Bureau of Land Management & Bureau of Mining Regulation and Reclamation

GUIDANCE DOCUMENT

HEAP LEACH DRAINDOWN ESTIMATOR AND PROCESS FLUID COST ESTIMATOR

Introduction

The Heap Leach Draindown Estimator (HLDE) model was developed by JBR Environmental Consultants, Inc. and Newmont Mining Corporation as a tool for estimating heap leach pad draindown curves that are designed to be used for reclamation bonding purposes. The HLDE model is widely used by the mining industry and by the Bureau of Land Management (BLM) in Nevada and the Nevada Division of Environmental Protection (NDEP). This user guide has been developed by the regulatory agencies to help define user inputs, improve clarity, and increase user comfort with the model.

The HLDE model is based on the Brooks and Corey (1964) equation:

$$K(\theta) = K_S \left(\frac{\theta - \theta_r}{\theta_{sat} - \theta_r} \right)^{\gamma}$$

Where,

θ is the volumetric moisture content
Ks is the saturated hydraulic conductivity
θ r is the residual moisture content
θ sat is the porosity or saturated moisture content
γ is an empirical parameter related to grain size distribution
*All moisture contents are volumetric

The results from HLDE are only as good as the data that is entered. Be sure that accurate hydrologic data is entered to receive accurate results. Site specific parameter values are always recommended. If site specific parameters are not used, justification may be required. The input information should be available in the Water Pollution Control Permit Application submitted to the NDEP, Bureau of Mining Regulation and Reclamation during permitting of the leach pad. Input information can also be obtained from various operations/process staff at the mine site. As the leach pad becomes more mature, the HLDE model should be updated with input values that reflect the actual characteristics of the leach pad.

Heap Leach Draindown Estimator (HLDE)

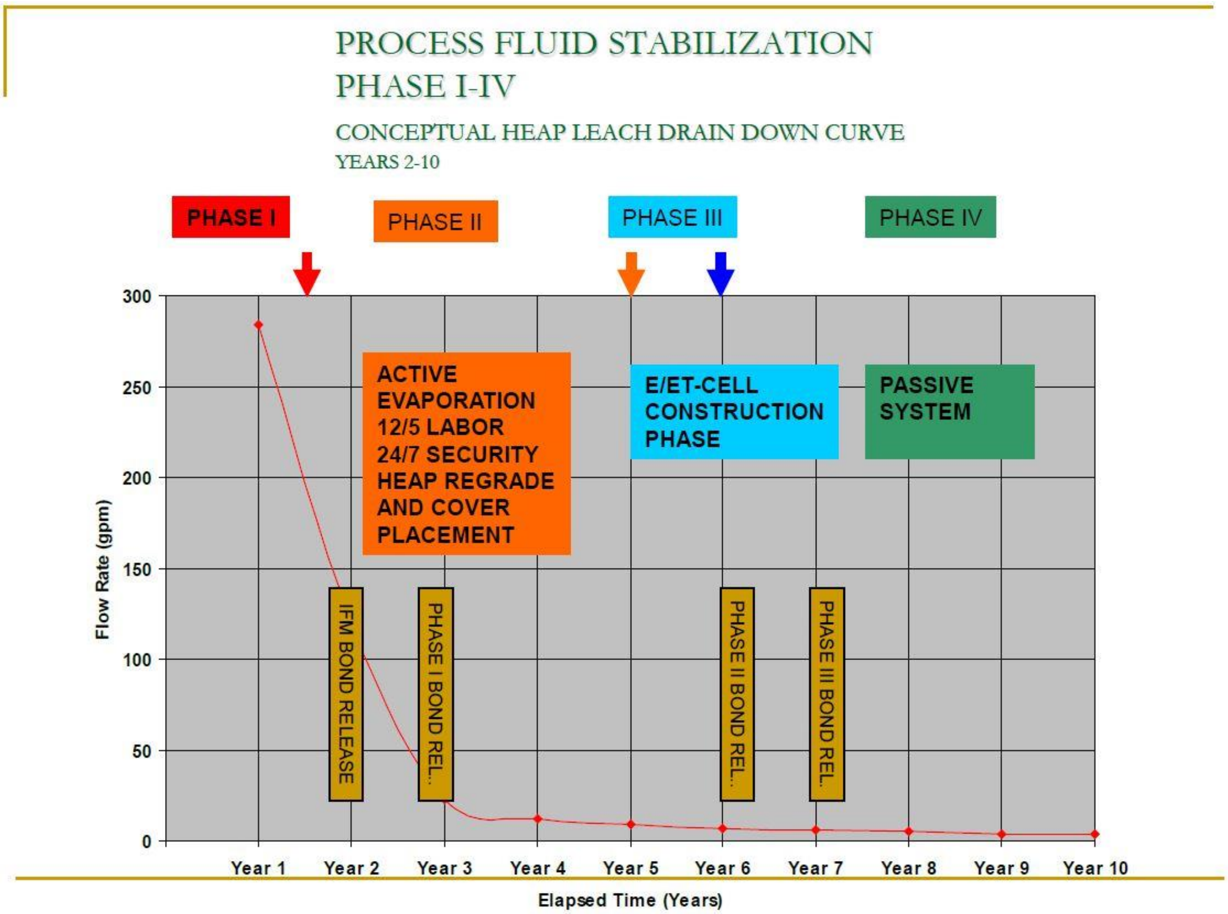
What is the goal of HLDE?

The goal of HLDE is to model/predict the draindown curve for the closure of a heap leach facility. This information is used to assess the manpower and equipment needed for interim fluid management, solution recirculation, and both active and passive evaporation. Assessing these needs is critical to determining the costs associated with the safe and proper process fluid stabilization of a heap leach facility after the sudden or unanticipated closure (or abandonment) of a site. The agencies view stabilization of a leach pad in two main categories:

1) Interim Fluid Management (IFM):

   43 CFR 3809.552(a) states, "If you conduct operations under a notice or a plan of operations and you provide an individual financial guarantee, it must cover the estimated cost as if BLM were to contract with a third party to reclaim your operations according to the reclamation plan, including construction and maintenance costs for any treatment facilities necessary to meet Federal and State environmental standards. <u>The financial guarantee must also cover any interim</u>

stabilization and infrastructure maintenance costs needed to maintain the area of operations in compliance with applicable environmental requirements while third-party contracts are developed and executed." So IFM considers the costs to recirculate solution and maintain a heap leach facility after closure, and during the time required for BLM/NDEP to establish a third-party contract for management of the PFS operations. IFM ensures that process ponds do not overtop. The NDEP regulations at Nevada Administrative Code (NAC) 519A.392 were established for these purposes, as well.



