



Discharge Limit (DL) Violations: Nitrogen

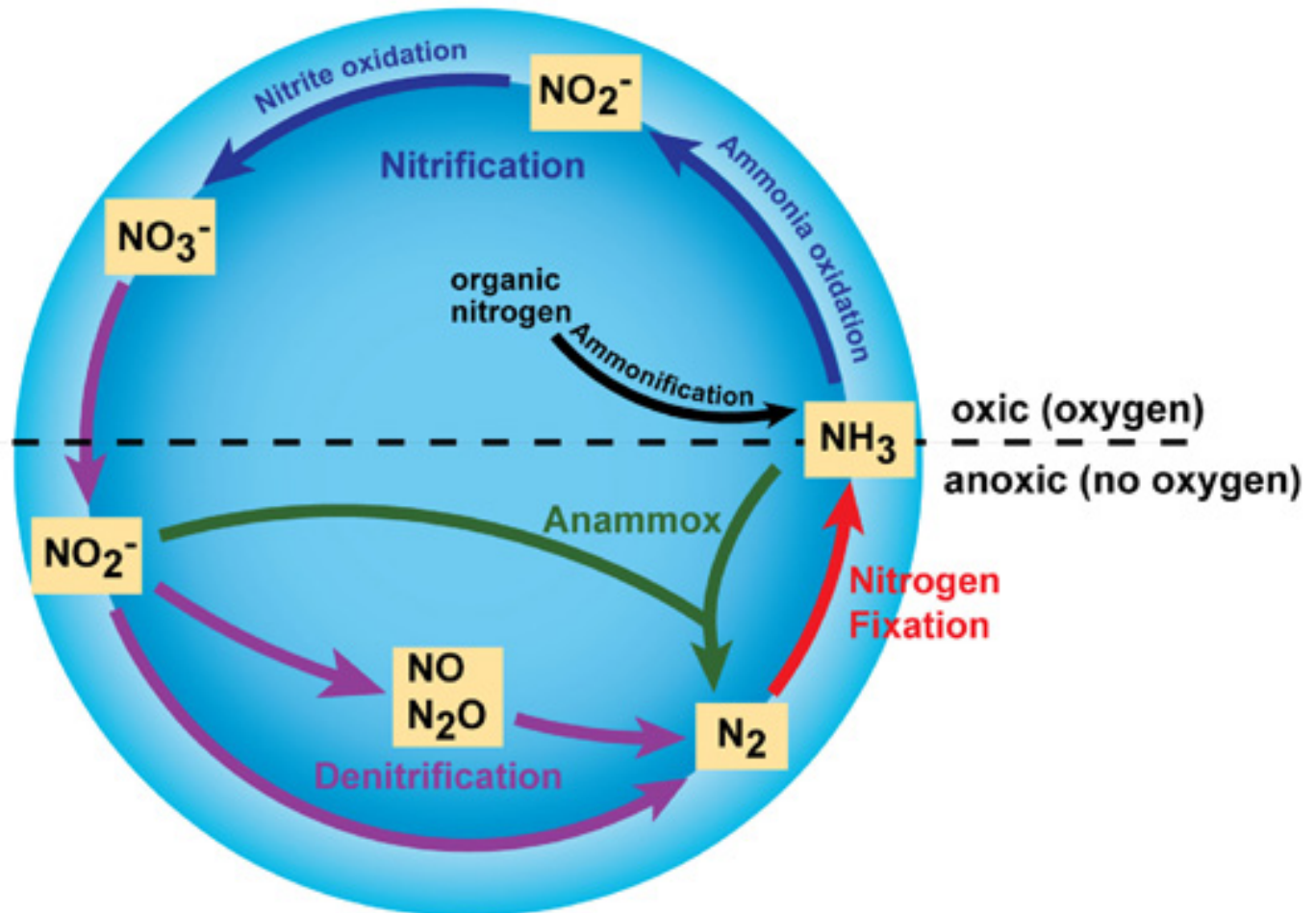
Joshua Litt

Environmental Science Specialist III

Groundwater Protection

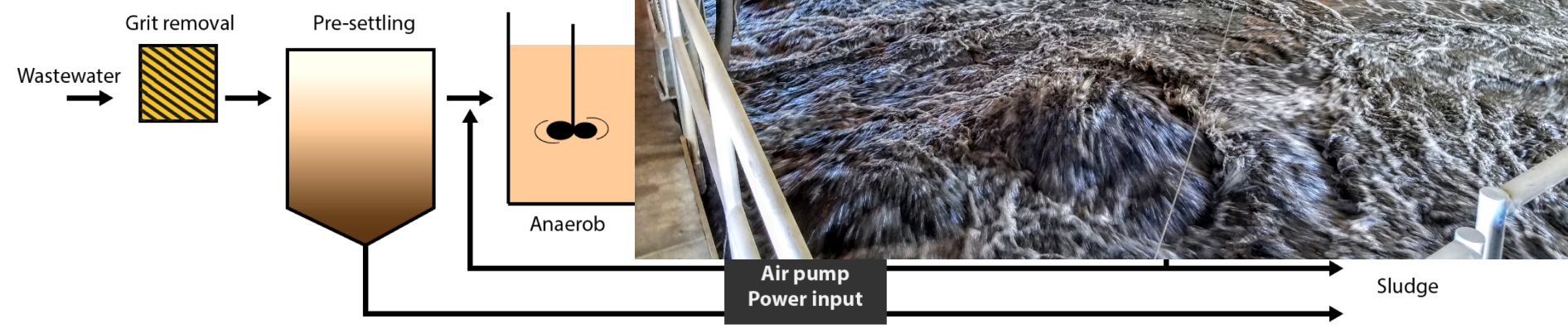


■ Nitrification/Denitrification






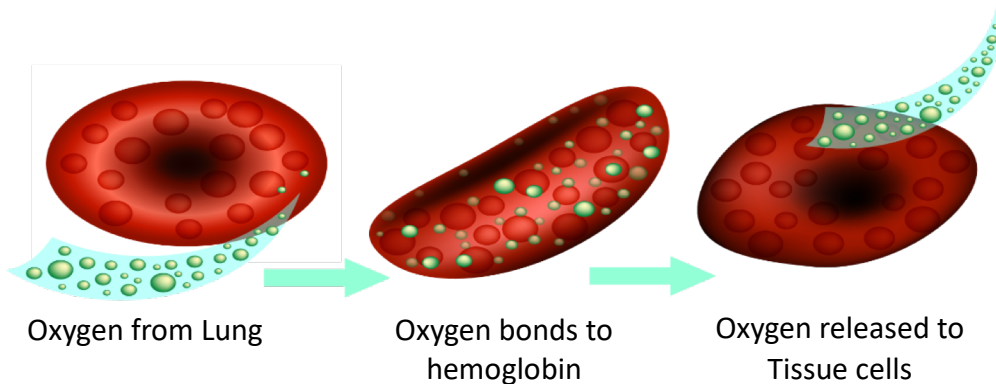
- Anaerobic: biological reactions in the absence of oxygen
- Anoxic: biological activity takes place with electron acceptors such as nitrite and nitrate; oxygen is only available in a combined form

Nitrification and Denitrification



- Methemoglobinemia - Hemoglobin is the molecule present in red blood cells & helps in distribution of oxygen to the body. Methemoglobin doesn't have the ability to release oxygen. When a patient suffers for this condition, hemoglobin in the body is unable to effectively release oxygen to the body tissues.

