DEERE & AULT
CONSULTANTS, INC.

MEMORANDUM

TO: Joe Shields P.E., HDR
Joy Jenkins Ph.D., P.E, US EPA

FROM: Christoph Goss, Ph.D., P.E.
Bence Close, P.E.

DATE: March 13, 2018

RE: Commodore 5 Tunnel Rehabilitation Concept; Creede, Colorado;
D&A Job No. CG-0547.002.00

This updated memorandum is in response to your request of November 29, 2017 to describe a rehabilitation concept for the Commodore 5 Tunnel near Creede, Colorado which could be implemented as a time critical removal action (TCRA). This rehabilitation would complement the Flow Control Interim Action and other options evaluated in the *Focused Feasibility Study for Flow Control; Nelson Tunnel/Commodore Waste Rock Pile NPL Site* by HDR and Deere & Ault Consultants Inc. dated March 27, 2017. The goal of this rehabilitation would be to maintain access from the portal to the Del Monte Shaft, secure the ground to keep material from impounding water in the Commodore 5, and maintain access to the Nelson Tunnel until the longer-term remediation is implemented (assumed to be within 15 years). This memo is intended to be the first step in developing plans for the rehabilitation of the Commodore 5 Tunnel as a TCRA.

This memo is a significant update and replacement of our Commodore 5 Tunnel Rehabilitation Concept memo dated December 13, 2017. It incorporates observations and measurements made during our site visit on January 30 and 31, 2018. Photos from the site visit are found in **Appendix 1**. **Table 1** has been updated to reflect quantities measured in the field. Since the ground support needs have been refined, costs in it have been updated to reflect recent projects. The figures have also been updated to reflect a new geologic map provided by DRMS and the area around the Bachelor Shaft.

Background

The Nelson Tunnel is a National Priorities List (Superfund) site located in the Creede Mining District in Mineral County, Colorado (**Figure 1**). A primary feature within the Creede Mining District is the Nelson Tunnel, which was constructed to access and dewater the underground mines along the highly productive Amethyst vein and to provide a haulage route for ore from operating mines (**Figures 2**, **3**, and **4**). The Nelson Tunnel (including the Wooster and

600 S. Airport Road, Building A, Suite 205
Longmont, CO 80503
Phone: 303-651-1468 ● Fax: 303-651-1469

Humphries extensions) is approximately two miles long and was constructed between 1893 and 1902. The Nelson Tunnel is the lowest tunnel constructed along the Amethyst vein system and functions as a drain for the underground workings that are connected via winzes and raises. The collapsed tunnel portal is located on the west side of West Willow Creek about one-mile north of the City of Creede.

There are three known and primary collapses within the Nelson Tunnel, forming three distinct mine pools, referred to as the Nelson Portal Pool, Lower Mine Pool, and Upper Mine Pool (**Figure 3**). Volumes of water stored behind collapses and in each of these pools are estimated by DRMS to be 1.2 million gallons (MG), 1.4 MG, and 19.5 MG, respectively.

At present, access to the Nelson Tunnel is through the Commodore 5 Tunnel, which was driven above the Nelson Tunnel to intersect the Amethyst vein complex and allow development of mines farther north. The portal of the Commodore 5 lies approximately 45 feet above and to the northeast of the Nelson Tunnel. The Nelson Tunnel was driven at varying gradients between one-half and one percent while the Commodore Level 5 was driven at a quarter percent or less, resulting in eventual junction at the Park Regent Mine (**Figure 3**). Portions of the Commodore 5 were rehabilitated by DRMS between 2002 and 2004. Some of these repairs now require maintenance or replacement.

Along with providing access to mine workings, the Commodore 5 serves the critical function as a water bypass or "relief valve" for the Nelson Upper mine pool. When the pool level rises above the collar of the Del Monte Raise, the water flows along the floor of the Commodore and dumps back into the Nelson at the No Name/Y02 Winze. If there were additional collapses in the Nelson Tunnel, the Commodore could serve a similar bypass function through the Daylight Winze. Hence, it is critical to keep the Commodore 5 open and accessible.

Rehabilitation

We have divided the rehabilitation into five segments. The first is the portal area including access across West Willow Creek. The second segment is the Commodore 5 Cross cut to the Daylight Corner (0+00 to 22+10). The third is the Daylight Corner intersection and Daylight Winze (22+10 to 23+10). The fourth the McClure Cross cut and Bachelor Shaft (**Figure 5**). The fifth segment is the Commodore 5 from the Daylight Winze to the Del Monte Raise (23+10 to 53+27. Segments one through four are needed no matter what action is taken in the future and require relatively little effort. Segment five will require significant effort and should only be undertaken if a long-term solution is deemed to be many years out. Detailed descriptions of observed ground conditions and recommended rehabilitation by station are found in **Table 1**. Survey spad locations and elevations are listed for reference. Selected photographs of each segment are found in **Appendix A**.

Segment 1: Portal Area

At this time, work in the portal area will be limited to activities the contractor will need for access and staging during construction. The key issue is that the existing bridge is narrow with

aging wooden planks. Access to the bridge is a narrow trail, inadequate for equipment larger than a small skid steer loader. The contractor should install a temporary bridge of appropriate size and capacity for their equipment and to accommodate seasonal creek flow changes. Other portal area work such as installing generators, lights, storage, offices, etc., would be included in a mobilization cost. See **Photos 1-4**.

Segment 2: Commodore 5 Cross Cut Portal to Daylight Corner 0+00 to 22+10

Segment 2 consists of the cross cut adit from the portal to the Daylight Corner where the adit intersects the Amethyst Vein. The first half of the segment was driven through slabby, closely spaced vertically jointed rhyolitic tuff. The second half is in a much more densely welded and massive rhyolitic tuff that eventually becomes the footwall of the Amethyst Vein (specifically the Willow Creek Member of the Bachelor Mountain Tuff). See the Geologic Map in **Figure 6**. Both areas were dry during our site visit. No ground support is currently installed. The track was generally in good shape after the first 200 feet. Several gallons per minute of water flowed through a ditch at the side of the track. See **Photos 5-11**.

Rehabilitation in this segment will consist of scaling, mucking, debris removal, ditch cleaning, track repair, replacement of the portal gate, and the installation of two air doors. The Manhattan Drift and another smaller room, near station 12+00, can serve as storage during construction.

Segment 3: Daylight Corner Intersection and Daylight Winze 22+10 to 23+10

Segment 3 consists of a small but critical area where the Commodore 5 turns and starts drifting on the vein. Here it is almost directly above the Nelson Tunnel where they connect through a collapsed raise and the Daylight Winze. This segment also includes the intersection with the McClure Cross cut. See **Photos 12-19.**

While the rock is generally good, the large span of the intersection and importance of keeping this area accessible leads us to recommend scaling, pattern bolting (6’ long), and installing wire mesh. The same applies at the wide section where the collapsed raise from the Nelson intersects the floor (22+10). Two small but high stopes in the middle of this segment should have steel sets, lagging, and foam installed underneath them to limit raveling.

Significant work is also needed at the Daylight Winze and the raise above it. Due to its importance of acting as the last drain into the Nelson Tunnel, the Daylight Winze should be fully rehabilitated by scaling, bolting, and installing new ladders and landings made of non-decaying or corroding material such as fiber reinforced plastic (FRP). This work would take place above the Nelson Tunnel without impacting the impounded mine pool areas. A cover capable of supporting vehicle traffic and allowing water inflow should also be installed. We anticipate the cover consisting of a concrete collar with coated steel beam supports and grated FRP cover.

