

# Lake Stevens Water Quality Update

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February 2024



Surface Water  
Management

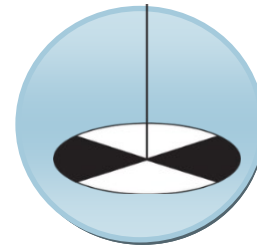
# Agenda

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- History of Lake Health & Lake Management Strategies
- Current Lake Health
- Next Lake Management Steps
- Actions the Community Can Take to Protect Lake Stevens



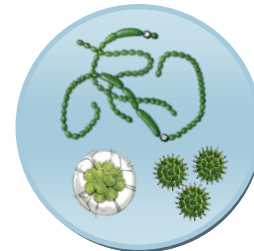
# How do we assess lake health?



WATER  
CLARITY



PHOSPHORUS

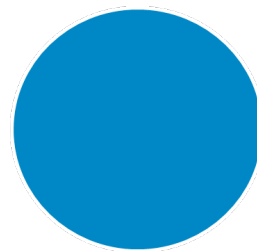


ALGAE

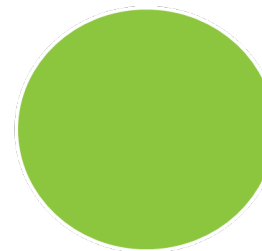


SHORELINE

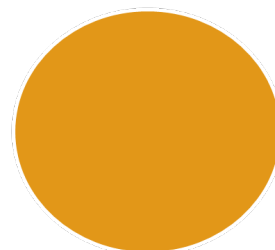
How do we  
rate health?



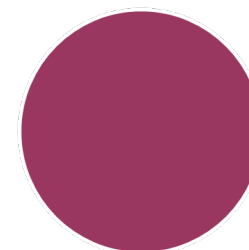
EXCELLENT



GOOD

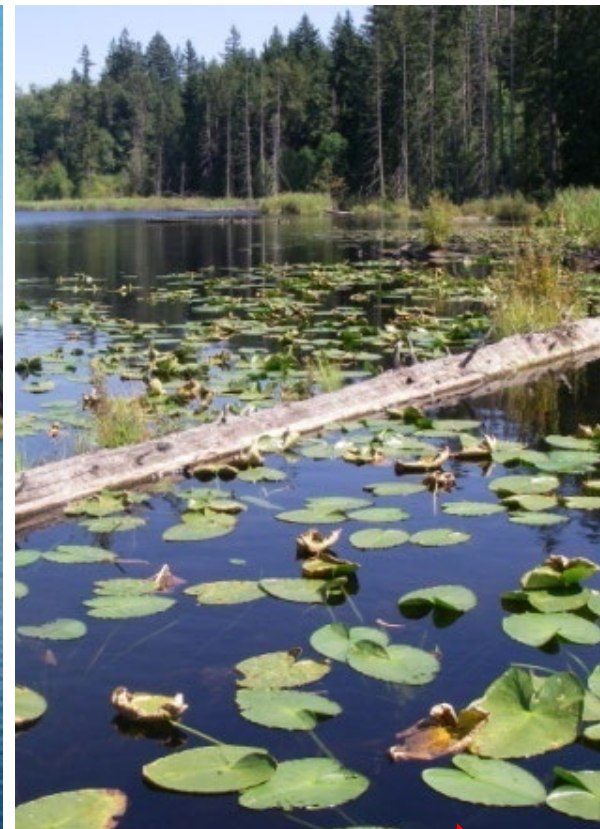


FAIR



POOR

# Lakes vary naturally



Problem if changing too fast



EXCELLENT



GOOD



FAIR



POOR



● Excellent Health . . with a lot of work

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# Water Quality Conditions in the 1970s and 1980s

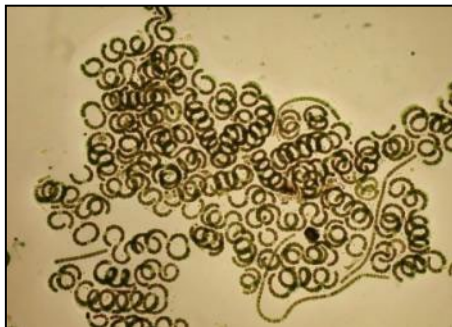
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# Toxin-Producing Cyanobacteria (Blue-green)

Toxin Group	Primary Target Organ in Mammals	Blue-green Algae Genera Known to Produce Toxin
<b>Microcystins</b>	Liver	<i>Microcystis</i> , <i>Anabaena</i> , <i>Planktothrix (Oscillatoria)</i> , <i>Nostoc</i> , <i>Hapalosiphon</i> , <i>Anabaenopsis</i>
<b>Anatoxin-a</b>	Nerve synapse	<i>Anabaena</i> , <i>Planktothrix (Oscillatoria)</i> , <i>Aphanizomenon</i>
<b>Cylindrospermopsins</b>	Liver	<i>Cylindrospermopsis</i> , <i>Aphanizomenon</i> , <i>Umezakia</i>
<b>Saxitoxins</b>	Nerve axons	<i>Anabaena</i> , <i>Aphanizomenon</i> , <i>Lyngbya</i> , <i>Cylindrospermopsis</i>

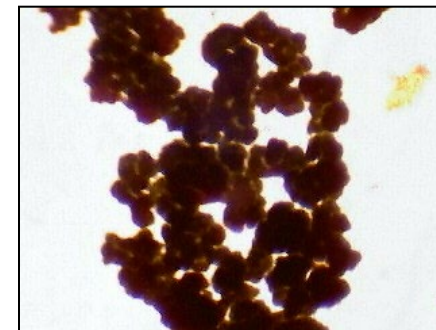
Anabaena



Aphanizomenon



Microcystis



Toxins can affect human and pet health

## Health symptoms include:

- Skin irritation or hives
- Diarrhea
- Nausea or vomiting
- Eye, ear, and throat irritation
- Headache/fever
- Labored breathing
- Muscle paralysis
- Death (extreme cases – mostly pets and wildlife)

Seek immediate medical attention from doctor or vet if symptoms occur after exposure.

**WARNING** ⚠

**TOXIC ALGAE PRESENT**  
**Lake unsafe for people and pets**

ADVERTENCIA - HAY ALGAS TÓXICAS EN EL LAGO - El lago es peligroso para personas y mascotas

- **Do not swim or water ski.**  
*No nade ni practique esquí acuático.*
- **Do not drink lake water.**  
*No beba agua del lago.*
- **Keep pets and livestock away.**  
*Mantenga a las mascotas y al ganado alejados.*
- **Clean fish well, discard guts.**  
*Limpie bien el pescado y deseche las tripas.*
- **Avoid areas of scum when boating.**  
*Evite las zonas con verdín al navegar.*

警告  
湖泊里发现有藻类  
湖泊对人和宠物不安全

경고  
호수에는 독성 조류가 자라고 있습니다.  
이 호수는 사람과 반려동물에게 안전하지 않습니다.

ВНИМАНИЕ  
ТОКСИЧЕСКИЕ ВОДОРОСЛИ В ОЗЕРЕ  
Озеро небезопасно для людей и домашних животных

УВАГА  
ТОКСИЧНІ ВОДОРОСЛІ В ОЗЕРІ!  
Озеро небезпечно для людей та домашніх тварин

CẢNH BÁO  
TRONG HỒ CÓ TẢO ĐỘC  
Hồ không an toàn cho người và thú nuôi

Call your doctor or veterinarian if you or your animals have sudden or unexplained sickness or signs of poisoning.

For more information or to report a bloom:  
[nwtotoxicalgae.org](http://nwtotoxicalgae.org) | 360-407-6000

Health

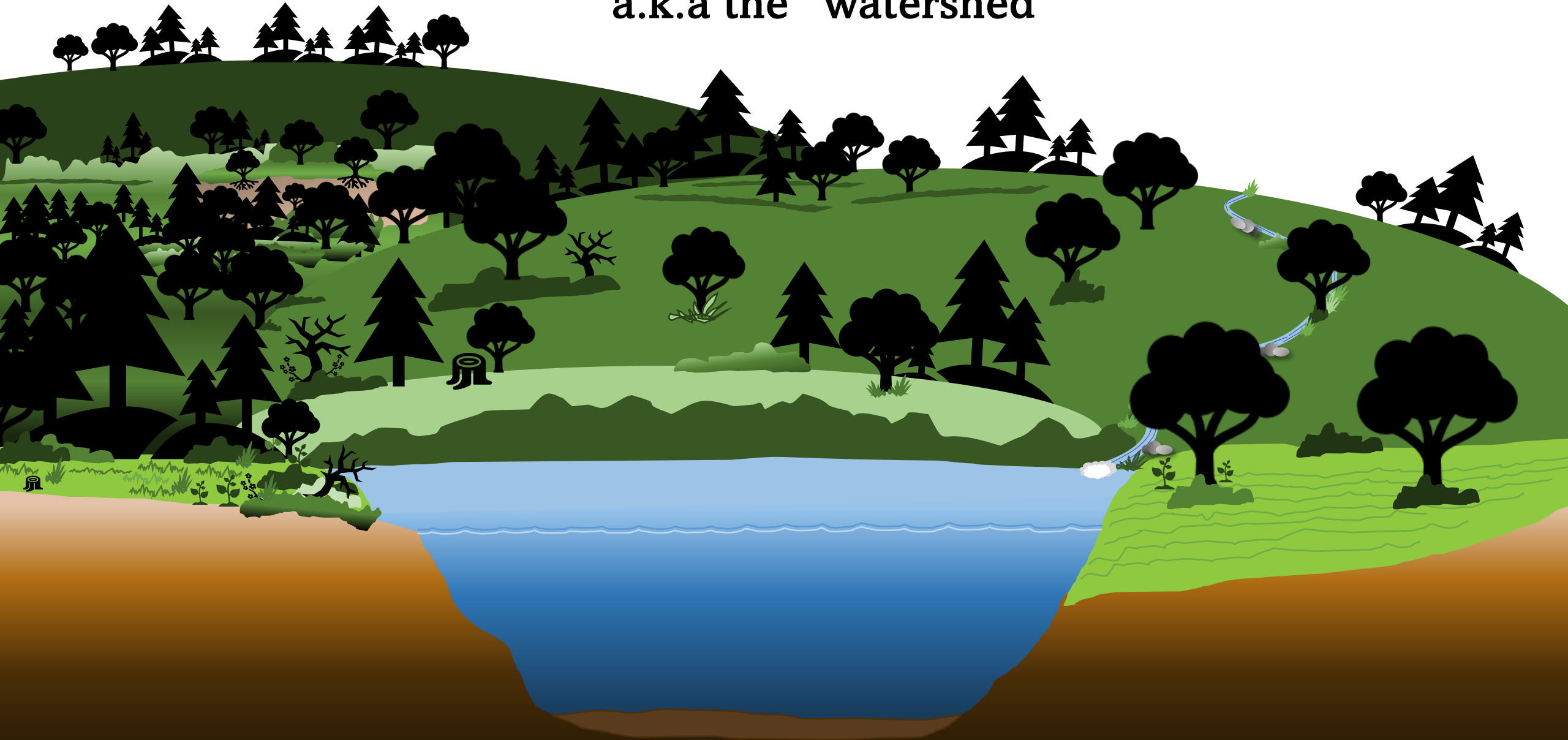
# What Causes Algae Blooms?

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- **Phosphorus** is key nutrient
- A little goes a long way
- 1 tsp = 30 lbs of algae
- BUT where does it come from??



Phosphorus comes from around the lake –  
a.k.a the “watershed”

