GEOSTATISTICAL ANALYSIS AND SIMULATION OF A METALLURGICAL PARAMETER: TOWARDS IMPROVED MINING EFFICIENCY AND CONFIDENCE IN THE GEOLOGICAL MODEL OF A KIMBERLITE.

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A dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Science in Mining Engineering.

Johannesburg, 2008

DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science in Mining Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University. The information on which this dissertation is based was generated whilst the candidate was in the employ of De Beers Group Services, Pty Ltd.

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ABSTRACT

The construction of geological models of kimberlites during an evaluation project typically suffers due to a lack of outcrop and dependency on visual core-logging criteria. A case study is presented showing how the inclusion of a metallurgical parameter (% Dense Media Separator, or DMS yield) obtained from large diameter drilling can be used to:

- enhance geological definition in a kimberlite,
- corroborate and support the identification of geological units, and
- contribute towards understanding the volcanology at the time of emplacement.

DMS yield represents the ratio of the mass of wet concentrate/mass of wet head-feed to the sampling plant and is a relative value. The %DMS yield data exhibited spatial structure within the three lobes which allowed the construction of variograms for unit M/PK, the dominant kimberlite type in the South lobe of the AK06 kimberlite. This kimberlite type revealed an extreme range of %DMS yield values which will present a challenge to the recovery of diamonds. It was therefore essential for mine planning purposes that zones of high %DMS yield were accurately defined and quantified.

Ordinary Kriging was applied to obtain the "best linear unbiased estimate" of %DMS yield at a local block scale. Conditional simulations using the Turning Bands and Sequential Gaussian methods were generated to quantify the variance of %DMS yield and the potential uncertainty. Indicator kriging was applied to the kimberlite to obtain the probability of intersecting %DMS yields above a particular cut-off (20%) which the main treatment plant design could not accommodate. A possible reason for the high %DMS yield values in the kimberlite was proposed and the location of problematic zones illustrated in 3-D space. This study represents pro-active use of geology to investigate resource risk, delineate problem areas in advance and develop a geo-metallurgical model.

ACKNOWLEDGEMENTS

The AK06 project team geologists and in particular Clement Rikhotso, Maanda Ratshitanga and Mark Krug are thanked for assistance in obtaining data and answering the inevitable questions. I would like to thank the following people who all contributed to the development of my interest in geostatistics and who made the time to answer many questions over the past few years – Dr. Ina Dohm, David Bush, Dr. Andy Grills, Sean Duggan, Gavin Brown, Johan Ferreira, Chris Prins, Fanie Nel, and Dr. David Rose. Prof. R. Minnitt is thanked for his assistance in administrative matters at the University of the Witwatersrand. De Beers Group Services Pty Ltd. is thanked for permission to undertake this study and for the financial support which enabled me to advance my interest in geostatistics. Frederic Rambert, Jacques Deraisme and the user support team at Geovariances in France are thanked for their ever prompt assistance in matters relating to the use of the ISATIS™ software.

Last but not least, a big thank-you to my wife Dina, for her patience during the past three years of study and who made the completion of this work possible.

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1.0 INTRODUCTION

The AK06 kimberlite is located 25km south of Orapa Mine in Central Botswana and less than 15km from the village of Letlhakane. AK06 forms part of the famous Orapa cluster of kimberlites (Figure 1).

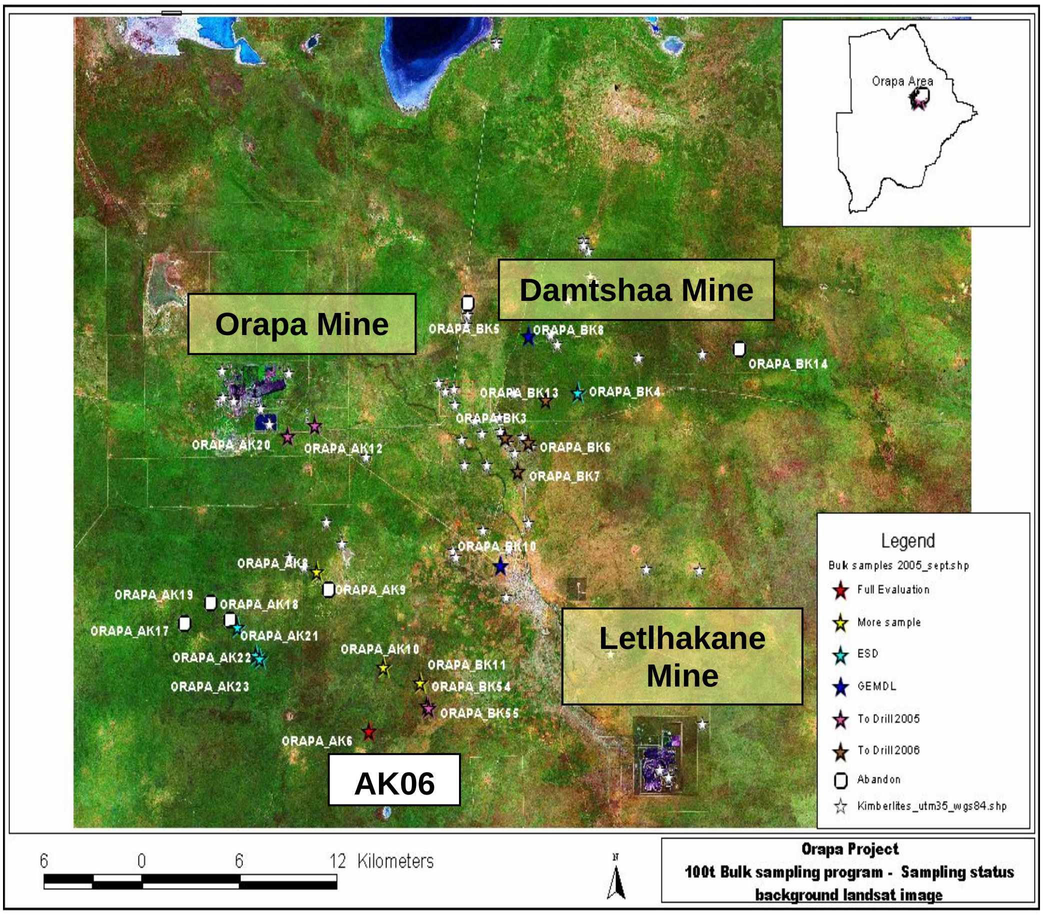


Figure 1: Location of the AK06 kimberlite within the Orapa cluster in relation to the Orapa, Damtshaa and Letlhakane mines (from Stiefenhofer, 2007a; modified from Rikhotso and Winzar, 2006).

The AK06 kimberlite was originally discovered by Debot, the prospecting arm of De Beers operating in Botswana, in 1969 and estimated to be 3.3ha in size (Rikhotso and Winzar, 2006). It was not until 2003 that a high resolution magnetic survey revealed the possibility that the kimberlite may be larger than originally believed. The possible presence of two lobes/pipes was also identified (Figure 2). A Joint Venture agreement was concluded between African Diamonds Plc (49%) and Debot (51%) in 2004, covering a number of kimberlites in the

Orapa area, including AK06. This resulted in the formation of Boteti Exploration (Pty) Ltd and a detailed investigation into AK06 commenced.

This study is presented in two parts – geology, followed by a geostatistical analysis. The reason for the geological detail will become apparent as the reader progresses through the sections on geology, geochemistry and the impact of geology on metallurgy. It will be shown that the kimberlite geology exerts a significant control over the percentage Dense Media Separator (%DMS) yield, particularly in the South lobe of AK06. In order to understand the distribution patterns of the %DMS values, it is essential to understand the geology of this pipe complex prior to attempting geostatistical analysis. The detailed pipe geology was reported by Stiefenhofer (2007a) and the geology, geochemistry and relationships between geology, chip density and %DMS yield was summarised from Stiefenhofer (op. cit.). Although this study focuses on the South lobe, it was decided to include features of the Centre and North lobes in order to present the complete geological picture.

The reasons for investigating the %DMS yield are as follows:

- Initial geostatistical investigations by Stiefenhofer (2007b) into the %DMS yield across all three pipes revealed complexity in the South lobe that was not fully addressed by the early work.
- It was felt that the combined use of more sophisticated techniques, e.g. conditional simulation studies and indicator kriging may represent more appropriate methods to understand the %DMS yield distribution in the South lobe than the use of ordinary kriging in isolation.
- Once a clearer picture of the %DMS yield distribution on a bench-by-bench level emerged, these data may be of use in refining the geological model for the South lobe.
- Last, but not least, the use of the above techniques would hopefully lead to a more robust estimate of the location of elevated %DMS zones per bench which would assist in mine planning and extraction of problematic ore zones in the South lobe.

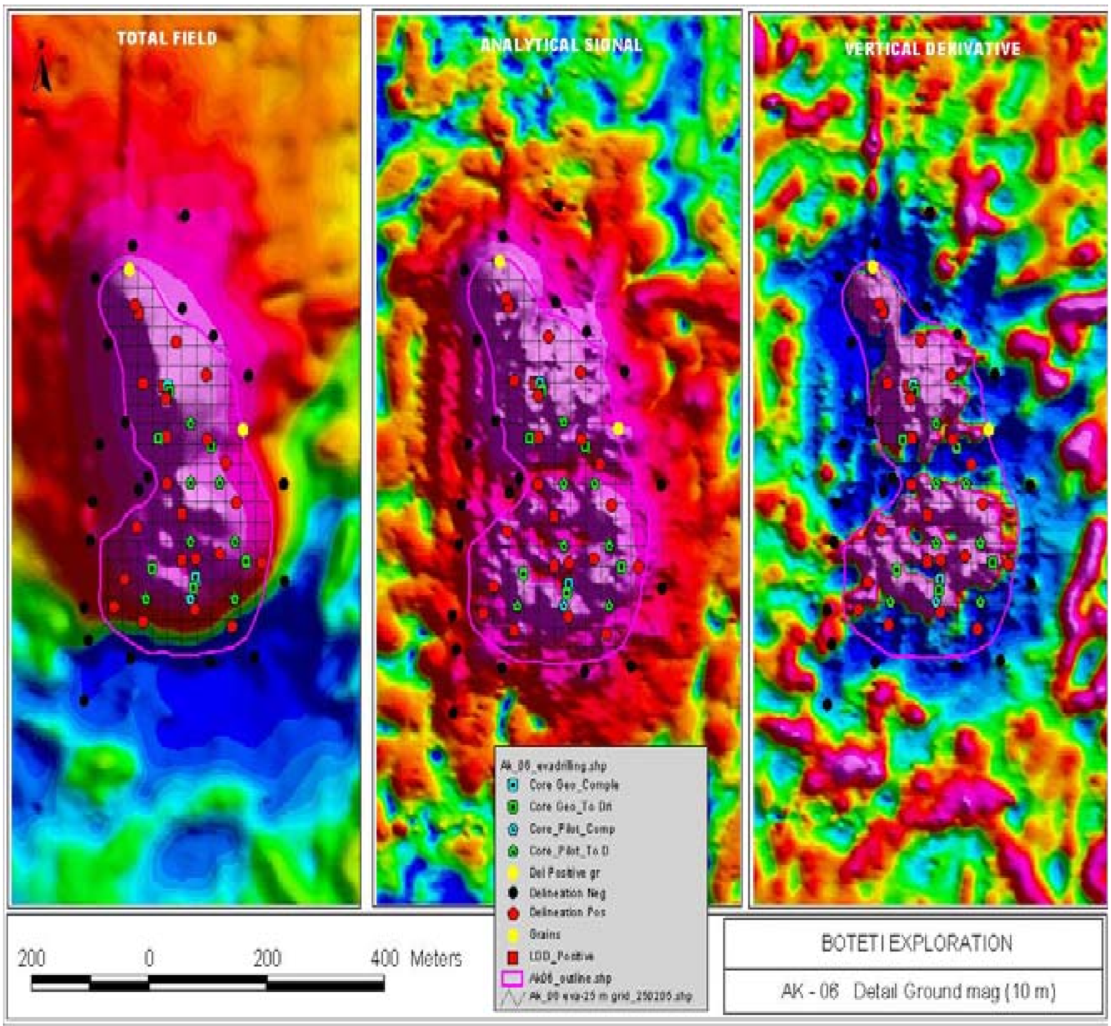


Figure 2: Location of percussion holes over AK06 and detailed ground magnetic profile (Figure from Rikhotso and Winzar, 2006).

The geostatistical analysis will commence with a data analysis of %DMS yield, followed by kriging methods, conditional simulation, and finally a discussion where the results of the various methods are compared. Sections in italic font represent mathematical definitions or proofs referred to in the text. The conclusions and salient points from this study were also presented as an extended abstract and poster at the Ninth International Kimberlite Conference in Frankfurt, Germany, during August 2008 (Appendix 1).

2.0 REGIONAL GEOLOGY OF THE AK06 AREA

The surficial deposits in the Orapa area are comprised of “Kalahari beds”. The average thickness of the “Kalahari beds” in the AK06 area is 16m (4m sand and 12m duricrust). There is however a considerable range for each subunit.

The Kalahari beds unconformably overly local equivalent units of the Karoo Supergroup and the AK06 kimberlite is located almost entirely within this Supergroup. The broad stratigraphic units, in increasing order of age, are the Upper Stormberg Group comprising lavas (Karoo basalts), the lower Stormberg Group, comprising the Ntane Sandstone Formation, and the Mosolotsane Formation (arenaceous), followed by the non-carbonaceous mudstones of the Tlhabala Formation, and the carbonaceous and coal-bearing mudstones of the Tlapana Formation. The Mea Arkose Formation may be locally present in parts of the Orapa cluster. No other units below the Tlapana formation were observed. The Karoo Supergroup unconformably overlies tonalitic and granitic basement. Smith (1984) and Carney et al. (1994) have undertaken detailed investigations into the geology of the Karoo Supergroup in Botswana and the general geology of Botswana respectively and the reader is referred to these sources for further geological information. The average thickness of the units in the AK06 area, based on drill hole intersections, are: basalt – 106m; Ntane Formation – 73m; Mosolotsane Formation 56m; Tlhabala Formation – 99m; Tlapana Formation – 136m (extracted from the country rock model – Opperman, 2007).

Appleyard (2005) reported U-Pb ages of 94±6 Ma for the South lobe and 100±11Ma for the North lobe kimberlite, at a confidence level of 95%. These ages are similar to the ages previously reported for Orapa AK01 and BK09. Barton & Smith (1995) reported mica with a Rb-Sr age of 90±5 Ma from the AK01 kimberlite and a Rb-Sr whole rock age of 99±3 Ma for the BK09 kimberlite.

3.0 KIMBERLITE GEOLOGY

AK6 is a roughly north-south oriented multi-lobate kimberlite (Figures 3, 4) that has a near surface expression of ~3.3ha and reaches a maximum area of approximately 7ha at ±120m below surface. A combined total of 44 6.5 inch percussion holes, 23 pilot holes (core), 31 large diameter holes (23 inch), and 51 delineation holes were used in the evaluation of the AK06 kimberlite and by Opperman (2007) to construct the 2007 geological model (Figure 4).

In addition to the distinct geology of the South lobe, the geology of the North and Centre lobes exhibit significant complexity, particularly on a textural level in hand-specimen or thin section. Inclusion of such abundant textural variation would have resulted in an overly complex geological model with limited application in a mining environment. It was therefore important to establish which geological features were most likely to impact diamond grade and the recovery of diamond from the host rock, and which features were of lesser importance.

The textural and visual studies were followed by spinel groundmass chemistry studies and geochemical sampling which were used to quantify the interpretations based on logging and petrographic studies (Stiefenhofer, 2006). Due to the extremely high DMS concentrate yields from the South lobe in particular, effort was made to investigate and correlate the variations in the kimberlite geology with the percentage DMS yield, chip density, and levels of crustal dilution, in order to assist mine and metallurgical planning.

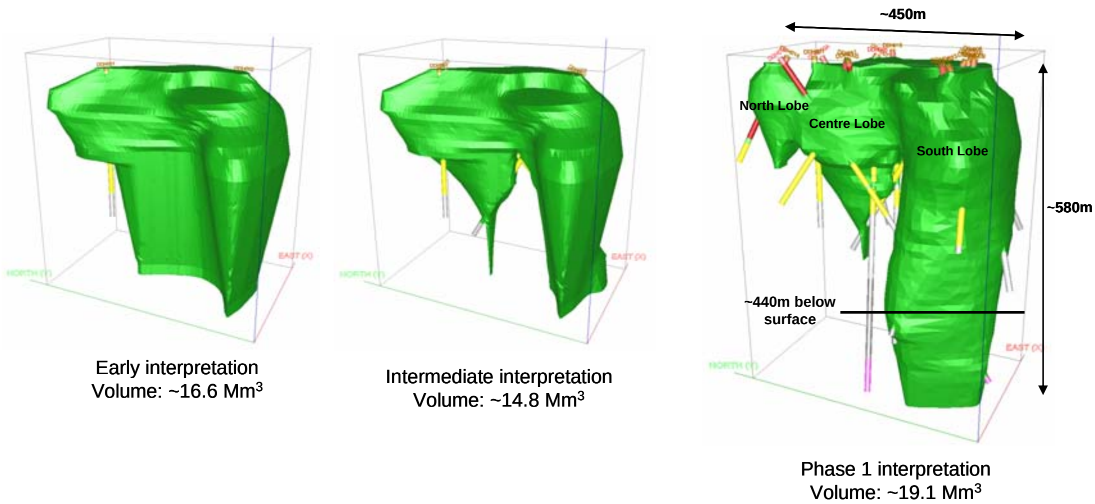


Figure 3: Development of the AK06 geological model from initial data up to the Phase 1 drilling data. The model derived from the Phase 1 data extended 450m in the north-south direction and the South lobe was modeled to a total depth of 580m. The final volume of the model constructed from the Phase 1 data was 21.26Mm^3 (Images – Hanekom, et al., 2005). Note that the original North lobe (Intermediate interpretation) was subsequently re-named the Centre lobe after discovery of a third small lobe to the north (Phase 1 interpretation).

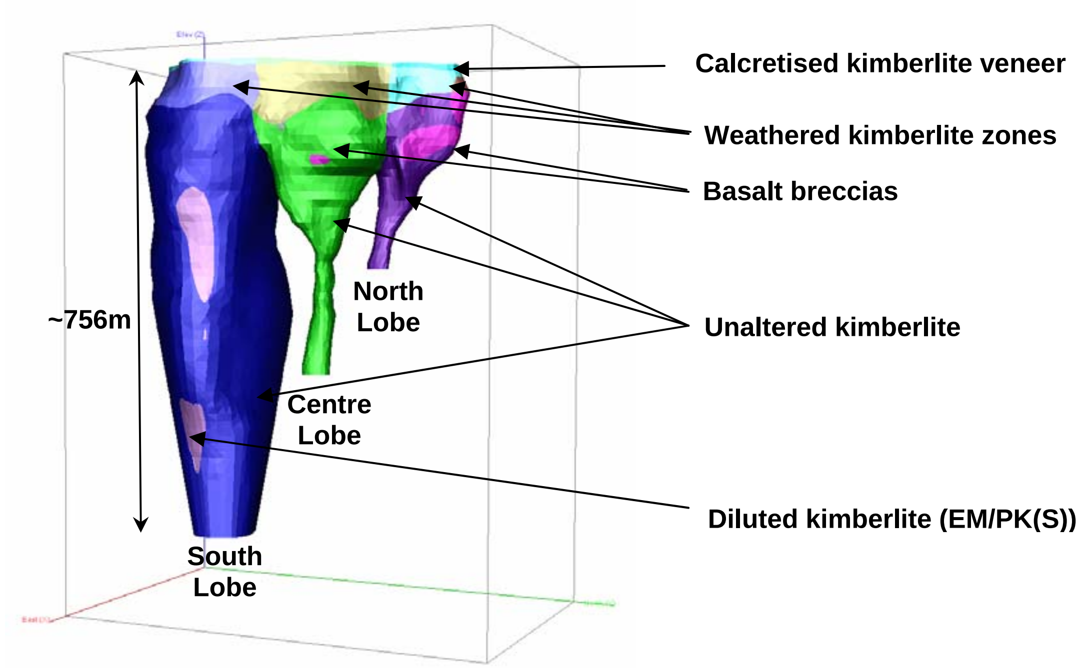


Figure 4: View of the 2007 geological model of AK06 based on Phase 1 and Phase 2 data, with the various geological units, looking south-west. Units are described in more detail in Section 3.1. (Image – Opperman, 2007).

3.1 Overview of main geological units per lobe

The units referred to below can be observed in Figure 4, except where otherwise stated. Table 1 contains the abbreviations of the lithology codes used throughout this document.

The upper parts of all three lobes contain severely **calcretised and silcretised** rock. This zone may be up to 20m thick, but frequently only about 10m. It was initially separated from the fresh kimberlite below due to the following reasons.

- Near total destruction of textures could result in a different kimberlite unit not being recognised in this zone (Plate 1). This concern was later addressed by detailed geochemical sampling of the duricrust and weathered zones and a comparison of these zones with the fresh kimberlite below. Analysis of these data showed that the weathered material correlated with the fresh kimberlite below. These results will not be discussed further since the weathered zones are not the focus of this study.
- Kimberlite affected by such duricrust formation may present metallurgical challenges during treatment of the ore.

The calcretised and silcretised zone is followed by a 30-50m thick **highly weathered zone** (Hanekom et al., 2006). Network veining of carbonate is common and olivine pseudomorphs are recognisable. An example of the carbonate network veining is shown in Plate 1 below the duricrust zone. The alteration decreases with depth and colour typically changes from buff through to reddish-brown. Carbonate veining decreases with depth and xenoliths in the kimberlite are increasingly recognisable. Hanekom et al. (2006) reported that unaltered kimberlite is generally intersected at about 70-90m below present day surface. Kimberlite exhibiting signs of increased alteration was also found close to the wall-rock contact in some holes, e.g. DDH001.

Each of the lobes is characterised by discontinuous zones of **brecciated basalt**, mixed with variable, but generally small amounts of kimberlite (<<20%). The basalt is typically fractured and carbonate veined to a variable degree and consists of vesicular and non-vesicular varieties. Visual and geochemical techniques allow for easy distinction between the basalt breccias and the undiluted kimberlite. Since several of the breccia units are located within the lobes, they are shown in Figure 5 below in exploded format to obtain some idea of their abundance and position relative to each other.

<u>Plate 1:</u> The upper duricrust zone from hole PLT017. Note that textures in the 0-16m interval (upper core box), and in particular 0-10m, have been completely destroyed. This hole was commenced in basalt and represents part of the basalt breccia zone in the south-west of the southern lobe.

Table 1: Correlation of initial numeric units and final unit codes used in the GEMS model. Data from Hanekom et al. (2006) and Opperman (2007).

Rock Code	Rock Type	Colour	Initial Unit Number
BASALT	Basalt	Red	N/A
BBX	Basalt breccia	Blue	N/A
BBX(C)	Basalt breccia Centre Lobe	Magenta	N/A
BBX(N)	Basalt breccia North Lobe	Magenta	N/A
BBX(S)	Basalt breccia South Lobe	Magenta	N/A
CALC	Calcrete	Custom 1	N/A
CBBX(N)	Calcretised basalt North Lobe	Custom 3	N/A
CBBX(S)	Calcretised basalt South Lobe	Custom 3	N/A
CFK(C)	Carbonate-rich fragmental kimberlite Centre Lobe	Custom 8	Units 2, 4, 5, 6
CKIMB(C)	Calcretised kimberlite Centre Lobe	Light Green	N/A
CKIMB(N)	Calcretised kimberlite North Lobe	Cyan	N/A
CKIMB(S)	Calcretised kimberlite South Lobe	Light Cyan	N/A
CLOBE	Centre lobe	Light Cyan	N/A
EM/PK(S)	Eastern diluted M/PK South Lobe	Custom 2	Unit 14
FK(C)	Fragmental kimberlite Centre Lobe	Green	Units 3, 7-12
FK(N)	Fragmental kimberlite North Lobe	Custom 13	N/A
GRANITE	Basement granite	Light Magenta	N/A
KDYKE	Kimberlitic dyke	Custom 12	N/A
KIMB	Kimberlite	Green	N/A
M/PK(S)	Magmatic/pyroclastic kimberlite South Lobe	Custom 6	Unit 13
MUDSTN	Mudstone	White	N/A
NLOBE	North lobe	Cyan	N/A
QTZT	Quartzite	Custom 3	N/A
RVK	Reworked volcaniclastics	Black	N/A
SAND	Sand/Top soil	Brown	N/A
SHALE	Shale	Black	N/A
SILCRETE	Silcrete	Light Red	N/A
SLOBE	South lobe	Light Blue	N/A
SSTN_MOS	Mosolotsane sandstone	Custom 3	N/A
SSTN_NTA	Ntane sandstone	Yellow	N/A
UNKNOWN	Unidentified rock type	White	N/A
WBBX(N)	Weathered basalt breccia North Lobe	Custom 9	N/A
WBBX(S)	Weathered basalt breccia South Lobe	Custom 9	N/A
WK(C)	Weathered kimberlite Centre Lobe	Custom 7	Unit 1
WK(N)	Weathered kimberlite North Lobe	Light Cyan	Unit 1
WK(S)	Weathered kimberlite South Lobe	Light Blue	Unit 1
WM/PK(S)	Western diluted M/PK South Lobe	Custom 10	N/A

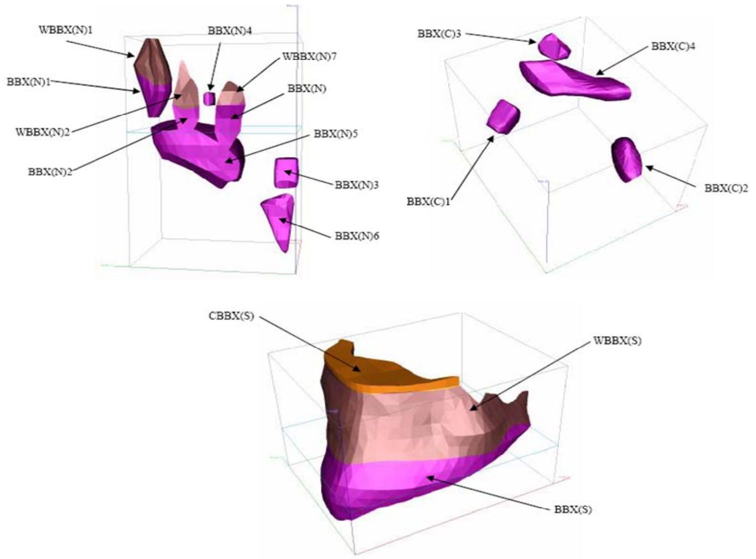


Figure 5: The relative size and positions of the modeled basalt breccia zones in each of the three lobes. North lobe (top), Centre lobe (right) and South lobe (bottom) (Images – Opperman, 2007).

Each lobe is dominated by **fragmental kimberlite**, shown in Figure 4 as unaltered kimberlite. Hanekom et al. (2006) reported that the textures observed in the **North lobe** kimberlite range from superficially magmatic to fragmental (VK)-looking material, often over short distances. Pyroclasts are clearly evident in some samples (Plate 2). Macroscopically, this unit is best described as a light greenish-grey, medium-grained (32-4mm), matrix-supported, poorly sorted, massive kimberlite. Basalt represents the dominant country rock lithology with lesser basement and Karoo sedimentary fragments. Distinction between altered basalt and Karoo sediments, particularly mudstone can be difficult at times due to levels of alteration. There was a relatively even distribution of coarse- and fine-grained material and no obvious bedding was observed in the core, although changes in style of alteration were noted in the core log of PLT010, as well as occasional changes in the abundance of sub-1cm sized crustal fragments.

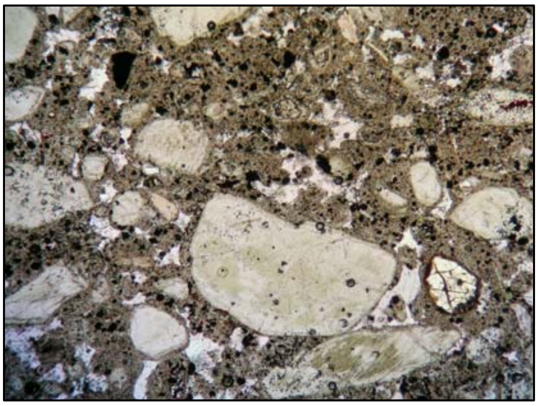
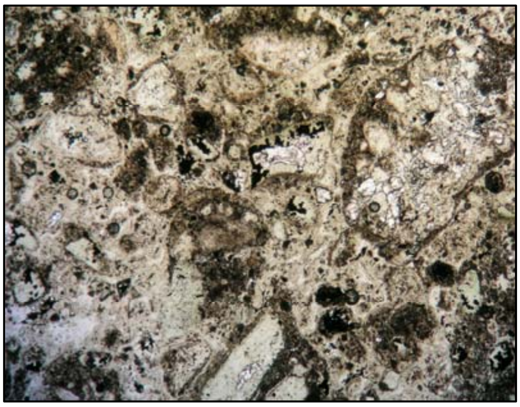



Plate 2: Examples of North lobe fragmental kimberlite textures observed in samples from PLT010, 84.09-84.18m (EGG781) on the left, and 161.81-161.90m (EGG 785) on the right. Images from Hanekom et al. (2006). Field of view is 3mm wide in both images.

Fragmental kimberlite from the **Centre lobe** bears a superficial resemblance to the kimberlite from the North Lobe in that both pipes exhibit non-fragmental, magmatic-looking material as well as fragmental volcaniclastic kimberlite (Plate 3) (Hanekom et al., 2006). This kimberlite is best described as medium-grained (32-4mm), matrix-supported, poorly sorted and massive. Basalt represents the dominant country rock lithology with lesser basement and Karoo sedimentary fragments. A number of visually distinct units were observed (Stiefenhofer and

Hanekom, 2005). Petrographic studies however did not provide conclusive support for retaining these subdivisions, or that any of these sub-types may have a significant impact on diamond grade. Macroscopically, colour and textural variations are common but contacts between texturally distinct units are generally gradational. There is a relatively even distribution of coarse- and fine-grained material and no obvious bedding was observed in the core, similar to samples from the North Lobe.

Hanekom et al., (2006) reported that the **South lobe** kimberlite is predominantly homogenous in appearance, though there are rare zones of crude layering defined by accumulations of olivine macrocrysts and sub-horizontal preferentially oriented crustal fragments. Macroscopically the kimberlite is grey in colour and contains approximately 5-10% thermally metasomatised/altered country rock xenoliths. Texturally the kimberlite can best be described as coarse to medium (+32 through to 4mm)-grained, matrix-supported, poorly sorted and massive. Zones of increased macrocrystic olivine, as noted above, may however represent bedding. These zones range from 0.16-1.5m in thickness. Olivine grains are relatively fresh and abundant opaque minerals occur. The abundance of fresh monticellite increases with depth, e.g. Plate 4. Lithic fragments are dominated by basalt with lesser basement and Karoo sediments, but the overall crustal dilution is very low (typically <10%), but 25% is possible on rare occasions.

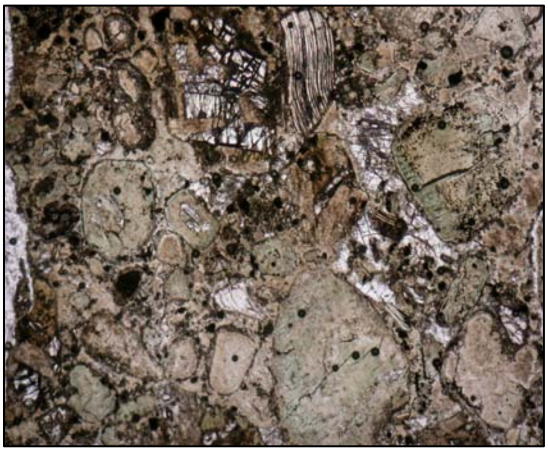
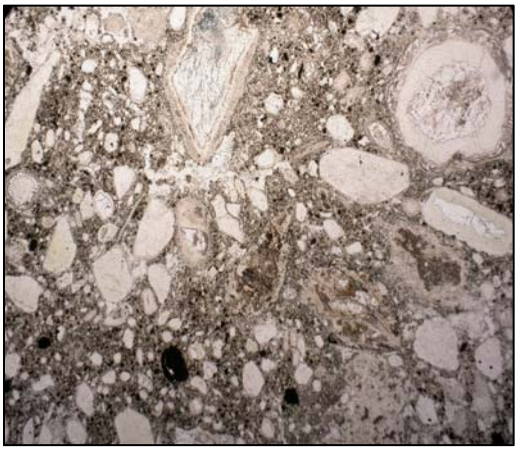
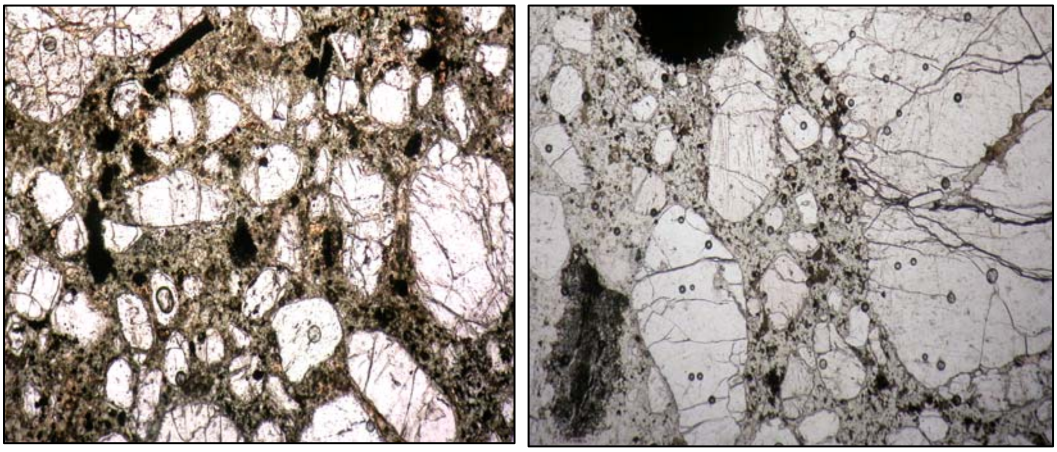



Plate 3: The range of petrographic textures in the more volcaniclastic-textured kimberlite units, e.g. unit 8 (left) and those of more "magmatic" appearance, e.g. Unit 7 (right). Field of view is 3mm wide in both images. Images from Hanekom et al. (2006).



<u>Plate 4:</u> Microscopic view of samples from 79.5m depth (left) and 289m (right) in DDH002. Note the decrease in alteration of particularly the groundmass minerals. The deeper sample contains fresh monticellite (colourless groundmass minerals) - rare in an African geological environment. Note the fresh olivine phenocrysts (smaller colourless euhedral crystals) and larger colourless macrocrysts, all of which are unaltered, in comparison with the olivines from the North and Centre lobes. Field of view is 3mm wide in both images. Images were taken from Hanekom et al. (2006).

A defined zone along the eastern part of the South lobe exhibits an increase in small (typically <1cm) lithic fragments. The unit is shown in Figure 4 as **diluted kimberlite – EM/PK(S)** and again in Figure 6. Hanekom et al. (2006) reported that this kimberlite contains fewer olivine macrocrysts in comparison with the remainder of the South lobe (Plate 5) and abundant coarse microlitic diopside was observed in thin section. The olivine phenocrysts are partly to completely serpentinised. Perovskite appears to be slightly more abundant in the diluted zones and the groundmass shows a greenish colour, possibly due to serpentinisation. Macroscopically the kimberlite is coarse to medium-grained (32-4mm), matrix-supported, poorly sorted and largely massive. Country rock clasts include basalt (dominant), basement, and Karoo sediments. Basement fragments may locally be more abundant than in the undiluted magmatic/pyroclastic kimberlite (Plate 6). Green serpentinised? zones are common in the core.

PLT008 intersected an altered kimberlite in the west of the South lobe (**WM/PK(S)**), variable in appearance and similar to samples collected from PLT010 in the North lobe. This altered kimberlite was not observed in any of the other holes drilled in the South lobe and the shape and dimensions of this unit can be compared with those of unit EM/PK(S) in Figure 6. Note however that the shape of this unit will be somewhat speculative due to the single drill hole intersection, since there are almost no data constraining the boundaries. Unit M/PK kimberlite is again intersected at ~233m below surface. Units EM/PK(S) and WM/PK(S) are distinct and should not be considered as the same kimberlite (Plates 6, 7). The kimberlite in unit WM/PK(S) is characterised by a greenish-

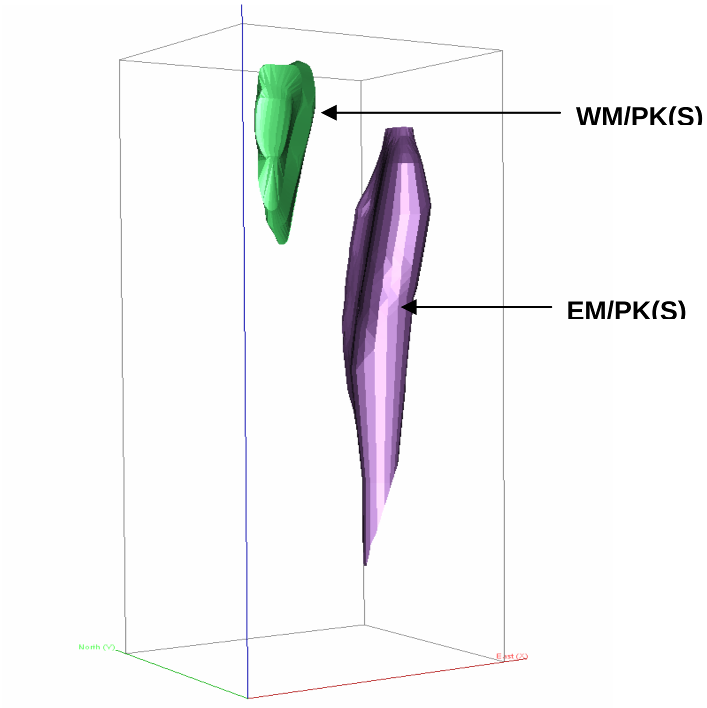


Figure 6: Morphology of units EM/PK(S) and WM/PK(S) in the South lobe (Image – Opperman, 2007).

grey colour and is medium-grained (4-32mm), matrix-supported, poorly sorted and massive in appearance. Olivine is serpentinised in hand specimen as well as on a thin section scale (Plate 8), and in places ferruginised or even weathered out of the core. Basalt represents the dominant country rock lithology. Secondary basement and rare black shale may also be present. Crustal dilution ranges from 7-36% in PLT008, as well as a single 1m interval of 76%.

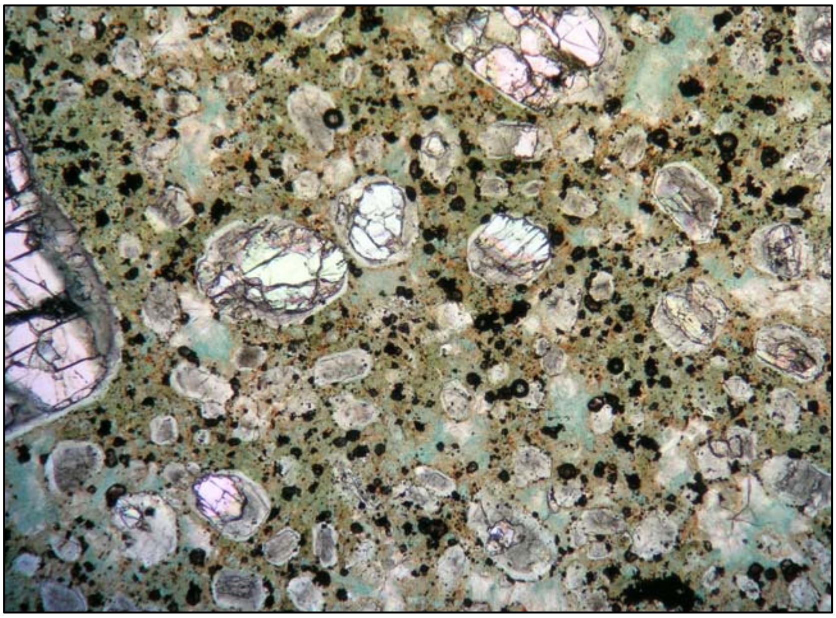


Plate 5: Sample EGF424, obtained from a depth of 205.6m in PLT001, illustrating the microscopic texture associated with the eastern diluted magmatic/pyroclastic kimberlite (EM/PK(S)). Note that the larger olivines are only partly altered, whereas all small olivines are totally altered. Field of view is 3mm wide. Image was taken from Hanekom et al. (2006).

Plate 6: PLT019, ~146.5-159.7m, left, illustrating the texture associated with unit EM/PK(S), showing the small (<1cm) basement fragments. Right – PLT022, ~370-383m, illustrates the appearance of unit M/PK(S). Images from Hanekom and Stiefenhofer (2006).

Plate 7: PLT08, ~185-198m, illustrating the texture associated with unit WM/PK(S) in core. Compare this kimberlite with unit M/PK(S), shown in Plate 6. Image from Hanekom and Stiefenhofer (2006).

Plate 8: Sample EGG 764, obtained from a depth of 143m in hole PLT008, illustrating the higher levels of alteration compared to a more typical south lobe kimberlite, e.g. Plate 4. Note the serpentinised greenish olivines, and the feldspar-bearing basalt fragment in the centre of the view. Field of view is 3mm wide. Image was taken from Hanekom et al. (2006).

4.0 GEOCHEMISTRY

4.1 Microprobe analysis of groundmass spinels

Stiefenhofer (2006) reported that microprobe analysis of groundmass spinels was attempted, but that the majority of opaque minerals were classified as magnetite. Due to the possibility of a secondary/hydrothermal paragenesis, no further work was undertaken on these oxides and attention was focussed on whole rock geochemical analysis instead.

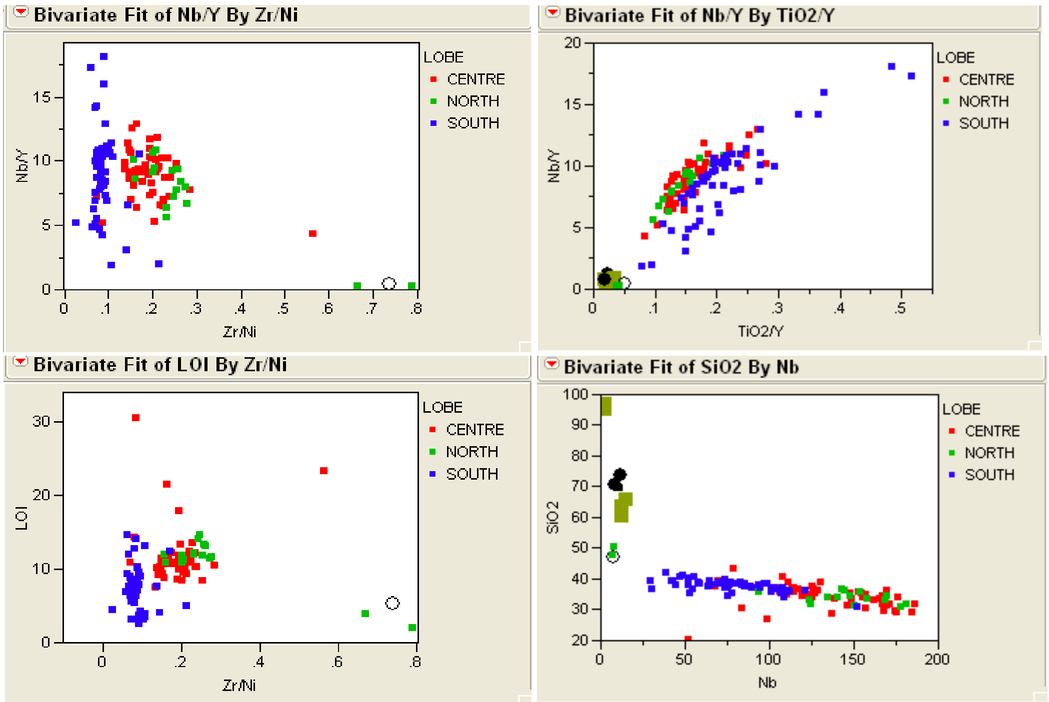
4.2 Whole Rock Geochemical analysis

A total of 208 samples, representing all three lobes, were submitted to the University of Pretoria for XRF analysis over a period of time. An attempt was made to exclude all country rock xenolith fragments greater than 1cm in diameter to avoid contamination of the results. A subset of 12 samples, representing the dominant country rock lithologies, was included in the 208 samples. These samples were submitted in order to quantify the amount of country rock contamination within the kimberlite samples. The bulk of the samples (55) were collected from the South lobe, a further 48 samples from the Centre lobe and the remaining 17 from the small North lobe. The weathered zone was also sampled and a further 76 samples analysed across all three lobes.

The available geochemical data have been used to:

- Test whether each of the three lobes can be characterised by a unique geochemical signature;
- Verify the position of the North, Central and South lobe contacts;
- Investigate whether geological sub-units exist within particularly the Central and South lobes.

Stiefenhofer (2006) showed that the geochemical signatures obtained from the North and Central lobes are almost identical, whereas that obtained from the South lobe is clearly distinct from the two smaller lobes (Figure 7). Samples from crustal lithologies were included for comparison and to assess the level of crustal contamination present in the kimberlite samples. Figure 7 shows that crustal contamination may not have had a significant impact on the geochemical trends of the kimberlite.



<u>Figure 7:</u> Plots of various trace element ratios, trace elements and major elements, all clearly distinguishing the South lobe from the North and Centre lobes. LOI = loss on ignition. Open circle – basalt; solid circle – basement; olive green symbols – Karoo sediments. The Karoo sediments and basement samples have not been plotted on the Zr/Ni plots due to their very high values. Crustal contamination is evident in one Centre lobe and two North lobe samples. Figure from Stiefenhofer (2006).

A small (approximately 4) number of samples from the Centre lobe exhibit erratic behaviour and deviate away from the main data trend (Figure 7). These samples also exhibit the highest LOI values and it is speculated that these samples may have been adversely affected by alteration and resultant clay formation. The generally more dispersed cloud of data points from the North and Centre lobes are also consistent with the more fragmental and altered textures (and therefore greater geochemical heterogeneity) observed by Hanekom et al. (2006).

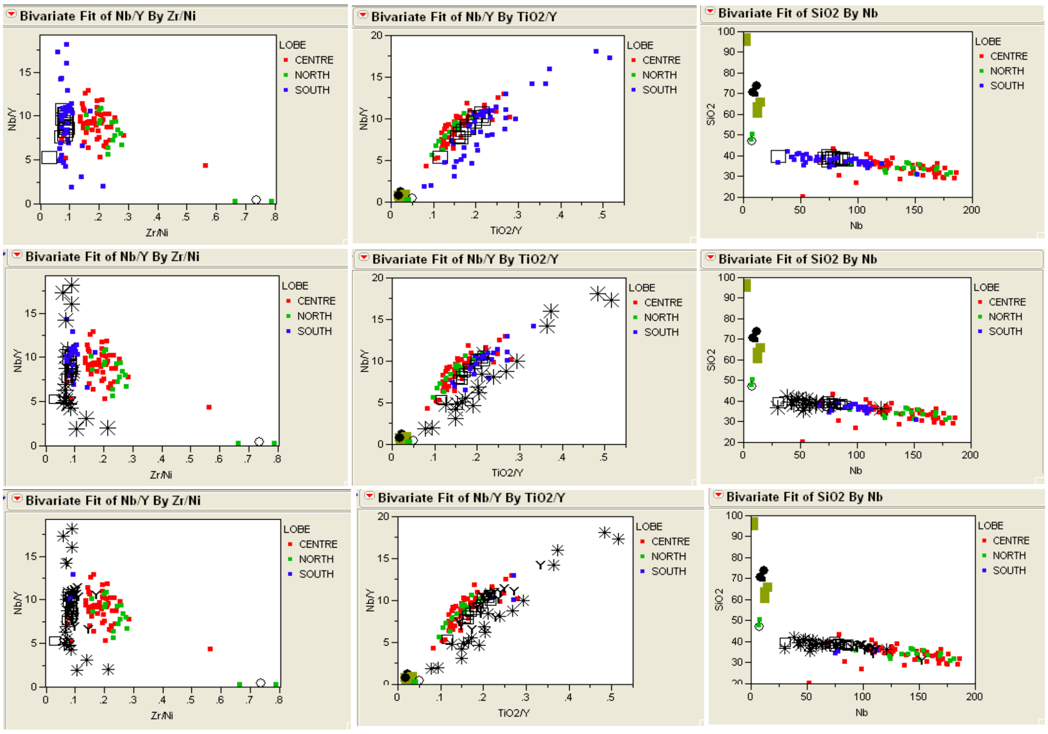


Figure 8: Plots of various trace element ratios, trace elements and major elements used in Figure 7, showing the relative composition of unit EM/PK(S), top, in black square symbols, unit WM/PK(S), middle, as black star symbols, and unit M/PK(S), bottom, as Y-symbols. Open circle – basalt; solid circle – basement; olive green symbols – Karoo sediments. The Karoo sediments and basement samples have not been plotted on the Zr/Ni plots due to their very high values. Figure from Stiefenhofer (2006).

Detailed comparison between the various units from the South lobe is made in Figure 8. The reader will note that the data points from the South lobe suggest that two trends are present in the data, particularly in TiO_2/Y and Nb/Y compositional space. Plotting each unit individually shows that the data from unit WM/PK(S) are responsible for the shift in composition (Figure 8, middle row). This unit is also responsible for the greatest scatter in data points and the scatter supports the petrographic observations that the unit is variable in appearance and altered in places. It is also clear that, in spite of its visual similarity to unit FK(N) from the North lobe, the geochemical composition of unit WM/PK(S) bears no resemblance to that of unit FK(N) from the North lobe. Unit WM/PK(S) is therefore unrelated to the North lobe, and possibly a variant of unit M/PK(S). Figure 8 also shows that units EM/PK(S) and WM/PK(S) should not be viewed as identical. In spite of the increased levels of sub-1cm sized crustal dilution and the presence of microlitic diopside in the groundmass, unit EM/PK(S) appears to exhibit greater similarity to unit M/PK(S) than unit WM/PK(S).

5.0 THE RELATIONSHIP BETWEEN GEOLOGY, CHIP DENSITY AND %DMS YIELD IN THE SOUTH LOBE

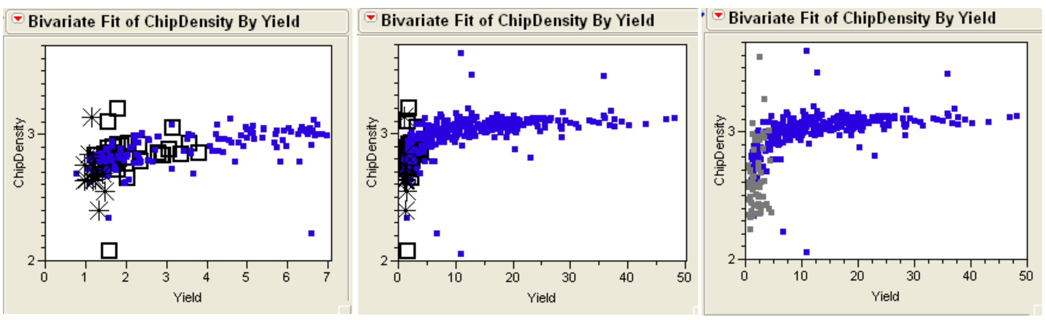
Each large diameter drill hole (LDD) was drilled over a vertical pilot core hole. This core hole was used to characterize the geology in detail prior to drilling the large diameter hole. This strategy allowed a close correlation between metallurgical parameters, diamond grade and the geology.

Stiefenhofer (2007a) investigated the relationship between chip density, %DMS yield and geology. The percentage DMS yield figures quoted in Stiefenhofer (2007b) and in this report were obtained from the ratio mass of wet concentrate/mass of wet head feed. The conclusions from this investigation are set out below.

