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Wasteload Allocation Study: Impact Potential Evaluation

Water Quality Advisory Committee

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Delaware River Basin Commission

DELAWARE • NEW JERSEY
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UNITED STATES OF AMERICA

WLA Study Phases:

- ✓ **Phase 0: Data Acquisition and Model Setup**
- ✓ **Phase 1: Develop Baseline Scenarios**
- **Phase 2: Impact Analysis**
- **Phase 3: Determine Allocation Strategy for Impactful PS**
- **Phase 4: WLA Refinements**

- At the first Co-Regulators Workgroup meeting (March 26, 2026), the States were asked to provide five years of discharge monitoring report (DMR) data (2021–2025)
- DRBC analyzed these data to develop baseline effluent concentrations for the WLA model, including **CBOD, NH₃/NH₄, NO₃/NO₂, and dissolved inorganic phosphorus (DIP)**
- Baseline effluent characterizations reflect our best estimate of current treatment performance

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Actual Condition (**calibration / corroboration**)

- “Actual Flows” hydrodynamic simulation
- Best estimate of actual discharge flows and concentrations

Baseline Permitted Condition

- “Permitted Flows” hydrodynamic simulation
 - Discharge flows set to permitted flow (constant)
- Discharge concentrations based on last 5-years
 - Monthly or annual constants
- CSO loads decreased to account for LTCP implementation

De Minimis Scenario

- “Permitted Flows” hydrodynamic simulation
- All 67 PS assigned background levels of PS-CBODu (1.5 mg/L) and NH₃-N (0.1 mg/L)

*All simulations conducted for 2012, 2018-2019

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67 PS Discharges
47 Municipal
20 Industrial



Potential DO Impact
NBOD + CBOD

WLA Study: Phase 2 Roadmap

Key



Benchmark



Modeling Test



Potential WLA

Potential DO Impact Simulations for CBOD + NBOD

Goal: *Evaluate the potential DO impact of each PS discharge individually by increasing both CBOD and NBOD concentrations to the high end of current permitted values across the Estuary.*

For each simulation, one PS discharge at a time was assigned:

- PS-CBOD_u = 35 mg/L
- NH₃-N = 35 mg/L

All other PS discharges were held at background concentrations:

- PS-CBOD_u = 1.5 mg/L
- NH₃-N = 0.1 mg/L

Each simulation was compared to a **De Minimis Scenario**, in which all PS discharges were assigned background concentrations:

- PS-CBOD_u = 1.5 mg/L
- NH₃-N = 0.1 mg/L

- Simulations were conducted for **2019** → a reasonable representation of a critical DO year
- Simulations use the “Permitted Flows” hydrodynamic simulation
- **ΔDO Impact Summaries** were prepared for **WQ Zones 2–5** during the **critical period (Mar – Oct)**

Impact metrics developed based on delta-DO between 2019 2D scenarios



Maximum Impact

Maximum ΔDO (mg/L) any cell any day:

Date: 2019-09-22

Cell: 31_131

River Mile: 89.9

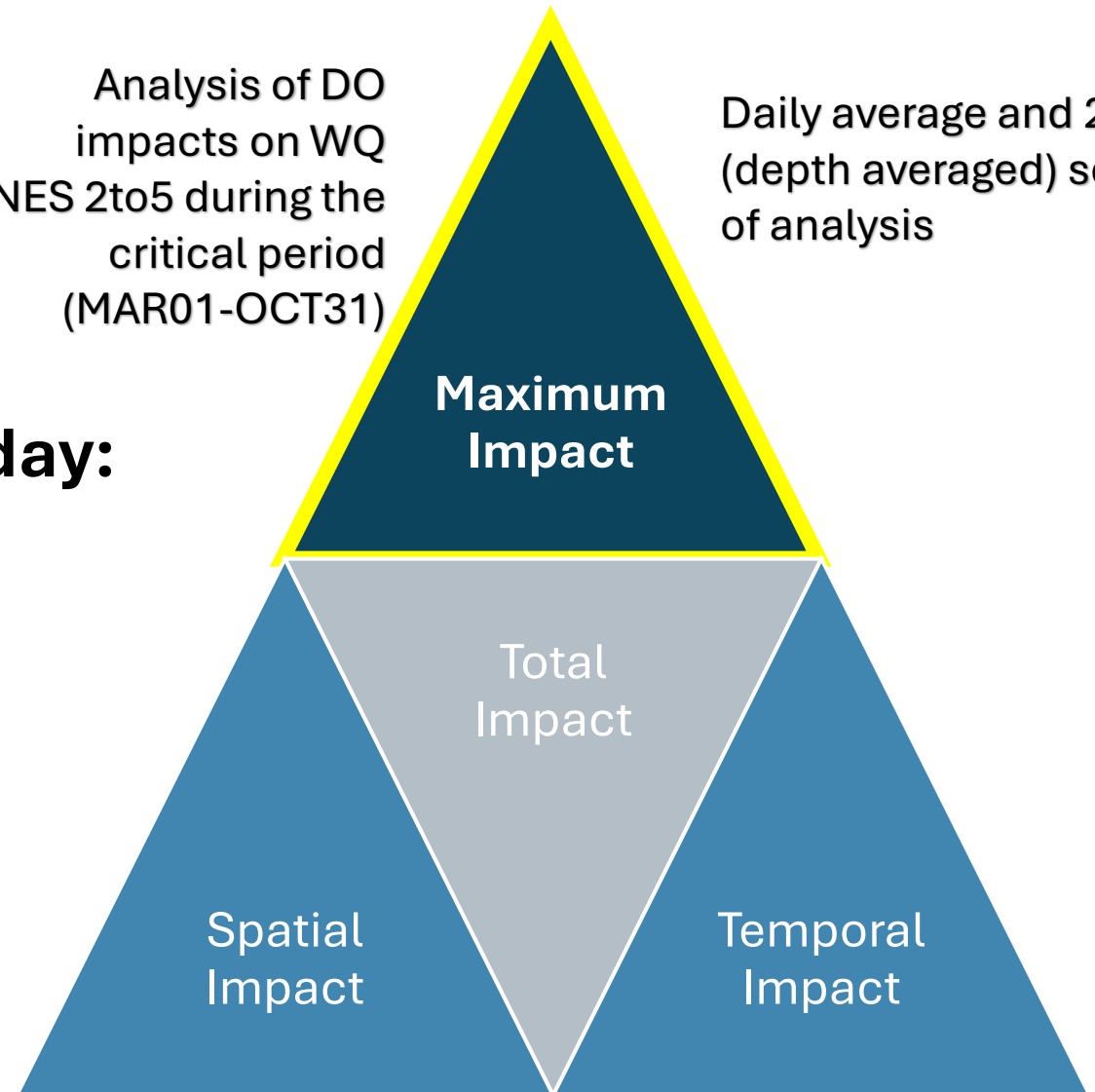
DO Before: 7.12

DO After: 4.724

Max ΔDO : 2.397

Analysis of DO
impacts on WQ
ZONES 2to5 during the
critical period
(MAR01-OCT31)

