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Memo

To:	Leslie Gomm	**Date:**	April 27, 2010
cc:		**From:**	Kelly Sexsmith Dylan MacGregor
Subject:	Review of inputs and assumptions used in the waste rock models	**Project #:**	1CY001.032

1 Introduction

A detailed review and update of the seepage water chemistry, seepage assignments, and NP availability used in the waste rock model was completed in July 2009 and provided to the individuals responsible for developing the overall water and load balances for the site. The review included: an update on the statistics for the seepage water quality; an evaluation of whether the seepage assignments are still appropriate for use in assessing overall impacts from the site; updated acid base accounting assumptions for the Vangorda dump; an update on the assumptions used to define NP availability in the models; and, a change in way seepage assignments are allowed to progress through time.

This work was completed as part of a more comprehensive review to identify potential improvements to the waste rock, open pit and tailings models (Task 4.1 of the overall project workplan), as documented in our memo "*Review of Inputs to Task 4.1: Site Water Balance and Load Modelling – Final Draft*" (SRK 2010a). Although it addresses some of the specific recommendations provided in the overall review, the work was completed in advance of the review to support the timing requirements for the site water and load balance modelling for inclusion in the Project Description.

This memo documents the specific recommendations made in support of the recent updates to the model.

2 Review and Update of Seepage Chemistry

2.1 Summary of Changes

Statistics on seepage chemistry quality for each of the different water types used in the models were updated to address the following issues:

- All of the data available as of July 2009 (i.e. data up to the fall of 2008) were used in the statistical calculations.
- Ore and waste rock seeps are now clearly separated in the statistics.
- Seeps that reflect influence from both ore and waste rock are now assigned to a new category of mixed ore and waste (eg. Faro 2 ore and waste).
- Seeps that are considered to be highly diluted by an upstream flow were removed from the statistics as the diluted seeps do not reflect source concentrations.

- Seeps that are used to represent specific components of the site are also used to represent the general water type that they belong with. For example, FD19 is used to specifically represent chemistry from the Northwest Dump, but is also a good example of a Type 2 seep, and is therefore used in the statistics for both Type 2 water and for the specific FD19 water.

- Three new water types were defined for seepage from the Grum dump.
  - WGD was established to represent the West portion of the Grum dump to better reflect local conditions in that part of the dump. This seep is based on data from SRK-GD-13/18.
  - Type G2 was developed based on recent Type 2 seeps from Grum.
  - Type G3 has was developed based on Type 3 waste seeps from Faro.

The specific seeps used in the calculation of statistics for each water type are summarized in Table 1. Table 1 also documents specific changes made to these selections since the last model update.

2.2 Results

The updated statistics for each of the water types and specific seeps used are provided in Table 2. These are the results that should be used as input in the water quality modelling.

SRK has also revised the format of the annual seepage monitoring report to include the statistics for each of these water types. The 2009 seepage monitoring report (SRK 2010b) will include an updated summary of statistics.

3 Review Assignments of Water Types to Dump Areas

The assignments of water types to specific dumps were reviewed and updated to reflect our current understanding of conditions. Changes are documented as follows.

3.1 Faro Oxide Fines and Medium Grade Ore Stockpile

The seepage assignments for the oxide fines pile should be set to “Other 1” for current and future conditions.

The seepage assignments for the medium grade ore stockpile should be set to “Other 5” for current and future conditions.

3.2 Grum and Vangorda Dumps

The assignments for the Vangorda and Grum dumps were revised as follows:

- Future Grum Main dump has now been assigned a mixture of G1b (50%), G2 (45%) and G3 (5%) chemistry.

- Current Grum SW dump has now been assigned as WGD (100%), while future Grum SW dump has been assigned WGD (50%) and Type 1b (50%).

- Future Vangorda main dump is now assigned 100% Vangorda Type 3 seepage chemistry to reflect greater clarity on the ABA results for this area.

The changes in seepage assignments for the Grum and Vangorda dumps are documented in Table 3.

3.3 Grum Ore Transfer Pad

The ore transfer pad at Grum was not previously modelled. Initially, there were plans to relocate the ore to another location. Under this scenario, SRK recommended assigning Grum Type 1b seepage quality to the base material in the ore transfer pad. In the current project description, all of the material stored in this location will be left in place. SRK recommends using Grum Sulphide Cell inputs for this area, summarized as follows:

Timing	Grum Type 1b	Grum Type 2 (based on new Type 2 seeps at Grum)	Grum Type 3 (equivalent to Faro Type 3)
Current	0.9	0.1	
Future			1

Additionally, in the absence of specific ABA results for this material, SRK recommends using the NP and AP data for the Grum Sulphide cell for this material.

3.4 Vangorda In-Pit Dumps

The In-Pit Dumps at Vangorda had previously been addressed in the pit lake models. Additionally, the information on the areas and composition of these dumps was from the 1996 ICAP reports and did not reflect final as-built conditions. Recent airphotos were used to define the actual areas of these dumps, and observations from various field investigations were used to define the dump characteristics and therefore seepage assignments.

