APPENDIX K
2013 AVF VEGETATION REPORT

BASELINE REPORT 325A – APPENDIX K

BASELINE MONITORING OF AVF VEGETATION

OTTER CREEK COAL PROJECT

POWDER RIVER COUNTY, MONTANA

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1.0 INTRODUCTION

A Plan of Study (POS) for baseline monitoring of AVF vegetation on Otter Creek was developed following April-May, 2013 conversations with Montana Department of Environmental Quality (MDEQ). The POS was designed to provide data suitable to describe existing vegetation resources in and adjacent to Otter Creek AVF areas, with the following goals:

1) Design representative transects across AVF areas at approximately one-mile intervals along mainstem Otter Creek. Transects were placed roughly perpendicular to the general direction of drainage, and located near existing AVF well batteries where available. Transect locations (Figure 1) were recorded with a sub-meter GPS device.
2) Select 3 to 5 sampling sites along each transect (depending on variations in hydrology and vegetation characteristics along the transect), where collection of vegetation production data (clip plots) could be accomplished concurrently with collection of soils profile data and hydrology data (piezometers and AVF wells). This allows direct correlations of various sample parameters in and out of the floodplain among the three disciplines, for instance root mass, rooting depth and above-ground production each in relation to depth to alluvial water, among numerous other comparisons. Each sampling site was also recorded by sub-meter GPS (Figure 1).
3) Use the direct data correlations to determine the relative significance of AVF functions to vegetation production (hay crop yield).

The selection of four cross-section transects, collectively comprising 16 sample site locations, was accomplished during a site visit with MDEQ personnel on June 26, 2014. The field inventory (quantitative sampling) of the AVF study area was conducted June 26-29, 2013 by Ken Scow, Drake Barton, Ed Darfler and Kathy Lloyd. Data analysis and report preparation were conducted by Ken Scow and Nancy Horn, with computer graphics by Dan Culwell.

2.0 METHODS

2.1 MAPPING DELINEATION

Vegetation resources of the AVF study area were earlier mapped (February 2012) on color ortho-photos (1 inch = 500 feet scale), based primarily on land use and land form definitions pertaining to alluvial valley floors, presented in ARM 17.24.301. These maps were used, in conjunction with baseline hydrology modeling and baseline vegetation and soils information, to assist in selecting transect placement for the AVF baseline monitoring inventory. Conceptual placement of transects was deliberated in the field in participation with MDEQ personnel, and modified as necessary to optimize data collection efforts.

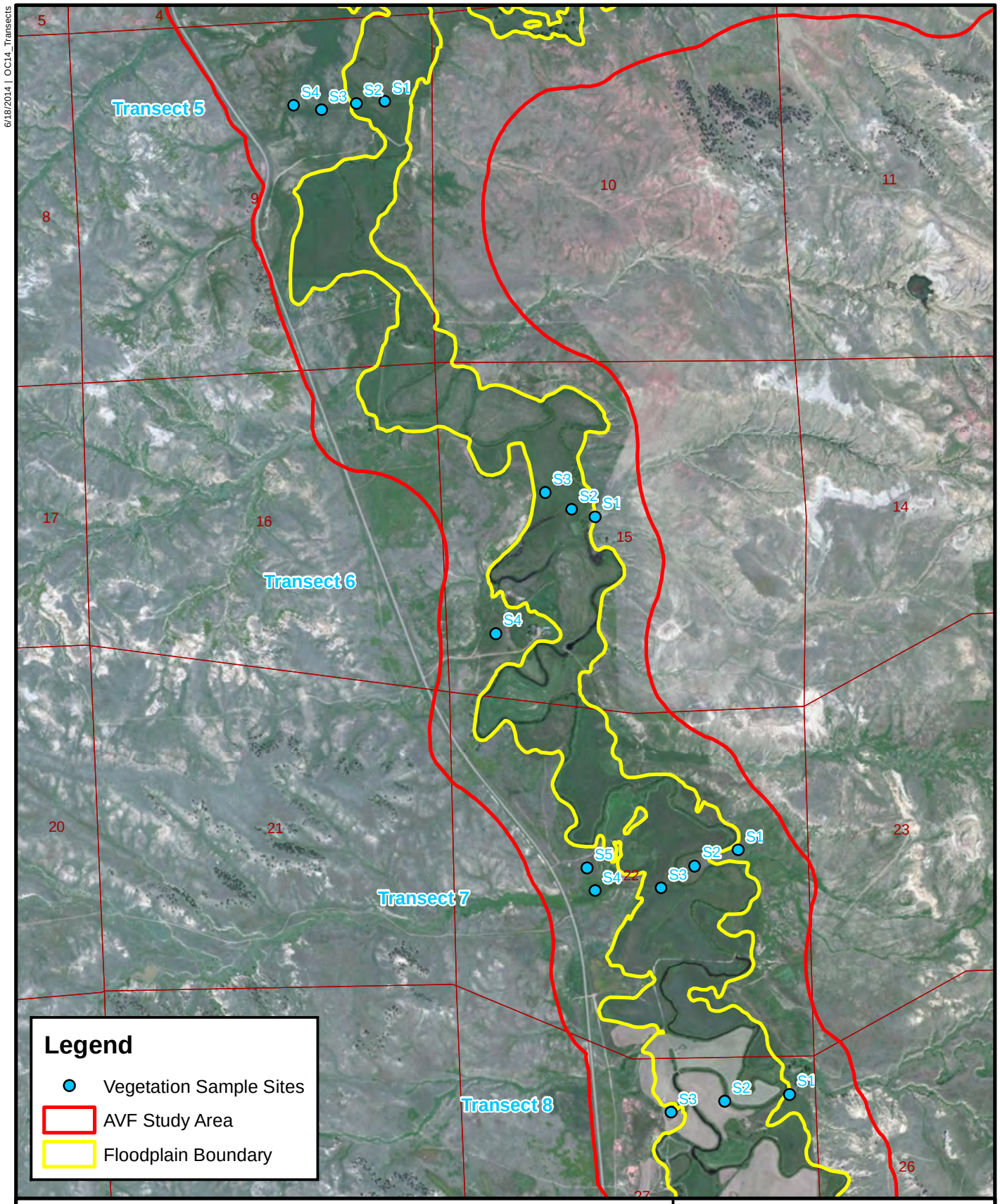

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Figure 1
Otter Creek AVF Study Area
Transect Locations

2.2 SAMPLE LOCATION AND SAMPLE SIZE

Figure 1 indicates the general delineation and distribution of transects and associated piezometer sites in the AVF study area. Selected sample sites were marked in the field with lath and ribbon, and recorded with a hand-held, submeter GPS unit. Sample sites are shown on Figure 1.

Sample size varied by sample parameter according to variability of terrace elevations (depth to water). Sample size was based on professional judgment, in consultation with MDEQ. The intent of the baseline monitoring study was to quantitatively characterize vegetation in and out of the floodplain and show variability of annual production as it relates to hydrology and soil characteristics. Sample sizes are listed below by sample parameter:

Sample Parameter	Sampling Method	Number of Samples
Transects	Inclusive (see below)	4
Hydrology	Piezometers	15
Vegetation	$0.5m^2$ Clip Plots	64
Soils	Auger Holes	15

2.3 QUANTITATIVE VEGETATION INVENTORY

Sampling of vegetation was conducted as described for the following components. Quantitative data were collected during the 2013 growing season near "peak production" (June 26-29).

Vegetation sample sites were established at piezometer locations, and at one additional site well above the floodplain (Transect 6, Site 4). Four $0.5m^2$ (1 x 0.5m) rectangular plots were placed systematically at each vegetation sample site (in homogeneous vegetation reflecting the site) to collect canopy cover and annual production data. Two plots were placed parallel and two plots perpendicular to the AVF Transect, each of the four plots at 12 meters from the GPS site center point.

Data collected in each $0.5m^2$ plot involved first an estimation of canopy cover, followed by harvest (clipping) of above-ground annual production in the plot.

A digital color photograph (oblique) was taken across each sample site, (approximately) in each of the four cardinal directions.

2.3.1 Canopy Cover

On each sample field form, location was recorded along with date, personnel, percent slope, aspect, topography and slope configuration.

In each $0.5m^2$ plot, an ocular estimate was made of percent cover for ground cover classes, including bare ground, rock, litter, lichens, moss and basal vegetation to total 100 percent. Nonstratified canopy cover was estimated to the nearest percent in each plot for total live vascular plant cover, for each morphological (functional) class category (tree, shrub, perennial graminoid, annual graminoid, perennial forb and annual/biennial forb), and for each vascular plant species.

Cover data are tabulated in the report by plot and sample site, and summarized by depth to water class (terrace level). Using these data, stratified cover values and relative cover values were generated in the office to evaluate composition.

2.3.2 Production

In each $0.5m^2$ quadrat, annual above-ground production was clipped and separated for the following herbaceous classes rooted within the quadrat: perennial grasses and sedges, annual grasses, perennial forbs (including "subshrubs/half-shrubs") and annual/biennial forbs. Each of the perennial classes was further separated as to origin (native vs. introduced). Annual production of shrubs was estimated by clipping ten annual leaders of each species, then counting the remaining leaders within a vertical projection of the quadrat to be used as a multiplier. In the laboratory, all production samples were dried until constant weight was achieved, and weighed to the nearest 0.1 gram.

Predicted average yield data for alfalfa and grain crops in the study area were obtained from the *Powder River County Soil Survey* and the USDA Natural Resources Conservation Service website, for comparison with on-site annual harvest data obtained from $0.5m^2$ clip plots and bale counts.

2.3.3 Species List/Sensitive Plants/Noxious Weeds

All vascular plant species encountered in the AVF study area during the quantitative inventory were recorded, and a comprehensive list was compiled. Taxa not readily identified in the field were collected and identified in the laboratory using a stereozoom binocular scope and taxonomic references including (but not limited to) Lesica (2012), Hitchcock *et al*. (1955-1969), Hitchcock and Cronquist (1973), Great Plains Flora Association (1986), Cronquist *et al.* (1972-2012), Gleason and Cronquist (1991), Holmgren (1998) and Bailey (1949). Nomenclature of vascular plant species follows Lesica (2012).

Noxious or declared weeds listed by the Montana County Weed Control Act or Powder River County were qualitatively assessed for distribution and abundance, as well as quantitatively sampled on cover estimation plots.

3.0 RESULTS

Hay is the only crop grown in the AVF study area, restricted to the primary valley bottoms. Hay fields are typically dominated by introduced pasture grasses, with alfalfa variable among fields. Dominant hay species are crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), alfalfa (*Medicago sativa*) and quackgrass (*Agropyron repens*).

Most of the 16 sample sites were on subirrigated/naturally flood-irrigated floodplains and lower terraces along Otter Creek. Other sample sites occurred on adjacent, less mesic toeslopes, fans, high terraces and low benches. Nearly all sites were on very gentle slopes of 0-5 percent gradient; aspect was variable. The predominant ecological sites are saline lowland (Haverson silty clay – Saline and Heldt silty clay loam – Saline soils), clayey (Heldt silty clay loam soils), and silty (McRae silt loam soils).

Following is a narrative description of AVF vegetation for each Transect sampled during the baseline monitoring inventory. All summary tables are presented in Section 6.0. Summary data are presented for annual production in Tables 1 through 4, for AVF Transects 5 through 8 respectively. Mean production is given in each table by site, and discussed by site in the following narrative. The AVF study area is shown in Figure 1.

The 2013 quantitative data are presented **by plot** in the appendices in section 7.0, including cover and constancy (Appendix B), and annual production (Appendix C). Appendix A is a list of all vascular plant species encountered during the 2013 AVF inventory; site photographs are presented in Appendix D.

3.1 TRANSECT 5

Transect 5 was comprised of four sample sites (Figure 1), sites 1 and 2 located on the floodplain (lowest terrace) positions, and sites 3 and 4 on the higher terraces outside the floodplain. Primary vegetation parameters are summarized below for each site inventoried on Transect 5 in 2013.

Transect 5

PARAMETER	SITE 1	SITE 2	SITE 3	SITE 4
FLOODPLAIN (Inside/Outside)	In	In	Out	Out
TOTAL ANNUAL PRODUCTION (tons/acre)	1.69	1.81	1.81	1.12
FUNCTIONAL GROUPS (relative production)				
Native Perennial Grasses				<<1
Introduced Perennial Grasses	94	93	92	94
Introduced Perennial Forbs	4	3	8	4
Annual/Biennial Forbs	2	4	<1	2
TOTAL CANOPY COVER (percent)	77	77	76	57
DOMINANT SPECIES (relative cover)				
Grasses				
Agropyron cristatum	35	42	66	91
Agropyron repens	27	12	9	
Bromus inermis	21	37	7	
Forbs				
Medicago sativa	13	3	14	5
Taraxacum laevigatum	2	2	2	

Total annual production on floodplain sites averaged 1.75 tons per acre compared to 1.47 tons per acre on higher terrace sites, yielding 19 percent greater production on floodplain than non-floodplain sites. On floodplain sites, relative production was primarily introduced perennial grass (94 percent of production), introduced perennial forb (4 percent), and annual/biennial forb (3 percent). Similarly, production at non-floodplain sites was comprised of introduced perennial grass (93 percent of production), introduced perennial forb (6 percent), and annual/biennial forb (1 percent).