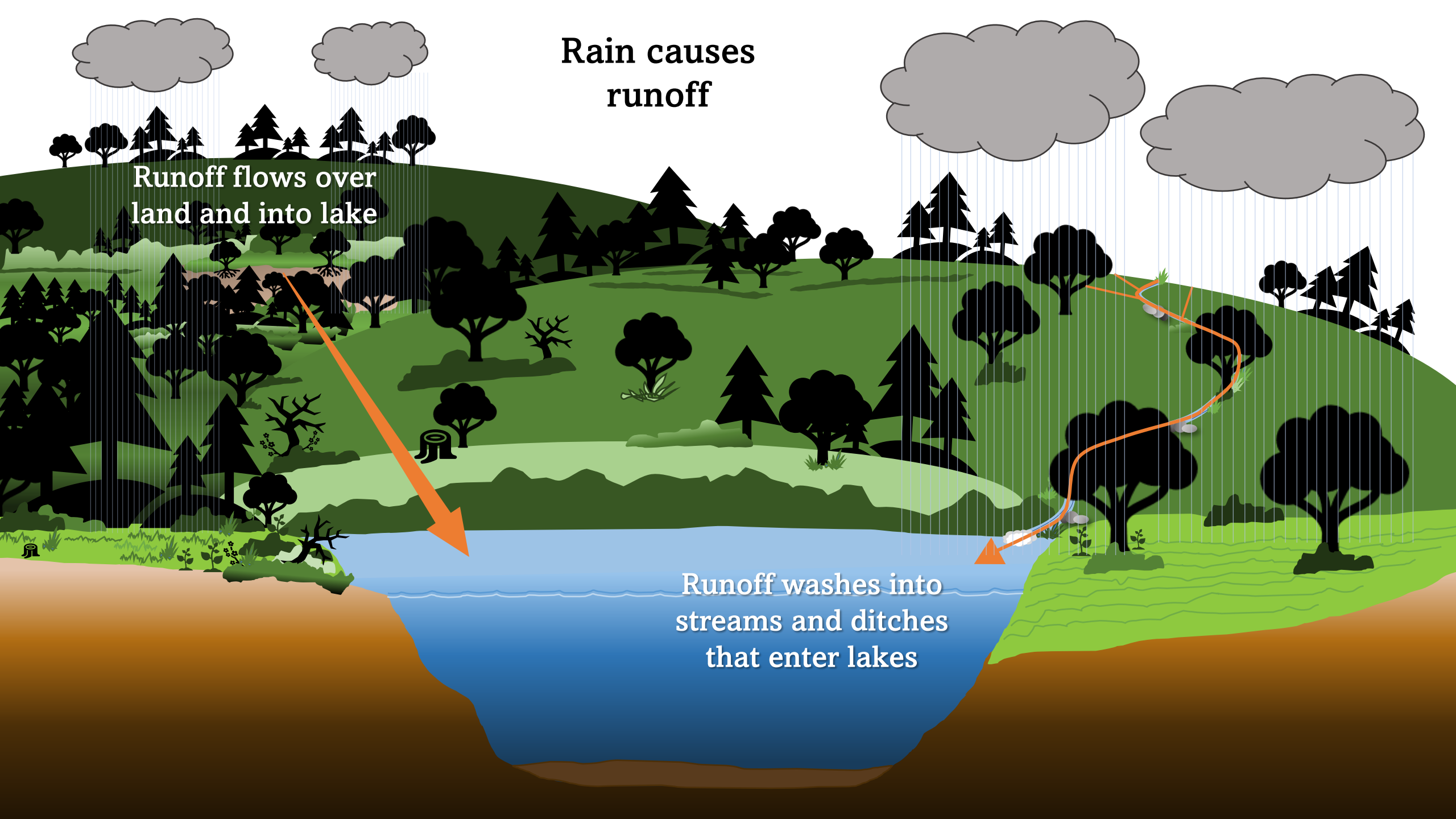




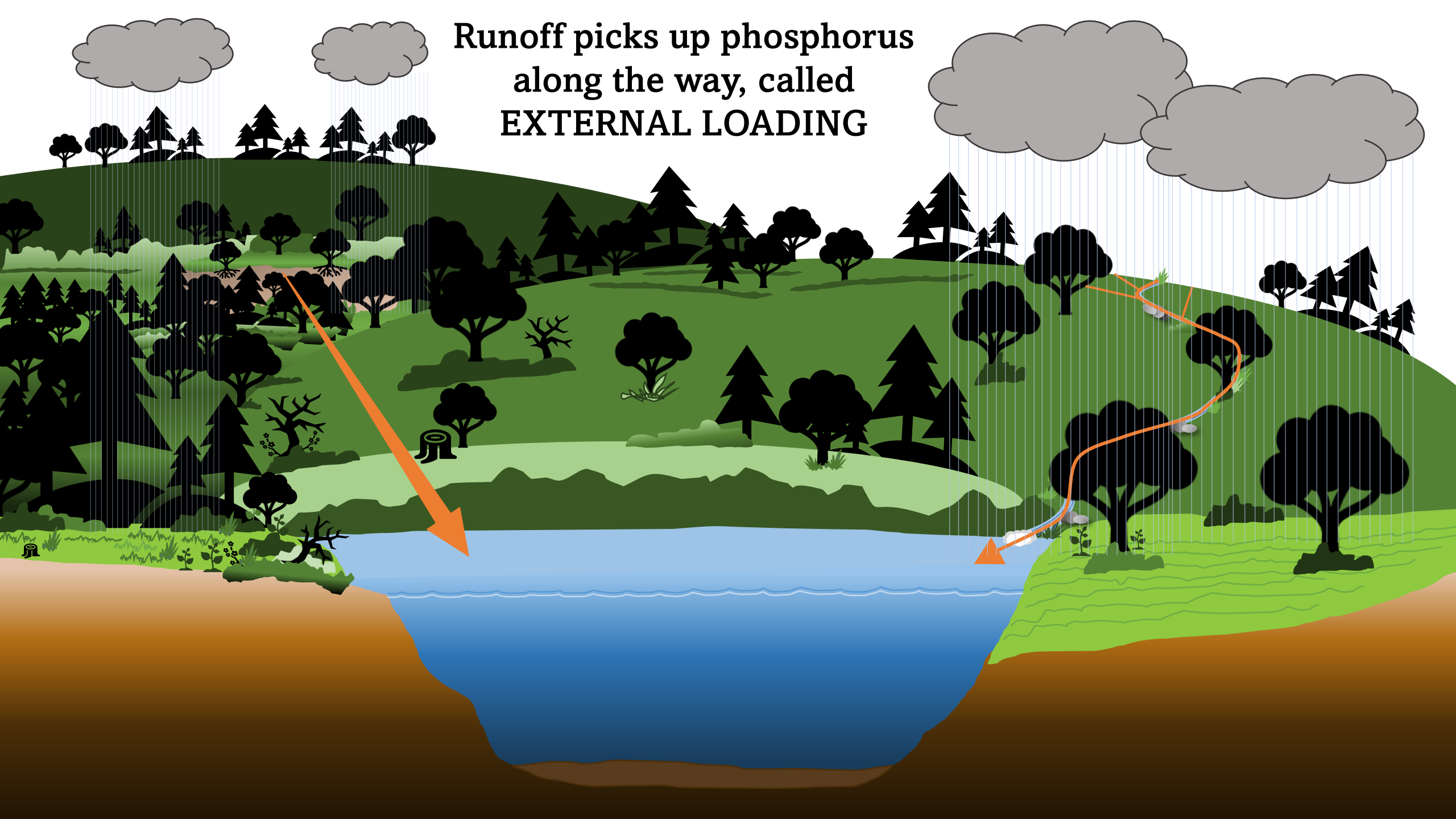
# Rain causes runoff

Runoff flows over land and into lake

Runoff washes into streams and ditches that enter lakes



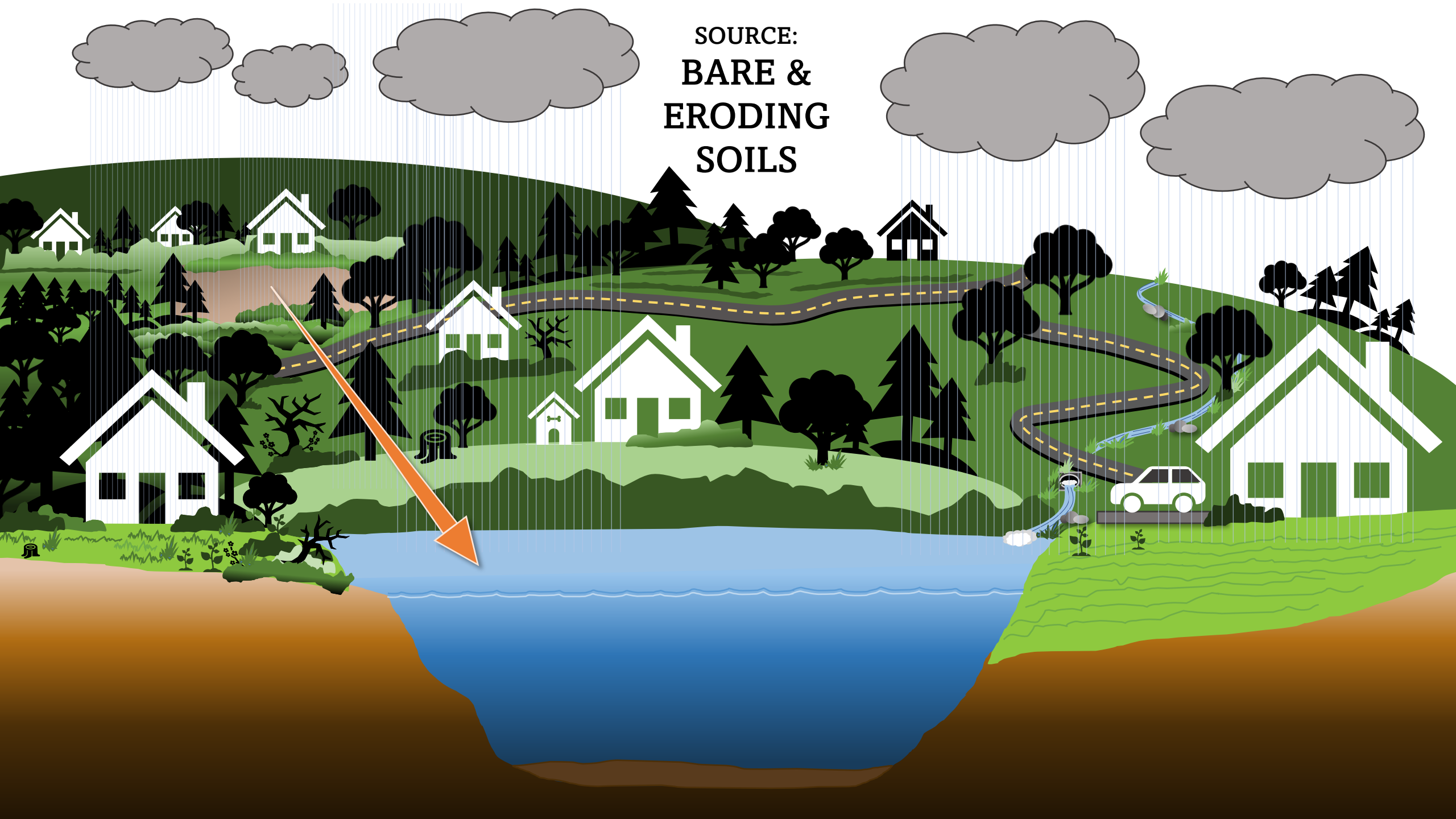
Runoff picks up phosphorus  
along the way, called  
**EXTERNAL LOADING**



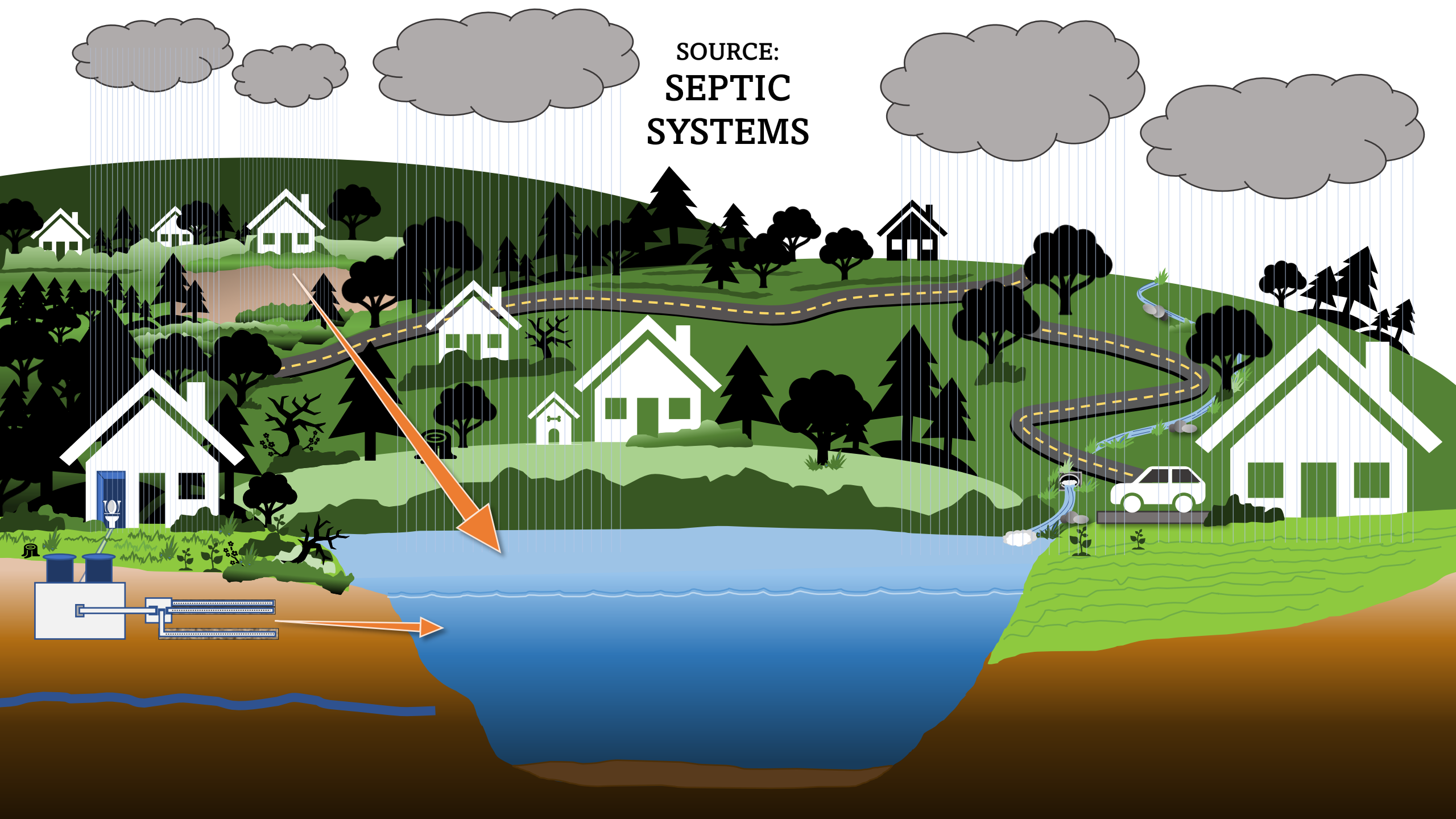
# People bring additional phosphorus sources



