Tailings Impoundment Draindown Estimate Methodology Utilized by BMRR

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Why?

NAC 519A.360 Amount of surety required.

4. In determining the cost of executing the plan for reclamation, the operator shall consider all activities in the plan for reclamation that are required by NAC 519A.010 to 519A.415, inclusive, or chapter 519A of NRS, including, if appropriate:

(b) Process Fluid Stabilization

How?

HYDRUS Model

Tailings Impoundment and Collection Pond Water Balance

Process Fluid Cost Estimator (PFCE)

(labor, material, equipment)

HYDRUS Model

Tailings Impoundment and Collection Pond Water Balance

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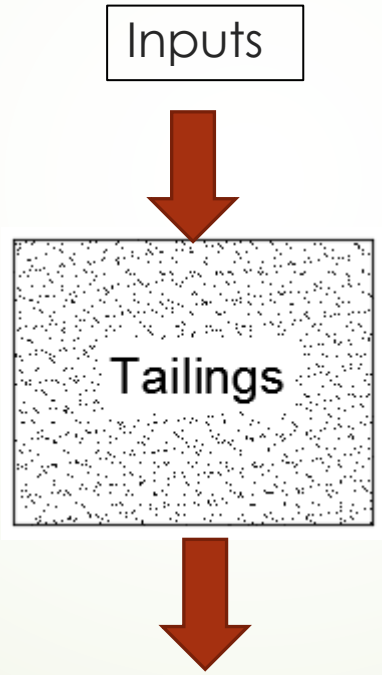
HYDRUS

- HYDRUS is a Windows-based modeling software for analysis of water flow, heat, and solute transport in saturated porous media.
- HYDRUS-1D is a public domain software and can be used to simulate in one-dimension.

  It can be downloaded from the website:

  https://www.pc-progress.com/en/Default.aspx?H1d-downloads
- HYDRUS 2D/3D extends the simulation capabilities to the second and third dimensions.

Hydrus Model



- Climate Data:
  - Precipitation
  - Evaporation
- Facility Information:
  - Average Tailings Thickness
  - Surface Area
- Material Properties:
  - Hydraulic conductivity
  - Moisture Content

HYDRUS Model

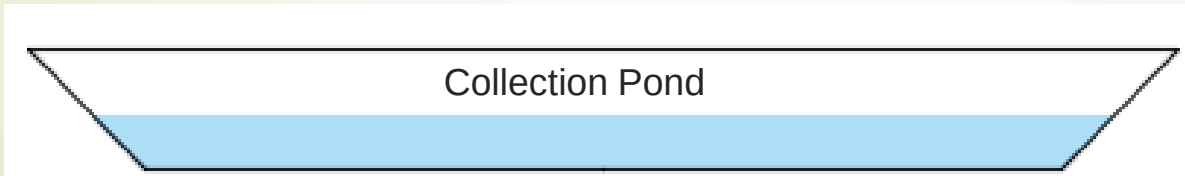
Tailings Impoundment and Collection Pond Water Balance

Process Fluid Cost Estimator (PFCE)

(labor, material, equipment)

