Reclamation Success Criteria

Highway Construction Projects in Colorado

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WE RAN SOME SAMPLES BACK AT THE LAB... IT'S DIRT ALRIGHT.
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CDOT Objectives

- Self sustaining ecological plant community
- Low maintenance vegetation
- 70% cover of suitable vegetation to terminate CDPHE SWMP permits as quickly as possible

Research Goals

- Identify and test a series of revegetation variables that upon utilization will reduce the revegetation/ stabilization time necessary to deactivate the CDPHE Construction Stormwater Permit
- Reduce the CDOT financial and professional resources for stabilization management
- Identify practices that can be of immediate use to CDOT statewide
- Reduce CDOT overall construction stormwater risk and liability

Project Overview (Phase I)

- Literature Review
  - Identification of Key Variables
  - 100+ variables were identified
    - Pre-Con Meetings (Process)
    - Soil Chemistry Seed Mix Designs (Technical)
- Review of DOT Specifications
  - Colorado – “Green Book”
  - Nebraska
  - Wyoming
  - Kansas
  - New Mexico
  - Utah
  - California

Outcome of Phase I (Literature Review)

- Topsoil
  - Depth
  - Quality
- Erosion Control
  - Topsoil Protection
  - Improve communication with all involved
- Soil Amendments
  - Correct Amount
  - Correct Type
  - Site Specific

Outcome of Phase I (DOTs)

- **Drought conditions impact reclamation success**
  - **Irrigation not an option**
- Need additional resources to watch contractors during critical times such as planting and plant establishment
  - Specification compliance is a problem
- Some DOTs are doing small research projects on soil amendments such a bio-sol
  - More observational than quantitative
- Certification or prequalification of revegetation contractors would be advantageous to revegetation success
- **Native plants take longer to establish than non-natives**
  - **Adds to the long term cost and permit-revegetation duration**
- Difficult to coordinate and plan revegetation expectations during the planning process
- High risk revegetation contractors are known and monitored whenever possible in the field
- Hard to make Contractors responsible for complete and successful site revegetation due to contracting constraints
- **Very few DOTs use soil testing before construction to assess amendment needs**
  - **Recognize the need for soil testing; some are uncertain about the soil testing methodology**
- There needs to be better communication with herbicide sprayers who impact revegetation growth

Outcome of Phase I (CDOT)

- **Contractors are not following Specifications**
- Lack of available resources to monitoring contractors during revegetation
- There is no real identified responsibility in the field to coordinate, oversee and monitor the Contractor during actual soil preparation, seeding and vegetative establishment before handing off the project to CDOT Maintenance
- **Needs revegetation training for the Engineers and/or Regional WPCMs**
- **Seed mixture too broad and not project, eco-zone specific**
- Inconsistencies on how percent vegetative cover is calculated before and after construction to achieve 70% vegetative cover
- **Better site specific reclamation plans developed within the SWMP developed by the Contractor**
- Contractor escrow fund should be considered to ensure revegetation occurs before departure from the project
- **Revegetation an afterthought by Contractors and some Project Engineers who are anxious to move onto the next project**

Phase I Conclusions

- **Develop 1-2 training modules on effective revegetation techniques**
- **Direct oversight and confirmation of the contractor revegetation activities especially during certain critical times**
  - **Seeding**
  - **Mulching**
  - **Seedbed Prep**
- **Early involvement of contractor regarding the proposed revegetation plan**
- **CDOT representative present during seeding to direct and answer questions from the contractor**
- **CDOT should consider having a revegetation certification process in which only qualified contractors can be used on CDOT projects.**
- **Consistent interpretation, understanding and measurement of the percent ground cover;**
  - **Overestimation of background vegetation may be occurring**
- **Revegetation process should be monitored at least annually.**
- **High risk revegetation contractors should be identified and closely monitored.**

