Planning for the Future: Utilizing Habitat and Climate Modeling to Prioritize Restoration Actions for Salmonids

City of Portland- BES

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Columbia Slough

Upstream Extent of Evaluation Area

Downtown Portland

Johnson Creek

Tryon Creek

Challenges and opportunities- urban streams

- Runoff from paved areas
- Degradation of riparian zones
- Noise/ light pollution
- Development of floodplain and groundwater sources
- Tiling and channelization
- Culverts/ dams
- Climate change

- Restoration of riparian areas
- Habitat reconnection
- Floodplain expansion
- Channel reconfiguration
- Culvert removals and repairs

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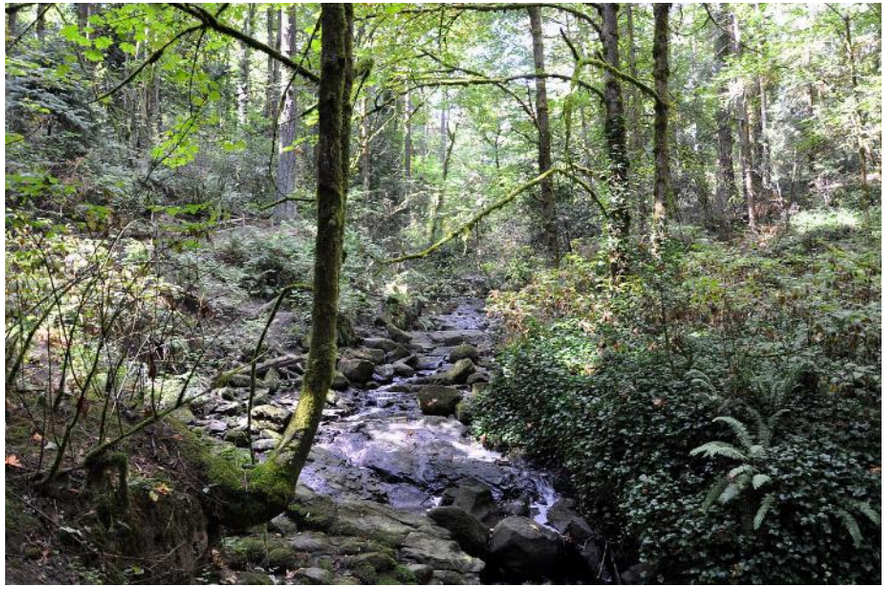
“The creation of a thousand forests is in one acorn”
— **Ralph Waldo Emerson**



Ecosystem modeling and evaluation

Evaluation of habitat for Salmon Safe certification, restoration planning, and stormwater system planning

Utilized Ecosystem Diagnosis and Treatment (EDT) for Johnson Creek and Tryon Creek

Examined countervailing effects of climate change and maturing restoration actions throughout watersheds over time

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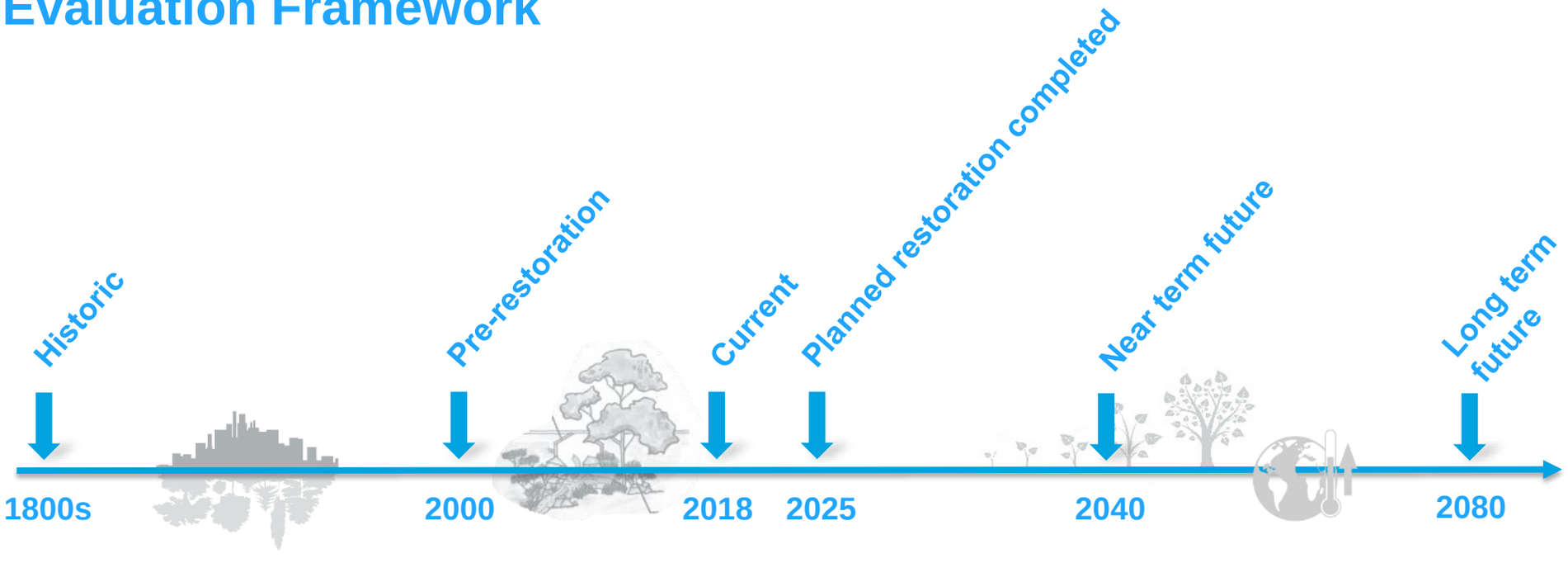
Evaluation Framework



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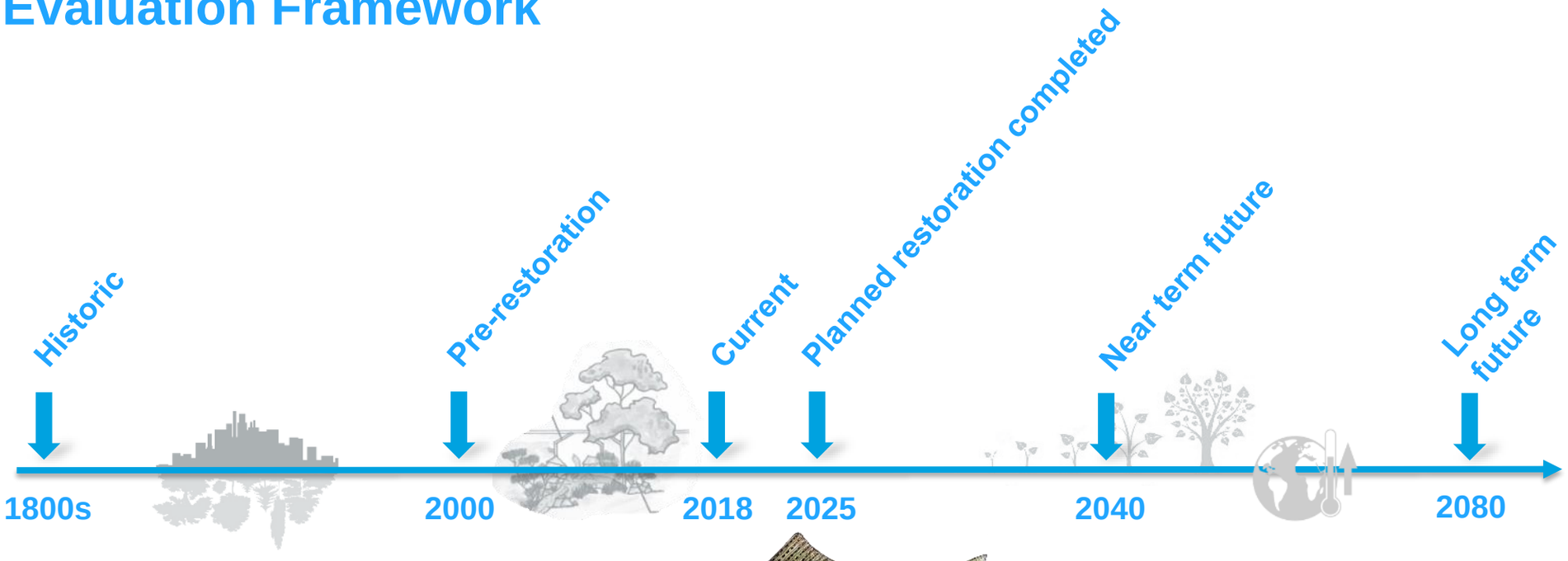

