STATUS OF THE SOUTH AFRICAN SMALL AND JUNIOR DIAMOND MINING SECTOR

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The Small and Junior diamond mining industry, which is dominated by alluvial diamond miners, and a few remaining small kimberlite operations, produced a high proportion of diamonds in South Africa in the late 1950s and early 1960s, prior to the discovery and development of major kimberlite mines such as Finsch and Venetia, in the 1970’s and 80’s. Subsequent to these discoveries the Small and Junior sector remained an active and important participant in the local diamond industry, particularly in respect of the highly sought after top-quality gemstone diamonds produced from the extensive alluvial deposits of South Africa. Since 2004 the sector has shown a strong decline. This report highlights the challenges faced by the Small and Junior diamond miners and makes recommendations for the revival of this sector.
IN SUMMARY

In terms of the overall diamond mining and production scenario in South Africa, in 2005 total diamond production for South Africa reported in the official Kimberley Process (KP) records amounted to about 15.96 million carats, whereas 2019 figures show a total of 7.18-million carats, representing a decrease of about 55%.

This decrease has been immensely negative for the economy, foreign earnings, employment, and communities in key mining provinces, especially so for areas such as Namaqualand on the West Coast of South Africa, the Northern Cape Province (NCP), including the once famous diamond centre of Kimberley, and the North West Province (NWP).

The majority of the Small and Junior diamond mining operations have always been located in the remote parts of the Northern Cape Province (NCP), including the West Coast, North West Province (NWP), with outliers in Limpopo (LP), Gauteng (GP), Free State (FSP), and Eastern Cape (ECP) Provinces. Significantly these operations provide economic benefit to these Provinces by drawing labour, supplies, and services primarily from small and remote towns and surrounding communities. Other than farming, which is becoming increasingly mechanised, the small diamond sector was, and still is, a key employer in the NCP (including the West Coast), and NWP.

A study by Farrell in 2012, which focussed mainly on land based alluvial diamond mining operations in the Northern Cape Province (particularly along the Vaal and Orange Rivers), noted the sharp decline (over 50%) in Small and Junior diamond miners following promulgation and implementation of new mineral legislation in 2004.

This latest study of the Small and Junior diamond mining sector was initiated in late-2018 to update the previous study, ascertain the current health and status of this sector, and given its overall importance in terms of providing economic benefits and employment in remote and depressed regions of the country, and production of exceptional gemstone diamonds, identify key drivers for its ongoing contraction and provide recommendations to revive the sector.

Key results
The outcomes to this study are summarised in the figure below right and once again reaffirm the decline in the number of small diamond mining operations since 2004. Notably these latest results highlight the urgent need for the revision of mineral and mining policy and regulations to support and stimulate the Small and Junior mining sector for the benefit of South Africa, and thereby reverse the strong contraction in the number of active operations, and employment numbers since 2000.

Study objectives
The study set out to review the Small and Junior Diamond Sector in detail, and in the process identify and document the key reasons for the on-going decline of the industry. Consequently, the key building blocks of this study involved the following:

• Interviews conducted according to a carefully structured questionnaire to document data, information, and responses during interviews with owners, management, and operators
• Construction of a comprehensive Database of Small and Junior Mining Operations for all positively identified, and visited alluvial and small kimberlite diamond operations
• Supplementation of the information gathered during site visits with public domain information for private and listed diamond companies
• Surveys via small aircraft to gather information from more remote and isolated areas
• Analysis and interpretation of the data obtained and compiled
• Completion of a Report on the Status of the industry with recommendations for its revival
• Subsequent regular update of this database.

IN SUMMARY

<Figure: Status of Small and Junior Diamond Mining Operations 2004-2020>
Sector challenges

Questionnaires were constructed to interview and collect key information at the operations visited from the persons responsible for the ownership, management, or supervision of the sites visited and thereby gather factual information on the challenges, health and outlook of the industry. A total of 62 on-site interviews were conducted, with supplementary information gathered from other sources including industry experts. The results collected as consequence of the site visits and completion of the questionnaires are summarised below.

In respect of the results from the questionnaires and interviews, the key concerns expressed by the owners and operators were:

1. The safety and security of their mining operations
2. Lengthy waiting periods for licence applications to be processed and granted
3. General inefficiency of the DMRE offices
4. Unreliable and increasingly expensive Eskom electricity supply
5. Finding and retaining skilled labour
6. Labour costs given poor education, and skills sets.

The above 6 concerns were flagged by 86%, 83%, 69%, 64%, 62% and 52% of the owners and operators interviewed in the NWP, Vaal River (NWP and NCP), MOR (NCP), LOR (NCP), and West Coast respectively. These responses, and additional concerns raised by industry drivers are presented and elaborated on in Table 6 of the comprehensive document that follows.

Recommendations

Based on the interviews with Small and Junior diamond mining operators, and supporting information gathered, the key factors impacting the profitability and future existence of the alluvial diamond mining industry were reviewed and analysed. A series of recommendations, which are listed in the table opposite, set out the interventions and requirements needed to revive and rebuild a sustainable business model for this sector.

Every effort should be made by the key stakeholders, particularly Government policy makers, the Department of Minerals and Energy, the Small and Junior mining sector, the South African Diamond Producers Organisation (SADPO), and other stakeholders and role-players to introduce modernised fit for purpose enabling mineral policies and regulations to revive this key sector.

The great majority of the Small diamond mining operations are in remote and economically depressed areas of the Northern Cape Province (NCP), including the West Coast, and North West Province (NWP). The Junior diamond mining business in South Africa draws employment mainly from small towns and surrounding communities in these areas, and other than farming which has become highly mechanised, the Small and Junior sector is a key employer in these regions.

Notes: cph - carats per hundred tonnes, NWP - North West Province, NCP - Northern Cape Province

### RECOMMENDATIONS

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</table>
| **Construct a ‘Fit for Purpose’ Artisanal, Small, and Junior (ASM) Mining Charter Policy and Regulations**  
*Local/Regional Charters to reflect small-scale nature of operations* | Ensure that a Standard Template is used and applied consistently at all DMRE offices across the country and at HO  
The Draft ASM Mining Policy 2021 recently published by the DMRE is a positive development |
| **Develop Enabling and Effective Mineral Policies and Interventions**  
*To Formulate (legal) (Zama Zama) Mining and Revitalise the Small-scale Diamond Mining Sector* | Implement modern regulations, including Operational Codes of Practices, Environmental Practices, Water Licence requirements, to reflect small-scale needs  
*Small-scale business users, SMMEs, and entrepreneurs* |
| **One-stop shop**  
Create a functional and professional One-Stop Shop to harmonise processes and requirements of different departments | This has been promised in the past by various Ministers but never implemented |
| **Unlock value from vast low-grade alluvial deposits that occur in the NWP and NCP** | Implement modern regulations, including Operational Codes of Practices, Environmental Practices, Water Licence requirements, to reflect small-scale needs  
*Small-scale business users, SMMEs, and entrepreneurs* |
| **Implement a Tick-box application procedure, process** | Ensure new entrants and HSSEAs are able to acquire rights quickly  
Create certainty, transparency, and long-term tenure for investment; for example, the internationally recognised Spatial Dimension/Timber/Carbon system and Leaf Cape (bush product) should become the new South African standard |
| **Provide Financial Support for Emerging Miners** | These procedures are typically short term - 16 – 36 months  
*Small-scale and small businesses* |
| **Implement a Small Miners Loan Legacy Policy** | Borrowers can apply for financial support or an accommodation of existing debt  
*Afeed to a fund to be contributed by the following:*  
• **Small Miners Development Fund**  
Professionally managed and administered fund to provide financial support to Small and Junior miners  
Drove transformation and Black ownership |
| **Unlock value from vast low-grade alluvial deposits that occur in the NWP and NCP** | Implement modern regulations, including Operational Codes of Practices, Environmental Practices, Water Licence requirements, to reflect small-scale needs  
*Small-scale business users, SMMEs, and entrepreneurs* |
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History of the industry

South Africa has been one of the leading producers of many of the world’s high demand minerals over the past 150 years, and diamonds are no exception. The discovery of the first diamond in 1866 or 1867, on the banks of the Orange River in the Northern Cape, represented the catalyst that ignited the modern mining evolution of Southern Africa. Today South Africa is the fifth largest supplier of natural diamonds in the world in terms of carats.

Diamonds were discovered in South Africa in late 1866 or early 1867 (de Wit et al., 2016), and the first diamond rush in the country took place along the banks of the Orange and then Vaal Rivers in 1869, in what is today the Northern Cape Province. Initial discoveries were of alluvial diamonds, and then in 1871 kimberlites (Dutroptas and Builtonfonte pipes) were discovered that lead to the development of the famous town of Kimberley (Davenport, 2013). From 1872 until the First World War South Africa produced more than 97% of the world’s diamonds, and became the home of the modern diamond industry (Wilson et al., 2007).

The country dominated world diamond supply producing more than 50% of global production until the early 1930’s, at the time of the Great Depression. Though no longer the dominant producer and supplier, South Africa continues to be a significant producer of high-quality gemstones (including rare coloured stones and exceptionally pure Type II D-flawless stones mostly found in kimberlite mines in Lesotho and along the Middle Orange River). It is this unique attribute which is a key focus of this report.

Of the estimated 4.5 billion carats of diamonds that have been produced globally, South Africa is estimated to have produced about 10%. South Africa is furthermore the only country in the world where diamonds are produced from large (world class) and small kimberlite pipes, blows (the roots of pipes), dykes (fissures), as well as from eluvial, alluvial, and marine sediments. The west coast of South Africa and Namibia is host to the only known megaplacer deposit recognised in the world.

South Africa is furthermore the only country in the world where diamonds are produced from large (world class) and small kimberlite pipes, blows (the roots of pipes), dykes (fissures), as well as from eluvial, alluvial, and marine sediments. The following statistics provide brief insight into the South African diamond industry and its performance since 2005:

In 2005 production of diamonds in carats and estimated splits were as follows:

- primary (kimberlite) – 14.5 million carats (90.8% of total)
- alluvial – 1.4 million carats (8.8% of total)
- marine deposits – 0.06 million carats (0.4% of total)
- Total: 15.96 million carats (revenue – US$1.32 billion; $84.78 per carat)

In 2018 the production was as follows with estimated splits as follows:

- kimberlites – 9.25 million carats
  (De Beers: 4.90m carats; Petra: 4.35m carats)
- other small kimberlites – 0.04 million carats
- alluvial deposits – 0.36 million carats
- marine deposits – 0.25 million carats
- Total: 9.91 million carats (revenue – US$1.32 billion; $84.78 per carat)

In 2019 the production was as follows with estimated splits below:

- kimberlites – 6.73 million carats
- land based alluvials – 0.30 million carats
- marine alluvials – 0.16 million carats
- Total: 7.18 million carats (revenue – US$873 million; at $122 per carat)

The above-mentioned statics indicate a strong and steady decline in South Africa’s diamond production, with consequent negative impacts for the economy, foreign earnings, employment, and communities in key mining provinces and areas, especially along the West Coast of South Africa. This should not be the case as the dispersal of diamonds from their primary sources (kimberlites) into streams and rivers, and ultimately to the sea (West Coast), is generally accompanied by an increase in average value per carat because flawed stones are progressively destroyed with greater transport distance (Gurney et al, 1991).
Definition of Artisanal, Small and Junior diamond mining operations

In the literature, there is a wide range of definitions to describe a Junior Miner, none of which can be accurately applied to alluvial diamond mining. Based on the data collected for this study, the following definitions are applied:

- **Artisanal miner**
- Small-scale miner
- **Junior miner**

The highest number of employees per company found during this study was 105 in the Middle Orange River (MOR) area. In respect of these various groupings and number of employees, the recent draft policy Discussion Document on Artisanal and Small-Scale Mining Policy 2021 issued by the Department of Mineral Resources and Energy (DMRE) on 6th May 2021 provides further information in respect of the activities and employees within these categories. It is useful and a good start in trying to hopefully set out a process that may lead to the formalisation of this sector, including the currently extensive and destructive informal or illegal (Zama Zama) miners. 

Classification and models of diamond deposits

Diamond deposits can be classified as either primary (kimberlites) or secondary (alluvial). Marine alluvial deposits are typically ancient beach deposits which have either been raised above the modern day mean seal level (msl), or beach deposits which are below msl and also referred to as drowned beaches.

Classic examples of each exist in South Africa (De Wit et al., 2016): Small wind-ablation deposits are known in Namibia but are absent south of the Orange River. Kimberlites are the primary source and host of diamonds, and represent ancient volcanic features or volcanoes that were intruded from great depth. These volcanic features or volcanoes that host of diamonds, and represent ancient intrusions may be represented by crater features where the original surface of the intrusions are preserved, diatremes or pipes, or small blows or surface of the intrusions are preserved, diatremes or pipes, or small blows or by wind, water in rivers and marine environments, and glacial processes. Figure 2 shows the distribution of land and marine alluvial deposits in Southern Africa. The diamonds found in alluvial deposits have been eroded from the host rock Kimberlite, and subsequently spread out over large parts of southern Africa by wind, water in rivers and marine environments, and glacial processes. Figure 2 shows the distribution of land and marine alluvial deposits in Southern Africa. The nature of diamondiferous alluvial gravel deposits is such that the diamonds do not occur evenly spread throughout the deposit. Diamonds are heavy minerals and are concentrated by water action in very specific areas or ‘trap sites’, thus the ‘nugget effect’. Cruel mining methods and the small scales of operation used in the past, often limited small miners to these high-grade areas. The ‘picking of the eyes’ of these deposits have for a long time made the remainder of the deposits less or unprofitable to mine. The proportion of gem quality diamonds found in alluvial and especially in the West Coast marine deposits is over 90 percent (Gumey, Levinson, and Smith 1991). The percentage of gem quality diamonds in kimberlites is highly variable. Harben and Nötstaller (1991) quoted figures of 40% for the Kimberley Mines and 55% for the Premier Mine.

Importantly there are still very significant reserves of alluvial diamond deposits available for mining in South Africa, possibly for another 100 years (see Table 9). These remaining deposits produce exceptional quality gemstone diamonds, typically with ROM average prices in excess of $400 per carat (see Table 8, and Figure 15) but are characterised by very low or ultra-low grade in terms of carats per hundred tonnes (cpht). Convincing investors to invest in alluvial diamond deposits has always been difficult. The main reasons for this is the low grade and the ‘nugget effect’ of these deposits, the difficulty of determining the profitability and predicting the grade and the low success rate achieved by companies who have attempted to mine these deposits.
Project objectives

The key focus of this study will be to undertake a comprehensive review and investigations of the Small and Junior diamond mining sector to establish the status and health of this immensely important industry.

As noted above South Africa is fortunate to host a multitude of large and small kimberlite pipes, fissures, blowouts, and extensive alluvial deposits. A significant proportion of these diamond deposits have in the past been successfully exploited hence creating and supporting:

- Large and small business opportunities
- Economic growth
- Employment opportunities for skilled and unskilled workers, and communities
- Diamond marketing and sales
- A local cutting and polishing industry to drive beneficiation
- Other upstream and downstream industries such as plant and equipment manufacture, and technology development.

Importantly most of the small diamond deposits and mining operations, which are the subject of this study, are located in remote areas of the economically depressed and challenged NWR, NCR western FSR, and West Coast (Namaqualand) of South Africa. Employment and economic activity related to the Small diamond sector has in the past been crucial for many small towns in these provinces by way of job creation and benefits for communities.

A study by Farrell (2012), which is dealt with in more detail in Section 1.5, showed that with the review of the Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA) in 2004, the Junior diamond sector had shown a strong decline. This trend has continued until recently, and many small and medium sized operators have left the business due to several reasons. This includes policy uncertainty, lack of investment, rising costs, and the unintended consequences of the MPRDA legislation. Unfortunately, very little additional information is available as publications like The Operating Mines and Quarries of South Africa that used to be published by the Mineral Economics Department of the DMRE, are no longer available, and have not been published by the DMRE since 2015 and 2016.

This study has set out to review the Small and Junior diamond industry in detail, and in the process identify and document the key reasons for the on-going decline of the industry. Consequently, the key building blocks of this study involved the following:

- Literature reviews to pinpoint Junior diamond mining areas and operations
- Interaction with DMRE offices and personnel in the Kimberley and Klerksdorp offices to access non-sensitive data for Junior mining licences and permits issued in South Africa
- Site visits to as many Small and Junior diamond mining operations as possible
- Interviews conducted according to a carefully structured questionnaire to document data, information, and responses during interviews with owners, management, and operators
- Construction of a comprehensive database of Junior Mining Operations for all positively identified, and visited Small and Junior diamond operations
- Supplementing of the information gathered during site visits with public domain information for private and listed diamond companies
- Surveys via small aircraft to gather information from more remote and isolated areas
- Analysis and interpretation of the data obtained and compiled
- Completion of a Report of the Status of the industry with recommendations for its revival
- Subsequent regular update of this database

Finally, based on the facts gathered, the key factors impacting the profitability and future existence of the alluvial diamond mining and small kimberlite mine industry were analysed, and recommendations made on what is required to revive and build a sustainable business model for the future are presented later in this report.

This study has set out to review the Small and Junior diamond industry in detail, and in the process identify and document the key reasons for the on-going decline of the industry.

Farrell 2012 study highlighted the following:

- A flourishing Junior alluvial diamond mining industry existed in South Africa before the implementation of the MPRDA in 2004
- There was a sharp decline from 2004 which was further exacerbated by the downfall of global economic markets in the Global Financial Crash during 2008/2009
- Subsequently disjointed and ineffective current legislation and regulations (MPRDA) and proposed legislation (MPRDAA) and red-tape have continued to impact negatively on the fragile Small mining industry.
- The key conclusion from Farrell’s study was that the MPRDA which replaced the South African Minerals Act, Act 50 of 1991:
  - Did not make adequate provision for the needs of the Small and Junior mining sector, and that the existence of this specific mining sector was mainly affected by economic factors and inadequate mineral policy
  - Threatened the existence of the alluvial diamond mining industry in South Africa.

The objectives of the study by Farrell (2012) were to examine the concept of sustainable development, its origin and relevance to the MPRDA and the Mineral and Petroleum Resources Development Amendment Act, Act 49 of 2008 (MPRDA), and the overall importance of the Small diamond mining sector for the Northern Cape Province in respect of jobs, employment, and economic activities.

The factors and impacts which led to the downsizing of the alluvial diamond mining industry were examined in detail. The impacts were further evaluated against the intention of sustainable development which is promoted through the Constitution of South Africa, the MPRDA, and the National Environmental Management Act, Act 107 of 1998 (NEMA).
Figure 3 below illustrates the decline of the Small and Junior diamond industry (comprising predominantly alluvial operations) over time, and how the industry was clearly affected by the implementation of the MPRDA. Importantly, the work, research, and results from Farrell were focussed primarily on the Northern Cape Province (NCP) land-based small scale, with some small overlap into the North West Province (NWP) and Free State Province (FSP) during the period 2000 to 2012.

No direct work and information collection was for example done for the West Coast Small and Junior diamond mining operations. Within this context (ie. focus on land-based operations in the NCP) the results of this latest study were collected across the complete geographic spread from the West Coast to Limpopo Province (LP), and for a range of Small and Junior diamond mining operations (alluvials and kimberlites). Results from this latest study effectively show that the decline in the industry is even more severe than the study by Farrell (2012) indicated.

These latest results once again reaffirm the stark decline of the Small and Junior diamond miners and contraction of employment numbers (jobs) in this important sector.

Subsequent to the work by Farrell (2012), the results of this recent AEON study and outcomes for the period 2019-2020 have been added to Figure 3 with a fourth column dated 2020 reflecting the latest number of operators and project employment numbers.

These latest results reaffirm the stark decline of the Small and Junior diamond miners and contraction of employment numbers (jobs) in this important sector.

FIGURE 3: Diagram indicating the decline of the primarily self-funded Small and Junior diamond mining sector (primarily alluvial diamond operators) since the implementation of the MPRDA in 2004 (Sources: This study, Farrell, 2012, SADPO; Global Diamond Network)

Importance of the Small and Junior diamond sector

Diamond production from ‘Diggers’ and small operations typically working on ‘Claims’ supported many small communities subsequent to the discovery of diamonds on the Orange River in 1866, and in the early 1900’s.

Interestingly in 1871, it is estimated that approximately 5 000 people were living near diggings operating along the Vaal River adjacent to Klipdrift, known today as Barkley West (Ilabe, 1872).

The Small and Junior diamond mining industry, which is dominated by alluvial diamond miners, and a few remaining small kimberlite operations, produced a high proportion of diamonds in South Africa in the late 1950s and early 1960s prior to the discovery of major kimberlite mines such as Finsch Mine and Venetia (De Wit, 2016).

The great majority of the Small and Junior diamond mining operations are in remote and economically depressed areas of the Northern Cape Province (NCP), including the West Coast, and North West Province (NWP). This sector draws employment mainly from small towns and surrounding communities in these areas, and other than farming, which is becoming increasingly mechanised, the small diamond sector is a key employer in these regions.

As noted in Figure 3 opposite, the Small and Junior diamond sector has shown a strong contraction in the number of active operations, and employment numbers since 2000. There is a critical need to reverse this situation.

The following sections, tables, figures, and annexures provide a thorough review of this important sector and industry, highlighting its problems and challenges, and provides recommendations to revive the Small and Junior diamond mining sector.
**PROJECT STUDY AND DATA-COLLECTION**

**Methodology and area coverage**

This research project was initiated in June 2018 during a visit to a NCP and NWP, and implemented fully in January 2019 with a review and acceptance of the proposal that was submitted to the African Earth Observation Network (AEON) at Nelson Mandela University (NMU) by the author of this report in late 2018.

