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FINAL SITE SCREENING AND IDENTIFICATION FOR THE PROPOSED 30 YEAR ASH FACILITY AT THE KENDAL POWER STATION

Report No : 12935 - Site Identification v5

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1 INTRODUCTION

1.1 Proposed project

Kendal Power Station is a coal-fired power station situated south west of the town of Ogies (Figure 1-1). The power station became operational in 1993**.** The Kendal Power Station employs an indirect dry-cooling system that uses a condenser, cooling water and cooling tower system to effectively cool the cooling water to required temperatures.

Coal it used as a fuel source to heat pure demineralised water to produce steam. The steam produced, in turn, drives an electrical turbine producing electricity, which is fed into the electricity grid at its produced. Waste steam exiting the turbine enters the condenser where it condensates for reuse. In the condenser cooling water flows through thousands of condenser tubes, in an enclosed unit surrounded by the waste steam. As a result of the temperature difference between the water and steam, condensation is achieved through transferral of waste heat to the cooling water. The warmed cooling water flows to a cooling tower where an upward draft of air removes the heat from the water. After cooling, this water returns to the condenser.

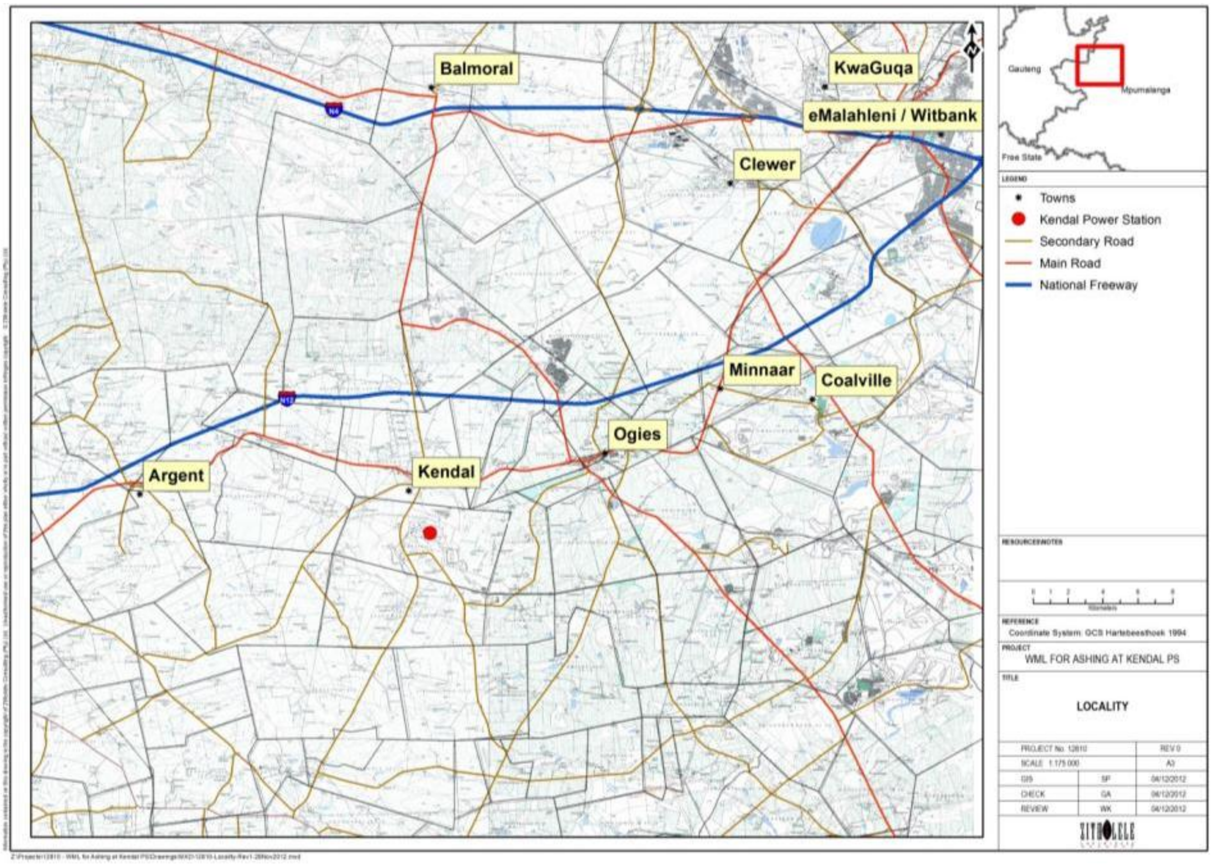

Figure 1-1: Location of the Kendal Power Station

This cooling system, where cooling water flowing through the above mentioned elements, cools down as the cold air passes over them and returns to the condenser, is referred to as a closed system as there is no loss of water due to evaporation and uses significantly less water in its cooling processes than conventional wet cooled power stations. Kendal has six (6) 686 megawatt (MW) electricity generating units, with a combined installed capacity of 4116 MW. The station's cooling towers are the largest structures of their kind in the world with a height and base diameter of 165 m.

The current ash disposal facility of the Kendal Power Station is running out of space due to the poor quality coal accessible for combustion, which has a higher ash content than was anticipated. In addition the life span of Kendal has also been extended from 2023 to 2053, which would render the available ash disposal space inadequate to accommodate the continuation of disposal for the life of the station. Kendal requires an additional 37 year (maximum) disposal site to take it to the end of its lifespan.

Zitholele has been appointed to undertake the Environmental Impact Assessment (EIA) and Waste Management License (WML) Application in terms of the National Environmental Management Act ([NEMA] Act 107 of 1998, as amended 2010) and the National Environmental Management: Waste Act ([NEM:WA] Act 59 of 2008). Zitholele has also been appointed to undertake the Integrated Water Use Licence Application (IWULA) in terms of the National Water Act ([NWA] Act 36 of 1998). It is envisaged that the project will include the following components:

- A dry ash disposal facility of estimated 1000 ha (including associated infrastructure such as stackers, ash water return dams, pipelines and conveyors, access roads, etc.);
- A conveyor belt for the transportation of ash to the ash dump;
- The waste stream comprising of a combined bottom ash and fly ash waste stream;
- Services including electricity and water supply in the form of power lines, pipelines, and associated infrastructure; and
- Access and maintenance roads to the site.

1.2 Purpose of this report

The purpose of this report is to table an approach undertaken for the consideration of alternatives and selection of suitable sites for further detailed investigations.

2 CONSIDERATION OF ALTERNATIVES

2.1 Approach taken

The optimal goal in building an ash disposal facility and associated infrastructure is to effectively minimise the negative social and environmental impact while responsibly and carefully disposing of an existing waste stream generated at the Kendal Power Station.

To ensure that defensible alternatives are identified and considered a structured approach is utilised. Initially, the project team determined the need and motivation for the proposed project (NEMA, 1998). This discussion identifies all the potential solutions that can result in the need being met. When dealing with waste related projects, this discussion typically was structured around the waste hierarchy (National Management Waste Strategy [NMWS], 2010) as shown in Figure 2-1.

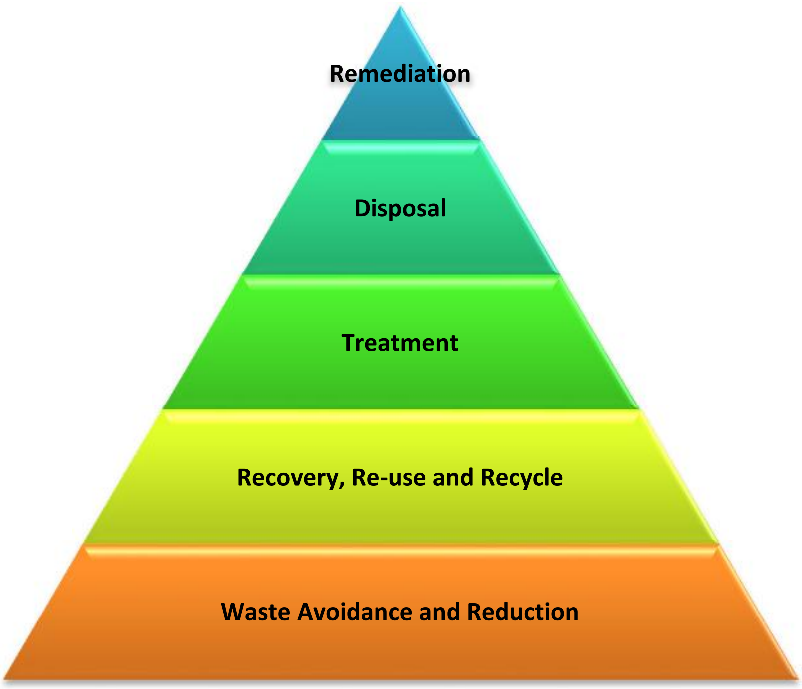

Figure 2-1: Waste Hierarchy

The essence of the approach is to group waste management measures across the entire value chain in a series of steps, which are applied in descending order of priority. The foundation of the hierarchy, and the first choice of measures in the management of waste, is waste avoidance, then reduction. Where waste cannot be avoided, it should be recovered, reused, recycled and treated (NMWS, 2010). Waste should only be disposed of as a last resort.

In working through these systematic hierarchical steps alternative solutions are generated. Waste management could be a single solution best suited to a type of waste, or a combination of several solutions. In each of these steps alternatives can be evaluated and excluded as being not feasible. Technical scientific information is utilised to exclude alternatives in each of these steps. Once feasible alternative solutions are identified a process of evaluation can commence to evaluate the environmental, social, and technical acceptability of these solutions, within each solution alternatives may be considered to improve the positive aspects or reduce the negative aspects of each solution.

2.2 Identification of Alternative Waste Management Solutions

The current status, available information, and further studies required based on the implementation of the Waste Hierarchy is summarised in Figure 2-1. Based on the information available to date the following alternative solutions to the ash waste stream exists:

- **Avoidance and Minimisation:**
  - None. Kendal Power Station has been in operation since 1993, therefore the generation of the ash waste stream is unavoidable.
- **Recovery / Recycling / Re-use:**
  - Use of ash in construction activities i.e. as aggregate in road construction, or as a cement extender;
  - Other applications include cosmetics, toothpaste, kitchen counter tops, floor and ceiling tiles.
- **Treatment**
  - No feasible alternatives are currently available to treat the ash waste.
- **Disposal**
  - Disposal to a suitably designed ash disposal facility.
- **Remediation**
  - Capping of the new facility at the end of life.

Due to the large volumes of ash that will be generated it has been concluded that a dry ash disposal facility will be required, even with the implementation of all the other alternatives.

