Adaptive Management for Recovery of Terrestrial/ Wetland Ecosystem Function within Reservoir Footprints

Columbia River Adaptive Management Workshop

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Restoring
Ecosystem Function

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Basin Components

Treaty Dams/ Reservoirs

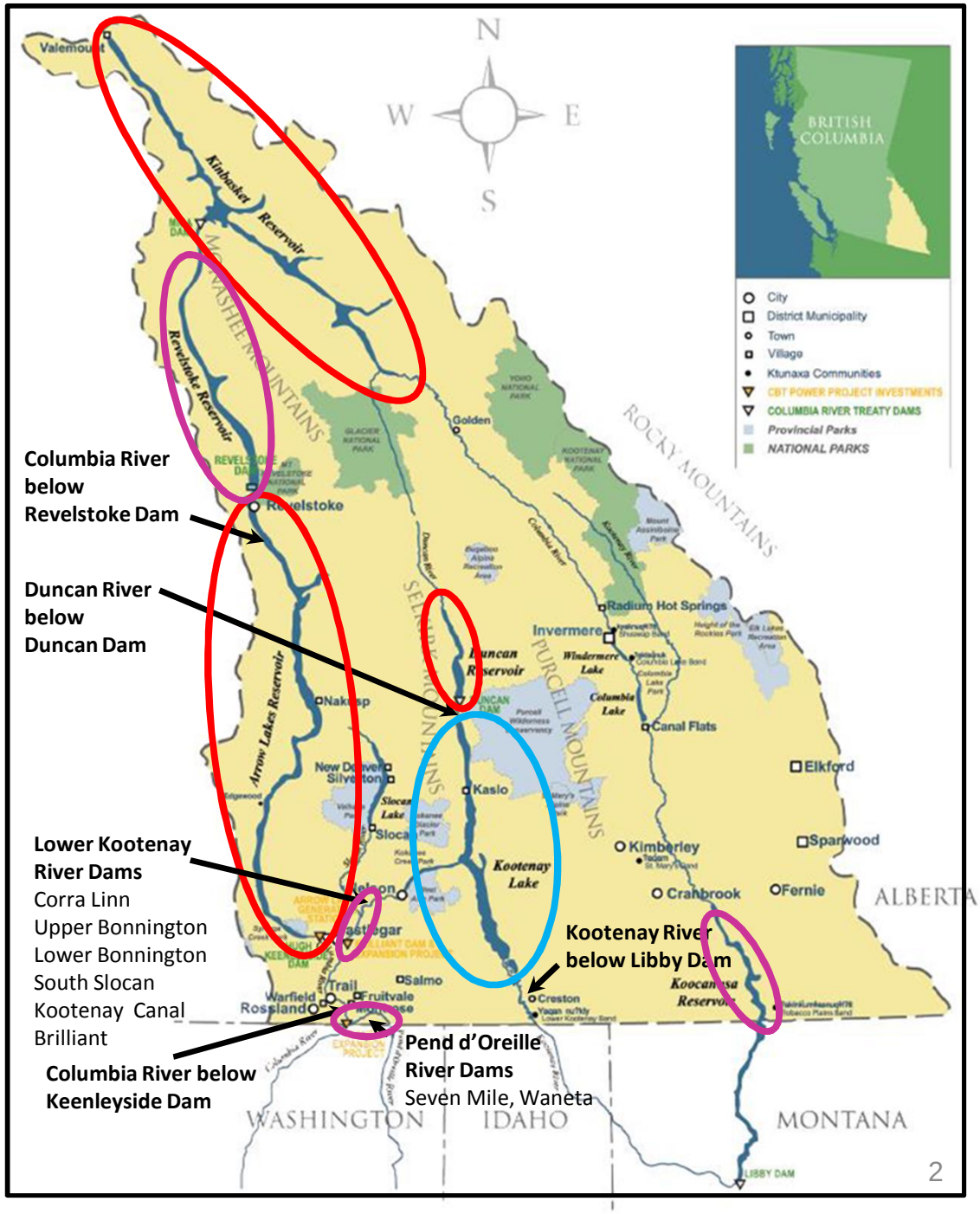
- Keenleyside/ Arrow Lakes
- Mica/ Kinbasket
- Duncan

Non-Treaty Dams/ Reservoirs

- Revelstoke
- Libby/ Koocanusa
- Lower Kootenay River Dams
- Pend dÕOrielle Dams

Affected Lakes/ Rivers

- Kootenay Lake
- Kootenay River (lower/ upper)
- Duncan River
- Columbia River (above/ below Arrow)
- Pend dÕOrielle River

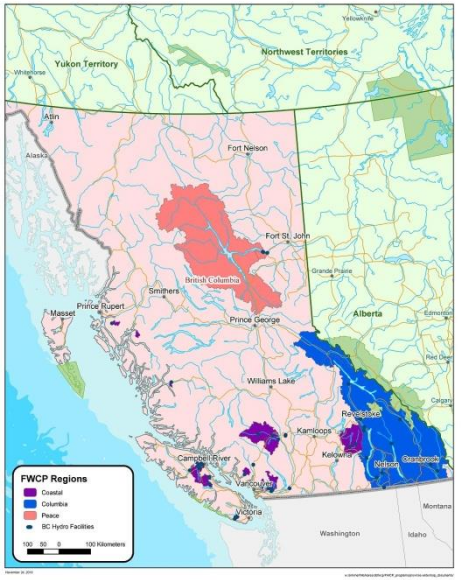


Fish and Wildlife Compensation Program - Columbia

Å Established to offset impacts of BC Hydro dams and reservoirs on fish and wildlife

Å Objectives

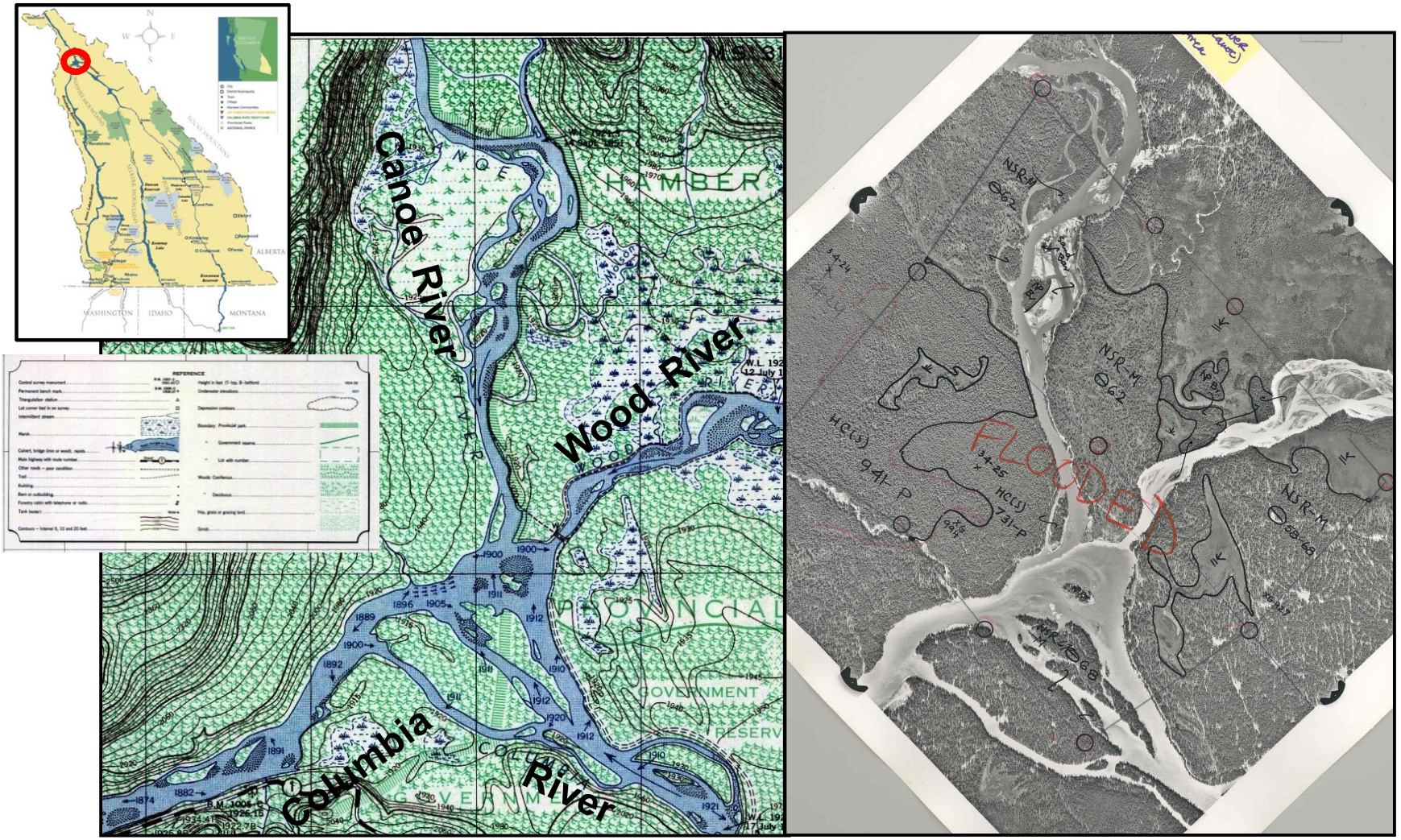
- ï Meet water license obligations for compensation for dam impacts
- ï Sustain and enhance fish and wildlife impacted by dams



