



**WATER
OVER
ROADWAY**

6PPD Proviso Scope

- 1) identify priority areas affected by 6PPD or other related chemicals toxic to aquatic life from roads and transportation infrastructure

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- 2) identify best management practices for reducing toxicity of 6PPD
- 3) **develop a standard method for the laboratory measurement of 6PPD-quinone and related chemicals**

6PPD Spatial PAC Scope

- 1) identify priority areas affected by 6PPD or other related chemicals toxic to aquatic life from roads and transportation infrastructure

Why Identify Priority Areas?

Informs, supports and enhances:

- 1) Toxic chemical assessment strategies & modeling

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- 5) Cost/ benefit analysis & funding priorities

Stormwater & Roads

- 1) Stormwater is rain and snow melt that runs off rooftops, **paved streets, highways, and parking lots.**
- 2) Most stormwater is not treated, it flows downstream directly into streams, lakes, and marine waters.
- 3) Stormwater runoff is the leading threat to Washington's urban waters, streambeds, banks, and habitats.



Best Management Practices

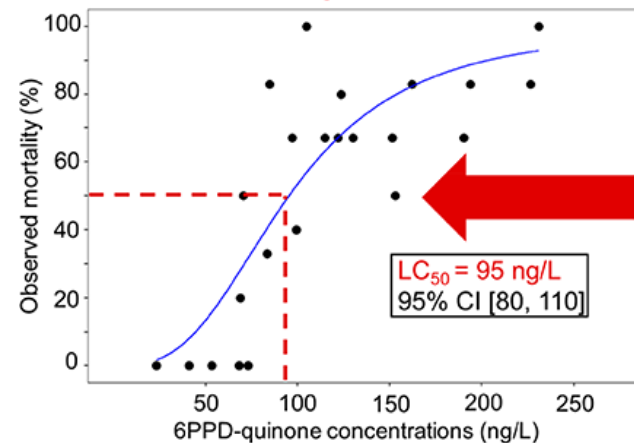
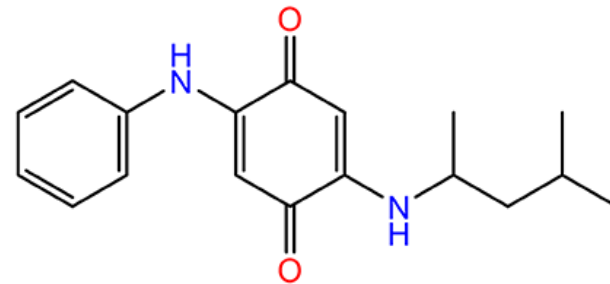
Best Management Practices (BMPs) are the schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices approved by the Department that, when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.



6PPD-Quinone BMPs?

- What BMPs treat 6PPD-Quinone?
 - **We don't know yet** - BMPs are currently being evaluated for treatment of 6PPD-Q
 - Promising work by Jen McIntyre et al. suggests that infiltration treats 6PPD-Q
- Is Dilution the solution with 6PPD-Quinone?
 - Lethal Concentrations (LC50) is very low, it doesn't take much to be lethal to Coho.

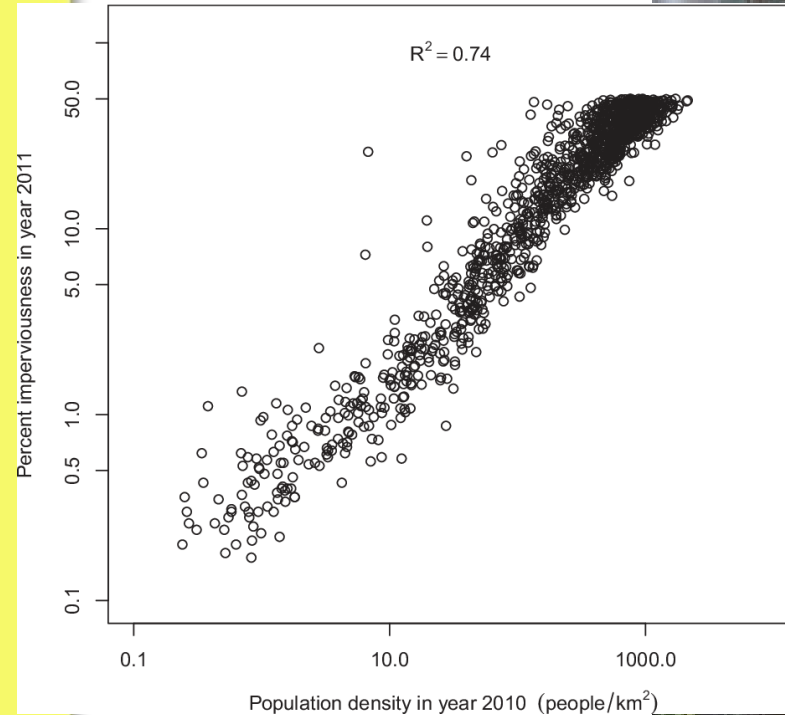
6PPD-Q measured with commercial standard: lower environmental concentrations, lower LC50 (more toxic)



