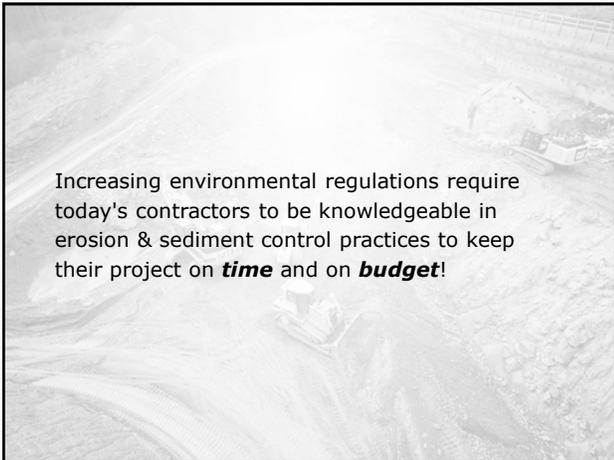


INTRODUCTION & CALCULATIONS

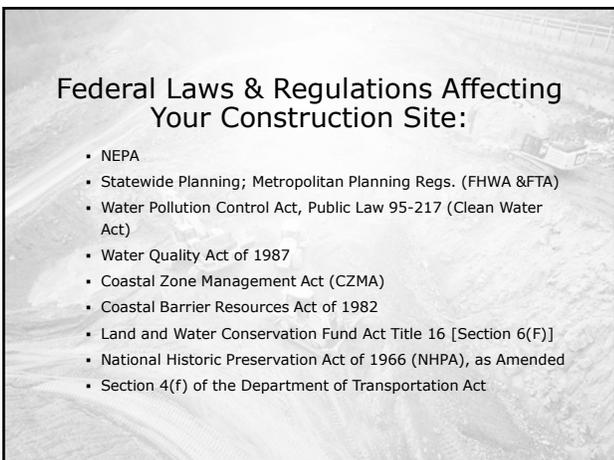
This section is designed to show the connection between the science of erosion and sediment control and the best management practices (BMPs) used on construction sites.

1



Increasing environmental regulations require today's contractors to be knowledgeable in erosion & sediment control practices to keep their project on **time** and on **budget!**

2



Federal Laws & Regulations Affecting Your Construction Site:

- NEPA
- Statewide Planning; Metropolitan Planning Regs. (FHWA &FTA)
- Water Pollution Control Act, Public Law 95-217 (Clean Water Act)
- Water Quality Act of 1987
- Coastal Zone Management Act (CZMA)
- Coastal Barrier Resources Act of 1982
- Land and Water Conservation Fund Act Title 16 [Section 6(F)]
- National Historic Preservation Act of 1966 (NHPA), as Amended
- Section 4(f) of the Department of Transportation Act

3

- Archaeological Resources Protection Act (ARPA)
- Surface Transportation and Uniform Relocation Assistance Act (STURAA) of 1987
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
- Superfund Amendments and Reauthorization Act (SARA)
- Resource Conservation and Recovery Act (RCRA)
- Clean Air Act & Amendments
- Safe Drinking Water Act of 1974
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Rivers and Harbors Act of 1899
- Ocean Dumping Act
- Uniform Relocation and Real Property Acquisition Policies Act of 1970, as Amended

4

- Noise Control Act of 1972
- Title VI of the Civil Rights Act of 1964
- Executive Order 11990, Protection of Wetlands, 1977
- Executive Order 11988, Floodplain Management, 1977
- Executive Order 12185, Energy Conservation, 1979
- Executive Order 12898, Environmental Justice, 1994
- Endangered Species Act of 1973, as amended
- Fish and Wildlife Act of 1956
- Fish and Wildlife Coordination Act
- Migration Bird Conservation Act
- Watershed Protection and Flood Prevention Act
- Estuary Protection Act
- Wild and Scenic Rivers Act
- Farmlands Protection Policy Act
- Tribal Treaties

5

- State Laws & Regulations affecting your construction site:**
- SEPA
 - Washington State Shoreline Management Act
 - Governor's Executive Order EO 81-18 (Water Quality Certification)
 - Governor's Executive Order EO 89-10, Protection of Wetlands, 1989
 - Governor's Executive Order EO 90-04, Protection of Wetlands, 1990
 - Governor's Executive Order EO 80-01, Farmlands Preservation, 1980
 - Hazardous Waste Management Act
 - Waste Reduction Act
 - Model Toxics Control Act
 - Washington State Growth Management Act
 - Washington State Water Pollution Control Act
 - Forest Practices Act

6

- Flood Control Zone Act of 1935
- Surface Mining - DNR
- Archaeological Sites and Resources Act
- Indian Graves and Records Act
- Abandoned and Historic Cemeteries Act
- Clean Air Washington Act of 1991
- Commute Trip Reduction Act of 1991
- Critical Areas Ordinances (Growth Management Act)
- Grading Permit
- Clearing Permit
- Building Permit
- Conditional Use Permit
- Water Rights Permit
- Shoreline Substantial Development Permit

7



Ecology News
 Department of Ecology News Release - December 16, 2002
 Belfair mine fined for violating environmental permit

OLYMPIA - A sand-and-gravel mine near Belfair has been **fined \$18,000 for violating a permit** that is intended to protect water quality and prevent erosion. Inspectors with the Department of Ecology (Ecology) found that Belfair Sand & Gravel Inc. **failed to submit an adequate plan to control erosion and sediment**, did not build ponds to hold storm water as required, and has not submitted monitoring reports of its stormwater discharges for the past two years.

...**"Fortunately, this has been a dry fall, but we can't rely on the lack of rainfall to prevent muddy runoff,"** Pacifico said. "There are simple, reasonable steps these operations can take to protect water quality and still make a profit."

8



Ecology News Department of Ecology News Release - February 18, 2009

OLYMPIA - **Stowe Construction** company of Sumner Wa, has been fined **\$36,000 for violations of its construction stormwater permit.**

Ecology's \$36,000 penalty against Stowe Construction cites the company for failing to:

- Prevent, control and treat stormwater run-off from the site.
- Keep a stormwater pollution plan and inspection reports on site.
- Prevent the discharge of muddy water from the site.
- Maintain silt fencing, plastic sheeting, check dams and drain inlets, all of which are used to control and reduce stormwater run-off from a construction site.