2) Process Fluid Stabilization (PFS) is defined at NAC 519A.068 as, "binding, containing or otherwise treating contaminants in a fluid, including, without limitation, meteoric waters, that have intentionally or unintentionally been introduced into a heap leaching facility or tailings facility to prevent the contaminants from degrading the waters in this State through naturally occurring environmental conditions which may be reasonably expected at the mine site." PFS is considered to occur in phases:

- Phase 1 – Recirculation of process solution and active evaporation of fluids.
- Phase II – Active evaporation of fluids when recirculation is no longer required.
- Phase III – Construction of passive evaporation system (E/ET Cells) and placement of cover material on heap leach facility.
- Phase IV – Passive evaporation of process solution.

What are the Inputs for HLDE? (Many of these inputs are included in the Water Pollution Control Permit application.):

1. Total Area of Heap Leach Pad: surface area covered by a heap leach pad (HLP) in square feet. Include all portions of the lined area that would report to the process ponds. A separate HLDE model should be prepared for each HLP, unless multiple pads report to one process pond.

2. Area of Actively Used Heap Leach Pad: the maximum surface area authorized for active leaching in the Plan of Operations and/or Water Pollution Control Permit.

3. Area of Historically Used Heap Leach Pad: the remaining surface area of the HLP that is not considered actively leached.

4. Operational Draindown Rate: amount of process fluid that drains from HLP in gallons per minute (often disclosed in Water Pollution Control Permit Fact Sheet – not to be exceeded).

Total Area of Heap Leach Pad	ft^2		
	acres	0	
Area of Actively Used Heap Leach Pad	ft^2	Cell F6	Site specific input. See User Guide notes 1 - 4.
Area of Historically Used Heap Leach Pad	ft^2		
Operational Draindown Rate	gpm	Cell F8	
Application Rate	gpm/ft^2		= "Operational Draindown Rate"/"Area of Actively Used HLP" = Cell F8/Cell F6. See User Guide note 5.
Height of Heap Leach Pad	ft		= ore volume / HLP lined footprint. See User Guide note 6.
Saturated Hydraulic Conductivity (K_s)	ft/day		Site specific input. See User Guide notes 7 - 9.
Residual Water Content (θr)	Decimal		
θs (saturated moisture content)	Decimal		
θapp (active application moisture content)	Decimal		Site specific input, or $\theta app = (\theta s - \theta r)*0.75 + \theta r$
$\theta hist$ (moisture content of historic part at PFS start)	Decimal		Site specific input, or refer to HLDE "Notes" Tab.
γ (empirical drainage parameter)	unitless		Site specific input, refer to HLDE "Notes" Tab. See User Guide note 12.
Time unit of interest		Days	

5. Application Rate: is the amount of cyanide solution added to the HLP in gallons per minute (gpm) per square foot (often disclosed in Water Pollution Control Permit fact sheet – not to be exceeded).

6. Height of Heap Leach Pad: is the average height of material being leached, calculated as volume of heap material divided by total area of heap leach pad.

7. Saturated Hydraulic Conductivity (K_S): is the rate of solution flow through the heap under saturated conditions, expressed in feet per day (generally less than 100 feet per day).

8. Residual Water Content (θ_r): is the moisture content of heap material after solution application has ended and gravity drainage is complete (θ_r is generally determined through column tests).

9. Saturated Moisture Content (θ_s): is the moisture content of the heap when saturated. If you had a known volume filled with rocks and leachate, what percentage of the volume would be leachate (varies depending on grain size of heap material and pore spacing, but generally between 0.20 to 0.30)?

10. Active Application Moisture Content (θ_{app}): is the moisture content of the heap during operations. (Should be slightly less than θ_s; refer to HLDE "Notes" tab.)

11. Moisture Content of Historic Part of HLP (θ_{hist}): is the moisture content of the heap leach pad that has been leached in the past but is not currently under active leach. (Refer to HLDE "Notes" tab.)

12. Empirical Drainage Parameter (γ): This CANNOT BE DETERMINED UNTIL ALL OTHER INPUTS ARE IN PLACE. Gamma is a unitless number generally related to the pore size of the heap material. Crushed ore will generally be less than 10, while run-of-mine ore will have a higher gamma value. (Refer to "Notes" tab.) To determine the gamma value, set the "Pump

Capacity" in cell E46 to 0. (This is done to eliminate recirculation when determining the gamma value.) Start with a gamma value of 10 and adjust the value up or down until the "Total Flow gpm" column on the HLDE "Calcs active" tab (cell H15) is close to the "Operational Draindown Rate" in cell F8 on the "Input & Results" tab. Once the calculated total flow on Day 1 is approximately equal to the operation draindown rate, your gamma value is correct. Remember to RESET the Pump Capacity value.

13. Precipitation: (Some of this information can be found in Water Pollution Control Permit application):

Precipitation				
Total Annual Precip		inches		Site specific input
Uncovered Infiltration Rate	Cell D21			Site specific input, refer to "Notes" tab, or use "Infiltration Rate" Calculator
Covered Infiltration Rate				Site specific input, or = 50% of uncovered infiltration rate= 50% x Cell D21
Monthly portion				
	%	inches/mo.	inches/day	
January		0.00	0.000	Site specific input = monthly precip. / annual total
February		0.00	0.000	
March		0.00	0.000	
April		0.00	0.000	
May		0.00	0.000	
June		0.00	0.000	
July		0.00	0.000	
August		0.00	0.000	
September		0.00	0.000	
October		0.00	0.000	
November		0.00	0.000	
December		0.00	0.000	
Total (must equal 100%)	**0%**	**0.00**	**0.00**	

a. Enter Total annual precipitation for the site, in inches

b. Uncovered Infiltration Rate: percentage of precipitation that infiltrates portions of the heap leach pad that have not been covered as part of reclamation (use on-site data, if available. Otherwise, use the rates provided on HLDE "Notes" tab or use the "Estimated Precipitation Infiltration Rate Calculator for Uncovered Heap Leach Pad" tool developed by NDEP and available at the Division's webpage BMRR Reclamation Cost Estimator.

c. Covered Infiltration Rate: percentage of precipitation that infiltrates portions of the HLP that have been covered as part of reclamation. If cover study has been completed, those values should be used. If cover study has not been completed, assume covered infiltration rate is about ½ of uncovered infiltration rate.

d. Monthly portion: Add precipitation distribution as a percentage, by month. Most mine sites have meteorology stations which would provide the best data, if an adequate period of record exists. If site specific data is not available, or the period of record is too short to establish representative average values, use Western Regional Climate Center (WRCC), NOAA Climate database, or PRISM database.

