COAL CREEK STABILIZATION PROJECT

CONCEPTUAL PLANNING PHASE

Wyoming Game and Fish Department Project

Lincoln County, Wyoming

(Sections 25,26, 27, & 36 – T28N, R119W, 6th P.M.)

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⚒ ENGINEER'S CERTIFICATE ⚒

WE HEREBY CERTIFY, THAT WE HAVE PREPARED OR DIRECTLY SUPERVISED THE PREPARATION OF THIS REPORT, AND THAT WE ARE DULY REGISTERED PROFESSIONAL ENGINEERS IN THE STATE OF WYOMING.

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COAL CREEK STABILIZATION PROJECT – CONCEPTUAL PLANNING PHASE
Wyoming Game and Fish Department Project
Lincoln County, WY (Sections 25, 26, 27, & 36 – T28N, R119W, 6th P.M.)

1.0 PROJECT DESCRIPTIONS

1.1 Overall Site Summary

Several locations along Coal Creek have eroded along the banks over the past years, due to natural precipitation runoff, livestock grazing, and construction of a two-track road which altered the natural topography of the land and thus the existing runoff flow path. In addition to the creek bank erosion, several storm conveyance structures have diminished and washed out over the years. The erosion problem has been an increasing concern along certain areas of interest of Coal Creek; therefore the Wyoming Game and Fish Department (WGFD) and Bureau of Land Management (BLM) have begun planning for stabilization improvements for these areas along Coal Creek, and one area along Little Muddy Creek. The areas of interest for the Coal Creek Stabilization Project are located in Lincoln County, WY in Sections 25, 26, 27, and 36, Township 28 North, Range 119 West, of the 6th Principal Meridian. The project starts (on the west end) approximately 1-3/4 miles east of Wyoming Highway 89, and ends approximately two (2) miles to the southeast in the north half of Section 36, Township 28 North, Range 119 West. (See Quad/Vicinity Map and Google Earth Map in Appendix A for the general location along Coal Creek which will be discussed in this report. The Google Earth Map includes ownership boundaries and names in addition to the general location of the project.)

The BLM and WGFD personnel, along with AVI pc, have evaluated the two (2) mile stretch of Coal Creek for areas of concern (some areas of which are higher priority than others). Eleven (11) sites were identified along this stretch of Coal Creek (See Appendix B for the Overall Project Site Map along Coal Creek). Site #1, actually situated along Little Muddy Creek, is located on the southeast end of the project, and Site #11 is located at the northwest end of the project, with the site identification numbers increasing as the project proceeds from the southeast end of the project to the northwest end of the project. For discussion purposes of each site, a general description of the sites erosion problems will be summed up, different options for alleviating the erosion will be outlined; conceptual cost estimates compiled for each site (and each option of each site), and lastly the 11 sites will be prioritized in a separate section of this report. Together, the site cost estimates and the site priorities will help the Wyoming Game and Fish Department plan the regrading, reclamation, creek re-routing, culvert placement, potential erosion material to use, and other general solutions to stabilize and improve the creek banks, and adjacent two track road, for the 11 sites identified along Coal Creek, in Lincoln County, WY.

For the Coal Creek-bank stabilization portion of the improvements, each site will be given a general bank area recommended to be stabilized. The recommended erosion control materials for the 11 sites will include, but are not limited to, Armortec blocks, permanent and/or temporary turf reinforcement mats (mat brand to be determined), Bonded Fiber Matrix material, Coconut Fiber erosion control blanket, riprap rock material, and possible concrete placement. As aforementioned, each site will have a cost estimate associated with the different stabilization and/or reclamation options considered to stabilize the creek banks. (See Appendix E for erosion Product Data Information) For some sites, a total realignment of the Coal Creek channel is presented as an option to stabilize the bank. All proposed storm structures (at locations where the roadway crosses Coal Creek and/or Little Muddy Creek) should be designed based on HS-20 loadings.

Also addressed in this report are several other miscellaneous considerations relevant to all of the sites. The other miscellaneous considerations will focus on temporary fence placement, revegetation material (near the creek, and on the steeper slopes), and existing roadway improvements features.

1.2 Individual Site Descriptions

Site 1, situated in the north half of Section 36 along Little Muddy Creek, encompasses replacing a structure crossing and modifying the roadways at this location (down to a single two-track road).

Site 2, stretches from the north half of Section 36 up into the South half of Section 25, and consists of five (5) separate sub-sites (sites 2-1, 2-2, 2-3, 2-4, and 2-5). Sites 2-1, 2-2, and 2-3 consist of different options to improve, and stabilize, the creek bank slopes. Site 2-4 looks at three (3) separate structure options for constructing a roadway crossing across Coal Creek. Site 2-5 includes costs for reclaiming a stretch of roadway connecting Site 1 to Site 2-4.

Site 3, located in the southwest quarter of Section 25, looks at different options for stabilizing the roadway toe slope.

Site 4, located in the southwest quarter of Section 25, inspects options for roadway improvements, existing storm structure improvements, and slope stabilization.

Site 5, also located in the southwest quarter of Section 25, outlines roadway toe slope and backslope stabilization options, and roadway improvements.

Site 6, sited in the southwest quarter of Section 25, reviews options for roadway toe slope and backslope stabilization options, roadway improvements, and a roadway realignment. This site also looks at using a retaining wall as a tool for improving the slope stability, and the general costs associated with constructing a retaining wall.

Site 7, situated approximately 600 feet northwest of Site 6, includes stabilizing the roadway toeslope in place, and includes roadway erosion improvements.

Site 8, located in northeast quarter of Section 26, outlines different options for improving a storm structure crossing Coal Creek Road (with options for constructing a new culvert).

Site 9, found in the northeast quarter of Section 26, looks at stabilizing and grading Coal Creek Road, and reviews an option to re-route the creek.

Site 10, also located in the northeast quarter of Section 26, outlines stabilization options including creek realignment with re-grading, and also outlines roadway toeslope and backslope stabilization in place.

Site 11 (located in the northeast quarter of Section 27), which is the very northwest site for this project, breaks out options for stabilizing the creek banks.

Section 2.0 – Summary Of Sites includes detailed individual site summaries, cost estimates, and a more in depth description of each site. For simplicity purposes, a table is shown below, which outlines each of the sites (and sites options) Total Improvement Costs.

INDIVIDUAL SITE TOTAL COSTS (BY OPTION)	
SITE #1	
SITE 1 – OPTION 1	**$ 19,591.83**
SITE 1 – OPTION 2A	**$ 46,008.33**
SITE 1 - OPTION 2B	**$ 53,008.33**
SITE 1 – OPTION 2C	**$ 62,008.33**
SITE #2	
SITE 2-1 – OPTION 1	**$ 24,937.55**
SITE 2-1 – OPTION 2	**$ 15,740.05**
SITE 2-2 – OPTION 1	**$ 46,491.55**
SITE 2-2 – OPTION 2	**$ 28,772.55**
SITE 2-3 – OPTION 1	**$ 18,275.05**
SITE 2-3 – OPTION 2	**$ 43,813.55**
SITE 2-4 – OPTION 1A	**$ 39,306.95**
SITE 2-4 – OPTION 1B	**$ 46,306.95**
SITE 2-4 – OPTION 1C	**$ 55,306.95**
SITE 2-5 – OPTION 1	**$ 7,972.55**
SITE #3	
SITE 3 – OPTION 1	**$ 16,121.75**
SITE 3 – OPTION 2	**$ 17,909.25**
SITE #4	
SITE 4 – OPTION 1	**$ 7,206.13**
SITE 4 – OPTION 2	**$ 12,633.63**
SITE #5	
SITE 5 – OPTION 1	**$ 16,052.20**
SITE 5 – OPTION 2	**$ 17,027.20**
SITE #6	
SITE 6 – OPTION 1	**$ 23,250.88**
SITE 6 – OPTION 2	**$ 22,860.88**
SITE 6 – OPTION 3	**$ 127,868.38**
SITE #7	
SITE 7 – OPTION 1	**$ 24,948.88**
SITE #8	
SITE 8 – OPTION 1	**$ 7,801.93**
SITE 8 – OPTION 2A	**$ 65,695.43**
SITE 8 – OPTION 2B	**$ 76,695.43**
SITE 8 – OPTION 2C	**$ 91,695.43**
SITE 8 – OPTION 3	**$ 12,676.93**
SITE #9	
SITE 9 – OPTION 1	**$ 50,737.25**
SITE #10	
SITE 10 – OPTION 1	**$ 28,182.80**
SITE 10 – OPTION 2	**$ 11,867.80**
SITE 10 – OPTION 3	**$ 14,753.80**
SITE #11	
SITE 11 – OPTION 1	**$ 31,811.63**
SITE 11 – OPTION 2	**$ 21,704.13**

For Site 2-1 Option 1, Site 2-2 Option 2, Site 2-3 Option 1, Site 4 Option 2, Site 9 Option 1, Site 10 Option 1, and Site 11 Option 2, extra engineering will be required for channel relocation work. A lump sum of $20,000 should be added to overall project cost to account for this extra engineering if channel realignment is chosen for any site.

2.0 SITE REMEDIATION ALTERNATIVES AND COST ESTIMATES

2.1 **SITE #1**: (See Appendix C for a Topographic Survey Map of Site #1)

Site #1 consists of an existing timber bridge crossing that has washed out. Old deck timbers are stockpiled on the west side of Little Muddy Creek. The east railroad tie abutment is still in place. Due to the washout, a low water crossing has developed to the south of the old timber bridge. Several two track roads converge from varying direction to the crossing.

The best option appears to be to place a new crossing at the site of the washout, and regrade and fill in the south low water crossing. The drainage structure (to be HS-20 rated) for the new crossing could be one of the following:

1.) Reinforced Concrete Box (10'x4')
2.) Bridge Structure
3.) Structural Steel Multiplate Drainage Structure (73" x 55")

The following table is a cost estimate summarizing the conceptual costs to repair washout at Site #1. The cost estimate breaks out the cost for each of the aforementioned options. Note that for all of the sites cost estimates, the Project Overhead cost IS included/added into the total project improvements costs. Of the 11 sites throughout this project, only Site #1 is located at Little Muddy Creek, while the rest of the project sites are located along Coal Creek.

SITE 1: (PRIORITY LEVEL #9)					
**Option 1 - South Low Water Crossing Improvements*					
**Option 2 - Structure Improvements at North Crossing*					
ITEM NO.	**ITEM**	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**TOTAL AMOUNT**
I.	**Project Overhead**				
	Mobilization	LS	1	$4,226.83	$4,226.83
	Force Account	FA	1	$1,000.00	$1,000.00
Sub Total Project Overhead					**$5,226.83**
II.	**Project Improvements**				
ALL OPTIONS	Remove Existing Timber Bridge	LS	1	$1,500.00	$1,500.00
ALL OPTIONS	Temporary Coffer Dam	SF	180	$30.00	$5,400.00
OPTION 1	Regrade/Remove South Low Water Crossing	LS	1	$2,000.00	$2,000.00
OPTION 1	Fill Material for South Low Water Crossing	CY	75	$10.00	$750.00
OPTION 1	Revegetation	SY	280	$5.00	$1,400.00
Sub Total OPTION 1 Project Improvements					**$11,050.00**

OPTION 2	Fill Material for Structure	CY	15	$15.00	$225.00
OPTION 2	Crushed Base Grading 'W' (6")	SY	40	$22.00	$880.00
OPTION 2	Riprap (Class 12)	CY	50	$75.00	$3,750.00
Option 2A	Install Reinforced Concrete Box (10'x4')	LF	20	$600.00	$12,000.00
Option 2A	Concrete Headwall & Wingwall	EA	2	$3,000.00	$6,000.00
Option 2B	Install Bridge Structure	LF	20	$800.00	$16,000.00
Option 2B	Bridge Structure Abutments	EA	2	$4,500.00	$9,000.00
Option 2C	Install Steel Multiplate Drainage Structure (73” x 55”)	LF	40	$550.00	$22,000.00
Option 2C	Headwall & Wingwall for Steel Multiplate Drainage Structure	EA	4	$3,000.00	$12,000.00
Sub Total OPTION 2A Project Improvements					**$29,755.00**
Sub Total OPTION 2B Project Improvements					**$36,755.00**
Sub Total OPTION 2C Project Improvements					**$45,755.00**
OPTION 1 - 15% CONTINGENCY					$1,657.50
OPTION 2 - 15% CONTINGENCY					$5,513.25
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$1,657.50
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$5,513.25
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$19,591.83**
OPTION 2A PROJECT IMPROVEMENTS COSTS					**$46,008.33**
OPTION 2B PROJECT IMPROVEMENTS COSTS					**$53,008.33**
OPTION 2C PROJECT IMPROVEMENTS COSTS					**$62,008.33**

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(Site 1 - East View)

(Site 1 – East View)

(Site 1 – North View)

(Site 1 – East View)

2.2 **SITE #2**: (See Appendix C for a Topographic Survey Map of Site #2)

Site #2 consists of a larger area along the creek with several eroded banks and a low water crossing. Site #2 consists of five (5) subareas (Areas 2-1, 2-2, 2-3, 2-4, and 2-5). Beginning on the northwest end of Site #2, there is a small disturbed toe slope that could be graded and reclaimed in place (See Area 2-1 on Topographic Survey map in Appendix C). At this same location, a road relocation could begin, and run onto the ridge to the west of the current road. The relocation would parallel the existing road for around 1200 feet to the existing cattle guard at the southeast edge of the disturbance. Also included with Site 2-1 costs, are two (2) 18" RCP Culverts with Flared End Sections (Seen on Site 2-2 and Site 2-3 improvement drawings). Both of these culverts are proposed to be installed between Sites 2-2 and 2-3, at two (2) separate locations where the natural topography of the land carries runoff, which converges to a point discharge thus creating greater erosion potential.

The roadway realignment was examined, and it was determined that this option is not viable for the full stretch of Site #2 (excluding Site 2-5); this is because the existing backslopes (west of the road) are in the range of 2:1 to 3:1, so moving the road to the north would only make the backslope steeper. Certain smaller stretches of the roadway realignment were then examined, and a realignment at Site 2-3 could work with proposed backslope grades of 4:1 catching the existing ground.

Near the southeast end of the site there is an existing low water crossing (Area 2-4 on Topographic Survey Map in Appendix C) that needs to have a formal crossing of a type similar to that discussed at Site #1.

At Area 2-2 (See Topographic Survey Map in Appendix C) someone had made an earlier attempt to re-route the creek away from the roadway. Now the creek has two channels in this area. A better job could be done to make the realignment permanent; then regrade and reclaim slope adjacent to the realignment of Coal Creek. Also for this site, an option of constructing a new retaining wall, including grading operations, was priced.

In Area 2-3 (See Topographic Survey Map in Appendix C) it is also an option to relocate the creek giving some room to regrade and reclaim the slope. As aforementioned, a roadway realignment at this area of concern was examined in order to improve the erosion along the banks.

If the roadway is not relocated, the crown needs to be reversed such that runoff doesn't run directly off the road into the creek, but instead flows in a borrow ditch along the west side of the road and taken into the creek in a stable fashion. This may also require the placement of a couple small (12" or 18" RCP) culverts.

The overall options for Site #2, Area 2-1 and Area 2-4 are as described above. For Areas 2-2 and 2-3, options to fix the erosion along the creek banks include:

1.) If the road is relocated, the areas can be regraded using the area of the roadway to help flatten slopes. After relocation and regrading, all areas will need stabilized and reclaimed.
2.) If the road is not relocated the best option would be to perform a creek relocation in these areas. Regrade the slopes after the relocation, and then reclaim and stabilize the entire site. Also at these two (2) locations, reverse the crown and place new culverts.
3.) Without moving the road it would be very difficult to reclaim Area 2-2. If retaining walls were designed and constructed at this area, reclamation of this

area could be done. There is room to push the road west if desired, at Area 2-3. Again, under this option the roadway crown would be regraded.

Site Area 2-5 is an existing two track roadway running from Site 1 to Site 2-4 (in the north half of Section 36). The existing two track road is approximately 1915 lineal feet long and crosses the creek at one (1) known location. Also, the road was assumed to be 7.5' wide, based on the roadway width obtained from the survey shots near Site 1. This existing roadway will need to be reclaimed (and removed from use). Costs are examined for ripping, scarifying, seeding, fertilizing, and mulching for the reclamation of this roadway.

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize each of the four (4) subareas at Site #2. The cost estimate breaks out the cost for each of the aforementioned options.

SITE 2: (PRIORITY LEVEL #2)					
SITE 2-1:					
**Option 1 - Creek Realignment*					
**Option 2 - Slope Stabilization In-Place*					
ITEM NO.	**ITEM**	**UNIT**	**QUANTITY**	**AVG. UNIT PRICE**	**TOTAL AMOUNT**
I.	**Project Overhead**				
	Mobilization	LS	1	$2,812.55	$2,812.55
	Force Account	FA	1	$1,000.00	$1,000.00
Sub Total Project Overhead					**$3,812.55**
II.	**Site 2-1 Project Improvements**				
ALL OPTIONS	18" RCP Culvert w/ FES (EA End)	EA	2	$1,500.00	$3,000.00
ALL OPTIONS	Unclassified Excavation and Regrade/Recompact Road	LS	1	$4,000.00	$4,000.00
OPTION 1	Import Fill Material	CY	405	$5.00	$2,025.00
OPTION 1	Revegetation	SY	695	$5.00	$3,475.00
OPTION 1	Riprap (Class 12)	CY	50	$75.00	$3,750.00
Sub Total OPTION 1 Project Improvements					**$16,250.00**
OPTION 2	Stabilize and Revegetate In-Place	SY	145	$15.00	$2,175.00
Sub Total OPTION 2 Project Improvements					**$9,175.00**
OPTION 1 - 15% CONTINGENCY					$2,437.50
OPTION 2 - 15% CONTINGENCY					$1,376.25
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$2,437.50
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$1,376.25
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$24,937.55**
OPTION 2 PROJECT IMPROVEMENTS COSTS					**$15,740.05**

SITE 2-2:

**Option 1 - Retaining Wall Installation*

**Option 2 - Creek Realignment*

II.	**Site 2-2 Project Improvements**				
OPTION 1	"Design Pro" Retaining Wall	SF	1050	$30.00	$31,500.00
OPTION 1	Unclassified Excavation	CY	130	$3.50	$455.00
OPTION 1	Revegetation	SY	175	$5.00	$875.00
Sub Total OPTION 1 Project Improvements					**$32,830.00**
OPTION 2	18" ADS N-12 HDPE Pipe	LF	70	$30.00	$2,100.00
OPTION 2	18" HDPE FES	EA	2	$300.00	$600.00
OPTION 2	Nyloplast Inlet	EA	2	$900.00	$1,800.00
OPTION 2	Import Fill Material	CY	180	$5.00	$900.00
OPTION 2	Revegetation & Stabilization Material	SY	670	$15.00	$10,050.00
OPTION 2	Riprap (Class 12)	CY	50	75	$3,750.00
Sub Total OPTION 2 Project Improvements					**$19,200.00**
OPTION 1 - 15% CONTINGENCY					$4,924.50
OPTION 2 - 15% CONTINGENCY					$2,880.00
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$4,924.50
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$2,880.00
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$46,491.55**
OPTION 2 PROJECT IMPROVEMENTS COSTS					**$28,772.55**

SITE 2-3:

**Option 1 - Creek Realignment*

**Option 2 - Road Realignment*

II.	**Site 2-3 Project Improvements**				
OPTION 1	Import Fill Material	CY	525	$5.00	$2,625.00
OPTION 1	Revegetation	SY	950	$5.00	$4,750.00
OPTION 1	Riprap (Class 12)	CY	50	$75.00	$3,750.00
Sub Total OPTION 1 Project Improvements					**$11,125.00**
OPTION 2	Unclassified Excavation	CY	2500	$3.50	$8,750.00
OPTION 2	Crushed Base Grading 'W' (Road Realigned)	SY	515	$8.00	$4,120.00
OPTION 2	Revegetation	SY	2740	$5.00	$13,700.00
OPTION 2	18" ADS N-12 HDPE Pipe	LF	60	$30.00	$1,800.00
OPTION 2	18" HDPE FES	EA	2	$300.00	$600.00
OPTION 2	Nyloplast Inlet	EA	2	$900.00	$1,800.00
Sub Total OPTION 2 Project Improvements					**$30,770.00**
OPTION 1 - 15% CONTINGENCY					$1,668.75

OPTION 2 - 15% CONTINGENCY	$4,615.50
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$1,668.75
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$4,615.50
OPTION 1 PROJECT IMPROVEMENTS COSTS	**$18,275.05**
OPTION 2 PROJECT IMPROVEMENTS COSTS	**$43,813.55**

SITE 2-4:

**Option 1A - Reinforced Concrete Box Drainage Structure*

**Option 1B- Bridge Structure*

**Option 1C - Structural Steel Plate Arch Pipe Drainage Structure*

II.	**Site 2-4 Project Improvements**				
OPTION 1	Excavate / Dredge Creek Bottom to Prepare Culvert Placement	LS	1	$1,500.00	$1,500.00
OPTION 1	Temporary Coffer Dam	SF	72	$30.00	$2,160.00
OPTION 1	Crushed Base Grading 'W' (6" - Road)	SY	16	$8.00	$128.00
OPTION 1	Import Fill Material (Crossing Improvements)	CY	10	$15.00	$150.00
OPTION 1	Riprap (Class 12)	CY	50	$75.00	$3,750.00
OPTION 1A	Install Reinforced Concrete Box (10'x4')	LF	20	$600.00	$12,000.00
OPTION 1A	Concrete Headwall & Wingwall	EA	2	$3,000.00	$6,000.00
OPTION 1B	Install Bridge Structure	LF	20	$800.00	$16,000.00
OPTION 1B	Bridge Structure Abutment	EA	2	$4,500.00	$9,000.00
OPTION 1C	Install Steel Multiplate Drainage Structure (73”x55”)	LF	40	$550.00	$22,000.00
OPTION 1C	Headwall & Wingwall for Steel Multiplate Drainage Structures	EA	4	$3,000.00	$6,000.00
Sub Total OPTION 1A Project Improvements					**$25,688.00**
Sub Total OPTION 1B Project Improvements					**$32,688.00**
Sub Total OPTION 1C Project Improvements					**$41,688.00**
15% CONTINGENCY					$4,903.20
15% CONTINGENCY – DESIGN / CONSTRUCTION MANAGEMENT FEES					$4,903.20
OPTION 1A PROJECT IMPROVEMENTS COSTS					**$39,306,95**
OPTION 1B PROJECT IMPROVEMENTS COSTS					**$46,306.95**
OPTION 1C PROJECT IMPROVEMENTS COSTS					**$55,306.95**

SITE 2-5:					
**Option 1 – Roadway Reclamation*					
II.	**Site 2-5 Project Improvements**				
OPTION 1	Ripping and Scarifying	SY	1600	$1.00	$1,600.00
OPTION 1	Seeding, Fertilizer, and Mulch	SY	1600	$1.00	$1,600.00
Sub Total OPTION 1 Project Improvements					**$3,200.00**
15% CONTINGENCY					$480.00
15% CONTINGENCY – DESIGN / CONSTRUCTION MANAGEMENT FEES					$480.00
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$7,972,55**

(Site 2-1 – South View)

(Site 2-1 – South View)

(Site 2-2 – North View)

(Site 2-2 – North View)

(Site 2-3 – South View)

(Site 2-3 – South View)

(Site 2-4)

2.3 **SITE #3**: (See Appendix C for a Topographic Survey Map of Site #3)

The erosion concern for this site consists of an area of slope damage that is not that steep. A large grass buffer strip exists between the toe slope and Coal Creek.

