

Trenchless Works (HDD)- Beneath the A2 Motorway

GG 104 Safety Risk Assessment

Quality control

Document history

Revision	Purpose description	Originated	Reviewed	Authorised	Date
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Table of contents

Contents

Quality control	2
Document history	2
Table of contents	3
Introduction/ Executive Summary	4
1. Planning	5
2. Categorisation of activity type	6
3. Identification of affected populations	12
4. Scope 12	
5. Safety baselines and safety objectives	13
6. Safety risk assessment	13
7. Update the safety risk assessment	19
7.1. Assumption validation and monitoring	20
8. Appendices	22

Introduction/ Executive Summary

The planned development entails constructing, operating, and maintaining a Battery Energy Storage System (BESS) along with its necessary infrastructure, including battery storage cabinets, a substation, and inverters. This initiative will be designated as the Dartford Energy Hub, and details regarding the BESS storage facility and its ancillary components are available in the site location and proposed site layout in the Appendix.

The project has secured a connection agreement with the National Grid at the Northfleet East Substation, located on Pepperhill Lane, Gravesend DA11 8HX, just north of the A2 on our site. Consequently, Horizontal Directional Drilling (HDD) is proposed to be conducted beneath the A2 to install the underground cables linking the infrastructure of the Dartford Energy Hub with minimal disruption to traffic and the regular operation of the A2.

Following our discussions with National Highways, please be advised that this is a working document and will be monitored and updated during detailed studies as part of the CD 622 geotechnical assessments, which are set to commence after successful planning determination.

Key Objectives for HDD Projects:

Planning and Design:

- Conduct thorough geotechnical investigations to assess soil conditions and identify potential obstacles.
- Develop detailed bore path designs to ensure safe and efficient installation.

Regulatory Compliance:

- Obtain necessary permits and adhere to local regulations governing drilling activities.
- Ensure compliance with environmental guidelines to minimize ecological impact.

Equipment and Technology:

- Utilise advanced locating systems to monitor drill head position and maintain accuracy.
- Employ appropriate drilling rig and support equipment suitable for the project's scale.

Safety Measures:

- Implement comprehensive safety protocols to protect workers, the public, road users and other stakeholders.

- Regularly inspect equipment and maintain communication among team members.
- Good communication with all stakeholders, road users, statutory bodies and third parties.

Environmental Considerations:

- Manage drilling fluids responsibly to prevent contamination.
- Restore the site post-installation to its original condition or better.

1. Planning

- Introduction and Context

The proposed activity involves crossing the A2 motorway using a Horizontal Directional Drill (HDD) to install underground utilities without disrupting traffic. This trenchless technology minimises surface disturbances and is commonly employed in highway and road crossings to reduce environmental impact and maintain road safety. The project will require careful planning to ensure compliance with all relevant regulations, minimise risks, and guarantee the safety of road users, construction personnel, and other parties.

As part of the planning condition, a satisfactory CTMP (Construction Transport Management Plan (CTMP)) as well as CEMP (Construction Environmental Management Plan) to ensure that all traffic and environmental impacts will be minimised.

- **Management of the SRA Process and Activity Ownership**
 - The **SRA process** is managed by **Clearstone Energy (“the Client”)**, who is responsible for assessing, documenting, and mitigating safety risks associated with the activity. This will be by HSE policies and requirements, particularly CDM regulation.
 - The **Activity Owner** will be the appointed competent Principal Contractor and Principal Designer, responsible for overseeing the HDD operations, ensuring compliance with safety protocols, and coordinating with relevant regulatory bodies, including National Highways and subcontractors.
- **Feasible Options**

This section provides a high-level overview of the options we thoroughly reviewed before making this decision. The proposed site layout provided in the Appendices illustrates that the A2 is the central link connecting the Dartford Energy Hub to Northfleet Substation. All other alternative routes, such as existing bridges and roads, were examined but ruled out as

unsuitable due to insufficient capacity or the need for substantial reinforcements, which may impact the A2.

1. Proceed with Horizontal Directional Drilling (HDD) (Preferred Option)

- Minimises surface disruption to the A2 motorway.
- Reduces the impact on road users and environmental disruption.
- Aligns with the industry's best practices and safety regulations.

2. Use Open-Cut Trenching (Not Preferred as no viable route is identified to cross the A2)

- Requires significant excavation, leading to major road closures and traffic disruption.
- Higher safety risks for workers and road users.
- Increased environmental impact.