Thereafter, and with the support of the South African Diamond Producers Organisation (SADPO) based out of Kimberley and a number of experienced geologists, field trips were undertaken to as many small diamond mining operations as possible. Working visits were also undertaken to the Department of Minerals and Energy (DMRE) offices in Kimberley (NCP) and Klerksdorp (NWP), the intention being to collect geospatial information of issued diamond permits, prospect, and mining licences. Further information was collected from remote areas by light-aircraft overflights, and additional data was sourced from literature searches.

The project was initiated in earnest in early 2019, with a visit in January 2019 to DMRE offices in Kimberley which lasted a month. The outcome of this visit was the collection of a total of 869 licences (78 Mining Rights, 655 Mining Permits and 136 Prospecting Rights) issued between 2005 and 2019. In June 2019 the North West DMRE offices (located in Klerksdorp) were visited. This latter visit lasted for two weeks and yielded the collection of a total of 270 licences (56 Mining Rights, 655 Mining Permits and 149 Prospecting Rights).

Following visits to provincial DMRE offices, 72 operations were visited in person to collect information of spatial, financial, operational and geological information. During these site visits a total of 62 interviews were conducted with owners, contractors, and operators about the status and challenges faced by the Small and Junior diamond miners and operators, also known as the Small Diamond Mining Industry (SDMI). The information was collected using questionnaires for inland alluvial deposits, and conducting interviews with the manager or person in charge of the operation.

**Site visits and interviews**

The research project aimed to survey and collect information on the Small and Junior diamond producers, represented by either owner operators holding prospecting rights, mining rights or 5ha mining permits, or represented by contract operators.

**TABLE 1** below provides a summary of the field trips undertaken during this study. This includes visits to operations, basic geological examinations, and conducting interviews with the manager or person in charge of the operation.

<table>
<thead>
<tr>
<th>DATE</th>
<th>PROVINCE, AREA, TOWNS</th>
<th>OWNER/OPERATOR</th>
<th>SITES VISITED</th>
<th>COMMENTS</th>
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<td>19 June</td>
<td>NCP, Kimberley area</td>
<td>Te Beers</td>
<td>Big Hole Diamond Museum</td>
<td>Review history of the diamond mining industry of South Africa and the world</td>
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<td>NCP, Kimberley area</td>
<td>Illegal Miners (Zama Zamas)</td>
<td>Kaalkloof Floors and Settlement</td>
<td>Small-scale illegal mining operations visit with journalist</td>
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<td>20 June</td>
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<td>Off Mining, Vaal River east of Vaal River</td>
<td>Vaal River alluvial deposits</td>
<td>Pre-interview visit</td>
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<td>The Island, Vaal River</td>
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<td>21 June</td>
<td>NWP, Bloemhof Area, Eerndingbult</td>
<td>Dawie van Niekerk</td>
<td>Shallow alluvial deposits covered by red sand</td>
<td>Health and Safety Consultant from Kimberley outlined the many challenges and unnecessary costs faced by small diamond miners</td>
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<td>Various Operations</td>
<td>Lower Vaal River</td>
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<tr>
<td>5 August</td>
<td>NWP, Masibulantsho/Phalaborwa area, Kimberley</td>
<td>Graham and Johan</td>
<td>Various Operations</td>
<td>Extensive 3D modeling deposits across dolomites, includes large scale 3D deposits</td>
</tr>
<tr>
<td>6 August</td>
<td>NWP, Fort Beaufort, Klerksdorp</td>
<td>Various Operations</td>
<td>Lower Vaal River</td>
<td>Extensive 3D modeling deposits across dolomites, includes large scale 3D deposits</td>
</tr>
<tr>
<td>12 August</td>
<td>NWP, Longlands</td>
<td>Various Operations</td>
<td>Various Operations</td>
<td>Various Operations</td>
</tr>
<tr>
<td>13 August</td>
<td>NWP, Longlands</td>
<td>Various Operations</td>
<td>Various Operations</td>
<td>Various Operations</td>
</tr>
<tr>
<td>25 August</td>
<td>NWP, Longlands</td>
<td>Various Operations</td>
<td>Various Operations</td>
<td>Various Operations</td>
</tr>
<tr>
<td>27 August</td>
<td>NWP, Longlands</td>
<td>Various Operations</td>
<td>Various Operations</td>
<td>Various Operations</td>
</tr>
</tbody>
</table>

**2020**

January | Write-up of information, fact checking, verification and collection of information from additional sources |
February | Interaction with emerging black small miners attempting to apply for 5ha mining permits in the Bakerville (NWP) and Longlands (NCP) areas, and provision of advice and assistance to some of the parties |
March to December | The Covid-19 pandemic which impacted the entire globe and which has been devastating for the world diamond industry negatively impacted the final parts of the project and its timely completion due to lockdown requirements, inability to travel, and related challenges. The sad death of the head of AEON at NMU, and promoter of this study also had an impact on the study |

**2021**

Jan-Feb | Monitoring and support where possible to 5ha mining permit applicants |
Mar-May | Updating, compilation, editing, and final write-up of this study |

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Zama Zamas operating on the Kimberley Floors
Structure of questionnaires

Data for this report was collected using questionnaires with open ended questions. There were two different questionnaires: one for inland deposits and the other for marine deposits in the West Coast of South Africa.

The questionnaires included questions pertaining to locality of the mined deposit, general financial details of the mine (e.g. capital value of the business), challenges that are faced by diggers and most importantly, the impact that the industry has on surrounding communities in terms of employment.

These questionnaires were completed during personal interviews on site, off site, or emailed to the relevant people. Personal interviews that were conducted on site allowed the opportunity to observe and photograph the geology, mode of operation, and situational challenges at various operations. The photographs were used to support the main information that was gathered during the interviews.

Inland Alluvial Mining Operations

The Inland Alluvial Deposit Questionnaire was developed to be completed by Junior miners operating in the Northwest and Northern Cape provinces of South Africa. In order to measure the size of mining operations questions relating to the amount of diamond bearing gravel or ore an operation moves (e.g. stripping ratio and gravel cut-off size), diesel consumption and number of employees were asked. Financial questions relating to business investment and were also asked. These questions helped with measuring the commitment of the diggers to the community and the business.

West Coast Alluvial Operations

The West Coast Deposit Questionnaire was developed to be completed by divers (diamond miners in the West Coast) operating in the West Coast Alluvial gravel deposits. These deposits are also mostly found in the Northern Cape province of South Africa and the border with Namibia. The main difference between the Inland Alluvial Deposit Questionnaire and the Alluvial Deposit Questionnaire is that the in the West Coast Alluvial Deposit Questionnaire the question about salary spend was asked in terms of diamond sale percentage because divers do not sell their diamonds themselves and do not normally have continuously employed labour.

These questionnaires were completed during personal interviews on site, off site, or emailed to the relevant people.

Information from additional sources

To ensure that as much information could be gathered on the Small and Junior diamond sector within the time and budget constraints of the project, additional information was sourced from a series of small aircraft over flights of more remote and less accessible areas of the NCP, NWP, and FSP.

Information was also gathered by working visits to DMRE offices, and there was important and useful interaction with a wide range of experienced diamond experts at different University departments and in private practice.

Overflights of Remote Areas

During the course of this study important additional regional information was obtained from generally more remote area by means of four flights in light aircraft. This ensured considerable cost and time saving, and provided information that may otherwise not have been obtained. The flight dates and areas flown are summarised in Table 2.

<table>
<thead>
<tr>
<th>DATE</th>
<th>PROVINCE</th>
<th>AREA</th>
<th>SITES</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1</td>
<td>Northern Cape (March 2019)</td>
<td>Middle-Orange River (MOR) – Hopetown, Douglas, Pixieka, Marydale, Schmidltief on return leg</td>
<td>11</td>
<td>This flight highlighted the vast remaining extent of alluvial gravel on the sections of the MSR that were unflown</td>
</tr>
</tbody>
</table>
| #2  | Northern Cape (North West, September 2019) | Schutskameka, Vaal River northwards to Christiana | 32 | As noted above, this flight again highlighted remaining areas alluvial gravel along the Riet River, though large parts of the deposits in the Schutskameka area are drill
| #3  | North West (September 2019) | Christiana, Schweitzer Rynies, Makwassie (traversed on a grid pattern) | 28 | Extensive areas of interfluve gravel/rook/rookies remain to be drained and mined following new interpretations and a revised geological model for this region |
| #4  | Aerial Survey (18 October 2019) | Makwassie Spruit to Bornkloof (Old pattern) | 24 | Gravel deposits in the traditional 'Spruit' areas are largely mined-out. Few areas remain, and many of the unsluice and tailings should be reprocessed with new technology |

Working Visits to DMRE Offices (Kimberley and Klerksdorp)

During January and May of 2019, several weeks were spent in the Kimberley and DMRE offices in Kimberley and Klerksdorp respectively working with department officials to gather mineral rights information related to Small and Junior mining permits, prospecting and mining rights off the South African Mineral Resources Administration System (SAMRAD). According to the DMRE Website this system should allow the general public to view the locality of applications, rights and permits made or held in terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002) (The MPRDA), and where applications in terms thereof can be submitted electronically. Although the exercise was generally informative, and department officials were most helpful, and a large amount of information was accessed over the period of several weeks, the system was slow and difficult to use, and at the end of day the nature of the data and information reviewed was not particularly beneficial to this project. Further discussion in this respect is provided in Chapter 5.

DMRE Publication

Previously the Directorate of Mineral Economics of the Department of Minerals (DMR) published annual reports that related to mining (large, mid-sized and small) and quarrying activities being conducted throughout the Republic of South Africa. (see for example DMR 2013, 2015 a and b, and 2016 references). However, in investigation it was found that the annual DMR reports compiled by the Minerals Economics Directorate ceased to be published after the last versions referenced above. Given the ‘dated nature of these past publications, information contained therein was of little use to the current study.

Summary

The two previous sections of this work and report that were initiated in earnest in early 2019 provide background to the planning and activities pursued.

It is noted that the visits to the DMRE offices in Kimberley (January 2019) and DMRE offices in Klerksdorp (June 2019) to collect possible information that would assist and add value to this study were not particularly useful. Consequently, the information and data collection activities were somewhat revised to ensure maximum possible coverage by actual on the ground visits, supplemented by over-flights of more remote areas.

In the subsequent sections of the report the setting and geology of the kimberlite and alluvial deposits are covered, the data and information collected is interpreted and analysed, and observations, recommendations, and conclusions are presented.

To add value to this study it will be important that the database created and used in this study is updated, and added to on a regular basis in the future.
KIMBERLITE AND ALLUVIAL DEPOSITS

Kimberlites or primary deposits
Kimberlites have been defined by Clement et al. (1984) as a volatile-rich, potassic, ultrabasic igneous rock which occurs as small volcanic pipes, dykes and sills. It has an inorganic texture resulting from the presence of macrocrysts (phenocrysts and xenocrysts) set in a fine-grained matrix. The mineralogy comprises olivine with several of the following: phlogopite, calcite, serpentine, diopside, monticellite, apatite, perovskite and ilmenite.

Kimberlite commonly contains well-rounded fragments (xenoliths) of upper-mantle-derived ultramafic rocks, such as peridotite and eclogite, and xenocrysts such as pyrope garnet, picro-ilmenite, chrome spinel and chrome diopside. Kimberlite may contain diamond, diopside, picro-ilmenite, chrome spinel and chrome diopside such as pyrope garnet, picro-ilmenite, chrome spinel and chrome diopside. Kimberlite may contain diamond, but only as a very rare constituent. Kimberlite commonly contains well-rounded fragments (xenoliths) of upper-mantle-derived ultramafic rocks, such as peridotite and eclogite, and xenocrysts such as pyrope garnet, picro-ilmenite, chrome spinel and chrome diopside. Kimberlite may contain diamond, but only as a very rare constituent. More details and description of these rocks, including their typical settings, diamond characteristics, and the unusual (non-kimberlitic) occurrences of some diamonds can be found in the following publications: Bristow (1985), Field et al. (2008), Komproob (1974), Levinton et al. (1992), Mitchell (1991), Orlov (1973), Pearson and Nixon (1996), Scott (1990), and Skinner (1984), Shilo et al. (1978), Slodkiewicz (1983), and Sobolev and Shatsky (1990).

Over 850 kimberlite occurrences are known in South Africa, but only about 50 carry quantities or grades of diamonds that can be measured by diligent sampling (approximately 5%) (Vorster, 2003). Of these 50 occurrences, many are considered sub-economic either because the quantity or quality of diamonds, or the quantity of ore is insufficient for sustainable long term economic mining (Figure 4).

Table 3 below provides a brief summary of the large (or world class) diamond mines that have provided the bulk of South Africa’s diamond production since the discovery of the famous Kimberley mines in 1869, and small kimberlites diamond producers that have over the years sustained small scale economic production, often intermittently, and other small kimberlites which were sampled with the objective of developing small mines but have never supported sustainable exploitation.

Table 3: Summary of Southern African large and small kimberlite diamond mines.

<table>
<thead>
<tr>
<th>RSA - LARGE WORLD CLASS KIMBERLITE MINES</th>
<th>OWNER/PROVINCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venetia (operational)</td>
<td>DeBeers; Limpopo Province</td>
</tr>
<tr>
<td>Cullinan (operational)</td>
<td>Petra Diamonds; Gauteng Province</td>
</tr>
<tr>
<td>DuToitspan/Baltfontein (open-pit, operational)</td>
<td>Ekapa Mining; NCP</td>
</tr>
<tr>
<td>Messina (operational)</td>
<td>Ekapa Mining; NCP</td>
</tr>
<tr>
<td>Kimberley mine</td>
<td>Mixed-out and closed; NCP</td>
</tr>
<tr>
<td>Kimberley mines tailings retreatment operations (active operations)</td>
<td>Ekapa Mining; NCP</td>
</tr>
<tr>
<td>Finsch (operational)</td>
<td>Petra Diamonds; NCP</td>
</tr>
<tr>
<td>Koffiefontein (operational)</td>
<td>Petra Diamonds; FSP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RSA - small kimberlite mines</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bellbank/Dan Carl Fissures (flooded), Frank Smith (care and maintenance, tailings retreatment ceased), Helam Fissures (flooded), Jaggarfontein (flooded, reprocessing tailings), Kareevlei West (Blue Rock Diamonds), Loxotera (care and maintenance), Marthinus Mine (closed), Newlands (closed), Roberts Victor (closed, tailings retreatment ceased - uneconomic), Samaara (Kaalvallei), Sover Fissures (mixed out/closed), Star Fissure mine (closed/flooded, plant vandalised, removed for scrap), The Oaks (mixed out), Voorspoed (care and maintenance), Venetia (operational)</td>
<td>Petra Diamonds; Gauteng Province</td>
</tr>
<tr>
<td>This group lists small kimberlite, blow, and fissure diamond mines; Includes the Marthinus pipe (0.3ha) which was an exceptionally rich (high-grade) kimberlite blow in Limpopo Province that repaid its capital development costs (Capex) in 3 days</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RSA - other small kimberlites</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Goedevonde, Kamfersdam (some past tailings retreatment), Kimberley-West, Klipspringer fissures, Koowater, Lace (flooded, in liquidation), London (Südwest), Limpopo, Montrose, National, New Els, Palmietrivier, Paardeberg-East, Preytonk, Postmasburg, Riverton Station (tailings), Sarlomar Fissures, Schuler, Thomasburg fissures (extension of Klipspringer fissures), Una Fissures, West End, Zoal-n-Zuur</td>
<td>Small kimberlites (pipes, blows, and fissures) that were bulk-sampled or mined for short periods, but were never economic on a sustainable basis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesotho diamond mines</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kao, Letseng, Letlhakane (closed, uneconomic), Mothae</td>
<td>Letseng and Mothae produce exceptional large white Type-2a diamonds</td>
</tr>
<tr>
<td>Swaziland</td>
<td>Small Group 2 kimberlite mined out by Trans Hex Group – eastern Swaziland adjacent to Mbuluzi River</td>
</tr>
</tbody>
</table>

Sources: Site visits, Company Annual Reports, Bristow pers comm., DeMelion (PhD in preparation), Scott, K. (2005), Company presentations, News Releases, Diamond Tender Houses, and small mine producers.
The presences of these 'old' diamonds in extensive Archean glomerates older than about 2 700 suggests that there may have been deep-seated Archaean kimberlite or similar intrusives that transported diamonds to the earth's surface in the Archean.

In South Africa two main types of kimberlite rocks are recognised, namely Group-I monticellite-kimberlites named after the type locality at Kimberley, and Group-II micaceous kimberlites, a typical example being the Finsch kimberlite and mine in the Northern Cape near Postmasburg. These types were previously documented by Wagner (1914):

• Group-I, or olivine-rich, monticellite-serpentine-calctite kimberlites correspond in general to the 'basaltic' kimberlites of Wagner (1914)

• Group-II, or micaceous kimberlites correspond to the 'micaceous' lamprophyric kimberlites described by Wagner (1914).

Ages of Kimberlite Intrusions in Southern Africa

Ages of kimberlite intrusions that have been dated reliably in South Africa range in age from the early-Proterozoic to Cretaceous. Diamonds showing radiation damage were also recovered from gold-bearing conglomerates in the Witwatersrand Basin. The presences of these 'old' diamonds in extensive Archean glomerates older than about 2 700 suggests that there may have been deep-seated Archaean kimberlite or similar intrusives that transported diamonds to the earth's surface in the Archean.

A summary of some of the well-known kimberlites in Southern Africa is shown in Table 4.

### Table 4: Ages of kimberlite intrusions, including diamond-bearing pipes and dykes in Southern Africa and for inferred source rocks that transported diamonds into the Witwatersrand Basin.

<table>
<thead>
<tr>
<th>Age-Peiod</th>
<th>Age-Bracket MA</th>
<th>Kimberlites</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jurassic-Cretaceous</td>
<td>240 - 80</td>
<td>Delbeers, Kimberley, Orapa, Koffriefontein, Finsch, Luson, Roberts Victor, Miersfontein, Deliwe (Zambia), Janoeng (Botswana), Letseng, Mthatha, Kao, Lohagong (Lesotho)</td>
<td>The majority of mines in southern Africa have been in this age bracket.</td>
</tr>
<tr>
<td>Late-Proterozoic</td>
<td>600 - 550</td>
<td>Venetia, The Oaks, Mooklofo, Muvoca (Zimbabwe), Martin Drift (Botswana)</td>
<td>Venetia is a world-class asset operated by DeBeers transitioning from open pit to underground mine at considerable cost.</td>
</tr>
<tr>
<td>Mid-Proterozoic</td>
<td>1 200 – 1 000</td>
<td>Cullinan, National, Schulter, Moremose, Martin Drift (Botswana)</td>
<td>The famous Cullinan diamond mine has undergone a modernisation programme to end its LDM</td>
</tr>
<tr>
<td>Early-Proterozoic</td>
<td>1 700 – 1 600</td>
<td>Xero, Elston, Rivers, White Ladies</td>
<td>Kuruman area of N Cape Province</td>
</tr>
<tr>
<td>Archean</td>
<td>&gt; 2 900</td>
<td>Diamonds recovered from Witwatersrand gold bearing conglomerates</td>
<td>These diamonds show extensive radiation damage.</td>
</tr>
</tbody>
</table>

Evaluation of Kimberlites

The very low abundance of diamonds in kimberlites (parts per million and parts per trillion) and the typical nugget effects makes it difficult to predict whether a kimberlite will carry diamonds in economic quantities without bulk sampling (Rombouts, 2003). Advances in the study of the chemistry of kimberlite indicator minerals (KIMs) from disaggregated mantle xenoliths (particularly peridotitic and ecologitic gnearts, chromites, and to some extent ilmenites) as well as micro-diamond analysis studies can provide good indications as to the potential (McClennen, 2010) of samples derived from kimberlites. For kimberlites rocks, or other primary source rocks such as lamproites, to contain diamonds, it is a requirement that the intrusion (which forms at lithospheric depths) passes through diamond-bearing mantle (diamondiferous peridotite and/ or eclogite within the lithospheric roots of cratons). Kimberlites and lamproites act effectively as passenger trains which must stop at stations to collect their passengers, in this case diamond bearing lithospheric mantle, for transport to their destination, in this case the earth’s surface.

A further important aspect regarding the existence of diamonds is that once the source rocks are sampled and assimilated in significant quantities by the kimberlite, the disaggregated diamonds must be preserved (rather than resorbed) within the kimberlite (Fikile et al., 1995), although in many cases diamonds recovered from their primary host rocks may show some signs of resorption, probably by the kimberlite magma becoming somewhat ‘oxidising’ in character, rather than reducing.

Kimberlites intrusions typically occur in clusters, often characterised by a large range in size. The Orapa cluster in north-east Botswana is a classic example of this, with over 50 known intrusive pipes, the largest, AK-1 or now famous Orapa main pipe being 1.5 X 1 km in dimensions or about 120 ha in size, whereas most of the other intrusions are much smaller, with some being no more than 1 or 2 hectares in size.

**Alluvial or secondary diamond deposits**

Major alluvial-diamond deposits, or diamond placers, develop on or adjacent to cratonic source areas where there is a favourable interplay between climate, basin dynamics, regional and local structures, and local geomorphic factors (Helgren, 1979, Lynn, 1991, Spaggiari et al. (1999). Regions where humid tropical palaeo-climatic conditions alternated with semi-arid conditions are most favoured.

Here, the deep weathering of rocks during humid periods leads to efficient liberation of weathering-resistant minerals (such as diamond), and the stripping of the deep regolith during semi-arid phases leads to the transportation of the released diamonds (De Wit, 1995).

