Reservoir level and discharge data for Jump Creek and Forth Lake should be collected from the City of Nanaimo and Harmac at regular intervals and uploaded to the regional water database.

9.0 KNOWLEDGE AND DATA GAPS

9.1 Early Warning Monitoring and Cumulative Effects Analysis

Although an abundance of water-related information is being collected each year within the RDN, insufficient regulatory guidance and the inability of MOE/RDN to electronically track this information creates large data/knowledge gaps. This severely impedes the RDN's ability to properly manage watersheds and aquifers in a sustainable manner. In the absence of regulatory guidance, water users and groundwater practitioners are left to develop studies that may not be consistent with other studies or may not sufficiently advance the state of knowledge in a watershed or water region. Studies are often focussed on local scale issues, whereas a more regional approach may be necessary to understand the project impact and cumulative effects of numerous water users in a water region. There is a need for developing a consistent approach and consistent data requirements for all water-related studies.

Monitoring of surface water and groundwater use and its corresponding effects on creek/river flows and aquifer performance will provide an early warning system to help prevent over use. It is

[29] Chemical elements of the same family but with different atomic weights. Technique is used to assess origin, recharge elevation, and age of water.

the only way that cumulative impacts to a watershed and underlying aquifers can be accurately quantified and appropriate water resource management strategies developed. In the absence of these data, unrestricted extraction of groundwater in particular, can lead to aquifer dewatering and supply wells running low or dry without much notice. This was the case in the Cowichan Valley Regional District in the summer and early fall of 2012 when low flows and declining groundwater levels reached critical levels.

Typical groundwater studies submitted for subdivision approval in BC involves a 100 day predictive calculation to accommodate for seasonal fluctuations in water levels. Although these short-term predictive assessments may be adequate for addressing seasonal variations, the approach is inadequate for planning community water supply that extend over a lifetime (100 years or more).

It is imperative that cumulative effects analysis becomes standard hydrogeological practice for confirming water supply in advance of land development. Submission of groundwater monitoring and following up with submission of aquifer performance data, once a groundwater supply system becomes operational, should also be required to confirm theoretical predictions upon which the approval was granted. In the absence of regulatory guidance, there is limited opportunity to properly manage water resources within the RDN such that sustainable use can be achieved.

9.2 Mandatory Submission and Review of Well Logs

An electronic tracking system for assigning well permit, well tag, and mapped aquifer numbers is needed. This information can provide the cross-referencing of production well logs with monitoring information needed to develop accurate water budget estimates. The system should be universally applied to all water wells but consideration should also be given to include other types of monitoring wells that are drilled for investigative purposes. These may include environmental monitoring wells, wells used for remediation, geotechnical wells, geothermal wells, etc…. The rationale is that any activity occurring in the subsurface that has the potential to affect the quality or quantity of fresh groundwater resources needs to be considered as part of water resource management planning. Waterline understands that extending the requirements beyond water supply wells would create some challenges. However; it should be noted that protection of fresh water resources for present and future residents of RDN/BC is at stake.

Hydrogeologists rely on high quality well data to complete groundwater related assessments, therefore it is essential that more effort be made to elevate the quality of data collected by drillers and ultimately compiled in the MOE Wells database. This should be done in coordination/consultation with the BC Water Well Drillers Association. A system is needed that makes it easy for drillers to submit high quality well log information to MOE. Well log information should also be reviewed by a hydrogeologist prior to uploading to the BC Wells database to ensure that all information is being captured. This includes well screen interval, lithology/aquifer name, pumping test data, hand held GPS location, etc…. Although this may seem an onerous and expensive task, it would more than offset the long-term cost of installing new MOE wells or conducting countless studies to try to sort out the information at a later date.

