sample intervals noted as "no sample" in the West Kirkland database are actually less than detection values, and therefore have been changed to "0" in the current database.

12.1.1.2 Pre-Allied Drilling Data for Hasbrouck

Collar Locations: None of the pre-2010 drill-hole collars were originally surveyed; locations were based on drill maps and photos. In December 2010, Allied Nevada geologists re-established collar locations for as many pre-2010 historical drill holes as possible. Most locations had physical features on the ground (i.e. drill casing) and were marked by stakes and metal tags on the side of the drill road. These sites have also been corroborated by an historical drill collar map. Kevin Haskew, a Professional Land Surveyor with Advanced Surveying & Professional Services in Goldfield, Nevada, subsequently surveyed the collars using the NAD83 datum. Seventy-three pre-2010 historic drill holes were located and surveyed and all 73 holes showed material differences of up to 50ft in collar locations. The database provided to MDA by West Kirkland included the new 2010 survey data.

MDA compared the 2010 survey data against the previous collar locations within the 2003 MDA database. The average x, y shift was 25ft in the Easting and 5ft in the Northing though the data showed variability of a fairly constant ± 10ft from these average values, with the occasional outlier of >25ft difference. To standardize the treatment of the pre-Allied drill collars within this current resource, this shift was used to convert the collar locations of the remaining 51 unsurveyed, pre-Allied drill holes.

Additional to the revisions to the 51 drill collars noted above, one collar location was corrected for a likely typographical error, and minor changes were made to the final depths of two drill holes.

Downhole Survey: No discrepancies were noted in the downhole survey data between data sets. None of the pre-Allied drill holes were surveyed

Assays: No material discrepancies were noted in the Hasbrouck assay data; the only differences noted pertained to decimal rounding differences.

12.1.2 MDA Audit of Allied Data

Collar Locations: MDA validated the Three Hills and Hasbrouck collar locations against the original collar survey data provided by Haskew Engineering. There were no discrepancies in the Three Hills collar data; 16 Hasbrouck holes had differences of greater than 5ft between the original survey data and the West Kirkland database. The current Hasbrouck database was revised to match the original survey data.

Downhole Surveys: No material differences between the West Kirkland database and original downhole surveys were observed. MDA added the downhole survey data for holes THC13-019 through THC13-023 which were missing from the West Kirkland database.

Assays: No material errors were noted in the Three Hills and Hasbrouck gold assay data; only minor differences due to rounding were observed. Ninety-one silver values were corrected in the Hasbrouck database. The majority of these changes were due to the inclusion of cyanide-leach data instead of original fire assay values.

12.1.3 Database Audit Summary

MDA audited the Three Hills and Hasbrouck databases and believes that the data are adequate for use in the resource estimation and classification.

12.2 Site Visit

T. Dyer (MDA) visited the Three Hills and Hasbrouck project on May 1, 2014. P. Tietz (MDA) visited the Three Hills and Hasbrouck project office and field site on July 25, 2014. The latter site visit included a review of the Three Hills cross-section gold model in the Tonopah office and site visits to both Three Hills and Hasbrouck Mountain. Drill site and mineralization verification procedures were conducted, and core drilling/sampling procedures were appraised. The result of the site visit is that MDA has no significant concerns with the project procedures.

12.3 Quality Assurance/ Quality Control

Historic pre-2010 Programs

No quality control documentation has been found for the Cordex, Franco-Nevada, and FMC Hasbrouck drill campaigns, other than for check assays (see Section 12.5.4, below). Based upon the era of drilling for these campaigns (1974 to 1988) it is not unusual that no QA/QC program was employed. Quality control data exist for the Euro- Nevada drill holes, but because the Euro-Nevada drill holes were drilled outside the Hasbrouck Mineral Resource area, this data has not been evaluated.

Allied Nevada 2010 – 2013

Allied Nevada utilized standards, duplicates and check assays to evaluate the analytical accuracy and precision of the assay laboratory during the time the drill samples are analyzed. At both the Hasbrouck and Three Hills deposits, Allied Nevada submitted certified reference materials (CRMs) and blank samples in the project sample stream to monitor assay accuracy and possible contamination during sample preparation. The CRMs were obtained from Minerals Exploration and Environmental Geochemistry of Reno, Nevada (“MEG”) and had a range of gold and silver grades that were within the expected grade range for the deposit samples as summarized in Table 12.1. Data available to MDA indicates that duplicates were inserted with samples from 39 RC holes and 1 core hole drilled in 2011 at the Hasbrouck deposit. MDA has no information on what type(s) of duplicates were inserted, or how the duplicates were collected. Therefore, MDA has not evaluated this duplicate data.

Table 12.1 Summary of QA/QC Reference Materials for the Allied Nevada Drilling at Three Hills and Hasbrouck Deposits

StandardID	Source	Certified Gold Value PPM	1 SD PPM
A607003X	MEG	0.734	0.059
Cove 1	MEG	0.473	0.069
Cove 2	MEG	0.663	0.126
Cove 3	MEG	0.852	0.059
Cove 4	MEG	2.044	0.134
Cove 10	MEG	0.437	0.026
Cove 11	MEG	0.484	0.041
Cove 12	MEG	0.418	0.035
MEG-AU-09.01	MEG	0.687	0.073
MEG-AU-09.03	MEG	2.090	0.331
MEG-AU-09.04	MEG	3.397	0.407
S105003X	MEG	0.525	0.075
S107001X	MEG	0.234	0.016
S107005X	MEG	2.416	0.526
S107011X	MEG	9.262	0.868
S107020X	MEG	0.320	0.068

West Kirkland 2014

West Kirkland's 2014 QA/QC program utilized blanks, standards and duplicate samples inserted with core and RC samples prior to shipment to ALS. These were inserted on a regular basis as shown in Table 12.2:

Table 12.2 West Kirkland QA/QC Sample Insertion Template

Position in Sample Sequence	QA/QC Sample Type
12	Blank
18	Standard 1
24	Duplicate
38	Duplicate
42	Blank
52	Standard 2
67	Blank
70	Duplicate
91	Standard 1
94	Standard 2
112	Blank
repeat	*as above*

MDA has not evaluated the West Kirkland QA/QC data since these drill data are not included within the current resource estimate.

12.3.1 Three Hills Standards

Allied Nevada inserted CRM's obtained from MEG into the drilling sample stream prior to shipment of samples to the laboratory. CRM's were inserted at 80ft intervals in the RC sample stream, and at variable intervals of 80ft to 220ft in the core sample stream. Records indicate a total of 122 CRM's were inserted, 15 of which accompanied core samples in 2013. MDA has no assay results for the CRM's inserted with the 2013 core samples, and only gold assays for the 107 CRM's inserted with RC samples. The effective insertion rate for standards used by Allied at Three Hills is therefore 4%. A total of 13 CRM's returned gold values more than 2 standard deviations from the recommended average value. One of these corresponds well to the average value for a different CRM and may have been mislabeled. The remaining 12 failures represent a failure rate of 0.4% and were equally divided outside the upper and lower control limits.

Results for West Kirkland's standards used in the 2014 drilling program at Three Hills have not been evaluated by MDA, because the 2014 drill holes are not included in the current resource estimate.

12.3.2 Hasbrouck Deposit Standards

Data available to MDA indicate that Allied Nevada inserted a total of 1,063 certified reference materials (CRM's), or standards, into the sample stream for RC and core drilling at Hasbrouck Mountain during 2010, 2011 and 2012. Of these, 1,049 fire-assay atomic absorption results for gold, and 425 results for silver by atomic absorption are available, corresponding to 4.6% of Allied's drill hole gold assays and 1.9% of Allied's drill hole silver assays. The CRM's were inserted at roughly eighty foot intervals, in conjunction with quartz pulp blanks. According to

Wilson (2014), in the original overall Allied Nevada assay data set, thirty two standards were mistakenly given a Quartz sample designation. The standard labels contained the correct standard name, and were hand notated with the Quartz designator. The values returned clearly represented the values for the standard printed on the label. The sample standard designator was corrected and the standards placed in the standards analysis data set.

Two cases were documented, and several additional cases were suspected, where the standard and quartz material, which were submitted together, were mixed together at the lab before analysis. The suspected cases were included in the standards failure statistics of Wilson (2014), who noted two cases in which the standard and quartz data had been swapped. Wilson reported these were corrected and data assigned to the proper data set.

Wilson (2014) reported a failure rate of 6.3% of the Allied Nevada CRM gold assays (greater than 2 standard deviations difference from the CRM recommended average value), but noted that the majority of the failures were within 5% of the over and under limits. MDA's review of the CRM gold data found no significant difference from that of Wilson (2014). 15 different, but in some cases, similarly named, CRM's were used. More than half of the failures had gold results that correspond well with other CRM's used in the program. MDA suspects, but can not demonstrate, that the majority of the failures are likely due to mislabeling or incorrectly entering the CRM names prior to shipment of samples to the laboratory.

MDA has not evaluated the 425 assays of CRM's for silver. The quantity of silver QA-QC control samples would appear to be a small. However, silver accounts for such a minor value in the estimated resource that MDA does not consider silver to be material to the estimate.

12.3.3 Three Hills Blanks

Records indicate that Allied Nevada inserted one or two quartz pulp blanks per hole with samples from the 2013 core drilling. However, MDA does not have the results, and notes that pulp blanks are not useful for monitoring contamination that could possibly occur during the crushing and pulverizing stages of the sample preparation.

12.3.4 Hasbrouck Deposit Blanks

Two types of blank samples were inserted in the Hasbrouck Mountain drill sample stream by Allied Nevada to monitor possible contamination: 1) blanks described as crushed landscaping granite, and 2) quartz pulps supplied by MEG. The crushed granite blanks were inserted at the start of each sample run to monitor possible contamination during sample preparation (Wilson, 2014). MDA has assay results for 63 crushed granite Blanks. Allied Nevada also inserted 345 quartz pulp blanks from MEG at approximately 80ft intervals, for which MDA has assay results for 227 cases. The total insertion rate for which MDA has gold assay results is 1.3% of Allied Nevada's Hasbrouck drilling samples. MDA considers the number of blanks to be on the low side, particularly because 78% were submitted as pulps and as such, do not monitor possible contamination during crushing and pulverizing.

MDA has no quantitative data on the expected gold concentration of the particular crushed granite used, but in MDA's experience such material typically contains less than 0.005g Au/t, which is the lower detection limit of the assay method. Values less than 3 times the lower detection limit are generally considered to be within the analytical uncertainty. 16% of the inserted granite Blanks assayed greater than 0.015g Au/t, and 7.9% assayed ≥0.050g Au/t. The two highest failures were inserted as two successive samples in hole HSB11-30 and returned 0.376 and 0.282g Au/t. These values correspond well with 2 different standards used by Allied Nevada. It is possible that these two significant failures could have been mislabeled standards, but MDA cannot exclude the possibility of some contamination in HSB11-30. If contamination has occurred in HSB11-30, it is not material on a deposit scale.

12.3.5 Historical Check Assays—Three Hills

At the Three Hills Deposit, MDA reviewed the data in 2003 and 2006, and determined that the correlation between check assays and samples from earlier drilling programs indicated no significant bias. No historic samples are available for re-assay. A total of 100 metallic screen assays were also completed. The average grade of these agreed closely with the original sample average grade, with the metallic assays being 3% lower on the average.

12.3.6 Historical Check Assays—Hasbrouck Deposit

At the Hasbrouck deposit Cordex sent 342 out of the total of 935 original Union Assay rotary drilling samples to Rocky Mountain Geochemical for check assays. Almost 75% of the original results that were equal to or greater than 0.025 oz Au/ton were checked. MDA does not know whether pulps, rejects or sample splits were analyzed in the check assays. As reported by Prenn and Gustin (2006) the original Union gold assays compare well with the Rocky Mountain check analyses at values up to 0.05 oz Au/ton. Union Assay values greater than 0.05 oz Au/ton, however, tended to be higher than the Rocky Mountain check assays. The Union silver assays were systematically higher than the Rocky Mountain check analyses.

The most complete check assay data available from the Cordex drilling program is for hole H-24. This was also the only Cordex hole that was sampled at 5-foot intervals. The Rocky Mountain check assays for H-24 are systematically lower than the Legend checks for both gold and silver. The Rocky Mountain and Legend analyses were performed on the same pulps. Legend and Union results compare well for both gold and silver, while the Rocky Mountain-Union comparisons for gold and silver in hole H-24 are fair, based on the limited data (Prenn and Gustin, 2006).

The systematic discrepancy in silver analyses between the primary Cordex assay lab, Union Assay, and the primary check assay lab, Rocky Mountain Geochemical, is a concern. Based on the limited H-24 check assay data, the Legend results support the original Union analyses. The apparent bias of Union Assay to higher gold values compared to Rocky Mountain at values greater than 0.05 oz Au/ton is also a concern. Legend H-24 check assays are systematically lower than Rocky Mountain, which again supports the original Union assays.

Franco-Nevada check assays were performed by Rocky Mountain Geochemical, who also performed the original assays. MDA does not know if the checks were done on the original pulps, rejects or sample duplicates. The gold checks compare well with the original assays, although the means differ significantly (0.039 oz Au/ton for the checks versus 0.031 oz Au/ton for the originals). If one sample is removed, however, the mean of the check assays lowers to 0.034 oz Au/ton, while the original mean remains unchanged. The silver assays also compare well, with most of the variation occurring in original assays between 0 and 0.5 oz Ag/ton.

Bechtel (1986) reported that Chemex Labs Ltd performed check assays on 50 rejects of the original Rocky Mountain samples for Franco-Nevada. The check assays averaged 0.037 oz Au/ton, compared to the original Rocky Mountain average of 0.040 oz Au/ton. Bechtel concluded that there was no significant bias in the assay data, and therefore considered the original Franco-Nevada assays to be reliable. MDA does not have the Chemex check assay data to review.

FMC drill cuttings were assayed for gold and silver by Intermountain Analytical using two-assay-ton fire assay (Cofer, 1989). Five-foot check samples were taken every 50ft and sent to Bondar-Clegg for gold + 17 element analyses. The results of these check samples are not known to MDA.

MDA lacks check assay data for the Cordex T-series holes and underground sampling, as well as the Corona and Euro-Nevada reverse circulation drilling programs.

Wilson (2012) reported that Allied Nevada obtained check assays for the 2010-2011 drilling at the Hasbrouck deposit. MDA does not have the check assay data, but Wilson (2012) concluded:

> "*In the Author's opinion the gold and silver assays from the 2010-2011 drilling campaign are acceptably accurate for use in mineral resource estimation. For the 2012 drill campaign, no check assays were completed at Hasbrouck, as the drilling was exploratory in nature and did not encounter large zones of mineralization.*"

12.3.7 MDA Check Assays – Three Hills

As part of the current study, and to bolster the existing Three Hills QA/QC data set, MDA collected 32 core-twin check samples from the 2013 Three Hills Allied core holes that are currently in storage. These samples consisted of the remaining half-core left after the initial sampling. The samples were sent to ALS Minerals in Reno, NV, and analysed using the same fire assay methods as the original sampling/assaying program. The original assays averaged 0.081oz Au/ton while the check assays averaged 0.084oz Au/ton indicating no significant bias in the full data set. Though if the four highest grade sample pairs (>0.15oz Au/ton) are removed from the data set, there is an average 15% high bias in the check samples.

These results suggest that the Allied core hole gold assay values used in the resource estimate are potentially skewed low and therefore lends a conservative aspect to the current resource.

12.4 Summary Statement

MDA has reviewed the available QAQC data and the assessments of that data made by Wilson (2014) and references therein, including Prenn (2003) and Prenn and Gustin (2003, 2006). MDA agrees with the conclusions of these preceding studies and considers the assay data to be adequate for the estimation of the current Three Hills and Hasbrouck mineral resources.

13.0 METALLURGICAL TESTING AND MINERAL PROCESSING

The Hasbrouck project includes separate heap leach and absorption facilities at each deposit. Conventional cyanide heap leaching will be utilized at both proposed mines. The proposed extraction methods, process flow, and types of processing facilities are described in 17.0. Throughout this section the term "ore" is used in a processing and metallurgical context, to refer to the material being processed, and does not refer to an economic class of mineralized material.

Section 13.1 and Section 13.2 describe the types and extents of metallurgical tests performed by historical owners of both Three Hills and Hasbrouck. The metallurgical studies carried out by West Kirkland in 2014 and 2015 are summarized in Section 13.3 and Section 13.4. Detailed, integrated summaries of metallurgical studies of the Three Hills and Hasbrouck mineralization are presented in Sections 13.5 and Section 13.6.

13.1 Three Hills Historical Metallurgical Testing

The earliest known metallurgical test of Three Hills material was in 1991; the report of this test has not been found. Records exist for 6 column leach tests and 42 bottle roll tests of surface and drill samples from the Three Hills deposit performed between 1991 and West Kirkland's acquisition of the property in April, 2014. Historical and current metallurgical tests from 1996 through 2015 are listed in Table 13.1.

13.2 Hasbrouck Historical Metallurgical Testing

Previous technical reports mention metallurgical tests performed between 1975 and 1985; records have not been found for these. Records of metallurgical tests performed between 1986 and 1988, inclusive, exist and describe bottle roll, agitation leach, vat leach, column leach, gravity tests, and flotation tests, which utilized drill cuttings and bulk surface and bulk underground samples. Pre-1989 work was not considered in this report as sample locations could not be verified. Since 1989 and up to West Kirkland's acquisition of the property in April 2014, metallurgical tests were performed which involved 70 column leach tests and 70 bottle roll tests performed on surface and drill samples. These later tests were carried out variously at McClelland Laboratories Inc. ("McClelland") in Sparks, Nevada, and at Kappes-Cassiday and Associates ("KCA"), in Reno, Nevada, as shown in Table 13.1.

13.3 Three Hills Metallurgical Testing By West Kirkland

In 2014, metallurgical testing was performed at KCA to confirm recovery, leaching time, and percolation performance of ROM mineralized material. This testing is summarized in Table 13.1.

13.4 Hasbrouck Metallurgical Testing By West Kirkland

In 2014 and 2015, further metallurgical data was obtained by WK, with studies focused on the relations of particle size and host-rock lithologies to gold and silver recoveries from samples of the Hasbrouck deposit (KCA, 2015). In particular, the use of high pressure grinding rolls for crushing of Hasbrouck mineralization was evaluated. This testing is summarized in Table 13.1.

Table 13.1 Summary of Process Test Work

Date	Owner	Laboratory	Report No.	Sample Source	Test Work Type	Summary of Results
THREE HILLS						
11 Nov 1996	Eastfield	McClelland	2335	Drill Core Composites	Bottle roll and column leach tests	Bottle Roll avg extraction; Au - 74% at 96 hr. Column avg extraction; Au - 85%, 1.5" crush, 103 days
30 Nov 1996	Eastfield	McClelland	2335	Drill Core Composite	Column leach tails tests for environmental characterization	Negligible deleterious material detected
13 Dec 1996	Eastfield	McClelland	2390	RC Chips	Bottle roll tests	Average extraction; Au - 76% in 24 – 48 hr.
2 Jun 2014	WK	Wetlabs	1405390	Surface sample	Environmental characterization	Negligible deleterious material
10 Jun 2014	WK	KCA	0140069-THB01-01	Bulk Sample sites for 48in Column Test	Cyanide shake tests	Recoveries in line with other tests at 3HM
23 Oct 2014	WK	KCA	140083-THB04-01	Composites from 6 diamond drill holes	ABA and Total Metal Analysis	Negligible deleterious material detected
27 Oct 2014	WK	KCA	0140137-THB08-01	Drill Core TH13C0022 and Bulk Surface Sample	Bottle rolls, cyanide shakes	Confirmed that bulk sample for 48in column test is representative of lithology, head grade, and metallurgical performance recovery of general ore body
19 Mar 2015	WK	KCA	140082-THB03-02	Bulk Sample for 48in Column Test	ROM 48in column leach and bottle roll tests	Bottle Roll extraction at 96 hr; Au - 91%, 10# sizing Column extraction at 133 days; Au - 81%, ROM sizing

HASBROUCK						
Date	**Owner**	**Laboratory**	**Report No.**	**Sample Source**	**Test Work Type**	**Summary of Results**
8 Mar2012	Allied	McClelland	3536	Drill Core Composites	Bottle roll and column leach for gold & silver extraction	Bottle roll (-10 mesh) avg extractions; Au - 69%, Ag - 23% Column leach (3/4" & 3/8") avg extractions; Au - 61%, Ag - 12%
14 Mar 2012	Allied	McClelland	3465	Drill Core Composites	Bottle roll and column leach for gold & silver extraction	Bottle roll (-10 mesh) avg extractions; Au- 62%, Ag - 24% Column leach (3/4" & 3/8") avg extr'ns: Au - 51%, Ag - 12%
11 Jun 2014	WK	Wetlab	1405636	Surface sample	Environmental characterization	Negligible deleterious material
18 Aug 2014	WK	KCA	0140112-05HSB-01	Surface Samples	Bond Low Impact Crusher Work Index and Bond Abrasion	Crusher Work Index: 18.7 kWh/tonne Abrasion Index: 0.29
15 Jan 2015	WK	McClelland	3948	Drill Core	Agglomeration, strength & stability	P80 3/8in crush, 5lb/ton cement is required to produce stable agglomerates.
5 Mar 2015	WK	KCA	0140117-HSB07-01	Bulk Surface Sample	Cone Crusher and HPGR, Bottle Roll and Column Leach	Bottle roll (96 hr) – Au: Cone 35%, HPGR 49% Ag; Cone 19%, HPGR 30% Column leach (75 day) – Au; Cone 45%, HPGR 55% Ag: Cone 25%, HPGR 38%
9 Mar 2015	WK	KCA	0140171-HSB11-01	Bulk Surface Sample	Compacted Permeability & Agglomeration on HPGR product	HPGR products are stable and permeable to 125ft depth when agglomerated with 5lb/ton cement.
1 Apr 2015	WK	KCA	0140171-HSB12-01	Drill Core	Cone crusher versus HPGR product extractions Bottle rolls	Cone crushing - Au 47.3%, Ag - 14% HPGR crushing - Au 61.5%, Ag - 14%

13.5 Three Hills – Analysis of Test Results

The following sections present a summary compilation and analysis of all relevant metallurgical tests from the Three Hills deposit. Metallurgical work conducted in 1988 is not included here, as the source of the material cannot be determined; it has been summarized by Prenn and Gustin (2006).

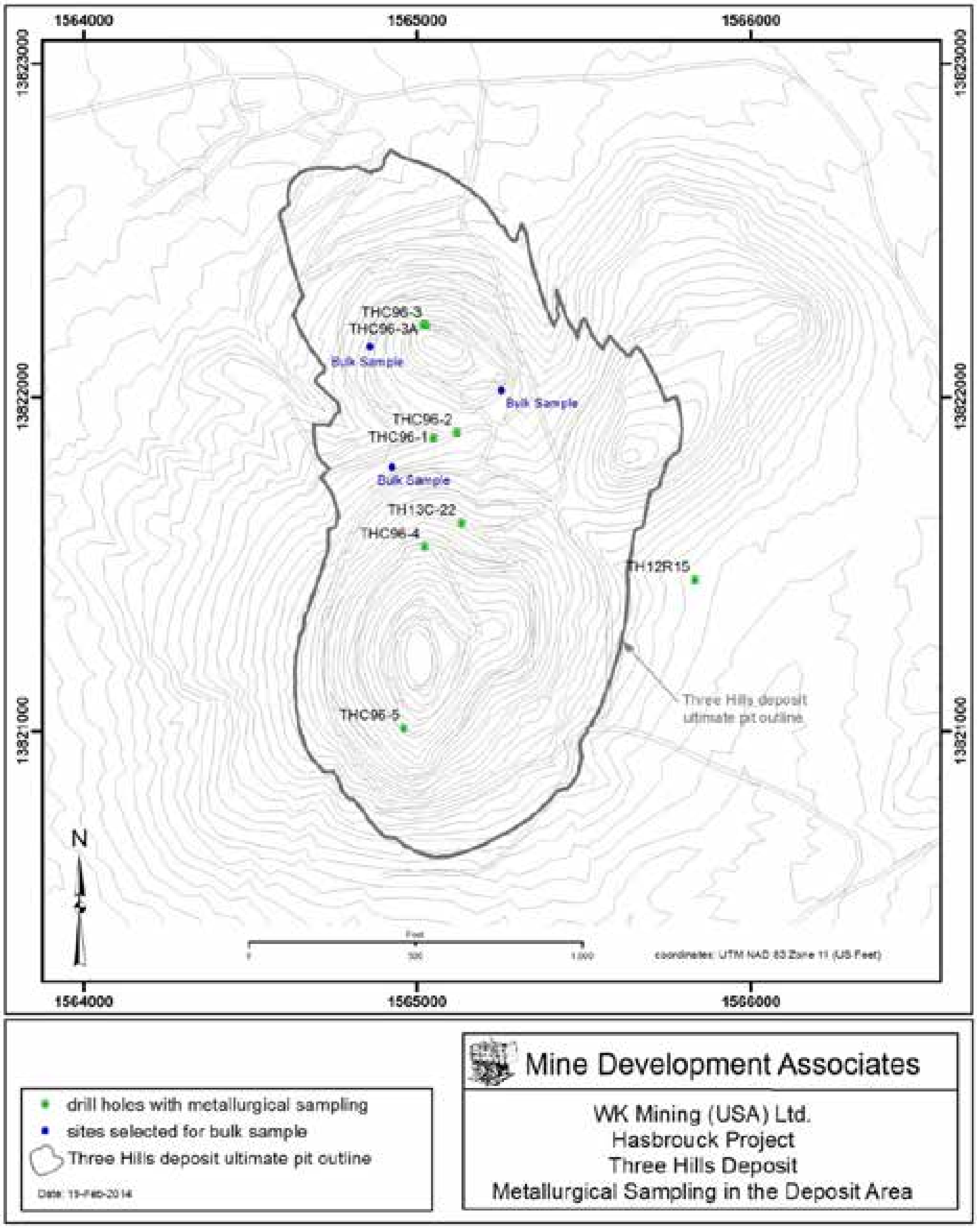
13.5.1 Three Hills Ore Description

The Three Hills ores are contained primarily in the Siebert Formation with limited mineralization in the underlying Fraction Tuff where it is associated with clay alteration. The Siebert Formation consists of interlayered siltstones, sandstones, conglomerates, and tuffs. The coarser, more permeable sandstones and conglomerates are generally pervasively silicified and are the preferred hosts for gold mineralization at Three Hills.

13.5.2 Three Hills Sample Locations

Figure 13.1 shows the location of the 1996 and 2012 diamond drill holes and 2014 bulk sample locations where material was obtained for use in the 1996 and 2014 Three Hills metallurgical test work programs. The samples are spatially and stratigraphically representative of the ore planned to be processed.

Figure 13.1 Map Showing Locations of Metallurgical Test Samples



13.5.3 Three Hills Bottle Roll Test Results

Bottle roll tests were completed in 1996 by McClelland, and in 2014 by KCA (report dated March, 2015), on composite samples from the Three Hills deposit. The materials were crushed, and milled as necessary, to various sizes, to determine any effect of grain size on gold and silver extraction. The results are presented and summarized in Table 13.2.

Table 13.2 Three Hills Bottle Roll Test Results
(data from McClelland (1996a) and KCA (2015)

Test	Material	Size (inches)	Grade oz/ton Head	Grade oz/ton Tails	Extracted Au, %	Consumption lb/ton NaCN	Consumption lb/ton Lime	Report
½ (THC96-1,2)	Three Hills	P80 1/4	0.041	0.014	68.2	0.16	5.3	11-Nov-1996
3 (THC96-3, 3A)	Three Hills	P80 1/4	0.025	0.006	73.9	0.10	4.4	11-Nov-1996
4 (THC96-4)	Three Hills	P80 1/4	0.024	0.006	75.0	0.10	4.9	11-Nov-1996
5 (THC96-5)	Three Hills	P80 1/4	0.009	0.002	77.8	0.16	4.5	11-Nov-1996
71051A	Three Hills	10 mesh	0.023	0.002	91.0	0.01	2.0	19-Mar-2015

13.5.4 Three Hills Column Leach Test Results

Two series of column leach tests were performed on Three Hills material, one by McClelland in 1996 using composites of diamond drill core and one by KCA in 2014 using composites of a bulk surface sample. The McClelland tests used 6in diameter, 10ft high columns and tested material crushed to P70 1.5in. The KCA tests used a 4ft diameter, 22ft high column, and tested un-crushed P80 3.8in material collected from drill roads by a track-mounted excavator. Based on typical particle size distributions of ROM ore, this sample was considered to be slightly finer than can be expected of ROM material produced by blasting. The results are presented and summarized in Table 13.3.

Table 13.3 Three Hills Column Tests, Grades and Reagent Consumption
(data from McClelland (1996a) and KCA (2015)

Test	Material	Crush Size (inches)	Au Head Grade (oz/ton)	Au Tails (oz/ton)	Recovered Au (%)	NaCN lb/ton	Lime lb/ton	Report
½ (THC96-1,2)	Three Hills	P70 1.5	0.04	0.002	95	2.11	5	11-Nov-96
3 (THC96-3, 3A)	Three Hills	P70 1.5	0.026	0.003	88.5	3.1	5	11-Nov-96
4 (THC96-4)	Three Hills	P70 1.5	0.026	0.004	84.6	2.84	5	11-Nov-96
5 (THC96-5)	Three Hills	P70 1.5	0.01	0.003	70	3.2	5	11-Nov-96
71015	Three Hills	ROM (P80 3.8)	0.024	0.005	81	0.75	4	19-Mar-15

Drain down volume and retained moisture were measured at the completion of leaching. The results are summarized in Table 13.4 and Table 13.5.

Table 13.4 Three Hills ROM Column Testing Drain Down
(data from KCA, 2015)

KCA Test No.	Description	Sample Weight (kg)	Gallons Solution released/ton$_{dry\ ore}$	
71015	Bulk Material	11,991	24 hour	0.57
			48 hour	0.78
			72 hour	1.08
			96 hour	1.33
			120 hour	1.54
			144 hour	1.61
			168 hour	1.82

Table 13.5 Three Hills ROM Column Testing Retained Moisture
(data from KCA, 2015)

KCA Test No.	Description	Days Leached	Retained Solution, gal/ton$_{dryore}$
71015	Bulk Material	133	39.6

Tests predict that the final drain down moisture of the ROM material will be 14%.

13.5.5 Three Hills - Recovery versus Particle Size

The McClelland (1996a) column leach test results were studied for the effect of crush size on recovery (See Table 13.2, Table 13.3, Table 13.5 and Figure 13.2 and Figure 13.3).

Figure 13.2 Three Hills Head and Tail Screen Gold By Size Fraction

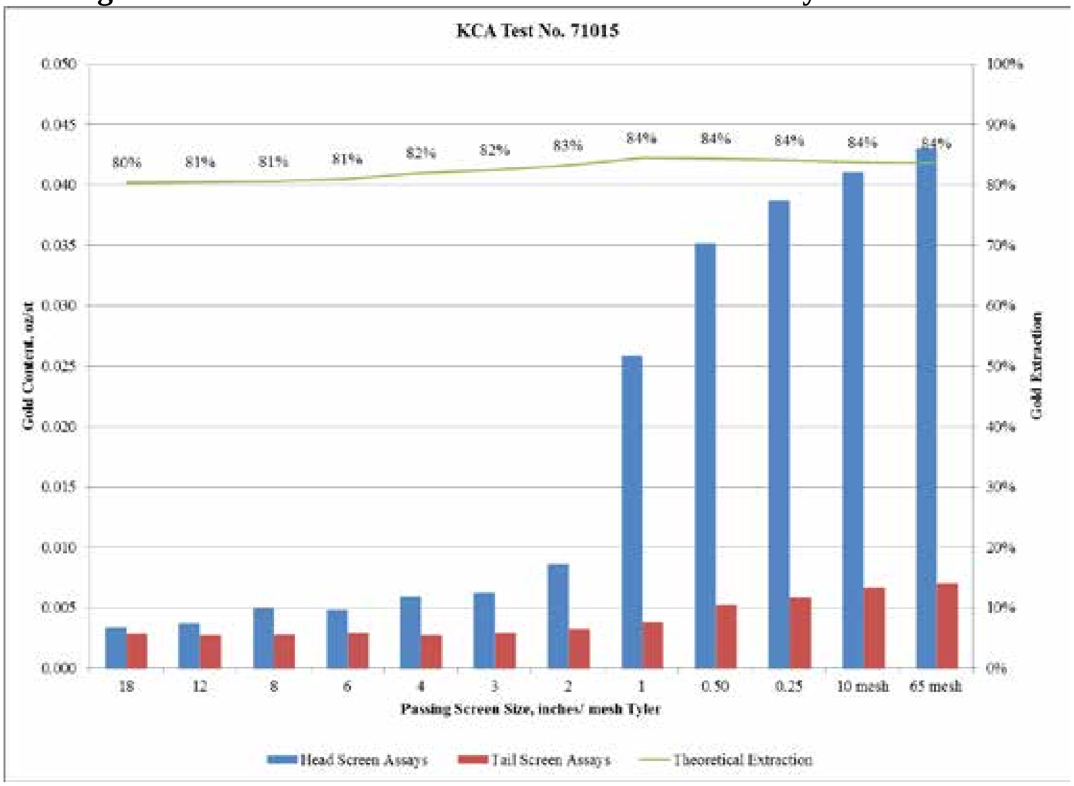
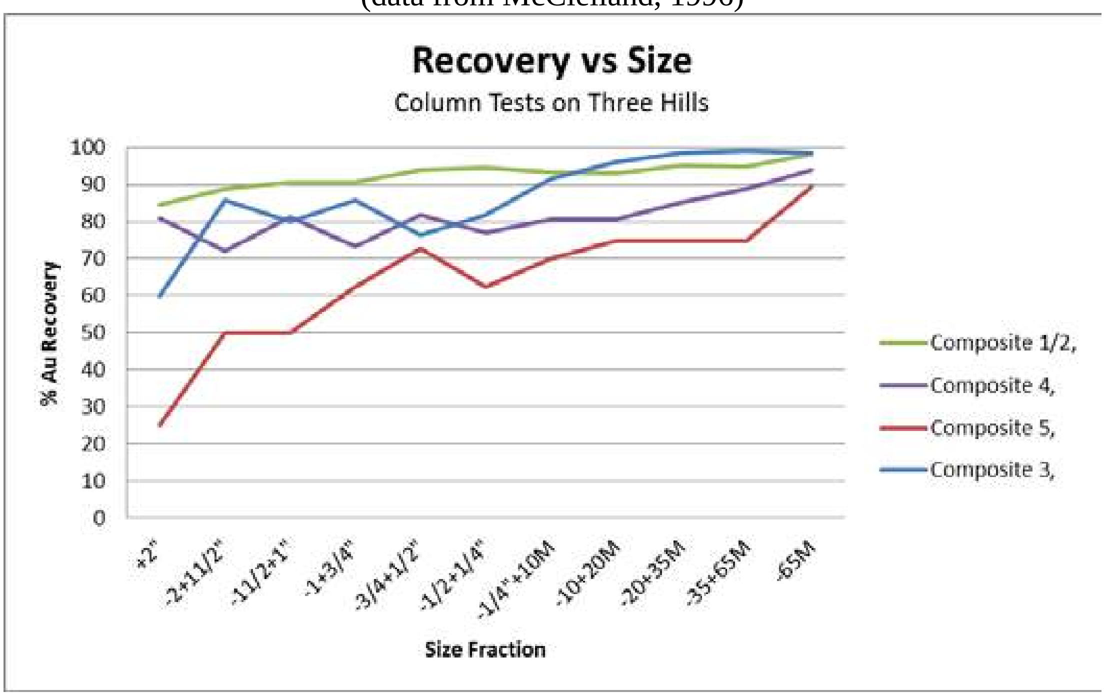


Figure 13.3 Three Hills Column Recovery by Size Fraction
(data from McClelland, 1996)



Results from the relatively small number of samples of this test indicate a weak increase in gold recovery with decreasing particle size. The strongest increase in gold recovery was observed in Composite 5 (Figure 13.3). The relatively low recovery from the +2in size fraction in Composite 5 compared to much higher recoveries from the other composites is due to a lack of material in this size fraction and is therefore not considered cause for concern.