The updated areas and seepage assignments for current and future conditions are provided in Table 4. Figure 1 shows the locations of these dumps in the pit.

4 Review of ABA Data

A comprehensive review of the ABA values assigned to each of the dumps was not completed as part of this update. However, in evaluating some of the information for the Vangorda Dump, SRK identified a problem with the ABA statistics. Corrected values for ABA from the Vangorda Dump are provided in Table 5.

The assignments of ABA data to each of the dumps are based on the average characteristics of each of the rock types and the expected mixture of rock types present in the dumps. Given the variability in the NP and AP and the uncertainty in the relative proportions of rock type, it would be appropriate to consider using a range of NP and AP values in future model updates. This should be discussed in the upcoming meetings.

5 Review of NP Availability

NP availability is a function of both the chemical reactivity and the physical availability.

Recent studies by SRK (SRK 2009) showed that for most rock units, laboratory measurements of NP provided a reasonable indication of the buffering potential provided by reactive carbonate minerals. In a few of the rock units, notably the intrusives (10E and 10F) and the calc-silicates (3D) at Faro, up to half of the NP may be contributed by silicate minerals, which may not provide sufficient buffering to maintain neutral pH conditions in the rock.

The physical availability of NP and sulphides in the field is dependent on the distribution of these minerals in the rock, size of individual mineral grains, the relative reactivity, precipitation of secondary minerals and a number of other macro-scale features that cannot be accurately quantified. Sensitivity analyses have been recommended to assess the potential range of physical availability of the NP.

SRK recommends completing sensitivity analyses using a range of total NP availability between 25 and 75% of the measured NP. This accounts for a reduction of up to 50% of the total NP to account for reduced reactivity (as measured in the NP study), and an additional reduction of 50 to 75% to account for limited physical availability of the reactive NP.

Given the uncertainty in these inputs, SRK recommends using a simple uniform probability distribution between 25% and 75% to assess the sensitivity of the model to the expected range of NP availability. In otherwords, equal probability should be considered for 25% availability as for 50% or 75% availability.

6 Progression of Seepage Chemistry over Time

In previous modelling, water chemistry was allowed to progress from current average chemistry to current maximum chemistry, to future maximum chemistry. In the new modelling, we are recommending two scenarios, as follows:

- *Best Estimate*: **current average** chemistry from time zero to the time when 70% depletion of the available NP occurs, followed by a linear increase in chemistry to **future average** conditions by the time when 100% depletion of the available NP occurs.

- *Upper Bound*: **current maximum** chemistry from time zero to the time when 70% depletion of the available NP occurs, followed by a linear increase in chemistry to **future maximum** conditions by the time when 100% depletion of the available NP occurs.

7 References

SRK Consulting, 2009. Faro Mine Complex NP Study Report, 2008/09 Task 18. Report Prepared for Deloitte and Touche. SRK Project Reference Number 1CD003.114. May 2009.

SRK Consulting, 2010a. Review of Inputs to Task 4.1: Site Water Balance and Load Modelling – Final Draft. Memo to file. Project 1CY001.032. January 11, 2010.

SRK Consulting, 2010b. Faro Mine Complex, 2009 Waste Rock and Seepage Monitoring Report. SRK Project Reference Number 1CY001.033. In preparation (expected date of completion March 2010.

