Table III-13a
Spoilpile Volumes - Reclamation Plan

	Pre-Reclamation Volume (000 CCY)	Post-Reclamation Volume (000 CCY)	Volume to Backfill (000 CCY)
Spoilpile 1	1,866	1,020	846
Spoilpile 2	3,342	1,987	783
Spoilpile 3 N	1,539	107	1432
Spoilpile 3 S	1,481	613	868
Total	8,228	3,727	3,929

*This reflects the 572,000 ccy of material already backfilled from SP 2 in 2010 and 2011.

3.5.6 Post-Mining Topography (Final Cut Lake)

The final cut lake configuration at the end of the permit term and that used for bonding purposes are the same with the exception of the amount of backfill and lake volume. Pit 2 will be completely backfilled and a final cut lake will be created in Pit 1 after it is partially backfilled. The location and configuration of the final cut lake and the regraded spoilpiles for the plan are shown on Plate III-18. The following tables summarize the size and configuration of the lake, and show other similar lakes in King County. Appendix III-20 is a stage-storage graph for the final cut lake.

Table III-14
Summary of Small, Deep-water
Lakes in King County

Lake Name	Surface Area (acres)	Maximum Depth (ft.)
Annette	85	17
Caroline	310	55
Derrick	140	36
Eagle	130	52
Findley	92	26
Kaleetan	180	41
Kulla Kulla	210	54
Langlois	98	39
Loch Katrine	200	49
Table III-14 (Continued)		
Loch Katrine (Upper)	130	23
Mason	92	29
Meridian	90	150

Moolock	150	41
Nadeau	7	18
Phillipa	340	120
SMC	180	37
Tuscohatchie	130	26

Table III-15
Dimensions of Final Cut Lake

Average Length	1,700 ft.
Average Width	900 ft.
Average Depth	47 ft.
Maximum Depth	105 ft.
Water Level	755 ft.
Surface Area	33.7 acres
Volume	1,450 acre-feet

Table III-16
Comparison of Depth vs. Surface Area for the Proposed Final Cut Lake

Contour Interval	Depth (Ft.)	Surface Area (acres)	% of SA
755-750	0-5	2.42	7.2
750-725	5-30	7.31	21.7
725-700	30-55	9.87	29.3
700-675	55-80	6.95	20.6
675-650	80-105	7.19	21.2
		33.7	100

3.5.7 Post Mining Land Use

3.5.7.1 Forestry

The landowner, Palmer Coking Coal Company intends to operate the property as a tree farm subsequent to final reclamation and has requested that all upland areas be reclaimed accordingly. Palmer requires most of the surface facilities, except for the coal preparation plant and crushing/screening plant, to support this post-mining land use (see Appendix III-14).

3.5.7.2 Fish and Wildlife Habitat

Creation of a final cut lake and riparian border to serve as fish and wildlife habitat is considered a highest and best use of the pit area. Based on consultation with the WDFW in 2000, there are no known species of concern or priority habitats that require special consideration located within the permit area. A number of federal, state and county regulations both protect against wetland loss and encourage the development of more wetlands and lakes. According to the Puget Sound Water Quality Management Plan (1987):

> "Wetlands are a valuable resource for a number of reasons. First, they are the most biologically productive ecosystems in nature, anchoring theestuarine and freshwater food chains through photosynthesis and the production of innumerable small organisms upon which larger creatures depend.
>
> For a fast diversity of species, including birds, fish, reptiles, invertebrates and mammals, wetlands are an essential habitat for feeding, nesting, cover, and breeding. At least one-third of our state's threatened and endangered species require natural wetlands for their survival.
>
> Wetlands also slow and store floodwaters, reduce shoreline erosion from wind and tidal action, and help recharge groundwater supplies. Wetlands function naturally to improve water quality by filtering out sediments, using excess nutrients, and breaking down some toxic chemicals. Socioeconomic benefits are provided by wetlands. Wetlands are a scenic destination for hiking, boating, photography, and nature appreciation. Wetlands contribute to a productive commercial and recreational fishery. Wetlands also provide important educational and research opportunities. The economic value of these functions is very high."

