COLUMBIA RIVER TREATY

HYDROMETEOROLOGICAL COMMITTEE

2005 ANNUAL REPORT

NOVEMBER 2005

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Introduction

The Columbia River Treaty Hydrometeorological Committee (CRTHC) was established in September 1968 by the Entities. The Committee is responsible for planning and monitoring the operation of data facilities in accord with the Treaty. It also assists the Entities in matters related to hydrometeorological and water supply forecasting.

This report summarizes Committee activities during the 2005 operating year. The Annual Report focuses on:

- action taken on proposed changes to the hydrometeorological network
- updates to CRT communications and data storage systems
- updates to data exchange requirements
- updates to forecasting procedures
- miscellaneous activities of the Committee

The Committee began issuing regular Annual Reports in 2001. General background information on Committee activities contained in the 2001 and 2002 annual reports is now presented in a separate supplemental document. The

supplement contains general information that does not typically change from year to year. Appendices in the 2005 supplemental document include:

- Appendix A – Introduction to the Committee terms of reference
- Appendix B – Terms of reference for the CRTHMC
- Appendix C – Process for reviewing hydrometeorological data networks
- Appendix D – List of contributors of hydrometeorological data
- Appendix E – Data communication and storage systems
- Appendix F – Data exchange reports
- Appendix G – Treaty studies, models, and forecast requirements

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Acronyms

AEC - Actual Energy Capability
AER - Actual Energy Regulation
AOP - Assured Operating Plan
BC Hydro - British Columbia Hydro and Power Authority
BPA - Bonneville Power Administration
CBT - Columbia Basin Telecommunications
CROHMS - Columbia River Operational Hydrometeorological Management System
CRT - Columbia River Treaty
CRTHC - Columbia River Treaty Hydrometeorological Committee
CRTOC - Columbia River Treaty Operating Committee
CWMS - Corps Water Management System
CWS - Columbia Winter Specified
DOP - Detailed Operating Plan
EC - Environment Canada
ESA - Endangered Species Act
ESP - Ensemble Streamflow Prediction
FCOP - Flood Control Operating Plan
FRO - Fall runoff, used in Libby water supply forecasting procedure
FTP - File Transfer Protocol

HYDSIM - Hydrologic Simulation model

MSC - Meteorological Service of Canada, Environment Canada

MSRM - BC Ministry of Sustainable Resource Management

NRCS - Natural Resources Conservation Service

NWPP - Northwest Power Pool

NWRFC - Northwest River Forecast Center, US National Weather Service

NWSRFS - National Weather Service River Forecast System

Operating Year - August 1 to July 31 (CRTOC)

PEBCOM - Permanent Engineering Board Engineering Committee

PNCA - Pacific Northwest Coordination Agreement

POP - CRT Principles and Procedures Document

QPF - Quantitative Precipitation Forecast

RCS - Regional Climate Station

RFS - River Forecast System

RODS - BPA's Real-time Operations Dispatch and Scheduling

SNOTEL - SNOwpack TELemetry, NRCS snow pillow and climate data network

STP - Single Trace Procedure (NWRFC procedure using ESP)

SSARR - Streamflow Synthesis and Reservoir Regulation hydrologic model

TSR - Treaty Storage Regulation study

UBCWM - University of British Columbia Watershed Model

USACE - US Army Corps of Engineers

USBR - US Bureau of Reclamation

Water Year - October 1 to September 30 (CRTHMC)

WLAP - BC Ministry of Water, Land, and Air Protection

WSC - Water Survey of Canada, Environment Canada

WSF - Water Supply Forecast

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2005 Annual Summary

The Hydrometeorological Committee was established in September 1968 by the Entities and is responsible for planning and monitoring the operation of data facilities in accord with the Treaty and otherwise assisting the Entities as needed. The Committee consists of four members as follows:

UNITED STATES SECTION	CANADIAN SECTION
Nancy L. Stephan, BPA Co-Chair	Eric Weiss, B.C. Hydro, Chair
Peter Brooks, USACE Co-Chair	Stephanie Smith*, B.C. Hydro, Chair
	Wuben Luo, B.C. Hydro, Member

*Stephanie Smith became the official B.C. Hydro Chair in October 21, 2004, replacing Eric Weiss.

