APPENDIX G

Climate Change Assessment

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Climate Change Assessment

May 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Contents

Table Index

Figure Index

Summary and Recommendations

This climate change assessment was undertaken by GHD as part of the Environmental Impact Assessment for the proposed re-establishment and operation of the Mt Todd Gold Mine.

The study aims to assess changes in projected climate patterns for the region, asset vulnerabilities and typical control measures for adaptation over the proposed operating life of the mine.

A review of Commonwealth Scientific and Industrial Research Organisation's (CSIRO's) Climate Change in Australia Technical Report 2007 highlighted that the site will possibly be vulnerable to average temperature increases and extreme precipitation events. Other climate conditions such as total annual rainfall, wind speed, humidity and evaporation rates are projected to remain relatively constant over 20 and 50 year return periods.

Based on the results of the study, it is recommended that special consideration be given to the risks of flash flooding. In particular, the following aspects of the design should be reviewed:

- the design flood level criteria for the mine and design outcomes, especially with regard to roads, stockpiles, ponds, open pits, water treatment and storage facilities; and
- resilience of the overall site water balance to wet and dry periods.

It is recommended that a standard weather station be maintained at the Mt Todd site to enable systematic monitoring of conditions and to allow future comparisons with climate projections.

1. Introduction

Vista Gold Australia Pty Ltd (Vista Gold) proposes to re-establish and operate the Mt Todd Gold Mine. A climate change assessment has been prepared as part of the planning process for the Project. It addresses the requirements of Sections 6.4 (Climate) and 10.1 (Climate Change) of the *Guidelines for the Preparation of an Environmental Impact Statement, Mt Todd Gold Project, Katherine Region NT* (NT EPA (formerly NRETAS) 2011).

The assessment aims to assess changes in projected climate patterns for the region over the proposed operating life of the mine. This information will be used to select climate parameters for the final design.

This report includes projections for the following climatic features:

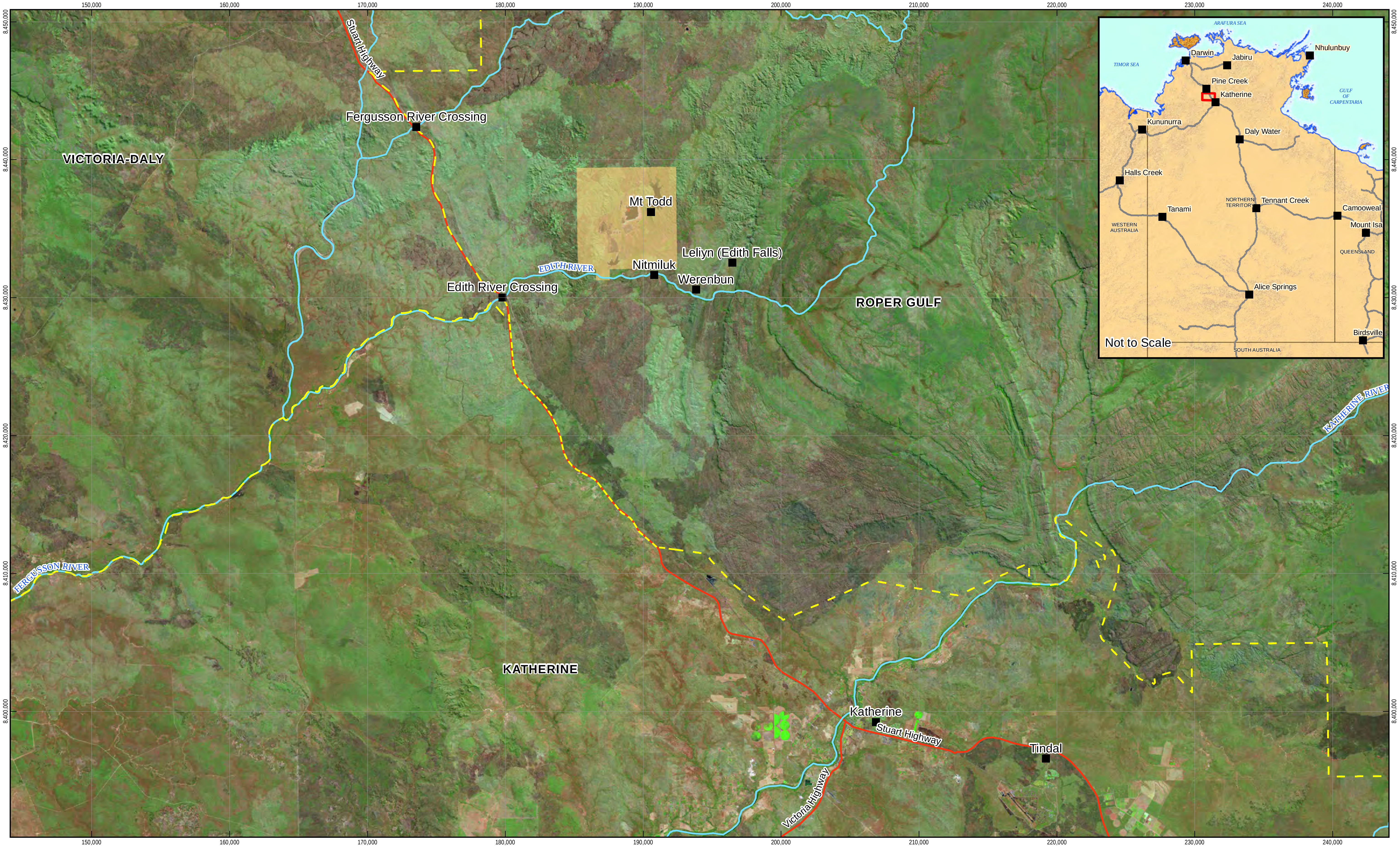
- temperature change (^{o}C);
- extreme heat – projected number of days above 35^{o}C (days);
- rainfall change – Annual (%);
- windspeed (%);
- tropical Cyclones (frequency and intensity);
- relative humidity (%);
- solar radiation (%); and
- evaporation increase (%).

