

Evaluation of Urban Nutrient Loading and Treatment Technologies

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Project Background

More than 7,000 U.S. 303(d) listed waters are impaired due to excess levels of nutrients

- * 3rd largest cause of water impairment
- * Nitrogen and Phosphorus

More stringent regulation by EPA and state authorities for nutrient removal efficiencies

- * Costly
- * Technologically difficult

Colorado Regulation 85

- * Adopted June 11, 2012; compliance date in 2023
 - * All new permits will need to meet new effluent standards
- * Requires WWTPs to reduce nitrogen and phosphorus

Constituent	Existing WWTPs	New WWTPs
Total Inorganic Nitrogen	15 mg/L (annual median)	7 mg/L (annual median)
Total Phosphorus	1 mg/L (annual median)	0.7 mg/L (annual median)

Regulation 85 – Nutrient Trading

- * Point – Point Source
 - * Issued on 1:1 ratio
- * Nonpoint – Point Source
 - * Must receive division approval
 - * Issued on 2:1 ratio (minimum)

Believed to:

- * Optimize cost-effective approaches,
- * Yield net results equal to or greater than required,
- * Achieve multiple environmental and economic benefits

Project Objectives

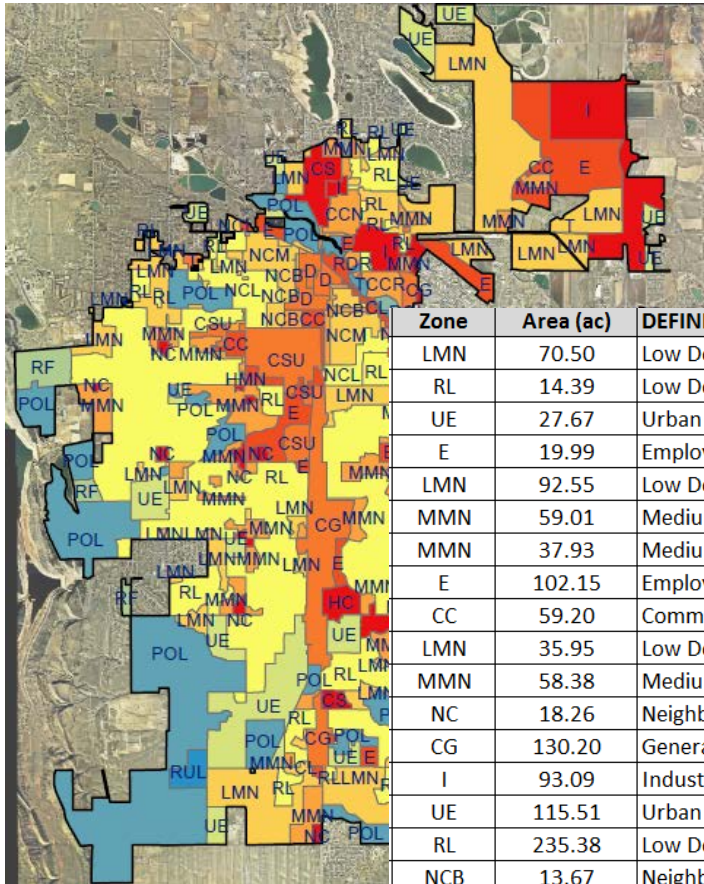
Fort Collins case-study:

- * Evaluate Technologies for Nutrient Reduction
 - * Wastewater Treatment Plants and Stormwater BMPs
- * Evaluate the economic requirements for each
- * Optimize nutrient reduction costs and technologies
 - * Multi-Criterion Decision Analysis (MCDA)
 - * Integrate WWTP and urban stormwater results
- * Create distributable fact-sheet to utilities

City of Fort Collins Wastewater Discharges

- * Flow rates from Fort Collins WWTPs
 - * Drake WRF discharges 10-12 million gallons per day
 - * Mulberry WRF discharges 3-4 million gallons per day
- * Effluent Nutrient Concentrations
 - * Total Nitrogen is 10-15 mg/L
 - * Total Phosphorus is 1 mg/L

