MINE DEVELOPMENT ASSOCIATES
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# Technical Report and Updated Preliminary Feasibility Study: Hasbrouck and Three Hills Gold-Silver Project Esmeralda County, Nevada

*Prepared for*

**WEST KIRKLAND MINING, INC.**

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# 1.0 EXECUTIVE SUMMARY

## 1.1 Introduction

Mine Development Associates ("MDA") has prepared this Technical Report and updated Preliminary Feasibility Study ("PFS") on the Hasbrouck gold-silver project, located in the state of Nevada, at the request of West Kirkland Mining Inc. ("WKM"), a Canadian corporation publicly traded on the TSX Venture Exchange (TSX: WKM). This report supersedes the Technical Report and PFS of Tietz et al. (2015). In January, 2014, WKM entered into an agreement with Allied Nevada Gold Corp. ("Allied") to acquire up to a 100% interest in Allied's Hasbrouck and Three Hills properties in Esmeralda County, Nevada. WKM's subsidiary, WK Mining (USA) Ltd., subsequently completed the acquisition of an initial 75% interest in the Hasbrouck and Three Hills properties from subsidiaries of Allied Nevada Gold Corp. ("ANV") on April 24, 2014. On September 11, 2014 WK Mining (USA) entered into a mining lease-to-purchase agreement with Eastfield Resources (USA) Inc., covering 7 patented mining claims that became part of the Three Hills Property. Total consideration to be paid over the life of the lease is CDN$280,000, of which CDN$155,000 has been paid. On June 19, 2015, Allied announced that the United States Bankruptcy Court for the District of Delaware had approved the sale of Allied's exploration properties and related assets (excluding the Hycroft operation) to Clover Nevada LLC ("Clover Nevada"), a wholly-owned subsidiary of Waterton Precious Metals Fund II Cayman, LP ("Waterton"), which included a 25% interest in the Hasbrouck project. The sale did not materially affect the contractual rights of WKM and WKM holds the title to the Hasbrouck properties. In this report the term WKM is used to refer to both West Kirkland Mining Inc., and WK Mining (USA), interchangeably.

The purpose of this Technical Report and updated Preliminary Feasibility Study is to provide an updated economic analysis for the Hasbrouck project, comprised of the Hasbrouck gold-silver deposit and the nearby Three Hills gold deposit. Project economics are improved, compared to the 2015 PFS, resulting from reduced estimates of capital and operating costs, and a slightly increased gold recovery at the end of the mine life. Changes in the current PFS include

- A reduction in diesel price;
- Detailing of Three Hills construction schedule;
- Deferment of the Three Hills gold plant and toll processing of carbon;
- Use of refurbished crushing and conveying equipment;
- Water sourced from wells instead of the town of Tonopah;

- Added gold recovery assumed during drain down of heap-leach pads;
- Reclamation and bond recalculation; and
- Metal price increase.

This report and the estimates provided herein have been prepared in accordance with the disclosure and reporting requirements set forth in the Canadian Securities Administrators' National Instrument 43-101 ("NI 43-101"), Companion Policy 43-101CP, and Form 43-101F1, as well as with the Canadian Institute of Mining, Metallurgy and Petroleum's "CIM Definition Standards - For Mineral Resources and Reserves, Definitions and Guidelines" ("CIM Standards") adopted by the CIM Council on May 10, 2014.

The Hasbrouck project comprises the Three Hills Mine and the Hasbrouck Mine. WKM made the strategic decision shortly after acquiring the properties in April, 2014, to permit each mine separately in order to accelerate permitting the Three Hills Mine under an Environmental Assessment, and to reduce the initial expenditure on permitting to just that necessary for the project to commence at the Three Hills Mine.

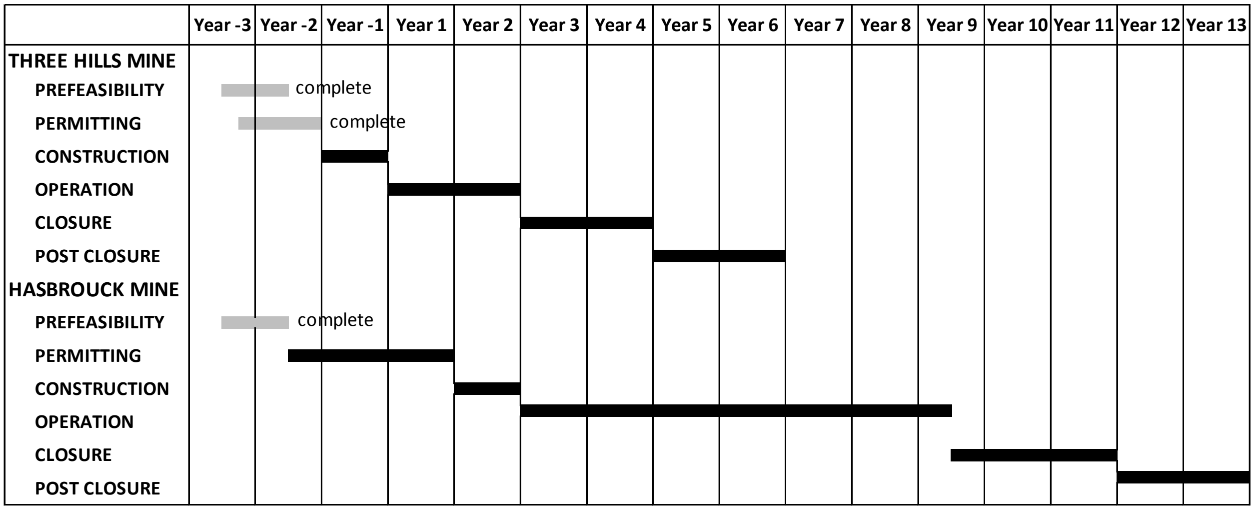
WKM started work on permitting the Three Hills Mine in June, 2014, with the final permit issued in June, 2016 (Table 1.1).

**Table 1.1 Three Hills Mine – Key Permit Acquisition Schedule**
(from WKM, 2016)

| KEY PERMITS | | |
|---|---|---|
| **PERMIT/APPROVAL** | **AGENCY** | **Issued** |
| Decision Record/Finding of No Significant Impact (DR/FONSI) | US Bureau of Land Management | 2015-11-25 |
| New Class I Air Quality Operating Permit to Construct (OPTC) | NV Bureau of Air Pollution Control | 2016-06-07 |
| New Class II Air Quality Operating Permit (AQOP) | NV Bureau of Air Pollution Control | 2016-06-07 |
| Mercury Operating Permit to Construct (MOPTC) | NV Bureau of Air Pollution Control | 2016-06-07 |
| Reclamation Permit (NRP) | NV Bureau of Mining Regulation and Reclamation | 2015-12-03 |
| Water Pollution Control Plan (WPCP) | NV Bureau of Mining Regulation and Reclamation | 2015-10-31 |

Permitting the Hasbrouck Mine has commenced and is planned to proceed concurrently with constructing and operating the Three Hills Mine, thereby allowing permits for the Hasbrouck Mine to be in hand when needed as shown in Figure 1.1 below. Year -2 and -3 occur prior to construction of the mine, and for this study those costs are consider to be sunk costs. Most of these activities have been completed to date. Year -1 represents the initiation of the project and when pre-production activities will commence.

**Figure 1.1 Hasbrouck Project Schedule**




Acquiring key permits for the Hasbrouck Mine is expected to take 33 months and $3 million. The nature of the permitting process does not allow accurate estimates of time and money; the amounts allowed in this study are considered conservative given the straightforward nature of the Hasbrouck Mine and recent experience of permitting similar operations in Nevada. The cost and time might be more than estimated, but are more likely to be less.

WKM commenced the process for obtaining permits for the Hasbrouck Mine by commissioning Enviroscientists Inc. to perform base-line botany studies in 2014 and 2015. A class III cultural survey was performed by Western Cultural Resource Management in 2011 with no findings that would have a negative impact on the project.

The Hasbrouck Mine plan presented in this report will require the typical amount of permitting for a mining operation in Nevada, including the completion of an Environmental Impact Statement ("EIS"). There appear to be no biological, cultural, hydrological, or geochemical issues that would otherwise delay or disrupt the timely process of applications for development.

There are no known environmental issues at either property that would be expected to have a material impact on WKM's ability to extract the mineral resources.

## 1.2 Access, Property Description and Land

The Hasbrouck gold-silver project includes two separate deposits, Hasbrouck and Three Hills, located in the northern portion of Esmeralda County, Nevada. The Three Hills deposit is located approximately 1 mile west of the town of Tonopah and is accessed via county-maintained roads from the northwest end of Tonopah and from US Highway 95 some 3 miles south of Tonopah. U.S. Highway 6 passes 1.25 miles north of the Three Hills deposit, and is a major east-west transportation corridor through central Nevada. The Hasbrouck deposit is located approximately 5 miles by road south of the town of Tonopah, and is accessed directly off U.S. Highway 95. U.S. Highway 95 is the main north–south transportation corridor through central Nevada and passes immediately to the west of the Hasbrouck deposit.

Elevations of the p roperties vary between 5,600ft and 6,300ft. The principal physiographic features of both the Hasbrouck and Three Hills deposits are prominent hills that rise 200-700ft off the valley floor. Vegetation in the area consists of sagebrush and other desert plants on the lower slopes and valleys. Trees are absent from the properties (including yucca brevifolia). The climate is semi-arid.. Average annual precipitation is 5 inches, which accumulates through winter snows and, to a lesser extent, summer thunderstorms.

The Three Hills deposit is covered by 13 patented claims and 100 unpatented lode claims occupying a total of approximately 1,967 acres in Sections 2, 3, 4, 5, 8, 9, 10 and 11, T2N, R42E, and Sections 33 and 34, T3N , R42E of the Mount Diablo Base and Meridian. The Hasbrouck deposit is covered by 28 patented mining claims and 583 unpatented mining claims occupying an area of approximately 10,750 total acres within Sections 1, 2, 3, 4, 5, 9, 10, 11, 12,13,14, 15,16, 21, 22, 23 and 24, T1N, R42E, Sections 6, 7, 18, 19 and 20, T1N, R43E, and Sections 27, 28, 29, 32, 33, 34, and 35, T2N, R42E of the Mount Diablo Base and Meridian.

All unpatented claims are located on U.S. federal land managed by the Battle Mountain District of the U.S. Bureau of Land Management ("BLM"). The unpatented claims are registered and recorded with the BLM, Esmeralda and Nye Counties as appropriate, but have not been surveyed by a mineral land surveyor. Mineral tenure is held in the name of WK Mining (USA) Ltd., which is a wholly-owned subsidiary of WKM. At the time of writing this report WKM had completed a transfer of the properties into an LLC, with a date of recordation in Nye County of September 9, 2106 and a date of recordation in Esmeralda County of September 12, 2016. At present 100% of the LLC is held by WKM. All required payments have been made to the appropriate authorities and the claims are in good standing.

Patented and unpatented claims at the Hasbrouck and Three Hills deposits are subject to mineral production royalties of between 2% and 4% net smelter return ("NSR"). At the Hasbrouck deposit, 19 of the patented claims and three of the unpatented mining claims are subject to a mineral production royalty of 4% NSR. The remaining 9 patented mining claims and 256 of the unpatented mining claims are subject to a mineral production royalty of 2% NSR.

## 1.3 History

Silver and gold mineralization was first discovered on Hasbrouck Mountain in 1902. Early mining exploited the Kernick vein, which was worked on a small scale through the mid-1920s. The early miners completed about 6,500ft of adits and 1,000ft of raises and recorded production of 740 tons of ore that grossed $10,406. A large, near-surface, low-grade gold-silver deposit was outlined by Cordex Exploration following surface and underground sampling, geologic mapping, rotary drilling and metallurgical testing conducted in 1974-1975 and 1980. During the 1980s and 1990s Franco-Nevada, FMC, Euro-Nevada, and Corona successively drilled the property before Newmont merged with Euro-Nevada in 2002 and took control of the property. Newmont vended the property to Vista Gold in 2003. Allied Nevada gained control of Hasbrouck when it was formed as a spin-off company from Vista in 2007. Allied Nevada conducted surface mapping, geochemical sampling, drilling, data verification, metallurgical studies, CSAMT and gravity surveys, and completed a preliminary economic assessment which is superseded by the 2015 PFS and this technical report. In 2014 WKM carried out geologic mapping, surface sampling, drilling and a structural geologic interpretation. WKM also conducted a re-interpretation of geophysical data obtained by previous operators.

Modern exploration at Three Hills began in 1974 when Cordex Exploration obtained the property. During the 1970's, 1980's and 1990's, Cordex, Saga Exploration, Echo Bay, Gexa Gold, Coeur D'Alene Mines, Eastfield Resources, and Euro-Nevada carried out various campaigns of surface mapping, sampling, geophysical surveys and drilling. Newmont acquired control of Three Hills via their merger with Euro-Nevada and subsequently sold the property to Vista Gold in 2003. Vista did not conduct exploration at Three Hills; the property was part of the spin-off to Allied Nevada in 2007. Allied Nevada initiated exploration at Three Hills in 2012. Drilling in 2012 and 2013 was focused on expanding known mineralization. During 2014 WKM performed geologic mapping, sampling, a gravity survey, drilling and detailed structural analysis at Three Hills.

## 1.4 Geology and Mineralization

The Three Hills deposit, located in the Tonopah Mining District, is a low-sulfidation, epithermal gold deposit, and occurs in a zone of pervasive silicification within the outcropping Siebert Formation immediately above and along the contact with the underlying Fraction Tuff. Mineralization occurs in discontinuous, irregular 0.05in to 0.5in wide veinlets, vein stockworks, and erratic breccia veins of chalcedony and quartz. Oxidation has destroyed sulfide minerals within the deposit. The currently drill-defined extent of mineralization is approximately 1,000ft east–west by 2,700ft north–south with a maximum depth of 500ft. Mineralization remains open at depth, down-dip to the east along the Siebert/Fraction Tuff contact.

The Hasbrouck deposit is a low-sulfidation, epithermal gold–silver deposit located in the western portion of the Divide Mining District. Host rocks are primarily tuffs and sediments of the Siebert Formation with limited mineralization within the underlying Fraction Tuff. An erosional remnant of silica sinter, deposited during hot spring activity, has been mapped near the top of the mountain. Gold and silver mineralization consists principally of 0.1in to 1.0in wide, discontinuous silica-pyrite veinlets, sheeted veinlets and stockworks, all closely associated with larger, but erratic bodies of hydrothermal breccia. Sulfide minerals have been largely oxidized. Mineralization is accompanied by strong pervasive silicification, with associated adularia and pyrite, and has a known extent of 2,800ft east–west by 2,400ft north–south, with a maximum depth of 900ft. Mineralization is open at depth and to a limited extent to the northwest and east.

## 1.5 Drilling

For Three Hills, the current database includes 291 drill holes with a total of 88,199ft of historical drilling performed from 1974 through 2013. During 2014, WKM drilled 3 diamond-core holes and 11 reverse-circulation ("RC") holes. The diamond-core holes were drilled within the Three Hills gold-silver deposit to obtain samples for geotechnical studies. The 2014 RC holes were drilled mainly to expand the eastern and down-dip portions of the Three Hills resource. It is MDA's opinion that the 2014 RC holes do not materially affect the current resource estimate due to their locations and therefore have not been included in the current resource database. The drilling does show that the deposit is open to the east, and more drilling may add more resources in this area.

The current database for the Hasbrouck deposit contains a total of 216,760ft of historical drilling completed by five companies from 1974 through 2012. This includes 28,606ft of diamond-core drilling in 43 holes, and 188,154ft of RC and conventional rotary drilling in 274 holes. During 2014, WKM completed 4,150ft of RC drilling in 14 drill holes at the Hasbrouck deposit. All of the 2014 holes are external to the estimated mineral resources and are not included in the current database.

## 1.6 Sample Preparation, Analyses and Security

MDA has evaluated the available information for historical sample preparation methods, analytical procedures and sample security. MDA concludes that the sampling, assaying, and security procedures used at Three Hills and Hasbrouck have followed industry standard procedures, and are adequate for the estimation of the current mineral resources.

## 1.7 Data Verification

MDA completed a full audit of the Allied 2010-2013 drill data at Three Hills and Hasbrouck for the current resource estimate. QA/QC data are not available for drilling conducted before 2010. 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 mineral resources.

## 1.8 Metallurgical Testing

Column-leach and bottle-roll cyanide extraction tests indicate that mineralization comprising the Three Hills and Hasbrouck gold-silver deposits is amenable to cyanide heap leaching. An average gold recovery of 79.0% is estimated for Three Hills mineralization based on expected run-of-mine ("ROM") (no crushing) particle sizes. An additional 2.5% gold recovery is forecast during the final drain down of the Three Hills Mine heap-leach facility. Silver contents are low and recovery of silver has not been estimated, but is expected to be negligible.

Testing of material from the Hasbrouck deposit has shown that gold recoveries increase with decreasing particle size and also vary with the stratigraphic hosts to the mineralization. An average gold recovery of 75.8% has been estimated for mineralization in the lower Siebert unit, and an average gold recovery of 61.0% has been estimated for mineralization in the upper Siebert. Silver recovery has been estimated to average 11% for both units. These recoveries assume primary jaw crushing and secondary cone crushing, followed by tertiary high-pressure grinding-roll crushing. An additional 1.5% gold recovery is forecast during the final drain down of the Hasbrouck Mine heap-leach facility.

Increased gold recovery of 2.5% and 1.5% during drain-down of heap-leach pads at the Three Hills and Hasbrouck Mines, respectively, was included in this study. These values were derived from the gold recovery-time curves at each mine. Drain-down recovery is generally not included in economic studies, but recovery during drain-down is in fact realized at most leaching operations. While there is a risk that the full drain-down recovery will not be realized in actual production, recognizing gold recovered during drain-down is considered valid and appropriate in this case.

## 1.9 Mineral Resources Estimate

The modeling and estimation of the mineral resources at the Hasbrouck Project were completed under the supervision of Paul Tietz, a qualified person with respect to mineral resource estimations under NI 43-101.

To complete the resource estimation for the Three Hills deposit, the drill data were evaluated statistically, geology and gold mineral domains were interpreted on east-west oriented cross sections spaced at 100-foot intervals that span the extents of the presently defined deposit, and the gold mineral domains were refined on north-south oriented long sections spaced at 20-foot intervals. The final modeled gold mineral domains were then coded into a 20ft x 20ft x 20ft block model and used to constrain the gold grade estimation. Grade estimation was by Inverse Distance Cubed (“ID3”). The effective date of the Three Hills resource estimate is August 5, 2014.

The Three Hills deposit gold resources, at the reported 0.005oz Au/ton cutoff grade, are inclusive of estimated reserves and are summarized in Table 1.2 (effective date: August 4, 2014).

**Table 1.2 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

To complete the resource estimation for the Hasbrouck deposit, the drill data were evaluated statistically, geology and gold and silver mineral domains were interpreted on cross sections spaced at 50- and 100-foot intervals that span the extents of the presently defined deposit, and the mineral domains were refined on level plans spaced at 10-foot intervals. The final modeled mineral domains were then coded into a 20ft x 20ft x 20ft block model and used to constrain the gold and silver grade estimations. Grade estimation was by Inverse Distance Squared (“ID2”). The effective date of the Hasbrouck deposit resource estimate is November 3, 2014.

The Hasbrouck deposit gold and silver resources, at the reported 0.006oz AuEq/ton cutoff grade, are inclusive of estimated reserves and are summarized in Table 1.3 (effective date: November 3, 2014). The gold-equivalent (“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 an approximate 4:1 difference in gold versus silver recovery in the proposed heap-leach processing scenario.

**Table 1.3 Hasbrouck Deposit Reported Mineral Resources (0.006oz AuEq/ton Cutoff)**
oz AuEq/ton = oz Au/ton + (oz Ag/ton x 0.000417)

| 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

## 1.10 Mineral Reserves Estimate

MDA has used Measured and Indicated resources as the basis to define reserves for both the Three Hills and Hasbrouck deposits, which together compose the Hasbrouck project. Open-pit mining was selected as the mining method. Reserve definition was done by identifying ultimate pit limits using economic parameters and pit optimization techniques. The economic parameters used for pit optimization are presented in Table 1.4.

**Table 1.4 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 |

Crushing and stacking costs do not apply to Three Hills because Three Hills ore will be processed using ROM leaching.

Silver was not used to generate value in Three Hills because there are no stated silver resources for that deposit. For the Hasbrouck deposit, the value from silver was calculated with constant silver to gold ratio based on $1,250/oz Au to $18.00/oz Ag prices. Gold and silver recoveries were applied based on initial estimates provided by Herb Osborne of H.C. Osborne and Associates, the Qualified Person responsible for Section 13.0. Table 1.5 shows the recoveries used for each deposit.

**Table 1.5 Metallurgical Recoveries**

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

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 using a 5% discount rate and a processing limit of 5,400,000 tons per year. The gold price used for the Hasbrouck project cash-flow calculation was $1,275 per ounce gold and $18.21 per ounce silver. MDA believes that the pit designs resulting from the initial analysis are well within reason.

Pit designs were created using 20ft bench heights for mining. This corresponds to the resource model block heights. Because the resource models have been diluted to the block grades, MDA considers the block size to be reasonable with respect to dilution and equipment anticipated to be used in mining, and believes that this represents an appropriate amount of dilution for statement of reserves.

Proven and Probable reserves for the Three Hills and Hasbrouck deposits are shown in Table 1.6 and Table 1.7, respectively. Total Proven and Probable reserves for the entire Hasbrouck project are shown in Table 1.8. These reserves are shown to be economically viable based on the Hasbrouck project cash flows and MDA believes that they are reasonable for the statement of Proven and Probable reserves.

**Table 1.6 Three Hills In-Pit Probable Reserves**

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

Three Hills Proven and Probable reserves were defined using a 0.005 oz Au/t cutoff

**Table 1.7 Hasbrouck In-Pit 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 |

Hasbrouck upper Siebert Proven and Probable reserves were defined using a 0.008 oz Au/t cutoff
Hasbrouck lower Siebert Proven and Probable reserves were defined using a 0.007 oz Au/t cutoff

**Table 1.8 Total Hasbrouck Project In-Pit 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 |

***Some summation discrepancies may be noticeable to minor rounding issues***

## 1.11 Mining Methods

The Hasbrouck project PFS includes mining at both the Three Hills Mine and the Hasbrouck Mine. These are planned as open-pit, truck and loader operations. Access roads were included in the pit and waste rock storage area designs, which were considered suitable for the type of equipment used. Waste rock storage areas were designed to contain the rock waste associated with the reserves. One main waste rock storage areas was identified for Three Hills and 2 additional waste rock storage areas were designed for Hasbrouck. Safety berms were designed between the designed pits and dumps and US Highway 50 to contain any material that may try and roll off of the mining site.

The PFS has been based on contract mining. Only Proven and Probable reserves were used to schedule mine production, and Inferred resources inside of the pit were considered as waste.

Three Hills production schedules have been completed based on a 15,000tpd production requirement for the ROM heap-leach pad. Detailed monthly schedules were created for the construction period based on construction requirements for heap-leach over-liner and fill material requirements defined by NewFields. In total, 504,000 cubic yards (702,000 tons) of waste rock is scheduled for construction purposes.

Ore placed on the pad at Three Hills Mine had a lag time applied so that gold production was not assumed at time of placement. The schedule assumed that the operational recovery of 79% would take up to 8 months. Drain-down recovery of 2.5% was assumed during the 12 months after final operational recovery was achieved.

Hasbrouck Mine production schedules were completed based on a 17,500tpd production requirement. Mining at Hasbrouck was assumed to start during the second year of production for the project. Little pre-stripping is required as ore is located near the surface, though waste rock is mined early to provide construction fill material.

A lag time in gold recovery was applied to ore placed on the heap-leach pad. The schedule assumed that the full recovery of recoverable gold placed on the pad would take up to 8 months. Upper Siebert ore was assigned a 55.6% operational recovery and lower Siebert was assigned a 76.6% operational recovery. Both ore types were assigned 11% recovery for silver. Drain-down gold recovery of 1.5% was assumed during the 24-months after operational recovery was achieved. No drain-down recovery of silver was assumed.

It is anticipated that the contractor will have between 60 and 80 operators and staff involved with the operation. It has been assumed that the contractor will work 12 hour shifts, 2 shifts per day, 7 days per week. Other mine personnel will be maintained by the owner for general activities, including mine supervision, engineering, surveying, geology, and ore control.

All mining is anticipated to be above the water table, so no dewatering wells will be required. Storm water that enters the pit will be handled by allowing for sumps in the pit as needed. Any excess water that doesn't naturally infiltrate into the ground will be placed in water trucks using a portable pump and then used for dust control on haul roads.

## 1.12 Mineral Processing

The Hasbrouck project will utilize two separate heap-leach facilities to be located approximately 5 miles apart. The Three Hills Mine will be constructed and operated first, and will be a 15,000 ton per day, ROM operation, utilizing conventional, cyanide heap leaching of ore stacked on a single use pad. Gold will be leached with dilute cyanide solution and recovered from the solution using a carbon adsorption circuit. Loaded carbon will be processed offsite by "toll-stripping" where the carbon is stripped of metal in a desorption-recovery plant and returned for re-use along with the doré product. If required, loaded carbon may also be processed by "ashing" where carbon is smelted directly to produce doré bars.

The Hasbrouck Mine will be constructed after production commences at the Three Hills Mine so as to be ready to produce when Three Hills Mine ceases production, and will be a 17,500 ton per day heap-leach operation utilizing conventional heap leaching of crushed ore stacked on a single-use pad. Crushing will be performed in three stages: mined ore will pass first through a primary jaw crusher and a secondary cone crusher, and then through a high-pressure grinding-roll unit. Agglomeration with cement will be required prior to stacking of ore on the heap. Gold and silver will be leached with a dilute cyanide solution and recovered using a carbon adsorption-desorption-recovery ("ADR") process to produce doré bars.

## 1.13 Project Infrastructure -Water, Power and Buildings

Water for both the Three Hills and Hasbrouck Mines is planned to be obtained from wells that will be drilled near each mine. HDPE pipelines will be installed from the wells to a 500,000 gallon water storage tank at each site. These tanks will store water for use as process make-up and fire water. No potable water supply will be installed at Three Hills Mine, potable water being obtained from the town of Tonopah water system. A potable water system will be installed at Hasbrouck Mine. This requires obtaining a water right to appropriate groundwater. Water rights are available for lease or purchase from 2 mining companies and a local land owner.

Electrical power at the Three Hills Mine will be supplied by a generator fueled by liquefied natural gas. Power at the Hasbrouck Mine will be supplied by NV Energy, the regional power distribution company. An overhead powerline will be installed connecting the switching station to the Hasbrouck Mine.

The estimated connected load at the Three Hills mine site (not including the laboratory which is to be located in Tonopah) is 0.9 MW, with an average draw of 0.6 MW.

At the Hasbrouck Mine the attached load for the water supply system, the crushing system, the conveying and stacking system, the ADR plant and ancillary equipment is estimated to be 6.5 MW, with an average draw of 4.1 MW.

Diesel-fired backup generators will be installed in the process area at each mine site to provide emergency power.

Administration, safety, mine operations, warehouse, assay laboratory (to be located in Tonopah), process buildings, and process maintenance buildings are planned for the Hasbrouck project. During the time that Three Hills Mine will be operated, buildings in Tonopah will be rented. During the time the Hasbrouck Mine will be operated, three trailers of double- and triple-wide sizes will be installed for offices, safety, and conference and training purposes.

A full service laboratory will be established, sized to process 100 solid samples per day and 150 solution samples per day. The laboratory will be installed in a building that is to be rented in the town of Tonopah.

The process shop and warehouse at the Three Hills Mine will be a single, 2,900 $ft^2$ steel building located near the CIC adsorption circuit. The process shop and warehouse at Hasbrouck will be a 3,430 $ft^2$ steel building located near the ADR plant.

The reagents storage building at the Hasbrouck Mine will be 1500 $ft^2$. The ADR plant will be a steel building approximately 145ft x 42ft x 44ft high. An additional section approximately 14ft x 25ft x 20ft high for the caustic area will be attached to the ADR section. The refinery will be approximately 79.5ft x 44.5ft x 22.75ft high, and will share a wall with the ADR building. The refinery area will contain a secure space for a safe.

## 1.14 Environmental Studies, Permitting and Social Impact

Mineral exploration at both the Three Hills Mine and the Hasbrouck Mine is authorized by the U. S. Bureau of Land Management ("BLM") under multiple Notices, each of which authorizes up to five acres of disturbance and is bonded with the BLM. Existing disturbances and bond amounts for each Notice are shown in Table 1.9.

**Table 1.9 Existing Disturbance and Notices for the Hasbrouck Project**

| Notice # | Disturbance Acreage | Bond Amount |
|---|---|---|
| NVN-91216 | 4.88 | $ 65,450.00 |
| NVN-89964 | 1.84 | $ 14,033.00 |
| NVN-89750 | 4.53 | $ 18,758.00 |

On purchasing the properties in 2014, WKM chose to permit the Three Hills and Hasbrouck Mines separately in order to take advantage of the fact that the Three Hills Mine could be permitted under the relatively short and simple environmental assessment process rather than the much longer environmental impact statement process that would have been required if the two mines had been permitted as one operation. This decision resulted in key permits to construct and operate the Three Hills Mine being obtained by June 2016. Work on permitting the Hasbrouck Mine has been ongoing since 2014 to ensure that permits for Hasbrouck Mine will be in hand to allow continuous production Three Hills Mine comes to an end.

WKM is in the process of acquiring permits for the Hasbrouck Mine and anticipates this will take up to 2 years and cost $3 million. A Plan of Operations will be submitted for the Hasbrouck Mine when operational and baseline surveys are complete and operations and design for the project are at a level where a Plan Application can be developed to the necessary level of detail.

The review and approval process for the Plan by the BLM constitutes a federal action under the National Environmental Policy Act ("NEPA") and BLM regulation. Thus, for the BLM to process the Plan Application the BLM is required to comply with NEPA and prepare either an Environmental Assessment ("EA"), or an Environmental Impact Statement ("EIS").

## 1.15 Capital and Operating Costs

MDA has authored Section 21.0, Capital and Operating Costs, with subsections for Process Capital and Process Operating costs provided by KCA. NewFields has provided inputs for Processing Capital and also some input to Infrastructure Capital Costs, which are included in the Other Capital Costs (Section 21.9).

Initial capital at the start of the project for the startup of Three Hills Mine is estimated to be $46,742,000, which includes working capital of $4,864,000. Growth capital is $90,556,000 attributed to the startup of Hasbrouck Mine, and sustaining capital is $10,560,000, including the return of working capital. A summary of capital costs is shown in Table 1.10.

**Table 1.10 Hasbrouck Project Capital Cost Summary**

| *Direct Costs* | Units | Initial | Growth | Sustaining | Total |
|---|---|---|---|---|---|
| Pre-Production | K USD | $ 5,813 | $ 190 | | $ 6,003 |
| Mining | K USD | $ 184 | $ 77 | $ 127 | $ 388 |
| Plant and Recovery | K USD | $ 8,073 | $ 38,313 | $ - | $ 46,386 |
| Leach Pads | K USD | $ 7,617 | $ 10,048 | $ 9,348 | $ 27,012 |
| Ponds and Site Infrastructure | K USD | $ 1,948 | $ 2,910 | $ - | $ 4,858 |
| Water Supply | K USD | $ 1,740 | $ 3,030 | $ - | $ 4,770 |
| Roads | K USD | $ 1,013 | $ 1,039 | $ - | $ 2,052 |
| Light Vehicles | K USD | $ 490 | $ 113 | $ 336 | $ 938 |
| Site and Administration | K USD | $ 47 | $ 77 | $ - | $ 124 |
| Safety & Security | K USD | $ 82 | $ 5 | $ 10 | $ 97 |
| Owner's Capital | K USD | $ 6,383 | $ 10,506 | $ (2,247) | $ 14,642 |
| ***Total Direct Costs*** | K USD | $ 33,389 | $ 66,308 | $ 7,573 | $ 107,270 |
| ***Indirect Costs*** | | | | | |
| Initial Fills | K USD | $ 146 | $ 1,764 | $ - | $ 1,910 |
| Indirects | K USD | $ 1,229 | $ 2,615 | $ 421 | $ 4,265 |
| EPCM | K USD | $ 1,466 | $ 5,465 | $ 514 | $ 7,445 |
| Newmont Buyout | K USD | $ - | $ 1,000 | $ - | $ 1,000 |
| ***Total Indirects*** | K USD | $ 2,841 | $ 10,844 | $ 935 | $ 14,620 |
| ***Contingencies*** | | | | | |
| Mining (15%) | K USD | $ 550 | $ 30 | $ - | $ 579 |
| Plant and Recovery (20%) | K USD | $ 1,760 | $ 7,560 | $ - | $ 9,320 |
| Leach Pads (15% - 25%) | K USD | $ 1,142 | $ 2,512 | $ 2,337 | $ 5,991 |
| Roads, Ponds, Water, and Infrastructure (25%) | K USD | $ 1,145 | $ 1,697 | $ - | $ 2,842 |
| Other (15%) | K USD | $ 1,050 | $ 1,605 | $ (285) | $ 2,370 |
| Total Contingency | K USD | $ 5,647 | $ 13,404 | $ 2,052 | $ 21,103 |
| Total Capital Cost | K USD | $ 41,878 | $ 90,556 | $ 10,560 | $ 142,993 |
| Working Capital | K USD | $ 4,864 | $ (4,864) | $ - | $ - |
| Total Capital w/ Working Capital | K USD | $ 46,742 | $ 85,692 | $ 10,560 | $ 142,993 |

Mining and re-handle operating costs were estimated by MDA based on first principle costs plus the addition of the contractor's assumed recovery of mining capital and profit margin of 15%. Processing operating costs were estimated by KCA. General and administrative costs and Nevada net proceeds tax were estimated by MDA. Reclamation costs were estimated by Enviroscientists Inc. and Paul Sterling using BLM reclamation cost estimate spreadsheets.

The total cost per ton processed for all ore is $8.33. Table 1.11 shows a summary of the operating cost estimate.

Note that Table 1.13 shows an operating cost of $8.43 per ton based on the World Gold Council Adjusted Operating Cost definition. This apparent discrepancy is due to inclusion of silver credits and exclusion of reclamation costs in the World Gold Council definition.

**Table 1.11 Operating Cost Summary**

| | | K USD | USD per ton Processed |
|---|---|---|---|
| ***Three Hills*** | Mining Cost | $ 30,670 | $ 3.18 |
| | Process Cost | $ 24,575 | $ 2.55 |
| ***Hasbrouck*** | Mining Cost | $ 130,943 | $ 3.68 |
| | Process Cost | $ 139,963 | $ 3.93 |
| | Re-handle | $ 2,340 | $ 0.07 |
| ***Total*** | Mining Cost | $ 161,613 | $ 3.57 |
| | Process Cost | $ 164,538 | $ 3.63 |
| | Re-handle | $ 2,340 | $ 0.05 |
| | G&A Cost | $ 20,621 | $ 0.46 |
| | Reclamation - Three Hills | $ 3,419 | $ 0.35 |
| | Reclamation - Hasbrouck | $ 5,519 | $ 0.15 |
| | Nevada Net Proceeds Tax | $ 19,201 | $ 0.42 |
| | Net Operating Cost | $ 377,251 | $ 8.33 |

## 1.16 Economic Analysis

MDA completed an economic analysis based on the cash flow developed from the production schedule and the capital and operating costs previously discussed. Table 1.13 shows a summary of key information for the Hasbrouck project. The life-of-project after-tax net present value is $120,384,000 using a 5% discount rate. The payback period is 3.11 years and the internal rate of return is 43%. These values are based on 100% of the project; WKM has a 75% interest in the project and has the right to make an offer on the remaining 25%.

Hasbrouck Project economic results are shown in Table 1.12.

**Table 1.12 Hasbrouck Project Economic Results**

| | | |
|---|---|---|
| Pre-Tax Payback Period | Years | 2.95 |
| After-Tax Payback Period | Years | 3.11 |
| Pre-Tax Net Present Value | 5% | $145,282 |
| | 8% | $118,546 |
| | 10% | $103,544 |
| Pre-Tax Internal Rate of Return | IRR | 49% |
| After-Tax Net Present Value | 5% | $120,384 |
| | 8% | $ 97,387 |
| | 10% | $ 84,484 |
| After-Tax Internal Rate of Return | IRR | 43.2% |

**Table 1.13 Hasbrouck Project Highlights Based on 100% of the Project**

| | Units | Three Hills Mine | Hasbrouck Mine | Total Hasbrouck Project |
|---|---|---|---|---|
| **PROJECT STATISTICS** | | | | |
| HEADGRADE | oz Au/ton - g Au/t | 0.018 - 0.62 | 0.017 - 0.57 | 0.017 - 0.58 |
| Ore | million tons | 10 | 36 | 45 |
| Annual Ore | million tons | 5 | 6 | 6 |
| Processing Rate | tons per day | 15,000 | 17,500 | 15,986 |
| Stripping Ratio | waste:ore | 0.9 | 1.1 | 1.1 |
| Contained Metal | | | | |
| Gold Grade | oz Au/ton - g Au/t | 0.018 - 0.62 | 0.017 - 0.57 | 0.017 - 0.58 |
| Silver Grade | oz Ag/ton - g Ag/t | NA | 0.297 - 10.17 | 0.233 - 8.00 |
| Gold Equivalent Grade (1) | oz AuEq/ton - g AuEq/t | 0.018 - 0.62 | 0.017 - 0.59 | 0.017 - 0.59 |
| Gold | kOz | 175 | 588 | 762 |
| Silver | kOz | NA | 10,569 | 10,569 |
| Gold Equivalent (1) | kOz | 175 | 610 | 784 |
| Recoverable Metal | | | | |
| Gold Recovery | % | 81.5% | 74.0% | 75.7% |
| Silver Recovery | % | | 11.0% | 11.0% |
| Gold | kOz | 142 | 435 | 577 |
| Silver | kOz | NA | 1,163 | 1,163 |
| Gold Equivalent ($1,275/$18.21) | kOz | 142 | 452 | 594 |
| Average Annual Gold Production | kOz | 69 | 71 | 71 |
| Averge Annual Silver Production (2) | kOz | NA | 194 | 194 |
| Average Annual AuEq Production | kOz | 69 | 74 | 74 |
| | | | | |
| Gold Price | US$/oz | $ 1,275 | $ 1,275 | $ 1,275 |
| Silver Price | US$/oz | NA | $ 18.21 | $ 18.21 |
| | | | | |
| **CAPITAL** | | | | |
| Initial Capex | US$ million | $ 47 | | |
| Growth Capex | US$ million | | $ 83 | |
| Sustaining Capex | US$ million | | $ 13 | |
| LOM Capex | US$ million | | | $ 143 |
| Contingency (included) | US$ million | $ 6 | $ 15 | $ 21 |
| Contingency (included) | % | 14% | 19% | 17% |
| **OPERATING COST** | | | | |
| Adjusted Operating Cost per Ton of Ore (3) | US$/ton ore | $ 7.40 | $ 8.71 | $ 8.43 |
| Mining | US$/ton ore | $ 3.18 | $ 3.74 | $ 3.62 |
| Processing | US$/ton ore | $ 2.55 | $ 3.93 | $ 3.63 |
| G&A | US$/ton ore | $ 0.44 | $ 0.46 | $ 0.46 |
| Other (4) | US$/ton ore | $ 1.23 | $ 0.58 | $ 0.72 |
| Adjusted Operating Cost (3) | US$/oz Au net of by-products | $ 502 | $ 714 | $ 661 |
| All-in Sustaining Cost (5) | US$/oz Au net of by-products | $ 544 | $ 774 | $ 717 |
| Mine Life | year | 1.7 | 7.1 | 8.8 |
| PROJECT ECONOMICS | | | | |
| NPV (5%) - after tax | US$ million | | | $ 120.4 |
| IRR - after tax | % | | | 43% |
| Payback Period | year | | | 3.1 |

Notes:
(1) Gold equivalent calculations are made using the ratio of recovered silver / gold and metal prices.
(2) Silver production is averaged over the Hasbrouck Mine life only
(3) World Gold Council - Adjusted Operating Costs include:
On-site mining and G&A, royalties and production taxes, permitting and community cost related to current operations, 3rd party smelting, refining and transport costs, stock-piles and inventory write-downs, site-based non-cash remuneration, operational stripping costs and by-product credits.
(4) Other category includes royalties, production taxes, permitting, refining, and by-product credit
(5) World Gold Council All-in Sustaining Costs includes:
Adjusted Operating Costs (above) plus corporate G&A, reclamation & remediation—accretion & amortization, expenditures sustaining exploration and study costs, capital exploration, capitalized stripping and sustaining capital.
(6) World Gold Council - All-in Sustaining Costs includes:
Adjusted Operating Costs (above) plus corporate G&A (including share-based remuneration), reclamation & remediation - accretion & amortization (on-site), sustaining exploration and study costs, sustaining capital exploration, capitalized stripping and sustaining capital expenditure.
(7) Project economics are presented for 100% of the project which is jointly owned by WKM (75%) and Waterton Precious Metals Fund(25%).
(8) Some totals may not sum properly due to rounding.

## 1.17 Comparison of 2016 PFS to 2015 PFS

Table 1.14 shows a comparison between the 2015 PFS and the current, 2016 PFS, and the relative impacts on the NPV (5%), IRR, initial capital, and life-of-mine ("LOM") cash flows. The NPV in this study is higher by $45 million, the largest factors in producing this difference being the higher metal prices used in the study and assumptions for drain-down recovery of gold. The next largest differences are the reduction of mining costs due to lower fuel prices, followed by savings on water costs by sourcing water from water wells instead of the Tonopah city water assumed in the 2015 PFS.