Total mean canopy cover ranged from 77 percent on floodplain sites to 67 percent on higher terrace sites, therefore, 16 percent greater cover on floodplain versus non-floodplain sites. In order of canopy dominance, the three most important species on floodplain sites included *Agropyron cristatum*, *Bromus inermis* and *Agropyron repens*, compared to *Agropyron cristatum*, *Medicago sativa* and *Agropyron repens* on non-floodplain sites.

3.2 TRANSECT 6

Transect 6 was comprised of four sample sites (Figure 1), sites 2 and 3 located on floodplain terrace positions, and sites 1 and 4 on the higher terraces/toeslopes outside the floodplain. Primary vegetation parameters are summarized below for each site inventoried on Transect 6 in 2013.

Transect 6

PARAMETER	SITE 1	SITE 2	SITE 3	SITE 4
FLOODPLAIN (Inside/Outside)	Out	In	In	Out
TOTAL ANNUAL PRODUCTION (tons/acre)	2.68	1.99	1.78	1.91
FUNCTIONAL GROUPS (relative production)				
Native Perennial Grasses	27		3	
Introduced Perennial Grasses	39	99	95	99
Introduced Perennial Forbs	7	<1	1	<1
Annual/Biennial Forbs	26	<1	<1	<1
TOTAL CANOPY COVER (percent)	99	85	90	86
DOMINANT SPECIES (relative cover)				
Grasses				
Agropyron cristatum	23	3	5	92
Agropyron elongatum/intermedium		42		
Agropyron repens		6		
Bromus inermis		34	71	
Elymus junceus				3
Poa pratensis		13	17	
Agropyron smithii	17		3	
Forbs				
Taraxacum laevigatum	17	2	3	2
Sisymbrium loeselii	34			

Total annual production on floodplain sites averaged 1.89 tons per acre compared to 2.30 tons per acre on non-floodplain sites, yielding 18 percent *less* production on floodplain than non-floodplain sites. This appeared attributable to the go-back, rank weedy nature of site 1 located just outside the floodplain, a highly mesic site exhibiting heavy stratification of five different functional groups (see above and Table 2), particularly the upper-canopy weedy annual forb *Sisymbrium loeselii*. On floodplain sites, relative production was primarily introduced perennial grass (97 percent of production) and native perennial grass (2 percent). By contrast, production at non-floodplain sites was comprised of introduced perennial grass (69 percent of production), native perennial grass (14 percent), annual/biennial forb (13 percent), and introduced perennial forb (4 percent).

Total mean canopy cover ranged from 88 percent on floodplain sites to 93 percent on non-floodplain sites, therefore, 6 percent *greater* cover on non-floodplain versus floodplain sites. In order of canopy dominance, the most important species on floodplain sites included *Bromus inermis*, *Agropyron intermedium* and *Poa pratensis*, compared to *Sisymbrium loeselii*, *Agropyron cristatum*, *Agropyron smithii* and *Taraxacum laevigatum* on non-floodplain sites.

3.3 TRANSECT 7

Transect 7 was comprised of five sample sites (Figure 1), sites 2 and 3 located on floodplain (lowest terrace) positions, and sites 1, 4 and 5 on higher, non-floodplain positions. Primary vegetation parameters are summarized below for each site inventoried on Transect 7 in 2013.

Transect 7

PARAMETER	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
FLOODPLAIN (Inside/Outside)	Out	In	In	Out	Out
TOTAL ANNUAL PRODUCTION (tons/acre)	1.61	1.71	3.06	2.43	2.41
FUNCTIONAL GROUPS (relative production)					
Native Perennial Grasses	1	4			4
Introduced Perennial Grasses	95	90	100	85	91
Introduced Perennial Forbs	<1	<1	<<1	11	3
Annual/Biennial Forbs	1	<<1	<<1	4	<1
TOTAL CANOPY COVER (percent)	71	76	94	97	89
DOMINANT SPECIES (relative cover)					
Grasses					
Agropyron cristatum	72	63	4		62
Agropyron repens			1		
Bromus inermis		8	57	68	11
Elymus junceus			37		
Agropyron smithii	2	5			6
Forbs					
Medicago sativa		2		15	
Taraxacum laevigatum	8	5		4	16
Sisymbrium loeselii	1				
Shrub					
Artemisia cana	10	13			

Total annual production on floodplain sites averaged 2.38 tons per acre compared to 2.15 tons per acre on non-floodplain sites, yielding 11 percent greater production on floodplain than non-floodplain sites. On floodplain sites, relative production was comprised of introduced perennial grass (95 percent of production) and native perennial grass (2 percent). Production on non-floodplain sites was comprised of introduced perennial grass (90 percent of production), introduced perennial forb (5 percent), native perennial grass (2 percent) and annual/biennial forb (2 percent).

Total mean canopy cover ranged from 85 percent on floodplain sites to 86 percent on non-floodplain sites, a difference of 1 percent less cover on floodplain sites. In order of canopy dominance, the most important species on floodplain sites included *Agropyron cristatum, Bromus inermis* and *Elymus junceus*, compared to *Agropyron cristatum*, *Bromus inermis, Taraxacum laevigatum* and *Medicago sativa* on non-floodplain sites.

3.4 TRANSECT 8

Transect 8 was comprised of three sample sites (Figure 1), site 2 located on the floodplain terrace position, and sites 1 and 3 on higher sites outside the floodplain. Primary vegetation parameters are summarized below for each site inventoried on Transect 8 in 2013.

Transect 8

PARAMETER	SITE 1	SITE 2	SITE 3
FLOODPLAIN (Inside/Outside)	Out	In	Out
TOTAL ANNUAL PRODUCTION (tons/acre)	2.72	2.55	2.09
FUNCTIONAL GROUPS (relative production)			
Native Perennial Grasses	7	11	
Introduced Perennial Grasses	67	39	98
Introduced Perennial Forbs	25	49	
Annual/Biennial Forbs	<<1		2
TOTAL CANOPY COVER (percent)	90	93	77
DOMINANT SPECIES (relative cover)			
Grasses			
Agropyron cristatum		10	95
Bromus inermis	47	17	
Poa pratensis	10	5	
Agropyron smithii	6	12	
Forbs			
Medicago sativa	30	54	
Taraxacum laevigatum	4		

Total annual production on the floodplain site averaged 2.55 tons per acre compared to 2.40 tons per acre on non-floodplain sites, yielding 6 percent greater production on floodplain than non-floodplain sites. On the floodplain site, relative production was comprised of introduced perennial forb (49 percent of production), introduced perennial grass (39 percent) and native perennial grass (11 percent). By contrast, production at non-floodplain sites was comprised of introduced perennial grass (83 percent of production), introduced perennial forb (13 percent) and native perennial grass (4 percent).

Total mean canopy cover ranged from 93 percent on the floodplain site to 84 percent on non-floodplain sites, therefore, 11 percent greater cover on the floodplain versus non-floodplain sites. In order of canopy dominance, the most important species on the first terrace site included *Medicago sativa*, *Bromus inermis*, *Agropyron smithii* and *Agropyron cristatum*, compared to *Agropyron cristatum*, *Bromus inermis*, *Medicago sativa* and *Poa pratensis* on second terrace sites.

4.0 DISCUSSION

Four AVF monitoring transects were established on Otter Creek in June, 2013 (Figure 1). A variable number of sample sites were placed on each transect to represent the lowest, floodplain positions as well as higher terrace sites outside the floodplain. Most sites represent hay cropland, while several sites are go-back tame pasture with weedy forbs and/or shrubs re-invading the pasture at site 1 on Transect 6, and sites 1 and 2 on Transect 7.

As determined by clipping, sites within the Otter Creek floodplain generally averaged higher annual above-ground production than non-floodplain sites, ranging from 6 percent higher (Transect 8) to 11 and 19 percent higher (Transects 7 and 5, respectively). Similarly, canopy cover averaged from 11 percent higher (Transect 8) to 16 percent higher (Transect 5) on floodplain versus non-floodplain sites. On Transect 7, cover averaged 1 percent less on floodplain versus non-floodplain sites. Transect 6 was very anomalous due to the weedy nature of site 1. Non-floodplain sites averaged 18 percent higher production and 6 percent greater canopy cover than did floodplain sites on Transect 6.

Considering the 2013 clip plot data collectively, seven sample sites were located within the Otter Creek floodplain, and nine sites outside the floodplain. Sites within the floodplain averaged 2.08 ± 0.52 tons per acre compared to 2.09 ± 0.53 tons per acre averaged for sites outside the floodplain, therefore, virtually identical.

Run-in fields are those receiving water from intermittent seasonal flow in tributary drainages to Otter Creek, where diversion structures (berms) have been constructed to direct this flow. Three of the 16 sample sites were located in run-in fields, one inside the floodplain (Transect 7, Site 3) and two outside the floodplain (Transect 7, Site 4 and Transect 8, Site 1). Excluding the three run-in sites, six in-floodplain sites averaged 1.92 tons per acre compared to 1.95 tons per acre for seven sites outside the floodplain, again nearly the same. For perspective, among sample sites within the floodplain, the run-in site had 1.59 times the production averaged by the six non-run-in sites. Outside the floodplain, the two run-in sites averaged 1.32 times the production as the seven non-run-in sites.

These comparative results are similar to those shown by data for bale counts, although the tons per acre values are higher for the hand-clipping data. The clipping data yield higher numbers because manual clipping is done at ground level in a carefully defined quadrat, while machine mowing is conducted two to four inches above ground level over a much larger surface.

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6.0 SUMMARY TABLES

OTTER CREEK AVF VEGETATION PRODUCTION BY SITE

TABLE	TRANSECT	PAGE
	Annual Above-ground Production	
1	Transect 5	13
2	Transect 6	14
3	Transect 7	15
4	Transect 8	16

Table 1

Annual Above-ground Production (grams/m^2 and pounds/acre) for Four Sample Sites, Otter Creek AVF Transect 5, 2013.

	TRANSECT 5							
	SITE 1		SITE 2		SITE 3		SITE 4	
	First Terrace		First Terrace		Second Terrace		Second Terrace	
	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre
CLASS\SPECIES								
NATIVE PERENNIAL GRAMINOIDS							0.15	1.3
INTRODUCED PERENNIAL GRAMINOIDS	356.50	3181.2	379.38	3385.4	370.65	3307.5	236.05	2106.4
NATIVE PERENNIAL FORBS							0.24	2.1
INTRODUCED PERENNIAL FORBS								
Alfalfa (*Medicago sativa*)	14.54	129.7	8.75	78.1	30.56	272.7	9.58	85.5
Noxious (*Cirsium arvense*)								
Other IPF (*Taraxacum laevigatum*)	1.64	14.6	1.67	14.9	1.29	11.5	0.08	0.7
ANNUAL GRAMINOIDS	0.09	0.8	0.10	0.8				
ANNUAL/BIENNIAL FORBS	6.08	54.2	16.35	145.9	2.66	23.7	4.69	41.8
SHRUBS								
TOTAL PRODUCTION	378.84	3380.5	406.23	3625.0	405.16	3615.4	250.78	2237.8
TOTAL Tons/Acre		1.69		1.81		1.81		1.12

Production samples were harvested in four 0.5m^2 quadrats (0.5 x 1 meter rectangular) at each sample site, dried to constant weight and weighed in the laboratory, and converted to grams per square meter (doubled); grams per m^2 were converted to pounds per acre by multiplying by a factor of 8.9235; pounds/acre values were divided by 2000 to obtain tons per acre.

Table 2

Annual Above-ground Production (grams/m^2 and pounds/acre for Four Sample Sites, Otter Creek AVF Transect 6, 2013.

	TRANSECT 6							
	SITE 1		SITE 2		SITE 3		SITE 4	
	Second Terrace		First Terrace		First Terrace		Second Terrace	
	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre
CLASS\SPECIES NATIVE PERENNIAL GRAMINOIDS	161.82	1444.0			11.06	98.7		
INTRODUCED PERENNIAL GRAMINOIDS	231.19	2063.0	442.05	3944.6	380.65	3396.7	424.75	3790.3
NATIVE PERENNIAL FORBS								
INTRODUCED PERENNIAL FORBS								
Alfalfa (*Medicago sativa*)					0.11	1.0		
Noxious (*Cirsium arvense*)					0.29	2.6		
Other IPF (*Taraxacum laevigatum*)	43.44	387.6	2.61	23.2	3.99	35.6	0.73	6.5
ANNUAL GRAMINOIDS	4.97	44.3			0.03	0.2	0.23	2.1
ANNUAL/BIENNIAL FORBS	158.75	1416.6	1.33	11.9	3.36	29.9	1.84	16.4
SHRUBS								
TOTAL PRODUCTION	**600.16**	5355.5	**445.99**	3979.7	**399.48**	3564.7	**427.55**	3815.2
TOTAL Tons/Acre		2.68		1.99		1.78		1.91

Production samples were harvested in four 0.5m^2 quadrats (0.5 x 1 meter rectangular) at each sample site, dried to constant weight and weighed in the laboratory, and converted to grams per square meter (doubled); grams per m^2 were converted to pounds per acre by multiplying by a factor of 8.9235; pounds/acre values were divided by 2000 to obtain tons per acre.

