Preliminary Environmental Risk Assessment
Marda East Gold Project

EPA Factor	Environmental Aspect	Risk Title	Causes	Relevant Information	Consequences	Maximum Credible Gain / Loss					Proposed Management	Residual Risk (*Assumes recommended*				
						Likelihood	Consequence: Environment	Consequence: Human Health	Consequence: Community	Risk Level (Priority)		Likelihood	Consequence: Environment	Consequence: Human Health	Consequence: Community	Risk Level (Priority)
Flora and Vegetation	Flora and Vegetation	Flora, vegetation and terrestrial environmental quality may be impacted by disturbance in the Development Envelope	Clearing and disturbance	Small footprint area (less than 50ha). No DRF in the Development Envelope. Development Envelope is proximal to BIF ecosystem (including Priority Ecological Community).	Localised loss of vegetation. Ecosystem fragmentation. Edge effects.	5	2			M (10)	Progressive clearing and rehabiltiation. Restriction on clearing outside the disturbance footprint. Rehabilitation according to best practices outlined in Mine Closure Plan.	4	2			M (13)
Landforms	Waste Rock Landform	Waste rock landform becomes unstable or causes pollution	Non-competent or potentially acid forming waste rock stored in an inappropriate manner in a waste rock landform	Based on materials characterisation at Marda Central, waste rock is expected to be competent, non-acid forming with some acid neutralising capacity.	Landform instability, degradation, acid or metalliferous drainage and loss of integrity of surrounding soils.	2	5			M (9)	Materials characterisation study to be conducted for Marda East. Mine plan and rehabilitation plan to be amended when necessary to reflect materials characterisation and to ensure competent, non-acid forming material is stockpiled and available at the required time for successful rehabilitation.	1	4			L (18)
Landforms	Landscape Values	Landscape values are adversely affected	Changes to the landforms due to the development of the pits and waste rock landforms	The proposed Red Legs pit is located at the foothills of the BIF ranges.	Loss of landscape values. Impact on the topography of the disturbance footprint.	5	3			H (5)	Careful design of waste rock landforms to ensure that the rehabilitated landforms will be visually congruent as much as practicable with adjacent landforms.	5	2			M (10)
Subterranean Fauna	Subterranean Fauna and Habitat	Loss of subterranean fauna and fauna habitat	Groundwater drawdown, excavation	Groundwater table is expected to be below the maximum pit depth (to be confirmed). Desktop study indicates that the area is unlikely to have endemic subterranean fauna.	Loss of subterranean fauna and fauna habitat.	2	2			L (20)	Hydrogeological study will confirm likely interaction with groundwater.	2	2			L (20)
Terrestrial Environmental Quality	Habitat	Fragmentation of habitat and loss of ecosystem function	Clearing and disturbance	Small footprint area (less than 50ha). Development Envelope is proximal to BIF ecosystem (including Priority Ecological Community).	Localised loss of vegetation. Ecosystem fragmentation. Edge effects.	3	3			M (11)	Progressive clearing and rehabiltiation. Restriction on clearing outside the disturbance footprint. Rehabilitation according to best practices outlined in Mine Closure Plan.	3	2			L (15)
Terrestrial Environmental Quality	Solid Waste Management	Potential contamination of land, surface water and groundwater, as a result of inappropriate management of solid waste	Incorrect disposal of solid waste products (excluding waste rock)	Existing project controls at Marda Central including waste management infrastructure.	Deterioration of terrestrial and inland water environmental qualities, degradation of ecosystem functioning.	3	2			L (15)	All waste to be collected and recycled or reused where possible, with residual waste disposed of in a licensed landfill or collected and transported offsite by a licensed waste removal officer Internal waste management procedures and reporting including for National Pollutants Inventory.	2	2			L (20)
Terrestrial Fauna	Terrestrial Fauna	Terrestrial fauna may be impacted by disturbance in the Development Envelope	Clearing and disturbance. Fauna casualties due to interaction with road vehicles.	Small footprint area (less than 50ha). No endangered species within the Development Envelope. Malleefowl mounds observed within the Development Envelope. Development Envelope is proximal to BIF ecosystem (including Priority Ecological Community).	Localised loss of habitat. Ecosystem fragmentation. Edge effects. Fauna deaths.	5	3			H (5)	Speed limits on mine vehicles. Procedure on management of fauna injuries to be implemented, including contacts for wildlife carers in the area. Progressive clearing and rehabiltiation. Restriction on clearing outside the disturbance footprint. Rehabilitation according to best practices outlined in Mine Closure Plan. Relocation of conservation significant species prior to clearing, where possible.	4	3			M (8)