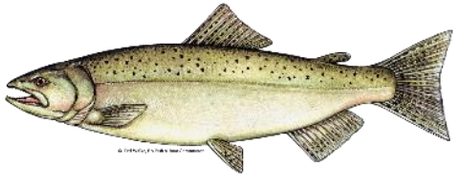

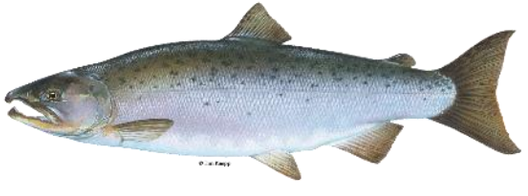

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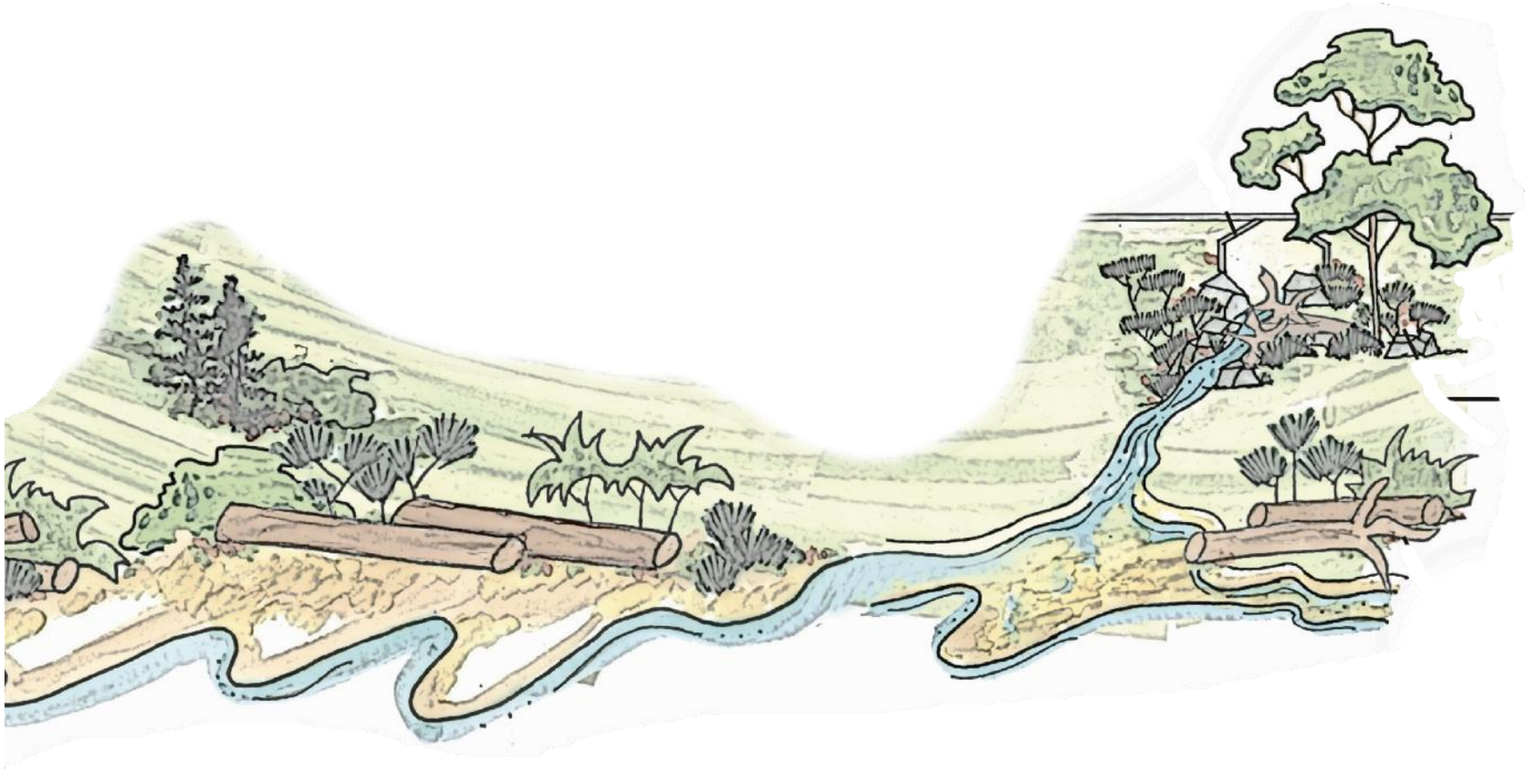
Overview of the Model



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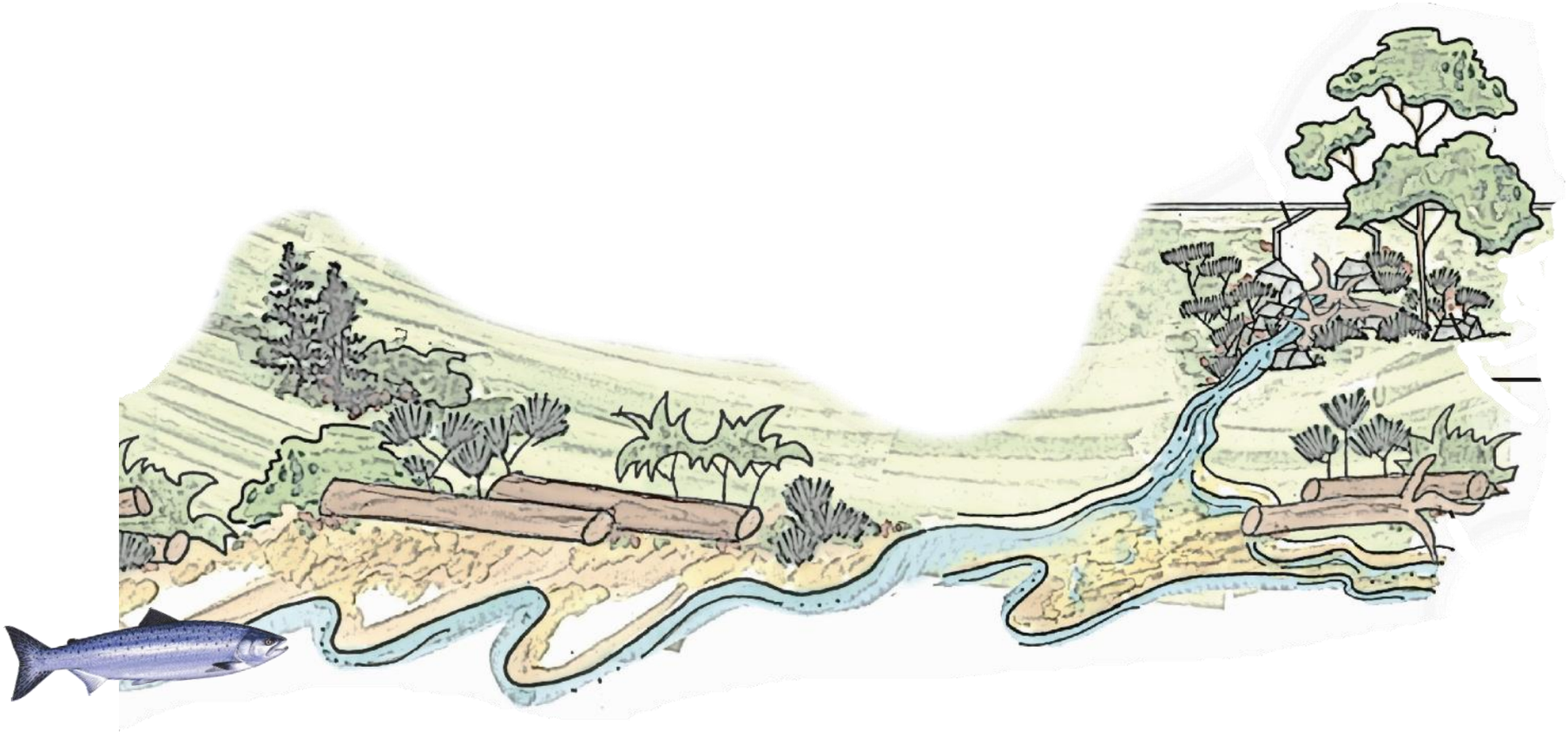