The column tests performed by McClelland in 1996 achieved an average gold recovery of 84.5%, but used material crushed to a P70 of 1.5in. After a 2% operational discount, the relatively small, 3.4% increase in recovery which results from crushing to 1.5in is not sufficient to offset the associated increase in capital and operating costs, and 79% recovery from an ROM leach is considered to be the best economic approach for this project. Consequently, Three Hills mineralized material is planned to be leached without crushing, i.e. an ROM heap leach.

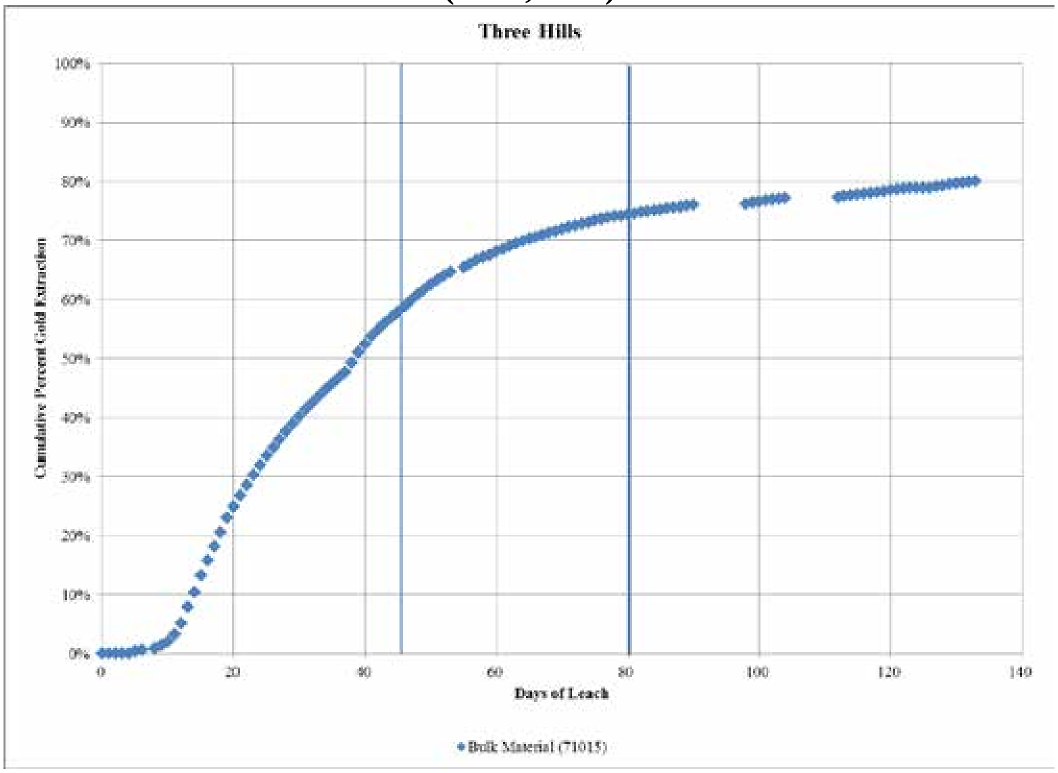
While KCA's 2014 48in column tests on P80 3.8in material may be used to predict the recovery from an ROM heap leach, it should be noted that the material used in this test was finer than expected from mining operations. Comparing the 48in column test results to the 6in column test results on Composites 2, 3, and 4 (81.0%, 88.5% and 84.6% gold recovery, respectively) lead to the conclusion that coarser ROM material will have a slightly lower recovery than that of the 48in column tests.

13.5.6 Three Hills Leach Cycle Duration

Field leach cycle duration has been predicted using data from the 2014 KCA 48in column tests. Field leach durations are typically longer than the column leach durations due to solution application rates being lower and column leach mechanics of diffusion and displacement not precisely representing the flow of fluid in that occur in a heap. Generally, the greater the diameter of the column, the more closely it approximates to field leach times.

There are three distinct domains in a column leach curve. The "initial leach", the "bend" or "knee" and the "final tail out" as shown in Figure 13.4, using data extracted from Table 13.6.

Figure 13.4 48in Column Test Recovery vs. Time (KCA, 2014)



The column was leached/rinsed for a total period of 133 days at a rate of 0.0025 gpm/ft^2. Empirical formulas were used to relate column days to field days.

Table 13.6 Predicted Three Hills Field Leaching Times

Domain	Column Days	Empirical Factor	Predicted Field Days
Initial Leach	0-45	1.6	72
Bend/Knee	45-80	1.3	46
Final Tail	80-133	1.0	53
Predicted Leach Cycle Duration			**171**

13.5.7 Projected Recovery of Gold at Three Hills

The 48in column test performed by KCA in 2014 used material excavated from the surface with a P80 3.8in sizing and achieved a gold recovery of 81.1%, using slightly finer material than expected in full scale ROM applications. Thus the KCA test results indicate a slightly higher gold recovery than can be expected at full scale due to the previously mentioned relationship of gold recovery increasing weakly with decreasing particle size, and a 2.1% deduction is applied. This leads to predicted operational gold recovery of 79% at Three Hills for ROM material.

13.5.8 Projected Consumption of Reagents

13.5.8.1 Three Hills Cyanide Consumption

The 2014 KCA ROM column test data was used to predict field cyanide consumption. In this test, 0.75lb NaCN/ton was consumed. To address the difference between columns and leach pads that occur in practice, the test value of 0.75lb NaCN/ton was multiplied by 0.6 to predict a full-scale heap leach cyanide consumption of 0.45lb/ton. This factor is based on field experience. Tests to date have not indicated preg-robbing tendencies.

13.5.8.2 Three Hills Cement and Lime Consumption

Lime (“CaCO”) will be required for pH control of the leaching solutions at Three Hills. Based on the lime consumed in the KCA (2014) ROM column test, lime consumption is predicted to be 4.0 lb/ton. Agglomeration (cement) will not be needed at Three Hills Mine.

13.5.9 Three Hills - Compacted Permeability Results

A reliable indication of the permeability to be expected when leaching Three Hills ROM material was gained from the solution flow rates through the 48in diameter, 22ft high column test performed by KCA in 2014. Solution wetted the entire sample and flowed satisfactorily throughout the test.

Lab-scale compacted permeability tests were performed by KCA in 2014 on tailings material from the ROM 48in diameter column leach test, screened to -3in, this being the largest size that the KCA test equipment could handle. This test indicated problems with percolation. It is believed that the relatively large amount of fine material in the sample used in the compacted permeability testing created this problem. Previous screen analysis of 1.5 inch crushed material showed a significantly smaller amount of fines than in the sample used in the foregoing test. It is inferred that there will be insufficient fines in full scale ROM operations to cause percolation problems and the heap leach pad is expected to perform properly.

During loading and leaching operations of the heap leach at Three Hills, percolation will be closely monitored to ensure proper solution flow, and adjustments made as required to ensure adequate percolation.

13.5.10 Three Hills Comminution Test Results

No comminution tests have been carried out on mineralized material at Three Hills as crushing and screening is not contemplated there. Since the first metallurgical studies were performed on Three Hills material, the relatively high recovery from coarse particle sizes and the low grade of the deposit have always suggested that an ROM heap leach would be the appropriate process.

13.6 Hasbrouck Test Results

In 2014 and 2015, West Kirkland commissioned tests at KCA to evaluate the relationships between particle size and recovery, host-rock lithology and recovery, and elevation and recovery. The use of an HPGR for crushing Hasbrouck ore was evaluated. Metallurgical tests conducted prior to 1988 were summarized by Wilson (2014), but have not been included as the sample locations are not known. Metallurgical tests are summarized in Table 13.1

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13.6.1 Hasbrouck Ore Description

The Hasbrouck ores are contained in the Siebert Formation. The Siebert Formation is separated into two lithological packages, designated the upper Siebert and the lower Siebert. The upper Siebert is dominated by sandstones and conglomerates and is heavily silicified. The lower Siebert is dominated by lithic tuff with interbedded siltstones and sandstones. The contact between the upper and lower Siebert is gradational over a 50 to 100ft elevation range due to over-lapping lithologies between the two units. Post-depositional faulting has produced vertical offsets of the modeled contact of up to 100ft.

Previous owners of the Hasbrouck deposit identified a relationship between depth from surface and metal recovery. Re-analysis of the geological data in 2015 revealed that the relationship with recovery is with lithologies, rather than with depth. WK's work in 2015 further identified the relationship between stratigraphy and recovery. In particular, the bottle roll tests on HPGR products identified and quantified this relationship. WK's bottle roll tests on HPGR crushed core resulted in gold recoveries of 61% and 75.8% being assigned to the upper and lower Siebert, respectively (see 13.6.11).

13.6.2 Hasbrouck Sample Locations

The locations of the core holes and intervals of drill samples used in the Hasbrouck metallurgical test work in 2012-2015 are shown in Figure 13.5. The locations of bulk surface samples are shown in Figure 13.6. The samples are considered to be spatially and stratigraphically representative of the ores to be processed.

Figure 13.5 Hasbrouck Deposit Drill-hole Metallurgical Samples 2012 – 2014, Relative To Block Model and Proposed Pit

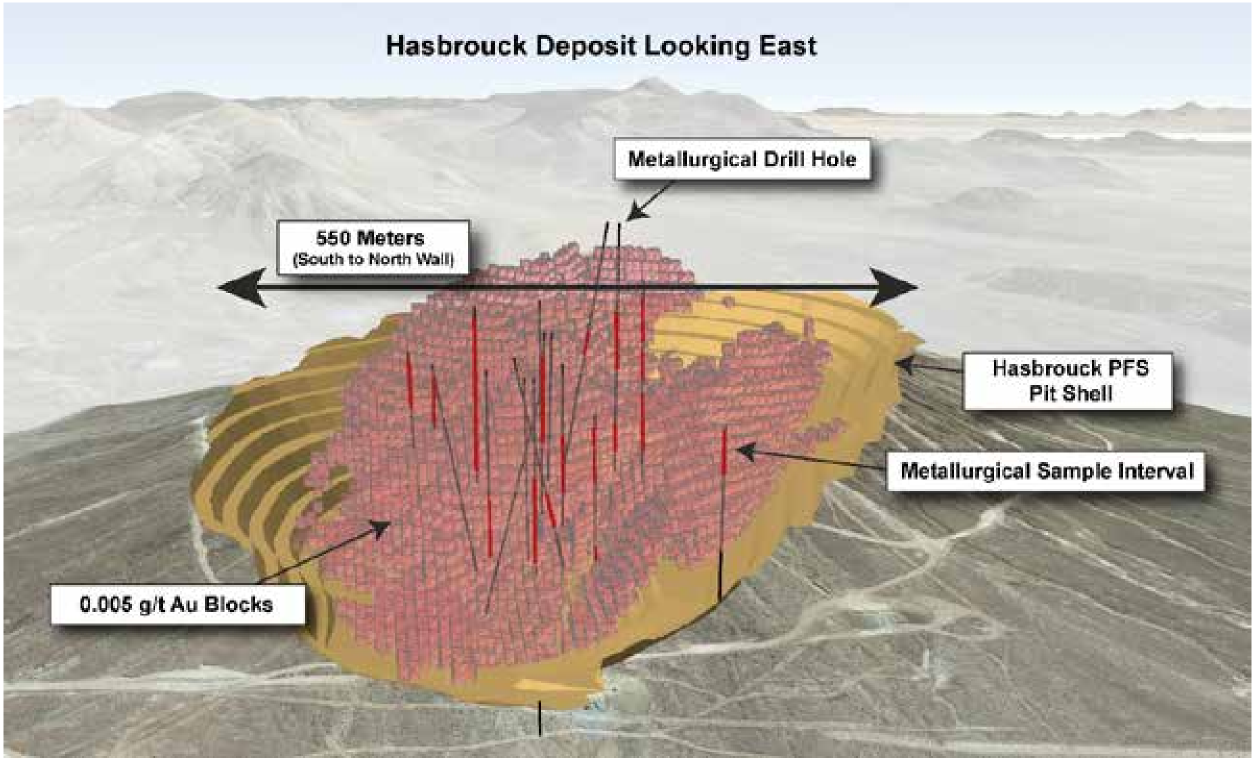
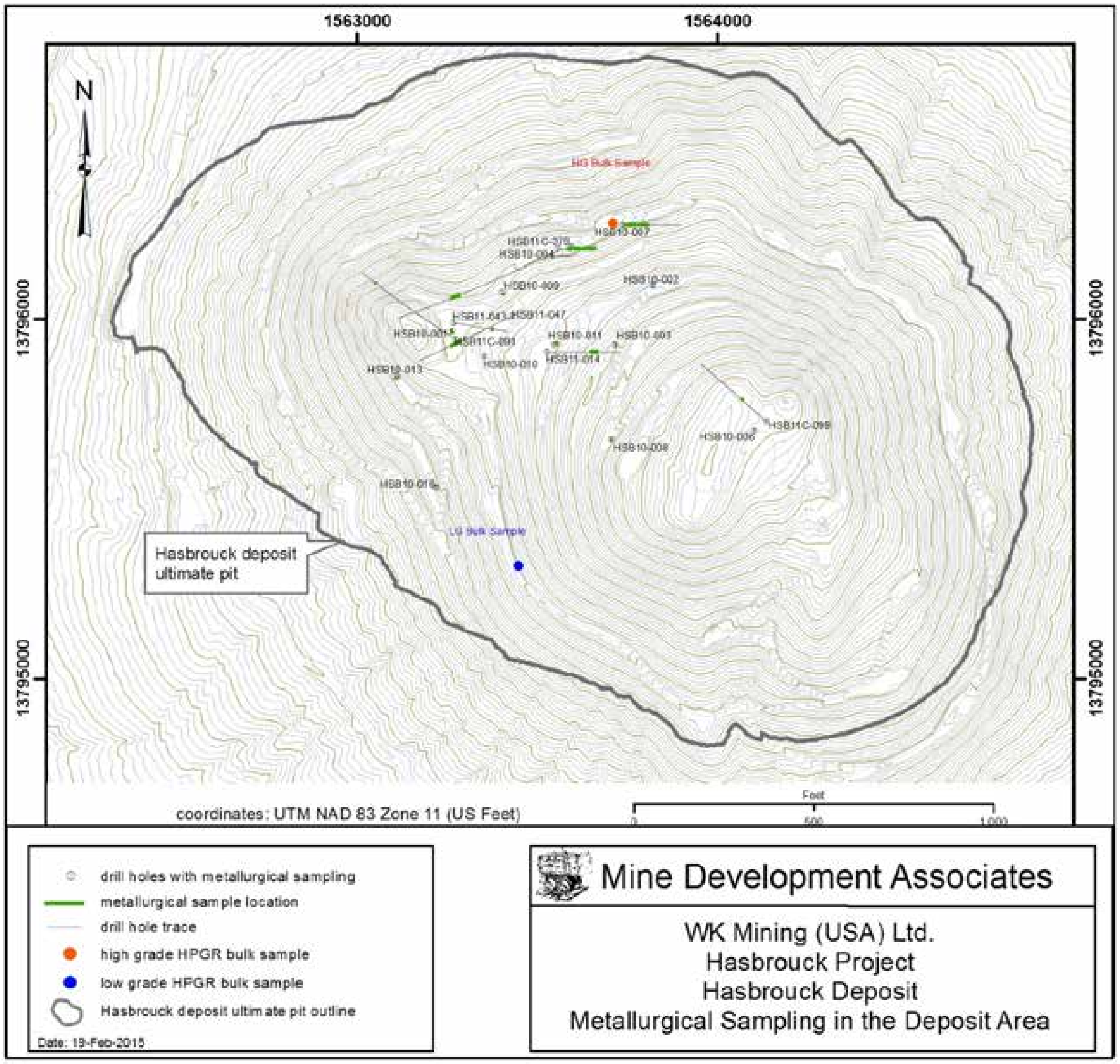


Figure 13.6 Locations of 2012 – 2014 Samples for Metallurgical Testing, Hasbrouck Deposit



13.6.3 Hasbrouck Deposit Bottle Roll Test Results

Bottle roll tests were completed in 2012 at McClelland on composite samples from the Hasbrouck deposit and the data were reported by McPartland (2012) and Wright (2012). The materials were crushed and milled to various sizes to determine effects of particle size on gold and silver extraction. A summary of the results is presented in Table 13.7 and details are given in Table 13.17 in Section 13.7.14.

Table 13.7 Summary of Bottle Roll Test Results on Cone Crushed Material
(Data from McPartland, 2012 and Wright, 2012)

Material	Size (mesh)	Head Grade, oz/ton		Extraction, %		Consumption, lb/ton	
		Au	Ag	Au	Ag	NaCN	Lime
Hasbrouck	10M	0.024	0.56	65.9	23.2	0.14	2.4
Hasbrouck	200M	0.022	0.53	89.3	50.7	0.20	2.8

The results show a strong increase in gold recovery with decreasing particle size.

Detailed data that provide support to the summary tables presented above are presented Section 13.7.14 in Table 13.17, Table 13.18 and Table 13.19.

13.6.4 Hasbrouck Deposit Column Tests

Allied Nevada commissioned 70 column tests which were performed by McClelland in 2012. The columns were loaded with composite samples from nine core holes representing the ore, sized at P80 3/4in and P80 3/8in sizes. Results are presented in Table 13.8.

Table 13.8 Gold Recovery in Column Tests
(data from McClelland, 2012)

Job Number	Column Number	% Au Recovery		% Ag Recovery	
		-3/4"	-3/8"	-3/4"	-3/8"
3536	0	42.9	36.8	13.3	16.7
3536	1	38.1	52.4	8.0	12.0
3536	2	61.5	66.7	12.0	16.7
3536	3	64.7	72.2	3.7	7.4
3536	4	71.4	78.6	4.3	9.1
3536	5	36.4	45.5	19.2	18.8
3536	6	56.3	69.2	4.8	6.7
3536	7	67.9	66.7	7.1	12.5
3536	8	69.2	66.7	14.3	11.1
3536	9	84.6	80.0	10.5	8.2
3536	10	75.0	79.2	5.1	6.4
3536	11	55.9	66.7	5.0	6.6
3536	12	50.0	50.0	13.6	16.7
3536	13	64.7	75.0	6.8	10.9
3536	14	64.3	62.5	5.3	10.5
3536	15	40.0	26.7	16.3	23.1
3536	16	41.7	44.4	9.1	14.3
3536	17A	58.1	67.6	20.0	23.8
3536	17B	58.6	72.4	14.0	28.9
3536	18	85.7	90.0	8.3	15.7
Average		*61.3*	*65.4*	*10.0*	*13.8*
3465	1	33.3	38.1	18.6	22.4
3465	2	50.0	61.1	13.9	23.9
3465	3	60.0	66.7	12.9	18.3
3465	4	73.0	65.3	8.3	12.7
3465	5	75.0	83.3	2.6	3.5
3465	6	23.1	28.6	6.9	12.1
3465	7	31.6	36.4	7.7	14.8
3465	8	36.4	45.0	14.9	23.4
3465	9	50.0	50.0	10.2	15.2
3465	10	73.0	70.3	16.2	20.0
3465	11	45.0	52.6	4.3	7.6
3465	12	40.0	46.7	7.8	12.7
3465	13	41.2	47.4	2.6	4.9
3465	14	30.5	47.2	5.1	8.8
3465	15	61.1	65.0	4.8	7.5
Average		*48.2*	*53.6*	*9.1*	*13.9*

13.6.5 Hasbrouck Deposit – Gold Recovery by Size Fraction

2012 test data demonstrated that gold recovery increases strongly with decreasing particle size. A head and tail screen analysis was done on each column. Figure 13.7 and Figure 13.8 show the results of this head and tails screen analysis.

Figure 13.7 2012 Column Leach Gold Recovery by Size Fraction
(Data from Wright, 2012)

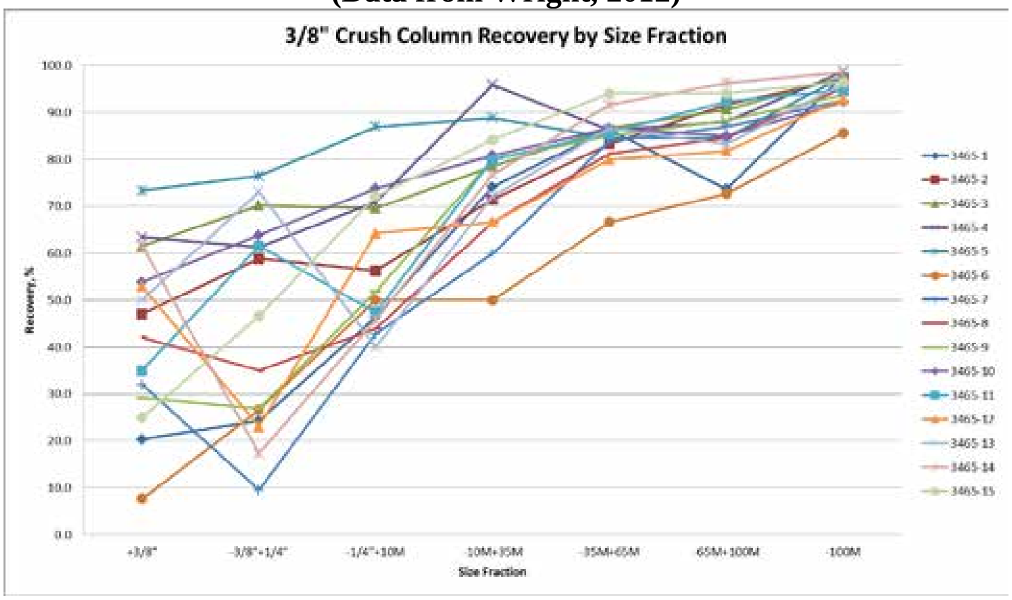
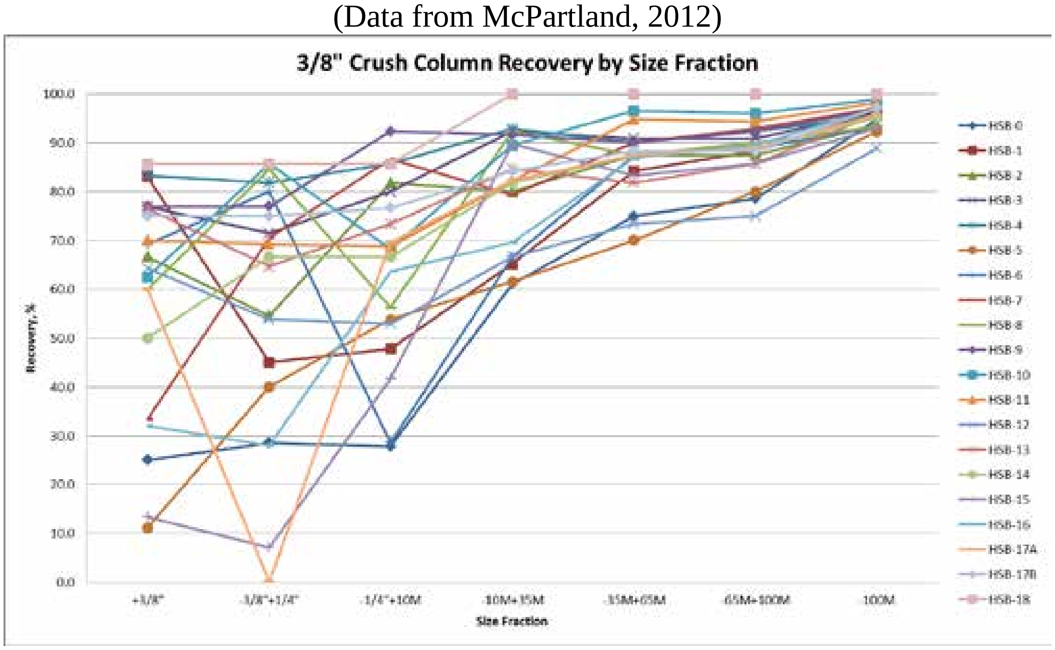


Figure 13.8 Column Gold Recovery by Size Fraction
(Data from McPartland, 2012)



The 2012 column leach data were studied to determine the relationship between particle size and recovery. As summarized in Figure 13.7 and Figure 13.8, it is clear that gold recovery increases with decreasing particle size.

13.6.6 Hasbrouck Deposit - Gold and Silver Recovery by Lithology and Elevation

Test data indicated that the upper Siebert and lower Siebert have significantly different gold recoveries, but no significant difference for silver recoveries. Gold recovery increases slightly within each lithological unit as elevation decreases (Figure 13.9). Silver recovery within each unit decreases slightly with elevation (Figure 13.10).

The differences in gold recoveries between the two Siebert lithologic units are most likely caused by the degree of silicification in the mineralized material. Pervasive silicification, hydrothermal brecciation, and siliceous veining are common within the upper Siebert volcaniclastic rocks. Silicification and veining decrease, and become more structurally controlled, within the lower Siebert tuffaceous and fine-grained sedimentary rocks at depth. Argillic alteration, characterized by the presence of illite and montmorillonite, forms an envelope around the silicified and mineralized zones and is most common in the lower Siebert tuffaceous rocks.

Figure 13.9 Column Leach Gold Recovery by Stratigraphic Unit and Sample Elevation

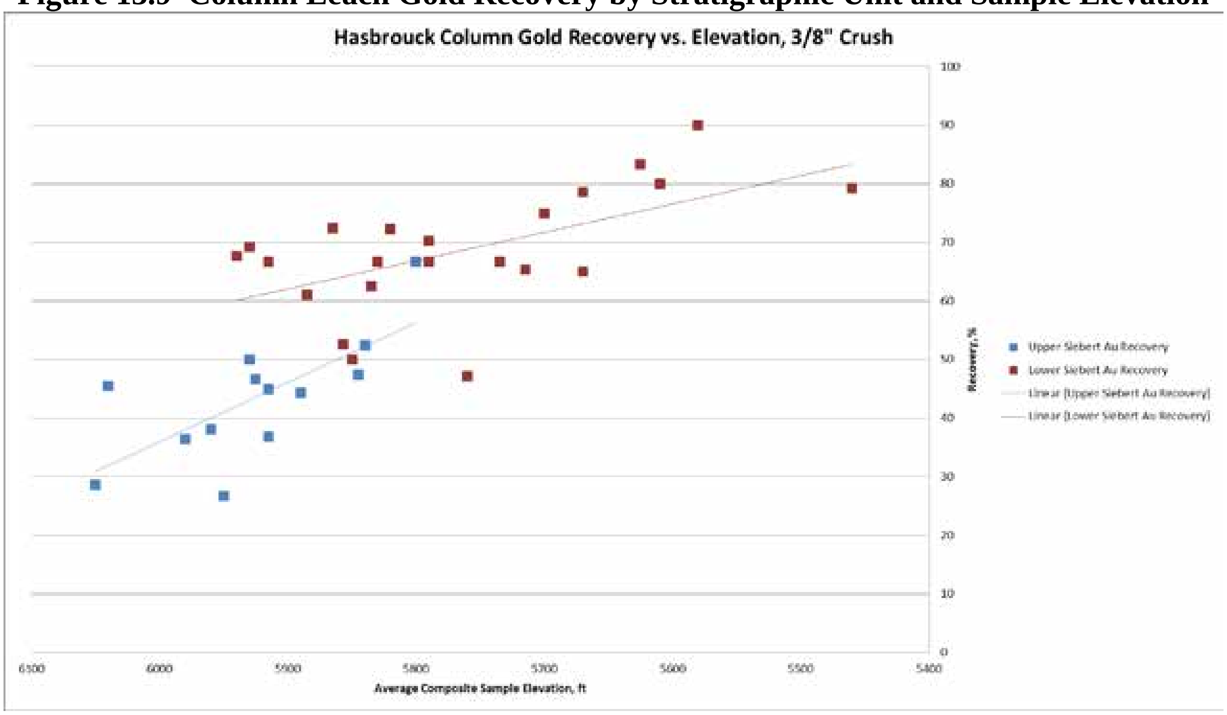
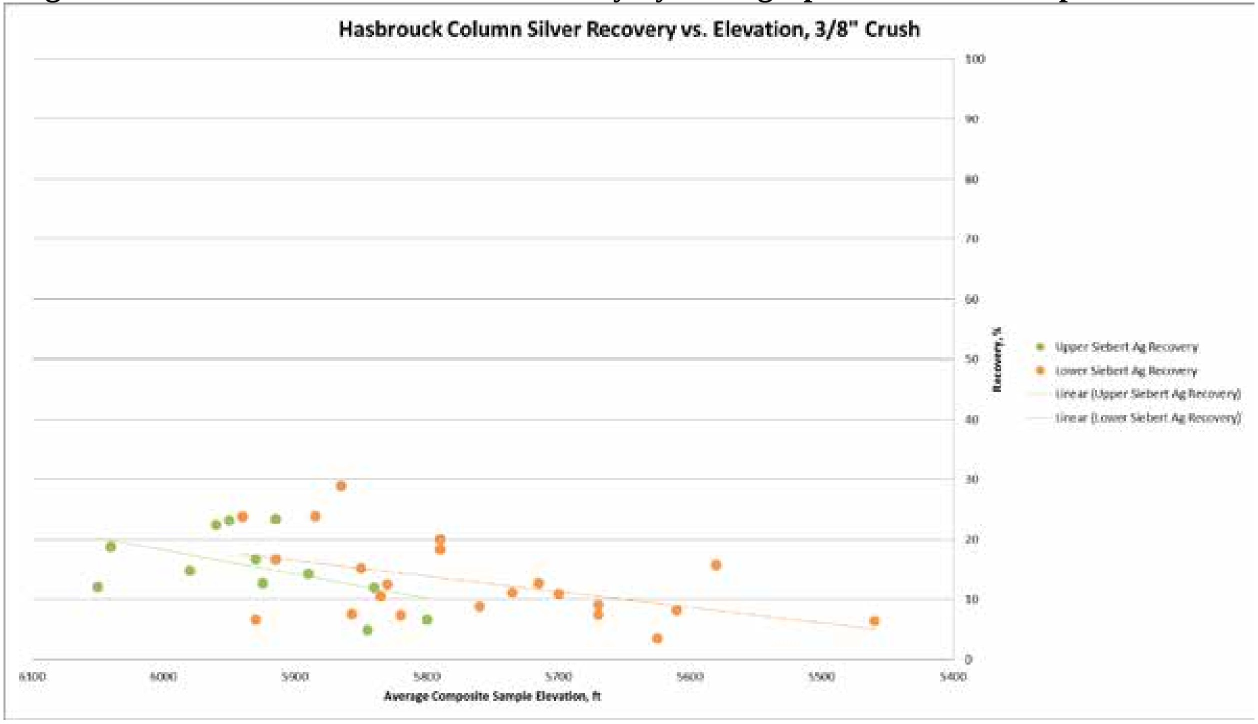


Figure 13.10 Column Leach Silver Recovery by Stratigraphic Unit and Sample Elevation



13.6.7 Hasbrouck Deposit High Pressure Grinding Roll Testing

Two series of HPGR tests were performed by KCA (2014) using a 15 ton per hour HPGR unit and a laboratory scale cone crusher. Surface samples from the Hasbrouck mineralization were used to determine the difference in gold and silver recoveries from using the HPGR versus a conventional crusher.

The HPGR crushes the rock by applying very high pressure via two counter-rotating, tungsten-carbide studded rollers. Pressure applied to the rock is by hydraulic rams which force one roll towards the other, and may be varied; the higher the pressure, the finer the product. Literature on the HPGR suggests that its crushing action selectively opens microfractures, thus exposing to cyanide the planes of weakness that tend to be mineralized in deposits such as Hasbrouck.

Due to the way material flows through the HPGR, material at the outer edges of the rollers is subjected to lower pressures relative to material that flows through the center. Consequently this edge material is crushed less and in certain applications operators choose to recycle edge material to achieve more thorough crushing of HPGR product.