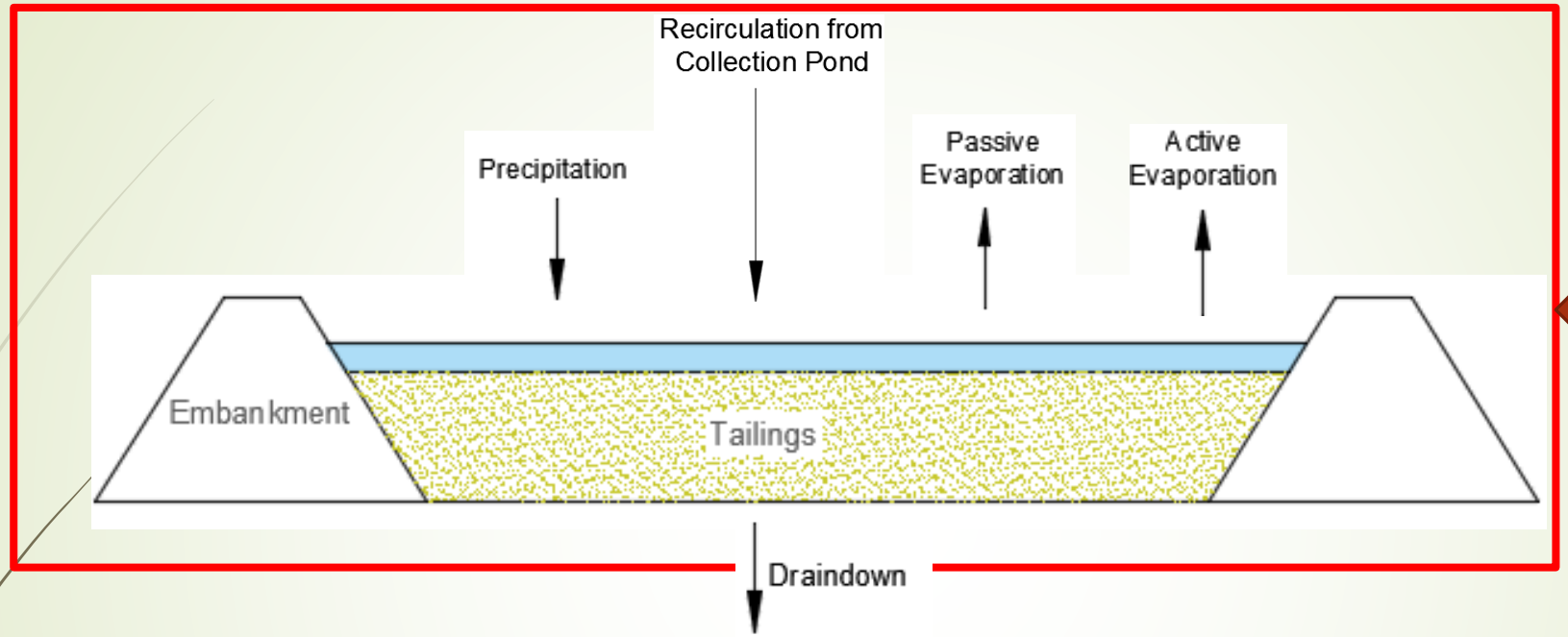
Water Balance

Tailings Impoundment Water Balance

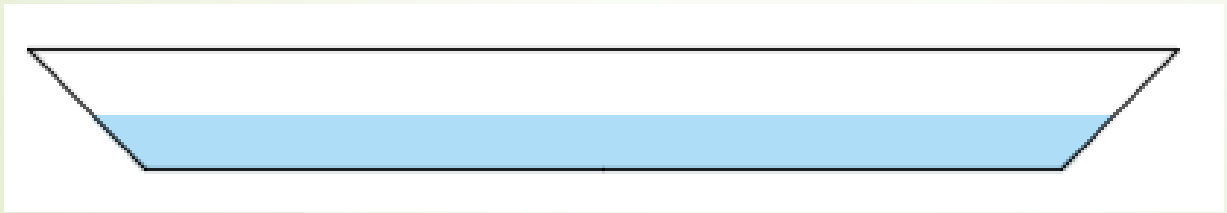


Collection Pond Water Balance

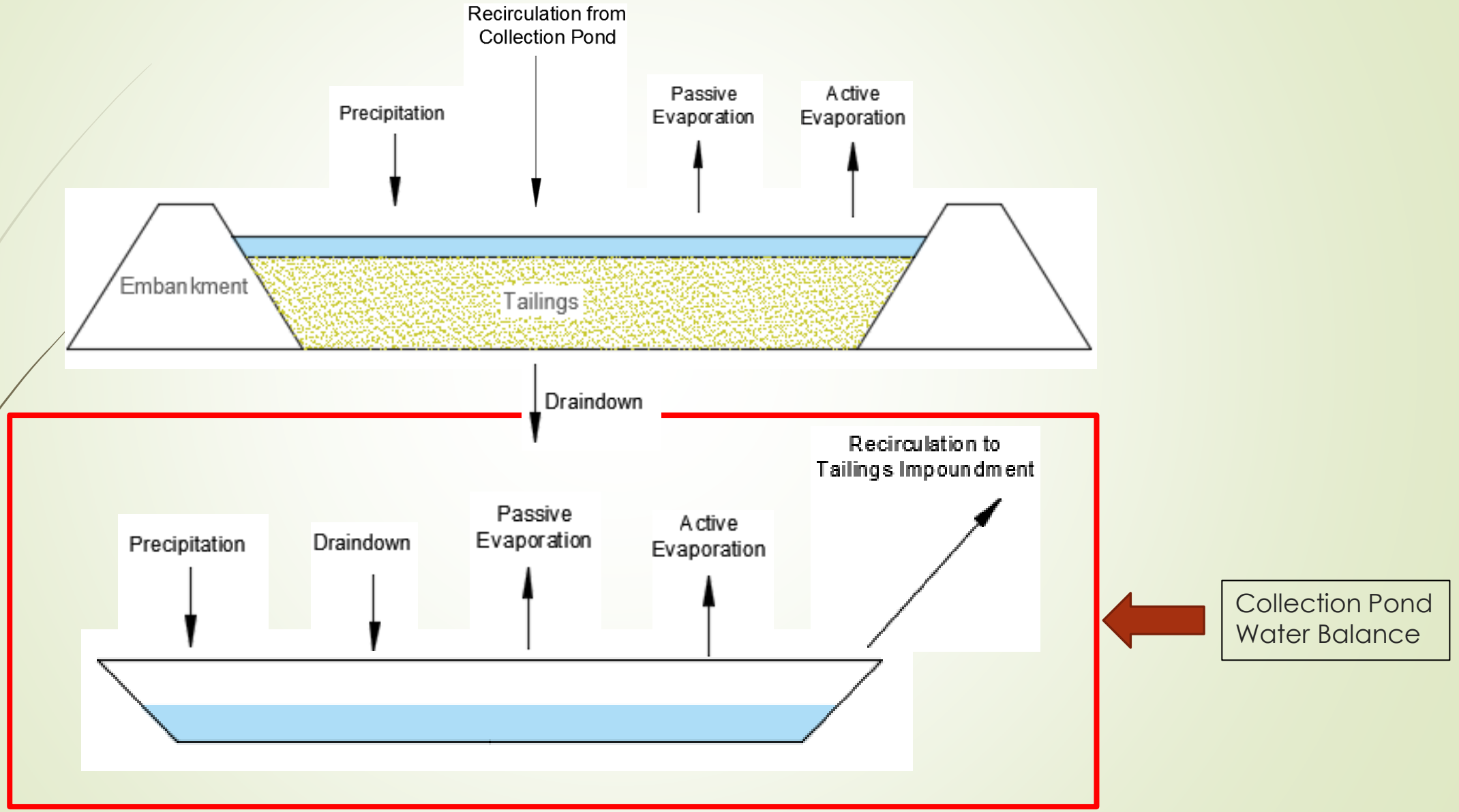
Water Balance



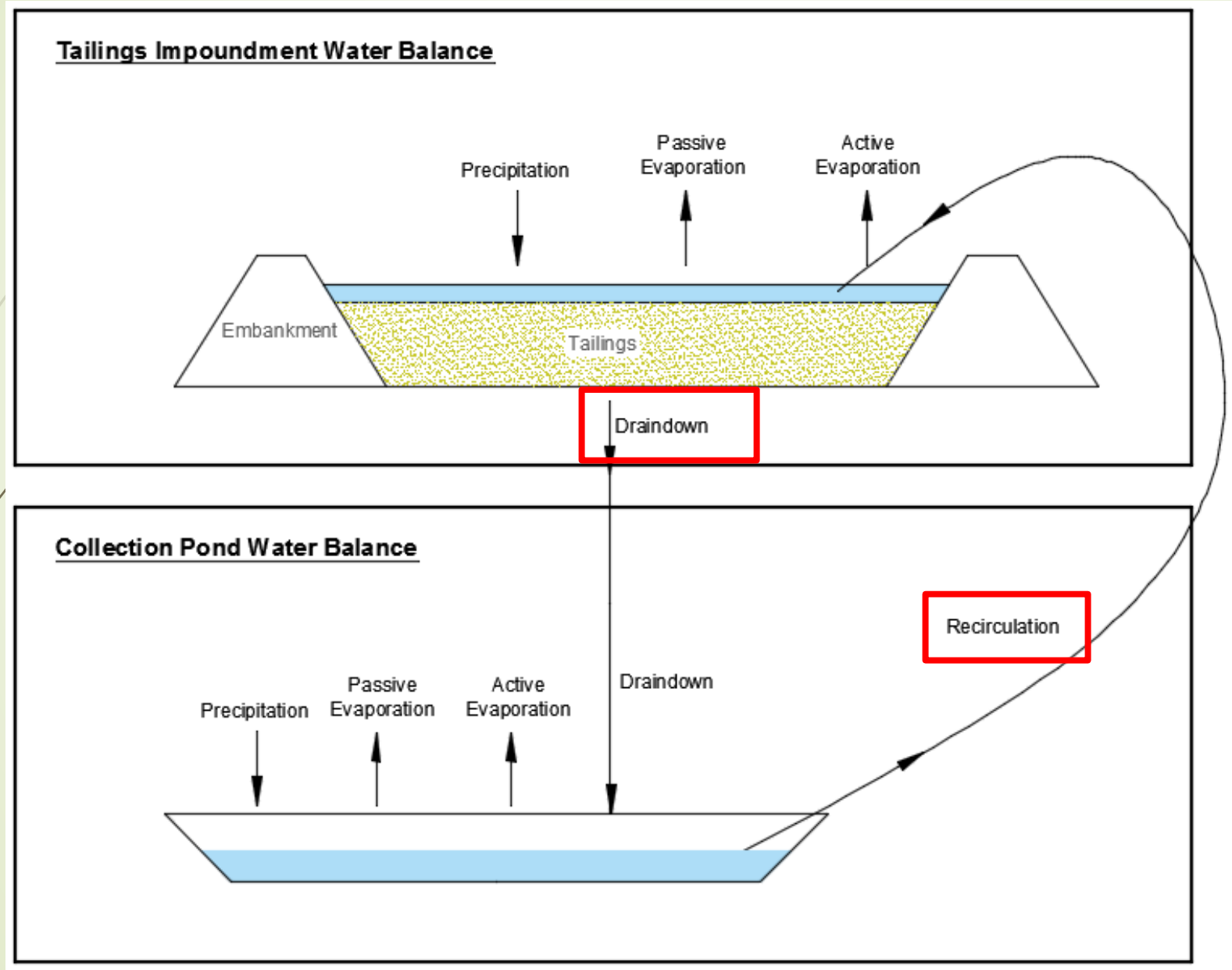
Tailings Impoundment Water Balance



Water Balance



Collection Pond Water Balance


Tailings Impoundment Water Balance
Precipitation
Passive Evaporation
Active Evaporation
Embankment
Tailings
Draindown
Collection Pond Water Balance
Recirculation
Precipitation
Passive Evaporation
Active Evaporation
Draindown

Water Balance Calculation

