Lake Powell Pipeline Project
FERC Additional Information Request Schedule B – Item 11

Exhibit E
Geology and Soils

11. In response to our comments on the PLP, you revised the description of the South Alternative in sections 5.3.1.1.9 and 5.3.1.2.2.7 of exhibit E to state that all excavated rock would be used for the proposed project and assume 75 percent of the rock would be of suitable quality for pipe bedding, backfill and road construction. In section 5.3.1.2.4.7, you make a similar assumption for the existing highway alternative where substantial excavated rock would represent 51.5 percent of bedding needs. By making this assumption, little or no aggregate import would be required.

However, our review of the new rock strength information provided in table 3-2 of Final Study Report 4, *Geology and Soil Resources*, indicates that few rock types along the alignment may meet regional standards for hardness and would be acceptable to use as bedding or road construction materials once crushed into aggregate. In your response to our comment 20 on the PLP, you state quantification of the rock quality along the alignment is not yet possible. In order to complete our analysis of the potential need for and effects of importing aggregate for proposed project bedding and road construction, we need information for two scenarios—one with 50 percent of the rock excavated being usable and 50 percent being imported and the other with 25 percent being usable and 75 percent being imported. Please provide revised quantities and source locations of aggregate materials from commercial sources under all alternatives for the two scenarios described above.

UBWR Response:

It is important to note that Table 3-2 of Final Study Report 4, *Geology and Soil Resources* (Table 3-2) only presents the probable geologic material at discrete locations along the alignment and does not attempt to identify or characterize the geology between the stations identified. The material quantities presented in Exhibit E and Final Study Report 4 *Geology and Soil Resources* were determined from data including published USGS geologic mapping of each alignment and field reconnaissance of surface geology along each alignment by professional geologists. Tables 2-1, 2-2 and 2-3 provide the types and lengths of trench construction which would most likely be used along the alternative pipeline alignments and the estimated material quantities generated during construction of the LPP project, based upon the likely trench sections and lengths of different pressure classes of steel pipe as a result of the pipeline hydraulics.

Tables 2-1, 2-2 and 2-3 identify by alignment stationing (to the extent possible) the most likely geological strata under the identified alignments based upon observations and interpretations made during geological pedestrian surveys as well as reviewing geological maps prepared by USGS. Tables 2-1, 2-2 and 2-3 for the Proposed Action, Existing Highway Alternative, and Southeast Corner Alternative alignments, respectively, show the assumed condition that 75 percent of the blasted material would be suitable for use as pipe bedding. Please note that for

Table 2-1
Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 75% of Blasted Rock Useable as Bedding:

	Volumes per Lineal Foot of Trench											
	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF of Trench ---->	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF of Trench ---->	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-1
Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT : Assumes 75% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H / MH	7,250-14,500 / 1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[c]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	**83,950**						**TOTALS**	**129,180**	**0**	**623,729**	**110,019**	**0**	**558,004**	**44,571**	**0**	**216,152**	**65,448**	**0**	**341,852**

NOTE:
[a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 SOUTH:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2985+00	500	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	4,798	-	-	4,292	-	-	1,663	-	-	2,630
2985+00	3015+00	3000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
3015+00	3183+50	16850	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	161,690	-	-	144,652	-	-	56,033	-	-	88,619
3183+50	3214+50	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
3214+50	3222+00	750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	7,197	-	-	6,439	-	-	2,494	-	-	3,944
3222+00	3323+50	10150	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	97,398	-	-	87,135	-	-	33,753	-	-	53,381
3323+50	3420+00	9650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	92,600	-	-	82,842	-	-	32,090	-	-	50,752
3420+00	3510+00	9000	1	Blasting	hard Moenkopi formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	61,352	-	-	52,252	-	-	21,168	-	-	31,083	-	-
3510+00	3518+50	850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	6,409	-	-	5,550	-	-	2,024	-	-	3,526	-
3518+50	3538+50	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
3538+50	3540+00	150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,131	-	-	979	-	-	357	-	-	622	-
3540+00	3558+00	1800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	12,270	-	-	10,450	-	-	4,234	-	-	6,217	-	-
3558+00	3558+50	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
3558+50	3568+00	950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	6,476	-	-	5,515	-	-	2,234	-	-	3,281	-	-
3568+00	3717+00	14900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	101,572	-	-	86,506	-	-	35,045	-	-	51,460	-	-
3717+00	3722+50	550	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
3722+50	3861+00	13850	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	94,414	-	-	80,410	-	-	32,576	-	-	47,834	-	-
3861+00	3867+00	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3867+00	3879+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
3879+00	4100+00	22100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	150,653	-	-	128,307	-	-	51,980	-	-	76,327	-	-
4100+00	4164+00	6400	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	43,628	-	-	37,157	-	-	15,053	-	-	22,104	-	-
4164+00	4231+50	6750	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
4231+50	4244+50	1300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
4244+50	4247+00	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4247+00	4255+00	800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	5,454	-	-	4,645	-	-	1,882	-	-	2,763	-	-
4255+00	4257+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4257+50	4259+50	200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,363	-	-	1,161	-	-	470	-	-	691	-	-
4259+50	4262+50	300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	2,045	-	-	1,742	-	-	706	-	-	1,036	-	-
4262+50	4267+00	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4267+00	4269+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4269+50	4303+00	3350	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	22,837	-	-	19,449	-	-	7,879	-	-	11,570	-	-
4303+00	4412+00	10900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	74,304	-	-	63,283	-	-	25,637	-	-	37,645	-	-
4412+00	4414+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4414+50	4431+00	1650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	11,248	-	-	9,579	-	-	3,881	-	-	5,699	-	-
4431+00	4437+50	650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
4437+50	4585+00	14750	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	100,549	-	-	85,635	-	-	34,693	-	-	50,942	-	-
4585+00	4604+00	1900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	12,952	-	-	11,031	-	-	4,469	-	-	6,562	-	-
4604+00	4608+50	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4608+50	4768+00	15950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	108,730	-	-	92,602	-	-	37,515	-	-	55,087	-	-
4768+00	4780+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
4780+00	4932+00	15200	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	114,612	-	-	99,243	-	-	36,191	-	-	63,052	-
4932+00	5054+00	12200	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	91,991	-	-	79,655	-	-	29,048	-	-	50,607	-
5054+00	5132+50	7850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	59,191	-	-	51,254	-	-	18,691	-	-	32,563	-
5132+50	5136+50	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
5136+50	5137+00	50	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	377	-	-	326	-	-	119	-	-	207	-
5137+00	5150+00	1300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	9,802	-	-	8,488	-	-	3,095	-	-	5,393	-
5150+00	5166+50	1650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	11,248	-	-	9,579	-	-	3,881	-	-	5,699	-	-
5166+50	5172+00	550	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
5172+00	5178+50	650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
5178+50	5182+00	350	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	2,386	-	-	2,032	-	-	823	-	-	1,209	-	-
5182+00	5187+00	500	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	3,408	-	-	2,903	-	-	1,176	-	-	1,727	-	-
5187+00	5200+00	1300	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
5200+00	5270+00	7000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	52,782	-	-	45,704	-	-	16,667	-	-	29,037	-
5270+00	5655+00	38500	3	> 15' - Excavatable	deep alluvium / eolian soils	soil	-	-	-	-	369,440	-	-	330,510	-	-	128,029	-	-	202,481
	Total	**289,500**						**TOTALS**	**961,183**	**354,393**	**973,977**	**818,610**	**306,869**	**871,345**	**331,638**	**111,906**	**337,530**	**486,972**	**194,963**	**533,815**

Table 2-1
Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 75% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5 - HS-2 SOUTH TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5655+00	5880+00	22500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	215,906	-	-	193,155	-	-	74,822	-	-	118,333
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Sinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	**143,500**						**TOTALS**	**262,451**	**49,012**	**945,190**	**223,521**	**42,439**	**845,591**	**90,554**	**15,476**	**327,554**	**132,968**	**26,963**	**518,037**

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-		4,762	-	-	8,296	-
70+00	105+00	3500	1	1000	basalt	basalt	H / MH	7,250-14,500 / 1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-	-	20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H / MH	7,250-14,500 / 1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	**24,000**						**TOTALS**	**30,676**	**109,334**	**0**	**26,126**	**94,672**	**0**	**10,584**	**34,524**	**0**	**15,542**	**60,148**	**0**

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.

Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.

Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).

Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTALS (ALL SEGMENTS)	**1,666,732**	**806,810**	**3,612,831**	**1,419,505**	**698,616**	**3,232,132**	**575,074**	**254,765**	**1,252,021**	**844,431**	**443,852**	**1,980,111**

Total - All Segments (ft):	**733,000**
Total - All Segments (mi):	**138.8**

TOTAL BEDDING + BACKFILL (CY):	**5,350,254**
TOTAL PIPE BEDDING (CY):	**2,081,860**
TOTAL BACKFILL (CY):	**3,268,394**

Total Volume of Material Excavated with no Expansion (CY):	**6,086,373**
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	**15,055**
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	**154,564**
Volume of Expanded Rock after Recompaction to 65% of In-situ Volume - See Note 2 (CY):	**2,861,380**
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-situ Volume - See Note 3 (CY):	**4,550,096**

Assumptions

75% of Blasted Rock is Usable as Pipe Bedding (CY):	**2,146,035**
100% of Soil/Ripped Rock is Usable for Backfill (CY):	**4,550,096**
25% of Blasted Rock is Usable for Non-bedding Purposes (Roads) (CY):	**715,345**
Minimum Volume of Road Construction Material Required (CY):	**9,778**
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	**705,567**

Surplus of Blasted Rock Suitable for Bedding (To Be Used for Backfill) (CY):	**64,175**

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

Volume of Backfill Required for Pipeline Construction (CY):	**3,268,394**
Volume of Soil and Ripped Rock Available for Backfill (CY):	**4,550,096**
Volume of Blasted Rock Available for Backfill (CY):	**769,742**
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	**2,051,444**
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	**153,600**
Total Volume of Excess Soil, Ripped Rock, and Blasted Rock to be Wasted (CY):	**1,897,844**

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	**2847**	**5.0**

Check Assumptions Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	**294,071**
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	**103,133**
Volume of Remaining 25% of Blasted Rock Resulting from Assumption that 75% of Blasted Rock is Suitable for Use as Bedding (CY):	**715,345**

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Table 2-2

Lake Powell Pipeline Project

Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 75% of Blasted Rock Useable as Bedding:

	Volumes Per Lineal Foot of Trench											
	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF of Trench -->	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF of Trench -->	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-2
Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 75% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H/MH	7,250-14,500/1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[b]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	**83,950**						**TOTALS**	**129,180**	**0**	**623,729**	**110,019**	**0**	**558,004**	**44,571**	**0**	**216,152**	**65,448**	**0**	**341,852**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 (HWY):

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2990+00	1000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
2990+00	3094+00	10400	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	99,797	-	-	89,281	-	-	34,584	-	-	54,696
3094+00	3248+50	15450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	148,256	-	-	132,633	-	-	51,378	-	-	81,256
3248+50	3336+50	8800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	84,443	-	-	75,545	-	-	29,264	-	-	46,281
3336+50	3514+50	17800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	170,806	-	-	152,807	-	-	59,193	-	-	93,615
3514+50	3602+50	8800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	84,443	-	-	75,545	-	-	29,264	-	-	46,281
3602+50	3650+00	4750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	45,580	-	-	40,777	-	-	15,796	-	-	24,981
3650+00	3684+00	3400	1	Blasting	Shinarump member-Chinle	conglomerate	H/MH	7,250-14,500/1,810-7,250	23,177	-	-	19,740	-	-	7,997	-	-	11,743	-	-
3684+00	3690+00	600	1	Blasting	Shinarump member-Chinle	conglomerate	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3690+00	3700+00	1000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
3700+00	3770+00	7000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
3770+00	3780+00	1000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
3780+00	3820+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
3820+00	3844+50	2450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,510	-	-	21,032	-	-	8,147	-	-	12,885
3844+50	3850+00	550	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	5,278	-	-	4,722	-	-	1,829	-	-	2,893
3850+00	3965+00	11500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
3965+00	4020+00	5500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	52,777	-	-	47,216	-	-	18,290	-	-	28,926
4020+00	4109+50	8950	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	85,883	-	-	76,833	-	-	29,763	-	-	47,070
4109+50	4130+00	2050	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,671	-	-	17,599	-	-	6,817	-	-	10,781
4130+00	4151+00	2100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	20,151	-	-	18,028	-	-	6,983	-	-	11,044
4151+00	4261+00	11000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	105,554	-	-	94,431	-	-	36,580	-	-	57,852
4261+00	4270+00	900	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	8,636	-	-	7,726	-	-	2,993	-	-	4,733
4270+00	4310+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
4310+00	4338+00	2800	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	26,868	-	-	24,037	-	-	9,311	-	-	14,726
4338+00	4355+00	1700	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
4355+00	4405+00	5000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
4405+00	4420+00	1500	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	14,394	-	-	12,877	-	-	4,988	-	-	7,889
4420+00	4460+00	4000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
4460+00	4495+00	3500	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	33,585	-	-	30,046	-	-	11,639	-	-	18,407
4495+00	4518+00	2300	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	22,070	-	-	19,745	-	-	7,648	-	-	12,096
4518+00	4540+00	2200	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	21,111	-	-	18,886	-	-	7,316	-	-	11,570
4540+00	4590+00	5000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
4590+00	4607+50	1750	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	16,793	-	-	15,023	-	-	5,819	-	-	9,204
4607+50	4670+50	6300	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	60,454	-	-	54,083	-	-	20,950	-	-	33,133
4670+50	4685+00	1450	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	13,914	-	-	12,448	-	-	4,822	-	-	7,626
4685+00	4708+50	2350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	22,550	-	-	20,174	-	-	7,815	-	-	12,359
4708+50	4795+00	8650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	83,004	-	-	74,257	-	-	28,765	-	-	45,493
4795+00	4808+00	1300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
4808+00	4855+50	4750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	45,580	-	-	40,777	-	-	15,796	-	-	24,981
4855+50	5069+00	21350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	204,871	-	-	183,283	-	-	70,998	-	-	112,285
5069+00	5100+00	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
5100+00	5148+00	4800	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	46,060	-	-	41,206	-	-	15,962	-	-	25,244
5148+00	5171+00	2300	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	22,070	-	-	19,745	-	-	7,648	-	-	12,096
5171+00	5180+00	900	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	8,636	-	-	7,726	-	-	2,993	-	-	4,733
5180+00	5182+50	250	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
5182+50	5202+00	1950	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	18,712	-	-	16,740	-	-	6,485	-	-	10,256
	Total	**244,200**						**TOTALS**	**27,268**	**0**	**2,304,919**	**23,223**	**0**	**2,062,040**	**9,408**	**0**	**798,766**	**13,815**	**0**	**1,263,274**

NOTE: 2760+00 = Start at HS-1
2990+00 = Junc w/ Start of S. Alignment
5202+00 = End at HS-2(Hwy)

Table 2-2
Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 75% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5- HS-2 (HWY) TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5202+00	5265+00	6300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	60,454	-	-	54,083	-	-	20,950	-	-	33,133
5700+00	5880+00	18000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	172,725	-	-	154,524	-	-	59,858	-	-	94,667
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	145,300						TOTALS	262,451	49,012	962,462	223,521	42,439	861,044	90,554	15,476	333,540	132,968	26,963	527,504

NOTE: 5202+00 = Start at HS-2 (Hwy) using Hwy Alignment Stationing from HGL
5700+00 = Start at intersection of S. and Hwy Alignments, using current S. Alignment Stationing

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
70+00	105+00	3500	1	Blasting	basalt	basalt	H/MH	7,250-14,500/1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-	-	20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	24,000						TOTALS	30,676	109,334	0	26,126	94,672	0	10,584	34,524	0	15,542	60,148	0

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.
Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft of native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.
Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).
Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTAL - ALL SEGMENTS	732,817	452,417	4,961,046	624,118	391,748	4,438,280	252,845	142,859	1,719,243	371,273	248,889	2,719,037

Total - All Segments (ft):	689,500
Total - All Segments (mi):	130.6

TOTAL BEDDING + BACKFILL (CY):	5,454,145

TOTAL PIPE BEDDING (CY):	2,114,946

TOTAL BACKFILL (CY):	3,339,199

Total Volume of Material Excavated with no Expansion (CY):	6,146,279
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	15,055
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	154,564
Volume of Expanded Rock after Recompaction to 65% of In-Situ Volume - See Note 2 (CY):	1,432,666
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-Situ Voume - See Note 3 (CY):	5,780,131