3. Do Nothing (Not Viable)

- Prevents project completion, affecting planned infrastructure development.
- May not align with regulatory or operational requirements.
- Significant developments within the country to address climate change and energy crises could not occur.

2. Categorisation of activity type

Ref	Feature	Selection criteria		A/B/C selection and justification
		Type	Indicator (highlight selection)	
1	Extent of prior experience of activity. The degree of knowledge available from undertaking the activity previously or the degree to which knowledge is available from the activity being undertaken by other industries or organisations.	A	Activities for which there is significant experience within National Highways. Previous safety studies and data are available, and some activity features are codified in a standard or formal procedure.	A—The appointed HDD contractor possesses significant prior experience in this activity, considerable expertise in similar projects, and is fully aware of the relevant legislation and requirements. They will also be responsible for CD 622 requirements and obtain all necessary consents before any construction works, overseen by the Principal Designer and Contractor during the construction phase. Furthermore, there is extensive experience within National Highways, with previous safety studies, data, and established procedures readily available. This guarantees that the work is carried out safely and efficiently without adversely affecting the A2 motorway.
		B	Activities for which there is limited experience within National Highways but there is transferable experience elsewhere in the UK or internationally. Activities for which there is limited experience in National Highways but there is experience elsewhere in the UK or internationally, including in different industries, which is deemed sufficiently similar to the activity in question to be deemed relevant. Activities for which there is experience within National Highways but that experience is in a different application of the activity and some adaptation will be required. There might also be local and site specific issues to take into account that can affect the relevance of the available experience.	
		C	Activities for which there is no previous applicable experience from either National Highways or other industries.	

2	Statutory and formal processes and procedures (including standards and legislation). Consideration of the applicability of current standards, formal processes or procedures, guidance and legislation.	A	The activity is substantially or entirely within the scope of existing standards, guidance, formal processes or procedures and applicable legislation. The activity requires minimal or no safety related departures from standard or safety related changes to formal processes or procedures (including any legislation). The nature and type of a departure is the most important element in determining the categorisation and so a single safety departure may change this.	A – The activity is fully compliant with existing standards, guidelines, and legislation.
		B	The activity is largely within the scope of existing standards, guidance, formal processes or procedures. There can be some safety related departures from standards needed and/or safety related changes to formal processes or procedures. The activity can need minor changes to existing legislation. Whilst the number of safety departures from standards, formal processes or procedures can affect the categorisation, the most important element in determining this is the nature and type of the departures.	
		C	Activities that are not within the scope of existing standards, formal processes or procedures and require new ones to be developed. Activities for which significant departures from standards, formal processes or procedures are required. Activities which require significant changes to existing legislation or new legislation to be written. Whilst the number of safety departures from standards, formal processes or procedures can affect the categorisation, the most important element in determining this is the nature and type of the departures. For example, a large number of safety departures that can be addressed straightforwardly will have less impact on feature type than a single safety departure that cannot and requires a detailed risk assessment to support it.	

3	Impact on the organisation. The effect that the activity will have on current National Highways processes, procedures, structure, roles and responsibilities, competencies, policies and strategy, in addition to contractual and workforce arrangements.	A	The activity has no impact on National Highways. The activity has a minor impact on any of these for a finite period of time. Length of time National Highways is affected by decision to undertake the activity is short term.	A – According to the preferred option suggested for crossing the A2, this activity will not affect the National Highway, and any work nearby will be confined to a brief duration.
		B	The activity can lead to permanent minor changes to any of these. These minor changes can introduce new roles and responsibilities, policies, contractual and workforce arrangements. The activity can require a change to organisational arrangements. Length of time National Highways is affected by decision to undertake the activity is medium term.	
		C	The activity has significant impact on any of these. The activity can change core safety roles and responsibilities. Length of time National Highways is affected by decision to undertake the activity is long term.	
4	Activity scale. Consideration of the size and/or scale of the activity. Does or can the activity have an impact on the motorway and all-purpose trunk roads, either directly or indirectly.	A	The impact of the activity is limited in nature or scale.	A – The activity near the motorway will require specialised traffic management and will be meticulously planned to minimise disruption, including working outside peak hours and ensuring the least possible disturbance. This will be reflected in the CEMP and CTMP issued to National Highways for review before construction. The A2 motorway itself will remain unaffected, as the HDD method is specifically designed to eliminate the need for any work on the A2.
		B	The impact of the activity is significant in nature or scale.	
		C	The impact of the activity is wide ranging across the network, and/or significantly impacts infrastructure, interventions or workforce.	

