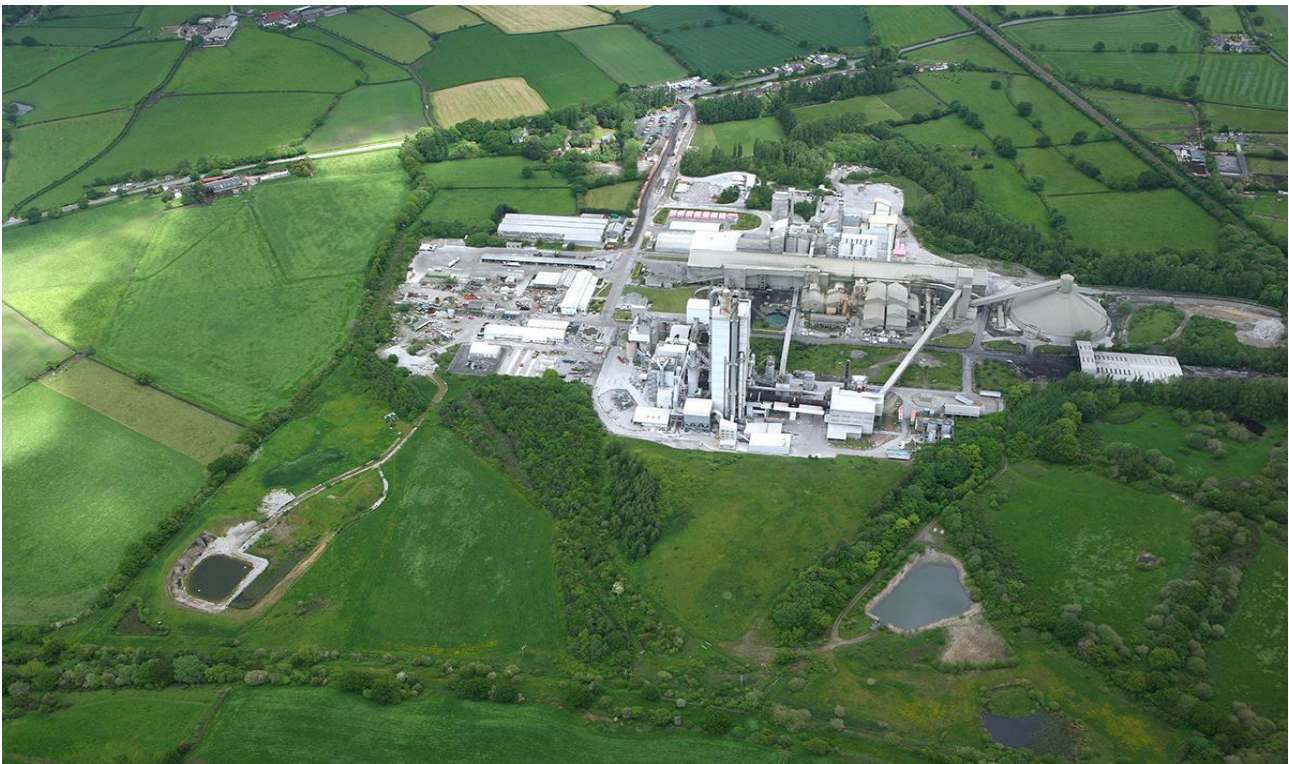


HEIDELBERG MATERIALS

Padeswood Carbon Capture Plant - FEED Phase

Environmental Aspect and Impact Register

Document no. Rev 0: 215000-00190-000-EN-REP-00002-A



Disclaimer

This report has been prepared on behalf of and for the exclusive use of Heidelberg Materials, and is subject to and issued in accordance with the agreement between Heidelberg Materials and Worley Limited. Worley Limited accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party. Copying this report without the permission of Heidelberg Materials or Worley Limited is not permitted.

The information contained in these documents is protected by the Global Data Protection Regulation (GDPR). Worley complies with the provisions of the Regulation and the information is disclosed on the condition that the Recipient also complies with the provisions of the (GDPR). In particular, all of the resumes and the information contained therein, must be kept securely, must be used only for the purposes of assessing the suitability of the individuals to perform the tasks proposed and/or assessing the overall capabilities of Worley to undertake the Work proposed and must be destroyed upon completion of those purposes.