- Initiated “Dam Impacts Project” to:
  - Update our understanding of the impacts of dam construction
  - Assist in prioritization of compensation options
  - To support ongoing strategic and program planning
  - Facilitate reporting progress in addressing the impacts

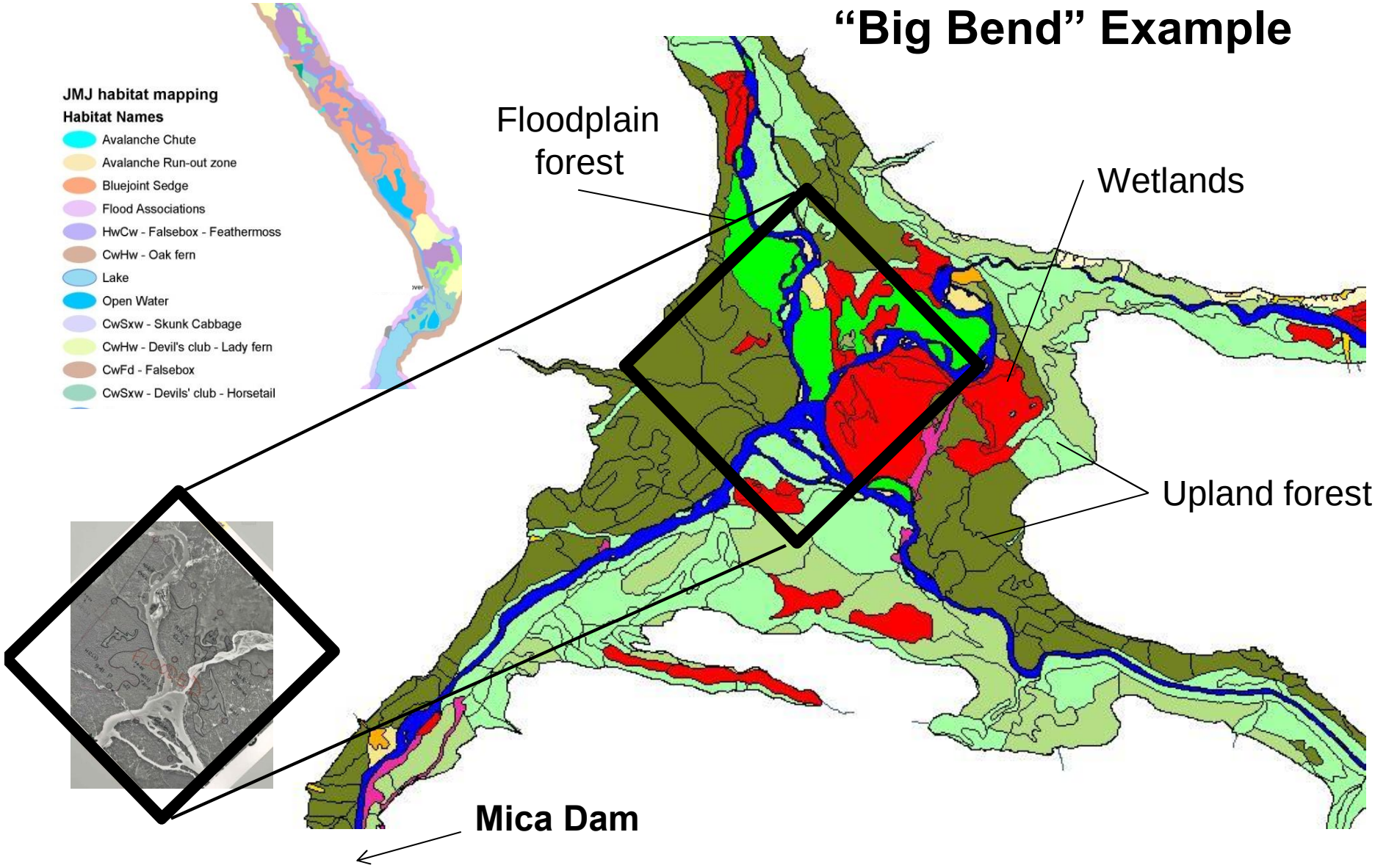
Dam Footprint Ecosystem Mapping

Primary Information Sources

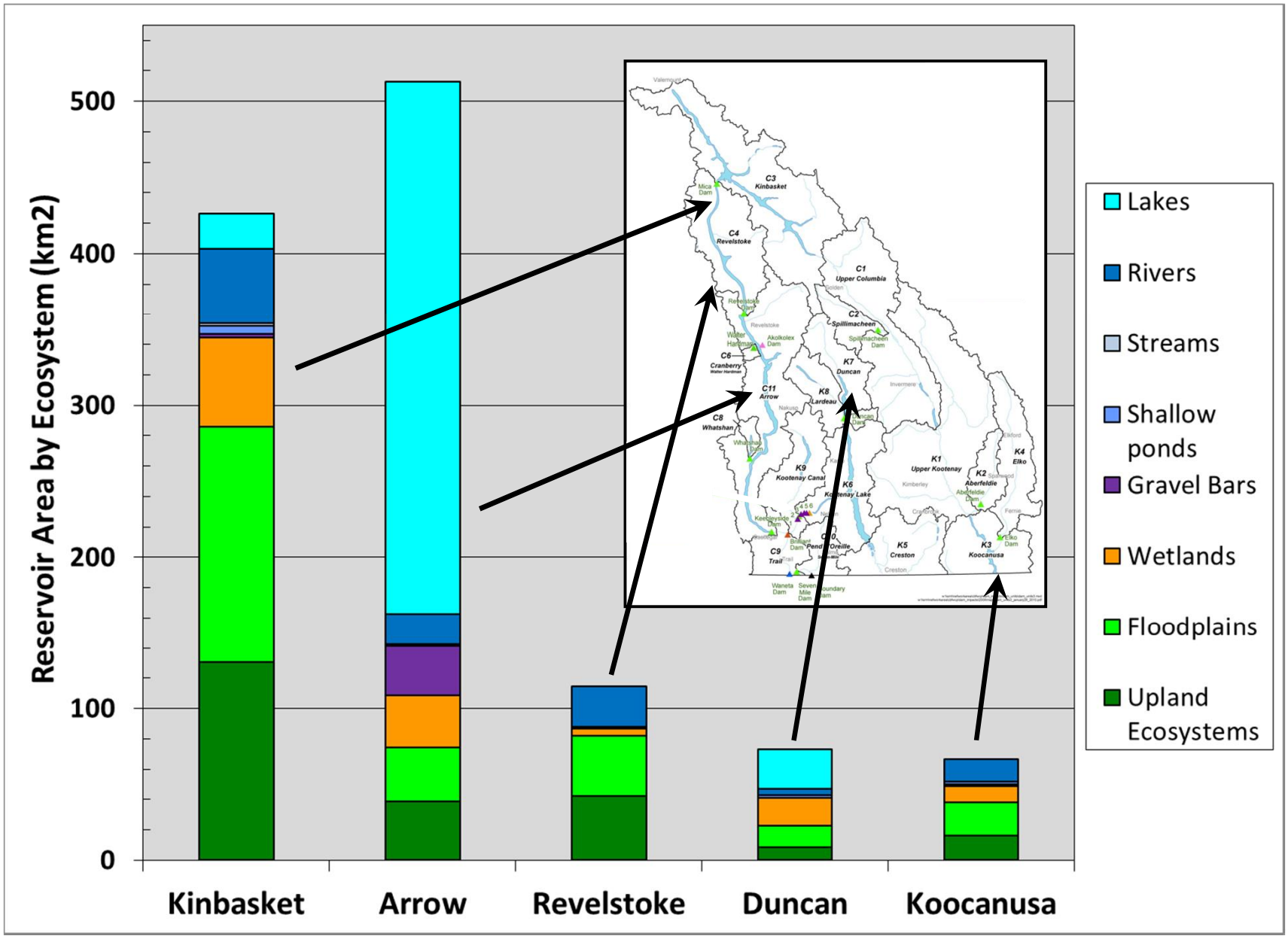


Mica Dam

Ecosystem Mapping Results



Area Flooded by Ecosystem



Environmental Impacts

Habitat Losses

- Terrestrial Uplands
- Riparian Forests
- Wetlands
- Large Rivers
- Low Gradient Streams
- Lakes

Species Impacts

- 47 fish species
- 289 vertebrate species

Lost Primary Productivity

- Carbon sequestration

Downstream Impacts:

- Channel Stability
- Nutrients/ Oxygen
- Riparian Ecosystems
- River Flow Regimes
- Water Temperature
- Anadromous Fish Blockages