9

UNITED STATES ATTORNEY'S OFFICE 

Prominent Pierce County Developer Pleads Guilty To Criminal Violation Of Clean Water Act - Western District of Washington - April 12, 2012

Bryan Stowe and Stowe Construction Agree to \$750,000 in Fines and Community Service Payments

- A prominent Sumner, Washington developer and his construction company have pleaded guilty in U.S. District Court in Tacoma to felony violations of the Clean Water Act. **The charges filed against BRYAN STOWE, 65, and STOWE CONSTRUCTION Inc.**, are the first storm water pollution criminal charges brought in Western Washington.
- Oct 10, 2012
- Bryan Stowe, 65, was sentenced to six months in prison, one year of supervised release, and a \$300,000 fine for knowingly violating a national pollution discharge elimination permit.**

10

UNITED STATES ATTORNEY'S OFFICE 

Prominent Pierce County Developer Pleads Guilty To Criminal Violation Of Clean Water Act (Western District of Washington - April 12, 2012)

"... This plea serves as notice to our regional developers ... these are serious environmental crimes that will be vigorously pursued."

These pleas are the second and third pleas entered in connection with this investigation. In December 2011, STOWE CONSTRUCTION **employee Timothy Barger pleaded guilty to making false statements to government officials**, a violation of 18 U.S.C. 1001.

Sentenced to 1 year probation

11

SW WASHINGTON DEVELOPER PLEADS GUILTY TO ILLEGALLY FILLING WETLANDS 

Western District of Washington - September 20, 2010

PHILIP A. SMITH, 53, of Chehalis, Washington, pleaded guilty ... to damaging approximately 98 acres of wetlands in southwest Washington ...without first obtaining a permit. SMITH is scheduled to be sentenced ...January 10, 2011. **The maximum criminal penalties for the felony violation include up to three years in prison and a fine of not more than \$50,000 per day of violation.**

"... "Mr. Smith deliberately chose to ignore environmental laws ...," said Ecology Director Ted Sturdevant. "Today's plea agreement is a consequence of his decision to bulldoze dozens of acres of wetlands and a creek."

...In early 2008, the Environmental Protection Agency issued an order to SMITH requiring him to restore the wetlands. He did not comply with the order and a separate civil case was filed requiring restoration of the damaged wetlands. **The civil case is being handled separately from the criminal case..**

Plea deal -Restore the wetland, pay \$20,000 fine, 2 years House Arrest

12

DEQ News Release : Sept. 10, 2009

DEQ Issues \$18,162 in Penalties to Hillsboro Construction Company for Stormwater Permit Violations at Morning Wood Subdivision in Rockaway Beach

The Oregon Department of Environmental Quality has issued penalties totaling \$18,162 to S. Kem Design & Construction, Inc. for failing to comply with conditions of the stormwater discharge permit for construction activities at the Morning Wood subdivision construction site in Rockaway Beach, Oregon.

...
DEQ issued the penalty because failing to properly implement the ESCP could have resulted in the discharge of sediments from the construction site to Rock Creek. Sediment from construction sites can damage aquatic species and ruin habitat. It can also reduce the safety of public waters for public use.

13

DEQ News Release December 7, 2010

DEQ fines development company \$10,688 for violating discharge permit and submitting false information on Klamath Falls project

The Oregon Department of Environmental Quality has issued penalties totaling \$10,688 to Brower Inc., ... For violations of its construction stormwater discharge permit at the Partridge Hill subdivision site in Klamath Falls and for submitting false information to DEQ about conditions at the site.

...
 On Dec. 28, 2009, **DEQ received a "notice of termination of permit"** from Brower Inc. Certifying that all conditions of the permit and its termination had been met, ... DEQ officially terminated the permit on Dec. 30, 2009.

However, during a Jan. 12, 2010 inspection of the site, DEQ observed unstabilized soils, temporary instead of permanent erosion and sediment controls still in place, ... another inspection DEQ conducted at the site **on Nov. 13, 2010 confirmed that temporary erosion and sediment controls were still in place** and documented the **continued existence of unstabilized soils.**

14

DEQ News Release : Sept. 16, 2011

Failure to Follow Erosion and Sediment Control Plan at Seaside Subdivision Construction Site Leads to \$11,806 DEQ Penalty

The Oregon Department of Environmental Quality has issued an \$11,806 penalty to Bruce Ritchie, of Portland, for failing to fully implement his erosion and sediment control plan during construction of the Blue Heron Pointe housing subdivision in Seaside during the past two years.

...
 An April 2011 DEQ inspection of the site, where construction activities had been temporarily ceased for months, revealed numerous erosion and sediment discharge problems. The problems included several exposed and unstabilized slopes; lack of catch basin inlet protection; several uncovered piles of soil, gravel and construction debris; and areas where soil had been disturbed or left unprotected.

DEQ issued Ritchie an \$11,806 penalty for violating his permit by failing to implement and maintain the erosion and sediment controls specified in the plan. ...

15



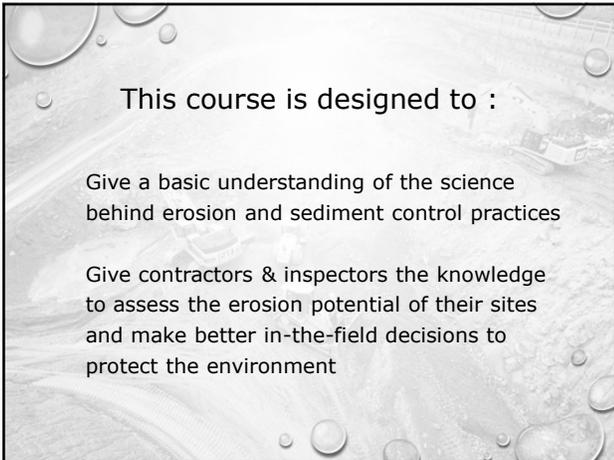
DEQ News Release : March 29, 2023

DEQ seeks comment on proposed expedited settlement action and consent order with TC Hayden Properties, LLC

BOISE—The Idaho Department of Environmental Quality (DEQ) is seeking public comment on a proposed settlement action and consent order with TC Hayden Properties, LLC for violations of the 2022 general permit for discharges from construction activities.