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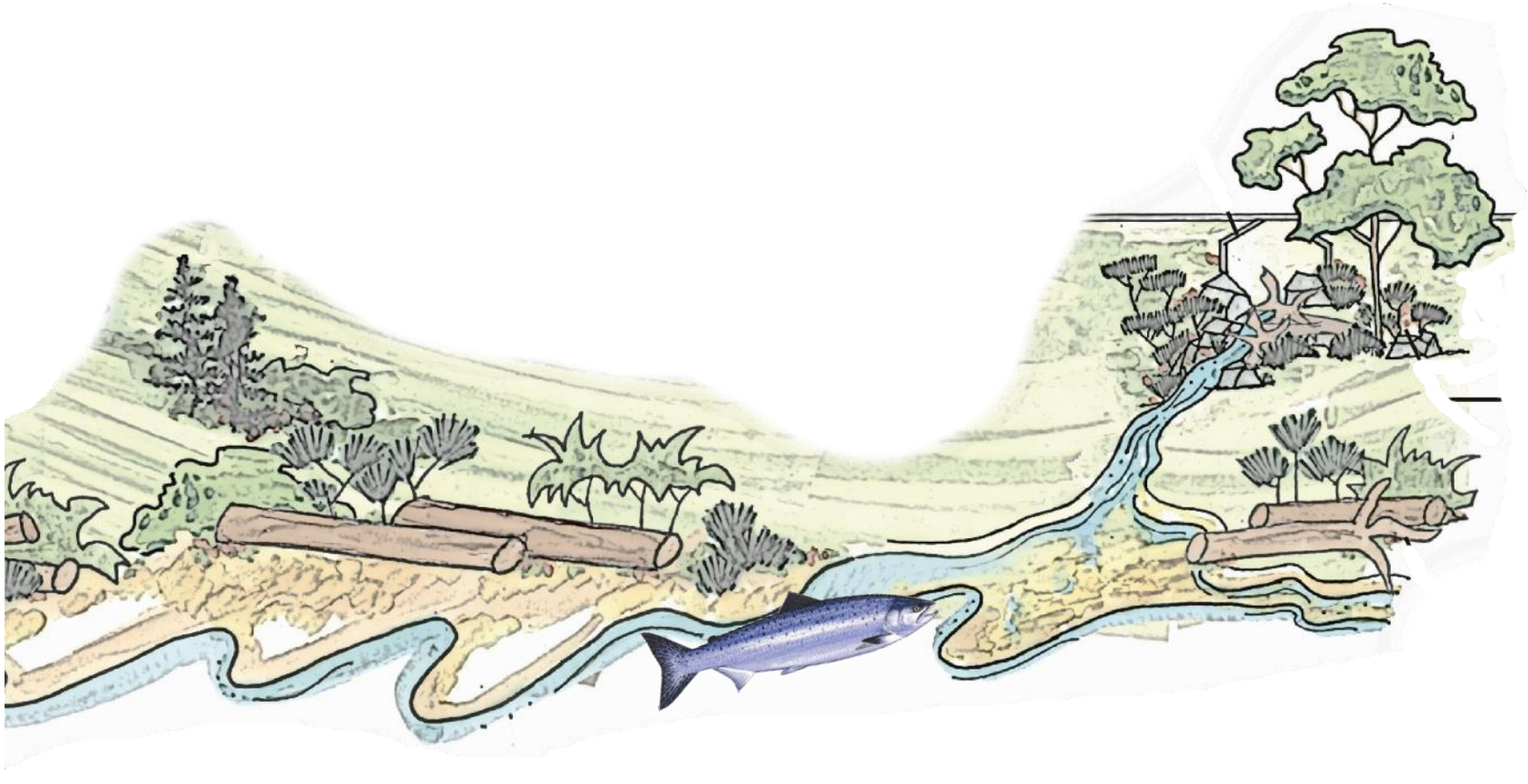

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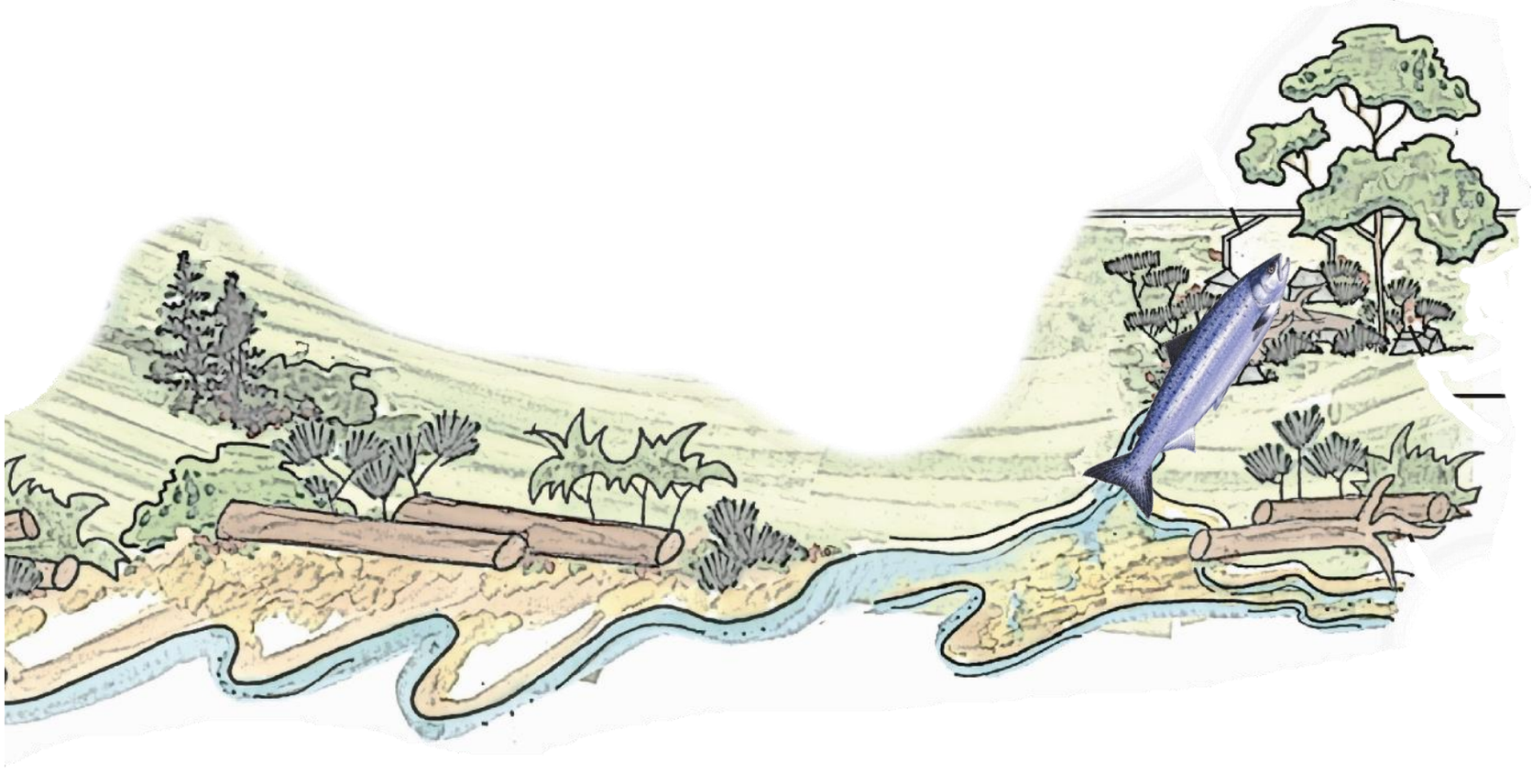

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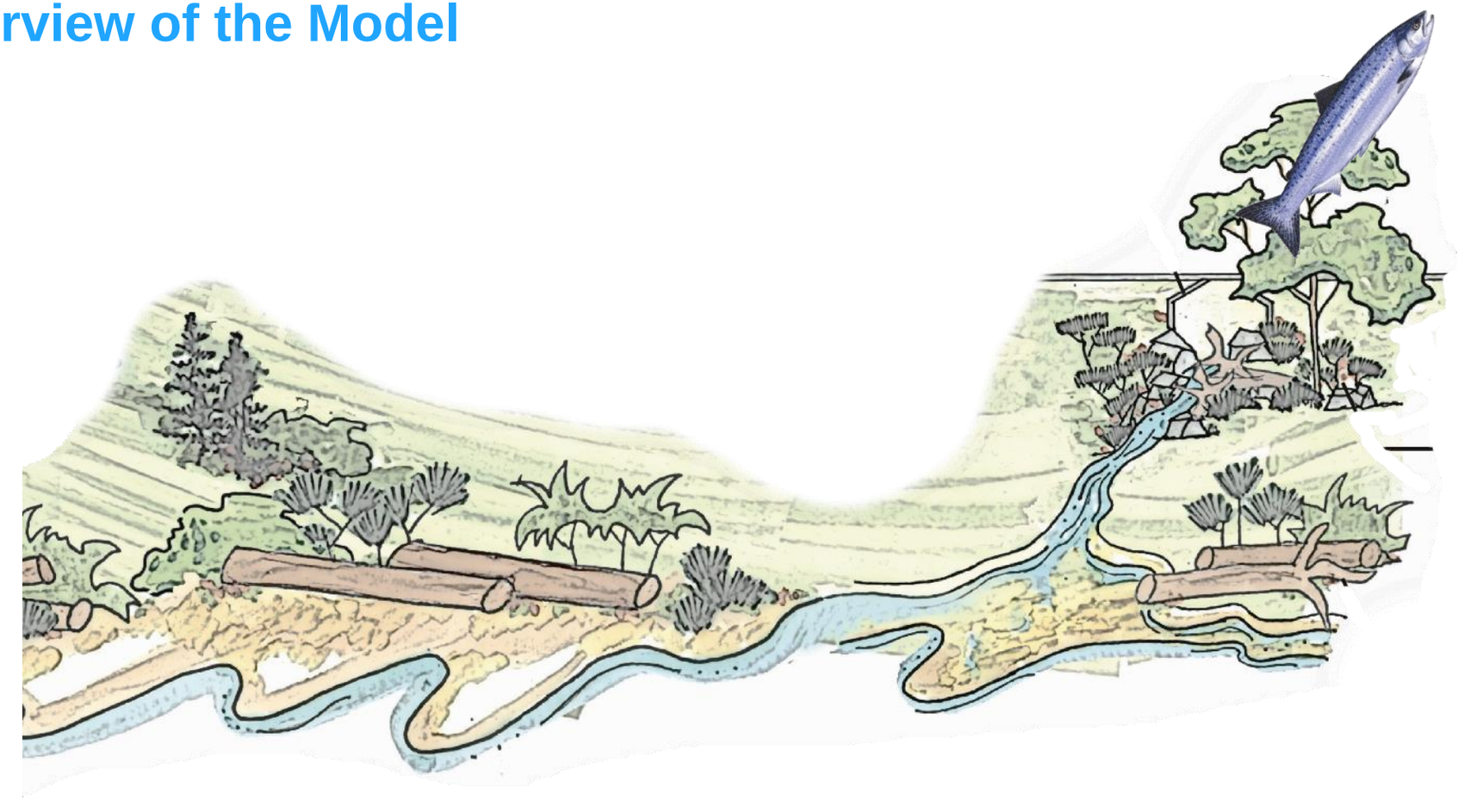

