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IWULA, IWUL and Specialist Studies Review of the proposed Yzermyn Colliery Mpumalanga

Version - Draft

18 November 2016

Revised on 1 December 2017

Centre for Environmental Rights

GCS Project Number: 16-1159

Client Reference: Yzermyn Coal Mine

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Director	Andrew Johnstone		**1 December 2017**

EXECUTIVE SUMMARY

GCS Water and Environment (Pty) Ltd (GCS) was requested by the Centre for Environmental Rights (CER) to assist them with the review of the Integrated Water Use License Application (IWULA), Integrated Water Use License (IWUL) issued to Atha-Africa Ventures (Pty) Ltd (Atha) in respect of their proposed Yzermyn underground coal mine near Wakkerstroom, Mpumalanga and the associated specialist studies pertaining to the IWUL.

The Minister of Mineral Resources under Section 103 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) granted a Mining Right to Atha on the 14 April 2015. The IWUL was issued to Atha for proposed water uses in terms of the National Water Act, 1998 (Act No. 36 of 1998) by the Department of Water and Sanitation. The IWUL was issued on the 7 July 2016 (License No. 05/W51A/ACFGIJ/4726) for the following water use activities:

- Section 21(a) – Taking water from a water resource;
- Section 21(c) – Impeding or diverting the flow of water in a watercourse;
- Section 21(f) – Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit;
- Section 21(g) – Disposing of waste in a manner which may detrimentally impact on a water resource;
- Section 21(i) – Altering the bed, banks, course or characteristics of a watercourse; and
- Section 21(j) – Removing, discharging or disposing of water found underground.

This report serves to detail the findings of the review undertaken and to highlight areas of concern. The CER requested that the following be specifically undertaken as part of the review:

- GCS to fully and properly assess the environmental impacts of Atha's (and its specialists') model of the mine. GCS was however not required to devise a groundwater model of the mine that would be better e.g. mine layout/operations/mitigation measures that would be less environmentally harmful, a proper monitoring plan, etc.
- GCS to pick up on and highlight any big gaps, inaccurate information, key uncertainties, things that make no sense or have been overlooked, mitigation measures and/or monitoring provisions that are inadequate or unacceptably vague (i.e. cannot be measured, audited or enforced), contradictions/inconsistencies between specialists, etc.
- GCS to focus on the GN704 exemptions issue with regards to the Hydrology Section.

From the findings detailed in sections 5.1, 5.2 and 5.3, it is evident that several aspects of the specialist investigations need additional investigation (refer to Section 6 for a summary of the findings). The specialist reports compiled for the proposed mining activities have not identified all impacts associated with the planned mine and as a result, the IWUL does not contain sufficient license conditions in order to ensure that the impact of the mine will be able to be mitigated to an acceptable standard. It is not possible to provide proper license conditions without the identification of all impacts and an understanding of the interconnection of the various water resources (hydrogeology, hydrology and wetlands).

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1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was requested by the Centre for Environmental Rights (CER) to assist with the review of the Integrated Water Use License Application (IWULA), Integrated Water Use License (IWUL or WUL) issued to Atha-Africa Ventures (Pty) Ltd (Atha) in respect of the Yzermyn underground coal mine near Wakkerstroom, Mpumalanga, and the associated specialist studies pertaining to the IWUL.

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2 PROJECT TEAM

The project team for the Scope of work is detailed in Table 2.1.

Table 2.1 Project Team

Name	Designation	Professional Registrations	Years of Experience
Andrew Johnstone	Managing Director	SACNASP (Pr.Sci.Nat – 400192/87)	31
Alvar Koning	Senior Ecologist	Not Applicable	16
Brendon Bredenkamp	Hydrogeologist	SACNASP (Pr.Sci.Nat – 400015/09)	11
Karen King	Surface Water and Soils Unit Manager	SACNASP (Pr.Sci.Nat – 400035/11)	13
Kate Langlands	Water Use Authorisation Unit Manager	SACNASP (Pr.Sci.Nat – 400172/14)	8

3 SCOPE OF WORK

The scope of work for this report is to review the documentation submitted as part of the IWULA for the proposed Yzermyn Underground Coal Mine and its associated specialist studies, as well as the IWUL issued by the DWS namely:

- Hydrogeology & Geochemistry;
- Wetlands;
- Hydrology; and
- IWULA and the IWUL issued by the DWS.

3.1 Hydrogeology & Geochemistry

The following scope of work was proposed for the GCS review:

- Review all documents relevant to the hydrogeological component. Specific reference will be made to:
    - Assess how the dolerite sill was characterised;
    - High level review of the geochemistry and hydro-geochemistry;
    - Briefly evaluate the conceptual model of the site and potential shortcomings;
    - The potential impacts of the mining was appraised, mainly regarding the impact on wetlands/seeps and springs and if sufficient scientific evidence is available to quantify the impacts;
    - The post-closure impacts relating to potential contaminant plume migration from the underground workings, shafts and surface infrastructure were evaluated;
    - The decant location, likely volumes, quality and timing was reviewed based on the reports; and
    - The likely design philosophy to manage the decant was also reviewed, as well as the reported costs associated with a water treatment plant based on the volume and water quality.
- Define the major gaps in the hydrogeological study.

3.2 Wetlands

The scope of work for the wetland assessment review included review of the wetland reports associated with the IWULA and IWUL in which the following aspects will be considered:

- Methods of Assessment:
    - Seasonality of site visit;
    - Delineation of wetlands; and
    - Wetland Integrity.
- Wetland Assessment Results:
    - Sensitivity of present vegetation;
    - Wetland Functionality;
    - Present Ecological State of wetlands present on site; and
    - Recommended Ecological Category for the wetlands occurring on site;
- Impact Assessment:
    - The significance of the impacts given that the mine is situated in a threatened ecosystem;
    - Identification of impacts related to all phases, including cumulative impacts;
    - Sufficient mitigation measures to address the identified impacts;

- Consistency of identified impacts between the SAS wetland delineation letter (SAS/KNES05122014), the SAS wetland report (completed in 2014) and the Natural Scientific Services (NSS) biodiversity assessment (completed in 2013); and
- The relevance of the impacts of the underground workings on the wetlands occurring on site in terms of the hydrogeological studies.

3.3 Hydrology

The scope of work for the hydrological assessment review included:

- Review of the relevant specialist studies;
- Shortfalls and data gaps were highlighted, focussing on the requirements of General Notice 704 of the South African National Water Act, 1998 (Act No. 36 of 1998); and
- An explanation of how the outstanding information will likely affect the potential risk to and from surface water and related mitigation measures proposed by Atha/its EAP/specialists.

3.4 IWULA and the IWUL issued by the DWS

The scope of work for this section included the following:

- Review of the IWULA submitted to the DWS;
- Review of the IWUL issued; and
- Determine whether the conditions / mitigation measures prescribed in the IWUL are based on sound science and good environmental practice using input from the findings of sections 3.1, 3.2 and 3.3 above.

4 METHODOLOGY

4.1 Hydrogeology & Geochemistry

The following reports were reviewed as part of the study:

- Delta h (August 2014) - Yzermyn Underground Coal Mine - Numerical Groundwater Model Report, Project Number: Delh.2014.028-2;
- EcoPartners (Pty) Ltd (2015) - AMENDED Environmental and Social Impact Assessment Report and Environmental and Social Management Programme, Yzermyn Underground Coal Mine, DEA Reference – 14/12/16/3/3/2/693 (amended ESIAR (2015));
- Atha-Africa Ventures (Pty) Ltd (August 2015) - Integrated Water and Waste Management Plan, Yzermyn Underground Coal mine (IWWMP);
- Dennis, I (2016), Review of the groundwater documentation related to the proposed Yzermyn Colliery, Centre for Water Sciences and Management North-West University;

- Brownlie, S (2016), Review of Environmental Impact Assessment Report & Environmental Management Programme, and Environmental Authorisation, for Yzermyn underground coal project; and
- WSP (2013), Proposed Yzermyn Underground Coal Mine - Hydrological Assessment, project no: 24514-004 (WSP Hydrological Assessment (2013)).

External reference:

- Barnett, B, Townley, LR, Post, V, Evans, RE, Hunt, RJ, Peeters, L, Richardson, S, Werner, AD, Knapton, A and Boronkay, A, 2012. Australian groundwater modelling guidelines, Waterlines report, National Water Commission, Canberra.

4.2 Wetlands

The following reports were reviewed as part of the study:

- Appendix F8, Section A: Biodiversity Baseline and Impact Assessment Report, NSS (2013) 1649, 1877, 1933 rev1;
- Appendix F9, Section B: Floral Assessment Report, NSS (2013) 1649, 1877, 1933 rev1;
- Appendix F10, Section C: Faunal Assessment Report, NSS (2013) 1649, 1877, 1933 rev1;
- Appendix F11, Section D: Aquatic Assessment Report, NSS (2013) 1649, 1877, 1933 rev1;
- Appendix F12, Section E: Wetland Assessment Report, NSS (2013) 1649, 1877, 1933 rev1;
- Appendix F13, Section F: Sensitivity Assessment 1649, 1877, 1933 rev1 Report, NSS (2013);
- Appendix F14, Section G: Impact Assessment Report, NSS (2013), 1649, 1877, 1933 rev1 (all of the above referred to herein as NSS (2013));
- Appendix F7: Wetland Ecological Assessment Report, SAS (2014), SAS214124 (SAS (2014));
- Letter from the Department of Mineral Resources (DMR) to Atha dated 4 February 2014, incorporating letter by the Department of Water Affairs (DWA), as it was then, dated 9 January 2014;
- IWWMP, 2015;
- Appendix F1: Disturbed wetland delineation letter dated 9 December 2014, SAS/KNES05122014 (SAS delineation letter, 2014);
- Annexure 8: Confirmation of detailed wetland assessment and delineation in the vicinity of the proposed Yzermyn Surface Project Area (dated 10 November 2015).

4.3 Hydrology

The following reports were reviewed as part of the study:

- EcoPartners (Pty) Ltd (2015): The amended ESIAR (2015);
- EcoPartners, 2014: Water Usage Adjacent to Parts of the Assegaai River and Mawandla River. Downstream Water Usage for a proposed underground Coal Mine. REPORT NR: ATH1406ECA02. 5 August 2014;
- Highlands Hydrology, 2014: Conceptual Stormwater Management Plan for the Proposed Yzermyn Underground Coal Mine. 3 March 2014;
- SimX Consulting, 2015: Yzermyn Water Balance Simulation Model (ver. 0.8d) Technical Report. 5 February 2015; and
- WSP, 2013: Proposed Yzermyn Underground Coal Mine – Hydrological Assessment. 2013/08/16. Project number: 24514-004 (WSP Hydrological Assessment (2013)).

4.4 IWULA and the IWUL issued by the DWS

The following reports were reviewed as part of the study:

- DWS, 2016: Integrated Water Use License issued to Atha-Africa Ventures (Pty) Ltd; and
- Atha-Africa Ventures (Pty) Ltd (August 2015): Integrated Water and Waste Management Plan for Yzermyn Underground Coal Mine including Annexures.

4.5 Further documents reviewed

The following further reports and submissions by Atha were reviewed subsequent to completion of the original GCS study in November 2016:

- **Revised Wetland Ecological Assessment by Scientific Aquatic Services CC dated May 2015:**

  Subsequent to completion of the original review by GCS in November 2016, it transpired that the IWUL was granted on the strength of a further specialist report not among those listed above, namely a revised version of Appendix F7: Wetland Ecological Assessment Report, SAS (2014), SAS214124 (listed in paragraph 4.2 above).

The revised version of the SAS (2014) report is dated May 2015 and is entitled '*Wetland Ecological Assessment as Part of the Environmental Assessment and Authorisation Process for the Proposed Yzermyn Coal Mining Project near Dirkiesdorp, Mpumalanga Province*' (SAS (2015)). The report only became available to CER on 8 September 2017 once the WUL record had been provided to it as part of the process leading up to an appeal before the Water Tribunal.

GCS was asked by CER to review the SAS (2015) report and to supplement the findings of its original report dated November 2016 (the original GCS report) as required. The amendments to the original GCS report are indicated in bold font for ease of reference. These are primarily related to the SAS (2015) report and the further documents described in this section, but are also in some places intended to elucidate earlier findings and comments.

The SAS (2015) report largely repeats the findings of the SAS (2014) report but includes in addition, the results of a wetlands delineation which SAS conducted in November 2014 of wetlands situated within the proposed surface infrastructure footprint. It also includes the results of a further assessment of the surface infrastructure wetlands and a new assessment of two wetlands located within 500m of the surface infrastructure footprint boundary and/or underground mining boundary, which SAS conducted in May 2015 (SAS (2015) Pgs. iii and 54). The newly assessed surface infrastructure wetlands are labelled S1 and S2 in the SAS (2015) report, and the two newly identified wetlands are labelled S11 and CVB5 (Depicted on Pg. 58). The SAS findings pertaining to these wetlands, as also the previous SAS findings in relation to previously assessed wetlands, are contained predominantly in Chapter 4 of the SAS (2015) report (Pgs. 54 to 87).

As is elaborated upon in the appropriate places below, the SAS (2015) report does not alter in any material respects the conclusions drawn in the original GCS Report.

The SAS (2015) report does however provide further evidence of the fact that the proposed mine poses a substantial risk to sensitive and important water resources. SAS (2015) confirms that the NFEPA wetland, CVB5, which is located within 500m of the underground mining boundary, falls within PES category B and EIS category A. As appears from the Delta h (2014) report (read with SAS (2015) Pg. 58), this NFEPA wetland corresponds with the cone of dewatering in the deep

fractured aquifer (Delta h (2014) Pg. 53). The headwaters of the NFEPA wetland also fall within the dewatering cone of the shallow weathered aquifer (Delta h (2014) Pg. 52). The wetland is a Channelled Valley Bottom Wetland (which is a valley-bottom wetland with a river channel running through it). The base flow of a river is groundwater dependent. Any drawdown in the deep or shallow aquifers beneath this river would result in a reduction of the base flow of the river. This important impact has not been assessed in any of the specialist studies conducted in support of the IWULA.

As regards the wetlands falling within the surface infrastructure footprint, the SAS (2015) report revises the PES category of the surface infrastructure wetlands (S1 and S1) to Category C, which means that they are moderately modified, but the natural habitat remains predominantly intact. SAS (2015) also revises the EIS category of these wetlands to C which means that they are "*considered to be ecologically important and sensitive on a provincial or local scale*" although the biodiversity of such wetlands is not usually sensitive to flow and habitat modifications. These seep wetlands therefore remain ecologically important.

In any event, SAS concludes in the SAS (2015) report, as it did previously, that even if mitigation measures as stipulated in the SAS (2015) report were to be strictly implemented, operational impacts on the wetlands in the SAS (2015) study area would be of <u>medium-high</u> levels, whilst the impacts of closure would be of a <u>medium-high</u> to <u>high</u> level. The implication of this is that the impacts assessed in relation to the wetlands cannot be mitigated. The various problems with the proposed mitigation measures (including that they themselves have not been assessed, and are in any event not adequately incorporated into the IWUL) are outlined in the relevant places below (Pg. 105).

