



# Bonneville Power Administration

## Economic Dispatch in the Pacific Northwest

- Hydro dominated system with associated volatility. Resources are energy limited, interlinked, with varying periods of operational flexibility due to limited storage and non-power constraints.
- Long history of resource coordination (e.g. Columbia River Treaty with Canada, Pacific Northwest Coordination Agreement, Mid-Columbia Hourly Coordination, Hydro/Thermal Coordination)
- A robust bilateral energy market already exists in the region
- Hydro system operation and coordination can lead to a variety of dispatch scenarios and even flow reversals
- Significant IPP development in the last 5 years – over 5,000 MW added in the region
- Historical high availability of short-term transmission on the BPA grid allowed decentralized economic dispatch through bilateral arrangements among owners/LSEs
- In response to increased risk of internal constraints, moving to flow based ATC methodology to more accurately capture transmission effects in dispatch.

# Federal Columbia River Power System

## Columbia River Basin & BPA Service Area

### BPA

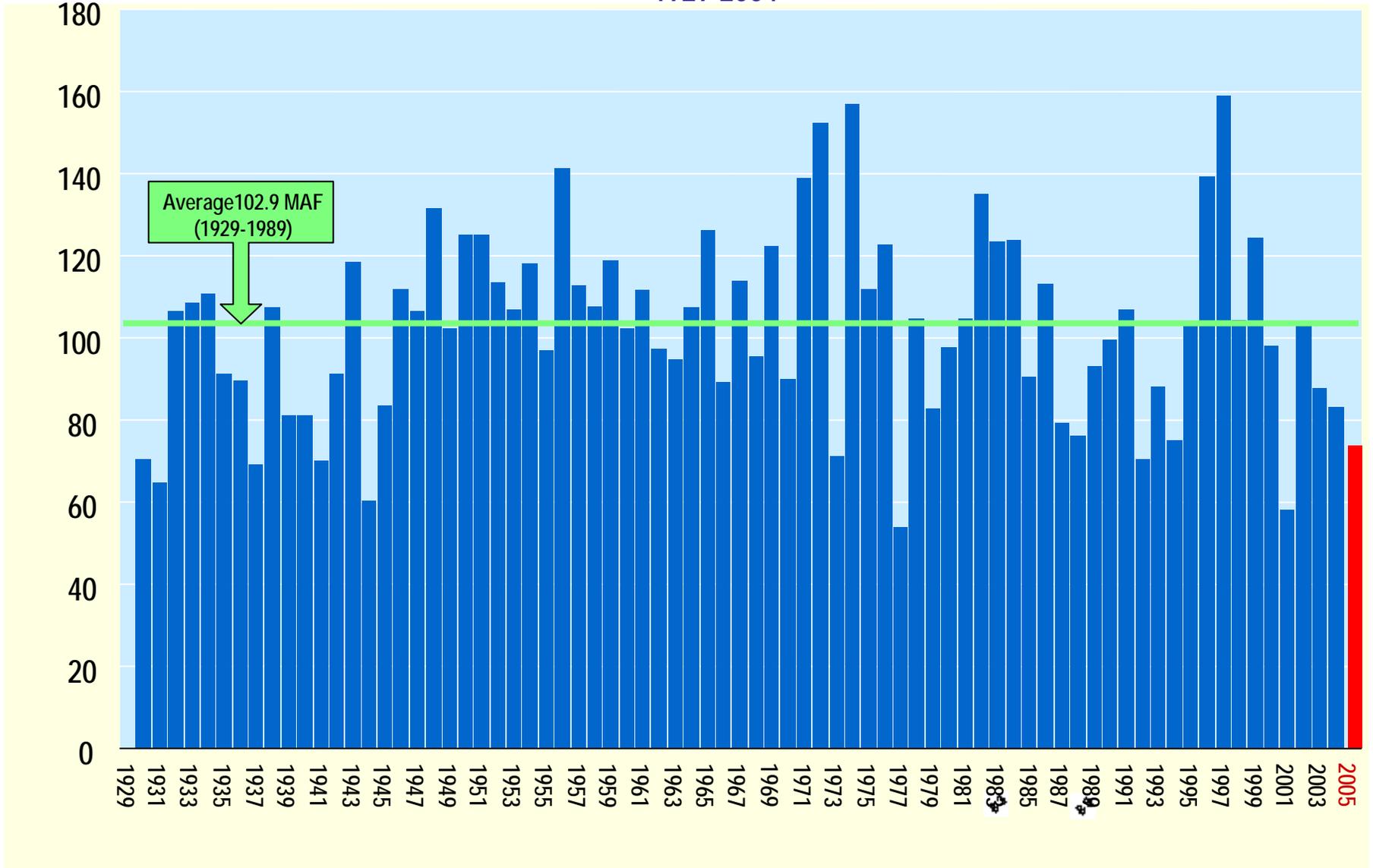
- Markets power at cost from 31 federal dams and 1 nuclear plant – 45% of electricity used in PNW
- Markets transmission services – owns 75% (15,000 miles) of the high-voltage lines in PNW
- 300,000 square mile service area – includes WA, OR, ID, and Western MT
- Large geographic footprint
- Low density of load
- Predominantly interlinked hydro, with base-loaded thermal resources
- Hydro generation output is controlled by water storage releases