5	Technical. Measure of technical and/or technological novelty and/or innovation the activity involves.	A	An activity where any processes, techniques, methodologies and/or technologies involved are currently in widespread use and re-examination is unlikely to be needed.	A – Trenchless technologies are widely used in the UK, with HDD being the most common method. As a result, this technology is well-established, with standardised processes, safety protocols, and regulations in place. Upon completion of assessments like CD 622 undertaken by our HDD contractor and subject to approval from National Highways, no re-examination would be required.
		B	There can be some experience of the processes, techniques, methodologies and/or technologies. The experience can be from use in either another application, or by another road authority, supplier, industry or perhaps from overseas in which case some additional work can be required to adapt them and/or to demonstrate that safety can be assured for the intended application.	
		C	Activities that use new processes, techniques, methodologies and/or technologies for which there is no previous experience in the UK or elsewhere.	
6	Stakeholder impact and interest. The quantity and/or impact of stakeholders, their interest in terms of safety risk and resulting ability to influence or/impact on the activity. The degree to which the safety issues, as perceived, are capable of	A	Activities for which the quantity and/or impact of stakeholders, their interest in terms of safety risk and resulting ability to influence or impact the activity is low.	A – The activity engages existing utility asset owners, landowners, national strategic roads, local authorities, High Speed 1, and Highways England. With appropriate design, management, and monitoring, their assets will remain unaffected. All legislation and guidance will be adhered to strictly and consents/licences will be put in place before any construction commencement.
		B	Activities that have only a single or a few stakeholders but their impact, in terms of their attitude towards, or ability to influence, and/or interest in the successful achievement of the activities aim in terms of safety risk can be significant. Alternatively, it will represent an activity that has several stakeholders but the amount, or type, of safety issues involved are limited.	

	being understood and fully addressed.	C	Activities for which there are a large number of stakeholders and their impact in terms of their attitude towards, or ability to influence safety can be significant. Stakeholders with a strong interest in the potential safety impact of the activity on themselves. Activities where there are conflicting needs arising from different stakeholders or stakeholder groups.	
Overall Categorisation		A/B/C selection and justification		
		Overall, the categorisation is A - When designed and managed correctly, HDD should not affect the motorway directly. However, conducting risk assessments and implementing precautionary measures are crucial to maintaining structural integrity and avoiding unintended consequences. To achieve this, Clearstone Energy will collaborate solely with highly skilled, experienced, industry-leading companies with extensive HDD technology expertise.		

3. Identification of affected populations

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Identification of affected populations (Use GG104 Table 1.3 to identify affected groups)

Group:	Describe group and how decision affects them. Mention any specific risk groups (i.e. motorcyclists):	Affected?
Workers	People directly employed by and in a contractual relationship with National Highways.	Yes, potentially indirectly.
Users	All road users, including the emergency services, walkers, cyclists, horse riders, and those at work, but who are not in a contractual relationship with National Highways.	Yes, potentially indirectly.
Other parties	Any persons who could be affected by the National Highways network, but who are neither using it, nor working on it.	Yes, potentially indirectly.

4. Scope

The scope of this Safety Risk Assessment (SRA) includes:

- Geographical Coverage: The assessment focuses on A2 Motorway infrastructure, particularly the area surrounding Northfleet East Grid Substation.
- Timeframe: The evaluation applies to short-term operations. A detailed programme will be shared for approval before construction.
- Extent of Work: The assessment covers HDD activities, associated launch/reception pits, utility crossings, and ground stability risks. **No direct impact to A2**
- Traffic and Infrastructure Impact: It encompasses potential impacts on carriageways, pedestrian footways, cycle lanes, and adjacent structures but excludes any direct modifications to the motorway. **No direct impact to A2**

Assumptions Shaping the Outcome

The following assumptions have influenced the risk assessment approach:

- HDD operations will be conducted without surface excavation on the motorway.
- Geotechnical and borehole studies (including CD622 compliance) provide accurate data on ground conditions.
- Minimal vibration impact is expected, based on soil composition and controlled drilling techniques.
- Substantial pre-construction and enabling activities will be completed.

