

## LIST OF TUNNELS - Coos Bay Subdivision

Tunnel No.	MP @ N. Portal	Length	Tunnel Liner	Condition	Comments	Curve
13	669.47	2496 ft	Timber sets, shotcreted steel sets, steel sets with timber lagging, 100 ft unlined, 55 ft. concrete portal barrels	Poor - Good	Rotting timber sets and lagging	tangent/ 8°
14	681.09	471 ft	Shotcreted steel sets, shotcreted bedrock, 50 ft. N. portal concrete barrel	Good	Thin shotcrete, cracking and spalling	8°
15	720.73	2,143 ft	<i>Shotcrete over steel and timber sets, timber sets and lagging, N. &amp; S. portal are 50 ft. long concrete barrels</i>	<i>Poor - Good</i>	<i>Rotting timber sets and lagging, several cave-ins, recent repair work</i>	<i>tangent</i>
16	721.52	633 ft	Shotcrete over timber and steel sets, N. & S. portal are 50 ft. long concrete barrels	Good		7°
17	727.7	1,200 ft	Shotcrete over bedrock, timber sets, shotcreted steel sets, N. & S. portal concrete barrels	Poor - Good	Timber sets with rotting foot blocks, offsets, cracks in shotcrete	tangent/ 2°
18	734.48	1,580 ft	Shotcrete over steel and timber sets, timber sets and lagging, N. & S portal are 50 ft. long concrete barrels	Poor - Good	Timber sets with rotting foot blocks, offsets, cracks in shotcrete	tangent
19	745.62	4,202 ft	Shotcrete over bedrock, shotcrete over steel sets, S. portal 50 ft concrete barrel	Fair - Good	Landslides over both portals, shotcrete thin and cracking, bedrock exposed	tangent/ 6°
20	750.1	874 ft	Shotcrete over bedrock, shotcrete over steel sets, S. portal 50 ft concrete barrel	Fair	Large areas of spalling shotcrete with exposed bedrock	2°
21	751.2	478 ft	Shotcrete over bedrock, N. & S. portal are 50 ft. long concrete barrels	Good		4°

**Total Length 11,581 ft**

**TUNNEL 13**  
**Coos Bay Subdivision, Oregon**  
**MP 669.47 to 669.94**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets	
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.
0+00	0+00	0	5	Concrete Portal				North Portal @ MP 669.47											
0+00	0+65	65	5	Concrete Barrel				Concrete lined ditch approx. 2' below TOR											
0+65	1+02	37	5	Shotcrete over Steel Sets	2	Y	0	Shotcrete over steel sets at 2'-spacing, shotcrete is 4"-8" thick; Concrete lined ditch extends 2' below TOR											
1+02	3+60	258	5	Shotcrete over Steel Sets	4	Y	0	Shotcrete over steel sets at 2'-spacing, shotcrete is flush with steel sets (~8" 10" thick); Timber lagging likely still in place; Concrete lined ditch extends 2' below TOR; Several drip locations, heavy drip from west spring line at Sta.2+80											
3+60	4+17	57	5	Shotcrete over Steel Sets	2	Y	0	Shotcrete over steel sets at 4'-spacing, shotcrete is 6"-10" thick; Concrete lined ditch extends 2' below TOR											
4+17	4+34	17	5	Steel Sets	4	Y	0	Steel sets at 4'-spacing used as jump sets, timber lagging still in place, coarse wire mesh was installed between sets (set up for shotcrete application); Bedrock 0.5' - 2.5' behind lagging; Concrete lined ditch 2' below TOR											
4+34	4+40	6	4 - 5	Unlined		Y	0	Exposed bedrock; Fault with 2"-offset across tunnel at Sta.4+39	- Install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete			1	60	432	5				
4+40	6+18	178	5	Timber Sets on Concrete Curb with Timber Lagging	4	Y	0	Timber sets at 4'-spacing on concrete curb with timber lagging; Bottoms of two timber sets are rotted at Sta.5+95, shifted on top of concrete curb; Bedrock 2' - 3.5' behind lagging, bedrock appears massive with healed joints, limey appearance; Concrete lined ditch 2' below TOR, ditch ends at Sta.6+18; Concrete curb ends at Sta.6+18	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete.)										
6+18	6+35	17	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Dry											
6+35	6+48	13	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Deteriorated lagging along east wall, wood foot blocks in fair condition generally (no cracks or squeezing); Dry											
6+48	7+35	87	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging, foot blocks in fair condition; Dry; - End of curve at ~Sta.7+00											
7+35	8+15	80	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging, two foot blocks underneath post typically, in fair condition; Dry; - 3" sag along east sidewall between Sta.7+84 and 7+96											
8+15	8+86	71	4 - 5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging, one foot block underneath post typically, foot blocks show advanced deterioration; - 1" sag at Sta.8+45	Replace wood foot blocks with shotcrete footings OR Remove timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			14	840	5112	64			71	19
8+86	9+92	106	3	Unlined		N		Exposed bedrock consists of sandstone with siltstone interbeds; Section is dry in general; Section is roughly 24 feet wide and 25 feet high - RQD is 90-100 (est.); - Joint spacing 3'-6", 3 to 5 joint sets + random sets, surface roughness is rough to smooth, unfavorable joints direction; Medium-high to High-strength rock (75-150 MPa) (est.); - Rock Mass Rating (RMR) ~85 (est.), Rock Class I-II; - Large portions of the crown consist of one bedding plane; - Vertical fault across section between Sta.9+04 on the east wall and Sta.9+59 on the west wall, ~ 2' of offset, RQD ~50-60 around fault; - Rock debris in ditch along both sidewalls are evidence for occasional rockfall	- Install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete			21	1260	8480	106				
9+92	12+74	282	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging, in fair condition; Dry; Bedrock consists of sandstone commonly, limey appearance	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete.)										
12+74	13+93	119	3 - 4	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; - 1"-2"-sag along west sidewall between Sta.12+82 and 13+24, locally rotted, squeezed foot blocks, bottom of timber posts also deteriorated locally; - 2"-sag along west sidewall between Sta.13+24 and 13+35; - 2.5"-sag along west sidewall between Sta.3+55 and 13+64	- Remove timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			24	1440	8568	158			119	31
13+93	14+19	26	2 - 3	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; 6"-sag; Rotted foot blocks and deteriorated bottoms of posts, timber lagging is falling out and rotted away locally; Exposed bedrock appears to be competent, no significant overbreak throughout section	- Remove timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			5	300	1872	34			26	8
14+19	14+83	64	5	Shotcrete over Steel Sets	2	Y	0	Shotcreted steel sets at 2'-spacing on concrete curb; Shotcrete application is 6"-10" thick; Shotcrete was placed over existing timber lagging; 4'-5' wide void space between bedrock and shotcreted sets along east sidewall and in the crown, 2'-wide void space between bedrock and shotcreted sets along west sidewall	Backfill void space behind lagging with cementations material (Void space average 3'-wide)										