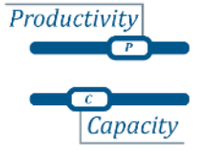

SYSTEM GEOMETRY

- Connectivity
- Length
- Obstructions

HABITAT ATTRIBUTES

- Vary by reach, month, and scenario
- Dozens of environmental attributes

Aggregation of attributes by reach and month into survival factors

LIFE HISTORIES

- Spawning locations
- Timing of life stage transitions
- Speed
- Thousand of "trajectories" sampling the environment

Trajectories continue to move through system: survival, growth, and capacity limited by environmental conditions

RULES

Survival factors (such as channel stability, temperature, sediment load, etc.) degrade benchmark productivity and/or capacity by life stage.

BENCHMARKS

- *Maximum density fish/m² per life stage and species*
- *Benchmark survival per life stage*
- *Benchmark growth factor per life stage*

EQUILIBRIUM ABUNDANCE

Overall system equilibrium abundance, and capacity and productivity.

EDT- **Ecosystem Diagnosis and Treatment-** framework

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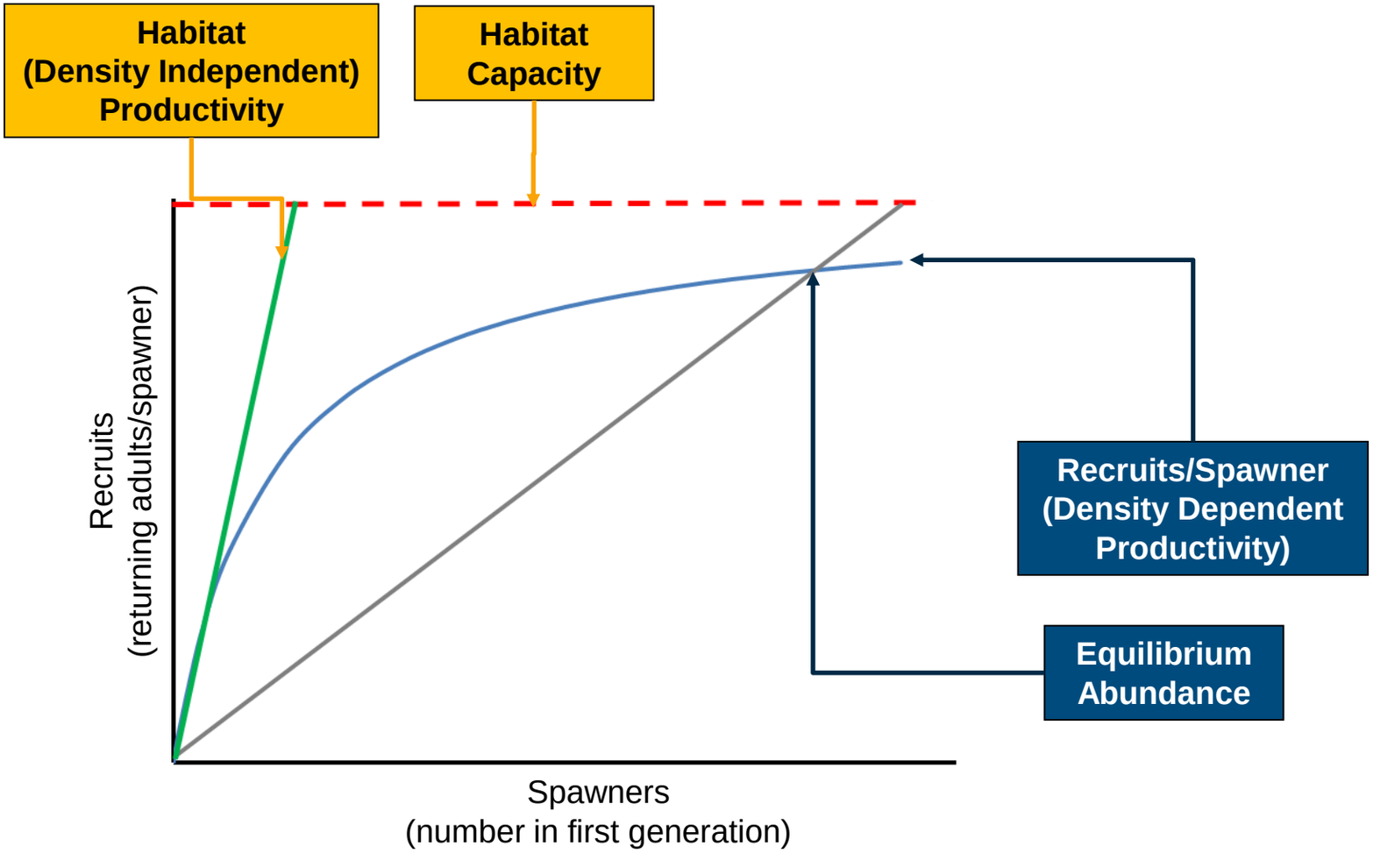
The Beverton-Holt Function



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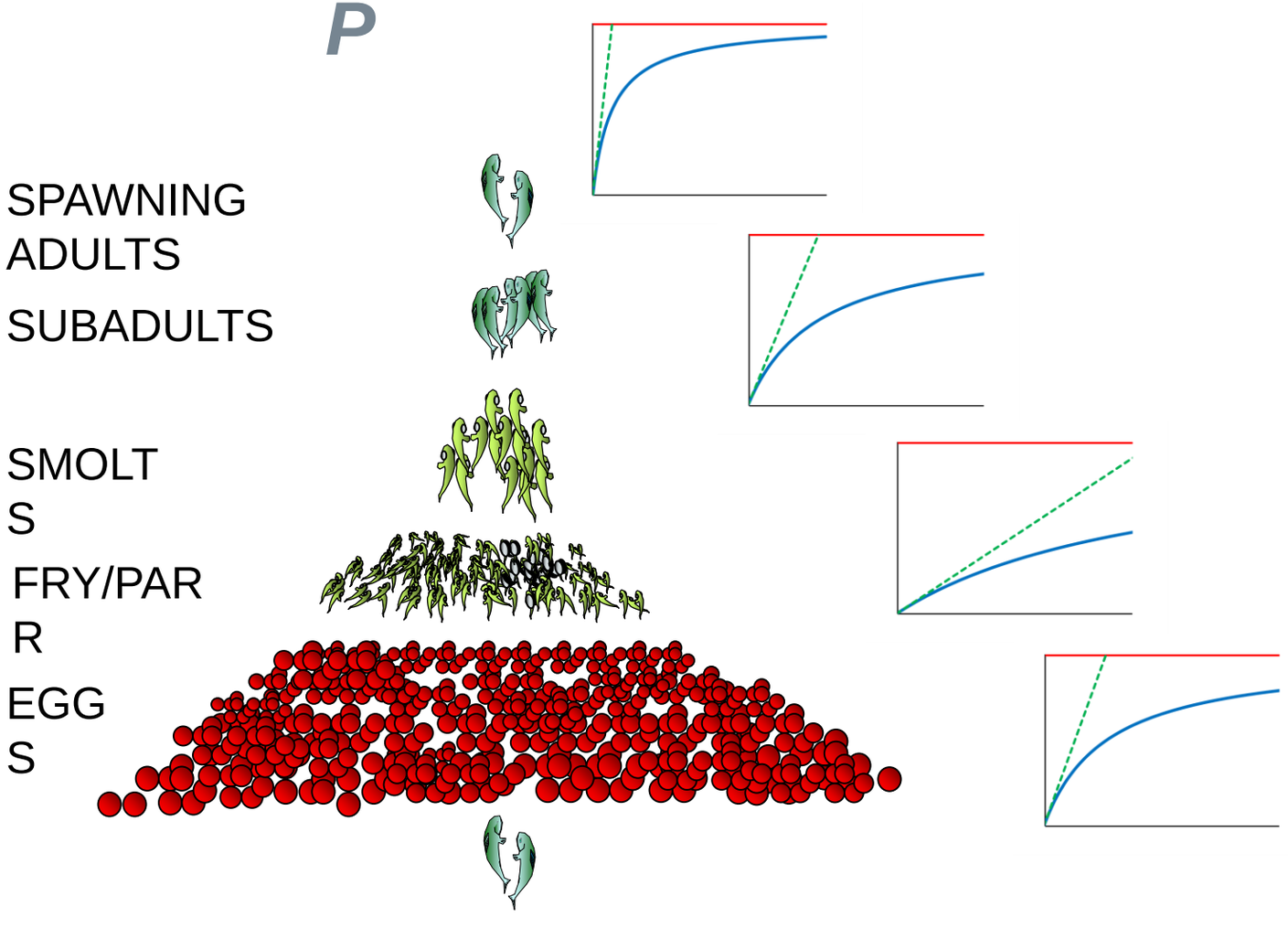
Aggregate Life Stage *P* = Population