Volume of Backfill Required for Pipeline Construction (CY):	3,339,199
Volume of Soil and Ripped Rock Available for Backfill (CY):	5,780,131
Volume of Blasted Rock Available for Backfill (CY):	349,647
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	2,790,579
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	153,600
Total Volume of Excess Soil, Ripped Rock and Blasted Rock to be Wasted (CY):	2,636,979

Assumptions

75% of Blasted Rock is Usable as Pipe Bedding (CY):	1,074,499
100% of Soil/Ripped Rock is Usable for Backfill (CY):	5,780,131
25% of Rock is Usable for Non-bedding Purposes (Roads) (CY):	358,166
Minimum Volume of Road Construction Material Required (CY):	8,519
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	349,647

Additional Material Needed for Pipe Bedding (CY):	1,040,447

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	2724	7.2

Check Assumption Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	294,071
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	103,133
Volume of Remaining 25% of Blasted Rock Resulting from Assumption that 75% of Blasted Rock is Suitable for Use as Bedding (CY):	358,166

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Table 2-3
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 75% of Blasted Rock Useable as Bedding:

	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF Trench	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF Trench	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-3
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 75% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H/MH	7,250-14,500/1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[b]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	**83,950**						**TOTALS**	**129,180**	**0**	**623,729**	**110,019**	**0**	**558,004**	**44,571**	**0**	**216,152**	**65,448**	**0**	**341,852**

NOTE:
[a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 SOUTH:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2985+00	500	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	4,798	-	-	4,292	-	-	1,663	-	-	2,630
2985+00	3015+00	3000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
3015+00	3183+50	16850	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	161,690	-	-	144,652	-	-	56,033	-	-	88,619
3183+50	3214+50	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
3214+50	3222+00	750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	7,197	-	-	6,439	-	-	2,494	-	-	3,944
3222+00	3323+50	10150	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	97,398	-	-	87,135	-	-	33,753	-	-	53,381
3323+50	3420+00	9650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	92,600	-	-	82,842	-	-	32,090	-	-	50,752
3420+00	3510+00	9000	1	Blasting	hard Moenkopi formation	sandstone	H/MH	7,250-14,500/1,810-7,250	61,352	-	-	52,252	-	-	21,168	-	-	31,083	-	-
3510+00	3518+50	850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	6,409	-	-	5,550	-	-	2,024	-	-	3,526	-
3518+50	3538+50	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
3538+50	3540+00	150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,131	-	-	979	-	-	357	-	-	622	-
3540+00	3558+00	1800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	12,270	-	-	10,450	-	-	4,234	-	-	6,217	-	-
3558+00	3558+50	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
3558+50	3568+00	950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	6,476	-	-	5,515	-	-	2,234	-	-	3,281	-	-
3568+00	3717+00	14900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	101,572	-	-	86,506	-	-	35,045	-	-	51,460	-	-
3717+00	3722+50	550	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
3722+50	3861+00	13850	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	94,414	-	-	80,410	-	-	32,576	-	-	47,834	-	-
3861+00	3867+00	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3867+00	3879+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
3879+00	4045+00	16600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	113,161	-	-	96,375	-	-	39,044	-	-	57,331	-	-
4045+00	4076+00	3100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	21,132	-	-	17,998	-	-	7,291	-	-	10,706	-	-
4076+00	4167+00	9100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	62,034	-	-	52,832	-	-	21,404	-	-	31,429	-	-
4167+00	4200+50	3350	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	22,837	-	-	19,449	-	-	7,879	-	-	11,570	-	-
4200+50	4230+50	3000	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
4230+50	4262+00	3150	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	21,473	-	-	18,288	-	-	7,409	-	-	10,879	-	-
4262+00	4332+50	7050	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	48,059	-	-	40,931	-	-	16,582	-	-	24,349	-	-
4332+50	4334+00	150	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
4334+00	4356+00	2200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	14,997	-	-	12,773	-	-	5,174	-	-	7,598	-	-
4356+00	4358+00	200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,363	-	-	1,161	-	-	470	-	-	691	-	-
4358+00	4362+50	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4362+50	4363+00	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
4363+00	4375+50	1250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,521	-	-	7,257	-	-	2,940	-	-	4,317	-	-
4375+50	4382+00	650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
4382+00	4456+00	7400	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	50,445	-	-	42,963	-	-	17,405	-	-	25,557	-	-
4456+00	4458+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4458+50	4503+50	4500	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	30,676	-	-	26,126	-	-	10,584	-	-	15,542	-	-
4503+50	4513+50	1000	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
4513+50	4526+50	1300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
4526+50	4547+50	2100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	14,315	-	-	12,192	-	-	4,939	-	-	7,253	-	-
4547+50	4553+50	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
4553+50	4690+00	13650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	93,051	-	-	79,248	-	-	32,105	-	-	47,143	-	-
4690+00	4725+50	3550	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	26,768	-	-	23,178	-	-	8,452	-	-	14,726	-
4725+50	4882+50	15700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	118,382	-	-	102,507	-	-	37,381	-	-	65,126	-
4882+50	5004+00	12150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	91,614	-	-	79,329	-	-	28,929	-	-	50,400	-
5004+00	5060+00	5600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	42,226	-	-	36,563	-	-	13,333	-	-	23,230	-
5060+00	5086+50	2650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	18,065	-	-	15,385	-	-	6,233	-	-	9,152	-	-
5086+50	5110+00	2350	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	16,020	-	-	13,644	-	-	5,527	-	-	8,116	-	-
5110+00	5132+50	2250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock			-	16,966	-	-	14,691	-	-	5,357	-	-	9,333	-
5132+50	5180+00	4750	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock			-	35,816	-	-	31,013	-	-	11,310	-	-	19,704	-
5180+00	5565+00	38500	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	369,440	-	-	330,510	-	-	128,029	-	-	202,481
	Total	**280,601**						**TOTALS**	**899,831**	**354,393**	**973,977**	**766,358**	**306,869**	**871,345**	**310,470**	**111,906**	**337,530**	**455,889**	**194,963**	**533,815**

NOTE:
4045+00 = Start of SE Corner using HGL stationing
4262+00 = End of SE Corner on HGL stationing, also equals station 4352+00 on the standard South Alignment; refer to Segment 4 Station Equation Table at bottom of sheet.
HS-2(South) is near station 5565+00 using the SE Corner Stationing in the HGL and 5655+00 using the South Alignment stationing .

Table 2-3
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 75% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5 - HS-2 SOUTH TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5655+00	5880+00	22500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	215,906	-	-	193,155	-	-	74,822	-	-	118,333
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	143,500						TOTALS	262,451	49,012	945,190	223,521	42,439	845,591	90,554	15,476	327,554	132,968	26,963	518,037

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
70+00	105+00	3500	1	1000	basalt	basalt	H/MH	7,250-14,500/1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-	-	20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	24,000						TOTALS	30,676	109,334	0	26,126	94,672	0	10,584	34,524	0	15,542	60,148	0

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.
Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.
Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).
Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTAL - ALL SEGMENTS	1,605,380	806,810	3,612,831	1,367,253	698,616	3,232,132	553,906	254,765	1,252,021	813,347	443,852	1,980,111

Total - All Segments (ft):	724,101
Total - All Segments (mi):	137.1

TOTAL BEDDING + BACKFILL (CY):	5,298,002
TOTAL PIPE BEDDING (CY):	2,060,692
TOTAL BACKFILL (CY):	3,237,310

Total Volume of Material Excavated with no Expansion (CY):	6,025,020
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	15,055
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	154,564
Volume of Expanded Rock after Recompaction to 65% of In-situ Volume - See Note 2 (CY):	2,778,555
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-situ Volume - See Note 3 (CY):	4,550,096

Assumptions

75% of Blasted Rock is Usable as Pipe Bedding (CY):	2,083,916
100% of Soil/Ripped Rock is Usable as Backfill (CY):	4,550,096
25% of Blasted Rock is Usable for Non-bedding Purposes (Roads) (CY):	694,639
Minimum Volume of Road Construction Material Required (CY):	9,778
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	684,861

Surplus of Blasted Rock for Suitable for Bedding (To Be Used for Backfill) (CY):	23,224

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

Volume of Backfill Required for Pipeline Construction (CY):	3,237,310
Volume of Soil and Ripped Rock Available for Backfill (CY):	4,550,096
Volume of Blasted Rock Available for Backfill (CY):	708,085
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	2,020,871
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	153,600
Total Volume of Excess Soil, Ripped Rock, and Blasted Rock to be Wasted (CY):	1,867,271

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	2823	4.9

Check Assumption Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	294,071
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	103,133
Volume of Remaining 25% of Blasted Rock Resulting from Assumption that 75% of Blasted Rock is Suitable for Use as Bedding (CY):	694,639

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Segment 4 Station Equation Table:

Proposed Action Stationing versus Southeast Corner Alternative

Proposed Action Stationing		Southeast Corner Alt. Stationing	
From Station:	To Station:	From Station:	To Station:
4352+00	4422+50	4262+00	4332+50
4422+50	4424+00	4332+50	4334+00
4424+00	4446+00	4334+00	4356+00
4446+00	4448+00	4356+00	4358+00
4448+00	4452+50	4358+00	4362+50
4452+50	4453+00	4362+50	4363+00
4453+00	4465+50	4363+00	4375+50
4465+50	4472+00	4375+50	4382+00
4472+00	4546+00	4382+00	4456+00
4546+00	4548+50	4456+00	4458+50
4548+50	4593+50	4458+50	4503+50
4593+50	4603+50	4503+50	4513+50
4603+50	4616+50	4513+50	4526+50
4616+50	4637+50	4526+50	4547+50
4637+50	4643+50	4547+50	4553+50
4643+50	4780+00	4553+50	4690+00
4780+00	4815+50	4690+00	4725+50
4815+50	4972+50	4725+50	4882+50
4972+50	5094+00	4882+50	5004+00
5094+00	5150+00	5004+00	5060+00
5150+00	5176+50	5060+00	5086+50
5176+50	5200+00	5086+50	5110+00
5200+00	5222+50	5110+00	5132+50
5222+50	5270+00	5132+50	5180+00
5270+00	5655+00	5180+00	5565+00

clarity, the portions of Tables 2-1, 2-2 and 2-3 pertaining to steel pipe pressure classes are not shown.

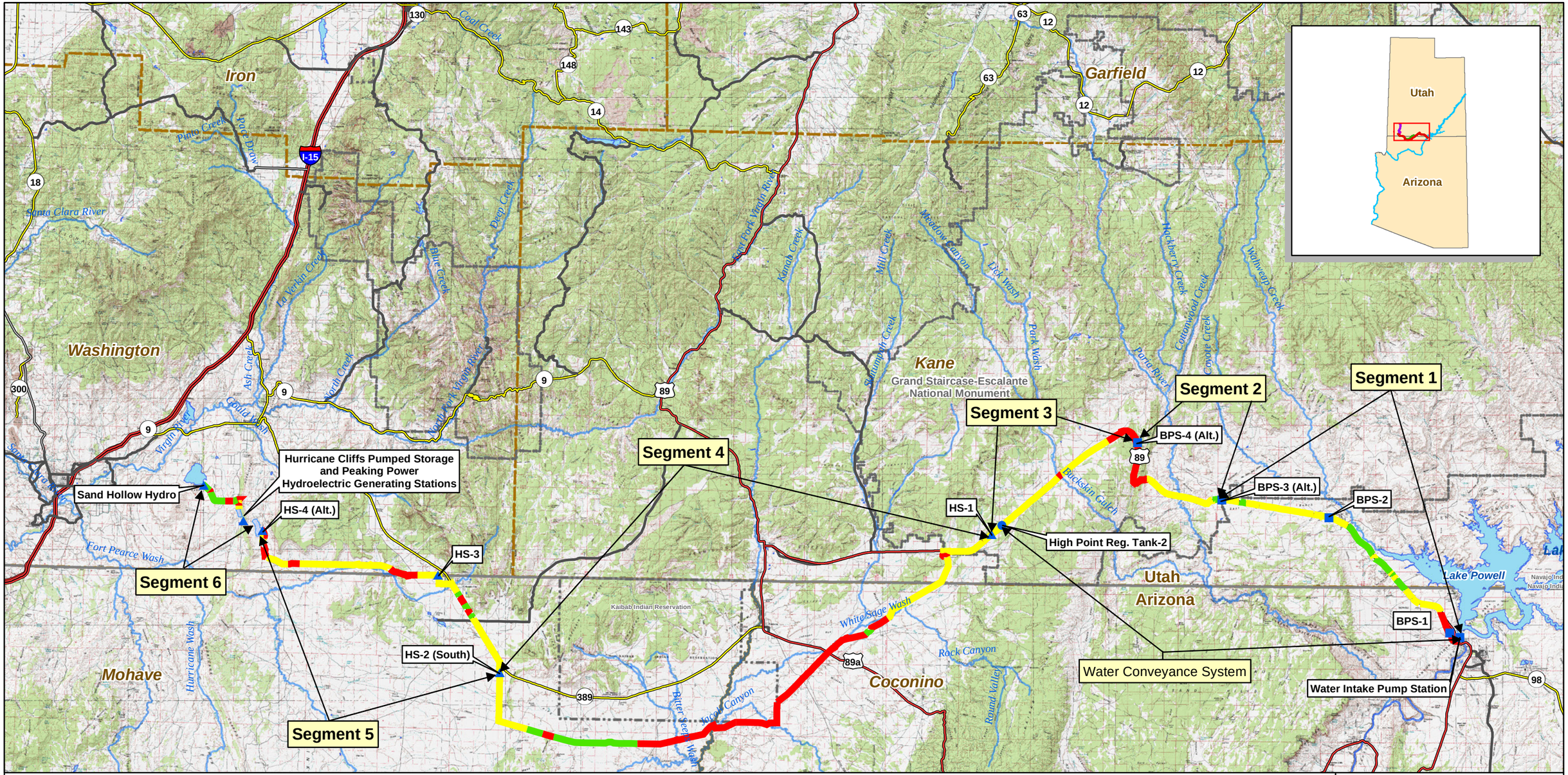
Each alignment – Proposed Action, Existing Highway Alternative, and Southeast Corner Alternative - was separated into six segments, which are identified in Figures 2-1, 2-2, and 2-3, respectively. Note that all of the segments are identical among the three alternative pipeline alignments except for Segment 4. Segment 4 is the portion of the LPP project where the three alternative alignments diverge from the common alignment on the eastern end of the segment and subsequently converge on the western end.

Based upon the earth material estimated to be present, three trench sections were identified as most likely to be used during construction to install the pipe. These three trench sections are shown in Figure 2-4 and consist of trenches resulting from blasting/excavation (blasting) only (Trench 1), a combination of blasting/excavation followed by ripping/excavating (excavation over blasted rock) (Trench 2), and ripping/excavation only (Trench 3).

Tables 2-1, 2-2 and 2-3 first show the volume per lineal foot of trench for the three possible trench sections using the dimensions shown on Figure 2-4. Note the relative volumes per lineal foot – 6.82, 7.54, and 9.6 cy/lf – for Trench 1, Trench 2, and Trench 3, respectively. This is why the Existing Highway Alternative generates the largest volume of material even though it is the shortest pipeline route. A larger percentage of the material which would be encountered along that alignment is excavatable with no blasting required and as such Trench 3 would be the prevalent trench section used to install the pipe for the Existing Highway Alternative.

The three different trench types are color coded on Tables 2-1, 2-2 and 2-3, and Figures 2-1, 2-2 and 2-3. Red shows portions of the alignment that would require blasting (Trench 1), green shows those portions which would require a combination of excavation over blasted rock (Trench 2), and yellow shows those portions that would only require ripping followed by excavation or excavation only (Trench 3). The column labeled “Excavatability” identifies for the particular portion of the alignment in terms of the type of trench that would most likely be used and thus determines formulas used to calculate the amount of blasting/ripping/excavation, pipe bedding, and backfill necessary to complete the work. Note that the portions of the alignment with the yellow color code have three different excavatability categories, ripping only, ripping/excavating, or excavating only. All three of these categories are assumed to have the same trench section (Trench 3) as shown on Figure 2-4. The “Description” column provides definition for the excavatability identified in the “Excavatability” column.

The “Comments” and “Lithology” columns are populated based upon observations made during the geologic pedestrian surveys which were completed in summer 2009 and spring 2010 as well as reviewing geological maps prepared by USGS. The “Hardness” column lists the hardness description of the lithology determined from the geologic pedestrian survey based upon the U.S. Bureau of Reclamation (Reclamation) Engineering Geology Field Manual (Reclamation 1998). The “Unconfined Compressive Strength” column lists the compressive strength corresponding to the hardness as per the Natural Resources Conservation Service (NRCS) National Engineering Handbook (NRCS 2012).