### Table 1.14 Economic Comparisons – 2015 PFS vs 2016 PFS

| Item | NPV (5%) (US $M) | IRR (%) | Initial Capital (US $M) | LOM Cash Flow (US $M) | Payback (years) |
|---|---|---|---|---|---|
| **2015 Prefeasibility Study** | **$75** | **25.6%** | **$54** | **$117** | **3.7** |
| **Impact on After Tax** | | | | | |
| **Changes Made in 2016 PFS** | | | | | |
| Diesel Cost Reduced | $7 | 2.3% | $0 | $10 | |
| Pre-Production Mining Cost Increased | $1 | -0.6% | $5 | $1 | |
| Gold Plant Deferred (2 Years) | $1 | 2.3% | -$6 | $0 | |
| Refurbished Crushing & Conveying Plant | $3 | 1.6% | $0 | $4 | |
| Water Sourced from Wells | $7 | 7.1% | -$1 | $3 | |
| Gold Recovered During Drain Down Recognized | $10 | 1.7% | $0 | $15 | |
| Reclamation Bond Amounts Recalculated | $0 | 0.3% | -$2 | $0 | |
| Metal Price Increased ($1,275/$18.21 vs $1,225/$17.50) | $19 | 5.2% | $0 | $24 | |
| Other * | -$3 | -2.4% | -$4 | -$2 | |
| **Summed Changes Made in 2016 PFS** | **$45** | **17.6%** | **-$8** | **$55** | |
| **2016 Prefeasibility Study** | **$120** | **43.2%** | **$47** | **$171** | **3.1** |

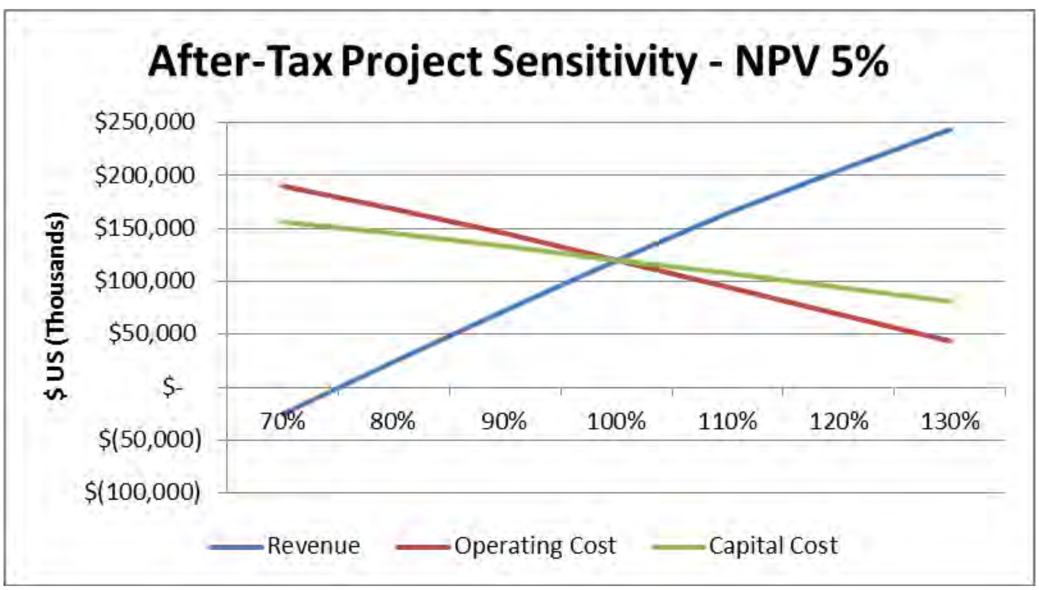
## 1.18 Project Sensitivity

Project sensitivities were analyzed with respect to gold price, revenues, operating costs, and capital costs. As with most precious metal projects, the Hasbrouck project is most sensitive to gold price and revenue. Table 1.15 shows the sensitivity analysis by gold price. Figure 1.2 shows the project sensitivity to changes in revenue, operating costs, and capital costs graphically.

**Table 1.15 After-Tax Project Sensitivity**

| | After Tax Sensitivity - Metal Price (K USD) | | | | | |
|---|---|---|---|---|---|---|
| **Au Price** | **Undisc. CF** | **NPV 5%** | **NPV 8%** | **NPV 10%** | **IRR** | **Ag Price** |
| $ 1,000 | $ 36,130 | $ 16,779 | $ 8,124 | $ 3,313 | 12% | $ 14.29 |
| $ 1,050 | $ 61,589 | $ 36,237 | $ 24,870 | $ 18,530 | 18% | $ 15.00 |
| $ 1,100 | $ 86,063 | $ 54,971 | $ 41,009 | $ 33,204 | 24% | $ 15.71 |
| $ 1,150 | $ 110,847 | $ 73,937 | $ 57,345 | $ 48,057 | 30% | $ 16.43 |
| $ 1,200 | $ 135,024 | $ 92,477 | $ 73,332 | $ 62,603 | 35% | $ 17.14 |
| $ 1,225 | $ 147,164 | $ 101,779 | $ 81,350 | $ 69,896 | 38% | $ 17.50 |
| $ 1,250 | $ 159,305 | $ 111,082 | $ 89,369 | $ 77,190 | 41% | $ 17.86 |
| **$ 1,275** | **$ 171,446** | **$ 120,384** | **$ 97,387** | **$ 84,484** | **43%** | **$ 18.21** |
| $ 1,300 | $ 183,587 | $ 129,687 | $ 105,406 | $ 91,778 | 46% | $ 18.57 |
| $ 1,350 | $ 207,174 | $ 147,764 | $ 120,992 | $ 105,958 | 51% | $ 19.29 |
| $ 1,400 | $ 230,210 | $ 165,393 | $ 136,179 | $ 119,768 | 56% | $ 20.00 |
| $ 1,500 | $ 275,060 | $ 199,698 | $ 165,723 | $ 146,628 | 65% | $ 21.43 |

**Figure 1.2 After-Tax Project Sensitivity**



## 1.19 Risks and Opportunities

MDA has identified a number of external and internal risks and opportunities that may affect the economics of the Hasbrouck project.

### External Risks

- The project's economic viability is generally at risk from changes in external factors which would lead to increases in input costs (construction costs, operating costs), or a fall in the price of gold or silver which would reduce revenue.
- A decrease in gold or silver price would not only reduce revenue, but would also reduce the amount of economically minable ore as a decrease in metal prices would result in a higher cut-off grade  Under the current gold price environment, the reserves are considered robust.
- While no environmental and permitting risks are currently identified, and permits are in-hand for the Three Hills Mine, this is an area where risk to cost and schedule generally exist.  Typical environmental and permitting risks include items being discovered on the project site such as sensitive or endangered botany, or cultural artifacts, which would have the effect of extending schedules, increasing permitting costs, and potentially making permitting impossible at the Hasbrouck Mine.

### Internal Risks

- Current drill spacing is adequate and there is a low risk of a decrease in resources due to additional drilling and subsequent re-modeling and re-estimations.
- The project's economic viability is generally at risk from internal factors such as poor construction or operational execution resulting in construction and commissioning cost and schedule over-runs, scope creep, and increased operating costs.  This is mitigated by supplying management to oversee construction.
- Should the metallurgical efficiencies and reagent consumption rates assumed in this study not be generally achieved, the project would not achieve the economic performance predicted in this study.
- There is a risk that permeability in a full-scale heap leach at Three Hills Mine will be inadequate, based on testing done on a bulk sample by KCA in 2014.  The particle size distribution of ROM ore will be coarser than that tested, and the risk of poor permeability at full-scale is deemed to be low.  It is not possible to be certain about percolation through ROM ore as no compacted permeability test equipment exists capable of handling material of this particle size.  The risk of low percolation rates can be mitigated by performing field permeability tests on ROM ore during the early phase of mining and making appropriate adjustments to methods of stacking and leaching.  Thus, during initial leaching operations at Three Hills, percolation will be closely monitored to observe the percolation rate, allowing early adjustments to be made as necessary.  Early adjustments include installing intermediate drains in the heap at various elevations as the heap grows in height.  While this would increase costs somewhat, it is a viable and proven technique

which can be implemented simply and quickly should percolation decrease to unacceptable rates as stacking height increases.

- Predicted gold recovery from Three Hills ore is based on the results of a column-leach test on material that was somewhat finer than ROM ore is expected to be. The expected gold recovery predicted by the test could therefore be biased high. This risk is deemed to be low, given the flat Three Hills particle size/gold recovery curve.
- This study contemplates using certain pieces of mobile crushing and screening equipment at the Hasbrouck Mine that will tend to have a fall-off in availability and higher maintenance costs over time when compared to non-mobile equipment. Thus the availability factor in this study may have been overstated. This risk can be mitigated by increasing the robustness of foundations that mobile equipment will be mounted on to approximate those of non-mobile equipment.
- Increased gold recovery of 2.5% and 1.5% from drain down of heap-leach pads at the Three Hills and Hasbrouck mines, respectively, was included in this PFS. This type of recovery is generally not included in economic studies, but additional recovery is realized in most leaching operations. There is a risk that the full drain-down recovery will not be realized in actual production.
- If the current off-site toll carbon processor cannot handle all the loaded carbon, then the operating costs will increase due to the higher cost of selling the loaded carbon to an ashing refiner.
- Fuel price used in this study for contract mining is $1.70 per gallon. However, if the cost of fuel rises, mining costs will be adversely affected.
- Geotechnical studies are preliminary at Hasbrouck Mine and additional drilling is recommended to raise the level of certainty for final pit slope angles. There is a risk that additional geotechnical studies might result in flatter pit slopes than used in this study, which would have an adverse impact on costs and reserves. This risk is considered minimal because a large portion of the mining is above the crest of the ultimate pit.
- Contract mining costs are based on first principle costs estimated by MDA and adjusted to include a contractor return on capital and profit. These costs have not been vetted by contractors. This risk needs to be mitigated by obtaining contractual costs through competitive bidding by qualified mining contractors.
- Finding and keeping the skilled employees required to operate the Hasbrouck project might prove challenging, given its rural location. Inadequate staffing would tend to increase operating costs by reducing operating efficiencies and increasing repair and maintenance costs. Recruiting costs might be higher than predicted.

## Opportunities

- Additional drilling along the periphery of the Hasbrouck and Three Hills deposits has the potential to extend the resources to the east and west at the Hasbrouck Mine, and to the east and southeast at the Three Hills Mine. Such expansion could improve the project economics by reducing waste, extending the LOM and increasing overall revenues.

- Additional drilling could also result in reclassification of resources from Inferred to Indicated, and from Indicated to Measured. Within the 2 pits there are 3.3 million tons of Inferred resources that are currently treated as waste. Any upgrade of Inferred material to Indicated or higher classification, could improve the project economics by increasing ore tonnage and reducing waste tonnage, extending the LOM and increasing overall revenues.
- Engaging contractors more closely in the mine planning and design might result in identifying cost-reductions.
- Mining costs may be reduced by WKM deciding to operate the mine using their own equipment and employees, thus avoiding paying the contractor's profit. The increase in initial and sustaining capital for mining equipment might be mitigated by leasing equipment.
- Additional geotechnical studies might result in pit slopes being steepened, leading to a smaller amount of waste rock to be mined per ton of ore. Geotechnical information gained from mining operations at Three Hills may help geotechnical understanding of the Hasbrouck mine in common geotechnical domains, which may allow for further steepening of the Hasbrouck Mine pit slopes.
- HPGR crushing and micro-fracturing performance might be understated in the laboratory due to the very short time that samples take to be crushed by the laboratory-scale HPGR, typically measured in seconds or, for larger samples, several minutes. Such short runs do not allow time to optimize HPGR settings. It is expected that under steady-state running at full-scale, fine tuning of crushing parameters, such as the amount of choke feeding, recirculation, roll rotation speed, and roll closing force, will result in greater efficiency in crushing and micro-fracturing which in turn will result in higher gold and silver recovery than indicated by laboratory scale tests.
- The HPGR model selected for this study was a first-pass choice. A larger machine would allow a greater amount of recirculation which would result in a finer product size and consequently a greater recovery of gold and silver.
- Bottle roll tests on HPGR crushed lower Siebert material may have understated gold recovery relative to gold recovery that could be expected from column leach tests, perhaps by an amount similar to the 6% increase demonstrated with upper Siebert ore. The 2% allowance made for this effect in this study might therefore be too low.
- Faster gold recovery from solution, and hence more efficient operation, might be achieved at the Hasbrouck Mine by increasing the number of carbon columns in the adsorption plant from 5 to 6.
- Additional metal recovery from both the Three Hills and Hasbrouck mines might occur beyond the leach cycle time assumed in this study.
- The overall design of the crushing and screening plant presented in this study is a first-pass design and was not reviewed by other equipment suppliers. The opportunity exists to optimize the crushing and screening plant general arrangement and individual components, with the help of other equipment suppliers' input. Areas that are especially

targeted for review include the configuration of grizzlies at the primary crusher (both static and vibrating), and conveyor layouts to and from the secondary crushers.

- A pug mill was included in the Hasbrouck Mine process plant to address the concern that the HPGR might produce "cake" rather than granular particles, which might occur when there is sufficient clay-sized material and moisture in the HPGR feed. Caked material would tend to reduce agglomeration and access of solutions to the ore once place in the heap. Planning to pass all crushed ore through the pug mill, as has been assumed in this study, is conservative as in reality the pug mill will only be required under moist conditions when clay is present in the ore, which is a small percentage of the time; for the majority of the time ore can by-pass the pug mill, with mixing of cement and ore being achieved at the various conveyor transfer points. Reducing the operating time of the pug mill would reduce operating costs.
- The various construction and capital equipment costs used in this study are based on budget costs obtained from one source in each case. It is possible that lower costs might be achieved by competitive bidding.
- The earthworks component of civil construction might be performed in part, or all, by mining equipment. This could reduce construction costs as mining equipment tends to operate at lower unit costs than civil equipment. Additionally, using mining equipment might eliminate the need for mobilization and de-mobilization of construction equipment, which would offer further cost savings.
- Predicted consumption of cyanide at the Three Hills and Hasbrouck mines was based on data from column leach tests using 500 ppm NaCN concentrations. It is common in many heap leach operations to utilize a lower cyanide concentration than predicted by laboratory-scale testing. Typical field concentrations can be in the range of 125-250 ppm where the ore is relatively free of significant cyanide-consuming constituents. Actual consumption may be lower than has been assumed in this study; a lower cyanide concentration would lead to lower operating costs.
- It may be possible to reduce operating costs by optimizing crew rotations and hours.
- Mobile equipment has been included in the Hasbrouck crushing circuit design. A thorough review of the crushing system using stationary equipment could identify possible design changes that could result in lower operating costs.

## 1.20 Recommendations

WKM does not intend to complete additional studies or testing in advance of commencing construction and operation at the Three Hills Mine.

MDA makes the following recommendations for studies in advance of commencing construction and operation at the Hasbrouck Mine as shown in Table 1.16.

**Table 1.16 Hasbrouck Mine Studies Recommendations**

| | |
|---|---|
| Hasbrouck Mine Metallurgy Test Work | $ 390,000 |
| Hasbrouck Mine Geotechnical Work | $ 360,000 |
| **Total Recommended Budget** | **$ 750,000** |

The estimated costs of the recommendations total $750,000. Additional exploration drilling is not included in the immediate production recommendations. However, Three Hills will benefit from additional drilling to the east and northeast of the main deposit in the future, and there is potential for resource expansion along trend to the west and east at Hasbrouck.

## 2.0 INTRODUCTION AND TERMS OF REFERENCE

Mine Development Associates ("MDA") has prepared this Technical Report and updated Preliminary Feasibility Study ("PFS") on the Hasbrouck gold-silver project, located in the State of Nevada, at the request of West Kirkland Mining Inc. ("WKM"). This update builds on MDA's 2015 PFS Technical Report titled "*Technical Report and Preliminary Feasibility Study: Hasbrouck and Three Hills Gold-Silver Project Esmeralda County, Nevada*" ("2015 PFS") by Tietz et al. (2015). On April 12, 2016 WKM announced "The Company is updating modelled project costs to reflect current contractor rates and oil prices and is actively investigating several opportunities for synergies with other similar scale projects or Nevada domiciled deposits and operations". As presented in this PFS, the principal changes from the 2015 PFS are: a reduction in diesel price; detailing of Three Hills construction schedule; deferment of Three Hills gold plant and toll processing of carbon; use of refurbished crushing and conveying equipment; water sourced from wells instead of the town of Tonopah; added gold recovery assumed during drain down of heap-leach pads; reclamation and bond recalculation; and metal price increase.

WKM is listed on the Toronto Venture Exchange ("TSX.V") under the symbol "WKM". In January, 2014, WKM announced it had entered into an agreement with Allied Nevada Gold Corp. ("Allied") to acquire up to a 100% interest in Allied's Hasbrouck and Three Hills gold-silver properties (the "Hasbrouck Project"). WKM subsequently has announced that its subsidiary WK Mining (USA) Ltd. completed the acquisition of an initial 75% interest in the Hasbrouck Project. On September 11, 2014, WK Mining (USA) entered into a mining lease to purchase agreement with Eastfield Resources (USA) Inc., covering 7 patented mining claims that became part of the Three Hills Property. Total consideration to be paid over the life of the lease is CDN$280,000, of which CDN$30,000 has been paid. On June 19, 2015, Allied announced that the United States Bankruptcy Court for the District of Delaware had approved the sale of Allied's exploration properties and related assets (excluding the Hycroft operation) to Clover Nevada LLC ("Clover Nevada"), a wholly-owned subsidiary of Waterton Precious Metals Fund II Cayman, LP ("Waterton"), including Allied's 25% interest in the Hasbrouck project. The sale does not materially affect the contractual rights of WKM and WKM holds the title to the Hasbrouck properties. In this report the term WKM is used to refer to both West Kirkland Mining Inc., and WK Mining (USA), interchangeably.

This report has been prepared to comply with the disclosure and reporting requirements set forth in the Canadian Securities Administrators' National Instrument 43-101 ("NI 43-101"), Companion Policy 43-101CP, and Form 43-101F1, as well as with the Canadian Institute of Mining, Metallurgy and Petroleum's "CIM Definition Standards - For Mineral Resources and Reserves, Definitions and Guidelines" ("CIM Standards") adopted by the CIM Council on May 10, 2014.

Gold and silver mineralization occurs at the Three Hills and Hasbrouck deposits in high-level, low-sulfidation, hot spring-type epithermal systems. Technical Reports by Prenn (2003, 2006) and Prenn and Gustin (2003, 2006) have provided previous descriptions of the two deposits separately. An earlier description of the Three Hills deposit was given by Hardy (1996). The two deposits have also been described jointly in Technical Reports by Flint et al. (2012), Wilson (2014), and, most recently, by Tietz et al. (2015).

## 2.1 Project Scope and Terms of Reference

The purpose of this Technical Report is to present an updated Preliminary Feasibility Study ("PFS") of the Hasbrouck gold-silver project for WKM, with improved project economics based on more detailed, reduced estimates of capital and operating costs, and a slight increase in gold recovery at the end of the mine life. This report has been prepared by Thomas L. Dyer, P.E., Senior Engineer for MDA and Paul Tietz, C.P.G., Senior Geologist for MDA, with contributions from Herbert C. Osborne of Osborne and Associates, Ryan T. Baker, Principal Engineer with NewFields Mining Design & Technical Services, LLC, and Carl E. Defilippi, Senior Engineer for Kappes, Cassiday & Associates. The Mineral Resources were estimated and classified under the supervision of Mr. Tietz to the standards and requirements stipulated in NI 43-101. The PFS was prepared under the supervision of Mr. Dyer. Mineral Reserves have been estimated and classified for this report under the supervision of Mr. Dyer to the standards and requirements stipulated in NI 43-101. Mr. Dyer and Mr. Tietz are Qualified Persons under NI 43-101. There is no affiliation between Mr. Dyer, Mr. Tietz, Mr. Osborne, Mr. Baker and Mr. Defilippi and WKM, except that of independent consultant/client relationships.

The scope of this study included a review of pertinent technical reports and data provided to the authors by WKM relative to the general setting, geology, project history, exploration activities and results, methodology, quality assurance, interpretations, drilling programs, and metallurgy. MDA has relied on the data and information provided by WKM for the completion of this report. Mr. Tietz visited the Hasbrouck and Three Hills properties on July 25, 2014. The site visit followed inspections in June, 2014 of project drill core stored at Allied's Hycroft Mine near Gerlach, Nevada, and at Kappes Cassiday and Associates in Reno, Nevada. During the site visit, Mr. Tietz reviewed the project geology and drill locations with project personnel. Mr. Dyer visited the Hasbrouck project on May 1, 2014, and inspected drill core in June, 2014 with Mr. Tietz at Kappes Cassiday's facility. Mr. Defilippi and Mr. Baker conducted site visits at Hasbrouck and Three Hills on May 1, 2014, at which time they inspected the properties and pertinent local infrastructure. Mr. Osborne has not visited the site. MDA has made such independent investigations as deemed necessary in the professional judgment of the authors to be able to reasonably present the conclusions discussed herein.

The authors have relied almost entirely on data and information provided by WKM and previous companies involved with the project. The authors have reviewed much of the available data, made a site visit, and have made judgments about the general reliability of the underlying data. Where deemed either inadequate or unreliable, the data were either eliminated from use or procedures were modified to account for lack of confidence in that specific information. MDA has made such independent investigations as deemed necessary in the professional judgment of the authors to be able to reasonably present the conclusions discussed herein.

The effective date of this Technical Report and the PFS is September 1, 2016, which is the date of the revised cash-flow model as described in WKM's September 1, 2016 press release on the project economics. The Three Hills resource database has an effective date of July 15, 2014 while the effective date of the Three Hills resource estimate is August 4, 2014. The Hasbrouck deposit resource database has an effective date of October 15, 2014 while the effective date of the Hasbrouck deposit resource estimate is November 3, 2014. A total of 14 holes at Three Hills and 14 holes at Hasbrouck were drilled by WKM in late 2014, and this information has been reviewed by MDA. It is MDA's opinion that WKM's 2014 drilling would not materially change the resource estimates and is not material to the conclusions of the PFS. For this reason the 2014 resource databases have not been updated to include the WKM drilling of 2014.

## 2.2 Frequently Used Acronyms, Abbreviations, Definitions, and Units of Measure

In this report, measurements are given in Imperial units, except where the original information was reported in metric units. Assays have been reported in the manner in which they were received; all early work is in Imperial units (troy oz/short ton), and more recent work is reported in ppm.

Currency, units of measure, and conversion factors used in this report include:

| | | |
|---|---|---|
| **Linear Measure** | | |
| 1 centimeter | = 0.3937 inch | |
| 1 meter | = 3.2808 feet | = 1.0936 yard |
| 1 kilometer | = 0.6214 mile | |
| **Area Measure** | | |
| 1 hectare | = 2.471 acres | = 0.0039 square mile |
| **Capacity Measure (liquid)** | | |
| 1 liter | = 0.2642 US gallons | |
| **Weight** | | |
| 1 tonne (metric) | = 1.1023 short tons | = 2,205 pounds |
| 1 kilogram | = 2.205 pounds | |

**Currency** Unless otherwise indicated, all references to dollars ($) in this report refer to currency of the United States.

**Frequently used acronyms and abbreviations**

| | |
|---|---|
| 3-D | three dimensional |
| AA | atomic absorption spectrometry |
| Ag | silver |
| As | arsenic |
| Au | gold |
| Bi | bismuth |
| BLM | United States Department of the Interior, Bureau of Land Management |
| BMRR | Bureau of Mining Regulation and Reclamation |
| C.P.G. | Certified Professional Geologist |
| CN | cyanide |
| Cu | copper |
| cuft | cubic feet |
| F | Fahrenheit |
| ft | feet |
| G&A | general and administrative |

| | |
|---|---|
| g | grams |
| g/t | grams per tonne |
| gal | gallons (US) |
| gal/h | gallons (US) per hour |
| GCL | geosynthetic clay liner |
| gpm | gallons (US) per minute |
| GPS | Global Positioning System |
| Hg | mercury |
| HDPE | high-density polyethylene |
| HPGR | High-pressure grinding roll |
| ICP | inductively coupled plasma method of analysis |
| in | inches |
| K | thousands |
| km | kilometer |
| lb | pound or pounds (2,000lb to 1 ton, 2,204.6lb to 1 tonne) |
| IRR | internal rate of return |
| kwh | kilowatt hour |
| LOM | life of mine |
| m | meter |
| M | mesh |
| Ma | million annum |
| MDA | Mine Development Associates, the authors of this Technical Report |
| mil | one thousandth of an inch (0.0254mm) |
| NaCN | sodium cyanide |
| NDEP | Nevada Division of Environmental Protection |
| NPV | net present value |
| NSR | net smelter return |
| oz | troy ounce (12oz to 1 pound) |
| oz/ton | troy ounce per short ton (used in metallurgical tables) |
| opt | troy ounce per short ton (used in historical drilling assays and resource estimates) |
| Oz | troy ounce (12oz to 1 pound) |
| Ozs | troy ounces |
| P70 | crushed to 70% passing through a specified screen size. |
| P80 | crushed to 80% passing through a specified screen size. |
| Pb | lead |
| P.E. | Professional Engineer |
| PFS | Preliminary Feasibility Study |
| ppb | parts per billion |
| psig | pounds per square inch at gauge |
| ppm | parts per million (1ppm to 0.0292oz/ton) |
| QA/QC | quality assurance/quality control |
| RC | reverse circulation drilling method |
| ROM | run of mine |
| Se | selenium |
| st | short ton, used in metallurgical test result tables |
| Tl | thallium |

| | |
|---|---|
| T | short ton (imperial) 2,000lb |
| ton | short ton (imperial) 2,000lb |
| t | metric ton (tonne) |
| tonne | metric ton |
| Tpd | (short) tons per day |
| TPD | (short) tons per day |
| Tph | (short) tons per hour |
| USD | currency of the United States |
| USGS | United States Geologic Survey |
| Zn | zinc |

## 3.0 RELIANCE ON OTHER EXPERTS

The authors are not experts in legal matters, such as the assessment of the legal validity of mining claims, private lands, mineral rights, and property agreements. The authors rely on information provided by WKM as to the title of the unpatented mining claims and private mineral rights comprising the Hasbrouck project, the terms of property agreements, and the existence of applicable royalty obligations. Sections 4. 2 and 4.3 are based on information provided by WKM, and the authors offer no professional opinions regarding the provided information.

The authors did not conduct any investigations of the social-economic issues associated with the Hasbrouck gold-silver project, and the authors are not experts with respect to these issues. MDA has relied on WKM to provide full information concerning the legal status of the company and related companies, as well as current legal title and material terms of all agreements relating to the property.

The authors are not experts with regard to environmental permitting or liabilities. For Section 4.4 and Section 20.0 on Environmental Studies, Permitting and Social or Community Impact MDA has relied on Mr. Richard Delong, President of Enviroscientists Inc., an environmental permitting and government relations consultancy, who provided expertise to WKM for environmental and permitting issues. Mr. Richard DeLong is a Certified Environmental Manager and a Licensed Professional Geologist. Mr. Paul Sterling, a consultant to WKM, has provided WKM with information on reclamation costs.

Although MDA is not an expert with respect to any of the above 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 or reserves as of the date of this report.

# 4.0 PROPERTY DESCRIPTION AND LOCATION

The authors are not experts in land, legal, environmental, and permitting matters. This Section 4 is based on information provided to the authors by WKM. The authors present this information to fulfill reporting requirements of NI 43-101 and can express no opinion regarding the legal or environmental status of the Hasbrouck project.

## 4.1 Location

The Hasbrouck project includes the Three Hills and Hasbrouck gold and silver deposits, located 2 miles west and 5 miles south of Tonopah, Nevada, respectively (Figure 4.1). Tonopah is an historic mining town in south-central Nevada, approximately 4 hours by car southeast of Reno, and 3 hours northwest of Las Vegas, Nevada.

The topographic maps covering the project area are the Mount Butte, Klondike and Mud Lake 7.5 minute quadrangles, Nevada, at 1:24,000-scale, published by the U.S. Geologic Survey. The approximate center of the Hasbrouck deposit is at latitude 37°59’32” North and longitude 117°16’0” West, and the approximate center of the Three Hills deposit is at latitude 38°3’46” North and longitude 117°15’44’ West.

## 4.2 Land Area

WKM has acquired a 75% interest in the Hasbrouck gold-silver project in Nevada from subsidiaries of Allied Nevada Gold Corp. The project consists of two deposits: Three Hills and Hasbrouck. The Three Hills deposit (Figure 4.2) is covered by 13 patented claims and 100 unpatented lode claims (Appendix A) occupying a total of approximately 1,967 acres in Sections 2, 3, 4, 5, 8, 9, 10 and 11, T2N, R42E, and Sections 33 and 34, T3N , R42E of the Mount Diablo Base and Meridian. Each claim within the property boundary is identified by 2 by 2in by 4ft wood posts marked with a scribed aluminum tag as required by Nevada statutes. The claims have not been surveyed by a mineral land surveyor, but they are registered and recorded with the U.S. Bureau of Land Management (“BLM”), Esmeralda and Nye Counties.

The Hasbrouck deposit (Figure 4.3) is covered by 28 patented and 583 unpatented lode mining claims occupying an area of approximately 10,750 acres (Appendix A). All claims are located on U.S. federal land managed by the Battle Mountain District of the BLM. The claims are in a contiguous block that is located in Sections 1, 2, 3, 4, 5, 9, 10, 11, 12,13,14, 15,16, 21, 22, 23 and 24, T1N, R42E, Sections 6, 7, 18, 19 and 20, T1N, R43E, and Sections 27, 28, 29, 32, 33, 34, and 35, T2N, R42E of the Mount Diablo Base and Meridian. Each claim within the property boundary is identified by 2 by 2in by 4ft wood posts marked with a scribed aluminum tag as required by Nevada statutes. The claims have not been surveyed by a mineral land surveyor, but they are registered and recorded with the BLM, Esmeralda and Nye Counties.

Current holding costs for unpatented mining claims are $155 Maintenance Fee per claim, each year to the BLM, and $12.00 Intent to Hold Fee per claim, each year to Esmeralda County. WKM has provided documentation that all federal fees to maintain the claims for another year have been paid through September 1, 2017. County fees and taxes for both the patented and unpatented claims have been paid in full to Esmeralda and Nye Counties through November, 1, 2017. WKM maintains title insurance on the properties.

**Figure 4.1 Hasbrouck Project Location Map**

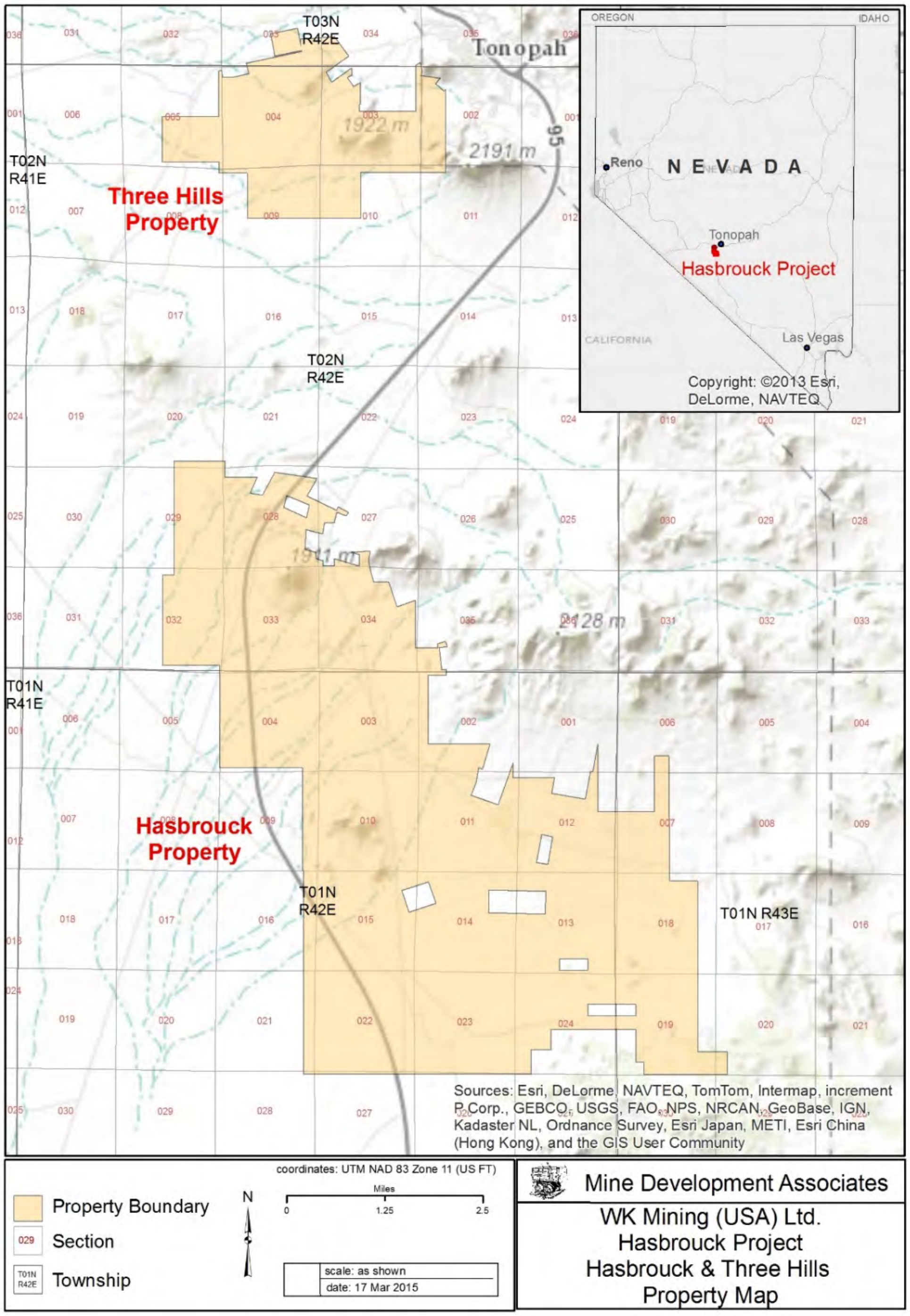


**Figure 4.2 Land Status Map of the Three Hills Property**
(Land data provided by West Kirkland Mining, 2014)

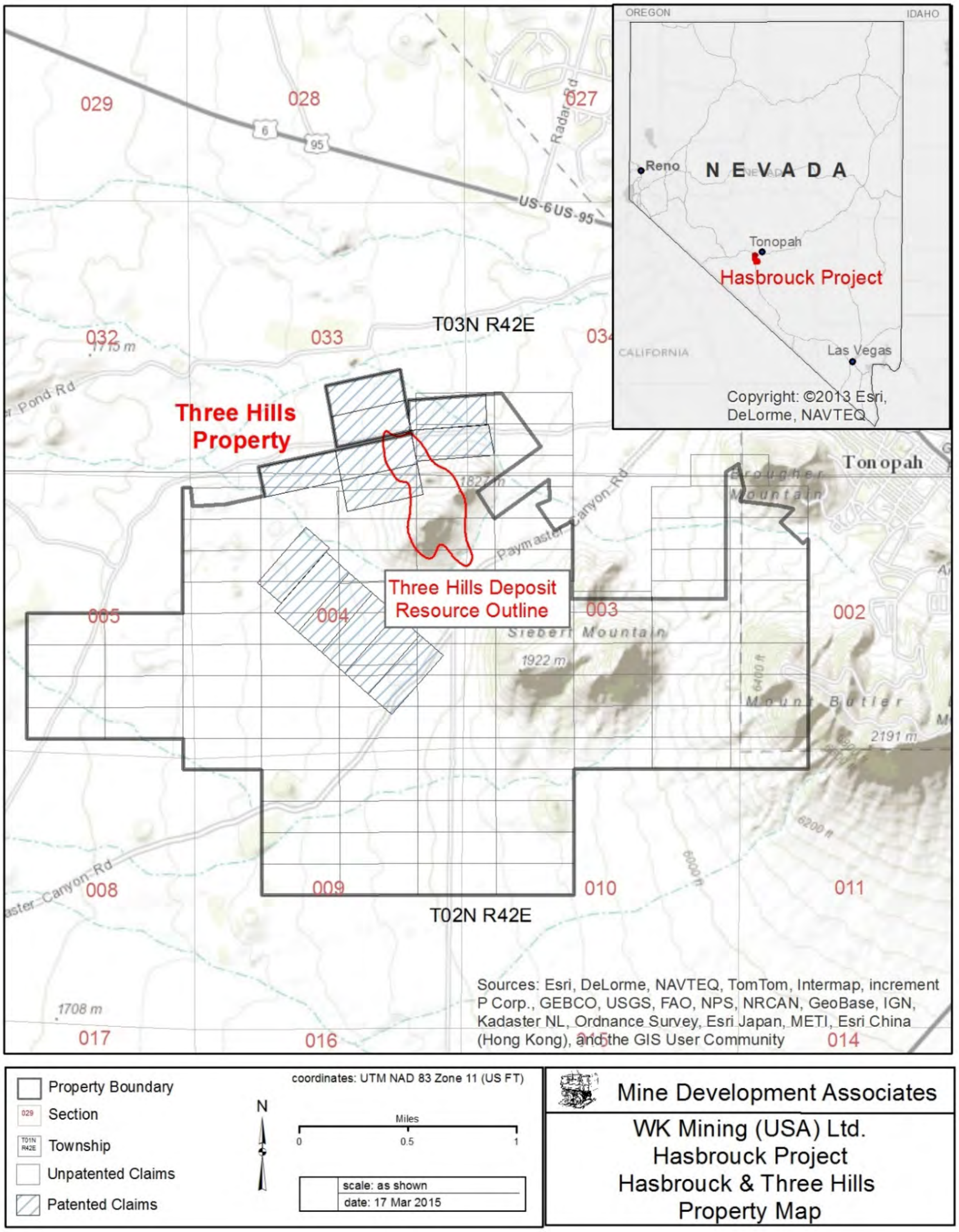
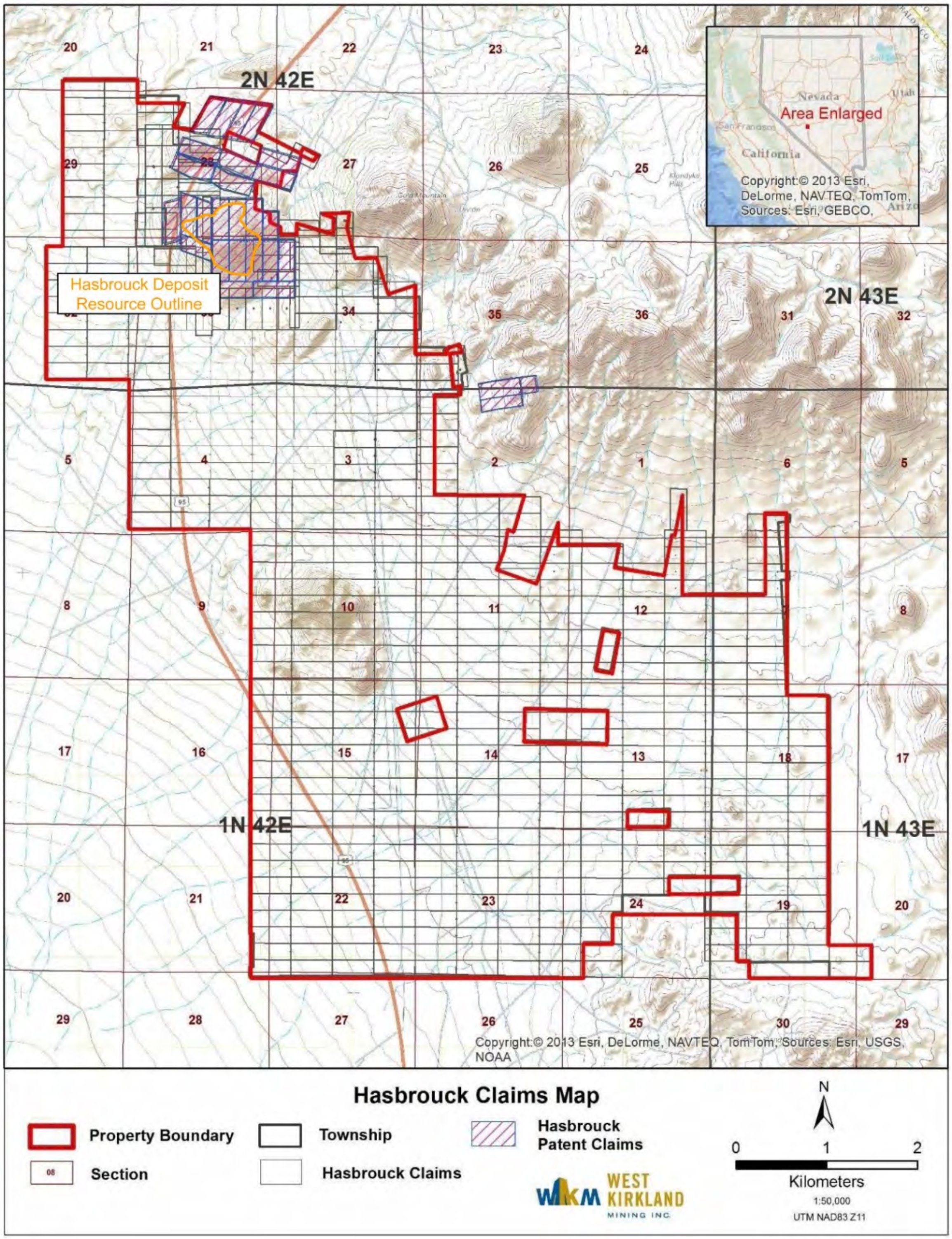


**Figure 4.3 Land Status Map of the Hasbrouck Deposit Area**
(Land data provided by West Kirkland Mining, 2014)



## 4.3 Agreements and Encumbrances

WKM's subsidiary WK Mining (USA) Ltd. ("WK") has finalized and executed a Purchase and Sale Agreement (the "PSA") with Allied to acquire the Hasbrouck and Three Hills properties. WK has paid both the deposit and initial payment with total consideration having been paid to Allied being $20,000,000. Title to the properties has been transferred to WK.