Building Cities in the Rain

Overall Planning Process

1. Establish prioritization goals.
2. Review any regional-scale information as an initial screen. (See Puget Sound Characterization Project.)
3. Assess local, watershed-specific information. (See “Local Prioritization” table as a starting point.)
4. Actively seek input from natural resource agencies and tribes.
5. Involve the public in the prioritization process.
6. For stormwater control transfer programs, seek approval from Ecology.



Rosburg et al.



6PPD Proviso Focus

Priority area focus:

TOXICS	BIOTA	WATER
6PPD	Aquatic life	All waterways
6PPD-Quinone	Coho & Steelhead	Lowlands - small streams
Tire Wear Particles (TWP)	Salmonids	Estuaries
All road runoff associated toxic chemicals	Chinook	Highlands – big rivers

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Proviso Report Timeline 2022

Submit to Legislature

Nov. 1, 2022



November

Ecology Legislative Office

September

August

Finalize Report

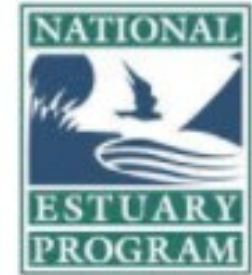
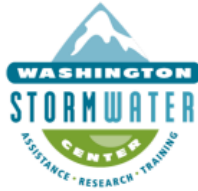
Draft Review

June - July

May

Draft Report

Stakeholder Coordination & Funding



**PRIORITIZATION
EFFORTS**



DEPARTMENT OF
ECOLOGY
State of Washington



Multi-Disciplinary Integration

ROADS & TIRES

FORESTS

STREAMS

RAIN & SNOW

**PRIORITIZATION
EFFORTS**

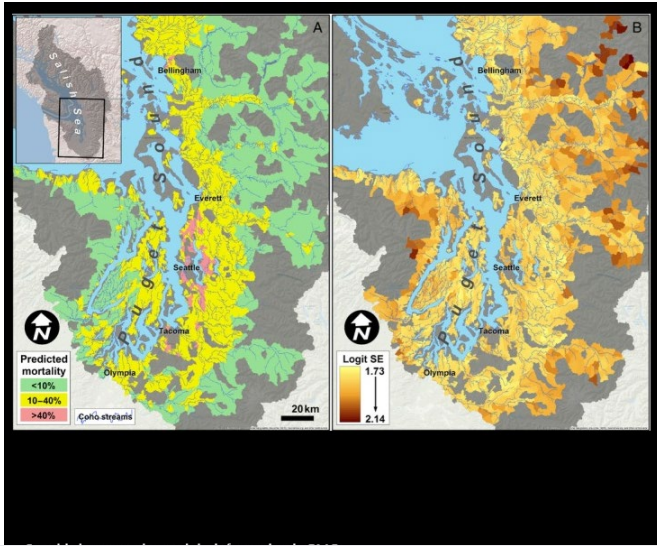
LANDSCAPE

FISH

**AQUATIC
HABITAT**

HUMANS

Ecoforensic Kudos



Car Tires & Salmon Health: Exploring New Research on Stormwater Impacts W...
2. Are coho salmon uniquely sensitive?

Well Water | Tire Leachate | Well Water | Tire Leachate

2 coho + 2 chum | 2 coho + 2 chum | 2 coho + 2 chum | 2 coho + 2 chum

November 2017 Repeated 4x

YES

- Tire Leachate = 320 mg/L
- 24 h exposure
- Expect 100% mortality in coho

Isolating a deadly compound in tires

STEPS	Number of chemical features
1 Water passes through tiny pieces of tire tread from new and used tires	>2,000
2 Ion exchange removes charged components, followed by resin chromatography to adsorb organic compounds	1,355
3 Silica gel chromatography was used to separate the remaining organic compounds by their polarity	659
4 Using HPLC, the mixture is pumped through C18 (a hydrophobic medium) to separate the chemicals	225
5 Another step with HPLC using pentafluorophenyl as the medium	26
6 A final step with HPLC used phenyl as the medium	4