- More altered lithologies returned lower density values (Figure 9, right).
- Lithologies exhibiting increased crustal dilution exhibit lower chip density values (Figures 9, 11, 12).
- Chip density and yield values are correlated for units such as the basalt breccia, WM/PK(S) and EM/PK(S), but the correlation between these two variables is weaker within the M/PK(S) where the density value typically stabilises at a value of 3 g/cm^3, in spite of significant variation in the %DMS yield (Figures 10-12).
- A clear relationship exists between crustal dilution and %DMS yield. Yield is lower for those units exhibiting elevated crustal dilution, e.g. the basalt-rich breccias (WBBX) (Figures 11, 12).

- Yield is also lower for those units exhibiting increased crustal dilution in the form of sub-1cm sized crustal dilution, e.g. unit EM/PK(S).
- More altered units e.g. WK(S) exhibit lower yield. Petrographic studies detailed in Stiefenhofer (2007a) provided clear evidence that the levels of alteration decrease with increased depth in unit M/PK(S).
- Data from holes LDD26 and 027 exhibit substantial variability within unit M/PK(S). Detailed examination of the core log for hole LDD026 suggests that internal changes in sub-1cm lithic content may be responsible for some of the variations within the M/PK(S), e.g. 140m (increasing crustal dilution) and 277.6m (decreasing crustal dilution), i.e. the changes visible within unit M/PK(S) may well be attributable to primary geological processes (Figure 11).

The distribution of %DMS yield as a function of down-hole depth for holes drilled in the South lobe is illustrated in Figure 13. This exercise was undertaken in an attempt to determine whether any lateral or vertical trends exist across the lobe which could be correlated across different holes. Figure 13 shows that no clear relationships exist but that %DMS yields increase from depths of 70-100m. It is however evident that some drill holes around the western, northern and eastern perimeter of the South lobe exhibit lower %DMS yield compared to those



<u>Figure 9:</u> Bivariate plots of yield vs. chip density comparing the densities of units WM/PK(S) (star symbols), EM/PK(S) (squares) and all weathered samples (grey squares). Note that the plot on the left is an enlargement of the 0-7% DMS yield on the X-axis (centre plot). Figure from Stiefenhofer (2007a).

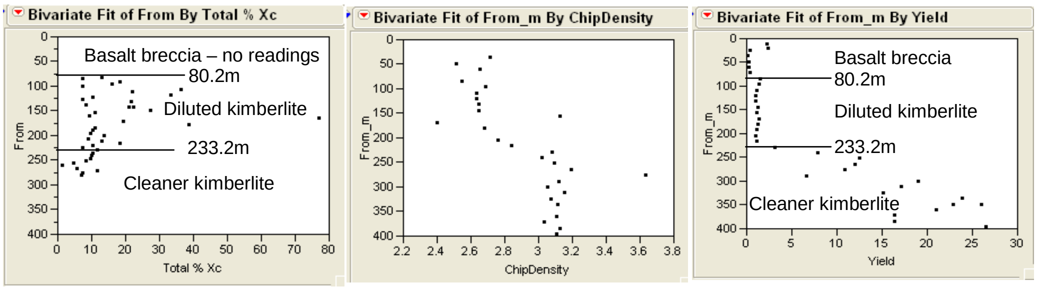


Figure 10: Geological data from PLT008, compared to the %DMS yield and chip density data from LDD017. The left-hand plot illustrates the total percent crustal dilution, the middle plot chip density and the right-hand plot %DMS yield with geological boundaries from the geological log. Note that the cleaner kimberlite (unit M/PK(S)) exhibits a relatively constant chip density in spite of the increasing %DMS yield. The diluted kimberlite is unit WM/PK(S) and the cleaner kimberlite unit M/PK(S). Position of LDD017/PLT008 relative to the other LDD and pilot holes is shown in Figures 13 and 15. Figure from Stiefenhofer (2007a).

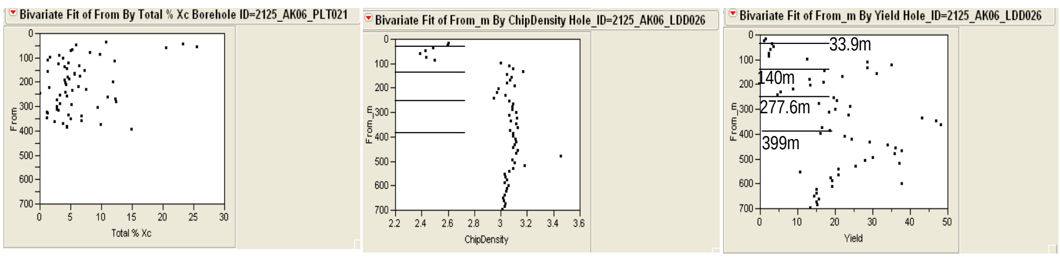


Figure 11: Various geological data from PLT021, compared to the %DMS yield and chip density data from LDD026. The left-hand plot illustrates the total percent crustal dilution, the middle plot chip density and the right-hand plot %DMS yield with geological boundaries from the geological log. The depth of 33.9m represents the end of the basalt. An increase in basement fragments is evident at 277.6m, and 399m represents the end-of-hole depth. All these variations are within unit M/PK(S). Position of LDD026/PLT021 relative to the other LDD and pilot holes is shown in Figures 13 and 15. Figure from Stiefenhofer (2007a).

holes nearer the centre of the pipe. The overall range in yield values is also notably higher towards the centre of the pipe compared to the perimeter.

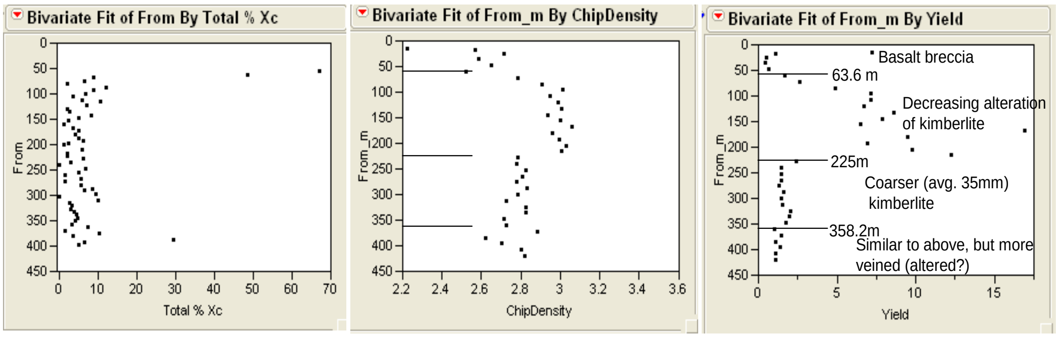


Figure 12: Various geological data from PLT016, compared to the %DMS yield and chip density data from LDD028. The left-hand plot illustrates the total percent crustal dilution, the middle plot chip density and the right-hand plot %DMS yield with geological boundaries from the geological log. Unit M/PK(S) is present up to 225m, thereafter unit EM/PK(S). Position of LDD026/PLT021 relative to the other LDD and pilot holes is shown in Figures 13 and 15. Figure from Stiefenhofer (2007a).

Stiefenhofer (2007a) attributed the substantial variation in %DMS yield to a combination of geological processes, both primary as well as secondary. In an effort to further quantify the distribution of %DMS yield within the South lobe, a cut-off value was obtained from the project metallurgist regarding the accepted limit of %DMS yield which the proposed plant was expected to accommodate. A value of 17% at a cut point of 3.15 (Ep=0.08) was proposed for Phase 2 (70-390m) (Rodel, written comm. to author, 24/04/2007). This value was used to separate the consistently lower yield, outer part of unit M/PK from the inner, more variable zone. It is important to note that the core of the pipe also contains values lower than 17%, but that the samples are scattered throughout the core in such a way that no consistent geometry could be derived from them, unlike the perimeter of the pipe. The above concept was ultimately modeled in GEMS by Farrow (2007) and the final solid shown in Figure 14.

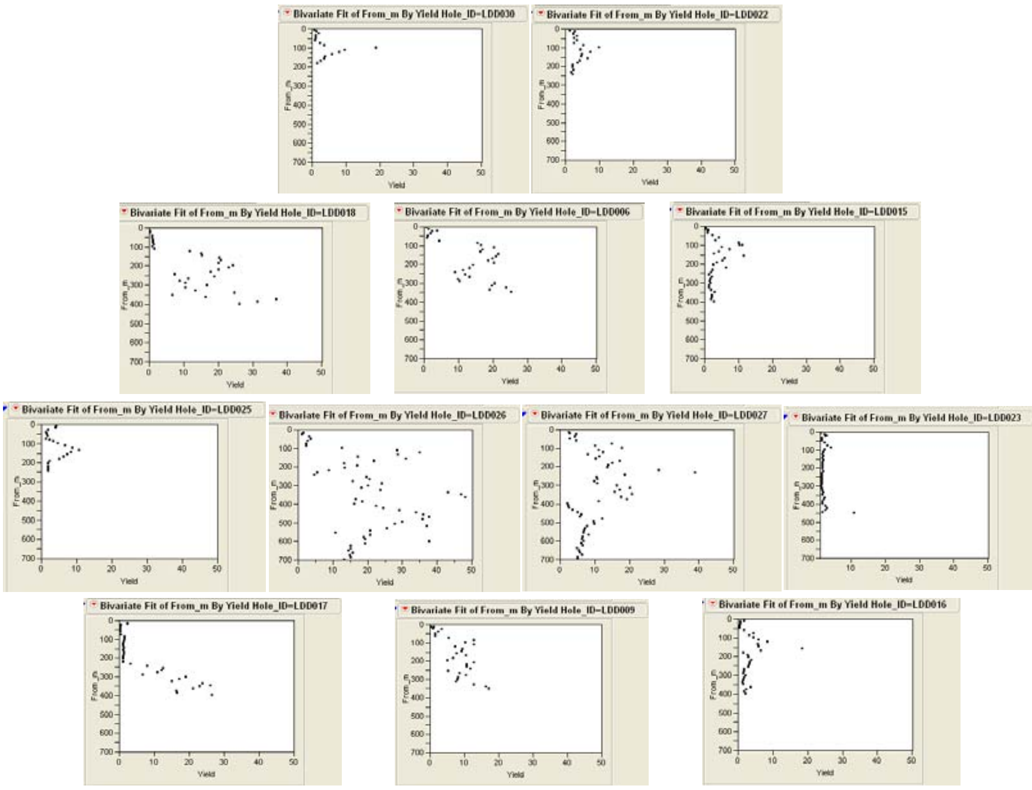
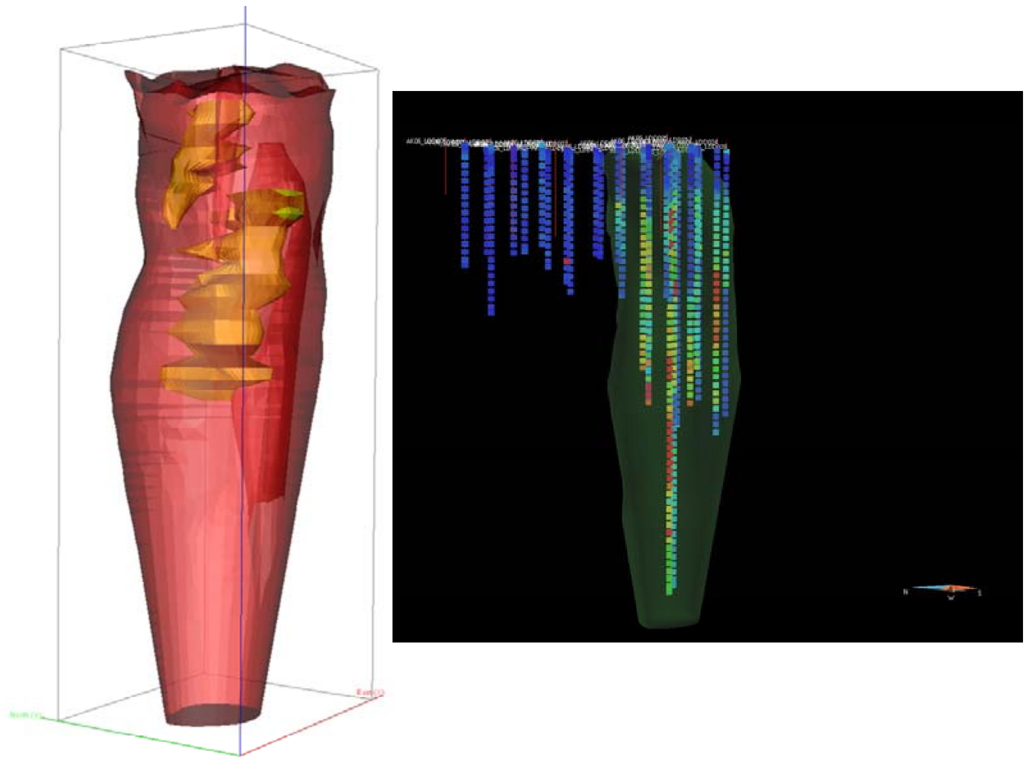


Figure 13: %DMS yield as a function of down-hole depth for selected holes drilled into the South lobe. Note that all plots have been produced on the same scale and are therefore directly comparable. Holes are spatially in the correct position relative to each other. Holes drilled near the centre of the pipe exhibit the most extreme yield values whereas those closer to the side-wall exhibit less variation in %DMS yield and also overall lower yields. Figure from Stiefenhofer (2007a).

6.0 SUMMARY OF THE MAIN AK06 GEOLOGICAL FEATURES

- The kimberlite is tri-lobate, although geological investigations suggest that the North and Centre lobes contain broadly similar volcanic in-fill.
- The size of the pipes increase from north to south. U-Pb age dating suggests that the North lobe is the oldest, although the distinction in ages is within error. Contact relationships between the South and Centre lobes however support these age data since the northern part of the South lobe cross-cuts the Centre lobe. These contact relationships were obtained from geochemical studies.



<u>Figure 14:</u> Envelope of high %DMS yield in the central part of the South lobe shown in orange, looking northeast (image from Farrow, 2007) on the left and yield values in the South lobe shown on the right. Yields range from 0.05% in dark blue to 28.5% in red. All yield values above 28.5% are shown in red in the right-hand figure. Units EM/PK(S) and WM/PK(S) are visible as dark red structures within the pipe (left). Dimensions of the South lobe are the same as those stated in Figures 3 and 4. (GOCAD image by A. Wolmarans).

- The South lobe kimberlite is completely different from the North and Centre lobes and exhibits this difference across a range of variables – pipe shape, nature of the kimberlite (both visually as well as geochemically), nature of the alteration products of the kimberlite, mantle-derived mineralogy and components, density and hardness. All three lobes exhibit considerable textural inhomogeneity on a microscopic level. Textures in the South lobe range from near uniform "magmatic"-looking areas to "segregationary" textures, now carbonate and serpentine-filled. Textures from the North and Centre lobes are generally more "segregationary" which may point to the presence of considerable porosity in these rocks at the time of emplacement. Textures in the North and Centre lobes overall exhibit a more fragmental appearance. This, together with the presence of clear pyroclasts, e.g. Plate 2, in the North lobe, leaves little doubt that the in-fill in these two lobes can be classified as volcaniclastic.

- The South lobe is more homogeneous in comparison to the other two lobes, but exhibits zones of olivine concentration and alignment of preferred orientation of lithic fragments. This, together with the paucity of lithic contamination and trends observed from other data sources, e.g. %DMS yield, may be the clues pointing to a volcaniclastic (pyroclastic?) origin, rather than a magmatic origin. Variable levels of sintering within the main pyroclastic kimberlite of the South lobe have resulted in variable primary porosity in the kimberlite (Sparks and Field, pers. comm., 2007). It is proposed that areas of unit M/PK that suffered the highest levels of sintering have escaped severe fluid flow and alteration, thereby preserving the high primary %DMS yield. Less sintered, more porous areas suffered more alteration over time and therefore exhibit lower %DMS yield.
- Previous examples of such clastogenic textures have shown that once the sintering process has been completed in kimberlites, very little evidence is left by which this process can be recognised, e.g. examples from Angola (Stiefenhofer, pers. obs.), except perhaps for an apparent segregationary texture on a microscopic level. The North and Centre lobes exhibit no obvious correlation between %DMS yield and chip density, but this may be a function of lower numbers of samples. The South lobe however does exhibit a strong correlation between %DMS yield and chip density.
- A complex interplay of at least four primary as well as secondary geological factors is responsible for the variations in %DMS yield observed in the South lobe.
- The South lobe kimberlite exhibits very low levels of alteration. Fresh olivine can already be found at depths of 80m and at deeper levels unaltered monticellite may be found in the groundmass. Similarly, any mantle xenoliths within the South lobe are relatively unaltered. The low

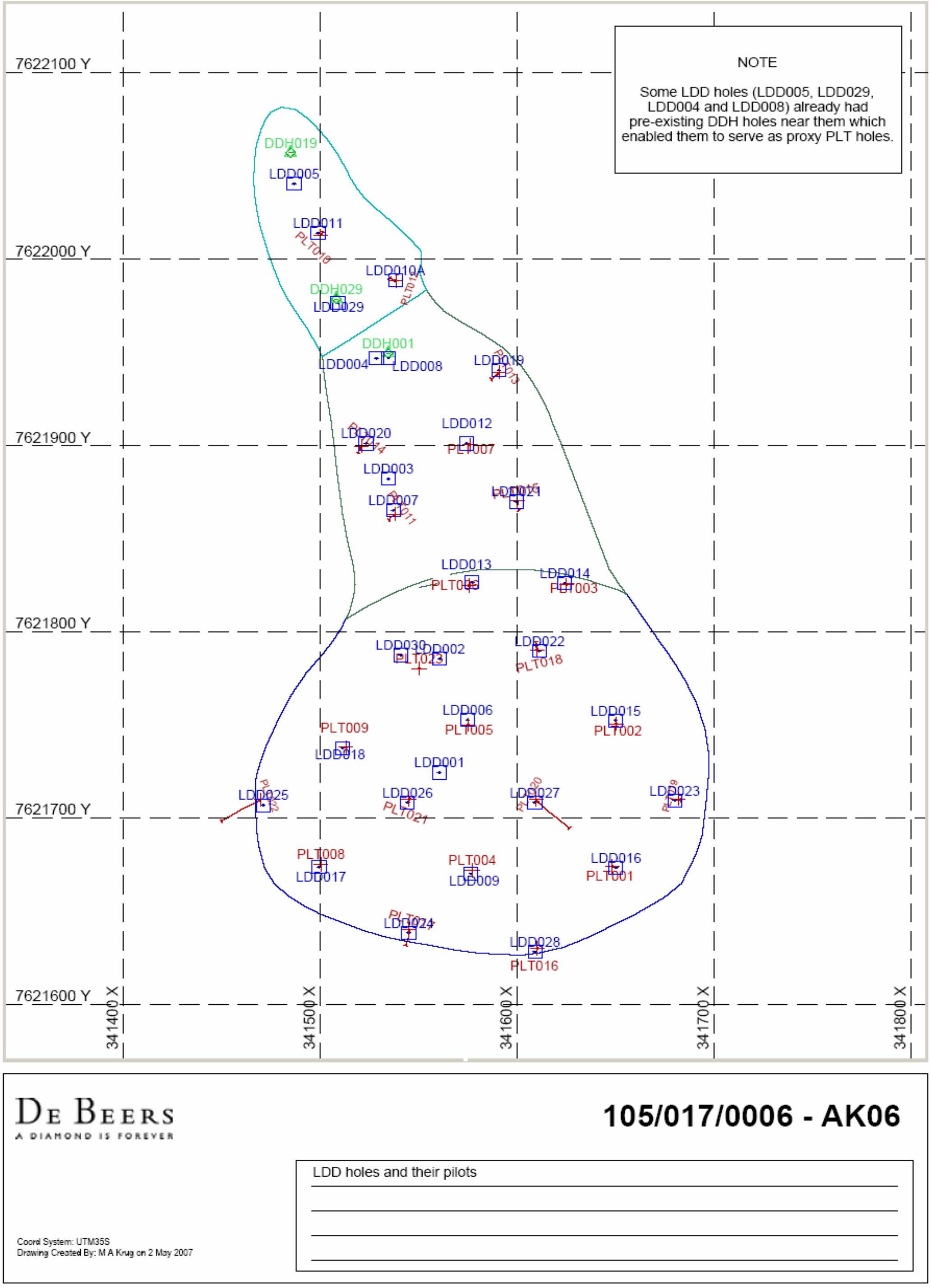


Figure 15: Locations of LDD holes and corresponding pilot holes (PLT), some of which are discussed in the text. Image – M. Krug.

levels of alteration resulted in a large percentage of fresh, dense mantle minerals, which explains the abnormally high percentage heavy minerals reporting to the DMS during the LDD sampling campaigns. Hydrothermal and/or secondary magnetite has crystallised in the South lobe, which may also increase the concentrate yield.

- Alteration of any kimberlite is generally more pronounced around the pipe perimeter, which may explain the association of lower %DMS yields with the margins of the South lobe.
- Increased crustal dilution moderates the %DMS yield as well as chip density in the South lobe. This applies both to units containing large fragments of crustal material, e.g. the basalt breccias, as well as units with sub-1cm-sized fragments of crustal dilution. It is speculated that such zones of fine crustal dilution may in part be responsible for some of the internal %DMS yield variation observed within unit M/PK(S).
- The South lobe overall contains low levels of crustal dilution. Under normal circumstances this would have been a positive feature. However in this kimberlite it unfortunately exacerbates the %DMS yield problem in the plant.
- Zones of increasing and decreasing abundances of indicator minerals and olivines could in some, but not all instances be correlated with fluctuations in chip density and %DMS yield in unit M/PK(S) of the South lobe.
- The significantly different geological and physical features observed in the South lobe compared to the North and Centre lobes suggest that a spectrum of volcanic and eruptive processes were active during the formation of the AK06 kimberlite complex. These geological distinctions correspond to differences with respect to diamond characteristics (Chinn et al., 2008). In addition to the distinctions in diamond grade which are evident between geological units at these occurrences, geo-metallurgical factors differ considerably between units.

7.0 DMS YIELD STATISTICAL DATA ANALYSIS

Geostatistical analysis of the %DMS yield within unit M/PK by Stiefenhofer (2007b) using the 17% yield boundary was successful in the upper part of the South lobe, but did not produce acceptable results at depth. The complexity and variability of the yield distribution within unit M/PK required a more in-depth geostatistical investigation which was not possible in 2007 due to time constraints. The following sections in this document will now deal with further geostatistical analysis of unit MPK. Four different geostatistical techniques were employed to investigate the DMS yield in unit M/PK on a local block scale. Ordinary and Indicator Kriging was used to honour the larger scale trends and patterns in the data, whereas conditional Turning Bands and Sequential Gaussian simulations were used in an attempt to quantify the variability of the data on a block scale and to obtain a representation of the real variance of the data since the simulations were conditioned to the sample data. The performance of one method against the other was also investigated, e.g. Ordinary Kriging vs. Indicator Kriging and Turning Bands vs. Sequential Gaussian conditional simulations.

All data were estimated into 25x25x12m blocks. Where enough samples were available, the data were grouped according to the primary geological units. Units were combined where geological interpretations suggested this could be done, if insufficient numbers of samples existed. Where geological units could not be grouped, a zonal average of %DMS yield was obtained for the unit in question, e.g. WM/PK(S). The analysis focused on the upper part of the resource, i.e. from surface to 620 m.a.m.s.l. (approx. 400m depth). All estimates were performed using ISATIS™ software.

A total of 25 (26 if a repeat hole is included) large diameter holes (23 inch) were drilled on a grid of approximately 70m with sample lifts of 12m. Ream samples, generated due to the cleaning of partial hole collapses, or due to the transition from conventional mud rotation to reverse air flood techniques, were excluded from the analysis due to the risk of contamination from unknown parts of the hole. After exclusion of ream samples, a total of 686 samples were imported into

ISATIS™ for analysis. Samples were not regularised. A total of 58 samples were derived from the north lobe, 119 from the centre lobe, and 509 were recovered from the south lobe (Table 2). These samples were investigated by Stiefenhofer (2007b) during the first analysis of %DMS yield across all three pipes. The phase 1 drilling yielded 321 samples and phase 2 yielded 365 samples.

Stiefenhofer (2007b) performed a test for duplicate analyses in ISATIS™ but none were found. Verification of the spatial location of borehole collars was also performed but no anomalies were discovered. The low numbers of samples in some of the kimberlite units prevented confident geostatistical analysis and samples from some units had to be combined. Units WK and CKIMB in the south lobe and CBBX and WBBX in the south lobe were combined. The univariate statistical parameters for some of the minor geological units are presented in Table 3.

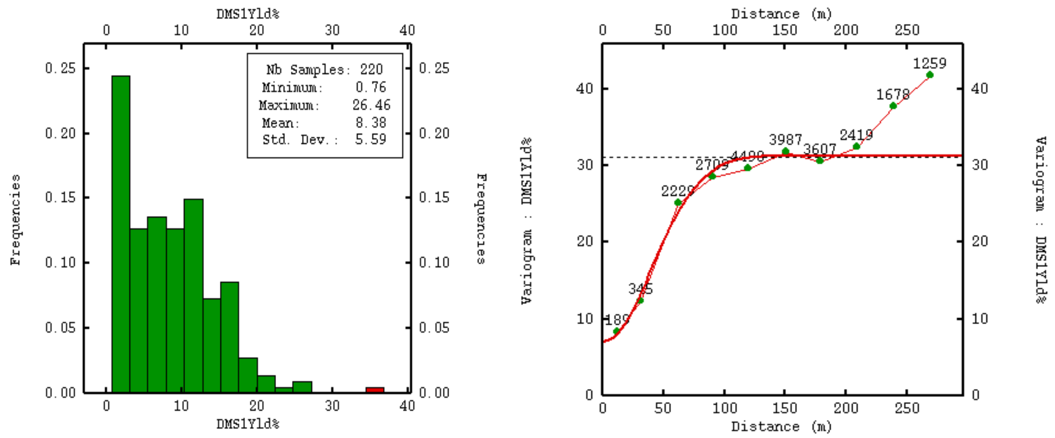
The univariate statistical parameters of the major South lobe lithological units, and those that were combined, are presented in graphic format in Figures 16-20, taken from Stiefenhofer (2007b). The relevant variogram parameters are also shown in Figures 16-20. Outlier samples were excluded from units M/PK and Yield_17 in order to improve the definition of the sill in the experimental variograms (Figures 16-17). In addition, a Gaussian variogram model rather than a spherical model was used for unit M/PK. A cubic model was also tested, but exhibited little difference compared to the Gaussian model, apart from a longer range. Separate horizontal and vertical experimental variograms were attempted, but in all instances the horizontal variogram suffered from a severe lack of data. Omni-directional experimental variograms were utilized, not only due to the poor results obtained for the horizontal variograms, but also because no clear evidence could be found in the geology data to suggest definite horizontal structures such as bedding.

Table 2: Listing of available samples per lithology per lobe. Note that samples below 400m depth are also included, e.g. units M/PK and Yield_17. The same number of samples from the South lobe, used by Stiefenhofer (2007b), formed the data set for the current investigation, but the lower depth was limited to 620 m.a.m.s.l. North and Centre lobe data are shown for information purposes only. These two pipes were excluded from the current study.

North Lobe	Unit	No samples
	WK	11
	FK	34
	BBX	5
	BASALT	6
	SANDSTONE	2
	TOTAL	**58**
Centre Lobe		
	CKIMB	1
	WK	30
	CFK	40
	FK	33
	BBX	6
	BASALT	6
	SANDSTONE	3
	TOTAL	**119**
South Lobe		
	CKIMB	3
	CBBX	1
	WK	76
	WBBX	20
	M/PK	281
	Yield_17	59
	EM/PK	43
	WM/PK	12
	BASALT	14
	TOTAL	**509**

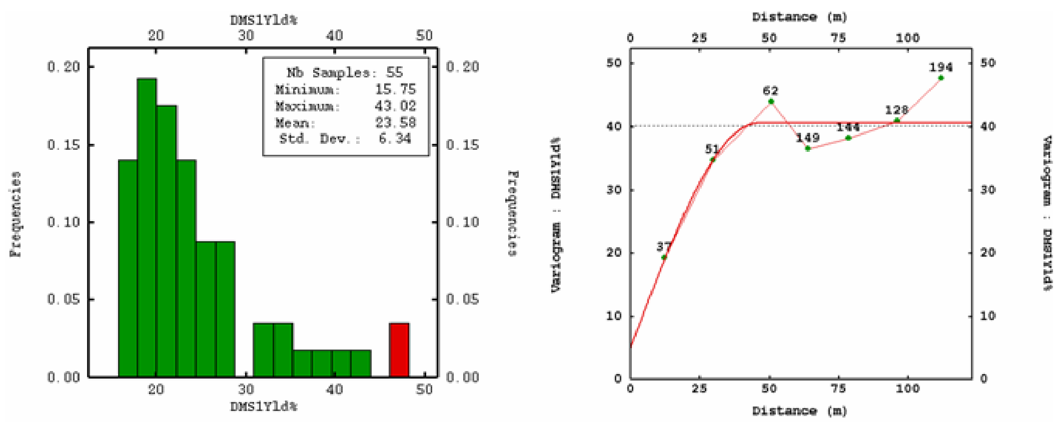
Table 3: Univariate statistical parameters for minor lithological units (Stiefenhofer, 2007b).

Lobe	Lithology	Number	Minimum	Maximum	Mean	Variance
South	**Basalt**	14	0.41	7.19	1.69	3.13
South	**WM/PK**	12	0.96	1.46	1.17	0.02



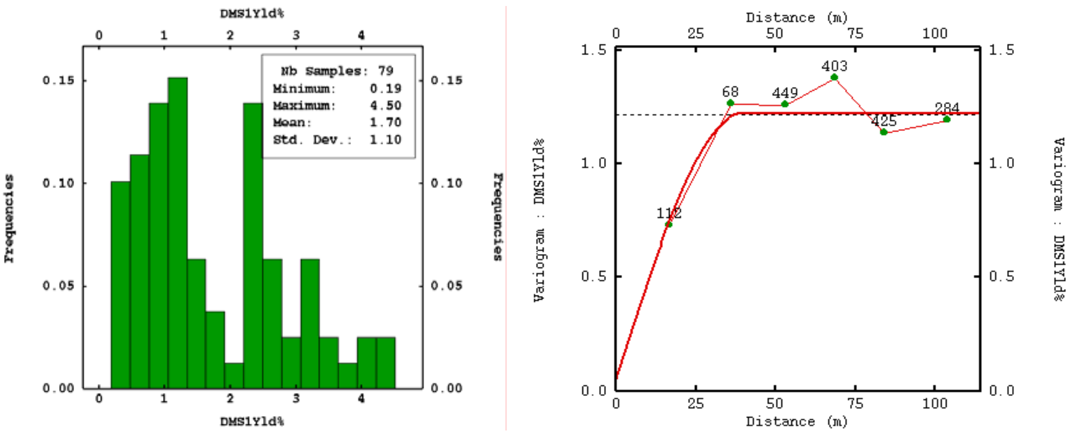
Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - M/PK Z>620)
- Variable #1 : DMS1Yld%
Experimental Variogram : in 1 direction(s)
D1 :
Angular tolerance = 90.00
Lag = 30.00m, Count = 10 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1 - Nugget effect, Sill = 7.028
S2 - Gaussian - Scale = 98.56m, Sill = 24.32

Figure 16: Univariate statistical and model variogram parameters for yield data from the M/PK kimberlite in the South lobe. One outlier, 0.5% of the distribution, was excluded from the variogram fitting, but included during kriging.



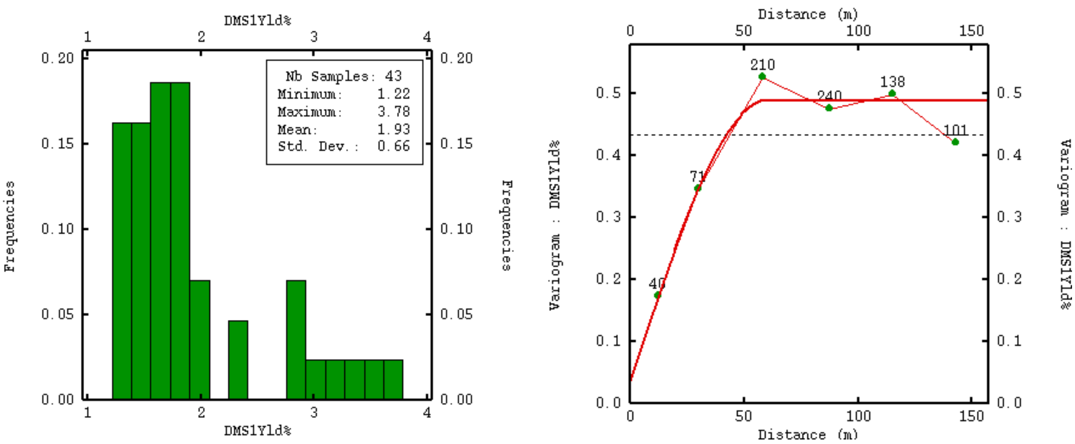
Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - Yield_17 Z>620)
- Variable #1 : DMS1Yld%
Experimental Variogram : in 1 direction(s)
D1 :
Angular tolerance = 90.00
Lag = 16.00m, Count = 8 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1 - Nugget effect, Sill = 5.035
S2 - Spherical - Range = 45.81m, Sill = 35.61

Figure 17: Univariate statistical and model variogram parameters for yield data from unit 17_Yield in the South lobe. Two outliers, 3.5% of the distribution, was excluded from the variogram fitting, but included during kriging.



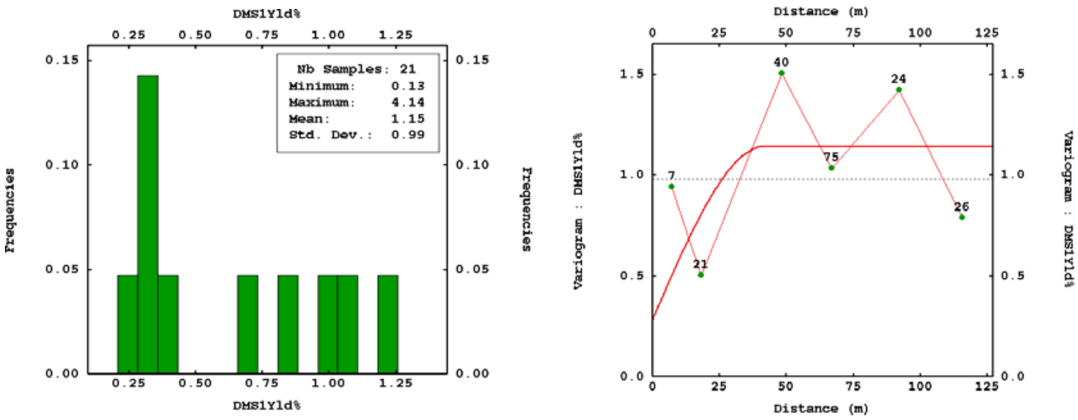
Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - WK and CKIMB)
- Variable #1 : DMS1Yld%
Experimental Variogram : in 1 direction(s)
D1 :
Angular tolerance = 90.00
Lag = 17.00m, Count = 7 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1 - Nugget effect, Sill = 0.05138
S2 - Spherical - Range = 39.79m, Sill = 1.172

Figure 18: Univariate statistical and model variogram parameters for yield data from the weathered and calcretised kimberlite in the South lobe – WK & CKIMB.



Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - EM/PK)
- Variable #1 : DMS1Yld%
Experimental Variogram : in 1 direction(s)
D1 :
Angular tolerance = 90.00
Lag = 29.00m, Count = 6 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1 - Nugget effect, Sill = 0.03395
S2 - Spherical - Range = 60.27m, Sill = 0.4552

Figure 19: Univariate statistical and model variogram parameters for yield data from unit EM/PK in the South lobe.

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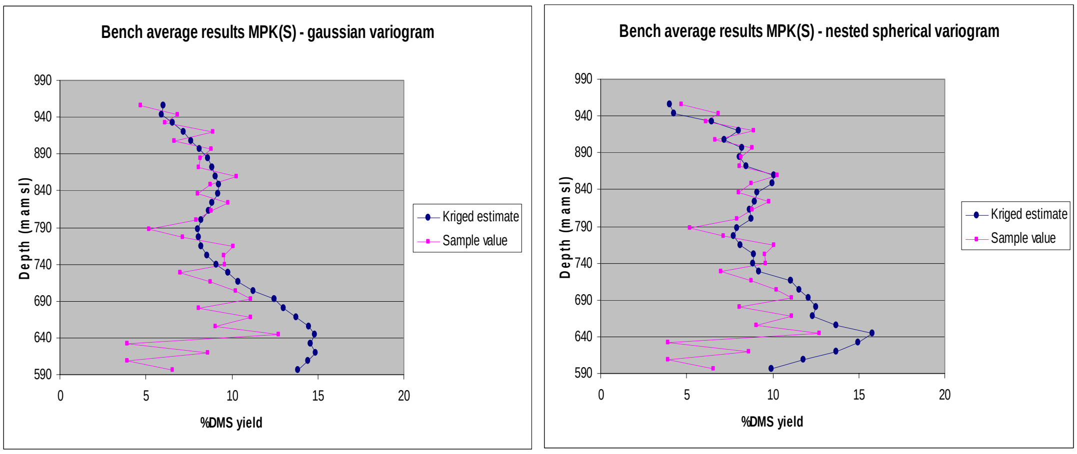
Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - CBBX and WBBX)
- Variable #1 : DMS1Yld%
Experimental Variogram : in 1 direction(s)
D1   :
      Angular tolerance =  90.00
      Lag =  23.00m, Count = 6 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1   - Nugget effect, Sill =     0.2834
S2   - Spherical - Range = 41.88m, Sill =     0.8614
```

Figure 20: Univariate statistical and model variogram parameters for yield data from the combined units of calcretised and weathered basalt breccia in the South lobe – CBBX & WBBX.

8.0 GEOSTATISTICAL ANALYSIS OF UNIT M/PK, SOUTH LOBE

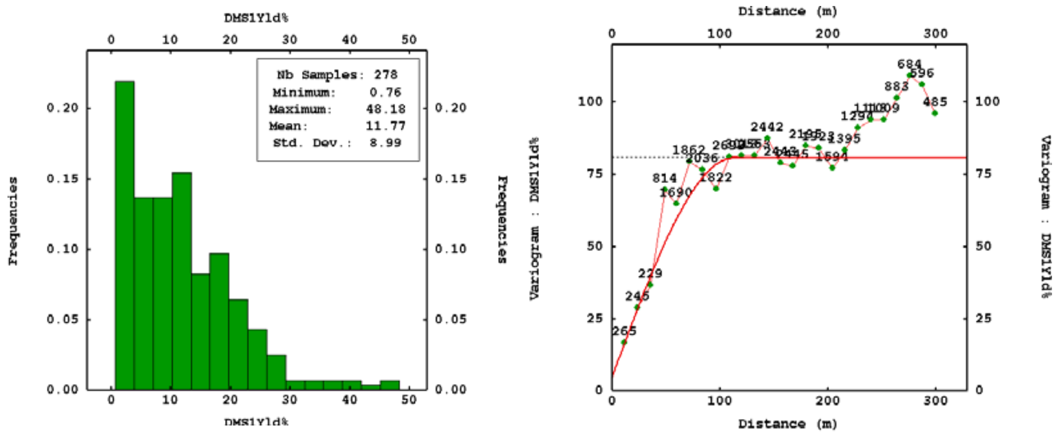
Stiefenhofer (2007b) analysed and kriged units M/PK and Yield_17 separately (see Section 7.0) in an attempt to moderate the very high variance which was encountered in the %DMS yield data. Figure 21 illustrates the comparison between the bench averaged estimates vs. bench averaged sample data for unit Yield_17 and M/PK obtained by Stiefenhofer (2007b). Although the estimates for unit Yield_17 were satisfactory, it was found that the estimates for unit M/PK deteriorated notably below approximately 728 m.a.m.s.l. This occurred regardless of the variogram model chosen (Figure 21). At this point, the variance of the %DMS yield in unit M/PK increases notably towards the lowest benches.

With hindsight, it is clear that the subdivision of unit M/PK into a higher and lower yield zone did not result in the improved kriging results as was hoped. The introduction of the 17% yield boundary was also somewhat arbitrary (treatment plant parameter) and not based on a valid geological distinction. In view of the poor results, it was therefore decided to revert back to a single M/PK unit, to repeat the kriging exercise from the start, and to re-investigate the variography of unit M/PK. The use of indicator kriging was considered to provide the mine planning department with a probability of intersecting yield above the cut-off acceptable to the plant.



<u>Figure 21:</u> Bench averaged kriged estimates for unit M/PK(S) using a gaussian variogram (left) and a nested spherical variogram (right) compared against bench averaged sample values. Note the deviation of kriged estimates away from the bench-averaged sample values below approximately 728 m.a.m.s.l. A few estimates also revealed values lower than those of the primary sample data which should not be the case.

The univariate statistical and model variogram parameters of unit M/PK (previously separated as M/PK and Yield_17) are shown in Figure 22. No clear geological structures, such as bedding which could be correlated between drill holes, were observed. Rare, localised examples did however occur. Due to the lack of major structure within the M/PK lithology, an omni-directional variogram was chosen. A 12m lag interval was chosen due to the 12m sampling interval in the vertical dimension. Vertical and horizontal variograms were evaluated separately but it was very difficult to construct meaningful variograms in the horizontal direction. The nugget value in the vertical variogram compared well with that of the omni-directional variogram.



Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - M/PK & Yield_17 comb Z>620)
- Variable #1 : DMS1Yld%
Experimental Variogram : in 1 direction(s)
D1 :
Angular tolerance = 90.00
Lag = 12.00m, Count = 26 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1 - Nugget effect, Sill = 4.75
S2 - Spherical - Range = 112.32m, Sill = 75.86

Figure 22: Univariate statistical and model variogram parameters for yield data from the M/PK kimberlite in the South lobe. A spherical variogram with a single structure was modeled. No outliers or data were excluded in the construction of the variogram.

Should any structures occur in the kimberlite that remained undetected, it is expected, given the pipe morphology and kimberlite petrology, that these would exhibit a sub-vertical orientation. The choice of variogram type and lag distance was therefore correlated with the geological observations as far as possible. Figures 22 and 23 show that the variance of %DMS yield in unit M/PK is now higher than was the case previously (Figures 16-17), which is to be expected. Both spherical and gaussian variogram models were considered (Figure 23). Chilès and Delfiner (1999) however noted that gaussian models should best be used for data which are highly continuous, e.g. geophysical or topographical data. It was also discovered that use of the gaussian variogram worsens negative kriging weights (Section 8.1). It was therefore decided to proceed using the spherical model rather than the gaussian example, although the data set was kriged using both models in order to compare the output (Section 8.1).

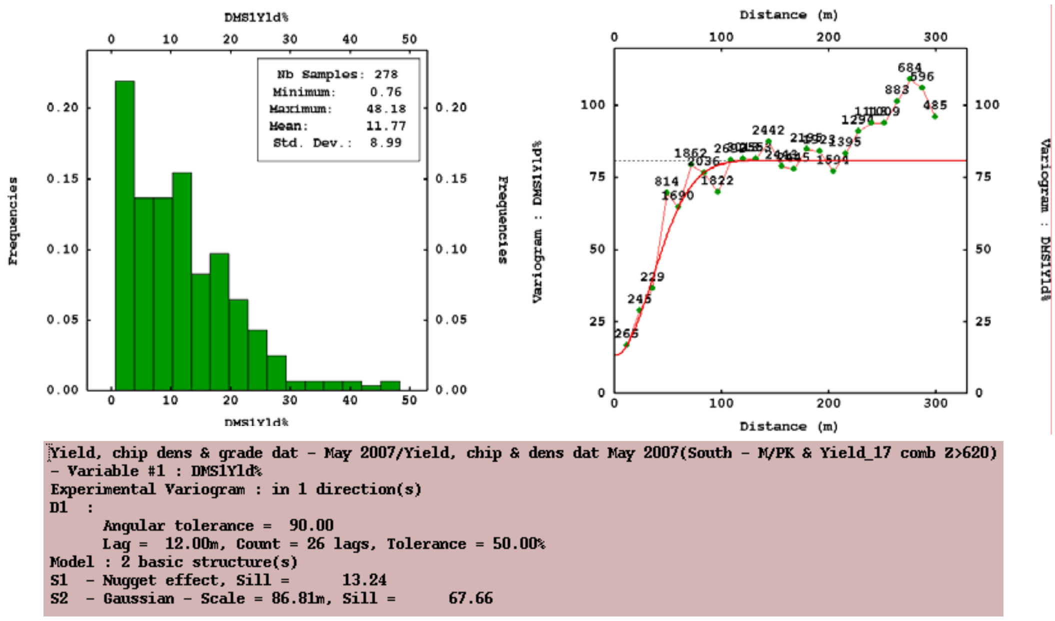


Figure 23: Univariate statistical and model variogram parameters for yield data from the M/PK kimberlite in the South lobe. A Gaussian variogram with a single structure was modeled. No outliers or any data were excluded in the construction of the variogram.

8.1 Ordinary Kriging

Local block estimates of %DMS yield were obtained using Ordinary Kriging (unknown mean) with a moving neighbourhood and the variogram model in Figure 22. The samples were systematically collected and were of similar size, hence no regularisation or declustering was applied.

Blocks were discretised into 5x5x1, based on the stabilisation of the estimation variance at 5x5x1 in a discretisation test (Figure 24).

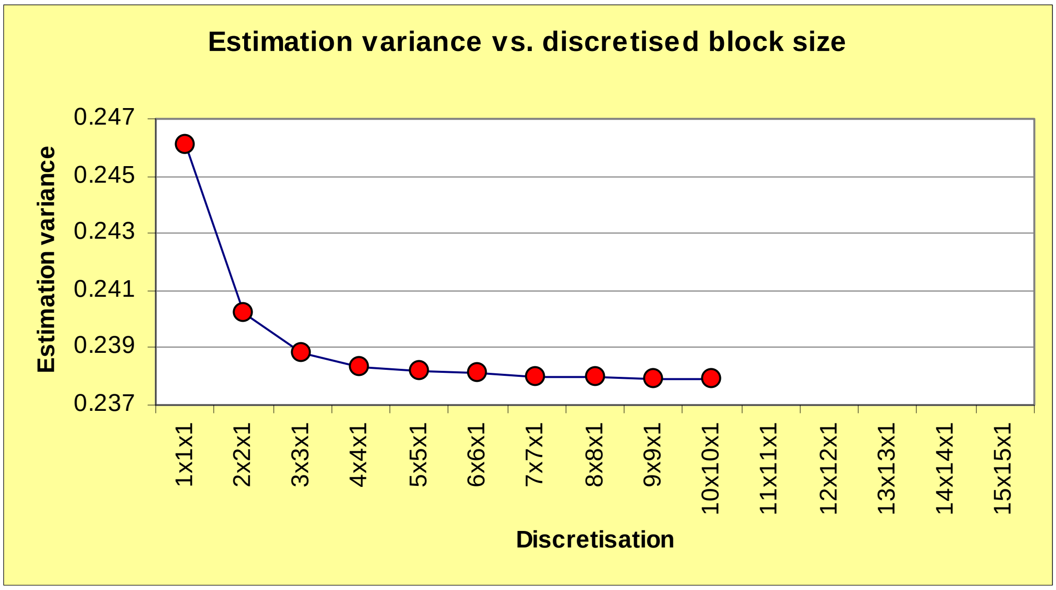


Figure 24: Discretisation test used to determine the optimal block discretisation of 5x5x1.

The number of samples used to populate the search neighbourhood was optimised to reduce the negative kriging weights to a minimum. The optimal number of samples per sector (4 sectors) ranged from 15 to 5 for testing purposes. The best results were obtained using 5x4 samples during kriging. Stiefenhofer (2007b) used 10x4 samples during the previous estimate of unit M/PK. The minimum number of samples in any kriging neighbourhood was five. A variety of kriging neighbourhoods were evaluated (Appendix 2) and this was undertaken using the following parameters:

- Slope of regression of the data values vs. the estimates (Z/Z*)
- Weight of the mean in simple kriging
- Minimizing negative kriging weights

Other parameters which were considered included:

- Variance of the estimator Z*
- Percentage blocks filled
- Mean of the estimate vs. mean of the sample data

Initially, symmetrical omni-directional neighbourhoods were considered and a value of 90x90x90m proved the most effective. Evaluation of the results revealed however that this neighbourhood resulted in unrealistic extrapolation of very high outlier data points into neighbouring blocks within the lower levels of unit M/PK. It was also found that too much emphasis was being placed on samples in the vertical dimension. Extending the search neighbourhood in the horizontal direction and decreasing the search distance in the vertical dimension to 140x140x24m resulted in an improved correlation between sample data and estimates (Figure 25). Cross-validation of samples against estimates also improved somewhat (Figure 28). Any remaining empty blocks, typically near the perimeter, were populated with estimates using a neighbourhood of 200x200x12m and failing that, a bench average value, which at times had to be manually modified (see below).

In spite of the improvements, Figure 25 still shows a relatively poor correlation between bench averaged sample data and kriged estimates over the last four benches. Closer inspection of the data revealed that several drill holes had reached their maximum depth and those that were still continuing had sampled predominantly within low %DMS yield areas more to the east. The kriging process had propagated higher %DMS yield values into the north-western part of the pipe at depth, in the absence of any constraining sample data.

The poorly sampled north-west of unit M/PK at depth (Benches 31-35) was re-evaluated in terms of geology using angled delineation holes, e.g. DDH15 and DDH30, both of which pass through this area of M/PK at depth. The impact of geology on the %DMS yield was discussed up to Section 6.0 of this document. It was shown that alteration and crustal dilution decreases the %DMS yield in unit M/PK. Visual examination of the photographs from these two holes proved to be helpful. It showed that more altered M/PK was located at Benches 19-25 and less altered kimberlite at Benches 26-35. It therefore appears that the northwest of unit M/PK at depth may return elevated %DMS values rather than low yields.

The kriged estimates were therefore more likely to represent reality and the bench averaged sample data from benches 32-35 may be biased towards lower %DMS yield. A few blocks at the perimeter of the resource beyond the range of the kriging neighbourhood were uninformed and had to be manually populated. Initially the relevant bench averages were used, but Figure 26 shows the obvious discontinuity which resulted. Each block was thereafter re-populated using the average kriged grade from the immediately surrounding blocks, resulting in a more realistic output.

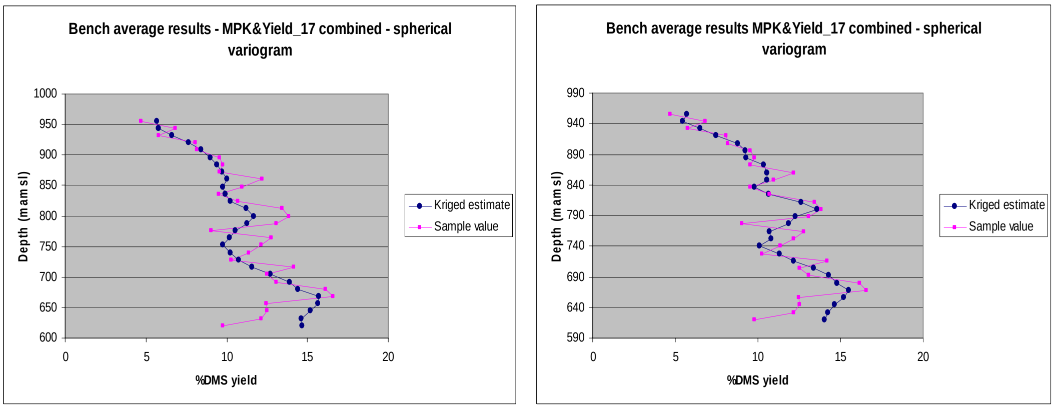


Figure 25: Bench averaged kriged estimates compared to bench averaged sample results for unit M/PK (M/PK and Yield_17 combined) showing estimates for a 90x90x90m kriging neighbourhood (left) and the final 140x140x24m neighbourhood (right).

The kriged output is presented in Appendix 3 where the local estimates within unit M/PK are graphically shown for every alternate bench. The sample positions are represented by cross-symbols which are proportional to the value of the sample. In addition, the numerical value of the %DMS yield in the sample is stated below its position. The local kriged estimate is represented by colour code. The same display format is retained throughout this study. Results per block are located in Appendix 8. Although unit M/PK is the focus of this study, kriged estimates of the minor units e.g. EM/PK(S), WM/PK(S), and weathered kimberlite, generated by Stiefenhofer (2007b), are also shown in Appendix 3 to avoid non-populated blocks appearing, and in order for the reader to appreciate the magnitude of the %DMS yield changes between some of the geological units, e.g. weathered kimberlite and breccias (Benches 2-6) vs. unit M/PK (Bench 8 onwards). The ordinary kriged estimates were hereafter also used to verify the output obtained from other techniques, e.g. indicator kriging (Section 8.2) and conditional simulation (Section 9.0). Comparisons between the various methods employed in the study are made in Section 10.

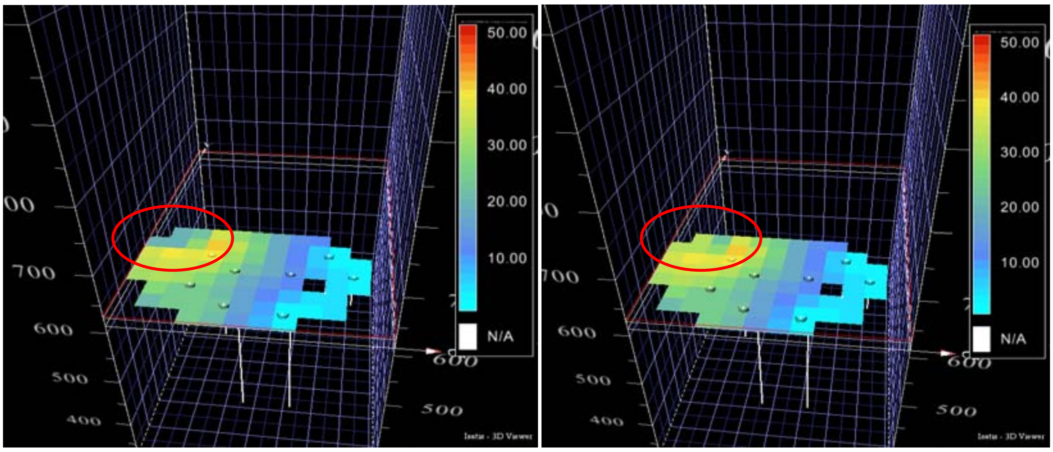


Figure 26: Bench 34, unit M/PK in the South lobe, where uninformed blocks were populated using the bench average (circled) on the left. The blocks were re-populated with an average of the blocks immediately surrounding them (right), which resulted in more realistic estimates, given the geological data (see text for discussion). The empty block in the east is due to the presence of a different geology – unit EM/PK(S).

Validation of the block estimates was performed using a combination of comparison of bench averaged estimates and sample data (Figure 25), comparison of $mean_{estimate}$ vs. $mean_{samples}$ (Figure 27), cross-validation (Figure 28), and a graphic comparison of the estimates against the sample results (Appendix 3).

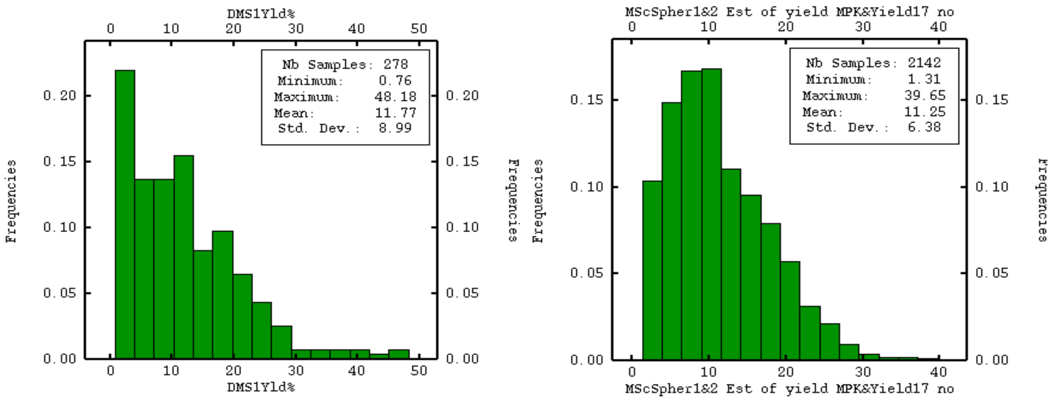


Figure 27: Comparison of univariate statistical parameters of the %DMS yield sample data from unit MPK (left) against those of the ordinary kriged estimates (right).

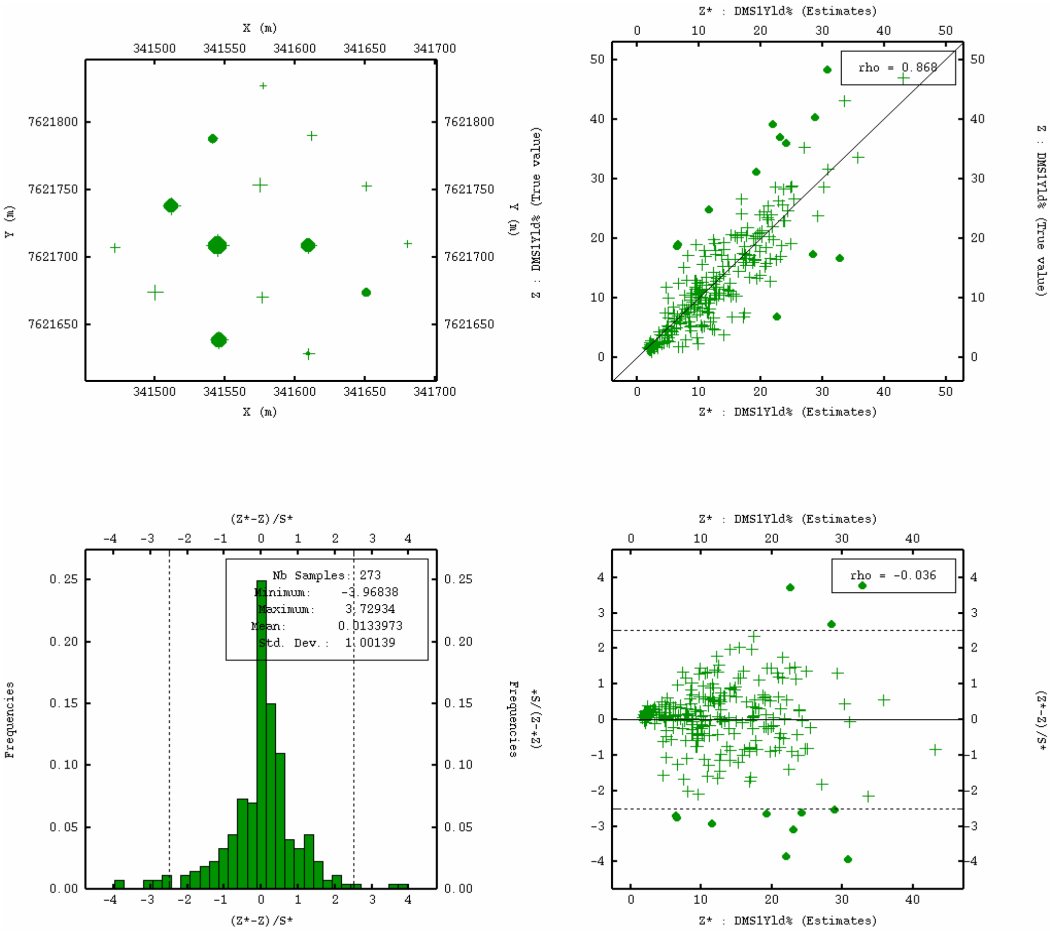


Figure 28: Cross validation of the estimates from unit M/PK. A total of 95% of the estimates tested as robust. The threshold for outliers is set at the 99% confidence limit of a normal distribution (bottom left). Estimates regarded as outliers (non-robust estimates), shown as solid symbols, all exhibit significant increase or decrease in value compared to that of its closest neighbour. Examples of such high localised variance are evident in the sample data as well and are a characteristic of this geological unit.

8.2 Indicator Kriging

The use of indicator kriging (IK) was first proposed by Journel (1982, 1988) as a non-parametric approach to parametric methods such as Disjunctive Kriging. Simplicity of use is a major advantage of IK over Disjunctive Kriging. The method has since attracted considerable debate as to whether or not it is a valid technique. Particular problems include, amongst others that the indicator variogram tends towards pure nugget effect as the threshold increases.

Indicator kriging (IK) of the %DMS yield in unit M/PK was investigated in an attempt to quantify the probability of encountering yield above the design limit of the treatment plant. A value of 17% at a cut point of 3.15 (Ep=0.08) was initially proposed for Phase 2 (70-390m) by Rodel, (written comm. to author, 24/04/2007), but this was subsequently updated to 20% in 2008. The image presented in Figure 14, Section 6.0 and the definition of the old unit Yield_17 (Fig. 17, Section 7.0) is still based on the previous 17% cut-off value. The more recent estimates reported in this section however utilise a 20% cut-off as the maximum permissible yield to the treatment plant.

Problems preventing application of indicator kriging, e.g. change of sample support (Chilès and Delfiner, 1999), or clustering of data (Isaaks and Srivastava, 1989) were not present in this data set. Extreme threshold indicator values and negative kriging weights (Appendix 4) were avoided, as recommended by Chilès and Delfiner (1999) and Goovaerts (1997). A number of different cut-off values of yield were investigated (Figure 29) but only indicator kriged estimates performed using the 20% cut-off are reported here and displayed in Appendix 5. Individual indicator variograms were constructed for cut-offs at every interval shown in Figure 29 up to 35%, however only the variogram for the 20% cut-off is shown in Figure 30. Adjacent cut-off values e.g. 25% and 30% were examined and also kriged, but only for comparison and quality control purposes. A value of 0.60 or 60% probability of exceeding the 20% DMS yield limit on the plant is proposed as the cut-point for deciding which mining blocks will require blending or modification prior to treatment. This probability value was selected following visual examination of the output.

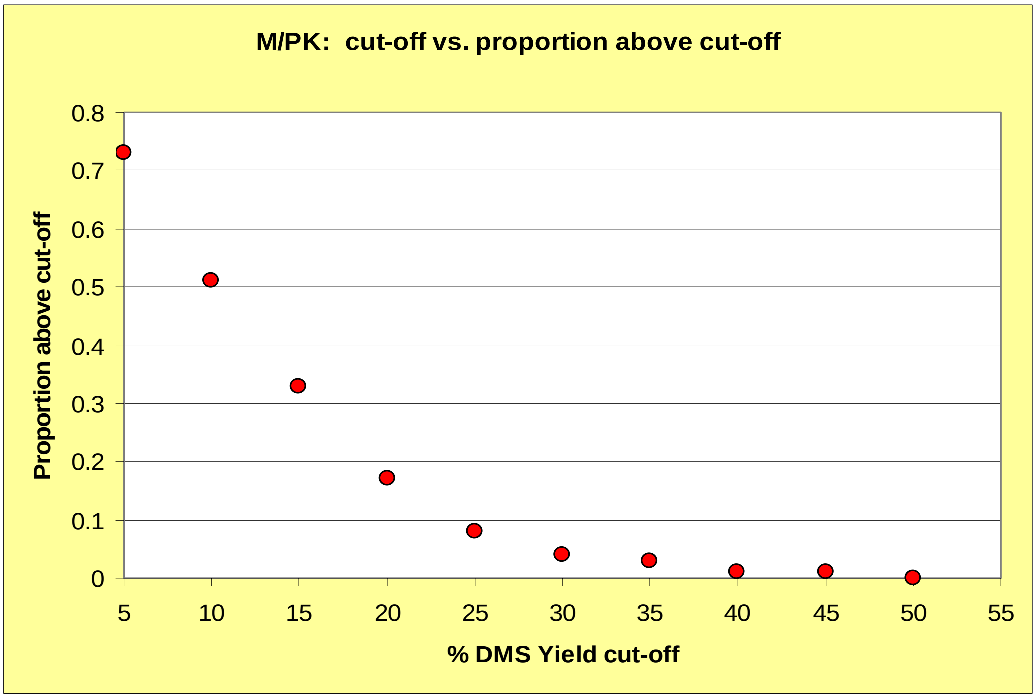
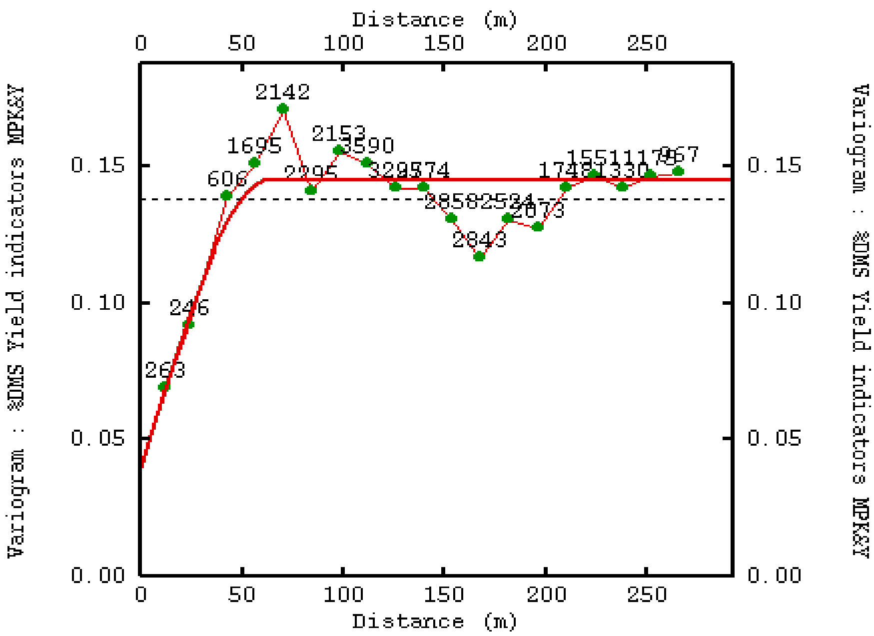


Figure 29: Relationship between various cut-offs of %DMS yield and the proportion above cut-off.

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Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - M/PK & Yield_17 comb Z>620)
- Variable #1 : %DMS Yield indicators MPK&Yield_17 comb[00004]
Experimental Variogram : in 1 direction(s)
D1  :
      Angular tolerance =   90.00
      Lag =  14.00m, Count = 20 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1  - Nugget effect, Sill =     0.03902
S2  - Spherical - Range = 64.34m, Sill =      0.1062
```