**TUNNEL 13**  
**Coos Bay Subdivision, Oregon**  
**MP 669.47 to 669.94**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets	
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.
14+83	14+87	4	2	Unlined		N		Exposed bedrock; Separated rock blocks in crown, obvious rockfall hazard	- Install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row) and apply 6"-thick steel fiber reinforced shotcrete			1	60	288	5				
14+87	15+12	25	2 - 3	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Advanced deterioration of wood foot blocks, rotted lagging is falling out; - 4'-5"-sag along east sidewall from Sta.14+93 to 15+12	- Remove timber lining, install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and 6"-thick apply steel fiber reinforced shotcrete			5	360	1800	33			25	7
15+12	15+20	8	2	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Rotted and deteriorated timber sets (3), advanced deterioration of wood foot blocks, rotted lagging is falling out; Exposed bedrock along east sidewall; - 2'-3"-sag along west sidewall from Sta.15+00 to 15+33 (extends into following section - see below)	- Remove timber lining, install rockbolts (row-spacing 5 feet, six 15'-long rockbolts per row), and apply 6"-thick steel fiber reinforced shotcrete			2	180	576	10			8	3
15+20	15+49	29	2	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Advanced deterioration of wood foot blocks, rotted lagging; Bedrock appears to be competent; - 7"-sag from Sta.15+29 to 15+33 and from Sta.15+33 to 15+49 along east sidewall; - 4"-sag from Sta.15+33 to 15+53 along west sidewall (extends into following section - see below)	Remove timber lining, install rockbolts (row-spacing 5 feet, five 15'-long rockbolts per row), and apply 6"-thick steel fiber reinforced shotcrete			6	450	2088	38			29	8
15+49	15+69	20	3 - 4	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Rotted lagging; Bedrock appears to be competent;	Remove timber lining, install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			4	288	1440	18			20	6
15+69	16+14	45	2	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; - Rotted timber sets and timber lagging along east sidewall between Sta.15+69 and 16+02, bedrock rubble fell through lagging - rockfall hazard; - Deteriorated timber posts and wood foot blocks along west sidewall between Sta.15+69 and 16+14, timber lagging is rotted and falling out	- Remove timber lining, install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			9	648	3240	40			45	12
16+14	16+58	44	3 - 4	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Deteriorated sets, lagging, and wood foot blocks at various stages; - Timber lagging in 1/4-arch rotted - but mostly still in place - along west sidewall between Sta.16+34 and 16+49, deterioration along backside of timber posts, foot blocks in fair condition	- Remove timber lining, install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			9	648	3168	39			44	12
16+58	16+89	31	3	Timber Sets with Timber Lagging on Wood Foot Blocks	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Rotted lagging, condition of foot blocks fair to very poor throughout section; - Drip from crown at Sta.16+82	- Remove timber lining, install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			6	432	2232	28			31	9
16+89	17+08	19	4	Steel Sets on I-beams and Timber Sets with Timber Lagging	4	N		Steel sets installed between existing timber sets (timber sets at 4'-spacing), wood boards were used to strap section together; steel set footings are cut I-beams; in-place timber lagging generally dry	- Remove timber sets, wood foot blocks, and timber lagging, clean footings, and apply 4"-thick steel fiber reinforced shotcrete between steel sets. Use shotcrete to tie in steel web and for footing support.					1368	17				
17+08	18+27	119	4	Timber Sets with Timber Lagging and Wood Foot Blocks	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Sets, lagging, and foot blocks generally in fair condition; Apparently competent bedrock close behind lagging typically; - Damp lagging between Sta.17+20 to 17+36; - Damp and rotted lagging between Sta.17+61 to 17+69; - Drip at east springline at Sta.17+63, - Drip at west springline at Sta.17+67; - 3'-4"-wide void space between lagging and rock from 3'-4" below east springline to bottom of east sidewall between Sta.17+90 and 18+39	Replace wood foot blocks with shotcrete footings OR - Remove timber lining, install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			24	1728	8568	107			119	31
18+27	18+40	13	3	Timber Sets with Timber Lagging on Wood Foot Blocks	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Rotted lagging and deteriorated posts along west sidewall	- Remove timber lining, install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			3	216	936	11			13	4
18+40	18+44	4	2	Unlined				Exposed bedrock with apparent recent rockfall (rock fragments up to 2'x1'x1' size)	- Install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			1	72	288	3				
18+44	19+20	76	5	Shotcrete over Steel Sets	2	Y	0	Shotcrete over steel sets at 2'-spacing on concrete curb; Shotcrete application flush with steel sets (~6"-10"-thick); Shotcrete was applied over existing timber lagging	Backfill void space behind lagging with cementations material (Potentially 2'-wide void space)										
19+20	19+66	46	5	Shotcrete over Steel Sets	2	Y	0	Shotcrete over steel sets at 2'-spacing on concrete curb; Shotcrete application ~4"-6"-thick; Shotcrete was applied over existing timber lagging	Backfill void space behind lagging with cementations material (Potentially 2'-wide void space)										
19+66	19+75	9	3	Unlined				Exposed bedrock in fair condition; RQD ~60-70% in east sidewall, ~80-90% in crown, ~70-80% in west sidewall (all est.)	- Install rockbolts (row-spacing 5 feet, six 12'-long rockbolts per row), and apply 4"-thick steel fiber reinforced shotcrete			2	144	648	8				

**TUNNEL 13**  
**Coos Bay Subdivision, Oregon**  
**MP 669.47 to 669.94**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets	
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.
19+75	20+25	50	5	Steel Sets on I-beams	2	N		Steel sets at 2'-spacing on I-beams; Wire mesh was installed between sets; Timber lagging was left in place; Large void space between existing timber lagging and bedrock locally; - Drips from crown between Sta.19+80 to 19+98	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete OR installation of steel channel lagging between steel sets and backfilling void space with cementitious material.										
20+25	21+71	146	5	Shotcrete over Steel Sets	4	Y		Shotcreted steel sets at 4'-spacing; Shotcrete application is flush with steel sets; Shotcrete was placed over existing timber lagging; Shotcrete or concrete footing throughout section	Backfill void space behind lagging with cementations material (Potentially 2'-wide void space)										
21+71	22+97	126	5	Steel Sets on I-beams	2	N		Steel sets at 2'-spacing on I-beams; Existing timber lagging was left in place; Styrofoam was used to backfill large void space between lagging and bedrock; - Drip from west springline at Sta.22+57	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete OR installation of steel channel lagging between steel sets and backfilling void space with cementitious material.										
22+97	23+23	26	2	Steel Sets on I-beams	4	N		Steel sets at 4'-spacing on I-beams ; Existing timber lagging was left in place, timber lagging is rotted and falling into tunnel; Rock debris collected behind lagging; Occasional rock fall is evident (see below); - Rockfall material and rotted lagging on tracks along east sidewall from Sta.22+97 to 23+23	Remove timber lagging and all loose debris behind lagging - Apply 6"-thick steel fiber reinforced shotcrete between steel sets, Use shotcrete to tie in steel web and for footing support OR Install steel channel lagging between steel sets and backfill void space with cementitious material				1872	48					
23+23	23+39	16	3 - 4	Steel Sets on I-beams	4	N		Steel sets at 4'-spacing founded on I-beams; Existing timber lagging was left in place; Timber lagging rotted in places	Remove timber lagging and all loose debris behind lagging - Apply 6"-thick steel fiber reinforced shotcrete between steel sets, Use shotcrete to tie in steel web and for footing support OR Install steel channel lagging between steel sets and backfill void space with cementitious material				1152	29					
23+39	23+53	14	2	Steel Sets on I-beams	4	N		Steel sets at 4'-spacing founded on I-beams ; Existing timber lagging was left in place, timber lagging is rotted and falling into tunnel; Rock debris collected behind lagging; Rockfall material and rotted lagging on tracks along east sidewall	Remove timber lagging and all loose debris behind lagging - Apply 6"-thick steel fiber reinforced shotcrete between steel sets, Use shotcrete to tie in steel web and for footing support OR Install steel channel lagging between steel sets and backfill void space with cementitious material				1008	26					
23+53	23+95	42	3 - 4	Steel Sets on I-beams	4	N		Steel sets at 4'-spacing founded on I-beams ; Existing timber lagging was left in place, timber lagging is rotted and ready to fall into tunnel; Bedrock appears to be close behind lagging along east sidewall; Generally 3' to 4' void space behind lagging in crown; Damp to wet with drips.	Remove timber lagging and all loose debris behind lagging - Apply 6"-thick steel fiber reinforced shotcrete between steel sets, Use shotcrete to tie in steel web and for footing support OR Install steel channel lagging between steel sets and backfill void space with cementitious material				3024	224					
23+95	24+31	36	2	Steel Sets on I-beams	4	N		Steel sets at 4'-spacing founded on I-beams ; Existing timber lagging was left in place, rotted timber lagging with bedrock debris behind; - Day-lighted section in crown between ~Sta.24+20 and 24+31, flowing water from crown	Remove timber lagging and all loose debris behind lagging - Apply 6"-thick steel fiber reinforced shotcrete between steel sets, Use shotcrete to tie in steel web and for footing support OR Install steel channel lagging between steel sets and backfill void space with cementitious material				2592	192					

**TUNNEL 13**  
**Coos Bay Subdivision, Oregon**  
**MP 669.47 to 669.94**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets	
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.
24+31	24+96	65	5	Concrete Barrel				Concrete barrel - Crack across barrel at Sta.24+71 with some spalling and water seepage along crack											
24+96	24+96	0	5	Concrete Portal				South Portal @ MP 669.94											
Total Length (ft.):		2496							Total:	0	0	137	9126	60752	1243	0	0	550	150
Repair Level 2 (ft.):		166																	
Repair Level 2-3 (ft.):		51																	
Repair Level 3 (ft.):		159																	
Repair Level 3-4 (ft.):		241																	
Repair Level 4 (ft.):		138																	
Repair Level 4-5 (ft.):		77																	
Repair Level 5 (ft.):		1664																	

Repair Level	Description
1	Repairs should be completed immediately to <6 months
2	Repairs should be completed in 0 to 12 months
3	Repairs should be completed in 12 - 30 months
4	Repairs should be completed in 30 - 48 months
5	No immediate repairs required based on the current conditions

**COST ESTIMATE FOR REPAIR LEVELS 1 AND 2 (incl. Level 2-3):**

Est. Total Steel Sets (No.):	0 (Est. Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est. Total Rockbolts (LF):	2070 (Est. Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$165,600
Est. Total Concrete (cy):	0 (Est. Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est. Total Shotcrete (cy):	429 (Est. Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$386,100
Est. Total Timber Sets (No.):	38 (Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$57,000

Est. Sub Total for Level 1 and 2 (incl. Level 2-3) Repairs: \$608,700  
Mobilization (15%): \$91,305  
Contingency (20%): \$121,740  
Est. Total of Level 1 and 2 (incl. Level 2-3) Construction Cost: \$821,745

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est. Total Steel Sets (No.):	0 (Est. Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est. Total Rockbolts (LF):	9126 (Est. Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$730,080
Est. Total Concrete (cy):	0 (Est. Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est. Total Shotcrete (cy):	1243 (Est. Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$1,118,700
Est. Total Timber Sets (No.):	150 (Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$225,000

