APPENDIX J

TAILINGS DEPOSITION MODELING

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Tailings deposition within Tailings Cell A was modeled using Golder's proprietary software *GoldTail*. This software performs geometrical calculations inside of the tailings cells to determine the final configuration of the cell surface affected by the tailings discharge. The purpose of the tailings deposition modeling is to provide mill operations personnel with a method for tailings discharge which enhances design of the tailings cells by providing protection to the constructed underdrain system from potential slimes clogging, as well as provides initial buttressing to the geomembrane liner system.

DEPOSITIONAL PHASES

Tailings deposition was modeled within Tailings Cell A in the following five simplified phases:

- *Phase 1* – Deposition commences within sub-cell A1 (or A2) in the vicinity of the underdrain sump to provide approximately 10 feet of tailings deposition over the sump area. This phase of deposition provides coarse-grained underflow tailings over the underdrain sump to enhance effectiveness of the tailings underdrain system;

- *Phase 2* – Continued deposition within the remainder of the first sub-cell to push the pond toward the sump area;

- *Phase 3* – This phase was modeled with deposition commencing within the other sub-cell in the vicinity of the underdrain sump, again providing approximately 10 feet of coarse-grained underflow tailings over the underdrain sump area. (Note: During actual operations, Golder recommends reversing the order of the modeled Phases 2 and 3 in order to buttress the geomembrane liner system within both sub-cells at the on-set of operations, prior to completely filling the first sub-cell);

- *Phase 4* – Continued deposition within the remainder of the second sub-cell to push the pond toward the sump area; and

- *Phase 5* – Once both sub-cells are filled, tailings deposition will proceed along the perimeter of the entire tailings cell in stages (as dictated by tailings operations), until the tailings cell is full (with 3 feet of freeboard provided at the perimeter of the cell).

The perimeter discharge of Phase 5 will leave a depression in the center of the cell resulting from the tailings beach slopes and perimeter discharge arrangement. Although not modeled, a sixth and final phase of deposition would involve extending the tailings discharge pipes to the center of the cell to more efficiently use the available tailings storage space, and develop grades which support closure cover construction.

DEPOSITIONAL GEOMETRY

Three basic elements are considered in the tailings deposition simulation: (1) base surface (topography) which corresponds to the topographic base of the tailings cell; (2) limiting planes, which define the surroundings in which the tailings are deposited; and (3) the discharge cone, which represents the behavior of deposited tailings from a single discharge (Barrientos & Barrera, 2008; Golder Associates S.A., 2008).

GoldTail assumes that the deposited tailings can be represented by a cone, where the cone's vertex represents the discharge location, and the adopted tailings depositional slopes are used to develop the cone's geometry. The primary variables governing the behavior of the tailings deposition are: tailings depositional slopes; volume and location of the decant pond;, tailings solids concentration (by weight); tailings gradation or particle size; mass distribution of tailings by discharge point; solids specific gravity; tailings production; and tailings depositional dry density (Barrientos et al. 2008). Figure J-1 shows the basic representative variables governing the behavior of the tailings deposition used by the computer code *GoldTail*.

Considering the tailings physical characteristics the following angles for the tailings slopes were adopted:

i_d = Slope at the discharge point = 5 %
i_1 = Slope of the tailings beach = 2%
i_2 = Pool side slope, below water = 10%
i_3 = Slope at base of pool = 0.5%
h = Depth of pool = 10 feet

Note that these variables should be considered only as first estimates. Actual discharge tailings slopes and pond volume data will provide more accurate simulation results.

Figure J-2 illustrates the geometry of Tailings Cell A prior to deposition. As discussed previously, five phases which represent the end of each general tailings deposition stage were considered:

- Phase 1 - Four (4) discharge points in cell A1 were considered (discharge points 1, 2, 3, and 4; see Figure J-3). ; The location of the discharge points were specified in order to produce an approximate tailings deposition cover of 10 feet over the underdrain sump;

- Phase 2 - Eight (8) discharge points (discharge points 5 through 12; see Figure J-4) located at the mid-height bench of cell A1 with two feet freeboard were considered for this phase;

- Phase 3 - Similar to Phase 1, four (4) discharge points and two feet freeboard were considered in cell A2 (discharge points 13 through 16; see Figure J-5), where the location of the points were specified in order to produce an approximate tailings deposition cover of 10 feet over the underdrain sump;

- Phase 4 - Like Phase 2, eight (8) discharge points and two feet freeboard were considered in cell A2 (discharge points 17 through 24; see Figure J-6);

- Phase 5 - Twenty–four (24) discharge points located along the perimeter of the tailings cell (discharge points 25 through 48; see Figure J-7) and three feet of freeboard were considered for this ultimate depositional phase.