Justification for Assumptions

- HDD as a Trenchless Method: Industry best practices and past projects confirm that HDD can be executed without impacting motorway integrity if appropriate safety measures are followed.
- Ground Stability Measures: Geotechnical studies indicate that soil conditions are suitable for HDD without significant subsidence or structural impact risk.
- CD 622 Managing Geotechnical Risk (**Undertaken with National Highways Geotechnical team**)
- Avoiding Danger from Underground Services (HSG47)
- Construction and Design Management (CDM 15)
- Health and Safety in Construction (HSE)
- National Grid Specification for Safe Working Practices - EE SPEC:53/1
- UK Power network safety rules - G81 Technical Library
- The relevant safety specifications of other asset owners will be strictly adhered to throughout the design and construction phases.

5. Safety baselines and safety objectives

Due to lack of available numerical data, no specific numerical safety objective has been set for road workers, road users or other parties in this context. The risk to all populations must be managed So Far As Is Reasonably Practicable (SFAIRP), as evidenced in step 6 below.

6. Safety risk assessment

Likelihood (L) x Severity (s) = Risk value (R)	Severity (S)				
	Minor harm; Minor damage or loss no injury	Moderate harm; Slight injury or illness, moderate damage or loss	Serious harm; Serious injury or illness, substantial	Major harm; Fatal injury, major damage or loss	Extreme harm; Multiple fatalities, extreme loss or damage

				damage or loss		
Likelihood (L)	Very unlikely; Highly improbable, not known to occur	1	2	3	4	5
	Unlikely; Less than 1 per 10 years	2	4	6	8	10
	May happen; Once every 5-10 years	3	6	9	12	15
	Likely; Once every 1-4 years	4	8	12	16	20
	Almost certain; Once a year or more	5	10	15	20	25

Risk value (R)	Required action
Low (1-9)	Ensure assumed risk treatments are maintained and reviewed as necessary.
Medium (10-19)	Additional risk treatments needed to reduce risk rating to a level which is equivalent to a test of SFAIRP for the population concerned.
High (20-25)	Hazard to be avoided or risk to be reduced to tolerable.

Ref	Hazard and Risk description What is the hazard and what risk(s) does it present? How – does this have potential to cause harm, loss or failure?	Population(s) and sub-population(s) affected	Before			Response/Treatments/Control measures	After			Details/Assumptions/ Monitoring requirements
			Likelihood	Severity	Risk		Likelihood	Severity	Risk	
1	Traffic Disruptions - Impact on A2 motorway traffic due to drilling operations	Users of the A2 motorway,	3	4	12	The launch and reception pits will be strategically positioned to ensure no impact on the motorway. Throughout the operation, a strict safety distance from the motorway structure will be maintained to prevent any potential effects on its integrity or traffic flow. Implement the traffic management plan, notify local authorities, and schedule work during off-peak hours.	2	4	8	The drilling operation will be monitored continuously throughout its duration to ensure no impact on the motorway structure or traffic at any time.
2	Ground Stability - Possible subsidence or collapse during drilling	Users of the A2 motorway, workers	3	3	9	A specialist team will conduct a comprehensive site investigation to ensure that boreholes and geotechnical studies,	2	2	4	The drilling operation will be continuously monitored throughout its duration to ensure no impact on the motorway structure or traffic at

						including CD622, are properly executed. Experts will carry out the design phase utilizing on-site survey data to accurately assess level details and existing infrastructure. A Principal Designer will be appointed to oversee the project and ensure full compliance with all relevant regulations. Use appropriate drilling fluids and monitor ground conditions continuously.				any time. A gyro steering engineer will monitor the drill's direction on-site, ensuring it aligns with the design and achieves the required outcome.
3	Utility Strikes - Striking existing underground utilities (gas, water, telecom)	Workers, Residents, and businesses relying on utilities	5	5	25	Conduct Ground-Penetrating Radar and Electromagnetic location surveys in accordance with PAS 128 – 2022 standards and trial pits to verify utility locations; liaise with asset owners. For data collection, utilise the latest technology and collaborate with industry-leading companies for utility and TOPO surveys. Cross-reference	2	5	15	At the pre-construction phase, the Principal Designer should monitor the accuracy of the information used to plan the HDD profile and ensure that every effort is made to minimise risks. During the construction phase, the drilling operation will be continuously monitored throughout its duration to ensure that there is no impact

