

BASIN AREA (AC.)	CN	D10	VOL-10 (CF)	FLOW 100(CFS)
PA-S	1.749	89	1.003	6369
PA-1	0.365	91	1.137	1507
PA-C	1.277	90	1.069	4650
PA-N1	0.41	88	1.003	1041
PA-N2	0.56	89	0.941	2039
PA-N(N1+N2)	Totals	3080,	2.75	1.62

BLM

RIM

BLM

LEGEND

FLOW ARROW

RIM

DRAINAGE SWALE

RIPRAP

DIVERSION DIKE

WATER BAR

CHECK DAM

SILT FENCE

EXISTING

CONTOURS

BASIN LABEL

PA-N1

BASIN

BOUNDARY

RECEIVED

JUN 28 2012

GRAND JUNCTION FIELD OFFICE

DIVISION OF

REGULATION MINING & SAFETY

SCALE: 1" = 80'

RIMROCK EXPLORATION & DEVELOPMENT

PRINCE ALBERT MINE - 110D PERMIT APPLICATION

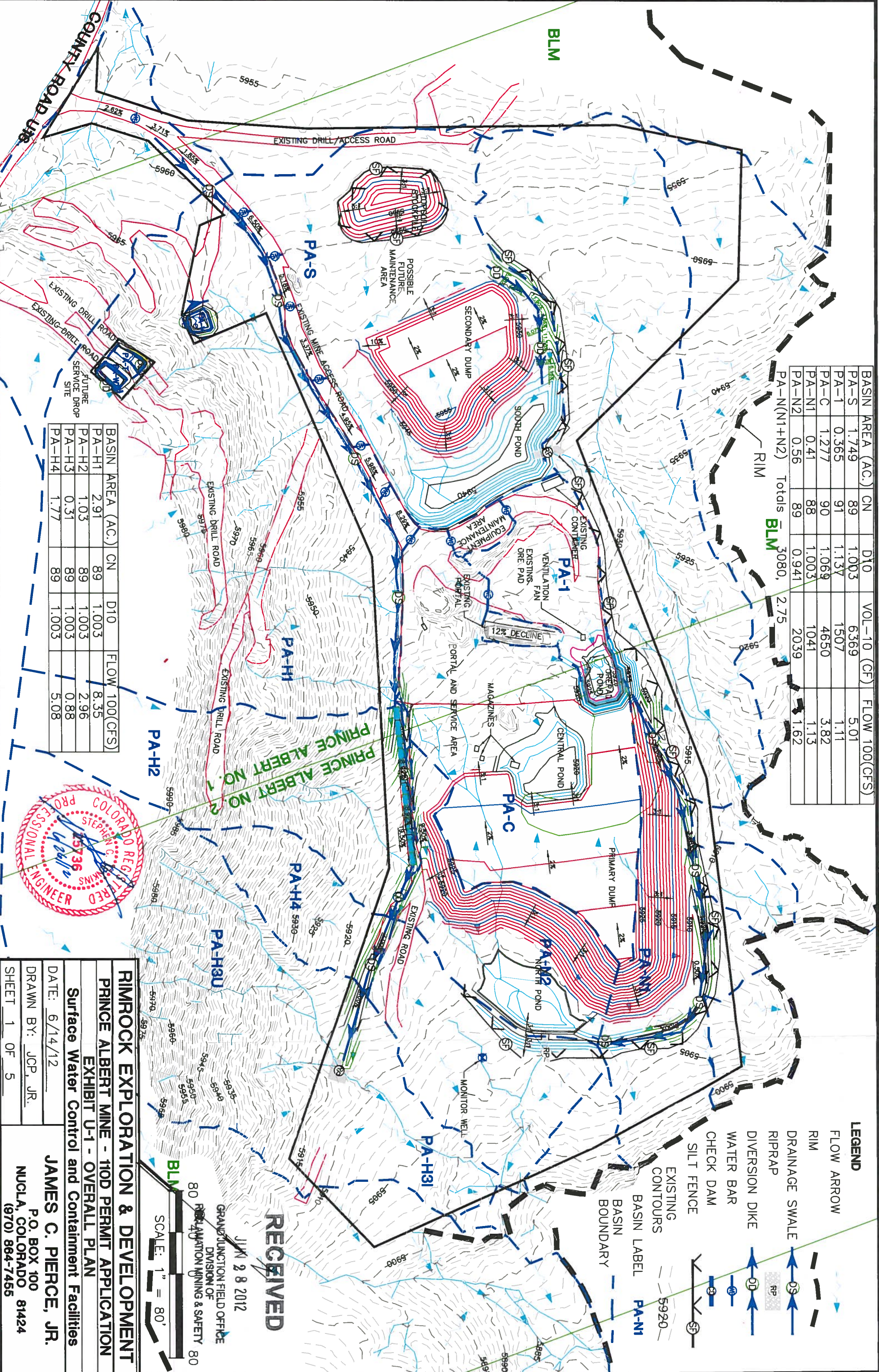
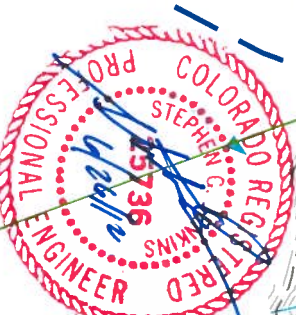
EXHIBIT U-1 - OVERALL PLAN