Table 3

Annual Above-ground Production (grams/m2 and pounds/acre) for Five Sample Sites, Otter Creek AVF Transect 7, 2013.

	TRANSECT 7									
	SITE 1		SITE 2		SITE 3		SITE 4		SITE 5	
	Second Terrace		First Terrace		First Terrace		Bottom		Third Terrace	
	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre
CLASS\SPECIES										
NATIVE PERENNIAL GRAMINOIDS	3.76	33.6	14.34	127.9					23.34	208.2
INTRODUCED PERENNIAL GRAMINOIDS	342.45	3055.9	345.45	3082.6	684.80	6110.8	461.05	4114.2	491.50	4385.9
NATIVE PERENNIAL FORBS	0.78	6.9	0.04	0.4						
INTRODUCED PERENNIAL FORBS										
Alfalfa (*Medicago sativa*)			1.28	11.4			56.62	505.2		
Noxious (*Cirsium arvense*)										
Other IPF (*Taraxacum laevigatum*)	2.31	20.6	1.29	11.5	0.44	3.9	4.70	41.9	16.82	150.1
ANNUAL GRAMINOIDS	0.24	2.1					0.39	3.5	4.74	42.3
ANNUAL/BIENNIAL FORBS	5.40	48.1	0.26	2.3	0.46	4.1	21.66	193.2	2.64	23.6
SHRUBS										
Artemisia cana	5.34	47.7	19.97	178.2					0.39	3.4
TOTAL PRODUCTION	**360.27**	3214.8	**382.62**	3414.3	**685.69**	6118.8	**544.41**	4858.0	**539.42**	4813.5
TOTAL Tons/Acre		1.61		1.71		3.06		2.43		2.41

Production samples were harvested in four 0.5m2 quadrats (0.5 x 1 meter rectangular) at each sample site, dried to constant weight and weighed in the laboratory, and converted to grams per square meter (doubled); grams per m^2 were converted to pounds per acre by multiplying by a factor of 8.9235; pounds/acre values were divided by 2000 to obtain tons per acre.

Table 4

Annual Above-ground Production (grams/m^2 and pounds/acre) for Three Sample Sites, Otter Creek AVF Transect 8, 2013.

	TRANSECT 8					
	SITE 1		SITE 2		SITE 3	
	Second Terrace		First Terrace		Second Terrace	
CLASS\SPECIES	grams/m2	lbs/acre	grams/m2	lbs/acre	grams/m2	lbs/acre
NATIVE PERENNIAL GRAMINOIDS	43.78	390.7	64.17	572.6		
INTRODUCED PERENNIAL GRAMINOIDS	411.45	3671.6	224.81	2006.0	456.75	4075.8
NATIVE PERENNIAL FORBS						
INTRODUCED PERENNIAL FORBS						
Alfalfa (*Medicago sativa*)	150.77	1345.4	281.32	2510.3		
Noxious (*Cirsium arvense*)						
Other IPF (*Taraxacum laevigatum*)	4.09	36.5	0.53	4.7		
ANNUAL GRAMINOIDS						
ANNUAL/BIENNIAL FORBS	0.35	3.1			10.68	95.3
SHRUBS						
TOTAL PRODUCTION	**610.44**	5447.2	**570.82**	5093.7	**467.43**	4171.1
TOTAL Tons/Acre		2.72		2.55		2.09

Production samples were harvested in four 0.5m2 quadrats (0.5 x 1 meter rectangular) at each sample site, dried to constant weight and weighed in the laboratory, and converted to grams per square meter (doubled); grams per m^2 were converted to pounds per acre by multiplying by a factor of 8.9235; pounds/acre values were divided by 2000 to obtain tons per acre.

7.0 APPENDICES

(Data by Plot)

APPENDIX	PARAMETER	PAGE
A	List of Vascular Plant Species	A-i
B	Canopy Cover and Constancy	B-i
C	Annual Above-ground Production	C-i
D	AVF Site Photographs	D-i

APPENDIX A

List of Vascular Plant Species Recorded in the Otter Creek AVF Baseline Study Area, 2013.

Appendix A

List of Vascular Plant Species, Otter Creek AVF Baseline Study Areas, Powder River County, Montana, 2013.

Binomial	Code	Common Name
NATIVE PERENNIAL GRAMINOIDS (Cool Season)		
Agropyron smithii (Elymus smithii, Pascopyrum smithii*)	Agr smi	Western wheatgrass
Koeleria macrantha (Koeleria cristata, Koeleria pyramidata)	Koe mac	Prairie junegrass
Stipa comata (Hesperostipa comata, Stipa curtiseta)	Sti com	Needle-and-thread
Stipa viridula (Nassella viridula)	Sti vir	Green needlegrass
NATIVE PERENNIAL GRAMINOIDS (Warm Season)		
Bouteloua gracilis	Bou gra	Blue grama
INTRODUCED PERENNIAL GRAMINOIDS		
Agropyron cristatum (Agropyron desertorum)	Agr cri	Crested wheatgrass
Agropyron intermedium (Elymus hispidus, Thinopyrum ponticum, Agropyron elongatum)	Agr int	Intermediate wheatgrass
Agropyron repens (Elymus repens*, Elytrigia repens)	Agr rep	Quackgrass
Bromus inermis*	Bro ine	Smooth brome
Elymus junceus (Psathyrostachys juncea*)	Ely jun	Russian wildrye
Poa pratensis*	Poa pra	Kentucky bluegrass
INTRODUCED ANNUAL GRAMINOIDS		
Bromus japonicus (Bromus arvensis*)	Bro jap	Japanese brome
Bromus tectorum	Bro tec	Cheatgrass brome
Triticum aestivum	Tri aes	Common wheat
NATIVE PERENNIAL FORBS AND SUBSHRUBS		
Artemisia frigida	Art fri	Fringed sagewort
Sphaeralcea coccinea	Sph coc	Scarlet globemallow
Vicia americana*	Vic ame	American vetch
INTRODUCED PERENNIAL FORBS		
Cirsium arvense*	Cir arv	Canada thistle
Convolvulus arvensis	Con arv	Field bindweed
Rumex patienta	Rum pat	Patience dock
Taraxacum laevigatum	Tar lae	Red-seeded dandelion
NATIVE ANNUAL/BIENNIAL FORBS		
Androsace occidentalis*	And occ	Western rockjasmine
Collinsia parviflora	Col par	Blue-eyed Mary
Descurainia incana* (Descurainia richardsonii)	Des inc	Richardson's tansymustard
Descurainia pinnata	Des pin	Pinnate tansymustard
Draba nemorosa	Dra nem	Woods draba
Draba reptans	Dra rep	Carolina draba
Euphorbia glyptosperma	Eup gly	Corrugate-seeded spurge
Galium aparine*	Gal apa	Cleavers
Iva xanthifolia (Cyclachaena xanthiifolia*)	Iva xan	Tall marsh-elder
Lappula redowskii	Lap red	Western stickseed
Phacelia linearis	Pha lin	Threadleaf phacelia
Plantago patagonica	Pla pat	Woolly plantain
Polygonum sawatchense*	Pol saw	Sawatch knotweed

Appendix A

List of Vascular Plant Species, Otter Creek AVF Baseline Study Areas, Powder River County, Montana, 2013.

Binomial	Code	Common Name
INTRODUCED ANNUAL/BIENNIAL FORBS		
Alyssum alyssoides	Aly aly	Pale alyssum
Alyssum desertorum	Aly des	Desert alyssum
Asperugo procumbens*	Asp pro	Madwort
Atriplex heterosperma	Atr het	Two-seed orache
Camelina microcarpa*	Cam mic	Littlepod falseflax
Chenopodium album*	Che alb	Lambsquarters
Descurainia sophia	Des sop	Flixweed tansymustard
Kochia scoparia (Bassia scoparia*)	Koc sco	Belvedere summercypress
Medicago lupulina*	Med lup	Black medick
Melilotus officinalis*	Mel off	Yellow sweetclover
Sisymbrium loeselii	Sis loe	Loesel tumblemustard
Thlaspi arvense*	Thl arv	Fanweed
Tragopogon dubius	Tra dub	Common salsify
NATIVE SHRUBS		
Artemisia cana*	Art can	Silver sagebrush

Scientific nomenclature follows Lesica (2012). The more recent, most commonly used synonyms, partial synonyms/combinations, and misapplied names are given in parentheses. These, as well as common names, are taken from a variety of sources including:

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*An asterisk indicates nomenclature appearing on the National Wetland Plant List (Lichvar 2012). Taxa with no asterisk do not appear on the NWPL, and are to be considered "Upland" species in the context of wetland inventories; additionally, the 2012 NWPL rates wetland plants at only the species level and does not distinguish among infraspecific taxa in assigning wetland ratings.

APPENDIX B

Percent Canopy Cover by Plot for Sixteen Sites on Four Transects, Otter Creek AVF Baseline Study Area, 2013.

AVF TRANSECT	TABLE	PAGE
Transect 5	B1	B1-1
Transect 6	B2	B2-1
Transect 7	B3	B3-1
Transect 8	B4	B4-1

Footnotes for the tables in Appendix B:

All transect/site locations are shown on Plate 1.

Trace cover values were assigned 0.3 percent for each $0.5m^2$ canopy cover estimation plot.

Binomials follow Lesica (2012).

Table B1

Percent Canopy Cover by Class and Species for Four Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 5																				
	SITE 1					SITE 2					SITE 3					SITE 4					TOTAL
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	Cover
					n=4					n=4					n=4					n=4	n=16
SITE PARAMETERS*																					
Slope (percent)	0-1	0-1	0-1	0-1		0-1	0-1	0-1	0-1		0-2	0-2	0-2	0-2		0-1	0-1	0-1	0-1		
Aspect (degrees)	0	0	0	0		0	0	0	0		0	0	0	0		0	0	0	0		
Topography	Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		
Configuration	Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		
Photo # (Digital)	043	044	045	046		047	048	049	050		063	064	065	066		067	068	029	070		
Investigator	DB/KL	DB/KL	DB/KL	DB/KL		DB/KL	DB/KL	DB/KL	DB/KL		DB/KL	DB/KL	DB/KL	DB/KL		DB/KL	DB/KL	DB/KL	DB/KL		
Date	6/26	6/26	6/26	6/26		6/26	6/26	6/26	6/26		6/28	6/28	6/28	6/28		6/28	6/28	6/28	6/28		
GROUND COVER																					
Bare Ground	49	34	33	40	39.0	35	42	32	12	30.3	40	33	25	20	29.5	60	60	55	60	58.8	39.38
Rock			0.3		0.1												0.3			0.1	0.04
Litter	44	59	60	53	54.0	58	51	61	80	62.5	54	60	68	75	64.3	35	35	40	35	36.3	54.25
Basal Vegetation	7	7	7	7	7.0	7	7	7	8	7.3	6	7	7	5	6.3	5	5	5	5	5.0	6.38
Total	100	100	100.3	100	100.08	100	100	100	100	100	100	100	100	100	100	100	100.3	100	100	100.08	100.04
VEGETATION STRUCTURE (nonstratified cover)																					
Total Vegetation	74	80	82	72	77.0	82	70	75	82	77.3	68	82	85	68	75.8	59	54	58	57	57.0	71.75
Total Vegetation	*83.2*	*93.2*	*93.5*	*77.8*	*86.9*	*96.3*	*73.9*	*77.3*	*86.6*	*83.5*	*75.3*	*95.8*	*104.5*	*73.2*	*87.2*	*61.8*	*56.2*	*60.8*	*62.5*	*60.3*	*79.49*
Perennial Graminoids	73	78	56	70	69.3	74	67	73	81	73.8	64	76	75	55	67.5	53	54	58	55	55.0	66.38
Perennial Graminoids	*77.0*	*84.0*	*59.0*	*70.3*	*72.6*	*80.0*	*69.0*	*76.0*	*84.0*	*77.3*	*69.0*	*80.0*	*83.0*	*55.0*	*71.8*	*53.0*	*54.0*	*58.0*	*55.3*	*55.1*	*69.16*
Annual Graminoids		0.3		0.3	0.2	0.3				0.1											0.06
Annual Graminoids		*0.3*		*0.3*	*0.2*	*0.3*				*0.1*											*0.06*
Perennial Forbs and Subshrubs	4	6	33	4	11.8	6	3	3	2	3.5	6	11	20	17	13.5	7	0.3	0.3	4	2.9	7.91
Perennial Forbs and Subshrubs	*4.3*	*6.3*	*33.3*	*4.0*	*12.0*	*6.0*	*3.0*	*0.0*	*0.0*	*2.3*	*6.0*	*12.0*	*20.3*	*17.0*	*13.8*	*7.3*	*0.3*	*0.6*	*4.3*	*3.1*	*7.79*
Annual/Biennial Forbs	1	2	1	2	1.5	9	2	1	2	3.5	0.3	4	1	1	1.6	1	2	2	2	1.8	2.08
Annual/Biennial Forbs	*1.9*	*2.6*	*1.2*	*3.2*	*2.2*	*10.0*	*1.9*	*1.3*	*2.6*	*4.0*	*0.3*	*3.8*	*1.2*	*1.2*	*1.6*	*1.5*	*1.9*	*2.2*	*2.9*	*2.1*	*2.48*
CLASS\SPECIES																					
NATIVE PERENNIAL GRAMINOIDS (Cool Season)																					
Agropyron smithii																			0.3	0.1	0.02
TOTAL NPG(C)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.1**	**0.02**
INTRODUCED PERENNIAL GRAMINOIDS																					
Agropyron cristatum	44	25	53		30.5			65	78	35.8	57	64	55	55	57.8	53	54	58	55	55.0	44.75
Agropyron repens	33	55	6	0.3	23.6	18	5	11	6	10.0	12	16	3		7.8						10.33
Bromus inermis		4		70	18.5	62	64			31.5			25		6.3						14.06
TOTAL IPG	**77.0**	**84.0**	**59.0**	**70.3**	**72.6**	**80.0**	**69.0**	**76.0**	**84.0**	**77.3**	**69.0**	**80.0**	**83.0**	**55.0**	**71.8**	**53.0**	**54.0**	**58.0**	**55.0**	**55.0**	**69.14**