Changes in the base level of a river basin produce alternating periods of local sediment erosion (degradation) and deposition (aggradation), which are conducive to the local concentration of diamonds (Adams et al., 1978). These changes also lead to the development of terraces, as the river cuts downwards to equilibrate with a lowered base level (Oldknow and Hooke, 2017). A terrace is a preserved section of river sediment (usually gravel) abandoned by a river as it incises downwards in response to a lowering of its base level (by, for example, a lowering of the sea level). Terraces may occur at different heights above modern river level, the higher terraces being the oldest (Enoren and Rey, 2004).

Further important controls on the formation of alluvial deposits and their diamond concentration are summarised, and the distribution of South Africa's land and marine alluvial diamond deposits is presented in summary form in Figure 5 over page.

**Liberation and Transport of Diamonds**

When kimberlite or other rocks containing diamonds are weathered, the diamonds within the rocks are liberated as the rocks break down. In some cases, they are concentrated into alluvial deposits above or near the kimberlite source known as residual placer deposits (Bluck et al., 2005). In the vast majority of cases, however, they are transported, along with the weathered rock fragments, down active drainage channels.

Mass flow of sedimentary loads in high energy flood periods, and progressive river transport over millions of years, causes diamonds with fractures, points of weakness, imperfections and planes of weakness within them, to progressively break into smaller stones with fewer cracks and fractures. Consequently, whereas...
kimberlite pipes are characterised by low average ROM diamond values that are seldom higher than $500 per carat, alluvial diamonds typically show ROM values that may be several orders of magnitude higher in value than kimberlite goods (see Table 8).

As alluvial diamonds are transported from their sources down drainage systems or through wind corridors, as for example on the Namibian west coast, some are deposited in suitable trap sites, forming alluvial or transient placer deposits. Because good quality diamonds (typically the gemstone component) are so hard and resistant to breakage and abrasion, they are not broken down by attrition to the same extent as other minerals and they may survive extremely long distances of transport within active drainage systems, some reaching the river mouth at the coast where they are concentrated to form terminal placer deposits (Marshall and Baxter-Brown, 1995).

South Africa’s Kaapvaal craton fulfills the requirements for the formation of extensive alluvial diamond deposits and mega-placer diamond deposits. This remarkable craton comprises:

- two very extensive conduits or conveyor belts forming westward-flowing drainage off the Kaapvaal craton that has been efficient, partly because of the craton’s uplift, to the point that much of the Kaapvaal craton lies more than 1 km above sea level, which is much higher than the 400-500 m elevation of most cratons in the world (Nylblade and Robinson, 1994) and this has maintained a strong flow along the drainage channels

- multiple ages of kimberlite intrusions, including diamondiferous pipes stretching from the Cretaceous to the Proterozoic, which were eroded over a considerable period of time, providing an ongoing source of diamonds to the drainage channels

- two very extensive conduits or conveyor belts forming westward-flowing drainage off the Kaapvaal craton that has been efficient, partly because of the craton’s uplift, to the point that much of the Kaapvaal craton lies more than 1 km above sea level, which is much higher than the 400-500 m elevation of most cratons in the world (Nylblade and Robinson, 1994) and this has maintained a strong flow along the drainage channels

- numerous diamond-bearing kimberlitic intrusions, both pipes some of which are still of considerable size in spite of considerable erosion, and dyke or fissure systems

Though the rivers draining the Kaapvaal craton, in particular the Orange and its Vaal River tributary, Clifffants and other rivers draining theNamaquaLand region, are believed to have changed over time (e.g. De Wit, 1996), they have, nevertheless, focused the supply of diamonds and sediment within two reasonably limited areas, creating an extensive land-based as well as the west coast mega-placer to develop. In addition there was enough wind and wave energy, along with strong coastal currents, in the terminal placer to ensure that much of the sediment accompanying the diamonds has been removed from the placer site, thus ensuring a suitable environment for deposition and reworking at the terminus, and lastly a key point highlighted by Bluck et al. (2005) is that these conditions occurred contemporaneously, to the point that a mega-placer was formed off the west coast of South Africa and Namibia.

Diamond mega-placer deposits are defined as deposits containing more than 50 million carats of diamonds, 95% of which are gem quality (Bluck et al., 2005). The only two mega-diamond placer deposits known in the world have formed along the West Coast of Southern Africa. One off the mouth of the Orange River and the other further to the south. It is believed that onshore and offshore mining operations along the West Coast of South Africa and Namibia have recovered some 200 million carats of diamonds. Moore and Moore (2004) and (Levinston et al., 1992) estimated a total resource of 1.5 billion carats in this area. The main groups of controls that lead to the development of mega-placers are:

1. the craton;
2. the drainage;
3. the nature of the environment at the terminus, and
4. the timing of the deposition (Bluck et al., 2005).

The Orange-Vaal River Drainage System or ‘Conveyor-belt:

The Orange-Vaal River system is the principal fluvial conduit draining the bulk of the central and western parts of Southern Africa (Figure 5) and the Kaapvaal craton. It is a large, long-lived continental-scale river system with a drainage basin of approximately 1 million square kilometres, 60% of which falls within South Africa, the remainder falling within Lesotho (where the river originates at an altitude of 3 100m above sea level), Botswana and Namibia. In a detailed study, Jacob (2016) calculated the length of the Orange River to be 2 600 km, using GIS measurements.

Approximately half-way along its length, its main tributary, the Vaal River joins the Orange River. The Orange-Vaal system traverses a variety of rock types from Archaean to Cainozoic in age and passes through climatic zones from wet (at its source), becoming increasing arid towards its outlet into the Atlantic Ocean in the west.

An important aspect of these two key rivers is the presence of the Orange and Vaal Rivers, and their tributaries including the Harts, Riet, and Molopo Rivers, is that their gradients also played a role in the concentration of diamonds and formation of alluvial deposits. Gradients of the above westerly flowing rivers are very low, compared to the generally far steeper gradients of the many east flowing rivers which flow off the Kaapvaal Craton as shown in Table 5.

### TABLE 5: Gradients of large rivers flowing to the west and east off the diamond-yielding Kaapvaal and Zimbabwe cratons.

<table>
<thead>
<tr>
<th>RIVERS</th>
<th>FLOW DIRECTION</th>
<th>GRADIENT (METRE-FALL PER KM)</th>
<th>ADJACENT DIAMONDIFEROUS KIMBERLITES</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaal</td>
<td>West</td>
<td>0.22</td>
<td>Numerous</td>
<td>Extensive alluvial deposits</td>
</tr>
<tr>
<td>Orange</td>
<td>West</td>
<td>1.4</td>
<td>Numerous in Lesotho</td>
<td>Extensive alluvial deposits</td>
</tr>
<tr>
<td>Save (Zimbabwe)</td>
<td>East</td>
<td>2.3</td>
<td>Kimberlites associated with Marange deposits</td>
<td>Sparse uneconomic alluvial diamond deposits east of Mozambique border</td>
</tr>
<tr>
<td>Limpopo</td>
<td>East</td>
<td>0.5</td>
<td>Venetia, Belbridge</td>
<td>No significant downstream alluvial deposits other than Krone deposits proximal to Venetia</td>
</tr>
<tr>
<td>Mbuluzi (Swaziland)</td>
<td>East</td>
<td>6</td>
<td>Okalwayo and (Elaine alluvials)</td>
<td>No alluvials</td>
</tr>
<tr>
<td>Tugela</td>
<td>East</td>
<td>6</td>
<td>Lesothi kimberlites</td>
<td>No alluvials</td>
</tr>
</tbody>
</table>

Sources: DeMeillon (PhD in progress), Google-pro map, Various topographic map sheets, Wikipedia sources.
Ages of the alluvial deposits

Most of the known pre-Karoo kimberlites occur in areas that are considered to have been cratonic highlands during the Carboniferous (~300 my) Dwyka period, and would therefore have been subjected to extensive downwasting and ice scouring during Dwyka glaciation (Moore and More, 2004).

Several authors have discussed the potential significance of Dwyka glaciation on the distribution of diamonds in South Africa (Harger, 1909; Du Toit, 1951; Stratten, 1979; Marshall, 1986; Maree, 1978; Moore and Moore, 2004) and increasingly evidence is being presented supporting the importance of the Carboniferous glaciers and their end products (diamictites with coarse boulders) in respect of the alluvial deposits.

Some of the diamond-bearing sediments eroded and transported during pre-Karoo and Dwyka times would have been deposited in alluvial deposits upstream of the mouth on the present Atlantic coast. These would have formed a second, more proximal source of diamonds near the present West Coast when they were re-eroded and transported once Gondwana broke up and the present Atlantic coast of South Africa developed (Moore and Moore, 2004). The origins of the extensive and massive west coast diamond placer deposits remains a matter of contention, which is not discussed in this report.

A summary of the main alluvial deposits of South Africa and their likely ages of deposition, is presented in Table 6, bearing in mind that in many cases the older river gravels and terraces would often have been eroded, reworked, even removed, with this material and diamonds redeposited into younger terraces and deposits.

Controls in the formation of alluvial deposits

(Trap-sites, Deflation and Enrichment (‘Rookkoppies’), Lithification and Other)

The interplay of a range of regional and local geology, structures, bedrock lithology, topography and geomorphic factors, and erosion influence and control the formation of alluvial deposits and their associated concentration of diamonds. Bedrock that erodes to produce good trap sites, such as gullies and potholes and also contributes coarse clasts to the river sediment, generally yield the richest alluvial deposits.

Because of their high relative density, and durability, diamonds tend to concentrate in the lower parts of a deposit where they are more likely to become trapped in bedrock irregularities such as potholes. While the pothole is active (i.e. sediment is passing through and light material is escaping while heavy minerals remain), attrition between minerals occurs until a critical size is attained, at which time a mineral is washed out. Since diamonds are very hard, they suffer little attrition, and are further concentrated relative to other heavy minerals. This also leads to the nugget effect which is ubiquitous in alluvial deposits, and to a lesser extent in kimberlites, and which presents challenges to the systematic and reliable evaluation of primary and secondary diamond projects. Examples of the types of rocks, structures and bedrocks that exert control and help develop alluvial deposits which lead to the concentration of diamonds in alluvial settings are highlighted overleaf.
Erosion of cover rocks – in the central and western areas of the Kaapvaal craton an important control in respect of the formation of South Africa’s exceptional alluvial diamond deposits was the erosion of cover rocks down to the point that the Carboniferous Dwyka diamictite were exposed at the base of the Karoo rocks. The exposure of the diamictites played a significant role between the entrapment of diamonds on land for three reasons: (1) the alluvial system now had enough coarse material eroded from the Dwyka diamictite to build gravel bars to trap more diamonds on land; (2) the pre-Karoo topography that was then being exhumed is characterised by steep gorges and spilays that creates significant bed roughness and turbulence for the concentration of heavy minerals like diamonds, and (3) the progressive exposure of numerous clast and boulders (‘Erratics’) during the downward erosion of the Dwyka diamictite provided important irregularities and flow-disturbances which assisted in the local entrapment of diamonds on the bedrock. The Dwyka sediments could also be an additional source of diamonds from pre-Karoo kimberlites.

• Venterdorp Supergroup lavas – as noted previously there are a variety of good examples in South Africa where a strong relationship exists between alluvial deposits and Venterdorp lava bedrock in the Vaal-Harts River basin (Lynn, 1991), the best example being the Houtgatstdam area, about 15kms north-west of Kimberley, where fractured and weathered lavas have in the past yielded some exceptional diamonds.

• Droogeveld Sloots – large and extensive north-east, south-west trending fractures in Venterdorp lavas which have been weathered out into narrow gulley’s and ‘sloots’ are prevalent to the west of Barkly West. The Droogeveld Sloots and similar structures extending onto Rooiport are famous for yielding high quality diamonds and high localised grades of alluvial goods.

• Karoo dolerite dykes – a few isolated dolerite dykes that are found on Karoo bedrock are either associated with intrusive dolerite dykes and sills (eg, on the farm Klipfontein 35 near Alwal North) or with hardened and indurated Karoo sediments, such as the Seta deposit in the Limpopo Province. The deposits which do occur on Karoo bedrock are generally of lower grade than those that have formed on harder substrates (De Wet, 1990).

• Waterfalls and plunge-pools – these settings are important for diamond concentrations and in the past have yielded super-enrichment of high-quality diamonds, well known examples being the famous Ochatra ‘groyne’ locality on the LOR, and the Saxendrift fault ‘waterfall’ zone on the west-side of this property in the MDR. At Ochatra high concentrations of diamonds were also found on the upper slope ‘push-bar’ downstream of the actual waterfall plunge pool, and is also a common zone to find enriched diamond concentrations.

• Banded-ironstone (high-Specific gravity) control in the MOR – approximately 30km downstream of the confluence of the Vaal and Orange Rivers, a large ancient drainage introduced massive volumes of banded ironstone clasts, weathered from the adjacent Asbestos Hills Formation, into the fluvial system. This sudden increase in bedload density had a profound impact on the diamond concentration ability of this section of the river.

• Weathered Proterzoic gneisses and schists of the Lower Orange River and West Coast marine alluvial played a key role in the concentrations of diamonds in the lower reaches of the Orange River. Millions of carats of small diamonds (typically 1 carat and less) have been found on ancient beach deposits of the West Coast between the Otifants River in the south, and Orange River in the north. The high-grade marine deposits have been extensively mined by small, medium and large companies since the late 1920’s.

• Potchel formation – The longer a potchel is active the higher the relative diamond concentration may become. Changes in slope and sites, where rivers exit from the confines of gorges, are also favoured localities for the development of placers. Concentrations of diamonds are higher in areas of a river where coarse gravel has been trapped and retained for longer periods of time. The highest grades and coarsest diamonds occur in the sedimentary settings that can extract and retain the passage of population of diamonds effectively, notably in feed bedrock trap sites (Jacob et al., 1990).

• Terrace and ‘Rookoppie’ deposits – The formation of terraces and their preservation or erosion has been explained in above. Once formed, the subsequent recurrence of wet and humid tropical conditions after the initial formation of a diamictonous terrace may lead to the enrichment of the terrace. As the terrace material weathered, the talcoid component will be washed out, leaving a deposit enriched in resistant materials such as quartz, agate and, of course, diamond. The highest (and oldest) Rookoppie gravel terraces and associated deflation-deposits of the Vaal River basin, and Middle Orange River (eg. Brakfontein and Saxendrift) are good examples of such deposits.

• Lithification – Alluvial deposits may become metamorphosed, lithified, siltified, and cemented by carbonates or calcrites to form hard and solid rock, and are commonly known as palaeo places. The Witwatersrand gold deposits produced minor quantities of diamond along with gold, uranium and other by-products are an example of this. Records from the Modderfontein ‘B’ Mine showed that in one year it produced about 194 carats (Goetze, 1976). Later weathering and reworking of these deposits provide a mechanism for releasing diamonds into the system, and excellent example being the exceptionally high grade coluvial and eluvial Marange deposits in southern Zimbabwe. 

Mining low- and ultra-low grade alluvial deposits

Today’s Small and Junior diamond miners make use of large-scale earthmoving equipment in order to acquire the economies of scale required to mine the remaining low-grade deposits. Many deposits are covered by hard-pans calcrite that requires blasting or large doses to rip and break up. Some are buried under thick overburden.

The development of mobile screens now makes it possible to screen out 70% of the ROM material at the mine face which reduces transport costs and rehabilitation costs. New technologies like the use of bulk X-Ray machines and X-Ray Transmission (XRT) have made it possible to recover diamonds more efficiently.

Most Small and Junior alluvial diamond miners of today de-sand the product from their scalping screens before processing through the concentration plants. The main reason being that the value of the larger diamonds outweigh the value of the smaller diamonds by an order of magnitude. If de-sanding is done at 6mm, 35% or more of the plant feed can be reclaimed by a coarser fraction. At 6mm, approximately 75% of the diamonds would be screened out but this represents only 5-7% of the value (De Meillon, pers com). The average size and value of the diamonds recovered now increases significantly.

De-sanding at the scalping screen or at the plant before processing makes for additional savings. The sand recovered can be used for rehabilitation and mine areas can recover much quicker. Siltens dams are now up to 90% smaller as the sand has been removed as a dry product before processing. Water usage at the rotary pan plants used by most junior miners is reduced by up to 90% as the puddle mixture in the pan can now be re-circulated.

A further important point about this sector is that the mining and recovery processes utilised by the small or Junior diamond miners are environmentally friendly as no chemicals are used, and high rehabilitation standards are set by most operators.

Alluvial diamond mining is the only migrant mining industry in South Africa. Self-funded companies with limited cash-flow cannot afford to mine in areas where the grades are too low and their equipment insufficient. Most of the plant and equipment used by Junior alluvial diamond miners are mobile and can be hosed up and moved at short notice. The main reasons why these operators are successful are their ingenuity, adaptability and ability to move and start up a new operation in a very short space of time (less than 6 weeks).

Table 7: Modern Smart-technology applications and support systems available to successful Small and Junior diamond miners

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>APPLICATIONS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-frequency X-Ray Tomography</td>
<td>Efficient recovery of large and exceptional diamonds</td>
<td>Key reason why many large stones have been recovered in the past 5 years</td>
</tr>
<tr>
<td>Mineral Sorting</td>
<td>Efficient recovery of large and exceptional diamonds</td>
<td>Essential for delineation of bed-rock pipe and selecting calcrete to form hard and solid rock, and are commonly known as palaeo places. The Witwatersrand gold deposits produced minor quantities of diamond along with gold, uranium and other by-products are an example of this. Records from the Modderfontein ‘B’ Mine showed that in one year it produced about 194 carats (Goetze, 1976). Later weathering and reworking of these deposits provide a mechanism for releasing diamonds into the system, and excellent example being the exceptionally high grade coluvial and eluvial Marange deposits in southern Zimbabwe.</td>
</tr>
<tr>
<td>Modern Diamond X-Ray Recovery systems e.g., Beneventech (UK) technology</td>
<td>Efficient removal of coarse and exceptional diamonds</td>
<td>Efficient removal of coarse and exceptional diamonds; high-Tan and -B diamonds, minimum diamond damage; access to stripped-overburden, and reworking of these deposits provide a mechanism for releasing diamonds into the system, and excellent example being the exceptionally high grade coluvial and eluvial Marange deposits in southern Zimbabwe.</td>
</tr>
<tr>
<td>High-fines De-sanding Screening</td>
<td>Efficient removal of coarse and exceptional diamonds</td>
<td>Unique technology for the recovery of coarse and exceptional diamonds; high-Tan and -B diamonds, minimum diamond damage; access to stripped-overburden, and reworking of these deposits provide a mechanism for releasing diamonds into the system, and excellent example being the exceptionally high grade coluvial and eluvial Marange deposits in southern Zimbabwe.</td>
</tr>
<tr>
<td>X-Ray Tomography</td>
<td>Efficient recovery of large and exceptional diamonds</td>
<td>Unique technology for the recovery of coarse and exceptional diamonds; high-Tan and -B diamonds, minimum diamond damage; access to stripped-overburden, and reworking of these deposits provide a mechanism for releasing diamonds into the system, and excellent example being the exceptionally high grade coluvial and eluvial Marange deposits in southern Zimbabwe.</td>
</tr>
<tr>
<td>Modern Drone Technology</td>
<td>Efficient removal of coarse and exceptional diamonds</td>
<td>Unique technology for the recovery of coarse and exceptional diamonds; high-Tan and -B diamonds, minimum diamond damage; access to stripped-overburden, and reworking of these deposits provide a mechanism for releasing diamonds into the system, and excellent example being the exceptionally high grade coluvial and eluvial Marange deposits in southern Zimbabwe.</td>
</tr>
</tbody>
</table>
SUMMARY OF THE ALLUVIAL DEPOSITS

Introduction

As noted in the previous sections of this report, the ages of alluvial diamond deposits in South Africa vary from 2.9 Billion years (diamonds in the Witwatersrand gold deposits) to recent, though the majority of the deposits that have been preserved and are mined today vary in age from recent to Miocene age (1 – 25 my).

Exceptional gemstone diamond populations

Following the rapid erosion that had taken place during the early Cretaceous, it would logically be expected that the diamond populations along current drainages would be a good mixture of diamonds from most of the Kimberlites, especially if the possible contribution of diamonds from the Dwyka sediments is also considered.