Month #	Month	Days in Month	Monthly Precip (in)	Monthly Evap (in)	Evap Efficiency	Draindown Rate (from Hydrus Model) (GPM)	Collection Pond								Tailings Impoundment							
							Inflow		Outflow			NetFlow (gal)	Pond Inventory (gal)	Fluid Depth (ft)	Inflow		Outflow			NetFlow (gal)	Pond Inventory (gal)	Fluid Depth (ft)
							Precip (gal)	Draindown from Previous (gal)	Active Evap (gal)	Passive Evap (gal)	Recirc to Tails Impoud. (gal)				Precip (gal)	Recirc from Collection Pond (gal)	Draindown from Current Month (gal)	Active Evap (gal)	Passive Evap (gal)			
0		"	"	"	"	264.4	"	"	"	"		"	318,917	5.0	"	"	"	"	"	"	42,093,539	8.0
1	Jan	31	0.99	3.63	0.3	247.6	10,834	11,802,816	0	8,558	11,486,175	11,805,092	637,834	10.0	1,604,460	11,486,175	11,054,838	4,285,440	1,915,805	-4,165,448	37,928,091	7.2
2	Feb	28	0.79	5.51	0.325	221.5	8,645	9,985,015	0	12,990	9,980,669	9,980,669	637,834	10.0	1,280,327	9,980,669	8,931,140	4,193,280	2,908,013	-4,771,437	33,156,653	6.3
3	Mar	31	0.38	8.94	0.35	195.4	4,158	9,888,048	0	21,077	9,871,129	9,871,129	637,834	10.0	615,853	9,871,129	8,721,258	4,999,680	4,503,017	-7,736,973	25,419,680	4.8
4	Apr	30	0.35	7.85	0.3	163.9	3,830	8,439,927	0	18,507	8,425,250	8,425,250	637,834	10.0	567,233	8,425,250	7,081,118	4,147,200	3,587,729	-5,823,563	19,596,117	3.7
5	May	31	0.57	4.85	0.375	143.1	6,238	7,317,155	0	11,434	7,311,959	7,311,959	637,834	10.0	923,780	7,311,959	6,387,679	5,356,800	2,107,105	-5,615,845	13,980,273	2.7