Terrestrial Fauna	Noise and Vibration	Excessive noise has an adverse impact on terrestrial fauna in the area leading to migration away from the area	Noise and vibration from mining operations	Small mining operation, blasting occurring no more than approximately once per week. Small footprint with connected habitat with dense vegetation in surrounding areas.	Fauna migration out of immediate Development Envelope and future avoidance of the area until operations cease.	4	1			L (19)	Dampeners on mine vehicles to ensure compliance with WA Noise Regulations.	4	1			L (19)
Terrestrial Fauna	Light	Excessive light at night may interfere with natural ecological processes including insect swarming, migration, hunting, etc	The site will operate 24 hours a day and lights will be used on machines and stationary equipment at night to facilitate safe operation	The area is remote and surrounded by dense vegetation. Small mining operation with duration of less than three years.	Increased mortality of fauna attracted to the lights, change to migratory patterns of fauna passing through, detrimental outcomes to ecosystem functon.	2	3			L (14)	Use of directional lighting on fixed plant to minimise impacts and visibility of lighting from above. Lights to be turned off machines that are not in use.	2	3			L (14)
Hydrological Processes	Groundwater Quantity	Localised drawdown of groundwater levels	Groundwater extraction for the purposes of pit dewatering and dust suppression	Groundwater table is expected to be below the maximum pit depth (to be confirmed). No conservation significant groundwater dependent ecosystems. No groundwater uses in the local area.	Loss of stygofauna habitat.	1	1			L (25)	Hydrogeological study to confirm groundwater levels.	1	1			L (25)
Hydrological Processes	Surface Water Hydrology	Hydrological flows are interrupted or significantly altered	Mine infrastructure occurring on drainage lines	Small footprint. No major drainage lines. All drainage lines are ephemeral in the vicinity of the project. Downstream water body is an ephemeral salt lake. Low average rainfall and high average evaporation rates.	Interruption to downstream flows or alteration of quantity of downstream flows.	5	2			M (10)	Diversion drains and bunds will direct water in the direction of existing drainage lines. Rehabilitation and MCP will include restoration of original drainage lines where possible. The mine will operate as a nil discharge system.	5	1			L (17)

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Inland Waters Environmental Quality	Groundwater Quality	Heavy metal contamination of groundwater	Flushing of broken rock with oxygenated rainwater and percolation into the groundwater aquifer	Groundwater table is expected to be below the maximum pit depth (to be confirmed). No conservation significant groundwater dependent ecosystems. No groundwater uses in the local area.	Potential changing groundwater quality which may affect stygofauna habitat.	1	1			L (25)	Hydrogeological study to confirm groundwater levels. Small scale pit dewatering to surface settlement pond if required. Desktop stygofauna assessment to be completed.	1	1			L (25)
Inland Waters Environmental Quality	Surface Water Quality	Downstream surface water quality is adversely affected	Runoff from mine infrastructure causes increased sedimentation, erosion or contamination	Small footprint. No major drainage lines. All drainage lines are ephemeral in the vicinity of the project. Downstream water body is an ephemeral salt lake. Low average rainfall and high average evaporation rates. Waste rock material is expected to be benign.	Loss of downstream ecological values, altered sediment and erosion regimes.	4	2			M (13)	Diversion drains around mine infrastructure will separate clean and dirty water. Dirty water will be collected in sediment ponds for treatment. Uncontrolled discharges will be prevented through implementation of licence conditions. The mine will operate as a nil discharge system. Soil characterisation survey to be completed	2	2			L (20)
Inland Waters Environmental Quality	Liquid Waste Management	Potential contamination of land, surface water and groundwater, as a result of inappropriate management of liquid waste	Incorrect disposal of liquid waste including hydrocarbons	Existing project controls at Marda Central including waste management infrastructure.	Deterioration of terrestrial and inland water environmental qualities, degradation of ecosystem functioning.	3	2			L (15)	Hydrocarbons and hazardous chemicals to be stored according to Australian Standards to minimise spillage risks. Training and awareness associated with waste management to be implemented. Workshop and washpad facilities to include infrastructure to capture and treat contaminated water (including oil water separators). All hardstand areas to be bunded and runoff captured for treatment. Internal waste management procedures and reporting including for National Pollutants Inventory	2	2			L (20)
