Budd Inlet, Capitol Lake, and Deschutes River TMDL

Briefing for Deschutes Advisory Group on *draft* scenarios

May 24, 2012

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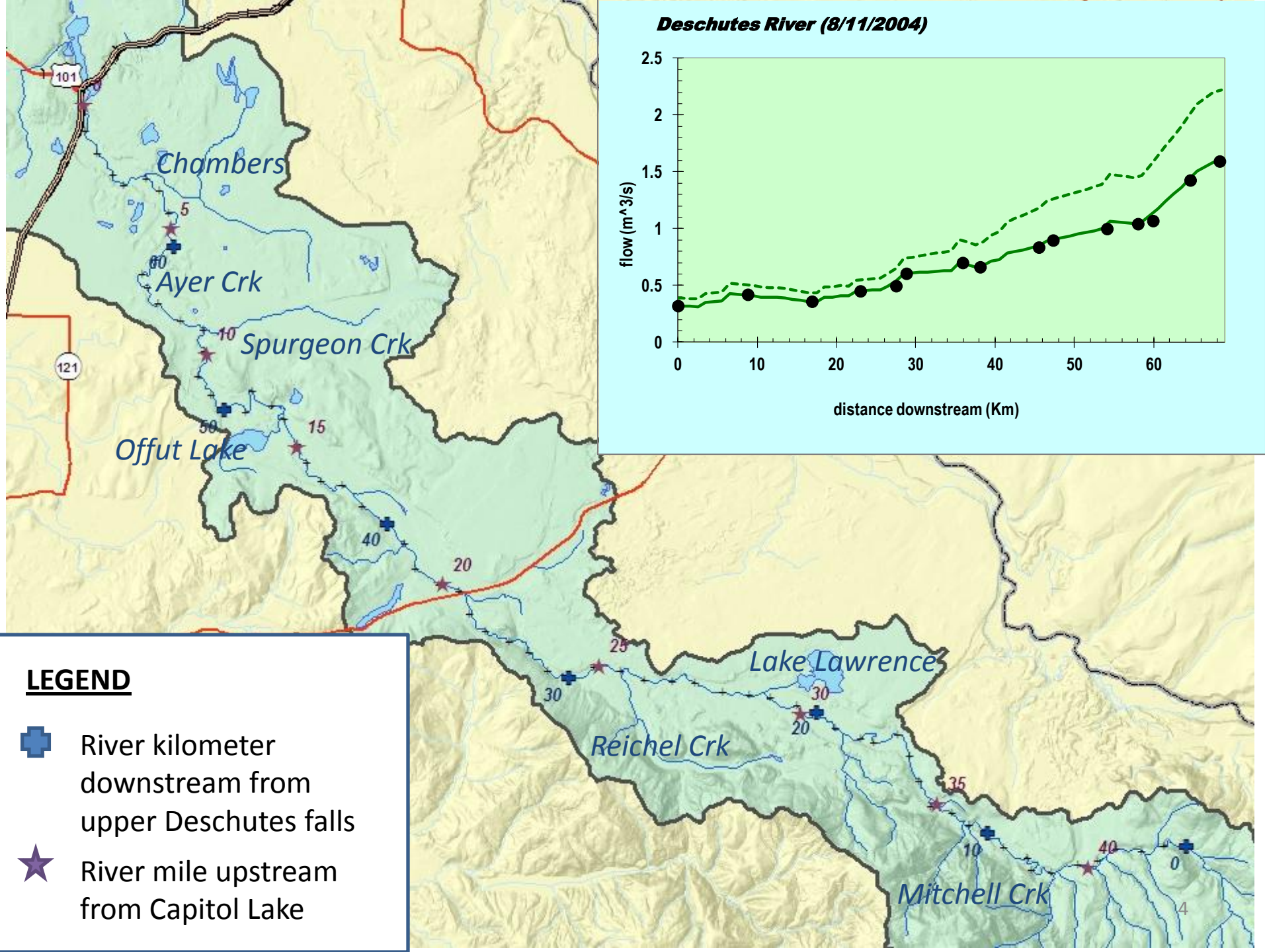
Purpose

- Provide *draft* results for scenarios
  - Identified by the Deschutes Advisory Group in September 2011
  - Clarified and ranked in order of analysis in March 2012
- Organized by water body
  - Deschutes River – Mindy
  - Capitol Lake – Anise
  - Budd Inlet (*some simple calculations*) – Mindy
- No feasibility or cost considerations

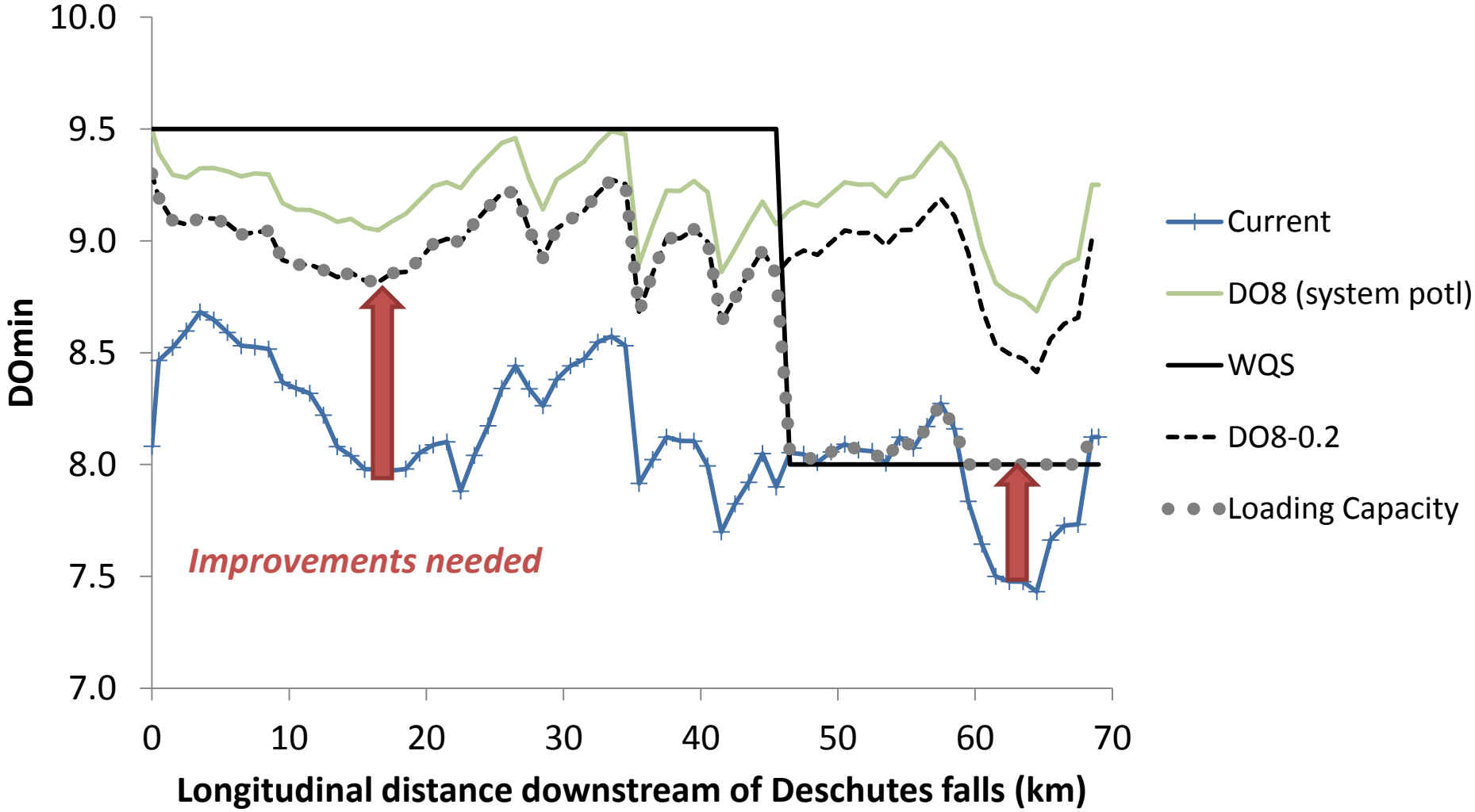
Deschutes scenarios

Starting point: what was in the technical report for DO and pH

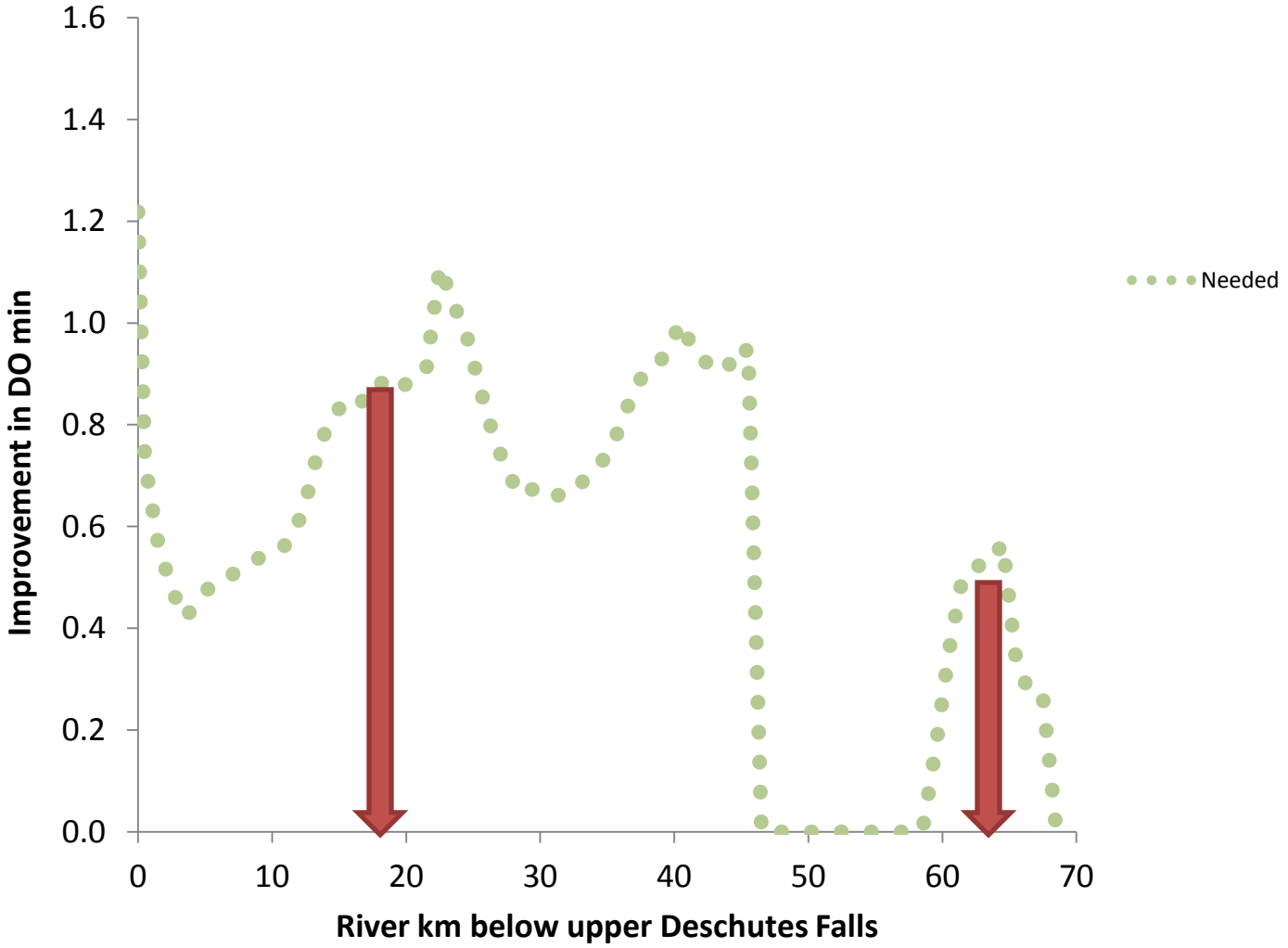
1. Reduce nonpoint phosphorus sources
2. Shift from septic systems to centralized WW
3. Evaluate potential land conversion
4. Increase nonpoint sources
5. Increase channel complexity
6. Reduce exempt wells and conserve water (*temperature done in technical report*)


Deschutes River (8/11/2004)
flow (m^3/s)
distance downstream (Km)
2.5
2
1.5
1
0.5
0
0
10
20
30
40
50
60
101
121
Chambers
Ayer Crk
Spurgeon Crk
Offut Lake
Lake Lawrence
Reichel Crk
Mitchell Crk
5
10
15
20
25
30
35
40
LEGEND
River kilometer downstream from upper Deschutes falls
River mile upstream from Capitol Lake

Technical Report – Current, system potential, and target DO



Technical Report scenarios – DOmin



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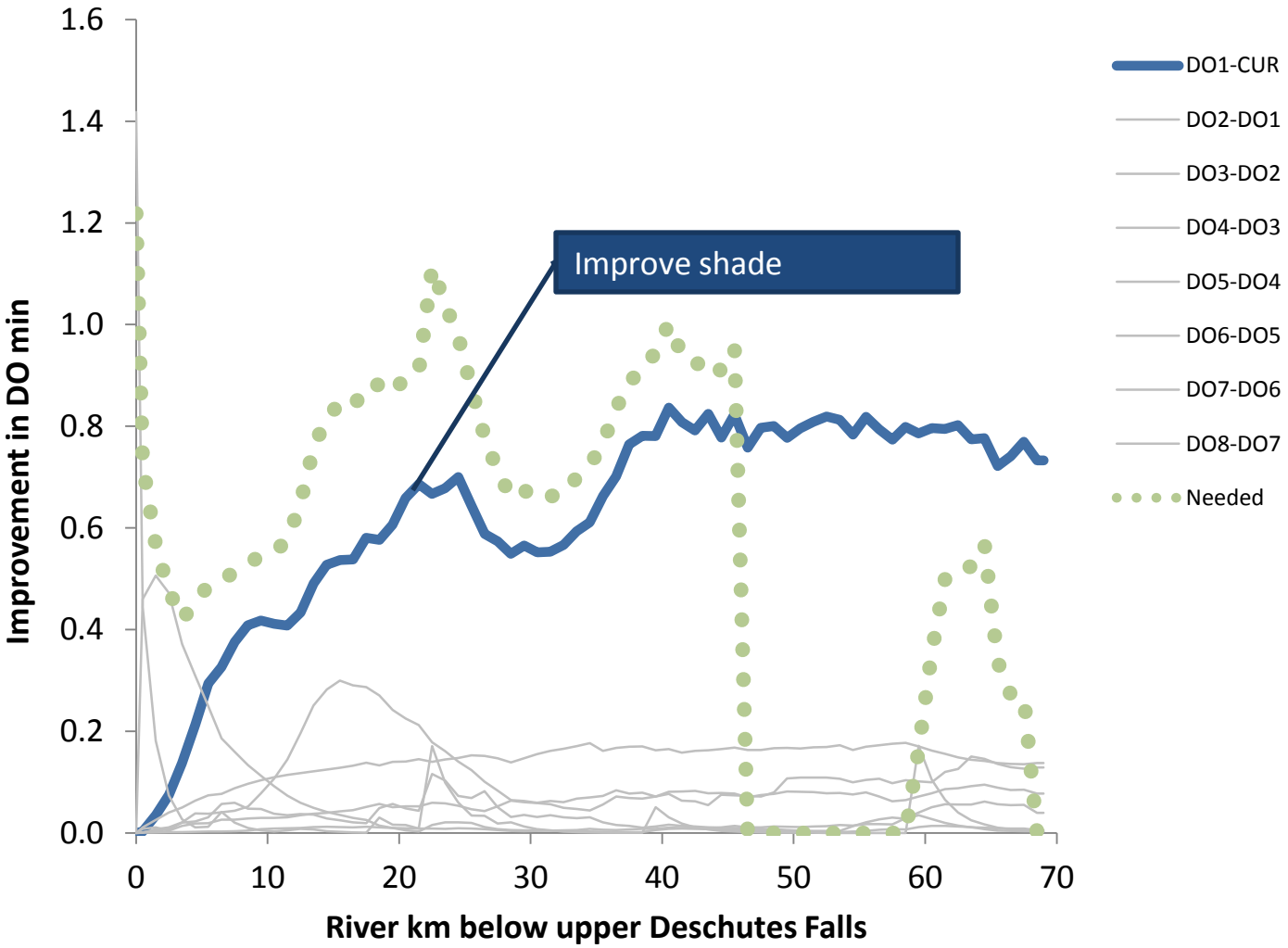

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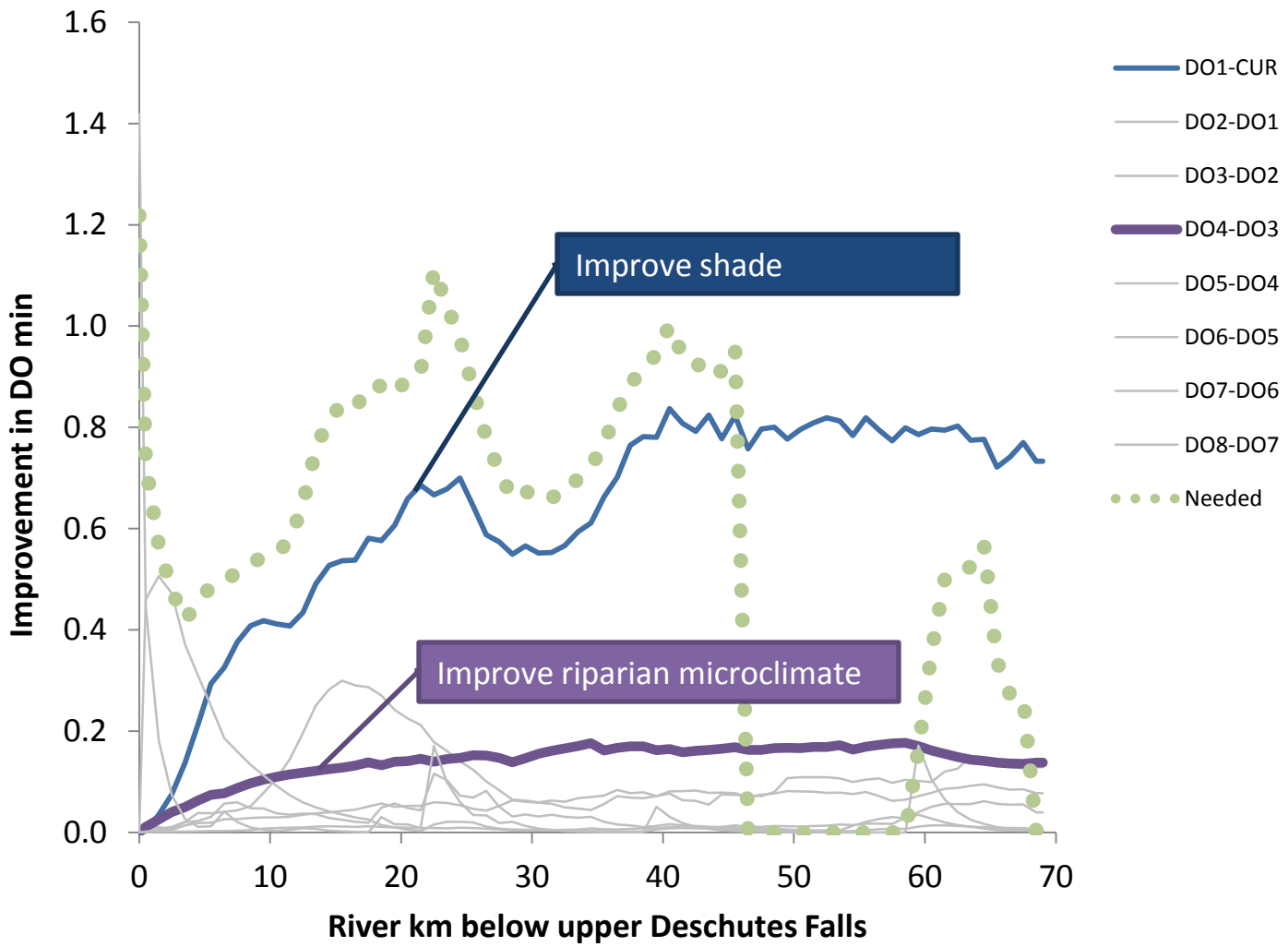

