



Evaluation of Pollutants in Wastewater Generated by Mobile Car Washing Operations

City of Durham

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A Little Background. Why are we doing this?

REGULATORY DRIVERS

Existing TMDLs and Nutrient Management Strategies for Falls and Jordan Lakes

- Nitrogen
- Phosphorus
- Turbidity
- Fecal Coliform

303(d) Listings

- Zinc
- Copper
- Dissolved Oxygen
- Biological Impairment
- Fecal Coliform



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NPDES permit requirements to address stormwater impacts to local streams

Identify and quantify benefits of current programs. Credit for what we are doing

A Little Background. Why are we doing this?



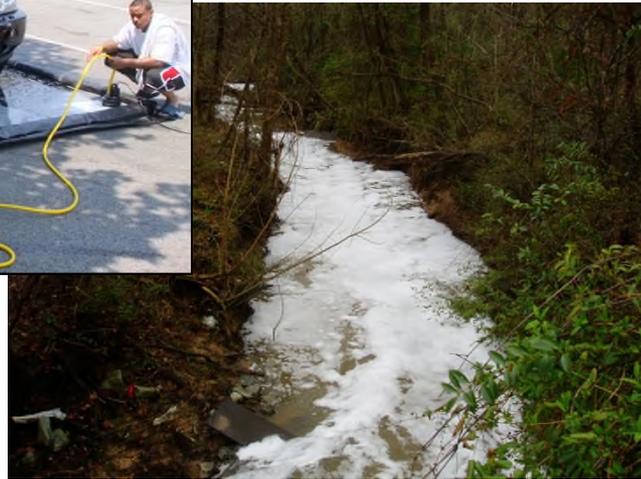
Photo courtesy of AndrewH. Photo modified from its original version.
http://en.wikipedia.org/wiki/File:Land_Rover_Series_III_mud_bogging.jpg



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Durham's Stormwater Pollution Control Ordinance

- Required in the City's NPDES permit for the municipal separate storm sewer system (MS4)



- Bans non-stormwater discharges to the City's stormwater system (some exceptions)
- Mobile car washing operations included
 - Vendors must collect, contain, and properly dispose of wastewater to sanitary sewer

Mobile Car Wash Wastewater Collection and Containment



Typical containment and collection system cost ~ \$250

- Sump pump or wet vac, hose, extension cord, tarp, berm materials
- Cost may be higher if wastewater tank is needed

Goals and Objectives



- Identify pollutants in mobile car wash wastewater
- Quantify pollutant concentrations in car wash wastewater
- Calculate pollutant loads from mobile car washing operations in the City
 - Determine reduction of pollutant loads to the City's MS4 from ordinance enforcement

Sample Strategy



Initially wanted five participating companies, ended up using two

- Fine forgiveness
- \$\$\$ Paid

Minimum 25 vehicles (ended up with 27)

Composite samples, based on volume

- 3-5 vehicles per composite
- 3 composites per day/company

Documentation

- Vehicle year/make/model (1982-2012)
- Date of previous wash (3 days to....?)
- Garaged/parked in open
- Cleaning supplies used by vendor

Analytical Measurements



Nutrients

- Nitrate + Nitrite
- Total Kjeldahl Nitrogen
- Total Phosphorus

Metals

- Cadmium
- Chromium
- Copper
- Manganese
- Nickel
- Lead
- Antimony
- Zinc



Polycyclic Aromatic Hydrocarbons (PAHs)

5-day Biochemical Oxygen Demand (BOD)

Total Suspended Solids (TSS)

Total Organic Carbon (TOC)

Chloride

Sample Collection

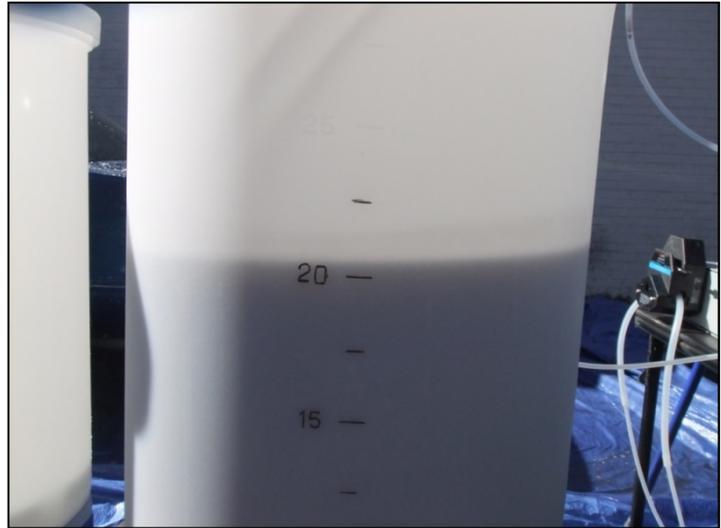


DURHAM



1869
CITY OF MEDICINE

Sample Collection (continued)



DURHAM



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Sample Collection (continued)