Details on how personal information provided to Worley is processed can be found at <https://www.worley.com/site-services/privacy>.

PROJECT 215000-00190-000 - 215000-00190-000-EN-REP-00002-A: Padeswood Carbon Capture Plant - FEED Phase - Environmental Aspect and Impact Register

Rev	Description	Originator	Reviewer	Worley Approver	Revision Date	Customer Approver	Approval Date
Rev 0	Issued for Design				01 August 2024		
		O Mancell Smith	A Stephen	A Moghaddam			

Revision History

Rev	Status	Section	Description of Change
0	IFD	All	Issue for Design

Table of contents

1. Introduction	4
1.1 Project Description	4
1.2 Document Purpose	4
1.3 Abbreviations and Definitions	5
1.4 Technical Terms	5
1.5 References	6

List of tables

Table 1-1: Table of Abbreviations	5
Table 1-2: Table of Terms	6
Table 1-3: References	6

1. Introduction

1.1 Project Description

The Heidelberg Materials Padeswood Cement Works CCS Project will enable post combustion carbon capture from the existing cement kiln 4 and from a new Combined Heat and Power (CHP) plant designed to provide the heat and electricity required to operate the Carbon Capture Plant (CCP).

Captured CO₂ will be transported by pipeline to the HyNet CO₂ main pipeline at Northop Hall AGI for onward transportation to storage offshore in depleted gas fields operated by Eni U.

The whole project will enable the production of net zero cement for use in the UK construction industry.

The detailed process description is covered in Ref 1.

1.2 Document Purpose

The Padeswood Carbon Capture Plant Environmental Impact Identification (ENVID) study was executed in early FEED on the 16 January 2024. The study was a workshop-based exercise which had inputs from key stakeholders in the design from Worley, Heidelberg Materials (HM) and Mitsubishi Heavy Industries (MHI). The workshop followed the impact identification and ranking methodology detailed in the ENVID terms of reference (ToR) document (Ref 1).

Following the completion of the ENVID study, a report (Ref 2) documenting the activities and outcome of the workshop was prepared, which should be referred to alongside this document.

This document comprises the Environmental Aspect and Impacts Register which was developed with reference to the findings of the ENVID study report.

The Environmental Aspect and Impacts Register is considered a live document, which is to be reviewed and updated as the design of the facility develops to ensure all relevant environmental hazards and impacts are captured.

1.3 Abbreviations and Definitions

Abbreviation	Description
AGI	Above Ground Installation
CCP	Carbon Capture Plant
CCS	Carbon Capture and Storage
CHP	Combined Heat and Power
CO₂	Carbon Dioxide
DNS	Development of National Significance
ENVID	Environmental Impact Identification
FEED	Front End Engineering Design
H₂S	Hydrogen Sulphide
HCN	Hydrogen Cyanide
HM	Heidelberg Materials
MHI	Mitsubishi Heavy Industries
NO_x	Oxides of Nitrogen
SO_x	Oxides of Sulphur
TOR	Terms of Reference
VOC	Volatile Organic Compounds

Table 1-1: Table of Abbreviations

1.4 Technical Terms

Term	Description
Cause	Event, situation, or condition that results, or could result, directly or indirectly in an accident or incident.
COMPANY	Heidelberg Materials
Consequence	Direct, undesirable result of an accident sequence usually involving a fire, explosion, or release of toxic material. Consequence descriptions may be qualitative or quantitative estimates of the effects of the accident in terms of factors such as health impacts, economic loss and environmental damage.
CONTRACTOR	Consortium of Worley Europe Limited and Mitsubishi Heavy Industries Limited (MHI)
DELIVERY PARTNER	Company other than the prime COMPANY and CONTRACTOR associated with the delivery of the PROJECT.
Environmental Impact Identification (ENVID)	Is a team-based brainstorming workshop used to identify environmental aspects and impacts associated with the project design, construction, operations and decommissioning. ENVID workshops may be broad in their scope and thus have a wide applicability.
Hazard	Condition or practice with the potential to cause harm to people, the environment, property or reputation.
LICENSOR	MHI entering a Licensing Agreement with the CLIENT
PROJECT	Padeswood Carbon Capture Plant

Term	Description
SUB-SUPPLIER	The organisation selected by the SUPPLIER/VENDOR to supply the part of equipment and services.
SUPPLIER/VENDOR	Company / organisation supplying equipment, materials or services.
WORK	Shall mean all and any of the WORKs and / or services and / or materials required to be provided under the Contract with CLIENT.