Est. Sub Total for Repairs: \$2,073,780  
Mobilization (15%): \$311,067  
Contingency (20%): \$414,756  
Est. Total of Construction Cost: \$2,799,603

**TUNNEL 14**  
**Coos Bay Subdivision, Oregon**  
**MP 681.09 to 681.18**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets			
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.		
0+00	0+00	0	5	Concrete Portal		N		North Portal @ MP 681.09													
0+00	0+50	50	5	Concrete Barrel		N		In general dry; Spalling concrete in east sidewall at Sta. 0+24													
0+50	0+90	40	5	Shotcrete over Bedrock		N		Shotcrete cover over bedrock generally in good condition; Shotcrete is relatively thin in crown (<1") and not reinforced													
0+90	1+90	100	4-5	Shotcrete over Bedrock		N		Shotcrete cover over bedrock very thin in crown (0.5" to 1") and not reinforced, thickness in sidewalls estimated to be around 2"; Large areas with spalling shotcrete in crown; Crown is built up by one bedding plane	Cover spalling areas with steel fiber reinforced shotcrete to desired thickness of 4 inches, new application shall extend to the bottom of sidewalls (2"-thick over existing shotcrete)					7200	66						
1+90	4+51	261	5	Shotcrete over Bedrock		N		Shotcrete cover over bedrock generally in good condition; Shotcrete is relatively thin in crown (<1") and not reinforced													
4+51	4+71	20	5	Shotcrete over Steel Sets	2 and 4	Y	-3	Shotcrete over steel sets at 4'-spacing on concrete curb; relatively thin shotcrete cover (2"-4"); Top of concrete curb is 2 to 3 inches below TOR; Last three steel sets at South Portal are at a 2'-spacing;													
4+71	4+71	0	5	Shotcrete over Steel Sets	2	Y	-3	South Portal @ MP 681.18													
Total Length (ft.):										Total:		0	0	0	0	7200	66	0	0	0	0
Repair Level 4-5 (ft.):																					
Repair Level 5 (ft.):																					

- Repair Level:
- 1 Repairs should be completed immediately to <6 months
  - 2 Repairs should be completed in 0 to 12 months
  - 3 Repairs should be completed in 12 - 30 months
  - 4 Repairs should be completed in 30 - 48 months
  - 5 No immediate repairs required based on the current conditions

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est. Total Steel Sets (No.):	0	(Est. Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est. Total Rockbolts (LF):	0	(Est. Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$0
Est. Total Concrete (cy):	0	(Est. Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est. Total Shotcrete (cy):	66	(Est. Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$59,400
Est. Total Timber Sets (No.):	0	(Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$0

Est. Sub Total for Repairs: \$59,400  
Mobilization (15%): \$8,910  
Contingency (20%): \$11,880  
**Est. Total of Construction Cost: \$80,190**

**TUNNEL 15**  
**Coos Bay Subdivision, Oregon**  
**MP 720.73 to 720.14**

Shannon Wilson, Inc.

Station To	Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rock bolts		Shotcrete		Concrete		Timber Sets		
			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.	
00+00	0	5	Concrete Portal				North Portal @ MP 720.73												
00+26	26	5	Concrete Barrel				Concrete Barrel												
01+35	109	5	Shotcrete over Steel Sets on Concrete Curb	4.0	Y	6	Steel sets, covered with shotcrete, spaced 4 ft, concrete between sets (?)												
01+47	12	5	Shotcrete over Steel (and Timber?) Sets on Concrete Curb	N/A	Y	6	Steel (and timber?) sets covered with shotcrete												
02+10	63	4	Timber Sets on Concrete Curb with Timber Lagging	1.5	Y	6	Wood ribs, spaced 1.5 ft, fair condition, wet, slight deterioration	Remove timber sets and lagging and install rock bolts in crown and sidewalls (row-spacing 5 feet, six 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			12	1008	4536	57				63	43
02+15	5	3	Timber Sets on Concrete Curb with Timber Lagging	1.5	Y	6	3 timber sets, offset, crushed and cracked joints	Remove timber sets and lagging and install rock bolts in crown and sidewalls (row-spacing 5 feet, six 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			1	84	360	4				5	4
02+77	62	4	Timber Sets on Concrete Curb with Timber Lagging	1.0-2.0	Y	6	Wood ribs spaced 1-2 ft, fair to good condition, dry	Remove timber sets and lagging and install rock bolts in crown and sidewalls (row-spacing 5 feet, six 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			12	1008	4464	56				62	42
02+93	16	3	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Deteriorated wood sets, wet - heavy dripping	Remove timber sets and lagging and install rock bolts in crown and sidewalls (row-spacing 5 feet, ten 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			3	420	1152	14				16	9
03+06	13	5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Timber sets in fair condition, dry	<i>(Current conditions of timber lining is fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, six 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.)</i>											
03+20	14	2	Timber Sets on Concrete Curb with Timber Lagging	1.0-2.0	Y	6	Rotting timber sets, sp. 1-2 ft, sheared, offset joints, dry in general	Remove timber sets and lagging and install rock bolts in crown and sidewalls (row-spacing 5 feet, ten 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			3	420	1008	12				14	10
03+32	12	1-2	Timber Sets on Concrete Curb with Timber Lagging	1.0-2.0	Y	6	Rotting timber sets, sp. 1-2 ft, sheared, offset joints, wet - a timber set fell into the tunnel on 07/05/2007 at approximately Sta.3+28	Remove timber sets and lagging and install rock bolts in crown and sidewalls (row-spacing 5 feet, ten 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			2	280	864	10				12	9
03+56	24	2	Timber Sets on Concrete Curb with Timber Lagging	1.5	Y	6	Rotting timber sets, spaced 1.5 ft., dry in general - the east 1/4-arch segment of the timber set located at around Sta. 3+43 fell into the tunnel on 01/18/2007	Remove timber sets and lagging and install rock bolts in crown and sidewalls (row-spacing 5 feet, ten 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			5	700	1728	21				24	17
03+72	16	2	Timber Sets on Concrete Curb with Timber Lagging	1.0	Y	6	Rotting timber sets, spaced 1 ft., heavy dripping	Remove timber sets and lagging and install rock bolts (row-spacing 5 feet, ten to twelve 15'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete. The construction of the new liner may require the use of steel sets for temporary and permanent support, also, due to the wet condition of the area, backfilling of the area with concrete or shotcrete maybe required instead of applying shotcrete. Prior to construction, the drilling of probe holes maybe required in order to obtain information about the current general ground condition.	20	6	4	600	1440	18				16	17
03+86	14	3	Timber Sets on Concrete Curb with Timber Lagging	1.5	Y	6	Rotting timber posts along west side, spaced 1.5 ft	Remove timber sets and lagging and install rock bolts (row-spacing 5 feet, six 14'-long rock bolts per row) and apply 4"-thick steel fiber reinforced shotcrete			3	210	1008	12				14	10
04+15	29	4-5	Timber Sets on Concrete Curb with Timber Lagging	1.5-2.0	Y	6	Wood ribs, fair condition - Timber sets were shotcreted during repairs in November 2006; Rock bolts were installed in crown and sidewalls north of caved in/collapsed area	<i>Section may require more shotcrete between the existing timber sets for completion - or remove current lining and replace with additional rock bolts and a 4" thick application of shotcrete</i>											
04+42	27	5	Steel Arches on Steel and Timber Posts; Shotcreted and Backfilled	4.0	Y	6	Wood ribs w/ steel straps - 3 full steel sets (4'-spacing) were installed after a cave-in/collapse occurred in the west sidewall in November 2006, remaining section consist of arch segments only (placed on a wall plate supported by in-place timber posts); Low-strength concrete was used to backfill area between and behind steel sets; Rock bolts and/or Spiling were installed through out the section												
04+60	18	4-5	Timber Sets on Concrete Curb with Timber Lagging	4.0	Y	6	Wood ribs with longitudinal cracks in several timbers - Timber sets were shotcreted during repairs in November 2006; Rock bolts were installed in crown and sidewalls	<i>Section may require more shotcrete between the existing timber sets for completion - or remove current lining and replace with a 4" thick application of shotcrete</i>											
04+79	19	4-5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	"Tight" timber sets; numerous offsets; poor condition - Timber sets were partially shotcreted in sidewalls during repairs in November 2006; Rock bolts were installed in crown during repairs	<i>Section may require more shotcrete between the existing timber sets for completion - or remove current lining and replace with additional rock bolts and a 4" thick application of shotcrete</i>											
04+86	7	5	Shotcrete over Steel Sets on Concrete Curb	4.0	Y	6	Caved area up ~15 ft (est. 10 to 15 cy of rock fall material) - Section was stabilized in November 2006 with two steel sets spaced at 4 feet, steel channel lagging was installed and arches and crown were backfilled with shotcrete.												
05+12	26	2	Timber Sets on Concrete Curb with Timber Lagging	1.5	Y	6	Rotted timber and crushed butt joints; Bowed sets along east sidewall were reinforced with rock bolts recently.	Remove timber lining, install rock bolts (row-spacing 5 feet, eight to ten - two rock bolts in each sidewall - 12'-long rock bolts per row), and apply 4"-thick steel fiber reinforced shotcrete.			5	600	1872	23				26	18
05+29	17	5	Steel Sets on Concrete Curb	1.5	Y	6	Steel sets, spaced 1.5 ft	<i>For long-term stability, remove timber lagging behind steel sets and apply 4"-thick shotcrete over exposed ground between sets.</i>					1224	15					

**TUNNEL 15**  
**Coos Bay Subdivision, Oregon**  
**MP 720.73 to 720.14**

Shannon Wilson, Inc.