						information with asset owner data. If utilities are not identified with the required level of confidence, a trial hole is necessary to confirm their location.				on the motorway structure or traffic at any time.
4	Proximity to HS1 Tunnel - Risk of ground movement affecting tunnel integrity		3	4	20	Conduct detailed ground investigation, engage with HS1 stakeholders, and use non-intrusive monitoring techniques.	2	4	8	Appropriate monitoring as set out by the agreed safe system of work. This is outside the scope of impact on A2
5	Environmental Impact - Potential contamination of soil and groundwater	HDD crew handling drilling fluid, Residents near water sources, agricultural lands	3	3	9	Employ environmentally friendly drilling fluids and establish spill response procedures. Use spill containment mats and vacuum trucks.	2	2	4	ISO 14001 approved the management system for the project's delivery. Agreed SSOW (Safe System of Works in Place)
6	Worker Safety Exposure to high-pressure drilling fluids and machinery hazards	Workers	3	3	2	Provide PPE, conduct safety briefs, and enforce exclusion zones around HDD operations.	2	2	4	ISO 18001 approved management for delivery of project. Agreed SSOW (Safe System of Works in Place)
7	Equipment Failure - Breakdown of HDD equipment leading to project delays		2	4	8	Conduct pre-use inspections, maintain spare parts availability,	1	2	2	Daily inspections, work planning, and utilising drilling

						and implement emergency response plans.				equipment less than 3 years old.
8	Vibration and Stability Concerns – While generally low, some vibrations or shifts in soil structure could occur, especially in unstable ground conditions.		4	3	12	Geotechnical Surveys – Conduct comprehensive soil investigations to assess ground conditions and identify areas susceptible to instability. Structural Risk Assessments – Evaluate surrounding structures, roadways, and underground utilities for their vulnerability to vibrations. Selection of Appropriate Drilling Parameters – Adjust drilling speed, pressure, and fluid flow to minimise vibrations.	2	3	6	Vibration Monitoring Sensors: Install sensors near critical infrastructure to detect and measure vibrations. Ground Movement Monitoring: Use inclinometers and settlement markers to track soil displacement. Immediate Response Plan: Establish thresholds for vibration levels; if these are exceeded, adjust drilling parameters or pause operations.

7. Update the safety risk assessment

Should there be any significant changes to the project design, optioneering, safety risk analysis or assumptions made within this safety risk assessment, it will be updated to consider and control any new safety risks. Significant changes include, but are not limited to:

- Significant assumptions in the assessment.
- Milestones in the activity development, such as trial development.
- A change to a/an additional safety control measure/treatment.
- New information emerging as a result of monitoring of the activity (see step 8).
- Business area specific procedures, such as document control.

The project will proceed through a comprehensive feasibility study lifecycle, involving engagement with all relevant parties, preliminary design, and subsequently detailed design. Each stage will present a range of variables that may influence the project work. This document will be reviewed at each stage. The key stages identified at this point include:

- Engagement with HS1
- Engagement with Statutory Undertakers
- Engagement with Kent County Council / Local Highways Unit
- Engagement with local businesses, residents, parish councils, etc.
- CD622 Lifecycle (Submission / Review / Acceptance)
- Supply Chain Engagement
- Supply Chain Selection
- Supply Chain Confirmation
- Outline Design Stage

- Detailed Design Stage
- SHEQ Planning Stage (Throughout project lifecycle)
- National Grid Engagement