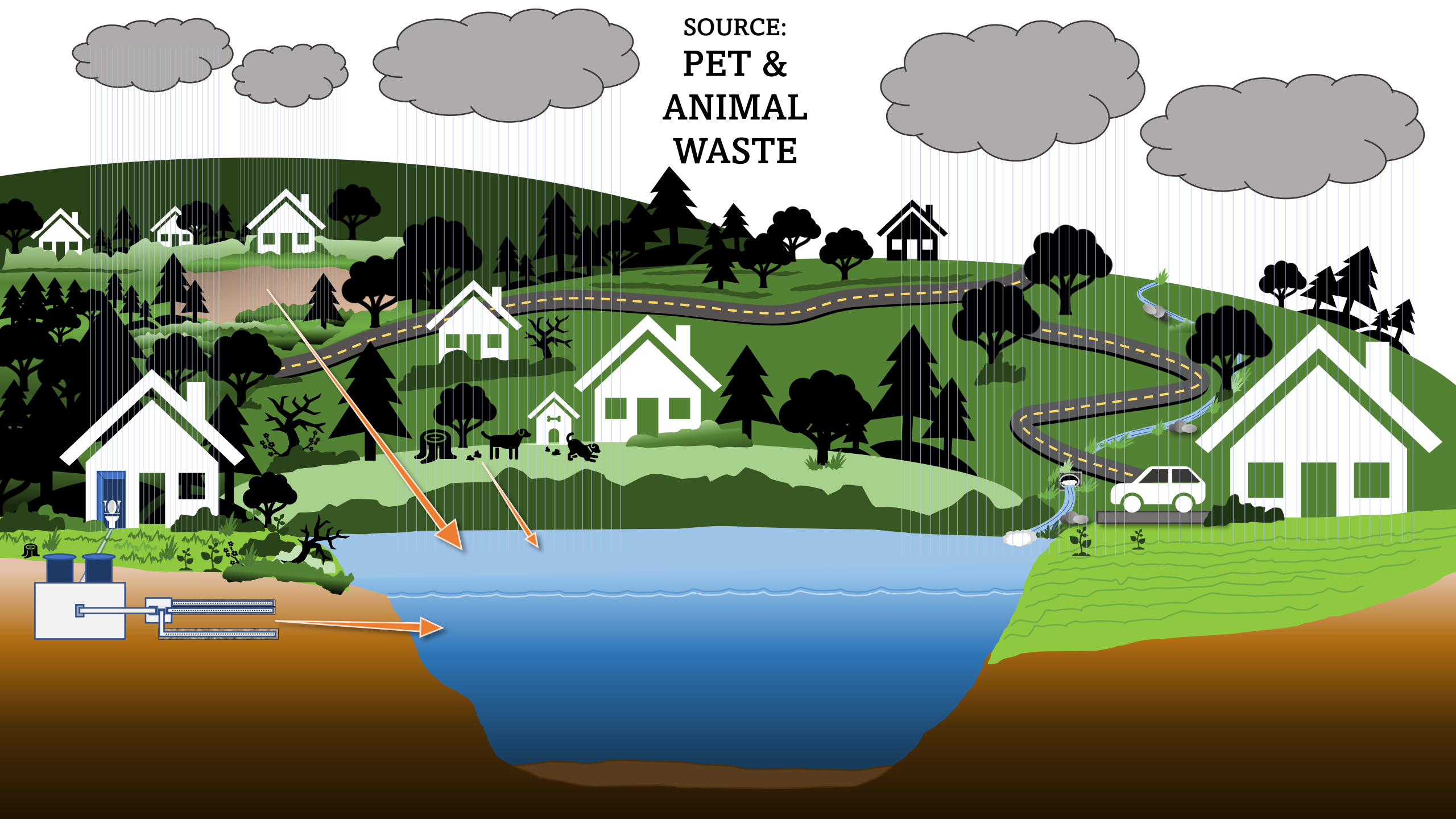
SOURCE:  
BARE &  
ERODING  
SOILS



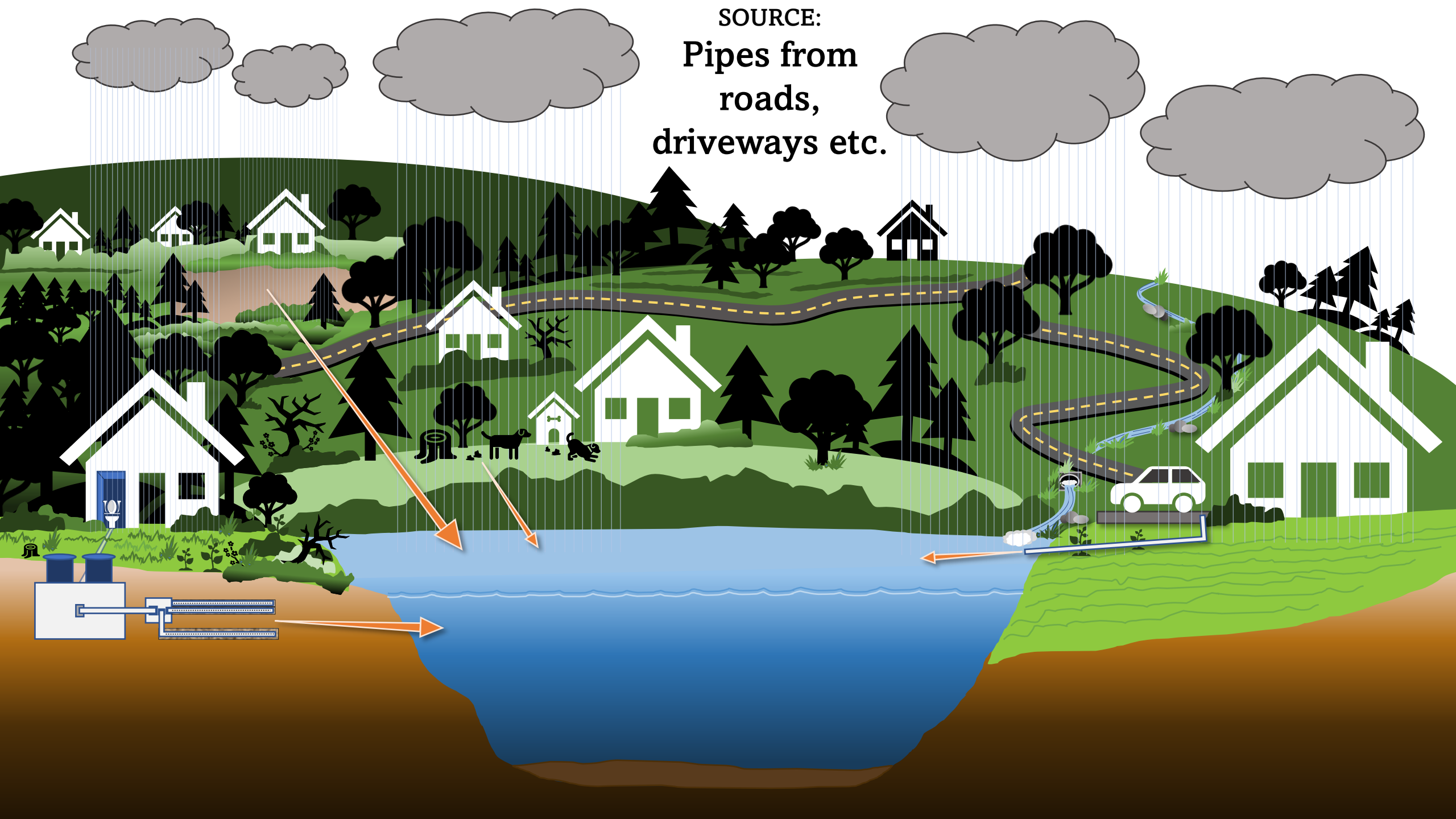
SOURCE:  
SEPTIC  
SYSTEMS



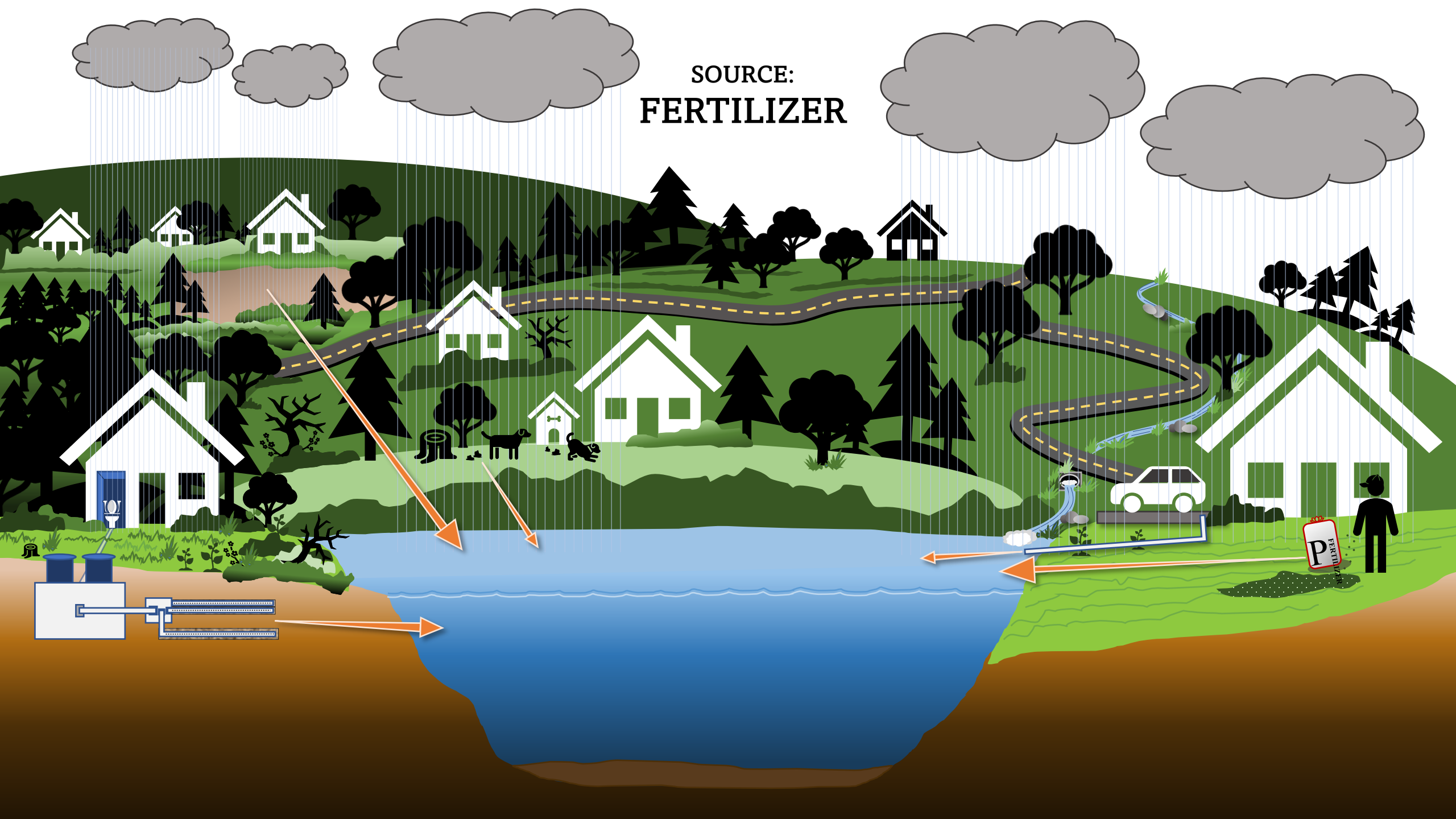
SOURCE:  
PET &  
ANIMAL  
WASTE



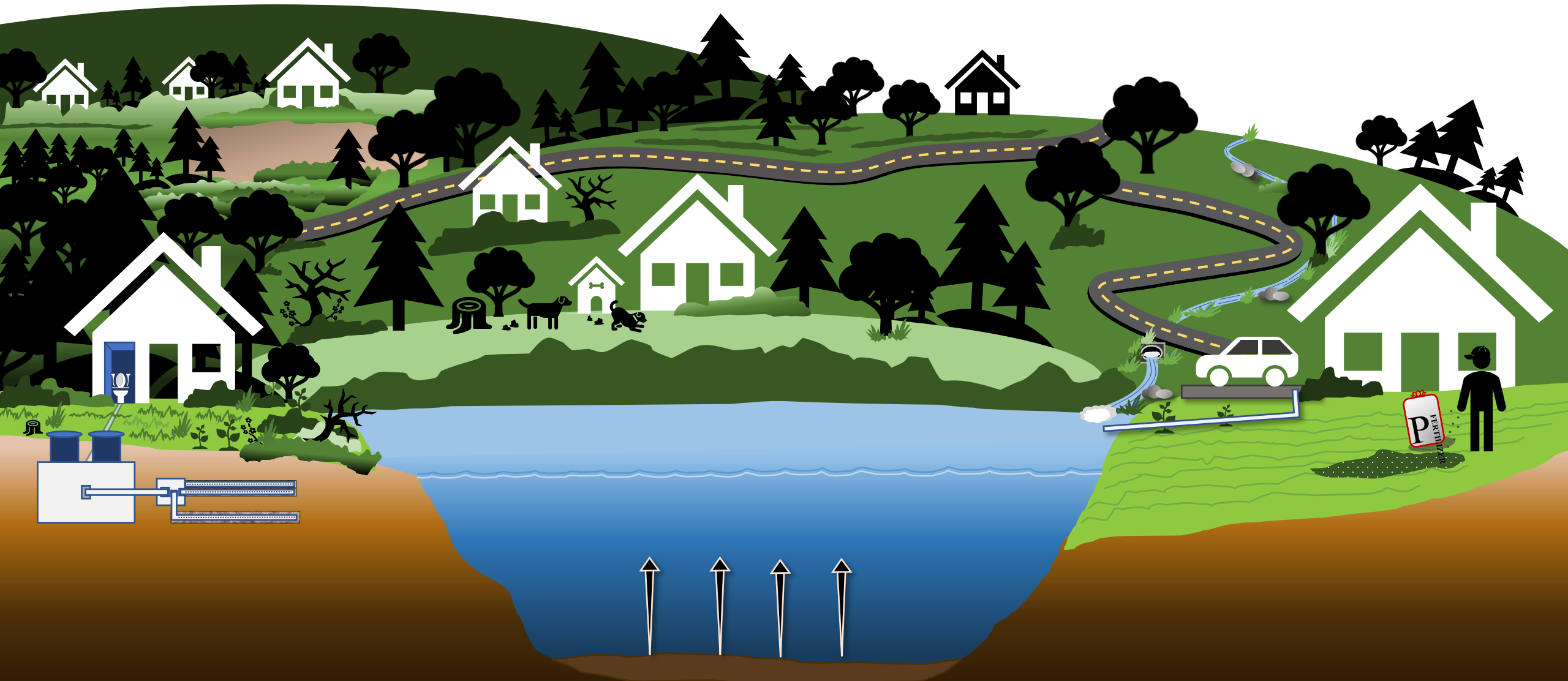
SOURCE:  
Pipes from  
roads,  
driveways etc.



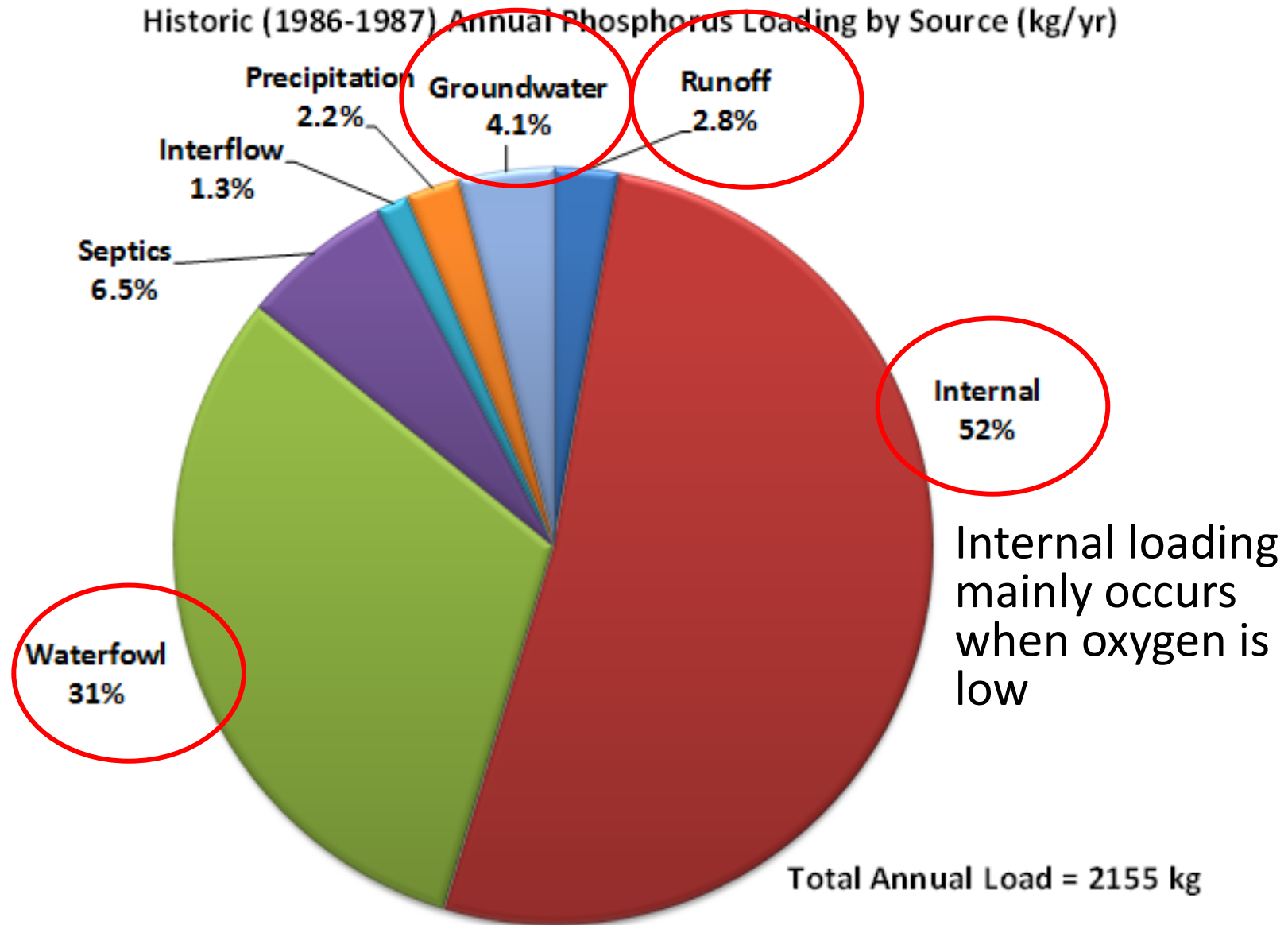
SOURCE:  
FERTILIZER

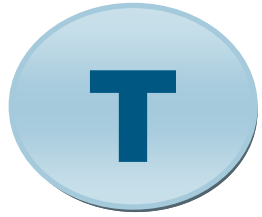


All that Phosphorus builds up at the lake bottom which can recycle back into the water which is called - INTERNAL LOADING