For Phases 1 through 4 above, a pool volume equal to 847,655 ft^3 was assumed in order to provide a minimum water head of 10 feet for pump operations.

Results of the *GoldTail* depositional modeling simulation, where the sequence of the tailings deposition can be appreciated, are illustrated in Figures J-2 through J-7. A perspective view of Tailing Cell A at the end of each phase is shown in Figure J-8. Table J-1 summarizes the discharge volumes at each discharge point for the various phases.

REFERENCES

Barrientos, M., and Barrera, S. 2008. "*Modeling of a tailings impoundment raising*." Golder Associates S.A., Santiago.

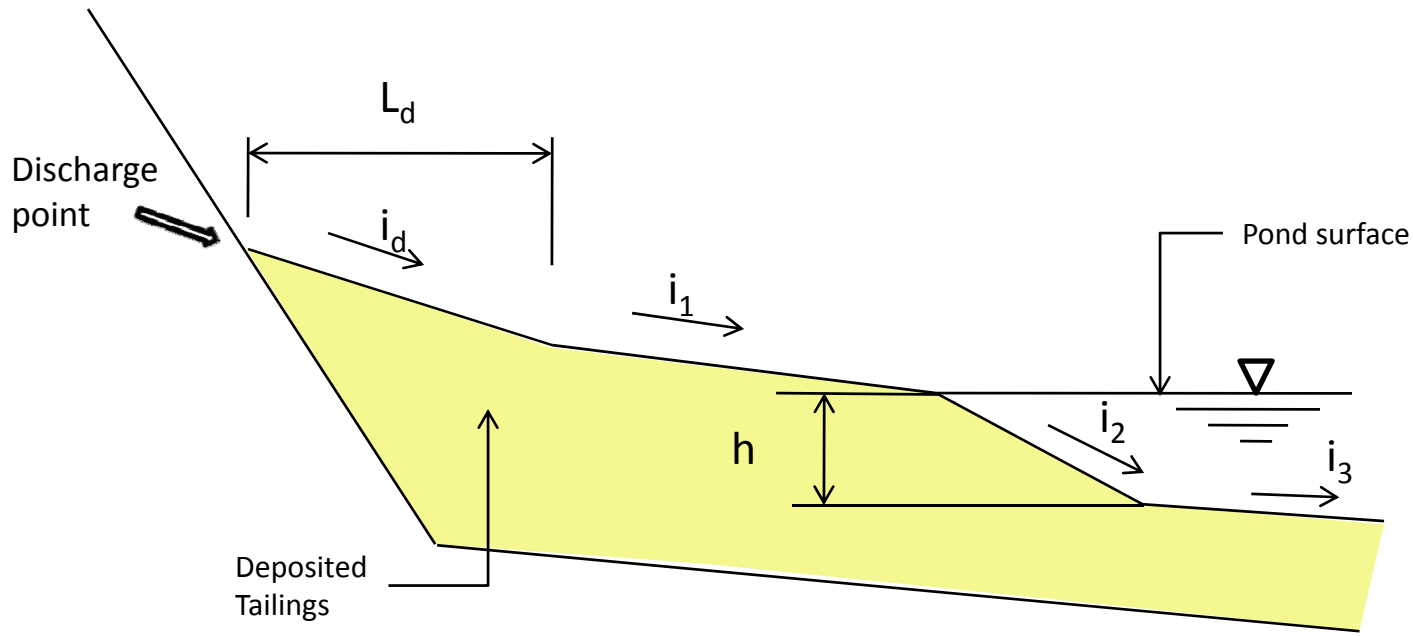
Barrientos, M., Mussé, M., Eldridge, T., and Pinto, M. 2008. "*Management tools for tailing impoundment modeling*." Golder Associates S.A., Santiago.

Golder Associates S.A. 2008. "*Herramienta Para El Modelamiento De Depósitos De Relaves, Manual Del Usuario*." (Spanish). *GoldTail*, Version 1.17, Rev. A. March.