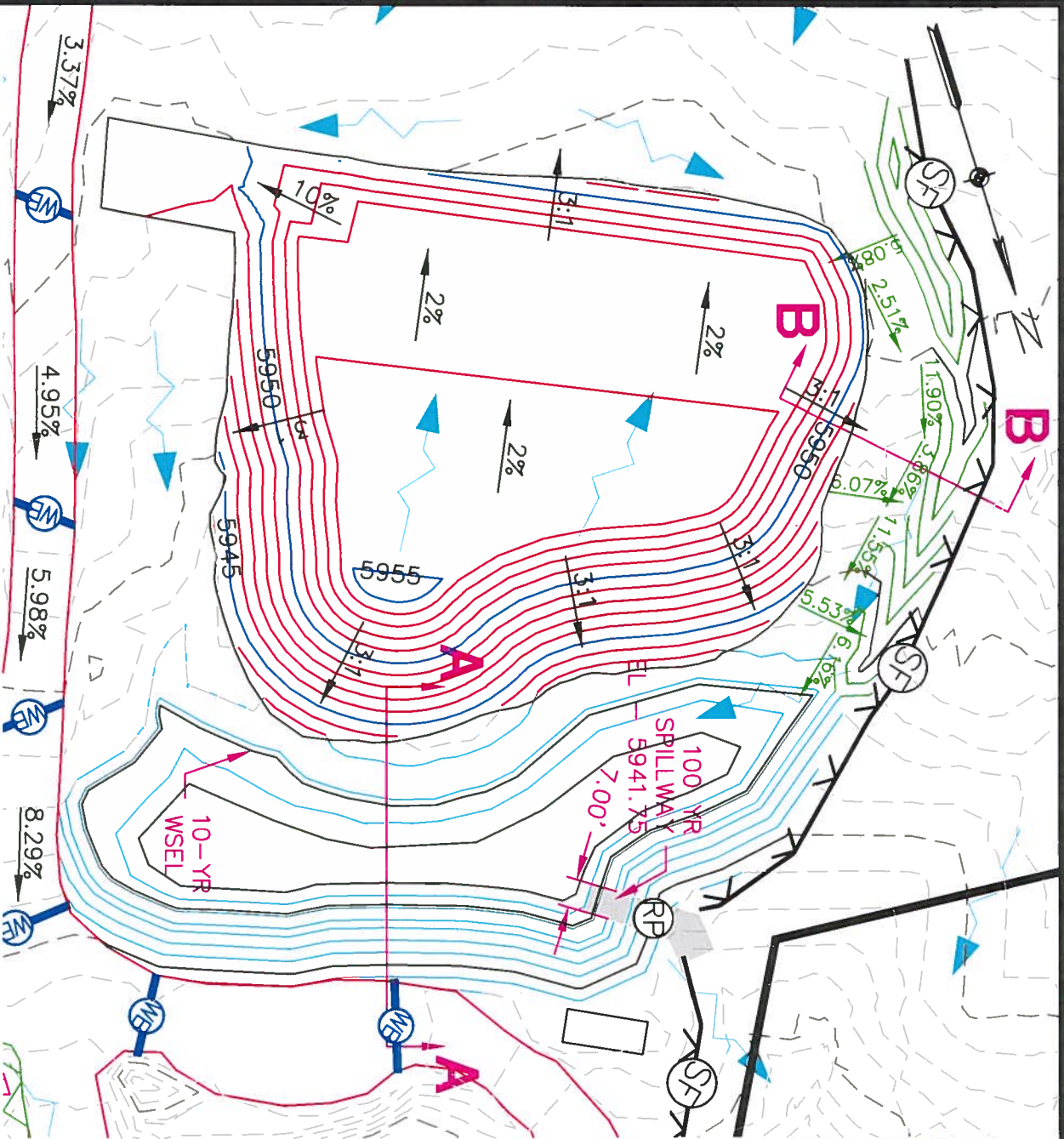
Surface Water Control and Containment Facilities

DATE: 6/14/12

DRAWN BY: JCP, JR.

JAMES C. PIERCE, JR.
P.O. BOX 100
NUCLA, COLORADO 81424
(970) 864-7465





SPILLWAY RIPRAP DESIGN
100-YR/24HR PEAK DESIGN FLOW – 5.01 CFS

Height of flow (Broad Crested Weir) – $H = (Q/CL)^{2/3}$

For C = 2.84, Q = 5.01 cfs, L = 84 in

H = 4.79 in, Spillway Elevation @ 5941.75, Crest @ 5943.0

RIPRAP DESIGN – FROM PAP-0790 – SIMPLIFIED DESIGN GUIDELINES FOR RIPRAP SUBJECTED TO OVERTOPPING FLOW (BuRec, CSU)

D50 $Cu^{1/4} = 0.55(qf^{0.52}/S^{3/4})(\sin \alpha / (Gs \cos \alpha - 1)(\cos \alpha \tan \phi - \sin \alpha))^{1.11}$
D50 = $(0.55(qf^{0.52}/S^{3/4})(\sin \alpha / (Gc \cos \alpha - 1)(\cos \alpha \tan \phi - \sin \alpha))^{1.11})/Cu^{1/4}$

FOR SOUTH POND –

D50 = median stone size (m)

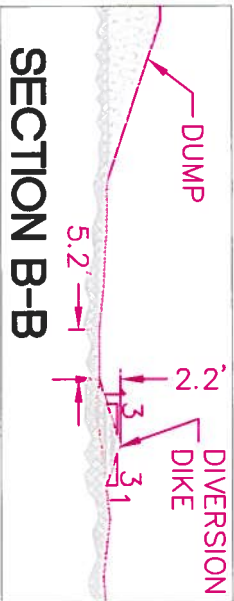
Cu = coefficient of uniformity = 1.95, qf = unit discharge (m³/m/s) = 0.066