Table 1-2: Table of Terms

1.5 References

Ref	Document Number	Document Title
Ref 1	215000-00190-000-EN-PRO-00001	ENVID Terms of Reference
Ref 2	215000-00190-000-EN-REP-00004	ENVID Report

Table 1-3: References

Environmental Aspects and Impacts Register

Ref	Issue	Scenario			Type (Continuous, Intermittent)	Details of Environmental Aspect		Responsible Equipment / system / element	Receptor							Existing Mitigation	Risk Matrix			Actions/ Recommendations		
		Normal	Planned	Unplanned		Cause	Impact		Air	Land	Water	Communities	Workforce	Fauna / Flora	Local Species		Severity	Likelihood	Risk Ranking	ENVID Action	Description	Responsible
ENV 1	Treated Flue Gas Emissions from New Stack	●			Continuous	Standard operation has treated flue gas vented via new stack.	Emissions of Water, Nitrogen, Oxygen, CO2 and trace gas amounts are emitted from the new stack. Amine emissions will be <1mg/Nm3. Standard combustion related pollutants of NOx, SOx and CO. No environmental concerns.	New Vent Stack	●							Covered by standard design processes. CHP/CCP stack will be subject to continuous emission monitoring for pollutant concentrations of NOx, SOx, CO etc and CO2 rates as per BAT requirements. BAT and Emerging guidance recommends Amine monitoring but is silent on frequency, which is left to operator to decide on.	Insignificant	Likely	Low			
ENV 2	Untreated Flue Gas Emissions from New Stack		●		Intermittent	In event flue gas treatment is unavailable, untreated flue gas is routed to new stack.	CO2 that would normally be captured by CCU is emitted by new stack. Emissions of Pollutants NOx, SOx PM and CO will be at similar levels to existing plant. Other emissions include water, Nitrogen, Oxygen and trace gas amounts. No environmental concern	New Vent Stack	●							Covered by standard design processes. As per above new stack will have CEMS installed in compliance with BAT requirements.	Insignificant	Likely	Low			
ENV 3	CO2 Venting		●		Intermittent	CO2 will be added to treated flue gas but may have increased flowrates compared to untreated flue gas and different temperatures.	Mixing of streams may result in suboptimal dispersion of flue gas plume. Potential for plume to fall or approach ground level.	New Vent Stack	●				●	●			Critical	Remote /Rare	High	Action 1	Review the CO2 venting scenarios and conduct any modelling identified after initial screening. CO2 will be added to the treated/untreated flue gas flowing to the new flue stack but may have increased CO2 flowrates, different discharge temperatures and may disperse differently compared to the flue gas from the existing flue gas stack.	Worley - Tech
ENV 4	Emissions from Existing Flue Gas Stack.		●		Continuous	Existing Flue Stack will be available as backup during commissioning and initial start up of CCU and will eventually decommissioned.	When required to be used, flue gas will be emitted via the existing stack. Same emission levels as current operations.	Existing vent stack	●							Covered by existing permitting conditions / emission controls. Existing stack CEMS will be maintained until existing stack decommissioned.	Insignificant	Likely	Low			
ENV 5	Venting from the Fuel gas system			●	Intermittent	Safety venting of the fuel gas system due to overpressure of the line.	Potential releases of hydrocarbons	Fuel gas over pressure vent	●							As per BAT requirements, venting is not standard operations and will be regulated to only occur for safety issues and at safe location.	Minor	Unlikely	Low			
ENV 6	Venting of Steam	●	●		Intermittent	Venting of system during normal operations and planned shutdown/start-up	Release of steam to environment	Steam System Vents	●							Covered by standard design processes.	Insignificant	Likely	Low			
ENV 7	Venting from the Hydrogen Generator unit/system			●	Intermittent	Overpressure protection Venting (safety venting)	Venting of hydrogen and O2.	Hydrogen Generator	●							Oxygen will be vented via local vent in event of over pressurisation. Hydrogen will be vented via safe location vent in event of over pressurisation only. Covered by standard design processes.	Insignificant	Possible	Low			
ENV 8	Ammonia Venting	●			Intermittent	Ammonia Venting from by existing design processes.	Release of ammonia. Streams anticipated to be circa 25% Ammonia.	Ammonia system	●							Covered by standard design processes.	Insignificant	Possible	Low			
ENV 9	Reclaimer Vents	●			Continuous	Reclaimer vent moved by vacuum pump to the CO2 header and eventual disposal via new flue gas stack.	Vent gas include water and trace amounts of solvent. Included in treated flue stack amine concentrations.	Reclaimer Vent (to stack)	●							Amine monitoring is required by BAT. Monitoring scheme to be established based on concentration level and likelihood of fluctuations. (i.e., more frequent in initial year to establish baseline then decision can be made to drop to bi-annual sampling)	Insignificant	Possible	Low			

