



Impaired Waters



Waters are classified as impaired when they fail to meet state water quality standards and have been placed on the federal impaired waters list 303(d)

The Impaired Waters Process



Test the water



Place on list



Do TMDL study



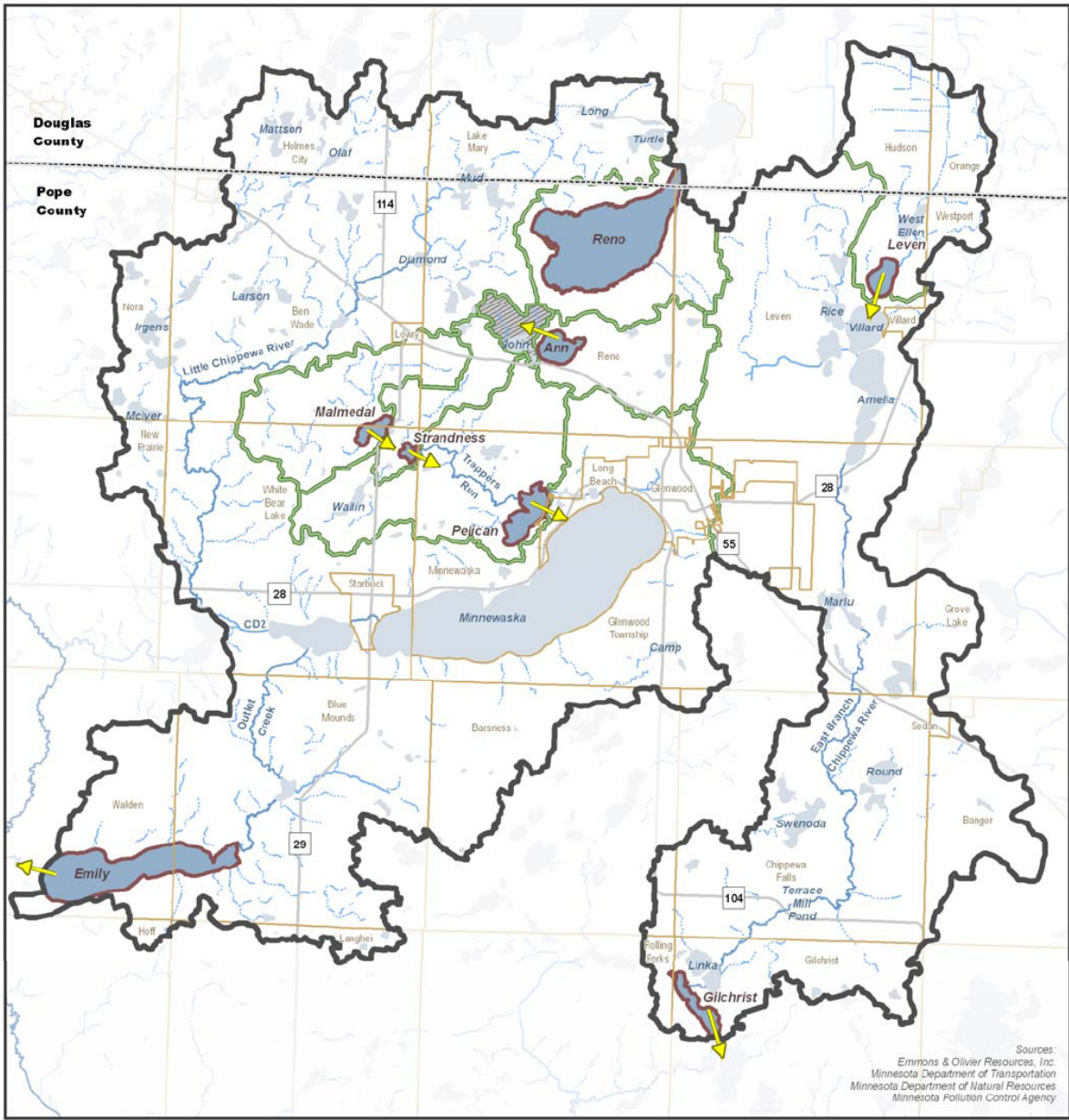
Evaluate results



Implement actions



Do Implementation Plan



8 Lake TMDL

- Leven
- Gilchrist
- Reno
- Ann
- Malmedal
- Strandness
- Pelican
- Emily



Total Maximum Daily Load (TMDL)

- A Total Maximum Daily Load study must be conducted for lakes, streams and rivers that have been listed as impaired.
- Total Maximum Daily Load is the extent to which a body of water is able to assimilate or tolerate a pollutant and still maintain its water quality standards.