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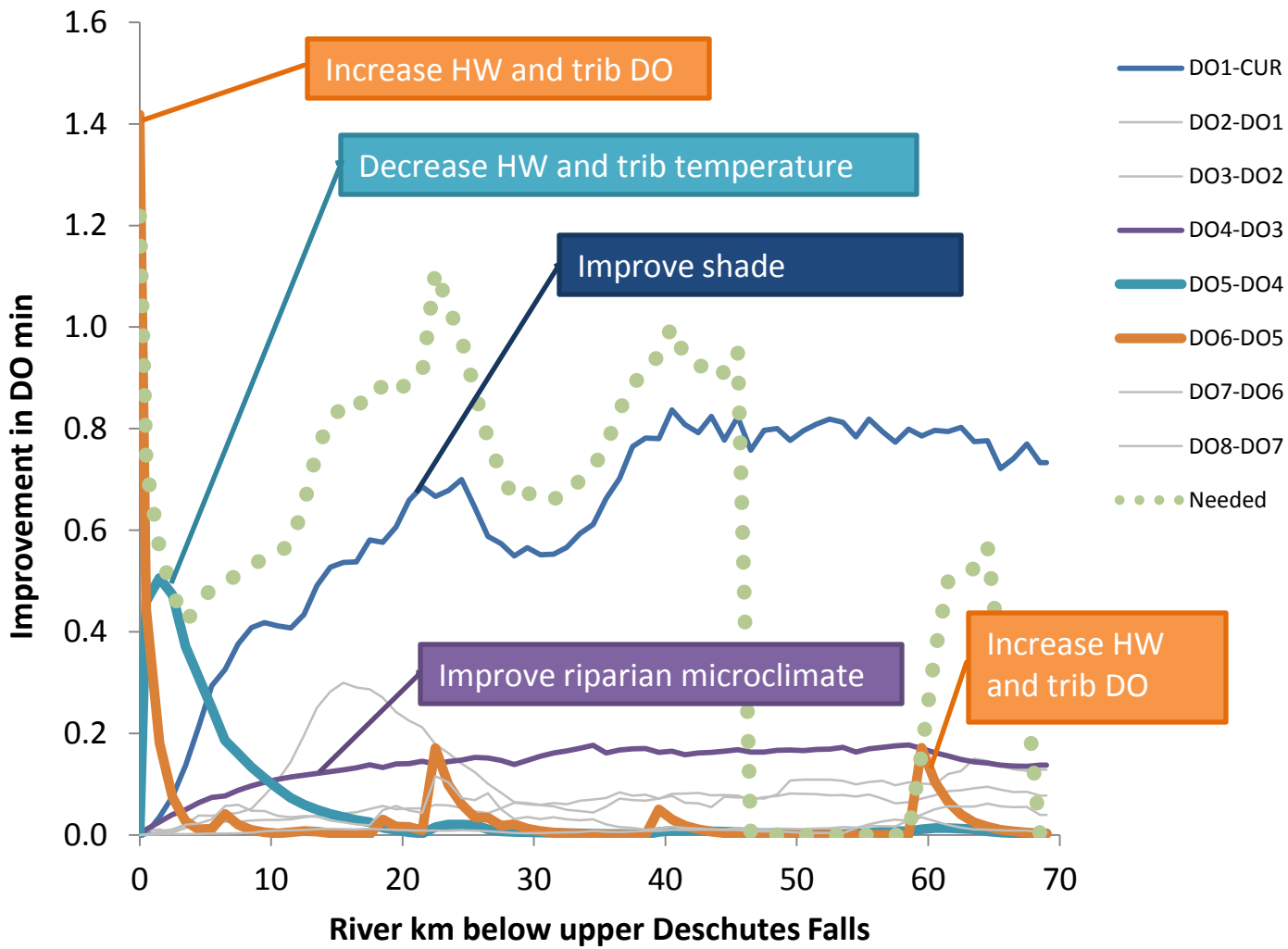

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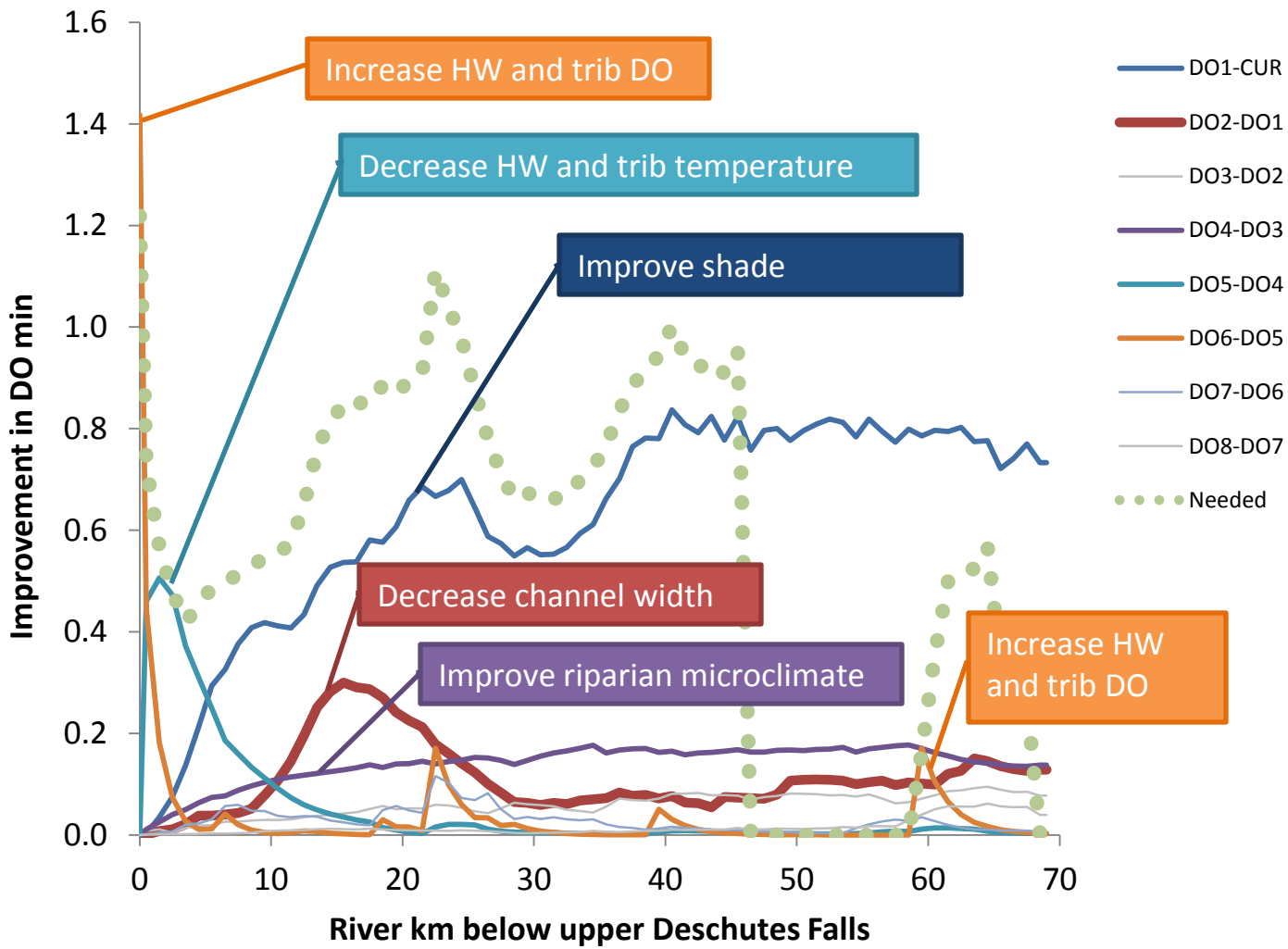

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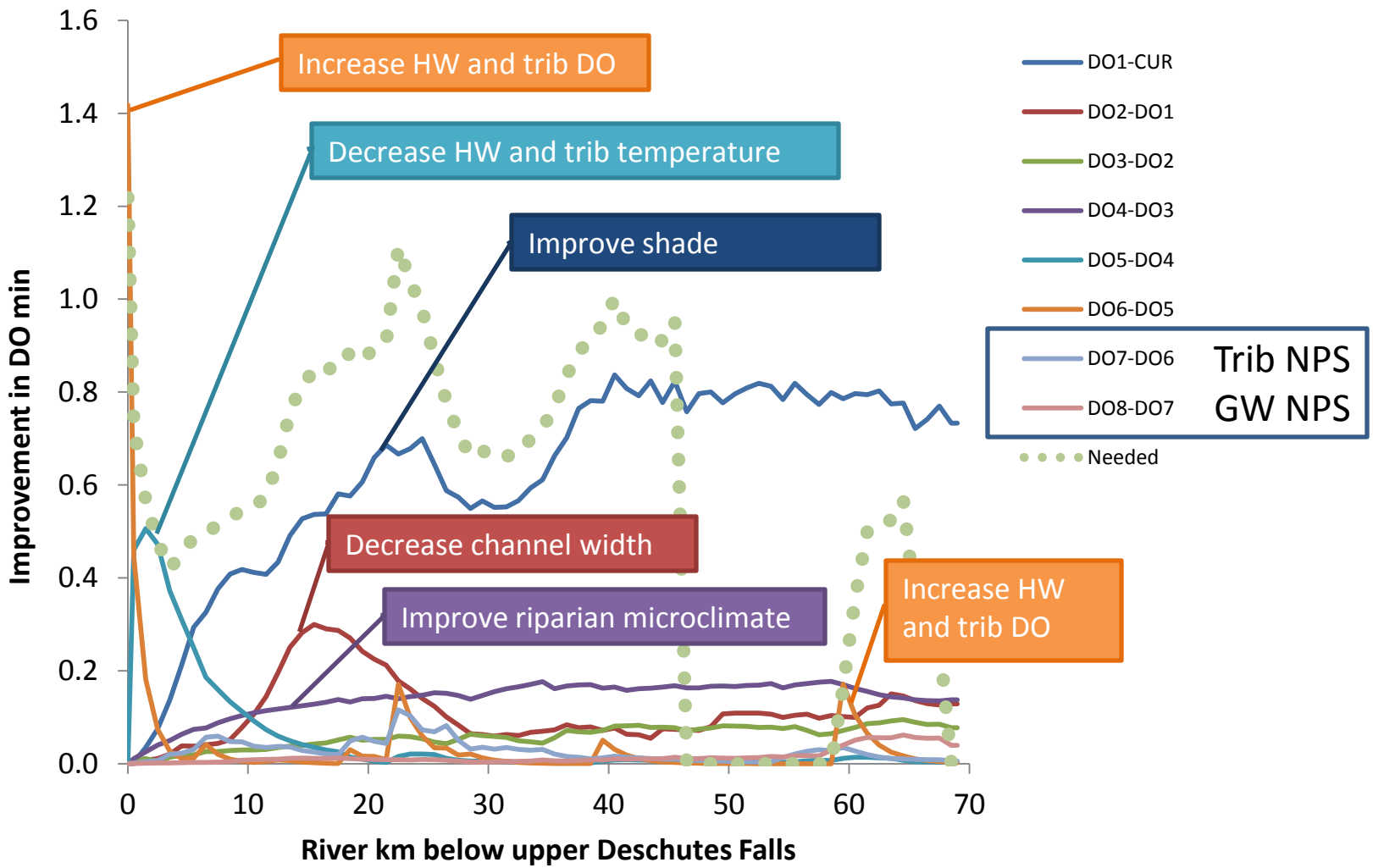
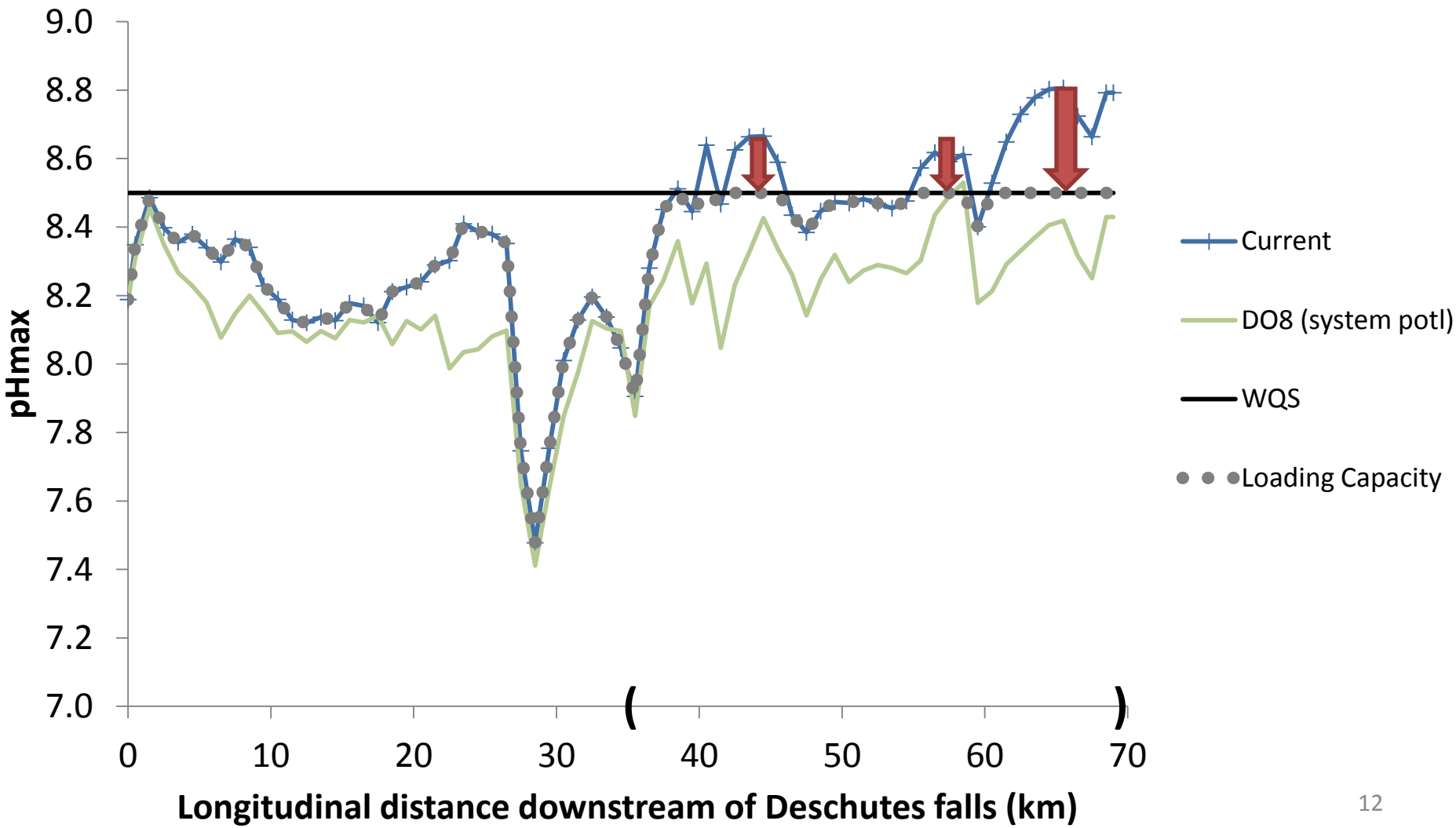


Technical Report – Current, system potential, and target pHmax



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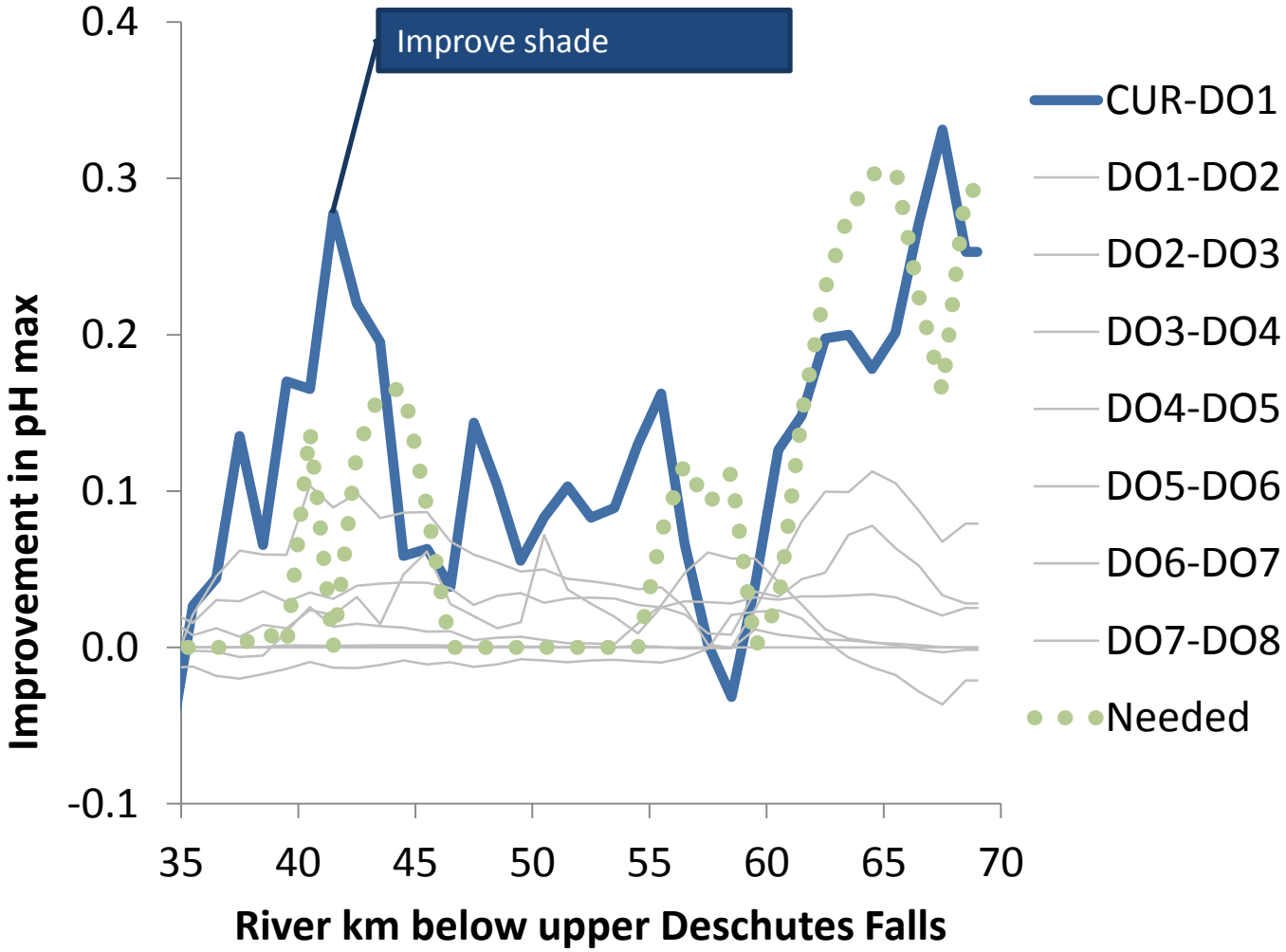

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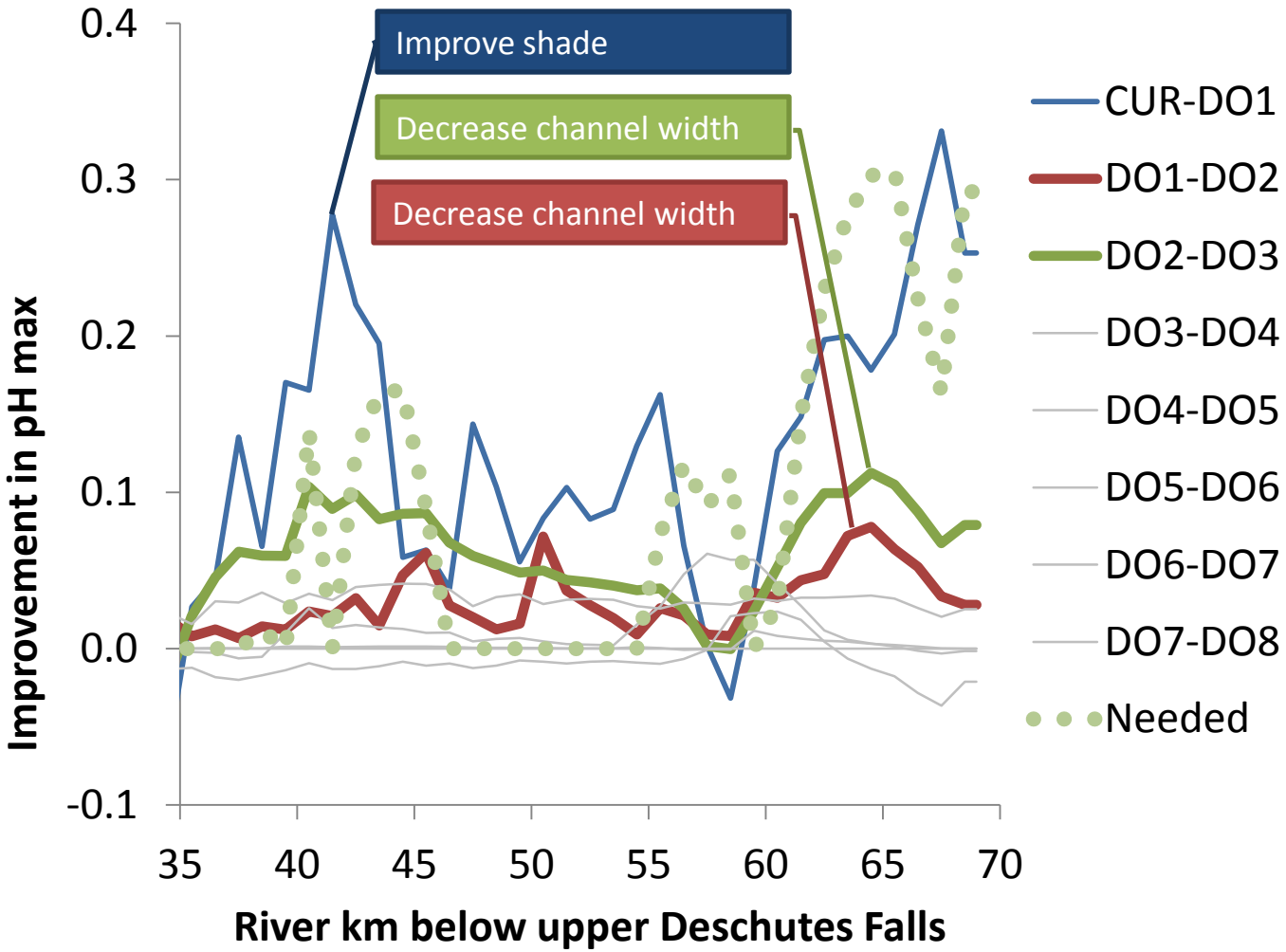