Segment 4: McClure Cross Cut to Bachelor Shaft 22+68 to 28+68 (separate stationing)

The rock in the McClure Crosscut, in the hanging wall, consists of massive rhyolitic tuff, specifically the Campbell Mountain Member of the Bachelor Mountain Tuff. It was dry during our site visit and contained some ore chutes from upper levels. No ground support was noted but there was a moldy wood canopy possibly providing protection from small debris. See **Photos 20-31.**

Based on our observations, only minimal cleanup work will be required in the McClure Cross Cut area. The moldy canopy may have to be removed and replaced with bolts and wire mesh, depending on the ground conditions behind it. The bulk of the work will be in the Bachelor Shaft where the untreated wood ladders and landings should be replaced with fiber glass reinforced plastic ladders and landings, anchored into the rock wall. **Figure 5** shows the Bachelor Shaft in cross section. Note that the work would be limited to the Bachelor Shaft and landing, without impacting or accessing the Nelson Tunnel.

Segment 5: Daylight Winze to Del Monte Raise 23+10 to 53+27

From the Daylight Winze to the Commodore Shaft, the Commodore Level 5 main haulage tunnel generally follows the Amethyst Vein. While mined in some areas, the Amethyst Vein is often visible as hard, silicified breccia with altered, clayey gouge material near its edges. The hanging wall and foot wall are well defined in many areas and dip steeply to the West. Occasional roof falls are visible and range in volume from a few cubic feet to a few cubic yards. During our site visit, the tunnel was moist with water visible as minor pools behind collapses and dipping from various stopes and the Archimedes Raise. Timber ground support was failing at various stopes.

The Commodore Shaft area consists of two large underground chambers, neither of which had any ground support. This demonstrates the generally good rock quality in the foot wall in this area. North of the Commodore Shaft, the ground becomes blockier and weaker. A large roof fall by the 44 Raise caused mine pool two to three feet deep to build up behind it. At various locations, the tunnel curves around sections of bad ground where the main drive had been abandoned. North of the No Name (Y02) Winze, iron staining is visible on the floor. When the Upper Mine Pool elevation exceeds that of the Del Monte Raise collar, the mine water flows from the Del Monte Raise to the No Name Winze where it drops back into the Nelson Tunnel. See **Photos 32-62**.

Rehabilitation work in this segment will require considerable time, cost, and effort. While the removal of the wood and rock debris from the floor is a significant undertaking, the main cost will be in the installation of steel stulls and steel sets. At numerous locations, the back has been stoped up and supported with timber posts. Most of these are rotting and need to be replaced. Removing and disposing of the timber will also be a major cost factor, particularly if they must be removed from site. There are also several raises that ravel down material. For safety and to keep the Commodore 5 open, these areas will need lagged steel sets with foam backfill across the openings. For safety, this work will have to be carried out sequentially from the Daylight Winze to the Del Monte Raise.

An item of note is the pool behind the 44 Raise debris pile. To avoid interfering with the work, prior to removing the debris this pool should be pumped out into the nearby Commodore Shaft, allowing it to flow into the mower mine pool. Given the quantity and buffering effect of the Nelson mine pools, this is unlikely to have a significant impact on the flow out of the Nelson Tunnel. If needed, caustic could be added to the 44 Raise pool prior to pumping.

The area of greatest concern for keeping the "overflow" from the Del Monte Raise to the No Name/Y02 Winze open is a section of clay gouge between stations 47+10 and 47+40. It is supported by rail posts, rail lagging, and wood lagging. If the lagging fails in this area, the drift would likely be blocked, leading to higher water pressures and water volume in the upper mine pool.

Due to its importance of acting as the overflow for the upper mine pool, the No Name/Y02 Winze should be fully rehabilitated by scaling, bolting, and installing new ladders and landings, much like the Daylight Winze. This work would take place above the Nelson Tunnel without impacting the impounded mine pool areas. A cover capable of supporting vehicle traffic and allowing water inflow should also be installed. We anticipate the cover consisting of a concrete collar with coated steel beam supports and grated FRP cover.

The collar at the Del Monte Raise should have an elevated platform installed above the high water line to allow safe and efficient sampling without hindering the flow of the mine pool. This platform would also be made of FRP or similar material.

Cost Summary and Assumptions

Table 1 provides unit prices and estimated costs for the various rehabilitation tasks defined. It is important to understand that the costs provided in **Table 1** are for direct costs and do not include indirect tasks, overhead costs, and contingency for completion of a project. Major assumptions used to develop **Table 1** include:

- For Segment 1-4, there is adequate room to store muck, timbers, and other debris that needs to be removed to complete the rehabilitation within the mine complex. Costs for disposal or materials outside the mine are not included.
- For Segment 5, there is adequate room to store muck and debris within the mine complex but, given the large quantity, timbers will have to be disposed of offsite.
- Work within the mine can be completed without the use of air purifying or air supplying respirators.
- Pricing is based on engineering judgment and experience at recent projects.
- Assumes work will be initiated in 2018.
- Costs for handling water are not included in the estimate. It is assumed work between the No-Name/Y02 Winze and the Del Monte Raise will be completed when the water Level in the Upper Mine Pool is below Commodore Level 5.
- Local mine rescue team

Table 2 presents feasibility level construction costs for completing the work for Segments 1-4 and for Segments 1-5 after accounting for indirect costs overhead costs, and contingency.

Table 2: Opinion of Probable Cost Summary[5]

Segment	Direct Cost [1]	30% Indirect Cost[2]	10% Contractor OH and Profit[3]	25% Contingency[4]	Estimated Construction Cost
Segments 1-4	$xxx,xxx	$xxx,xxx	$xxx,xxx	$xxx,xxx	$xxx,xxx
Segment 5	$xxx,xxx	$xxx,xxx	$xxx,xxx	$xxx,xxx	$xxx,xxx
Segments 1-5	$xxx,xxx	$xxx,xxx	$xxx,xxx	$xxx,xxx	$xxx,xxx

Notes:
1 From Table 1
2 Includes Mobilization/Demobilization, Site Setup, Site Management, Health and Safety/Mine Rescue
3 Allowance for potentially unburdened unit rates and estimates
4 Based on rates used in FFS
5 The Administrative Record copy of this report has had estimated costs and other procurement sensitive information redacted or removed to protect the integrity of the Government's contracting process. An un-redacted copy of the report will be placed in the site file and be made available to the public once the information can be released w/o compromising the contracting process at the Site.