The Columbia River Treaty Hydrometeorological Committee (CRTHC) met twice in the 2004-2005 water year. The mid-year meeting took place on February 24th, 2005 at B.C. Hydro's Headquarters in Vancouver, British Columbia and the fall meeting took place on September 30, 2005 at Bonneville Power Administration's Headquarters in Portland, Oregon.

The Columbia River Treaty Hydrometeorological Committee 2003-2004 Annual Report was completed in May of 2005 and distributed to the Columbia River Operating Committee at their meeting in Portland the same month.

Numerous issues arose throughout the year for the Committee varying from streamflow and water supply forecasting, to coordinating observed data, to addressing hydromet station changes.

With the completion of the 2000 Level Modified Flow study in 2003, the Committee dealt with how to apply, if at all, the information from this study to forecasting. Two areas where the Committee discussed the application of the Modified Flow data was in producing forecasts for AER/TSR purposes. The benefits to using a common data set are:

1. Consistency in methodology for computing a longer water supply forecast period from a shorter water supply forecast period.
2. Easier coordination of monthly streamflows for AER/TSR submittals.

One area discussed was the derivation of the January-July volume for ECC computations from the volumes and periods produced by forecast equations. In particular, the Libby and Dworshak equations produce a volume forecast for April-August and April-July, respectively. In the past, the 30-year normal was used to convert this to a January-July volume. The CRTHC agreed that in order to align this computation with the monthly distribution factors for Libby and Dworshak to be implemented next year, to use the 71-year mean from the 2000 Level Modified Flow study to compute the January-July volumes. As new modified flow studies are developed and distribution factors updated, the recommendation is to also base the January-July computations on the new period of record.

Coordination of streamflows for the AER/TSR is occasionally a cumbersome and time-consuming process primarily because the process involves coordination between three organizations, BPA, USACE, and BCH, with various techniques for developing forecasts. In addition, the issue of how to blend an objective approach with a subjective or informed forecast has always been questionable. More specifically, how to blend knowledge of current conditions and the short-term (next 15 to 45 days) forecast with an objective method for the longer-range periods when little is known about the future weather or runoff shape. The USACE and BPA have been working on a methodology to limit the coordination to only the near-term streamflow forecast, with a common methodology to shape the longer-term forecast (based on the 71-year mean). While each organization is still left to develop its

own short-term forecast and coordination still needs to occur for this period, once the short-term is agreed to, the remainder of the periods will use distribution factors based on the 71-year record mean from the 2000 Modified Flow study. This approach primarily applies to the water supply season.

A second issue which the Committee worked on throughout 2005 was the discrepancy in observed streamflow data for Canadian projects. For AER/TSR purposes, BPA submits the observed flows for Mica, Arrow, and Duncan. Traditionally, the observed numbers were taken from the NWRFC runoff processor which computes the observed unregulated flow at various points across the Basin, including the Canadian projects. Intermittently, it was noted that the NWRFC observed runoff for the Canadian projects was not the same as the observed values computed by BC Hydro. This issue was noted in 2004 and still continued to be a problem in 2005. However, steps were taken to move closer to resolving the issue in 2005. BCH began sending the NWRFC daily information on their projects in order to track flows throughout the month and avoid discrepancies at the end of the month. Even at the end of 2005, discrepancies continued to materialize but the Committee, with the help of the NWRFC, is isolating some of the causes and expects to resolve the issue in 2006.

Station issues are an ongoing item for the Committee (see Schedule 1 for Committee's response). This year the areas of focus were:

- Mount Cook (1E02P) and Cook Creek (1E14P) snow pillows
- Fernie precipitation site
- Kaslo
- Morrissey Ridge Snow pillow/climate station
- Oyama Lake Snow Course
- Ochoco Ranger Station coop site (U.S. site)

Station networks

The Committee process for reviewing proposed changes to the operation of stations within the hydrometeorological network is described in Appendix C of the 2005 Supplemental Report. The process is intended to ensure that changes made to the network do not negatively affect the monitoring, planning, and operations of Treaty facilities. Schedule 1 summarizes the Committee's response to changes to stations of the CRT hydrometeorological network in 2005.