Figure 30: The model indicator variogram parameters for yield data from unit M/PK at a cut-off of 20% DMS yield. A spherical variogram with a single structure was modeled.

The number of samples used to populate the search neighbourhood was optimised to reduce the negative kriging weights to a minimum. The optimal number of samples per sector (4 sectors) was set at 5 during kriging. A minimum number of five samples were maintained in the kriging neighbourhood at all times. The kriging neighbourhood also remained identical, i.e. 140x140x24m for every cut-off investigated. Evaluation of the kriging neighbourhoods is presented in Appendix 4.

The kriged output is presented in Appendix 5 where the probability of exceeding a 20% DMS yield within unit M/PK is shown for every alternate bench. The naming and symbol conventions previously used for Ordinary Kriging in Appendix 3, still apply. Other kimberlite lithologies in the South lobe contain substantially lower DMS yields which will not exceed 20%. These zones will appear as pale blue colours in Appendix 5. Results per block are shown in Appendix 8.

9.0 CONDITIONAL SIMULATION OF %DMS YIELD IN UNIT M/PK, SOUTH LOBE

The differences between kriging and conditional simulation can be subtle at times, yet the two methods differ fundamentally (e.g. Journel, 1974; Goovaerts, 1997; Leuangthong et al., 2004). Conditional simulation differs from kriging in two major ways (Deutsch and Journel, 1998). The aim of kriging is to provide the best linear unbiased estimate of the variable, without consideration of the spatial statistics of all the estimates collectively. The emphasis is on local accuracy, whereas simulation focuses on more correct spatial continuity (Deutsch and Journel, 1998; Olea, 1999). Secondly, conditional simulation presents a more accurate picture of the true variance within a dataset compared to kriging. Chilès and Delfiner (1999) provided a useful summarised comparison of the various simulation methods in their Table 7.1. It was therefore decided to compare the kriged %DMS yield output from this study against a simulation of the %DMS yield data. No single simulation algorithm can account for the wide range of features observed in practice. Two methods of conditional simulation were therefore chosen to investigate the %DMS yield in unit M/PK. The Turning Bands method represents an older simulation method, but which remains in favour particularly by French geostatisticians. The Sequential Gaussian Simulation method was more recently developed, and remains a popular method of simulation due to its ease of application and less complex mathematical basis (Dowd, 2007; Deutsch, 2008). These methods are discussed in more detail in the following sections.

9.1 Turning Bands Simulation

The Turning Bands (TB) method was first developed for geostatistical simulation use by Matheron (1973) where he attempted to combine the simplicity of one-dimensional simulation and the efficiency of 3D simulation. The TB method was already in existence in the case of Brownian (a fractal process) random functions since the late 1950's (Chentsov, 1957). More recent reference to this method can be found in Chilès and Delfiner (1999), Olea (1999), and Lantuéjoul (2002). TB represents the first large-scale 3D Gaussian simulation algorithm implemented (Deutsch and Journel, 1998). In brief, the method is described as a series of one-dimensional simulations along *n* lines which collectively represent a regular partitioning of 3D space. Each node in 3D space is then projected onto a particular point on each of the lines. The simulated value at the node is then taken as the sum of the values at *n* projected points. The TB method reduces the simulation of a Gaussian random function with covariance *C* to the simulation of independent stochastic processes with covariances C_θ where θ is a direction parameter (Lantuéjoul, 2002). The simulations along each line are frequently discretised such that the same value is assigned to the entire "band" perpendicular to the lines, hence the name "turning bands" (Chilès and Delfiner, 1999). In 3D space the maximum number of regularly spaced directions is 15, and these are defined by lines joining opposite edges of an icosahedron (polyhedron with 20 faces and 30 edges – Dowd, 2007; Chilès and Delfiner, 1999).

Typically however, these 15 lines show up in the realisations as "bands", i.e. artefacts of the simulation process (Chilès, 1977), which is one of the reasons why some workers avoid this technique (Deutsch and Journel, 1998; Olea, 1999 and references therein). Others e.g. Rambert (pers. comm. to the author) maintain that the TB method remains one of the better methods of generating a simulation. In order to progress beyond 15 lines, Chilès and Delfiner (1999) recommend taking random directions or groups of lines, or better still, quasi-random sequences. It is essential to choose a sufficient number of lines or "bands" (several hundred) to avoid generating these artefacts during the simulation process. The TB method itself produces a non-conditional simulation which then has to be conditioned through the use of kriging (Olea, 1991). The more detailed description of the TB method below was taken from Dowd (2007), which is in turn based on the work by Matheron (1973).

9.1.1 The theory of Turning Bands Simulation

Consider the line l drawn in three-dimensional space R^3 (Figure 31). Then x_l is the projection of a point x on the line l.

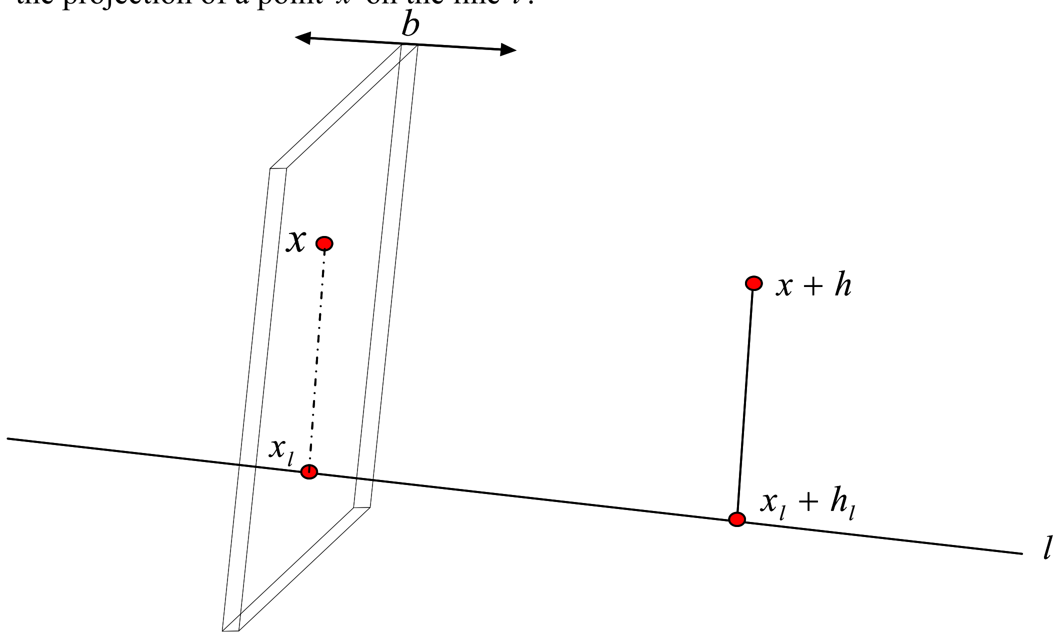


Figure 31: Point x and the projection x_l onto the line l. One interval b is illustrated with distance $b/2$ on either side of the plane. Image modified from Dowd (2007) and David (1977).

Y_{x_l} is a one-dimensional, second order stationary random function which is defined on l with $E = 0$ and a one-dimensional covariance function $C_1(h_l)$.

$Z(x)$ is a 3-D random function where $Z(x) = Y(x_l), \forall x \in R^3$, $Z(x)$ is second-order stationary, $E = 0$, and its covariance function

$$E\left[Z(x)Z(x+h)\right] = E\left[Y(x_l)Y(x_l+h)\right] = C_1(h_l)$$

Realisations $y(x_l)$ of the random function $Y(x_l)$ are generated along the line l. At all points x_l on line l a plane is constructed at right angles to the line and all points x on this line are assigned the value $y(x_l)$. It is not possible to construct continuous realisations of $y(x_l)$ and line l is therefore subdivided into small intervals, labelled b. Each interval is assigned one realisation and any point x falling within distance $b/2$ on either side of the plane is assigned the value $y(x_l)$. The concept is illustrated in Figure 32 for a 2-D situation where values of $y(x_i)$ are generated at each point x_i on the line l with a spacing b. The bands extend outwards into space at right angles to line l. Sample positions 1, 6 and 12 are awarded the value $y(x_1)$, sample positions 2, 7, 8, 13 and 18 are awarded the value $y(x_2)$, etc.

One can now transfer this procedure to a 3-D example by defining the direction of these lines as a uniform selection of radii $(l_1, l_2, ..., l_n)$ within a unit sphere. A one-dimensional random function $Y\left(x_{l_i}\right)$ is defined on each line l_i, similar to the 2-D example above. $E = 0$ and $C_1\left(h_{l_i}\right)$ is identical for each $Y\left(x_{l_i}\right)$. All $Y\left(x_{l_i}\right)$ are independent of each other. As before, let x_{l_i} represent the projection of any point x on the line l_i and $Z_i(x)$ the 3-D random function defined by

$Z_i(x) = Y(x_{l_i}), \forall x \in R^3$. There are then n random functions $Z_i(x), i = 1, 2, ..., n$ defined at each point of the 3-D space. These random functions are then summed and expressed as another second order stationary random function

$$Z_s(x), x \in R^3 : Z_s(x) = \sum_{i=1}^{n} Z_i(x)$$

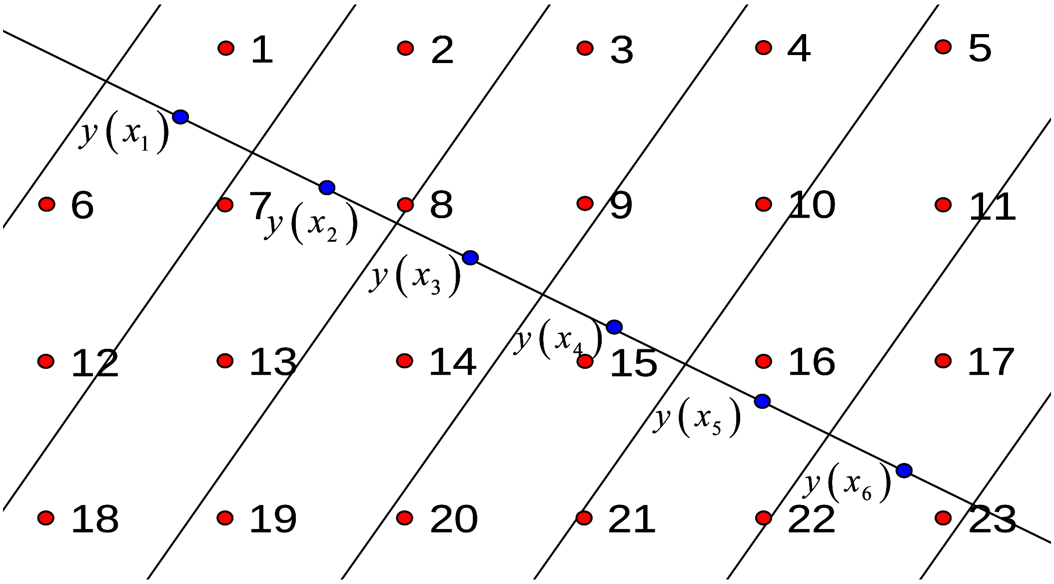


Figure 32: Values of $y(x_i)$ are generated at each point x_i on the line l. Image modified from Dowd (2007).

which has $E = 0$ and covariance defined as

$$C_3(h) = E\left[Z_s(x) Z_s(x+h)\right]$$

but as $n \to \infty, C_3(h)$ tends towards the isotropic covariance

$$C_3(h) = \int_{1/2\,unit\,sphere} C_1(h_r)\,dr$$

If, in a 3-D environment, the vertical Z-axis is chosen to coincide with the vector h, then this line is defined by two angles, viz. θ (rotation perpendicular to the Z-axis, i.e. the horizontal plane), and φ (rotation about the Z-axis). All radii of a unit semi-sphere can then be obtained by rotating the line l through 360^0 in the horizontal plane ($0 \le \theta \le 2\pi$) and through 90^0 in the vertical ($0 \le \varphi \le \pi/2$). This concept is graphically illustrated in Figure 33. Integration over the full range of both angles in two dimensions and expressing h in trigonometric relationships results in the following expression for $C_3(h)$

$$C_3(h) = \int_0^{2\pi} d\theta \int_0^{\pi/2} C_1\left(\left|h\cos\varphi\right|\right)\sin\varphi \, d\varphi$$

and setting $u = \left|h\cos\varphi\right| \quad \therefore \; du = h\sin\varphi \, d\varphi$

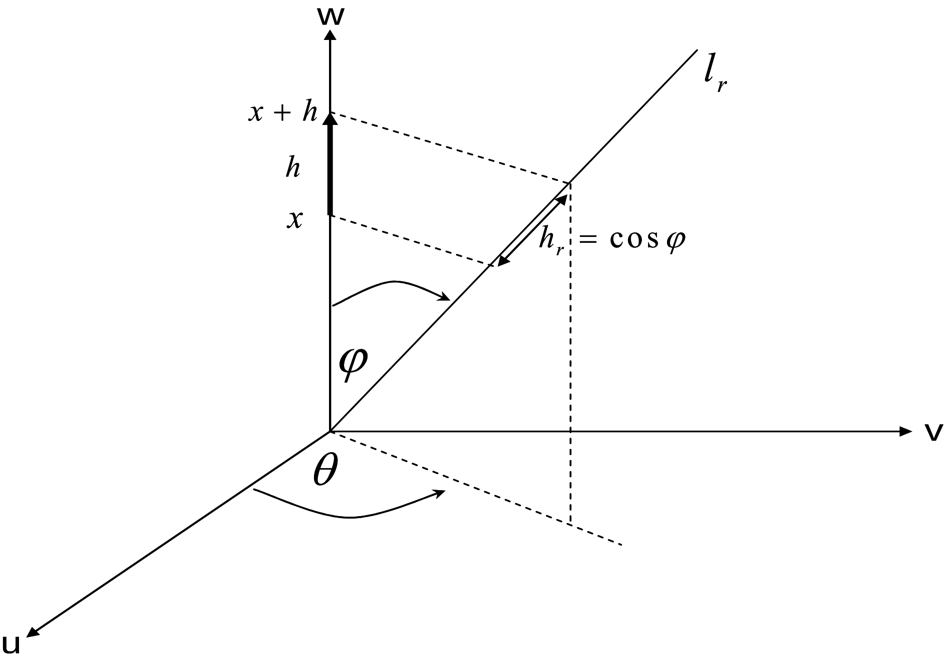


Figure 33: Variables defined in the text and used to define $C_3(h)$ for a unit semi-sphere expressed as a trigonometric function. Image after Dowd (2007).

$$C_3(h) = \int_0^{2\pi} d\theta \int_0^{\pi/2} C_1(u)\frac{du}{h}$$

$$C_3(h) = \frac{2\pi}{h}\int_0^h C_1(u)\,du$$

inverting the equation:

$$C_1(h) = \frac{1}{2\pi}\frac{d}{dh}\left(hC_3(h)\right)$$

Since it is not possible to generate an infinite number of lines l_i a more practical solution would be to define lines joining the mid points of opposite edges of the largest possible regular polyhedron, the icosahedron which has 30 edges, i.e. 15 lines. Each point x in R^3 is assigned the sum

$$z_s(x) = \sum_{i=1}^{15} z_i(x)$$

with a corresponding covariance of

$$C^*(h) = \sum_{i=1}^{15} C_1(h_l)$$

rather than the theoretical covariance

$$C(h) = \frac{2\pi}{h}\int_0^h C_1(u)\,du$$

Dowd (2007) stated that it is difficult to determine a theoretical expression for $C^*(h)$ and evaluate the bias due to discrete approximation. A simple multiplicative correction can however be made by comparing the two expressions when $C_1(h)$ is a constant

$$C^{*}(h) = 15t$$

$$C(h) = 2\pi t$$

$$C^{*}(h) = \frac{15}{2\pi} C(h)$$

Chilès and Delfiner (1999) noted that to progress beyond 15 lines, random directions or groups of 15 lines can be employed. Independent random directions drawn from a uniform distribution on a half-sphere however provide a rather irregular discretisation. Quasi-random sequences offer better results, e.g. Freulon and Fouquet (1991).

The following section discusses the generation of non-conditional simulations in one dimension (after Dowd, 2007). The standard covariance models which are used in mining (of which the spherical model is one) can be expressed as convolution products of a function $f(u)$ and its transpose:

$$\breve{f}(u) = f(-u)$$

A convolution is an integral which defines the overlap of one function $g(t)$ as it is shifted over another function $f(t)$ and effectively blends one function with another (Weisstein,2007), for example:

$$f(t) * g(t) = \int_{0}^{t} f(\tau) g(t-\tau) d\tau$$

Convolutions are however more typically taken over the range $-\infty \rightarrow +\infty$

$$C(h) = f * \breve{f} = \int_{-\infty}^{\infty} f(u) f(u+h) du$$

If the three dimensional function $C(h)$ can be expressed in this form, then the same applies to the one-dimensional function

$$C_1(h) = f_1 * \breve{f}_1 = \int_{-\infty}^{\infty} f_1(u) f_1(u+h)\,du$$

This implies that a one-dimensional simulation can be carried out as a moving average with a weighting function $f_1(u)$. A stationary random measure $T(dr)$ is generated on the line and regularised by the weighting function $f_1(u)$.

$$Y(u) = \int_{-\infty}^{\infty} f_1(u+r) T(dr) = T * \breve{f}_1$$

One-dimensional function $Y(u)$ then has a covariance function

$$C_1(h) = f_1 * \breve{f}_1$$

In practice, Dowd (2007) advises that discrete points on the line must be used and $T(dr)$ is replaced by independent random variables T_i from the same distribution. Dowd (2007) then defines the random function Y_i at a point as:

$$Y_i = \sum_{j=-\infty}^{\infty} f(j) T_{i+j}$$

Realisations t_i of the random variables T_i are assigned at set intervals on the line. The t_i are randomly drawn from a uniform distribution with interval $(-0.5, +0.5)$. Figure 34 illustrates realisations $t_{i-k}, \ldots t_i, \ldots t_{i+k}$ which exist at points $i-k, \ldots i, \ldots i+k$.

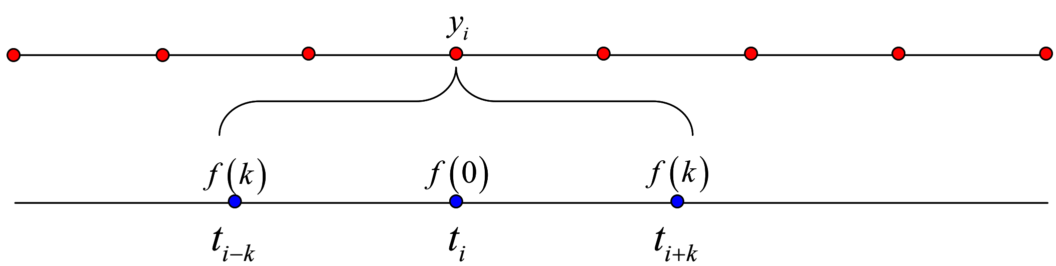


Figure 34: Realisations $t_{i-k}, \ldots t_i, \ldots t_{i+k}$ which exist at points $i-k, \ldots i, \ldots i+k$.

This step is followed by taking the moving average Y_i weighted by the function $f(u)$ and defined at each point i as:

$$Y_i = \sum_{k=-\infty}^{\infty} t_{i+k} f(k)$$

This step, i.e. summing over infinity, is not possible in reality, but for example in the case of the spherical model, $f(u)$ is defined within the finite interval $[-a/2, a/2]$. Equation

$$C_1(h) = \frac{1}{2\pi}\frac{d}{dh}\left(hC_3(h)\right)$$

previously defined on p.65 is then used to determine the one-dimensional covariance functions which correspond to each of the three-dimensional covariance functions. The one-dimensional covariance functions must then be expressed as convolution products using equation

$$C_1(h) = f_1 * \breve{f}_1 = \int_{-\infty}^{\infty} f_1(u) f_1(u+h)\, du$$

previously defined on p.67 to determine the weighting function $f(u)$. The covariance functions for the spherical model are shown below.

$$\begin{aligned} C_3(h) &= C\left[1 - \frac{3h}{2a} + \frac{h^3}{2a^3}\right] && h \le a \\ &= 0 && h > a \end{aligned}$$

$$\begin{aligned} C_1(h) &= \frac{1}{2\pi}\frac{d}{dh}\left(hC_3(h)\right) \\ &= \frac{C}{2\pi}\left[1 - \frac{3h}{a} + \frac{2h^3}{a^3}\right] && h \le a \\ &= 0 && h > a \end{aligned}$$

$C_1(h)$ expressed as a convolution product:

$$C_1(h) = f * \check{f}$$

where:

$$f(u) = \sqrt{\frac{12C}{2\pi a^3}}u \qquad -\frac{a}{2} \leq u \leq \frac{a}{2}$$
$$= 0 \qquad otherwise$$

9.1.2 Application of the Turning Bands technique

The following steps were followed to generate the TB conditional simulations for this study.

- Transfer of the raw data into Gaussian space using the Gaussian Anamorphosis function in ISATIS™ (Figure 35).
- Model variogram fitted to the data in normal space (Figure 36).
- Generating a non-conditional block simulation using TB.
- Conditioning of the TB simulation using ordinary kriging (neighbourhood and parameters identical to those utilised in Section 8.1.
- Optimising the number of block simulations. This has been set equal to 100. It was found that minimal benefit was obtained by additional simulation runs.
- Optimising the number of turning bands using the variance about the mean of the estimate produced. This number was optimised to 1200 bands (Figure 37).
- Back-transformation of the simulated values to the raw space.
- Verify the conditional simulation by comparing the variogram of the input sample data against variograms of individual point simulations, and by comparing the univariate statistics of the sample data against those of the conditional simulation and kriged output.

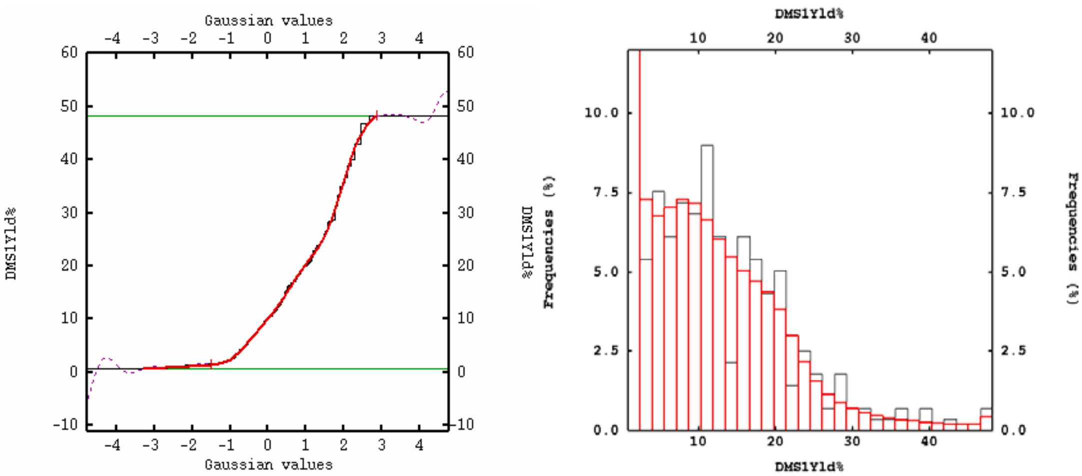
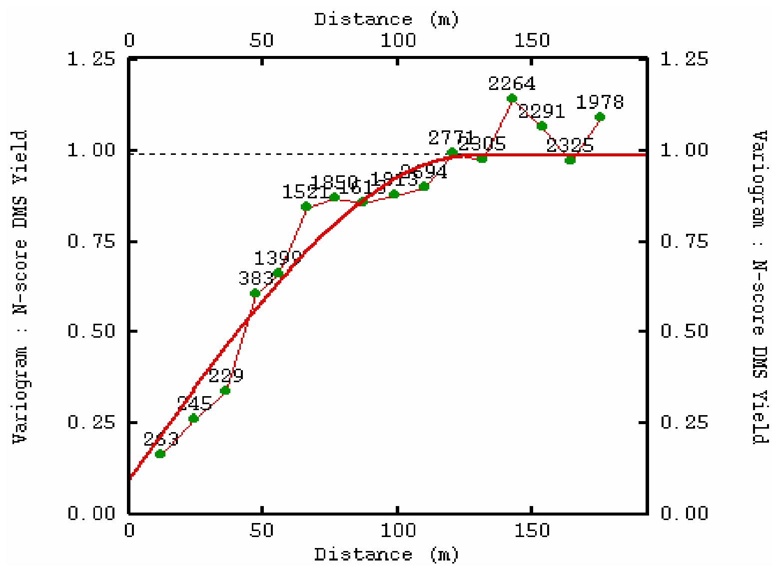


Figure 35: The Gaussian anamorphosis fitting (left), and the histogram (right) which was constructed from the Gaussian data. Distribution of the data is shown in black and that of the model in red. The fitting statistics are: Experimental mean = theoretical mean = 11.77% yield; Experimental variance = $80.78\%^2$ and theoretical variance = $80.67\%^2$. Interval of definition on the Gaussian variable is [-3.49,3.06] and on the raw variable [0.76, 48.18].



Yield, chip dens & grade dat - May 2007/Yield, chip & dens dat May 2007(South - M/PK & Yield_17 comb Z>620)
- Variable #1 : N-score DMS Yield
Experimental Variogram : in 1 direction(s)
D1 :
Angular tolerance = 90.00
Lag = 11.00m, Count = 17 lags, Tolerance = 50.00%
Model : 2 basic structure(s)
S1 - Nugget effect, Sill = 0.09428
S2 - Spherical - Range = 128.03m, Sill = 0.8914

Figure 36: Univariate statistical and model variogram parameters for yield data from the M/PK kimberlite in the South lobe, modeled in Gaussian space. A spherical variogram with a single structure was modeled.

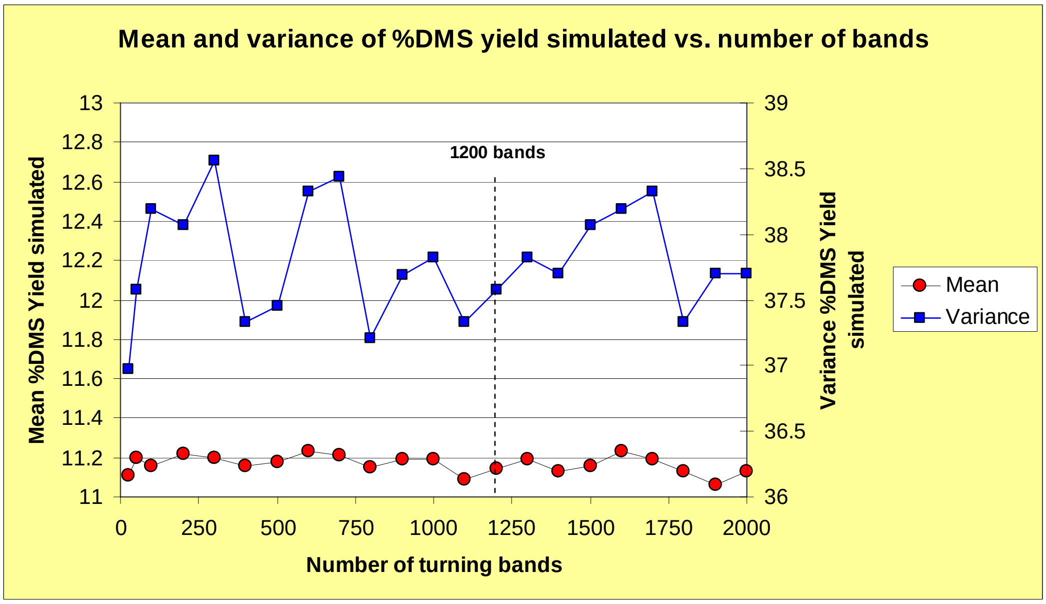
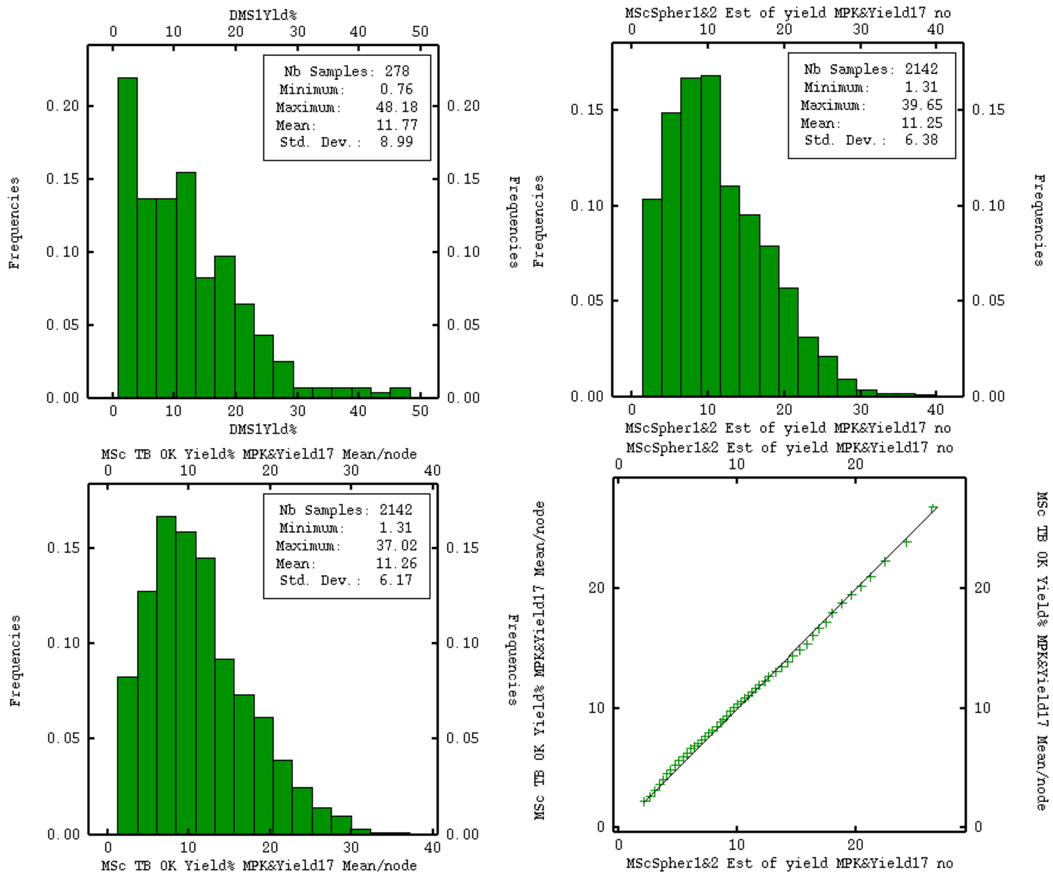


Figure 37: Optimisation of the number of turning bands using variance about the simulated mean. The final simulations were performed using 1200 bands.

The univariate statistical parameters generated from the TB simulation of %DMS yield are illustrated in Figure 38 and compared against those of the sample data and the kriged output shown in Figure 27. Since the conditional step of the simulation also involves Ordinary Kriging and the parameters were identical to those employed in section 8.1, it is to be expected that the univariate statistics from the two techniques should be very similar. This is also evident when examining a quantile-quantile plot showing the output from the kriging and TB techniques (Figure 38). Turning Band simulation results are presented in Appendix 6 for every alternate bench and results per block are shown in Appendix 8. The results of the simulations are discussed and compared in Section 10. In addition, the average variance per node was obtained for the 100 simulations and used to investigate the impact of edge effects and low sample numbers (Figure 39). The output from the TB simulations only relate to unit M/PK and no conditional simulations were performed on the minor geological units.



<u>Figure 38:</u> Comparison of univariate statistical parameters of the %DMS yield sample data from unit MPK (top left) against those of the ordinary kriged estimates (top right) from Figure 27 and those obtained from the Turning Bands conditional simulation (bottom left). Note that each data point on this graph represents the mean of 100 simulations per node. The output from the kriging and simulation is also compared using a quantile-quantile plot (bottom right) where ordinary kriged estimates are plotted on the X-axis and the conditional Turning Band simulation on the Y-axis.

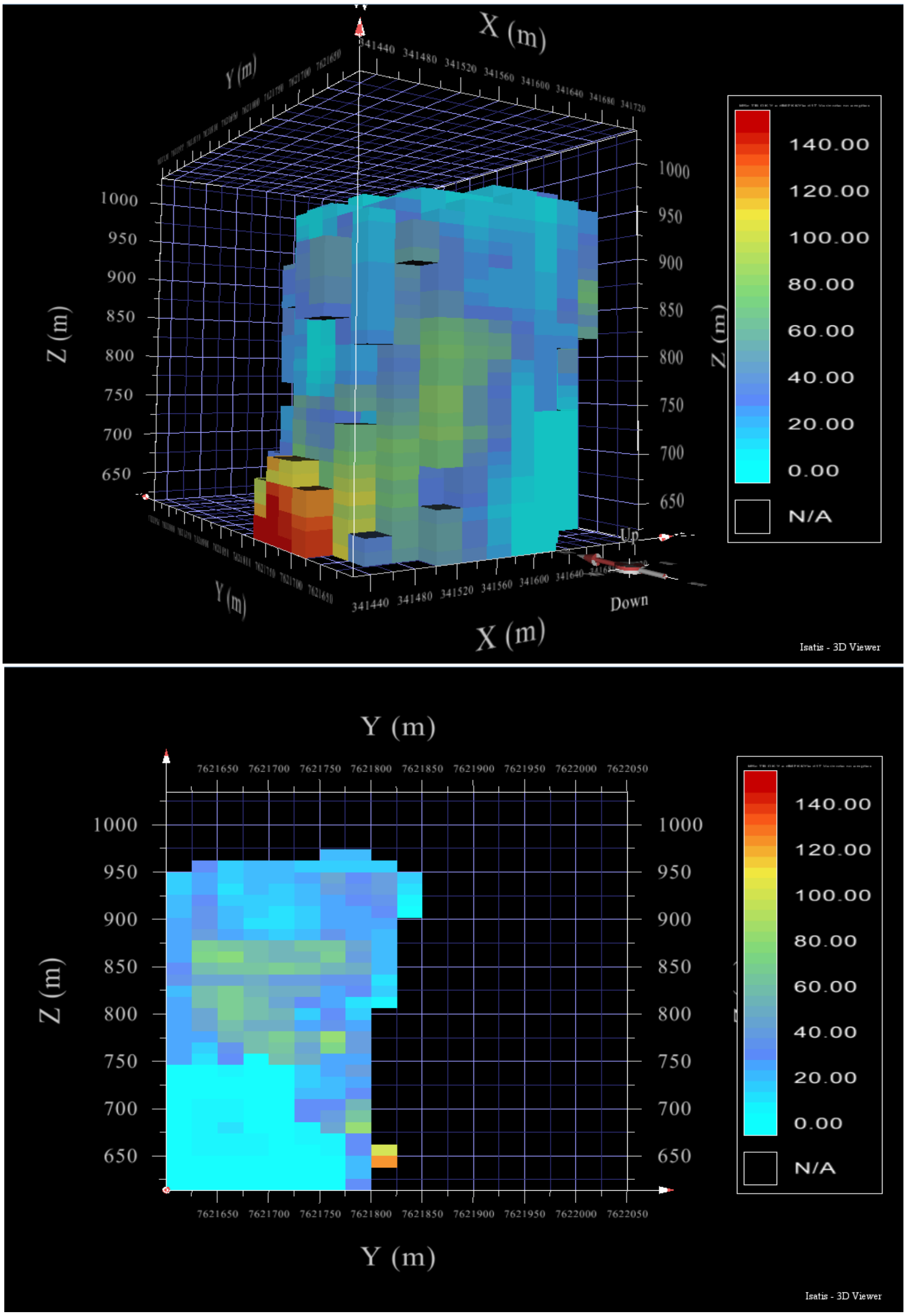


Figure 39: Mean variance of 100 simulations at each node viewed from the south-west (top) and the east (bottom). The western and northern part of the South lobe at depth contains the highest %DMS yield and is poorly sampled, resulting in elevated variance per block (see also Appendix 3). Note the much lower variance along the eastern margin.

9.2 Sequential Gaussian Simulation

The theory on which Sequential Gaussian Simulation (SGS) is based has been developed by Journel and Alabert (1989; 1990), and detailed by numerous other authors, e.g. Deutsch and Journel (1998), Olea (1999), Dimitrakopoulos (2007), Dowd (2007), and Deutsch (2008). The method is an application of Bayes' theorem which allows the decomposition of a multivariate into a series of conditional distributions.

9.2.1 The theory of Sequential Gaussian Simulation

The following theoretical explanation of the essential mathematical principles on which the SGS technique is based was taken from Olea (1999).

$Z(x)$ defines a subset of N variates of a random function and $z(x)$ defines a sampling of size n. The conditional cumulative frequency distribution function $F(x_1, x_2, ..., x_N; t_1, t_2, ..., t_N | n)$ is given by

$$F(x_1, x_2, ..., x_N; t_1, t_2, ..., t_N | n)$$
$$= F(x_1; t_1 | n) F(x_2; t_2 | n+1) ... F(x_n; t_n | n+N-1)$$

Consider the bivariate case to develop the proof of this statement. Using Bayes' theorem one can break the bivariate cumulative frequency distribution function into the product of two univariate cumulative frequency distribution functions

$$F(x_1, x_2; t_1, t_2 | n) = F(x_1; t_1 | n) F(x_2; t_2 | n+1)$$

where $F(x_2; t_2 | n+1)$ is the probability that Prob$\left[Z(x_2) \le t_2\right]$ is conditional to the original sampling, plus the value $z(x_1)$ drawn from the distribution $F(x_1; t_1 | n)$.