Project Pump Station
Project Regulating Tank
Project Hydro Station
Hurricane Cliffs Forebay/Afterbay
Lakes & Reservoirs
Major Rivers & Streams

Excavatability
Blasting
Mixed-Soil over Blasting
Excavatable; Mixed-Soil over Rippable; Rippable

Interstate
US Highway
ST Highway
Hwy
Major Road

National Park/Monument
GSENM-Boundary
Tribal Lands
State Boundaries
County Boundaries

FERC Project Number:
12966-001
BLM Serial Numbers:
AZA-34941
UTU-85472

0 2.5 5 10 15 20 Miles

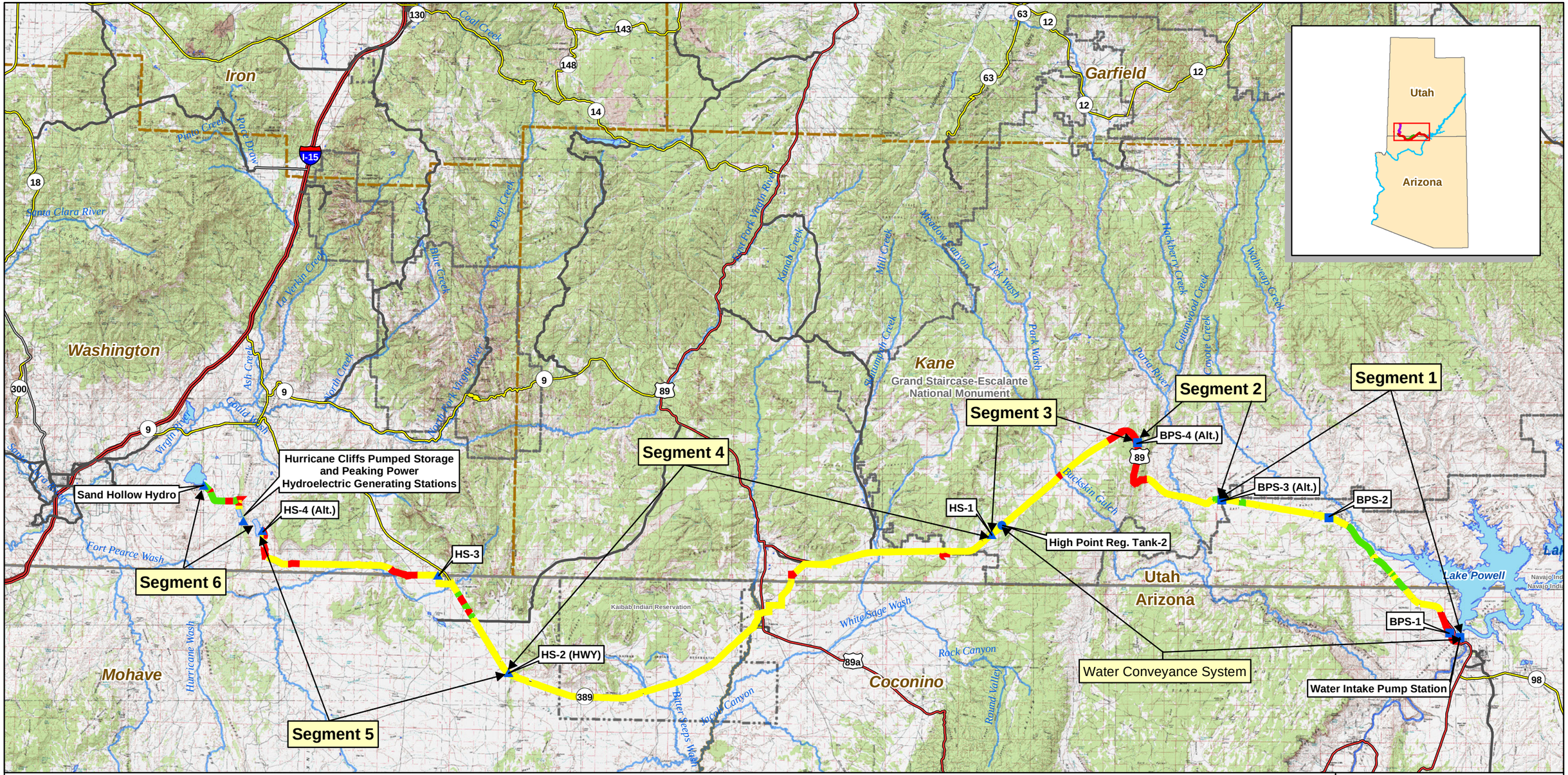
N

Lake Powell Pipeline Project

Spatial Reference: UTM Zone 12N, NAD-83

UDWRe **Figure 2-1** MWH

Segment Identification
Proposed Action Alignment
Excavatability



- Project Pump Station
- Project Regulating Tank
- Project Hydro Station
- Hurricane Cliffs Forebay/Afterbay
- Lakes & Reservoirs
- Major Rivers & Streams

Excavatability

- Blasting
- Mixed-Soil over Blasting
- Excavatable; Mixed-Soil over Rippable; Rippable

- Interstate
- US Highway
- ST Highway
- Hwy
- Major Road
- National Park/Monument
- GSENM-Boundary
- Tribal Lands
- State Boundaries
- County Boundaries

FERC Project Number:
12966-001
BLM Serial Numbers:
AZA-34941
UTU-85472

0 2.5 5 10 15 20 Miles

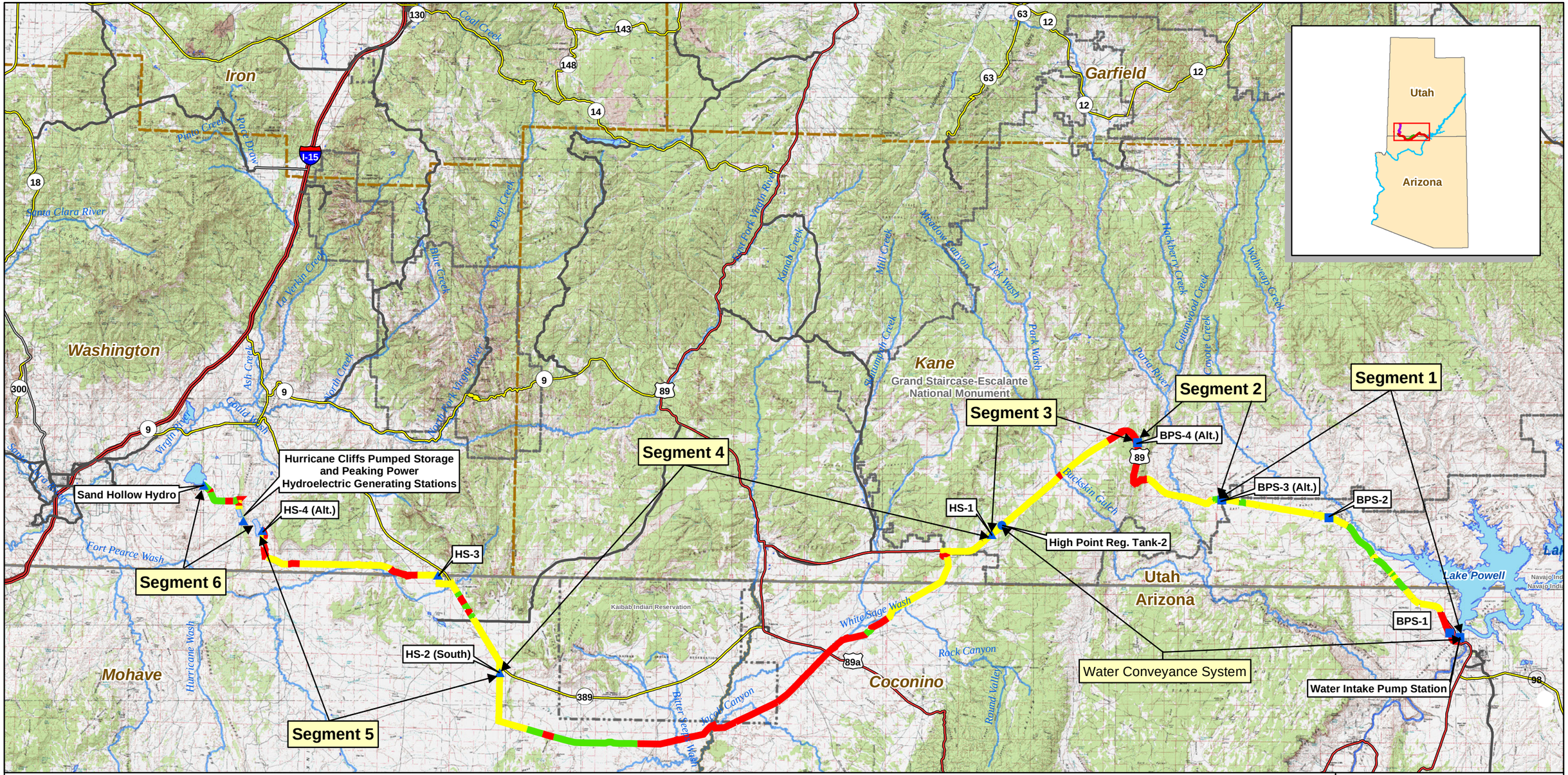
N

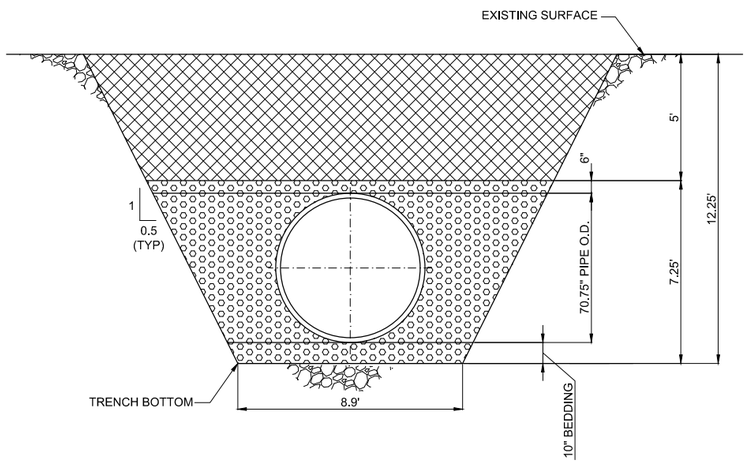
Lake Powell Pipeline Project

Spatial Reference: UTM Zone 12N, NAD-83

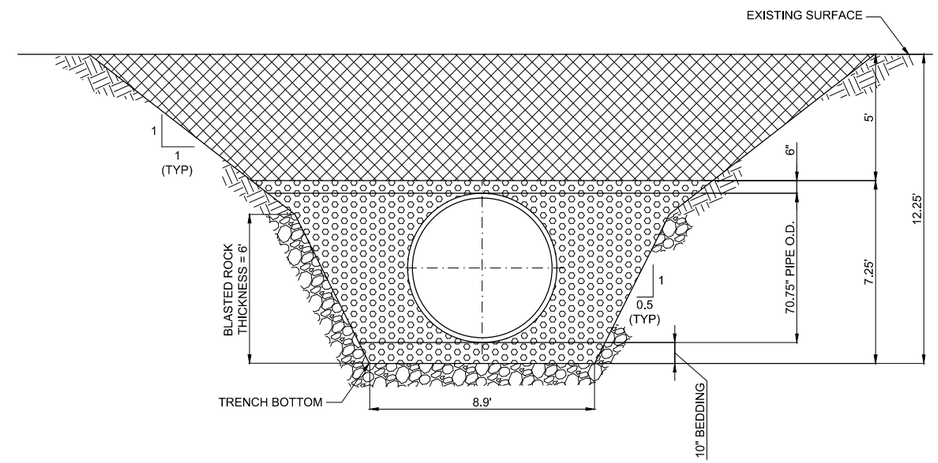
UDWRe **Figure 2-2** MWH

Segment Identification
Existing Highway Alternative
Excavatability

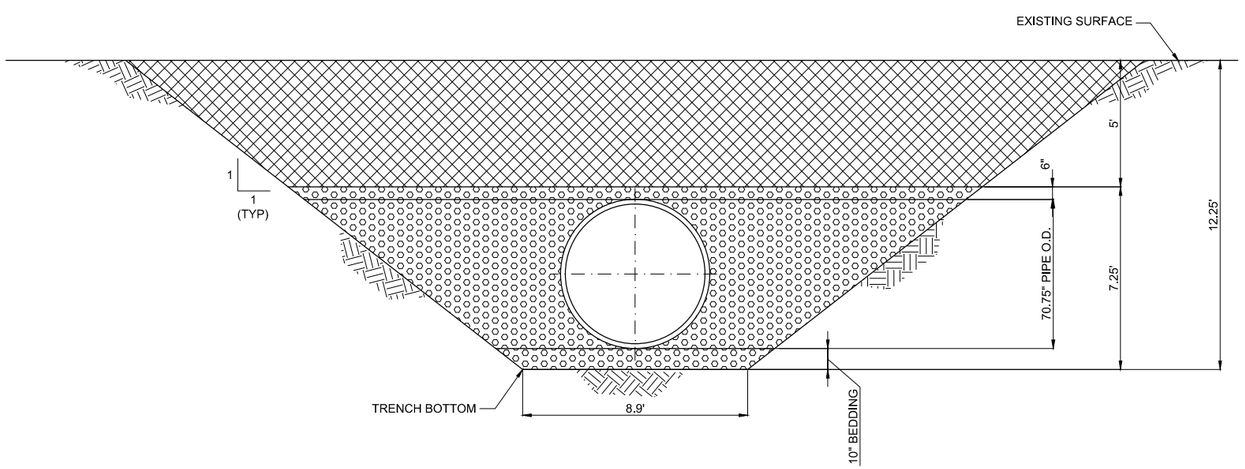

Iron
Garfield
Washington
Kane
Grand Staircase-Escalante National Monument
Mohave
Coconino
Utah
Arizona
Kaibab Indian Reservation
Lake Powell
Utah
Arizona
Segment 1
Segment 2
Segment 3
Segment 4
Segment 5
Segment 6
BPS-4 (Alt.)
BPS-3 (Alt.)
BPS-2
BPS-1
HS-1
High Point Reg. Tank-2
HS-4 (Alt.)
HS-3
HS-2 (South)
Sand Hollow Hydro
Hurricane Cliffs Pumped Storage and Peaking Power Hydroelectric Generating Stations
Water Conveyance System
Water Intake Pump Station
Project Pump Station
Project Regulating Tank
Project Hydro Station
Hurricane Cliffs Forebay/Afterbay
Lakes & Reservoirs
Major Rivers & Streams
Excavatability
Blasting
Mixed-Soil over Blasting
Excavatable; Mixed-Soil over Rippable; Rippable
Interstate
US Highway
ST Highway
Hwy
Major Road
National Park/Monument
GSENM-Boundary
Tribal Lands
State Boundaries
County Boundaries
FERC Project Number:
12966-001
BLM Serial Numbers:
AZA-34941
UTU-85472
0 2.5 5 10 15 20 Miles
N
Lake Powell Pipeline Project
Spatial Reference: UTM Zone 12N, NAD-83
UDWRe Figure 2-3 MWH
Segment Identification
Southeast Corner Alternative
Excavatability



TRENCH 1 - BLASTED ROCK



TRENCH 2 - SOIL OVER BLASTED ROCK



TRENCH 3 - SOIL AND / OR RIPPED ROCK

LEGEND:

- BACKFILL
- PIPE BEDDING
- ROCK
- EXCAVATABLE MATERIAL

0 3 6
SCALE IN FEET

UTAH DIVISION OF WATER RESOURCES
LAKE POWELL PIPELINE PROJECT

UDWRe MWH.

FIGURE 2-4

TYPICAL TRENCH SECTIONS
EXCAVATION QUANTITY CALCULATIONS

At the bottom of the third page of each table (Table 2-1; Table 2-2; and Table 2-3) are summaries of quantities calculated for each trench type and material type. The quantities of blasted rock used to determine the amount of blasted rock usable for bedding (assumed to be 75 percent of the volume of blasted rock excavated) are the total for Trench 1, 0.351 of the total of Trench 2 (0.351 is the ratio of the area of blasted rock to the total trench cross sectional area for Trench 2), the volume of rock from the Lake Intake Tunnels and Shafts (calculated separately), and the rock generated from the Cockscomb cut (also calculated separately). It was assumed that the blasted rock would have an expansion factor of 35 percent (FHA 2007). The total volume of blasted rock as defined above including expansion for the Proposed Action is 2,861,380 cubic yards. From the total volume of blasted rock, a quantity was calculated for that portion (75 percent) of the rock assumed to be suitable for use as bedding and for that portion (25 percent) assumed to be unsuitable. For the purposes of this calculation no consideration was given to the hardness of the blasted rock, although rock was determined to require blasting based in part on field observations of hardness during the geologic pedestrian survey. Of particular relevance to FERC's Additional Information Request Item 11, it was determined that for the Proposed Action the volume of rock assumed to be unsuitable for use as bedding (25 percent of the volume of blasted rock excavated) would be approximately 715,345 cubic yards. This can be seen at the bottom row of the box in the summary area entitled "Check Assumptions Regarding Percent Suitability of Blasted Rock."