SAS does not alter its previous conclusion that "*[t]he potential for post-closure decant of water from the underground mine void via the adit and/or unsealed exploration boreholes (Delta H, 2014) is of particular concern, as this will have a long term effect on surface water quality of not only the wetlands in the study area, but also on aquatic resources within the greater catchment of the Assegaai River. Should it be considered <u>economically feasible to treat the decant water post-closure until water quality stabilises, which could take many decades</u>, to pre-mining water quality standards in such a way as to support the post closure land use,…the project would be considered feasible, although the impacts on the wetland resources would remain high.*" (own emphasis)

There is no information whatsoever in the IWWMP or in its specialist studies pertaining to the likely cost of a water treatment plant designed to operate post closure. This is a material gap in information.

Furthermore, the SAS (2015) report (like the SAS (2014) report) contains the findings of a Level 1 WET-Health assessment (comprising a desktop level with limited field verification). SAS (2015) confirms that it did not conduct field assessments of all of the wetlands which lie within the boundary of the undermining area (See SAS (2015) Pgs. 14 to 16 and 24). The SAS (2015) report does not contain an evaluation of the impacts which the Delta h report had identified as being likely. It does not, for example, consider what the implications for the wetlands would be of the cones of dewatering predicted by Delta h.

<u>In other words, there has never been a proper wetland assessment conducted by SAS as regards the wetlands in the underground mining area, or as regards the likely impacts of the mine on such wetlands</u>. As a result any proposed mitigation measure is not based on field data

The available information (predominantly provided by Delta h) suggests that these wetlands, which are high value wetlands, will be severely impacted upon by the underground workings of the mine as a result of the drawdown of groundwater in the surrounding aquifers due to mine dewatering.

- A letter dated 26 October 2015 from DWS and a response by Atha dated 10 November 2015 together with further documents provided by Atha:

These two letters and associated documents are among several documents which were not made available as part of the public participation process preceding the appeal against the IWUL to the Water Tribunal.

CER has requested GCS to consider the water-related concerns raised by DWS in its letter of 26 October 2015 and Atha's responses in its letter of 10 November 2015.

In its letter of 26 October 2015 DWS noted that:

(1) Impacts and mitigation measures associated with dewatering had not been included in the IWWMP and its specialist studies;

(2) Wetlands "*must be delineated into HGM Units based on ground-truthing, not on NFEPA maps*";

(3) "*The studies are … not representative of summer months, and are therefore regarded as incomplete*" (DWS requested "*a detailed study that is inclusive of summer months*");

(4) It is still "*unclear exactly how the wetlands on site and within 500m are being fed*" - This observation was made in relation to the wetlands associated with the underground mining area as appears from the following elaboration "*Without this knowledge, how can it be known if undermining may cause the wetlands above to dry up as a result of seepage into the underground mine? …How will groundwater abstraction affect the wetlands?*"

(5) There must be "*not (sic) net wetland loss for wetlands with PES of class A and B*";

(6) "*A strategy to treat acid mine drainage over both the short and the long term must be determined*";

(7) "*A more in-depth assessment in terms of an integrated perspective from the Geohydrologist, Soil Scientist, and Wetland Specialist, must be given*";

(8) "*Discharge of treated effluent into a wetland has been proposed…What is the impact of discharging the treated effluent onto the wetland? How will this impact on the drivers of the wetland? What will be the status of the wetland as a result of the discharge?*"

(9) "*You are required to provide a detailed Rehabilitation Plan that has input from Specialists on the various environmental issues*";

(10) "*The WULA is not recommended in this sensitive area by this Department. The risk of future pollution to the natural system and degradation of PES class A wetlands and rivers is seen as high and unacceptable*"

As appears in the relevant places below, it is clear that these important concerns raised by DWS have still not been dealt with by Atha. The Rehabilitation Plan which Atha provided to the DG following this letter, for example, pertains only to the surface infrastructure area of the mine.

5 FINDINGS

5.1 Hydrogeology & Geochemistry

An extensive consulting review process was undertaken for the Environmental Impact Assessment report, Environmental Management Programme and environmental authorisation for the proposed Yzermyn Underground Coal Project by the CER. Pertaining to the hydrogeological studies both Dennis (2016) and Brownlie (2016) have largely identified the shortcomings and discrepancies in the specialist studies and how they were referenced in the EIA documents. This report summarises the results of the additional review of the hydrogeological component in the specialist's reports by GCS.

5.1.1 Comments on Report Extracts

A number of report extracts are discussed below and generally set the context of the impacts and how they were interpreted by GCS. Italic text indicates direct quotations from the documents.

5.1.1.1 Delta h (2014) Yzermyn Underground Coal Mine - Numerical Groundwater Model Report

Section 1.3. Data Sources and Deficiencies (Pg.2)

Delta h (2014) stated the following: "*While new groundwater information (e.g. hydraulic tests and water level measurements) beyond that gathered by WSP (2013) were made available by the client for the model development, the absence of seasonal groundwater elevation (measurements cover 2013 and 2014 dry seasons only) and spring (discharge) data preclude the development of a transient groundwater flow model, which could capture the seasonal variability of water levels and associated mine inflows. Considering the large area of interest and the limited monitoring (single season) data, deficiencies in hydrogeological information for the Yzermyn aquifer limit the confidence of the model predictions. Once more monitoring data become available; the confidence level of the model can be increased by recalibration and transient modelling of the existing conditions and future impacts.*"

Delta-h stressed the limited/low confidence level of the model predictions in terms of representing transient or seasonal groundwater flow. In GCS' view and Barnett et al (2012), the model cannot be used for design or engineering purposes.

Section 2.2 Geology (Pg.4)

Delta h (2014) reported on the likely presence of dolerite dykes and sills and furthermore mention that they *"have significant impacts on groundwater flow"*. These intrusions play an important role in the Karoo type aquifers as they generally act as preferential flows or barriers for groundwater flow and contaminants and are mostly targeted for water supply purposes as well.

It is also reported that *"Several faults with throws up to 10 m (typically around 5 to 6 m) transect the proposed underground mining area, but their influence on groundwater flow as a potential preferential flow path or flow barrier is not yet known."*

The location, orientation and hydrogeological characteristics of the dykes, sills and faults are important to consider, especially as they could interconnect the reported aquifers. This has not been properly assessed. It is not evident that the lateral extent, thickness etc. of the dykes, sills and faults were estimated or obtained from any exploration drill logs or geological model (A geological model is a spatial representation of the distribution of sediments and rocks in the subsurface[1]). These features could compartmentalise the aquifers, and affect processes such as recharge and aquifer discharge.

Another important aspect is that the dolerite sills could have different hydrogeological characteristics at shallow depths i.e. they may act as preferential flow paths in the shallow areas where they are more weathered and become flow barriers at depths where they are less weathered. It is important to assess the hydrogeological characteristics of the sills across the proposed mining area as such characteristics may influence the mine inflows as well as the significance of the impacts on both groundwater levels and the migration of potential contaminant plumes from the mine workings. The failure by Atha and its contracted specialists to assess such hydrogeological characteristics means that the aforesaid impacts could not have been – and have not been – established sufficiently. **As a result the notion that the dolerite sill may limit the impact of dewatering on the wetlands is flawed**.

[1] https://www.liag-hannover.de/fileadmin/user_upload/dokumente/Grundwassersysteme/BURVAL/buch/127-132.pdf

Section 3.1. Springs

Delta h (2014) reported that WSP (2013) only documented the locations of springs and not the associated discharge and percentage usage thereof (the reference here to "*WSP (2013)*" is to a Geohydrology Impact Assessment by WSP dated 3 September 2013 ("WSP Geohydrology Assessment (2013)") which was included in the initial ESIAR but which was subsequently replaced by the more detailed Delta h (2014) report in the amended ESIAR. This report is not to be confused with the WSP Hydrological Assessment (2013) first referred to in paragraph 4.1 above).

Seasonal spring discharge should have been measured to obtain proper baseline information, which could have been used to improve the groundwater model level of confidence. In particular, spring discharge should have been monitored on a monthly basis for a year during the wet and dry seasons. This is suggested as a recommendation in the Delta h (2014) report (Pg. 70) **and in the NSS (2013) report Pg. 254**. But the information would have to have been obtained and included in the Delta h model in order to properly assess the impact of the proposed project on the springs. It is, in other words, not an appropriate mitigation measure but in fact necessary for the proper evaluation of potential impacts.

Section 6.3.1. Groundwater Recharge (Pg.38)

Delta h reported that "*[m]ost of recharge that enters the shallow weathered aquifer exits the modelled domain (or shallow aquifer system) as outflow (baseflow) to rivers, indicating significant surface and groundwater interaction, though it [is] most likely limited to the rain season (not quantifiable based on monitoring data or with a steady-state model).*"

This statement confirms the interconnectivity between surface water and groundwater, and the significance of the fact that it could not be quantified due to the absence of seasonal data. It is essential that seasonal data is collected so that this interconnectivity can be quantified. In other words, the contribution of the groundwater resources to the streamflow/baseflow of the surface water resources needs to be assessed, because a decrease in the groundwater contribution to streamflow (which decrease is shown in the Delta h drawdown (Figures 3 & 4 attached) as a result of the dewatering impact of the mine) would reduce the overall runoff (i.e. water volume) of the surface water resources.

Section 6.3.2. Groundwater Abstractions (Pg.38)

The Delta h (2014) report said the following as regards groundwater abstractions:

"*The client intends to abstract groundwater to augment the water demand in the wash plant and for general mine supply (WSP 2013) depending on the actual encountered mine inflow rates over time. Groundwater abstractions are currently envisaged from boreholes CBH2D* *and CBH3S (see Table 3.1 for borehole details), with rates of 1 L/s with a duty cycle of 12 hours per day. WSP (2013) considered the pumping rates unsustainable based on the short term aquifer test results and the recent, site-specific long term pumping tests (chapter 4.3) confirmed the limited extent respectively longer term yield of the shallow aquifer*."

The Delta h report therefore confirmed what WSP had found, namely that the anticipated volumes of abstraction from boreholes CBH2D and CBH3S, which was anticipated at that stage, was not in fact possible. As appears from the IWWMP (Pg. 104), there will no longer be a discard dump (or wash plant) but there will be some groundwater abstraction from boreholes "*for initial water use during the start-up and also from mine dewatering to ensure safe operations*". The IWWMP goes on to say that "*[d]irty storm water harvesting will be used to reduce the need for pumping groundwater from boreholes and borehole water will eventually only be used during severe water shortages*".

It appears from this that the two boreholes will still be used, at least initially, to augment the water demand of the mine. The likely volumes of abstraction and drawdown cones associated with these two abstraction boreholes have not been assessed. The water strikes in these boreholes are relatively shallow, i.e. associated with the shallow weathered aquifer. It is likely that the cumulative drawdown impact of the borehole abstraction and the associated mine dewatering would be larger than the predicted impact, which only accounted for the mine dewatering. Furthermore, if the mine dewaters the shallow aquifer then the boreholes are likely to dry up.

Section 6.5. Selection of Calibration Targets and Goals (Pg.42)

The Delta h (2014) report stated that "*The groundwater monitoring program initiated by the client made more groundwater level measurements available for the model calibration; but do not cover a full hydrological year yet and preclude therefore a transient calibration of the model. The available measurements of 4 months within the same dry season (and one repetitive March reading) in 2013 and 2014 limit therefore the model calibration to steady-state only, which assumes average conditions over all seasons.*" (own emphasis)

The Delta h model in its current state can therefore not be used to assess any seasonal variations in groundwater levels, and can also not be used to assess the variable (seasonal) groundwater contribution to springs, surface water features and certain wetlands. This concurs with a finding in Section 5 of the Dennis (2015) review.

It must be noted here that the SAS (2015) report does not in any way alter this observation or other similar observations as regards there being insufficient information pertaining

to the hydrogeological system upon which to grant authorisation for the activities which are triggered, because it was not a groundwater report.

Section 7.1. Steady State Calibration (Pg.45)

"No site specific hydraulic test results are yet available for the dolerite sills or faults itself, but the calibrated values fall within literature ranges. The low permeability of the dolerite intrusions and assumed closed faults limit flow across these structures. The calibrated conductivity values were subsequently used for the predictive model runs described below." (Own emphasis)

GCS suggests, as recommended by Delta h, that this information be obtained by intrusive test work. This information is important as it may change the results of the modelling and consequently the significance of the impacts. It is also suggested that this information should have been obtained before any WUL decisions were made.

Table 7.1: Final hydraulic conductivities of the Yzermyn Groundwater Model (Pg.45)

It must be noted that the final hydraulic conductivities assigned to the faults and the dykes are lower than those assigned to the weathered and the fractured aquifers which contradicts the statement in the Conceptual Model (Section 4.2 Pg. 13 of the Delta h (2014) report) that: *"Elevated conductivities can be expected along (but not across) coal seams and dyke/sill contacts."* Lower hydraulic conductivities of the faults and dykes could result in lower water inflows into the mine and could influence the development of the drawdown and the migration of contaminants in the aquifers, which could affect the significance of the anticipated impacts. On the other hand, if the dykes and sills were to have "*elevated conductivities*", then the mine inflows and associated impacts could be greater. Accordingly, this contradiction is significant to the model's confidence level. Generally, the model has a low confidence as the monitoring data is very limited, the structural geology and dimensions of the sill are poorly defined, and the aquifer properties used in the model are incorrect.

Section 7.1. Sensitivity Analysis and Model Verification (Pg.47)

"Due to the prevalence of water level measurements in the shallow weathered aquifer, the model proofed during the calibration process [was] expectedly most sensitive to hydraulic conductivity values assigned [to] the weathered aquifer and the dolerite sill below the weathered aquifer (with assumed fixed recharge values). The influence of hydraulic conductivity values assigned to the fractured aquifer and faults was on the other hand less pronounced." (own emphasis)

The dolerite sill and its hydrogeological properties play a significant role in the model scenario results. However, as explained above, the dolerite sill has not been properly assessed. It is essential that a geological model (as explained above, a geological model is a spatial representation of the distribution of sediments and rocks in the subsurface[2]) be used in the numerical model to take into account the dolerite sill and the variations in its hydrogeological characteristics. Because this is lacking, the model results have a low confidence.

Section 8.1. Estimated Mine Inflow Rates (Pg.48)

The Estimated inflow rates into the workings of both seams was reported as 491 m^3/d. A sensitivity analysis on the inflows was conducted as a function of hydraulic conductivity ranges for the dolerite sill and fractures, the reported inflow ranges being from 218 to 3 010 m^3/d. The large range makes it impossible to determine the mine water balance and consequent Pollution Control Dam (PCD) sizing with any accuracy. The inflow range must be determined with greater certainty for design purposes**, both as far as the PCD and as far as the water treatment plant are concerned.**

The Delta h (2014) report stated clearly that: *"The calibrated groundwater flow model was used to estimate the annual average steady-state groundwater inflows into the underground mine voids. Since no annual mining plans over the life of mine were made available to the project team, only the inflow rates into the final, fully developed underground mine voids were determined. It must be noted that any steady-state groundwater model is likely to be a rough estimate of time dependent groundwater inflows, as it does not account for the increasing dewatering of the aquifer over time and hence reduced yields approaching the simulated steady-state inflows. However, in the absence of groundwater level measurements over time or mine development plans, the chosen approach appear[s] justified."* (own emphasis)

It is evident that no mine schedule (annual mining plans) was available at the time of modelling. Mine scheduling is generally included in such a model to simulate a more realistic groundwater inflow into an underground mine void as well as more realistic development of drawdown due to dewatering. This further illustrates that the operational model predictions were not adequately undertaken to represent the complexities in the hydrogeological system and the stresses which would be introduced by mining.