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Wastewater Disposal



MEAT AND POTATOES? BREAD AND BUTTER??sample results

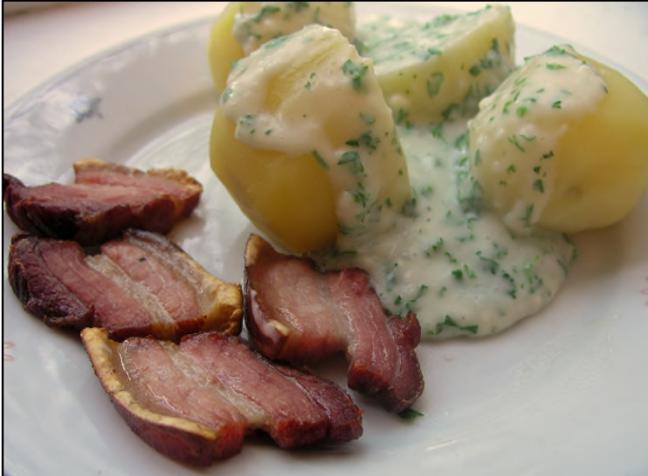


Photo courtesy of NillerDK..
http://en.wikipedia.org/wiki/File:Stegt_fl%C3%A6sk_med_persillesovs_2.jpg



Photo courtesy of Stu Spivack.
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Quality Control – Field Blanks

	Analyte	Units	MDL	MRL	Field Blank Day 1		Field Blank Day 2	
					Result	Flag	Result	Flag
Nutrients	Nitrate/Nitrite as N	mg/L	0.025	0.1	0.025	U	0.036	J
	Total Kjeldahl Nitrogen	mg/L	0.16	0.48	0.27	JB	0.16	U
	Total Phosphorus	mg/L	0.021	0.1	0.021	U	0.021	U
Metals	Antimony	ug/L	1	10	1	U	1	U
	Cadmium	ug/L	0.36	1	0.36	U	0.36	U
	Chromium	ug/L	1	10	1	U	1	U
	Copper	ug/L	1.6	10	1.62	J	2.66	JB
	Lead	ug/L	1.9	10	1.9	U	1.9	U
	Manganese	ug/L	1.1	10	1.1	U	1.1	U
	Nickel	ug/L	1.8	10	1.8	U	1.8	U
	Zinc	ug/L	3.8	10	4	J	3.8	U
PAHs	Benzo(a)anthracene	ug/L	1.3	10	1.3	U	1.3	U
	Benzo(a)pyrene	ug/L	1.3	10	1.3	U	1.3	U
	Benzo(g,h,i)perylene	ug/L	2.4	10	2.4	U	2.4	U
	Chrysene	ug/L	2	10	2	U	2	U
	Dibenzo(a,h)anthracene	ug/L	2.3	10	2.3	U	2.3	U
	Fluoranthene	ug/L	2.1	10	2.1	U	2.1	U
	Indeno(1,2,3-cd)pyrene	ug/L	2.2	10	2.2	U	2.2	U
	Napthalene	ug/L	1.3	10	1.3	U	1.3	U
	Phenanthrene	ug/L	1.4	10	1.4	U	1.4	U
Biochemical Oxygen Demand	mg/L	2	2	2	U	2	U	
Chloride	mg/L	1.9	5	1.9	U	1.9	U	
Total Suspended Solids	mg/L	1	1	1	U	1	U	
Total Organic Carbon	mg/L	0.22	1	0.59	J	0.26	J	



