

National Monitoring Program (NMP)

Long-Term Monitoring Projects to Document
Water Quality Improvements from BMPs

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In cooperation with

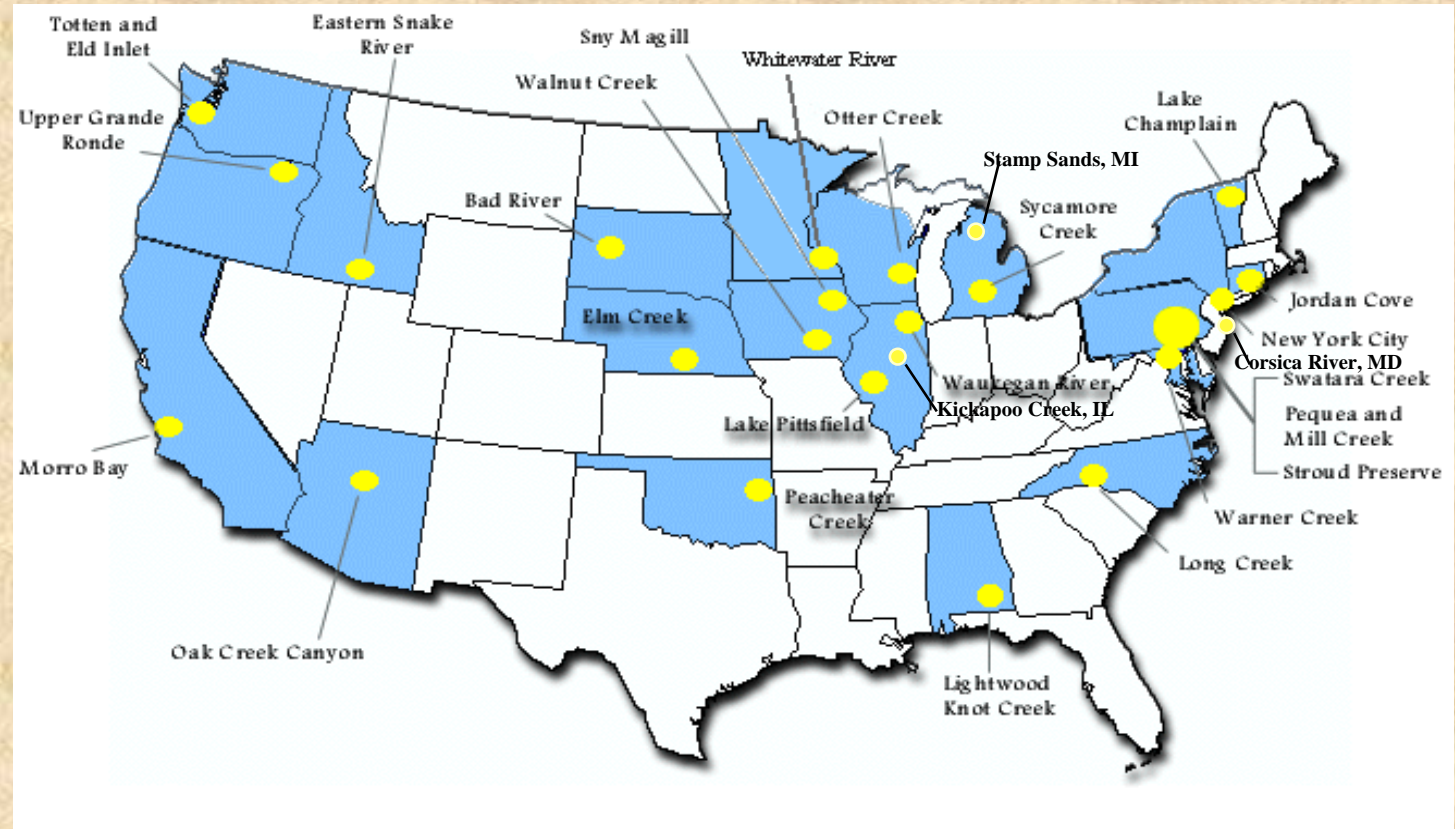
NMP Project Personnel Nationwide

U.S. EPA



USEPA Section 319 National Monitoring Projects (NMP)

