CAS Project
Traffic flow analysis risk assessment (TMM risk)
20 October 2024

Area:	NCH3, NCH2, Gloria,	Process:	All underground	Responsible Employee:		Date:	20-Oct-24

Identification						Assessment				Control	Assessment			Risk Reduction Plan					
Risk No:	TMM Type	Routine / Non-Routine	Risk Name (Activity)	Risk Exposure	Hazard / Aspect	Event / Impact (Activity / consequence)	Risk Category	Severity level	Probability level	Pure Risk	Existing Control Measures	Severity level	Probability level	Residual Risk	Result - action	Suggested controls to reduce the risk further, whenever necessary.	Severity level	Probability level	Potential reduction due to further action/s suggested.	Applicable legal or other requirements
1	Dump truck: Epiroc, Caterpillar (all models)	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming empty, • tramming fully loaded, • loading, • dumping into tips, • refuelling, • tyre changing, • routine maintenance, breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian when loading or dumping at tip., • V-P causing injury to pedestrian in workshop, • V-P causing injury while performing maintenance (caught in bucket). • LoC on decline. • V-V while tramming. • V-V while loading. • V-V during breakdown in high interaction risk area. • V-E while dumping and tramming.	• See TMM type hazard in worksheets 1.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Epiroc operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • Dump truck operating procedures in place. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Bin up alarm and interlock • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation lock. • Beacons or inclinometer to limit gear to second gear and use of retarder on decline. • V-V crawl. • Crawl speed is 3 km/hr. (note: Caterpillar machines may not be able to crawl at 3km/hr and only crawl at 5 km/hr) • Maximum speed is 14 km/hr. • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.
2	Dump truck: Epiroc MT42 BEV	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming empty, • tramming fully loaded, • loading, • dumping into tips, • battery changing, • tyre changing, • routine maintenance, breakdowns, • towing, • safe parking, • fail to safe events, **• fire on machine,** **• incident management,** **• emergencies,** • operator fatigue. • Travelling on decline.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian when loading or dumping at tip., V-P causing injury to pedestrian when changing batteries, • V-P causing injury to pedestrian in workshop, • V-P causing injury while performing maintenance (caught in bucket). • LoC on decline. • V-V while tramming. • V-V while loading. • V-V during breakdown in high interaction risk area. • V-E while dumping and tramming. **Note:** Battery fire is high risk for entire shaft and may cause multiple fatalities. The impact of CAS on batteries has not been determined and therefore must be subject to a separate risk assessment.	• See TMM type hazard in worksheets 1	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Epiroc operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Bin up alarm and interlock • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place.(note: battery regenerative retardation may enable only service brakes on decline - this must be risk assessed) • Safe park procedure in place. • Battery change procedure in place. • Emergency management procedures in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation lock. • Beacons or inclinometer to limit gear to second gear and use of retarder on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 14 km/hr. • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and battery changing bay. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.

ASSMANG MANGANESE
BLACK ROCK MINE OPERATIONS

CAS Project
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20 October 2024

TerreSauver

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Identification							Assessment				Control	Assessment			Risk Reduction Plan					
Risk No:	TMM Type	Routine / Non-Routine	Risk Name (Activity)	Risk Exposure	Hazard / Aspect	Event / Impact (Activity / consequence)	Risk Category	Severity level	Probability level	Pure Risk	Existing Control Measures	Severity level	Probability level	Residual Risk	Result - action	Suggested controls to reduce the risk further, whenever necessary.	Severity level	Probability level	Potential reduction due to further action/s suggested.	Applicable legal or other requirements
3	LHD: Epiroc Scooptram ST14	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming with empty scoop, • tramming with fully loaded scoop, • loading and loading into dump trucks, • dumping into tips, • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while refuelling, • V-P causing injury to pedestrian while operating in mining cycle - crushed against wall or under scoop etc, • V-P causing injury to pedestrian when loading or dumping at tip., • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel, • V-P causing injury while performing maintenance (caught in scoop). • LoC on decline. • V-V while tramming. • V-V while loading. • V-V during breakdown in high interaction risk area. • V-E while loading and tramming.	• See TMM type hazard in worksheets 1.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Epiroc operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • LHD operating procedures in place. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation and boom lock. • Beacons or inclinometer to limit gear to first gear on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 10 km/hr (second gear). • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.
4	LHD: Epiroc ST 14 BEV	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming empty, • tramming fully loaded, • loading, • dumping into tips, • battery changing, • tyre changing, • routine maintenance, breakdowns, • towing, • safe parking, • fail to safe events, **• fire on machine,** **• incident management,** **• emergencies,** • operator fatigue. • Travelling on decline.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while changing battery, • V-P causing injury to pedestrian while operating in mining cycle - crushed against wall or under scoop etc, • V-P causing injury to pedestrian when loading or dumping at tip., • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel, • V-P causing injury while performing maintenance (caught in scoop). • LoC on decline. • V-V while tramming. • V-V while loading. • V-V during breakdown in high interaction risk area. • V-E while loading and tramming. Note: Battery fire is high risk for entire shaft and may cause multiple fatalities. The impact of CAS on batteries has not been determined and therefore must be subject to a separate risk assessment.	• See TMM type hazard in worksheets 1 and 2.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Epiroc operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Bin up alarm and interlock • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place. • Battery change procedure in place. (note: battery regenerative retardation may enable only service brakes on decline - this must be risk assessed) • Emergency management procedures in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation lock. • Beacons or inclinometer to limit gear to second gear and use of retarder on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 14 km/hr. • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.