Table 1: Data Used in Statistical Calculations for Specific Water Types

Area	Water Type	Seeps used in statistics	Changes since previous versions
Faro	Type 1 waste	FD-02, FD-05, FD-06, FD-07, FD-14, FD-26, FD-44, and FD-50.	Dilute seeps FD-16, -17, and -18 were removed from the statistical calculations of F1 water chemistry because these seeps reflect the chemistry of Guardhouse Creek water flowing through the base of the dump, rather than true seepage from the dump material.
Faro	Type 2 waste	FD-08, FD-19, FD-21, FD-22, FD-23, FD-24, FD-26, FD-27, FD-30, FD-40, FD-44, FD-48, FD-49, FD-51, and FD-52.	None
Faro	Type 2 ore and waste	FD-01, FD-09, FD-10, FD-12, FD-31, FD-32, FD-35 and FD-38.	Detailed review of the data indicated there are no pure ore seeps that have a neutral pH (Type 2 characteristics). Therefore, a Type 2 mixed ore and waste category is used to replace the previous Type 2 ore category.
Faro	Type 3 ore	FD-04, FD-33, FD-34, FD-35, FD-37, FD-38, and FD-46.	Previous work included seeps from area of X23 (FD12, -31) in the source term for F3 Ore. These seeps reflect a mixture of waste rock and 'ore' seepage, and the inclusion of monitoring data from these stations in the F3 Ore water type results in significantly lower concentrations than consider only other ore seeps. To ensure that the F3 Ore source term appropriately reflects the known loadings from the various acidic ore and oxide fines stockpiles, only seep chemistry from pure ore or oxide fines sources was used in the revised statistical calculations which define the F3 Ore water type.
Faro	Type 3 waste	FD-13, FD-20, FD-21, FD-22, FD-23, FD-24, FD-27, FD-30, FD-36, FD-40, FD-47, and FD-49.	FD13 has recently developed very low pH chemistry and is showing considerably higher zinc than it has in the past. This is likely a reflection of sulphide cell drainage- in the current model the drainage from the sulphide cells is assigned Other 1 seepage chemistry (which is from the Oxide Fines seepage at FD-04). FD-04 and the recent drainage at FD-13 are in the same ballpark of zinc concentrations so there is no need to change model inputs for "other1" at present. In future, this should be reviewed in light of future trends in seep chemistry at FD-13.
Grum	Type 1a waste	GD-07, GD-08, GD-09, GD-10, GD-12, GD-13, and GD-18.	None. However, GD13 was noted to represent a large number of the individual samples. Future updates should consider potential for statistical bias
Grum	Type 1a waste for West Grum	GD-13 and GD-18.	This is a new seep type. Given the record of flow and water chemistry at GD-13 and GD-18, it was felt that the West Grum Dump dump loading could be best quantified using data from these two seeps to define the source term for this area. Summary statistics were therefore calculated separately for these two seeps and are provided as a West Grum Dump source term.
Grum	Type 1b waste	GD-01, GD-02, GD-04, GD-05, GD-06, GD-11, and GD-21.	None
Grum	Type 2 waste	GD-11, GD-16, GD-17, GD-19 and GD-20.	This is a new seep type. Since 2004 there have been several seeps classified as having Type 2 water chemistry at Grum. The current prediction does not incorporate a G2 source term, as the monitoring record did not include these type of seeps when the predictions were initially developed. The previous model used the V2 source term to reflect the portion of Grum dump drainage that was expected to have higher loads than were indicated by the pre-2004 Grum seepage monitoring. The calculated G2 chemistry was compared with F2w chemistry from Faro, and zinc and sulphate concentrations were found to be within a similar range. This similarity provides a measure of confidence that the G2 water type is not introducing an underestimation of loads for Grum waste rock that is modelled using the G2 source term. It should be noted that the May 2004 chemistry at GD-19 was previously assigned a Type 3 designation, based on a pH value slightly less than 6. For the purpose of calculating the G2 source term, this seep has been reclassified as Type 2, as it more appropriately reflects this group.
Grum	Type 3 waste	See F3W	This is a new seep type. While there have not been full ARD seeps identified at Grum, the expectation is that the sulphide cell and some small pockets of sulphides outside of the sulphide cell will go acidic in time. The current model uses a V3 water type to represent this condition. On review, it is recommended instead that the F3w water type be adopted for the revised prediction, as it is considered to be a more reasonable surrogate for the Grum sulphide cell drainage than the much-worse chemistry associated with acidic seepage at Vangorda. The G3 water type presently adopts the F3W water chemistry. Future Grum seepage monitoring results may provide opportunities to revise this to a Grum-specific water chemistry.
Vangorda	Type 2	VD-01, VD-02, VD-03, VD-05 and VD-06.	None
Vangorda	Type 3	VD-01, VD-03, VD-04, VD-05, VD-07, VD-08, VD-09, VD-10,and VD-12.	None. Chemistry of seeps draining the sulphide cell and the main waste dump were reviewed to evaluate whether there are significant chemical differences in seepage from the two waste types. This review showed that the seepage chemistry from both waste types is, in fact, sufficiently similar that there is no need to apply different source terms to the two parts of the Vangorda dump. As part of that review, seepage chemistry of pH 3 seeps was compared with that of pH 5-6 seeps to assess whether there were significantly higher concentrations at lower pH, and it was found that there were not significant differences in metal concentrations over the range from pH 3 to pH 6.