Weisstein (2007) listed the following definition of Bayes' theorem (after Papoulis, 1984).

Let A *and* B_j *be sets. Conditional probability requires that*

$$P\left(A \cap B_j\right) = P(A)\,P\left(B_j \middle| A\right)$$

$\cap$ *implies intersection, i.e. the set of elements common to A and B. Also,*

$$P\left(A \cap B_j\right) = P\left(B_j \cap A\right) = P\left(B_j\right)P\left(A \middle| B_j\right)$$

Then,

$$P\left(B_j \middle| A\right) = \frac{P\left(B_j\right)P\left(A \middle| B_j\right)}{P(A)}$$

Let

$$S \equiv \bigcup_{i=1}^{N} A_i$$

such that A_i *is an event in* S *and* $A_i \cap A_j = \varnothing$, *for* $i \neq j$ *. Then,*

$$A = A \cap S = A \cap \left(\bigcup_{i=1}^{N} A_i \right) = \bigcup_{i=1}^{N}\left(A \cap A_i\right)$$

$$P(A) = P\left(\bigcup_{i=1}^{N}\left(A \cap A_i\right) \right) = \sum_{i=1}^{N} P\left(A \cap A_i\right)$$

which can also be written as

$$P(A) = \sum_{i=1}^{N} P\left(A_i\right)P\left(A \middle| A_i\right)$$

therefore

$$P(A_i|A) = \frac{P(A_i)P(A|A_i)}{\sum_{j=1}^{N} P(A_j)P(A|A_j)}$$

The sequence of steps followed to generate a SGS (Dimitrakopoulos, 2007; Deutsch, 2008), is:

- Transform data to Gaussian space.
- Compute and model the variogram of the transformed data.
- Define a random path that passes through each node of the grid representing the deposit.
- Krig the normalised value at the selected node and obtain the kriged value

$$Y^*(z) = \sum_{i=1}^{n} w_i * Y(z_i)$$

  where $Y^*(z)$ is the estimate generated from sample $z_i, i = 1,...,n \quad n = \mathbb{Z}_+$ and $w_i, i = 1,....,n \quad n = \mathbb{Z}_+$ represents the weight assigned to each sample

  and the kriging variance (expressed in covariance format)

$$\sigma_{SK}^2(z) = \overline{C}(A,A) - \sum_{i=1}^{n} w_i \overline{C}(z_i, A)$$

  $\overline{C}(A,A)$ being the average covariance relating to distances between the centres of discretised blocks

  $\overline{C}(z_i, A)$ being the average covariance between the sample and the block which is to be estimated

- Draw a random residual that follows a normal distribution with a mean=0 and variance $= \sigma_{SK}^2(z)$.
- Add the residual to the kriged value to obtain the simulated value.

$$Y_s(z) = Y^*(z) + R(z)$$

- The simulated value could also be obtained by drawing from a normal distribution using the kriged estimate and the kriging variance as the mean and variance respectively.
- Add the new simulated point to the conditioning data set, move to the next node and repeat the kriging and random sampling of the resultant distribution.
- Once all nodes have been simulated, generate an inverse transform of the Gaussian conditionally simulated values back into "raw" space.

General advantages of the SGS method include (Dowd, 2007; Deutsch, 2008)

- Sequential simulations are easy to understand
- A variety of algorithms exist for implementation
- Conditioning and simulation are part of an integrated process
- Anisotropies are handled automatically
- Applicable to any covariance function

9.2.2 The application of Sequential Gaussian Simulation

The conditional Sequential Gaussian Simulations generated as part of this study were performed using the following steps.

- Transfer of the raw data into Gaussian space using the Gaussian Anamorphosis function in ISATIS™ (Figure 35).
- Model variogram fitted to the data in normal space (Figure 36).
- A standard neighbourhood as opposed to a sequential neighbourhood was used. The standard neighbourhood does not require migration of the input data points to the closest grid node and avoids potential bias in data location. The standard neighbourhood is also more compatible with the neighbourhood used during kriging which allows for more direct

comparison of the simulation results against the kriged output (ISATIS™ v8.03 help files).

- A total of 100 block simulations were run with a random order of node selections and independent paths were used for the various simulations.
- A point was kriged from the surrounding data at each simulation node using Simple Kriging.
- The kriged value thus obtained and the kriging variance represent the conditioning values of the Gaussian distribution, given the conditioning data and all previously simulated values. A value is then drawn at random from this distribution and added to the set of simulated values.
- Back-transformation of the Gaussian conditionally simulated values to raw space.
- Verify the conditional simulation by comparing the variogram of the input sample data against variograms of individual point simulations, and by comparing the univariate statistics of the sample data against those of the conditional simulation and kriged output.

The same anamorphosis function, model variogram and kriging neighbourhood parameters were used for the TB and SGS methods in order to for the results to be as directly comparable as possible. The univariate statistical parameters generated from the conditional sequential Gaussian simulation of %DMS yield are illustrated in Figure 40 and compared against those of the sample data, kriged output and TB simulation shown in Figures 27 and 38. The Conditional Sequential Gaussian simulation results are presented in Appendix 7 for every alternate bench and results per block are shown in Appendix 8. The output from the SGS simulations only relate to unit M/PK and no conditional simulations were performed on the minor geological units.

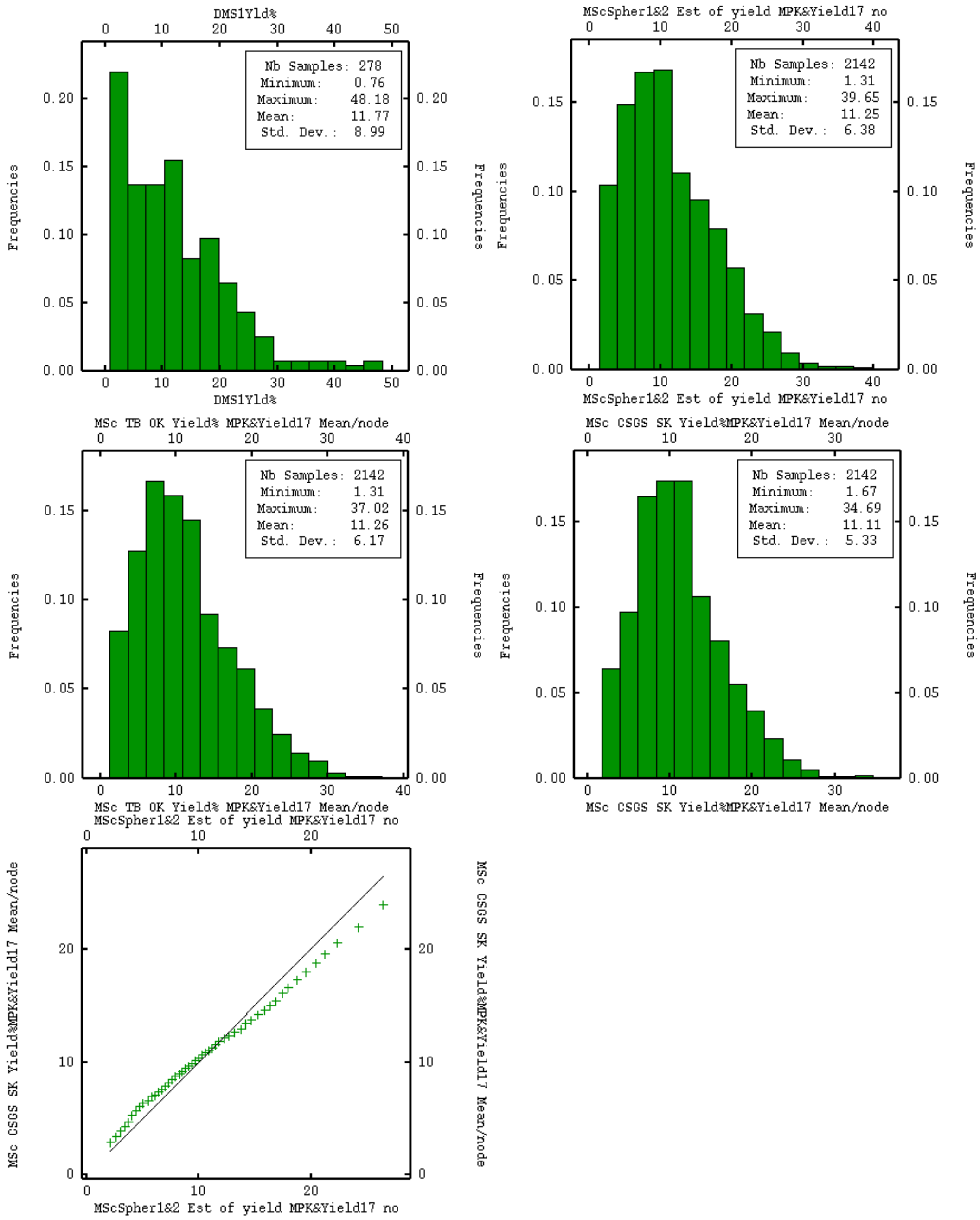


Figure 40: Comparison of univariate statistical parameters of the %DMS yield sample data from unit MPK (top left) against those of the ordinary kriged estimates (top right), those obtained from the Turning Bands conditional simulation (middle left) and the conditional Sequential Gaussian Simulation (middle right). Note that each data point on the conditional simulation graphs represents the mean of 100 simulations per node. The output from the ordinary kriging and CSGS simulation is also compared using a quantile-quantile plot (bottom left) where ordinary kriged estimates are plotted on the X-axis and the conditional SGS on the Y-axis.

10.0 DISCUSSION

The nature of this investigation presented a good opportunity to compare and test a standard linear method of kriging, a non-linear kriging method and conditional simulation techniques and compare their output relative to each other. Co-kriging of chip density and %DMS yield was briefly considered, but not followed through, since density data obtained from chips are not dry density values, and the dry densities which were obtained from the pilot holes were of a different support. The complexities involved in co-kriging these different supports were considered beyond the level at which this study was aimed. The following observations and conclusions can be made.

- Although %DMS yield is a relative number, the spatial structure imparted due to geological controls can be modeled and used to estimate the parameter on a local block scale. It is believed that the statistical parameters obtained from the variography, e.g. nugget effect, modeled range, etc. are realistic when viewed against the geological interpretations summarised in Section 6.0. If the geological interpretations regarding the %DMS yield were correct, then the 3-D simulation and kriging exercises also provided the location of the vent area of unit M/PK (see Appendix 3). The geostatistical investigations showed that the high DMS yield areas increase with depth, which would be consistent with more efficient heat preservation and more rapid pyroclast accumulation rates at depth in unit M/PK. Cooling rates of the pyroclasts would be higher closer to surface, limiting the development of sintered (i.e. high DMS yield) areas. Furthermore, the results showed that the vent does not present itself as a single vertical column, but moves around, in the western half of the pipe in this case. Location of the vent area is geologically and economically important since it may have a significant effect on diamond size frequency, depending on the dominant volcanic process.
- It is possible that the use of a lower nugget values for the variograms in Figures 22 and 36 may have resulted in the isolated high-yield areas in Benches 18-22 (Appendix 3) being more continuous. However, the

validity of a lower nugget value is questionable, given the nature of the geological processes at work.

- Insufficient sampling of the northern and western part of unit M/PK at depth and the resultant biased bench average values did impact negatively on the estimation and simulation processes, but could be corrected to some degree after manual intervention.
- The mean per node for 100 block simulations generated by the two conditional simulation techniques and the ordinary kriging are within 2% of each other and within 4.2% of the mean of the input sample data. No outliers were removed or input data modified during this exercise. Individual point simulations reproduced the variance of the input sample data (Figure 41) as well as the variography of the input sample data in the

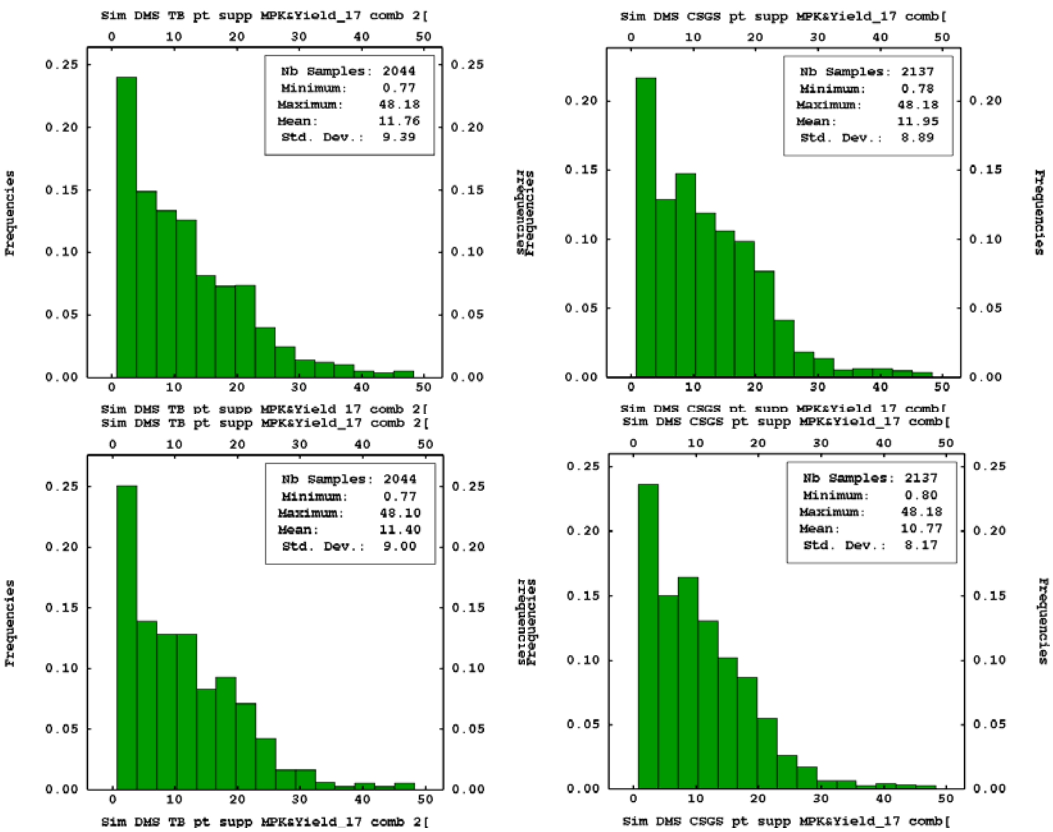


Figure 41: Histograms of two randomly chosen individual point simulations obtained using conditional Turning Bands (left) and two conditional Sequential Gaussian Simulations (right).

case of the Turning Bands method (Figure 42). Calculating the mean per node would create an averaged output similar to the original kriging process which is evident in the similarity between the Ordinary Kriging results and the conditional simulations, e.g. Figure 40.

- One of the reasons for using two methods of simulation in this study was to compare the quality of output by utilising the same input parameters as far as possible. Point simulations using the CSGS method did not reproduce the sill of the input variogram, even though the input variogram and kriging neighbourhood was exactly the same as those used for the TB method. The sills of the experimental variograms generally plotted below that of the sample data (Figure 42), suggesting a lower variance and the nugget values appear to be slightly higher than that of the model fitted to the variogram of the input data. The problem was also apparent to some degree in the TB method but less severe than for the CSGS. An attempt was made to increase the variance of the CSGS and improve the fit by increasing the number of simulations to 500 and by increasing the kriging neighbourhood to nearly 400m. This did result in some improvement (Figure 43), but the end-result was still less satisfactory than the TB output. Ergodic fluctuations or discrepancies between simulations and model statistics are a common feature in simulation studies, e.g. Goovaerts (1997) and Deutsch and Journel (1998). This is exacerbated when the range of the semi-variogram model is large with respect to the size of the simulated area and the nugget value small (Goovaerts, 1997), as in this study. The most likely explanation is that the simulated area (i.e. the grid) used in the simulations was too small, given the 128m range of the variogram in Gaussian space (Figure 36). The grid should be approximately 3 times the range of the variogram in size (Brown, pers. comm.). Increasing the discretisation density will not resolve the problem either (Deutsch and Journel, 1998). One possible solution, apart from increasing the grid size, is to post-process only those simulations which fit the model the best. Ultimately however, the reader should bear in mind

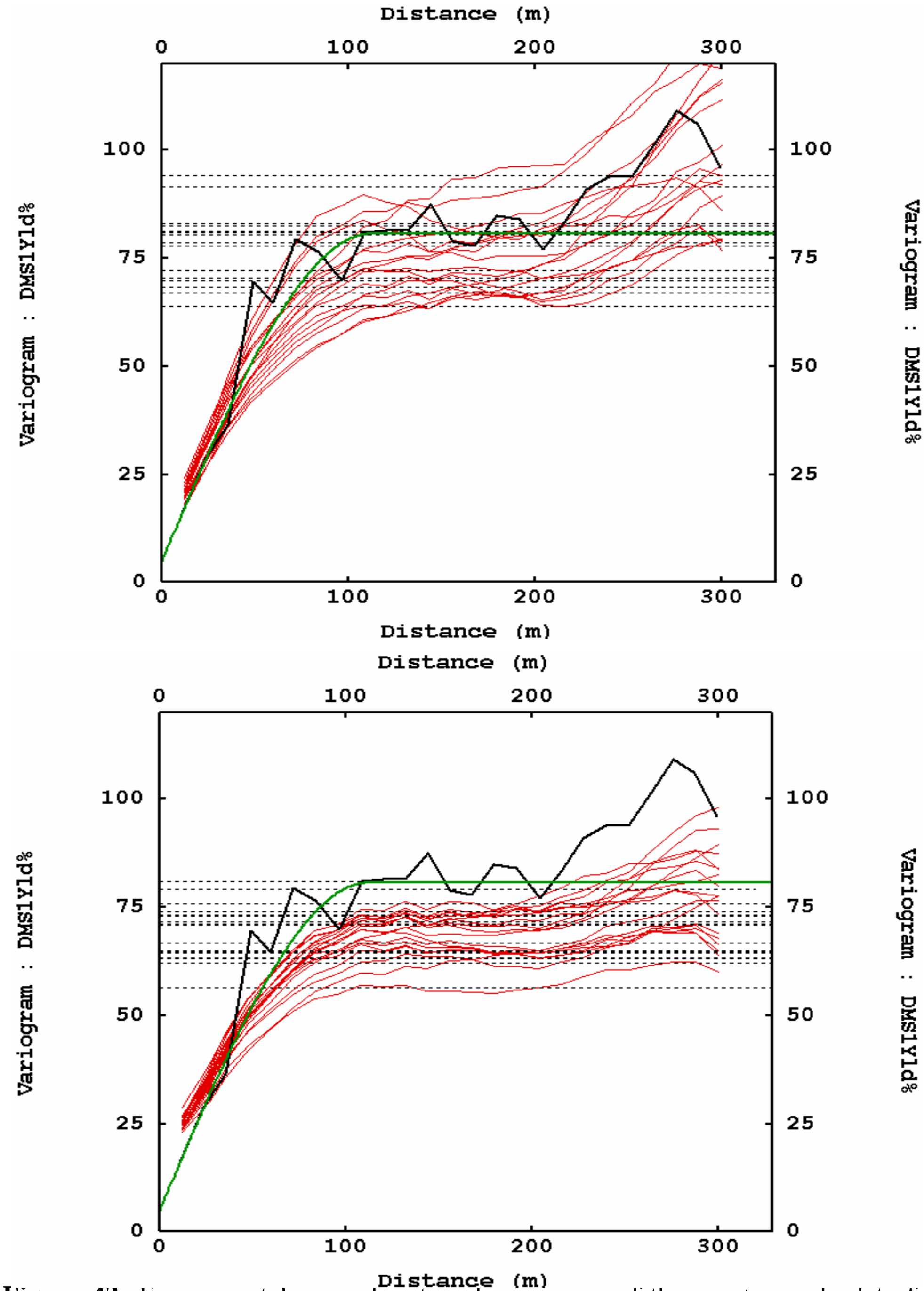


Figure 42: Experimental omni-directional variogram of the input sample data for unit M/PK (solid black line) and its modeled spherical variogram (green line) as shown in Figure 22, compared to the experimental omni-directional variograms shown in red from a selection of 18 out of 100 conditional TB point simulations (top) and a similar selection out of 100 conditional Sequential Gaussian point simulations (bottom). Dashed lines indicate the experimental variogram sills. The CSGS output did not reproduce the sill of the input data.

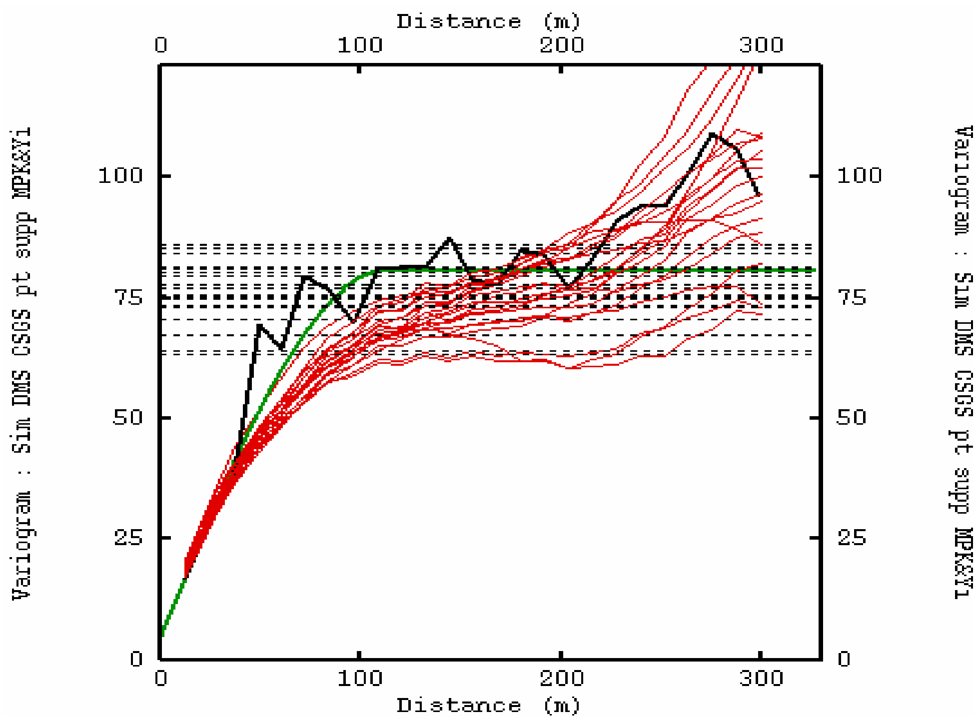


Figure 43: Experimental omni-directional variogram of the input sample data for unit M/PK (solid black line) and its modeled spherical variogram (green line) as shown in Figure 22, compared to the experimental omni-directional variograms shown in red from a selection out of a total of 500 conditional Sequential Gaussian point simulations. The kriging neighbourhood was more than doubled compared to the example shown in Figure 42.

that %DMS yield is a relative value, that unit M/PK suffers from biased sampling at depth (Section 8.1), that the variance of %DMS yield is high in unit M/PK, and that the model data were obtained from a sample which will depart from the parameters of the entire unit M/PK DMS yield population. An exact fit of the simulations to the model should therefore not be expected.

- The reader may wonder why some of the single outlier samples with extreme %DMS yield values were not excluded from the variogram modeling and kriging in order to reduce the high variance. These simulations and estimates were undertaken to be used in a pro-active manner to avoid treatment plant problems and it was therefore decided to follow a conservative approach with respect to the variance and include the extreme values.

- Examination of the minimum and maximum values of the SGS-derived data in Figure 40 shows that these data are the most smoothed, i.e. the lowest variance of any of the techniques.

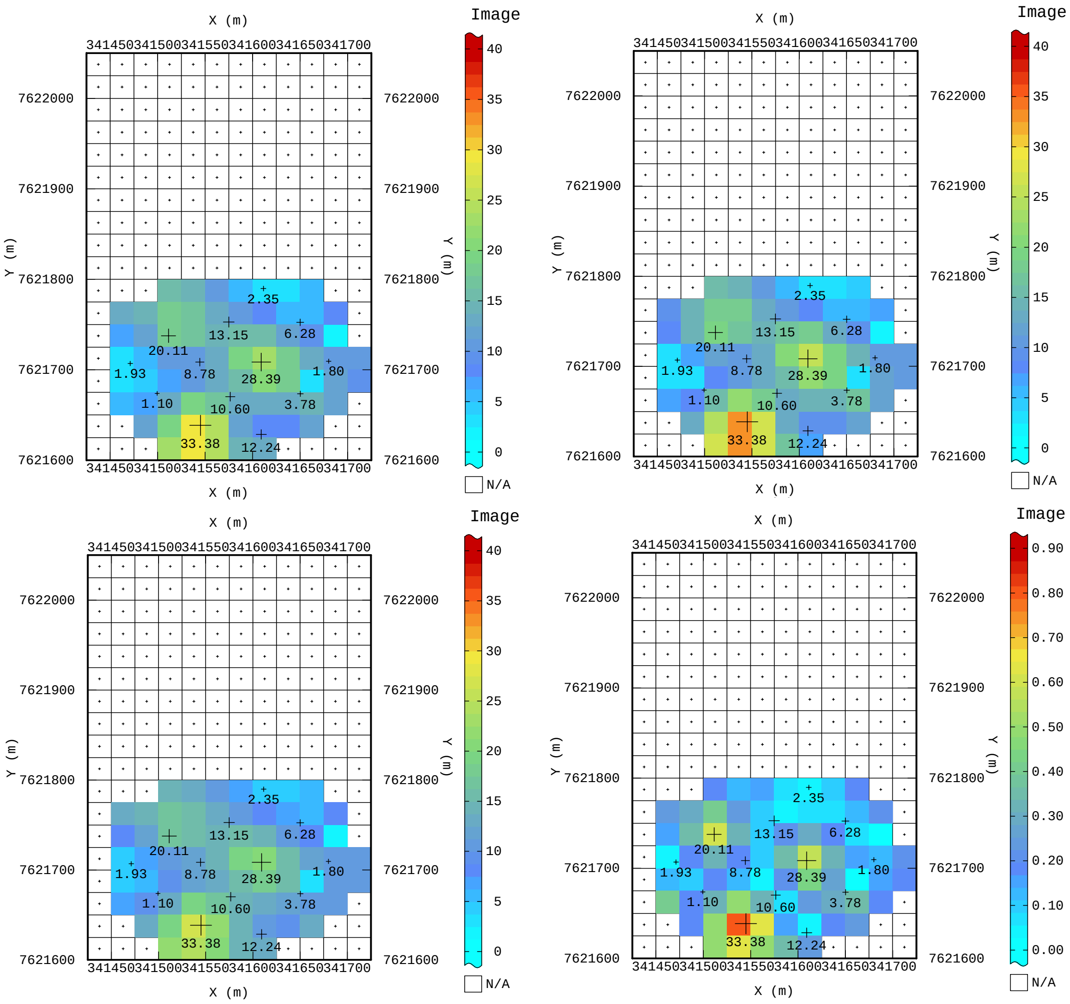


Figure 44: Output from the different techniques generated for Bench 20 (800 m.a.m.s.l) as an example. Conditional simulations are shown on the left with Turning Bands (top) and SGS (bottom). Ordinary kriging results are shown top right and indicator kriging results (Prob Z*>20%) bottom right. Note that all methods slightly under-estimated the high values.

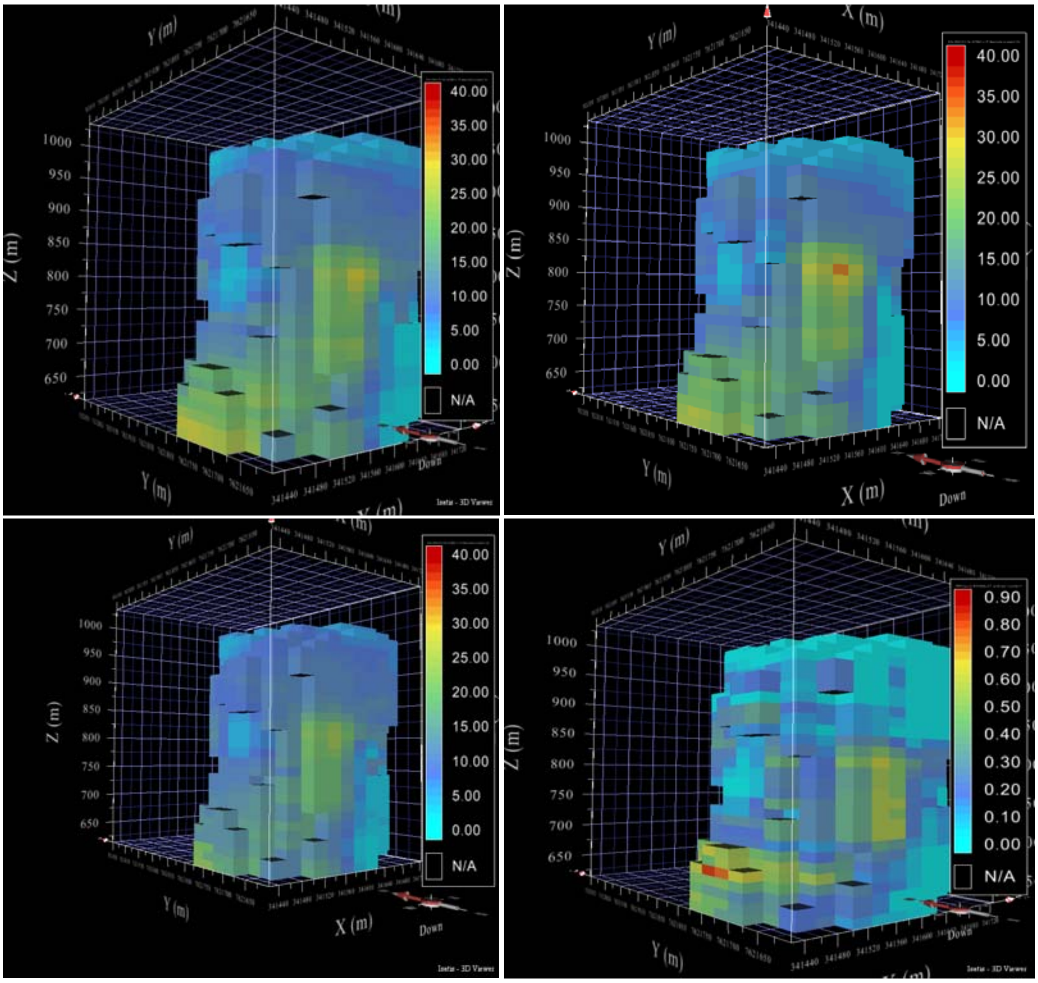


Figure 45: Output from the different techniques with the kimberlite viewed towards the north-east. Conditional block simulations (mean/node, 100 simulations) are shown on the left with Turning Bands (top) and SGS (bottom). Ordinary kriging results are shown top right and indicator kriging results (Prob Z*>20%) bottom right.

- The SGS method slightly over-simulated the low values and under-simulated the high data values compared to ordinary kriging, as shown in the examples in Figure 44, Figure 45 and Figure 46. This was not a localised feature but was observed across a large number of benches.
- Indicator kriging may have potentially useful applications in the metallurgy and ore treatment of a deposit, as long as the technique's limitations are not exceeded (Section 8.2). The main advantage is its

simplicity, although various probability-related outputs can also be obtained from post-processing techniques following conditional simulation. These include probability maps of each node belonging to the ore body and iso-cutoff maps.

- Ordinary kriged estimates returned the most consistent and reliable results, once the correct variogram and kriging neighbourhood was employed.

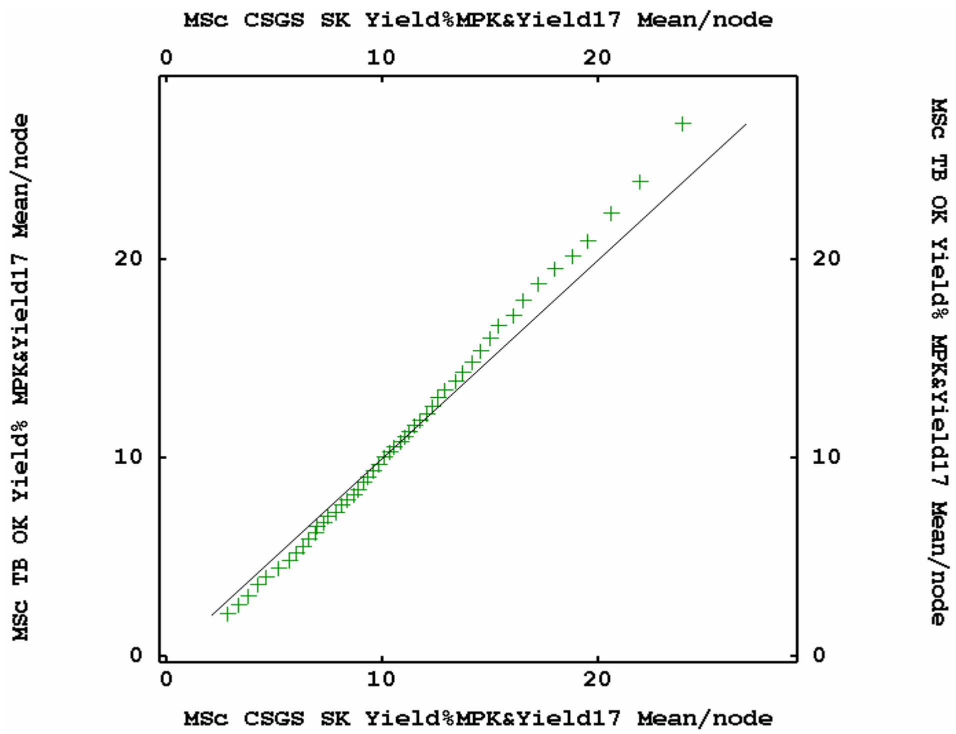


Figure 46:Q-Q plot of the mean of 100 realisations per node for conditional SGS (X-axis) vs. Turning Bands (Y-axis) showing the difference in output from the two simulation methods at low and high DMS yields.

Dowd (1992) noted a greater variance between the Turning Band simulations compared to those from the Sequential Gaussian method for both point and block simulations. These findings are in agreement with results from this study. Dowd (1992) attributed his results to the decrease in kriging variance as the number of simulated points or blocks increase. The result of this is an increasingly restricted range from which the simulated value is drawn from. Dowd (1992) then raised the question whether this phenomenon will result in the under-estimation of the natural variation in a resource if used for sensitivity analysis. It was decided to attempt a similar comparison on a randomly chosen block within the model. The average %DMS yield from 100 simulations produced using the conditional Turning Bands Method, and the average %DMS yield of 100 simulations produced using the Conditional Sequential Gaussian Method were calculated. The histograms and cumulative distribution functions are illustrated in Figure 47.

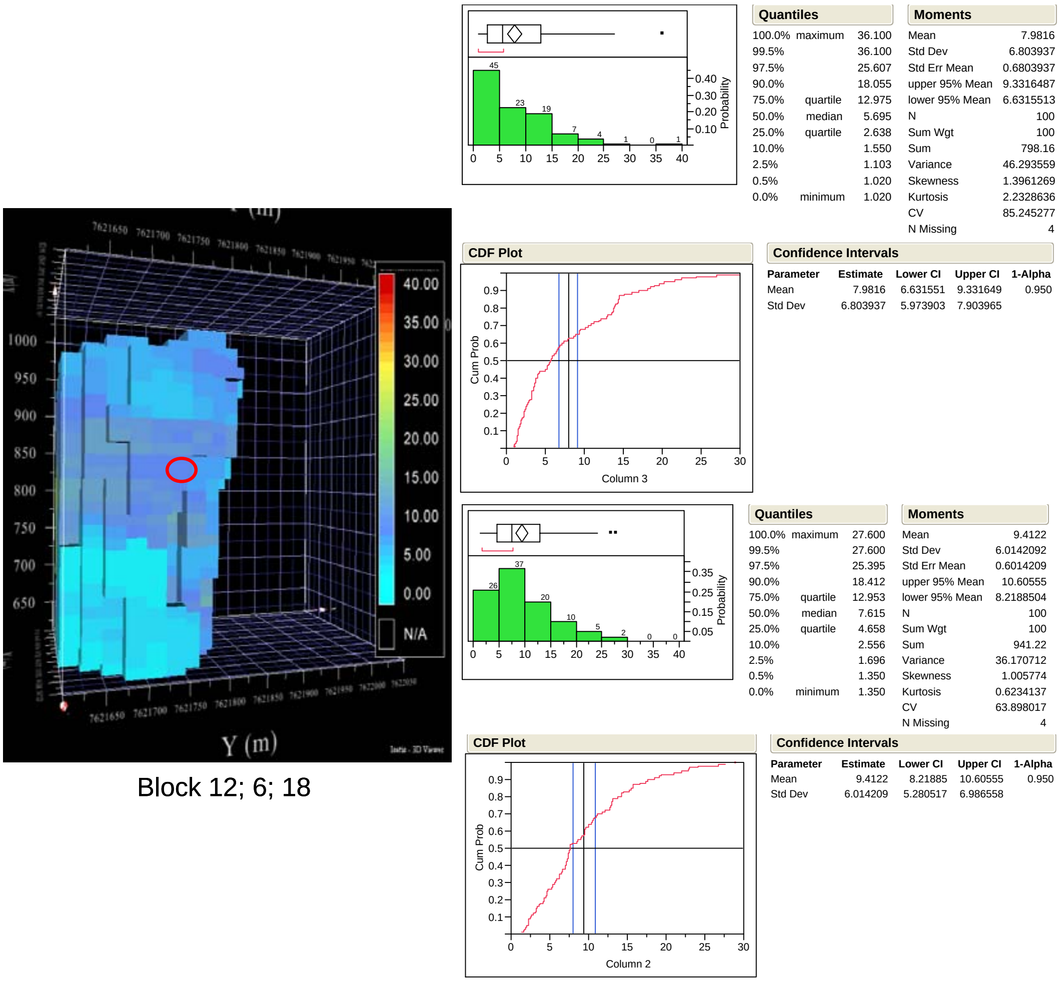


Figure 47: A comparison of the univariate statistical parameters of 100 conditional simulations of %DMS yield for a randomly chosen block 12;6;18, located on the eastern margin of unit M/PK on bench 18. Data from the Turning Bands method is shown on top and the SGS method below. The 15% limits about the mean, shown in blue, define the limit of acceptable variability for an indicated resource status.

The 15% limits about the mean are also illustrated. Although the two data sets appear similar, the variance and the 15% limits about the mean suggest that the CSGS method is about 14% less sensitive than the Turning Bands method, for the particular block in question, bearing in mind the issues regarding the CSGS method as identified in Figure 42. The above was included by way of example only. Similar analyses can be performed for any block in the model or for individual benches, and a confidence limit can be generated around the mean to assist in the assessment of resource risk. Figure 48, bottom, shows the mean conditionally simulated (TB) %DMS yield per bench along with the 95% confidence limits. A ±15% envelope about the mean, delineating the maximum permissible variability for an indicated resource is also shown for reference purposes. The increased variance associated with the DMS yield at depth is evident as well as the paucity of sample data over the last few benches. The 15% envelope is exceeded from bench 29 downwards. Single simulations exceed the 15% limit at bench 12 and again at Benches 7-9. It is however likely that the effects of incorrect geological unit definition, biased sampling, and less than optimal variography will dominate impact on the results over and above any smoothing effects in the conditional simulation, except of course when accurate variance is required for financial modeling.

The most significant risk imparted on a diamond mining operation by the resource is related to:

- Unidentified diluted ore zones.
- Unidentified multiple magma sources with different diamond size frequency distributions and possible change in assortment associated with particular units or areas in the pipe.
- Metallurgical problems associated with particular geological units or alteration zones.
- Under-sampling due to incorrectly identified geological units.
- Failure to appreciate the impact of particular volcanic processes.

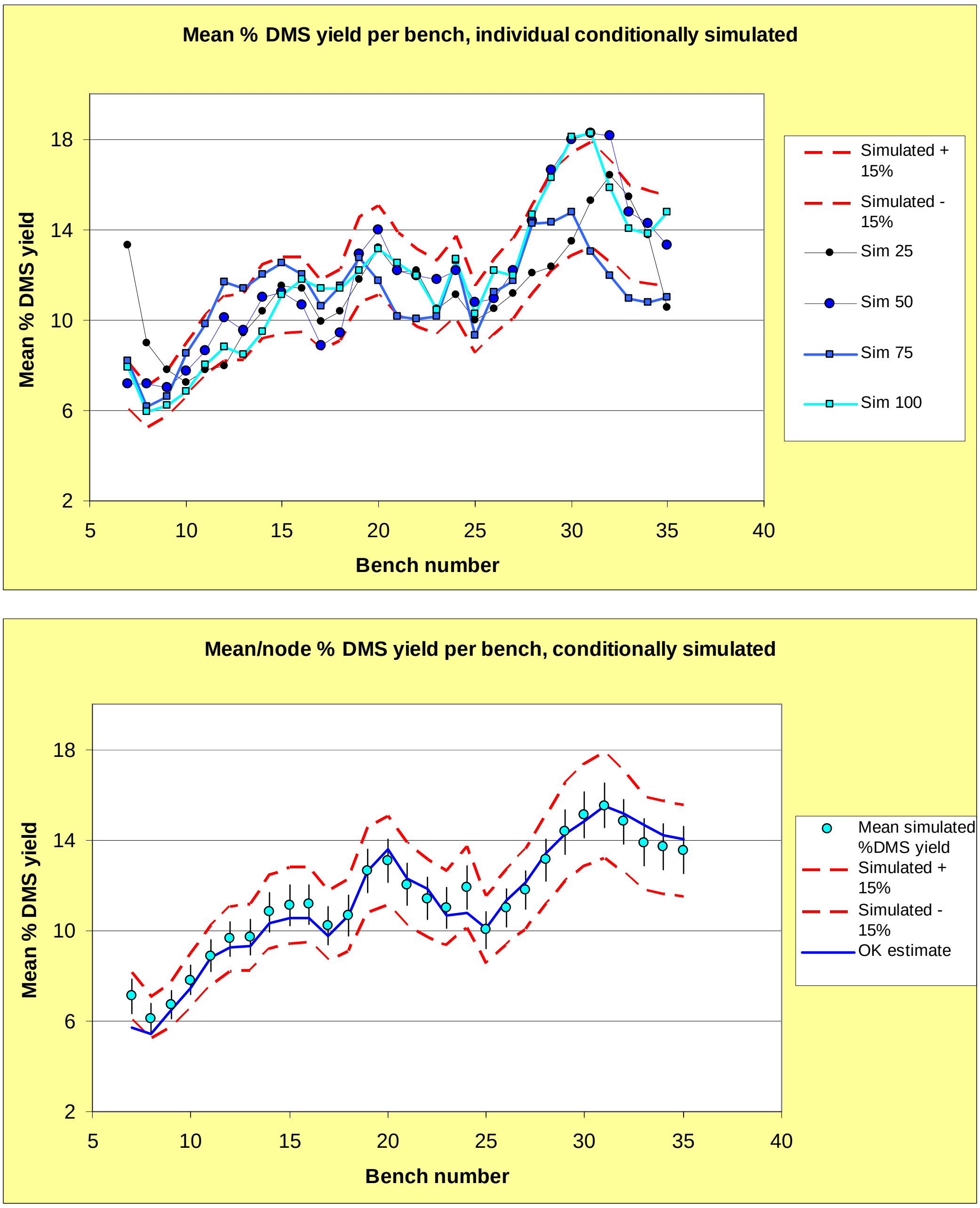


Figure 48: Mean conditionally simulated %DMS yield per bench (Turning Bands) with 95% confidence limits shown, compared to output from Ordinary Kriging, previously shown in Figure 25 (bottom) and four individual conditional simulations (top). The ±15% envelope about the mean is shown as a reference.

Many companies regard geological models as separate entities within a mining or evaluation project. Unfortunately this approach limits the value of geology considerably since geology impacts a range of disciplines as was demonstrated to some degree in this work. Geostatistical techniques can play a major role in quantifying geology and enhancing the value of geological models.

11.0 CONCLUSIONS

The following conclusions have been drawn from this study.

- It has been demonstrated that clear distinctions between the primary kimberlite types in the AK06 pipe complex can be correlated with changes in metallurgical parameters such as density and %DMS yield.
- Intra-lobe variations in density and %DMS yield can be correlated with both primary and post-emplacement geological processes.
- Areas within the South lobe where these metallurgical parameters exceed the capability of the treatment plant could be delineated using kriging methods and conditional simulations. The probability of intersecting such zones could be quantified. This represents pro-active use of geology to investigate resource risk, delineate problem areas in advance and develop a geo-metallurgical model to avoid metallurgical problems before they develop.
- Use of metallurgical parameters in the development of a kimberlite geological model may enhance understanding of some aspects of pipe emplacement. Variable levels of sintering within the main pyroclastic kimberlite of the South lobe have resulted in variable primary porosity in the kimberlite (Sparks and Field, pers. comm., 2007). It is proposed that areas of unit M/PK that suffered the highest levels of sintering have escaped severe fluid flow and alteration, thereby preserving the high primary %DMS yield. Less sintered, more porous areas suffered more alteration over time and therefore exhibit lower %DMS yield.
- It is essential that some geological knowledge of the kimberlite is available before attempting to interpret metallurgical parameters. Superficially similar metallurgical data may be caused by different geological processes.
- It is important that the geology be understood and continually referred to during the preparation of any estimate or conditional simulation. Population of uninformed blocks using bench averages should be verified

against the geology and against neighbouring blocks where data are available.

- Non-representative sampling can have a dramatic effect on the quality of kriged estimates produced, as was shown for Benches 30-35 in Section 8.1.
- Ordinary kriging remains one of the more robust estimation techniques when applied correctly.
- Point simulations using the CSGS method did not reproduce the sill of the input variogram, even though the input variogram and kriging neighbourhood was exactly the same as those used for the TB method. The sills of the experimental variograms generally plotted below that of the sample data. The problem was also apparent to some degree in the TB method but less severe than for the CSGS. The most likely explanation is the presence of ergodic fluctuations and that the simulated area used in the simulations was too small, given the range of the variogram in Gaussian space.
- Geologists have historically based their geological models largely on visual criteria in drill core or sampling. Kimberlites and diamond mining differ from other commodities in one important aspect. Due to the ultramafic nature of kimberlites, this rock type is very sensitive to hydrothermal alteration (Stripp et al., 2006). Hydrothermal fluid flow through any volcano is highly complex and may result in multiple visually distinct episodes overprinting the primary geology. A geological model which is based exclusively on visual criteria will therefore almost always be overly complicated and some of the units may in fact have no bearing on primary parameters which affect diamond assortment and size. Measurement of numeric geological parameters such as crustal dilution, particle size and analytical geochemical methods are essential in deciphering a kimberlite's complex history, particularly if an indicated resource status or higher is desired. Such geological techniques, integrated with statistically representative, regular sampling methodology opens up a geological model to a whole range of geostatistical and conditional

simulation possibilities. This will of course only be possible if the volcanic processes are understood and not ignored, e.g. Harrison et al. (2008) who considered the geological units in the Jay kimberlite at Ekati irrelevant for their simulations due to the fact that the grade changes were gradational across the geological boundaries. Correct integration of geological and geostatistical models represent the most optimized and proactive use of a geological model which can feed directly into mine and financial planning. The costs involved in generating such models will be mitigated by the decreased resource risk due to statistically valid and quantifiable models.

12.0 REFERENCES

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9th International Kimberlite Conference Extended Abstract No. 00238, 2008

The AK06 kimberlite, Botswana: use of a metallurgical parameter to enhance geological definition in a kimberlite

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Introduction

The construction of geological models of kimberlites during an evaluation project suffers due to a lack of outcrop. Geological information is typically obtained through the use of drill hole data, but confident geological models are only possible once considerable delineation drilling has taken place. A case study is presented showing how the inclusion of a metallurgical parameter can be used to 1) enhance geological definition in a kimberlite, 2) corroborate and support the identification of geological units, and 3), contribute towards understanding the volcanology at the time of emplacement.

Geology

The Cretaceous-aged AK06 kimberlite is located in the Orapa kimberlite cluster of north-central Botswana, some 25km south of Orapa Mine. The resource forms part of a joint venture agreement between De Beers, African Diamonds Plc and Wati Ventures. Figure 1 shows the north-south oriented, tri-lobate kimberlite complex with a near-surface expression of 4.4 ha (1012 mamsl).

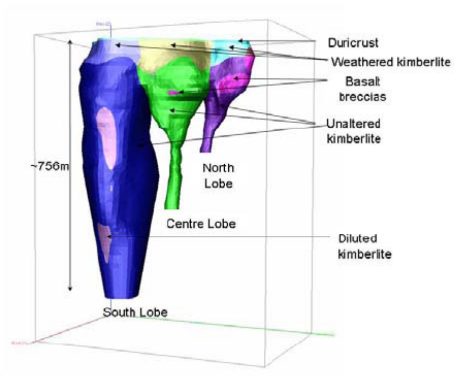

Figure 1: Geological model of the three lobes in the AK06 kimberlite complex. The vertical dimension is ±756m. Image from Opperman (2007).

Geological investigations have shown each lobe of the kimberlite to represent a distinct kimberlite pipe (Stiefenhofer, 2007a and references therein). The infill is interpreted as volcaniclastic kimberlite. The North and Centre lobes are broadly similar, but completely different from the South Lobe with respect to pipe morphology, infill, petrography, geochemistry and geo-metallurgical parameters. Chinn et al. (this volume) investigated the diamond populations from each lobe.

Each pipe is capped by duricrust (12m), followed by weathered kimberlite (30-70m), before unaltered kimberlite is intersected. Zones of basalt breccia occur within each pipe. The in-fill of the North and Centre lobes resemble typical volcaniclastic kimberlite, but exhibits textural heterogeneity on a macroscopic and microscopic scale. Pyroclasts are evident in places, but elsewhere the kimberlite is considerably more homogeneous in appearance. The South lobe kimberlite in contrast is harder, darker, denser, and exhibits preferential lithic clast orientation and olivine-rich zones in places. The South lobe kimberlite is also less diluted by crustal material. The initial geochemical investigation (see Figure 2 below) was performed using largely unaltered samples, but subsequent sampling of the weathered zones revealed similar results following multivariate

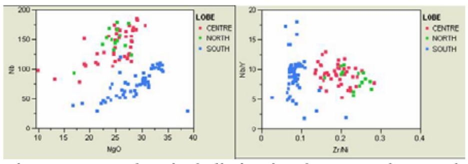

Figure 2: Geochemical distinction between the North/ Centre and South lobes.

statistical analysis. The South lobe is dominated by one kimberlite variety containing fresh groundmass components, including monticellite. Sub-units could be distinguished within each pipe using standard petrographic and geochemical techniques.

Discriminating petrographic features included crustal xenolith abundance, crustal xenolith type, and groundmass spinel abundance.

Sampling methodology

Twenty-five large diameter (23-inch) evaluation drill (LDD) holes were sunk vertically into AK06. Samples were collected in 12m vertical lifts. Each was preceded by a vertical diamond core pilot hole for geological control, in addition to other angled delineation holes. Continuous down hole data in the form of percentage dense media separator (%DMS) yield, as well as chip density readings were produced from the LDD holes. The % DMS yield represents the ratio of the mass of wet concentrate/mass of wet head-feed to the sampling plant for the purpose of this exercise and is a relative value.

Geostatistical analysis of %DMS yield

The %DMS yield data exhibited spatial structure within the kimberlite lobes which allowed the construction of variograms for the major kimberlite lithologies (Figure 3). This in turn allowed the generation of local block estimates (25x25x12m) of %DMS yield using ordinary kriging with hard boundaries (Figure 4) (Stiefenhofer, 2007b). The South lobe in particular revealed a wide range of %DMS yield values. Very high %DMS yield values in the principal geological unit presented a challenge to the recovery of diamonds. It was therefore essential for mine planning purposes that zones of high %DMS yield were accurately defined and quantified. Indicator kriging was applied to the South lobe data set to obtain the probability of intersection %DMS yields above a particular cut-off.