Station To	Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rock bolts		Shotcrete		Concrete		Timber Sets		
			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.	
05+74	45	5	Timber Sets on Concrete Curb with Timber Lagging	1.5	Y	6	Timber sets, spaced 1.5ft., with polyurethane grout, Sandstone exposed in 1/4 arch	Current condition of timber lining is fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, six 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.											
05+78	4	5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Fair wood sets dry, spaced 2 ft	Two timber sets were left in place, because they appeared to be tight when attempted to be removed during recent repair works. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, five 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.											
05+85	7	5	Shotcrete over bedrock		Y	6	Timber sets were removed and replaced with shotcrete and rock bolts												
05+92	7	5	Shotcrete over bedrock		Y	6	Timber sets were removed and replaced with shotcrete and rock bolts												
06+18	26	3	Timber Sets on Concrete Curb with Timber Lagging	1.5-2.0	Y	6	Rotted timber and crushed butt joints; thin steel strops in arch; hanging segments	Remove timber lining, install rock bolts (row-spacing 5 feet, ten - two in each sidewall - 12'-long rock bolts per row), and apply 4"-thick steel fiber reinforced shotcrete			5	600	1872	23				26	18
08+89	271	5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Good wood sets dry, spaced 2 ft	Current conditions of timber lining is fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, five 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.											
09+26	37	5	Steel Sets and Timber Sets on Concrete Curb with Timber Lagging	1.0-1.5	Y	6	Steel jump sets, timber sets, wet area at Sta.12+50 - one split set hanging down in arch	Remove timber sets and timber lagging between steel jump sets; place 4"-thick shotcrete over exposed ground and tie steel sets into shotcrete application.					2664	33				37	20
09+88	62	5	Shotcrete over Steel Sets on Concrete Curb	2.0	Y	6	Steel sets, covered with shotcrete , minor drips, scattered missing shotcrete in arch												
11+10	122	5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Wood ribs, sp. 2 ft, good condition, dry, sand deposits at toe of posts at Sta.11+25	Current conditions of timber lining is fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, five 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.											
12+66	156	5	Shotcrete over Steel Sets on Concrete Curb	2.0	Y	6	Steel ribs spaced 2 ft, covered with shotcrete, dry												
13+28	62	5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Good wood sets dry, spaced 2 ft	Current conditions of timber lining is fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, five 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.											
13+90	62	5	Shotcrete over Steel Sets on Concrete Curb	2.0	Y	6	Steel ribs spaced 2 ft, covered with shotcrete, dry												
14+34	44	5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Good wood sets dry, spaced 2 ft	Current conditions of timber lining is fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, five 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.											
14+47	13	3	Steel Sets and Timber Sets on Concrete Curb with Timber Lagging	1.0-1.5	Y	6	Steel jump sets, poor wood sets, lost 2 sections; Another timber set fell out on 11/17/2006 at approximately Sta.14+41.	Remove timber sets and timber lagging between steel jump sets; place 4"-thick shotcrete over exposed ground and tie steel sets into shotcrete application.					936	11				13	5
15+65	118	5	Timber Sets on Concrete Curb with Timber Lagging	2.0	Y	6	Good wood sets, dry, spaced 2 ft	Current conditions of timber lining is fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rock bolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rock bolts (row-spacing 5 feet, five 12'-long rock bolts per row) and application of 4"-thick steel fiber reinforced shotcrete.											
16+61	96	5	Shotcrete over Steel (and Timber) Sets	1.0	Y	6	Steel- and (possibly) wood ribs, spaced 1 ft, covered with shotcrete												
18+95	234	4	Shotcrete over Steel Sets on Concrete Curb	2.0	Y	6	Steel ribs spaced 2 ft, covered with shotcrete, local drips, scattered missing shotcrete in arch	Repair spalled shotcrete in crown and increase general thickness of shotcrete in crown (around 2 inches)					6318	58					
20+60	165	4	Shotcrete over Steel Sets on Concrete Curb	1.5-2.0	Y	6	Steel ribs spaced 1.5 to 2 ft, covered with shotcrete, abundant drips, missing shotcrete in arch locally	Repair spalled shotcrete in crown and increase general thickness of shotcrete in crown (around 2 inches)					4455	41					

**TUNNEL 15**  
**Coos Bay Subdivision, Oregon**  
**MP 720.73 to 720.14**

Shannon Wilson, Inc.

Station To	Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rock bolts		Shotcrete		Concrete		Timber Sets										
			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft²	cy	ft²	cy	ft.	No.									
21+43	83	4	Concrete Barrel		N		Concrete Barrel; longitudinal cracks in both sides, some displacement along cracks	Support sidewalls of concrete barrel with rock bolts; 1-2 rows on each side at a 5'-spacing, bolt length estimated to be 12 feet minimum. Initial work may require probe holes to determine thickness of concrete and depth to competent bedrock.																			
21+43	0	5	S-Portal		N		South Portal @ MP 721.14				4	816															
Length (ft.): 2143									Total:									20	6	59	6746	35901	408	0	0	328	224
Level 1-2 (ft.):		12																									
Level 2 (ft.):		80																									
Level 3 (ft.):		74																									
Level 4 (ft.):		607																									
Level 4-5 (ft.):		66																									
Level 5 (ft.):		1304																									

**COST ESTIMATE FOR REPAIR LEVELS 1 to 2 :**

Est. Total Steel Sets (No.):	6	(Est. Unit Rates: \$5000/per set)	Est. Total Construction Cost	\$30,000
Est. Total Rock bolts (LF):	2600	(Est. Unit Rates: \$80/per LF)	Est. Total Construction Cost	\$208,000
Est. Total Concrete (cy):	0	(Est. Unit Rates: \$100/per CY)	Est. Total Construction Cost	\$0
Est. Total Shotcrete (cy):	84	(Est. Unit Rates: \$900/per CY)	Est. Total Construction Cost	\$75,600
Est. Total Timber Sets (No.):	72	(Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Cost	\$107,500

Est. Sub Total for Level 1 and 2 (incl. Level 2-3) Repairs: \$421,100  
Mobilization (15%): \$63,165  
Contingency (20%): \$84,220  
Est. Total of Level 1 and 2 (incl. Level 2-3) Construction Cost: \$568,485

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est. Total Steel Sets (No.):	6	(Est. Unit Rates: \$5000/per set)	Est. Total Construction Cost	\$30,000
Est. Total Rock bolts (LF):	6746	(Est. Unit Rates: \$80/per LF)	Est. Total Construction Cost	\$539,680
Est. Total Concrete (cy):	0	(Est. Unit Rates: \$100/per CY)	Est. Total Construction Cost	\$0
Est. Total Shotcrete (cy):	408	(Est. Unit Rates: \$900/per CY)	Est. Total Construction Cost	\$367,200
Est. Total Timber Sets (No.):	224	(Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Cost	\$225,000

Est. Sub Total for Repairs: \$1,161,880  
Mobilization (15%): \$174,282  
Contingency (20%): \$232,376  
Est. Total of Construction Cost: \$1,568,538

Level  
Repairs should be completed immediately to <6 months  
Repairs should be completed in 0 to 12 months  
Repairs should be completed in 12 - 30 months  
Repairs should be completed in 30 - 48 months  
No immediate repairs required based on the current conditions

**TUNNEL 16**  
**Coos Bay Subdivision, Oregon**  
**MP 721.52 to 721.64**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rock bolts		Shotcrete		Concrete		Timber Sets								
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.							
0+00	0+00	0	5	Concrete Portal				North Portal @ MP 721.52																		
0+00	0+55	55	5	Concrete Barrel				Concrete barrel; Scattered cracks in barrel crown; Scattered drips in crown - 1/8"-1/4" open crack on east sidewall and 1/2" open crack on west wall at Sta.0+10; - Horizontal crack along west sidewall from Sta.0+11 to 0+55, offset in places up to 1/2"; - Horizontal crack 1/4" open along east sidewall from 0+11 to 0+55; other																		
0+55	4+10	355	5	Shotcrete over Steel Sets	2.5	Y	6	Shotcrete over steel sets at 2.5'-spacing on concrete curb; - Drips near center line of crown between Sta.1+21 and 1+33 ; - Damp with discoloration along center line of crown at Sta.3+53 and at Sta.3+83; - Damp spot on west side of crown at Sta.4+00																		
4+10	4+43	33	5	Shotcrete over Steel Sets	2.5	Y	6	Seepage in crown with dripping locally and orange discoloration																		
4+43	4+56	13	5	Shotcrete over Steel Sets	2.5	Y	6	Dry																		
4+56	4+86	30	5	Shotcrete over Steel Sets	2.5	Y	6	Seepage in crown with dripping locally and white to orange discoloration																		
4+86	5+00	14	5	Shotcrete over Steel Sets	2.5	Y	6	Dry; Orange discoloration																		
5+00	5+52	52	5	Shotcrete over Steel Sets	2.5	Y	6	Intermittent cracking in shotcrete application along center line of crown; - Seepage at west springline at Sta.5+04 ; - Heavy dripping and discoloration at Sta.5+11;																		
5+52	5+78	26	5	Shotcrete over Steel Sets	2.5	Y	6	Heavy dripping along west springline between Sta.5+52 and 5+57; Flowing water at contact of steel sets and concrete barrel																		
5+78	6+33	55	5	Concrete Barrel				Concrete barrel; Damp with local dripping																		
6+33	6+33	0	5	Concrete Portal				- Flowing water above springline in west sidewall at Sta.5+84 and 5+92;																		
Total Length (ft.):									Total:									0	0	0	0	0	0	0	0	0
Repair Level 5 (ft.):																		633								