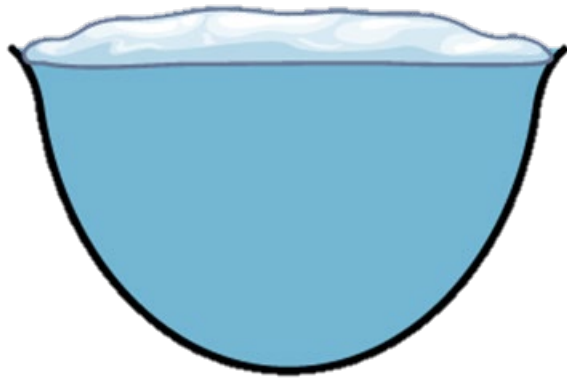


# Historic Sources of Phosphorus (1986-1987)

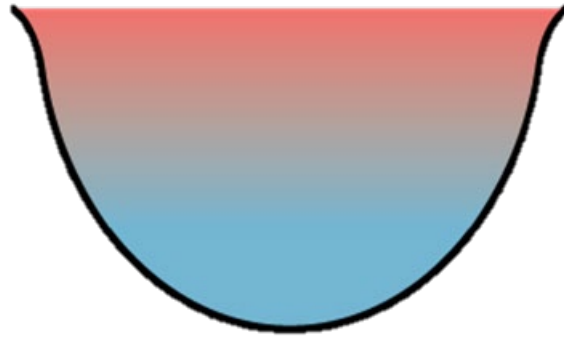




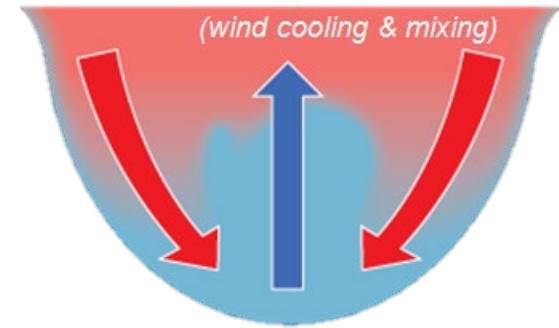
# Seasonal Cycle of Lakes - Temperature



Winter



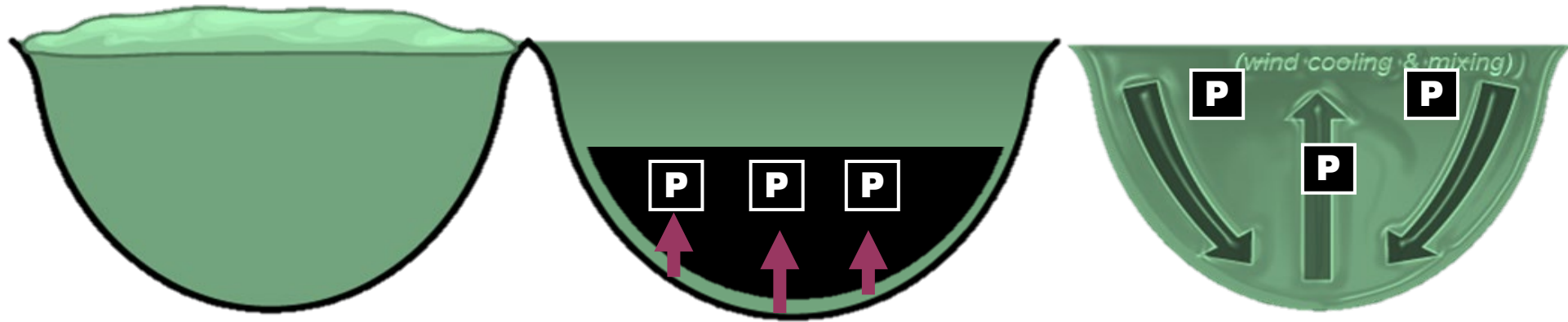
Summer



Fall Turnover



# Dissolved Oxygen



Winter

Summer

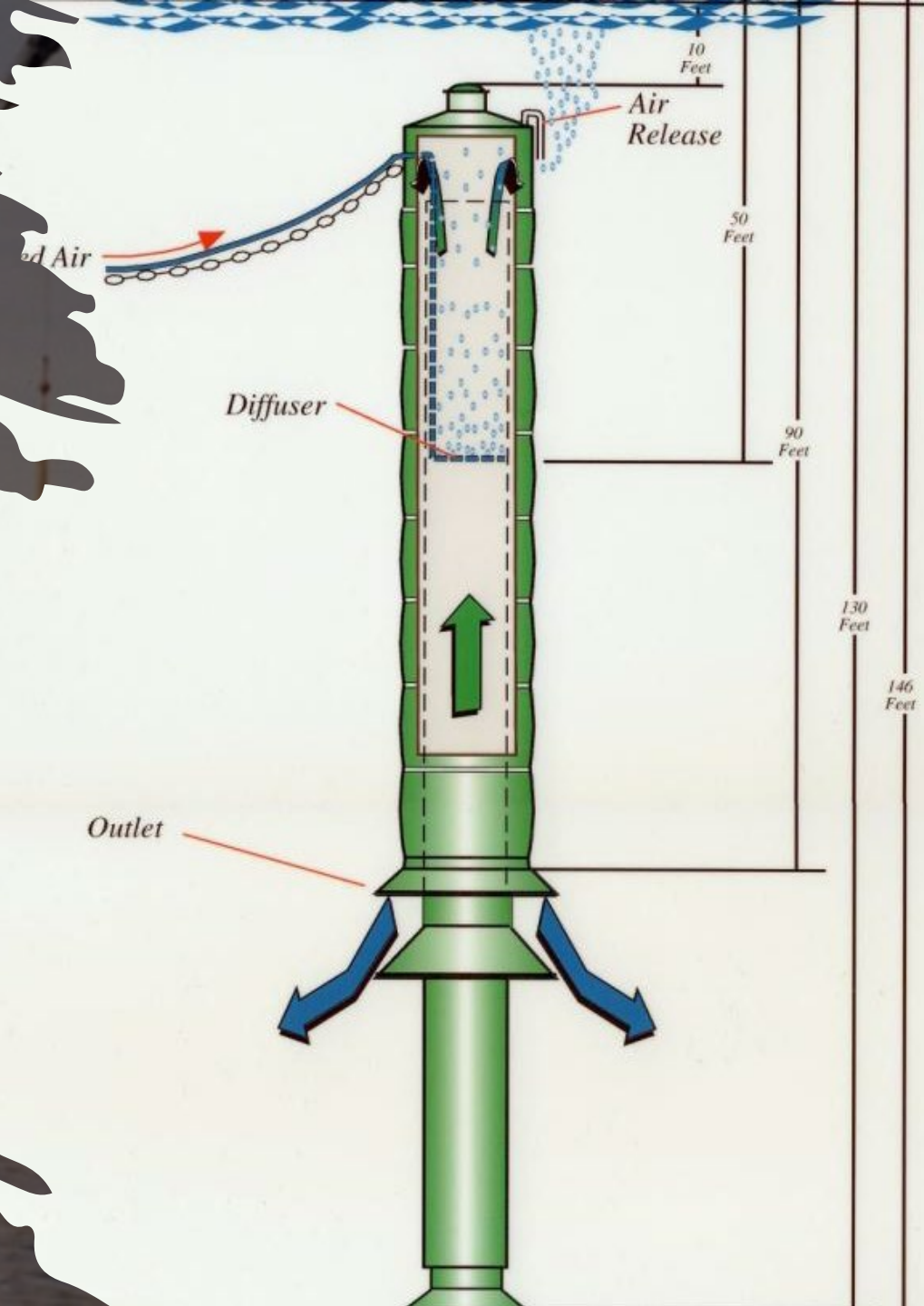
Fall

Phosphorus **bound to iron** in lake sediments **is released** when **no oxygen**

When the lake mixes it is spread throughout the lake

# Option #1 – Keep Oxygen in Bottom of Lake

- In 1994, a \$1.1 million hypolimnetic aeration system was installed
- The four aerators pull low-oxygen water from the lake bottom, mix it with air, and send the high-oxygen water back to the bottom.
- In the presence of oxygen, iron in the sediments stays bound and holds phosphorus



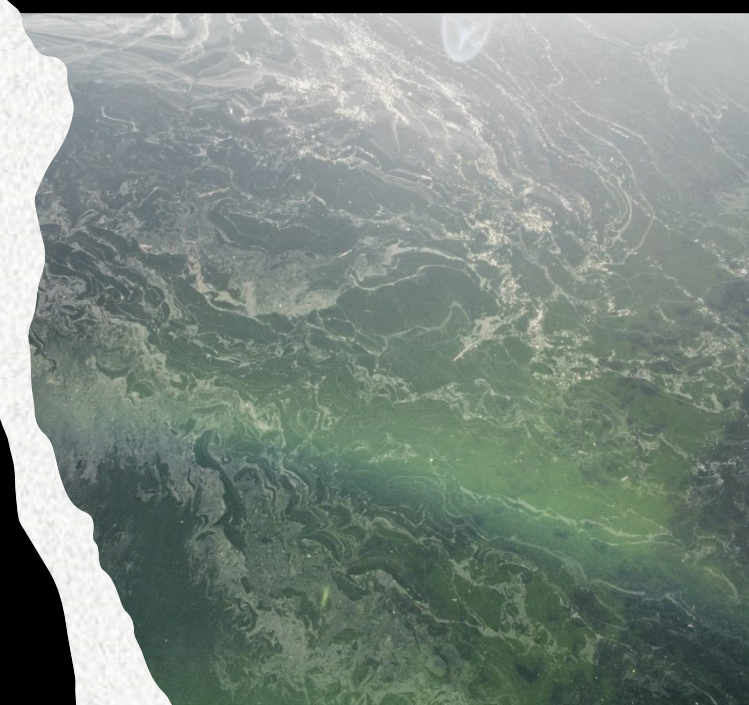


The aeration system provided significant benefits to the lake.

# Until it wasn't as effective, and algae returned

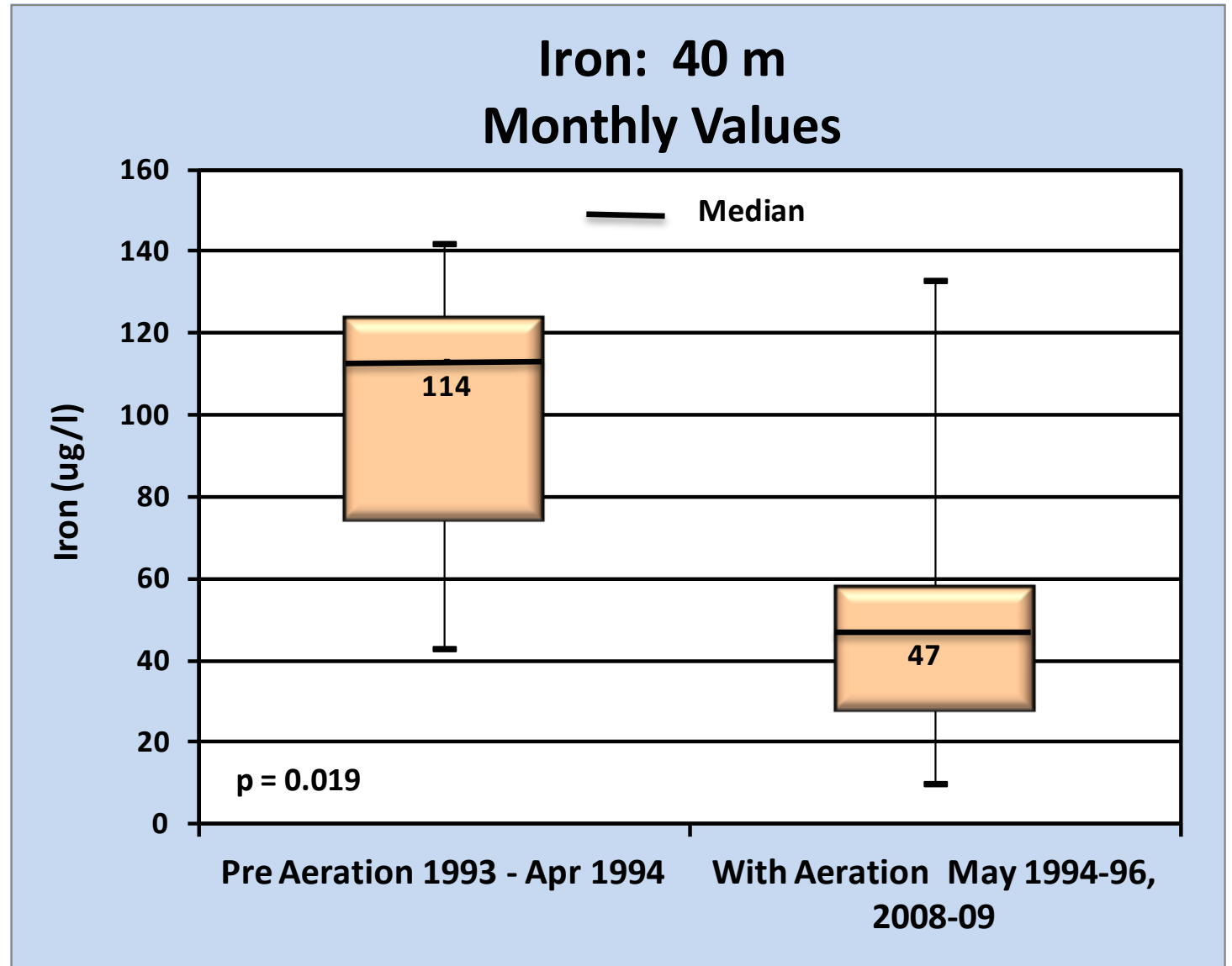


Year	Days Posted	Microcystin Range (µg/L)	Anatoxin Range (µg/L)
2010	-	0.7-2.5	0.030
2011	10	0.05-28.6	<MDL
2012	17	0.58	-
2013	45	10-28.3	-
2014	-	<MDL	<MDL
2015	14	23.8	<MDL



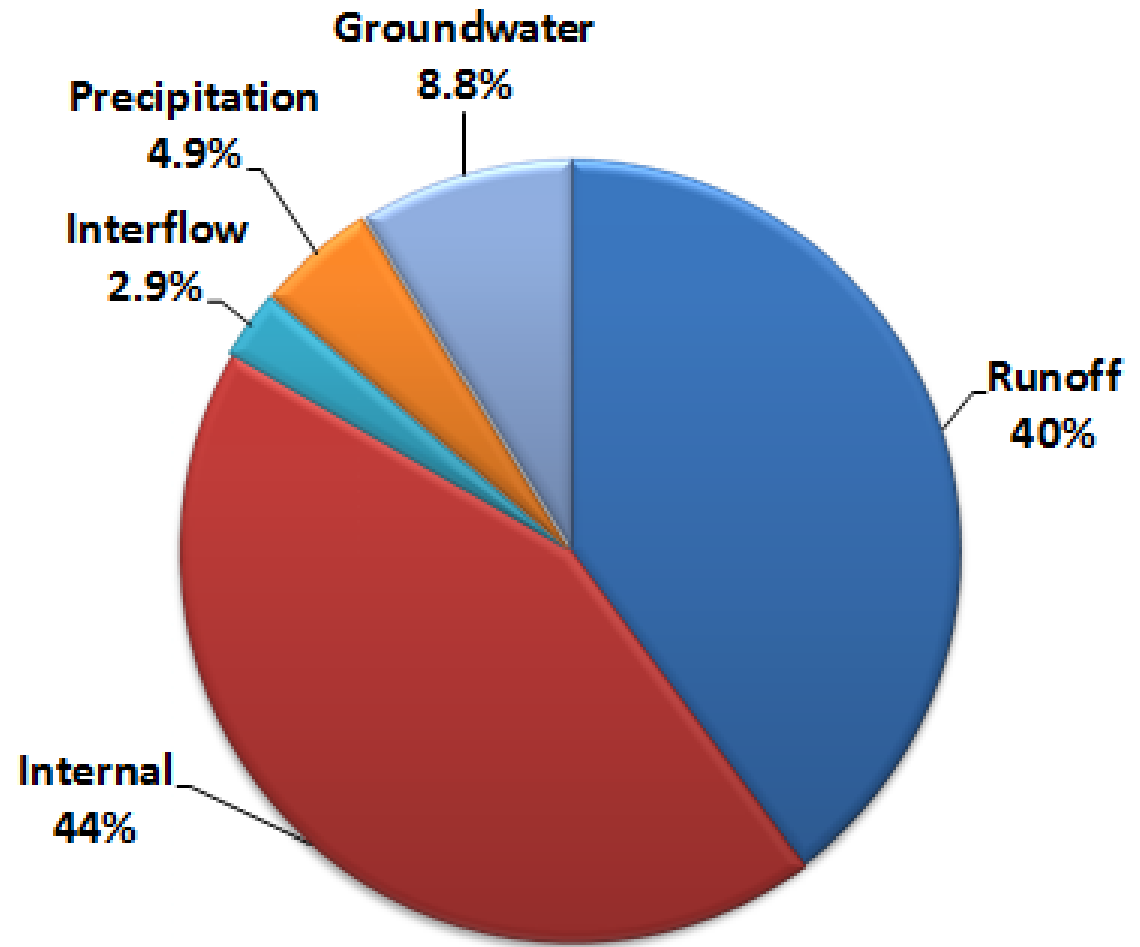
# Why did it stop working?