Red blood cell  Oxygen molecule  Hemoglobin molecule 

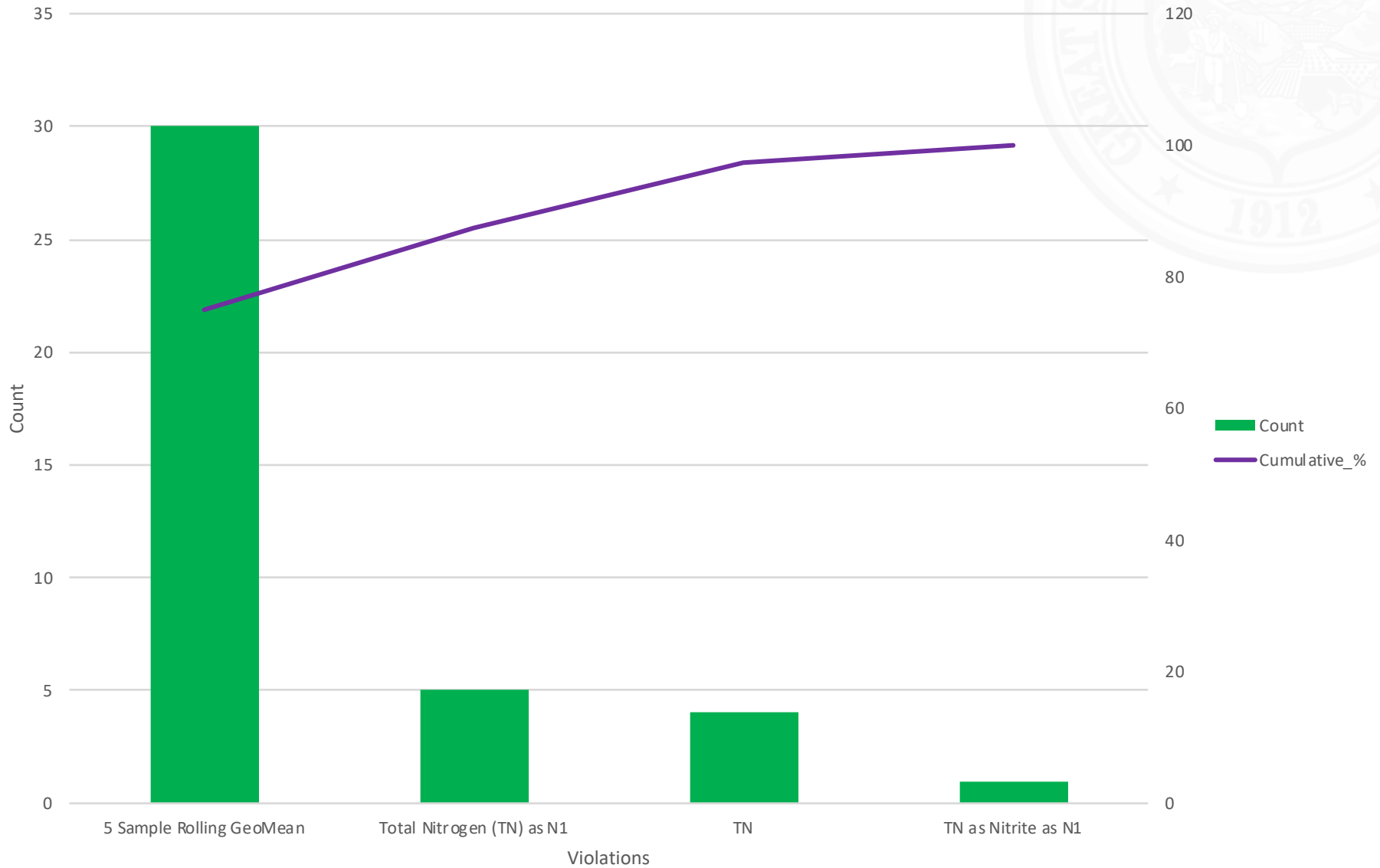


- Effluent rich in nitrates discharging into streams or rivers can cause algae blooms or other plants to grow rapidly, quickly depleting oxygen in the water and causing fish and other aquatic life to die.