Next, consideration was given to the material hardness of the rock strata identified. It is assumed that "Hard" or "Moderately Hard" rock as defined by Reclamation would be suitable for blasting, unless it was located adjacent to a Trench 3 area or if information in Table 3-2 indicated it would not be suitable for use as pipe bedding. Hardness values are shown in Tables 2-1, 2-2 and 2-3 for Trench 1 and Trench 2 materials. Material classified as "Hard" by Reclamation has an unconfined compressive strength ranging from 7,250 psi to 14,500 psi (NRCS 2012). Material classified as "Moderately Hard" by Reclamation has as unconfined compressive strength ranging from 1,810 psi to 7,250 psi (NRCS 2012). It is assumed that Trench 1 materials would be suitable for bedding and that Trench 2 blasting materials would be suitable for bedding if it is either adjacent to a Trench 1 area or if Table 3-2 supported its inclusion. Of particular relevance to FERC's Additional Information Request Item 11 is the box in the summary area of Tables 2-1, 2-2 and 2-3 with the title "Check Assumptions Regarding Percent Suitability of Blasted Rock." Using the criteria defined above in this paragraph, the blasted rock for Segments 1 and 2 are deemed to be unsuitable for use as pipe bedding. The volume of blasted rock deemed unsuitable for use as pipe bedding based on hardness is approximately 103,133 cubic yards. This amounts to approximately 3.6 percent of the blasted rock being unsuitable for use as pipe bedding vs. the 25 percent figure used in Exhibit E. This demonstrates that the assumption in Exhibit E for the Proposed Action that 75 percent of the blasted rock would be suitable for use as pipe bedding and 25 percent would be unsuitable is conservative. Furthermore, the assumption that none of the rippable material or excavation only material would be suitable for use as pipe bedding also is conservative. Therefore, under the Proposed Action (Table 2-1), it is highly unlikely that there would be a need to import pipe bedding material from offsite sources.

Under the Existing Highway Alternative, Table 2-2 shows that assuming 75 percent of the blasted rock is suitable for use as pipe bedding, there is an insufficient quantity of blasted rock to

meet the LPP project needs for pipe bedding. Approximately 1,040,447 cubic yards of pipe bedding would need to be imported from offsite sources for the Existing Highway Alternative.

Under the Southeast Corner Alternative, Table 2-3 shows that assuming 75 percent of the blasted rock is suitable for use as pipe bedding, 694,639 cubic yards would be unsuitable for pipe bedding. Using the hardness criteria as described above results in 103,133 cubic yards of material being unsuitable. The percentage of blasted rock deemed unsuitable based on hardness criteria is 3.7 percent of the blasted rock volume. Under this scenario as well the assumption that 75 percent of the blasted rock is suitable for use as pipe bedding is conservative. Again, the assumption that none of the rippable material or excavation-only material would be suitable for use as pipe bedding also is conservative. Therefore, under the Southeast Corner Alternative it is highly unlikely that there would be a need to import pipe bedding material from offsite sources.

As requested in Additional Information Request Item 11, Tables 2-4, 2-5 and 2-6 show material volumes under the Proposed Action, Existing Highway Alternative, and Southeast Corner Alternative, respectively, assuming 50 percent of the blasted rock would be suitable for use as pipe bedding. Tables 2-7, 2-8 and 2-9 show material volumes under the Proposed Action, Existing Highway Alternative, and Southeast Corner Alternative, respectively, assuming 25 percent of the blasted rock would be suitable for use as pipe bedding. Tables 2-10, 2-11, and 2-12 summarize the volume of pipe bedding material that would need to be imported for the three alignment alternatives assuming 75 percent, 50 percent, and 25 percent of the blasted rock would be suitable for use as pipe bedding, respectively.

Table 2-4

Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 50% of Blasted Rock Useable as Bedding:

Volumes per Lineal Foot of Trench												
	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF of Trench ---->	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF of Trench ---->	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-4

Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 50% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H / MH	7,250-14,500 / 1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[c]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	**83,950**						**TOTALS**	**129,180**	**0**	**623,729**	**110,019**	**0**	**558,004**	**44,571**	**0**	**216,152**	**65,448**	**0**	**341,852**

NOTE:
[a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 SOUTH:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2985+00	500	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	4,798	-	-	4,292	-	-	1,663	-	-	2,630
2985+00	3015+00	3000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
3015+00	3183+50	16850	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	161,690	-	-	144,652	-	-	56,033	-	-	88,619
3183+50	3214+50	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
3214+50	3222+00	750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	7,197	-	-	6,439	-	-	2,494	-	-	3,944
3222+00	3323+50	10150	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	97,398	-	-	87,135	-	-	33,753	-	-	53,381
3323+50	3420+00	9650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	92,600	-	-	82,842	-	-	32,090	-	-	50,752
3420+00	3510+00	9000	1	Blasting	hard Moenkopi formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	61,352	-	-	52,252	-	-	21,168	-	-	31,083	-	-
3510+00	3518+50	850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	6,409	-	-	5,550	-	-	2,024	-	-	3,526	-
3518+50	3538+50	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
3538+50	3540+00	150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,131	-	-	979	-	-	357	-	-	622	-
3540+00	3558+00	1800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	12,270	-	-	10,450	-	-	4,234	-	-	6,217	-	-
3558+00	3558+50	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
3558+50	3568+00	950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	6,476	-	-	5,515	-	-	2,234	-	-	3,281	-	-
3568+00	3717+00	14900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	101,572	-	-	86,506	-	-	35,045	-	-	51,460	-	-
3717+00	3722+50	550	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
3722+50	3861+00	13850	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	94,414	-	-	80,410	-	-	32,576	-	-	47,834	-	-
3861+00	3867+00	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3867+00	3879+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
3879+00	4100+00	22100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	150,653	-	-	128,307	-	-	51,980	-	-	76,327	-	-
4100+00	4164+00	6400	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	43,628	-	-	37,157	-	-	15,053	-	-	22,104	-	-
4164+00	4231+50	6750	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
4231+50	4244+50	1300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
4244+50	4247+00	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4247+00	4255+00	800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	5,454	-	-	4,645	-	-	1,882	-	-	2,763	-	-
4255+00	4257+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4257+50	4259+50	200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,363	-	-	1,161	-	-	470	-	-	691	-	-
4259+50	4262+50	300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	2,045	-	-	1,742	-	-	706	-	-	1,036	-	-
4262+50	4267+00	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4267+00	4269+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4269+50	4303+00	3350	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	22,837	-	-	19,449	-	-	7,879	-	-	11,570	-	-
4303+00	4412+00	10900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	74,304	-	-	63,283	-	-	25,637	-	-	37,645	-	-
4412+00	4414+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4414+50	4431+00	1650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	11,248	-	-	9,579	-	-	3,881	-	-	5,699	-	-
4431+00	4437+50	650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
4437+50	4585+00	14750	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	100,549	-	-	85,635	-	-	34,693	-	-	50,942	-	-
4585+00	4604+00	1900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	12,952	-	-	11,031	-	-	4,469	-	-	6,562	-	-
4604+00	4608+50	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4608+50	4768+00	15950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	108,730	-	-	92,602	-	-	37,515	-	-	55,087	-	-
4768+00	4780+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
4780+00	4932+00	15200	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	114,612	-	-	99,243	-	-	36,191	-	-	63,052	-
4932+00	5054+00	12200	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	91,991	-	-	79,655	-	-	29,048	-	-	50,607	-
5054+00	5132+50	7850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	59,191	-	-	51,254	-	-	18,691	-	-	32,563	-
5132+50	5136+50	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
5136+50	5137+00	50	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	377	-	-	326	-	-	119	-	-	207	-
5137+00	5150+00	1300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	9,802	-	-	8,488	-	-	3,095	-	-	5,393	-
5150+00	5166+50	1650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	11,248	-	-	9,579	-	-	3,881	-	-	5,699	-	-
5166+50	5172+00	550	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
5172+00	5178+50	650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
5178+50	5182+00	350	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	2,386	-	-	2,032	-	-	823	-	-	1,209	-	-
5182+00	5187+00	500	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	3,408	-	-	2,903	-	-	1,176	-	-	1,727	-	-
5187+00	5200+00	1300	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
5200+00	5270+00	7000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	52,782	-	-	45,704	-	-	16,667	-	-	29,037	-
5270+00	5655+00	38500	3	> 15' - Excavatable	deep alluvium / eolian soils	soil	-	-	-	-	369,440	-	-	330,510	-	-	128,029	-	-	202,481
	Total	**289,500**						**TOTALS**	**961,183**	**354,393**	**973,977**	**818,610**	**306,869**	**871,345**	**331,638**	**111,906**	**337,530**	**486,972**	**194,963**	**533,815**

Table 2-4
Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 50% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5 - HS-2 SOUTH TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5655+00	5880+00	22500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	215,906	-	-	193,155	-	-	74,822	-	-	118,333
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Sinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	**143,500**						**TOTALS**	**262,451**	**49,012**	**945,190**	**223,521**	**42,439**	**845,591**	**90,554**	**15,476**	**327,554**	**132,968**	**26,963**	**518,037**

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-		4,762	-	-	8,296	-
70+00	105+00	3500	1	1000	basalt	basalt	H / MH	7,250-14,500 / 1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-		20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H / MH	7,250-14,500 / 1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	**24,000**						**TOTALS**	**30,676**	**109,334**	**0**	**26,126**	**94,672**	**0**	**10,584**	**34,524**	**0**	**15,542**	**60,148**	**0**

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.

Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.

Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).

Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTALS (ALL SEGMENTS)	**1,666,732**	**806,810**	**3,612,831**	**1,419,505**	**698,616**	**3,232,132**	**575,074**	**254,765**	**1,252,021**	**844,431**	**443,852**	**1,980,111**

Total - All Segments (ft):	**733,000**
Total - All Segments (mi):	**138.8**

TOTAL BEDDING + BACKFILL (CY):	**5,350,254**
TOTAL PIPE BEDDING (CY):	**2,081,860**
TOTAL BACKFILL (CY):	**3,268,394**

Total Volume of Material Excavated with no Expansion (CY):	**6,086,373**
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	**15,055**
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	**154,564**
Volume of Expanded Rock after Recompaction to 65% of In-situ Volume - See Note 2 (CY):	**2,861,380**
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-situ Volume - See Note 3 (CY):	**4,550,096**

Assumptions

50% of Blasted Rock is Usable as Pipe Bedding (CY):	**1,430,690**
100% of Soil/Ripped Rock is Usable for Backfill (CY):	**4,550,096**
50% of Blasted Rock is Usable for Non-bedding Purposes (Roads) (CY):	**1,430,690**
Minimum Volume of Road Construction Material Required (CY):	**9,778**
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	**1,420,912**

Additional Material Needed for Pipe Bedding (CY):	**651,170**

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

Volume of Backfill Required for Pipeline Construction (CY):	**3,268,394**
Volume of Soil and Ripped Rock Available for Backfill (CY):	**4,550,096**
Volume of Blasted Rock Available for Backfill (CY):	**1,420,912**
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	**2,702,614**
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	**153,600**
Total Volume of Excess Soil, Ripped Rock, and Blasted Rock to be Wasted (CY):	**2,549,014**

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	**2847**	**6.7**

Check Assumptions Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	**294,071**
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	**103,133**
Volume of Remaining 50% of Blasted Rock Resulting from Assumtion that 50% of Blasted Rock is Suitable for Use as Bedding (CY):	**1,430,690**

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Table 2-5
Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 50% of Blasted Rock Useable as Bedding:

	Volumes Per Lineal Foot of Trench											
	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF of Trench -->	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF of Trench -->	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-5
Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 50% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H/MH	7,250-14,500/1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[b]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	83,950						TOTALS	129,180	0	623,729	110,019	0	558,004	44,571	0	216,152	65,448	0	341,852

NOTE:
[a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 (HWY):

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2990+00	1000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
2990+00	3094+00	10400	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	99,797	-	-	89,281	-	-	34,584	-	-	54,696
3094+00	3248+50	15450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	148,256	-	-	132,633	-	-	51,378	-	-	81,256
3248+50	3336+50	8800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	84,443	-	-	75,545	-	-	29,264	-	-	46,281
3336+50	3514+50	17800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	170,806	-	-	152,807	-	-	59,193	-	-	93,615
3514+50	3602+50	8800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	84,443	-	-	75,545	-	-	29,264	-	-	46,281
3602+50	3650+00	4750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	45,580	-	-	40,777	-	-	15,796	-	-	24,981
3650+00	3684+00	3400	1	Blasting	Shinarump member-Chinle	conglomerate	H/MH	7,250-14,500/1,810-7,250	23,177	-	-	19,740	-	-	7,997	-	-	11,743	-	-
3684+00	3690+00	600	1	Blasting	Shinarump member-Chinle	conglomerate	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3690+00	3700+00	1000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
3700+00	3770+00	7000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
3770+00	3780+00	1000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
3780+00	3820+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
3820+00	3844+50	2450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,510	-	-	21,032	-	-	8,147	-	-	12,885
3844+50	3850+00	550	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	5,278	-	-	4,722	-	-	1,829	-	-	2,893
3850+00	3965+00	11500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
3965+00	4020+00	5500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	52,777	-	-	47,216	-	-	18,290	-	-	28,926
4020+00	4109+50	8950	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	85,883	-	-	76,833	-	-	29,763	-	-	47,070
4109+50	4130+00	2050	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,671	-	-	17,599	-	-	6,817	-	-	10,781
4130+00	4151+00	2100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	20,151	-	-	18,028	-	-	6,983	-	-	11,044
4151+00	4261+00	11000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	105,554	-	-	94,431	-	-	36,580	-	-	57,852
4261+00	4270+00	900	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	8,636	-	-	7,726	-	-	2,993	-	-	4,733
4270+00	4310+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
4310+00	4338+00	2800	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	26,868	-	-	24,037	-	-	9,311	-	-	14,726
4338+00	4355+00	1700	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
4355+00	4405+00	5000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
4405+00	4420+00	1500	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	14,394	-	-	12,877	-	-	4,988	-	-	7,889
4420+00	4460+00	4000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
4460+00	4495+00	3500	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	33,585	-	-	30,046	-	-	11,639	-	-	18,407
4495+00	4518+00	2300	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	22,070	-	-	19,745	-	-	7,648	-	-	12,096
4518+00	4540+00	2200	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	21,111	-	-	18,886	-	-	7,316	-	-	11,570
4540+00	4590+00	5000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
4590+00	4607+50	1750	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	16,793	-	-	15,023	-	-	5,819	-	-	9,204
4607+50	4670+50	6300	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	60,454	-	-	54,083	-	-	20,950	-	-	33,133
4670+50	4685+00	1450	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	13,914	-	-	12,448	-	-	4,822	-	-	7,626
4685+00	4708+50	2350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	22,550	-	-	20,174	-	-	7,815	-	-	12,359
4708+50	4795+00	8650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	83,004	-	-	74,257	-	-	28,765	-	-	45,493
4795+00	4808+00	1300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
4808+00	4855+50	4750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	45,580	-	-	40,777	-	-	15,796	-	-	24,981
4855+50	5069+00	21350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	204,871	-	-	183,283	-	-	70,998	-	-	112,285
5069+00	5100+00	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
5100+00	5148+00	4800	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	46,060	-	-	41,206	-	-	15,962	-	-	25,244
5148+00	5171+00	2300	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	22,070	-	-	19,745	-	-	7,648	-	-	12,096
5171+00	5180+00	900	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	8,636	-	-	7,726	-	-	2,993	-	-	4,733
5180+00	5182+50	250	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
5182+50	5202+00	1950	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	18,712	-	-	16,740	-	-	6,485	-	-	10,256
	Total	244,200						TOTALS	27,268	0	2,304,919	23,223	0	2,062,040	9,408	0	798,766	13,815	0	1,263,274

NOTE:
2760+00 = Start at HS-1
2990+00 = Junc w/ Start of S. Alignment
5202+00 = End at HS-2(Hwy)