On September 11, 2014 WK entered into a mining lease to purchase agreement with Eastfield Resources (USA) Inc., covering 7 patented mining claims that became part of the Three Hills Property. Total consideration to be paid over the life of the lease is CDN$280,000, of which CDN$155,000 has been paid.

On June 19, 2015, Allied announced that the United States Bankruptcy Court for the District of Delaware had approved the sale of Allied's exploration properties and certain related assets (excluding the Hycroft operation) to Clover Nevada LLC ("Clover Nevada"), a wholly-owned subsidiary of Waterton Precious Metals Fund II Cayman, LP ("Waterton"), which included the 25% interest in the Hasbrouck project.

Pursuant to the PSA, WKM has the option of making an additional $10,000,000 payment (the "Final Payment") on or before October 22, 2016 (the "Final Payment Deadline"). If WKM pays the Final Payment to Waterton, and Waterton accepts the payment in accordance with the terms and conditions of the PSA, it will acquire the remaining 25% interest in the properties resulting in it owning a 100% interest in the properties.

If WKM does not make the Final Payment to Waterton on or before the Final Payment Deadline, or if WKM offers payment and Waterton chooses to decline the Final Payment, the properties shall be transferred into a limited liability company (the "LLC") with WKM retaining a 75% interest in the LLC and Waterton retaining 25% interest in the LLC. Upon entering the LLC both parties will be responsible for their share of the costs on a pro rata basis with Waterton's share of the costs accruing and payable in full 30 months after the signing of the PSA. At the time of writing this report WKM had completed a transfer of the properties into an LLC, with a date of recordation in Nye County of September 9, 2016 and a date of recordation in Esmeralda County of September 12, 2016. At present 100% of the LLC is held by WKM. WKM has no work commitments, but the project is subject to certain underlying royalties as described below.

The Hasbrouck property patented and unpatented claims are also subject to a purchase agreement between Vista Nevada and Newmont Capital Limited ("Newmont"), which was executed on May 23, 2003. This agreement covers both the Hasbrouck and the Three Hills deposits. Terms of the purchase agreement included a $50,000 cash payment on signing (completed), $200,000 or the equivalent in Vista Gold shares one year after signing (completed), and $500,000 upon commencement of commercial production on the property. An additional payment of $500,000 shall accrue if the average gold price over any three-month period of commercial production exceeds $400/oz.

Newmont held a one-time election to enter into a joint venture on the property. During 2010, Allied achieved the threshold trigger and Newmont elected not to enter into a joint venture and retained an NSR royalty of 2% on the Hasbrouck property.

For the Three Hills deposit, all claims are subject to a mineral production royalty of between 2% and 4%. Fifteen of the unpatented claims are subject to a mineral production royalty of 4% NSR. The remaining 85 unpatented claims and 3 of the patented claims at Three Hills are subject to a mineral production royalty of 2% NSR. The remaining 8 patented claims are subject to a mineral production royalty of 4% NSR.

At the Hasbrouck deposit, 19 of the patented claims and three of the unpatented mining claims are subject to a mineral production royalty of 4% of the net smelter returns ("NSR"). The remaining 9 patented mining claims and 256 of the unpatented mining claims are subject to a mineral production royalty of 2% NSR. The remaining 327 unpatented mining claims are not subject to a royalty.

## 4.4 Environmental Considerations

Enviroscientists Inc., an environmental permitting and government relations consultancy, provided the following information on environmental liabilities and permitting. WKM's U.S. subsidiary, WK, conducted the most recent exploration at Hasbrouck and Three Hills, and environmental permits were in WK's name.

### 4.4.1 Environmental Liabilities

Current environmental liabilities at the Hasbrouck and Three Hills deposits are limited to exploration drill roads and pads. Current bonding is in place to support this work, associated with multiple Notices authorized by the BLM for less than 5 acres of disturbance each. Existing disturbances and bond amounts for each Notice are shown in Table 4.1. Other than reclamation obligations, which consist of re-contouring and re-vegetating exploration drill roads and sites, there are no known environmental liabilities associated with the recent exploration activities conducted at the Hasbrouck and Three Hills deposits by Allied and WKM.

**Table 4.1 Existing Disturbance and BLM Notices for the Hasbrouck Project**

| Notice # | Disturbance Acreage | Bond Amount |
|---|---|---|
| NVN-91216 | 4.88 | $65,450.00 |
| NVN-89964 | 1.84 | $14,033.00 |
| NVN-89750 | 4.53 | $18,758.00 |

The Tonopah district is the center of extensive mining and exploration activity that has occurred over the past 110 years. Old workings and prospects are located throughout the Hasbrouck and Three Hills deposit areas. Contamination may occur in association with historic surface and underground workings, or from former operators in relation to drill pads and sumps where chemicals or oils may have collected.

### 4.4.2 Permits Required

The Three Hills Mine is permitted; all key permits are in hand with the last state air quality permit having been issued in June, 2016. Certain minor permits are still required, but obtaining them is routine and without risk.

Permitting for the Hasbrouck Mine commenced in 2011 when a cultural survey was performed. Biology base-line studies were performed in subsequent years. Work on permitting the Hasbrouck Mine is ongoing. A Plan of Operation for Hasbrouck Mine will be submitted to the BLM when operational and baseline surveys are complete and operations and design for the project are at a level where a Plan of Operation application can be developed to the necessary level of detail.

The review and approval process for the Hasbrouck Mine Plan of Operation by the BLM constitutes a federal action under the National Environmental Policy Act ("NEPA") and BLM regulations. Thus, for the BLM to process the Plan application, the BLM is required to comply with NEPA and prepare either an Environmental Assessment ("EA"), or an Environmental Impact Statement ("EIS"). The BLM will determine the level of NEPA to perform for the proposed Hasbrouck Mine following the submittal and acceptance of the Plan application. It is anticipated that an EIS will be required for the proposed Hasbrouck Mine.

The county, state, and federal permits required prior to commencement of mining operations for both the Three Hills and Hasbrouck mines are shown in Table 4.2.

**Table 4.2 Operating Permits Required**

| Permit | Issuing Agency |
|---|---|
| Plan of Operations | Bureau of Land Management |
| Rights-of-Way | Bureau of Land Management |
| Reclamation Permit | NDEP Bureau of Regulation and Reclamation |
| Air Quality Operating Permit | NDEP Bureau of Air Pollution Control |
| Mercury Air Operating Permit | NDEP Bureau of Air Pollution Control |
| Water Pollution Control Permit | NDEP Bureau of Regulation and Reclamation |
| Artificial Pond Permit | Nevada Department of Wildlife |
| Dam Safety Permit | Nevada Division of Water Resources |
| Hazardous Material Storage Permit | Nevada State Fire Marshal |
| County Road Maintenance Agreement | Esmeralda and Nye Counties |

## 4.5 Easements for Local Infrastructure

At the Hasbrouck Mine, both U.S. Highway 95 and the former U.S. Highway 95 have Right of Way boundaries and are immediately adjacent to the deposit. WKM has ascertained that mining in proximity to Highway 95 is viable and that relocating U.S. Highway 95 in order to exploit the Hasbrouck deposit is not required. Blasting will at times be subject to the requirements and constraints of the Nevada Department of Transportation, which include halting traffic flows for up to 20 minutes periodically.

A north-south buried fiber optic cable, owned by AT&T Inc., runs along the eastern boundary of the Hasbrouck Mine, just to the west of, and approximately parallel to, the old U.S. Highway 95. After consulting with AT&T Inc., WKM has determined that relocation of the buried cable will not be necessary.

At the Three Hills Mine another section of the same buried fiber optic cable runs north-south through the eastern portion of the Three Hills deposit and will require relocation for mining to take place. At a meeting with AT&T in Reno, Nevada, AT&T provided the opinion that it is practical to relocate the fiber optic cable. Subsequently AT&T have provided budget costs and schedule for such a move.

# 5.0 ACCESSIBILITY, PHYSIOGRAPHY, CLIMATE, LOCAL RESOURCES AND INFRASTRUCTURE

The information in this section has been modified from the Technical Reports completed in 2014 and 2015 (Wilson, 2014; Tietz et al. 2015).

## 5.1 Access

The Three Hills property is one mile southwest of Tonopah and is accessed via county-maintained roads from the northwest end of Tonopah (Paymaster Canyon Road) and on an un-named county-maintained road from the south. The deposit is approximately five miles north of the Hasbrouck deposit.

The Hasbrouck property is six miles south of Tonopah, Nevada, and will be accessed by a turn-out off U.S. Highway 95. U.S. Highway 95 passes through the property approximately 0.25 miles west of the Hasbrouck deposit and is an all-weather, all-season roadway suitable for commercial semi-trailer traffic.

U.S. Highway 95 is the main north–south transportation corridor through central Nevada and passes 2.25 miles east of the Three Hills deposit, and immediately to the west of the Hasbrouck deposit. U.S. Highway 6 passes 1.25 miles north of the Three Hills deposit, and is a major east-west transportation corridor through central Nevada. Both of the above provide all-weather, all-season access for commercial semi-trailers. Both highways pass through Tonopah, Nevada.

## 5.2 Physiography

Elevations of the properties vary between 5,600ft and 6,300ft. The principal physiographic features of the Hasbrouck and Three Hills properties are prominent hills that rise 200-700ft off the valley floor. This includes Hasbrouck Mountain, the core of the Hasbrouck deposit, which rises 700ft from the valley plain to a peak of 6,300ft. The principal physiographic features of the Three Hills property are the cluster of hills known as Three Hills, which rise 200ft from the valley floor to an elevation of about 6,100ft.

Vegetation in the area is typical of south-central Nevada and consists of sagebrush and other desert plants on the lower slopes and valleys. Trees are absent. Shadscale, white sage, and greasewood occur with sagebrush on the drier slopes and hills.

## 5.3 Climate

The climate is semi-arid. Average annual precipitation is 5 inches, which is accumulated through winter snows and, to a lesser extent, summer thunderstorms. The evaporation potential greatly exceeds the precipitation on an average annual basis in the area, creating a negative water balance which is addressed in Section 17.1.9.3. There are large temperature variations recorded for the Tonopah area, with an annual range of -12° F to 105° F, with the average temperatures being 23° F in winter and 73° F in summer. On average, 150 days per year are frost-free. Snow depths in winter are generally minimal on the property as storms are fairly intermittent and winter daytime high temperatures often exceed 32° F. The overall climate will permit production operations year round, although freezing winter temperatures need to be considered in the design of any heap leach processing system.

## 5.4 Local Resources and Infrastructure

### 5.4.1 Human Resources, Accommodation, and Amenities

The towns of Tonopah (population 2,500) and Goldfield (population 300) are within easy driving distance of the properties and have basic amenities, medical services, housing, apartments, commercial and office space for rent and for sale, and lots for sale. The residents of these two communities comprise an experienced work force with historical and recent ties to mining operations in Nevada. Taken together, these locations can provide living areas for employees and it is expected that residents of Tonopah and Goldfield will form a significant portion of the workforce.

#### 5.4.1.1 Electrical Power

An existing 55 kV power line, owned by NV Energy, a state-wide energy provider and the sole option for grid power for the project, transects the west side of the Hasbrouck deposit. Recent discussions with NV Energy indicate that after certain modifications are made there will be sufficient capacity to support the planned project requirements.

#### 5.4.1.2 Raw Water Supply

Raw water is defined as water, other than potable water, that will be required and be used by the project. It includes water for construction purposes, make-up water for mineral processing, water for dust control on mine roads, and any other sundry uses. The quantity of water required is estimated at between 350 and 500 gpm.

A primary source of raw water is from a well or wells, which would be installed close to each deposit. This would involve obtaining a water right to appropriate groundwater, which might be a new water right acquired from the state engineer on application, or by purchase or lease of an existing water right.

Raw water is also available from the Tonopah Public Utility (“TPU”), which has offered to sell water to the project. TPU has the necessary water permits and infrastructure in the form of wells, pumps, pipelines and tanks to meet the project’s needs, and is legally entitled to do so.

#### 5.4.1.3 Potable Water

Potable water for Three Hills Mine will be sourced from TPU as the intention is to locate administration and the assay laboratory in Tonopah.

Potable water for Hasbrouck Mine will be sourced from a water well installed close to the mine. A certified water supply system will be required in this case. A water right will also be required.

### 5.4.2 Mining Infrastructure

Both the Three Hills and Hasbrouck properties have adequate space to develop infrastructure for mine operations. This includes siting of the heap-leach facilities, waste rock storage areas, process buildings, workshops, etc.

# 6.0 HISTORY

This section describes exploration at Hasbrouck and Three Hills prior to acquisition by WKM and is largely taken from Wilson (2014), as presented in Tietz et al. (2015).

## 6.1 Three Hills Exploration History

Modern exploration in the Three Hills area started in 1974 when Cordex obtained the property and completed sampling and mapping in the project area. Cordex drilled 14 rotary holes in 1978, intersecting gold mineralization in most of the holes. Saga Exploration leased the property and, between 1983 and 1988, completed 33 air track and 28 reverse-circulation ("RC") drill holes. Two of the air track holes and 5 of the RC holes drilled by Saga are not included in the current database. Echo Bay leased the property in 1988 and completed an additional 77 reverse circulation drill holes during the next two years. During the period 1991 to 1995, Gexa Gold and Coeur D'Alene Mines completed sampling and metallurgical studies on the property and Gexa drilled two short diamond-core holes.

In 1995 the Eastfield Resources Ltd./Prism ("Eastfield") partnership optioned the property from Coeur D'Alene Mines, who had acquired the property by way of settlement of receivership of Gexa Resources, and completed additional drilling and testing on the property between 1995 and 1997. A number of geophysical studies (including magnetics and induced polarization) were completed, as well as geochemical sampling over a regular grid. A total of 19 soil lines, spaced 300-400ft apart were completed. Eastfield's induced polarization ("IP") survey was made over an area north of the Three Hills Deposit, with 12.3 line miles completed. Oxidation levels in the area are of sufficient depth to make it difficult to detect sulfide mineralization. No strong features were recognized. The Eastfield magnetic data has been useful in defining linear fault features and major lithology breaks.

A Master's thesis research project was completed by R. Thompson during the 1996 and 1997 exploration seasons at Three Hills. The thesis work included study of thin sections, whole rock geochemistry, and x-ray diffraction studies of the alteration mineralogy (Tregaskis and Garratt, 1998). Additionally, some samples were analyzed for gold, silver, arsenic, antimony, mercury, molybdenum, and occasionally copper, lead, and zinc. Arsenic, antimony, molybdenum, and mercury concentrations are elevated in the limonitic Siebert Formation over a widespread area in the northern portion of the Three Hills area.

Geologic mapping at Three Hills was completed by R. Thompson and S. Tregaskis (1997-1998). This mapping remains as the guide for exploration in the area.

Coeur D'Alene Mines sold the Three Hills property to Euro-Nevada, which subsequently merged with Newmont. Eastfield terminated their option agreement and returned the property to Newmont after the year 2000 exploration season.

On May 23, 2003, Vista executed a purchase agreement with Newmont Capital, which included both the Hasbrouck and the Three Hills properties. The terms of this agreement are detailed in

Section 4.3. Vista did not conduct exploration at Three Hills until the spin-off of Allied Nevada Gold Corp.

Allied initiated exploration at Three Hills in 2012 and drilled 17 RC holes that year, focused on expanding known mineralization. The best hole was TH12R-015, which returned 66m of 3.33 g/t Au. An additional 8 core holes were drilled for metallurgical samples and condemnation in 2013.

Allied identified a total of 312 rock-chip samples taken in the Three Hills area during exploration between 1974 and 2012. The bulk of the samples are channel samples taken from three road cuts and a 225ft adit. Allied was able to spatially locate and validate assay data for 204 of these samples. Rock-chip samples range from < 0.005 to 5.69ppm Au and <0.20 to >100ppm Ag. Approximately 70% of the samples were also analyzed for geochemistry, including Ba, Hg, Mn, As, Mo, and Sb. The Eastfield soil data were not located by Allied.

### 6.1.1 Hasbrouck Exploration History

Silver and gold mineralization was first discovered on Hasbrouck Mountain in 1902. Early mining exploited the Kernick vein, which was worked on a small scale through the mid-1920s. The only recorded production from Hasbrouck is 740 tons of ore by the Tonopah Hasbrouck Mining Company in 1923 and 1924 (Couch and Carpenter, 1943) that grossed $10,406. The early miners completed about 6,500ft of adits and 1,000ft of raises.

In 1974 Cordex completed detailed surface and road cut sampling, vertical conventional rotary drilling, geologic mapping, sampling of surface and underground workings, a mineral resource estimate, and metallurgical test work. The claims were relinquished at the end of 1975, but subsequently re-acquired in 1980. During the 1980 work program, Cordex undertook detailed underground sampling of the principal workings, including the Ore Car, Main, South, and Northeast adits. A total of 191 underground samples were collected over a total length of 3,862ft. One surface and two underground bulk samples were collected for metallurgical test work. In total, drilling by Cordex from 1974–1980 comprised 25 rotary drill holes (9,760ft) and one of the 1974 rotary drill holes was deepened using core drilling (959ft of core). A large, low-grade gold–silver deposit was outlined based on these activities. The current resource database excludes 3 of the Cordex drill holes due to uncertain collar locations.

Geological mapping of the Hasbrouck deposit area was undertaken as part of a Master's degree thesis research (Graney, 1985). The mapping defined multiple structural orientations and a number of breccia bodies believed to represent the controlling features of precious metal mineralization, primarily the east–west-trending Kernick vein zone.

Franco-Nevada optioned the property from Cordex in 1985, drilled 30 vertical RC drill holes (10,145ft), and completed metallurgical test work. A mineral resource and "mineable reserve" estimates (not in accordance with NI 43-101) were performed in 1986. The Franco-Nevada drilling succeeded in expanding and better defining the Hasbrouck deposit.

FMC optioned the property in 1988 and drilled 76 RC angle and vertical drill holes (34,255ft) and undertook additional metallurgical test work. The FMC program consisted primarily of definition and infill drilling, including a small zone of tightly-spaced shallow drilling on a 15ft x 25ft grid. Mineral resource and "mineable reserve" (in accordance with not NI 43-101) estimations were performed in 1988. FMC also completed an E-Scan geophysical survey over a portion of the deposit, and drilled two deep RC drill holes to test a geophysical anomaly which had been interpreted as a possible high-grade feeder zone to the known mineralization. No such zone was intersected in the drilling. Four of the RC drill holes (1,160ft) were sited on the Silver King claim, north of Hasbrouck Mountain, but no anomalous gold or silver values were returned.

Following FMC's relinquishment of their interest in the property in 1990, Euro-Nevada completed a 19 line-kilometer CSAMT geophysical survey and reconnaissance surface rock chip surveys to the north, east, and southeast of Hasbrouck. A number of geochemical and geophysical targets that were considered prospective for gold mineralization were developed from this work.

Corona optioned the property from Euro-Nevada in 1992 and drilled two RC drill holes (1,210ft) to the north of Hasbrouck Mountain, in the area of the Eliza Jane patented claim. The drill holes intersected broad zones of anomalous gold, silver and molybdenum mineralization. Corona also updated the "mineable reserve" (not in accordance with NI 43-101) estimate for the Hasbrouck deposit.

Homestake acquired Corona in 1993 and vended their interest in the Hasbrouck property to Prime Equities International Corporation ("Prime") in the same year. Based on the information currently available to WKM, neither Homestake nor Prime completed any substantive work on the project.

Euro-Nevada regained 100% interest in the property in 1993 and further refined the target exploration concepts that had been developed in 1990 and 1991. In 1996, Euro-Nevada completed an 18 hole RC drilling program (17,670ft) that tested these targets, which were aligned in a northwest-trending belt that passed to the north, east and southeast of Hasbrouck Mountain. Targets were identified by geophysical or geochemical anomalies, the presence of favorable alteration, structures and structural intersections, and favorable stratigraphy. The drilling failed to identify any new zones of significant gold or silver mineralization, but anomalous gold–silver values were encountered, typically over restricted down hole widths. The best results were returned from drilling in the area of the Eliza Jane patented claim.

Newmont took control of the Hasbrouck deposit by way of their merger with Euro-Nevada in 2002. Newmont then vended the property to Vista Gold on May 23, 2003. Allied Nevada assumed control of the property when Allied was floated as a spin-off company from Vista in 2007.

From 2010 to 2013, work completed by Allied included surface mapping, systematic geochemical sampling, several drill campaigns, data verification, metallurgical studies, a CSAMT geophysical program, regional gravity survey, and reinterpretation of the spatial geology, and completion of a preliminary economic assessment which is no longer relevant due to obsolescence of input costs and subsequent drilling.

Data collected prior to Allied's interest, including drill hole and surface sample data, have been located in variable grids, including truncated State Plane, and UTM NAD27 Zone 11. Allied converted these data to UTM NAD83 Zone 11 using Corpscon6. Elevation data have been based on the NGVD29 vertical datum. Field data collected by Allied utilized the UTM NAD83 Zone 11 coordinate grid system.

The greater Hasbrouck deposit was re-mapped at a scale of 1:6,000 by Allied personnel in 2011. Re-mapping by Allied personnel led to a re-interpretation of the structural framework and the relationship of various structural orientations to mineralization. In general, the stratigraphic interpretations have been retained from the previous mapping.

Selected road-cuts were systematically channel sampled by Allied on 10-ft nominal lengths with the goal of identifying structural patterns to mineralization. A total of 677 samples were collected by Allied and submitted to ALS Chemex in Reno, Nevada for precious metal and multi-element analysis. Numerous zones of outcropping mineralization were identified. Multiple structural zones were also highlighted as either mineralized, or as boundaries to mineralization.

Two geophysical surveys were undertaken by predecessors of Allied. These data were not available to WKM.

An E-SCAN (multi-directional resistivity) survey was completed over Hasbrouck Mountain in 1988 and reinterpreted in 1998. The scan shows a resistive cap at the top and at the Saddle Knob, as well as generally matching a mapped silicified northwest structural trend on the south side. A northwest linear on the north slope at Hasbrouck is also suggested by the survey. Resistive near-vertical zones were noted in the report that crudely match similar resistive zones defined in a later CSAMT survey by Allied (see below). The reprocessed color plan view files were found to generally match the near surface resistivity detailed in the later CSAMT. The 1988 E-Scan survey lacked the detail of Allied's later CSAMT.

A CSAMT survey for the areas north and south of Hasbrouck Mountain was completed in 1990. Except for a line run at the southern base of Hasbrouck Mountain (Wright, 2011a), the 1990 survey does not cover the main project. The southern line suggests a continuation to the south of a mapped fault (East Fault) under cover.

Allied completed a CSAMT survey in 2011 over Hasbrouck Mountain consisting of 11.5 line kilometers at 100 meter station spacing (Wright, 2011b). The survey identified a strong resistor in the Fraction Tuff on the eastern portion of the mountain. Drill intercepts confirm that the anomaly is likely a locally welded portion of the Fraction Tuff. The strong silicification in the upper Siebert units on Hasbrouck Mountain was outlined, and possible feeder faults are evident in the CSAMT images. The Saddle Fault Zone and the East Fault show as 'breaks' between resistive masses. The images match the mapped resistive northwest trending zones on the south and northern part of Hasbrouck. Drill testing of the upper portion of these zones confirmed the CSAMT resistivity model.

In 2010, Allied completed two gravity surveys: one over Hasbrouck proper, and a contiguous survey to the south of the Hasbrouck Mountain (Wright, 2010). Subsequently, a gravity survey was completed over the southern portion of the Hasbrouck claim block, with 729 new gravity data stations added contiguous to the 2010 gravity surveys (Wright, 2011a). This 2011 survey was combined with the previous surveys into a master gravity plot, and structural interpretations derived from the surveys were incorporated into the exploration and mapping efforts.

Regional gravity patterns indicate a strong northwest lineament, overprinted by north-south and northeast linears. This gravity signature has been interpreted as evidence of the Walker Lane shear zone, along with transverse faults. Hasbrouck Mountain lies on the northern edge of a major gravity linear (Wright, 2010, 2011a).

Drilling by Allied from 2010 through 2012 included 128 RC holes (117,093ft) and 43 diamond-core holes (28,606ft). Most of the drilling was focused on resource definition and expansion, but also included significant core drilling to provide material for metallurgical test work. The 2012 drilling was located at the Silver King and Mastif targets, both of which are external to the Hasbrouck deposit resource.

## 6.2 Historical Mineral Resource Estimates

This section has been largely summarized and modified from Wilson (2014), who noted that the historic estimates provide historical perspective regarding the range of estimates produced using different data, methods, and assumptions. These historic mineral resource estimates are superseded by the current mineral resource estimate described in Section 14.0 and are not to be relied on.

### 6.2.1 Historical Three Hills Estimates

Historic resource estimates for the Three Hills deposit, performed by Echo Bay, GEXA Gold and Eastfield Resources in 1988 through 1996, were summarized by MDA (Prenn, 2006) and are presented in Table 6.1. MDA believes that none of these historic estimates were prepared in full compliance with the provisions of National Instrument 43-101. They are included for historical completeness and should not be relied upon, and are superseded by the current resources estimated in Section 14 of this report.

**Table 6.1 Historical Three Hills Resource Estimates: 1988 through 1996**
(from Prenn, 2006)

| Company | Method | Year | Cut-off oz Au/t | Tons 000's | Grade oz Au/t | oz Au 000's |
|---|---|---|---|---|---|---|
| Echo Bay | Section | 1988 | 0.01<br>0.02 | 2,051.9<br>1,271.8 | 0.027<br>0.035 | 55.4<br>44.5 |
| Echo Bay | Section | 1988 | 0.01<br>0.02 | 7,357.0<br>3,526.0 | 0.026<br>0.036 | 191.0<br>127.0 |
| Echo Bay | Polygon | 1988 | 0.01<br>0.02 | 6,700.0<br>2,750.0 | 0.023<br>0.039 | 155.0<br>107.0 |
| Echo Bay | Section | 1990 | 0.01<br>0.02 | 6,450.0<br>3,180.0 | 0.026<br>0.036 | 167.7<br>114.5 |
| Gexa | ID3 | 1991 | 0.01<br>0.02 | 4,203.4<br>1,894.3 | 0.021<br>0.029 | 88.3<br>54.9 |
| Eastfield/Prism (MDA) | ID3 | 1996 | 0.01 | 6,286.0 | 0.023 | 144.6 |

In 2003 and 2006 MDA noted that some of the material estimated for the 1996 resource was not inside in Vista's property boundary for Three Hills. MDA subtracted the material outside the property boundary to update the 1996 resource estimate, but no additional drilling had been done that was considered material to the Three Hills resource (Table 6.2). MDA used a bulk density of 15.0ft$^3$/ton, based on an average of 19 drill core samples from the 1996 Eastfield drilling.

**Table 6.2 Historic Three Hills Resource Estimate 2003 and 2006**
(Prenn, 2006)

| | Indicated | | | Inferred | | |
|---|---|---|---|---|---|---|
| Cutoff oz Au/t | Tons 000's | oz Au/t | Oz Au 000's | Tons 000's | oz Au/t | Oz Au 000's |
| 0.000 | 5,744.0 | 0.023 | 133.8 | 1,855.0 | 0.001 | 1.3 |
| 0.010 | 5,736.0 | 0.023 | 133.6 | 10.6 | 0.015 | 0.2 |
| 0.015 | 4,754.0 | 0.025 | 120.2 | 1.4 | 0.034 | 0.0 |
| 0.020 | 3,180.0 | 0.030 | 96.6 | | | |
| 0.030 | 1,132.0 | 0.041 | 46.5 | | | |

The most recent historic estimate of mineral resources at Three Hills was presented in the Technical Report by Wilson (2014), utilizing Allied's geologic model and a drilling database reported to contain 287 holes drilled from 1974 through 2012. Table 6.3 summarizes the 2014 estimate of resources at Three Hills.

**Table 6.3 Summary of 2014 Estimated Resources, Three Hills**
(Feb 21, 2014, 0.005 opt Au Cutoff; from Wilson, 2014)

| Category | Tons (000's) | Gold opt | Silver opt | AuEq opt | Gold (000 oz) | Silver (000 oz) | AuEq (000 oz) |
|---|---|---|---|---|---|---|---|
| Measured | 1,091 | 0.023 | N/A | N/A | 25 | 0 | 25 |
| Indicated | 7,413 | 0.017 | N/A | N/A | 126 | 0 | 126 |
| **Measured & Indicated** | **8,504** | **0.018** | **N/A** | **N/A** | **151** | **0** | **151** |
| Inferred | 11,002 | 0.014 | | | 154 | | 154 |

AuEq calculated AuEq= Au + (Ag/57.14)

### 6.2.2 Historical Hasbrouck Estimates

Resource and reserve estimates for the Hasbrouck deposit performed prior to 2003 by various operators were summarized by Prenn and Gustin (2003) and are presented in Table 6.4. MDA believes that none of these historical estimates were prepared in full compliance with the provisions of National Instrument 43-101. They are included for historical completeness and should not be relied upon, and are superseded by the current resources estimated in Section 14 of this report. The following notes apply to some of the estimates:

1. The Cordex and FMC estimates were prepared in-house.
2. Bechtel, Inc. prepared the estimates for Franco-Nevada.

**Table 6.4 Historical (Non-43-101) Resource and Reserve Estimates for the Hasbrouck Deposit Prior to 2003 (0.020 oz Au/ton cutoff)**

| Company | Category as reported | Year | Tons ($x 10^6$) | | Grade Au (oz/ton) | Grade Ag (oz/ton) | Ounces Gold | Ounces Silver |
|---|---|---|---|---|---|---|---|---|
| Cordex | "Geologic Reserve" | 1975 | 5.0 | | 0.040 | 0.7 | 200,000 | 3,500,000 |
| Franco-Nevada | "Geologic Reserve" | 1986 | 7.7 | | 0.036 | 0.7 | 277,000 | 5,390,000 |
| FMC | "Geologic Reserve" | 1988 | 10.2 | | 0.038 | 0.41 | 388,000 | 4,180,000 |
| Franco-Nevada | "Mineable Reserves" | 1986 | 3.16 | | 0.038 | 0.61 | 120,000 | 1,930,000 |
| FMC | "Mineable Reserves" | 1988 | 1.90 | | 0.045 | 0.50 | 85,000 | 950,000 |
| Corona | "Mineable Inventory" | 1989 | 4.2 | | 0.036 | n/a | 151,000 | |

MDA is unaware of any of the companies listed in Table 6.4 having undertaken density measurements on the mineralized rocks at Hasbrouck. The only tonnage factor used that is known to MDA is 12 cubic feet per ton of ore, which was applied by Bechtel in the Franco-Nevada estimations and is likely a best-guess estimate. MDA concludes that generalized, unsupported tonnage factors were probably used in the historical estimations.

The Franco-Nevada "Geologic Reserve" was defined by a block model with 20ft x 20ft x 20ft blocks that were estimated using 20-foot vertical composites of drill assays and geostatistical techniques. The "Mineable Reserves" includes those portions of the "Geologic Reserve" that were defined by drill holes with approximately 100-foot spacing and that were encompassed in a pit with 45º slopes (Bechtel, 1986). The pit appears to have been placed on a best-fit basis to include the highest grade composites; economic parameters do not appear to have been used to generate the pit.

No information regarding the parameters or methods used in the Cordex and Corona (Barnett, 1989) estimations was reviewed by MDA. The Euro-Nevada "Mineable Reserves" were defined by drilling at approximately 100ft to 150ft spacing. The FMC "Mineable Reserves" estimate used assumed prices of $450/oz gold and $6.50/oz silver, and recoveries of 49% for gold and 9% for silver. MDA knows of no other parameters used in the "Mineable" estimations of Euro-Nevada, FMC and Corona.

In 2003 MDA estimated the Hasbrouck gold and silver resources at the request of Vista Gold, conforming to the CIM standards and definitions of 2000 (Prenn and Gustin, 2003). The 2003 MDA estimate is shown in Table 6.5. An updated Technical Report for Vista was provided by MDA in 2006, but no new technical data were available. The 2003 resource estimate remained unchanged in the 2006 updated MDA report (Prenn and Gustin, 2006).

**Table 6.5 2003 and 2006 Historic MDA Resource Estimate for the Hasbrouck Deposit**

| INDICATED RESOURCES | | | | | |
|---|---|---|---|---|---|
| | | GOLD | | SILVER | |
| Cut-off (oz Au/ton) | Tons (1000's) | Grade (oz Au/ton) | Ounces | Grade (oz Ag/ton) | Ounces |
| 0.01 | 20,300 | 0.023 | 459,000 | 0.32 | 6,464,000 |
| 0.02 | 8,100 | 0.034 | 277,000 | 0.45 | 3,663,000 |
| 0.03 | 3,100 | 0.051 | 160,000 | 0.6 | 1,876,000 |
| 0.04 | 2,000 | 0.06 | 121,000 | 0.64 | 1,291,000 |
| 0.05 | 1,100 | 0.073 | 81,000 | 0.7 | 784,000 |
| 0.08 | 280 | 0.108 | 31,000 | 0.85 | 242,000 |
| 0.10 | 130 | 0.131 | 17,000 | 0.82 | 110,000 |
| 0.15 | 27 | 0.174 | 4,700 | 0.61 | 16,000 |
| **INFERRED RESOURCES** | | | | | |
| | | **GOLD** | | **SILVER** | |
| **Cut-off (oz Au/ton)** | **Tons (1000's)** | **Grade (oz Au/ton)** | **Ounces** | **Grade (oz Ag/ton)** | **Ounces** |
| 0.01 | 8,200 | 0.021 | 172,000 | 0.19 | 1,589,000 |
| 0.02 | 2,300 | 0.035 | 83,000 | 0.25 | 592,000 |
| 0.03 | 1,000 | 0.052 | 52,000 | 0.33 | 333,000 |
| 0.04 | 760 | 0.057 | 43,000 | 0.31 | 235,000 |
| 0.05 | 410 | 0.068 | 28,000 | 0.27 | 110,000 |
| 0.08 | 70 | 0.102 | 7,200 | 0.17 | 12,000 |
| 0.10 | 44 | 0.111 | 4,900 | 0.14 | 6,000 |
| 0.15 | 0 | 0 | 0 | - | - |

Allied prepared an up-dated resource estimate and Technical Report and Preliminary Economic Assessment ("PEA") in accordance with NI 43-101 utilizing a November, 2011 database that incorporated drilling done by Allied in 2010 and 2011 (Flint et al., 2012). A bulk density of 2.4 tonnes per cubic meter was applied by Flint et al. (2012), apparently based on the 5 mineralized rock samples analyzed for bulk density by MDA in 2003 (Prenn and Gustin, 2006). The Allied

2012 resource estimate used ordinary kriging and gold-equivalent cut-off grades for the reporting of Inferred-only Resources as summarized in Table 6.6

**Table 6.6 2012 Hasbrouck Inferred Resource Estimate at Various Cut-off Grades**
Flint et al. (January, 2012)

| Cut-Off AuEq opt | Tons | Au opt | Au Oz | Ag opt | Ag oz | AuEq opt | AuEq oz |
|---|---|---|---|---|---|---|---|
| **0.005** | **128,608,197** | **0.009** | **1,157,474** | **0.228** | **29,322,669** | **0.013** | **1,671,907** |
| 0.006 | 111,187,572 | 0.010 | 1,111,876 | 0.247 | 27,463,330 | 0.015 | 1,667,814 |
| 0.007 | 96,298,939 | 0.011 | 1,059,288 | 0.264 | 25,422,920 | 0.016 | 1,540,783 |
| 0.008 | 83,597,819 | 0.012 | 1,003,174 | 0.283 | 23,658,183 | 0.017 | 1,421,163 |
| 0.009 | 73,192,760 | 0.013 | 951,506 | 0.300 | 21,957,828 | 0.019 | 1,390,662 |
| **0.010** | **64,634,418** | **0.014** | **904,882** | **0.316** | **20,424,476** | **0.020** | **1,292,688** |
| 0.011 | 57,391,006 | 0.015 | 860,865 | 0.331 | 18,996,423 | 0.021 | 1,205,211 |
| 0.012 | 51,208,442 | 0.016 | 819,335 | 0.346 | 17,718,121 | 0.022 | 1,126,586 |
| 0.013 | 45,762,953 | 0.017 | 777,970 | 0.361 | 16,520,426 | 0.023 | 1,052,548 |
| 0.014 | 40,832,277 | 0.018 | 734,981 | 0.376 | 15,352,936 | 0.024 | 979,975 |
| 0.015 | 36,819,290 | 0.019 | 699,567 | 0.391 | 14,396,342 | 0.025 | 920,482 |
| 0.016 | 33,357,756 | 0.019 | 633,797 | 0.406 | 13,543,249 | 0.026 | 867,302 |
| 0.017 | 29,793,687 | 0.020 | 595,874 | 0.421 | 12,543,142 | 0.028 | 834,223 |
| 0.018 | 26,958,523 | 0.021 | 566,129 | 0.436 | 11,753,916 | 0.029 | 781,797 |
| 0.019 | 24,368,890 | 0.022 | 536,116 | 0.452 | 11,014,738 | 0.030 | 731,067 |
| 0.020 | 22,213,157 | 0.023 | 510,903 | 0.466 | 10,351,331 | 0.031 | 688,608 |
| 0.025 | 12,940,980 | 0.027 | 349,406 | 0.551 | 7,130,480 | 0.037 | 478,816 |
| 0.030 | 7,939,904 | 0.032 | 254,077 | 0.632 | 5,018,019 | 0.043 | 341,416 |
| 0.035 | 4,835,234 | 0.037 | 178,904 | 0.715 | 3,457,192 | 0.050 | 241,762 |
| 0.040 | 2,917,621 | 0.044 | 128,375 | 0.812 | 2,369,108 | 0.058 | 169,222 |

Following WKM's acquisition of the Hasbrouck project from Allied in early 2014, an updated mineral resource estimate and Technical Report were prepared in accordance with NI 43-101 by Wilson (2014), incorporating 37 RC holes drilled in the Hasbrouck deposit by Allied in 2012. A summary of the 2014 resource estimate is presented in Table 6.7.

**Table 6.7 Summary of 2014 Hasbrouck Resource Estimate from Wilson (2014)**
***Cut-off Grade = 0.005opt AuEq***

| Category | Tons (000 tons) | Gold opt | Silver opt | AuEq opt | Gold (000 oz) | Silver (000 oz) | AuEq (000 oz) |
|---|---|---|---|---|---|---|---|
| Measured | 14,686 | 0.014 | 0.307 | 0.019 | 206 | 4,509 | 285 |
| Indicated | 55,002 | 0.011 | 0.248 | 0.015 | 605 | 13,640 | 844 |
| **Measured & Indicated** | **69,688** | **0.012** | **0.260** | **0.016** | **811** | **18,149** | **1,128** |
| Inferred | 58,921 | 0.007 | 0.189 | 0.010 | 412 | 11,136 | 607 |

AuEq calculated AuEq= Au + (Ag/57.14)

## 6.3 Historical Production

Although mining took place prior to 1900 in the vicinity of Tonopah, most of the production from the area took place between 1900 and 1920. Silver and gold mineralization was first discovered on Hasbrouck Mountain in 1902. Early mining exploited the Kernick vein, which was worked on a small scale through the mid-1920s. The recorded production from Hasbrouck comprises 740 tons of ore produced by the Tonopah Hasbrouck Mining Company in 1923 and 1924 that grossed $10,406 (Couch and Carpenter, 1943). The early miners excavated about 6,500ft of adits and 1,000ft of raises.

No production figures are available for the Three Hills deposit. Production from the Three Hills deposit may have included minor amounts of gold mined from several adits and shafts in the area.

# 7.0 GEOLOGIC SETTING AND MINERALIZATION

This section has been taken from the Technical Reports of Prenn and Gustin (2006), Wilson (2014) and sources therein, and remains unchanged from Tietz et al. (2015).