- 28 projects in U.S. (24 completed monitoring)
- “Long-term”
- BMPs, land use tracking, and water quality monitoring
- More projects wanted



Project summaries <http://ncsu.edu/waterquality>
NWQEP NOTES

Section 319 National Monitoring Program (NMP) Projects

Successes & Recommendations:

- 1. Experimental Design**
- 2. Lag Time**
- 3. Nutrient Management & Nutrient Mass Balance**
- 4. Livestock Exclusion/Fencing & Grazing Management**
- 5. Stream & Riparian Restoration**
- 6. LID & Better Site Design**

Section 319 NMP Projects

1. Experimental Design



Concept:

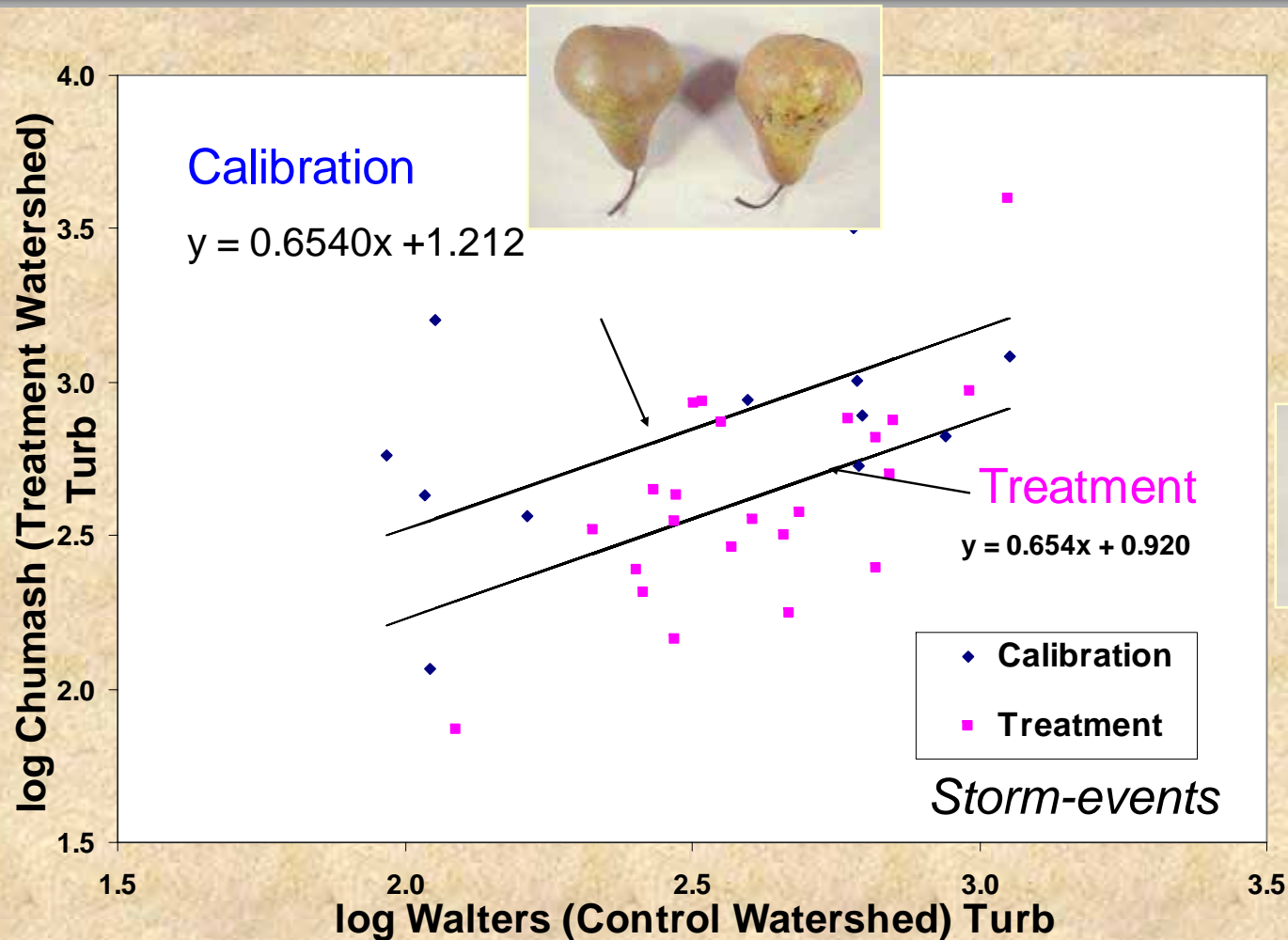
- Increase probability of isolating changes in water quality due to BMPs
- Minimize MDC
- Paired watershed design = ideal
- Upstream/downstream – before/after
- Nested watersheds
- Multiple watersheds
- Explanatory variables (covariates), e.g., discharge, stage height, season, upstream concentrations/load, baseflow vs storm flow)