TC Hayden Properties is the operator at the Wildcat Development in Hayden, Idaho, and was unpermitted at the time DEQ cited the violations. Coverage was later obtained under Permit IDR10C0D5. DEQ alleges the company failed to comply with all applicable conditions of the permit. DEQ prepared an expedited settlement agreement and consent order directing TC Hayden Properties **to resolve the violations and either pay a civil penalty or request a compliance conference. TC Hayden Properties made payment in full for the civil penalty of \$9,750 and signed the consent order.**

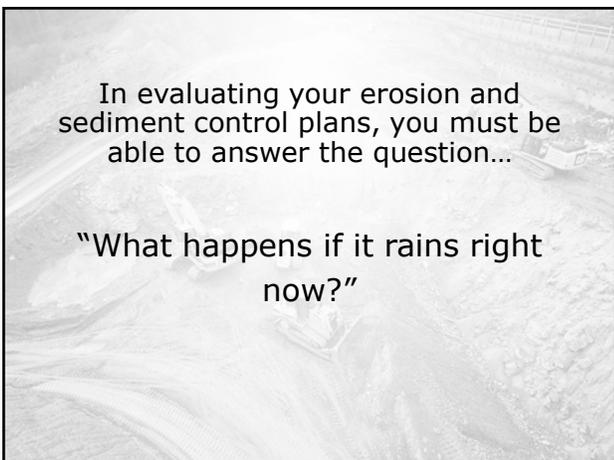
16



This course is designed to :

- Give a basic understanding of the science behind erosion and sediment control practices
- Give contractors & inspectors the knowledge to assess the erosion potential of their sites and make better in-the-field decisions to protect the environment

17



In evaluating your erosion and sediment control plans, you must be able to answer the question...

“What happens if it rains right now?”

18

D.B.E.C.S.

Drive By Erosion Control Syndrome

Definition :
The urge to **"do something"** and implement ineffective erosion controls that can be seen from the road

19

Symptoms of DBECS Include:

Placing straw bales or piles of rocks in the middle of nowhere or in concentrated water flows and calling them "check dams"...



20

Installing silt fence at the top of a hill



21

Covering piles of dirt with plastic to "prevent erosion" and then securing the plastic with dirt to keep in place...



22

Only One Known Cure For DEBECS;

Is to take *this course!*

(Punch line) ↪

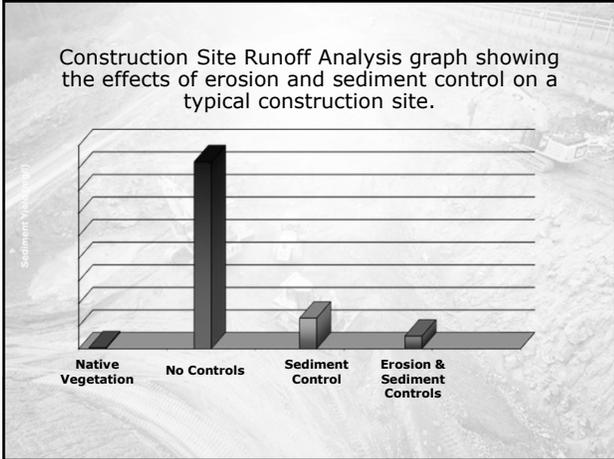
*A side effect of this course is becoming a Certified Erosion and Sediment Control Lead.

23

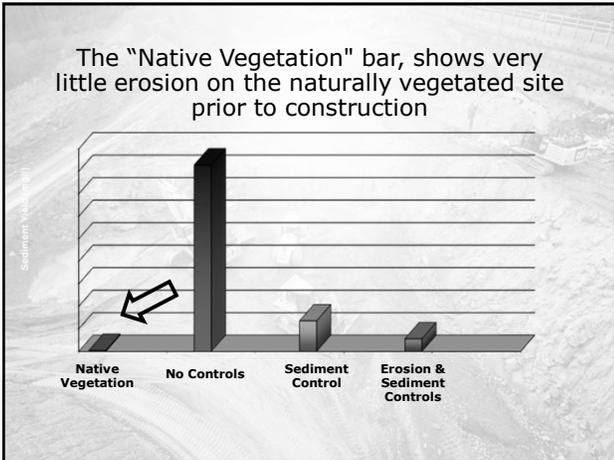
e-ro-sion n.

The group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the earth's surface.

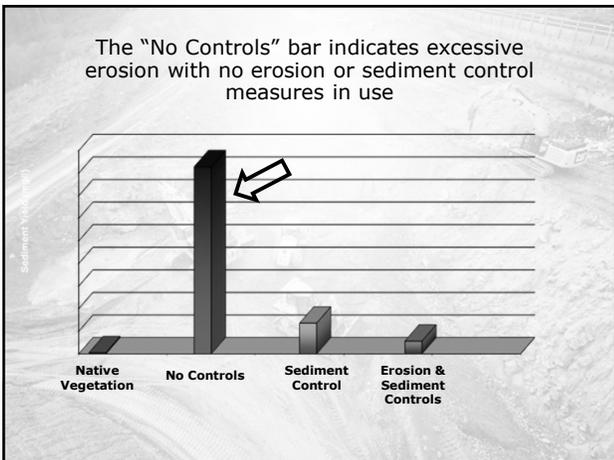
24



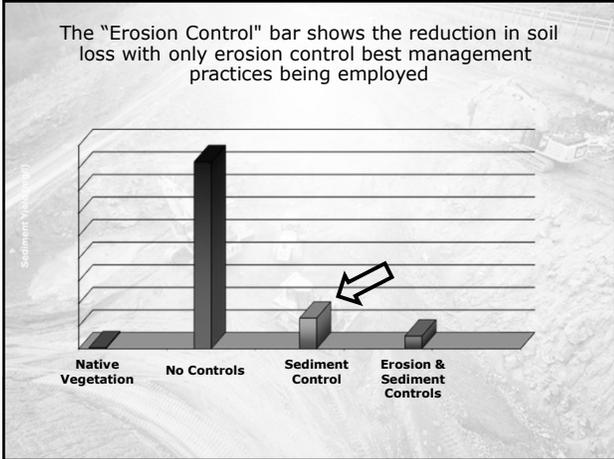
25



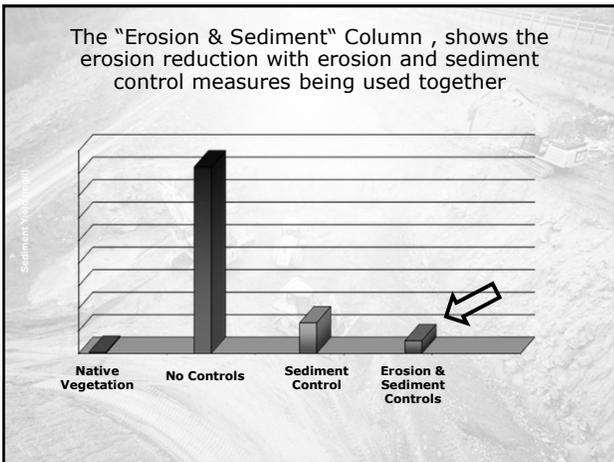
26



27



28



29

Conclusion

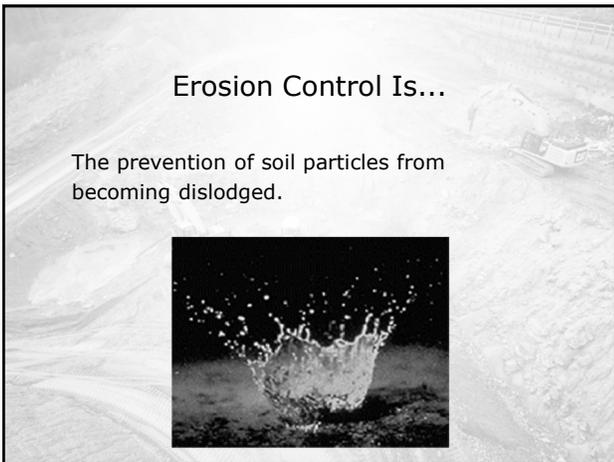
The graphs indicate:

- The benefits of using both erosion & sediment control measures
- The benefits of leaving as much natural vegetation intact as possible during construction.

