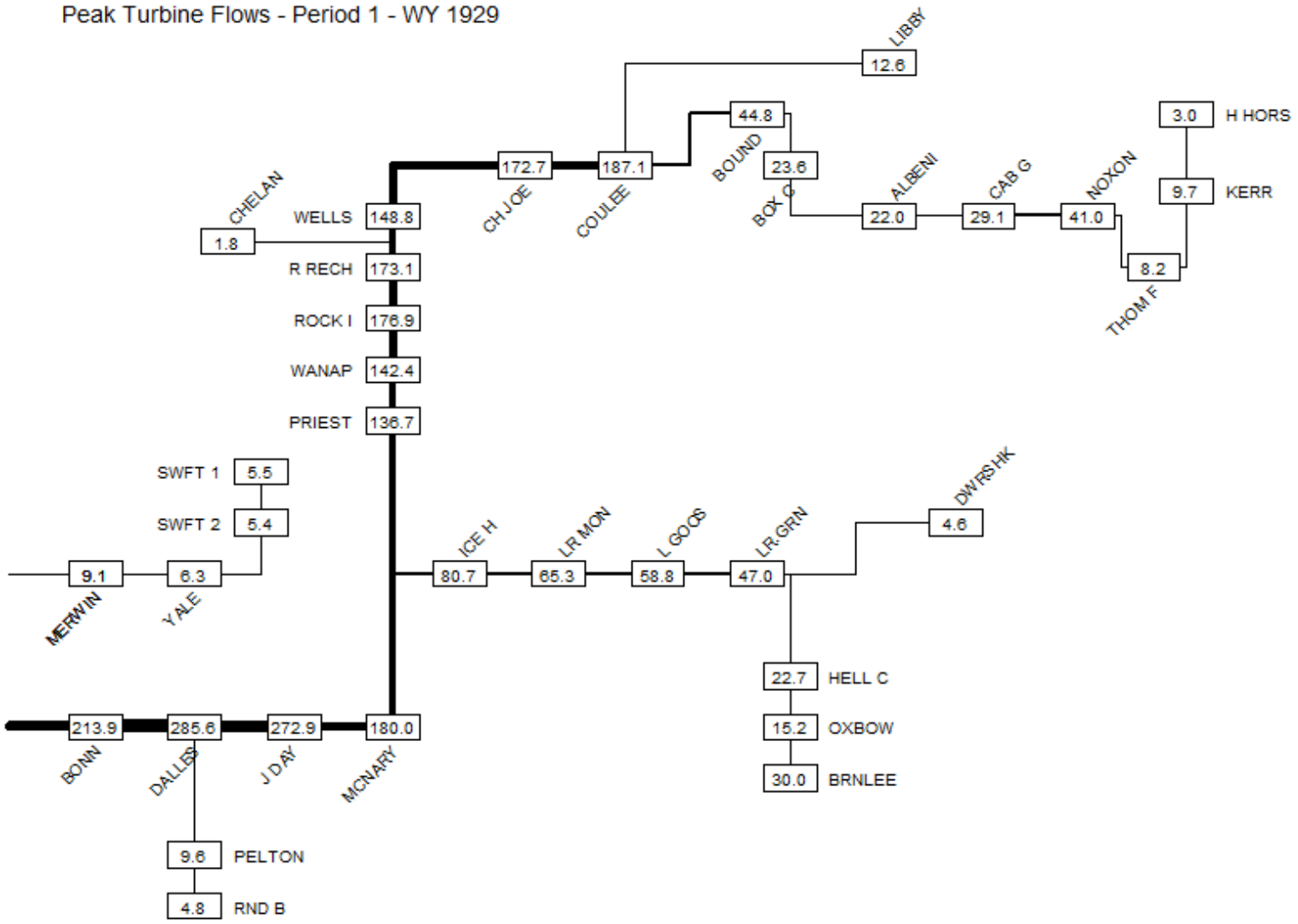
TRAP Model Updates

August 25, 2015

TRAP

- **TRAP**ezoidal approximation of sustained peaking capability of the regional hydro system
- Maximizes an input sustained peak period (e.g. 2, 4, 6, 10 hours)
- Linear Program with sustained-peak and off-sustained-peak turbine flow and spill as random variables
- Models 5 days of repeated operation



TRAP Hydro System Example

Inputs

- BPA Monthly Regulated Flows
- Modeled Projects and Zones
- Project Type
  - Reservoirs
  - Limited Pond
- Minimum Flow by Period
- Forced Outage Rates and Maintenance min and max by Period
- HK Curves
- Sustained Peak Length
- INC and DEC Requirements by Project Group

Key Assumptions

- 4 hour ramps, modeled as adding 4 hours to sustained peak period
- Weekday flows are assumed to be 110% of monthly average flows
- BiOp Spill as either minimum spill or percentage of flow as spill – percentage flow spill not optimized
- Independent outages constrain maximum generation
- Smaller hydro projects that are not modeled are assumed to be 50% load-following and 50% flat generation
- INCs and DECs are pooled between hydro projects optimally

Basic Formulation

- Linear system equations take the general form

  Storage Water + Project Water – Upstream Water = Side Flows

- Objective function maximizes turbine flows multiplied by the HK with a penalty of 10 * spill flows for extra spill

INC and DEC Logic

- INC and DEC requirements are constraints on the maximization for a pool of hydro projects
  - Maximum Possible Flow * HK Curve – Sustained-Peak Turbine Flow * HK Curve > INC Requirement
  - Minimum Possible Flow * HK Curve – Off-Sustained-Peak Turbine Flow * HK Curve < DEC Requirement
- That is, for a give pool of projects make sure the ability to increase generation and decrease generation exceeds the reserve requirements for those projects

Storage Logic

- For large reservoirs, e.g. Grand Coulee, storage within the week is unlimited
- For smaller ponds, storage is limited by input kcfs-hrs limit

Pondage Treatment

- Three points of storage measured:
  - *S0* represents pond content at the beginning of the off-sustained-peak period
  - *S1* represents pond content at the end of the off-sustained-peak period
  - *S2* represents pond content after the sustained-peak period
- Off-sustained-peak storage/draft (S1 – S0) is limited to 50% change of pond content and total storage/draft is limited to 20% change of pond content (S2 – S0)

Pondage Storage Representation

TRAP Results

- Optimizations for 2, 4 and 10 hours are used to produce curves that restrict maximum and minimum system generation in GENESYS

Download TRAP

- TRAP is publicly available code
  - Installer for Windows now available
  - Available on GitHub as a predominately Fortran code base
  - Supports MPI for parallel computing
  - GitHub's bug tracking and enhancement features document future work plans

https://github.com/NWCouncil/trap2