Daily average and 2D
(depth averaged) scale
of analysis



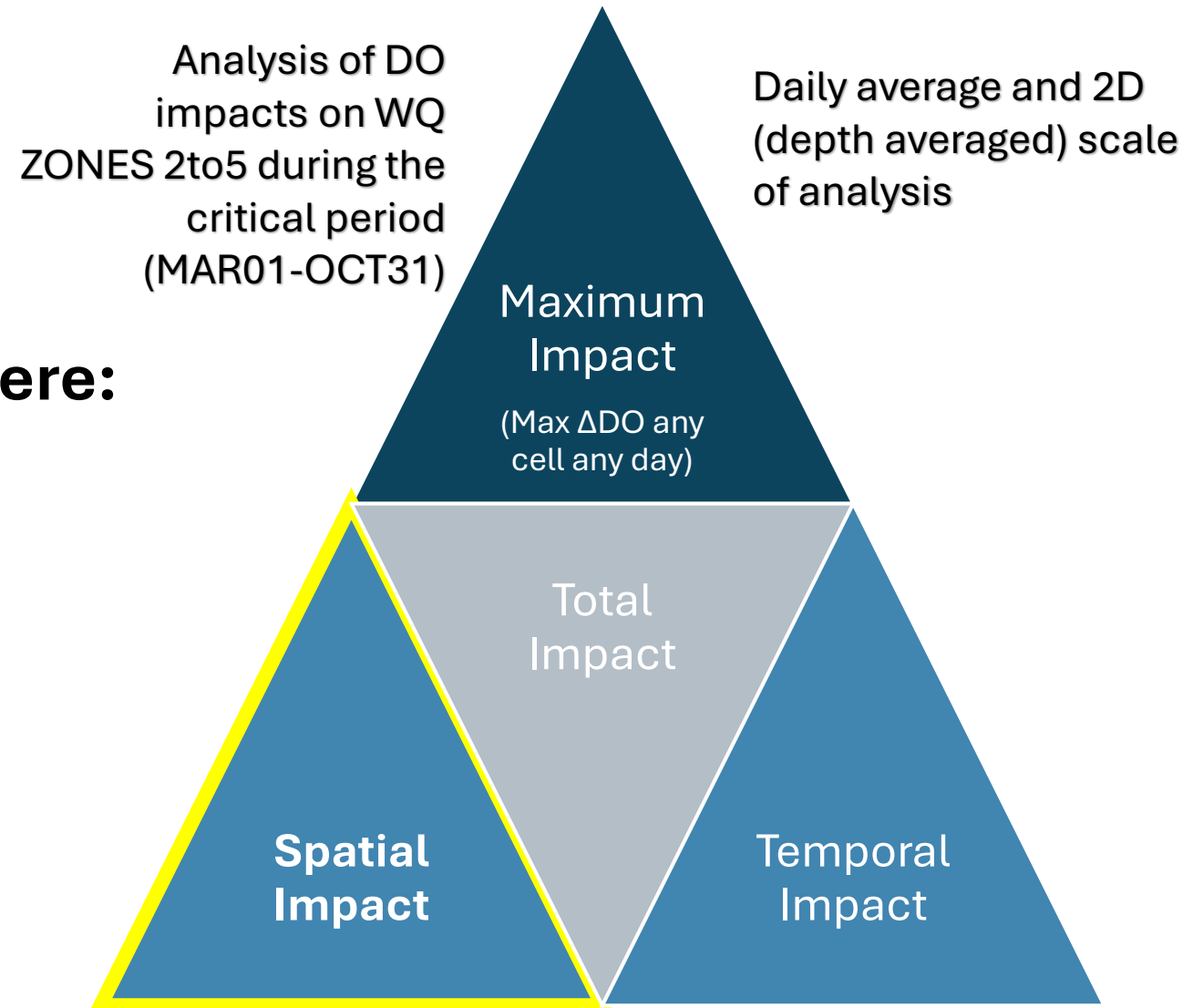
Impact metrics developed based on delta-DO between 2019 2D scenarios



Spatial Impact

Volume (or Area) of Influence where:

Max ΔDO > 0.01 mg/L: 95.3%
Max ΔDO > 0.05 mg/L: 93.2%
Max ΔDO > 0.10 mg/L: 92.0%
Max ΔDO > 0.15 mg/L: 91.2%
Max ΔDO > 0.25 mg/L: 84.4%
Max ΔDO > 0.50 mg/L: 50.6%
Max ΔDO > 1.00 mg/L: 26.4%



Impact metrics developed based on delta-DO between 2019 2D scenarios



Temporal Impact

of Days (out of 245) where worst cell:

$\Delta\text{DO} > 0.01 \text{ mg/L}$: 245

$\Delta\text{DO} > 0.05 \text{ mg/L}$: 245

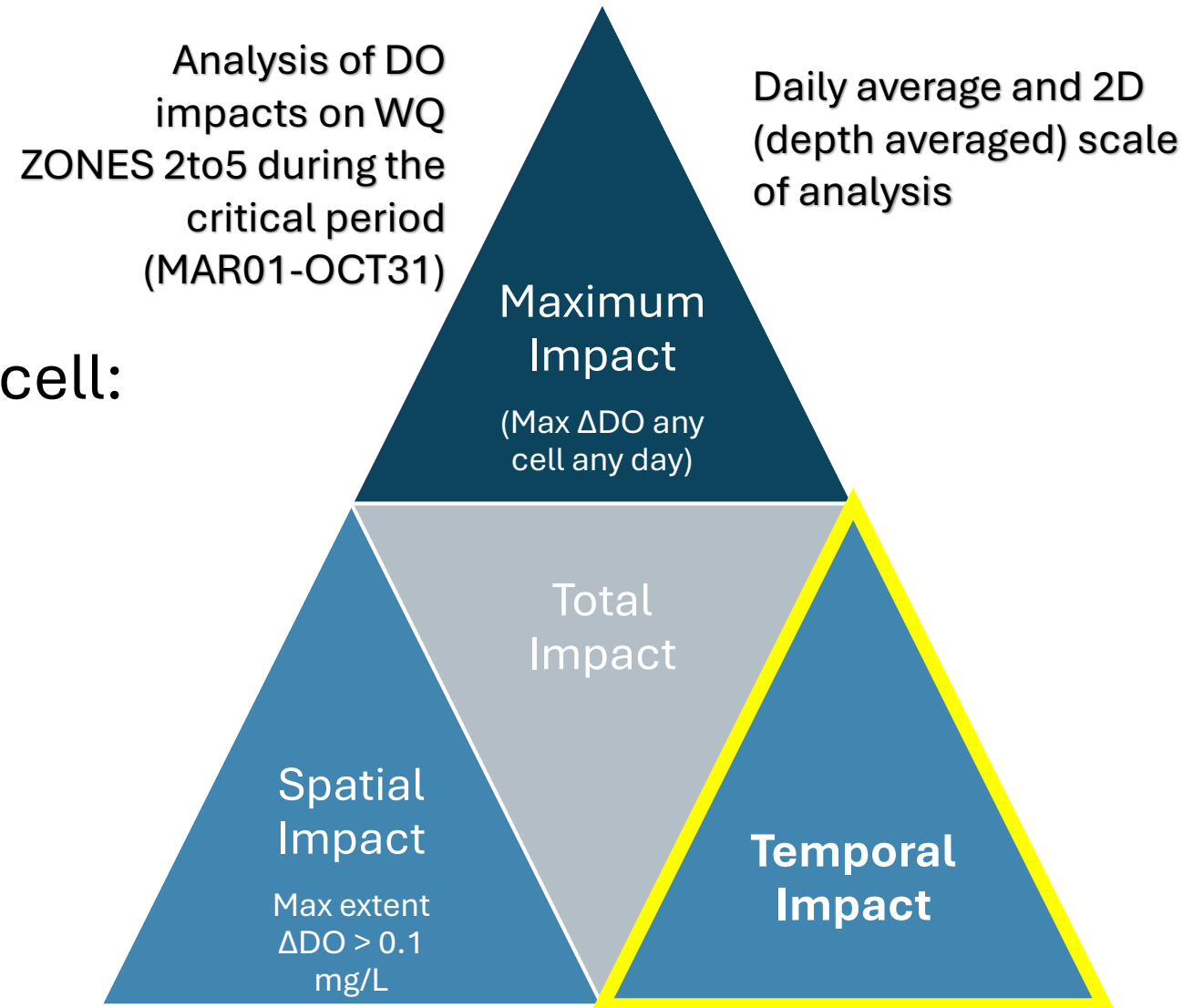
$\Delta\text{DO} > 0.10 \text{ mg/L}$: 245