Projections were obtained from publicly available data published by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in its *Climate Change in Australia Technical Report 2007* (CSIRO 2007) for the years 2030 and 2070.

1.1 Project Location

The Mt Todd Gold Mine site is located approximately 55 km north-west of Katherine, and 250 km south of Darwin. Mining and associated operations will primarily occur primarily on mine leases MLN 1070, MLN 1071 and MLN 1127, covering approximately 5,365 hectares (ha).

Figure 1 shows the location of the mine site.



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0 2.5 5 7.5 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

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LEGEND

- Place Names
- Major Roads
- Rivers
- LGA Boundaries
- Mt Todd Mineral Leases

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	27 May 2013

Location of Project - regional context

Figure 1

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Data source: NRETAS - Drainage (2011). Vista Gold - Mt Todd Mining Leases (2011). Geoscience Australia - Landsat Imagery (2007), Place Names, LGA Boundaries, Roads, States (2008). ESRI - SRTM (2009). Created by: CM

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

1.2 Project Overview

Mining will be an open-pit truck and shovel operation, using large haul trucks, hydraulic shovels and front end loaders to transport materials to the crusher, stockpiles, Run of Mine (ROM) pad and waste dump. Extracted ore, will be processed in an ore processing plant where it will be crushed, milled and then carbon in leach (CIL) leached followed by adsorption, desorption and recovery leading to gold dore (unrefined gold).

Approximately 17.8 million tonnes per annum (Mtpa) of ore will be processed. The CIL tailing will be detoxified and sent to an impoundment from which plant process water will be recycled. Gold dore will be transported for onward secure shipment to a refinery.

The Project, based on current known data, will have a life of around 19 years inclusive of construction, operations and closure. Construction is anticipated to commence in the first quarter of 2014 and take two years, including 6 months pre-production. The mine is scheduled to operate for a further 13 years. Closure and rehabilitation of the mine is expected to take four years.

The key elements of the Project include:

Mining and Mining Infrastructure

- extension of the existing Batman Pit from its current depth of 114m to approximately 588m (RL -400m) and surface area of 40 hectares (ha) to approximately 137ha;
- expansion of the existing waste rock dump (WRD) from a height of 24m above ground level to approximately 350m above ground level (RL 470m), and a footprint of 70ha to approximately 217ha. The dump currently contains 16Mt of waste rock and the expansion will provide total capacity of up to 510 Mt;
- construction of a Run of Mine (ROM) pad and ore stockpile;
- construction of an Ammonium Nitrate and Fuel Oil (ANFO) Facility;
- construction of heavy and light vehicle workshop and administration offices, and facilities comprising wash down area, tyre change facility, lube storage facility etc; and
- construction of haul roads and access roads.