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	Identification						Assessment				Control	Assessment			Risk Reduction Plan					
Risk No:	TMM Type	Routine / Non-Routine	Risk Name (Activity)	Risk Exposure	Hazard / Aspect	Event / Impact (Activity / consequence)	Risk Category	Severity level	Probability level	Pure Risk	Existing Control Measures	Severity level	Probability level	Residual Risk	Result - action	Suggested controls to reduce the risk further, whenever necessary.	Severity level	Probability level	Potential reduction due to further action/s suggested.	Applicable legal or other requirements
5	Drills Epiroc - all types (double boom 282)	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming with boom in incorrect position. • tramming with boom in correct position but trying to access incline in spoor or slippery road conditions (sliding back), • loading and loading into dump trucks, • dumping into tips, • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P with pedestrian caught in drill rotation while drilling. • V-P with pedestrian crushed against side wall by drill attachment - causing single facility or permanent total disability. • V-P causing injury to pedestrian while tramming, (particularly around corners). V-P causing injury to pedestrian while tramming, with boom in incorrect position V-P causing injury to pedestrian while tramming or turning up a incline with road in slippery condition (drill sliding and crushing pedestrian against wall) • V-P causing injury to pedestrian in workshop, • V-P causing injury while performing maintenance (caught in drill attachment or articulation). • LoC on decline. • V-V while tramming. • V-V while drilling. • V-V during breakdown in high interaction risk area. • Noise impact on hearing during drilling and or tramming.	• See TMM type hazard in worksheets 1.	Single fatality or permanent total disabilities	S	4	5	20	• All drilling installation is controlled from behind the support jacks of the machine. • See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Drill head change procedure in place. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Epiroc operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place in protection • **Note:** Drill fitted with pedestrian detection devices that prevent the pedestrian being entangled in drill rotation or movement - stop machine hydraulics automatically should pedestrian walk into "danger zone" while drilling. This must be verified.	4	3	12	• For all operation purposes effective warning CPS must be installed. (Level 7 & 8) • Safe park to include articulation and boom lock. • Crawl speed is 3 km/hr. • Maximum speed is >12,5 km/hr (to be verified). • Speed in workshop to be crawl speed. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, level 7 and level 8 only. • **Note:** Should drill not be fitted with: pedestrian detection devices that prevent the pedestrian being entangled in drill rotation or movement - stop machine hydraulics automatically should pedestrian walk into "danger zone" while drilling - TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) - **must be risk assessed for control confirmation as many such incidents have occured in SAMI** • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	2	8	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.
5	Roof bolter: Epiroc - Cabletec SL - Boltec 235 H	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming, • Changing drill in operation, • Drilling and bolting, • Refuelling, • Tyre changing or maintenance, • Routine maintenance, • Breakdowns, • Towing, • Safe parking, • Fail to safe events, • Fire on machine, • Incident management, • Emergencies, • Operator fatigue. • Travelling on decline.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P with pedestrian caught in drill rotation while drilling. • V-P with pedestrian crushed against side wall by drill attachment - causing single facility or permanent total disability. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while tramming, (particularly around corners) • V-P causing injury to pedestrian in workshop, • V-P causing injury while performing maintenance (caught in drill attachment or articulation). • LoC on decline. • V-V while tramming. • V-V while drilling. • V-V during breakdown in high interaction risk area. • Noise impact on hearing during drilling and or tramming. • V-P causing injury to pedestrian while changing drills or bolt attachments. • V-P causing injury to pedestrian by rocks falling on roof bolter operator	• See TMM type hazard in worksheet 1.	Single fatality or permanent total disabilities	S	4	3	12	• All drilling and bolt installation is controlled from behind the support jacks of the machine. • See worksheet 6 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Epiroc operations and maintenance manuals. • Traffic management plan in place. • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place in protection	4	3	12	• For all operation purposes effective warning CPS must be installed. (Level 7 & 8) • Safe park to include articulation and boom lock. • Crawl speed is 3 km/hr. • Maximum speed is 10 km/hr (second gear). • Speed in workshop to be crawl speed. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• Although the current risk is low, pedestrian warning is deemed necessary and therefore the roof bolter to be fitted with CPS effective warning and not auto retard and auto stop. • Traffic flow and hot spot analysis to determine current controls are within alignment of risk assessment.	4	2	8	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.