Table 2: Summary of Seepage Chemistry Statistics

Area	Type	Statistic	Acidity (to pH 8.3) CaCO3	Alkalinity-Total CaCO3	Chloride Cl	Sulphate SO4	Al	Sb	As	Be	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Sr	Tl	Sn	U	V	Zn
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Faro	1	Average	12	180	1.4	730	0.041	0.00025	0.00032	0.000077	0.033	0.0052	140	0.00017	0.0068	0.0095	0.12	0.011	120	0.16	0.00055	0.054	6.4	0.0017	0.000013	26	0.97	0.00033	1.6E-05	0.031	0.0077	3
		Median	12	190	1.3	510	0.0036	0.0002	0.00026	0.00005	0.035	0.0035	130	0.0001	0.0028	0.0037	0.026	0.00029	97	0.081	0.00013	0.055	4.4	0.0017	0.000009	8	0.66	0.0002	0.00001	0.011	0.0002	2.3
		Min	3	40	0.5	210	0.0016	0.00005	0.00014	0.00001	0.01	0.00046	54	0.0001	0.000056	0.0011	0.002	0.000061	27	0.00015	0.00005	0.014	2.2	0.0005	0.000005	2.2	0.21	0.000079	0.00001	0.0056	0.0002	0.045
		Max	34	320	2.7	2700	0.35	0.0007	0.0007	0.00019	0.05	0.02	280	0.0005	0.029	0.06	0.89	0.15	400	0.69	0.0022	0.14	24	0.0043	0.00003	150	3.8	0.0013	0.00005	0.15	0.049	14
		N	49	49	46	49	13	13	13	7	12	15	49	9	17	16	11	14	49	49	13	25	49	10	11	49	49	13	7	7	11	49
Faro	2w	Average	72	130	1.4	2100	0.6	0.00024	0.0013	0.00034	0.017	0.041	280	0.00018	0.085	0.1	2.7	0.05	320	7.7	0.00064	0.26	7.5	1.8	0.00008	11	1.4	0.00037	0.00001	0.006	0.0095	38
		Median	62	57	1.3	1300	0.22	0.0002	0.0007	0.0003	0.01	0.035	220	0.0002	0.06	0.042	1.1	0.046	160	3.7	0.0004	0.18	7.6	0.004	0.0001	5.6	0.84	0.00029	0.00001	0.0015	0.0002	30
		Min	14	2	0.5	330	0.002	0.00006	0.00016	0.00009	0.01	0.0025	49	0.0001	0.01	0.0034	0.02	0.0013	35	0.037	0.00005	0.014	0.2	0.00034	0.00001	2	0.18	0.00009	0.00001	0.00018	0.0002	3.9
		Max	280	450	3.2	11000	3.6	0.0004	0.0059	0.0006	0.05	0.1	680	0.0002	0.56	0.7	20	0.16	2000	36	0.0021	1.8	25	9	0.00012	65	3.8	0.0012	0.00001	0.015	0.048	170
		N	57	57	47	57	19	10	11	5	6	45	57	6	53	42	39	21	57	57	6	56	53	15	5	57	57	10	1	5	9	57
Faro	2ow	Average	420	200	10.0	3700	0.19	0.00027	0.0013	0.0021	0.01	0.11	470	0.011	0.4	0.2	37	0.046	500	38	0.0044	0.57	12	0.0032	0.00031	43	2.9	0.029	0.14	0.0075	0.047	230
		Median	420	220	13.0	4200	0.24	0.00025	0.0014	0.00069	0.01	0.047	490	0.00035	0.44	0.038	23	0.014	630	49	0.0046	0.63	13	0.0039	0.0002	45	3.1	0.0015	0.03	0.0073	0.034	220
		Min	22	13	0.7	950	0.002	0.0002	0.0003	0.0002	0.01	0.01	220	0.0002	0.015	0.01	0.05	0.0002	38	0.84	0.0003	0.05	5.7	0.0006	0.00006	7	0.72	0.0005	0.00005	0.0045	0.0002	14
		Max	2200	370	25.0	6300	0.38	0.0004	0.0021	0.007	0.01	0.65	620	0.033	1.1	2.4	140	0.23	870	85	0.0083	1.4	29	0.0049	0.00063	79	4.4	0.2	0.31	0.011	0.12	660
		N	40	40	30	40	12	6	7	4	3	39	40	6	40	32	39	12	40	40	4	38	40	6	6	40	40	7	5	3	8	40
Faro	3w	Average	1300	10	3.3	2500	27	0.0013	0.32	0.022	0.037	1.4	170	0.082	0.56	3.4	220	0.43	250	21	0.0011	0.93	6.5	1.6	0.00066	8.9	0.62	0.038	0.00061	0.13	0.019	270