Process Plant and Associated Facilities

- Ore Processing Plant capable of processing approximately 50,000 tonnes per day (tpd) of ore;
- processing and / or reclamation of the existing low grade ore (LGO) stockpile and scats stockpile, and construction and processing of new LGO stockpile with a footprint of approximately 47ha;
- raising the existing tailings storage facility (TSF1) from 16m to approximately 34m above ground level;
- construction of a new TSF2, approximately 300ha in area and up to 60m high (RL 175m);
- diversion of Horseshoe Creek and Stow Creek adjacent to TSF2 to provide flood protection;
- rehabilitation of the existing heap leach pad (HLP), if residual HLP material is not processed through the new plant;
- chemical and reagent storage and handling facility; and
- process plant workshops, administration offices, control room etc.

Other Infrastructure

- gas fired Power Station, including re-routing of the existing gas pipeline;
- anaerobic treatment wetlands, approximately 10ha in area;
- a 2m high raising of the raw water dam (RWD) and an increase in the area of inundation;
- construction of saddle dams at the RWD and TSF1;
- construction of three coffer dams at Retention Pond 1 (RP1) and deepening of RP1;
- water treatment plant;
- security gate house;
- potential re-alignment of access roads;
- site wide drainage, sediment traps; and
- modification to existing fuel storage and distribution facility.

2. Legislative Framework

This report is intended to fulfil Vista Gold's duty to provide a climate change assessment to the Northern Territory Environmental Protection Authority (NT EPA) under the Northern Territory *Environmental Assessment Act 1982*. The scope and methods for conducting the assessment are based on the following guidance documents:

- Northern Territory EPA (formerly NRETAS) 2011 Guidelines for the Preparation of an Environmental Impact Statement, Mt Todd Gold Project, Katherine Region NT.
- Northern Territory Government, Department of Natural Resources, Environment, the Arts and Sport, May 2010. *NT Environmental Impact Assessment Guide: Greenhouse Gas Emissions and Climate Change*.

The guidance documents cite recent publications published by CSIRO and the Bureau of Meteorology (BoM) as appropriate data sources for a climate change assessment.

3. Methods

This section outlines the types of data and information used in modelling possible global climate change. For the purposes of this report, the explanation is brief. Detailed information on the methodology employed by CSIRO for its climate projections can be found in the CSIRO Technical Report (CSIRO 2007).

3.1 Weather Station Selection

Climate Change projection data are sourced from those available in the CSIRO Australian Major Cities Summaries. The nearest major city to the site is Darwin. The climatic impacts in Darwin will differ slightly from those in the Mt Todd region and a review of historical meteorological data was undertaken to determine similarities or differences of significance.

An assessment of the regional variability of climate impacts was performed to identify a weather station meeting the following criteria:

1. Located near the Project site.
2. Projected climate changes for the weather station included in the CSIRO Technical Report (CSIRO 2007).
3. Representativeness of the selected weather station to the Project Site.

Katherine is the closest long-term weather station to Mt Todd and its climate data can be used for comparison and variability assessment. Katherine is located approximately 55 km south east of the project site. A summary of the variation between the climates of Darwin and the Katherine Aviation Museum weather station, which have similar lengths of records, is provided in Table 1. The variation identified between these two sites is considered acceptable for this level of climate risk assessment.

Table 1 Regional Variability, Darwin and Katherine

Climate Variable	Darwin Statistics	Katherine Statistics	Comments
Mean maximum temperature	32 °C	34 °C	Annual maximum temperatures and monthly maximum temperatures tend to be slightly higher for Katherine.
Mean minimum temperature	23.2 °C	20.3 °C	Mean minimum temperatures are lower at Katherine with cooler seasonal differences
Mean rainfall	1740.2 mm	1143.1 mm	The seasonal pattern of rainfall of the two centres is similar, with majority of rainfall during summer months (wet season). Katherine receives significantly less rainfall than Darwin.
Relative humidity (9am)	71%	66%	Relative humidity is lower at Katherine than at the coastal location of Darwin.
Relative Humidity (3pm)	56%	38%	
Wind speed (9am)	10.9 km/h	4.8 km/h	Wind speed is lower inland at Katherine compared to Darwin and more predominant during winter months (dry season) at Katherine.
Wind speed (3pm)	17.9 km/h	8.8 km/h	

3.2 Data Sources

Baseline climate conditions were obtained from publicly available data including:

- Bureau of Meteorology, Darwin Airport weather station (site number 014015) humidity record, based on the average at 9 am and 3 pm, years 1941-2012; and
- Bureau of Meteorology, Katherine Aviation Museum weather station (site number 014903) humidity record, based on the average at 9 am and 3 pm, years 1946-2011.

