



DO TMDL Advisory Committee Mtg June 16, 2016

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Longitudinal Structure

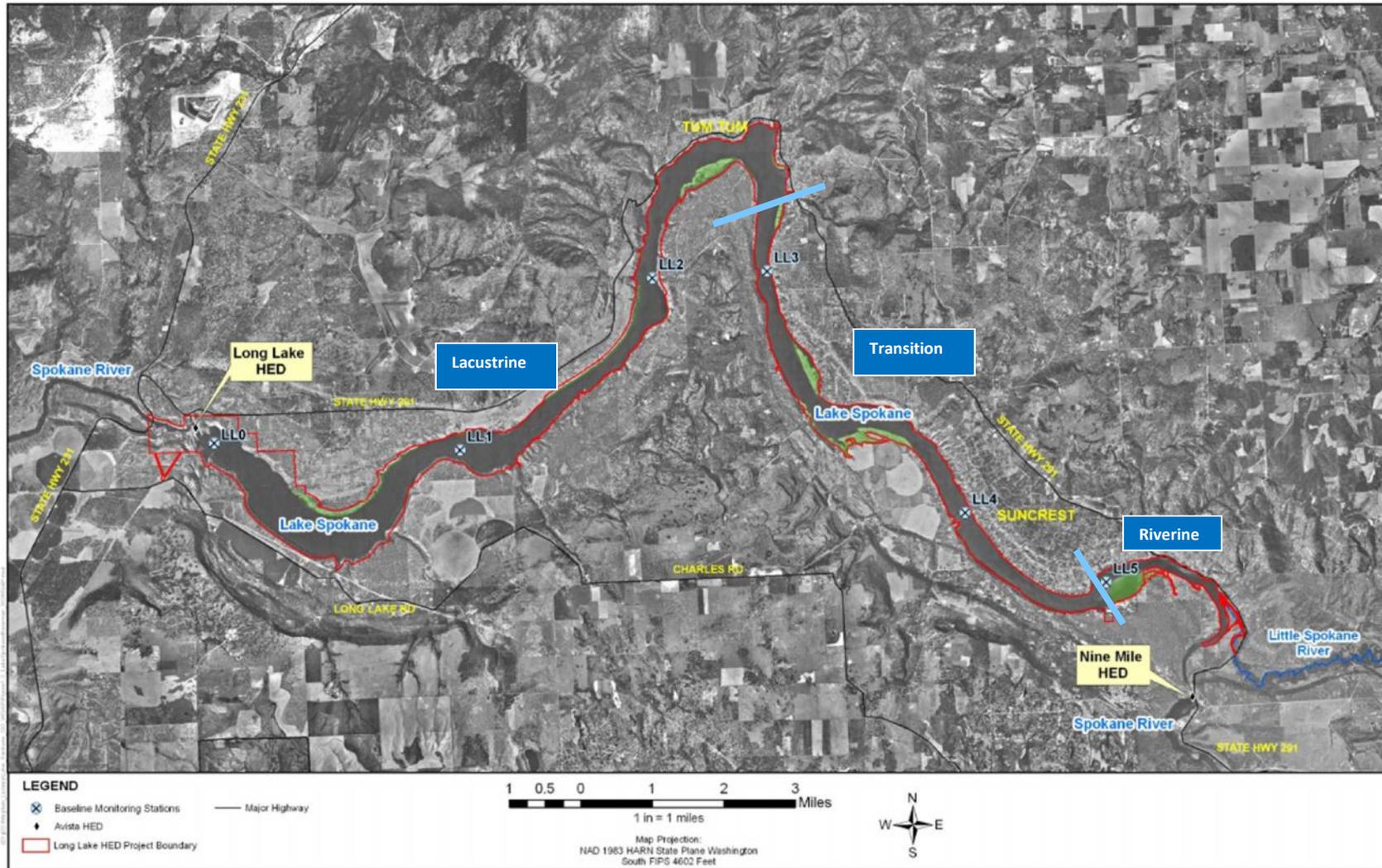
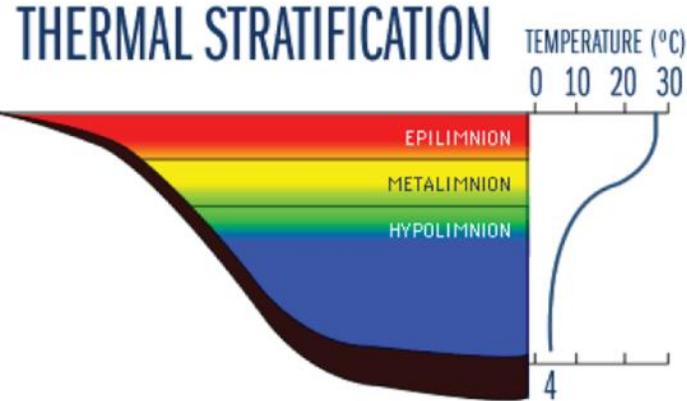