Table B1

Percent Canopy Cover by Class and Species for Four Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 5																				
	SITE 1					SITE 2					SITE 3					SITE 4					TOTAL
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	Cover
					n=4					n=4					n=4					n=4	n=16
INTRODUCED ANNUAL GRAMINOIDS																					
Bromus japonicus		0.3		0.3	0.2	0.3				0.1											0.06
TOTAL IAG	**0.0**	**0.3**	**0.0**	**0.3**	**0.2**	**0.3**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.06**
NATIVE PERENNIAL FORBS AND SUBSHRUBS																					
Sphaeralcea coccinea																0.3				0.1	0.02
Vicia americana																			0.3	0.1	0.02
TOTAL NPG	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.0**	**0.0**	**0.3**	**0.2**	**0.04**
INTRODUCED PERENNIAL FORBS																					
Convolvulus arvensis		0.3			0.1																0.02
Medicago sativa	4	5	33	2	11.0	4	2			1.5	5	10	20	15	12.5	7	0.3	0.3	4	2.9	6.98
Taraxacum laevigatum	0.3	1	0.3	2	0.9	2	1			0.8	1	2	0.3	2	1.3			0.3		0.1	0.76
TOTAL IPF	**4.3**	**6.3**	**33.3**	**4.0**	**12.0**	**6.0**	**3.0**	**0.0**	**0.0**	**2.3**	**6.0**	**12.0**	**20.3**	**17.0**	**13.8**	**7.0**	**0.3**	**0.6**	**4.0**	**3.0**	**7.76**
NATIVE ANNUAL/BIENNIAL FORBS																					
Androsace occidentalis																0.3		0.3	0.3	0.2	0.06
Collinsia parviflora		0.3		0.3	0.2																0.04
Descurainia incana	0.3				0.1	1	0.3			0.3		0.3	0.3	0.3	0.2						0.16
Draba reptans				0.3	0.1											0.3			0.3	0.2	0.06
Galium aparine				0.3	0.1																0.02
Lappula redowskii																	0.3			0.1	0.02
Phacelia linearis																					0.00
TOTAL NA/BF	**0.3**	**0.3**	**0.0**	**0.9**	**0.4**	**1.0**	**0.3**	**0.0**	**0.0**	**0.3**	**0.0**	**0.3**	**0.3**	**0.3**	**0.2**	**0.6**	**0.3**	**0.3**	**0.6**	**0.5**	**0.34**
INTRODUCED ANNUAL/BIENNIAL FORBS																					
Alyssum alyssoides	0.3	1	0.3	1	0.7	2		0.3	2	1.1	0.3	0.3	0.3	0.3	0.3	0.3	1	1	1	0.8	0.71
Camelina microcarpa	1	1	0.3	1	0.8	4	1	1	0.3	1.6		0.3	0.3	0.3	0.2	0.3	0.3	0.3	1	0.5	0.78
Chenopodium album			0.3		0.1							0.3			0.1						0.04
Sisymbrium loeselii												0.3			0.1			0.3		0.1	0.04
Thlaspi arvense	0.3	0.3	0.3	0.3	0.3	3	0.3			0.8		2	0.3	0.3	0.7						0.44
Tragopogon dubius							0.3		0.3	0.2		0.3			0.1	0.3	0.3	0.3	0.3	0.3	0.13
TOTAL IA/BF	**1.6**	**2.3**	**1.2**	**2.3**	**1.9**	**9.0**	**1.6**	**1.3**	**2.6**	**3.6**	**0.3**	**3.5**	**0.9**	**0.9**	**1.4**	**0.9**	**1.6**	**1.9**	**2.3**	**1.7**	**2.14**
TOTAL VEGETATION (Stratified)	**83.2**	**93.2**	**93.5**	**77.8**	**86.9**	**96.3**	**73.9**	**77.3**	**86.6**	**83.5**	**75.3**	**95.8**	**104.5**	**73.2**	**87.2**	**61.8**	**56.2**	**60.8**	**62.5**	**60.3**	**79.49**

1Nomenclature follows Lesica (2012). Current synonyms (in parentheses) are taken from The National Wetland Plant List (Lichvar 2012), available on the web at: (http://wetland_plants.usace.army.mil/).

2Wetland Indicator Status is derived from the Great Plains Region, National Wetland Plant List (Lichvar 2012).

Table B2

Percent Canopy Cover by Class and Species for Four Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 6																				
	SITE 1					SITE 2					SITE 3					SITE 4					TOTAL
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	Cover
					n=4					n=4					n=4					n=4	n=16
SITE PARAMETERS*																					
Slope (percent)	2-4	2-4	2-4	2-4		0-2	0-2	0-2	0-2		0-2	0-2	0-2	0-2		0-1	0-1	0-1	0-1		
Aspect (degrees)	E	E	E	E		0	0	0	0		0	0	0	0		0	0	0	0		
Topography	slope	slope	slope	slope		Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		
Configuration	Und	Und	Und	Und		Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		
Photo # (Digital)	683	684	685	686		075	076	077	078		071	072	073	074		559	560	561	562		
Investigator	KS/ED	KS/ED	KS/ED	KS/ED		DB/KL	DB/KL	DB/KL	DB/KL		DB/KL	DB/KL	DB/KL	DB/KL		KS/ED	KS/ED	KS/ED	KS/ED		
Date	6/29	6/29	6/29	6/29		6/29	6/29	6/29	6/29		6/28	6/28	6/28	6/28		6/26	6/26	6/26	6/26		
GROUND COVER																					
Bare Ground	33	16	3	5	14.3	30	13	13	15	17.8	15	12	14	12	13.3	40	10	35	40	31.3	19.13
Rock											0.3							0.3		0.1	0.02
Litter	60	76	89	88	78.3	62	80	79	78	74.8	77	80	79	80	79.0	55	85	60	55	63.8	73.94
Basal Vegetation	7	8	8	7	7.5	8	7	8	7	7.5	8	8	7	9	8.0	5	5	5	5	5.0	7.00
Total	100	100	100	100	100.0	100	100	100	100	100	100.3	100	100	101	100.25	100	100	100.3	100	100.08	100.08
VEGETATION STRUCTURE (nonstratified cover)																					
Total Vegetation	99	98	99	98	98.5	88	80	92	79	84.8	90	96	80	93	89.8	88	84	86	87	86.3	89.81
Total Vegetation	*192.0*	*206.3*	*252.3*	*209.0*	*214.9*	*103.2*	*100.3*	*108.6*	*87.6*	*99.9*	*106.2*	*111.6*	*90.2*	*114.5*	*105.6*	*91.0*	*85.6*	*96.9*	*91.9*	*91.4*	*127.95*
Perennial Graminoids	84	66	82	72	76.0	88	79	92	77	84.0	90	94	65	78	81.8	88	84	78	86	84.0	81.44
Perennial Graminoids	*90.0*	*74.0*	*96.0*	*88.0*	*87.0*	*102.0*	*98.0*	*107.0*	*82.0*	*97.3*	*100.0*	*105.0*	*87.0*	*112.3*	*101.1*	*88.0*	*84.0*	*90.0*	*86.0*	*87.0*	*93.08*
Annual Graminoids		7	3	7	4.3								0.3		0.1		0.3	0.3	0.3	0.2	1.14
Annual Graminoids		*7.0*	*3.3*	*7.0*	*4.3*								*0.3*		*0.1*		*0.3*	*0.3*	*0.3*	*0.2*	*1.16*
Perennial Forbs and Subshrubs	28	34	52	22	34.0	0.3	2	0.3	4	1.7	5	5	0.3	1	2.8	2	1	3	1	1.8	10.06
Perennial Forbs and Subshrubs	*28.0*	*34.0*	*62.0*	*22.0*	*36.5*	*0.3*	*2.0*	*0.3*	*4.0*	*1.7*	*5.3*	*5.0*	*0.6*	*1.3*	*3.1*	*2.0*	*1.0*	*3.0*	*1.0*	*1.8*	*10.74*
Annual/Biennial Forbs	68	82	74	88	78.0	0.3	0.3	1	1	0.7	1	2	2	0.3	1.3	1	0.3	3	5	2.3	20.58
Annual/Biennial Forbs	*74.0*	*91.3*	*91.0*	*92.0*	*87.1*	*0.9*	*0.3*	*1.3*	*1.6*	*1.0*	*0.9*	*1.6*	*2.3*	*0.9*	*1.4*	*1.0*	*0.3*	*3.6*	*4.6*	*2.4*	*22.98*
CLASS\SPECIES																					
NATIVE PERENNIAL GRAMINOIDS (Cool Season)																					
Agropyron smithii	14	42	58	34	37.0						3	7	2	0.3	3.1						10.02
TOTAL NPG(C)	**14.0**	**42.0**	**58.0**	**34.0**	**37.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.0**	**7.0**	**2.0**	**0.3**	**3.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**10.02**
NATIVE PERENNIAL GRAMINOIDS INTRODUCED PERENNIAL GRAMINOIDS																					
Agropyron cristatum	76	32	38	54	50.0			10		2.5	2	3		14	4.8	88	84	78	86	84.0	35.31
Agropyron intermedium						65	55	47		41.8											10.44
Agropyron repens							10		12	5.5											1.38
Bromus inermis						2	23	42	70	34.3	75	82	65	78	75.0						27.31
Elymus junceus																		12		3.0	0.75
Poa pratensis						35	10	8		13.3	20	13	20	20	18.3						7.88
TOTAL IPG	**76.0**	**32.0**	**38.0**	**54.0**	**50.0**	**102.0**	**98.0**	**107.0**	**82.0**	**97.3**	**97.0**	**98.0**	**85.0**	**112.0**	**98.0**	**88.0**	**84.0**	**90.0**	**86.0**	**87.0**	**83.06**