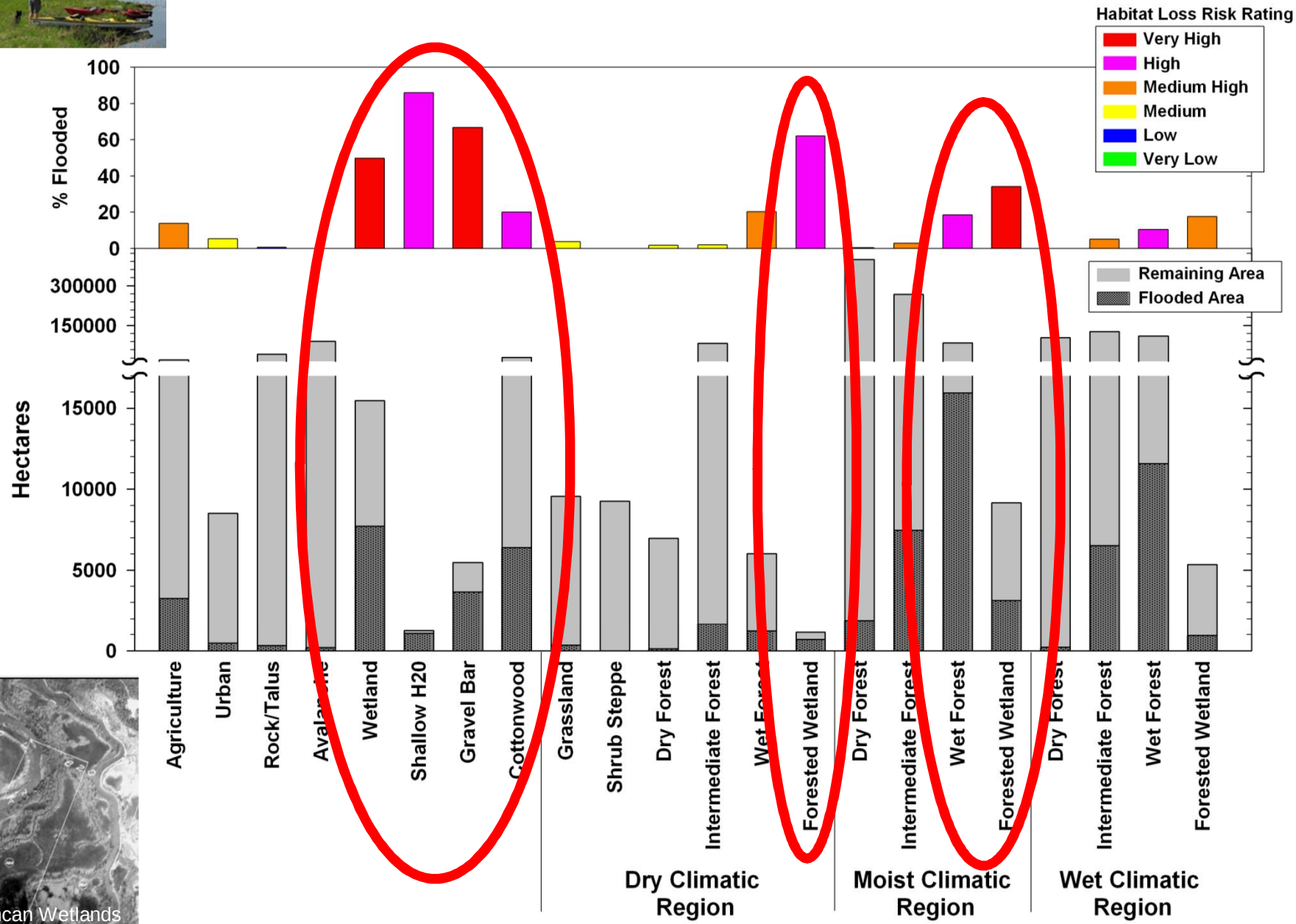
Reservoir Footprints

- Reservoir Flooding

Reservoir/ Operational

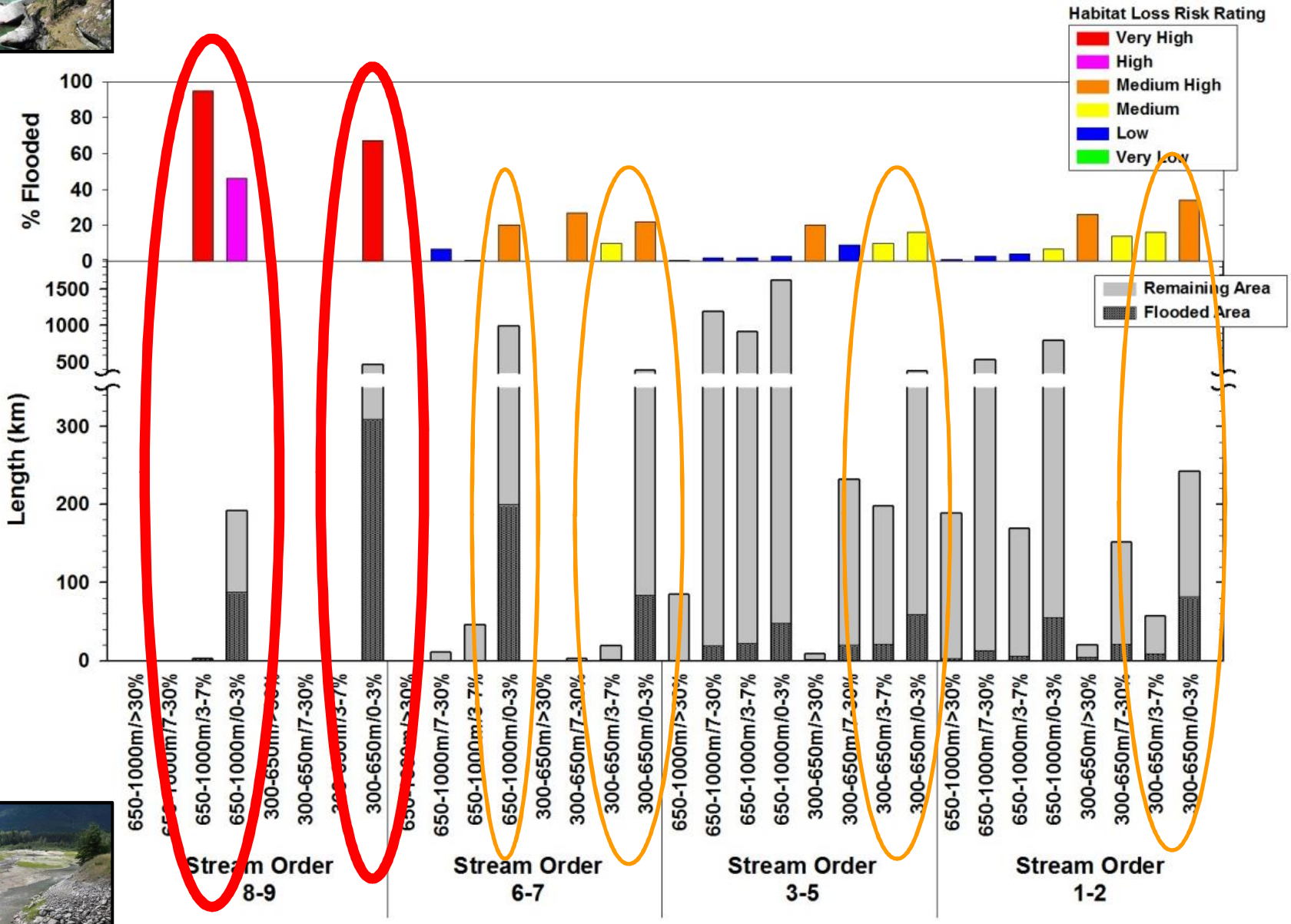
- Seasonal storage/ release
- Peaking
- Other dams