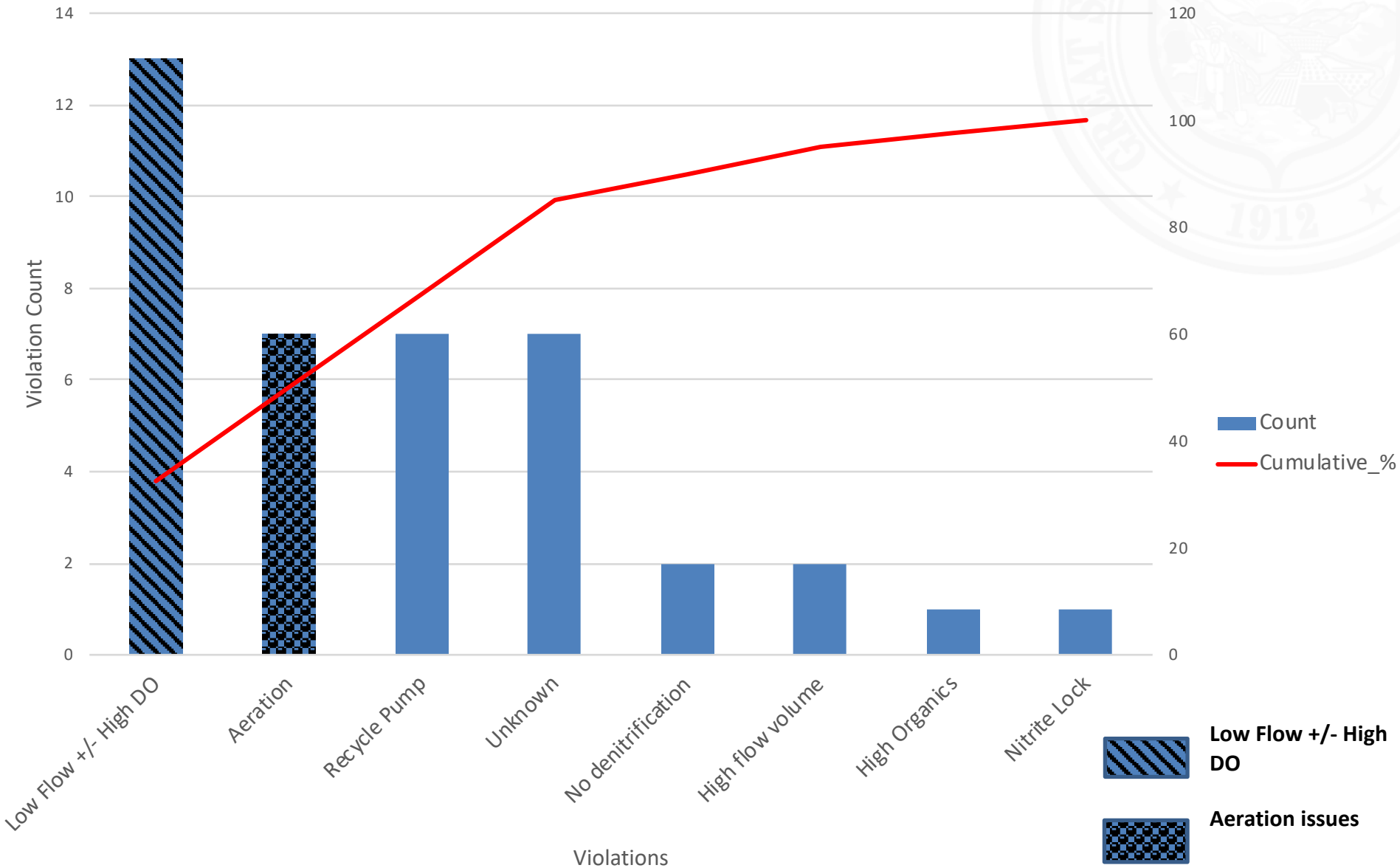
Nitrogen Type Exceedances

Nitrogen Violation Types



Nitrogen DL Violations

Discharge Limit (DL) Violations

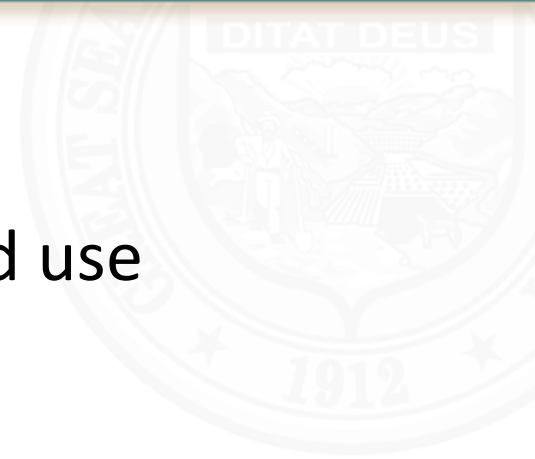


- The 5 smp rolling geo mean is determined by multiplying five (5) most recent monthly sample values (m_1 , m_2 , etc.) together and taking the fifth root of the product.
- $$GM5 = \sqrt[5]{(m_1)(m_2)(m_3)(m_4)(m_5)}$$
- Example: The required month is December.
Aug = 12.0 mg/l, Sep = 8.0 mg/l, Oct = 5.0 mg/l, Nov = 10.0 mg/l, Dec = 8.0 mg/l
- $$\sqrt[5]{(12)(8)(5)(10)(8)} = \sqrt[5]{38400} = 8.2 \text{ mg/l}$$