TMDL Analysis

- A TMDL is the sum of the individual waste loads from point sources, nonpoint sources and natural background, with an additional loading allowance for a margin of safety. This is generally described by the following equation...



$$\text{TMDL (AC)} = \text{WLA} + \text{LA} + \text{MOS}$$

Where:

- AC = **Assimilative Capacity** of the water body to achieve/maintain standards
- WLA = **Waste Load Allocation**, quantification of pollutant loads from point sources discharging to the water body
- LA = **Load Allocation**, quantification of pollutant loads from nonpoint sources
- MOS = **Margin of Safety**, reflects uncertainty in the analysis, a desire to provide an extra margin of protection for beneficial uses, or an allowance for future growth



Impairments for Excess Nutrients

- Data must show exceedances of two of the following three standards
 1. Total Phosphorus (causal factor)
 2. Chlorophyll- a (response variable)
 3. Secchi disk (response variable)



WQ Standards (Northern Glaciated Plains)

	Northern Glaciated Plains	Deep Lakes	Shallow Lakes	Lake Emily
Phosphorus (ppb)		< 65	< 90	102
Chlorophyll- a (ppb)		< 22	< 30	40
Clarity (Secchi) (meters)		0.9	0.7	0.5

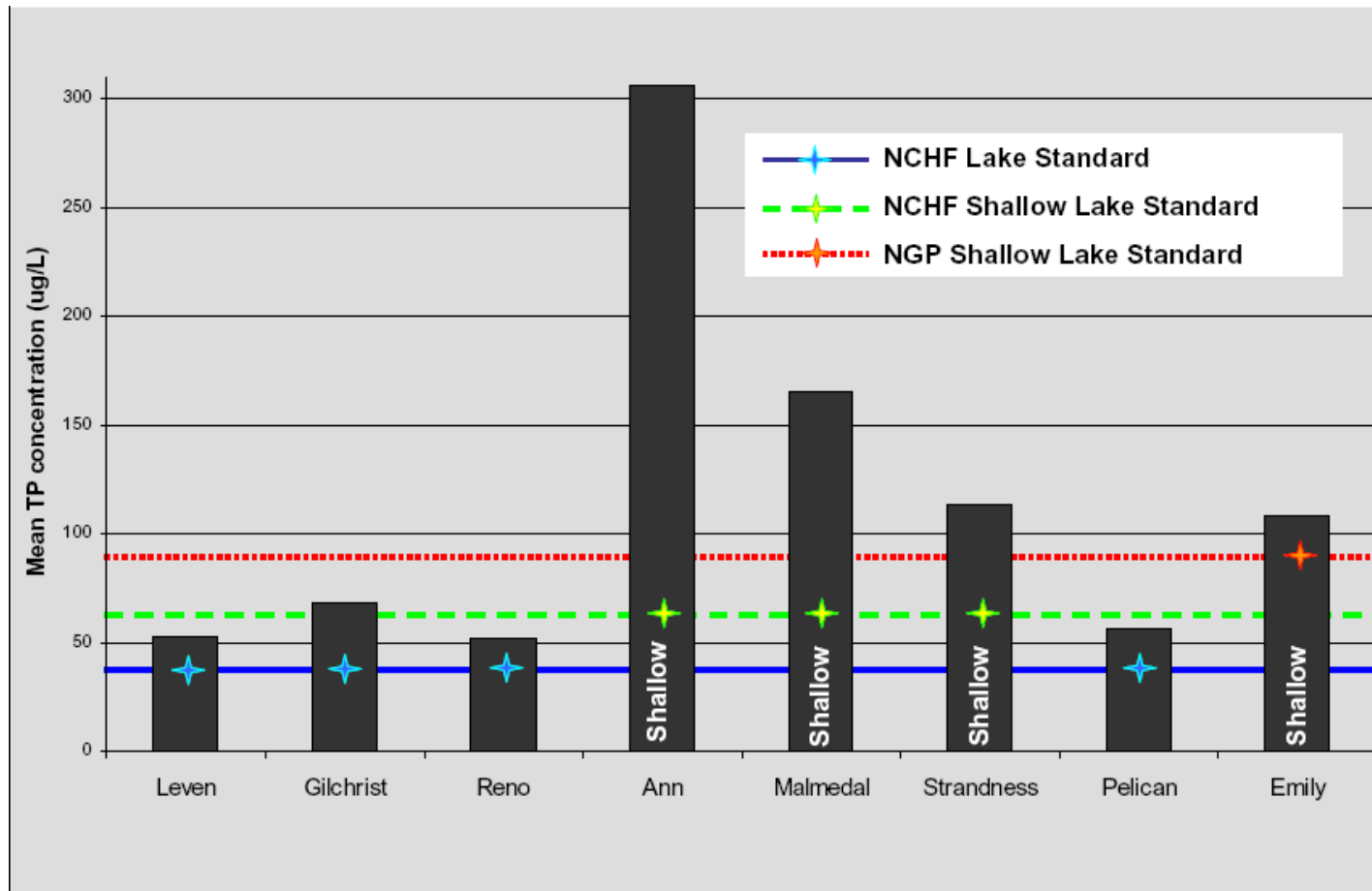


WQ Standards (North Central Hardwood Forest)

	Deep Lakes	Shallow Lakes	Leven	Gilchrist	Anne	Reno	Malmedal	Strandness	Pelican
P (ppb)	< 40	< 60	53	68	306	52	166	114	56
Chl- a (ppb)	< 14	< 20	23	41	60	17	97	39	21
Clarity Secchi meters	> 1.4	>1.0	1.5	1.3	1.8	2.3	0.4	0.7	1.3



Lake Water Quality



Lake Studies



Why require phosphorus control?