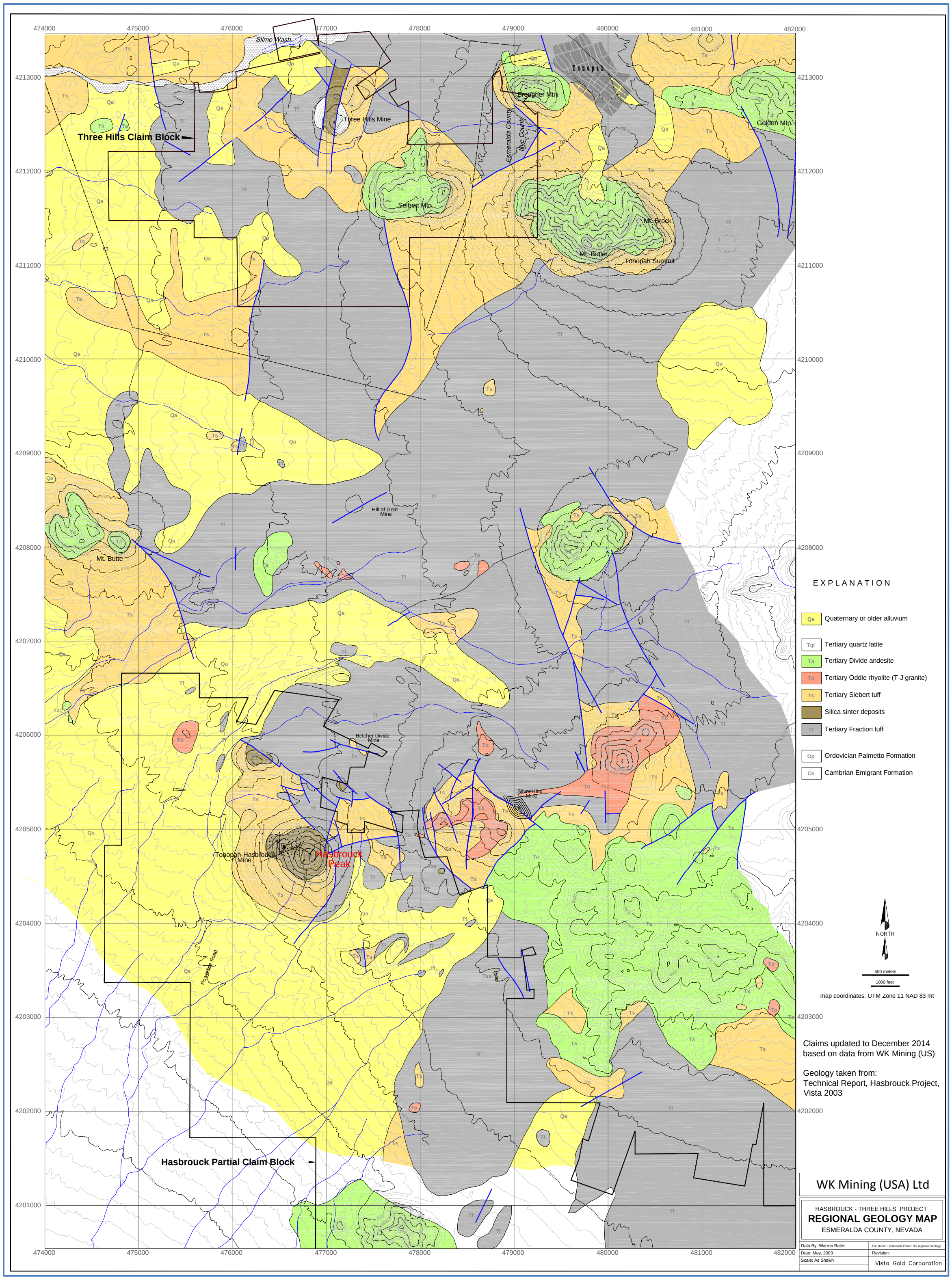
## 7.1 Geologic Setting

### 7.1.1 Regional Geology

The Three Hills and Hasbrouck properties are located in the western portions of the Tonopah and Divide mining districts, respectively, which are characterized by exposures of Tertiary volcanic and volcano-sedimentary rocks. The Divide district is believed to be related to a caldera collapse and dome-field setting (Graney, 1985). Both Tonopah and the Divide districts lie along the east margin of the Walker Lane belt, a northwest-trending province in western Nevada and eastern California (Stewart, 1988) that includes numerous epithermal precious metal deposits, many of which are related to Tertiary volcanic rocks. Prominent northwest-trending strike-slip faults and related north-south to northeast trending normal faults characterize much of the Walker Lane belt.

The Tertiary volcanic rocks of the Divide district have been assigned to the Mizpah Formation, West End Rhyolite, Fraction Tuff, Siebert Formation, Divide Andesite and Oddie Rhyolite, all of Miocene age (Bonham and Garside, 1974; Bonham and Garside, 1979). The older West End and Mizpah formations have been drilled along the northeast of the Three Hills area, and are the principal hosts to mineralization at Tonopah. These units have not been encountered at depth under Three Hills or the Hasbrouck deposit. Overlying these is the Fraction Tuff, believed to have been derived from eruptions related to the collapse of an Early Miocene caldera centered on the area. Subsequent Basin-and-Range extensional faulting led to the deposition of fluvial and lacustrine sedimentary units of the Siebert Formation, which are intercalated with air-fall and thin ash-flow tuffs. Flows and domes of the Brougher Rhyolite, overlie the Siebert, forming high hills and peaks. This unit is only known from outcrop exposures near Three Hills, and has not been encountered in drilling. Dikes and domes of the Oddie Rhyolite intrude the earlier units and are interpreted to be genetically related to the mineralization in the Divide district and at Three Hills. The Divide Andesite, variously described as high level intrusions or flows, is thought by some to be post-mineralization (e.g., Snyder, 1990). A regional geologic map of the Three Hills and Hasbrouck project area is shown in Figure 7.1.

**Figure 7.1 Regional Geologic Map of the Three Hills and Hasbrouck Area, Nevada**
(modified from Prenn and Gustin (2006))



### 7.1.2 Project Geology

#### 7.1.2.1 Three Hills Deposit Geology

The major rock types within the Three Hills property are, from oldest to youngest, the Mizpah Formation, Fraction Tuff, Siebert Formation, the Oddie Rhyolite and the Brougher Rhyolite. The Siebert Formation unconformably overlies the Fraction Tuff and both are intruded by the Oddie Rhyolite. The majority of the deposit lies in the Siebert Formation.

The Mizpah Formation ranges from trachyandesite to dacite, consisting of up to 700ft of porphyritic lava flows, dikes, lahars, and andesitic volcanoclastics. It is commonly altered hydrothermally, with quartz-sericite-adularia alteration associated with the main stage veins in the Tonopah district. The Mizpah Formation does not crop out in the project area, but can be found in an uplifted block to the east. It is the predominant host rock for Ag-Au vein mineralization in the Tonopah district, and westward extensions of the vein systems have been intercepted by drilling in the Three Hills property. K-Ar dating of the adularia associated with the mineralization at Tonopah ranges from 19-18 Ma.

The Fraction Tuff has been divided into two compositionally similar members; the Tonopah Summit and the King Tonopah Members. The Tonopah Summit Member is typically a poorly welded, quartz latite to rhyolite, lithic tuff. The King Tonopah Member is a welded rhyolitic, lithic, crystal tuff. K-Ar dates range from 21.5 to 17 Ma for both of the members, but do not clearly define stratigraphy between the two. Alteration is widespread in the Fraction Tuff, and it hosts silver veins and gold mineralization in the Three Hills area.

The overlying Siebert Formation is a sequence of volcaniclastic siltstones, sandstones, tuffs, and conglomerates deposited in fluvial and lacustrine conditions. Rapid facies changes are common in the formation. It has been broken down into two units in the project area: a thin bedded fine-grained tuff, and a coarse-grained volcaniclastic unit. The coarser, more permeable sandstones and conglomerates of the volcaniclastic unit are the preferred hosts for gold mineralization at Three Hills. K-Ar age dating suggests the Siebert ranges between 17-13 Ma in age. The upper parts of the Siebert are likely part of the regionally extensive Mid- to Late-Miocene Esmeralda Formation.

The Oddie Rhyolite is a pinkish-grey, weakly porphyritic, biotite-bearing high-silica rhyolite. It is almost always hydrothermally altered, and is associated with mineralization at Three Hills where domes appear to have proximal lapilli ejecta aprons that formed part of the Siebert Formation. K-Ar dating of the biotite has given an age of 16.9-16.4 Ma

Structure in the project area reflects effects of the Walker Lane dextral strike-slip faulting, superimposed on the Basin and Range extensional block faulting. The ages of the structures are between 26-16 Ma. The Walker Lane strike-slip faulting dominates and trends northwest, developing northeast and north-south trending extensional structures. The Basin and Range block faults trend north-south and form horsts and grabens bounded by high-angle normal faults that flatten to low-angle listric faults at depth. These high-angle faults are a control on the mineralization in Three Hills, where they cut the Siebert Formation, dropping the Siebert to the east, against Fraction Tuff to the west.

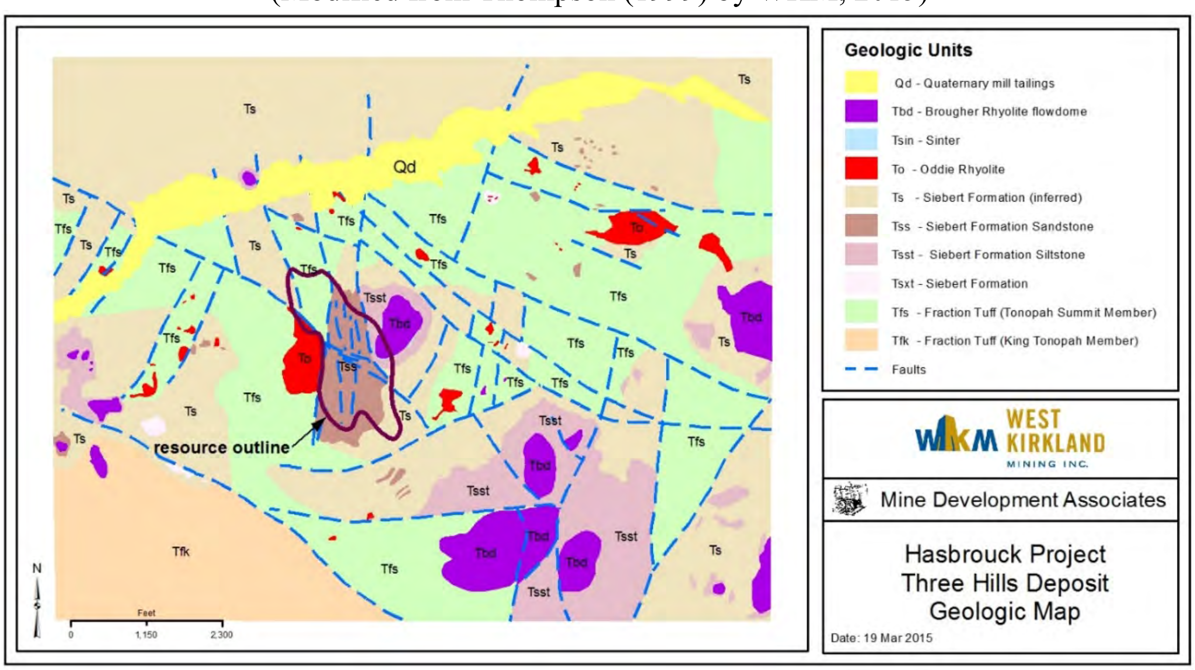
At the center of the property the "Three Hills" consist of the north, south, and east hills. Geologic mapping by Thompson (1999) shows the east hill is capped by Brougher Rhyolite, which appears to lie directly over the Siebert Formation as a flow (Figure 7.4). Oddie Rhyolite intrudes along north-south structures in the area and occurs as dikes, flows and flow domes. The west side of the south hill contains a flow that intruded along the main fault bounding the mineralization. Several smaller plugs are noted in outcrop and drilling to the east. A minor amount of mineralization has been drilled in the Oddie flows along the western edge of the hills.

The north and south hills are underlain by ash-flow, air-fall and water-lain tuffs and epiclastic sediments of the Siebert Formation. These volcanic and epiclastic units generally dip 30° to 40° to the east, immediately under the two hills, then become west dipping to flat lying under the east hill. The Siebert contains an upper portion dominated by epiclastic sediments and a lower portion containing various lithic, crystal and lapilli ash-flow units with interbedded epiclastic sediments. This is the dominant host for mineralization at Three Hills. The underlying Fraction Tuff is a secondary host to mineralization.

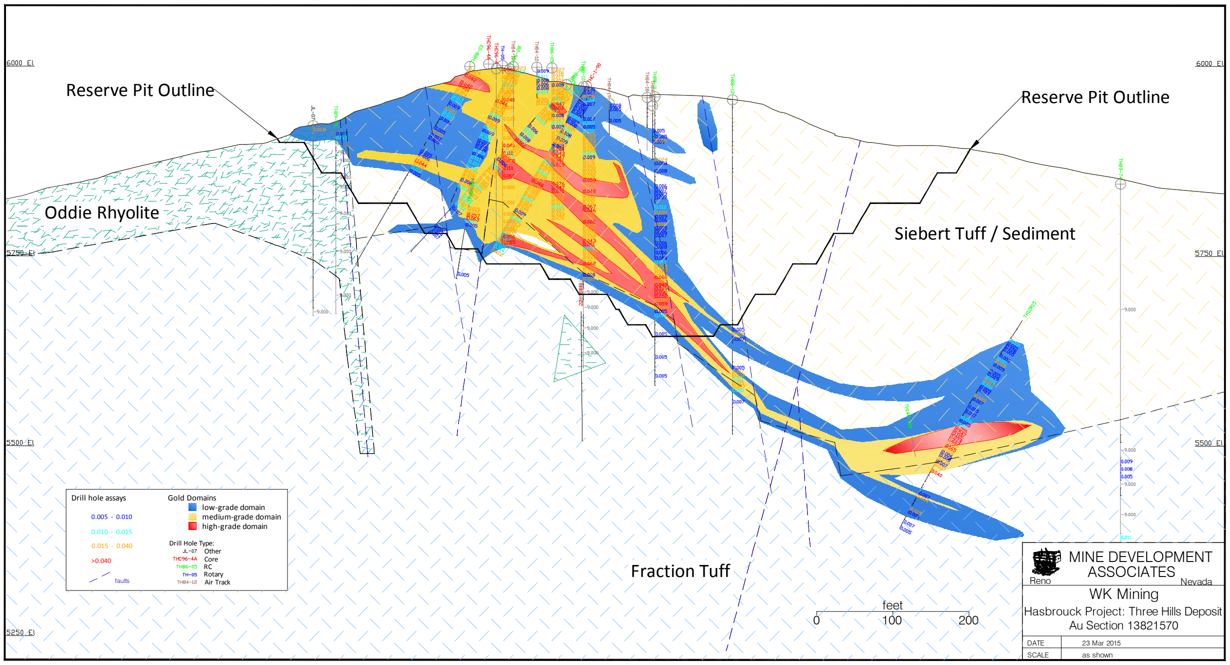
Historic drilling in the northeast portion of the area has encountered West End Rhyolite and Mizpah Andesite at depth. The West End Rhyolite is described as an irregular sill that has intruded the Mizpah Andesite. Drilling is limited, although thin zones of mineralization have been noted in both units. A geological map of the Three Hills area is included as Figure 7.2. An east-west cross-section looking north through the deposit is shown in Figure 7.3, and Figure 7.4 is a north-south cross-section looking west through the deposit.

**Figure 7.2 Geologic Map of the Three Hills Deposit Area**

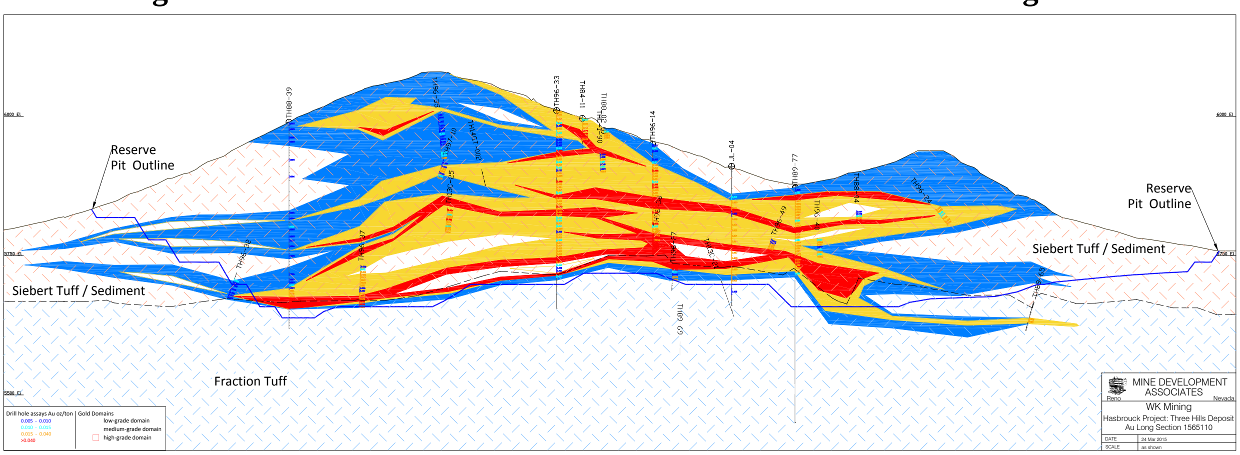
(Modified from Thompson (1999) by WKM, 2015)



## Figure 7.3 Three Hills East-West Cross-section 13821570 Looking North




## Figure 7.4 Three Hills North-South Cross-section 1565110 Looking West



### 7.1.2.2 Hasbrouck Deposit Geology

Details of the geology are provided by Graney (1985), who mapped Hasbrouck Mountain in detail and studied the alteration mineralogy as part of a Master's thesis supported by Cordex. The bulk of the topographic high of Hasbrouck Mountain (also known as Hasbrouck Peak) is underlain by ashflow, air-fall and waterlain tuffs and volcaniclastic sediments of the Siebert Formation. According to Graney's surface mapping, these volcanic and volcaniclastic units generally dip 10 to 40 degrees to the west and southwest, with the average dip being 20 degrees to the west. As at Three Hills, the upper portion of the Siebert Formation at Hasbrouck is dominated by epiclastic sediments, mostly sandstones and conglomerates of volcanic origin. Graney mapped several occurrences of chalcedonic sinter deposits, produced during hot spring activity, near the summit of the mountain. Hydrothermal breccias are exposed in various areas, especially along the western and northern slopes of Hasbrouck Mountain, generally to the north (in the hanging wall) of the Kernick structure. The lower portion of the Siebert Formation at Hasbrouck consists of various lithic, crystal and lapilli ash-flow units with interbedded epiclastic sediments. The Siebert Formation is underlain by the Fraction Tuff, which is exposed along the eastern base of Hasbrouck Mountain. The Fraction Tuff in this area is composed of lithic-rich ash flow tuff. Fluvial sandstones and conglomerates occur in the Siebert Formation immediately above the Fraction Tuff. The Fraction Tuff dips 40 degrees to the west (Graney, 1985).

Graney (1985) has mapped a series of generally north- to northeast-trending normal faults that cut Hasbrouck Mountain and are interpreted by Graney to be post-mineral structures. Most of these structures have displacements on the order of 100ft or less. The mineralized Kernick structure, which was the focus of historic underground production at Hasbrouck, trends roughly east-west across the western ridge of Hasbrouck Mountain and is reported to dip to the north at angles of 50 to 70 degrees (Graney, 1985).

Remapping of Hasbrouck Mountain by Allied's geologists led to a re-interpretation of the structural framework and the relationship of various structural orientations to mineralization (Figure 7.5, Figure 7.6, and Figure 7.7). High-angle faults mapped on Hasbrouck Mountain can generally be grouped into three orientations, north-south, N20°-35°E, and N40° – 60° W (Carter, 2011; Kunkel, 2012). North-south faults are the most prominent and appear to offset all other fault orientations (Figure 7.5). Offsetting relationships observed in outcrop of the northeast fault sets and northwest fault sets is equivocal.

**Figure 7.5 Geologic Map of the Hasbrouck Deposit**
from Wilson (2014)

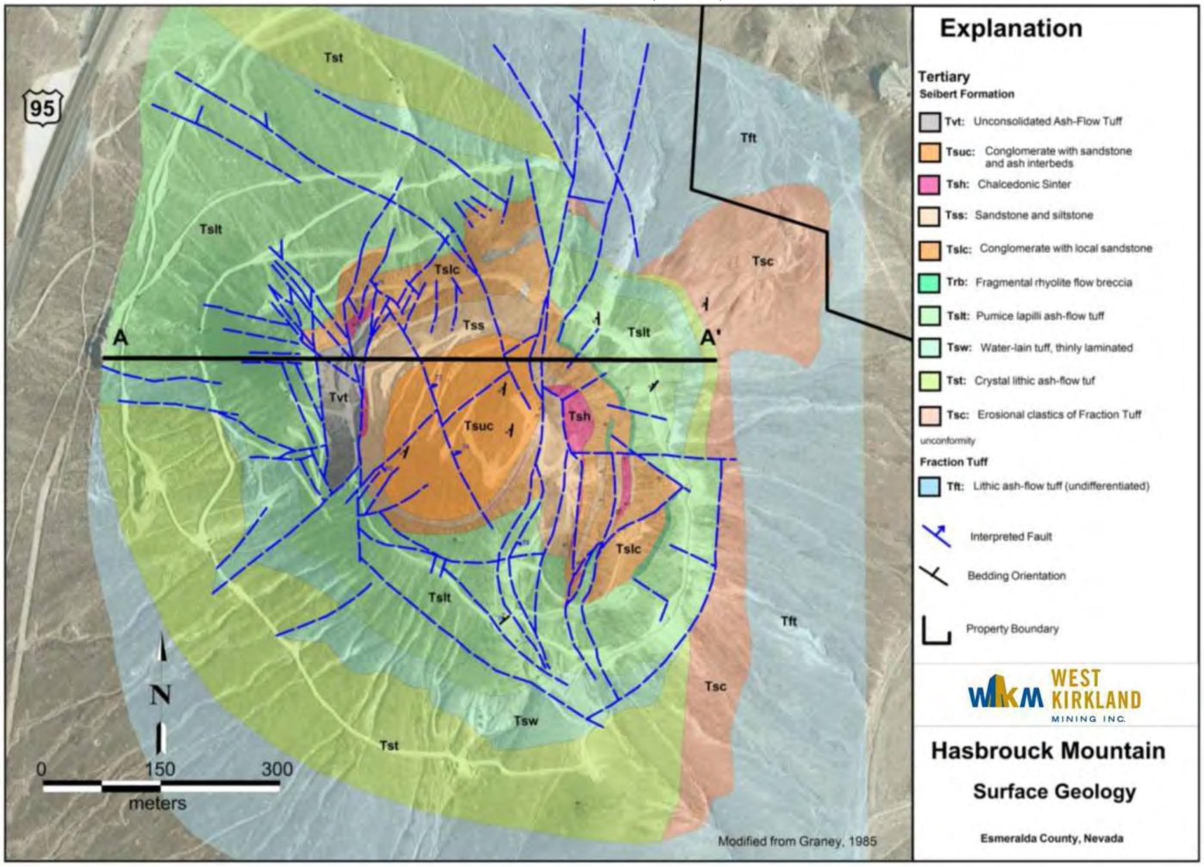



**Figure 7.6 East-West Cross-section Hasbrouck Deposit**
from Wilson (2014), looking north

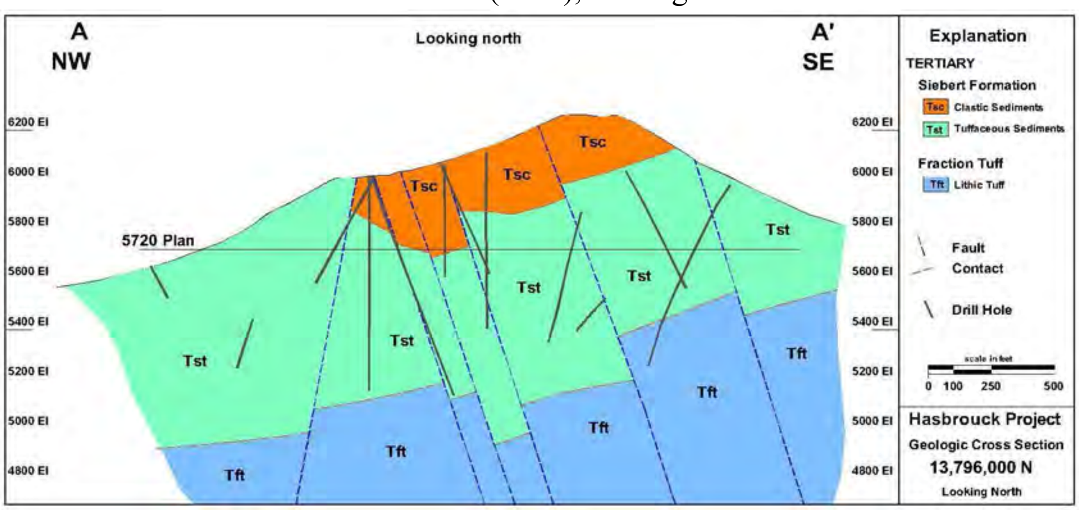
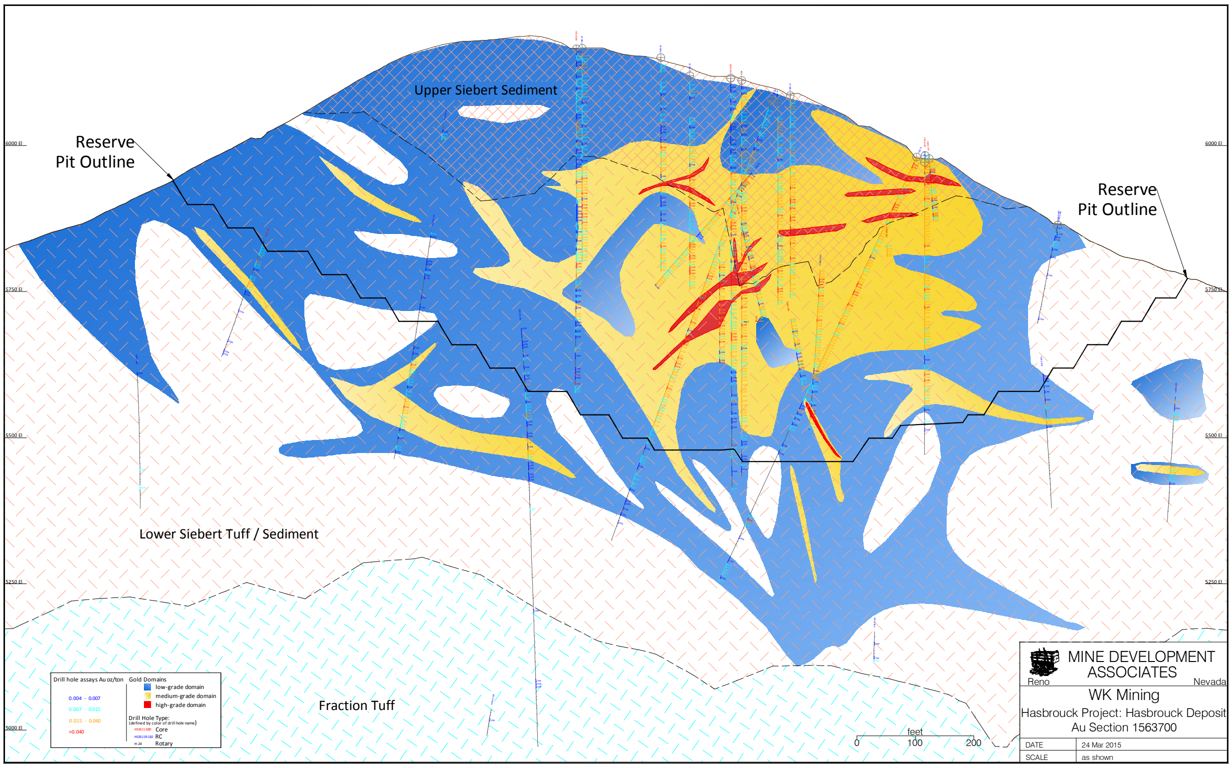


**Figure 7.7 Hasbrouck Deposit North-South Au Section 1563700 Looking West**




North-south faults are typically very high angle and may dip both to the east and west creating a series of horsts and grabens. Apparent normal offset appears to be on the order of several tens of feet to 100ft, but local evidence suggests there is also a strike-slip component. Northeast trending faults appear to be moderate to high-angle, dipping both to the northwest and southeast. Mapped northwest trending faults are more cryptic and discontinuous, typically forming broad, brecciated, steeply dipping zones.

## 7.2 Mineralization

### 7.2.1 Three Hills Mineralization

The drill-defined extent of Three Hills gold mineralization is approximately 1000ft east–west by 2700ft 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.

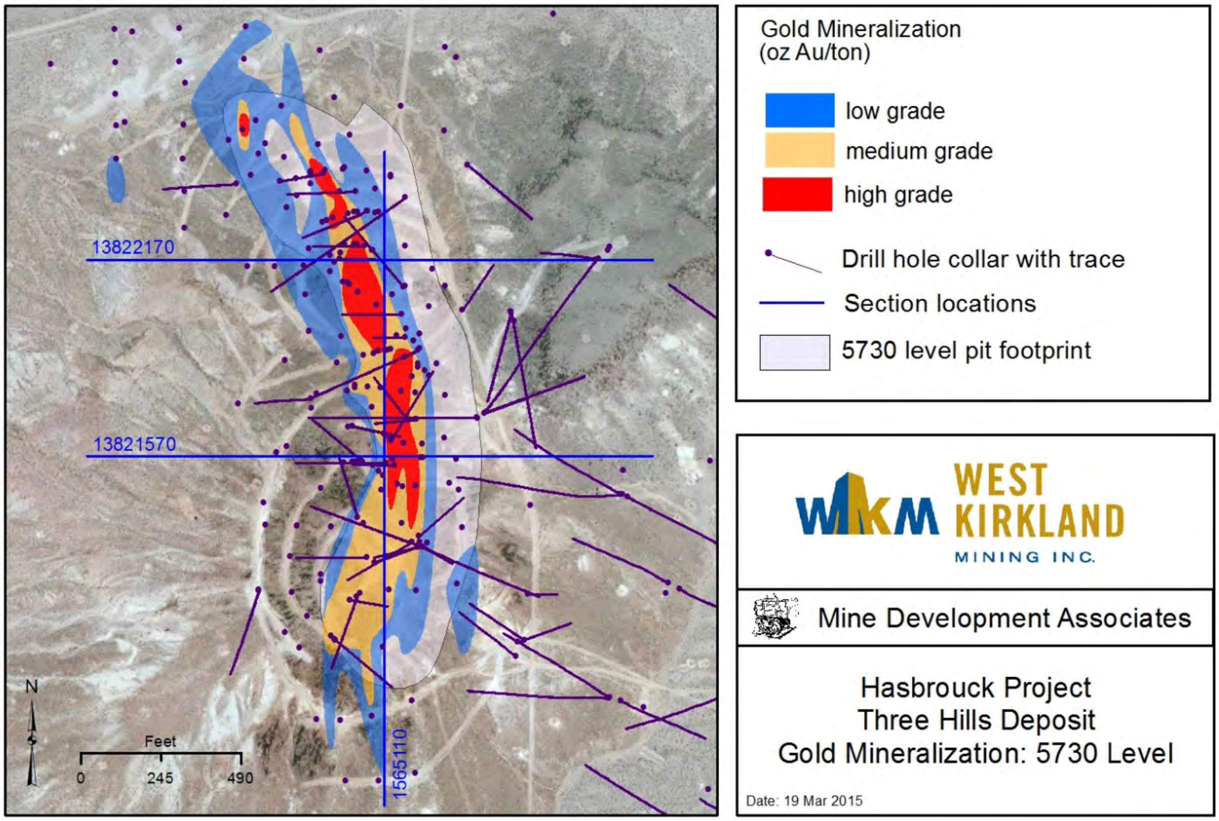
Gold mineralization at Three Hills is commonly associated with areas of higher permeability lithologies, rock unit contacts, and structural features. Previous authors have described the mineralization as “disseminated” though examination of outcrops and drill core shows the higher gold grades associated with discontinuous, irregular 0.05- to 0.5inch-wide veinlets, vein stockworks, and erratic breccia veins of chalcedony and quartz. Lower gold grades in the top of the south hill are found in zones of grey to brown chalcedony, and hydrothermal breccia veins and pipes. Figure 7.8 presents a level plan at the 5730ft elevation showing gold mineralization.

Tregaskis and Garratt (1998) describe the mineralization as being "intimately related" with alteration at Three Hills. The main resource is situated within a broad zone of pervasive silicification in the Siebert Formation and the upper 10-30ft of the Fraction Tuff. The contact between these two units contains consistently higher grades of gold and is more commonly argillized than silicified. The contact zone between the Siebert and Fraction controls mineralization lateral to the core of the deposit.

Hydrothermal fluids precipitated adularia, and quartz as the stable alteration assemblage such that the bulk of the mineralization occurred in rocks with cloudy adularized feldspar crystals, bipyramidal quartz crystals, quartz overgrowths, occasional preserved biotite flakes, and a silicified matrix. Argillic alteration (illite ± montmorillonite) forms an envelope around the silicified and mineralized zones, and along the Siebert–Fraction contact. Subsequent to mineralization the Three Hills deposit has been pervasively oxidized and Tregaskis and Garratt (1998) proposed that the gold was initially precipitated with pyrite that has now oxidized to goethite, hematite, and/or jarosite. Thompson (1999) proposed that the potassic alteration was a relatively early event and produced brittle rock that was later fractured by Walker Lane faulting.

Thompson (1999) mapped a series of Walker Lane structures oriented approximately N45W. The amount of strike slip movement is generally unknown, but is believed to have resulted in development of northeast and north-south trending extensional faults. These high angle structures form a series of horsts and grabens at the center of the property. Displacement along the north-south extensional faults ranges from 10- 500ft. The Three Hills deposit appears to be bounded by north-south faults and the western-most fault has been interpreted as a conduit for the emplacement of Oddie Rhyolite.

**Figure 7.8 Three Hills Level Plan 5730 Elevation**




### 7.2.2 Hasbrouck Mineralization

Hasbrouck mineralization has a 2,800ft east–west by 2,400ft north–south areal extent, with a maximum depth of 900ft. Mineralization is open at depth and to a limited extent to the north and east.

Precious metals mineralization at the Hasbrouck deposit is concentrated within the Siebert Formation, stratigraphically below the chalcedonic sinter horizons that outcrop near the peak of Hasbrouck Mountain (Graney, 1985). The overwhelming bulk of mineralization lies within the Main zone, a west-northwest-trending zone underlying Hasbrouck Mountain and parallel to the Walker Lane, while the smaller, east-west-trending, South zone occurs along the south flank of Hasbrouck Mountain approximately 700ft to the south of the Main zone. Weakly mineralized, sub-parallel structures occur between the Main and South zones.

The Kernick structure, which was the focus of historic underground at Hasbrouck, strikes roughly east-west across Hasbrouck Mountain and dips to the north. The majority of the mineralization in the deposit occurs in the hanging wall of the structure with the highest gold grades associated with 0.05- to 1.0inch wide, generally near-vertical, discontinuous silica-pyrite veinlets, sheeted 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 (0.01 to 0.05 oz Au/ton) along the peripheries of the deposit. This stratigraphic control has been commonly cited by geologists of the various companies involved at Hasbrouck in the past (e.g., Graney, 1985).

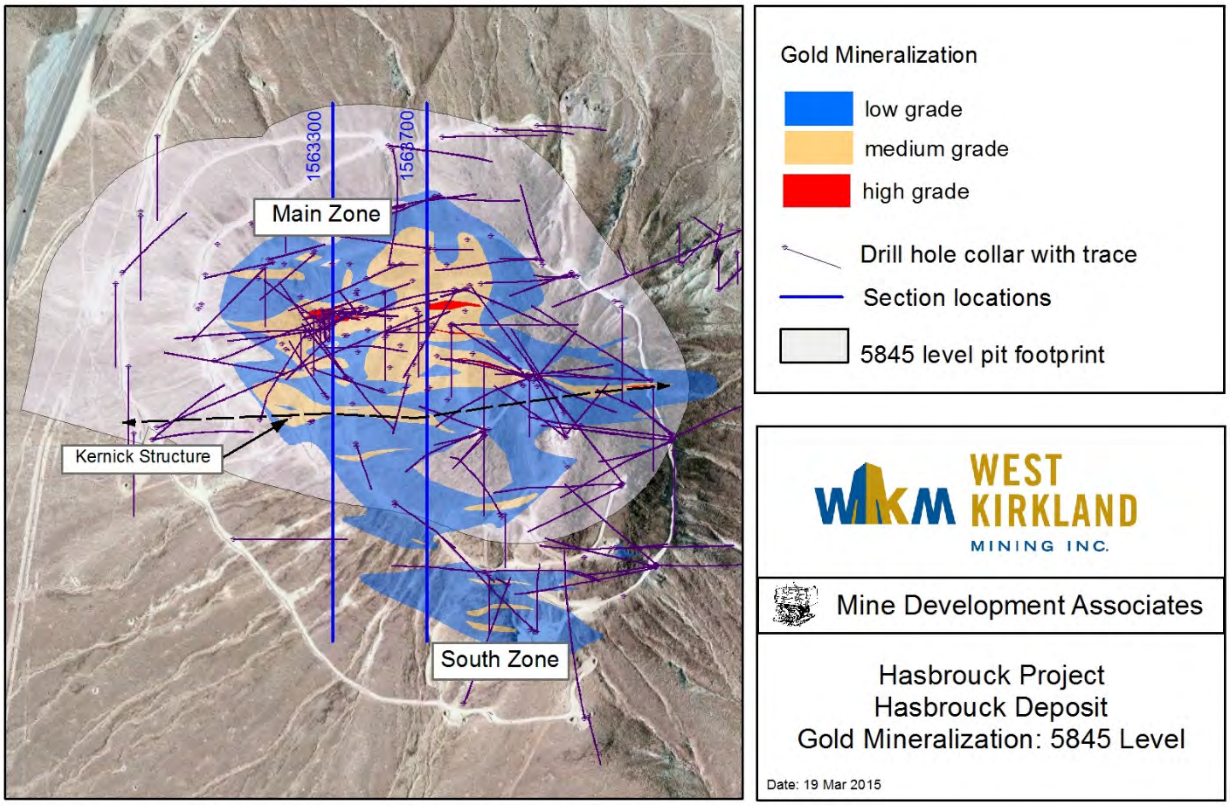
The Kernick structure served to focus higher-grade zones, although other such zones occur somewhat irregularly throughout the mineralized body in the hanging wall of the structure. A minor amount of mineralization lies in the footwall of the Kernick structure, along what are interpreted to be smaller, subsidiary structural zones.

The mineralization at Hasbrouck is accompanied by strong pervasive silicification, with associated adularia and pyrite, within the volcaniclastic rocks and lapilli tuff units of the upper Siebert Formation (Graney, 1985). Argillic alteration, characterized by the presence of illite and montmorillonite, forms an envelope around the silicified and mineralized zones.

Gold occurs as electrum, as inclusions in pyrite and in goethite derived from the partial to complete oxidation of pyrite, and within siliceous gangue minerals (Graney, 1985; Hazen, 1989). Silver occurs in the native state and in argentite (Wittkopp, 1982). Silver is also intimately associated with iron oxides derived from the oxidation of silver-rich sulfide minerals that occurred as inclusions in pyrite (Wittkopp, 1982).

Hasbrouck mineralization is primarily characterized as structurally-controlled, with secondary lithologic control. West-northwest and northeast fault orientations localize higher-grade mineralization (+0.05 oz Au/ton) with lower grade material occurring as halos and straddling the clastic and tuffaceous package contact within the Siebert Formation. North-south faults appear to be late-stage or offset mineralization. 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. Figure 7.9 presents a level plan at the 5,845ft elevation showing gold mineralization.

**Figure 7.9 Hasbrouck Deposit Level Plan 5845 Elevation**




Brecciated veins associated with northwest structures are dark gray to brick-red in color, and 0.05–20 inches in width. The breccia fragments are monolithic, and float in the silica matrix. Outcropping veins have the appearance of jasperoid, and strike parallel to the northwesterly-trending structural fabric. This vein type has been encountered in core holes. Banded quartz veins range from 0.05inches to as much as several inches in width. These veins parallel local structural trends, and consist of cream–white to tan to brown colored parallel bands from <0.05–0.5 inches in width. Veins have been noted in outcrop to undulate, and follow the outer trace of large blocks of fractured rock. A vein swarm trending northeast was noted to dip both to the east and west, but not to offset each other. Stockwork quartz–sulfide veins are typically up to 0.5inch in width. Silica occurs as gray or clear quartz selvages, with a center line of sulfides (typically oxidized). Occasionally, oxidized sulfides form selvages about the veins. Rare euhedral pyrite has been noted in some veins. Veins cross cut each other, and form a crude orthogonal set. Native gold in the form of small grains was noted in one vein along the center oxidized sulfide line.

Hydrothermal breccia zones contain diffuse silica flooding that crudely defines large vein zones. This silica is typically a medium brown color and has alternating bands of lighter and darker silica. The bands enclose and sometimes cross-cut breccia fragments. Veins in breccia zones often contain rock or vein fragments from rock units different than the surrounding rock, indicating transport. Vein margins may be planar, colloform, or crenulated.

# 8.0 DEPOSIT TYPES

The section has been modified from Prenn and Gustin (2006), Wilson (2014), and sources therein, as presented by Tietz et al. (2015).

Hasbrouck Mountain represents an erosional remnant of a Miocene geothermal system that produced epithermal precious metals mineralization in a hot springs environment. Examples of this type of deposit include the McLaughlin deposit in California and the Crowfoot-Lewis (Hycroft) and Hog Ranch deposits in Nevada, as well as Ladolam–Lihir deposits in Papua New Guinea. In common with these larger examples, gold and silver mineralization at Hasbrouck appears to have been emplaced at very shallow depths, and is associated with young hot spring-related systems with siliceous sinter deposits. In addition, the mineralized zones are typically associated with silica ±adularia replacement of volcaniclastic host rocks. These types of deposits contain characteristically low concentrations of both total sulfide minerals and base metals.

The Three Hills deposit is also considered to be a low-sulfidation, epithermal, volcanic-hosted precious-metals system. The bulk of the mineralization is within silicified portions of the Siebert Formation and along the Fraction Tuff/Siebert contact, associated with hydrothermal breccias, discontinuous narrow veins, sheeted vein zones and stockworks. Hydrothermal fluids circulated through faults and fractures until reaching the more permeable horizons of the Siebert Formation where they spread laterally, depositing gold and silver minerals.

A description for low-sulfidation epithermal deposits in general is modified below from Panteleyev (1996). Low-sulfidation epithermal deposits form within high-level, non-marine hydrothermal systems, which vary in crustal depths from about 3,280ft, to surficial hot spring settings. Host rocks range from volcanic rocks to sedimentary units. Calc-alkaline andesitic compositions predominate as volcanic rock hosts, particularly for the more base-metal rich, intermediate sulfidation subclass, but many deposits occur in more felsic units within terranes of bimodal volcanism and extensive subaerial ashflow deposits. A less common, but economically significant association is with alkalic intrusive rocks and shoshonitic volcanic rocks. Clastic and epiclastic sediments in volcanic basins and structural depressions are the principal non-volcanic host rocks.