TABLE

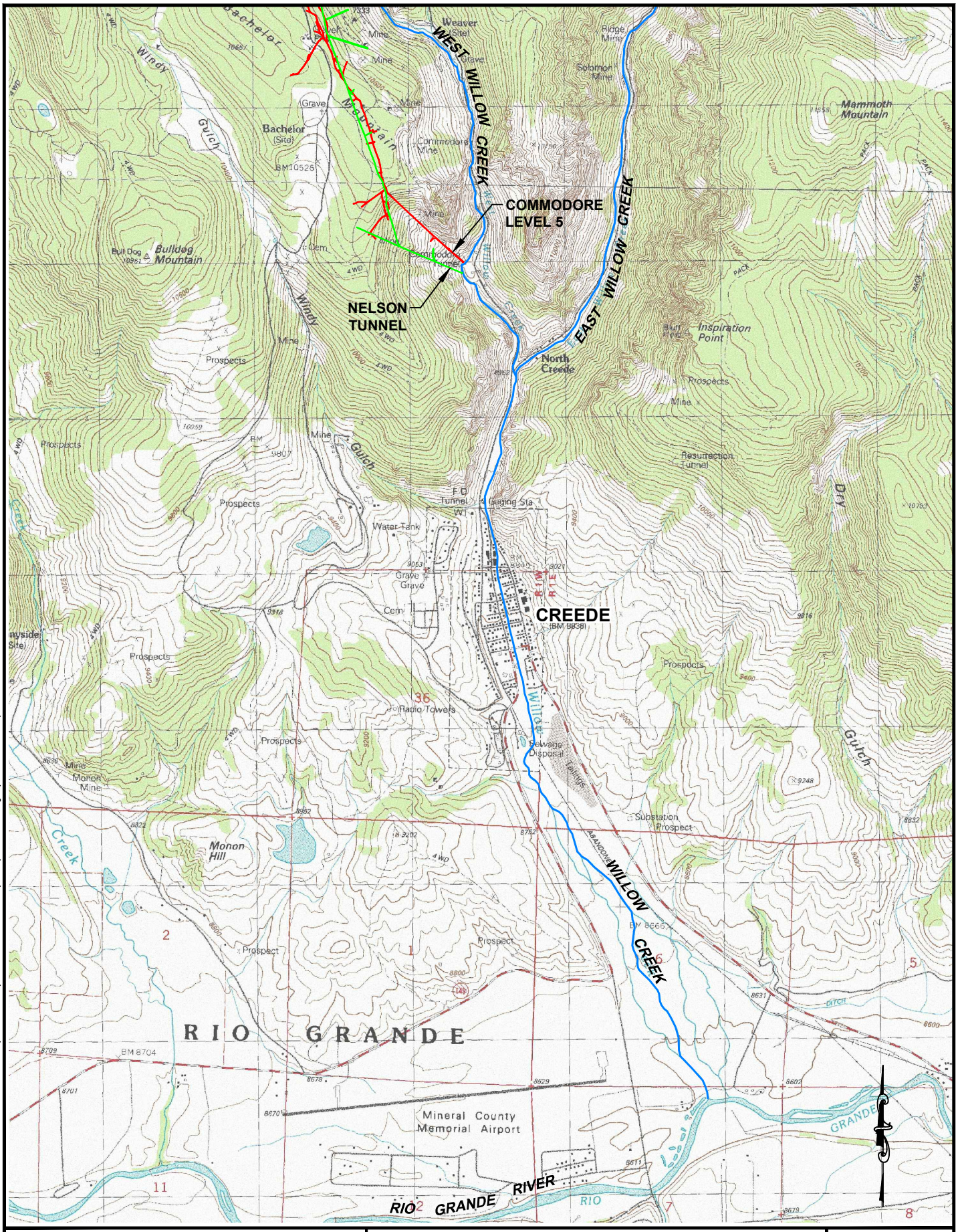
Table 1: Commodore 5 Rehabilitation Summary and Estimated Direct Costs

Pricing Item	Approximate Station		Length / Quantity	Unit	Description	Spad Elevation (Davis)	Notes
	Start	End					
Segment 1: Portal Area							
1			1	LS	Install temporary bridge for access to Com 5 and new security fence access gate		
Segment 2: Commodore 5 Cross Cut Portal to Daylight Corner							
2	0+00	22+10	2210	LF	Scaling, mucking, remove timber debris		Typical dimensions 8' high by 8' - 10' wide
3	0+00	22+10	2210	LF	Utilities installation		Install hangers at 10' OC for phone and transducer cable. Provide and install 1 external phone station
4	0+00	22+10	221	LF	General rail repair (assume 10% of track)		Replace occasional ties, add spacers, local ballast, locally replace rail
5	0+00	22+10	22	EA	Survey & install station markers		Every 100'
6	0+00	0+01	1	LS	Replace portal gate, frame, and lock		Inside steel sets: W4, 4' OC, 3.7' legs, 5' radius arch, 8' center height
7	0+20	0+21	1	LS	Replace air door		Inside steel sets: W4, 4' OC, 3.7' legs, 5' radius arch, 8' center height
8	0+00	2+00	200	LF	Focused rail work: fully replace		All new rail, ties and ballast
	2+60	2+60			Spad 1	9231.69	
9	6+95	6+96	1	LS	Replace air door		Frame ok, door opening is 6.7' high by 6.1' wide
	7+18	7+18			Spad 2	9233.08	
	11+68	11+68			Spad 3	9234.62	
	16+28	16+28			Spad 4	9236.02	
	21+14	21+14			Spad 5	9237.50	
10	21+90	22+10	20	LF	Focused rail work: fully replace		All new rail, ties and ballast
Segment 3: Daylight Corner Intersection and Daylight Winze							
11	22+10	23+10	100	LF	Scaling, mucking, remove timber debris		Typical dimensions 8' high by 8' - 10' wide
12	22+10	23+10	100	LF	Utilities installation		Install hangers at 10' OC for phone and transducer cable. Provide and install 1 internal phone station
13	22+10	23+10	30	LF	General rail repair (assume 30% of track)		Replace occasional ties, add spacers, local ballast, locally replace rail
14	22+10	23+10	1	EA	Survey & install station markers		Every 100', including to Bachelor Shaft
15	22+10	22+40	30	LF	Focused rail work: fully replace		All new rail, ties and ballast
16	22+10	22+30	20	LF	Stabilize raise to Nelson		9' high, 16' wide, remove timbers, muck, scale, bolt (15, 6' long)
	22+30	22+30			Daylight Corner		
17	22+30	22+80	50	LF	Bolt corner and McClure intersect / wire mesh		30' maximum span; needs track spacers/leveling
18	22+35	22+50	15	LF	Steel sets, lagging, foam at stope		40' high stope, at intersection, steel set size TBD
19	22+55	22+65	10	LF	Steel sets, lagging, foam at stope		3' wide stope at intersection, 100' high, steel set size TBD
	22+68	22+68			Spad 6/McClure Cross Cut	9238.30	
20	22+90	23+15	25	LF	Raise above Daylight Winze		Single post steel sets
21	22+97	23+10	1	LS	Daylight Winze		8' wide, new cover with inflow, rehab winze and ladders
Segment 4: McClure Cross Cut to Bachelor Shaft							
22	22+68	*28+68*	600	LF	Scaling, mucking, remove timber debris		Minimal work required
23	22+68	*28+68*	600	LF	Utilities installation		Install hangers at 10' OC for phone and transducer cable. Provide and install 1 internal phone station
24	22+68	*28+68*	6	EA	Survey & install station markers		Every 100' to Bachelor Shaft
25	Bachelor Shaft		1	LS	Install new ladders/platforms for Nelson access		Remove all existing and replace, include railing at platforms
Segment 5: Daylight Winze to Del Monte Raise							
26	23+10	53+27	3017	LF	General scaling/mucking		Typ. dimensions 8' high by 8' - 10' wide; minimal effort due to focused area work
27	23+10	53+27	3017	LF	Utilities installation		Install hangers at 10' OC for phone and transducer cable. Provide and install 2 internal phone stations at 38+18 and 53+27 (roughly every 1500 LF)
28	23+10	53+27	603	LF	General rail repair (assume 20% of track)		Replace occasional ties, add spacers, local ballast, locally replace rail
29	23+10	53+27	30	EA	Survey & install station markers		Every 100'
	24+38	24+38			Spad 11	9238.60	
30	24+40	26+40	200	LF	Focused rail work: fully replace		Rail ties have turned into mulch
	26+04	26+04			Spad 12	9239.17	
	26+40	26+45	5		Low back		5.6' high in short section; contractor eval need to scale w/o blasting
31	26+64	26+80	16	LF	Archimedes Raise		3 steel sets 12"x10", 6' OC, 7.6' wide x 8.2' tall inside, delaminating, corroding, add sister sets and lagging
32	27+10	27+50	40	LF	Rail Stulls		7' tall, 11.5' wide,16.2' maximum height above stulls; remove corroded lagging, scale, spot bolt, muck rotted timbers
33	27+30	27+42	12	LF	Cribbing on stulls		Install steel sets under cribbing 7.7' tall, 9' wide
34	27+50	27+80	30	LF	Steel stulls 10' long		Remove rotted timber stulls, add sister steel stulls
35	27+80	30+20	240	LF	Steel stulls w/ rotten timber lagging		Remove lagging, add a few stulls, scale, spot bolt, back height 15'
	29+06	29+06			Spad 13	9240.14	
36	30+20	30+40	20	LF	Raise: active raveling		11' wide; install 1 post steel sets with lagging and foam
37	30+50	32+00	150	LF	Steel stulls w/ rotten timber lagging		Remove lagging, add a few stulls scale, spot bolt
38	32+00	32+15	15	LF	Raise		6.2' wide, 8.7' tall; install steel sets, lagging and foam
	31+90	32+00	10		Narrow section over 10+ ft length		5.4' wide x 9.5' high; contractor evaluate need for expansion w/o blasting
39	31+90	32+00	10	LF	Timber lagging rotten		By spad 14 (no data); remove loose timber
40	32+00	32+20	20	LF	Raise: active raveling		New 2 cy debris pile on floor, water backing up 4"; 25' past Spad 14
41	32+20	32+60	40	LF	Steel pipe stulls with debris		6.6-8.5' long; 5.5-8.7 tall; bolt in new stulls or sets 2' OC for 10', stull 4' OC with lagging for 30'
42	32+80	33+05	25	LF	Failed timber stulls		Replace with steel stulls 10' diagonal width; remove debris
	33+18	33+50	32		Blacksmith's Shop		Use as muck/debris stockpile area
	33+81	33+81			Spad 15	9241.73	
43	34+20	34+45	25	LF	Steel pipe stulls with cribbing		7.7' long; add sister stulls
44	34+80	35+10	30	LF	Raise with mixed timbers		5.6' tall, 7.7 wide; new steel sets, lagging, and foam
45	35+22	35+82	1	LS	Commodore Shaft		Remove stockpiled lagging/timbers to create staging area
46	36+82	37+22	40	LF	44 Raise: very active raveling		Backs up water 3'; muck pile 30Lx8wx4H say 25cy; muck out and install steel sets 7.4' wide with lagging and foam
47	37+22	37+48	26	LF	Wood stulls		Add steel sister stulls
48	37+50	37+90	40	LF	Rotten timber lagging		Remove old timber lagging, scale, spot bolt, add sister stulls
49	38+10	38+30	20	LF	Large loose slabs in hanging wall		New heavy steel stulls (assume w8x28)
	38+49	38+49			Spad 17	9243.78	
50	38+70	38+90	20	LF	Raise with steel posts and rail		Add sister sets and lagging 8.4 tall, 12.4 wide
51	40+52	41+17	65	LF	Stope		6.5-9.6' diagonal; install steel sets, lagging, and foam
	40+67	40+67			Spad 18	9244.67	
52	41+00	41+10	10	LF	Abandoned drift, turn into foot wall		Scale and bolt
53	41+50	41+68	18	LF	Opening in left rib		7' tall, cribbing and rubble behind; install steel posts
	42+00	42+05	5		Low back and narrow spot just past Spad 19		5.8 tall 4.3 wide - contractor to evaluate if needed to enlarge w/o blasting
54	42+79	43+19	40	LF	Large chamber, drift in left rib		20' wide, remove rubble and timber, scale and pattern bolt
	43+58	43+58			Spad 20	9245.86	
55	43+50	43+90	40	LF	Cathedral		26' tall, 11' wide, remove timbers, muck, scale, bolt
56	44+00	44+17	17	LF	Raise with rail stulls; active raveling		9.1' stulls, height 7.8-9.6; install sister stulls, lagging and foam
57	44+60	44+74	1	LS	No Name Winze (Y02)		8' wide, new cover with inflow, rehab winze and ladders, scaling
58	44+60	53+27	867	LF	Debris removal Y02 to Del Monte		Avoid material blocking flow into YO2; more thorough clean up than rest
	45+43	45+43			Spad 21	9245.36	
59	45+45	46+10	65	LF	Drip pan		Remove timbers and drip pan; scale, spot bolt
60	46+20	46+21	1	EA	Small prop		Add sister prop
61	47+10	47+40	30	LF	Clay gouge left rib, rail & timbers		8.8 tall, 5.9 wide; install heavy steel sets and lagging
	47+80	47+80			Spad 22	9245.56	
	49+75	49+75			Spad 23	9244.15	Potential negative grade in this area may be due to spad height settimg and will not be addressed
	51+77	51+77			Spad 24	9244.17	
62	53+15	53+27	1	LS	Del Monte Raise		High water line 2' above floor; construct elevated platform

