EVALUATION OF VEGETATION ESTABLISHMENT ALONG THE S3 SECTION OF THE SDS PIPELINE ROUTE IN PUEBLO COUNTY, COLORADO: THIRD REPORT

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INTRODUCTION

This report presents the results of the third field evaluation of the S3 section of the SDS Pipeline Route located in Pueblo County. Field observations were made on September 12, 2013. Field work consisted of walking most of the S3 section of the SDS Pipeline Route in Pueblo County.

RESULTS

The overall purpose of the 2013 vegetation observations along the SDS Pipeline route in Pueblo County was to evaluate the status of the reclamation of the disturbances caused by the installation of the water pipe line. Observations made in late April (2013) revealed that only a few seedlings had become established, and mostly these were along parts of the S3 portion that had been irrigated, at least to some degree, in the fall of 2012. Drought conditions during the winter of 2012 and spring of 2013 had apparently limited germination and seedling development. Once irrigation began in late spring and early summer, more seedlings became apparent. In late July, seedling density evaluations were conducted in the various soil types that occur along the SDS route. As of July 24th seedling establishment showed uneven patterns along the S3 section of the pipeline, apparently primarily in response to differences in irrigation and, to some degree, soil type. The part of the S3 portion located north of Antelope showed better vegetation development than other parts of the S3 portion.

The primary purpose of the September field trip was to assess the status of vegetation development along the S3 portion of the SDS water pipeline with regard to any additional seedling establishment that may have occurred after late July and to evaluate the growth of plants that were noted during the July field trip.

General Observations

Following the July 2013 field trip, there were several major precipitation events that occurred along the SDS S3 section of the pipeline. Heavy rainfall and run-off along the pipeline route itself and from adjacent properties caused notable erosion, especially on the southern part of the S3 right-of-way. In some places, the erosion created rills and small gullies. In other places, sheet wash erosion washed the soil, seeds and seedlings off the right-of-way. At some sites, the water appeared to have been at least one foot deep (along drainage ways). These events also resulted in increased soil moisture, over and above what was being provided by irrigation along the route. The increased soil moisture was favorable for additional seeding germination as well as for enhanced establishment of already germinated seedlings in places where there was little or no erosion.

Much of the obvious erosion occurred in the southern part of the S3 route, especially in the Limon and Holt soils. Some repair work will be needed in this section. It may be possible to work around sites with good vegetation development and repair only the areas with erosion problems.

Seedling Density. In response to the additional moisture, more seedlings were noted in September compared with July. Also, there had been considerable growth of the plants that were already established in July. Seedling density and vegetation development was good on most of the soil types. The least successful vegetation development occurred on the Midway Shale/Shingle soil type. Also, as noted above, few seedlings were noted on the eroded surfaces.

Species Diversity. One of the expectations of the reclamation design was that by careful handling and placement of topsoil salvaged from the right-of-way, diverse plant communities would develop from the seeds present in the soil. Field observations suggest that this has occurred. In all, 73 species were observed along the S3 route (Table 1) in September and over the three field trips 103 species were noted. Many of these species were observed in the area prior to installation of the water line and others were included in the seed mix.

Weed Species. Noxious weed species occur to only a limited extent along the S3 section. Halogeton *(Halogeton glomeratus)* (a List C species on the Colorado Weed List) was commonly seen along the southern part of the S3 section of the pipeline route. The species occurs in the adjacent non-disturbed areas and seeds were likely present in the salvaged topsoil. This species should be controlled in order to reduce its abundance. Canada thistle *(Cirsium arvense)* and field bindweed *(Convolvulus arvensis)* were noted along the route, but they are widely scattered.

Vegetation Development. One of the primary concerns regarding vegetation establishment along the S3 route is whether or not the vegetation performance standards will be met within two years. Concern for the drought conditions that have characterized southern Colorado for the past several years influenced the design of the revegetation project relative to the installation of an irrigation system along the entire length of the S3 route. Irrigation along with natural precipitation provided adequate soil moisture for germination and establishment of the seeded species as well as species that