Mineralization in the near-surface, epithermal environment takes place in and beneath hot springs, and the slightly deeper underlying hydrothermal conduits. At greater crustal depth, mineralization can occur above, or peripheral to porphyry (and possibly skarn) mineralization. Normal faults, margins of grabens, coarse clastic caldera moat-fill units, radial and ring dike fracture sets, and hydrothermal and tectonic breccias can act as hydrothermal fluid channeling structures. Through-going, branching, bifurcating, anastomosing and intersecting fracture systems are commonly mineralized. Mineralization commonly forms where dilatational openings and cymoid loops develop, typically where the strike or dip of veins change.

Epithermal precious-metal deposits are in some cases zoned vertically, over about an 800–1,200ft interval, from a base metal poor, Au–Ag-rich top, to a relatively Ag-rich base metal zone and an underlying base metal-rich zone grading at depth into a sparse base metal, pyritic zone. From surface to depth, metal zones grade from Au–Ag–As– Sb–Hg-rich zones, to Au-Ag-Pb-Zn–Cu-rich zones, to basal Ag–Pb–Zn-rich zones.

Silicification is the most common alteration type with multiple generations of quartz and chalcedony, which are typically accompanied by adularia and calcite. Pervasive silicification in vein envelopes is in many cases flanked by sericite–illite–kaolinite assemblages. Kaolinite-illite–montmorillonite ± smectite can form adjacent to veins; kaolinite–alunite (advanced argillic alteration) may form along the tops of mineralized zones, above the paleo-water table. Propylitic alteration dominates at depth and along the deposit margins.

Mineralization characteristically comprises pyrite, electrum, gold, silver, and argentite. Other minerals can include silver sulphosalt and/or selenide minerals, chalcopyrite, sphalerite, and galena. Tellurides, roscoelite and fluorite are abundant in alkalic rock hosted systems, which may include significant molybdenite as an accessory mineral.

# 9.0 EXPLORATION

This section is taken from Tietz et al. (2015). WKM's subsidiary, Mining (USA) Ltd., completed the acquisition of an initial 75% interest in the Hasbrouck and Three Hills properties from subsidiaries of Allied on April 24, 2014. WKM subsequently conducted a limited exploration program in 2014. No exploration work was done in 2015 or 2016, through to the effective date of this report.

## 9.1 Three Hills Exploration

WKM performed geologic mapping, sampling, a gravity survey and detailed structural analysis at Three Hills during 2014. A total of 27 surface rock-chip samples were collected and assayed at ALS Chemex gold, silver and 45 major-, minor- and trace-elements. The gravity survey was completed by Magee Geophysical Services in June, 2014. Gravity measurements were conducted at 164 gravity stations spaced on a 200m by 200m grid over the western two thirds of the property. In addition, WKM extracted a 20-ton bulk sample of mineralized rock for testing of run of mine type metallurgical recoveries.

During 2014, after completion of MDA's resource estimate as reported in Section 14.0, WKM drilled 3 diamond-core holes and 11 RC holes for a total of 9,077ft of drilling at the Three Hills property (see Section 10.7). The diamond-core holes were drilled within the Three Hills gold-silver deposit to obtain samples for geotechnical studies. The 2014 RC holes were drilled mainly to expand the eastern and down-dip portions of the Three Hills resource. MDA has reviewed the 2014 drill results and it is MDA's opinion that the 2014 RC holes do not materially affect the resource estimate and therefore have not been included in the current resource database.

## 9.2 Hasbrouck Deposit Exploration

At Hasbrouck Mountain WKM carried out geologic mapping, surface sampling and a structural geologic interpretation. A sequence of 36 continuous rock-chip samples were taken from a road cut within the resource and assayed at ALS Chemex for gold, silver and 45 major-, minor- and trace-elements. The results confirmed mineralization at the surface between drill holes. Approximately 52 surface rock-chip samples were collected from the northeast flank of Hasbrouck Mountain and assayed for gold, silver and 45 major-, minor- and trace-elements at ALS-Chemex. The results from these samples led WKM to identify a zone of east-west mineralized structures northeast of the Hasbrouck resource. This zone was later tested with RC drilling during WKM's 2014 drilling campaign (see below and also Section 10.2). WKM also conducted a re-interpretation of geophysical data obtained by previous operators.

A total of 4,150ft of reverse-circulation drilling in 14 holes was performed by WKM at Hasbrouck Mountain during 2014. All of the drilling was done to the south, southeast, north and northeast of the current resource, for condemnation and to discover mineralization that may extend beyond the current resource. Eight of the RC holes were drilled northeast of the resource to test the east-west structures identified with the 2014 surface rock-chip sampling. The 2014 drilling is widely spaced, outside of, and does not materially affect the estimated resources; as such, it has not been included in the current resource database.

During 2014 WKM extracted a 2-ton bulk sample of mineralized rock for testing in a high-pressure grinding roll ("HPGR") comminution scenario (see Section 13.0).

# 10.0 DRILLING

This section remains unchanged from Tietz et al. (2015). Drilling at the Hasbrouck project has taken place at two separate properties: the Three Hills property and the Hasbrouck Mountain ("Hasbrouck") property. From 1974 through 2014, 6 companies have drilled in the vicinity of the estimated resources at Hasbrouck Mountain, and 7 companies have drilled at Three Hills, for a project database of approximately 319,396 in 638 drill holes (Table 10.1). This includes the drilling done in 2014 by WKM.

The earliest drilling was with conventional rotary methods, but the majority of the drilling has been by reverse-circulation methods as summarized in Table 10.2 and Table 10.3 for the current databases used for the resources estimated in this report. Drill spacing for the Three Hills estimated resources is generally 75-100ft but can be less than 50ft within the center of the deposit. Drill spacing for the Hasbrouck resources is generally 100-150ft but can be less than 50ft within the center of the deposit.

**Table 10.1 Summary of Drilling in the Hasbrouck Project**

| Year | Company | Area | Holes | Feet |
|---|---|---|---|---|
| 1974 - 1980* | Cordex | Hasbrouck Mtn | 25 | 10,629 |
| 1974 | Cordex | Three Hills | 14 | 5,055 |
| 1985 | Franco-Nevada | Hasbrouck Mtn | 30 | 10,156 |
| 1984 - 1988 | Saga Exploration | Three Hills | 59 | 6,715 |
| 1988 | FMC | Hasbrouck Mtn | 76 | 34,255 |
| 1988 - 1989 | Echo Bay | Three Hills | 72 | 24,420 |
| 1990 | Gexa Gold | Three Hills | 2 | 508 |
| 1992** | Corona Gold | Hasbrouck Mtn | 2 | 1,210 |
| 1991 - 1997 | Eastfield-Prism | Three Hills | 119 | 38,822 |
| 1996 | Euro-Nevada | Hasbrouck Mtn | 18 | 17,670 |
| 2010 - 2012 | Allied Nevada | Hasbrouck Mtn | 171 | 145,699 |
| 2012 - 2013 | Allied Nevada | Three Hills | 25 | 12,679 |
| 2014*** | West Kirkland | Hasbrouck Mtn | 14 | 4,150 |
| 2014*** | West Kirkland | Three Hills | 14 | 9,077 |
| | | **TOTALS** | **641** | **321,045** |
| *includes three holes not in resource database due to uncertain locations | | | | |
| ** external to resources, not in current Hasbrouck resource database | | | | |
| ***drilled after resource completion; not used in current estimate | | | | |

Three Cordex holes are not included within the Hasbrouck resource database due to uncertain collar locations. They are included in the project-wide drill totals for completeness.

The two RC drill holes drilled by Corona in 1992 are located well to the north of Hasbrouck. Due to their location, these latter holes are not included in the current Hasbrouck database (see Section 10.2) but are included in the project totals for completeness.

The locations of drill holes in the vicinity of the Three Hills estimated resources are shown in Figure 10.1, and Figure 10.2 shows the locations of drill holes in the vicinity of the Hasbrouck estimated resources.

**Figure 10.1 Drill-Hole Location Map for the Three Hills Area**

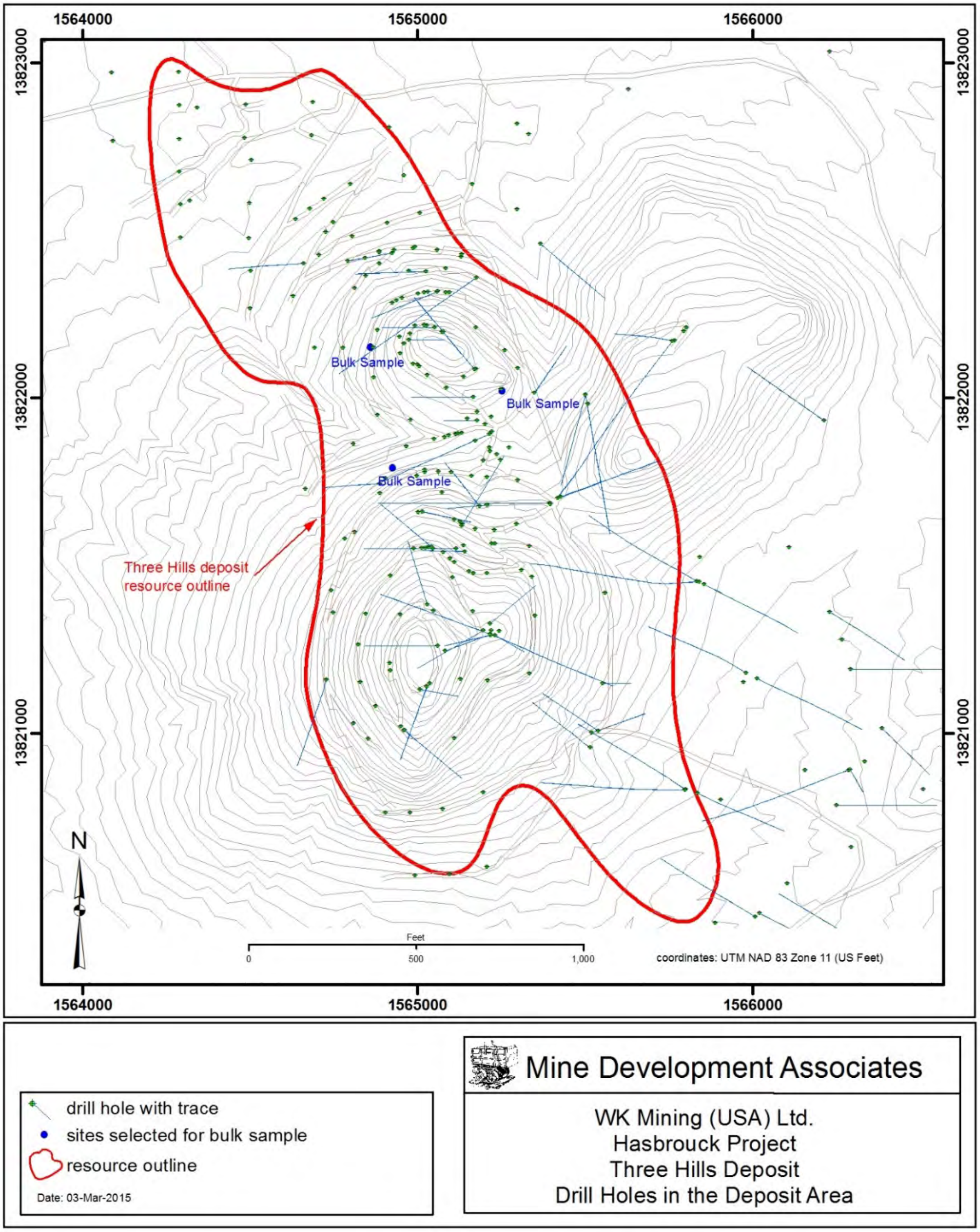
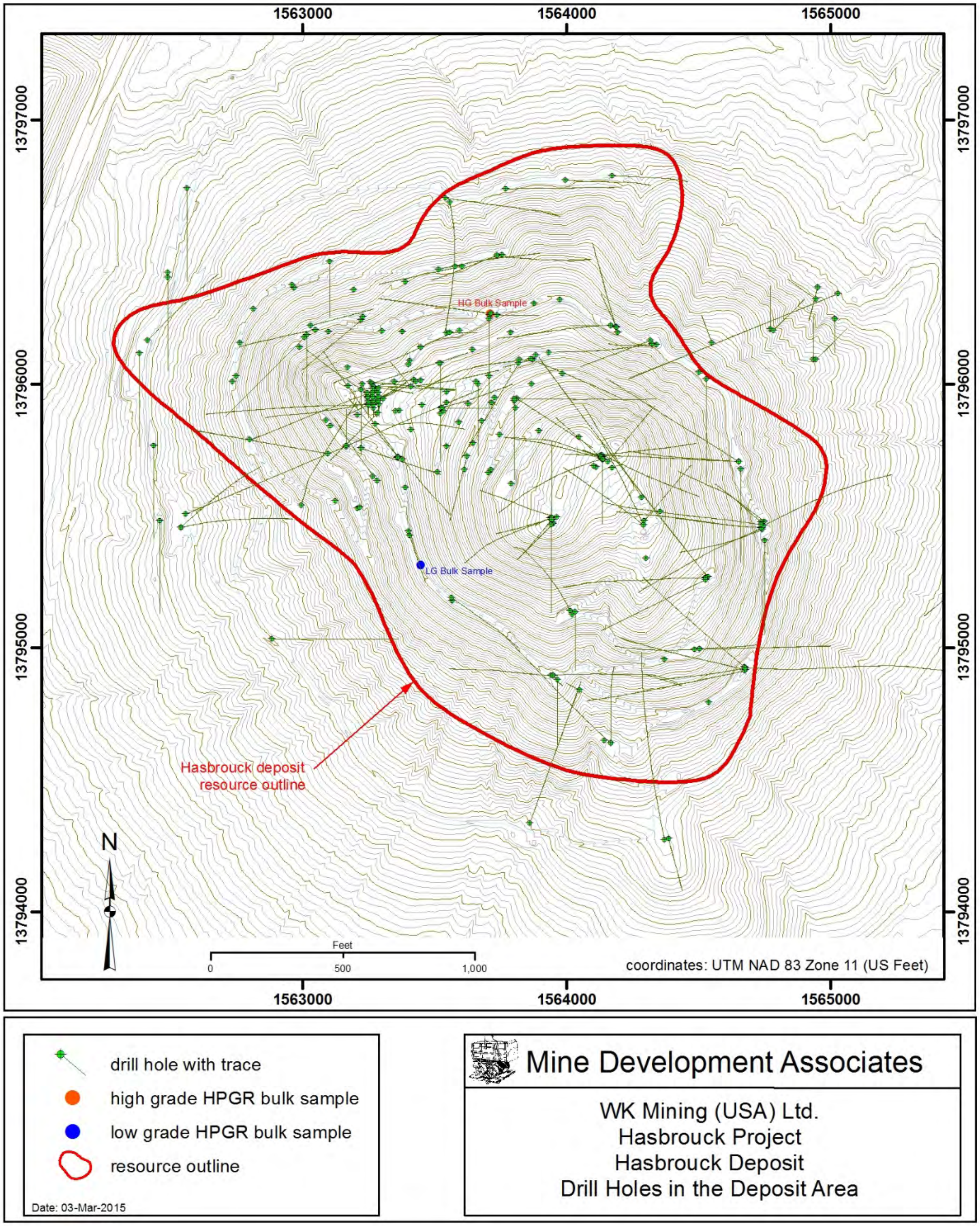


**Figure 10.2 Drill-Hole Location Map for the Hasbrouck Mountain Area**



## 10.1 Drilling at Three Hills

Drilling used for the estimation of gold resources at Three Hills is summarized in Table 10.2. The current resource database includes 291 drill holes for a total of 88,199ft of historic drilling completed from 1974 through 2013. Drilling and sampling procedures used prior to 2012 are not well known. Most of the drilling was completed by RC drilling and most of these holes did not intersect water. In 1974, Eklund Drilling completed holes using a Gardner Denver 15W drill rig. Drilling in 1996 and 1997 included that done by Hackworth Drilling of Elko Nevada, using a Schramm C-560 RC drill rig, with a nominal 5.5 in hole size, predominately using a down the hole hammer. Some drilling with tricone drill bits in difficult rock was mentioned in the reports. No information is available for drill sample recovery prior to 2012.

**Table 10.2 Summary of Drilling in the Vicinity of Three Hills**

| Year | Company | Type | Holes | Feet |
|---|---|---|---|---|
| | | | | |
| 1974 | Cordex | rotary | 14 | 5,055 |
| 1984 | Saga Exploration | air-track | 31 | 1,560 |
| 1985 | Saga Exploration | RC | 15 | 2,060 |
| 1986 | Saga Exploration | RC | 8 | 1,475 |
| 1988 | Echo Bay | RC | 40 | 12,335 |
| 1989 | Echo Bay | RC | 37 | 13,705 |
| 1990 | Gexa Gold | core | 2 | 508 |
| 1991 | Eastfield-Prism | unknown | 31 | 5,312 |
| 1996 | Eastfield-Prism | RC | 56 | 20,160 |
| 1996 | Eastfield-Prism | core | 8 | 1,395 |
| 1997 | Eastfield-Prism | RC | 24 | 11,955 |
| 2012 | Allied Nevada | RC | 17 | 9,170 |
| 2013 | Allied Nevada | core | 8 | 3,509 |
| | **Totals** | | **291** | **88,199** |
| 2014* | West Kirkland | RC | 11 | 7,200 |
| 2014* | West Kirkland | core | 3 | 1,877 |
| | | | | |
| **drilled after resource completion; not used in current estimate* | | | | |

Little is known about the sampling methods for holes prior to 1996, however, for the most part dry samples were collected from dry RC drilling, sampled continuously down-hole on 5ft intervals. The initial sampling by Cordex in 1974, and by Saga Exploration in 1984, was from conventional rotary drilling generally sampled on 10ft intervals.

A total of 10 core holes were drilled on the property prior to 2012. Only the first two core holes completed by Echo Bay were logged, split, and sampled for assays. Of the eight core holes drilled by Eastfield/Prism, only portions of two holes were split (THC96-1 and THC96-6), while the rest of the Eastfield/Prism core drilling was used for metallurgical tests. The Eastfield/Prism hole THC96-4A is included within the database though, besides the collar location, there is no other drill information within the database; the depth is noted as zero and there are no assays.

The digital database includes lithology codes for 221 of the 266 pre-2012 drill holes. The missing lithology data is from the 1991 Eastfield-Prism drilling (a total of 31 holes) along with a few holes from the various other drill campaigns.

The assay labs used by Cordex included Hunter, Union, and Rocky Mountain Geochem. All of the Eastfield/Prism work was completed at Chemex Labs. Most of the assays are inferred to have been completed using fire assay techniques (Prenn, 2003, 2006).

### 10.1.1 Drilling at Three Hills by Allied Nevada

Allied Nevada drilled 17 RC holes in 2012, focused on expanding known mineralization. During 2013 Allied Nevada drilled 8 core holes for metallurgical samples and condemnation. Drilling in 2012 and 2013 totaled 12,679ft.

### 10.1.2 Drilling at Three Hills by West Kirkland Mining

In the fall of 2014, WKM completed 11 RC holes and 3 diamond-core holes for a total of 9,077ft of drilling at Three Hills. The core holes were drilled within the estimated resource to obtain samples for geotechnical studies such as pit-slope planning. First Drilling Group USA conducted the core drilling with a track-mounted LF90 drill. PQ and HQ diameter core was recovered by triple tube methods with a 5ft core barrel.

The 2014 RC holes were drilled for resource expansion mainly in the eastern, down-dip portion of the estimated resource and are mainly east of the proposed open-pit extents. Boart Longyear performed the RC drilling with the same track-mounted MPD 1500 drill rig that was used at Hasbrouck in 2014. Drill bits of 5.5in diameter were used and samples were extracted through a conventional interchange as a continuous wet slurry on 5ft intervals.

The 2014 WKM drill data were 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 estimate or proposed open-pit mine design.

### 10.1.3 Collar and Down-hole Surveys at Three Hills

Early collar locations were estimated from placement on topographic maps. The locations of the 1996 and 1997 drill hole collars, and some earlier drill hole locations, were surveyed in 1996 and 1997 by Haskew Engineering, of Goldfield, Nevada. A Nevada State Plane survey grid was placed over Three Hills in 1996 by Haskew Engineering, of Goldfield, Nevada. Haskew Engineering provided drill hole collar surveys, claim corner surveys, and other location surveys for the remainder of the 1996 and 1997 drill seasons.

The 2012-2013 Allied Nevada drill hole collar locations were surveyed by a Professional Land Surveyor, Haskew Engineering of Goldfield, Nevada. WKM's 2014 drill hole collar locations were initially measured with hand-held GPS. After completion each hole collar was marked in the field with a brass tag and then surveyed professionally by Haskew Engineering.

No downhole survey records are available for the pre-2012 drilling, nor were any mentioned in the reports. International Directional Services ("IDS") conducted down-hole directional surveys of the majority of the 2012-2013 drill holes using gyroscopic tools. Measurements were reported at 50ft intervals. WKM's 2014 drill holes with depths greater than 300ft were also down-hole surveyed by IDS and directional data were reported at 50ft intervals.

### 10.1.4 Summary of Drilling Results at Three Hills

It is MDA's opinion that the drilling and sampling methods used at Three Hills follow industry standard procedures, and are appropriate methods to adequately interpret the geology and mineralized zones. There is a lack of downhole survey data for the pre-2012 drilling, though this risk is mitigated since these holes are generally shallow and most were drilled vertically.

## 10.2 Drilling at Hasbrouck Mountain

Drilling used for the estimation of gold-silver resources at Hasbrouck Mountain is summarized in Table 10.3. For the purposes of this report, drilling performed at Hasbrouck Mountain from 1974 through 2012 is considered historical. Drilling contractors and types of drill rigs employed in the 1974 through 2012 historic drill campaigns are summarized in Table 10.4.

**Table 10.3 Summary of Drilling in the Vicinity of Hasbrouck Mountain**

| Year | Company | Type | Holes | Feet |
|---|---|---|---|---|
| | | | | |
| 1974 | Cordex | rotary | 22 | 8,980 |
| 1985 | Franco-Nevada | RC | 30 | 10,156 |
| 1988 | FMC | RC | 76 | 34,255 |
| 1996 | Euro-Nevada | RC | 18 | 17,670 |
| 2010 | Allied Nevada | core | 14 | 7,613 |
| 2011 | Allied Nevada | RC | 92 | 97,163 |
| 2011 | Allied Nevada | core | 29 | 20,994 |
| 2012 | Allied Nevada | RC | 36 | 19,930 |
| | **Totals** | | **317** | **216,761** |
| 2014* | West Kirkland | RC | 14 | 4,150 |
| | | | | |
| **drilled after resource completion; not used in current estimate* | | | | |

**Table 10.4 Historic Drilling Contractors and Rig Types**
from Flint et al. (2012)

| Campaign | Contractor | Rig Type |
|---|---|---|
| Cordex | Eklund Drilling Company | G.D.15W |
| | Anaconda Drilling Company | Ingersoll Rand T-4 |
| | Unknown | C.P. 650 |
| | Joy Drilling Company | Joy-22 |
| Franco-Nevada | Eklund Drilling Company | TH-60 |
| FMC | Unknown | unknown |
| Corona | Brown and Root | D25K truck mount |
| Euro-Nevada | DeLong Construction and Drilling | unknown |
| Allied Nevada | Tonatec Drilling | LF70 |
| | National EWP Drilling | LF90, AC CT14 |
| | Leach Drilling | D40 |
| | Layne Drilling | Explorer 1500 |

Cordex focused its drilling in the northwest portion of the Hasbrouck Mountain. Drilling was reportedly by open rotary methods. From 1974–1980, Cordex drilled a total of 25 rotary drill holes (9,760ft) and one of the 1974 rotary drill holes was deepened using core drilling for an additional 959ft of drilling. The current resource database excludes 3 of the Cordex drill holes, including the deepened core hole, due to uncertain collar locations.

Holes H-1, 2 and 3 were drilled dry, without injecting any drilling fluids. Anaconda Drilling Company drilled H-1 and H-2 with an Ingersoll Rand T-4 rig. H-3 was drilled by a second contractor, unknown to MDA, who utilized a C.P. 650 rig. The remainder of the program was drilled by Eklund Drilling Company with a G.D.15W rig. Eklund injected water, detergent and other drilling fluids in an attempt to improve sample recoveries from those achieved by previous contractors. Cordex geologists completed fairly detailed geologic logs for each of the drill holes; MDA was provided with copies of logs for 21 of the holes.

Franco-Nevada and FMC continued with step-out drilling on Hasbrouck Mountain in the mid-1980s. Franco-Nevada drilled 30 vertical holes within the MDA resource model extents. The injection of foam and other drilling fluids is occasionally noted on the geologic logs, as is the medium of sample return (wet or dry). Intervals of no recovery are also noted. Eklund Drilling Company was contracted and used a TH-60 drill rig for this program.

MDA is not aware of what drilling company or drill rig was used in 1988 FMC program. The F88-series of holes within the MDA resource model extents were drilled to infill and expand upon holes drilled by the previous operators, while the T-series holes comprise a closely spaced drill pattern in the western portion of the MDA resource model extents. Fourteen of the T-series holes consist of 100-foot holes that were drilled on a 15 x 20 foot grid. The other T-hole lies on the grid and was drilled to a depth of 500ft. A total of 29 of the F88-series holes were angle holes, with angles varying from -45 to -75 degrees. With the exception of two holes drilled to the north, these angle holes were drilled in a southerly direction. The T-series holes were uniformly drilled at -60 degrees due south. The FMC geologic logs for the F88-series of holes provided to MDA are very summary in nature, and no comments on drilling methods are included. Intervals where no samples were collected due to lack of recovery are noted, but further specifics on recoveries are lacking. MDA was not provided with logs of any type for FMC's T-series of holes.

In 1996, following an 8 year hiatus in exploration, Euro-Nevada focused on drill targets outside of the known Hasbrouck resource area and was largely unsuccessful. The 1996 Euro-Nevada program was drilled by DeLong Construction and Drilling, but the type of drill is not known. Angle and vertical holes were drilled to cut various targets along a NW-SE trending belt that passes to the north, east and southeast of Hasbrouck Mountain, so that none of the holes lie within the MDA resource model extents. The geologic logs do not comment on sample recoveries, presence or absence of groundwater, drilling problems, etc., nor do the Euro-Nevada internal reports in MDA's possession.

No historic drill chips are available for inspection. Allied Nevada personnel and geologic consultants working for Allied Nevada, reinterpreted pre-2010 historic drill logs and recorded their reinterpretations in Allied's hand-written logging format. The hand-written reinterpretations were subsequently entered into an Excel spreadsheet. The following are comments on the pre-2010 historic geologic logs as stated by Flint et al. (2012):

- Cordex geologists completed fairly detailed geologic logs for each of the drill holes, and included lithology and alteration details;
- Franco-Nevada drill logs from the 1985 drill program (FN85-series) included lithology and localized alteration recorded primarily in a graphical format with minor associated text. Intervals of no recovery are noted;
- The FMC geologic logs for the F88-series of holes are summary in nature, with minimal geologic and alteration data recorded. No recovery data noted. Logs for the T-series drill holes have not been located;
- Poor-quality photocopies of the geologic logs from the Corona drilling are available; no comments on recoveries or sample quality recorded; and
- Geologic logs from the 1996 Euro-Nevada program denote lithology and alteration, but do not comment on sample recoveries, presence or absence of groundwater, or drilling problems.

MDA does not have information on drill bit diameters, drill sample weights, sample recoveries, and specific sampling methods for most of the pre-2010 historic drilling. Ground conditions at Hasbrouck, especially in the upper 300ft of the deposit, present difficult drilling conditions to both RC and core drilling techniques. These problematic ground conditions include clay alteration, highly fractured ground, voids, variable lithology and alteration, existing dump material and faults. As a result, RC and core recovery can be low in the upper portions of the deposit. As noted by Prenn and Gustin (2003, 2006):

- Sample recovery was a continual problem throughout the Cordex drilling program due to the highly fractured nature of the silicified rock;

- Sample recovery problems in the Franco-Nevada program were common, caused by lost circulation, open voids and the necessity of wet sampling due to the injection of water and additives;
- Geologic logs from the FMC drill programs describe intervals where no samples were collected due to lack of recovery; and
- Geologic logs from the Euro-Nevada drill programs do not provide information regarding sample recoveries, wet or dry samples, etc.

Both angled and vertical drill holes were completed. Dips of the drill holes typically range from -90° to -45°, with historic drill holes predominantly drilled at -90°. Drill hole depths ranged from 100 to 1,700ft. Few details are available for logging and sampling procedures used by the various operators from 1974 through 1996. Drill sample intervals varied from 0.5ft to 30ft, but approximately 91% of the assays were done on 5ft intervals. Assays during this period were limited to gold and silver by fire-assay and atomic absorption methods (see Section 11).

### 10.2.1 Drilling At Hasbrouck by Allied Nevada

In 2010, Allied Nevada completed 14 diamond-core drill holes totaling 7,613ft (Table 10.3). These drill holes were designed to confirm the results of earlier historic drilling and to provide material for metallurgical test work. Allied Nevada initiated a more extensive core and RC drilling program in January 2011. During 2012, Allied Nevada completed 37 reverse circulation holes (20,010ft) focused on the Silver King and Mastif targets, located outside of the main Hasbrouck deposit. Thirty-six of the 2012 RC holes are included in the current resource database.

Reverse circulation drilling was accomplished with standard RC tools utilizing a crossover sub and wet sample collection in the upper portions of the hole. A center return tri-cone drill bit was used for intervals of significant ground water flow. Drill cuttings were collected continuously down the hole, with individual samples taken over 5ft intervals. Samples were submitted for assay, as collected on the rig, with standards, blanks and duplicates inserted into the sample sequence as described below in Section 11. The drill crews sequentially pre-numbered the sample bags, representing the footage interval sampled. The drill crews were provided with 20 slot chip trays, representing 100ft total per tray, and numbered each with hole number, and start and stop footage for the 5ft interval.

According to Wilson (2014) water injection was regulated to minimize the fluid return while maintaining sufficient flow for drilling and sample return. Allied Nevada geologists provided drill crews with 20 in x 24 in bags. Cuttings were collected as a continuous fraction of the return stream from the drill rig by way of a rotary 36 inch vane splitter. The splitter had vane covers that can be added or removed to provide the desired sample weight for each interval. The cuttings were diverted to a clean, 5 gallon, plastic bucket that contained a small amount of a polymer flocculent. When a bucket was full of water and sample, it was removed and allowed to settle while another bucket was placed under the sample spout. If the drilled material contained clay, more flocculent would be added to the settling bucket and the contents stirred. When the 5ft sample run was complete the last sample bucket was removed, and another clean bucket was placed under the spout. The previous interval buckets were carefully decanted and their contents poured into the 20in x 24in mesh sample bag within another bucket.

During drilling, a strainer was placed under the waste discharge spout to collect chips for the character chip tray and logging purposes. At the end of each run, the drill sampler filled the chip tray slot for the sample interval and discarded the rest. When freezing temperatures were expected the sample bags were placed on plastic sheets to prevent them from freezing to the ground and ripping when picked up. Sample bags were allowed to dry and drain at the drill site, or in a holding area near the sample processing facility.

Filled chip trays were field-checked for numbering accuracy during visits to the drill rig and collected by an Allied Nevada geologist for logging by use of a binocular microscope. Allied Nevada personnel and geologic consultants retained by Allied Nevada, logged all 2010 – 2012 core and reverse circulation drill cuttings on site for geologic and geotechnical parameters. Logs were hand-written and subsequently entered into an Excel spreadsheet. The log sheet was divided into two primary sections: geotechnical and geology. Geological data collected included information on lithology, structure, alteration, metallurgy, and veins.

Logging of alteration and metallurgical characteristics were based on a qualitative scaling of 0 to 3, with 0 denoting absent, 1 for weak, 2 for moderate, and 3 for strong. Basic geotechnical data were collected on each core hole drilled. Each core interval drilled was logged for total core recovery, total fractures, joint condition rating ("JCR"), and sum of all core lengths greater than four inches for rock quality designation ("RQD"). Hardness data were not collected. Core was digitally photographed by ALS Chemex technicians prior to being split for assay. The digital photographs were submitted to Allied Nevada on a series of DVDs.

Procedures used by Allied Nevada for sampling and assaying are given in Section 11. Assays were nearly entirely performed using 5ft samples. All drill samples were analyzed for gold and silver with a combination of fire-assay, atomic absorption and gravimetric methods. In addition, approximately 0.7% of Allied Nevada's drill samples were assayed for Ag, Al, As, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Hg, K, La, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sc, Sr, Th, Ti, Tl, U, V, W, and Zn using inductively - coupled plasma-emission and mass spectrometry ("ICP" and "ICP-MS"), with either 4-acid digestion or aqua-regia digestion.

### 10.2.2 Drilling At Hasbrouck by West Kirkland Mining

A total of 4,150ft of RC drilling in 14 holes was completed by WKM in 2014. These holes were drilled for condemnation and resource expansion purposes and are located south, southeast and north of the Hasbrouck resource.

The drill data were 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 estimate or proposed open-pit mine design.

The drilling was performed by Boart Longyear using a track-mounted MPD 1500 drill rig with 5.5in diameter drill bits. Sample extraction was by conventional interchange with water injection to inhibit dust emissions. Samples were extracted as a continuous slurry on 5ft intervals, and split with a rotating vane wet splitter to approximately 7-8kg. Eight of the RC holes were drilled northeast of the resource to test east-west structures identified by surface rock-chip samples with anomalous geochemistry. Mineralization encountered in these holes is external to the resource and may be the subject of additional future drilling.

### 10.2.3 Collar and Down-hole Surveys at Hasbrouck Mountain

None of the pre-2010 historic drill-hole collars were originally surveyed. The Cordex and Franco-Nevada collar coordinates are rounded to the nearest 5 or 10ft, suggesting that they are not surveyed locations, and have been based on a drill hole location map constructed by Graney (1985) and subsequently augmented by FMC. The FMC holes are reported to the nearest 0.1ft, but it is not known if these were surveyed locations. In December 2010, Allied Nevada geologists re-established collar locations for as many pre-2010 historic 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 historic 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. The pre-2010 and Allied Nevada drill holes were converted to UTM in United States feet, which was used as a local mine grid. From late 2010 to present, Allied Nevada's mine surveyors located drill holes using accurate Global Positioning System ("GPS") equipment, reporting directly in UTM coordinates.

All of the Allied Nevada core hole collars were reportedly marked in the field by wooden lath and drill-hole collars were surveyed. The majority of Allied Nevada's holes were surveyed by a Professional Land Surveyor, but some holes were surveyed using hand held GPS devices, and some were located by measuring bearing and distance over short intervals from other surveyed holes.

No down-the-hole survey data were provided to MDA for any of the pre-2010 historic drill holes, so that constant dip angles are assumed in the database. This assumption is likely to introduce increasing error with increasing depth of the drill holes. The Euro-Nevada drill holes were apparently down-hole surveyed, but no data are available on survey methods or down-the-hole depths for which the surveys were performed. Eleven of the Allied Nevada core holes drilled in 2010 had down-hole surveys completed. The 2011 and 2012 holes were surveyed except in cases where poor ground conditions or other drilling difficulty prevented entering the hole with the survey tool. Allied Nevada's down-hole surveying was conducted by IDS technicians with gyroscopic tools lowered inside the drill string and projected to total depth when necessary. Measurements were reported at 50ft intervals.

WKM obtained collar locations for their 2014 RC drill holes with an initial measurement by hand-held GPS. After completion, each hole collar was marked with a brass tag; locations were then surveyed by a Professional Land Surveyor (Haskew Engineering). Down-hole directional surveys were performed for holes drilled to depths greater than 300ft. The directional surveys were done by IDS using gyroscopic methods; data were reported at 50ft intervals.

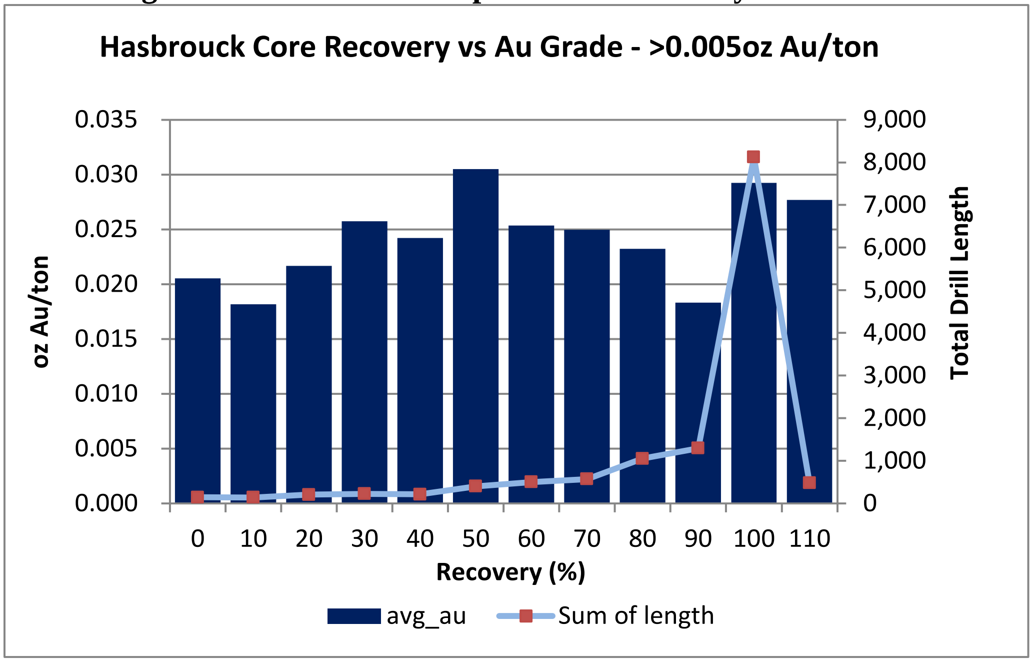
### 10.2.4 Core Recovery at Hasbrouck Mountain

Core recovery data are available for the Allied core drilling completed in 2010 and 2011. MDA reviewed the data set and the average core recovery for all Allied drill intervals is 89 percent, while average core recovery for those intervals assaying over 0.006 oz Au/ton is 90 percent. Over 60 percent of the core drilled has a core recovery of 100 percent, with a small percentage at greater than 100 percent, while approximately 7 percent of the total core drilled has recoveries less than 50 percent. The core is generally highly fractured within the mineralized horizons, and RQD measurements are typically low, averaging about 25 percent.

MDA checked the core recovery data against the core photos for six Allied core holes and observed that the Allied data recorded in the drill logs for these six core holes over-states core recovery by about 10 percent on average. If this observation holds true for all Allied core holes then average core recovery for the project would be 80-82 percent.

MDA analyzed the core recovery data to determine if there was a deposit-wide relationship between poor recovery intervals and changing gold grades. Figure 10.3 shows the average gold grades (blue vertical bars) and the total drill length (light blue line with orange data points) plotted in the vertical axis, while core recovery is plotted along the horizontal axis. The figure includes those mineralized intervals assaying greater than 0.005 oz Au/ton that occur within the current resource boundary. The core-recovery data have been separated into distinct bins for each ten percent increase in recovery. So the "70" value in the horizontal axis contains all data points which have core recovery values between 70 and 79 percent. All drill intervals with a recorded recovery percentage greater than 110 percent are included in the "110" recovery bin.

**Figure 10.3 Hasbrouck Deposit Core Recovery versus Gold Grade**



There is a sharp decrease in average gold grade associated with the initial drop in core recovery from 100 percent into the 90 percent range. Below 90 percent recovery, average gold grades gradually increase and then stay fairly level until core recovery drops below 30 percent where gold grades appear to again decrease. The small sample populations at the very low recoveries create some uncertainty in these observations.

Except for the average gold grades observed in the 50 percent recovery bin, core recovery loss is associated with a decrease in average gold grades. The sharp decrease in gold grade observed with just a small decrease in core recovery (from 100 percent to 90-99 percent core recovery) is likely due to the preferential loss of the gold-bearing fine and /or fracture-fill material occurring within silica veinlets cutting weakly mineralized wallrock. At lower core recoveries, both the fracture-fill material and the wallrock suffer core loss so average gold grades will increase as indicated in Figure 10.3

These results indicate that the gold assay values used in the resource estimate are potentially skewed low for those core intervals with less than 100 percent core recovery. This lends a conservative aspect to the current resource.

### 10.2.5 Summary of Drilling Results at Hasbrouck Mountain

It is MDA's opinion that the drilling and sampling methods used at Hasbrouck follow industry standard procedures, and are appropriate methods to adequately interpret the geology and mineralized zones. There is a lack of downhole survey data for the pre-2010 drilling, though this risk is mitigated because these holes are generally shallow and were drilled vertically. Core recovery analyses indicates that the gold assay values used in the resource estimate are potentially skewed low for those core intervals with less than 100 percent core recovery. This lends a conservative aspect to the current resource estimate.

# 11.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

## 11.1 Historic Sample Preparation and Analyses

This section remains unchanged from Tietz et al. (2015). Information on the historic sample preparation, analytical laboratories and methods, as available, is summarized from MDA (Prenn and Gustin 2003, 2006; Prenn 2003, 2006, and sources therein), Flint et al. (2012) and Wilson (2014).

### 11.1.1 Three Hills Surface Samples

*1974-1997*:

MDA is not aware of records describing the sample collection procedures, sample preparation and assay methods used for surface sampling conducted by Cordex, Saga, Echo Bay, and Eastfield Resources. Prenn (2006) reported that the geochemical analysis of gold, silver, arsenic, antimony, mercury, molybdenum, and occasionally copper, lead, and zinc was completed on the property, and that approximately 550 rock samples were collected in 1996-1997 by Rodney Thompson for a Masters Thesis at Colorado School of Mines. MDA has no information about the sampling and preparation procedures, and the assay types or methods utilized.