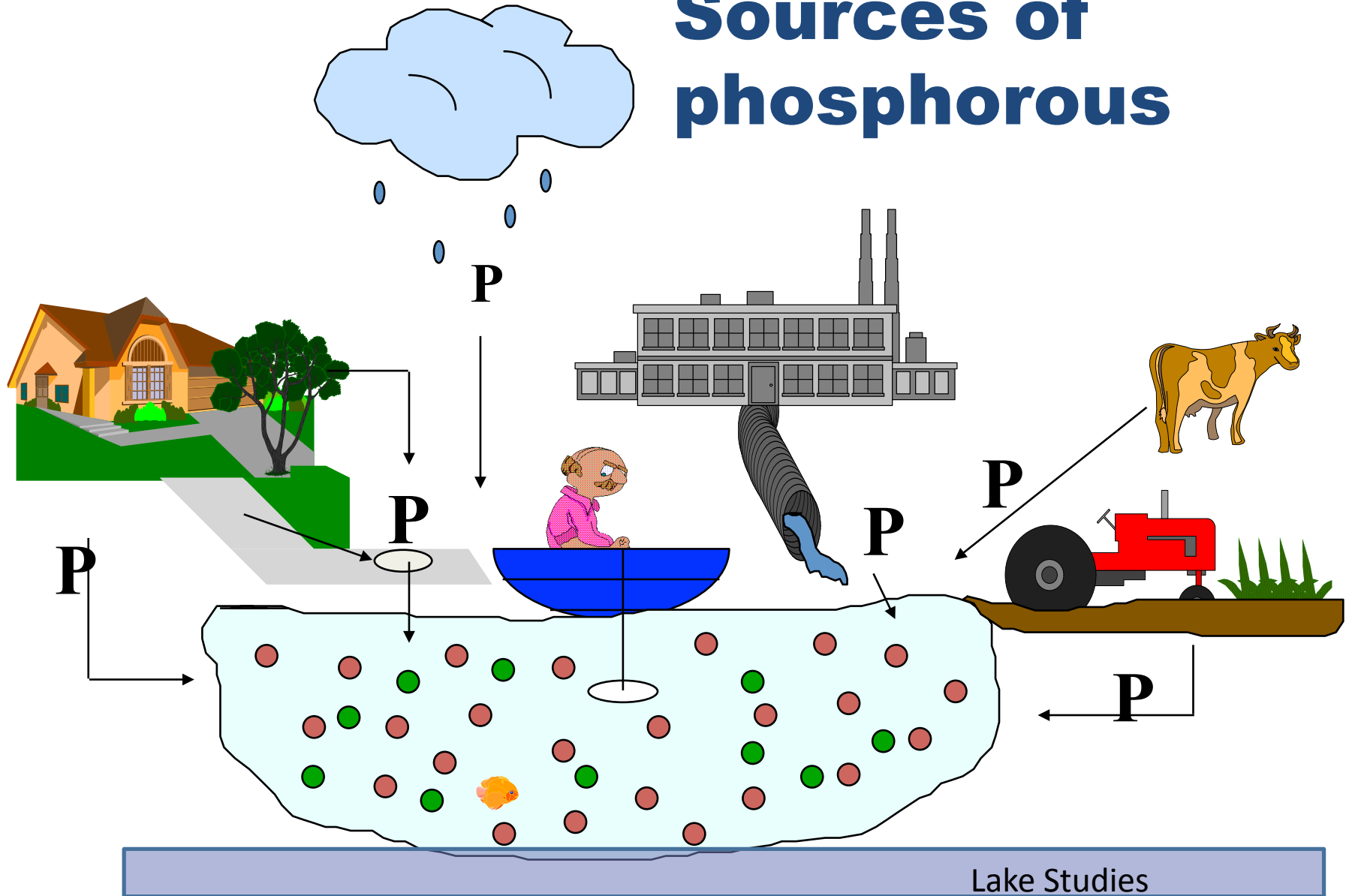
- Phosphorus is the limiting nutrient for algal growth in most Minnesota lakes and streams
- Other limiting factors such as sunlight and temperature cannot be controlled in a lake or stream