Table 8: ROM average diamond and grade values for alluvial deposits of Southern Africa

<table>
<thead>
<tr>
<th>ALLUVIAL DEPOSITS (LAND AND MARINE)</th>
<th>COMPANY OR OPERATOR</th>
<th>ROM VALE US$ PER CARAT</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krone alluvials (LP)</td>
<td>Diamcore Mining</td>
<td>~185 - 250</td>
<td>Deposits adjacent to Veneria kimberlites.</td>
</tr>
<tr>
<td>Lichtenburg Caligny Area (NWP)</td>
<td>Various private operators</td>
<td>~350 - 500</td>
<td>~1 – 1.5 cpht.</td>
</tr>
<tr>
<td>Venterdorp area (NWP)</td>
<td>Two mid-sized private operators</td>
<td>~350 - 500</td>
<td>~0.5 – 1.0 cpht</td>
</tr>
<tr>
<td>Schweizer Reynek Bloemhof-</td>
<td>Large number of small private mining operators</td>
<td>~600 - 700</td>
<td>~0.5 – 1.0 cpht</td>
</tr>
<tr>
<td>Hot River (NWP)</td>
<td>Malwasse, Bloemhof, Christiana</td>
<td>~700</td>
<td>~0.5 – 1.0 cpht</td>
</tr>
<tr>
<td>Proto-Vaal River (NCP)</td>
<td>Holpan, Klplam, other</td>
<td>~1 500</td>
<td>~0.5 – 1.5 cpht</td>
</tr>
<tr>
<td>Vaal River (NCP)</td>
<td>Schmidtsdrift, Roodport,</td>
<td>~900</td>
<td>~0.7 cpht</td>
</tr>
<tr>
<td>Riet River (NCP)</td>
<td>Schusterkama and downstream</td>
<td>~1 400</td>
<td>Low-grade deposits</td>
</tr>
<tr>
<td>Modder (Hopetown to Douglas)</td>
<td>Limed mid-sized private operators</td>
<td>~3 500</td>
<td>Ultra low-grade deposits, typically &lt;0.35 cpht</td>
</tr>
<tr>
<td>Modder (Douglas to Priekieka)</td>
<td>Various mid-sized private operators</td>
<td>~2 200</td>
<td>Low-grade deposits</td>
</tr>
<tr>
<td>Lower Orange River</td>
<td>Lower Orange River (Private Company)</td>
<td>~1 200</td>
<td>~1.2 carats per stone</td>
</tr>
<tr>
<td>West Coast marine deposits (NCP)</td>
<td>Alikor – production from small and medium land, beach and shallow water Contract miners</td>
<td>~400 - 600</td>
<td>~10 – 25 cpht</td>
</tr>
<tr>
<td>Kimberley River mouth marine</td>
<td>De Punt (THG) – shallow water operations off small boats</td>
<td>~400 - 600</td>
<td>Local concentrations of diamonds are similar to the offshore deposits found near the coast, but are more difficult to exploit</td>
</tr>
</tbody>
</table>

Sources: Company Annual Reports, presentations, and media releases. Diamond tenders, Small mining producers. (Bristow pers comm., De Meillon, PhD in preparation)

Note: Average diamond price estimates and grades in table above are based on a lower cut-off screen size of about 2mm unless otherwise indicated. Many inland alluvial diamond operators are using bottom cut-off screen sizes of 4 – 6 mm, which increases processing efficiency, lowers costs, and has the effect of producing higher average prices at reduced grade.
NWP alluvial deposits

Figure 6 shows a Digital Elevation Model (DEM) of the North West Province with the major towns and drainages indicated.

The main occurrences of alluvial diamond deposits are found in the Bakerville area north of Lichtenberg, in north-south trending broad drainages across karstic dolomitic topography between Lichtenberg and Ventersdorp, and in a triangle comprising Schweitzer Reyneke-Bloemhof-Wolmaranstad. The Vaal River flows through the southern edge of the NW Province and also carries excellent quality alluvial diamonds.

All these areas have been extensively mined in the past, but still contain extensive areas of unexploited low grade gravels. Recent modern geological studies and reinterpretation of the NW Province ‘Triangle’ has also led to a complete revision of the geological model for the area, and considerable enhancement of the diamond resources available in this ‘Triangle’.

Mahlkeng Area

The alluvial gravel in the Mahlkeng area represents a remnant of a broad alluvial plain that has been mined quite extensively (De Wit, 1996). The gravels have been deposited on Ventersdorp Lava bedrock that has undergone intense weathering to a yellowish clay. On the basis of its similar alteration characteristics to the Lichtenburg gravels, De Wit (1996) has interpreted the gravels to be at least of Late Cretaceous age.

The discovery of the Lichtenburg field in 1926 was one of the major diamond discoveries in South Africa and has yielded around 9 700 000 cts. The bulk of the deposits are confined to the highly karsified dolomites of the Transvaal Sequence. The setting of the gravel deposits in the Ventersdorp area is similar to that of Lichtenburg in karsified dolomites. Some of the deposits have been mined to a depth of 40 m or more. The average values in the area varies between 350 – 500 US$/ct with grades varying between 0,6 – 1,2 cph.

Schweitzer Reyneke-Bloemhof-Wolmaranstad Triangle

The gravel deposits in this triangle comprise by far the largest area extent (+ 100km²). These deposits have been described in detail by Marshall (1986, 1990). The mining operations in this area consists mainly of shallow, surficial workings.

The latest hypothesis by De Jager and Ward (pers comm) is that these deposits were formed from reworking of diamond-bearing glacial deposits transported by Carboniferous Dwyka ice sheets, which were reworked in a Karoo inland basin or sea during the Permian. This gave rise to extensive shallow deposits (generally referred to as ‘Roskoppe’) which blankets the area, including remnants of diamondiferous gravels formed along the shoreline in the vicinity of Schweitzer Reyneke. These gravels and diamonds were subsequently reworked in the younger north-south trending Bambos, Makwassie and Langasm drainages.

The average values of diamonds mined along the Vaal River in North West varies between US$800 and 1 000/ct with minimal grades varying between 0,5 – 2 cph.

Northern Cape Province (NCP) land-based deposits

The Northern Cape Province is endowed with many kimberlite intrusions. Most of them are uneconomical but contain some diamonds while others have been world class diamond mines like the mines around Kimberley, Koffiefontein, Jagersfontein, and Lime Acres (Finch).

The average values in the area varies between 500 - 800 US$/ct with grades varying between 0,5 – 0,8 cph.

Vaal River Alluvial Deposits

These numerous kimberlites, even those of low-grade, contributed a vast ‘budget’ of diamonds over millions of years into the Vaal River system, including its numerous tributaries. They are also one of key sources of diamonds to the Orange and Riet River systems.

The Harts River was once a major drainage in the area.

Would be diamonds eroded from the deposits to the north and brought down by drainages like the Bambospruit and the Makwassiepruit into the current river systems (Figure 1). Note that there are also significant drainages draining into the Ventersdorp area into the Vaal River (Skloospruit).

The average value of diamonds mined along the Vaal River varies between US$800 and 1 000/ct with minimal grades varying between 0,5 – 2 cph.

Harts River Valley Alluvial Deposits

The Harts River was once a major drainage in the area before it was captured by the Vaal River (Figure 6). The main sources of diamonds to the Harts River would be diamonds eroded from the Lichtenburg and Mahlkeng alluvial deposits as well as from the Bellsbank kimberlites on the Ghaap plateau.

The average value of diamonds mined from the Harts river varies between US$600 – US$800/ct.
This is seen clearly on the DEM in Figure 7. This type of feature is typical of all the larger scale deposits in the central area of the Northern Cape.

Further downstream, the river enters another gorge feature near Barkley West (Figure 8). As it exits this feature the well-known Waldeck's gravel splay was deposited. After the confluence of the Vaal and Harts Rivers further down, the sequence is repeated as the river exits the Bushmansloof Gorge upstream of Schmidsdrift.

Note that the kimberlites in the Kimberley area are situated to the north of the high which separates the Vaal River drainage from the Riet/Modder River drainage. This implies that the Kimberley kimberlites supplied the Vaal River system with diamonds, certainly since the time that the pre-Karoo high that separates these drainages became exposed.

Average values of diamonds mined along the Vaal River in the Northern Cape at a 2mm cut off are about $800 – 900 per carat, and at a 5mm bottom cut-off vary between US$1200 – 1400/ct. Movable grades vary between 0.3 – 1 cphf.

The Riet River Alluvials

The Riet River is the youngest of all the major diamondiferous drainages. Figure 9 shows a DEM of the Riet River drainage. The major source of diamonds to the Riet River system was the Koffiefontein Kimberlite. The Jagersfontein kimberlite higher up in the drainage as well as the Salljetepan fissure would also have contributed diamonds.

Above the confluence of the Riet and Modder Rivers, the Riet river flows mainly over Dwyka shales and there is not enough material to build significant gravel bars or bed roughness to trap diamonds. Immediately downstream of the town of Ritchie, the river enters a pre-Karoo gorge that had been filled with Dwyka diamictite. At the river system exhumed the pre-Karoo topography it carried the clasts that it eroded from the Dwyka with it to the point where it exits the gorge on the farm Schutsekama (Figure 9). The gravel splay that developed at the exit of the gorge became a very good trapsite for diamonds brought down the river. The splay at has an aerial extent of about 10 km long by 2km wide.

A second splay developed approximately 30km downstream from the farm Schutsekama as the river exits a much smaller gorge feature (Figure 9) before it joins the Vaal River.

Smaller deposits preserved as small scours or potholes are preserved on the farms Wicklow and Slypsteen.

Only downstream of Hopetown does the Orange River gain access to sufficient Dwyka clasts to start building gravel bars to trap diamonds in significant quantities. Here the river once again exhumes a pre-Karoo gorge filled with Dwyka diamictite. Where the river exits this gorge at Ettrick, the first significant gravel deposits are found (Figure 11). Smaller deposits preserved as small scours or potholes are preserved on the farms Wicklow and Slypsteen upstream of Ettrick as well as between the Van der Kloof Dam and Hopetown.

Further downstream of the gorge exits, values of +US$3 000 per carat are common. The grades in this area are however extremely low with average movable grades of 0.1 – 0.25 cphf.
Lower Orange River (LOR)

Traditionally, 2 broad ranges of palaeo-Orange River deposits are recognised along the lower reaches of the Orange River namely:

Proto-Orange deposits – these occur primarily as terraces at elevations >40m above the current river

Meso-Orange deposits – these occur at elevations <40m above the current Orange River

Historically, the proto terraces have a significantly higher grade and have been mined extensively while the meso terraces have been proven to be economic in localised areas only. Although diamonds have been recovered in terraces downstream of Prieska, very large-scale mining has taken place between Prieska and the Augrabies falls. The first significant gravel spay downstream of Augrabies is found at Grassdrift (Figure 13). This is again a typical gorge and spay feature with small remnants of Proto gravel and extensive lower terraces of Meso gravel. Downstream from Grassdrift, deposits like Oena, Reuning, Bloedrift and Ifakane have been mined extensively with smaller scale mining on some of the Meso terraces closer to Alexander Bay. Diamond values along the lower Orange River averages at around US$800 – 1,500/ct at a bottom cut-off of 3mm. Mlnable grades vary from 0.8 cphct to +5 cphct in the Proto gravels with much lower grades of 0.15 – 0.5 cphct in the Meso gravels. [16]

West Coast marine deposits

Extensive, high quality marine diamond placer deposits exist on raised and drowned-beaches of the West Coast of South Africa (south of the Orange River mouth) and in Namibia (north of the Orange River mouth). The South African deposits were discovered by Jack Carstens in 1925 (Carstens, 1962) just south of the Orange River mouth. Jacob (2005) has provided a useful summary of ideas for the origin of these marine deposits, and there is also more recent and ongoing work on their formation. In an early observation, Du Toit (1910) noted that the Vaal and Harts Rivers flow subparallel to the Ghaap Escarpment and these rivers, along with the middle Orange River, are presently eroding and exhuming the pre-Dwyka drainage system. These pre-Dwyka river valleys still contain Dwyka Group sediments and the interfluvies are composed of more resistant Archaean rocks, mainly Ventersdorp lavas. McCarthy (1983) also proposed the existence of a trans-Kalahari River that flowed from the north, across the Kalahari, to join the palaeo-Orange River about 20 kilometres downstream of the Orange Vaal River confluence.

Other theories on the drainage evolution include that of Dingle and Hendry (1984), who recognised that the Orange-Vaal system had been the most important drainage conduit for diamonds from the Kaapvaal craton since the break-up of Gondwana. Their theory proposed that the position of the Orange River mouth switched during the Palaeogene (~66 – 23 my) from its present position (at 20°S) to that of the present-day Olifants River mouth (at 31°S), then back again around 23 Ma ago. De Wit (1993, 1999) proposed the existence of two parallel west-flowing drainages during the Cretaceous. The northern ‘Kalahari’ River system stretched into Botswana, possibly via the Fish River, whereas the southern ‘Karoa’ River, had headwaters corresponding to those of the Molopo River. The course of part of the palaeo-Molopo River is defined by a deep sediment-filled channel that parallels, but south of, the modern course of the Molopo (Haddon, 1999), and it reached the coast at the present Orange River mouth. De Wit (1999) proposed that tributaries of...
the northern "Kalahari" River captured the upper part of the southern "Karoo River, forming the present-day Orange-Vaal drainage".

Studies of sediment off the West Coast suggest a large outflow from the current Olifants River mouth between 117.5 and 103 Ma (Brown et al., 1995), which could represent the "Karoo" River of De Wit (1999). The mouth of this river switched to the vicinity of the present Orange-Vaal mouth, between 103 and 68 Ma, where a large river was already active at the start of this period (Brown et al., 1995, Jacob, 2005).

**Revised Source and Transport Models**

For the West Coast diamond deposits More recent work on the drainage, evolution and diamond distribution of the lower Orange River system by Van der Westhuizen (2012) and others, has led to a revised diamond dispersal model operated in the lower Orange River system, which included the effects of: (1) pre-Karoo drainages, (2) Dykwa ice sheets and glaciers, and (3) post-Karoo drainages, of which the Orange-Vaal system has been the most important for at least the last 100 Ma (Jacob, 2005).

Although it has been proposed that South Africa’s deep weathered Cretaceous (~66 – 145 my) kimberlites were the main source of the inland and West Coast alluvial Diamonds (De Wit, 1996, 1999), clusters of older diamondiferous pipes are likely to have also shed diamonds which ended up on the west coast. Important diamondiferous kimberlite clusters, including the much older Premier (~1 200 my) and Venetia (~1 200 my) deposits, pre-Karoo sedimentation, which took place between 30 and 190 Ma ago.

These older kimberlites would have been subjected to rock-mass destruction and transport by Carboniferous Dykwa glaciers and their associated drainage systems. Pre-Karoo weathering and erosion with weathered material and detritus moving within pre-Karoo drainages would have also contributed additional diamonds. Overall it is likely that diamonds deposited on the west coast placer were transported in several stages and events from the cratonic/ninterland areas of South Africa and possibly Botswana, before (even if only in part), and post the break-up of Gondwanaland. Once transported to the coastal area and available in the marine west-coast setting they were reworked into the mega-placer of the Atlantic Ocean margin.

In summary, diamonds from older diamondiferous kimberlites (such as Cullinan and Venetia age pipes) would have liberated and transported to the south-west and western parts of the continent by Carboniferous Dykwa glaciers (Bosch, 2013; Bristow, pers comm, Hager, 1909), Van der Westhuizen, 2012).

Weathering of the diamondiferous kimberlites such as Juwanej (~240 my) and younger pipes including those at Swatruargens, Kimberley and in Lesotho areas (~165 to 84 my) would have contributed diamonds for transport westward by subsequent post-Gondwan打破-up transport systems via the proto-Vaal and Orange Rivers (Bristow pers comm; De Meillon pers comm, De Wit, 2010).

In addition, the possibility of diamonds being released from Nama sediments (~1 000 my), and hence kimberlites of 1 200 my and older, has been proposed by Moore and Moore (2004).

The west coast of southern Africa (RSA and Namibia) thus received inputs of diamonds transported from the hinterland of Southern Africa over a considerable period of time from kimberlites of multiple ages, the collective transport mechanisms in the form of glacial and large ancient rivers, and the likely weathering of Nama sediments. Concentration of the end deposits (ancient river terraces remnants, and marine beach deposits) was affected by water, wave action, and wind along the west coast.

**Outliers**

There are also interesting and important outliers of alluvial diamond deposits found around the country, which are generally (but not always) associated with kimberlite clusters and kimberlite diamond mines.

**Examples include Setsa and Krone (near the world class Venetia diamond mine in LP), the localised Marsfontein alluvials located to the south of the Marafon pipe and Klipspinger fissions, the Berylspoint alluvial deposits adjacent to the Cullinan diamond mine in GP which have been largely mined out and are also in a Game Reserve which makes exploitation unlikely, and a small alluvial deposit downstream of Alkali North created by a dolerite dyke.**

The Krone deposit has been the focus of a detailed delineation, evaluation, and development program by Diamcor Mining Inc, a listed Canadian (TSX) Junior mining company. A 2016 National Instrument technical report (N 43-101) by Grobbelaar and Hawkins reported an Inferred resource of about 20 million tonnes of gravel with a grade of about 12.7ct/h, and average diamond value of approximately $168 per carat. Additional low grade gravel deposits are also present and collectively the combined diamond resource has been reported as about 58 million tonnes by these authors. The main challenge with these deposits is sandy nature of the gravel deposits, and extensive and thick sand cover.

Recent 2021 tender diamond sales by the company have yielded prices in the range of $200 – 300 per carat. The deposit also regularly yields high quality special (~10.8 carat) stones, and given that Venetia mine produces large high quality exceptional diamonds it is possible that the Krone deposit could also yield occasional exceptional stones.

**Summary**

South Africa is host to unique alluvial gravel deposits that yield exceptional high-value gemstone diamond deposits. The deposits are ubiquitous in the N Cape and NW Provinces and on the Atlantic West Coast of South Africa (and Namibia). Overall, the alluvial diamond deposits of South Africa consistently represent the highest value per carat diamond supply in the world with some areas averaging upwards of US$75 000 per carat. As a consequence these diamonds are highly sought after by international buyers and manufacturers, and are found to populate some of the world’s most expensive retail diamond jewelers (Figure 15).

The defining characteristic of these diamondiferous alluvial gravel deposits is that they are very-low or ultra-low grade (as expressed in carats per hundred tonnes), and the diamonds that are found in these deposits do not occur evenly spread throughout the deposit. Diamonds are heavy minerals and are concentrated by water, wind, and other related mechanisms in specific areas or ‘trap sites’, thus showing a very strong ‘nuget effect’. Crude mining methods and the small scale of operation used in the past, often limited small mines to the high-grade areas. The ‘picking of the eyes’ of these deposits have for a long time made the remainder of the deposits unprofitable to mine. Technological advances made during the past 20 years and the strength of the US $ to other currencies have progressively changed the economic parameters and many previously unprofitable deposits are now being mined. The main difference in the business has been the size of the operations and the typical alluvial mine of today represents a significant earth moving fleet, and leading-edge processing treatment, and final recovery plant. There are still significant reserves of alluvial diamond deposits available for mining in South Africa, possibly for another 100 years. The remaining deposits comprise low and ultra-low grade in terms of carats per 100 tonnes (cplt). In spite of the low grades of these deposits, the application of new geological interpretations, careful delineation and evaluation of the deposits, the use of new technologies (eg, de-sanding, and efficient operators, to cost effectively exploit these deposits. What is lacking is practical, fit for purpose enabling mineral policies and regulations (less red-tape) to assist in the regrowth of the Small and Junior diamond mining sector, thereby reviving economic development and job creation in remote and poor areas of the NWP and NCP. Extensive un-explored low and ultra-low grade alluvial (gravel) diamond deposits occur in the SW (BWP and NCP) and other areas of the NCP. Land based and shallow marine deposits of the west coast have been highly exploited over the past 92 years and hence are depleted, but large resources of diamonds remain in the mid (B-Concessions), and deep-water (C-Concessions) of the west coast from about the Olifants River mouth in the south to Orange-Vaal mouth in the north.

High-level estimates are summarised in Table 9 overleaf.  

![FIGURE 15: Summary of the exceptional diamond qualities found in the alluvial deposits of South Africa. Synthetic gem diamond data is included for reference (Source: Global Diamond Network, Bristow pers comm)](image-url)
Large variations in grade of some deposits are indicative of certain older terraces that had higher grades. Most higher-grade deposits have been depleted.

**TABLE 9: High-level volume estimates of low- and ultra-low grade alluvial diamond deposits in the NCP, NWP and LP.**

<table>
<thead>
<tr>
<th>DEPOSITS/AREA</th>
<th>GRAVEL (TONNES)</th>
<th>GRADE (2MM CUT-OFF)</th>
<th>AVE US$/CT (2MM CUT-OFF)</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Klipriviersburg – Ventersdorp area (NWP)</td>
<td>100 000 000</td>
<td>0.5 – 1.5</td>
<td>~ $350 – 500</td>
<td>Extensive alluvial deposits which occur in dolomitic karst /paleo-setting/fillings, and broad drainage-channels linking potholes</td>
</tr>
<tr>
<td>Malanfontein – Ghaap Plateau (NWP)</td>
<td>10 000 000</td>
<td>0.5 – 1.2</td>
<td>~ $500</td>
<td>Small seston remnant deposits; volumes uncertain</td>
</tr>
<tr>
<td>Harts River Valley (NWP, NCP)</td>
<td>250 000 000</td>
<td>0.3 – 0.5</td>
<td>~ $800 – 1000</td>
<td>Requires modern work and delineation. Extensive gravels, uncertain volumes</td>
</tr>
<tr>
<td>Schweizer Reynke, Welmaranstal, Bloemhof (NWP)</td>
<td>200 000 000</td>
<td>0.5 – 1.0</td>
<td>~ $500 – 700</td>
<td>Work by De Millen and Bristow, Pieter Bosch, P DeJager, others indicates a ‘Karoo’ age model for these deposits. Estimates might be on low side</td>
</tr>
<tr>
<td>Vaal River (NWP)</td>
<td>100 000 000</td>
<td>0.35 – 0.8</td>
<td>~ $700</td>
<td>Extensive mining in past has depleted high-grade deposits; Remaining remnants difficult to delineate</td>
</tr>
<tr>
<td>Vaal River (NWP)</td>
<td>250 000 000</td>
<td>0.35 – 0.8</td>
<td>~ $900</td>
<td>Large and extensive Splay and older deposits filling glacial channel and outwash deposits</td>
</tr>
<tr>
<td>Hart River (NWP, NCP)</td>
<td>250 000 000</td>
<td>0.3 – 0.8</td>
<td>~ $300 – 800</td>
<td>Extensive gravel deposits which require modern study, delineation, and diamond population studies</td>
</tr>
<tr>
<td>Riet River (NCP)</td>
<td>25 000 000</td>
<td>0.35</td>
<td>~ $1 400</td>
<td>Splay-deposits with low grades, and large stone diamond population: source of diamonds likely to have been Koffiefontein kimberlites</td>
</tr>
<tr>
<td>Orange River (pre-Cretaceous) (NCP)</td>
<td>400 000 000</td>
<td>0.1 – 0.25</td>
<td>~ $3 500</td>
<td>Extensive ultra-low grade gravels, exceptional large stone Type-II diamond population; rare coloured stones; Lesotho kimberlite diamond population</td>
</tr>
<tr>
<td>Orange River Douglas to Upington (NCP)</td>
<td>600 000 000</td>
<td>0.2 – 0.6</td>
<td>~ $2 200</td>
<td>Extensive low-grade deposits preserved in multiple stepped Terrace deposits; mixed-diamond population Lesotho, Kimberley, Koffiefontein, and Fischer/Postmasburg Ghaap Plateau kimberlite sources</td>
</tr>
<tr>
<td>Lower Orange River (NCP; Namibia)</td>
<td>400 000 000</td>
<td>0.25 – 5</td>
<td>~ $1 200</td>
<td>High-quality diamond population (averaging ~1.25 cts per stone); mixed population – Orange River (Kapvaal Craton) and Botswana Craton (via proto-Fish River) also likely Carboniferous Dyke/Triple Trike diamond contribution</td>
</tr>
<tr>
<td>West Coast land and marine alluvial deposits (including marine, beach, and old channel deposits) (Orange River to Olifants River mouths)</td>
<td>&gt;200 000 000</td>
<td>~ 10 – 25</td>
<td>~ $400 – 600</td>
<td>Extensive marine deposits remain largely unexplored with new technologies, land deposits have been extensively exploited in the past, but low-grade deposits require new delineation &amp; evaluation.</td>
</tr>
</tbody>
</table>


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**SMALL AND JUNIOR DIAMOND MINERS DATABASE**

**Introduction**

At the outset of the Small and Junior diamond miners project, the intention was to collect up-to-date information in the field, with visits to current mining and project operations in the NWP, and NCP including the West Coast, with outliers in the FS, LP, and Gauteng Provinces.