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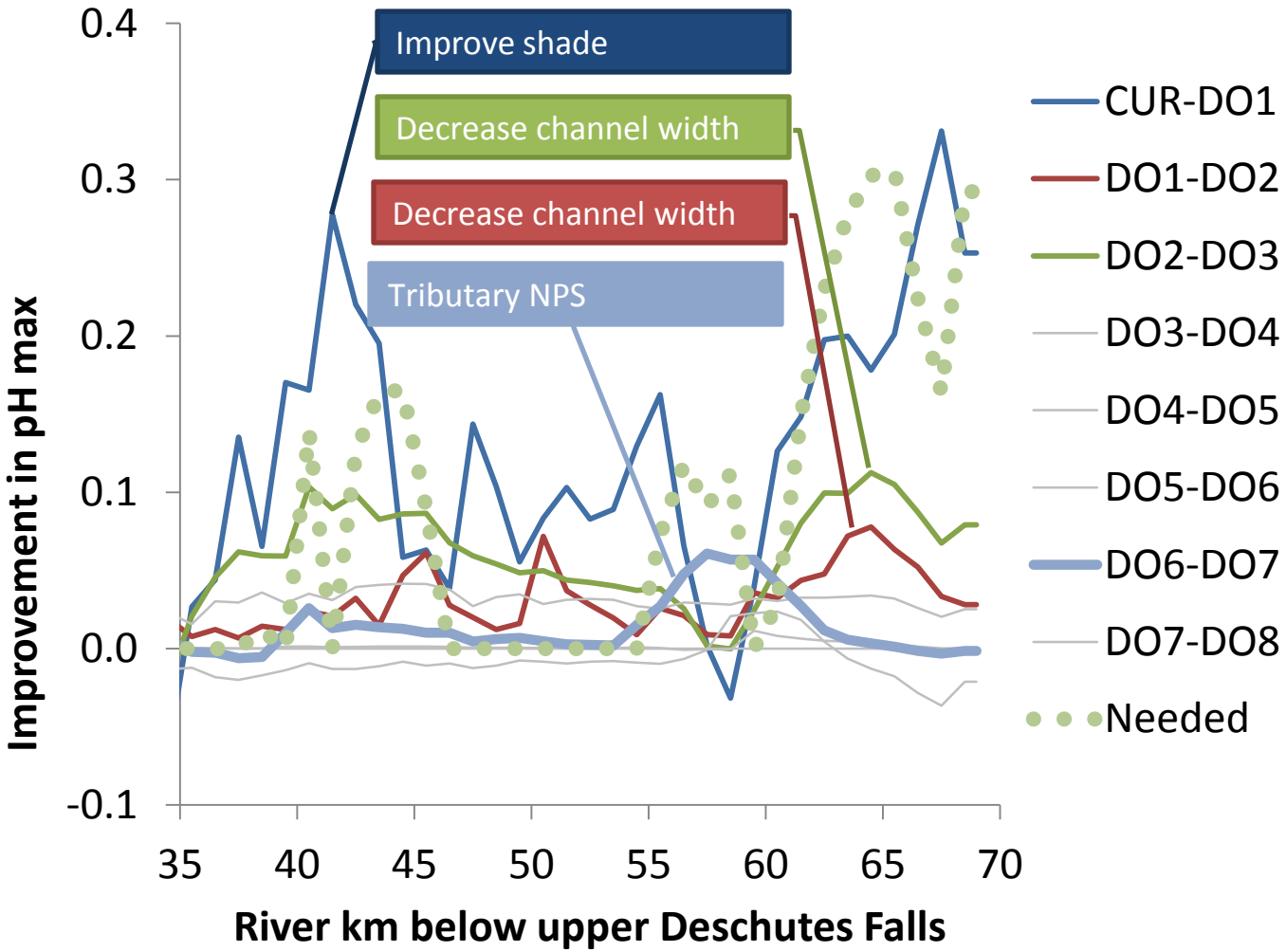

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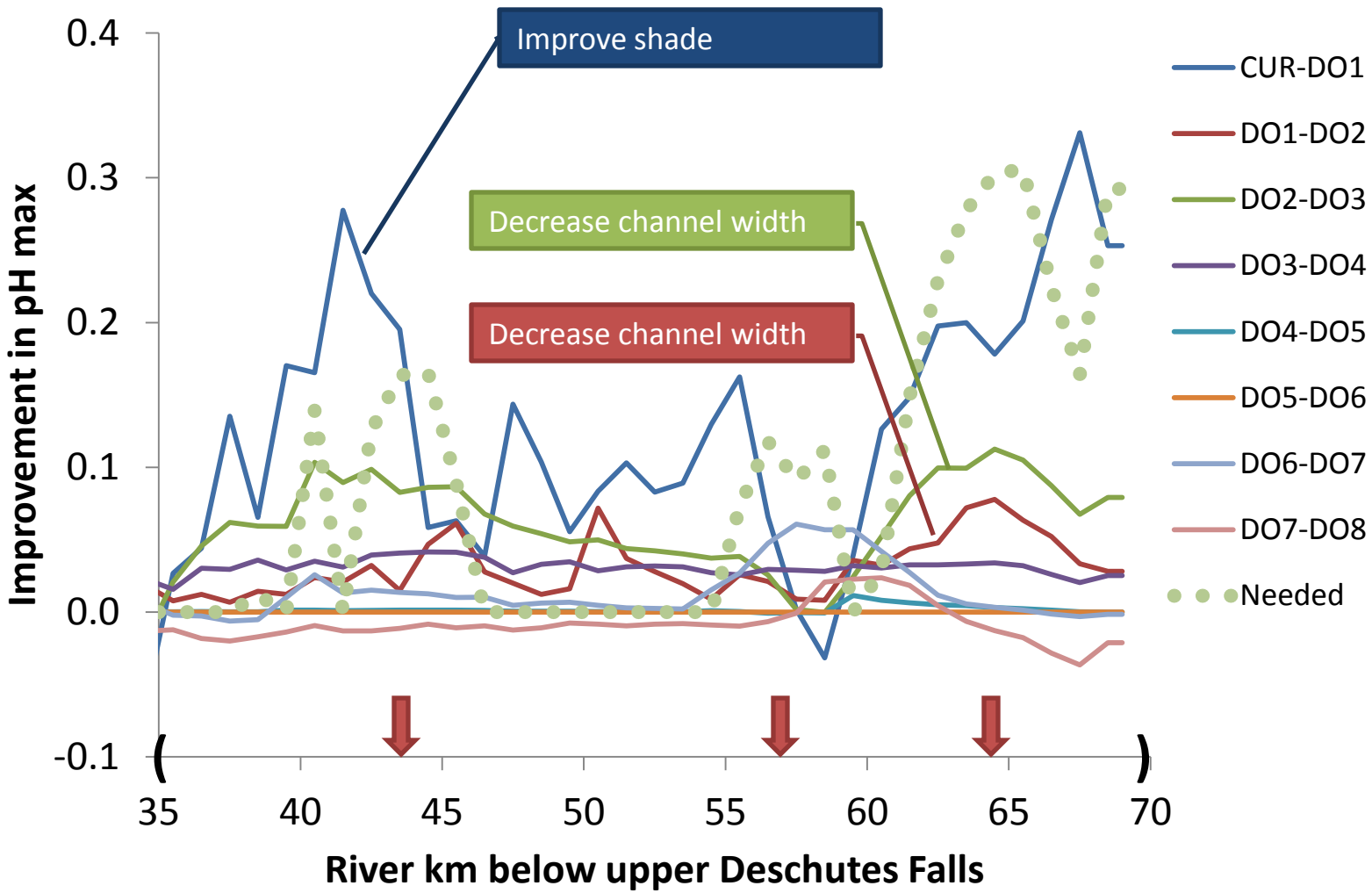

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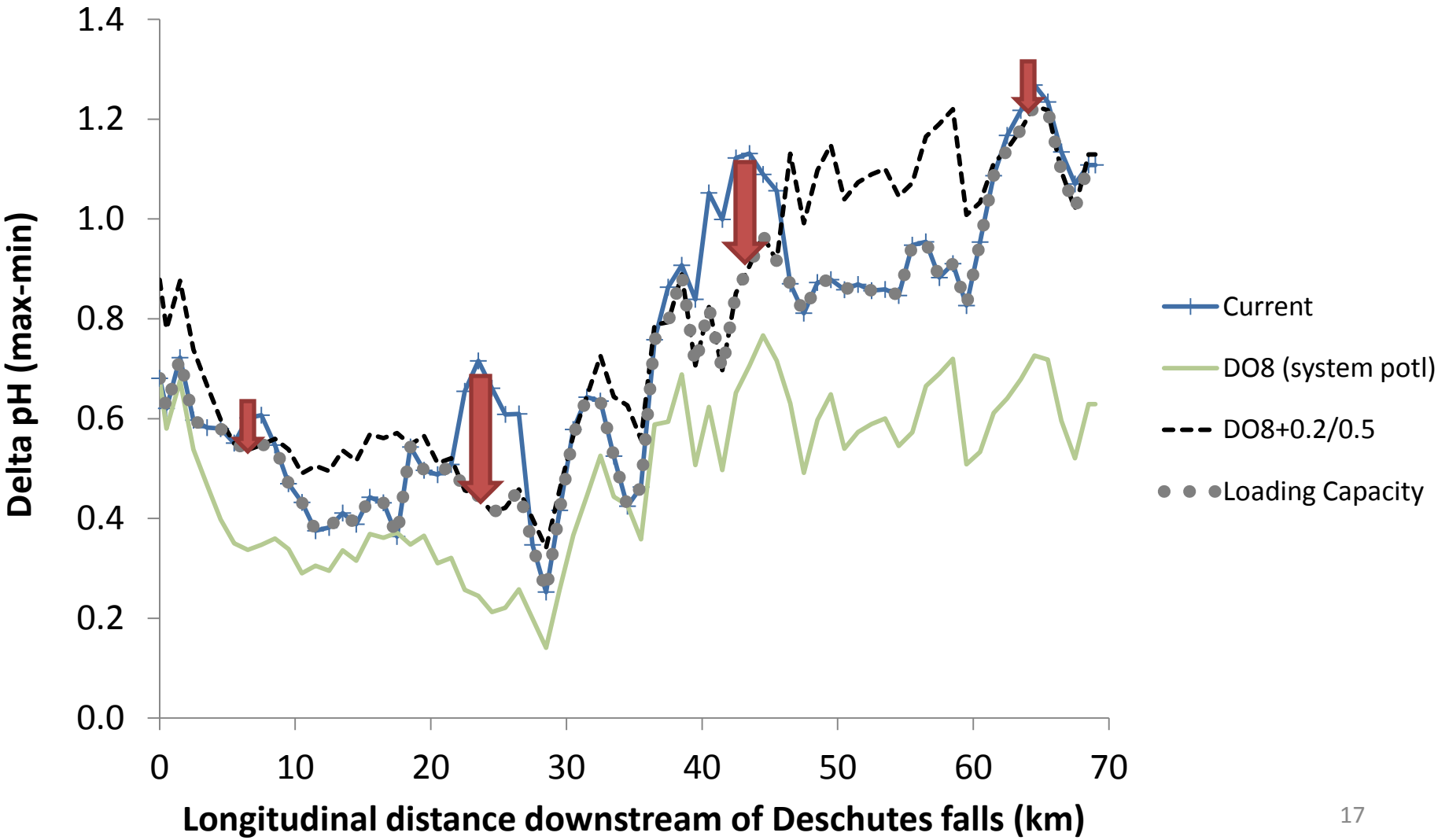

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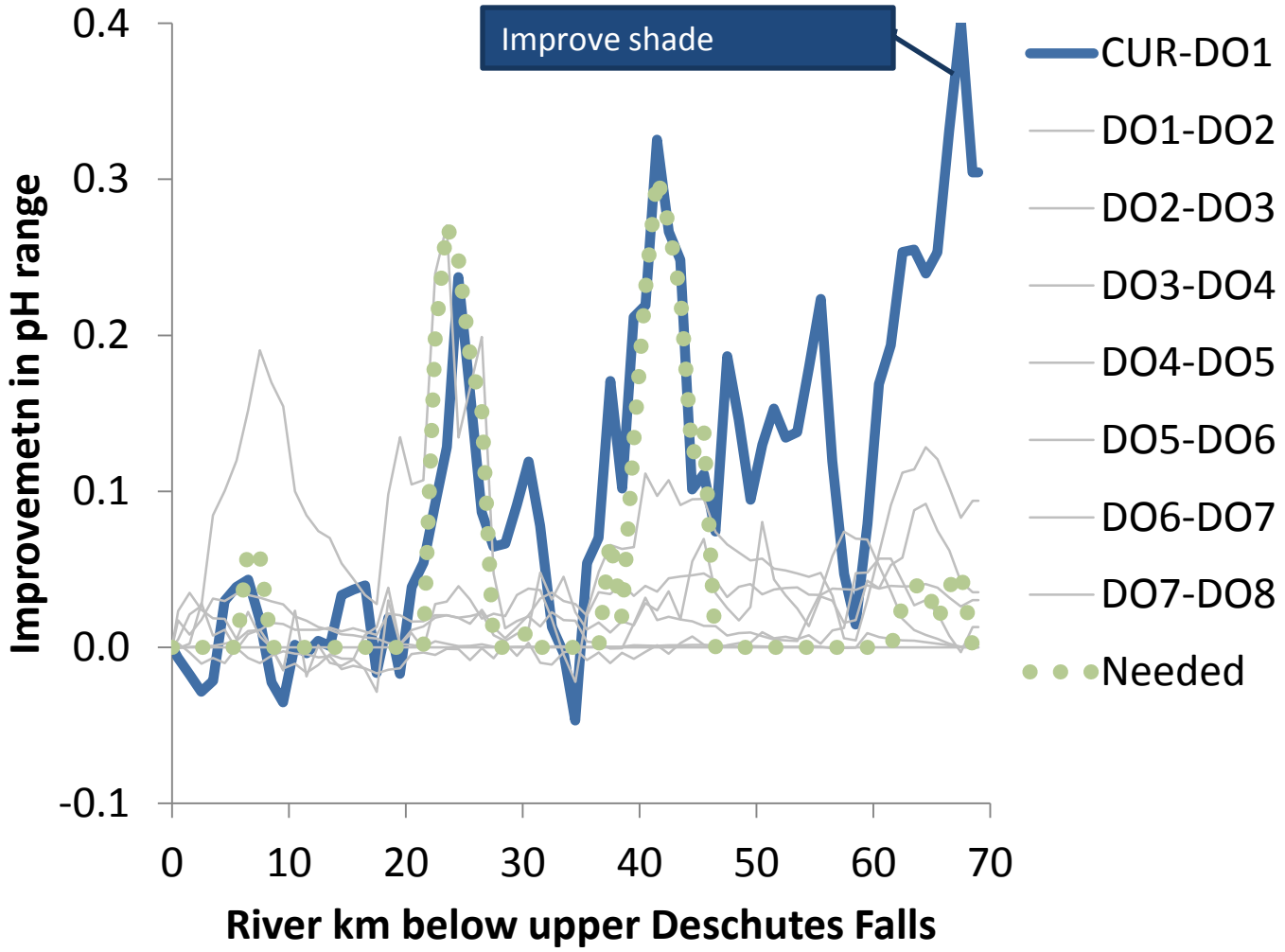

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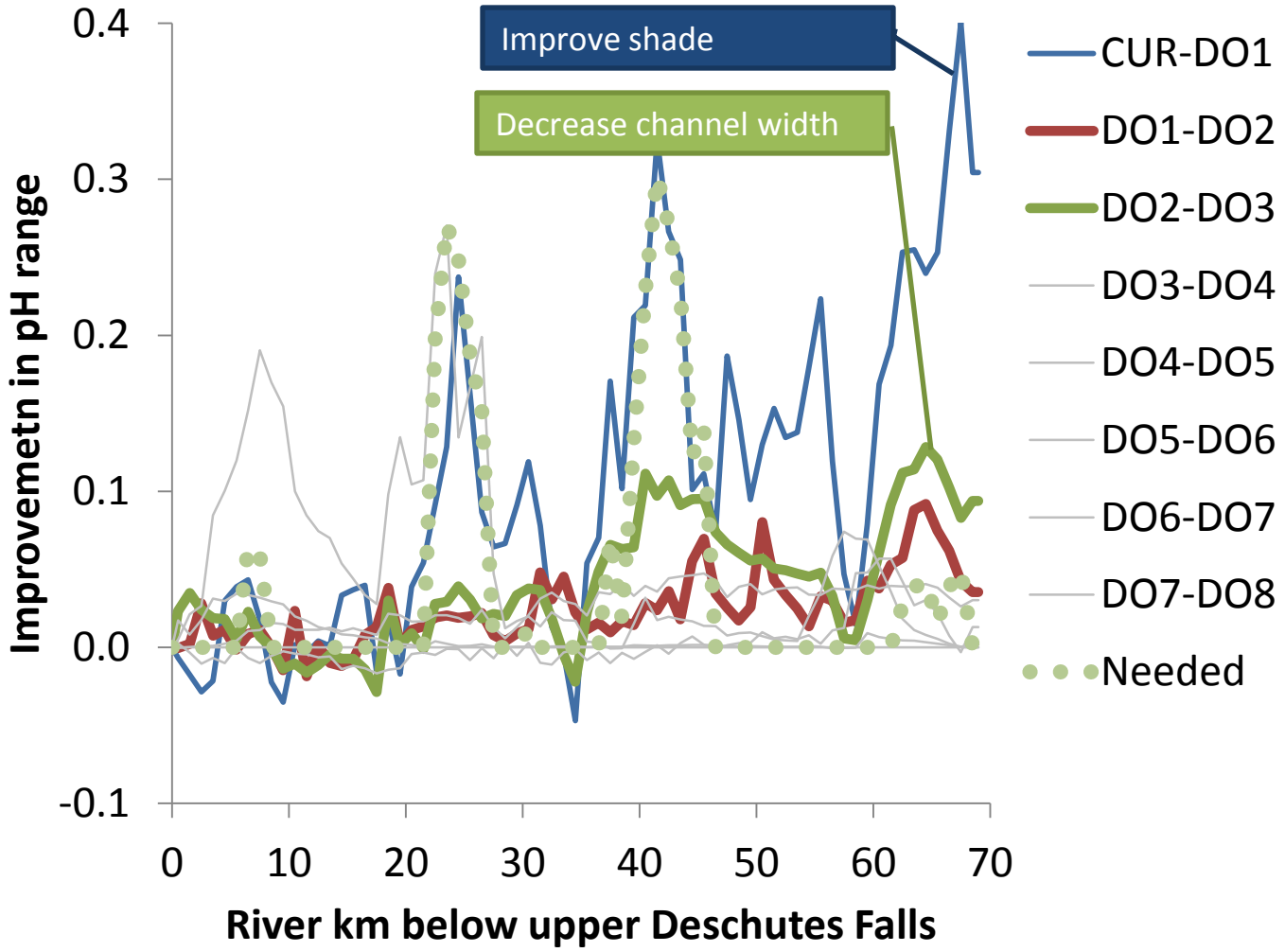