The best option here would be to regrade the slope in place, stabilize and reclaim the entire disturbed area. Looking at another option, there is room to flatten the roadway toeslope to 4:1, and catch the toeslope near the creek edge. The other improvement option for Site #3 is to place a culvert under the roadway, creating a catchment area on the upstream side. Also, the roadway crown needs to slope to the west side of the road into a borrow ditch leading to the new culvert.

SITE 3: (PRIORITY LEVEL #8)

**Option 1 - Roadway Toeslope Grading & Stabilization / Revegetataion*

**Option 2- Roadway Toeslope Stabilization In-Place*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$1,374.25	$1,374.25
	Force Account	FA	1	$1,000.00	$1,000.00
	Sub Total Project Overhead				**$2,374.25**
II.	**Project Improvements**				
ALL OPTIONS	Roadway Grading/Shaping	LF	140	$20.00	$2,800.00
ALL OPTIONS	18" ADS N-12 HDPE Pipe	LF	30	$30.00	$900.00
ALL OPTIONS	18" HDPE FES	EA	1	$300.00	$300.00
ALL OPTIONS	Nyloplast Inlet	EA	1	$900.00	$900.00
OPTION 1	Revegetation	SY	905	$5.00	$4,525.00
OPTION 1	Import Fill Material	CY	230	$5.00	$1,150.00
Sub Total OPTION 1 Project Improvements					**$10,575.00**
OPTION 2	Stabilize & Revegetate In-Place	SY	470	$15.00	$7,050.00
Sub Total OPTION 2 Project Improvements					**$11,950.00**
OPTION 1 - 15% CONTINGENCY					$1,586.25
OPTION 2 - 15% CONTINGENCY					$1,792.50
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$1,586.25
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$1,792.50
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$16,121.75**
OPTION 2 PROJECT IMPROVEMENTS COSTS					**$17,909.25**

(Site 3 – East View)

(Site 3 – South View)

(Site 3 – South View)

(Site 3 – North View)

2.4 **SITE #4**: (See Appendix C for a Topographic Survey Map of Site #4)

A smaller toe side bank with little to no buffer between the slope and the creek is the concern for this site. Natural cut banks on the north and south end could also be reclaimed.

Options for improving and stabilizing this site could be one of the following:

1.) The toe slope could be regraded and reclaimed in place; however, shifting the road slightly to the west could flatten the slope.

2.) Another option would be to shift the creek to the east, placing fill material to flatten the roadway toeslope, and then reclaiming the area.

3.) There is an existing 18" culvert at this site that needs removed, cleaned, and reset. Also, lower the downstream invert of the 18" culvert to match the toe of the slope.

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize Site #4. The cost estimate breaks out the cost for each of the aforementioned options.

SITE 4: (PRIORITY LEVEL #4)

**Option 1 - Existing Culvert Improvements*

**Option 2 - Creek Realignment*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$986.13	$986.13
	Force Account	FA	1	$500.00	$500.00
Sub Total Project Overhead					**$1,486.13**
II.	**Project Improvements**				
ALL OPTIONS	Roadway Grading/Shaping	LF	120	$20.00	$2,400.00
OPTION 1	Remove, Clean, & Reset Existing 18" CMP Culvert	LS	1	$1,800.00	$1,800.00
OPTION 1	Unclassified Excavation and Regrade/Recompact Road	LS	1	$200.00	$200.00
	Sub Total Option 1 Improvements				**$4,400.00**
OPTION 2	Import Fill Material	CY	75	$5.00	$375.00
OPTION 2	Revegetation	SY	410	$5.00	$2,050.00
OPTION 2	Riprap (Class 12)	CY	50	$75.00	$3,750.00
	Sub Total Option 2 Improvements				**$8,575.00**
OPTION 1 - 15% CONTINGENCY					$660.00
OPTION 2 - 15% CONTINGENCY					$1,286.25
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$660.00
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$1,286.25
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$7,206.13**
OPTION 2 PROJECT IMPROVEMENTS COSTS					**$12,633.63**

(Site 4 – South View)

(Site 4 – North View)

(Site 4 – Downstream end of Culvert)

(Site 4 – Upstream end of Culvert)

2.5 **SITE #5**: (See Appendix C for a Topographic Survey Map of Site #5)

The toe side slope at this site has very little buffer strip between the slope and the creek. Options for improving and stabilizing this site could be one of the following:

1.) There is some room to push the roadway to the west to create room to flatten the toe side slope. To stabilize the slope, a permanent turf reinforcing mat is recommended in addition to revegetating the slope. This creates an extremely steep backslope, as the existing road backslope is near 2:1, therefore after examining this option, it seems moving the roadway to the west is not feasible because of the extremely steep existing backslopes.

2.) Also at this site, the roadway could be crowned with a borrow ditch on the west side. A culvert would need added on the upstream side to catch and direct runoff into the creek.

3.) Stabilizing and reclaiming the slopes in place is also an option.

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize Site #5. The cost estimate breaks out the cost for each of the aforementioned options.

SITE 5: (PRIORITY LEVEL #3)

**Option 1 - Roadway Toeslope Stabilization In-Place*

**Option 2 - Roadway Backslope Stabilization In-Place*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$1,343.20	$1,343.20
	Force Account	FA	1	$500.00	$500.00
	Sub Total Project Overhead				**$1,843.20**
II.	**Project Improvements**				
ALL OPTIONS	Roadway Grading/Shaping	LF	125	$20.00	$2,500.00
ALL OPTIONS	18" ADS N-12 HDPE Pipe	LF	56	$30.00	$1,680.00
ALL OPTIONS	18" HDPE FES	EA	2	$300.00	$600.00
ALL OPTIONS	Nyloplast Inlet	EA	2	$900.00	$1,800.00
OPTION 1	Toe Slope Stabilization & Revegetation	SY	290	$15.00	$4,350.00
Sub Total OPTION 1 Project Improvements					**$10,930.00**
OPTION 2	Backslope Stabilization & Revegetation	SY	340	$15.00	$5,100.00
Sub Total OPTION 2 Project Improvements					**$11,680.00**
OPTION 1 - 15% CONTINGENCY					$1,639.50
OPTION 2 - 15% CONTINGENCY					$1,752.00
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$1,639.50
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$1,752.00
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$16,052.20**
OPTION 2 PROJECT IMPROVEMENTS COSTS					**$17,027.20**

(Site 5 – South View)

(Site 5 – West View)

(Site 5 – South View)

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2.6 **SITE #6**: (See Appendix C for a Topographic Survey Map of Site #6)

Erosion at Site #6 is the same as Site #5, except that there is some buffer strip on the toe side slope. The same recommendations could be used at this site to improve and stabilize the area.

In addition to the options recommended at Site #5 for Site #6, a new retaining wall option was reviewed. This layout option includes placing a new retaining wall along the creek edge, with a newly constructed road placed adjacent to the new wall, and 3:1 roadway backslopes tying to the existing ground uphill of the road. This option could be used at Sites #5 and #7 also, but was only priced for Site #6 (the price to construct this retaining wall option at Sites #5 and #7 would be similar due to the fact that these areas are all similar in their layout and erosion concern.)

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize Site #6. The cost estimate breaks out the cost for each option.

SITE 6: (PRIORITY LEVEL #5)

**Option 1 - Roadway Toeslope Stabilization In-Place*

**Option 2 - Roadway Backslope Stabilization In-Place*

**Option 3 - Roadway Realignment w/ Retaining Wall & Backslope Grading and Stabilization*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$1,808.38	$1,808.38
	Force Account	FA	1	$1,000.00	$1,000.00
	Sub Total Project Overhead				**$2,808.38**
II.	**Project Improvements**				
OPTIONS 1 & 2	Roadway Grading/Shaping	LF	175	$20.00	$3,500.00
ALL OPTIONS	18" ADS N-12 HDPE Pipe	LF	60	$30.00	$1,800.00
ALL OPTIONS	18" HDPE FES	EA	2	$300.00	$600.00
ALL OPTIONS	Nyloplast Inlet	EA	2	$900.00	$1,800.00
OPTION 1	Toe Slope Stabilization & Revegetation	SY	535	$15.00	$8,025.00
Sub Total OPTION1 Project Improvements					**$15,725.00**
OPTION 2	Backslope Stabilization & Revegetation	SY	515	$15.00	$7,725.00
Sub Total OPTION 2 Project Improvements					**$15,425.00**
OPTION 3	Crushed Base Grading 'W'	SY	450	$22.00	$9,900.00
OPTION 3	New Roadway Shaping	LS	1	$4,000.00	$4,000.00
OPTION 3	"Design Pro" Retaining Wall	SF	1875	$30.00	$56,250.00
OPTION 3	Revegetation & Stabilization Material	SY	840	$15.00	$12,600.00
OPTION 3	Import Fill Material	CY	1850	$5.00	$9,250.00
Sub Total OPTION 3 Project Improvements					**$96,200.00**

OPTION 1 - 15% CONTINGENCY	$2,358.75
OPTION 2 - 15% CONTINGENCY	$2,313.75
OPTION 3 - 15% CONTINGENCY	$14,430.00
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$2,358.75
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$2,313.75
OPTION 3 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$14,430.00
OPTION 1 PROJECT IMPROVEMENTS COSTS	**$23,250.88**
OPTION 2 PROJECT IMPROVEMENTS COSTS	**$22,860.88**
OPTION 3 PROJECT IMPROVEMENTS COSTS	**$127,868.38**

(Site 6 – West View)

(Site 6 – North View)

(Site 6 – South View)

2.7 **SITE #7**: (See Appendix C for a Topographic Survey Map of Site #7)

This site is very similar to the layout of Sites #5 and #6; however there is no room to relocate the roadway, due to the very steep slopes. Also, there is a small vegetation buffer strip between the toe of the slope and the creek. Because of the buffer strip, this site does not necessary need to be stabilized at this point in time.

An option for stabilizing the slope along this creek bank would be to contour and grade the slope in place, revegetate the slope and place permanent turf reinforcing mats for maximum vegetation reinforcement. Crown the road such that runoff doesn't run directly off the road into the creek, but instead flows in a borrow ditch along the south side of the road and taken into the creek in a stable fashion. This may also require the placement of a couple small (12" or 18" RCP) culverts.

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize Site #7. The cost estimate breaks out the cost for each of the aforementioned options.

SITE 7: (PRIORITY LEVEL #6)

**Option 1 - Roadway Toeslope Stabilization In-Place*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$1,946.38	$1,946.38
	Force Account	FA	1	$1,000.00	$1,000.00
	Sub Total Project Overhead				**$2,946.38**
II.	**Project Improvements**				
OPTION 1	Roadway Grading/Shaping	LF	220	$20.00	$4,400.00
OPTION 1	18" ADS N-12 HDPE Pipe	LF	65	$30.00	$1,950.00
OPTION 1	18" HDPE FES	EA	2	$300.00	$600.00
OPTION 1	Nyloplast Inlet	EA	2	$900.00	$1,800.00
OPTION 1	Stabilization & Revegetate In-Place	SY	545	$15.00	$8,175.00
Sub Total Project Improvements					**$16,925.00**
15% CONTINGENCY					$2,538.75
15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$2,538.75
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$24,948.88**

(Site 7 – East View)

(Site 7 – North View)

(Site 7 – West View)

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2.8 SITE #8: (See Appendix C for a Topographic Survey Map of Site #8)

Two (2) existing 71" x 47" arch pipes exist at this site. The existing 71" x 47" arch pipes have a capacity of 150 cfs (See Appendix D for Culvert Master Reports), and are in pretty good operating condition, relevant to hydraulic conveyance.

Options for improving hydraulic conveyance at this site include:

1.) The culverts are in average operating condition, but the creek at the upstream end of the pipes needs some grading in order to get better flow hydraulics to the culverts.
2.) The two (2) pipes could be replaced with either open bottom arch structure (73" x 55"), a box culvert (10' x 4'), or a bridge structure. The storm structure chosen to replace these existing culverts should also convey at least 150 cfs. Additionally, the new culverts should be HS-20 rating (which is typical of all new storm structures crossing Coal Creek or Little Muddy Creek).
3.) Excavate the creek bottom at the downstream end of the culverts, and place new riprap in order to protect against erosion.

The following table is a cost estimate summarizing the conceptual costs to improve the storm structure at Site #8. The cost estimate breaks out the cost for each of the aforementioned options.

SITE 8: (PRIORITY LEVEL #10)

**Option 1 - Grading at Upstream Inverts*

**Option 2 - New Culvert Installation*

**Option 3 - Riprap*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$6,151.93	$6,151.93
	Force Account	FA	1	$1,000.00	$1,000.00
	Sub Total Project Overhead				**$7,151.93**
II.	**Project Improvements**				
OPTION 1	Grade Area at Upstream Culvert Invert	CY	5	$100.00	$500.00
Sub Total OPTION 1 Project Improvements					**$500.00**
OPTION 2	Remove Existing 71" x 47" Arch CMP Culverts	LF	82	$15.00	$1,230.00
OPTION 2	Unclassified Excavation	CY	190	$3.50	$665.00
OPTION 2	Crushed Base Grading 'W'	SY	25	$22.00	$550.00
OPTION 2	Temporary Coffer Dam	SF	210	$30.00	$6,300.00
OPTION 2	Riprap (Class 12)	CY	50	$75.00	$3,750.00
OPTION 2A	Install Reinforced Concrete Box (10'x4')	LF	40	$600.00	$24,000.00
OPTION 2A	Concrete Headwall & Wingwall	EA	2	$3,000.00	$6,000.00
OPTION 2B	Install Bridge Structure	LF	40	$800.00	$32,000.00
OPTION 2B	Bridge Structure Abutment	EA	2	$4,500.00	$9,000.00
OPTION 2C	Install Steel Multiplate Drainage Structure (73" x 55")	LF	80	$550.00	$44,000.00
OPTION 2C	Headwall & Wingwall for Steel Multiplate Drainage Structures	EA	4	$3,000.00	$12,000.00

Sub Total OPTION 2A Project Improvements					**$42,495.00**
Sub Total OPTION 2B Project Improvements					**$53,495.00**
Sub Total OPTION 2C Project Improvements					**$68,495.00**
OPTION 3	Excavate / Dredge Creek Bottom to Prepare Riprap Placement	LS	1	$1,250.00	$1,250.00
OPTION 3	Riprap (Class 12)	CY	40	$75.00	$3,000.00
Sub Total OPTION 3 Project Improvements					**$4,250.00**
OPTION 1 – 15% CONTINGENCY					$75.00
OPTION 2 - 15% CONTINGENCY					$8,024.25
OPTION 3 - 15% CONTINGENCY					$637.50
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$75.00
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$8,024.25
OPTION 3 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$637.50
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$7,801.93**
OPTION 2A PROJECT IMPROVEMENTS COSTS					**$65,695.43**
OPTION 2B PROJECT IMPROVEMENTS COSTS					**$76,695.43**
OPTION 2C PROJECT IMPROVEMENTS COSTS					**$91,695.43**
OPTION 3 PROJECT IMPROVEMENTS COSTS					**$12,676.93**

(Site 8 – North View)

(Site 8 – West View)

(Site 8 – Upstream end of Culverts)

(Site 8 – Downstream end of Culverts)

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2.9 **SITE #9**: (See Appendix C for a Topographic Survey Map of Site #9)

At this site, there is a long barren slope (approximately 220 lineal feet along the creek) with the creek running immediately adjacent to the toe of the slope. The slope is highly erodeable and it is likely that additional material is added periodically, as a maintenance measure, to keep the roadway in place. The creek bottom at this location has a surprisingly hard bottom, consisting of clay and gravel.

The options for stabilizing this site are as follows:

1.) Relocate the creek to the south, then place fill material and grade to flatten the toe slope; stabilize and reclaim the area also.

2.) The current bank is too steep to stabilize and reclaim in place. On the west and east ends there is room for some backsloping of the natural cut banks at each end. The roadway could be moved to the north, flattening the slope, and creating a buffer strip at the toe. This would create a very steep backslope, on the north side, for the roadway.

-For both of these two (2) options, create a crown in the road to direct roadway runoff to a new borrow ditch along the north side of the roadway, and install a new culvert to direct runoff from the borrow ditch into the creek.

The roadway realignment to the north was examined, and it was determined that this option is not viable; this is because the existing backslopes (north of the road) are in the range of 2:1 to 3:1, so moving the road to the north would only make the backslope steeper.

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize Site #9. The cost estimate breaks out the cost for each of the aforementioned options.

SITE 9: (PRIORITY LEVEL #1)

**Option 1 - Creek Realignment*

**Option 2 (NOT viable) - Roadway Realignment is NOT viable*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$4,042.25	$4,042.25
	Force Account	FA	1	$1,000.00	$1,000.00
	Sub Total Project Overhead				**$5,042.25**
II.	**Project Improvements - Option #1**				
OPTION 1	18" ADS N-12 HDPE Pipe	LF	50	$30.00	$1,500.00
OPTION 1	18" HDPE FES	EA	2	$300.00	$600.00
OPTION 1	Nyloplast Inlet	EA	2	$900.00	$1,800.00
OPTION 1	Import Fill Material	CY	2500	$5.00	$12,500.00
OPTION 1	Revegetation	SY	2200	$5.00	$11,000.00
OPTION 1	Roadway Grading/Shaping	LF	200	$20.00	$4,000.00
OPTION 1	Riprap (Class 12)	CY	50	$75.00	$3,750.00
Sub Total Project Improvements					**$35,150.00**

15% CONTINGENCY	$5,272.50
15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$5,272.50
OPTION 1 PROJECT IMPROVEMENTS COSTS	**$50,737.25**

(Site 9 – East View)

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(Site 9 – West View)

(Site 9 – West View)

(Site 9)

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2.10 **SITE #10**: (See Appendix C for a Topographic Survey Map of Site #10)

A roadside bank has been trampled and grazed at this site, thus damaging the vegetation. There is a small grass buffer strip at the toe of the slope to the creek.

The options for stabilizing Site #10 are as follows:

1.) Regrade the slope, install Armor blocks or place permanent turf reinforcement mats, and reclaim the slope in place.
2.) One possibility for regarading is to flatten the slopes at the north and south ends into the natural vegetated flats.
3.) The roadway could be narrowed slightly, then flatten the slope. It would be tough to move the road to the east due to the steep and rocky backslope materials for the existing road cut, and because the fence line (and assumed property line) is only approximately 40 feet from the east edge of the road.
4.) Reroute the creek to the west at the existing bends, place fill to flatten the slope, and create an additional buffer area. This would include regrading, stabilizing, and reclaiming activities.
5.) An option of stabilizing and revegetating the roadway backslope, in place, is priced also.

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize Site #10. The cost estimate breaks out the cost for each of the aforementioned options.

SITE 10: (PRIORITY LEVEL #7)

**Option 1 - Creek Realignment*

**Option 2 - Toeslope Stabilization In-Place*

**Option 3 - Backslope Stabilization In-Place*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$1,117.80	$1,117.80
	Force Account	FA	1	$1,000.00	$1,000.00
Sub Total Project Overhead					**$2,117.80**
II.	**Project Improvements**				
OPTION 1	Import Fill Material	CY	1100	$5.00	$5,500.00
OPTION 1	Revegetation	SY	2160	$5.00	$10,800.00
OPTION 1	Riprap (Class 12)	CY	50	$75.00	$3,750.00
Sub Total OPTION 1 Project Improvements					**$20,050.00**
OPTION 2	Toe Slope Stabilization / Revegetation	SY	500	$15.00	$7,500.00
	Sub Total OPTION 2 Project Improvements				**$7,500.00**
OPTION 3	Rock Excavation	SY	540	$3.00	$1,620.00
OPTION 3	Backslope Stabilization / Revegetation	SY	540	$15.00	$8,100.00
Sub Total OPTION 3 Project Improvements					**$9,720.00**

OPTION 1 - 15% CONTINGENCY	$3,007.50
OPTION 2 - 15% CONTINGENCY	$1,125.00
OPTION 3 - 15% CONTINGENCY	$1,458.00
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$3,007.50
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$1,125.00
OPTION 3 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES	$1,458.00
OPTION 1 PROJECT IMPROVEMENTS COSTS	**$28,182.80**
OPTION 2 PROJECT IMPROVEMENTS COSTS	**$11,867.80**
OPTION 3 PROJECT IMPROVEMENTS COSTS	**$14,753.80**

(Site 10 – North View)

(Site 10 – North View)

(Site 10 – North / East View)

(Site 10 – East View)

(Site 10 – North View)

2.11 **SITE #11**: (See Appendix C for a Topographic Survey Map of Site #11)

At this site, there is bank erosion that is not associated with the roadway; it is just the natural cut bank.

The options for stabilizing this site are as follows:

1.) Flatten slopes to 4:1 at the creek bank, and catch the new 4:1 into the existing natural ground, and create a buffer strip.

2.) Reroute the channel to the south at natural oxbow points, then place fill material and grade to flatten the toe slope; stabilize and reclaim the area also.

The following table is a cost estimate summarizing the conceptual costs to improve and stabilize Site #11. The cost estimate breaks out the cost for each of the aforementioned options.