NMP Projects (examples):

- **Morro Bay, CA**
 - (Paired watershed)
- **Jordan Cove, CT**
 - 3 Paired watersheds (existing, new traditional, new LID residential development)
- **Lake Champlain Basin Watersheds, VT**
 - 3 Paired watersheds (2 treatment, 1 control)
- **Long Creek, NC**
 - Upstream/Downstream – Before/After

Morro Bay, California

Chumash Creek Treatment Watershed Grazing Management & Riparian Fencing ,
Paired Watershed Study



Morro Bay, California

Chumash Creek Treatment Watershed Grazing Management & Riparian Fencing ,
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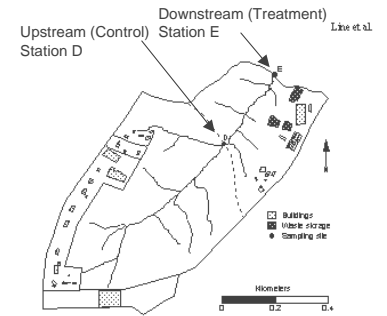


49% reduction in turbidity
– during storm events

- Increased infiltration
- Delayed peak flow
- Decreased fluctuations in DO
- Decrease in temperature



Long Creek, NC NMP - Upstream-Downstream/ Before-After BMP Implementation



BMPs: livestock exclusion (fencing, alt. water, crossings, riparian plantings, nutrient waste mgt)



Pollutant	Load Decr.	Conc. Decr.
TSS	83 %	74 %
Turbidity		69 %
TP	76 %	
Fecal Coli/step		85/ 81 %

Decrease flashy / high values



State Program:

- Monitoring guidance for CWMTF funding: storm composites for load calculations
- BMP effectiveness of fencing (low cost) and increased awareness
- CREP and Tar PAM NEP using effectiveness
- (Discussions on-going) target small streams/headwaters
- TMDL (pathogen)



2. Lag Time Walnut Creek, IA



BMPs

- Cropland BMPs
 - Native prairie/savanna restoration (~25% row crops converted)

13,000 acre (12 digit HUC) Treatment Watershed



Lag factors: low permeable soils near stream; root establishment; soil reserves; upstream cropland sources

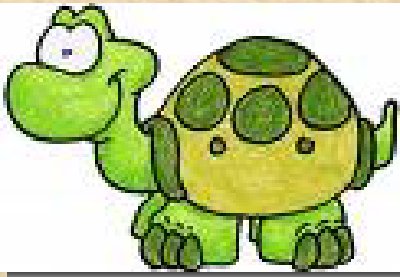
- **Paired Watershed w/ Covariates:** Control watershed, upstream, discharge, season
- **10 years:** 1.2 mg/l decrease in $\text{NO}_3\text{-N}$ over (10%)

Changes easier to detect in Subwatersheds

- $\text{NO}_3\text{-N}$ decrease 1.2 - 3.4 mg/l (12-40% reduction)

Contrast:

- Stream $\text{NO}_3\text{-N}$ increased rapidly after CRP lands converted back to cropland in control watershed



2. Lag Time

Long-term reponse time to document WQ change common with:

- **High soil test P**
- **Riparian revegetation / reforestation**
 - **Stroud Preserve, PA** (Reduction in groundwater nitrate from cropland took 10 years)
- **Nitrate in groundwater**
 - **Pequea & Mill Creek, PA** (reduction in N fertilizer did not document NO_3 reduction in stream.
Ground water age dating:
 - 3-4 years for land applied nutrients to reach springs
 - 15-39 years for ground water to reach stream channel
- **Benthic macroinvertebrates & fish**
 - **Lake Champlain Watersheds, VT** (no improvements in fish communities despite improved habitat and temperature)

Recommendations:

- Emphasizes need for long-term projects to measure success
- Target land treatment with short flow path
- Monitor small watersheds close to pollutant source
- Select indicator variables for short & long term monitoring

3. Nutrient Management & Nutrient Mass Balance



Concept:

- Source reduction = key to water quality improvements
- Nutrient inputs 'balance' outputs
- E.g., Precision Feeding & Nutrient management

NMP Projects with documented improvements in nutrients:

- New York City Watershed, NY (precision feeding, nutrient management)
- Lightwood Knot Creek, AL (cover, poultry litter storage/waste utilization)
- Syn Magill, IA (animal waste management systems)
- Long Creek, NC (manure spreading timing, nutrient management, pasture management)
- Peacheater Creek, OK (fertilizer rates based on soil testing)
- Otter Creek, WI (nutrient & pesticide management)

Findings:

- All document significant reductions in nutrients (N, P), most 50%; up to 75%
- All had nutrient management or mass balance as part of a SYSTEM of BMPs



New York City Watershed, NY

■ Precision Feeding

- Reduce P imports to farm in purchased feed
- Feed & home-grown forages analyzed for nutritional content & diets adjusted
- Dietary input of P reduced 25%
- Excretion of P reduced 33%



■ Manure storage & spreading - timing

■ Manure application based on soil test (P) – rates

■ Other BMPs in Whole Farm Planning

- Livestock exclusion & alternative water supply
- Relocated stream channel away from barn
- Elevated stream crossings
- Rotational grazing & crop rotations



New York City Watershed

Successes - Load Reductions

- 64% NH₃
 - 53% TDP
 - 36% PP
 - 28% TSS
 - 23% NO_x
- Improved farm P mass balance
 - Slowed net soil P accumulation



4. Livestock Exclusion/Fencing, Grazing Management



Concept:

- Remove immediate source of N&P (fencing, alternative water supply, raised stream crossing)
- Riparian plantings
 - Revegetate streambanks
 - Moderate water temperatures
 - Improved habitat

NMP Projects:

- Pequea & Mill Creek, PA (reductions: TP 14%, TKN 26%, TN 19%, TSS 37%)
- Morro Bay, CA
- Peacheater Creek, OK
- New York City Watershed, NY
- Long Creek, NC
- Lake Champlain Watersheds, VT



Section 319 NMP Project

Lake Champlain Basin, VT



“Build it

Pollutants:

- Phosphorus
- Bacteria

Results:

- Riparian buffers cost-effective
- 50% decrease in bacteria & TP (greater reduction at high loading rates)

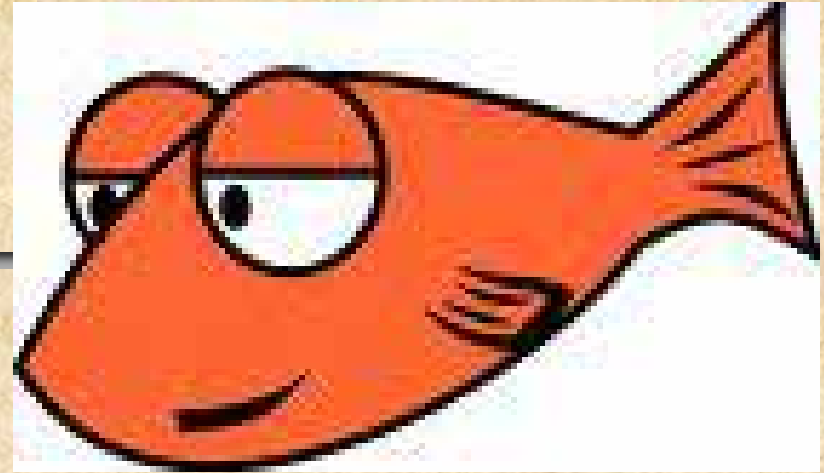
5. Stream & Riparian Restoration

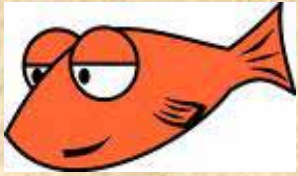
Concept:

- Channel modification
- Revegetate & stabilize streambanks
- Habitat improvement
- Moderated water temperatures
- Channel pool creation

NMP Projects:

- Upper Grande Ronde River Basin, OR
- Peacheater Creek, OK
- Waukegan River, IL
- Stroud Preserve, PA





Upper Grande Ronde River, OR

Channel Restoration, Cattle Exclusion/Fencing

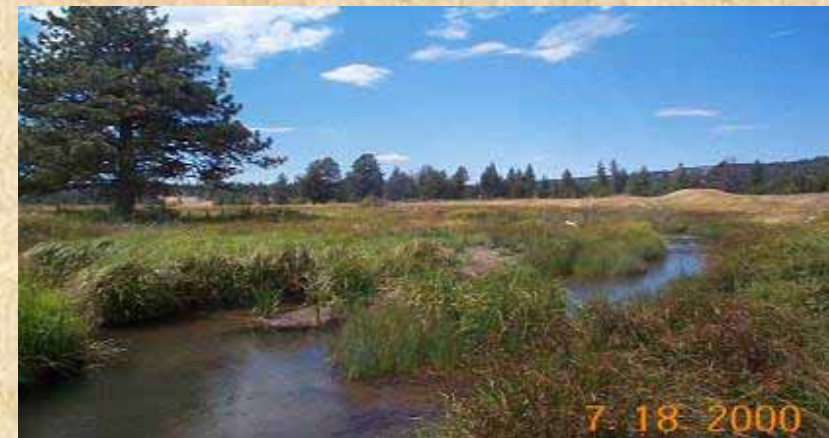
- **Water Quality Impairment.** Rainbow trout: temperature-sensitive

- **Successes**

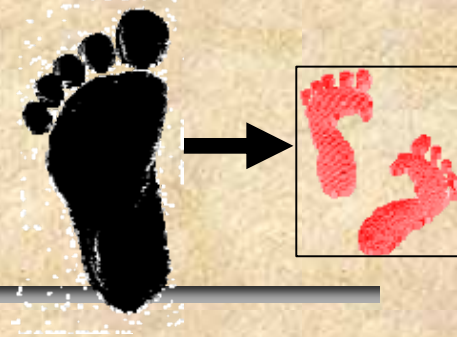
- Improved slope, W/D ratios, sinuosity, pools, cool water habitat
- Improved number of trout

- **Recommendations**

- Livestock exclusion alone is not enough to recover sensitive aquatic life if stream channel & habitat remain degraded
- Pool habitat provided critical temperature refugia



6. Low Impact Development (LID) / Better Site Design



Concept:

- Decreases development impact from large 'footprint' to smaller footprint
- Mimic pre-development hydrology (water quality and quantity)
- Innovative site design & stormwater management to reduce environmental impacts
- Manages stormwater close to the source (e.g., where it falls)
- Using on-site vegetation & soils for water quality & quantity treatment
- Minimize clearing & grading, working with existing topography and native vegetation

NMP Projects:

- **Villanova Stormwater BMPs, PA**
 - Long-term monitoring of individual stormwater BMPs (inflow / outflow) to measure effectiveness, BMP Demonstration & Research Park
- **Jordon Cove, CT**
 - First LID project in nation to evaluate with a paired watershed design

Jordan Cove, CT



Low Impact Development (LID) /Better Site Design



BMP Subdivision



Traditional Subdivision

Site Design

- Cluster design with shared open space
- Minimization of impervious surfaces (narrow road, shared driveways)

Construction BMPs

- Basement excavations
- Phased grading
- Immediate seeding of stockpiled topsoil & proposed lawn areas
- Sediment detention basins & swales