Projected climate conditions were obtained from CSIRO's Climate Change in Australia Technical Report 2007 (Appendix B City Summaries, Years 2030 and 2070, CSIRO 2007). This is considered the best current available data for this assessment.

3.3 Greenhouse Gas Emission Scenarios

In 2000, the Intergovernmental Panel on Climate Change (IPCC) published a Special Report on Emissions Scenarios (SRES) that described a family of six greenhouse gas emission scenarios to condition global climate models (IPCC 2000). Figure 2 presents the six global greenhouse gas emissions scenarios. The scenarios cover a wide range of the main driving forces of future emissions, from demographic to technological and economic developments. (Throughout this report, the terms 'emissions scenario' and 'sensitivity' are used interchangeably).

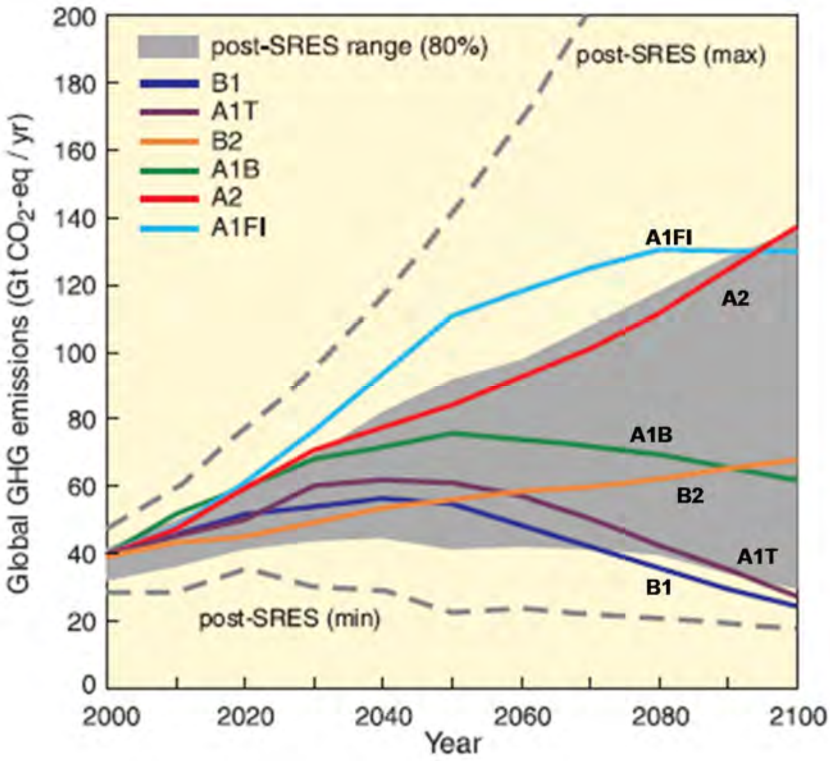

Figure 2 Greenhouse Gas Emissions Scenarios from 2000 through 2100 in the Absence of Additional Climate Policies (IPCC 2000)

The Mt Todd study used the A1B (medium) and A1FI (high) emissions scenarios for the target evaluation dates of 2030 and 2070. This provides a mid-point scenario on a shorter time horizon and a more extreme scenario on a longer-term time horizon to accommodate an upper level of risk.

3.4 Baseline Observational Data

Emissions projections and projected climatic changes are compared to a historical baseline. Baseline data for the Mt Todd study were obtained from the Bureau of Meteorology for Darwin Airport, as described in Section 3.2.

3.5 Global Climate Models

Mathematical simulations or computer models of the atmosphere and ocean are the principal tools for estimating the response of the climate to increases in greenhouse gases. The most sophisticated of these tools are Global Climate Models (GCMs), which express mathematically what is known of the processes that dictate the behaviour of the atmosphere and the ocean. GCMs include interaction of the atmosphere with the oceans and the surface of the Earth, including plants and other ground cover.

An ensemble of 23 models was used for the CSIRO study (Table 4.1, CSIRO 2007).