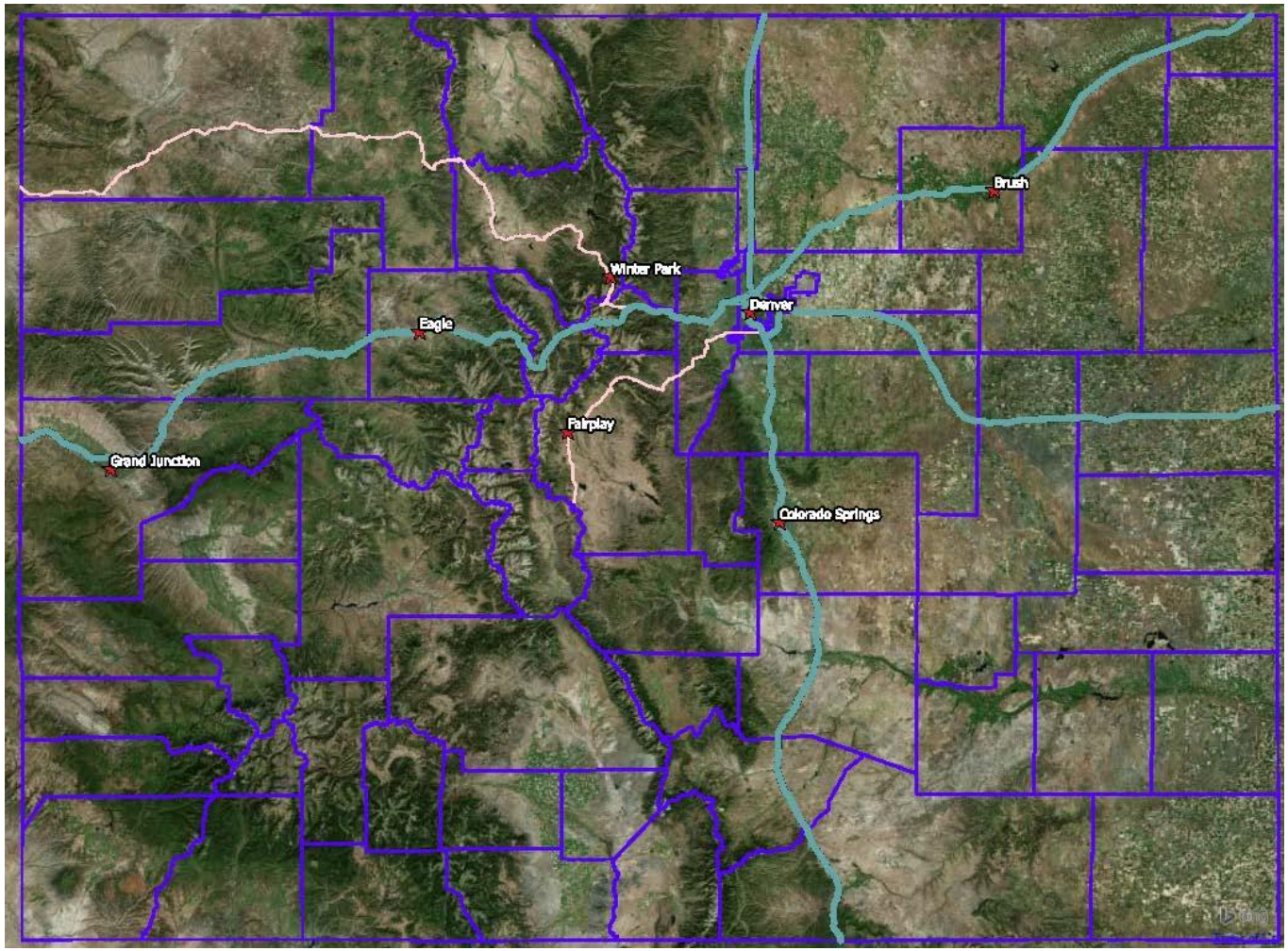
Phase I Conclusions

- Provide financial incentives to contractors to achieve 70% vegetative cover
- **Proper topsoil management is important**
- **Eco-zones should be evaluated and seed selection should be based upon those site characteristics**
- Identify creative contract vehicles or mechanisms
- Give the designer the opportunity to customize the revegetation process.
  - Stay away from boiler plate solutions as much as possible.
- Allow for the application of alternative revegetation practices
  - Imprinting
  - Custom soil amendments for challenging sites.
- **Have topsoil sampling, analysis and planning as a requirement in plans or specifications**
- **Use Certified Professional Soil Scientist.**
- Conduct periodic monitoring of seedling density and plant establishment
- **Seed mix design inspection**

Project Overview (Phase II)

- QA/QC Site Inspections
  - I-25 Colorado Springs – Southern Front Range
  - I-225 Denver – Metro Denver
  - I-76 Sterling – Eastern Plains
  - I-70 Eagle – Mountains
- Salvage Soil Testing and Analysis
- Forensic Study – Starts Tomorrow
  - Berthoud Pass
  - **Hwy 285**
  - Woodman Interchange
  - TREX @ University
  - Lone Tree and I-25

Project Locations



Phase II QA/QC Evaluations

- Project Engineer Changing Specifications
  - Removal of Soil Amendments
  - Changing Seeding Methods
  - Topsoil Salvage
- Seed Mix Design
  - Seed Mixtures
  - Seed Rates
- Baseline Vegetation Surveys
  - Not Performed
  - Not Documented
- Training
  - “Don’t know what I am looking at”

Compaction?

How much is enough?

Topsoil?

Seed Mixes

Common Name	Scientific Name	Seeding rate (# PLS/acre)	PLS/sq ft	% OF MIX
Blue grama	Bouteloua gracilis	2.0	38	18%
Western Wheatgrass	Pascopyrum smithii	6.0	15	7%
Sideoats Grama	Bouteloua curtipendula	3.0	13	6%
Little Bluestem	Schizachyrium scoparium	4.0	24	11%
Green Needlegrass	Nassella viridula	3.0	12	6%
Switchgrass	Panicum virgatum	4.0	36	17%
Prairie Junegrass	Koeleria macrantha	0.2	11	5%
Galletta	Pleuraphis jamesii	5.0	18	9%
Sand Dropseed	Sporobolus cryptandrus	0.1	12	6%
Upright prairie coneflower	Ratibida columnifera	0.5	29	14%
Blanket Flower	Gaillardia aristata	1.0	3	1%
Oats	Avena Sativa	3.0	1	0%
Total	--	**31.8**	**212**	**100%**