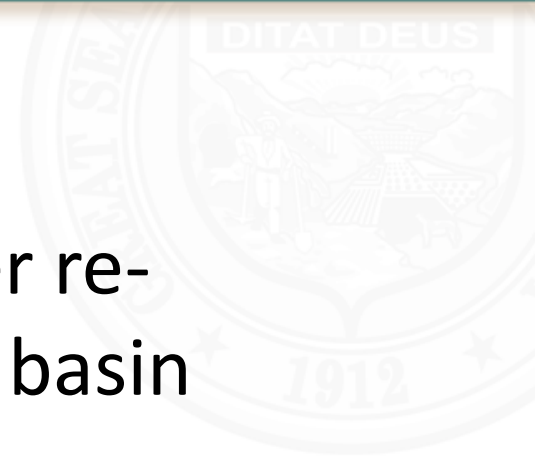
- J:\COMMON\KOUJ\Groundwater\Nitrogen\Lit
t- Nitrogen\5 smp rolling geo mean
example.xlsx



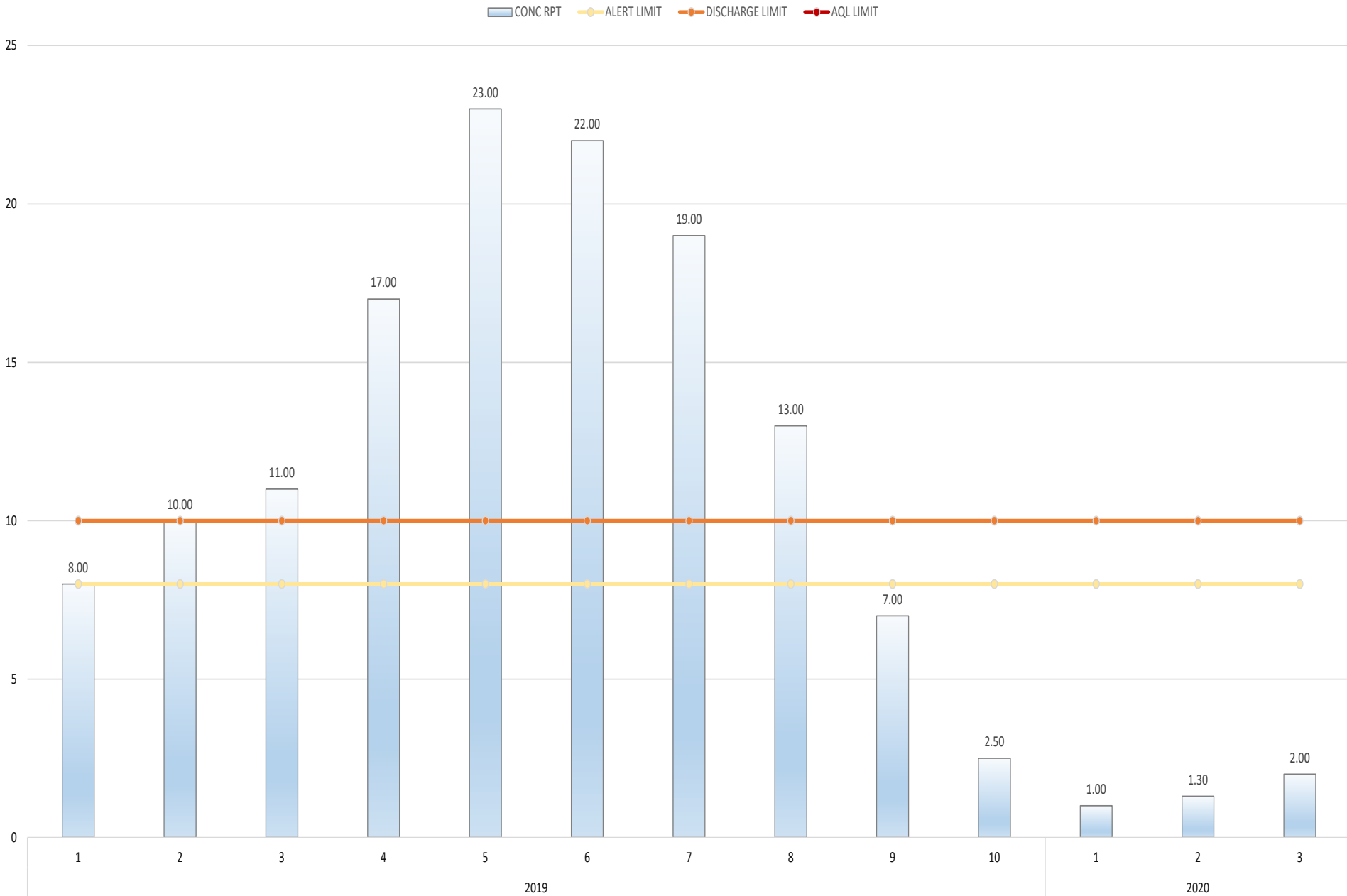
- If weekly readings:
 - Take the average of all the weeks and use
- If daily readings:
 - Take the average of all of the days
- Missed sample:
 - 5 Violations
 - Cannot use for 5 sample rolling geo mean calculation