3.6 Study Parameters

Future scenarios were extracted from the CSIRO dataset. These scenarios include projected changes to precipitation, maximum temperature, minimum temperature, wind speed and solar radiation. Projected changes to temperatures, precipitation, wind speed and water balance are presented for 2030 and 2070. Projected changes under two SRES emission scenarios were selected:

- A1FI– high climate sensitivity (referred to as A1FI). A1FI previously represented a worst-case scenario emissions projection. Recent observations of emissions make the A1FI scenario the most plausible compared to other scenarios, making this the ‘business as usual’ case (US Department of Energy, Oak Ridge National Laboratory 2011); and
- A1B – mid climate sensitivity (referred to as A1B).

3.7 Potential Climate Related Impacts

Changes in climatic conditions and water availability over the design life may have the potential to impact the Project’s infrastructure, processes, supply chain logistics and lifecycle maintenance costs.

Elements of mine operations that may be influenced by changing climatic conditions and their relevance to the Mt Todd Gold Project are presented in Table 2. Structures and processes are influenced by ambient air temperatures, precipitation, wind speeds and water availability. In addition, maintaining water balance is essential for mining and ore processing activities; necessitating the provision of appropriate resources to cope with periodic drought and/or flood conditions.

Table 2 Components of Mine Operations Influenced by Climatic Conditions and Relevance to Mt Todd System Components

Component	Key Climate Parameters for Mt Todd	Possible Influence on Mt Todd System
Administration and Plant Site Buildings	Ambient air temperature Humidity Extreme wind storms	Possible increased expansion and contraction from increased temperature variability. Increased air conditioning loads. Extreme humidity may impact electronic equipment. Wind sensitive design elements may be impacted.
Anaerobic Treatment Wetlands	Potential Evaporation Extreme precipitation as indicator of flash floods	Efficiency of wetlands may be affected by high rates of evaporation and/or extreme flood events Flooding may result in contaminant transport if containment is insufficient
Clay Borrow Area	Strong winds Extreme precipitation as an indicator of flash floods	Increases in mean wind speed may affect airborne dust from clay borrow area Flooding may result in contaminant transport if containment is insufficient
Critical Structures (e.g. pipelines)	Extreme precipitation as indicator of flash floods Extreme wind and sand storms Ambient air temperature	Temperature, rainfall wind and flooding characteristics of the site are an important civil design parameter. Changes in the parameters over time need to be understood.
Decant and Polishing Ponds	Potential Evaporation Extreme precipitation as indicator of flash floods	Capacity and efficiency of ponds may be effected by high rates of evaporation and/or extreme flood events Flooding may result in contaminant transport if containment is insufficient
Heap Leach Pad	Extreme precipitation as an indicator of flash floods Evaporation	Rehabilitation and closure plans should consider extreme flood events and evaporation rates
Low Grade Ore Stockpiles	Extreme wind storms Extreme precipitation as an indicator of flash floods	Increase in wind speed may affect airborne dust from stockpiles Flooding may result in contaminant transport if containment is insufficient
Mine Pit	Extreme precipitation as indicator of flash floods	Potential increased risk of flooding or inundation of pits
Power and Gas Supply	Ambient air temperature Humidity	Capacity and efficiency of gas turbine will degrade at high temperatures and humid conditions
Raw Water Dam	Potential Evaporation Extreme precipitation as indicator of flash floods	Capacity and efficiency of dam may be effected by high rates of evaporation and/or extreme flood events
Retention Ponds	Potential Evaporation Extreme precipitation as indicator of flash floods	Capacity and efficiency of ponds may be effected by high rates of evaporation and/or extreme flood events Flooding may result in contaminant transport if containment is insufficient

Component	Key Climate Parameters for Mt Todd	Possible Influence on Mt Todd System
Roads	Extreme precipitation as indicator of flash floods Extreme wind storms	Extreme precipitation, flash floods, wind and sandstorms may impede transportation to and from the site
Services (Fire Protection, Drinking and Sanitary Water)	Potential Evaporation Average Precipitation	Raw water will be harvested form the raw water dam. This will be the primary supply for process and potable water and fire water reserve. Flash flood and drought conditions may negatively impact water availability for the site.
Tailings Storage	Extreme precipitation as an indicator of flash floods Potential Evaporation	Flooding may result in contaminant transport if containment is insufficient Excessive evaporation could interfere with water balance required for recycled water scheme
Waste Rock Dump	Extreme precipitation as an indicator of flash floods Extreme wind storms	Increase in wind speed may affect airborne dust from stockpiles Flooding may result in contaminant transport if containment is insufficient
Water Treatment Plant	Potential Evaporation Extreme precipitation as indicator of flash floods	Capacity and efficiency of water treatment plant may be effected by high rates of evaporation and/or extreme flood events

4. Results

CSIRO's projected climate changes for Darwin are summarised in the following sections, including:

- annual Mean Temperature (^oC);
- number of days above 35 ^oC;
- annual Rainfall (%);
- annual Potential Evaporation (%);
- annual Wind-Speed (%);
- tropical Cyclones (frequency and intensity);
- annual Relative Humidity (%); and
- annual Solar Radiation (%).