- Repair Level:
- 1 Repairs should be completed immediately to <6 months
  - 2 Repairs should be completed in 0 to 12 months
  - 3 Repairs should be completed in 12 - 30 months
  - 4 Repairs should be completed in 30 - 48 months
  - 5 No immediate repairs required based on the current conditions

COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:			
Est. Total Steel Sets (No.):	0	(Est. Unit Rates: \$5000/per set)	Est. Total Construction Costs: \$0
Est. Total Rock bolts (LF):	0	(Est. Unit Rates: \$80/per LF)	Est. Total Construction Costs: \$0
Est. Total Concrete (cy):	0	(Est. Unit Rates: \$100/per CY)	Est. Total Construction Costs: \$0
Est. Total Shotcrete (cy):	0	(Est. Unit Rates: \$900/per CY)	Est. Total Construction Costs: \$0
Est. Total Timber Sets (No.):	0	(Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs: \$0
Est. Sub Total for Repairs: \$0			
Mobilization (15%): \$0			
Contingency (20%): \$0			
Est. Total of Construction Cost: \$0			

**TUNNEL 17**  
**Coos Bay Subdivision, Oregon**  
**MP 727.70 to 727.83**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets	
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.
0+00	0+00	0	5	Concrete Portal				North Portal @ MP 727.70											
0+00	1+28	128	5	Concrete Barrel				Concrete barrel; - Damp from Sta.0+25 to 1+28; - Crack in E-sidewall at Sta.0+52; - Crack in W-sidewall at Sta.0+57; - Crack at center line of crown from ~Sta.0+72 to 1+28; - Ditches along both sides are filled with silt and gravel, depth ditches appear to be at least 18" below rail											
1+28	1+43	15	5	Shotcrete over Steel Sets	1-1.5	Y	6	Shotcrete over steel sets at narrow spacing on concrete curb; Application is relatively thin (~4"-thick); Existing timber lagging was covered with shotcrete possibly; Track is sunk in mud; - Flowing water from 1/4-arch on E-sidewall (est. 5-10 gal/min) at Sta.1+39											
1+43	2+45	102	5	Shotcrete over Steel Sets	2	Y	6	Shotcrete over steel sets at 2'- spacing on concrete curb; Thickness of application is between 3" and 8", thinner in crown generally; Abundant drips, shotcrete is discolored at many locations, tunnel dries up around Sta.2+30 generally; Very muddy track											
2+45	3+39	94	5	Shotcrete over Steel Sets	4	Y	6	Shotcrete over steel sets at 4'- spacing on concrete curb; Thickness of application is between 4" and 6", thinner in crown generally; Scattered drips, shotcrete is discolored in many locations; Track dries up and ballast starts to become visible between Sta.2+50 and 2+60											
3+39	3+65	26	5	Shotcrete over Steel Sets	2	Y	6	Shotcrete over steel sets at 2'- spacing on concrete curb; Thickness of application is between 4" and 6", thinner in crown generally;											
3+65	4+29	64	5	Shotcrete over Steel Sets	4	Y	6	Shotcrete over steel sets at 4'- spacing on concrete curb; Thickness of application is between 4" and 6", thinner in crown generally; Dry											
4+29	4+52	23	5	Shotcrete over Steel Sets	2	Y	6	Shotcrete over steel sets at 2'- spacing on concrete curb; Thickness of application is between 4" and 6", thinner in crown generally;											
4+52	4+60	8	5	Timber Sets on Concrete Curb with Timber Lagging	4	Y	6	Timber sets at 4'-spacing on concrete curb with timber lagging; Dry	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete.)										
4+60	5+80	120	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Dry; Timber and foot blocks are in fair to good condition; Foot blocks are covered in ballast and debris along west sidewall; Bedrock appears to be less than 2' behind timber lagging (lagging almost complete throughout section)											
5+80	5+95	15	4 - 5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Dry; Timber and foot blocks are in fair to good condition generally; Lagging fell out in west sidewall, rotted at bottom, some rock debris behind lagging; Exposed Bedrock appears to be massive and competent	Remove timber sets and rotted timber lagging, and clean area from rock debris; - Install rockbolts (rockbolt rows at 5'-spacing, five 12'-long rockbolts per row); - Apply shotcrete to the desired thickness of 4 inches			3	180	1080	13			15	5
5+95	6+44	49	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Dry; Timber and foot blocks are in fair to good condition generally; Tracks start to become muddy again at around Sta.6+20 with signs of pumping	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete.)										
6+44	7+29	85	5	Timber Sets on Concrete Curb with Timber Lagging	4	Y	6	Timber sets at 4'-spacing on concrete curb with timber lagging; Footing of posts embedded in concrete curb one inch; Dry											
7+29	7+68	39	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Dry; Timber and foot blocks are in fair to good condition generally; Tracks are in very poor condition and totally sunk in wet mud, sagging (lowered?) track at approximately Sta.7+50											
7+68	7+80	12	4	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; - East sidewall: Rotted lagging with debris piled up 8'-12' high behind it, one post is rotted, Bedrock is exposed roughly 2' behind lagging	Remove timber sets and rotted timber lagging, and clean area from rock debris; - Install rockbolts (rockbolt rows at 5'-spacing, five 12'-long rockbolts per row); - Apply shotcrete to the desired thickness of 4 inches			2	120	864	10			12	4
7+80	8+52	72	5	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Dry; Timber and foot blocks are in fair to good condition generally; Severe drainage problem throughout this section: Track, ditches and footings of timber sets are entirely covered in wet mud	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete.)										
8+52	8+69	17	3	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Timber sets at 4'-spacing on wood foot blocks with timber lagging; Entire section sagged 12 inches, wood boards were used to strap sets together, foot blocks are crushed; Bedrock appears to be close behind lagging	Remove timber sets and timber lagging, and clean area from rock debris; - Install rockbolts (rockbolt rows at 5'-spacing, five 12'-long rockbolts per row); - Apply shotcrete to the desired thickness of 4 inches			3	180	1224	15			17	5
8+69	9+03	34	5	Shotcrete over Bedrock		N		Shotcrete over bedrock; Dry											

**TUNNEL 17**  
**Coos Bay Subdivision, Oregon**  
**MP 727.70 to 727.83**

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets	
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.
9+03	10+54	151	5	Shotcrete over Bedrock		Y	12	Shotcrete over bedrock; concrete curb is present along both sides of tunnel; Track appears to be lowered in this section											
10+54	11+45	91	5	Shotcrete over Steel Sets	2	Y	12	Shotcrete over steel sets on concrete curb at 2'-spacing											
11+45	12+00	55	5	Concrete Barrel				Drip at Sta.11+10											
12+00	12+00	0	5	Concrete Portal				Concrete barrel; Seepage in crown at contact of barrel and steel sets											
Total Length (ft.):		1200																	
Repair Level 3 (ft.):		17																	
Repair Level 4 (ft.):		12	55																
Repair Level 4-5 (ft.):		15																	
Repair Level 5 (ft.):		1156																	
Total:										0	0	8	480	3168	38	0	0	44	14

Repair Level:

1	Repairs should be completed immediately to <6 months
2	Repairs should be completed in 0 to 12 months
3	Repairs should be completed in 12 - 30 months
4	Repairs should be completed in 30 - 48 months
5	No immediate repairs required based on the current conditions

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est.Total Steel Sets (No.):	0	(Est.Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est.Total Rockbolts (LF):	480	(Est.Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$38,400
Est.Total Concrete (cy):	0	(Est.Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est.Total Shotcrete (cy):	38	(Est.Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$34,200
Est.Total Timber Sets (No.):	14	(Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$21,000
			Est. Sub Total for Repairs:	\$93,600
			Mobilization (15%):	\$14,040
			Contingency (20%):	\$18,720
			Est. Total of Construction Cost:	\$126,360