- 2009 sediment study completed
- Finding - Depletion of iron needed to bind all the phosphorus



# Why did it stop working?

- 
- 2011 study
  - External Phosphorus Loading increased 364 kg/yr to 560 kg/yr



Total Annual Load = 992 kg

## Option 2- Treat with Alum

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- Aluminum/phosphorus bonds are not affected by low oxygen
- Most common lake restoration method used today
- Safe as used in drinking water treatment, pickling (you can buy in store)
- Very large dose needed to bind all phosphorus in sediments
- Split into a small annual treatment over 9-12 years
- First treatment in 2013





2022 study examined efficacy of alum . .  
so how are we doing?





Excellent...  
Mostly



# Lake Stevens 2023 Health Report

## Lake Health = EXCELLENT

The lake health is excellent as alum treatments keep phosphorus and algae low. Actions are still needed to prevent pollution and improve shoreline health.

Health Indicators	Poor	Fair	Good	Excellent	Details
 <b>Water Clarity</b> <i>Visibility in water</i>	[Blue bar spanning from Poor to Excellent]				Excellent – Average clarity is 25.9 feet deep and is getting better.
 <b>Phosphorus</b> <i>Keeping it low prevents algae</i>	[Blue bar spanning from Poor to Excellent]				Excellent – Phosphorus levels are low as a result of ongoing alum treatments.
 <b>Algae</b> <i>Problematic if too much</i>	[Blue bar spanning from Poor to Excellent]				Excellent – Algae levels are low. The lake rarely has toxic algae blooms since restoration.
 <b>Shorelines</b> <i>Shoreline plants protect the lake</i>	[Maroon bar]	[Grey bar]	[Grey bar]	[Grey bar]	Poor – Only 16% of the lake shoreline has trees and shrubs rather than lawns.

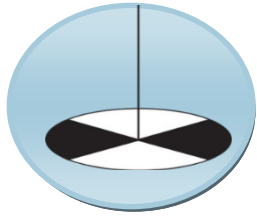
Possible ratings include: ■ Poor ■ Fair ■ Good ■ Excellent

## Lake Stevens Watershed

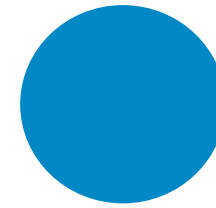
The properties inside the yellow line drain to the lake and make up the lake's watershed. The area outside the yellow line drains to other lakes, streams or rivers.