*2012-2013*:

Sparse records indicate that Allied Nevada's surface samples were assayed by ALS Chemex, using fire-assay with atomic absorption finish for gold, and gravimetric finish for silver, as well as ICP-AES determinations for 35 major, minor and trace elements with aqua-regia digestion. Samples were crushed to <2mm, and a 1kg split was pulverized to 85% at <75 microns. Information is not available to MDA regarding sample collection procedures, or the use of standard, blank or duplicate samples.

### 11.1.2 Hasbrouck Surface and Underground Samples

*1974-1996*:

MDA knows very little of the sampling methods, sample preparation procedures and details of assay techniques employed on any of the programs undertaken at Hasbrouck prior to 2010. In 1980, Cordex sampled the Main, Ore Car, South, and Northeast adit underground workings. No details of the underground sampling program of Cordex are available to MDA, including sample size, exact sampling procedures employed, assay laboratory used, etc. Also not available to MDA, and possibly these no longer exist, are records documenting the sampling procedures, sample preparation and assay methods used for surface samples collected by Franco-Nevada, FMC and Corona during the 1980's. Surface rock samples collected by Euro-Nevada in the 1990's were largely analyzed by ALS Chemex with fire assay methods for gold, and ICP-AES methods for 32 elements, including silver. Details of Euro-Nevada's sampling procedures, sample preparation, and sample digestion are not available.

*2010-2013*:

Allied Nevada personnel collected 667 channel samples from selected road cuts (Flint et al., 2012). The samples were analyzed by ICP methods with 4-acid digestion at ALS Chemex for gold, silver, and as many as 34 major-, minor- and trace-elements. MDA has no information on procedures used for the sample collection and sample preparation. QAQC standards, blanks and/or duplicate samples were not inserted.

### 11.1.3 Three Hills Drilling Samples

*1974-1997*:

Laboratory and sample preparation procedures prior to the mid 1990's are unknown. Notes on drill logs from 1974 indicate that Union Assay Laboratories ("Union"; Denver), Rocky Mountain Geochemical Laboratories ("Rocky Mountain"; Reno), Humboldt Laboratory ("Humboldt"; location unknown), and Skyline Laboratory ("Skyline"; Tucson) were used, presumably for fire assays. Gold assays previous to 1996 appear to have been completed using a fire assay method, as indicated on some drill hole logs and on one assay sheet. Silver, when assayed for, was determined using atomic absorption methods with a lower detection limit of 0.2 ppm. MDA has no information about sample preparation procedures, or the use of standard, blank and duplicate samples. The 1988 drilling samples may have been assayed in Gexa's mine lab near Beatty, Nevada.

During 1996 and 1997 drilling samples were analyzed at the Chemex Laboratory, Reno Nevada. The preparation was a 0 to 3kg primary crush, then ring pulverization to <150 mesh. In 1996 and 1997 gold was determined by fire assays done with a 30g charge and atomic absorption finish. The lower detection limit was 5 ppb, with an upper limit of 10,000 ppb. Over limit results were re-assayed using a fire assay with gravimetric finish. Cold-cyanide, shake-leach gold analyses were completed on selected 1996 drill hole samples. MDA does not have information on the use of standard, blank and duplicate samples utilized in the 1996-1997 drilling at Three Hills.

*2012-2013*:

Allied Nevada's drilling samples during 2012-2013 were prepared and assayed by ALS in Reno, Nevada. RC drilling samples were crushed to 70% passing 2mm, and a 1 kg split was pulverized to 85% passing 75 µm. Core samples were logged and sample intervals were marked by Allied Nevada geologists prior to shipping the whole core to ALS in Reno, Nevada. The core was ½ sawn by laboratory personnel at the ALS laboratory facilities. According to Flint et al. (2012), Allied Nevada geologists marked the core with cutting guide lines to best divide the core in a representative manner where veins were visible. Otherwise, core was reportedly sawed perpendicular to bedding.

Gold was determined by cyanide leach and by fire assay with atomic absorption finish on 30g sub-samples. The lower detection limit was 0.005 ppm. In cases of gold "over limits" (> 0.29167 ounces per ton), the fire assay was repeated using a gravimetric finish. Silver was determined by atomic absorption after 4-acid digestion of a 0.5 g sub-sample. The lower detection limit for silver was 0.5 ppm. In cases of silver > 29.167 opt, silver was re-analyzed using a gravimetric finish.

Allied Nevada inserted standards into the RC sample stream at 80ft intervals prior to shipment to the assay laboratories. Pulped quartz blanks were inserted at variable intervals with the core samples. MDA is has no information on blanks that may, or may not, have been inserted with the RC samples. (see details in Section 12).

### 11.1.4 Hasbrouck Drilling Samples

*1974-1996*:

Information on sample preparation and analytical procedures for drill samples prior to 2010 is very limited, and nothing is known of the use of standard, blank and duplicate QAQC samples during this period. The Cordex RC drill hole assays were handwritten in the margin of the drill logs. During the 1970's, when Cordex operated the property, this was a common practice for Nevada projects. Cordex gold and silver assays were performed by Union; Denver, Rocky Mountain; Reno, Humboldt; location unknown, and Skyline; Tucson and were recorded in ounce per ton units. The assay method is presumed to be fire assay (fusion). The sample preparation and assay methodology used were not recorded in the information provided. Prenn and Gustin (2006) noted that the Union detection limits on all Cordex holes except for H-24, were 0.005 opt Au and 0.10 opt Au. Drill hole H-24 had a detection limit of 0.003 opt Au.

Franco-Nevada's drill sample assays were performed by Rocky Mountain. Sample preparation and assay methodology are not documented. MDA noted that the Rocky Mountain assays were performed as one-assay-ton fire assays, with detection limits of 0.005 opt Au and 0.10 opt Au; copies of the original assay certificates were provided to MDA (Prenn and Gustin 2006). Prenn and Gustin (2003, 2006) reported that Bechtel was contracted by Franco-Nevada to monitor the drilling, sampling, assaying and metallurgical test work, to ensure that the data collection "met the requirements for the preparation of a pre-feasibility study".

The FMC reverse circulation samples were analyzed by Intermountain Analytical by two-assay-ton fire assay and were hand-written in the margins of the lithology logs. Detection limits were 0.005 opt Au and 0.05 opt Ag (Prenn and Gustin 2003, 2006). The only available information on the Corona analytical methods is reported in Prenn and Gustin (2003, 2006). The Corona RC samples were analyzed by Barringer Laboratories, Inc. ("Barringer") for which copies of the original assay certificates have been provided to MDA. MDA observed that in contrast to the previous programs, which restricted the elements analyzed to gold and silver, Barringer analyzed gold by fire assay with an atomic absorption finish, and silver and molybdenum by atomic absorption. Detection limits were 2 ppb for gold, 0.1 ppm for silver and 1 ppm for molybdenum.

Chemex Labs Inc. ("Chemex"; location unknown) assayed the Euro-Nevada RC samples (Prenn and Gustin 2003, 2006). Gold analyses were by fire assay and atomic absorption finish, with a detection limit of 5 ppb. Silver was analyzed by atomic absorption, using an aqua regia digestion, with a detection limit of 0.2 ppm silver. Wilson (2014) reported that Quality Control data exist for the Euro-Nevada drilling program, but MDA did not review these data because these holes are external to the Hasbrouck resource area.

*2010-2013*:

Core samples were logged and sample intervals were marked by Allied Nevada geologists prior to shipping the whole core to ALS Minerals Laboratories ("ALS", Reno, Nevada; formerly ALS Chemex). According to Flint et al. (2012), geologists marked the core with cutting guide lines to best divide the core in a representative manner where veins were visible. The core was ½ sawn by laboratory personnel at the ALS laboratory facilities. As stated by Flint et al. (2012), "*samples are prepared from a split of 70% passing -3 mesh if pieces are too large to fit in the pulverizer, and further crushing of 70% passing - 10 mesh. A 2.2 pound split is taken and pulverized to 85% passing - 200 mesh.*"

Allied Nevada's RC drilling samples were prepared and analyzed at ALS in Reno, Nevada, and at Inspectorate Labs, Sparks, Nevada. ALS and Inspectorate Labs are ISO 9001:2000 registered laboratories. Samples were crushed to 70% passing 2 mm, and a 1 kg split was pulverized to 85% passing 75 μm.

Gold was determined by fire assay and atomic absorption finish on 30g sub-samples. The lower detection limit was 0.005 ppm. In cases of gold "over limits" (> 0.29167 ounces per ton or > 10 g/t), the fire assay was repeated using a gravimetric finish. Silver was determined by atomic absorption after 4-acid digestion of a 0.5 g sub-sample. The lower detection limit for silver was 0.5 ppm. In cases of silver > 29.167 opt, silver was re-analyzed using a gravimetric finish. During the last half of 2011, additional silver analyses by fire assay gravimetric methods were employed in the program. "Screen fire analyses" were completed for select high grade gold holes (HSB11-019, HSB10-001).

Gold and silver cyanide-leach assays were determined on select samples in 2010, and on most gold samples in 2011. The laboratory method used a 30g charge, subjected to a cyanide leach cycle including agitation for one hour. The solutions were then analyzed on an Atomic Absorption Spectrometer. The lower level of detection for silver was 0.5 ppm, and the gold lower detection limit was 0.03 ppm.

A small percentage of Allied Nevada's drill samples in 2010 and 2011 were also assayed by ALS using ICP-AES methods to determine 35 major, minor and trace elements with a 4-acid digestion.

A review of assay certificates indicates Allied Nevada inserted blanks as the initial sample for RC holes and then at approximately every 20 to 40 samples, without a fixed frequency. Standards were inserted into the RC sample stream every 18 to 20 samples, but not in all holes, prior to shipment to the assay laboratories. Duplicates were included at intervals of approximately every 20 samples, but not for all holes (see details in Section 12).

## 11.2 Sample Preparation and Analysis by West Kirkland

### 11.2.1 Surface Sampling by West Kirkland at Three Hills and Hasbrouck

Rock-chip samples collected at Three Hills and Hasbrouck were all prepared and analyzed at ALS in Reno, Nevada. Samples were crushed in their entirety to 70% at <2mm, then riffle split to obtain a 250g subsample. The 250g subsamples were pulverized to at least 85% at <75 microns. Gold was determined by fire-assay on 30g charges with ICP-AES finish. The lower detection limit for gold was 1ppb. Silver and 47 major, minor and trace elements were analyzed with ICP-AES-MS methods using 4-acid digestion.

WKM did not insert blanks and standard samples into the sample stream for rock-chip samples taken at Three Hills and Hasbrouck.

### 11.2.2 West Kirkland's Drill Samples at Three Hills and Hasbrouck

Core samples were logged and sample intervals of approximately 4in to 5ft lengths were marked by WKM geologists prior to shipment of the whole core to ALS in Reno, Nevada. The core was ½ sawn by laboratory personnel at the ALS laboratory facilities. Sample intervals of ½ core were crushed in their entirety to 70% at <2mm, then riffle split to obtain a 250g subsample. The 250g subsamples were pulverized to at least 85% at <75 microns. Gold was determined by fire-assay on 30g charges with ICP-AES finish. The lower detection limit for gold was 1ppb. Samples assayed at >1 g/t gold were re-assayed with atomic absorption finish. Silver and 47 major, minor and trace elements were analyzed with ICP-AES-MS methods using 4-acid digestion.

WKM's RC samples were split at the drill rig to approximately 17 to 20lb samples for shipment to ALS in Reno, Nevada. After drying, the RC samples were crushed in their entirety to 70% at <2mm, then riffle split to obtain a 250g subsample. The 250g subsamples were pulverized to at least 85% at <75 microns. Gold was determined by fire-assay on 30g charges with ICP-AES finish. The lower detection limit for gold was 1ppb. Samples assayed at >1 g/t gold were re-assayed with atomic absorption finish. Silver and 47 major, minor and trace elements were analyzed with ICP-AES-MS methods using 4-acid digestion.

For both core and RC drilling, WKM inserted blank, standard and duplicate samples into the drill sample stream at regular intervals. Details are given in Section 12.

## 11.3 Sample Security

No information is available for sample security procedures used during drilling from 1974 through 1997 at the Hasbrouck and Three Hills deposits. During 2010 through 2013 Allied Nevada personnel transported drill core on a daily basis from drill sites at Hasbrouck and Three Hills to the Allied Nevada logging facility in Tonopah, Nevada (Wilson, 2014). RC samples were retrieved from the drill rig and stored in sample bins or on pallets. Personnel and vehicles dispatched from the assay laboratories travelled to the logging facility and picked up the samples. Sample identification numbers and missing samples were verified by the site geologists prior to release of the samples to the assay lab personnel.

During 2014 sample security was maintained by WKM in the following manner:

- Core samples drilled at Three Hills were under the continuous supervision of WKM's geologists at the drill sites, and were then transported by WKM personnel to WKM's secure facility in Tonopah, Nevada. ALS personnel travelled to Tonopah, took custody of the samples from WKM personnel, and transported the samples to the ALS laboratory in Reno, Nevada.
- RC drilling took place on a day-shift only basis. RC samples were transported daily by WKM personnel to either a locked storage container, or WKM's fenced storage area in Tonopah. Samples were not left at the drill rig unattended during the night. ALS personnel travelled to Tonopah, took custody of the samples from WKM personnel, and transported the samples to the ALS laboratory in Reno, Nevada.

## 11.4 Summary Statement

It is MDA's opinion that the sampling, assaying, and security procedures used at Three Hills and Hasbrouck follow industry standard procedures, and are adequate for the estimation of the current mineral resources.

# 12.0 DATA VERIFICATION

This section is taken from Tietz et al. (2015). MDA conducted an audit of the Three Hills and Hasbrouck databases and compiled and analyzed available quality control/quality assurance ("QA/QC") data collected by Allied. No QA/QC data are available for pre-Allied drilling conducted before 2010.

## 12.1 Database Audit

The Three Hills and Hasbrouck databases provided to MDA by WKM are the same data as used in the previous 2014 resource estimate (Wilson, 2014). For the current resource estimate, MDA completed a full audit of the Allied 2010-2013 drill data at Hasbrouck and Three Hills (196 drill holes), comparing these data against original survey notes and assay certificates. The pre-Allied data were previously audited by MDA in 2003 and 2006 and the current database was compared against both these historical databases along with data compiled in 2010 by Allied.

In an effort to standardize the coordinate system, measurements and locations are expressed in US Survey feet, a change from International feet used in the Wilson 2014 estimate.

### 12.1.1 MDA Audit of pre-Allied Data

The pre-Allied analytical and geological (drill log) data had been previously verified by MDA for both the Hasbrouck (Prenn and Gustin, 2006) and Three Hills (Prenn, 2006) deposits. For the current resource estimate, MDA compared the previous MDA audited data, along with data compiled by Allied, against the databases provided by WKM as summarized below.

#### 12.1.1.1 Pre-Allied Drilling Data for Three Hills

**Collar Locations**: There are no discrepancies between the WKM collar data and the previous databases.

The location of TH-13 is in question due to significant differences in the assay values and logged geology as compared with the adjacent drill holes. TH-13 remains in the database, but the assays were excluded from use in the resource estimate.

After reviewing additional historical data provided by Allied, the location of TH-01 was revised to reflect original survey data and locations noted on two plan maps.

The final drill depths for 17 drill holes were changed to reflect the current assay and geology data.

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

**Assays**: Eighteen assays were corrected in the Three Hills assay data received from WKM; thirteen of which are considered significant (>0.004oz Au/ton difference). The "less than detection" assays were also standardized as "0" within the current database, while over 700 sample intervals noted as “no sample” in the WKM 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 WKM 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 un-surveyed, 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 WKM database. The current Hasbrouck database was revised to match the original survey data.

**Downhole Surveys:** No material differences between the WKM 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 WKM 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 (“CRM”s) 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*

WKM'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 WKM 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 WKM'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 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 analyzed 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 involves a heap leach and absorption facility at each deposit. Conventional cyanide heap leaching will be utilized at both mines. The proposed extraction methods, process flow, and types of processing facilities are described in Section 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 WKM in 2014 and 2015 are summarized in Section 13.3 and Section 13.4. 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 WKM'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 rolls, 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 WKM's acquisition of the property in April 2014, metallurgical tests were performed which could be used in assessing the project and 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 Commissioned by West Kirkland

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

## 13.4 Hasbrouck Metallurgical Testing Commissioned by West Kirkland

In 2014 and 2015, further metallurgical data were obtained by WKM, with studies focused on the relationship between particle size and host-rock lithologies to gold and silver recoveries from Hasbrouck ore (KCA, 2015). In particular, the use of HPGR for crushing of Hasbrouck ore 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 | WKM | Wetlabs | 1405390 | Surface sample | Environmental characterization | Negligible deleterious material |
| 10 Jun 2014 | WKM | 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 | WKM | KCA | 140083-THB04-01 | Composites from 6 diamond drill holes | ABA and Total Metal Analysis | Negligible deleterious material detected |
| 27 Oct 2014 | WKM | 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 | WKM | 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%<br>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%<br>Column leach (3/4" & 3/8") avg extractions: Au - 51%, Ag - 12% |
| 11 Jun 2014 | WKM | Wetlab | 1405636 | Surface sample | Environmental characterization | Negligible deleterious material |
| 18 Aug 2014 | WKM | KCA | 0140112-05HSB-01 | Surface Samples | Bond Low Impact Crusher Work Index and Bond Abrasion | Crusher Work Index: 18.7 kWh/tonne<br>Abrasion Index: 0.29 |
| 15 Jan 2015 | WKM | McClelland | 3948 | Drill Core | Agglomeration, strength & stability | P80 3/8in crush, 5lb/ton cement is required to produce stable agglomerates. |
| 5 Mar 2015 | WKM | 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%<br>Ag; Cone 19%, HPGR 30%<br>Column leach (75 day) – Au; Cone 45%, HPGR 55%<br>Ag: Cone 25%, HPGR 38% |
| 9 Mar 2015 | WKM | 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 | WKM | KCA | 0140171-HSB12-01 | Drill Core | Cone crusher versus HPGR product extractions Bottle rolls | Cone crushing - Au 47.3%, Ag - 14%<br>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 used in those tests cannot be determined; it has been summarized by Prenn and Gustin (2006).

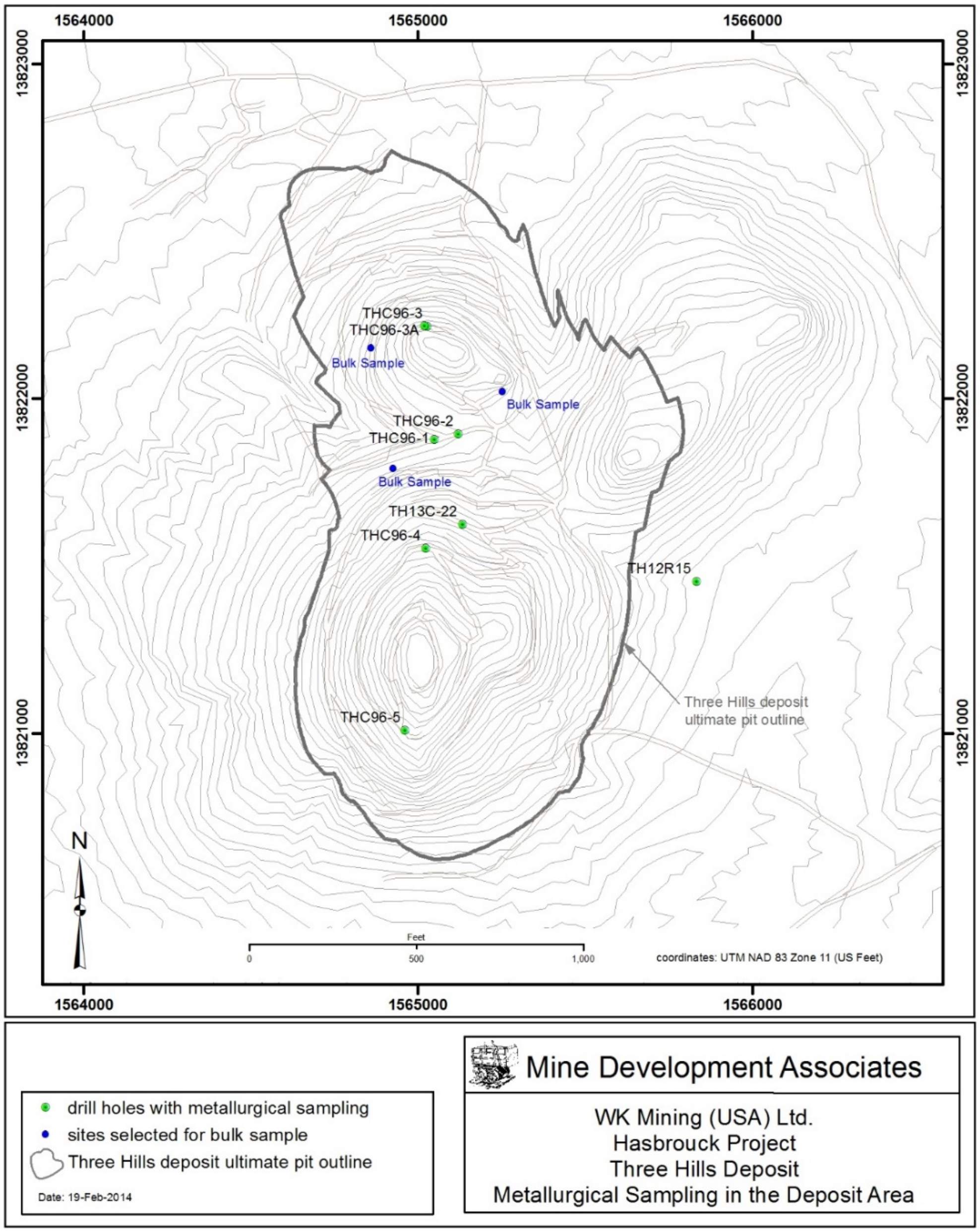
### 13.5.1 Three Hills - Ore Description

Three Hills ore is 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 produce various sizes to determine the 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)

| | | | Grade oz/ton | | | Consumption lb/ton | | |
|---|---|---|---|---|---|---|---|---|
| **Test** | **Material** | **Size (inches)** | **Head** | **Tails** | **Extracted Au, %** | **NaCN** | **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 |

*Note: NaCN = sodium cyanide.*

### 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 upon 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 the final drain-down moisture of the ROM material to 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**

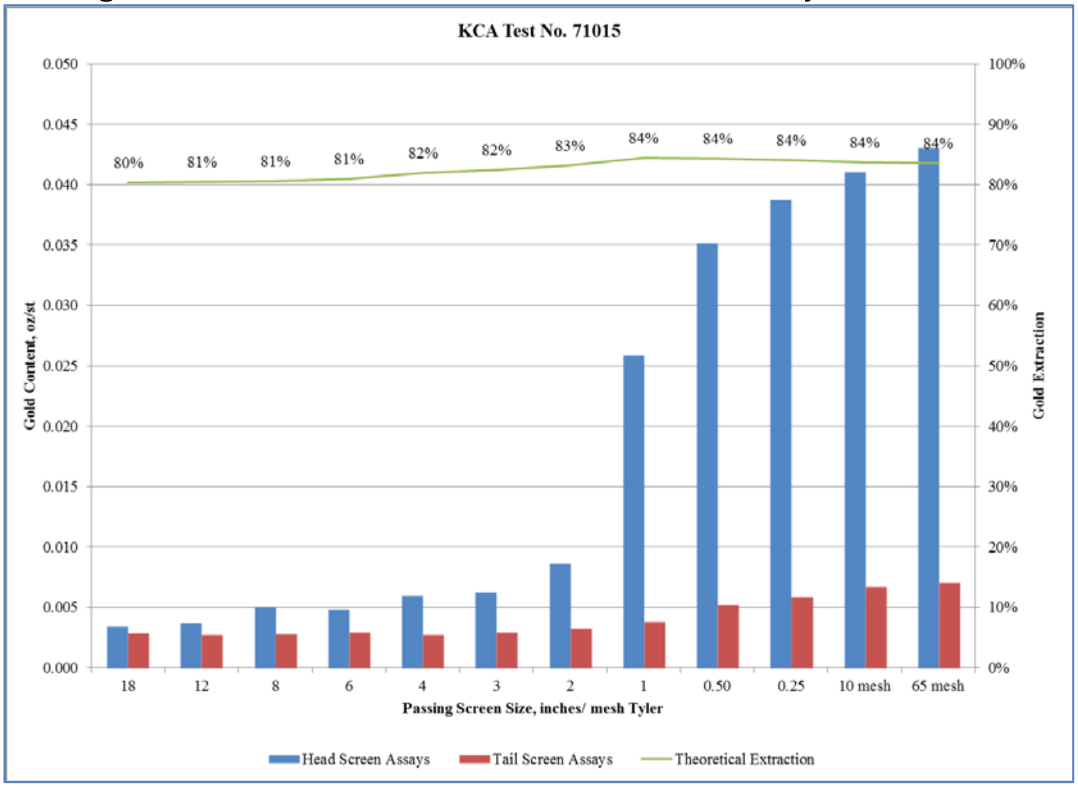
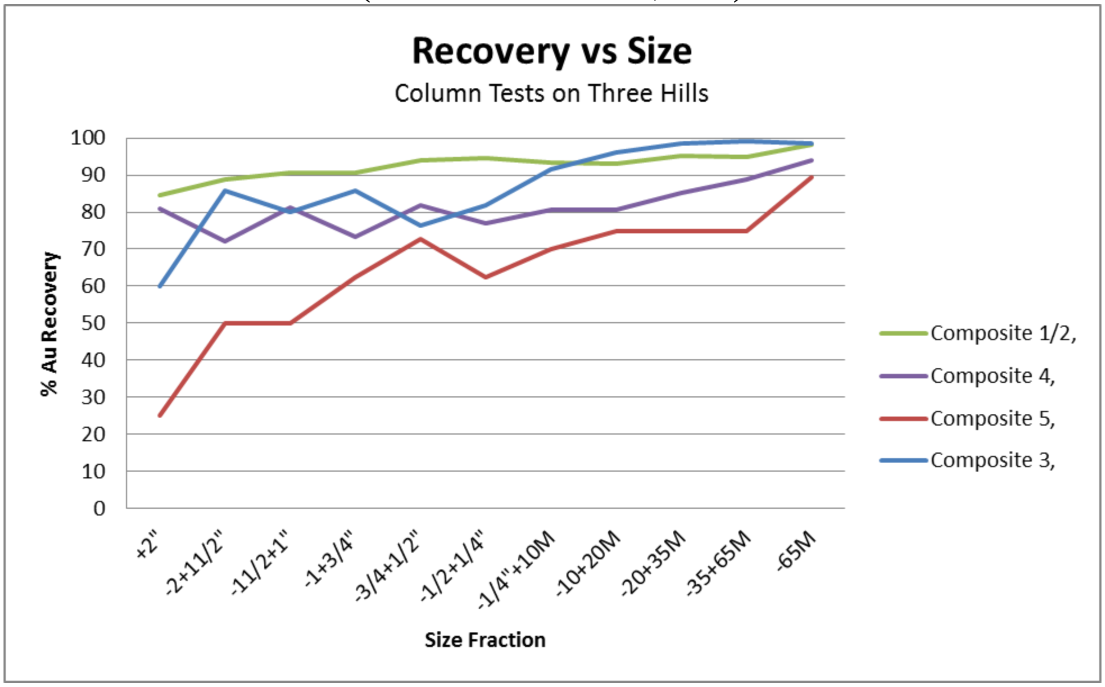



**Figure 13.3 Three Hills Column Recovery by Size Fraction**
(data from McClelland, 1996)



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 lack of material in this size fraction and is therefore not considered representative.

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, which is finer than the ROM sized material being considered at Three Hills. After a 2% operational discount, the relatively small 3.4% increase in recovery, which results from crushing to 1.5in, is not considered sufficient to offset the associated increase in capital and operating costs for crushing, and 79% recovery from an ROM leach is considered to be the most economic approach for this project. Consequently, Three Hills ore is planned to be leached without crushing, i.e. an ROM heap leach.

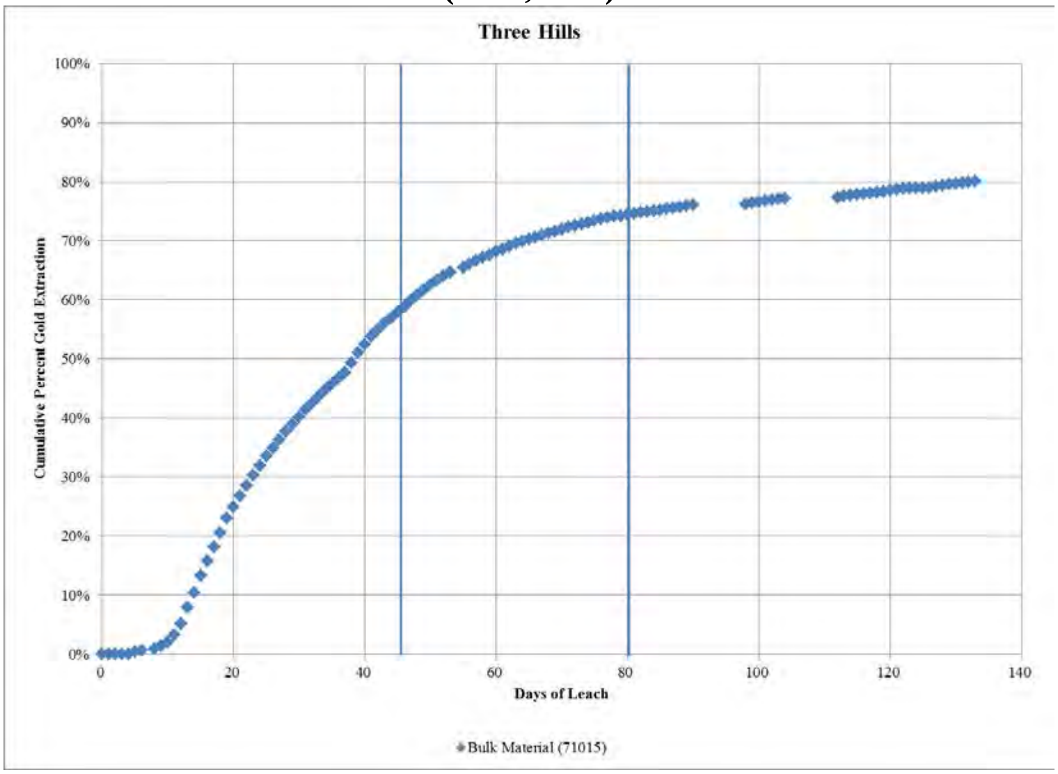
While KCA's 48in column tests in 2014 on P80 3.8in material may be used as a robust predictor of recovery from an ROM heap leach, it should be noted that the material used in this test was finer than expected from mining operations. Comparing the 48in column test results to the 6in column test results on Composites 2, 3, and 4 (81.0%, 88.5% and 84.6% gold recovery, respectively) leads 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 of 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 as shown in Table 13.6.

**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 can be expected in a full-scale ROM operation. 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 only weakly with decreasing particle size, and consequently a 2.1%

deduction is applied to account for this. This leads to a predicted operational gold recovery of 79% at Three Hills for ROM material.

Increased gold recovery of 2.5% during drain-down of the heap-leach pad at the Three Hills was included in this study. This was derived from the gold recovery-time curves. Drain-down recovery is generally not included in economic studies, but recovery during drain-down is in fact realized at most leaching operations. While there is a risk that the full drain-down recovery will not be realized in actual production, recognizing gold recovered during drain-down is considered valid and appropriate in this case.

### 13.5.8 Three Hills - Projected Consumption of Reagents

#### 13.5.8.1 Three Hills Cyanide Consumption

The 2014 KCA ROM column test data were used to predict field cyanide consumption. In this test, 0.75 lb NaCN/ton was consumed. To address the difference between laboratory-scale columns and full-scale heap leach operations, the test value of 0.75 lb NaCN/ton was multiplied by 0.6, resulting in a prediction for full-scale heap leach cyanide consumption of 0.45 lb/ton. This factor is based on field experience of multiple similar heap-leach operations.

#### 13.5.8.2 Three Hills Cement and Lime Consumption

Lime ("CaO") 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.

No cement will be required at the Three Hills heap leach.

### 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. This result provides a high degree of certainty that that permeability will acceptable through ROM material to a stacking height of at least 22ft.

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 particle size that the KCA test equipment could handle. These tests indicated poor percolation which is believed to be due to the un-representatively high fines content of the test sample. Previous screen analyses of 1.5in crushed Three Hills ore showed a significantly smaller amount of fines than in the sample used in the foregoing test. It is probable that the lower percentage of fines in ROM ore from full-scale operations will allow fluid to percolate though the heap acceptably and as it did in the 22ft high column test.

For the foregoing reasons it is believed that the Three Hills heap will percolate acceptably in practice at its full 150ft planned height. But it is not possible to be certain as no compacted permeability test equipment exists capable of handling ROM-sized material. Thus, during initial leaching operations at Three Hills, percolation will be closely monitored to observe the percolation rate, allowing early adjustments to be made as necessary. Adjustments that can be made include installing intermediate drains in the heap at various elevations as the heap grows in height. While this would increase costs somewhat, it is a viable and proven work-around which can be implemented simply and quickly should percolation decrease to unacceptable rates as stacking height increases.

### 13.5.10 Three Hills Comminution Test Results

No comminution tests have been carried out on Three Hills ore as a ROM heap leach has always been envisaged for this mine. 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 optimum process.

## 13.6 Hasbrouck Deposit Test Results

In 2014 and 2015, WKM 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 Mine ore was evaluated. Metallurgical tests conducted prior to 1988 were summarized by Wilson (2014) and are consistent with results of later tests, but have not been included as the sample locations are not known. Metallurgical tests are summarized in Table 13.1

.

### 13.6.1 Hasbrouck Deposit Ore Description

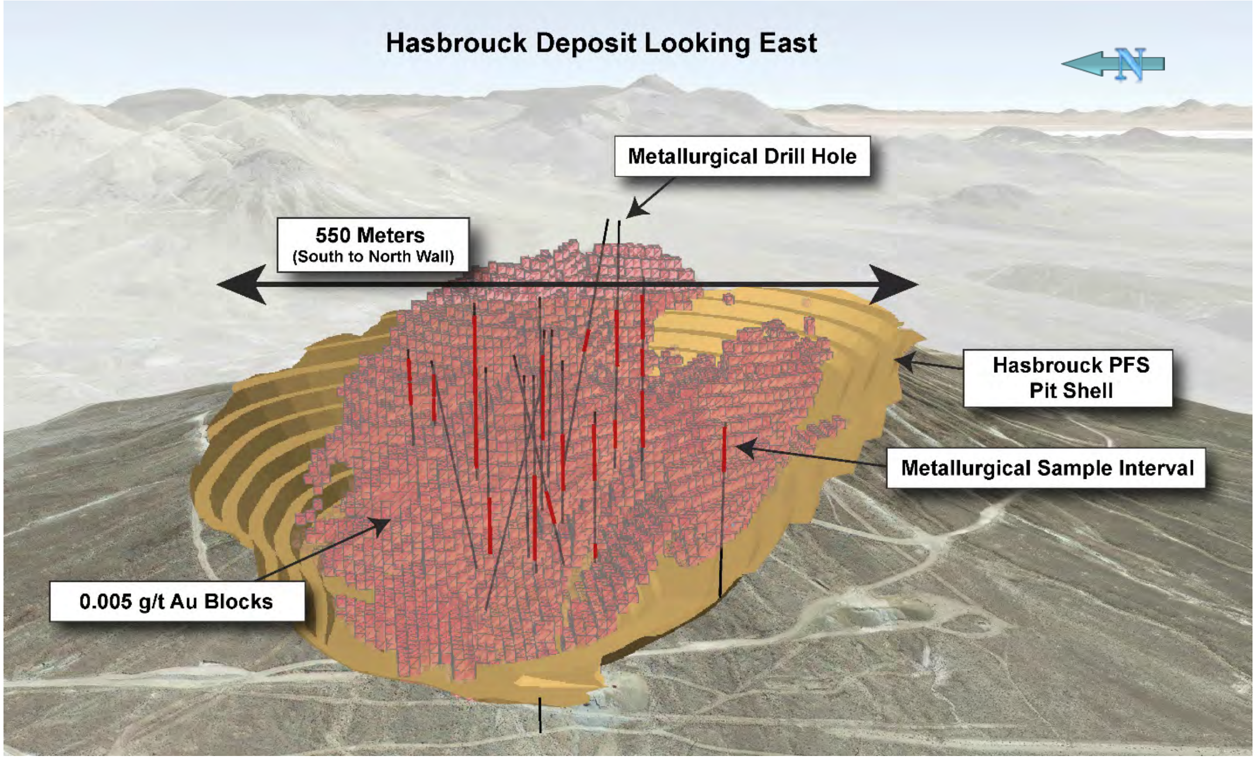
Hasbrouck Mine ores are contained in the Siebert Formation. The Siebert Formation is separated into two lithological packages, designated the upper Siebert and the lower Siebert. The upper Siebert is dominated by sandstones and conglomerates and is heavily silicified. The lower Siebert is dominated by 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 original surface (elevation) and metal recovery. Re-analysis of the geological data in 2015 revealed that the relationship with recovery is with lithologies, rather than with elevation. WKM'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. WKM's bottle roll tests on HPGR crushed core resulted in gold recoveries of 65.4% and 74.5% being assigned to the upper and lower Siebert, respectively (see Section 13.6.11). During mining operations, geological mapping will be used in these zones to estimate the percentages of each type of ore sent to the plant for accounting purposes.

### 13.6.2 Hasbrouck Deposit - Sample Locations

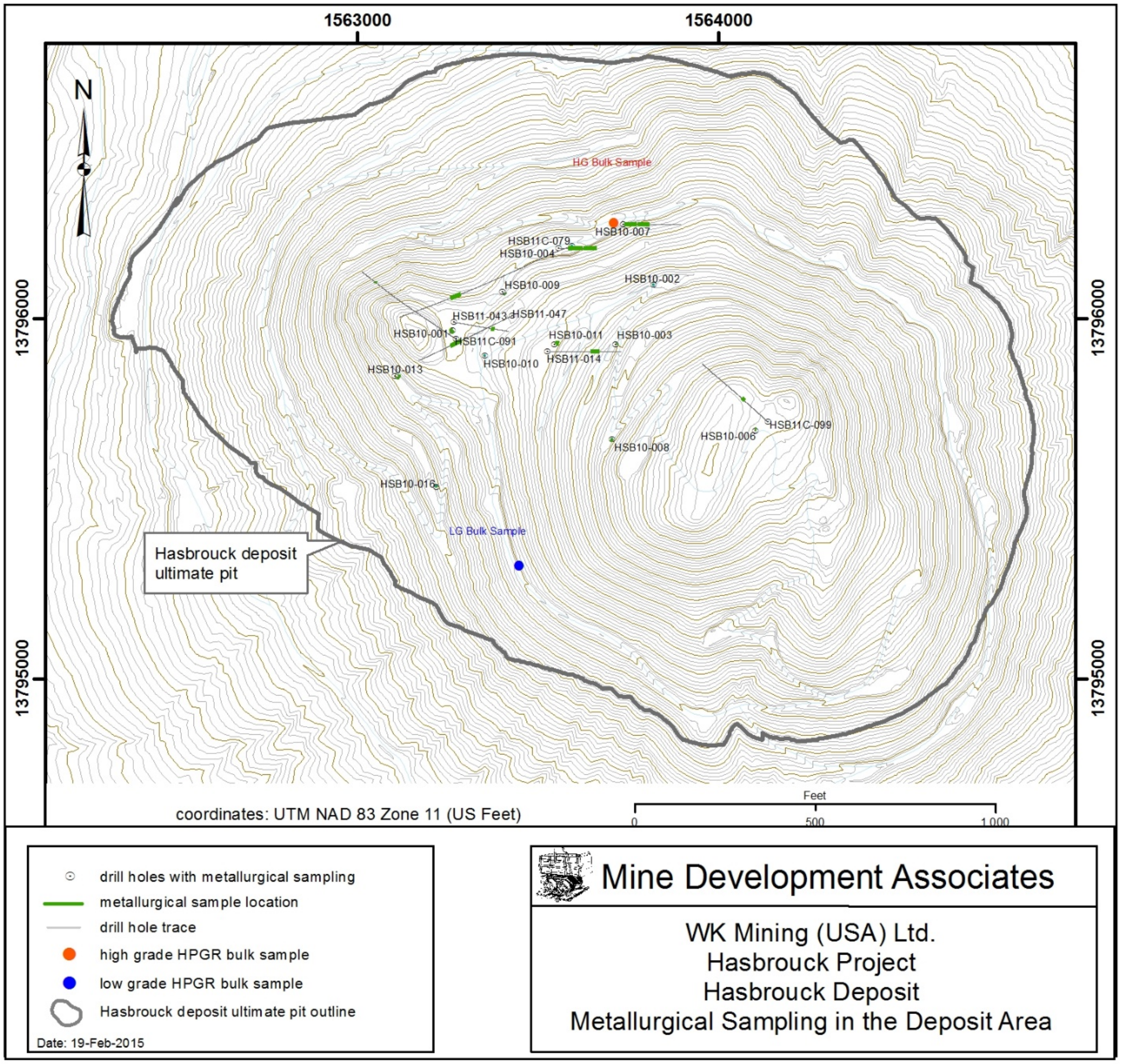
The locations of the core holes and intervals of drill samples used in the Hasbrouck metallurgical test work in 2012-2015 are shown in Figure 13.5. The locations of bulk surface samples are shown in Figure 13.6. The samples are considered to be spatially and stratigraphically representative of the ores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

**Figure 13.5 Hasbrouck Deposit Drill-hole Metallurgical Samples 2012 – 2014,**
(Perspective View Relative To Block Model and Proposed Pit; MDA 2016)




***Note: Not to scale***

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




### 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 the effect 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 Hasbrouck Deposit Bottle Roll Test Results on Cone Crushed Material**
(Data from McPartland, 2012 and Wright, 2012)

| | | Head Grade, oz/ton | | Extraction, % | | Consumption, lb/ton | |
|---|---|---|---|---|---|---|---|
| **Material** | **Size (mesh)** | **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 13.6.14 in Table 13.17, Table 13.18 and Table 13.19.