Quality Control – Duplicates



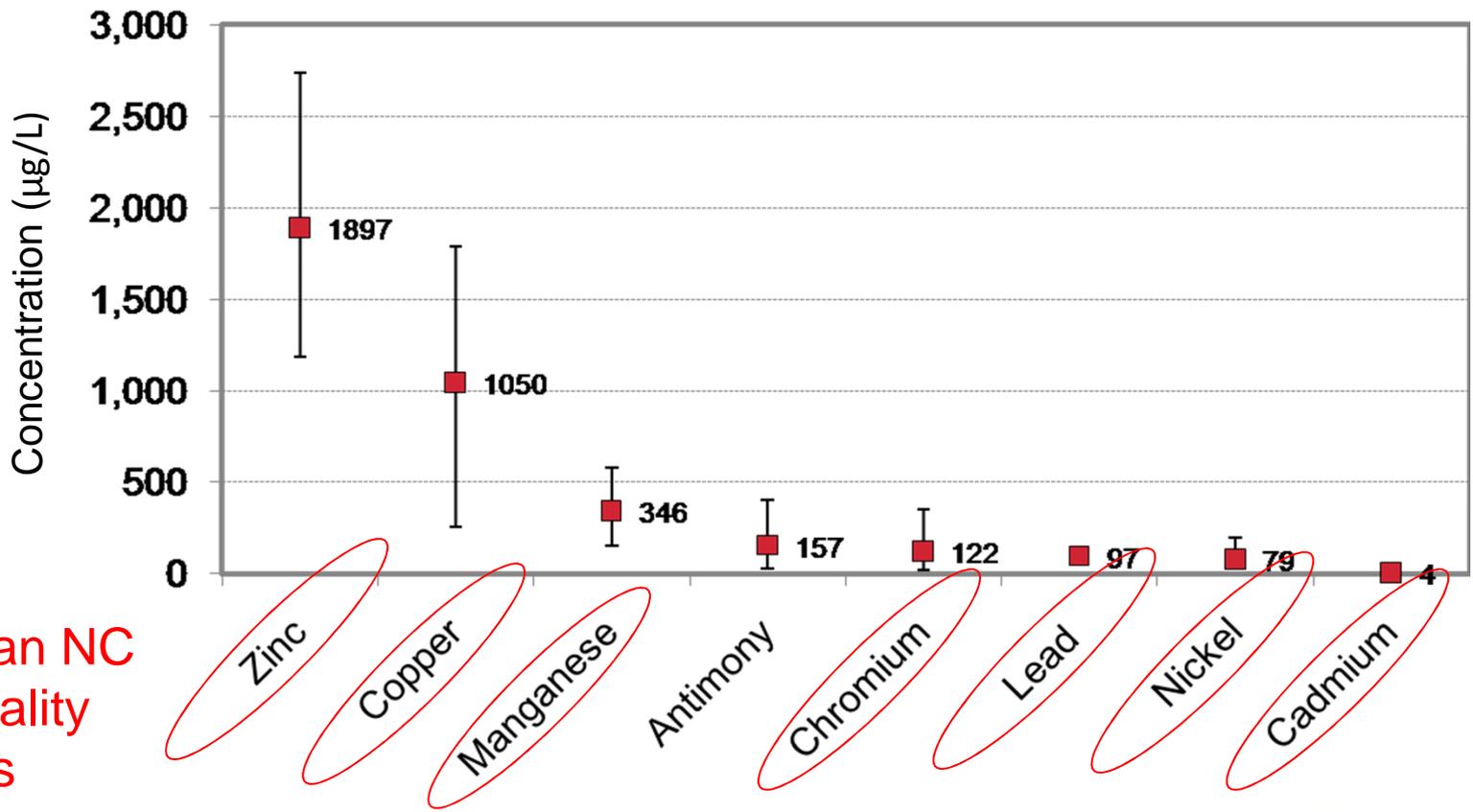
	Site ID	Dup ID	Analyte	Units	Result	Flag	Result	Flag	% Difference
Metals	MCW-02	MCW-04	Antimony Total	ug/L	46.3		45.4		1.9
	MCW-02	MCW-04	Cadmium Total	ug/L	0.36	U	0.388	J	-7.8
	MCW-02	MCW-04	Chromium Total	ug/L	53.9		50.2		6.9
	MCW-02	MCW-04	Copper Total	ug/L	683		672		1.6
	MCW-02	MCW-04	Lead Total	ug/L	83.8		86.1		-2.7
	MCW-02	MCW-04	Manganese Total	ug/L	285		274		3.9
	MCW-02	MCW-04	Nickel Total	ug/L	40.9		40.1		2.0
	MCW-02	MCW-04	Zinc Total	ug/L	1450		1420		2.1
	MCW-07	MCW-08	Antimony Total	ug/L	400		395		1.3
	MCW-07	MCW-08	Cadmium Total	ug/L	16.4		17.6		-7.3
	MCW-07	MCW-08	Chromium Total	ug/L	105		107		-1.9
	MCW-07	MCW-08	Copper Total	ug/L	1280	B	1280	B	0.0
	MCW-07	MCW-08	Lead Total	ug/L	119		137		-15.1
	MCW-07	MCW-08	Manganese Total	ug/L	354		361		-2.0
MCW-07	MCW-08	Nickel Total	ug/L	93.8		93.7		0.1	
MCW-07	MCW-08	Zinc Total	ug/L	2680		2680		0.0	
Nutrients	MCW-02	MCW-04	Nitrate/Nitrite as N	mg/L	0.56		0.58		-3.6
	MCW-02	MCW-04	Phosphorus Total	mg/L	2.5		2.5		0.0
	MCW-02	MCW-04	Total Kjeldahl Nitrogen	mg/L	9.3	B	9.4	B	-1.1
	MCW-07	MCW-08	Nitrate/Nitrite as N	mg/L	1.1		1.1		0.0
	MCW-07	MCW-08	Phosphorus Total	mg/L	3.4	D	3.2	D	5.9
	MCW-07	MCW-08	Total Kjeldahl Nitrogen	mg/L	18	D	18	D	0.0

Quality Control – Duplicates



	Site ID	Dup ID	Analyte	Units	Result	Flag	Result	Flag	% Difference
PAHs	MCW-02	MCW-04	Benzo(a)anthracene	ug/L	13	UD	13	UD	0.0
	MCW-02	MCW-04	Benzo(a)pyrene	ug/L	13	UD	13	UD	0.0
	MCW-02	MCW-04	Benzo(g,h,i)perylene	ug/L	24	UD	24	UD	0.0
	MCW-02	MCW-04	Chrysene	ug/L	20	UD	20	UD	0.0
	MCW-02	MCW-04	Dibenzo(a,h)anthracene	ug/L	23	UD	23	UD	0.0
	MCW-02	MCW-04	Fluoranthene	ug/L	21	UD	21	UD	0.0
	MCW-02	MCW-04	Indeno(1,2,3-cd)pyrene	ug/L	22	UD	22	UD	0.0
	MCW-02	MCW-04	Napthalene	ug/L	13	UD	13	UD	0.0
	MCW-02	MCW-04	Phenanthrene	ug/L	14	UD	14	UD	0.0
	MCW-07	MCW-08	Benzo(a)anthracene	ug/L	1.3	U	1.3	U	0.0
	MCW-07	MCW-08	Benzo(a)pyrene	ug/L	1.3	U	1.3	U	0.0
	MCW-07	MCW-08	Benzo(g,h,i)perylene	ug/L	2.4	U	2.4	U	0.0
	MCW-07	MCW-08	Chrysene	ug/L	2	U	2	U	0.0
	MCW-07	MCW-08	Dibenzo(a,h)anthracene	ug/L	2.3	U	2.3	U	0.0
MCW-07	MCW-08	Fluoranthene	ug/L	2.1	U	2.1	U	0.0	
MCW-07	MCW-08	Indeno(1,2,3-cd)pyrene	ug/L	2.2	U	2.2	U	0.0	
MCW-07	MCW-08	Napthalene	ug/L	1.3	U	1.3	U	0.0	
MCW-07	MCW-08	Phenanthrene	ug/L	1.4	U	1.4	U	0.0	
MCW-02	MCW-04	Biochemical Oxygen Demand	mg/L	78		78		0.0	
MCW-07	MCW-08	Biochemical Oxygen Demand	mg/L	310		200		35.5	
MCW-02	MCW-04	Chloride	mg/L	24		24		0.0	
MCW-07	MCW-08	Chloride	mg/L	82		18		78.0	
MCW-02	MCW-04	Total Suspended Solids	mg/L	180		200		-11.1	
MCW-07	MCW-08	Total Suspended Solids	mg/L	320		320		0.0	
MCW-02	MCW-04	Total Organic Carbon	mg/L	240	D	140	D	41.7	
MCW-07	MCW-08	Total Organic Carbon	mg/L	210	D	200	D	4.8	