Table B2

Percent Canopy Cover by Class and Species for Four Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 6																				
	SITE 1					SITE 2					SITE 3					SITE 4					TOTAL
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	Cover
					n=4					n=4					n=4					n=4	n=16
INTRODUCED ANNUAL GRAMINOIDS																					
Bromus japonicus		6	0.3	2	2.1								0.3		0.1			0.3		0.1	0.56
Bromus tectorum		1	3	5	2.3												0.3		0.3	0.2	0.60
TOTAL IAG	**0.0**	**7.0**	**3.3**	**7.0**	**4.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.0**	**0.1**	**0.0**	**0.3**	**0.3**	**0.3**	**0.2**	**1.16**
INTRODUCED PERENNIAL FORBS																					
Cirsium arvense														1	0.3						0.06
Medicago sativa											0.3		0.3		0.2						0.04
Taraxacum laevigatum	28	34	62	22	36.5	0.3	2	0.3	4	1.7	5	5	0.3	0.3	2.7	2	1	3	1	1.8	10.64
TOTAL IPF	**28.0**	**34.0**	**62.0**	**22.0**	**36.5**	**0.3**	**2.0**	**0.3**	**4.0**	**1.7**	**5.3**	**5.0**	**0.6**	**1.3**	**3.1**	**2.0**	**1.0**	**3.0**	**1.0**	**1.8**	**10.74**
NATIVE ANNUAL/BIENNIAL FORBS																					
Descurainia incana											0.3				0.1						0.02
Euphorbia glyptosperma																		0.3		0.1	0.02
Iva xanthifolia			3		0.8																0.19
Plantago patagonica																		0.3		0.1	0.02
Polygonum sawatchense	7	2	20	2	7.8																1.94
TOTAL NA/BF	**7.0**	**2.0**	**23.0**	**2.0**	**8.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.6**	**0.0**	**0.2**	**2.18**
INTRODUCED ANNUAL/BIENNIAL FORBS																					
Alyssum alyssoides									0.3	0.1	0.3	0.3	2	0.3	0.7	1	0.3	3	4	2.1	0.72
Alyssum desertorum		0.3			0.1																0.02
Camelina microcarpa	1	4			1.3	0.3		1	1	0.6	0.3	0.3	0.3	0.3	0.3				0.3	0.1	0.55
Chenopodium album						0.3				0.1											0.02
Descurainia sophia	4	5	4	4	4.3																1.06
Kochia scoparia		2			0.5																0.13
Medicago lupulina																			0.3	0.1	0.02
Melilotus officinalis						0.3			0.3	0.2				0.3	0.1						0.06
Sisymbrium loeselii	62	78	64	86	72.5																18.13
Thlaspi arvense							0.3	0.3		0.2		1			0.3						0.10
TOTAL IA/BF	**67.0**	**89.3**	**68.0**	**90.0**	**78.6**	**0.9**	**0.3**	**1.3**	**1.6**	**1.0**	**0.6**	**1.6**	**2.3**	**0.9**	**1.4**	**1.0**	**0.3**	**3.0**	**4.6**	**2.2**	**20.79**
TOTAL VEGETATION (Stratified)	**192.0**	**206.3**	**252.3**	**209.0**	**214.9**	**103.2**	**100.3**	**108.6**	**87.6**	**99.9**	**106.2**	**111.6**	**90.2**	**114.5**	**105.6**	**91.0**	**85.6**	**96.9**	**91.9**	**91.4**	**127.95**

1Nomenclature follows Lesica (2012). Current synonyms (in parentheses) are taken from The National Wetland Plant List (Lichvar 2012), available on the web at: (http://wetland_plants.usace.army.mil/).

2Wetland Indicator Status is derived from the Great Plains Region, National Wetland Plant List (Lichvar 2012).

Table B3

Percent Canopy Cover by Class and Species for Five Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 7																			
	SITE 1					SITE 2					SITE 3					SITE 4				
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover
					n=4					n=4					n=4					n=4
SITE PARAMETERS*																				
Slope (percent)	0-2	0-2	0-2	0-2		0	0	0	0		0	0	0	0		1-2	1-2	1-2	1-2	
Aspect (degrees)	0	0	0	0		0	0	0	0		0	0	0	0		100	100	100	100	
Topography	Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		Bottom	Bottom	Bottom	Bottom	
Configuration	Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		S (V)	S (V)	S (V)	S (V)	
Photo # (Digital)	679	680	681	682		675	676	277	678		663	664	665	666		667	668	669	670	
Investigator	KS/ED	KS/ED	KS/ED	KS/ED		KS/ED	KS/ED	KS/ED	KS/ED		KS/ED	KS/ED	KS/ED	KS/ED		KS/ED	KS/ED	KS/ED	KS/ED	
Date	6/28	6/28	6/28	6/28		6/28	6/28	6/28	6/28		6/27	6/27	6/27	6/27		6/27	6/27	6/27	6/27	
GROUND COVER																				
Bare Ground	2	4	32	14	13.0	10		18	15	10.8	7	23	4	25	14.8	3	12	10	6	7.8
Rock																				
Litter	94	91	65	82	83.0	86	95	76	80	84.3	88	70	90	68	79.0	90	82	85	88	86.3
Lichens																				
Moss																				
Water																				
Basal Vegetation	4	5	3	4	4.0	4	5	6	5	5.0	5	7	6	7	6.3	7	6	5	6	6.0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
VEGETATION STRUCTURE (nonstratified cover)																				
Total Vegetation	64	82	66	70	70.5	68	85	76	76	76.3	92	94	94	96	94.0	98	95	97	99	97.3
Total Vegetation	*72.9*	*113.3*	*79.6*	*78.2*	*86.0*	*82.6*	*108.6*	*87.0*	*103.6*	*95.5*	*121.3*	*125.3*	*100.9*	*142.3*	*122.5*	*140.0*	*116.6*	*118.9*	*158.3*	*133.5*
Perennial Graminoids	60	64	58	68	62.5	60	76	72	70	69.5	92	94	93	96	93.8	98	93	90	96	94.3
Perennial Graminoids	*64.3*	*64.0*	*58.3*	*70.3*	*64.2*	*66.3*	*77.0*	*76.0*	*84.0*	*75.8*	*118.0*	*124.0*	*96.0*	*142.0*	*120.0*	*98.0*	*93.0*	*90.0*	*96.0*	*94.3*
Annual Graminoids		1		0.3	0.3											1	2			0.8
Annual Graminoids		*1.0*		*0.3*	*0.3*											*1.0*	*2.0*			*0.8*
Perennial Forbs and Subshrubs	3	12	12	5	8.0	0.3	1	10	15	6.6	2	0.3		0.3	0.7	5		28	58	22.8
Perennial Forbs and Subshrubs	*3.0*	*12.0*	*12.0*	*5.0*	*8.0*	*0.3*	*1.0*	*10.0*	*15.3*	*6.7*	*2.0*	*0.3*		*0.3*	*0.7*	*0.0*	*1.0*	*28.3*	*59.0*	*22.1*
Annual/Biennial Forbs	4	4	9	2	4.8		0.3	1	0.3	0.4	1	1	4		1.5	38		0.3	3	10.3
Annual/Biennial Forbs	*4.6*	*4.3*	*9.3*	*2.6*	*5.2*		*0.6*	*1.0*	*0.3*	*0.5*	*1.3*	*1.0*	*4.9*		*1.8*	*41.0*	*20.6*	*0.6*	*3.3*	*16.4*
Native Shrubs	1	32			8.3	16	30		4	12.5										
Native Shrubs	*1.0*	*32.0*			*8.3*	*16.0*	*30.0*		*4.0*	*12.5*										
CLASS\SPECIES																				
NATIVE PERENNIAL GRAMINOIDS (Cool Season)																				
Agropyron smithii	4		2	2	2.0	7	1	6	4	4.5										
Koeleria macrantha	0.3			0.3	0.2	1				0.3										
Stipa comata						0.3			10	2.6										
Stipa viridula																				
TOTAL NPG(C)	**4.3**	**0.0**	**2.0**	**2.3**	**2.2**	**8.3**	**1.0**	**6.0**	**14.0**	**7.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Table B3

Percent Canopy Cover by Class and Species for Five Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 7																			
	SITE 1					SITE 2					SITE 3					SITE 4				
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover
					n=4					n=4					n=4					n=4
NATIVE PERENNIAL GRAMINOIDS (Warm Season)																				
Bouteloua gracilis	2		0.3		0.6															
TOTAL NPG(W)	**2.0**	**0.0**	**0.3**	**0.0**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
INTRODUCED PERENNIAL GRAMINOIDS																				
Agropyron cristatum	58	64	56	68	61.5	58	76	70	38	60.5	18				4.5					
Agropyron repens														4	1.0					
Bromus inermis									32	8.0	86	46	92	54	69.5	98	93	90	96	94.3
Elymus junceus											14	78	4	84	45.0					
TOTAL IPG	**58.0**	**64.0**	**56.0**	**68.0**	**61.5**	**58.0**	**76.0**	**70.0**	**70.0**	**68.5**	**118.0**	**124.0**	**96.0**	**142.0**	**120.0**	**98.0**	**93.0**	**90.0**	**96.0**	**94.3**
INTRODUCED ANNUAL GRAMINOIDS																				
Bromus japonicus		1		0.3	0.3															
Bromus tectorum																1	2			0.8
Triticum aestivum																				
TOTAL IAG	**0.0**	**1.0**	**0.0**	**0.3**	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**2.0**	**0.0**	**0.0**	**0.8**
NATIVE PERENNIAL FORBS AND SUBSHRUBS																				
Artemisia frigida		5			1.3															
Sphaeralcea coccinea									0.3	0.1										
TOTAL NPG	**0.0**	**5.0**	**0.0**	**0.0**	**1.3**	**0.0**	**0.0**	**0.0**	**0.3**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
INTRODUCED PERENNIAL FORBS																				
Medicago sativa						0.3			7	1.8								28	56	21.0
Rumex patienta																	1			0.3
Taraxacum laevigatum	3	7	12	5	6.8		1	10	8	4.8	2	0.3		0.3	0.7			0.3	3	0.8
TOTAL IPF	**3.0**	**7.0**	**12.0**	**5.0**	**6.8**	**0.3**	**1.0**	**10.0**	**15.0**	**6.6**	**2.0**	**0.3**	**0.0**	**0.3**	**0.7**	**0.0**	**1.0**	**28.3**	**59.0**	**22.1**
NATIVE ANNUAL/BIENNIAL FORBS																				
Descurainia pinnata													0.3		0.1					
Phacelia linearis	3		0.3		0.8															
TOTAL NA/BF	**3.0**	**0.0**	**0.3**	**0.0**	**0.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Table B3

Percent Canopy Cover by Class and Species for Five Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 7																			
	SITE 1					SITE 2					SITE 3					SITE 4				
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover
					n=4					n=4					n=4					n=4
INTRODUCED ANNUAL/BIENNIAL FORBS																				
Alyssum alyssoides											1		0.3		0.3					
Alyssum desertorum	0.3	0.3	2		0.7											2	0.3		2	1.1
Asperugo procumbens																				
Atriplex heterosperma												1	4		1.3					
Camelina microcarpa	1	1	5	2	2.3		0.3	1	0.3	0.4						3	0.3	0.3	0.3	1.0
Descurainia sophia							0.3			0.1						14	8	0.3	1	5.8
Melilotus officinalis																				
Sisymbrium loeselii	0.3	3		0.3	0.9															
Thlaspi arvense				0.3	0.1						0.3		0.3		0.2	22	12			8.5
Tragopogon dubius			2		0.5															
TOTAL IA/BF	**1.6**	**4.3**	**9.0**	**2.6**	**4.4**	**0.0**	**0.6**	**1.0**	**0.3**	**0.5**	**1.3**	**1.0**	**4.6**	**0.0**	**1.7**	**41.0**	**20.6**	**0.6**	**3.3**	**16.4**
NATIVE SHRUBS																				
Artemisia cana	1	32			8.3	16	30		4	12.5										
TOTAL NATIVE SHRUBS	**1.0**	**32.0**	**0.0**	**0.0**	**8.3**	**16.0**	**30.0**	**0.0**	**4.0**	**12.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
TOTAL VEGETATION (Stratified)	**72.9**	**113.3**	**79.6**	**78.2**	**86.0**	**82.6**	**108.6**	**87.0**	**103.6**	**95.5**	**121.3**	**125.3**	**100.9**	**142.3**	**122.5**	**140.0**	**116.6**	**118.9**	**158.3**	**133.5**

1Nomenclature follows Lesica (2012). Current synonyms (in parentheses) are taken from The National Wetland Plant List (Lichvar 2012), available on the web at: (http://wetland_plants.usace.army.mil/).

2Wetland Indicator Status is derived from the Great Plains Region, National Wetland Plant List (Lichvar 2012).