were present in the salvaged topsoil. Several examples of vegetation development are presented in Photos 1-8 on the following pages. Photographs from April show very little vegetation development. The corresponding photographs from September show the degree to which vegetation has become established. Field observations suggest that the vegetation cover values for all species would show that the performance standards may have been reached in many parts of the S3 route. However, much of the vegetation cover was provided by annual species. Major annual species included Russian thistle *(Salsola collina* and *Salsola australis)*, cowpen daisy *(Ximenesia enceliodes)*, pigweed species *(Amaranthus spp.*), goosefoot species *(Chenopodium spp.)* and fetid marigold *(Dyssodia aurea)*. One perennial forb that was not included in the seed mix, showy vervain *(Glandularia bipinnitifida)*, was also commonly encountered. All of the seeded grass species were encountered. The most common of the seeded grasses included blue grama *(Chondrosum gracile)*, side-oats grama *(Bouteloua curtipendula)*, sand dropseed *(Sporobolus cryptandrus)*, alkali sacaton *(Sporobolus airoides)*, western wheatgrass *(Pascopyrum smithii)* and galleta grass *(Hilaria [Pleuraphis] jamesii)*. In most places, vegetation cover by the annual broad-leaved species was greater than the cover by the seeded species. In order for the cover performance standard to be met, at least half of the vegetation cover needs to be provided by the seeded species.

Based on the 2013 field observations, it is likely that the performance standard can be met in 2014 in most of the area. Areas where revegetation repair work is undertaken will not likely meet the standards in 2014, since these areas will be in only their first growing season, and the conditions will be comparable to what was observed in 2013. Also, vegetation may be sparse in the Midway Shale/Shingle soil type where establishment of seeded species was limited.

Service Road. The service road located along the west side of the S3 section on the Walker Property was seeded in spring 2013. Some seedling development was noted, but on-going use of the road has limited vegetation establishment. Once repair work is completed along the S3 section, the access road should be disked and re-seeded.

Table 1. List of Species Observed along the S3 Section of the SDS Pipeline in Pueblo County. "(?)" indicates uncertain identification.

Scientific Name	Common Name	Observation Date		
		04/30/13	7/24/2013 7/25/2013	09/12/13
COOL SEASON PERENNIAL GRASSES				
Agropyron trachycaulum	Slender Wheatgrass		x	x
Aristida purpurea	Three-awn			x
Pascopyrum smithii	Western Wheatgrass	x	x	x
Puccinellia airoides	Alkali Grass			x
Sitanion longifolium	Squirreltail Grass		x	
WARM SEASON PERENNIAL GRASSES				
Bouteloua curtipendula	Side-oats Grama	x	x	x
Buchloe dactyloides	Buffalo Grass			x
Chondrosum gracile	Blue Grama	x	x	x
Hilaria (Pleuraphis) jamesii	Galleta Grass		x	x
Muhlenbergia asperifolia	Alkali Muhly			x
Sporobolus airoides	Alkali Sacaton		x	x
Sporobolus cryptandrus	Sand Dropseed		x	x
ANNUAL GRASSES				
Bromus japonicus	Japanese Brome		x	
Bromus tectorum	Cheatgrass		x	x
Chloris verticillata	Windmill Grass			x
Digitaria sanguinalis	Crab Grass		x	x
Echinochloa crus-galli	Barnyard Grass		x	x
Eragrostis cilianensis	Lovegrass			x
Munroa squarrosa	False Buffalo Grass		x	x
Panicum capillare	Witchgrass		x	x
Setaria sp.	Foxtail			x
Setaria viridis	Green Foxtail		x	x
NATIVE PERENNIAL FORBS				
Argemone polyanthemos	Prickly Poppy		x	
Asclepias subverticillata	Milkweed		x	x
Astragalus bisulcatus	Two-grooved Milkvetch	x	x	
Astragalus sp.	Milkvetch	x	x	x
Cirsium undulatum	Thistle	x	x	

Table 1. (Continued) List of Species Observed along the S3 Section of the SDS Pipeline in Pueblo County. "(?)" indicates uncertain identification.

Scientific Name	Common Name	Observation Date		
		04/30/13	7/24/2013 7/25/2013	09/12/13
Erigeron strigosus (?)	Daisy Fleabane		x	
Eriogonum sp.	Buckwheat		x	
Euphorbia marginata (?)	Snow-on-the-Mountain		x	
Evolvulus nuttallianus	Evolvulus		x	
Gaillardia aristata	Blanket Flower		x	
Glandularia bipinnatifida	Showy Vervain	x	x	x
Grindelia squarrosa	Curlycup Gumweed		x	x
Heterotheca villosa	Golden Aster		x	
Lesquerella sp.	Bladderpod	x		
Linum lewisii	Blue Flax		x	
Lomatium orientale (?)	Biscuitroot	x		
Physalis hederifolia	Ground Cherry			x
Physaria sp.	Double Bladderpod			x
Picradeniopsis oppositifolia	Bahia		x	
Polanisia dodecandra	Clammy Weed		x	
Psoralea lanceolata	Scurfpea		x	x
Sphaeralcea angustifolia	Globe Mallow			x
Sphaeralcea coccinea	Scarlet Globemallow	x	x	x
Stephanomeria pauciflora	Wire Lettuce		x	
Zinnia grandiflora	Zinnia		x	x
INTRODUCED PERENNIAL FORBS				
Convolvulus arvensis	Field Bindweed		x	
Cirsium (Breea) arvense	Canada Thistle		x	x
Malva neglecta	Cheeseweed		x	x
Rumex crispus	Curly Dock			x
Trifolium pratense	Red Clover		x	x
NATIVE ANNUAL/BIENNIAL FORBS				
Amaranthus arenicola	Pigweed			x
Artemisia dracunculus	False Tarragon		x	
Chamaesyce glyptosperma	Spurge		x	x
Chamaesyce stictospora	Spurge		x	
Chenopodium leptophyllum	Narrowleaved Goosefoot	x	x	
Cryptantha sp.	Cryptantha		x	