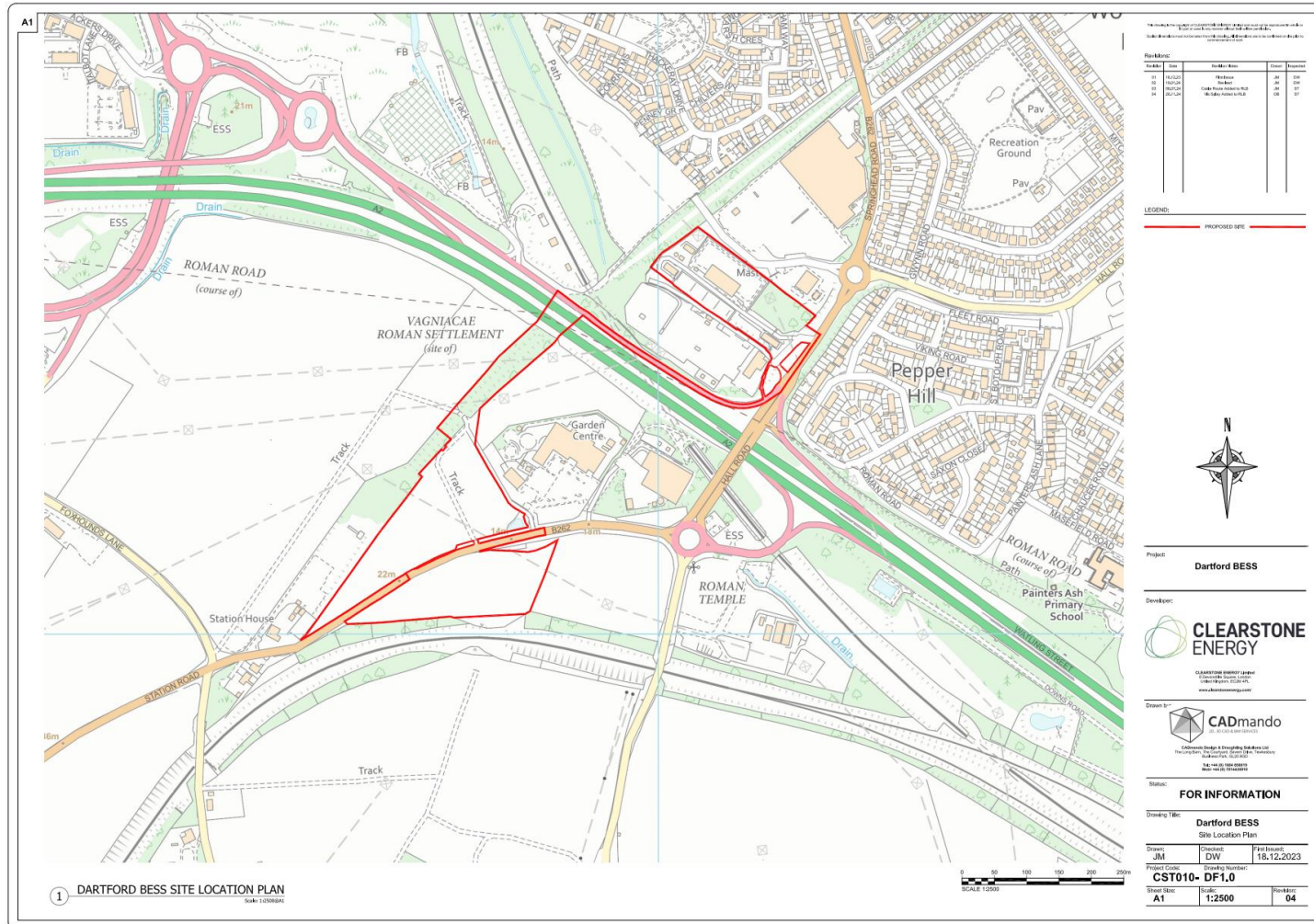
7.1. Assumption validation and monitoring

The safety risk assessment will be monitored and updated throughout the project's lifecycle by the Principal Contractor, with the Project Director accountable for this ongoing monitoring of the scheme, typically as part of regular business activities. At a minimum, this will occur on a monthly basis with relevant project stakeholders.