FINAL RESULT When dried, the resulting compound was a pink-magenta solid with a relatively simple chemical makeup **C18H22N2O2**

-NOAA; 2021



A

1000 mg/L TWP leachate

250 mg/L TWP leachate

Seattle Site 1, Seattle Site 2, Los Angeles, Seattle, San Francisco

B

Each passenger car
 4 tires: ~36 kg tire rubber
 140 – 700 g 6PPD
 1.4 – 500+ g 6PPD-quinone

Each heavy truck
 18 tires: ~900 kg tire rubber
 3600 – 18000 g 6PPD
 36 – 10,000+ g 6PPD-quinone

↑ Predicted
 ↓ Observed

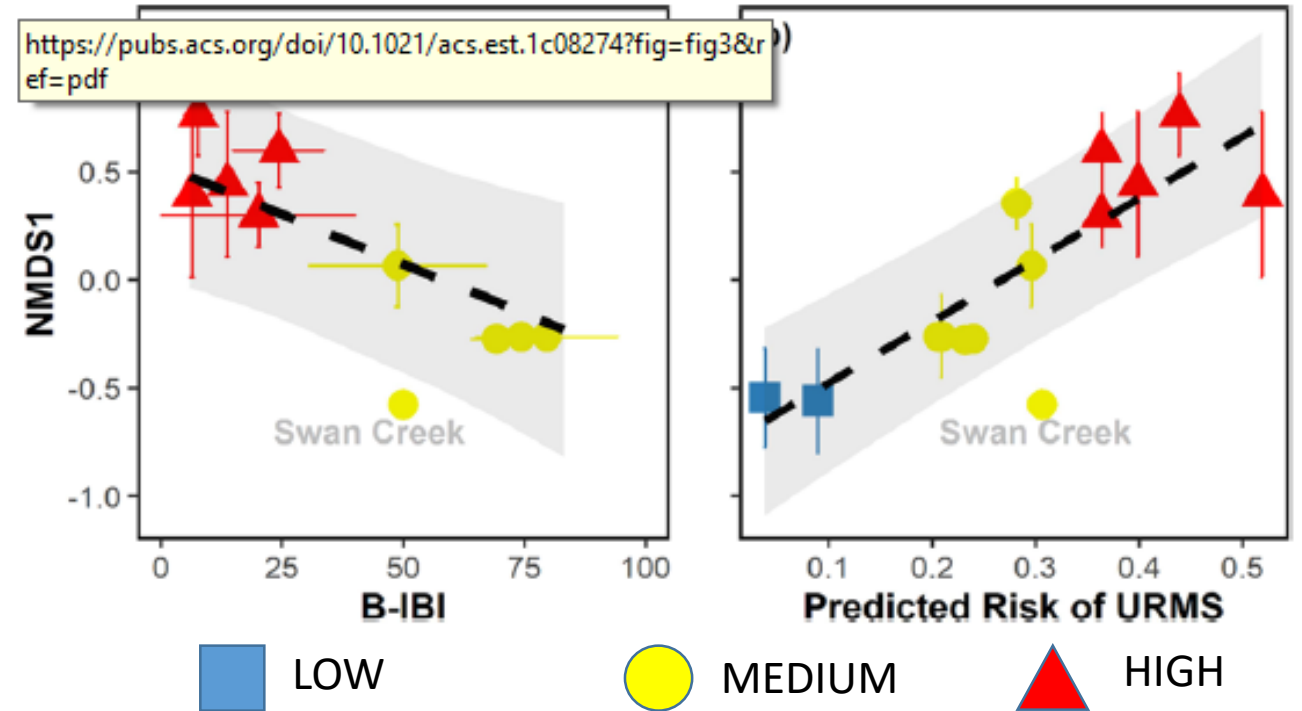
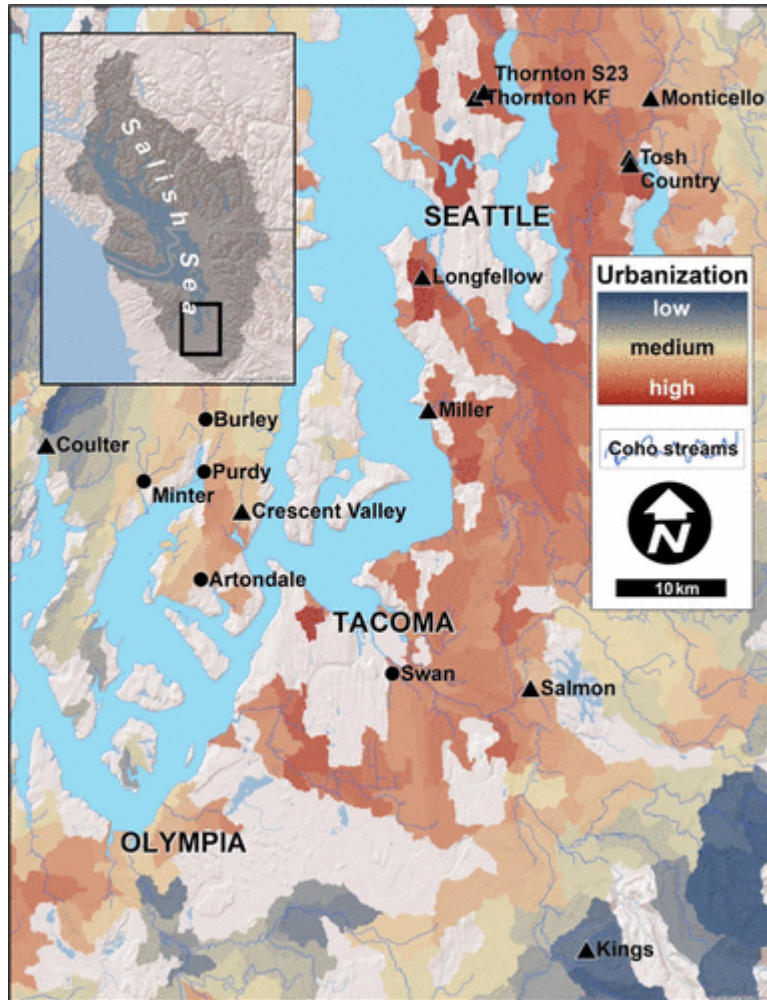
Multilane roadway runoff
 0.8 – 19 µg/L