Table B3

Percent Canopy Cover by Class and Species for Five Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 7					
	SITE 5					
	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	Cover
					n=4	n=20
SITE PARAMETERS*						
Slope (percent)	0-1	0-1	0-1	0-1		
Aspect (degrees)	0	0	0	0		
Topography	Terrace	Terrace	Terrace	Terrace		
Configuration	Straight	Straight	Straight	Straight		
Photo # (Digital)	671	672	673	674		
Investigator	KS/ED	KS/ED	KS/ED	KS/ED		
Date	6/27	6/27	6/27	6/27		
GROUND COVER						
Bare Ground						**9.25**
Rock						
Litter	94	94	94	93	93.8	**85.25**
Lichens						
Moss						
Water						
Basal Vegetation	6	6	6	7	6.3	**5.50**
Total	100	100	100	100	100	100.00
VEGETATION STRUCTURE (nonstratified cover)						
Total Vegetation	92	86	82	96	89.0	**85.40**
Total Vegetation	*119.0*	*109.2*	*128.2*	*141.6*	*124.5*	***112.37***
Perennial Graminoids	88	80	78	94	85.0	**81.00**
Perennial Graminoids	*92.0*	*81.6*	*88.3*	*131.0*	*98.2*	***90.51***
Annual Graminoids	14		0.3		3.6	**0.93**
Annual Graminoids	*14.0*	*2.3*	*0.3*	*0.3*	*4.2*	***1.06***
Perennial Forbs and Subshrubs	7	24	38	9	19.5	**11.50**
Perennial Forbs and Subshrubs	*7.0*	*24.0*	*38.0*	*9.0*	*19.5*	***11.38***
Annual/Biennial Forbs	6	1	0.3	1	2.1	**3.81**
Annual/Biennial Forbs	*6.0*	*1.3*	*0.6*	*1.3*	*2.3*	***5.23***
Native Shrubs			1		0.3	**4.20**
Native Shrubs			*1.0*		*0.3*	***4.20***
CLASS\SPECIES						
NATIVE PERENNIAL GRAMINOIDS (Cool Season)						
Agropyron smithii	6	1	18	5	7.5	**2.80**
Koeleria macrantha						**0.08**
Stipa comata		0.3			0.1	**0.53**
Stipa viridula		0.3	0.3		0.2	**0.03**
TOTAL NPG(C)	**6.0**	**1.6**	**18.3**	**5.0**	**7.7**	**3.44**

Table B3

Percent Canopy Cover by Class and Species for Five Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 7					
	SITE 5					
	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	Cover
					n=4	n=20
NATIVE PERENNIAL GRAMINOIDS (Warm Season)						
Bouteloua gracilis						0.12
TOTAL NPG(W)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.12**
INTRODUCED PERENNIAL GRAMINOIDS						
Agropyron cristatum	86	80	70	72	77.0	40.70
Agropyron repens						0.20
Bromus inermis				54	13.5	37.05
Elymus junceus						9.00
TOTAL IPG	**86.0**	**80.0**	**70.0**	**126.0**	**90.5**	**86.95**
INTRODUCED ANNUAL GRAMINOIDS						
Bromus japonicus	14	0.3	0.3		3.7	0.80
Bromus tectorum		1		0.3	0.3	0.22
Triticum aestivum		1			0.3	0.05
TOTAL IAG	**14.0**	**2.3**	**0.3**	**0.3**	**4.2**	**1.06**
NATIVE PERENNIAL FORBS AND SUBSHRUBS						
Artemisia frigida						0.25
Sphaeralcea coccinea						0.02
TOTAL NPG	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.27**
INTRODUCED PERENNIAL FORBS						
Medicago sativa						4.57
Rumex patienta						0.05
Taraxacum laevigatum	7	24	38	9	19.5	6.50
TOTAL IPF	**7.0**	**24.0**	**38.0**	**9.0**	**19.5**	**11.11**
NATIVE ANNUAL/BIENNIAL FORBS						
Descurainia pinnata						0.02
Phacelia linearis						0.17
TOTAL NA/BF	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.18**

Table B3

Percent Canopy Cover by Class and Species for Five Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 7					
	SITE 5					
	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	Cover
					n=4	n=20
INTRODUCED ANNUAL/BIENNIAL FORBS						
Alyssum alyssoides						0.07
Alyssum desertorum			0.3		0.1	0.36
Asperugo procumbens		1			0.3	0.05
Atriplex heterosperma	2				0.5	0.35
Camelina microcarpa						0.73
Descurainia sophia						1.18
Melilotus officinalis				0.3	0.1	0.02
Sisymbrium loeselii						0.18
Thlaspi arvense	3	0.3	0.3	1	1.2	1.98
Tragopogon dubius	1				0.3	0.15
TOTAL IA/BF	**6.0**	**1.3**	**0.6**	**1.3**	**2.3**	**5.05**
NATIVE SHRUBS						
Artemisia cana			1		0.3	4.20
TOTAL NATIVE SHRUBS	**0.0**	**0.0**	**1.0**	**0.0**	**0.3**	**4.20**
TOTAL VEGETATION (Stratified)	**119.0**	**109.2**	**128.2**	**141.6**	**124.5**	**112.37**

1Nomenclature follows Lesica (2012). Current synonyms (in parentheses) are taken from The National Wetland Plant List (Lichvar 2012), available on the web at: (http://wetland_plants.usace.army.mil/).

2Wetland Indicator Status is derived from the Great Plains Region, National Wetland Plant List (Lichvar 2012).

Table B4

Percent Canopy Cover by Class and Species for Three Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 8															
	SITE 1					SITE 2					SITE 3					
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	Cover
					n=4					n=4					n=4	n=12
SITE PARAMETERS*																
Slope (percent)	0	0	0	0		0	0	0	0		0-2	0-2	0-2	0-2		
Aspect (degrees)	0	0	0	0		0	0	0	0		340	340	340	340		
Topography	Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		Terrace	Terrace	Terrace	Terrace		
Configuration	Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		Straight	Straight	Straight	Straight		
Photo # (Digital)	059	060	061	062		055	056	057	058		051	052	053	054		
Investigator	DB/KL	DB/KL	DB/KL	DB/KL		DB/KL	DB/KL	DB/KL	DB/KL		DB/KL	DB/KL	DB/KL	DB/KL		
Date	6/27	6/27	6/27	6/27		6/27	6/27	6/27	6/27		6/27	6/27	6/27	6/27		
GROUND COVER																
Bare Ground	45	50	32	34	40.3	8	35	20	40	25.8	38	15	15	10	19.5	**28.50**
Rock											0.3		0.3		0.2	**0.05**
Litter	47	42	60	58	51.8	84	57	72	52	66.3	56	79	78	83	74.0	**64.00**
Lichens																
Moss																
Water																
Basal Vegetation	8	8	8	8	8.0	8	8	8	8	8.0	6	6	7	7	6.5	**7.50**
Total	100	100	100	100	100	100	100	100	100	100	100.3	100	100.3	100	100.15	**100.05**
VEGETATION STRUCTURE (nonstratified cover)																
Total Vegetation	87	80	94	97	89.5	92	93	92	93	92.5	74	76	78	78	76.5	**86.17**
Total Vegetation	*104.0*	*90.0*	*116.3*	*122.6*	*108.2*	*122.0*	*114.0*	*98.3*	*105.3*	*109.9*	*74.3*	*77.2*	*78.6*	*82.3*	*78.1*	***98.74***
Perennial Graminoids	61	78	70	65	68.5	77	44	12	31	41.0						**36.50**
Perennial Graminoids	*64.0*	*20.0*			*21.0*	*3.0*	*7.0*	*10.0*	*11.0*	*7.8*						***9.58***
Annual Graminoids																
Annual Graminoids																
Perennial Forbs and Subshrubs	38	5	45	55	35.8	40	65	86	70	65.3						**33.67**
Perennial Forbs and Subshrubs	*40.0*	*5.0*	*47.0*	*55.3*	*36.8*	*40.0*	*66.0*	*86.0*	*70.3*	*65.6*						***34.13***
Annual/Biennial Forbs			1		0.3						0.3	0.3	0.3	9	2.5	**0.91**
Annual/Biennial Forbs			*1.3*	*0.3*	*0.4*						*0.3*	*1.2*	*0.6*	*9.3*	*2.9*	***1.08***
Native Shrubs																
Native Shrubs																
CLASS\SPECIES																
NATIVE PERENNIAL GRAMINOIDS (Cool Season)																
Agropyron smithii		20			5.0	3	7	10	10	7.5						**4.17**
Stipa viridula									1	0.3						**0.08**
TOTAL NPG(C)	**0.0**	**20.0**	**0.0**	**0.0**	**5.0**	**3.0**	**7.0**	**10.0**	**11.0**	**7.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**4.25**

Table B4

Percent Canopy Cover by Class and Species for Three Sample Sites, Otter Creek Mine, Vegetation AVF Baseline Study Area, 2013.

	TRANSECT 8															
	SITE 1					SITE 2					SITE 3					
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	Mean
	1	2	3	4	Cover	1	2	3	4	Cover	1	2	3	4	Cover	Cover
					n=4					n=4					n=4	n=12
INTRODUCED PERENNIAL GRAMINOIDS																
Agropyron cristatum						15	34	0.3	1	12.6	74	76	78	73	75.3	29.28
Bromus inermis	58	45	60	55	54.5	60	4		13	19.3						24.58
Poa pratensis	6	20	8	12	11.5	4	3	2	10	4.8						5.42
TOTAL IPG	**64.0**	**65.0**	**68.0**	**67.0**	**66.0**	**79.0**	**41.0**	**2.3**	**24.0**	**36.6**	**74.0**	**76.0**	**78.0**	**73.0**	**75.3**	**59.28**
INTRODUCED PERENNIAL FORBS																
Medicago sativa	38	3	45	55	35.3	40	65	86	70	65.3						33.50
Taraxacum laevigatum	2	2	2	0.3	1.6		1		0.3	0.3						0.63
TOTAL IPF	**40.0**	**5.0**	**47.0**	**55.3**	**36.8**	**40.0**	**66.0**	**86.0**	**70.3**	**65.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**34.13**
NATIVE ANNUAL/BIENNIAL FORBS																
Lappula redowskii												0.3	0.3		0.2	0.05
TOTAL NA/BF	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.3**	**0.0**	**0.2**	**0.05**
INTRODUCED ANNUAL/BIENNIAL FORBS																
Alyssum alyssoides											0.3	0.3	0.3		0.2	0.08
Camelina microcarpa			0.3		0.1											0.03
Chenopodium album												0.3		0.3	0.2	0.05
Descurainia sophia														9	2.3	0.75
Kochia scoparia												0.3			0.1	0.03
Thlaspi arvense			1	0.3	0.3											0.11
TOTAL IA/BF	**0.0**	**0.0**	**1.3**	**0.3**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.9**	**0.3**	**9.3**	**2.7**	**1.03**
TOTAL VEGETATION (Stratified)	**104.0**	**90.0**	**116.3**	**122.6**	**108.2**	**122.0**	**114.0**	**98.3**	**105.3**	**109.9**	**74.3**	**77.2**	**78.6**	**82.3**	**78.1**	**98.74**

1Nomenclature follows Lesica (2012). Current synonyms (in parentheses) are taken from The National Wetland Plant List (Lichvar 2012), available on the web at: (http://wetland_plants.usace.army.mil/).

2Wetland Indicator Status is derived from the Great Plains Region, National Wetland Plant List (Lichvar 2012).

APPENDIX C

Annual Above Ground Production (grams/m^2) by Plot for Sixteen Sites on Four Transects, Otter Creek AVF Baseline Study Area, 2013.

AVF TRANSECT	TABLE	PAGE
Transect 5	C1	C-1
Transect 6	C2	C-2
Transect 7	C3	C-3
Transect 8	C4	C-5

Footnotes for the tables in Appendix C:

All transect/site locations are shown on Plate 1.

Production samples were harvested in four 0.5m^2 quadrats (0.5 x 1 meter rectangular) at each sample site, dried to constant weight and weighed in the laboratory, and converted to grams per square meter (doubled) for the tables in Appendix C.

Binomials follow Lesica (2012).

Table C1

Annual Above-ground Production (grams/m^2) for Four Sample Sites, Otter Creek AVF Transect 5, 2013.

	TRANSECT 5																			
	SITE 1					SITE 2					SITE 3					SITE 4				
	First Terrace					First Terrace					Second Terrace					Second Terrace				
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean
	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4
CLASS\SPECIES																				
NATIVE PERENNIAL GRAMINOIDS																			0.58	0.15
INTRODUCED PERENNIAL GRAMINOIDS	*434.60*	436.40	287.40	267.60	356.50	342.40	370.70	389.20	415.20	379.38	310.80	409.80	424.20	337.80	370.65	237.80	214.00	223.20	269.20	236.05
NATIVE PERENNIAL FORBS																0.34			0.62	0.24
INTRODUCED PERENNIAL FORBS																				
Alfalfa (*Medicago sativa*)	4.54	13.62	35.10	4.88	14.54	15.18	7.00	10.82	2.00	8.75	11.42	36.14	47.44	27.24	30.56	27.30	0.26	0.26	10.50	9.58
Noxious (*Cirsium arvense*)																				
Other IPF (*Taraxacum laevigatum*)	0.78	1.84	0.10	3.84	1.64	3.64	1.62	0.48	0.92	1.67	0.46	2.20	0.14	2.36	1.29			0.32		0.08
ANNUAL GRAMINOIDS		0.12		0.22	0.09	0.38				0.10										
ANNUAL/BIENNIAL FORBS	4.24	7.12	3.60	9.34	6.08	57.84	2.02	1.98	3.54	16.35	0.34	7.68	1.64	0.98	2.66	3.18	3.16	4.52	7.88	4.69
SHRUBS																				
TOTAL PRODUCTION	**444.16**	**459.10**	**326.20**	**285.88**	**378.84**	**419.44**	**381.34**	**402.48**	**421.66**	**406.23**	**323.02**	**455.82**	**473.42**	**368.38**	**405.16**	**268.62**	**217.42**	**228.30**	**288.78**	**250.78**

Footnotes are presented on cover page C-i.

Table C2

Annual Above-ground Production (grams/m^2) for Four Sample Sites, Otter Creek AVF Transect 6, 2013.

