

# INTERNATIONAL SOURIS RIVER STUDY BOARD CLIMATE ADVISORY GROUP

## TERMS OF REFERENCE

### INTRODUCTION

The International Souris River Study Board (Board), created by the International Joint Commission (Commission), has begun its work under the directive of the IJC (attached). This work will include review of the operations of Rafferty, Boundary, Grant Devine, and Lake Darling Reservoirs (Reservoirs), and other measures to make recommendations to governments regarding how the provision of flood control and water supply benefits might be maximized.

The Commission has directed the Board to develop watershed runoff and inflow sequences that include the projected impacts of anthropogenic climate change. The Commission has also directed the Board to assess possible adaptation strategies to address the potential future variability in water supplies associated with climate change.

In part, to assist with these directives, the Commission has developed a Climate Change Guidance Framework (CCGF - <https://www.ijc.org/en/what/climate/framework>) that will be used by the Board to plan climate change analysis.

The Board realizes that there exists considerable expertise in climate change outside of the membership and working groups of the Board. Therefore the International Souris River Study Board, by the authority granted it by the International Joint Commission, established a Climate Advisory Group (CAG) within the Souris River Basin.

### MEMBERSHIP

The Climate Advisory Group will consist of 6 core advisors: 3 from Canada and 3 from the United States of America. The CAG will be co-chaired by 2 additional individuals (1 from each country) who are actively engaged in Board activities. The 6 CAG advisors will provide guidance to the Board through the CAG co-chairs, and guidance to other individuals involved in the study via 3 climate working sub-groups, as described below:

The three climate working sub-groups (WSGs) will focus on:

1. Historical Analysis and Communication;
2. Hydrologic Model Calibration and Validation;
3. Hydrologic Model Forcing Selection, Bias Correction and Downscaling.

The composition of the WSGs may include representation from Federal and Provincial/State Governments who are actively engaged in Board activities. Each WSG will be led by a representative from the United States and a representative from Canada and will report back to the CAG.

#### Historical Analysis and Communication WSG

This group will be responsible for documenting the objectives that the Board is trying to achieve in terms of characterizing and accounting for the impacts of anthropogenic climate change on the hydrology of the Souris River Basin. Documenting the objectives of the Board is the first step in the Commission's Climate Change Guidance Framework (CCGF) and it is essential to accomplish this step

to effectively ensure success in the subsequent CCGF steps of analysis, action and updates.

Additionally, this group will be responsible for compiling evidence of and providing context related to the effects of climate change in the region encompassing the Souris River Basin. This effort will consist of reviewing reputable sources of literature related to hydroclimatic conditions within the region, performing an analysis to identify significant changes in observed hydrological/climatological records, and an investigation of if changes in hydroclimatic conditions can be reasonably attributed to anthropogenic climate change. This assessment will provide a solid foundation for what the Board understands about the potential for changing hydrologic and climatologic conditions in the Basin.

#### Hydrologic Model Calibration and Validation WG

This group will be responsible for identifying, calibrating and validating the hydrologic models for use in the study. The calibration and validation will be performed using a historic time period for which sufficient, observed model forcing data is available. Models currently being considered for inclusion are the R-based hydrologic model developed by the USGS, the Environment and Climate Change Canada (ECCC) MESH model, and potentially, the NOAA SAC-SMA hydrological model used for operational forecasting.

This WG will also ensure that the hydrologic models and the Souris River Basin Reservoir Model are setup in a way that is compatible with the forcings produced by the Global Circulation Models (GCMs).

This WG will evaluate whether the hydrologic models are able to reasonably replicate observed, historic streamflows when forced with GCM based meteorological outputs generated for their hindcast period. Accomplishing this may require some additional post-processing to mitigate or remove biases introduced in the modeling chain.

#### Hydrologic Model Forcing Selection, Bias Correction and Downscaling WG

This group will be responsible for selecting and appropriately applying the Global Circulation Model (GCM) based, climate changed meteorological outputs within the hydrologic models. This WG will also analyze and report on the results.

As detailed in the IPCC-5 report (IPCC, 2013), there is a collection of potential Representative Concentration Pathways (RCPs) representing projected greenhouse gas emissions that can be selected for analysis. Additionally, there are over 40 GCM available for use. With such a large number of RCP-GCM couplings available for use, it will likely be necessary to limit the number of RCP-GCM combinations adopted for this modeling study. Meteorological datasets produced by GCMs are generated on a relatively large spatial scale, thus for water resources applications GCM outputs are typically downscaled and bias corrected to spatial and temporal scales relevant to basin-scale impact studies.

One of the objectives of this WG will be to determine, if possible, to what degree each methodological choice made in the hydroclimate modeling chain introduces uncertainty into projections of climate changed hydrology. The uncertainty associated with the projections of future, climate changed temperature data and precipitation depths are significant. It is acknowledged that at this point, based on the methods and data resources available, it is not possible to fully characterize the uncertainty association with GCM based projections of hydroclimatology.

In order to properly apply and interpret meteorological forcing produced by GCMs it will be necessary

for this WG to:

1. Select a set of Representative Concentration Pathways (RCPs) of greenhouse gas emissions;
2. Select a set of simulations from various General Circulation Models (GCM);
3. Select an appropriate method (or methods) that can be used to downscale and bias correct the coarse-resolution GCM temperature and precipitation data to finer temporal and spatial scales;
4. Use the resulting finer-scale data as forcing data for the hydrologic models
5. Evaluate, characterize and communicate the uncertainty associated with projected, climate changed hydrology.

After translating projected, climate-changed meteorology into a hydrologic response, this WG will be tasked with developing a strategy for effectively evaluating and reporting results specific to ISR Study Board objectives.

The Climate Advisory Group will support the ISR Study Board as follows:

1. Review information provided by the ISR Study Board when required.
2. Inform the Board of potential conflicts with policies or interests
3. Suggest ideas or approaches to improve the results of the Study
4. Serve as a conduit for the latest, actionable climate change science input to the study process.

The following are the operational guidelines which the Climate Advisory Group will seek to follow:

1. The CAG will meet as they see fit, with minimum requirement to teleconference monthly.
2. Discussion during CAG meetings is to be open, frank and free-flowing. All members of the CAG have equal status during discussion and are expected to demonstrate fairness and a commitment to in-depth examination of matters under review.
3. Advice from the CAG to the Study Board should reflect the multiplicity of views of its members.
4. Minutes will be kept and will reflect the minimum detail required to effectively summarize the proceedings and advice offered. CAG Co-chairs will be responsible for the approval of the minutes and, with the assistance of the Study Managers, distribution. The minutes will be posted to the Study Board website, as authorized by the Study Board.