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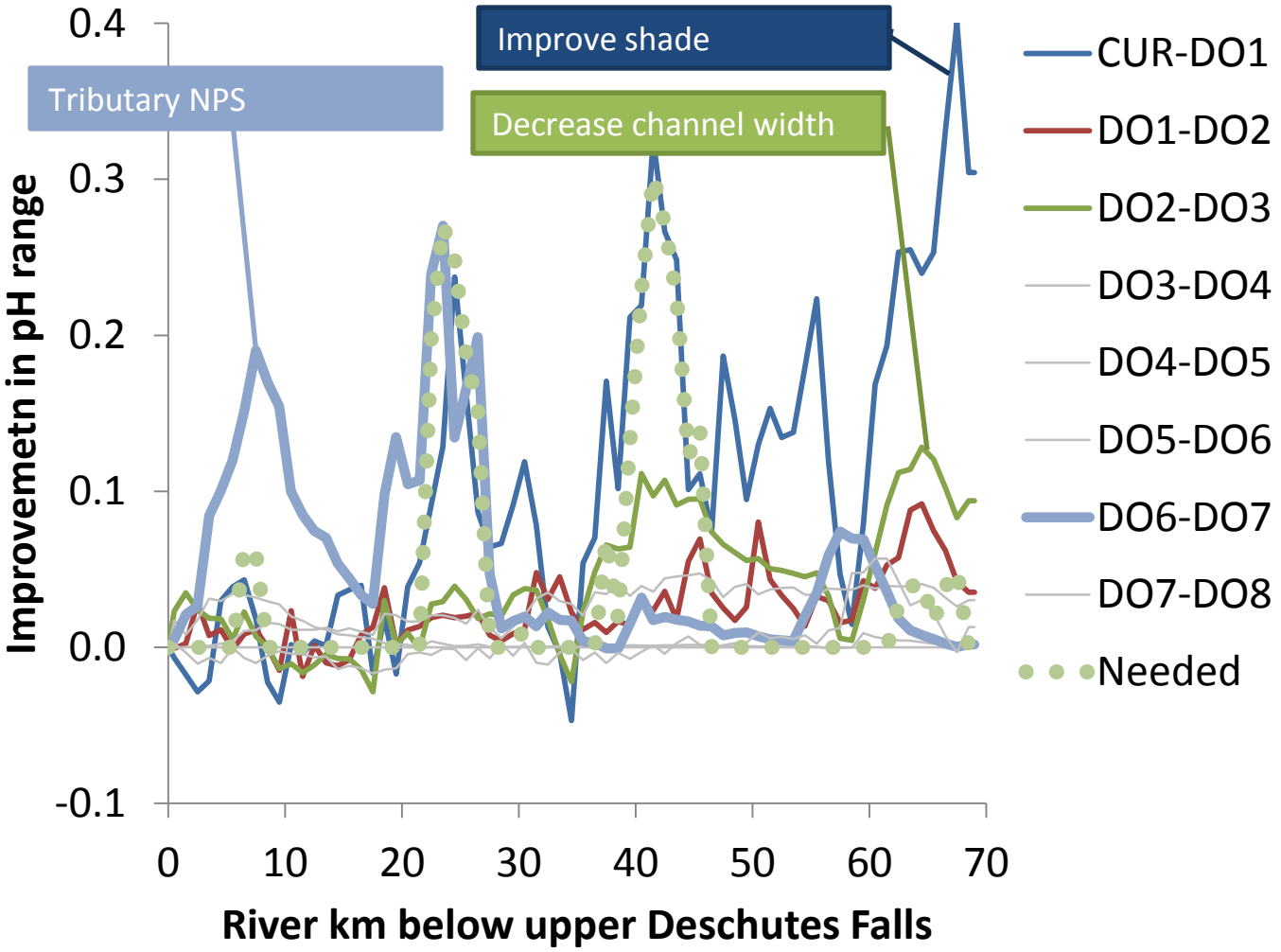

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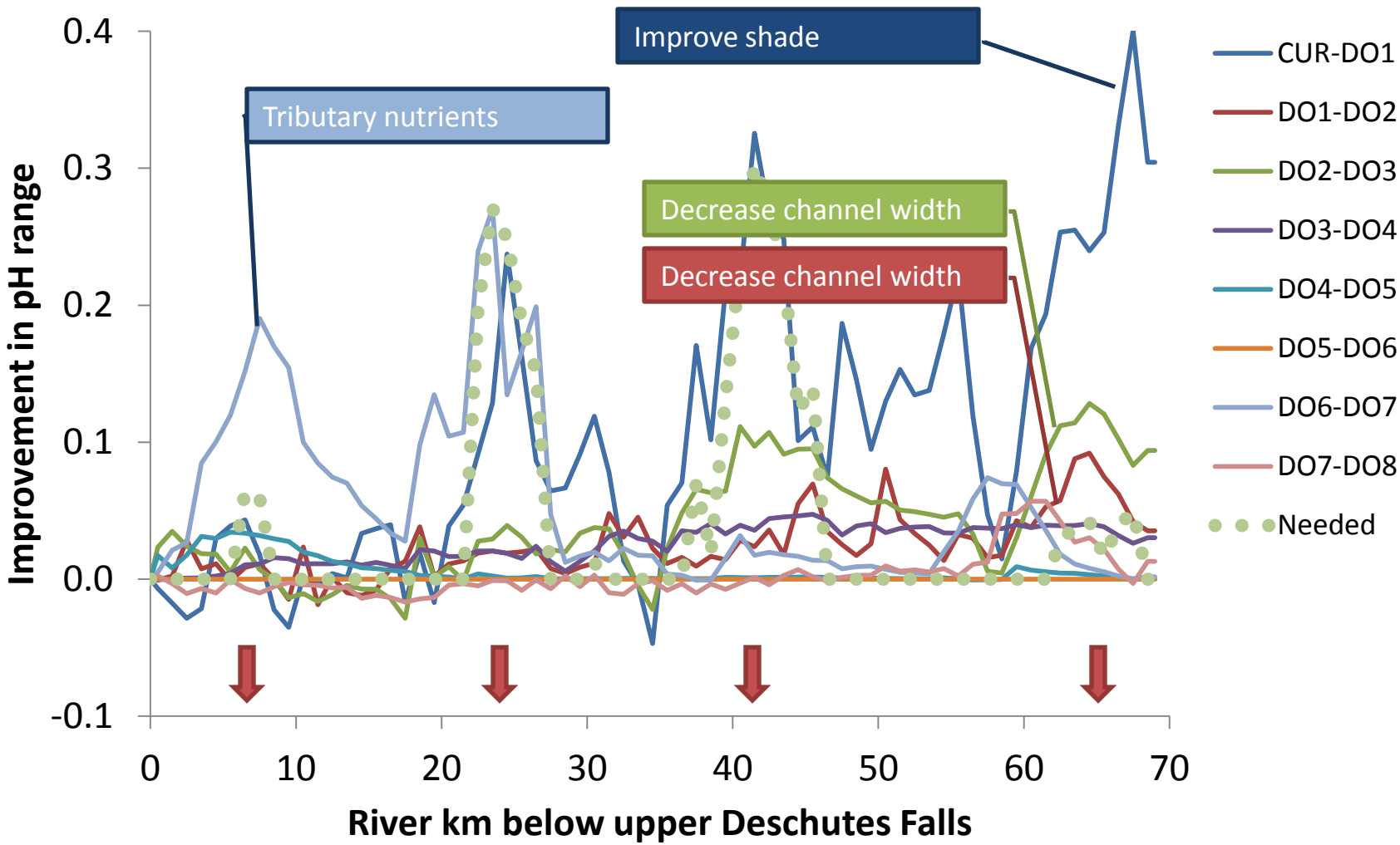

Deschutes scenarios

Starting point: what was in the technical report for DO and pH

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2. Shift from septic systems to centralized WW
3. Evaluate potential land conversion
4. Increase nonpoint sources
5. Increase channel complexity
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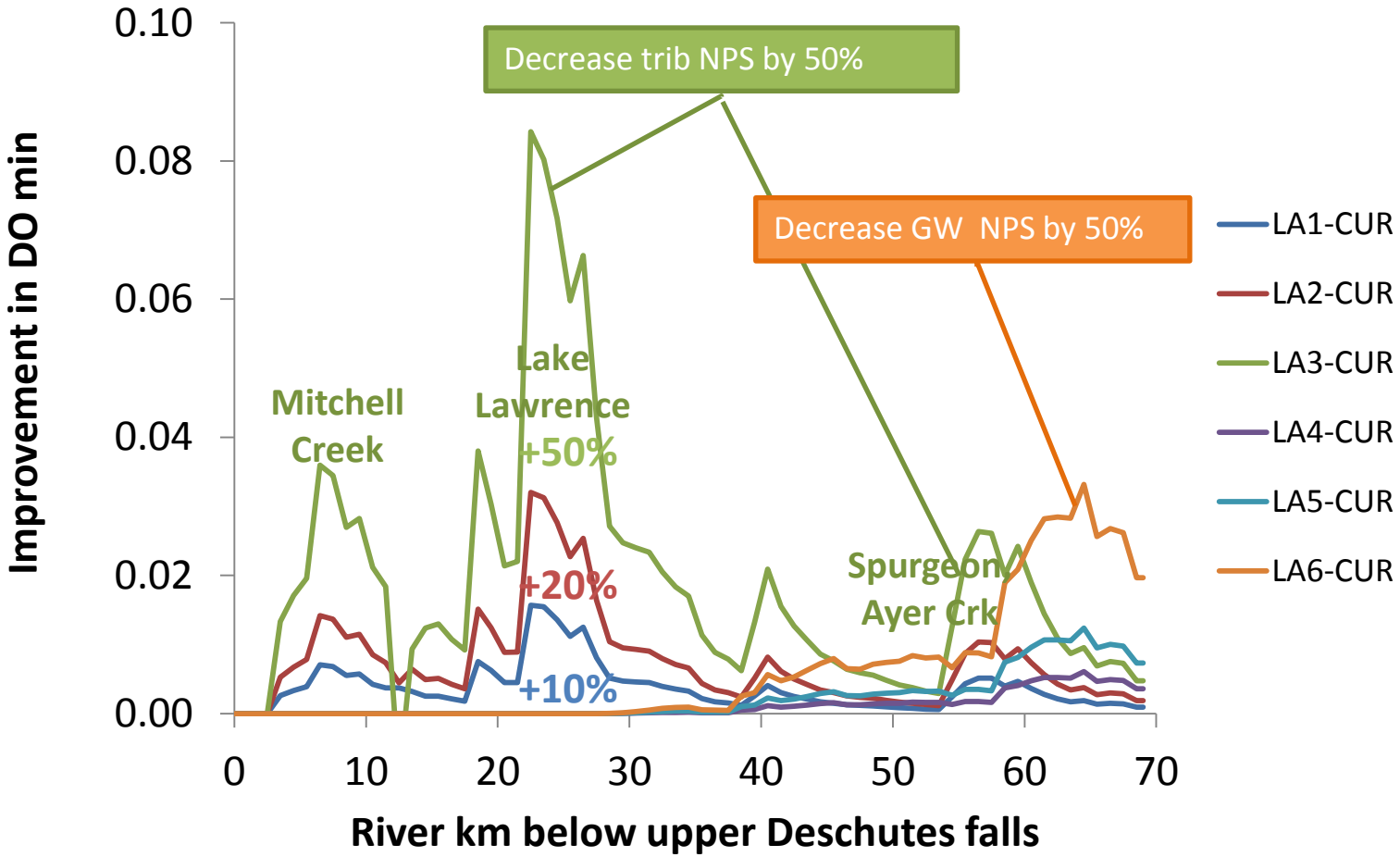
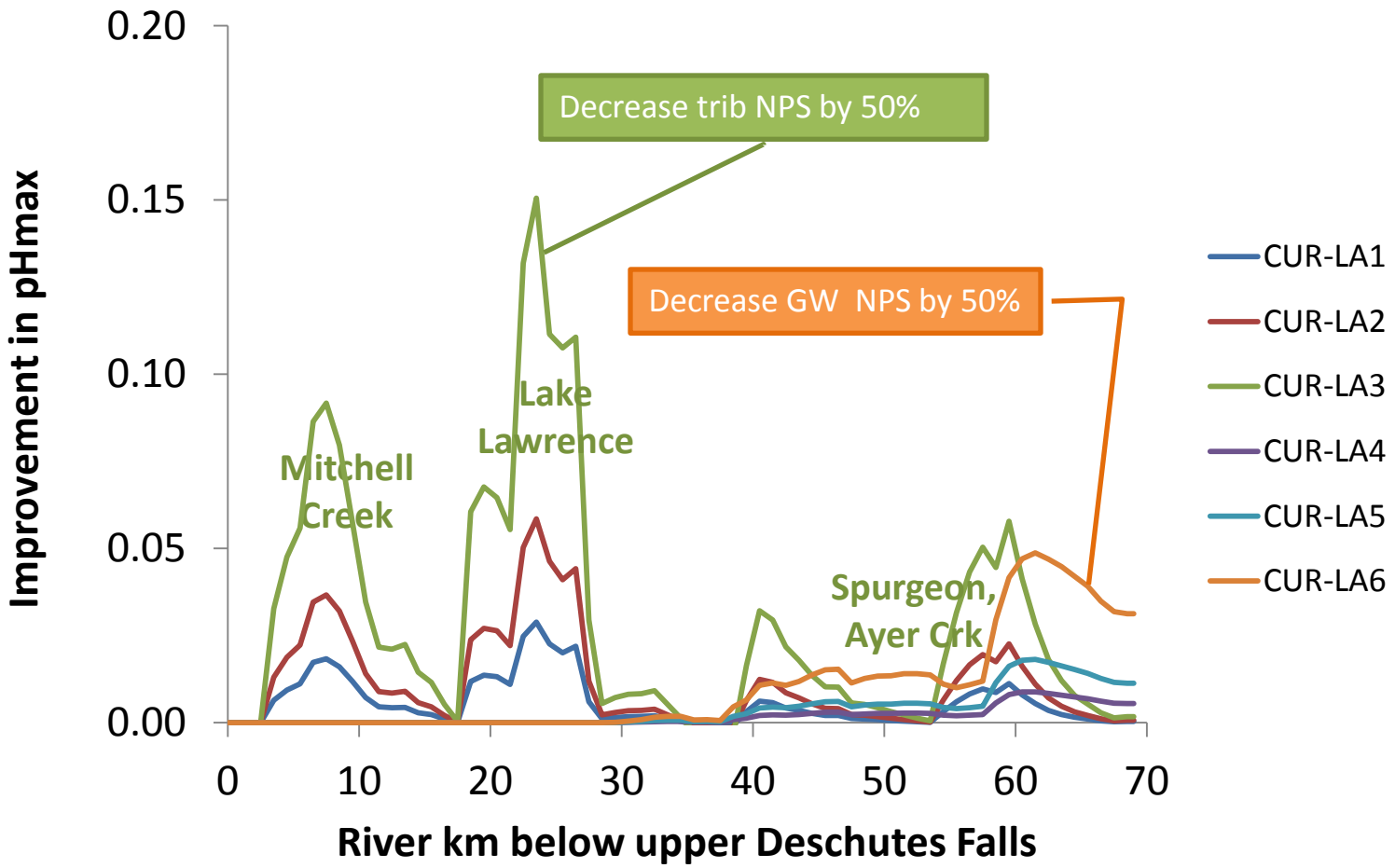
1. Reduce NPS phosphorus

- NPS = current – natural
- Scenario = current – (10, 20, 50%) NPS
- Evaluated tributaries and groundwater separately
- Both inorganic phosphorus and organic phosphorus decreased

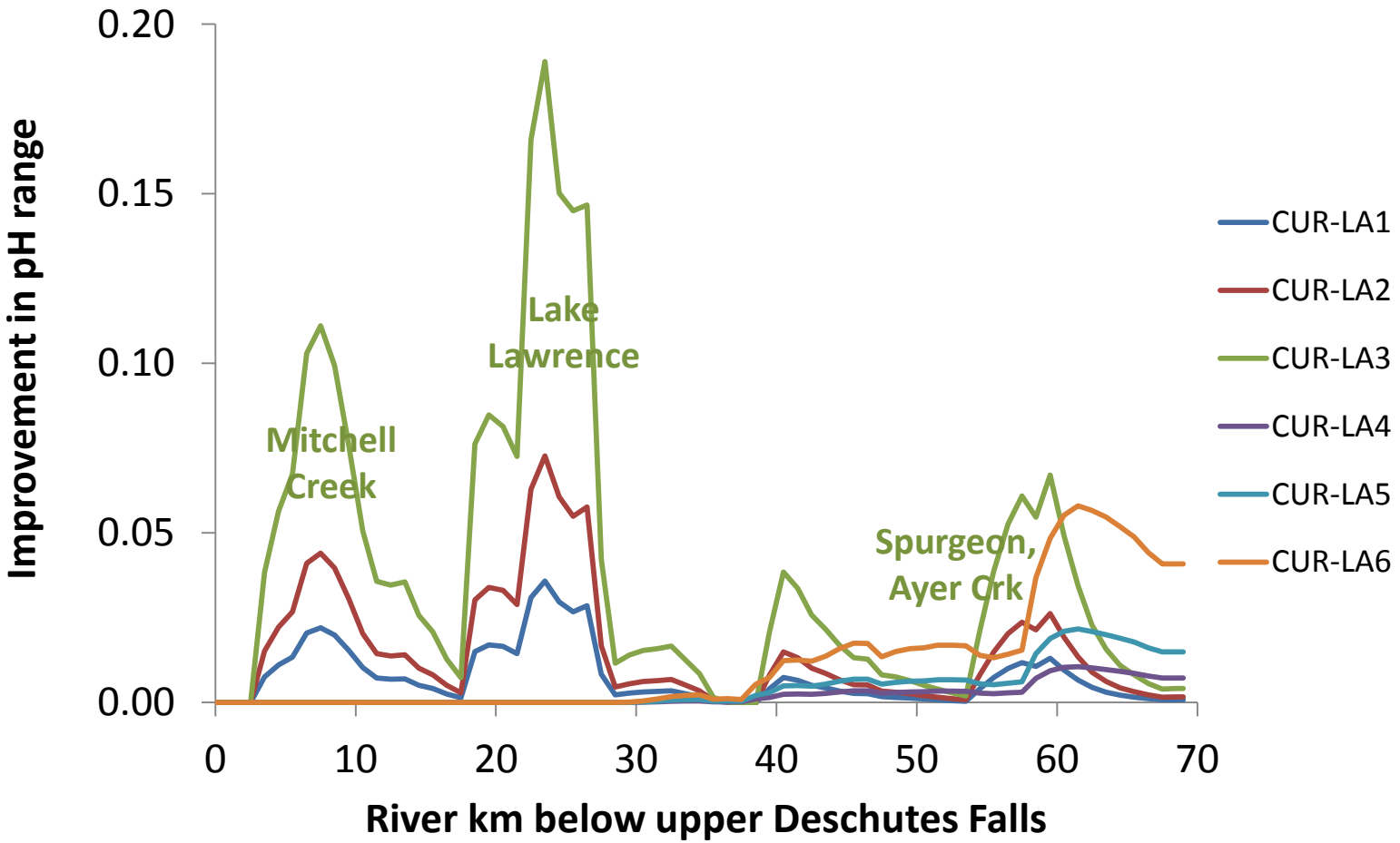
1. Decrease tributary and groundwater NPS – DOmin



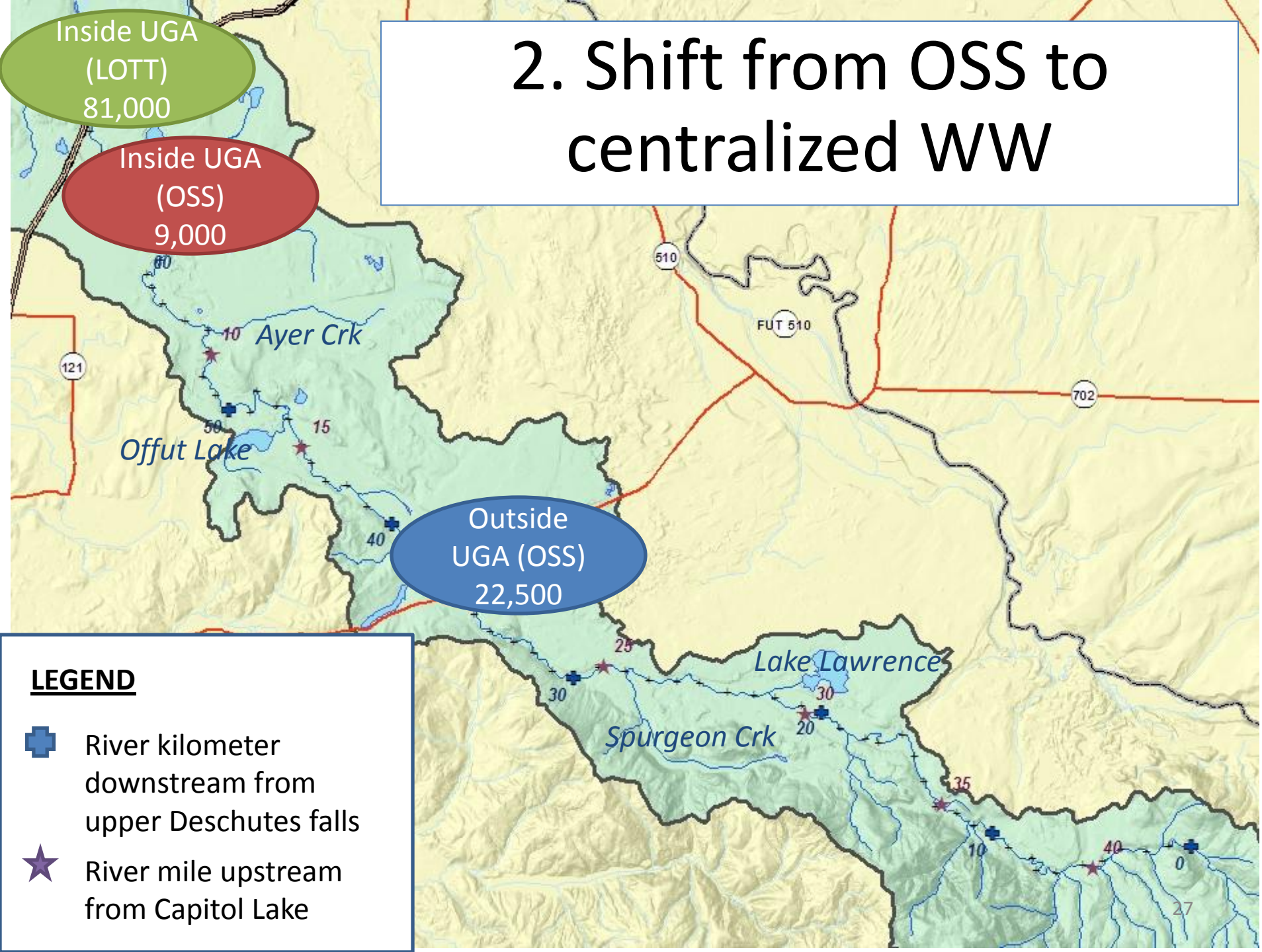
1. Decrease tributary and groundwater NPS – pHmax