Phosphorus = Algae

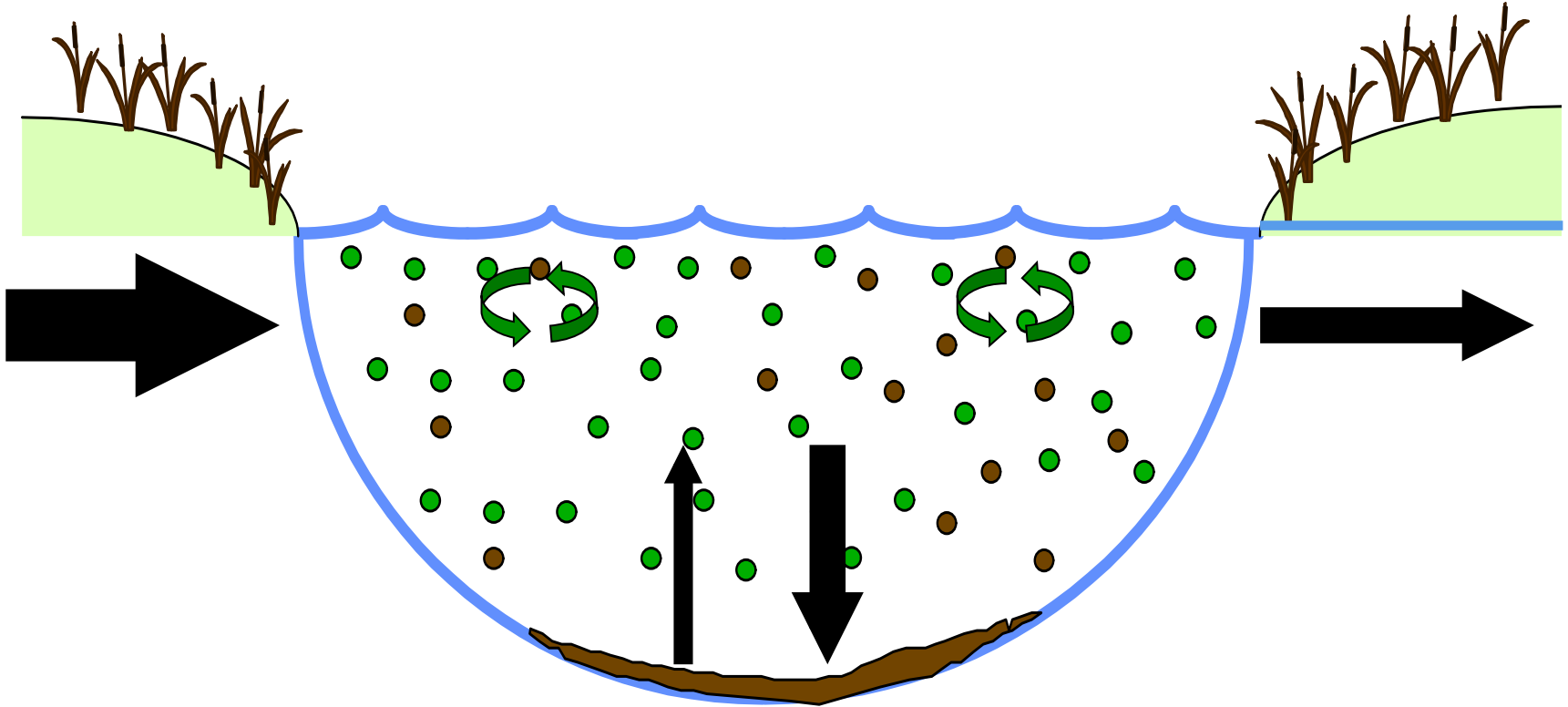


Sources of phosphorous





Phosphorus Cycle



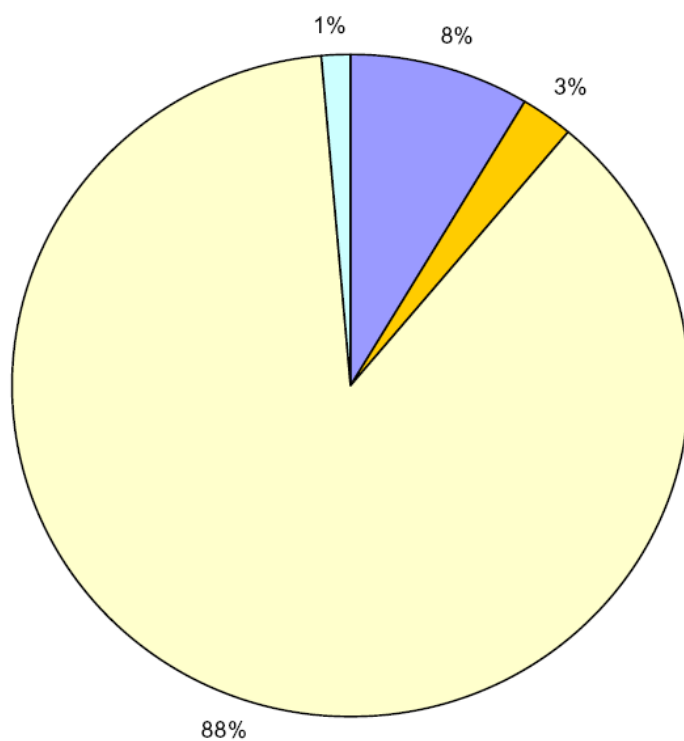


Phosphorus reductions needed to meet WQ standard

Lake Name	TP Load Reduction to Meet State Standards (from existing)
Ann	90 %
Emily	35 %
Gilchrist	48 %
Leven	35 %
Malmedal	72 %
Pelican	35 %
Reno	36 %
Strandness	54 %



Lake Leven P Inventory