3 SITE SCREENING

3.1 Defining the study area

The first step in the site identification process includes the identification of the study. The study area was identified using the following criteria, and shown in Figure 3-2:

1.) The study area must coincide with farm boundaries;
2.) The study area is located within a 10 km radius from Kendal Power Station, however priority areas will be investigated within a radius of 7 km. If no suitable options are identified developable areas up to 10 km will be considered;

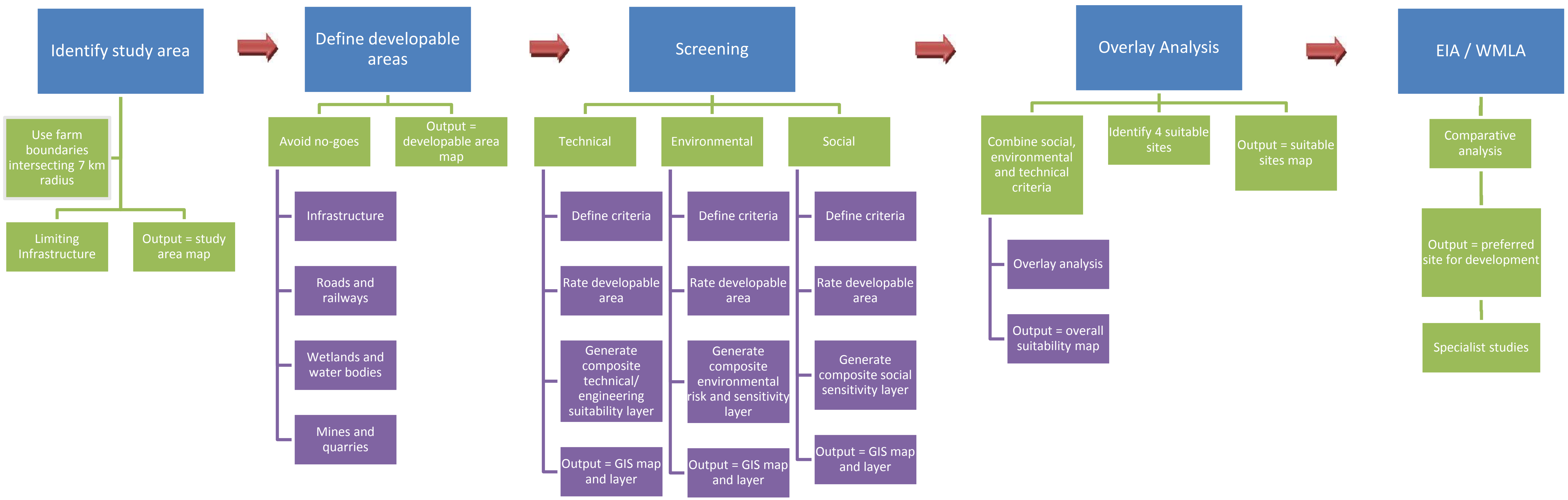

Figure 3-1: Site Selection Methodology.

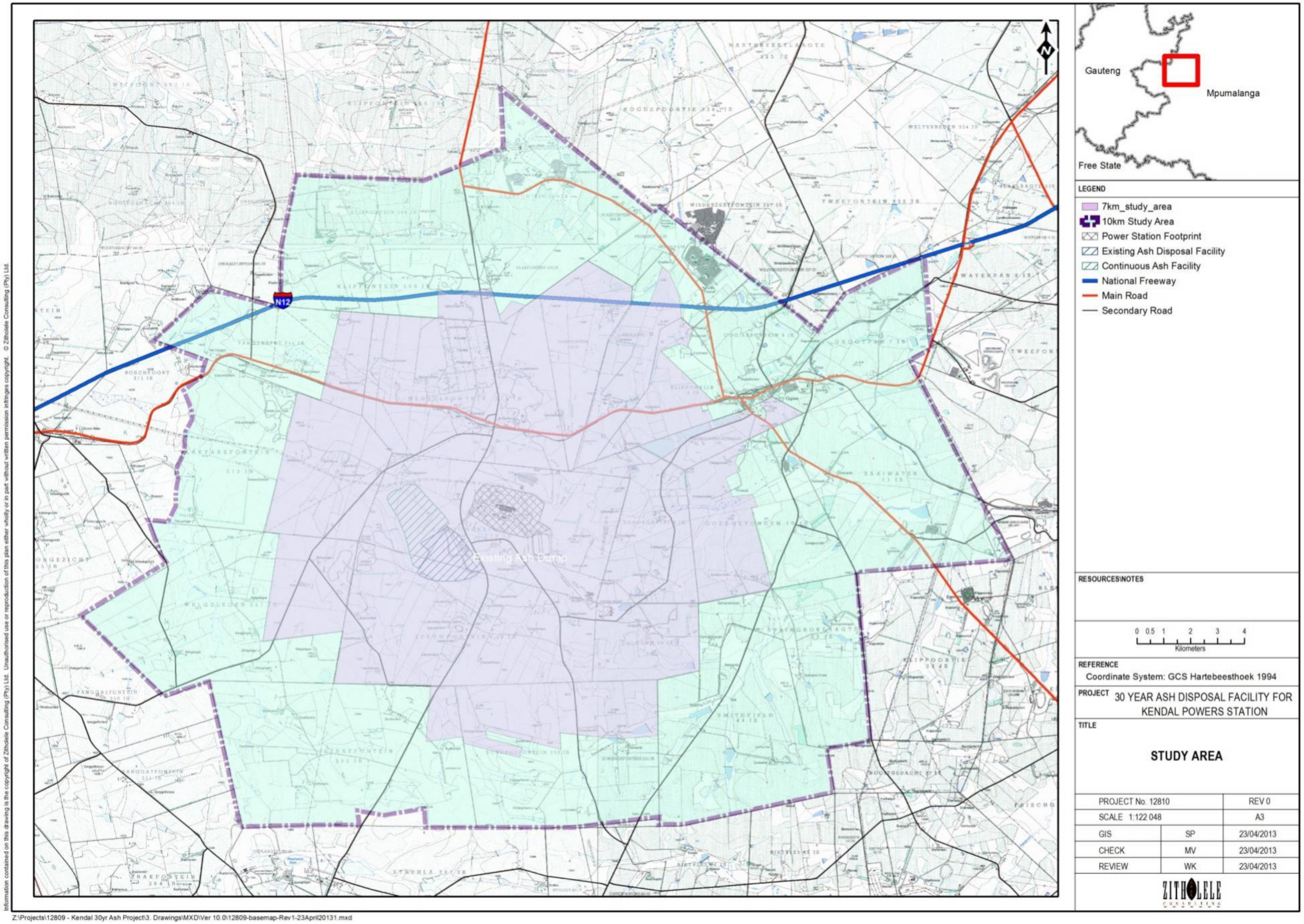

Figure 3-2: Study area for the Kendal 30yr Ash Dump project.

3.2 Defining the developable areas (Negative mapping)

The next step in the process is to define the developable areas. This was be done by using negative mapping in such a way as to exclude all areas within the study area that conflict with the proposed development. A draft list of "Limiting Factors" was drawn up and is shown in Table 3-1 below.

The preliminary desktop assessment of the study site from existing high-level environmental, social and cultural GIS layers, and Google Earth Imagery and 1:50000 topographical maps indicated that the following features were not detected within the study area:

- Cemeteries
- Churches
- Military Facilities
- Known Archaeological sites
- Monuments, and heritage and culturally significant areas
- Protected Areas and Parks

The presence or absence of these features will be verified during detailed specialist studies.

The following No-Go areas where no ash dumps may be placed were identified from the outset of the exercise:

- New Largo footprint, with a 100 m buffer;
- N12 National Road, with a 100 m buffer;
- Rail reserve across the study area, with a 50 m buffer;
- Wilge River, with a 500 m buffer; and
- High density residential areas – Wilge settlement, Phola settlement, Ogies and New Largo settlement, with a 100 m buffer.

After exclusion of the No-Go areas above, the remaining area was subjected to a negative mapping exercise. The objective of the negative mapping exercise was identify important features (environmental, social and technical) in the landscape that should not be impacted by the proposed disposal facility. The GIS layers containing these features are shown in Table 3-1.

In the first instance the feature footprint and substantial buffer for each feature were excluded from the developable area layer in the negative mapping exercise. The buffer width was informed either by legislation, for example the 500 m buffers around wetlands and rivers as stipulated by the National Water Act, or stipulated by existing guidelines and documentation for example pertaining to servitude widths for roads and transmission lines, or dictated by best practice and experience of the environmental assessment practitioner.

The philosophy in this first iteration was thus that if sufficient areas of suitable sizes could be identified, most of the sensitivities and important features in the landscape would already have been avoided. If no areas could be identified, then the buffers of selected features would be reduced and potential areas again investigated. With each iteration the buffers around the landscape feature would be reduced until an assigned minimum value for each feature is reached. For some features such as minor roads and transmission lines, it was assumed that these could be relocated if no other alternatives existed, however for rivers and wetlands it was assumed that they cannot be relocated. Four iterations were investigated before sufficient number and size developable areas were identified.

The following iterations of the negative mapping took place:

- Iteration 1 – Buffers as per Table 2, no suitable areas were identified (see Fig 3-3);
- Iteration 2 – Farmsteads, schools, powerline and roads buffers removed, no suitable areas identified (Fig 3-4);
- Iteration 3 – Built buffers reduced to 100 m, 1 potential site, 1 combination site (2 smaller areas) were identified (Fig 3-5); and
- Iteration 4 – Wetland and river buffers reduced to 100 m, several potential areas (Fig 3-6).

Table 3-1: Areas of avoidance. Red items indicate the identified No-Go areas.

Natural Environment				
Layer	**Iteration 1**	**Iteration 2**	**Iteration 3**	**Iteration 4**
Wilge River	***500 m buffer***			
Rivers / Streams	500 m	500 m	500 m	100 m
Wetlands / Dams	500 m	500 m	500 m	100 m
Red Data Species	100 m	100 m	100 m	100 m
Protected areas and parks	None in study area			
Social Environment				
High density residential areas	***500 m buffer***			
Farmsteads	1 km	☒	☒	☒
Schools	1 km	☒	☒	☒
Cemetries, Churches, Monuments, and heritage and culturally significant areas	Not identified in study area from high level scan			
Built Environment / Engineering Requirements				
New Largo footprint	***100 m buffer***			
Open Pits	100 m	100 m	☒	☒
Undermined Areas	100 m	100 m	☒	☒
Richards Bay Rail	***50 m buffer***			
Other Railway Lines	50 m	50 m	☒	☒
N12 National Road	***100 m buffer***			
Tarred Roads	100 m	☒	☒	☒
Farm Roads	100 m	☒	☒	☒
Overhead Power lines	Serv	☒	☒	☒
Gas Pipeline	Serv	☒	☒	☒
Water Pipeline	Serv	☒	☒	☒
Conveyor Belt	50 m	☒	☒	☒