During the permit term the Mud Lake wetland area will not be disturbed. This area was and is classified as fish and wildlife habitat and will be hydraulically connected to the new lake. The lake and downstream wetlands will be managed for the same use during the five-year bond release period. As noted in Appendix III-14, the landowner supports this continuation of the pre-mining land use and has determined it is compatible with a variety of longer-term uses.

30 CFR § 816.49 (b) (1) provides that the lake size will be adequate for its intended purpose. The key factors considered in the lake design are lake depth, slopes and stability of the lake banks and shoreline design.

> <u>Lake Depth</u>. The lake will have a variety of depths with a maximum depth of 105 feet. The average depth is 47 feet and approximately one fourth of the 33.7 acre lake will be less than 25 feet. Another factor somewhat unique to the area is preventing underwater weed infestation and algal blooms which is a problem in most shallow lakes in the area. This has been especially severe in Lake No. 12 located adjacent to the mine. Further discussion of this issue

is presented in Lake Twelve Management Plan issued by King County Surface Water Management Division in May 1994. That report pointed out that the unwanted weeds, especially Eurasian water milfoil, thrived at depths of less than 13 feet and significantly impacted other uses for the lake. The design for the proposed Final Cut Lake will inhibit the growth of such unwanted weeds.

One potentially negative aspect of the depth of the lake design is dissolved oxygen (DO) depletion. Seasonal stratification is expected to occur from April to November. This will result in some decline of dissolved oxygen levels in the lake bottom waters. Hart Crowser's report (Appendix III-21) discusses this in greater detail. The conclusion drawn in that report is that worst-case DO concentrations in the Final Cut Lake are expected to be similar to other lakes in the area, at levels exceeding the general threshold below which some sensitive aquatic life may experience reductions in growth or productivity. Based on this conclusion, the lake design (with regards to depth) is adequate to support the proposed fish and wildlife use.

Bank slopes. The underwater portion of the lake bank is designed to slope at 3H-4H:1V to a depth of eight feet which is equivalent to approximately 25 feet horizontally from the low water level of the lake. The design provides a nominal 32-feet wide zone (during average water conditions) around the perimeter of the lake for shallow water habitat. The design is adequate to support the fish and wildlife use. The slightly steeper underwater slopes will be located along the north edge of the lake and will provide habitat diversity compared to the normal shallow water perimeter areas. Beyond the shallow water zone the lake slopes at the angle of repose of the fill material. This material is expected to remain stable under a variety of seismic conditions because of the hydrostatic pressure exerted by the water and the fact that the entire perimeter of the lake will consist of fill material and there is no unfilled portion of the pit to which unstable material can flow.

Shoreline configuration. While a more irregular shoreline may more ideal for the fish and wildlife use, the shoreline design for the Final Cut Lake resembles those of other lakes in the area (e.g. Lake No. 12). There is no reason that the proposed shoreline design would not be adequate for the fish and wildlife use.

30 CFR § 816.49 (b) (2) requires the quality of impounded water to be suitable on a permanent basis for its intended use. Projected water quality is discussed more fully in section 3.5.8.1. This information allows the determination that the water quality of the lake will be suitable for its intended use and will meet applicable State and Federal water quality standards.

30 CFR § 816.49 (b) (3) requires the water level to be sufficiently stable and capable of supporting the intended use. The lake water level as discussed in section 3.5.8

shows that the water level will vary within five and one-half feet, which is well within the range of level variation at other lakes in the region and is capable of supporting the fish and wildlife habitat use.

30 CFR § 816.49 (b) (4) requires that final grading provide adequate safety and access for proposed users. The lake perimeter will be graded at 4H:1V to an eight foot depth although there are some areas along the northern edge of the lake that the grade will increase up to 3.0H:1V. This level of grading achieves this requirement as the lake is not proposed to be used for public purposes such as swimming or recreation. It will be a privately owned lake that will be managed as fish and wildlife habitat.