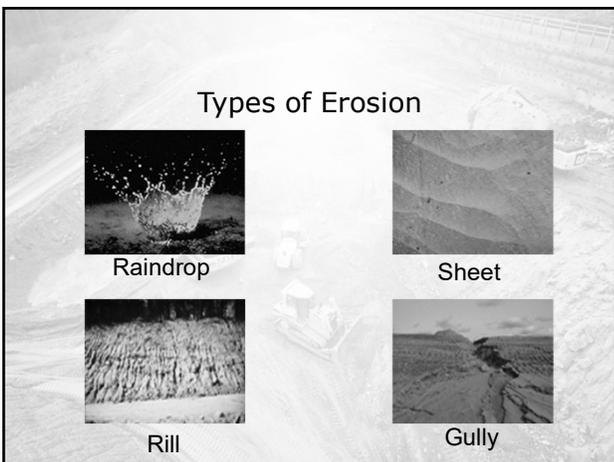
30



31



32



33

Sediment Control Is...

Capturing soil particles that have already become dislodged.



34

Types of Siltation Control



Sediment Pond



Silt Fence



Wattles



Check Dams

35

Is Erosion Potential Science or Guesswork?

Tools of the Trade;
Taking the guess work out.

36

Tools Available to Calculate Erosion Potential:

Revised Universal Soil Loss Equation (RUSLE)

- Calculates soil loss in tons per acre per year.

Rational Method for Computing Peak Runoff

- The rational method for computing peak runoff is used to calculate retention pond size during storm events

Channel Shear Stress $WHG = \text{Shear Stress}$

- Used to determine the type of treatment to use in conveyance channels such as the type of matting or size of rip rap.

These calculations are helpful in determining Volume of retention needed, how long storm water must be held in a retention pond before soil particles can settle and what treatment to use to prevent channel erosion.

37

Revised Universal Soil Loss Equation

Revised Universal Soil Loss Equation (RUSLE)

What does RUSLE tell us?

The revised universal soil loss equation computes the soil loss due to erosion in tons per acre per year.

$A = RKLSCP$ A=tons/acre/year

38

RUSLE Factors

RUSLE $A = RKLSCP$

A= Tons/Acre/Year
 R= Rainfall Factor
 K= Soil Erodibility Factor
 L= Slope Length
 S= Slope Steepness in %
 C= Cover
 P= Practice or Roughness Factor

39

What RUSLE Factors are Controllable?

R= Rainfall Factor (not controllable)

- The rainfall factor is not a controllable factor unless we can choose the time of year that our construction will begin or we can move our project to a different climate.

K= Soil Erodibility factor (controllable)

- Amending your existing soils can affect the soil erodibility factor.

L= Slope length (controllable?)

S= Slope Steepness in % (controllable?)

- Slope length and Steepness of temporary grades during construction should be considered in your erosion and sediment control planning. Final grades, however, are typically not controllable in the field.

40

C= Cover (controllable)

- The cover factor is the most controllable factor in the equations. Cover factor best management practices include: straw mulching, hydroseeding and mulching, and plastic covering.

P= Practice or Roughness Factor (controllable)

- The practice or roughness factor can be improved by leaving the soil surface tracked, instead of smooth.

41

K= Soil Erodibility Factor (controllable)

Using the texture class sand as an example: A 2% increase in organic content results and a 40% decrease in soil erodibility. A 4% increase in organic content results in a 60% decrease in soil erodibility.

NOTE : Organic content is by weight

Texture Class	< 0.5%	2% Organic by wt.	Erosion Reduction	4% Organic by wt.	Erosion Reduction
Sand	0.05	0.03	40%	0.02	60%
Sandy loam	0.27	0.24	11%	0.19	30%
Loam	0.38	0.34	11%	0.29	24%
Silt loam	0.48	0.42	13%	0.33	31%
Silt	0.60	0.52	13%	0.42	30%
Clay loam	0.28	0.25	11%	0.21	25%
Clay	0.25	0.23	8%	0.19	24%

42

Soil Samples

Soil sample results are given in percentages by weight, which is different than by volume.

Soils samples with organic content, which is light indicates

4% by weight = 15-20% by volume

43

C = Cover Factor (Controllable)

Cover measures are employed to protect against surface erosion		C Factor	Erosion Reduction
None (bare or fallow ground)		1.0	
Seeding	< 60 days	.40	60%
	> 60 days	.05	95%
	>365 days	.01	99%
Sod		.01	99%
Mulch	Tons / acre		
Straw / Hay	1.00	0.13	87%
	1.50	0.07	93%
	2.00	0.02	98%
Wood Fiber	1.75	0.10	90%
Woodchips -Hog Fuel	6.00	0.06	94%

44

Even newly planted seed, less than 60 days old, has an erosion reduction of up to 60%.

C = Cover Factor (Controllable)		C Factor	Erosion Reduction
None (fallow ground)		1.0	
Seeding	< 60 days	.40	60%
	> 60 days	.05	95%
	>365 days	.01	99%

45

C = Cover Factor (Controllable)		C Factor	Erosion Reduction
Mulch	Tons / acre		
Straw / Hay	1.00	0.13	87%
	1.50	0.07	93%
	2.00	0.02	98%
Wood Fiber	1.75	0.10	90%
Woodchips -Hog Fuel	6.00	0.06	94%

Hay Mulch – 1 ½ - 2 tons per acre required for coverage

Wood Fiber Hydromulch – Can be used at 4,000 lbs. per acre outside seeding window for winter coverage as a mulching application using wood fiber.