Mandatory submission of all well logs should be made a requirement. At present, provincial legislation calls for voluntary submission to MOE. This is problematic as some drillers have elected to not submit logs to MOE. In the absence of provincial legislation, a stronger stance is required by the BC Water Well Drillers Association to make on-going licensing of drillers

conditional on the submission of high quality well logs. Every well drilled in an aquifer within the RDN should be treated a potential monitoring point from which conceptual hydrogeological models can be developed and sustainable groundwater management can be accomplished. The public should be made aware that groundwater is a shared resource and not owned by individual landowners, despite the fact that wells and pumping equipment may be owned by individuals. Landowners are encouraged to submit well logs to MOE or the RDN as a cross-reference or check to ensure that drillers are submitting their well logs.

9.3 Standard of Practice for Aquifer Testing and Cumulative Effects Analysis

Standards of practice for conducting hydrogeological investigations are not unique to BC. Although the geology and regulatory system may differ, standard approaches to water supply investigations are well established in other jurisdictions and guidance documents have been developed which can be easily applied to aquifers in BC in the absence of formal legislation.

In advance of undertaking the water budget project, MOE reviewed historical groundwater study files and undertook the re-interpretation of over 100 aquifer tests conducted within the RDN over the last 20 years or more in an effort to estimate the hydraulic parameters of mapped aquifers. This exercise provided fundamental information required by Waterline for completing preliminary water budget assessments. Such analysis should be made a requirement every time an aquifer test is conducted.

Controlled aquifer testing is needed to quantitatively assess hydraulic characteristics of aquifers (transmissivity and storativity) and to fully assess the lateral extent, geometry, and aquifer boundaries. These data are essential for improving water budget calculations. There is an opportunity to collect high quality aquifer testing and groundwater monitoring information with every groundwater study or new well that is drilled and tested within the RDN. However, a clear and concise guidance document for individuals involved in aquifer testing and analysis (well owners, drillers, pump installers, and hydrogeologists) must be made available by the RDN. BC Certificate of Public Convenience Certificate Application Guideline is a useful reference and can be found at the following web address:
http://www.env.gov.bc.ca/wsd/water_rights/water_utilities/cabinet/appen5_guidelines_for_groundwater_reports_and_%20well_testing.pdf

There are numerous existing documents from other jurisdictions that provide similar guidance, such as Alberta Environment's Guide to Groundwater Authorization (updated March 2011). This document provides an excellent reference for groundwater practitioners detailing groundwater investigation and analysis approach. The document can be viewed at the following web address: http://environment.gov.ab.ca/info/library/8361.pdf.

There is also a need for assessment of cumulative effects for all new projects being proposed within the RDN if a stable, long-term groundwater supply is required. The standard practice by groundwater practitioners has generally been to complete a well capacity rating over a 100 day period to assess if sufficient supply exists for a newly proposed development. This practice is inadequate for considering the long-term cumulative effects of groundwater extraction on individual aquifers or even areas within aquifers. As was demonstrated with the long-term climate variability assessment using the Pacific Decadal Oscillation, it is possible to slowly dewater an aquifer during long periods of pumping as the total recharge to an aquifer declines over decades.

The situation in WR3 (FC) is a good example of how short-term predictive assessment is inadequate for planning community water supply that extends over a lifetime (100 years or more).

9.4 New MOE/RDN Observation Wells

The availability of high quality monitoring data will serve to increase the accuracy and certainty of water budget assessments. This will be important as the RDN moves to proactive watershed management planning and increasing the Tier level of assessment similar to the approach taken by the Ontario Ministry of Natural Resources (OMNR 2011). As indicated in the final summary of water budgets developed for each water region, at least one observation well should be installed in each mapped aquifer. There is also a need for coordinated regional water level monitoring in private wells so that present-day water table geometry (piezometric surface for confined aquifers) can be determined and areas of excessive drawdown identified. Some of the challenges and data needs include the following:

- Capturing volunteer landowner water level and water quality data. Some effort has been made by Vancouver Island University in this regard by creating an on-line database. However; to date, very little data has been collected.
- More data is needed in highly stressed areas. The RDN plans to install data loggers in existing wells to help supplement existing water level data from MOE's observation well network. Waterline has provided recommendations to the RDN for observation well locations based on a search of the Waterline Geodatbase constructed as part of the Water Budget Project.
- Significant recharge Areas identified as part of the present study need to be further refined. Observation wells will also need to be identified in these areas as well.
- Multi-level monitoring wells will need to be installed along creek/river margins where aquifers and surface water systems are suspected to interact. Water levels in aquifers that feed base flow to rivers/creeks will need to be maintained to ensure the protection of aquatic ecosystems. Other methods may be used to better define areas of interest, including; the installation of seepage meters at the base of rivers/creeks, thermal imaging of creeks/rivers to determine areas where groundwater may be upwelling, and electrical conductivity and temperature surveys. Surface water gauging above and below a critical reach where groundwater is suspected to discharge can also be used to assess/measure groundwater interactions with rivers/creeks.
- Observation wells also need to be installed in areas along the coast where salt water intrusion may be occurring or suspected to occur. Proper instrumentation including data loggers that measure changes in electrical conductivity of the groundwater will be required.
- Although water quality could not be addressed as part of the present study, largely due to the poor condition of the electronic data, future studies need to consider water quality assessment as it provides further confirmation on regional linkages between aquifers and surface water flow regimes.

9.5 Reactivation of Discontinued Water Survey of Canada Gauges

Some of the major creeks and rivers within the RDN lack surface water flow data. Although new hydrometric stations may be required, an immediate and less expensive solution would be to

reactivate previously discontinued Water Survey of Canada gauges. This approach requires less work as rating curves are already established and historical data already exists. There may also be a need to install new hydrometric stations in un-gauged creeks/rivers which has already been discussed for each specific water region.

9.6 Reporting System to Track Surface and Groundwater Use

The MOE/RDN need to establish an electronic tracking system to collect actual measured surface water and groundwater use information. As was shown for the Nanaimo River surface water budget assessment, using the licensed allocation values to complete the water budget calculation is misleading and may incorrectly indicate the level of stress on the river. Groundwater extraction volumes for large users also need to be tracked in a consistent manner. The RDN water service data is in a relatively good condition, however; data for large municipal users or private utilities was not always available. The Water Use Reporting Tracker web application previously developed by Vancouver Island University, or currently being developed by the Okanagan Water Basin should be considered for this purpose.

10.0 Recommended RDN Action Plan

10.1 Provincial and/or Local (RDN) Regulatory Guidance

Provincial regulatory change is underway with the BC Water Act modernization process (http://livingwatersmart.ca/water-act/groundwater.html) initiated in about 2005. However, after about 6 years of public consultation, MOE officials have indicated that another 4-5 years may be needed before formal legislation is established (Ted White, February 2012). The RDN simply cannot afford to wait for provincial guidance in this matter, as some of the mapped aquifers are already showing signs of stress. Increased demand for water supply resulting from population growth and coupled with climate change predictions that will likely cause a long-term reduction in aquifer recharge, has the potential for negative impact to all aquifers within the RDN.

Surface water and groundwater protection initiatives are most often driven by regulation, policies or guidelines. Although people generally want to do what is right for the environment, the tendency is always to do the minimum requirement at the minimum expense.

The stated purpose of the Drinking Water and Watershed Protection Program is to learn more about water within the RDN, use this information to make better land use decisions, and help communities protect the environment. In order to continue to move the watershed protection and management forward, a series of guidelines will need to be developed to ensure that high quality surface water and groundwater information is collected in a suitable electronic format. Once the Waterline Geodatabase has been transferred to the RDN and a user interface constructed, the final electronic format will be determined.

10.2 Community Engagement

Community engagement is the foundation for successful water and watershed management. As part of the Drinking Water and Watershed Protection Program the RDN initiated team Water Smart in partnership with Town of Qualicum Beach, Fairwinds Community & Resort, City of