Application of Cutting-Edge Toolkit for Optimal Operation of River Basin Infrastructure

Today's river basins contain infrastructure that regulate river flows. Managers face two closely-related questions: what is the best way to (a) operate the existing infrastructure; and, (b) design future infrastructure expansion? Addressing both questions requires the best use of the computer modeling technology available today. This project will address gaps through (a) improved solution methodology for river basin management models that use historical data; (b) improved real time operation in conjunction with seasonal flow forecasting model; (c) pattern matching techniques based on artificial intelligence to provide guidance for reservoir operation in cases where seasonal forecasting models are not available.

FUNDING DETAILS

RECIPIENT:
Optimal Solutions

PARTNERS:
Eastern Irrigation District, University of Alberta, MITACS
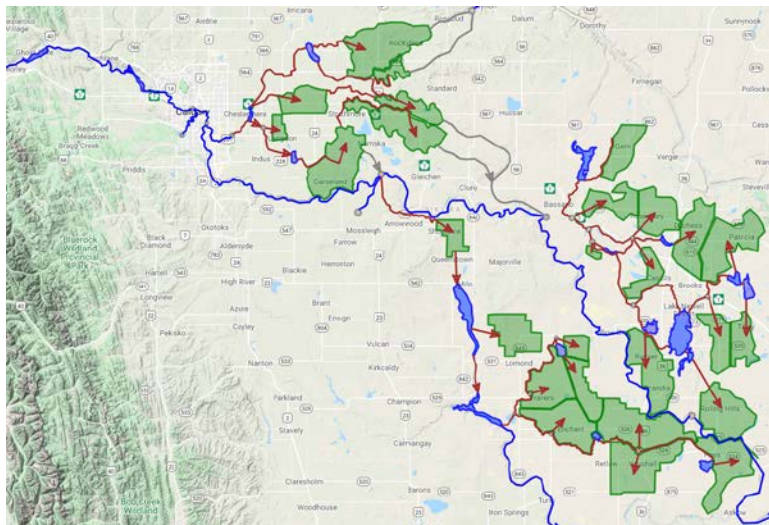
TOTAL BUDGET:
$190,000

AI FUNDING:
$75,000

PROJECT DATES:
MARCH 2020 – JUNE 2021

PROJECT TRL:
Start: 7
End: 10

APPLICATION

The intended market for this tool includes river basin management agencies, hydro power utilities, and consulting companies who offer services in the water sector. WEB.BM offers advantages to river basin management agencies and irrigation districts and can serve both as a seasonal operational tool and a river basin planning tool. While the focus to date has been on Irrigation Districts in Alberta, there is the potential for this tool to be used world-wide. On a 2019 World Bank funded test problem for Naramada River Basin in India, WEB.BM provided the highest quality results that were unmatched by any of the participating models.

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PROJECT GOALS

The key goals of the project are to:

- Develop the ability to forecast seasonal streamflow in the Oldman River basin for the needs of the Irrigation Districts in Alberta.
- Develop the ability to optimize reservoir operation by using the web based WEB.BM river basin management model. WEB.BM uses a linear programming solver to find the best water allocation in a river basin by combining multiple time step optimization and an equal deficit sharing constraint among selected stakeholder groups. The model will be demonstrated on the Bow and Oldman Irrigation districts and on two more river basins within this project.
- Investigate the use of artificial intelligence algorithms and software that learns from multiyear optimal solutions to derive short term operating rules based on pattern matching techniques.

BENEFITS TO ALBERTA

The successful implementation of this technology could result in:

- Improved river basin management tool for flood and drought management available to stakeholders in and outside of Alberta as the only on-line application of this kind in the world.
- Improved management of reservoir releases, which includes reduction in water wasted on spills as well as reduction of deficits to consumptive use during droughts.
- Reduction in deficits in irrigation water supply and improved management of water allocation within irrigation districts in Alberta and elsewhere.
- Improved ability to maintain environmental flow targets.
- Ability to better address necessary changes in future reservoir operation to counter the effects of climate change assumptions.
- Increased revenues and corporate growth of a small Alberta company.

4 Publications

1 Students Trained

1 Project Job

CURRENT STATUS	**APRIL 2020**
	The work on the project has started, and one of the two papers is compiled for the special edition of the Water Journal that will present the proposed methodology and early results. Also, web development of additional options that will improve the application has been under way since March 1, 2020.