Wood Chips or Hog Fuel – use on site rather than remove

46

P= Practice or Roughness Factor (Controllable)	p	Erosion Reduction
Compact, smooth, scraped with bulldozer or scraper up and down hill	1.3	^30%
Same as above, except raked with bulldozer and root-raked up and down hill	1.2	^20%
Compact, smooth, scraped with bulldozer or scraper across the slope	1.2	^20%
Same as above, except raked with bulldozer and root raked across the slope	0.90	10%
Loose as a disked plow layer	1.00	0%
Rough irregular surface, equipment tracks in all directions	0.90	10%
Loose with rough surface >0.3-m depth	0.80	20%
Loose with smooth surface <0.3-m depth	0.90	10%
Small Sediment Basins	0.50	50%

47

P= Practice or Roughness Factor (Controllable)	P	Erosion Reduction
Compact, smooth, scraped with bulldozer or scraper up and down hill	1.3	^30%
Same as above, except raked with bulldozer and root-raked up and down hill	1.2	^20%
Compact, smooth, scraped with bulldozer or scraper across the slope	1.2	^20%
Same as above, except raked with bulldozer and root raked across the slope	0.90	10%

Compact smooth site (P 1.3) shows an increase of up to 30% in erodibility, Tracked site perpendicular to water flows (P 0.90), a 10% reduction in erodibility.

The more irregular the surface the greater the erodibility reduction.

48

RUSLE Scenario

R= Rainfall Factor = 30
 K= Soil Erodibility factor = Silt
 L= Slope length = 100'
 S= Slope Steepness in % = 33% (3:1 or 3 to 1)
 C= Cover = Fallow (bare)
 P= Practice or Roughness Factor = Smooth

49

RUSLE Scenario

R= Rainfall Factor = 30
 K= Soil Erodibility factor = Silt (.60)
 L= Slope length = 100'
 S= Slope Steepness in % = 33% (.33)
 C= Cover = Fallow (1.0)
 P= Practice or Roughness Factor = Smooth (1.3)

(R)30x(K).60x(L)100x(S).33x(C)1x(P)1.3 (A)

772.2 tons/acre/year

50

RUSLE Scenario

What factors do we have control over that we can change to reduce the amount of soil loss?

(R)30x(K).42x(L)100x(S).33x(C).40x(P).8 =

(A) **133.06 tons/acre/year**

R= Rainfall Factor = 30
 K= Soil Erodibility factor = Silt **amend with 4% organic (.42)**
 L= Slope length = 100'
 S= Slope Steepness in % = 33% (.33)
 C= Cover = **Seeded < 60 days (.40)**
 P= Practice or Roughness Factor = **Tracked (.8)**

51

RUSLE Scenario

A comparison of the two examples shows an **83% reduction in soil loss** by:

- Amending existing soils with 4% organic material
- Tracking and seeding all exposed soils.

A= 772.2 tons/acre/year	A= 133.06 tons/acre/year
Silt	Amend with 4% Organic
Fallow	Newly Seeded
Compact , Smooth	Loose & Tracked

52

Rational Method for Computing Peak Runoff

The rational method of computing peak runoff is used to calculate the size of sediment pond systems for a given area and rainfall event intensity.

Q=CIA

- Q= Peak flow rate
- C= Runoff coefficient
(fraction of rainfall that becomes runoff)
- I=Design event intensity (inches/hour)
- A= Drainage Area (acres)

53

Soil Types & Erosion Potential

Being aware of the different soil types on your project can have a great influence on the erosion and sediment control measures you put in place

- Type A - Well drained sands & gravels
 - *Low erosion or runoff potential*
- Type B - Moderately fine to coarse texture
 - *Moderately low runoff potential*
- Type C - Fine to moderately fine texture
 - *Moderately high runoff potential*
- Type D - Heavy clay soils
 - *Very little infiltration and have a high runoff potential*

54

Runoff Coefficient Numbers by Soil Type and Land Use

Land Use	Soil Type			
	A	B	C	D
Forest Floor	40	60	73	79
Grassland Meadow	40	58	71	78
Residential lots ¼ Acre	61	75	83	87
Residential lots 1 Acre	51	68	79	84
Pasture or Range land	49	69	79	84
Lawns - Parks golf courses etc.	49	69	79	84
Freshly graded bare soil	77	86	91	94
Open bodies of water: wetlands, ponds	100	100	100	100

A land use of forest floor or undisturbed woodland in type "A" soils has 48% less runoff than the same soil type with a land use of bare soil.

55

Runoff Coefficient Numbers by Soil Type and Land Use

Land Use	Soil Type			
	A	B	C	D
Forest Floor	40	60	73	79
Grassland Meadow	40	58	71	78
Residential lots ¼ Acre	61	75	83	87
Residential lots 1 Acre	51	68	79	84
Pasture or Range land	49	69	79	84
Lawns - Parks golf courses etc.	49	69	79	84
Freshly graded bare soil	77	86	91	94
Open bodies of water: wetlands, ponds	100	100	100	100

A forest floor to freshly graded soil comparison for type "D" soils results in a 16% runoff reduction.

56

Rational Method for Computing Peak Runoff

The rational method peak runoff formula computes the peak runoff for a given site and rainfall intensity.

The runoff coefficient shown for type "D" soils is .94.

The coefficient of .94 means, 94% of rainfall on a given area will result in runoff.

Runoff calculations are based on a *design event intensity of a ten year 24-hour storm*; the average storm event in a ten year period in Western Washington & Oregon, .10 inch per hour, 2.4 inches per day.

57

How much stormwater is leaving my site?

Q=CIA

Q= Peak Flow Rate (cfs)

C= Runoff coefficient **Bare Soil Type A =.77**
(Fraction of rainfall that becomes runoff)

I=Design event intensity (inches/hour)
.10 in/hr (average 10 year, 24hr rain event)

A= Drainage Area (acres) 1 acre

58

Q=CIA

(C) .77 - **Type A soil** (I) .10 in/hr (A) 1 acre =
.077 cfs

24 hour event at .10 in/hr (2.4 in) = retention
area of (24 hours) 86400 seconds x .077 cf =
6673 cf

246 cu yds of retention per acre

59

Q=CIA

(C) .94 - **Type D soil** (I) .10 in/hr (A) 1 acre =
.094 cfs

24 hour event at .10 in/hr (2.4 in) = retention
area of (24 hours) 86400 seconds x .094 cf =
8122 cf

300 cu yds of retention per acre

60

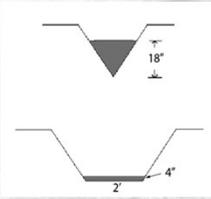
**Shear Stress at 5% grade
"V" shaped vs. flat bottom diversion ditch**