Because of the exceptionally large footprint of the small diamond mining sector, which effectively covers five provinces, spread from the Atlantic coast-line to the Limpopo Valley in the far north-east of the country, and more remote parts of the Orange, Vaal and Riet Rivers, and the NWP diamond-triangle (Schweitzer Reynke–Bloemhof–Wolmaranstad) to collect additional locality information.

Details of the information gathering processes including site visits and flights undertaken to cover remote areas and major river drainages are summarised in Tables 1 and 2 of this study.

It was anticipated that additional, important and useful information would be gained from the DMRE through direct interaction with their offices in the NCP (Kimberley) and NWP (Klerksdorp), as well as from DMRE publications in the public domain. However these sources proved to be disappointing in respect of providing additional useful information for this project and are discussed further.
Database structure

The method of information collection, database structure and fields, and content was premised on the authors personal experience of work done collecting ground water survey data from drilling programs, farmers, and other sources in the Karoo. This study was successfully published as an AEON sponsored MSc degree at Nelson Mandela University (Dlakavu, 2019).

In addition, other studies of this type of work were researched and reviewed, including the previous key study of the Small and Junior diamond mining sector completed by Farrell (2012). This comprehensive study published in 2012 provided an important benchmark for comparison purposes, and likewise provided important criteria and guidelines for the construction and content of the Small and Junior Diamond Mining Database (SJDMD) database constructed and populated by the author of this study.

An Excel spreadsheet was used to compile the database given its low cost, portability, flexibility and compatibility with many other database, GIS, and related applications. A summary of the structure and types of information collected and compiled in the database is shown in Table 10.

In addition to the summarised database compilation, questionnaires were compiled and used as the basis for interviews with Small and Junior miners to collect information during site visits, and in some cases telephonically from operators. The information gathered from these interviews was summarised and documented in spread-sheets included with the database.

It has also been recommended to SADPO that the existing database should continue to be updated and refined on an annual basis, and that it becomes a key tool for the medium and long-term monitoring and management of this critically important Small and Junior mining sector. The structure of the existing Excel Database is such that it can be easily updated in the future, and new categories and data sets added to the initial document created in 2019/2020.

<table>
<thead>
<tr>
<th>INFORMATION TYPE</th>
<th>PARAMETER</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of Collection</td>
<td>Site visit, Over-flight, Literature searches, company reports, latitude and longitude</td>
<td>Various approaches were utilised to optimise time and costs</td>
</tr>
<tr>
<td>Contact Details</td>
<td>Owner/operator/contractor, or other suitably qualified persons</td>
<td>DMRE challenges repeated highlighted</td>
</tr>
<tr>
<td>Mineral Right Details</td>
<td>Mine or Project name, Holder, Farm name, closest town, Water Use Licence, waiting period</td>
<td>Major challenge in respect of maintaining businesses</td>
</tr>
<tr>
<td>Life of Mine (LOM)</td>
<td>How frequently do operators move</td>
<td>For use in terms of estimating number of persons employed per area or Province, and economic information</td>
</tr>
<tr>
<td>Employee Details</td>
<td>Employee complement, education and skills, Race, Females, Headquartered/communities, turnover, BEE compliance</td>
<td>Key geological and mineral resource information</td>
</tr>
<tr>
<td>Operational Details</td>
<td>Size/number of pans, production mode (no. of shifts)</td>
<td>From present and future use</td>
</tr>
<tr>
<td>Costs and Turnover</td>
<td>Fuel, maintenance, wages, power, H&amp;S, Security, Training</td>
<td>Geology</td>
</tr>
<tr>
<td>Geology</td>
<td>Grade, Average diamond Dollar value per carat</td>
<td>Key geological and mineral resource information</td>
</tr>
<tr>
<td>Other</td>
<td>Other useful information</td>
<td>For present and future use</td>
</tr>
</tbody>
</table>

TABLE 10: Summary of key fields and information included in the Small and Junior Diamond Miners Database (SJDMD) constructed and utilised by the author of this study and document.

DMR directorate of mineral economics publications

Previously the Directorate of Minerals Economics of the Department of Minerals (DMR) published annual reports that related to mining (large, mid-sized and small) and quarrying activities being conducted throughout the Republic of South Africa (see for example DMR 2015a and b, and DMR 2016 references).

It was hoped at the start of the project that recent and current versions of these DMRE documents would still be available and helpful to this project, provide useful locality and other information on the small diamond miners, and assist in fast-tracking the project by providing additional useful data and localities that time and costs constraints would limit access to. However on investigation it was found that these annual DMR reports on mining and quarrying information compiled by the Minerals Economics Directorate ceased in the period 2015/2016. Consequently, given the ‘dated’ nature of these publications, information contained therein was of little use or benefit to this study.

Data gathering from NCP and NWP DMRE offices

With the assistance of the Chairperson of SADPO, and the Regional Managers (RM) of the Kimberley and Klerksdorp DMRE offices, time was spent in both these offices with the intention of reviewing and interrogating information and data for mining permit, prospecting, and mining licences for Small scale diamond miners and operators in the NCP and NWP. However the SAMRAD system proved to be challenging, though the individuals in charge of the minerals section were helpful in respect of providing assistance whenever possible. A large amount data was reviewed and accessed, but disappointingly it was found that records for 2018 and 2019 were not complete at the time of the visits by the author (January 2019 in Kimberley, and June 2019 in Klerksdorp).

Overall, the SAMRAD system was not at all user friendly, information was most difficult to access, and trying to sort and extract data in terms of date...

These reports documented important and useful information relating to mining and quarrying operations, including for example:

- the locations of operations
- ownership details
- contact details of the private owners or company
- type of commodity
- mining method employed (e.g. underground, open-pit, or open-cast)
- and other relevant and important information.

I information regarding licenses was downloaded from SAMRAD ONLINE.

This included:

- Issued diamond Prospecting Rights, which are licences that allow individual(s) or a company to inspect an area of land for identifying an actual or probable mineral deposit (valid up to five years).
- Issued diamond Mining Permits, which are licences that are issued to conduct mining operations (valid for two years)
- and issued Mining Rights, which are licences that are issued to mine minerals within a certain area (valid for a maximum of 30 years).
periods, localities, and licence types were also difficult. As a consequence, much of the information that should have been in the system was still to be found in the DMRE paper-filing system. This presented a further challenge and level of complexity. Individuals working on different files were again helpful in providing assistance where possible to the author of this work, but if they were busy or out of the office then information could not be accessed.

However, as explained above, this exercise was not particularly useful, although the experience gained at the two DMRE offices did clearly highlight why one of the key challenges and complaints documented during interviews with Small and Junior diamond miners was the difficult and long waiting periods for mineral rights applications to be processed and awarded.

Due to the incomplete nature of data and information gathered in the DMRE offices in the NCP and NWP, and the difficulty of compiling and correlating the most important and relevant data in respect of size of activity, period for which the operations had been active, whether the licences were still valid and for how long, or whether the licences had expired or operations had been stopped, this overall exercise was found to be of limited value.

Hence, although a series of maps were constructed to show the distribution of Prospecting, Mining Permits, and Mining Rights issued in the NCP and NWP, they are not included in this document and have been provided to SADPO for filing.

In the interests of making sure that the project work would be able to collect and interpret robust and reliable information, and would ensure a value-add outcome, the decision was made to visit as many sites as possible within the time frame and budget constraints. As noted previously

Due to the difficulty of compiling and correlating the diamond licensing data and shape file information, this exercise was found to be of limited value.

The information that was accessible is summarised and discussed in the following section. The initial intention was to use the DMRE information for the Small and Junior mining sector to construct maps that would help to identify where the greatest concentration of active operations were located so that these could be visited to collect information and data from the actual operations.

**Map compilations**

The information for diamond licences, including coordinates obtained from the Northern Cape DMRE office in Kimberley, and North West facility in Klerksdorp were used to create shapefiles which were in turn loaded into a QGIS system to create maps. A series of maps were thus created with the intention of using these to highlight where active prospecting and mining operations were being conducted.

**FIGURE 16: Bar graph showing the number of issued prospecting rights for diamonds between 2009 and 2018 from the Kimberley (NCP) DMRE office**

Prospecting Rights (2009-2018)
The approximate total number of issued Prospecting Rights for diamonds between 2009 and 2018 is 136. The highest number of Prospecting Rights issued in one year during this period was 21. These were issued in both 2010 and 2017. The lowest number of Prospecting Rights issued in one year during this period was 5 as issued in 2013. The number of Prospecting Rights increased by 7 between 2009 and 2010, decreased over a 3-year period thereafter from 21 to 5. After 2013 the number of issued Prospecting Rights followed a volatile trend between consecutive years (Figure 16).

Mining Permits (2004-2019)
The total number of issued Mining Permits for diamonds between 2004 and 2019 is 656. The highest number of Mining Permits issued in one year during this period is 149. These were issued in 2006. The lowest number of Mining Permits issued in one year during this period is 6. This quantity was issued in 2016. The number of Mining Permits increased between 2004 (11) and 2006 (149) and has since decreasing (Figure 17).

What is particularly interesting about the numbers of mining permits recorded in Figure 17, are the large number of Mining Permits issued during the period 2004 to 2011 (149 in 2006) which would suggest that it was easier and quicker for applicants to apply for 5ha Mining Permits and get into operation rapidly, and probably also extend and mine outside the original boundaries of the permit area. Unfortunately on further interrogation of the SAMRAD system it was difficult to ascertain why so many permits had been issued in this period, and how they had been monitored. Of interest is that the number of Mining Permit grants then drops considerably from 2012 onwards.

The DMRE information included in Figure 17 below is confusing and at odds with the detailed study carried out by Farrell (2012). Farrell’s study found that there were only about 200 Small mining diamond operations active in the NCP, whereas the data presented in Figure 18 overleaf implies that there should have been considerably more Small mining operations taking place on 5ha mining permits alone.

Overall, these types of inconsistencies and the inability to rapidly interrogate and find explanations for such situations, highlights the challenges and lack of user-friendliness of the SAMRAD system.
Mining Rights (2005-2018)
The total number of issued Mining Rights between 2005 and 2018 is 78. The highest number of Mining Rights issued in one year during this period is 16. These were issued in 2010. The lowest number of Mining Rights issued in one year during this period is 2. This quantity was issued in 2005, 2013 and 2016. The number of Mining Rights increased between 2005 and 2010 and generally decreased thereafter.

The total number of issued Prospecting Rights for diamonds between 2013 and 2019 was 149. The highest number of Prospecting Rights issued in one year during this period is 44 (issued in 2018). The lowest number of Prospecting Rights issued in one year during this period (2013-2018) was 6 as issued in 2013.

Mining Permits (2013-2019)
The total number of issued Mining Permits for diamonds between 2013 and 2019 was 62. The highest number of Mining Permits issued in one year during this period was 17 (issued in 2017). The lowest number of Mining Permits issued in one year during this period was 3 issued in 2014 (Figure 20).

Mining Rights (2009 – 2019)
The total number of issued Mining Rights for diamonds issued in the NWP between 2009 and 2019 was only 44. The highest number of Mining Rights issued was 19 and has no date. The lowest number of Mining Rights issued in one year during this period was 1 as was the case in 2011 and 2012. For the year 2010 there are no records of issued Mining Rights for diamonds from the North West province.
SAMRAD system and departmental administration challenges

SAMRAD ONLINE is a system where the general public can view the locality of applications, rights and permits made or held in terms of the MPRDA, and where applications in terms thereof can be submitted electronically (DMR Online Licence Application Portal, 2021).

According to the DMR (2011) the purpose of the SAMRAD system was to provide an integrated managerial system of information to improve the management of the administrative process supporting the mineral licensing administration. However from the personal experience gained during this project, interviews completed, a review of the literature, and the excellent study of the small diamond mining sector completed by Farrell (2012), it is clear that the SAMRAD licensing application system, which was meant to introduce transparency and to reduce the administrative burden on potential investors, has proven to be an obstacle to efficient, rapid, and cost effective licence and permit applications almost from the day it was launched.

In the lead up to the launch of the SAMRAD system in 2011, Minister Susan Shabangu placed a moratorium on all new prospecting right applications under the MPRDA for an initial period of six months from the 31st August 2010, so that existing applications could be loaded into the new system. This moratorium was then extended until 28th February 2011 (Faure, 2011), and then again until the 18th April 2011 (Shabangu, 2011, 2012). During this period no new prospecting or mining rights could be submitted.

The research by Farrell published in 2012 indicated that only half of applicants who tried to log onto the SAMRAD system were successful and significantly, more than tried to log onto the SAMRAD system were indicated that only half of applicants who could be submitted.

The research by Farrell published in 2012 took the initiative to investigate the operational success of the system and a small working committee was formed with the DMR to eradicate arising problems. The DMR observed that one of the major problems was, that originally the SAMRAD system had been designed to only deal with applications, but had subsequently been expanded, which resulted in the system being unable to cope with the workload. The DMR apologised to the COM (MC) and industry for the problems arising from the SAMRAD system (Misole, 2012). The challenges, namely:

(a) human resources;
(b) financial resources;
(c) change management; and
(d) training, were mainly due to short timeframes for testing the system’s effectiveness.

A task team was appointed in April 2012 to train DMR officials in each province and to eradicate problems identified by the COM review committee.

During this initial inadequate functioning of the SAMRAD system no new prospecting rights were being processed, which for larger companies, had a huge impact on business continuity plans, especially where current licences were due to expire. Other practical problems were also soon apparent and remain to this day. The NCP for example has a huge number of semi-literate people. Most of the Small-scale Artisanal miners are illiterate, not trained in computer skills and do not have access to computers. The SAMRAD system does not allow applicants to fill in forms and directly submit copies thereof. Completing templates in Word and Excel format and uploading in pdf format complicated matters further and effectively excluded small and emerging miners from being able to lodge legitimate applications cost effectively. The DMR previously indicated that they will assist Small scale miners with the uploading of documents unto the system but will not complete documents on their behalf (Mazabane, 2008) but this was also an inefficient intervention given the lack of capacity within the DMR.

Regrettably the outcome of the poorly researched and implemented SAMRAD system is that Small and Junior miners, and explorers, were forced to resort to the use of expensive consultants and legal advisors to manage and drive the application system on their behalf. This simply adds to the costs, time delays, and frustrations of Small operators, and caused many to exit the industry or operate illegally.

Large companies and mining houses already had large legal, environmental and compliance departments which could process and track applications but the system still added unnecessary costs. Foreign investors were also put off by the challenges of applying for exploration, prospecting, and mining rights, given that in many other parts of the world applications for early-stage exploration and prospecting rights can be done remotely via tick-box approach with simple, and cost-effective application, processing and monitoring procedures. The information collected was primarily from alluvial diamond operations, but a number of small kimberlite operations, including closed operations were also visited.

The primary data included in the SDMD as outlined in Table 10 was summarised in an Excel spreadsheet which can be easily updated and continuously improved in the future, while supplementary information gathered through interviews and from other sources and searches has been documented and summarized in tables included in the following chapter.

In spite of concerted attempts to locate and utilise additional information and supplementary information from other sources, including DMRE publications and regional offices in the NCP and NWP, this proved to be generally disappointing and not particularly helpful. It was difficult to locate and extract precise information such as locality, size of the mining activity, period for which the operations had been active, whether the licences were still valid and for how long, or whether the licences had expired. On the other hand, internet searches and company documents for publicly listed entities proved most useful.

Overall, the two periods spent in the DMRE Kimberley (approximately 4 weeks) and Klerksdorp DMRE office (2 weeks) through the kind efforts and support of the Regional Managers, was informative for the project, but added little useful beneficial data for the overall project.

Summary

In summary a number of activities, engagements and interventions were undertaken to collect reliable and meaningful data and information relating to the structure, activities, successes and frustrations of the Small and Junior diamond mining sector.
Number of operations identified and visited

Table 11 shows that an overall 72 operations were visited, 66 of which were operating, a further 95 over-flight points were recorded, and additional information was obtained for a further 52 localities from company press releases, published sources, and telephonic conversations.

Collectively this study indicates that there were approximately 220 Small and Junior mining operations, projects, start-up, care and maintenance, and closed operations in March 2020 (Table 11). A total of sixty two (62) interviews and discussions were conducted during site visits with information from the remaining 10 localities obtained from the internet and discussions with geologists involved at some of the sites.

About 45% of the interviewees expressed a negative outlook for the industry, with these opinions including general frustration about ineffective mineral and mining policy and DMRE inefficiency and performance, feelings of wanting to quit, scepticism, and worry about security, and related aspects. Only 22% of the overall interviewees expressed a positive outlook on the industry, with the rest being non-committal. The majority of the sites visited were of alluvial diamond operations, which included small, medium and large inland operations, marine diamond mining contractors on the west coast, and contract mining operators (mainly marine, and some land-based) at Alexkor and the Lower Orange River (LOR). Six (6) small kimberlite diamond mines including tailings retreatment operations, tailings retreatment activities, and closed operations, were also visited.