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Future conditions (2040-2080)

- Temperature Modeling (USFS Boise Lab STARS-SSN tools—Isaak et al)
- Input (GIS)
  - Empirical water temperature data (PAWMAP, USGS)
  - Empirical air temperature data (PRISM—Oregon State)
  - Shade estimated from canopy coverage (LiDAR top hit)
- Prediction (R Tools)
  - Water temperature estimated using shade, catchment, elevation, and future air temperature.
  - Air temperature from downscaled climate modeling, 2040 and 2080 RCP 8.5

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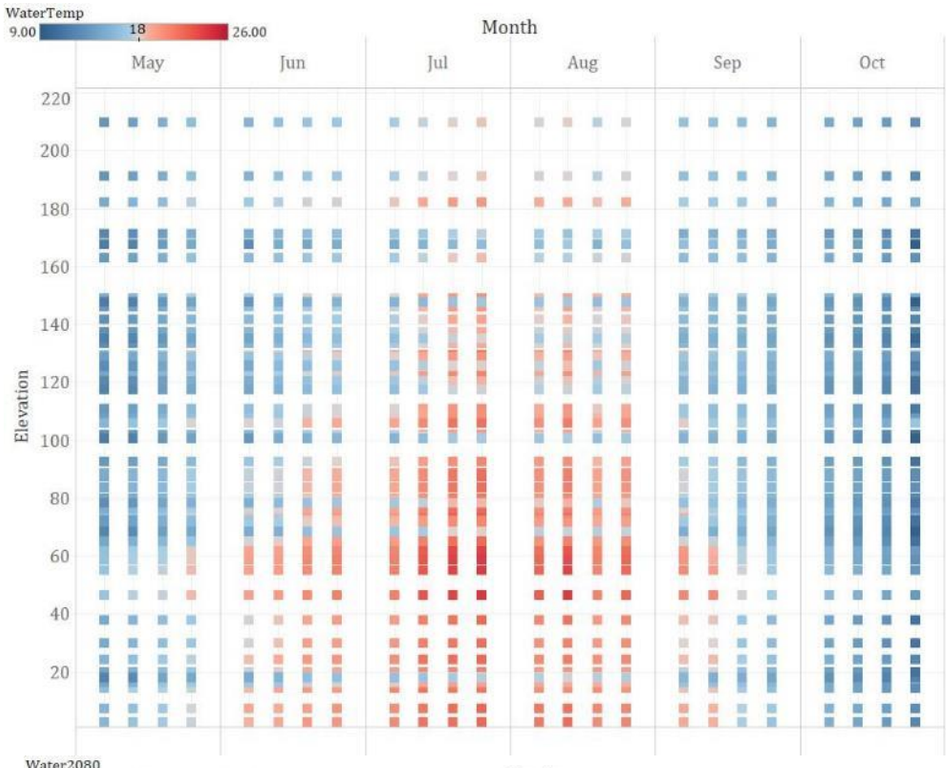
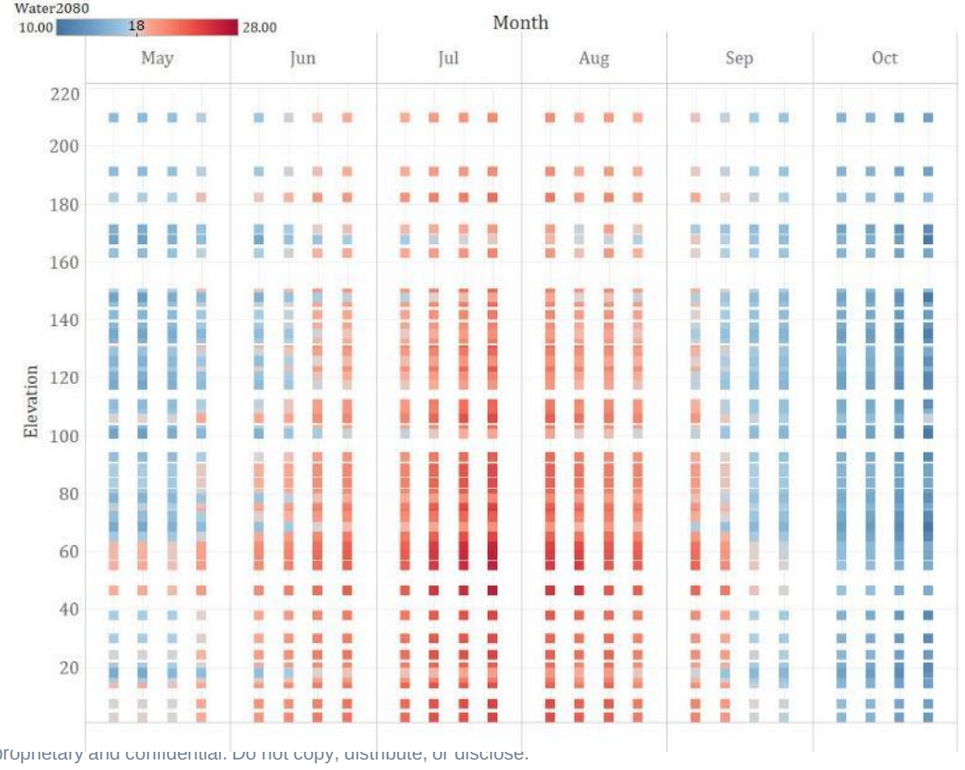