Figure 1. Lake Spokane Baseline Monitoring Stations

Vertical Structure



Discrete Depth Sampling Stations

| Lake Spokane Sampling Station and Discrete Depth | | | | | | |
|--|-----|-----|-----|-----|-----|-----|
| | LL0 | LL1 | LL2 | LL3 | LL4 | LL5 |
| Dep ths | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| | 5 | 5 | 5 | 5 | 4 | B-1 |
| | 15 | 20 | 15 | 10 | B-1 | |
| | 30 | B-1 | B-1 | B-1 | | |
| | B-1 | | | | | |

2015 Sample Dates:

- May 13-14
- June 9-10
- June 23-24
- July 7-8
- July 21-22
- August 4-5
- August 23-24
- Sept. 8-9
- Sept. 23-24
- October 13-14

Lab Analyses

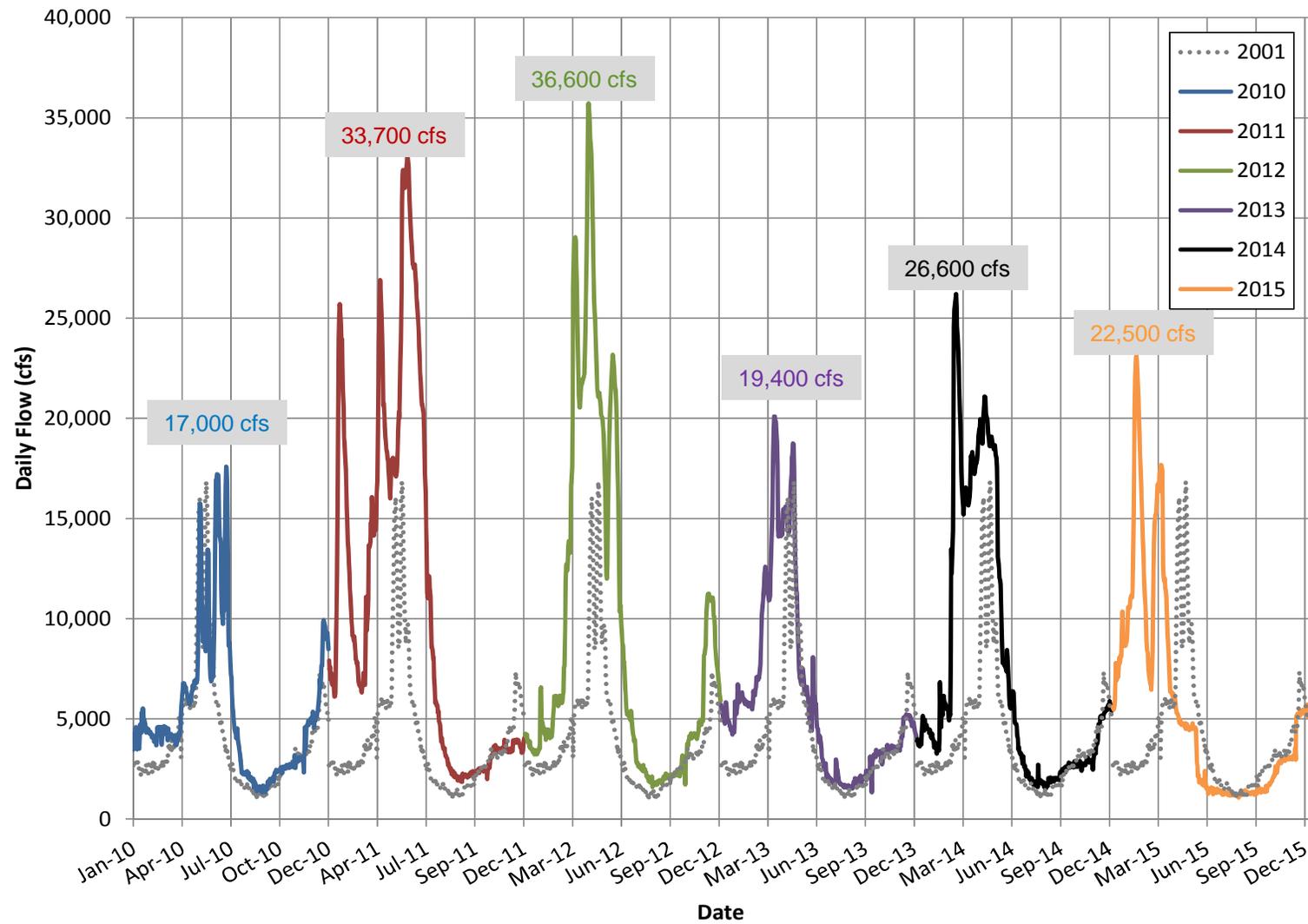
- Nitrate plus nitrite
- Total persulfate nitrogen (TN)
- Soluble reactive phosphorus (SRP)
- Total phosphorus (TP)
- Chlorophyll *a* (chl)
- Phytoplankton
- Zooplankton