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Scientific Name	Common Name	Observation Date		
		04/30/13	7/24/2013 7/25/2013	09/12/13
Descurainia pinnata	Tansy Mustard		x	x
Dyssodia aurea	Fetid Marigold	x	x	x
Dyssodia papposa	Fetid Marigold			x
Lappula redowskii	Stickseed		x	
Lepidium densiflorum	Peppergrass		x	x
Machaeranthera sp.	Machaeranthera			x
Nuttallia decapetala	White Evening Star		x	x
Plantago patagonica	Woolly Plantain		x	
Suaeda sp.	Sea-Blite			x
Tripterocalyx micranthus	Sand Verbena		x	
INTRODUCED ANNUAL/BIENNIAL FORBS				
Amaranthus albus	White Pigweed		x	x
Amaranthus graecizans	Pigweed		x	
Amaranthus retroflexus	Pigweed		x	x
Artemisia biennis	Biennial Wormwood		x	
Carduus nutans	Musk Thistle			x
Chamaesyce serpyllifolia	Spurge			x
Chenopodium sp.	Goosefoot	x	x	x
Conyza canadensis	Horseweed			x
Descurainia sp.	Tansy Mustard	x		
Erodium cicutarium	Filaree			x
Erysimum repandum	Wallflower		x	
Halogeton glomeratus	Halogeton		x	x
Helianthus annuus	Annual Sunflower			x
Hibiscus trionum	Flower-of-the-Hour			x
Kochia scoparia (Bassia sieversiana)	Kochia		x	x
Lactuca serriola	Prickly Lettuce			x
Melilotus alba	White Sweetclover		x	
Melilotus officinalis	Yellow Sweetclover		x	x
Portulaca oleracea	Purslane		x	x
Quincula lobata	Chinese Lantern		x	x
Salsola australis	Russian Thistle		x	x
Salsola collina	Russian Thistle		x	x
Solanum physalifolium	Nightshade			x

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Scientific Name	Common Name	Observation Date		
		04/30/13	7/24/2013 7/25/2013	09/12/13
Solanum rostratum	Buffalo Bur		x	x
Solanum triflorum	Nightshade		x	x
Tribulus terrestris	Caltrop			x
Verbena bracteata	Creeping Charlie		x	x
Ximenesia encelioides	Cowpen Daisy		x	x
Xanthium strumarium	Cocklebur			x
SHRUBS/TREES				
Atriplex canescens	Four-wing Saltbush	x	x	x
Atriplex confertifolia	Shadscale			x
Populus sargentii	Plains Cottonwood			x
CACTI AND SUCCULENTS				
Cylindropuntia imbricata	Cholla		x	x
Opuntia polyacantha	Plains Prickly-pear Cactus	x	x	x
Yucca glauca	Spanish Bayonet	x	x	x
		17	73	73

Photo 1. Southern end of the S3 section of the SDS pipeline. April 30, 2013.

Photo 2. Southern end of the S3 section of the SDS pipeline. September 12, 2013. Photo was taken near the location shown in Photo 1.

Photo 3. Small drainage with erosion control netting near Southern end of the S3 section of the SDS pipeline. April 30, 2013.

Photo 4. Small drainage with erosion control netting near Southern end of the S3 section of the SDS pipeline. September 12, 2013. Approximately the same location as Photo 3.

Photo 5. Central part of the S3 section of the SDS pipeline (looking north). April 30, 2013.

Photo 6. Central part of the S3 section of the SDS pipeline (looking north). September 12, 2013. Photo taken near the location shown in Photo 5.

Photo 7. Erosion control netting installed at the Steel Hollow Crossing point along the S3 section of the SDS pipeline (looking southeast). April 30, 2013.

Photo 8. Vegetation growth on erosion control netting installed at the Steel Hollow Crossing point along the S3 section of the SDS pipeline (looking southeast). September 12, 2013.