WHG = Shear Stress

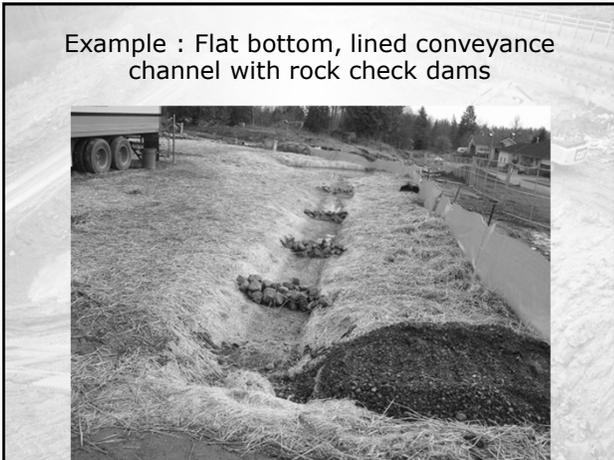
"V" ditch $62.4 \times 1.5 \times 0.05 = 4.68$

Flat ditch $62.4 \times .33 \times 0.05 = 1.03$

78% reduction in Shear Stress



64



65

Shear Stress Treatment Chart

Shear Stress	Treatment
0.01 – 0.04	Non-Cohesive Soil
0.01 – 0.10	Non Compacted Cohesive Soil
0.02 – 0.80	Compacted Cohesive Soil
0.33	Rock 1-inch
0.45	Jute
0.67	Rock 2-inch
0.6 – 1.0	Cut Grass
1.55	Excelsior Wood Mat
2.0 – 3.0	Synthetic or Coconut Mat
2.0	Rock 6-inch
2.1 – 3.7	Uncut Grass
4.0	Rock 12-inch

66

A treatment for the conveyance channel with a shear stress of 3.0 could be either a synthetic or coconut Matting or uncut grass lined swale.

Uncut grass has a higher shear stress than 6" rock.

2.0 – 3.0	Synthetic or Coconut Mat
2.0	Rock 6-inch
2.1 – 3.7	Uncut Grass
4.0	Rock 12-inch

67

Settling Times & Particle Sizes

Size of a sedimentation pond is based on :

- Quantity and duration of rainfall
- Settling times of soil particles

A retention pond should be large enough to hold a designed rainfall event and provide enough area for water flow velocities to slow enough to allow particles to settle.

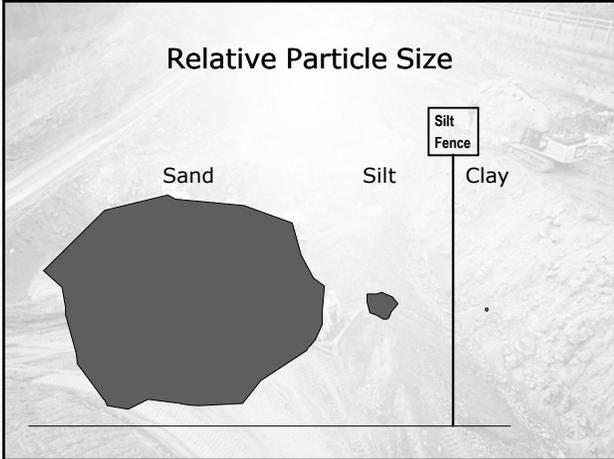
68

Settling Times & Particle Sizes

Sedimentation occurs when:

- The velocity of water slows for a sufficient time to allow particles to settle
- The settling rate is dependent on the soil particle size.

69



70

Settling Rate per particle size

Particle	Size (mm)	Settling Velocity mm/sec	1 Meter Settling Time
Gravel	10.00	1,000	.017 min
Sand	Coarse 0.60	63	.48 min
	Fine 0.15	15	2.01 min.
Silt	0.01	0.154	107 min. – 4.45 hrs
	0.003	0.0138	1206 min – 20.1 hrs
Clay	0.0015	0.0035	4830 min – 3.35 days
	0.0010	0.0015	10,800 min – 7.5 days
	0.0001	0.0000154	1,085,760 min - 754 days

71

Settling Rate per particle size

Particle	Size (mm)	Settling Velocity mm/sec	1 Meter Settling Time
Gravel	10.00	1,000	.017 min
Sand	Coarse 0.60	63	.48 min
	Fine 0.15	15	2.01 min.
Silt	0.01	0.154	107 min. – 4.45 hrs
	0.003	0.0138	1206 min – 20.1 hrs
Clay	0.0015	0.0035	4830 min – 3.35 days
	0.0010	0.0015	10,800 min – 7.5 days
	0.0001	0.0000154	1,085,760 min - 754 days

72

Settling Rate per particle size

Particle	Size (mm)	Settling Velocity mm/sec	1 Meter Settling Time
Gravel	10.00	1,000	.017 min
Sand	0.60	63	48 min
	Fine	0.15	15
Silt	0.01	0.154	107 min. – 4.45 hrs
	0.003	0.0138	1206 min – 20.1 hrs
Clay	0.0015	0.0035	4830 min – 3.35 days
	0.0010	0.0015	10,800 min – 7.5 days
	0.0001	0.0000154	1,085,760 min - 754 days

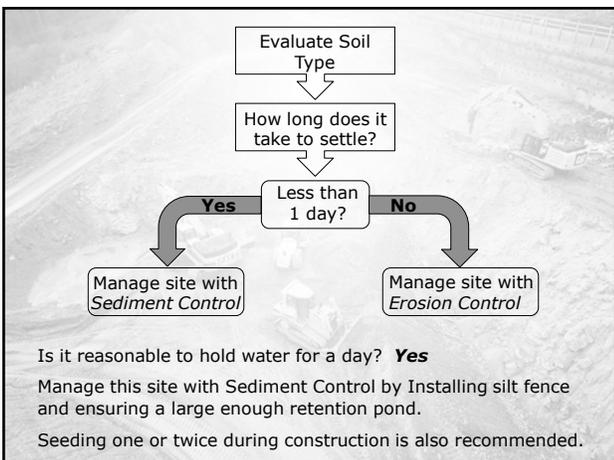
73

Settling Rate per particle size

Particle	Size (mm)	Settling Velocity mm/sec	1 Meter Settling Time
Sand Fine	0.15	15	2.01 min.
Silt	0.003	0.0138	1206 min – 20.1 hrs
Clay	0.0001	0.0000154	1,085,760 min - 754 days

How would you manage a site with silty/sandy soils?
With Erosion Control or Sediment Control?

74



75

How do I know what type of soil I have?

The geo tech report or a soil scientist can tell you what type of soil you have and what the erosion potential on your jobsite is.

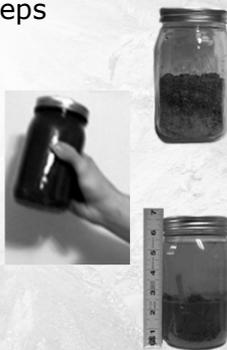
or

A simple way to evaluate erosion potential for a given soil is the jar test.