1. Decrease tributary and groundwater NPS – pH range



2. Shift from OSS to centralized WW



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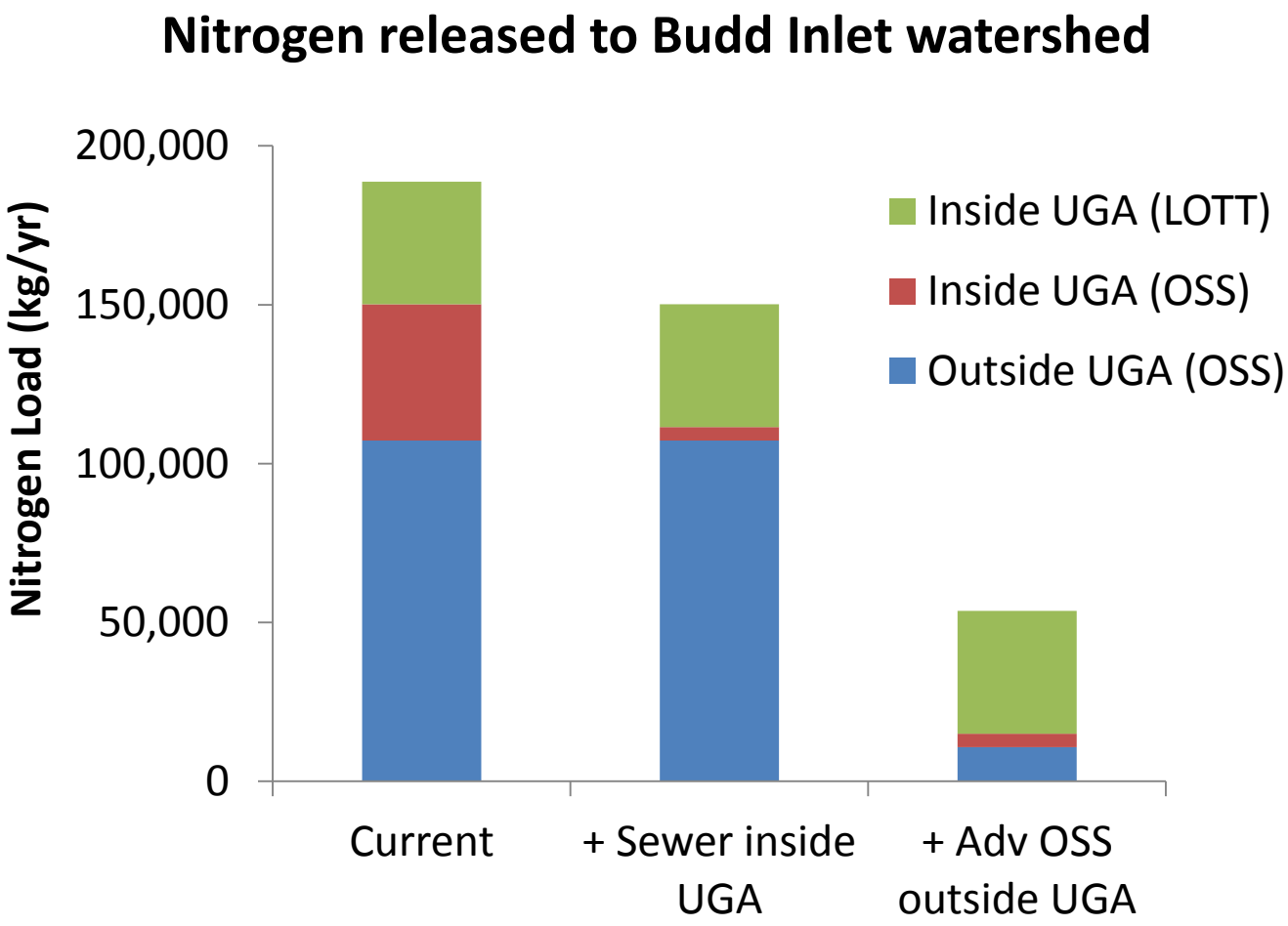


Calculation only (no model)

2. Shift from OSS to centralized WW

<u>Average Annual Effluent Concentrations (DIN as mg/L)</u>

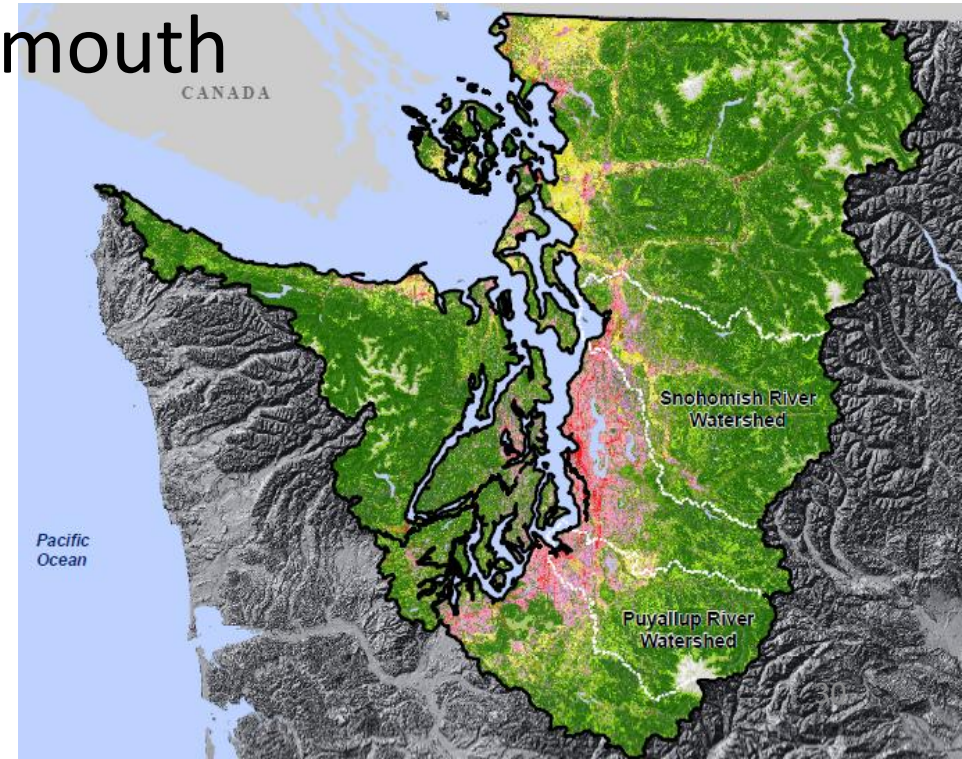
LOTT or advanced OSS	5mg/L	0.5kg/person/yr
septic	50mg/L	4.8kg/person/yr

<u>Average Flow (per capita)</u>

Q	69gal/person/day

3. Potential land conversion and future growth

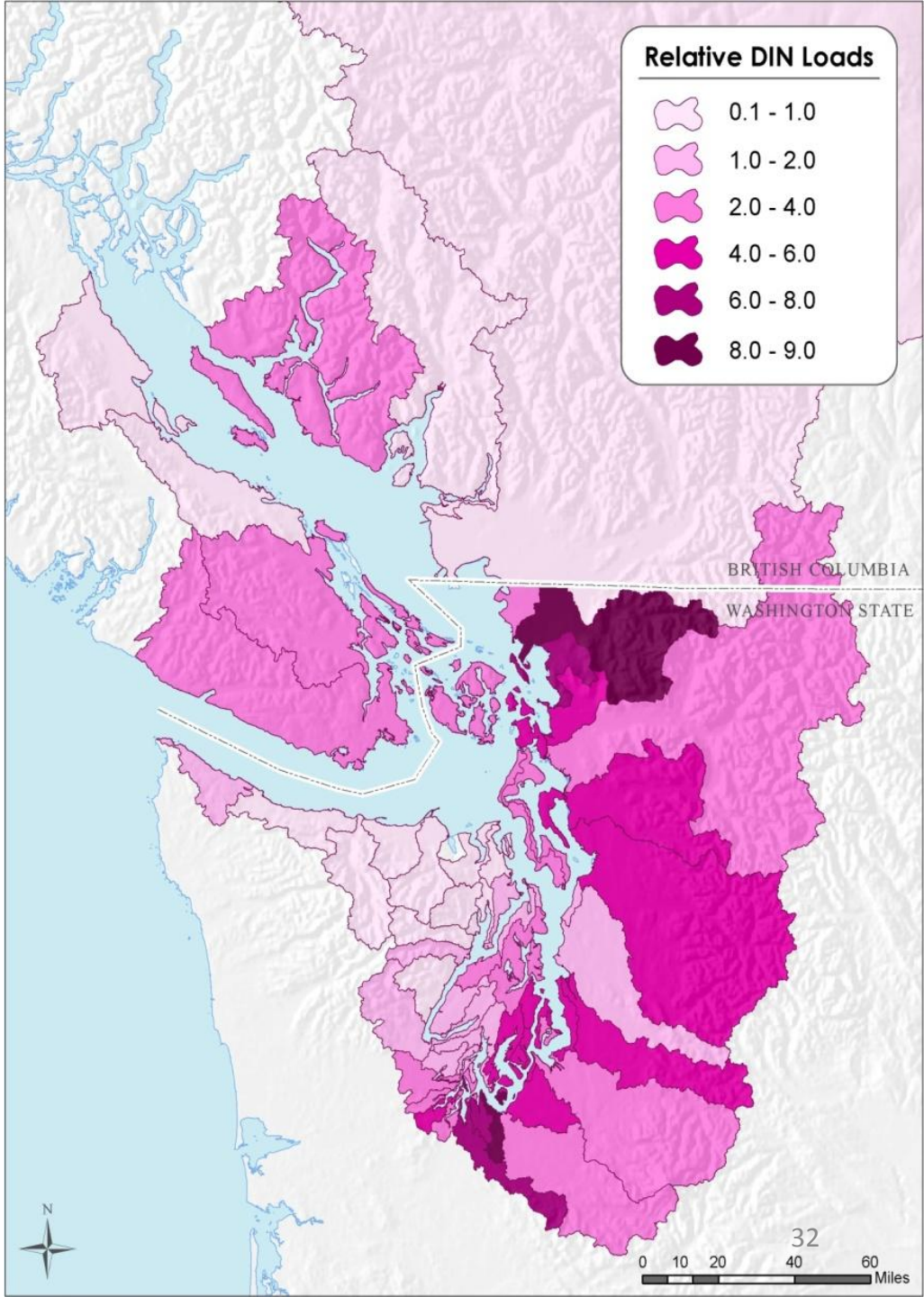
- Calculation only (no model)
- Unit-area loads from Toxics in Surface Runoff project accounted for only 20-50% of the loads delivered at the mouth



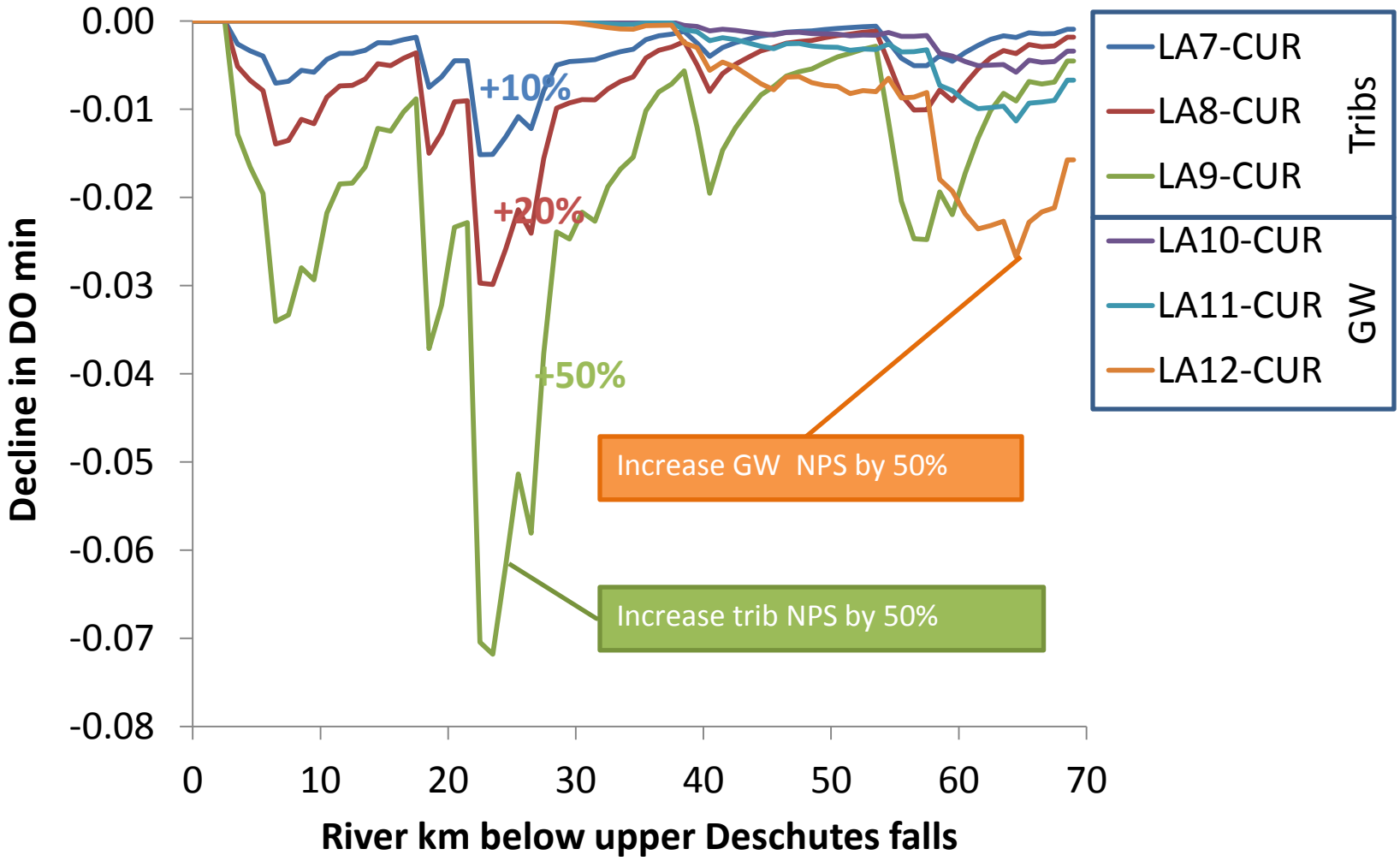
3. Potential land conversion and future growth

- Deschutes River loads at mouth equivalent to unit-area loads of 980 kg-N/km2-yr
  - Only storm events in agricultural lands produce unit-area loads as high:
    - 440-1330 kg-N/km2-yr in Toxics in Surface Runoff study
    - 1300 kg-N/km2-yr in Green River study
- *STOP – cannot estimate with available info*
- *REMINDER – Deschutes River is nitrogen hotspot*

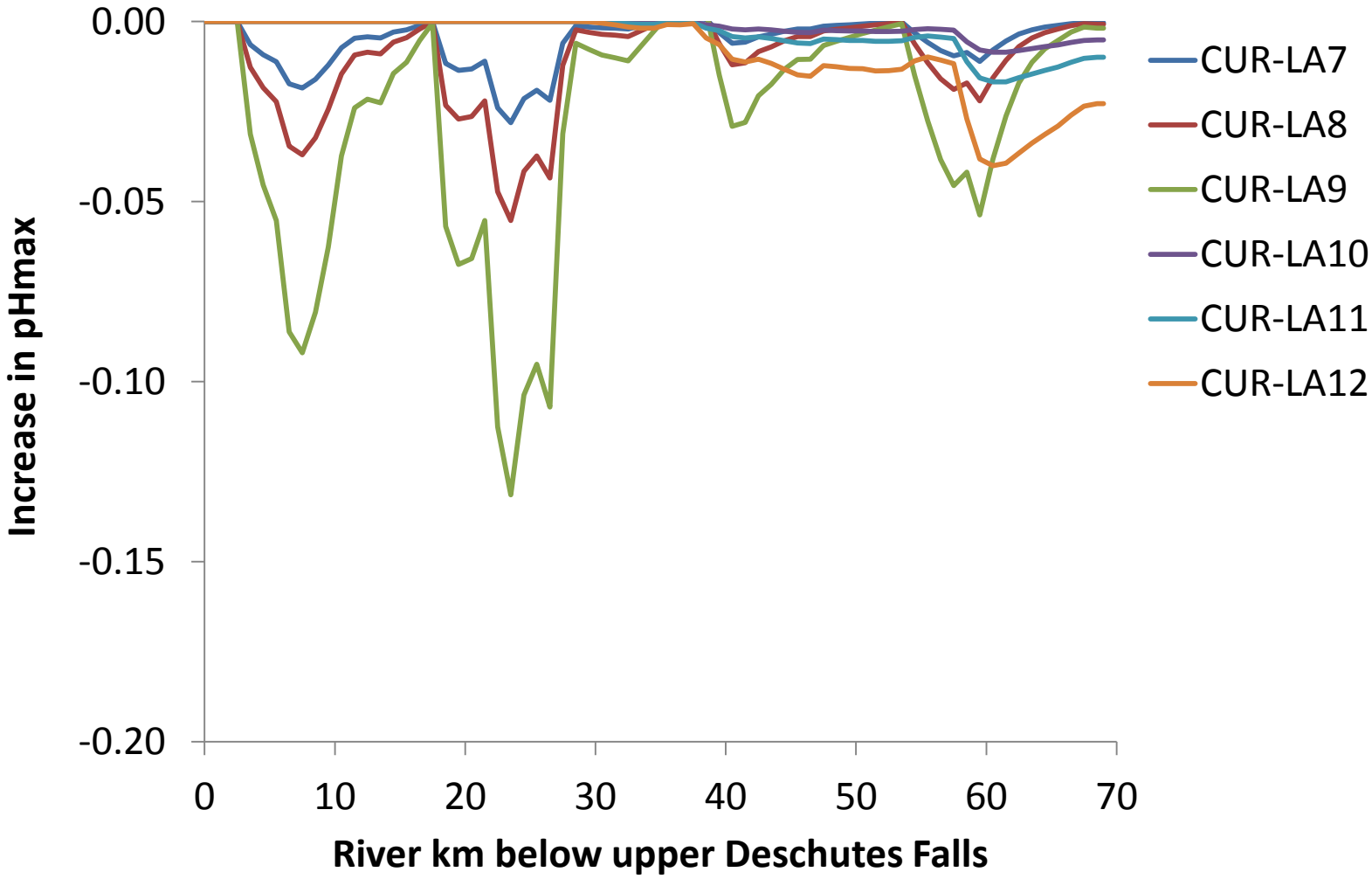
- Puget Sound nutrient load summary
- https://fortress.wa.gov/ecy/publications/SummaryPages/1103057.html
- Darker colors = higher loads per acre or hectare



4. Increase nonpoint sources, future growth – DOmin



4. Increase nonpoint sources, future growth – pHmax



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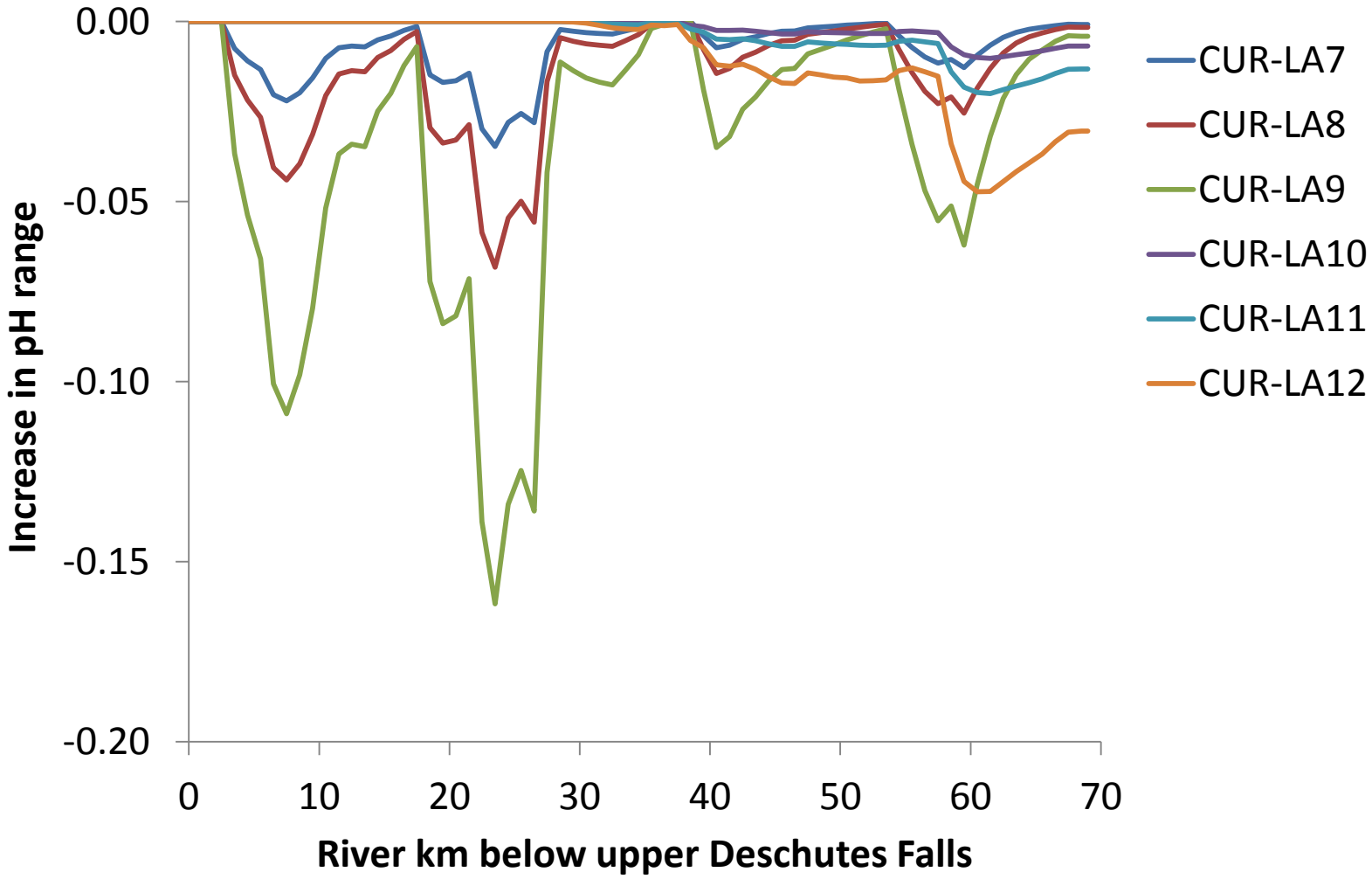


5. Increase channel complexity through river restoration

- <u>Aside</u>: What's channel complexity?