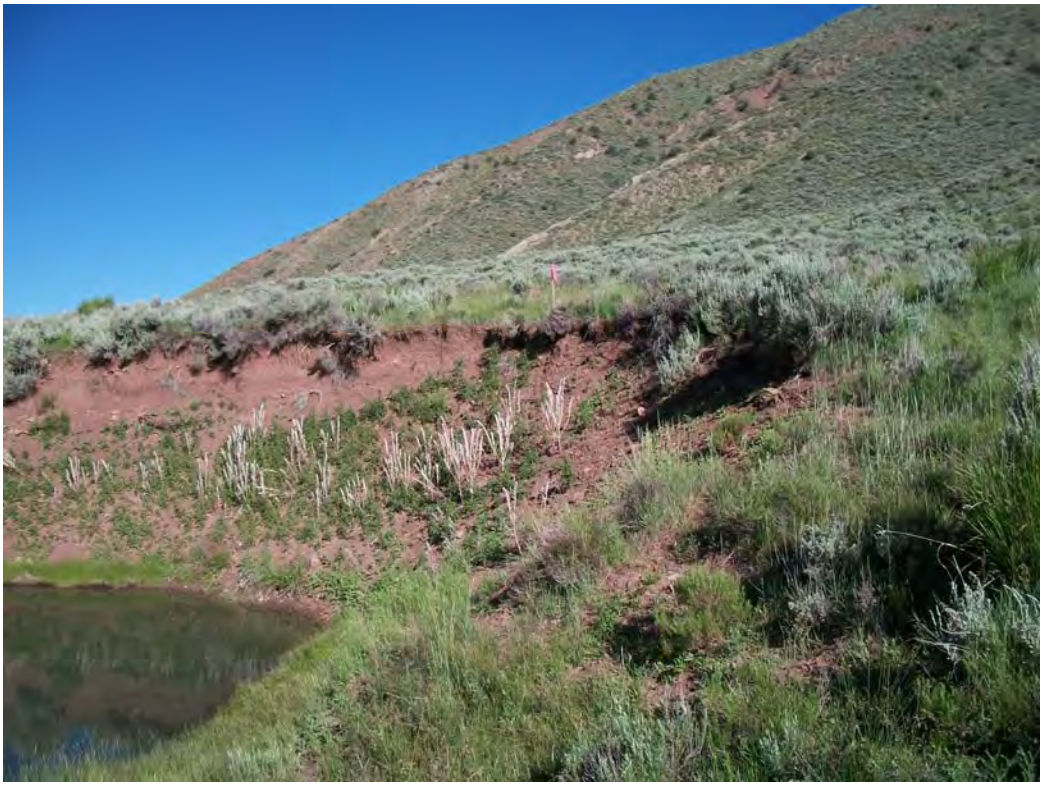
SITE 11: (PRIORITY LEVEL #11)

**Option 1 - Existing Creek Sideslope Grading & Stabilization*

**Option 2 - Creek Realignment*

ITEM NO.	ITEM	UNIT	QUANTITY	AVG. UNIT PRICE	TOTAL AMOUNT
I.	**Project Overhead**				
	Mobilization	LS	1	$2,504.13	$2,504.13
	Force Account	FA	1	$1,000.00	$1,000.00
Sub Total Project Overhead					**$3,504.13**
II.	**Project Improvements**				
OPTION 1	Unclassified Excavation	CY	1100	$3.50	$3,850.00
OPTION 1	Revegetation & Stabilization Material	SY	1195	$15.00	$17,925.00
Sub Total OPTION 1 Project Improvements					**$21,775.00**
OPTION 2	Import Fill Material	CY	1030	$5.00	$5,150.00
OPTION 2	Revegetation	SY	1020	$5.00	$5,100.00
OPTION 2	Riprap	CY	50	$75.00	$3,750.00
Sub Total OPTION 2 Project Improvements					**$14,000.00**
OPTION 1 - 15% CONTINGENCY					$3,266.25
OPTION 2 - 15% CONTINGENCY					$2,100.00
OPTION 1 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$3,266.25
OPTION 2 - 15% DESIGN / CONSTRUCTION MANAGEMENT FEES					$2,100.00
OPTION 1 PROJECT IMPROVEMENTS COSTS					**$31,811.63**
OPTION 2 PROJECT IMPROVEMENTS COSTS					**$21,704.13**

(Site 11 – West View)



(Site 11 – North View)

(Site 11 – North / West View)

(Site 11 – South View)

(Site 11)

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3.0 SITE PRIORITIES

For the 11 sites examined by Wyoming Game and Fish Department and AVI pc, a priority was associated with each site, as to which sites need improved and stabilized first. The sites were prioritized based on the magnitude of the erosion, the location of the erosion in relation to the existing roadway and storm structures, the current state of vegetation at the sites, quality of storm structures, traffic considerations, etc. The following list prioritizes each of the 11 sites (1 being the highest priority)

Site Priorities:
1 – Site #9
2 – Site #2
3 – Site #5
4 – Site #4
5 – Site #6
6 – Site #7
7 – Site #10
8 – Site #3
9 – Site #1
10 – Site #8
11 – Site #11

4.0 OTHER CONSIDERATIONS

The main issue with the slope stabilization options is the ability to keep the livestock off of the new vegetation, in order to establish and maintain revegetation over the long term. Temporary fence will likely be needed to keep the livestock off of the new vegetation, stabilization, and reclamation areas along Coal Creek, in order to achieve new vegetation growth. WGFD personnel, BLM personnel, and the Private Land Owners throughout the Coal Creek Erosion Improvements sites will coordinate the fence placement-location and timing amongst each other to maximize the livestock grazing opportunities while minimizing the damage done by the livestock to the new vegetation.

As far as the seeding, vegetating, and surfacing material along Coal Creek, willow planting is the preference for revegetation near the creek. For the steeper improved side slopes uphill of the creek, and roadway, a seed mix should be used which matches the existing ground cover throughout the 11 sites.

Extra road grading and gravel placement will be needed at the sites which elect to improve the roadway running along, and across Coal Creek, and at sites where new culverts will be placed at the low water crossings.

APPENDIX A

COAL CREEK QUAD/VICINITY MAP
&
COAL CREEK GOOGLE EARTH MAP

(WITH OWNERSHIP BOUNDARIES SHOWN)

AREA OF INTEREST ALONG COAL CREEK
(INCLUDES A 2 MILE ± STRETCH)

TOWNSHIP 28 NORTH
RANGE 119 WEST
6TH P.M.
LINCOLN COUNTY, WY

MILE POST 58

WYOMING HIGHWAY 89

3 MILES ± TO WYOMING
/ IDAHO STATE LINE

SCALE 1:24 000

United States Geological Survey 1967

H:\3090\Coal Creek\survey\Drawings\TOPO AND GOOGLE MAP OF COAL CREEK.DWG Mar 08, 2011 - 9:08am Robb

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK

DRAWING TITLE:
QUAD / VICINITY MAP

PRELIMINARY PLAN
NOT FOR CONSTRUCTION
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1103 OLD TOWN LANE, SUITE 10
CHEYENNE, WY 82009

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JKM	7-16-10

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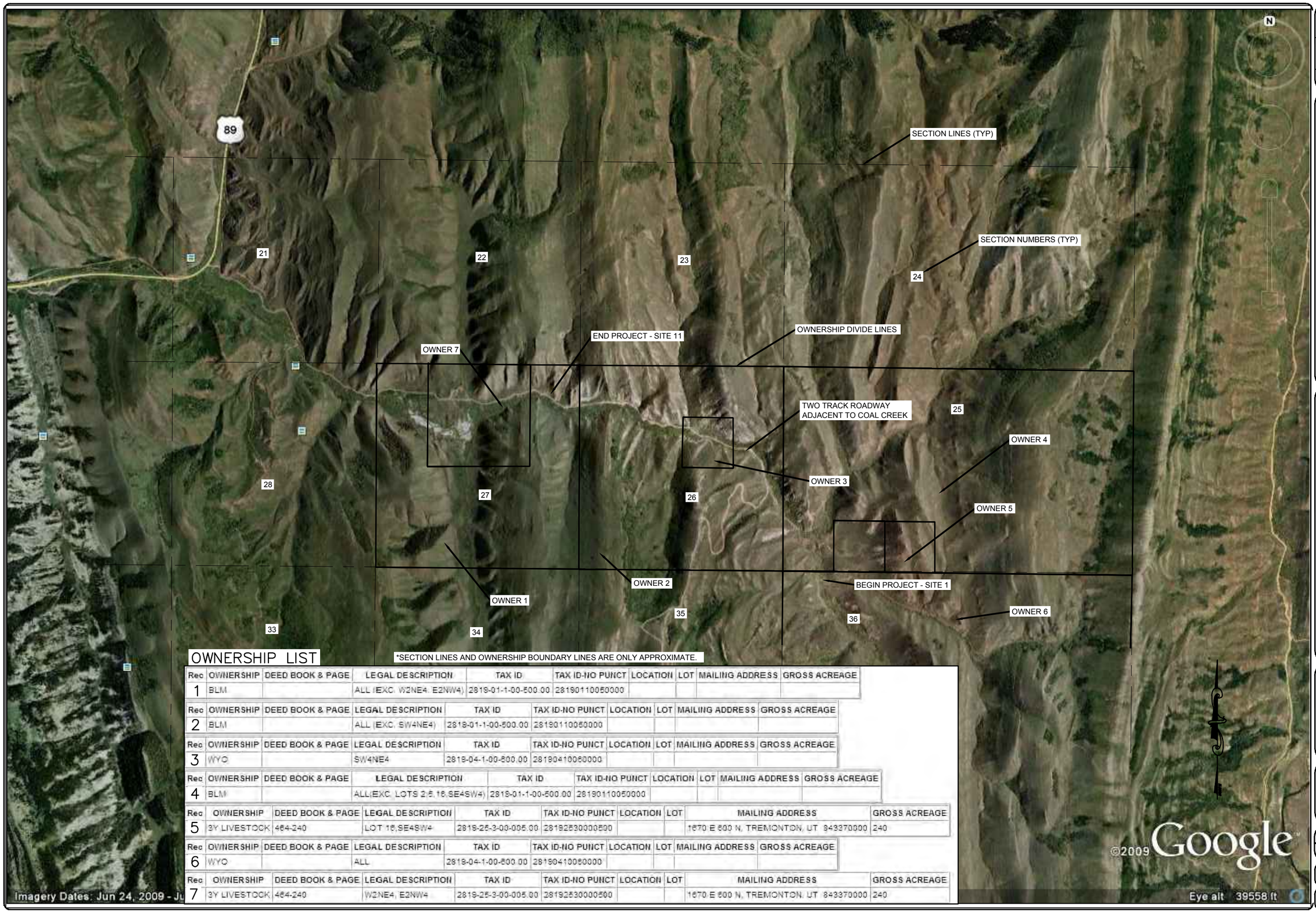

OWNERSHIP LIST

*SECTION LINES AND OWNERSHIP BOUNDARY LINES ARE ONLY APPROXIMATE.

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
1	BLM		ALL (EXC. W2NE4, E2NW4)	2819-01-1-00-500.00	28190110050000				

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
2	BLM		ALL (EXC. SW4NE4)	2819-01-1-00-500.00	28190110050000				

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
3	WYO		SW4NE4	2819-04-1-00-500.00	28190410050000				

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
4	BLM		ALL(EXC. LOTS 2,5,16,SE4SW4)	2819-01-1-00-500.00	28190110050000				

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
5	3Y LIVESTOCK	464-240	LOT 16,SE4SW4	2819-25-3-00-005.00	28192530000560			1670 E 600 N, TREMONTON, UT 843370000	240

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
6	WYO		ALL	2819-04-1-00-500.00	28190410050000				

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
7	3Y LIVESTOCK	464-240	W2NE4, E2NW4	2819-25-3-00-005.00	28192530000560			1670 E 600 N, TREMONTON, UT 843370000	240

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK

DRAWING TITLE:
GOOGLE EARTH MAP

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CHEYENNE, WY 82009

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APPENDIX B

OVERALL PROJECT SITE MAP

OWNER AREA 7
OWNER AREA 1
OWNER AREA 2
SITE 11
SITE 10
DIRECTION OF CREEK FLOW
OWNER AREA 4
SITE 8
SITE 7
EXISTING FENCELINE
SITE 9
OWNER AREA 3
SITE 6
SITE 5
SITE 4
SITE 3
OWNER AREA 5
SITE 2
OWNER AREA 6
SITE 2-5
SITE 1
7080
6800
6600
6450
6467
6483
6533
6555
26
Creek
Spring
Little Muddy Cr
Stoner Cr

OWNERSHIP LIST: OWNERSHIP BOUNDARY LINES ARE ONLY APPROXIMATE.

Rec	OWNERSHIP	DEED BOOK & PAGE	LEGAL DESCRIPTION	TAX ID	TAX ID-NO PUNCT	LOCATION	LOT	MAILING ADDRESS	GROSS ACREAGE
1	BLM		ALL (EXC. W2NE4, E2NW4)	2819-01-1-00-500.00	28190110050000				
2	BLM		ALL (EXC. SW4NE4)	2819-01-1-00-500.00	28190110050000				
3	WYO		SW4NE4	2819-04-1-00-600.00	28190410060000				
4	BLM		ALL(EXC. LOTS 2,5,16,SE4SW4)	2819-01-1-00-500.00	28190110050000				
5	3Y LIVESTOCK	464-240	LOT 16,SE4SW4	2819-25-3-00-005.00	28192530000500			1670 E 600 N, TREMONTON, UT 843370000	240
6	WYO		ALL	2819-04-1-00-600.00	28190410060000				
7	3Y LIVESTOCK	464-240	W2NE4, E2NW4	2819-25-3-00-005.00	28192530000500			1670 E 600 N, TREMONTON, UT 843370000	240

SCALE: 1"=800'

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NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
APPENDIX B
OVERALL PROJECT SITE MAP

PRELIMINARY PLAN
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1009 OLD TOWN LANE, SUITE 101
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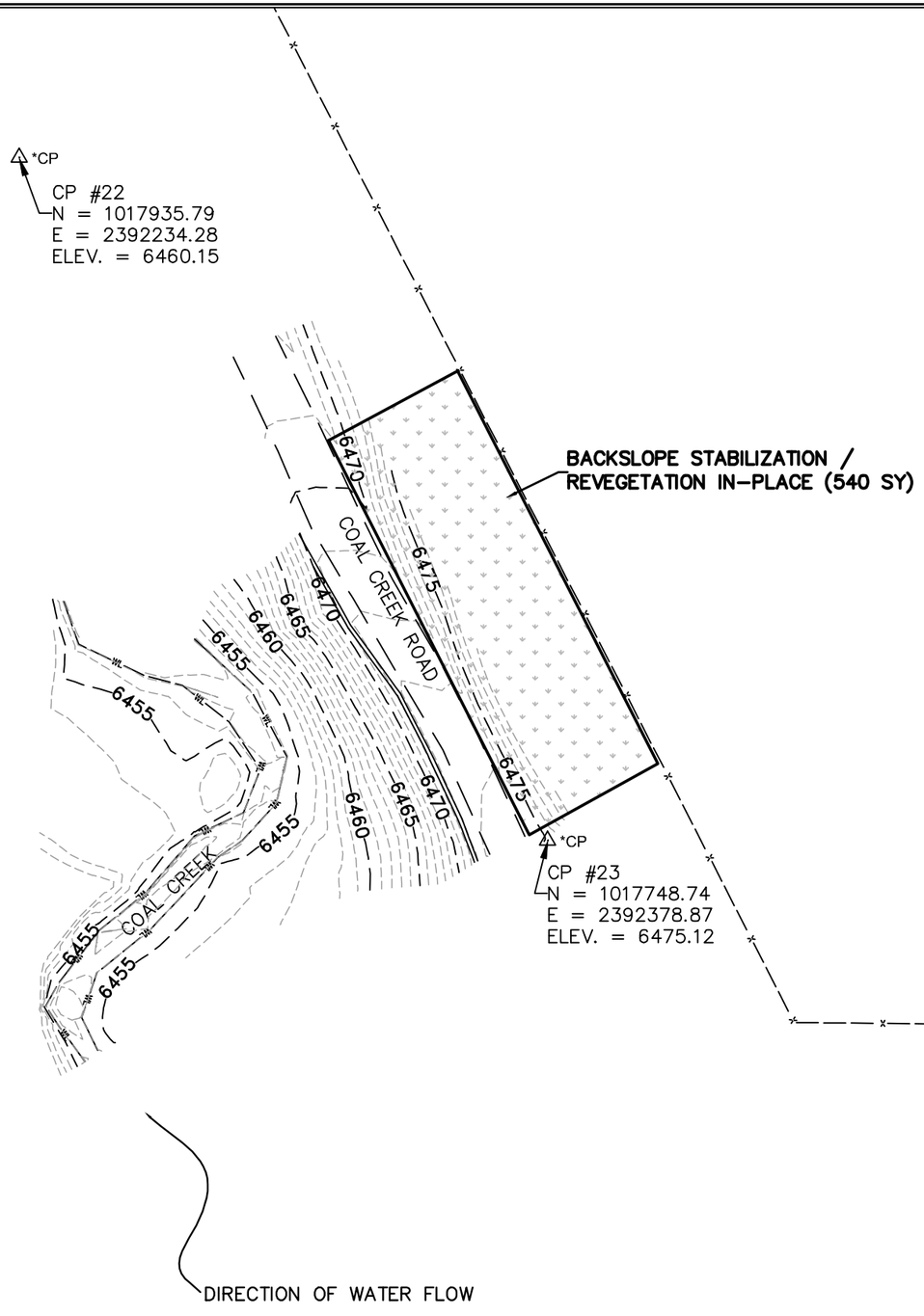
APPENDIX C

TOPOGRAPHIC SURVEY MAPS
OF SITES 1 - 11
(WITH IMPROVEMENT OPTIONS INCLUDED)

LEGEND

- 6560 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- WL EXISTING WATER LINE
- EXISTING FENCE LINE
- △ EXISTING CONTROL POINT



SCALE: 1"=40'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:28pm GRIGGS

NO.	REVISION	DATE

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CHEYENNE, WY 820006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 10
OPTION 3

PRELIMINARY PLAN
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PHONE (307) 637-3077
2020 CAREY AVENUE, SUITE 101
CHEYENNE, WY 82001

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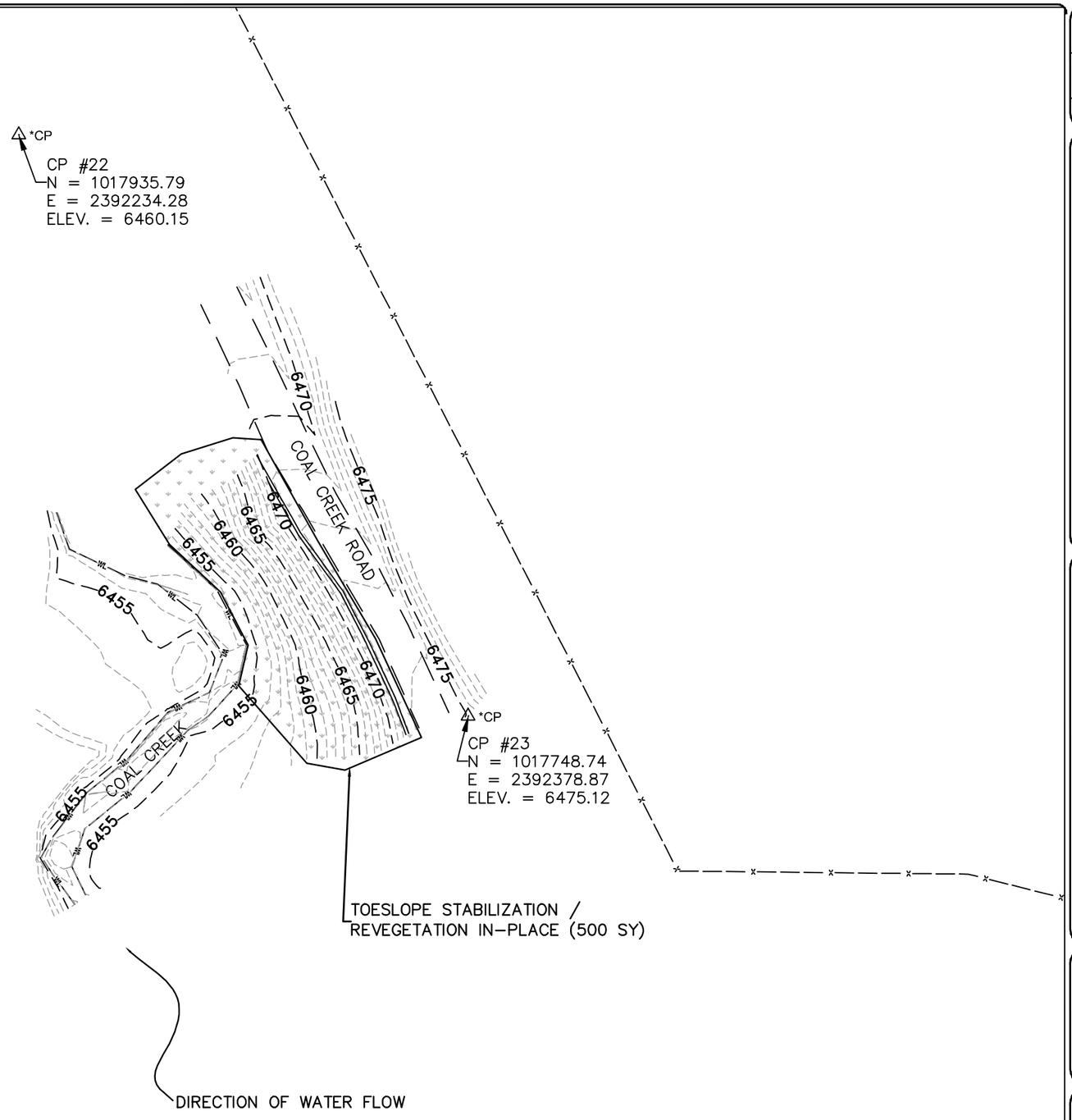
LEGEND

- 6560 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- WL EXISTING WATER LINE
- EXISTING FENCE LINE
- △ EXISTING CONTROL POINT



SCALE: 1"=40'

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NO.	REVISION	DATE

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CHEYENNE, WY 820006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 10
OPTION 2

PRELIMINARY PLAN
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2232 OLD TOWN LANE, SUITE 101
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LEGEND

- 6560 INDEX CONTOUR
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- WL EXISTING WATER LINE
- EXISTING FENCE LINE
- EXISTING CONTROL POINT

*CP
CP #22
N = 1017935.79
E = 2392234.28
ELEV. = 6460.15

NEW REVEGETATION AREA / GRADING AREA
(1100 CY FILL) / (1260 SY REVEG)

PROPOSED CREEK REALIGNMENT CENTERLINE

CREEK REALIGNMENT STATIONING

BOP Sta = 0+00.00

EOP Sta = 1+04.25

0+30
0+40
0+50
0+60
0+70
0+80
0+90
1+00
1+04.25

COAL CREEK ROAD

COAL CREEK

6455
6460
6465
6470
6475

RIPRAP (CLASS 12)

DIRECTION OF WATER FLOW

*CP
CP #23
N = 1017748.74
E = 2392378.87
ELEV. = 6475.12

SCALE: 1"=40'

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NO.	REVISION	DATE

PREPARED FOR:
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CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 10
OPTION 1

PRELIMINARY PLAN
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NEW NYLOPLAST DROP INLET, AND
18" ADS N-12 HDPE PIPE (33 LF)

NEW REVEGETATION AREA / GRADING AREA
(2500 CY FILL) / (2200 SY REVEG)

ROADWAY GRADING (200 LF)

NEW NYLOPLAST DROP INLET, AND
18" ADS N-12 HDPE PIPE (25 LF)

COAL CREEK ROAD

COAL CREEK

*CP
CP #24
N = 1017401.50
E = 2393032.30
ELEV. = 6467.52

BOP Sta = 0+00.00

PROPOSED CREEK
REALIGNMENT CENTERLINE

EOP Sta = 1+53.49

*CP
CP #25
N = 1017385.78
E = 2393334.29
ELEV. = 6470.62

RIPRAP (CLASS 12)

DIRECTION OF WATER FLOW

CREEK REALIGNMENT STATIONING

SCALE: 1"=40'