Note: Quantities based on reconnaissance on January 31, 2018. Some station numbers and spans are estimated and will require additional field confirmation

The Administrative Record copy of this report has had estimated costs and other procurement sensitive information redacted or removed to protect the integrity of the Government's contracting process. An un-redacted copy of the report will be placed in the site file and be made available to the public once the information can be released w/o compromising the contracting process at the Site.

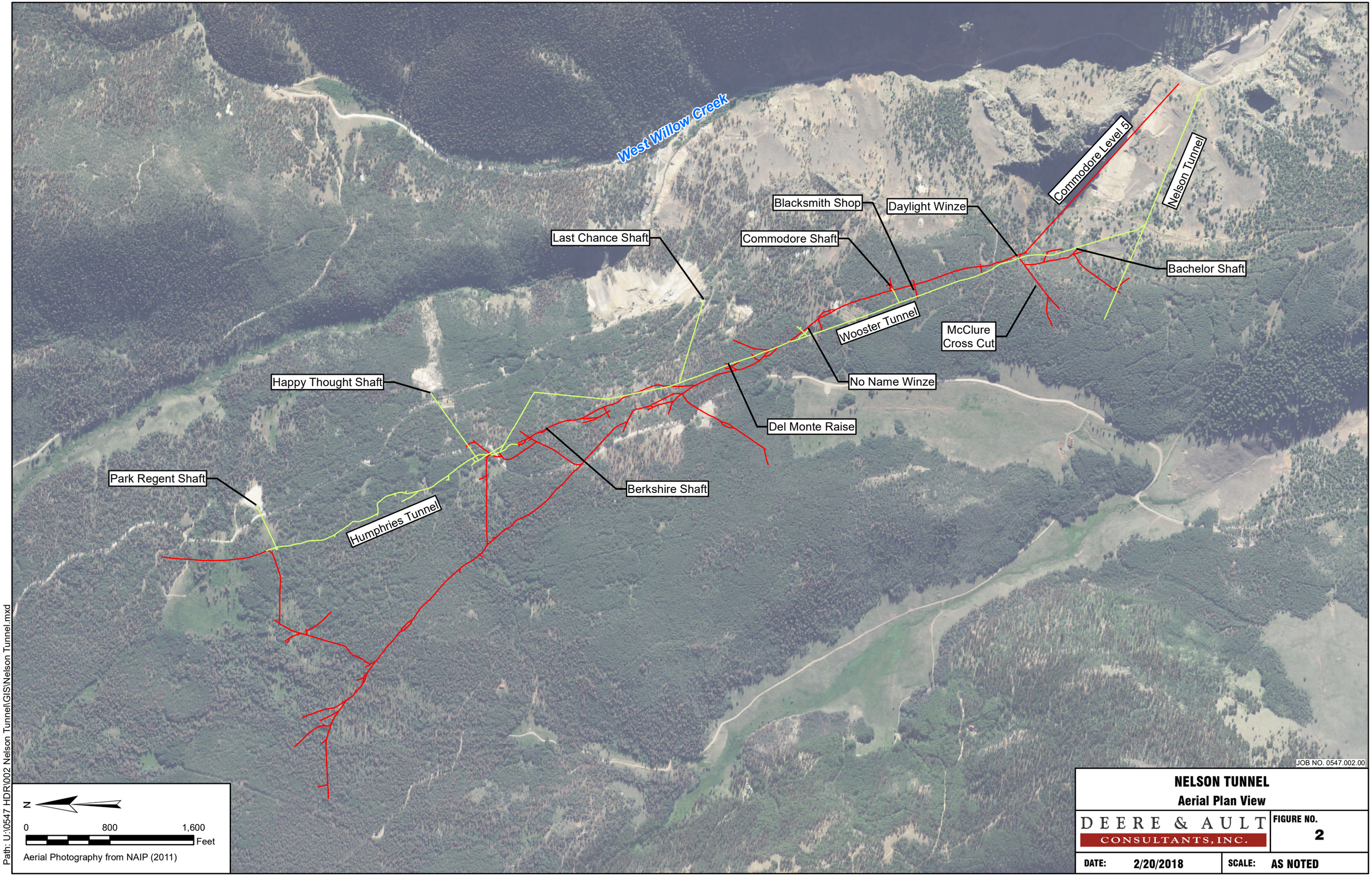
FIGURES



DEERE & AULT CONSULTANTS, INC.