30 CFR § 816.49 (b) (5) ensures that the proposed impoundment will not result in the diminution of the quality and quantity of water utilized by adjacent or surrounding landowners for agricultural, industrial, recreational or domestic uses. There are no adjacent or surrounding agricultural, industrial or domestic users. These are all supplied from the City of Black Diamond municipal water system or from private wells that have not been adversely impacted by mining and will not be adversely impacted by construction of the final cut lake in Pit 1.

30 CFR § 816.49 (b) (6) requires that the impoundment be suitable for the approved post-mining land-use of fish and wildlife habitat. The evidence is very strong that this will be the case.

3.5.8 Post-mining Hydrology

3.5.8.1 Water Quality in the Final Cut Lake

The applicant has been sampling water quality from Pit 2 on a monthly/quarterly basis since August 1992 as a requirement of its NPDES permit. While the Pit 2 data is interpreted by WDOE as a potential source of groundwater, it is also indicative of the final cut lake water quality. Sampling is conducted by a professional employee of Pacific Coast Coal Company who is trained in technically sound sampling procedures. Metal concentrations are analyzed by Lauck's Testing Laboratory (Seattle) while temperature, specific conductance and pH are measured on site at the time of sampling. Temperature, pH and specific conductance have been provided to OSM on a monthly basis and the metals on a quarterly basis. The following table summarizes the quarterly Pit 2 sampling from August of 1992 through May of 1997.

Table III-18
Pit 2 Water Quality

	Min.	Max.	Average
PH	7.6	8.8	8.3
Sp. Cond.	487	1,200	918
Arsenic	ND (<0.005)	0.028	ND (<0.005)
Iron	ND (<0.05)	0.84	0.157
Manganese	ND (<0.002)	0.07	0.017
Mercury	ND (<0.0002)	0.001	ND (<0.0002)
Lead	ND (<0.005)	0.03	ND (<0.005)
Chromium	ND (<0.001)	0.009	0.001
Hardness	36	400	185

All values are expressed in mg/L except pH and S.C. (umho/cm).

For calculation of the average all non-detectable (ND) values are assumed to be zero.

On page three of Appendix III-21, Projected Water Quantity and Quality Characteristics for the Final Cut Lake (Hart Crowser Earth and Environmental Technologies), it states that the data obtained from the in-pit sampling “represent conservative estimates of long-term lake water quality, since natural settling and attenuation mechanisms within the lake are expected to further improve water quality conditions.”

OSMRE made the following predictions of water quality in the pit and final cut lake in the original Cumulative Hydrologic Impact Assessment (CHIA) for the John Henry No. 1 Mine. The pit predictions match to the observed values fairly closely.

Table III-19
*Expected Range of Mine Discharge

	Low Flow Period	High Flow Period
PH	8.4	6.7
Conductivity	610	250
Arsenic	0.047	0.02
Mercury	**ND	**ND
Iron	3.5	1.4
Manganese	0.10	0.04

* All values are expressed in mg/L except pH and Conductivity (umho/cm).
** ND = Not detectable (Assumed to be 0).

OSMRE concluded that no surface or groundwater impacts would occur as a result of the creation of a final cut lake. The following paragraphs are excerpts from the CHIA:

"Following backfilling and reclamation of Pits 1 and 2, restoration of the backfilled pits will occur until a steady-state hydraulic head distribution similar to the pre-mining condition has been established. Water quality of groundwater within the backfilled pit areas has been estimated based on water samples from abandoned mine drainage at the nearby McKay Section 12 Mine and is presented in Table IV-16 (CHIA). A slight increase in TDS and a decrease in pH may be expected, accompanied by a change in water type from a sodium bicarbonate chemistry to a calcium bicarbonate chemistry with higher levels of sulfate (although not exceeding drinking water supply standards). Results of water quality sampling indicate that levels of trace elements and heavy metals in spoils groundwater will not exceed background levels."