S = embankment slope (unitless) = 0.333, α = embankment slope (degrees) = 18.43

Gs = specific gravity of riprap = 2.24, phi = angle of repose of the riprap = 42

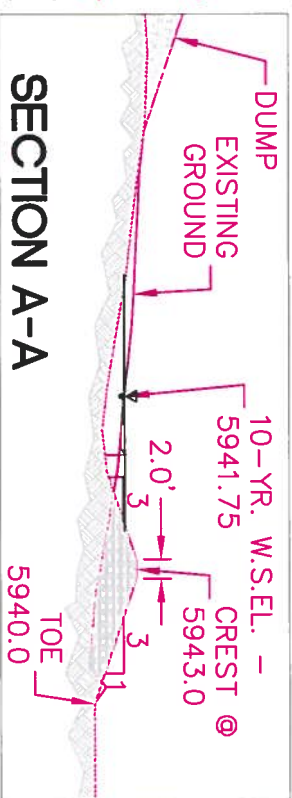
D50 = 0.126m or 5.0in

DIVERSION DIKE

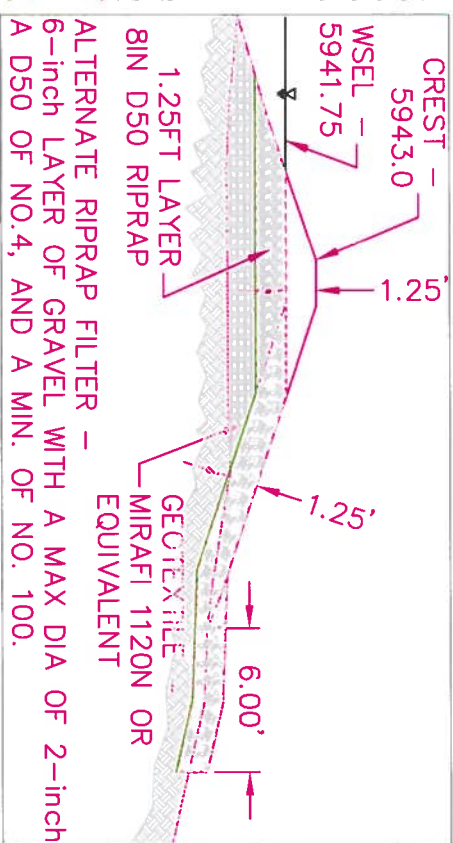


SECTION B-B
1' = 20'

SOUTH DETENTION



SECTION A-A
1' = 20'



SECTION THRU SPILLWAY
1/8" = 1'

For interstitial flow, Vi (flow velocity) = $(gD50)^{0.5} \cdot 2.48s^{0.58} \cdot Cu^{-2.22}$ where s = slope in ft per ft = 0.333

$Vi = (32.16 \times (5/12))^{0.5} \times (2.48 \times (0.333)^{0.58}) \times (1.95^{-2.22}) = 1.090$ fps

Average velocity is the interstitial velocity multiplied by the porosity (Np) of the riprap – $Vav = Vi \times Np$.

for Np = 0.45, Vav = 1.090x0.45 = 0.49 fps.

Depth of flow is the flow quantity divided by the average velocity – $Y = Q/Vav$, $Y = (5.01/77ft.)/0.49fps = 1.46$ ft. or 17.5 in., using an integer multiple of D50 for thickness gives 4xD50 for 20 inches of 5 in. D50 riprap.

To provide a safety factor use a riprap with a D50 of 7.5 in.

$Vi = (32.16 \times (7.5/12))^{0.5} \times (2.48 \times (0.333)^{0.58}) \times (1.95^{-2.22}) = 1.33$ fps

$Vav = 1.19 \times 0.45 = 0.60$ fps.

$Y = (5.01cfs/77ft)/0.60fps = 1.19$ ft or 14.3 in, using an integer multiple of D50 for thickness gives 2xD50 for 15 inches of 7.5 in D50 riprap.

100-YR/24HR PEAK DESIGN FLOW – 5.01 CFS

Channel Data Maximum Minimum

Slope 0.1155 ft/ft – 0.025 ft/ft

Manning's n 0.0280

Height 24.0 in

Width 62.0 in

Left slope 0.333 ft/ft (V/H) – 0.052 ft/ft

Right slope 0.050 ft/ft (V/H) – 0.333 ft/ft

Computed Results:

Depth 1.91 in – 4.8 in

Velocity 4.54 fps – 2.8 fps

Percent full 7.9 % – 19.9 %

DETENTION POND 10-YR/24 HR DESIGN VOLUME –

BASIN	AREA	CN	D10	VOLUME
PA-S	1.749	89	1.003	6,369

VOLUME PROVIDED @ ELEVATION (MODIFIED SPILLWAY) – ELEV AREA CONIC

5943.0	8304.86	15,009.2
5942.0	5973.22	7,902.1
5941.75	5520.33	6,517.7
5941.0	3897.19	3,003.7
5940.0	2191.55	0.0

DETENTION POND 100-YR/24 HR DESIGN VOLUME – RECLAMATION MINING & SAFETY DIVISION OF

BASIN	AREA	CN	D100	VOLUME
PA-S	1.749	89	1.873	11,890



NOTE –

SEE SHEET U-5 FOR TYPICAL SECTIONS (LATERAL) THRU SPILLWAY.