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4	LDV: Toyota Land cruiser Single cab	R	• Pre-start check, • functional brake testing, • compliance brake testing, • tramming, • transporting passengers, • transporting load. • Refuelling, • Tyre changing or maintenance, • Routine maintenance, • Breakdowns, • Towing, • Safe parking, • Fail to safe events, • Fire on machine, • Incident management, • Emergencies, • Operator fatigue. • Travelling on decline.	• V-P when pedestrian approaches operator to speak with operator. • V-P with pedestrian crushed when TMM skids into side wall. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian in workshop, • V-P causing injury while performing maintenance (caught in fork attachment or articulation). • LoC on decline. (due to too much service brake application and or to high a speed) • V-V while tramming. • V-V during breakdown in high interaction risk area.	• See TMM type hazard in worksheet 1.	Injuries that require time off work / loss time injury / RWC (Restricted work case) - No permanent disabilities	S	2	4	8	• See worksheet 6 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Toyota operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place in protection	2	3	6	• For all operation purposes effective warning CPS must be installed. (Level 7 & 8) • Crawl speed is 3 km/hr. • Maximum speed is 14 km/hr (second gear). (TMM to be fitted with speed limitation device) • Speed in workshop to be crawl speed. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• Although the current risk is low, pedestrian warning is deemed necessary and therefore the LDV to be fitted with CPS effective warning and not auto retard and auto stop. • Traffic flow and hot spot analysis to determine current controls are within alignment of risk assessment.	2	2	4	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.
12	Scaler: Aard, Bell	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming • tramming with boom extension in unsafe position • descaling, • cleaning face area after descaling, •Changing of pecker or scoop (tool heads), • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline.	• V-P with pedestrian struck by tool - causing single fatality or permanent total disabilities. • V-P with pedestrian struck by wheels during rotation on own axis or rapid turning. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while refuelling, • V-P causing injury to pedestrian while operating in mining cycle - crushed against wall etc, • V-P causing injury to during tool change, • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel, • V-P causing injury while performing maintenance. • LoC on decline. • V-V while tramming. • V-V during breakdown in high interaction risk area. • V-E while tramming (rapid turning and poor visibility).	• See TMM type hazard in worksheet 1.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tool head changing SOP in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Aard and Bell operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • LHD operating procedures in place. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation and boom lock. • Beacons or inclinometer to limit gear to first gear on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 10 km/hr (second gear). • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.

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Risk No:	TMM Type	Routine / Non-Routine	Risk Name (Activity)	Risk Exposure	Hazard / Aspect	Event / Impact (Activity / consequence)	Risk Category	Severity level	Probability level	Pure Risk	Existing Control Measures	Severity level	Probability level	Residual Risk	Result - action	Suggested controls to reduce the risk further, whenever necessary.	Severity level	Probability level	Potential reduction due to further action/s suggested.	Applicable legal or other requirements
13	Grader CAT 120G	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • cleaning roads, • tramming, • leveling road surfacs and scraping rocks to side, • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline.	• V-P with pedestrian while scraping roads. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while refuelling, • V-P causing injury to pedestrian while operating in mining cycle - crushed against wall etc, • V-P causing injury to pedestrian when scraping at tip., • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel, • V-P causing injury while performing maintenance. • LoC on decline. • V-V while tramming. • V-V while scraping. • V-V during breakdown in high interaction risk area. • V-E whilescraping.	• See TMM type hazard in worksheets 1.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Caterpillar operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • Grader operating procedures in place. • Tip exclusion zone in place to protect tip operator. (when cleaning at tips) • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to includescarper in lowered position. • Beacons or inclinometer to limit gear to first gear on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 16 km/hr (fourth gear in both forward and reverse). • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.
14	Dozer: Epiroc ST1030 wheel dozer	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming with empty scoop, • tramming with fully loaded scoop, • loading and loading into dump trucks, • dumping into tips, • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while refuelling, • V-P causing injury to pedestrian while operating in mining cycle - crushed against wall or under scoop etc, • V-P causing injury to pedestrian when dozing at tip., • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel, • V-P causing injury while performing maintenance (caught in scoop). • LoC on decline. • V-V while tramming. • V-V while loading. • V-V during breakdown in high interaction risk area. • V-E while loading and tramming.	• See TMM type hazard in worksheets 1.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with Epiroc operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • LHD operating procedures in place. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation and boom lock. • Beacons or inclinometer to limit gear to first gear on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 10 km/hr (second gear). • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.