<table>
<thead>
<tr>
<th>Localities</th>
<th>Operations Visited</th>
<th>Flight Points Recorded</th>
<th>Other Sources</th>
<th>Total</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>Kimose alluvial, Thomyfushi (Klippringle) kimberlite fissures</td>
</tr>
<tr>
<td>NWP</td>
<td>36</td>
<td>52</td>
<td>2</td>
<td>80</td>
<td>Mainly located in NWP diamond triangle and Vaal River proximity</td>
</tr>
<tr>
<td>NCP</td>
<td>10</td>
<td>34</td>
<td>6</td>
<td>45</td>
<td>Primarily Vaal and Orange River</td>
</tr>
<tr>
<td>MOR</td>
<td>8</td>
<td>9</td>
<td>17</td>
<td>35</td>
<td>Between Douglas and Prieska</td>
</tr>
<tr>
<td>LOR</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>13</td>
<td>Old Trans Hex Operations</td>
</tr>
<tr>
<td>West Coast (Alexkor)</td>
<td>10</td>
<td>3</td>
<td>4</td>
<td>17</td>
<td>Orange River mouth to Port Nolloth coastal land and marine strip. Mainly small boat and beach operations, limited number of land mining ventures</td>
</tr>
<tr>
<td>West Coast (The Punt)</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>Ollants River mouth area, mostly small boat and beach mining operations</td>
</tr>
<tr>
<td>Small kimberlites</td>
<td>6</td>
<td></td>
<td>14</td>
<td>20</td>
<td>Primarily located in the NCP (see Table 12)</td>
</tr>
<tr>
<td>Tailings Operations</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>Kimberley (Klapa), Jagtvoorfontein (Heenst), Leisler (Golden Falls), Robert Victor (Private)</td>
</tr>
<tr>
<td>Care and Maintenance</td>
<td>4</td>
<td>11</td>
<td>10</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Start-up Projects</td>
<td>3</td>
<td></td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>72</td>
<td>96</td>
<td>53</td>
<td>220</td>
<td></td>
</tr>
<tr>
<td>Kimberlite Mines</td>
<td>Locality</td>
<td>History/Current Status</td>
<td>Comments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>----------</td>
<td>------------------------</td>
<td>----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>BelAfrik/San Carl (Frontier Diamonds Ltd, 100%)</td>
<td>Ghaap; Ewerpark (Ranky West District), NCP</td>
<td>Flooded (Company has ceased operations)</td>
<td>Type 2 Kimberlite, unlikely to be re-developed; historically produced high quality diamonds; previous owner Sedergren/Petra Diamonds.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Frank Smith (Private company)</td>
<td>Ranky West District, NCP</td>
<td>Care and maintenance; recent drilling work completed, same owner as Lothian below (P14)</td>
<td>U/L mine; low grade but high quality diamonds; requires major recapitalisation; some remaining tailings retreatment potential.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Scudderpden (Private company)</td>
<td>Roshoff Road, FSP</td>
<td>Interimment small-scale tailings retreatment</td>
<td>U/L mine; needs recapitalisation.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Roberts Victor (Private company)</td>
<td>Roshoff Road, FSP</td>
<td>U/L sealed off due to fatalities caused by a mud rush; Tailings retreatment caused in late 2015</td>
<td>Limited tailings retreatment options, but small, low value diamonds.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>New Elands (Private company)</td>
<td>Roshoff Road, FSP</td>
<td>Closed</td>
<td>Old mine, marginal. Unlikely to be redeveloped.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Zou in Zuur (Private company)</td>
<td>Roshoff Road, FSP</td>
<td>Fissure mine, small past production, Flooded</td>
<td>Unlikely to be redeveloped; mineral rights were hijacked; litigation costs pre-empted development work.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Helam Fissure Mine</td>
<td>Swartburg, NWP</td>
<td>Redevelopment and modernisation underway subject to adequate funding being available (Information source = Davidson pers comm)</td>
<td>U/L mine; planned new development will provide +10years LOE; initially support ~ 170 employees; presently reworking tailings.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Jagersfontein (Private company)</td>
<td>FSP</td>
<td>Actively retreating old tailings</td>
<td>Marginal operation; badly impacted by political/ community interference requiring excessive legal costs.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Kimberley Tailings dumps (Ekapa Mining, private mining company)</td>
<td>Kimberley, NCP</td>
<td>Costs of security, illegal miners, and depressed diamond prices for small goods impacting sustainability</td>
<td>Employ about 2,000 local people in Kimberley, Ekapa Mining, private mining company.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Kuwater Kimberlite (Private company)</td>
<td>NW of Postmasburg; NCP</td>
<td>Small Kimberlite pipe undergoing sampling and testing (similar to Malakgane in same general area)</td>
<td>Small Group-2 Kimberlite under evaluation; some previous sampling done by Moisone Diamonds in late 1990s.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Lace Mine (Elerarat/ECC)</td>
<td>Kroonstad District; NCP</td>
<td>Flooded</td>
<td>U/L mine; unlikely to be re-explored and redeveloped; 3 kilns from Voorspoed.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Laagte Fissure Mine (Private company)</td>
<td>Windcourt area, adjacent to Holan akaiveld mine; NCP</td>
<td>Chequered past history involving fraud and misappropriation of shareholder funds</td>
<td>Type 1 Kimberlite; Low grade, limited tailings retreatment potential; Current owner Golden Fossils (Melior) Ltd.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Compliment Fissure (Private owner)</td>
<td>Samara Road (east of Kimberley), FSP</td>
<td>Care and maintenance</td>
<td>Small kimberlite, U/L mine, owned out of Hong Kong looking to redevelop this mine, as well as Frank Smith.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Newlands Fissure Mine (Private Mine)</td>
<td>Barkley West District, NCP</td>
<td>Care and maintenance; up for sale?</td>
<td>U/L mine, high value kimberlite, possible large stone producer, hence renewed interest.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Sandia/Kaazalis (Private company)</td>
<td>Near Welkom, FSP</td>
<td>Mined briefly in 1980s, 90% then closed, prospecting planned to large stone, possibly kimberlite</td>
<td>Type 1 kimberlite; small scale fissure mining operations, winterly extension of the Sober fissures.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Star Fissure Mine (Frontier Diamonds Ltd)</td>
<td>Theunissen, FSP</td>
<td>Closed, infrastructure and headgear stripped in 2020</td>
<td>Group 7 kimberlite; Fissure mine.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Thimphu Fissure Mine (Sedergren/Petra Diamonds, public company, AIM, London)</td>
<td>Limpopo Province</td>
<td>Prospecting program underway</td>
<td>Type 2 research as kimberlite; Extension of Klipdrift kimberlite (Manfredt's) fissures.</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Voorspoed (De Beers)</td>
<td>Kroonstad District; FSP</td>
<td>Care and maintenance</td>
<td>Type 1 kimberlite; Open pit, requires drilling, detailed resource work, and new development; should be developed in conjunction with Lase.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>West End Mine (Private company owner)</td>
<td>Postmasburg; NCP</td>
<td>Past small-scale production; business sold in 2019 to Black mining group</td>
<td>Small pipe/blow, will need recapitalisation and redevelopment; challenging given it is an old mine.</td>
<td></td>
</tr>
</tbody>
</table>

Unfortunately, this sector has also shrunk along with the rest of the Small and Junior diamond mining sector. Almost all of the small kimberlite localities visited (6 in total, and documented in Table 12) were closed, standing idle, and unlikely to ever be reopened. Only one locality, Helam fissure mine near Swartburgs (NWP), was being recapitalised and redeveloped, and prospecting of diamondiferous fissures was being conducted at Thorns (Klipspinger) in LP (Table 12). Problems and challenges faced and experienced by existing and previous Small kimberlite mine operators were once again the same as those experienced by the alluvial mining operators.

Cost and expenditure results

Table 13 (below) and Figure 22 (overleaf) show key costs (financial data) and employment parameters which were interrogated in the course of the study.

**Table 13: Details of the Small and Junior miners operating costs expressed as a percentage of Annual Turnover (AT)**

<table>
<thead>
<tr>
<th>NWP &amp; Vaal River NCP</th>
<th>MOR</th>
<th>LOR</th>
<th>WEST COURST (MARINE)</th>
<th>Average %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary spend</td>
<td>26%</td>
<td>29%</td>
<td>22%</td>
<td>18%</td>
</tr>
<tr>
<td>Employee training</td>
<td>5%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Compliance (H&amp;S, SLP,</td>
<td>5%</td>
<td>8%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>RA Levies, BEE, License</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applications, social and consultant fees</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel and lubricants, repair and maintenance</td>
<td>26%</td>
<td>25%</td>
<td>24%</td>
<td>15%</td>
</tr>
<tr>
<td>Eskom power / self generation</td>
<td>5%</td>
<td>4%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Security and insurance</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Interest financing and loans</td>
<td>11%</td>
<td>12%</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Projects (State and permit holders)</td>
<td>11%</td>
<td>12%</td>
<td>22%</td>
<td>15%</td>
</tr>
<tr>
<td>Diamond sales (1.5 – 2%)</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Profit</td>
<td>8%</td>
<td>7%</td>
<td>6%</td>
<td>15%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Capital cost of plant, equipment (estimates)

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>$900 m (2x16 foot Pan operation)</td>
</tr>
<tr>
<td>loafers</td>
<td>$135.50 m (4 x 16 foot Pan, de-sanding, operation)</td>
</tr>
<tr>
<td>Smaller gold operations</td>
<td>$85.50 m (4 x 16 foot Pan, de-sanding, operation)</td>
</tr>
<tr>
<td>Consolidation or small scale venture, short life or boat operation</td>
<td>$35 m</td>
</tr>
</tbody>
</table>

Sources: 
- Information compiled in the Small Miners survey and database from this study
- Estimates from a limited number of operators and equipment suppliers, and additional supporting data from Delahorne (2018), and PhD in preparation.
**Employee numbers**

Overall, the study and data collected shows that the Small and Junior diamond operators on average employ 26 employees and spend an average of about 23% of their Annual Turnover on salaries.

The MOR operations employ the most people (average 56) with these larger operations spending proportionally less (approximately 22%) of the Annual Turnover on employee remuneration and more on operational costs such as diesel, maintenance, and equipment, given the more challenging geology and hard calcite layers covering the gravel deposits in this area.

The West Coast diving operations employ the least number of people, with an average of about 10 per operation.

These are generally smaller than inland operations and typically involve small converted fishing boat diving and dredging operations, or shallow water diving operations with suction pumps off the shore line.

The study was focussed on reviewing the extent and footprint of the existing industry, the number of operators still active in the sector (for comparison with numbers determined in previous studies), the overall geology and characteristics of the deposits, the style of operations, financial information and the challenges and frustrations faced by the existing operators. There is still additional information and work to be done on this sector, but the intention of this report was to provide an initial overview of the existing industry, and a platform and database for ongoing future studies.

**Questionnaire responses**

A summary of the results of interviews undertaken with Small and Junior diamond miners are presented in Table 14. The interviews and discussions with owner/operators from a range of operations were particularly informative. In all cases the owners and operators were most positive and forthcoming about their operations and expenditures, though from the outset it was decided that getting into sensitive financial details would be counterproductive to the aims of this study.

The six most common challenges were the difficulty of attracting and finding skilled labour and labour costs given the poor levels of education and productivity.

These 6 concerns were flagged by 86%, 83%, 69%, 54%, 62% and 52% respectively, of the operators from the NWP, Vaal River (NWP and NCP), MOR (NCP), LOR (NCP), and West Coast respectively and results are presented in Table 14, part A overleaf.

Other concerns raised and documented in respect of the six most common challenges were the difficulty of attracting and finding skilled labour and labour costs given the poor levels of education and productivity.

Because operators in the West Coast of South Africa mostly operate as contractors on licences held by companies such as Alexkor, LOR (Lower Orange River), and Trans Hex, the issue of waiting periods for the granting of licences was less of a concern. However, several contract diver-operators on the West Coast of South Africa expressed a longing to be able to go through the licence application process so as to operate on their own licences.

The other concerns summarised in Part B of Table 14 overleaf are again highly relevant and were raised repeatedly by all the parties interviewed, including small and informal miners encountered during the study, as well as consultants and a range of interested parties with involvement in the industry.

In respect of the results from the questionnaires and interviews, 6 key concerns expressed by the owners and operators were:

1. The safety and security of their operations and personnel
2. Lengthy waiting periods for licence applications to be processed and granted and general inefficiency of the DMRE offices
3. Unreliable and increasingly expensive Eskom electricity supply
4. Challenges in respect of BBBEE compliance
5. Finding and retaining skilled labour
6. Labour costs given poor education, and skills sets

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**Item 11, the lack of recognition of the sector by numerous operators and stakeholders was also seen as a very real and worrying aspect of the sector.**
**Complexity and costs of applications**

*SHA Mining Permit Responses*

During this study, emerging Small-scale Black diamond miners were engaged with and their challenges in respect of trying to become committed and long-term alluvial diamond miners were shared and documented. From the outset of these discussions, it was apparent that this aspiring group of small miners are severely hampered in respect of trying to become alluvial miners, regardless of them being unequivocally historically disadvantaged South African citizens. They more than anyone receive no support for their endeavours regardless of the many promises made over the years by the likes of the Minister and Deputy Ministers of Minerals and Energy.

Four individuals trying to establish small scale mining prospects and operations were engaged with. They included Mr K (and his three Sons) from Longlands, Mr H and Mr J (trying to obtain Sha mining permits at Bakerville), and Mr M trying to revive and renew a mining licence also at Bakerville. In every case the lack of institutional support, including access to information (CGS), basic technical support (Mintek), mentoring (DMRE), and seed-funding to cover costs were unattainable and non-existent. Mr K had through an acquaintance managed to have a Basic Assessment Report (BAR) completed for his Sha Mining Permit at Longlands at a discounted cost of about R65 000, but then had no money left for mining tools and access to water so was unable to operate.

In the case of the Bakerville applicants, Mr R was endeavouring to initiate a pick and shovel operation on a previously mined piece of ground at Bakerville, an area which has experienced almost 100 years of intensive alluvial diamond exploitation with minimal rehabilitation. In this case an experienced diamond geologist offered to act as benefactor for the licence process and costs required for his Sha mining right. This process was officially launched in January 2020 after wasting nearly a month trying to sort overlapping applications and grants on the ineffective SAMRAD system.

This situation is one of the key reasons and drivers for the burgeoning illegal and unmanaged artisanal and Zama Zama mining growth in all commodities across South Africa.

To drive this application process, it was essential to utilise the resources of an experienced Consultant Group to handle the public consultation process and ensure paperwork was processed and moved through the DMRE office. The Covid-19 situation caused delays of about 6 weeks, and the grant was finally officially signed-off and awarded to Mr R some 6 months after application, to Mr M some 13 months after lodging the application in mid-January 2021 at an all-in cost of about R130 000 (Annexure 1).

This situation whereby a Sha mining permit takes as long as 13 months is untenable, and for an emerging honest HOSA Small-scale miner is unaffordable and unacceptable. This situation is one of the key reasons and drivers for the burgeoning illegal and unmanaged artisanal and Zama Zama mining growth in all commodities across South Africa.

**Prospecting Rights**

Alluvial Diamond Mining is a nomadic mining sector where deposits are difficult to evaluate as diamonds are only concentrated in specific areas. In practice, the majority of Small alluvial diamond miners move their whole mining operation at least once every 15 months, typically onto adjacent properties (Farms) on contiguous alluvial terrace or ‘run’ that may stretch over hundreds of square kilometres and which don’t adhere to man-made boundaries.

A further key contributor to this challenge is that many deposits have also been worked extensively in the past, typically without utilising known geological information and less efficient technology. Hence some of the previously mined contiguous areas will be unprofitable, whereas other parts of these same geological deposits can be mined profitably today using modern mining methods. Modern mapping, revised geological interpretations and new geological models of areas that were considered in the past to be depleted due to historical mining, have now shown the existence of extensive previously unrecognised diamond resources, as for example in the Schwartzweber–Christiana-Wolmanrand diamond-triangle of the NWP.

For the above reasons it is crucial that Prospecting Right (and Mining Right) applications be expedited and issued in a timely manner, for example a maximum of four (4) months after application, to ensure that continuous operations can progress across farm boundaries. Ideally in these situations Permits should be automatically extended and granted across farm boundaries where the size and format of the operations do not change, instead in many cases, taking months and years to be granted. In these latter circumstances the time delays and costs of stop-start operations are unaffordable, causing mine closures, job losses and economic hardship.
Illegal miners (Zama Zamas)

The presence of Zama Zamas in the gold mining industry and their negative impact on the income of gold mining industries, loss of income to the state, and the degrading impact on law and order in the areas that they operate in, is well documented.

During the past 5 years, the Zama Zamas phenomenon has spilled over to the diamond mining industry in the Kimberley and West Coast areas. The main reasons for this are:

- High rates of unemployment in the surrounding communities
- The withdrawal of large companies that owned these deposits and the inability of smaller companies with fewer resources to secure these areas
- The inability of the local law enforcement agencies to apply the rules of law due to corruption, lack of resources and skill
- The inability of the local DMRE offices to mediate between the different parties to legalise these operations
- Frustration from Small mining entrepreneurs with the slow and expensive permitting system.

As these issues were not addressed right from the onset, it allowed organised crime syndicates a foothold and the situation especially in Kimberley has generally been chaotic. Small mining entrepreneurs that were issued with permits under a deal with Ekapa Mining in Kimberley (who were previously in a joint venture with Petra Diamonds) have been forced off their ground by syndicates and disgruntled residents who did not get ground to mine on.

There are however also examples where collaboration between small miners from local communities and larger companies have proven very successful. For example the collaboration between the Lower Orange River (LOR) mid to large scale diamond mining operations, and the small artisanal miners from local communities, first instituted and successfully operated under the previous ownership of the Trans Hex Group (see THG, 1998), provides an excellent example whereby artisanal operators and larger companies can work together if the type of deposit allows it.

Local beneficiation

In order to make diamonds available for local beneficiation, local producers can obtain exemption from a 5% export levy enacted by the South African Diamond and Precious Metals Regulator (SADPMR), provided they ensure that 15% by value of their production is beneficiated over a 6-months production cycle.

By exporting to large diamond centres like Dubai, Antwerp, Israel and India, small diamond producers (rough diamonds) are exposed to a much larger audience than those prepared to travel to South Africa and they can potentially earn higher prices. Hardly any of the producers interviewed considered using this process to export their diamonds. The main reason was that 15% of their value was too high to benefit from the beneficiation gains.

Unfortunately, the diamond beneficiation sector in RSA has also shown a strong decline since about 2000, in spite of efforts by the State Diamond Trader (SDT) to ensure that up to 10% of local rough production is bought at effectively ‘discounted’ market prices for redistribution to historically disadvantaged cutters and polishers.

However, at this point the matter of beneficiation in RSA is not a focus of this study, though it is a related challenge for Small diamond miners and requires attention for the benefit of all parties, including new entrants to diamond manufacturing.

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Summary

Compared with its heyday between the 1990s and early 2000s, today’s Small and Junior diamond mining sector is but a shadow of its past. In 2000, prior to South Africa’s changes to mineral policy ownership and regulations, and introduction of new ownership requirements, this sector supported some 2,000 small and medium-sized private and listed operators (Farrell, 2012).

Results collected in this study in terms of the number of operations and their employment numbers are summarised, together with previous information from other sources including Farrell (2012), DMRE publications from prior to 2015, literature reviews, and interviews and discussions with several experienced diamond geologists and proprietors of Global Diamond Network all attest to the strong decline of the industry since 2012 as shown in Figure 3.

This recent study has highlighted that there are currently about 216 operations and projects either on care and maintenance or being restarted, representing a decline of about 90% since the year 2000. A small part of this (at most 20%) can possibly be ascribed to the ‘age’ of the sector and past or historical exploitation of easy to mine higher grade deposits. However, as highlighted in Chapter 3 (Table 4) there have been substantive technological advances in the geological understanding, delineation of deposits, mining, processing, and in particular recovery of diamonds which more than offset the decline in grades.

As a consequence of the steep decline (~90%) in the number of Small and Junior diamond mines from the year 2004 to 2020, there has been a concomitant significant loss of jobs as employee numbers have decreased from about 25,000 in year 2000, to about 5,278 in year 2020 as shown in Figure 3.

The economic impact of these job losses amongst communities and small town such as Port Nolloth, Prieska, Douglas, and Kimberley in the NCP, and Bloemhof, Schweitzer Reinecke, and Wolmaranstad, amongst others in the NWP, are obvious and significant in terms of economic decline in these regions. This aspect is discussed further in Chapter 7.

In this section developments in the mining sector and the impacts the decline in mining activity, including the very obvious contraction of the small diamond mining sector is considered broadly against the backdrop of the economic challenges, impacts, and unemployment situation faced by the Northern Cape Province. At the outset it should be noted that obtaining reliable and up-to-date economic, GDP, employment, and sectorial information for the individual provinces is challenging, and hence this initial analysis has been done at a high level, with the intention of following up with more detailed analysis at a later stage.

Economic summary

South Africa has a total of nine provinces: Northern Cape, Eastern Cape, Free State, Western Cape, Limpopo, North West, KwaZulu Natal, Mpumalanga and Gauteng

Key details of the Northern Cape Province (NCP) are the following:

- It is the largest (372,889 km2) and most sparsely populated (population density ≤ 3.1/km²) province bordering the North West, Free State, Eastern Cape and Western Cape provinces.
- It comprises five district municipalities (Namaqua, Polokwane, ZF Mcwane, Frances Baard and John Taolo Gaetsewe).
- It has the smallest population share (21.5% in 2016), which falls under the smallest contribution to South Africa’s economy (11.3%) (Statistics South Africa, 2019).
- Mining was the largest primary industry contributor to the NCP economy (20.2% in 2015, and 17.5% in 2016).
- The earliest known exploration for minerals in South Africa was undertaken in the far west of the NCP in 1852 and lead to the discovery of copper near the modern day town of Springbok.
- The NCP has hosted a treasure trove of minerals in the past, a large portion of which (particularly diamonds) have been mined out since their discovery over 150 years ago – mineral deposits include diamonds, tigers eye, copper, zinc, iron ore, manganese, wollastonite, dimension stone, talc, rare-earth minerals hosted in monazite), heavy minerals, limestone, building materials and sand. Large areas of the Province are unexplored in a modern sense.
- Mining was the largest primary industry contributor to the NCP economy (20.2% in 2015, and 17.5% in 2016).
- The overall largest contributor the NCP economy is community services (22.0% in 2015, and 22.5% in 2016), which falls under the tertiary sector.
- The economy of the NCP made the smallest contribution to South Africa’s
This negative economic growth highlighted in the last bullet point above and in Figures 23 and 24 is largely attributed to a decrease in the economic activity of two primary sector industries: mining (e.g. -0.2% in 2015; -8.5% in 2016) and agriculture (e.g. 0.7% in 2015; -6.2% in 2016) (Northern Cape Provincial Treasury, 2018). Though the NCP economy picked up slightly in 2018, the overall negative trend, concomitant job losses, economic hardship, and poor service delivery is ongoing.

Notable also is that the overall decline in economic activity highlighted in Figure 24, shows a broadly similar declining trend to that shown by the progressive fall in diamonds production expressed in carats shown in Chapter 1, which in turn shows the alarming decline in the large diamond mining sector reflected by the withdrawal of Trans Hex from their Baken and LOR operations, De Beers Kleringse from their once highly productive West Coast operations, and De Beers exit of the Kimberley mines, all immensely damaging to the NCP.

Added to the above challenges has been the equally stark decline of the Small and Junior diamond mining sector, as reflected in Figure 3 at the start of this report. Regrettably the downward trend in numbers of small diamond mining operators and attendant job losses, is symptomatic of the challenges faced by entrepreneurs and small business across the country, all of whom are constrained by poor policy regimes and excessive red tape.