		Median	220	2	0.7	1300	9.2	0.0002	0.0014	0.0088	0.05	0.12	130	0.02	0.24	1	27	0.29	140	6.3	0.00035	0.31	5.9	0.006	0.00012	4	0.49	0.0011	0.0001	0.023	0.001	59
		Min	27	1	0.5	69	0.23	0.0001	0.00037	0.0019	0.01	0.018	6.5	0.0002	0.03	0.03	0.042	0.069	3.8	0.16	0.00013	0.05	0.01	0.0004	0.000028	1.6	0.044	0.00015	0.00001	0.0062	0.0002	2.2
		Max	20000	92	48.0	28000	410	0.009	3.5	0.21	0.05	47	470	0.52	6.3	61	4300	1.6	2100	320	0.003	12	20	9	0.0043	110	2.1	0.4	0.0025	0.59	0.081	4500
		N	49	49	40	49	46	8	13	23	3	47	49	19	48	49	48	36	49	49	6	48	38	15	9	49	49	11	5	8	7	49
Faro	3o	Average	17000	4.1	87	21000	220	0.48	85	0.018	0.5	12	320	0.5	5.7	150	2600	1.9	590	310	0.0092	5.1	5.2	0.24	0.028	37	0.72	0.16	0.0068	0.69	0.048	7300
		Median	8700	1.0	2.5	12000	94	0.41	29	0.0086	0.5	6.3	330	0.35	3.1	8.3	1200	1.7	380	150	0.0092	3.2	4	0.014	0.0058	17	0.49	0.0097	0.0068	0.55	0.048	5500
		Min	210	0.50	0.5	700	2.4	0.003	0.04	0.001	0.5	0.082	80	0.012	0.08	0.12	1.3	0.36	39	5.7	0.0003	0.08	0.94	0.001	0.0007	2	0.22	0.0029	0.0001	0.0036	0.006	99
		Max	53000	31	1100	67000	990	1.5	450	0.05	0.5	57	510	1.2	20	560	15000	4.9	3200	2400	0.018	16	11	0.7	0.1	220	2.4	0.6	0.013	1.7	0.09	35000
		N	24	24	16	24	22	6	14	6	1	24	24	10	24	23	24	16	24	24	2	23	5	3	4	13	24	4	2	4	2	24
	Others																															
Faro	SRK-FD04	Average	31000	1	340.0	36000	500		38			9.6	380	0.74	11	250	6700		1700	940		7.7				10	0.48					6900
	(Other 1)	Median	34000	1	160.0	38000	500		17			11	420	0.9	11	130	5300		1600	630		7.5				10	0.4					7800
		Min	5800	1	0.5	7500	27		9			1.7	160	0.22	1.4	55	1300		190	130		0.8				10	0.22					1200
		Max	50000	1	1100.0	59000	990		87			16	500	1.1	20	560	15000		3200	2400		15				10	0.9					11000
		N	4	4	4	4	4		3			4	4	3	4	3	4		4	4		4				1	4					4
Faro	SRK-FD05/6	Average	11	200	1.5	450	0.003	0.00017	0.00027	0.00001	0.03	0.0021	120	0.00014	0.00081	0.0019	0.008	0.00021	93	0.085	0.00017	0.044	3.7	0.0014	0.000011	5.9	0.51	0.00014	0.00001	0.0088	0.0002	2.9
	(Other 2)	Median	9	210	1.3	400	0.0021	0.0002	0.0002	0.00001	0.02	0.0016	120	0.0001	0.0002	0.0017	0.006	0.00024	86	0.005	0.00013	0.031	3.6	0.0017	0.000007	5.8	0.46	0.00011	0.00001	0.01	0.0002	2
		Min	3	85	0.6	210	0.0016	0.00011	0.00016	0.00001	0.01	0.00046	54	0.0001	0.000056	0.0013	0.002	0.000061	45	0.00015	0.0001	0.014	2.2	0.0005	0.000005	2.2	0.21	0.000079	0.00001	0.0056	0.0002	0.53
		Max	31	320	2.5	1200	0.006	0.0002	0.0005	0.00001	0.05	0.0057	200	0.0002	0.0028	0.0033	0.02	0.00031	210	0.49	0.0003	0.12	5.2	0.0025	0.00002	9	0.84	0.00021	0.00001	0.011	0.0002	14
		N	20	20	20	20	7	7	7	3	7	7	20	5	7	7	5	7	20	20	7	10	20	5	5	20	20	7	3	3	5	20
Faro	SRK-FD14	Average	9	110	0.9	1600	0.0076	0.00056	0.00045	0.00015	0.035	0.01	180	0.0003	0.009	0.018	0.38	0.0026	230	0.18	0.0019	0.069	15	0.0027	0.000018	90	2.3	0.00096	0.00003	0.086	0.017	3.8