14. Pond Capacity Data:

    a. Pond Capacity Data: enter volume of pregnant pond(s) or other double-lined pond(s) capable of receiving solution by gravity using connecting spillways.

    b. Beginning Pond Level: enter volume of solution held in pregnant pond(s) during normal operations, plus 24 hours of draindown. If overtopping occurs, use 12 hours of draindown instead of 24 hours.

Pond Capacity Data			
Pond Capacity Data[2]	Cell E40	gal	Pond storage capacity from bottom to freeboard. See User Guide note 14(a).
	0	ft3	
Beginning Pond Level		gal	= Pond volume at normal operating levels plus 24 hours of draindown. See User Guide note 14(b).
	0	ft3	Generally = 50% "Pond Capacity Data" (Cell E40) + 24 hours of draindown.

15. Recirculators:

    a. Pump Capacity: Should generally be the same as the Operational Draindown Rate. A higher pump capacity can be used if there is pond overtopping, but this pump capacity should be limited to 1.5 times the Operational Draindown Rate in cell F8.

    b. Pond Volume that Triggers Recirculation: enter pond volume that triggers recirculation. This volume should be set below the freeboard volume of the main operating pond(s). Ideally, the recirculation volume should be set to the normal operating volume of that pond, or approximately 50% of the pond capacity. The pond volume that triggers recirculation should not exceed 75% of the pond capacity. If more than one pond is needed, additional pumps will be required in the Process Fluid Cost Estimator (PFCE) spreadsheet.

Recirculators			
Pump Capacity	Cell E46	gpm	Generally = "Operational Draindown Rate" = Cell F8
	0	ft^3/day	
Pond Volume that Triggers Recirculation		gal	= <75% of "Pond Capacity Data" = no more than 75% x Cell E40
	0	ft3	

16. Monthly Evaporation Data: enter pan evaporation data in inches per month (Again, site specific information is ideal. If no evaporation data is available onsite, use a representative site on WRCC or similar. Another option is to monitor evaporation loss from the process ponds.)

17. Evaporators:

    a. Number of Evaporators on Day 1: enter number of evaporator units that would be used (Keep in mind that evaporators must be at least 500 feet apart to prevent overspray and all solution must be kept within containment. These factors may limit the amount of evaporators that can be used at any given time).

    b. Evaporator Pump Capacity: The EcoMister dual evaporation pumps used in PFCE operate at 160 gallons per minute.

    c. Evaporator Operator Time: evaporators generally run for 12 hours per day.

d. Efficiency: enter efficiency rating as a percentage for each month that evaporators would be used to establish the Average Efficiency. Use table on “Notes” tab or the “Evaporation Efficiency Calculator” developed by NDEP if site-specific data is not available. The Evaporation Efficiency Calculator is available at BMRR Reclamation Cost Estimator. Do not input 0% for months that evaporators would not be used because that will erroneously decrease the average efficiency.

Evaporators				
Number of Evaporators on Day 1		Cell K22		Site specific input, based on the available space for Evaporators at the pond - assume min. 500 ft perimeter clearance between evaporators.
Evaporator Pumping Capacity			gpm	160 gpm (typical)
Evaporator Operating Time			hr/day	Generally = 12 hr/day, but can be adjusted to aviod overflow
	Efficiency	Effective Evaporation		
	%	ft^3/day		
January		0		1. Site specific input; or 2. refer to HLDE "Notes" Tab; or 3. use "Effeciency" Calculator ---See User Guide note 17(d).
February		0		
March		0		
April		0		
May		0		
June		0		
July		0		
August		0		
September		0		
October		0		
November		0		
December		0		
Averages	Cell J39	0		

18. ET Cell Data:

a. Total Existing ET Cell Area: If engineering design has been completed for E/ET-cell construction, enter the surface area (in square feet) for the designed E-cell. If engineering has not been completed, enter the surface area at freeboard of pond(s) that will be converted to ET cell (must be double-lined pond).

b. Total Flow Capacity of ET Cell: Enter site-specific flow capacity, if known. If site specific data is not available, flow capacity is generally assumed to be 2.0 gpm per acre.

ET Cell Data			
Total Existing ET Cell Area[1]		ft^2	Site specific input, measured at freeboard. See User Guide note 18(a).
	0.00	ac	
Total Flow Capacity of ET Cell		gpm/ac	Generally = 2.0 gpm/ac, unless site specific data is available.
	0.00	gpm	

What do all these numbers mean?

The modeled results from HLDE are used as input parameters in PFCE (see below). More specifically, HLDE will provide the total volume of water recirculated, number of months recirculation would be required (Phase 1), number of months required for active evaporation (Phase II), and total volume evaporated, among other data. This information is needed to calculate the costs for safe and effective process fluid stabilization and interim fluid management.

Process Fluids Cost Estimator (PFCE)

What is the goal of PFCE?

- PFCE is designed to estimate the costs for successful IFM and heap leach draindown.

What are the inputs?

19. PFCE allows the user to input parameters for up to four facilities at each mine site. If facilities are separated by considerable distances, additional labor and support equipment may be required. Ask yourself, "Can one crew manage these multiple facilities?" If not, two PFCE models may be required for the site.

Company Name:		Site specific input. Do not include additional Facilities if a separate crew would be required to manage the IFM and PFS. See User Guide note 19.
Project Name:		
Facility-1 Name		
Facility-2 Name		
Facility-3 Name		
Facility-4 Name*		
Submittal Date:		
WPCP No.(s)		

20. Recirculation:
    a. Total volume recirculated (millions of gallons): enter the volume provided in HLDE, "Input and Results" tab, cell AC42.