TABLE J-1

CALCULATED TAILINGS VOLUMES

Phase	Discharge Point	Volume (ft^3)	Cumulative Volume (ft^3)
1	1	225,378	448,535
	2	6,169	
	3	77,711	
	4	139,278	
2	5	1,395,337	6,953,708
	6	1,246,304	
	7	844,947	
	8	400,631	
	9	433,419	
	10	584,222	
	11	291,940	
	12	1,756,908	
3	13	225,378	448,535
	14	6,169	
	15	77,711	
	16	139,278	
4	17	1,395,337	6,953,708
	18	1,246,304	
	19	844,947	
	20	400,631	
	21	433,419	
	22	584,222	
	23	291,940	
	24	1,756,908	
5	25	452,474	36,555,237
	26	1,419,190	
	27	1,390,370	
	28	474,317	
	29	1,131,104	
	30	2,219,771	
	31	1,725,130	
	32	1,764,596	
	33	2,034,371	
	34	1,882,605	
	35	2,379,151	
	36	1,058,410	
	37	491,054	
	38	1,496,713	
	39	1,309,687	
	40	516,716	
	41	1,204,710	
	42	1,991,989	
	43	2,032,452	
	44	1,978,008	
	45	1,150,919	
	46	4,009,009	
	47	1,219,823	
	48	1,222,667	
Total (ft^3)			51,359,724



Tailings Beach Slopes

i_d : At discharge point
i_1 : On beach
i_2: Pool slope
i_3: Pool base
h: Depth of pool

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VARIABLES DEFINING TAILINGS DEPOSITION

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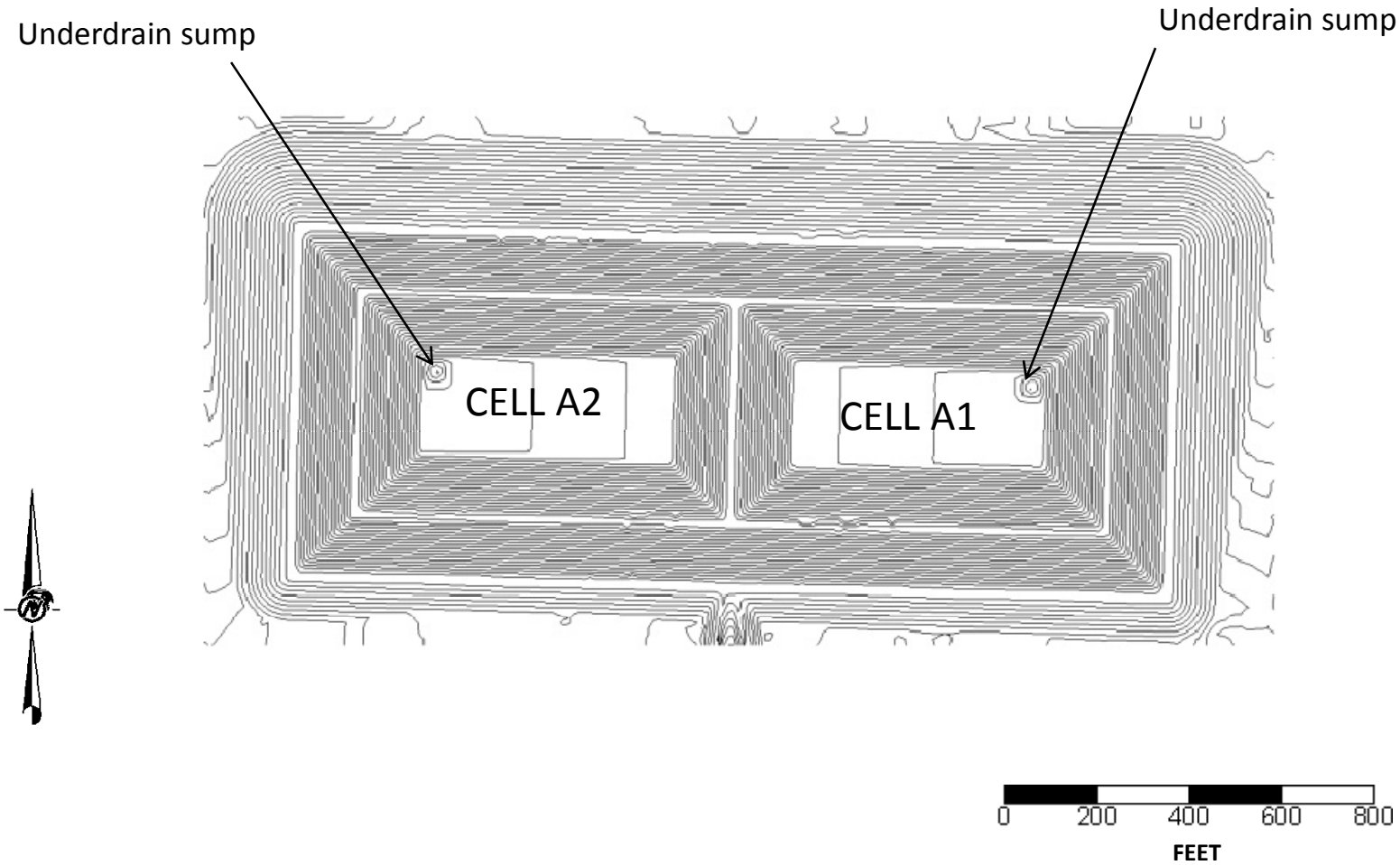
MONTROSE COUNTY, COLORADO