Table 2-5
Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 50% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5- HS-2 (HWY) TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5202+00	5265+00	6300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	60,454	-	-	54,083	-	-	20,950	-	-	33,133
5700+00	5880+00	18000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	172,725	-	-	154,524	-	-	59,858	-	-	94,667
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	145,300						TOTALS	262,451	49,012	962,462	223,521	42,439	861,044	90,554	15,476	333,540	132,968	26,963	527,504

NOTE: 5202+00 = Start at HS-2 (Hwy) using Hwy Alignment Stationing from HGL
5700+00 = Start at intersection of S. and Hwy Alignments, using current S. Alignment Stationing

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
70+00	105+00	3500	1	Blasting	basalt	basalt	H/MH	7,250-14,500/1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-	-	20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	24,000						TOTALS	30,676	109,334	0	26,126	94,672	0	10,584	34,524	0	15,542	60,148	0

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.
Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft of native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.
Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).
Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTAL - ALL SEGMENTS	732,817	452,417	4,961,046	624,118	391,748	4,438,280	252,845	142,859	1,719,243	371,273	248,889	2,719,037

Total - All Segments (ft):	689,500
Total - All Segments (mi):	130.6

TOTAL BEDDING + BACKFILL (CY):	5,454,145

TOTAL PIPE BEDDING (CY):	2,114,946

TOTAL BACKFILL (CY):	3,339,199

Total Volume of Material Excavated with no Expansion (CY):	6,146,279
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	15,055
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	154,564
Volume of Expanded Rock after Recompaction to 65% of In-Situ Volume - See Note 2 (CY):	1,432,666
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-Situ Voume - See Note 3 (CY):	5,780,131

Assumptions

50% of Blasted Rock is Usable as Pipe Bedding (CY):	716,333
100% of Soil/Ripped Rock is Usable for Backfill (CY):	5,780,131
50% of Rock is Usable for Non-bedding Purposes (Roads) (CY):	716,333
Minimum Volume of Road Construction Material Required (CY):	8,519
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	707,814

Additional Material Needed for Pipe Bedding (CY):	1,398,614

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

Volume of Backfill Required for Pipeline Construction (CY):	3,339,199
Volume of Soil and Ripped Rock Available for Backfill (CY):	5,780,131
Volume of Blasted Rock Available for Backfill (CY):	707,814
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	3,148,745
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	153,600
Total Volume of Excess Soil, Ripped Rock and Blasted Rock to be Wasted (CY):	2,995,145

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	2724	8.2

Check Assumption Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	294,071
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	103,133
Volume of Remaining 50% of Blasted Rock Resulting from Assumption that 50% of Blasted Rock is Suitable for Use as Bedding (CY):	716,333

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Table 2-6
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 50% of Blasted Rock Useable as Bedding

	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF Trench	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF Trench	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-6
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 50% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H/MH	7,250-14,500/1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[b]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	**83,950**						**TOTALS**	**129,180**	**0**	**623,729**	**110,019**	**0**	**558,004**	**44,571**	**0**	**216,152**	**65,448**	**0**	**341,852**

NOTE:
[a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 SOUTH:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2985+00	500	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	4,798	-	-	4,292	-	-	1,663	-	-	2,630
2985+00	3015+00	3000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
3015+00	3183+50	16850	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	161,690	-	-	144,652	-	-	56,033	-	-	88,619
3183+50	3214+50	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
3214+50	3222+00	750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	7,197	-	-	6,439	-	-	2,494	-	-	3,944
3222+00	3323+50	10150	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	97,398	-	-	87,135	-	-	33,753	-	-	53,381
3323+50	3420+00	9650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	92,600	-	-	82,842	-	-	32,090	-	-	50,752
3420+00	3510+00	9000	1	Blasting	hard Moenkopi formation	sandstone	H/MH	7,250-14,500/1,810-7,250	61,352	-	-	52,252	-	-	21,168	-	-	31,083	-	-
3510+00	3518+50	850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	6,409	-	-	5,550	-	-	2,024	-	-	3,526	-
3518+50	3538+50	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
3538+50	3540+00	150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,131	-	-	979	-	-	357	-	-	622	-
3540+00	3558+00	1800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	12,270	-	-	10,450	-	-	4,234	-	-	6,217	-	-
3558+00	3558+50	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
3558+50	3568+00	950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	6,476	-	-	5,515	-	-	2,234	-	-	3,281	-	-
3568+00	3717+00	14900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	101,572	-	-	86,506	-	-	35,045	-	-	51,460	-	-
3717+00	3722+50	550	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
3722+50	3861+00	13850	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	94,414	-	-	80,410	-	-	32,576	-	-	47,834	-	-
3861+00	3867+00	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3867+00	3879+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
3879+00	4045+00	16600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	113,161	-	-	96,375	-	-	39,044	-	-	57,331	-	-
4045+00	4076+00	3100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	21,132	-	-	17,998	-	-	7,291	-	-	10,706	-	-
4076+00	4167+00	9100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	62,034	-	-	52,832	-	-	21,404	-	-	31,429	-	-
4167+00	4200+50	3350	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	22,837	-	-	19,449	-	-	7,879	-	-	11,570	-	-
4200+50	4230+50	3000	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
4230+50	4262+00	3150	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	21,473	-	-	18,288	-	-	7,409	-	-	10,879	-	-
4262+00	4332+50	7050	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	48,059	-	-	40,931	-	-	16,582	-	-	24,349	-	-
4332+50	4334+00	150	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
4334+00	4356+00	2200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	14,997	-	-	12,773	-	-	5,174	-	-	7,598	-	-
4356+00	4358+00	200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,363	-	-	1,161	-	-	470	-	-	691	-	-
4358+00	4362+50	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4362+50	4363+00	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
4363+00	4375+50	1250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,521	-	-	7,257	-	-	2,940	-	-	4,317	-	-
4375+50	4382+00	650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
4382+00	4456+00	7400	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	50,445	-	-	42,963	-	-	17,405	-	-	25,557	-	-
4456+00	4458+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4458+50	4503+50	4500	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	30,676	-	-	26,126	-	-	10,584	-	-	15,542	-	-
4503+50	4513+50	1000	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
4513+50	4526+50	1300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
4526+50	4547+50	2100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	14,315	-	-	12,192	-	-	4,939	-	-	7,253	-	-
4547+50	4553+50	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
4553+50	4690+00	13650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	93,051	-	-	79,248	-	-	32,105	-	-	47,143	-	-
4690+00	4725+50	3550	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	26,768	-	-	23,178	-	-	8,452	-	-	14,726	-
4725+50	4882+50	15700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	118,382	-	-	102,507	-	-	37,381	-	-	65,126	-
4882+50	5004+00	12150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	91,614	-	-	79,329	-	-	28,929	-	-	50,400	-
5004+00	5060+00	5600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	42,226	-	-	36,563	-	-	13,333	-	-	23,230	-
5060+00	5086+50	2650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	18,065	-	-	15,385	-	-	6,233	-	-	9,152	-	-
5086+50	5110+00	2350	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	16,020	-	-	13,644	-	-	5,527	-	-	8,116	-	-
5110+00	5132+50	2250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock			-	16,966	-	-	14,691	-	-	5,357	-	-	9,333	-
5132+50	5180+00	4750	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock			-	35,816	-	-	31,013	-	-	11,310	-	-	19,704	-
5180+00	5565+00	38500	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	369,440	-	-	330,510	-	-	128,029	-	-	202,481
	Total	**280,601**						**TOTALS**	**899,831**	**354,393**	**973,977**	**766,358**	**306,869**	**871,345**	**310,470**	**111,906**	**337,530**	**455,889**	**194,963**	**533,815**

NOTE:
4045+00 = Start of SE Corner using HGL stationing
4262+00 = End of SE Corner on HGL stationing, also equals station 4352+00 on the standard South Alignment; refer to Segment 4 Station Equation Table at bottom of sheet.
HS-2(South) is near station 5565+00 using the SE Corner Stationing in the HGL and 5655+00 using the South Alignment stationing .

Table 2-6
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 50% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5 - HS-2 SOUTH TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5655+00	5880+00	22500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	215,906	-	-	193,155	-	-	74,822	-	-	118,333
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	143,500						TOTALS	262,451	49,012	945,190	223,521	42,439	845,591	90,554	15,476	327,554	132,968	26,963	518,037

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
70+00	105+00	3500	1	1000	basalt	basalt	H/MH	7,250-14,500/1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-	-	20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	24,000						TOTALS	30,676	109,334	0	26,126	94,672	0	10,584	34,524	0	15,542	60,148	0

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.
Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.
Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).
Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTAL - ALL SEGMENTS	1,605,380	806,810	3,612,831	1,367,253	698,616	3,232,132	553,906	254,765	1,252,021	813,347	443,852	1,980,111

Total - All Segments (ft):	724,101
Total - All Segments (mi):	137.1

TOTAL BEDDING + BACKFILL (CY):	5,298,002
TOTAL PIPE BEDDING (CY):	2,060,692
TOTAL BACKFILL (CY):	3,237,310

Total Volume of Material Excavated with no Expansion (CY):	6,025,020
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	15,055
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	154,564
Volume of Expanded Rock after Recompaction to 65% of In-situ Volume - See Note 2 (CY):	2,778,555
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-situ Volume - See Note 3 (CY):	4,550,096

Assumptions

50% of Blasted Rock is Usable as Pipe Bedding (CY):	1,389,277
100% of Soil/Ripped Rock is Usable as Backfill (CY):	4,550,096
50% of Blasted Rock is Usable for Non-bedding Purposes (Roads) (CY):	1,389,277
Minimum Volume of Road Construction Material Required (CY):	9,778
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	1,379,499

Additional Material Needed for Pipe Bedding (CY):	671,415

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

Volume of Backfill Required for Pipeline Construction (CY):	3,237,310
Volume of Soil and Ripped Rock Available for Backfill (CY):	4,550,096
Volume of Blasted Rock Available for Backfill (CY):	1,379,499
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	2,692,285
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	153,600
Total Volume of Excess Soil, Ripped Rock, and Blasted Rock to be Wasted (CY):	2,538,685

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	2823	6.7

Check Assumption Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	294,071
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	103,133
Volume of Remaining 50% of Blasted Rock Resulting from Assumption that 50% of Blasted Rock is Suitable for Use as Bedding (CY):	1,389,277

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Segment 4 Station Equation Table:

Proposed Action Stationing versus Southeast Corner Alternative

Proposed Action Stationing		Southeast Corner Alt. Stationing	
From Station:	To Station:	From Station:	To Station:
4352+00	4422+50	4262+00	4332+50
4422+50	4424+00	4332+50	4334+00
4424+00	4446+00	4334+00	4356+00
4446+00	4448+00	4356+00	4358+00
4448+00	4452+50	4358+00	4362+50
4452+50	4453+00	4362+50	4363+00
4453+00	4465+50	4363+00	4375+50
4465+50	4472+00	4375+50	4382+00
4472+00	4546+00	4382+00	4456+00
4546+00	4548+50	4456+00	4458+50
4548+50	4593+50	4458+50	4503+50
4593+50	4603+50	4503+50	4513+50
4603+50	4616+50	4513+50	4526+50
4616+50	4637+50	4526+50	4547+50
4637+50	4643+50	4547+50	4553+50
4643+50	4780+00	4553+50	4690+00
4780+00	4815+50	4690+00	4725+50
4815+50	4972+50	4725+50	4882+50
4972+50	5094+00	4882+50	5004+00
5094+00	5150+00	5004+00	5060+00
5150+00	5176+50	5060+00	5086+50
5176+50	5200+00	5086+50	5110+00
5200+00	5222+50	5110+00	5132+50
5222+50	5270+00	5132+50	5180+00
5270+00	5655+00	5180+00	5565+00

Table 2-7
Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 25% of Blasted Rock Useable as Bedding:

	Volumes per Lineal Foot of Trench											
	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF of Trench ---->	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF of Trench ---->	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	131,650						TOTALS	119,296	271,450	749,914	101,601	235,049	670,893	41,161	85,715	259,882	60,440	149,333	411,011

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	60,400						TOTALS	163,946	22,621	320,021	139,628	19,587	286,299	56,567	7,143	110,903	83,062	12,444	175,396

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-7
Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 25% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H / MH	7,250-14,500 / 1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H / MH	7,250-14,500 / 1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[c]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	**83,950**						**TOTALS**	**129,180**	**0**	**623,729**	**110,019**	**0**	**558,004**	**44,571**	**0**	**216,152**	**65,448**	**0**	**341,852**

NOTE:
[a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 SOUTH:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2985+00	500	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	4,798	-	-	4,292	-	-	1,663	-	-	2,630
2985+00	3015+00	3000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
3015+00	3183+50	16850	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	161,690	-	-	144,652	-	-	56,033	-	-	88,619
3183+50	3214+50	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
3214+50	3222+00	750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	7,197	-	-	6,439	-	-	2,494	-	-	3,944
3222+00	3323+50	10150	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	97,398	-	-	87,135	-	-	33,753	-	-	53,381
3323+50	3420+00	9650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	92,600	-	-	82,842	-	-	32,090	-	-	50,752
3420+00	3510+00	9000	1	Blasting	hard Moenkopi formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	61,352	-	-	52,252	-	-	21,168	-	-	31,083	-	-
3510+00	3518+50	850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	6,409	-	-	5,550	-	-	2,024	-	-	3,526	-
3518+50	3538+50	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
3538+50	3540+00	150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,131	-	-	979	-	-	357	-	-	622	-
3540+00	3558+00	1800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	12,270	-	-	10,450	-	-	4,234	-	-	6,217	-	-
3558+00	3558+50	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
3558+50	3568+00	950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	6,476	-	-	5,515	-	-	2,234	-	-	3,281	-	-
3568+00	3717+00	14900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	101,572	-	-	86,506	-	-	35,045	-	-	51,460	-	-
3717+00	3722+50	550	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
3722+50	3861+00	13850	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	94,414	-	-	80,410	-	-	32,576	-	-	47,834	-	-
3861+00	3867+00	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3867+00	3879+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
3879+00	4100+00	22100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	150,653	-	-	128,307	-	-	51,980	-	-	76,327	-	-
4100+00	4164+00	6400	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	43,628	-	-	37,157	-	-	15,053	-	-	22,104	-	-
4164+00	4231+50	6750	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
4231+50	4244+50	1300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
4244+50	4247+00	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4247+00	4255+00	800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	5,454	-	-	4,645	-	-	1,882	-	-	2,763	-	-
4255+00	4257+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4257+50	4259+50	200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,363	-	-	1,161	-	-	470	-	-	691	-	-
4259+50	4262+50	300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	2,045	-	-	1,742	-	-	706	-	-	1,036	-	-
4262+50	4267+00	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4267+00	4269+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4269+50	4303+00	3350	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	22,837	-	-	19,449	-	-	7,879	-	-	11,570	-	-
4303+00	4412+00	10900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	74,304	-	-	63,283	-	-	25,637	-	-	37,645	-	-
4412+00	4414+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4414+50	4431+00	1650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	11,248	-	-	9,579	-	-	3,881	-	-	5,699	-	-
4431+00	4437+50	650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
4437+50	4585+00	14750	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	100,549	-	-	85,635	-	-	34,693	-	-	50,942	-	-
4585+00	4604+00	1900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	12,952	-	-	11,031	-	-	4,469	-	-	6,562	-	-
4604+00	4608+50	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4608+50	4768+00	15950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	108,730	-	-	92,602	-	-	37,515	-	-	55,087	-	-
4768+00	4780+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H / MH	7,250-14,500 / 1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
4780+00	4932+00	15200	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	114,612	-	-	99,243	-	-	36,191	-	-	63,052	-
4932+00	5054+00	12200	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	91,991	-	-	79,655	-	-	29,048	-	-	50,607	-
5054+00	5132+50	7850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	59,191	-	-	51,254	-	-	18,691	-	-	32,563	-
5132+50	5136+50	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
5136+50	5137+00	50	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	377	-	-	326	-	-	119	-	-	207	-
5137+00	5150+00	1300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	9,802	-	-	8,488	-	-	3,095	-	-	5,393	-
5150+00	5166+50	1650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	11,248	-	-	9,579	-	-	3,881	-	-	5,699	-	-
5166+50	5172+00	550	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
5172+00	5178+50	650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
5178+50	5182+00	350	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	2,386	-	-	2,032	-	-	823	-	-	1,209	-	-
5182+00	5187+00	500	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	3,408	-	-	2,903	-	-	1,176	-	-	1,727	-	-
5187+00	5200+00	1300	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
5200+00	5270+00	7000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	52,782	-	-	45,704	-	-	16,667	-	-	29,037	-
5270+00	5655+00	38500	3	> 15' - Excavatable	deep alluvium / eolian soils	soil	-	-	-	-	369,440	-	-	330,510	-	-	128,029	-	-	202,481
	Total	**289,500**						**TOTALS**	**961,183**	**354,393**	**973,977**	**818,610**	**306,869**	**871,345**	**331,638**	**111,906**	**337,530**	**486,972**	**194,963**	**533,815**

Table 2-7

Lake Powell Pipeline Project
Excavation Quantities

PROPOSED ACTION ALIGNMENT: Assumes 25% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5 - HS-2 SOUTH TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5655+00	5880+00	22500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	215,906	-	-	193,155	-	-	74,822	-	-	118,333
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H / MH	7,250-14,500 / 1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Sinarump member-Chinle	sandstone/conglomerate	H / MH	7,250-14,500 / 1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H / MH	7,250-14,500 / 1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	143,500						TOTALS	262,451	49,012	945,190	223,521	42,439	845,591	90,554	15,476	327,554	132,968	26,963	518,037

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-		4,762	-	-	8,296	-
70+00	105+00	3500	1	1000	basalt	basalt	H / MH	7,250-14,500 / 1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-		20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H / MH	7,250-14,500 / 1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	24,000						TOTALS	30,676	109,334	0	26,126	94,672	0	10,584	34,524	0	15,542	60,148	0

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.

Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.

Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).

Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTALS (ALL SEGMENTS)	1,666,732	806,810	3,612,831	1,419,505	698,616	3,232,132	575,074	254,765	1,252,021	844,431	443,852	1,980,111

Total - All Segments (ft):	733,000
Total - All Segments (mi):	138.8

TOTAL BEDDING + BACKFILL (CY):	5,350,254
TOTAL PIPE BEDDING (CY):	2,081,860
TOTAL BACKFILL (CY):	3,268,394

Total Volume of Material Excavated with no Expansion (CY):	6,086,373
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	15,055
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	154,564
Volume of Expanded Rock after Recompaction to 65% of In-situ Volume - See Note 2 (CY):	2,861,380
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-situ Volume - See Note 3 (CY):	4,550,096

Assumptions

25% of Blasted Rock is Usable as Pipe Bedding (CY):	715,345
100% of Soil/Ripped Rock is Usable for Backfill (CY):	4,550,096
75% of Blasted Rock is Usable for Non-bedding Purposes (Roads) (CY):	2,146,035
Minimum Volume of Road Construction Material Required (CY):	9,778
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	2,136,257

Additional Material Needed for Pipe Bedding (CY):	1,366,515

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

Volume of Backfill Required for Pipeline Construction (CY):	3,268,394
Volume of Soil and Ripped Rock Available for Backfill (CY):	4,550,096
Volume of Blasted Rock Available for Backfill (CY):	2,136,257
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	3,417,959
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	153,600
Total Volume of Excess Soil, Ripped Rock, and Blasted Rock to be Wasted (CY):	3,264,359

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	2847	8.5

Check Assumptions Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	294,071
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	103,133
Volume of Remaining 75% of Blasted Rock Resulting from Assumption that 25% of Blasted Rock is Suitable for Use as Bedding (CY):	2,146,035

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Table 2-8
Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 25% of Blasted Rock Useable as Bedding:

	Volumes Per Lineal Foot of Trench											
	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF of Trench -->	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF of Trench -->	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	3	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-8
Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 25% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H/MH	7,250-14,500/1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[b]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	83,950						TOTALS	129,180	0	623,729	110,019	0	558,004	44,571	0	216,152	65,448	0	341,852

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 (HWY):

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2990+00	1000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
2990+00	3094+00	10400	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	99,797	-	-	89,281	-	-	34,584	-	-	54,696
3094+00	3248+50	15450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	148,256	-	-	132,633	-	-	51,378	-	-	81,256
3248+50	3336+50	8800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	84,443	-	-	75,545	-	-	29,264	-	-	46,281
3336+50	3514+50	17800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	170,806	-	-	152,807	-	-	59,193	-	-	93,615
3514+50	3602+50	8800	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	84,443	-	-	75,545	-	-	29,264	-	-	46,281
3602+50	3650+00	4750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	45,580	-	-	40,777	-	-	15,796	-	-	24,981
3650+00	3684+00	3400	1	Blasting	Shinarump member-Chinle	conglomerate	H/MH	7,250-14,500/1,810-7,250	23,177	-	-	19,740	-	-	7,997	-	-	11,743	-	-
3684+00	3690+00	600	1	Blasting	Shinarump member-Chinle	conglomerate	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3690+00	3700+00	1000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
3700+00	3770+00	7000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
3770+00	3780+00	1000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
3780+00	3820+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
3820+00	3844+50	2450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,510	-	-	21,032	-	-	8,147	-	-	12,885
3844+50	3850+00	550	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	5,278	-	-	4,722	-	-	1,829	-	-	2,893
3850+00	3965+00	11500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
3965+00	4020+00	5500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	52,777	-	-	47,216	-	-	18,290	-	-	28,926
4020+00	4109+50	8950	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	85,883	-	-	76,833	-	-	29,763	-	-	47,070
4109+50	4130+00	2050	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,671	-	-	17,599	-	-	6,817	-	-	10,781
4130+00	4151+00	2100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	20,151	-	-	18,028	-	-	6,983	-	-	11,044
4151+00	4261+00	11000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	105,554	-	-	94,431	-	-	36,580	-	-	57,852
4261+00	4270+00	900	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	8,636	-	-	7,726	-	-	2,993	-	-	4,733
4270+00	4310+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
4310+00	4338+00	2800	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	26,868	-	-	24,037	-	-	9,311	-	-	14,726
4338+00	4355+00	1700	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
4355+00	4405+00	5000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
4405+00	4420+00	1500	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	14,394	-	-	12,877	-	-	4,988	-	-	7,889
4420+00	4460+00	4000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
4460+00	4495+00	3500	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	33,585	-	-	30,046	-	-	11,639	-	-	18,407
4495+00	4518+00	2300	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	22,070	-	-	19,745	-	-	7,648	-	-	12,096
4518+00	4540+00	2200	2	Rippable	weathered Moenkopi formation	sandsotne/claystone	-	-	-	-	21,111	-	-	18,886	-	-	7,316	-	-	11,570
4540+00	4590+00	5000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
4590+00	4607+50	1750	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	16,793	-	-	15,023	-	-	5,819	-	-	9,204
4607+50	4670+50	6300	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	60,454	-	-	54,083	-	-	20,950	-	-	33,133
4670+50	4685+00	1450	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	13,914	-	-	12,448	-	-	4,822	-	-	7,626
4685+00	4708+50	2350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	22,550	-	-	20,174	-	-	7,815	-	-	12,359
4708+50	4795+00	8650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	83,004	-	-	74,257	-	-	28,765	-	-	45,493
4795+00	4808+00	1300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
4808+00	4855+50	4750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	45,580	-	-	40,777	-	-	15,796	-	-	24,981
4855+50	5069+00	21350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	204,871	-	-	183,283	-	-	70,998	-	-	112,285
5069+00	5100+00	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
5100+00	5148+00	4800	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	46,060	-	-	41,206	-	-	15,962	-	-	25,244
5148+00	5171+00	2300	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	22,070	-	-	19,745	-	-	7,648	-	-	12,096
5171+00	5180+00	900	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	8,636	-	-	7,726	-	-	2,993	-	-	4,733
5180+00	5182+50	250	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
5182+50	5202+00	1950	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	18,712	-	-	16,740	-	-	6,485	-	-	10,256
	Total	244,200						TOTALS	27,268	0	2,304,919	23,223	0	2,062,040	9,408	0	798,766	13,815	0	1,263,274

NOTE: 2760+00 = Start at HS-1
2990+00 = Junc w/ Start of S. Alignment
5202+00 = End at HS-2(Hwy)

Table 2-8

Lake Powell Pipeline Project
Excavation Quantities

EXISTING HIGHWAY ALTERNATIVE: Assumes 25% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5- HS-2 (HWY) TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5202+00	5265+00	6300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	60,454	-	-	54,083	-	-	20,950	-	-	33,133
5700+00	5880+00	18000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	172,725	-	-	154,524	-	-	59,858	-	-	94,667
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	145,300						TOTALS	262,451	49,012	962,462	223,521	42,439	861,044	90,554	15,476	333,540	132,968	26,963	527,504

NOTE: 5202+00 = Start at HS-2 (Hwy) using Hwy Alignment Stationing from HGL
5700+00 = Start at intersection of S. and Hwy Alignments, using current S. Alignment Stationing

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
70+00	105+00	3500	1	Blasting	basalt	basalt	H/MH	7,250-14,500/1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-	-	20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	24,000						TOTALS	30,676	109,334	0	26,126	94,672	0	10,584	34,524	0	15,542	60,148	0

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.
Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft of native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.
Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).
Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTAL - ALL SEGMENTS	732,817	452,417	4,961,046	624,118	391,748	4,438,280	252,845	142,859	1,719,243	371,273	248,889	2,719,037

Total - All Segments (ft):	689,500
Total - All Segments (mi):	130.6

TOTAL BEDDING + BACKFILL (CY):	5,454,145

TOTAL PIPE BEDDING (CY):	2,114,946

TOTAL BACKFILL (CY):	3,339,199

Total Volume of Material Excavated with no Expansion (CY):	6,146,279
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	15,055
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	154,564
Volume of Expanded Rock after Recompaction to 65% of In-Situ Volume - See Note 2 (CY):	1,432,666
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-Situ Voume - See Note 3 (CY):	5,780,131

Volume of Backfill Required for Pipeline Construction (CY):	3,339,199
Volume of Soil and Ripped Rock Available for Backfill (CY):	5,780,131
Volume of Blasted Rock Available for Backfill (CY):	1,065,980
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	3,506,912
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	153,600
Total Volume of Excess Soil, Ripped Rock and Blasted Rock to be Wasted (CY):	3,353,312

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	2724	9.2

Assumptions

25% of Blasted Rock is Usable as Pipe Bedding (CY):	358,166
100% of Soil/Ripped Rock is Usable for Backfill (CY):	5,780,131
75% of Rock is Usable for Non-bedding Purposes (Roads) (CY):	1,074,499
Minimum Volume of Road Construction Material Required (CY):	8,519
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	1,065,980

Additional Material Needed for Pipe Bedding (CY):	1,756,780

Check Assumption Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	294,071
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	103,133
Volume of Remaining 75% of Blasted Rock Resulting from Assumption that 25% of Blasted Rock is Suitable for Use as Bedding (CY):	1,074,499

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Table 2-9
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 25% of Blasted Rock Useable as Bedding:

	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3	TRENCH 1	TRENCH 2	TRENCH 3
				TOTAL	TOTAL	TOTAL	3/4 IN MINUS	3/4 IN MINUS	3/4 IN MINUS	NATIVE BACKFILL 0.5 FT ABOVE PIPE TO SURFACE		
CF/LF Trench	184.1	203.6	259.1	156.8	176.3	231.8	63.5	64.3	89.8	93.3	112.0	142.0
CY/LF Trench	6.82	7.54	9.60	5.81	6.53	8.58	2.35	2.38	3.33	3.45	4.15	5.26

SEGMENT 1 - INTAKE PUMP STATION TO BPS-3 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	1+50	150	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
1+50	175+00	17350	1	Blasting	hard Navajo Sandstone and Carmel Formation	sandstone	H/MH	7,250-14,500/1,810-7,250	118,273	-	-	100,730	-	-	40,808	-	-	59,922	-	-
175+00	280+00	10500	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	100,756	-	-	90,139	-	-	34,917	-	-	55,222
280+00	320+00	4000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,383	-	-	34,339	-	-	13,302	-	-	21,037
320+00	370+00	5000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	47,979	-	-	42,923	-	-	16,627	-	-	26,296
370+00	393+00	2300	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	17,343	-	-	15,017	-	-	5,476	-	-	9,541	-
393+00	430+00	3700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	27,899	-	-	24,158	-	-	8,810	-	-	15,348	-
430+00	450+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
450+00	460+00	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
460+00	470+00	1000	2	Rippable	poorly cemented Entrada Sandstone	soil	-	-	-	-	9,596	-	-	8,585	-	-	3,325	-	-	5,259
470+00	530+50	6050	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	45,619	-	-	39,501	-	-	14,405	-	-	25,096	-
530+50	543+00	1250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	9,425	-	-	8,161	-	-	2,976	-	-	5,185	-
543+00	560+00	1700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	-	-	-	12,818	-	-	11,100	-	-	4,048	-	-	7,052	-
560+00	580+00	2000	2	Rippable	poorly cemented Entrada Sandstone	sandstone	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
580+00	648+50	6850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	51,651	-	-	44,725	-	-	16,310	-	-	28,415	-
648+50	658+50	1000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	7,540	-	-	6,529	-	-	2,381	-	-	4,148	-
658+50	663+00	450	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,393	-	-	2,938	-	-	1,071	-	-	1,867	-
663+00	750+00	8700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	65,600	-	-	56,803	-	-	20,715	-	-	36,089	-
750+00	780+46	3046	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,229	-	-	26,149	-	-	10,129	-	-	16,020
780+46	840+00	5954	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,134	-	-	51,113	-	-	19,800	-	-	31,314
840+00	860+00	2000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	19,192	-	-	17,169	-	-	6,651	-	-	10,519
860+00	877+00	1700	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
877+00	878+50	150	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
878+50	886+50	800	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	7,677	-	-	6,868	-	-	2,660	-	-	4,207
886+50	897+00	1050	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	10,076	-	-	9,014	-	-	3,492	-	-	5,522
897+00	900+50	350	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,359	-	-	3,005	-	-	1,164	-	-	1,841
900+50	910+00	950	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	9,116	-	-	8,155	-	-	3,159	-	-	4,996
910+00	1040+62	13062	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	125,341	-	-	112,133	-	-	43,437	-	-	68,696
1040+62	1150+00	10938	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	104,959	-	-	93,899	-	-	36,373	-	-	57,526
1150+00	1180+00	3000	2	Rippable	weathered Upper Carmel formation	sandstone/claystone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1180+00	1210+00	3000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
1210+00	1240+00	3000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	22,621	-	-	19,587	-	-	7,143	-	-	12,444	-
1240+00	1316+50	7650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	73,408	-	-	65,673	-	-	25,439	-	-	40,233
	Total	**131,650**						**TOTALS**	**119,296**	**271,450**	**749,914**	**101,601**	**235,049**	**670,893**	**41,161**	**85,715**	**259,882**	**60,440**	**149,333**	**411,011**

SEGMENT 2 - BPS-3 ALT TO BPS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1316+50	1330+00	1350	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	12,954	-	-	11,589	-	-	4,489	-	-	7,100
1330+00	1334+00	400	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	3,016	-	-	2,612	-	-	952	-	-	1,659	-
1334+00	1360+00	2600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	M	725-1,810	-	19,605	-	-	16,976	-	-	6,191	-	-	10,785	-
1360+00	1374+00	1400	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	13,434	-	-	12,019	-	-	4,656	-	-	7,363
1374+00	1400+00	2600	2	Rippable	weathered Upper Carmel formation/Entrada Sandstone	sandstone/claystone	-	-	-	-	24,949	-	-	22,320	-	-	8,646	-	-	13,674
1400+00	1431+00	3100	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
1431+00	1483+00	5200	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	49,898	-	-	44,640	-	-	17,292	-	-	27,348
1483+00	1496+00	1300	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
1496+00	1500+00	400	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	3,838	-	-	3,434	-	-	1,330	-	-	2,104
1500+00	1534+50	3450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	33,106	-	-	29,617	-	-	11,473	-	-	18,144
1534+50	1575+00	4050	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
1575+00	1635+00	6000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
1635+00	1680+00	4500	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	43,181	-	-	38,631	-	-	14,964	-	-	23,667
1680+00	1687+50	750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
1687+50	1714+50	2700	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	18,406	-	-	15,676	-	-	6,351	-	-	9,325	-	-
1714+50	1920+50[a]	20600	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	140,428	-	-	119,598	-	-	48,452	-	-	71,146	-	-
	Total	**60,400**						**TOTALS**	**163,946**	**22,621**	**320,021**	**139,628**	**19,587**	**286,299**	**56,567**	**7,143**	**110,903**	**83,062**	**12,444**	**175,396**