Nonpoint Source Nutrient Modeling Sub-basin Delineation

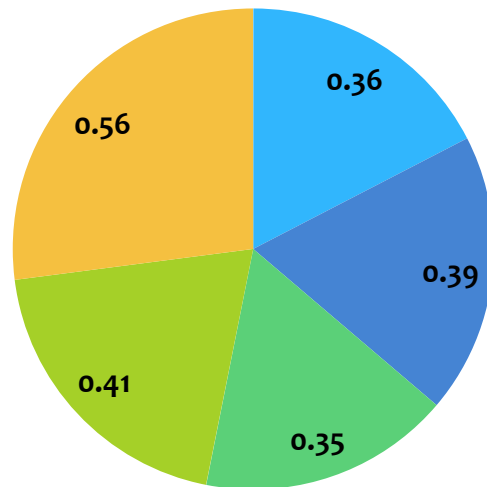


Zone	Area (ac)	DEFINITION	BMP Cost Cover Classification	% Impervious
LMN	70.50	Low Density Mixed-Use Neighborhood	Residential - Single Family (1,000 sf)	50
RL	14.39	Low Density Residential	Residential - Single Family (2,000 sf)	45
UE	27.67	Urban Estate	Residential - Single Family (4,000 sf)	30
E	19.99	Employment	Commercial	80
LMN	92.55	Low Density Mixed-Use Neighborhood	Residential - Single Family (1,000 sf)	50
MMN	59.01	Medium Density Mixed-Use Neighborhood	Residential - Multi-Unit (detached)	70
MMN	37.93	Medium Density Mixed-Use Neighborhood	Residential - Multi-Unit (detached)	70
E	102.15	Employment	Commercial	80
CC	59.20	Community Commercial	Commercial	80
LMN	35.95	Low Density Mixed-Use Neighborhood	Residential - Single Family (1,000 sf)	50
MMN	58.38	Medium Density Mixed-Use Neighborhood	Residential - Multi-Unit (detached)	70
NC	18.26	Neighborhood Commercial	Industrial - Light	90
CG	130.20	General Commercial	Commercial	75
I	93.09	Industrial	Industrial - Heavy	90
UE	115.51	Urban Estate	Residential - Single Family (4,000 sf)	30
RL	235.38	Low Density Residential	Residential - Single Family (2,000 sf)	45
NCB	13.67	Neighborhood Conservation Buffer	Residential - Single Family	70
HMN	51.30	High Density Mixed-Use Neighborhood	Residential - Apartments	80

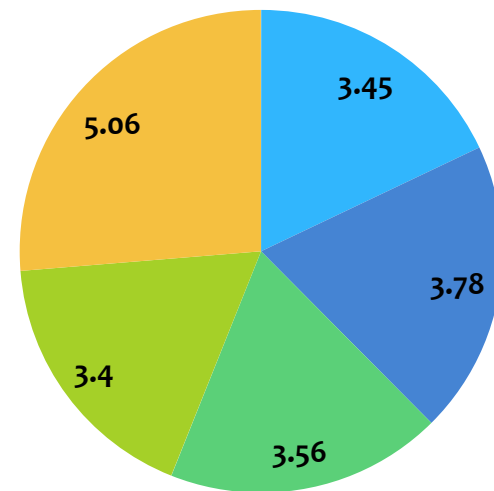
Stormwater Runoff Nutrient Concentrations

- Commercial
- Highway
- Industrial
- Open Space
- Residential

PHOSPHORUS (mg/L)



NITROGEN (mg/L)



From the Colorado Urban Drainage and Flood Control District

Annual Nutrient Loading Results

Baseline Scenario

- * Stormwater

- * Total Annual Phosphorus Load: 20,000 lbs

- * Total Annual Nitrogen Load: 200,000 lbs

- * Wastewater

- * Total Annual Phosphorus Load: 30,000 lbs

- * Total Annual Nitrogen Load: 500,000 lbs

Wastewater Technologies for Nutrient Reduction

- * Nutrient Removal
 - * Bardenpho Process
 - * Centrate and RAS Reaeration Basins (CaRRB)
 - * Anaerobic Ammonium Oxidation (ANAMMOX)
- * Nutrient Recovery
 - * Ammonia Stripping
 - * Struvite Precipitation and Ostara®
 - * Electrodialysis
 - * Selective Adsorption

Stormwater Modeling Scenarios for Nutrient Reduction

- * Existing BMP nutrient removal performance
 - * Retrofit of detention basins for water treatment
 - * Implementation of city-wide BMPs
 - * Bioretention Cells
 - * Permeable Pavements
 - * Constructed Wetlands
 - * Green Roofs
- Capture and treat runoff from the stormwater quality design storm through infiltration or phytoremediation

Next Steps

- * Model effluent nutrient concentrations from all wastewater removal technologies
- * Evaluate stormwater BMP scenarios
- * Compare nutrient removal efficiencies and lifecycle costs
 - * Nutrient trading analysis

Questions?