Total Volume of Water to drain out in 1 year	710,082,616	gal	
Total Volume of Water to drain out in 2 years	744,439,394	gal	
Total Volume of Water to drain out in 3 years	762,892,301	gal	
Total Volume of Water to drain out in 4 years	777,153,643	gal	
Total Volume of Water to drain out in 5 years	789,748,897	gal	
Total Volume of Water to drain out in 10 years	839,163,676	gal	
Total Volume of Water to drain out in 20 years	902,953,475	gal	
Total Volume of Water to drain out in 30 years	951,404,718	gal	
Total Volume of Water Actively Evaporated in 1 year	51,185,434	gal	
Total Volume of Water Actively Evaporated in 2 years	63,808,171	gal	
Total Volume of Water Actively Evaporated in 3 years	69,505,411	gal	
Total Volume of Water Actively Evaporated in 4 years	73,193,545	gal	
Total Volume of Water Actively Evaporated in 5 years	75,116,785	gal	
Total Volume of Water Actively Evaporated in 6 years	75,167,769	gal	
Total Volume of Water Actively Evaporated in 10 years	75,379,465	gal	
Total Volume of Water Actively Evaporated in 20 years	75,707,810	gal	
Total Volume of Water Actively Evaporated in 30 years	Cell AC40	gal	<--- Actively Evaporated Volume to be used in PFCE
Total Volume of Water Recirculated to Pad	Cell AC42	gal	<--- Recirculated Volume to be used in PFCE

Recirculation					
Pumping systems must be consistent with approved WPCP					
Facility	Facility-1	Facility-2	Facility-3	Facility-4	
Total volume recirculated (millions of gallons)					HLDE "Input & Results" Tab Cell AC42
Operational Pumping Rate (gpm)					HLDE "Input & Results" Tab Cell E46
Static Head (feet) (1)					Site specific input. Elevation difference between intake hose on the recirculation pump and top of the facility
Pressure Head (feet) (2)					Site specific input, generally <50 feet. See User Guide note 20(d).
Friction Head (feet) (3)	0	0	0	0	
Total Head (feet)	0	0	0	0	

b. <u>Operational Pumping Rate (gpm)</u>: enter pump capacity rate from HLDE, "Input and Results" tab, cell E46.

c. <u>Static Head (feet)</u>: the vertical difference in elevation between the intake hose on the recirculation pumps (at the process pond) and the discharge point (on top of the heap).

d. <u>Pressure Head</u>: the operating pressure necessary for irrigation system in place and used by the operator (emitters, impact sprinklers, wobblers, etc.). Typically in the range of 20-50 feet when emitters and sprinklers have been removed.

e. <u>Pump Selection</u>: choose the appropriate pump based on the B.E.P. (best efficiency point) Flow Rate and B.E.P Head needed. If the Operational Pumping Rate exceeds the B.E.P. Flow Rate and/or B.E.P. Head, you must select the next largest pump. Ideally, only one pump is needed, but multiples can be used.

Pump Selection	Pump # 1	Pump # 2	Pump # 3	Pump # 4	
Model Number	HH-225c	HH-150	HH-125c	HH-80c	
B.E.P. Flow Rate @ given RPM (gpm) (4)	4,000	2,090	620	410	
B.E.P. Head @ given RPM (feet)	260	260	340	320	
RPM	1,900	2,000	2,200	2,200	
Monthly Cycle (rental) Rate (24/7 operation)	$ 4,484	$ 3,364	$ 2,906	$ 1,566	
Monthly Maintenance Rate (24/7 operation)	$ -	$ -	$ -	$ -	
Monthly Environmental Fee	$ -	$ -	$ -	$ -	
Select # of pumps for each model for Facility-1 (5)					Site specific input. * make sure the B.E.P. Flow Rate and Head in the Pump Selection are larger than the Operational Pumping Rate (Row 23) and Total Head (Row 27) for individual facility. Use multiple pumpsfor each facility, if needed.
Select # of pumps for each model for Facility-2					
Select # of pumps for each model for Facility-3					
Select # of pumps for each model for Facility-4					

21. Process Fluid Stabilization:

a. <u>Phase 1 Duration</u>: refer to HLDE model to determine the number of months recirculation would be required. The easiest way to determine this is by using the "Phase 1/II Duration Calculator" tool created by NDEP and available at [BMRR Reclamation Cost Estimator](). Another method is to select the "Calcs active" tab and review column AA. Phase 1 ends when the "time to fill pond" is consistently greater than 14 days and there is no longer any recirculation being performed ("Calcs active" tab, column Q). There are instances where the "time to fill pond" is consistently greater than 14 days, but recirculation would still occur 2 or 3 days per month. In this instance, Phase 1 could end because the Phase II labor crew could likely manage the remaining recirculation component. If <u>all</u> factors seem reasonable, Phase 1 could be finished. Phase 1 is entered into PFCE in whole months.

Process Fluid Stabilization						
Time-frames to be determined by HLDE or other acceptable method. Provide supporting documentation.						
Facility	Facility-1	Facility-2	Facility-3	Facility-4	SITE	
Phase I Duration (months) (6)					#NUM!	Use "Phase durations" calculator
Phase II Duration (months) (7)					#NUM!	
Phase III Duration (months)	1	1	1	1	1	
ET Cell Conversion Cost*						
*Provide supporting documentation for estimated cost.					Site specific input - can be estimated from ET Cell Convension calculator	

b. <u>Phase II Duration</u>: begins the month after Phase 1 ends and continues until active evaporation is no longer required. The easiest way to determine the Phase II duration is by using the "Phase Duration Calculator" tool created by NDEP, but you can also select the "Calcs active" tab in HLDE and review columns K and L. To determine the Phase II Duration, add up the number of months when active evaporation occurs. Do not count the inactive months in your total (i.e., November to March or whichever months are not included in the "Evaporators" section of HLDE; usually about 6 to 7 months per year).

c. <u>ET Cell Conversion Cost</u>: if ET cells would be constructed for Phase III, insert cost and attach supporting documentation

22. Active Evaporation:

Total Volume of Water to drain out in 1 year	710,082,616 gal	
Total Volume of Water to drain out in 2 years	744,439,394 gal	
Total Volume of Water to drain out in 3 years	762,892,301 gal	
Total Volume of Water to drain out in 4 years	777,153,643 gal	
Total Volume of Water to drain out in 5 years	789,748,897 gal	
Total Volume of Water to drain out in 10 years	839,163,676 gal	
Total Volume of Water to drain out in 20 years	902,953,475 gal	
Total Volume of Water to drain out in 30 years	951,404,718 gal	
Total Volume of Water Actively Evaporated in 1 year	51,185,434 gal	
Total Volume of Water Actively Evaporated in 2 years	63,808,171 gal	
Total Volume of Water Actively Evaporated in 3 years	69,505,411 gal	
Total Volume of Water Actively Evaporated in 4 years	73,193,545 gal	
Total Volume of Water Actively Evaporated in 5 years	75,116,785 gal	
Total Volume of Water Actively Evaporated in 6 years	75,167,769 gal	
Total Volume of Water Actively Evaporated in 10 years	75,379,465 gal	
Total Volume of Water Actively Evaporated in 20 years	75,707,810 gal	
Total Volume of Water Actively Evaporated in 30 years	Cell AC40 gal	<--- Actively Evaporated Volume to be used in PFCE
Total Volume of Water Recirculated to Pad	Cell AC42 gal	<--- Recirculated Volume to be used in PFCE

a. Total Volume Evaporated (millions of gallons): refer to Cell AC40 on the "Input and Results" tab in HLDE (see above).

b. Static Head between pond and evaporator location (feet): the vertical difference in elevation between the intake hose at the process pond and evaporator location. Evaporators are often located at the top of the heap leach pad, but this can vary from site-to-site.