DRAWN	EF	DATE	MAY 2008	JOB NO.	073-81694
CHECKED	KFM	SCALE	N.T.S.	DWG. NO.	
REVIEWED	JMJ	FILE NO.	Figures-tailings.pptx	FIGURE NO.	J-1



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TITLE
TAILINGS CELL A PRE-DEPOSITION GRADING PLAN

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PIÑON RIDGE PROJECT - TAILINGS CELLS DESIGN
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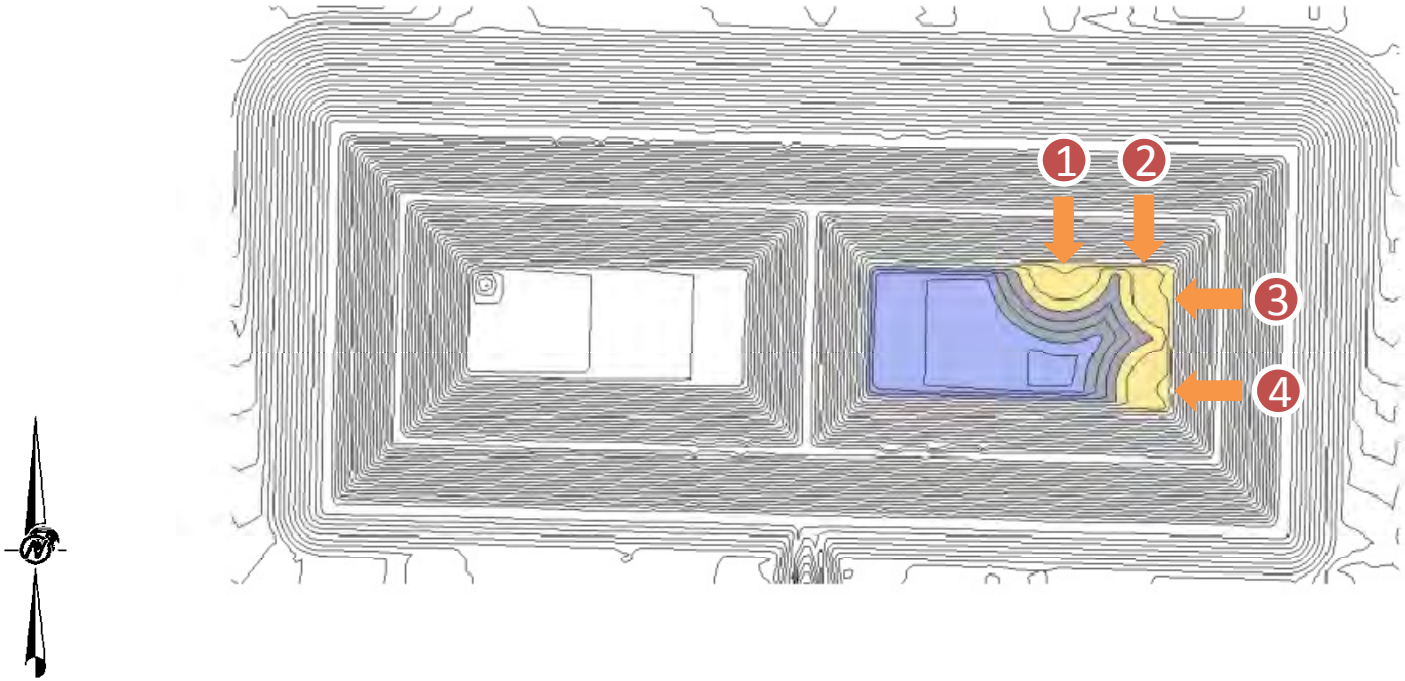