$\Delta\text{DO} > 0.15 \text{ mg/L}$: 245

$\Delta\text{DO} > 0.25 \text{ mg/L}$: 245

$\Delta\text{DO} > 0.50 \text{ mg/L}$: 212

$\Delta\text{DO} > 1.00 \text{ mg/L}$: 136

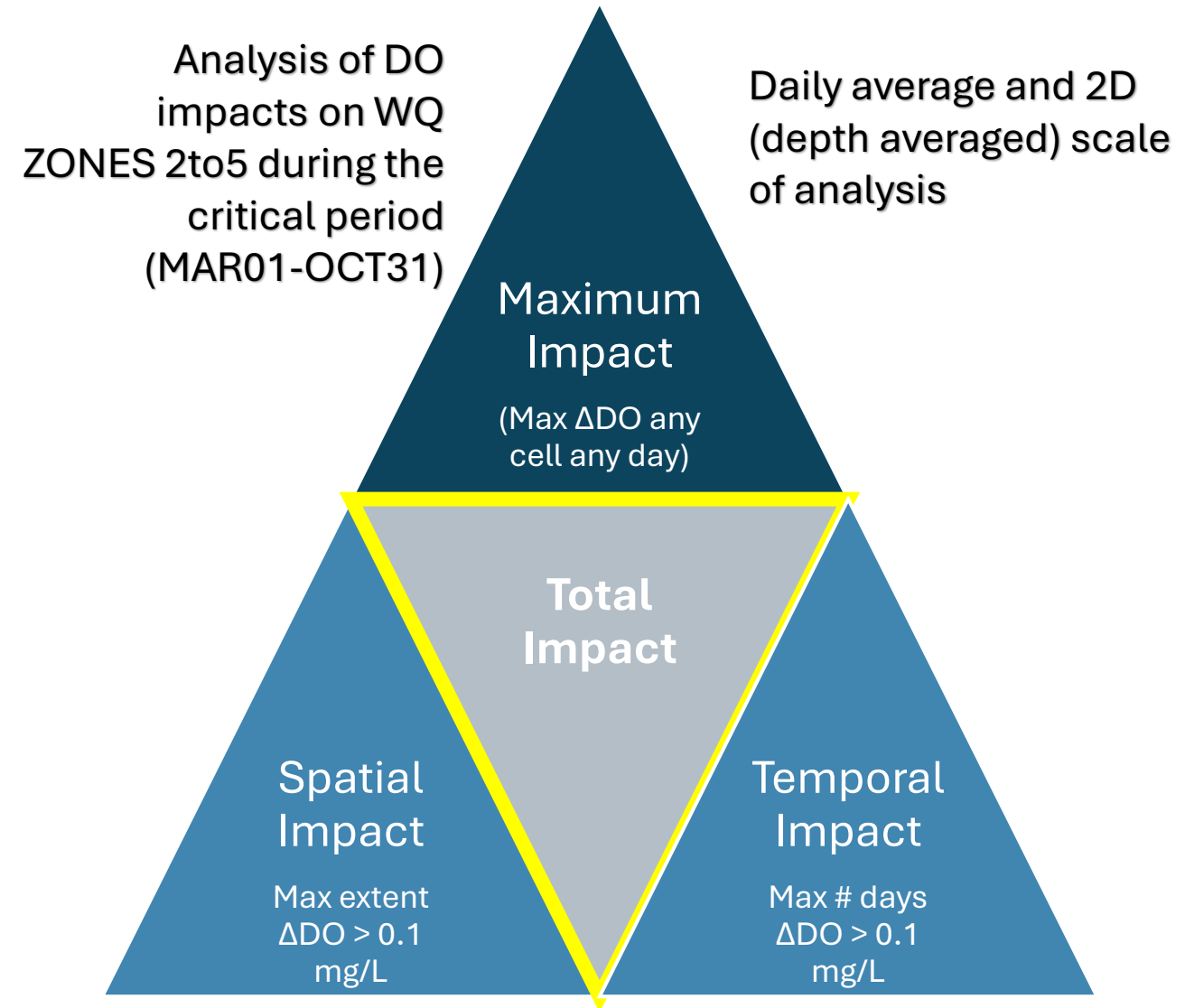


Impact metrics developed based on delta-DO between 2019 2D scenarios



Total Impact
(integrates spatial and
temporal impacts)

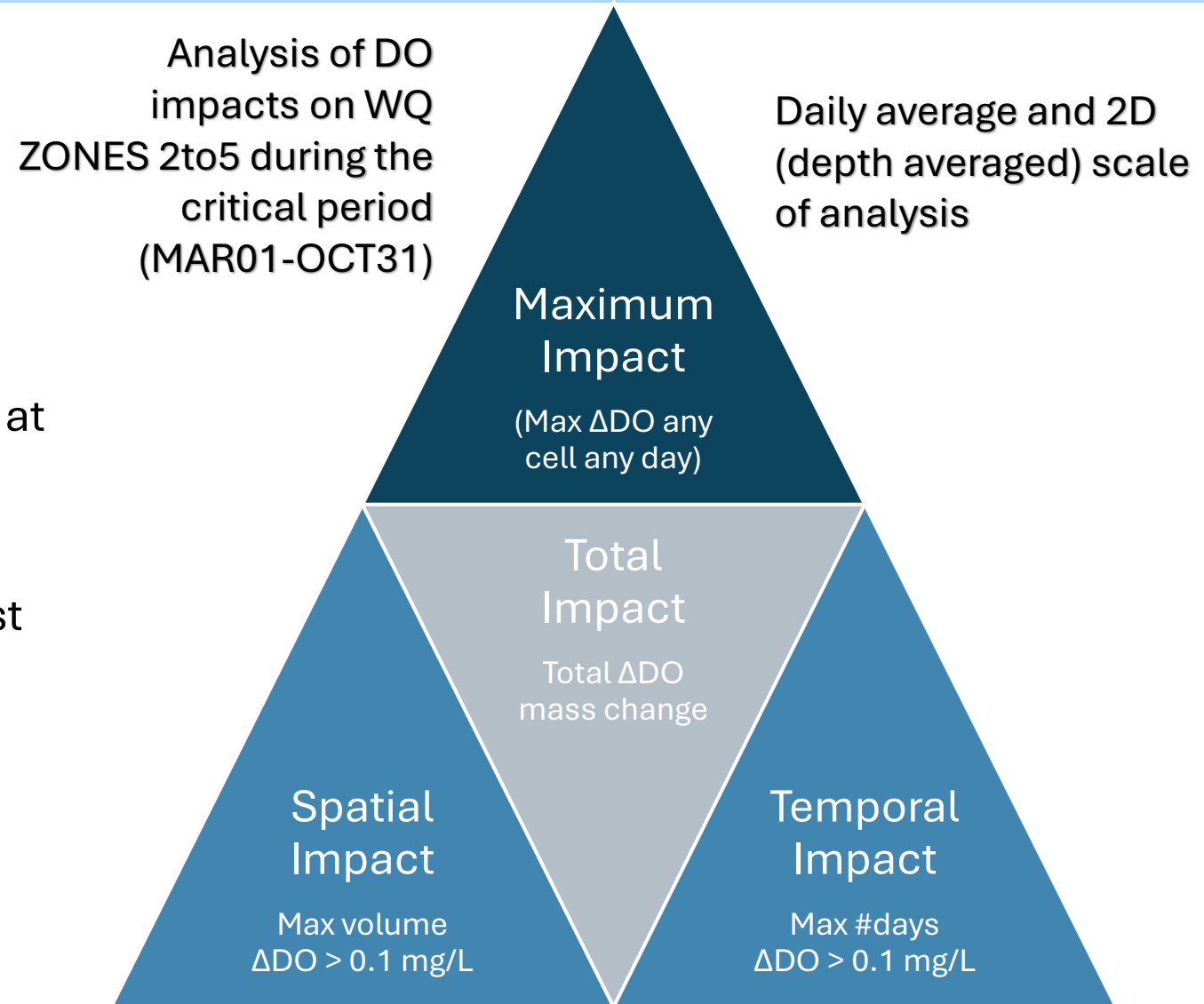
Total $\sum \Delta DO$ every cell every day:
Total $\sum \Delta DO$ (mg/L): 84.2