RIMROCK EXPLORATION & DEVELOPMENT

PRINCE ALBERT MINE - 110D PERMIT APPLICATION

EXHIBIT U-2 - STRUCTURES

Surface Water Control and Containment Facilities

DATE: 6/14/12

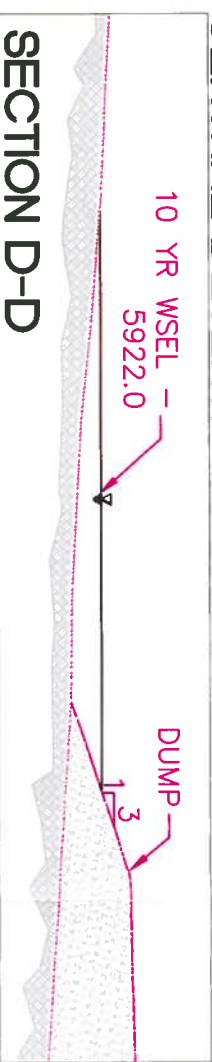
DRAWN BY: JCP, JR.

JAMES C. PIERCE, JR.
P.O. BOX 100
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(970) 864-7465

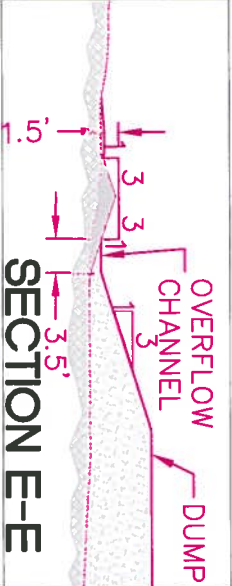
RECEIVED

BASIN	AREA	CN	D10	VOLUME	ELEV	AREA	VOL (CONIC)
PA-C	1.277	90	1.069	4,650	5923.0	5060	9254.6
DETENTION POND	100-YR/24 HR DESIGN			VOLUME	5922.0	3646	4921.2
				JAN 2 8 2012	5921.0	2459	1888.3
BASIN	AREA	CN	D10	VOLUME	GRAND JUNCTION FIELD OFFICE	1370	0.0
PA-C	1.277	90	1.957	8,681	RECLAMATION MINING & SAFETY		

CENTRAL DETENTION POND



CENTRAL DETENTION OVERFLOW

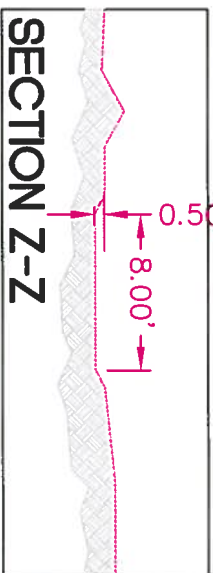
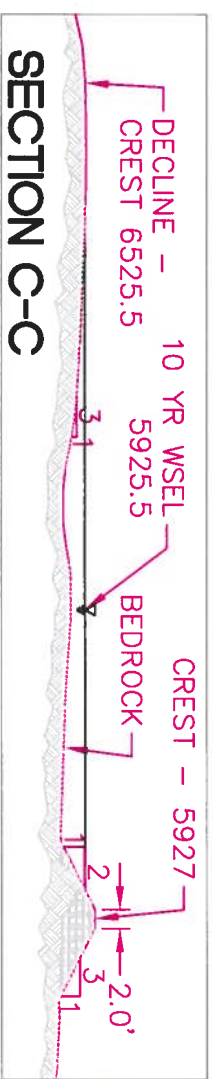


SECTION D-D

DETENTION POND 24 HR/10/100 - YR DESIGN VOLUME					100-YR PEAK DESIGN FLOW -- 3.82 CFS	
					1' = 20'	
BASIN	AREA	CN	D10	VOLUME	Channel Data	
PA-1	0.365	92	1.210	1,603	Flowrate	3.82 cfs
BASIN	AREA	CN	D100	VOLUME	Slope	0.095 ft/ft
PA-1	0.365	92	2.133	2,826	Height	18.0 in

Professional Engineer Seal for Colorado, No. 25736, signed by Stephen J. Perkins.

OREPAD DETENTION



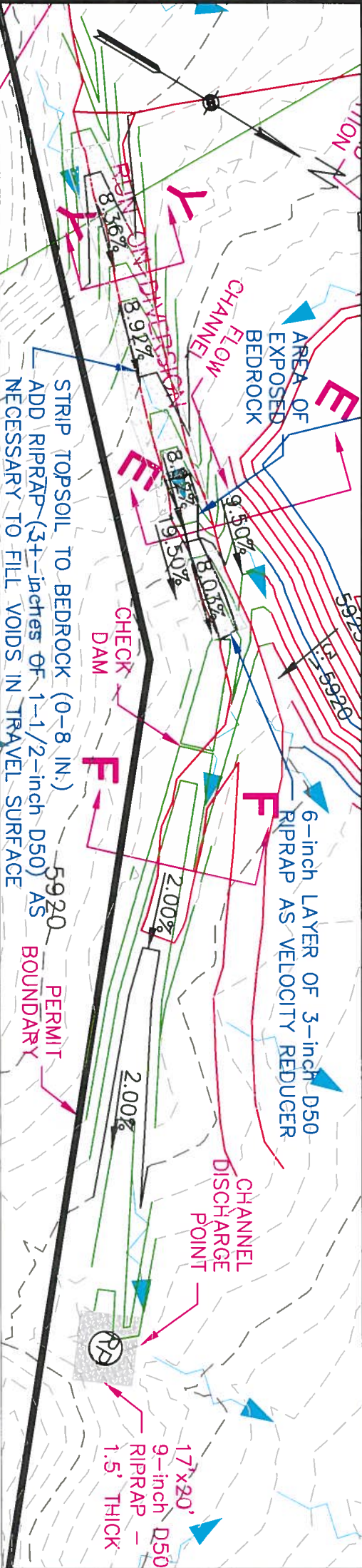
Flowrate	3.82 cfs
Slope	0.095 ft/ft
Height	18.0 in
Bottom Width	42.0 in
Left slope	0.33 ft/ft (V/H)
Right slope	0.33 ft/ft (V/H)
Manning's n	0.0280
Depth	2.10 in
Velocity	4.73 fps
Percent full	8.76 %