Receiving waters during storms
 <0.2 – 3.5 µg/L

LC₅₀
 0.8-1.5 µg/L



URMS & B-IBI Correlations



Peters & Lundin et al. 2022

State of the Salmon



“A watershed/ecosystem approach is the best approach to solving these issues because of their multi - jurisdictional nature” - Washington Treaty Indian Tribes, NWIFC



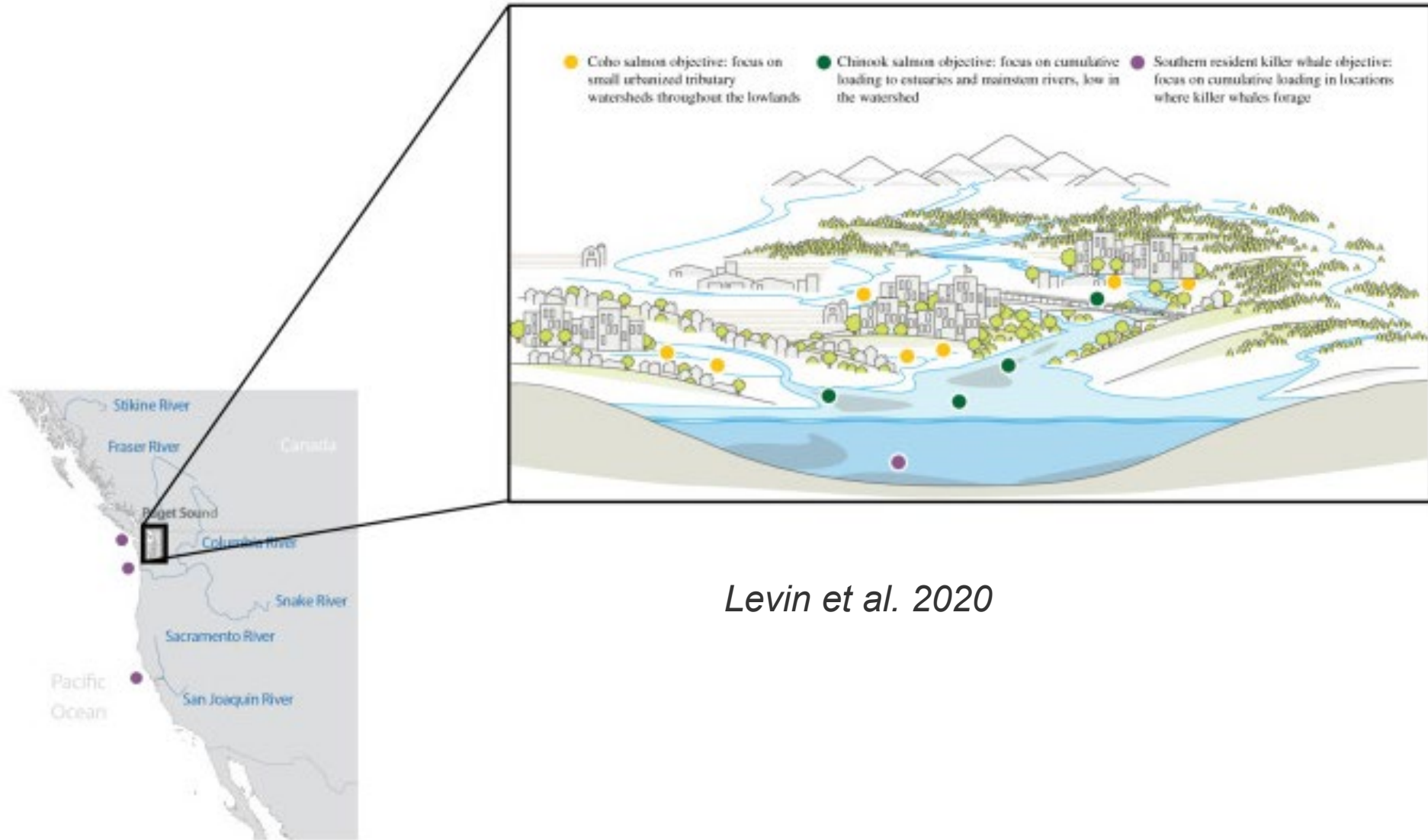
Environmental Law

- 1) **The Clean Water Act** - “no toxics in toxic amounts” in our surface waters.
- 2) **The Endangered Species Act** - protects species at risk of extinction.
- 3) **Tribal Treaty Rights/Boldt Decision** - salmon exist at sufficient levels to enable harvest by Native Americans.

We need to strategically help directly and indirectly fill information gaps about 6PPD-quinone to incorporate adaptive management strategies

ESA Listed

- Puget Sound Chinook – listed as threatened in 1999
- Hood Canal & Strait of Juan de Fuca summer chum – listed as threatened in 1999
- Lake Ozette sockeye – listed as threatened in 1999
- Puget Sound steelhead – listed as threatened in 2007
- NMFS listed Southern Resident Killer Whales as endangered in 2006, and designated most of Puget Sound as critical habitat.
- **Coho NOT listed (YET)**



Discussion points

Prioritization Metrics

- | | | |
|--------------------------|---|---|
| 1) Streams | 13) Movement (cell phone data) | (conservation units) |
| 2) Roads | 14) Toxics loading | 23) Coho wild |
| 3) Urban gradient | 15) Conductivity/TSS | 24) Aquatic life habitat distribution & life history use and connectivity |
| 4) Imperviousness | 16) B-IBI | 1) Coho (eat Sockeye eggs) |
| 5) Population density | 17) Hydrology/Flashiness | 2) Steelhead |