LEGEND

- PHASE 1 DEPOSITION POINT
- POND
- TAILINGS

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TITLE

TAILINGS DEPOSITION PHASE 1

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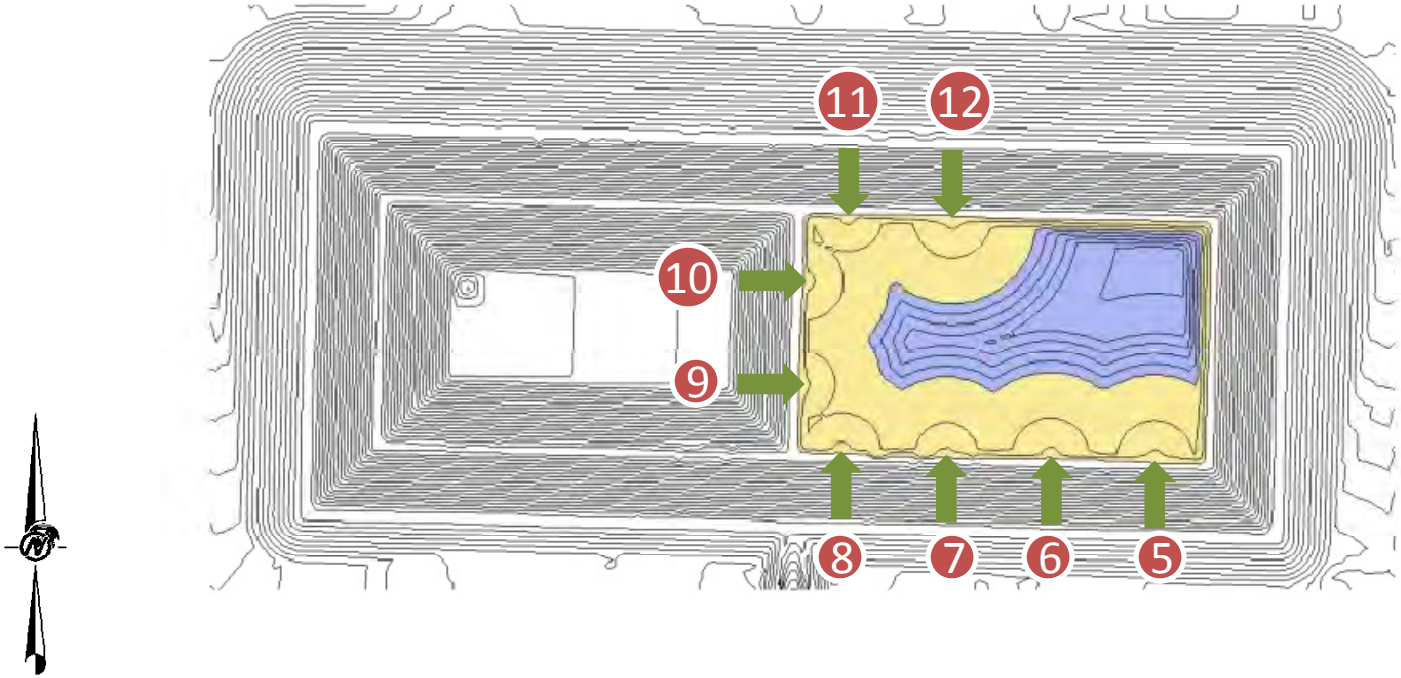
REVIEWED	JMJ	FILE NO.	Figures-tailings.pptx	FIGURE NO.	**J-3**