SECTION Z-Z

SEE SHEET U-5 FOR CALCULATIONS

SECTION C-C

T = 20'



100-YR PEAK DESIGN FLOW - RUN ON DIVERSION - PLAN VIEW

SECTION Y-Y

SECTION E-E

SECTION F-F

DISCHARGE POINT RIPRAP PROTECTION SIZING -

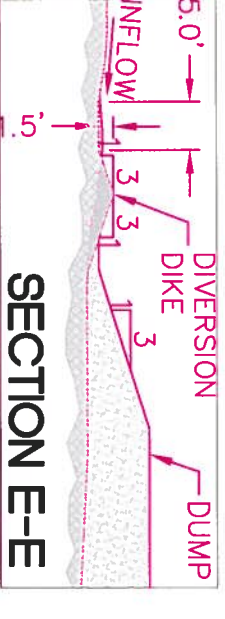
Flow	8.35 cfs	SECTION Y-Y	8.35 cfs	SECTION E-E	11.31 cfs	SECTION F-F	0.0352
Slope	0.089 ft/ft		0.195 ft/ft		0.020 ft/ft		
Depth	18.0 in						
Bottom width	60.0 in						
Left slope	0.33 ft/ft (V/H)		0.33 ft/ft (V/H)		0.33 ft/ft (V/H)		
Right slope	0.133 ft/ft (V/H)		0.133 ft/ft (V/H)		0.33 ft/ft (V/H)		
Manning's n	0.0390		0.0350		0.028		
Depth	3.52 in		2.67 in		5.9 in		
Velocity	4.34 fps		6.10 fps		4.0 fps		
Percent full	19.6 %		14.8 %		32.8 %		

Using the Shear Stress design formula -
ST=62.4dxs, where d is depth (ft) and s is
slope (ft/ft) yields a ST of 1.4 which equates
to a 6-inch d50 RIPRAP.
As an additional safety factor upsized to a
9-inch D50. Thickness is 2 x d50 or 1.5 ft.

EAST RUN ON DIVERSION SWALE

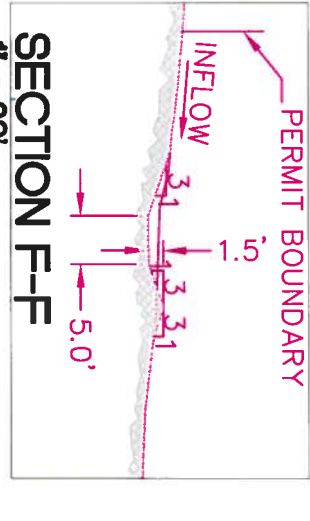
CHECK DAM

T = 4'



SECTION E-E

T = 20'



SECTION F-F

T = 20'

RIMROCK EXPLORATION & DEVELOPMENT

PRINCE ALBERT MINE - 110D PERMIT APPLICATION

EXHIBIT U-3 - STRUCTURES 2

Surface Water Control and Containment Facilities

DATE: 6/14/12

DRAWN BY: JCP, JR.

SHEET 3 OF 5

JAMES C. PIERCE, JR.