LEGEND

6560	INDEX CONTOUR
	INTERMEDIATE CONTOUR
	EXISTING DIRT ROAD
WL	EXISTING WATER
	EXISTING FENCE
	EXISTING CONTROL POINT

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5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 9
OPTION 1

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DRAWING NO. OF

CP #2 (2" ALUM. CAP)
N = 1017238.69
E = 2394015.05
ELEV. = 6479.74

CP

DIRECTION OF WATER FLOW

LEGEND

-6560- INDEX CONTOUR

INTERMEDIATE CONTOUR

EXISTING DIRT ROAD

WL EXISTING WATER LINE

EXISTING FENCE LINE

EXISTING CONTROL POINT

71"x47" ARCH CMP
INV. = 6475.42

COAL CREEK ROAD

6480

COAL CREEK

71"x47" ARCH CMP
INV. = 6475.42

*CP

CP #26
N = 1017187.81
E = 2393959.56
ELEV. = 6478.30

CP #27
N = 1017149.88
E = 2394164.18
ELEV. = 6479.61

*CP

71"x47" ARCH CMP
INV. = 6474.51

CLASS 12 RIPRAP (40 CY);
24'W x 24'L x 2'T

71"x47" ARCH CMP
INV. = 6474.64

6475

6480

EXCAVATE / DREDGE TRENCH BOTTOM TO PREPARE
RIPRAP PLACEMENT

COAL CREEK

SCALE: 1"=20'

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PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 8
OPTION 3

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CP #2 (2" ALUM. CAP)
N = 1017238.69
E = 2394015.05
ELEV. = 6479.74

CP

DIRECTION OF WATER FLOW

TEMPORARY COFFER DAM (210 SF)

REMOVE EXISTING CULVERTS

71"x47" ARCH CMP
INV. = 6475.42

COAL CREEK ROAD

6480

COAL CREEK

71"x47" ARCH CMP
INV. = 6475.42

*CP

CP #26
N = 1017187.81
E = 2393959.56
ELEV. = 6478.30

71"x47" ARCH CMP
INV. = 6474.51

71"x47" ARCH CMP
INV. = 6474.64

6475

COAL CREEK

CP #27
N = 1017149.88
E = 2394164.18
ELEV. = 6479.61

*CP

CRUSHED BASE GRADING 'W' FOR ROAD SURFACING (25 SY)

INSTALL NEW STORM STRUCTURE
STRUCTURE TO BE DETERMINED BY OWNER AS FOLLOWS:
1.) NEW REINFORCED CONCRETE BOX (40 LF – 10'X4'),
2.) BRIDGE STRUCTURE (40 LF), OR
3.) 2 – STRUCTURAL STEEL MULTIPLATE DRAINAGE STRUCTURE
(80 LF OF 2 – 73"X55" PLATES);
ALL INCLUDE ABUTMENT STRUCTURE;
–10'x4' RCB DEPICTED GRAPHICALLY
&
EXCAVATE TRENCH (190 CY)

SCALE: 1"=20'

LEGEND

-6560- INDEX CONTOUR
INTERMEDIATE CONTOUR
EXISTING DIRT ROAD
EXISTING WATER LINE
EXISTING FENCE LINE
EXISTING CONTROL POINT

NO. | REVISION | DATE

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COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 8
OPTION 2

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309 OLD TOWN LANE, SUITE 101
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CP #2 (2" ALUM. CAP)
N = 1017238.69
E = 2394015.05
ELEV. = 6479.74

CP

LEGEND

-6560- INDEX CONTOUR
INTERMEDIATE CONTOUR
EXISTING DIRT ROAD
EXISTING WATER LINE
EXISTING FENCE LINE
EXISTING CONTROL POINT

DIRECTION OF WATER FLOW

FILL AREA – GRADE AREA TO MATCH UPSTREAM INVERTS
(5 CY FILL)

71"x47" ARCH CMP
INV. = 6475.42

71"x47" ARCH CMP
INV. = 6475.42

*CP

CP #26
N = 1017187.81
E = 2393959.56
ELEV. = 6478.30

COAL CREEK ROAD

6480

6480

6480

6480

CP #27
N = 1017149.88
E = 2394164.18
ELEV. = 6479.61

*CP

71"x47" ARCH CMP
INV. = 6474.51

71"x47" ARCH CMP
INV. = 6474.64

6475

6475

COAL CREEK

COAL CREEK

SCALE: 1"=20'

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CHEYENNE, WY 82006

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COAL CREEK
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DRAWING TITLE:
SITE 8
OPTION 1

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JKM	DEC 2010

JOB NO.:
2-3090.09

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SLOPE STABILIZATION / REVEGETATION IN PLACE (545 SF)

CP #28
N = 1016779.11
E = 2395364.11
ELEV. = 6499.59

ROADWAY GRADING (220 LF)

DIRECTION OF WATER FLOW

CP #3 (2" ALUM. CAP)
N = 1016748.54
E = 2395560.48
ELEV. = 6509.51

*CP

CP

COAL CREEK

COAL CREEK ROAD

ST

LT

6500
6505
6510
6515
6520
6525

NEW NYLOPLAST DROP INLET,
AND 18" ADS N-12 HDPE PIPE
(35 LF)

NEW NYLOPLAST DROP INLET,
AND 18" ADS N-12 HDPE PIPE
(30 LF)

*CP CP #29
N = 1016706.04
E = 2395559.90
ELEV. = 6516.32

LEGEND

- 6560 — INDEX CONTOUR
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- WL — EXISTING WATER LINE
- EXISTING FENCE LINE
- EXISTING CONTROL POINT

SCALE: 1"=20'

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NO.	REVISION	DATE

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5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 7
OPTION 1

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engineering
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PHONE (307) 637-6217
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CHEYENNE, WY 82009

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JKM	DEC 2010

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2-3090.09

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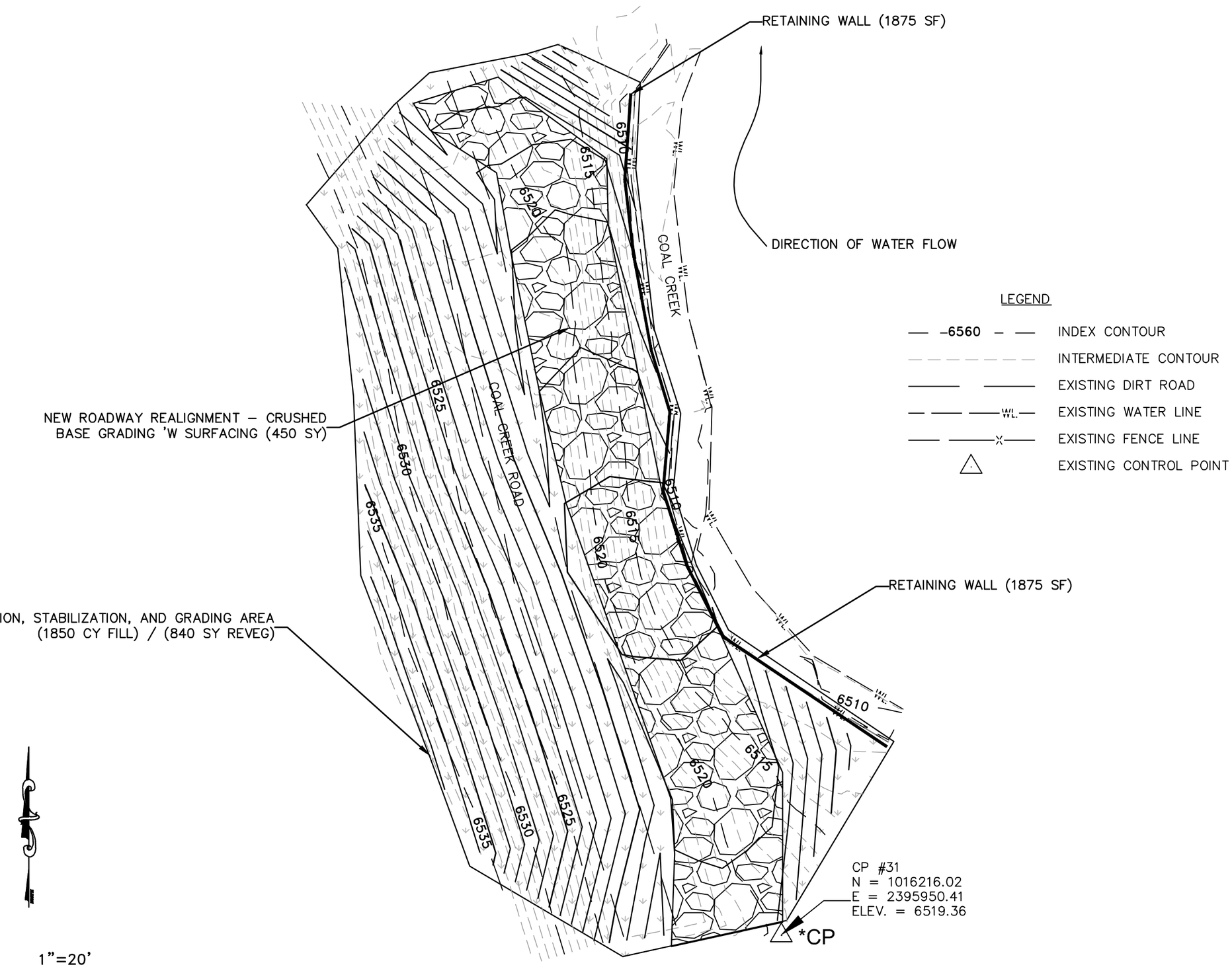

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5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 6
OPTION 3

PRELIMINARY PLAN
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CHEYENNE, WY 82009

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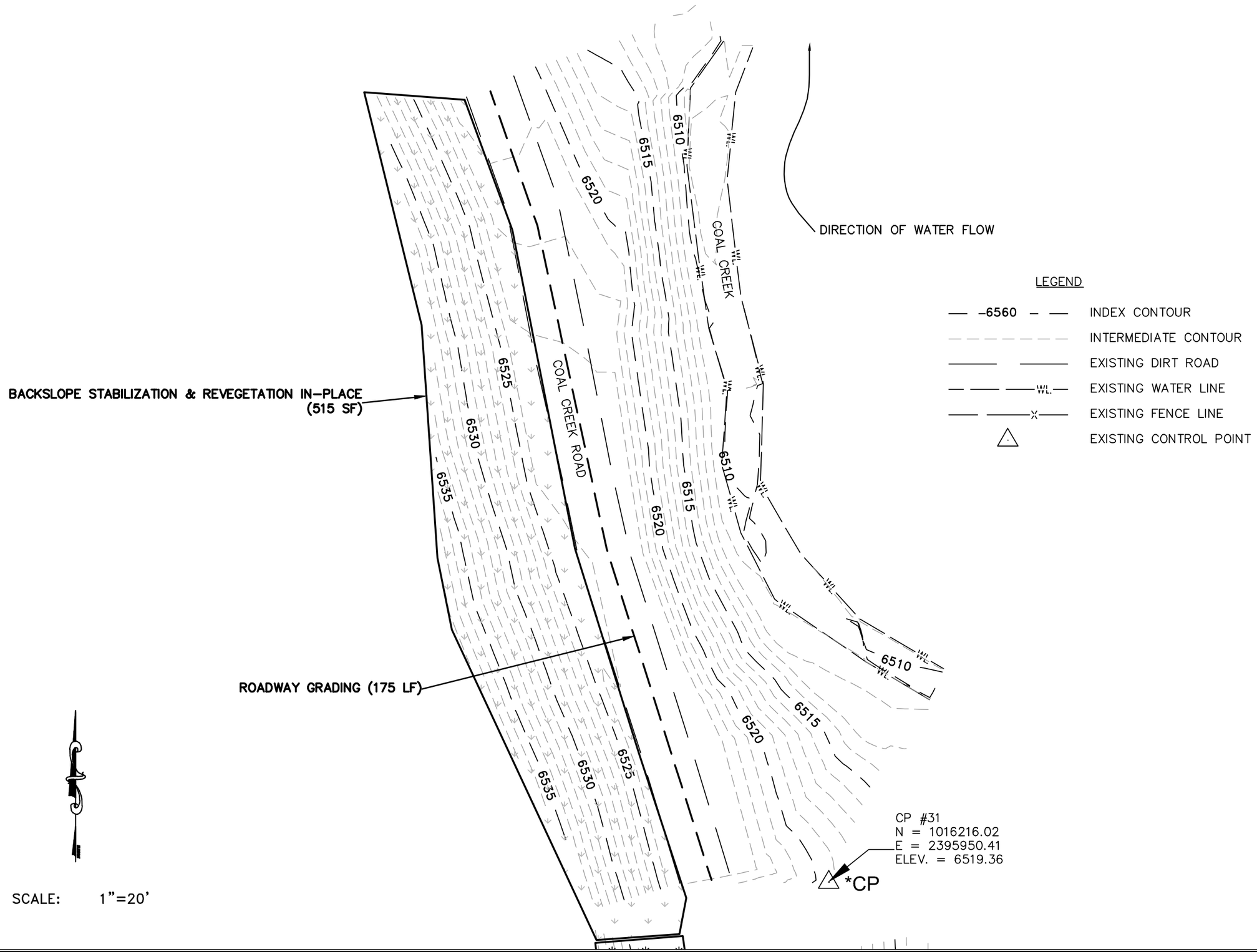
JKM	DEC 2010

JOB NO.: 2–3090.09

DRAWING NO. OF



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5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 6
OPTION 2

PRELIMINARY PLAN
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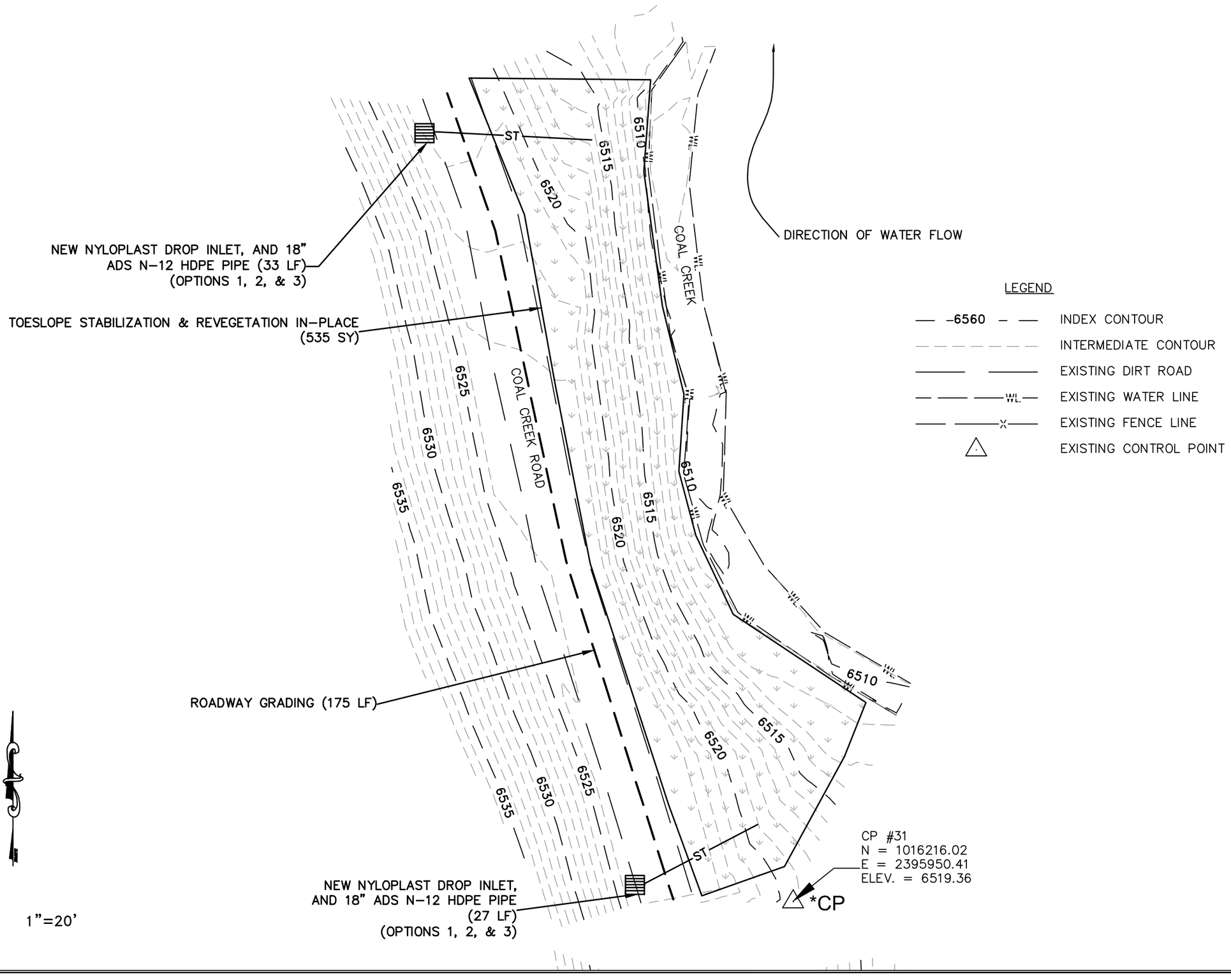
2424 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF



SCALE: 1"=20'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:22pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 6
OPTION 1

PRELIMINARY PLAN
NOT FOR CONSTRUCTION
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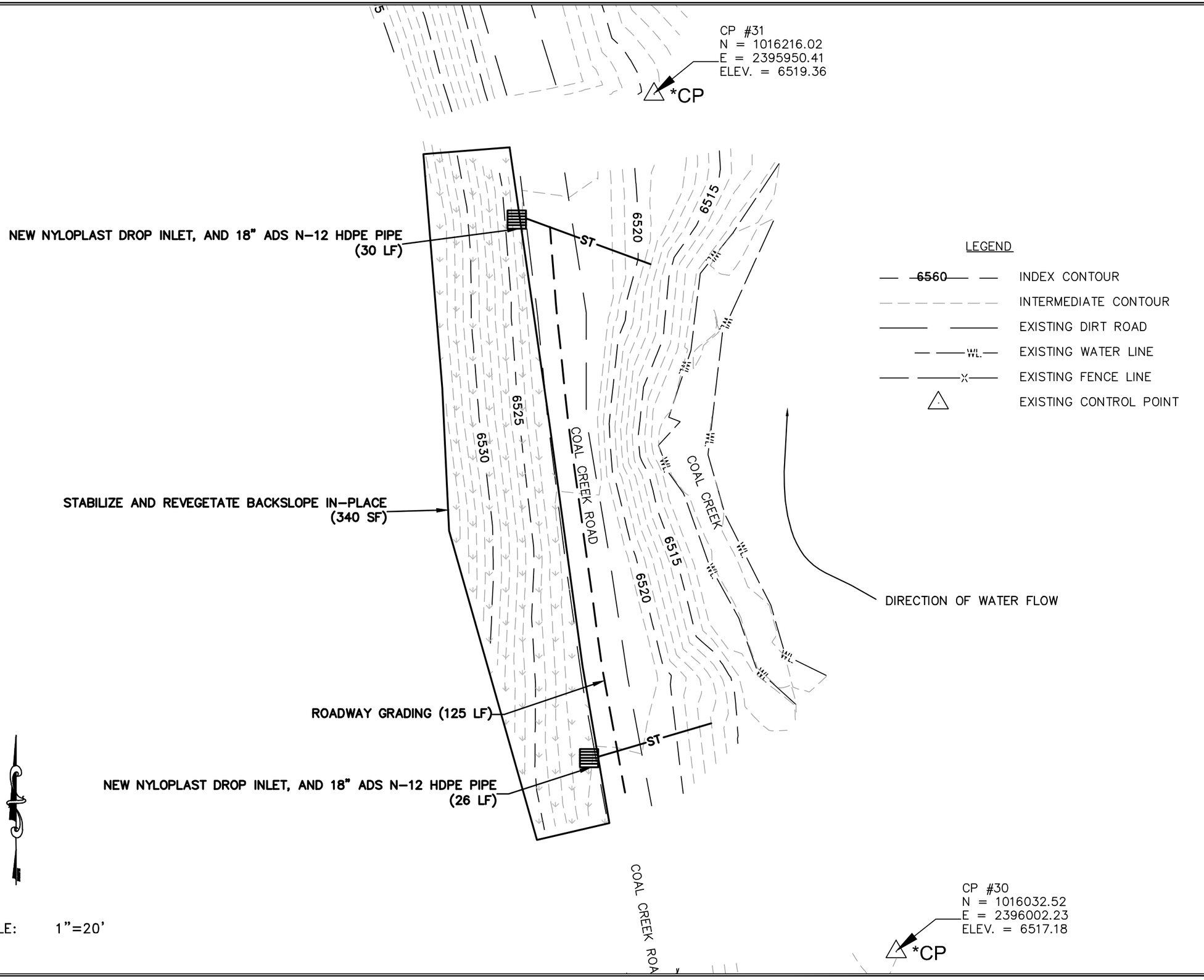
avi p.c.
engineering planning surveying
PHONE (307) 637-2077
5208 CLUB TOWER LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF



H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:21pm GRIGGS

NO. | REVISION | DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 5
OPTION 2

PRELIMINARY PLAN
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engineering planning surveying
PHONE (307) 637-6187
2520 COY TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF

CP #31
N = 1016216.02
E = 2395950.41
ELEV. = 6519.36

*CP

NEW NYLOPLAST DROP INLET, AND 18" ADS N-12 HDPE PIPE
(30 LF)

ST

6520

6515

6525

6530

COAL CREEK ROAD

COAL CREEK

6515

6520

DIRECTION OF WATER FLOW

ROADWAY GRADING (125 LF)

STABILIZE AND REVEGETATE TOE SLOPE IN-PLACE
(290 SF)

ST

NEW NYLOPLAST DROP INLET, AND 18" ADS N-12 HDPE PIPE
(26 LF)

COAL CREEK ROA

CP #30
N = 1016032.52
E = 2396002.23
ELEV. = 6517.18

*CP

LEGEND

6560	INDEX CONTOUR
	INTERMEDIATE CONTOUR
	EXISTING DIRT ROAD
WL	EXISTING WATER LINE
X	EXISTING FENCE LINE
△	EXISTING CONTROL POINT

SCALE: 1"=20'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:21pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 5
OPTION 1