	TRANSECT 6																			
	SITE 1					SITE 2					SITE 3					SITE 4				
	Second Terrace					First Terrace					First Terrace					Second Terrace				
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean
	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4
CLASS\SPECIES																				
NATIVE PERENNIAL GRAMINOIDS	58.12	141.58	329.20	118.38	161.82						10.22	24.52	7.48	2.02	11.06					
INTRODUCED PERENNIAL GRAMINOIDS	317.80	177.60	268.80	160.56	231.19	330.00	470.00	684.20	284.00	442.05	369.56	387.76	260.66	504.60	380.65	535.20	396.60	382.40	384.80	424.75
NATIVE PERENNIAL FORBS																				
INTRODUCED PERENNIAL FORBS																				
Alfalfa (*Medicago sativa*)											0.12		0.32		0.11					
Noxious (*Cirsium arvense*)														1.16	0.29					
Other IPF (*Taraxacum laevigatum*)	36.18	48.18	59.72	29.66	43.44	0.38	3.78	0.42	5.84	2.61	9.40	6.32	0.24		3.99	1.12	0.56	1.06	0.18	0.73
ANNUAL GRAMINOIDS		8.10	3.72	8.06	4.97								0.10		0.03		0.16	0.24	0.52	0.23
ANNUAL/BIENNIAL FORBS	125.68	207.78	81.52	220.00	158.75	0.22	0.08	1.90	3.12	1.33	2.32	4.82	5.82	0.46	3.36	0.38	0.14	2.96	3.88	1.84
SHRUBS																				
TOTAL PRODUCTION	**537.78**	**583.24**	**742.96**	**536.66**	**600.16**	**330.60**	**473.86**	**686.52**	**292.96**	**445.99**	**391.62**	**423.42**	**274.62**	**508.24**	**399.48**	**536.70**	**397.46**	**386.66**	**389.38**	**427.55**

Footnotes are presented on cover page C-i.

Table C3

Annual Above-ground Production (grams/m^2) for Five Sample Sites, Otter Creek AVF Transect 7, 2013.

	TRANSECT 7																			
	SITE 1					SITE 2					SITE 3					SITE 4				
	Second Terrace					First Terrace					First Terrace					Bottom				
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean
	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4
CLASS\SPECIES																				
NATIVE PERENNIAL GRAMINOIDS	9.94		2.76	2.34	3.76	17.66	1.36	14.90	23.42	14.34										
INTRODUCED PERENNIAL GRAMINOIDS	336.40	458.60	246.60	328.20	342.45	259.40	489.20	354.80	278.40	345.45	705.20	623.80	707.80	702.40	684.80	566.00	411.60	436.80	429.80	461.05
NATIVE PERENNIAL FORBS		3.10			0.78				0.16	0.04										
INTRODUCED PERENNIAL FORBS																				
Alfalfa (*Medicago sativa*)						0.10			5.00	1.28								72.10	154.38	56.62
Noxious (*Cirsium arvense*)																				
Other IPF (*Taraxacum laevigatum*)	0.84	3.42	3.92	1.04	2.31		0.26	2.18	2.72	1.29	1.54	0.10		0.10	0.44	3.54	14.54	0.10	0.60	4.70
ANNUAL GRAMINOIDS		0.24	0.30	0.42	0.24											0.26	1.30			0.39
ANNUAL/BIENNIAL FORBS	3.52	4.26	12.06	1.74	5.40		0.14	0.78	0.10	0.26	0.70	0.60	0.52		0.46	53.12	30.54	0.10	2.86	21.66
SHRUBS																				
Artemisia cana	1.12	20.24			5.34	51.48	26.00		2.40	19.97										
TOTAL PRODUCTION	**351.82**	**489.86**	**265.64**	**333.74**	**360.27**	**328.64**	**516.96**	**372.66**	**312.20**	**382.62**	**707.44**	**624.50**	**708.32**	**702.50**	**685.69**	**622.92**	**457.98**	**509.10**	**587.64**	**544.41**

Footnotes are presented on cover page C-i.

Table C3

Annual Above-ground Production (grams/m^2) for Five Sample Sites, Otter Creek AVF Transect 7, 2013.

	TRANSECT 7				
	SITE 5				
	Third Terrace				
	PLOT NUMBER				Mean
	1	2	3	4	Prod.
					n=4
CLASS\SPECIES					
NATIVE PERENNIAL GRAMINOIDS	12.86	3.08	62.88	14.52	23.34
INTRODUCED PERENNIAL GRAMINOIDS	586.00	442.60	295.00	642.40	491.50
NATIVE PERENNIAL FORBS					
INTRODUCED PERENNIAL FORBS					
Alfalfa (*Medicago sativa*)					
Noxious (*Cirsium arvense*)					
Other IPF (*Taraxacum laevigatum*)	3.14	15.68	41.42	7.04	16.82
ANNUAL GRAMINOIDS	15.44	3.32	0.10	0.10	4.74
ANNUAL/BIENNIAL FORBS	8.98	0.72	0.26	0.60	2.64
SHRUBS					
Artemisia cana			1.54		0.39
TOTAL PRODUCTION	**626.42**	**465.40**	**401.20**	**664.66**	**539.42**

Footnotes are presented on cover page C-i.

Table C4

Annual Above-ground Production (grams/m^2) for Three Sample Sites, Otter Creek AVF Transect 8, 2013.

	TRANSECT 8														
	SITE 1					SITE 2					SITE 3				
	Second Terrace					First Terrace					Second Terrace				
	PLOT NUMBER				Mean	PLOT NUMBER				Mean	PLOT NUMBER				Mean
	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4	1	2	3	4	Prod. n=4
CLASS\SPECIES															
NATIVE PERENNIAL GRAMINOIDS		175.12			43.78	16.78	74.44	51.02	114.42	64.17					
INTRODUCED PERENNIAL GRAMINOIDS	400.20	203.40	611.40	430.80	411.45	547.40	188.60	4.40	158.82	224.81	373.60	476.00	497.00	480.40	456.75
NATIVE PERENNIAL FORBS															
INTRODUCED PERENNIAL FORBS															
Alfalfa (*Medicago sativa*)	165.66	9.02	212.40	216.00	150.77	124.06	279.80	454.80	266.60	281.32					
Noxious (*Cirsium arvense*)															
Other IPF (*Taraxacum laevigatum*)	4.44	4.26	7.50	0.16	4.09		1.82		0.30	0.53					
ANNUAL GRAMINOIDS															
ANNUAL/BIENNIAL FORBS			1.26	0.12	0.35						1.08	1.88	0.50	39.24	10.68
SHRUBS															
TOTAL PRODUCTION	**570.30**	**391.80**	**832.56**	**647.08**	**610.44**	**688.24**	**544.66**	**510.22**	**540.14**	**570.82**	**374.68**	**477.88**	**497.50**	**519.64**	**467.43**

Footnotes are presented on cover page C-i.

APPENDIX D

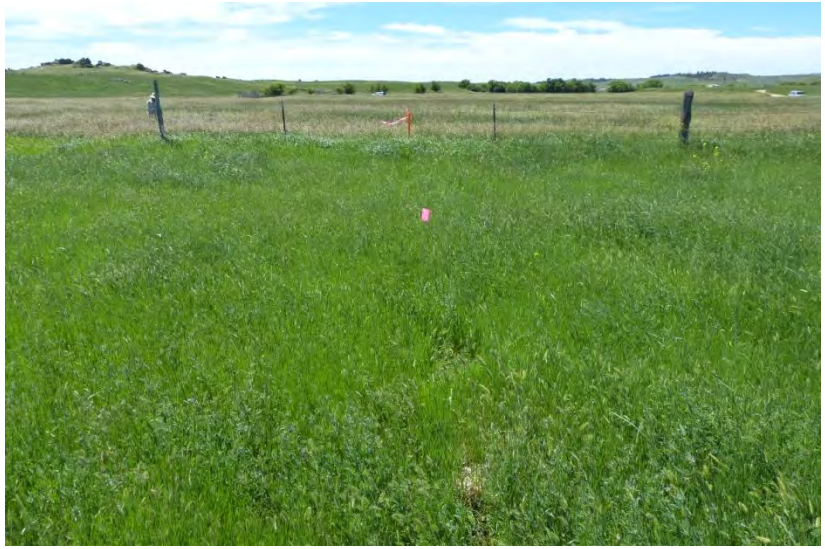
Otter Creek AVF Photos, 2013

AVF TRANSECT	SITE	PAGE
Transect 5	1	D-1
	2	D-2
	3	D-3
	4	D-4
Transect 6	1	D-5
	2	D-7
	3	D-8
	4	D-9
Transect 7	1	D-10
	2	D-11
	3	D-12
	4	D-13
	5	D-14
Transect 8	1	D-15
	2	D-16
	3	D-17

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 5 – Site 1 Facing North

Transect 5 – Site 1 Facing East



Transect 5 – Site 1 Facing South

Transect 5 – Site 1 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 5 – Site 2 Facing North

Transect 5 – Site 2 Facing East

Transect 5 – Site 2 Facing South

Transect 5 – Site 2 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 5 – Site 3 Facing North

Transect 5 – Site 3 Facing East

Transect 5 – Site 3 Facing South

Transect 5 – Site 3 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 5 – Site 4 Facing North

Transect 5 – Site 4 Facing East

Transect 5 – Site 4 Facing South

Transect 5 – Site 4 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 6 – Site 1 (6/29/13) Facing North

Transect 6 – Site 1 (8/21/13) Facing Northwest

Transect 6 – Site 1 (6/29/13) Facing West

Transect 6 – Site 1 (8/21/13) Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 6 – Site 1 (6/29/13) Facing East