	(Other 3)	Median	8	120	0.5	1400	0.0036	0.00065	0.0005	0.00015	0.035	0.0076	180	0.0003	0.012	0.0046	0.21	0.0038	220	0.079	0.0021	0.063	15	0.0021	0.00002	120	2.2	0.0011	0.00003	0.086	0.001	2.9
		Min	3	40	0.5	510	0.003	0.00034	0.00014	0.00011	0.02	0.0049	72	0.0001	0.0002	0.0011	0.05	0.00019	88	0.005	0.0014	0.04	7	0.0018	0.000005	13	0.93	0.00051	0.00001	0.022	0.0002	1
		Max	24	160	2.5	2700	0.016	0.0007	0.0007	0.00019	0.05	0.02	280	0.0005	0.02	0.06	0.89	0.0039	400	0.5	0.0022	0.14	24	0.0043	0.00003	150	3.8	0.0013	0.00005	0.15	0.049	11
		N	10	10	8	10	3	3	3	2	2	4	10	2	5	4	3	3	10	10	3	10	10	3	3	10	10	3	2	2	3	10
Faro	SRK-FD19	Average	120	380	2.1	3800	0.16	0.00037	0.003	0.0006	0.01	0.028	570	0.0002	0.086	0.052	0.4	0.0072	600	21	0.0021	0.41	9.8	0.005	0.00009	20	3.2	0.00031		0.014	0.024	66
	(Other 4)	Median	110	400	2.1	3800	0.007	0.0004	0.0018	0.0006	0.01	0.014	590	0.0002	0.062	0.018	0.07	0.007	580	18	0.0021	0.38	10	0.0053	0.00009	21	3.3	0.00032		0.014	0.024	53
		Min	67	260	1.1	3100	0.002	0.0003	0.0013	0.0006	0.01	0.0073	450	0.0002	0.035	0.011	0.02	0.0014	400	12	0.0021	0.27	6.9	0.004	0.00006	15	2.3	0.00026		0.013	0.0002	36
		Max	280	450	2.8	5100	0.48	0.0004	0.0059	0.0006	0.01	0.082	680	0.0002	0.29	0.18	2.9	0.014	770	36	0.0021	0.68	12	0.0057	0.00012	26	3.8	0.00036		0.015	0.048	170
		N	14	14	9	14	3	3	3	1	1	7	14	1	14	8	9	4	14	14	1	14	14	3	2	14	14	3		2	2	14
Faro	SRK-FD37	Average	30000	1	2.0	36000	310	0.72	130	0.031	0.5	28	290	0.75	9.8	340	3900	2.9	610	360	0.018	9.2		0.36	0.055	2.7	0.42	0.3	0.013	1.4	0.09	16000
	(Other 5)	Median	31000	2	0.5	35000	280	0.53	90	0.035	0.5	26	280	0.82	9.7	320	3200	2.4	600	360	0.018	9		0.36	0.055	2.7	0.42	0.3	0.013	1.4	0.09	14000
		Min	11000	1	0.5	13000	71	0.3	9.7	0.009	0.5	10	220	0.26	3.2	120	1000	0.6	240	130	0.018	3.2		0.014	0.01	2	0.28	0.0029	0.013	1.1	0.09	6100
		Max	53000	2	5.0	67000	580	1.5	450	0.05	0.5	57	350	1.2	17	560	9400	4.9	1100	660	0.018	16		0.7	0.1	3.4	0.6	0.6	0.013	1.7	0.09	35000
		N	8	8	3	8	8	4	8	3	1	8	8	3	8	8	8	5	8	8	1	8		2	2	2	8	2	1	2	1	8
Faro	SRK-FD40	Average	300	9	0.9	750	13	0.00023	0.0016	0.0079	0.01	3.7	65	0.021	0.23	1.3	44	0.25	74	4.1	0.00025	0.18	1.3	0.00087	0.0002	3.1	0.26	0.00047	0.00005	0.027	0.0006	69
	(Other 6)	Median	150	2	0.5	610	8.3	0.0002	0.0013	0.0074	0.01	0.07	68	0.023	0.17	0.65	29	0.15	61	3.2	0.00025	0.12	1.2	0.0008	0.00012	3	0.24	0.00029	0.00005	0.027	0.0006	44
		Min	43	1	0.5	330	0.48	0.0001	0.0004	0.0019	0.01	0.02	23	0.0041	0.019	0.01	1.1	0.08	29	0.037	0.0002	0.06	1.1	0.0008	0.0001	1.6	0.12	0.00027	0.00005	0.0099	0.0002	21
		Max	1200	29	2.5	2000	39	0.0004	0.0036	0.017	0.01	47	120	0.042	0.65	5.1	160	0.75	180	13	0.0003	0.48	1.7	0.001	0.00038	4.6	0.4	0.00085	0.00005	0.045	0.001	200
		N	13	13	11	13	10	3	4	6	1	13	13	5	10	13	9	10	13	13	2	13	3	3	3	13	13	3	1	2	2	13