"The effect of spoils groundwater inflow to surface water bodies will be minimal and will not degrade or alter the use classification of area lakes and streams. The surface water body most likely to be affected in this manner is the final cut lake, as this water body will be in direct contact with backfilled spoils. A mass-balance approach is utilized to estimate the water quality of this final cut lake based on inflow rates from surface runoff, precipitation on open lake/wetland areas, the groundwater inflow as detailed in Appendix XIII-2 of Vol. VI of the original PAP. Analysis has been done for both the high-flow and low flow months to provide a range of anticipated water quality in the proposed lake/wetlands."

"From Table 4.18 (CHIA) it is seen that groundwater inflows to the proposed final-cut lake range from nine percent to nearly 50 percent of the total inflow, depending on the season. Thus, groundwater quality may influence to a large extent the suitability of the proposed lake for post-mining use which includes aquatic habitat and recreation activities."

"Using the mass balance approach, the approximate chemical makeup of the water comprising the final-cut lake can be estimated. The results of this analysis are given in Table 4.19 (CHIA)."

Components of Final Cut Lake Inflows During Post-mining Period

	Precipitation	Runoff	Ground Inflow (assume from spoils)	Total
Dry Season (Jul)	38.7	46.7	82.5	167.9
Wet Season (Dec)	216	607	82.5	905.5

NOTE: All flows in gpm on an average monthly basis.

Table III-19a
Anticipated Chemical Quality of
Final Cut Lake During Post-mining Period.

	Dry Season	Wet Season	Water Quality Criteria
PH	6.9	6.8	6.5 to 8.5
EC	400	130	
TDS	270	90	500
SAR	1.0	0.2	
Cations:			
Mg	18	5	
Ca	47	11	
K	2.2	0.8	
Na	9.2	3.6	270
Anions:			
HCO3	164	45	
C1	1.8	0.9	250
NO3	0.6	0.5	
SO4	81	20	250
Metals:			
Hg	<0.0005	<0.0005	
As	<0.01	<0.01	0.05
Fe (total)	0.24	0.53	0.30
Mn (total)	0.03	0.05	0.05

NOTE: All concentrations in milligrams per liter (mg/L) except pH (pH units), EC (micromhos per centimeter), and SAR (milliequivalent ratio).

“Water quality predictions for the proposed final cut lake area indicates that during the wet season, surface runoff into the lake from undisturbed areas may contribute concentrations of total iron which exceed the accepted drinking-water standard, although acceptable for aquatic life. This prediction is based on average total iron concentrations observed for the Mud Lake drainage basin in the existing water quality of this drainage basin.”

“Levels of total iron and total manganese in excess of accepted water quality criteria occasionally observed in area surface waters and groundwater in the existing (pre-mining) environment. Additionally, concentrations of arsenic in excess of drinking-water standards in groundwater are observed at several monitoring wells and private wells, most notably the Buckley well located on the northwest edge of Lake No. 12. Based on water-quality samples from groundwater and surface water sources from disturbed areas at the existing McKay Section 12 Mine, it can be inferred that iron and manganese will continue to propagate through the hydrologic environment at levels similar to existing background conditions with possible slight increases. However, it does not appear likely that arsenic and other trace elements and heavy metals present in overburden and interburden strata will be sufficiently mobile in the hydrologic environment to be present in concentrations grater than accepted water-quality standards. The presence of high arsenic levels in the Buckley well is presumably due to local geochemical conditions in the recharge area located in the uplands north of Lake No. 12. This recharge area does not lie within the proposed John Henry No. 1 Mine permit area and will not be disturbed by the mining operation."

"Groundwater quality of the backfilled mine pits is not expected to degrade or preclude usage of area groundwater resources either during mining or in the post-mining period. This conclusion is based on groundwater samples that were taken from areas down gradient of existing mined areas and spoil piles at the McKay Section 12 Mine. Water quality of surface water bodies which intercept groundwater seepage from backfilled areas, such as the reconstructed Mud Lake/wetlands area, should be of acceptable quality to support proposed post-mining uses."