High channel complexity

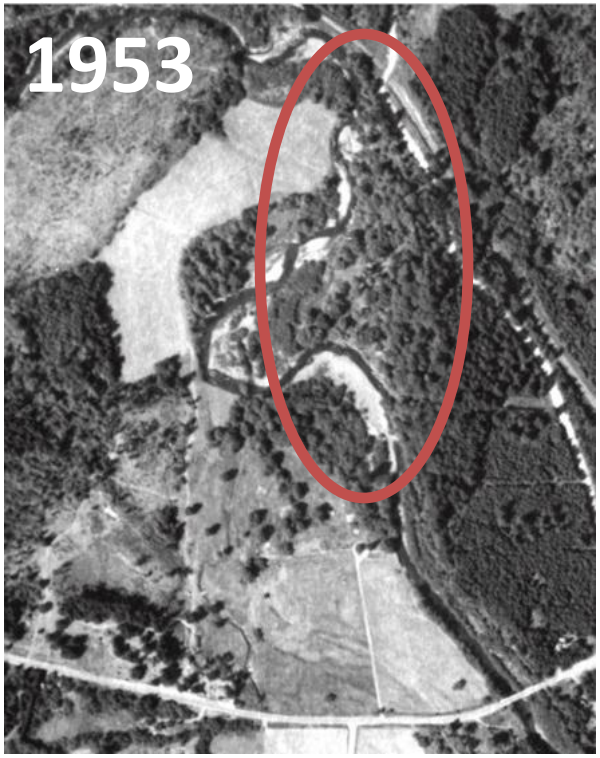
Low channel complexity

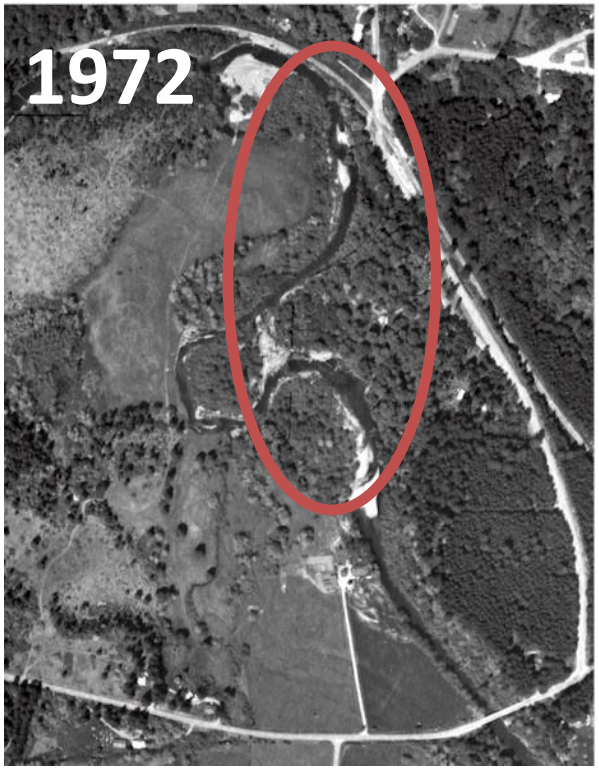
Channel and riparian restoration goals

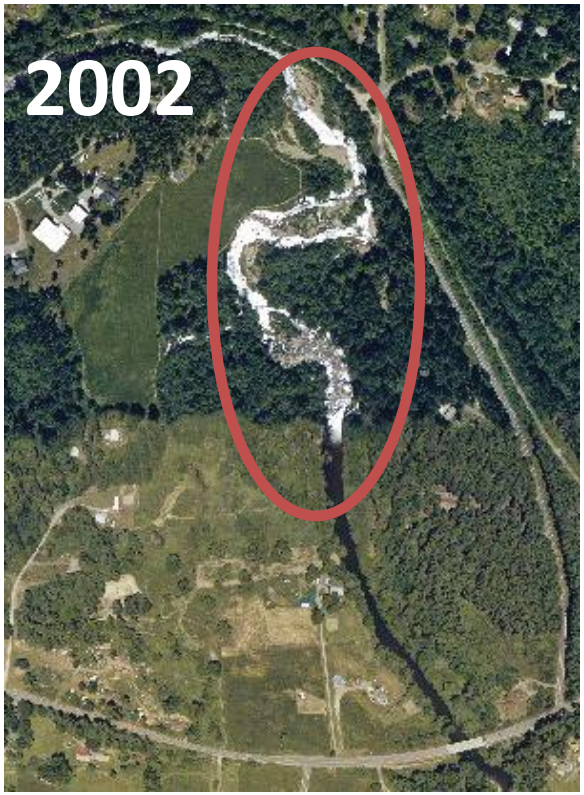
- Goal: identify and reestablish the conditions under which natural states create themselves

- Goal is not to remove or control all disturbance

Rivers move … a lot







Anyone recognize this location?

Low channel complexity

Low/mid channel complexity

Mid-level channel complexity

High channel complexity

But not good for floating the Deschutes…

LWD abundance varies with stream order

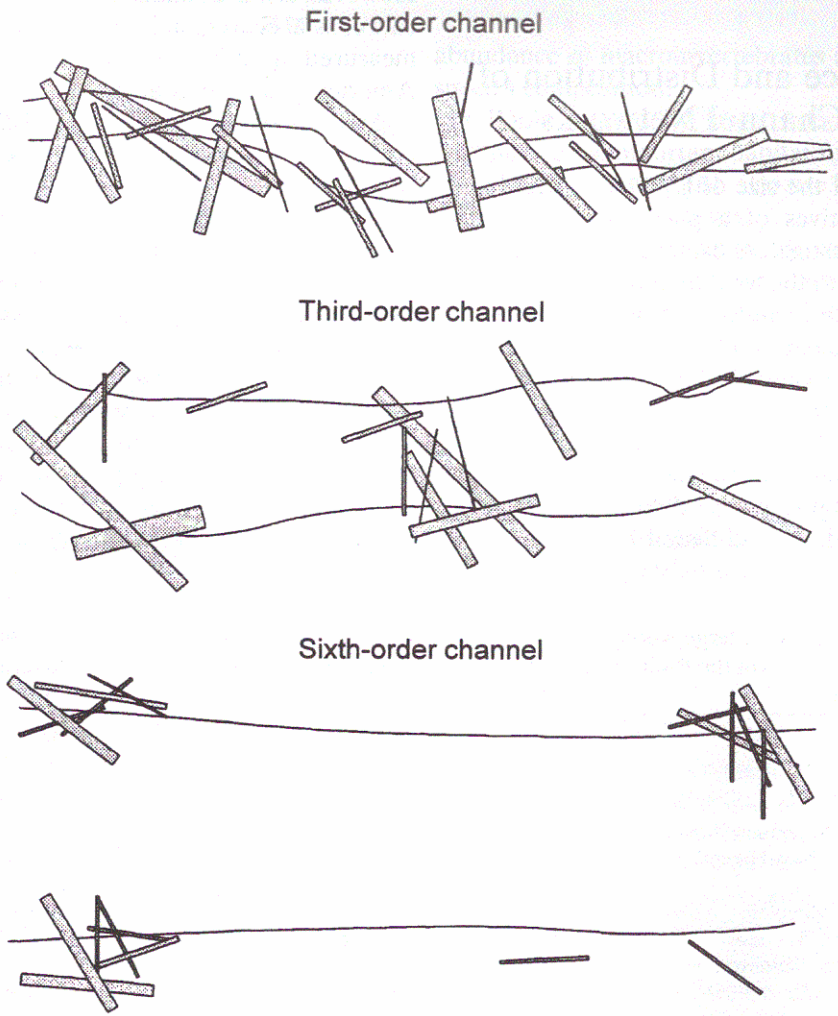


FIGURE 13.1. Typical distribution of LWD in channels of various size. Aggregation of wood increases with channel size and total wood abundance decreases. This figure is based on maps of LWD in the McKenzie River basin, Oregon (Swanson et al. 1982).

Source: Naiman and Bilby Figure 13.1 – River Ecology and Management

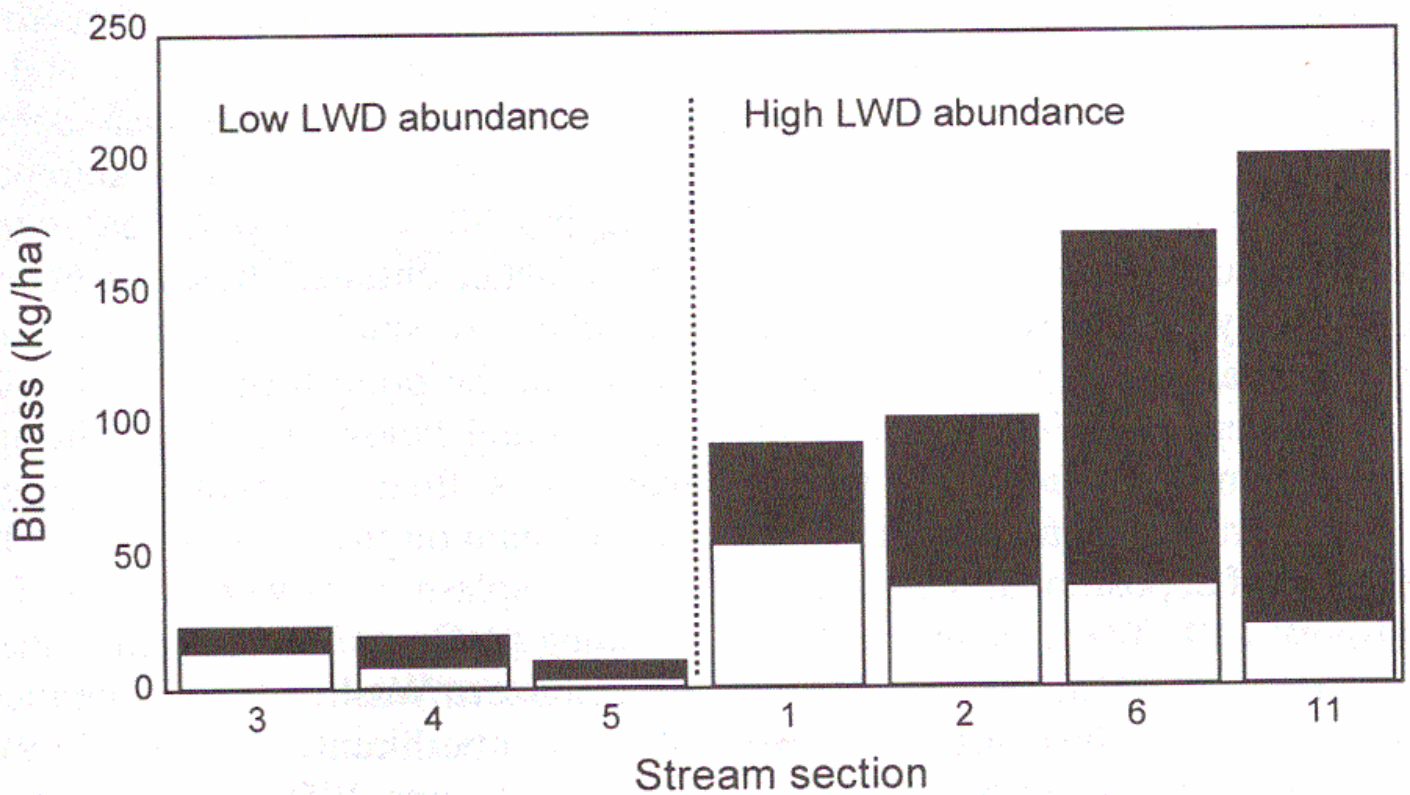
Why does LWD, complexity matter?

- To the stream
  - Channel stability
    - Restoration projects: LWD jams as armoring
  - Very important in step-pools and pool/riffle channel types– creates the channel form
    - Depositional environments (deeper pools, sediment and organic matter retention)
  - Creates mixed (heterogeneous) microhabitats

Why does LWD, complexity matter?

- To the biota
  - When LWD is removed experimentally
    - Fish abundance decreases
    - Macroinvertebrate community changes
      - Collectors and predators decrease
      - Scrapers and filterers increase
    - Increased export (transport) of coarse, fine, and dissolved organic matter
      - Less food available for biota

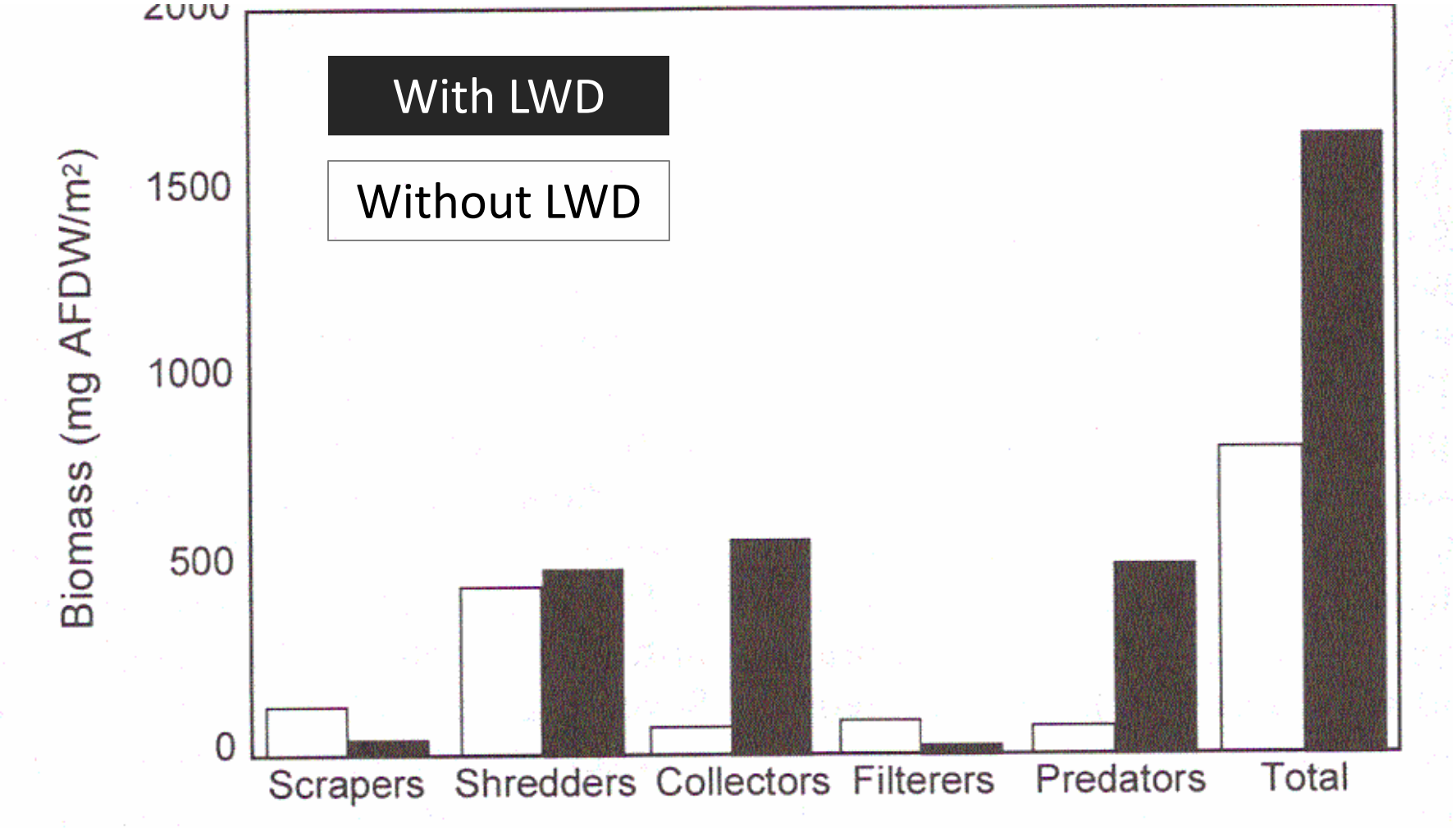
Fish abundance varies with LWD



E 13.8. Biomass of juvenile coho salmon □ and cutthroat trout ■ in southern British Columbia stream
es with little LWD and abundant LWD (data from Fausch and Northcote 1992).

Source: Naiman and Bilby Figure 13.8

Macroinvertebrate functional feeding group varies with LWD



Source: Naiman and Bilby Figure 13.7

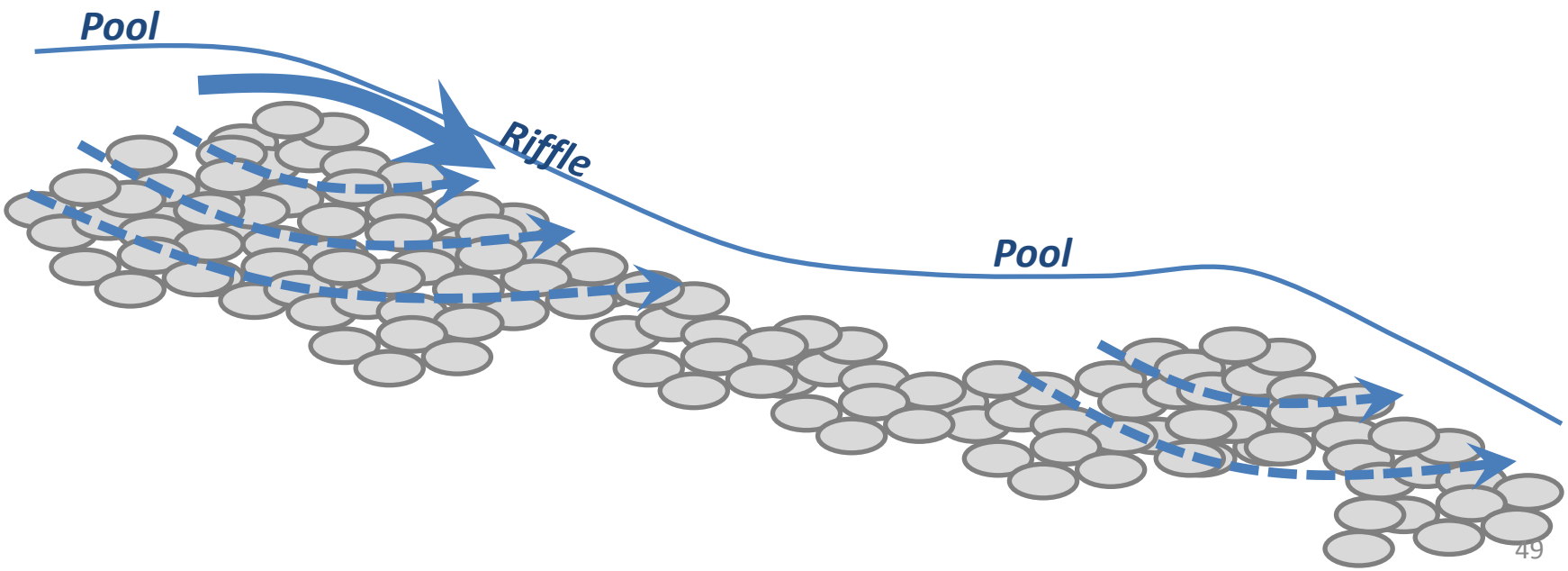
Why does LWD, complexity matter?