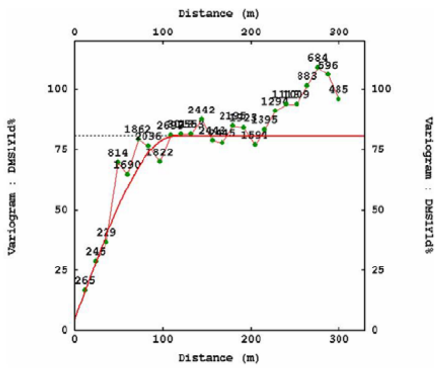

Figure 3: Modeled single-structure spherical variogram of %DMS yield for the major kimberlite unit in the South Lobe, used to produce some of the estimates shown in Figure 4. Lag=12m, range=112m.

Kriging methods however produce a "best" (minimum error variance) linear estimate. The results do not reflect the true histogram and inherent variance or covariance (i.e. variography) that may occur within the dataset (e.g. Journel, 1974; Goovaerts, 1997). A conditional simulation using the Turning Bands method (Matheron, 1973) was generated for the main kimberlite unit in the South lobe to quantify the variance in %DMS yield per bench and obtain the full distribution of potential uncertainty.

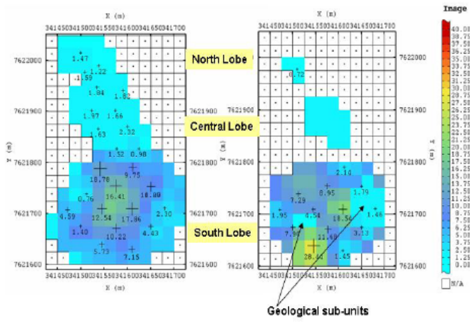

Figure 4: Plan view showing ordinary kriged %DMS yield estimates of the three lobes on Benches 10 (108m, left) and 22 (252m, right). Numbers and symbol sizes within the kimberlite reflect sample data. The boundary between the South and Centre lobes is clearly visible due to the large difference in %DMS yield.

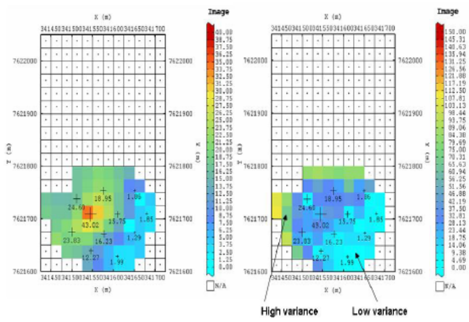

Figure 5: The left-hand image represents the mean %DMS yield value per node of 100 simulations on Bench 30 (348m) and the right hand image the corresponding variance from these simulations. The minor kimberlite units were not included in the simulations.

Discussion

Sparks and Field (pers. comm., 2007) reported the presence of sintering textures and interpreted the South lobe infill as pyroclastic kimberlite. This is in agreement with our own observations from core logging and petrographic studies (Stiefenhofer, 2007a). This interpretation is critical in understanding the distribution of %DMS yield values in the South lobe.

A complex interplay of primary and secondary factors were responsible for the variations in %DMS yield observed in the AK06 pipe complex and in particular the South Lobe.

- %DMS yield is lower for those units exhibiting elevated crustal dilution, e.g. the basalt-rich breccias.
- Primary geological sub-units which formed as a result of volcanic processes may exhibit distinct %DMS levels (Figures 6 and 7).
- Variable levels of sintering within the main pyroclastic kimberlite of the South lobe would have resulted in variable primary porosity in the kimberlite (Sparks and Field, pers. comm., 2007). It is proposed that areas that suffered the highest levels of sintering have escaped severe fluid flow and alteration, thereby preserving the high primary %DMS yield. Less sintered, more porous areas exhibited correspondingly higher alteration and therefore lower %DMS yield.
- More weathered kimberlite exhibits lower %DMS yield. This applies to weathering as well as post-emplacement hydrothermal alteration (e.g. Stripp et al., 2006). The perimeter of the kimberlite may be more altered than the interior on a local scale and may correlate with lower %DMS yield values.

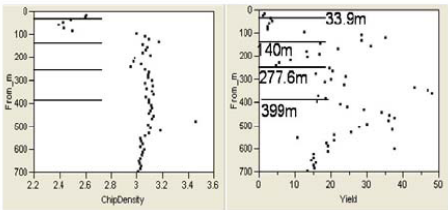

Figure 6: Correlation between logged geology from core hole PLT021 vs. the chip density and %DMS yield sample data from LDD026 in the South Lobe. Sampling interval is 12m. Basalt is present up to 33.9m, but the remainder of the sampling occurred within one major geological unit. Note the gradual, but systematic changes in %DMS yield. It is suggested that these cyclic changes may be of a primary origin and a reflection of volcanic processes.

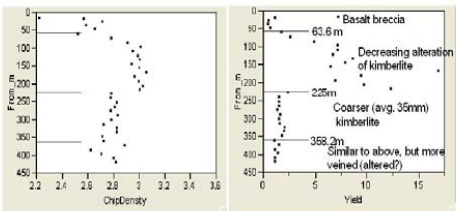

Figure 7: Correlation between logged geology from core hole PLT016 vs. the chip density and %DMS yield sample data from LDD028 in the South Lobe. Sampling interval is 12m. Note the change in density where the coarse sub-unit commences.

Assuming that the pyroclastic interpretation is correct, the local %DMS yield estimates can be used to identify the level of intensity of the sintering process in the South lobe pyroclastic kimberlite. The highest %DMS yield in the South lobe pyroclastic kimberlite occurs slightly north-west of centre as a single coherent area up to Bench 16 (180m), e.g. Figure 4 (left), whereafter multiple zones of high yield become evident (Figure 4, right) up to Bench 30 (348m), before coalescing into a single zone again. The overall %DMS yield increases with depth. Geological core logs and geostatistical estimates have shown that continuity is more pronounced in the vertical than in the horizontal direction. It is proposed that the areas of highest %DMS yield may represent the zone immediately adjacent to the vent or conduit.

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Conclusion

It has been demonstrated that clear geological distinctions between the kimberlite lobes in the AK06 pipe complex can be correlated with metallurgical parameters such as % DMS yield towards the construction of a geo-metallurgical model. Local %DMS yield block estimates could be used to enhance the internal definition of the kimberlite and complement the geological data. It is however essential that the geology of the kimberlite is understood before attempting to interpret metallurgical parameters. Superficially similar metallurgical data may be caused by different geological processes, e.g. dilution and alteration.

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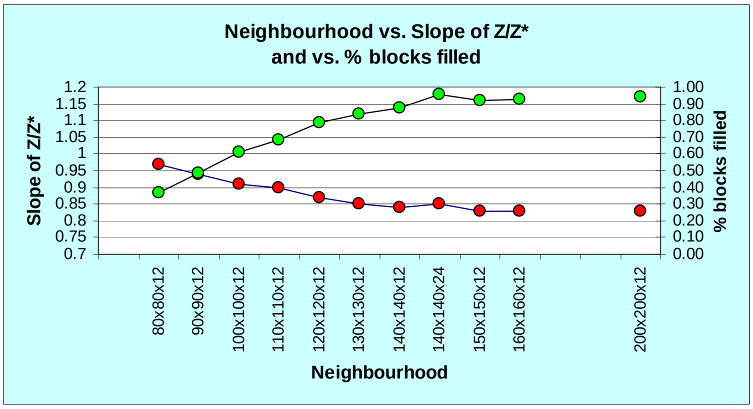
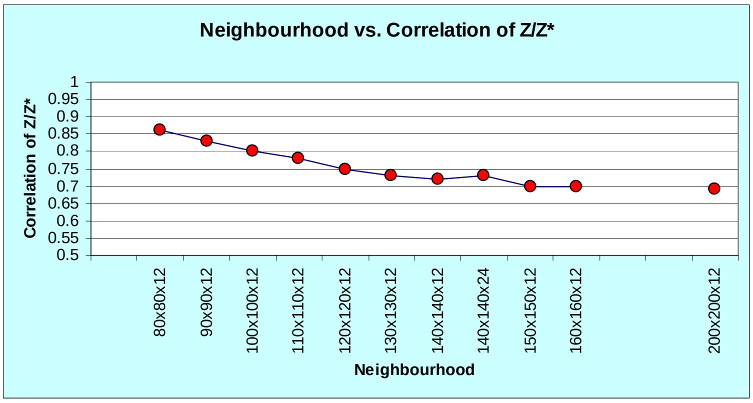
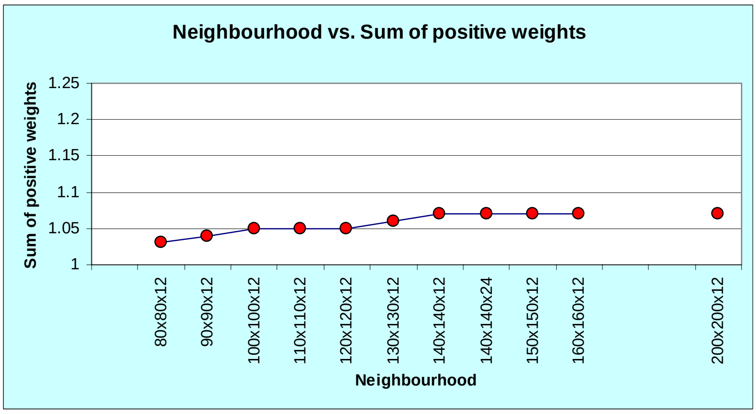
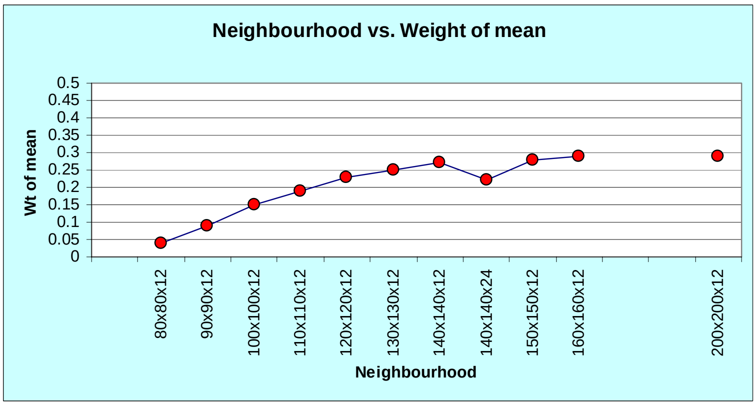
Appendix 2 – Comparison of neighbourhoods for Ordinary Kriging







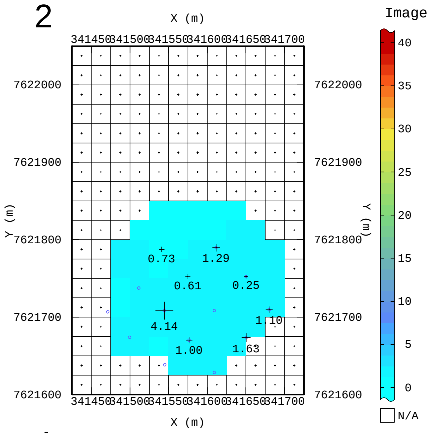


Appendix 3 – Ordinary Kriging estimates

AK06 bench levels

Bench	Z From	Z To	Z-mid bench
1	1022	1034	1028
2	1010	1022	1016
3	998	1010	1004
4	986	998	992
5	974	986	980
6	962	974	968
7	950	962	956
8	938	950	944
9	926	938	932
10	914	926	920
11	902	914	908
12	890	902	896
13	878	890	884
14	866	878	872
15	854	866	860
16	842	854	848
17	830	842	836
18	818	830	824
19	806	818	812
20	794	806	800
21	782	794	788
22	770	782	776
23	758	770	764
24	746	758	752
25	734	746	740
26	722	734	728
27	710	722	716
28	698	710	704
29	686	698	692
30	674	686	680
31	662	674	668
32	650	662	656
33	638	650	644
34	626	638	632
35	614	626	620

2



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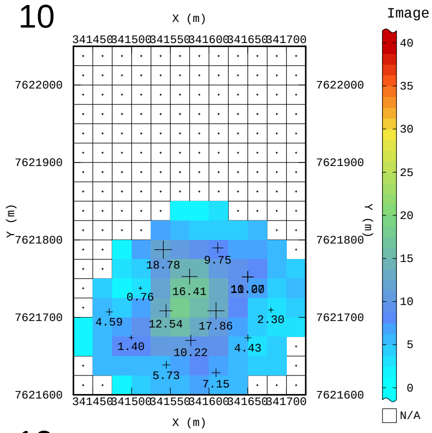

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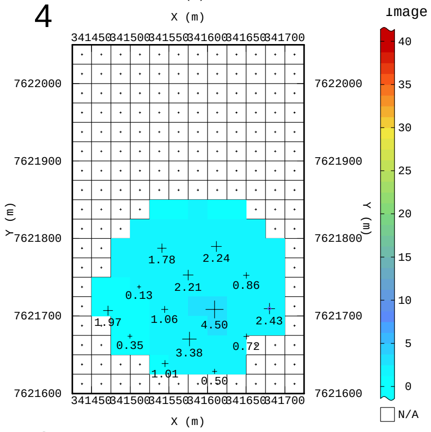

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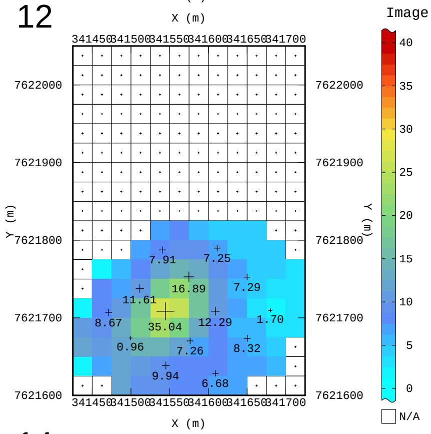

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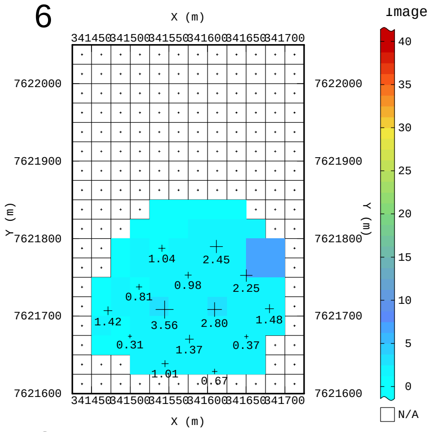

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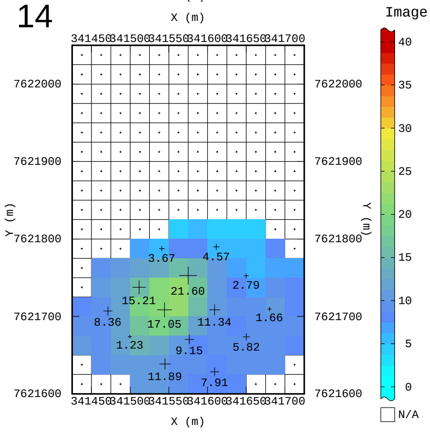

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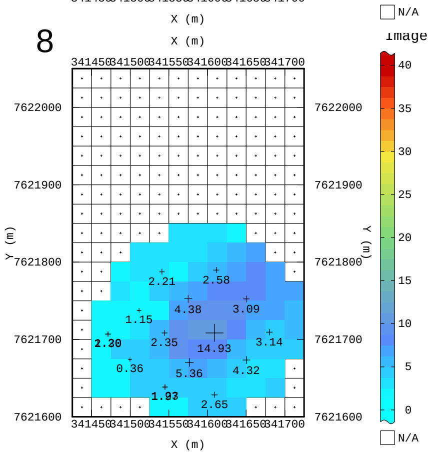

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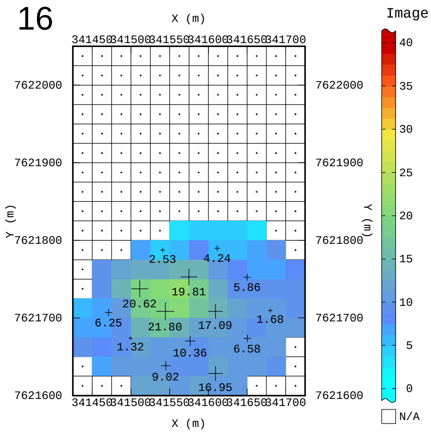

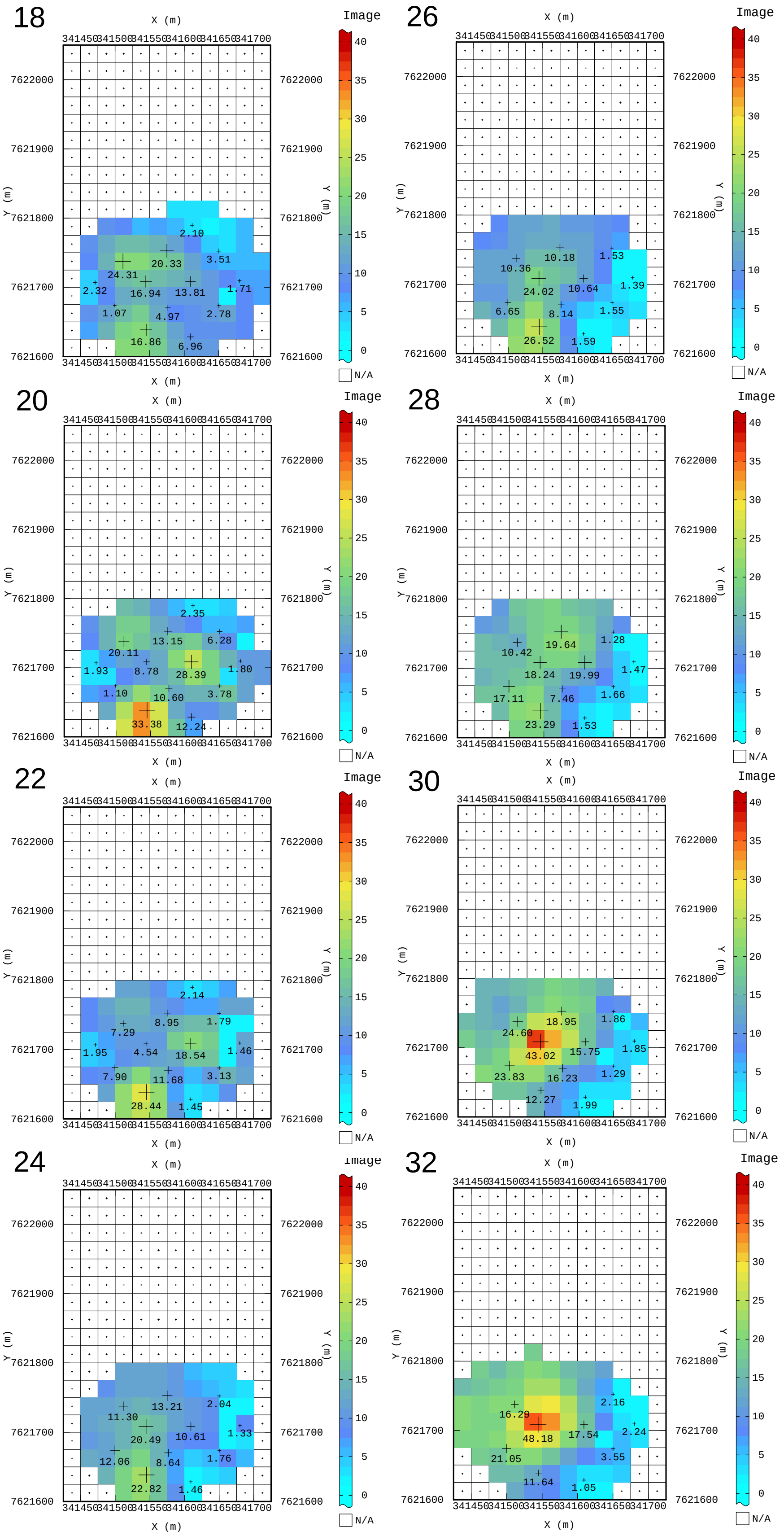
18
X (m)
Y (m)
Image
N/A
2.10
3.51
20.33
24.31
2.32
16.94
13.81
1.71
1.07
4.97
2.78
16.86
6.96
26
10.18
1.53
10.36
24.02
10.64
1.39
6.65
8.14
1.55
26.52
1.59
20
2.35
13.15
6.28
20.11
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12.24
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18.24
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22
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3.13
28.44
1.45
30
18.95
1.86
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15.75
1.85
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12.27
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13.21
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11.30
20.49
10.61
1.33
12.06
8.64
1.76
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11.64
1.05

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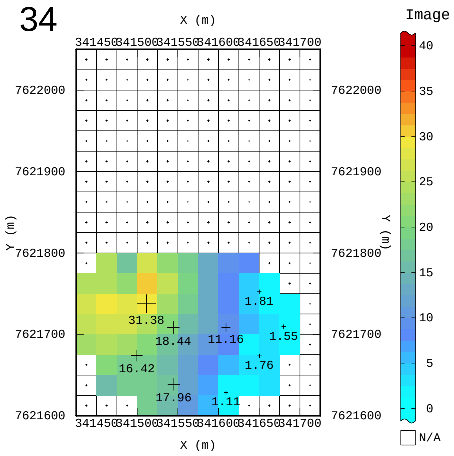
X (m)
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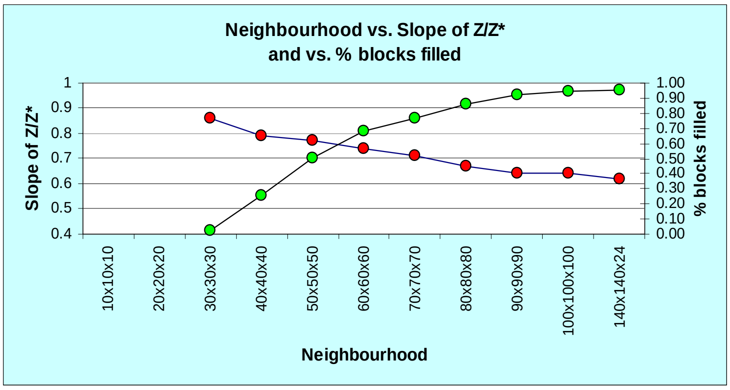
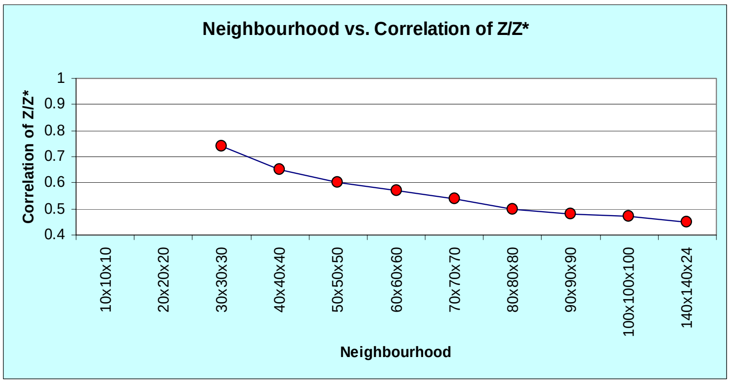
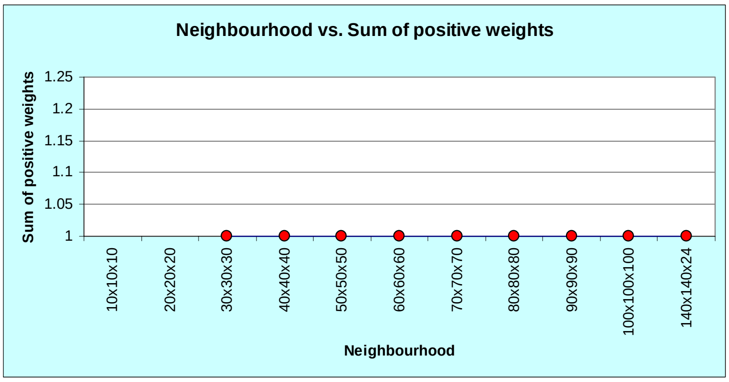
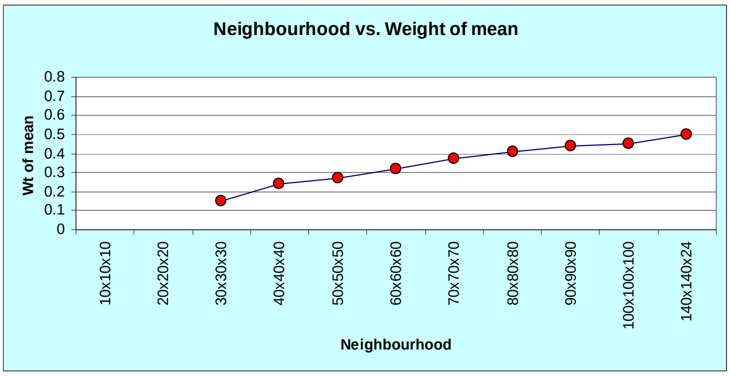
341500
341550
341600
341650
341700
7622000
7621900
7621800
7621700
7621600
Y (m)
31.38
18.44
11.16
1.81
1.55
16.42
1.76
17.96
1.11
Image
40
35
30
25
20
15
10
5
0
N/A

Appendix 4 - Comparison of neighbourhoods for Indicator Kriging

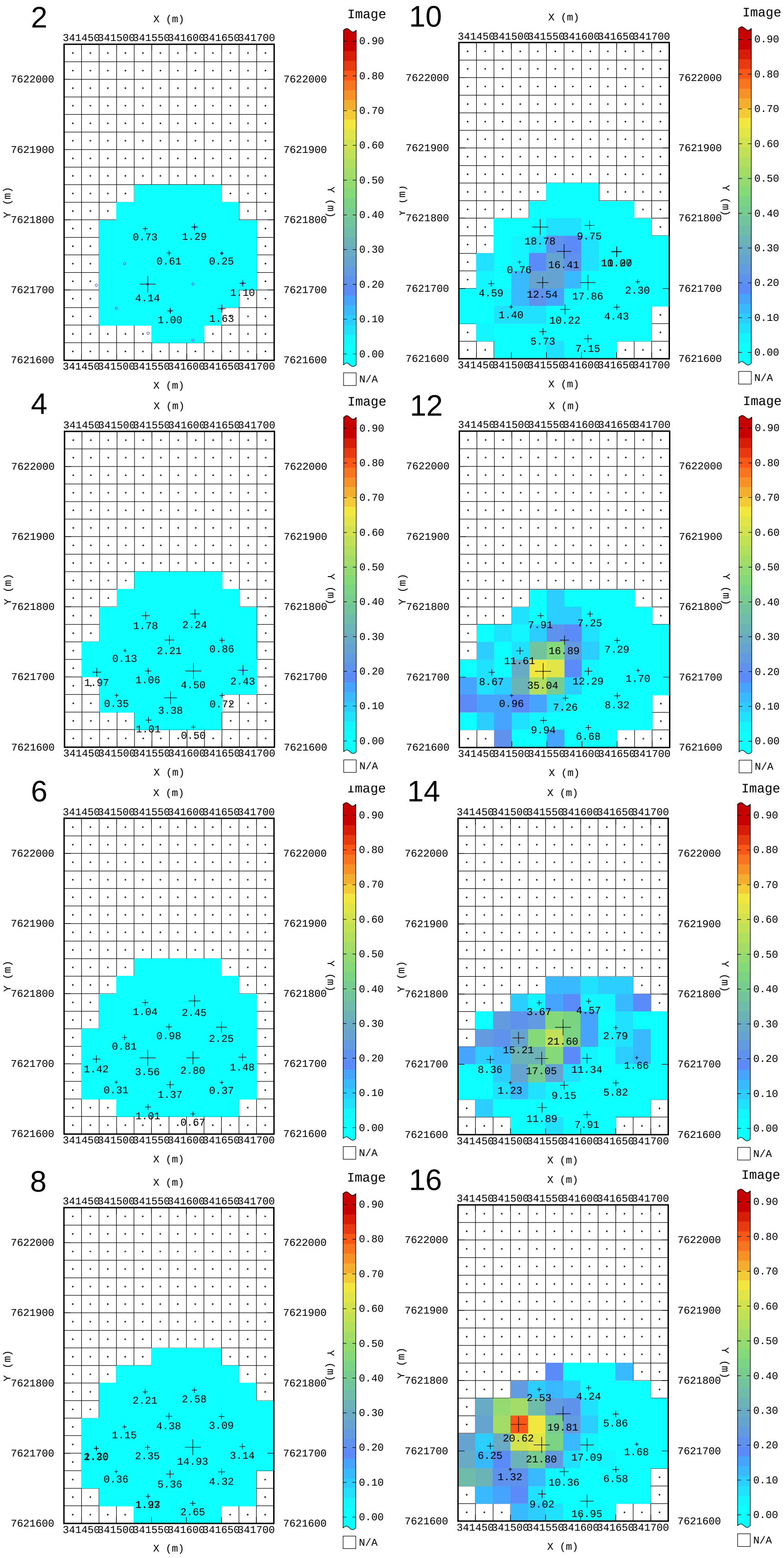








Appendix 5 – Indicator Kriging estimates



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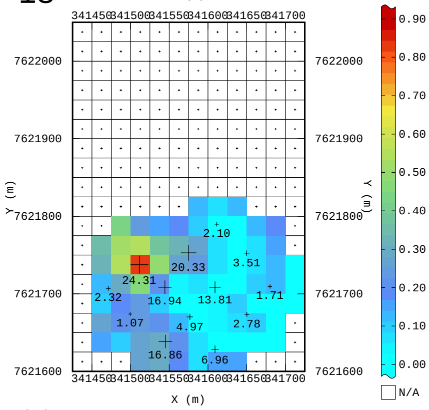

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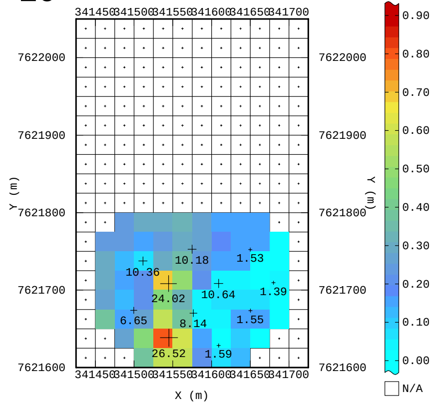

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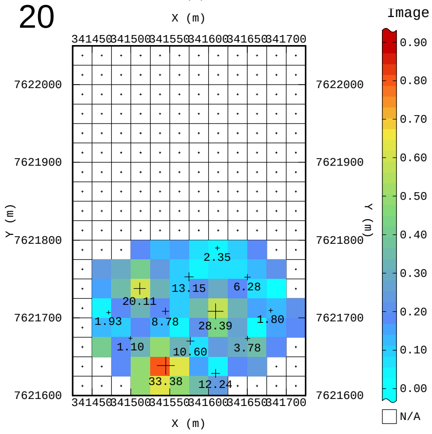

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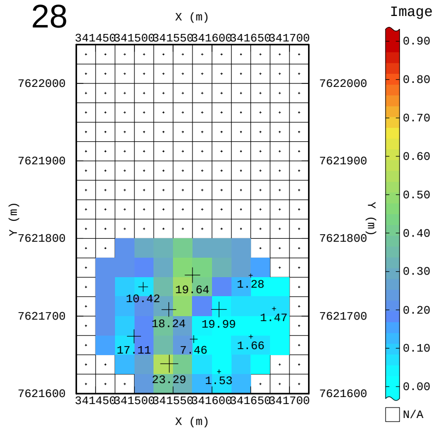

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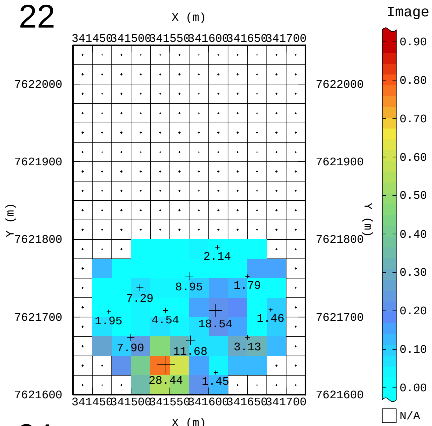

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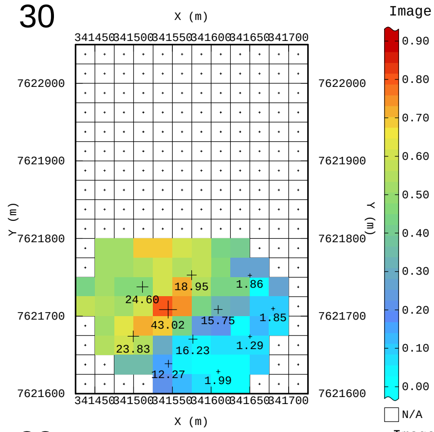

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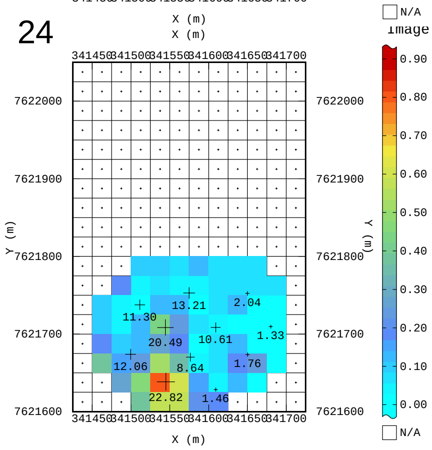

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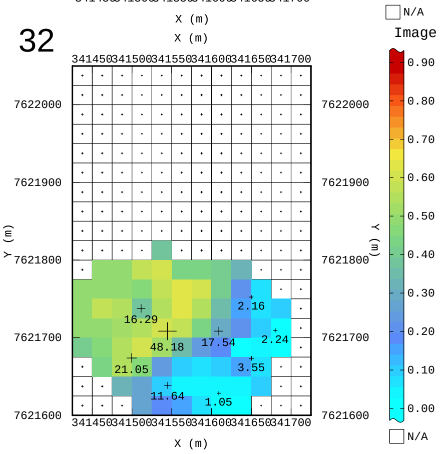

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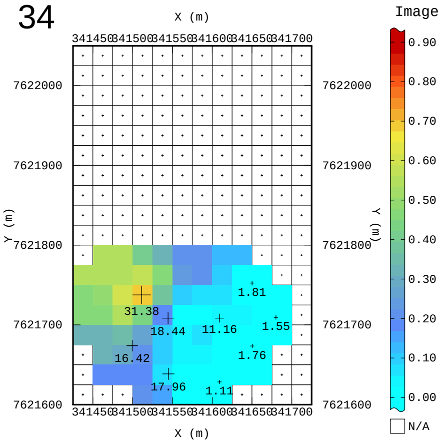
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7622000
7621900
7621800
7621700
7621600
Y (m)
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11.16
1.81
1.55
16.42
1.76
17.96
1.11
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0.60
0.50
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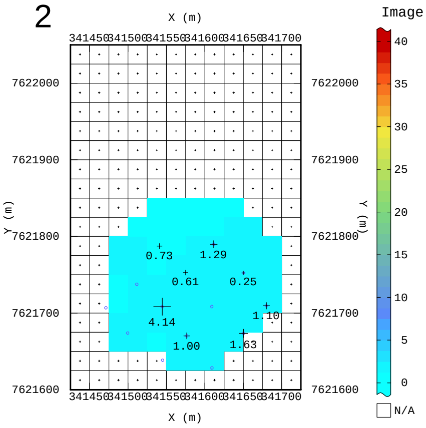
0.30
0.20
0.10
0.00
N/A

2



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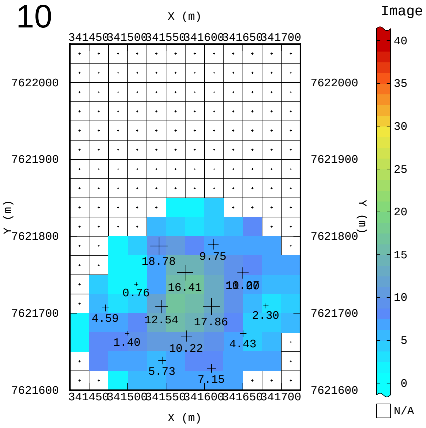

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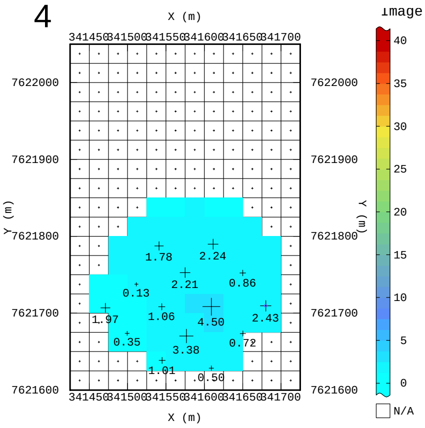

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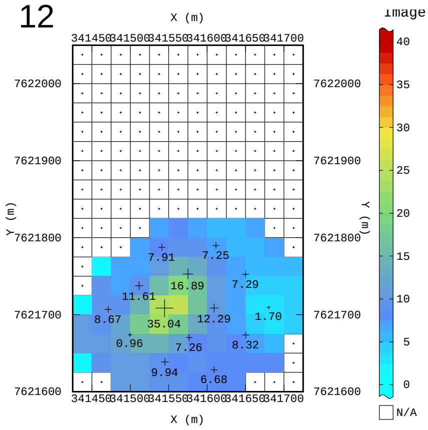

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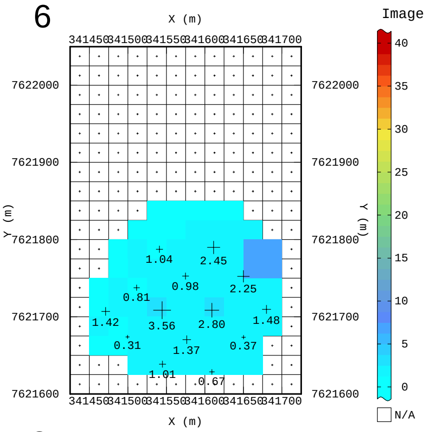

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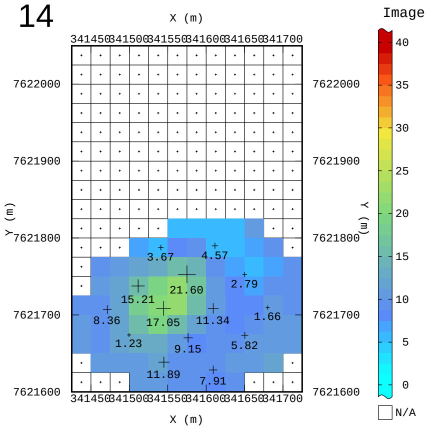

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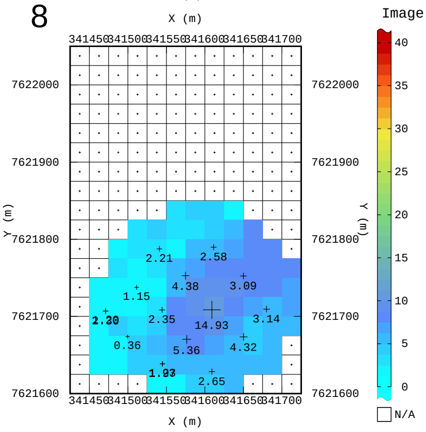

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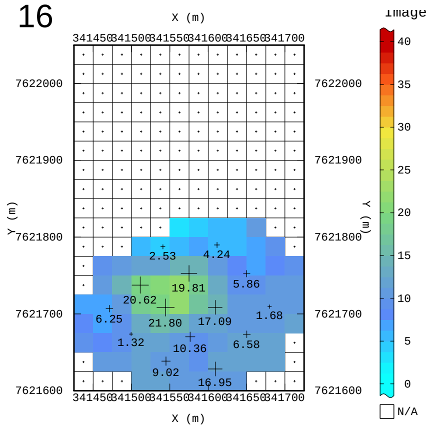

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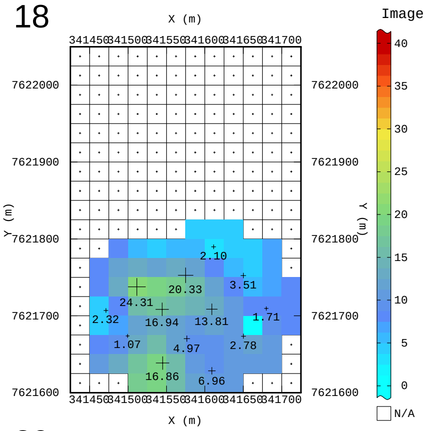

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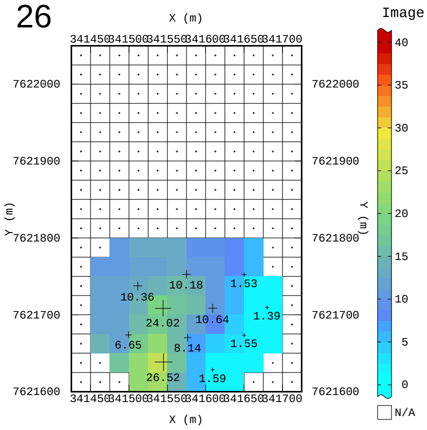

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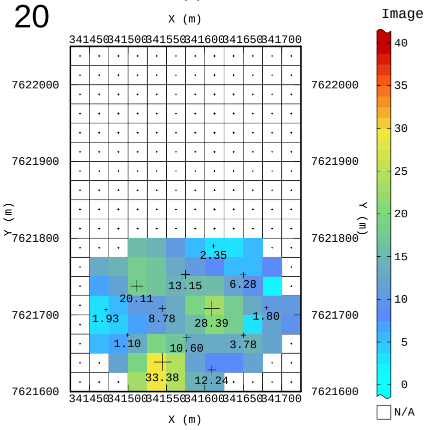

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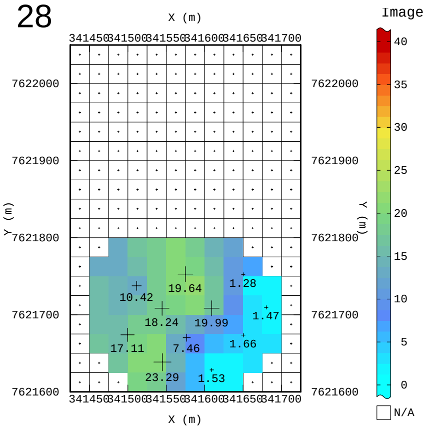

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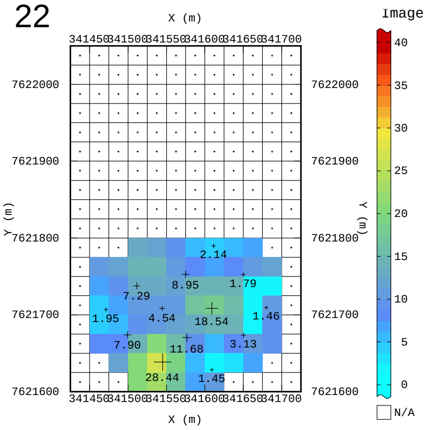

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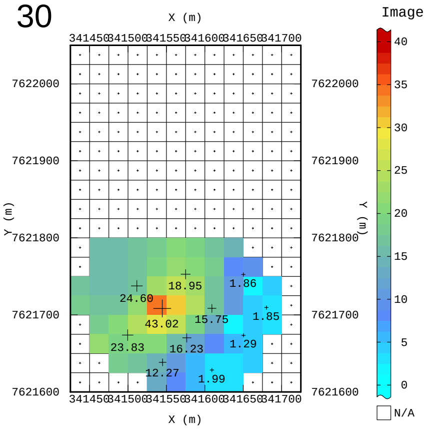

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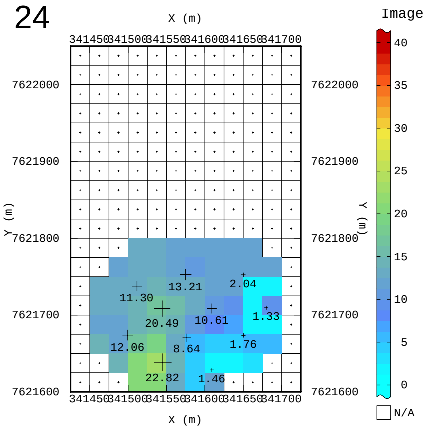

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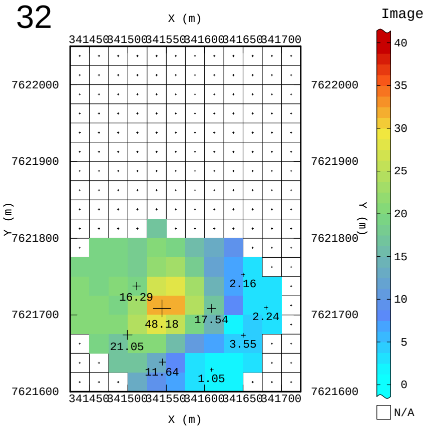

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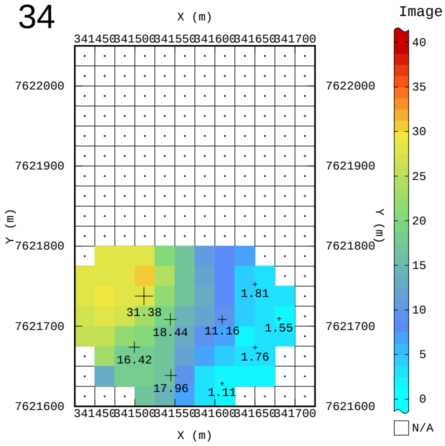

X (m)
341450
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341600
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341700
7622000
7621900
7621800
7621700
7621600
Y (m)
31.38
18.44
11.16
1.81
1.55
16.42
1.76
17.96
1.11
Image
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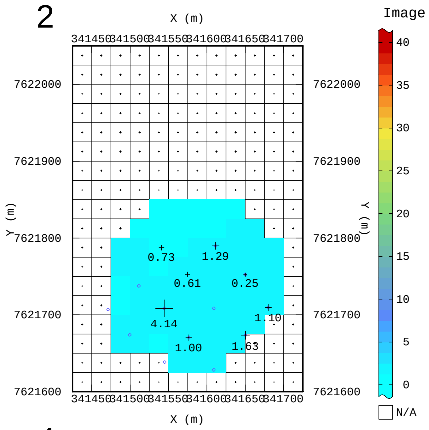
30
25
20
15
10
5
0
N/A

Appendix 7 - Conditional Sequential Gaussian Simulations

2



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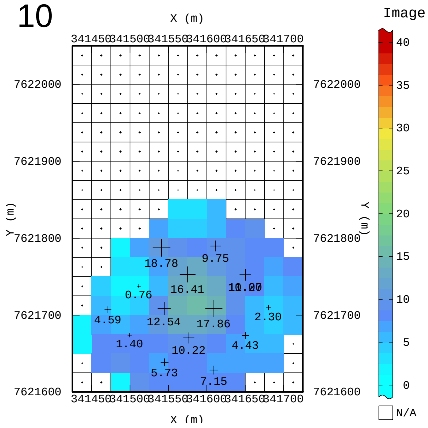

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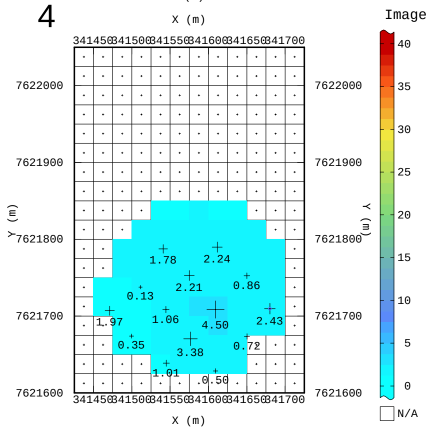

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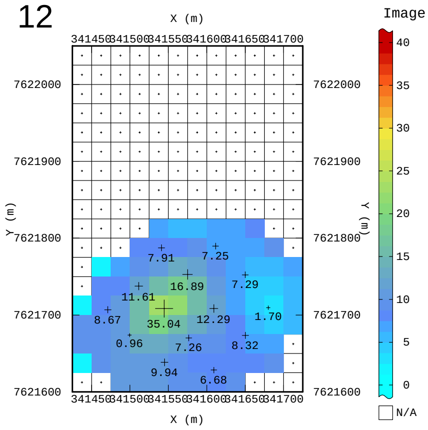

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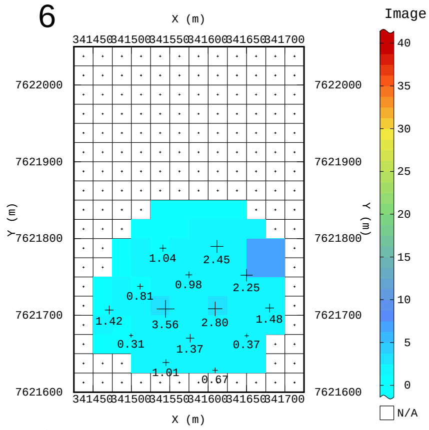

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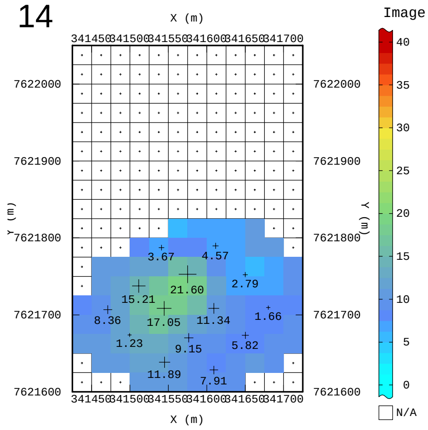

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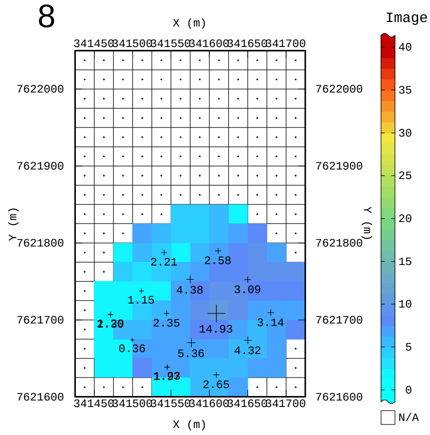

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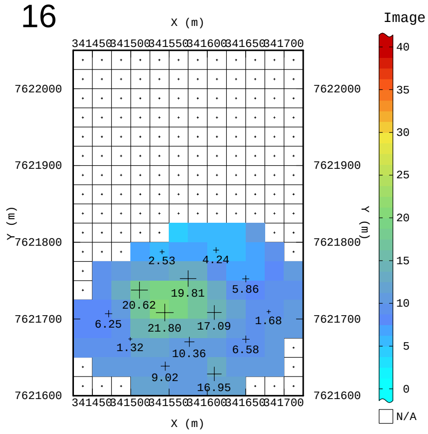

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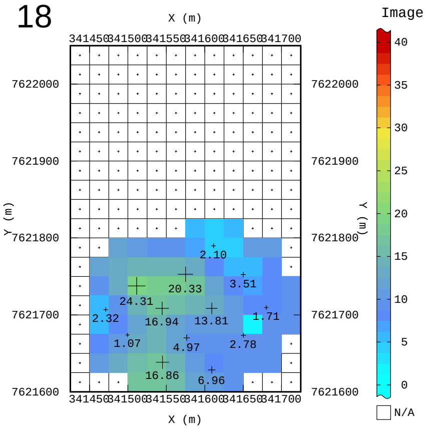

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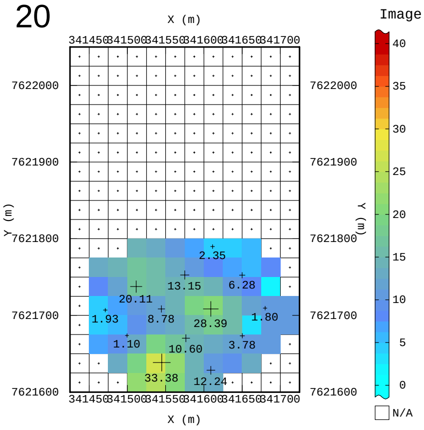