NELSON TUNNEL	FIGURE NO.
VICINITY MAP	1
JOB NO. 0547.002.00	SCALE: None

Tuesday, February 20, 2018 1:54:25 PM DRAWING: U:\0547 HDR\002 Nelson Tunnel\CAD\PAC Drawings\Nelson-mine pools.DWG



Path: U:\0547 HDR\002 Nelson Tunnel\GIS\Nelson Tunnel.mxd

JOB NO. 0547.002.00

NELSON TUNNEL

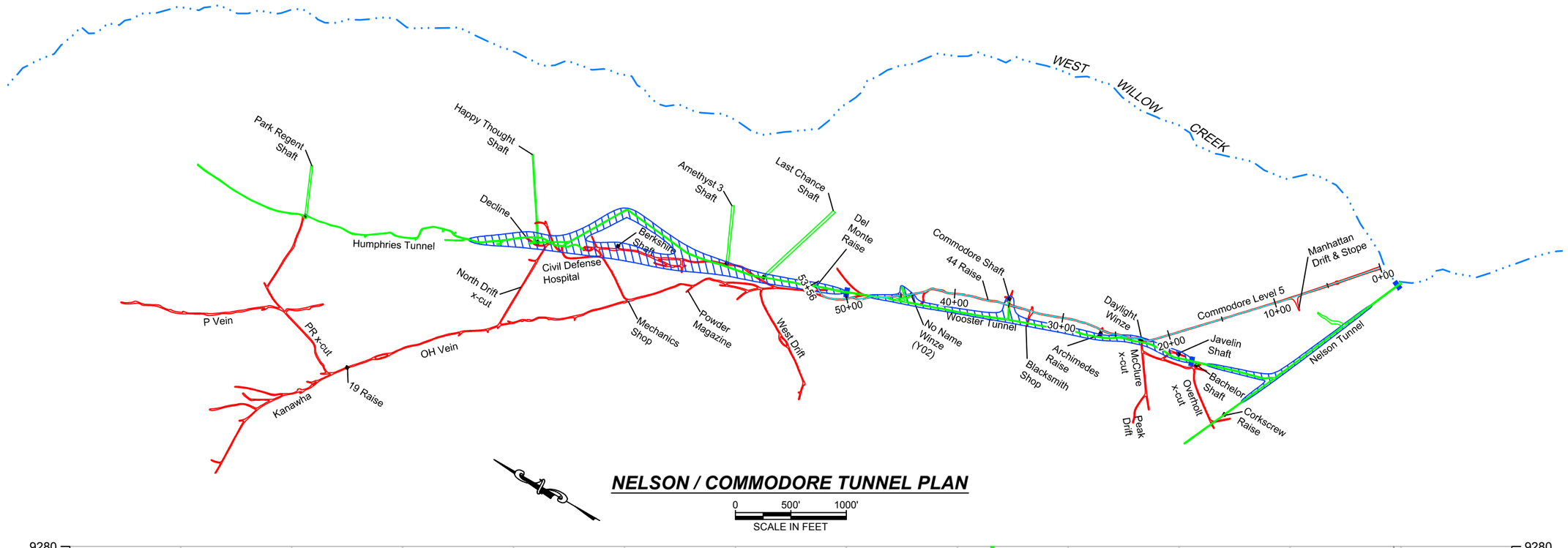
Aerial Plan View

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **2**

DATE: **2/20/2018**

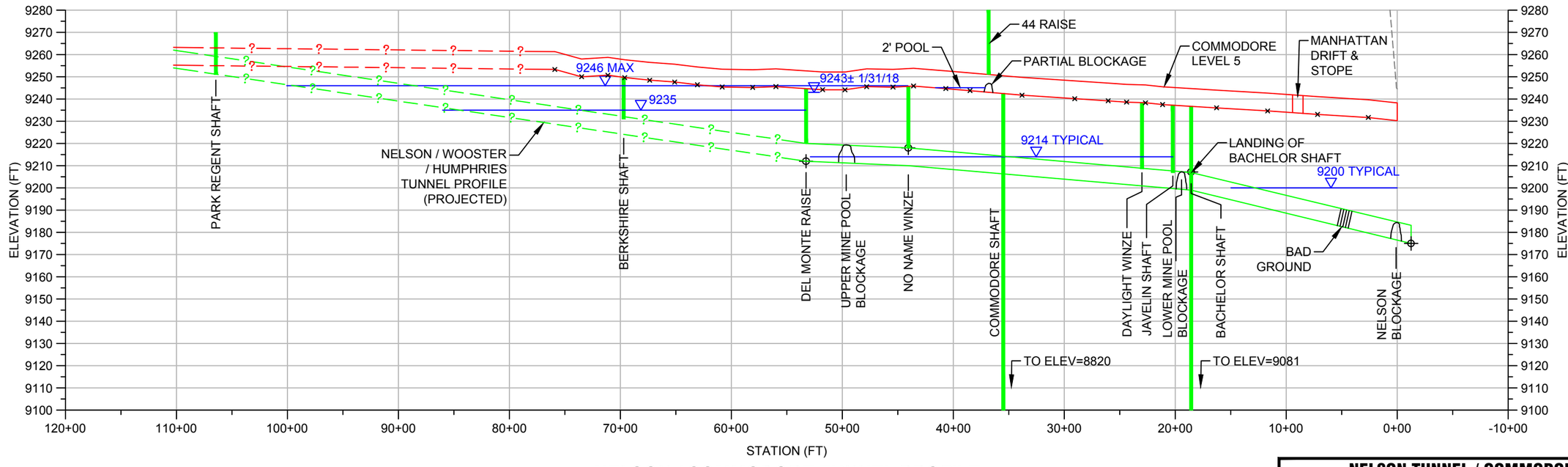
SCALE: **AS NOTED**



NELSON / COMMODORE TUNNEL PLAN

0 500' 1000'

SCALE IN FEET



NELSON / COMMODORE TUNNEL PROFILE

Vertical Scale (FT) 0 25' 50'

Horizontal Scale (FT) 0 500' 1000'

JOB NO. 0547.002.00

NOTES:

BASE MAP BY CDRMS

× COMMODORE TUNNEL ELEVATION SURVEY POINTS

⊕ NELSON TUNNEL ELEVATION SURVEY POINTS

NELSON TUNNEL / COMMODORE 5

PLAN & PROFILE

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 3

DATE: MARCH 2018

SCALE: AS NOTED

WEST WILLOW CREEK

Amethyst 3 Shaft

Last Chance Shaft

Del Monte Raise

Commodore Shaft

44 Raise

Wooster Tunnel

No Name Winze (Y02)