NOTE: [a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

Table 2-9
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 25% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 3 - BPS-4 ALT TO HS-1:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
1920+50[a]	1929+00	850	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	5,794	-	-	4,935	-	-	1,999	-	-	2,936	-	-
1929+00	1954+50	2550	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	17,383	-	-	14,805	-	-	5,998	-	-	8,807	-	-
1954+50	1982+50	2800	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	19,087	-	-	16,256	-	-	6,586	-	-	9,670	-	-
1982+50	2050+00	6750	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	46,014	-	-	39,189	-	-	15,876	-	-	23,313	-	-
2050+00	2051+00	100	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	682	-	-	581	-	-	235	-	-	345	-	-
2051+00	2090+00	3900	1	Blasting	steeply dipping/faulted/hard bedrock (Cockscomb)	sandstone/claystone	H/MH	7,250-14,500/1,810-7,250	26,586	-	-	22,642	-	-	9,173	-	-	13,469	-	-
2090+00	2162+00	7200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	69,090	-	-	61,810	-	-	23,943	-	-	37,867
2162+00	2277+00	11500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	110,352	-	-	98,724	-	-	38,242	-	-	60,481
2277+00	2278+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2278+50	2283+00	450	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
2283+00	2283+50	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2283+50	2296+50	1300	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
2296+50	2297+00	50	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	480	-	-	429	-	-	166	-	-	263
2297+00	2299+50	250	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	2,399	-	-	2,146	-	-	831	-	-	1,315
2299+50	2340+00	4050	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	38,863	-	-	34,768	-	-	13,468	-	-	21,300
2340+00	2360+00	2000	1	Blasting	hard Kaibab formation	limestone	H/MH	7,250-14,500/1,810-7,250	13,634	-	-	11,611	-	-	4,704	-	-	6,907	-	-
2360+00	2404+00	4400	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	42,222	-	-	37,773	-	-	14,632	-	-	23,141
2404+00	2405+00	100	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	960	-	-	858	-	-	333	-	-	526
2405+00	2430+00	2500	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	23,990	-	-	21,462	-	-	8,314	-	-	13,148
2430+00	2431+50	150	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,439	-	-	1,288	-	-	499	-	-	789
2431+50	2433+50	200	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	1,919	-	-	1,717	-	-	665	-	-	1,052
2433+50	2681+00	24750	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	237,497	-	-	212,471	-	-	82,304	-	-	130,167
2681+00	2696+80[b]	1580	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	15,161	-	-	13,564	-	-	5,254	-	-	8,310
2696+80[b]	2760+00[c]	6320	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	60,646	-	-	54,255	-	-	21,017	-	-	33,239
	Total	**83,950**						**TOTALS**	**129,180**	**0**	**623,729**	**110,019**	**0**	**558,004**	**44,571**	**0**	**216,152**	**65,448**	**0**	**341,852**

NOTE:
[a]BPS-4 Alt. elevation 5047 ft MSL is at Station 1915+50; Station 1920+50 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[b]High Point Reg. Tank 2 elevation 5691 ft MSL is at Station 2681+00; Station 2696+80 from Plan and Profile used to calculate excavation/material and pipe pressure class only.
[c]HS-1 elevation 5574 ft MSL is at Station 2742+50; Station 2760+00 from Plan and Profile used to calculate excavation/material and pipe pressure class only.

SEGMENT 4 - HS-1 TO HS-2 SOUTH:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
2760+00	2790+00	3000	2	Rippable	weathered Moenkopi formation	sandstone/claystone/limestone	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2790+00	2950+00	16000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	153,533	-	-	137,355	-	-	53,207	-	-	84,148
2950+00	2980+00	3000	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	28,788	-	-	25,754	-	-	9,976	-	-	15,778
2980+00	2985+00	500	2	Rippable	weathered Chinle formation	sandstone/claystone/conglomerate	-	-	-	-	4,798	-	-	4,292	-	-	1,663	-	-	2,630
2985+00	3015+00	3000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
3015+00	3183+50	16850	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	161,690	-	-	144,652	-	-	56,033	-	-	88,619
3183+50	3214+50	3100	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	29,747	-	-	26,613	-	-	10,309	-	-	16,304
3214+50	3222+00	750	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	7,197	-	-	6,439	-	-	2,494	-	-	3,944
3222+00	3323+50	10150	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	97,398	-	-	87,135	-	-	33,753	-	-	53,381
3323+50	3420+00	9650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	92,600	-	-	82,842	-	-	32,090	-	-	50,752
3420+00	3510+00	9000	1	Blasting	hard Moenkopi formation	sandstone	H/MH	7,250-14,500/1,810-7,250	61,352	-	-	52,252	-	-	21,168	-	-	31,083	-	-
3510+00	3518+50	850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	6,409	-	-	5,550	-	-	2,024	-	-	3,526	-
3518+50	3538+50	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
3538+50	3540+00	150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,131	-	-	979	-	-	357	-	-	622	-
3540+00	3558+00	1800	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	12,270	-	-	10,450	-	-	4,234	-	-	6,217	-	-
3558+00	3558+50	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
3558+50	3568+00	950	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	6,476	-	-	5,515	-	-	2,234	-	-	3,281	-	-
3568+00	3717+00	14900	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	101,572	-	-	86,506	-	-	35,045	-	-	51,460	-	-
3717+00	3722+50	550	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	3,749	-	-	3,193	-	-	1,294	-	-	1,900	-	-
3722+50	3861+00	13850	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	94,414	-	-	80,410	-	-	32,576	-	-	47,834	-	-
3861+00	3867+00	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
3867+00	3879+00	1200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,180	-	-	6,967	-	-	2,822	-	-	4,144	-	-
3879+00	4045+00	16600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	113,161	-	-	96,375	-	-	39,044	-	-	57,331	-	-
4045+00	4076+00	3100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	21,132	-	-	17,998	-	-	7,291	-	-	10,706	-	-
4076+00	4167+00	9100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	62,034	-	-	52,832	-	-	21,404	-	-	31,429	-	-
4167+00	4200+50	3350	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	22,837	-	-	19,449	-	-	7,879	-	-	11,570	-	-
4200+50	4230+50	3000	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	20,451	-	-	17,417	-	-	7,056	-	-	10,361	-	-
4230+50	4262+00	3150	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	21,473	-	-	18,288	-	-	7,409	-	-	10,879	-	-
4262+00	4332+50	7050	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	48,059	-	-	40,931	-	-	16,582	-	-	24,349	-	-
4332+50	4334+00	150	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,023	-	-	871	-	-	353	-	-	518	-	-
4334+00	4356+00	2200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	14,997	-	-	12,773	-	-	5,174	-	-	7,598	-	-
4356+00	4358+00	200	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,363	-	-	1,161	-	-	470	-	-	691	-	-
4358+00	4362+50	450	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	3,068	-	-	2,613	-	-	1,058	-	-	1,554	-	-
4362+50	4363+00	50	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	341	-	-	290	-	-	118	-	-	173	-	-
4363+00	4375+50	1250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,521	-	-	7,257	-	-	2,940	-	-	4,317	-	-
4375+50	4382+00	650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
4382+00	4456+00	7400	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	50,445	-	-	42,963	-	-	17,405	-	-	25,557	-	-
4456+00	4458+50	250	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	1,704	-	-	1,451	-	-	588	-	-	863	-	-
4458+50	4503+50	4500	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	30,676	-	-	26,126	-	-	10,584	-	-	15,542	-	-
4503+50	4513+50	1000	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
4513+50	4526+50	1300	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	8,862	-	-	7,547	-	-	3,058	-	-	4,490	-	-
4526+50	4547+50	2100	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	14,315	-	-	12,192	-	-	4,939	-	-	7,253	-	-
4547+50	4553+50	600	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	4,090	-	-	3,483	-	-	1,411	-	-	2,072	-	-
4553+50	4690+00	13650	1	Blasting	hard Moenkopi or Kaibab formation	sandstone/limestone	H/MH	7,250-14,500/1,810-7,250	93,051	-	-	79,248	-	-	32,105	-	-	47,143	-	-
4690+00	4725+50	3550	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	26,768	-	-	23,178	-	-	8,452	-	-	14,726	-
4725+50	4882+50	15700	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	118,382	-	-	102,507	-	-	37,381	-	-	65,126	-
4882+50	5004+00	12150	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	91,614	-	-	79,329	-	-	28,929	-	-	50,400	-
5004+00	5060+00	5600	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	42,226	-	-	36,563	-	-	13,333	-	-	23,230	-
5060+00	5086+50	2650	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	18,065	-	-	15,385	-	-	6,233	-	-	9,152	-	-
5086+50	5110+00	2350	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	16,020	-	-	13,644	-	-	5,527	-	-	8,116	-	-
5110+00	5132+50	2250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock			-	16,966	-	-	14,691	-	-	5,357	-	-	9,333	-
5132+50	5180+00	4750	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock			-	35,816	-	-	31,013	-	-	11,310	-	-	19,704	-
5180+00	5565+00	38500	5	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	369,440	-	-	330,510	-	-	128,029	-	-	202,481
	Total	**280,601**						**TOTALS**	**899,831**	**354,393**	**973,977**	**766,358**	**306,869**	**871,345**	**310,470**	**111,906**	**337,530**	**455,889**	**194,963**	**533,815**

NOTE:
4045+00 = Start of SE Corner using HGL stationing
4262+00 = End of SE Corner on HGL stationing, also equals station 4352+00 on the standard South Alignment; refer to Segment 4 Station Equation Table at bottom of sheet.
HS-2(South) is near station 5565+00 using the SE Corner Stationing in the HGL and 5655+00 using the South Alignment stationing .

Table 2-9
Lake Powell Pipeline Project
Excavation Quantities

SOUTHEAST CORNER ALTERNATIVE: Assumes 25% of Blasted Rock Useable as Bedding (CONT.):

SEGMENT 5 - HS-2 SOUTH TO HS-4 ALT:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
5655+00	5880+00	22500	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	215,906	-	-	193,155	-	-	74,822	-	-	118,333
5880+00	5900+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
5900+00	5925+00	2500	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	17,042	-	-	14,514	-	-	5,880	-	-	8,634	-	-
5925+00	5950+00	2500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	18,851	-	-	16,323	-	-	5,952	-	-	10,370	-
5950+00	5990+00	4000	1	Blasting	Moenave formation	sandstone	H/MH	7,250-14,500/1,810-7,250	27,268	-	-	23,223	-	-	9,408	-	-	13,815	-	-
5990+00	6010+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
6010+00	6070+00	6000	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	57,575	-	-	51,508	-	-	19,953	-	-	31,556
6070+00	6170+00	10000	5	Mixed-Soil over Rippable	variable soil depth over bedrock	soil over rippable bedrock	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6170+00	6240+00	7000	2	Rippable	Petrified Forest member-Chinle	claystone	-	-	-	-	67,171	-	-	60,093	-	-	23,278	-	-	36,815
6240+00	6370+00	13000	1	Blasting	Shinarump member-Chinle	sandstone/conglomerate	H/MH	7,250-14,500/1,810-7,250	88,620	-	-	75,475	-	-	30,577	-	-	44,898	-	-
6370+00	6453+00	8300	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	79,645	-	-	71,253	-	-	27,601	-	-	43,652
6453+00	6459+00	600	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	5,758	-	-	5,151	-	-	1,995	-	-	3,156
6459+00	6463+50	450	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	4,318	-	-	3,863	-	-	1,496	-	-	2,367
6463+50	6770+00	30650	3	> 15' - Excavatable	deep alluvium/eolian soils	soil	-	-	-	-	294,112	-	-	263,120	-	-	101,924	-	-	161,196
6770+00	6820+00	5000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	34,084	-	-	29,029	-	-	11,760	-	-	17,269	-	-
6820+00	6920+00	10000	2	Rippable	weathered Moenkopi formation	sandstone/claystone	-	-	-	-	95,958	-	-	85,847	-	-	33,254	-	-	52,593
6920+00	6926+50	650	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	4,431	-	-	3,774	-	-	1,529	-	-	2,245	-	-
6926+50	6934+00	750	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	5,113	-	-	4,354	-	-	1,764	-	-	2,590	-	-
6934+00	6980+00	4600	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	31,358	-	-	26,706	-	-	10,819	-	-	15,887	-	-
6980+00	6993+00	1300	2	Rippable	large boulders	boulders	-	-	-	-	12,475	-	-	11,160	-	-	4,323	-	-	6,837
6993+00	7010+00	1700	2	Rippable	large boulders	boulders	-	-	-	-	16,313	-	-	14,594	-	-	5,653	-	-	8,941
7010+00	7090+00	8000	1	Blasting	Virgin Limestone	limestone	H/MH	7,250-14,500/1,810-7,250	54,535	-	-	46,446	-	-	18,816	-	-	27,630	-	-
	Total	143,500						TOTALS	262,451	49,012	945,190	223,521	42,439	845,591	90,554	15,476	327,554	132,968	26,963	518,037

SEGMENT 6 - HCH Portal to Afterbay to Sand Hollow Hydro:

From Station:	To Station:	Length (ft)	Excavatability	Description	Comments	Lithology	Hardness*	Unconfined Compressive Strength ** (psi)	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
0+00	50+00	5000		Tunneling																
50+00	70+00	2000	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	15,081	-	-	13,058	-	-	4,762	-	-	8,296	-
70+00	105+00	3500	1	1000	basalt	basalt	H/MH	7,250-14,500/1,810-7,250	23,859	-	-	20,320	-	-	8,232	-	-	12,088	-	-
105+00	190+00	8500	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	64,092	-	-	55,498	-	-	20,238	-	-	35,259	-
190+00	200+00	1000	1	Blasting	Navajo Sandstone	sandstone	H/MH	7,250-14,500/1,810-7,250	6,817	-	-	5,806	-	-	2,352	-	-	3,454	-	-
200+00	202+50	250	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	1,885	-	-	1,632	-	-	595	-	-	1,037	-
202+50	221+00	1850	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	13,950	-	-	12,079	-	-	4,405	-	-	7,674	-
221+00	240+00	1900	4	Mixed-Soil over Blasting	variable soil depth over bedrock	soil over hard bedrock	MH	1,180-7,250	-	14,327	-	-	12,405	-	-	4,524	-	-	7,881	-
	Total	24,000						TOTALS	30,676	109,334	0	26,126	94,672	0	10,584	34,524	0	15,542	60,148	0

Excavatability	Trench Section
1	1
2	3
3	3
4	2
5	3

Trench 1: Applies to trenching (blasting) in rock only.
Criteria = 1) bottom width is 3' wider than pipe OD; 2) 10" of bedding under pipe; 3) bedding completely covers pipe + 0.5 ft above pipe; 4) 5 ft native backfill; 5) trench wall slope = 0.5:1. For all of LPP (70.75" OD), Trench 1 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

Trench 2: Applies to mixed - soil over blasted rock only and assumes 6 ft depth blasted rock, 6.25 ft soil.
Criteria would be same as Trench 1 except rock in bottom 6 ft would have 0.5:1 slope, soil would have 1:1 slope. For all of LPP (70.75" OD), Trench 2 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft. At contact of rock and soil, trench width would be 12 ft.

Trench 3: Applies to excavated trench only (all soil or soil + rippable rock).
Criteria would be same as for Trench 1 except slope would be 1:1 from bottom to top. For all of LPP (70.75" OD), Trench 3 would be 7.25 ft of bedding +5 ft of backfill = 12.25 ft depth, trench bottom width would be 8.9 ft.