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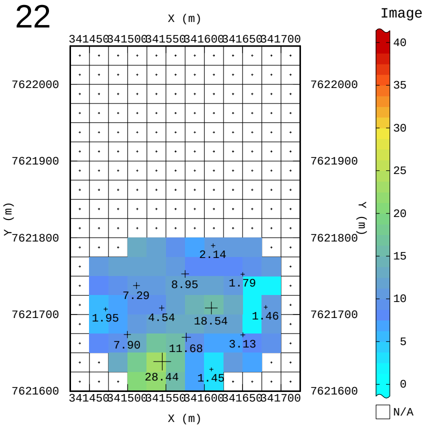

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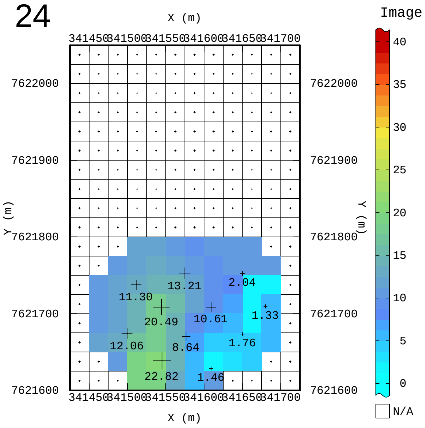

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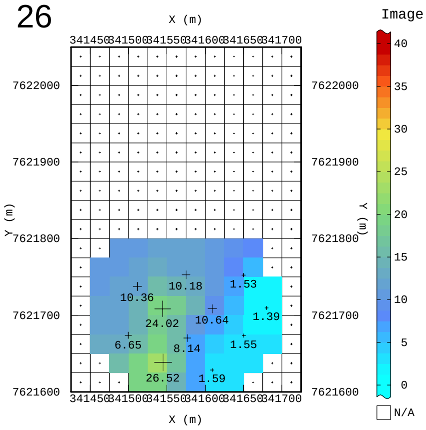

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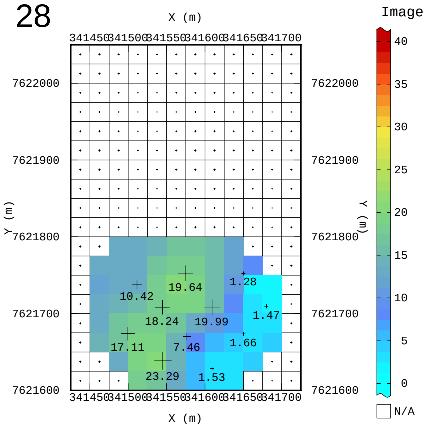

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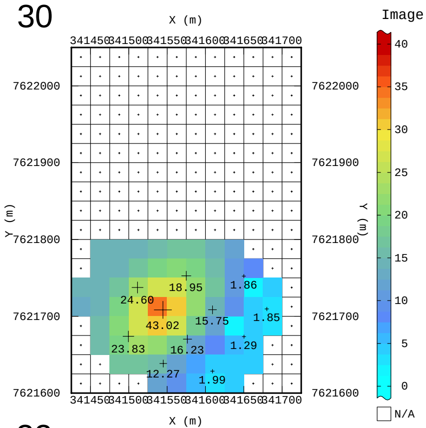

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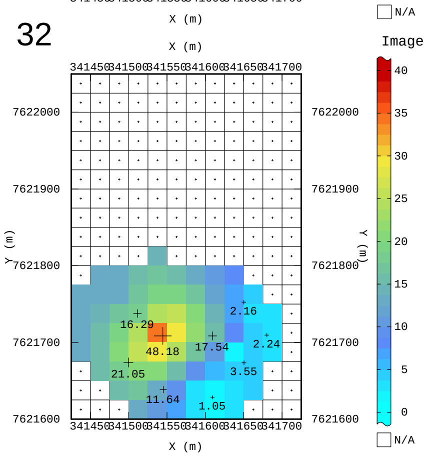

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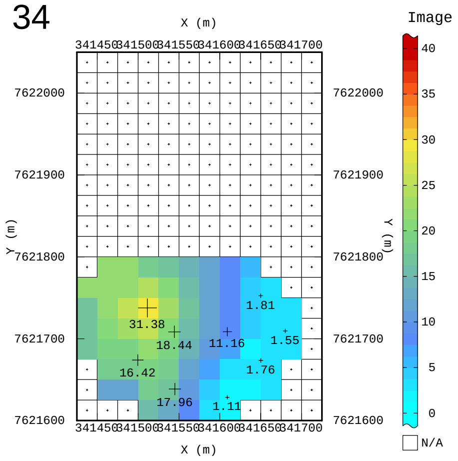
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7621900
7621800
7621700
7621600
Y (m)
31.38
18.44
11.16
1.81
1.55
1.76
16.42
17.96
1.11
Image
40
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30
25
20
15
10
5
0
N/A

Appendix 8 – Results per block

Sample Number	X	Y	Z	OK DMS yield	IK20 DMS yield	TB DMS yield	CSGS DMS yield
6476	341687.5	7621738	620	1.61	0	2.55	3.55
6441	341687.5	7621713	620	1.59	0	2.14	2.86
6406	341687.5	7621688	620	1.59	0	2.43	3.33
5881	341662.5	7621763	620	3.28	0	3.7	4.21
5846	341662.5	7621738	620	2.08	0	2.88	2.99
5811	341662.5	7621713	620	1.93	0	2.41	2.52
5776	341662.5	7621688	620	2.54	0	2.28	2.63
5741	341662.5	7621663	620	3.19	0	2.38	2.84
5251	341637.5	7621763	620	3.43	0	4.14	4.96
5216	341637.5	7621738	620	2.83	0	3.94	3.95
5111	341637.5	7621663	620	3.41	0.09	2.39	2.61
5076	341637.5	7621638	620	2.03	0	1.79	2.25
4656	341612.5	7621788	620	9.18	0.14	8.2	8.61
4621	341612.5	7621763	620	7.27	0.12	7.1	8.14
4586	341612.5	7621738	620	5.86	0.07	6.36	6.39
4551	341612.5	7621713	620	4.67	0.04	4.72	4.39
4516	341612.5	7621688	620	4.95	0.11	3.9	3.88
4481	341612.5	7621663	620	4.28	0.07	2.92	3.29
4446	341612.5	7621638	620	2.38	0	1.6	1.96
4411	341612.5	7621613	620	2.38	0	1.6	2.2
4026	341587.5	7621788	620	11.44	0.16	10.39	11.83
3991	341587.5	7621763	620	11.73	0.24	10.54	11.61
3956	341587.5	7621738	620	10.11	0.12	10.02	9.79
3921	341587.5	7621713	620	8.78	0.08	8.45	8.55
3886	341587.5	7621688	620	8.38	0.09	7.21	7.58
3851	341587.5	7621663	620	7.56	0.11	5.17	5.94
3816	341587.5	7621638	620	6.19	0.05	3.42	4.21
3781	341587.5	7621613	620	6.03	0.05	3.02	4.02
3396	341562.5	7621788	620	16.87	0.33	14.55	14.99
3361	341562.5	7621763	620	16.07	0.25	14.06	15.37
3326	341562.5	7621738	620	15.17	0.14	14.04	15.04
3291	341562.5	7621713	620	14	0.04	13.51	13.73
3256	341562.5	7621688	620	13.28	0.06	12.65	13.44
3221	341562.5	7621663	620	12.89	0.09	11.41	11.98
3186	341562.5	7621638	620	12.81	0.03	10.06	10.26
3151	341562.5	7621613	620	11.46	0.06	8.08	9.04
2766	341537.5	7621788	620	19.51	0.29	18.57	17.48
2731	341537.5	7621763	620	21.66	0.38	19.9	19.82
2696	341537.5	7621738	620	22.9	0.38	20.85	20.94
2661	341537.5	7621713	620	19.43	0.18	18.83	19.04
2626	341537.5	7621688	620	18.36	0.15	18.47	19.18
2591	341537.5	7621663	620	18.07	0.17	18.29	18.95
2556	341537.5	7621638	620	17.97	0.1	17.44	17.45
2521	341537.5	7621613	620	15.7	0.08	13.89	14.82
2136	341512.5	7621788	620	22.07	0.39	22.76	19.07
2101	341512.5	7621763	620	27.72	0.53	27.98	22.73
2066	341512.5	7621738	620	27.95	0.63	27.02	25.25
2031	341512.5	7621713	620	25.62	0.48	25.16	25.15
1996	341512.5	7621688	620	22.69	0.4	22.53	24.92
1961	341512.5	7621663	620	21.4	0.39	21.51	23.37
1926	341512.5	7621638	620	19.27	0.23	19.26	20.3
1891	341512.5	7621613	620	17.1	0.12	16.59	17.28
1506	341487.5	7621788	620	20.34	0.5	27.34	22.51
1471	341487.5	7621763	620	23.82	0.5	27.34	22.51
1436	341487.5	7621738	620	29.83	0.61	30.26	22.51
1401	341487.5	7621713	620	26.31	0.51	26.99	25.88
1366	341487.5	7621688	620	22.47	0.45	21.96	24.14
1331	341487.5	7621663	620	21.38	0.46	20.56	21.91
1296	341487.5	7621638	620	18.73	0.23	18.53	12.48
876	341462.5	7621788	620	25.09	0.5	27.34	22.51
841	341462.5	7621763	620	25.09	0.5	27.34	22.51

806	341462.5	7621738	620	26.4	0.39	28.41	21.82
771	341462.5	7621713	620	25.55	0.38	27.34	22.32
736	341462.5	7621688	620	24.16	0.38	25.22	21.05
701	341462.5	7621663	620	22.92	0.38	24.27	18.29
666	341462.5	7621638	620	16.05	0.19	13.41	12.48
211	341437.5	7621763	620	25.09	0.5	27.34	22.51
176	341437.5	7621738	620	25.08	0.46	27.63	22.51
141	341437.5	7621713	620	23.84	0.35	26.73	17.66
106	341437.5	7621688	620	23.14	0.36	25.42	17.34
6477	341687.5	7621738	632	1.7	0	2.82	3.33
6442	341687.5	7621713	632	1.7	0	2.24	2.57
6407	341687.5	7621688	632	2.2	0	2.81	3.12
5882	341662.5	7621763	632	1.96	0	3.04	3.61
5847	341662.5	7621738	632	2.03	0	2.8	2.77
5812	341662.5	7621713	632	2.63	0	2.63	2.51
5777	341662.5	7621688	632	3.56	0	2.8	2.92
5742	341662.5	7621663	632	3.51	0	2.51	3.2
5707	341662.5	7621638	632	3.11	0	2.41	3.25
5287	341637.5	7621788	632	7.77	0.11	6.72	6.12
5252	341637.5	7621763	632	3.92	0	4.39	4.35
5217	341637.5	7621738	632	4.53	0.03	4.56	4.22
5182	341637.5	7621713	632	5.93	0.04	4.85	4.51
5112	341637.5	7621663	632	3.68	0	2.61	3.22
5077	341637.5	7621638	632	1.89	0	1.74	2.15
4657	341612.5	7621788	632	9.71	0.14	8.62	8.48
4622	341612.5	7621763	632	8.41	0.11	7.98	7.59
4587	341612.5	7621738	632	8.48	0.08	7.95	7.99
4552	341612.5	7621713	632	9.73	0.03	9.09	8.65
4517	341612.5	7621688	632	8.73	0	7.13	6.96
4482	341612.5	7621663	632	5.93	0	3.88	3.65
4447	341612.5	7621638	632	2.16	0	1.61	1.74
4412	341612.5	7621613	632	1.87	0	1.53	1.79
4027	341587.5	7621788	632	12.7	0.21	10.86	12.17
3992	341587.5	7621763	632	13.27	0.2	11.61	12.18
3957	341587.5	7621738	632	12.97	0.08	12.71	11.97
3922	341587.5	7621713	632	12.67	0.03	12.15	12.1
3887	341587.5	7621688	632	10.36	0.08	9.53	10.06
3852	341587.5	7621663	632	8.54	0.06	6.45	6.57
3817	341587.5	7621638	632	6.39	0	3.71	4.07
3782	341587.5	7621613	632	5.59	0	2.95	3.61
3397	341562.5	7621788	632	18.22	0.21	16.32	14.63
3362	341562.5	7621763	632	18.93	0.23	16.92	16.22
3327	341562.5	7621738	632	17.73	0.11	16.7	16.82
3292	341562.5	7621713	632	15.6	0.01	14.87	16.19
3257	341562.5	7621688	632	13.3	0.04	13.36	14.4
3222	341562.5	7621663	632	12.43	0.04	11.82	12.28
3187	341562.5	7621638	632	12.14	0	9.9	10.21
3152	341562.5	7621613	632	10.06	0	7.3	8.32
2767	341537.5	7621788	632	22.39	0.31	20.53	16.8
2732	341537.5	7621763	632	25.74	0.47	24.32	21.05
2697	341537.5	7621738	632	23.24	0.38	21.78	23.24
2662	341537.5	7621713	632	20.27	0.18	19.36	21.23
2627	341537.5	7621688	632	17.17	0.09	17.14	19.42
2592	341537.5	7621663	632	16.07	0.1	16.6	18.3
2557	341537.5	7621638	632	16.76	0.07	16.54	16.58
2522	341537.5	7621613	632	16.08	0.15	13.95	13.44
2137	341512.5	7621788	632	26.99	0.39	27.73	18.72
2102	341512.5	7621763	632	30.22	0.58	30.11	24.92
2067	341512.5	7621738	632	29.69	0.69	28.57	29.18
2032	341512.5	7621713	632	24.8	0.43	23.57	25.51
1997	341512.5	7621688	632	20.95	0.25	20.61	21.52
1962	341512.5	7621663	632	18.37	0.22	18.73	19.28

1927	341512.5	7621638	632	18.04	0.19	18.22	18.38
1892	341512.5	7621613	632	17.59	0.21	16.99	15.8
1507	341487.5	7621788	632	17.24	0.54	28.62	21.92
1472	341487.5	7621763	632	21.91	0.54	28.62	21.92
1437	341487.5	7621738	632	28.4	0.59	27.88	25.86
1402	341487.5	7621713	632	27.21	0.56	27.46	23.15
1367	341487.5	7621688	632	22.58	0.34	22.17	19.79
1332	341487.5	7621663	632	18.49	0.29	17.74	18.47
1297	341487.5	7621638	632	17.6	0.18	17.57	12.28
877	341462.5	7621788	632	24.62	0.54	28.62	21.92
842	341462.5	7621763	632	24.62	0.54	28.62	21.92
807	341462.5	7621738	632	29.03	0.5	29.79	21.92
772	341462.5	7621713	632	26.84	0.47	27.71	20.12
737	341462.5	7621688	632	23.91	0.33	25.06	19.03
702	341462.5	7621663	632	21.05	0.31	22.64	17.97
667	341462.5	7621638	632	15.99	0.17	13.53	12.28
212	341437.5	7621763	632	24.62	0.54	28.62	21.92
177	341437.5	7621738	632	26.53	0.46	27.65	16.34
142	341437.5	7621713	632	25.55	0.46	26.83	17.05
107	341437.5	7621688	632	23.39	0.32	25.25	16.53
6478	341687.5	7621738	644	1.42	0	2.69	3.22
6443	341687.5	7621713	644	1.88	0	2.48	3
6408	341687.5	7621688	644	2.74	0	2.9	3.8
5883	341662.5	7621763	644	1.65	0	2.87	3.8
5848	341662.5	7621738	644	2.17	0	2.97	3.21
5813	341662.5	7621713	644	3.73	0	3.33	3.53
5778	341662.5	7621688	644	4.81	0	3.48	3.95
5743	341662.5	7621663	644	4.47	0	2.68	3.45
5708	341662.5	7621638	644	3.32	0	2.32	3.22
5288	341637.5	7621788	644	8.15	0.11	6.57	6.86
5253	341637.5	7621763	644	4.23	0	4.44	5.49
5218	341637.5	7621738	644	6.27	0.03	5.53	5.78
5183	341637.5	7621713	644	9.21	0.04	7.51	7.27
5113	341637.5	7621663	644	5.5	0	2.98	3.83
5078	341637.5	7621638	644	2.35	0	1.66	2.42
5043	341637.5	7621613	644	2.19	0	1.69	2.75
4658	341612.5	7621788	644	10.82	0.14	9.17	8.79
4623	341612.5	7621763	644	9.99	0.11	8.93	9.24
4588	341612.5	7621738	644	11.17	0.05	9.97	11.24
4553	341612.5	7621713	644	14.91	0.02	13.95	14.09
4518	341612.5	7621688	644	12.64	0	10.52	10.16
4483	341612.5	7621663	644	7.81	0	4.72	4.66
4448	341612.5	7621638	644	2.77	0	1.57	2.09
4413	341612.5	7621613	644	1.49	0	1.31	2.18
4028	341587.5	7621788	644	15.22	0.2	12.36	11.91
3993	341587.5	7621763	644	16.1	0.2	13.82	13.71
3958	341587.5	7621738	644	18.69	0.11	17.11	16.1
3923	341587.5	7621713	644	20.52	0.08	19.25	17.72
3888	341587.5	7621688	644	17.66	0.08	15.44	14.04
3853	341587.5	7621663	644	11.3	0.09	8	7.77
3818	341587.5	7621638	644	5.98	0	3	4.24
3783	341587.5	7621613	644	5.08	0	2.35	3.63
3398	341562.5	7621788	644	16.76	0.16	15.88	14.48
3363	341562.5	7621763	644	18.02	0.17	17.23	17.4
3328	341562.5	7621738	644	23.91	0.2	22.69	19.66
3293	341562.5	7621713	644	24.33	0.2	22.65	18.94
3258	341562.5	7621688	644	21.71	0.15	19.68	17.26
3223	341562.5	7621663	644	15.33	0.09	13.6	13.11
3188	341562.5	7621638	644	10.54	0	7.97	9.07
3153	341562.5	7621613	644	9.34	0	6.13	7.23
2803	341537.5	7621813	644	19.97	0.29	18.27	14.19
2768	341537.5	7621788	644	21.2	0.25	19.97	16.91

2733	341537.5	7621763	644	26.03	0.37	25.21	20.5
2698	341537.5	7621738	644	26.24	0.42	23.99	23.06
2663	341537.5	7621713	644	25.34	0.33	23.38	20.96
2628	341537.5	7621688	644	22.97	0.25	21.4	19.27
2593	341537.5	7621663	644	18.15	0.14	17.36	16.96
2558	341537.5	7621638	644	14.02	0.05	14.12	13.61
2523	341537.5	7621613	644	15.49	0.15	13.85	11.04
2138	341512.5	7621788	644	24.16	0.31	24.4	17.39
2103	341512.5	7621763	644	25.41	0.43	25.5	22.27
2068	341512.5	7621738	644	28.07	0.59	25.21	27.89
2033	341512.5	7621713	644	25.16	0.45	23.12	24.88
1998	341512.5	7621688	644	21.97	0.33	21.14	20.58
1963	341512.5	7621663	644	17.82	0.22	17.69	17.7
1928	341512.5	7621638	644	16.04	0.15	16.69	16.25
1893	341512.5	7621613	644	17.06	0.21	16.64	13.66
1508	341487.5	7621788	644	16.41	0.43	24.41	21.06
1473	341487.5	7621763	644	20.54	0.43	24.41	21.06
1438	341487.5	7621738	644	24.34	0.49	22.82	21.06
1403	341487.5	7621713	644	23.26	0.44	23.33	21.88
1368	341487.5	7621688	644	19.96	0.3	19.97	19.16
1333	341487.5	7621663	644	17.05	0.28	16.82	17.09
1298	341487.5	7621638	644	15.5	0.18	15.96	12.16
878	341462.5	7621788	644	21.46	0.43	24.41	21.06
843	341462.5	7621763	644	21.46	0.43	24.41	21.06
808	341462.5	7621738	644	23.97	0.39	24.95	21.06
773	341462.5	7621713	644	22.48	0.37	23.78	18.25
738	341462.5	7621688	644	20.43	0.28	22.04	17.04
703	341462.5	7621663	644	20.27	0.31	21.74	16.14
213	341437.5	7621763	644	21.46	0.43	24.41	21.06
178	341437.5	7621738	644	22.05	0.35	23.59	21.06
143	341437.5	7621713	644	21.39	0.35	23.1	14.87
108	341437.5	7621688	644	19.84	0.27	22.4	14.87
6479	341687.5	7621738	656	2.33	0.09	3.19	3.52
6444	341687.5	7621713	656	2.04	0	2.78	3.2
6409	341687.5	7621688	656	2.74	0	3.31	3.69
5884	341662.5	7621763	656	2.2	0.06	3.26	4.51
5849	341662.5	7621738	656	2.13	0.08	3.22	3.71
5814	341662.5	7621713	656	2.84	0.09	3.54	4.08
5779	341662.5	7621688	656	5.49	0.05	4.1	4.18
5744	341662.5	7621663	656	5.32	0.08	3.79	4.09
5709	341662.5	7621638	656	4.11	0.09	3.24	3.78
5289	341637.5	7621788	656	11.65	0.33	8.87	7.97
5254	341637.5	7621763	656	6.88	0.2	6.37	6.43
5219	341637.5	7621738	656	6.16	0.14	6.89	6.86
5184	341637.5	7621713	656	7.57	0.21	8.09	7.63
5114	341637.5	7621663	656	6.5	0.15	4.46	4.16
5079	341637.5	7621638	656	3.12	0.05	2.16	2.7
5044	341637.5	7621613	656	2.33	0	2.15	2.68
4659	341612.5	7621788	656	14.37	0.41	12.55	10.66
4624	341612.5	7621763	656	13.41	0.4	12.46	11.45
4589	341612.5	7621738	656	15.39	0.34	14.5	13.81
4554	341612.5	7621713	656	17.24	0.28	16.95	15.07
4519	341612.5	7621688	656	14.56	0.2	14.01	11.05
4484	341612.5	7621663	656	8.64	0.11	6.91	5.18
4449	341612.5	7621638	656	3.08	0.03	1.8	1.86
4414	341612.5	7621613	656	1.72	0	1.64	1.94
4029	341587.5	7621788	656	15.91	0.43	15.29	13.45
3994	341587.5	7621763	656	18.48	0.6	18.07	16.41
3959	341587.5	7621738	656	23.98	0.56	23.44	20.48
3924	341587.5	7621713	656	26	0.43	24.87	22
3889	341587.5	7621688	656	20.48	0.23	19.95	17.3
3854	341587.5	7621663	656	11.94	0.08	10.75	8.98

3819	341587.5	7621638	656	5.29	0.03	3.64	3.75
3784	341587.5	7621613	656	5.04	0.08	2.99	3.08
3399	341562.5	7621788	656	19.97	0.43	19.56	16.15
3364	341562.5	7621763	656	23.54	0.63	23.18	19.61
3329	341562.5	7621738	656	28.96	0.64	28.23	25.54
3294	341562.5	7621713	656	33.15	0.57	32.14	29.91
3259	341562.5	7621688	656	27.38	0.36	25.94	24.31
3224	341562.5	7621663	656	17.22	0.11	15.7	15.59
3189	341562.5	7621638	656	9.81	0.06	8.72	9.14
3154	341562.5	7621613	656	8.17	0.17	6.5	7.34
2804	341537.5	7621813	656	17.56	0.37	17.09	13.92
2769	341537.5	7621788	656	20.46	0.6	20.29	16.4
2734	341537.5	7621763	656	22.53	0.58	21.67	19.82
2699	341537.5	7621738	656	28.35	0.55	26.32	24.6
2664	341537.5	7621713	656	35.17	0.61	31.85	33.76
2629	341537.5	7621688	656	29.49	0.51	28.19	28.91
2594	341537.5	7621663	656	20.62	0.24	20.1	20.53
2559	341537.5	7621638	656	13.15	0.09	13.59	13.72
2524	341537.5	7621613	656	9.97	0.19	9.74	11.2
2139	341512.5	7621788	656	18.72	0.57	18.58	15.02
2104	341512.5	7621763	656	18.98	0.46	18.46	16.77
2069	341512.5	7621738	656	20.55	0.38	19.06	18.57
2034	341512.5	7621713	656	26.28	0.54	23.43	24.11
1999	341512.5	7621688	656	24.98	0.6	24.01	25.24
1964	341512.5	7621663	656	20.21	0.47	20.3	20.59
1929	341512.5	7621638	656	15.39	0.27	16.97	16.65
1894	341512.5	7621613	656	12.51	0.27	13.57	13.16
1509	341487.5	7621788	656	15.34	0.5	19.43	13.72
1474	341487.5	7621763	656	17.86	0.5	19.43	13.38
1439	341487.5	7621738	656	20.67	0.54	20.17	16.32
1404	341487.5	7621713	656	19.61	0.53	19.23	18.86
1369	341487.5	7621688	656	20.27	0.56	20.54	20.53
1334	341487.5	7621663	656	17.02	0.54	17.4	18.53
1299	341487.5	7621638	656	15.95	0.32	16.61	16.11
879	341462.5	7621788	656	17.52	0.5	19.43	13.38
844	341462.5	7621763	656	16.58	0.5	19.43	13.38
809	341462.5	7621738	656	19.07	0.56	19.78	14.69
774	341462.5	7621713	656	19.16	0.5	20.01	15.52
739	341462.5	7621688	656	19.45	0.48	21.23	16.24
704	341462.5	7621663	656	17.89	0.44	19.76	16.19
214	341437.5	7621763	656	15.19	0.5	19.43	13.38
179	341437.5	7621738	656	20.69	0.5	20.52	13.38
144	341437.5	7621713	656	20.43	0.5	20.73	12.91
109	341437.5	7621688	656	19.11	0.42	20.51	13.09
6480	341687.5	7621738	668	2.52	0.13	3.37	3.96
6445	341687.5	7621713	668	2.4	0.07	2.65	2.96
6410	341687.5	7621688	668	3.18	0.08	3.22	3.37
5885	341662.5	7621763	668	3.88	0.16	4.28	5.99
5815	341662.5	7621713	668	3.64	0.05	4.02	4.31
5780	341662.5	7621688	668	4.61	0.11	4.09	4.08
5745	341662.5	7621663	668	4.37	0.05	3.67	4.14
5710	341662.5	7621638	668	3.57	0.06	3.04	3.97
5290	341637.5	7621788	668	8.55	0.16	8.28	9.44
5255	341637.5	7621763	668	7.13	0.11	6.7	8.63
5220	341637.5	7621738	668	6.21	0.17	7.07	8.99
5185	341637.5	7621713	668	9.51	0.18	9.27	8.75
5115	341637.5	7621663	668	6.66	0.06	4.92	4.85
5080	341637.5	7621638	668	2.99	0.05	2.75	3.28
5045	341637.5	7621613	668	1.44	0	1.92	3.31
4660	341612.5	7621788	668	13.3	0.37	12.47	12.68
4625	341612.5	7621763	668	12.61	0.38	12.31	14.18
4590	341612.5	7621738	668	14.76	0.33	14.07	16.09

4555	341612.5	7621713	668	16.96	0.4	16.58	17.34
4520	341612.5	7621688	668	13.43	0.27	12.64	12.96
4485	341612.5	7621663	668	8.09	0.13	6.63	7.15
4450	341612.5	7621638	668	3.72	0.02	2.46	3.2
4415	341612.5	7621613	668	1.53	0	1.81	2.95
4030	341587.5	7621788	668	14.71	0.37	15	15.56
3995	341587.5	7621763	668	18.51	0.45	18.46	19.37
3960	341587.5	7621738	668	24.39	0.5	22.76	23.69
3925	341587.5	7621713	668	27.17	0.44	25.5	25.89
3890	341587.5	7621688	668	22.24	0.26	21.05	20.01
3855	341587.5	7621663	668	12.08	0.07	10.86	11.93
3820	341587.5	7621638	668	5.47	0.02	4.61	5.89
3785	341587.5	7621613	668	4.81	0.06	3.35	4.55
3400	341562.5	7621788	668	17.85	0.51	18.18	17.07
3365	341562.5	7621763	668	22.11	0.56	22.99	21.76
3330	341562.5	7621738	668	30.81	0.68	28.78	28.05
3295	341562.5	7621713	668	38.18	0.73	35.78	33.61
3260	341562.5	7621688	668	31.79	0.47	29.81	28.01
3225	341562.5	7621663	668	18.21	0.11	16.81	18.37
3190	341562.5	7621638	668	10.17	0.04	9.22	11.24
3155	341562.5	7621613	668	7.9	0.14	6.59	8.1
2770	341537.5	7621788	668	17.97	0.73	18.77	15.92
2735	341537.5	7621763	668	20.18	0.62	20.24	18.46
2700	341537.5	7621738	668	28.16	0.58	25.69	23.77
2665	341537.5	7621713	668	39.65	0.82	37.02	34.35
2630	341537.5	7621688	668	35.17	0.78	33.21	32.19
2595	341537.5	7621663	668	23.68	0.36	22.96	22.52
2560	341537.5	7621638	668	14.19	0.13	14.54	15.07
2525	341537.5	7621613	668	10.74	0.16	11.47	11.14
2140	341512.5	7621788	668	17.42	0.68	18.29	13.8
2105	341512.5	7621763	668	15.82	0.52	17.08	13.89
2070	341512.5	7621738	668	15.82	0.35	15.41	14.32
2035	341512.5	7621713	668	26.83	0.63	24.57	23.34
2000	341512.5	7621688	668	28.71	0.9	27.45	26.96
1965	341512.5	7621663	668	23.28	0.71	23.84	22.22
1930	341512.5	7621638	668	16.5	0.39	17.86	16.53
1510	341487.5	7621788	668	13.13	0.59	15.42	14.39
1475	341487.5	7621763	668	15.05	0.59	15.42	12.59
1440	341487.5	7621738	668	15.47	0.52	16.62	13.59
1405	341487.5	7621713	668	19.21	0.65	19.64	17.88
1370	341487.5	7621688	668	22.01	0.85	23.29	21.23
1335	341487.5	7621663	668	20.1	0.81	21.73	20.13
1300	341487.5	7621638	668	18.6	0.54	19.92	14.39
880	341462.5	7621788	668	15.08	0.59	15.42	14.39
845	341462.5	7621763	668	14.08	0.59	15.42	14.39
810	341462.5	7621738	668	16.99	0.66	19.19	13.83
775	341462.5	7621713	668	17.99	0.7	20.02	14.86
740	341462.5	7621688	668	20.01	0.72	22.3	16.52
705	341462.5	7621663	668	19.68	0.52	22.84	16.34
215	341437.5	7621763	668	15.17	0.59	15.42	14.39
180	341437.5	7621738	668	20.88	0.82	22.22	12.83
145	341437.5	7621713	668	22.4	0.77	22.47	12.92
110	341437.5	7621688	668	20.97	0.64	21.37	13.02
6481	341687.5	7621738	680	5.53	0.26	4.62	4.47
6446	341687.5	7621713	680	2.82	0.11	2.68	3.27
6411	341687.5	7621688	680	2.72	0.06	3.02	3.43
5886	341662.5	7621763	680	9.98	0.27	8.82	8.46
5816	341662.5	7621713	680	4.69	0.1	4.45	4.87
5781	341662.5	7621688	680	4.44	0.12	4.2	4.29
5746	341662.5	7621663	680	4.57	0.08	4.52	4.2
5711	341662.5	7621638	680	3.73	0.11	4	4.24
5291	341637.5	7621788	680	14.71	0.42	13.97	11.73

5256	341637.5	7621763	680	8.48	0.25	8.09	10.98
5221	341637.5	7621738	680	11.28	0.42	10.73	10.13
5186	341637.5	7621713	680	11.12	0.3	10.21	8.76
5116	341637.5	7621663	680	6.47	0.08	6.04	5.05
5081	341637.5	7621638	680	2.55	0	2.63	3.77
5046	341637.5	7621613	680	1.64	0	2.9	3.79
4661	341612.5	7621788	680	17.22	0.43	17.46	14.55
4626	341612.5	7621763	680	18.34	0.46	17.93	15.5
4591	341612.5	7621738	680	17.3	0.43	16.73	16.68
4556	341612.5	7621713	680	16.55	0.33	16.37	14.3
4521	341612.5	7621688	680	13.26	0.22	13.34	11.71
4486	341612.5	7621663	680	9.12	0.08	8.23	7.74
4451	341612.5	7621638	680	3.52	0	3.02	3.89
4416	341612.5	7621613	680	1.76	0	2.82	3.52
4031	341587.5	7621788	680	18.29	0.59	19.26	17.03
3996	341587.5	7621763	680	19.81	0.58	20.42	19.27
3961	341587.5	7621738	680	23.61	0.54	23.34	21.75
3926	341587.5	7621713	680	25.58	0.43	24.45	22.11
3891	341587.5	7621688	680	19.25	0.23	18.85	18.08
3856	341587.5	7621663	680	11.14	0.04	11.29	12.34
3821	341587.5	7621638	680	7.08	0.01	5.91	7.08
3786	341587.5	7621613	680	5.66	0.06	5.17	5.63
3401	341562.5	7621788	680	18.88	0.61	20.7	16.98
3366	341562.5	7621763	680	20.83	0.55	21.93	20.69
3331	341562.5	7621738	680	26.79	0.7	25.21	26.26
3296	341562.5	7621713	680	32.37	0.75	30.17	31.11
3261	341562.5	7621688	680	26.78	0.43	25.09	26.55
3226	341562.5	7621663	680	17.12	0.08	16.11	18.18
3191	341562.5	7621638	680	10.64	0.04	10.77	11.6
3156	341562.5	7621613	680	9.17	0.14	8.45	9.05
2771	341537.5	7621788	680	16.86	0.7	18.66	15.91
2736	341537.5	7621763	680	18.32	0.61	18.98	19.67
2701	341537.5	7621738	680	25.16	0.61	23.17	27.19
2666	341537.5	7621713	680	36.99	0.79	33.77	34.69
2631	341537.5	7621688	680	30.42	0.68	28.17	30.49
2596	341537.5	7621663	680	21.83	0.29	20.59	22.27
2561	341537.5	7621638	680	13.99	0.16	14.37	15.19
2526	341537.5	7621613	680	13.83	0.21	13.33	12.24
2141	341512.5	7621788	680	15.23	0.69	17.33	14.13
2106	341512.5	7621763	680	14.31	0.55	16.34	16.85
2071	341512.5	7621738	680	18.34	0.46	17.49	22.8
2036	341512.5	7621713	680	23.62	0.61	21.96	26.99
2001	341512.5	7621688	680	25.56	0.7	24.24	27.1
1966	341512.5	7621663	680	21.31	0.56	20.88	22.71
1931	341512.5	7621638	680	16.68	0.35	17.15	17.43
1511	341487.5	7621788	680	14.08	0.52	15.05	14.9
1476	341487.5	7621763	680	11.42	0.52	15.05	14.9
1441	341487.5	7621738	680	13.53	0.45	15.1	17.06
1406	341487.5	7621713	680	16.73	0.53	17.1	19.09
1371	341487.5	7621688	680	19.76	0.63	20.21	20.5
1336	341487.5	7621663	680	18.81	0.6	19.57	19.49
1301	341487.5	7621638	680	16.73	0.36	18.17	17.22
881	341462.5	7621788	680	14.08	0.52	15.05	14.9
846	341462.5	7621763	680	14.08	0.52	15.05	14.9
811	341462.5	7621738	680	13.85	0.53	16.04	13.89
776	341462.5	7621713	680	15.12	0.55	16.58	14.36
741	341462.5	7621688	680	16.72	0.53	18.12	15.25
706	341462.5	7621663	680	20.44	0.54	22.33	15.75
181	341437.5	7621738	680	15.82	0.45	17.24	14.9
146	341437.5	7621713	680	17.92	0.56	17.68	12.58
6447	341687.5	7621713	692	2.53	0.02	2.19	2.67
6412	341687.5	7621688	692	2.31	0	2.51	2.95

5887	341662.5	7621763	692	9.7	0.14	8.23	9.66
5817	341662.5	7621713	692	4.76	0.02	3.83	4.13
5782	341662.5	7621688	692	4.37	0.13	3.58	3.6
5747	341662.5	7621663	692	4.52	0	3.85	3.77
5712	341662.5	7621638	692	3.77	0	3.56	4.16
5292	341637.5	7621788	692	12.77	0.08	11.86	13.07
5257	341637.5	7621763	692	12.45	0.08	11.11	12.22
5222	341637.5	7621738	692	11.57	0.12	10.49	10.84
5187	341637.5	7621713	692	10.97	0.02	9.63	8.4
5117	341637.5	7621663	692	5.76	0	4.92	4.77
5082	341637.5	7621638	692	2.53	0	2.86	3.56
5047	341637.5	7621613	692	1.77	0	2.65	3.54
4662	341612.5	7621788	692	15.04	0.1	14.87	15.27
4627	341612.5	7621763	692	16.36	0.14	15.59	16.02
4592	341612.5	7621738	692	17.05	0.14	16.12	16.14
4557	341612.5	7621713	692	16.58	0.05	16.36	14.84
4522	341612.5	7621688	692	12.32	0.06	12.12	10.58
4487	341612.5	7621663	692	7.58	0	6.56	6.84
4452	341612.5	7621638	692	3.14	0	3	4.06
4417	341612.5	7621613	692	2.09	0	2.52	3.94
4032	341587.5	7621788	692	16.27	0.24	17.29	18.08
3997	341587.5	7621763	692	19.29	0.31	19.61	20.23
3962	341587.5	7621738	692	21.93	0.27	21.97	21.45
3927	341587.5	7621713	692	22.14	0.2	21.7	20.75
3892	341587.5	7621688	692	16.33	0.07	15.96	15.58
3857	341587.5	7621663	692	9.89	0.01	9.63	10.67
3822	341587.5	7621638	692	6.39	0	5.74	7.66
3787	341587.5	7621613	692	6.68	0.07	5.39	6.09
3402	341562.5	7621788	692	18.77	0.37	20.21	17.88
3367	341562.5	7621763	692	20.09	0.38	20.62	22.09
3332	341562.5	7621738	692	23.8	0.48	23.32	24.01
3297	341562.5	7621713	692	24.76	0.49	23.41	23.71
3262	341562.5	7621688	692	20.98	0.3	19.45	20.45
3227	341562.5	7621663	692	15	0.14	14.32	15.58
3192	341562.5	7621638	692	12.71	0.19	12.02	12.23
3157	341562.5	7621613	692	11.83	0.25	9.66	10.24
2772	341537.5	7621788	692	17.53	0.48	18.82	15.26
2737	341537.5	7621763	692	18.4	0.42	18.99	18.91
2702	341537.5	7621738	692	22.31	0.46	21.5	21.49
2667	341537.5	7621713	692	26.01	0.74	24.98	23.19
2632	341537.5	7621688	692	22.99	0.46	21.17	22.86
2597	341537.5	7621663	692	20.43	0.32	19.81	19.26
2562	341537.5	7621638	692	17.15	0.28	16.73	15.52
2527	341537.5	7621613	692	15.61	0.27	15.01	14.41
2142	341512.5	7621788	692	16.85	0.47	18.7	13.31
2107	341512.5	7621763	692	16.09	0.38	17.44	14.61
2072	341512.5	7621738	692	16.7	0.29	17.17	16.5
2037	341512.5	7621713	692	21.31	0.42	20.83	19.44
2002	341512.5	7621688	692	20.94	0.43	20.38	20.22
1967	341512.5	7621663	692	19.72	0.31	19.59	18.76
1932	341512.5	7621638	692	18.62	0.32	18.92	17.16
1512	341487.5	7621788	692	16.13	0.46	14.33	13.62
1477	341487.5	7621763	692	11.28	0.46	14.33	13.62
1442	341487.5	7621738	692	15.7	0.4	16.79	14.7
1407	341487.5	7621713	692	17.31	0.43	17.08	16.24
1372	341487.5	7621688	692	17.93	0.34	17.9	16.37
1337	341487.5	7621663	692	17.2	0.32	17.36	16.14
1302	341487.5	7621638	692	16.14	0.18	17.27	13.62
882	341462.5	7621788	692	16.13	0.46	14.33	13.62
847	341462.5	7621763	692	16.13	0.46	14.33	13.62
812	341462.5	7621738	692	16.72	0.51	18.07	13.49
777	341462.5	7621713	692	17.05	0.51	17.28	14.17

742	341462.5	7621688	692	18.42	0.45	18.86	14.87
707	341462.5	7621663	692	18.2	0.4	19.11	14.49
182	341437.5	7621738	692	19.68	0.64	19.6	12.14
147	341437.5	7621713	692	19.87	0.55	18.93	13.02
6448	341687.5	7621713	704	2.42	0.07	1.71	2.07
6413	341687.5	7621688	704	2.08	0	2.03	2.66
6378	341687.5	7621663	704	3.05	0	2.57	3.84
5888	341662.5	7621763	704	9.48	0.14	6.94	8.24
5818	341662.5	7621713	704	4.82	0.06	3.01	3.48
5783	341662.5	7621688	704	4.48	0	2.93	3.15
5748	341662.5	7621663	704	4.49	0.08	3.02	3.48
5713	341662.5	7621638	704	3.65	0	2.91	3.9
5293	341637.5	7621788	704	13.79	0.27	11.59	12.3
5258	341637.5	7621763	704	13.46	0.27	11.07	11.38
5223	341637.5	7621738	704	12.22	0.12	10.13	10.17
5188	341637.5	7621713	704	11.24	0.07	8.78	8.65
5153	341637.5	7621688	704	8.54	0	6.69	6.41
5118	341637.5	7621663	704	4.97	0.07	3.82	4.33
5083	341637.5	7621638	704	2.45	0.09	2.36	3.22
5048	341637.5	7621613	704	1.98	0.13	2.15	3.45
4663	341612.5	7621788	704	16.08	0.29	14.5	15.71
4628	341612.5	7621763	704	17.48	0.34	15.88	15.81
4593	341612.5	7621738	704	17.98	0.19	16.75	15.47
4558	341612.5	7621713	704	17.45	0.05	16.74	16.01
4523	341612.5	7621688	704	11.77	0.02	10.5	10.93
4488	341612.5	7621663	704	6.6	0.02	5.2	5.68
4453	341612.5	7621638	704	2.61	0.02	2.31	2.76
4418	341612.5	7621613	704	2.62	0.08	2.27	3.32
4033	341587.5	7621788	704	17.08	0.3	17.52	17.06
3998	341587.5	7621763	704	19.8	0.44	19.69	18.67
3963	341587.5	7621738	704	21.37	0.41	22.25	19.73
3928	341587.5	7621713	704	19.87	0.17	20.4	19.18
3893	341587.5	7621688	704	13.32	0.03	13.48	13.5
3858	341587.5	7621663	704	7.94	0.03	7.93	7.89
3823	341587.5	7621638	704	6.67	0.08	5.57	6.11
3788	341587.5	7621613	704	8.3	0.14	5.46	6
3403	341562.5	7621788	704	19.55	0.4	20.58	16.29
3368	341562.5	7621763	704	19.7	0.48	20.2	18.39
3333	341562.5	7621738	704	20.05	0.51	20.56	20.02
3298	341562.5	7621713	704	19.16	0.49	19.39	18.94
3263	341562.5	7621688	704	15.99	0.28	16.07	16.74
3228	341562.5	7621663	704	13.86	0.24	13.36	13.98
3193	341562.5	7621638	704	15.67	0.4	14.09	13.84
3158	341562.5	7621613	704	15.23	0.31	11.98	12.69
2773	341537.5	7621788	704	17.79	0.33	18.06	14.88
2738	341537.5	7621763	704	17.54	0.31	17.54	16.29
2703	341537.5	7621738	704	17.76	0.34	17.73	17.73
2668	341537.5	7621713	704	18.45	0.29	18.43	18.27
2633	341537.5	7621688	704	17.98	0.38	17.98	18.57
2598	341537.5	7621663	704	20.21	0.35	20.36	19.27
2563	341537.5	7621638	704	21.83	0.54	20.95	20.5
2528	341537.5	7621613	704	19.64	0.37	17.95	17.47
2143	341512.5	7621788	704	16.43	0.3	17.45	12.88
2108	341512.5	7621763	704	15.08	0.18	15.74	13.26
2073	341512.5	7621738	704	13.37	0.07	13.7	13.59
2038	341512.5	7621713	704	15.72	0.22	15.99	15.97
2003	341512.5	7621688	704	17.39	0.18	17.91	18.41
1968	341512.5	7621663	704	19.64	0.19	19.75	19.36
1933	341512.5	7621638	704	20.59	0.27	20.51	19.63
1898	341512.5	7621613	704	19.22	0.24	19.23	17.93
1513	341487.5	7621788	704	10.21	0.2	13.02	12.54
1478	341487.5	7621763	704	11.87	0.2	13.02	12.54

1443	341487.5	7621738	704	14.07	0.11	14.33	12.86
1408	341487.5	7621713	704	15.09	0.12	14.57	14.55
1373	341487.5	7621688	704	15.84	0.09	16.08	16.41
1338	341487.5	7621663	704	16.36	0.07	16.19	16.43
1303	341487.5	7621638	704	16.21	0.13	16.94	12.54
848	341462.5	7621763	704	10.74	0.2	13.02	12.54
813	341462.5	7621738	704	15.56	0.2	16.04	11.95
778	341462.5	7621713	704	15.96	0.2	15.47	13.04
743	341462.5	7621688	704	14.54	0.2	15.24	13.67
708	341462.5	7621663	704	16.76	0.15	17.47	14.18
6449	341687.5	7621713	716	2	0.02	1.46	1.69
6414	341687.5	7621688	716	2.04	0	1.74	2.21
6379	341687.5	7621663	716	2.77	0	2.18	3.32
5924	341662.5	7621788	716	9.53	0.08	6.97	8.63
5889	341662.5	7621763	716	8.67	0.14	6.12	6.36
5784	341662.5	7621688	716	3.84	0.13	2.47	2.57
5749	341662.5	7621663	716	4.18	0.16	2.54	3.12
5714	341662.5	7621638	716	3.31	0	2.39	3.61
5294	341637.5	7621788	716	11.08	0.08	9.05	10.49
5259	341637.5	7621763	716	11.2	0.08	8.85	9.15
5224	341637.5	7621738	716	10.42	0.12	7.5	7.94
5189	341637.5	7621713	716	10.19	0.02	7.01	6.49
5154	341637.5	7621688	716	7.19	0.15	5.17	4.72
5119	341637.5	7621663	716	3.94	0.14	3.15	3.49
5084	341637.5	7621638	716	1.83	0.09	2.03	2.71
5049	341637.5	7621613	716	1.94	0.13	1.83	3
4664	341612.5	7621788	716	12.63	0.1	10.85	12.48
4629	341612.5	7621763	716	14.22	0.14	12.35	12.83
4594	341612.5	7621738	716	14.68	0.14	13.14	13.48
4559	341612.5	7621713	716	15.1	0.05	13.96	12.93
4524	341612.5	7621688	716	9.55	0.09	8.44	8.68
4489	341612.5	7621663	716	5.22	0.05	4.27	4.79
4454	341612.5	7621638	716	2.08	0.02	2.01	2.56
4419	341612.5	7621613	716	2.72	0.08	1.99	3.08
4034	341587.5	7621788	716	13.41	0.24	12.52	13.93
3999	341587.5	7621763	716	15.79	0.31	14.83	16.42
3964	341587.5	7621738	716	17.95	0.27	18.86	18.05
3929	341587.5	7621713	716	17.05	0.15	17.91	16.57
3894	341587.5	7621688	716	11.3	0.04	11.64	12.3
3859	341587.5	7621663	716	6.85	0.03	6.76	7.67
3824	341587.5	7621638	716	7.41	0.14	5.91	6.47
3789	341587.5	7621613	716	9.36	0.22	5.71	6.52
3404	341562.5	7621788	716	14.86	0.21	15.09	14.55
3369	341562.5	7621763	716	15.96	0.31	16.05	18
3334	341562.5	7621738	716	17.54	0.47	17.94	18.88
3299	341562.5	7621713	716	17.82	0.47	17.94	18.27
3264	341562.5	7621688	716	15.36	0.3	15.31	16.11
3229	341562.5	7621663	716	14.25	0.33	13.68	15.13
3194	341562.5	7621638	716	17.83	0.61	15.91	15.73
3159	341562.5	7621613	716	17.61	0.58	13.98	14.18
2774	341537.5	7621788	716	14.09	0.17	14.08	14.15
2739	341537.5	7621763	716	14.05	0.17	13.62	16.11
2704	341537.5	7621738	716	16.52	0.29	16.11	17.6
2669	341537.5	7621713	716	17.32	0.44	17.05	19.21
2634	341537.5	7621688	716	17.89	0.45	17.66	19.52
2599	341537.5	7621663	716	20.72	0.52	20.88	21.1
2564	341537.5	7621638	716	25.07	0.81	24.49	23.54
2529	341537.5	7621613	716	23.05	0.57	21.34	19.47
2144	341512.5	7621788	716	13.25	0.15	14.04	12.25
2109	341512.5	7621763	716	12.64	0.08	12.97	14.04
2074	341512.5	7621738	716	13.79	0.06	13.68	15.3
2039	341512.5	7621713	716	14.83	0.21	15.21	16.75

2004	341512.5	7621688	716	15.91	0.22	16.49	18.28
1969	341512.5	7621663	716	19.07	0.27	19.07	19.88
1934	341512.5	7621638	716	21.15	0.47	21.54	20.09
1899	341512.5	7621613	716	21.2	0.38	20.95	18.82
1514	341487.5	7621788	716	7.97	0.21	11.66	12.2
1479	341487.5	7621763	716	9.59	0.21	11.66	12.2
1444	341487.5	7621738	716	12.05	0.1	12.06	12.53
1409	341487.5	7621713	716	12.59	0.12	12.18	14.38
1374	341487.5	7621688	716	12.98	0.09	13.44	15.92
1339	341487.5	7621663	716	14.28	0.16	14.1	16.71
1304	341487.5	7621638	716	15.41	0.26	16.02	16.78
849	341462.5	7621763	716	8.27	0.21	11.66	12.2
814	341462.5	7621738	716	12.55	0.19	12.87	11.73
779	341462.5	7621713	716	12.83	0.2	12.59	12.53
744	341462.5	7621688	716	11.33	0.19	12.23	13.02
709	341462.5	7621663	716	15.23	0.39	15.76	13.93
6450	341687.5	7621713	728	2.34	0.05	1.49	1.85
6415	341687.5	7621688	728	2.19	0	1.64	2.19
6380	341687.5	7621663	728	2.84	0	1.98	3.54
5925	341662.5	7621788	728	8.5	0.14	6.25	8.3
5890	341662.5	7621763	728	7.29	0.15	5.29	6.21
5785	341662.5	7621688	728	3.64	0.07	2.25	2.23
5750	341662.5	7621663	728	3.95	0.17	2.21	2.95
5715	341662.5	7621638	728	2.98	0	2.15	3.38
5295	341637.5	7621788	728	9.68	0.14	7.82	9.9
5260	341637.5	7621763	728	9.42	0.14	7.62	8.55
5225	341637.5	7621738	728	7.94	0.16	5.87	7.05
5190	341637.5	7621713	728	8.09	0.04	5.47	5.23
5155	341637.5	7621688	728	6.12	0.08	4.48	3.81
5120	341637.5	7621663	728	3.19	0.15	2.64	3.11
5085	341637.5	7621638	728	1.31	0.09	1.63	2.74
5050	341637.5	7621613	728	1.91	0.14	1.7	2.99
4665	341612.5	7621788	728	10.96	0.15	9.35	10.64
4630	341612.5	7621763	728	11.73	0.17	10.1	11.04
4595	341612.5	7621738	728	11.66	0.15	10.6	10.79
4560	341612.5	7621713	728	11.43	0.05	10.78	9.99
4525	341612.5	7621688	728	8.16	0.06	7.5	6.54
4490	341612.5	7621663	728	4.33	0.05	3.82	4.01
4455	341612.5	7621638	728	1.94	0.03	1.84	2.53
4420	341612.5	7621613	728	2.56	0.08	1.83	2.8
4035	341587.5	7621788	728	10.86	0.25	9.73	11.4
4000	341587.5	7621763	728	12.03	0.27	11.18	11.84
3965	341587.5	7621738	728	14.45	0.23	14.89	13.36
3930	341587.5	7621713	728	15.38	0.2	16.15	14.11
3895	341587.5	7621688	728	10.96	0.03	11.39	10.86
3860	341587.5	7621663	728	7.42	0.03	7.18	7.48
3825	341587.5	7621638	728	7.97	0.14	5.64	6.26
3790	341587.5	7621613	728	9.59	0.22	5.19	6.26
3405	341562.5	7621788	728	13.06	0.31	12.92	11.77
3370	341562.5	7621763	728	13.07	0.29	12.92	12.44
3335	341562.5	7621738	728	15.27	0.35	15.07	14.94
3300	341562.5	7621713	728	17.17	0.48	16.96	17.7
3265	341562.5	7621688	728	15.43	0.31	15.29	15.56
3230	341562.5	7621663	728	15.63	0.37	15.25	15.03
3195	341562.5	7621638	728	19.23	0.61	16.85	16.46
3160	341562.5	7621613	728	18.76	0.58	14.42	14.31
2775	341537.5	7621788	728	12.36	0.3	12.63	11.75
2740	341537.5	7621763	728	13.04	0.24	12.47	12.67
2705	341537.5	7621738	728	15.62	0.29	14.85	15.07
2670	341537.5	7621713	728	19.39	0.68	19.07	19.58
2635	341537.5	7621688	728	18.35	0.45	17.99	18.44
2600	341537.5	7621663	728	21.62	0.57	22.09	19.57