### 13.6.4 Hasbrouck Deposit - Column Tests

Allied Nevada commissioned 70 column tests performed by McClelland in 2012. 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 Hasbrouck Deposit 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 |
| ***3536 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 |
| ***3465 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 Hasbrouck Deposit Column Leach Gold Recovery by Size Fraction**
(Data from Wright, 2012)

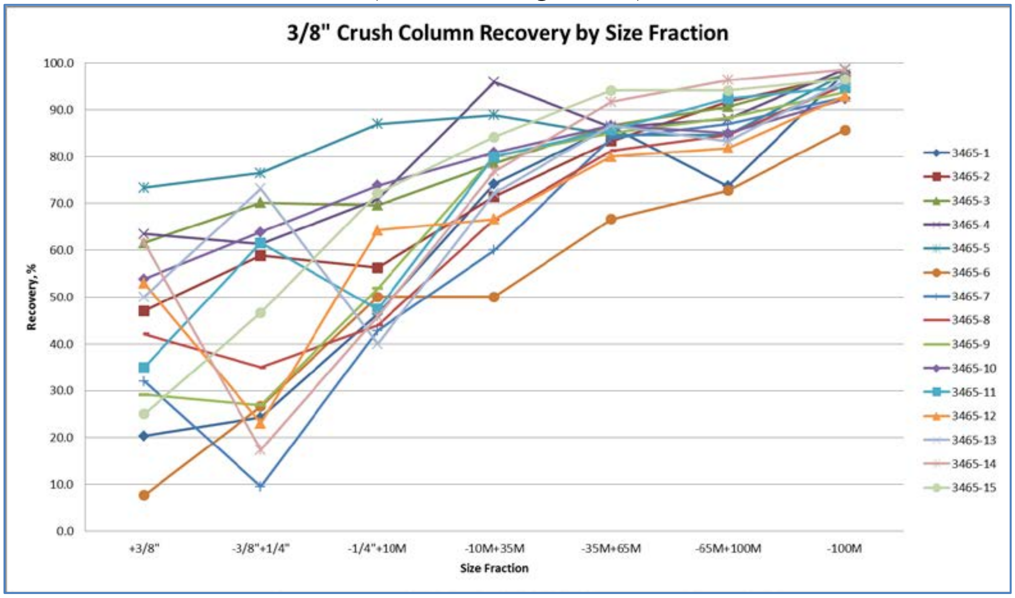
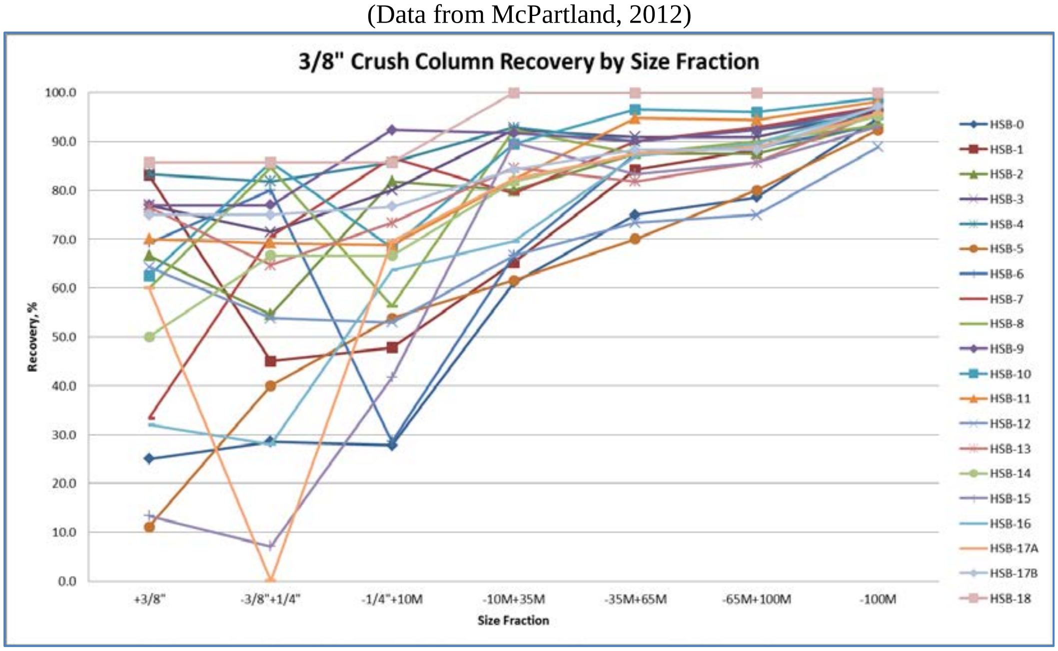



**Figure 13.8 Hasbrouck Deposit Column Leach Gold Recovery by Size Fraction**
(Data from McPartland, 2012)



The 2012 column leach data were studied to determine the relationship between particle size and recovery. As shown 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

An analysis of 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 as elevation decreases (Figure 13.10).

The difference in gold recoveries between the two Siebert stratigraphic units is most likely due to the degree of silicification of the ore. Pervasive silicification, hydrothermal brecciation, and siliceous veining are common within the upper Siebert volcaniclastic rocks. Silicification and veining are less pervasive and mineralization is more structurally controlled 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.

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

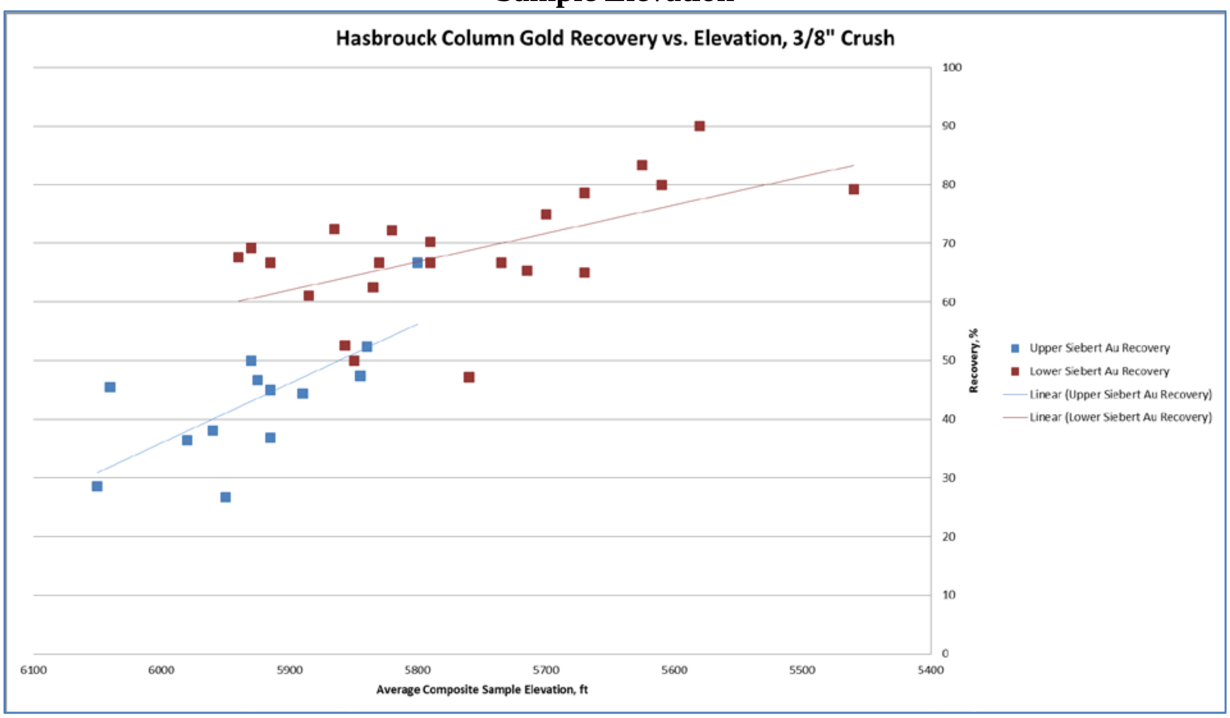
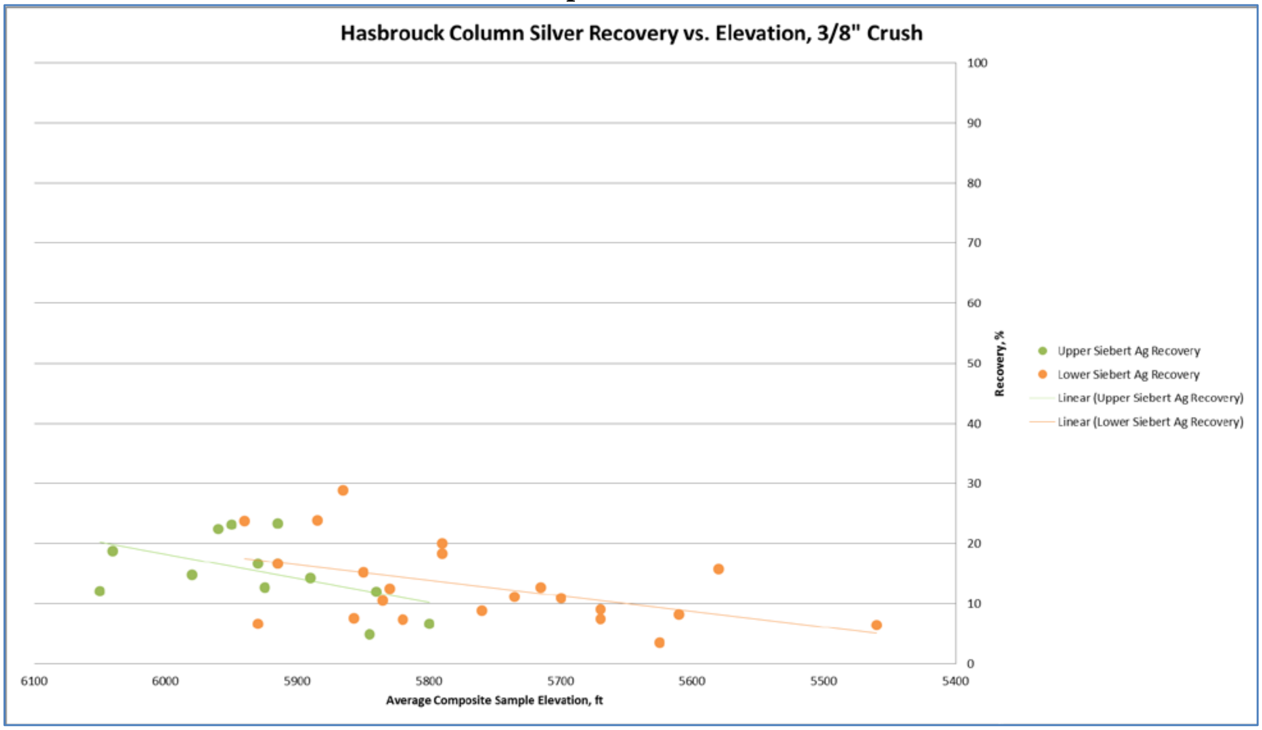


**Figure 13.10 Hasbrouck Deposit Column Leach Silver Recovery by Stratigraphic Unit and Sample Elevation**




### 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 in this test which was designed to establish the difference in gold and silver recoveries between an HPGR and a conventional crusher (Figure 13.11).

The HPGR crushes the rock by applying high pressure to it by means of two counter-rotating tungsten-carbide studded rollers. Pressure applied to the rock is generated by hydraulic rams which force one roll towards the other; pressure may be varied to optimize the crushing process. Generally, higher pressure creates a finer product. Literature on the HPGR suggests that its crushing action selectively opens microfractures which allow cyanide access to planes of weakness in rock such as that found at Hasbrouck Mine.

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

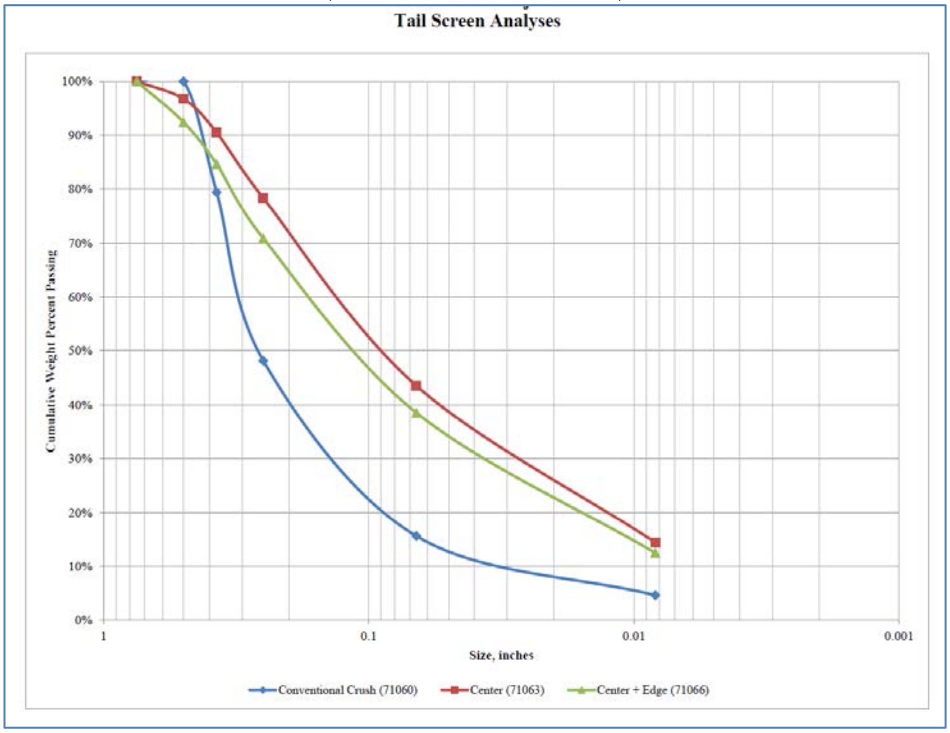
In both test series, based on manufacturer's experience at similar operations, between 20% and 25% of the HPGR edge material product was collected as it exited the machine. Splitting the HPGR product in this way was performed to quantify the difference in the amount of crushing experienced by center material relative to edge material, and the effect that 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**


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 particle size that can be practically produced at full-scale by a conventional crusher. The remaining 750kg of the composite sample was crushed by the HPGR.

The particle size distributions of HPGR center, HPGR edge, and conventionally crushed p80 3/8in material are presented in Figure 13.12.

**Figure 13.12 Hasbrouck Deposit HPGR versus Conventional-Crush Size Distributions**
(Data from KCA, 2015)




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

**Table 13.9 Hasbrouck Deposit 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 predominantly 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 were 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 Deposit HPGR – Upper Siebert Bottle Roll Gold and Silver Recoveries

| Description | | | | Cone Crush | | | HPGR Center | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Avg. Elev. ft | Siebert | Rock Type | Au Head oz/ton | Au Tail oz/ton | Au Recovery at 96 hr % | Au Head oz/ton | Au Tail oz/ton | Au Recovery at 96 hr % | 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 | | | | Cone Crush | | | HPGR Center | | | |
| | Avg. Elev. ft | Siebert | Rock Type | Ag Head oz/ton | Ag Tail oz/ton | Ag Recovery at 96 hr % | Ag Head oz/ton | Ag Tail oz/ton | Ag Recovery at 96 hr % | 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 Deposit HPGR – Lower Siebert Bottle Roll Gold and Silver Recoveries

| Description | Ave Elev. ft | Siebert | Rock Type | Cone Crush Au Head oz/ton | Cone Crush Au Tail oz/ton | Cone Crush Au Recovery at 96 hr % | HPGR Center Au Head oz/ton | HPGR Center Au Tail oz/ton | HPGR Center Au Recovery at 96 hr % | Difference in HPGR vs Cone Crush Recovery % |
|---|---|---|---|---|---|---|---|---|---|---|
| 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%** |

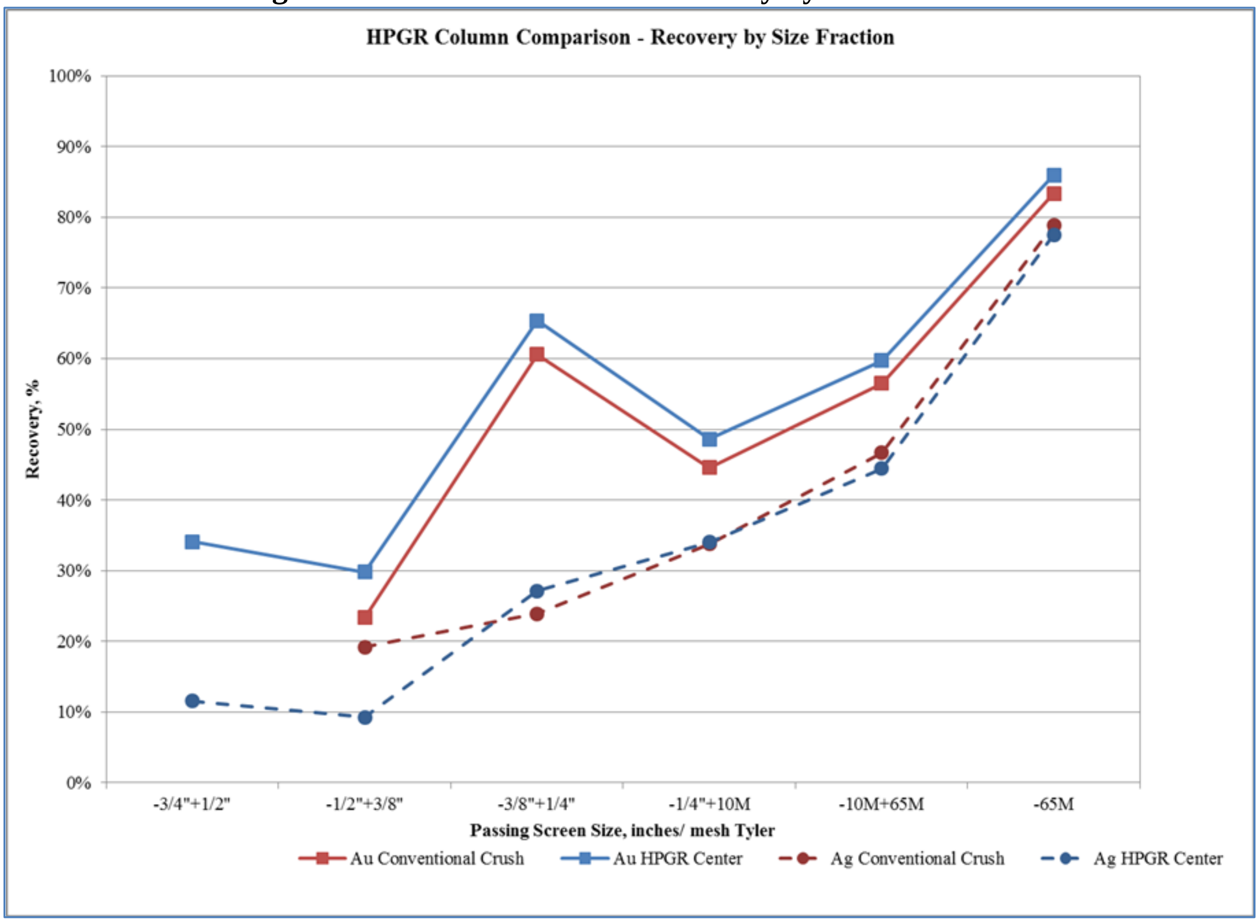
| Description | Avg. Elev ft | Siebert | Rock Type | Cone Crush Ag Head oz/ton | Cone Crush Ag Tail oz/ton | Cone Crush Ag Recovery at 96 hr % | HPGR Center Ag Head oz/ton | HPGR Center Ag Tail oz/ton | HPGR Center Ag Recovery at 96 hr % | Difference in HPGR vs Cone Crusher Recovery % |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 ore by 14% and by 6.4 % from the lower Siebert ore, relative to a cone crusher. There is no indication that HPGR crushing will significantly improve silver recovery.

While the differential in gold recovery was demonstrated by the results shown in Table 13.10 and Table 13.11 for the upper and lower Siebert, it should be noted these results were generated from bottle roll tests and as such are known to be less representative of the performance of a full-scale heap leach than column leach results. To adjust for this, the bottle roll recoveries for upper Siebert were compared to the column leach recoveries on similar material; 6% difference was noted. This 6% difference has been added to the bottle roll results to approximate column test results for the upper Siebert. This was not possible for the lower Siebert as no column data were generated for HPGR product.

**Figure 13.13 HPGR Column Recovery by Size Fraction**




The recovery from ore crushed in a full-scale HPGR has been predicted by using the column test data presented in Table 13.9, and the McPartland and Wright 2012 data. The higher gold recovery from ore crushed in an HPGR compared to a cone crusher is explained by 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 might increase gold recovery by 4%.
- Smaller particle size; test data from crushing Hasbrouck material demonstrates that an HPGR with edge recycling will crush to P75 1/4in which results in 6% to 14% higher recovery than a conventional crusher at P80 3/8in crush.

To obtain maximum benefit from the finer crushing and microfracturing generated by an HPGR, the crushing circuit will be configured to recycle a certain percentage of edge material. Predicting gold recovery at full scale with recycling approximately 25% of edge material is achieved by factoring recovery from an HPGR center product recovery with that of a cone crusher and then applying to the historical data base of recoveries from conventionally crushed ore. 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 Hasbrouck Deposit 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 show that this material is hard to crush and moderately abrasive.

### 13.6.9 Hasbrouck Deposit - Agglomeration and Permeability Test Results

Agglomeration tests were performed to evaluate the need to agglomerate both conventionally crushed and HPGR crushed ore. Results are summarized in Table 13.13 and show that both 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 Deposit 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, lb/ton** | 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, lb$_{dry}$/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 Deposit 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 were 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 Hasbrouck Deposit - Summary of 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 based on the 2012 McClelland 6in column tests. Experience teaches that 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 Deposit 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 were completed in 3in columns and were terminated at 75 days, i.e. before leaching was completed. These column tests 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 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, gold recovery from conventionally crushed material was predicted at 44.6%.

KCA's 2014 bottle roll tests on HPGR crushed upper Siebert material showed a 14% increase in gold recovery compared to a conventional crusher (Table 13.10). The data on upper Siebert material indicates that bottle roll tests under-report gold recovery by at least 6% compared to column leach test data. (Table 13.9 and Table 13.10). An experience-based deduction of -2.4% has been applied to laboratory-scale gold recovery predictions to represent what will occur at full scale. The operational gold recovery is therefore predicted to be 62.2% for ore hosted in the upper Siebert unit (i.e., 43%+14%+6%-2.4%).

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 70.2%. Bottle roll tests by KCA in 2014 indicated that using an HPGR will result in 6.4% higher gold recovery than 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 74.6% (70.2%+6.4%-2%) for ore hosted in the lower Siebert unit. It should be noted that no comparative column tests are available to factor the bottle roll tests done on lower Siebert ore crushed in an HPGR as was possible for upper 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 72.2% is predicted for all ore contemplated in this study to be mined at the Hasbrouck Mine.

Silver recoveries do not appear to benefit from HPGR crushing. Tests on 3/8in, conventionally crushed material indicated that an average recovery of 13% 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 the Hasbrouck ore.

Increased gold recovery of 1.5% during drain-down of the heap-leach pad at the Hasbrouck Mine was included in this study. This value was derived from the gold recovery-time curves. Drain-down recovery is generally not included in economic studies, but recovery during drain-down is in fact realized at most leaching operations. While there is a risk that the full drain-down recovery will not be realized in actual production, recognizing gold recovered during drain-down is considered valid and appropriate in this case.

### 13.6.12 Hasbrouck Deposit - Cyanide Consumption

The column leach test data were used to predict field consumption of cyanide at the Hasbrouck Mine. An average consumption of 3.29lb NaCN/ton was observed in the 2012 column leach tests on conventionally crushed material. The 2015 column leach tests on HPGR crushed materials consumed an average of 1.81 lb NaCN/ton, a slight increase compared to the conventionally crushed material in the same tests that consumed 1.73 lb NaCN/ton (KCA, March, 2015). Based on experience, consumption of cyanide during production is expected to be 40% of the KCA HPGR laboratory consumption results, or 0.75 lb NaCN/ton.

### 13.6.13 Hasbrouck Deposit - Cement and Lime Consumption

Cement will be required for agglomeration at Hasbrouck. Compacted permeability tests indicated that adding 4 lb/ton of cement to crushed ore will be sufficient to maintain stable and permeable agglomerates for a heap height of 125ft. However, the pH was slightly lower than optimal at this addition rate and so an addition rate of 5 lb/ton is projected for full-scale operations.

### 13.6.14 Hasbrouck Deposit - Detailed Results of Bottle Roll and Column Leach Tests

Detailed data that was used for the summary tables presented in Section 13.4 are given in Table 13.17, Table 13.18 and Table 13.19.

## Table 13.17 Hasbrouck Deposit 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 |
| CY-34 | HSB-16 | 5890 | Upper | Tslc/Tslt | 200M | 0.027 | 0.63 | 92.6 | 63.5 | 0.1 | 3 | 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-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 |
| CY-15 | 3465-15 | 5670 | Lower | Tslt | 10M | 0.025 | 0.46 | 68 | 10.9 | 0.14 | 1.8 | 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-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 Deposit 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 Deposit 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 the Three Hills and Hasbrouck deposits was performed by the previous owners and by WKM. Testing included:

- Bottle roll tests that evaluated amenability of Three Hills and Hasbrouck ores to cyanidation;
- Column leach tests that evaluated the amenability of the crushed and ROM ore from both deposits to conventional heap leaching;
- Abrasion testing of ore from the Hasbrouck deposit;
- Comminution testing of ore from the Hasbrouck deposit; and
- HPGR testing of Hasbrouck deposit ore.

Review of the studies above, summarized in Table 13.1, support the following conclusions:

- Three Hills Deposit
  - Metallurgical performance is consistent throughout the deposit.
  - Gold recovery increases weakly 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.
  - Drain-down recovery for gold is predicted to be 2.5% over 12 months.
  - Consumption of NaCN is predicted to be 0.45 lb/ton.
  - Consumption of lime (“CaO”) is predicted to be 4 lb/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 ore crushed in an HPGR and tested in both columns and bottle rolls are predicted to be 55.6% for gold and 11.0% for silver.
  - Recoveries for lower Siebert ore crushed in an HPGR and tested in both columns and bottle rolls are predicted to be 76.6% for gold and 11.0% for silver at 115 days.
  - Mine scale recovery using a weighted average of the upper and lower Siebert units are predicted to be 72.2% for gold and 11.0% for silver.

- Drain-down gold recovery for both upper and lower Siebert units is predicted to be 1.5% over 24 months. No recovery of silver during drain-down is predicted.
- Within each lithological unit, gold recovery slowly increases with decreasing elevation; for economic modelling of the project, a single average recovery value has been used due to the weakness of this effect.
- There is no significant correlation between either gold or silver grade and recovery.
- NaCN consumption is predicted to be 0.75 lb/ton.
- Cement consumption is predicted to be 5lb /ton.

## 13.8 Hasbrouck Project Metallurgical Parameter Summary

Predicted Hasbrouck project metallurgical parameters, based on all available data, are 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 Hasbrouck Project Recovery Factors**
(from WKM, 2016)

**THREE HILLS MINE**

| Three Hills Mine - Gold Recovery | Recovery | Source Documents |
|---|---|---|
| Column Recovery | 81.1% | 1996-11-11 - MLI - 3HM - Bottle Rolls & Columns - Report 2335<br>2015-03-19 - KCA - 3HM - 48in Column Test - Report 0140082-THB03-02 |
| Operational Adjustment Factor | -2.1% | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| **Operational Recovery** | **79.0%** | 2015-03-19 - KCA - 3HM - 48in Column Test - Report 0140082-THB03-02 |
| **Drain-Down Recovery** | **2.5%** | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Leach Time to Operational Recovery | 171 days | |
| Leach Recovery Schedule:- | | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Month Placed | 0% | |
| 1st Month | 0% | |
| 2nd Month | 43% | |
| 3rd Month | 18% | |
| 4th Month | 9% | |
| 5th Month | 5% | |
| 6th Month | 3% | |
| 7th Month | 1% | |
| Drain-Down Recovery Schedule:- | | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| 1st Month | 0.10% | |
| 2nd Month | 0.20% | |
| 3rd Month | 0.25% | |
| 4th Month | 0.38% | |
| 5th Month | 0.38% | |
| 6th Month | 0.38% | |
| 7th Month | 0.25% | |
| 8th Month | 0.20% | |
| 9th Month | 0.15% | |
| 10th Month | 0.10% | |
| 11th Month | 0.08% | |
| 12th Month | 0.05% | |

| Three Hills Mine Reagent Consumption | Amount | Source Documents |
|---|---|---|
| 3HM NaCN Consumption | 0.45 lb/ton | 2015-03-19 - KCA - 3HM - 48in Column Test - Report 0140082-THB03-02<br>2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| 3HM Cement Consumption | nil | N/A |
| 3HM Lime Consumption | 4 lb/ton | 2015-03-19 - KCA - 3HM - 48in Column Test - Report 0140082-THB03-02 |

## HASBROUCK MINE

| Hasbrouck Mine - Upper Siebert Gold Recovery | Recovery | Source Documents |
|---|---|---|
| ANV 3/8" Recovery (Columns) | 47.6% | 2012-03-14 - MLI - HBM - Heap Leach and Milling - Report 3465<br>2012-03-08 - MLI - HBM - Heap Leach and Milling - Report 3536<br>2016-08-16c - HC Osborne - HBP - 2016 PFS Metallurgical Factors.xlxs |
| HPGR Adjustment Factor (Columns) | 10.0% | 2015-03-05 - KCA - HBM - HPGR Test #1 - Bulk Sample - Report KCA0140117 HSB07 01<br>2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Operational Adjustment Factor | -2.0% | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| **Operational Recovery** | **55.6%** | |
| **Drain-Down Recovery** | **1.50%** | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Leach Time to Operational Recovery | 115 days | 2012-03-14 - MLI - HBM - Heap Leach and Milling - Report 3465<br>2012-03-08 - MLI - HBM - Heap Leach and Milling - Report 3536 |
| Leach Recovery Schedule:- | | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Month Placed | 0% | |
| 1st Month | 0% | |
| 2nd Month | 39.6% | |
| 3rd Month | 9.0% | |
| 4th Month | 4% | |
| 5th Month | 2% | |
| 6th Month | 1% | |
| 7th Month | 0% | |
| Drain-Down Recovery Schedule | | (See Hasbrouck Weighted Average Gold Recovery below) |

| Hasbrouck Mine - Lower Siebert Gold Recovery | Recovery | Source Documents |
|---|---|---|
| ANV 3/8" Recovery (Columns) | 70.2% | 2012-03-14 - MLI - HBM - Heap Leach and Milling - Report 3465<br>2012-03-08 - MLI - HBM - Heap Leach and Milling - Report 3536<br>2016-08-22a- HC Osborne - HBP - 2016 PFS Metallurgical Factors.xlxs |
| HPGR Adjustment Factor (BRs) | 6.4% | 2015-04-01 - KCA - HBM - HPGR Test #2 - Core Sample - Report KCA0140171-HSB12-01<br>2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Columns vs. BR Adjustment Factor | 2.0% | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Operational Adjustment Factor | -2.0% | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| **Operational Recovery** | **76.6%** | 2016-08-16c - HC Osborne - HBP - 2016 PFS Metallurgical Factors.xlxs<br>2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| **Drain-Down Recovery** | **1.5%** | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Leach Time to Operational Recovery | 115 days | 2012-03-14 - MLI - HBM - Heap Leach and Milling - Report 3465<br>2012-03-08 - MLI - HBM - Heap Leach and Milling - Report 3536 |
| Leach Recovery Schedule:- | | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Month Placed | 0.0% | |
| 1st Month | 0.0% | |
| 2nd Month | 57.0% | |
| 3rd Month | 11.0% | |
| 4th Month | 4.0% | |
| 5th Month | 3.0% | |
| 6th Month | 1.0% | |
| 7th Month | 0.6% | |
| Drain-Down Recovery Schedule | | (See Hasbrouck Weighted Average Gold Recovery below) |

| Hasbrouck Mine Weighted Average Gold Recovery | Weighted Recovery | Source Documents |
|---|---|---|
| Upper Siebert % of Reserve | 19.3% | 2016-08-11-MDA-HBP-Sched_v7_Econ_v3 |
| Upper Siebert Recovery of Reserve | 10.7% | |
| Lower Siebert % of Reserve | 80.7% | 2016-08-11-MDA-HBP-Sched_v7_Econ_v3 |
| Lower Siebert Recovery of Reserve | 61.8% | |
| **Weighted Average Recovery** | **72.6%** | |
| **Drain-Down Recovery** | **1.5%** | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Leach Time to Operational Recovery | 115 days | 2012-03-14 - MLI - HBM - Heap Leach and Milling - Report 3465<br>2012-03-08 - MLI - HBM - Heap Leach and Milling - Report 3536 |
| Drain-Down Recovery Schedule:- | | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| 1st Month | 0.015% | |
| 2nd Month | 0.015% | |
| 3rd Month | 0.030% | |
| 4th Month | 0.045% | |
| 5th Month | 0.060% | |
| 6th Month | 0.075% | |
| 7th Month | 0.090% | |
| 8th Month | 0.090% | |
| 9th Month | 0.090% | |
| 10th Month | 0.090% | |
| 11th Month | 0.075% | |
| 12th Month | 0.075% | |
| 13th Month | 0.075% | |
| 14th Month | 0.075% | |
| 15th Month | 0.075% | |
| 16th Month | 0.075% | |
| 17th Month | 0.075% | |
| 18th Month | 0.075% | |
| 19th Month | 0.075% | |
| 20th Month | 0.075% | |
| 21st Month | 0.060% | |
| 22nd Month | 0.045% | |
| 23rd Month | 0.030% | |
| 24th Month | 0.015% | |

| Hasbrouck Mine Silver Recovery | Recovery | Source Documents |
|---|---|---|
| ANV 3/8" crush work | 13% | 2012-03-14 - MLI - HBM - Heap Leach and Milling - Report 3465<br>2012-03-08 - MLI - HBM - Heap Leach and Milling - Report 3536 |
| Operational Adjustment Factor | -2% | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| **Operational Recovery** | **11%** | |
| **Drain-Down Recovery** | **0%** | |
| Leach time to Operational Recovery | 115 days | 2012-03-14 - MLI - HBM - Heap Leach and Milling - Report 3465<br>2012-03-08 - MLI - HBM - Heap Leach and Milling - Report 3536 |
| Leach Recovery Schedule:- | | 2016-08-23 - H.C. Osborne - Technical Memo - Hasbrouck Project Metallurgy |
| Month Placed | 0% | |
| 1st Month | 0% | |
| 2nd Month | 7% | |
| 3rd Month | 2% | |
| 4th Month | 1% | |
| 5th Month | 1% | |
| 6th Month | 0% | |
| 7th Month | 0% | |

*Note: 3HM = Three Hills Mine; HBM = Hasbrouck Mine; Source Documents are internal WKM electronic files.*

## Table 13.21 Hasbrouck and Three Hills Predicted Reagent Consumptions

| Hasbrouck Mine Reagent Consumption | Amount | Source Documents |
|---|---|---|
| HBM NaCN Consumption | 0.75 lb/ton | 2015-04-01 - KCA - HBM - HPGR Recovery Test - Core Sample - Report KCA0140171-HSB12-01 |
| HBM Cement Consumption | 5 lb/ton | 2015-01-15 - MLI - HBM - Agglomeration of 0.375in Core - Report 3948<br>2015-03-09 - KCA - HBM - HPGR Comp Perm Test - Bulk Sample - Report KCA0140171 HSB11 01 |
| HBM Lime Consumption | nil | N/A |

# 14.0 MINERAL RESOURCES

## 14.1 Introduction

This section is taken from Tietz et al. (2015). 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 WKM by the definitions and criteria set forth in NI 43-101; there is no affiliation between Mr. Tietz and WKM 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™ 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 WKM. These data were incorporated into a digital database using State Plane coordinates, Nevada West zone, NAD83 datum, expressed in US Survey feet.