PRELIMINARY PLAN
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engineering planning surveying AMI p.c.
PHONE (307) 637-6337
2424 OLD TOWN LANE, SUITE 101
Cheyenne, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
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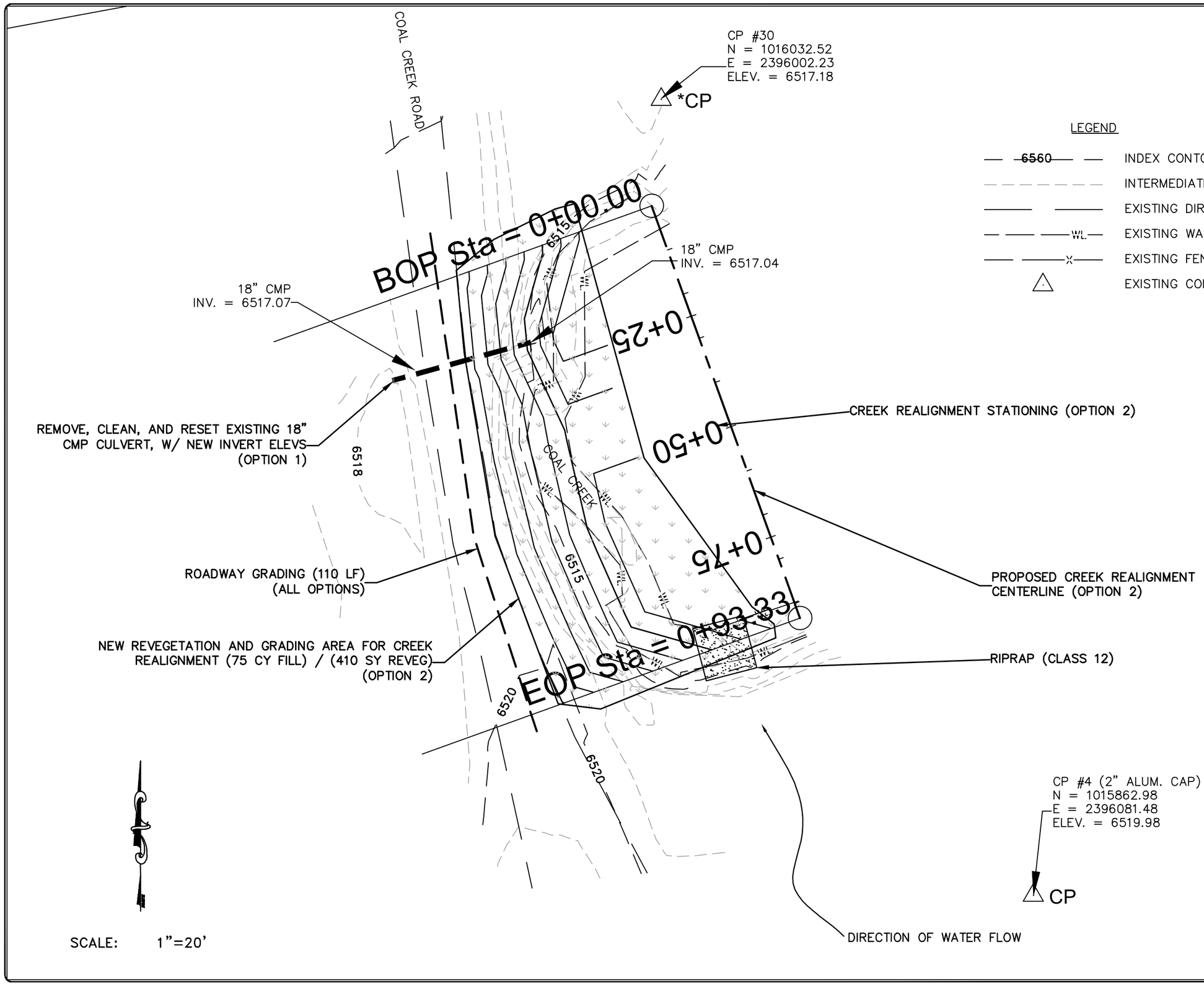
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF



H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:20pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 4
OPTIONS 1 & 2

PRELIMINARY PLAN
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engineering planning surveying
PHONE (307) 637-6017
2529 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

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JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF

LEGEND

- —6560— INDEX CONTOUR
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- WL EXISTING WATER LINE
- EXISTING FENCE LINE
- EXISTING CONTROL POINT

CP #32
N = 1015506.01
E = 2396167.02
ELEV. = 6532.48
*CP

6520
6525
6530
6535
6540
6545
WL
COAL CREEK
COAL CREEK ROAD

DIRECTION OF WATER FLOW

NEW NYLOPLAST DROP INLET, AND 18" ADS N-12 HDPE PIPE (30 LF)

STABILIZE AND REVEGETATE SLOPE IN PLACE (470 SY)

CP #33
N = 1015350.35
E = 2396221.96
ELEV. = 6537.13
*CP

ROADWAY GRADING (140 LF)

SCALE: 1"=20'

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NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 3
OPTION 2

PRELIMINARY PLAN
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engineering planning surveying
PHONE (307) 637-2077
2518 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

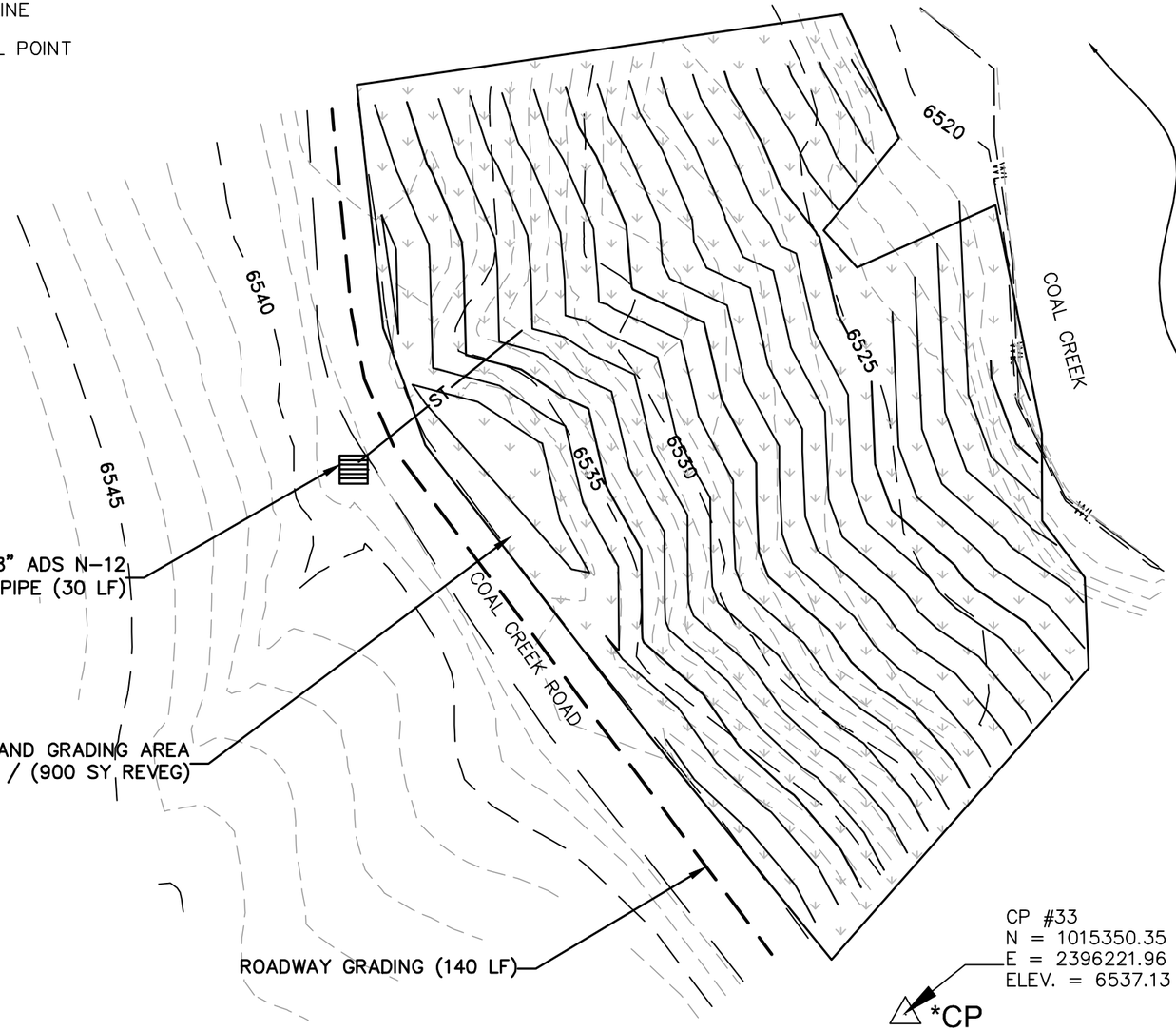
JOB NO.: 2-3090.09

DRAWING NO. OF

LEGEND

- INDEX CONTOUR (6560)
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- EXISTING WATER LINE (WL)
- EXISTING FENCE LINE
- EXISTING CONTROL POINT

CP #32
N = 1015506.01
E = 2396167.02
ELEV. = 6532.48
*CP



CP #33
N = 1015350.35
E = 2396221.96
ELEV. = 6537.13
*CP

SCALE: 1"=20'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:20pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 3
OPTION 1

PRELIMINARY PLAN
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engineering planning surveying
PHONE (307) 637-2077
208 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
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JKM	DEC 2010

JOB NO.: 2-3090.09

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COAL CREEK ROAD

SITE 1

SITE 2-4

SITE 2-5 - APPROXIMATELY 1915 LF OF EXISTING RD LEADING FROM SITE 1 TO SITE 2-4; EXISTING TWO TRACK ROAD TO BE RECLAIMED; (1500 SY REVEGETATION)

SCALE: 1"=200'

PRELIMINARY PLAN
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these plans are for review only and not to be used for the construction of any improvements either public or private. All pc accepts no liability for any unauthorized use of these plans

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 2-5
OPTION 1

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

NO.	REVISION	DATE

engineering planning surveying pc
PHONE (307) 632-6017 FAX (307) 632-6019
CHEYENNE, WY 82009

DESIGNED BY: JKM
DRAWN BY: CMC/JMG
CHECKED BY: JKM
DATE: DEC 2010
JOB NO.: 2-3090.09
DRAWING NO.: OF

AREA 2–3

DIRECTION OF WATER FLOW

COAL CREEK

6540

AREA 2–4

IMPORT FILL MATERIAL (10 CY) TO CONSTRUCT
NEW CROSSING AROUND NEW CULVERT

–EXCAVATE / DREDGE CREEK BOTTOM IN PREPARATION FOR NEW CULVERT PLACEMENT
–INSTALL CRUSHED BASE GRADING 'W' FOR ROADWAY SURFACING (16 SY)
–INSTALL NEW STORM STRUCTURE;
STRUCTURE TO BE DETERMINED BY OWNER AS FOLLOWS:
1.) REINFORCED CONCRETE BOX (20 LF – 10'x4');
2.) BRIDGE STRUCTURE (20 LF), OR
3.) 2 – STRUCTURAL STEEL MULTIPLATE DRAINAGE STRUCTURES (40 LF TOTAL OF 2 – 73"x55" PLATES);
ALL INCLUDE ABUTMENT STRUCTURES
–10'x4' RCB DEPICTED GRAPHICALLY

TEMPORARY COFFER DAM (72 SF)

6540

6545

COAL CREEK ROAD

SCALE: 1"=20'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 – 2:19pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 2–4
OPTION 1

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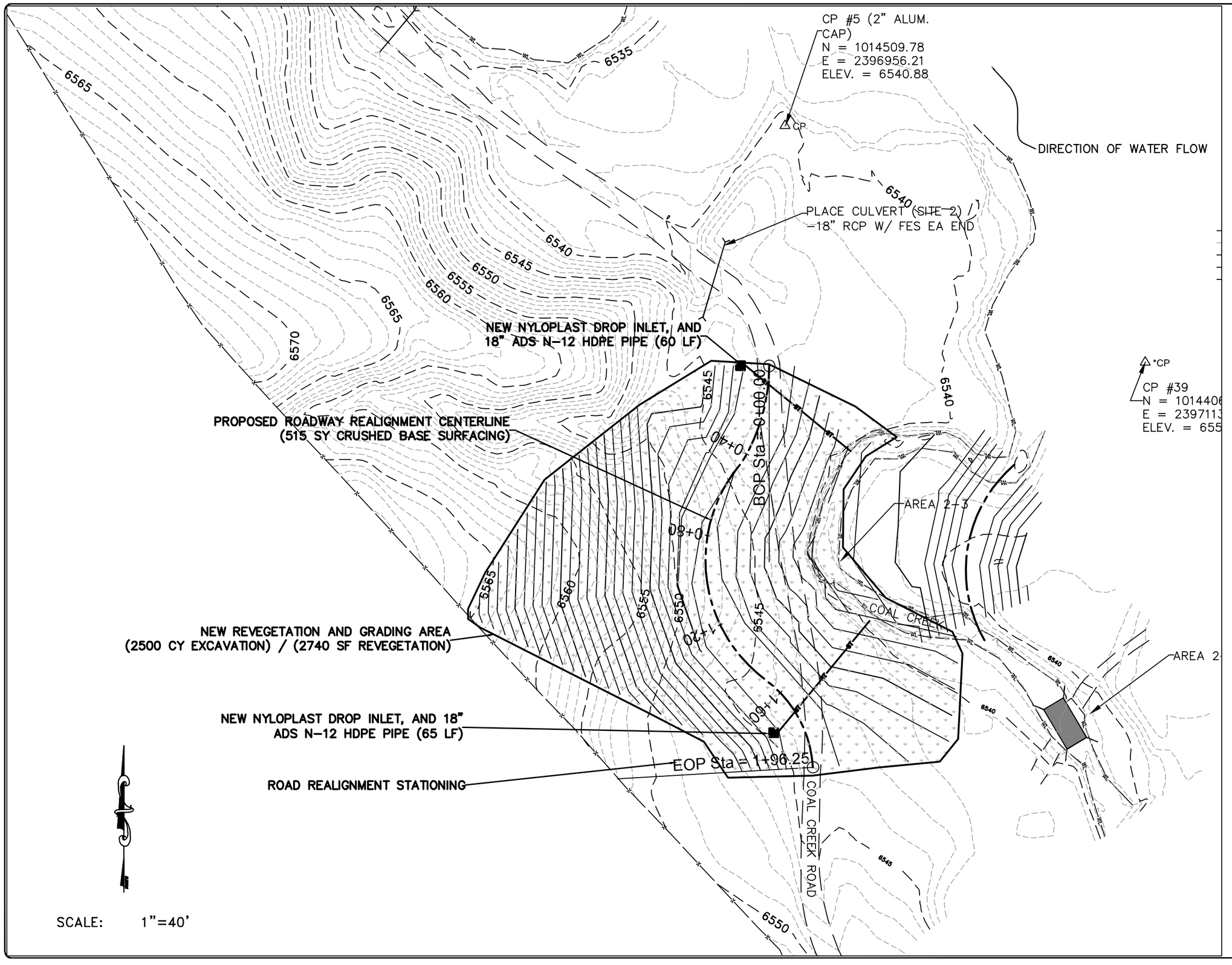
engineering planning surveying
PHONE (307) 637-6017
908 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2–3090.09

DRAWING NO. OF



SCALE: 1"=40'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:18pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 2-3
OPTION 2

PRELIMINARY PLAN
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PHONE (307) 637-6017
508 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
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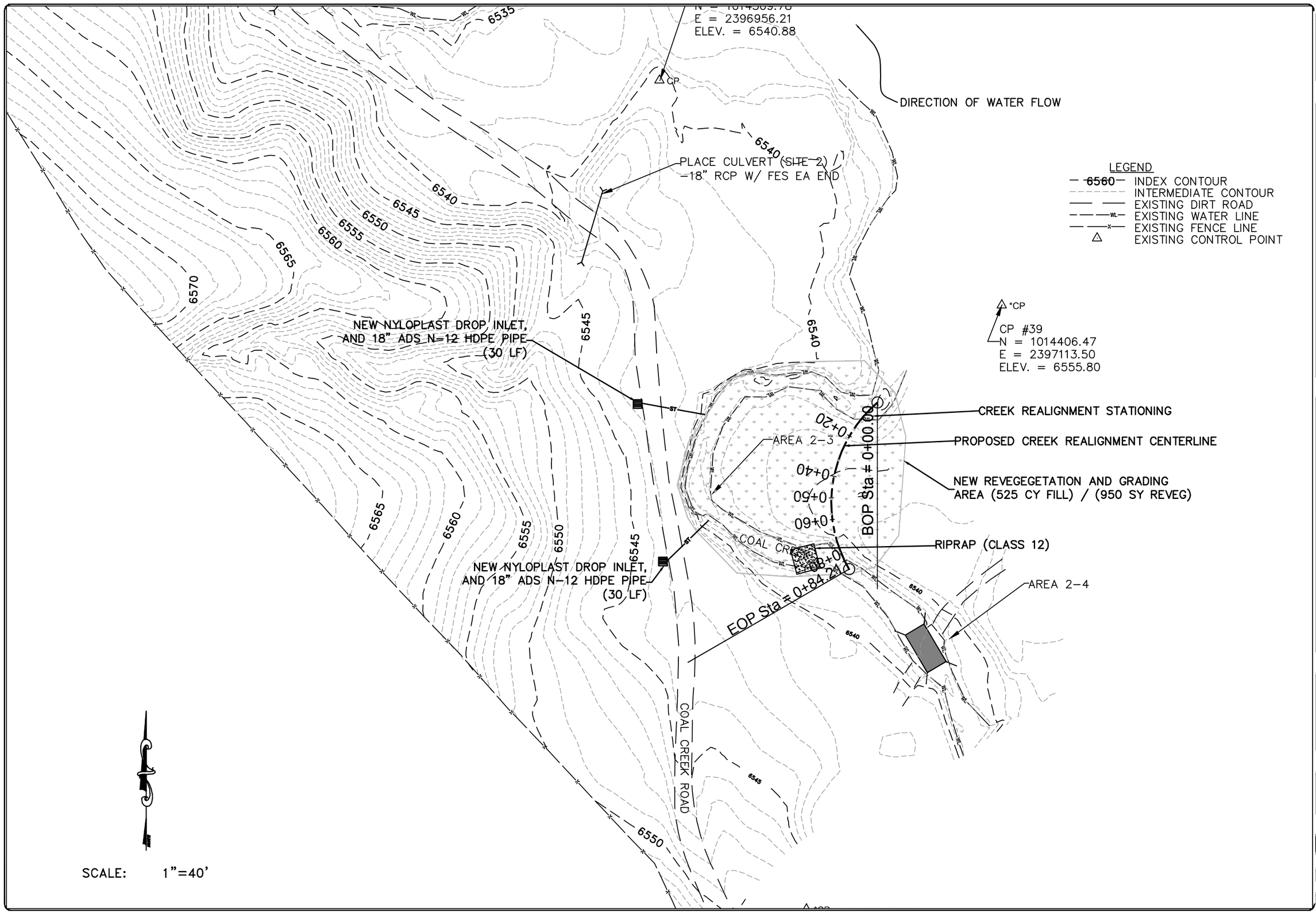
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF



SCALE: 1"=40'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:18pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 2-3
OPTION 1

PRELIMINARY PLAN
NOT FOR CONSTRUCTION
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engineering
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surveying
PHONE (307) 637-2077
2528 OLD FORT LARK, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF

BOP Sta = 0+00.00

NEW REVEGETATION, STABILIZATION AND GRADING AREA (180 CY FILL) / (670 SF REVEG)

PROPOSED CREEK REALIGNMENT CENTERLINE

DIRECTION OF WATER FLOW

AREA 2–2

CREEK REALIGNMENT STATIONING

EOP Sta = 1+18.96

CP #37
N = 1014624.30
E = 2396745.37
ELEV. = 6534.79

*CP

NEW NYLOPLAST DROP INLET, AND 18" ADS N–12 HDPE PIPE (40 LF)

RIPRAP (CLASS 12)

NEW NYLOPLAST DROP INLET, AND 18" ADS N–12 HDPE PIPE (30 LF)

PLACE CULVERT (SITE 2) –18" RCP W/ FES EA END

COAL CREEK ROAD

COAL CREEK

6530 6535 6540 6545 6550 6555 6560

0+50 1+00

ST

SCALE: 1"=20'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:17pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 2–2
OPTION 2

PRELIMINARY PLAN
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avi p.c.
engineering planning surveying
PHONE (307) 637-6217
200 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
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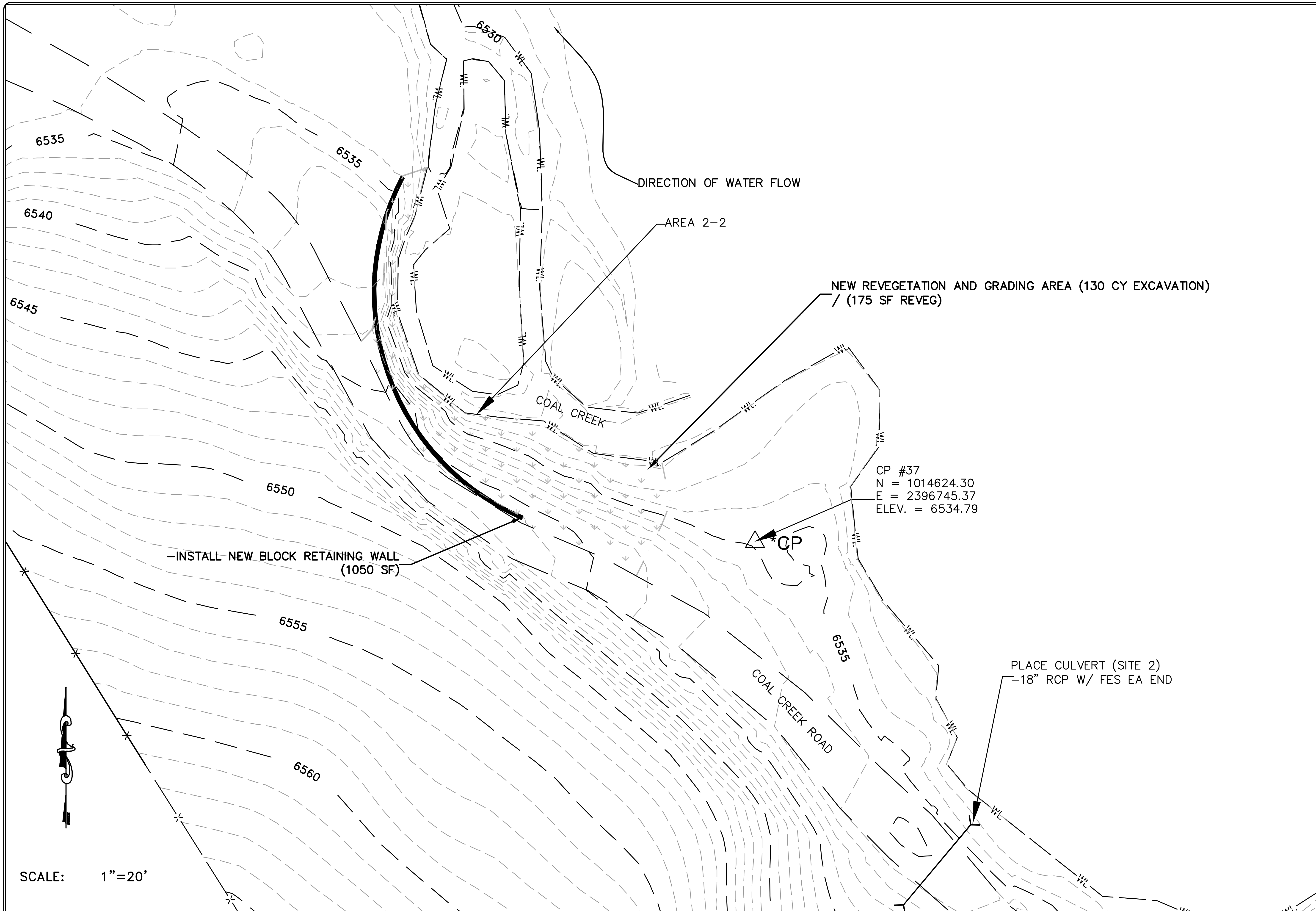
JKM	DEC 2010