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NUCLA, COLORADO 81424

(970) 864-7455

WEST DIVERSION SWALE

100-YR PEAK DESIGN FLOW
SUB-BASIN PA-N1 - 1.13 CFS

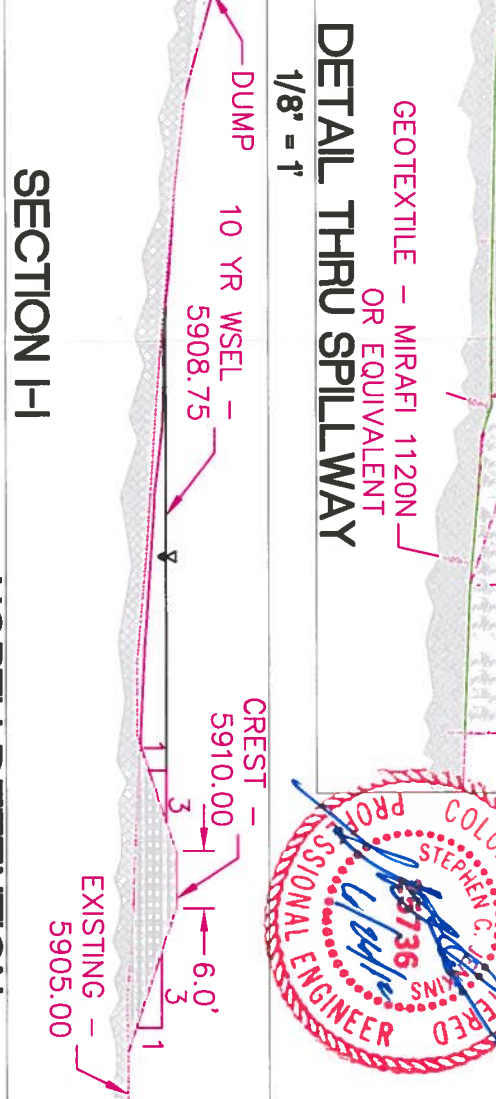
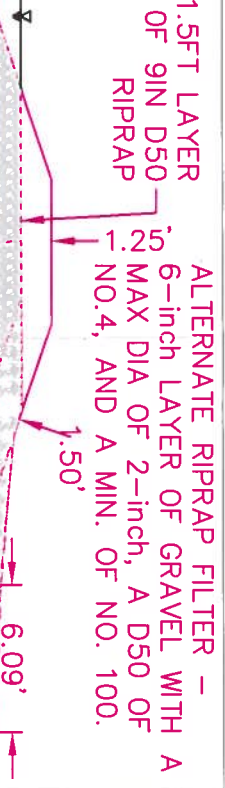
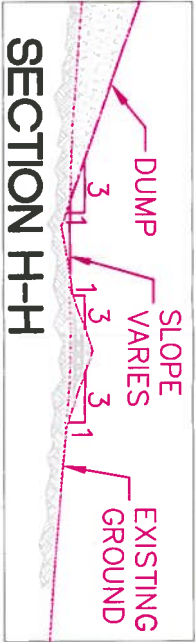
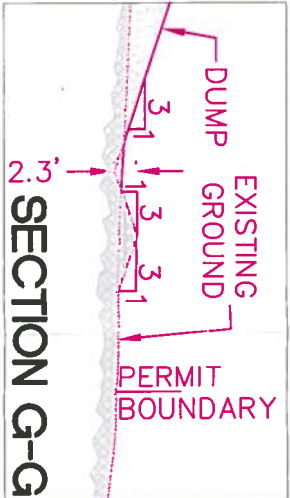
Channel Data:

Flowrate	1.13 cfs
Manning's n	0.0280
Slope	0.0663 ft/ft
Height	24.0 in
Left slope	0.33 ft/ft (V/H)
Right slope	0.33 ft/ft (V/H)
Depth	3.76 in
Velocity	3.83 fps
Percent full	15.67%