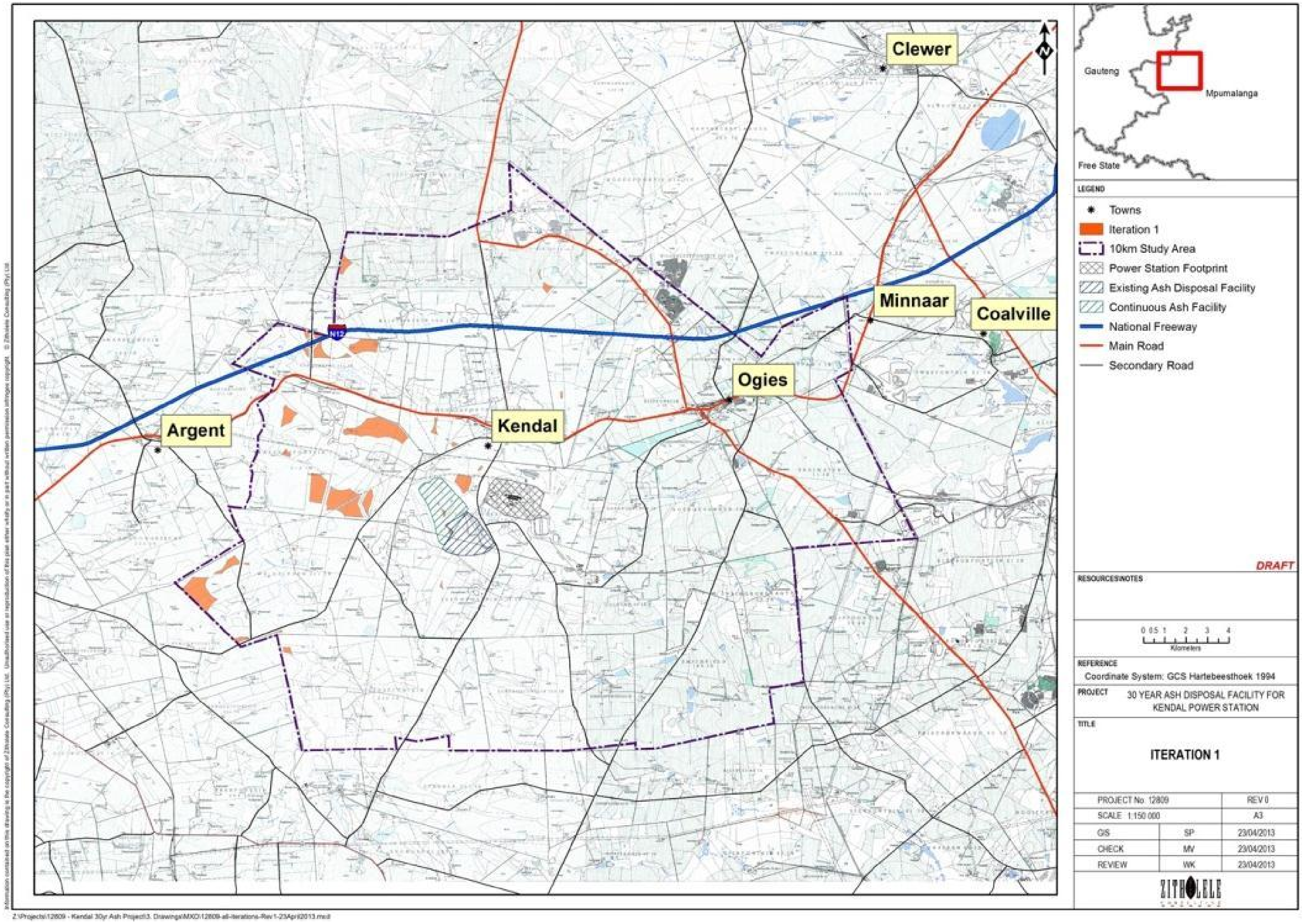

Figure 3-3: First Negative Mapping Iteration

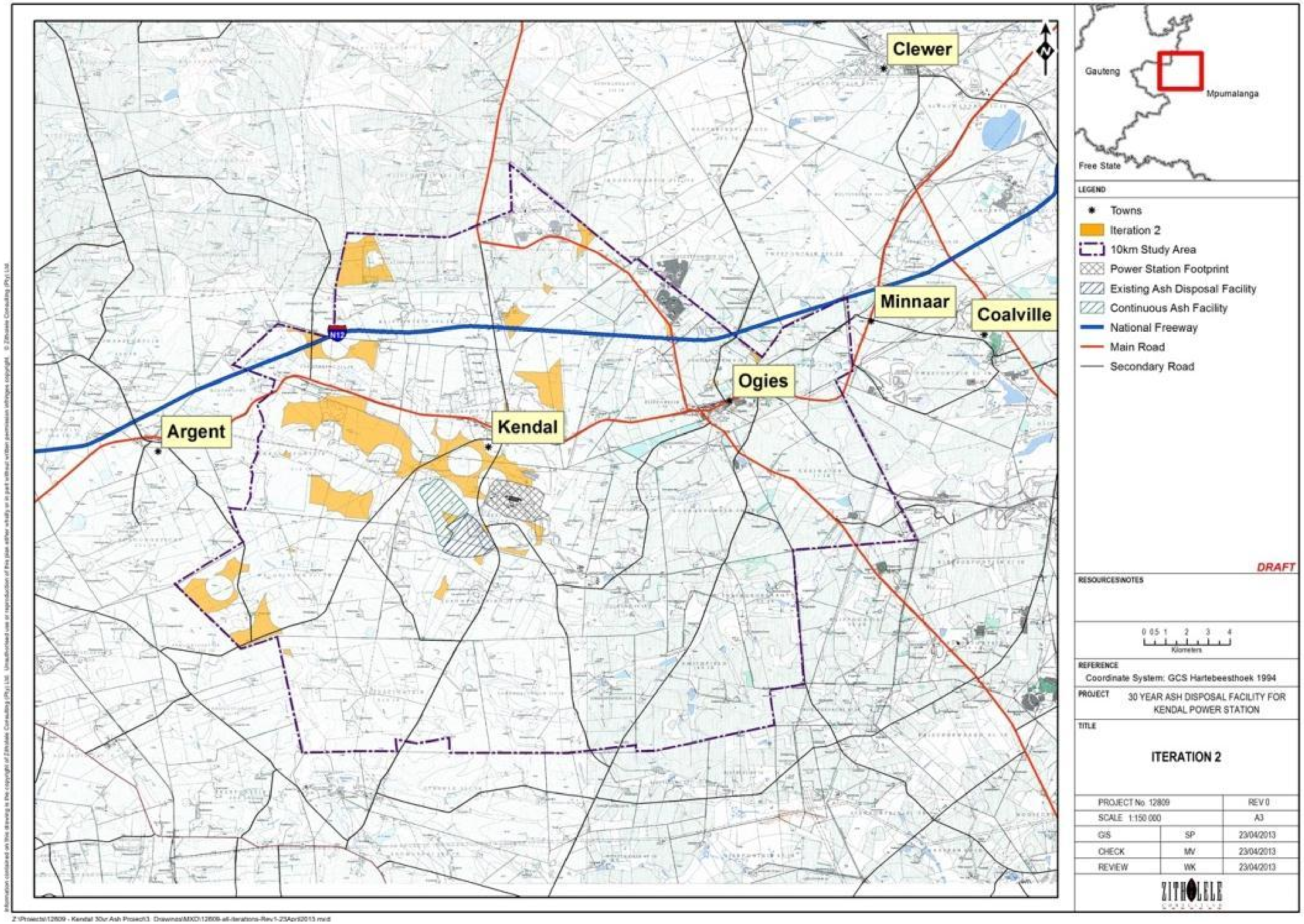

Figure 3-4: Second Negative Mapping Iteration

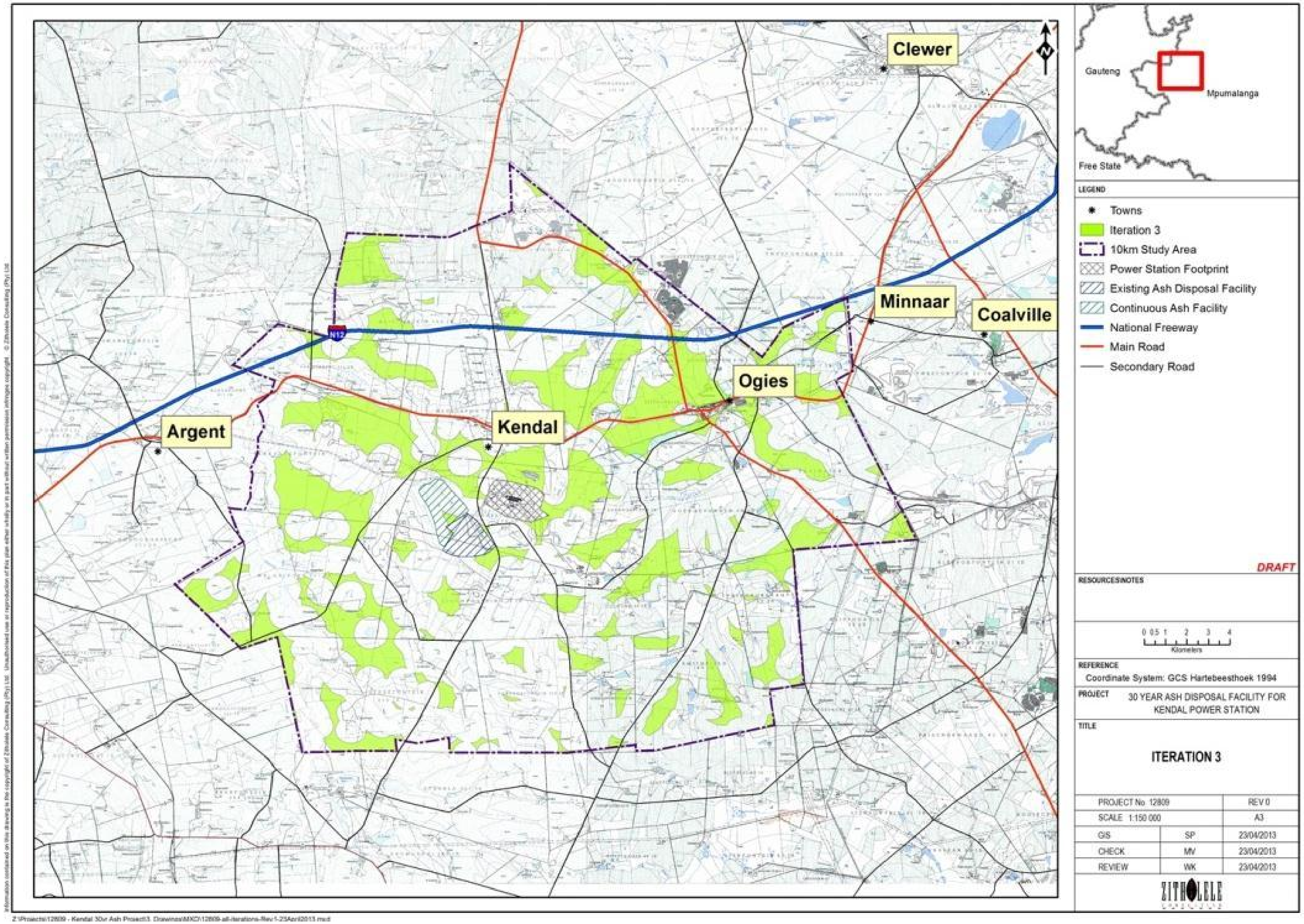

Figure 3-5: Third Negative Mapping Iteration

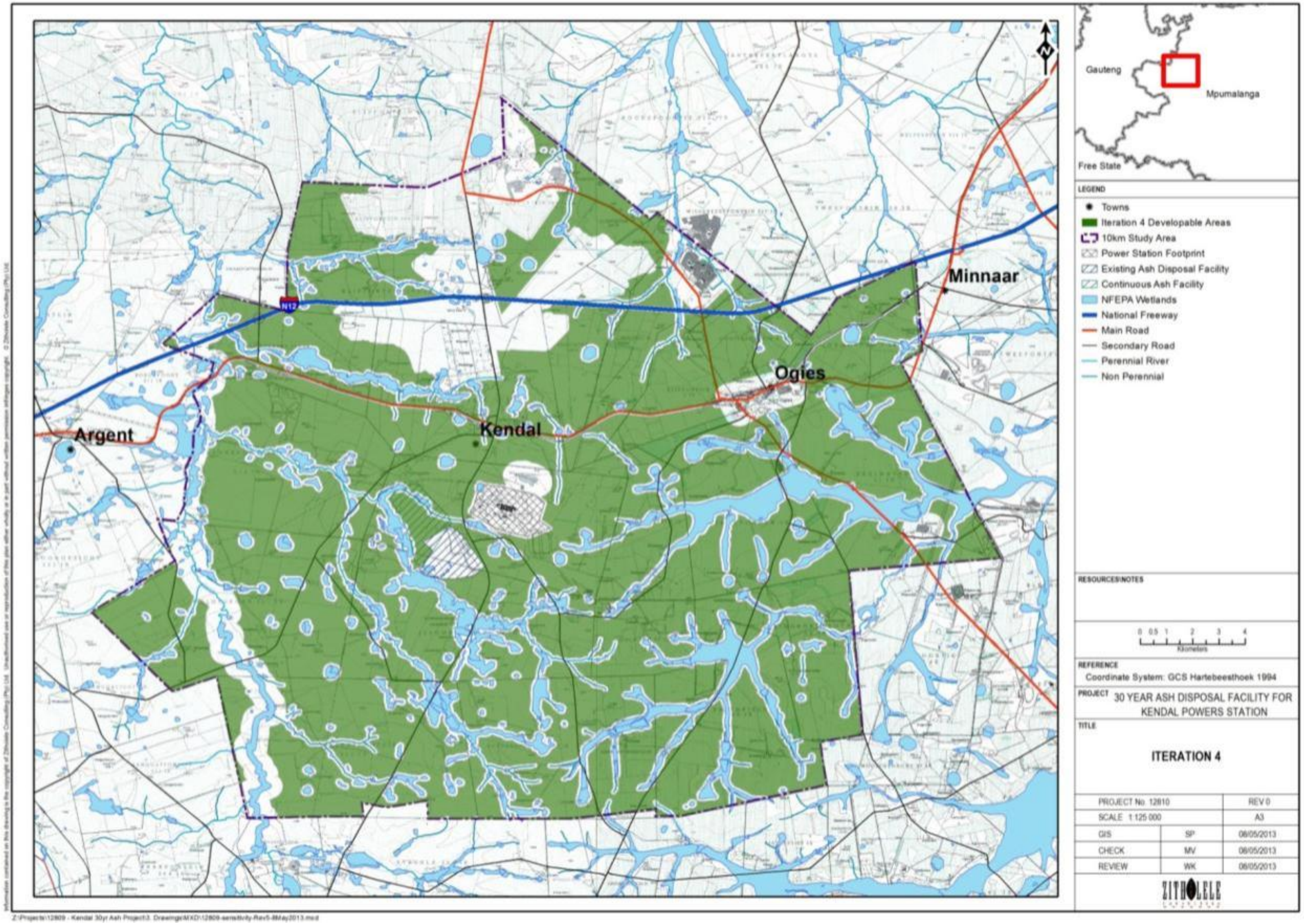

Figure 3-6: Fourth Negative Mapping Iteration

3.3 Determination of potential disposal areas

In order to determine the potential footprint requirements of a potential ash disposal site, the following technical specifications were assumed:

- Ash production would continue in the range of 576 223 m^3 per month;
- Total ash produced over the life of the ash disposal facility would be in the order of 256 million m^3;
- The maximum design life of the facility would be 37 years;
- The facility side slopes should be 1:5.

Using the technical specifications above, a minimum and maximum facility footprint scenario was developed by the technical team. Assuming a facility height of 50 m, which has proven feasible at other dry ash disposal facilities in the region, the maximum footprint scenario would require a facility footprint of approximately **770 ha**. For the minimum footprint scenario a maximum height of 100 m would require a facility footprint of approximately **520 ha**. The viability of the minimum footprint scenario is however dependant of the underlying geotechnical conditions in the study area. In both these scenarios the calculated facility footprints did include 15% additional area to allow for topography variability, and additional 50 ha to house return water dams, roads, conveyor alignment, site camp, etc.

Assuming an ash disposal facility footprint range between 520 ha and 770 ha, and the available developable area (Iteration 4), sites of sufficient size was demarcated. Consultation with the specialist team revealed that water resources in the developable area north and northeast of the Kendal Power Station were destroyed due to mining activities. These areas where water resources were destroyed were included as developable areas. Based on this 9 potential areas was identified that could support the ash disposal facility (see Figure 3-7, Table 3-2).

Further consultation with the specialist team revealed that the pan just west of the Kendal Power Station was severely polluted for large parts of the year, but that flamingos have been sighted at the pan during the high flow periods of the year. Given the status of the pan and the close proximity to the Kendal Power Station the project team decided to include another area (Site H) in the sensitivity analysis of potential areas.

Thus, the negative mapping exercise identified 9 potential developable areas within the study area as shown in Figure 3-7.

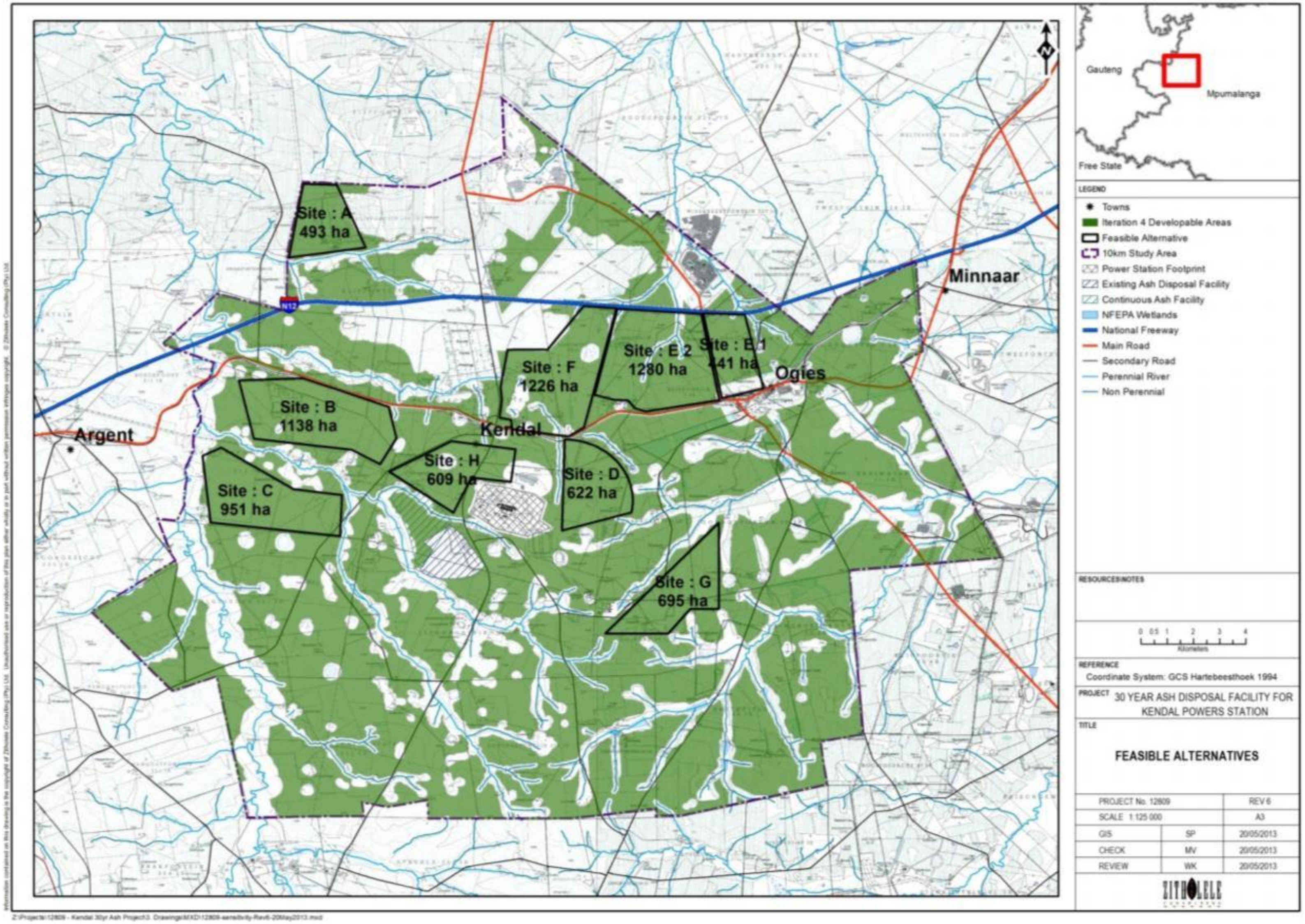

Figure 3-7: Potential feasible sites identified during the site identification process

The list of potential sites with coverage in hectares is provided in Table 3-2.

Table 3-2: List of potential sites and associated areas

Potential Sites	
Individual Sites:	
Site:	**Area (Ha):**
Site A	492
Site B	1 137
Site C	950
Site D	622
Site E2	1 280
Site F	1 226
Site G	694
Site H	609
Area Combinations:	
Area E1 & E2	441 + 1 280 = 1 721

Site A was excluded from further analysis as the small potential size of the area (<520ha) and the absence of other identified areas in close proximity to the area resulted in it being fatally flawed.