In both test series, based on manufacturer's experience at similar operations, between 20% and 25% of the HPGR product was recovered as edge material, as it exited the machine. Splitting the HPGR product in this way was performed to quantify the difference in crushing experienced by center material relative to edge material, and the effect this has on gold recovery. In Test Series 1, center-plus-edge material was tested in one column, while center-only material was tested in another. In Test Series 2, center material and edge material were collected and tested separately.

Figure 13.11 View of SMALLWAL HPGR unit at KCA Used for Testing Hasbrouck Samples

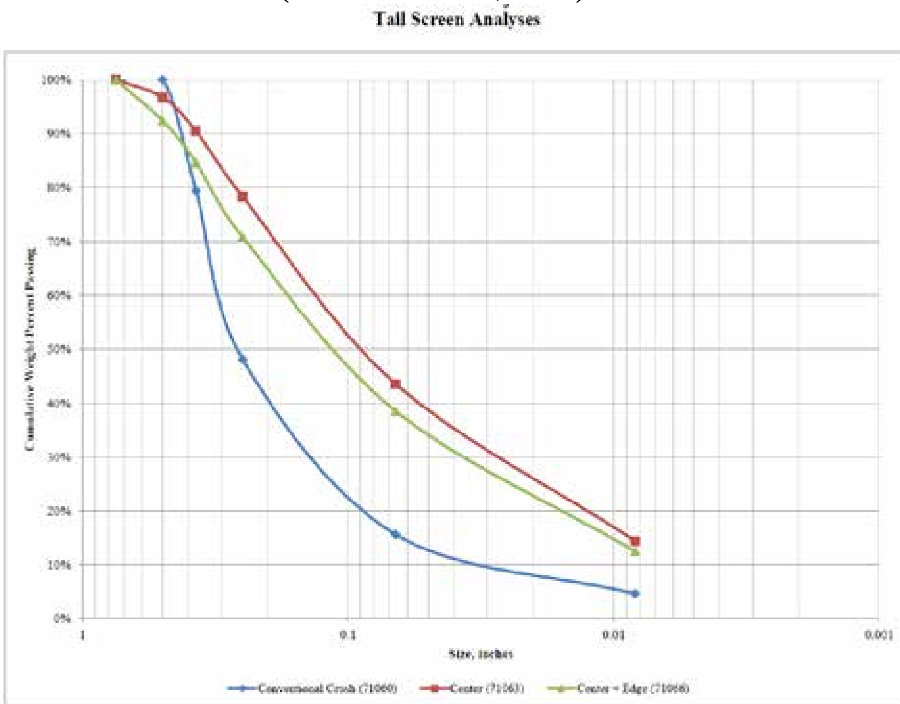
Feed Chute to Rolls

HPGR Test Series 1 was performed using a composite of samples taken from two surface locations (Figure 13.6). This sample consisted of approximately 80% upper Siebert and 20% lower Siebert material. It was cone crushed to P80 3/4in, assayed, and mixed to form a single 800kg composite sample, from which 50kg was separated and crushed by a conventional (cone) crusher to P80 3/8in, this being the smallest that can be economically crushed at full-scale by a conventional crusher. The remaining 750kg of the composite sample was crushed by the HPGR.

The particle size distribution of HPGR center, HPGR edge, and conventionally crushed p80 3/8in material are presented in Figure 13.12. No particle size distribution work was done in the second series of HPGR tests.

Figure 13.12 HPGR versus Conventional-Crush Size Distributions

(Data from KCA, 2015)



Recoveries for all three crusher products from the Series 1 test program were determined in 75-day column tests, results summarized in Table 13.9.

Table 13.9 HPGR Test Series 1 – Column Test Recoveries

(Data from KCA, 2015)

KCA Test ID	**71060**	**71063**	**71066**
Description	**Conventional Crush**	**HPGR Center**	**HPGR Center + Edge**
P80 - Crush Size (in)	0.38	0.26	0.32
Calculated Head Gold (oz Au/ton)	0.0243	0.0275	0.0247
Extracted Gold (oz Au/ton)	0.011	0.0151	0.0127
Weighted Avg. Tail Screen (oz Au/ton)	0.0133	0.0124	0.012
Extracted Gold (%)	45%	55%	51%
Calculated Head Silver (oz Ag/ton)	0.385	0.371	0.376
Extracted Silver (oz Ag/ton)	0.097	0.14	0.131
Weighted Avg. Tail Screen (oz Ag/ton)	0.288	0.231	0.245
Extracted Silver (%)	25%	38%	35%
Calculated Tail p80 Size (in)	0.38	0.26	0.32
Days of Leach	75	75	75
Consumption NaCN(lb/ton)	1.73	1.8	1.81
Addition Hydrated Lime (lb/ton)	0	0	1.01
Addition Cement (lb/ton)	4.04	4.06	4.03

HPGR Test Series 2 consisted of bottle roll tests performed on core samples from lower Siebert material, as Test Series 1 represented upper Siebert material. Material for this test was obtained from 4 diamond core holes (Figure 13.6). Core was conventionally crushed to P80 3/4in, and 5kg was split from each and conventionally crushed to P80 3/8in. The remaining P80 3/4in material was crushed with an HPGR. HPGR center and edge products were collected separately. No size distribution data was collected.

Bottle roll testing was done on splits from both HPGR test series. The bottle roll test results are summarized in Table 13.10 and Table 13.11

Table 13.10 Hasbrouck HPGR – Upper Siebert Bottle Roll Gold and Silver Recoveries

Description	Avg. Elev. ft	Siebert	Rock Type	Cone Crush			HPGR Center			
				Au Head oz/ton	Au Tail oz/ton	Au Recov at 96 hrs %	Au Head oz/ton	Au Tail oz/ton	Au Recovery at 96 hrs %	Difference in HPGR vs Cone Crush Recovery %
Bulk Surface (Test 1)		Upper/Lower % (80/20)		0.026	0.017	35%	0.024	0.012	49%	14%

Description	Avg. Elev. ft	Siebert	Rock Type	Cone Crush			HPGR Center			
				Ag Head oz/ton	Ag Tail oz/ton	Ag Recov at 96 hrs %	Ag Head oz/ton	Ag Tail oz/ton	Ag Recovery at 96 hrs %	Difference in HPGR vs Cone Crusher Recovery %
Bulk Surface (Test 1)		Upper/Lower % (80/20)		0.419	0.34	19%	0.402	0.283	30%	11%

Table 13.11 Hasbrouck HPGR – Lower Siebert Bottle Roll Gold and Silver Recoveries

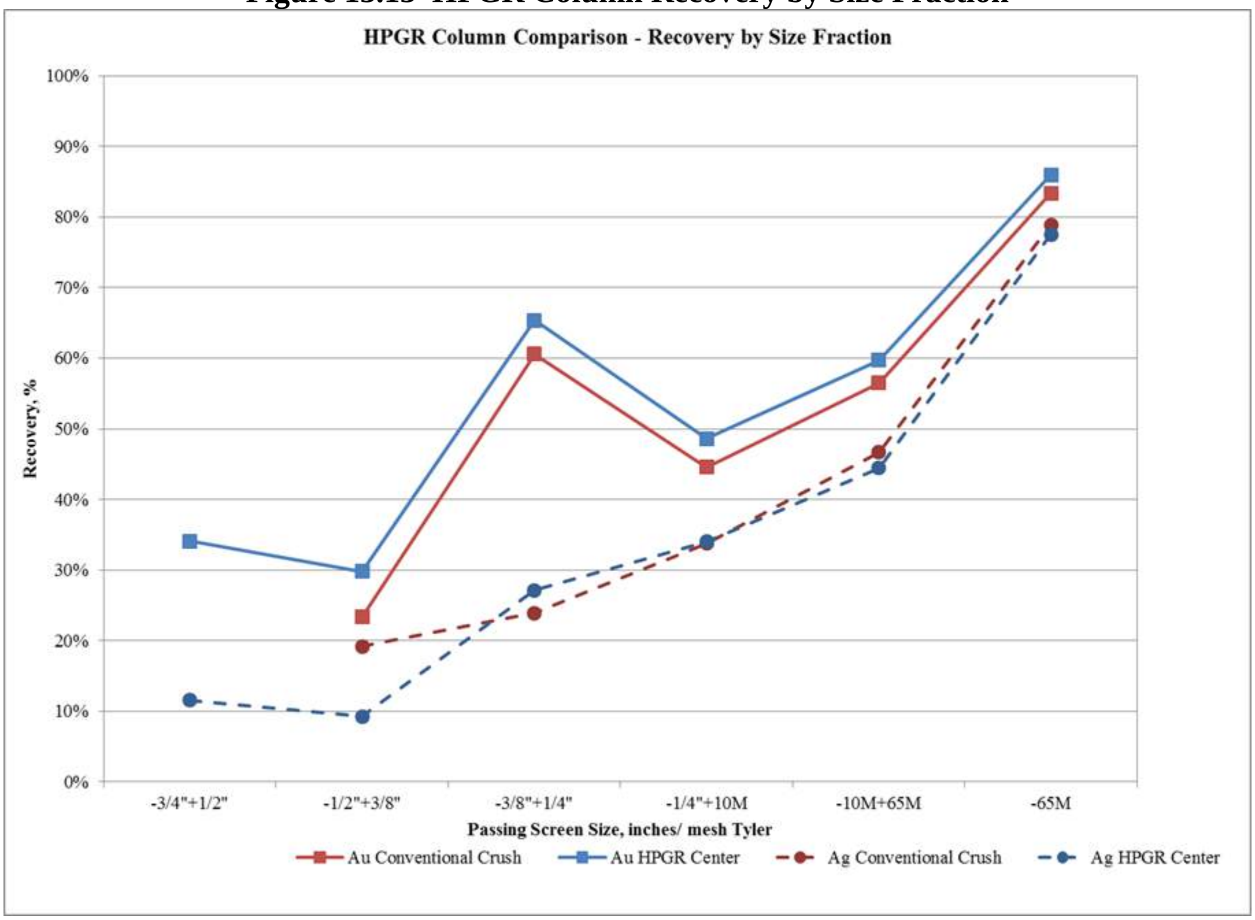
Description	Ave Elev. ft	Siebert	Rock Type	Cone Crush			HPGR Center			Difference in HPGR vs Cone Crush Recovery %
				Au Head oz/ton	Au Tail oz/ton	Au Recov at 96 hrs %	Au Head oz/ton	Au Tail oz/ton	Au Recovery at 96 hrs %	
HSB11-043; 494'-532'	5520	Lower	Tsw	0.018	0.013	69%	0.019	0.004	78.00%	9%
HSB11C-079; 572'-627'	5500	Lower	Tsw	0.018	0.006	69%	0.02	0.006	71%	2%
HSB11C-091; 532'-541':550.5'-577'	5565	Lower	Tslt	0.019	0.005	74%	0.017	0.0037	78.00%	4%
HSB11C-099; 345'-386'	5900	Lower	Tslt	0.014	0.008	56%	0.011	0.004	67%	11%
Average										**6.40%**
Description	**Avg. Elev ft**	**Siebert**	**Rock Type**	**Cone Crush**			**HPGR Center**			**Difference in HPGR vs Cone Crusher Recovery %**
				Ag Head oz/ton	**Ag Tail oz/ton**	**Ag Recov at 96 hrs %**	**Ag Head oz/ton**	**Ag Tail oz/ton**	**Ag Recovery at 96 hrs %**	
HSB11-043; 494'-532'	5520	Lower	Tsw	0.287	0.276	4%	0.283	0.266	6%	2%
HSB11C-079; 572'-627'	5500	Lower	Tsw	0.465	0.452	3%	0.468	0.442	6%	3%
HSB11C-091; 532'-541':550.5'-577'	5565	Lower	Tslt	0.163	0.152	7%	0.163	0.143	12%	5%
HSB11C-099; 345'-386'	5900	Lower	Tslt	0.292	0.248	15%	0.292	0.248	15%	0%
Average										**3.00%**

Note: Tslc = lower conglomerate in upper Siebert; Tsw = tuffaceous siltstone; Tslt = latitic tuff in lower Siebert.

Based on the above results using an HPGR is predicted to improve gold recoveries from the upper Siebert by 14% and by 6.4 % from the lower Siebert relative to a cone crusher. Test results indicate HPGR crushing will not significantly improve silver recovery.

While the differential in gold recovery was demonstrated in Table 13.10 and Table 13.11 for the upper and lower Siebert, these results are bottle rolls and as such are less representative of the performance of a heap leach than column leach results. To adjust for this, the bottle roll recoveries for upper Siebert were compared to the column leach recoveries and a minimum 6% difference was noted. This 6% difference was added to the bottle roll results to approximate column results for the upper Siebert. This was not possible for the lower Siebert as no column data was generated for HPGR product.

Figure 13.13 HPGR Column Recovery by Size Fraction



The recovery from a full scale HPGR product is predicted by using the column test data presented in Table 13.9, and the McPartland and Wright 2012 data. It is understood that an HPGR will provide higher gold recovery than a conventional crusher due to two distinct mechanisms:

- Micro-fracturing; Research done by others suggest this is due to the different crushing mechanism of an HPGR vs. a conventional crusher. Micro-fractures are created in the particles, allowing cyanide greater access to contained gold. Analysis of the Hasbrouck data suggests that this micro-fracturing effect can add between 0 and 4% to the gold recovery from Hasbrouck ores.
- Smaller particle size; test data from crushing Hasbrouck material indicates that an HPGR with edge recycling will crush to P75 1/4in, leading to between 6% and 14% higher recovery than a conventional crusher at P80 3/8in crush.

To maximize gold recovery, the HPGR in the full scale crushing process will be configured in closed circuit, with edge material recycled back through the center to improve gold recovery. To predict what gold recovery will be achieved during production, gold recovery from the center material is best compared with that from the coarsely cone crushed material (Table 13.10 and Table 13.11). In Table 13.10 and Table 13.11 the gold recoveries were normalized to a 96 hour leach by taking the fraction of leaching completed, based on solution assays, and multiplying that by the ultimate recovery.

13.6.8 Hasbrouck Deposit - Work Index and Abrasion Index Test Results

Standard comminution tests were performed on representative Hasbrouck Deposit surface samples by ALS Metallurgy under the supervision of KCA. The materials were combined into a composite sample and subjected to a Bond Low Impact Crusher test and a Bond abrasion test. Results are summarized in Table 13.12.

Table 13.12 Bond Crusher Work Index and Abrasion Index
(Data from Albert, 2014)

KCA Sample No.	Description	Crusher Work Index Values kW-hr/MT	Crusher Work Index Values kW-hr/st	Abrasion Index Values A_i
71028	Hasbrouck	18.71	16.97	0.2856

Note - Comminution test work completed by ALS Metallurgy, Kamloops, BC Canada.

Results indicate that this material is hard to crush and is moderately abrasive.

13.6.9 Hasbrouck Deposit - Agglomeration and Permeability Test Results

Agglomeration tests were performed to compare and evaluate the need to agglomerate conventionally crushed and HPGR crushed material. Results are summarized in Table 13.13 and indicate that the HPGR and conventionally crushed material will require cement addition for a heap lift height of 25ft.

Agglomeration tests were followed by compacted permeability tests, conducted under a compaction loading equivalent to a 125ft tall heap. Results of the compacted permeability tests are presented in Table 13.14.

Table 13.13 Hasbrouck Preliminary Agglomeration Testing
(Data from KCA, 2015)

KCA Test No.	71058 A	71058 B	71058 C	71058 D	71058 E	71058 F	71058 G	71058 H	71058 I	71058 J	71058 K	71058 L
Description	HPGR Composite, Conventionally Crushed				HPGR Composite, HPGR (Center Material)				HPGR Composite, Weighted Edge (24%) + Center (76%)			
Top Size of Material, inches	3/8"	3/8"	3/8"	3/8"	HPGR	HPGR	HPGR	HPGR	HPGR	HPGR	HPGR	HPGR
Dry Ore, kg	2	2	2	2	2	2	2	2	2	2	2	2
Cement, lbs/st	0	4	8	16	0	4	8	16	0	4	8	16
Water Added, mLs	0	77	79	92.5	0	86.5	62	80	0	157	122	125
Column Area, ft^2	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049
Initial Height, inches	11	10.5	10.25	10.5	8.25	9.5	10	10	8.5	9	10.25	10.75
Final Height, inches	11	10.5	10.25	10.5	8.25	9.25	10	10	8.5	9	10.25	10.75
pH on Day 3	8	10.1	10.7	11.1	7.8	10.9	11.2	11.2	7.9	9.2	9.2	10.8
pH Comment	Low	Good	Good	Good	Low	Good	Good	Good	Low	Low	Low	Good
% Slump	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%
Slump Result	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Apparent Bulk Density, lbs_{dry}/ft^3	97.99	102.66	105.16	102.66	130.65	116.53	107.79	107.79	126.81	119.77	105.16	100.27
Flow Out, gpm/ft^2	10.51	10.13	13.43	12.74	0.1	5.85	4.56	9.17	0.1	4.81	8.81	6.96
Flow Result	Pass	Pass	Pass	Pass	Fail	Pass	Pass	Pass	Fail	Pass	Pass	Pass
Visual Estimate of % Pellet Breakdown	N/A	<3	<3	<3	N/A	<3	<3	<3	N/A	<3	<3	<3
Pellet Result	N/A	Pass	Pass	Pass	N/A	Pass	Pass	Pass	N/A	Pass	Pass	Pass
Out Flow Solution, Color and Clarity	Light Brown & Cloudy	Colorless & Clear	Colorless & Clear	Colorless & Clear	Colorless & Clear	Colorless & Clear	Colorless & Clear	Colorless & Clear	Brown & Cloudy	Colorless & Clear	Colorless & Clear	Colorless & Clear
Solution Result	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass	Pass	Pass
Overall Test Result	Pass	Pass	Pass	Pass	Fail	Pass	Pass	Pass	Fail	Pass	Pass	Pass

Table 13.14 Hasbrouck Compacted Permeability Test
(Data from KCA, 2015)

KCA Test ID	Description	Cement Added (lb/ton)	Effective Height (feet)	Flow Rate (gpm/ft^2)	Crush Size (inches)	% Pellet Breakdown	% Slump	Effluent Ave pH	Pass/Fail
71081 A	HPGR Crushed Center	9	125	2,389	0.3	<3	0	11.6	Pass
71081 B	HPGR Crushed Center	4	125	2,033	0.3	<3	0	11.1	Pass
71081 C	HPGR Crushed Center	2	125	2,488	0.3	<3	0	9.49	Pass

Results show that the agglomerates are stable and permeable with 4 lb/ton of cement. However, the pH of the effluent was low at a cement addition rate of 4 lb/ton, and thus 5 lb/ton cement is recommended to maintain pH above 10.5 in the heap.

13.6.10 Hasbrouck Deposit - Leach Cycle Time Results

The 2012 Hasbrouck column test results for the -3/8in, conventionally crushed materials were studied to estimate an average value for leach cycle duration. The column leach cycle results for gold extraction are shown in Table 13.15.

Table 13.15 Summary of Hasbrouck Leach Cycle Duration Results for Gold
(Data from KCA, 2015)

			Bending Point				Recovery Complete		
Test	Crush	Description	S/O at Bend	Rec. at Bend	Lab Days	Field Days	Recovery	Lab Days	Total Days
P-2	-3/8"	HSB-0	0.55	16.3	7	51.1	35.8	49	100
P-4	-3/8"	HSB-1	1.02	34.8	13	95.2	51.0	45	140
P-6	-3/8"	HSB-2	1.02	51.7	13	95.0	64.2	44	139
P-8	-3/8"	HSB-3	0.61	50.6	8	57.2	70.6	49	106
P-10	-3/8"	HSB-4	0.70	56.4	9	65.4	76.4	65	130
P-12	-3/8"	HSB-5	0.54	24.5	7	50.3	43.6	49	99
P-14	-3/8"	HSB-6	0.55	42.3	8	51.0	68.5	49	100
P-16	-3/8"	HSB-7	0.71	49.3	9	66.3	66.7	40	106
P-18	-3/8"	HSB-8	0.55	49.3	7	51.6	66.7	34	86
P-20	-3/8"	HSB-9	0.47	54.7	6	43.6	78.0	50	94
P-22	-3/8"	HSB-10	0.53	54.2	7	49.8	79.2	47	97
P-24	-3/8"	HSB-11	0.53	43.0	7	50.0	66.7	50	100
P-26	-3/8"	HSB-12	0.54	25.7	7	50.2	50.0	42	92
P-28	-3/8"	HSB-13	0.77	58.1	10	71.7	74.4	66	138
P-30	-3/8"	HSB-14	0.69	43.1	9	64.6	62.5	40	105
P-32	-3/8"	HSB-15	0.78	16.7	10	72.8	26.7	36	109
P-34	-3/8"	HSB-16	0.45	25.2	6	42.5	44.4	50	93
P-36	-3/8"	HSB-17A	0.78	47.1	10	72.9	67.6	89	162
P-38	-3/8"	HSB-17B	0.78	56.2	10	72.5	72.4	68	141
P-40	-3/8"	HSB-18	0.78	77.0	10	72.9	87.0	53	126
P-2	-3/8"	3465-1	0.84	22.6	12	78.4	37.1	71	149
P-4	-3/8"	3465-2	0.65	37.8	9	61.0	58.3	58	119
P-6	-3/8"	3465-3	0.80	45.6	11	74.7	66.7	64	139
P-8	-3/8"	3465-4	0.71	44.0	10	66.7	65.3	77	144
P-10	-3/8"	3465-5	0.64	63.9	9	59.9	80.6	56	116
P-12	-3/8"	3465-6	0.58	17.1	8	53.9	26.4	50	104
P-14	-3/8"	3465-7	0.65	22.7	9	60.9	36.8	43	104
P-16	-3/8"	3465-8	0.58	29.0	8	54.7	45.0	39	94
P-18	-3/8"	3465-9	0.65	33.6	9	60.6	50.0	54	115
P-20	-3/8"	3465-10	0.63	52.7	9	59.1	70.3	62	121
P-22	-3/8"	3465-11	0.59	33.7	9	55.0	50.0	55	110
P-24	-3/8"	3465-12	0.53	32.0	8	49.4	44.0	35	84
P-26	-3/8"	3465-13	0.58	33.7	8	54.2	48.4	45	99
P-28	-3/8"	3465-14	0.73	33.4	11	68.4	46.8	75	143
P-30	-3/8"	3465-15	0.64	48.5	9	60.1	64.0	57	117

Note: “ = inch; S/O = Tons Solution/Tons Ore; Rec. = gold recovery in percent;

Field leach duration has been predicted from the 2012 McClelland 6in column tests. Field leach durations are typically longer than the column leach durations due to solution application rates being lower and column leach mechanics of diffusion and displacement not precisely representing the flow of fluid in that occur in a heap. Generally, the greater the diameter of the column, the more closely it approximates to field leach times.

There are three distinct domains in a column leach curve. The “initial leach”, the “bend” or “knee” and the “final tail out”. The leach duration results from the 2012 column tests were highly variable due to grade and lithology.

Leach cycle duration is predicted to be 115 days. as shown in Table 13.16.

Table 13.16 Hasbrouck Leach Cycle Duration

Column Leach Domain	Column Days	Empirical Factor	Predicted Field Days
Initial leach	15	3.0	45
Bend/Knee	20	1.5	30
Final Tail	40	1.0	40
Predicted Leach Cycle Duration			**115**

Data from the large number of column leach tests on 3/8in crushed material provide a good basis for predicting the leach time required for the HPGR crushed material. The average leach time of all the 2012 column leach tests on conventionally crushed 3/8in material was 115 days. The 2014 column leach tests on HPGR crushed material was completed in 3in columns and were terminated at 75 days, before leaching was completed. The columns were terminated at 75 days as the HPGR and conventionally crush material had both reached their “final tail” with a similar recovery rates (on a daily basis) and the difference in gold total gold recovery between the two products had been established. Based on the similarity at 75 days, it is predicted that the HPGR crushed material will achieve complete gold recovery in the same time as the conventionally crushed material of 115 days.

13.6.11 Hasbrouck Deposit - Predicted Recovery of Gold and Silver

For upper Siebert material the 13 column leach tests performed by McPartland and Wright in 2012, on 3/8in, conventionally crushed material was estimated to be 43% recovery of gold.

KCA’s 2014 bottle roll tests on HPGR crushed upper Siebert material showed a 14% increase in gold recovery (Table 13.10) compared to a conventional crusher. The data on upper Siebert material indicates that bottle roll tests under-report gold recovery by a minimum of 6% compared to column leach test data. (Table 13.9 and Table 13.10). A deduction of -2% is recommended to be applied to the laboratory-scale results for gold recovery to account for field conditions. The value of 2% for the deduction factor was chosen based on operational experience. The projected operational gold recovery is therefore predicted at 61% (43%+14%+6%-2%) for ore hosted in the upper Siebert unit.

For lower Siebert ore, 21 column leach tests performed by McClelland in 2012 on 3/8in conventionally crushed material gave an estimated average gold recovery of 71.4%. Bottle roll tests by KCA in 2014 indicated that using an HPGR will result in 6.4% higher gold recovery than by a conventional crusher (Table 13.11). It is recommended that a deduction factor of -2% be applied to the laboratory-scale results for gold recovery to account for field conditions, resulting in a projected operational gold recovery of 75.8% (71.4%+6.4%-2%) for ore hosted in the lower Siebert unit. Of note, no comparative column tests have been completed for HPGR crushing of lower Siebert ore. For upper Siebert ore, bottle roll tests understated the gold recovery by 6%, showing the potential for further tests to reveal a similar increase in recovery in the lower Siebert.

The mine plan put forward in this study has 81% of the ore tonnage coming from the lower Siebert and 19% from the upper Siebert. Thus a weighted average gold recovery of 72.9% is predicted for all ore contemplated by this study to be mined from the Hasbrouck deposit.

Silver recoveries do not appear to benefit from HPGR crushing. Tests on 3/8in, conventionally crushed material indicated an average recovery of 13% of the contained silver could be expected from both the upper and lower Siebert. A -2% operational deduction factor is recommended to be applied to the laboratory-scale results to account for field conditions, resulting in a predicted 11% operational recovery of silver from ore in the Hasbrouck deposit.

13.6.12 Hasbrouck Deposit - Cyanide Consumption

The column leach test data were evaluated to provide a basis for predicting field consumption of cyanide at Hasbrouck. An average consumption of 3.29lb NaCN/ton was observed for the 2012 column leach tests using conventionally crushed material. The 2015 column leach tests on HPGR crushed materials consumed an average of 1.81lb NaCN/ton, a slight increase compared to the conventionally crushed material that consumed 1.73lb NaCN/ton (KCA, March, 2015). Consumption of cyanide during production is expected to be 41% of the KCA HPGR laboratory consumption results, or 0.75lb NaCN/ton. The reduced cyanide consumption during production is due to expected field operating conditions.

13.6.13 Hasbrouck Deposit - Cement and Lime Consumption

Cement will be required for agglomeration at Hasbrouck. The compacted permeability test indicated that adding 4lb/ton of cement to material to be leached will be sufficient to maintain stable and permeable agglomerates for a heap height of 125ft. However, the pH was less than ideal at this addition rate, thus an addition rate of 5lb/ton is projected for full-scale operations.

13.6.14 Detailed Results of Bottle Roll and Column Leach Tests

Detailed data that provide support to the summary tables presented in Section 13.4 are presented below in Table 13.17, Table 13.18 and Table 13.19.

Table 13.17 Hasbrouck Bottle Roll Test Results
(Data from McPartland, 2012, Wright, 2012, and KCA, March, 2015))

						Head Grade, oz/ton		Extraction, %		Consumption lb/ton		
Test	Description	Avg. Elev (ft)	Seibert Unit	Rock Type	Size	Au	Ag	Au	Ag	NaCN	Lime	Report
CY-1	HSB-0	5915	Upper	Tsuc/Tss	10M	0.023	0.31	39.1	22.6	0.1	2	8-Mar-12
CY-18	HSB-0	5915	Upper	Tsuc/Tss	200M	0.022	0.33	86.4	57.6	0.29	2.5	8-Mar-12
CY-2	HSB-1	5840	Upper	Tss/Tslt	10M	0.023	0.51	52.2	15.7	0.1	2.2	8-Mar-12
CY-19	HSB-1	5840	Upper	Tss/Tslt	200M	0.02	0.51	90	45.1	0.15	2.7	8-Mar-12
CY-3	HSB-2	5915	Lower	Tss	10M	0.012	0.28	66.7	28.6	0.1	2.4	8-Mar-12
CY-20	HSB-2	5915	Lower	Tss	200M	0.011	0.29	90.9	62.1	0.14	2.2	8-Mar-12
CY-4	HSB-3	5820	Lower	Tss/Tslt	10M	0.02	0.88	79.8	54.3	0.23	2.4	8-Mar-12
CY-21	HSB-3	5820	Lower	Tss/Tslt	200M	0.018	0.8	87.4	64.3	0.31	2.3	8-Mar-12
CY-5	HSB-4	5670	Lower	Tslt	10M	0.015	0.36	80	36.1	0.15	3	8-Mar-12
CY-22	HSB-4	5670	Lower	Tslt	200M	0.012	0.37	91.7	51.4	0.14	2.6	8-Mar-12
CY-6	HSB-5	6040	Upper	Tss/Tslc	10M	0.01	0.35	50	28.6	0.1	2.2	8-Mar-12
CY-23	HSB-5	6040	Upper	Tss/Tslc	200M	0.009	0.35	88.9	62.9	0.6	2.4	8-Mar-12
CY-7	HSB-6	5930	Lower	Tslt/Tsw	10M	0.012	0.21	66.7	19	0.1	3.5	8-Mar-12
CY-24	HSB-6	5930	Lower	Tslt/Tsw	200M	0.011	0.21	90.9	47.6	0.29	2.9	8-Mar-12
CY-8	HSB-7	5830	Lower	Tslt	10M	0.023	0.19	73.9	26.3	0.1	3.8	8-Mar-12
CY-25	HSB-7	5830	Lower	Tslt	200M	0.022	0.17	90.9	58.8	0.14	2.9	8-Mar-12
CY-9	HSB-8	5735	Lower	Tslt/Tsw	10M	0.013	0.14	84.6	14.3	0.1	3.1	8-Mar-12
CY-26	HSB-8	5735	Lower	Tslt/Tsw	200M	0.011	0.11	90.9	36.4	0.3	2.7	8-Mar-12
CY-10	HSB-9	5610	Lower	Tslt/Tsw	10M	0.014	0.6	85.7	11.7	0.14	2.9	8-Mar-12
CY-27	HSB-9	5610	Lower	Tslt/Tsw	200M	0.012	0.63	91.7	28.6	0.16	2.8	8-Mar-12
CY-11	HSB-10	5460	Lower	Tsw/Tslt	10M	0.022	0.85	81.8	9.4	0.1	2.6	8-Mar-12
CY-28	HSB-10	5460	Lower	Tsw/Tslt	200M	0.023	0.86	95.7	26.7	0.3	3.2	8-Mar-12
CY-12	HSB-11	5800	Upper/Lower	Tslc/Tslt	10M	0.032	0.6	71.9	10	0.15	2.6	8-Mar-12
CY-29	HSB-11	5800	Upper/Lower	Tslc/Tslt	200M	0.027	0.58	96.3	32.8	0.46	3.4	8-Mar-12
CY-13	HSB-12	5930	Upper	Tslc	10M	0.013	0.25	61.5	20	0.1	2.6	8-Mar-12
CY-30	HSB-12	5930	Upper	Tslc	200M	0.013	0.26	84.6	57.7	0.31	2.2	8-Mar-12
CY-14	HSB-13	5700	Lower	Tslt/Tslc	10M	0.019	0.46	68.4	15.2	0.1	3	8-Mar-12
CY-31	HSB-13	5700	Lower	Tslt/Tslc	200M	0.021	0.49	76.2	38.8	0.1	2.9	8-Mar-12
CY-15	HSB-14	5835	Lower	Tsw/Tslt	10M	0.016	0.21	75	14.3	0.1	2.6	8-Mar-12
CY-32	HSB-14	5835	Lower	Tsw/Tslt	200M	0.012	0.17	91.7	35.3	0.1	3.8	8-Mar-12
CY-16	HSB-15	5950	Upper	Tslc	10M	0.021	0.49	47.6	30.6	0.1	2.3	8-Mar-12
CY-33	HSB-15	5950	Upper	Tslc	200M	0.018	0.48	83.3	72.9	0.1	3.4	8-Mar-12
CY-17	HSB-16	5890	Upper	Tslc/Tslt	10M	0.026	0.7	57.7	20	0.1	2.4	8-Mar-12