Common Name	Scientific Name	Seeding rate (# PLS/acre)	PLS/sq ft
Western Wheatgrass	Pascopyrum smithii	4.0	10
Sideoats Grama	Bouteloua curtipendula	2.0	9
Blue grama	Bouteloua gracilis	1.2	23
Little Bluestem	Schizachyrium scoparium	1.5	9
Prairie Junegrass	Koeleria macrantha	0.1	5
Thiskspike Wheatgrass	Elymus lanceolatus	3.0	11
Prairie Sandreed	Calamovilfa longifolia	3.0	19
Sand Dropseed	Sporobolus cryptandrus	0.1	12
Oats	Avena Sativa	3.0	1
Upright prairie coneflower	Ratibida columnifera	0.3	5
Purple prairie clover	Dalea purpureum	0.5	2
Blanket Flower	Gaillardia arustata	1.0	3
Lewis flax	Linum lewisii	0.5	3
Total	--	**20.2**	**112**

Common Name	Scientific Name	Seeding rate (# PLS/acre)	PLS/sq ft	% OF MIX
Mountain brome	Bromus marginatus	8.0	17	8%
Slender Wheatgrass	Elymus trachycaulus	6.0	22	11%
Tall Fescue	Festuca arundinacea	3.0	16	8%
Western Wheatgrass	Pascopyrum smithii	8.0	20	10%
Sandbergs Bluegrass	Poa secunda	2.0	42	22%
Alkali sacatons	Sporobolus airoides	2.0	80	41%
Total	--	**29.0**	**197.1**	**100%**

Pre-Disturbance Vegetation

What is 70%

Site A

Salvage Technique	Depth	pH	EC	Sol. Ca	Sol. Mg	Sol. Na	SAR	NO3-N	NH4-N	Inorganic N	Bray P-1	Exch. K
	inches	S.U.	dS/m	meq/L			--	mg/kg				
Uniform	0-6	6.8	0.19	0.70	0.33	0.35	0.5	1.8	7.3	9.1	1.2	127
Field	0-14	6.7	0.24	1.05	0.50	0.30	0.3	3.6	7.1	10.7	1.3	114
NRCS	0-16	6.4	0.34	1.45	0.40	0.48	0.5	2.6	6.6	9.2	0.8	91
No Salvage	0-18	6.9	0.30	1.60	0.67	0.43	0.4	2.6	6.9	9.5	0.4	71
Topsoil	Pile	6.2	0.20	0.80	0.33	0.39	0.5	5.3	4.9	10.2	1.5	54

Salvage Technique	Depth	Exch. Ca	Exch. Mg	Exch. Na	SO4-S	OM	Sand	Silt	Clay	Texture
	inches	meq/100 g			mg/kg	%				--
Uniform	0-6	4.65	1.01	0.03	7	1.7	72	16	12	Sandy Loam
Field	0-14	4.47	0.94	0.02	8	1.6	68	22	10	Sandy Loam
NRCS	0-16	4.81	1.02	0.04	2	1.6	68	22	10	Sandy Loam
No Salvage	0-18	4.45	0.93	0.03	8	1.2	72	18	10	Sandy Loam
Topsoil	Pile	4.35	0.94	0.04	5	0.8	76	12	12	Sandy Loam

Site B

Salvage Technique	Depth inches	pH S.U.	EC dS/m	Sol. Ca meq/L	Sol. Mg meq/L	Sol. Na meq/L	SAR --	NO3-N mg/kg	NH4-N mg/kg	Inorganic N mg/kg	M3 - P mg/kg	Exch. K mg/kg
Uniform	0-6	6.6	0.17	0.55	0.33	0.39	0.6	2.9	2.0	4.9	34	213
Imported	Sur	7.6	1.55	7.90	3.17	4.35	1.9	26	2.5	29	48	181
No Salvage	0-18	7.7	0.37	2.50	0.92	0.26	0.2	3.2	2.6	5.8	59	192
Topsoil	Berm	7.4	0.42	1.75	1.17	0.61	0.5	14	3.5	18	110	140

Salvage Technique	Depth inches	Exch. Ca meq/100 g	Exch. Mg meq/100 g	Exch. Na meq/100 g	SO4-S mg/kg	OM %	Sand %	Silt %	Clay %	Texture --
Uniform	0-6	4.41	1.38	0.03	15	1.3	76	16	8	Sandy Loam
Imported	Sur	17.42	2.83	0.37	40	0.4	68	15	17	Sandy Loam
No Salvage	0-18	5.98	1.18	0.02	10	0.9	81	11	8	Loamy Sand
Topsoil	Berm	3.52	1.28	0.05	16	1.0	84	10	6	Loamy Sand

How Much?

Conclusions

Process is Important

Seed mix could be impacting success

Know what your Importing

Forensics study help verify/modify finding to date

Questions ?