TECHNICAL MEMORANDUM

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From: Steve Finch, Principal Hydrogeologist-Geochemist
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Subject: Post reclamation open pit surface area storm-water runoff calculations, Copper Flat Project, New Mexico Copper Corporation

John Shomaker & Associates, Inc. (JSAI) developed and calibrated a groundwater flow model for the New Mexico Copper Corporation (NMCC) Copper Flat project (JSAI, 2014), which included the proposed Copper Flat open pit. The model was calibrated to historical and current conditions at the Copper Flat Open Pit, and used to predict effects of the proposed mining plan.

The purpose of this technical memorandum is to establish storm-water runoff coefficients and watershed areas representative of the post-mining reclamation of the proposed Copper Flat Open Pit Surface Drainage Area (OPSDA). The post-mining OPSDA and watershed areas discussed in this memo are shown on Figure 1.

After reclamation, there will be three areas with different runoff coefficients inside the OPSDA:

1. Reclaimed watershed area surrounding the open pit;
2. Reclaimed sections of the Open Pit shell; and
3. Un-Reclaimed sections of the Open Pit shell.

Curve numbers for the different areas shown on Figure 1 and listed in Table 1 were derived from the NRCS Part 630 Hydrology National Engineering Handbook. The curve number equation (from NRCS, 2004) and precipitation statistics from the Hillsboro station were used to develop the assigned runoff coefficients presented in Table 1.

Post mining OPSDA reclamation will include re-contouring, placement of cover materials, and revegetation. As described in the NMCC Baseline Data Report, cover materials will resemble sandy to silty loam representative of Hydrologic Soil Group B (NRCS, 2009).

The hydrologic conditions of the reclaimed OPSDA will be classified as poor to fair, resembling desert shrub with less than 40 percent vegetative cover (NRCS, 2004). A Curve Number of 75 is representative of Desert Shrub landscape, Hydrologic Soil Group B, and less than 40 percent vegetative cover (NRCS, 2004; table 9-1).

Table 1. Summary of corresponding Curve Number and assigned Runoff Coefficient for sub-regions within the reclaimed Copper Flat Open Pit Surface Drainage Area

sub-region name	corresponding Curve Number	assigned Runoff Coefficient
Reclaimed OPSDA	75	0.071
Reclaimed Pit Shell	90	0.303
Un-Reclaimed Pit Shell	80	0.126

The reclaimed pit shell includes the haul road and potentially other accessible areas. Reclaimed surface is expected to resemble improved dirt road, and have a corresponding runoff curve number of 90 (NRCS, 2004; table 9-1).

The un-reclaimed pit shell was assigned a runoff curve number of 80, which has been derived from water balance studies for other open pits, such as the Cunningham Hill Mine Reclamation Project (JSAI, 2012).

Precipitation statistics were used with the runoff curve number to calculate the runoff coefficient presented in Table 1. Surface-water runoff is calculated from daily precipitation data, and soil conditions represented by a runoff curve number (NRCS, 2004a). Runoff is estimated using the following equations:

$$Ia = S*0.2$$

$$S = (1{,}000/CN)-10$$

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

where,

Ia equals the initial abstraction including surface storage, interception by vegetation and infiltration prior to runoff, in inches depth over the drainage area.

S equals the potential maximum retention of water by the soil in equivalent inches depth over the drainage area.

CN equals the runoff curve number

P equals the accumulated rainfall in inches depth over the drainage area

Q equals the accumulate volume of runoff in inches depth over the drainage area

The runoff equations (above) are used to calculate the average annual runoff for the period of record from the Hillsboro Station. An example for Curve Number equal 90 is presented in Table 2. The calculated average annual runoff for period of record is divided by the average annual precipitation for period of record (12.5 in./yr) to derive the runoff coefficient.

Table 2. Summary of Hillsboro Station precipitation statistics and calculated runoff used to derive runoff coefficient for reclaimed pit shell area (CN=90)

Range in daily precipitation events	No. of daily precipitation events within range for period of record*	Average number of precipitation events per year for period of record	average magnitude of precipitation event for range (in.)	P-Ia for CN =90	runoff per average event for range (in.)	average runoff per year (in.)
>3	3	0.031	3.29	3.070	2.86	0.090
2 - 3	21	0.219	2.31	2.090	1.89	0.414
1 - 2	168	1.752	1.32	1.100	0.92	1.606
0.5 - 1	490	5.109	0.7	0.480	0.33	1.682
					sum	3.79
Runoff coefficient (CN=90) = (3.79 in)/(12.5 in) = 0.303						

* Hillsboro station period of record equals 95.9 years or 35,037 days with average annual precipitation of 12.5 inches per year

Attachments

Figure 1. Map showing post-mining watershed areas for the Copper Flat Open Pit Drainage Area.

References

JSAI, 2012, Updated and re-calibrated groundwater flow and solute transport model for predicting potential effects from the Cunningham Hill Mine Open pit, Santa Fe County, New Mexico: Consultant's report prepared for LAC Minerals (USA), LLC.