Active Evaporation						
Facility	Facility-1	Facility-2	Facility-3	Facility-4	SITE	
Total volume evaporated (millions of gallons) (8)					0.0	HLDE "Input & Results" Tab Cell AC40
Static Head between pond and evaporator location (ft) (9)						Site specific input. Elevation difference between intake hose on evaporator pump and top of the facility.
Number of 160 gpm Dual Pac evaporators used (10)					0	HLDE "Input & Results" Tab Cell K22. Remember to use min. 500 ft perimeter clearance between evaporators.
Average evaporation efficiency during months of operation						HLDE "Input & Results" Tab Cell J39

c. Number of evaporators used: input number of evaporators from cell K22 on HLDE "Input and Results" tab.

d. Average evaporation efficiency during months of operation: input percentage from cell J39 in HLDE "Input and Results" tab.

23. Sampling:

a. NDEP Profile 1 Water – Number of samples analyzed: input the number of samples and frequency established with NDEP in the Water Pollution Control Permit for each facility.

b. NDEP Profile II Water – Number of samples analyzed: input the number of samples and frequency established with NDEP in the Water Pollution Control Permit for each facility.

Sampling				semi-		
Per approved Water Pollution Control Permit(s) (WPCP)	weekly	monthly	quarterly	annually	annually	
NDEP Profile I Water - # of samples analyzed:						Site specific input based on WPCP requirements
NDEP Profile II Water - # of samples analyzed:						Site specific input based on WPCP requirements

24. IFM Travel:

a. Select nearest town with hotel: use dropdown to select the nearest town

b. Road miles from hotel to site: input travel miles from the town to the mine site.

IFM Travel			
Select nearest town with hotel (11)			Site specific input
	miles	hours	
Road miles from Carson City to hotel	#N/A	#N/A	
Road miles from hotel to site		0.00	Site specific input

25. Hazardous Waste Disposal: enter total actual annual invoice(s) amount from last year. This cell should **not** be left blank. The EPA's Envirofacts website at EPA Enviro-Facts Search can provide hazardous waste information (volumes generated, shipped, etc.) for applicable mine sites.

26. Snow removal: use dropdown to answer yes or no.

27. Site Map: use the dropdown lists to answer yes or no.

Hazardous Waste Disposal				
Enter total actual annual invoice(s) amount from last year.	$1,000	Site specific input		
Snow Removal				
Is snow plowing in winter necessary to manage the facility?	No	Site specific input		
Site Map				
Is map included showing facilities and monitoring locations?	Yes	Site specific input		
Final Permanent Closure Plan (FPCP)				
Is FPCP on file and acceptable to regulatory agencies?	No	Site specific input		
If answer is yes, include copy of the FPCP.				
Is Project in Clark, Esmeralda, Lincoln, or Nye County?	Yes	Site specific input		
Phase I Site Supervision				
Is Site Supervisor for reclamation present during Phase I?	No	Site specific input		
If answer is yes, include reference to page in document.				Site specific input

28. Final Plan for Permanent Closure (FPPC): use dropdown to answer yes or no.

29. Phase 1 Site Supervision: use dropdown to answer yes or no. If SRCE includes a site supervisor in the Construction Management (Constr. Mgmt) tab for the same timeframe as Phase 1, select "yes."

Where do I find the results, and what do I do with them?

PFCE contains individual tabs for each step of the IFM and PFS process detailing how the costs for each phase are calculated. The costs are consolidated in the "Cost Summary" tab.

	Labor	Equipment	Materials	Total
Interim Fluid Management	$1,208,346	$84,082	$136,000	$1,428,429
Process Fluid Stabilization				
Phase I	#NUM!	#NUM!	#NUM!	#NUM!
Phase II	#NUM!	#NUM!	#NUM!	#NUM!
Phase III	$93,663	$20,892	$1,000	$115,555
Total PFS (Phases I-III)	#NUM!	#NUM!	#NUM!	#NUM!
Evaporation	N/A	$0	#DIV/0!	#DIV/0!
Total PFS + Evaporation	#NUM!	#NUM!	#NUM!	#NUM!
Grand Total = IFM + PFS + Evapora	**Cell E38**	**Cell F38**	**Cell G38**	**#NUM!**
	Operator will insert numbers from Cells E38, F38 and G38 in SRCE Cost Summary tab manually.			

30. Transfer the cost summary information from PFCE into the SRCE "Cost Summary" tab under Section "C. Detoxification/Water Treatment/Disposal of Wastes."
    a. On PFCE Cost Summary tab, use values from "Grand Total = IFM + PFS + Evaporation"
    b. For a heap leach facility, enter the labor, equipment, and material costs from PFCE Grand Total into the SRCE "Cost Summary" tab Section C., "Heaps" row, or cells D57, E57, and F57.
    c. If the site contains heap leach and tailings facilities, the combined costs may need to be evenly divided between, the "Heaps" and "Tailings" rows of Section C. in SRCE, "Cost Summary" tab.
31. Alternatively, costs can be added to the "Other Users" tab, then for "Cost Type" select "C. Water Management."

Use of PFCE for Tailings Draindown

Mining operations with tailings storage facilities (TSF) will often use PFCE to estimate closure costs of the TSF. It is not as simple to prepare a PFCE guide for tailings because there is not a standardized tool for calculating tailings draindown like we have for heap leach draindown. The mining industry will use various models to calculate the water balance of the TSF and estimate tailings draindown rates. No matter how the tailings draindown is calculated/modeled, we are looking for the same results as HLDE, such as Total Volume Recirculated, Operational Pumping Rate (tailings draindown rate), Phase 1 duration, Phase II duration, and Total Volume Evaporated. If the operator can produce those results (using the model of their choice), and the underlying assumptions are acceptable, we can input those values into PFCE to determine a cost.