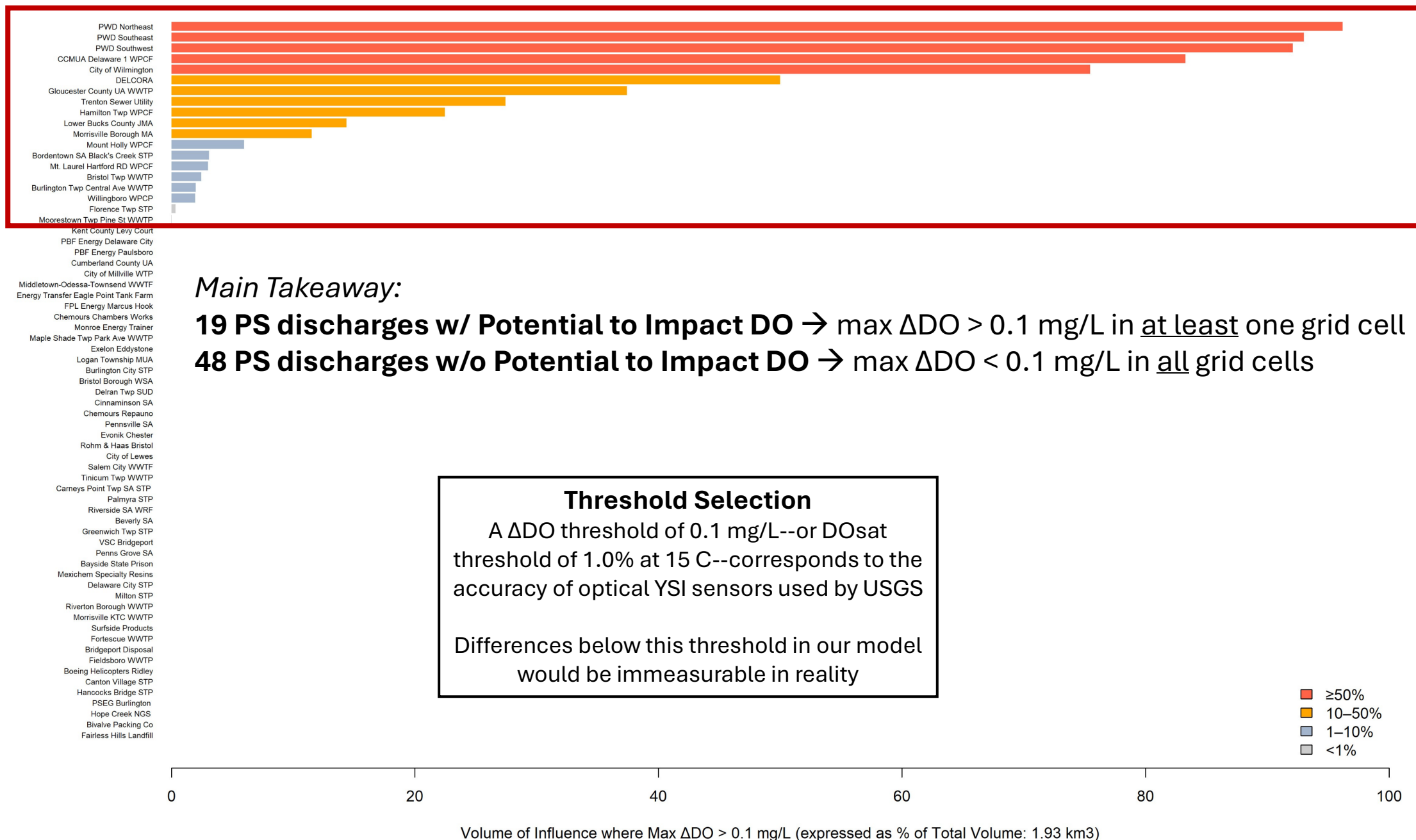
Impact metrics developed based on delta-DO between 2019 2D scenarios



- Maximum Impact
 - Maximum ΔDO between scenarios
- Spatial Impact
 - Volume (or Area) where $\Delta\text{DO} > 0.1$ mg/L for at least one day
- Temporal Impact
 - Max #days where $\Delta\text{DO} > 0.1$ mg/L in at least one cell
- Total Impact
 - Total ΔDO mass over time and space

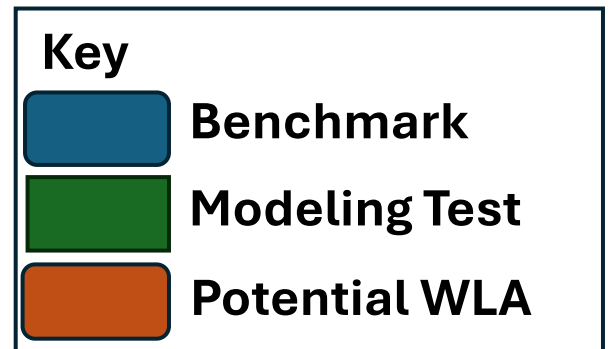
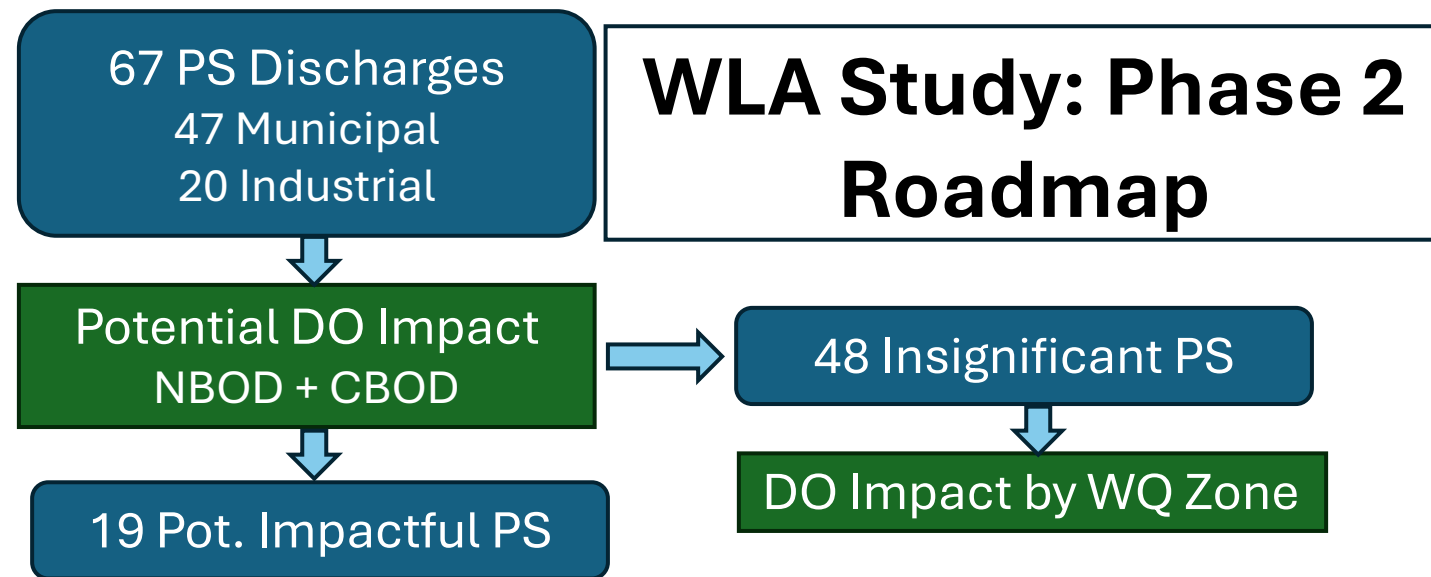