WKM 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 were 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)

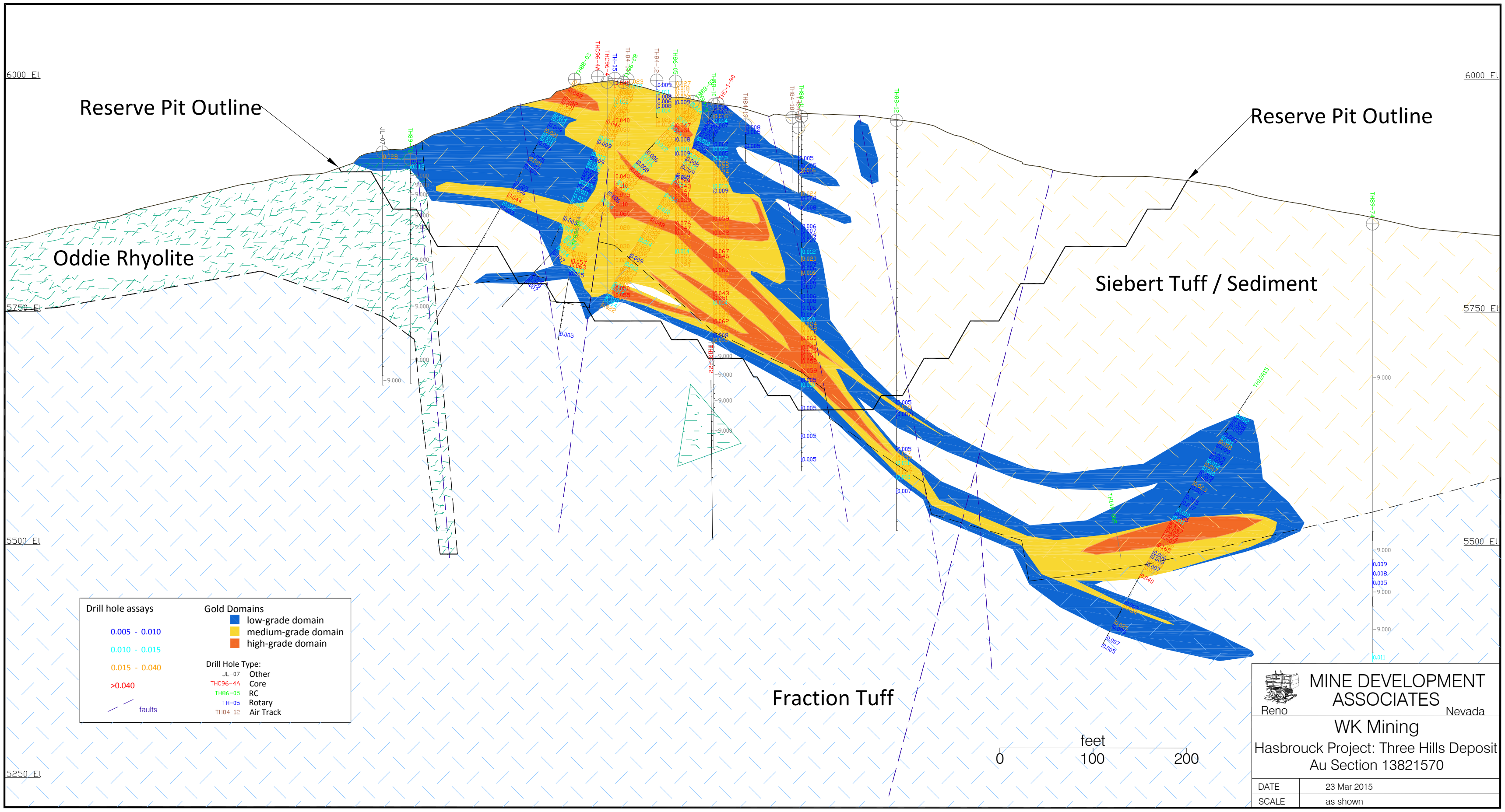
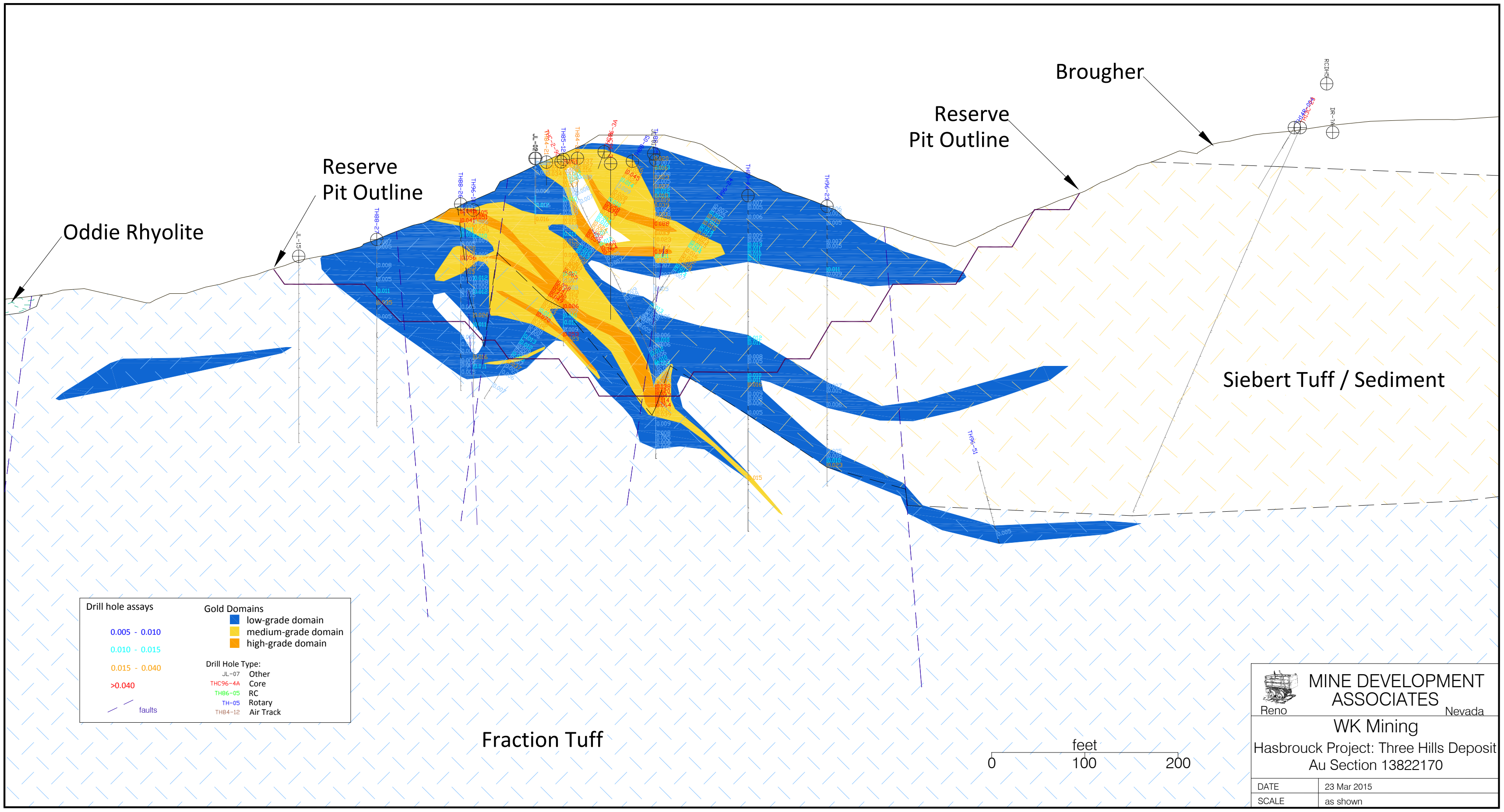


**Figure 14.2 Three Hills Section 13822170 Showing Geology and Gold Mineral Domains, Looking North**
(location of Section shown in Figure 7.8)



### 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 |

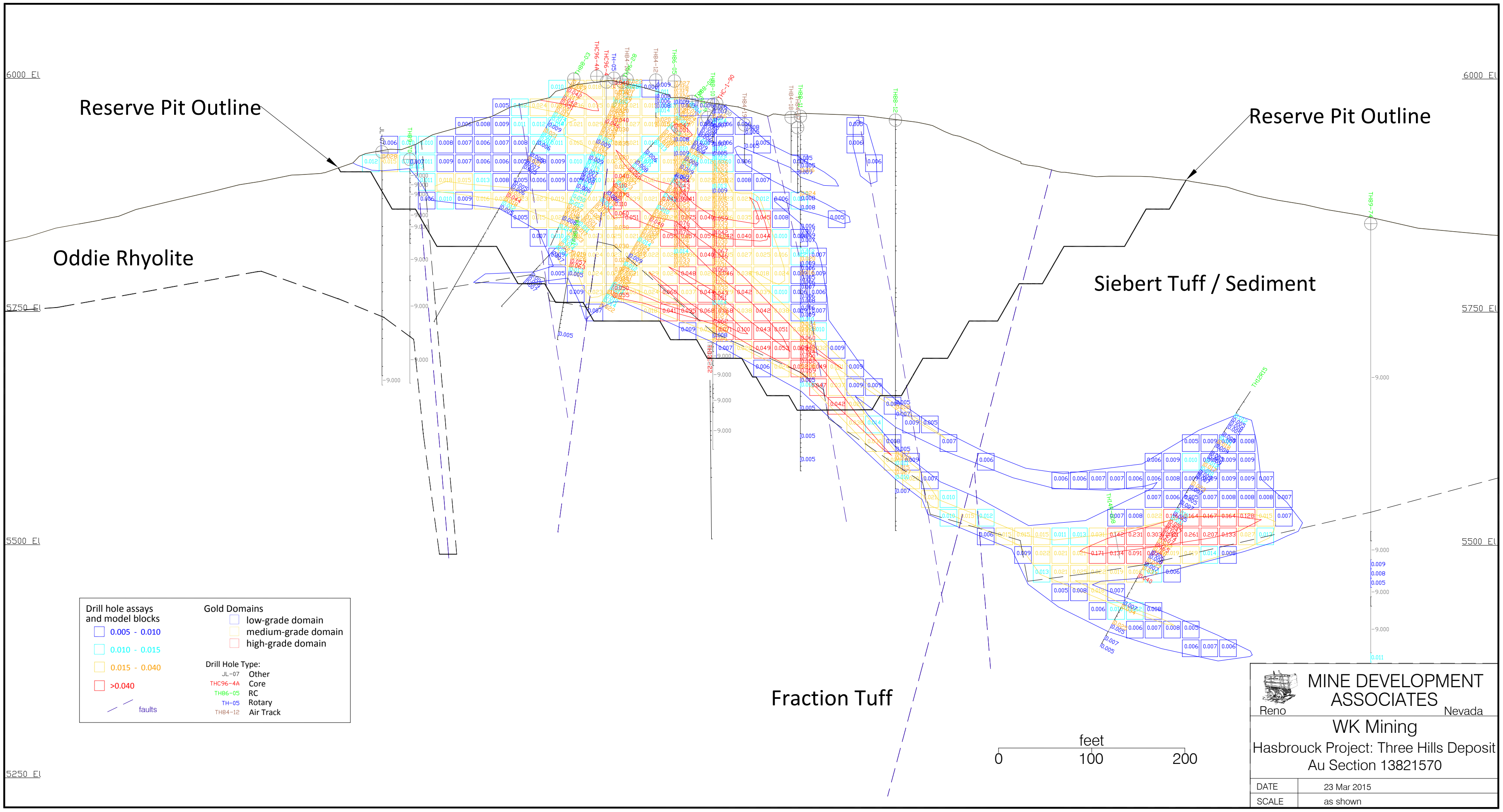
Note: rounding may cause apparent inconsistencies

## Table 14.8 Three Hills Mineral Resources

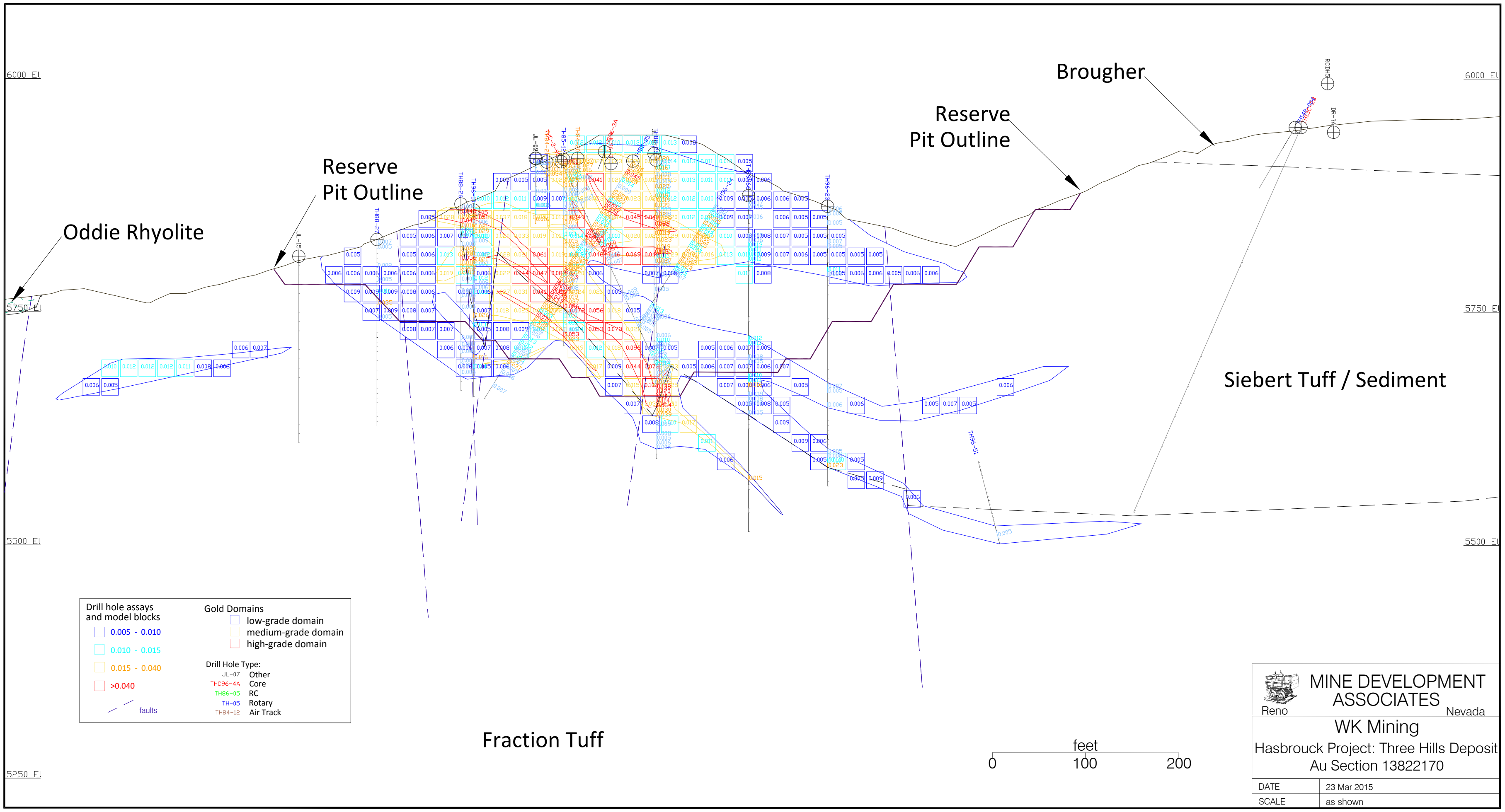
| Cutoff | Indicated Resource | | |
|---|---|---|---|
| (oz Au/ton) | Tons | oz Au/ton | oz Au |
| 0.004 | 11,593,000 | 0.017 | 192,000 |
| ***0.005*** | ***10,897,000*** | ***0.017*** | ***189,000*** |
| 0.006 | 10,034,000 | 0.018 | 185,000 |
| 0.007 | 9,098,000 | 0.020 | 179,000 |
| 0.008 | 8,157,000 | 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 WKM 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™ 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 WKM. These data were incorporated into a digital database using State Plane coordinates, Nevada West zone, NAD83 datum, expressed in US Survey feet.

WKM drilled 14 RC exploration holes located south, southeast, and north of the current resource model in 2014. These drill data were 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.

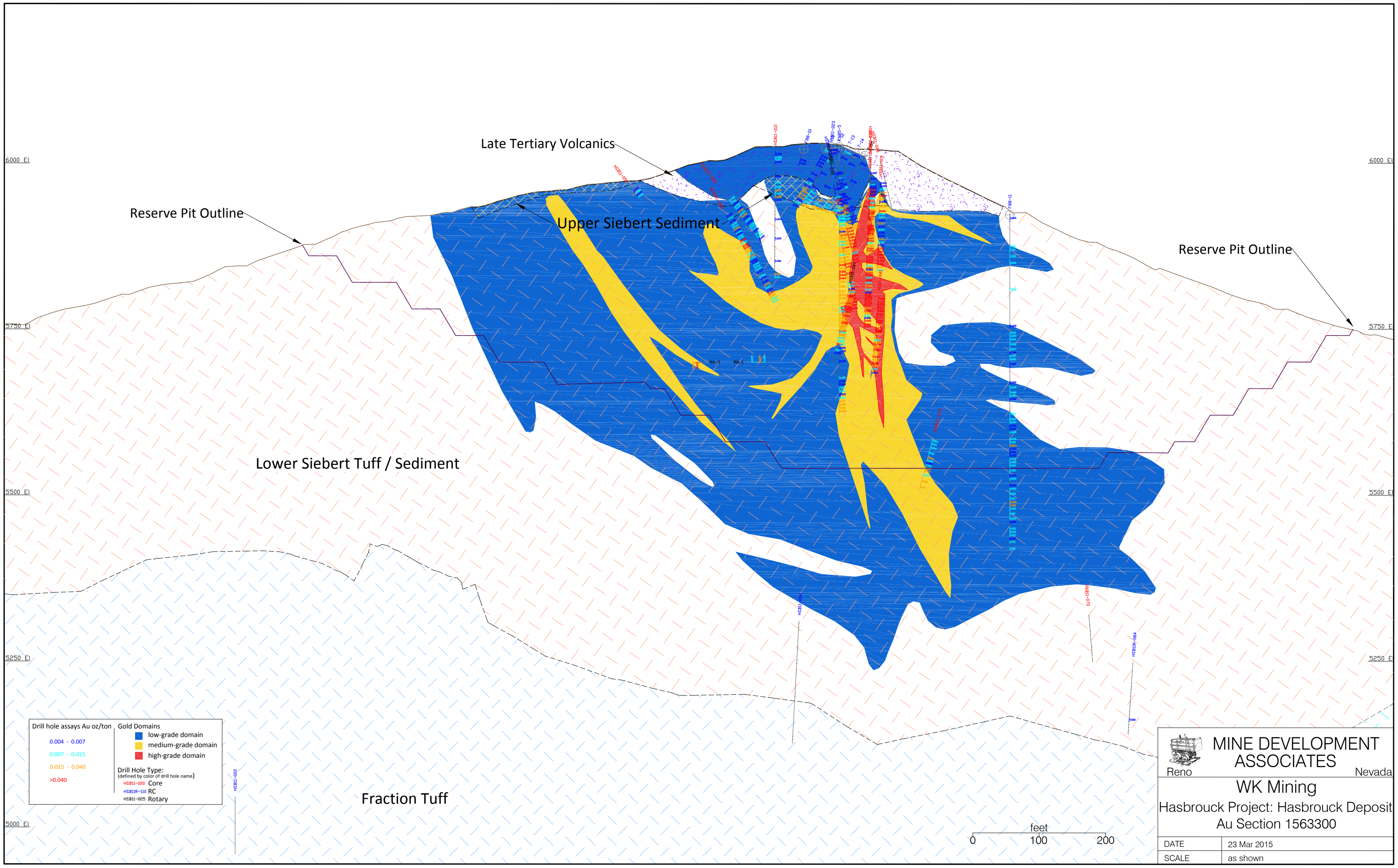
In a general sense, medium-grade zones of mineralization (gold domain 200) typically are associated with moderate to strong pervasively silicified Siebert Formation, often containing thin silica veinlets. The silicified Siebert occurs wallrock to the high-grade mineralization (gold domain 300) which 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.

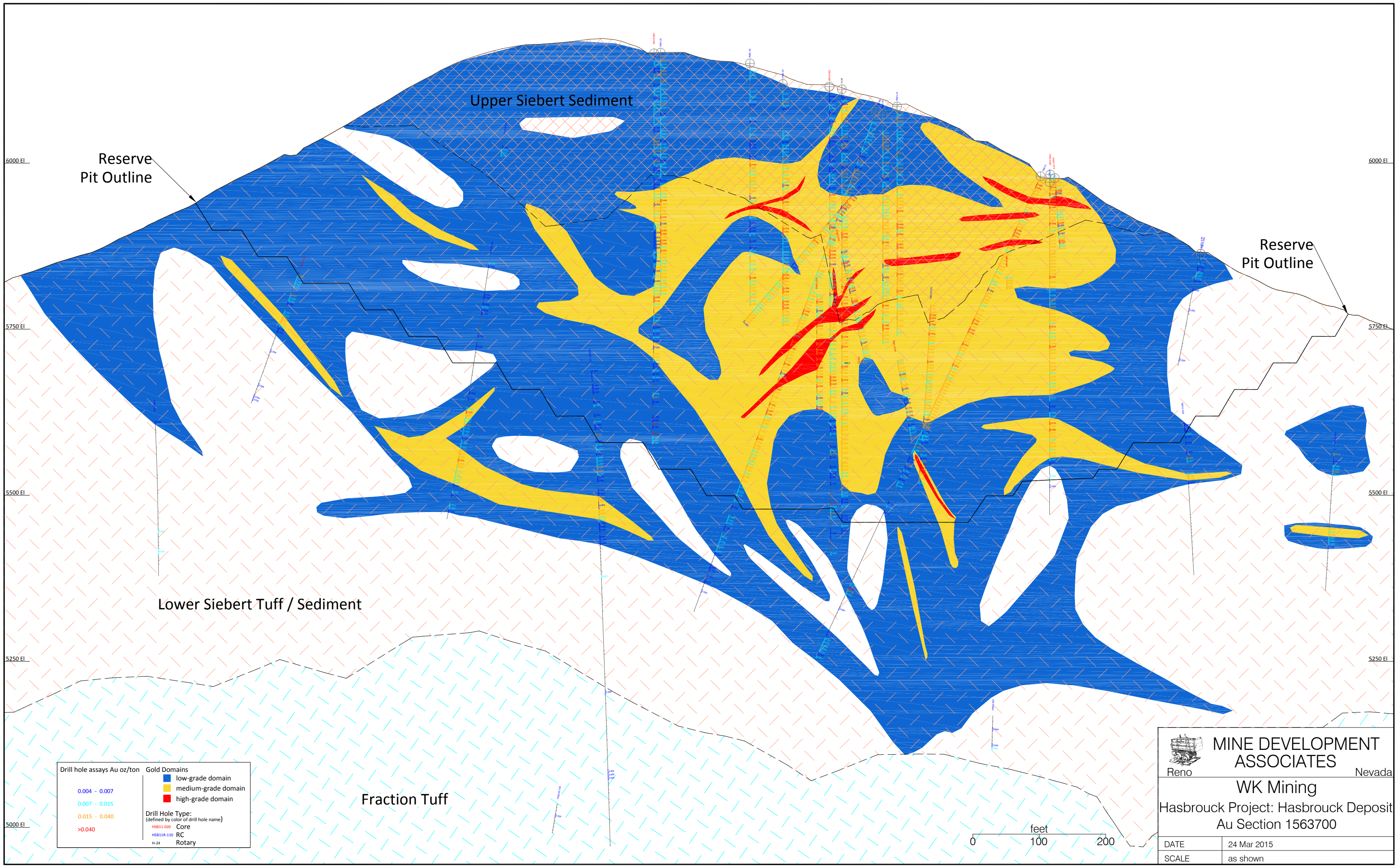
Representative cross sections showing gold mineral-domain interpretations are presented in Figure 14.5 and Figure 14.6.

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**

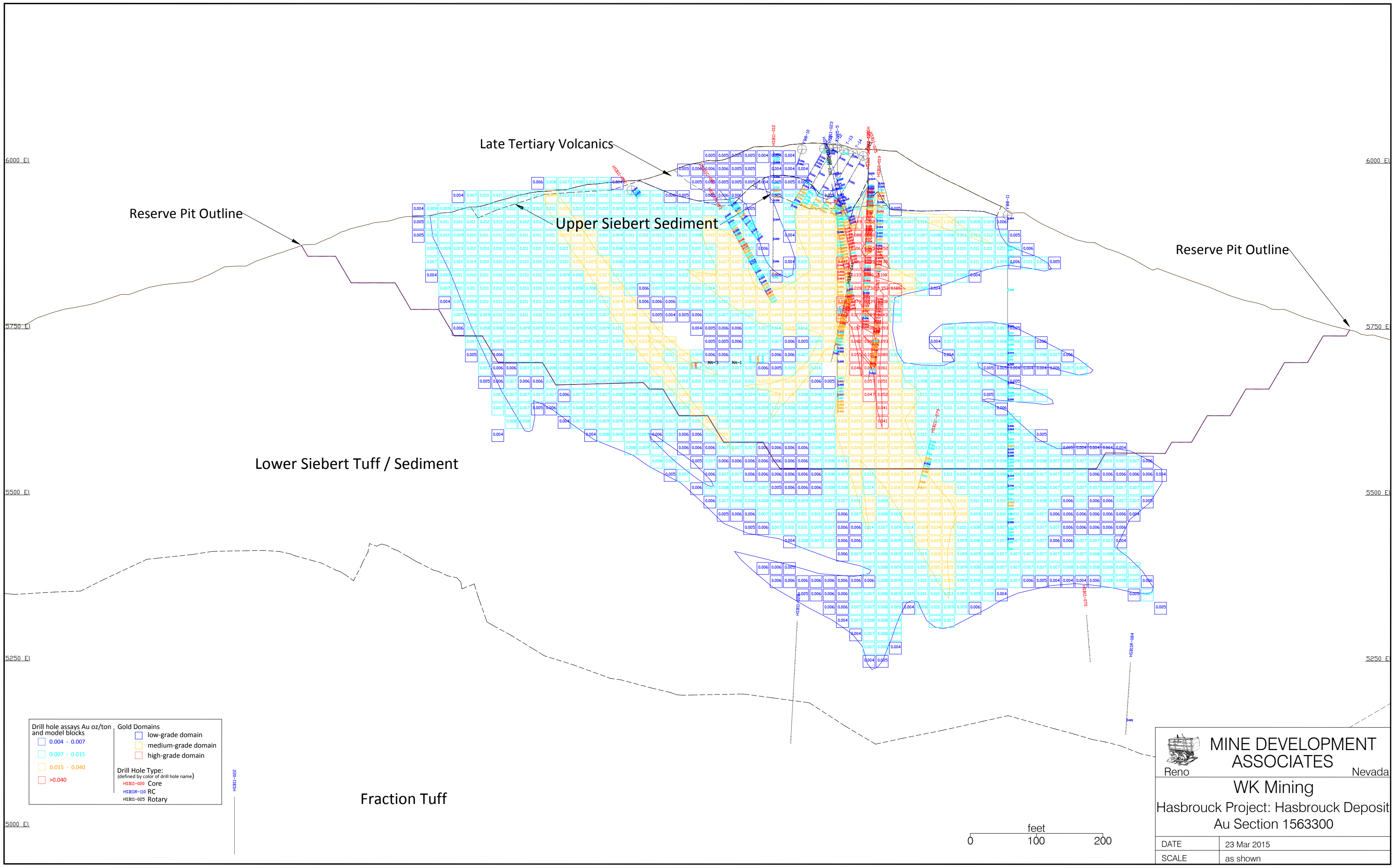
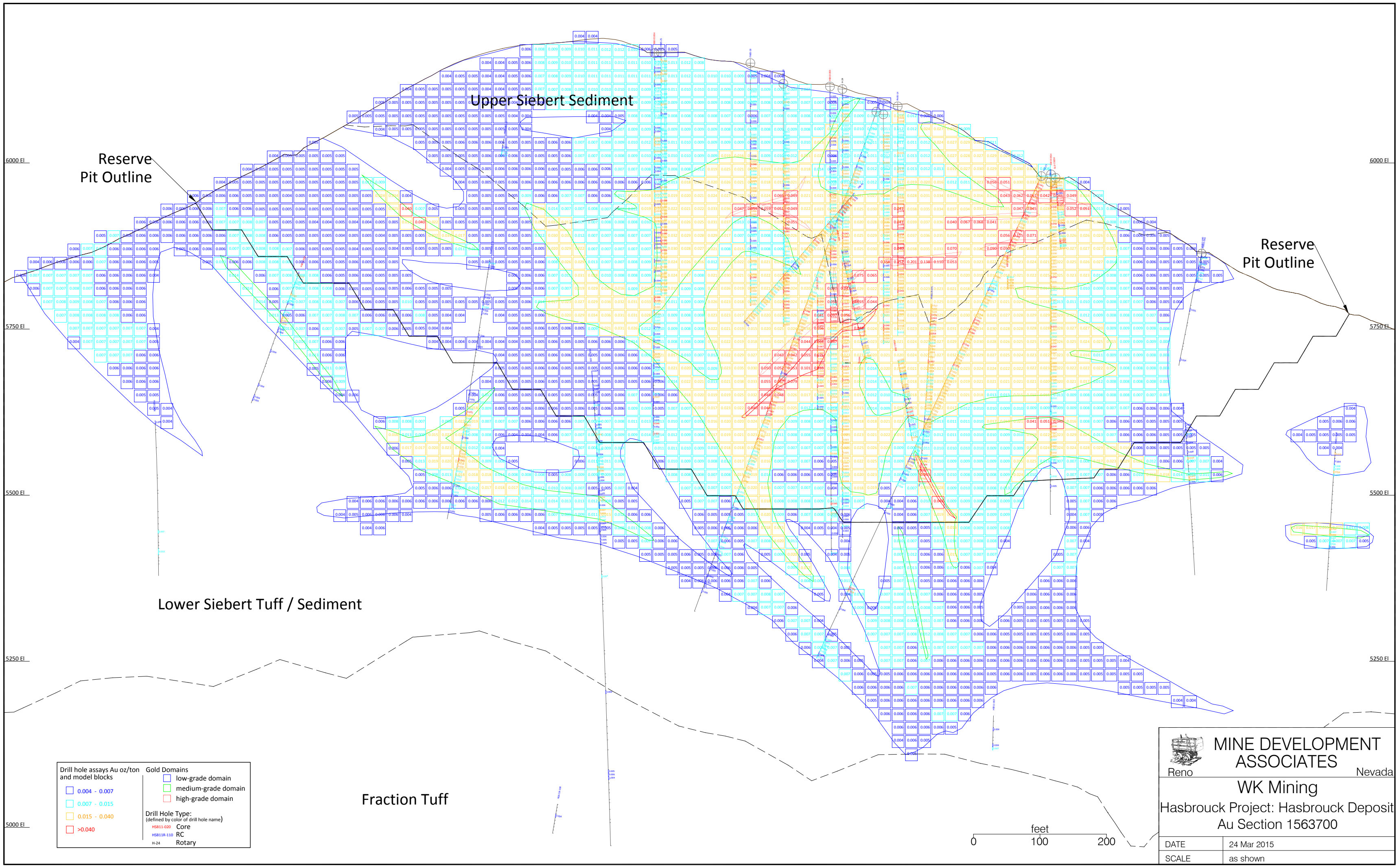


**Figure 14.8 Hasbrouck Deposit Section 1563700 Showing Block Model Gold Grades, Looking West**



### 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 WKM 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. MDA then considered mining, processing, metallurgical, infrastructure, economic, marketing, legal, environmental, social and governmental factors for defining the estimated reserves.

Three Hills has been designed using five pit phases in order to detail construction needs. The ultimate Three Hills pit design was expanded outside of the optimized pit shell to include additional Brougher Rhyolite which will be used for construction (see Section 16.5).

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 for the 2015 PFS using Geovia's Whittle (version 4.5.2) software and has not been updated for this study. The optimization used economic and geometrical parameters to define the ultimate pit for both deposits. The economic and geometrical parameters from 2015 remain relevant for this study. 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 ore will be processed using ROM leaching.

Yearly general and administrative costs ("G&A") have been estimated by MDA with input from WKM 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.

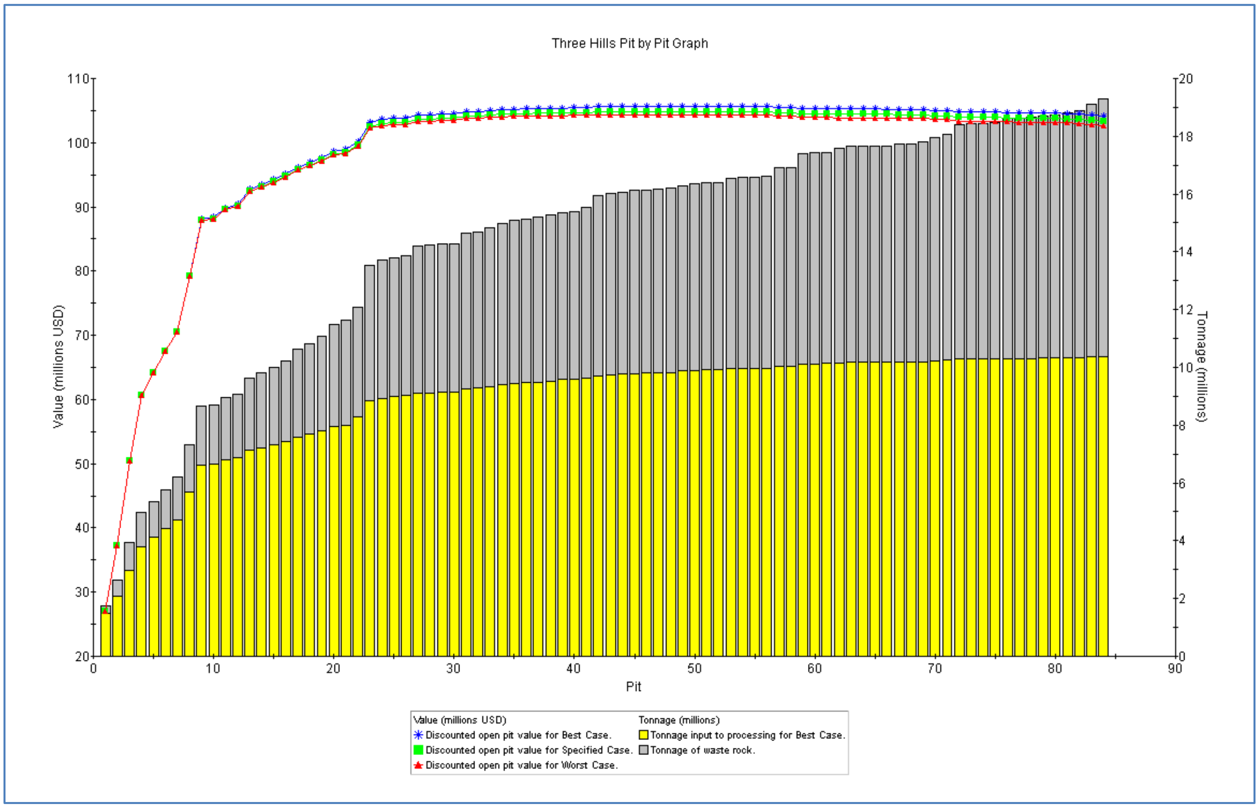
**Table 15.6 Three Hills Pit Optimization Results**

| | | 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

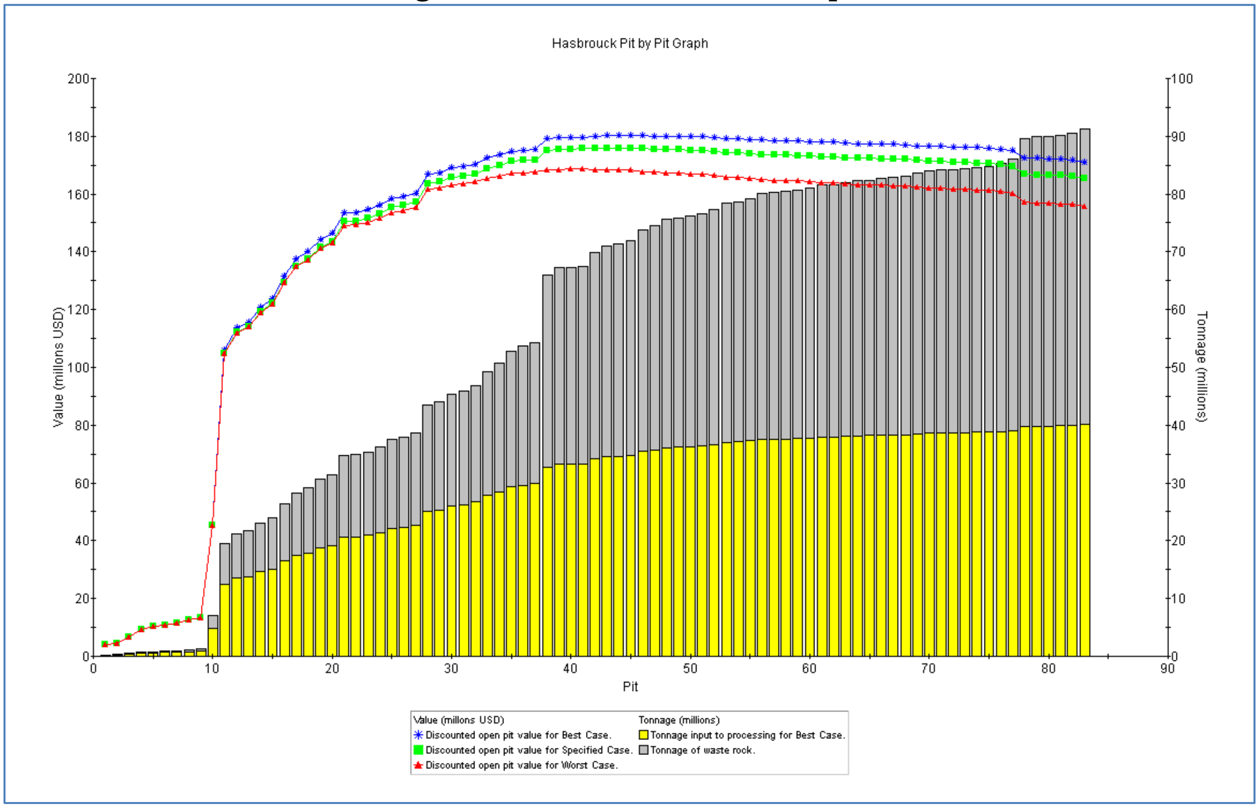
**Table 15.8 Hasbrouck Pit Optimization Results**

| | | 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 ultimate pit design was completed 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 Haul Roads

Haul 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 1,400ft 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

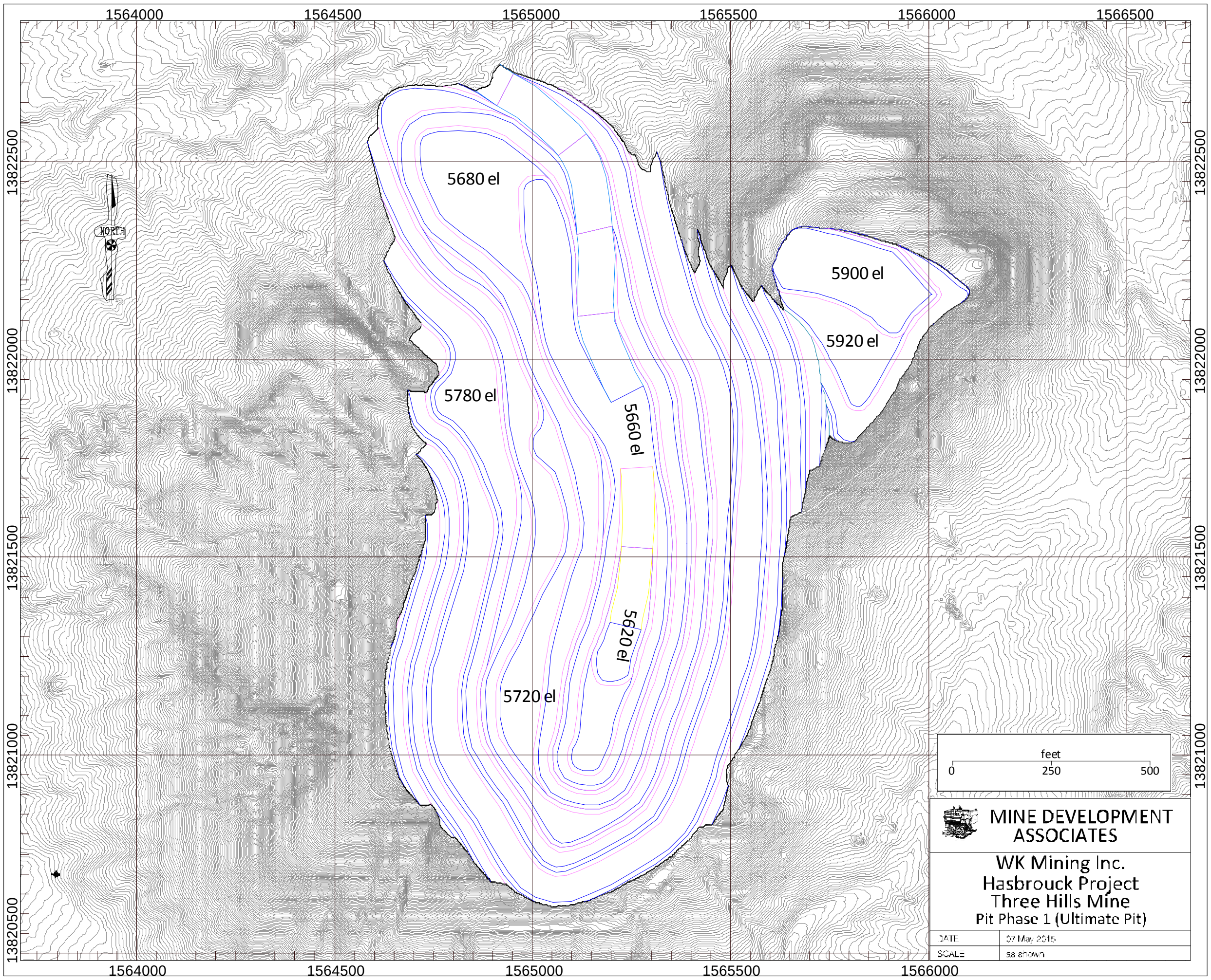
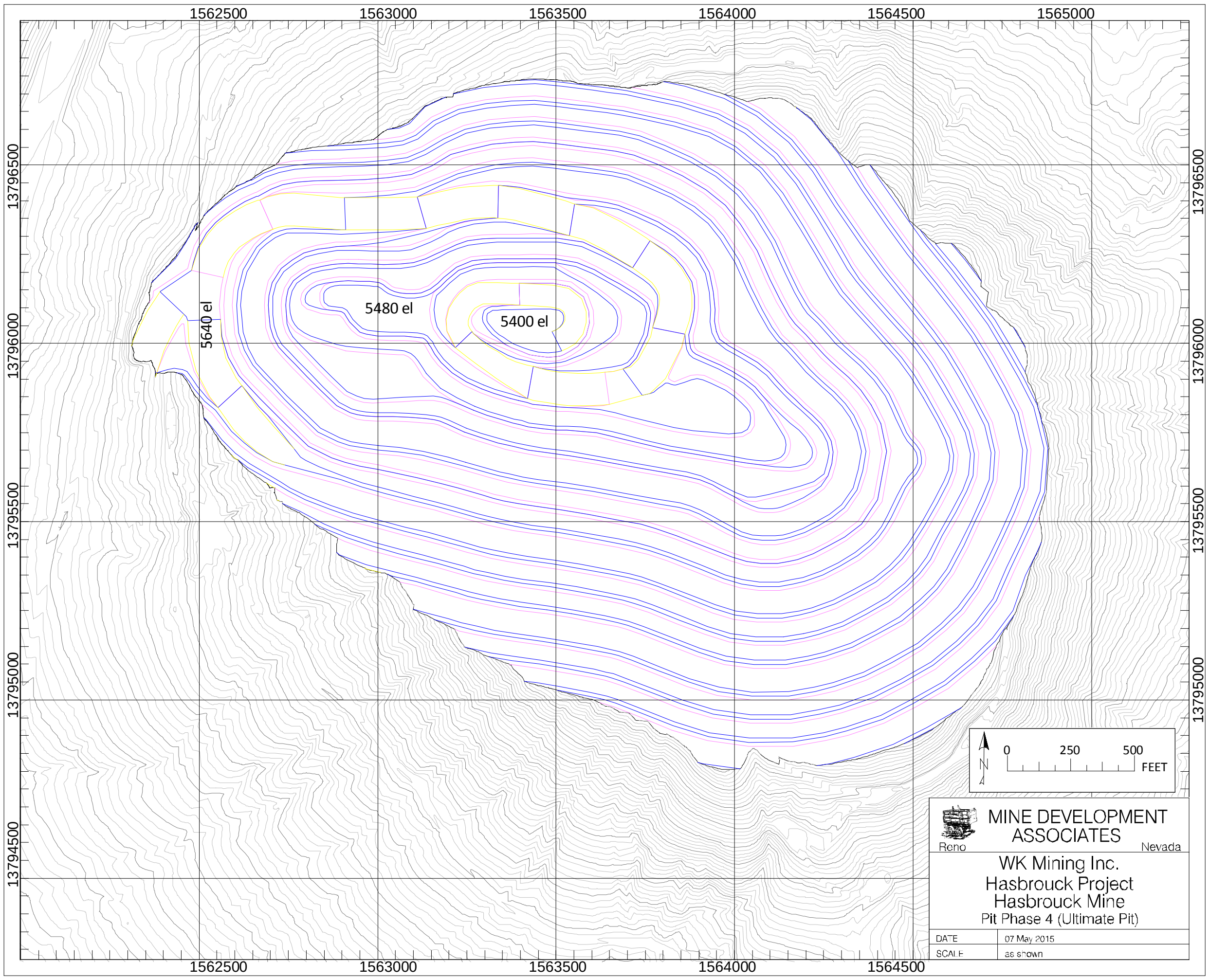


**Figure 15.4 Hasbrouck Ultimate Pit Design (Phase 4)**




### 15.3.5 Pit Phasing

The Three Hills pit was divided into 5 phases in order to sequence the mining of construction materials followed by ore. The pit phases are shown in Figure 15.5 and are described as follows:

- Phase 1: Consists primarily of Brougher Rhyolite to be used for leach-pad over-liner material and some access road material. Phase 1 does not contain any ore as defined and is mined solely to provide construction material.

- Phase 2: This contains a mixture of Brougher Rhyolite and Siebert waste material to be used for access roads and fill around the leach pad, ponds, and roads. Phase 2 does not contain any ore, and is also used only to provide construction material.

- Phase 3: Mines ore and waste from the top of the southern hill down to the 5,880ft elevation.