2565	341537.5	7621638	728	25.39	0.81	25.28	23.16
2530	341537.5	7621613	728	23.41	0.57	22.67	20
2145	341512.5	7621788	728	12.09	0.28	12.73	11.22
2110	341512.5	7621763	728	11.83	0.14	11.87	11.47
2075	341512.5	7621738	728	12.27	0.07	12.61	12.27
2040	341512.5	7621713	728	14.31	0.22	14.62	14.46
2005	341512.5	7621688	728	14.64	0.21	15.27	14.35
1970	341512.5	7621663	728	17.38	0.27	17.64	15.87
1935	341512.5	7621638	728	21.22	0.47	21.86	19.81
1900	341512.5	7621613	728	21.35	0.38	21.81	19.65
1515	341487.5	7621788	728	7.73	0.23	10.86	10.81
1480	341487.5	7621763	728	9.12	0.23	10.86	10.81
1445	341487.5	7621738	728	11.57	0.14	11.56	11.7
1410	341487.5	7621713	728	12.27	0.17	12	12.14
1375	341487.5	7621688	728	11.09	0.13	11.47	11.49
1340	341487.5	7621663	728	11.87	0.16	12.24	12.73
1305	341487.5	7621638	728	15.32	0.26	16.4	15.8
850	341462.5	7621763	728	8.06	0.23	10.86	10.81
815	341462.5	7621738	728	12.11	0.29	11.98	11.22
780	341462.5	7621713	728	12.11	0.29	11.69	11.57
745	341462.5	7621688	728	10.89	0.27	11.44	11.97
710	341462.5	7621663	728	14.16	0.39	14.62	12.72
6451	341687.5	7621713	740	2.56	0	1.83	2.99
6416	341687.5	7621688	740	2.86	0	2.12	3.22
6381	341687.5	7621663	740	3.16	0	2.48	4.36
5926	341662.5	7621788	740	7.15	0	6.14	8.4
5891	341662.5	7621763	740	5.99	0	5.44	7.05
5786	341662.5	7621688	740	3.6	0	2.41	3.03
5751	341662.5	7621663	740	4.04	0.18	2.56	3.33
5716	341662.5	7621638	740	2.82	0	2.47	3.37
5296	341637.5	7621788	740	8.01	0	7.33	8.69
5261	341637.5	7621763	740	7.86	0	7.05	8.19
5226	341637.5	7621738	740	7.11	0	6.05	6.68
5191	341637.5	7621713	740	6.88	0	5.15	5.07
5156	341637.5	7621688	740	5.66	0	4.3	4.16
5121	341637.5	7621663	740	3.03	0.15	2.78	3.02
5086	341637.5	7621638	740	1.38	0.1	1.74	2.26
5051	341637.5	7621613	740	1.96	0.15	1.89	2.97
4666	341612.5	7621788	740	8.96	0	8.13	9.65
4631	341612.5	7621763	740	9.55	0	8.9	9.47
4596	341612.5	7621738	740	9.63	0	9.31	9.3
4561	341612.5	7621713	740	9.78	0	9.55	8.61
4526	341612.5	7621688	740	7.27	0.03	6.32	6.99
4491	341612.5	7621663	740	3.89	0.06	3.74	4.07
4456	341612.5	7621638	740	1.91	0.03	1.77	1.98
4421	341612.5	7621613	740	2.42	0.09	1.9	2.58
4036	341587.5	7621788	740	9.15	0	8.85	9.96
4001	341587.5	7621763	740	9.8	0	9.27	10.54
3966	341587.5	7621738	740	12.2	0.05	12.94	11.53
3931	341587.5	7621713	740	12.68	0.06	13.24	12.24
3896	341587.5	7621688	740	10.76	0.03	11.31	10.77
3861	341587.5	7621663	740	7.84	0.04	7.4	7.6
3826	341587.5	7621638	740	7.85	0.14	5.1	5.64
3791	341587.5	7621613	740	8.91	0.22	5.01	5.77
3406	341562.5	7621788	740	10.61	0.08	11.07	10.43
3371	341562.5	7621763	740	10.81	0.04	11.04	10.96
3336	341562.5	7621738	740	14.03	0.26	13.9	13.2
3301	341562.5	7621713	740	15.91	0.37	15.75	15.09
3266	341562.5	7621688	740	15.42	0.28	15.37	14.75
3231	341562.5	7621663	740	15.84	0.36	15.15	14.97
3196	341562.5	7621638	740	18.2	0.6	15.47	15.05
3161	341562.5	7621613	740	17.15	0.48	13.38	13.17

2776	341537.5	7621788	740	9.79	0.09	11.17	11.46
2741	341537.5	7621763	740	10.85	0.06	11.1	11.79
2706	341537.5	7621738	740	14.6	0.21	14.15	13.59
2671	341537.5	7621713	740	16.04	0.26	15.98	15.26
2636	341537.5	7621688	740	17.59	0.42	17.14	16.27
2601	341537.5	7621663	740	19.55	0.5	19.93	18.67
2566	341537.5	7621638	740	23.53	0.78	23.66	22.22
2531	341537.5	7621613	740	21.23	0.57	19.98	19.47
2146	341512.5	7621788	740	9.65	0.09	11.19	11.67
2111	341512.5	7621763	740	9.83	0.04	10.68	11.23
2076	341512.5	7621738	740	11.02	0.05	11.62	11.2
2041	341512.5	7621713	740	13.22	0.2	13.68	13.24
2006	341512.5	7621688	740	13.41	0.2	13.97	13.99
1971	341512.5	7621663	740	15.62	0.27	16	16.12
1936	341512.5	7621638	740	18.76	0.41	19.47	19.36
1901	341512.5	7621613	740	18.76	0.38	19.07	19.48
1481	341487.5	7621763	740	10.24	0.14	9.84	10.2
1446	341487.5	7621738	740	9.42	0.04	10.43	11.23
1411	341487.5	7621713	740	10	0.05	10.64	11.78
1376	341487.5	7621688	740	9.08	0.09	9.99	11.84
1341	341487.5	7621663	740	10.18	0.11	10.56	13.41
1306	341487.5	7621638	740	12.97	0.26	13.97	15.64
851	341462.5	7621763	740	9.92	0.14	9.84	10.2
816	341462.5	7621738	740	9.22	0.09	10.25	10.9
781	341462.5	7621713	740	9.09	0.09	10	10.73
746	341462.5	7621688	740	8.75	0.2	9.81	11.11
6522	341687.5	7621763	752	3.1	0.08	11.74	11.15
6452	341687.5	7621713	752	7.97	0	9	5.84
6417	341687.5	7621688	752	3.46	0	2.37	5.77
6382	341687.5	7621663	752	5.66	0	5.34	5.52
5927	341662.5	7621788	752	4.23	0.08	11.74	11.15
5892	341662.5	7621763	752	4.49	0.08	11.74	11.15
5752	341662.5	7621663	752	8.33	0.23	6.04	4.65
5717	341662.5	7621638	752	4.25	0	3.59	4.05
5297	341637.5	7621788	752	4.48	0.08	11.74	11.15
5262	341637.5	7621763	752	5.9	0.08	11.74	11.15
5227	341637.5	7621738	752	9.88	0.12	11.72	7.92
5192	341637.5	7621713	752	9.43	0	9.98	7.23
5157	341637.5	7621688	752	7.6	0.11	7.18	6.03
5122	341637.5	7621663	752	5.22	0.18	4.27	4.19
5087	341637.5	7621638	752	2.87	0.11	2.41	2.73
4667	341612.5	7621788	752	5.41	0.08	11.74	11.15
4632	341612.5	7621763	752	7.23	0.08	11.74	8.92
4597	341612.5	7621738	752	10.55	0.06	11.5	9.42
4562	341612.5	7621713	752	10.36	0.03	10.58	9.74
4527	341612.5	7621688	752	7.54	0.07	7.7	7.5
4492	341612.5	7621663	752	4.19	0.07	3.83	4.57
4457	341612.5	7621638	752	2.03	0.03	1.82	2.31
4422	341612.5	7621613	752	1.97	0.17	11.74	11.15
4037	341587.5	7621788	752	10.84	0.13	11.48	9.23
4002	341587.5	7621763	752	10.53	0.04	10.35	10.51
3967	341587.5	7621738	752	12.1	0.03	12.8	12.11
3932	341587.5	7621713	752	12.23	0.08	12.91	12.31
3897	341587.5	7621688	752	9.25	0.01	10.11	9.6
3862	341587.5	7621663	752	6.6	0.04	6.21	7.28
3827	341587.5	7621638	752	6.98	0.15	4.34	5.63
3792	341587.5	7621613	752	8.8	0.22	4.62	6.11
3407	341562.5	7621788	752	11.44	0.07	11.86	10.21
3372	341562.5	7621763	752	11.94	0.03	12.06	11.64
3337	341562.5	7621738	752	13.63	0.11	13.71	13.87
3302	341562.5	7621713	752	15.03	0.23	15.32	15.29
3267	341562.5	7621688	752	13.91	0.17	14.22	14.55

3232	341562.5	7621663	752	14.47	0.35	13.7	14.18
3197	341562.5	7621638	752	17.21	0.61	14.48	14.67
3162	341562.5	7621613	752	16.94	0.58	12.63	13.26
2777	341537.5	7621788	752	11.5	0.09	12.76	11.39
2742	341537.5	7621763	752	12.48	0.06	12.87	12.7
2707	341537.5	7621738	752	14.34	0.12	13.82	14.77
2672	341537.5	7621713	752	17.34	0.42	17.14	17.65
2637	341537.5	7621688	752	16.53	0.28	16.1	17.68
2602	341537.5	7621663	752	19.18	0.52	19.6	18.35
2567	341537.5	7621638	752	22.86	0.81	23.15	20.87
2532	341537.5	7621613	752	21.29	0.57	20.82	19.41
2147	341512.5	7621788	752	11.81	0.09	13.39	11.92
2112	341512.5	7621763	752	12.34	0.03	13.25	12.36
2077	341512.5	7621738	752	12.51	0.03	12.82	13.24
2042	341512.5	7621713	752	13.76	0.12	14.25	14.38
2007	341512.5	7621688	752	14.13	0.13	14.8	14.84
1972	341512.5	7621663	752	16.43	0.24	17.05	16.39
1937	341512.5	7621638	752	19.45	0.47	20.13	19.37
1902	341512.5	7621613	752	19.47	0.38	20.5	19.37
1482	341487.5	7621763	752	8.81	0.17	11.74	11.15
1447	341487.5	7621738	752	12.4	0.03	13.26	11.84
1412	341487.5	7621713	752	12.55	0.05	13.19	11.8
1377	341487.5	7621688	752	11.41	0.09	12.11	11.69
1342	341487.5	7621663	752	11.74	0.16	12.13	13.41
1307	341487.5	7621638	752	13.81	0.26	14.61	11.15
817	341462.5	7621738	752	11.97	0.09	13.05	10.68
782	341462.5	7621713	752	11.73	0.09	12.63	10.68
747	341462.5	7621688	752	10.84	0.19	11.87	10.99
712	341462.5	7621663	752	13.16	0.39	13.87	11.74
6523	341687.5	7621763	764	9.05	0	10.22	9.26
6453	341687.5	7621713	764	9.12	0	9.62	9.08
6418	341687.5	7621688	764	8.87	0	8.32	8.37
6383	341687.5	7621663	764	7.68	0	6.36	7.48
5928	341662.5	7621788	764	5.96	0	7.38	7.8
5893	341662.5	7621763	764	8.14	0	9.63	8.81
5753	341662.5	7621663	764	9.95	0.23	7.35	5.93
5718	341662.5	7621638	764	5.71	0	4.41	11.37
5298	341637.5	7621788	764	5.07	0	6.24	11.37
5263	341637.5	7621763	764	6.49	0	8.25	8.41
5228	341637.5	7621738	764	10.87	0	12	10.03
5193	341637.5	7621713	764	12.03	0	12.23	10.1
5158	341637.5	7621688	764	10.1	0	9.51	8.15
5123	341637.5	7621663	764	6.66	0.18	5.07	5.06
5088	341637.5	7621638	764	2.95	0.11	2.29	3.34
4668	341612.5	7621788	764	5.11	0	5.58	6.89
4633	341612.5	7621763	764	7.3	0	8.08	8.67
4598	341612.5	7621738	764	11.01	0	11.79	10.29
4563	341612.5	7621713	764	12.31	0	12.7	10.54
4528	341612.5	7621688	764	9.67	0.03	9.24	8.38
4493	341612.5	7621663	764	4.52	0.07	4.11	5.03
4458	341612.5	7621638	764	2.07	0.03	1.8	2.44
4423	341612.5	7621613	764	1.89	0.12	10.78	11.37
4038	341587.5	7621788	764	6.93	0	6.82	7.98
4003	341587.5	7621763	764	8.92	0	8.93	9.67
3968	341587.5	7621738	764	12.38	0.03	13.04	12.1
3933	341587.5	7621713	764	14.29	0.06	15.08	12.39
3898	341587.5	7621688	764	9.57	0	10.15	10.08
3863	341587.5	7621663	764	6.77	0.04	6.47	6.52
3828	341587.5	7621638	764	6.97	0.15	4.2	5.84
3793	341587.5	7621613	764	9.08	0.22	4.98	6.09
3408	341562.5	7621788	764	8.48	0.06	8.76	10.02
3373	341562.5	7621763	764	10.97	0.03	11.04	11.47

3338	341562.5	7621738	764	12.48	0.11	12.5	14.43
3303	341562.5	7621713	764	13.41	0.2	13.34	15.54
3268	341562.5	7621688	764	12.68	0.16	13.17	14.04
3233	341562.5	7621663	764	14.2	0.35	13.76	13.47
3198	341562.5	7621638	764	17.89	0.6	15.23	15.06
3163	341562.5	7621613	764	17.48	0.48	13.31	13.86
2778	341537.5	7621788	764	9.42	0.08	10.43	11.61
2743	341537.5	7621763	764	11.54	0.05	11.92	12.64
2708	341537.5	7621738	764	15.01	0.11	14.74	15.58
2673	341537.5	7621713	764	17.45	0.26	17.35	17.69
2638	341537.5	7621688	764	14.7	0.26	14.35	17.18
2603	341537.5	7621663	764	19.65	0.5	20.22	19.14
2568	341537.5	7621638	764	23.56	0.78	23.43	21.88
2533	341537.5	7621613	764	22.97	0.57	22.1	19.84
2148	341512.5	7621788	764	10.51	0.09	12.51	12.78
2113	341512.5	7621763	764	11.27	0.04	12.41	13.77
2078	341512.5	7621738	764	14.18	0.03	14.16	15.1
2043	341512.5	7621713	764	12.56	0.1	12.98	14.35
2008	341512.5	7621688	764	12.25	0.12	12.74	15.2
1973	341512.5	7621663	764	15.83	0.25	16.33	16.78
1938	341512.5	7621638	764	19.5	0.41	19.67	19.19
1903	341512.5	7621613	764	20.77	0.38	21.08	19.33
1483	341487.5	7621763	764	9.16	0	9.86	12.1
1448	341487.5	7621738	764	8.89	0.02	8.81	11.56
1413	341487.5	7621713	764	8.21	0.02	8.19	10.7
1378	341487.5	7621688	764	8.36	0.04	8.33	10.93
1343	341487.5	7621663	764	10.27	0.09	10.12	12.35
1308	341487.5	7621638	764	12.67	0.22	12.77	14.62
818	341462.5	7621738	764	6.54	0	6.63	10.02
783	341462.5	7621713	764	5.42	0	5.75	8.9
748	341462.5	7621688	764	5.52	0.08	6.27	9.06
713	341462.5	7621663	764	13.35	0.25	13.52	10.22
6524	341687.5	7621763	776	12.4	0.15	11.48	10.05
6454	341687.5	7621713	776	11.35	0.1	10.04	10.97
6419	341687.5	7621688	776	10.21	0.09	9.11	10.25
6384	341687.5	7621663	776	12.05	0.14	9.09	9.36
5929	341662.5	7621788	776	6.28	0	6.83	10.97
5894	341662.5	7621763	776	11.33	0.15	10.34	8.89
5754	341662.5	7621663	776	14.42	0.33	10.48	8.13
5719	341662.5	7621638	776	8.99	0.13	6.28	6.95
5299	341637.5	7621788	776	4.56	0	5.26	10.97
5264	341637.5	7621763	776	7	0	7.7	7.93
5229	341637.5	7621738	776	15.36	0.13	14.51	11.02
5194	341637.5	7621713	776	18.04	0.18	16.17	13.25
5159	341637.5	7621688	776	16.69	0.15	13.84	11.62
5124	341637.5	7621663	776	10.8	0.28	7.54	7.29
5089	341637.5	7621638	776	4.56	0.11	3.44	10.97
4669	341612.5	7621788	776	3.64	0	3.79	10.97
4634	341612.5	7621763	776	7.16	0	7.27	7.63
4599	341612.5	7621738	776	16.11	0.15	14.8	12.23
4564	341612.5	7621713	776	20.1	0.22	18.69	15.24
4529	341612.5	7621688	776	16.53	0.21	14.07	12.48
4494	341612.5	7621663	776	5.75	0.07	5.23	7.28
4459	341612.5	7621638	776	2.64	0.03	2.23	3.13
4424	341612.5	7621613	776	3.01	0.14	11.21	3.28
4039	341587.5	7621788	776	5.47	0.04	5.09	6.68
4004	341587.5	7621763	776	9.24	0.02	8.62	8.45
3969	341587.5	7621738	776	14.51	0.09	14.2	12.13
3934	341587.5	7621713	776	17.76	0.16	17.34	14.66
3899	341587.5	7621688	776	13.72	0.08	13.16	13.09
3864	341587.5	7621663	776	9.92	0.06	8.97	9.71
3829	341587.5	7621638	776	7.41	0.16	5.37	7.22

3794	341587.5	7621613	776	11.1	0.22	6.95	7.09
3409	341562.5	7621788	776	9.17	0	8.75	9.78
3374	341562.5	7621763	776	10.51	0	10.39	10.44
3339	341562.5	7621738	776	11.71	0.03	11.59	11.33
3304	341562.5	7621713	776	10.19	0.01	10.5	11.52
3269	341562.5	7621688	776	11.7	0.05	12.45	12.54
3234	341562.5	7621663	776	16.21	0.33	15.45	15.28
3199	341562.5	7621638	776	22.13	0.6	18.78	16.92
3164	341562.5	7621613	776	21.26	0.48	16.98	15.34
2779	341537.5	7621788	776	11.78	0	12.03	11.94
2744	341537.5	7621763	776	13.79	0	14.04	11.88
2709	341537.5	7621738	776	13.71	0.05	13.56	11.03
2674	341537.5	7621713	776	10.03	0.01	10.62	8.78
2639	341537.5	7621688	776	10.76	0.08	10.93	11.81
2604	341537.5	7621663	776	20.64	0.46	20.15	17.43
2569	341537.5	7621638	776	27.84	0.78	26.54	23.4
2534	341537.5	7621613	776	25.75	0.55	23.41	21.38
2149	341512.5	7621788	776	12.47	0	13.44	13.52
2114	341512.5	7621763	776	13.9	0	14.27	12.33
2079	341512.5	7621738	776	12.78	0.07	13.06	10.08
2044	341512.5	7621713	776	10.09	0.05	10.27	9.12
2009	341512.5	7621688	776	9.07	0.04	9.11	10.15
1974	341512.5	7621663	776	15.5	0.23	14.82	13.68
1939	341512.5	7621638	776	21.78	0.41	20.4	18.31
1904	341512.5	7621613	776	22.1	0.36	20.38	20.03
1484	341487.5	7621763	776	11.82	0	11.6	11.55
1449	341487.5	7621738	776	10.64	0	9.61	9.15
1414	341487.5	7621713	776	7.38	0	6.83	6.94
1379	341487.5	7621688	776	5.59	0.01	5.72	6.9
1344	341487.5	7621663	776	9.03	0.09	8.31	9.42
1309	341487.5	7621638	776	11.68	0.22	11.42	13.66
854	341462.5	7621763	776	8.32	0.14	11.21	10.97
819	341462.5	7621738	776	7.75	0	6.99	8.24
784	341462.5	7621713	776	4.45	0	4.34	5.8
749	341462.5	7621688	776	4.42	0.07	4.93	5.59
714	341462.5	7621663	776	8.47	0.27	7.75	7.88
7085	341712.5	7621713	788	8.23	0.2	8.82	11.25
7050	341712.5	7621688	788	9.34	0.2	8.65	11.68
6525	341687.5	7621763	788	7.9	0.17	9.27	9
6455	341687.5	7621713	788	9.22	0.13	10.66	11.64
6420	341687.5	7621688	788	10.53	0.15	10.37	11.68
6385	341687.5	7621663	788	11.38	0.19	10.27	10.43
5930	341662.5	7621788	788	5.29	0.1	6.44	12.03
5895	341662.5	7621763	788	6.4	0.12	7.28	7.76
5860	341662.5	7621738	788	9.54	0.1	10.04	10.19
5825	341662.5	7621713	788	13.58	0.15	14.4	12.58
5755	341662.5	7621663	788	18.87	0.4	15.91	10.06
5720	341662.5	7621638	788	12.29	0.2	10.28	12.03
5300	341637.5	7621788	788	3.51	0.06	4.52	4.55
5265	341637.5	7621763	788	6.51	0.06	7.16	7.34
5230	341637.5	7621738	788	14.21	0.19	13.82	12.04
5195	341637.5	7621713	788	20.07	0.33	19.41	16.81
5160	341637.5	7621688	788	18.57	0.27	16.97	15.13
5125	341637.5	7621663	788	13.37	0.3	10.78	9.89
5090	341637.5	7621638	788	9.32	0.2	6.35	12.03
4670	341612.5	7621788	788	2.84	0.02	3.25	3.75
4635	341612.5	7621763	788	8	0.06	7.73	8.35
4600	341612.5	7621738	788	18.07	0.29	16.83	15.13
4565	341612.5	7621713	788	27.77	0.56	25.1	24.14
4530	341612.5	7621688	788	21.19	0.41	19.45	18.3
4495	341612.5	7621663	788	12	0.15	10.02	10.16
4460	341612.5	7621638	788	6.07	0.07	4.88	5.45

4425	341612.5	7621613	788	5	0.2	11.89	5.27
4040	341587.5	7621788	788	5.47	0.04	5.32	6.28
4005	341587.5	7621763	788	9.31	0.03	9.06	10.03
3970	341587.5	7621738	788	15.73	0.19	15.48	15.32
3935	341587.5	7621713	788	20.74	0.35	19.86	19.49
3900	341587.5	7621688	788	16	0.21	15.85	16.12
3865	341587.5	7621663	788	12.66	0.08	12.44	11.67
3830	341587.5	7621638	788	11.22	0.16	9.24	10.51
3795	341587.5	7621613	788	14.36	0.28	10.99	9.85
3410	341562.5	7621788	788	8.25	0.12	8.25	9.94
3375	341562.5	7621763	788	9.58	0.07	10.29	11.65
3340	341562.5	7621738	788	12.26	0.06	12.59	12.93
3305	341562.5	7621713	788	10.16	0.07	10.32	12.14
3270	341562.5	7621688	788	11.36	0.07	11.93	12.4
3235	341562.5	7621663	788	16.39	0.31	15.72	16.38
3200	341562.5	7621638	788	25.59	0.61	22.46	21.15
3165	341562.5	7621613	788	24.55	0.48	21.08	18.08
2780	341537.5	7621788	788	11.2	0.09	11.7	13.11
2745	341537.5	7621763	788	13.66	0.13	13.97	13.64
2710	341537.5	7621738	788	12.29	0.18	12.63	13.19
2675	341537.5	7621713	788	6.88	0.1	7.9	9.61
2640	341537.5	7621688	788	8.3	0.11	8.61	10.42
2605	341537.5	7621663	788	20.95	0.46	19.41	17.9
2570	341537.5	7621638	788	31.87	0.78	29.32	27.12
2535	341537.5	7621613	788	28.78	0.55	26.58	23.93
2150	341512.5	7621788	788	11.58	0.1	12.63	14.24
2115	341512.5	7621763	788	14.23	0.2	14.77	14.43
2080	341512.5	7621738	788	14.8	0.28	14.5	14.58
2045	341512.5	7621713	788	8.18	0.17	8.57	9.92
2010	341512.5	7621688	788	5.65	0.1	6.36	7.55
1975	341512.5	7621663	788	14.16	0.24	12.89	11.59
1940	341512.5	7621638	788	22.58	0.42	19.92	18.73
1905	341512.5	7621613	788	24.13	0.36	21.8	20.93
1485	341487.5	7621763	788	11.1	0.16	10.88	12.71
1450	341487.5	7621738	788	10.42	0.18	9.48	10.59
1415	341487.5	7621713	788	5.88	0.09	5.44	6.11
1380	341487.5	7621688	788	3.13	0.04	4	4.65
1345	341487.5	7621663	788	6.9	0.09	6.49	7.35
1310	341487.5	7621638	788	12.9	0.2	11.45	12.8
855	341462.5	7621763	788	7.49	0.2	11.89	12.03
820	341462.5	7621738	788	6.46	0.08	6.21	7.52
785	341462.5	7621713	788	2.83	0.03	3.18	4.06
750	341462.5	7621688	788	2.82	0.08	3.76	4.14
715	341462.5	7621663	788	7.08	0.28	6.74	6.58
7086	341712.5	7621713	800	10.97	0.2	10.76	10.67
7051	341712.5	7621688	800	10.47	0.18	9.78	11.08
6526	341687.5	7621763	800	7.48	0.2	7.9	8
6456	341687.5	7621713	800	10.42	0.13	11.01	10.15
6421	341687.5	7621688	800	11.69	0.17	11.6	11.05
6386	341687.5	7621663	800	12.2	0.19	11.91	11.14
5931	341662.5	7621788	800	4.47	0.18	5.23	5.45
5896	341662.5	7621763	800	5.05	0.11	5.61	6.09
5861	341662.5	7621738	800	9.06	0.08	8.94	8.41
5826	341662.5	7621713	800	14.02	0.14	13.67	11.72
5756	341662.5	7621663	800	17.03	0.35	14.57	10.95
5721	341662.5	7621638	800	12.39	0.24	12.12	12.66
5301	341637.5	7621788	800	2.63	0.09	3.69	4.51
5266	341637.5	7621763	800	5.43	0.07	5.84	6.62
5231	341637.5	7621738	800	13.04	0.17	11.91	10.77
5196	341637.5	7621713	800	19.66	0.33	18.38	15.58
5161	341637.5	7621688	800	19.32	0.28	18.05	15.33
5126	341637.5	7621663	800	14.54	0.3	13.04	11.27

5091	341637.5	7621638	800	9.18	0.19	7.9	8.99
4671	341612.5	7621788	800	2.79	0.03	3.36	4.24
4636	341612.5	7621763	800	8.01	0.08	7.64	8.01
4601	341612.5	7621738	800	17.52	0.29	15.93	14.32
4566	341612.5	7621713	800	25.34	0.58	22.99	20.94
4531	341612.5	7621688	800	21.98	0.42	20.64	18.18
4496	341612.5	7621663	800	14.07	0.23	13.75	12.7
4461	341612.5	7621638	800	9.18	0.06	8.7	10.71
4426	341612.5	7621613	800	7.37	0.24	12.96	12.66
4041	341587.5	7621788	800	6.02	0.07	6.01	6.83
4006	341587.5	7621763	800	10.11	0.05	10.01	10.79
3971	341587.5	7621738	800	16.4	0.2	15.57	15.19
3936	341587.5	7621713	800	20.44	0.36	19.16	18.94
3901	341587.5	7621688	800	16.11	0.22	15.87	16.2
3866	341587.5	7621663	800	13.04	0.08	13.55	13.9
3831	341587.5	7621638	800	13.24	0.15	12.05	14.38
3796	341587.5	7621613	800	17.46	0.34	14.95	13.93
3411	341562.5	7621788	800	10.59	0.17	10.19	10.83
3376	341562.5	7621763	800	12.8	0.1	12.86	12.77
3341	341562.5	7621738	800	14.04	0.09	14.52	14.03
3306	341562.5	7621713	800	13.3	0.1	13.16	13.87
3271	341562.5	7621688	800	12.5	0.05	12.67	13.51
3236	341562.5	7621663	800	17.97	0.32	16.55	16.79
3201	341562.5	7621638	800	26.33	0.62	23.89	22.44
3166	341562.5	7621613	800	27.5	0.48	24.02	21
2781	341537.5	7621788	800	14.18	0.14	14.39	13.62
2746	341537.5	7621763	800	17.57	0.25	17.27	15.63
2711	341537.5	7621738	800	16.76	0.32	17.09	15.32
2676	341537.5	7621713	800	10.03	0.17	10.51	11.76
2641	341537.5	7621688	800	10.57	0.12	10.15	12.37
2606	341537.5	7621663	800	22.2	0.5	19.48	18.78
2571	341537.5	7621638	800	32.9	0.81	29.99	26.76
2536	341537.5	7621613	800	32.55	0.64	29.83	24.73
2151	341512.5	7621788	800	15.13	0.18	15.01	14.61
2116	341512.5	7621763	800	18.73	0.39	18.56	16.74
2081	341512.5	7621738	800	18.93	0.62	18.57	16.73
2046	341512.5	7621713	800	11.31	0.32	10.91	11.13
2011	341512.5	7621688	800	7.59	0.19	7.32	9.79
1976	341512.5	7621663	800	15.53	0.31	13.11	13.63
1941	341512.5	7621638	800	24.43	0.49	19.93	19.51
1906	341512.5	7621613	800	27.39	0.48	23.68	21.39
1486	341487.5	7621763	800	14.81	0.3	14.68	14.01
1451	341487.5	7621738	800	13.82	0.36	12.37	11.54
1416	341487.5	7621713	800	6.63	0.19	5.69	6.97
1381	341487.5	7621688	800	3.33	0.09	3.93	5.85
1346	341487.5	7621663	800	7.98	0.18	6.9	8.91
1311	341487.5	7621638	800	13.63	0.18	11.63	13.57
856	341462.5	7621763	800	9.61	0.24	12.96	12.66
821	341462.5	7621738	800	8.22	0.14	7.49	7.52
786	341462.5	7621713	800	3.12	0.05	3.38	4.45
751	341462.5	7621688	800	2.5	0.14	3.51	4.1
716	341462.5	7621663	800	7.16	0.4	6.2	6.54
7087	341712.5	7621713	812	8.69	0.12	9.07	10.11
7052	341712.5	7621688	812	10.42	0.13	10.24	10.19
6527	341687.5	7621763	812	5.51	0	6.79	7.14
6492	341687.5	7621738	812	6.9	0.07	7.91	7.92
6457	341687.5	7621713	812	8.9	0.08	9.69	8.91
6422	341687.5	7621688	812	9.77	0.12	10.46	9.55
6387	341687.5	7621663	812	10.88	0.12	11.67	10.35
5932	341662.5	7621788	812	3.53	0	5.23	12.26
5897	341662.5	7621763	812	3.75	0	4.81	5.08
5862	341662.5	7621738	812	6.52	0.04	7.07	6.66

5827	341662.5	7621713	812	10.32	0.08	10.66	9.26
5757	341662.5	7621663	812	14.7	0.3	13.64	10.46
5722	341662.5	7621638	812	10.51	0.12	11.93	10.18
5302	341637.5	7621788	812	2.27	0.08	3.83	4.42
5267	341637.5	7621763	812	3.98	0.04	4.89	5.62
5232	341637.5	7621738	812	8.82	0.08	9.02	8.56
5197	341637.5	7621713	812	13.43	0.2	13.18	11.46
5162	341637.5	7621688	812	14.63	0.14	14.67	12.3
5127	341637.5	7621663	812	12.58	0.23	12.49	11.19
5092	341637.5	7621638	812	7.47	0.09	7.94	9.89
5057	341637.5	7621613	812	7.98	0.23	12.55	12.26
4707	341612.5	7621813	812	2.72	0	4.24	5.01
4672	341612.5	7621788	812	2.87	0.04	3.45	4.44
4637	341612.5	7621763	812	7.35	0.11	7.64	7.42
4602	341612.5	7621738	812	13.36	0.21	12.99	11.81
4567	341612.5	7621713	812	16.64	0.26	16.25	14.33
4532	341612.5	7621688	812	14.73	0.21	14.91	13.92
4497	341612.5	7621663	812	10.87	0.13	11.35	11.83
4462	341612.5	7621638	812	8.66	0.03	9	10.13
4427	341612.5	7621613	812	8.59	0.23	12.55	12.26
4042	341587.5	7621788	812	7.71	0.17	7.68	7.64
4007	341587.5	7621763	812	11.52	0.23	11.21	11.19
3972	341587.5	7621738	812	15.58	0.28	15.28	14.24
3937	341587.5	7621713	812	16.33	0.23	16.29	15.36
3902	341587.5	7621688	812	12.46	0.09	13.06	14.68
3867	341587.5	7621663	812	11.39	0.05	11.85	13.18
3832	341587.5	7621638	812	13.22	0.15	12.51	14.17
3797	341587.5	7621613	812	15.84	0.21	14.47	14.3
3412	341562.5	7621788	812	13.18	0.26	12.8	11.29
3377	341562.5	7621763	812	16.23	0.3	15.91	14.85
3342	341562.5	7621738	812	16.73	0.26	17.23	16.32
3307	341562.5	7621713	812	14.14	0.08	14.69	15.86
3272	341562.5	7621688	812	12.43	0.02	12.71	14.65
3237	341562.5	7621663	812	16.72	0.24	15.34	17.16
3202	341562.5	7621638	812	22.3	0.44	19.87	21.65
3167	341562.5	7621613	812	22.13	0.34	20.04	19.6
2782	341537.5	7621788	812	16.29	0.32	16.35	13.18
2747	341537.5	7621763	812	20.29	0.48	20.34	16.69
2712	341537.5	7621738	812	19.96	0.5	20.2	18.72
2677	341537.5	7621713	812	14.4	0.24	14.7	15.59
2642	341537.5	7621688	812	15.41	0.14	13.95	14.7
2607	341537.5	7621663	812	20.5	0.38	17.91	18.6
2572	341537.5	7621638	812	28.74	0.62	25.39	25.38
2537	341537.5	7621613	812	25.36	0.49	22.99	22.9
2152	341512.5	7621788	812	16.99	0.35	16.36	13.2
2117	341512.5	7621763	812	20.82	0.63	20.42	16.27
2082	341512.5	7621738	812	21.06	0.83	20.7	18.73
2047	341512.5	7621713	812	14.45	0.49	13.75	13.95
2012	341512.5	7621688	812	13.34	0.2	11.51	11.84
1977	341512.5	7621663	812	17.92	0.33	15.22	14.22
1942	341512.5	7621638	812	22.67	0.42	19.05	18.94
1907	341512.5	7621613	812	23.06	0.39	20.32	20.24
1522	341487.5	7621788	812	14.24	0.28	14.04	12.91
1487	341487.5	7621763	812	16.03	0.46	15.65	13.79
1452	341487.5	7621738	812	15.69	0.57	14.43	12.33
1417	341487.5	7621713	812	8.56	0.29	7.32	8.16
1382	341487.5	7621688	812	7.78	0.2	6.53	7.02
1347	341487.5	7621663	812	11.75	0.26	9.91	9.48
1312	341487.5	7621638	812	16.34	0.17	13.76	13.08
857	341462.5	7621763	812	10.16	0.23	12.55	12.26
822	341462.5	7621738	812	8.83	0.23	8.47	8.17
787	341462.5	7621713	812	3.32	0.08	3.83	4.57

752	341462.5	7621688	812	3.99	0.13	4.31	4.5
717	341462.5	7621663	812	9.12	0.32	7.76	7.05
682	341462.5	7621638	812	4.93	0.23	12.55	12.26
7123	341712.5	7621738	824	6.23	0	7.99	9.41
7088	341712.5	7621713	824	6.39	0	7.96	9.17
7053	341712.5	7621688	824	6.77	0	8.27	9.57
6563	341687.5	7621788	824	5.91	0.18	6.43	10.97
6528	341687.5	7621763	824	5.69	0.15	6.68	7.95
6493	341687.5	7621738	824	5.52	0.11	6.72	7.82
6458	341687.5	7621713	824	7.04	0.13	8.11	8.56
6423	341687.5	7621688	824	7.59	0	9.03	9.1
6388	341687.5	7621663	824	8.67	0	10.46	9.8
6353	341687.5	7621638	824	8.49	0	10.25	9.65
5933	341662.5	7621788	824	3.31	0.13	4.8	10.97
5898	341662.5	7621763	824	3.51	0.07	4.68	5.74
5863	341662.5	7621738	824	5.22	0.06	6.01	7.19
5828	341662.5	7621713	824	7.7	0.11	8.31	8.69
5758	341662.5	7621663	824	12.32	0.1	12.03	9.94
5723	341662.5	7621638	824	8.96	0	10.73	9.55
5338	341637.5	7621813	824	2.96	0.13	4.69	5.29
5303	341637.5	7621788	824	2.23	0.01	3.9	4.64
5268	341637.5	7621763	824	4.7	0.01	5.66	5.64
5233	341637.5	7621738	824	7.39	0.02	7.58	8.2
5198	341637.5	7621713	824	10.12	0.02	10.29	10.57
5163	341637.5	7621688	824	10.36	0.09	10.49	10.87
5128	341637.5	7621663	824	10.33	0.07	10.66	9.51
5093	341637.5	7621638	824	9.43	0	10.09	8.98
5058	341637.5	7621613	824	10.49	0.16	10.5	9.41
4708	341612.5	7621813	824	3.12	0.07	4.29	4.73
4673	341612.5	7621788	824	3.32	0.02	3.73	4.29
4638	341612.5	7621763	824	8.4	0.08	8.31	8.22
4603	341612.5	7621738	824	11.81	0.08	11.43	12.12
4568	341612.5	7621713	824	13.3	0.02	13.28	13.1
4533	341612.5	7621688	824	11.12	0.03	11.47	10.98
4498	341612.5	7621663	824	9.1	0.03	9.85	9.23
4463	341612.5	7621638	824	8.79	0	9.18	8.44
4428	341612.5	7621613	824	10.06	0.16	10.5	10.97
4078	341587.5	7621813	824	3.32	0.13	3.76	5.96
4043	341587.5	7621788	824	6.06	0.09	5.48	7.02
4008	341587.5	7621763	824	12.5	0.27	11.69	12.79
3973	341587.5	7621738	824	16.45	0.23	15.79	16.48
3938	341587.5	7621713	824	14.96	0.06	14.96	14.96
3903	341587.5	7621688	824	10.3	0.01	10.99	10.68
3868	341587.5	7621663	824	8.57	0.01	9.09	8.83
3833	341587.5	7621638	824	11.4	0.06	11.02	10.4
3798	341587.5	7621613	824	13.5	0.08	12.13	12.14
3413	341562.5	7621788	824	6.35	0.17	5.23	8.98
3378	341562.5	7621763	824	14.56	0.32	13.15	14.99
3343	341562.5	7621738	824	18.44	0.27	17.91	17.89
3308	341562.5	7621713	824	15.71	0.04	15.95	15.85
3273	341562.5	7621688	824	11.66	0	12.01	11.95
3238	341562.5	7621663	824	12.59	0.14	12.15	11.54
3203	341562.5	7621638	824	16.83	0.2	15.19	14.34
3168	341562.5	7621613	824	18.21	0.18	16.25	15.3
2783	341537.5	7621788	824	6.21	0.16	4.58	9.51
2748	341537.5	7621763	824	15.22	0.39	12.48	14.73
2713	341537.5	7621738	824	20.12	0.5	19.45	18.48
2678	341537.5	7621713	824	17.17	0.21	17.25	17
2643	341537.5	7621688	824	13.98	0.11	13.15	13.92
2608	341537.5	7621663	824	17.5	0.21	15.91	14.59
2573	341537.5	7621638	824	20.95	0.29	19.07	16.6
2538	341537.5	7621613	824	21.04	0.3	18.98	17.31

2153	341512.5	7621788	824	8.54	0.23	6.19	11.04
2118	341512.5	7621763	824	16.02	0.56	13.58	14.93
2083	341512.5	7621738	824	21.22	0.82	20.4	19.27
2048	341512.5	7621713	824	15.91	0.46	16.1	14.79
2013	341512.5	7621688	824	12.58	0.23	11.53	11.92
1978	341512.5	7621663	824	15.78	0.23	13.66	13.66
1943	341512.5	7621638	824	19.37	0.27	16.66	15.33
1908	341512.5	7621613	824	20.08	0.28	18.03	16.54
1523	341487.5	7621788	824	9.23	0.42	7.63	12.24
1488	341487.5	7621763	824	13.01	0.53	11.57	13.63
1453	341487.5	7621738	824	14.6	0.56	13.48	13.23
1418	341487.5	7621713	824	8.94	0.28	8.11	9.07
1383	341487.5	7621688	824	8.46	0.17	7.41	7.65
1348	341487.5	7621663	824	11.52	0.21	9.84	10.04
1313	341487.5	7621638	824	14.94	0.1	13.18	12.7
858	341462.5	7621763	824	9.26	0.34	8.59	11.57
823	341462.5	7621738	824	8.65	0.31	8.14	8.98
788	341462.5	7621713	824	3.87	0.12	4.38	5.59
753	341462.5	7621688	824	4.47	0.1	4.85	5.54
718	341462.5	7621663	824	9.04	0.26	8.09	7.72
683	341462.5	7621638	824	6.95	0.16	10.5	10.97
7124	341712.5	7621738	836	5.98	0	7.58	9.2
7089	341712.5	7621713	836	6.51	0	7.95	9.48
7054	341712.5	7621688	836	6.11	0	8.05	9.53
6564	341687.5	7621788	836	6.53	0	7.16	10.48
6529	341687.5	7621763	836	6.39	0	7.17	8.39
6494	341687.5	7621738	836	5.56	0	6.69	8.07
6459	341687.5	7621713	836	6.96	0	7.84	9.01
6424	341687.5	7621688	836	6	0	7.56	9.75
6389	341687.5	7621663	836	6.74	0	8.86	9.45
6354	341687.5	7621638	836	7.38	0	9.66	10.48
5934	341662.5	7621788	836	4.18	0	5.25	10.48
5899	341662.5	7621763	836	3.83	0	4.9	6.52
5864	341662.5	7621738	836	5.75	0	6.64	7.27
5829	341662.5	7621713	836	7.29	0	7.92	9.14
5794	341662.5	7621688	836	6.81	0	7.71	9.64
5759	341662.5	7621663	836	7.75	0	9.05	9.55
5724	341662.5	7621638	836	8.73	0	10.7	10.48
5339	341637.5	7621813	836	2.52	0	4.32	5.33
5304	341637.5	7621788	836	3.03	0.02	4.47	5.47
5269	341637.5	7621763	836	5.61	0.01	6.18	6.66
5234	341637.5	7621738	836	8.56	0.02	8.7	8.67
5199	341637.5	7621713	836	10.2	0.02	10.25	9.82
5164	341637.5	7621688	836	8.98	0	9.31	9.46
5129	341637.5	7621663	836	8.48	0	9.62	9.02
5094	341637.5	7621638	836	9.53	0	10.6	9.7
5059	341637.5	7621613	836	10.35	0	11.28	10.22
4709	341612.5	7621813	836	2.44	0	3.84	4.97
4674	341612.5	7621788	836	4.2	0.02	4.52	5.08
4639	341612.5	7621763	836	9.77	0.08	9.29	8.99
4604	341612.5	7621738	836	13.52	0.07	13.06	12.41
4569	341612.5	7621713	836	14.44	0.02	14.26	13.05
4534	341612.5	7621688	836	11.32	0	11.35	11.14
4499	341612.5	7621663	836	9.4	0	9.54	10.01
4464	341612.5	7621638	836	10.15	0	10.27	9.97
4429	341612.5	7621613	836	11.03	0	10.99	10.57
4079	341587.5	7621813	836	3.13	0.06	3.9	5.46
4044	341587.5	7621788	836	6.98	0.09	6.5	6.76
4009	341587.5	7621763	836	14.09	0.21	13.22	12.26
3974	341587.5	7621738	836	18.53	0.21	18.19	16.21
3939	341587.5	7621713	836	16.73	0.06	16.66	15.39
3904	341587.5	7621688	836	11.23	0.03	11.23	11.73

3869	341587.5	7621663	836	8.31	0	8.51	9.47
3834	341587.5	7621638	836	10.78	0	10.49	10.71
3799	341587.5	7621613	836	12.15	0	11.22	11.71
3414	341562.5	7621788	836	5.9	0.13	5.34	6.16
3379	341562.5	7621763	836	14.93	0.25	13.78	12.13
3344	341562.5	7621738	836	20.31	0.32	20.08	16.91
3309	341562.5	7621713	836	17.65	0.21	18.02	15.52
3274	341562.5	7621688	836	12.17	0.11	12.28	12.2
3239	341562.5	7621663	836	10.43	0.06	10.37	10.48
3204	341562.5	7621638	836	11.12	0	10.99	11.41
3169	341562.5	7621613	836	12.59	0	11.96	12.35
2784	341537.5	7621788	836	4.38	0.12	3.53	4.71
2749	341537.5	7621763	836	14.51	0.37	12.08	11.04
2714	341537.5	7621738	836	20.25	0.59	20.01	17.45
2679	341537.5	7621713	836	15.86	0.22	16.34	15.44
2644	341537.5	7621688	836	13.86	0.2	13.61	13.54
2609	341537.5	7621663	836	11.82	0.04	11.76	13.04
2574	341537.5	7621638	836	12.76	0.04	12.6	13.52
2539	341537.5	7621613	836	12.99	0.1	12.66	13.78
2154	341512.5	7621788	836	7.58	0.24	5.97	8.21
2119	341512.5	7621763	836	15.06	0.56	13.25	12.79
2084	341512.5	7621738	836	19.9	0.84	20.05	17.73
2049	341512.5	7621713	836	16.83	0.56	17.26	15.12
2014	341512.5	7621688	836	12.12	0.22	12.09	12.28
1979	341512.5	7621663	836	11.78	0.16	11.31	12.44
1944	341512.5	7621638	836	11.79	0.11	11.29	13.48
1909	341512.5	7621613	836	12.6	0.14	12.2	13.36
1489	341487.5	7621763	836	13.05	0.43	12.03	12.37
1454	341487.5	7621738	836	14.33	0.53	14.26	13.26
1419	341487.5	7621713	836	10.42	0.28	10.12	10.56
1384	341487.5	7621688	836	7.63	0.12	7.47	8.83
1349	341487.5	7621663	836	8.61	0.14	8.45	10.04
1314	341487.5	7621638	836	9.78	0	9.72	11.76
859	341462.5	7621763	836	8.89	0.32	8.82	10.67
824	341462.5	7621738	836	9.45	0.21	9.4	9.58
789	341462.5	7621713	836	5.31	0.07	5.9	7.36
754	341462.5	7621688	836	4.89	0.05	5.57	7.42
719	341462.5	7621663	836	6.93	0.15	6.74	8.79
684	341462.5	7621638	836	5.58	0.11	10.05	10.48
124	341437.5	7621688	836	6.3	0.14	7.35	7.71
89	341437.5	7621663	836	7.58	0.17	7.28	8.62
7160	341712.5	7621763	848	7.86	0	8.92	10.18
7125	341712.5	7621738	848	8.99	0	10.2	9.85
7090	341712.5	7621713	848	9.36	0	10.91	10.31
7055	341712.5	7621688	848	10.34	0	11.59	10.31
6565	341687.5	7621788	848	9.06	0	9.62	9.05
6530	341687.5	7621763	848	7.25	0	8.24	8.45
6495	341687.5	7621738	848	9.89	0	10.03	8.82
6460	341687.5	7621713	848	10.75	0	11.18	9.41
6425	341687.5	7621688	848	10.02	0	11.05	10.44
6390	341687.5	7621663	848	10.02	0	12.08	10.69
6355	341687.5	7621638	848	9.95	0	11.98	10.84
5970	341662.5	7621813	848	3.15	0.14	10.99	10.84
5935	341662.5	7621788	848	6.63	0	7.46	7.45
5900	341662.5	7621763	848	6.27	0	7.21	7.01
5865	341662.5	7621738	848	8.77	0	9.41	8.2
5830	341662.5	7621713	848	10.42	0	10.56	9.66
5795	341662.5	7621688	848	9.9	0	10.27	9.44
5760	341662.5	7621663	848	10.25	0	11.37	9.19
5725	341662.5	7621638	848	10.94	0	12.48	10.84
5340	341637.5	7621813	848	4.3	0	5.89	6.05
5305	341637.5	7621788	848	5.24	0.02	6.18	5.91