Johnson-Current



Johnson-2080

Climate Change

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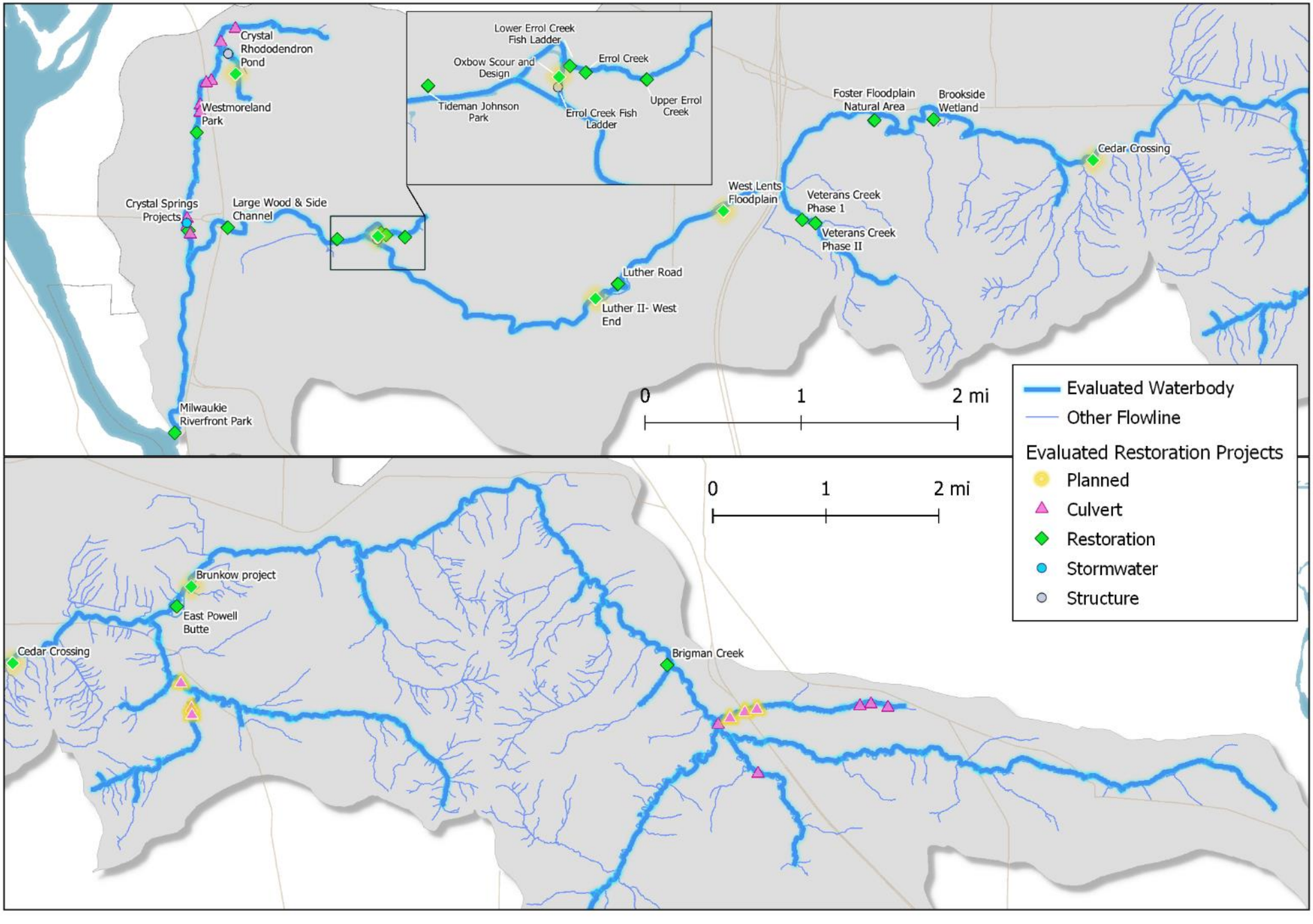
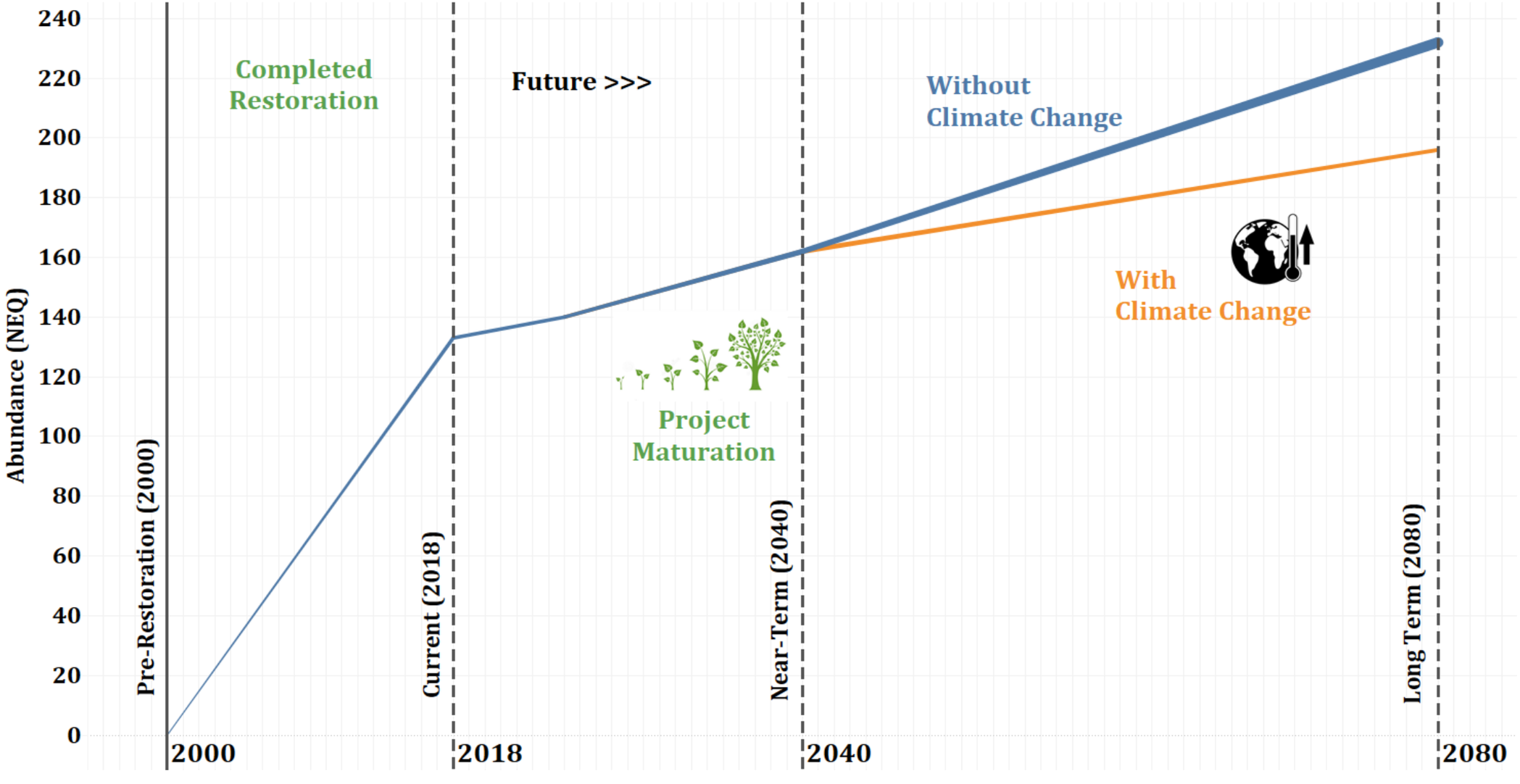

Crystal Rhododendron Pond
Westmoreland Park
Crystal Springs Projects
Large Wood & Side Channel
Milwaukie Riverfront Park
Lower Errol Creek Fish Ladder
Oxbow Scour and Design
Errol Creek
Tideman Johnson Park
Errol Creek Fish Ladder
Upper Errol Creek
West Lents Floodplain
Luther Road
Luther II- West End
Foster Floodplain Natural Area
Brookside Wetland
Cedar Crossing
Veterans Creek Phase 1
Veterans Creek Phase II
0
1
2 mi
Evaluated Waterbody
Other Flowline
Evaluated Restoration Projects
Planned
Culvert
Restoration
Stormwater
Structure
Brunkow project
East Powell Butte
Cedar Crossing
Brigman Creek

Results: Johnson Creek – Coho



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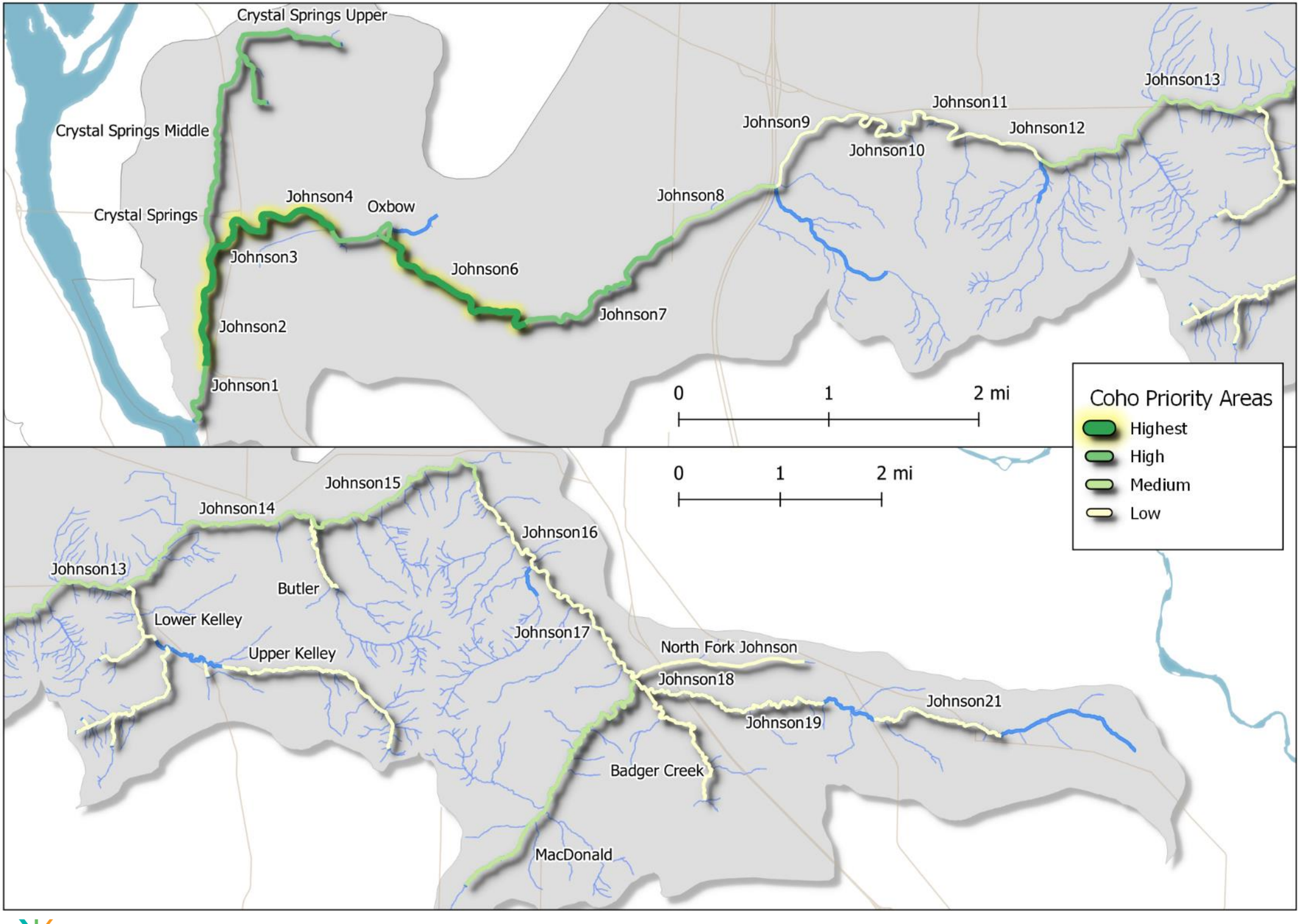