West Drift

owder azine

63+56

50+00

45+00

40+00

35+00

30+00

25+00

Blacksmith Shop

Archimedes Raise

Daylight Winze

McClure x-cut

Peak Drift

Overholt x-cut

Bachelor Shaft

Corkscrew Raise

Javelin Shaft

Commodore Level 5

20+00

15+00

10+00

5+00

0+00

Manhattan Drift & Stope

Nelson Tunnel

SEGMENT 1 - PORTAL
SEGMENT 2 - 0+00 - 22+10
SEGMENT 3 - 22+10 - 23+10
SEGMENT 4 - McCLURE CROSS CUT & BACHELOR SHAFT
SEGMENT 5 - 23+10 - 53+56

0 200' 400'
SCALE IN FEET

JOB NO. 0547.002.00

NELSON TUNNEL / COMMODORE 5

PLAN VEIW

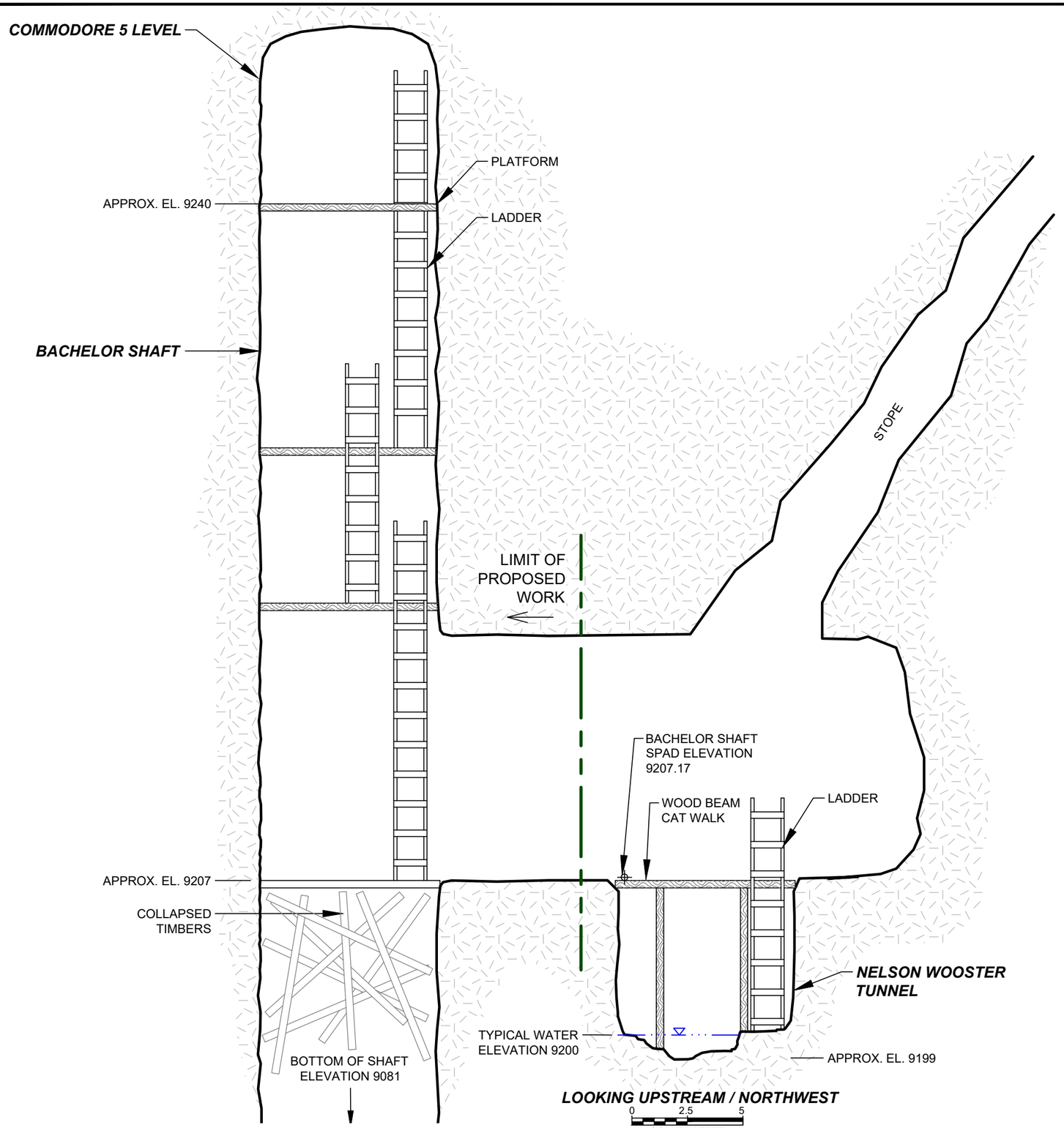
DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 4

DATE: MARCH 2018

SCALE: AS NOTED

Wednesday, March 07, 2018 2:38:03 PM DRAWING: U:\0547 HDR\002 Nelson Tunnel\CAD\DAC Drawings\Nelson-mine pools.DWG



JOB NO. 0547.002.00

NELSON TUNNEL / COMMODORE 5

BACHELOR SHAFT CROSS SECTION

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **5**

DATE: **FEB. 2018**

SCALE: **AS NOTED**

-1000N

-2000N

-3000N

-4000N

Symbols

- Tbw - Willow Creek Rhyolite
- Tbc - Campbell Mountain Rhyolite
- Tunnel Walls
- Vein, with strike & dip (arrow indicating dip direction)
- Shaft or Raise

Abbreviations

BR	Breccia
Fe/FeOx	Iron or Iron Oxide
GO	Gouge
IRR	Irregular
MIN	Mineralization
SH	Shear
SULF	Sulfidization
VIS	Visible
WK	Weak

Approx. elev. at portal 9220'

Daylight Winze

Bachelor Shaft

STOPED IRR. UP 60-75' OVER 2-4' WIDTH. OPEN DOWN 20' TO HUMPHREY TUNNEL (?) WATER FILLED

IRR. STOPING UP 15-60', DOWN 20-40' OVER 2-4' WIDTHS.

OPEN DOWN 40' ±

1-2" GO & SH.

Tbw

Tbc

2-3" BR, FeOX

3-6" IRR, BR FeOX

2-7" IRR. SH. BR & GO. NO VISIBLE SULF.

6" SH WITH MnO

2-6" HIGHLY BR.ROCK

OVERHOLT X-CUT

McCLURE X-CUT

ARCHIMEDES RAISE

LAGGED IN BACK

5' COARSE BR. WITH 6" FINE GO. ON H.W.

COMMODORE SHAFT

LAGGED

4-6' COARSE BR. NO VIS. MIN.

1-2" WK. SH.

2-12" IRR. SH. & GO.

CAVED

TELLER DRIFT

1-5' SH. & GO. NO VIS. MIN.

12-18" GO. & BR. WK. MIN.

8' IRR. BR. & GO. FeOX

Blacksmith Shop

2-3" WK. IRR. SH.

IRR. STOPED 2-4' WIDE

2-6" SH. & OPEN FRAC.

No Name Winze

Del Monte Raise

STOPED AREA CAVED

BR. & GO. OVER WIDTH OF DRIFT - NOT HIGHLY MIN.

CAVED

IRR. STOPING OVER 4-8' WIDTHS

STOPED 4-5' WIDE STONG Fe STAINED GO. ZONE FAIR TO GOOD SULF. VIS.

2" IRR. FRAC. WK. MIN.

4-18" WK. SH. & GO.

RAISE UP 50' ±

2-6" SH. - WK. MIN.

2" IRR. FRAC. WK. MIN.

