

## Memorandum

**To:** File  
**CC:**  
**From:** Chris Garrett, SWCA  
**Date:** April 5, 2013  
**Re:** Estimates of Phasing of Stormwater Reductions during Operations

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The purpose of this memo is to estimate the amount and phasing of stormwater reductions during operations of the mine. All surface water modeling conducted by Rosemont has been for post-closure stormwater losses. Losses during the 20-25 year operation of the mine are greater and also of interest for determining impacts to riparian resources.

### **Methodology**

The amount of surface water lost can be assumed to be directly proportional to the acreage "removed" from the watershed. During operations, "removal" means that a portion of the watershed has been cut off from downstream flow, and that the stormwater is being retained on site without any discharge downstream.

To complicate the issue, reclamation of the perimeter buttresses will be occurring concurrent with operations. So over time, while acreage is lost to the watershed from disturbance and construction, other acreage is being added back to the watershed through concurrent reclamation.

Timing and acreages of the portions of the watershed removed by mining activities was primarily obtained from the *Preliminary Site Water Management Plan for the Barrel Alternative, Rosemont Copper Project* (Tetra Tech, July 2012). Timing of the portions of watershed concurrently reclaimed was primarily taken from the *Preliminary Reclamation and Closure Plan for the Barrel Alternative, Rosemont Copper Company* (CDM Smith, July 2012).

It should be noted that both of these reports were specifically for the Barrel Alternative. Similar detail has not been prepared by Rosemont for other alternatives; however, timing of impacts is expected to be similar between alternatives, even though the post-closure amounts of stormwater loss will differ by alternative.

### **Acreage Removed from Watershed**

Table 1 was compiled by looking at 12 sub-watershed areas defined in the Site Water Management Plan, and determining when runoff from those sub-watershed areas is lost to the downstream watershed (based on the figures included in the plan).

### **Acreage Concurrently Reclaimed**

The acreage concurrently reclaimed was obtained directly from the Reclamation and Closure Plan (Table 13-2).

### **Conclusions**

Under the assumption that flow reduction is approximately equivalent to the percentage of the watershed where stormwater is retained and isolated from downstream flow, the reduction in flow could be expected to be between 30 and 40 percent during the first 10 years of mine life. Most impacts actually occur by Year 7, and after that concurrent reclamation begins to improve the flow conditions until they reach post-closure conditions, which have been modeled.

The analysis provided is an estimate only, and should not be taken as actual stormflow modeling. For instance, based solely on acreages, the estimate predicts that flows should only be reduced by 5% at closure; however, actual surface water modeling indicates those reductions are closer to 17%.

Given the uncertainties involved with surface water modeling, and particularly with downstream impacts to riparian areas, these estimates are considered approximate but reasonable to inform the analysis.

Table 1. Summary of Changes in Effective Watershed Area over Time during Mine Operations

Sub Watershed Area	Acreage Removed from Watershed																	
	Quarter -7	Quarter -6	Quarter -5	Quarter -4	Quarter -3	Quarter -2	Quarter -1	End of Year 1	End of Year 2	End of Year 3	End of Year 5	End of Year 7	End of Year 8	End of Year 10	End of Year 11	End of Year 12	End of Year 15	End of Year 22
Crusher Stormwater Pond	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
Pit Stormwater Pond		543	543	543	543	543	543	543	543	543	543	543	543	543	543	543	543	543
TS Pond/Plant Site		90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
Pond S2A			216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216
Pond S1				63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
Pond S1C				55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Pond S3A				490	490	490	490	490	490	490	490	490	490	490	490	490	490	490
Pond SM1					397	397	397	397	397	397	397	397	397	397	397	397	397	397
Pond S3C					905	905	905	905	905	905	905	905	905	905	905	905	905	905
Pit Diversions				121	121	121	121	121	121	121	121	121	121	121	121	121	121	121
PCA2						78	78	78	78	78	78	78	78	78	78	78	78	78
Eastern Waste Rock												726	726	726	726	726	726	726
<b>TOTAL ACREAGE REMOVED BY MINING</b>	<b>250</b>	<b>883</b>	<b>1100</b>	<b>1829</b>	<b>3131</b>	<b>3208</b>	<b>3208</b>	<b>3208</b>	<b>3208</b>	<b>3208</b>	<b>3208</b>	<b>3934</b>	<b>3934</b>	<b>3934</b>	<b>3934</b>	<b>3934</b>	<b>3934</b>	<b>3934</b>
<b>TOTAL ACREAGE RECLAIMED</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>114</b>	<b>283</b>	<b>542</b>	<b>710</b>	<b>866</b>	<b>944</b>	<b>1100</b>	<b>1177</b>	<b>1254</b>	<b>1483</b>	<b>3473</b>
<b>TOTAL ACREAGE MISSING FROM WATERSHED</b>	<b>250</b>	<b>883</b>	<b>1100</b>	<b>1829</b>	<b>3131</b>	<b>3208</b>	<b>3208</b>	<b>3094</b>	<b>2925</b>	<b>2666</b>	<b>2498</b>	<b>3068</b>	<b>2990</b>	<b>2834</b>	<b>2757</b>	<b>2680</b>	<b>2451</b>	<b>461</b>
<b>% of Watershed Lost (at Barrel/Hwy 83)</b>	<b>3%</b>	<b>10%</b>	<b>12%</b>	<b>20%</b>	<b>35%</b>	<b>36%</b>	<b>36%</b>	<b>34%</b>	<b>32%</b>	<b>30%</b>	<b>28%</b>	<b>34%</b>	<b>33%</b>	<b>31%</b>	<b>31%</b>	<b>30%</b>	<b>27%</b>	<b>5%</b>

Underlined numbers are interpolated

Percentage based on watershed area of 9,024 acres (from USGS gage data for 09484580 BARREL CANYON NEAR SONOITA, AZ)