						Head Grade, oz/ton		Extraction, %		Consumption lb/ton		
Test	Description	Avg. Elev (ft)	Seibert Unit	Rock Type	Size	Au	Ag	Au	Ag	NaCN	Lime	Report
CY-34	HSB-16	5890	Upper	Tslc/Tslt	200M	0.027	0.63	92.6	63.5	0.1	3	8-Mar-12
CY-35	HSB-17A	5940	Lower	Tslt	10M	0.028	0.67	75	29.9	0.1	2.7	8-Mar-12
CY-38	HSB-17A	5940	Lower	Tslt	200M	0.026	0.64	88.5	60.9	0.27	3.8	8-Mar-12
CY-36	HSB-17B	5865	Lower	Tslt	10M	0.023	0.39	78.3	30.8	0.15	2.5	8-Mar-12
CY-39	HSB-17B	5865	Lower	Tslt	200M	0.027	0.49	92.6	46.9	0.29	4.2	8-Mar-12
CY-37	HSB-18	5580	Lower	Tslt	10M	0.007	0.54	85.7	18.5	0.16	2.8	8-Mar-12
CY-40	HSB-18	5580	Lower	Tslt	200M	0.009	0.58	88.9	39.7	0.15	5	8-Mar-12
CY-1	3465-1	5960	Upper	Tslc	10M	0.035	0.71	62.9	39.4	0.16	2	14-Mar-12
CY-16	3465-1	5960	Upper	Tslc	200M	0.033	0.57	90.9	54.4	0.16	2.7	14-Mar-12
CY-2	3465-2	5885	Lower	Tslt	10M	0.015	0.75	73.3	36	0.14	1.6	14-Mar-12
CY-17	3465-2	5885	Lower	Tslt	200M	0.014	0.77	92.9	54.5	0.14	2.3	14-Mar-12
CY-3	3465-3	5790	Lower	Tslt	10M	0.045	1.2	73.3	29.2	0.3	2	14-Mar-12
CY-18	3465-3	5790	Lower	Tslt	200M	0.043	1.16	90.7	50	0.14	2.6	14-Mar-12
CY-4	3465-4	5715	Lower	Tslt	10M	0.088	1.7	67	21.8	0.14	2.2	14-Mar-12
CY-19	3465-4	5715	Lower	Tslt	200M	0.078	1.67	92.3	44.9	0.16	2.6	14-Mar-12
CY-5	3465-5	5625	Lower	Tslt	10M	0.018	0.84	77.8	6	0.31	2.7	14-Mar-12
CY-20	3465-5	5625	Lower	Tslt	200M	0.017	0.78	94.1	20.5	0.14	3.2	14-Mar-12
CY-6	3465-6	6050	Upper	Tss	10M	0.014	0.31	42.9	25.8	0.14	2.2	14-Mar-12
CY-21	3465-6	6050	Upper	Tss	200M	0.012	0.25	75	68	0.15	2.8	14-Mar-12
CY-7	3465-7	5980	Upper	Tslc	10M	0.022	0.29	50	27.6	0.14	1.8	14-Mar-12
CY-22	3465-7	5980	Upper	Tslc	200M	0.017	0.24	82.4	70.8	0.15	2.9	14-Mar-12
CY-8	3465-8	5915	Upper	Tslc	10M	0.023	0.45	52.2	33.3	0.19	2	14-Mar-12
CY-23	3465-8	5915	Upper	Tslc	200M	0.019	0.34	84.2	79.4	0.14	2.6	14-Mar-12
CY-9	3465-9	5850	Lower	Tslt	10M	0.029	0.49	58.6	26.5	0.14	1.8	14-Mar-12
CY-24	3465-9	5850	Lower	Tslt	200M	0.023	0.4	87	60	0.15	2.4	14-Mar-12
CY-10	3465-10	5790	Lower	Tslt	10M	0.042	1.11	73.8	26.1	0.15	1.8	14-Mar-12
CY-25	3465-10	5790	Lower	Tslt	200M	0.038	0.91	86.8	54.9	0.14	2.1	14-Mar-12
CY-11	3465-11	5857	Lower	Tslt	10M	0.022	0.65	63.6	18.5	0.14	2.3	14-Mar-12
CY-26	3465-11	5857	Lower	Tslt	200M	0.019	0.59	94.7	49.2	0.14	2.7	14-Mar-12
CY-12	3465-12	5925	Upper	Tslc	10M	0.016	0.62	50	24.2	0.14	2.2	14-Mar-12
CY-27	3465-12	5925	Upper	Tslc	200M	0.013	0.61	76.9	59	0.15	2.6	14-Mar-12
CY-13	3465-13	5845	Upper	Tslc/Tslt	10M	0.023	0.41	52.2	14.6	0.14	1.8	14-Mar-12
CY-28	3465-13	5845	Upper	Tslc/Tslt	200M	0.031	0.43	96.8	39.5	0.14	2.1	14-Mar-12
CY-14	3465-14	5760	Lower	Tslt	10M	0.050	0.56	60	17.9	0.14	2.1	14-Mar-12
CY-29	3465-14	5760	Lower	Tslt	200M	0.045	0.55	95.6	47.3	0.14	2.2	14-Mar-12

						Head Grade, oz/ton		Extraction, %		Consumption lb/ton		
Test	**Description**	**Avg. Elev (ft)**	**Seibert Unit**	**Rock Type**	**Size**	**Au**	**Ag**	**Au**	**Ag**	**NaCN**	**Lime**	**Report**
CY-15	3465-15	5670	Lower	Tslt	10M	0.025	0.46	68	10.9	0.14	1.8	14-Mar-12
CY-30	3465-15	5670	Lower	Tslt	200M	0.021	0.44	95.2	31.8	0.16	2.3	14-Mar-12
73109A	HSB11-014:275-335	5795	Upper/Lower	Tslc	10M	0.020	0.53	51	18	0.32	1	Jan-15
73111A	HSB11-014:275-335	5795	Upper/Lower	Tslc	200M	0.017	0.58	90	49	0.5	1.5	Jan-15
73109B	HSB11-043:494-532	5520	Lower	Tsw	10M	0.020	0.28	87	7	0.3	1.5	Jan-15
73111B	HSB11-043:494-532	5520	Lower	Tsw	200M	0.021	0.29	97	28	1.25	1.5	Jan-15
73109C	HSB11C-079:572-627	5500	Lower	Tsw	10M	0.018	0.45	84	5	0.46	1.5	Jan-15
73111C	HSB11C-079:572-627	5500	Lower	Tsw	200M	0.019	0.47	96	24	0.77	2	Jan-15
73109D	HSB11C-091:532-541:550.5-577	5565	Lower	Tslt	10M	0.022	0.16	83	11	0.32	1.5	Jan-15
73111D	HSB11C-091:532-541:550.5-577	5565	Lower	Tslt	200M	0.020	0.16	95	43	0.86	2	Jan-15
73110A	HSB11C-099:345-386	5900	Lower	Tslt	10M	0.013	0.28	68	21	0.34	1.5	Jan-15
73112A	HSB11C-099:345-386	5900	Lower	Tslt	200M	0.011	0.28	90	57	0.51	1.5	Jan-15

Note: Tslc = lower conglomerate in upper Siebert; Tsw = tuffaceous siltstone; Tslt = latitic tuff in lower Siebert; Tsuc = upper conglomerate in upper Siebert; Tss = sandstone in upper Siebert.

Table 13.18 Hasbrouck Column Tests, Grades and Reagents
(Data from McPartland, 2012, and Wright, 2012)

						Head Grade oz/ton		Consumption, lb/ton	
Test	Description	Avg. Elev (ft)	Siebert	Rock Type	Crush Size	Au	Ag	NaCN	Lime
P-1	HSB-0	5915	Upper	Tsuc/Tss	3/4	0.014	0.30	3.12	2.0
P-2	HSB-0	5915	Upper	Tsuc/Tss	3/8	0.019	0.30	3.04	2.0
P-3	HSB-1	5840	Upper	Tss/Tslt	3/4	0.021	0.50	3.19	2.2
P-4	HSB-1	5840	Upper	Tss/Tslt	3/8	0.021	0.50	3.64	2.2
P-5	HSB-2	5915	Lower	Tss	3/4	0.013	0.25	3.38	2.4
P-6	HSB-2	5915	Lower	Tss	3/8	0.012	0.24	3.19	2.4
P-7	HSB-3	5820	Lower	Tss/Tslt	3/4	0.017	0.27	3.32	2.8
P-8	HSB-3	5820	Lower	Tss/Tslt	3/8	0.018	0.27	3.16	2.8
P-9	HSB-4	5670	Lower	Tslt	3/4	0.014	0.23	3.00	3.0
P-10	HSB-4	5670	Lower	Tslt	3/8	0.014	0.16	3.19	3.0
P-11	HSB-5	6040	Upper	Tss/Tslc	3/4	0.011	0.26	2.78	2.2
P-12	HSB-5	6040	Upper	Tss/Tslc	3/8	0.011	0.32	2.83	2.2
P-13	HSB-6	5930	Lower	Tslt/Tsw	3/4	0.016	0.21	2.25	3.6
P-14	HSB-6	5930	Lower	Tslt/Tsw	3/8	0.013	0.15	2.29	3.6
P-15	HSB-7	5830	Lower	Tslt	3/4	0.028	0.14	2.49	3.8
P-16	HSB-7	5830	Lower	Tslt	3/8	0.027	0.16	2.51	3.8
P-19	HSB-8	5735	Lower	Tslt/Tsw	3/4	0.013	0.07	2.61	3.2
P-18	HSB-8	5735	Lower	Tslt/Tsw	3/8	0.015	0.09	2.88	3.2
P-17	HSB-9	5610	Lower	Tlst/Tsw	3/4	0.013	0.57	2.64	3.0
P-20	HSB-9	5610	Lower	Tlst/Tsw	3/8	0.015	0.61	2.32	3.0
P-21	HSB-10	5460	Lower	Tsw/Tslt	3/4	0.024	0.78	0.89	2.6
P-22	HSB-10	5460	Lower	Tsw/Tslt	3/8	0.024	0.78	2.60	2.6
P-23	HSB-11	5800	Upper/Lower	Tslc/Tslt	3/4	0.034	0.60	2.59	2.6
P-24	HSB-11	5800	Upper/Lower	Tslc/Tslt	3/8	0.033	0.61	2.87	2.6
P-25	HSB-12	5930	Upper	Tslc	3/4	0.014	0.22	2.88	2.6
P-26	HSB-12	5930	Upper	Tslc	3/8	0.014	0.24	3.08	2.6
P-27	HSB-13	5700	Lower	Tslt/Tslc	3/4	0.017	0.44	3.21	3.0
P-28	HSB-13	5700	Lower	Tslt/Tslc	3/8	0.016	0.46	3.34	3.0
P-29	HSB-14	5835	Lower	Tsw/Tslt	3/4	0.014	0.19	2.86	2.6
P-30	HSB-14	5835	Lower	Tsw/Tslt	3/8	0.016	0.19	2.91	2.6
P-31	HSB-15	5950	Upper	Tslc	3/4	0.015	0.49	2.81	2.4
P-32	HSB-15	5950	Upper	Tslc	3/8	0.030	0.52	2.97	2.4
P-33	HSB-16	5890	Upper	Tslc/Tslt	3/4	0.024	0.66	2.90	2.4
P-34	HSB-16	5890	Upper	Tslc/Tslt	3/8	0.027	0.63	3.28	2.4
P-35	HSB-17A	5940	Lower	Tslt	3/4	0.031	0.60	5.33	2.6
P-36	HSB-17A	5940	Lower	Tslt	3/8	0.034	0.63	5.85	2.6
P-37	HSB-17B	5865	Lower	Tslt	3/4	0.029	0.50	4.12	2.6
P-38	HSB-17B	5865	Lower	Tslt	3/8	0.029	0.38	4.54	2.6

						Head Grade oz/ton		Consumption, lb/ton	
Test	**Description**	**Avg. Elev (ft)**	**Siebert**	**Rock Type**	**Crush Size**	**Au**	**Ag**	**NaCN**	**Lime**
P-39	HSB-18	5580	Lower	Tslt	3/4	0.007	0.48	3.93	2.6
P-40	HSB-18	5580	Lower	Tslt	3/8	0.010	0.51	4.50	2.6
P-1	3465-1	5960	Upper	Tslc	3/4	0.036	0.70	3.98	2.0
P-2	3465-1	5960	Upper	Tslc	3/8	0.042	0.76	4.91	2.0
P-3	3465-2	5885	Lower	Tslt	3/4	0.016	0.72	2.68	2.0
P-4	3465-2	5885	Lower	Tslt	3/8	0.018	0.71	3.07	2.0
P-5	3465-3	5790	Lower	Tslt	3/4	0.050	1.16	3.72	2.0
P-6	3465-3	5790	Lower	Tslt	3/8	0.045	1.26	4.20	2.0
P-7	3465-4	5715	Lower	Tslt	3/4	0.074	1.45	4.72	2.0
P-8	3465-4	5715	Lower	Tslt	3/8	0.075	1.65	4.34	2.0
P-9	3465-5	5625	Lower	Tslt	3/4	0.020	0.78	3.48	2.5
P-10	3465-5	5625	Lower	Tslt	3/8	0.018	0.85	3.75	2.5
P-11	3465-6	6050	Upper	Tss	3/4	0.013	0.29	2.55	2.0
P-12	3465-6	6050	Upper	Tss	3/8	0.014	0.33	2.58	2.0
P-13	3465-7	5980	Upper	Tslc	3/4	0.019	0.26	2.66	2.0
P-14	3465-7	5980	Upper	Tslc	3/8	0.022	0.27	2.81	2.0
P-15	3465-8	5915	Upper	Tslc	3/4	0.022	0.47	2.87	2.0
P-16	3465-8	5915	Upper	Tslc	3/8	0.020	0.47	3.09	2.0
P-17	3465-9	5850	Lower	Tslt	3/4	0.026	0.49	3.33	2.0
P-18	3465-9	5850	Lower	Tslt	3/8	0.028	0.46	3.23	2.0
P-19	3465-10	5790	Lower	Tslt	3/4	0.037	0.99	3.14	2.0
P-20	3465-10	5790	Lower	Tslt	3/8	0.037	1.00	3.38	2.0
P-21	3465-11	5857	Lower	Tslt	3/4	0.020	0.69	2.99	2.0
P-22	3465-11	5857	Lower	Tslt	3/8	0.019	0.66	2.97	2.0
P-23	3465-12	5925	Upper	Tslc	3/4	0.015	0.64	2.11	2.0
P-24	3465-12	5925	Upper	Tslc	3/8	0.015	0.63	2.11	2.0
P-25	3465-13	5845	Upper	Tslc/Tslt	3/4	0.017	0.39	2.24	2.0
P-26	3465-13	5845	Upper	Tslc/Tslt	3/8	0.019	0.41	2.63	2.0
P-27	3465-14	5760	Lower	Tslt	3/4	0.059	0.59	4.01	2.0
P-28	3465-14	5760	Lower	Tslt	3/8	0.053	0.57	3.97	2.0
P-29	3465-15	5670	Lower	Tslt	3/4	0.018	0.42	2.79	2.0
P-30	3465-15	5670	Lower	Tslt	3/8	0.020	0.40	2.77	2.0

Note: Tslc = lower conglomerate in upper Siebert; Tsw = tuffaceous siltstone; Tslt = latitic tuff in lower Siebert; Tss = sandstone in upper Siebert.

Table 13.19 Hasbrouck Column Tests, Extractions and Tails
(Data from McPartland, 2012, and Wright, 2012)

				Extracted, %		Tails Grade, oz/ton	
Test	**Description**	**Siebert Unit**	**Crush Size (inches)**	**Au**	**Ag**	**Au**	**Ag**
P-1	HSB-0	Upper	P80 3/4	42.9	13.3	0.008	0.26
P-2	HSB-0	Upper	P80 3/8	36.8	16.7	0.012	0.25
P-3	HSB-1	Upper	P80 3/4	38.1	8.0	0.013	0.46
P-4	HSB-1	Upper	P80 3/8	52.4	12.0	0.010	0.44
P-5	HSB-2	Lower	P80 3/4	61.5	12.0	0.005	0.22
P-6	HSB-2	Lower	P80 3/8	66.7	16.7	0.004	0.20
P-7	HSB-3	Lower	P80 3/4	64.7	3.7	0.006	0.26
P-8	HSB-3	Lower	P80 3/8	72.2	7.4	0.005	0.25
P-9	HSB-4	Lower	P80 3/4	71.4	4.3	0.004	0.22
P-10	HSB-4	Lower	P80 3/8	78.6	9.1	0.003	0.20
P-11	HSB-5	Upper	P80 3/4	36.4	19.2	0.007	0.21
P-12	HSB-5	Upper	P80 3/8	45.5	18.8	0.006	0.26
P-13	HSB-6	Lower	P80 3/4	56.3	4.8	0.007	0.20
P-14	HSB-6	Lower	P80 3/8	69.2	6.7	0.004	0.14
P-15	HSB-7	Lower	P80 3/4	67.9	7.1	0.009	0.13
P-16	HSB-7	Lower	P80 3/8	66.7	12.5	0.009	0.14
P-19	HSB-8	Lower	P80 3/4	69.2	14.3	0.004	0.06
P-18	HSB-8	Lower	P80 3/8	66.7	11.1	0.005	0.08
P-17	HSB-9	Lower	P80 3/4	84.6	10.5	0.002	0.51
P-20	HSB-9	Lower	P80 3/8	80.0	8.2	0.003	0.56
P-21	HSB-10	Lower	P80 3/4	75.0	5.1	0.006	0.74
P-22	HSB-10	Lower	P80 3/8	79.2	6.4	0.005	0.73
P-23	HSB-11	Upper/Lower	P80 3/4	55.9	5.0	0.015	0.57
P-24	HSB-11	Upper/Lower	P80 3/8	66.7	6.6	0.011	0.57
P-25	HSB-12	Upper	P80 3/4	50.0	13.6	0.007	0.19
P-26	HSB-12	Upper	P80 3/8	50.0	16.7	0.007	0.20
P-27	HSB-13	Lower	P80 3/4	64.7	6.8	0.006	0.41
P-28	HSB-13	Lower	P80 3/8	75.0	10.9	0.004	0.41
P-29	HSB-14	Lower	P80 3/4	64.3	5.3	0.005	0.18
P-30	HSB-14	Lower	P80 3/8	62.5	10.5	0.006	0.17
P-31	HSB-15	Upper	P80 3/4	40.0	16.3	0.009	0.41
P-32	HSB-15	Upper	P80 3/8	26.7	23.1	0.022	0.40
P-33	HSB-16	Upper	P80 3/4	41.7	9.1	0.014	0.60
P-34	HSB-16	Upper	P80 3/8	44.4	14.3	0.015	0.54
P-35	HSB-17A	Lower	P80 3/4	58.1	20.0	0.013	0.48
P-36	HSB-17A	Lower	P80 3/8	67.6	23.8	0.011	0.48
P-37	HSB-17B	Lower	P80 3/4	58.6	14.0	0.012	0.43
P-38	HSB-17B	Lower	P80 3/8	72.4	28.9	0.008	0.27

				Extracted, %		Tails Grade, oz/ton	
Test	**Description**	**Siebert Unit**	**Crush Size (inches)**	**Au**	**Ag**	**Au**	**Ag**
P-39	HSB-18	Lower	P80 3/4	85.7	8.3	0.001	0.44
P-40	HSB-18	Lower	P80 3/8	90.0	15.7	0.001	0.43
P-1	3465-1	Upper	P80 3/4	33.3	18.6	0.024	0.57
P-2	3465-1	Upper	P80 3/8	38.1	22.4	0.026	0.59
P-3	3465-2	Lower	P80 3/4	50.0	13.9	0.008	0.62
P-4	3465-2	Lower	P80 3/8	61.1	23.9	0.007	0.54
P-5	3465-3	Lower	P80 3/4	60.0	12.9	0.020	1.01
P-6	3465-3	Lower	P80 3/8	66.7	18.3	0.015	1.03
P-7	3465-4	Lower	P80 3/4	73.0	8.3	0.020	1.33
P-8	3465-4	Lower	P80 3/8	65.3	12.7	0.026	1.44
P-9	3465-5	Lower	P80 3/4	75.0	2.6	0.005	0.76
P-10	3465-5	Lower	P80 3/8	83.3	3.5	0.003	0.82
P-11	3465-6	Upper	P80 3/4	23.1	6.9	0.010	0.27
P-12	3465-6	Upper	P80 3/8	28.6	12.1	0.010	0.29
P-13	3465-7	Upper	P80 3/4	31.6	7.7	0.013	0.24
P-14	3465-7	Upper	P80 3/8	36.4	14.8	0.014	0.23
P-15	3465-8	Upper	P80 3/4	36.4	14.9	0.014	0.40
P-16	3465-8	Upper	P80 3/8	45.0	23.4	0.011	0.36
P-17	3465-9	Lower	P80 3/4	50.0	10.2	0.013	0.44
P-18	3465-9	Lower	P80 3/8	50.0	15.2	0.014	0.39
P-19	3465-10	Lower	P80 3/4	73.0	16.2	0.010	0.83
P-20	3465-10	Lower	P80 3/8	70.3	20.0	0.011	0.80
P-21	3465-11	Lower	P80 3/4	45.0	4.3	0.011	0.66
P-22	3465-11	Lower	P80 3/8	52.6	7.6	0.009	0.61
P-23	3465-12	Upper	P80 3/4	40.0	7.8	0.009	0.59
P-24	3465-12	Upper	P80 3/8	46.7	12.7	0.008	0.55
P-25	3465-13	Upper	P80 3/4	41.2	2.6	0.010	0.38
P-26	3465-13	Upper	P80 3/8	47.4	4.9	0.010	0.39
P-27	3465-14	Lower	P80 3/4	30.5	5.1	0.041	0.56
P-28	3465-14	Lower	P80 3/8	47.2	8.8	0.028	0.52
P-29	3465-15	Lower	P80 3/4	61.1	4.8	0.007	0.40
P-30	3465-15	Lower	P80 3/8	65.0	7.5	0.007	0.37

13.7 Summary of Test Results and Conclusions

Metallurgical testing of material from Three Hills and Hasbrouck was completed by the previous owners and WK. The testing included:

- Bottle roll tests that evaluated amenability of the mineralized materials from Three Hills and Hasbrouck to cyanidation;
- Column leach tests that evaluated the amenability of the crushed and run-of-mine material from both deposits to conventional heap leaching;
- Abrasion testing of mineralized material from the Hasbrouck deposit;
- Comminution testing of mineralized material from the Hasbrouck deposit; and
- High pressure grinding roll ("HPGR") testing.

Review of the studies above and summarized in Table 13.1 indicated the following conclusions:

- Three Hills Deposit
  - Metallurgical performance is consistent throughout the deposit.
  - Gold recovery increases with decreasing particle size.
  - There is no significant correlation between grade and recovery.
  - Field recovery for gold from a two-stage leach cycle is predicted to be 79% at 171 days.
  - Consumption of sodium cyanide (NaCN) is predicted to be 0.45lb/ton.
  - Consumption of lime ("CaO") is predicted to be 4lb/ton.
  - Percolation of solution through ROM material is predicted to be acceptable.
- Hasbrouck Deposit
  - Gold and silver recoveries increase strongly with decreasing particle size.
  - Recoveries for upper Siebert material crushed in an HPGR and tested in both columns and bottle rolls are predicted to be 61.0% for gold and 11.0% for silver.
  - Recoveries for lower Siebert material crushed in an HPGR and tested in both columns and bottle rolls are predicted to be 75.8% for gold and 11.0% for silver.
  - Mine scale recovery using a weighted average of the upper and lower Siebert units are predicted to be 72.9% for gold and 11.0% for silver.
  - Within each lithological unit, gold recovery slowly increases with decreasing elevation; for economic modelling of the project, a single average recovery value may be used due to the weakness of this effect.

- There is no significant correlation between gold or silver grade and recovery.
- The leach cycle for HPGR crushed mineralized material is predicted to be 115 days.
- NaCN consumption is predicted to be 0.75lb/ton.
- Cement consumption is predicted to be 5lb/ton.

13.8 Hasbrouck Project Metallurgical Parameter Summary

A summary of predicted Hasbrouck project metallurgical parameters, based on all available data, is presented in Table 13.20 and Table 13.21 and are recommended for use in the economic analysis of this project at the pre-feasibility level of studies.

Table 13.20 Three Hills and Hasbrouck Recovery Factors

Three Hills Deposit Gold Recovery			
48 Inch Column Leach Test Recovery			81.1%
Operational and Particle Size Deduction			-2.1%
Predicted Operational Gold Recovery			**79.0%**
Hasbrouck Deposit - Upper Siebert Gold Recovery			
McClelland 3/8in Column Leach Recovery			43.0%
HPGR Add, Bottle Roll Tests (Table 13.10)			14.0%
Bottle Roll to Column Leach Factor (Table 13.09)			6.0%
Operational Deduction			-2.0%
Predicted Operational Gold Recovery			**61.0%**
Hasbrouck Deposit - Lower Siebert Gold Recovery			
McClelland 3/8" Column Leach Recovery			71.4%
HPGR Add, Bottle Roll Tests (Table 13.11)			6.4%
Bottle Roll to Column Leach Factor			no data
Operational Deduction			-2.0%
Predicted Operational Au Recovery			**75.8%**
Hasbrouck Weighted Gold Recoveries	**% of Reserves**	**Operational Gold Recovery**	**Weighted Gold Recovery**
Upper Siebert	19.3%	61.0%	11.8%
Lower Siebert	80.7%	75.8%	61.2%
Weighted Average Gold Recovery			**72.9%**
Hasbrouck Deposit Silver Recovery			
McClelland 3/8" Recovery			13%
Operational Deduction			-2%
Predicted Operational Silver Recovery			**11%**

Table 13.21 Hasbrouck and Three Hills Predicted Reagent Consumptions

Reagents	Amount
Hasbrouck Cement Consumption	5 lb/ton
Hasbrouck Lime Consumption	N/A
Hasbrouck NaCN Consumption	0.75 lb/ton
Three Hills Cement Consumption	N/A
Three Hills Lime Consumption	4 lb/ton
Three Hills NaCN Consumption	0.45 lb/ton

14.0 MINERAL RESOURCES

14.1 Introduction

Mineral Resource estimation described in this section for the Three Hills and Hasbrouck deposits follows the guidelines of Canadian Instrument 43-101 ("NI 43-101"). The modeling and estimation of gold and silver resources were done under the supervision of Paul G. Tietz, a qualified person under NI 43-101 with respect to mineral resource estimation. Mr. Tietz is independent of West Kirkland by the definitions and criteria set forth in NI 43-101; there is no affiliation between Mr. Tietz and West Kirkland except that of an independent consultant/client relationship.

MDA classifies resources in order of increasing geological and quantitative confidence into Inferred, Indicated, and Measured categories to be in compliance with the "CIM Definition Standards - For Mineral Resources and Mineral Reserves" (2014), where:

Mineral Resource

Mineral Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.

A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction.

The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.

Material of economic interest refers to diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal, and industrial minerals.

The term Mineral Resource covers mineralization and natural material of intrinsic economic interest which has been identified and estimated through exploration and sampling and within which Mineral Reserves may subsequently be defined by the consideration and application of Modifying Factors. The phrase 'reasonable prospects for eventual economic extraction' implies a judgment by the Qualified Person in respect of the technical and economic factors likely to influence the prospect of economic extraction. The Qualified Person should consider and clearly state the basis for determining that the material has reasonable prospects for eventual economic extraction. Assumptions should include estimates of cutoff grade and geological continuity at the selected cut-off, metallurgical recovery, smelter payments, commodity price or product value, mining and processing *method and mining, processing and general and administrative costs. The Qualified Person should state if the assessment is based on any direct evidence and testing.*

Interpretation of the word 'eventual' in this context may vary depending on the commodity or mineral involved. For example, for some coal, iron, potash deposits and other bulk minerals or commodities, it may be reasonable to envisage 'eventual economic extraction' as covering time periods in excess of 50 years. However, for many gold deposits, application of the concept would normally be restricted to perhaps 10 to 15 years, and frequently to much shorter periods of time.

Inferred Mineral Resource

An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.

An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

An Inferred Mineral Resource is based on limited information and sampling gathered through appropriate sampling techniques from locations such as outcrops, trenches, pits, workings and drill holes. Inferred Mineral Resources must not be included in the economic analysis, production schedules, or estimated mine life in publicly disclosed Pre-Feasibility or Feasibility Studies, or in the Life of Mine plans and cash flow models of developed mines. Inferred Mineral Resources can only be used in economic studies as provided under NI 43-101.

There may be circumstances, where appropriate sampling, testing, and other measurements are sufficient to demonstrate data integrity, geological and grade/quality continuity of a Measured or Indicated Mineral Resource, however, quality assurance and quality control, or other information may not meet all industry norms for the disclosure of an Indicated or Measured Mineral Resource. Under these circumstances, it may be reasonable for the Qualified Person to report an Inferred Mineral Resource if the Qualified Person has taken steps to verify the information meets the requirements of an Inferred Mineral Resource.

Indicated Mineral Resource

An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.

Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation.

An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.

Mineralization may be classified as an Indicated Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such as to allow confident interpretation of the geological framework and to reasonably assume the continuity of mineralization. The Qualified Person must recognize the importance of the Indicated Mineral Resource category to the advancement of the feasibility of the project. An Indicated Mineral Resource estimate is of sufficient quality to support a Pre-Feasibility Study which can serve as the basis for major development decisions.

Measured Mineral Resource

A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit.

Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation.

A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be converted to a Proven Mineral Reserve or to a Probable Mineral Reserve.

Mineralization or other natural material of economic interest may be classified as a Measured Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such that the tonnage and grade or quality of the mineralization can be estimated to within close limits and that variation from the estimate would not significantly affect potential economic viability of the deposit. This category requires a high level of confidence in, and understanding of, the geology and controls of the mineral deposit.

Modifying Factors

Modifying Factors are considerations used to convert Mineral Resources to Mineral Reserves. These include, but are not restricted to, mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors.

MDA reports resources at cutoffs that are reasonable for deposits of this nature given anticipated mining methods and plant processing costs, while also considering economic conditions, because of the regulatory requirements that a resource exists "in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction."

Although MDA is not an expert with respect to any of the following factors, MDA is not aware of any unusual environmental, permitting, legal, title, taxation, socio-economic, marketing, or political factors that may materially affect the Hasbrouck mineral resources as of the date of this report.

14.2 Three Hills Deposit

The Three Hills deposit was modeled and estimated by evaluating the drill data statistically, interpreting mineral domains on cross sections and then orthogonal "long" sections, analyzing the modeled mineralization statistically to establish estimation parameters, and estimating gold grades into a three-dimensional block model. All modeling of the Three Hills resources was performed using Geovia Surpac^{TM} software (version 6.6).

The effective date of the Three Hills mineral resource estimate is August 4, 2014.

14.2.1 Three Hills Data

A geologic model for estimating the gold resources at Three Hills was created from drilling data generated by historic operators, over a period from 1974 through 2013. The Three Hills deposit mineral resource reported in this technical report is based on project drill database consisting of 291 drill holes totaling 88,199ft. The large majority of the drilling (273 total holes for 82,787ft) has been by some form of rotary percussion drilling (reverse circulation, rotary, air track). Eighteen diamond core holes for 5,412ft have been drilled on the project.

The Three Hills drill-hole assay database contains 14,884 gold assays, and 6,934 silver assays. Due to the generally low silver values, and subsequent minor impact on projected economics, only gold was estimated in the current resource. All less-than-detection values were converted to "0" for use in the resource estimate.

The geology database includes drill-hole lithology and alteration data. Project digital topography was provided by West Kirkland. These data were incorporated into a digital database using State Plane coordinates, Nevada West zone, NAD83 datum, expressed in US Survey feet.

West Kirkland drilled three core holes for geotechnical purposes, ten RC exploration holes, and one water well which was logged and sampled for assay, in 2014. These drill data was received by MDA after completion of the current resource estimate. MDA reviewed the data and determined that the 2014 drilling would have no material impact on the resource model or estimate.

14.2.2 Deposit Geology Pertinent to Resource Modeling

Three Hills mineralization is contained primarily within the outcropping Siebert Formation with limited mineralization in the underlying Fraction Tuff. The Siebert Formation consists of interlayered siltstones, sandstones, conglomerates, and tuffs and the coarser, more permeable sandstones and conglomerates are generally pervasively silicified and are the preferred hosts for gold mineralization at Three Hills. The higher gold grades are associated with discontinuous, irregular 0.05- to 0.5inch-wide veinlets, vein stockworks, and erratic breccia veins of chalcedony and quartz.

The sub-horizontal to east-dipping contact between the Siebert and Fraction Tuff contains consistently higher grades of gold and is more commonly argillized than silicified. This contact zone controls mineralization lateral to the core of the deposit.

The drill-defined extent of Three Hills gold mineralization is approximately 1,000ft east–west by 2,700ft north–south with a maximum depth of 500ft along the down-dip eastern edge of the deposit. Mineralization remains open at depth to the east and southeast along the Siebert-Fraction contact.

The Three Hills deposit is pervasively oxidized to the base of the drill-defined mineralization.

The water table was not encountered in drilling and the resource is considered to be above the water table for future mine development.

14.2.3 Three Hills Geologic Model

A cross-sectional geologic model of the Three Hills deposit was created by MDA that consisted of a total of 29 vertical, north-looking cross sections spaced at 100ft intervals across the deposit.

Using the interpreted drill data, along with the surface geology, the geologic model included the wallrock lithologies, with all apparent structural offsets, and the zones of moderate to strong silicification. The modeled lithologies included the Siebert Formation (Ts), the Fraction Tuff (Tf), the Brougher Rhyolite (Tbrt), and the Oddie Rhyolite (To). The resulting cross-sectional model was used as a template to guide the mineral-domain modeling (discussed below).

The lithology cross-sectional polygons were converted into 3-dimensional solids which were used to code the block model on a block-in, block-out basis. The silicification polygons were three-dimensionally rectified to the drill data and vertical slices of the polygons were created at 20ft intervals orthogonal to the cross sections. The silicification zones were then modeled on 20ft-spaced long sections used to code the block model also on a block-in, block-out basis. The lithology solids and long-section silicification polygons were used to assign density values to the block model (see Section 14.2.6 for details on the block model density).

14.2.4 Mineral-Domain Grade Model

The gold mineral domains were modeled on the same 29 east-west cross-sections as the geologic model. In order to define the mineral domains, the natural populations were first identified on quantile graphs that plot the gold-grade distributions of the drill-hole assays. This analysis led to the identification of low- (~0.004 to ~0.015 oz Au/ton), medium- (~0.015 to 0.04oz Au/ton), and high-grade (>~0.04 oz Au/ton) gold populations, assigned to domains 100, 200, and 300, respectively.

The drill-hole traces, topographic profile, and the lithology/alteration geologic interpretations were plotted on the sections with gold assays (colored by the grade-domain population ranges) plotted along the drill-hole traces, and these data were used as the base for MDA's interpretations of the mineral domains. Mineral-domain envelopes were interpreted on the sections to more-or-less capture assays corresponding approximately to each of the defined grade populations.

Due to inconsistencies in the geologic logs of the historic RC holes, as well as the fact that essentially all subsurface geologic information is derived from RC chips, it was difficult to correlate the three mineral domains to specific geologic characteristics. In a general sense, medium-grade zones of mineralization (domain 200) typically are associated with moderate to strong pervasively silicified Siebert Formation, often containing thin silica veinlets. While high-grade assays occur both within narrow mineralized structural breccias that extend up into the Siebert and within the base of the Siebert just above the contact with the Fraction Tuff. The low-grade (domain 100) zones envelope the domain 200 mineralization, but they extend progressively further laterally away from the within the breccia,

Representative cross sections showing gold mineral-domain interpretations are in Figure 14.1 and Figure 14.2.

