Sediment Transport Prototypes
Novel Methods to Disconnect Roads from Streams

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Overview

Introduction
- Problem statement
- Research objective
- Hypothesis

Methods
- Site description
- Field methods
- Analytical methods

Results
- Turbidity/SSC
- Aggregate degradation
- Subgrade pressure
- Rutting

Conclusion
- Agreement with existing knowledge
- Next steps
Sediment Originating from Unpaved Forest Roads

Why is it important?

Sediment from forest roads leaches into nearby streams and degrades aquatic habitat

Endangered Species Act
Threatened salmonid species in Willamette and Lower Columbia Basins (NMFS 2015)

- Chinook Salmon
- Chum Salmon
- Coho Salmon
- Steelhead
Research Objective

For a small, field scale, test track with sediment control treatments

Observe and Quantify

1) Sediment transport leaving surface aggregate
2) Physics of sediment generation in surface aggregate
3) Treatment efficacy – benefit, service life, construction

During wet-weather hauling conditions
Hypotheses

- Filtration devices will provide a sediment sequestration benefit
- Geogrid reinforcement will improve aggregate performance (reduce rutting)
Justification of Approach

Past Efforts

• Use of geotextile to segregate aggregate
• Use of geogrid to prevent rutting

Methods to manage sediment:

• Geogrid reinforcement
• Use of poorly graded surface aggregate
• Confining materials to provide filtration of runoff
Dunn Research Forest

Reconstructed 120 ft section of road

- 6 treatments
- 12 ft x 20 ft sections
- Insloped towards ditch
- 2 aggregate varieties

Methods

Results

Conclusion
Field Testing

- Runoff Collection Flume
- ISCO Pump Sampler
- Sprinklers ~ 0.60 in/hr
Runoff Collection Trench

12” layer of aggregate, unbound at road surface

Geotextile layer with overlain with geogrid (Geo-treatments only)

Flexible PVC water bar with buried wood support

Pool liner-like material to provide confinement

Simulated Rainfall

Runoff collected for laboratory analysis

Direction of Truck Traffic
Construction

Photos: Ben Leshchinsky
Methods

Analytical Methods

Turbidity

Suspended Solids

Screening/Sieving

Data Logger

Permeability

Photo: Ben Leshchinsky
Test Track After 600 Truck Passes

Photo: Ben Leshchinsky
Preliminary Results

Turbidity and Suspended Solids Concentration (SSC)
Turbidity and SSC Time Series

**Turbidity**

- **Well-Graded Aggregate**
  - Control
  - Biomass
  - Geotextile

- **Poorly-Graded Aggregate**

**Suspended Solids Concentration**

- **Well-Graded Aggregate**
- **Poorly-Graded Aggregate**
Permeability Testing

**Influent**
- 1% fines by mass
- Approx. 5,500 NTU

**Effluent**
- Max 1,500 NTU at peak
- 900 NTU prior to flushing

![Graph showing turbidity levels over time with and without geotextile.](image)

The relationship between turbidity and time can be described by the equation:

\[ y = 0.93x - 23.09 \]

with a coefficient of determination of \(R^2 = 0.73\).

What does a geotextile cost?
- Fabric $1.25 per sq. yrd
- Geogrid $1.50 per sq yrd
Aggregate Degradation

- Aggregate degradation = Function of truck traffic
- % increase of fines > % increase of coarse grains

![Graph showing change in mass with particle size for well-graded and poorly-graded aggregate.]

Well-graded Aggregate

- Light Color 100 Truck Passes
- Dark Color 600 Truck Passes

Poorly-graded aggregate
Geotextile reinforcement ~ Lower subgrade pressure
Findings

- Sand filter berm (if implemented correctly) can provide a substantial reduction in turbidity > 70 % reduction in turbidity
- Geogrid reinforcement improved load distribution for well-graded rock
- Geogrid reinforcement improved rutting for well-graded rock
- Aggregate degraded in proportion to truck traffic.
References