# Variability in Columbia River Streamflow

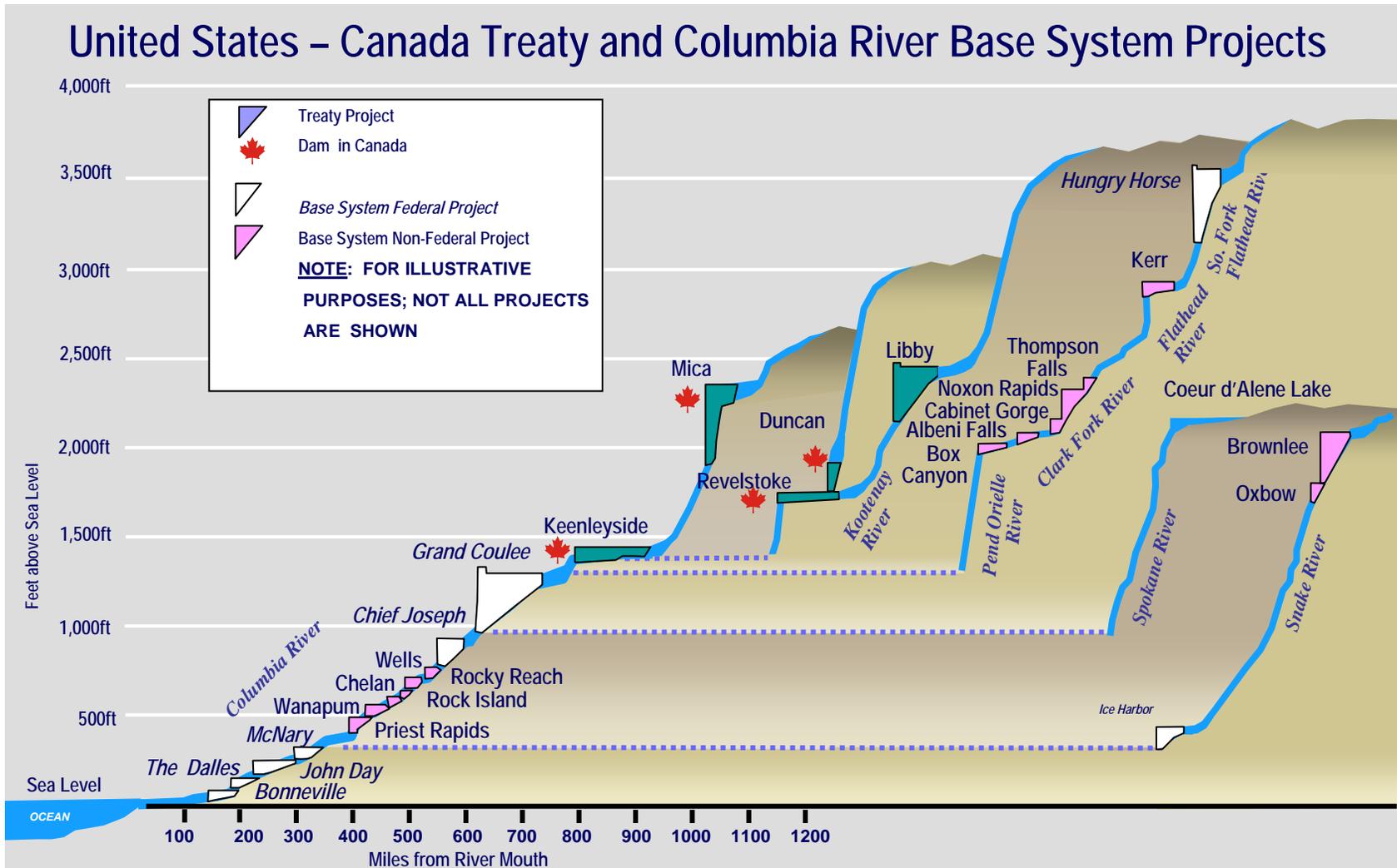
Water Year Runoff (January-July) at The Dalles  
1929-2004