3.5.8.2 Surface Water Hydrology

The hydrologic analysis for the final cut lake includes:

1) Runoff determination for the 100 year storm.
2) Seasonal water input analysis.
3) Worst case fluctuation in water levels.
4) Effect on Mud Lake stream flows.
5) Spillway design.

The peak runoff determination was accomplished using the SCS Upland Curve Method. The basin is estimated to be approximate 351 acres, including approximately 28 acres of lake surface area.

Peak runoff into the lake during the 100 year - 24 hour event would be 48.33 cfs. Total runoff volume would be 56.31 acre-feet.

Assuming the lake was empty initially, and that input to the lake is a function of surface runoff and direct precipitation to the lake minus lake evaporation, total lake input may be estimated.

Ground water input to the lake is assumed to be negligible based upon observation in the pits. So far in 340 feet of excavation, groundwater input has been less than 10 gpm. This compares favorably with earlier estimates by GeoEngineers and OSMRE. Restoration of the backfilled areas is also considered negligible based upon the relative impermeability of the spoil.

The drainage basin area used in the analysis is listed in the table below.

Table III-20
Drainage Basin Acreage's

Drainage Basin	Pre-mining Acres	Post-mining Acres
Lake 12	382	372
Ginder Creek	923	920
Mud Creek/Lake	401	188
Final Cut Lake	-	226
Total	1,706	1,706

Plate III-22 is a map of the Post-mining Drainage Basins.

The seasonal curve number for disturbed and undisturbed reclaimed areas were as follows:

Table 20a
Seasonal Curve Numbers

	Dec-Feb	Mar-May	June-Aug	Sept-Nov
Undisturbed Land *	70	70	70	70
Disturbed Land *	77	77	77	77

* Estimated from King County Surface Water Design Manual (1994).

The runoff volume for these areas was calculated using the formula:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

$$\text{where } S = \frac{1000}{CN} - 10$$

Q = runoff inches
P = precipitation inches
CN = curve number

Data used in Hydrological Budget Analysis:

Table III-21
Data used in Hydrological Budget Analysis (inches)

	Dec-Feb	Mar-May	June-Aug	Sept-Nov	Annual
Precipitation	19.5 (a)	13.6 (b)	6.8 (b)	16.1 (b)	56.0
Runoff reclaimed area	16.3	10.6	4.2	13.0	44.1
Runoff undisturbed area	15.2	9.5	3.5	11.9	40.1
Lake evaporation	1.4 (c)	6.6 (c)	11.9 (c)	4.1 (c)	24.0

(a) Source: Phillips, E.L., 1968 Washington Climate, King, Kitsap, Mason and Pierce counties; Washington State University, College of Agriculture, Publication EM 2734, 16p plus tables.
(b) Proportionately increased from the monthly precipitation data for Buckley which is tabulated in Phillips (1968).
(c) Adjusted from Phillips (1968).

The flows were calculated using:

$$Q = \frac{V \times A \times 43560}{T \times 60 \times 60 \times 24 \times 12}$$

Where Q = flow in cfs
V = volume in inches
A = Area in acres
T = volume period in days (91.25 days per quarter)

The units for the equation above are $$\frac{(in)(ac)\left(ft^2/ac\right)}{(days)\left(\sec/\min\right)\left(\min/hr\right)\left(hr/day\right)\left(in/ft\right)}$$

This gives average projected lake outflow (cfs) for each quarter.

Table III-22
Average Projected Lake Outflow (cfs)

	Area (acres)	Dec-Feb	Mar-May	June-Aug	Sept-Nov	Average
Direct Precipitation	28	0.25	0.17	0.09	0.21	0.18
Runoff reclaimed area	93	0.69	0.46	0.18	0.56	0.47
Runoff undisturbed area	105	0.73	0.46	0.17	0.58	0.48
Lake evaporation	28	(0.02)	(0.09)	(0.15)	(0.05)	(0.08)
Total	226	1.65	1.00	0.29	1.30	1.05

Note that the area for lake evaporation is not added to the total area. It is used to support the calculations in the other columns. Average annual flow through the final cut lake will be 1.05 cfs (760 acre-feet/year). At 1,450 acre-feet volume it will take 1.9 years to fill the lake to the spillway level under average annual precipitation conditions. The main cause for seasonal fluctuations in lake level would be dry years. Data from a drought in 1987 was used to estimate dry season fluctuations in lake level.