The cross-sectional mineral-domain polygons were digitized and then three-dimensionally rectified to the drill data. Vertical slices of the polygons were created at 20-foot intervals orthogonal to the cross sections, and the mineral domains were then modeled on 20-foot-spaced long sections. The final product of the long-section work is a set of 20-foot-spaced mineral-domain envelopes that three-dimensionally honor the drill data at the resolution of the block model.

Figure 14.1 Three Hills Section 13821570 Showing Geology and Gold Mineral Domains, Looking North
(location of Section shown in Figure 7.8)

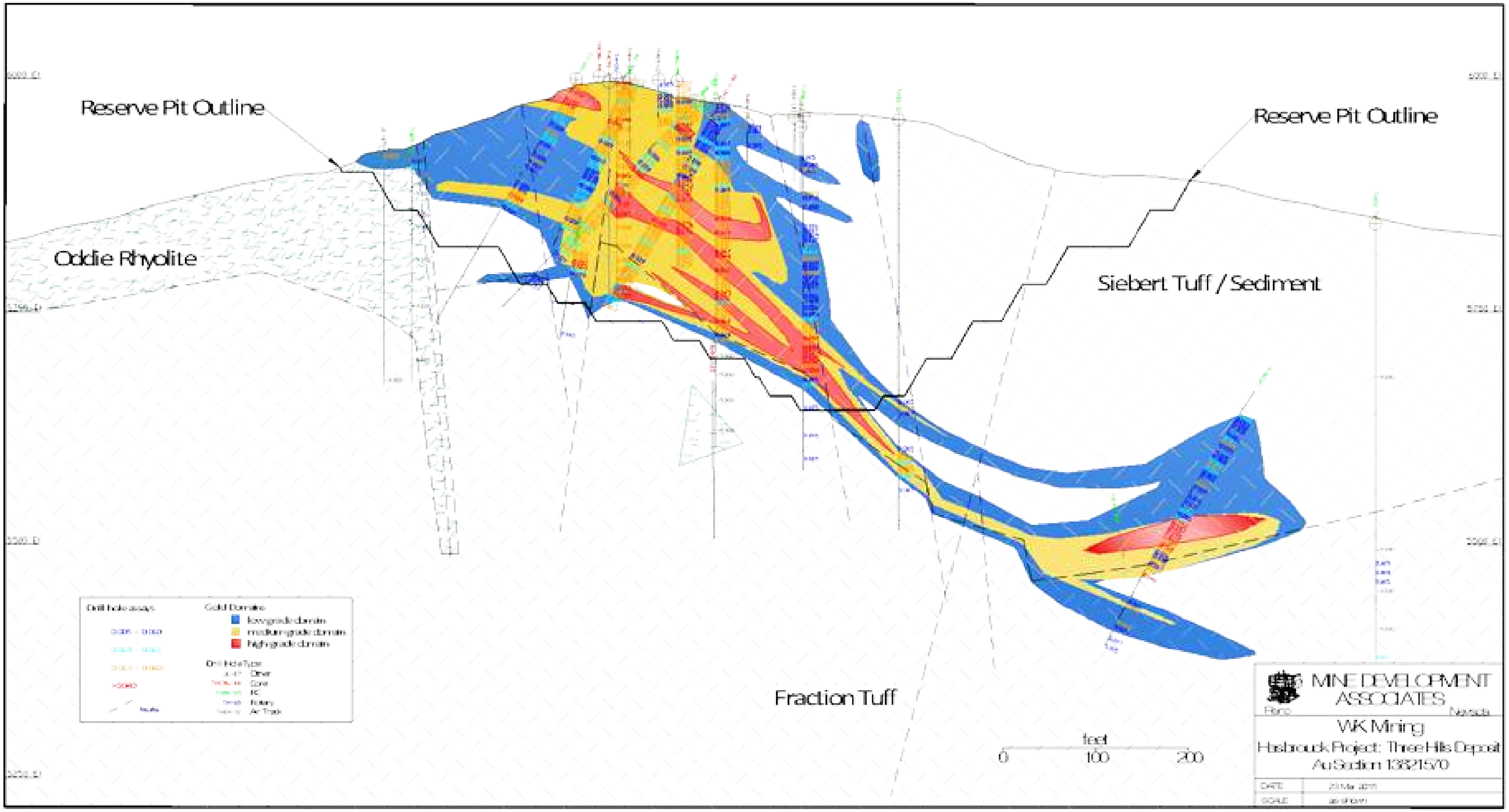
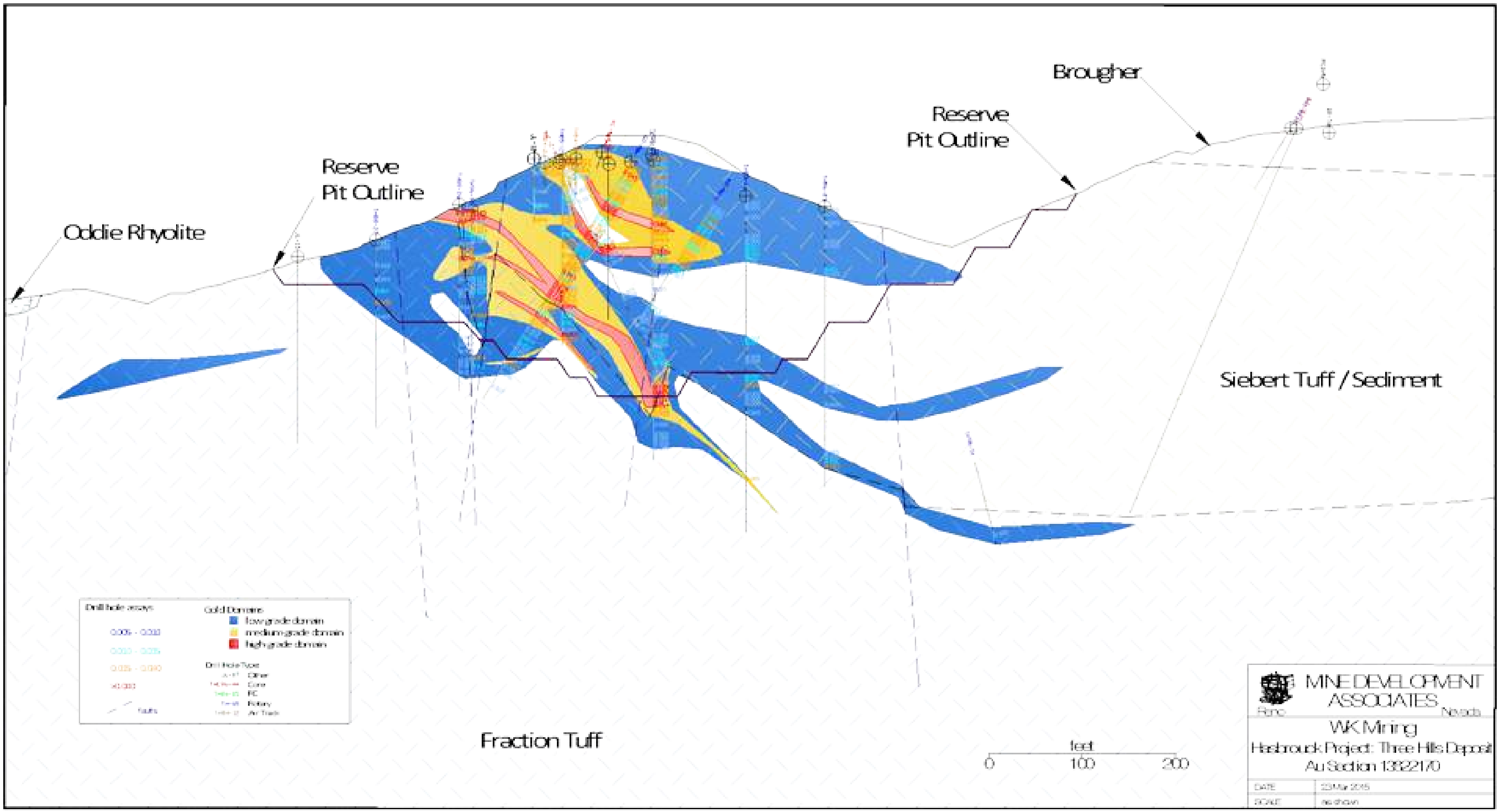


Figure 14.2 Three Hills Section 13822170 Showing Geology and Gold Mineral Domains, Looking North
(location of Section shown in Figure 7.8)



14.2.5 Three Hills Sample Coding and Compositing

Drill-hole assays were coded by the sectional mineral-domain polygons. MDA analyzed the assay data and capped a total of 11 individual metal analyses which were statistically and spatially deemed beyond a given domain's natural population of samples. This number of samples capped represents approximately 0.25% of the total domain-coded assay values within the database. The capped analyses occur within all grade ranges and all estimation areas. Descriptive statistics of the uncapped and capped sample grades by domain are presented in Table 14.1.

Compositing was made at 20ft down-hole lengths, honoring all mineral domain boundaries. Length-weighted composites were used in the block-model grade estimation and the volume inside each mineral domain was estimated using only composites from inside that domain. Composite descriptive statistics for the metal domains are presented in Table 14.2.

Table 14.1 Three Hills Mineral Domain Assay Statistics

Domain	Assays	Count	Mean (oz Au/ton)	Median (oz Au/ton)	Std. Dev.	CV	Min. (oz Au/ton)	Max. (oz Au/ton)	# Capped
100	Au	2517	0.008	0.006	0.006	0.780	0.000	0.122	4
	Au Cap	2517	0.008	0.006	0.005	0.680	0.000	0.050	
200	Au	1566	0.022	0.020	0.013	0.560	0.000	0.259	3
	Au Cap	1566	0.022	0.020	0.011	0.480	0.000	0.090	
300	Au	413	0.093	0.060	0.137	1.470	0.012	1.607	4
	Au Cap	413	0.088	0.060	0.097	1.090	0.012	0.700	
All	*Au*	*4496*	*0.021*	*0.011*	*0.048*	*2.350*	*0.000*	*1.607*	*11*
	Au Cap	*4496*	*0.020*	*0.011*	*0.037*	*1.870*	*0.000*	*0.700*	

Table 14.2 Three Hills Mineral Domain Composite Statistics

Domain	Count	Mean (oz Au/ton)	Median (oz Au/ton)	Std. Dev.	CV	Min. (oz Au/ton)	Max. (oz Au/ton)
100	848	0.008	0.007	0.004	0.47	0.000	0.035
200	572	0.022	0.021	0.007	0.33	0.000	0.053
300	187	0.088	0.064	0.072	0.82	0.017	0.700
All	*1607*	*0.020*	*0.012*	*0.032*	*1.59*	*0.000*	*0.700*

14.2.6 Density

The density database consists of 112 density measurements on core samples collected during the 1996 and 2013 core drilling programs. The samples were from all significant rock types and gold grade ranges, and the procedures used the water immersion method.

MDA analyzed the data and the general statistics by modeled rock type and gold mineral domain. After reviewing the data, two samples were removed due to spurious results. The tonnage factor statistics (in cuft/ton units) for the remaining 110 samples are shown in Table 14.3. Due to the often highly fractured nature of the deposit, and the fact that voids resulting from many of the open fractures cannot be accurately reflected in density determinations, the measured density values were factored up by 1% to 2% to account for the unavoidable sample-selection bias. The factored data, shown in the "Model TF" column in Table 14.3, reflect the actual tonnage factor values assigned to the Three Hills block model.

Table 14.3 Descriptive Statistics of Three Hills Tonnage Factor (ft^3/ton) Values by Rock Type

Rock Type	Count	Mean	Median	Min.	Max.	Std.Dev.	Model TF
Tbrt	1	14.43	14.43	14.43	14.43		14.60
To	23	14.48	14.53	13.60	15.25	0.45	14.65
Tf	21	15.56	15.34	14.12	17.12	0.90	15.60
Ts (non-silic)	27	15.98	15.66	14.34	18.09	1.02	16.00
Ts (silic)	27	14.30	14.12	12.62	16.27	0.95	14.50
100200300 (non-silic)	11	15.33	15.10	13.93	17.47	0.98	15.50

14.2.7 Three Hills Block Model Coding

The 20ft-spaced long-sectional mineral-domain polygons were used to code a north-south three-dimensional block model that is comprised of 20ft (width) x 20ft (length) x 20ft (height) blocks. In order for the block model to better reflect the irregularly shaped limits of the various gold domains, as well as to explicitly model dilution, the percentage volume of each mineral domain within each block is stored (the "partial percentages").

Lithology and silicification are coded into the block model on a block-in/block-out basis. The percentage of each block that lies below the topographic surface is also stored. Each block is assigned a tonnage factor listed on Table 14.3 based on its coded lithology, silicification, and mineral domain.

14.2.8 Resource Model and Estimation

The resource estimate reflects the general northerly trend and variably east-dipping nature of the Three Hills gold mineralization. To replicate the change in orientation observed within the deposit, two search-ellipse orientations were used to control the resource estimate. The first orientation (designated Area 10) represents the generally horizontal nature of the near-surface, low- and mid-grade mineralization within the Siebert Formation. The second orientation area (Area 20) is coded into the block model using a solid and represents the deeper mineralization that occurs along the east-dipping Siebert/Fraction Tuff contact. See Table 14.4 for the search ellipse parameters.

Table 14.4 Three Hills Search Ellipse Orientations

Est. Area	Azimuth	Plunge	Tilt
10	0	0	0
20	0	0	-35

Grade interpolation utilized Inverse Distance Cubed (ID3), with nearest neighbor and ordinary kriging estimates also being made for checking estimation results and sensitivities. Variography and geostatistical evaluations were made to determine distances for search and classification criteria. The estimation parameters applied at Three Hills are summarized in Table 14.5. The estimation used two search passes with successive passes not overwriting previous estimation passes. The first-pass search distances take into consideration the results of both the variography and drill-hole spacing. The second pass was designed to estimate grade into all blocks coded to the mineral domains that were not estimated in the first pass.

The estimation passes were performed independently for each of the mineral domains, so that only composites coded to a particular domain were used to estimate grade into blocks coded by that domain. The estimated grades were coupled with the partial percentages of the mineral domains to enable the calculation of a single weight-averaged block-diluted grade for each block.

Table 14.5 Summary of Three Hills Estimation Parameters

Estimation Parameters: Gold Domains 100+200+300

Estimation Pass	Search Ranges (ft)			Comp Constraints		
	Major	Semi-Major	Minor	Min	Max	Max/hole
1 (area 10)	200	150	100	2	15	3
1 (area 20)	200	133	67	2	15	3
2	500	500	500	1	18	3

14.2.9 Three Hills Mineral Resources

MDA classified the Three Hills resources by a combination of distance to the nearest sample and the number of samples, while at the same time taking into account reliability of underlying data and understanding and use of the geology (Table 14.6). There are no Measured Resources due to the general lack of QA/QC data that could be used for verification purposes and to some uncertainties related to historic drill hole locations. Indicated Resources are limited to the near-surface, north-south core of the deposit. The mineralization at depth along the east side of the deposit and the scattered mineralization to the northwest are considered Inferred only.

Table 14.6 Three Hills Classification Parameters

Class	Estimation Pass	Min. Number of Drill holes	Min. Number of Composite	Avg. Dist. to Nearest 2 Composites
Indicated*	1	2	2	100
Inferred	all other modeled mineralization			
*only within north-south oriented center of deposit				

The Three Hills mineral resources are inclusive of reserves and listed in Table 14.7 using a cutoff grade of 0.005 oz Au/ton. The cutoff was chosen to capture mineralization potentially available to open-pit extraction and heap-leach processing. The block-diluted resources are also tabulated at additional cutoffs in order to provide grade-distribution information, as well as to provide for economic conditions other than those envisioned by the 0.005 oz Au/ton cutoff (Table 14.8). Three Hills resources have an effective date of August 4, 2014.

Figure 14.3 and Figure 14.4 show cross sections of the block model that correspond to the mineral-domain cross sections in Figure 14.1 and Figure 14.2, respectively.

Table 14.7 Three Hills Reported Mineral Resources (0.005oz Au/ton Cutoff)

Class	Tons	oz Au/ton	oz Au
Indicated	10,897,000	0.017	189,000
Inferred	2,568,000	0.013	32,000

Note: rounding may cause apparent inconsistencies

Table 14.8 Three Hills Mineral Resources

Cutoff	Indicated Resource		
(oz Au/ton)	Tons	oz Au/ton	oz Au
0.004	11,593,000	0.017	192,000
0.005	***10,897,000***	***0.017***	***189,000***
0.006	10,034,000	0.018	185,000
0.007	9,098,000	0.020	179,000
0.008	8,157,000	0.021	173,000
0.009	7,355,000	0.023	166,000
0.010	6,689,000	0.024	160,000
0.012	5,771,000	0.026	151,000
0.015	4,838,000	0.029	138,000
0.020	3,385,000	0.034	114,000

Cutoff	Inferred Resource		
(oz Au/ton)	Tons	oz Au/ton	oz Au
0.004	3,113,000	0.011	34,000
0.005	***2,568,000***	***0.013***	***32,000***
0.006	2,087,000	0.014	30,000
0.007	1,683,000	0.016	27,000
0.008	1,318,000	0.019	25,000
0.009	1,046,000	0.022	23,000
0.010	858,000	0.024	21,000
0.012	615,000	0.030	18,000
0.015	402,000	0.039	16,000
0.020	200,000	0.062	12,000

Figure 14.3 Three Hills Section 13821570 Showing Block Model Gold Grades, Looking North

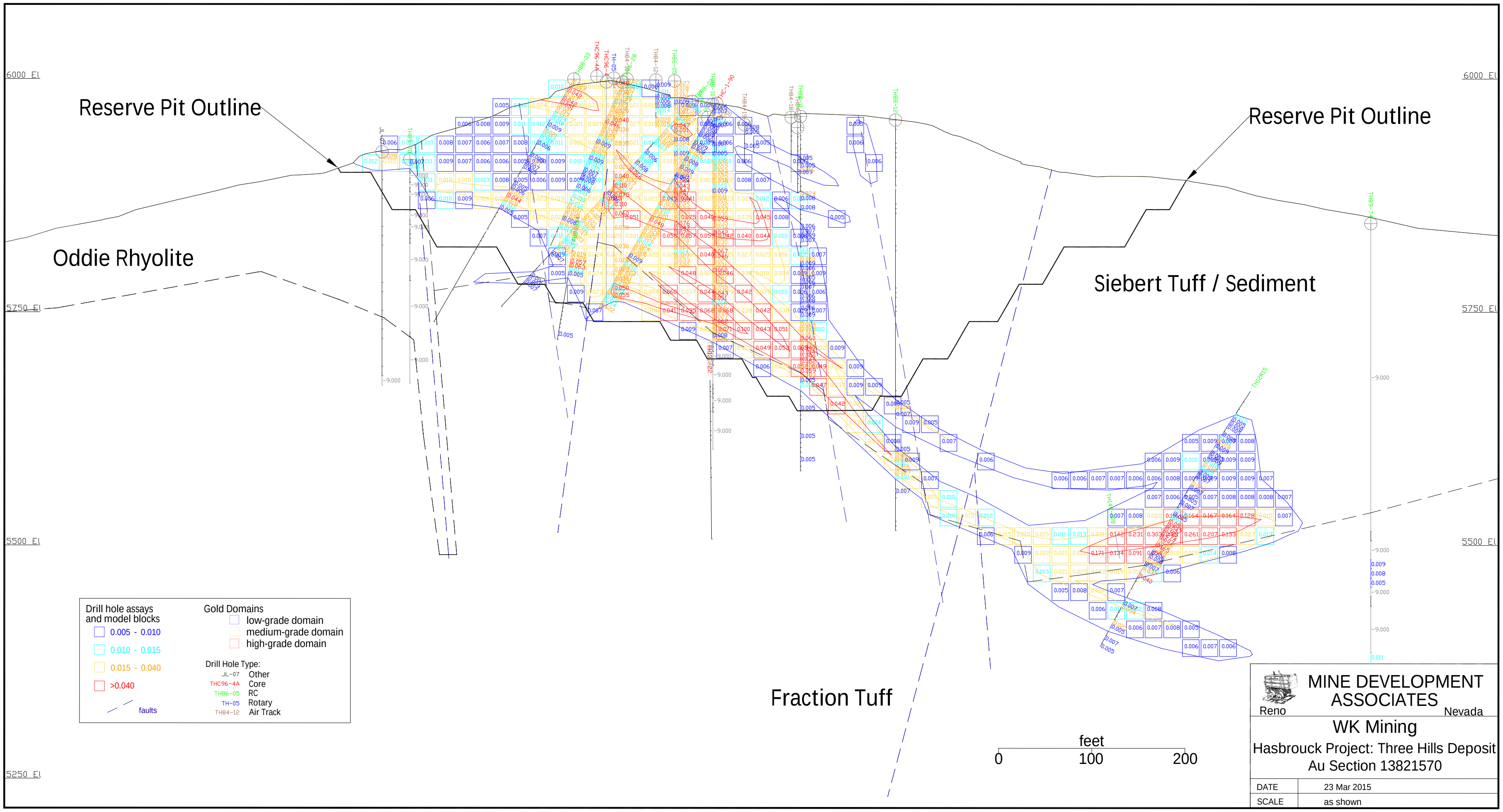
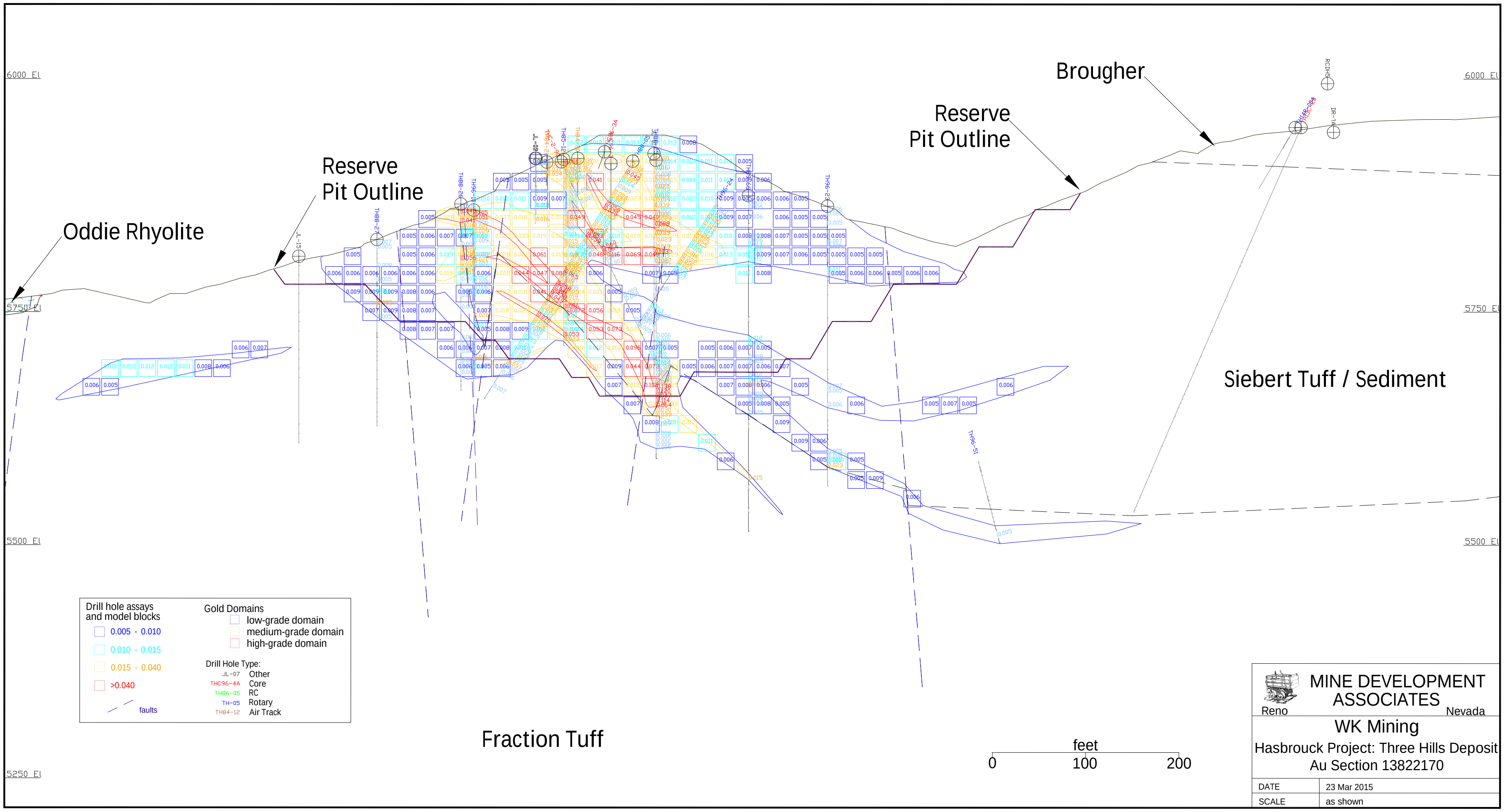


Figure 14.4 Three Hills Section 13822170 Showing Block Model Gold Grades, Looking North



14.2.10 Model Checks

Volumes indicated by the sectional mineral-domain modeling were compared to the long-section volumes and those coded to the block model to assure close agreement, and all block-model coding was checked visually on the computer. Nearest-neighbor and ordinary-krige estimates of the Three Hills resources were undertaken as a check on the inverse-distance-cubed resource model. Grade-distribution plots of assays and composites versus the nearest-neighbor, krige, and inverse-distance block grades were also evaluated as a check on the estimation. Finally, the inverse-distance grades were visually compared to the drill-hole assay data to assure that reasonable results were obtained.

14.2.11 Comments on the Three Hills Resource Modeling

The Three Hills gold resource is based on drill-sample analyses, density measurements, logged silicification content, and lithologic and structural geologic contacts. At a 0.005oz Au/ton cutoff, Three Hills mineralization consists of a single, irregularly shaped deposit that extends for more than 2,700ft north-south and 1,000ft east-west. Mineralization remains open at depth to the east and southeast along the Siebert-Fraction contact.

Mineralization at Three Hills is similar in style to that at Hasbrouck, though the degree and spatial extent of silicification and brecciation/veining is smaller and generally not as well developed.

There are no Measured resources at Three Hills due to a general lack of QA/QC data that could be used for verification purposes and to some uncertainties related to historic drill hole locations. Indicated resources are limited to the near-surface, north-south core of the deposit.

The core of the deposit is relatively well-defined and infill drilling is not expected to materially change the current resource model and estimate. Additional drilling on the periphery of the deposit, including following up on the 2014 drill program completed by West Kirkland on the southeast edge of the deposit, has the potential to upgrade the classification of the existing Inferred resource and to expand the resource to the east and southeast.

14.3 Hasbrouck Deposit

The Hasbrouck deposit was modeled and estimated by evaluating the drill data statistically, interpreting mineral domains on cross sections and then level plans, analyzing the modeled mineralization statistically to establish estimation parameters, and estimating gold and silver grades into a three-dimensional block model. All modeling of the Hasbrouck resources was performed using Geovia Surpac^{TM} software, version 6.6.

The effective date of the Hasbrouck deposit mineral resource estimate is November 3, 2014.

14.3.1 Data

A geologic model for estimating the gold and silver resources at Hasbrouck was created from drilling data generated by historic operators, over a period from 1974 through 2012. The Hasbrouck deposit mineral resource reported in this technical report is based on project drill database consisting of 317 drill holes totaling 216,761ft. The large majority of the drilling (252 total holes for 179,174ft) has been by reverse circulation (RC) while 43 diamond core holes for 28,607ft and 22 air-track holes for 8,980ft have also been drilled on the project.

The Hasbrouck drill-hole assay database contains 42,150 gold assays, and 42,143 silver assays. Both gold and silver were estimated in the current resource. Also included in the database are 14,201 gold and 13,782 silver cyanide leach analyses though a unique cyanide leach model was not complete at Hasbrouck. All less-than-detection values were converted to "0" for use in the resource estimate.

The database includes the 191 underground samples collected by Cordex in 1980 from the Main, Ore Car, South, and Northeast adit underground workings. These data have been used to guide the development of the geology and gold mineral model, but the gold and silver assay data has not been used in the estimation of mineral resources presented in this Technical Report because of lack of knowledge of collection technique and the inability to verify assay values.

The geology database includes drill-hole lithology and alteration data. Project digital topography was provided by West Kirkland. These data were incorporated into a digital database using State Plane coordinates, Nevada West zone, NAD83 datum, expressed in US Survey feet.

West Kirkland drilled 14 RC exploration holes located south, southeast, and north of the current resource model in 2014. These drill data was received by MDA after completion of the current resource estimate. MDA reviewed the data and determined that the 2014 drilling would have no material impact on the resource model or estimate.

14.3.2 Deposit Geology Pertinent to Resource Modeling

The precious metals mineralization at Hasbrouck is concentrated within the Siebert Formation, stratigraphically below the chalcedonic sinter horizons that outcrop near the peak of Hasbrouck Mountain.

The upper portion of the Siebert Formation is dominated by volcaniclastic sedimentary rocks, mostly sandstones and conglomerates. Beneath Hasbrouck Mountain, the upper Siebert has a maximum thickness of about 300ft and the base of the upper Siebert is generally marked at the bottom of the lower-most conglomerate. The lower portion of the Siebert Formation consists predominantly of various lithic, crystal and lapilli ash-flow units with interbedded volcaniclastic sedimentary units, primarily sandstone and siltstone. The lower Siebert lithologies outcrop along drill roads along the north, east, and south flanks of Hasbrouck Mountain. The upper/lower Siebert contact is not a smooth plane but is disrupted by numerous north-south and northwest-directed faults that have 50 to 100ft of apparent vertical offset.

The mineralization at Hasbrouck is accompanied by strong pervasive silicification, with associated adularia and pyrite, within both the volcaniclastic rocks and tuffaceous units of the Siebert Formation. Pervasive silicification and hydrothermal brecciation/veining is common within the upper Siebert and the top of the lower Siebert. Silicification and veining decreases and becomes more structurally-controlled at depth within the lower Siebert tuffaceous and fine-grained sedimentary rocks. Argillic alteration, characterized by the presence of illite and montmorillonite, forms an envelope around the silicified and mineralized zones and is most common in the lower Siebert tuffaceous rocks.

The Kernick structure, which was the focus of the historic underground production at Hasbrouck, strikes roughly east-west across Hasbrouck Mountain and dips to the north. Although the Kernick structural zone itself is mineralized, the bulk of the mineralization in the deposit occurs in the hanging wall of the structure and consists principally of millimeter- to centimeter-scale, discontinuous silica-pyrite veinlets, sheeted veinlets and stockworks, all closely associated with multiple, larger and coalesced, but erratic bodies of hydrothermal breccias. The sheeted vein and enclosing hydrothermal breccias are interpreted to be dominantly near-vertical, west-northwest trending zones. Stratigraphic control, whereby the porous volcaniclastic units are preferentially mineralized, is prevalent throughout the deposit but is especially evident in many of the moderate-grade zones along the peripheries of the deposit. A minor amount of mineralization lies in the footwall of the Kernick structure, along what are interpreted to be smaller, subsidiary structural zones.

At a 0.006oz Au/ton cutoff, Hasbrouck mineralization consists of a single, irregularly shaped deposit that extends for more than 2,500ft in an east-west and about 2,400ft in a north-south direction. The silver mineralization outline at a 0.25oz Ag/ton cutoff is similar to the gold outline, although it is somewhat less extensive. Mineralization remains open at depth along the intersection of the cross-cutting structural fabrics. However, deeper drilling into the Fraction Tuff has yet to intersect significant mineralization.

Oxidation: The Hasbrouck mineralization is predominantly oxidized though isolated zones of minor (<1 percent sulfide) remnant sulfides can occur throughout the deposit. The partially oxidized sulfidic mineralization is generally associated with areas of strong pervasive silicification or within thin silica veins. Due to the irregular and varying nature of oxidation, and also the irregular distribution of the cyanide leach data, a unique oxidation model was not completed.

As discussed in Section 13.0, metallurgical tests indicate that the upper and lower Siebert have different gold extraction characteristics possibly related to the degree of silicification within these two stratigraphic horizons.

Groundwater: The water table was not encountered in drilling. The resource is considered to be above the water table and ground water is not expected to be a factor in future mine development.

14.3.3 Lithology/Alteration Model

A cross-sectional lithologic/structural model of the Hasbrouck deposit was created by MDA based on north-looking cross sections spaced at 100-foot intervals.

Using the interpreted drill data, along with the surface geology, the lithology model included the wallrock lithologies, with all apparent structural offsets. The modeled lithologies included the upper and lower portions of the Siebert Formation (Tsus and Tslt, respectively), the Fraction Tuff (Tf), and the young Tertiary volcanics/sinter/Quaternary colluvium unit which overlie the Siebert Formation in the west-center portion of Hasbrouck hill. These post-Siebert lithologies are a small, fault-bounded erosional remnant that appears to be post-mineral. The lower portion of the Siebert Formation was not explicitly modeled but is considered the "default" lithology within the model.

The volcaniclastic-dominant upper Siebert Formation and Fraction Tuff lithology cross-sectional polygons were converted into 3-dimensional solids which were used to code the block model.

Using the lithology solids as a guide, zones of moderate to strong silicification were modeled on 28 west-looking cross-sections spaced at 100-foot intervals with the spacing decreasing to 50-foot within the west-center of the deposit. The resulting cross-sectional model was used as a template to guide the mineral-domain modeling (discussed below).

The Tertiary volcanic/Quaternary alluvium and silicification polygons were three-dimensionally rectified to the drill data and vertical slices of the polygons were created orthogonal to the cross sections. The volcanic and silicification zones were then modeled on 10-foot- and 20-foot-spaced level plans, respectively, used to code the block model. The lithology solids and level plans were used to assign density values to the block model (see Section 14.3.6 for details on the block model density).