- To water quality
  - More sinuosity increases stream length
    - Velocity increases
    - Reaeration increases
    - Dissolved oxygen increases
  - More vertical drops and obstructions
    - Reaeration increases
    - Dissolved oxygen increases
    - Temperature decreases

End aside on channel complexity. Could go on for hours….

5a. Increase channel complexity

- Hyporheic exchange flow (HEF)
  - % surface water flow that recirculates through gravels
  - Cooling effect and biogeochemical processing



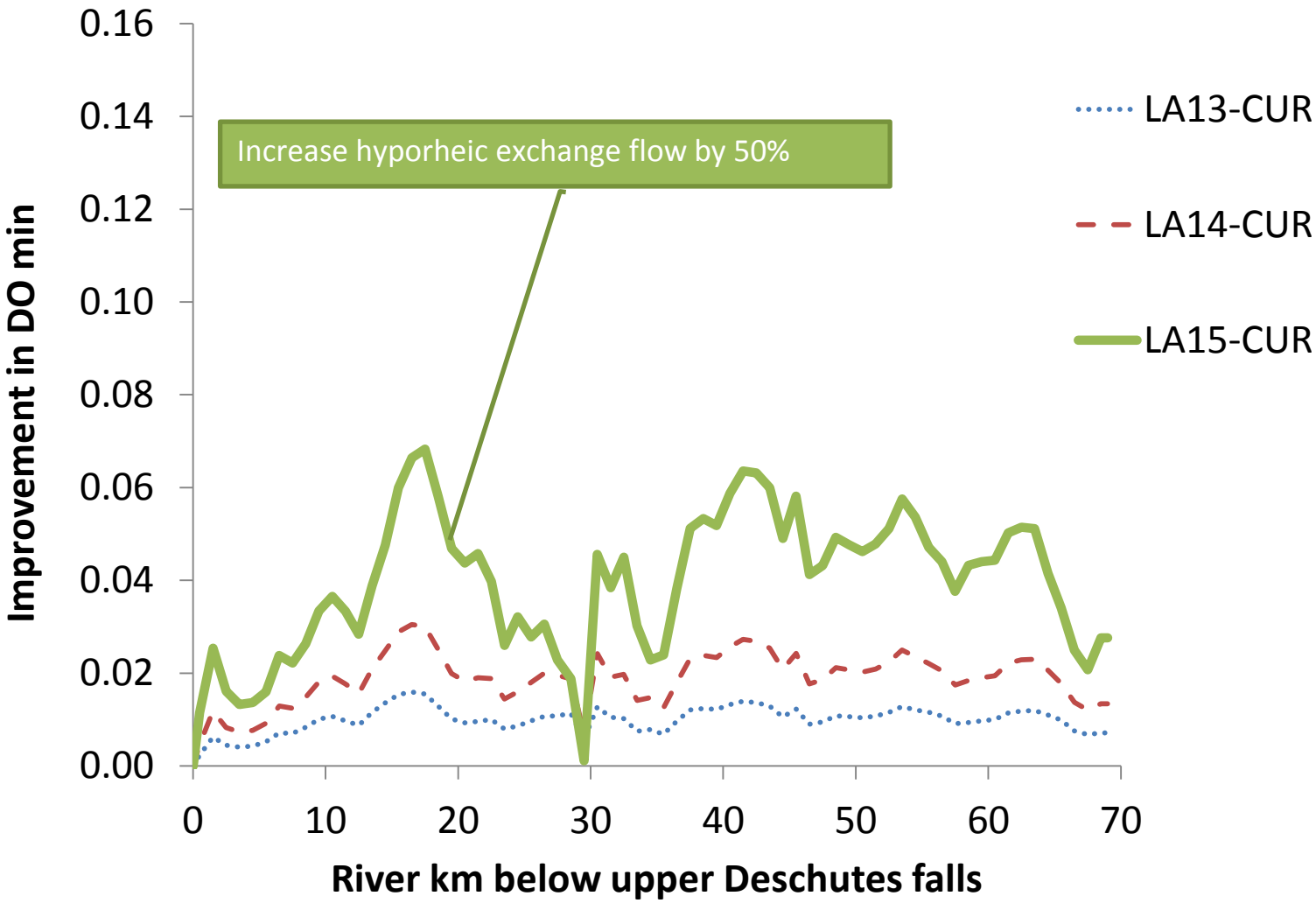
5b. Increase channel complexity

- Manning's n
  - Roughness of bottom
  - Roughness increases as channel complexity increases

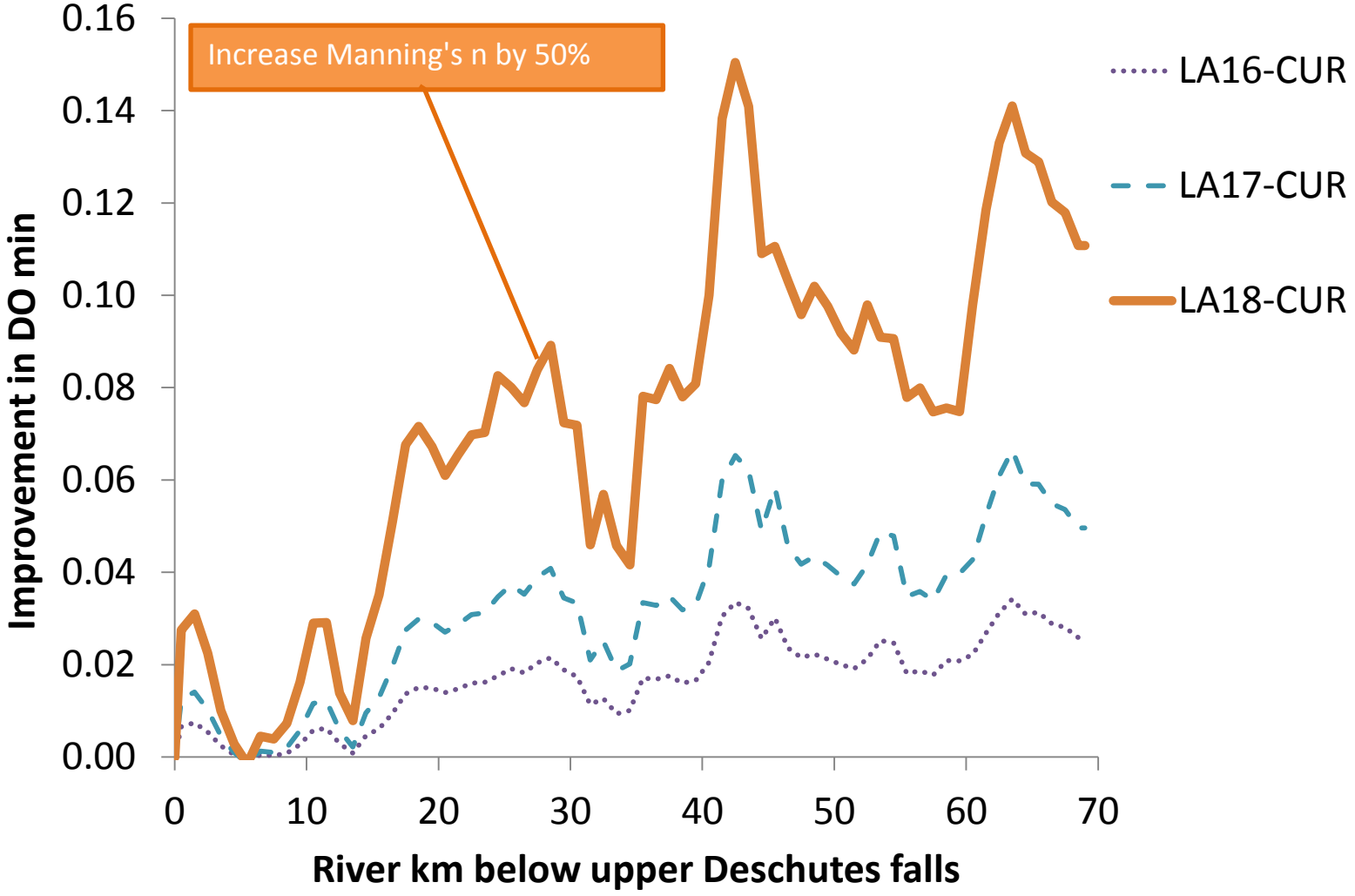
http://www.bing.com/maps/?v=2&cp=47.006459662542994~-122.90114350097802&lvl=18&dir=0&sty=h&form=LMLTCC

http://www.bing.com/maps/?v=2&cp=46.83924385902393~-122.57280467053566&lvl=18&dir=0&sty=h&form=LMLTCC