Table 2: Summary of Seepage Chemistry Statistics (Cont.)

Area	Type	Statistic	Acidity (to pH 8.3) CaCO3	Alkalinity-Total CaCO3	Chloride Cl	Sulphate SO4	Al	Sb	As	Be	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Mo	Ni	K	Se	Ag	Na	Sr	Tl	Sn	U	V	Zn
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L
Grum	1a	Average	11	320	1.4	380	0.006	0.00047	0.0037	0.00005	0.023	5.3E-05	160	0.0003	0.004	0.0017	0.23	0.00021	78	0.11	0.0012	0.09	3	0.0027	0.00003	3.2	0.67	0.00017	0.026	0.018	0.0006	0.036
		Median	9	340	1.3	410	0.004	0.00049	0.0029	0.00005	0.01	0.00004	170	0.0002	0.002	0.001	0.23	0.00023	71	0.007	0.0014	0.087	3	0.0023	0.00003	3	0.67	0.000075	0.026	0.018	0.0004	0.011
		Min	1	110	0.5	7	0.002	0.0003	0.0016	0.00005	0.01	0.00002	42	0.0002	0.00029	0.0008	0.008	0.00008	23	0.0014	0.0005	0.05	2	0.0012	0.00003	2	0.19	0.00002	0.00005	0.018	0.0004	0.005
		Max	40	470	2.5	840	0.014	0.0006	0.0076	0.00005	0.05	0.0001	290	0.0005	0.012	0.0038	0.43	0.0003	180	1.9	0.0016	0.13	4.1	0.0045	0.00003	5.9	1.3	0.0005	0.051	0.018	0.001	0.39
		N	29	29	26	29	4	4	4	1	3	3	29	3	4	4	4	4	29	29	4	12	18	3	1	29	29	4	2	1	3	29
Grum	1b	Average	25	510	1.9	1400	0.0027	0.0015	0.0048	0.00066	0.03	0.0016	340	0.00037	0.01	0.0084	0.23	0.0061	250	0.13	0.001	0.4	7	0.0017	0.0012	11	1.3	0.00041	0.022	0.031	0.011	3.7
		Median	22	540	1.9	1300	0.002	0.0013	0.0036	0.00005	0.03	0.0015	350	0.0005	0.0044	0.0024	0.015	0.0013	240	0.056	0.0009	0.35	7	0.0014	0.00003	11	1.4	0.00035	0.00005	0.028	0.001	2.9
		Min	1	260	0.5	330	0.001	0.0005	0.0006	0.00001	0.01	0.00028	120	0.0001	0.0004	0.0014	0.006	0.00076	70	0.0016	0.0003	0.086	1.8	0.0002	0.000005	2	0.46	0.00022	0.00001	0.0092	0.0002	1.1
		Max	69	700	2.8	2500	0.005	0.0038	0.02	0.0056	0.05	0.005	480	0.0005	0.05	0.041	0.8	0.072	440	1	0.0033	1.4	12	0.0045	0.011	18	2.4	0.00071	0.099	0.052	0.059	17
		N	50	50	37	50	15	15	15	9	8	15	50	12	21	19	13	15	50	50	15	50	50	12	9	50	50	15	12	8	15	50
Grum	2	Average	93	300	1.6	1700	0.037	0.0011	0.0016	0.00005	0.01	0.044	310	0.0003	0.14	0.22	8.8	0.021	260	2.2	0.0019	0.66	7.3	0.0031	0.00003	6.8	1.1	0.0033	0.00005	0.013	0.0006	44
		Median	83	290	1.8	1700	0.002	0.0009	0.0009	0.00005	0.01	0.025	320	0.0002	0.063	0.0055	0.75	0.0045	250	1.5	0.0008	0.5	6.5	0.0029	0.00003	5.4	0.96	0.0044	0.00005	0.0037	0.0006	17
		Min	7	39	0.5	570	0.001	0.0005	0.0006	0.00005	0.01	0.0024	170	0.0002	0.0084	0.0015	0.015	0.0012	110	0.11	0.0003	0.1	2.7	0.0002	0.00003	2.3	0.51	0.00048	0.00005	0.0019	0.0002	7.7
		Max	240	660	2.8	4100	0.28	0.0029	0.0048	0.00005	0.01	0.18	460	0.0005	0.7	2.1	46	0.14	570	7.5	0.0044	2.7	20	0.0092	0.00003	15	1.8	0.006	0.00005	0.033	0.001	140
		N	15	15	14	15	8	7	7	2	4	12	15	6	15	11	9	8	15	15	7	15	15	7	2	15	15	7	2	3	6	15
Grum	SRK-GD13/18	Average	13	330	1.1	520	0.006	0.00047	0.0037	0.00005	0.023	5.3E-05	180	0.0003	0.004	0.0017	0.23	0.00021	100	0.064	0.0012	0.09	3	0.0027	0.00003	3.9	0.84	0.00017	0.026	0.018	0.0006	0.059
		Median	12	390	1.0	500	0.004	0.00049	0.0029	0.00005	0.01	0.00004	170	0.0002	0.002	0.001	0.23	0.00023	96	0.034	0.0014	0.087	3	0.0023	0.00003	3.9	0.86	0.000075	0.026	0.018	0.0004	0.021
		Min	2	110	0.5	300	0.002	0.0003	0.0016	0.00005	0.01	0.00002	80	0.0002	0.00029	0.0008	0.008	0.00008	44	0.0014	0.0005	0.05	2	0.0012	0.00003	2	0.36	0.00002	0.00005	0.018	0.0004	0.007
		Max	30	470	2.5	840	0.014	0.0006	0.0076	0.00005	0.05	0.0001	290	0.0005	0.012	0.0038	0.43	0.0003	180	0.61	0.0016	0.13	4.1	0.0045	0.00003	5.9	1.3	0.0005	0.051	0.018	0.001	0.39
		N	16	16	14	16	4	4	4	1	3	3	16	3	4	4	4	4	16	16	4	12	13	3	1	16	16	4	2	1	3	16
Vangorda	2	Average	640	130	1.1	3600	0.042	0.0003	0.023	0.007	0.042	0.13	330	0.0099	1.8	0.027	91	0.041	480	140	0.0075	2.7	9.3	0.0045	0.00057	7.6	1.3	0.068	0.082	0.016	0.017	310
		Median	310	150	0.8	2900	0.026	0.0004	0.002	0.007	0.05	0.08	390	0.0005	0.91	0.015	7.9	0.0064	400	45	0.0022	2.4	11	0.006	0.0005	8.8	1.6	0.0013	0.036	0.016	0.001	130
		Min	35	5	0.4	320	0.004	0.0001	0.0004	0.00005	0.01	0.028	69	0.0002	0.029	0.001	0.06	0.0008	27	2.4	0.0003	0.065	0.92	0.001	0.00027	0.3	0.25	0.0005	0.00005	0.011	0.0002	13
		Max	6200	350	4.0	19000	0.1	0.0004	0.13	0.014	0.05	1.1	530	0.029	10	0.072	1100	0.11	2800	1200	0.028	7.2	14	0.008	0.0012	16	2.3	0.4	0.26	0.021	0.11	2600
		N	33	33	25	33	7	3	7	2	5	33	33	3	33	12	31	10	33	33	6	33	26	7	5	31	33	9	4	2	7	33
Vangorda	3	Average	11000	22	1.8	25000	110	0.037	6.7	0.031	0.05	4.6	430	0.19	13	12	1600	0.96	2500	1500	0.16	11	9.8	0.056	0.012	6.5	1.7	2.4	2	0.6	0.52	4700
		Median	5900	2	0.5	18000	29	0.002	0.045	0.024	0.05	1.6	440	0.11	7.7	0.7	1000	1	2000	1100	0.021	6.6	10	0.026	0.004	5	1.5	0.0077	2.6	0.49	0.068	2800
		Min	210	1	0.5	1600	0.4	0.0004	0.005	0.0064	0.05	0.14	200	0.013	0.3	0.032	0.12	0.0007	110	18	0.018	0.75	3	0.0068	0.0005	1.3	0.45	0.0017	0.006	0.003	0.001	87
		Max	42000	130	11.0	89000	690	0.11	48	0.082	0.05	23	600	0.57	38	180	8400	2.5	8400	4800	0.43	38	28	0.14	0.026	15	5.5	16	3	1.7	2.6	17000
		N	45	45	21	45	34	3	10	8	3	43	45	9	45	25	45	25	45	45	3	45	21	9	9	24	45	12	4	6	7	45