	TRENCH 1 EXCAVATION BLASTED ROCK (CY)	TRENCH 2 EXCAVATION SOIL OVER BLASTED ROCK (CY)	TRENCH 3 EXCAVATION SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BEDDING + BACKFILL BLASTED ROCK (CY)	TRENCH 2 BEDDING + BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BEDDING + BACKFILL SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 PIPE BEDDING BLASTED ROCK (CY)	TRENCH 2 PIPE BEDDING SOIL OVER BLASTED ROCK (CY)	TRENCH 3 PIPE BEDDING SOIL AND/OR RIPPED ROCK (CY)	TRENCH 1 BACKFILL ROCK (CY)	TRENCH 2 BACKFILL SOIL OVER BLASTED ROCK (CY)	TRENCH 3 BACKFILL SOIL AND/OR RIPPED ROCK (CY)
TOTAL - ALL SEGMENTS	1,605,380	806,810	3,612,831	1,367,253	698,616	3,232,132	553,906	254,765	1,252,021	813,347	443,852	1,980,111

Total - All Segments (ft):	724,101
Total - All Segments (mi):	137.1

TOTAL BEDDING + BACKFILL (CY):	5,298,002
TOTAL PIPE BEDDING (CY):	2,060,692
TOTAL BACKFILL (CY):	3,237,310

Total Volume of Material Excavated with no Expansion (CY):	6,025,020
Volume of Rock from the Lake Intake Tunnels and Shafts - See Note 1 (CY):	15,055
Volume of Rock from the Cockscomb Area Cut Slope Reductions (CY):	154,564
Volume of Expanded Rock after Recompaction to 65% of In-situ Volume - See Note 2 (CY):	2,778,555
Volume of Expanded Soil and Ripped Rock after Recompaction to 90% of In-situ Volume - See Note 3 (CY):	4,550,096

Assumptions

25% of Blasted Rock is Usable as Pipe Bedding (CY):	694,639
100% of Soil/Ripped Rock is Usable as Backfill (CY):	4,550,096
75% of Blasted Rock is Usable for Non-bedding Purposes (Roads) (CY):	2,083,916
Minimum Volume of Road Construction Material Required (CY):	9,778
Remaining Volume of Blasted Rock Unsuitable for Use as Pipe Bedding Which can be Used for Backfill (CY):	2,074,138

Additional Material Needed for Pipe Bedding (CY):	1,366,053

Notes

Note 1 - (Assumes 100% of Rock from Hurricane Cliffs and Sand Hollow Tunnels used for Dam Construction)
Note 2 - Disregards ripped rock which has been assumed to be unsuitable for bedding
Note 3 - Includes ripped rock which has been crushed

Volume of Backfill Required for Pipeline Construction (CY):	3,237,310
Volume of Soil and Ripped Rock Available for Backfill (CY):	4,550,096
Volume of Blasted Rock Available for Backfill (CY):	2,074,138
Excess Soil, Ripped Rock, and Blasted Rock not Used for Backfill (CY):	3,386,924
Volume of Soil and Ripped Rock from Pipeline Construction Required for Dam Construction at Hurricane Cliffs (CY):	153,600
Total Volume of Excess Soil, Ripped Rock, and Blasted Rock to be Wasted (CY):	3,233,324

Thickness of Material Wasted on Pipeline ROW

ROW	Acreage	Thickness (in)
Total Pipeline:	2823	8.5

Check Assumption Regarding Percent Suitability of Blasted Rock

Volume of Excavation of Soil Over Blasted with Rock Assumed to be Unsuitable for Use as Bedding (Segments 1 and 2) (CY):	294,071
Volume of Rock Unsuitable for Use as Bedding in Excavation Volume of Soil Over Blasted Rock with Rock Unsuitable for Use as Bedding (CY):	103,133
Volume of Remaining 75% of Blasted Rock Resulting from Assumtion that 25% of Blasted Rock is Suitable for Use as Bedding (CY):	2,083,916

*** H / MH = Hard or Moderately Hard (US BOR Engineering Geology Field Manual, Second Edition)**
**** From Table 4-3 of Part 631 of the National Engineering Handbook (NRCS) (Compressive strength values converted from metric units)**

Trench 2 - Blasted Rock Portion (CF/LF of Trench): 71.4
Trench 2 - Ratio - Blasted Rock Volume to Total Excavation Volume: 0.351

Segment 4 Station Equation Table:

Proposed Action Stationing versus Southeast Corner Alternative

Proposed Action Stationing		Southeast Corner Alt. Stationing	
From Station:	To Station:	From Station:	To Station:
4352+00	4422+50	4262+00	4332+50
4422+50	4424+00	4332+50	4334+00
4424+00	4446+00	4334+00	4356+00
4446+00	4448+00	4356+00	4358+00
4448+00	4452+50	4358+00	4362+50
4452+50	4453+00	4362+50	4363+00
4453+00	4465+50	4363+00	4375+50
4465+50	4472+00	4375+50	4382+00
4472+00	4546+00	4382+00	4456+00
4546+00	4548+50	4456+00	4458+50
4548+50	4593+50	4458+50	4503+50
4593+50	4603+50	4503+50	4513+50
4603+50	4616+50	4513+50	4526+50
4616+50	4637+50	4526+50	4547+50
4637+50	4643+50	4547+50	4553+50
4643+50	4780+00	4553+50	4690+00
4780+00	4815+50	4690+00	4725+50
4815+50	4972+50	4725+50	4882+50
4972+50	5094+00	4882+50	5004+00
5094+00	5150+00	5004+00	5060+00
5150+00	5176+50	5060+00	5086+50
5176+50	5200+00	5086+50	5110+00
5200+00	5222+50	5110+00	5132+50
5222+50	5270+00	5132+50	5180+00
5270+00	5655+00	5180+00	5565+00

Table 2-10
Summary Volume of Imported Pipe Bedding Material Needed
(Assuming 75% of blasted rock is suitable for use as pipe bedding)

Alignment	Volume (cy)
Proposed Action	0
Existing Highway Alternative	1,040,447
Southeast Corner Alternative	0

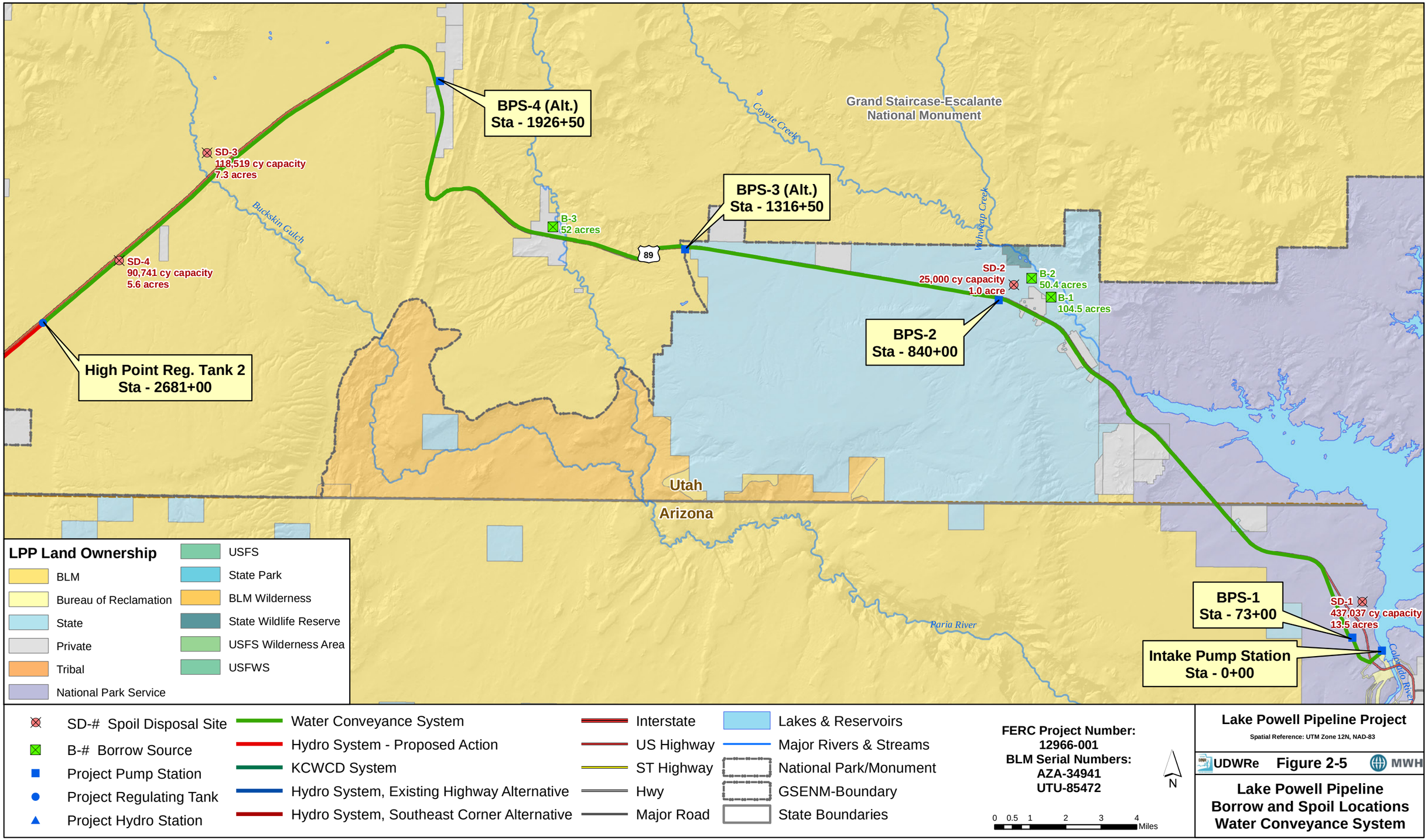
Table 2-11
Summary Volume of Imported Pipe Bedding Material Needed
(Assuming 50% of blasted rock is suitable for use as pipe bedding)

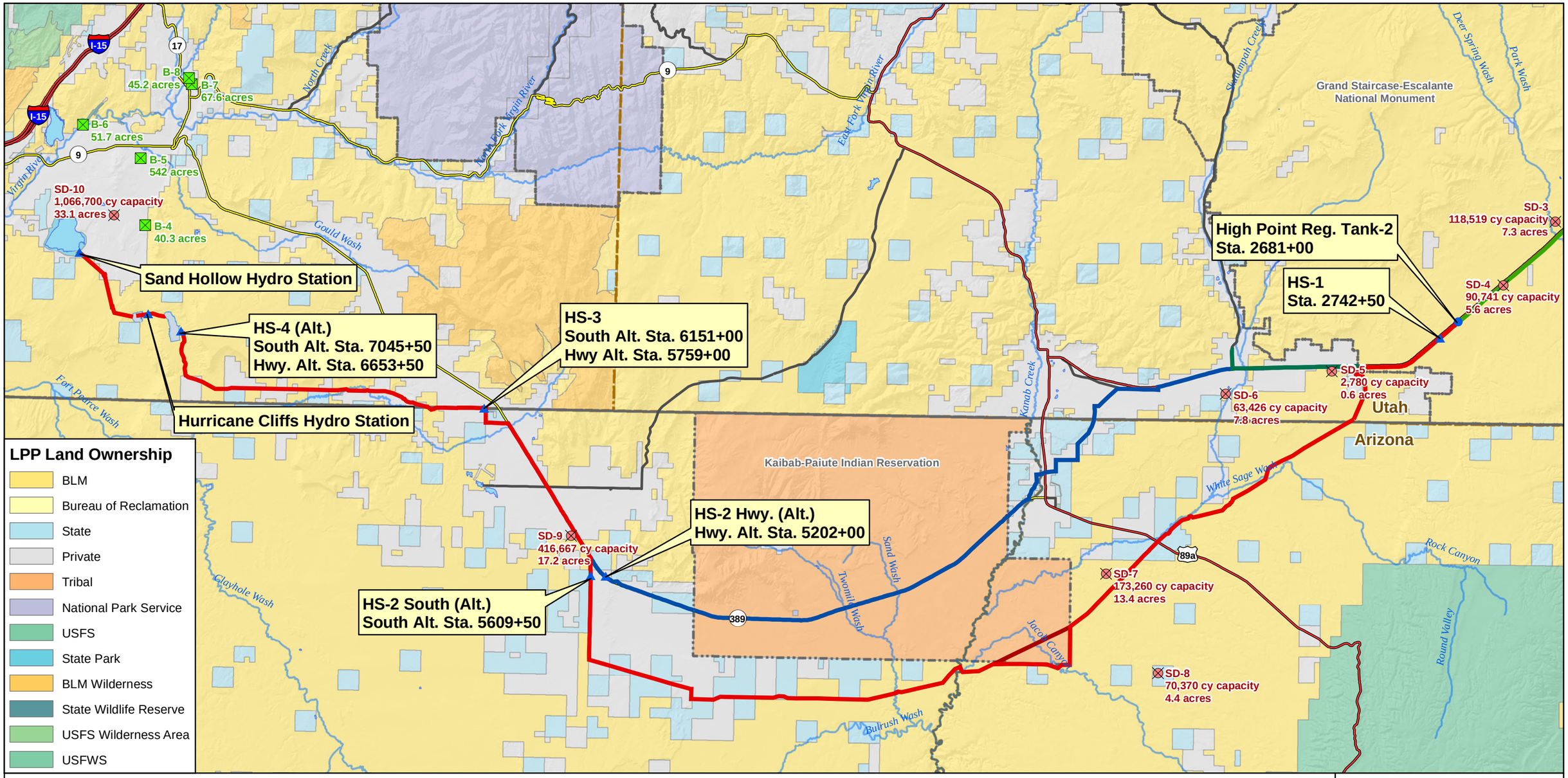
Alignment	Volume (cy)
Proposed Action	651,170
Existing Highway Alternative	1,398,614
Southeast Corner Alternative	671,415

Table 2-12
Volume of Imported Pipe Bedding Material Needed
(Assuming 25% of blasted rock is suitable for use as pipe bedding)

Alignment	Volume (cy)
Proposed Action	1,365,515
Existing Highway Alternative	1,756,780
Southeast Corner Alternative	1,366,053

Figures 2-5 and 2-6 show the locations of potential borrow and spoil pits along the LPP project Water Conveyance and Hydro systems, respectively. Depending on the available volume of acceptable borrow and spoil capacity at these pits, pipe bedding material and spoil locations outside of the LPP project area could be needed.


BPS-4 (Alt.)
Sta - 1926+50
Grand Staircase-Escalante
National Monument
Coyote Creek
SD-3
118,519 cy capacity
7.3 acres
Buckskin Gulch
B-3
52 acres
BPS-3 (Alt.)
Sta - 1316+50
89
Wahweap Creek
SD-4
90,741 cy capacity
5.6 acres
SD-2
25,000 cy capacity
1.0 acre
B-2
50.4 acres
B-1
104.5 acres
BPS-2
Sta - 840+00
High Point Reg. Tank 2
Sta - 2681+00
Utah
Arizona
Paria River
BPS-1
Sta - 73+00
SD-1
437,037 cy capacity
13.5 acres
Intake Pump Station
Sta - 0+00
Colorado River
LPP Land Ownership
BLM
Bureau of Reclamation
State
Private
Tribal
National Park Service
USFS
State Park
BLM Wilderness
State Wildlife Reserve
USFS Wilderness Area
USFWS
SD-# Spoil Disposal Site
B-# Borrow Source
Project Pump Station
Project Regulating Tank
Project Hydro Station
Water Conveyance System
Hydro System - Proposed Action
KCWCD System
Hydro System, Existing Highway Alternative
Hydro System, Southeast Corner Alternative
Interstate
US Highway
ST Highway
Hwy
Major Road
Lakes & Reservoirs
Major Rivers & Streams
National Park/Monument
GSENM-Boundary
State Boundaries
FERC Project Number:
12966-001
BLM Serial Numbers:
AZA-34941
UTU-85472
N
0 0.5 1 2 3 4
Miles
Lake Powell Pipeline Project
Spatial Reference: UTM Zone 12N, NAD-83
UDWRe
Figure 2-5
MWH
Lake Powell Pipeline
Borrow and Spoil Locations
Water Conveyance System



SD-# Spoil Disposal Site
B-# Borrow Source
Project Pump Station
Project Regulating Tank
Project Hydro Station

Water Conveyance System
Hydro System - Proposed Action
KCWCD System
Hydro System, Existing Highway Alternative
Hydro System, Southeast Corner Alternative

Interstate
US Highway
ST Highway
Hwy
Major Road

National Park/Monument
GSENM Boundary
Tribal Lands
State Boundaries
County Boundaries

Hurricane Cliffs Forebay/Afterbay
Lakes & Reservoirs
Major Rivers & Streams

FERC Project Number:
12966-001
BLM Serial Numbers:
AZA-34941
UTU-85472

N

0 1.25 2.5 5 7.5 10 Miles

Lake Powell Pipeline Project

Spatial Reference: UTM Zone 12N, NAD-83

UDWRe **Figure 2-6** MWH

Lake Powell Pipeline
Borrow and Spoil Locations
Hydro System

It is unclear to UDWRe what “regional standards for hardness” and what “would be acceptable material to use as bedding or road construction materials once crushed into aggregate” that FERC references in Additional Information Request Item 11. Neither the Arizona Department of Transportation (ADOT) nor the Utah Department of Transportation (UDOT) list hardness or strength requirements for pipe bedding or aggregates used for roadway surfacing (ADOT 2008) (UDOT 2012).

References

Arizona Department of Transportation (ADOT). 2008. Standard Specifications for Road and Bridge Construction.

Natural Resources Conservation Service (NRCS). 2012. National Engineering Handbook, Part 631 Geology.

Utah Department of Transportation (UDOT). 2012. Standard Specifications for Road and Bridge Construction.

U.S. Department of the Interior, Bureau of Reclamation (Reclamation). 1998. Engineering Geology Field Manual, Second Edition.

U.S. Department of Transportation – Federal Highway Administration (FHA). 2007. Geotechnical Technical Design Manual, Exhibit 4.6-F, Shrink/Swell Factors for Common Materials.