Climate change assessments typically include projections for sea level rise, but this is not directly applicable for the Mt Todd site due to its elevated inland location. Sea level rise is unlikely to impact product exports over the expected lifetime of operations.

Projected future climate changes are provided relative to a global baseline period averaged between 1980 and 1999. For convenience, the baseline is often called 1990 as this is the intended reference time. Projections of future climate parameters are derived by adding the projected change to the observed baseline climate applicable at 1990. The long term data record of Katherine is used as the local climate baseline for Mt Todd.

4.1 Temperature

The CSIRO study provides projected changes in annual mean temperatures (^oC) applicable to the years 2030 and 2070. The projected changes were applied to the historical average annual mean temperature, resulting in a series of projected degree change of mean temperature for Darwin.

Generally, the annual average mean temperature in Darwin is expected to increase by 0.7^{o}C to 1.4^{o}C, and by 2.3°C to 4.4°C in 2070. The modelling suggests a small annual mean temperature increase would also apply for the Mt Todd region. In applying the projected increase in temperature it is expected that the annual average mean temperature in the region will increase slightly by 2030. These results are summarised in Table 3.

Table 3 Projected Average Annual Mean Temperature Change (°C) (values in brackets correspond with the 10th and 90th percentile results)

Emissions Scenario, Year	Katherine Baseline (°C)	Change from Baseline Temperature (°C)	Katherine Max Projected Mean Temperature (°C)
A1B, 2030	34	1 (0.7-1.4)	35 (34.7-35.4)
A1FI, 2070	34	3.2 (2.3-4.4)	37.2 (36.3-38.4)

4.2 Extreme Temperature

The CSIRO study estimates that the incidence of extreme temperatures (often taken to be above 35°C) will increase under both A1B and A1F1 scenarios. Without a specific analysis of modelled data for the Mt Todd region however, we simply present the Darwin data as a reference because it would be inappropriate to view this statistic in any site-relative sense. Under the A1B scenario, the frequency of temperatures >35°C in Darwin is projected to exceed 28 days by 2030 and to exceed 141 days under the A1F1 scenario for 2070.

The baseline frequency of days exceeding 35°C in Katherine is significantly higher than in Darwin (151 days versus 11) and although an increased frequency in future climates is indicated, the percentage increase in this statistic will likely be less than Darwin's at the Mt Todd site and a higher temperature statistic would be more informative at Mt Todd (say 40°C). Nonetheless, Table 4 summaries the CSIRO projections for increases in the count of days exceeding 35°C in Darwin, plus the Katherine baseline count.

Table 4 Projected Average Duration of Extreme Temperatures (values in brackets correspond with the 10th and 90th percentile results)

Emissions Scenario, Year	Duration of T>35 °C (days/year)
Baseline	151
Baseline Darwin	11
A1B, 2030 (Darwin)	28 (28-69)
A1FI, 2070 (Darwin)	141 (141-308)

4.3 Rainfall

The CSIRO study provides projected changes in annual mean precipitation (mm/yr) for the years 2030 and 2070. The projected changes were applied to the historical daily-sampled precipitation record recorded at the Katherine Aviation Museum. Results are summarised in Table 5.

Table 5 Projected Average Annual Mean Rainfall Change (mm/yr) (values in brackets correspond with the 10th and 90th percentile results)

Emissions Scenario, Year	Katherine Baseline (mm/yr)	Change from Baseline Rainfall (%)	Katherine Projected Average Annual Mean Rainfall (mm/yr)
A1B, 2030	1,143	0 (-7.0 - -6.0)	1,143 (1,136 - 1,137)
A1FI, 2070	1,143	-1 (-21.0 - -20.0)	1,142 (1,122 - 1,123)

Although the average annual mean figures are relatively constant over the 20 and 50-year return periods, there is a wide degree of variability between the 10th and 90th percentile results. This is an indication that there may be a greater occurrence of extreme dry and wet periods.