Terrestrial – Wetland Habitat Losses

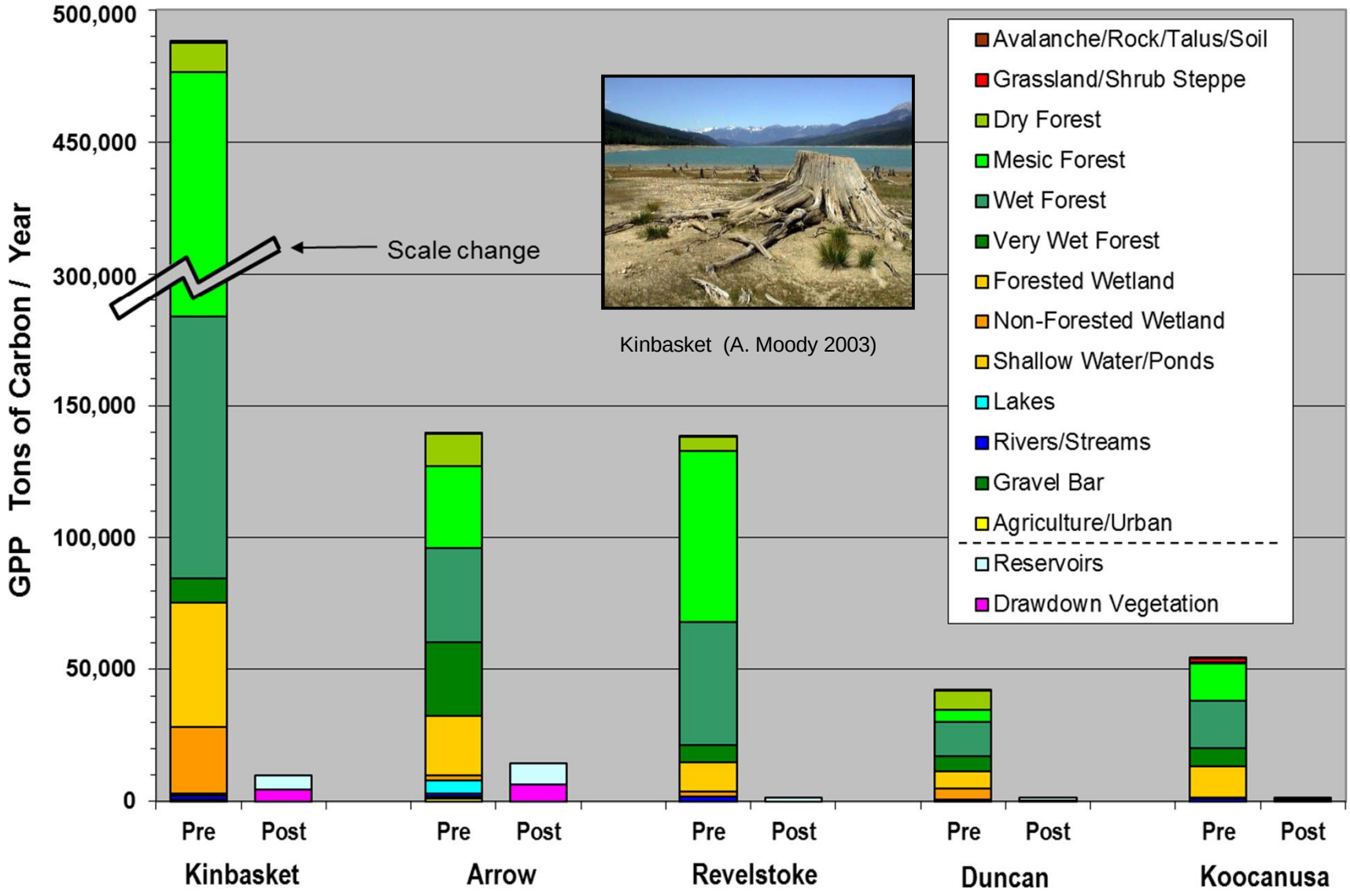



Duncan Wetlands

River and Stream Habitat Losses



Primary Productivity Changes



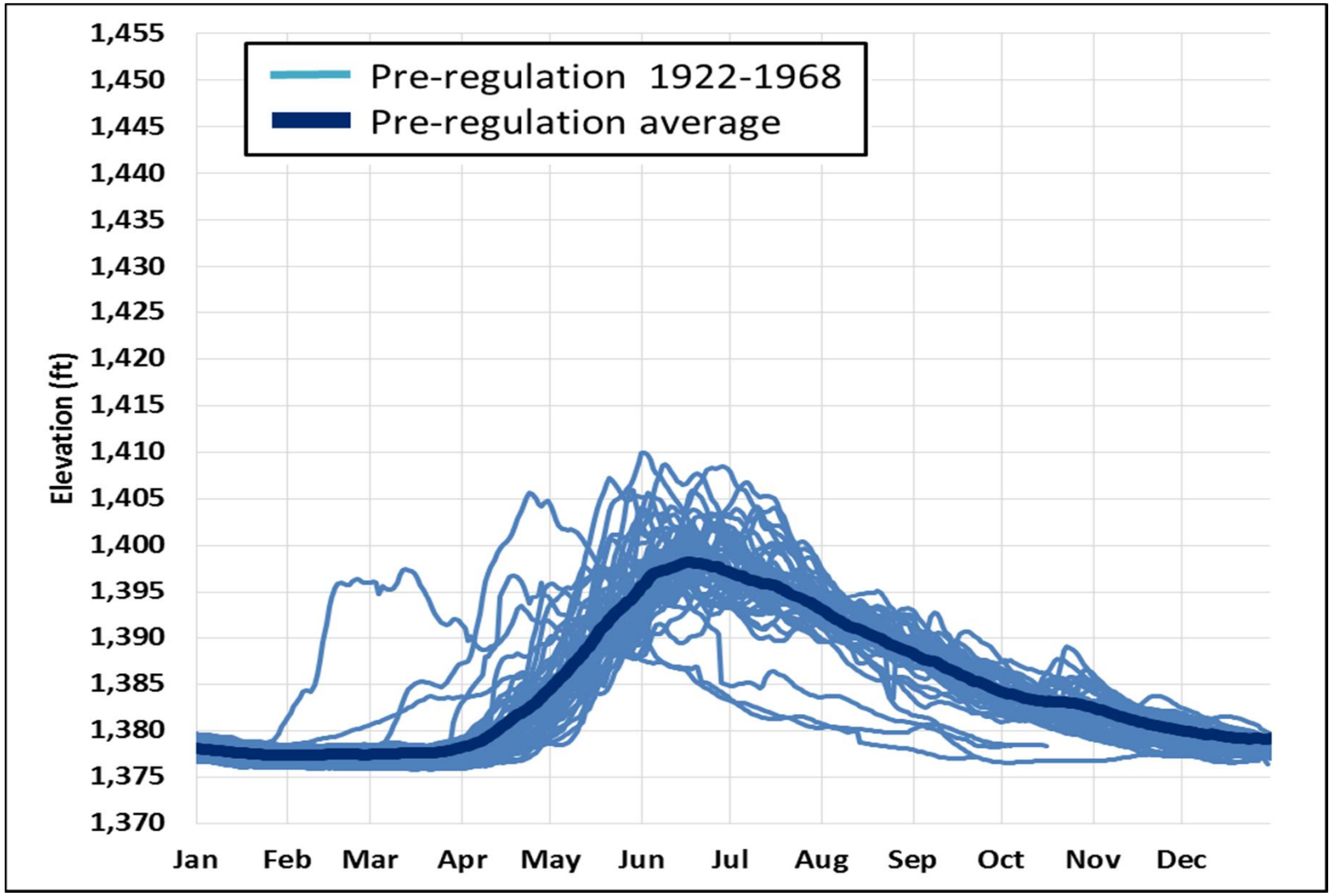
Adaptive Management for Improving Ecosystem Function

Mid-Elevation Arrow Example

Issues (potential objectives):

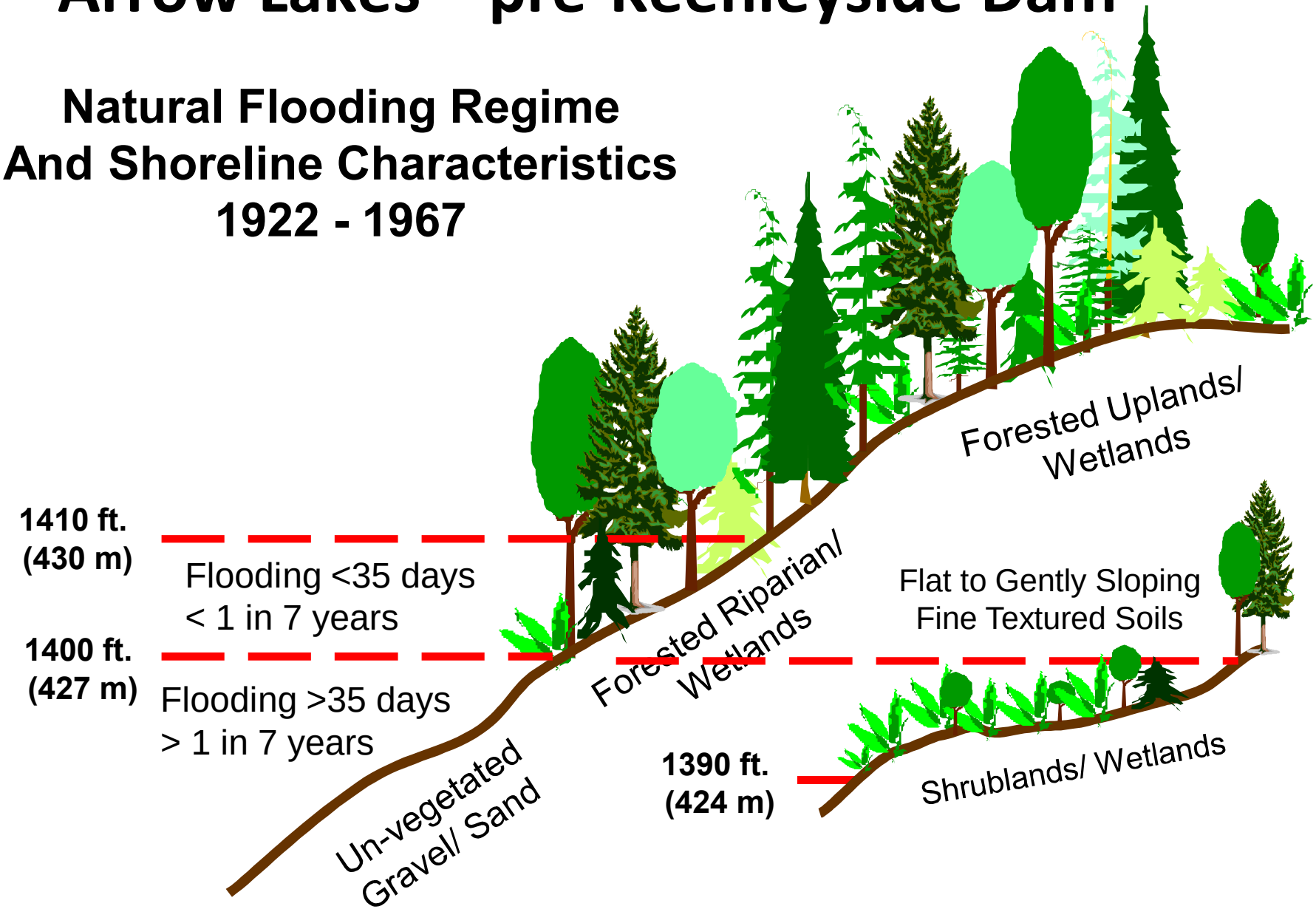
- Footprint habitat losses:
  - terrestrial ecosystems/ wetlands
  - low gradient streams/ aquatic ecosystems
- Footprint agricultural losses
- Recreational concerns – reducing seasonal water level fluctuations/ increased certainty
- Minimizing impacts on:
  - Flood risk management
  - Hydro power generation
  - Fisheries
  - Downstream ecosystem function