2 https://www.liag-hannover.de/fileadmin/user_upload/dokumente/Grundwassersysteme/BURVAL/buch/127-132.pdf

Section 8.1.1. Sensitivity of estimated mine inflow rates (Pg.49)

Delta h (2014) performed a sensitivity analysis of the estimated mine inflow rates by varying the hydraulic conductivity of the semi-permeable dolerite sill. The authors stated that: "*the simulated mine inflows are highly sensitive to larger than expected conductivity values of the dolerite sill, but less sensitive to lower values. The simulated inflows for the base case scenario appear to be already substantially limited by the overlying aquitard, and a further reduction of its conductivity has limited influence on mine inflows. Should the dolerite sill on the other hand be more permeable (e.g. fractured or weathered) than assumed, mine inflows are expected to increase substantially.*" (own emphasis)

This statement makes it clear that the hydrogeological characteristics of the dolerite sill are essential to the simulation of realistic modelling scenarios for the proposed mine. This dolerite sill is likely to dictate the extent of the drawdown in the shallow aquifer. The characteristics of the dolerite sill also have implications for the decant volumes of the mine post-closure. A sill with higher hydraulic conductivity than that used (modelled) in the Delta h (2014) study could result in higher decant volumes – which would need to be treated

There are thus too many unknowns in the model for it to be reliably used as a management tool and to properly assess the impacts.

Section 8.2. Impacts Associated with Mine Inflows

Pg.51 Section 8.2.1. Description of Impacts

The Delta h (2014) report states that: *"environmental impacts associated with the mine inflows are primarily associated with:*

- *The partial dewatering of the aquifer above and in the vicinity of the underground mine voids with subsequent impacts on groundwater dependant eco-systems and groundwater users;*
- *The interception of ambient groundwater flow, which would have under natural conditions discharged into the surface drainages, provided baseflow to the rivers, or contributed to deeper regional groundwater flow."* (own emphasis)

It is also reported that: *"The simulated extent of the (steady-state) zone of impact (2m cut-off) of the underground workings on the shallow weathered aquifer extends predominantly upstream of the mine and is limited to around 2 km SW and 3 km towards the SE (Figure 8.2). Significant impacts with drawdowns above 5m are likely to be limited to an area immediately SE above the underground mine workings and associated with the low permeability dolerite sill contact (the low permeability and groundwater flow within the* *dolerite exaggerates the drawdown).*" (The "*2m cut-off*" referred to above is the zone where the groundwater levels are 2m deeper than the natural/ambient groundwater level.)

It is incorrect to suggest, as the Delta h (2014) report does, that only impacts with drawdowns above 5m in the shallow aquifer are significant. Drawdown of 0.5 - 2m could also significantly impact on groundwater-dependant eco-systems and groundwater users, i.e. springs could dry up and yields be reduced. The Delta h model shows that drawdowns of between 2m and 5m will coincide with large parts of the area associated with the underground workings.

Delta- H estimates that the mine dewatering will result in a drawdown cone as shown in Figures 1, 2, 3 and 4 (which are attached) during the 15 years of operation of the mine. Delta-h further calculates that it would take some 45 years for water levels to rebound in the mine prior to decant. This shows that some of the wetlands could be dewatered for a period of 60 years which will be detrimental to the wetlands.

It must be emphasised that all wetlands situated above the underground workings of the mine which are fed by groundwater would dry up as a result of the dewatering effects of the mine. They would remain dry throughout the operation of the mine, and after the mine is closed until the mine void fills. Even then, the original groundwater levels will not be re-established. The final drawdown of the ambient groundwater levels will be dependent on the decant level or pumping level (the environmental critical level), in order to prevent decant, with the consequence that these wetlands may never be restored.

The SAS (2015) report contains two new statements which pertain to hydrogeology which are dealt with here. The first is that "*… wetland resources located further than 200m away from the surface infrastructure footprint and the underground mining boundary are highly unlikely to be affected by the proposed mining activities, as they are not located within the same catchment of the activities. Therefore, the likelihood of excess sediment or runoff of dirty water from the affected footprint entering these systems is considered unlikely*" (Pg. 66)

A watershed or catchment is not necessarily however a groundwater divide. This means that there can be one continuous groundwater body underlying both surface water catchments. If groundwater is affected in one catchment, it could also be affected in the adjacent catchment. Any wetlands linked to the groundwater body could also then be impacted upon (even if they are located in an adjacent catchment). (This point is also made by Dennis (2015) Pg. 9).

It is clear that the underground mining traverses a number of catchments and as a result the potential drawdown in the shallow and deep aquifers around the mine will cross catchment divides.

The SAS (2015) report also contains a new statement to the effect that "*it is deemed highly unlikely that wetlands within the 500m radius of either the surface infrastructure or the underground mining boundary will be impacted, due to the elevation of these resources, and due to the catchment divides which separate them from the immediate zone of influence of the proposed mining activities*" (Pg. 83)

The elevation of the water resources is however immaterial to the question of whether or not the wetlands will be affected by the underground workings and associated dewatering of the mine. Channelled Valley Bottom Wetlands would inevitably be affected by the cone of dewatering produced by the mine. This cone of dewatering has been established by Delta h to extend 2 km SW and 3 km SE from the underground workings (in respect of the shallow weathered aquifer) and 2 km N of the underground workings (in respect of the deep fractured aquifer) (Delta h (2014) Pgs. 51 to 53).

It should be noted that SAS itself in the SAS (2015) report identifies the following impacts on "*wetland hydrological function*":

- **During the operational phase: "*[d]ewatering of wetland habitat downgradient of mining activities, leading to loss of water within wetland habitat and altered hydrological patterns*" and "*[f]ormation of groundwater cone of dewatering, leading to reduced recharge of wetland resources*" (Pg. 98), with "*HIGH*" impacts on the study-area wetlands both unmitigated <u>and with mitigation</u> (Pgs. 99 and 100).**
- **During the closure phase: "*[a]ltered hydrology due to the decant of water from the underground mine voids via the adit and/or unsealed boreholes in the vicinity*" and "*[a]ccumulation of toxic water in the ground water plume, resulting in the long-term, large scale contamination of aquifers and surface water*" (Pg 98), with "*HIGH*" impacts on the study-area wetlands both unmitigated <u>and with mitigation</u> (Pgs. 99 and 100).**

Pg.52 Figure 8.2 and reproduced in this report as Figure 3.

The figure illustrates the simulated groundwater table drawdown in the shallow weathered Karoo aquifer. The locations of the mapped springs are also indicated. This figure thus shows that certain springs around the proposed mining area will be affected by the dewatering. It can also be seen that the headwaters of many of the minor streams/non perennial rivers are likely to be affected especially since a number of the mapped springs (no labels on map) are located at the headwaters of the streams. The springs contribute to the flow of the minor streams/non perennial rivers and form an important component of surface water-groundwater interaction.

Pg.53

The Delta h (2014) report stated that: *"Groundwater dependant eco-systems and yields of (water supply) springs located <u>within the significant zone of dewatering of the shallow aquifer</u>, limited to the site boundaries, could be negatively impacted and some may dry up during the life of mine."* (own emphasis)

As pointed out above, this conclusion that significant impacts are associated only with a drawdown of 5m or more is incorrect, as groundwater-dependant eco-systems and yields of springs could also be negatively impacted by the shallower drawdowns of the weathered aquifer depicted in Figure 8.2.

<u>Section 8.7. Confidence in Model Predictions (Pg.69)</u>

Delta h (2014) defined the confidence level of the model and also summarised the data uncertainties requiring further work: *"Despite all efforts to account for data uncertainties, the values presented are by definition of <u>low confidence</u> (class 1, predictive model time frame far exceeds that of calibration) and should be verified once more water level measurements, hydraulic conductivities (especially of <u>faults and contact zones to dolerite dykes or sills</u>) and groundwater monitoring data become available. The confidence in predicted mine inflows and plume migration rates for later years of mine development can significantly be improved by observation data from earlier years and subsequent updates of the groundwater model"*

GCS agrees with the low level of confidence or Class 1 status of the model, as well as the parameters requiring further verification. GCS also points out the fact that a proposed mining schedule (mine depletion plan) was not included in the model, which means that it could not produce an accurate simulation of the likely changes to water flows in and around the mine and associated impacts over the life of the mine. The model should have been updated with the parameters requiring verification as well as the mine depletion plan before a decision on the WUL was made, as the model should not be used in its current state for any decision-making.

The Australian groundwater modelling guidelines (Barnett et al, 2012), referenced by the Delta h (2014) report state that: "*Class 1 model, for example, has relatively low confidence associated with any predictions and is therefore best suited for <u>managing low-value resources</u> (i.e. few groundwater users with few or <u>low-value groundwater dependent ecosystems</u>) for assessing impacts of low-risk developments or when the modelling objectives are relatively modest.*" (own emphasis).

The IWWMP (2015) Pg. 103 and the amended ESIAR (2015) Pg.335 state that the proposed Yzermyn Underground Coal Mine Project is situated in a "*sensitive and conservation important area*". It is furthermore stated in the IWWMP (Pg.59) and ESIAR (Pg.175) that the: "*catchment area is considered to have a very high ecological sensitivity based on the local diversity of habitats and species.*" It is also stated on Pg.59 of the IWWMP and Pg.175 of the ESIAR that: "*Such quaternary catchments and rivers are generally highly sensitive to flow modifications*".

Based on these statements and the results of the specialist studies it is evident that the area on and surrounding the proposed mining activity is a <u>moderate to high value groundwater-dependant ecosystem</u>. In light of this, a Class 3 model with a high level of confidence is required before a decision may be taken which will affect the resource.

The Australian groundwater modelling guidelines state that one of the specific uses of a Class 3 model is: "*Simulating the interaction between groundwater and surface water bodies to a level of reliability required for dynamic linkage to surface water models.*" In the case of the Yzermyn project it was important to accurately simulate the surface water–groundwater interactions due to the fact of "*significant surface and groundwater interaction*" [Pg.38 (Delta h, 2014)] in the area. GCS also refers to the IWWMP (Pg. 187) where it says that: "*Pumping of groundwater required for safe mining conditions may have a direct impact on the water table (reducing natural groundwater recharge), and could have impacts on sensitive ecosystems such as wetlands, springs and resultant loss of flora and fauna species*". The Delta h (2014) report does not assess the groundwater impacts with sufficient certainty and therefore is unable to determine the reduction in catchment surface water run-off.

<u>Section 9. Recommendations (Pg.70)</u>

The Delta H report stated that: "*Any potential post-closure decant from the mine should be captured and treated to applicable standards before [being] released into the environment. A suitable treatment facility should be designed to cater for post-closure decant quantities and qualities (to be refined once mine becomes operational).*"

The Delta h (2014) report stipulated the need for a water treatment plant but stated that the design could be refined during the operational phase of the mine. GCS is however of the opinion that post-closure decant water qualities and quantities should be determined (by means of geochemical modelling) in the pre-mining phase, to guide the conceptual design of the water treatment plant required for that phase. It is important to assess the capital (capex) and operational (opex) costs of a treatment plant before the commencement of mining in order to determine whether the mine is financially viable. The post-closure quality of the water to be treated, the volume of water, as well as the target quality of water post-treatment will govern these capex and opex expenses.

GCS refers to condition 14.1 of the WUL (Pg.48), which states that: "*The water user must ensure that there is a budget sufficient to complete and maintain the water use and for successful implementation of the rehabilitation programme*". The cost of water treatment on closure of the mine needs to be quantified to determine the financial viability of the mine. If the long term water treatment costs exceed the profit from the mine the mine should not proceed. In addition, the post closure treatment costs need to be quantified in order to assess the quantum of the financial provision required in the environmental and closure fund.

It should be emphasised that a water treatment plant is only described in any detail in the IWWMP (including its associated specialist studies) insofar as the operational phase is concerned (Pgs. 152-156). A water treatment plant is envisaged as being necessary to treat dirty water arising from operations including water pumped from underground mining, dirty storm water and treated sewage water. It was estimated by SimX (Pg.154 of the IWWMP) that there will be 8 900m^3/a of water which will not be used in the mine water circuit and which will need to be treated to pre-mining water qualities and then discharged into the seep wetland (Wetland system 1). There is no detail whatsoever contained in the Decommissioning and Closure section of the IWWMP (Pgs. 30-31) or in the Closure and Rehabilitation Plan itself (Annexure C) as regards the water treatment plant which would be required to operate post-closure.

The water treatment plant which is required post-closure would, in all likelihood, be a different one to the one required for the operation phase. That is because it would only come on line once water begins to decant from the mine post-closure, Delta H has estimated will occur after 45 years. (The Delta h report estimates decant ranges between 1-6l/s (86.4 to 518m^3/day) with sulphate concentrations of 1 000mg/l.)

The WUL also only authorises the discharge of water containing waste from the water treatment plant to a maximum quantity of 8886 m^3/yr, which as stated above, is the quantity envisaged by SimX will be discharged during the operational phase. This is clear

from the IWWMP (Pgs. 152-156, in particular Pg. 156) compared with the WUL (Pgs. 34 and 36). One of the key water uses triggered by the closure of the mine has therefore not been authorised at all. This represents a fundamental flaw in the authorisation process and in the authorisation itself.

Even in relation to the operational phase, there are no design drawings of the water treatment plant which is envisaged. Furthermore, authorisation of the water treatment plant as a mitigation measure in the operational phase, is problematic for at least the following reasons:

- **Whereas the IWWMP states that water from the water treatment plant will be discharged into 'seep wetland (Wetland system 1)' (Pg. 154), the WUL authorises discharge into 'Wetland system 2; Seep wetland (S2)' (Pg. 34);**
- **In any event the likely impact of a discharge of 8 900m^3/a of treated water into either of these wetland systems has not been assessed - The SAS 2015 report (the Wetlands Assessment upon which Atha relies) does not list the water treatment plant as an essential mitigation measure during the operational phase at all;**
- **The volume of water which would need to be treated in the water treatment plant (and therefore released back into the environment) would depend, in part, on the rate of groundwater inflow into the mine. This is not known with any certainty because of the acknowledged limitations of the Delta h study.**
- **In addition, stormwater runoff from the dirty areas on the site will also be channelled to the PCD. If this is taken into consideration, together with the calculated inflows into the mine (accepting those for present purposes to be correct), the volume of water to be treated as calculated in the IWWMP, page 154, is entirely incorrect. This has significant implications for the size of the water treatment plant which will be required. See Table 8.1 from Delta H reproduced below:**

Table 5.1 Delta h Report: Table 8.1 Estimated inflow rates for the proposed Yzermyn Underground Coal Mine

Simulated Yzermyn Underground Mine (steady-state) Inflow Rates			
Coal Seam	m^3/a	m^3/d	L/s*
Alfred	102 835	282	3.3
Dundas	76 362	209	2.4
TOTAL	**179 197**	**491**	**5.7**

Note rounding errors for derived units.