CAVED - OPEN FRAC. OPEN UP 40± 2-6' WIDE

Source: Unknown

DRAFT

JOB NO. 0547.002.00

COMMODORE 5

GEOLOGIC MAP

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 6

DATE: FEBRUARY 2018

SCALE: AS NOTED

APPENDIX A
SELECTED PHOTOGRAPHS FROM SITE VISIT
JANUARY 30-31, 2018

Photo 1: Commodore Levels 3, 4, and 5 Portal Area with Willow Creek in front

Photo 2: Willow Creek at portal looking upstream; Note small bridge and path for access

Photo 3: Nelson Tunnel and Commodore Level 5 Portal; Note steep grading left of portal

Photo 4: Commodore 5 Portal Area close up

Photo 5: Portal Gate to be replaced

Photo 6: First Air Door to be replaced

Photo 7: Floating rail ties and poor drainage near 1+00

Photo 8: Typical rail, ditch, and invert in Commodore 5 Cross Cut

Photo 9: Manhattan Drift

Photo 10: Underground storage chamber along Commodore 5 Cross Cut

Photo 11: Typical conditions in Commodore 5 Cross Cut

Photo 12: Daylight Corner with collapsed raise from Nelson Tunnel in left rib

Photo 13: Close up of collapsed raise from Nelson Tunnel

Photo 14: Intersection with McClure Cross Cut to left; Daylight Winze to right

Photo 15: Looking up stope at Daylight intersection

Photo 16: Overview of Daylight Winze; Note decayed wood cover

Photo 17: Daylight Winze with rotten wood cover

Photo 18: Looking down Daylight Winze: Note smooth footwall, ladder, and landing

Photo 19: Raise above Daylight Winze: Note Amethyst Vein in center

Photo 20: McClure Cross Cut with debris

Photo 21: Moldy canopy in McClure Cross Cut

Photo 22: McClure Cross Cut typical view

Photo 23: McClure Cross Cut ore chute

Photo 24: Top of Bachelor Shaft

Photo 25: Looking down into Bachelor Shaft; Small first landing visible

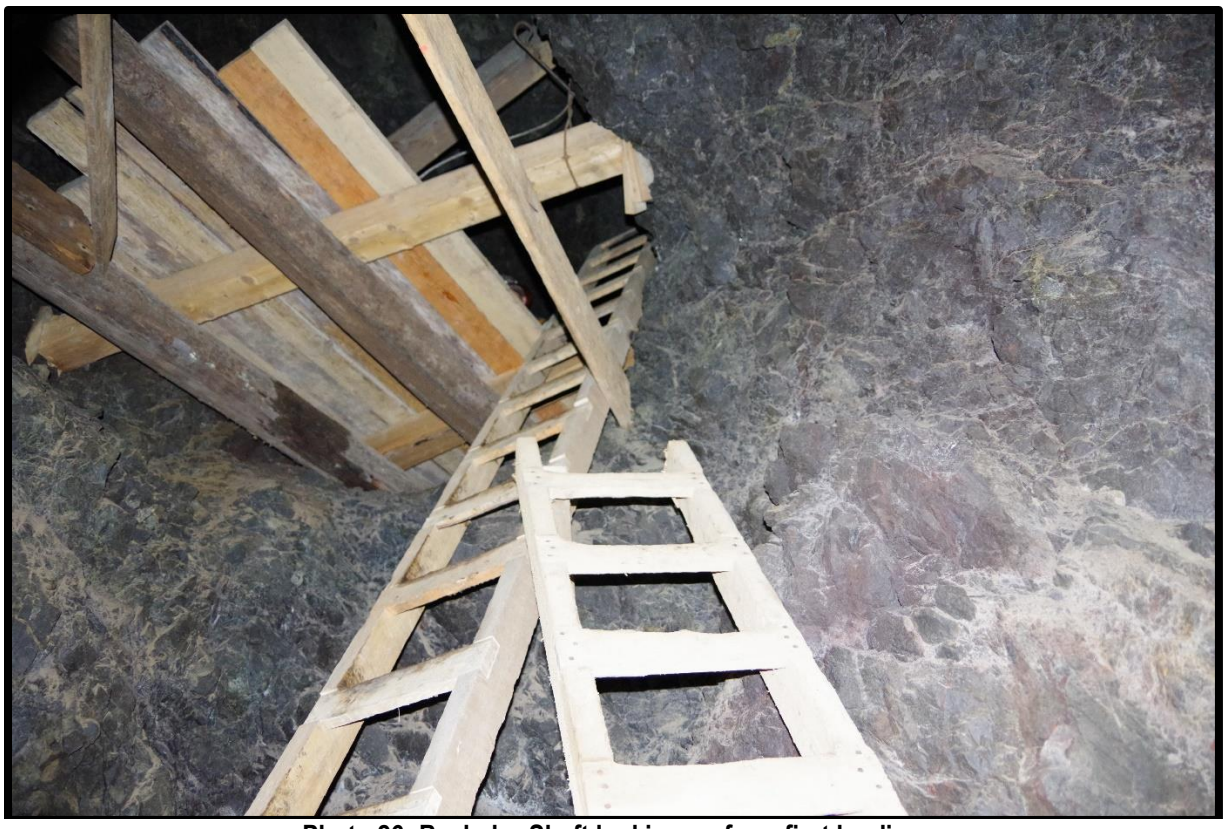


Photo 26: Bachelor Shaft looking up from first landing

Photo 27: Bachelor Shaft looking up

Photo 28: : Bachelor Shaft looking up to second landing

Photo 29: Bachelor Shaft bottom and second landing seen from far side of Nelson Tunnel

Photo 30: Bachelor Shaft at Nelson Tunnel landing

Photo 31: Collapsed Timbers at Bachelor Shaft Nelson Tunnel landing

Photo 32: Decayed rail ties near 25+00; Note staining from water

Photo 33: Measuring Archimedes Raise dimensions 26+64

Photo 34: Close up of Archimedes Raise steel posts; Note corrosion and delamination

Photo 35: Typical timber stulls; Note hanging wall, Amethyst vein, and foot wall

Photo 36: Steel rail stulls with rotten timber lagging 30+50

Photo 37: Looking up raise at 30+20

Photo 38: Debris from actively raveling raise near 32+00; Note water backed up behind

Photo 39: Steel pipe stulls near 32+20; Note pipe cribbing

Photo 40: Failed timber stulls near 32+80

Photo 41: Debris pile at very active 44 Raise 36+82

Photo 42: Debris pile at 44 Raise 36+82 looking outby; Note water ponded behind pile

Photo 43: Steel rail stulls and rotten wood lagging near 37+50

Photo 44: Large loose slabs in hanging wall near 38+10; View is outby

Photo 45: Raise with steel sets and rail near 38+70

Photo 46: Abandoned heading near 41+00; Drift moves into foot wall

Photo 47: Sealed opening in left rib near 41+50; Loose debris is behind it

Photo 48: Large chamber and drift in left rib near 42+79

Photo 49: Large chamber and drift in left rib near 42+79 looking outby; Note timber and other debris

Photo 50: Cathedral near 43+50; Note loose muck in right rib and rotten timber lagging

Photo 51: Raise with steel rail, wood posts, and rotten cribbing near 44+00

Photo 52: Looking up raise near 44+00

Photo 53: No Name/Y02 Winze 44+60

Photo 54: Looking down No Name/y02 Winze

Photo 55: Drip pan in back near 45+45

Photo 56: Area of clay gouge in left rib near 47+10

Photo 57: Area of clay gouge in left rib near 47+10; Note heavy steel rail lagging

Photo 58: Area of clay gouge in left rib near 47+10 looking outby; Note timber lagging