In Situ

- Water temperature
- Dissolved oxygen
- pH
- Conductivity
- Secchi Disc Depth



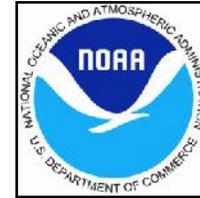
Lake Spokane Inflow



2001 Peak Streamflow = 16,800 cfs

*2001, 2010-2015 Peak Streamflows from USGS, Spokane River @ Spokane Gage

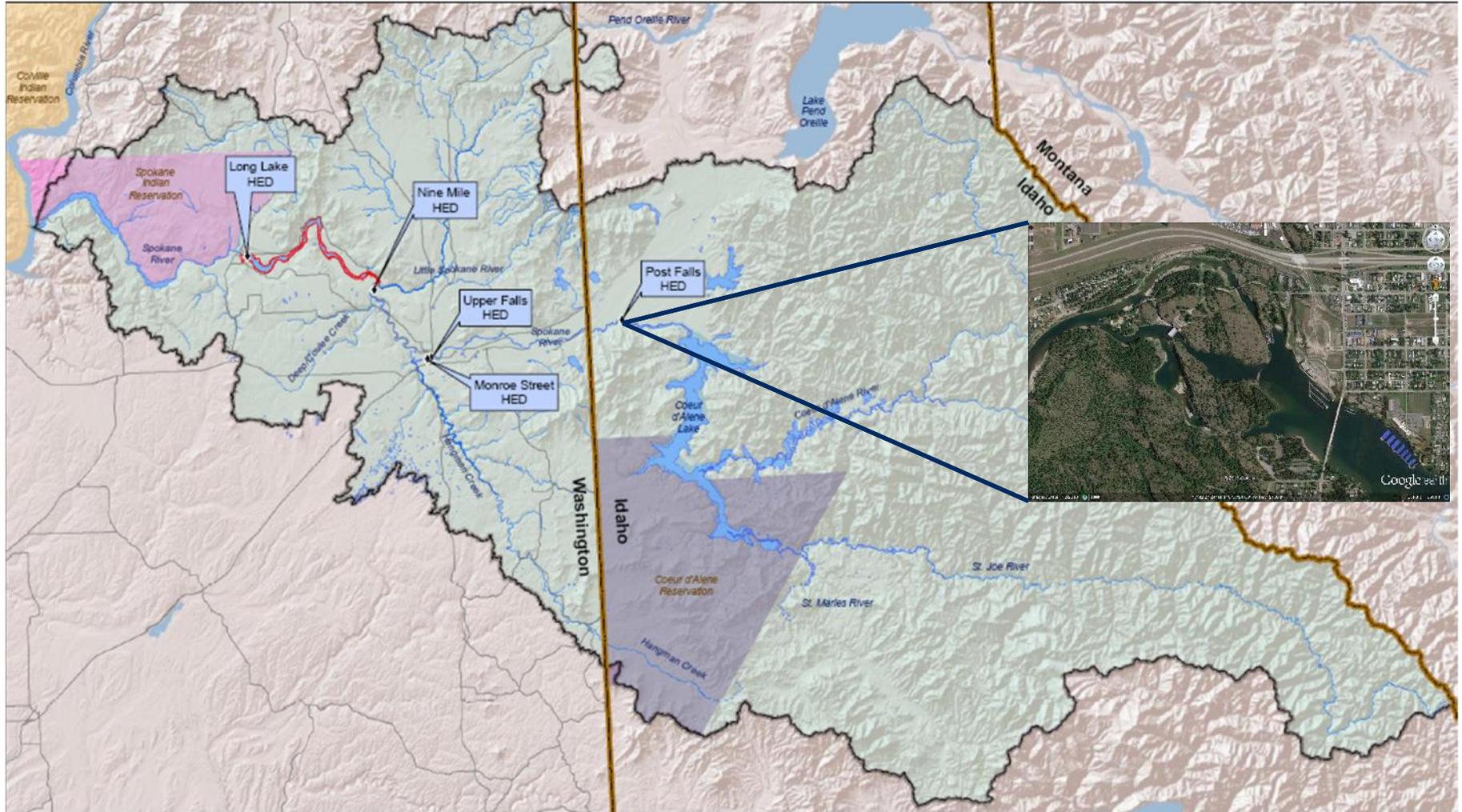




2015 NWS/NOAA Weather Observations

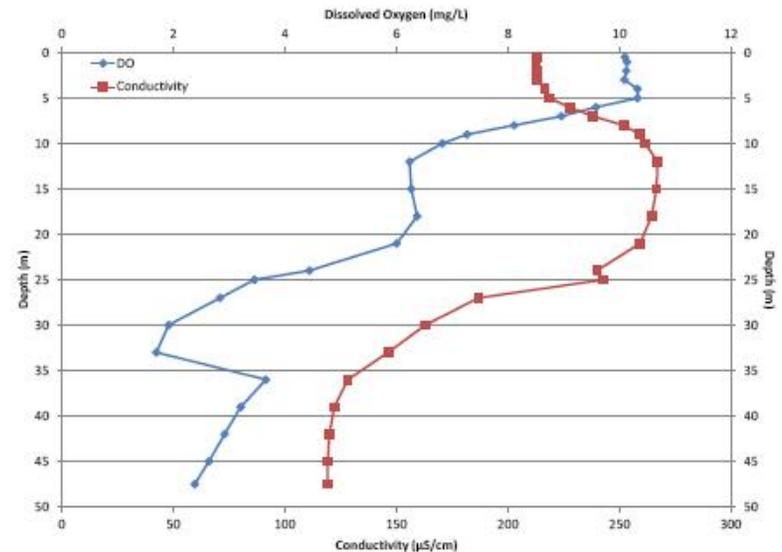
- Very Low Snowpack
- Early Snowmelt
- Record Hot June (and spring/summer)
- Very/Record Dry June (and spring/summer)
- High evaporation rates

Post Falls HED



2015 Lake Spokane Monitoring

- Dissolved Oxygen
 - Max conc. ~11.4 to 14.5 mg/L
 - Ave conc. 7.1 to 10.9 mg/L
 - **Min conc. 0 mg/L**
 - July – Sept. volume weighted hypolimnetic ave. ranged from 5.4 to 7.0 mg/L