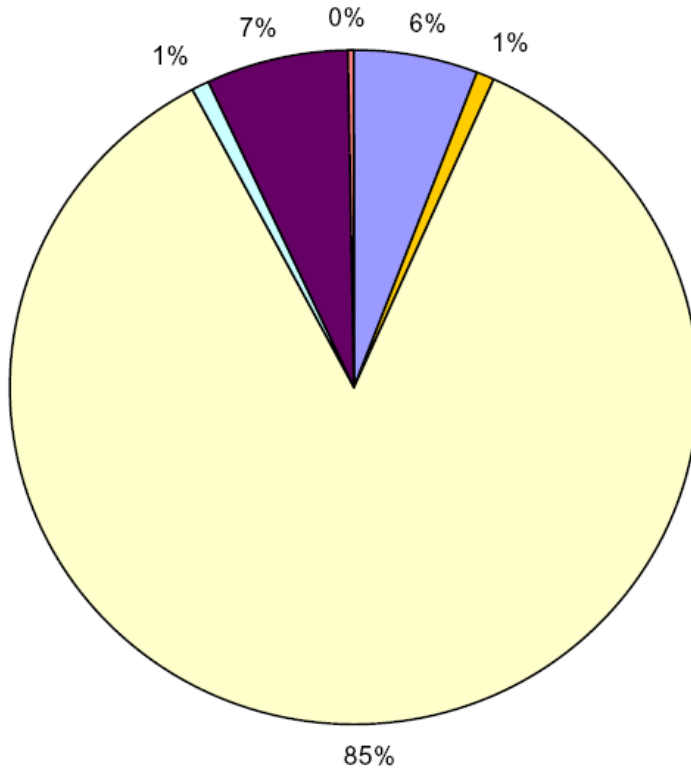


- Feedlots Not Requiring NPDES Permit Coverage
- Atmospheric Deposition
- Stormwater Runoff
- ISTS

Phosphorus Source	Annual TR3 Load [lbs/yr]
Stormwater Runoff	2,097
Feedlots Not Requiring NPDES Permit Coverage	203
Atmospheric Deposition	66
SSTS	30
Total	2,396



Gilchrist Lake P Inventory

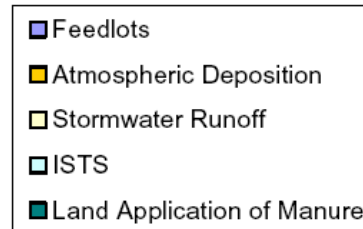
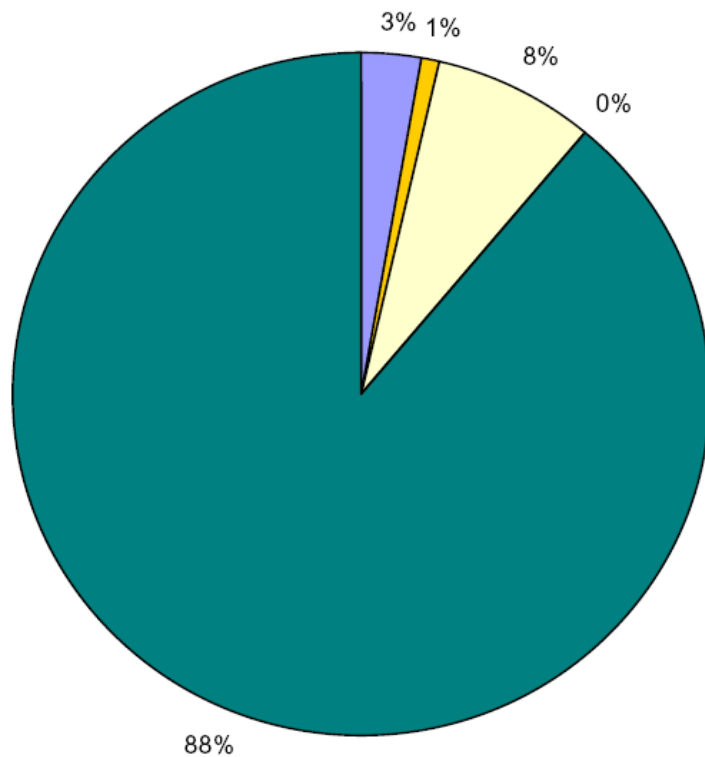