76

Jar Test Steps

1. Fill a jar half full with soil.
2. Add water and then shake.
3. Place the jar on your desk and note how long it takes to settle.
4. Observe and measure the layers.

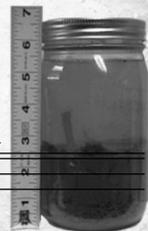


77

Observe and Measure the Layers

0.15" Clay	5%
0.5" Sand	22%
0.5" Silt	22%
1.15" Coarse Sand	51%
2.25" Total	

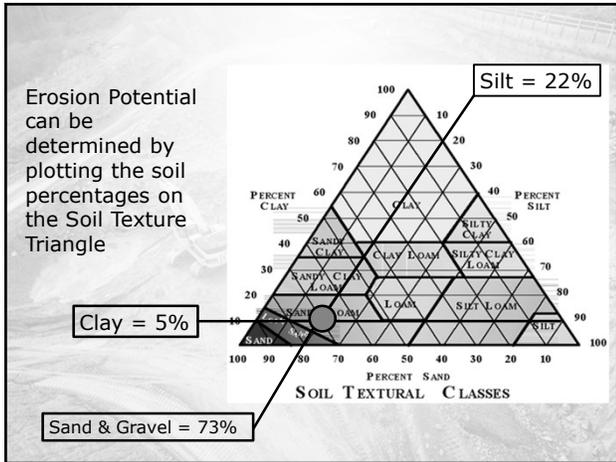
2.25" Total



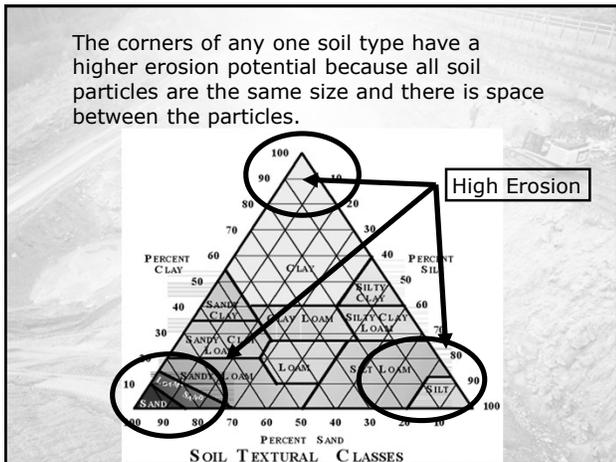
Because the different particles settle at different rates we can get a visual analysis of the soil types.

We can then plot the percentages of the soil types on the Soil Texture Triangle to determine the erodibility of the soil.

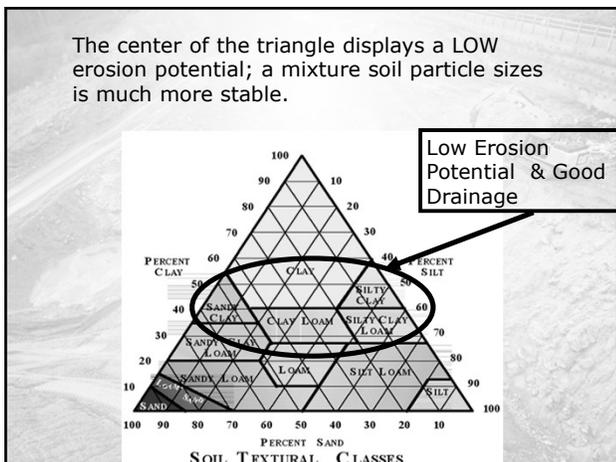
78



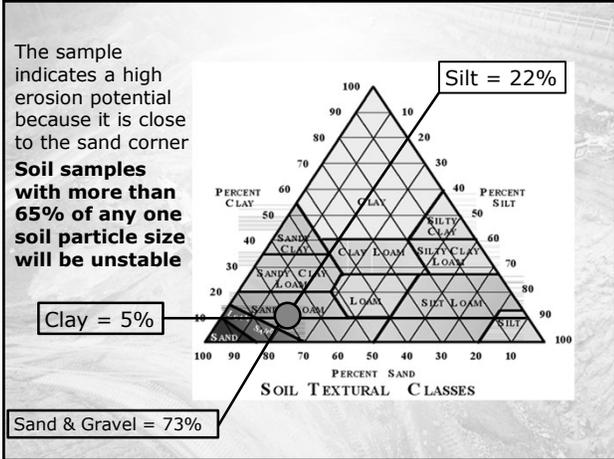
79



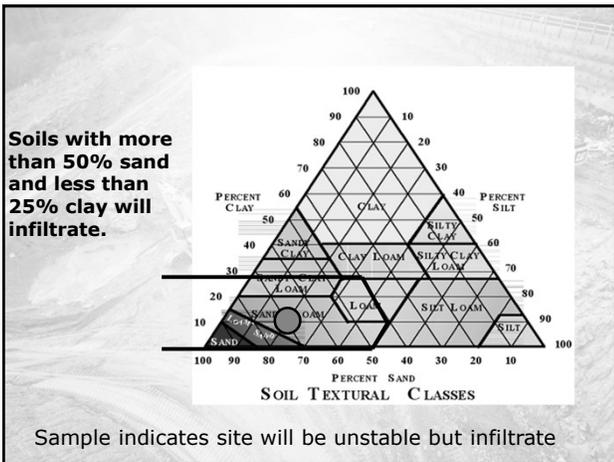
80



81



82



83

Settling Rate Test

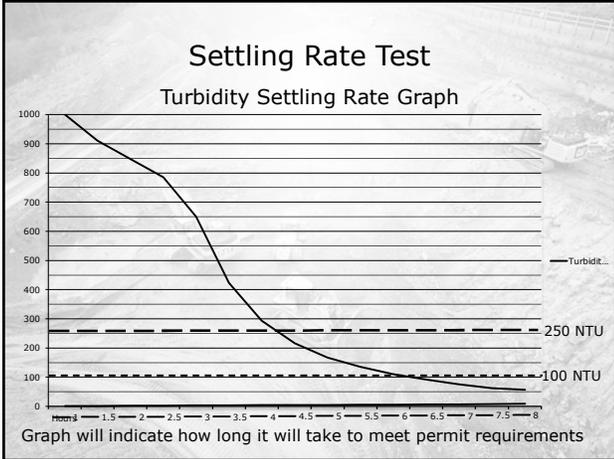
- 1) Perform Jar Test.
- 2) Wait 1 hour for the large particles to settle
- 3) Test for turbidity by meter every hour
- 4) Plot readings on your **Settling Rate Graph**