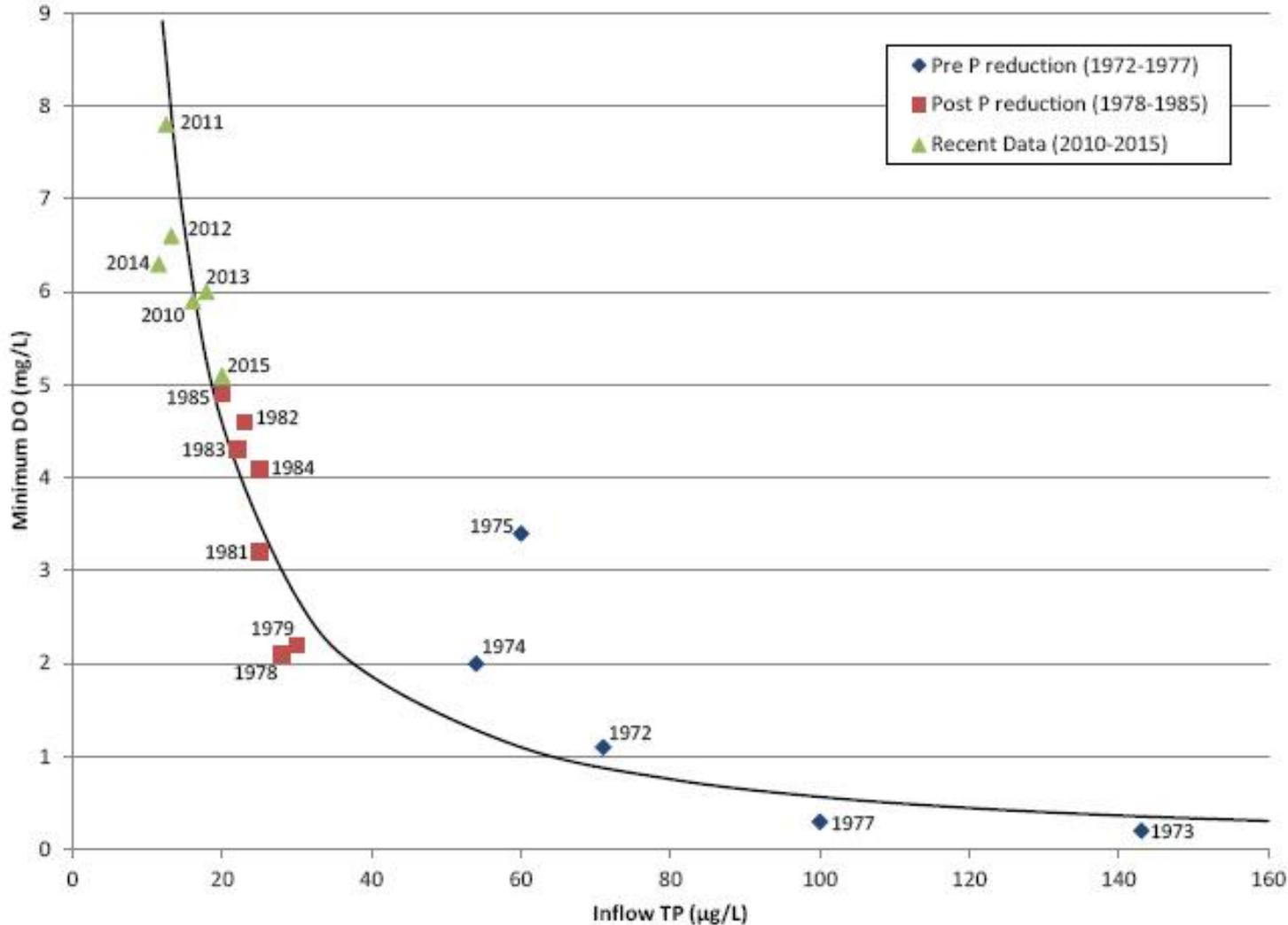
Ave. DO & Conductivity for LL0, LL1, LL2 (late July – Sept.)

- Total Phosphorus
 - Ranged from 3.1 to 59 µg/L
 - Volume weighted hypolimnetic TP conc. ave <40 µg/L
- Soluble Reactive Phosphorus
 - Ranged from non-detect (1.0 µg/L) to 53 µg/L

2015 Lake Spokane Monitoring

- Nitrogen
 - Ranged from 470 to 2,300 $\mu\text{g/L}$
 - Most of the TN consisted of nitrate + nitrite
- Chlorophyll-a
 - Ranged from 0.2 to 18.2 $\mu\text{g/L}$
 - Often highest at ~16 ft depth
- Transparency
 - Ranged from 1.2 to 9.9 m depth
- Zooplankton/Phytoplankton
 - diatoms and green algae greatest biovolume
 - substantial cyanobacteria biovolume at LL5 in late July and late August

June – October Volume Weighted Mean Inflow TP Concentrations related to Volume Weighted Hypolimnetic DO Concentrations before and after advanced wastewater treatment.

