

Joint Orientations Based on April 2009 Geologic Reconnaissance

Location	Dip Direction (degrees)	Dip (degrees)	Length (ft)	Spacing (ft)	Shape/Roughness	Aperture (inches)	Comments
On hillside above portal area, 150 ft downhill (west) of transmission tower 1 (J1)	289	46	40		planar/slightly rough	tight	
Same (J1)	298	69			planar/slightly rough	tight	
On hillside above portal area (J2)	222	82	10	3 to 4	planar/slightly rough	tight	
(J3)	295	78	8	<2 to 15	undulating/slightly rough	tight	
On hillside above portal area, half way between transmission towers 1 and 2 (J4)	48	57			planar/slightly rough	< 0.25	
Same (J4)	142	80	30	3 to 15	planar/slightly rough	<0.25	Major joint - forms rock face
Same (J4)	302	84	30	3 to 15	planar/slightly rough	<0.25	Major joint - forms rock face
On hillside above the portal area in the vicinity of transmission tower 2 (S1)	290	66			planar/slightly rough	tight	Possible shear
On hillside above the portal area in the vicinity of transmission tower 2 (J5)	281	56	50	10	irregular to planar/slightly rough	tight	
Same (J5)	303	86	10	3	slightly rough		Persistent face former
Same (J5)	301	84	12	3		2 to 6	Persistent face former - near vertical striations
Same (J5)	72	78	12	3	irregular/slightly rough	tight	
Same (J5)	294	78	20		planar/slightly rough	tight	

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Same (J5)	172	76	3		slightly rough	tight	
On hillside above portal area (J6)	288	76	8	3	planar/slightly rough	tight	
On hillside above portal area (J7)	282	52	100	10	planar/slightly rough	tight	Very persistent
Same (J7)	273	52	10		planar/slightly rough	tight	Very persistent
On hillside above portal area (J8)	125	86	5	9	planar/slightly rough	tight	Minor face
Same (J8)	46	88			slightly rough	tight	Minor face
On hillside above portal area (J9)	346	74	5	0.5 to 15	slightly rough	tight	
On hillside above Surge Tank	125	88	20 to 50	3 to 20	planar		
	212	75					In graben above B-2
	110	84			planar		250 ft above Surge Tank
	152	88	50	2 to 5	irregular		
Devil's Elbow Adit	309	38	30	0.1 to 4	planar/slightly rough	tight to 1	Parallel to valley - possible exfoliation joint
	248	66		2	undulating/smooth	tight	Portal
	10	90	10		undulating/slightly rough	0.5	Not common
	285	90	30	1 to 5	undulating/slightly rough	0.25	Portal
	310	74	3.5	0.5 to 0.6	planar/slightly rough	tight	220 to 225 ft inside of adit
	305	44		0.5 to 2	planar/slightly rough	tight	Slight alteration (bleaching) of rock in 10 ft wide zone located 614 ft inside of adit.
	133	78		4 to 15	planar	tight	1017 ft inside adit. Minor bleaching along joint surface.

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Location	Dip Direction (degrees)	Dip (degrees)	Length (ft)	Spacing (ft)	Shape/Roughness	Aperture (inches)	Comments
Outcrop along south side of canyon between 50 and 200 ft west of Gorge Dam	314	78	15	3 to 4	planar/slightly rough	tight	Very significant, face-forming joint
	314	76	15	3 to 4	planar/slightly rough	tight	
	60	75	10	>10	planar/slightly rough	tight	Not very prominent
	87	15	50	0.5 to 8	planar/slightly rough	tight	Joint surface shows 1 inch weathered zone
	310	70	>50	>2	planar/slightly rough		Major face-forming joint
	330	70	>30	10	Planar/rough	tight	
Large rock face adjacent to south abutment of Gorge Dam access bridge	220	86	>50				Possible fault
	41	86	>50	1 to 4	undulating/rough	narrow to moderately wide	Forms face of outcrop. Possible fault
	103	20	20	0.5 to 3	planar/slightly rough	narrow	
	121	87	30	0.6 to 5	rough	narrow	
	303	53	12	1 to 10	undulating/very rough	18	Exfoliation surface
	139	70	20	4	irregular/slightly rough	1	Possible exfoliation surface

NOTE: *J1, J2*, etc. = joint sets composed of roughly parallel-trending similar joints.