Air	Dust	Conservation significant flora such as Tetratheca may be impacted by fugitive dust	Blasting, excavation, transport and handling of ore and waste rock, vehicle movements, lift-off from stockpiles and exposed surfaces	Priority flora are found within the Development Envelope. No DRF found within the Development Envelope (including Tetratheca). Hydrological watershed exists between the BIF ridges and the Development Envelope.	Localised loss of vegetation condition due to dust generation, erosion and sedimentation on cleared areas.	3	3			M (11)	Dust suppression will be carried out. Clearing will be restricted during strong winds to reduce dust generation. Speed limits on mine vehicles to reduce dust generation on roads. Progressive clearing	2	3			L (14)
Air	Dust	Flora, vegetation and terrestrial environmental quality may be impacted by fugitive dust	Blasting, excavation, transport and handling of ore and waste rock, vehicle movements, lift-off from stockpiles and exposed surfaces	Priority flora are found within the Development Envelope. No DRF found within the Development Envelope.	Localised loss of vegetation condition due to dust generation, erosion and sedimentation on cleared areas.	5	1			L (17)	Dust suppression will be carried out. Clearing will be restricted during strong winds to reduce dust generation. Speed limits on mine vehicles to reduce dust generation on roads. Progressive clearing	2	1			L (24)
Air	Human Health	Human health may be adversely impacted by dust and odour associated with mine activities	Blasting, excavation, transport and handling of ore and waste rock, vehicle movements, lift-off from stockpiles and exposed surfaces	Small footprint area, blasting not likely to occur more than once per week. Development Envelope is isolated with limited public access.	Detrimental health impacts to mine workers.	3		2		L (15)	Procedures requiring use of personal protective equipment including eye protection and/or breathing apparatus when on site in areas of high dust. Procedures to restrict access of mine workers during blasting. Speed limits on mine vehicles to reduce dust generation on roads.	2		2		L (20)
Air	Greenhouse Gas Emissions	Greenhouse gas emissions associated with the project contribute to net increase in greenhouse gas emissions	Fuel consumption (gas and diesel) and power generation	Project duration of less than three years.	Contribution to global impacts associated with increased greenhouse gas emissions.	5	1			L (17)	Limit to haulage distances and idling times associated with haulage. Procedures for minimising energy use including use of energy efficient lights and energy efficient buildings where possible.	5	1			L (17)
Amenity	Surrounding Land Use and Community Receptors	Loss of amenity contributing in a loss of landform amenity values in the area.	Changes to the landforms, specifically adjacent to iconic ranges, and long term visual impacts through pit and waste dump being left in closure	Development Envelope lies within a region dominated by conservation tenure associated with BIF ranges. The Development Envelope has limited vehicle access and anecdotal evidence indicates visitor numbers are reasonably low.	Loss of amenity values in the area, particularly in relation to the conservation areas associated with BIF ranges.	4	2		4	H (4)	Mine closure plan has been delivered for Marda Central and will be amended to include Marda East. Proposed rehabiltiation includes shaping of landforms to reflect regional landforms, topsoiling and revegetation with locally indigenous species. Temporary infrastructure will be removed and access tracks and hard stand areas rehabilitated by ripping, seeding and replacement of vegetation stands to promote complex ecosystem recovery	4	2		4	H (4)
Amenity	Local Towns and Services	Changes to composition, size and structure of local communities	Temporary influx of mine workers in the region associated with the project	The site is likely to operate as a fly-in-fly-out site, given its remote location. The Proposal includes the mining of an additional two pits to that proposed in the Marda Central project and is not likely to significantly increase the number of mine workers in the area.	Changes to economic processes, town amenity and composition, stress on services.	2			3	L (14)	Fly-in-fly-out schedules, rosters to ensure number of mine workers on site does not dramatically increase at various times, putting stress on local resources.	2			3	L (14)