5.1.1.2 Amended ESIAR (2015)

Section 8.8.4.3 Impact 3: Decline in Water Quality and Resultant Deterioration in PES and Functionality (Pg.342)

"In terms of biodiversity, both fauna and flora are exposed to surface and groundwater contamination as the wetlands are fed by both the shallow weathered aquifers and the deep fractured aquifers. Any contamination within these aquifers will therefore impact on the surface water quality downstream. This contamination will impact on the PES [Present Ecological State] *of the wetlands and the eco-services the wetland can provide, the main one of which is the maintenance of Biodiversity."*

This confirms the potential significant impact of any contamination of groundwater on biodiversity. A shortcoming of the Delta h (2014) study is that no contaminant plume from the mine workings was simulated. In addition to the potential decant, a groundwater contaminant plume is likely to develop post-closure. The contaminant plume is likely to migrate down-gradient in the weathered aquifer from where the mining occurs. In addition a contaminant plume is likely to develop down-gradient of the mine adits and shafts as these are intended to be connected to the mine workings in or near the weathered aquifer. As is evident from the Delta h (2014) report, the post-closure mine water quality is likely to be characteristic of AMD (acid mine drainage), which will determine the nature of the contaminant plume. In the absence of a simulated contaminant plume, it is not possible to identify the water users, wetlands and areas most likely to be affected by groundwater contamination.

The potential increase in the salt load (especially sulphate, chloride and nitrate) entering the streams/ rivers was also not assessed.

The shortcomings described above are significant especially given the sensitivity of the groundwater-dependant ecosystems. This is an important potential impact which has not been assessed and for which no mitigation measure has been provided.

Section 18.3 Recommendations (Pg.812)

The amended ESIAR (2015) states:

"It is recommended that the post-closure decant water be treated until legally acceptable water quality stabilizes.

It is recommended that the treated decant emanating from the treatment plant must be discharged to the adjacent hillslope seepage wetlands making use of a spigot which then drains into a sand filter along the edge of the hillslope seepage wetland to allow for recharge *of the hillslope seepage wetland and ensure that water reaching the valley bottom wetland resource is further cleansed and contributes to the instream flow of the local drainage network. This mitigation method will impact on wetlands (positively and negatively).*

It is recommended that a filter drain in the form of small trenches filled with sand is installed to direct flow of clean water around the adit to the sand filter placed outside the water treatment plant to enable clean water to remain separate from dirty water. This mitigation method will impact on wetlands (positively and negatively).”

As noted above, the mitigation measure of discharging treated water into the wetlands may be plausible but has not been assessed by the specialists (either in relation to the operational or the closure phases) and it is not known what the significance of the impact will be (positive or negative).

5.1.2 Summary of Findings

The findings discussed below are based on the review of the hydrogeological-related documents.

5.1.2.1 Dolerite sill

No conclusive understanding of the dolerite sills in the mining area could be obtained from the available reports. This information should be present in an exploration/geology report, as numerous exploration boreholes have been drilled in the area; however no such report forms part of the WULA (or Atha’s application for an environmental authorisation) and furthermore the information is not contained in the WULA documents (or the documents comprising Atha’s application for an environmental authorisation). It is therefore not known whether the dolerite sill occurs across the entire mining area and/or underlying any of the wetlands.

There is no hydrogeological information in respect of the sills, dykes and faults. This is a material gap in the environmental assessments, and has a potentially significant impact on the veracity of the groundwater modelling results. The implication of this is that the potential environmental impacts of the mine may not have been correctly identified or assessed, and the mitigation measures which have been identified may be ineffectual.

SAS (SAS delineation letter, 2014) reported that the sill would minimise the impact of drawdown on the wetlands. **This statement is repeated in the SAS (2015) report (Pg. 65) where SAS makes the following statement (which is not contained in the SAS (2014) report): “…*it is not envisaged that wetland systems located within the proposed***

***underground mining boundary will be directly impacted, due to the relatively impervious underlying shale and dolerite sill, which is likely to prevent dewatering of the watercourses which are to be undermined. This observation has been supported by the geohydrologists who undertook the assessment of the site.*" (Pgs. 65 to 66)**

It is not correct that this observation is supported by anything contained in the WSP Geohydrology Assessment (2013) or Delta h reports. Delta h found that the wetlands would be impacted by the cones of dewatering. The Delta h report indicates a drawdown in both the shallow and deep aquifers (Figures 3 & 4 attached).

There is furthermore no scientific basis for the proposition that the wetland systems within the underground mining boundary will not be directly impacted due to the presence of an impermeable dolerite sill extending across the entire underground mining area. The presence of an uninterrupted sill of this magnitude is highly unlikely. The fact that the coal seam is faulted (See Pg. 11 above) suggests strongly that the dolerite sill is not uninterrupted. WSP stated that geological exploration borehole results indicated no dolerite sills in the vicinity of the adit entrance (Pgs. 15 to 16).

There is, as has been pointed out above, simply insufficient data to characterise the dolerite sill and its impact on groundwater flow. Neither the lateral extent of the dolerite sill nor its hydrological properties is known. Even if an impermeable dolerite sill did overlay the entire area, its integrity would be materially compromised by the ventilation shaft, existing prospecting boreholes, the two abstraction boreholes and blasting in the underground workings.

The new statement by SAS in SAS (2015) is further undermined by a statement made elsewhere in the same report that "*wetlands within the zone of impact of the underground mining boundary are unlikely to be significantly impacted as long as strict mitigation measures are implemented*" (Pg. 83) (which suggests that SAS (2015) considered that the likelihood of impact would be determined by the efficacy of (unspecified) mitigation measures, rather than by geology).

5.1.2.2 Geochemistry and hydro-geochemistry (water quality)

The majority (67%) of the Yzermyn coal samples were classified as potentially acid generating (Delta h, 2014). The intended composition of the mine roof and floor has not been reported. It is essential that the coal seam (pillars), the roof and floor lithology's are geochemically characterised. In any event, the geochemical properties of the coal (as potentially acid generating) remain important, as pillars of coal are intended to be left underground. It is unknown what the geochemical characteristics of the "*overburden and sandstone excavated during the development of the adit*" (Pg. 23 of IWWMP) would be and whether it has any acid generation potential. This should have been assessed before the WUL was granted **as this material is going to be used for construction on surface**.

Furthermore the source terms (i.e. the types/chemical compositions and anticipated discharge quantities) of the various contaminant sources were listed by Delta h (2014), based on data from similar mining operations in the region. The underground workings were classified as a potential contaminant source and the mine water was assigned an average pH of 7.5 and sulphate concentration of 2576 mg/l, based on information taken from Hlobane, 82km SE of project. The decant water was reported as having a pH of 8.39 and sulphate concentration of 927 mg/l, also based on information taken from Hlobane. The source of this data is questionable as it is not stipulated what seam was mined at Hlobane (whether this is the same seam that is proposed to be mined at Yzermyn) and it is not site-specific. The implications of this are that the potential environmental impacts of the mine may have been mischaracterised in the environmental assessments.

Data from surrounding mining companies which have coal mines in the Alfred and Dundas seam show significant AMD contamination. Decant from the YUCM is likely to have similar values to that which is produced by these coal mines. Refer to Section 5.4.2 of this document for the standards of discharge required by the IUCMA.

A complete and reliable geochemical model is required in order to understand the potential impacts of the mine on water quality, and is currently lacking from Atha's environmental assessments. **There is currently no geochemical model whatsoever among the specialist studies. Such a model is imperative in order to predict long term water quality trends.**

Furthermore it is essential to determine whether the underground mine void would be flooded entirely or only partially after the termination of mining, as this would have a significant impact on post-closure water qualities. This too is lacking from Atha's environmental assessments. **In instances where coal mine voids fill up slowly post closure, the level of contamination of groundwater is far greater because of the extended period of availability of oxygen which interacts with the pyrite generating AMD. As the water enters the mine void, salts are leached from the exposed coal seams which increases the dissolved solid content of the groundwater and potential decant. In the case of the YUCM, the Delta h report has calculated that the worst case scenario is likely, namely the exposure of parts of the coal seam for 45 years before groundwater levels rebound in the mine void.**

Water quality samples were collected from the monitoring boreholes, however the actual receptors, viz. the springs, were not sampled. The baseline water quality was therefore not assessed comprehensively. It is essential that the baseline water quality is comprehensively monitored before mining commences, as suggested in the proposed mitigation measures by (Delta h (2014) pg. 70). Moreover this baseline water quality ought to have been assessed before the WUL was granted (as this data is essential to properly assess the impacts of the mine).

5.1.2.3 Conceptual Model

GCS generally disagrees with the Delta h (2014) conceptual model due to the inconclusive/limited information on preferential flow paths/barriers.

The main preferential flow paths/barriers were not assessed by any field testing. In addition, no field work was conducted to assess the connectivity between the groundwater, surface water and the different wetland types. The conceptual model is materially incomplete and needs to be updated with this information before it can be utilised/relied upon.

5.1.2.4 The potential impacts of the mining on springs/wetlands and seeps

The Delta h (2014) report stated that there will be an impact on groundwater-dependant ecosystems and groundwater users, confirming that some springs within the drawdown cone of the shallow aquifer would be negatively impacted (pg.51). Groundwater-dependant ecosystems such as wetlands are also likely to be impacted.

However the impacts of the anticipated mine dewatering on the sensitive ecosystems and wetlands have not been quantified by the Delta h (2014) groundwater model, or by any of the other environmental studies/assessments of the mine. Dennis (2015) in her review mentioned that the main concern regarding the Delta h (2014) modelling report is the limited number of scenarios addressed. For example, the potentials impacts on wetlands, baseflow and springs were not quantified in respect of each of the various mining stages. GCS concurs with this finding.

The Delta h (2014) report confirmed that baseflow to rivers and contributions to deeper regional groundwater flow would be affected, but once again this could not be quantified due to insufficient data (pgs.54 and 38).

5.1.2.5 The post closure impacts relating to potential contaminant plume

The potential impacts of pollution plumes emanating from the mine void were not addressed in any of the specialist studies and this remains a significant gap in information. Should the mining proceed, once the mine water levels and the water levels in the surrounding aquifer have equilibrated to new levels, a groundwater gradient will develop resulting in migration of contaminated water from the mine void into the surrounding aquifer. This contaminated groundwater may then daylight (come to surface) as seepage in a surface water body/river or even wetlands and springs.

The shafts are also likely to act as conduits for the contaminated mine water, as they intersect both the deeper fractures and the shallower weathered aquifers, thereby spreading the contaminated water.

The environmental impacts/risks of pollution plumes emanating from the mine void could be severe and should be quantified by numerical modelling or water balance calculations in order to properly understand the impacts/risks and devise appropriate mitigation measures.

5.1.2.6 Mine Water Decant

The Delta h (2014) report stated that "*…it will take around 45 years for the mine voids itself (sic) to be completely flooded …once active dewatering has stopped. Thereafter, decant from the underground mine voids via the adit and/or unsealed exploration boreholes in the vicinity are likely to occur*" (Pg. 68).

The decant rate was reported to range from 1 to 6 l/sec with associated sulphate concentrations in the order of 1 000 mg/L based on information taken from Hlobane, 82km SE of project (Pg. 69). It is however unknown if the coal seams that are mined at Hlobane are the same that are proposed to be mined at Yzermyn. No site specific assessment of the post-closure water qualities was done, although this is necessary for design criteria for the water treatment plant. The post-closure water qualities would also be dependent on whether the mine would be totally (or merely partially) flooded post-closure, in respect of which there is no conclusive information. An accurate assessment of the final mine water rebound level is essential.

Both the amended ESIAR (2015) (see Pg. 111) and the IWWMP (see Pg.3) confirm that decant is expected.

5.1.2.7 Decant management

Delta h (2014) stipulated that any potential post-closure decant from the mine should be captured and treated to applicable standards before being released into the environment. A suitable treatment facility should be designed to cater for post-closure decant quantities and qualities. It is also proposed by Delta h (2014) that the post-closure water level in the mine voids should be monitored and managed below critical levels to prevent diffuse seepage into the weathered aquifer utilising suitable engineering designs (e.g. active pumping or passive dewatering of the adit by drain systems).

The IWWMP (Pg. 20) states that a third party may be contracted to construct a water treatment plant and that it is anticipated and proposed that a modular water treatment plant be installed to meet the requirements of the mine.

As mentioned in Section 5.1.1.2 of this report, the amended ESIAR (2015) takes the management of decant further by stating that the decant will be treated until "*legally acceptable water quality stabilizes*". The report also recommends that the treated water be discharged in the "*adjacent hillslope seepage wetlands making use of a spigot which then drains into a sand filter along the edge of hillslope seepage*". It is reported that the discharge would impact on the wetlands either positively <u>or</u> negatively (in other words, no conclusive information is given on the impact on wetlands). The impact has however not been assessed by the specialists and the environmental consequences of this impact are entirely unknown.

No capex and opex costs of a treatment plant **(either during the operation phase or post-closure)** are available in Atha's environmental assessments, amended ESIAR (2015) or IWWMP. This information is however vital to assess the financial viability of the mine, particularly in the light of condition 14.1 of the WUL, and should have been before the decision-maker in order to make a decision on the WULA.

5.2 Wetlands

5.2.1 Methods of Assessment

The following methods of assessment were reviewed in the reports listed in Section 4.2 **and 4.5**:

- Seasonality of site visit;
- Delineation of wetlands; and
- Wetland Integrity.

5.2.1.1 Seasonality of Site Visits

The wetland assessment by Natural Scientific Services (NSS (2013)) comprised two surveys. One was conducted as a high flow survey (summer) and the other as a low flow survey (winter). Only one survey was conducted for the purpose of the Wetland Ecological Assessment Report (SAS (2014)). This survey was done during the early dry season (May 2014).

In November 2014 SAS conducted a delineation of wetlands situated within the proposed surface infrastructure footprint with the input of a registered surveyor (which resulted in the SAS delineation letter, 2014). This did not comprise a detailed assessment of the surface infrastructure wetlands, which was only conducted subsequently in May 2015 (see SAS (2015) p. 54). In May 2015 SAS conducted a detailed assessment of the surface infrastructure wetlands and the two wetland resources located within 500m of the surface infrastructure footprint and underground mine area (which resulted in the SAS 2015 report) (SAS (2015 Pgs. iii and 54).