Input Data

Collection Pond Water Balance

Tailings Impoundment Water Balance

Input Data

Month #	Month	Days in Month	Monthly Precip (in)	Monthly Evap (in)	Evap Efficiency	Draindown Rate (from Hydrus Model) (GPM)
0		**	**	**	**	264.4
1	Jan	31	0.99	3.63	0.3	247.6
2	Feb	28	0.79	5.51	0.325	221.5
3	Mar	31	0.38	8.94	0.35	195.4
4	Apr	30	0.35	7.85	0.3	163.9
5	May	31	0.57	4.85	0.375	143.1

Climate Data

Hydrus Output

Evaporator Efficiency

Collection Pond Water Balance

Collection Pond							
Inflow			Outflow				
Precip (gal)	Draindown from Previous (gal)	Active Evap (gal)	Passive Evap (gal)	Recirc to Tails (gal)	NetFlow (gal)	Pond Inventory (gal)	Fluid Depth (ft)
**	**	**	**	**	**	318,917	5.0
10,834	11,802,816	0	8,558	11,486,175	11,805,092	637,834	10.0
8,645	10,698,230	0	12,990	10,693,885	10,693,885	637,834	10.0
4,158	9,888,048	0	21,077	9,871,129	9,871,129	637,834	10.0
3,830	8,721,258	0	18,507	8,706,581	8,706,581	637,834	10.0
6,238	7,081,118	0	11,434	7,075,922	7,075,922	637,834	10.0

Tailings Impoundment Water Balance

Tailings Impoundment							
Inflow			Outflow				
Precip (gal)	Recirc from Collection Pond (gal)	Draindown from Current Month (gal)	Active Evap (gal)	Passive Evap (gal)	NetFlow (gal)	Pond Inventory (gal)	Fluid Depth (ft)
**	**	**	**	**	**	42,093,539	8.0
1,604,460	11,486,175	11,054,838	4,285,440	1,915,805	-4,165,448	37,928,091	7.2
1,280,327	10,693,885	9,569,079	4,492,800	2,908,013	-4,995,680	32,932,410	6.3
615,853	9,871,129	8,721,258	4,999,680	4,503,017	-7,736,973	25,195,437	4.8
567,233	8,706,581	7,317,155	4,285,440	3,587,729	-5,916,509	19,278,928	3.7
923,780	7,075,922	6,181,625	5,184,000	2,107,105	-5,473,028	13,805,900	2.6

HYDRUS Model

Tailings Impoundment and Collection Pond Water Balance

Process Fluid Cost Estimator (PFCE)

(labor, material, equipment)

What is Process Fluid Cost Estimator (PFCE) ?

- Process Fluid Cost Estimator (PFCE) is an estimation tool for the calculation of labor, equipment and material costs required for managing the heap leach and tailings storage facility process fluids during closure.
- Two important concepts in PFCE:

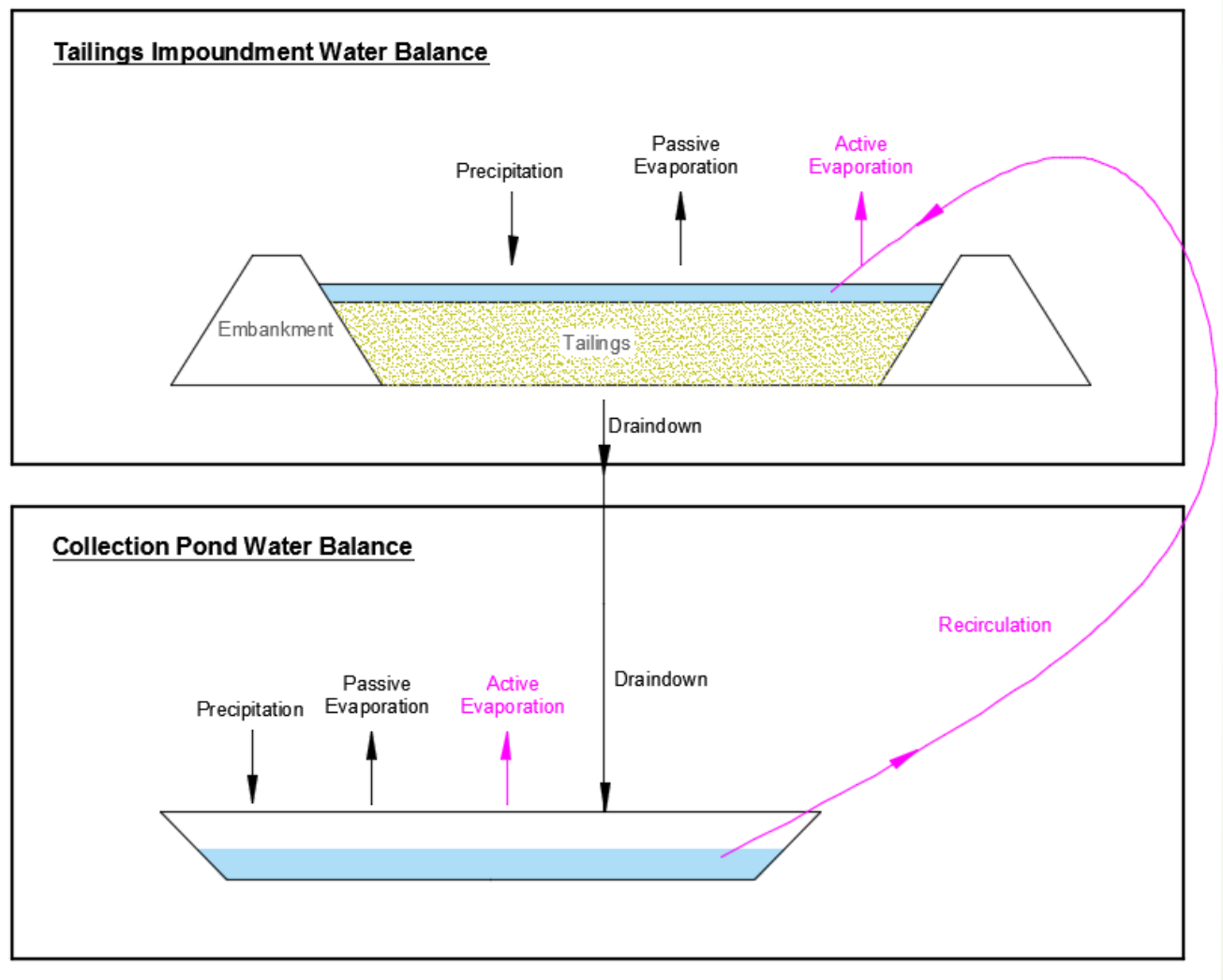
- Recirculation
  - Duration (how long)
  - Volume