MAF



# Pacific Northwest Hydro Characteristics

- Projects share a common fuel supply, affected by non-power constraints.
- Hydro operations have effects upstream and downstream, either immediately or in the future.
- Hydro is used for regulation and load-following, while thermal tends to be base-loaded.



# Pacific Northwest Hydro Coordination

- Pacific Northwest hydro operations are coordinated under various agreements, including: the Columbia River Treaty, the Pacific Northwest Coordination Agreement (PNCA), and the Mid-Columbia Hourly Coordination Agreement (MCHC).
- Coordination captures benefits of diversity between hydro and thermal resources and load diversity so that all parties benefit, creates certainty for variable resources (like hydro), maximizes generation output of limited fuel, and helps “shape” resources to meet load.
- The PNCA protects participants from changes in anticipated upstream storage releases.
- The Columbia River Treaty (with Canada) assumes that PNW resources are coordinated.
- Basic assumptions of PNW coordination agreements:
  - The “one utility” principle – determine the optimum power operation within non-power constraints as if operated by a single entity; a MW is a MW *regardless of location*.
  - Power generation is optimized on a monthly basis by directing the amount and timing of storage releases at specific reservoirs.
  - Coordination will be safe for all parties (voluntary, changes only if agreed to by all).
  - Recognize the autonomy of owners to operate their resources for their own needs while providing certainty to other coordinated parties (using obligations for energy exchanges based on theoretical optimum hydro operation).
  - Since power benefits are independent of location, there is a requirement for sufficient transmission capacity to make coordination work.

# Considerations in Hydro Coordination

There is a high value in coordinated operation.

- Hydro-thermal coordination creates firm power and displaces capital.

Parties cannot coordinate simply on short-term price signals.

- Hydro projects are interdependent resources.
- River coordination spans multiple plants and long time periods.
- Long-term system thinking dominates operational strategy.