Both of the detailed assessments conducted by SAS were therefore based on fieldwork conducted in the dry season. SAS itself records the shortcomings of this approach "*This limited the use of vegetation indicators for the assessment. As a result, some aspects of ecology of these systems, some of which may be important, may have been overlooked as a result of the seasons in which the extensive filed surveys were conducted*" (SAS (2015) Pg. 15 and see Pg. 62). Whereas SAS concludes that the results contained in SAS (2015) are nevertheless considered sufficiently reliable to guide informed decision making, GCS differs strongly with this view.

Due to the dynamic nature of the drivers of wetlands, it is critical to conduct two seasonal surveys (wet & dry) to accurately determine the seasonal zone, Present Ecological State (PES) / Wetland Health (WETHealth) and Ecological Importance and Sensitivity (EIS) of the wetlands. Water levels will fluctuate between different seasons as runoff and infiltration from the catchment varies due to the absence / presence of rain. These fluctuations may have an effect on the wetland assessment results. Furthermore, determining the extent of a wetland only during the dry season would not result in a complete or accurate account of the wetland boundaries.

As noted above, DWS was concerned about this limitation.

While it is true that the compilers of the earlier NSS (2013) report had conducted both summer and winter surveys, that report also recommended that the proposed mine should not proceed at all (NSS (2013) Pg. 269). In any event, DWS had the NSS (2013)

report as referenced, when it concluded that a further detailed study inclusive of summer months was required.

What is even more significant however is that the SAS (2015) report (like the SAS (2014) report) did not conduct a proper assessment of the wetlands which lie within the underground mining boundary (See SAS (2015) Pgs. 14 to 16, as well as pg.64 read with pg. 24 [i.e. the description of a level 1 assessment]). The SAS (2015) report (like the SAS (2014) report) also focused on the impacts of the proposed mine on the wetlands which lie within the surface infrastructure area, which is inappropriate given the severity of the likely impacts on the wetlands falling within the underground mining area (See SAS (2015) Pg. 88 where it is stated "*The impact tables below serve to summarise the significance of perceived impacts on the biodiversity of the study area, in particular the surface infrastructure and previously proposed dump footprint areas*").

<u>In other words, there has never been a proper wetland assessment conducted by SAS as regards the wetlands in the underground mining area, or as regards the likely impacts of the mine on such wetlands</u>.

5.2.1.2 Delineation of wetlands

NSS (2013) delineated the then surface infrastructure area wetlands by means of both desktop and field based investigation, whereas it delineated the wetlands within the underground mining area only by means of a desktop wetland delineation (Pg. 179). Similarly, SAS (2015) delineated the wetland resources in the surface infrastructure area in detail according to the DWA (2005) methodology, but delineated the remaining wetlands in less detail (SAS (2015) pg.14).

It is of great importance that there is accurate (ground-truth) information on the extent of the wetlands associated with the underground mining area, before mining commences and authorisation (environmental authorisation or WUL) is granted. Such information would enable the specialist to determine whether the anticipated drawdown and dewatering would have an impact on the wetlands. This baseline data (which is currently lacking) should then be used in the monitoring programme of these wetlands.

Determining the extent of a wetland as per the requirements prescribed by the Department of Water and Sanitation (DWS) in "A practical field procedure for identification and delineation of wetlands and riparian areas", 2005, requires the delineation of the wetland by means of the following indicators:

- Terrain Unit - identify those parts of the landscape where wetlands are most likely to occur e.g. valley bottoms and low lying areas;
- Soil Form - identify the soil forms associated with prolonged and frequent saturation;
- Soil Wetness - identify the soil morphological "signatures" (redoximorphic features) that develop in soils characterised by prolonged and frequent saturation; and
- Vegetation - identify the presence of hydrophytic vegetation associated with frequently saturated soils.

The vast majority of the wetlands have therefore not been delineated based on actual fieldwork. This amounts to a material gap in the information which is currently before the decision-maker.

5.2.1.3 Wetland Integrity

The Wetland Ecological Assessment Report (SAS (2014), Pg. 24) stated that the PES/ WETHealth (i.e. the health or integrity of the wetlands) study comprised a Level 1 assessment. **The SAS (2015) report confirmed that the study (as amended) remained a Level 1 assessment (Pg. 24).** A Level 1 assessment is a desktop evaluation with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution. However, taking into consideration the sensitivity of the wetlands occurring within the study site, GCS is of the opinion that a level 2 assessment should have been / has to be conducted. This involves structured sampling and data collection in respect of each wetland and its surrounding catchment. Although a Level 1 assessment can be used as an indicator of the quality of the wetlands present on a site, a Level 2 assessment will comprise of actual and real-time data. In the case of the Yzermyn mine, a level 2 assessment is necessary to enable the authorities to make informed decisions in terms of the necessary authorisations. This data is also necessary to obtaining baseline data on which to base the monitoring plan.

5.2.2 Wetland Assessment Results

The following wetland assessment results were reviewed in the reports listed in Section 4.2 **and 4.5**:

- Sensitivity of present fauna and flora;
- Wetland Functionality;
- Present Ecological State of wetlands present on site; and
- Recommended Ecological Category for the wetlands occurring on site.

5.2.2.1 Sensitivity of present fauna and flora

GCS is of the opinion that the sensitivity of the vegetation within the mining surface and underground footprint, especially the wetlands, was identified correctly in both the NSS (2013) and the SAS **(2015)** reports.

The proposed mine is situated in a threatened ecosystem (Wakkerstroom/Luneburg Grasslands). The proposed mine is also situated within and adjacent to the Mabola Protected Environment and adjacent to the KwaMandlagampisi Protected Environment. Concerns were raised regarding the location of the mine by the DWA, in its letter dated 9 January 2014 **and again in the DWS letter dated 26 October 2015 referred to in paragraph 4.5 above**. These have not been addressed in the IWWMP (2015).

Six Conservation Important (CI) floral species that are listed on the South African National Biodiversity Institute (SANBI) Threatened Species Programme were found by NSS (2013) in the study area, and 30 species that are listed as Protected Species under the Mpumalanga Conservation Act 10 of 1998. 26 of these were found during surveys of the mining area. 21 CI mammals have been recorded previously in the proposed mining area, and eight CI mammal species, including one Endangered and five Near Threatened species, were found there by NSS (2013). 18 CI bird species have been recorded in or near the proposed mining area, and NSS (2013) observed five CI species during surveys related to the project. Several globally, nationally or provincially Near Threatened reptiles and frogs are also likely to occur at the site.

Nevertheless the now rejected SAS delineation letter, 2014 stated the following: "*The importance of [the] hillslope seepage wetlands from a floral and faunal habitat conservation point of view is therefore considered extremely limited*", "*the loss of these vegetation and habitat resources within the proposed infrastructure area is therefore not considered significant at any spatial scale*". GCS doubts the veracity of these statements because they contradict what was stated in the NSS (2013) and the SAS (2014) **and (2015)** reports.

5.2.2.2 Wetland Functionality

Subject to the following, GCS is of the opinion that the current (baseline) functionality of the wetlands **which formed the subject of the NSS (2013) and SAS (2014) reports** was calculated correctly in the NSS (2013) and SAS (SAS (2014)) reports. **GCS accepts for present purposes the further information as regards the wetland functionality of S1, S2, CVB5 and S11 contained in the SAS (2015) report.** However, the functionality of these wetlands would change dramatically if mining were to commence. The impacts of the drawdown and dewatering associated with the mine on the wetlands would be significant.

5.2.2.3 Present Ecological State of wetlands present on site

Subject to the following, GCS is of the opinion that the PES baseline classifications in the reports compiled by NSS (2013) and SAS (2014) are correct. **GCS accepts (for present purposes) the new PES classifications of S1 and S2 contained in SAS (2015).**

The Present Ecological State (PES) of the wetlands **(falling within the 181.1 study area defined by NSS and the surface infrastructure area as it then was (in the case of SAS (2014))** was determined to be A/B category, i.e. largely natural, in the wetland assessment reports compiled by NSS (2013) and SAS (SAS (2014)). **As explained above, the SAS (2015) report assigns a lower category to the surface wetlands than it did previously (Category C). That does not alter the primary observation, which is that not enough is known about the extensive wetlands which fall within the boundary of the underground mining area. The PES of relatively far smaller wetlands in the surface infrastructure area is not material in light of the extent of the gaps in information as regards the greater wetland area. In any event, as regards the surface infrastructure wetlands, a Category C PES wetland is one in respect of which the natural habitat remains predominantly intact.**

Based on the conclusions of the hydrogeology review conducted by GCS (see paragraph 5.1.1.1 of this report), it is evident that the integrity of these wetlands **(as well as the other extensive wetlands overlying the undermining area and the newly identified wetlands CVB5 and S11)** would change substantially should mining commence.

The findings of the hydrogeology report conducted by Delta h (2014) included that: "*The simulated extent of the (steady-state) zone of impact (2m cut-off) of the underground workings on the shallow weathered aquifer extends predominantly upstream of the mine and is limited to around 2 km SW and 3 km towards the SE (Figure 8.2). Significant impacts with drawdowns above 5m are likely to be limited to an area immediately SE above the underground mine workings and associated with the low permeability dolerite sill contact (the low permeability and groundwater flow within the dolerite exaggerates the drawdown).*" **(Pg. 51 and see Figure 8.2 on Pg. 52)).**

However, the review conducted on this report by the GCS hydrogeologist (see paragraph 5.1.1.1 of this report) concluded: "*It is incorrect to suggest, as the Delta h (2014) report does, that only impacts with drawdowns above 5m in the shallow aquifer are significant. Drawdown of 0.5 - 2m could also significantly impact on groundwater-dependant eco-systems and groundwater users, i.e. springs could dry up and yields be reduced. The Delta h model* *shows that drawdowns of between 2m and 5m will coincide with large parts of the area associated with the underground workings."*

Based on this, GCS concludes that all wetlands in the cones of dewatering of the shallow and deep aquifers would be negatively impacted by the drawdown.

In this regard, the following statement was made by SAS in the SAS delineation letter, 2014: "*The dolerite sills occurring at a depth of around 20 to 30 m and above the coal seams act as an impermeable geological layer which will prevent any drawdown of water from the wetlands and no significant moisture deficit is envisaged which will affect the larger wetland area, and only very localized impacts from dewatering at the box cut is envisaged. In addition there will be … no significant change in the wetland hydrology beyond the footprint of the surface infrastructure and immediate surrounds from the current condition … Based on the observations presented above it can be concluded that the impact on the wetland resources will be limited to the footprint of the proposed surface infrastructure and the immediate surrounds.*" (Pgs. 1 and 2). **As noted above, a similar statement was made in the SAS (2015) report (Pg. 65).** Based on the review of the Delta h (2014) report conducted by the GCS hydrogeologist (see paragraphs 5.1.1.1, 5.1.2.1 and 5.1.2.4 of this report), this statement is not true. A drawdown of between 2m and 5m is anticipated to occur in the shallow aquifer underneath the wetlands within the area of the underground mining activities. This drawdown would not only be localised at the box cut. This will lead to negative impacts on the wetlands occurring above the underground mining area, with some of the springs and wetlands drying up.

(It is noted here that it appears from the record prepared for the appeal in the Water Tribunal that the SAS delineation letter, 2014 has been rejected by the DWS altogether as having not met basic requirements. Consequently many of the extensive and material criticisms of this letter in the original GCS report will not be made in this version of the report. Those criticisms however remain valid and must be considered should the SAS delineation letter, 2014 be taken into account for any decision-making.)

5.2.2.4 Recommended Ecological Class of the wetlands occurring on site

The Recommended Ecological Class (REC) of the newly assessed surface infrastructure wetlands (S1 and S2) is Category C. The REC of the wetland systems 1 to 4 is Category A/B. These wetland systems should therefore not be permitted to deteriorate from their Present State (SAS (2015) Pg. 83). The REC of the newly assessed NFEPA wetland, CVB5 (being REC Category B), and the newly assessed S11 (also being REC Category B) means that these too are required to be maintained in their present state.

If mining occurs, this will not be adhered to. As previously discussed and referenced, the underground mining area would have a detrimental effect on the wetlands occurring above this area **and within the cones of dewatering**. The drawdown would have a detrimental effect on the water availability of these wetlands, which would alter the wetland habitat and the functionality of these wetlands. As the proposed mine is situated at the headwaters of a number of streams draining into the Assegaai River, the Present Ecological State of the river will also be effected. GCS also refers to the impacts discussed in paragraph 5.2.3.1 below. No possible mitigation for these impacts exists.

5.2.3 Impact Assessment

The following impact assessment results were reviewed in the reports listed in Sections 4.2 **and 4.5**:

- The significance of the impacts given that the mine is situated in a threatened ecosystem;
- Identification of impacts related to all phases, including cumulative impacts;
- Sufficient mitigation measures to address the identified impacts; and
- The relevance of the impacts of the underground workings on the wetlands occurring on site in terms of the hydrogeological studies.

5.2.3.1 The significance of the impacts given that the mine is situated in a threatened ecosystem

GCS refers to paragraph 5.2.2.1 above and reiterates that the mine is intended to be situated in a threatened ecosystem. It is GCS's view that the impacts of the mine on this ecosystem have not been discussed or analysed sufficiently in Atha's environmental assessments, the amended ESIAR (2015) or the IWWMP. The surface area footprint as well as the underground mining activities of the mine would impact on this threatened ecosystem. The construction of the surface infrastructure would involve vegetation removal and would alter the habitat, which would lead to the total destruction of part of a field type that is classified as being a threatened ecosystem. The underground mining would result in a drawdown, which would result in a loss of water in these ecosystems. Light, noise and dust pollution and the impacts of these on the important fauna in the area has not been properly assessed. This is of critical importance, especially for the bird species present in the area.

GCS agrees with the impacts identified in the NSS report (2013). These impacts correspond with the findings of the Delta h report (2014). GCS is of the opinion that the drawdown that is anticipated to occur, as identified in the Delta h report, would lead to springs and wetlands drying up. This would have a significant impact on, for example but not limited to, the vegetation, birds and amphibians that depend on these wetland systems. The impacts on these species would not only occur on the surface area footprint, but also the underground mining works footprint.

The proposed mining activities will be situated in the headwaters of a number of streams. It will severely impact water provision downstream of the mine. The headwaters associated with the mining area drain into the Usuthu River System, via the Assegaai River. The wetlands are of critical importance to this river system.

5.2.3.2 Identification of impacts related to all phases, including cumulative impacts

No cumulative impacts were determined in the SAS (2014) **or (2015)** reports or in the SAS delineation letter, 2014. It is critical to determine the cumulative impacts of the current project, future projects and historical projects on the environment, in terms of vegetation lost, dewatering and drawdown of the aquifers.

In the NSS (2013) report, the following cumulative impacts were identified by NSS:

- Water, air, noise and light pollution;
- Reduction and deterioration of regional groundwater;
- Deterioration and loss of wetland habitat, species, ecosystem functioning and services;
- Deterioration of aquatic habitat, species, ecosystem functioning and services;
- Increased erosion, sedimentation and invasion of alien species;
- Loss and deterioration of threatened terrestrial floral communities, vegetation types, ecosystem functioning, services and faunal habitats; and
- Reduction in the richness and abundance of floral and faunal species, and extirpation (eradication) of locally restricted populations or species.