Upper Arrow Lake pre-Keenleyside

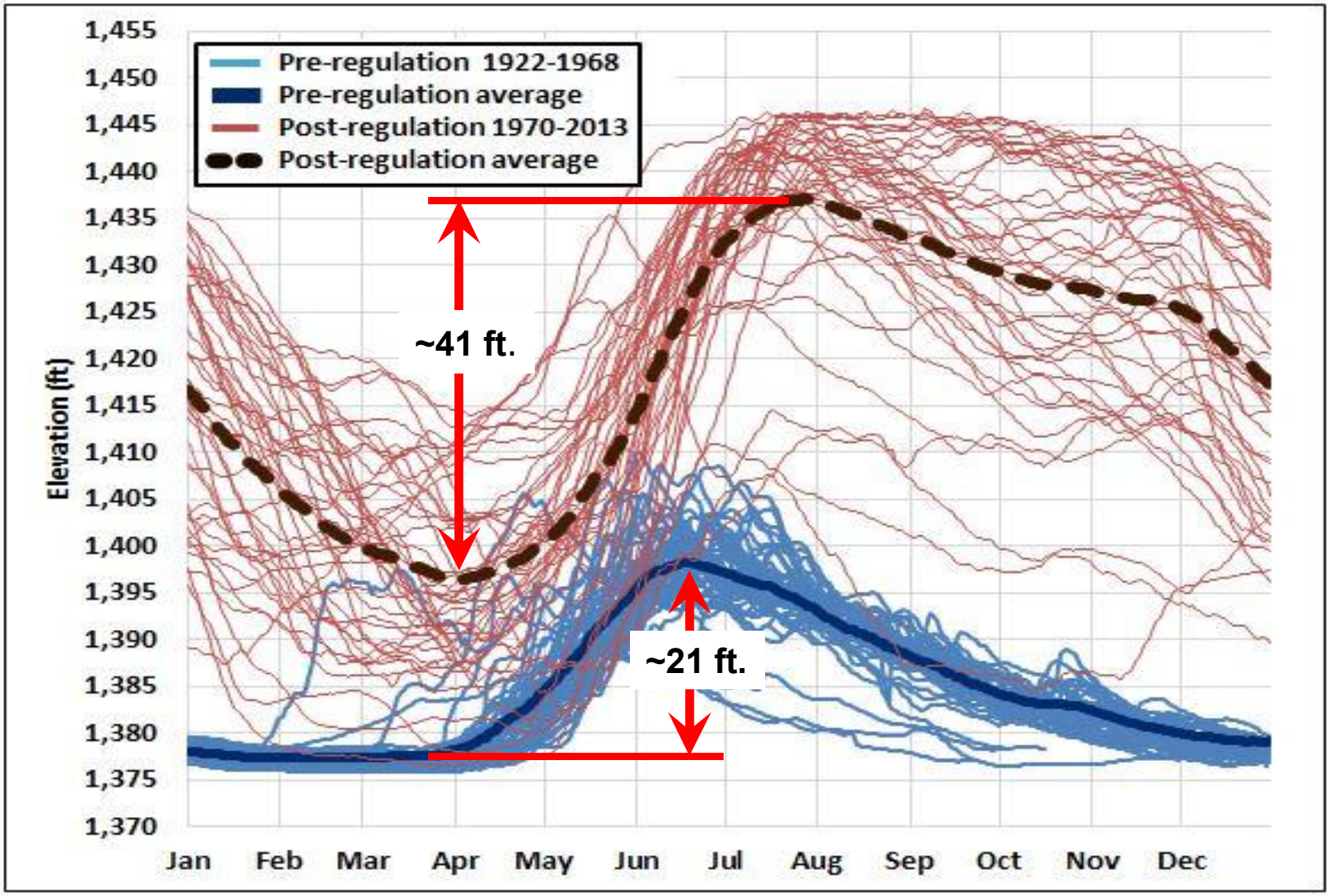


Arrow Lakes – pre-Keenleyside Dam

Natural Flooding Regime And Shoreline Characteristics 1922 - 1967



Upper Arrow Lake pre- and post-Keenleyside



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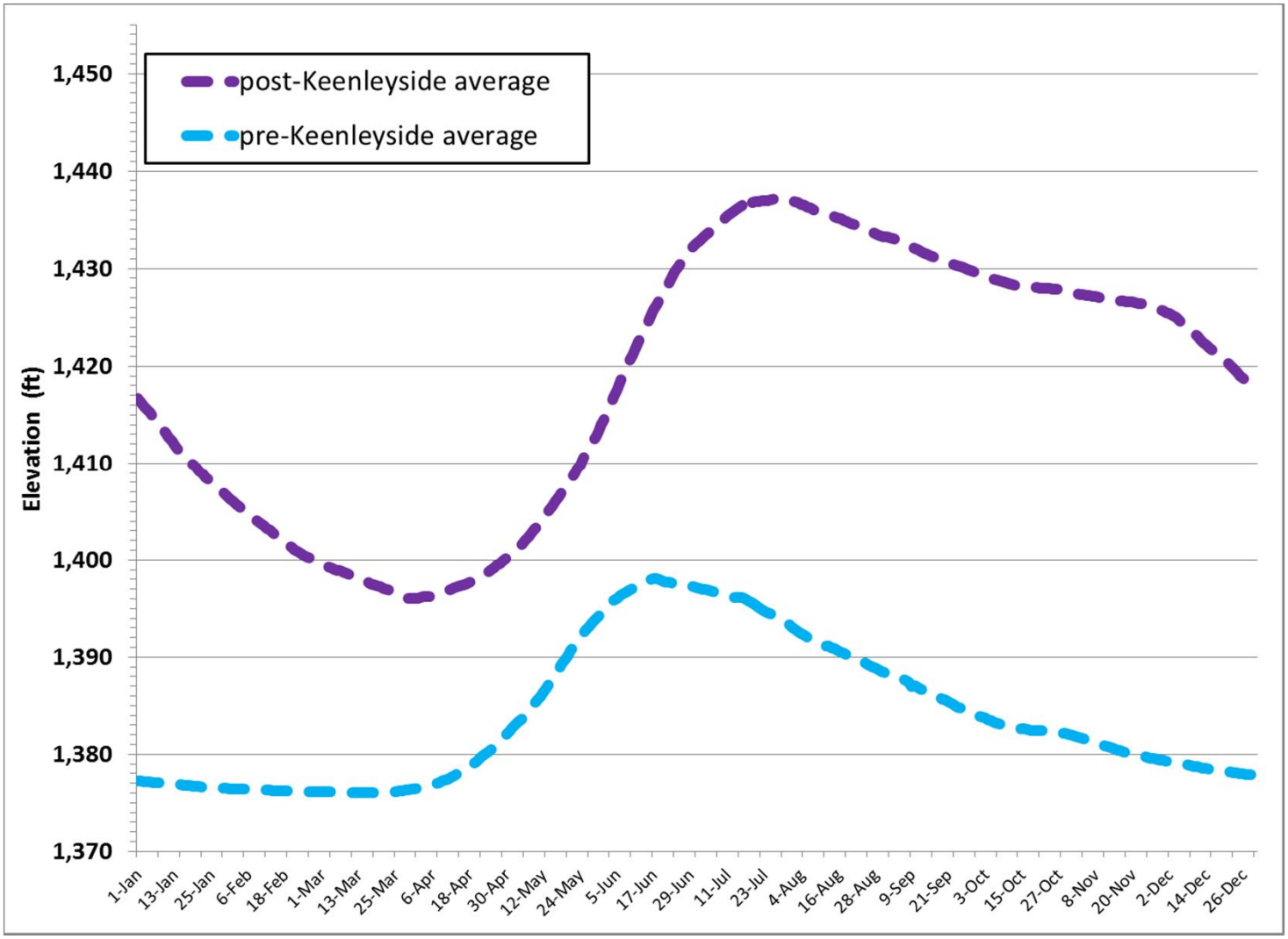