JOB NO.: 2–3090.09

DRAWING NO. OF



SCALE: 1"=20'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:16pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 2-2
OPTION 1

PRELIMINARY PLAN
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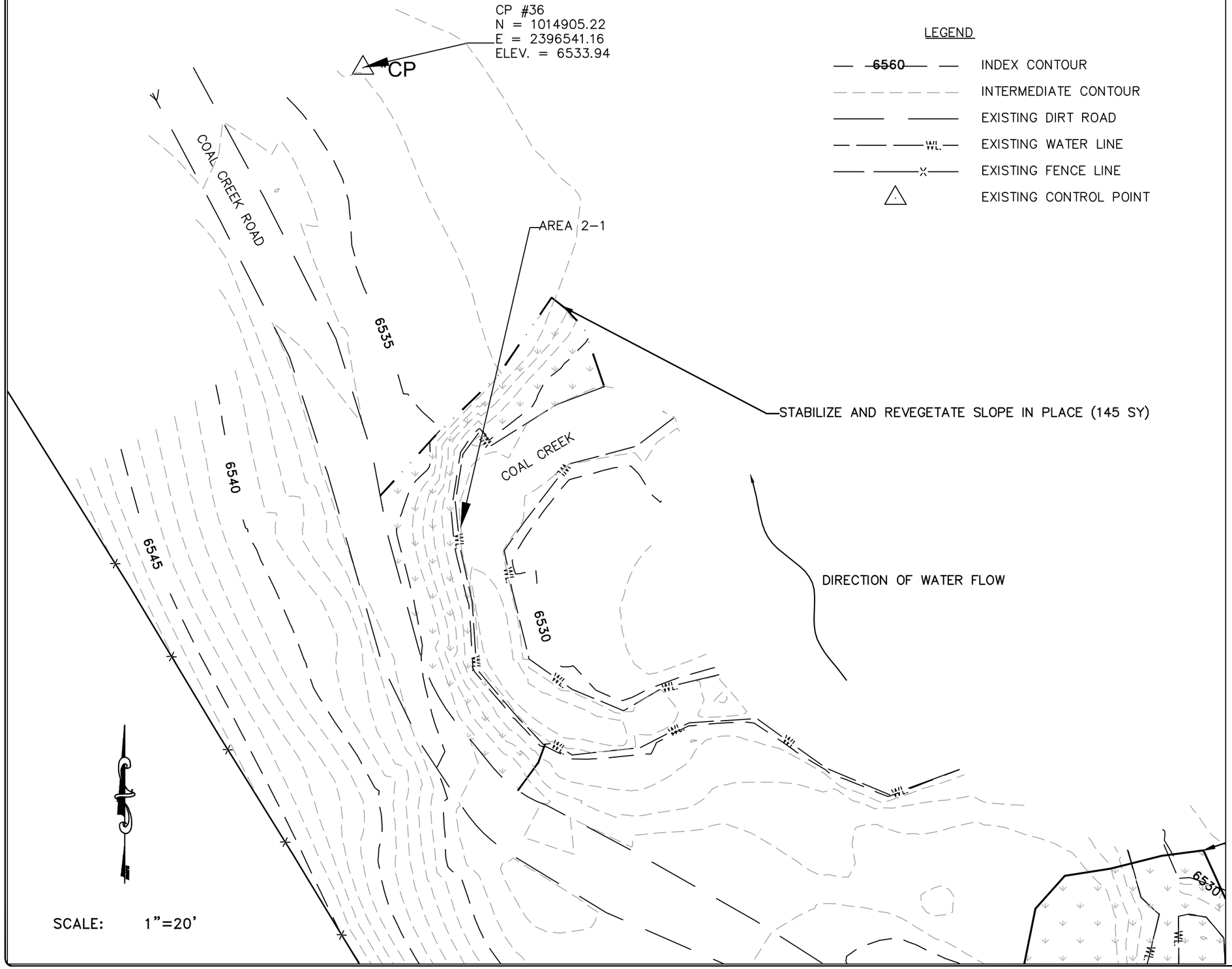
1103 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY: JKM	DRAWN BY: CMC/JJG
CHECKED BY: JKM	DATE: DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF



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PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 2-1
OPTION 2

PRELIMINARY PLAN
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PHONE (307) 637-6187
2424 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
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JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF

CP #36
N = 1014905.22
E = 2396541.16
ELEV. = 6533.94

CP

LEGEND

6560 — INDEX CONTOUR

INTERMEDIATE CONTOUR

EXISTING DIRT ROAD

WL — EXISTING WATER LINE

EXISTING FENCE LINE

EXISTING CONTROL POINT

COAL CREEK ROAD

AREA 2–1

BOP Sta = 0+00.00

NEW REVEGEGETATION AND GRADING AREA (405 CY FILL) / (695 SY REVEG)

PROPOSED CREEK REALIGNMENT CENTERLINE

COAL CREEK

0+20

0+40

0+60

DIRECTION OF WATER FLOW

EOP Sta = 0+63.57

CREEK REALIGNMENT STATIONING

DIRECTION OF WATER FLOW

RIPRAP CLASS 12)

6545

6540

6535

6530

6535

6530

SCALE: 1"=20'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:15pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANS

DRAWING TITLE:
SITE 2–1 OPTION 1

PRELIMINARY PLAN
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PHONE (307) 637-6217
2020 CAREY AVENUE, SUITE 801
CHEYENNE, WY 82001

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
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JKM	DEC 2010

JOB NO.: 2–3090.09

DRAWING NO. OF

SCALE: 1"=20'

DIRECTION OF WATER FLOW

RECLAIM ROAD UP TO SOUTH END OF SITE 2
(SITE 2–5 WORK)

CP #6 (2" ALUM. CAP)
N = 1012965.76
E = 2397508.99
ELEV. = 6555.88

CP

COAL CREEK ROAD

REMOVE EXISTING TIMBER BRIDGE

REVEGETATE AREA PER SOUTH LOW
WATER CROSSING REGRADING (280 SY)

6555

6555

LITTLE MUDDY CREEK

WL

6560

TWO TRACK ROAD

CP #35
N = 1012928.29
E = 2397725.49
ELEV. = 6562.50

*CP

TWO TRACK ROAD

OLD RETAINING WALL

TEMPORARY COFFER DAM

6560

6555

6555

WL

*CP

CP #34
N = 1012864.76
E = 2397543.90
ELEV. = 6557.09

REGRADE/REMOVE SOUTH LOW WATER CROSSING
(75 CY IMPORT FILL MATERIAL)

LEGEND

- 6560 - INDEX CONTOUR
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- WL EXISTING WATER LINE
- X EXISTING FENCE LINE
- EXISTING CONTROL POINT

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:14pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 1 OPTION 1

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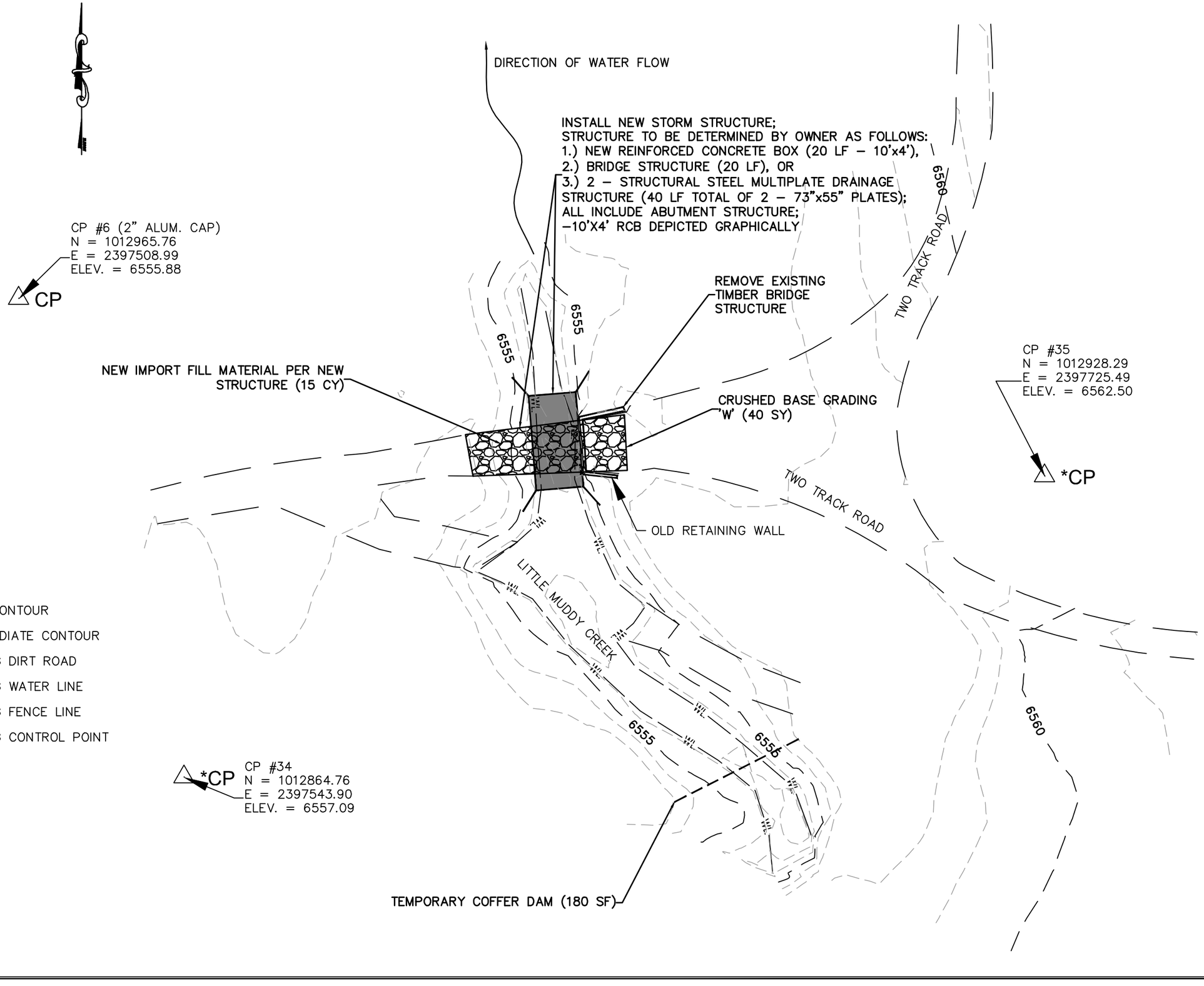
avi p.c.
engineering
planning
surveying
PHONE (307) 637-6017
1109 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.:
2–3090.09

DRAWING NO. OF

SCALE: 1"=20'



LEGEND

- 6560 — INDEX CONTOUR
- INTERMEDIATE CONTOUR
- EXISTING DIRT ROAD
- WL — EXISTING WATER LINE
- EXISTING FENCE LINE
- EXISTING CONTROL POINT

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:15pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 1
OPTION 2

PRELIMINARY PLAN
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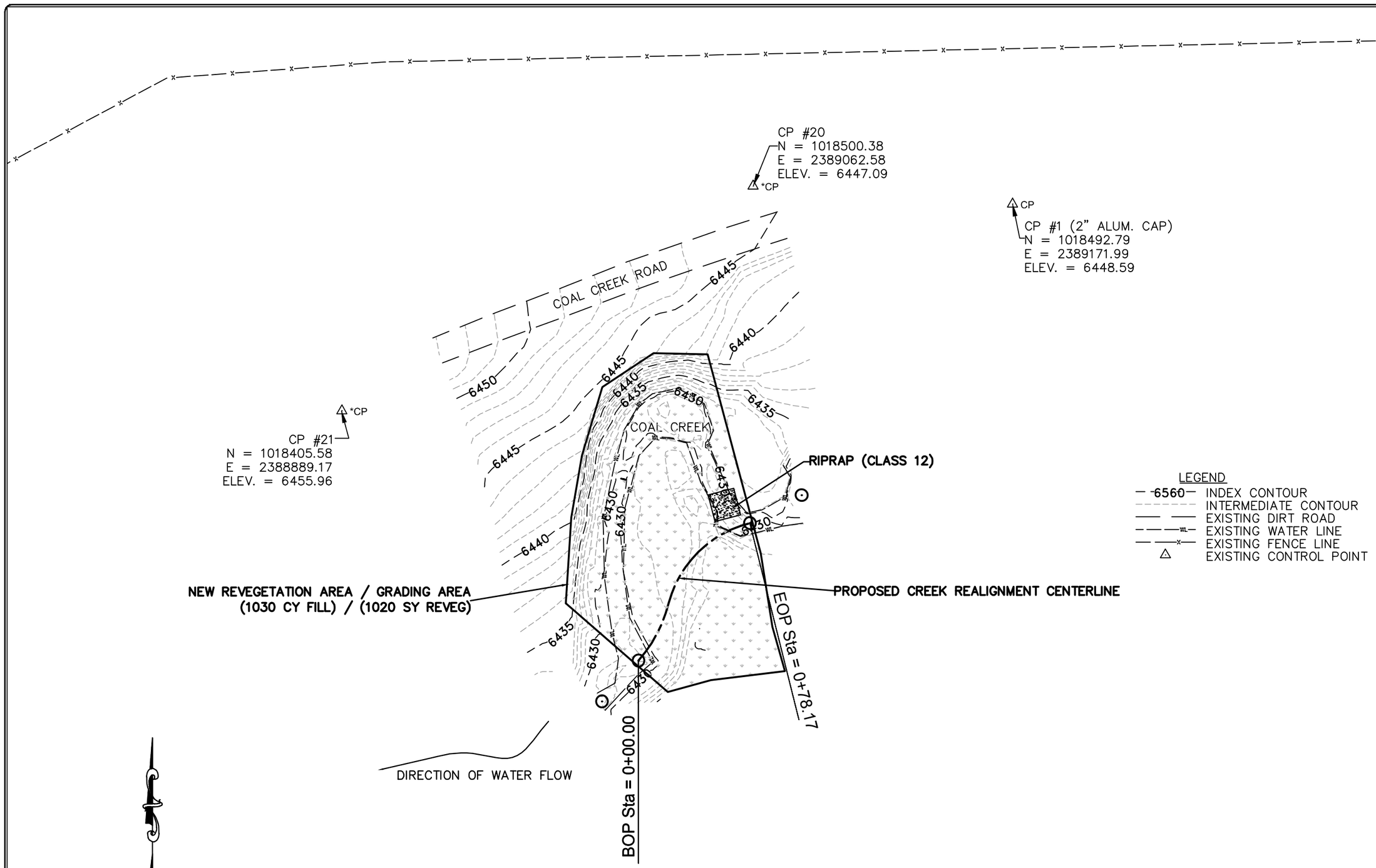
PHONE (307) 637-6337
2424 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2–3090.09

DRAWING NO. OF



SCALE: 1"=40'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:29pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 11
OPTION 2

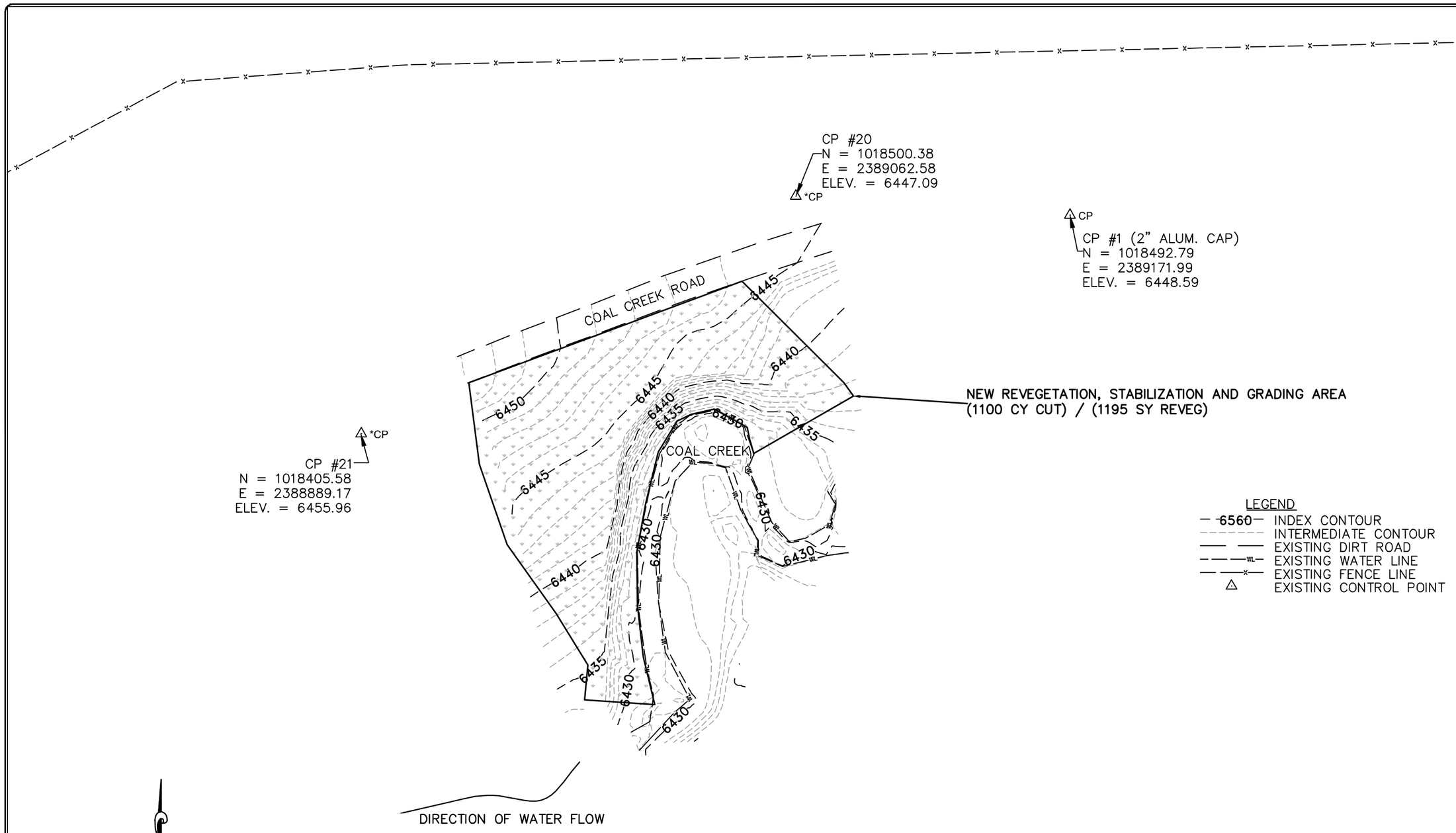
PRELIMINARY PLAN
NOT FOR CONSTRUCTION
these plans are for review only and not to be used for the construction of any improvements either public or private. AVI pc accepts no liability for any unauthorized use of these plans

engineering planning surveying
AVI p.c.
PHONE (307) 637-6187
525 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF



SCALE: 1"=40'

H:\3090\Coal Creek\survey\Drawings\3090 COAL CREEK TOPO.DWG Mar 08, 2011 - 2:29pm GRIGGS

NO.	REVISION	DATE

PREPARED FOR:
WYOMING GAME AND FISH DEPARTMENT
5400 BISHOP BLVD
CHEYENNE, WY 82006

PROJECT:
COAL CREEK
EROSION IMPROVEMENTS PLANNING

DRAWING TITLE:
SITE 11
OPTION 1

PRELIMINARY PLAN
NOT FOR CONSTRUCTION
these plans are for review only and not to be used for the construction of any improvements either public or private. AVI pc accepts no liability for any unauthorized use of these plans

engineering planning surveying
AVI p.c.
PHONE (307) 637-6017
309 OLD TOWN LANE, SUITE 101
CHEYENNE, WY 82009

DESIGNED BY:	DRAWN BY:
JKM	CMC/JJG
CHECKED BY:	DATE:
JKM	DEC 2010

JOB NO.: 2-3090.09

DRAWING NO. OF

APPENDIX D

CULVERT MASTER REPORTS

Culvert Calculator Report
SITE 8 EXISTING ARCH PIPES

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	6,479.00	ft	Headwater Depth/ Height	0.91	
Computed Headwater Elevation	6,479.00	ft	Discharge	149.92	cfs
Inlet Control HW Elev	6,478.57	ft	Tailwater Elevation	6,476.64	ft
Outlet Control HW Elev	6,479.00	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	6,475.42	ft	Downstream Invert	6,474.64	ft
Length	40.00	ft	Constructed Slope	0.019500	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	2.00	ft
Slope Type	Steep		Normal Depth	1.66	ft
Flow Regime	N/A		Critical Depth	1.90	ft
Velocity Downstream	7.15	ft/s	Critical Slope	0.012819	ft/ft

Section					
Section Shape	Arch		Mannings Coefficient	0.025	
Section Material	Steel and Aluminum Var CR		Span	5.92	ft
Section Size	71 x 47 inch		Rise	3.92	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev	6,479.00	ft	Upstream Velocity Head	0.88	ft
Ke	0.90		Entrance Loss	0.79	ft

Inlet Control Properties					
Inlet Control HW Elev	6,478.57	ft	Flow Control	N/A	
Inlet Type	Thin wall projecting		Area Full	36.2	ft^2
K	0.03400		HDS 5 Chart	40	
M	1.50000		HDS 5 Scale	3	
C	0.04960		Equation Form	1	
Y	0.57000				

AVI ENGINEERING
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Culvert Calculator Report
SITE 8 EXISTING ARCH PIPES

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	6,479.00	ft	Headwater Depth/ Height	0.91	
Computed Headwater Elevation	6,479.00	ft	Discharge	149.92	cfs
Inlet Control HW Elev	6,478.57	ft	Tailwater Elevation	6,476.64	ft
Outlet Control HW Elev	6,479.00	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	6,475.42	ft	Downstream Invert	6,474.64	ft
Length	40.00	ft	Constructed Slope	0.019500	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	2.00	ft
Slope Type	Steep		Normal Depth	1.66	ft
Flow Regime	N/A		Critical Depth	1.90	ft
Velocity Downstream	7.15	ft/s	Critical Slope	0.012819	ft/ft

Section					
Section Shape	Arch		Mannings Coefficient	0.025	
Section Material	Steel and Aluminum Var CR		Span	5.92	ft
Section Size	71 x 47 inch		Rise	3.92	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev	6,479.00	ft	Upstream Velocity Head	0.88	ft
Ke	0.90		Entrance Loss	0.79	ft

Inlet Control Properties					
Inlet Control HW Elev	6,478.57	ft	Flow Control	N/A	
Inlet Type	Thin wall projecting		Area Full	36.2	ft²
K	0.03400		HDS 5 Chart	40	
M	1.50000		HDS 5 Scale	3	
C	0.04960		Equation Form	1	
Y	0.57000				

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Culvert Calculator Report
SITE 8 PROPOSED BOX CULVERT OPTION 2

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	6,479.00	ft	Headwater Depth/ Height	0.90	
Computed Headwater Elevation	6,479.00	ft	Discharge	165.97	cfs
Inlet Control HW Elev	6,478.87	ft	Tailwater Elevation	6,476.64	ft
Outlet Control HW Elev	6,479.00	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	6,475.42	ft	Downstream Invert	6,474.64	ft
Length	40.00	ft	Constructed Slope	0.019500	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.41	ft
Slope Type	Steep		Normal Depth	1.11	ft
Flow Regime	Supercritical		Critical Depth	2.05	ft
Velocity Downstream	11.80	ft/s	Critical Slope	0.003065	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 4 ft		Rise	4.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev	6,479.00	ft	Upstream Velocity Head	1.02	ft
Ke	0.50		Entrance Loss	0.51	ft

Inlet Control Properties					
Inlet Control HW Elev	6,478.87	ft	Flow Control	N/A	
Inlet Type	90 and 15 ° wingwall flares		Area Full	40.0	ft²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	2	
C	0.04000		Equation Form	1	
Y	0.80000				

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APPENDIX E

PRODUCT DATA INFORMATION

(3-Sided Structural Steel Multiplate Structure at Twin Creek)

(3-Sided Structural Steel Multiplate Structure at Twin Creek)

(Retaining Wall Structure)

(North American Green – Erosion Control Mat)

(North American Green – Erosion Control Mat after vegetation growth)

Mat, Inc.
FLOODWOOD, MINNESOTA

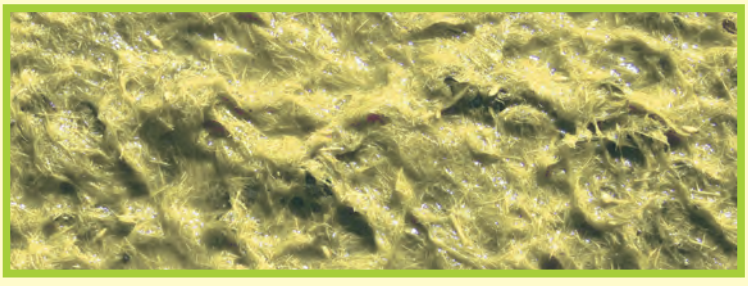
SOIL GUARD®

BONDED FIBER MATRIX

Soil Guard® Bonded Fiber Matrix* (BFM) represents a breakthrough in erosion control technology. It is a one or two-step erosion control system that revolutionized the practice of soil conservation. It is highly cost-effective and has been a market leader since 1993. It is the only BFM on the market requiring it be applied by Certified Applicators and comes with a company backed warrantee.