3.4 Environmental and Social Sensitivity Analysis

Each of the developable areas identified were rated according to their environmental and social sensitivity, and their technical / geotechnical suitability. This section provides the environmental and social sensitivity analysis that was undertaken for the potential sites that was identified.

Several environmental and social layers were used to calculate the environmental and social sensitivity of the proposed developable areas. These layers are listed in

Table 3-4. The sensitivity of the features in each layer was rated according to a rating scale ranging from 1 to a maximum of 5. The rating scale is provided in Table 3-3 below.

Table 3-3: Sensitivity rating scale used for rating of the site elements

Rating	Description
1	**Very Low sensitivity**
2	**Low sensitivity**
3	**Moderate sensitivity**
4	**High sensitivity**
5	**Very High sensitivity**

Table 3-4: List of data layers used and rating values assigned to the site elements

Shapefile	Data source	Data	Value	Reasoning
Mpumalanga Biodiversity Conservation Plan	SANBI (2007)	Protected, Irreplaceable Area	5	In order of importance and sensitivity, with Protected and Irreplaceable areas the most sensitive.
		Highly significant	4	
		Important and Necessary	3	
		Least concern	2	
		No Natural	1	
Natural wetlands (NFEPA)	SANBI (2010)	Wetlands with a 100 to 500m buffer.	5	Wetlands and rivers were given a No-Go buffer area of 100m (Iteration 4). Sensitivities applicable for area between 100 m and 500 m from a river or wetland.
Rivers (NFEPA)	NFEPA (National Freshwater Ecosystem Protection Areas)	Unmodified, Natural	5	
		Largely Natural	4	
		Moderately/Largely Modified	3	
		Seriously Modified	2	
		Critically, Extremely modified	1	
Land Capability	Agricultural Geo-referenced Information Systems (AGIS)	High potential arable land	4	
		Moderate potential arable land	3	
		Marginally potential arable land	2	
Landuse	DWAF 2009	Urban Residential	5	Resettlement is a last option
		Wetlands, water bodies	4	DWA mandated to protect all wetlands and waterbodies
		Mines, Quarries	3	Important land uses, but can be bought out
		Thickets, Forestry	1	
Agri Fields	Department of Agriculture (DoA) (2008)	Agricultural Fields	4	Quality agricultural lands
Households		500 m buffer	5	
		1 km buffer	3	
Mine areas		Workings	4	
		Resources	3	
		Coal rights	1	
Roads - Small Scale	AfriGIS (2012)	National road (excl. N12)	4	Avoid moving major roads, however crossing of roads is possible
		Main, Arterial road	3	
		Secondary road	1	
Rail (RBY) via Ogies	DWAF	Railway line - standard	5	Important major railway line
Rail via Kendal		Railway line - standard	3	Rail is cheaper to move but logistically is just as difficult
Powerlines (HV)	Eskom	765 kV, 533 kV, 400 kV Tx	4	
Powerlines - Tx		275 kV, 220 kV	3	
Powerlines - Dx		132 kV	2	
Other Tx infrastructrure		Power substation footprint (HV), 88 kV and less	1	

The biodiversity conservation plan is a layer that rates the conservation value of any piece of land in the study area, the higher the rating the more sensitive the piece of land. This rating takes into consideration fauna, flora and soils as well as enough space around the features to allow them to be sustainable. In addition to the conservation plan rating the Department of Water Affairs' NFEPA data was used to identify wetlands and rivers of conservation importance.