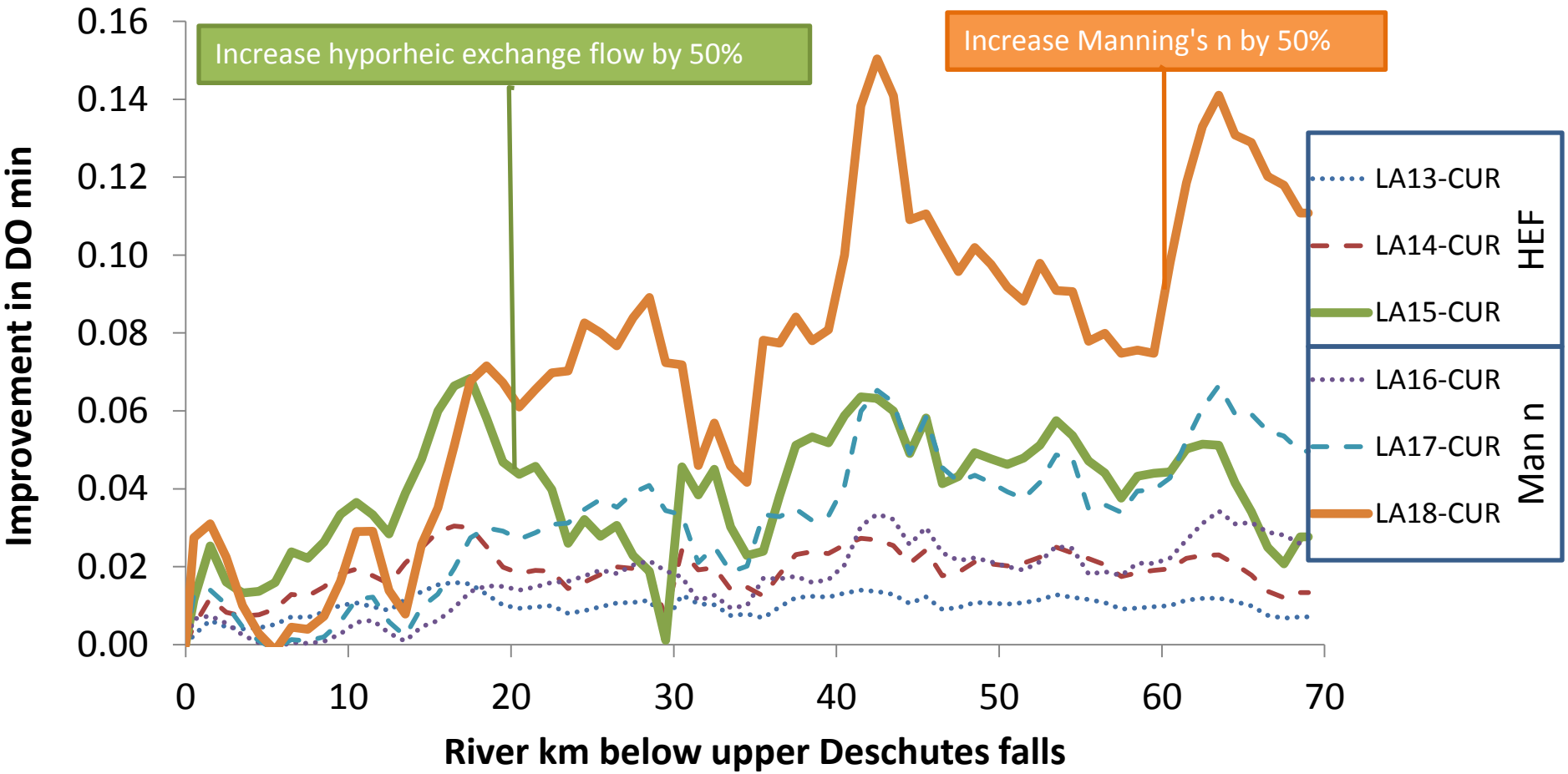
5a. Increase HEF



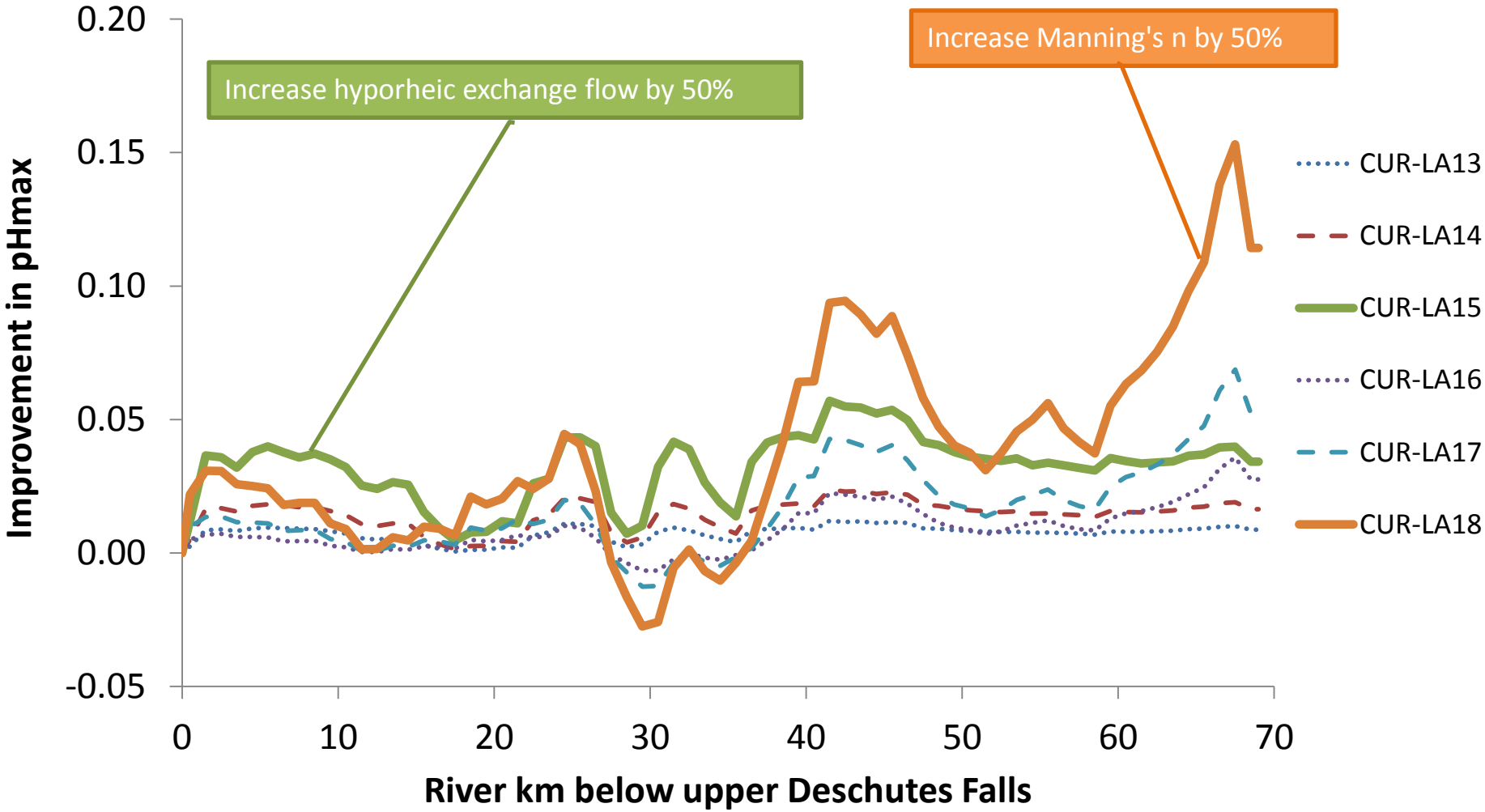
5b. Increase Manning's n



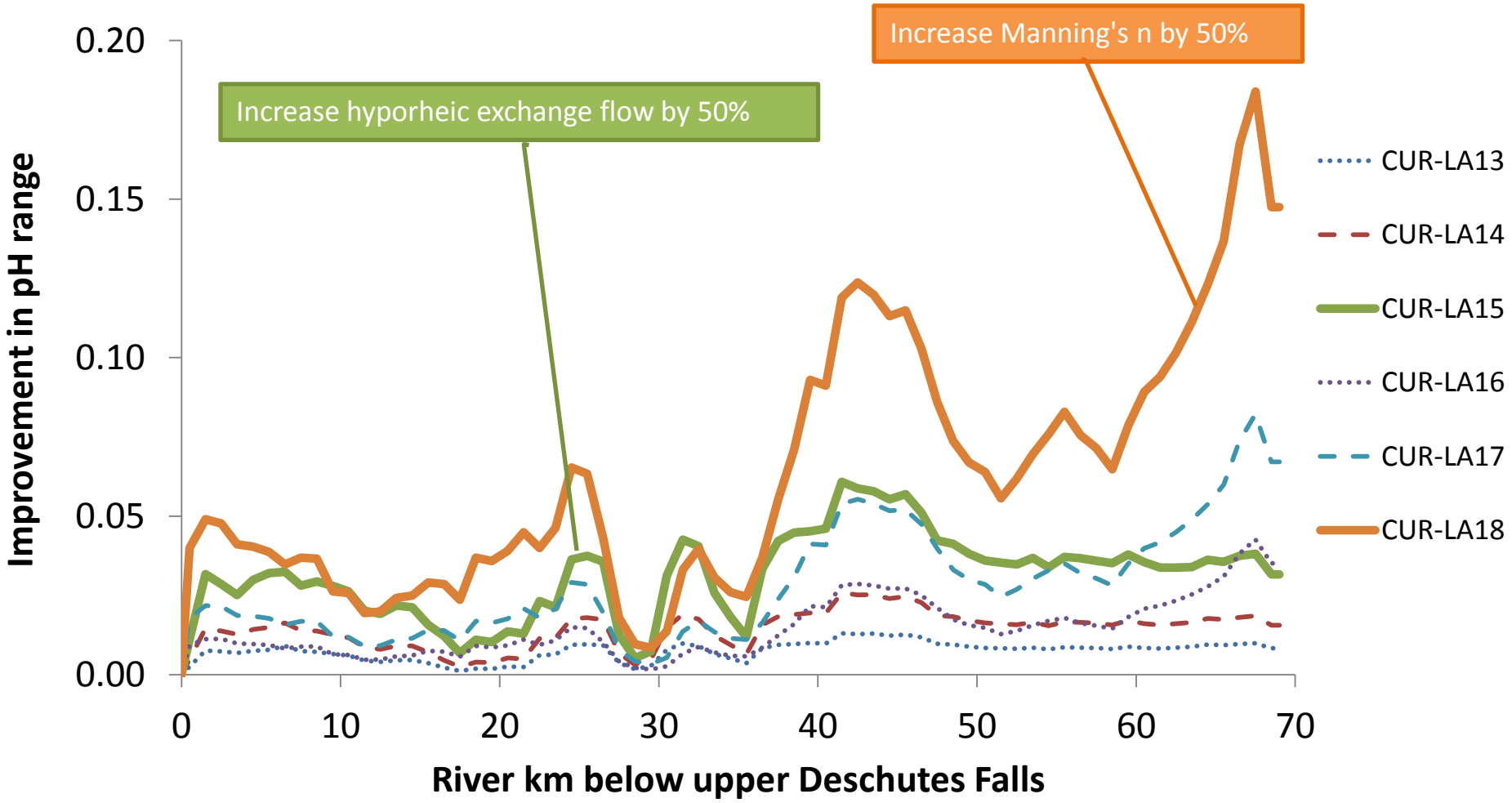
5. Increase HEF and Manning's n – DOmin



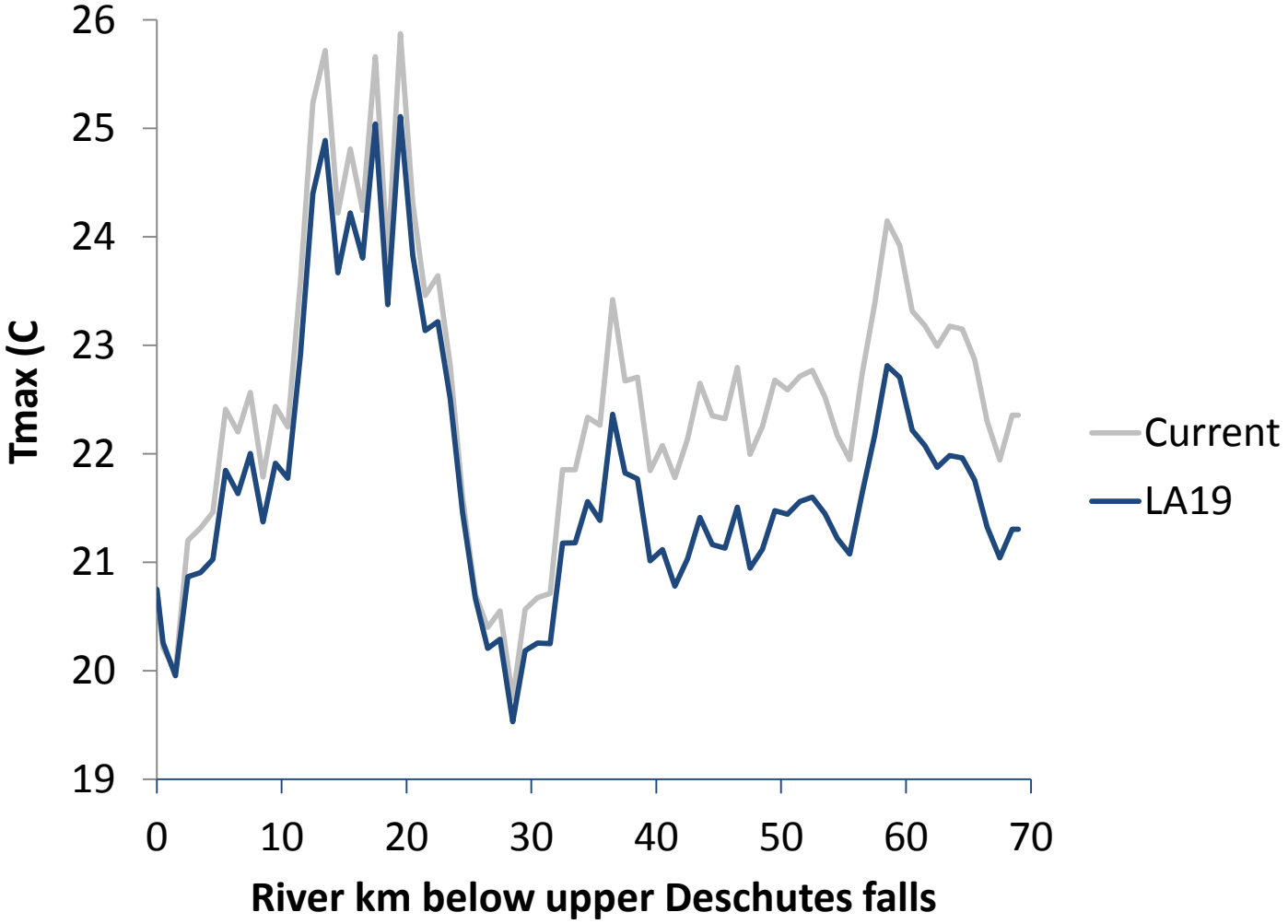
5. Increase HEF and Manning's n – pHmax



5. Increase HEF and Manning's n – pH range



6. Water conservation, exempt wells (temperature benefit)



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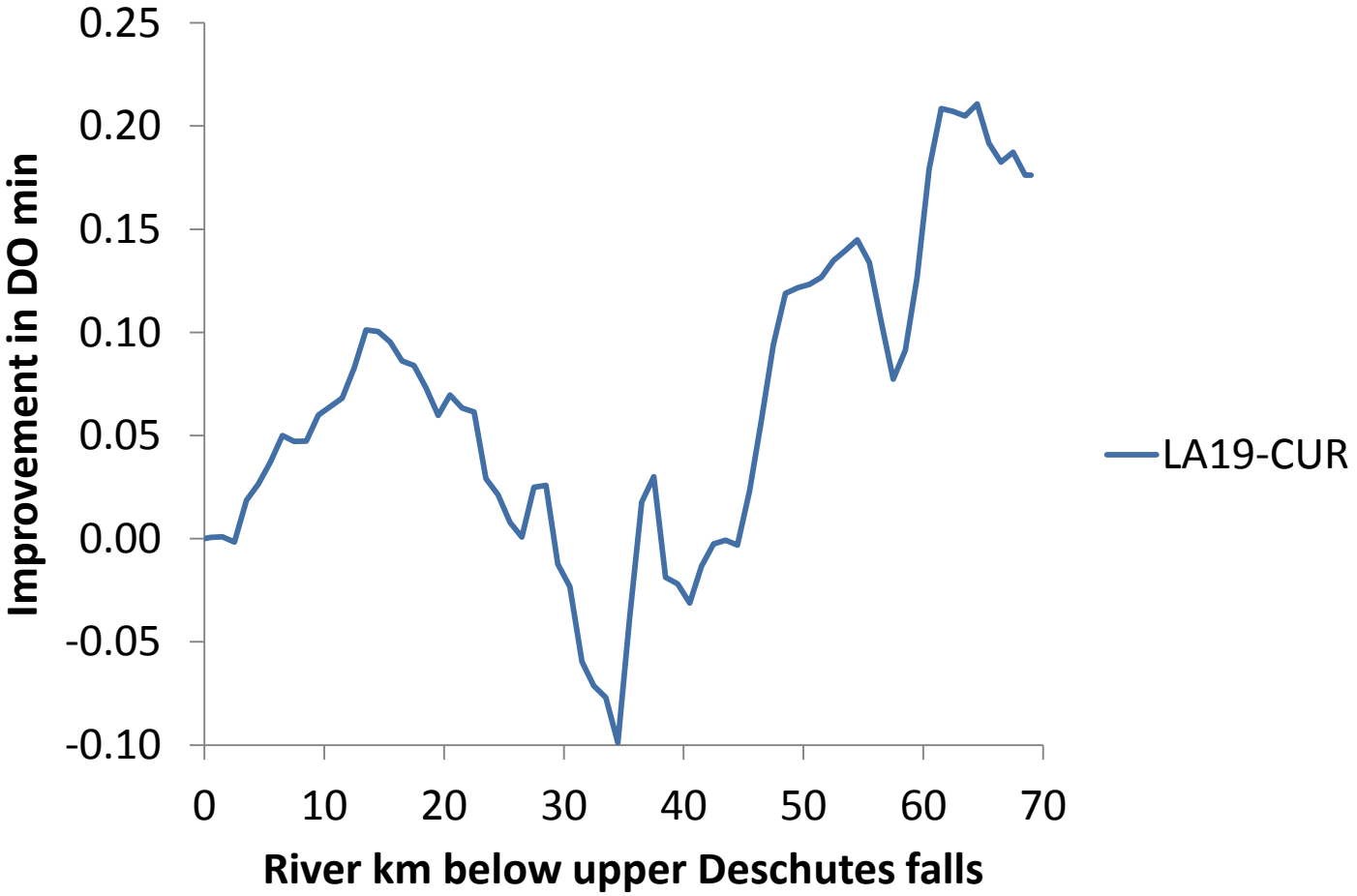

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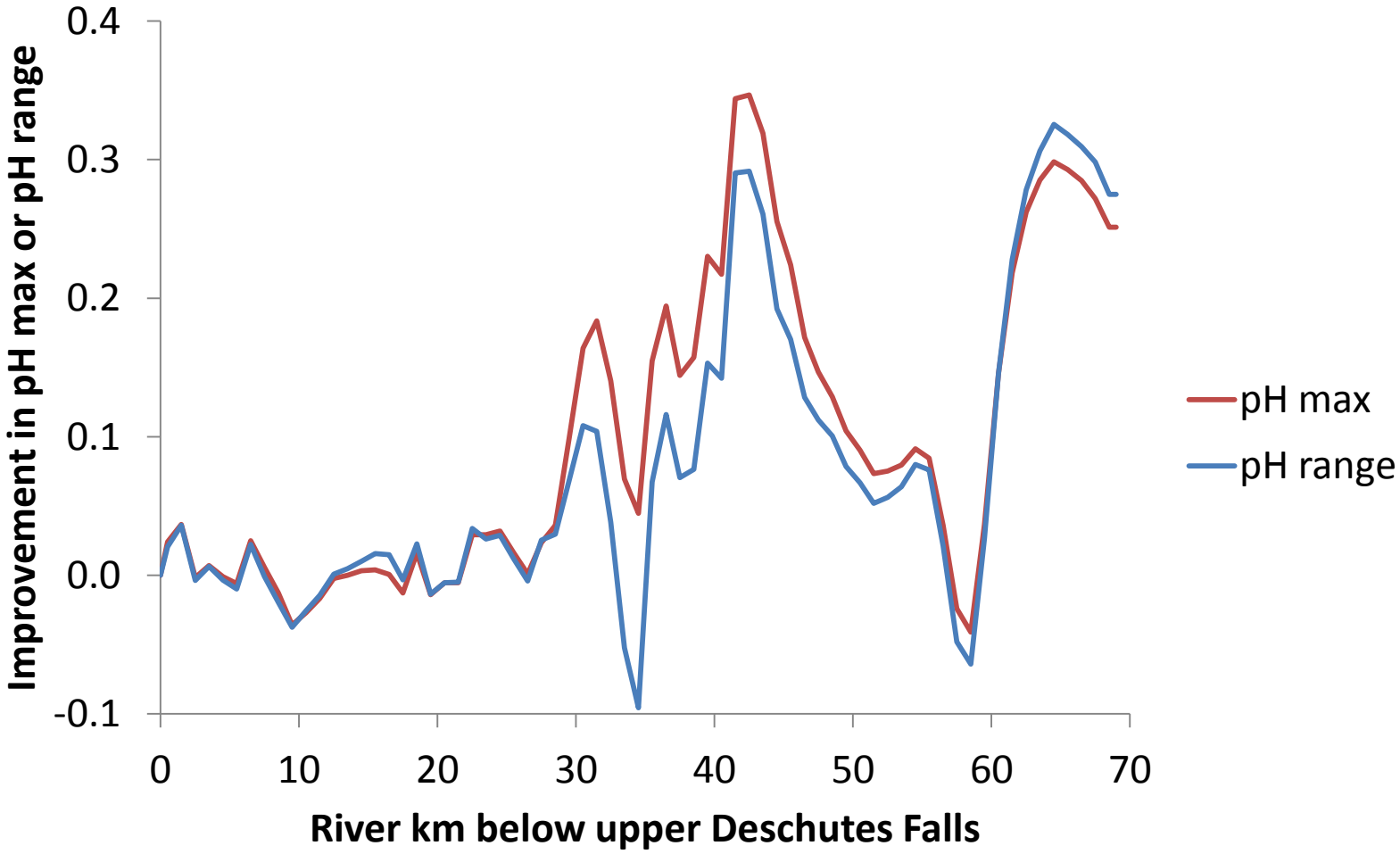


Deschutes River scenario results

- Portions of Deschutes River are sensitive to tributary or groundwater phosphorus
- NPS reductions alone will not meet water quality standards
- Restoring mature riparian vegetation and channel structure would have the greatest impact on DO and pH in the Deschutes River

Next steps for Deschutes scenarios:

- Mix and match scenarios
  - Considering discussion today
- Identify zones of greatest influence
  - Influences extend a few km downstream, but generally coincide with greatest benefit shown on previous graphics

Capitol Lake scenarios

- (separate presentation)

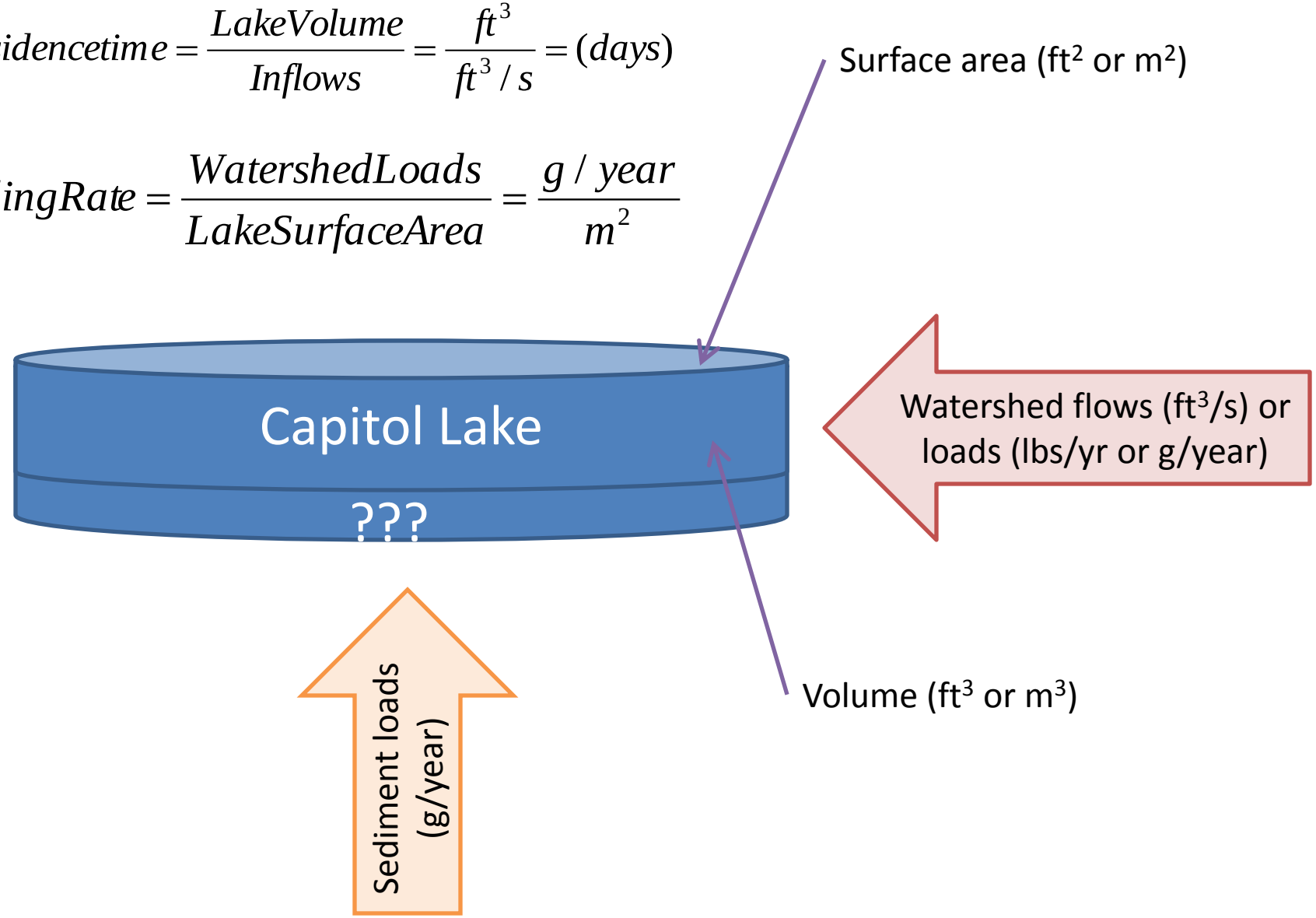
Questions from General Administration:

- If Capitol Lake were to be managed as a lake with routine dredging of a nominally uniform thirteen feet, how would this affect the five TMDL water quality factors* for the lake and for Budd Inlet?
- Effect of watershed improvements?
- Both?

* *Dissolved oxygen, temperature, pH, fecal coliform bacteria, and fine sediment*

$$\text{Residence time} = \frac{Lake\,Volume}{Inflows} = \frac{ft^3}{ft^3/s} = (days)$$

$$Loading\,Rate = \frac{Watershed\,Loads}{Lake\,Surface\,Area} = \frac{g/year}{m^2}$$



Increase depth (3.2 m ➡ 4.0 m, +22%)

- Increase volume
  - 3.36×10^6 ➡ 4.19×10^6 m^3
- Increase mean annual residence time
  - 3.5 ➡ 4.3 days
- Increase summer residence time
  - 23.0 ➡ 28.6 days

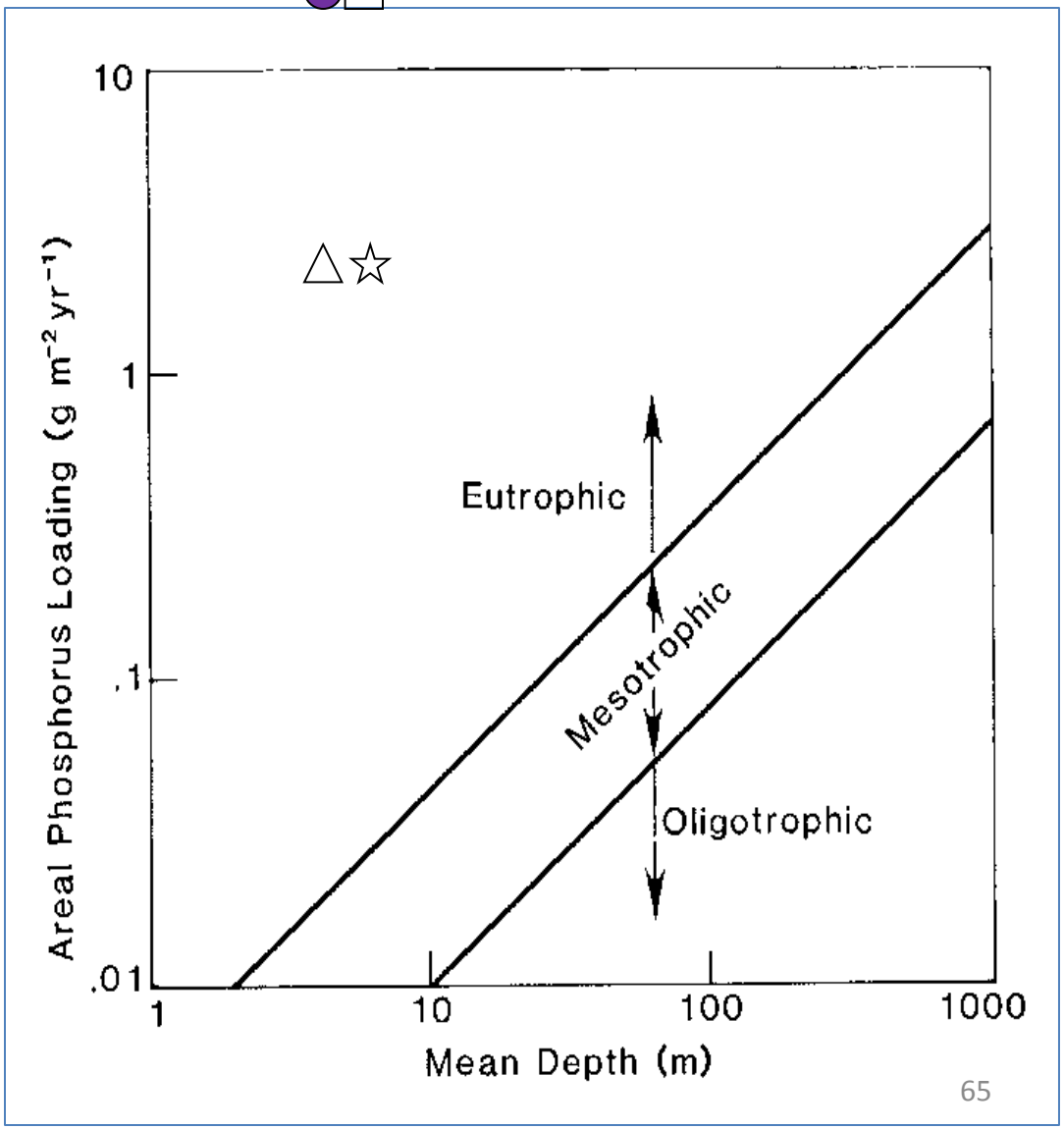
Vollenweider (1968)

<u>Deschutes River</u> Loading Rates (g/m^2/yr)

- 25.9 *(estimated annual)*
- 1.9 *(measured summer)*

<u>Capitol Lake Sediment</u> Loading Rates (g/m^2/yr)

- 1.6 *(average model)*
- 10.6 *(maximum measured)*



Conclusion

"Given the large areal phosphorus loading and continued relatively shallow depths in Capitol Lake, ***we do not believe that the proposed dredged lake alternative would result in measurable improvements in water quality***."

Budd Inlet scenarios

1. Reduce nonpoint nitrogen
2. Advanced wastewater treatment for all plants
3. Extend LOTT outfall
4. Reduce other SPS nutrient sources
5. Shellfish for restoration
6. Decrease boater waste

6. Decrease boater waste

- Calculation only (no model)
- Annual and peak summer estimates
- Recreational boaters ~0.4 kg/d nitrogen
- Marinas ~4.6 kg/d nitrogen

<u>Loads per person:</u>

FC	1950	10^6/day/person
TP	1	kg-P/yr
TN	4.5	kg-N/yr

Saanich Inlet, Vancouver Island

Recreational boaters

	Annual	Peak Summer	
Number of people using Budd Inlet per day	5	200	
Proportion of time on Budd Inlet	10%	30%	
Proportion of people peeing overboard:	50%	50%	
Proportion of people defecating:	1%	1%	
Fecal Coliform Load:	9.75	1170	10^6/day
Phosphorus Load:	1.4E-05	0.002	kg/d
Nitrogen Load:	3.1E-03	0.370	kg/d
	1.13	135	kg/yr

Marinas

	Annual	Peak Summer	
Number of people using Budd Inlet marinas	500	2000	
Proportion of time at marina	75%	75%	
Proportion of people peeing overboard:	25%	25%	
Proportion of people defecating to marine:	5%	5%	
Fecal Coliform Load:	36562	146250	10^6/day
Phosphorus Load:	0.05	0.205	kg/d
Nitrogen Load:	1.2	4.6	kg/d
	422	1688	kg/yr