LEGEND

- PHASE 2 DEPOSITION POINT
- POND
- TAILINGS

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TAILINGS DEPOSITION PHASE 2

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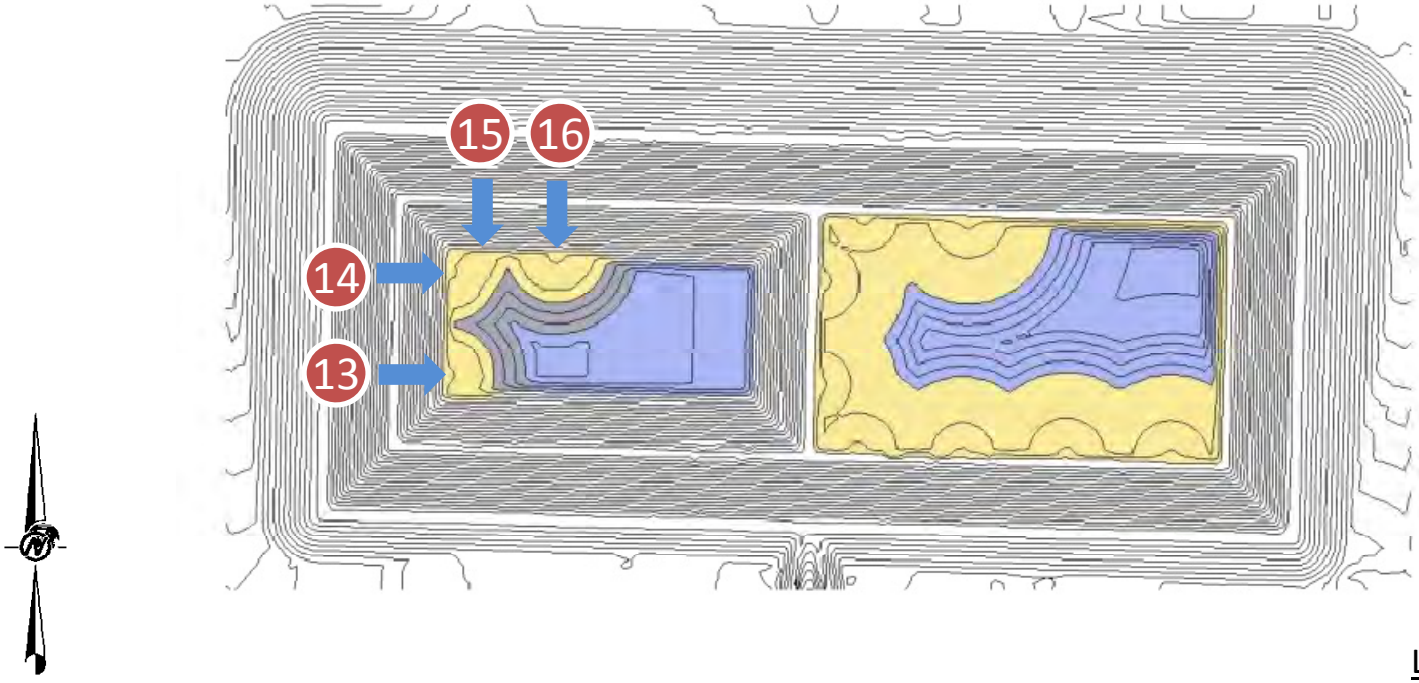

LEGEND

- PHASE 3 DEPOSITION POINT
- POND
- TAILINGS

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TITLE

TAILINGS DEPOSITION PHASE 3

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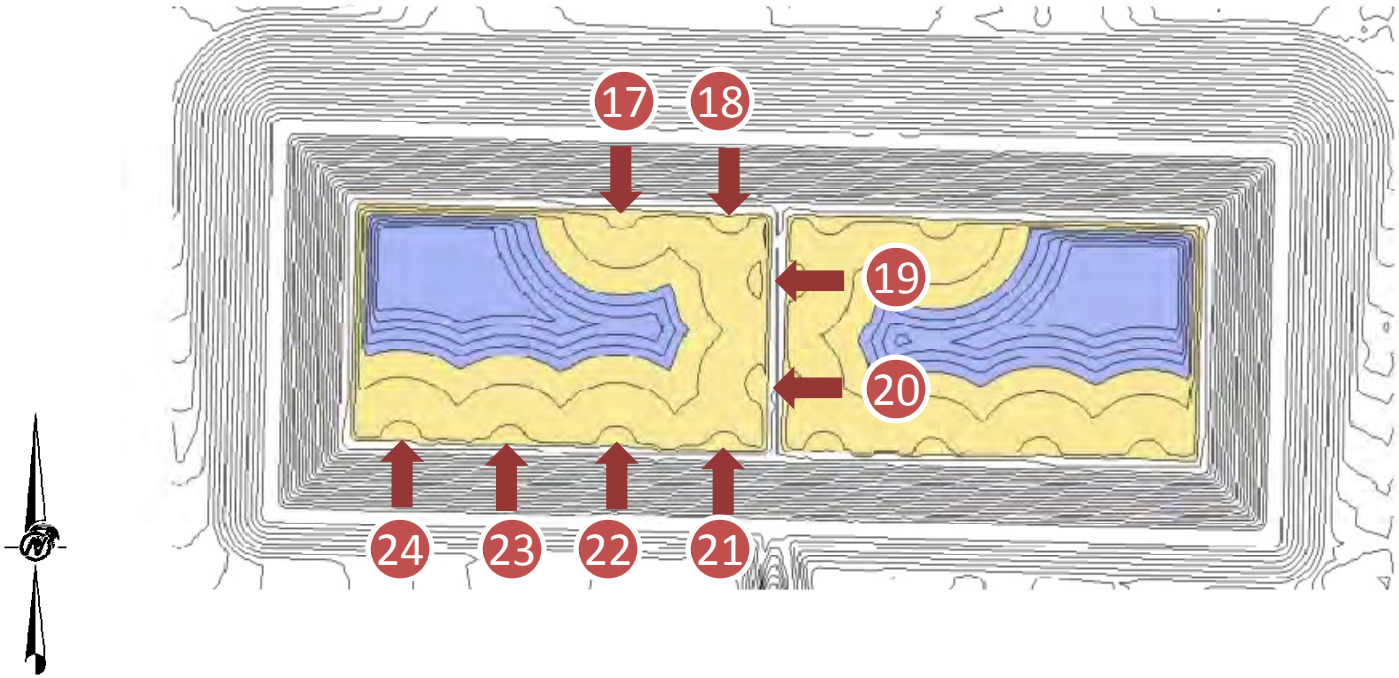
REVIEWED	JMJ	FILE NO.	Figures-tailings.pptx	FIGURE NO.	J-5