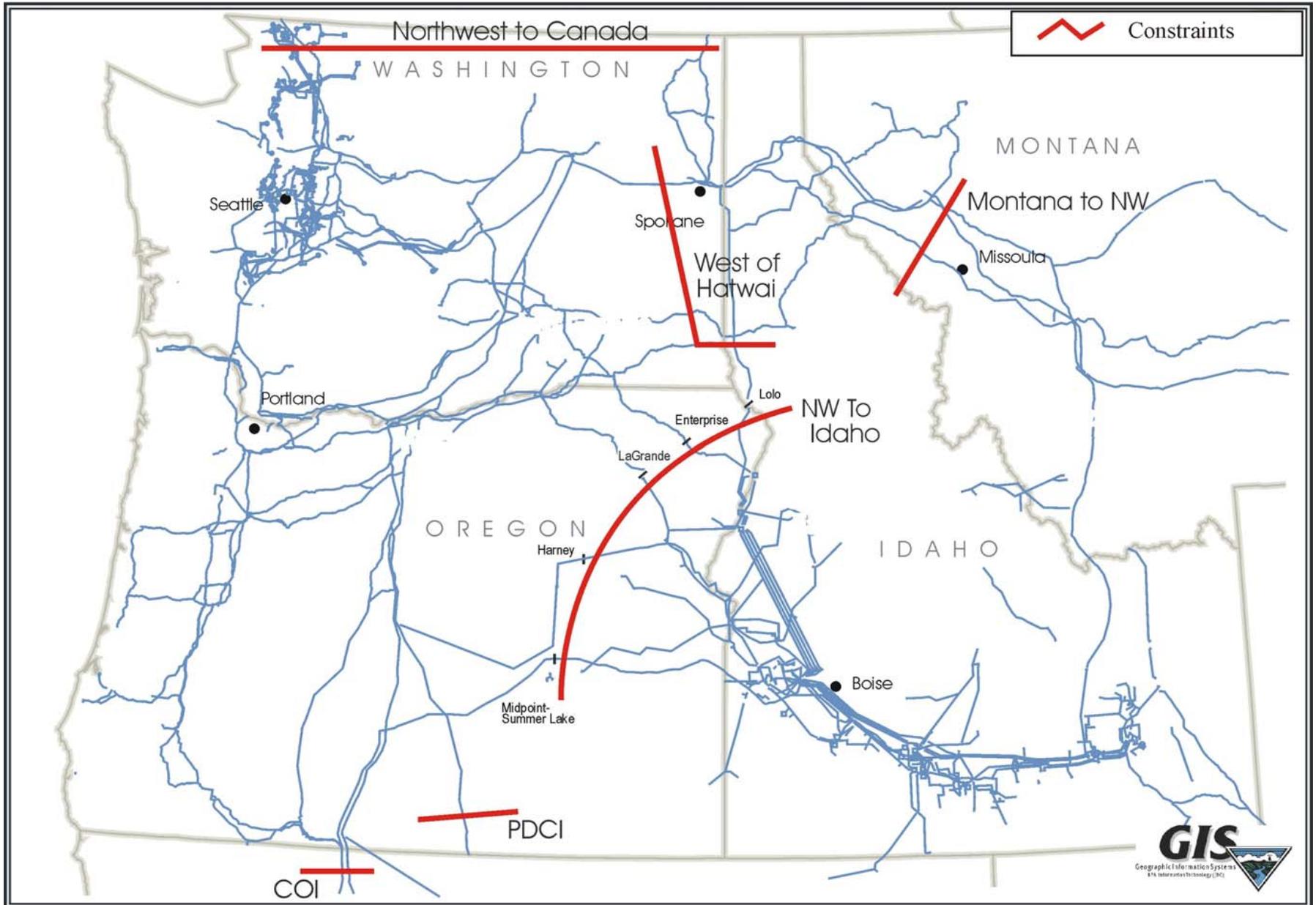
Unplanned obligations can disrupt coordination.

- Many non-power constraints affect hydro production.
- Hydro is not necessarily responsive to short-term price or “must run” orders.
- Short-term cost is opportunity cost relative to long-term use.