Although the surface infrastructure layout of the mine has changed since the drafting of the NSS (2013) report, GCS is of the opinion that all of the cumulative impacts identified by NSS remain relevant. In this regard, GCS specifically points out that the impacts identified by NSS associated with the underground workings remain the same (see further section 5.2.3.4 below). Furthermore, although the NSS (2013) report was based on the WSP Geohydrology Assessment (2013), where after the Delta h (2014) hydrogeological report was obtained, the impacts identified by NSS correspond with the findings of the Delta h (2014) report.

The DWA's letter dated 9 January 2014 raised the concern that the wetlands were not sufficiently assessed and that the impacts were not sufficiently determined. However, these concerns have not been addressed in the IWWMP (2015) **or in the specialist reports which**

underpin it. The fact that SAS conducted a more in depth analysis of the wetlands within in the surface infrastructure area (albeit, again in the dry season), does not in any way address the lack of reliable information as regards the likely impacts on the wetlands associated with the underground workings of the mine.

5.2.3.3 Sufficient mitigation measures to address the identified impacts

GCS is of the opinion that the mitigation measures proposed by NSS in the NSS (2013) report (Pg.241-242, 253-254, 260-261, 263-266) "*should the project go ahead*" are insufficient to address the anticipated impacts of the mine. As appears from paragraph 5.1.2.4 above, the impacts on wetlands associated with the underground mining area will be significant. Some of the springs that feed into these wetlands will completely dry up. If mining were to commence, there are no mitigation measures that could be formulated to prevent this. In this regard, GCS agrees with NSS's statements (in the NSS (2013) report) that "*The main recommended mitigation measure* [in respect of the anticipated impact of "Construction of Infrastructure & Resultant Loss of Habitat & Species"] *is to avoid all areas of Very High and High sensitivity. This would make the project a No Go as almost the entire undermining area is rated as having a Very High or High sensitivity.*" (Pg.241) and "*Due to the HIGH and long-term (if not irreversible) status of this impact* [being "Decline in Water Inputs & Resultant Deterioration in PES & Functionality"] *in an area far exceeding the study area, the project should be a NO GO*" (Pg.253).

None of the impacts that are anticipated to result from the underground mining activities and the associated drawdown area are properly assessed in the SAS (2015) report.

In the DWA's letter dated 9 January 2014 and in its subsequent letter dated 26 October 2015 referred to above concerns were raised regarding the possibility that the wetlands may dry up as a result of the mining. Table 5-7 in Atha's IWWMP, entitled "Identified risks and mitigation measures associated with each water use", specifies the following mitigation measures in respect of the impact of the cones of dewatering on wetlands:

- **"Monitor inflow of water into the mine workings.**
- **Monitor groundwater levels.**
- **Grout excessive inflows.**
- **Cover drilling to detect potential zones of high inflow.**
- **Pre-grout zones of potential excessive inflow."**

See GCS's comments on the mitigation measures of grouting and cover drilling on pgs 55 and 56 below. In summary, the DWS's concerns regarding the impact of the cones of dewatering on the wetlands have not been adequately addressed.

GCS has drawn the conclusion that the Delta h (2014) findings do not in any material way undermine the findings contained in the NSS report (2013). Although Delta h reported that the vast majority of springs are associated with contact to low permeability dolerite sills (p. 7); that localised perched aquifers may occur on clay layers or lenses (p. 12); and that the perched aquifer system is disconnected from hydraulic impacts related to the proposed underground mine (p. 13), it also reported that springs located within the significant zone of dewatering of the shallow aquifer could be negatively impacted and may dry up during the life of mine (pp. 52 and 53). As Prof Dennis points out in her review, the cones of dewatering modelled by WSP and Delta h are similar (Dennis, I (2016) p. 7).

In Atha's response to the EA appeal, the allegation is made that there is a lack of interrelatedness between the wetland and the groundwater impacts, but there is not the requisite data to support this conclusion. In the Delta h (2014) report Pg. 51 it is stated that "*the environmental impacts associated with the mine inflows are primarily associated with:*

- *The partial dewatering of the aquifer above and in the vicinity of the underground mine voids with subsequent impacts on groundwater dependent eco-systems and groundwater users*".

5.2.3.4 The relevance of the impacts of the underground workings on the wetlands occurring on site in terms of the hydrogeological studies

It is evident from the Baseline and Impact Assessment Report, NSS (2013) that the WSP Geohydrology Assessment (2013) was consulted in conducting the assessment and drafting the report. An updated geohydrological assessment was done by Delta h in 2014, where after a wetland ecological assessment was conducted by SAS Environmental **in 2014 and updated by it in 2015 (SAS (2014) and SAS (2015))**. The Wetland Ecological Assessment Reports (SAS (2014) and **(2015)**) do not properly assess and report on the impacts identified in the Delta h (2014) hydrogeological report. The fact that the surface infrastructure layout was changed does not change the impacts associated with the underground mining activities.

Figure 4-36 on p 135 of the IWWMP is a map indicating the wetlands and the cone of dewatering in the shallow aquifer. This map also indicates that a number of springs will be affected by the dewatering. See also GCS Figure 1 attached. According to the Delta h (2014) report, the underground mining would cause a drawdown of between 2m and 5m in the aquifer that feeds the wetlands (the shallow aquifer). This would have a negative impact on the wetlands above the underground mine area, as well as surrounding wetlands within the drawdown cone. Some of the shallow wetlands, for example the seepage wetlands, would completely dry up (Delta H Pgs. 51 to 53). It is GCS's conclusion that assuming the drawdown cone determined by Delta h (2014) to be correct, the impact that the underground mining activities will have on the wetlands is significant.

5.3 Hydrology

5.3.1 Comparison between Reports

In the process of supplementing the original GCS report, it was discovered that another key specialist report which was placed before the decision-maker, was never made available to the public or to CER. Neither CER nor GCS has had sight of this report. This report is referred to in the IWWMP as the Onno Fortuin Consulting 'Yzermyn Mining Project: SWMP Final Design Report' May/August 2015 and the IWWMP purports to summarise the report from pages 158 to 164 thereof. As appears from the IWWMP (Pg.163) the report recommends a new PC Dam arrangement involving the following preliminary designs: PC Dam 1: Normal HDPE open dam (L = 150m, W = 63m, D = 3m, Side Slopes 1:3, Vol = 23 000m3); Steel Tanks: 7 x Sectional Steel Tanks – 3 panels high with Dia = 14.642m. Combined storage capacity of the 7 x steel tanks = 7 742m3.' (IWWMP p. 163).

The PCD capacity has been increased to approx. 30 742m3 capacity, as compared to the Highlands Hydrology (2014) and SimX (2015) reports 19 000m3 capacity.

It is impossible for GCS to review this aspect of the IWULA and the IWUL without access to the repor. Since the steel tanks and PCD dam are among the water uses authorised, this aspect ought to form part of any complete review of the information contained in the IWULA.

For present purposes, the revised GCS review will confine its scope to the reports to which the CER (and therefore GCS) were granted access:

What is pertinent however is that the existing water balance which formed the basis of the WUL is no longer valid. The volume of water to be discharged from the water treatment plant, which volume forms part of the WUL, is no longer correct.

Aside from the Storm Water Management Plans (Onno Fortuin Consulting and Highlands Hydrology) and the coarse-scale dynamic water balance (SimX), the hydrological impacts of the proposed mine have not been assessed since the 2013 WSP study, which is based on an outdated layout and does not account for the updated groundwater model (Delta h (2014)).

Further to this, all volumetric output inaccuracies in the groundwater study for the mine (Delta h (2014)) (as discussed in section 5.1.1.1 of this report) will carry through into the water balance calculations (WSP and SimX studies) and the Storm Water Management Plans, including the Pollution Control Dam (PCD) sizing (Onno Fortuin Consulting and Highlands Hydrology), in other words, all the surface water reports. To elaborate, the estimated water inflow rate into the mine's underground workings is reported in the Delta h (2014) report as 491 m^3/d, with a sensitivity range of between 218 to 3010 m^3/d. The decant range reported in the Delta h (2014) report is between 1 and 6l/s. These large ranges translate into a wide range of potential PCD sizes, a wide range of water volumes moving between and being stored in the components of the mine water balance, and a wide range of volumes to be treated and discharged. These large ranges make it impossible to determine the mine water balance and consequent PCD sizing with any accuracy. The inflow and decant ranges must be determined with greater certainty for these to be accurately and responsibly determined.

Delta h (2014) itself stated that the confidence level of the groundwater model predictions is low, and the GCS hydrogeologist agrees with this finding (see sections 5.1.1.1 and 5.1.2.3 above). Furthermore, the GCS hydrogeologist has found that the location, orientation and hydrogeological characteristics of the dykes, sills and faults in the mine area have not been assessed or reported on sufficiently (see sections 5.1.1.1 and 5.1.2.1 above). The lack of confidence in the groundwater model compromises the accuracy of predicted water balance, storm water management plan and PCD sizing.

5.3.2 WSP Hydrological Assessment (2013)

The WSP Hydrological Assessment (2013) bases certain of its conclusions on findings contained in the WSP Geohydrological Assessment (2013), and to the extent that these have been revised by Delta h the conclusions are of limited assistance [see for example the discussion of decant and dewatering on Pg.8 of the WSP Geohydrological Assessment where a different range of water inflows into the underground workings to that contained in Delta h (2014) report (and referred to in paragraph 5.3.1 above) are given].

While groundwater volumes were used as inputs into the water balance calculated in the WSP Hydrological Assessment (2013), no conjunctive groundwater-surface water modelling was undertaken and wetland interactions/processes have not been modelled in any of Atha's environmental studies/assessments. The failure to assess the surface water-groundwater interaction means that the impact of dewatering on surface water streamflow has not been assessed.

The argument is advanced in the WSP Hydrological Assessment (2013) that it is not necessary to follow the GN 704 regulations in respect of flood line calculations and mining because the watercourse considered to pose the highest risk of flooding is perennial, the associated contribution catchment area (4.25km^2) is small and the vertical elevation difference between the watercourse bed and site of interest is great (between 8m and 10m). GCS is of the view that it is still necessary to follow the GN 704 regulations because the regulations specify that an Exclusion Zone should be outlined within which infrastructure may not be placed and mining may not be undertaken, which is the more conservative of the flood lines and the 100m buffer line at every point.

The legal section of the WSP Hydrological Assessment (2013) should have emphasised GN 704 as these are the most relevant mining-related surface water regulations and should guide the scope of the Storm Water Management Plan (which it did) and Flood Line assessments (which it did not – as has just been discussed).

In respect of water quality monitoring, Acid Mine Drainage (AMD) should have been addressed in the WSP Hydrological Assessment (2013) and the following should have been included: iron, manganese, aluminium, total alkalinity, calcium, magnesium, chloride and sodium. A surface water monitoring plan in conjunction with a groundwater monitoring plan is needed that includes depth to groundwater, monitoring locations, chemistry suite and frequency. The DMR letter to Atha (dated 4 February 2014) also highlights that a monitoring plan that includes a recommended chemistry suite, monitoring positions and frequencies is needed.

The WSP Hydrological Assessment (2013) also fails to calculate the mine's Environmental Water Requirements. "Environmental Water Requirements" refers to the water regime necessary to sustain the ecological values of aquatic ecosystems and biological diversity at a low level of risk. These should be taken into consideration when assessing the volume of clean water that should be released from the mine.

The WSP Hydrological Assessment (2013) fails to assess the impact of the mine's surface water on the larger area, including a calculation of the proportion of the overall catchment's surface water that will be removed for use at the mine (the reduction in catchment yield). The statement that the "*cumulative impacts with regards to water quality and quantity are expected to be limited*" is unfounded and should be removed as the proposed study concerns coal mining in a sensitive wetland area, further mines exist and are proposed in the area, AMD was not considered and interactions between the surface water, the wetlands and the groundwater were not considered.

Further to this, the amended ESIAR (2015) highlights that, "*the W51A catchment area is considered to have a very high ecological sensitivity based on the local diversity of habitats and species. It must be noted that the surrounding grasslands and terrestrial habitat types act as localised catchments for streams and rivers. Such quaternary catchments and rivers are generally highly sensitive to flow modifications and have no or limited capacity for commercial use. There are numerous streams and rivers that drain from the target area. Many of these are headwaters and mountain streams that flow into larger river systems, and ultimately into the Assegaai River. This area is considered a critical area for the generation of high quality water and has been included in the Freshwater Ecosystem Priority Areas (FEPA)*', and '*The Assegai River Catchment has been identified by the DWA as being important catchments* (sic) *in the country, as they are a key source of water supply to industry, commercial agriculture and rural communities. With further mining developments in the area, this catchment is likely to come under increased pressure, not only in terms of water abstraction/ discharge, but also in terms of the potential contamination of these rivers by diffuse sources of pollution.*" **(SAS has removed a description of the importance of the W51A catchment area which it had in its original wetland assessment report from its revised wetland assessment report – compare Pgs 38-39 SAS (2014) with Pgs 38-40 of SAS (2015)).**

To add to this, no cumulative impacts were determined in the Wetland Ecological Assessment Reports, compiled by SAS (SAS (2014) and **SAS (2015)**).

The WSP Hydrological Assessment (2013) highlights that, "*Due to a lack of flow gauges in the vicinity of the proposed mine development, the model was calibrated based on flow measurements made during the dry season at a single point in time. To ensure the validity of the model, additional flow measurements for calibration purposes are required, including wet season flows.*" Additional flow measurements are required to calibrate the model, and the flow results should not have been calibrated on a once-off reading.

In the WSP Hydrological Assessment (2013), construction-phase risks centre on soil erosion and vegetation-loss, increased flows in what is termed 'Catchment 19' and implementation of a flow monitoring plan. Operational-phase risks centre on increased flows in 'Catchment 19' and decreases in 'Catchment 16' and 'Catchment 17'. Were calibration data to become available, flow volumes could increase or decrease, potentially changing the flows in the modelled catchments.

The water quality risks are stated in the WSP Hydrological Assessment (2013) as, "*The decrease in the water quality is expected to have a Medium environmental significance,* *reduced to Low Medium should the mitigation measures … be implemented*". These risks would likely increase if AMD were accounted-for.

5.3.3 Highlands Hydrology SWMP Report

GCS does not agree with the identification in the Highlands Hydrology SWMP Report of rain gauge W5E009 as being a good source of data because this rain gauge falls within a different quaternary catchment to the site and is near a dam. There is no mention of rain gauge 407730W which appears to be the closest to the site. Furthermore, although it is unclear how the Mean Annual Precipitation depicted in Figure 2-2 in respect of the area of the proposed mine was calculated, the figure does depict that area as having a Mean Annual Precipitation ranging from to 901 to 1150mm.

The flood peaks were calculated using only one method, whereas at least the SCS-SA method should have been considered and the results compared. The SCS-SA method calculates peak flows for small catchments, was designed for South African conditions and takes soil moisture conditions into account.

Flow values were not calibrated. This means that they were not verified against measured data, so it is not clear how accurate the flow values are.