In addition to the standard reporting, there were additional actions and issues during 2005. These are summarized as follows:

- In September 2005, the Canadian Section issued letters to the list of data agencies noted in Appendix D of the 2005 Supplemental Report. The letters requested data collection agencies to notify the Committee of proposed changes in station networks in the Columbia basin.

- BCH indicated that Environment Canada is in the process of converting to a new web-based data collection system. The system requires observers to have access to the web. BCH unsure if there will be any impacts to the Treaty hydromet network.

- At the February 2005 PEB meeting, the PEB requested a summary report of station issues/changes/closures over the past few years. The CRTHC is planning to provide a draft report to the PEBCOM at the end of October 2005 and a final report to the PEB in January 2006.

Communication and data storage systems

CBT, other communication systems, and CROHMS are described in Appendix E of the 2005 Supplemental Report. The CBT system, operated by the USACE in Portland, is the primary communications system for transmitting data from the Columbia River Treaty hydrometeorological network. Agencies, including the NWRFC, USACE, and BC Hydro, also use other communication systems to exchange data. CROHMS is the central system for collecting and re-distributing hydrometeorological data used to support the operations of Treaty projects.

In addition to the standard reporting, there were additional actions and issues during 2005. These are summarized as follows:

- The USACE reported that the last project (McNary) on the old CBT system (dedicated circuit) had converted to transferring data via the web. The CBT system is now entirely web-based.

- The CRTHC will continue to pursue causes for differences between the NWRFC's end of month observed streamflows for Canadian projects and BCH's values. One of the issues may be the rating tables for the Canadian projects in CROHMS. Another possible source may be issues with tracking revised data in CROHMS. The CRTHC will be looking into this in 2006.

Data exchange

Appendix F of the 2005 Supplemental Report describes current data exchange reports. Data exchanged among operational projects and entity agencies may be categorized according to the type of data and the frequency of transmission. Types of data include project data, weather and streamflow data, forecasts, as

well as reports and messages. The frequencies of transmission may be hourly, daily, or monthly.

In addition to the standard reporting, there were additional data exchange actions and issues during 2005. These are summarized as follows:

- BC Hydro provided e-mails to BPA and the NRCS on snow course data as it became available. BCH has access to data earlier than the final snow course report is available on the Internet. BCH also provided updates if a snow course measurement was delayed due to weather.

- The Committee continued to address the discrepancy in observed streamflow data for Canadian projects. For AER/TSR purposes, BPA submits the observed flows for Mica, Arrow, and Duncan. Traditionally, the observed numbers were taken from the NWRFC runoff processor which computes the observed unregulated flow at various points across the Basin, including the Canadian projects. Intermittently, it was noted that the NWRFC observed runoff for the Canadian projects was not the same as the observed values computed by BC Hydro. This issue was noted in 2004 and still continued to be a problem in 2005. However, steps were taken to move closer to resolving the issue in 2005. BCH began sending the NWRFC daily information on their projects in order to track flows throughout the month and avoid discrepancies at the end of the month. Even at the end of 2005, discrepancies continued to materialize but the Committee, with the help of the NWRFC, is isolating some of the causes and expects to resolve the issue in 2006.

- Whatshan was a point of confusion in 2005. The Arrow inflows produced by FLOCAL do not include a Whatshan piece, neither a regulated nor unregulated value. The Arrow inflows tracked in the Treaty spreadsheet (coordinated between BPA and BCH for Treaty accounting) include a regulated Whatshan outflow. For Treaty modeling (TSR), accounting, and tracking, the Arrow inflow needs to include a Whatshan regulated outflow. The Whatshan data was found to be one of the problems with the discrepancy between the numbers BCH was sending the NWRFC

and what the NWRFC was calculating. The identification of this issue only impacted the observed flows coordinated between the NWRFC and BCH. The values for Arrow submitted by BPA for the AER/TSR still continue to be from the Treaty spreadsheet which correctly contains a Whatshan regulated outflow in the observed Arrow value.

- Turbine Curve Information: (Revelstoke/Mica) A review was conducted of the Mica and Revelstoke gross head generation tables with respect to the original drawings in an effort to improve the accuracy of the tables. In a test run of the Mica inflow calculation for the period 1994-2003 inclusive, the revised tables produced an average inflow 0.27% lower than using the previous tables. Results from testing the new Revelstoke curves are still pending. The revised tables have yet to be implemented into the BC Hydro Inflow Calculation program (FLOCAL).