**Note-* Longer settling times require a larger pond to hold more stormwater, longer.

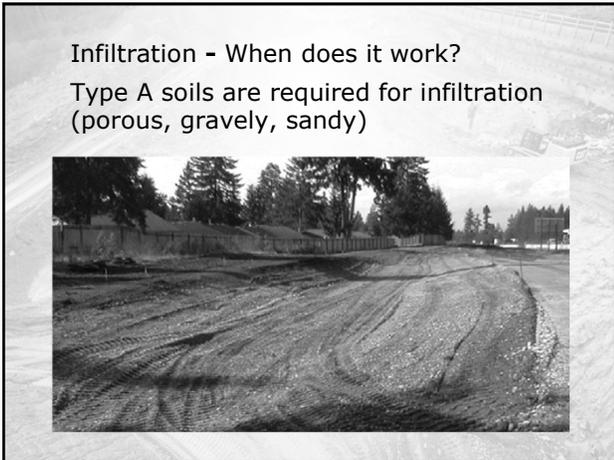
(www.eco-3.com/washington-planning/jobsite-planning)



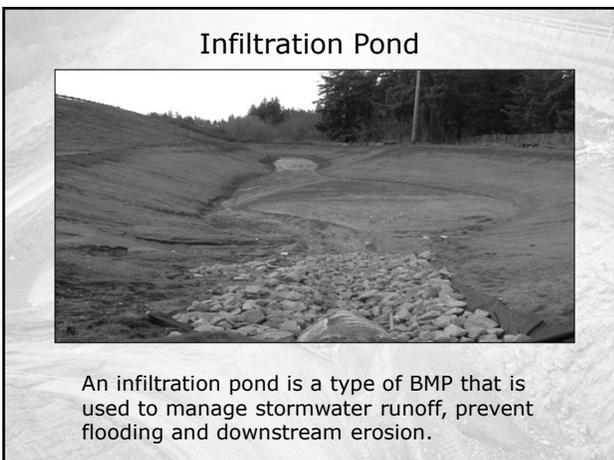
84



85



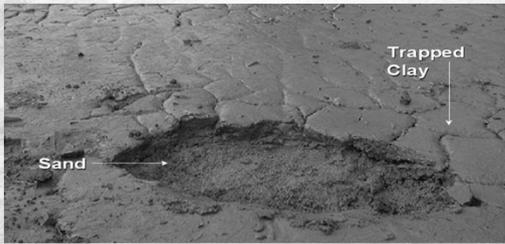
86



87

Infiltration ponds can lose effectiveness if the clay sediment blocks the porous layers.

When this occurs, maintenance is required.



88

Soils that are less porous can be used if there is a forest floor duff layer



89

Agricultural Sprinklers can be used if the lay of the land is uneven



90

Infiltration - Slow and Steady

The amount of water that can be treated can be deceiving

A typical 2 1/2" trash pump at 250 gallons per minute will infiltrate:

- 15,000 gallons/hour
- 360,000 gallons/day

91

Need to Know

- Seed Counts
- Growing Degree Day
- Pure Live Seed (PLS)
- Phosphorus

92

Seed Count

It is not only the cost per pound, but how many seed are you actually getting

Seed	Number of Seeds per #	Cost / #
Winter Rye	18,000	20¢
Ryegrass	250,000	\$1.00
Fine Fescue	350,000	\$1.25
Bluegrass	2,250,000	\$1.50
Bentgrass	6-8,000,000	\$ 5.00

93

Percentage by Weight vs. Seed Count

Percentages on a seed label are by weight, not seed count.

A label that shows a 90% ryegrass, 10% bluegrass blend will result in a stand of grass that is 50/50

Seed	% on label	Number of Seeds per #	Seeds in Mix	% of Stand
Ryegrass	80%	250,000	225,000	50%
Bluegrass	10%	2,250,000	225,000	50%

94

Growing Degree Day (GDD)

A Growing Degree Day (GDD) is a temperature range in which something will germinate and grow.

For grass seed it is 50°F – 80°F

If a grass seed has a germination period of 7 days, that is 7 days between 50°F – 80°F

If the temperature drops to below 50°F for half of the day, that is ½ GDD and it will take 14 days to germinate.

Seed will typically germinate and grow it will just take longer

95

Pure Live Seed (PLS)

PLS is used to specify seeding rates in erosion control applications for certain types of seed; typically collected seed or seed used in Inland Northwest climates, when the germination & purity of the seed are not known until the seed is obtained.

96

Determining Factors

PLS is determined by germination & purity of the seed on the seed label.

A seed with 90% purity & 80% germination yields 72% PLS

Purity x Germination = PLS
 $.90 \times .80 = 72\% \text{ PLS}$

97

Application rate

A specification that indicates 22# PLS means that 100% of 22# has to grow.

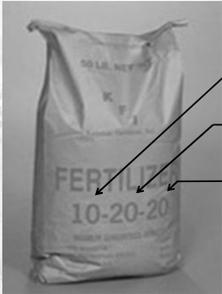
Application rate of Bulk seed is determined by dividing PLS of seed by specified Seed Rate.

(Specified Seed Rate) 22# = 30.55 # Bulk Seed
 (PLS of our seed).72

A specification of 22# PLS requires 30.55 # Bulk Seed to meet specifications

98

What do the numbers on the fertilizer bag mean?



Nitrogen (N)

Phosphate (P)

Potash (K)
(Potassium)

99

The numbers indicate the percentage of what is in the bag



10% N	5# N
20% P x 50# bag =	10# P
20% K	10# K

100

Phosphorus Considerations

You may be asked to develop a phosphorus mitigation plan if your site discharges to a 303d body of water listed for phosphorus.

Your plan would be a **more aggressive erosion control** to prevent sediment transfer, preventing the phosphorus present in the soil from entering your discharge. The use of a **low phosphorus fertilizer** would also be applicable.

ODOT Standard Specs:01030.14 Fertilizer
 (b) Type of Fertilizer
 (3) Statewide, Near Water - For application within 50 feet of open water, furnish **22-2-11 low-phosphorus fertilizer analyzing 22% nitrogen, 2% phosphorus, and 11% potassium ...**

101

Restrictions on Fertilizers Containing Phosphorous in Washington State

On April 15, 2011 ESHB 1489 (RCW 15.54.500) was signed into law which, with **prohibits the display and retail sale of turf fertilizers that contain phosphorous,** and the use of such fertilizers on turf with **some exemptions...**

The law became effective on January 1, 2013

102

Exemptions:

- Establishment of grass or repair of damaged grass during the growing season in which the grass is established.
- Pasture
- Interior house plants & Flower and vegetable gardens
- Grass grown for sod
- Agricultural production & Silvicultural production
- Use on soil that is deficient in plant available phosphorous as determined by a soil test within the last 36 months.

103