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Heritage	Cultural Heritage and Indigenous Communities	Loss of culturally significant heritage sites	Inadvertent disturbance or clearing of areas of cultural significance, or artefacts	There are no Aboriginal cultural heritage sites within the Development Envelope and the area has been given clearance for disturbance as part of a formal archaeological and ethnographic process.	Loss of Aboriginal heritage values.	2			4	**M (12)**	Cultural Heritage Management Plan to be developed in consultation with DAA as part of forward works and will include procedure for chance find and monitoring during clearing.	1			4	**L (18)**
Human Health	Noise and Vibration	Excessive noise has an adverse health impact on mine workers	Noise and vibration from mining operations	Small mining operation, blasting occurring no more than approximately once per week. Remote location away from residences, main roads and towns.	Deterioration of hearing in mine employees.	2		3		**L (14)**	Procedures requiring use of personal protective equipment including earplugs when on site in areas of high noise. Dampeners on mine vehicles to ensure compliance with WA Noise Regulations.	1		1		**L (25)**
Human Health	Public Safety	Creation of pit lake resulting in public safety risk	Intersection of groundwater aquifer and subsequent failure to backfill waste rock to above groundwater level. Natural accumulation of rainwater in pit particularly in years where tropical cyclone depressions extend to the Development Envelope.	Area is not generally accessible to the public.	Public injury or death as a result of falling into the pit lake.	2		5		**M (9)**	Hydrogeological study will confirm whether intersection of groundwater aquifer is likely. Backfill study to be completed as mining progresses to determine sterilisation and subsequent backfill options to ensure groundwater infiltration does not occur in closure. Pit abandonment bunding. Access roads from the main Bullfinch-Evanston Road to be rehabilitated at closure.	1		5		**M (16)**
Rehabilitation and Closure	Waste Rock Landform	Waste rock landform becomes unstable or causes pollution leading to failure of rehabilitation objectives	Non-competent or potentially acid forming waste rock stored in an inappropriate manner in a waste rock landform	Based on materials characterisation at Marda Central, waste rock is expected to be competent, non-acid forming with some acid neutralising capacity.	Landform instability, degradation, acid or metalliferous drainage and loss of integrity of surrounding soils.	2	5			**M (9)**	Materials characterisation study to be conducted for Marda East. Soil characterisation survey to be carried out. Mine plan and rehabilitation plan to be amended when necessary to reflect materials characterisation and to ensure competent, non-acid forming material is stockpiled and available at the required time for successful rehabilitation.	2	4			**M (12)**
Rehabilitation and Closure	Revegetation	Revegetation and establishment of complex ecosystem not successful on waste dump	Failure to adequately stockpile topsoil and vegetation Failure to implement best practice rehabiltiation methods including waste dump design, topsoiling, ripping and seeding with appropriate species Successive poor rainfall seasons leading to failure of germination processes	Rainfall has been seaonsally variable at the Development Envelope in preceding years.	Loss of quality of land and soils, failure to reestablish ecological values. Decreased amenity for future generations.	3	4		4	**M (7)**	Mine closure plan has been delivered for Marda Central and will be amended to include Marda East. Soil characterisation survey to be carried out. Topsoil and vegetation stockpiling to be implemented on site. Use of local species with germination success in varying rainfall conditions. Rehabilitation monitoring.	2	4		4	**M (12)**
Rehabilitation and Closure	Ecological Function of the Development Envelope	Creation of pit lake negatively impacts ecological function in the area	Intersection of groundwater aquifer and subsequent failure to backfill waste rock to above groundwater level. Natural accumulation of rainwater in pit particularly in years where tropical cyclone depressions extend to the Development Envelope.	The maximum pit depth is not expected to intersect groundwater. Low average rainfall and high average evaporation rates.	Increase in feral animals in the area. Increase in grazing pressures. Increase in weed infestation.	3	3			**M (11)**	Hydrogeological study will confirm whether intersection of groundwater aquifer is likely. Backfill study to be completed as mining progresses to determine sterilisation and subsequent backfill options to ensure groundwater infiltration does not occur in closure. Pit abandonment bunding.	2	2			**L (20)**