DO Impact of PS Dischargers between Mar - Oct within WQ Zones 2 - 5



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Potential DO Impact Simulations by WQ Zone

Goal: Evaluate the potential DO impact of the 48 Insignificant PS discharges grouped by WQ Zone

For each simulation, insignificant PS discharges were grouped by WQ Zone and assigned :

- PS-CBODu = 35 mg/L
- NH₃-N = 35 mg/L

All other PS discharges were held at background concentrations :

- PS-CBODu = 1.5 mg/L
- NH₃-N = 0.1 mg/L

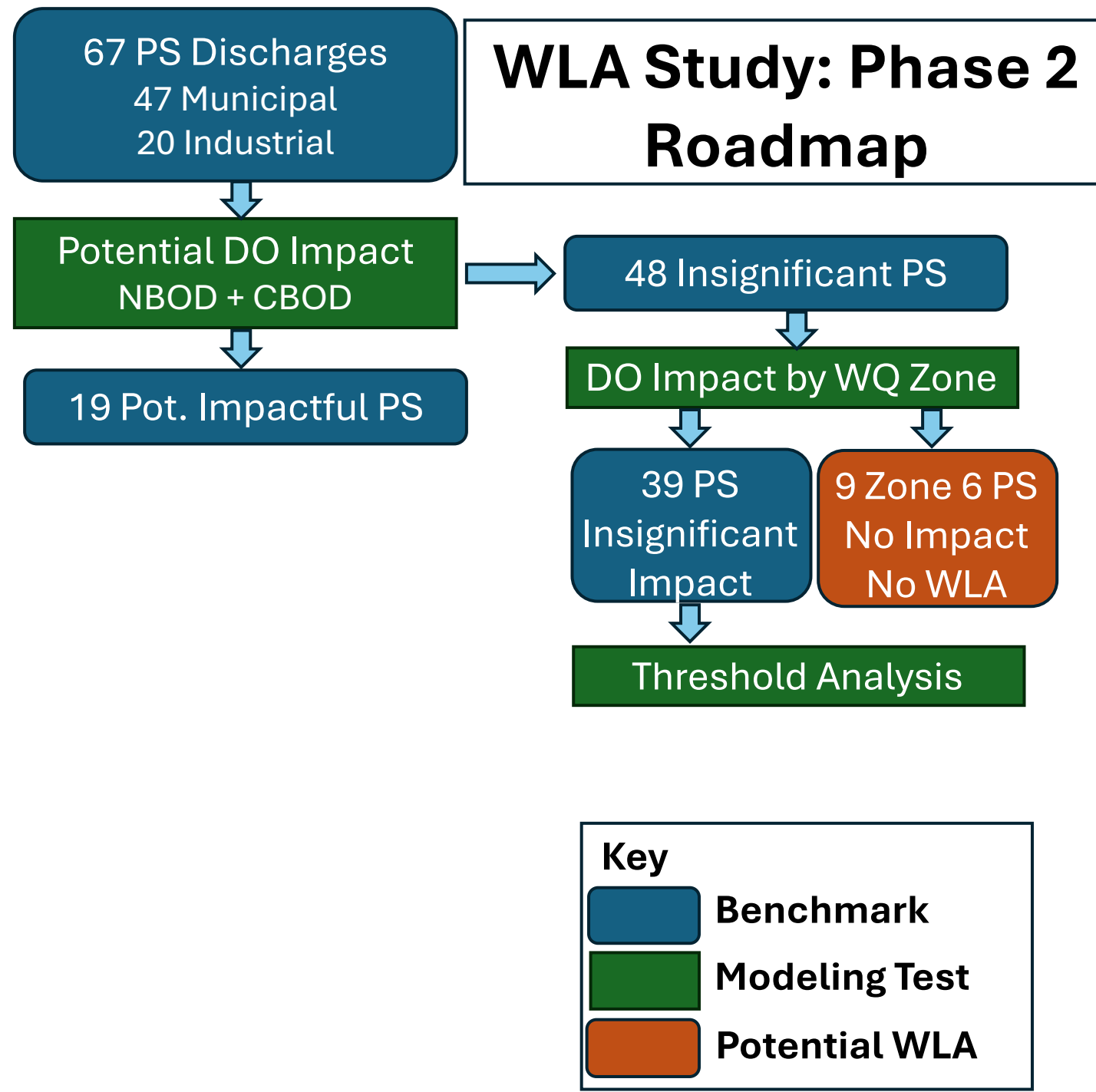
These simulations were compared to a *De Minimis Scenario* where PS-CBODu = 1.5 mg/L and NH₃-N = 0.1 mg/L

DO Impact within WQ Zones 2 -5 between Mar – Oct

WQ Zone	Max ΔDO	Area ΔDO > 0.1	Days ΔDO > 0.1	Total ΔDO	Change in 10th Percentile DO
2 (# PS=12)	0.532	0.222	172	9.442	0.338
3 (# PS=2)	0.095	0	0	2.056	0.062
4 (# PS=12)	0.219	0.347	168	11.007	0.186
5 (# PS=13)	0.115	0.002	46	7.312	0.102
6 (# PS=9)	0.004	0	0	0.0504	0.002

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Threshold Analysis for 48 Insignificant PS

Goal: Evaluate the cumulative potential DO impact of the 48 Insignificant PS discharges at varying NBOD and constant CBOD

For each simulation, all non-impactful PS discharges were assigned:

- PS-CBODu = 35 mg/L
- NH₃-N = **X** mg/L

All other PS discharges were held at:

- PS-CBODu = 35 mg/L
- NH₃-N = 0.1 mg/L

These simulations were compared to a *De Minimis Scenario* where:

- PS-CBODu = 35 mg/L
- NH₃-N = 0.1 mg/L

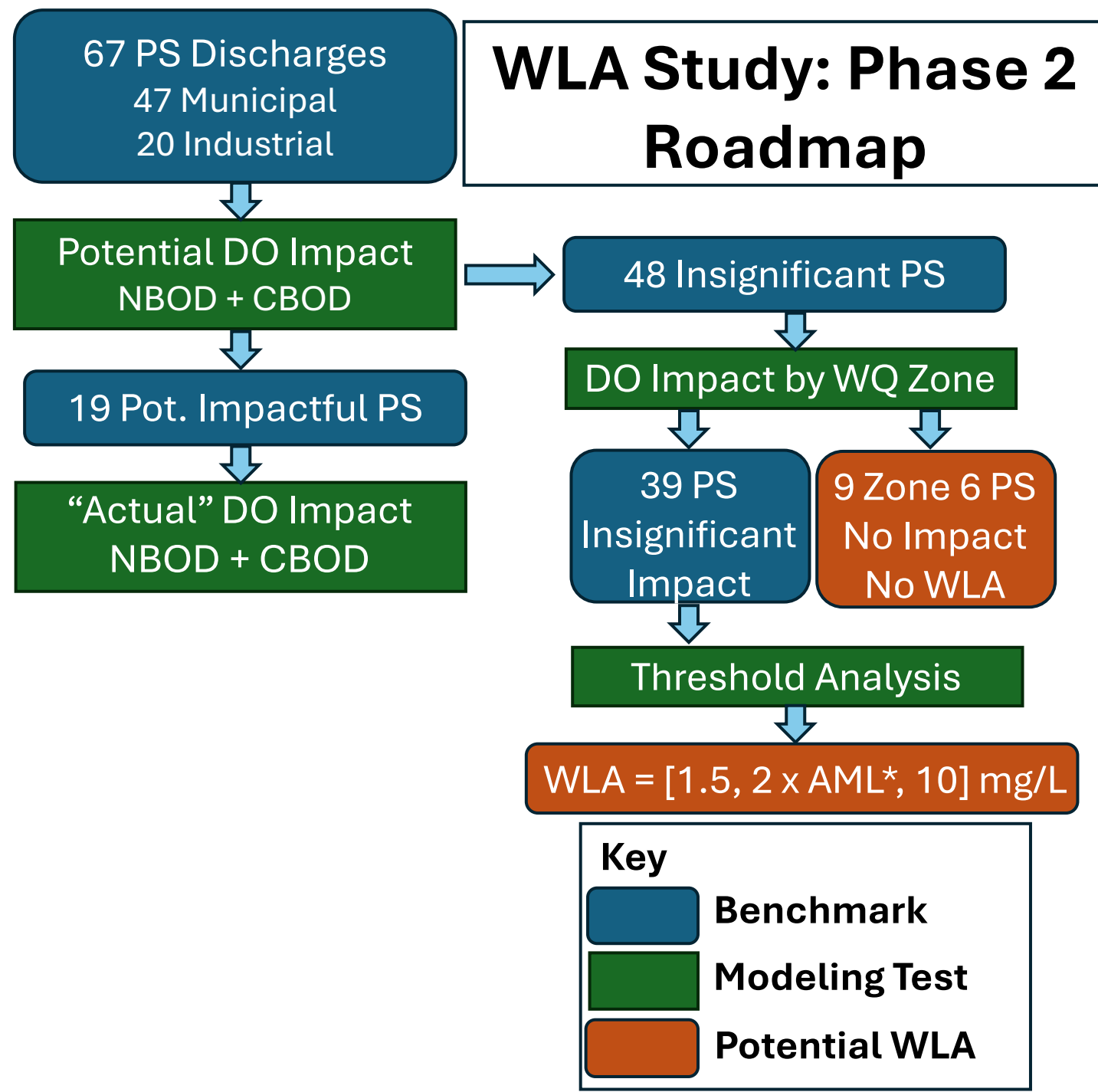
DO Impact within WQ Zones 2 -5 between Mar – Oct

NH ₃ -N Threshold	Max ΔDO	AOI ΔDO > 0.1	Days ΔDO > 0.1	Total ΔDO	Change in 10th Percentile DO
15 mg/L	0.147	0.076	68	9.905	0.091
12 mg/L	0.113	0.033	28	7.637	0.07
10 mg/L	0.091	0	0	6.336	0.051

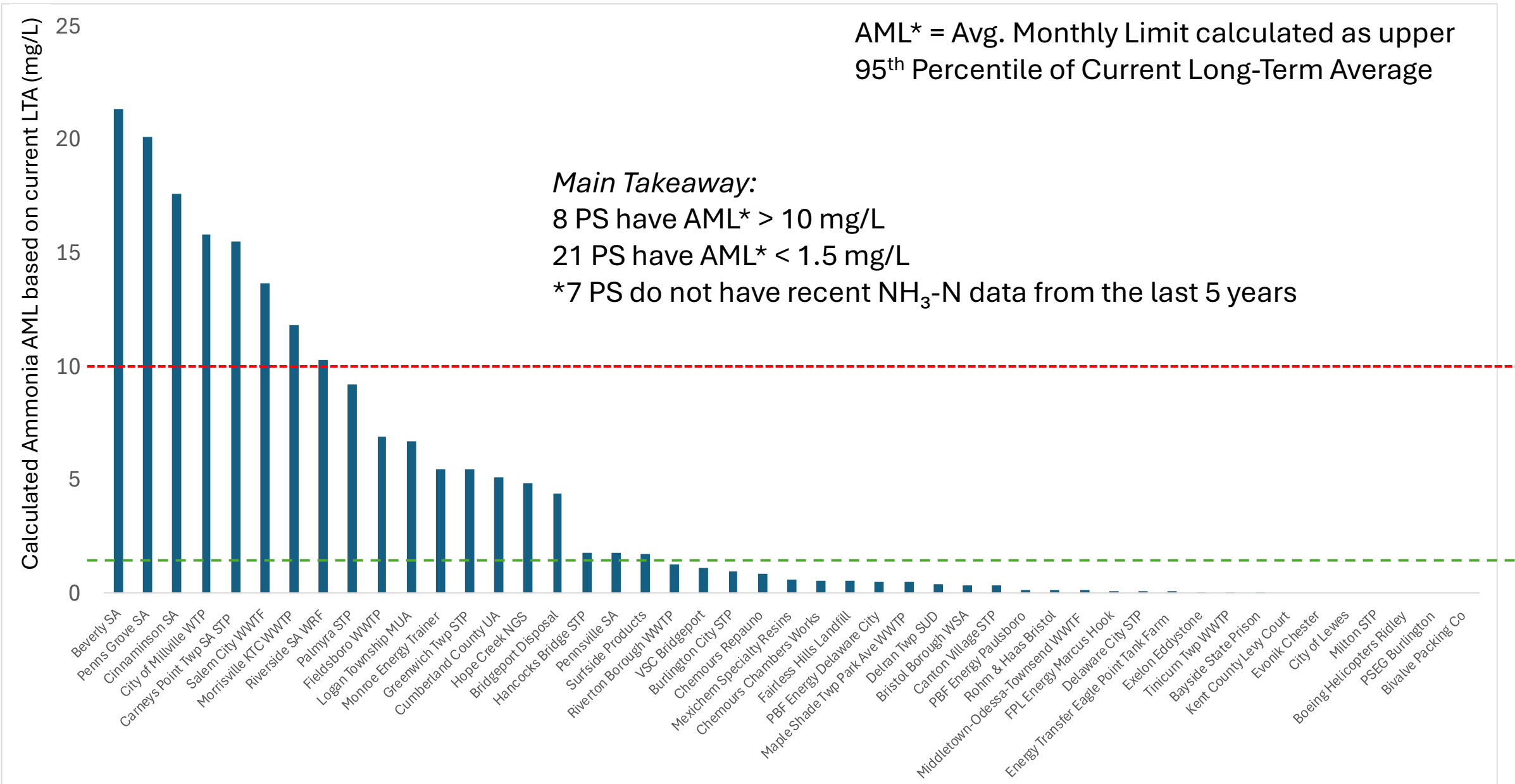
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*AML = Avg. Monthly Limit calculated as upper 95th Percentile of Current Long-Term Average