- Feedlots Not Requiring NPDES Permit Coverage
- Atmospheric Deposition
- Direct Drainage Stormwater Runoff
- ISTS
- Loading from Amelia
- Loading from Linka

Phosphorus Source	Annual TP Load [lbs/yr]
Direct Drainage Stormwater Runoff	7,200
Feedlots Not Requiring NPDES Permit Coverage	494.3
Atmospheric Deposition	76
SSTS	68.1
Loading from Amelia Lake	565
Loading from Linka Lake	31
Total	8,434.4



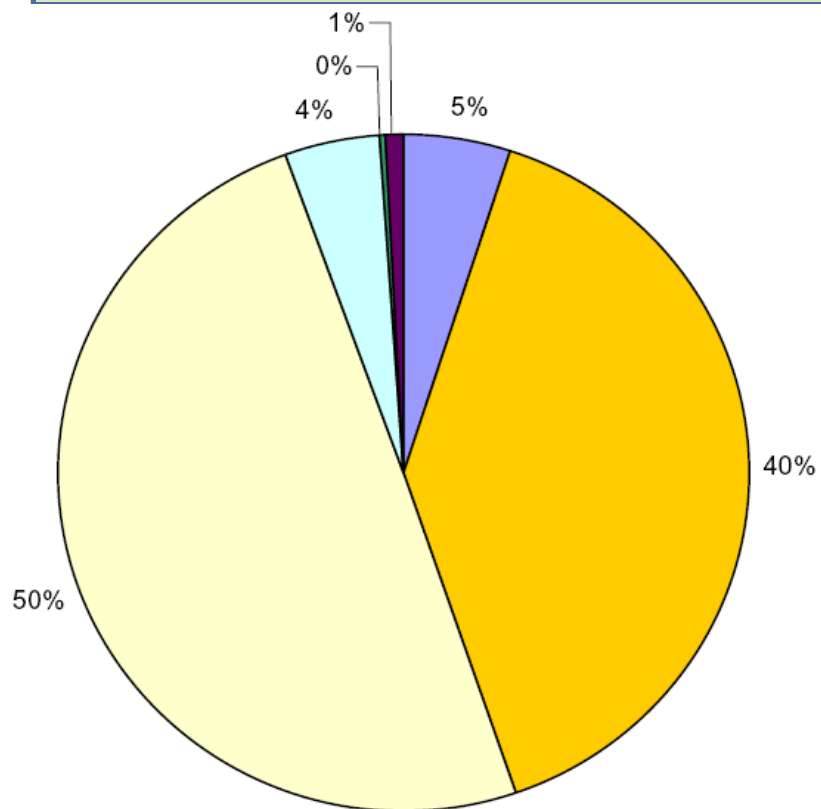
Anne Lake External P Inventory



Phosphorus Source	Annual TP Load [lbs/yr]
Stormwater Runoff	921
Feedlots	336.4
Atmospheric Deposition	85
SSTS	8.3
Land Application of Manure	10,763
Total	12,113.6



Reno P Inventory

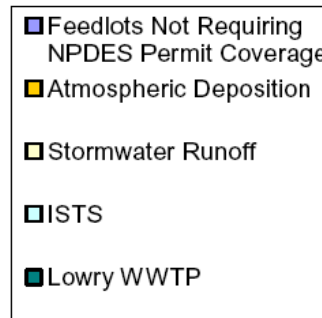
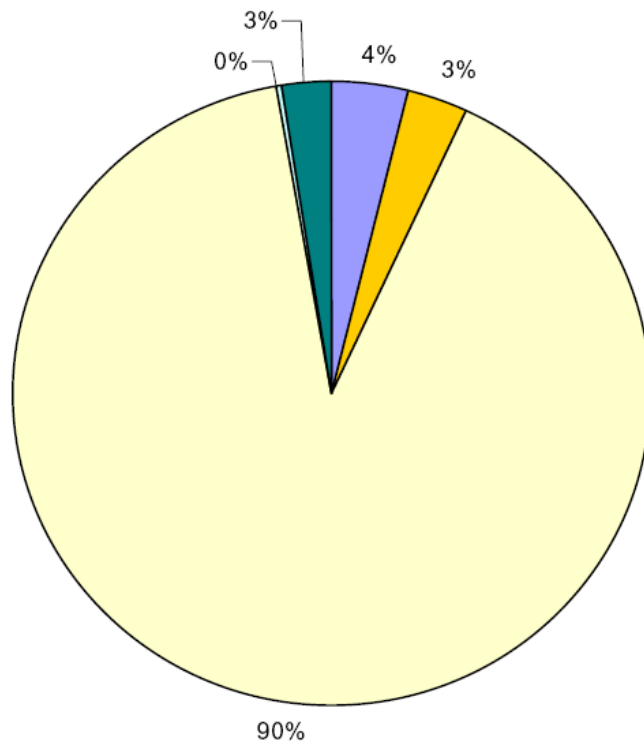