ASSMANG MANGANESE
BLACK ROCK MINE OPERATIONS

CAS Project
Traffic flow analysis risk assessment (TMM risk)
20 October 2024

erreSauver

Area:	NCH3, NCH2, Gloria,	Process:	All underground	Responsible Employee:		Date:	20-Oct-24

	Identification						Assessment				Control	Assessment			Risk Reduction Plan				
Risk No:	TMM Type	Routine / Non-Routine	Risk Name (Activity)	Risk Exposure	Hazard / Aspect	Event / Impact (Activity / consequence)	Risk Category	Severity level	Probability level	Pure Risk	Existing Control Measures	Severity level	Probability level	Residual Risk	Result - action	Suggested controls to reduce the risk further, whenever necessary.	Severity level	Probability level	Potential reduction due to further action/s suggested.	Applicable legal or other requirements
15	UV: 1) Aard UV 80 lube 2) Aard UV 80 emulsion 3) Fermel Carr/MKIII RORO 4) Fermel Cassette Carrier 5) Fermel flatbed 6) Fermel K/Cab Flat Crane 7) Toyota LC plus crane 8) Aard lube unit 9) Fermel Mav K/Cab Jampot 10) Fermel Maverick Man Lift 11) Fermel placer dumper 12) Fermel single cab man lift 13) Fermel S/Cab Stad load Bin 14) Aard UV 120 water bowser 15) Aard SECO diesel tanker 16) Aard UV 80 scissor lift 17) Fermel UV 80 Liberator 18) Bird	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming with various attachments and fittings, • working or performing various functions thorughout mine. • loading and unloading various items, • dust suppression, • refueling other vehicles, • emulsion loading and pumping, • scissor lift and lifting operations, • passenger transport, • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline. Note: see note in sheet 1 about various operations.	• V-P with pedestrian caught in articulation - causing single fatality or permanent total disabilities. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while refuelling, • V-P causing injury to pedestrian while operating in mining cycle - crushed against wall or under scoop etc, • V-P causing injury to pedestrian when at tip or in parking area, • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel, • V-P causing injury while performing maintenance (caught in articulation). • LoC on decline. • V-V while tramming. • V-V while loading. • V-V during breakdown in high interaction risk area. • V-E while loading and tramming or working.	• See TMM type hazard in worksheets 1.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with various OEMs operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • UV operating procedures in place. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation . • Beacons or inclinometer to limit gear to first gear on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 16 km/hr (third gear). • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment. **Note:** Its is recommended that a separate risk assessment is performed for each UV type in the functions it performs. This risk assessment has been completed this way because of the approval given by the Steerco in 2019 on the list under "UV" as a general type. As a genral type, the UV must be level 9 enabled. Should further detremination of CAS level be required, the above is recommended.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.
16	Manitou: Telehandlers, forklifts, cranes, tyre handler. MVT675T, Crane MHT-X 780 T Evolution, 8T MHT 780 Telescopic Handler,	R	• Pre-start check, • functional brake testing, • compliance brake testing, • tramming with various attachments and fittings, • working or performing various functions thorughout mine. • loading and unloading various items, • lifting operations, • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing, • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline. Note: see note in sheet 1 about various operations.	• V-P with load being dropped onto pedestrian - causing single fatality or permanent total disabilities. • V-P causing injury to pedestrian while tramming (particularly if boom is in raised position), • V-P causing injury to pedestrian while refuelling, • V-P causing injury to pedestrian while operating - crushed against wall or under boom or load or between TMM load and other object etc, • V-P causing injury to pedestrian when at tyre bay or in parking area, • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel (changing TMM tyre of acting as a tyre handler), • V-P causing injury while performing maintenance (caught in boom or in wheel turning). • LoC on decline. • V-V while tramming. • V-V while loading or unloading. • V-V during breakdown in high interaction risk area. • V-E while loading and tramming or working.	• See TMM type hazard in worksheets 1.	Single fatality or permanent total disabilities	S	4	5	20	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with various OEMs operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • Manitou operating procedures in place. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	4	4	16	• For all operation purposes effective warning, auto retard and auto stopping of TMM for pedestrians, CPS must be installed. • Safe park to include articulation . • Beacons or inclinometer to limit gear to first gear on decline. • V-V crawl. • Crawl speed is 3 km/hr. • Maximum speed is 16 km/hr (third gear). • Speed in workshop to be controlled by beacons to crawl speed. • Isolation zones for attendant at tips and fuel filling. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• TMM must be fitted with CPS effective warning, auto retard and auto stop. (level 9) • Traffic flow and hot spot analysis to determine current controls are aligned with risk assessment. **Note:** Its is recommended that a separate risk assessment is performed for each Manitou type in the functions it performs. This risk assessment has been completed this way because of the approval given by the Steerco in 2019 on the list under "UV" as a general type. As a genral type, the UV must be level 9 enabled. Should further detremination of CAS level be required, the above is recommended. (Manitou has recently provided a risk assessment for MHT 780 which must be incorporated into any future risk assessment) **Important note:** it may be higher risk to auto stop some Manitous when they are carrying a load than for them to be only have auto retard. This must be atered for in the CAS installation.	4	3	12	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.