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LEGEND

- PHASE 4 DEPOSITION POINT
- POND
- TAILINGS

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TITLE

TAILINGS DEPOSITION PHASE 4

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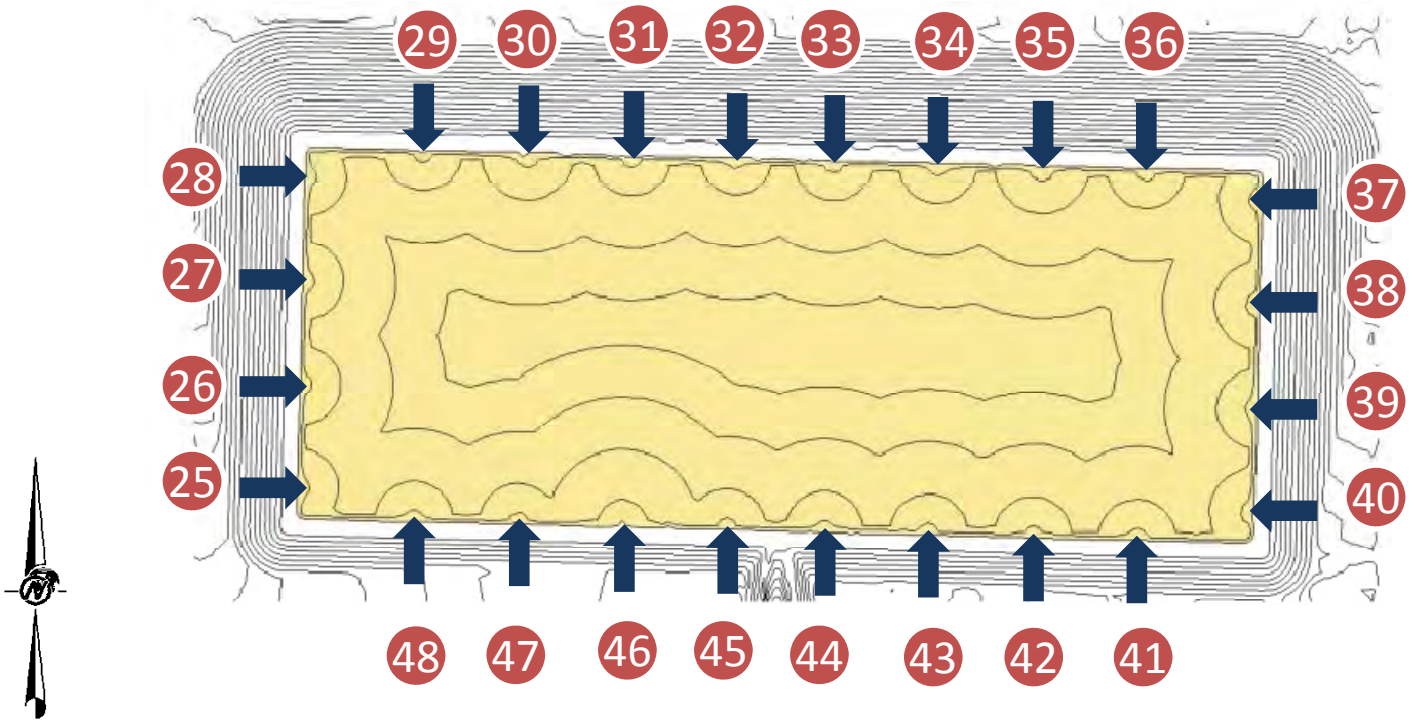
REVIEWED	JMJ	FILE NO.	Figures-tailings.pptx	FIGURE NO.	J-6