RECEIVED

JUN 28 2012

GRAND JUNCTION FIELD OFFICE
DIVISION OF
RECLAMATION MINING & SAFETY

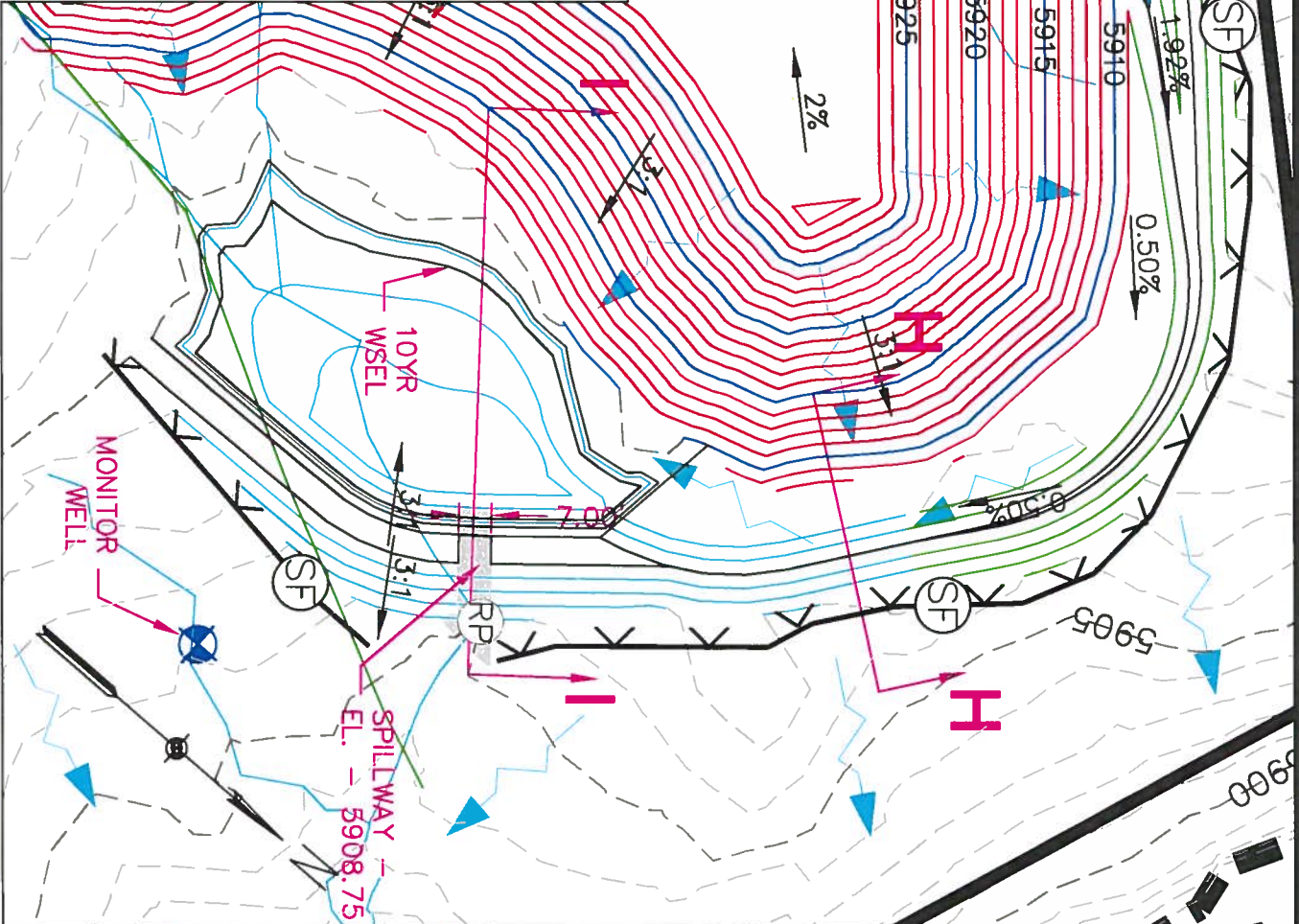


SECTION I-I
NORTH DETENTION
1" = 20'

ELEVATION	AREA	VOLUME (CONIC)
5909.33	4506.63	6370.0
5909.0	4221.22	4915.6
5908.75	3697.25	3926.5
5908.0	2371.78	1668.9
5907.0	1053.97	0.0

RIMROCK EXPLORATION & DEVELOPMENT
PRINCE ALBERT MINE - 110D PERMIT APPLICATION
EXHIBIT U-4 - STRUCTURES 3

Surface Water Control and Containment Facilities	
DATE: 6/14/12	JAMES C. PIERCE, JR. P.O. BOX 100 NUCLA, COLORADO 81424 (970) 864-7465
DRAWN BY: JCP, JR.	
SHEET 4 OF 5	



PLAN VIEW

SPILLWAY RIPRAP DESIGN
100-YR/24HR PEAK DESIGN FLOW - 6.58 CFS -
SUM N1+N2+C

Height of flow (Broad Crested Weir) - $H = (Q/CL)^{2/3}$

For $C = 2.84$, $Q = 6.58$ cfs, $L = 84$ in

$H = 5.75$ in, Spillway Elevation @ 5941.75, Crest @ 5943.0

RIPRAP DESIGN - FROM PAP-0790 - SIMPLIFIED DESIGN GUIDELINES
FOR RIPRAP SUBJECTED TO OVERTOPPING FLOW (BuRec, CSU)

$$D50 Cu^{1/4} = 0.55(qf^{0.52}/S^{3/4})(\sin \alpha / (Gs \cos \alpha - 1))^{1.11}$$
$$D50 = (0.55(qf^{0.52}/S^{3/4})(\sin \alpha / (Gs \cos \alpha - 1))^{1.11}) / Cu^{1/4}$$

FOR NORTH POND -

- D50 = median stone size (m)
- Cu = coefficient of uniformity = 1.95,
- qf = unit discharge ($m^3/m/s$) = 0.087
- S = embankment slope (unitless) = 0.333,
- α = embankment slope (degrees) = 18.43
- Gs = specific gravity of riprap = 2.24,
- ϕ = angle of repose of the riprap = 42
- D50 = 0.145M use 6.0in

For interstitial flow, V_i (flow velocity) = $(gD50)^{0.5} \cdot 2.48s^{0.58} \cdot Cu^{-2.22}$
where s = slope in ft per ft = 0.333

$V_i = (32.16 \times (6/12))^{0.5} \times (2.48 \times (0.333)^{0.58} \times (1.95^{-2.22})) = 1.194$ fps

Average velocity is the interstitial velocity multiplied by the porosity
(Np) of the riprap - $V_{av} = V_i \times Np$.

for $Np = 0.45$, $V_{av} = 1.194 \times 0.45 = 0.537$ fps.

Depth of flow is the flow quantity divided by the average velocity -
 $Y = Q/V_{av}$, $Y = (6.58/77ft.)/0.537fps = 1.75$ ft. or 21.0 in., using
an integer multiple of D50 for thickness gives 4xD50 for 24 inches
of 6 in. D50 riprap.

BASIN	AREA	CN	D10	VOLUME
PA-N1	0.41	88	1.792	2,666
PA-N2	0.56	89	1.003	2,039
TOTAL -				3,441
VOLUME PROVIDED @ ELEVATION 5908.75 - 3926.5				
DETENTION POND 100 YR/24-HR DESIGN VOLUME - (RAISED SPILLWAY)				
BASIN	AREA	CN	D10	VOLUME
PA-N1	0.41	88	0.941	1,402
PA-N2	0.56	89	1.003	2,039
TOTAL -				3,441
VOLUME PROVIDED @ ELEVATION 5908.75 - 3926.5				
DETENTION POND 100 YR/24-HR DESIGN VOLUME - (RAISED SPILLWAY)				
BASIN	AREA	CN	D10	VOLUME
PA-N1	0.41	88	1.792	2,666
PA-N2	0.56	89	1.873	3,807
TOTAL -				6,473
VOLUME PROVIDED @ ELEVATION 5909.33 - 6370.0				

OREPAD POND OVERFLOW TO PORTAL

Given Input Data:

Flowrate 1.11 cfs
Slope 0.005 ft/ft
Manning's n 0.0300
Height 6.0 in
Bottom width 96.0 in
Left slope 0.50 ft/ft (V/H)
Right slope 0.50 ft/ft (V/H)