ASSMANG MANGANESE
BLACK ROCK MINE OPERATIONS

CAS Project
Traffic flow analysis risk assessment (TMM risk)
20 October 2024

TerreSauver

Area:	NCH3, NCH2, Gloria,	Process:	All underground	Responsible Employee:		Date:	20-Oct-24

	Identification						Assessment				Control	Assessment			Risk Reduction Plan					
Risk No:	TMM Type	Routine / Non-Routine	Risk Name (Activity)	Risk Exposure	Hazard / Aspect	Event / Impact (Activity / consequence)	Risk Category	Severity level	Probability level	Pure Risk	Existing Control Measures	Severity level	Probability level	Residual Risk	Result - action	Suggested controls to reduce the risk further, whenever necessary.	Severity level	Probability level	Potential reduction due to further action/s suggested.	Applicable legal or other requirements
19	Bobact: Skid steer loader: S650, S770, TR50.210	R	• 'Pre-start check, • functional brake testing, • compliance brake testing, • tramming with empty scoop, • tramming with fully loaded scoop, • loading and loading into dump trucks, • dumping into tips, • refuelling, • tyre changing, • routine maintenance, • breakdowns, • towing or loading onto a flatbed. • safe parking, • fail to safe events, • fire on machine, • incident management, • emergencies, • operator fatigue. • Travelling on decline.	• V-P with pedestrian while scraping roads. • V-P causing injury to pedestrian while tramming, • V-P causing injury to pedestrian while refuelling, • V-P causing injury to pedestrian while operating in mining cycle - crushed against wall etc, • V-P causing injury to pedestrian when scraping at tip., • V-P causing injury to pedestrian in workshop, • V-P causing injury to pedestrian while changing tyre or wheel, • V-P causing injury while performing maintenance. • LoC on decline. • V-V while tramming. • V-V while scraping. • V-V during breakdown in high interaction risk area. • V-E while scraping.	• See TMM type hazard in worksheets 1.	Injuries that require time off work / loss time injury / RWC (Restricted work case) - No permanent disabilities	S	3	2	6	• See worksheet 3 TMM register for safety devices fitted to TMM. • CPS level 7 and 8 Vehicle Detection System (VDS) fitted. • Checklist in place. • Training and licensing of operators in place. • Tyre changing SOP in place. • Machine operation and maintenance in accordance with various OEMs operations and maintenance manuals. • Traffic management plan in place. (including RCAP) • TMM MCOP in place. • Supervision in place. • Planned Task Observation. • Manitou operating procedures in place. • Tip exclusion zone in place to protect tip operator. • TMM lighting standard in place. • Reflective strips, reflective overalls. • Safe walkways and crossings • Travelling in decline procedure in place. • Safe park procedure in place.	3	1	3	• For all operation purposes effective warning CPS must be installed. (Level 7 & 8) • Crawl speed is 3 km/hr. • Maximum speed is 14 km/hr • Speed in workshop to be crawl speed. • CPS error is a "No-Go". • Braking system testing is critical to ensuring safe stopping of machine. • TMM must act as a beacon when stopped in "unsafe area". • Effective isolation zones to avoid nuisance alarms to be installed.	• Although the current risk is low, pedestrian warning is deemed necessary and therefore the Bocat to be fitted with CPS effective warning and not auto retard and auto stop. • Traffic flow and hot spot analysis to determine current controls are within alignment of risk assessment.	2	1	2	• See BRMO - CAS Project - Definitions, Abbreviations and References Standard - 3 December 2023 rev 0 - specifically Section 8 References.
17		R					S			0				0					0	