In some of the layers, e.g. the biodiversity and river layers, the components of the layers were grouped into 5 categories, which were conveniently aligned with each group's sensitivity as proposed in Table 3-3. The remaining layers did not contain enough different components and assigned sensitivities to allow a sliding sensitivity scale of 1 to 5. In these instances the existing components in each layer was simply rated according to the perceived sensitivity as judged by the assessment practitioners and specialist team.

In the next step of the sensitivity analysis, the rated layers were overlaid on top of one another in a Geographical Information System package (ArcGIS 10.1). Where several components overlaid the same geographical area, the highest sensitivity rating of all of these layers was assigned to the particular area (or polygon). In instances where the highest rating was shared between 2 or more layers, the overall sensitivity rating of the area (or polygon) was bumped to the next level to ensure that the individual sensitivities in each layer translated into a cumulative higher sensitivity. This is described in a simplified manner below.

Environmental/Social layer sensitivity 1:	4
Environmental/Social layer sensitivity 2:	3
Environmental/Social layer sensitivity 3:	3
Environmental/Social layer sensitivity 4:	1
Combined sensitivity	**4**

However, with 2 or more sensitivity layers with the same rating the combined rating is as follow:

Environmental/Social layer sensitivity 1:	4
Environmental/Social layer sensitivity 2:	4
Environmental/Social layer sensitivity 3:	3
Environmental/Social layer sensitivity 4:	1
Combined sensitivity	**5**

The result of the sensitivity analysis includes a separate sensitivity layer for the environmental and social components. The environmental and social sensitivity layer was subsequently "clipped" with the developable areas layers to exclude all the No-Go areas identified at the start of the exercise (see Figure 3-8 and Figure 3-9).

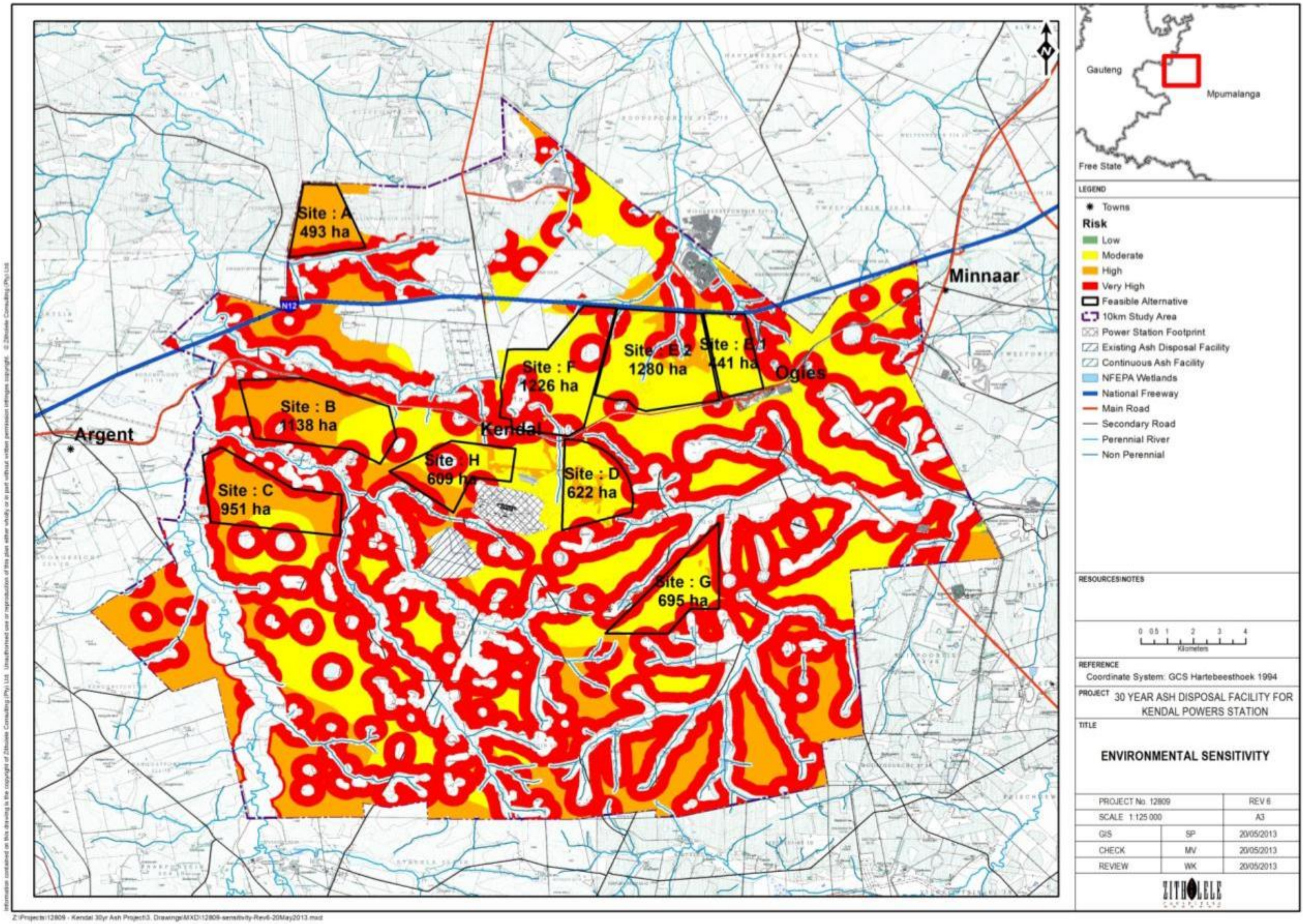

Figure 3-8: Environmental sensitivity of environmental features within the study area

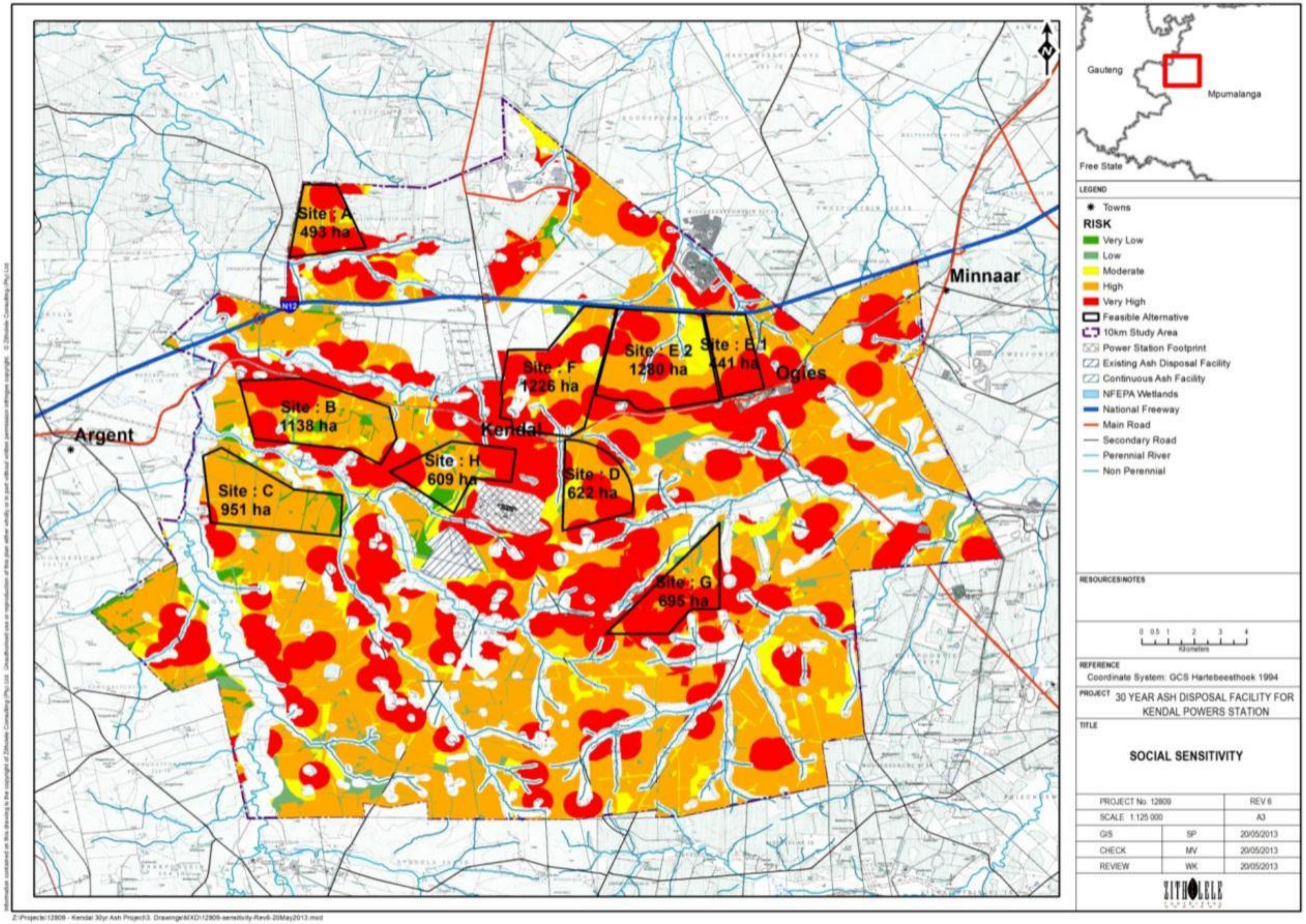

Figure 3-9: Social sensitivity of social features within the study area

3.5 Overlay analysis

During the overlay analysis the sensitivities within the identified areas was considered. The environmental and social sensitivity layers were "clipped" with the identified areas and the highest sensitivity per site element, as identified in Table 3-4, was determined for each site element.

The ratings per site element were summarised in a table format where the un-weighted score represented the sum of all the sensitivity ratings and the weighted scores represented the sum of all the sensitivity ratings after a weighting per element had been factored into each rating.

Higher un-weighted and weighted scores represent more sensitive area, thus less ideal for placement of an ash disposal facility, whereas lower scores represent more suitable sites.

The ratings per environmental element are provided in Table 3-5 and Figure 3-10 below.

Table 3-5: Environmental site identification matrix

Element	Weighting	B	C	D	E1	E2	F	G	H
Terrestrial Biodiversity	3	1	3	4	1	1	3	2	4
Wetlands - NFEPA	5	4	4	3	1	1	2	5	3
Rivers - NFEPA	5	4	4	2	1	1	1	5	2
Land Capability	2	3	4	3	1	1	1	3	3
Score Un-weighted		**12**	**15**	**12**	**4**	**4**	**7**	**15**	**12**
Rank Un-weighted		**4**	**7**	**4**	**1**	**1**	**3**	**7**	**4**
Score Weighted		**49**	**57**	**43**	**15**	**15**	**26**	**62**	**43**
Rank Weighted		**6**	**7**	**4**	**1**	**1**	**3**	**8**	**4**

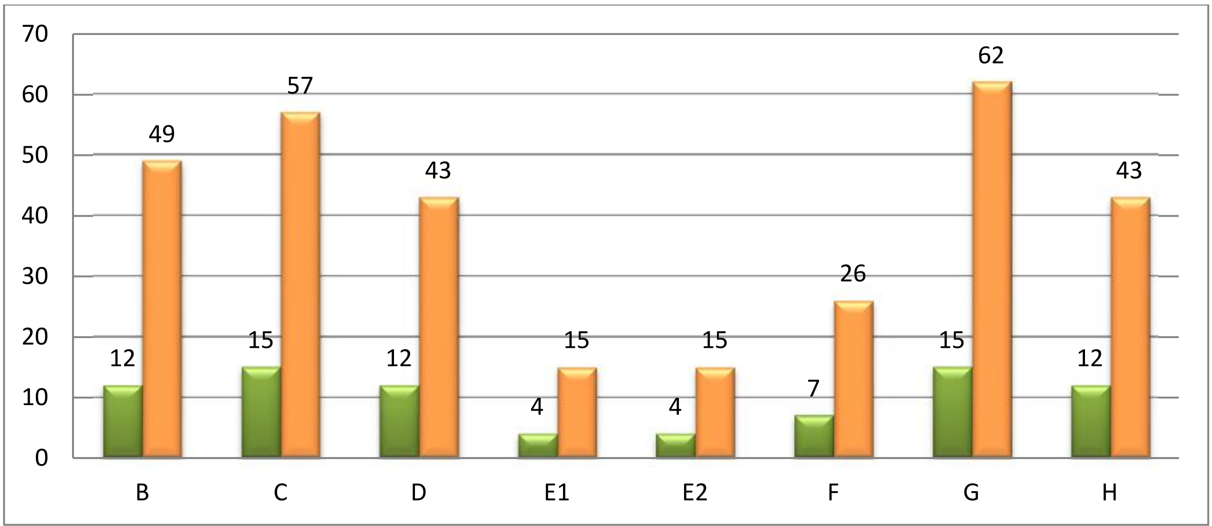

Figure 3-10: Environmental site identification un-weighted (green) and weighted (orange) sensitivity scores

As expected the site areas where mining is the predominant land-use (E1, E2 and F) has rated very favourably as less environmentally sensitive sites. Site areas D and H also rated with moderate environmental sensitivities.