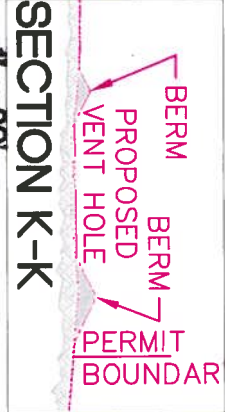
Computed Results:

Depth 1.72 in
Velocity 0.93 fps
Percent full 28.70 %

VENT BORE HOLE DETENTION DESIGN VOLUME -

BASIN	AREA	C10	D10	VOLUME
PA-V	0.010	0.63	1.97	46.6

VOLUME PROVIDED @ ELEVATION -



ELEVATION	AREA (SF)	VOLUME (CF)
5961.5	392.0	411.0
5961.0	322.3	233.2
5960.0	156.8	0.0

WATER TANK BASIN 10-YR/24 HR DESIGN VOLUME -

BASIN	AREA	C10	D10	VOLUME
PA-T	0.016	0.63	1.97	74.3

VOLUME PROVIDED @ ELEVATION -



ELEVATION (FT)	AREA (SF)	VOLUME (CF)
5975.5	321.2	194.4
5975.0	143.9	81.1
5974.5	93.7	22.1
5974.0	9.4	0.0

WATER TRUCK DUMP STATION 10-YR/24 HR DESIGN VOLUME -

BASIN	AREA	C10	D10	VOLUME
PA-WT	0.009	0.63	1.97	41.5

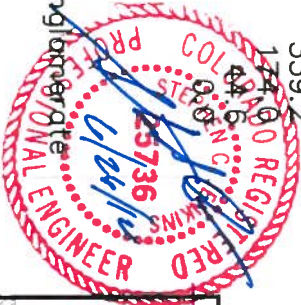
VOLUME PROVIDED @ ELEVATION -



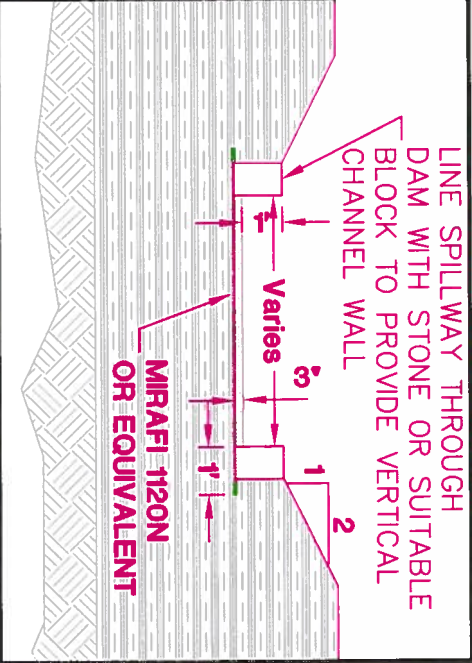
ELEVATION (FT)	AREA (SF)	VOLUME (CF)
5981.0	369.00	339.2
5980.5	293.28	141.0
5980.0	225.46	44.6
5979.5	5.90	0.0

RIPRAP SPECIFICATION -

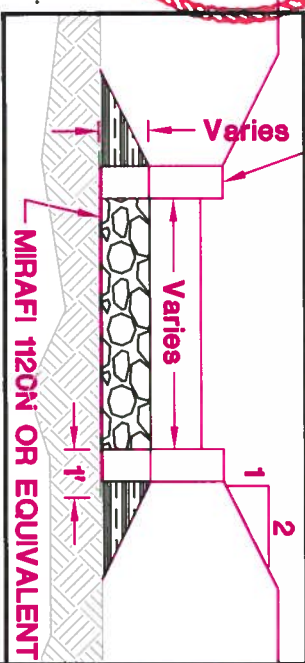
1. Riprap is to be well cemented sandstone or conglomerate with a minimum Specific Gravity of 2.24 (139 pcf).
2. Riprap will be free of shale or shale inclusions or visible fractures.
3. Maximum riprap stone size will be 2xD50.
4. For riprap embankment protection the porosity of the layer will be 0.45.
5. Riprap shall be angular with approximately equal Length, Width, and Depth dimensions - maximum ratio of any dimension to another shall not exceed 3.0.
6. Stones selected for riprap will produce a 'ring' when struck by a hammer, break with difficulty, and have a dense appearance.



LATERAL SPILLWAY SECTION (typ.) 1/4" = 1'



LINE SPILLWAY DOWN FACE OF EMBANKMENT WITH STONE OR SUITABLE BLOCK TO PROVIDE VERTICAL CHANNEL WALLS



LATERAL SPILLWAY SECTION AT TOE (typ.) 1/4" = 1'

RIMROCK EXPLORATION & DEVELOPMENT PRINCE ALBERT MINE - 110D PERMIT APPLICATION EXHIBIT U-5 - STRUCTURES 4

Surface Water Control and Containment Facilities

DATE: 6/14/12

DRAWN BY: JCP, JR.

SHEET 5 OF 5

JAMES C. PIERCE, JR.

P.O. BOX 100
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(970) 864-7455

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JUN 28 2012

GRAND JUNCTION FIELD OFFICE

DIVISION OF

RECLAMATION MINING & SAFETY

SECTION J-J

T = 20'

PLAN VIEW T = 20'

BOREHOLE/SERVICE DROP DETENTION/DIVERSION