HEAP LEACH DRAINDOWN ESTIMATOR

	A	B	C	D
1		Company :		
2		Project :		
3				
4		Total Area of Heap Leach Pad	ft^2	surface area covered by heap leach pad(s) (including liner)
5				
6		Area of Actively Used Heap Leach Pad	ft^2	surface area that is under active leach at any given point in time
7		Area of Historically Used Heap Leach Pad		surface area that has been leached in the past but is not currently under active leach
8		Operational Draindown Rate	gpm	amount of process fluid that drains from HLP
9		Application Rate	gpm/ft^2	amount of solution added to the heap
10		Height of Heap Leach Pad	ft	the average height of material being leached
11		Saturated Hydraulic Conductivity (K_s)	ft/day	permeability of the ore when it is saturated.
12		Residual Water Content (θr)	--	
13		θs (saturated moisture content)	--	
14		θapp (active application moisture content)	--	moisture content of ore under various conditions.
15		θhist (moisture content of historic part at PFS start)	--	
16		γ (empirical drainage parameter)	--	
17				
18				
19		**Precipitation**		
20		Total Annual Precip	inches	annual precipitaion at site
21		Uncovered Infiltration Rate	%	the infiltration rate for uncovered leach pad
22		Covered Infiltration Rate	%	the infiltration rate for covered leach pad
23				
24		**Monthly portion**		
25		January	%	precipitation of the month
26		February	%	precipitation of the month
27		March	%	precipitation of the month
28		April	%	precipitation of the month
29		May	%	precipitation of the month
30		June	%	precipitation of the month
31		July	%	precipitation of the month
32		August	%	precipitation of the month
33		September	%	precipitation of the month
34		October	%	precipitation of the month
35		November	%	precipitation of the month
36		December	%	precipitation of the month
37				
38				
39		**Pond Capacity Data**		
40		Pond Capacity Data	gal	the pond storage capacity calculated from bottom of the pond to the freeboard (excluding sump volume)
41				
42				
43		Beginning Pond Level	gal	the pond fluid level at the beginning of the closure.
44				
45		**Recirculators**		
46				
47		Pump Capacity	gpm	the rate of the pump used to recirulate the fluid from pond to Heap Leach Pad
48				
49		Pond Volume that Triggers Recirculation	gal	the pond volume when the recirculation will be triggerred.

HEAP LEACH DRAINDOWN ESTIMATOR

	G	H	I	J
1		**HLDE**		Revised:
2		**Version 1.2**		
3				
4				
5		**Monthly Evaporation Data**		
6				
7		January	inches	evaporation of the month
8		February	inches	evaporation of the month
9		March	inches	evaporation of the month
10		April	inches	evaporation of the month
11		May	inches	evaporation of the month
12		June	inches	evaporation of the month
13		July	inches	evaporation of the month
14		August	inches	evaporation of the month
15		September	inches	evaporation of the month
16		October	inches	evaporation of the month
17		November	inches	evaporation of the month
18		December	inches	evaporation of the month
19				
20				
21		**Evaporators**		
22		Number of Evaporators on Day 1	--	number of evaporators placed around the pond
23		Evaporator Pumping Capacity	gpm	evaporator pump rate
24		Evaporator Operating Time	hr/day	evaporator operating hours
25				
26			Efficiency	
27		January	%	evaporator evaporation efficiency of the month
28		February	%	evaporator evaporation efficiency of the month
29		March	%	evaporator evaporation efficiency of the month
30		April	%	evaporator evaporation efficiency of the month
31		May	%	evaporator evaporation efficiency of the month
32		June	%	evaporator evaporation efficiency of the month
33		July	%	evaporator evaporation efficiency of the month
34		August	%	evaporator evaporation efficiency of the month
35		September	%	evaporator evaporation efficiency of the month
36		October	%	evaporator evaporation efficiency of the month
37		November	%	evaporator evaporation efficiency of the month
38		December	%	evaporator evaporation efficiency of the month
39				
40				
41		**ET Cell Data**		
42–43		Total Existing ET Cell Area	ft^2	the ET cell surface area
44–45		Total Flow Capacity of ET Cell	gpm/ac	2.0 gpm (typical)

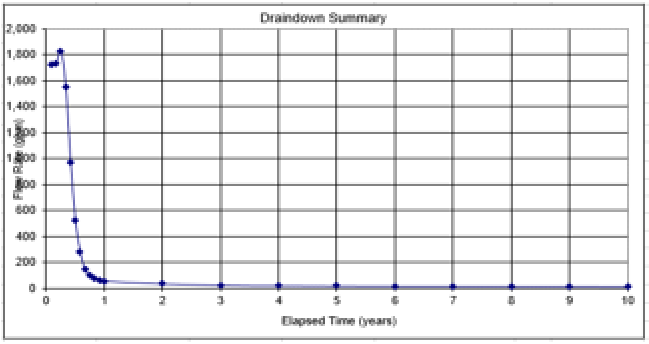
HEAP LEACH DRAINDOWN ESTIMATOR

	A	B	C	D	E	F	G
1		Company :					
2		Project :					
3							
4		Total Area of Heap Leach Pad			ft^2		Site specific input. See User Guide notes 1 - 4.
5					acres	0	
6		Area of Actively Used Heap Leach Pad			ft^2	Cell F6	
7		Area of Historically Used Heap Leach Pad			ft^2		
8		Operational Draindown Rate			gpm	Cell F8	
9		Application Rate			gpm/ft^2		= "Operational Draindown Rate"/"Area of Actively Used HLP" = Cell F8/Cell F6. See User Guide note 5.
10		Height of Heap Leach Pad			ft		= ore volume / HLP lined footprint. See User Guide note 6.
11		Saturated Hydraulic Conductivity (K_s)			ft/day		Site specific input. See User Guide notes 7 - 9.
12		Residual Water Content (θr)			Decimal		
13		θs (saturated moisture content)			Decimal		
14		θapp (active application moisture content)			Decimal		Site specific input, or θapp = (θs-θr)*0.75 +θr
15		θhist (moisture content of historic part at PFS start)			Decimal		Site specific input, or refer to HLDE "Notes" Tab.
16		γ (empirical drainage parameter)			unitless		Site specific input, refer to HLDE "Notes" Tab. See User Guide note 12.
17		Time unit of interest				Days	
18							
19		**Precipitation**					
20		Total Annual Precip			inches		Site specific input
21		Uncovered Infiltration Rate		Cell D21			Site specific input, refer to "Notes" tab, or use "Infiltration Rate" Calculator
22		Covered Infiltration Rate					Site specific input, or = 50% of uncovered infiltration rate= 50% x Cell D21
23		**Monthly portion**					
24				%	inches/mo.	inches/day	
25		January			0.00	0.000	Site specific input = monthly precip. / annual total
26		February			0.00	0.000	
27		March			0.00	0.000	
28		April			0.00	0.000	
29		May			0.00	0.000	
30		June			0.00	0.000	
31		July			0.00	0.000	
32		August			0.00	0.000	
33		September			0.00	0.000	
34		October			0.00	0.000	
35		November			0.00	0.000	
36		December			0.00	0.000	
37		Total (must equal 100%)		**0%**	**0.00**	**0.00**	
38							
39		**Pond Capacity Data**					
40		Pond Capacity Data[2]			Cell E40	gal	Pond storage capacity from bottom to freeboard. See User Guide note 14(a).
41					0	ft3	
42		Beginning Pond Level				gal	= Pond volume at normal operating levels plus 24 hours of draindown. See User Guide note 14(b).
43					0	ft3	Generally = 50% "Pond Capacity Data" (Cell E40) + 24 hours of draindown.
44							
45		**Recirculators**					
46		Pump Capacity			Cell E46	gpm	Generally = "Operational Draindown Rate" = Cell F8
47					0	ft^3/day	
48		Pond Volume that Triggers Recirculation				gal	= <75% of "Pond Capacity Data" = no more than 75% x Cell E40
49					0	ft3	