**TUNNEL 18**  
**Coos Bay Subdivision, Oregon**  
**MP 734.48 to 734.77**

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets	
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.
0+00	0+00	0	5	Shotcrete over Steel Sets	2	Y	12	North Portal @ Sta.734.48											
0+00	1+02	102	5	Shotcrete over Steel Sets	2	Y	12	Shotcrete over Steel Sets at 2'-spacing on concrete curb; Shotcrete ~6" thick over steel sets; Dry											
1+02	4+00	298	5	Shotcrete over Steel Sets	4	Y	12	Shotcrete over Steel Sets at 4'-spacing on concrete curb; Shotcrete ~6" thick over steel sets; Dry											
4+00	4+12	12	5	Shotcrete over Steel Sets	4	Y	0	Shotcrete over Steel Sets at 4'-spacing on concrete curb; Shotcrete ~6" thick over steel sets; Dry; Gradual change in curb height beginning at the North Portal (12" above TOR to 0" above TOR)											
4+12	6+94	282	5	Shotcrete over Steel Sets	2	Y	0 and 6	Shotcrete over Steel Sets at 2'-spacing on concrete curb; Shotcrete ~6"-8" thick over steel sets; Dry generally; - Crack along center line of crown between Sta.5+70 and 6+30, drip from existing drain in crown adjacent to crack at Sta.5+82; - Abrupt change in curb height, raised 6" at Sta.5+84; - Fouled tracks											
6+94	9+05	211	5	Shotcrete over Steel Sets	4	Y	6 and 0	Shotcrete over Steel Sets at 2'-spacing on concrete curb; Shotcrete ~6"-8" thick over steel sets; Dry; - Abrupt change in curb height, lowered 6" at Sta.7+00.											
9+05	9+22	17	3 - 4	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Bottom of timber posts and/or wood footing blocks show initial stages of deterioration, but do not show signs of advanced distress or movement.	Replacement of wood footing blocks (and bottom of timber posts when deteriorated). Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top or rail, whichever is shallower OR Remove existing timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete)			3	180	1224	15			17	5
9+22	9+36	14	2	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Bottom of timber posts and/or wood footing blocks are severely deteriorated, show signs of crushing, squeezing, and/or shifting, and/or are cracked. Set sagging along east wall.	Cutting and removal of deteriorated wood footing blocks and rotted bottom sections of timber posts. Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top of rail, whichever is shallower OR Remove existing timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete).			3	180	1008	12			14	5
9+36	9+60	24	3 - 4	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Bottom of timber posts and/or wood footing blocks show initial stages of deterioration, but do not show signs of advanced distress or movement.	Replacement of wood footing blocks (and bottom of timber posts when deteriorated). Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top or rail, whichever is shallower OR Remove existing timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete).			5	300	1728	21			24	7
9+60	10+78	118	2	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Bottom of timber posts and/or wood footing blocks are severely deteriorated, show signs of crushing, squeezing, and/or shifting, and/or are cracked. Sagged posts on both sides of tunnel.	Cutting and removal of deteriorated wood footing blocks and rotted bottom sections of timber posts. Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top of rail, whichever is shallower OR Remove existing timber lining, install rockbolts (row-spacing 5 feet, five 15'-long rockbolts per row) and apply 6"-thick steel fiber reinforced shotcrete).			24	1440	8496	106			118	31
10+78	11+10	32	1	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Six posts on the east side kicked out at the bottom and shifted into tunnel by up to 2 ft. (smallest distance to nearest rail is 3.5 ft., measured at top of rail). Rock fragments and crushed rotted timber lagging is caught behind displaced timber posts. Bedrock is exposed locally.	Removal of six existing timber sets (or shifted posts); Installation of six replacement steel sets; Installation of rockbolts (rockbolt rows at 5'-spacing, six 15'-long rockbolts per row); Application of shotcrete to the desired thickness of 6"; Footing blocks and bottom of posts of the two sets to the south of the failed area need to be cut and removed, and then replaced with shotcrete along the east side.			6	540	2304	42			32	9
11+10	12+80	170	2	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Bottom of timber posts and/or wood footing blocks are severely deteriorated, show signs of crushing, squeezing, and/or shifting, and/or are cracked. Sagged posts on east side between Sta.11+10 and 12+00; sagged posts on west side between Sta.11+00 and 11+20, Sta.11+72 and 11+76, and Sta.12+72 and 12+80); - Fouled track, shoulder heaving from Sta.11+20 to 12+30	Cutting and removal of deteriorated wood footing blocks and rotted bottom sections of timber posts. Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top of rail, whichever is shallower OR Remove existing timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete).			34	2040	12240	154			170	44

**TUNNEL 18**  
**Coos Bay Subdivision, Oregon**  
**MP 734.48 to 734.77**

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets			
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft²	cy	ft²	cy	ft.	No.		
12+80	13+22	42	3 - 4	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Bottom of timber posts and/or wood footing blocks show initial stages of deterioration, but do not show signs of advanced distress or movement.	Replacement of wood footing blocks (and bottom of timber posts when deteriorated). Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top or rail, whichever is shallower OR Remove existing timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete).			8	480	3024	38			42	12		
13+22	14+20	98	2	Timber Sets on Wood Foot Blocks with Timber Lagging	4	N		Bottom of timber posts and/or wood footing blocks are severely deteriorated, show signs of crushing, squeezing, and/or shifting, and/or are cracked. Sagged posts on east side between Sta.13+22 and 13+58 (~12"-sag), and Sta.14+06 and 14+16 (<6"-sag);. Sagged posts on west side between Sta.13+22 and 13+50, and at sta.13+94	Replacement of wood footing blocks (and bottom of timber posts when deteriorated). Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top or rail, whichever is shallower OR Remove existing timber lining, install rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and apply 4"-thick steel fiber reinforced shotcrete).			20	1200	7056	88			98	26		
14+20	14+82	62	5	Timber Sets on Concrete Curb with Timber Lagging	4	Y	6	Timber posts and lagging in fair to good condition	(Current conditions of timber lining and wood foot blocks are fair to good generally. However, timber will deteriorate over time and may cause problems in these sections in the future. Replacing the timber lining with rockbolts and steel fiber reinforced shotcrete is recommended in the future in order to maintain the long-term stability of the tunnel. Future repairs should include installation of rockbolts (row-spacing 5 feet, five 12'-long rockbolts per row) and application of 4"-thick steel fiber reinforced shotcrete OR Replacement of wood footing blocks and bottom of timber posts when deteriorated. Establish new footing for timber sets with shotcrete on bedrock or a minimum of 2 ft below top or rail, whichever is shallower.)												
14+82	15+27	45	1	Timber Sets with Timber Lagging	4	Y	6	Posts on west side shifted into tunnel at the bottom; Rubble and detached rotted timber lagging and cribbing caught behind posts between Sta.15+20 and 15+27; Timber set is missing at Sta.15+18; Timber lagging rotted and missing locally; Some timber sets are separated at butt joints and from timber lagging; Posts are rotted at the bottom along the east side between Sta.15+00 and 15+10	Removal of ten existing timber sets; Installation of rock bolts (rockbolt rows at 5'-spacing, six 15'-long rockbolts per row); Application of shotcrete to desired thickness of 6".			9	675	3240	60			45	12		
15+27	15+80	53	5	Concrete Barrel				Concrete barrel													
15+80	15+80	0	5	Concrete Portal				South Portal @ Sta.734.77													
Total Length (ft.):		1580										0	0	112	7035	40320	536	0	0	560	149

Repair Level 1 (ft.):	77
Repair Level 2 (ft.):	400
Repair Level 3-4 (ft.):	83
Repair Level 5 (ft.):	1020

- Repair Level:
- 1 Repairs should be completed immediately to <6 months
  - 2 Repairs should be completed in 0 to 12 months
  - 3 Repairs should be completed in 12 - 30 months
  - 4 Repairs should be completed in 30 - 48 months
  - 5 No immediate repairs required based on the current conditions

**COST ESTIMATE FOR REPAIR LEVELS 1 AND 2:**

Est.Total Steel Sets (No.):	0 (Est.Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est.Total Rockbolts (LF):	6075 (Est.Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$486,000
Est.Total Concrete (cy):	0 (Est.Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est.Total Shotcrete (cy):	462 (Est.Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$415,800
Est.Total Timber Sets (No.):	125 (Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$187,500

Est. Sub Total for Level 1 and 2 Repairs: \$1,089,300  
Mobilization (15%): \$163,395  
Contingency (20%): \$217,860  
Est. Total of Level 1 and 2 Construction Cost: \$1,470,555

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est.Total Steel Sets (No.):	0 (Est.Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est.Total Rockbolts (LF):	7035 (Est.Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$562,800
Est.Total Concrete (cy):	0 (Est.Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est.Total Shotcrete (cy):	536 (Est.Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$482,400
Est.Total Timber Sets (No.):	149 (Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$223,500

Est. Sub Total for Repairs: \$1,268,700  
Mobilization (15%): \$190,305  
Contingency (20%): \$253,740  
Est. Total of Construction Cost: \$1,712,745