Because mining has been the largest contributor to the province’s economy ever since the discovery of diamonds in the province in 1866, and subsequently other world class mineral deposits, developing related secondary industries such as beneficiation of primary sector outputs, would have been beneficial and commendable. However, many attempts to develop sustainable diamond cutting and polishing facilities in Kimberley to boost local beneficiation have failed dismally (Krivitz, 2011, and Kolver, 2013).

The only potential recently proposed value-add diamond activity in the ‘home’ of diamonds is provided by Kimberley International Diamond and Jewellery Academy (KIDJA) which is intended to provide training (about 405 to date) interested in the diamond valuation, and cutting and polishing sector. This organisation has also found it challenging to keep its doors open. In similar vein, Vedanta Zinc International which recently made one of the largest private sector investments of approximately US$400 million (Global Africa Network, April, 2019) in the NCP at their Garmsgberg zinc mine, is proposing that they will look to secure off-shore smelting options due to the costly and unreliable electrical power from Eskom in RSA.

Unemployment in the Northern Cape Province is officially about 29% (Northern Cape Provincial Treasury, 2018; Statistics South Africa, 2021). If the expanded unemployment rate, “which includes the unemployed as well as those available for work who did not look for work” (Patsy, 2017) is included, then this unemployment figure is between about 42 and 50% (Statistics South Africa, 2018, 2021). In 2017 the province had about 65 000 discouraged jobseekers, a situation which has almost certainly got worse as employment in the mining and agriculture sectors has continued to fall through 2018 and 2019, and has been further exacerbated by the Covid-19 pandemic of 2020.

The decline in the Small diamond mining sector which has been confirmed in this study is regrettably part of a far larger job loss scenario being experienced across South Africa.

Mining remains an important employer employing about 10.6% of the labour force in the first quarter of 2017 (Northern Cape Provincial Treasury, 2018). Previously De Beers mining operations in Kimberley, Finnsch, and Kleringse on the west coast were a key mainstay of the economy, but Kimberley operations have contracted strongly and the old mines and tailings are now owned by Elkana Mining, and the Kleringse operations in Namakaland have shut down with dire consequence for employment in the region. Trans Hex, once a thriving junior diamond miner on the Lower Orange River and coastal deposits has also ceased operating in the Northern Cape, and Alexkor, the state diamond miner, is also struggling and retrenched employers in 2019.

Large mining companies still operating in the province include Kumba Iron-Ore an Anglo American plc subsidiary, Assmang Manganese (jointly owned and managed by African Rainbow Minerals and Assore), South32 Manganese, Kgalagadi Manganese, Vedanta lead and zinc (Black Mountain), and Petra Diamonds, with some mid-tier operations also active in the manganese sector.

Onion Minerals is also looking to reopen...
Unemployment and illegal mining – Zama Zamas

During this study of South Africa's Small and Junior diamond miners, there were also visits and engagements with illegal artisanal miners active on the Kenilworth Floors (previously a large kimberlite tailings dump) on the north-east side of Kimberley.

The more extensive activities of illegal diamond miners around greater Kimberley were also noted on trips to this town, and equally in Namaqualand where illegal mining activities are prevalent in the old Klerksdorp mine workings and tailings, the Lower Orange River areas previously mined by the Trans Hex Group, and parts of the Alexkor concession. The activities of Ekapa and Petra Diamonds in respect of their efforts to formalise illegal artisanal activities around Kimberley were also followed during the course of this study.

Mine owners Ekapa Diamonds and Petra Diamonds (Petra has subsequently entered their joint venture with Ekapa) granted more than 800 unlicensed, or informal, Small-scale miners the right to legally mine about 600ha of diamond-rich waste fields. This project was launched in the middle of 2018 in Kimberley, the site of a 19th-century diamond rush that lured fortune-seekers from about the world. Regrettably this first South African project to bring illegal miners into the formal fold has been plagued by violence in diamond capital Kimberley, creating challenges to national efforts to stem a booming illicit trade.

The aim of the government-backed scheme was to curb illegal mining and black-market trade of diamonds, and serve as a blueprint for future attempts elsewhere in the country, not only in the diamond sector, but also potentially manganese, gold and chrome. However the project has suffered from regular violence, with informal miners not included in the scheme attacking infrastructure, cutting and stealing fences, petrol-bombing three Ekapa trucks, blocking access roads with rocks and burning tyres, attacking security guards, and even members of the newly licensed co-operative, according to mine owner Ekapa Minerals, which is running the initiative.

The issues faced by this pilot scheme is a challenge to wider corporate and governmental efforts to bring SA’s estimated tens of thousands of informal miners, or Zama Zamas, into the mainstream, to boost productivity and curb crime. According to 2017 estimates by the Minerals Council of South Africa, illicit mining and mineral trading cost about $1.5bn (R17.3bn) a year in lost sales, taxes and royalties, and sees criminal networks exploit vulnerable workers struggling to make ends meet.

While the government had previously acted in an advisory capacity, particularly so the previous Deputy Minister Gwede Mantashe said he was not happy because it (informal mining) must not be in the periphery" (Reuters, 2019).

The Ekapa project's troubles demonstrate the downside of piecemeal formalisation of projects and policy in a country whose regulation of Small-scale mining lags far behind its African counterparts. Ekapa and Petra Diamonds (previously a joint venture partner of Ekapa), launched the initiative in 2018 at Kimberley, in the Northern Cape, hoping to address the problem of an influx of Zama Zamas, a Zu‘ derived word which loosely translates as “keep trying".

Estimates made by Ekapa indicated that as much as R6m (approximately US$400 300) worth of diamonds were being taken by illegal miners each month. In a bid to stem that, the company formed 836 miners into the Batho Pele mining co-operative, according to mine owner Ekapa Minerals, which is running the initiative.

Zama Zamas with 'Shaker screen'

The overall track record on the ground is not promising. Illegal miners who are not part of the cooperative have stolen fences, petrol-bombed Ekapa trucks, regularly blocked access roads with rocks and burning tyres, sabotaged a waste pipeline, shutting down the mine processing plant. Ekapa security teams have been attacked with knives, slingshots, rocks, petrol bombs and, in one instance, a hunting rifle, the company said.

Declining large-scale mining industry

Diamonds found in the Northern Cape, be they old tailings deposits, kimberlite mines, low grade alluvial deposits, or the remnants of once extensive marine alluvial deposits on the Namaqualand west coast are finite and rapidly declining assets. The majority of the primary diamond sources (kimberlite pipe mines) of the province are some 150 years old and rapidly approaching final closure.

Production from the once famous large underground Kimberley diamond mines has almost ceased, reprocessing of the extensive old mine tailings dumps around Kimberley is also declining and becoming marginal, and diamonds being recovered from "floors" and remnants of tailings by the Artisanal Mining co-operative, for example, are expected to run out in about five years. Likewise the deposits of the West Coast such as Alesker have been exploited for some 90 years, and the large tracts of beach deposits mined previously by De Beers at Kleinsee and Trans Hex along the west coast are largely depleted.

In the case of the project created by Ekapa Mining and its then partner Petra Diamonds, the view of 44-year-old miner Kagiso Nofomela who hails from the town of Kuruman some 242kms away was that ‘our dream is that, when we give the land back to Ekapa, 90% of us will have something in our pockets, we must have money, cars, homes and our kids must be educated.’ Unfortunately, examples from South Africa and the rest of Africa show that very few informal miners ever accumulate real wealth, and instead unemployment continues to grow, and disease and poor working conditions result in illnss and death.
Increased security activities and bolstering of its security defences, and health and safety procedures to deal with the illegal miners drove Ekapa’s security costs up to about R700,000 per month before the project began, and the company has had to continually enhance security processes at considerable cost. It also reported to using alternative, longer routes for its trucks, adding to the company’s financial burden. A police spokesperson interviewed in November 2019 said its records showed 22 criminal incidents linked to illegal mining across Ekapa’s property and the area mined by Batho Pele between March and October in 2019, including an attempted murder and three serious assaults. Members of the co-operative, who cannot afford formal security, have also been targeted.

“The problem that we are encountering now is from the other Zama Zamas. They want to enter this thing with force,” said Batho-Pele cooperative member Victor Taku. “They come here with weapons, others come here with firearms, others come here with a spade” (Reuters, 2019). The 44-year-old Taku paid for his son’s university fees with the money he made mining. With joblessness in South Africa at an 11-year high and the economy in distress, that income is out of reach for many South Africans.

The Ekapa project’s considerable challenges and related costs of safety and security, highlight the need for the government to provide clear policy on small-scale or artisanal mining using rudimentary techniques. In contrast with other African countries such as Mali, Democratic Republic of Congo, and Tanzania, South African law has no provisions for this. South Africa’s legislative framework “is just missing in action when it comes to artisanal and small-scale mining,” according to David Perkins, an economist at Mining Dialogues 360, an NGO (Webberg and Reid, November 2019). Illegal mining issues and attempts to formalise the activities of Zama Zamas are too big for companies to handle on their own, and for greater efforts including research of the problem, a review of artisanal or informal mining structures applied in countries north of South Africa, dialogue with all the parties, education, and meaningful policy interventions will be required as a priority.

The 44-year-old Taku paid for his son’s university fees with the money he made mining. With joblessness in South Africa at an 11-year high and the economy in distress, that income is out of reach for many South Africans.

Interestingly in Sierra Leone, a well known diamond producing country with extensive shallow alluvial deposits, and small kimberlite mines, the DeBeers Group launched a pilot project called GemFair (http://gemfair.com) in April 2018 incorporating digital innovation to trace and sell ethically sourced artisanal and small-scale mined (ASM) diamonds.

The project involves the development of a toolkit that can be used in the field to create secure and transparent source to market tracking (a Responsible Supply Chain of Minerals process), at the same time seeking to improve ethical standards, working conditions, and value for small-scale miners in this sector (Zerouki, 2019). According to a recent update of the project progress from DeBeers (Zerouki, 2020), the Sierra Leone initiative now has 94 mining sites participating in the project, from an initial start of 16 sites. It is regrettable that after nearly 150 years of diamond mining and experience in South Africa, a similar diamond initiative has not been implemented by the world’s best known diamond company in what used to be its own backyard.

Greater collaboration between law enforcement, government departments such as the DMRE, companies, and NGO’s will be needed to provide long term solutions for this challenge. Equally collaboration between law enforcement agencies, Government departments such as the DMRE, private security firms, and communities will be needed to try and address the multimillion-rand criminal operations that benefit from illegal mining.

Efforts to bring illegal mining into the mainstream are also hindered by a lack of accurate data about how many Zama Zama’s are involved, what income they generate, and under what conditions they work. In respect of the illegal miners around Kimberley, Northern Cape police commissioner Lieutenant-General Rismati Shivuri noted in 2019 “We have so many people that we don’t even know where they come from. That is the challenge we are having.” Researcher Pontsho Ledwaba (2017), of the Witwatersrand University in Johannesburg, has stated that there could be as many as 150,000 informal miners across RSA.

To plug this data gap the World Bank has proposed to government that it conduct a comprehensive study of artisanal mining, and may even fund it “Accurate, reliable data is an essential first step to understanding the sector, recognising miners and formalising their work”. However while the World Bank is apparently in continuing dialogue with the South African government, no study of the sector is planned at this time. Even should formalisation projects such as that at Kimberley ultimately prove successful, another important question looms in the longer term: What happens to the small-scale miners when the resources run out, and where do they go? I

The economic challenges and joblessness outlined above are not unique to the NCP. They are increasingly been faced by every other province in South Africa and the country as a whole, and point to an urgent need for enabling mineral and mining policies that will encourage development and new investment in the untapped resources of the NCP (and West Coast), NWP and country as a whole.

I

It is interesting to note that in 2019 “The Department of Mineral Resources believes that small-scale mining has an important role to play in the community upliftment, job creation and poverty alleviation” (Brand South Africa, 2012). Subsequently similar statements have been made by Government Ministers over the years in respect of small scale mining. This has included efforts to formalise illegal mining activities in the Kimberley area in mid-2018. However, a mixture of the ineffective legislative changes, rising costs, and other challenges such as unreliable and increasingly expensive electrical supply past the global financial crash (GFC) of 2008/2009 has, following a short-lived economic rebound, seen the economy of the NCP continue to show a decline and related loss of jobs. Interestingly other knowledgeable parties in the diamond industry have suggested that in spite of the setbacks imposed on the industry by the global financial crash GFC in 2008/2009 the extent and impact of the diamond mining activities across the Northern Cape, the industry had the potential to employ about 4 000 to 5 000 people more after 2009 (Kovats, 2011).
CONCLUSIONS

Decline of the Small and Junior diamond mining sector

An extensive regional study and survey of the Small and Junior diamond mining sector, which comprises primarily alluvial diamond operations, and minor kimberlite tailings and small kimberlite mine activity, was completed from late-2018 through to 2021 with the Covid-19 pandemic unfortunately impacting the project in 2020.

The geographical coverage and nature of the survey work, data collection, database structure, and analysis are summarised comprehensively in the previous sections of this report. This study has confirmed that this previously productive and successful small or Junior diamond mining industry has experienced steady decline since 2004 (Figure 25) when the Mineral and Petroleum Resources Development Act (MPRDA) was implemented, and continues to experience on-going challenges as highlighted in this report and summarised in Table 15 (see also African Mining, 2019; Bristow, 2017, 2018).

The Covid-19 pandemic of 2020 has had further far-reaching negative impact on the international and local diamond sector and been immensely challenging for the Small and Junior diamond sector. There is an urgent requirement for an immediate review of the existing disabling mineral policy interventions and mining policy frameworks that apply to this sector. Unless far reaching changes, and enabling and sustaining mineral policy interventions are implemented as soon as possible, the Small and Junior diamond mining and development sector will contract further; with negative consequences for employment and job creation in the depressed NCP (including the West Coast), NWP and elsewhere in South Africa.

At the time of the implementation of the MPRDA, there were approximately 2 000 diamond miners employing some 25 000 people (Farrell, 2012). Today that figure has plummeted to about 220 Small and Junior mining operators with a drastic reduction in employment numbers projected to be about 5 720. Since 2013, there also appears to have been about a 61% decrease in prospecting right applications in the NCP where the bulk of alluvial diamond mining takes place – largely the ambit of entrepreneurs, local private operators, and farmers. Like many other mining sectors, the diamond mining sector is also seeing rapid growth of illegal operations. Much of this on the back of poorly-considered policy.

This important Small mining sector faces considerable challenges and further decline unless its potential contributions in respect of the exceptional quality of its diamond production, financial contributions, and job creation benefits, are recognised and supported, and enabling mineral and mining policy is introduced as a priority.

Whereas the sector previously produced approximately 300 000 carats per year valued at R4.2 billion (~USD300 000 000 at an average price of USD1 000 per carat) with foreign exchange earnings from production estimated at R3.2 billion (SADPO, 2019), the industry faces declining production and revenue trends, and these have been further negatively impacted by the Covid-19 pandemic.

This important Small mining sector faces considerable challenges and further decline (De Meillon and Bristow, 2002) unless its potential contributions in respect of the exceptional quality of its diamond production, financial contributions, and job creation benefits, are recognised and supported, and enabling mineral and mining policy is introduced as a priority.

Whereas the Small and Junior diamond mining industry previously employed about 25 000 people in 2000 (Farrell, 2012), this latest study shows that employee numbers are about 5 720 with an annual salary bill of approximately R550 million. It is the primary employer in remote rural areas in the NWP and NCP where over 90% of the alluvial diamond mining is conducted, and where existing unemployment levels are officially at 50%, but in many small towns are considered to be as high as 80%.

Challenges faced by the sector

A collective summary which draws on the content of Table 14 and the authors extensive investigation of the Small and Junior diamond mining sector summarising the key causes for the decline of the industry is presented in Table 15 overlief.

These challenges are causing operators to consider leaving the industry, and unless meaningful interventions are made to address this situation the industry will continue to decline with further job losses and negative economic consequences already economically stressed NCP (including the West Coast), NWP, and elsewhere in the country.

Current mineral and mining policies, the Mining Charter 3 (MCh3) and associated Implementation Guidelines, and ‘one-size fits all’ MH+S Regulations make no distinction between the geology, mineral resources, structure, size, and funding differences between Small or Junior miners versus large private or publicly listed mining companies.

Unless the key differences between the two sectors are recognised, and enabling ‘fit for purpose’ mineral and mining policies are implemented for the Small and Junior mining sector, there will be an ongoing decline of South Africa’s entrepreneurial miners and job losses in vulnerable rural communities.
TABLE 15: Key challenges faced by Small and Junior diamond miners, including emergent miners based on research conducted during this project.

<table>
<thead>
<tr>
<th>CHALLENGES ACTIVITIES</th>
<th>IMPACTS/COMMENTS</th>
</tr>
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<tbody>
<tr>
<td>1 Safety and Security</td>
<td>Rising crime and lawlessness in rural and remote areas is becoming a challenge for small operators and their employees.</td>
</tr>
<tr>
<td>2 Mineral and Mining Policy Uncertainty</td>
<td>3 Mining Chart 3 years - Charter is unsuitable for small miners</td>
</tr>
<tr>
<td>3 Inefficiencies in the DMRE Systems and Processes</td>
<td>SAMRAD system is clumsy and requires replacement with a modern user-friendly system</td>
</tr>
<tr>
<td>4 Access to Information and Technical support</td>
<td>Impossible to secure geological information for small alluvial and kimberlite deposits</td>
</tr>
<tr>
<td>5 Onshore Mine Health and Safety Requirements</td>
<td>Current situation of one size fits all application of MNHS requirements is untenable</td>
</tr>
<tr>
<td>6 Water Use Licences and NEMA Requirements</td>
<td>Department of Water Affairs (DWA) is dysfunctional and time periods to attend to applications are untenable</td>
</tr>
<tr>
<td>7 Complex and Expansive Environmental and Rehabilitation requirements</td>
<td>NEMA requirements are appropriate to large mining operations such as deep level gold mines, and large PGM operations.</td>
</tr>
<tr>
<td>8 Social and Labour Plans</td>
<td>Operations are mostly in remote areas with short LOMs. Municipalities lack resources and capacity to implement SLP’s.</td>
</tr>
<tr>
<td>9 Unsustainable Compliance Costs</td>
<td>Compliance costs are typically as much as 5 – 10% of turnover for small operators which is disproportionate compared to large mining operations. Small scale operators are typical one mine ventures and costs cannot be shared across multiple operations.</td>
</tr>
<tr>
<td>10 Lack of Coordination between different Departments</td>
<td>Application processes for mineral rights involves several departments including DMRE, Water Affairs, Environment, Heritage local Municipalities. Lack of coordination between these institutions is confusing, time consuming, and costly. Particularly challenging and costly for Sha Mining Permit applicants, detrimental to new entrants and transformation.</td>
</tr>
<tr>
<td>11 Rising Costs destroying profitability</td>
<td>Inefficiencies of granting process, and increased compliance costs, impacting profitability. Eskom’s tariff hikes and unreliability (load shedding) are also challenging to small operators.</td>
</tr>
<tr>
<td>12 Volatile business</td>
<td>Diamond business and pricing has changed significantly since GFC of 2008/09. Price volatility has increased and small goods (Melee) are being impacted by synthetic or laboratory grown diamonds</td>
</tr>
<tr>
<td>13 Ownership of Mineral Rights</td>
<td>Substantial numbers of Mineral Right Licences are held in ownership structures that fail BEE objectives</td>
</tr>
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</table>

Key failings of RSA minerals and mining policy

The overarching and continued key failings of existing policy and series of mining charters published over the past several years, including the MC-III is that none of these policies and proposals acknowledge that South Africa’s mining sector is not a homogenous grouping of only large mining conglomerates. It is made up of players of all sizes from Small, Junior, Mid-tier, privately funded operators and mid-sized operations (collectively referred to as Junior miners), to large privately held multinational and publicly-owned operations.

MC-III overlooks the cost constraints and economic plight of the Small and Junior diamond producers, in an environment where these diamond producers are price-takers and cannot cover the additional burden of costly BEE deals, increasingly onerous compliance requirements, unrealistic procurement obligations, enterprise development, and employment equity by simply raising selling prices.

The requirements of MC-III and Implementation Guidelines tabled in December 2018, is that aside from being impractical from a situational perspective, they further complicate and increase operating costs of mining operations, unsustainably for Junior operators. The inevitable outcome will be the ongoing shutdown of operations and retrenchments in rural areas where there simply are no other prospects of decent employment.

The inevitable outcome will be the ongoing shutdown of operations and retrenchments in rural areas where there simply are no other prospects of decent employment.

The downstream impact will also be significant – diamond traders, cutting and polishing industries, jewellery manufacturing and retail sales into global markets will be severely impacted.

Upstream suppliers of goods and services could for example stand to lose some R2.1 billion in annual turnover derived from alluvial diamond mining activities.

Collapse of entrepreneurial businesses that have been shut out of the industry by onerous and ineffective policies and charters, and the large mining industry will be disastrous. Upstream suppliers of goods and services could for example stand to lose some R2.1 billion in annual turnover derived from alluvial diamond mining activities (SADPO, 2019; De Melion, 2020).
RECOMMENDATIONS TO REVIVE THE SMALL AND JUNIOR DIAMOND SECTOR

Potential of the alluvial sector and the Small and Junior miners

As reported in this study (see Figure 25, and Table 14) the Small diamond mining sector has shown a strong decline in the number of operations and jobs since 2000. This has impacted negatively on the economically challenged NCP and NWP, the West Coast, and many small towns and communities in remote parts of these provinces.

There are however still considerable resources of low-grade alluvial diamond deposits in the NWP, NCP, and LP which could be exploited to yield increased diamond production and revenue, additional job creating, and provide economic benefits to towns and communities in these provinces. Importantly the entrepreneurial skills, experience, and technology exists to exploit these deposits, will also be lost unless the importance of this sector is recognized and supported, and enabling mineral policy and regulations are introduced to revive its capacity and contributions.