The ratings per social element are provided in Table 3-6 and Figure 3-11 below.

Table 3-6: Social site identification matrix

Element	Weighting	B	C	D	E1	E2	F	G	H
Land Use	5			1	5	1		1	1
Households	5	5	1	4	4	1	3	5	5
Fields	4	3	4	3	1	1	1	3	3
Mining	4			4	4	4	4	4	4
Roads	2	1	1	1	5	4	4	1	1
Powerlines	2	3		1	1				4
Pipelines	2	4							4
Wind direction (Air Quality)	3	4	4	3	4	4	4	3	3
Score Un-weighted		**20**	**10**	**17**	**24**	**15**	**16**	**17**	**25**
Rank Un-weighted		**6**	**1**	**4**	**7**	**2**	**3**	**4**	**8**
Score Weighted		**65**	**35**	**66**	**89**	**50**	**55**	**69**	**85**
Rank Weighted		**4**	**1**	**5**	**8**	**2**	**3**	**6**	**7**

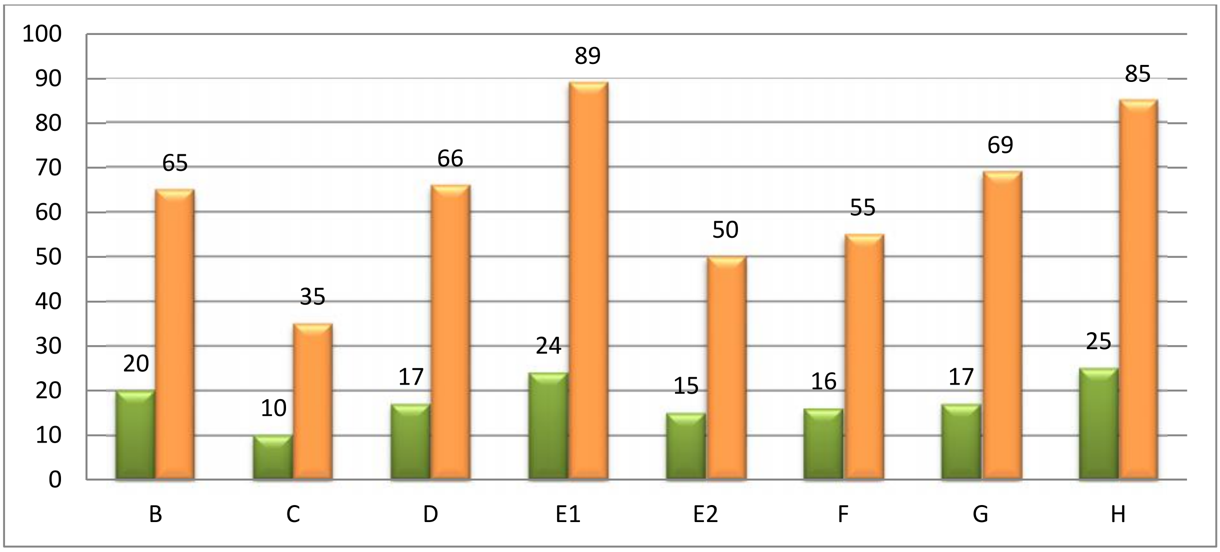

Figure 3-11: Social site identification un-weighted (green) and weighted (orange) sensitivity scores

Site areas C, E2 and F emerged as the least socially sensitive areas, with areas B and D emerging as moderately sensitive areas.

3.6 Technical Suitability Rating

3.6.1 Design Assumptions and Information

Sites identification

Nine (9) site areas were identified using GIS negative mapping in such a way as to exclude areas within the study area that conflict with the proposed ash disposal facility. These sites marked the proposed developable areas that needed to be investigated further. The areas are shown on Figure 3-7.

Assumptions

In order to rank the sites for technical suitability, certain design assumptions had to be made. These are listed below:

- Mechanical stackers will be utilized as per original ashing procedure. A multi-level stacker set-up is assumed making use of 2 stackers simultaneously.
- The preliminary ash classification report identified this as an hazardous waste product hence a H:H Lagoon barrier system was proposed.
- The current monthly ash production of 576,223 m^3 will be maintained throughout the life of the ashing facility.
- The life of the ashing facility was assumed to be 37 years (2016 to 2053).

Stacker Philosophy

A multi-level stacker setup is proposed for the Kendal 30 yr ash facility operations. Conventional operations dictate that this setup would allow the initial stacker to place an estimated 15 m front stack and 12 m back stack, which will consolidate the underlying soil layers, increasing their strength in time to support the second stacker's 21 m front stack and 12 m back stack as shown in Figure 3-12. The front and back stack to be placed by the second stacker is dependent on the geotechnical conditions within the study area. The thickness of the layers deposited by the back stack will be determined geotechnical conditions has been confirmed.

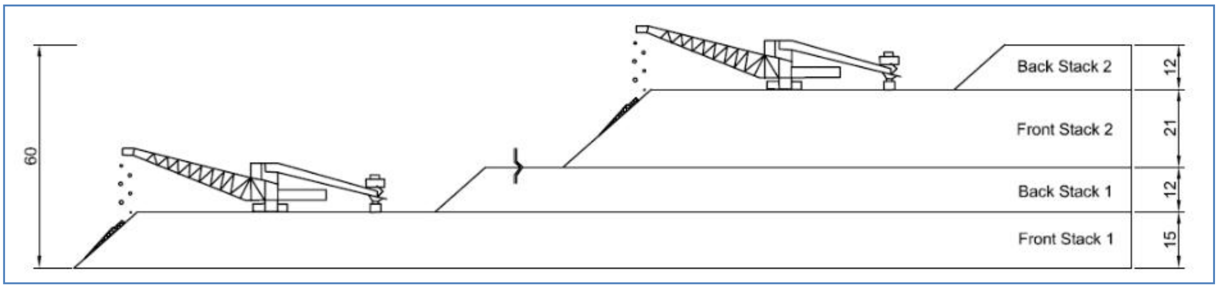

Figure 3-12: Multi Stacker Philosophy

Site characteristics

Characterisation of the nine site areas in terms of area, average slope and drainage direction are given in the table below:

Site ID	Area (ha)	Average Slope (%)	No. of drainage directions
A	493	3.3	2
B	1 138	3.1	2
C	956	2.2	1
D	622	2.6	2
E1	441	1.0	1
E2	1 280	1.6	1
F	1 226	1.4	2
G	695	2.1	2
H	609	3.5	3

Preliminary site suitability

Over a period of 37 years, the total ash production will amount to approximately 252 million m^3. Each of the above site areas was assessed against a number of site selection criteria before being taken into the next round of assessment.

At each of the identified site areas, a 50 metre zone was taken from the site boundary to determine the toe of the ash dump. This was reserved for service roads, stormwater drainage, and return water pipelines, etc. The volume for each site was determined for heights of 50, 75 and 100 metres. These heights were suggested based on geotechnical conditions and engineering designs based on the development of a similar ash disposal facility for the Kusile Power Station nearby. These three heights are considered as potential viable scenarios, pending the desktop geotechnical investigation. Once a preliminary geotechnical study has been done, the maximum height, and the corresponding volume, for each site will be known and assessed further. The results of this assessment are given in Table 3-7 below.

Table 3-7: Storage capacity in years for each of the identified sites for a maximum period of 37 years

Site ID	Storage potential (No of years)		
	50 metres high	75 metres high	100 metres high
A	20	27	32
B	52	72	88
C	42	57	69
D	27	36	44
E1	17	23	27
E2	61	85	106
F	49	66	79
G	28	37	44
H	25	33	39

Site areas A, and E1, do not meet the minimum requirement of having a total storage potential of 37 years. E1 may be considered further as a supplement to its neighbours, E2, if these areas are deemed feasible after this round of site identification.

Site A was excluded from further analysis as its insufficient size resulted in it being fatally flawed.

Site selection criteria

Methodology

A technical evaluation was done on the remaining sites that were identified above. The following process of selecting the most feasible areas was used:

1. Formulate the list of selection criteria that will form the base of the comparison between the different alternatives. The site selection criteria used is given in Table 3-8 below.

Table 3-8: Technical evaluation criteria, descriptions and weighting

No	Criteria	Description	Weighting
1	Distance to powerstation (conveyor route)	Capital costs based on feasible routing	5
2	Topography	Amount of levelling, excavation and fill required	2
3	Storage and expansion potential	Possibility of extension onto facility for power station life beyond 2053	1
4	Accessibility	Access to site in terms of conveyors and general vehicle access including consideration of river, railway and road crossings	3
5	Capacity of site	Amount of ash to be accommodated on site, life of ash stack and height	5
6	Storage efficiency	Efficiency of land usage – higher dumps with smaller footprints are more economical in terms of liner costs	3
7	Drainage direction	One way drainage more suitable than two or more directional drainage	3
8	Capital costs	Capital costs	5
9	Operational costs	Operational costs	5
10	Diversion of natural or major infrastructure	Includes diversion of roads, power lines, pipelines and streams	5
11	Undermined areas	The depth and extent of undermined areas impacts on the feasibility and storage capacity of a particular site	5
12	Open casts mining	Impacts on the feasibility and storage capacity of a particular site	5
13	Operability	Ease of operations – based on shape of ash dump	5
14	Rehabilitation	Ease of rehabilitation	5

2. Apply a weighting to each criteria as per the list below:

Weighting	Description
1	Nice to have
2	Significant
3	Important
4	Good site
5	Technical priority

3. Each of the identified 9 site areas was scored against the fourteen objectives listed above using the system indicated in the table below:

Score	Description
5	Unacceptable
4	Tolerable
3	Acceptable
2	Good
1	Ideal

4. Sum the scores of all the objectives for each alternative before applying the weighting. This will provide an un-weighted ranking which is the first indication of the preferable sites.
5. Apply the weightings and sum the scores again. This will provide a weighted ranking which is the final indication of the preferable sites.

The results of the site selection, based on the objectives identified above, are listed in the Table 3-9 and Figure 3-13 below.