- Feedlots Not Requiring NPDES Permit Coverage
- Atmospheric Deposition
- Stormwater Runoff
- ISTS
- Groundwater

Phosphorus Source	Annual TP Load [lbs/yr]
Stormwater Runoff	1,023
Feedlots Not Requiring NPDES Permit Coverage	106
Atmospheric Deposition	818
SSTS	92
Groundwater	10.1
Loading from Maple	15
Total	2,064.2



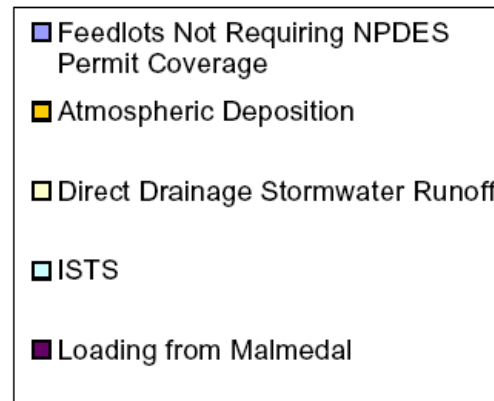
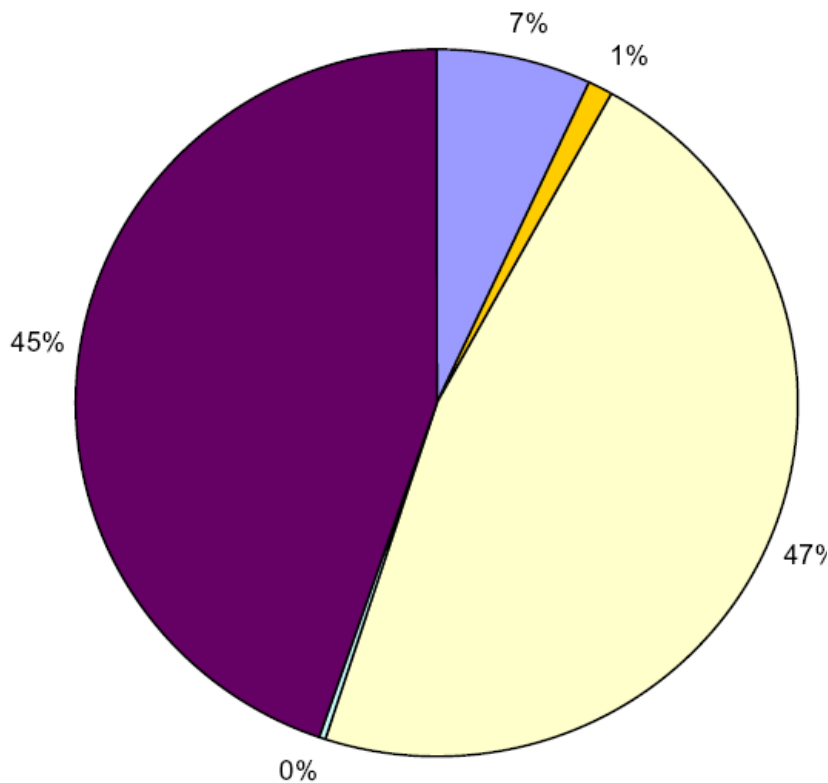
Malmedal P Inventory



Phosphorus Source	Annual TP Load [lbs/yr]
Stormwater Runoff	1,325
Feedlots Not Requiring NPDES Permit Coverage	56.5
Atmospheric Deposition	46
SSTS	2
Lowry WWTF	37.9
Total	1,467.4