Table III-23
Data used in worst case Hydrological Budget Analysis (inches)

	Dec-Feb	Mar-May	June-Aug	Sept-Nov	Annual
Precipitation	15.35 (a)	14.85 (a)	1.09 (a)	5.17 (a)	36.46
Runoff reclaimed area	12.27	11.78	0.07	2.77	26.89
Runoff undisturbed area	11.19	10.71	0.01	2.16	24.07
Lake evaporation	1.4 (b)	6.6 (b)	17.4 (c)	5.1 (c)	30.50

(a) 1987 precipitation (recent drought year)
(b) GeoEngineers hydrological report Feb. 1983 (Table 1)
(c) CHIA Simons, H & Associates, Dec 1984 (Table 2.6)

Table III-24
Projected Lake Outflow in worst case (CFS) - 1987 Data Used

	Area (Acres)	Dec-Feb	Mar-May	June-Aug	Sept-Nov
Direct Precipitation	28	0.20	0.19	0.01	0.07
Runoff reclaimed area	93	0.52	0.51	0.01	0.12
Runoff undisturbed area	105	0.54	0.52	0.00	0.10
Lake evaporation	28	(0.02)	(0.09)	(0.22)	(0.07)
Total	226	1.24	1.13	(0.20)	0.22

The lowest water level in the final cut lake occurs in the June-August period with a net (0.20) cfs outflow, which reduces the water level by less than 1.3 feet. Since the normal water level will be 755 feet, the low water level will be 753.7 feet or higher during dry years.

Table III-25
Comparison of Drainage Sub-basin Areas and Flows

	Pre Mining		During Filling of Impoundment		Reclaimed	
Drainage Basin	Acres	Cfs	Acres	Cfs	Acres	Cfs
Mud Lake Creek	78	0.16	63	0.32	63	0.32
Mud Lake	323	0.79	125	0.63	125	0.63
Final Cut Lake	-	-	226	0	226	1.05
Total Mud Lake Creek	401	0.95	414	0.95	414	2.00

During the filling of the impoundment Mud Lake creek flow will not be reduced from baseline. The reason for this is discussed below. After the filling of the lake in approximately 2.6 years, the flow will be increased by 1.05 cfs to 2.00 cfs. As noted in Table III-25 Mud Lake (wetlands) will continue to receive an average of 0.63 cfs from 125 acres immediately surrounding the wetland as shown on Plate III-20. Once the lake is full an additional 1.05 cfs will flow from the lake through the Mud Lake wetland. The 0.63 cfs from Franklin Hill and other areas surrounding the wetland will continue to flow through the wetland.

Direct Impact From Lake Fill on Downstream Flow. Actual water flow data from Mud Lake Creek over the period 1993-1999 is used to estimate the impacts on downstream flow when the lake is being filled. This analysis shows total flow of 2.00 cfs with 1.05 cfs average flow into the new lake and 0.95 cfs residual flow in Mud Lake Creek while the lake is filling. These numbers are based on actual conditions from 1993-1999 and should reasonably reflect future conditions.

Original estimates for average flow from both Mud Lake Creek and Ginder Creek watershed were presented in the Determination of Hydrological Consequences prepared by Systems Architects Engineers (SAE) Inc., P.S. under a SOAP contract. Those flow estimates were based on USGS regression models using drainage area and average precipitation. The model results were then correlated with the stream flow record at Big Soos Creek located down drainage from the mine site. The correlation was made using watershed area proportioning techniques. Average annual flow in Ginder Creek was estimated at 2.5 cfs, flow into Ginder Lake was estimated at 0.2 cfs, flow into Mud Lake wetland was estimated at 0.79 cfs and average annual flow in Mud Lake Creek estimated at 1.3 cfs. As it turns out these were incorrect.