As is already the case the informal and illegal (Zama Zama’s) diamond mining sector will expand if greater efforts are not made to properly support and grow the formal Small or Junior mining sector. Small and Junior miners have themselves developed considerable ‘home-grown’ expertise covering the geology, shallow strip or open-cast mining, fine-sand screening, gravel processing, diamond recovery, water recycling, and rehabilitation of these unique deposits.

The role of the Small and Junior explorers and miners

Worldwide, including in many countries in Africa such as Botswana and Namibia, Small and Junior exploration and mining businesses are the backbone of a healthy minerals industry.

History shows that most discoveries of new deposits are made by prospectors and Junior explorers and miners, as they are typically less risk-averse and more focused on exploration and early-stage development as a means of survival, compared to risk-averse Large or Senior mining companies.

Mineral discoveries that are ‘small’ or ‘mid-tier’ are exploited by Junior miners, whereas bigger deposits requiring large capital expenditure are typically built and mined through joint ventures between Junior and Senior companies or sold to Senior companies. This synergy between Junior and Senior companies is well documented worldwide and benefits the entire minerals sector.

A further reality is that ore bodies are finite thus there is a need for synergy between Junior explorers who are fleetfooted and make discoveries to replace old and depleted assets mined by the Senior mining operators, thereby ensuring the long-term sustainability of the minerals sector. This synergy is lacking in the current South African mining industry.

While low- and ultra-low grade alluvial diamonds are amongst the highest risk commodity to mine globally, the industry also has the lowest cost-entry relative to other minerals for Small and Junior miners. Given the many changes taking place in the international diamond industry, including the rapid growth and impact of synthetic or laboratory grown diamonds (LED’s) on Melee and smaller diamond sizes (< than 2 carats), and impact of technology such as Sarine, Galaxy, and lasers, in the cutting and polishing sector (middle of the Pipeline), the high quality and typically large alluvial gemstones mined from South Africa’s alluvial deposits are ideally positioned to benefit from these changes. The increasing demand for quality natural diamonds to fill niches in the middle and high-end value segments of the international diamond market provide opportunities for this sector.

Equally there have been considerable improvement and innovation in the technology available to delineate deposits, treat gravels, and recover diamonds, which add value to the industry and assist with the exploitation of ultra-low grade gravel deposits (see Table 7).

Recommendations, interventions, and changes to revive South Africa’s Small and Junior diamond mining sector are presented in Table 16.
Enabling policy framework

Properly researched and implemented enabling policy regime, including recognition and support for the existing, and previously much larger formal Small-mining sector, is clearly lacking in the local informal and small diamond mining sector, including the Ekapa efforts and Government’s formalisation of the Kimberley artisanal-miners or Zama Zama situation.

The current ineffective and challenging policy environment as depicted in Figure 26 opposite is hindering the survival and growth of the existing Small, Junior, and Large mining sectors and making it difficult to find solutions to sustain and grow these key sectors. The Small and Junior diamond mining sector with its entrepreneurial approach, experience, skills and technology could be creating many more jobs and economic benefit to financially stressed Provinces, and be providing increased production of high-quality gemstones to support more in-country beneficiation, and generate foreign exchange through international marketing and sales.

In contrast to the situation reflected in Figure 26, Figure 27 opposite reflects the situation in an optimally functioning minerals and mining regime where enabling minerals policy and reduced red-tape ensure growth and positive spin-offs for owners (companies), government, employees, job creation and communities.

Recommendations

The alluvial deposits, experience, skill sets and technologies exist in the country to revitalise and expand the small diamond mining sector. This will benefit financially-challenged provinces such as the NW and N Cape, and create new employment. A number of key recommendations or interventions are presented in Table 16 opposite address the challenges being experienced by the industry.

With revised and customised enabling mineral policy and regulations, the Small and Junior and less capital-intensive diamond mining sector should be a driver of transformation and an incubator for black-owned and operated entrepreneurial mining businesses. This will only happen if the MC-III policy makers recognise the pitfalls and problems of applying a ‘one-size fits all’ approach designed for a handful of large publicly-owned companies, to an industry dominated by small, privately-funded, entrepreneurial mining businesses. There is an urgent need for consultation between Government and the Junior mining industry to agree on amendments to MC-III policies and regulations that will enhance and promote transformation and empowerment in the industry, and at the same time ensure that the Junior sector is able to survive and continue to play a vital role in SA’s broader minerals industry.

TABLE 16: Recommendations to facilitate the revitalisation of the Small and Junior diamond mining sector

<table>
<thead>
<tr>
<th>RECOMMENDATIONS</th>
<th>PROCEDURES/BENEFITS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Construct ‘Fit for Purpose’ Artisanal, Small-scale, (ASM) and Junior Mining Charter Policies and Regulations</td>
<td>• Rewrite Charter and policies to reflect small-scale nature of operations &lt;br&gt;• Create Standard Templates for mineral right application procedures and requirements for different rights – viz. &lt;br&gt;• ASM operations &lt;br&gt;• Mining Permits &lt;br&gt;• Exploration and Prospecting Rights &lt;br&gt;• Mining Rights</td>
<td>• Unlock value from vast low-grade alluvial diamond deposits that occur in the NWP and N Cape &lt;br&gt;• Ensure that the Standard Template is used and applied consistently in all DMRE offices across the country and at HD &lt;br&gt;• The Draft ASM Mining Policy 2021 recently published by the DMRE is a positive development</td>
</tr>
<tr>
<td>2. Replace/Modestise the SAMRAD system and streamline processes for granting of minerals rights</td>
<td>• Create a functional and professional One-Stop Shop to harmonise processes and requirements of different departments</td>
<td>• Encourage new investment, particularly foreign investment &lt;br&gt;• Ensure that new entrants and HSSAs are able to acquire rights rapidly</td>
</tr>
<tr>
<td>3. Artisanal and Small-scale Mining Permits Establish effective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Small-miners – Prospecting/Mining Rights</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Junior-miners – Prospecting/Mining Rights</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Provide Financial Support for Emerging Miners (eg. Small-miners Development Fund)</td>
<td>• These operations are typically short term – 18 – 36 months</td>
<td></td>
</tr>
</tbody>
</table>

- Artisanal and Small-scale Mining Permits Establish effective:
- Small-miners – Prospecting/Mining Rights
- Junior-miners – Prospecting/Mining Rights
- Provide Financial Support for Emerging Miners (eg. Small-miners Development Fund)
Future developments and the impact of the Covid-19 pandemic

In respect of the future of the Small and Junior diamond mining sector, SADPO and its many committed members have over the past three and a half years made considerable efforts and interventions to highlight necessary legislative and regulatory challenges, reduce red-tape, and to provide solutions to sustain and grow this key sector and drive transformation.

South Africa currently lacks a healthy junior exploration and mining sector. Key members of the SADPO management team, including Amo Mangena, Gert Van Niekerk and Lyndon De Meillon, and many existing and aspiring small miners, amongst others, consider the revival of South Africa’s Small and Junior diamond sector as the catalyst for the growth of the sector, revival of job creation, and importantly, transformation and creation of genuine HDSA ownership.

SADPO has also highlighted that the Covid-19 pandemic and world-wide lockdowns in 2020 and 2021 and the consequences thereof, are proving to be most challenging for the international and local diamond sector. However, the Small and Junior diamond entrepreneurs are resilient and already many of these operators are adapting to the harsh challenges created by Covid-19. Notably, the large size-ranges and exceptional gemstone quality of the unique alluvial diamonds produced by the Small and Junior operators in South Africa, including the NWP, NCP, and West Coast, have been amongst the first diamond production parcels to show recovery of demand and prices as the constraints of the pandemic eased in early 2021. The turnaround and renewed growth of this sector has excellent upside potential if an enabling mineral and mining policy environment is implemented to assist in reviving economic growth in the NCP, including the West Coast, and NWP as a priority. Every effort and opportunity should be pursued with and by Government, the DMRE, policy makers, the mining and operating entities, employees, and communities, to drive positive interventions and enabling mineral policies to revive this sector for the benefit of all stakeholders.

Importantly these interventions should be aimed at driving transformation of the Small and Junior sector, creating economic development and employment, and uplifting communities in remote and depressed regions.

Notes: cpht – carats per hundred tonnes; NWP – North West Province; NCP – Northern Cape Province

**TABLE 16: Recommendations to facilitate the revitalisation of the Small diamond mining sector continued**

<table>
<thead>
<tr>
<th>No.</th>
<th>Implement a Small Miners Levy or Royalty (eg. 2%) to underwrite a Fund to contribute to the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>• Small Miners Development Fund</td>
</tr>
<tr>
<td></td>
<td>• Implement effective SLPs and other programs on a region by region basis</td>
</tr>
<tr>
<td></td>
<td>• Government to contribute on a Rand for Rand basis</td>
</tr>
<tr>
<td></td>
<td>• Replace ineffective SLPs, Procurement, and related requirements with Miners Levy and Development Fund</td>
</tr>
<tr>
<td></td>
<td>• Accommodate other Implementation Guideline requirements in this levy or royalty structure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Develop Enabling and Effective Policies and Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>• To Formalise Illegal (Zama Zama) Miner and Revitalise the Small-scale Diamond Mining Sector</td>
</tr>
<tr>
<td></td>
<td>• Ensure that transparent marketing and sales structure are set up to purchase diamonds from</td>
</tr>
<tr>
<td></td>
<td>Artisanal and Small-scale miners and prevent illegal sales and loss of revenue to the State</td>
</tr>
<tr>
<td></td>
<td>• Leverage experience, skills, and modern technology applied to Small and Junior diamond mining</td>
</tr>
<tr>
<td></td>
<td>• Leverage exceptional high-quality diamond product recovered with unique RSA alluvial deposits</td>
</tr>
<tr>
<td></td>
<td>• Leverage job creation abilities of entrepreneurs and small businesses</td>
</tr>
<tr>
<td></td>
<td>• Reduce red tape: Encourage entrepreneurs to utilise their considerable skills, experience,</td>
</tr>
<tr>
<td></td>
<td>and new technologies to revive the sector</td>
</tr>
<tr>
<td></td>
<td>• The recently published discussion document on Artisanal and Small Scale Mining Policy</td>
</tr>
<tr>
<td></td>
<td>(DMRE 5 May 2021) is a positive in this respect</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>One-stop Shop</th>
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<tbody>
<tr>
<td>9</td>
<td>Create a Functional and Coordinated One-stop Shop portal for handling all mineral right and</td>
</tr>
<tr>
<td></td>
<td>environmental applications to revive the local Small and Junior mining sector</td>
</tr>
<tr>
<td></td>
<td>This has been promised in the past by various Ministers but never implemented</td>
</tr>
<tr>
<td></td>
<td>Urgent need for co-ordinated and harmonised minerals exploration, and mining development, and</td>
</tr>
<tr>
<td></td>
<td>related environmental and job creation policies that will promote Small mining businesses, SME’s, and entrepreneurs.</td>
</tr>
</tbody>
</table>

**ABBREVIATIONS AND ACRONYMS**

cpht  carats per hundred tonnes (measure of tenor or grade of diamonds typically used for kimberlites)
cpm cubed  carats per cubic metre (diamond grade measurement often applied to alluvial deposits)
u/g  under-ground mining method
o/c  open cast mining method
LOM  Life of mine
ROM  Run of mine values
Tce(e)  Terrace or Terraces
Tpm  Tones per month
US$/carat  Method of expressing values of diamonds
FSP  Free State Province
GP  Gauteng Province
LP  Limpopo Province
NCP  Northern Cape Province
NWP  North West Province
WCP  Western Cape Province
AEON  African Earth Institute Network
ADI  Alluvial Diamond Industry
ANC  African National Congress
ASM  Artisanal and Small-scale Mining
BBBEE  Broad Based Black Economic Empowerment
BEE  Black Economic Empowerment
CGS  Council for Geoscience (previously the Geological Survey)
COM  Chamber of Mines – renamed the Minerals Council (MC)
DMR  Department of Mineral Resources
DMRE  Department of Mineral Resources & Energy
DWF  Department of Water Affairs and Forestry
EIA  Environmental Impact Assessment
EMP  Environmental management programmes
ESKOM  Electricity Supply Commission
Fm  Formation
GDP  Gross Domestic Product
HDI  Historically Disadvantaged Individuals
HDSA  Historically Disadvantaged South Africans
HIV/AIDS  Human ImmunoDeficiency Virus/Acquired Immunodeficiency Syndrome
HRD  Human Resource Development
ISAP’s  Interested and Affected parties
IDP  Integrated Development Plan
LOR  Lower Orange River – section of Orange River from Upington to the Orange River mouth where it exits into the Atlantic Ocean in north-west Namibia
MC  Minerals Council of South Africa – previously the Chamber of Mines (COM)
MH&SS  Mine Health and Safety
MINTEK  State funded research and development (R&D) organisation specialising in mineral processing,
extractive metallurgy, and related technology
MOR  Middle Orange River – section of Orange River located between Lesotho and Upington, more specifically the Hopetown-Doug-
las-Prieska river section
MPRDA  Mineral and Petroleum Resources Development Amendment Act, Act 49 of 2008
MPRR  Mineral & Petroleum Resources Royalty Act, Act 28 of 2008
NEMA  National Environmental Management Act, Act 107 of 1998
NGO’s  Non-governmental Organisations
NMU  Nelson Mandela University
RDP  Reconstruction and Development Programme
SADPO  South African Diamond Producers Organisation
SARS  South African Revenue Service
SRA  Surface Rights Agreement
Stats SA  Statistics South Africa
This has been an evolving research project that was a collaboration between various entities such as academia, private and state organisations, and Small and Junior miners that I am grateful to have been part of. I am thankful to all the many people who assisted, hosted, transported, and provided information and data to me during the course of this project, and in particular the following organisations and individuals.

I am eternally thankful and appreciative of the dedicated support and sacrifices made by my family throughout my academic journey.

Thanks, are also due to the personnel in the offices of the Department of Mineral Resources in Kimberley and Klerksdorp for opening their doors and assisting me with retrieving non-sensitive information relating to diamond mining licences for mining permits, prospecting rights, and mining rights.

Rosika Delport of Aftershock Studios is thanked for her compilation and construction of the excellent geological map images, and figures 3, 23, 24, 25, 26 and 27 reproduced in this Report.

Finally, I am eternally thankful and appreciative of the dedicated support and sacrifices made by my family throughout my academic journey. The year 2020 was a difficult year for everyone and it was with great sadness that we unfortunately lost my sister (Funivi Dlakavu) who through her genuine excitement for my projects always pushed me to work hard.

In particular, I would like to thank the South African Diamond Producers Organisation (SADPO) including the generous support of a number of individual members, and the Africa Earth Observatory Network – Earth Stewardship Research Institute (AEON-ESSRI) for financially supporting me and this research project.

I would also like to express my appreciation and thanks to the chairperson of SADPO, Mr. Gert Van Niekerk, and Mrs. Lynette Kruger for always supporting me during this project, introducing me to the SADPO committee, providing contacts and meeting arrangements, and assisting with accommodation and transport in the Northern Cape and North West Provinces.

Sincere thanks are due to the various Small and Junior diamond miners who were the subject of this report. I would like to thank every Junior miner who took time to complete and helped improve questionnaires, and answer my questions about their activities.

I would like to thank the directors of the AEON-ESSRI, the late Prof. Maarten De Wit and Prof. Moctar Doucouré for providing me a workspace in the AEON Commons where I gained input from other researchers during presentations. One such opportunity was presenting this research project during one of Dr. Mike De Wit’s short courses, where I received feedback from students who showed interest about the diamond industry. The support of my fellow students and academics at AEON-ESSRI is appreciated.

I am particularly grateful to Dr. John Bristow and Mr. Lyndon De Mellion for exposing and teaching me about the geology of alluvial diamond deposits, sharing their experiences about their origin and the high-quality diamonds they yield, allowing me to use unpublished data on the setting and mining of these deposits, and assisting me with the Database structure, and to compile, process, report and edit the information that was gathered during this research project.

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<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DESCRIPTION</th>
<th>COST</th>
<th>TIMELINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation of Application Documents for lodging with the DMR</td>
<td>R100</td>
<td>(Time: 1 – 3 months)</td>
</tr>
<tr>
<td>2</td>
<td>Submission of Application</td>
<td>R100</td>
<td>(Time: 1 – 3 months)</td>
</tr>
<tr>
<td>3</td>
<td>Review of Application and subsequent submission of the same to the DMR</td>
<td></td>
<td>(Time: 6 – 12 months)</td>
</tr>
<tr>
<td>4</td>
<td>Estimation of Timelines and Costs</td>
<td></td>
<td>(Costs: R0 - R8 000)</td>
</tr>
</tbody>
</table>

**STATUS OF THE SA SMALL AND JUNIOR DIAMOND MINING SECTOR**

**MINING PERMITS (5ha)**

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>DESCRIPTION</th>
<th>COST</th>
<th>TIMELINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Water Use Licence Application (WUL)</td>
<td>Cost R50 000 (does not include specialist studies)</td>
<td>Cost R0 - R50 000 (includes specialist studies)</td>
</tr>
<tr>
<td>6</td>
<td>Environmental Authorisation Application (EAA)</td>
<td>Cost R50 000 (does not include specialist studies)</td>
<td>Cost R0 - R50 000 (includes specialist studies)</td>
</tr>
</tbody>
</table>

See also section on specialist studies and notes at end of Table.
Permits and licences that may be required depending on activities and the receiving environment include:

1. WUL as per NWA
2. Waste management licence as per NEMAQA
3. Atmospheric emissions licence as per NWMAQA
4. Protected fauna/flora licence as per NEMBA
5. Heritage building permits as per NHRA
6. Re-zoning approval in terms of local Municipal bylaws
7. Public participation and consultation also a requirement

(Timelines: causes added time delays to environmental permitting, and should not apply to most small and medium-diamond operations)

(Costs: These are included for most part in Section#6, #7 above. Biggest cost factor is the time wastage associated with engaging several different Government Departments and local Municipalities and their inherent inefficiencies)

Social and Labour Plan (SLP) Not required Not required Comprehensive Social and Labour Plan (SLP) required to be finalised and submitted to the various Government Departments, and the DPME for approval, and where applicable, conditions.

Registration in the Mining Titles Office Not-applicable Costs and time involved in making appointments, legal fees for providing paperwork and agreements to complete process

TOTAL: COST ESTIMATES

R65 000 – R130 000 (Dependent on the DMRE office and work programmes required – see notes below)

From R350 000 – R1,5 million (Scope of work and size of operations will dictate costs and timelines e.g. drilling and bulk-sampling programs will add to time and costs)

From R500 000 to R2 million (Nature and size of operations, WUL etc. will dictate costs and timelines)

SPECIALIST STUDIES

Tree Licence Applications Must be undertaken by a Botanist; required in any protected trees are present or identified within the application area

(Timelines: min 1 month)

Cost: R15 000

Notes:
1. General – All of the above requirements may vary considerably in detail, time, and costs between individual DMRE offices (e.g. Limpopo, NW Province, Free State, N Cape) given inefficiencies of processes, different interpretations of the regulations and requirements, plate, and incorrect interpretations and application of DMRE regulations. A key challenge all these processes is that there are no standard templates and tick boxes processes which are applied consistently across all regional DMRE offices, and Head Office in Pretoria.
2. Necessity to use Lawyers and Consultants – Because of the inherent inefficiencies of the DMRE offices, the dysfunctionality of the SAMRAD system, and other regulatory challenges, it has become a standard practice to utilise expensive lawyers and consultants (e.g. environmentalists, hydrologists, engineers, and other disciplines) to assist with mineral rights applications. This has resulted in considerable costs and timelines in terms of work programmes and the submission of documentation which are poorly managed and co-ordinated, present considerable time delays and added costs to the process.
3. Impact on Small and Junior Miners – The consequence of the information and requirements, activities, timelines, and costs involved in the above Table is that Small and Junior miners cannot afford the costs and lengthy time periods required for even the simplest of mineral right applications, as for example a 5ha Mining Permit. Consequently, more and more small and very small miners are exiting the sector which is simultaneously attracting larger and larger mining companies into the sector, resulting in a reduction of small and illegal alluvial miners (Zuma Zamus). This is progressively adding to lawlessness and crime, negative environmental impacts, and loss of revenue and royalties to the State.
4. Although all Small and Junior diamond miners understand the need for Transformation and BEE, it is difficult to see how that was enforced in the alluvial diamond mining industry a further reason for the lack of growth in the industry. Due to the high financial risk associated with alluvial diamond mining, there are few financial mechanisms available for new BEE entrepreneurs to enter the industry or to buy into existing operations. In order to become compliant, an existing operation has to finance the 51% BEE ownership in-house which in most cases is not possible (due to the low profit margins and high financial risk) and has resulted in many operations closing down. A more flexible Transformation and BEE compliant mechanism is required for the industry.
5. The requirement to appoint a permanent engineer if an operation generates more than 2500 kW was questioned and noted as impractical by many participants. The mining and processing operations of most Small and Junior alluvial diamond mines are shallow, uncomplicated, and generally do not exceed the 2500 kW limit where one or 2 large earthmoving units are required to break the hard calcrete layers. In remote areas there are very few qualified engineers available to serve the industry. This is another example of unnecessary costs added onto small and junior diamond mining sector.
AEON-ESSRI aims to provide a research and educational environment to seek consilient knowledge and engagement amongst earth and life sciences, engineering, resource economics, human and cultural sciences through application and dissemination of Earth Stewardship Science.