Notwithstanding the above projection for little change in future climates, rainfall statistics for the region indicate a period of increased rainfall since 1988 relative to the longer-term baseline annual mean (1941-2012). The shift in the mean annual rainfall since 1988 at Darwin is of the order of 4% and at Katherine is of the order of 3%.

These shifts are representative of the range of variability on inter-decadal timescales that can occur in such statistics and, in association with consideration of extreme rainfall events, should form the basis of sensitivity analyses of the design for expanded mine operations.

4.4 Potential Evaporation

Annual potential evaporation changes were estimated by CSIRO for the years 2030 and 2070. Annual potential evaporation is projected to increase by 3% in 2030 and 10% in 2070 (Table 6).

Table 6 Projected Average Change in Potential Evaporation % (values in brackets correspond with the 10th and 90th percentile results)

Emissions Scenario, Year	Baseline Katherine (mm/yr)	% Change in Potential Evaporation	Katherine Projected Change in Potential Evaporation
A1B, 2030	2,400	3 (2-5)	2,472 mm/yr
A1FI, 2070	2,400	10 (7-15)	2,424 mm/yr

4.5 Wind speed

The CSIRO study projected changes in annual average mean wind speed (m/s) for the years 2030 and 2070. The projected changes were applied to the historical daily wind speed record at Katherine Aviation Museum. A forecast change in wind speed is unlikely to provide any major impact to the Mt Todd site. These results are presented in Table 7.

Table 7 Projected Annual Average Mean Wind Speed Change (km/h) (values in brackets correspond with the 10th and 90th percentile results)

Emissions Scenario, Year	Katherine Baseline (km/h)	Change from Baseline Wind Speed (%)	Projected Average Annual Mean Wind Speed (km/h)
A1B, 2030	6.8	1 (-1.0; 2.0)	7.8 (5.5; 8.8)
A1FI, 2070	6.8	2 (-4.0; 7.0)	8.8 (2.8;13.8)

4.6 Tropical Cyclones

The CSIRO study projected broad regional trends in tropical cyclone activity; it did not provide a projection for the Darwin area specifically. For the NT, the study indicates that there is likely to be an increase in 'the proportion of the tropical cyclones in the more intense categories, but a possible decrease in the total number of cyclones.' Additionally, the study found that the location of cyclones is not likely to change over time. This can be interpreted as being unlikely to significantly change the tropical cyclone threat at the Mt Todd site compared with the present climate.

4.7 Relative Humidity

Changes in annual relative humidity were projected by CSIRO for 2030 and 2070. The projected changes were applied to the historical daily humidity records for data recorded from the Katherine Aviation Museum. Average humidity is projected to decrease by 0.5% by 2030 and 1.5% by 2070 (Table 8).

Table 8 Projected Annual Average Relative Humidity (%) (values in brackets correspond with the 10th and 90th percentile results)

Emissions Scenario, Year	Katherine Baseline (%)	Change from Baseline Humidity (%)	Projected Average Annual Humidity (%)
A1B, 2030	52	-0.5 (-1.0; 0.0)	51.5 (53; 52)
A1FI, 2070	52	-1.5 (-3.2; 0.1)	50.5 (48.8; 52.1)

4.8 Solar Radiation

Changes in annual solar radiation were projected by CSIRO for 2030 and 2070. Average solar radiation is projected to stay the same by 2030 and increase by 0.1% by 2070 (Table 9).

Table 9 Projected Average Change in Annual Solar Radiation % (values in brackets correspond with the 10th and 90th percentile results)

Emissions Scenario, Year	Katherine Baseline (Kwh/m^2)	% Change in Annual Solar Radiation
A1B, 2030	6.3	0 (-1.1; 1.3)
A1FI, 2070	6.3	0.1 (-3.6; 4.3)

4.9 Summary of Potential Climate Risks to the Project

Based on the climate change analysis, some conclusions can be drawn, these are summarised in Table 10.