14.3.4 Mineral-Domain Grade Model

A mineral domain is a natural grade population of a metal that occurs within a specific geologic setting. In order to define the mineral domains, the natural populations were first identified on quantile graphs that plot the metal-grade distributions of the drill-hole assays. This analysis led to the identification of low- (~0.004 to ~0.015 oz Au/ton), medium- (~0.015 to 0.07oz Au/ton), and high-grade (>~0.07 oz Au/ton) gold populations, assigned to domains 100, 200, and 300, respectively. Two silver populations were identified, low (~0.25 to ~1.0oz Ag/ton) and medium (>~1.0oz Ag/ton), assigned to domains 100 and 200, respectively. Ideally, each of these populations can be correlated with specific geologic characteristics that are captured in the project database to aid in the definition of the mineral domains.

The gold and silver mineral domains were modeled on the same west-looking cross-sections as the silicification model. The drill-hole traces, topographic profile, and the lithology/alteration geologic interpretations were plotted on the sections with gold and silver assays (colored by the grade-domain population ranges) plotted along the drill-hole traces, and these data were used as the base for MDA's interpretations of the mineral domains. Mineral-domain envelopes for each metal were interpreted on the sections to more-or-less capture assays corresponding approximately to each of the defined grade populations.

In a general sense, medium-grade zones of mineralization (gold domain 200) typically are associated with moderate to strong pervasively silicified Siebert Formation, often containing thin silica veinlets. The silicified Siebert occurs wallrock to the high-grade mineralization (gold domain 300) which occurs primarily within narrow, near-vertical mineralized structural breccias or zones of that extend up through the Siebert. The low-grade (domain 100) zones envelope the domain 200 mineralization, but they extend progressively further laterally away from the within the breccia. In general, the low-grade silver domain is spatially associated with the mid-grade gold domain while mid-grade silver domain 200 is associated with the high-grade gold domain.

Erratic low-grade gold and silver mineralization occurs within the post-mineral lithologies (Tertiary volcanic/Quaternary alluvium) that occur as erosional remnants on the west side of Hasbrouck Mountain. The mineralization within these units occurs primarily as mineralized cobbles and boulders that have eroded off the exposed mineralized Siebert formation. A unique mineral domain (domain 10 for gold and silver) was created so that grade estimation is constrained within this mineral type.

Representative cross sections showing gold mineral-domain interpretations are presented in Figure 14.5 and Figure 14.6.

The cross-sectional mineral-domain polygons were digitized and then three-dimensionally rectified to the drill data. The rectified polygons were sliced at 10-foot vertical intervals and the mineral domains were then modeled on 10-foot-spaced level plans. The final product of the level plan work is a set of 10-foot-spaced mineral-domain envelopes that three-dimensionally honor the drill data at twice the resolution of the 20-foot block model. The 10-foot level plan intervals were chosen to ensure that the occasional thin, sub-horizontal mineral zones are coded into the block model.

Figure 14.5 Hasbrouck Deposit Section 1563300 Showing Geology and Gold Mineral Domain Looking West

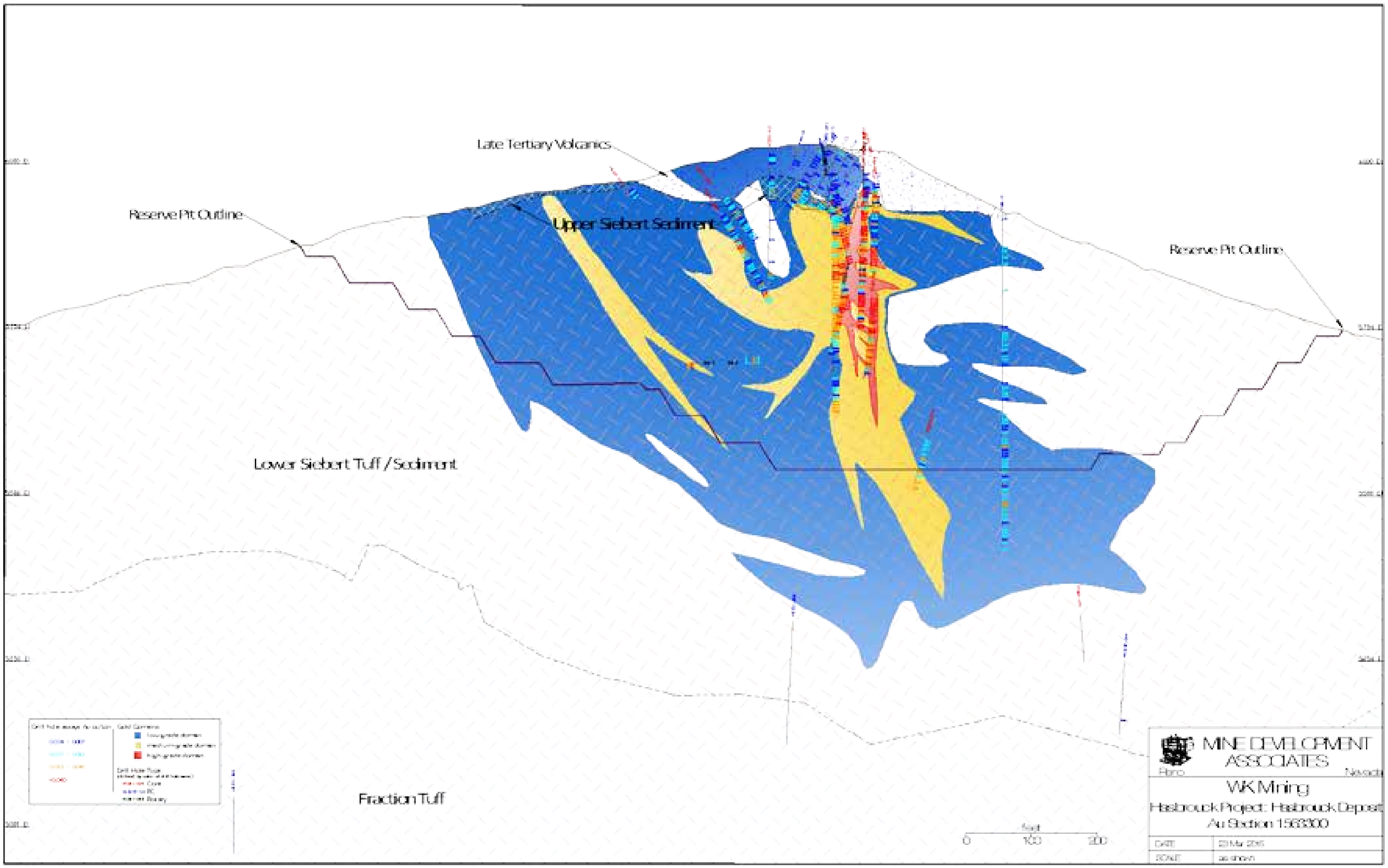
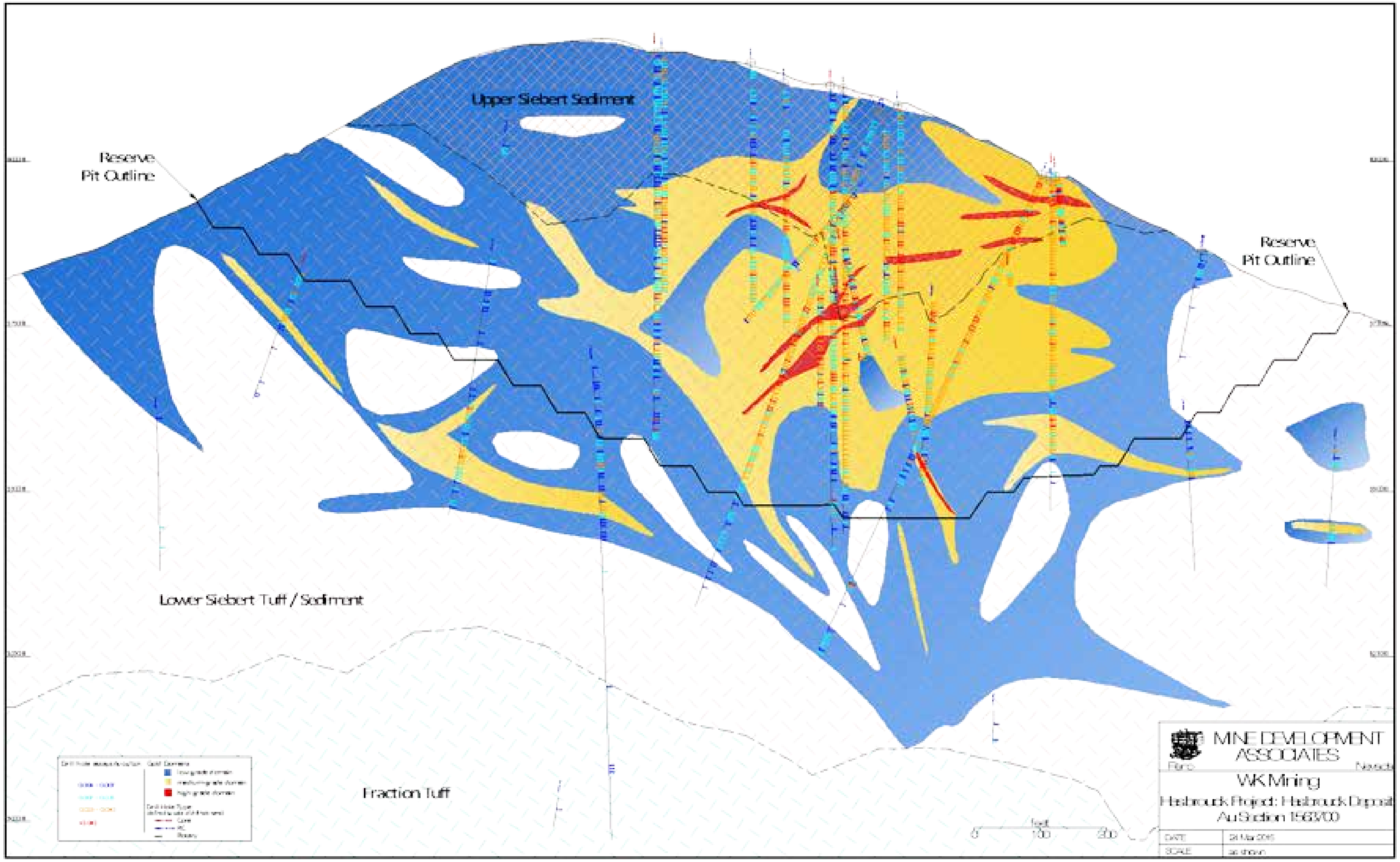


Figure 14.6 Hasbrouck Deposit Section 1563700 Showing Geology and Gold Mineral Domain Looking West



14.3.5 Sample Coding and Compositing

Drill-hole assays were coded by the sectional mineral-domain polygons. MDA analyzed the assay data and capped a total of 24 individual metal analyses which were statistically and spatially deemed beyond a given domain's natural population of samples. This number of samples capped represents less than 0.1% of the total domain-coded assay values within the database. The capped analyses occur within all grade ranges and all estimation areas. Descriptive statistics of the uncapped and capped sample grades by domain are presented in Table 14.9.

Compositing was made at 20ft down-hole lengths, honoring all mineral domain boundaries. Length-weighted composites were used in the block-model grade estimation and the volume inside each mineral domain was estimated using only composites from inside that domain. Composite descriptive statistics for the metal domains are presented in Table 14.10.

Table 14.9 Hasbrouck Mineral Domain Assay Statistics

Domain	Assays	Count	Mean (oz Au/ton)	Median (oz Au/ton)	Std. Dev.	CV	Min. (oz Au/ton)	Max. (oz Au/ton)	# Capped
10	Au	331	0.005	0.003	0.005	1.090	0.000	0.039	
	Au Cap	331	0.005	0.003	0.005	1.090	0.000	0.039	
100	Au	9880	0.007	0.006	0.006	0.880	0.000	0.116	7
	Au Cap	9880	0.007	0.006	0.006	0.860	0.000	0.070	
200	Au	5072	0.025	0.020	0.024	0.970	0.000	0.849	8
	Au Cap	5072	0.024	0.020	0.018	0.760	0.000	0.200	
300	Au	434	0.168	0.097	0.285	1.690	0.000	3.165	7
	Au Cap	434	0.153	0.097	0.173	1.130	0.000	1.000	
All	*Au*	*15717*	*0.017*	*0.009*	*0.054*	*3.220*	*0.000*	*3.165*	22
	Au Cap	*15717*	*0.016*	*0.009*	*0.038*	*2.330*	*0.000*	*1.000*	

Domain	Assays	Count	Mean (oz Ag/ton)	Median (oz Ag/ton)	Std. Dev.	CV	Min. (oz Ag/ton)	Max. (oz Ag/ton)	# Capped
10	Ag	329	0.110	0.080	0.140	1.320	0.000	1.140	
	Ag Cap	329	0.110	0.080	0.140	1.320	0.000	1.140	
100	Ag	8894	0.370	0.320	0.230	0.630	0.000	2.410	
	Ag Cap	8894	0.370	0.320	0.230	0.630	0.000	2.410	
200	Ag	980	1.990	1.340	2.300	1.160	0.000	66.210	2
	Ag Cap	980	1.980	1.340	2.170	1.100	0.000	20.000	
All	*Ag*	*10203*	*0.510*	*0.350*	*0.860*	*1.690*	*0.000*	*66.210*	*2*
	Ag Cap	*10203*	*0.510*	*0.350*	*0.830*	*1.630*	*0.000*	*20.000*	

Table 14.10 Hasbrouck Mineral Domain Composite Statistics

Au Domain	Count	Mean (oz Au/ton)	Median (oz Au/ton)	Std. Dev.	CV	Min. (oz Au/ton)	Max. (oz Au/ton)
10	105	0.004	0.004	0.004	0.790	0.000	0.019
100	2842	0.007	0.007	0.004	0.590	0.000	0.070
200	1481	0.024	0.022	0.012	0.500	0.001	0.165
300	157	0.153	0.105	0.120	0.790	0.027	0.697
All	*4585*	*0.016*	*0.009*	*0.031*	*1.920*	*0.000*	*0.697*

Ag Domain	Count	Mean (oz Ag/ton)	Median (oz Ag/ton)	Std. Dev.	CV	Min. (oz Ag/ton)	Max. (oz Ag/ton)
10	106	0.110	0.080	0.110	1.06	0.000	0.740
100	2547	0.370	0.340	0.180	0.49	0.000	1.310
200	326	1.980	1.440	1.720	0.87	0.300	18.460
All	*2979*	*0.510*	*0.350*	*0.720*	*1.41*	*0.000*	*18.460*

14.3.6 Density

The density database consists of 344 density measurements on core samples collected by Allied Nevada during the 2010 and 2011 core drilling programs. The samples were from all significant rock types and gold grade ranges, and the procedures used the water immersion method.

MDA analyzed the data and the general statistics by modeled rock type and gold mineral domain. After reviewing the data, four samples were removed due to spurious results or potential sampling bias. The tonnage factor statistics (in cuft/ton units) for the remaining 340 samples are shown in Table 14.11. Due to the often highly fractured nature of the deposit, and the fact that voids resulting from many of the open fractures cannot be accurately reflected in density determinations, the measured density values were factored up by 1% to 2% to account for the unavoidable sample-selection bias. The factored data, shown in the “Model TF” column in Table 14.11, reflect the actual tonnage factor values assigned to the Hasbrouck block model.

Table 14.11 Descriptive Statistics of Hasbrouck Tonnage Factor (cuft/ton) by Rock Type

Rock Type	Count	Mean	Median	Min.	Max.	Std.Dev.	Model TF
Tvf/Qal	14	17.15	17.32	12.76	21.08	3.08	17.58
Non-silicified	65	15.94	16.18	12.81	20.15	1.57	16.23
Au_100200300 (non-silic)	60	14.38	13.99	12.61	18.31	1.37	14.35
Silicified	201	13.23	13.08	12.32	17.60	0.77	13.33

14.3.7 Underground Workings

MDA was provided the plan maps of the historic underground workings associated with the Kernick structure (Main adit) along with the more limited workings developed on the SE adit, NE adit and the Ore Car Adit. Modeled solids of the Kernick and Ore Car workings were also provided. MDA used the location of the underground workings to guide the mineral domain modeling and also incorporated the workings into the block model to account for the volume loss. The latter volume loss, although minor at <1% of total deposit volume, is coded into the block model as the percentage of each block containing underground workings or stopes.

14.3.8 Block Model Coding

The 10-foot-spaced level plan mineral-domain polygons were used to code a three-dimensional block model that is comprised of 20 foot (width) x 20 foot (length) x 20 foot (height) blocks. Each 20-foot high block is coded using the average volume of the two 10-foot-spaced levels. In order for the block model to better reflect the irregularly shaped limits of the various gold and silver domains, as well as to explicitly model dilution, the percentage volume of each mineral domain within each block is stored (the "partial percentages").

Lithology and silicification are coded into the block model on a block-in/block-out basis. The block model also contains a "rock_pct" attribute that is the percentage of each block that lies below the topographic surface minus the percentage of each block containing underground workings or stopes.

Each block is assigned a tonnage factor listed on Table 14.11 based on its coded lithology, silicification, and mineral domain.

14.3.9 Resource Model and Estimation

The resource estimate reflects the general west-northwest trend and variably-dipping nature of the Hasbrouck gold mineralization. To replicate the change in orientation observed within the deposit, three search-ellipse orientations were used to control the resource estimate. The first orientation (designated Area 10 and considered the model default code) represents the generally horizontal nature of the bedding-related low- to mid-grade mineralization within the Siebert Formation peripheral to the higher-grade, near-vertical. The second and third orientation areas (Area 20 and 30) are coded into the block model using solids and represent the more structurally-controlled mineralization that occurs along the east-dipping Siebert/Fraction Tuff contact. See Table 14.12 for the search ellipse parameters.

Table 14.12 Hasbrouck Search Ellipse Orientations

Area	Major Bearing	Mj Plunge	Tilt
1	0	0	0
2	100	0	60
3	100	0	90

Grade interpolation utilized Inverse Distance Squared (ID2), with nearest neighbor and ordinary kriging estimates also being made for checking estimation results and sensitivities. Variography and geostatistical evaluations were made to determine distances for search and classification criteria.

The estimation parameters applied at Hasbrouck are summarized in Table 14.13. The estimation used two search passes for the low-grade domains (coded domains 10 and 100), and three search passes for the mid-and high-grade mineral domains (domains coded as 200 and 300), with successive passes not overwriting previous estimation passes. The first-pass search distances take into consideration the results of both the variography and drill-hole spacing. The second- and third-pass was designed to estimate grade into all blocks coded to the mineral domains that were not estimated in the first pass. Due to the generally similar mineral orientations and statistical correlations between the gold and silver mineralization, and the relatively low value that the silver contributes to the project economics, the silver estimate uses the same estimation parameters as developed for the gold mineralization.

Table 14.13 Summary of Hasbrouck Estimation Parameters

Estimation Pass	Search Ranges (ft)			Comp Constraints		
	Major	Semi-Major	Minor	Min	Max	Max/hole
Domain 10 and 100						
1	300	300	200	2	15	3
2	500	500	500	1	18	3
Domain 200 and 300						
1 (area 1)	150	150	100	2	12	3
1 (area 2 and 3)	150	150	50	2	12	3
2	300	300	200	2	18	3
3	500	500	500	1	18	3

The estimation passes were performed independently for each of the mineral domains, so that only composites coded to a particular domain were used to estimate grade into blocks coded by that domain. The estimated grades were coupled with the partial percentages of the mineral domains to enable the calculation of a single weight-averaged block-diluted grade for each block.

14.3.10 Hasbrouck Mineral Resources

MDA classified the Hasbrouck resources to Measured, Indicated, and Inferred categories using a combination of distance to the nearest sample and the number of samples, while at the same time taking into account reliability of underlying data and understanding and use of the geology (Table 14.14). The pre-Allied drilling is limited to Indicated and Inferred resources only due to the general lack of QA/QC data that could be used for verification purposes and to some uncertainties related to drill-hole locations.

Table 14.14 Hasbrouck Classification Parameters

Class	Estimation Pass	Min. Number of Drill holes	Min. Number of Composites	Avg. Dist. to Nearest 2 Composites
Measured	1	2*	3	50
Indicated	1	2	2	145
Inferred	all other modeled mineralization			

* minimum one Allied hole

The Hasbrouck stated resource is fully diluted to 20ft x 20ft x 20ft blocks and tabulated on gold-equivalent ("AuEq") grade cutoff that was chosen to capture mineralization potentially available to open-pit extraction and heap-leach processing. The block dimensions were chosen as practical sizes for open-pit mining of a deposit of this kind.

The Hasbrouck mineral resources are inclusive of reserves and listed in Table 14.15 using a cutoff grade of 0.006oz AuEq/ton. The formula used to calculate the AuEq grade is:

$$\text{oz AuEq/ton} = \text{oz Au/ton} + (\text{oz Ag/ton} \times 0.000417)$$

The AuEq grade is calculated using the individual gold and silver grades of each block, along with a gold price of $1,300.00 per ounce gold and a silver price of $22 per ounce silver. The AuEq grade calculation includes the difference in gold versus silver recovery in the proposed heap-leach processing scenario.

The block-diluted resources are also tabulated at additional cutoffs in Table 14.16 in order to provide grade-distribution information, as well as to provide for economic conditions other than those envisioned by the 0.006oz AuEq/ton cutoff. Hasbrouck resources have an effective date of November 3, 2014.

Figure 14.7 and Figure 14.8 show cross sections of the block model that correspond to the mineral-domain cross sections in Figure 14.5 and Figure 14.6, respectively.

Table 14.15 Hasbrouck Reported Mineral Resources (0.006oz AuEq/ton cutoff grade)

Class	Tons	oz Au/ton	oz Au	oz Ag/ton	oz Ag
Measured	8,261,000	0.017	143,000	0.357	2,949,000
Indicated	45,924,000	0.013	595,000	0.243	11,147,000
M+I	54,185,000	0.014	738,000	0.260	14,096,000
Inferred	11,772,000	0.009	104,000	0.191	2,249,000

Note: rounding may cause apparent inconsistencies

Table 14.16 Hasbrouck Mineral Resources

Cutoff	Measured Resource				
(oz AuEq/ton)	Tons	oz Au/ton	oz Au	oz Ag/ton	oz Ag
0.005	9,142,000	0.016	147,000	0.327	2,992,000
0.006	***8,261,000***	***0.017***	***143,000***	***0.357***	***2,949,000***
0.007	7,501,000	0.019	139,000	0.386	2,896,000
0.008	6,700,000	0.020	134,000	0.420	2,814,000
0.009	5,925,000	0.022	128,000	0.457	2,706,000
0.010	5,243,000	0.023	122,000	0.493	2,584,000
0.012	4,349,000	0.026	114,000	0.544	2,364,000
0.015	3,575,000	0.029	105,000	0.595	2,128,000
0.020	2,708,000	0.034	91,000	0.668	1,808,000

Cutoff	Indicated Resource				
(oz AuEq/ton)	Tons	oz Au/ton	oz Au	oz Ag/ton	oz Ag
0.005	50,281,000	0.012	616,000	0.225	11,312,000
0.006	***45,924,000***	***0.013***	***595,000***	***0.243***	***11,147,000***
0.007	40,310,000	0.014	562,000	0.268	10,819,000
0.008	34,082,000	0.015	521,000	0.299	10,204,000
0.009	28,350,000	0.017	478,000	0.332	9,399,000
0.010	23,731,000	0.019	440,000	0.359	8,528,000
0.012	17,457,000	0.022	381,000	0.406	7,085,000
0.015	13,293,000	0.025	333,000	0.440	5,853,000
0.020	9,495,000	0.029	274,000	0.482	4,579,000

Cutoff	Measured and Indicated Resource				
(oz AuEq/ton)	Tons	oz Au/ton	oz Au	oz Ag/ton	oz Ag
0.005	59,423,000	0.013	763,000	0.241	14,304,000
0.006	***54,185,000***	***0.014***	***738,000***	***0.260***	***14,096,000***
0.007	47,811,000	0.015	701,000	0.287	13,715,000
0.008	40,782,000	0.016	655,000	0.319	13,018,000
0.009	34,275,000	0.018	606,000	0.353	12,105,000
0.010	28,974,000	0.019	562,000	0.384	11,112,000
0.012	21,806,000	0.023	495,000	0.433	9,449,000
0.015	16,868,000	0.026	438,000	0.473	7,981,000
0.020	12,203,000	0.030	365,000	0.523	6,387,000

Cutoff	Inferred Resource				
(oz AuEq/ton)	Tons	oz Au/ton	oz Au	oz Ag/ton	oz Ag
0.005	13,629,000	0.008	113,000	0.172	2,343,000
0.006	***11,772,000***	***0.009***	***104,000***	***0.191***	***2,249,000***
0.007	9,525,000	0.010	91,000	0.219	2,087,000
0.008	7,085,000	0.011	75,000	0.247	1,751,000
0.009	4,897,000	0.012	59,000	0.278	1,363,000
0.010	3,487,000	0.014	48,000	0.305	1,063,000
0.012	2,086,000	0.017	35,000	0.333	695,000
0.015	1,289,000	0.020	25,000	0.377	485,000
0.020	696,000	0.023	16,000	0.423	294,000

Figure 14.7 Hasbrouck Deposit Section 1563300 Showing Block Model Gold Grades Looking West

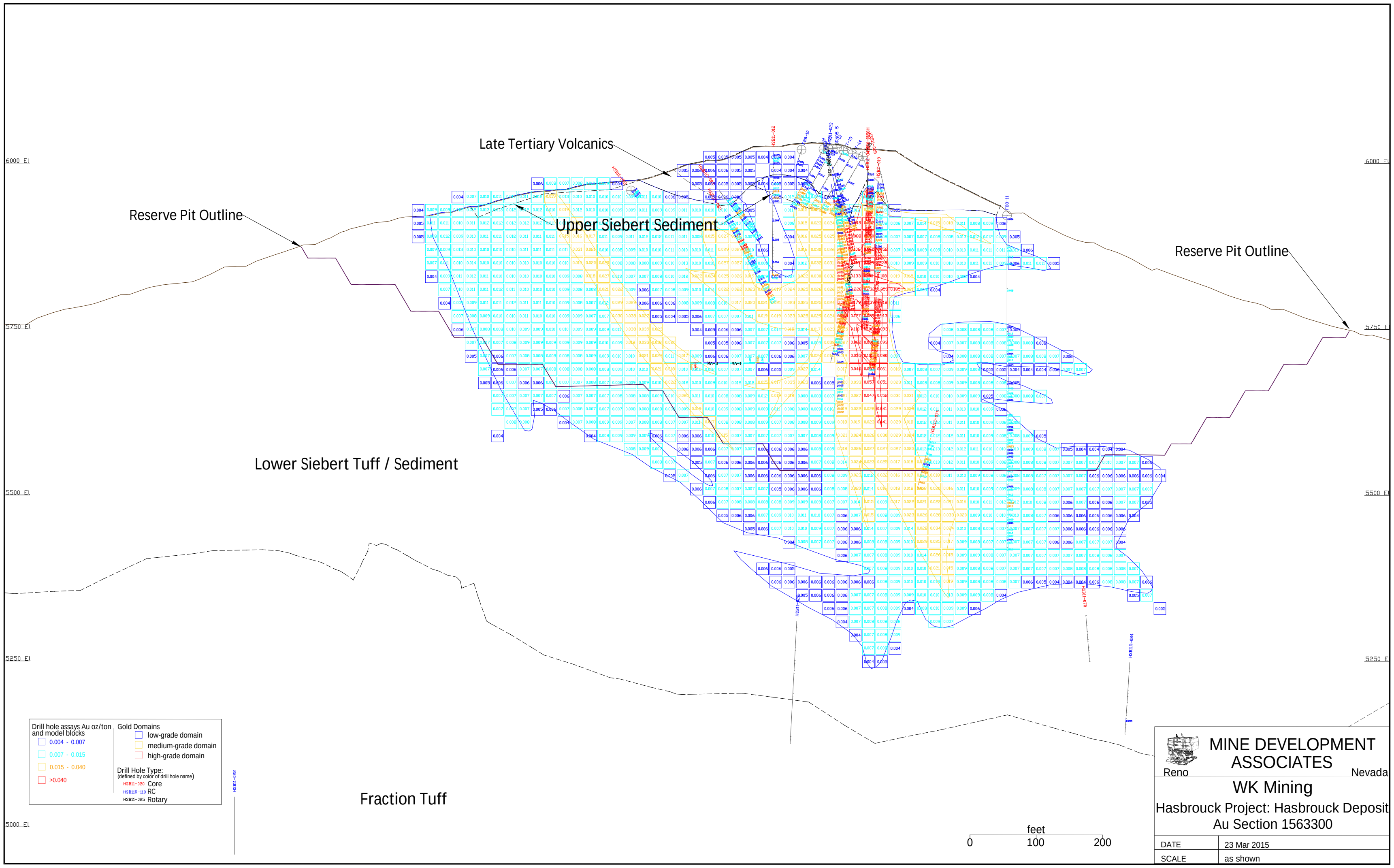
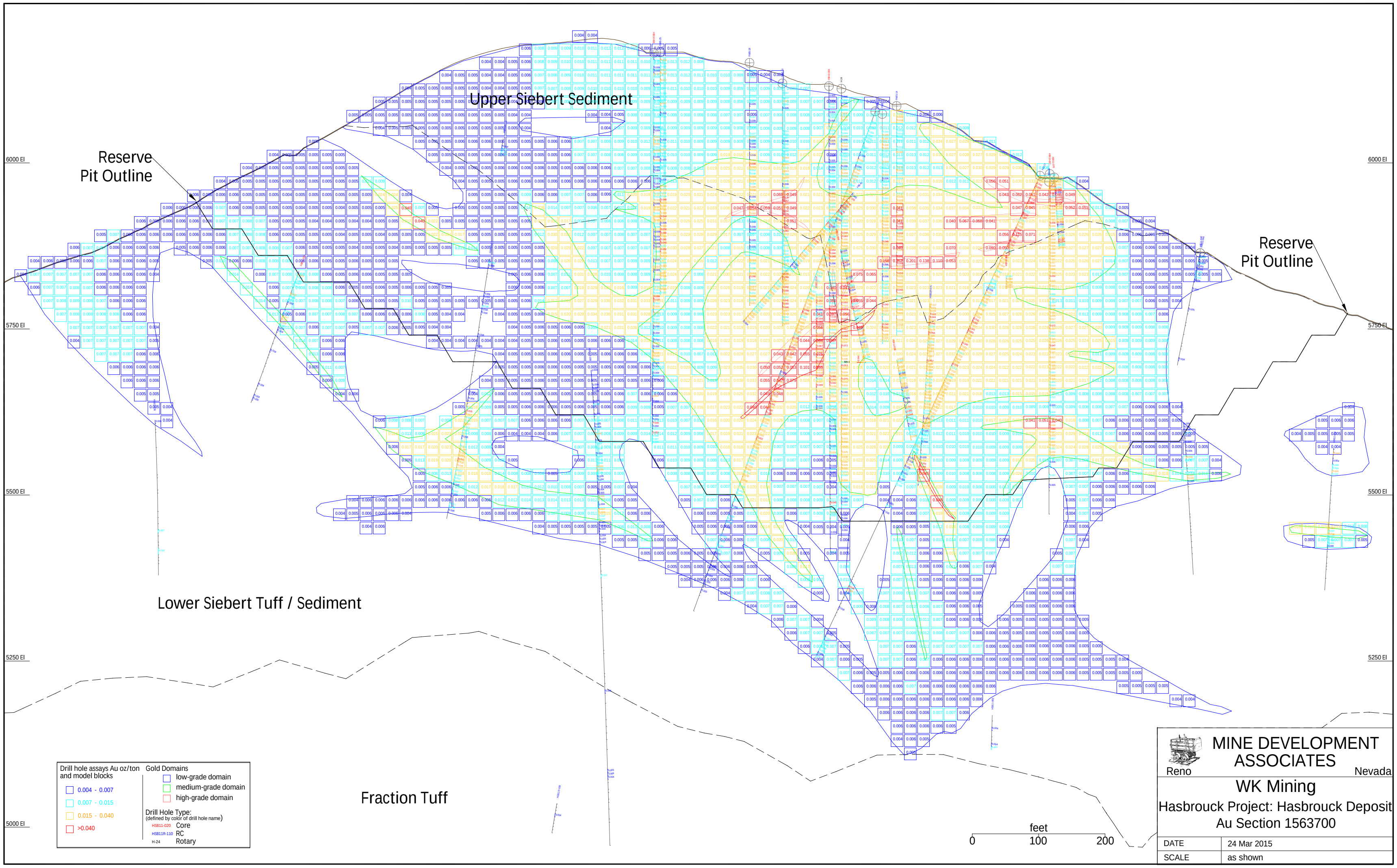


Figure 14.8 Hasbrouck Deposit Section 1563700 Showing Block Model Gold Grades, Looking West



14.3.11 Model Checks

Volumes indicated by the sectional mineral-domain modeling were compared to the level-plan volumes and those coded to the block model to assure close agreement, and all block-model coding was checked visually on the computer. Nearest-neighbor and ordinary-krige estimates of the Hasbrouck resources were undertaken as a check on the inverse-distance-squared resource model. Grade-distribution plots of assays and composites versus the nearest-neighbor, krige, and inverse-distance block grades were also evaluated as a check on the estimation. Finally, the inverse-distance grades were visually compared to the drill-hole assay data to assure that reasonable results were obtained.