**TUNNEL 19**  
**Coos Bay Subdivision, Oregon**  
**MP 745.62 to 746.41**

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets		
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft²	cy	ft²	cy	ft.	No.	
0+00	0+00	0	5	Shotcrete over Steel Sets		Y	1	North Portal @ MP 745.62; Skin slides at the west side of the portal area occurred in the past and resulted in blocked drainage (muddy track and ditches inside the tunnel)												
0+00	0+35	35	5	Shotcrete over Steel Sets	2	Y	1	Shotcrete -6" thick over steel sets, dry, fouled tracks												
0+35	0+50	15	5	Shotcrete over Steel Sets	4	Y	1	Shotcrete -6" thick over steel sets, dry, fouled tracks												
0+50	10+86	1036	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick) - 0+00 to 2+10 (approx.): 6" curved track; - Drainage ditches along both sides of tunnel are in very bad shape and essentially non-existent, tracks are covered in mud (no ballast visible until -Sta.7+00), ditches clear and show up approximately between Sta.5+00 and 6+00	In general, the shotcrete application over bedrock appears to be thin (less than 2 inches) throughout the tunnel, the shotcrete is not reinforced; Color changes of the shotcrete indicate multiple applications in the past, suggesting repair of previously spalled shotcrete; In general, the present shotcrete cover in the tunnel is in good condition and does not show signs of cracking and advancing deterioration; However, spalling shotcrete was observed at several locations in the tunnel, some associated with small rockfalls; It is recommended to cover exposed bedrock in areas where shotcrete is spalling (sidewalls: 2"-thick, spalled areas: 4"-thick) within the next 48 to 60 months in order to prevent further weathering and deterioration of bedrock and potential rockfalls; this will also help to prevent the spalling from progressing into the existing shotcrete application surrounding the spalled areas; Due to the generally thin shotcrete cover new spalling of shotcrete has to be expected in the future at any location throughout the tunnel; because of the good condition of the existing shotcrete cover and the dry state of the tunnel, however											
10+86	10+91	5	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (~ 5'x5'), shotcrete fragments on track					360	3						
10+91	11+14	23	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
11+14	11+20	6	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (~ 6'x3') associated with rock fall, shotcrete fragments and rock fragments (largest rock ~ 4'x2'x1') on track and in ditches					432	4						
11+20	11+31	11	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
11+31	11+36	5	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (~ 5'x3') associated with rock fall, shotcrete fragments and small rock fragments on track					360	3						
11+36	26+32	1496	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick), color changes in shotcrete (light-gray and dark-gray) suggest multiple applications or previous shotcrete repair work - Slight drip from E-sprinkle at Sta.13+60; - Both ditches are silted up and muddy again starting at around Sta. 26+00												
26+32	26+76	44	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (~ 6'-15'-wide area) associated with rock fall, shotcrete fragments and small rock fragments on ground					3168	29						
26+76	32+20	544	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
32+20	32+40	20	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete across tunnel crown (~ 20'-wide) associated with rock fall, shotcrete fragments and small rock fragments on ground					1440	13						
32+40	32+70	30	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
32+70	32+90	20	4-5	Shotcrete over Bedrock		N	-	Area with spalling shotcrete (8'x5' and 10'x4') in tunnel crown (< 1.0"-thick application), shotcrete fragments on ground, scattered small rock fragments on track at Sta.32+70					1440	13						
32+90	33+70	80	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
33+70	33+92	22	4-5	Shotcrete over Bedrock		N	-	Area with patches of spalling shotcrete in tunnel crown (0.5"-1.0"-thick application), shotcrete fragments on ground (no rock fragments) - track and ditches are very muddy and carry wood debris (condition continues to S-Portal)					1584	14						
33+92	35+62	170	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
35+62	35+90	28	4-5	Shotcrete over Bedrock		N	-	Patches of spalling shotcrete in tunnel crown (0.5"-1.0"-thick application), shotcrete fragments and scattered small rock fragments on ground					2016	18						
35+90	36+92	102	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
36+92	36+99	7	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (< 0.5"-thick application)					504	4						
36+99	37+93	96	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
37+93	38+26	33	4-5	Shotcrete over Bedrock		N	-	Patches of thin spalling shotcrete in tunnel crown					2376	22						
38+26	38+50	24	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete across tunnel crown (~ 20'-wide)					1728	16						
38+50	38+68	16	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in western half of tunnel crown (~ 10'-wide approx.)					1152	10						
38+68	38+84	16	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
38+84	39+21	37	4-5	Shotcrete over Bedrock		N	-	Two 5' to 10'-wide patches of thin spalling shotcrete in tunnel crown					2664	24						
39+21	39+28	7	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
39+28	39+33	5	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (5'x4')					360	3						
39+33	39+56	23	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
39+56	39+59	3	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (3'x2')					216	2						
39+59	39+97	38	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
39+97	40+02	5	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (5'x5')					360	3						
40+02	41+00	98	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick)												
41+00	41+07	7	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (7'x6')					504	4						
41+07	41+38	31	5	Shotcrete over Bedrock		N	-	Shotcrete applied over bedrock, shotcrete cover is thin in general (0.5" to 2.0"-thick) - 41+21 to 41+38: Seepage at springline along W-sidewall												
41+38	41+47	9	4-5	Shotcrete over Bedrock		N	-	Spalling shotcrete in tunnel crown (9'x4')					648	6						
41+47	42+02	55	5	Concrete		N	-	Concrete Barrel												

**TUNNEL 19**  
**Coos Bay Subdivision, Oregon**  
**MP 745.62 to 746.41**

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets		
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft²	cy	ft²	cy	ft.	No.	
42+02	42+02	0	5	Concrete		N	-	South Portal @ MP 746.41; Skin slides at the east side of the portal area occurred in the past and resulted in blocked drainage (muddy track and ditches inside the tunnel)												
Total Length (ft.):									Total:		0	0	0	0	21312	191	0	0	0	0
Repair Level 4-5 (ft.):		291																		
Repair Level 5 (ft.):		3911																		

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est.Total Steel Sets (No.):	0	(Est.Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est.Total Rockbolts (LF):	0	(Est.Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$0
Est.Total Concrete (cy):	0	(Est.Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est.Total Shotcrete (cy):	191	(Est.Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$171,900
Est.Total Timber Sets (No.):	0	(Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$0

Est. Sub Total for Repairs: \$171,900  
Mobilization (15%): \$25,785  
Contingency (20%): \$34,380

**Repair Level:**

- 1 Repairs should be completed immediately to <6 months
- 2 Repairs should be completed in 0 to 12 months
- 3 Repairs should be completed in 12 - 30 months
- 4 Repairs should be completed in 30 - 48 months
- 5 No immediate repairs required based on the current conditions