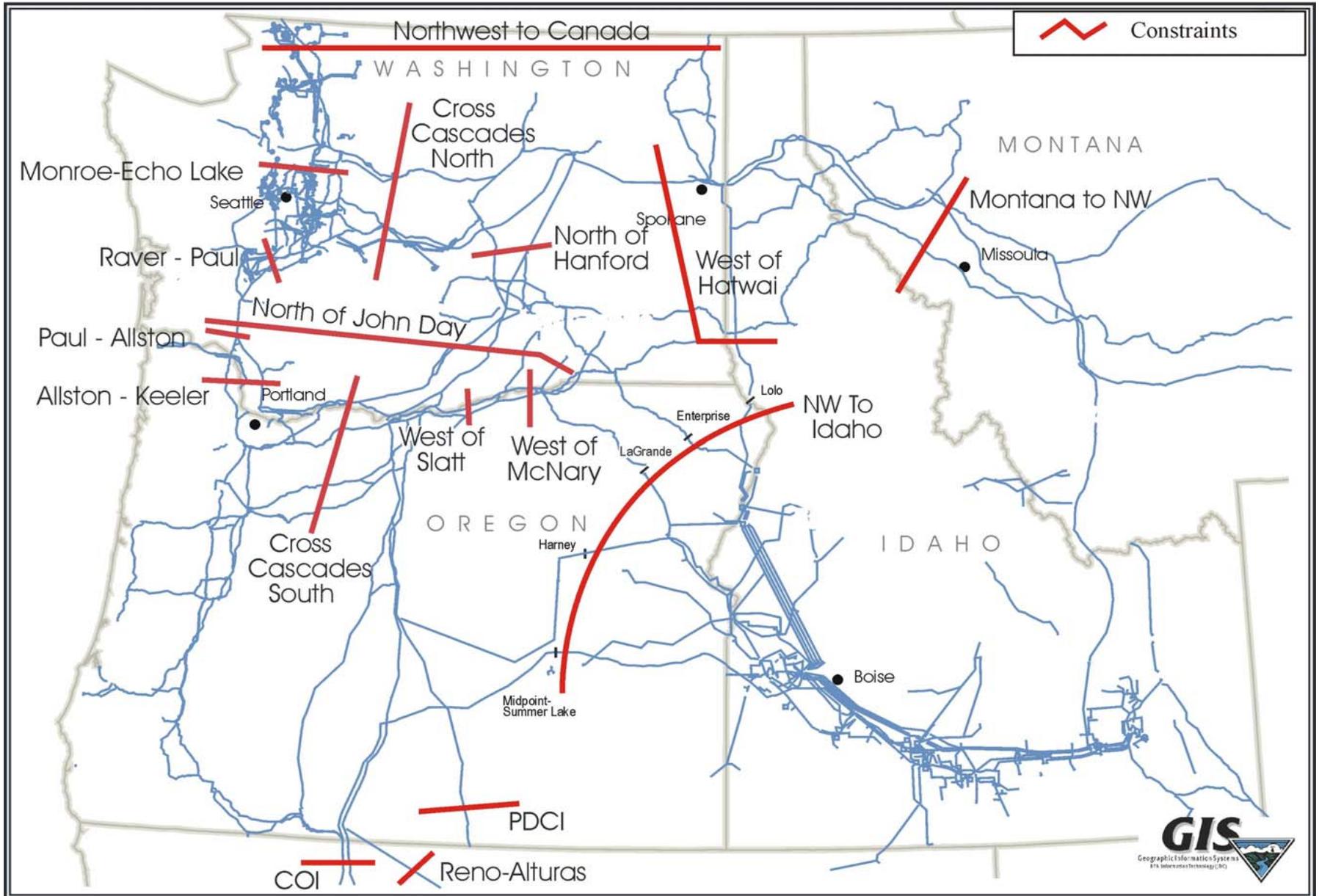
Hydro-thermal coordination may cause transmission flow reversals.

- Base loading coal allows using and recharging hydro storage.
- Requires broad, flexible transmission rights.