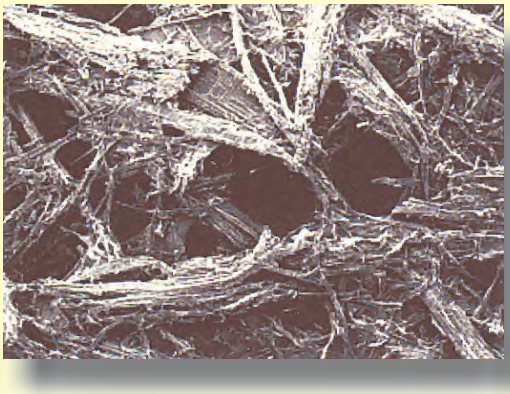
Unique among erosion control systems, Soil Guard® delivers the performance of a blanket combined with dramatic cost savings of time and labor. The result is a cost-benefit ratio that makes it the best choice for a very wide range of erosion control needs. Now erosion control planners and contractors can rely on its state-of-the-art features to minimize erosion and promote germination.

Hydraulically applied, Soil Guard® conforms to the contours of the ground and dries to form a bonded fiber matrix. Once dry, the matrix can be hydrated repeatedly and will hold soil and seed without washing away. As vegetation takes hold, Soil Guard® slowly decomposes to enrich the soil. Soil Guards® patented formula is non-toxic and completely bio-degadable so it is safe to use around wildlife, pets and children. (A toxicity report available upon request.)



Soil Guards® distinctive and patented yellow color makes for easy gauging of application rate to ensure proper application. Besides lending a beautifying effect to the job site it gives instant recognition that Soil Guard® was used where requested or specified.

Shown here At 40X magnification, Soil Guard® fibers bond to form a matrix that holds soil and seed in place.



A Measurably Better Erosion Control System

One or Two Step Application for 100% Coverage

Conforms to the soil surface, No special site preparations, eliminates tenting and under-rilling problems, Excellent germination results, adheres to almost any soil surface.

Enhanced Germination

Holds seed and fertilizer in Place. Allows moisture, sunlight and plants to penetrate.

Substantial Savings with Every Application

Requires less labor and substantially less time to install. Soil Guard® application is significantly less than conventional methods. Can be applied to sites where blanket-like protection is required.

Reduced Soil Erosion and Water Runoff

Dries into a flexible mat. Minimizes the impact of even heavy rain. Slowly releases moisture to the soil below. Remains cohesive and bonded to the soil.

Fully Biodegradable

Non-toxic and fully biodegradable. Made from a blend of wood fibers, a natural binding agent, and a mixture of organic and mineral activators. No plastic netting, so it's safer for wildlife. No harmful residues.

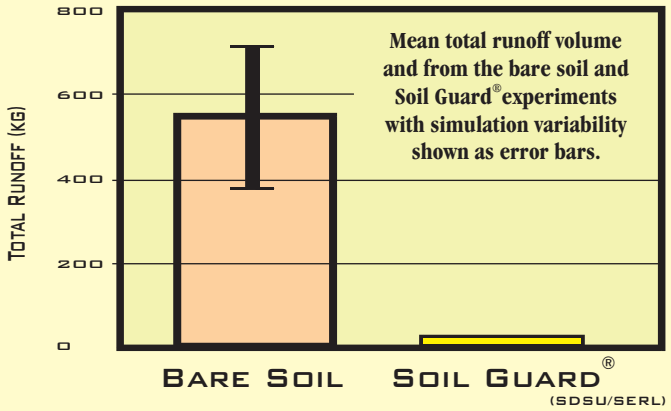
More Convenient Handling

Self-contained one bag system is easy to apply and relatively maintenance free. Packaged in durable paper or plastic bags for easy transport and handling.

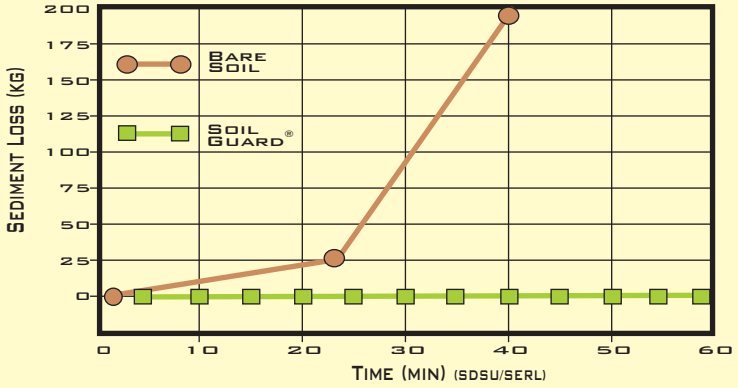
Soil Guard® conforms to the contours of bare soil immediately on contact for erosion controlling protection.

Because Soil Guard® is hydraulically applied it can be used to treat areas that may be difficult if not impossible to protect with other erosion control systems.

Sediment Run Off



Cumulative Sediment Export



Lab Test Confirm Soil Guards® All Around Performance

Soil Guard® was put to the test under controlled conditions at the nation's top erosion control laboratory. To judge Soil Guards® performance, the university-based lab ran the same series of tests used to evaluate other types of erosion control materials. In short, they subjected Soil Guard® to enough simulated rainfall to cause failure in any other material. Yet remarkably, after the standard test length, Soil Guard® showed no signs of failure. The test length had to be doubled before Soil Guard® showed any measurable soil loss. The results were dramatic by any measure.

Leading Erosion Control Test Facility
(minimum performance)

Specification Item	Class	Type	Site Conditions	Sediment Loss		Min. Vegetation Density	
				Max. Loss	Soil Guard	Minimum	Soil Guard
169 "Soil Retention Blanket"	1 "Slope Protection"	A	Slopes 1:3 or Flatter - Clay Soil	0.34	.27	80%	84%
		B	Slopes 1:3 or Flatter - Sand Soil	12.20	8.04	70%	87%
		C	Slopes Steeper Than 1:3 - Clay Soil	0.34	.27	80%	84%
		D	Slopes Steeper Than 1:3 - Sand Soil	26.84	8.04	70%	87%

Soil Guard® exceeds minimum standards set by a leading test facility in both soil types with slopes mentioned above. (TTI)

Choose Soil Guard® Bonded Fiber Matrix when:

- Steep or rugged terrain make soil preparation difficult or impossible.
- Weather or schedules demand immediate erosion protection and fast plant growth.
- Severe slopes or surface flows require erosion protection for up to nine months.
- Nearby wildlife habitat or residential areas need nontoxic solutions. (When used as directed)
- Cost-effectiveness, timeliness, results and quality are important.

With its accurate chemistry, trust Soil Guard®
to produce Easy, Consistent and Reliable results.

Tech Specs

Product properties have been determined using scientifically sound and reliable test methods. Other test methods may produce slightly different results.

Ingredients:

Wood fiber content..... >88%
Guar gum tackifier content by weight..... <9%
Basic yellow dye..... <1%
Trade secret..... <1%
Trade secret..... <1%

Composition:

Organic matter (min.)..... 94%
Inorganic matter (ash) (max.)..... 6%
Moisture content (total weight base)..... 12%±3%
pH at 3% consistency in water slurry (avg.)..... 4.8
Water-holding capacity (min.)..... 1.2gal./lb.

Coverage:

3000-4000 lbs. /Acre to achieve 100% coverage.

"C" Factor	6" Rainfall
Soil Guard®	0.001
Bare Soil	231
Percent % Of Effectiveness	99.9

(1) Results confirmed by the San Diego State University Soil Erosion Research Laboratory (SDSU/SERL). Testing conducted December 2006. Technical Report Number 01-2006 ASTM 6459-99

Performance

Drying Time..... 12-24 Hrs.
Longevity..... up to 9 mos.
depending on sight conditions

Packaging and Shipping

Net Wt. 50 lbs. 22.6 kg. Net Dry Wt. 44-45 lbs.

Packaged in 50 lb. (22.6 kg.) Plastic or Multiwalled paper bags.

Available in palletized 36 bag units Or 18 bag units

Product Certification and MSDS available upon request.

Intended Use

Soil Guard® has been designed to control superficial erosion caused by wind or falling rain on the treated area. Soil Guard® controls erosion until permanent stabilizing vegetation can be established in disturbed areas commonly associated with: state, county, or city D.O.T., Corps of Engineers/flood control, landfills, water retention ponds, landscaping, retaining wall structures, pipe and cable trenching, ski areas, golf courses, home lawns, and wetlands.

Non-Intended Uses

1. The prevention of landslides on soils that display deep seated instabilities or that are subject to surface peeling or frost heave.
2. Extended or permanent erosion control in non-vegetative applications.
3. As a channel liner or in areas where poor site design concentrates overland water flow.

Mat, Inc.
Quality Erosion Control Products

ECTC Directing Member

* Soil Guard® is a Bonded Fiber Matrix (BFM) as defined by the Erosion Control Technology Council (ECTC).

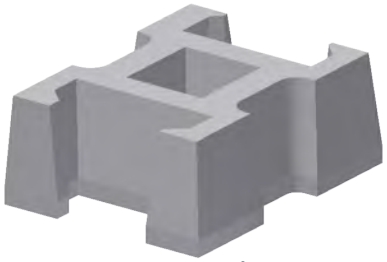
Contact Mat, Inc. At 1-888-477-3028 or visit our website at www.soilguard.com today to learn more about how Soil Guard® can help you hold your ground.

CONTECH®
CONSTRUCTION PRODUCTS INC.

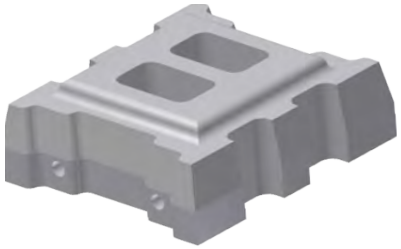
Armortec Product Details

ArmorWedge®

ArmorRoad®



ArmorLoc®

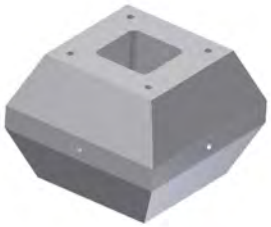


ArmorFlex® - Open Cell

A-Jacks®

ArmorFlex® - Close Cell

ArmorStone®



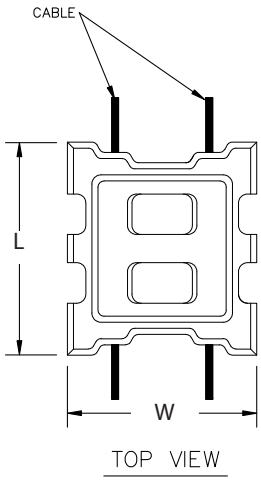
ArmorFlex® OS

MANUFACTURING SPECIFICATION
ASTM D6684-04

ARMORTEC
Erosion Control Solutions

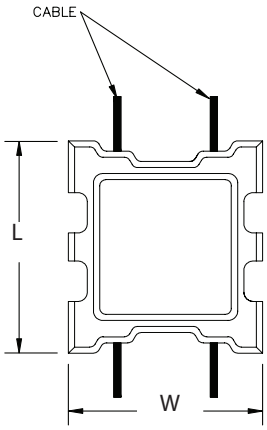
ArmorFlex®

(not to scale)



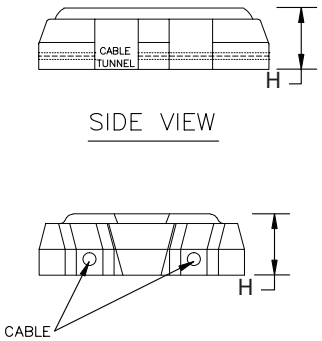
TOP VIEW

Open Cell Block

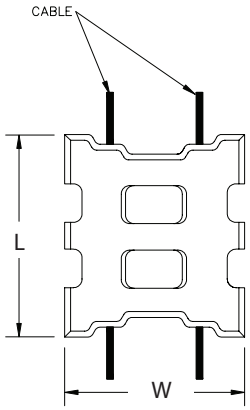


TOP VIEW

Close Cell Block

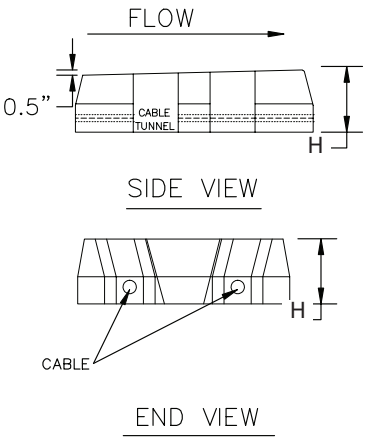


END VIEW



TOP VIEW

Tapered Series



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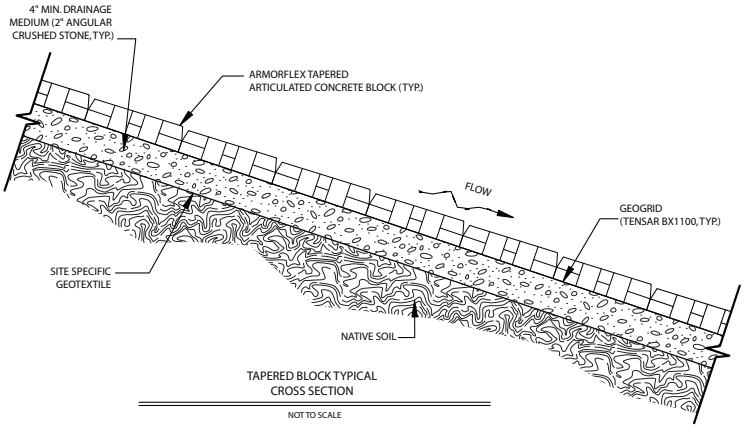
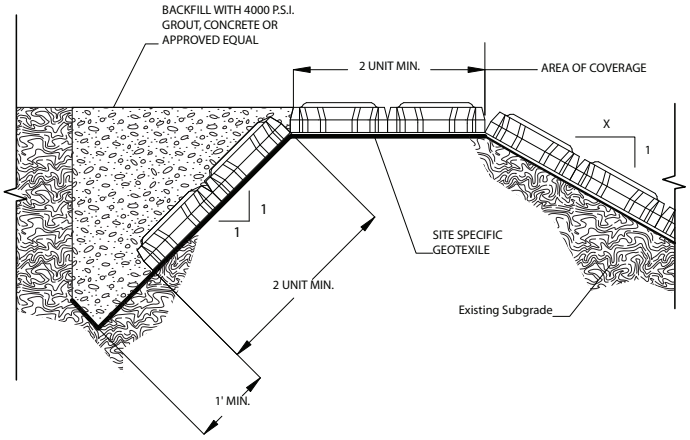


Tapered Series - Cross Section

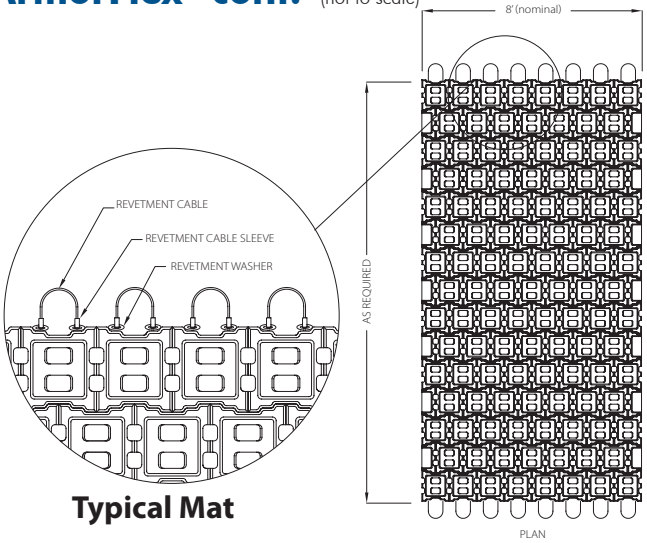


Top of Slope - Standard Detail

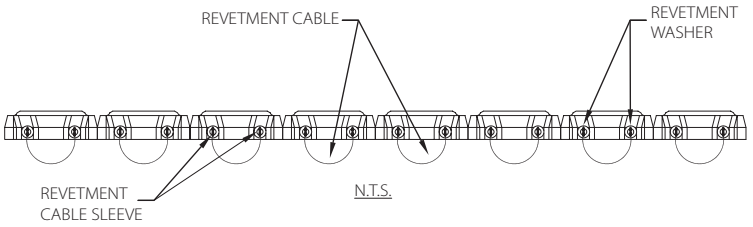
ArmorFlex Unit Specification

Concrete Block Class	Open/Closed Cell	Nominal Dimensions			Gross Area/ (sq. ft.)	Block Weight		Open Area %
		L	W	H		lbs	lbs/sq. ft.	
30s	Open	13.0	11.6	4.75	0.98	31-36	32-37	20
50s	Open	13.0	11.6	6.00	0.98	45-52	45-53	20
40	Open	17.4	15.5	4.75	1.77	62-71	35-40	20
50	Open	17.4	15.5	6.00	1.77	81-94	46-53	20
70	Open	17.4	15.5	8.50	1.77	120-138	68-78	20
40L	Open	17.4	23.6	4.75	2.58	90-106	35-41	20
70L	Open	17.4	23.6	8.50	2.58	173-201	67-78	20
45s	Closed	13.0	11.6	4.75	0.98	39-45	40-45	10
55s	Closed	13.0	11.6	6.00	0.98	53-61	54-62	10
45	Closed	17.4	15.5	4.75	1.77	78-89	43-50	10
55	Closed	17.4	15.5	6.00	1.77	94-108	53-61	10
85	Closed	17.4	15.5	8.50	1.77	145-167	82-98	10
45L	Closed	17.4	23.6	4.75	2.58	108-126	42-49	10
85L	Closed	17.4	23.6	8.50	2.58	209-243	81-94	10
High Velocity Application Block Classes								
40-T	Open	17.4	15.5	4.75	1.77	62-71	35-40	20
50-T	Open	17.4	15.5	6.00	1.77	81-94	46-53	20
70-T	Open	17.4	15.5	8.50	1.77	120-138	68-78	20

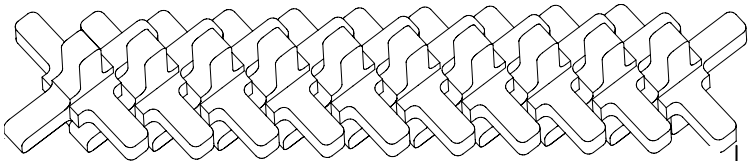
ArmorFlex® cont. (not to scale)



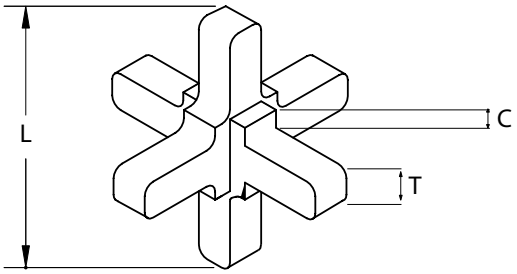
Typical Mat



A-Jacks® (not to scale)



A-Jacks Placement Profile

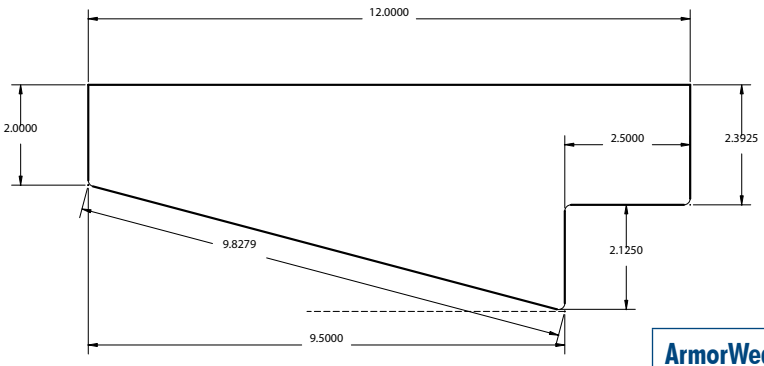


A-Jacks Unit

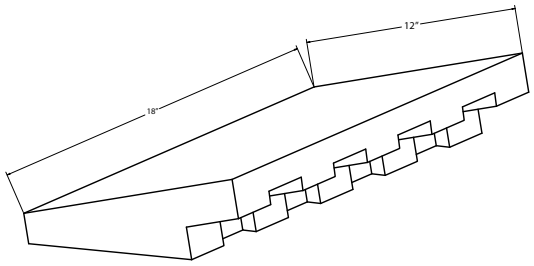
A-Jacks Unit Specification

A-JACKS	L(IN)	T(IN)/H(IN)	C(IN)	VOL(FT^3)	WT (LBS)
AJ-24	24	4	1.84	0.56	78
AJ-48	48	7.36	3.68	4.49	629
AJ-72	72	11.04	5.52	15.14	2.120
AJ-96	96	14.72	7.396	35.87	5.022
AJ-120	120	18.40	9.20	70.69	9.699