Table 10 Summary of Potential Climate Risks to the Mt Todd Project

Climate Parameter	Project Components Most Likely Affected	Implications for the Site	Potential Adaptation Options
Ambient air temperature	Administration and Plant Site Buildings Power and Gas Supply Critical Structures	Increases in the number of extreme heat days may have a minor impact on the Project.	Consider appropriate temperature ranges in selection of plant and equipment. Undertake adequate preventative maintenance of plant, pumps, generators etc. as part of standard procedures. Monitor plant and equipment on days of extreme weather conditions. Appropriate design of structures and material selections. Consider appropriate temperature suitability of stored chemicals and explosives.
Extreme precipitation / flash floods / tropical cyclones	Anaerobic Treatment Wetlands Clay Borrow Area Critical Structures Decant and Polishing Ponds	The mean annual rainfall is not projected to change significantly for the 2030 and 2070 scenarios. Precipitation extremes	Ensure site drainage is sufficient to manage potential extremes in rainfall events. Appropriate bunding of watercourse redirection and overflow collection areas should be provided as

Climate Parameter	Project Components Most Likely Affected	Implications for the Site	Potential Adaptation Options
	Low Grade Ore Stockpiles Mine Pit Raw Water Dam Retention Ponds Roads Services Tailings Storage Waste Rock Dump Water Treatment Plant	may increase, thus accentuating the risk of flash floods. The incidence of tropical cyclones will likely stay the same or decrease, however the intensity of extreme cyclonic events may increase. The Project catchment is characterised by perennial flows which recharge groundwater levels.	appropriate/necessary. For recycled plant process water, ensure design considers both dry and wet periods. Provisions should be considered for adequate supply reserves. For example, tailings thickening agents may be considered during dry periods. Ponds should be sized appropriately including overflow capacity Open pit slopes should be walled and designed to withstand appropriate flood volumes.
Evaporation	Anaerobic Treatment Wetlands Decant and Polishing Ponds Raw Water Dam Retention Ponds Services Tailings Storage Water Treatment Plant	Projected changes in evaporation rates are not considered significant for the water requirements for the site. Therefore this risk is not considered significant.	N/A
Wind speed	Administration and Plant Site Buildings Critical Structures Low Grade Ore Stockpiles Roads Waste Rock Dump	Projected increase in mean wind speed is relatively insignificant and is thus unlikely to have any considerable impact on the Project.	N/A
Humidity	Administration and plant site buildings Power and Gas Supply	Impacts of humidity changes are unlikely to have any significant impact on the site.	N/A

4.10 Limitations and Uncertainty

This assessment of the Mt Todd Gold Project is a high-level analysis of potential climate change impacts, and therefore its limitations need to be considered. These may include:

- assessment of risks and possible adaptation plans are qualitative, not quantitative;
- climate change scenarios are based on publicly available projections;
- these projections are regional rather than localised – therefore there is a level of uncertainty associated with these; and
- these projections consider the years 2030 and 2070 only, as compared to the 1990 baseline climate condition (as specified in the IPCC report (2000).

The risk assessment component is the result of a desktop study, combining site-specific details provided by Vista Gold from their Pre-feasibility Study with publicly available climate information and in-house GHD knowledge related to generic mine operations. This risk assessment information is provided as general guidance, and as core information that may be used to guide further investigation of impacts and asset resilience. This does not constitute a full assessment. Therefore these projections, vulnerabilities and control measures are not exhaustive.

The projections chosen for this assessment are the medium and high emissions scenarios (A1B and A1F1: IPCC AR4 reports), which rely on the base assumptions of a homogenous world with an economic focus (which does not allow for major wars, trade embargos or a shift to an environmental focus). Upper limits of the model are used to ensure a conservative approach is produced by considering higher impacts, and therefore risk.

The methods employed in this study involve the following limitations and uncertainties.

- Uncertainty in projections: SRES A1B was selected as the mid-range scenario for future global mean temperature increase, while A1FI was selected as the highest end of global mean temperature increase.
- The uncertainty related to the projected temperature, precipitation and wind values generated by the various GCMs was represented by the 10^{th} and 90^{th} statistical percentiles. The uncertainty range presented in this report cannot cover the full range of uncertainties of future climate change. The CSIRO Report (CSIRO 2007) provides further details on the uncertainties associated with the projections summarised herein.
- The assumptions that projected changes available for Darwin can be directly applied to Katherine climate data and that these data are fully representative of conditions at Mt Todd.

5. References

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GHD

Level 5, 66 Smith Street
Darwin NT 0800
T: 8 8982 0100   F: 8 8981 1075   E: drwmail@ghd.com.au

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		Name	Signature	Name	Signature	Date
1	A Marcotte L Slechta	K Fitzpatrick		I McCardle		15/05/2013
2	A Maddocks	K Fitzpatrick		I McCardle		15/6/13