  → Phase I

- Active Evaporation
  - Duration (how long)
  - Volume

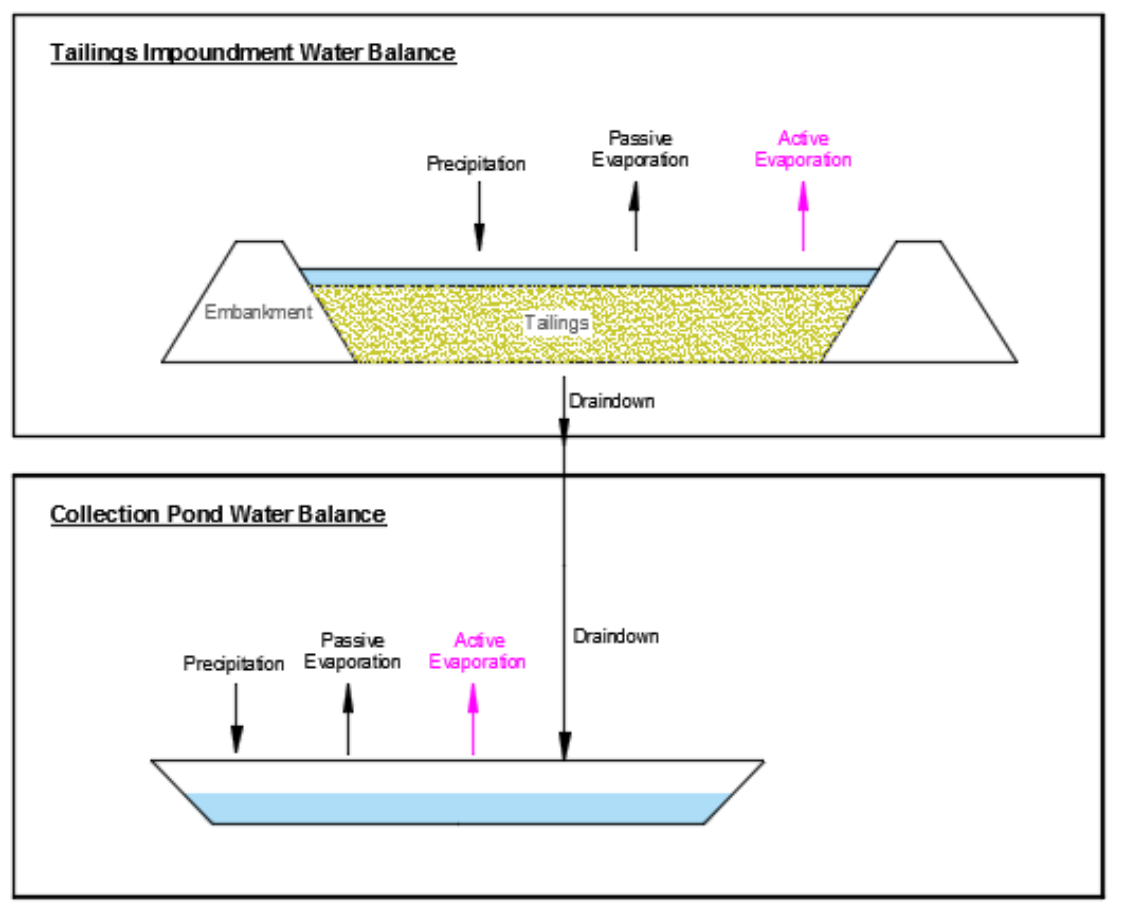
  → Phase II

What is Phase I in Process Fluid Cost Estimator (PFCE)?



- Phase I is the duration when the recirculation occurs.

What is Phase II in Process Fluid Cost Estimator (PFCE)?



- Phase II is the duration when the active evaporation occurs after Phase I.

Process Fluids Cost Estimator (PFCE) - Phase I

Phase I = 2 months

Total Recirculated Volume = 2,000,000 gals

Month #	Collection Pond								Tailings Impoundment							
	Inflow		Outflow			NetFlow	Pond Inventory	Fluid Depth	Inflow		Outflow			NetFlow	Pond Inventory	Fluid Depth
	Precip (gal)	Draindown from Previous (gal)	Active Evap (gal)	Passive Evap (gal)	Recirc to Tails Impoud. (gal)	(gal)	(gal)	(ft)	Precip (gal)	Recirc from Collection Pond (gal)	Draindown from Current Month (gal)	Active Evap (gal)	Passive Evap (gal)	(gal)	(gal)	(ft)
0	**	**	**	**		**	318,917	5.0	**	**	**	**	**	**	4,209,000	1.4
1	10,834	11,802,816	1,000,000	8,558	1,000,000	9,805,092	637,834	10.0	160,446	1,000,000	11,054,838	1,000,000	756,647	-11,651,038	0	0.0
2	8,645	10,698,230	1,000,000	12,990	1,000,000	8,693,885	637,834	10.0	128,033	1,000,000	9,569,079	1,000,000	980,912	-10,421,958	0	0.0
3	4,158	9,888,048	1,000,000	21,077	0	8,871,129	637,834	10.0	61,585	0	8,721,258	1,000,000	1,591,535	-11,251,207	0	0.0
4	3,830	8,721,258	1,000,000	18,507	0	7,706,581	637,834	10.0	56,723	0	7,317,155	0	1,397,488	-8,657,921	0	0.0
5	6,238	7,081,118	1,000,000	11,434	0	6,075,922	637,834	10.0	92,378	0	6,181,625	0	863,416	-6,952,663	0	0.0
6	7,989	6,387,679	1,000,000	5,941	0	5,389,726	637,834	10.0	118,309	0	5,715,292	0	448,620	-6,045,604	0	0.0
7	14,664	5,530,927	0	2,381	0	5,543,210	637,834	10.0	217,169	0	4,574,020	0	179,804	-4,536,654	0	0.0
8	18,166	4,726,487	0	1,297	0	4,743,356	637,834	10.0	269,031	0	3,757,458	0	97,913	-3,586,341	0	0.0
9	16,306	3,757,458	0	1,202	0	3,772,561	637,834	10.0	241,479	0	3,302,608	0	90,792	-3,151,921	0	0.0