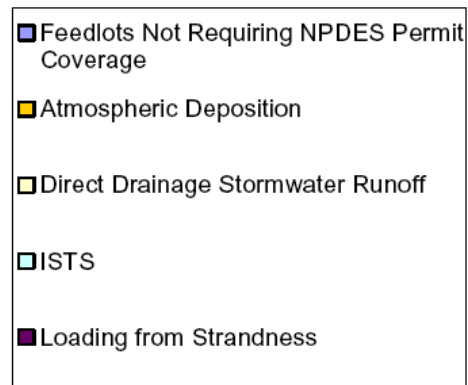
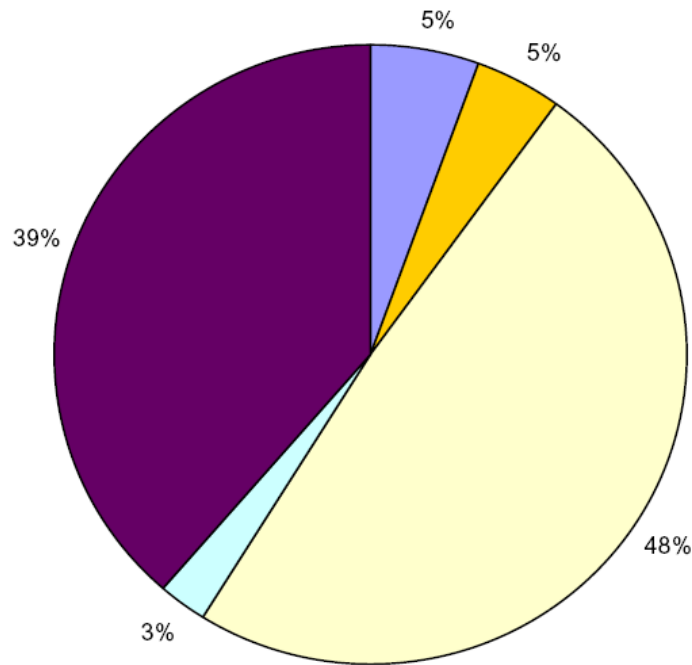
Strandness P Inventory



Phosphorus Source	Annual TP Load [lbs/yr]
Direct Drainage Stormwater Runoff	868
Feedlots Not Requiring NPDES Permit Coverage	125.6
Atmospheric Deposition	20
SSTS	4
Loading from Malmedal Lake	821
Total	1,838.6



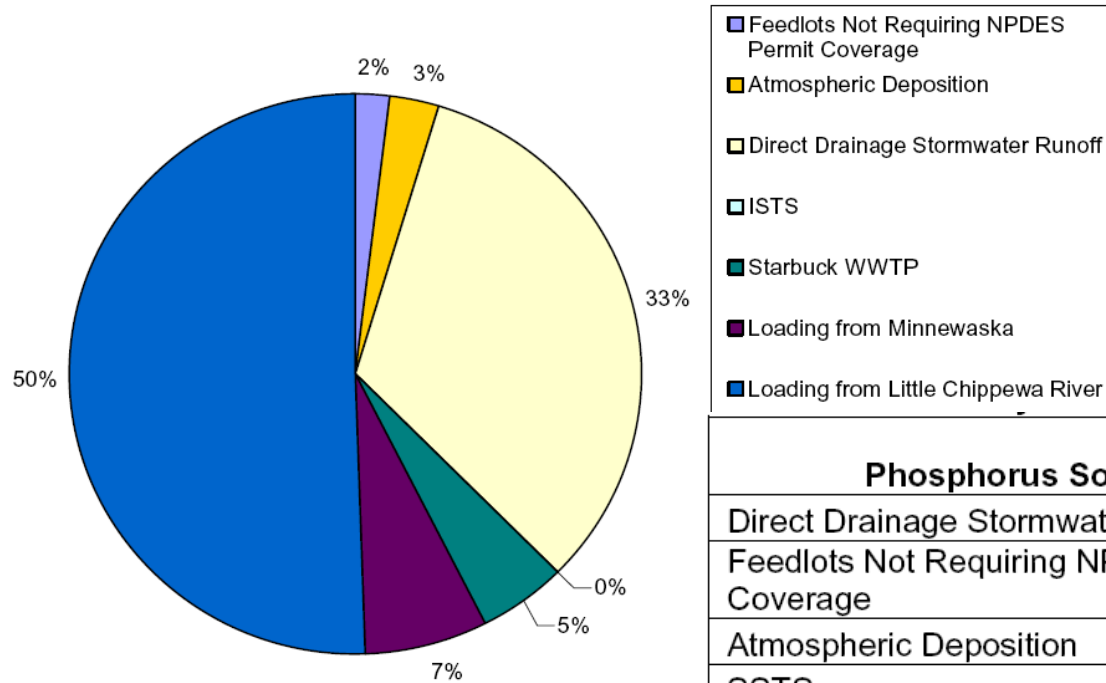
Pelican Lake P Inventory



Phosphorus Source	Annual TP Load [lbs/yr]
Direct Drainage Stormwater Runoff	1,257
Feedlots Not Requiring NPDES Permit Coverage	140
Atmospheric Deposition	119
SSTS	70
Loading from Strandness Lake	994
Total	2,580



Lake Emily External P Inventory



Phosphorus Source	Annual TP Load [lbs/yr]
Direct Drainage Stormwater Runoff	5,981
Feedlots Not Requiring NPDES Permit Coverage	350.9
Atmospheric Deposition	527
SSTS	7
Starbuck WWTF	890
Loading from Lake Minnewaska	1,263
Loading from Little Chippewa River	9,251
Total	18,269.9

The Impaired Waters Process



Test the water



Place on list



Do TMDL study



Evaluate results



Implement actions



Do Implementation Plan



Impaired Waters



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