Jordan Cove, CT

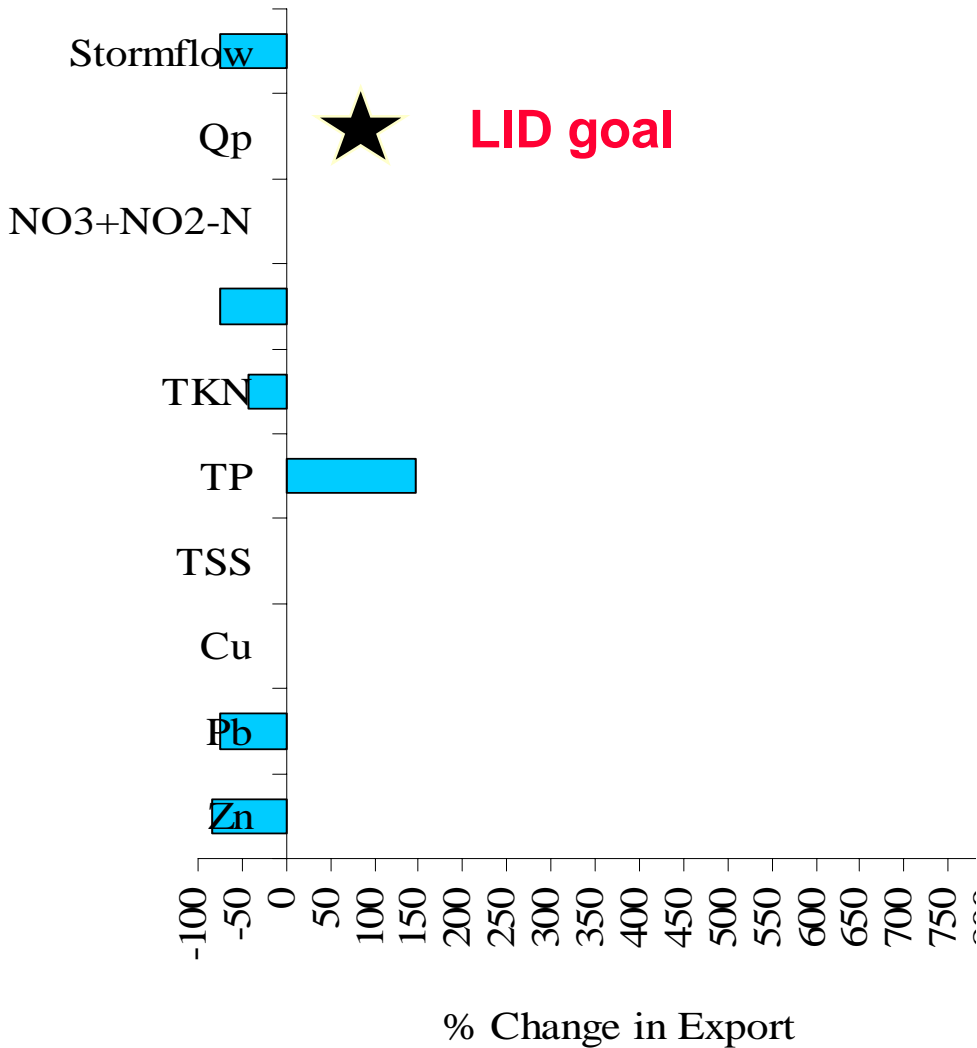


Structural & Non-structural BMPs

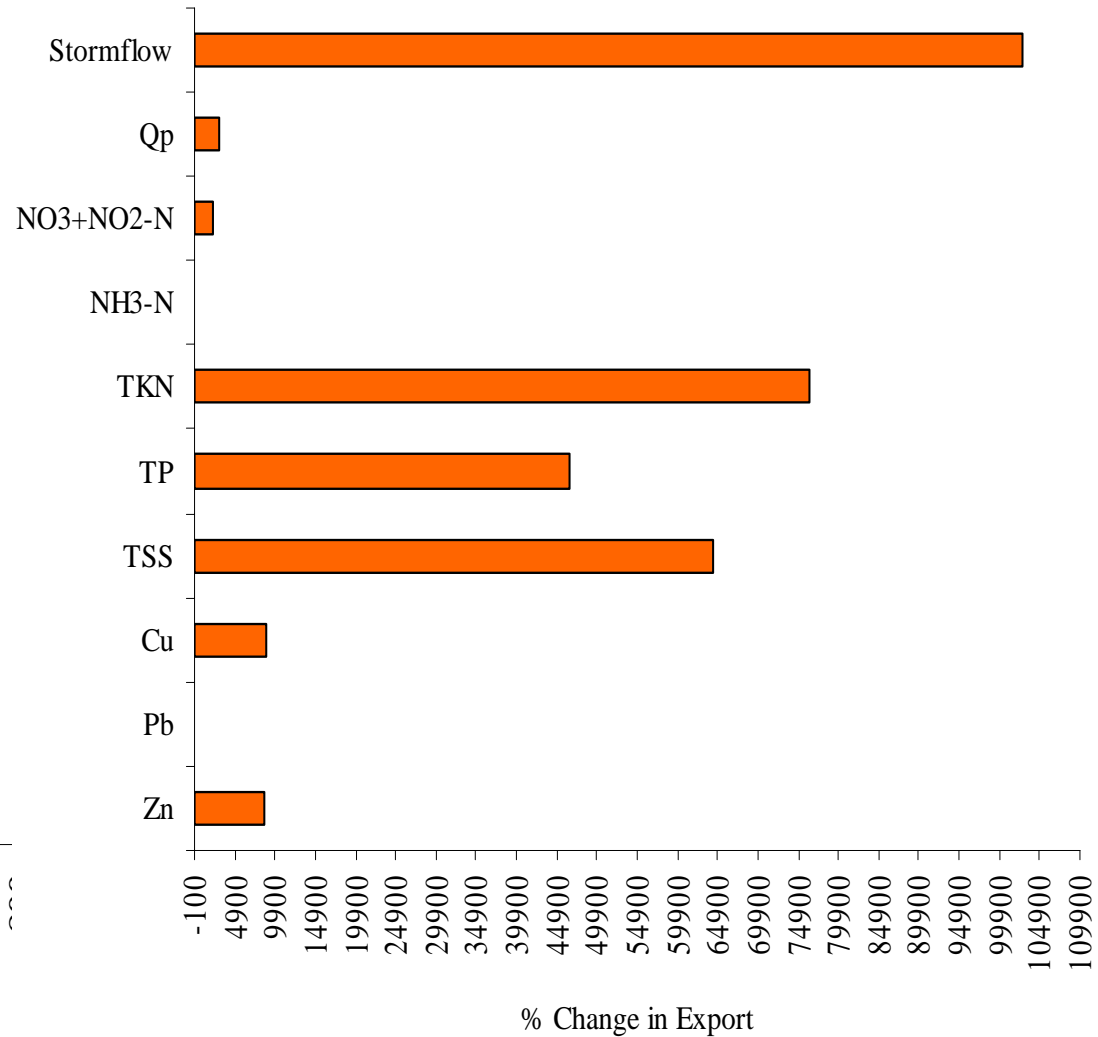
- Grassed swales (not curb & gutter)
- Pervious roads & driveways
- Rain gardens (bioretention basin)
 - Individual house lots
 - Cul de sac
- Pet waste management
- Homeowner fertilizer management plans

Post-construction – flow & export

BMP Watershed



Traditional Watershed



Section 319 NMP Projects

Lessons Learned

- *Continued need for more long-term projects like NMP projects that link land use and water quality*
- *Coordination essential. E.g., strong project manager, roles of cooperators stated*
- *Accurate identification of pollutants and sources*
- *Good monitoring design (paired watershed, up/down-before/after, nested – with Explanatory Variables)*
- *Land use/land treatment tracking*
- *Need for flexibility/ adaptability in implementation & monitoring*
- *Clear data analysis plan from beginning*
- *Need for frequent data evaluation and feedback to monitoring program*
- *Reporting and communication plan for project evaluation and conveying lessons-learned to policy-makers*



Morro Bay Watershed Model, 4-H