Forecasting

The Committee is involved with various Treaty planning studies and models from time to time. These studies and models and associated forecasting requirements are described in Appendix G of the 2005 Supplement Report.

DWORSHAK VOLUME FORECAST PROCEDURES

Randy Wortman (USACE) provided a presentation (Sep. '05) on the new Dworshak forecast equations (both pre-season and seasonal). The new equations were developed using principle component analysis. The new results were also compared to the initial Dworshak equations developed with the NRCS in 1993, the NRCS revision in 1995, and the NRCS update again in 1999. During the first month or so of the new water year, the CRTHC members are

tasked with reviewing the new procedures and providing a recommendation as to their technical soundness in terms of their hydrological and statistical development to the CRTOC.

CANADIAN TREATY PROJECTS VOLUME RUNOFF FORECAST PROCEDURE

Wuben Luo provided a presentation and report on the new Mica water supply forecast procedure. The methodology used to develop the equations was also based on principle component analysis, but approached the issue from a monthly step aggregated to produce the period volume, rather than only predicting the actual period volume. The purpose of this approach was to provide a better understanding of monthly volumes and a more realistic estimate of the uncertainties around those volumes. The study has also added 15 years of data to the analysis and produced early season forecasts equations (Nov 01, Dec 01).

Stephanie reported that equations have been developed for Arrow, Mica, Revelstoke and Whatshan. The Arrow equation includes the Whatshan inflow as part of its total. The current timeline for this project is to have all equations and the GUI program completed around April of 2006, with plans to implement the new procedures in 2007. It is assumed that the procedures for all Treaty projects will be reviewed by the CRTHC prior to implementation in Treaty procedures in 2007.

APPLICATION OF 71-YEAR MEAN DATA

With the completion of the 2000 Level Modified Flow study in 2003, the Committee dealt with how to apply, if at all, the information from this study to forecasting. Two areas where

the Committee discussed the application of the Modified Flow data was in producing forecasts for AER/TSR purposes. The benefits to using a common data set are:

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Schedule 1 Changes to the hydrometeorological network in 2005

The following pages document changes to the Columbia River Treaty Hydrometeorological Network in operating year 2005. Reports for Canadian stations include:

- **Mount Cook (1E02A) and Cook Forks (1E06) snow courses**: The CRTHMC received a note from BC MWLAP of their intention to discontinue these two manual snow courses and replace with the Mount Cook (1E02P) and Cook Creek (1E14P) snow pillows. The two snow courses were located in the North Thompson region and were sampled in the past through skiing to the location by the snow surveyor. The snow surveyor retired and accessing the two sites required strong skiing and hiking abilities and there were safety concerns. The CRTHMC evaluated the potential closures and concluded that the impact to treaty operations was relatively small.

- **Fernie precipitation site:** Fernie climate station had not reported to Environment Canada since June 2004. Fernie precipitation data is used in the water supply forecasting procedures for Libby. BCH pursued this issue and found that Environment Canada was in the process of updating their new online data entry

system, which was finally in place for Fernie in the spring. Observed data for Fernie resumed in April 2005.

- **Kaslo**: BCH was informed that the station moved to a more open site on October 6, 2004. Since the new location is very close to the old site, the changes in catch characteristics was assumed to be minor and therefore of little or no impact.

- **Morrissey Ridge Snow pillow/climate station**: Climate auto station broke down in June 2005. When the contractor visited the site, they determined that fairly extensive repair work was needed to restore the station. BCH consulted with the US as to whether the station was critical and worth the cost of repair. The site was repaired in September 2005 after BPA and the NWRFC indicated that it is an important site for the US.

- **Oyama Lake Snow Course (2F19)**: Capture and melt characteristics may have changed due to logging in the area to control Pine Bark Beetle infestation. Snow course is still on schedule for 2006 season, but situation bears watching if the infestation results in impacts to the forest.

- **Ochoco Ranger Station coop site (U.S. site):** The ranger station was closed resulting in no observer. It was determined that there was no significant impact to Treaty procedures or operations.