Table 3-9: Technical site identification and ratings matrix

Objective	Weight	B	C	D	E1	E2	F	G	H
Distance to powerstation (conveyor route)	5	3	4	1	4	4	2	3	1
Topography	2	4	3	3	5	5	5	3	4
Storage and expansion potential	1	1	1	4	5	1	1	3	4
Accessibility	3	3	2	2	4	4	3	3	1
Capacity of site	5	1	1	3	5	1	1	2	3
Storage efficiency	3	3	3	3	3	3	3	3	3
Drainage direction	3	4	1	4	1	1	2	4	5
Capital costs	5	3	4	2	4	4	3	4	2
Operational costs	5	3	3	2	4	3	3	4	1
Diversion of natural or major infrastructure	5	1	1	1	5	4	4	1	5
Under mined areas	5	4	1	4	5	1	1	3	1
Open cast mining (Inst)	5	1	1	1	4	4	4	1	1
Operability	5	2	2	4	1	1	3	3	3
Rehabilitation	5	2	2	4	1	1	3	3	3
Score Un-weighted		**35**	**29**	**38**	**51**	**37**	**38**	**40**	**37**
Rank Un-weighted		2	1	5	8	3	5	7	3
Score Weighted		**139**	**120**	**147**	**204**	**150**	**155**	**159**	**139**
Rank Weighted		2	1	4	8	5	6	7	2

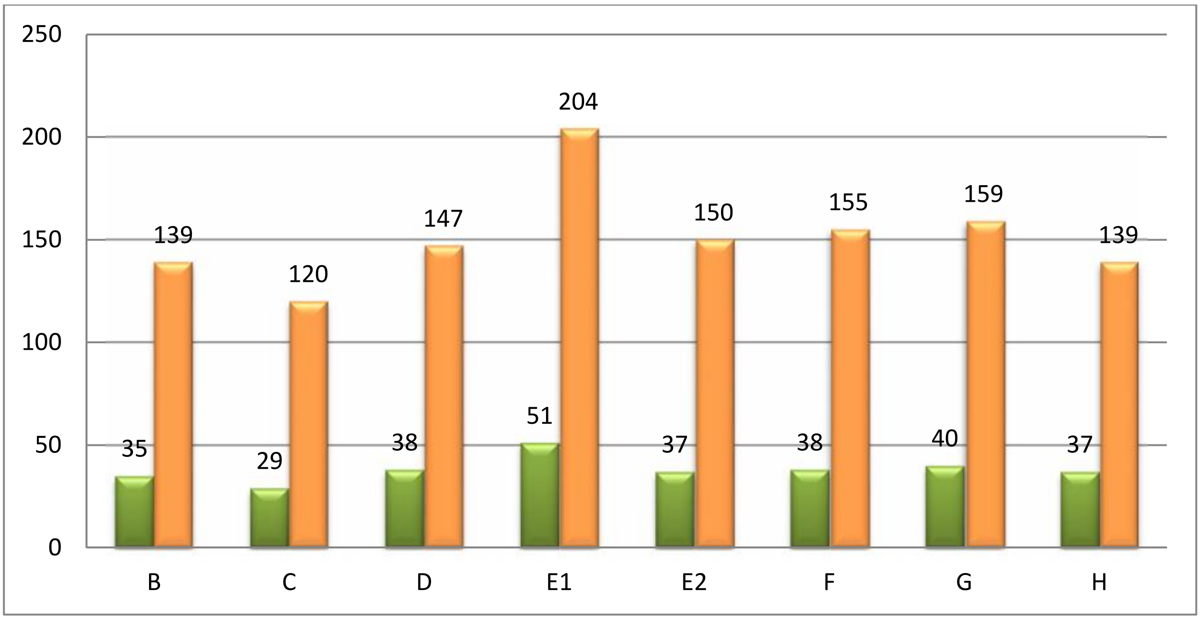

Figure 3-13: Technical site identification un-weighted (green) and weighted (orange) sensitivity scores

4 COMBINED RATING OF TECHNICAL, ENVIRONMENTAL, AND SOCIAL CRITERIA

The totals calculated for the Environmental and Social elements (Environmental & Social Sensitivity Matrices) were added to the Technical totals (Technical Site Selection Matrix), in order to achieve a combined rating of all elements used as part of the identification criteria (Table 4-1).

Table 4-1: Combined equally wieghted site identification and ratings matrix

Aspect	Weighting	B	C	D	E1	E2	F	G	H
Environmental	**33.33%**								
Score Un-weighted		12	15	12	4	4	7	15	12
Score Weighted		49	57	43	15	15	26	62	43
Social	**33.33%**								
Score Un-weighted		20	10	17	24	15	16	17	25
Score Weighted		65	35	66	89	50	55	69	85
Technical	**33.33%**								
Score Un-weighted		35	29	38	51	37	38	40	37
Score Weighted		253	212	256	308	215	236	290	267
Combined Score Un-weighted		***22.3***	***18.0***	***22.3***	***26.3***	***18.7***	***20.3***	***24.0***	***24.7***
Combined Rank Un-weighted		**4**	**1**	**4**	**8**	**2**	**3**	**6**	**7**
Combined Score Weighted		***122.3***	***101.3***	***121.7***	***137.3***	***93.3***	***105.7***	***140.3***	***131.7***
Combined Rank Weighted		**5**	**2**	**4**	**7**	**1**	**3**	**8**	**6**

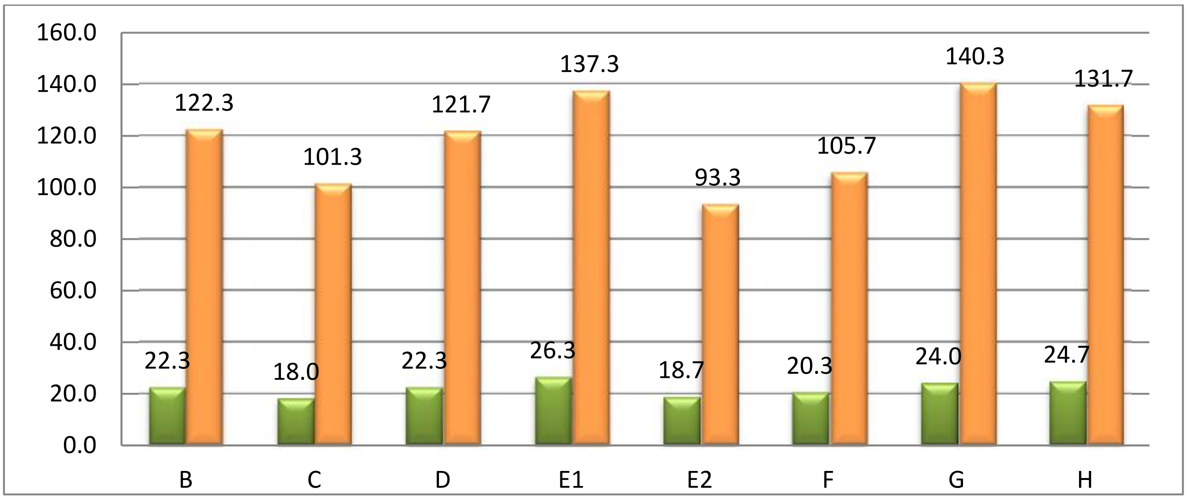

Figure 4-1: Combined, equally weighted site identification sensitivity scores

Table 4-2 summarises the results of the site selection matrix and identifies the primary advantages and disadvantages of each of the site areas. It further lists actions required in order to arrive at three most favourable site areas:

Table 4-2: Matrix results and site area summaries

Ranking	Site area	Notes
1	**E2**	The site area has good drainage potential as one way drainage occurs. This site area also largely transformed as the entire site is either currently being mined, being prepared for mining or will be mined in the short term future, therefore no sensitive environmental or social elements are present on with the mined area. The size of the identified area in E2 (1280 ha) is an advantage as the exact placement of an ash facility footprint of between 520 and 770 ha can be optimised inside the identified area to further avoid sensitivities on site. Socially the site is relatively uninhabited and no major relocations of people are expected. Disadvantages of site area E2 is the fact that the entire site is either currently being mined (strip mining) or will be mined in the short term future. The straight line distance from the power station to the closest edge of site area E2 is ~5.7 km, making it one of the furthest areas to the power station. Considering E2 is situated to the east of the Kendal Power Station, and the fact that the existing ash conveyor exits the power station on its western side, establishing a conveyor alignment will be challenging from its current exit point. Site area E2 is further wedged between the N12 in the north and the R555, also a major road, in the south, which means the conveyor will have to cross the R555 and Richards Bay railway line. Visual and air quality impacts are likely to be more pronounced and will have to be managed and mitigated intensely. The primary risk factor in considering site area E2 is the existing mining activities on site. The entire site is earmarked for strip mining, with approximately half of the site already being mined. The high level desktop information suggest that no underground mining is occurring within the footprint of site area E2, however this will have to be confirmed. Another risk is the low success of institutional arrangements given the uncertainty, given the transfer of liability between the mine and Eskom. This site area thus has a high risk of being fatally flawed as a result of current mining operations and institutional arrangements. Further, in the event that the site area is excluded, E1 will also become redundant as the Site area is dependent on the viability of E2. In order to arrive at a level where confident decision-making can occur, more detailed investigations regarding the geotechnical conditions within the site boundaries must be undertaken. Consultation with the mining house must also be undertaken. Actions required are as follows: 1. Consult with mine houses (Anglo American - New Largo, Xtrata Coal SA - Tweefontein North) regarding property and mineral rights. a. This will require consultation with relevant departments of Eskom regarding manner and content of consultation with mine houses.

		2. Information regarding mining plans and scheduling, quality of the minerals mined and lifespan of the mine must be obtained. 3. Access to the property and more detailed geotechnical investigations on site is required to verify the viability of an ash disposal facility and dump height. 4. Access to the property for a site visit by the EAPs is required to confirm site sensitivities (i.e. environmental, social and technical).
2	**C**	The site area has good drainage potential in one drainage direction. The size of the identified area C (956 ha) is an advantage as the exact placement of an ash facility footprint of between 520 and 770 ha can be optimised inside the identified area to further avoid sensitivities on site. Socially the site is uninhabited and no major relocations of people are expected. The location of the site area west of the existing Kendal Power Station allows for a natural extension of the conveyor westward from the transfer house to the site, which is technically more preferred. The disadvantages of site area C is its close proximity to the Wilge River along its western extent. This could be mitigated to some extent by placement of the ash disposal facility in the eastern and central parts of the site area. Preliminary information regarding affected mining houses indicates that mining rights on land portions on the western portion of the site is owned by Anglo American's Zondagsfontein mining project (Zibulo Colliery). The straight line distance from the power station to the closest edge of site area C is ~4.7 km, making it one of the furthest areas to the power station. The conveyor will have to cross two secondary roads. Registered mineral rights on some properties within the site area are the determining factor in determining if C is a viable site alternative. Surface and underground mining activities will have to be confirmed. This site area currently has a low to moderate risk of being fatally flawed as procurement of agricultural land and mining rights is a very possible option to secure the identified area. The site area has no existing mining activities within the identified boundaries therefore this site is a good alternative to investigate further in the next phase. The next phase of the study must include the following: 1. Confirmation of owners of the mineral rights, and mineral rights granted. 2. Consultation with mineral rights owners regarding property and mineral rights. a. This will require consultation with relevant departments of Eskom regarding manner and content of consultation with mine houses. 3. Access to the property for a site visit by the EAPs and specialist team is required to confirm site sensitivities (i.e. environmental, social and technical).
3	**F**	A sizable portion of the site area is transformed through mining activities, or is being prepared for mining in the short term future. It is further suspected that illegal mining activities are also occurring on