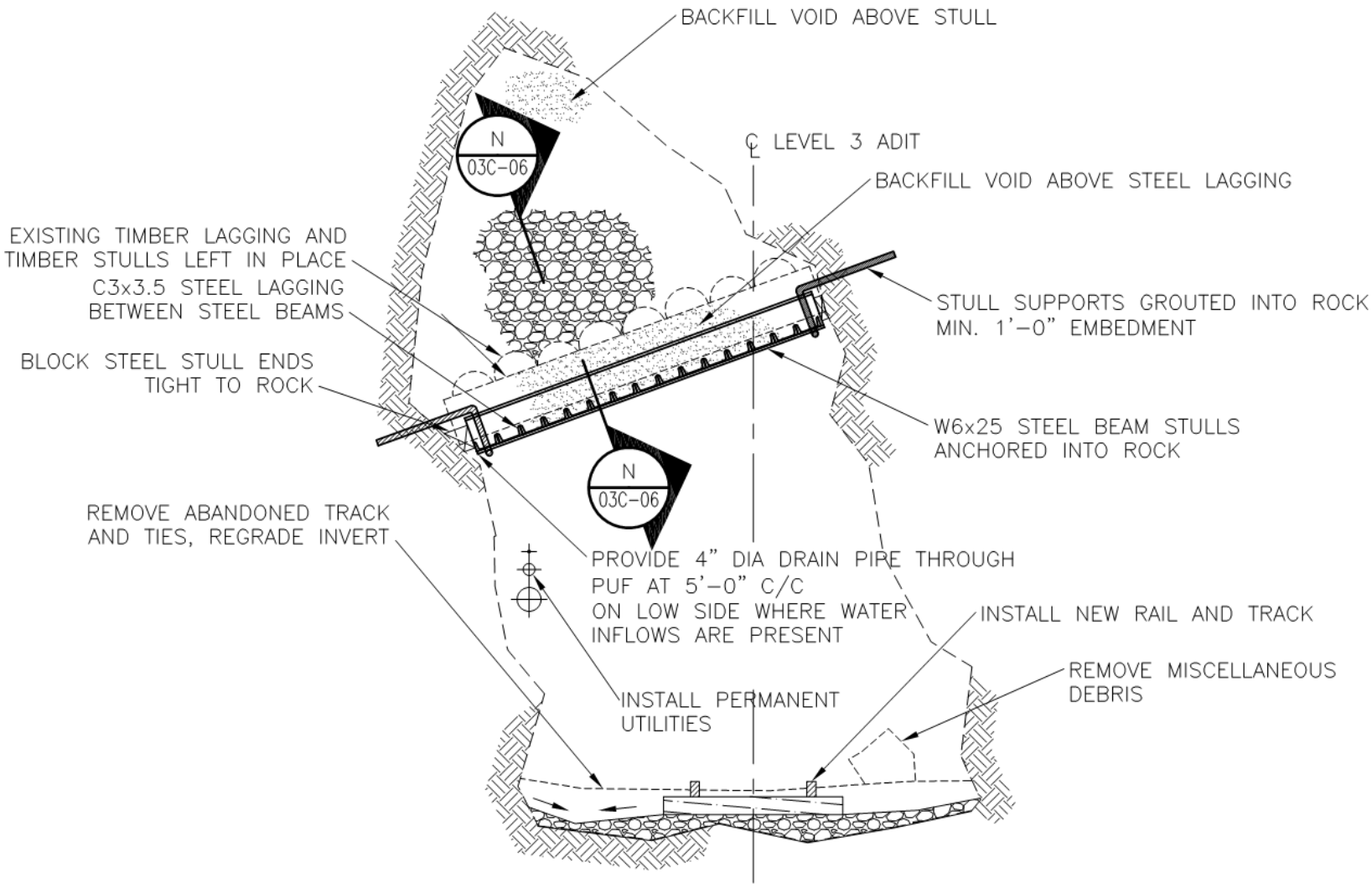
Photo 59: Typical draft near 50+00; Note high water line from upper mine pool overflow

Photo 60: Del Monte Raise 53+15; Note sampling platform

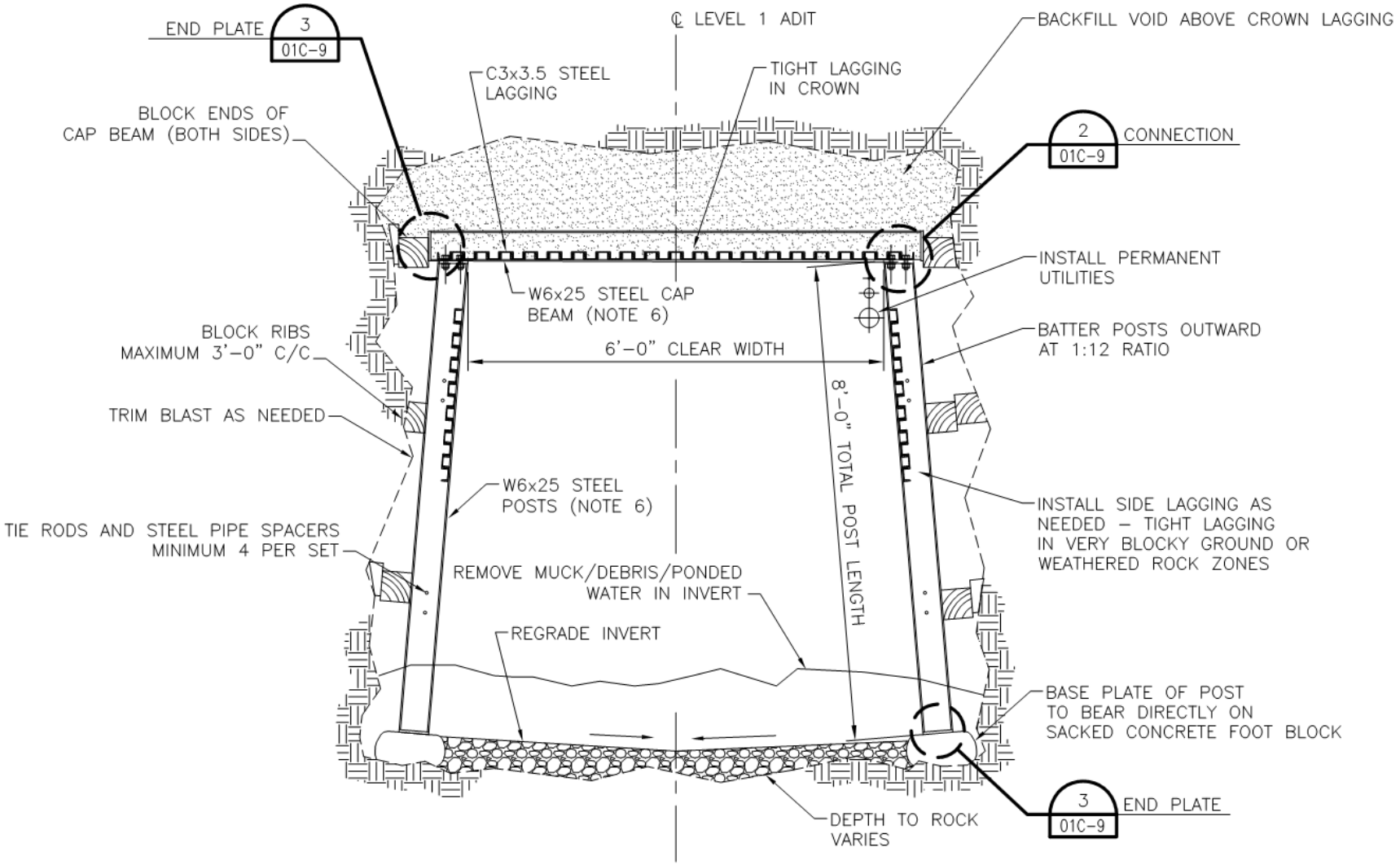
Photo 61: Del Monte Raise 53+15; Note clear water

Photo 62: Del Monte Raise 53+15 looking down

APPENDIX B
TYPICAL SUPPORT DETAILS



Typical Stulls (Courtesy of HDR-Standard Mine)



Typical Steel Sets with Backfill (Courtesy of HDR-Standard Mine)