**TUNNEL 20**  
**Coos Bay Subdivision, Oregon**  
**MP 750.12 to 750.28**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rockbolts		Shotcrete		Concrete		Timber Sets		
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.	
0+00	0+00	0	5	Concrete Portal		N		North Portal @ MP 750.12												
0+00	0+54	54	5	Concrete Barrel		N		Generally dry to damp; - Thin crack with seepage on west sidewall at ~Sta.0+09; - Open crack (1/4"-wide) in east sidewall at ~Sta.0+25; - Scattered drips around Sta.0+42												
0+54	1+53	99	5	Shotcrete over Bedrock		N		Generally thin shotcrete cover, especially in crown; Shotcrete is not reinforced; No cracks observed; - Bedrock exposed in crown between Sta.1+43 and 1+53												
1+53	1+73	20	3	Shotcrete over Steel Sets	3.5	Y	6	Shotcreted steel sets to bridge overbreak/cave-in area (steel sets do not touch and support ground in crown); Caved-in section is 10'-15' high in crown; Loose bedrock material, originating from open ground behind shotcreted steel sets, piled up at the bottom of the east sidewall at each end of the section; Dry	Exposed bedrock in overbreak/caved-in area is actively deteriorating and falling out, no ground support established - steel sets only work as "canopy". Establish a bulkhead on both ends of the steel set section and backfill the void space with cementitious material. This may require the application of shotcrete and the construction of two additional steel sets at each end of the section.	8	2			576	8	672	124			
1+73	5+08	335	5	Shotcrete over Bedrock		N		Generally thin shotcrete cover, especially in crown; Shotcrete is not reinforced; Dry in general; - 9 rockbolts scattered in crown between Sta.1+75 - 1+85; - Spalled shotcrete in crown (2'x2') at Sta.2+19; - 5 rockbolts scattered in crown between Sta.2+23 and 2+29, drip above western springline; - Spalled shotcrete (2'x2') along west wall at Sta.2+46, 2+51, and 2+58; - Seepage in west wall at roughly ~Sta.2+70 (fault?); - Spalled shotcrete in crown (3' x 1') at Sta.4+11												
5+08	5+53	45	4-5	Shotcrete over Bedrock		N		Generally thin shotcrete cover, especially in crown; Shotcrete is not reinforced; Dry in general; - 5 to 7'-high overbreak area between Sta.5+08 and 5+38 across crown, shotcreted from Sta.5+08 to 5+24 with some spalling at Sta.5+10 (4'x4'), Sta.5+14 (3'x2'), Sta.5+21 (5'x2'), and Sta.5+22 (1'x3'), large spalling area with bedrock exposed between Sta.5+24 and 5+38; associated with scattered rock fall as indicated by debris on tunnel floor; - Spalling on east wall at Sta.5+37 (2'x2') and Sta.5+49 (4'x6'); - Spalled shotcrete in crown at Sta.5+48 (3'x3')	Due to relatively large size of areas with spalled shotcrete (in addition to occasional rockfalls evidently), it is recommended to repair and secure the area with a 2" (over existing shotcrete in sidewalls) to 4" (over exposed bedrock)-thick steel fiber reinforced shotcrete cover.					3240	30					
5+53	5+97	44	4	Shotcrete over Steel Sets	4' and 3'	Y	6	Shotcreted steel sets to bridge overbreak/cave-in area (steel sets do not touch and support ground in crown, locally); Overbreak is 3'-5' high in crown; No signs of instabilities or rock falls were observed; Section consists of 12 steel sets at 4'-spacing generally, last 3 sets at the south end of section at 3'-spacing	Establish a bulkhead on both ends of the steel set section and backfill the void space with cementitious material. This may require the application of shotcrete at each end of the section.					?	?	1056	117			
5+97	6+32	35	5	Shotcrete over Bedrock		N		Generally thin shotcrete over bedrock; Scattered small drip locations; Muddy track												
6+32	6+54	22	4-5	Shotcrete over Bedrock		N		Spalled shotcrete on east wall (8'x22')	Cover exposed bedrock in areas where shotcrete is spalling (including sidewalls: 2"-thick, spalled areas: 4"-thick)					1584	14					
6+54	7+14	60	5	Shotcrete over Bedrock		N		Generally thin shotcrete over bedrock; Dry; Muddy Track;												
7+14	7+26	12	4-5	Shotcrete over Bedrock		N		Spalled shotcrete in crown (12'x9')	Cover exposed bedrock in areas where shotcrete is spalling (including sidewalls: 2"-thick, spalled areas: 4"-thick)					864	8					
7+26	8+20	94	5	Shotcrete over Bedrock		N		Generally thin shotcrete over bedrock; spalled shotcrete in crown at Sta.7+62 (3'x4')												
8+20	8+74	54	5	Concrete Barrel		N		-Some scowering behind concrete barrel at contact at Sta.8+20; Drip zone in crown at Sta.8+41;	- Scowering behind concrete barrel at contact at Sta.8+20; Drip zone in crown at Sta.8+41;											
8+74	8+74	0	5	Concrete Portal		N		Seepage from crack in west sidewall at Sta.8+45	Seepage from crack in west sidewall at Sta.8+45											
Total Length (ft.):										874										
Repair Level 3 (ft.):										20										
Repair Level 4 (ft.):										44										
Repair Level 4-5 (ft.):										79										
Repair Level 5 (ft.):										731										
										Total:	8	2	0	0	6264	60	1728	241	0	0

Total Length (ft.):	874
Repair Level 3 (ft.):	20
Repair Level 4 (ft.):	44
Repair Level 4-5 (ft.):	79
Repair Level 5 (ft.):	731

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est. Total Steel Sets (No.):	2 (Est. Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$10,000
Est. Total Rockbolts (LF):	0 (Est. Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$0
Est. Total Concrete (cy):	241 (Est. Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$24,100
Est. Total Shotcrete (cy):	60 (Est. Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$54,000
Est. Total Timber Sets (No.):	0 (Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$0

Est. Sub Total for Repairs: \$88,100  
Mobilization (15%): \$13,215  
Contingency (20%): \$17,620  
**Est. Total of Construction Cost: \$118,935**

- Repair Level:
- 1 Repairs should be completed immediately to <6 months
  - 2 Repairs should be completed in 0 to 12 months
  - 3 Repairs should be completed in 12 - 30 months
  - 4 Repairs should be completed in 30 - 48 months
  - 5 No immediate repairs required based on the current conditions

**TUNNEL 21**  
**Coos Bay Subdivision, Oregon**  
**MP 751.21 to 751.30**

Shannon Wilson, Inc.

Station		Length, ft	Repair Level	Lining		Concrete Curb		Comments	Repairs	Steel Sets		Rock bolts		Shotcrete		Concrete		Timber Sets		
From	To			Type	Set Spacing, ft	Y/N	Height above TOR, in			ft	No.	Rows	LF	ft <sup>2</sup>	cy	ft <sup>2</sup>	cy	ft.	No.	
0+00	0+00	0	5	Concrete Portal		N		North Portal @ MP 751.21												
0+00	0+55	55	5	Concrete Barrel		N		In general dry; Thin crack across concrete barrel with some seepage at Sta. 0+10												
0+55	3+63	308	4-5	Shotcrete over Bedrock		N		Shotcrete cover generally in good condition; Shotcrete was applied after tunnel fire; Shotcrete is steel fiber reinforced; Exposed bedrock at bottom 3' 4' of sidewalls (weathered sandstone with scattered siltstone layers), bedrock debris and shotcrete rebound piled along both sidewalls; - 3 rock bolts in crown at Sta.0+70; - 4 rock bolts in crown east of center line at ~Sta.1+94; - Thin crack in crown, 4 rock bolts in crown at ~Sta.2+40	Extend 3"-thick shotcrete cover to the base of the sidewalls in order to prevent excessive weathering and deterioration of exposed sandstone which could result in undermining and spalling of the existing shotcrete application.					3696	34					
3+63	4+24	61	5	Shotcrete over Steel Sets	2.5	Y	6	Non-reinforced shotcrete over steel sets; Dry; - Wire mesh exposed at ~Sta.3+75; - Scattered spalling between Sta.3+93 and 4+24);												
4+24	4+78	54	5	Concrete Barrel		N		Dry in general; - Moist with some dripping at Sta.4+32												
4+78	4+78	0	5	Concrete Portal		N		South Portal @ MP 751.30												
Total Length (ft.):		478																		
Repair Level 4-5 (ft.):		308																		
Repair Level 5 (ft.):		170																		
										Total:	0	0	0	0	3696	34	0	0	0	0

Repair Level:

1	Repairs should be completed immediately to <6 months
2	Repairs should be completed in 0 to 12 months
3	Repairs should be completed in 12 - 30 months
4	Repairs should be completed in 30 - 48 months
5	No immediate repairs required based on the current conditions

**COST ESTIMATE FOR REPAIR LEVELS 1 TO 5:**

Est. Total Steel Sets (No.):	0 (Est. Unit Rates: \$5000/per set)	Est. Total Construction Costs:	\$0
Est. Total Rock bolts (LF):	0 (Est. Unit Rates: \$80/per LF)	Est. Total Construction Costs:	\$0
Est. Total Concrete (cy):	0 (Est. Unit Rates: \$100/per CY)	Est. Total Construction Costs:	\$0
Est. Total Shotcrete (cy):	34 (Est. Unit Rates: \$900/per CY)	Est. Total Construction Costs:	\$30,600
Est. Total Timber Sets (No.):	0 (Est. Removal Unit Rate: \$1500/per set)	Est. Total Removal Costs:	\$0

Est. Sub Total for Repairs: \$30,600  
Mobilization (15%): \$4,590  
Contingency (20%): \$6,120  
Est. Total of Construction Cost: \$41,310

**ESTIMATED CONSTRUCTION COST SUMMARY**  
**Tunnel Assessment - Coos Bay Subdivision, Oregon**

Shannon Wilson, Inc.

Tunnel #	Milepost @ N-Portal	Length (ft.)	Repair Level 1&2 (incl.2-3)						Repair Level 1 to 5					
			Steel Sets (No.)	Rockbolts (LF)	Shotcrete (cy)	Remove Timber Sets (No.)	Concrete (cy)	Est. Total Construction Cost	Steel Sets (No.)	Rockbolts (LF)	Shotcrete (cy)	Remove Timber Sets (No.)	Concrete (cy)	Est. Total Construction Cost
Tunnel 13	669.47	2,496	-	2,070	429	38	-	\$821,745	-	9126	1243	150	-	\$2,799,603
Tunnel 14	681.09	471	-	-	-	-	-	-	-	-	66	-	-	\$80,190
Tunnel 15	720.73	2,143	6	2,600	84	72	-	\$568,485	6	6746	408	224	-	\$1,568,538
Tunnel 16	721.52	633	-	-	-	-	-	-	-	-	-	-	-	-
Tunnel 17	727.70	1,200	-	-	-	-	-	-	-	480	38	14	-	\$126,360
Tunnel 18	734.48	1,580	-	6,075	462	125	-	\$1,470,555	-	7035	536	149	-	\$1,712,745
Tunnel 19	745.62	4,202	-	-	-	-	-	-	-	-	191	-	-	\$232,065
Tunnel 20	750.12	874	-	-	-	-	-	-	2	-	60	-	241	\$118,935
Tunnel 21	751.21	478	-	-	-	-	-	-	-	-	34	-	-	\$41,310
<b>Totals:</b>		<b>14,077</b>	<b>6</b>	<b>10,745</b>	<b>975</b>	<b>235</b>	<b>-</b>	<b>\$2,860,785</b>	<b>8</b>	<b>23387</b>	<b>2576</b>	<b>536</b>	<b>241</b>	<b>\$6,679,746</b>