14.3.12 Comments on the Hasbrouck Resource Modeling

The Hasbrouck gold and silver resource is based on drill-sample analyses, density measurements, logged silicification content, and lithologic and structural geologic contacts. At a 0.006oz AuEq/ton cutoff, Hasbrouck mineralization consists of a single, irregularly shaped deposit that extends for more than 2,500ft in an east-west direction over the top of Hasbrouck Mountain. The mineralization at Hasbrouck is accompanied by strong pervasive silicification within the upper Siebert and the top of the lower Siebert. Within the large, continuous lower-grade mineralized shell, higher-grade gold and silver mineralization is related to dominantly near-vertical, west-northwest trending zones of sheeted silica veinlets and stockworks, all closely associated with multiple, larger and coalesced, but erratic bodies of hydrothermal breccias. Stratigraphic control, whereby the porous volcaniclastic units are preferentially mineralized, is prevalent throughout the deposit, but is especially evident in many of the moderate-grade zones along the peripheries of the deposit. Structural control is present along various northwest trending sub parallel structures. Crosscutting N-S structures locally off-sets mineralization.

The core of the deposit is relatively well-defined and infill drilling is not expected to materially change the current resource model and estimate. Additional drilling along the periphery of the deposit, including following up on the limited 2014 drill program completed by West Kirkland on the northeast edge of the deposit, has the potential to extend the resource to the east and west along the dominant mineral trend observed within the deposit.

15.0 MINERAL RESERVE ESTIMATES

15.1 Introduction

MDA classifies reserves in order of increasing confidence into Probable and Proven categories to be in accordance with the "CIM Definition Standards - For Mineral Resources and Mineral Reserves" (2014), and therefore Canadian National Instrument 43-101. Mineral reserves for the Hasbrouck project were developed by applying relevant economic criteria in order to define the economically extractable portions of the resource. CIM standards require that modifying factors be used to convert Mineral Resources to Reserves. The standards define modifying factors and Proven and Probable Reserves with CIM's explanatory material shown in italics as follows:

Mineral Reserve

Mineral Reserves are sub-divided in order of increasing confidence into Probable Mineral Reserves and Proven Mineral Reserves. A Probable Mineral Reserve has a lower level of confidence than a Proven Mineral Reserve.

A Mineral Reserve is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at Pre-Feasibility or Feasibility level as appropriate that include application of Modifying Factors. Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified.

The reference point at which Mineral Reserves are defined, usually the point where the ore is delivered to the processing plant, must be stated. It is important that, in all situations where the reference point is different, such as for a saleable product, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported.

The public disclosure of a Mineral Reserve must be demonstrated by a Pre-Feasibility Study or Feasibility Study.

Mineral Reserves are those parts of Mineral Resources which, after the application of all mining factors, result in an estimated tonnage and grade which, in the opinion of the Qualified Person(s) making the estimates, is the basis of an economically viable project after taking account of all relevant Modifying Factors. Mineral Reserves are inclusive of diluting material that will be mined in conjunction with the Mineral Reserves and delivered to the treatment plant or equivalent facility. The term 'Mineral Reserve' need not necessarily signify that extraction facilities are in place or operative or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.

'Reference point' refers to the mining or process point at which the Qualified Person prepares a Mineral Reserve. For example, most metal deposits disclose mineral reserves with a "mill feed" reference point. In these cases, reserves are

reported as mined ore delivered to the plant and do not include reductions attributed to anticipated plant losses. In contrast, coal reserves have traditionally been reported as tonnes of "clean coal". In this coal example, reserves are reported as a "saleable product" reference point and include reductions for plant yield (recovery). The Qualified Person must clearly state the 'reference point' used in the Mineral Reserve estimate.

Probable Mineral Reserve

A Probable Mineral Reserve is the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource. The confidence in the Modifying Factors applying to a Probable Mineral Reserve is lower than that applying to a Proven Mineral Reserve.

The Qualified Person(s) may elect, to convert Measured Mineral Resources to Probable Mineral Reserves if the confidence in the Modifying Factors is lower than that applied to a Proven Mineral Reserve. Probable Mineral Reserve estimates must be demonstrated to be economic, at the time of reporting, by at least a Pre-Feasibility Study.

Proven Mineral Reserve

A Proven Mineral Reserve is the economically mineable part of a Measured Mineral Resource. A Proven Mineral Reserve implies a high degree of confidence in the Modifying Factors.

Application of the Proven Mineral Reserve category implies that the Qualified Person has the highest degree of confidence in the estimate with the consequent expectation in the minds of the readers of the report. The term should be restricted to that part of the deposit where production planning is taking place and for which any variation in the estimate would not significantly affect the potential economic viability of the deposit. Proven Mineral Reserve estimates must be demonstrated to be economic, at the time of reporting, by at least a Pre-Feasibility Study. Within the CIM Definition standards the term Proved Mineral Reserve is an equivalent term to a Proven Mineral Reserve.

Modifying Factors

Modifying Factors are considerations used to convert Mineral Resources to Mineral Reserves. These include, but are not restricted to, mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors.

MDA has used Measured and Indicated resources as the basis to define reserves for both the Three Hills and Hasbrouck mines, which together compose the Hasbrouck project. Reserve definition was done by first identifying ultimate pit limits using economic parameters and pit optimization techniques. The resulting optimized pit shells were then used for guidance in pit design to allow access for equipment and personnel. Three Hills has been designed using a single pit phase, and Hasbrouck has been designed using four pit phases. MDA used the phased pit designs to define the production schedule, which was then used for cash-flow analysis for the pre-feasibility study. The final cash-flow model was produced by MDA and demonstrates that the deposits make a positive cash flow and are reasonable with respect to statement of reserves for the Hasbrouck project.

15.2 Pit Optimization

Pit optimization was done using Geovia's Whittle (version 4.5.2) software. The optimization used economic and geometrical parameters to define the ultimate pit for both deposits. Pit optimization used only Measured and Indicated resources for processing. All Inferred material was considered to be waste.

15.2.1 Economic Parameters

Economic parameters used for the pit optimization are provided in Table 15.1. These are initial parameters used for the pre-feasibility to determine the pit design, and may differ from the final values used in the cash-flow model. Pit optimizations were re-run using the final cash-flow values as a test to ensure that pit designs remained valid.

Table 15.1 Pre-Feasibility Economic Parameters

	Three Hills	Hasbrouck	
Mining	$ 2.00	$ 2.00	$/ton Mined
Crushing & Stacking	NA	$ 3.20	$/ton Processed
Leaching	$ 2.33	$ 1.30	$/ton Processed
G&A Cost per Ton	$ 0.42	$ 0.42	$/ton Processed
Refining - Au	$ 5.00	$ 5.00	$/oz Au Produced
Refining - Ag	NA	$ 0.25	$/oz Ag Produced
Royalty	4%	4%	NSR

Mining costs are based on budgetary quotations from mining contractors and include owners costs for engineering, geology, and contract management. Processing costs were provided by KCA and are broken into crushing and stacking, followed by leaching. Crushing and stacking costs do not apply to Three Hills because Three Hills material will be processed using run-of-mine leaching.

Yearly general and administrative costs ("G&A") have been estimated by MDA with input from West Kirkland and are discussed later. The yearly G&A costs have been divided by the average annual tonnage to determine the cost per ton.

The royalty has been applied as a gross smelter return ("GSR"), which means that the royalty percentage has been multiplied by the recovered metal and metal prices. This is conservative as the royalty will have deductions for metal transportation, insurance, and refining costs.

Gold and silver recovery estimates were provided by Herb Osborne of H.C. Osborne and Associates, the Qualified Person responsible for Section 13.0. Table 15.2 shows the recoveries used for each deposit.

Table 15.2 Metallurgical Recoveries

	Gold	Silver
Three Hills	79.0%	NA
Hasbrouck Upper Seibert	61.0%	11.0%
Hasbrouck Lower Seibert	75.8%	11.0%

Pit optimizations were completed using varying gold and silver prices to better understand the sensitivity of each deposit to metal price. The gold price was incremented from $300 to $2,000 per ounce in $20.00 steps for both Three Hills and Hasbrouck. As Three Hills does not have any stated silver resources, silver was not used to generate value in Three Hills. However, for Hasbrouck the value from silver was calculated with constant silver to gold ratio based on $1,250/oz Au to $18/oz Ag prices. Lower metal price pit shells were analyzed while determining pit phasing.

The ultimate pit limits were determined using prices of $1,250 and $18.00 per ounce of gold and silver respectively. The ultimate pit was selected on Whittle discounted evaluations of the various pit shells using a 5% discount rate and a processing limit of 5,400,000 tons per year.

Of note, the final gold price used for the Hasbrouck project cash flow was $1,225 per ounce Au and $17.50 per ounce Ag. This change in prices had a minimal impact on the results (less than 2 % on tonnage) and MDA believes that the pit designs resulting from the initial analysis are well within reason.

15.2.2 Geometrical Parameters

The only geometrical parameters applied to the Three Hills and Hasbrouck pit optimizations are slope parameters. Slopes have been based on a geotechnical study from Golder Associates Inc. (Golder, 2015). The study was completed as part of the pre-feasibility and includes recommendations for both Three Hills and Hasbrouck mines. These recommendations are documented in the Golder Associates report: "*Hasbrouck Project, Esmeralda County, Nevada Pre-Feasibility Level Pit Slope Evaluation*" (January, 2015). The geotechnical report was further reviewed by SRK Consulting and documented in a memorandum "*Hasbrouck Project Geotech PFS Review*" (Wellman, 2015). In summary, SRK Consulting concluded that "*The methodology and approach presented in the report by Golder Associates is valid and in accordance with industry accepted best practices. It is SRK's opinion that the slope angle recommendations provided by Golder are appropriate at a pre-feasibility study (PFS) level*".

15.2.2.1 Three Hills Mine Slope Parameters

Slope parameters were based on studies provided by Golder Associates. Three Hills slope recommendations were provided based on rock type and maximum slope heights. MDA flagged a zone type into the block model based on the rock types. The Three Hills recommended inter-ramp slopes are shown by zone in Table 15.3, as provided by Golder Associates. MDA flattened the slopes used for the pit optimization to represent the overall angle that reflects the inclusion of ramps in the final pit designs as shown in Table 15.3.

Table 15.3 Three Hills Slope Parameters

	Zone Number	Inter-Ramp Angle (degrees)	Maximum Slope Height	Overall Angle Used
North Siebert	1	35°	120ft	25° to 35°
South Siebert	2	40°	200ft	38°
Fraction Tuff	3	45°	200ft	45°
Brougher Dacite Flow	4	45°	200ft	45°
Oddie Ryholite	5	45°	200ft	45°

15.2.2.2 Hasbrouck Mine Slope Parameters

The mining at Hasbrouck will be predominately in the Siebert Formation. For the Siebert Formation, Golder provided slope recommendations based on the overall slope height. In addition, it was recommended that a 65ft geotechnical bench (or the addition of a ramp) be added to the design every 120ft in wall height. Table 15.4 shows the recommended slopes by wall height.

Table 15.4 Hasbrouck Slope Recommendations

Overall Slope Heights (ft)	Inter-Ramp Angle (degrees)	Maximum Height w/out Geotech Bench (ft)
<= 360	40°	120
360 to 480	35°	120
480 to 600	32°	120
600 to 720	30°	120
720 to 840	28°	120

Because the deposit is located under the top of Hasbrouck Mountain, the wall heights in different directions will be variable for both the ultimate pit and any pit phases that are designed. For pit optimizations, the modeling area was divided into 9 different zones around the potential pit so that slopes could be provided in a variable manner. The optimization required some trial and error to apply the slopes appropriately based on how far down the edge of the hill each pit would be mined. The final pit optimizations included some flattening to account for ramps and required geotechnical benches.

15.2.3 Cutoff Grades

Internal and external cutoff grades were calculated for both the Three Hills and Hasbrouck mines based on the economic parameters. Internal cutoff grades assume that an economical pit design has been developed, and because all of the material inside of the pit will be mined, regardless of waste/ore classification, the mining cost inside the pit is a sunk cost. Thus, the internal cutoff grade does not include mining cost. In contrast, the external cutoff grade includes the mining cost and is a break-even cutoff grade.

The calculated cutoff grades for both Three Hills and Hasbrouck are shown in Table 15.5. These are shown by gold price to illustrate how the gold price can impact the cutoff grade choice. However, the resulting cutoff grades are very low in relation to the minimum detection limits when assaying for gold. As such, a minimum cutoff grade has been applied for each deposit. For pit optimization work, a minimum cutoff grade of 0.005 and 0.007 ounces gold per ton has been applied to the Three Hills and Hasbrouck mines, respectively. When running pit optimizations, Whittle is allowed to select the most economic destination for material (process it or place it in the waste dump), so where the economic cutoff grade is higher than the minimum cutoff grade, the economic cutoff grade prevails.

Table 15.5 Calculated Cutoff Grades (oz Au/ton)

			Hasbrouck			
Au Price	Three Hills		Upper Seibert		Lower Siebert	
($/oz Au)	Internal	External	Internal	External	Internal	External
$1,000	0.004	0.006	0.010	0.014	0.008	0.011
$1,050	0.003	0.006	0.010	0.013	0.008	0.011
$1,100	0.003	0.006	0.009	0.013	0.008	0.010
$1,150	0.003	0.005	0.009	0.012	0.007	0.010
$1,200	0.003	0.005	0.009	0.012	0.007	0.009
$1,250	0.003	0.005	0.008	0.011	0.007	0.009
$1,300	0.003	0.005	0.008	0.011	0.006	0.009
$1,350	0.003	0.005	0.008	0.010	0.006	0.008
$1,400	0.003	0.004	0.007	0.010	0.006	0.008
$1,450	0.003	0.004	0.007	0.010	0.006	0.008
$1,500	0.002	0.004	0.007	0.009	0.006	0.007

15.2.4 Pit-Optimization Method and Results

The choice of ultimate pits and pit phases were done as a two-step process. The first step was to optimize a set of pit shells based on varying a revenue factor. Whittle did this using a Lerchs-Grossman ("LG") algorithm. The revenue factor was multiplied by the recovered ounces and the metal prices, essentially creating a nested set of pit shells based on different metal prices. For both Three Hills and Hasbrouck, the revenue factors were varied from 0.30 to 2.0 in increments of 0.020. A base price of $1,000 per ounce of gold, and $18.00 per ounce of silver was used, so the resulting pit shells represent gold prices from $300 to $2,000 per ounce in increments of $20.00. This has the potential of generating up to 86 different pit shells that can be used for analysis, though in some cases pit shells with increments are coincidental to other pits and reported as a single pit.

The second step of the process was to use the Pit by Pit ("PbP") analysis tool in Whittle to generate a discounted operating cash flow (note that capital is not included). This used a rough scheduling by pit phase for each pit shell to generate the discounted value for the pit. The program develops three different discounted values: best, worst, and specified. The best case value uses each of the pit shells as pit phases or pushbacks. For example, when evaluating pit 20, there would be 19 pushbacks mined prior to pit 20, and the resulting schedule takes advantage of mining more valuable material up front to improve the discounted value. Evaluating pit 21 would have 20 pushbacks; pit 22 would have 21 pushbacks and so on. Note that this is not a realistic case as the incremental pushbacks would not have enough mining width between them to be able to mine appropriately, but this does help to define the maximum potential discounted operating cash flow.

The worst case does not use any pushbacks in determining the discounted value for each of the pit shells. Thus, each pit shell is evaluated as if mining a single pit from top to bottom. This does not get the advantage of mining more valuable material up front, so it generally provides a lower discounted value than that of the best case.

The specified case allows the user to specify pit shells to be used as pushbacks and then schedules the pushbacks and calculates the discounted cash flow. This is more realistic than the base case as it allows for more mining width, though the final pit design will have to ensure that appropriate mining width is available. The specified case has been used for each mine to determine the ultimate pit limits to design to, as well as to specify guidelines for designing pit phases.

15.2.4.1 Three Hills Pit Optimization Results

The Three Hills mine pit optimizations were completed using Whittle software with the parameters previously discussed. The basic LG results are shown in Table 15.6 by gold price in $100 per ounce increments. The PbP analysis results are listed in Table 15.7 and shown graphically in Figure 15.1.

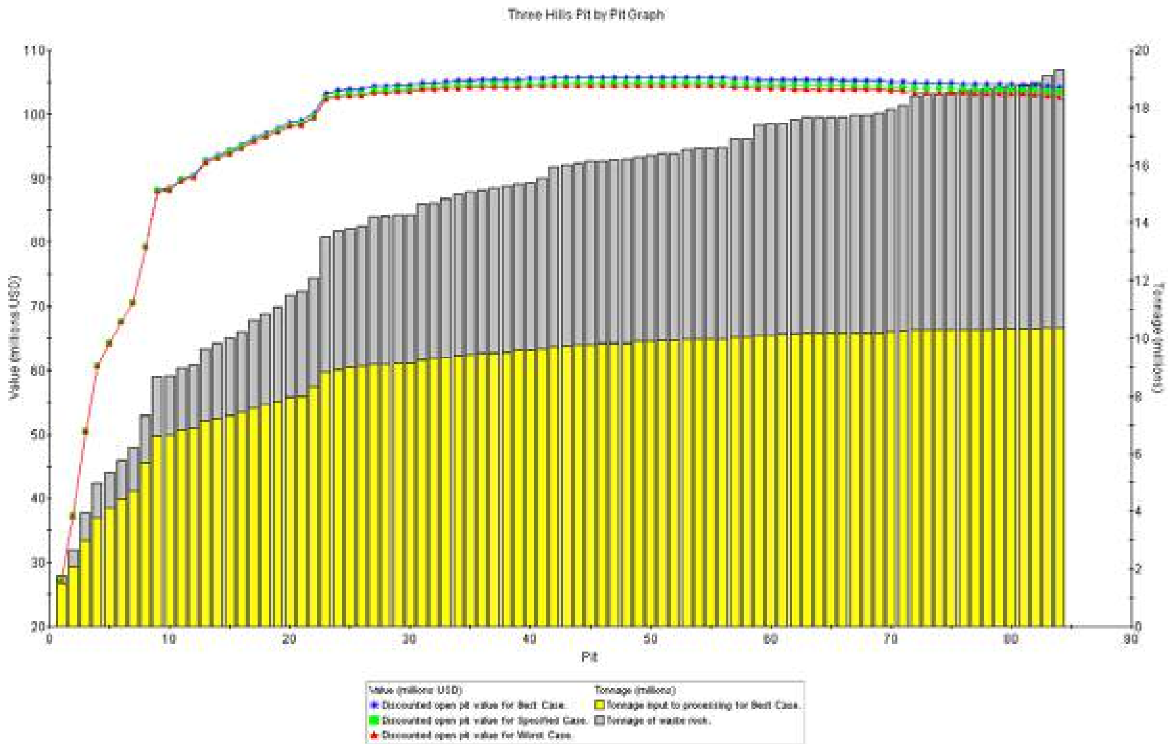
Table 15.6 Three Hills Pit Optimization Results

		Material Processed			Waste	Total	Strip
Pit	Pit Au Price	K Tons	oz Au/ton	K ozs Au	K Tons	K Tons	Ratio
1	$ 300	1,105	0.030	33	627	1,732	0.57
6	$ 400	3,378	0.027	90	2,370	5,748	0.70
11	$ 500	5,741	0.022	129	3,203	8,944	0.56
16	$ 600	6,674	0.021	142	3,563	10,237	0.53
21	$ 700	7,606	0.020	153	4,033	11,639	0.53
26	$ 800	9,014	0.019	168	4,838	13,852	0.54
31	$ 900	9,265	0.019	171	5,375	14,640	0.58
36	$ 1,000	9,459	0.018	174	5,677	15,136	0.60
41	$ 1,100	9,638	0.018	175	5,905	15,544	0.61
46	$ 1,200	9,793	0.018	177	6,352	16,145	0.65
51	$ 1,300	9,910	0.018	178	6,477	16,387	0.65
56	$ 1,400	9,963	0.018	179	6,652	16,615	0.67
61	$ 1,500	10,130	0.018	181	7,304	17,434	0.72
66	$ 1,600	10,174	0.018	181	7,495	17,669	0.74
71	$ 1,700	10,243	0.018	182	7,825	18,068	0.76
75	$ 1,800	10,290	0.018	183	8,197	18,487	0.80
79	$ 1,900	10,313	0.018	183	8,369	18,683	0.81
84	$ 2,000	10,385	0.018	184	8,891	19,276	0.86

Table 15.7 Three Hills Pit by Pit Analysis Results

	Au Price ($/oz)	Material Processed			Waste	Total	Strip	Discounted Op Cost (M US)		
Pit	to Create Pit	K Tons	oz Au/ton	K ozs Au	K Tons	K Tons	Ratio	Best	Spec	Worst
1	$ 300	1,480	0.024	36	252	1,732	0.17	$ 27.03	$ 27.03	$ 27.03
2	$ 320	2,097	0.024	51	544	2,641	0.26	$ 37.22	$ 37.22	$ 37.22
3	$ 340	2,984	0.024	70	946	3,930	0.32	$ 50.53	$ 50.53	$ 50.53
4	$ 360	3,776	0.023	86	1,204	4,980	0.32	$ 60.57	$ 60.57	$ 60.57
5	$ 380	4,112	0.022	92	1,257	5,369	0.31	$ 64.19	$ 64.19	$ 64.19
6	$ 400	4,441	0.022	97	1,309	5,750	0.29	$ 67.52	$ 67.52	$ 67.52
7	$ 420	4,708	0.022	102	1,489	6,196	0.32	$ 70.53	$ 70.53	$ 70.53
8	$ 440	5,671	0.021	117	1,639	7,310	0.29	$ 79.15	$ 79.14	$ 79.14
9	$ 460	6,622	0.020	132	2,029	8,651	0.31	$ 88.15	$ 87.96	$ 87.96
10	$ 480	6,642	0.020	133	2,042	8,685	0.31	$ 88.35	$ 88.15	$ 88.15
11	$ 500	6,819	0.020	136	2,127	8,946	0.31	$ 89.82	$ 89.58	$ 89.58
12	$ 520	6,890	0.020	137	2,175	9,065	0.32	$ 90.42	$ 90.16	$ 90.16
13	$ 540	7,147	0.020	141	2,472	9,619	0.35	$ 92.75	$ 92.44	$ 92.41
14	$ 560	7,224	0.020	143	2,592	9,815	0.36	$ 93.49	$ 93.17	$ 93.13
15	$ 580	7,333	0.020	144	2,666	9,999	0.36	$ 94.24	$ 93.90	$ 93.84
16	$ 600	7,449	0.020	146	2,791	10,240	0.37	$ 95.07	$ 94.70	$ 94.63
17	$ 620	7,567	0.020	148	3,049	10,617	0.40	$ 96.18	$ 95.79	$ 95.71
18	$ 640	7,702	0.019	150	3,115	10,817	0.40	$ 96.89	$ 96.49	$ 96.38
19	$ 660	7,805	0.019	152	3,289	11,093	0.42	$ 97.63	$ 97.21	$ 97.09
20	$ 680	7,957	0.019	154	3,536	11,493	0.44	$ 98.64	$ 98.19	$ 98.04
21	$ 700	7,992	0.019	155	3,650	11,642	0.46	$ 98.94	$ 98.49	$ 98.34
22	$ 720	8,272	0.019	158	3,806	12,078	0.46	$ 100.11	$ 99.61	$ 99.41
23	$ 740	8,835	0.019	166	4,685	13,519	0.53	$ 103.16	$ 102.55	$ 102.24
24	$ 760	8,930	0.019	167	4,797	13,727	0.54	$ 103.57	$ 102.95	$ 102.62
25	$ 780	8,988	0.019	168	4,821	13,809	0.54	$ 103.76	$ 103.13	$ 102.79
26	$ 800	9,017	0.019	168	4,839	13,855	0.54	$ 103.85	$ 103.21	$ 102.87
27	$ 820	9,098	0.019	169	5,120	14,218	0.56	$ 104.33	$ 103.68	$ 103.32
28	$ 840	9,104	0.019	170	5,125	14,229	0.56	$ 104.35	$ 103.70	$ 103.33
29	$ 860	9,142	0.019	170	5,134	14,275	0.56	$ 104.43	$ 103.77	$ 103.40
30	$ 880	9,153	0.019	170	5,136	14,289	0.56	$ 104.45	$ 103.79	$ 103.42
31	$ 900	9,268	0.019	171	5,376	14,644	0.58	$ 104.83	$ 104.15	$ 103.76
32	$ 920	9,288	0.018	172	5,399	14,686	0.58	$ 104.87	$ 104.19	$ 103.80
33	$ 940	9,330	0.018	172	5,487	14,818	0.59	$ 105.00	$ 104.31	$ 103.91
34	$ 960	9,398	0.018	173	5,573	14,971	0.59	$ 105.13	$ 104.43	$ 104.03
35	$ 980	9,430	0.018	173	5,665	15,096	0.60	$ 105.23	$ 104.52	$ 104.11
36	$ 1,000	9,462	0.018	174	5,678	15,140	0.60	$ 105.26	$ 104.55	$ 104.13
37	$ 1,020	9,491	0.018	174	5,714	15,204	0.60	$ 105.31	$ 104.59	$ 104.17
38	$ 1,040	9,517	0.018	174	5,748	15,264	0.60	$ 105.34	$ 104.62	$ 104.20
39	$ 1,060	9,582	0.018	175	5,762	15,344	0.60	$ 105.39	$ 104.66	$ 104.22
40	$ 1,080	9,595	0.018	175	5,787	15,383	0.60	$ 105.41	$ 104.68	$ 104.24
41	$ 1,100	9,641	0.018	175	5,906	15,547	0.61	$ 105.47	$ 104.73	$ 104.28
42	$ 1,120	9,713	0.018	176	6,226	15,939	0.64	$ 105.59	$ 104.84	$ 104.37
43	$ 1,140	9,743	0.018	177	6,291	16,035	0.65	$ 105.62	$ 104.86	$ 104.39
44	$ 1,160	9,765	0.018	177	6,309	16,073	0.65	$ 105.63	$ 104.87	$ 104.39
45	$ 1,180	9,794	0.018	177	6,351	16,145	0.65	$ 105.64	$ 104.87	$ 104.39
46	$ 1,200	9,796	0.018	177	6,353	16,148	0.65	$ 105.64	$ 104.87	$ 104.39
47	$ 1,220	9,815	0.018	177	6,365	16,180	0.65	$ 105.64	$ 104.87	$ 104.39
48	$ 1,240	9,824	0.018	177	6,380	16,204	0.65	$ 105.64	$ 104.87	$ 104.39
49	$ 1,260	9,880	0.018	178	6,412	16,293	0.65	$ 105.63	$ 104.85	$ 104.36
50	$ 1,280	9,905	0.018	178	6,453	16,358	0.65	$ 105.63	$ 104.84	$ 104.35
51	$ 1,300	9,913	0.018	178	6,478	16,391	0.65	$ 105.62	$ 104.83	$ 104.34

Figure 15.1 Three Hills PbP Graph



15.2.4.2 Three Hills Pit Shell Selected for Design Guidance

The PbP results shown in Table 15.7 provide the basis for determining the ultimate pit limits. The best discounted value for the specified case was obtained with pit shell 45, and this was used for guidance in pit design. Due to the limited size for the pit shell, no pit phases were designed.

15.2.4.3 Hasbrouck Pit Optimization Results

Hasbrouck mine pit optimizations were completed using Whittle software with the parameters previously discussed. The basic LG results are shown in Table 15.8 by gold price in $100 per ounce increments. The PbP analysis results are shown in Table 15.9 and graphically in Figure 15.2

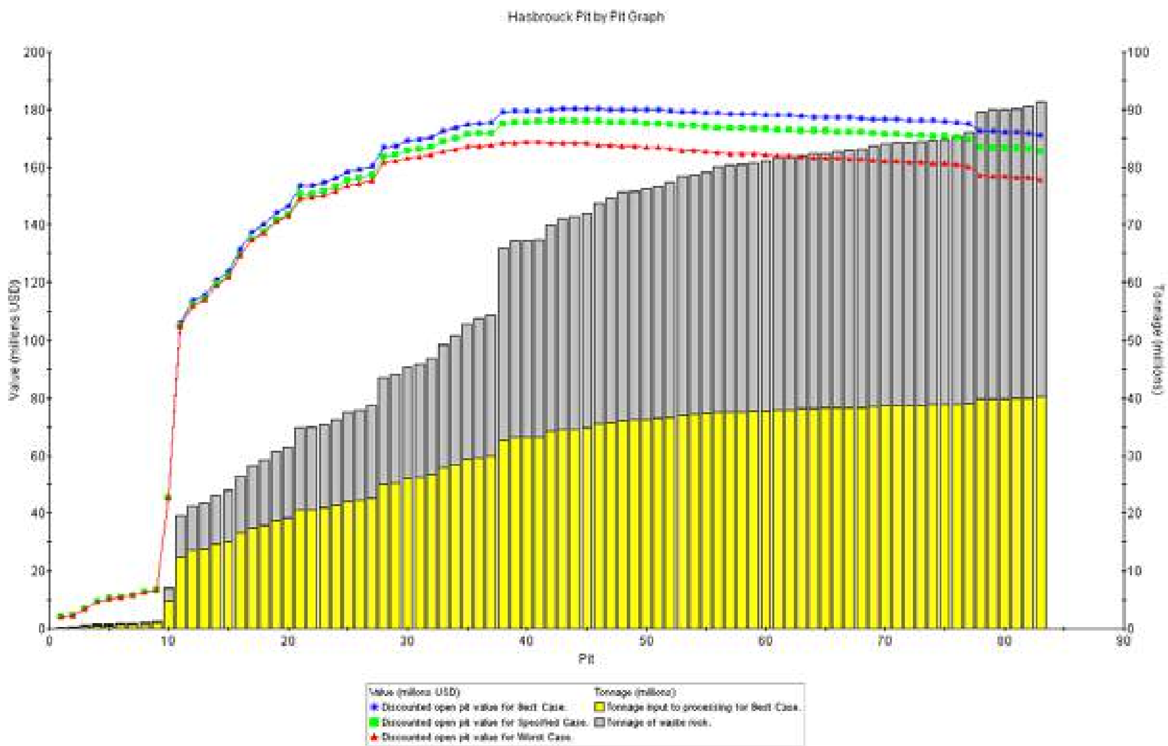
Table 15.8 Hasbrouck Pit Optimization Results

		Material Processed					Waste	Total	Strip
Pit	Au Price	K Tons	Oz Au/ton	K Ozs Au	Oz Ag/ton	K Ozs Ag	K Tons	K Tons	Ratio
3	$ 400	354	0.029	10	0.479	170	146	500	0.41
8	$ 500	729	0.027	20	0.483	352	374	1,103	0.51
13	$ 600	8,255	0.027	226	0.485	4,000	13,485	21,740	1.63
18	$ 700	12,393	0.024	299	0.435	5,388	16,741	29,134	1.35
23	$ 800	16,450	0.022	358	0.397	6,531	18,838	35,288	1.15
28	$ 900	21,867	0.019	426	0.363	7,947	21,726	43,593	0.99
33	$ 1,000	26,631	0.018	476	0.331	8,817	22,629	49,260	0.85
38	$ 1,100	32,158	0.017	552	0.308	9,889	33,830	65,988	1.05
43	$ 1,200	34,208	0.017	576	0.303	10,356	36,864	71,072	1.08
48	$ 1,300	36,106	0.017	596	0.296	10,690	39,559	75,665	1.10
53	$ 1,400	37,052	0.016	606	0.294	10,902	41,404	78,456	1.12
58	$ 1,500	37,635	0.016	612	0.292	10,995	42,783	80,418	1.14
63	$ 1,600	38,111	0.016	617	0.291	11,090	43,930	82,041	1.15
68	$ 1,700	38,373	0.016	620	0.290	11,140	44,658	83,031	1.16
73	$ 1,800	38,744	0.016	623	0.289	11,203	45,747	84,491	1.18
78	$ 1,900	39,782	0.016	634	0.289	11,490	49,907	89,689	1.25
83	$ 2,000	40,144	0.016	638	0.288	11,574	51,216	91,360	1.28