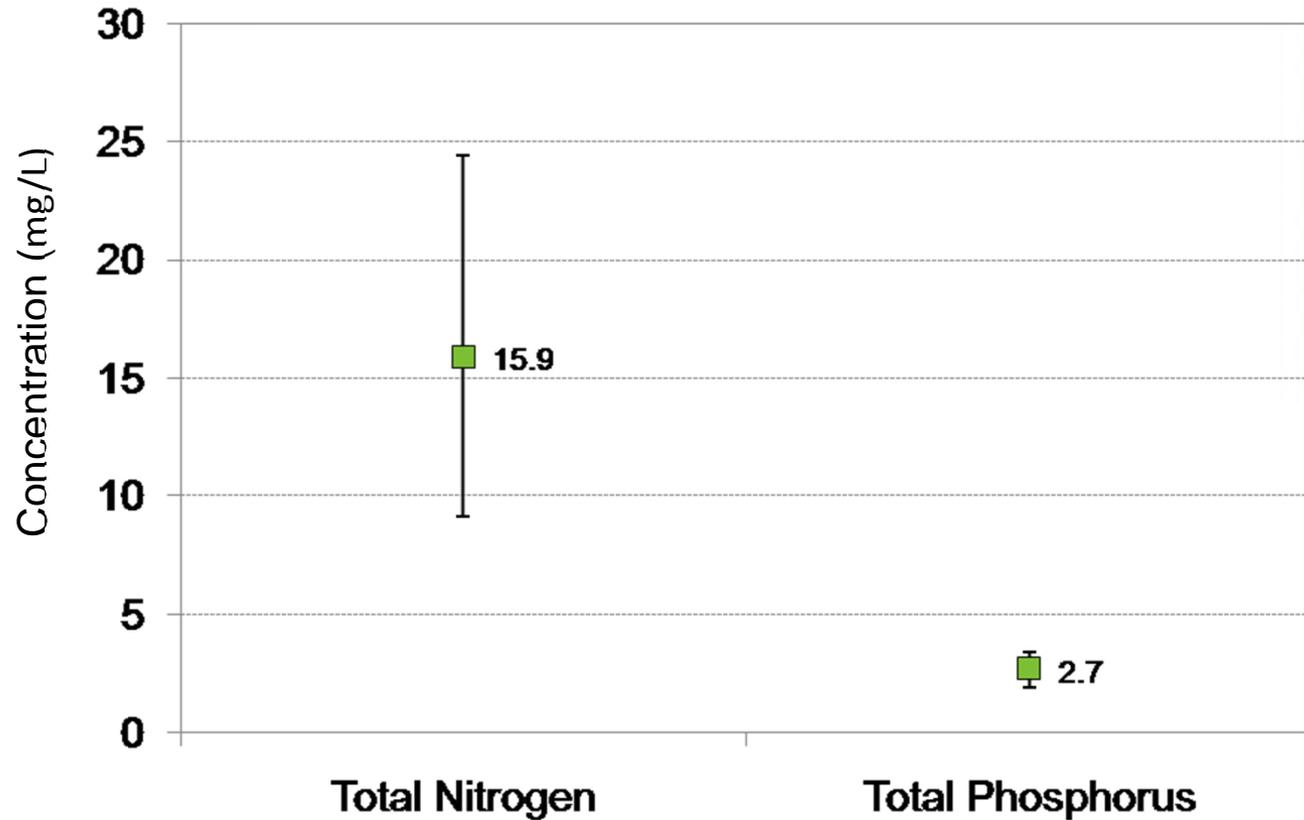
Composite Concentrations: Metals



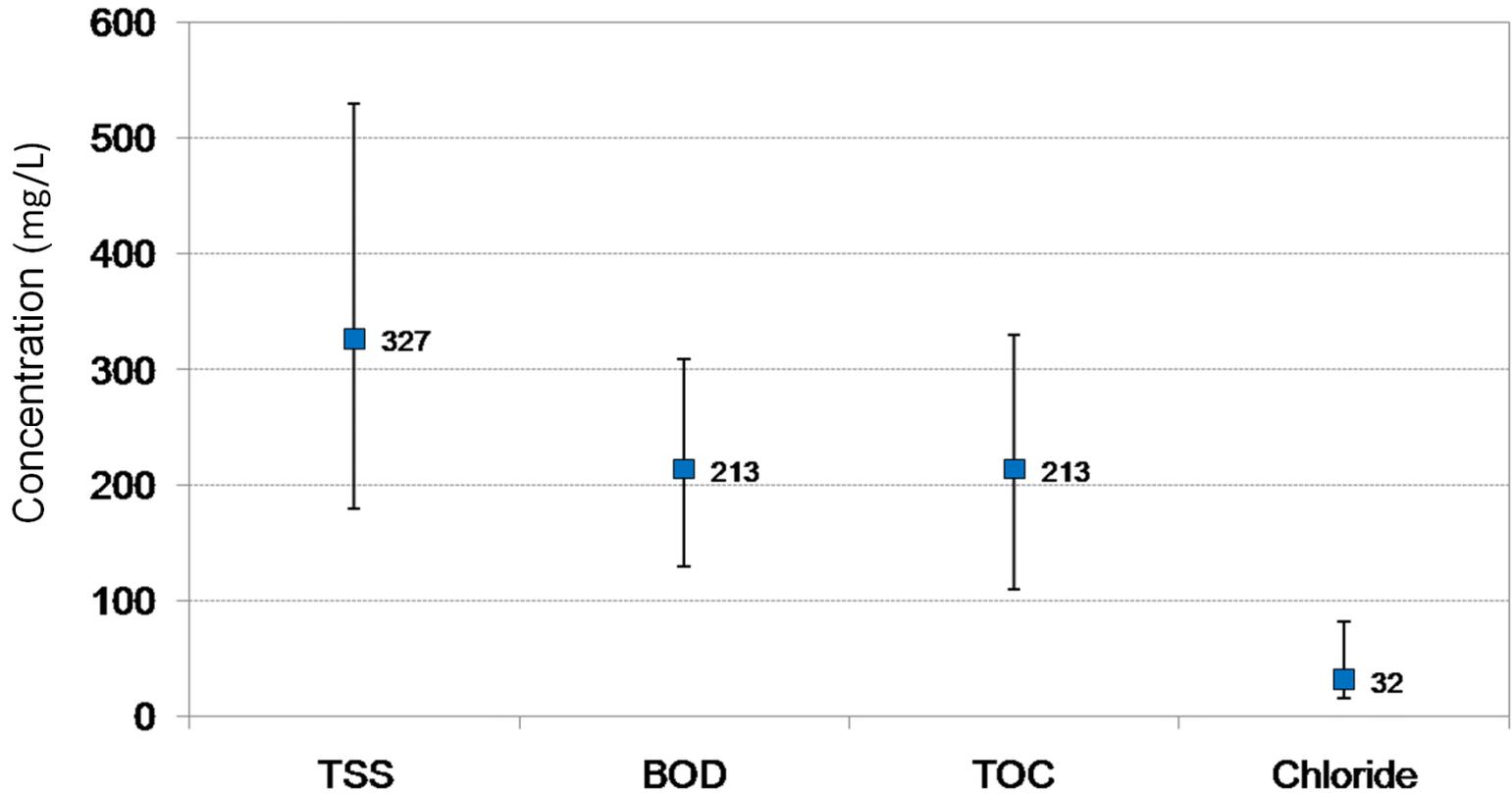
Higher than NC
 Water Quality
 Standards



Composite Concentrations: Nutrients



Composite Concentrations: TSS, BOD, TOC, Chloride





Composite Concentrations: PAHs

All non-detect!

Analyte		Units	Metcalf and Eddy, 2003 (Low Strength)	Metcalf and Eddy, 2003 (Medium Strength)	Metcalf and Eddy, 2003 (High Strength)	Durham WRFs (Mean)	Mobile Car Wash Study (Mean)
Metals	Zinc	ug/L	-	-	-	470	1897
	Copper	ug/L	-	-	-	35	1050
	Manganese	ug/L	-	-	-	-	346
	Antimony	ug/L	-	-	-	-	156.9
	Chromium	ug/L	-	-	-	8.7	121.5
	Lead	ug/L	-	-	-	5.0	97.1
	Nickel	ug/L	-	-	-	10.9	78.5
	Cadmium	ug/L	-	-	-	1.39	3.69
Nutrients	Total Nitrogen	mg/L	20	40	70	-	15.9
	Total Kjeldahl Nitrogen	mg/L	20*	40*	70*	39	14.97
	Nitrate/Nitrite as N	mg/L	0	0	0	-	0.95
	Phosphorus Total	mg/L	4	7	15	6.3	2.7
Biochemical Oxygen Demand	mg/L	110	190	350	289	213	
Chloride	mg/L	30	50	90	-	32	
Total Suspended Solids	mg/L	120	210	400	-	327	
Total Organic Carbon	mg/L	80	140	260	-	213	

Untreated Domestic Wastewater Comparisons



Calculating Annual # of Washes

Phone surveyed companies on compliance list

- 50 companies, 21 respondents
- Classified each as auto rental, contract, executive, full-time, or part-time

16 companies considered active that did not respond to phone survey

- Identifiable business license
- Active company voicemail
- Company website/facebook account
- Observed in the field during 2011
 - Assumed part-time if outside Durham (5)
 - Assumed full-time if in Durham (11)



Median value from survey results (21 respondents) applied to the 16 non-respondents based on classification