ArmorWedge® (not to scale)



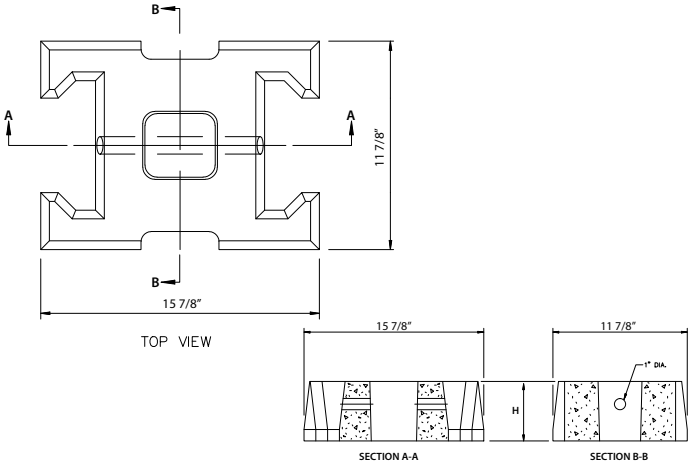
Side View - Typical Block



ArmorWedge Unit Specification

UNIT DIMENSION	UNIT WEIGHT (LBS)	SYSTEM WEIGHT (LBS)	UNIT COVERAGE (SF)	COMPRESSIVE STRENGTH (PSI)	MAXIMUM ABSORPTION (LBS/FT^3)
12x18	40-52	36-40	1.1875	4000	12

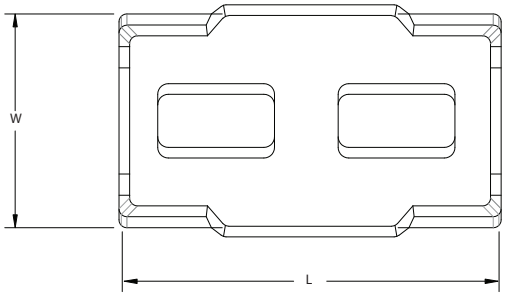
ArmorLoc® (not to scale)



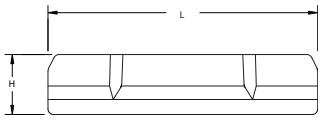
ArmorLoc Unit Specification

BLOCK	TECHNICAL DATA			DIMENSIONS AND WEIGHTS				
	Specific Weight lbs/ft³	Compressive Strength psi	Max Absorption, Avg. of 3 units 10 lbs/ft³	Thick-n2ess Inches (H)	Gross Area/ Grid ft²	Weights/ Grid lbs	Weights/ Area lbs/ft²	Open Area %
3510	130-150	4000 min	10	4	1.0	30-35	30-35	25
4511	130-150	4000 min	10	5.25	1.1	44-50	40-45	20

ArmorStone® (not to scale)



PLAN

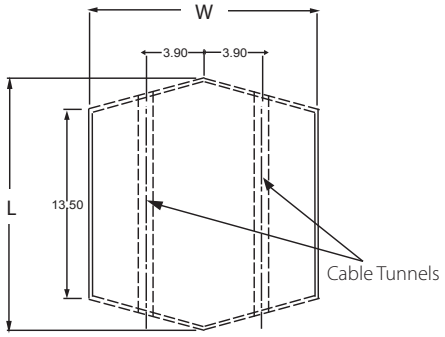


FRONT

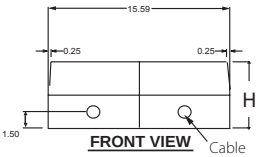
ArmorStone Unit Specification

CONCRETE BLOCK CLASS		NOMINAL DIMENSIONS (IN.)			UNIT COVERAGE (SF)	BLOCK		OPEN AREA %
		L	W	H		UNIT WEIGHT LBS.	SYSTEMS WEIGHTS LBS./SF	
AS 40	Open	18.00	10.00	4.50	1.25	50-54	40-44	25
AS 55	Closed	18.00	10.00	4.50	1.25	61-66	49-53	5

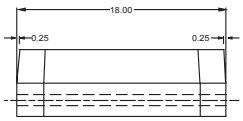
ArmorRoad® (not to scale)



TOP VIEW



FRONT VIEW



SIDE VIEW

ArmorRoad Unit Specification

BLOCK	TYPE	L	W	H	SF COVERAGE PER UNIT	WEIGHT LBS PER UNIT	SF PER TRUCK LOAD
Mat	Closed	18.00	15.60	6.00	1.74	105-109	750
Individual	Closed	18.00	15.60	6.00	1.74	100-104	750

Armortec Minimum Physical Requirements per ASTM 06684-04

MIN. DENSITY (IN AIR) LBS/FT³		MIN. COMPRESSIVE STRENGTH PSI		MAX WATER ABSORPTION LBS/FT³	
Ave. of 3 Units	Individual Unit	Ave. of 3 Units	Individual Unit	Ave. of 3 Units	Individual Unit
130	125	4,000	3,500	9.1	11.7

Why Use Vmax³® Reinforced Vegetation in Place of Hard Armor?

- Much more economical than rock or concrete, at less than 1/3 the installed cost
- Easier to install than rock or concrete and requires no heavy equipment for installation
- Recognized and emphasized by the U.S. EPA as a preferred Best Management Practice (BMP) in meeting National Pollutant Discharge Elimination System (NPDES) regulations
- Unlike rock, poured concrete, and articulated concrete blocks (ACBs), poses no threat to pedestrians or automobiles when used near travel routes
- Provides a natural filter for runoff water by allowing infiltration, entrapping sediments, and absorbing harmful pollutants; while hard armor enables little or no water infiltration or pollutant removal
- Requires next to no maintenance, other than periodic mowing; whereas rock rip rap collects trash, supports weed growth, and requires special attention when mowed around
- Offers a flexible lining that won't crack and deteriorate like concrete can
- Provides an aesthetically pleasing landscape

Why Use Vmax³ Composite TRMs Instead of Conventional TRMs?

1 Maximum Erosion Protection

- Vmax³ TRMs are surface-applied to provide the highest level of erosion protection at the lowest cost. Many conventional TRMs require costly soil in-filling, which is extremely vulnerable to erosion.
- The unique, corrugated permanent matting structure of Vmax³ forms a shear plane perpendicular to water flow that deflects erosive hydraulic forces away from the soil surface.
- Unlike conventional, open-structured TRMs, the Vmax³ natural or synthetic fiber matrix shields soil from the erosive forces of raindrop impact and prevents shear stress extraction of soil particles from or through the matting structure.

2 Maximum Vegetation Establishment

- Unlike conventional, open-structured TRMs, the fiber matrix of Vmax³ better regulates moisture and temperature for maximum seed germination and plant development.
- The Vmax³ corrugated matting structure deflects shear forces away from newly planted seed and structurally reinforces seedlings.

3 Maximum Vegetation Reinforcement

- The high-strength, 3-D matting structure of Vmax³ fortifies both stem and root systems for the ultimate in vegetation reinforcement.
- Its UV-stabilized, synthetic matting structure maintains strength and integrity even under long-term exposure to sunlight.
- The high-strength matting structure resists damages from natural forces—and from man-made forces, such as heavy foot traffic, maintenance equipment, and vehicular traffic.
- The permanent matting structure of all three Vmax³ products exceeds FHWA FP-03 standards for TRMs.

Vmax³ Composite Reinforcement Series — Product Application Guide

All Vmax³ rolls have standard dimensions of 6.5 ft. (2 m) x 55.5 ft. (16.9 m).

Product	Product Description	Typical Applications	Limiting Shear Stress Flow Duration lbs./ft.² (Pascal)				Permissible Velocity ft./s (m/s)		FHWA FP-03 Category	ECTC Category	Typical Projects
			Bare Soil		Vegetated						
			0.5 hrs	50 hrs	0.5 hrs	50 hrs	Unvegetated	Vegetated			
SC250	5.0-lb. UV-stable polypropylene top and bottom nets 24.0-lb. UV-stable polypropylene corrugated center net 70% straw/30% coconut fiber matrix	1:1 & greater slopes Medium- to high-flow channels Stream banks	3.0 (144)	2.5 (120)	10.0 (480)	8.0 (383)	9.5 (2.9)	15.0 (4.6)	Type 5.A, B, and C	Type 5.A, B, and C	Roadside ditches, golf course swales, steep slopes, stream banks
C350	8.0-lb. UV-stable polypropylene top and bottom nets 24.0-lb. UV-stable polypropylene corrugated center net 100% coconut fiber matrix	1:1 & greater slopes High-flow channels Shorelines	3.2 (153)	3.0 (144)	12.0 (576)	10.0 (480)	10.5 (3.2)	20.0 (6.0)	Type 5.A, B, and C	Type 5.A, B, and C	Severe slopes, drainage areas, high-flow areas, stream banks, shorelines
P550	24.0-lb. UV-stable polypropylene top and bottom nets 24.0-lb. UV-stable polypropylene corrugated center net 100% polypropylene fiber matrix	1:1 & greater slopes Extreme, high-flow channels Shorelines	4.0 (191)	3.25 (156)	14.0 (672)	12.0 (576)	12.5 (3.8)	25.0 (7.6)	Type 5.A, B, and C	Type 5.A, B, and C	Severe slopes, spillways, swales, high-flow areas, shorelines

Note: This guide is for general purposes only. Actual project design and product selection should be developed using North American Green ECMDS® software, available at www.nagreen.com.

The North American Green Advantage

North American Green's Erosion Solutions *Specialists* are specially trained to provide on-site support and utilize state-of-the-art North American Green Erosion Control Materials Design Software (ECMDS®), to ensure your project design through selection and installation of cost-effective erosion control products.

- As an extra advantage, North American Green's exclusive DOT System® is standard on all Vmax³ products. The DOT System provides installation staple patterns that are clearly marked on the mats. This greatly increases installer accuracy, which ensures proper installation and excellent results in the extremely critical applications for which Vmax³ products are used.
- North American Green products are known for their quality — all blankets and mats produced by North American Green are stitched on 1.5-inch (3.81-cm) centers, adding significantly to field performance capabilities.
- North American Green products are thoroughly tested under field and laboratory conditions to accurately quantify performance.
- North American Green products are backed by our Ultimate Assurance Guarantee. If our products fail to control soil loss to the specified limits, we will upgrade you to the next higher performance product, free. You can be 100% confident in your project design. Contact your North American Green Erosion Solutions *Specialist* for guaranteed solutions to your most critical erosion problems.

NORTH AMERICAN GREEN
EROSION CONTROL Products Guaranteed SOLUTIONS
A tensar. Company

NORTH AMERICAN GREEN
14649 Highway 41 North | Evansville, Indiana 47725
800-772-2040 | 812-867-6632
www.Vmax3.com

All Vmax³ products have been tested by AASHTO's National Transportation Product Evaluation Program for RECPs.

NORTH AMERICAN GREEN
A tensar. Company

Vmax³ Composite Reinforcement Series

Save Money and Permanently Control Erosion with Vmax³

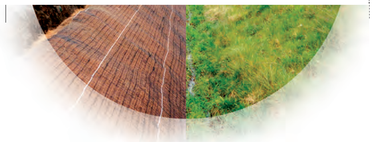
You could spend less than 1/3 the installed cost of rock rip rap for permanent erosion control on your next job, with Vmax³.

ROCK RIP RAP – COST FOR 1 ACRE INSTALLED	
Equipment	$1,331
Labor	$484
Rock Rip Rap & Fabric	$54,751
Total Cost for 1 Acre Installed	$56,566
That's **$11.69** per square yard installed	
VMAX³ – COST FOR 1 ACRE INSTALLED	
Equipment	$0
Labor	$242
Vmax³ & Staples	$16,020
Total Cost for 1 Acre Installed	$16,262
That's **$3.36** per square yard installed	

Cost shown in U.S. Dollars.

Earn LEED Green Building Rating System points using Vmax³.

See www.nagreen.com for details.

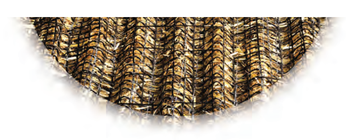


The Vmax³® Difference

Composite Construction for Complete Erosion Protection

North American Green's Vmax³ Permanent Composite Turf Reinforcement Mats are designed to maximize performance through all of the developmental phases of a reinforced vegetative lining — unvegetated, vegetation establishment, and vegetation maturity. All three Vmax³ TRMs feature a patented composite construction that elevates their erosion control and permanent turf reinforcement capabilities well beyond those of conventional TRMs.

Each Vmax³ product begins with a permanent, three-dimensional corrugated turf reinforcement matting structure incorporated with either natural organic or UV-stabilized synthetic fibers. This specially-designed TRM structure anchors and reinforces the roots and stems of vegetation for long-term stability, and helps create a shear plane that actually deflects the flowing water away from the soil surface — improving its immediate to long-term erosion control capabilities. The fiber matrix further supplements the TRM structure's ground cover and moisture retention properties for dramatically improved erosion control and mulching action. By ensuring effective seed and soil protection immediately after installation, Vmax³ TRMs give you confidence from the start that your reinforced turf designs will develop as planned.
And, with proven vegetation reinforcement capabilities under flow-induced shear stresses of over 14 lbs./ft.² (672 Pa), Vmax³ products give you confidence that your steep slopes, medium-to high-flow channels, stream banks, and shorelines will withstand nature's forces for years to come. Backed by the most comprehensive product performance guarantee in the industry, Vmax³ TRMs give you confidence to design with vegetation instead of rock rip rap or concrete in most critical erosion control applications.



Vmax³® SC250® Permanent Turf Reinforcement Mat

1:1 & greater slopes
Medium- to high-flow channels
Stream banks

Vmax³ SC250 is constructed of a permanent, high-strength, three-dimensional matting structure that incorporates a straw/coconut fiber matrix. The straw/coconut fiber matrix enhances the permanent matting component's initial mulching and erosion control performance for up to 24 months.

SC250 provides extended-term, pre-vegetated erosion protection and permanent turf reinforcement in a wide range of applications, including severe slopes, medium- to high-flow channels, and stream banks. It is proven in extensive laboratory and field research to increase the shear resistance of vegetation to 10 lbs./ft.² (480 Pa).

With the toughest unreinforced grasses typically failing at shear stress levels of 3.7 lbs./ft.², the high-performance SC250 more than doubles the shear resistance of vegetation. This enables SC250 to be used in applications where rock rip rap and concrete were once specified.

Top Net
Polypropylene
5.0 lbs./1,000 ft.²
(2.44 kg/100 m²) approx. wt.

Center Net
Polypropylene, corrugated
24.0 lbs./1,000 ft.²
(11.7 kg/100 m²) approx. wt.

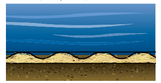
Matrix Material
70% agricultural straw
0.35 lbs./yd.²
(0.19 kg/m²)
30% coconut fiber
0.15 lbs./yd.²
(0.08 kg/m²)

Bottom Net
Polypropylene
5.0 lbs./1,000 ft.²
(2.44 kg/100 m²) approx. wt.

Thread
Permanent

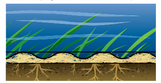
Performance Profile

Phase 1 (Unvegetated)



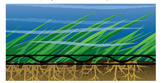
Unprotected seed and soil are highly susceptible to erosion. Upon installation, the SC250's straw/coconut fiber matrix and corrugated matting structure provide a uniform mulch layer and effective erosion protection for seed and soil under flow-induced shear stresses up to 3.0 lbs./ft.² (144 Pa).

Phase 2 (Vegetation Establishment)



The tender stems and undeveloped root systems of immature vegetation provide little protection for the soil surface and are prone to damage or removal at shear stresses of only 0.6 lbs./ft.² (29 Pa).*
The SC250 continues providing erosion protection between, and structural support for, developing plants — increasing the permissible shear stress of new vegetation up to 8 lbs./ft.² (383 Pa).

Phase 3 (Vegetation Maturity)



Under flow-induced shear stress of only 1.0 lb./ft.² (48 Pa), unreinforced mature vegetation may allow significant soil loss and experience physical damage.**

The SC250's corrugated matting structure reinforces soils and anchors vegetation roots and stems — increasing the permissible shear stress of the permanent vegetative stand up to 10 lbs./ft.² (480 Pa).

*Based on FHWA HEC#15 Permissible Shear Stress for Class D Vegetation [2 to 6" tall (5 to 15 cm), fair stand].
**Based on FHWA HEC#15 Permissible Shear Stress for Class C Vegetation [6" tall (15 cm), good stand].

Vmax³® C350® Permanent Turf Reinforcement Mat

1:1 & greater slopes
High-flow channels
Shorelines

Vmax³ C350 is composed of a permanent, high-strength, three-dimensional matting structure, incorporated with a 100% coconut-fiber matrix that supplements the permanent matting structure's initial mulching and erosion control capabilities for up to 36 months.

C350 is designed to provide long-term, pre-vegetated erosion protection and permanent turf reinforcement in a range of applications, including steep slopes, high-flow channels, and shorelines. Proven in extensive laboratory and field research, C350's high-strength, 3-D matting structure boosts the shear resistance of vegetation to an amazing 12 lbs./ft.² (576 Pa).

With permanent erosion protection exceeding that of 30-inch (0.76 m) rock rip rap, C350 provides a cost-effective, environmentally friendly solution to erosion control projects for severe conditions.

Top Net
Polypropylene
8.0 lbs./1,000 ft.²
(3.91 kg/100 m²) approx. wt.

Center Net
Polypropylene, corrugated
24.0 lbs./1,000 ft.²
(11.7 kg/100 m²) approx. wt.

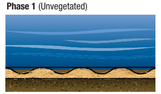
Coconut Fiber
0.50 lbs./yd.²
(0.27 kg/m²)

Bottom Net
Polypropylene
8.0 lbs./1,000 ft.²
(3.91 kg/100 m²) approx. wt.

Thread
Permanent

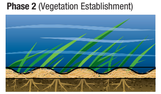
Performance Profile

Phase 1 (Unvegetated)



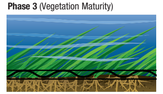
Unprotected seed and soil are highly susceptible to erosion. Upon installation, the C350's coconut fiber matrix and corrugated matting structure provide a uniform mulch layer and effective erosion protection for seed and soil under flow-induced shear stresses up to 3.2 lbs./ft.² (153 Pa).

Phase 2 (Vegetation Establishment)



The tender stems and undeveloped root systems of immature vegetation provide little protection for the soil surface and are prone to damage or removal at shear stresses of only 0.6 lbs./ft.² (29 Pa).*
The C350 continues providing erosion protection between, and structural support for, developing plants — increasing the permissible shear stress of new vegetation up to 10 lbs./ft.² (480 Pa).

Phase 3 (Vegetation Maturity)



Under flow-induced shear stress of only 1.0 lb./ft.² (48 Pa), unreinforced mature vegetation may allow significant soil loss and experience physical damage.**

The C350's corrugated matting structure reinforces soils and anchors vegetation roots and stems — increasing the permissible shear stress of the permanent vegetative stand up to 12 lbs./ft.² (576 Pa).

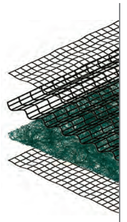
*Based on FHWA HEC#15 Permissible Shear Stress for Class D Vegetation [2 to 6" tall (5 to 15 cm), fair stand].
**Based on FHWA HEC#15 Permissible Shear Stress for Class C Vegetation [6" tall (15 cm), good stand].

Vmax³® P550® Permanent Turf Reinforcement Mat

1:1 & greater slopes
Extreme, high-flow channels
Shorelines

North American Green's P550 is made of a permanent, ultra-high-strength, three-dimensional matting structure incorporated with a permanent, 100% polypropylene fiber matrix. The 100% polypropylene fiber matrix enhances the permanent matting structure's initial mulching and erosion control properties, as well as its permanent vegetation reinforcement capabilities.

P550 is designed to provide long-term, pre-vegetated erosion protection and permanent turf reinforcement in an extensive range of severe applications, including steep slopes; extreme, high-flow channels; and shorelines. P550 is proven to drive the shear resistance of vegetation to over 14 lbs./ft.² (672 Pa) — for maximum vegetation reinforcement.



Top Net
Polypropylene
24.0 lbs./1,000 ft.²
(11.7 kg/100 m²) approx. wt.

Center Net
Polypropylene, corrugated
24.0 lbs./1,000 ft.²
(11.7 kg/100 m²) approx. wt.

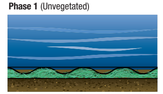
Polypropylene Fiber
0.50 lbs./yd.²
(0.27 kg/m²)

Bottom Net
Polypropylene
24.0 lbs./1,000 ft.²
(11.7 kg/100 m²) approx. wt.

Thread
Permanent

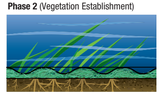
Performance Profile

Phase 1 (Unvegetated)



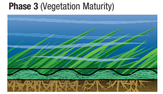
Unprotected seed and soil are highly susceptible to erosion. Upon installation, the P550's polypropylene fiber matrix and corrugated matting structure provide a uniform mulch layer and effective erosion protection for seed and soil under flow-induced shear stresses up to 4.0 lbs./ft.² (191 Pa).

Phase 2 (Vegetation Establishment)



The tender stems and undeveloped root systems of immature vegetation provide little protection for the soil surface and are prone to damage or removal at shear stresses of only 0.6 lbs./ft.² (29 Pa).*
The P550 continues providing erosion protection between, and structural support for, developing plants — increasing the permissible shear stress of new vegetation to 12 lbs./ft.² (576 Pa).

Phase 3 (Vegetation Maturity)



Under flow-induced shear stress of only 1.0 lbs./ft.² (48 Pa), unreinforced mature vegetation may allow significant soil loss and experience physical damage.**

The P550 reinforces soils and anchors vegetation roots and stems — increasing the permissible shear stress of the permanent vegetative stand to 14 lbs./ft.² (672 Pa).

*Based on FHWA HEC#15 Permissible Shear Stress for Class D Vegetation [2 to 6" tall (5 to 15 cm), fair stand].
**Based on FHWA HEC#15 Permissible Shear Stress for Class C Vegetation [6" tall (15 cm), good stand].