Foliation Orientations Based on April 2009 Geologic Reconnaissance

Location	Dip Direction (degrees)	Dip (degrees)	Remarks
On hillside above portal area 150 feet west of transmission tower 1 (J1)	175	34	Forms upper surface of rock outcrops in area
Same (J1)	176	20	Same
On hillside above portal area near transmission tower 2 (J5)	112	15	
On hillside above portal area near transmission towers	714	40	Forms foliation joint
Same	190	42	Forms foliation joint
Devil's Elbow Adit	115	20	312 ft inside adit
	204	44	493 ft inside adit
	52	61	About 740 ft inside adit

NOTE: J1, J2, etc. = Near the vicinity of joint sets (noted in Joints table).

Devil's Elbow Adit Fracture Zone, Fault, and Dike Orientations Based on April 2009 Geologic Reconnaissance

Feature	Location (footage inside of adit)	Dip Direction (degrees)	Dip (degrees)	Remarks
Fault	258 to 262	312	83	4 in to 1.2 ft wide, joint spacing in fault is 1 inch to 6 inches, planar, iron-oxide stained, 2 inch intensely weathered zone in center, wet but not seeping, no rockfall.
Minor fracture	337	350	75	0.5 gpm seepage
Fracture zone	432 to 436	20	66	joint spacing 0.3 to 3, planar feature, sight, slightly iron-oxide stained, seepage, no rockfall.
Fault	551 to 575	~180	72 to 81	N-S strike, 8 to 10 ft wide, joint spacing <1 inch to 5 ft, anastomosing joints, 1 ft of gouge with calcite (remineralized), iron-oxide stained, drag features, fresh to intensely weathered gouge, slight drip, 6 inch wide zone of caving in crown, no other rockfall.
Minor fracture	581 to 582	291	76	4 inch wide, slightly weathered, iron-oxide stained zone located 581 to 582 ft inside adit. Planar, slightly rough, tight, with significant rockfall.
Fault	720 to 729	307	79	1 to 2 ft wide fault zone. Fracture spacing 0.25 to 4 inches, planar/slightly rough failure plane, tight, 0.5 inch gouge, no rockfall, no seepage.
Fracture zone	754 to 767	288	75	2 inch to 2 ft wide, slightly to moderately weathered zone with joint spacing of 2 to 8 inches, planar/slightly rough, tight, iron-stained joints. 0.1 to 0.4 ft wide gouge zone with intensely weathered rock, 1 to 2 gpm seepage, and very minor rockfall
Fault	823 to 838	290	46	6 ft wide planar/slightly rough fault zone with joint spacing of <2 inches. Fault zone is tight, iron-oxide stained, and slightly to intensely weathered, with significant rockfall and significant seepage (3 gpm). 1 ft wide cavity in crown.
Fracture zone or minor fault with little offset	958 to 961	115	74	0.5 to 2.1 ft wide zone with joints spaced 1 inch to 1 ft apart within zone. 0.25 to 2 inch wide gouge zone, wet but not dripping, no rockfall.
Dike	972 to 977	300	55	Possibly andesite or diabase, fresh rock, appears to be some offset visible in tunnel sidewalls.
Fracture zone	1067	293	78	Joint spacing 2 to 4 feet within zone
Fracture zone	1078 to 1084	290	54	9 inch wide bleached zone with < 4 inch joint spacing and possible minor offset. No seeps. Rockfall consists of two 3 ft by 0.5 ft slabs.