Transect 6 – Site 1 (6/29/13) Facing South

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 6 – Site 2 Facing North

Transect 6 – Site 2 Facing East

Transect 6 – Site 2 Facing South

Transect 6 – Site 2 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

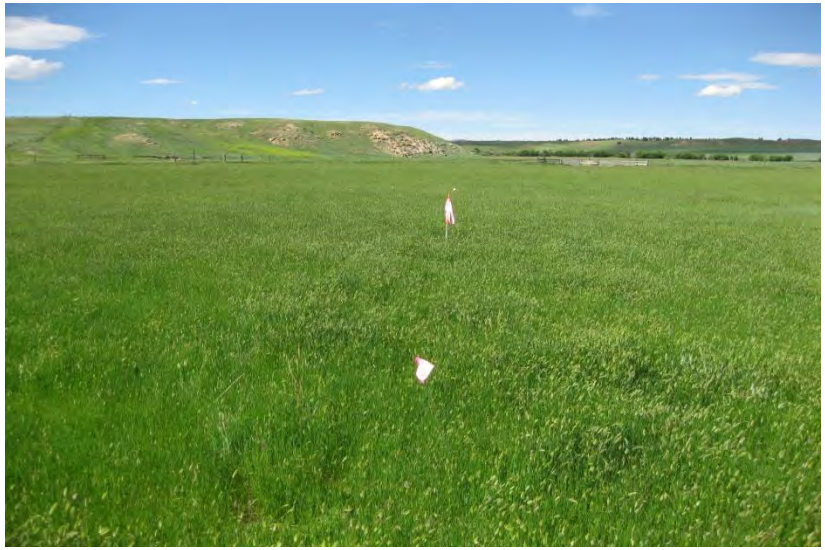
Transect 6 – Site 3 Facing North

Transect 6 – Site 3 Facing East

Transect 6 – Site 3 Facing South

Transect 6 – Site 3 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013



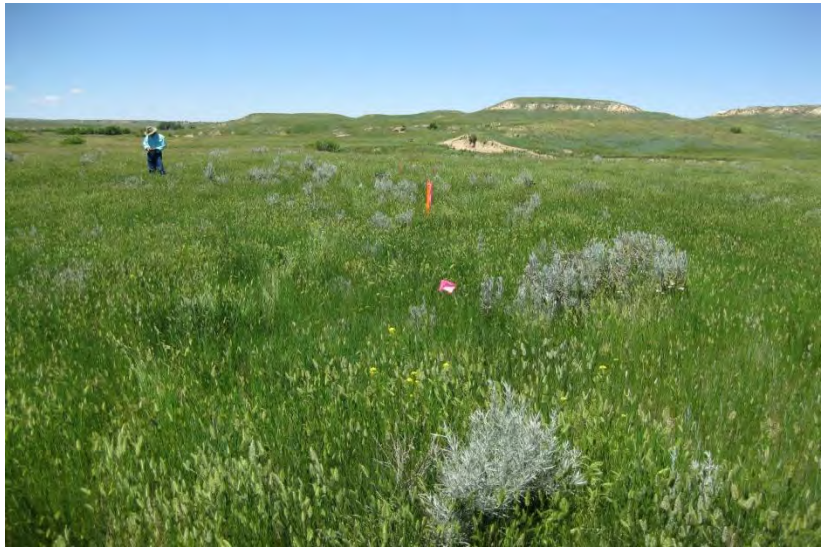
Transect 6 – Site 4 Facing North

Transect 6 – Site 4 Facing East

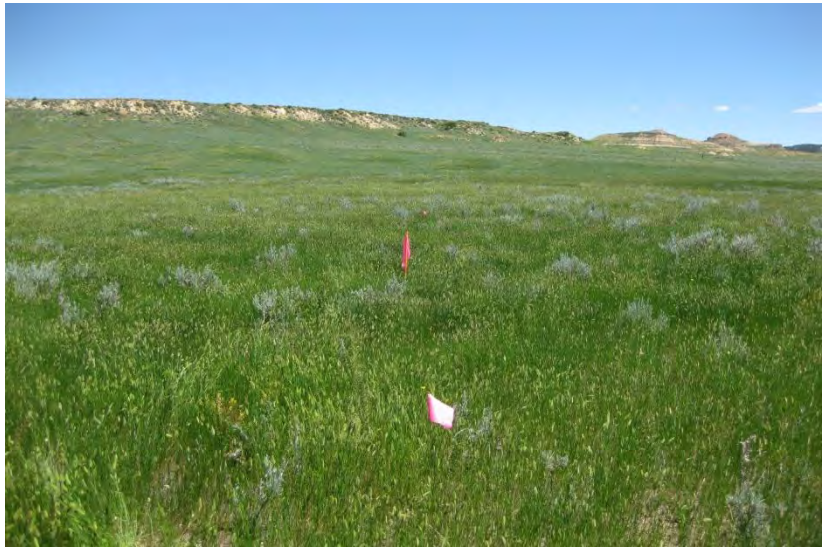
Transect 6 – Site 4 Facing South

Transect 6 – Site 4 Facing West

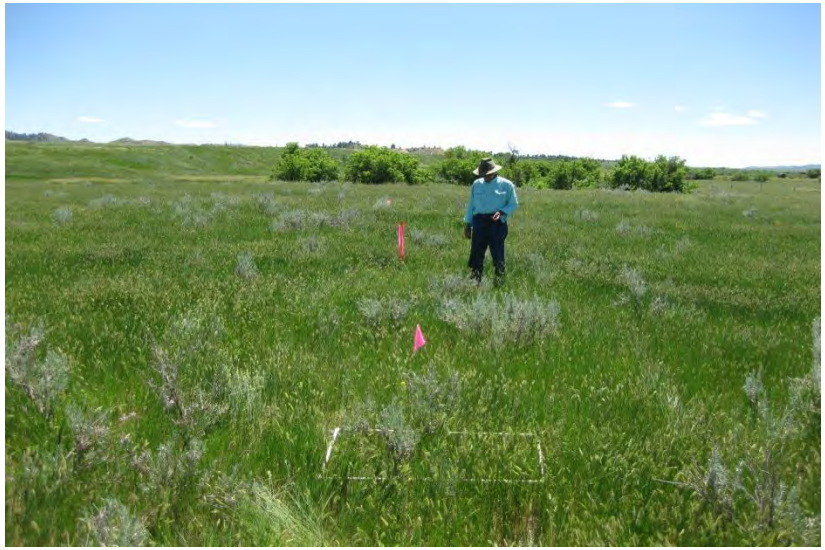
APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013



Transect 7 – Site 1 Facing North



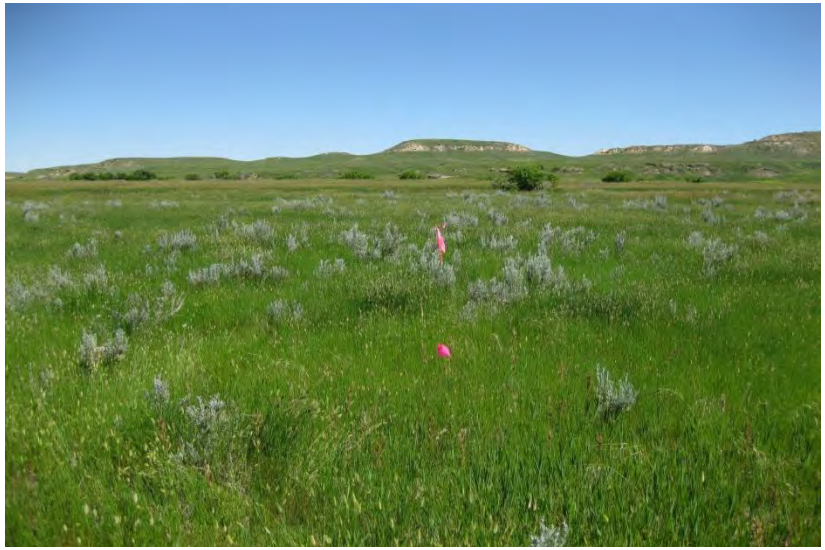
Transect 7 – Site 1 Facing East



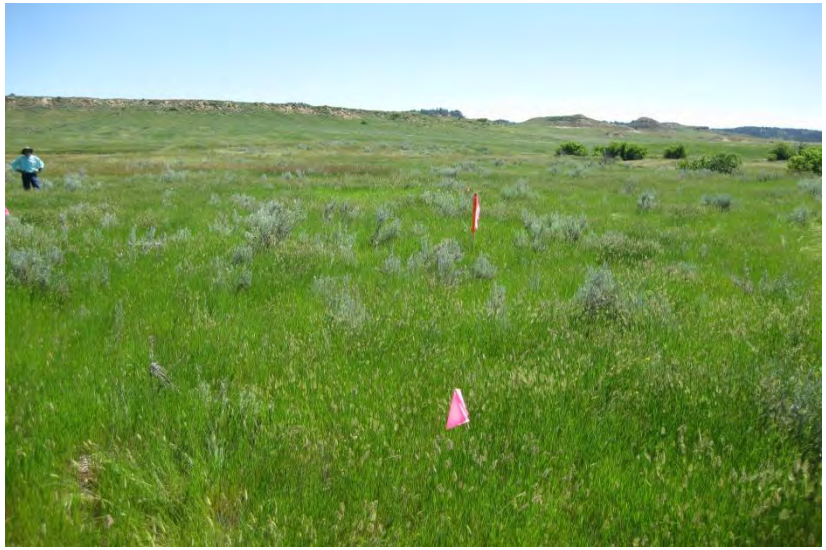
Transect 7 – Site 1 Facing South

Transect 7 – Site 1 Facing West

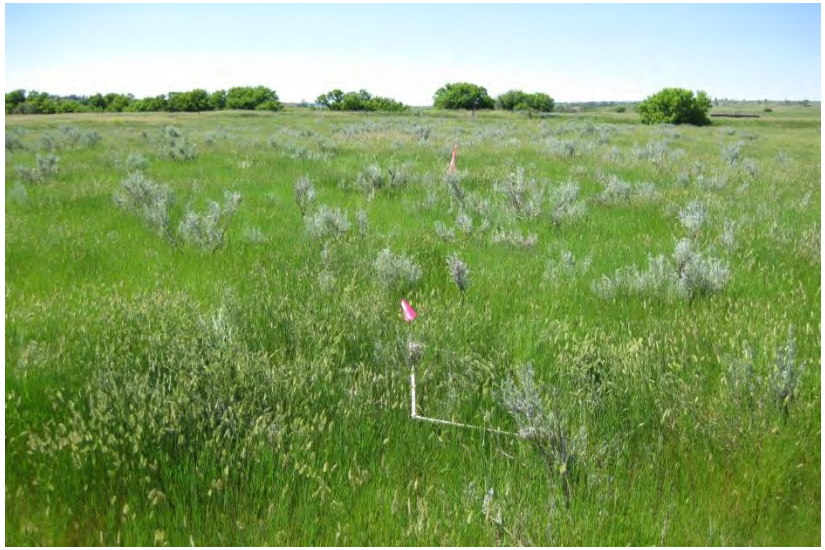
APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013



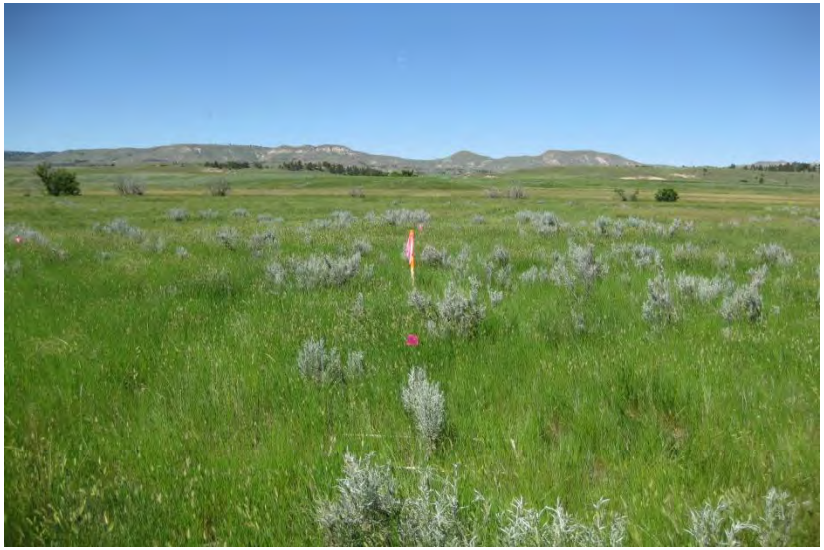
Transect 7 – Site 2 Facing North



Transect 7 – Site 2 Facing East



Transect 7 – Site 2 Facing South



Transect 7 – Site 2 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 7 – Site 3 Facing North

Transect 7 – Site 3 Facing East

Transect 7 – Site 3 Facing South

Transect 7 – Site 3 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

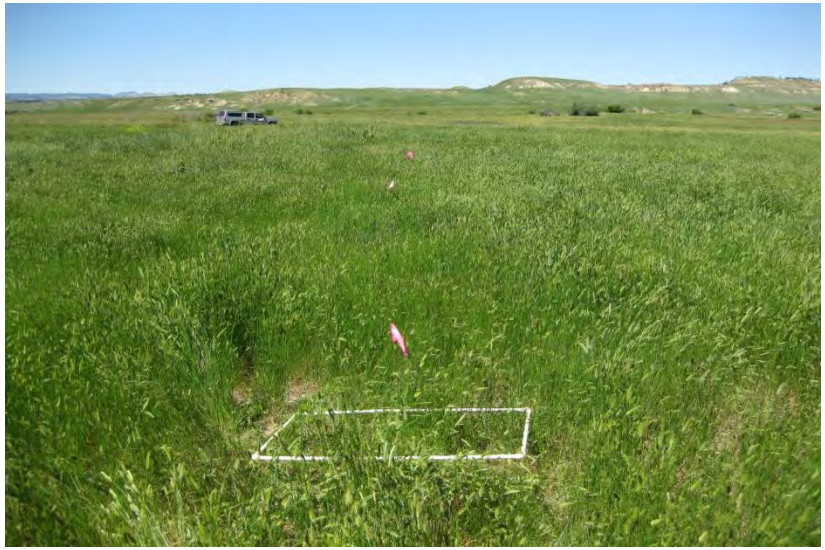
Transect 7 – Site 4 Facing North

Transect 7 – Site 4 Facing East

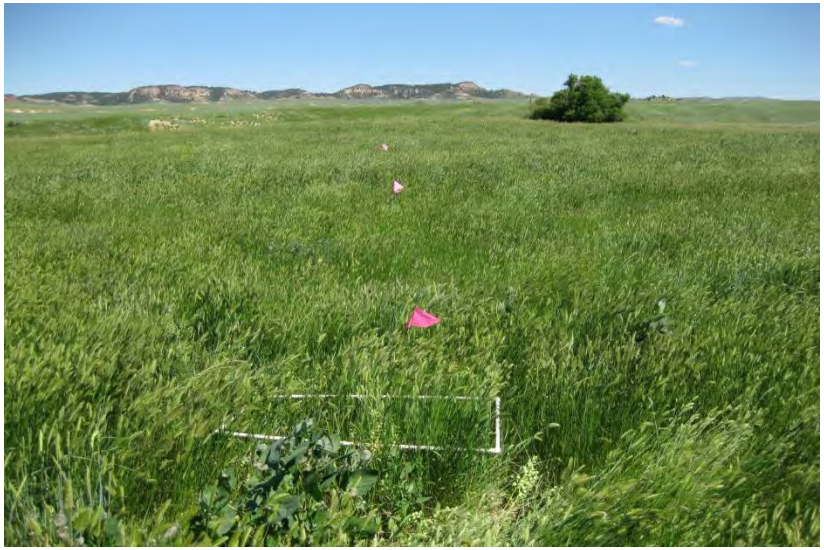
Transect 7 – Site 4 Facing South

Transect 7 – Site 4 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013



Transect 7 – Site 5 Facing North



Transect 7 – Site 5 Facing Southeast

Transect 7 – Site 5 Facing South

Transect 7 – Site 5 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 8 – Site 1 Facing North

Transect 8 – Site 1 Facing East

Transect 8 – Site 1 Facing South

Transect 8 – Site 1 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 8 – Site 2 Facing North

Transect 8 – Site 2 Facing East

Transect 8 – Site 2 Facing South

Transect 8 – Site 2 Facing West

APPENDIX D. OTTER CREEK AVF Sample Site Photos, 2013

Transect 8 – Site 3 Facing North

Transect 8 – Site 3 Facing East

Transect 8 – Site 3 Facing South

Transect 8 – Site 3 Facing West