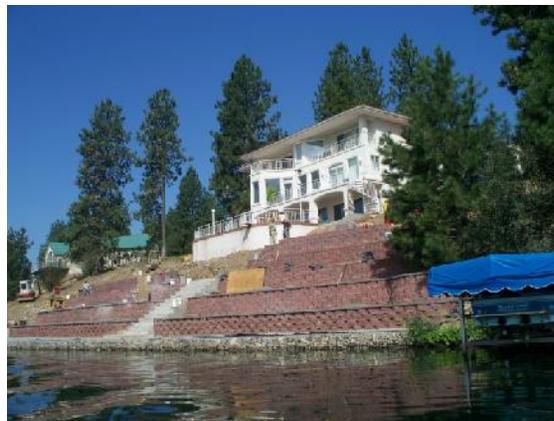


Source: TetraTech 2016 (Lake Spokane Annual Summary Report, 2015 Baseline Water Quality Monitoring Results)



DO WQAP Implementation

- Carp Population Reduction
- Bulkhead Rmvl/Reducing lawn areas
- Grazing land lease
- Wetlands/Floating Treatment Wetland
- Planting trees
- Education



Rainbow Trout Stocking

- 155,000 Rainbow Trout stocked annually, FERC License Requirement



Questions?

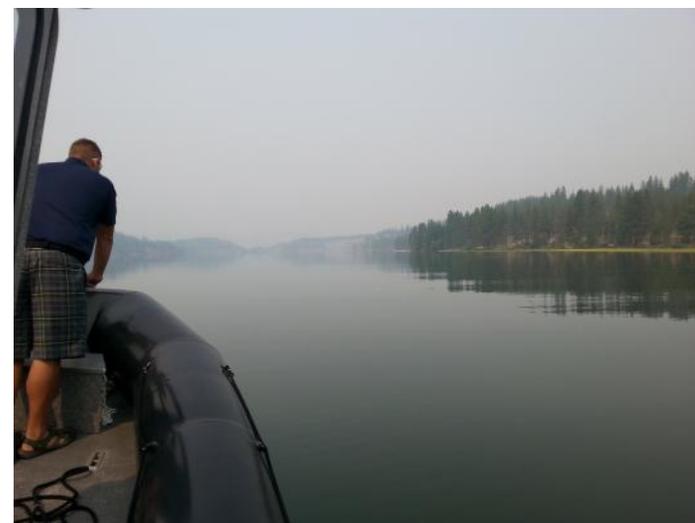


Table 4. Inflows and water residence times in Lake Spokane during 2010-2015. Residence times are for June through October.

| Year | Total Annual Flow Volume (cf x10 ⁶) | Annual Mean Daily Flow (cfs) | Mean Daily Summer (June-October) Flow (cfs) | Residence Time ¹ Whole Lake (days) | Residence Time ¹ Transition/Riverine Zones (days) |
|------|---|------------------------------|---|---|--|
| 2010 | 167,113 | 5,299 | 4,671 | 23.9 | 4.5 |
| 2011 | 337,576 | 10,704 | 7,828 | 14.4 | 2.7 |
| 2012 | 293,971 | 9,296 | 5,768 | 19.4 | 3.6 |
| 2013 | 189,846 | 6,020 | 3,035 | 36.8 | 6.9 |
| 2014 | 234,999 | 7,452 | 3,581 | 31.3 | 5.9 |
| 2015 | 171,137 | 5,427 | 1,595 | 70.1 | 13.2 |

¹residence time = lake volume/outflow

Table 5. Daily flows and water residence times in Lake Spokane during 2010-2015, using DO TDML seasonal timeframes.

| Year | Mean Daily Summer Flow (cfs) | | | | Residence Time ¹ Whole Lake (days) | | | | Residence Time ¹ Transition/Riverine Zones (days) | | | |
|------|------------------------------|--------|--------------|-------|---|------|--------------|------|--|------|------------|------|
| | May | June | July – Sept. | Oct. | May | June | July – Sept. | Oct. | May | June | July–Sept. | Oct. |
| 2010 | 10,036 | 13,297 | 2,550 | 2,620 | 11.2 | 8.4 | 43.8 | 42.7 | 2.1 | 1.6 | 8.2 | 8.0 |
| 2011 | 25,596 | 24,323 | 4,232 | 2,538 | 4.3 | 4.6 | 26.5 | 44.1 | 0.8 | 0.9 | 5.0 | 8.3 |
| 2012 | 23,667 | 17,333 | 3,092 | 2,520 | 4.8 | 6.5 | 36.1 | 44.4 | 0.9 | 1.2 | 6.8 | 8.3 |
| 2013 | 9,037 | 5,956 | 2,133 | 2,884 | 8.5 | 18.7 | 52.5 | 38.8 | 1.6 | 3.5 | 9.8 | 7.3 |
| 2014 | 19,127 | 8,243 | 2,373 | 2,657 | 5.9 | 13.6 | 47.2 | 41.9 | 1.1 | 2.6 | 8.9 | 7.9 |
| 2015 | 4,724 | 2,360 | 1,317 | 1,678 | 23.8 | 47.5 | 84.8 | 66.6 | 4.5 | 8.9 | 15.9 | 12.5 |