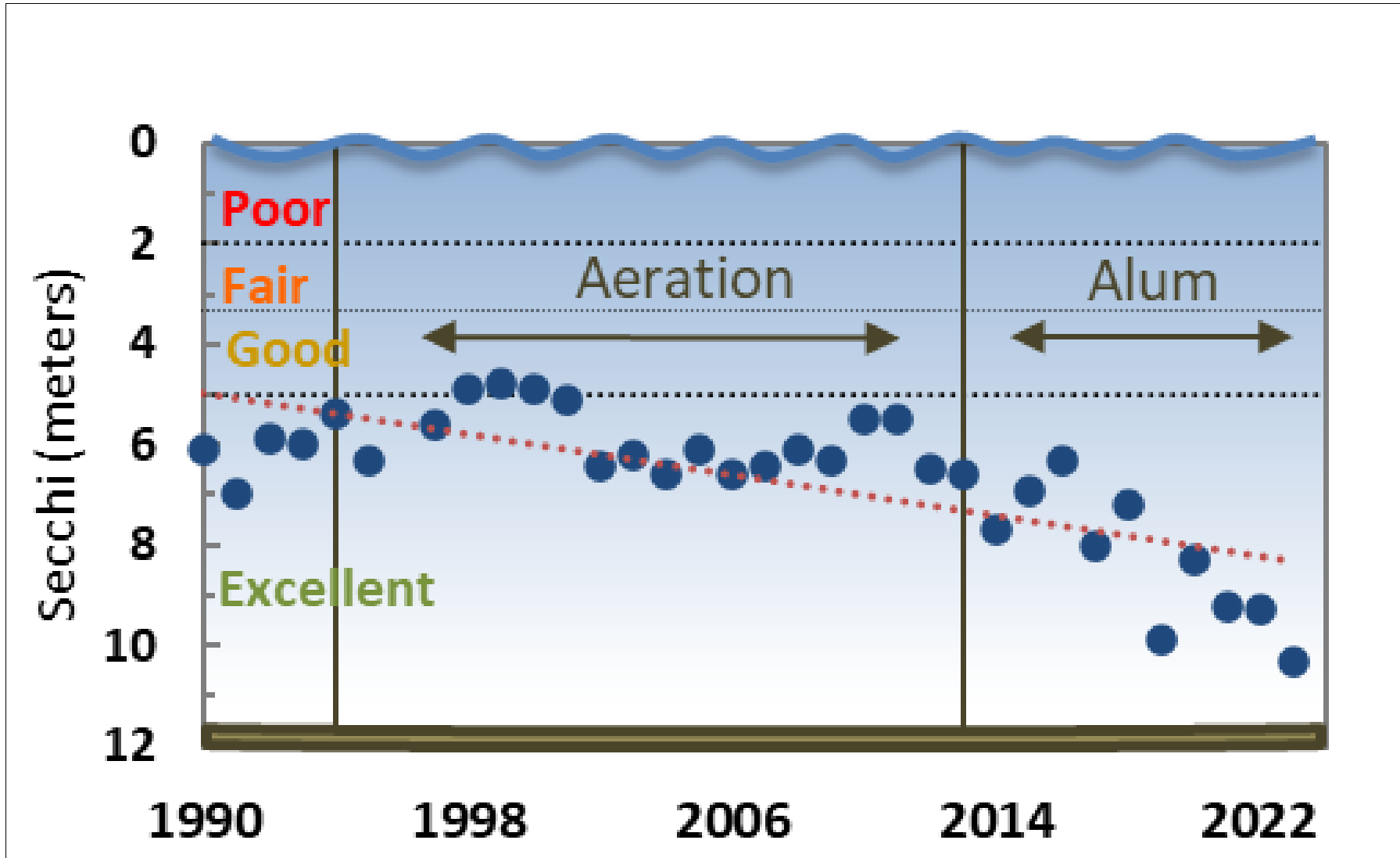
## Lake Stevens Facts



# Water Clarity

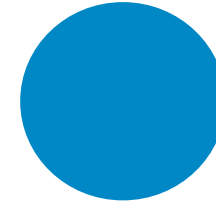


EXCELLENT

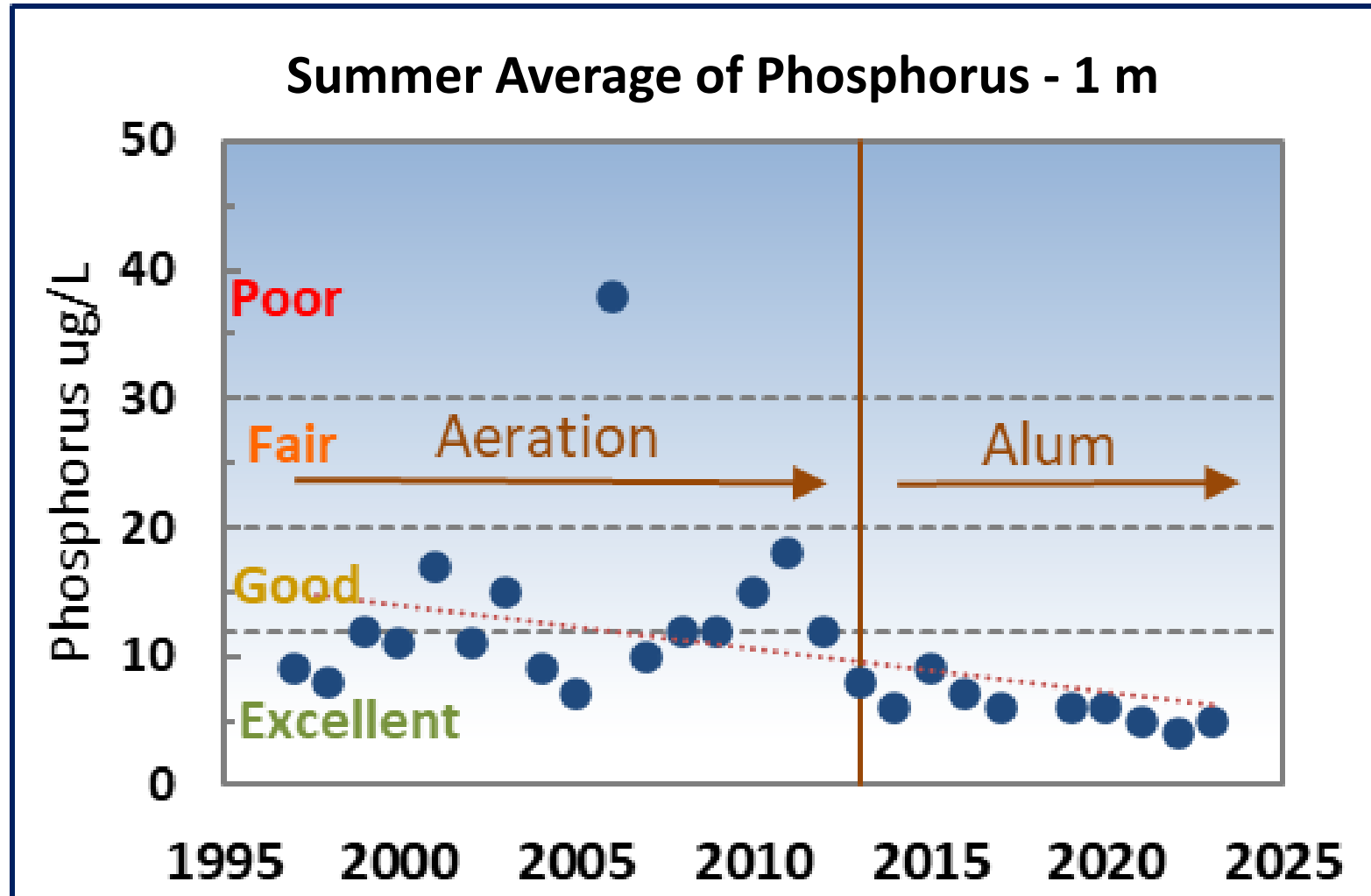




# Phosphorus

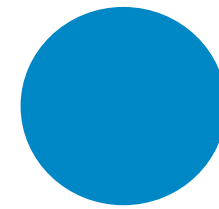


EXCELLENT

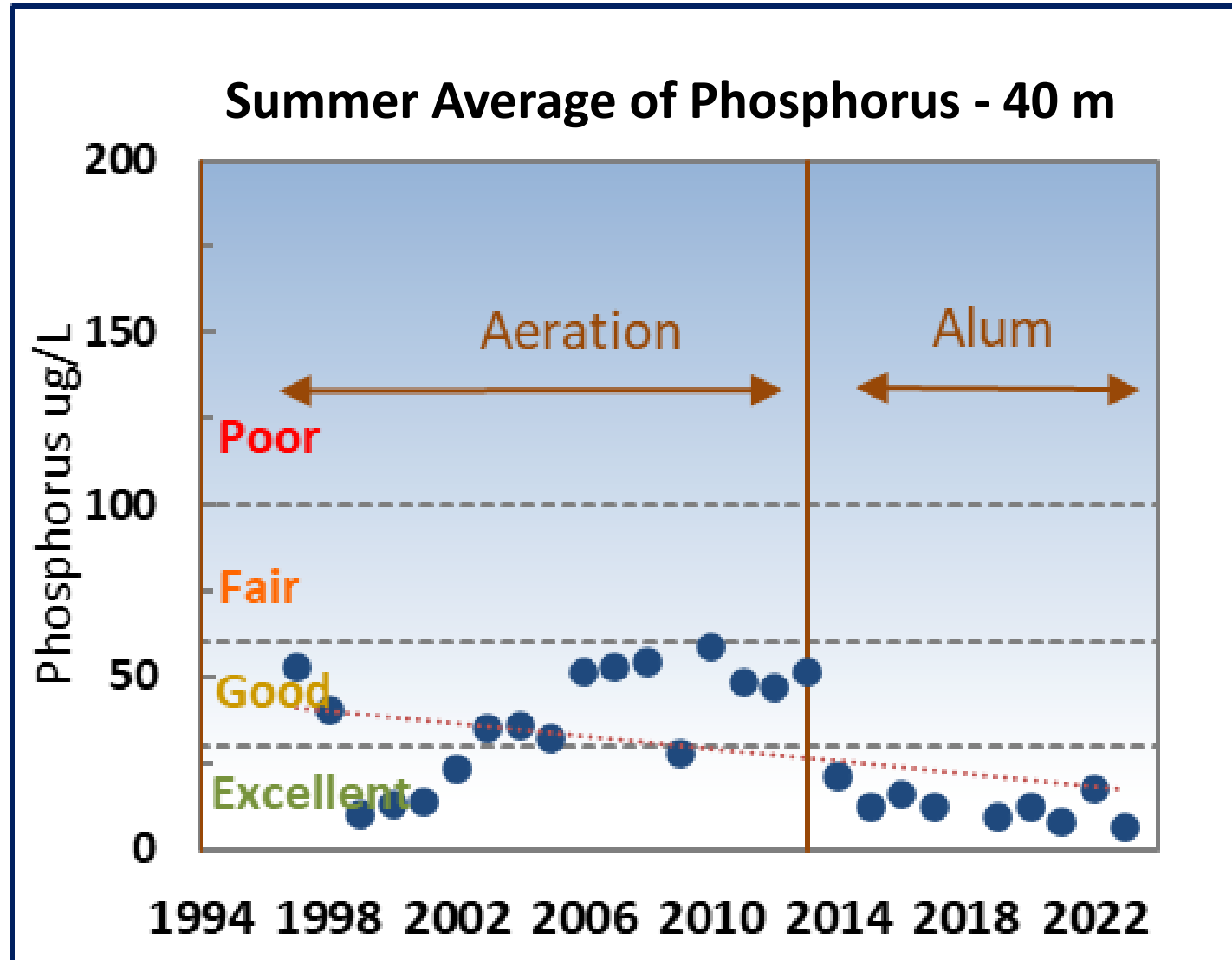


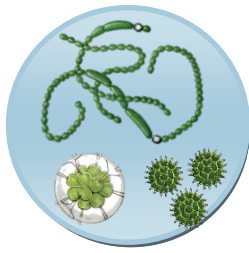


# Phosphorus



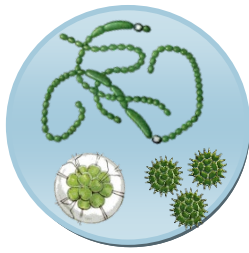
EXCELLENT



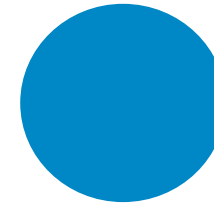


# Algae

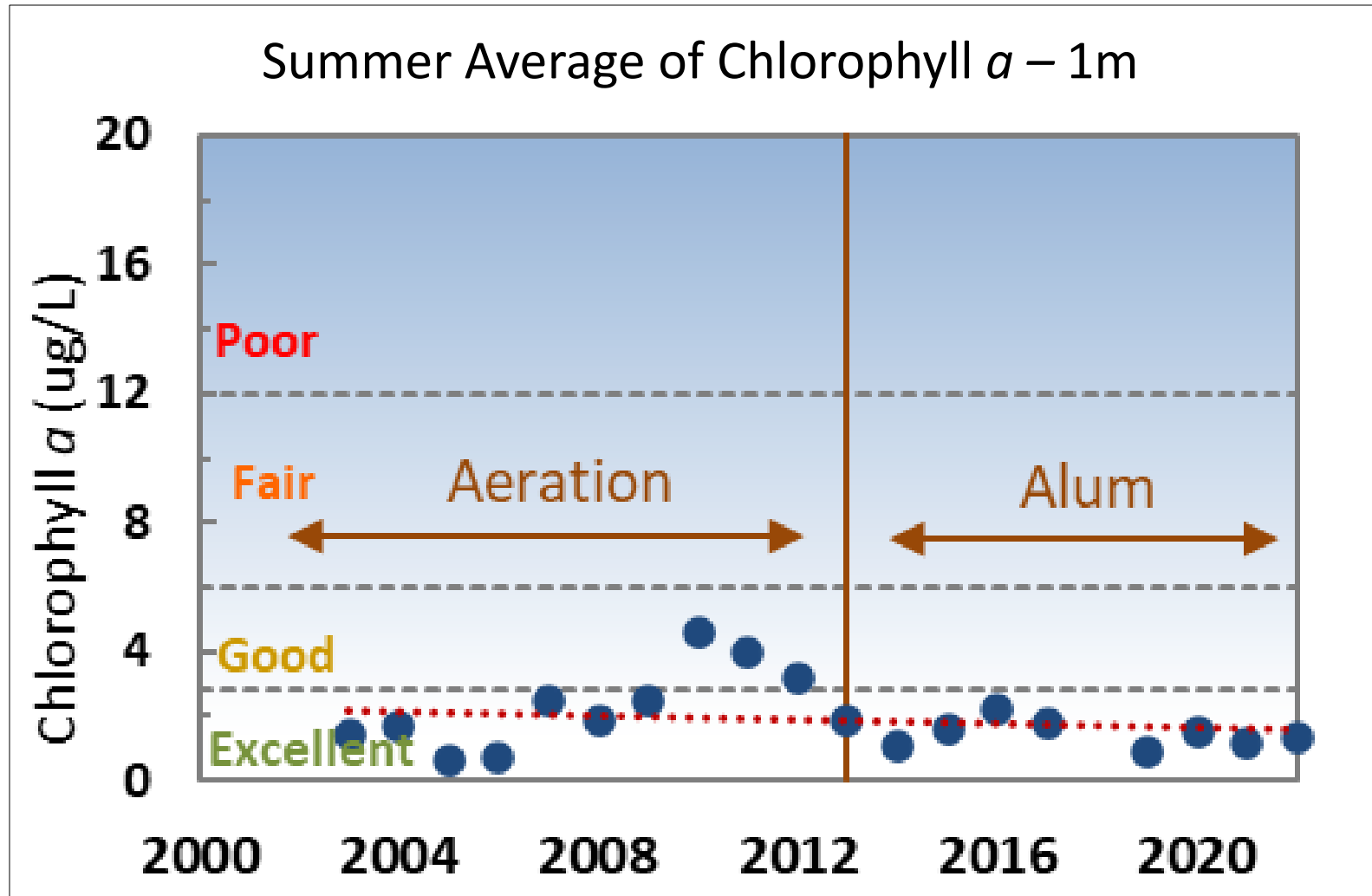


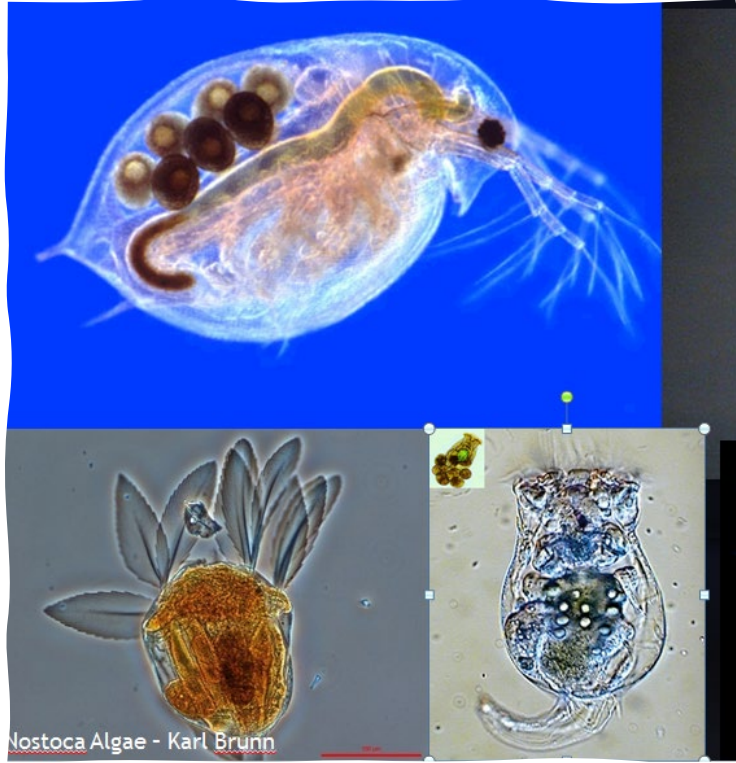


# Algae



EXCELLENT

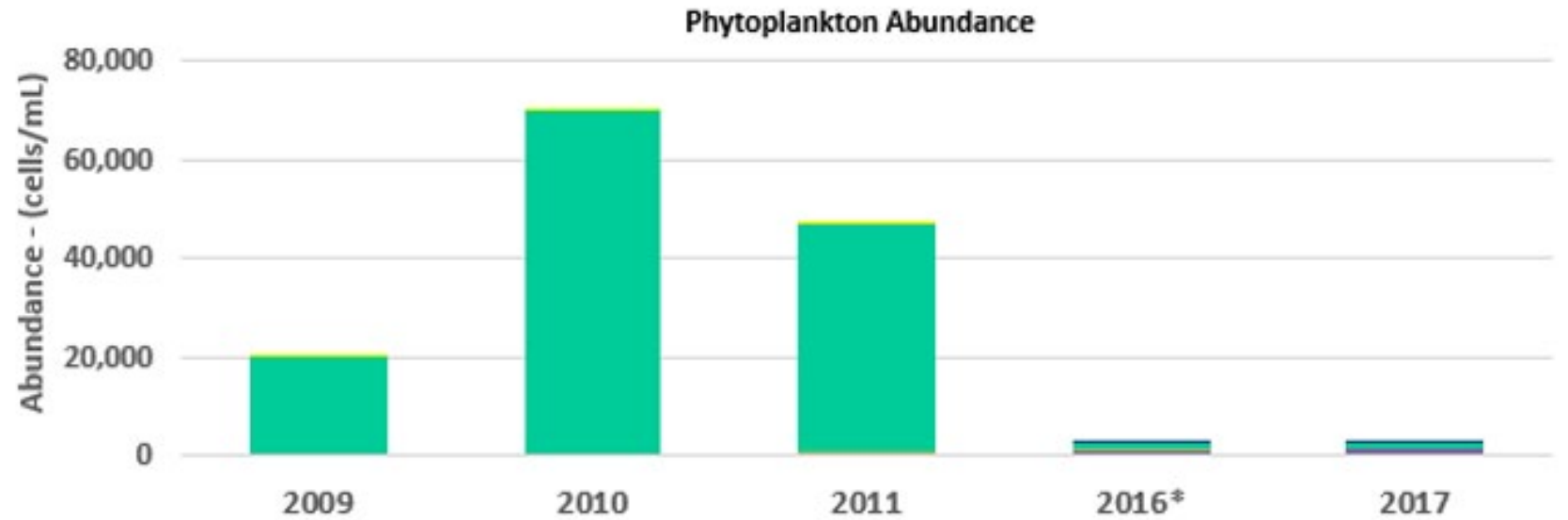




# Lake Food Chain

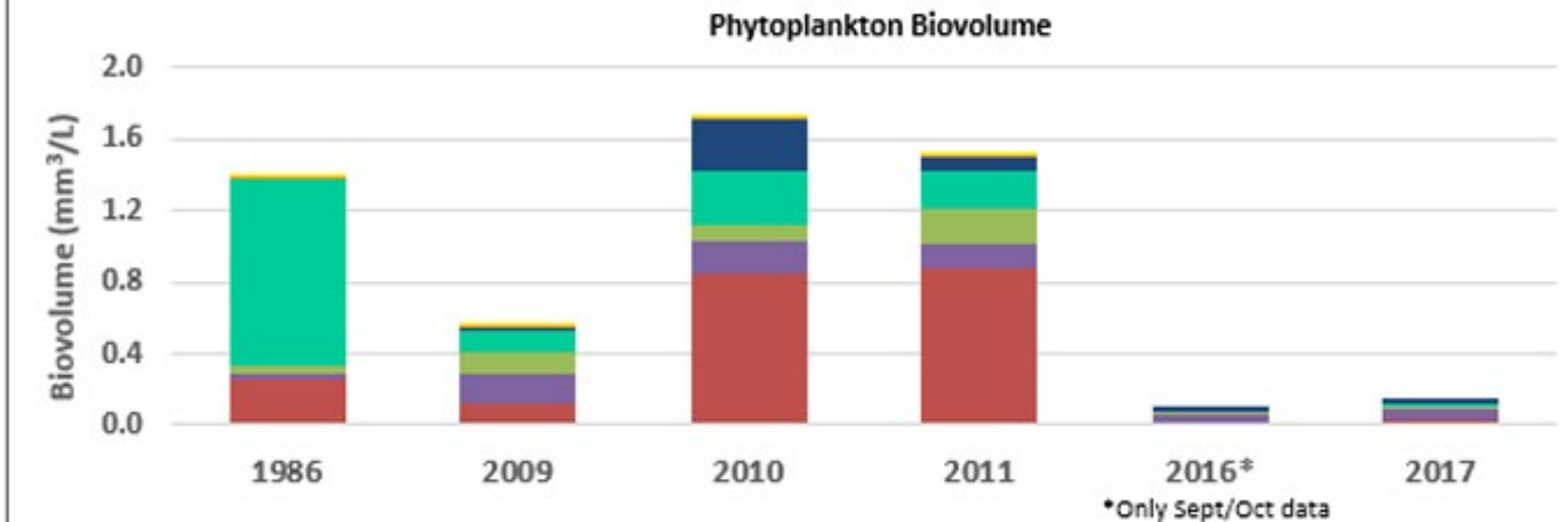
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Less Overall  
Algae