HEAP LEACH DRAINDOWN ESTIMATOR

	G	H	I	J	K	L	M	N	O	P
1		**HLDE**		Revised:						
2		**Version 1.2**								
3										
4		**Monthly Evaporation Data**								
5				Pan Evap.						
6				inches/mo.	inches/day					
7		January			0.00					
8		February			0.00					
9		March			0.00					
10		April			0.00					
11		May			0.00					
12		June			0.00		Site specific input			
13		July			0.00					
14		August			0.00					
15		September			0.00					
16		October			0.00					
17		November			0.00					
18		December			0.00					
19		Total		**0.00**						
20										
21		**Evaporators**								
22		Number of Evaporators on Day 1			Cell K22		Site specific input, based on the available space for Evaporators at the pond - assume min. 500 ft perimeter clearance between evaporators.			
23		Evaporator Pumping Capacity				gpm	160 gpm (typical)			
24		Evaporator Operating Time				hr/day	Generally = 12 hr/day, but can be adjusted to aviod overflow			
25				Efficiency	Effective Evaporation					
26				%	ft^3/day					
27		January			0					
28		February			0					
29		March			0					
30		April			0					
31		May			0					
32		June			0		1. Site specific input; or 2. refer to HLDE "Notes" Tab; or 3. use "Effeciency" Calculator ---See User Guide note 17(d).			
33		July			0					
34		August			0					
35		September			0					
36		October			0					
37		November			0					
38		December			0					
39		Averages		Cell J39	0					
40										
41		**ET Cell Data**								
42		Total Existing ET Cell Area[1]				ft^2	Site specific input, measured at freeboard. See User Guide note 18(a).			
43					0.00	ac				
44		Total Flow Capacity of ET Cell				gpm/ac	Generally = 2.0 gpm/ac, unless site specific data is available.			
45					0.00	gpm				

HEAP LEACH DRAINDOWN ESTIMATOR



	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1											
2											
3–22		(chart)									
23		Total Volume of Water to drain out in 1 year				710,082,616	gal				
24		Total Volume of Water to drain out in 2 years				744,439,394	gal				
25		Total Volume of Water to drain out in 3 years				762,892,301	gal				
26		Total Volume of Water to drain out in 4 years				777,153,643	gal				
27		Total Volume of Water to drain out in 5 years				789,748,897	gal				
28		Total Volume of Water to drain out in 10 years				839,163,676	gal				
29		Total Volume of Water to drain out in 20 years				902,953,475	gal				
30		Total Volume of Water to drain out in 30 years				951,404,718	gal				
31											
32		Total Volume of Water Actively Evaporated in 1 year				51,185,434	gal				
33		Total Volume of Water Actively Evaporated in 2 years				63,808,171	gal				
34		Total Volume of Water Actively Evaporated in 3 years				69,505,411	gal				
35		Total Volume of Water Actively Evaporated in 4 years				73,193,545	gal				
36		Total Volume of Water Actively Evaporated in 5 years				75,116,785	gal				
37		Total Volume of Water Actively Evaporated in 6 years				75,167,769	gal				
38		Total Volume of Water Actively Evaporated in 10 years				75,379,465	gal				
39		Total Volume of Water Actively Evaporated in 20 years				75,707,810	gal				
40		Total Volume of Water Actively Evaporated in 30 years				Cell AC40	gal	<--- Actively Evaporated Volume to be used in PFCE			
41											
42		Total Volume of Water Recirculated to Pad				Cell AC42	gal	<--- Recirculated Volume to be used in PFCE			
43											
44		**ERROR - POND OVERFLOWING**						<--- Overflow indicator - it is hidden when no overflow.			

PROCESS FLUIDS COST ESTIMATOR

NEVADA STANDARDIZED
PROCESS FLUIDS COST ESTIMATOR
Heap Leach Pad and Tailings Storage Facility
INTERIM FLUID MANAGEMENT (IFM)
PROCESS FLUID STABILIZATION (PFS)
SUMMARY

2019 Cost

Note: Use of this bond cost calculator is not required, but operators using these spreadsheets may realize a quicker preparation time as well as a faster agency approval time due to the standardization of costs and methodologies.

Company Name:	0
Project Name:	0
Submittal Date:	January 0, 1900
WPCP Number(s):	0

	Labor	Equipment	Materials	Total
Interim Fluid Management	$1,208,346	$84,082	$136,000	$1,428,429
Process Fluid Stabilization				
Phase I	#NUM!	#NUM!	#NUM!	#NUM!
Phase II	#NUM!	#NUM!	#NUM!	#NUM!
Phase III	$93,663	$20,892	$1,000	$115,555
Total PFS (Phases I-III)	#NUM!	#NUM!	#NUM!	#NUM!
Evaporation	N/A	$0	#DIV/0!	#DIV/0!
Total PFS + Evaporation	#NUM!	#NUM!	#NUM!	#NUM!
Grand Total = IFM + PFS + Evaporatio	**Cell E38**	**Cell F38**	**Cell G38**	**#NUM!**

Operator will insert numbers from Cells E38, F38 and G38 in SRCE Cost Summary tab manually.