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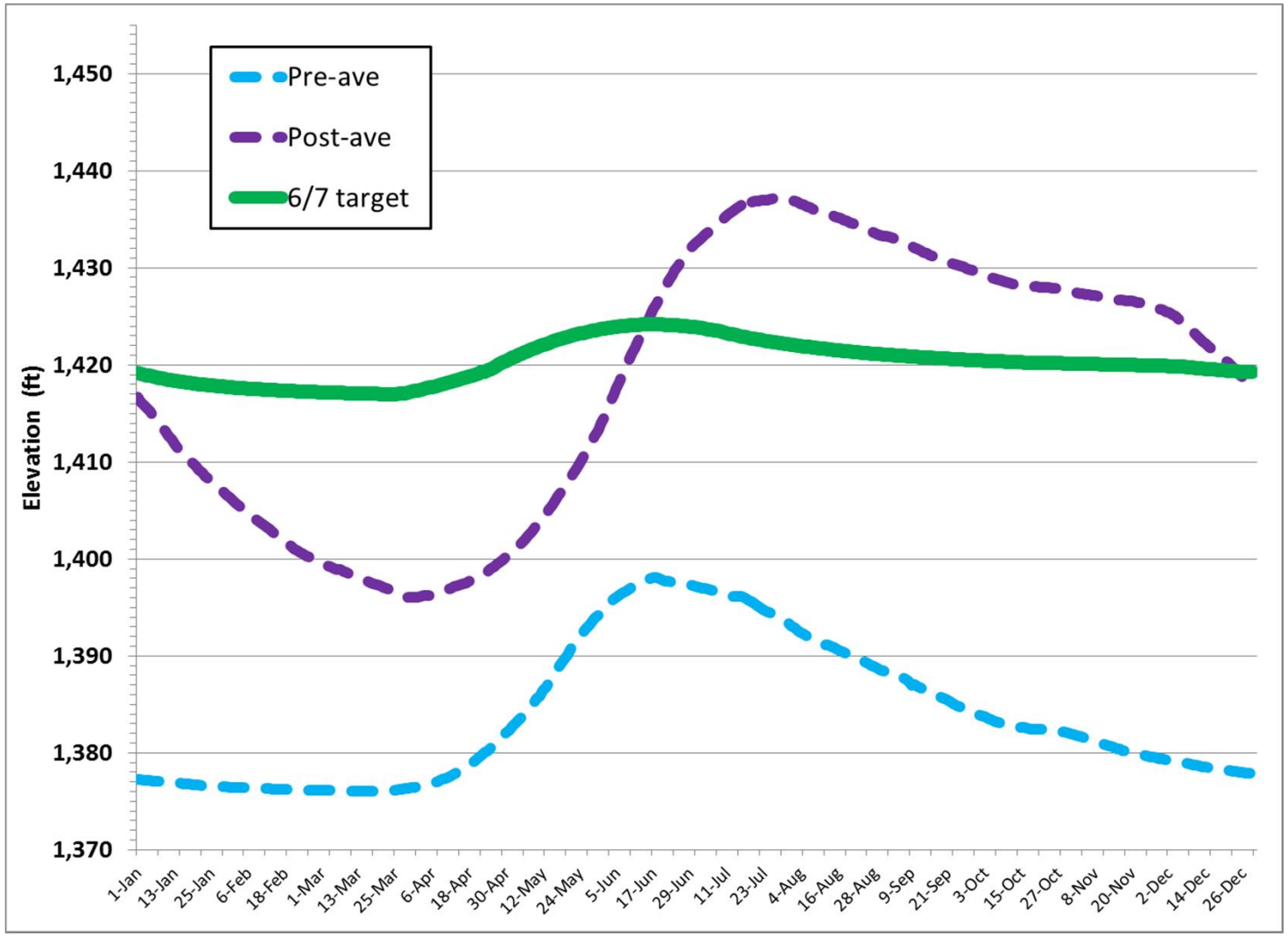

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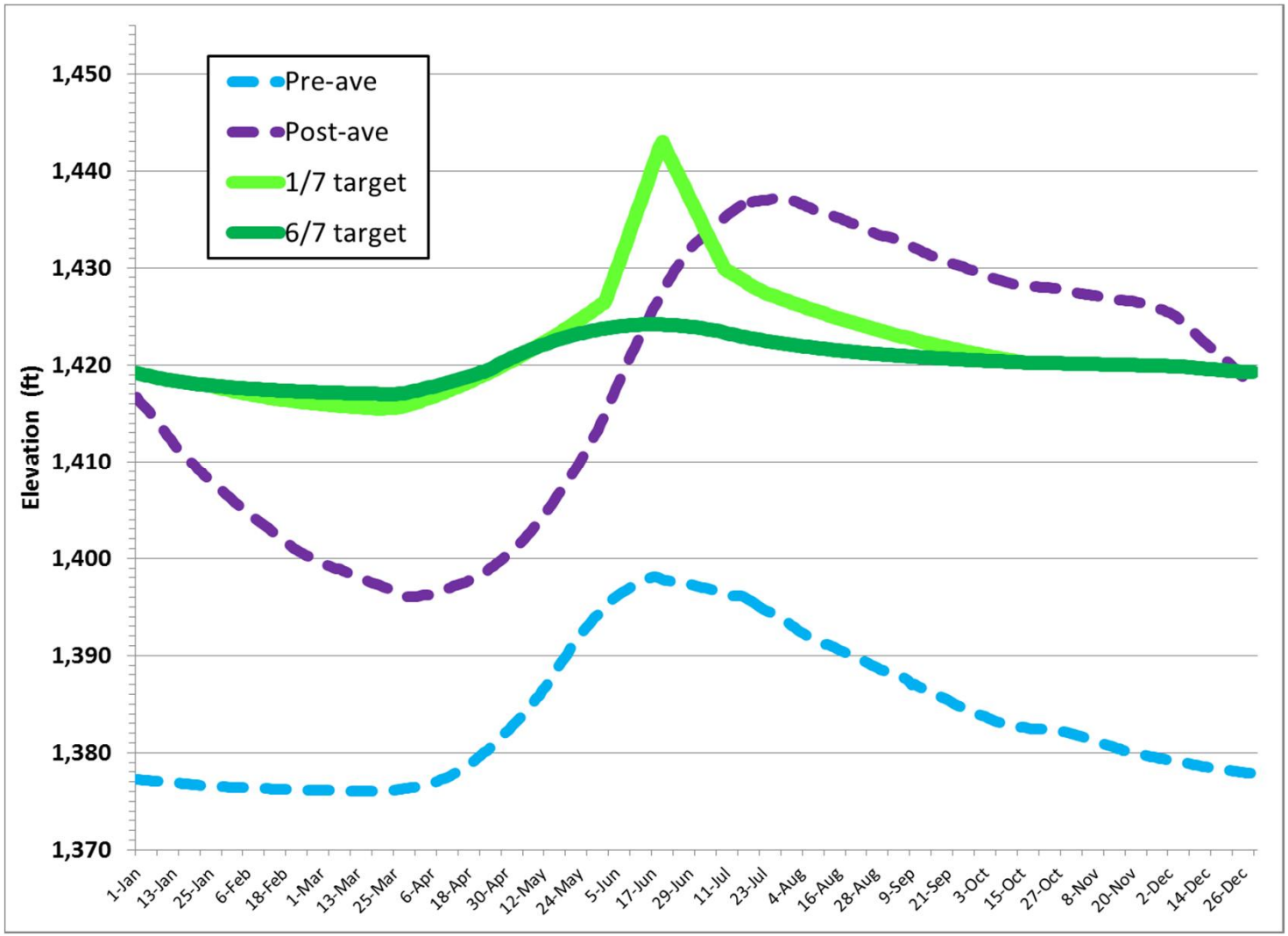