| 6) Precipitation | 18) Stream size | 3) Beavers |
| 7) Ozone | 19) Basin size | 4) Access between rearing and spawning grounds |
| 8) Carbon Monoxide | 20) Coho population status – decreasing or increasing | |
| 9) Land cover | 21) Coho population size | |
| 10) Land use | 22) Coho genetic diversity | |
| 11) Soil type | | |
| 12) SW Filtration Status | | |

Prioritization Criteria

Habitat Criteria –

Identify streams with stream flow impacts (too much or too little) and flashiness

B-IBI metric threshold Good, Fair, Poor

Fish use – Focus on Steelhead & Coho for now

Habitat amount, total stream miles, variety of habitat type & connectivity for all life stages

Existing water quality impairments 303d, 305 TSS, Temp, DO, etc.

Additional toxics loading

Stream width (per comm. ~10 ft. across)

Stream flow – beaver dams, stagnant waters vs. fast flowing, discharge cutoff

Integrative - Good habitat if they can only make it through the urban zones

Crossings Criteria –

Bridges, direct or indirect flow

Fish passage/blockage plans?

Road & Stormwater Criteria

Roads within buffer zone of stream (WSDOT uses 500 ft. range)

Traffic above certain AADT (WSDOT uses 30,000 for retrofit prioritization, probably much lower for 6PPD-Q source loading)

Number of lanes

Speed

Traffic type – trucks vs cars

Stops, turns & curves

Slope adjacent to road

Soil type adjacent to road

Filterened or non-filtered runoff?

Buffer Zones

Buffer Zones is the creation of an undisturbed area or strip of natural vegetation or an established suitable planting that will provide a living filter to reduce soil erosion and runoff velocities.