LEGEND

- PHASE 5 DEPOSITION POINT
- POND
- TAILINGS

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TITLE

TAILINGS DEPOSITION PHASE 5

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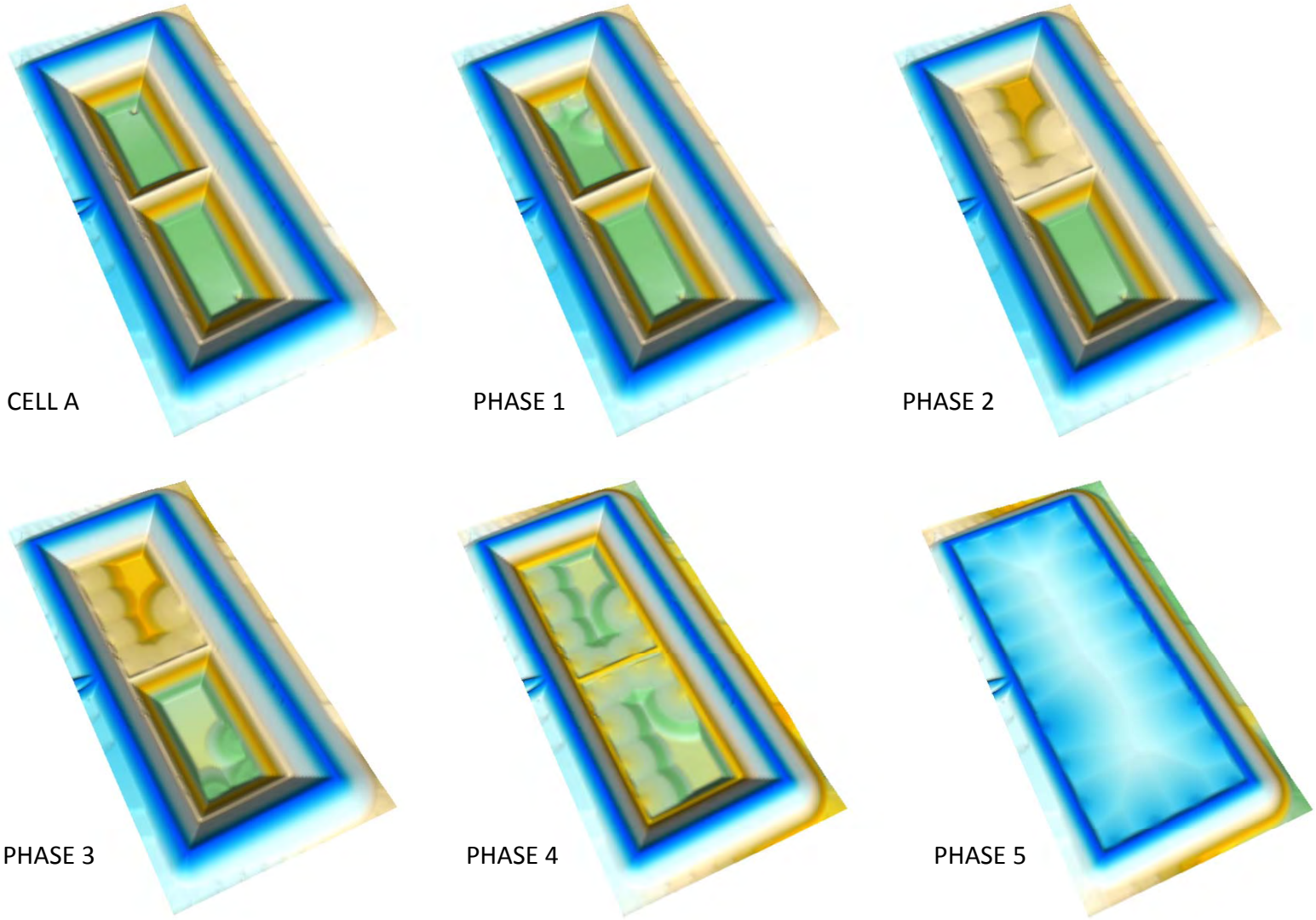
REVIEWED	JMJ	FILE NO.	Figures-tailings.pptx	FIGURE NO.	J-7



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TITLE
TAILINGS DEPOSITION PERSPECTIVE VIEW

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ENERGY FUELS RESOURCES CORPORATION
PIÑON RIDGE PROJECT - TAILINGS CELLS DESIGN
MONTROSE COUNTY, COLORADO

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REVIEWED	JMJ	FILE NO.	Figures-tailings.pptx	FIGURE NO.	**J-8**