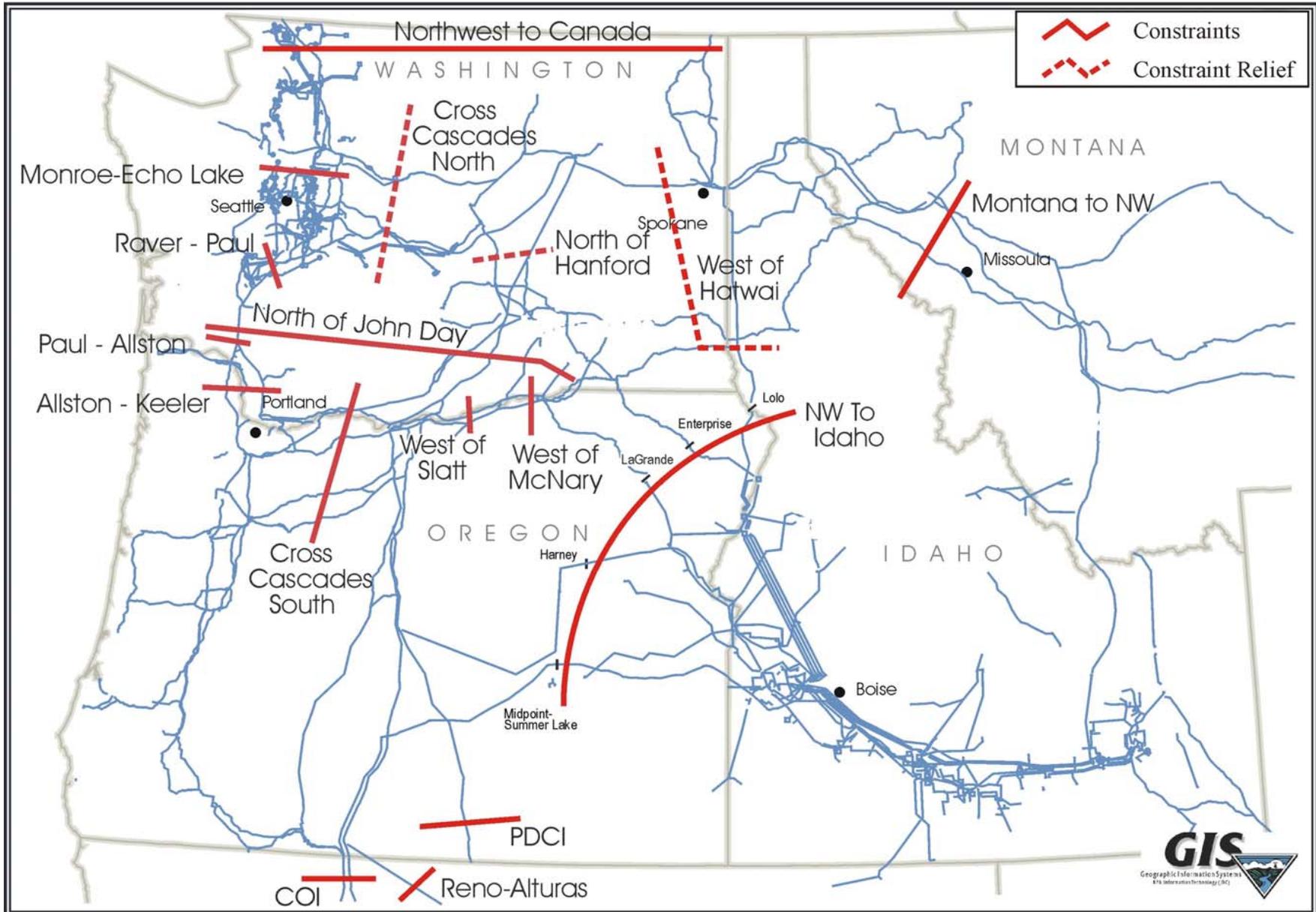
# 1994 NW Constraints



# 2001 NW Constraints



# 2005 NW Constraints



# Established ATC Methodology for Flow-based Transmission System