Table 3: Revisions to Grum and Vangorda Seepage Assignments (new assignments on right portion of table).

Source Terms from "DumpWQPred_JTC_DDS_23Oct2007_Rev05.xls"

-this file was the 2004 model that had been updated with new seepage statistics yearly

Time 1 year

Source	Code	Current Seep Types (as fraction)			
		G1a	G1b	V2	V3
Grum Main Sulphide Cell	G1-S		0.9	0.1	0
Grum Main Dump	G1-B		1	0	
Grum Southwest Dump	G2	1	0	0	
Overburden Dump	G3-O	1			
Vangorda Main Sulphide Cell	V1-S				1
Vangorda Main Dump	V1-B			0.8	0.2
Baritic Fines Dump	V2				1
Overburden Dump	V3-O		0.9	0.1	

Time 1000 years

Source	Code	Current Seep Types (as fraction)			
		G1a	G1b	V2	V3
Grum Main Sulphide Cell	G1-S		0	0	1
Grum Main Dump	G1-B		0.9	0.1	
Grum Southwest Dump	G2	0	0.9	0.1	
Overburden Dump	G3-O	1			
Vangorda Main Sulphide Cell	V1-S				1
Vangorda Main Dump	V1-B			0.7	0.3
Baritic Fines Dump	V2				1
Overburden Dump	V3-O		0.9	0.1	

Reassigned source terms based on July 2009 review by SRK (KSS and DBM, July 7/8)

Time 1 year

Source	Code	Current Seep Types (as fraction)						
		G1a	G1b	WGD	G2	G3	V2	V3
Grum Main Sulphide Cell	G1-S		0.9				0.1	0
Grum Main Dump	G1-B		1				0	
Grum Southwest Dump	G2		0	1			0	
Overburden Dump	G3-O	1						
Vangorda Main Sulphide Cell	V1-S							1
Vangorda Main Dump	V1-B						0.8	0.2
Baritic Fines Dump	V2							1
Overburden Dump	V3-O		0.9				0.1	

Time 1000 years

Source	Code	Current Seep Types (as fraction)						
		G1a	G1b	WGD	G2	G3	V2	V3
Grum Main Sulphide Cell	G1-S		0				0	1
Grum Main Dump	G1-B		0.5		0.45	0.05		
Grum Southwest Dump	G2	0	0.5	0.5				
Overburden Dump	G3-O	1						
Vangorda Main Sulphide Cell	V1-S							1
Vangorda Main Dump	V1-B							1
Baritic Fines Dump	V2							1
Overburden Dump	V3-O		0.9				0.1	

Yellow indicates July 2009 revisions

Table 4: Seepage Assignments and Areas for In-Pit Dumps at Vangorda

	Source	Code	Current Seep Types (as fraction)				Area
			G1a	G1b	V2	V3	m2
Pit	Dump Southeast of Ramp	VPL1			0.5	0.5	50,000
Area	Dump inside Hairpin	VPL2			0.8	0.2	23,000
	Oxide Fines Dump	VPL3				1	4,000

	Source	Code	Future Seep Types (as fraction)				Area
			G1a	G1b	V2	V3	m2
Pit	Dump Southeast of Ramp	VPL1				1	50,000
Area	Dump inside Hairpin	VPL2			0.7	0.3	23,000
	Oxide Fines Dump	VPL3				1	4,000

Figure 1: In Pit Dumps at Vangorda.

Table 5: Revised ABA Data for Vangorda Main Dump.

Name	Code	Contained tonnes	Area m2	AP	NP	NNP	NP/AP	S %
Main Dump	V1-B	5,400,000	327,397	67	28	-39	0.42	2.18