Survey data was not referenced in the report and no comment was made on the quality of this data. Better data is required for flood line calculations. The survey data used in the study is at 2m intervals, whereas 1m intervals or less is required for the flood line calculations and 0.5m intervals for design purposes.

The PCD sizes in the Highlands Hydrology Report need to be recalculated as they are stated to be sized in accordance with GN 704 (to spill not more than once, on average, in 50 years) yet they should not spill at all considering the sensitivity of the environment. It should be noted that whereas the Highlands Hydrology Report was based on there being more than on PCD, the later SimX report envisaged only one. Furthermore, as stated above, the PCDs (**or PCD**) should be resized on the basis of more accurate groundwater assessment results.

The Highlands Hydrology Report also states that it is unlikely that the PCDs would be near-empty most of the time. It is necessary that the system be designed with the PCDs kept near-empty, otherwise they will not be able to contain the storm event volumes for which they are designed. There is insufficient information in the specialist studies and IWWMP about the proposed treatment plant, so it cannot be established what volumes of water are intended to be pumped from the PCDs to the plant for treatment prior to discharge (which information is necessary to determine the correct PCD sizes).

The report also states that "*The design of the … berms/channels … should also be investigated and revised during the detailed design phase to accommodate site specific conditions*." It is acceptable to undertake final Storm Water Management Plan (SWMP) designs after a WUL is granted as long as the existing conceptual SWMP is correct. As this section makes evident, the existing conceptual SWMP is not correct. For one thing, the PCDs have been incorrectly sized.

5.3.4 SimX Water Balance Report

The SimX Consulting Water Balance Report states that the PCD was simulated to operate at between 25% and 50% of its capacity, yet PCDs should be operated nearly empty to minimise spills. (Note: the SimX Consulting Water Balance Report conceptualised one PCD, whereas the Highlands Hydrology SWMP Report conceptualised two PCDs. This is because one of the PCDs conceptualised by Highlands Hydrology pertained to the discard dump, which was no longer part of the project when the SimX Consulting water balance was conducted.) Furthermore, the PCD should have been simulated using daily rainfall inputs (as opposed to the monthly rainfall inputs, which were utilised in the SimX report), with a very conservative approach to PCD spills because this is an environmentally-sensitive area in which no discharge is acceptable.

Like the Highlands Hydrology SWMP Report, the SimX Consulting Water Balance Report used data from rain gauge W5E009 in its simulation model. This data source therefore suffers from the same deficiencies mentioned above.
The model was simulated on the basis of 31 years of rainfall records. A longer record such as that of the WR2012 data (WRC, 2015) would have produced more reliable results.

The SimX Consulting Water Balance Report states that 'poison distributions' were used to simulate the rainfall, with no mention of whether other statistical distributions which may have provided a better fit were considered. GCS is of the view that the statistical calculations associated with the rainfall data should have been undertaken more comprehensively. No mention is made of whether evaporation was considered within the simulations.

The report states that the average monthly rainfall for the simulated period compares well with the historic averages, yet the simulated (modelled) rainfall is consistently lower than the measured rainfall. This means that the rainfall data used has caused the PCD to be undersized, which will cause it to spill. The report states that the simulated Mean Annual

Precipitation (MAP) (910mm) is higher than the observed (884mm). However, observed and simulated daily rainfall figures are not compared.

The report recommends that the model should be used for Water Conservation and Water Demand Management (WC/WDM) strategies (as per DWS requirements) when operations have commenced; however this is inappropriate because the results are at too coarse a scale (monthly time-steps) to provide sufficient information on which to base WC/WDM strategies.

No dry and wet season water balances were calculated, nor were dry and wet season wetland measurements taken.

The aim of a pollution control dam is to contain the dirty water and prevent the discharge of dirty water into the catchment. Dirty water includes water containing suspended solids and dissolved salts. Suspended solids originate from runoff from the infrastructure area, run off mine dumps, stock piles and roads, plus suspended solids due to mining activities underground. Dissolved solids will originate from the run of mine stockpile, waste rock dumps and the underground workings. As a result the PCD needs to be designed and sized so as not to allow discharge into the catchment according to Government Notice 702. Any discharge will impact on downstream water quality.

5.3.5 EcoPartners Downstream Water Usage Report

In the EcoPartners report, the comment, "*It is recommended that the proposed mine development ensure that water discharged to the rivers are of such quality that it does not pollute the rivers and affect the downstream water users*" is in fact an essential legislated outcome and not appropriate as a mere recommendation.

The comments, "*Note that the river system of interest in this study, does not feed into or link to the Wakkerstroom Wetland Complex*" and "*Neither the KwaMandlangampisi Protected Environment nor the Tafelkop Nature Reserve are located downstream from the proposed Yzermyn underground coal mine and both of them is* (sic) *separated from the mining area by a watershed*" are unsubstantiated and of questionable scientific value, as no mention is made of investigation into surface water-groundwater or wetland links in this area.

The report does not address the varied impacts of the mine on water usage and affected communities, under both drought and flood conditions, with seasonal variations. Again, no discharge of polluted/contaminated water into the environment would be acceptable due to the environmental sensitivities of the area.

5.3.6 Amended ESIAR (2015)

The amended ESIAR (2015) states, "*It is the opinion of the independent environmental practitioner that the impact of the Yzermyn Underground Coal Mine on the environment of the relevant area can be mitigated to ensure ecologically sustainable development and use of natural resources… .*" Without modelling the interaction between surface water, groundwater and wetlands there is no basis upon which this conclusion may validly be made.

The amended ESIAR (2015) addresses the risk of flooding by stating that, "*Flooding is an environmental emergency as well as a safety and health hazard, as any pollution or waste on the ground has the potential to be washed into the adjacent river system. Flooding also has high erosion potential.*" However, no flood lines or flood risk Exclusion Zone have been calculated in respect of the mine site. Further to this, no mention is made of the risk of flooding downstream of the mine.

The amended ESIAR (2015) addresses some effects of AMD, but surface water baseline sampling for AMD was not undertaken and the potential effects of other potential pollutants have not been addressed.

The IWWMP (2015) states that, "*Very little direct impact on surface water is expected from the mining operation with a very small reduction in direct run-off and water flow to the seep wetlands from within the surface layout footprint. All water management infrastructure will be in place to stop polluted water from reaching any surface water resource.*" This cannot be concluded as the effects of AMD have not been quantified, flood lines have not been calculated, the water balance needs to be recalculated, and the surface water-groundwater interaction has not been determined in the IWULA.

5.3.7 IWULA (IWWMP August 2015)

The Integrated Water Use License Application (IWULA) submitted to apply for the proposed water uses triggered by the proposed mining operation was compiled in line with the requirements of the NWA. The document was structured as an Integrated Water and Waste Management Plan (IWWMP) in line with the Operational Guideline: Integrated Water and Waste Management Plan compiled by the DWS dated 2010.

The application included various appendixes (including specialist studies) to enable informed decision making by the DWS. However, GCS has identified various discrepancies and gaps in the specialist studies. It is accordingly questionable that the DWS was in a position to make an informed decision on the IWULA on the basis of the specialist studies.

The specialist reports compiled for the proposed mining activities have not identified all of the potential environmental impacts associated with the planned mine and, as a result, the IWULA does not contain sufficient mitigation measures to reduce the impacts of the mine to an acceptable standard. It is not possible to provide proper mitigation measures without the identification of all impacts and a detailed understanding of the interconnection of the various water resources (groundwater, surface water and wetlands).

The following comments are made on the IWWMP that was submitted and approved:

- **License Application Forms:**
  - **DW902 license application forms are required for all properties on which water uses are taking place. In Appendix D (entitled WUL Application) of the IWULA submitted, there is only one DW902 form. All water use require landowner consent in order for the DWS to issue an IWUL.**
- Wetlands and Sensitive Areas:
  - The executive summary (Pg. 3 under the heading "site description") states that "[t]*he watercourses which are predominantly perennial in nature, located within the Usutu to Mhlatuze Water Management Area, are considered to have a very high ecological sensitivity based on the local diversity of habitats and species*" (own emphasis) and goes on to further state that "*[n]o National Freshwater Ecological Priority Area (NFEPA) or local FEPA wetlands were identified in the direct sphere of influence of the YUCM site*" (own emphasis). This is contradicted in Section 4.4 in the Surface Water Section on page 59 of the IWWMP which states "*[t]his area is considered a critical area for the generation of high quality water and some streams has been included in the Freshwater Ecosystem Priority Areas (FEPA)*" (own emphasis). It is further contradicted in Section 4.9.1 on Pg. 73 which states "*based on the review of literature as well as the provincial and NFEPA databases it is evident that the wetland resources of the area are particularly important from a wetland conservation point of view with the wetlands that were identified by the NFEPA database being defined as NFEPA wetlands. Their FEPA status indicates that they should remain in a good/near natural condition (Category A/B) in order to contribute to the national biodiversity goals and support sustainable use of water resources (SAS, May 2015)*" (own emphasis).
  - The area is further highlighted as a sensitive area in Section 4.12.3 on Pg. 99 of the IWWMP where it is stated that "*All four Sensitivity Maps indicate that the proposed YUCM Project is situated in a sensitive and conservation important area, and correspond with the MTPA's (2013) Mpumalanga*

Biodiversity Sector Plan, and the DEA et al's (2013) Atlas of Sensitive Areas for Mining" (own emphasis).

- Water Supply:
  - In Section 4.5 on Pg. 60 it is stated that the "*Upper Usutu to Mhlatuze WMA is already highly developed and cannot sustain additional water use*" (own emphasis). Pg. 76 in Section 4.10 states that "*at the date of the initial compilation of this IWWMP (November 2013), the reserve of the Assegaai River was still pending*" (own emphasis). **A preliminary reserve determination has been undertaken for quaternary catchment W51A (DWS, 20 April 2016) after the submission of the IWULA to the DWS and prior to the issuance of the IWUL. The reserve states that groundwater quality in the catchment is ideal water quality, suitable for lifetime use with no adverse health effects. The reserve also recommends that a groundwater monitoring program be developed to monitor any adverse impacts on the groundwater resources. With regards to the surface water, the reserve states that conditions for the protection of the stream have been provided by the Chief Directorate.**
- Groundwater:
  - On Pg. 3 of the executive summary it is stated that "*The cone of water drawdown for the shallow aquifer is predicted to be about 8m at its worst area of impact, due to mine dewatering and could potentially have a limited impact on the wetlands in the mine target area*". The impacts resulting from the drawdown on the wetland area, although briefly mentioned in the IWWMP, have not been quantified and can therefore not be assumed to be limited as indicated in the report. In this review, GCS has found that the cone of dewatering will have a significant impact on the wetlands above the underground mining area – see section 5.2.3.4 above.
- Construction (Pg.20)
  - The IWWMP states that: "*…a water treatment plant will be required for the mine. The water treatment plant may be contracted to a third party and constructed with capacity to treat excess water to discharge quality. It is anticipated that the water treatment plant will also be required to be operational following mine closure in order to treat decant from the mine. It is proposed that a modular water treatment plant be installed during the operational phase to meet the requirements of the mine.*"
  - It is however not stated what the required or acceptable water quality of the discharge after treatment other than the statement on Pg. 242 of the IWWMP

that: "*The mine plans to treat any polluted water that could arise after closure to ensure downstream water quality is not compromised*".

- No information on the concept design of the water treatment plant **(either for the operational or the post-closure phase)** were has been provided. It should be ensured that the capex and opex cost of a treatment plant **for both phases** are included in the financial provision of the proposed project. The water treatment plant and the decant management system will form a large component of the financial provision and **would** influence the mine Net Present Value (financial viability).

- Table 7-1: List of exemptions from regulation GN 704 that are needed for YUCM (Pg.. 225)
  - The first exemption in Annexure 2 of the IWWMP was requested for*: "Placing the PCD and product stockpiles within 100m of hill slope seep wetlands on the farm Portion 1 of Yzermyn 96HT. Overburden to be used in construction of the adit pads". .* It is unknown what the geochemical characteristics of the "*overburden and sandstone excavated during the development of the adit"* (Pg. 23 of IWWMP) will be and if it has any acid generation potential. This should have been assessed before the exemption was granted.
  - In Annexure 2 of the IWWMP (Table 7-1) a second exemption is requested for underground mining below various wetlands. The following mitigations are proposed: *"The mine will monitor the wetlands as well as groundwater in the area. Any significant water ingress into the underground workings will be reduced by grouting and the groundwater model will be updated as new information becomes available. All impacted wetlands will be rehabilitated after mine closure. As a contingency, the mine will discharge treated (clean) mine water into effected wetlands, should the undermined wetlands experience reduced functionality due to proven mining impacts. See contingency plans in Appendix P."*
  - The aforesaid proposed mitigation measures have not been assessed by Atha's groundwater specialists (WSP Geohydrology Assessment (2013) or Delta h (2014)), and therefore their appropriateness and effectiveness have not been established. It was inappropriate for Atha to request exemption on the basis of unassessed mitigation measures, and there is no factual or scientific basis on which DWS could reasonably have granted the exemption sought.
  - In addition the wetlands that could be impacted have only been studied at a desktop level and as a result it will be impossible to determine the impact by dewatering and mitigation measures

- Grouting may reduce potential inflows into the underground workings and therefore also reduce the potential drawdown. However this was not assessed or simulated by Delta h (2014) and it is therefore not known whether this proposed measure will reduce the impacts. **Grouting is very seldom used in coal mines due to safety risks arising from uncontrolled water inrushes.** In addition, grouting is a large operational expense and it is usually too expensive to grout the whole of the underground workings. Furthermore the potential impacts of grouting have not been assessed in any of the specialist studies which form part of the WULA. Grouting can lead to the build-up of pore pressures with consequent underground rock stability issues and result in sudden inrushes which can lead to an unsafe mining environment. This proposed mitigation measure has not been addressed in the IWWMP or in the amended ESIAR (2015). **It has also not been included as an express condition of the IWUL.** Atha should have indicated that sufficient financial provision has been provided for grouting, should it be found to be acceptable by, amongst others, the rock engineering specialists. On the basis of the available information, it is unclear whether the mine would be financially viable if grouting were employed as a mitigation measure. The financial viability of the mine is something which must be evaluated and established before an environmental authorisation or WUL is granted.
- **Cover drilling is usually undertaken ahead of mining developments to prevent uncontrolled discharge into the mine working. Cover drilling is not a mitigation measure. If cover drilling and grouting is undertaken it is usually used in the development roadways or adits and not along mining panels.**
- As regard to the proposed mitigation measure that "*the groundwater model will be updated as new information becomes available*", this will in no way mitigate identified impacts. The model is purely an assessment/management tool, which should be utilised to guide the development of appropriate mitigation measures. Comprehensive and appropriate mitigation measures to address the environmental impacts of the mine – including those associated with underground mining below wetlands – should have been in place before the environmental authorisation and WUL were granted (on the assumption that mitigation is possible, **which is by no means certain and has not been assessed**).
- The groundwater and wetland specialists contracted by Atha have not assessed the impacts of discharging treated water into the wetlands **either**

during operations or post-closure. Accordingly, reliance on this measure is inappropriate and unjustified.