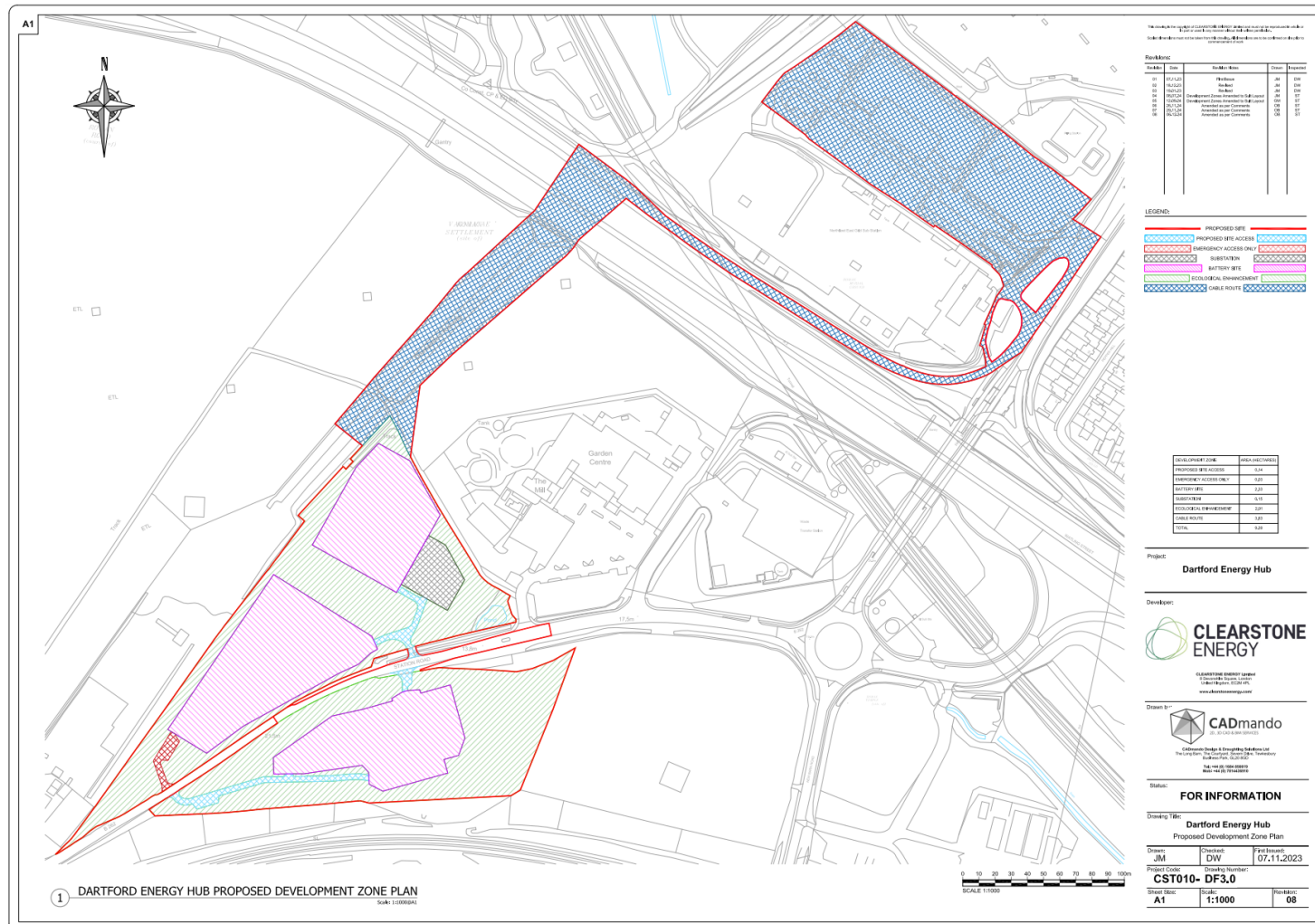
Ref	Monitoring requirement	Parameters	Monitoring method(s)
1	Road traffic collisions (RTCs)	• High level analysis of the number of injury RTCs since scheme opening (as reported in ControlWorks). • Initial analysis of causes of injury RTCs. • Compare injury RTCs to safety baseline. • Report non-injury RTCs (no comparison as no reliable before figure). • Assessment of RTC (location and severity).	ROC ControlWorks logs / Traffic officer liaison meetings / Stakeholder liaison (if no ControlWorks logs)
2	Maintenance access, roadworks and resources	• Feedback on the use of maintenance access such as: - Off network access (inc. fixed access gantries)	MSP performance feedback

		- Temporary traffic management (TTM) • Number of incidents during TTM including: - Incidents during deployment and removal - Vehicle breaches into roadworks - Technology / power failure • Severity (consequence) of incidents and near misses	
3	Impact of weather conditions	• Assess if the winter maintenance procedure is performing as expected (note: this will be particularly relevant to snow ploughing activities) • Record any instances of flooding and its impact, quantitative information will be used if available.	ROC ControlWorks logs / Traffic officer liaison meetings / MSP performance feedback
4	Junction operation	• Review of junction operation / layout: - Identification of congestion seed points and compare to baseline - Assessment of driver behaviour at junction locations • Consideration of impact of any emergency areas / laybys on diverges	Drive through survey / CCTV monitoring / HALOGEN, TCD, TRIS and traffic plots / Traffic officer liaison meetings
5	Operational performance	• Overall performance of scheme - Does traffic flow smoothly through the scheme - Any impact from technology failures or operational issues • Flow of traffic through all lanes by considering lane utilisation and traffic flow	Drive through survey / HALOGEN, TCD, TRIS and traffic plots / Traffic officer liaison meetings / Stakeholder liaison

8. Appendices



Appendix A – Site Location Plan



Appendix B – Development Zone Plan