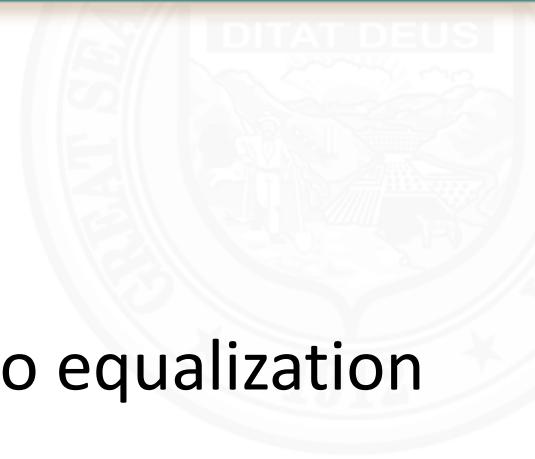
- Low flow facility; <15,000 gpd
- Original design called for sand filter re-circulation line to the equalization basin
- Revamped facility and line was removed



Case Study Cont'd



- Installed re-circulation line
 - Carbon source added
 - Sends pre-disinfected effluent back to equalization basin
 - Passes through system again
- Total Nitrogen concentrations dropped



- Sludge
 - Additional carbon source
 - Gradually re-feed back into aeration basin
 - Acts as a carbon source
 - Bugs create Oxygen Reduction Potential
 - Removes DO (addition of coarse bubbles)

Dissolved Oxygen

- Bacteria need free dissolved oxygen in order to “work”
- Good aerobic conditions
- Coarse air or fine diffusers



- **Low Dissolved Oxygen:**
 - Bacteria will consume oxygen from nitrate (NO_3), leaving nitrogen gas, that will escape to atmosphere
- **Carbon source**
 - Bacteria **MUST** have carbon food source
 - Methanol, acetic acid etc.
- **Temperature**
 - Between $5^\circ - 30^\circ \text{ C}$ ($41^\circ - 86^\circ \text{ F}$)
 - Increase in temperature = increase in denitrification

Reclaimed Water

Type of Direct Reuse	Minimum Class of Reclaimed Water Required
Golf course irrigation	B
Restricted access landscape irrigation	B
Landscape impoundment	B
Dust control	B
Soil compaction and similar construction activities	B
Pasture for milking animals	B
Livestock watering (dairy animals)	B
Concrete and cement mixing	B
Materials washing and sieving	B
Street cleaning	B
Pasture for non-dairy animals	C
Livestock watering (non-dairy animals)	C
Irrigation of sod farms	C
Irrigation of fiber, seed, forage, and similar crops	C
Silviculture	C

■ Classes mean

g geo

Questions?

If you have questions, I can be reached at
602-771-4805 or at
litt.joshua@azdeq.gov