Table 15.9 Hasbrouck Pit by Pit Analysis Results

	Au Price ($/oz)	Total Material Processed					Waste	Total	Strip	LoM	Disc. Op Cash Flow (M USD)		
Pit	to Create Pit	K Tons	Oz Au/ton	K Ozs Au	Oz Ag/ton	K Ozs Ag	K Tons	K Tons	Ratio	Years	Best	Specified	Worst
1	360	230	0.027	6	0.430	99	33	262	0.14	0.04	$ 3.93	$ 3.93	$ 3.93
2	380	256	0.028	7	0.441	113	46	302	0.18	0.05	$ 4.42	$ 4.42	$ 4.42
3	400	412	0.027	11	0.434	179	88	500	0.21	0.08	$ 6.86	$ 6.86	$ 6.86
4	420	585	0.026	15	0.447	262	147	733	0.25	0.11	$ 9.48	$ 9.48	$ 9.48
5	440	639	0.026	17	0.445	284	175	814	0.27	0.12	$ 10.24	$ 10.24	$ 10.24
6	460	694	0.026	18	0.439	305	187	880	0.27	0.13	$ 10.90	$ 10.90	$ 10.90
7	480	735	0.026	19	0.440	324	218	953	0.30	0.14	$ 11.45	$ 11.45	$ 11.45
8	500	823	0.025	21	0.438	361	280	1,103	0.34	0.15	$ 12.53	$ 12.53	$ 12.53
9	520	881	0.025	22	0.442	390	329	1,211	0.37	0.16	$ 13.20	$ 13.20	$ 13.20
10	540	4,912	0.020	98	0.300	1,471	2,104	7,016	0.43	0.91	$ 45.18	$ 45.18	$ 45.18
11	560	12,474	0.020	253	0.355	4,425	7,102	19,576	0.57	2.31	$ 105.98	$ 104.81	$ 104.66
12	580	13,502	0.020	271	0.352	4,750	7,752	21,254	0.57	2.50	$ 113.62	$ 112.21	$ 112.05
13	600	13,798	0.020	276	0.350	4,825	7,936	21,734	0.58	2.56	$ 115.64	$ 114.16	$ 114.00
14	620	14,607	0.020	291	0.348	5,086	8,505	23,111	0.58	2.70	$ 120.91	$ 119.20	$ 119.02
15	640	15,132	0.020	299	0.347	5,255	8,826	23,958	0.58	2.80	$ 123.98	$ 122.13	$ 121.95
16	660	16,455	0.020	322	0.345	5,676	9,983	26,438	0.61	3.05	$ 131.73	$ 129.51	$ 129.30
17	680	17,468	0.019	338	0.344	6,012	10,785	28,253	0.62	3.23	$ 137.56	$ 135.10	$ 134.89
18	700	17,897	0.019	346	0.343	6,137	11,229	29,126	0.63	3.31	$ 140.05	$ 137.42	$ 137.20
19	720	18,716	0.019	359	0.342	6,399	11,994	30,710	0.64	3.47	$ 144.32	$ 141.61	$ 141.12
20	740	19,169	0.019	365	0.341	6,544	12,269	31,438	0.64	3.55	$ 146.33	$ 143.58	$ 142.99
21	760	20,625	0.019	390	0.336	6,932	14,172	34,797	0.69	3.82	$ 153.38	$ 150.50	$ 149.23
22	780	20,666	0.019	390	0.336	6,944	14,212	34,878	0.69	3.83	$ 153.55	$ 150.67	$ 149.40
23	800	20,934	0.019	394	0.336	7,039	14,344	35,278	0.69	3.88	$ 154.47	$ 151.56	$ 150.22
24	820	21,431	0.019	401	0.335	7,188	14,877	36,308	0.69	3.97	$ 156.29	$ 153.33	$ 151.79
25	840	22,061	0.019	410	0.334	7,374	15,460	37,521	0.70	4.09	$ 158.38	$ 155.40	$ 153.64
26	860	22,269	0.019	413	0.334	7,428	15,666	37,934	0.70	4.12	$ 159.05	$ 156.06	$ 154.25
27	880	22,687	0.018	418	0.333	7,555	16,064	38,752	0.71	4.20	$ 160.30	$ 157.30	$ 155.36
28	900	25,062	0.018	450	0.329	8,241	18,519	43,581	0.74	4.64	$ 166.90	$ 163.69	$ 161.57
29	920	25,314	0.018	453	0.329	8,327	18,670	43,984	0.74	4.69	$ 167.46	$ 164.22	$ 162.06
30	940	26,009	0.018	462	0.326	8,484	19,425	45,434	0.75	4.82	$ 169.01	$ 165.63	$ 163.18
31	960	26,290	0.018	465	0.326	8,571	19,691	45,980	0.75	4.87	$ 169.57	$ 166.16	$ 163.61
32	980	26,697	0.018	470	0.325	8,671	20,143	46,840	0.75	4.94	$ 170.34	$ 166.89	$ 164.14
33	1000	27,789	0.017	484	0.321	8,920	21,458	49,247	0.77	5.15	$ 172.34	$ 168.85	$ 165.50
34	1020	28,448	0.017	492	0.318	9,057	22,322	50,770	0.78	5.27	$ 173.45	$ 169.94	$ 166.31
35	1040	29,335	0.017	503	0.316	9,258	23,480	52,814	0.80	5.43	$ 174.76	$ 171.21	$ 167.23
36	1060	29,645	0.017	507	0.315	9,352	23,984	53,628	0.81	5.49	$ 175.17	$ 171.62	$ 167.41
37	1080	29,871	0.017	510	0.314	9,392	24,339	54,210	0.81	5.53	$ 175.44	$ 171.86	$ 167.56
38	1100	32,790	0.017	557	0.303	9,937	33,180	65,970	1.01	6.07	$ 179.25	$ 175.24	$ 168.37
39	1120	33,251	0.017	563	0.302	10,053	33,961	67,212	1.02	6.16	$ 179.64	$ 175.60	$ 168.57
40	1140	33,311	0.017	563	0.302	10,069	34,054	67,365	1.02	6.17	$ 179.68	$ 175.64	$ 168.59
41	1160	33,339	0.017	564	0.302	10,080	34,074	67,413	1.02	6.17	$ 179.69	$ 175.65	$ 168.60
42	1180	34,188	0.017	574	0.300	10,265	35,764	69,952	1.05	6.33	$ 180.04	$ 175.90	$ 168.56
43	1200	34,534	0.017	578	0.300	10,357	36,518	71,052	1.06	6.40	$ 180.13	$ 175.93	$ 168.46
44	1220	34,654	0.017	580	0.300	10,385	36,751	71,405	1.06	6.42	$ 180.15	$ 175.93	$ 168.43
45	1240	34,847	0.017	582	0.299	10,426	37,049	71,896	1.06	6.45	$ 180.16	$ 175.90	$ 168.37
46	1260	35,473	0.017	589	0.297	10,548	38,330	73,803	1.08	6.57	$ 180.11	$ 175.73	$ 167.69
47	1280	35,772	0.017	592	0.297	10,628	38,836	74,608	1.09	6.62	$ 180.05	$ 175.60	$ 167.52
48	1300	36,094	0.017	596	0.296	10,690	39,551	75,645	1.10	6.68	$ 179.92	$ 175.40	$ 167.21
49	1320	36,208	0.016	597	0.296	10,713	39,720	75,928	1.10	6.71	$ 179.88	$ 175.33	$ 167.10
50	1340	36,319	0.016	598	0.295	10,729	39,890	76,210	1.10	6.73	$ 179.81	$ 175.24	$ 166.97
51	1360	36,420	0.016	600	0.295	10,752	40,106	76,526	1.10	6.74	$ 179.75	$ 175.15	$ 166.86
52	1380	36,677	0.016	602	0.295	10,809	40,575	77,252	1.11	6.79	$ 179.55	$ 174.89	$ 166.49
53	1400	37,039	0.016	606	0.294	10,902	41,395	78,434	1.12	6.86	$ 179.20	$ 174.44	$ 165.89

Figure 15.2 Hasbrouck PbP Graph



15.2.4.4 Hasbrouck Pit Shells Selected for Design Guidance

The PbP results shown in Table 15.9 provide the basis for determining the ultimate pit limits for the Hasbrouck mine. The best discounted value for the specified case was obtained with pit shell 44, and this was used for guidance in pit design. In order to maximize the specified case discounted cash flow, other pit shells were used as pit phases or pushbacks in the analysis. These included pit shells 9, 18, and 30. These pit shells were also used for guidance for the design of phase 1, phase 2, and phase 3 respectively.

15.3 Pit Designs

Detailed pit designs were completed for both the Three Hills and Hasbrouck mines. Three hills was completed as a single ultimate pit and the Hasbrouck pit design was completed in 4 pit phases. All of the pit designs were completed in Surpac 6.4.1 software using similar design parameters.

15.3.1 Bench Height

Pit designs were created to use 20ft bench heights. This corresponds to the resource model block heights, and MDA believes this to be reasonable with respect to dilution and equipment anticipated to be used in mining.

15.3.2 Pit Design Slopes

Slope parameters were based on geotechnical studies provided by Golder Associates as previously discussed in sections 15.2.2.1 and 15.2.2.2.

15.3.2.1 Three Hills Pit Slope Design Parameters

Three Hills pit design has been completed to contain toes, crests, and ramp strings. The design was completed as a single pit using 20ft bench heights. Slope parameters used are based on the recommendations of Golder (2015). Table 15.10 shows the parameters used for the Three Hills ultimate pit design.

Table 15.10 Three Hills Slope Design Parameters

	Catch Bench Separation (ft)	Bench Face Angle (degrees)	Catch Bench Width (ft)	Inter-Ramp Angle (degrees)	Max Height w/out Ramp or 65 ft. Geotech Bench (ft)
North Siebert	40	60°	35	35°	120
South Siebert	40	60°	25	40°	200
Fraction Tuff	40	70°	25	45°	200
Brougher Dacite Flow	40	70°	25	45°	200
Oddie Ryholite	40	70°	25	45°	200

15.3.2.2 Hasbrouck Pit Slope Design Parameters

Hasbrouck mine pit designs have been completed with toes, crest, and ramp access. The design was completed using 4 different pit phases in order to promote mining of higher value material as early as possible in the schedule. The slope recommendations were provided by Golder (2015). Table 15.11 shows the parameters used for the Hasbrouck pit designs based on wall height. The parameters were applied to all pit phases individually.

Table 15.11 Hasbrouck Pit Design Parameters

Overall Slope Hieght (ft)	No. of Geotech Catch Benches	Catch Bench Separation (ft)	Bench Face Angle (degrees)	Catch Bench Width (ft)	Inter-Ramp Angle (degrees)	Max Height w/out Ramp or 65 ft. Geotech Bench (ft)
<= 360	2	40	60°°	25	40°	120
360 to 480	3	40	60°	34	35°	120
480 to 600	4	40	60°	41	32°°	120
600 to 720	5	40	60°	46	30°	120
720 to 840	6	40	60°	52	28°	120

15.3.3 Haulage Roads

Haulage roads and ramps were designed for both mines to have a maximum centerline gradient of 10%. In areas where the ramps may curve along the outside of the pit, the inside gradient may be up to 11% or 12% for short distances. A portion of mining will occur in areas where mining benches are above the lowest crest point in the design. In some of these areas, haul roads have been designed inside of the ultimate pit footprint and ramps are not incorporated into the high-wall design. These haul roads provide access to upper benches and then are consumed by mining the pit.

In the interior pit phases for the Hasbrouck mine, a ramp is left in the high wall. These ramps are mined out by subsequent pit phases. Access to the upper benches of the ultimate pit is gained on the previous (phase 3) pit ramp left in the high wall, which is mined out in the final phase leaving a high wall without a ramp. After the pit is advanced below the lowest pit crest, ramp access is carried in the pit design.

The design anticipates the use of 100-ton type trucks. The ramp widths are based on the Caterpillar 777 style trucks with an operating width of 20ft. Haul roads are generally designed to be 90ft wide, which allows for 3.35 times the width of the truck for running width, plus another 23ft for a single berm at least half the tire height.

In the lower portion of the Three Hills ultimate pit, a slot cut is driven 80ft wide. This is used as a ramp, and the width is considered to be the minimum mining width. As the slot cut will not require berms, the width is sufficient for 2 way traffic.

Haulage outside of the pit is required to deliver material to the waste dumps and heap leach pad at Three Hills, and to the crusher or coarse stockpile at the Hasbrouck mine. In cases where these roads require a berm on each side, the road design width is 115ft. This allows for 69ft of running width.

15.3.4 Ultimate Pit Designs

Ultimate pit designs were developed for both the Three Hills and Hasbrouck mines. The ultimate pit for Three Hills is shown in Figure 15.3. The pit extends from the bottom elevation of 5,620ft to the upper crest at 5,990ft. The pit extents are approximately 1,100ft east to west and 2,125ft north to south.

The ultimate pit for Hasbrouck is shown in Figure 15.4. The top of Hasbrouck Mountain is about 6,270ft in elevation and the most upper crest of the ultimate pit is at approximately 5,960ft. The lowest bench of the ultimate pit is at 5,400ft elevation. The pit extents are approximately 2,500ft east to west and 1,900ft north to south.

Figure 15.3 Three Hills Ultimate Pit Design

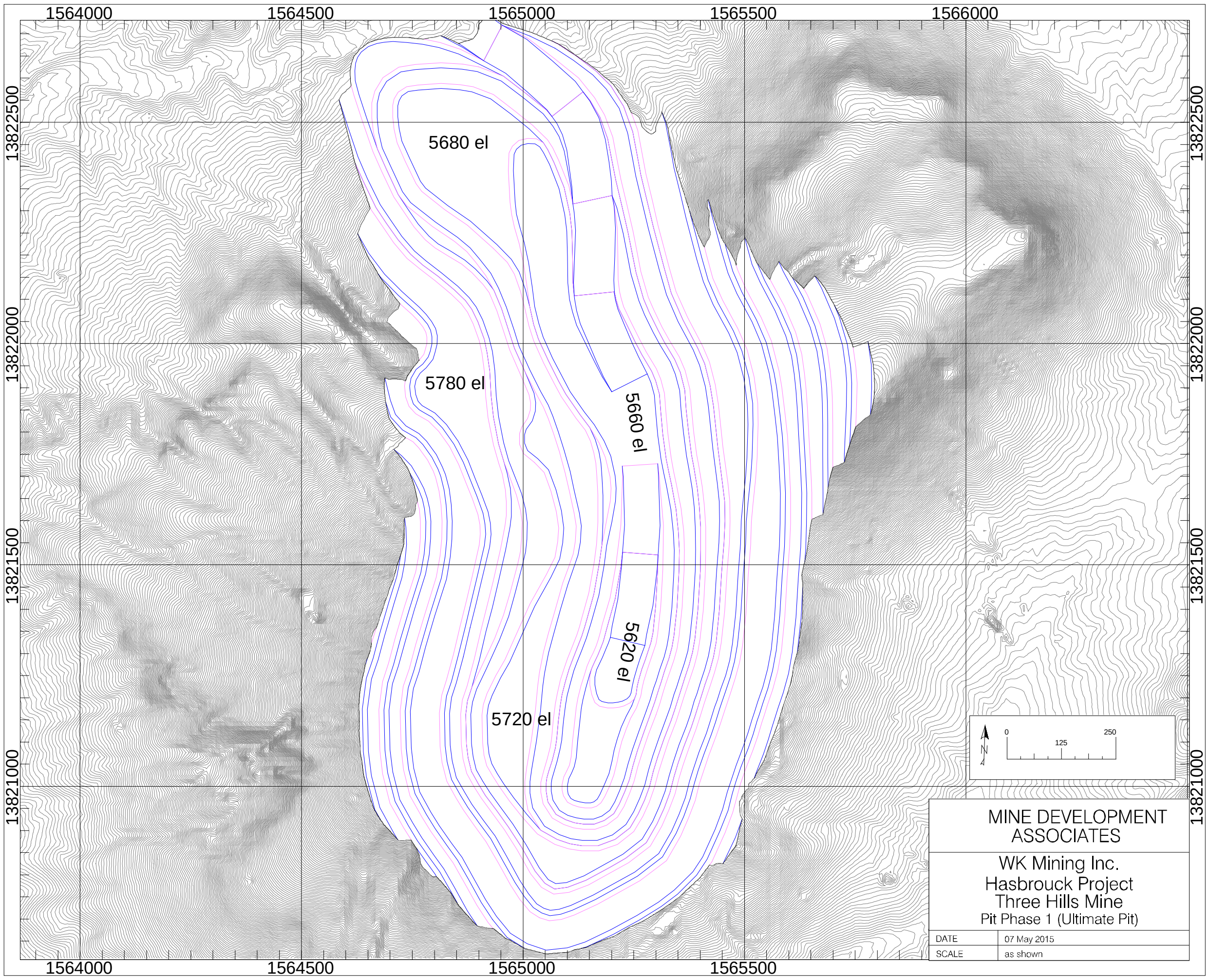
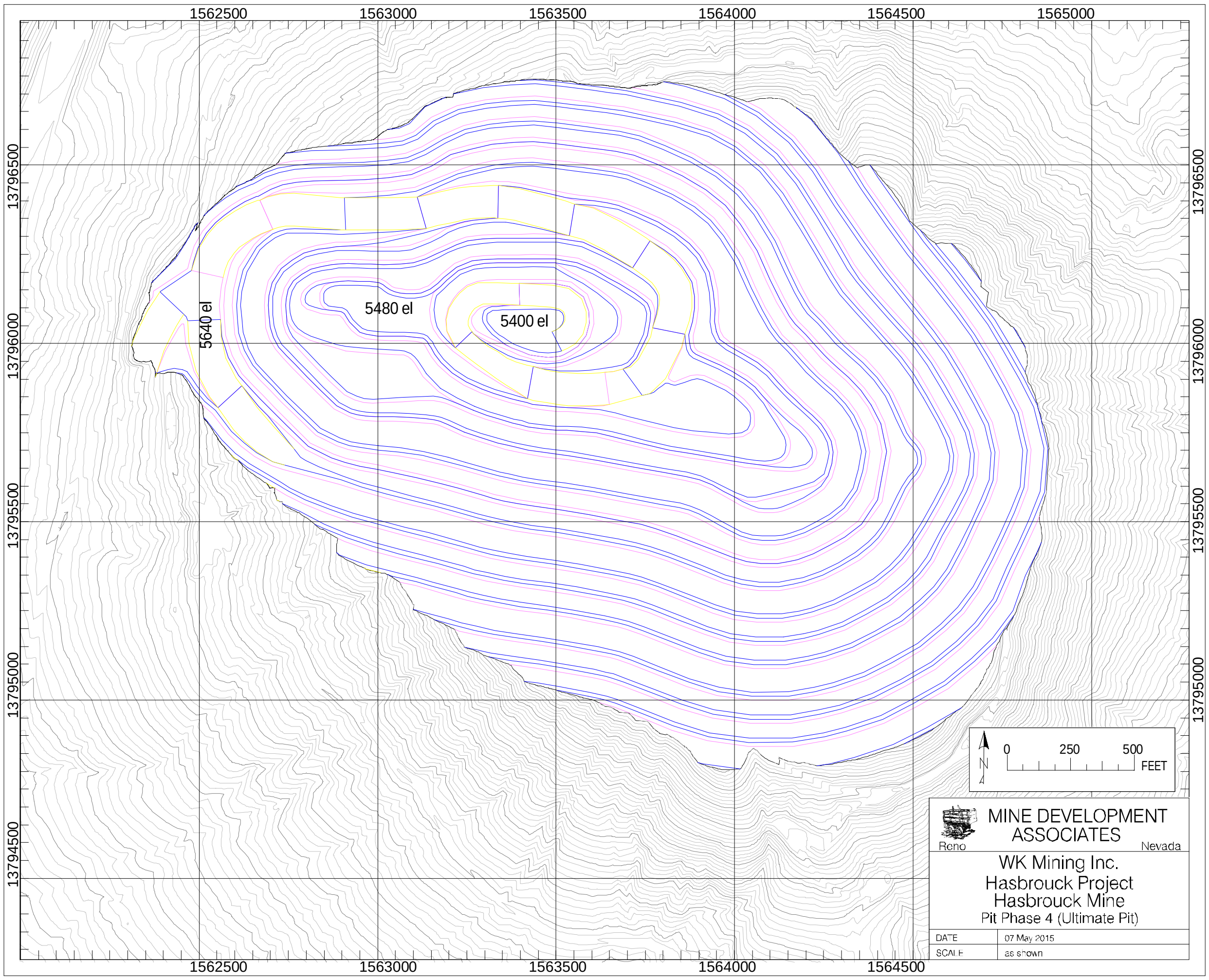


Figure 15.4 Hasbrouck Ultimate Pit Design (Phase 4)



15.3.5 Pit Phasing

The Three Hills pit was designed as a single pit, with no additional pit phases designed.

Hasbrouck was designed to achieve the ultimate pit using 4 pit phases. These start at the top of the mountain and mine downward. The pits primarily work from west to east. The 4 pit phases are described as follows:

- Phase 1: Start mining on the top of the mountain at 6,270ft elevation. The bottom bench of phase 1 is at 5,700ft elevation. Access will be developed on the surface inside the pit boundary, and then mined out as phase 1 is mined down. The uppermost crest that is left behind is at the 6,170ft elevation. A ramp is left in the southeast high-wall of the pit for easy access to phase 2. The phase 1 pit design is shown in Figure 15.5.

- Phase 2: Mining starts at the crest of phase 1 (the 6,170ft elevation) and mines down to the bottom of phase 2 at the 5,600ft bench. The upper most crest of phase 2 is at approximately 6,110ft in elevation. Phase 2 pit design is shown in Figure 15.6.
- Phase 3: Mining starts at the crest of phase 2 (the 6,100ft bench) and continues to phase 3's ultimate depth at the 5,440ft elevation. Access is gained using the phase 2 ramp that was left behind. Again, a ramp is left in the high-wall of phase 3 to provide access for phase 4. Phase 3 pit design is shown in Figure 15.7.
- Phase 4: Mining starts at the phase 3 crest on the 6,060ft bench. Phase 4 achieves the ultimate pit with the bottom bench located at the 5,400ft elevation. This is the final pit phase and no ramps are left in the final high-wall. However, the wall is accessible every 120ft in height from the crest via the 65ft wide geotechnical benches. The ultimate pit shown in Figure 15.4 represents the phase 4 design.

Figure 15.5 Hasbrouck Phase 1 Pit Design

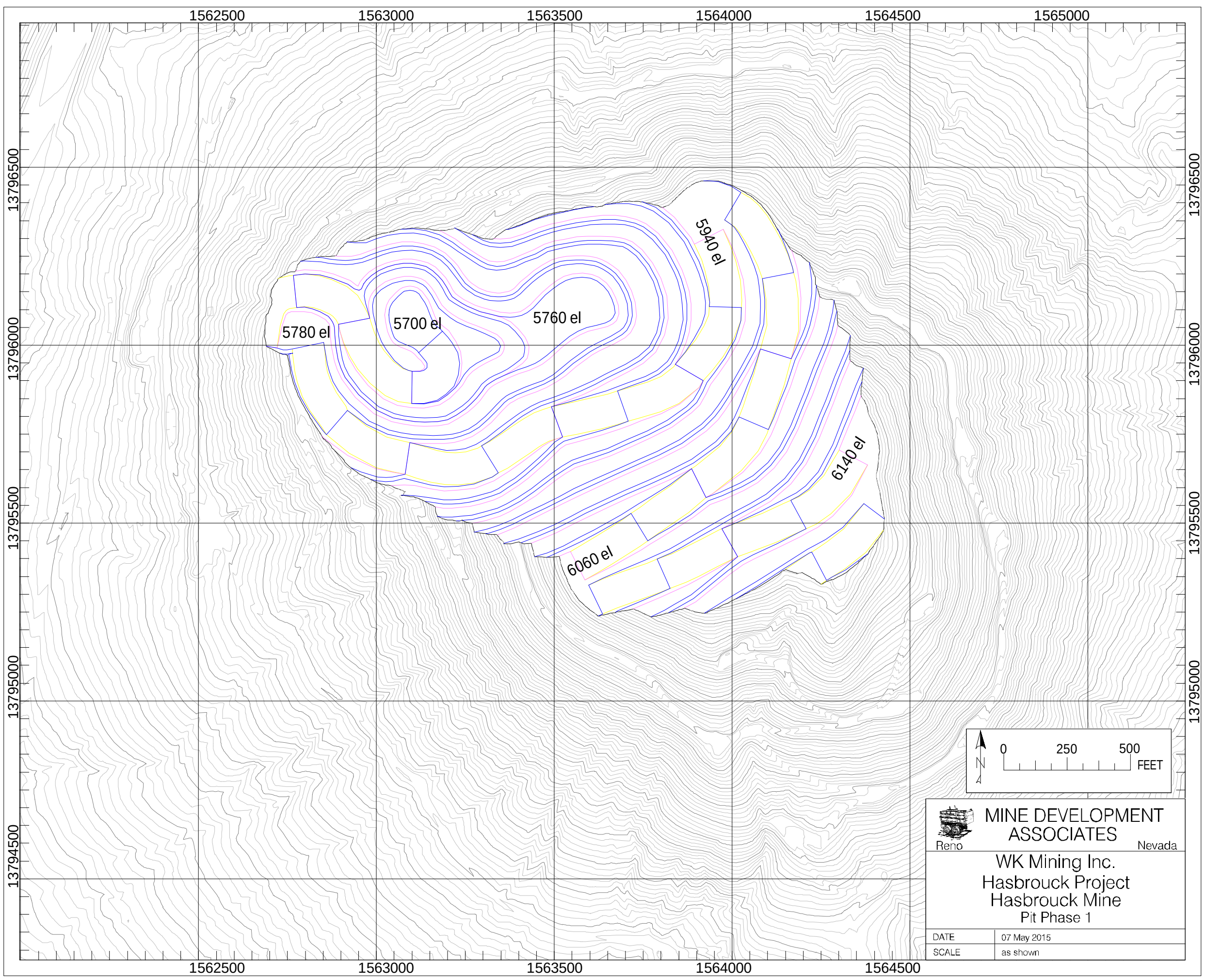


Figure 15.6 Hasbrouck Phase 2 Pit Design

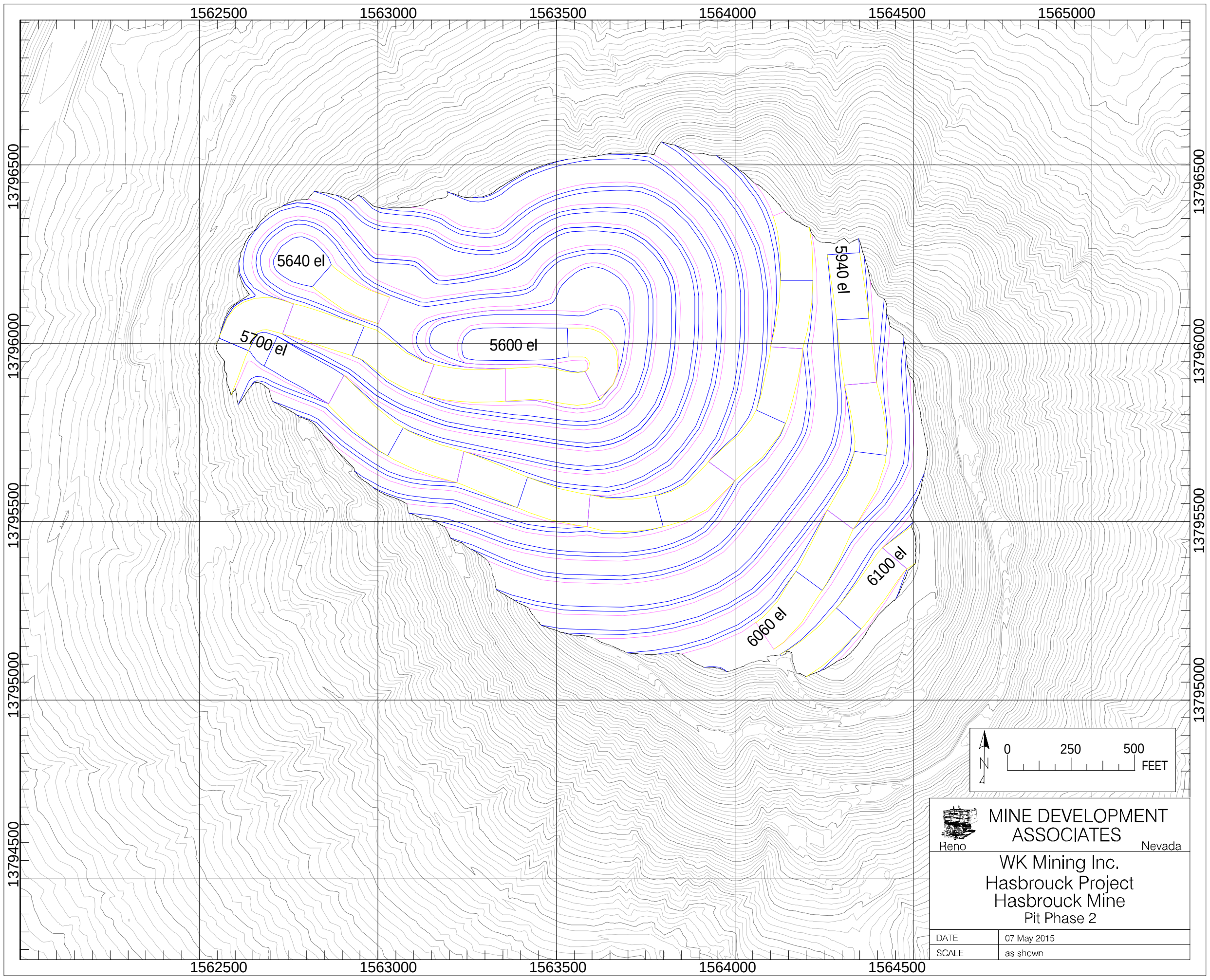
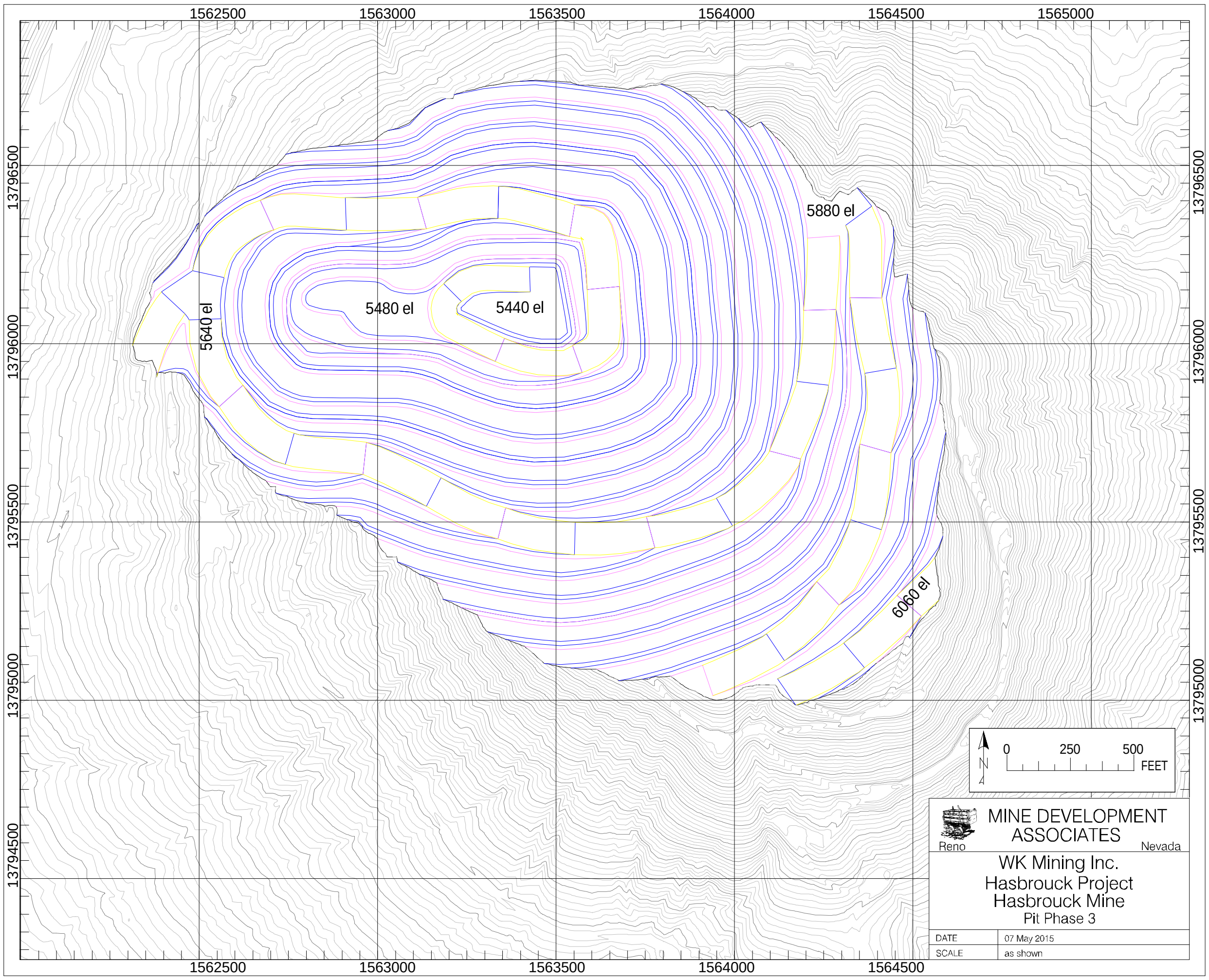


Figure 15.7 Hasbrouck Phase 3 Pit Design



15.4 Dilution

The resource models for the Three Hills and Hasbrouck deposits were created using 3-dimensional mineralized domains to confine the estimations by reporting grade and portion of each block within the various domains. The domains were then diluted back to the block size based on the contribution of each domain to the block. The resource models have block dimensions of 20ft long by 20ft wide by 20ft high for both Three Hills and Hasbrouck.

Because the resource models have been diluted to the block grades, MDA considers the block size to be reasonable and believes that this represents an appropriate amount of dilution for statement of reserves.

15.5 Three Hills and Hasbrouck Mine Proven and Probable Reserves

Table 15.12 through Table 15.15 report the Proven and Probable reserves for the Three Hills and Hasbrouck mines, based on the pit designs discussed in previous sections. These reserves are shown to be economically viable based on the Hasbrouck project cash flows created for the PFS and MDA believes that they are reasonable for the statement of Proven and Probable reserves. The reference point for the estimated reserves is at the exit from the respective open pits at the Three Hills and Hasbrouck mines. Summation discrepancies may be noticeable due to minor rounding issues.

Table 15.12 Three Hills Probable Reserves
(0.005oz Au/ton cutoff)

	K Tons	oz Au/ton	K Ozs Au
Probable	9,653	0.018	175

Cutoff grade for Three Hills reserves: 0.005 oz Au/ton

Table 15.13 Hasbrouck Proven and Probable Reserves

Upper Siebert	K Tons	oz Au/ton	K Ozs Au	oz Ag/ton	K Ozs Ag
Proven	1,301	0.020	26	0.387	504
Probable	5,576	0.016	89	0.260	1,452
Proven & Probable	6,877	0.017	114	0.284	1,955
Lower Siebert					
Proven	4,942	0.021	101	0.417	2,058
Probable	23,798	0.016	372	0.275	6,555
Proven & Probable	28,740	0.016	473	0.300	8,614
Total Hasbrouck					
Proven	6,242	0.020	127	0.410	2,562
Probable	29,374	0.016	461	0.273	8,007
Proven & Probable	35,617	0.017	588	0.297	10,569

Cutoff grade for Hasbrouck reserves: upper Siebert 0.008 oz Au/ton, and Hasbrouck lower Siebert 0.007 oz Au/ton

Table 15.14 Combined Three Hills and Hasbrouck Proven and Probable Reserves

	K Tons	oz Au/ton	K Ozs Au	oz Ag/ton	K Ozs Ag
Proven	6,242	0.020	127	0.410	2,562
Probable	39,028	0.016	635	0.205	8,007
Proven & Probable	45,270	0.017	762	0.233	10,569

Cutoff grade for Three Hills reserves: 0.005 oz Au/ton
Cutoff grade for Hasbrouck reserves: upper Siebert 0.008 oz Au/ton, and Hasbrouck lower Siebert 0.007 oz Au/ton