5.3.7.1 Assessment of impacts and associated mitigation measures

The following impacts were not assessed or quantified as part of the IWWMP and specialist studies:

- Geohydrology:
    - **Neither operational** nor post-closure contaminant plume migration have been assessed;
    - Mitigations in respect of the potential impacts on springs, wetlands and base flow have not been assessed by the specialists; and
    - The groundwater model is unreliable and as a result the associated impacts and any potential mitigation measures cannot be assessed and quantified.
- Wetlands:
    - Biodiversity
        - The impacts of the anticipated noise and light pollution during the construction and operational phases of the mine on the avifauna have not been assessed/quantified; and
        - The impacts of the anticipated noise and light pollution during the construction and operational phases of the mine on the protected bats found 100m away from the proposed adit have not been assessed/quantified.
    - Wetlands
        - The impacts associated with the anticipated water drawdown have not been assessed at all. Impacts associated with this would include:
            - Loss of vegetation and wetland habitat;
            - Loss of avifaunal species;
            - Reduced flow in the downstream water system;
            - Impacts on fish populations downstream; and
            - Loss of amphibian species.
- Hydrology:
    - The impact of the mine's water usage **(including through dewatering)** on the decrease in water availability in the greater catchment area has not been assessed/quantified;
    - The impacts of a deterioration in water quality, specifically Acid Mine Drainage, on the surface water quality downstream of the mine have not been assessed/quantified. The impacts of the PCDs (or PCD) spilling on the environment have not been assessed/quantified; and

- The sizing of the PCDs (or PCD) has not been adequately assessed/quantified.

5.3.8 IWUL Issued

5.3.8.1 Water Uses Licensed

The IWUL was issued on the 7 July 2016 (License No. 05/W51A/ACFGIJ/4726) for the following water use activities:

- Section 21(a) – Taking water from a water resource:
  - Abstraction of water from supply well CBH2D (groundwater); and
  - Abstraction of water from supply well CBH3S (groundwater).
- Section 21(c) – Impeding or diverting the flow of water in a watercourse and Section 21(i) - Altering the bed, banks, course or characteristics of a watercourse:
  - Circular Sectional Steel Tanks associated with the PCD system for the purpose of water conservation reducing evaporation;
  - PCD, silt trap and drying slab for waste water pollution control;
  - Construction and operation of the adit for access to the underground;
  - Construction and operation of the main workshop platform;
  - RoM Stockpile Slab A (Raw Coal);
  - RoM Stockpile Slab B (Processed Product);
  - Office Block and parking area;
  - Pipeline – Main pump from steel tanks to water treatment plant;
  - Pipeline – Outlet pipe from PCD to Steel Tanks;
  - Pipeline – Dirty water sump with float pump back to PCD;
  - Dirty water cut off Flo-drain Y;
  - Dirty water cut off Flo-drain X;
  - Dirty water cut off Flo-drain A;
  - Dirty water cut off Flo-drain B;
  - Dirty water cut off Flo-drain C;
  - Clean Water Diversion berm A;
  - Clean Water Diversion berm B;
  - Canal A1, A2, Chute B, Canal E, C and F for process water to the PCD for re-use / recycling;
  - Canal D for process water to report to the PCD for re-use / recycling;
  - 8m access road for heavy vehicles for collection of product coal;
  - 7m access road for light vehicles;
  - RoM Stockpile 3A and coal product 3B;
  - Perimeter fence;
  - Electricity supply route to pumps;

  - Sewage pipeline and treated sewer water pipeline – treated sewage will be discharged back to the PCD for re-use / recycling;
  - Pipeline – Treated wastewater from PCD to be discharged into seep wetland S2;
  - Clean water cut off Flo-drain A discharge point to underground filter drains;
  - Clean water cut off Flo-drain B discharge point to underground filter drains;
  - Clean water cut off Flo-drain C discharge point to underground filter drains;
  - Treated excess waste water discharge point to underground filter drains;
  - Rehabilitation of disturbed seep wetlands S1 and S2;
  - Underground mining activities and voids;
  - Borehole pipeline for CBH2D; and
  - Borehole Pipeline for CBH3S.
- Section 21(f) – Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit:
  - Discharge excess water treated to an acceptable quality into the wetland.
- Section 21(g) – Disposing of waste in a manner which may detrimentally impact on a water resource:
  - RoM Stockpile Slab A;
  - RoM Stockpile Slab B;
  - Disposal and storage of contaminated water in the PCD;
  - Tanks associated with the PCD;
  - Bio-mite sewage treatment plant;
  - Sewage solids from treatment process to be temporarily stored;
  - Wastewater treatment plant;
  - Water treatment brine to be crystallised and temporarily stored;
  - Hazardous waste from workshops to be temporarily stored;
  - Pollution Control Dam; and
  - PCD process water use for dust suppression on roads within the mining area.
- Section 21(j) – Removing, discharging or disposing of water found underground:
  - Pumping out of groundwater flowing into the adit and underground workings via rock fissures.

From the information provided it appears that all water uses identified as part of the proposed mining operation have been applied for and licensed in the IWUL issued.

5.3.8.2 IWUL Conditions

The water uses applied for in the IWWMP have been included in the IWUL issued. With regards to the IWUL conditions, the IWUL has been compiled with various conditions with which the proposed activities will need to comply.

The conditions contained within the IWUL are mostly general conditions which are included in almost all licenses issued for mining activities with many of the conditions being repeated. There are specific conditions detailed in Annexures III and IV of the IWUL with regards to the construction of infrastructure within sensitive areas and underground mining. Specifically condition 1.18 of Annexure III states that "*the Licensee will not be authorised to commence underground mining at Zoetfonetin 94 HT until the Licensee provides to this Department a signed copy of the DW902 form by the surface rights owner of that property*". It is unclear if this form has been signed and submitted to the DWS.

The IWUL does not contain as express conditions the mitigation measures recommended by the various specialists. Instead it purports (in relation to certain of the authorised activities, but not all) to incorporate by reference the contents of the entire reports of the specialists. There is no attempt to list the recommendations made in these reports or to reconcile them with each other (IWUL Pgs. 18 to 19, Condition 1.2 of Appendix III of the IWUL).

Insofar as the IWUL purports to incorporate by reference the recommendations contained in the SAS (2015) report (Pgs. 93-94; 96-97; 99-100), these are wholly inadequate including because:

- **They relate only to surface infrastructure wetlands;**
- **They do not include the requirement of a water treatment plant during the operational phase; and**
- **Several of them are nonsensical (as for instance ensuring that 'no decant occurs throughout the life and post-closure of the facility' (Pg. 99), when that is an inevitability without constant pumping post-closure which has not been provided as a mitigation measure).**

Monitoring and control have been included in the IWUL conditions in both Annexures III and IV. Monitoring will be required throughout the life of mine and after mining ceases. Although included in the license, the IWUL requires that a full monitoring program be submitted to the DWS for approval, which reinforces the finding that there is not already a comprehensive monitoring program established. This is further evident in the mitigation measures provided in the amended ESIAR (2015) that require that a comprehensive monitoring program be established. Although this is not a requirement prior to the issue of the license, the monitoring program needs to be submitted to the DWS for approval prior to the commencement of activities.

From the findings detailed in sections 5.1, 5.2 and 5.3 above, it is evident that several aspects of the specialist investigations need additional investigation (refer to Section 6 below for a summary of the findings). The specialist reports compiled for the proposed mining activities have not identified all impacts associated with the planned mine and as a result, the IWUL does not contain sufficient license conditions in order to ensure that the impact of the mine will be able to be mitigated to an acceptable standard. It is not possible to provide proper license conditions without the identification of all impacts and an understanding of the interconnection of the various water resources (geohydrology, hydrology and wetlands).

It should also be noted that, in terms of the IWUL, water may only be discharged into the wetlands if the quality of the water meets the criteria of the parameters stipulated in Table 2: Quality of water contacting water to be discharged within the license, as follows (please note that Nitrate levels ought to have been, but were not included as part of the constituent list):

Constituent	Average Discharge Concentration
Coliforms (Colony forming Units / ml)	0
Enteric Pathogens (E.coli)	0
Alkalinity (mg/l)	20
Aluminium (mg/l)	0.005
Calcium (mg/l)	150
Chloride (mg/l)	50
Potassium	50
Iron as Fe (mg/l)	0.1
Sodium	50
Magnesium and Mg (mg/l)	70
pH at 25 degrees Celsius	6-9
Sulphate as SO_4 (mg/l)	80
Total Dissolved Solids	450
Total Suspended Solids	5
Manganese and Mn (mg/l)	0.18

The IUCMA currently do not have *modelled Resource* Quality Objectives (RQOs)/limits for Usuthu Catchment. They are making use of the Special limits as described in Table 2.3 in the General Authorisation No.665 dated 3 September which includes that the Assegaai

river catchment. The special limits are included in the Table that follows for discharge water quality.

SUBSTANCE/PARAMETER	GENERAL LIMIT	SPECIAL LIMIT
Faecal Coliforms (per 100 ml)	1000	0
Chemical Oxygen Demand (mg/l)	75 (i)	30(i)
pH	5,5-9,5	5,5-7,5
Ammonia (ionised and un-ionised) as Nitrogen (mg/l)	6	2
Nitrate/Nitrite as Nitrogen (mg/l)	15	1,5
Chlorine as Free Chlorine (mg/l)	0,25	0
Suspended Solids (mg/l)	25	10
Electrical Conductivity (mS/m)	70 mS/m above intake to a maximum of 150 mS/m	50 mS/m above background receiving water, to a maximum of 100 mS/m
Ortho-Phosphate as phosphorous (mg/l)	10	1 (median) and 2,5 (maximum)
Fluoride (mg/l)	1	1
Soap, oil or grease (mg/l)	2,5	0
Dissolved Arsenic (mg/l)	0,02	0,01
Dissolved Cadm ium (mg/l)	0,005	0,001
Dissolved Chromium (VI) (mg/l)	0,05	0,02
Dissolved Copper (mg/l)	0,01	0,002
Dissolved Cyanide (mg/l)	0,02	0,01
Dissolved Iron (mg/l)	0,3	0,3
Dissolved Lead (mg/l)	0,01	0,006
Dissolved Manganese (mg/l)	0,1	0,1
Mercury and its compounds (mg/l)	0,005	0,001
Dissolved Selenium (mg/l)	0,02	0,02
Dissolved Zinc (mg/l)	0,1	0,04
Boron (mg/l)	1	0,5

6 CONCLUSION

6.1 Hydrogeology & Geochemistry

The following conclusions were reached as part of the Hydrogeological specialist review:

- No hydrogeological information is available for the sills, dykes and faults, which are reported to have a large influence on the modelling results;
- The Delta h model was run in steady state and could not quantify seasonal variations in groundwater levels or the seasonal difference of impacts on the springs, baseflow and other groundwater-dependant ecosystems;
- The confidence level of the model used by Delta h to assess the groundwater impacts is low due to a number of data uncertainties. Based on modelling guidelines this type of model is only suitable for assessing low-value groundwater dependent ecosystems, which is inappropriate in the context of the Yzermyn mine, which is situated in an environmentally sensitive, vulnerable and important area;

- The simulated dewatering will impact on springs and wetlands and baseflow to rivers above and in the vicinity of the underground mine voids;
- The impact of the groundwater abstraction from the proposed production boreholes has not been assessed;
- Mine water decant is likely to occur, and a water treatment plant has been proposed to mitigate this impact **but only for the operational phase**. It has also been proposed that the treated water be discharged into the hillslope seepage wetlands. These mitigation measures were not discussed **or assessed** in the specialists reports;
- The potential impacts of pollution plumes emanating from the mine void were not addressed, which may be a significant impact post-closure.

6.2 Wetlands

The following conclusions were reached as part of the Wetland specialist review:

- The applicant needs to conduct a wetland assessment in both the wet and the dry seasons;
- The wetlands that are associated with the underground mining must be delineated in the field and not only on desktop level (as was done), as the 5m drawdown that will occur, according to the Delta h report (2014), will impact on all wetlands occurring above the underground mining area;
- The proposed mine will be situated in a threatened ecosystem and no mitigation measures have been assessed as being likely to prevent this;
- Cumulative impacts were not identified in the Wetland Ecological Assessment Reports (SAS (2014) and **SAS (2015)**); and
- Impacts associated with the groundwater and wetland interlinkage were not taken into consideration.

6.3 Hydrology

The following conclusions were reached as part of the Hydrology specialist review:

- The WSP Hydrological Assessment (2013) is based on outdated information and should be updated before it can be relied upon;
- GN 704 was applied appropriately to the Storm Water Management Plan (Highlands Hydrology Report) and was considered in the WSP Hydrological Assessment (2013), but an Exclusion Zone (as specified in GN704) was not delineated and should have been; and
- Various updates to and calibrations of the studies are required and AMD must be taken into account. Were the flow calculations to change owing to study updates and calibration, water quantity-related risks and mitigation methods would change. Were AMD taken into account, the water quality-related risks and mitigation

measures would change. The existing water quantity-related and water-quality risks and mitigation methods are potentially inaccurate and inappropriate.

The following should have been undertaken:

- Modelling of conjunctive groundwater-surface water processes that also accounts for wetland processes;
- Proper assessment of the qualitative and quantitative impact of the mine's surface water on the larger area including calculation of the extent to which the mine will reduce the overall water volumes available to the greater catchment;
- Proper calibration of simulated flow results in all the surface water reports;
- Calculation of a flood line Exclusion Zone (as specified in GN704);
- Testing for an expanded chemistry suite, sampling of baseline AMD and design of a conjunctive groundwater-surface water monitoring plan on the basis thereof;
- Use of a consistent, long-term, good quality rainfall record across the studies;
- Carrying through of updates made to groundwater studies to surface water studies which should themselves have been updated, specifically as regards pollution plume impacts, seasonal decant rates, volumes of inflows into the underground workings and drawdown extents;
- Revision of PCD designs based on the PCD being operated near-empty and resizing of the PCD;
- Performance of flood peak and statistical distribution calculations using more comparative methodologies;
- Simulation of dynamic water balance at a daily time-step, and calculation of dry and wet season water balances in conjunction with the wet and dry season wetland studies;
- Assessment of effects on water usage and affected communities and areas under drought and flood conditions with seasonal variations in conjunction with wet and dry season wetland studies;
- Re-evaluation of risks of flooding of the site and downstream;
- Modelling of mine void pollution plumes and analysis of their impacts;
- Re-evaluation of risks once groundwater, surface water and wetland studies had been updated in a conjunctive manner; and
- Formulation of mitigation measures based on updated studies.

6.4 IWUL issued by the DWS

From the specialist conclusions highlighted in Sections 6.1 to 6.3, it is evident that not all potential impacts have been identified and assessed in order for the DWS to make a sound decision when issuing the IWUL.

As a result, the IWUL does not contain sufficient license conditions in order to ensure that the impacts of the mine may be mitigated to an acceptable standard. It is not possible to provide proper license conditions without the identification of all impacts and an understanding of the interconnection of the various water resources (geohydrology, hydrology and wetlands).

APPENDIX I: FIGURES 1-5