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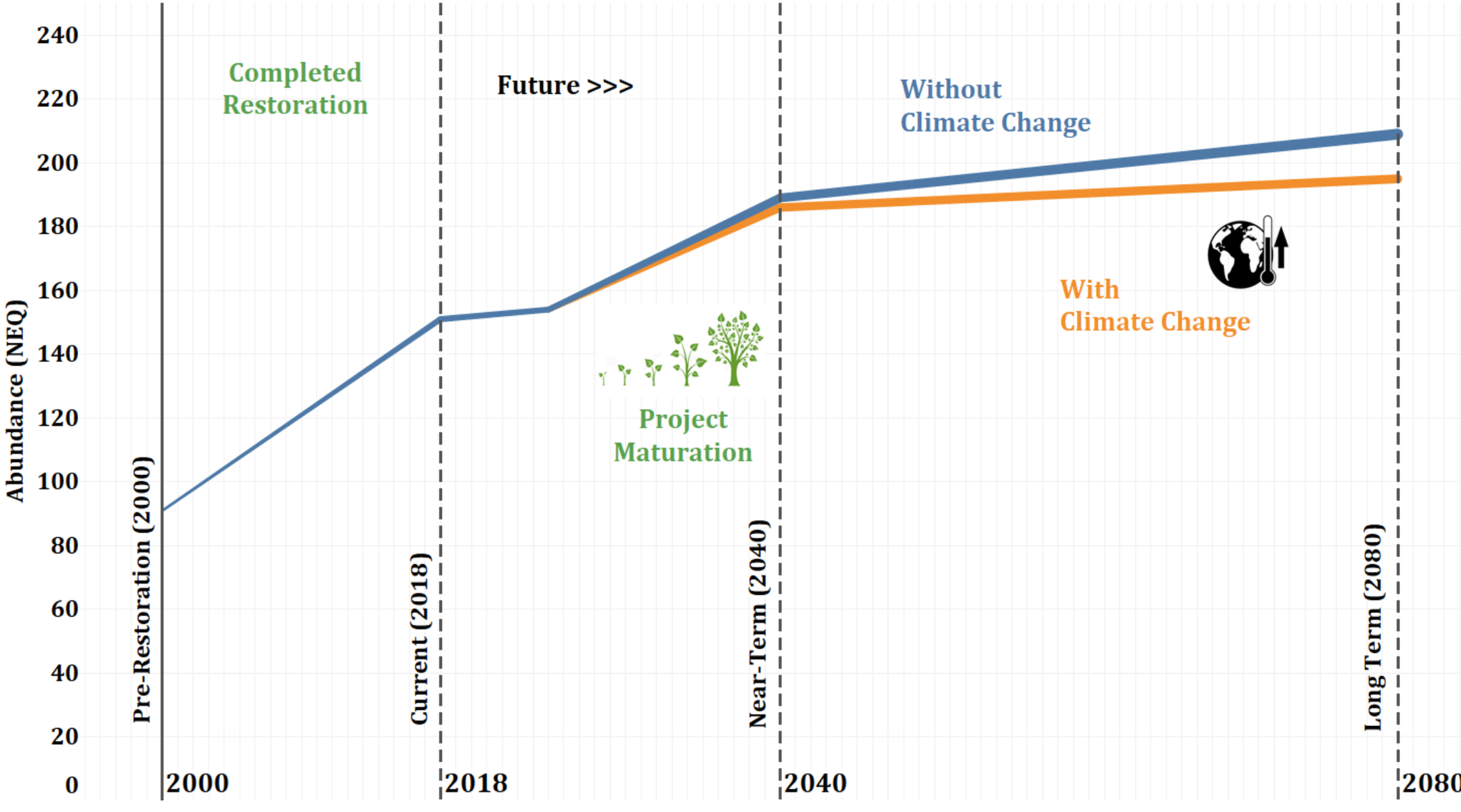
Results: Johnson Creek – Chinook



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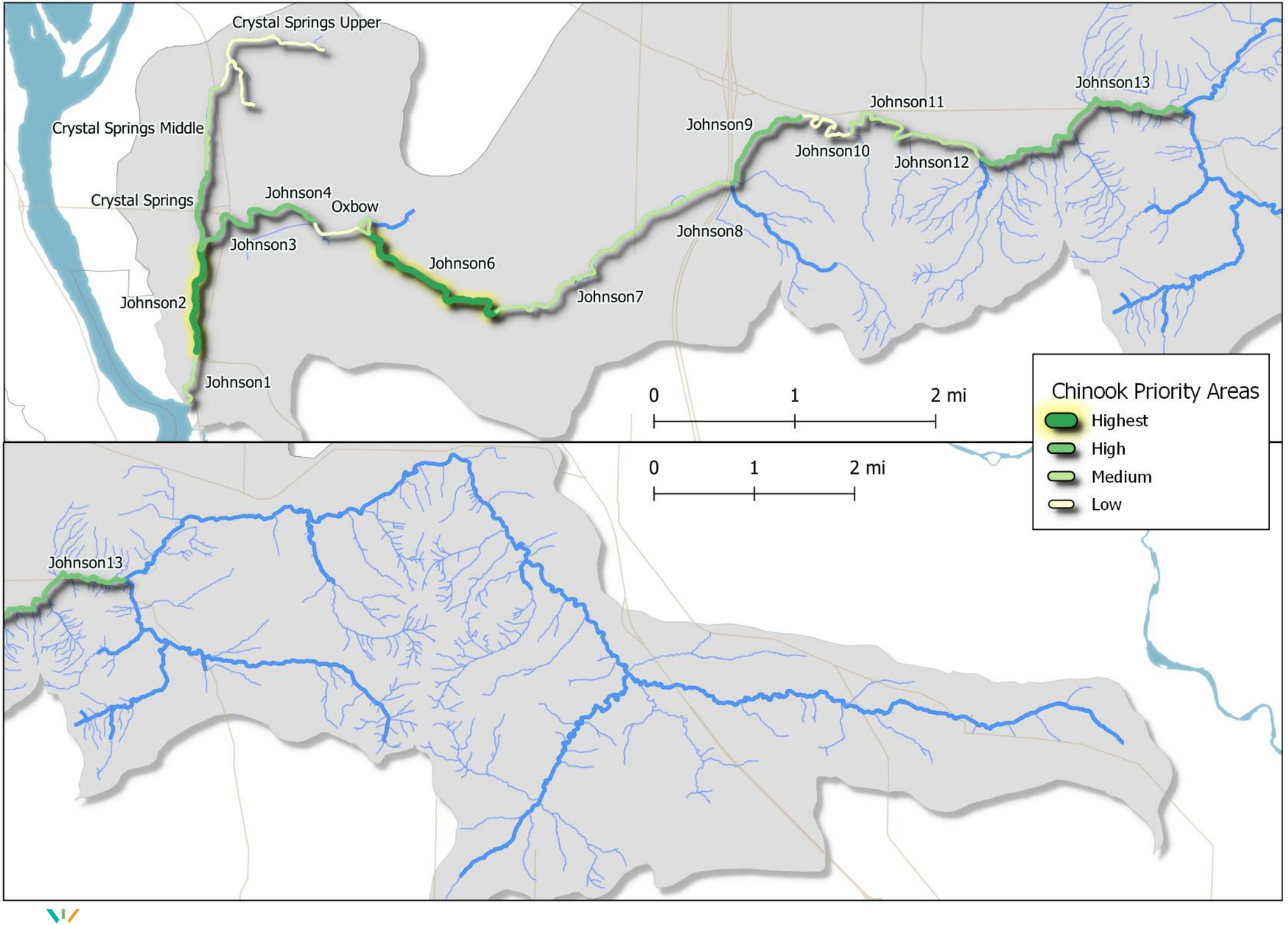
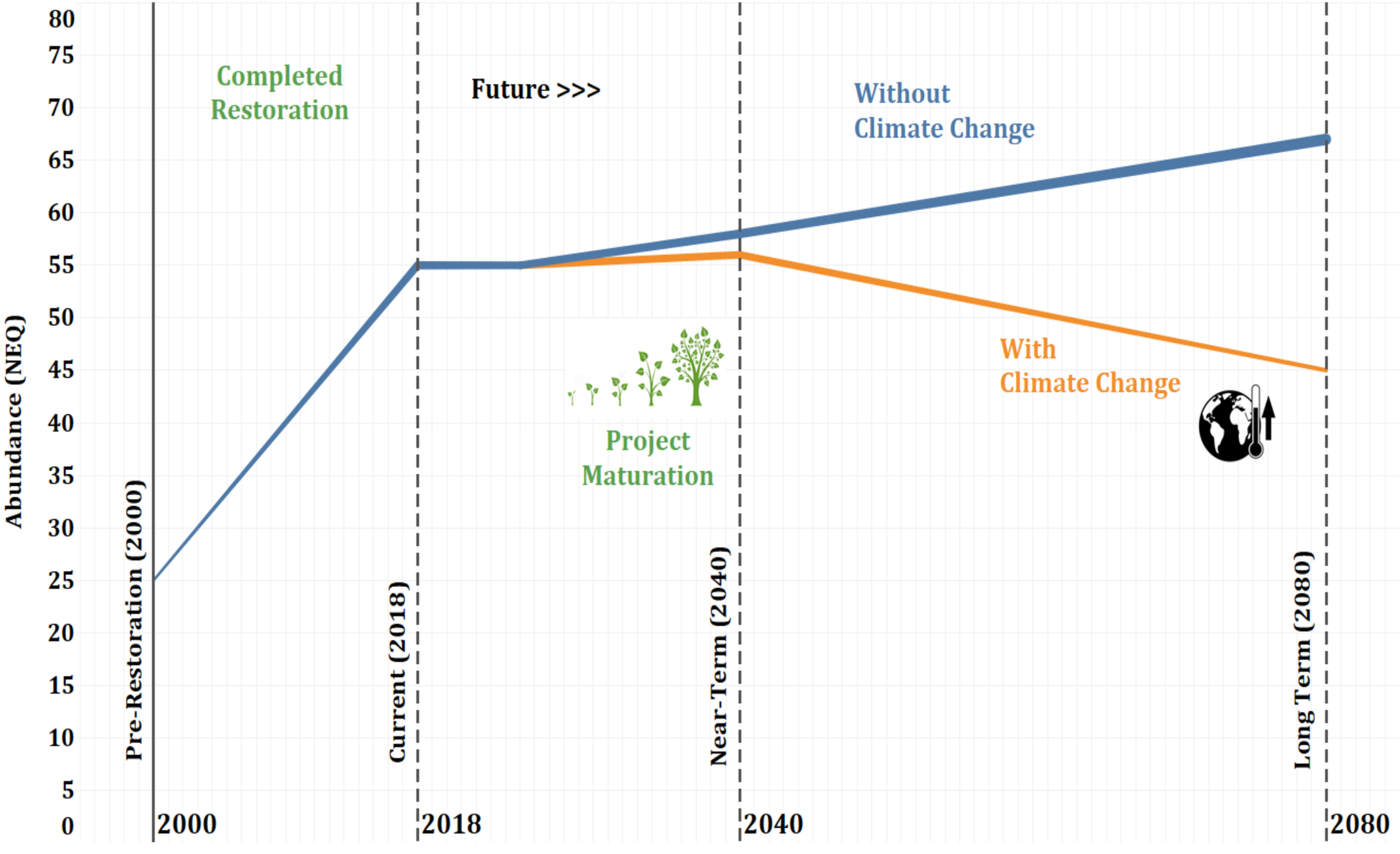