The 1993-99 period used to estimate flow from Mud Lake Creek showed actual flows of 1.99 cfs compared to the 1.3 cfs estimated by SAE. PCCC does not directly monitor the flow in Ginder Creek but does monitor the flow into Ginder Lake. Flow into Ginder Lake averaged 0.8 cfs over the same seven-year period. The combination of flow through Mud Lake Creek and flow into Ginder Lake was 2.8 cfs compared to estimated (from the regression analysis) combined flow of 1.5 cfs. This represents an 87 percent increase of actual flow over projected for these two points where flow is measured. It is logical to assume, based on the relative size of the watersheds, that a proportional increase in Ginder Creek flow also occurred during the same period. Applying the factor determined for Mud Lake and the flow into Ginder Lake to predicted flow for Ginder Creek results in average annual flow of 4.67 cfs in Ginder Creek above its confluence with Mud Lake Creek.

Thus the reduction in annual average flow in Ginder Creek at its confluence with Rock Creek due to lake filling under the new plan is 15.6 percent. The correct comparison is 6.66 cfs (1.67+0.32+4.67) before and after the fill with 5.62 cfs (0.32+.63+4.67) during the fill.

<u>Spillway Design</u> The lake outlet discharges directly down a 75 foot trapezoidal spillway into Mud Lake. The spillway was designed with the assumption that the

peak inflow produced by the 100-year 24-hour storm event, plus the normal flow during winter months would pass through the spillway. See Appendix III-22 for plan and sectional views of the spillway design.

Lake surface area	-	33.7 acres
100 yr. storm volume	-	56.31 acre-feet
100 yr. storm peak flow	-	48.33 cfs
Normal winter flow	-	2.54 cfs (see Table III-22)

The channel will be from the final cut lake outflow at an elevation of 755 feet to Mud Lake at an elevation of approximately 753 feet. The channel will be trapezoidal and have the following dimensions:

Base width	6 feet
Gradient	0.027 feet/feet (2V/75H)
side slopes	3h:1v
D 50	0.67 feet
Riprap thickness	1.0 feet
Filter thickness	1.0 feet
Channel length	75 ft.

The drainage basin for the Final Cut Lake is shown on Plate III-20. For the purpose of this calculation, the 226 acre basin was split up into 4 watersheds. The following watersheds were input into OSM's public domain 'STORM' software (see Appendix III-22). Watershed #1 is 60 acres and represents the area on the hillside to the south of the PA from which the drainage will be routed to the lake. Of the remaining 94 acres of the hillside (watershed #2) 45 acres will drain directly to the final cut lake and 49 acres drain into Mud Lake wetlands. Watershed #3 (93 acres) is the reclaimed backfill area to the north of the final cut lake and its drainage will sheet flow directly into the final cut lake. Watershed #4 (76 acres) is located north of the backfill area and its drainage will sheet flow into Mud Lake wetlands. The boundaries of these sub-watersheds are delineated on Plate III-20.

The 100-year 24-hour storm event was used to ensure adequate sizing of the lake's discharge structure. The value of 4.4 inches was taken from the King County Surface Water Design Manual. A curve number of 70 was used for undisturbed areas and 77 was used for those areas that will have been reclaimed. Using the STORM program, the peak discharge of cfs was calculated. This value was added to the normal winter discharge of 2.54 cfs (drawn from Table III-22) to determine the total flow of cfs. The total volume of discharge from the design event is acre-feet. Assuming no discharge during the event, this would raise the lake surface level by only 2 feet.

STORM was then used to calculate the flow depth in the spillway by passing the total flow through the spillway design (see Appendix III-22). The peak flow will pass through the spillway at a depth of 1.00 feet, leaving one foot of freeboard.