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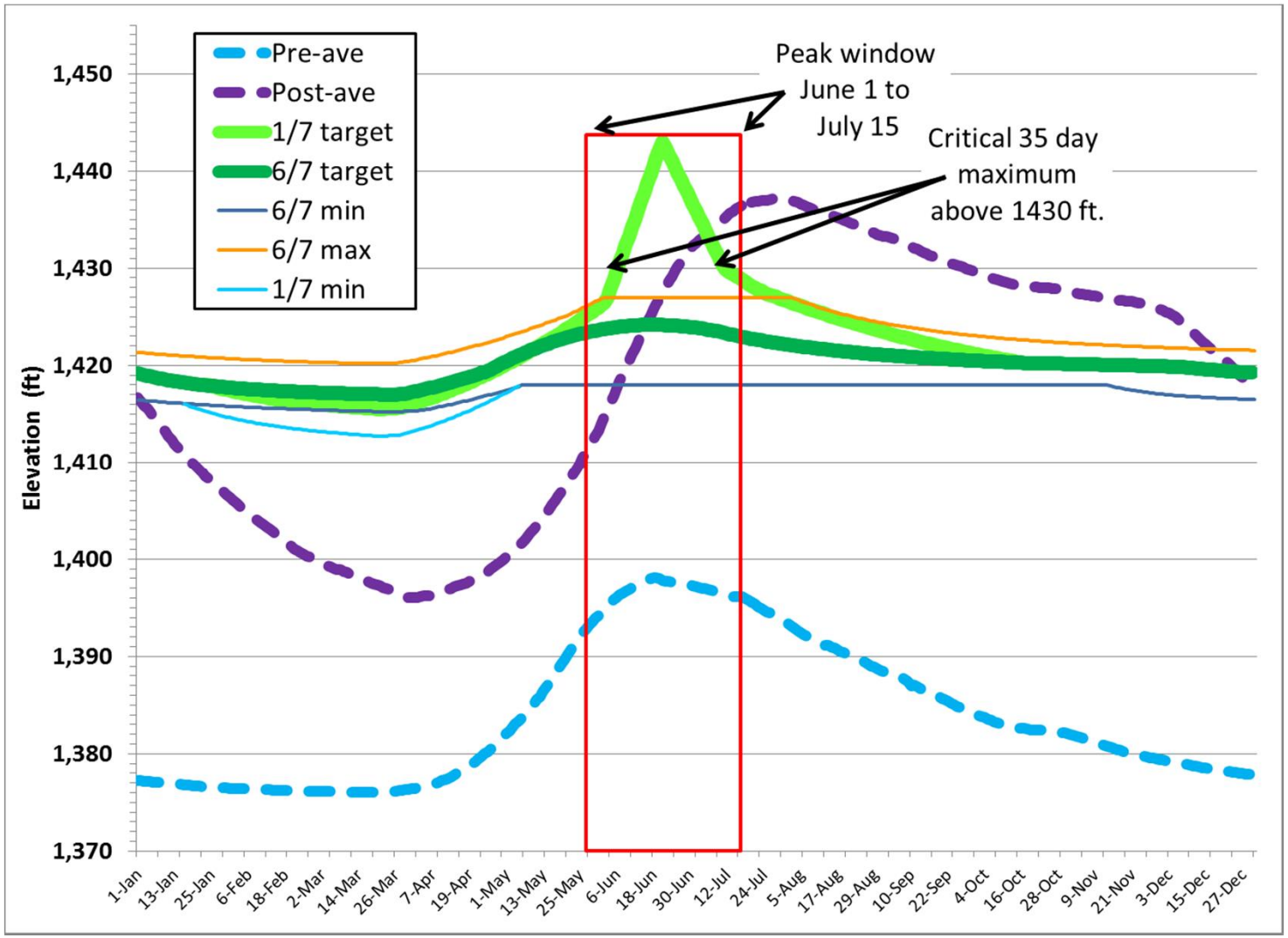

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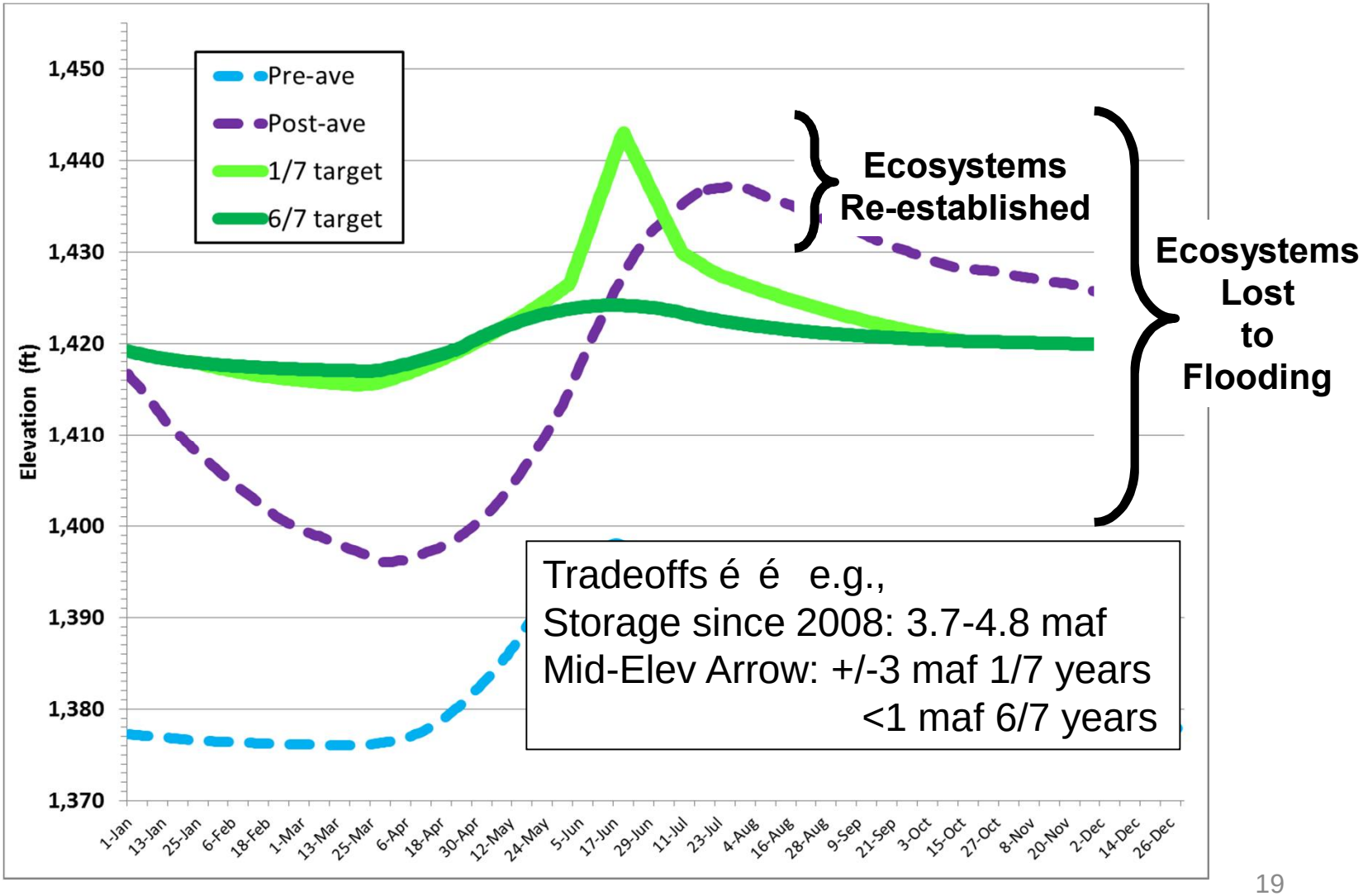
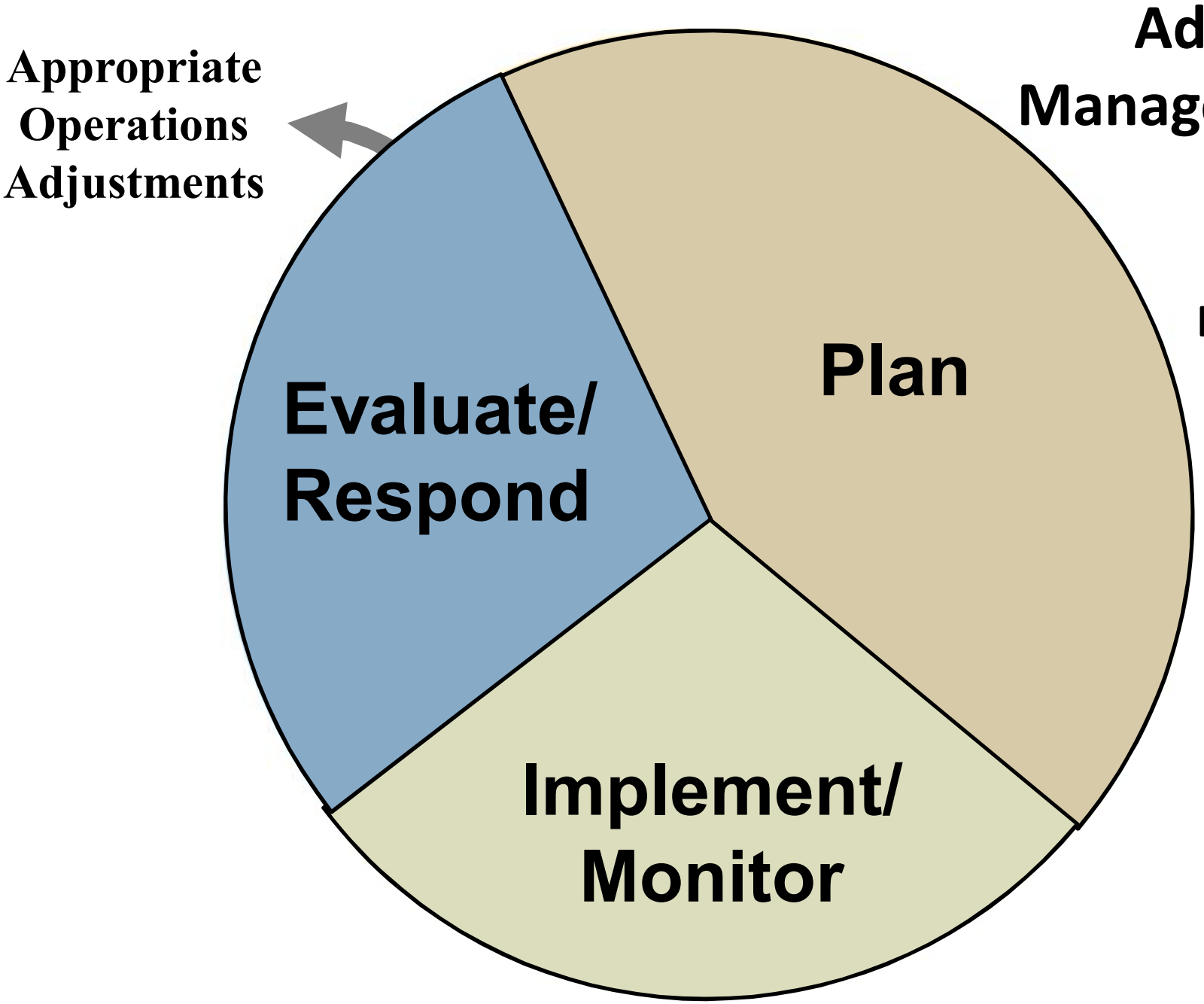