5270	341637.5	7621763	848	7.55	0	7.95	7.37
5235	341637.5	7621738	848	9.48	0.03	9.84	9.83
5200	341637.5	7621713	848	11.38	0.02	11.13	11.46
5165	341637.5	7621688	848	10.65	0.03	10.81	10.1
5130	341637.5	7621663	848	10.9	0	11.71	9.72
5095	341637.5	7621638	848	10.54	0	11.6	10.96
5060	341637.5	7621613	848	10.68	0	11.21	11.29
4710	341612.5	7621813	848	3.98	0	5.4	5.47
4675	341612.5	7621788	848	5.47	0.02	5.74	5.65
4640	341612.5	7621763	848	11.08	0.07	10.55	9.12
4605	341612.5	7621738	848	12.87	0.09	13.15	12.65
4570	341612.5	7621713	848	14.36	0.04	14.32	14.67
4535	341612.5	7621688	848	12.17	0.01	12.16	12.69
4500	341612.5	7621663	848	11.22	0	11.23	11.04
4465	341612.5	7621638	848	11.71	0	11.42	12.81
4430	341612.5	7621613	848	11.1	0	10.73	12.19
4080	341587.5	7621813	848	4.13	0	4.83	5.55
4045	341587.5	7621788	848	7.69	0.09	7.38	7.39
4010	341587.5	7621763	848	14.27	0.2	13.98	13.27
3975	341587.5	7621738	848	18.49	0.23	18.44	17.48
3940	341587.5	7621713	848	16.49	0.14	16.61	17.44
3905	341587.5	7621688	848	12.22	0.06	12.05	14.12
3870	341587.5	7621663	848	8.85	0	8.96	10.6
3835	341587.5	7621638	848	9.8	0	9.54	11.11
3800	341587.5	7621613	848	11.27	0	10.47	11.18
3450	341562.5	7621813	848	2.76	0.2	3.69	4.79
3415	341562.5	7621788	848	5.9	0.12	5.75	6.7
3380	341562.5	7621763	848	14.88	0.23	14.3	13.53
3345	341562.5	7621738	848	21.67	0.41	22.13	19.8
3310	341562.5	7621713	848	21.14	0.43	21.53	19.71
3275	341562.5	7621688	848	14.3	0.24	14.1	14.53
3240	341562.5	7621663	848	10.39	0.04	10.78	10.58
3205	341562.5	7621638	848	9.8	0.01	10.16	10.33
3170	341562.5	7621613	848	10.73	0.07	10.68	11.24
2785	341537.5	7621788	848	3.91	0.09	3.87	5.37
2750	341537.5	7621763	848	13.61	0.36	12.12	11.92
2715	341537.5	7621738	848	20.57	0.65	20.68	19.05
2680	341537.5	7621713	848	19.22	0.63	19.79	20.13
2645	341537.5	7621688	848	16.38	0.4	15.75	15.51
2610	341537.5	7621663	848	11.15	0.12	11.88	12.03
2575	341537.5	7621638	848	10.74	0.07	11.19	10.64
2540	341537.5	7621613	848	11.93	0.1	12.24	11.31
2155	341512.5	7621788	848	6.57	0.24	5.7	7.22
2120	341512.5	7621763	848	13.51	0.53	12.29	12.19
2085	341512.5	7621738	848	19.16	0.79	19.26	17.77
2050	341512.5	7621713	848	17.84	0.6	17.68	16.59
2015	341512.5	7621688	848	14.11	0.32	13.64	13.82
1980	341512.5	7621663	848	11.97	0.21	11.81	11.93
1945	341512.5	7621638	848	10.92	0.19	11.38	10.93
1910	341512.5	7621613	848	11.76	0.14	12.22	11.75
1490	341487.5	7621763	848	11.65	0.48	10.79	11.15
1455	341487.5	7621738	848	13.77	0.52	13.95	12.64
1420	341487.5	7621713	848	11.21	0.29	11.15	11.21
1385	341487.5	7621688	848	8.99	0.17	9.15	9.97
1350	341487.5	7621663	848	9.27	0.21	9.15	9.92
1315	341487.5	7621638	848	10.46	0.15	10.13	10.42
860	341462.5	7621763	848	9.67	0.3	9.33	9.96
825	341462.5	7621738	848	9.91	0.27	10.16	9.47
790	341462.5	7621713	848	6.69	0.1	7.36	8.03
755	341462.5	7621688	848	6.39	0.13	7.07	7.78
720	341462.5	7621663	848	8.34	0.31	8.09	8.93
685	341462.5	7621638	848	6.5	0.14	10.99	10.84

160	341437.5	7621713	848	5.08	0.26	6.98	8.06
125	341437.5	7621688	848	7.46	0.3	8.31	7.71
90	341437.5	7621663	848	9.2	0.35	8.91	9.07
7161	341712.5	7621763	860	8.6	0	10.12	9.62
7126	341712.5	7621738	860	6.82	0	8.51	9.7
7091	341712.5	7621713	860	7.35	0	9.19	10.07
7056	341712.5	7621688	860	8.4	0	10.08	10.05
7021	341712.5	7621663	860	9.96	0	12.18	10.86
6566	341687.5	7621788	860	7.32	0.18	8.33	11.26
6531	341687.5	7621763	860	7.77	0	8.63	8.52
6496	341687.5	7621738	860	7.85	0.12	8.26	9.07
6461	341687.5	7621713	860	8.61	0.14	9.09	9.53
6426	341687.5	7621688	860	7.86	0	9.08	10.29
6391	341687.5	7621663	860	9.78	0	11.96	10.77
6356	341687.5	7621638	860	9.37	0	11.8	10.23
5971	341662.5	7621813	860	3.51	0.17	11.03	11.26
5936	341662.5	7621788	860	5.55	0.13	6.8	7.52
5901	341662.5	7621763	860	6.03	0.06	6.59	8.83
5866	341662.5	7621738	860	8.25	0.07	8.38	9.82
5831	341662.5	7621713	860	8.46	0.09	8.56	10.55
5796	341662.5	7621688	860	10.53	0	10.38	12.16
5761	341662.5	7621663	860	10.72	0	11.49	11.89
5726	341662.5	7621638	860	9.94	0	11.46	11.26
5341	341637.5	7621813	860	5.25	0.1	6.47	6.43
5306	341637.5	7621788	860	4.85	0.03	5.84	6.88
5271	341637.5	7621763	860	7.52	0.01	7.6	9.45
5236	341637.5	7621738	860	8.76	0.05	9.47	10.82
5201	341637.5	7621713	860	10.36	0.03	10.33	11.02
5166	341637.5	7621688	860	9.98	0.04	9.8	12.04
5131	341637.5	7621663	860	11.14	0	11.07	12.31
5096	341637.5	7621638	860	9.6	0	10.45	11.14
5061	341637.5	7621613	860	10.53	0	10.75	10.45
4711	341612.5	7621813	860	4.08	0.08	5.6	6.24
4676	341612.5	7621788	860	6.07	0.04	6.23	7.01
4641	341612.5	7621763	860	10.76	0.15	10.25	10.1
4606	341612.5	7621738	860	12.46	0.17	12.77	12.77
4571	341612.5	7621713	860	12.18	0.05	12.5	11.8
4536	341612.5	7621688	860	10.17	0.02	10.4	11.36
4501	341612.5	7621663	860	10.55	0	10.35	10.85
4466	341612.5	7621638	860	9.53	0	9.52	9.41
4431	341612.5	7621613	860	10.51	0	10.15	9.14
4081	341587.5	7621813	860	3.74	0.06	5.17	6.14
4046	341587.5	7621788	860	8.6	0.18	8.66	7.51
4011	341587.5	7621763	860	14.76	0.45	14.96	13.85
3976	341587.5	7621738	860	18.9	0.45	19.49	17.49
3941	341587.5	7621713	860	17.59	0.25	18.07	15.74
3906	341587.5	7621688	860	12.1	0.07	12.43	12.6
3871	341587.5	7621663	860	8.45	0	8.72	9.68
3836	341587.5	7621638	860	9.6	0	9.3	9.59
3801	341587.5	7621613	860	10.39	0	10.13	9.47
3451	341562.5	7621813	860	3.74	0.25	4.57	5.14
3416	341562.5	7621788	860	6.41	0.2	6.87	6.93
3381	341562.5	7621763	860	15.95	0.47	15.31	14.42
3346	341562.5	7621738	860	22.13	0.61	22.53	21.1
3311	341562.5	7621713	860	22.13	0.51	22.29	21.09
3276	341562.5	7621688	860	15.43	0.26	15.17	16.3
3241	341562.5	7621663	860	10.46	0.05	10.9	11.34
3206	341562.5	7621638	860	9.22	0.02	10.06	10.22
3171	341562.5	7621613	860	10.89	0.14	10.6	10.66
2786	341537.5	7621788	860	4.5	0.09	5.06	5.74
2751	341537.5	7621763	860	13.68	0.35	12.86	12.42
2716	341537.5	7621738	860	21.25	0.62	21.1	20.65

2681	341537.5	7621713	860	25.66	0.81	25.46	24.24
2646	341537.5	7621688	860	17.85	0.43	17.09	18.18
2611	341537.5	7621663	860	13.63	0.16	13.77	13.15
2576	341537.5	7621638	860	11	0.05	11.42	11.18
2541	341537.5	7621613	860	10.76	0.1	10.82	11.13
2156	341512.5	7621788	860	6.28	0.22	6.56	7.6
2121	341512.5	7621763	860	12.48	0.38	12.13	11.63
2086	341512.5	7621738	860	18.47	0.61	18.32	17.89
2051	341512.5	7621713	860	18.29	0.5	17.8	18.89
2016	341512.5	7621688	860	14.93	0.34	14.13	15.11
1981	341512.5	7621663	860	12.43	0.16	12.21	11.95
1946	341512.5	7621638	860	11.78	0.14	11.48	10.92
1911	341512.5	7621613	860	11.02	0.14	11.24	10.86
1491	341487.5	7621763	860	10.37	0.42	10.38	10.81
1456	341487.5	7621738	860	12.88	0.39	13.18	13.4
1421	341487.5	7621713	860	11.6	0.21	11.58	12.59
1386	341487.5	7621688	860	11.28	0.18	10.88	11.43
1351	341487.5	7621663	860	10.97	0.21	10.64	10.88
1316	341487.5	7621638	860	11.66	0.15	10.94	10.49
861	341462.5	7621763	860	9.54	0.15	9.59	11.12
826	341462.5	7621738	860	9.66	0.34	10.09	10.29
791	341462.5	7621713	860	7.49	0.15	8.36	8.77
756	341462.5	7621688	860	7.54	0.13	8.05	8.94
721	341462.5	7621663	860	9.68	0.31	8.97	9.96
686	341462.5	7621638	860	8.33	0.17	11.03	11.26
161	341437.5	7621713	860	7	0.27	8.24	8.03
126	341437.5	7621688	860	8.81	0.3	9.38	8.54
91	341437.5	7621663	860	10.69	0.35	9.75	9.47
7162	341712.5	7621763	872	6.86	0	8.79	9.27
7127	341712.5	7621738	872	8.27	0	9.54	9.12
7092	341712.5	7621713	872	8.55	0	9.73	8.71
7057	341712.5	7621688	872	9.05	0	10.35	9.13
7022	341712.5	7621663	872	8.49	0	10.64	9.5
6567	341687.5	7621788	872	8.38	0.18	9.03	10.48
6532	341687.5	7621763	872	6.45	0	7.4	7.27
6497	341687.5	7621738	872	9.2	0.12	8.94	7.46
6462	341687.5	7621713	872	10.11	0.14	10.02	8.01
6427	341687.5	7621688	872	9.51	0	10.35	8.3
6392	341687.5	7621663	872	9.06	0	10.89	9.25
6357	341687.5	7621638	872	9.92	0	12.05	9.76
5972	341662.5	7621813	872	4	0.11	10.77	10.48
5937	341662.5	7621788	872	6.14	0.13	6.94	10.48
5902	341662.5	7621763	872	5.24	0.06	5.78	5.99
5867	341662.5	7621738	872	7.4	0.07	7.37	6.45
5832	341662.5	7621713	872	9.02	0.09	8.71	7.87
5797	341662.5	7621688	872	9.56	0	9.58	7.83
5762	341662.5	7621663	872	9.86	0	11	8.31
5727	341662.5	7621638	872	9.5	0	10.8	10.48
5342	341637.5	7621813	872	4.39	0.1	5.92	7.11
5307	341637.5	7621788	872	5.22	0.03	5.83	6.71
5272	341637.5	7621763	872	6.54	0.02	6.94	6.35
5237	341637.5	7621738	872	7.57	0.04	7.85	7.44
5202	341637.5	7621713	872	8.98	0.03	8.68	8.77
5167	341637.5	7621688	872	8.05	0.01	7.77	9.18
5132	341637.5	7621663	872	9.31	0	9.41	8.75
5097	341637.5	7621638	872	9.83	0	10.45	9.55
5062	341637.5	7621613	872	8.62	0	9.07	9.64
4712	341612.5	7621813	872	4.53	0.08	5.72	6.5
4677	341612.5	7621788	872	5.73	0.04	6.01	6.33
4642	341612.5	7621763	872	10.07	0.16	9.98	9.24
4607	341612.5	7621738	872	10.7	0.15	10.78	11.43
4572	341612.5	7621713	872	10.33	0.03	10.3	11.22

4537	341612.5	7621688	872	8.86	0.01	9.05	10.58
4502	341612.5	7621663	872	9.02	0	8.96	9.3
4467	341612.5	7621638	872	8.67	0	8.79	8.69
4432	341612.5	7621613	872	8.09	0	8.51	9.04
4082	341587.5	7621813	872	5.09	0.12	6.12	6.51
4047	341587.5	7621788	872	8.46	0.18	8.77	8.05
4012	341587.5	7621763	872	14.82	0.45	14.82	14.59
3977	341587.5	7621738	872	17.47	0.45	17.33	17.5
3942	341587.5	7621713	872	15.26	0.17	15.18	15.76
3907	341587.5	7621688	872	11.49	0.06	11.85	12.21
3872	341587.5	7621663	872	7.72	0	8.02	9.43
3837	341587.5	7621638	872	9.15	0	8.86	9.15
3802	341587.5	7621613	872	8.73	0	8.88	9.39
3452	341562.5	7621813	872	4.29	0.12	5.38	5.94
3417	341562.5	7621788	872	7.75	0.16	8.04	7.9
3382	341562.5	7621763	872	15.76	0.46	15.26	15.2
3347	341562.5	7621738	872	22.17	0.59	21.66	19.27
3312	341562.5	7621713	872	22.28	0.47	22.24	18.05
3277	341562.5	7621688	872	16.57	0.26	15.89	14.62
3242	341562.5	7621663	872	11	0.04	10.97	11.27
3207	341562.5	7621638	872	9.31	0.01	9.77	10.68
3172	341562.5	7621613	872	9.71	0.07	9.5	10.46
2787	341537.5	7621788	872	5.29	0.05	5.87	6.65
2752	341537.5	7621763	872	13.05	0.24	12.53	12.47
2717	341537.5	7621738	872	20.37	0.46	19.91	17.21
2682	341537.5	7621713	872	20.28	0.33	20.08	18.08
2647	341537.5	7621688	872	19.48	0.4	19.22	16.32
2612	341537.5	7621663	872	13.28	0.06	13.21	13.47
2577	341537.5	7621638	872	11.05	0	11.31	11.92
2542	341537.5	7621613	872	10.65	0	10.94	10.73
2157	341512.5	7621788	872	7.04	0.11	7.49	8.52
2122	341512.5	7621763	872	11.87	0.21	11.7	11.25
2087	341512.5	7621738	872	16.24	0.27	16.13	14.64
2052	341512.5	7621713	872	18.79	0.34	18.18	15.95
2017	341512.5	7621688	872	16.86	0.28	15.91	14.63
1982	341512.5	7621663	872	14.39	0.13	13.57	12.86
1947	341512.5	7621638	872	10.91	0	11.16	11.63
1912	341512.5	7621613	872	10.71	0	11.11	11.06
1492	341487.5	7621763	872	10.97	0.23	10.83	10.76
1457	341487.5	7621738	872	12	0.22	12.41	12.37
1422	341487.5	7621713	872	12.35	0.12	12.28	12.14
1387	341487.5	7621688	872	11.57	0.1	11.76	11.86
1352	341487.5	7621663	872	11.44	0.08	11.3	11.45
1317	341487.5	7621638	872	10.28	0	10.63	10.97
862	341462.5	7621763	872	9.7	0	9.91	10.16
827	341462.5	7621738	872	10.72	0.23	11.13	10.05
792	341462.5	7621713	872	8.96	0.1	9.99	9.2
757	341462.5	7621688	872	8.79	0	9.72	9.83
722	341462.5	7621663	872	9.7	0	9.93	10.83
687	341462.5	7621638	872	9.13	0.11	10.77	10.48
162	341437.5	7621713	872	8.54	0.16	9.91	8.59
127	341437.5	7621688	872	9.55	0	10.83	9.35
92	341437.5	7621663	872	10.08	0	10.22	10.3
7163	341712.5	7621763	884	3.98	0	5.88	7.85
7128	341712.5	7621738	884	3.23	0	4.78	7.28
7093	341712.5	7621713	884	2.86	0	4.18	6.73
7058	341712.5	7621688	884	3.92	0	5.07	7.19
7023	341712.5	7621663	884	4.75	0	6.43	8.66
6568	341687.5	7621788	884	4.64	0	6.32	9.94
6533	341687.5	7621763	884	3.94	0	5.11	6.21
6498	341687.5	7621738	884	3.59	0	4.07	5.66
6463	341687.5	7621713	884	2.98	0	3.48	5.69

6428	341687.5	7621688	884	3.72	0	4.59	6.3
6393	341687.5	7621663	884	5.11	0	6.54	7.67
6358	341687.5	7621638	884	5.96	0	8	9.94
5973	341662.5	7621813	884	4.39	0	6.25	7.87
5938	341662.5	7621788	884	4.73	0	5.94	6.83
5903	341662.5	7621763	884	4.11	0	4.7	5.22
5868	341662.5	7621738	884	3.9	0	4.19	4.89
5833	341662.5	7621713	884	3.78	0	3.86	5.63
5798	341662.5	7621688	884	4.87	0	4.85	6.36
5763	341662.5	7621663	884	6.23	0	6.91	7.09
5728	341662.5	7621638	884	6.65	0	8.2	8.67
5343	341637.5	7621813	884	4.51	0	5.85	6.71
5308	341637.5	7621788	884	4.75	0.02	5.65	6.31
5273	341637.5	7621763	884	6.01	0.01	6.54	6.02
5238	341637.5	7621738	884	5.72	0.04	6.37	6.15
5203	341637.5	7621713	884	6.66	0.01	6.68	7.34
5168	341637.5	7621688	884	6.95	0.01	7.13	7.21
5133	341637.5	7621663	884	7.32	0	7.72	7.42
5098	341637.5	7621638	884	7.18	0	7.87	8.36
5063	341637.5	7621613	884	7.01	0	7.77	9.21
4713	341612.5	7621813	884	5.13	0	5.93	6.38
4678	341612.5	7621788	884	6.07	0.02	6.51	6.57
4643	341612.5	7621763	884	9.78	0.08	9.89	8.99
4608	341612.5	7621738	884	10.18	0.09	10.37	9.99
4573	341612.5	7621713	884	9.58	0.03	9.96	9.67
4538	341612.5	7621688	884	8.39	0.01	9.01	9.16
4503	341612.5	7621663	884	8.23	0	8.38	8.59
4468	341612.5	7621638	884	7.95	0	7.84	8.67
4433	341612.5	7621613	884	7.77	0	8.19	9.15
4083	341587.5	7621813	884	5.56	0.06	6.63	6.72
4048	341587.5	7621788	884	8.72	0.09	8.91	8.31
4013	341587.5	7621763	884	13.13	0.2	13.07	12.19
3978	341587.5	7621738	884	16.92	0.23	16.42	14.7
3943	341587.5	7621713	884	15.34	0.14	15.31	14.48
3908	341587.5	7621688	884	11.53	0.06	11.56	11.65
3873	341587.5	7621663	884	7.57	0	7.96	9.67
3838	341587.5	7621638	884	8.37	0	8.11	9.69
3803	341587.5	7621613	884	8.73	0	9.07	9.68
3453	341562.5	7621813	884	6.08	0.16	6.54	6.47
3418	341562.5	7621788	884	8.28	0.1	8.65	8.09
3383	341562.5	7621763	884	14.9	0.2	14.41	12.85
3348	341562.5	7621738	884	21.13	0.37	20.03	18.23
3313	341562.5	7621713	884	22.84	0.45	22.13	20.33
3278	341562.5	7621688	884	17.02	0.27	16.19	16.07
3243	341562.5	7621663	884	11.13	0.04	10.9	11.32
3208	341562.5	7621638	884	9.09	0.01	9.37	10.45
3173	341562.5	7621613	884	9.55	0.07	9.64	10.68
2788	341537.5	7621788	884	6.41	0.02	6.64	7.43
2753	341537.5	7621763	884	12.31	0.09	12.11	11.64
2718	341537.5	7621738	884	18.84	0.27	17.5	17.29
2683	341537.5	7621713	884	22.27	0.42	22.22	22.12
2648	341537.5	7621688	884	20.88	0.37	20.07	18.8
2613	341537.5	7621663	884	13.25	0.08	13.05	13.57
2578	341537.5	7621638	884	10.79	0.03	10.86	10.87
2543	341537.5	7621613	884	10.58	0	10.98	10.61
2158	341512.5	7621788	884	7.25	0.06	7.72	8.21
2123	341512.5	7621763	884	10.43	0.03	10.72	10.97
2088	341512.5	7621738	884	14.01	0.05	13.14	14.11
2053	341512.5	7621713	884	17.32	0.2	15.83	15.96
2018	341512.5	7621688	884	17.61	0.2	16.77	15.62
1983	341512.5	7621663	884	14.44	0.11	13.49	12.94
1948	341512.5	7621638	884	11.72	0.08	11.54	11.53

1913	341512.5	7621613	884	10.73	0	11.39	10.86
1493	341487.5	7621763	884	8.9	0.06	9.63	9.81
1458	341487.5	7621738	884	10.38	0	11.35	11.01
1423	341487.5	7621713	884	12.13	0.02	11.81	12.01
1388	341487.5	7621688	884	11.95	0.05	12.19	12.31
1353	341487.5	7621663	884	11.55	0.07	11.43	11.31
1318	341487.5	7621638	884	11.57	0.15	11.22	10.76
1283	341487.5	7621613	884	12.16	0.2	11.75	10.61
863	341462.5	7621763	884	9.53	0	10.39	10.08
828	341462.5	7621738	884	9.61	0.05	10.89	9.9
793	341462.5	7621713	884	9.29	0.03	10.18	10.11
758	341462.5	7621688	884	9.48	0.08	10.19	10.25
723	341462.5	7621663	884	10.87	0.17	10.66	10.1
688	341462.5	7621638	884	7.46	0.07	9.64	9.94
128	341437.5	7621688	884	10.4	0.16	10.73	9.34
93	341437.5	7621663	884	11.55	0.18	10.99	9.69
7164	341712.5	7621763	896	3.5	0	5.64	6.85
7129	341712.5	7621738	896	3.32	0	4.52	5.73
7094	341712.5	7621713	896	3.03	0	3.89	5.21
7059	341712.5	7621688	896	3.56	0	4.39	5.76
6569	341687.5	7621788	896	4.31	0	6.35	9.59
6534	341687.5	7621763	896	4.06	0	5.55	6.03
6499	341687.5	7621738	896	3.35	0	3.78	4.75
6464	341687.5	7621713	896	2.49	0	2.71	3.57
6429	341687.5	7621688	896	3.04	0	3.68	4.72
6394	341687.5	7621663	896	4.89	0	6.21	6.62
6359	341687.5	7621638	896	5.62	0	7.85	9.59
5974	341662.5	7621813	896	4.67	0	6.61	7.91
5939	341662.5	7621788	896	4.71	0	5.94	6.9
5904	341662.5	7621763	896	4.69	0	5.21	6.04
5869	341662.5	7621738	896	4.16	0	4.38	4.79
5834	341662.5	7621713	896	3.59	0	3.6	4.23
5799	341662.5	7621688	896	5.02	0	4.79	5.57
5764	341662.5	7621663	896	6.13	0	6.67	7.23
5729	341662.5	7621638	896	6.33	0	8.11	8.4
5344	341637.5	7621813	896	4.2	0	5.73	6.94
5309	341637.5	7621788	896	4.87	0.02	5.92	7.04
5274	341637.5	7621763	896	6.52	0.01	7.1	7.37
5239	341637.5	7621738	896	6.19	0.02	7.08	7.35
5204	341637.5	7621713	896	6.81	0.01	6.95	7.38
5169	341637.5	7621688	896	5.82	0.01	6.68	8.03
5134	341637.5	7621663	896	7.46	0	7.99	8.19
5099	341637.5	7621638	896	7.11	0	8.13	8.35
5064	341637.5	7621613	896	6.96	0	8.15	9.18
4714	341612.5	7621813	896	4.61	0	5.71	6.7
4679	341612.5	7621788	896	6.41	0.02	6.63	7.4
4644	341612.5	7621763	896	9.66	0.07	9.95	9.36
4609	341612.5	7621738	896	10.18	0.09	10.96	10.92
4574	341612.5	7621713	896	10.19	0.03	10.49	11.27
4539	341612.5	7621688	896	8.38	0.01	9.21	10.12
4504	341612.5	7621663	896	8.66	0	9.25	8.84
4469	341612.5	7621638	896	7.68	0	8.25	8.01
4434	341612.5	7621613	896	7.17	0	7.74	8.34
4084	341587.5	7621813	896	6.09	0	7.09	6.15
4049	341587.5	7621788	896	8.98	0.09	9.26	8.78
4014	341587.5	7621763	896	12.83	0.19	13.1	12.42
3979	341587.5	7621738	896	17.04	0.24	17.11	16.01
3944	341587.5	7621713	896	17.02	0.19	16.45	15.83
3909	341587.5	7621688	896	12.65	0.09	12.69	12.56
3874	341587.5	7621663	896	7.49	0	8.54	8.85
3839	341587.5	7621638	896	8.57	0	8.92	8.62
3804	341587.5	7621613	896	8	0	8.68	8.85

3454	341562.5	7621813	896	7.86	0.1	7.74	6.15
3419	341562.5	7621788	896	9.13	0.1	9.51	8.54
3384	341562.5	7621763	896	14.85	0.2	14.7	12.97
3349	341562.5	7621738	896	21.55	0.45	20.9	18.69
3314	341562.5	7621713	896	25.73	0.64	25.37	21.67
3279	341562.5	7621688	896	19.51	0.4	18.3	16.13
3244	341562.5	7621663	896	11.48	0.06	11.54	11.27
3209	341562.5	7621638	896	7.9	0.02	8.62	9.84
3174	341562.5	7621613	896	8.49	0.14	8.92	9.37
2824	341537.5	7621813	896	7.26	0	7.45	6.32
2789	341537.5	7621788	896	7.89	0.02	7.79	7.91
2754	341537.5	7621763	896	11.59	0.1	11.02	10.89
2719	341537.5	7621738	896	18.69	0.38	16.22	15.93
2684	341537.5	7621713	896	27.07	0.67	24.68	22.9
2649	341537.5	7621688	896	23.52	0.56	22.76	18.87
2614	341537.5	7621663	896	14.83	0.14	13.76	13.46
2579	341537.5	7621638	896	9.8	0.03	9.53	10.52
2544	341537.5	7621613	896	8.98	0	9.39	10.27
2159	341512.5	7621788	896	7.03	0.06	7.05	7.78
2124	341512.5	7621763	896	7.66	0.04	7.44	8.84
2089	341512.5	7621738	896	10.89	0.07	8.76	11.61
2054	341512.5	7621713	896	17.2	0.3	14.5	15.32
2019	341512.5	7621688	896	18.23	0.32	17.58	15.12
1984	341512.5	7621663	896	14.57	0.17	14.12	12.68
1949	341512.5	7621638	896	10.89	0.08	10.44	10.78
1914	341512.5	7621613	896	9.08	0	10.04	10.35
1494	341487.5	7621763	896	6.14	0.06	6.85	7.26
1459	341487.5	7621738	896	6.69	0.01	7.15	8.16
1424	341487.5	7621713	896	10.53	0.02	9.62	10.09
1389	341487.5	7621688	896	12.65	0.1	12.05	10.87
1354	341487.5	7621663	896	12.35	0.15	11.89	10.66
1319	341487.5	7621638	896	11.26	0.15	10.54	10.48
1284	341487.5	7621613	896	11.8	0.2	10.94	10.54
829	341462.5	7621738	896	7.6	0.11	8.8	8.31
794	341462.5	7621713	896	8.37	0.06	9.26	8.71
759	341462.5	7621688	896	9.29	0.08	9.71	9.27
724	341462.5	7621663	896	10.77	0.17	10.6	9.85
689	341462.5	7621638	896	7.39	0.09	9.53	9.59
129	341437.5	7621688	896	10.54	0.16	10.17	9.4
94	341437.5	7621663	896	11.53	0.18	11.02	9.31
7165	341712.5	7621763	908	5.41	0	6.45	7.63
7130	341712.5	7621738	908	3.82	0	4.95	6.16
7095	341712.5	7621713	908	2.5	0	3.92	5.18
7060	341712.5	7621688	908	3.41	0	4.67	5.31
6570	341687.5	7621788	908	5.95	0	6.8	7.92
6535	341687.5	7621763	908	5.99	0	6.63	6.55
6500	341687.5	7621738	908	4.13	0	4.59	5.12
6465	341687.5	7621713	908	2.16	0	2.75	3.59
6430	341687.5	7621688	908	3.27	0	3.85	4.45
6395	341687.5	7621663	908	4.71	0	5.86	6.06
6360	341687.5	7621638	908	5.4	0	7.41	7.46
5975	341662.5	7621813	908	5.98	0	7.17	8.33
5940	341662.5	7621788	908	6.71	0.09	7	7.6
5905	341662.5	7621763	908	6.33	0.04	6.52	6.25
5870	341662.5	7621738	908	5.53	0.02	5.45	5.65
5835	341662.5	7621713	908	4.03	0.02	4.05	4.42
5800	341662.5	7621688	908	4.65	0	4.74	4.89
5765	341662.5	7621663	908	5.53	0	6.18	6.26
5730	341662.5	7621638	908	6.01	0	7.45	7.39
5345	341637.5	7621813	908	5.56	0.09	5.99	7.29
5310	341637.5	7621788	908	7.12	0.01	7.53	6.78
5275	341637.5	7621763	908	8.37	0.01	8.77	7.46

5240	341637.5	7621738	908	8.32	0.03	8.72	7.96
5205	341637.5	7621713	908	8.88	0	8.89	7.42
5170	341637.5	7621688	908	6.77	0.02	7.49	7.46
5135	341637.5	7621663	908	7.41	0	8.09	7.27
5100	341637.5	7621638	908	6.97	0	8.01	8.04
5065	341637.5	7621613	908	6.11	0	7.09	8.83
4715	341612.5	7621813	908	4.58	0.04	4.49	6.09
4680	341612.5	7621788	908	6.99	0.02	7.18	6.58
4645	341612.5	7621763	908	11.11	0.08	11.2	9.8
4610	341612.5	7621738	908	12.49	0.09	12.92	12.05
4575	341612.5	7621713	908	12.39	0.03	12.9	11.59
4540	341612.5	7621688	908	10.21	0.02	11.06	10.46
4505	341612.5	7621663	908	8.73	0	9.37	8.62
4470	341612.5	7621638	908	7.58	0	8.34	7.62
4435	341612.5	7621613	908	6.27	0	6.89	8.27
4120	341587.5	7621838	908	2.9	0.09	2.88	4.2
4085	341587.5	7621813	908	4.91	0.03	4	5.1
4050	341587.5	7621788	908	9.12	0.09	8.5	8.27
4015	341587.5	7621763	908	14.6	0.25	14.76	13.67
3980	341587.5	7621738	908	18.38	0.26	18.43	17.09
3945	341587.5	7621713	908	18.77	0.2	18.48	16.77
3910	341587.5	7621688	908	14.17	0.07	14.31	14.41
3875	341587.5	7621663	908	8.32	0	9.38	10.5
3840	341587.5	7621638	908	8.2	0	8.77	8.77
3805	341587.5	7621613	908	7.27	0	7.98	8.12
3490	341562.5	7621838	908	3.32	0.09	2.84	4.15
3455	341562.5	7621813	908	6.75	0.07	5.15	5.53
3420	341562.5	7621788	908	11.41	0.09	11.09	9.05
3385	341562.5	7621763	908	16.36	0.27	15.97	13.95
3350	341562.5	7621738	908	20.44	0.41	19.31	17.74
3315	341562.5	7621713	908	22.89	0.47	21.98	21.22
3280	341562.5	7621688	908	18.17	0.28	16.72	18.07
3245	341562.5	7621663	908	11.36	0.04	11.48	12.63
3210	341562.5	7621638	908	7.14	0.02	7.98	9.34
3175	341562.5	7621613	908	7.48	0.14	8.31	9.01
2825	341537.5	7621813	908	8.51	0.04	6.91	6.73
2790	341537.5	7621788	908	10.73	0.05	9.63	8.28
2755	341537.5	7621763	908	12.67	0.1	10.44	8.89
2720	341537.5	7621738	908	14.93	0.29	11.03	11.29
2685	341537.5	7621713	908	24.27	0.67	21.26	18.34
2650	341537.5	7621688	908	19.44	0.42	18.1	17.17
2615	341537.5	7621663	908	13.99	0.14	13.21	11.93
2580	341537.5	7621638	908	8.15	0.03	8.3	8.74
2545	341537.5	7621613	908	6.74	0	7.72	9.1
2160	341512.5	7621788	908	8.88	0.09	6.59	6.51
2125	341512.5	7621763	908	6.88	0.03	4.45	4.98
2090	341512.5	7621738	908	5.65	0.06	2.99	4.02
2055	341512.5	7621713	908	12.26	0.21	8.65	8.34
2020	341512.5	7621688	908	14.15	0.28	12.87	11.5
1985	341512.5	7621663	908	12.2	0.11	12.2	10.79
1950	341512.5	7621638	908	8.69	0.08	8.98	9.64
1915	341512.5	7621613	908	6.49	0	7.84	9.76
1495	341487.5	7621763	908	4.43	0.13	3.76	4.46
1460	341487.5	7621738	908	3.34	0.04	2.98	3.88
1425	341487.5	7621713	908	7.06	0.03	5.47	5.75
1390	341487.5	7621688	908	10.72	0.1	9.98	8.51
1355	341487.5	7621663	908	10.83	0.15	10.88	9.31
1320	341487.5	7621638	908	8.93	0.15	9.16	9.49
1285	341487.5	7621613	908	9.88	0.2	9.67	9.71
830	341462.5	7621738	908	5.54	0.21	5.61	6.19
795	341462.5	7621713	908	6.63	0.1	7.2	6.65
760	341462.5	7621688	908	7.84	0.08	8.41	8.19

725	341462.5	7621663	908	8.95	0.17	9.25	8.71
690	341462.5	7621638	908	6.86	0.09	8.74	8.71
7166	341712.5	7621763	920	4.87	0	6.53	8.36
7131	341712.5	7621738	920	5.23	0	5.71	6.32
7096	341712.5	7621713	920	3.83	0	4.85	5.5
7061	341712.5	7621688	920	3.65	0	5.19	5.72
6571	341687.5	7621788	920	5.77	0	7.4	8.45
6536	341687.5	7621763	920	5.86	0	6.97	7.42
6501	341687.5	7621738	920	4.72	0	5.26	5.84
6466	341687.5	7621713	920	2.92	0	3.44	4.08
6431	341687.5	7621688	920	3.03	0	4.21	4.67
6396	341687.5	7621663	920	3.79	0	5.54	6.01
6361	341687.5	7621638	920	4.38	0	6.74	7.22
5976	341662.5	7621813	920	6.11	0	7.81	9.3
5941	341662.5	7621788	920	6.6	0	7.33	8.72
5906	341662.5	7621763	920	7.75	0	7.8	8.45
5871	341662.5	7621738	920	6.67	0	6.63	7.75
5836	341662.5	7621713	920	4.94	0	5.02	6.19
5801	341662.5	7621688	920	3.82	0	4.55	5.34
5766	341662.5	7621663	920	3.71	0	4.88	5.51
5731	341662.5	7621638	920	4.53	0	6.34	6.75
5346	341637.5	7621813	920	4.86	0	5.68	7.81
5311	341637.5	7621788	920	6.6	0.02	6.99	8.82
5276	341637.5	7621763	920	9.05	0.01	9.42	9.87
5241	341637.5	7621738	920	9.73	0.01	9.91	9.99
5206	341637.5	7621713	920	8.38	0.01	8.77	9.47
5171	341637.5	7621688	920	6.86	0	7.56	8.01
5136	341637.5	7621663	920	5.99	0	6.79	6.72
5101	341637.5	7621638	920	5.44	0	6.67	7.01
5066	341637.5	7621613	920	5.39	0	6.67	7.76
4751	341612.5	7621838	920	3.6	0	3.95	5.44
4716	341612.5	7621813	920	3.82	0	4.1	5.98
4681	341612.5	7621788	920	7.63	0.02	7.41	8.87
4646	341612.5	7621763	920	11.11	0.08	11.43	10.86
4611	341612.5	7621738	920	13.22	0.07	13.32	12.85
4576	341612.5	7621713	920	13.46	0.02	13.21	14.2
4541	341612.5	7621688	920	10.9	0	11.46	11.61
4506	341612.5	7621663	920	9.03	0	9.74	8.69
4471	341612.5	7621638	920	7.1	0	7.68	7.22
4436	341612.5	7621613	920	5.87	0	6.45	7.65
4121	341587.5	7621838	920	2.13	0	2.46	3.32
4086	341587.5	7621813	920	3.86	0.02	3.41	4.36
4051	341587.5	7621788	920	9.11	0.08	8.06	8.26
4016	341587.5	7621763	920	14.67	0.19	14.84	12.73
3981	341587.5	7621738	920	16.66	0.21	17.11	14.92
3946	341587.5	7621713	920	16.14	0.11	16.21	15.07
3911	341587.5	7621688	920	13.6	0.04	14.41	12.67
3876	341587.5	7621663	920	9.76	0	10.57	9.79
3841	341587.5	7621638	920	7.88	0	8.43	8.18
3806	341587.5	7621613	920	6.5	0	7.03	7.86
3491	341562.5	7621838	920	2.43	0	2.35	3.37
3456	341562.5	7621813	920	5.88	0.02	4.66	4.86
3421	341562.5	7621788	920	10.73	0.07	10.23	9.45
3386	341562.5	7621763	920	14.48	0.2	13.84	11.62
3351	341562.5	7621738	920	17.03	0.28	15.62	13.01
3316	341562.5	7621713	920	17.97	0.26	17.36	14.25
3281	341562.5	7621688	920	15.29	0.15	15.33	12.66
3246	341562.5	7621663	920	10.61	0.02	11.24	9.54
3211	341562.5	7621638	920	6.61	0.01	7.36	8.19
3176	341562.5	7621613	920	5.91	0.07	6.55	8.01
2826	341537.5	7621813	920	7.29	0	6.09	7.16
2791	341537.5	7621788	920	11.4	0	9.56	10.6

2756	341537.5	7621763	920	10.2	0.08	7.1	7.27
2721	341537.5	7621738	920	11.32	0.18	7.08	6.16
2686	341537.5	7621713	920	13.74	0.26	11.4	9.8
2651	341537.5	7621688	920	13.98	0.2	13.41	10.79
2616	341537.5	7621663	920	10.14	0.06	10.24	8.63
2581	341537.5	7621638	920	5.87	0	6.22	7.39
2546	341537.5	7621613	920	5.13	0	5.5	8.57
2161	341512.5	7621788	920	6.61	0	4.77	6.3
2126	341512.5	7621763	920	4.19	0.03	2.31	3.3
2091	341512.5	7621738	920	2.71	0.04	1.47	1.67
2056	341512.5	7621713	920	6.84	0.12	4.08	3.94
2021	341512.5	7621688	920	9.31	0.12	7.92	7.38
1986	341512.5	7621663	920	8.73	0.07	9.04	8.24
1951	341512.5	7621638	920	5.74	0	6.68	8.13
1916	341512.5	7621613	920	4.85	0	5.78	8.87
1496	341487.5	7621763	920	2.87	0	2.49	3.54
1461	341487.5	7621738	920	1.55	0	1.76	2.34
1426	341487.5	7621713	920	4.06	0.01	3.21	3.47
1391	341487.5	7621688	920	7.16	0.05	7.38	6.06
1356	341487.5	7621663	920	7.54	0.08	8.52	8.12
1321	341487.5	7621638	920	5.95	0	7.25	9.25
831	341462.5	7621738	920	4.41	0.06	4.23	4.65
796	341462.5	7621713	920	5.24	0.03	5.48	5.19
761	341462.5	7621688	920	5.74	0	7.04	6.96
726	341462.5	7621663	920	5.96	0	7.71	8.52
691	341462.5	7621638	920	5.83	0.04	7.65	7.89
7167	341712.5	7621763	932	6.47	0	8.17	8.71
7132	341712.5	7621738	932	5.55	0	6.53	6.92
7097	341712.5	7621713	932	3.94	0	5.41	6.5
7062	341712.5	7621688	932	4.79	0	6.08	6.49
6607	341687.5	7621813	932	6.02	0	7.58	10.04
6572	341687.5	7621788	932	6.97	0	8.03	9.51
6537	341687.5	7621763	932	7.04	0	8.19	7.91
6502	341687.5	7621738	932	6.48	0	7.02	6.86
6467	341687.5	7621713	932	4.26	0	4.71	5.63
6432	341687.5	7621688	932	3.57	0	4.72	5.84
6397	341687.5	7621663	932	3.55	0	5.34	5.84
6362	341687.5	7621638	932	4.16	0	6.26	7.09
5977	341662.5	7621813	932	6.76	0	8.12	8.92
5942	341662.5	7621788	932	8.09	0	8.28	9.41
5907	341662.5	7621763	932	8.61	0	9.03	9
5872	341662.5	7621738	932	8.03	0	8.17	8.14
5837	341662.5	7621713	932	5.82	0	5.94	6.63
5802	341662.5	7621688	932	3.88	0	4.7	5.63
5767	341662.5	7621663	932	3.22	0	4.6	5.38
5732	341662.5	7621638	932	3.85	0	5.61	6.55
5347	341637.5	7621813	932	5.91	0	6.65	6.86
5312	341637.5	7621788	932	7.79	0	8.01	8.41
5277	341637.5	7621763	932	9.95	0	10.27	9.85
5242	341637.5	7621738	932	10.79	0	10.69	10.43
5207	341637.5	7621713	932	9.85	0	9.54	9.08
5172	341637.5	7621688	932	7.17	0	7.78	6.82
5137	341637.5	7621663	932	5.04	0	5.84	5.64
5102	341637.5	7621638	932	4.46	0	5.81	6.14
5067	341637.5	7621613	932	4.1	0	5.28	7.02
4752	341612.5	7621838	932	4.23	0	4.5	4.89
4717	341612.5	7621813	932	4.57	0	4.65	4.93
4682	341612.5	7621788	932	6.64	0	6.59	6.79
4647	341612.5	7621763	932	10.16	0	10.21	10.06
4612	341612.5	7621738	932	12.77	0	12.56	11.31
4577	341612.5	7621713	932	12.9	0	12.43	10.49
4542	341612.5	7621688	932	10.5	0	11.37	9.15

4507	341612.5	7621663	932	7.21	0	8.05	7.41
4472	341612.5	7621638	932	5.37	0	6.03	6.1
4437	341612.5	7621613	932	4.42	0	4.86	6.71
4122	341587.5	7621838	932	2.36	0	2.73	3.51
4087	341587.5	7621813	932	3.51	0	3.31	3.9
4052	341587.5	7621788	932	6.93	0	6.26	6.91
4017	341587.5	7621763	932	11.43	0	11.21	10.42
3982	341587.5	7621738	932	14.22	0	13.99	12.12
3947	341587.5	7621713	932	14.2	0	13.47	12.07
3912	341587.5	7621688	932	12.07	0	12.4	11.21
3877	341587.5	7621663	932	8.6	0	9.11	9.8
3842	341587.5	7621638	932	5.92	0	6.68	7.4
3807	341587.5	7621613	932	5.01	0	5.54	6.87
3492	341562.5	7621838	932	2.35	0	2.38	3.8
3457	341562.5	7621813	932	4.97	0	4.19	4.2
3422	341562.5	7621788	932	8.21	0	7.64	6.51
3387	341562.5	7621763	932	10.94	0	9.47	9
3352	341562.5	7621738	932	11.7	0	9.75	10.16
3317	341562.5	7621713	932	11.44	0	10.23	10.3
3282	341562.5	7621688	932	11.4	0	10.56	9.9
3247	341562.5	7621663	932	8.57	0	8.75	8.84
3212	341562.5	7621638	932	5.43	0	6.16	7.05
3177	341562.5	7621613	932	3.98	0	4.78	7.13
2827	341537.5	7621813	932	6.46	0	5.37	5.87
2792	341537.5	7621788	932	7.41	0	6.06	5.15
2757	341537.5	7621763	932	7.85	0	4.71	4.79
2722	341537.5	7621738	932	6.96	0	3.64	4.71
2687	341537.5	7621713	932	8.22	0	5.84	6.51
2652	341537.5	7621688	932	8.5	0	7.57	7.79
2617	341537.5	7621663	932	7.01	0	6.95	7.56
2582	341537.5	7621638	932	4.44	0	4.78	6.36
2547	341537.5	7621613	932	4.01	0	4.67	7.56
2197	341512.5	7621813	932	6.4	0	4.87	7.08
2162	341512.5	7621788	932	6.28	0	4	5.55
2127	341512.5	7621763	932	4.3	0	2.07	3.08
2092	341512.5	7621738	932	2.17	0	1.35	1.8
2057	341512.5	7621713	932	4.22	0	2.53	3.48
2022	341512.5	7621688	932	5.93	0	5.17	6.16
1987	341512.5	7621663	932	5.95	0	6.11	7.63
1952	341512.5	7621638	932	4.05	0	4.79	8.13
1497	341487.5	7621763	932	2.72	0	2.16	3.77
1462	341487.5	7621738	932	1.58	0	1.66	2.55
1427	341487.5	7621713	932	2.98	0	2.54	3.16
1392	341487.5	7621688	932	4.79	0	5	5.48
1357	341487.5	7621663	932	5.11	0	6.16	7.88
1322	341487.5	7621638	932	4.86	0	6.21	9.02
832	341462.5	7621738	932	3.6	0	3.39	4.3
797	341462.5	7621713	932	4.26	0	4.25	4.56
762	341462.5	7621688	932	4.57	0	5.51	6.13
7168	341712.5	7621763	944	7.2	0	8.71	9.22
7133	341712.5	7621738	944	5.13	0	6.6	8.28
7098	341712.5	7621713	944	5.01	0	6.45	7.48
7063	341712.5	7621688	944	3.94	0	5.91	7.68
6573	341687.5	7621788	944	7.1	0	8.16	6.76
6538	341687.5	7621763	944	7.19	0	8.46	8.96
6503	341687.5	7621738	944	6.41	0	7.55	7.83
6468	341687.5	7621713	944	4.74	0	5.59	6.75
6433	341687.5	7621688	944	3.78	0	5.07	6.53
6398	341687.5	7621663	944	3.68	0	5.56	6.65
6363	341687.5	7621638	944	4.1	0	6.08	6.76
5978	341662.5	7621813	944	6.82	0	8.05	8.73
5943	341662.5	7621788	944	7.65	0	8.32	9.28

5908	341662.5	7621763	944	7.8	0	8.19	9.09
5873	341662.5	7621738	944	7.47	0	8.07	8.32
5838	341662.5	7621713	944	5.7	0	6.29	7.25
5803	341662.5	7621688	944	3.79	0	4.87	6.22
5768	341662.5	7621663	944	3.09	0	4.77	5.58
5733	341662.5	7621638	944	3.19	0	5.4	6.35
5348	341637.5	7621813	944	5.34	0	6.25	7.21
5313	341637.5	7621788	944	6.3	0	6.81	7.98
5278	341637.5	7621763	944	8.42	0	8.65	8.54
5243	341637.5	7621738	944	9.13	0	9.28	9.03
5208	341637.5	7621713	944	7.96	0	8.21	8.82
5173	341637.5	7621688	944	5.51	0	6.53	6.93
5138	341637.5	7621663	944	3.89	0	5.34	5.65
5103	341637.5	7621638	944	3.48	0	5.26	5.43
5068	341637.5	7621613	944	3.94	0	5.31	6.84
4753	341612.5	7621838	944	3.7	0	4.9	5.56
4718	341612.5	7621813	944	3.8	0	4.67	5.58
4683	341612.5	7621788	944	5.75	0	5.97	6.27
4648	341612.5	7621763	944	8.13	0	8.13	7.87
4613	341612.5	7621738	944	9.75	0	9.52	9.79
4578	341612.5	7621713	944	10.74	0	10.21	10.86
4543	341612.5	7621688	944	7.95	0	8.77	8.63
4508	341612.5	7621663	944	5.64	0	6.88	6.38
4473	341612.5	7621638	944	4.12	0	5.05	5.01
4438	341612.5	7621613	944	3.83	0	4.36	5.62
4123	341587.5	7621838	944	3.25	0	3.82	4.42
4088	341587.5	7621813	944	2.84	0	3.59	4.4
4053	341587.5	7621788	944	4.97	0	5.2	5.65
4018	341587.5	7621763	944	7.36	0	7.32	6.5
3983	341587.5	7621738	944	9.38	0	9.15	8.26
3948	341587.5	7621713	944	10.03	0	9.19	9.46
3913	341587.5	7621688	944	8.59	0	8.52	8.59
3878	341587.5	7621663	944	6.51	0	7.55	6.85
3843	341587.5	7621638	944	4.75	0	5.82	5.91
3808	341587.5	7621613	944	3.99	0	4.95	6.16
3493	341562.5	7621838	944	2.82	0	3.23	4.38
3458	341562.5	7621813	944	2.85	0	3.67	4.51
3388	341562.5	7621763	944	6	0	5.29	5.58
3353	341562.5	7621738	944	7.24	0	5.9	6.67
3318	341562.5	7621713	944	9.34	0	8.29	7.43
3283	341562.5	7621688	944	8.78	0	8.24	7.16
3248	341562.5	7621663	944	6.18	0	6.71	6.31
3213	341562.5	7621638	944	4.49	0	5.64	6.35
2828	341537.5	7621813	944	3.31	0	3.95	5.82
2793	341537.5	7621788	944	3.23	0	3.4	4.8
2758	341537.5	7621763	944	4.87	0	3.55	4.51
2688	341537.5	7621713	944	5.27	0	3.52	5.39
2653	341537.5	7621688	944	5.36	0	4.65	6.51
2618	341537.5	7621663	944	4.95	0	5.02	6.52
2583	341537.5	7621638	944	4.04	0	4.58	6.41
2198	341512.5	7621813	944	2.54	0	3.35	7.24
2163	341512.5	7621788	944	3.1	0	3.01	5.43
2128	341512.5	7621763	944	2.47	0	2.08	3.52
2058	341512.5	7621713	944	2.97	0	2.28	4.09
2023	341512.5	7621688	944	3.96	0	3.72	5.61
1988	341512.5	7621663	944	4.14	0	4.49	6.92
1953	341512.5	7621638	944	4.25	0	4.82	8.04
1498	341487.5	7621763	944	2.79	0	2.57	4.3
1393	341487.5	7621688	944	3.79	0	4.04	5.53
6574	341687.5	7621788	956	7.9	0	6.96	6.84
6539	341687.5	7621763	956	7.05	0	6.96	6.84
6504	341687.5	7621738	956	6.4	0	6.96	6.84

6434	341687.5	7621688	956	4.23	0	5.93	6.84
6399	341687.5	7621663	956	3.65	0	6.96	6.84
5979	341662.5	7621813	956	5.73	0	6.96	6.84
5944	341662.5	7621788	956	7.33	0	6.96	6.84
5909	341662.5	7621763	956	8.02	0	6.96	6.84
5874	341662.5	7621738	956	5.08	0	6.82	8.72
5349	341637.5	7621813	956	5.79	0	6.96	6.84
5314	341637.5	7621788	956	6.1	0	6.96	6.84
5279	341637.5	7621763	956	7.9	0	8.6	6.84
5244	341637.5	7621738	956	7.08	0	8.27	8.28
5209	341637.5	7621713	956	7.33	0	7.96	7.27
5174	341637.5	7621688	956	5.25	0	6.55	6.52
5139	341637.5	7621663	956	3.58	0	5.75	5.75
5104	341637.5	7621638	956	4.66	0	6.88	6.84
4719	341612.5	7621813	956	4.58	0	6.96	6.84
4684	341612.5	7621788	956	5.05	0	6.96	6.84
4614	341612.5	7621738	956	6.74	0	7.64	7.67
4579	341612.5	7621713	956	7.36	0	7.61	6.76
4544	341612.5	7621688	956	6.91	0	7.9	6.28
4509	341612.5	7621663	956	5.46	0	7.28	5.72
4474	341612.5	7621638	956	3.69	0	5.42	6.84
3984	341587.5	7621738	956	6.91	0	7.63	7.17
3949	341587.5	7621713	956	6.73	0	7.23	7.26
3914	341587.5	7621688	956	6.25	0	6.92	6.83
3879	341587.5	7621663	956	4.85	0	6.45	6.21
3844	341587.5	7621638	956	3.7	0	5.41	5.54
3284	341562.5	7621688	956	5.35	0	6.47	6.96
2829	341537.5	7621813	956	4.32	0	6.96	6.84
2654	341537.5	7621688	956	4.85	0	6.45	6.49
2199	341512.5	7621813	956	4.82	0	6.96	6.84
2164	341512.5	7621788	956	3.95	0	6.96	6.84
6575	341687.5	7621788	968	6.65	0	6.96	6.84
6540	341687.5	7621763	968	6.8	0	6.96	6.84
5945	341662.5	7621788	968	6.87	0	6.96	6.84
5910	341662.5	7621763	968	7.45	0	6.96	6.84