Crystal Springs Upper
Crystal Springs Middle
Crystal Springs
Johnson4
Oxbow
Johnson3
Johnson2
Johnson1
Johnson6
Johnson7
Johnson8
Johnson9
Johnson10
Johnson11
Johnson12
Johnson13
0
1
2 mi
Chinook Priority Areas
Highest
High
Medium
Low
Johnson13

Results: Johnson Creek – Steelhead



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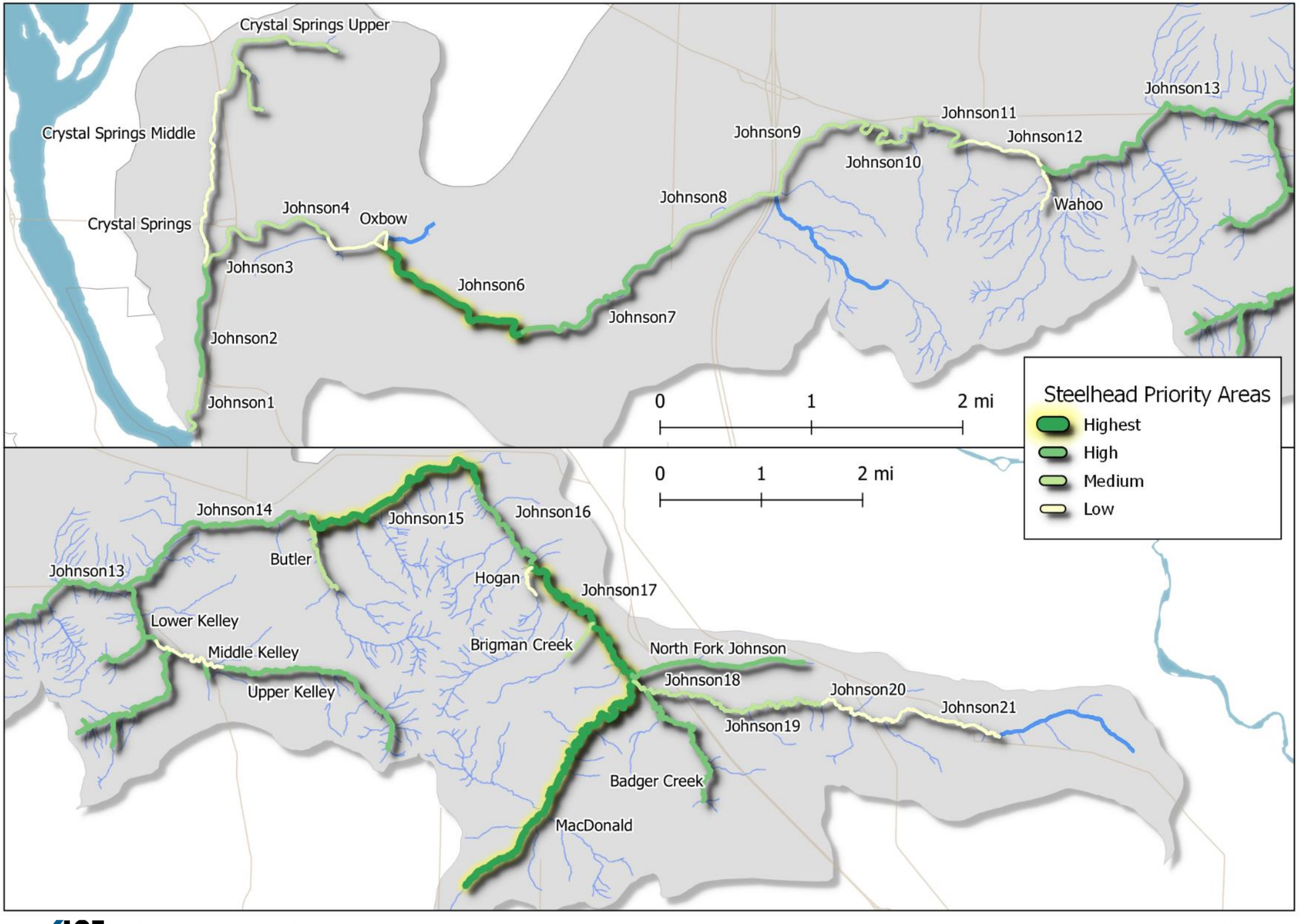
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Crystal Springs Middle
Crystal Springs
Johnson4
Oxbow
Johnson3
Johnson6
Johnson8
Johnson9
Johnson11
Johnson13
Johnson12
Johnson10
Wahoo
Johnson7
Johnson2
Johnson1
0
1
2 mi
Steelhead Priority Areas
Highest
High
Medium
Low
Johnson14
Johnson15
Johnson16
Butler
Johnson13
Hogan
Johnson17
Lower Kelley
Middle Kelley
Brigman Creek
North Fork Johnson
Johnson18
Johnson20
Johnson21
Upper Kelley
Johnson19
Badger Creek
MacDonald

Conclusions

- In Johnson Creek, greatest restoration potential for Chinook and Coho is in lower reaches, while greatest restoration potential for steelhead is in upper reaches

- Incorporating both climate change and restoration project maturation into urban planning provides more accurate information

- Addition of predicted future land and incorporation of additional data could provide useful information

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Acknowledgements

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