\*Only Sept/Oct data

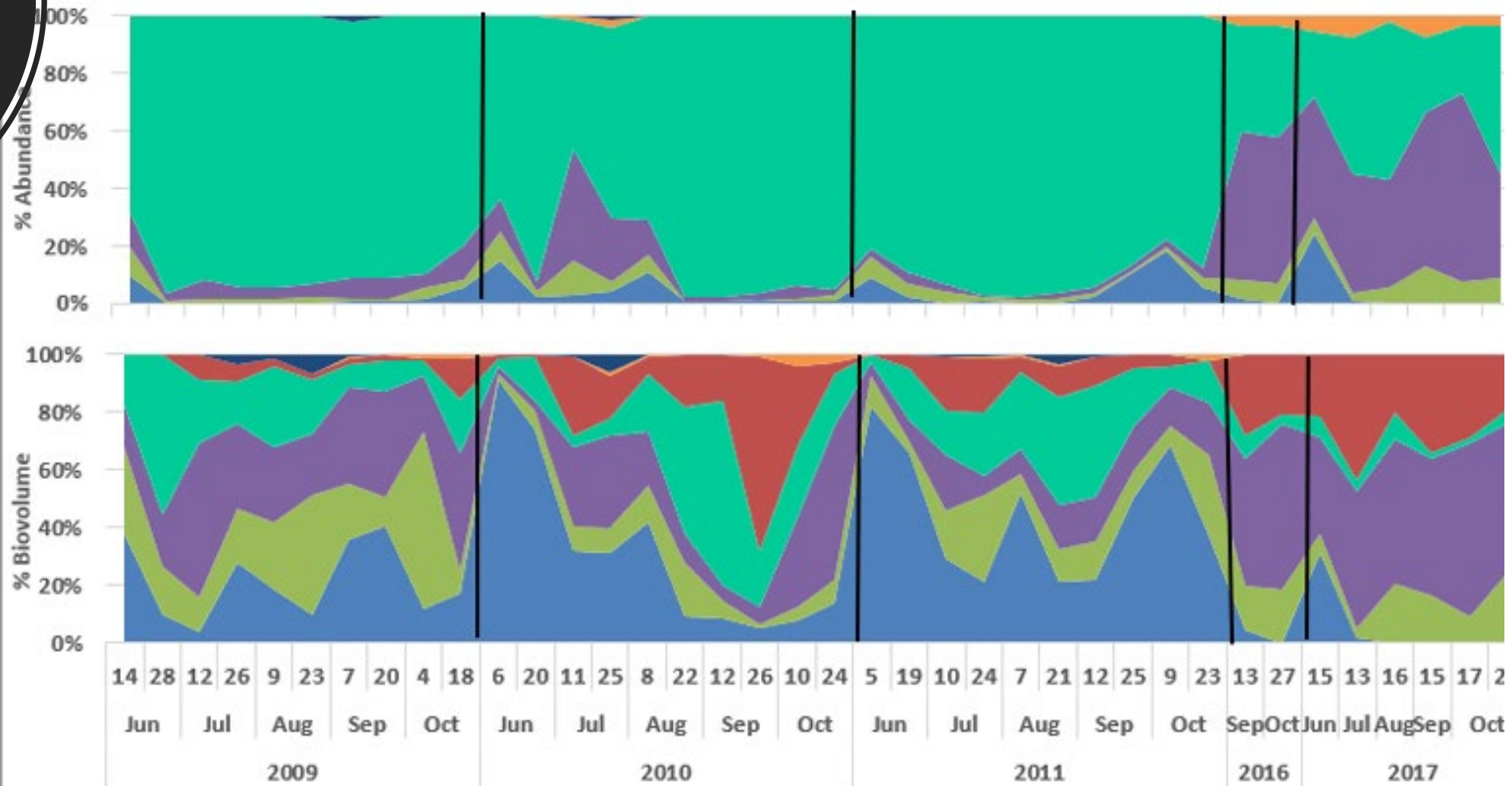
\*Only Sept/Oct data



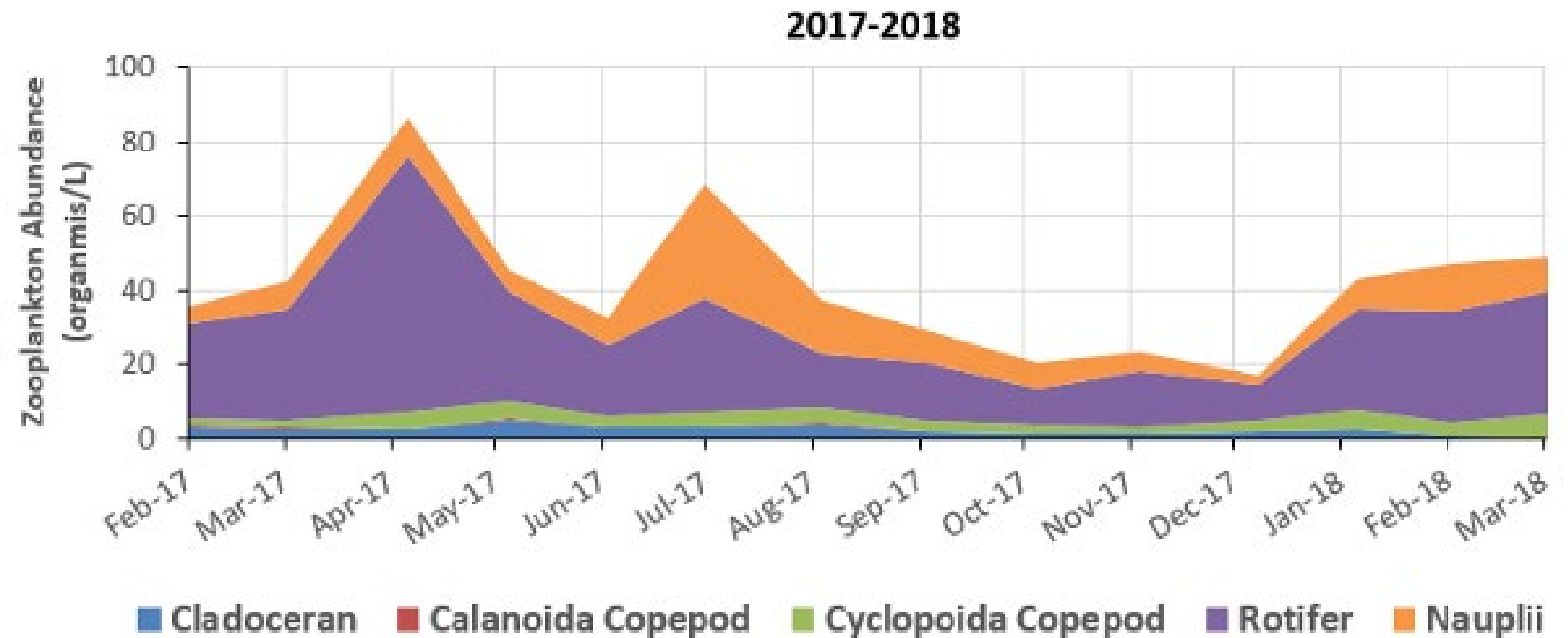
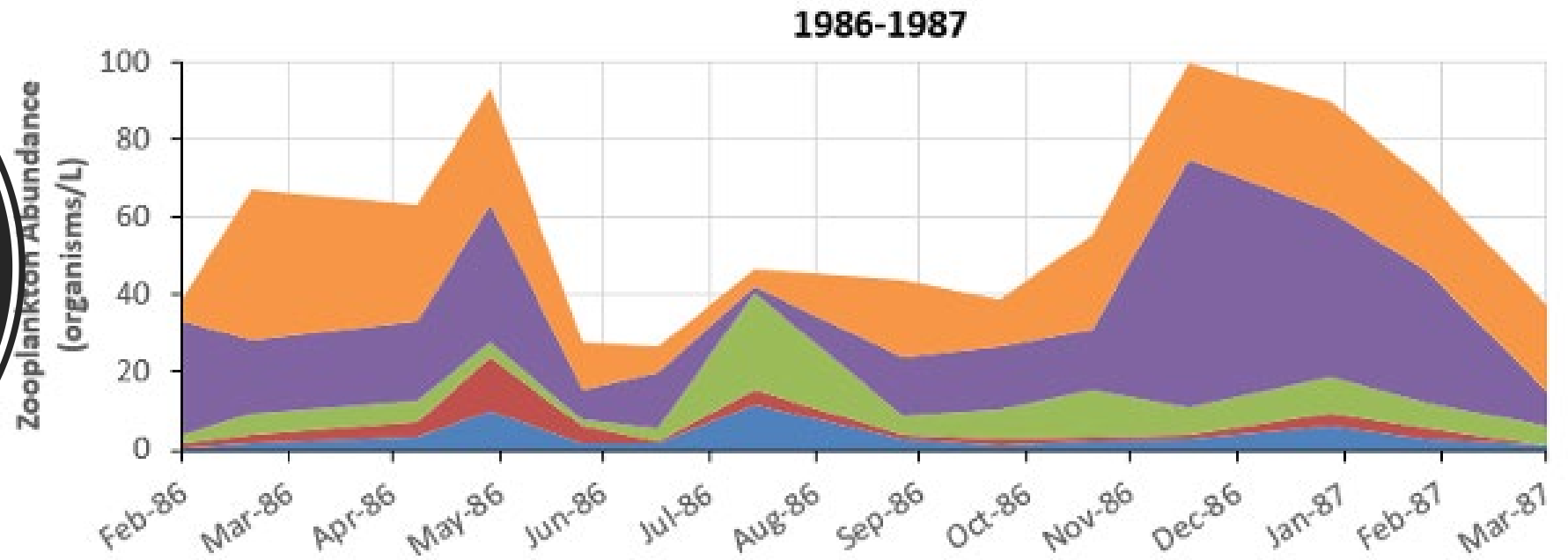
\*Only Sept/Oct data

■ Bacillariophyte ■ Chryso- & Cryptophyte ■ Chlorophyte ■ Cyanophyte ■ Dinophyte ■ Euglenophyte ■ Unknow

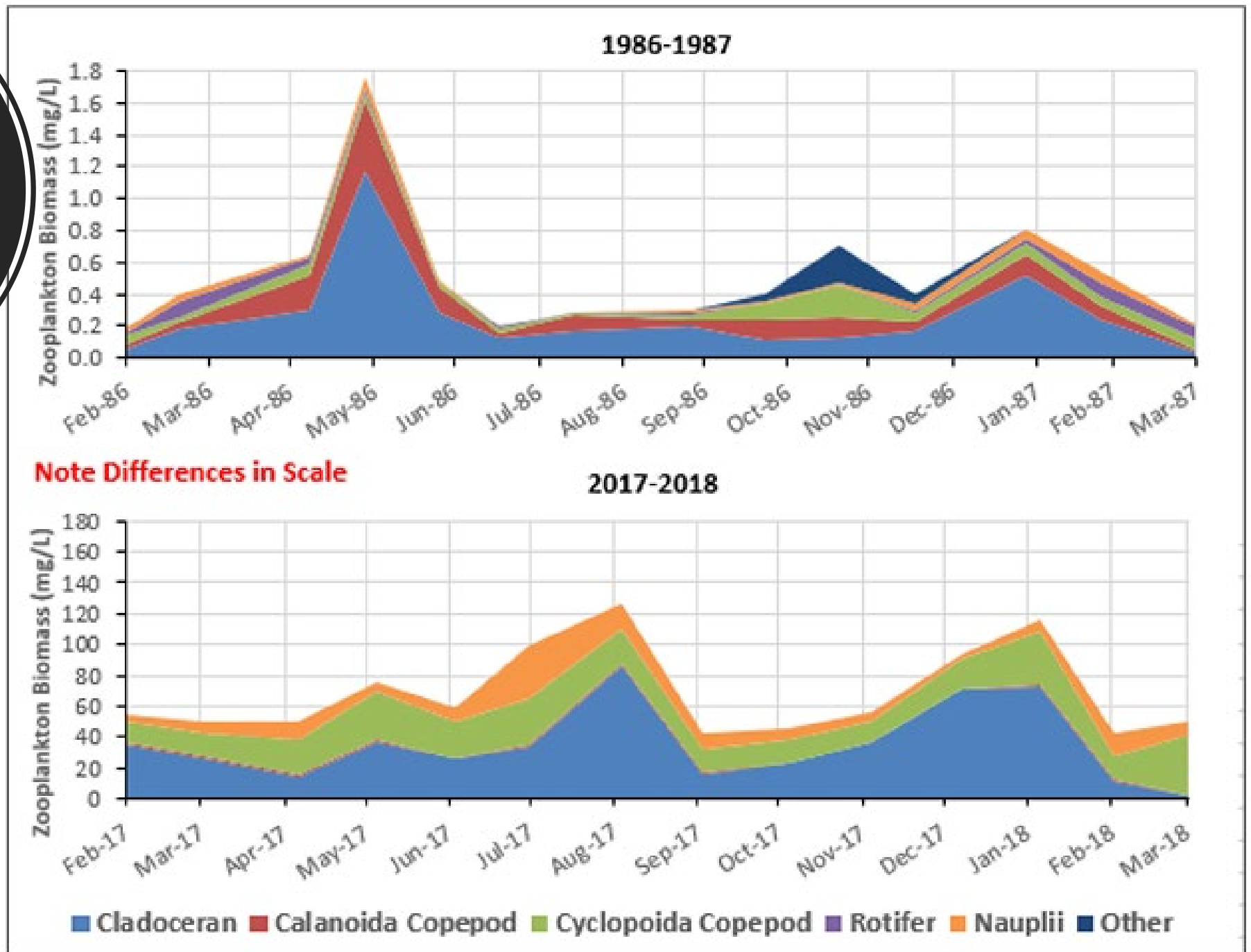
BUT More  
Diverse Algal  
Community



Similar  
Zooplankton  
Abundance



More  
Zooplankton  
Biomass?