or

Phase I Duration & Recirculated Volume

PFCE - Phase II

Phase II = 4 months

Total Actively Evaporated Volume = 9,000,000 gals

Month #	Collection Pond								Tailings Impoundment							
	Inflow		Outflow			NetFlow	Pond Inventory	Fluid Depth	Inflow		Outflow			NetFlow	Pond Inventory	Fluid Depth
	Precip (gal)	Draindown from Previous (gal)	Active Evap (gal)	Passive Evap (gal)	Recirc to Tails Impoud. (gal)	(gal)	(gal)	(ft)	Precip (gal)	Recirc from Collection Pond (gal)	Draindown from Current Month (gal)	Active Evap (gal)	Passive Evap (gal)	(gal)	(gal)	(ft)
0	**	**	**	**		**	318,917	5.0	**	**	**	**	**	**	4,209,000	1.4
1	10,834	11,802,816	1,000,000	8,558	1,000,000	9,805,092	637,834	10.0	160,446	1,000,000	11,054,838	1,000,000	756,647	-11,651,038	0	0.0
2	8,645	10,698,230	1,000,000	12,980	1,000,000	8,693,885	637,834	10.0	128,033	1,000,000	9,569,079	1,000,000	980,912	-10,421,958	0	0.0
3	4,158	9,888,048	1,000,000	21,077	0	8,871,129	637,834	10.0	61,585	0	8,721,258	1,000,000	1,591,535	-11,251,207	0	0.0
4	3,830	8,721,258	1,000,000	18,507	0	7,706,581	637,834	10.0	56,723	0	7,317,155	0	1,397,488	-8,657,921	0	0.0
5	6,238	7,081,118	1,000,000	11,434	0	6,075,922	637,834	10.0	92,378	0	6,181,625	0	863,416	-6,952,663	0	0.0
6	7,989	6,387,679	1,000,000	5,941	0	5,389,726	637,834	10.0	118,309	0	5,715,292	0	448,620	-6,045,604	0	0.0
7	14,664	5,530,927	0	2,381	0	5,543,210	637,834	10.0	217,169	0	4,574,020	0	179,804	-4,536,654	0	0.0
8	18,166	4,726,487	0	1,297	0	4,743,356	637,834	10.0	269,031	0	3,757,458	0	97,913	-3,586,341	0	0.0
9	16,306	3,757,458	0	1,202	0	3,772,561	637,834	10.0	241,479	0	3,302,608	0	90,792	-3,151,921	0	0.0

Phase II Duration &
Active Evaporated Volume

Process Fluid Cost Estimator (PFCE)

Recirculation	
Pumping systems must be consistent with approved WPCP	
Facility	Facility-1
Total volume recirculated (millions of gallons)	2

Process Fluid Stabilization	
Time-frames to be determined by HLDE or other acceptable method. Provide supporting documentation.	
Facility	Facility-1
Phase I Duration (months) (6)	2
Phase II Duration (months) (7)	4

Active Evaporation	
Facility	Facility-1
Total volume evaporated (millions of gallons) (8)	9.0

(6) Input number of months HLDE or other model shows recirculation is taking place.
Phase I duration for SITE will be selected from HLP or TSF with longest Phase I duration.
(7) Input number of months HLDE or other model shows active evaporation is taking place.
Only include the actual number of months that evaporators are running.
Phase II duration for SITE will be selected from longest HLP or TSF Phase I + Phase II duration less SITE Phase I duration.

Questions?

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https://ndep.nv.gov/land/mining