¹residence time = lake volume/outflow



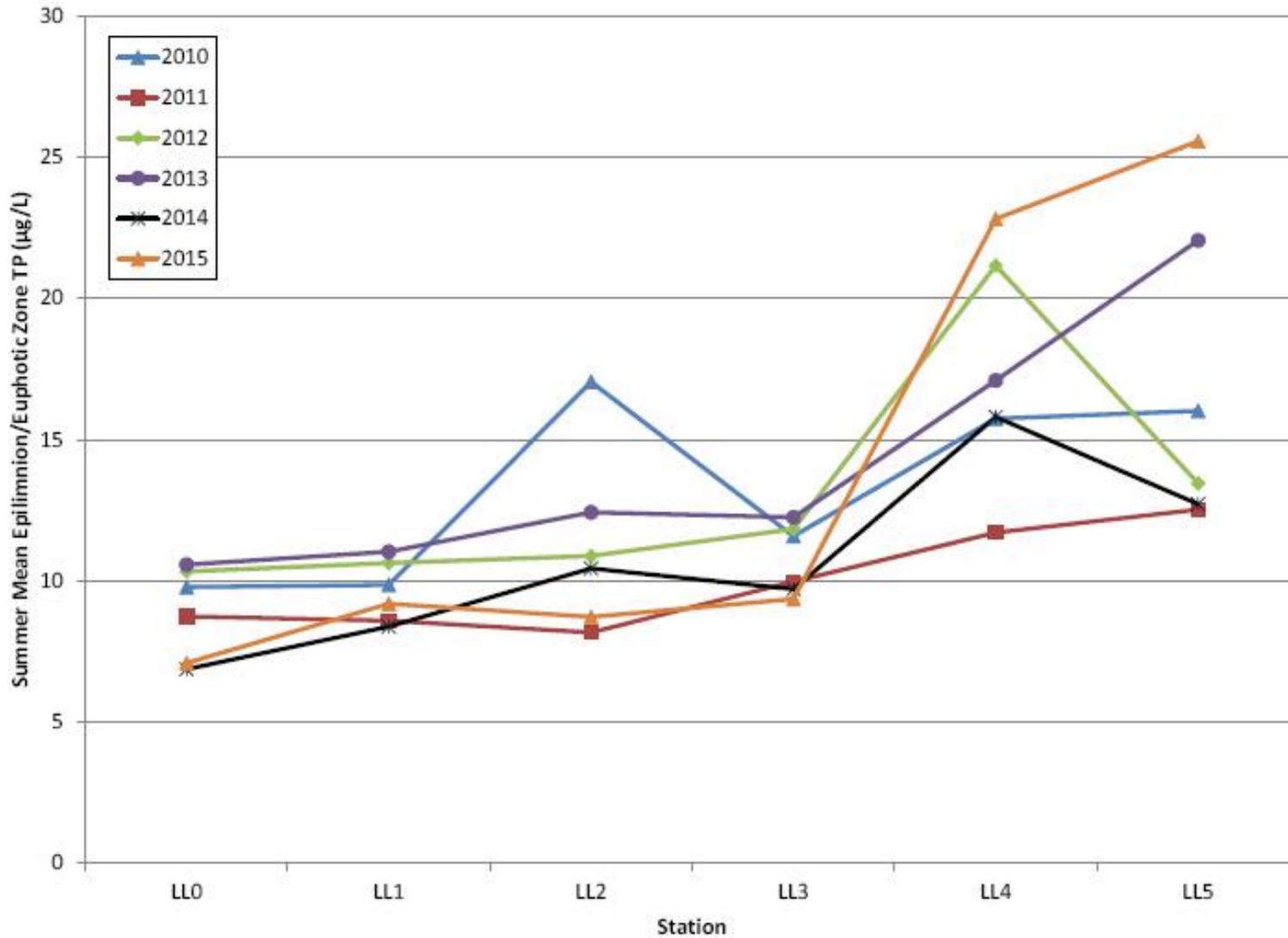


Figure 103. Summer (June-September) Mean Epilimnion/Euphotic Zone TP Concentrations, 2010-2015
 (Data is presented from down-reservoir to up-reservoir, left to right.)