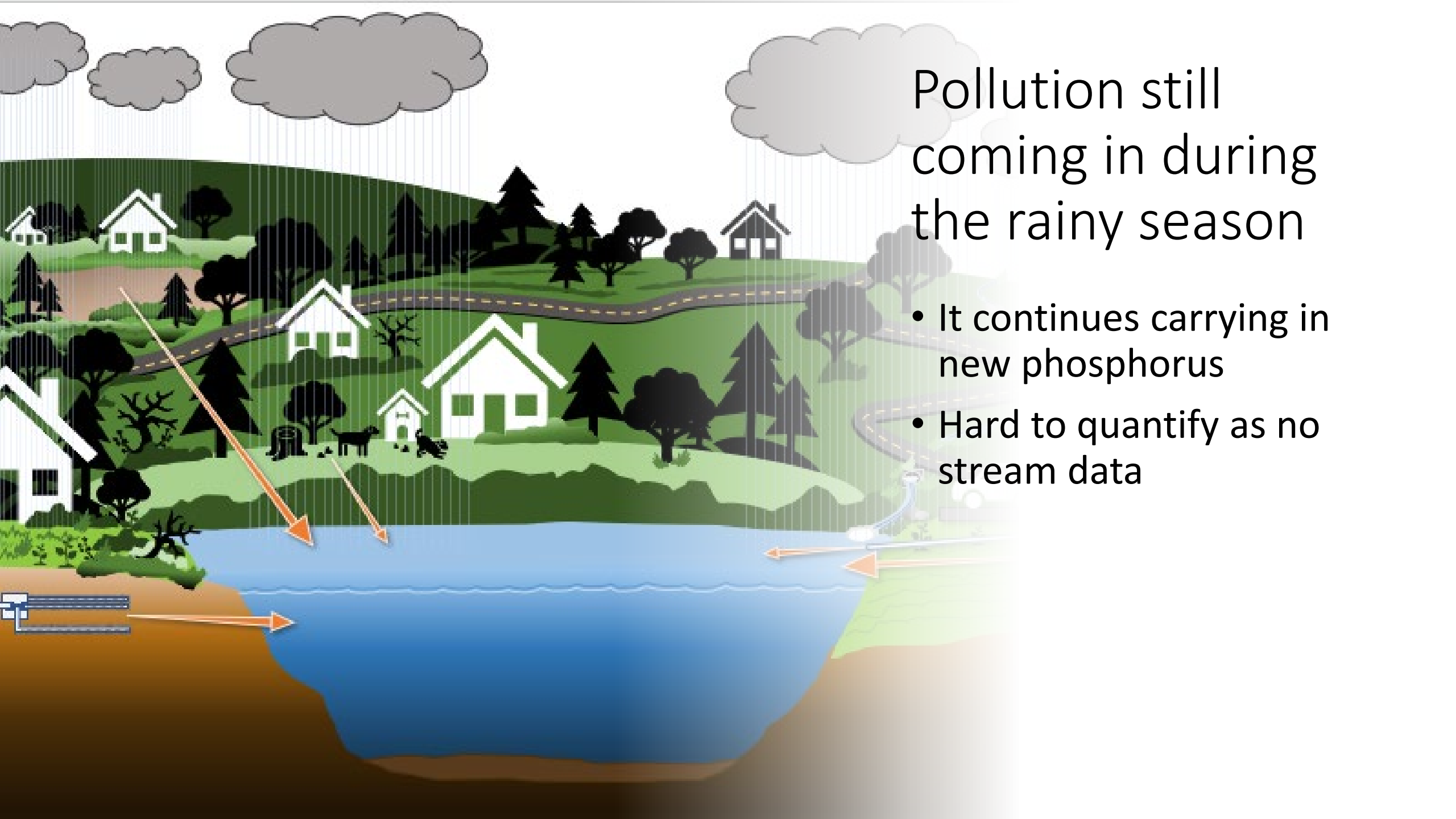




But there are  
some problems

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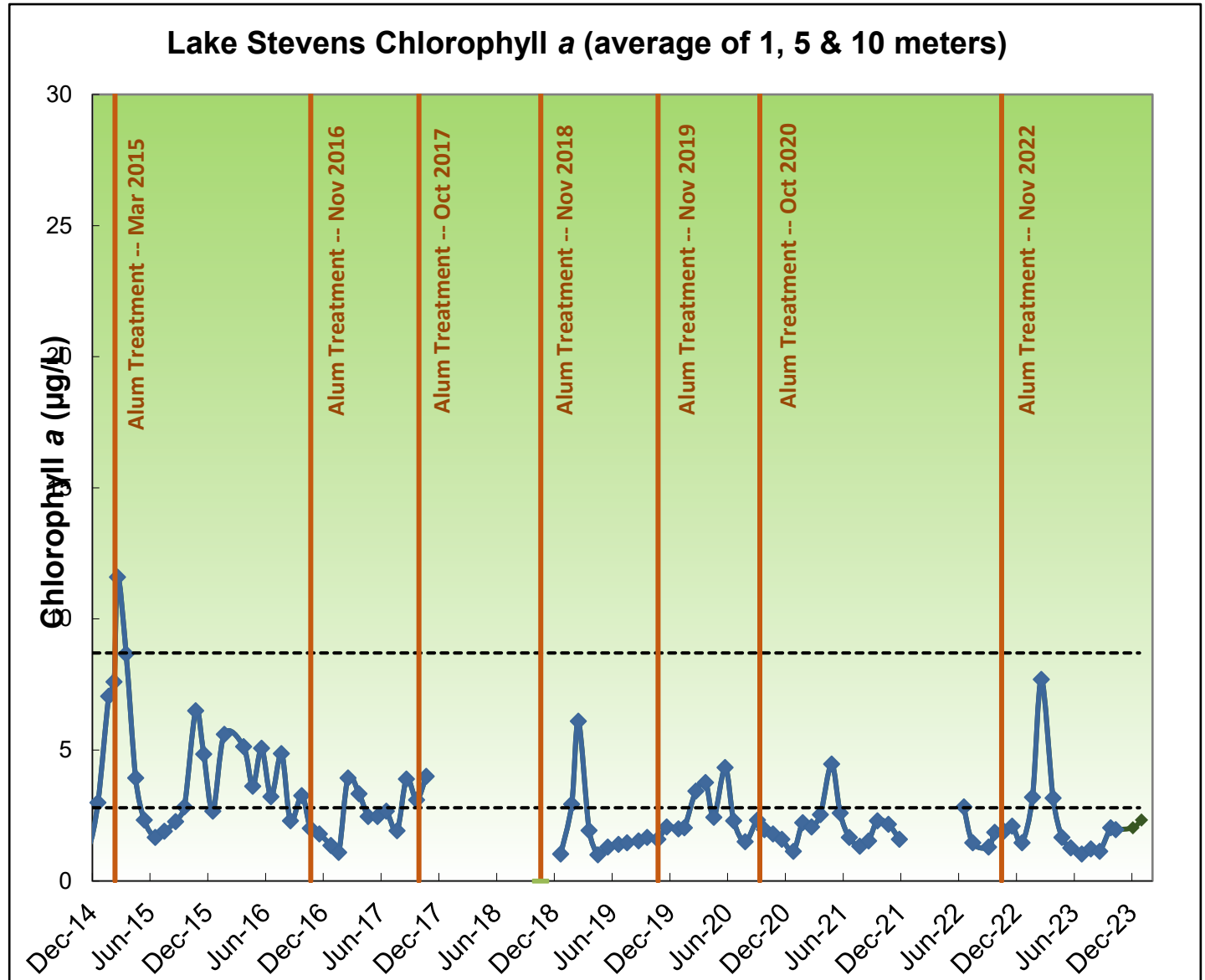


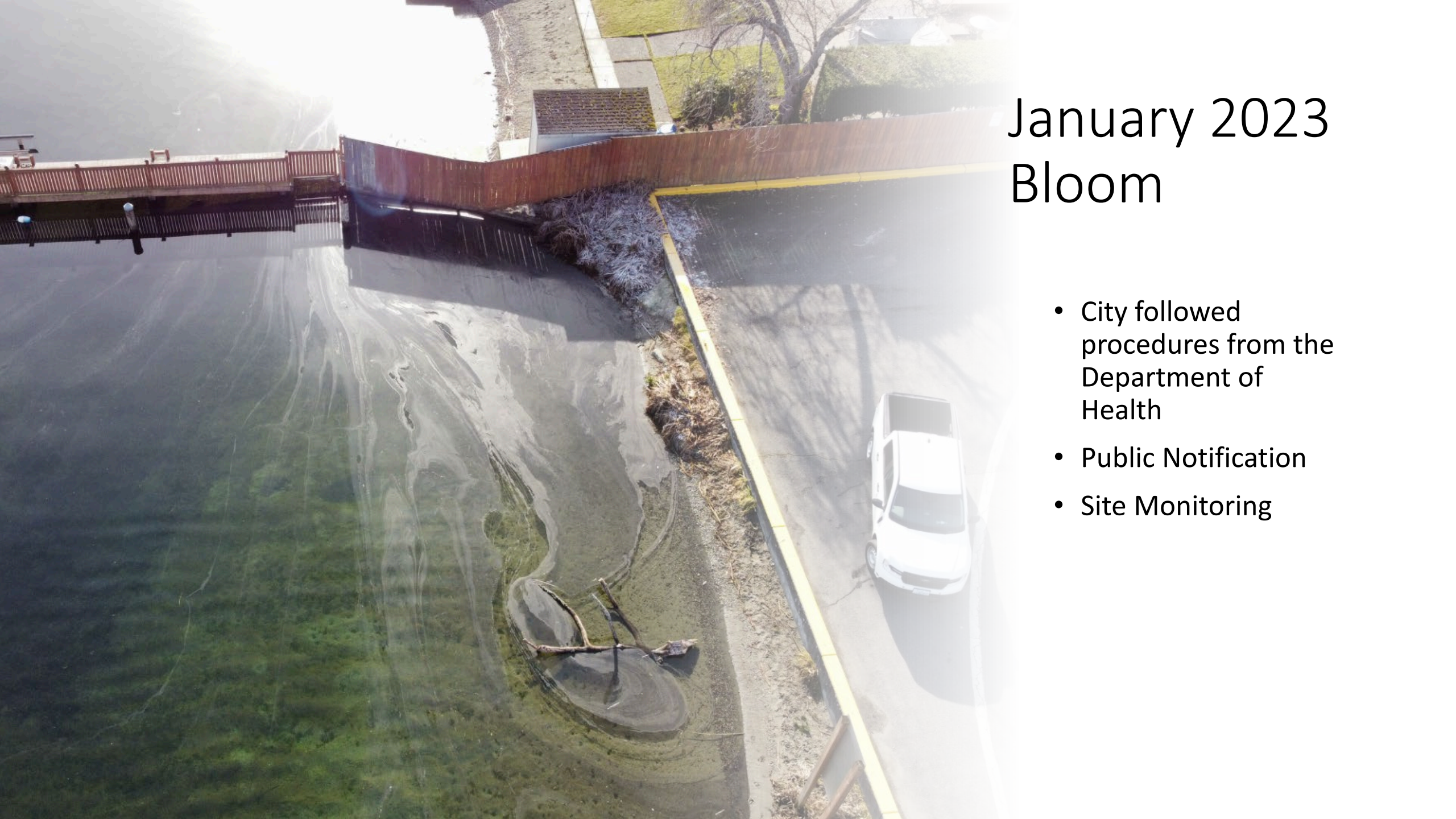


# Pollution still coming in during the rainy season

- It continues carrying in new phosphorus
- Hard to quantify as no stream data

Phosphorus  
causes  
winter/spring  
blooms



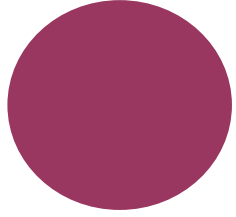


# January 2023 Bloom

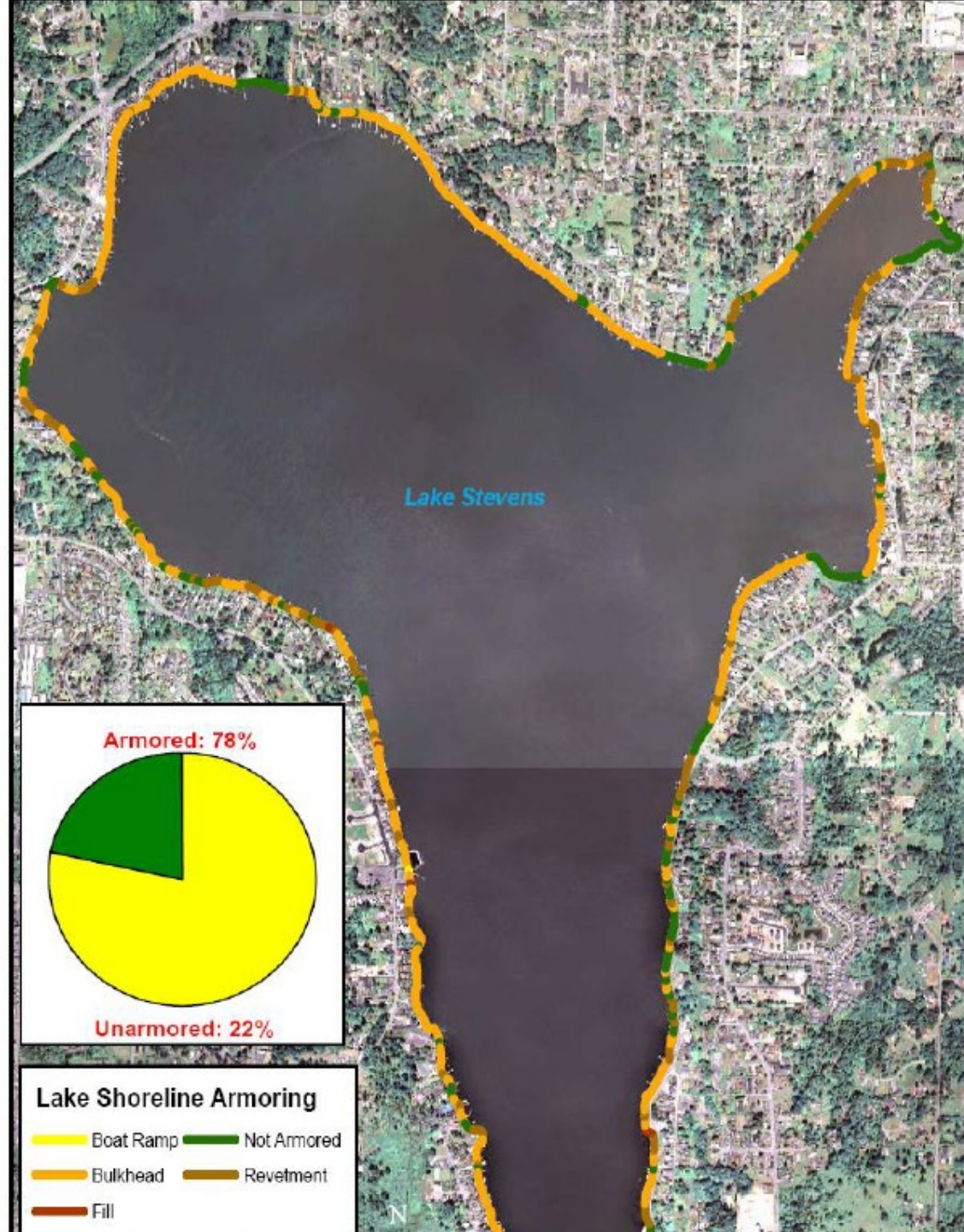
- City followed procedures from the Department of Health
- Public Notification
- Site Monitoring



# Shoreline Health



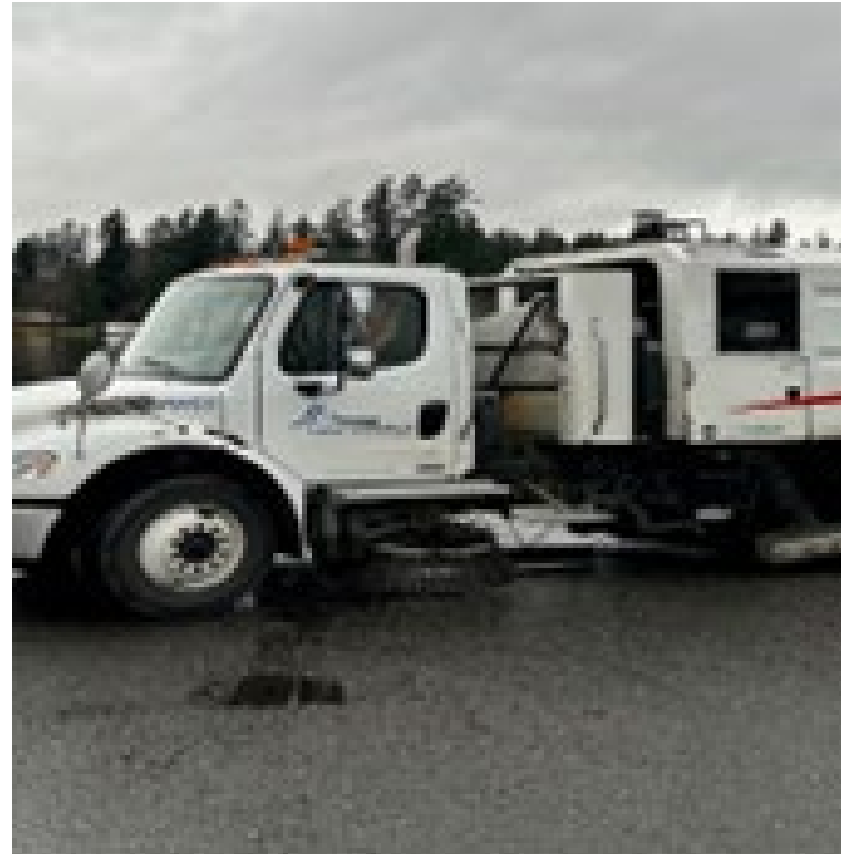
Poor



# City's Lake Management Program

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- **Land use and development requirements for the lake shoreline -Shoreline Master Program (SMP)**
- **Routine Maintenance of Stormwater Infrastructure**
  - 2023 Stormwater Maintenance Summary
    - Cleaned 38 Stormwater Detention ponds
    - Sweep every city street 3+ times
    - 200+ tons a material disposal
    - 1,597 Basins cleaned.
    - 96 pipes and culverts cleaned
- **Education and Outreach – I Love Lake Program**
- **Routine Water Quality Monitoring and Lake Treatment**
- **Implementation of the NPDES Program**





## Next Steps

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- Small alum treatments but only every 1-3 years
- Continue to reduce external loading
  - City Actions
  - Community Actions
- Better assess external loading (stream monitoring etc.)
- Continue monitoring lake and adaptively manage



Community can  
make a  
difference

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# I Love Lake

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- Youth Education
- Private stormwater detention facility maintenance workshops
- Promotes natural yard care and best practices on private property

The program is implemented in partnership with the Snohomish Conservation District

Use  
phosphorus  
free  
fertilizers



If you use fertilizer,  
look for the zero  
in the middle

22	0	12
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# Practice natural yard care





# Dispose of lawn clippings properly

Put in green waste bin or use a mulching mower and leave on lawn

# Scoop the Poop (At Home Too)

## The Poop Solution

**Scoop the poop, bag it,  
and put it in the trash.**





Regularly  
Inspect Septic  
Systems

# Don't feed the ducks & geese?

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- Keeps the birds healthy – no bread or bird seed
- Avoid:
  - Malnutrition
  - Overcrowding
  - Loss of natural behavior
  - Disease
    - Swimmer's itch
    - Bird die-offs
- Goose poop on beach and in water





# Create Healthy Shorelines

Replace some lawn with deeply rooted trees and shrubs while still allowing for views and access

# Healthy Shorelines are Good for Water Quality & Habitat





**Eroding Shoreline**

Healthy Shorelines also keep Geese off your lawn and Prevent Shoreline Erosion from wind and wakes!



Thank you!

See all reports and data at <https://snohomishcountywa.gov/5393/>