Adaptive Management Cycle

An Example

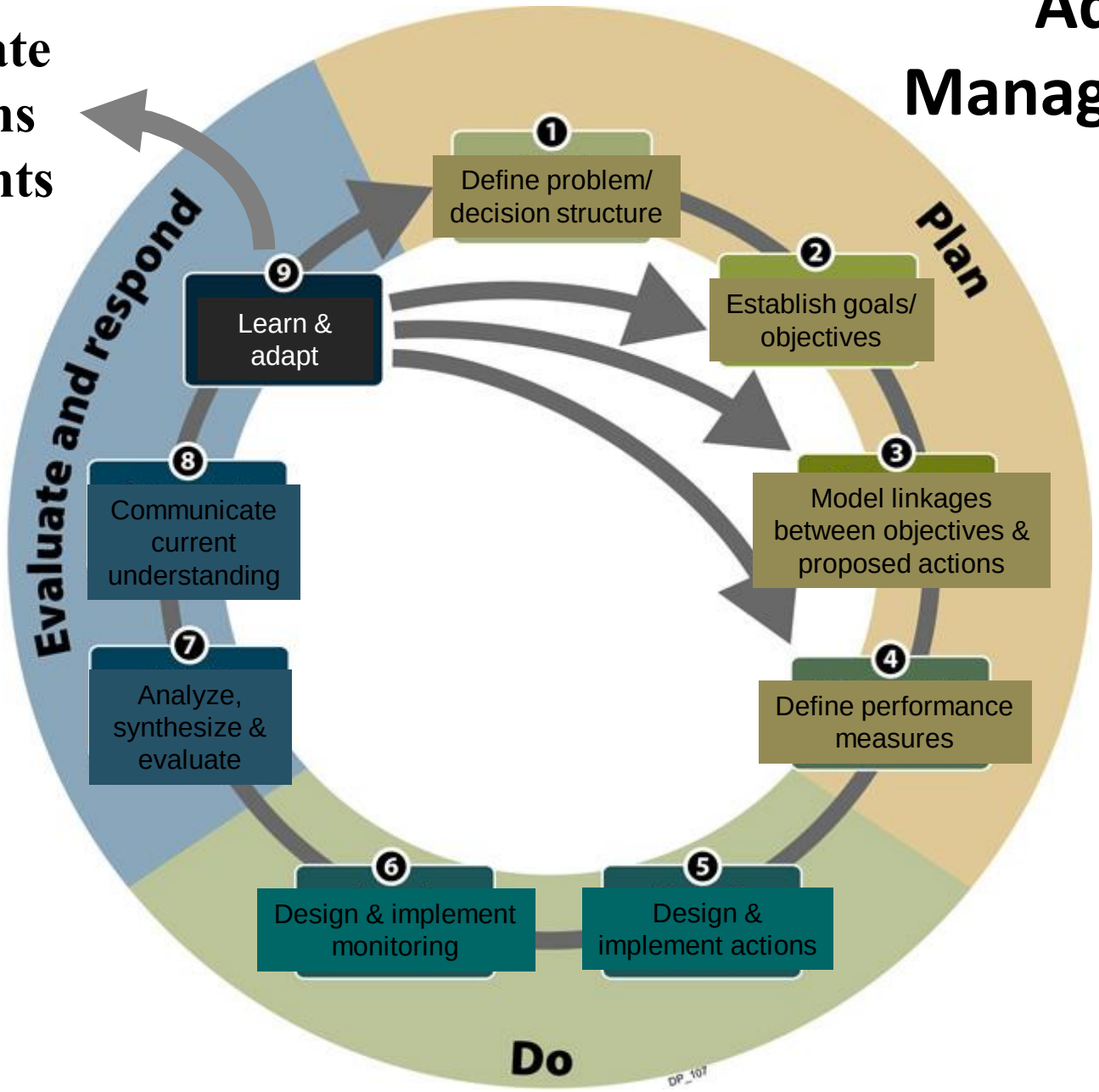


Asapted from: The Sacramento-San Joaquin River Delta Plan - Government of California http://deltacouncil.ca.gov/delta-plan-0

Adaptive Management Cycle

An Example

Appropriate Operations Adjustments



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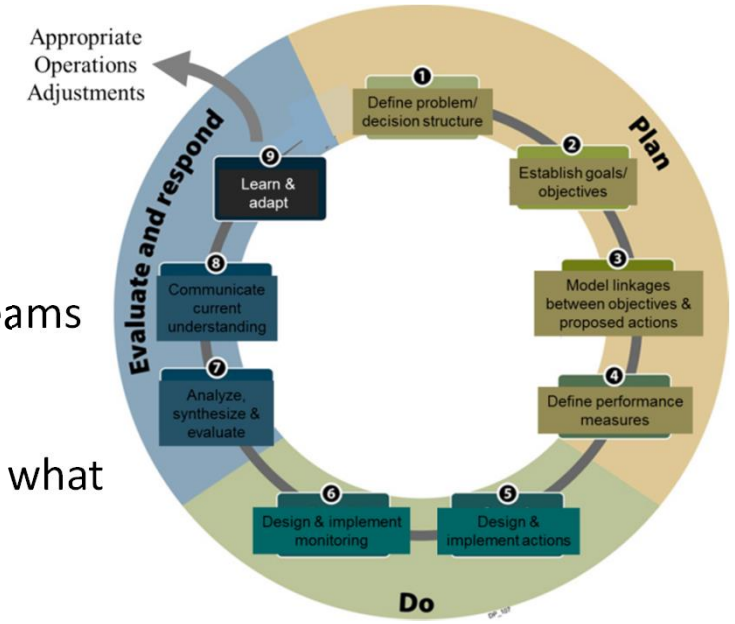
Mid Elevation Arrow Example



1. **Problem** – lost habitats – terrestrial/wetland/streams
   Decision Structure – CRT entities/ BC Gov.
2. **Objectives** – restore lost habitats and agriculture
3. **Objectives/Actions** – investigations/ modeling of what operations hinder habitat restoration
4. **Performance Measures** – re-vegetation, stream channel stability, storage impacts
5. **Action** – Limit flooding in upper 2m to once in seven years and <35 days (alternatives in other reservoirs - different durations, different periodicity?)
6. **Monitoring**
   - **Reservoir:** periodic vegetation plots, stream channel assessments, reservoir productivity, reservoir fish populations, recreation use, agriculture opportunities
   - **Downstream:** river channel changes, flow regimes, loss of flood storage, power production
7. **Analysis** - how many plots re-vegetated, species in plots, growth, stability of steam channels
8. **Communication of Results** - to public and decision-makers
9. **Adaption** – Long-term changes to reservoir management?

“Times have changed – no longer is our goal sustainable development …. our goal must now be sustainable survival”

Blackstock 2008, p.15

“We have options, but the past is not one of them”

Sauchyn and Kulshreshtha 2008, p.295

Links to studies available at:
http://www.kootenayresilience.org/columbia-river-treaty