PROCESS FLUIDS COST ESTIMATOR

	A	E	F	G	H	I	J–O
1	**Heap Leach Pad (HLP) and Tailings Storage Facility (TSF)**						
2	**Interim Fluid Management (IFM)**						
3	**Process Fluid Stabilization (PFS)**						
4							
5	green cells are for User Inputs on this page						
6	yellow cells are from Unit Costs sheet						
7							
8	Company Name:						Site specific input. Do not include additional Facilities if a separate crew would be required to manage the IFM and PFS. See User Guide note 19.
9	Project Name:						
10	Facility-1 Name						
11	Facility-2 Name						
12	Facility-3 Name						
13	Facility-4 Name*						
14	Submittal Date:						
15	WPCP No.(s)						
16	* If more than four facilities, enter in separate Process Fluids Cost Estimator.						
17	Additional labor and support equipment may be required for larger sites having						
18	multiple facilities separated by considerable distances.						
19	***Recirculation***						
20	Pumping systems must be consistent with approved WPCP						
21	Facility	Facility-1	Facility-2	Facility-3	Facility-4		
22	Total volume recirculated (millions of gallons)					HLDE "Input & Results" Tab Cell AC42	
23	Operational Pumping Rate (gpm)					HLDE "Input & Results" Tab Cell E46	
24	Static Head (feet) (1)					Site specific input. Elevation difference between intake hose on the recirculation pump and top of the facility.	
25	Pressure Head (feet) (2)					Site specific input, generally <50 feet. See User Guide note 20(d).	
26	Friction Head (feet) (3)	0	0	0	0		
27	Total Head (feet)	0	0	0	0		
28							
29	**Pump Selection**	Pump # 1	Pump # 2	Pump # 3	Pump # 4		
30	Model Number	HH-225c	HH-150	HH-125c	HH-80c		
31	B.E.P. Flow Rate @ given RPM (gpm) (4)	4,000	2,090	620	410		
32	B.E.P. Head @ given RPM (feet)	260	260	340	320		
33	RPM	1,900	2,000	2,200	2,200		
34	Monthly Cycle (rental) Rate (24/7 operation)	$ 4,484	$ 3,364	$ 2,906	$ 1,566		
35	Monthly Maintenance Rate (24/7 operation)	$ -	$ -	$ -	$ -		
36	Monthly Environmental Fee	$ -	$ -	$ -	$ -		
37	Select # of pumps for each model for Facility-1 (5)						Site specific input. * make sure the B.E.P. Flow Rate and Head in the Pump Selection are larger than the Operational Pumping Rate (Row 23) and Total Head (Row 27) for individual facility. Use multiple pumps for each facility, if needed.
38	Select # of pumps for each model for Facility-2						
39	Select # of pumps for each model for Facility-3						
40	Select # of pumps for each model for Facility-4						
41							
42	***Process Fluid Stabilization***						
43	Time-frames to be determined by HLDE or other						
44	acceptable method. Provide supporting documentation.						
45	Facility	Facility-1	Facility-2	Facility-3	Facility-4	SITE	
46	Phase I Duration (months) (6)					#NUM!	Use "Phase durations" calculator
47	Phase II Duration (months) (7)					#NUM!	
48	Phase III Duration (months)	1	1	1	1	1	
49	**ET Cell Conversion Cost***						
50	*Provide supporting documentation for estimated cost.					Site specific input - can be estimated from ET Cell Conversion calculator	

PROCESS FLUIDS COST ESTIMATOR

	A–D	E	F	G	H	I	J–O
51							
52	***Active Evaporation***						
53	Facility	Facility-1	Facility-2	Facility-3	Facility-4	SITE	
54	Total volume evaporated (millions of gallons) (8)					0.0	HLDE "Input & Results" Tab Cell AC40
55	Static Head between pond and evaporator location (ft) (9)						Site specific input. Elevation difference between intake hose on evaporator pump and top of the facility.
56	Number of 160 gpm Dual Pac evaporators used (10)					0	HLDE "Input & Results" Tab Cell K22. Remember to use min. 500 ft perimeter clearance between evaporators.
57	Average evaporation efficiency during months of operation						HLDE "Input & Results" Tab Cell J39
58							
59	***Sampling***				semi-		
60	Per approved Water Pollution Control Permit(s) (WPCP)	weekly	monthly	quarterly	annually	annually	
61	NDEP Profile I Water - # of samples analyzed:						Site specific input based on WPCP requirements.
62	NDEP Profile II Water - # of samples analyzed:						Site specific input based on WPCP requirements.
63							
64	***IFM Travel***						
65	Select nearest town with hotel (11)			Site specific input			
66		miles	hours				
67	Road miles from Carson City to hotel	#N/A	#N/A				
68	Road miles from hotel to site		0.00	Site specific input			
69							
70	***Hazardous Waste Disposal***						
71	Enter total actual annual invoice(s) amount from last year.	$1,000	Site specific input				
72	***Snow Removal***						
73	Is snow plowing in winter necessary to manage the facility?	No	Site specific input				
74	***Site Map***						
75	Is map included showing facilities and monitoring locations?	Yes	Site specific input				
76	***Final Permanent Closure Plan (FPCP)***						
77	Is FPCP on file and acceptable to regulatory agencies?	No	Site specific input				
78	If answer is yes, include copy of the FPCP.						
79	**Is Project in Clark, Esmeralda, Lincoln, or Nye County?**	Yes	Site specific input				
80	***Phase I Site Supervision***						
81	Is Site Supervisor for reclamation present during Phase I?	No	Site specific input				
82	If answer is yes, include reference to page in document.						Site specific input
83	***Notes:***						
84	**Recirculation pumps are rented (short time frame). Equipment for evaporation is purchased (longer time frame).**						
85	(1) Static head is the difference in elevation between pumps and discharge point						
86	(2) Pressure head is the operating pressure necessary for irrigation system in place (emitters, impact sprinklers, wobblers, etc.).						
87	For tailings storage facilities the pressure head may be zero.						
88	(3) Friction head is estimated as 25% of Static Head. If this value is not used,						
89	provide calculations for friction head loss (i.e. Hazen-Williams equation and length of pipe).						
90	(4) B.E.P. = Best Efficiency Point for pump operation at given RPM.						
91	(5) Use B.E.P. to select pump(s) required to handle operational pumping rate at total head required.						
92	Add pumps in series to get required head and in parallel to get required flow. Do not have more than two pumps in series.						
93	(6) Input number of months HLDE or other model shows recirculation is taking place.						
94	Phase I duration for SITE will be selected from HLP or TSF with longest Phase I duration.						
95	(7) Input number of months HLDE or other model shows active evaporation is taking place.						
96	Only include the actual number of months that evaporators are running.						
97	Phase II duration for SITE will be selected from longest HLP or TSF Phase I + Phase II duration less SITE Phase I duration.						
98	(8) Include volume of supernatant pool if a tailings storage facility						
99	(9) Evaporators must have a minimum 500 foot clearance of approved containment for overspray.						
100	This may require evaporator placement on heap leach pad and additional pumping power to overcome elevation head.						
101	Provide site-specific details for placement of evaporators.						
102	(10) EcoMister Dual-Pac evaporators include 2, 40 hp motor evaporators and 1, 30 hp pump, dual unit pumps 160 gpm aloft.						
103	(11) IFM travel mileage is from Carson City, Nevada to town with hotel nearest to site.						