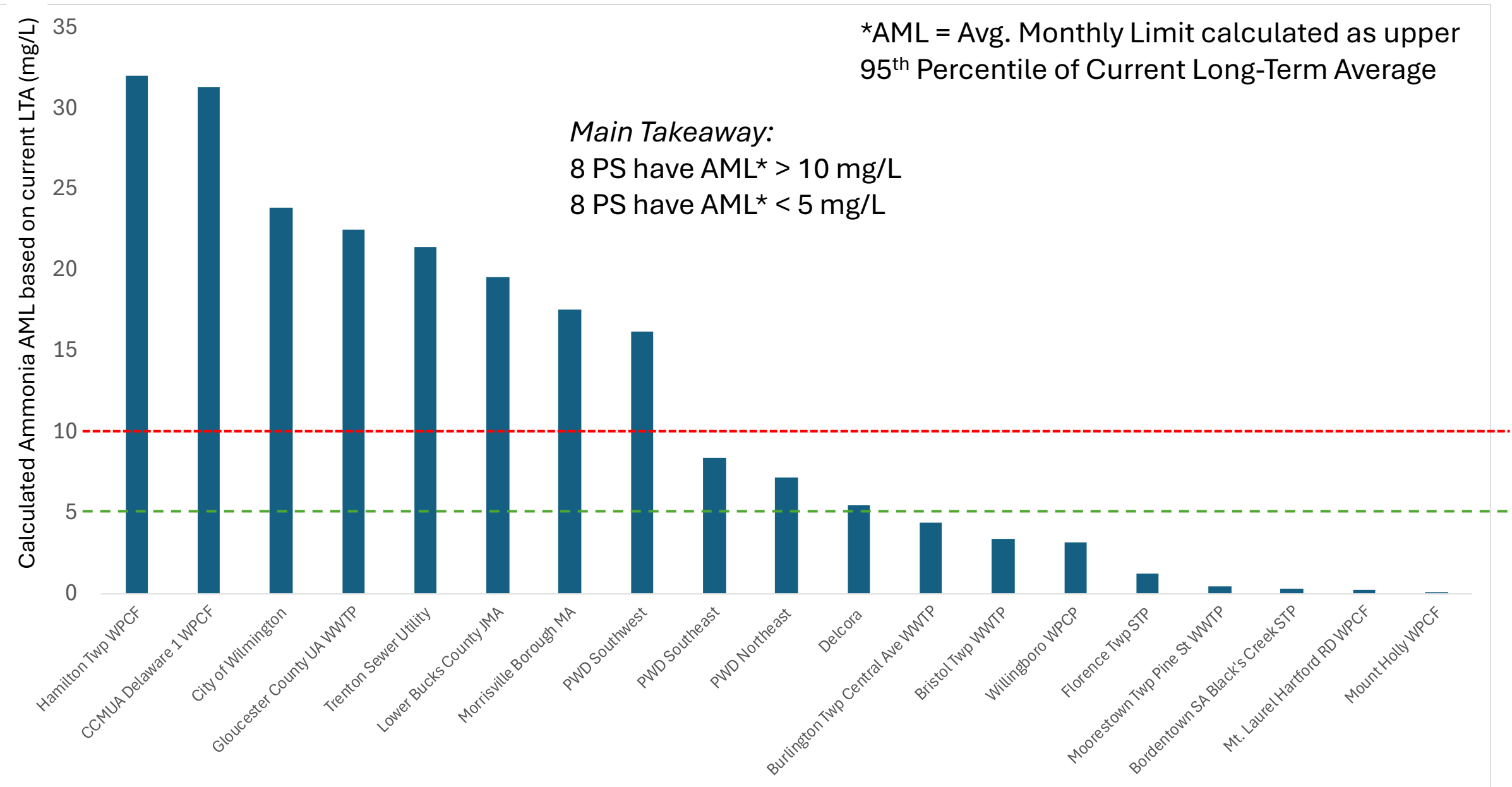
Calculated NH₃-N AML for 48 Individually Insignificant PS



Calculated NH₃-N AML for 19 Pot. Impactful PS

*AML = Avg. Monthly Limit calculated as upper 95th Percentile of Current Long-Term Average

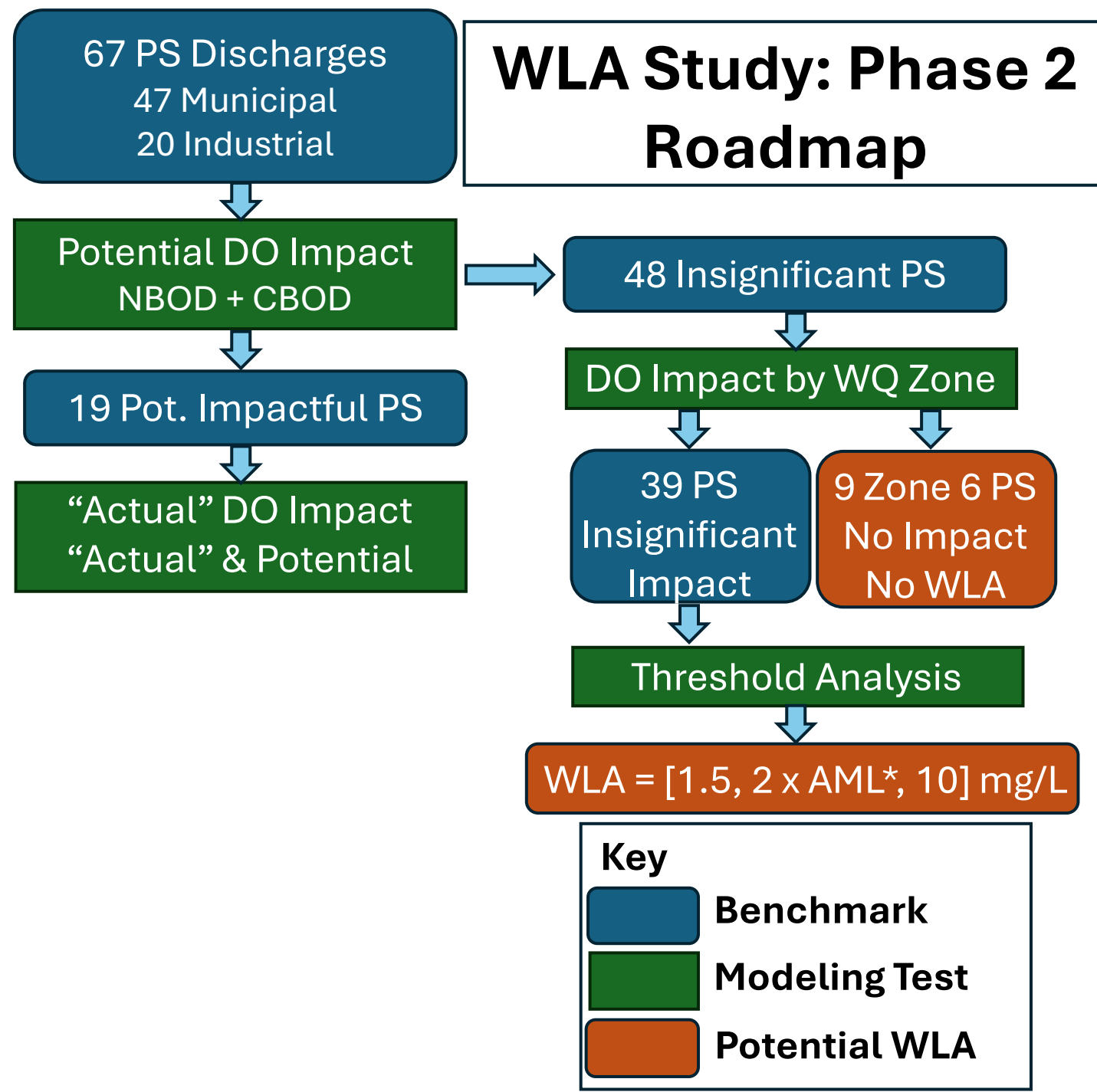
Main Takeaway:
8 PS have AML* > 10 mg/L
8 PS have AML* < 5 mg/L



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Testing 19 Potentially Impactful PS at their Current Treatment Level

Goal: Evaluate the DO impact of the 19 Impactful PS discharges at their calculated AML based on their current LTA

For each simulation, one PS discharge at a time was assigned:

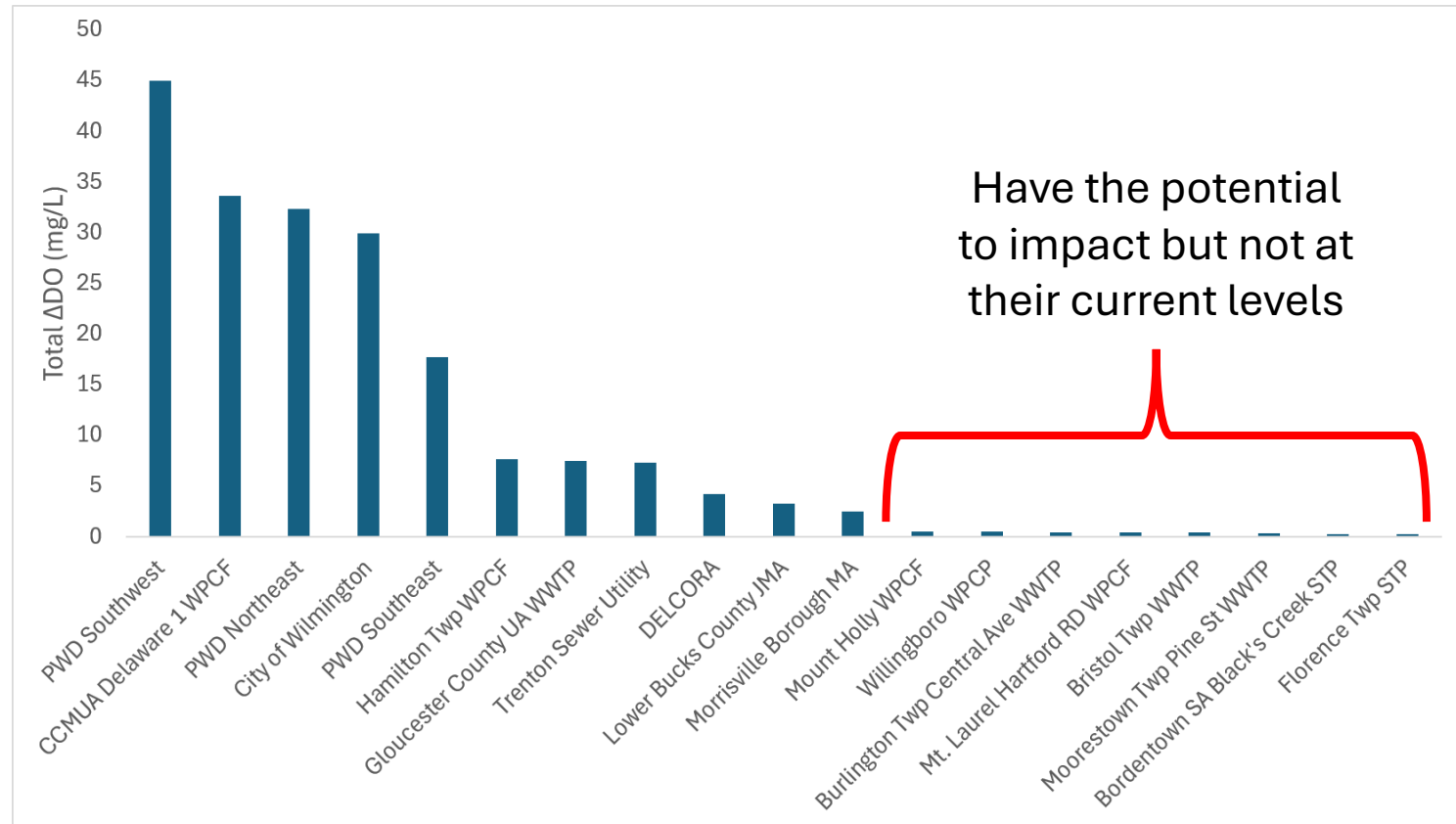
- PS-CBOD_u = 35 mg/L
- NH₃-N = **AML**

All other PS discharges were held at:

- PS-CBOD_u = 1.5 mg/L
- NH₃-N = 0.1 mg/L

These simulations were compared to a *De Minimis Scenario* where PS-CBOD_u = 1.5 mg/L and NH₃-N = 0.1 mg/L

DO Impact within WQ Zones 2 -5 between Mar – Oct

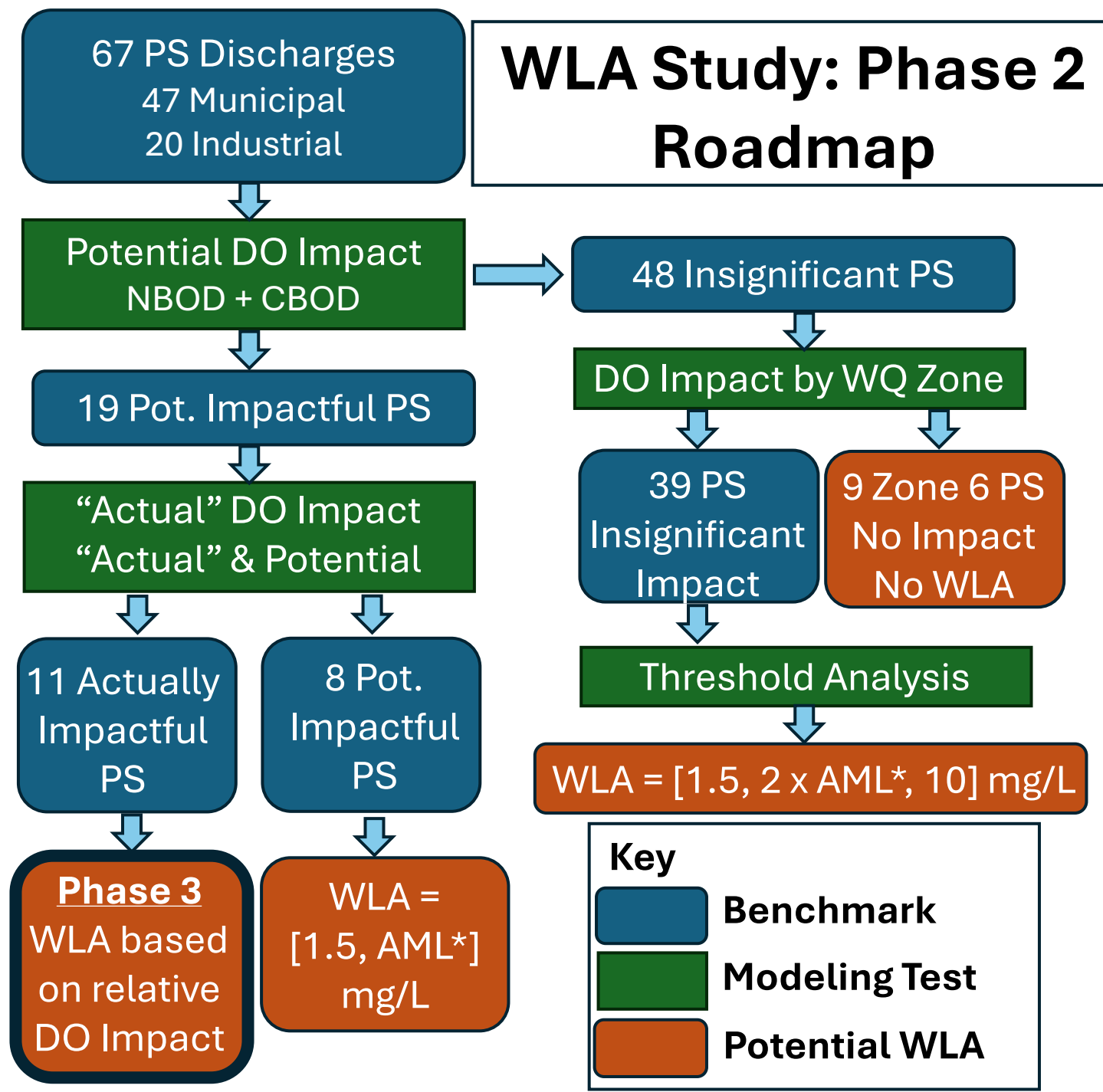


AML = Avg. Monthly Limit calculated as upper 95th Percentile of Current Long-Term Average

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