		site F, but this will have to be confirmed. The remaining portions are being cultivated. On-pit ash disposal may be a viable option. The size of the F (1226 ha) is an advantage as the exact placement of an ash facility footprint of between 520 and 770 ha can be optimised inside the identified area to further avoid sensitivities on site. The conveyor alignment may also be less challenging than other alternatives considering that the site is directly north of the power station. Socially the site is relatively uninhabited and no major relocations of people are expected. The disadvantage of site area F is the fact that a portion of the site area is either currently being mined (strip mining) or will be mined in the short term future. A large portion of the site area is also under cultivation. The site area drains in two directions. Site area F is also wedged between the N12 in the north and the R555 in the south, which means the conveyor will have to cross the R555 and Richards Bay railway line. Visual and air quality impacts are likely to be more pronounced and will have to be managed and mitigated intensely. The primary risk factor in considering site area F is the existing mining activities on site, and the presence and extent of underground mining, which is unknown at this stage and will have to be confirmed. This site area thus has a moderate risk of being fatally flawed as a result of mining operations on a portion of the site area identified. In order to arrive at a level where confident decision-making can occur, more detailed investigations regarding the geotechnical conditions within the site boundaries must be undertaken. Actions required are as follows: 1. Consult with mine houses (Anglo American - New Largo, Xstrata Coal SA - Tweefontein North) regarding purchase of property and mineral rights. a. This will require consultation with relevant departments of Eskom regarding manner and content of consultation with mine houses. 2. Information regarding mining plans and scheduling, quality of the minerals mined and lifespan of the mine must be obtained. 3. Access to the property and more detailed geotechnical investigations on site is required to verify the viability of an ash disposal facility and dump height. 4. Access to the property for a site visit by the EAPs and specialist team is required to confirm site sensitivities (i.e. environmental, social and technical).
4	**D**	The close proximity of site area D to the Kendal Power Station is its greatest advantage. Terrestrial and aquatic biodiversity sensitivity is comparatively low considering the area is largely cultivated lands. Conveyor alignment from the existing transfer house may be challenging but capital costs will be comparatively low when considering all potential alternatives, and will not have to cross major roads. Preliminary information indicates that mining rights on site area D is owned by Xstrata Coal SA (Tweefontein North). Further, an estimated

		80% of site area D is undermined. A large portion of the area is being cultivated and three established households (which need to be confirmed) are present within the site area. The area also drains in two directions. Registered mineral rights on properties and undermined areas within the site area are the determining factors in the viability of this site alternative. The extent of surface and underground mining activities will however have to be confirmed. This site area thus has a moderate to high risk of being fatally flawed as a result of current mining operations. In order to arrive at a level where confident decision-making can occur, more detailed investigations regarding the geotechnical conditions within the site boundaries must be undertaken. Actions required are as follows: 1. Consult with Xstrata regarding property and mineral rights. a. This will require consultation with relevant departments of Eskom regarding manner and content of consultation with mine houses. 2. Information regarding mining plans and scheduling, quality of the minerals mined and lifespan of the mine must be obtained. 3. If consultation proves fruitful, access to the property and more detailed geotechnical investigations on site is required to verify the viability of an ash disposal facility and dump height. 4. Access to the property for a site visit by the EAPs is required to confirm site sensitivities (i.e. environmental, social and technical).
5	**B**	The size of the identified area B (1138 ha) is an advantage as the exact placement of an ash facility footprint of between 520 and 770 ha can be optimised inside the identified area to further avoid sensitivities on site. The location of the site area west of the existing Kendal Power Station allows for a natural extension of the conveyor westward from the transfer house to the site, without having to cross any major roads or watercourses. The disadvantage of site area B is its relatively close proximity to the Wilge River along its western extent. Preliminary information regarding affected mining houses indicates that mining rights on a portion of the north eastern quadrant of the site area is owned by Anglo American's New Largo mining project. A medium density settlement is also located just north of the mining area footprint. Further, transmissions lines cross the site area from east to west while the Kendal – Kusile water pipeline cuts through the north eastern quadrant of the site. The conveyor will have to cross two secondary roads and the area also drains in two directions. The main risk factors are the existing mining operations and associated settlement in the western portion of the identified site area, which affect approximately half of the area. Considering that size of the area, if half of the area is excluded from only approximately 570 ha will be available for consideration in the placement of the ash disposal facility. Further, considering the topography of the site it is very likely that less than 520 ha will be available for siting of the

		facility. This site area thus has a moderate to high risk of being fatally flawed as a result of current mining operations. In order to arrive at a level where confident decision-making can occur, more detailed investigations regarding the geotechnical conditions within the site boundaries must be undertaken. Actions required are as follows: 1. Consultation with Anglo American regarding property and mineral rights. a. This will require consultation with relevant departments of Eskom regarding manner and content of consultation with mine houses. 2. Information regarding mining plans and scheduling, quality of the minerals mined and lifespan of the mine must be obtained. 3. Access to the property and more detailed geotechnical investigations on site is required to verify the viability of an ash disposal facility and dump height. 4. Access to the property for a site visit by the EAPs is required to confirm site sensitivities (i.e. environmental, social and technical).
6	**H**	The close proximity of site area H to the Kendal Power Station is its greatest advantage. Conveyor alignment from the existing transfer house will be a simple exercise of extending the conveyance system from the existing transfer house westwards. The implementation of the conveyance system will be the least expensive of the considered options. Terrestrial and aquatic biodiversity sensitivity is comparatively low considering the area is largely presently or historically cultivated lands. H is largely unaffected by mining activities or registered mineral rights, except for a very small sliver of land in the north eastern corner of the site area. This portion constitutes approximately 10 to 15 ha and can be excluded from the site area. Preliminary information indicates that the mining rights on the small portion of site area H are owned by Xstrata Coal SA (Tweefontein North). Excluding the sliver of the site with registered mineral rights, the site is not large enough (~600 ha) to receive the full 37 years of ash. A sizable portion of the site area is being cultivated and the area has drains in three directions, which will require intensive stormwater and dirty water management. The site area is further bisected by most of the high voltage transmission line infrastructure evacuating electricity from the Kendal Power Station in a north westward direction. The Kendal – Kusile water pipeline also cuts through the site area. Besides the infrastructure through the site area, a pan is also located centrally in the area. During the low flow season the pan is often polluted, while during the high flow season the pan is flushed, during which time flamingos have been recorded. A number of households are also present in the north eastern and western extent of the site area. The greatest risk factor for implementation of this site is the likely relocation of major infrastructure, including the Kendal access road, high voltage transmission lines leaving Kendal, the Kendal-Kusile pipeline, and the destruction of a wetland water body. This site area

		thus has a high risk of being fatally flawed as a result of infrastructure relocation requirements. In order to arrive at a level where confident decision-making can occur, more detailed investigations regarding the infrastructure relocation requirements within the site boundaries must be undertaken. However, these investigations can be undertaken in the next phase of the project. Actions required are as follows: 1. Consultation with relevant departments within Eskom (Transmission, Maintenance, etc.), and the National and provincial roads authority. 2. Confirmation of owners of the mineral rights, and mineral rights granted. 3. Consultation with mineral rights owners regarding property and mineral rights. a. This will require consultation with relevant departments of Eskom regarding manner and content of consultation with mine houses. 4. Access to the property for a site visit by the EAPs is required to confirm site sensitivities (i.e. environmental, social and technical).
7	**E1**	Site area E1 hold no real advantages as a potential ash disposal area on its own. It is associated with site E2, but remains a separate area as the two areas are separated by the R545, which is unlikely to be rerouted to join the two areas. Thus in combination site area E1 and E2 does provide a larger potential area, but will result in 2 separate ash dumps. Preliminary information indicates that existing surface mining activities are occurring on site area E1. Preliminary information indicates that mining rights are held by Xstrata Coal SA and African Rainbow Minerals (Goedgevonden Colliery, Tweefontein North), Anglo American (New Largo project). The extent of undermining, if present, is unknown at this point. Further, the site is not large enough (~441 ha) to receive the minimum projected ash volume, i.e. a facility footprint of 520 ha. The site is bordered in the south by the town of Ogies, and the R555 and Richards Bay railway line, while in the north by the N12, and Phola settlement a short distance away. The area is bordered in the west by the R545. The risk with site area E1 is inherited from site area E2, i.e. high risk, as the area cannot be viable as a stand-alone site. Therefore if site area E2 is fatally flawed then site E1 will also be fatally flawed. The information requirement identified for E2 is consequently also relevant to E1.
8	**G**	Site area G is located to the south east of the Kendal Power Station. The site area has a number of households that will have to be relocated. Preliminary information regarding affected mining houses indicates that mining rights on land portions are owned by Xstrata Coal SA and African Rainbow Minerals (Goedgevonden Colliery, Tweefontein North). Underground mining activities have been confirmed, however the extent of the underground mining activities

		will need confirmation. The straight line distance from the power station to the closest edge of site area C is ~6.5 km, making it one of the furthest areas to the power station and the site area is characterised by extensive agricultural activities. Further, more detailed, investigations in the next phase of the project regarding the geotechnical conditions within the site boundaries must be undertaken. Consultation with the Xstrata Coal SA and African Rainbow Minerals must also be undertaken. Actions required are as follows: 1. Consult with Xstrata Coal SA and African Rainbow Minerals regarding property and mineral rights. a. This will require consultation with relevant departments of Eskom regarding manner and content of consultation with mine houses. 2. If consultation proves fruitful, access to the property and more detailed geotechnical investigations on site is required to verify the viability of an ash disposal facility and dump height. 3. Access to the property for a site visit by the EAPs is required to confirm site sensitivities (i.e. environmental, social and technical).

5 CONCLUSION AND RECOMMENDATION

The top six feasible site areas include site areas E2, C, F, D, B and H, in order of most feasible to less feasible.

Two of the top three feasible site areas (E2, C, F) currently have existing mining activities on site with mineral rights registered on all three sites (based on limited GIS information, but will need confirmation). The viability of these sites will largely depend on the extent of existing mining activities, the particular minerals to which rights are owned, negotiations between Eskom and the mining houses (Anglo American, Xstrata Coal SA, African Rainbow Minerals), the capital costs of sterilising affected mineral rights, and the presence and degree of undermining on these site areas.

Of the three top feasible areas, E2 has a high risk of being fatally flawed due to the fact that the entire site is earmarked for mining operations with half the site already being mined in a formal capacity. E2 is also at risk of being fatally flawed due to the transitional arrangements associated with transferring property and liability from an existing mine to Eskom.

Of the next three most feasible site areas (ranked 4, 5 and 6), area D (ranked 4) and B (ranked 5) both has existing mining activities associated with the site areas, with confirmed undermining present within site the D boundary. The extent and depth of the underground mining activities is currently not known by the project team and must be requested from the mining house in question. The possibility exist that the extent and depth of the underground mining will allow stable geotechnical conditions within the site area to receive the ash disposal facility, therefore it will be unwise to eliminate the site area D at this early stage given the limited number of viable areas.

Site H, although not currently being mined, has other challenges that make it a very difficult and costly option to implement. These challenges include the realignment and relocation of almost all of the high voltage powerlines exiting the Kendal Power Station, the relocation of the Kendal – Kusile pipeline, the relocation of a section of the R545 to Kendal, and the destruction of a pan that are known to house greater and lesser flamingos during the high flow season. This alternative has a high risk of being fatally flawed as the relocating transmission lines could result in a loss of transmission of electricity for a period of time, which is not an acceptable risk to the demand for and conveyance of electricity in South Africa.

Considering the above, it is the EAPs recommendation that the two sites with high associated risks (i.e. E2 and H) be eliminated as non-feasible options, and that the remaining 4 site areas (i.e. C, F, D, and B) be taken forward to the Scoping Phase and DEIR phase for further detailed investigations. The information requirements associated with each of the remaining 4 sites can be obtained and considered in the Scoping Phase of the EIA.