Calculating Annual # of Washes

Rental Car



Contract



Executive

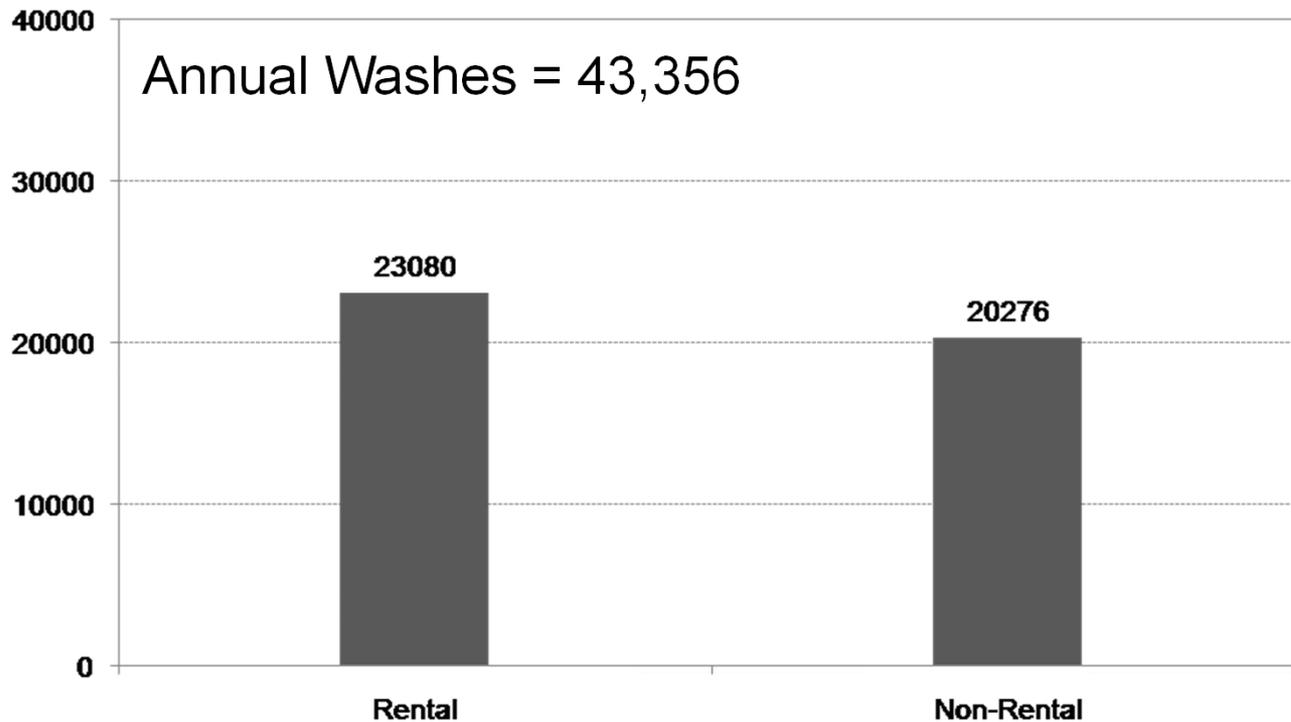


Full-time/Part-time



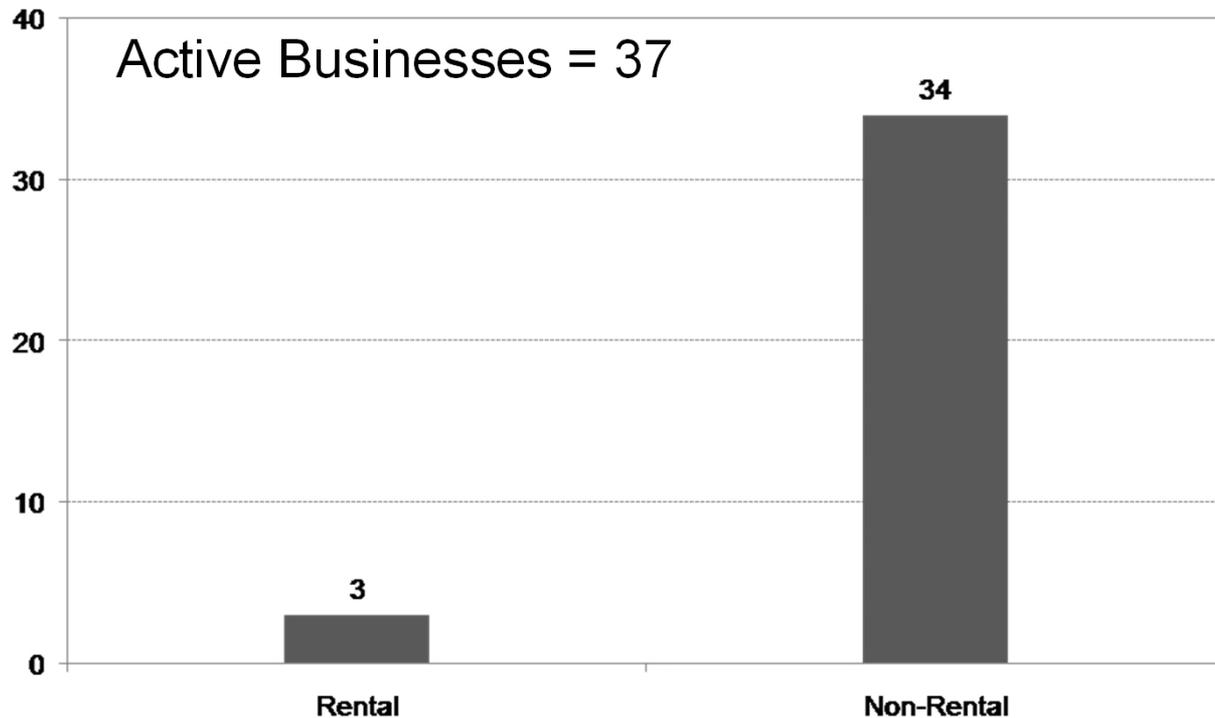


Annual Mobile Car Washes in Durham

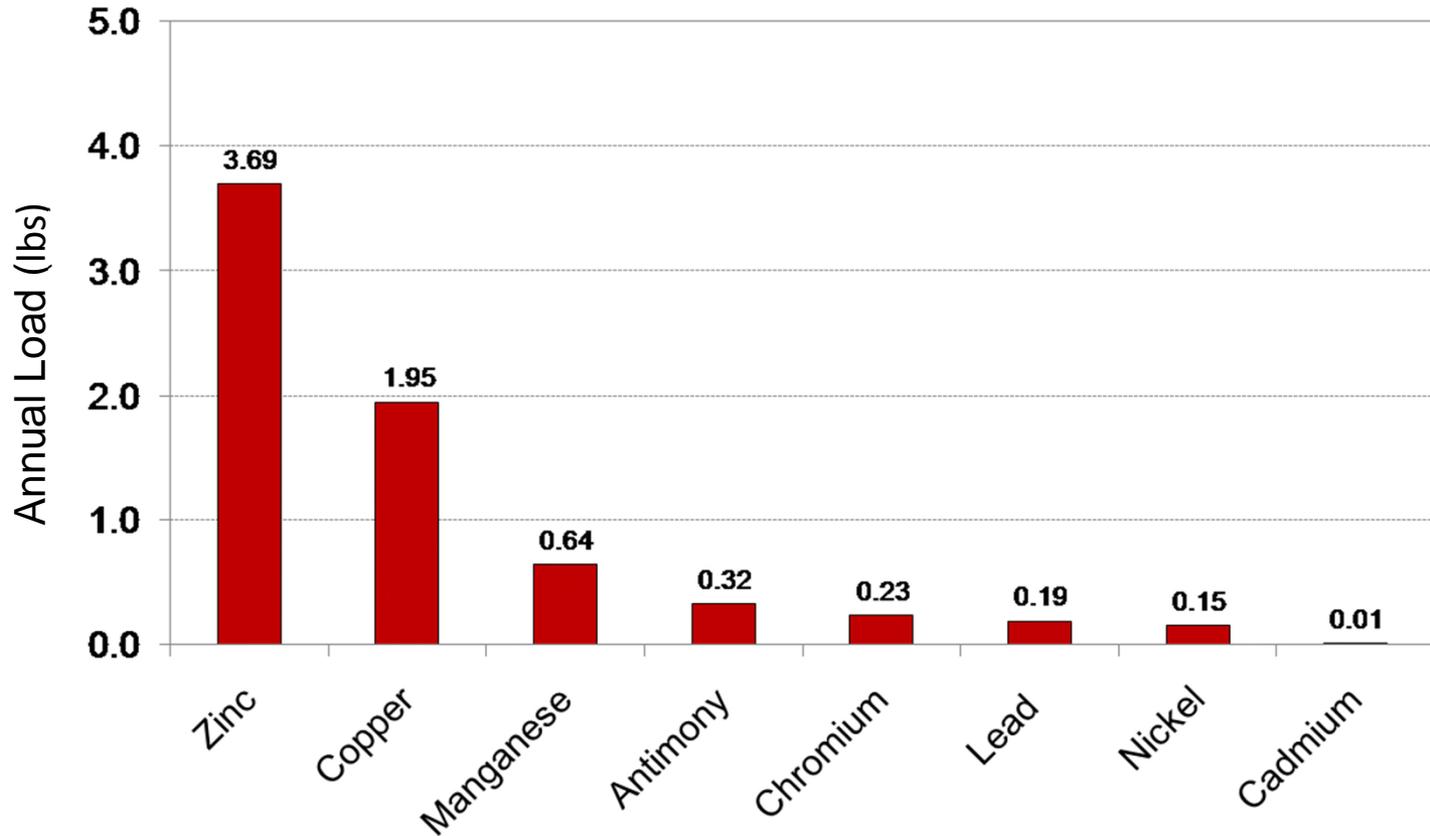




Mobile Car Washing Businesses in Durham

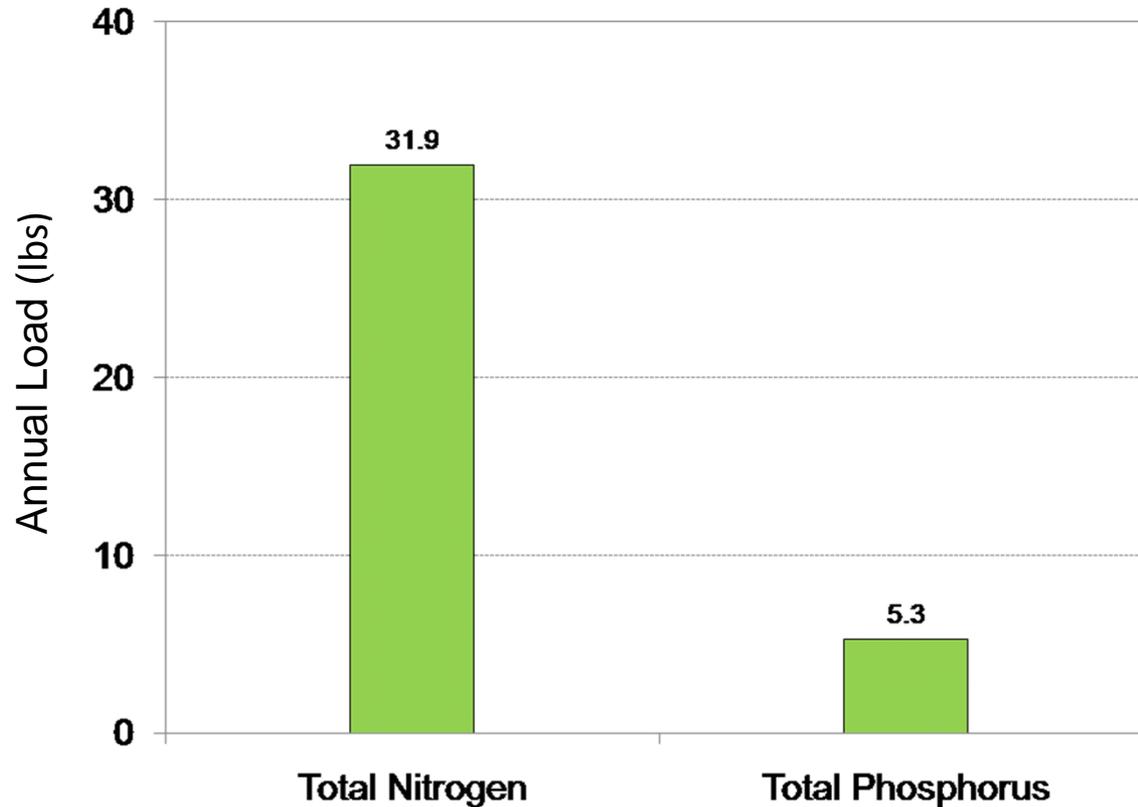


Annual Loads: **Metals**



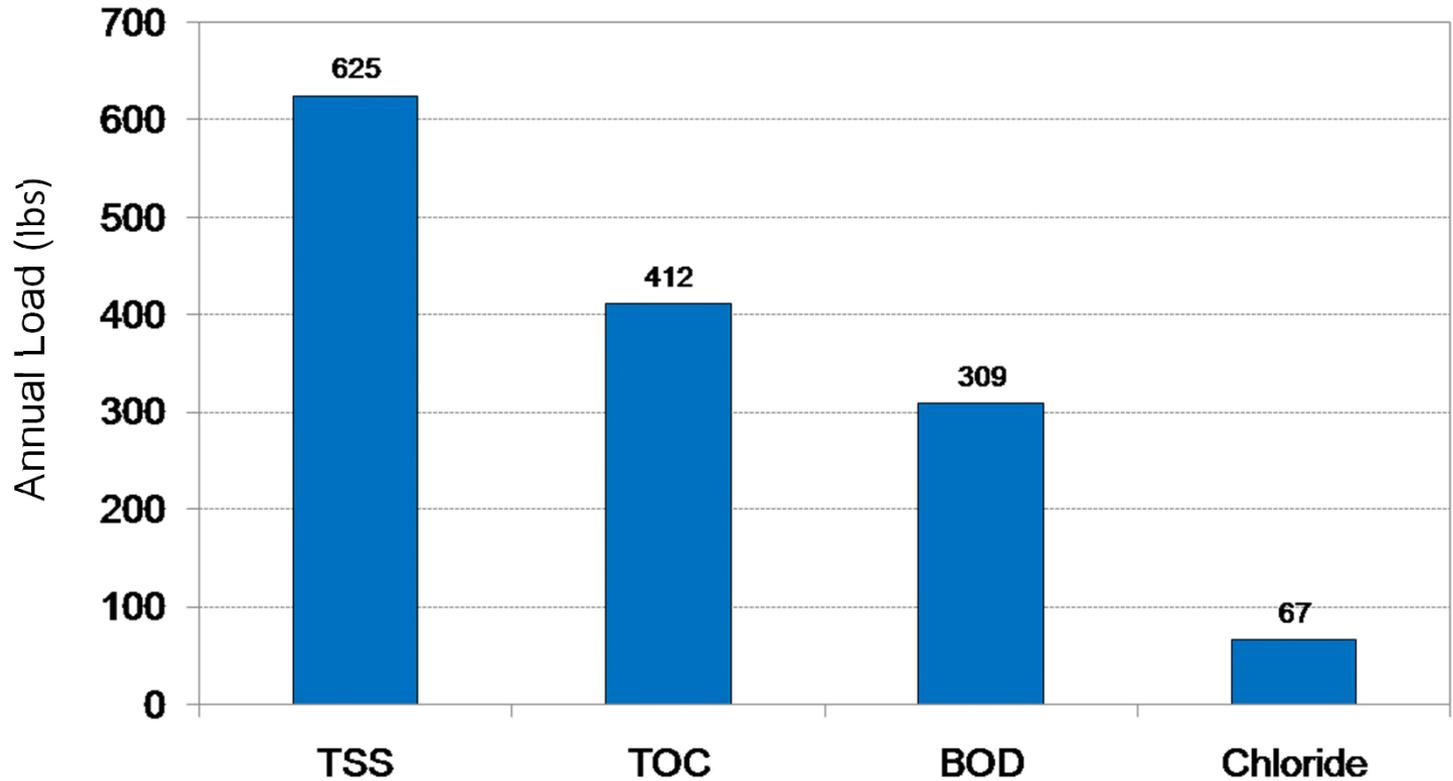


Annual Loads: **Nutrients**





Annual Loads: TSS, BOD, TOC, Chloride





In Summary.....

PAHs were not detected in any sample

Several pollutant concentrations in mobile car wash wastewater are similar to or higher than untreated domestic wastewater

- Metals up to 30x higher (copper!)
- Nutrients similar to low strength
- TSS, TOC, BOD, Chloride between medium and high strength

Estimated >40,000 car washes by “mobile” setups

- Approximately half of those by just a few rental car companies

Annual metals loads highest for zinc (3.7 lbs) and copper (2 lbs)

- Streams in Durham on 303(d) list for zinc and copper

Annual nutrient loads of 31.9 lbs TN and 5.3 lbs TP

- Falls and Jordan Lakes Nutrient Management Strategies

High annual loads of TSS (625 lbs), TOC (412 lbs), BOD (309 lbs), Chloride (67 lbs)

- Streams in Durham on 303(d) list for turbidity and DO