[JSAI] John Shomaker & Associates, Inc., 2014a, Model of groundwater flow in the Animas Uplift and Palomas Basin, Copper Flat Project, Sierra County, New Mexico: consultant's report prepared for New Mexico Copper Corporation, August 15, 2014, 89 p. plus figures and appendices.

[NRCS] National Resources Conservation Service, 2004, Part 630 Hydrology Engineering Handbook, Chapter 9 Hydrologic Soil Groups, July 2004, 13 p.

[NRCS] National Resources Conservation Service, 2004a, Part 630 Hydrology Engineering Handbook, Chapter 10 Estimation of Direct Runoff from Storm Rainfall, July 2004, 79 p.

[NRCS] National Resources Conservation Service, 2009, Part 630 Hydrology Engineering Handbook, Chapter 7 Hydrologic Soil Groups, January 2009, 13 p.

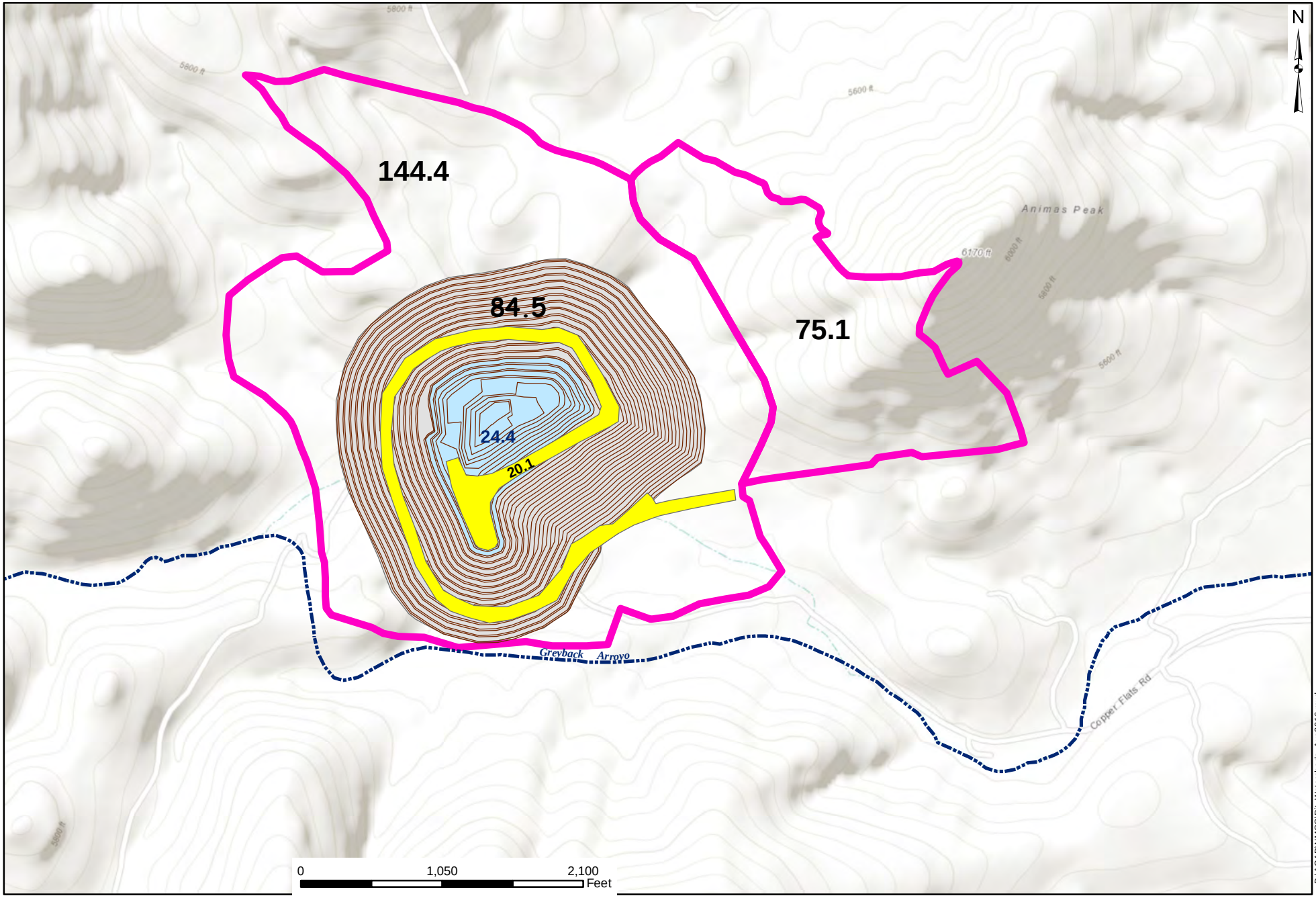

Figure 1. Map showing post-mining watershed areas for the Copper Flat Open Pit Drainage Area.