Ref	Issue	Scenario			Type (Continuous, Intermittent)	Details of Environmental Aspect		Responsible Equipment / system / element	Receptor							Existing Mitigation	Risk Matrix			Actions/ Recommendations		
		Normal	Planned	Unplanned		Cause	Impact		Air	Land	Water	Communities	Workforce	Fauna / Flora	Local Species		Severity	Likelihood	Risk Ranking	ENVID Action	Description	Responsible
ENV 10	Emissions from Storage	●			Intermittent	Storage tank breathing losses	Potential releases to atmosphere of vapours in the storage tanks.	Storage tanks	●							Amine storage tank breather would not contain amine in vapour or suspended aerosol droplets. Hot oil system tanks will have N2 blanketing. Water is other anticipated emission from storage. Covered by standard design processes.	Insignificant	Possible	Low			
ENV 11	Fugitive Emissions of flue gas	●			Intermittent	Treated and untreated flue gas fugitive emissions from instrumentation and pipe works.	Leaks of both untreated flue gas and treated flue gas components.	Pipelines	●							Unlikely to have environmental impact due to very low pressure system. Covered by standard design processes.	Insignificant	Unlikely	Low			
ENV 12	Leaks and Fugitive emissions of CO2 gases	●			Intermittent	CO2 leaks and fugitive emissions from across system.	Health and Safety impact but limited environmental impact	CO2 containing streams	●							Covered by standard design processes including BAT recommendations to rationalise number of potential leak components through design, and residual items to be specced for low-leak rates	Minor	Unlikely	Low			
ENV 13	Leaks and Fugitive emissions of Hydrogen	●			Intermittent	Hydrogen leaks and fugitive emissions from the various instrumentation and pipe works	Health and Safety impact but limited environmental impact	Hydrogen Generator and connected piping/systems	●							Covered by standard design processes. Also see comment above.	Minor	Unlikely	Low			
ENV 14	SF6 Emissions	●			Intermittent	Potential for SF6 emissions from leaks in gas insulated switchgear	No impact identified. No gas insulation switchgear in design	Switchgear	●							No gas insulation switchgear in design	Insignificant	Remote /Rare	Low			
ENV 15	Combustion Emissions from Boiler	●			Continuous	Boiler is new CO2 source in addition to existing kiln.	No impact. CO2 will be captured as part of scope of project	Boiler	●							CO2 will be captured as part of scope of project	Insignificant	Remote /Rare	Low			
ENV 16	Oil Spillage	●	●	●	Intermittent	Spillage or leaks of the oil for the hot oil system	Potential contamination of soil and ground water.	Hot Oil Medium System		●	●					Covered by standard design processes.	Insignificant	Possible	Low			
ENV 17	Contamination by Produced water	●			Continuous	Potential contamination from flue gas condensate, blowdown from cooling tower/steam, FGD wastewater and solvent wastewater	Potential contamination of waterways	Produced water system		●	●					Produced water is not discharged to receiving environment. It is reused / sent to cement plant. Covered by standard design processes in alignment with Waste gas / Wastewater management and treatment BAT.	Insignificant	Remote /Rare	Low			
ENV 18	Contamination from chemicals	●			Intermittent	Chemical contamination of soil and/or groundwater from the storage, transfer and discharge of chemicals.	Potential contamination of soil and ground water.	Chemical storage		●	●					Covered by standard design processes.	Minor	Unlikely	Low			
ENV 19	Diesel spills	●	●	●	Intermittent	Diesel spills from the emergency diesel generator day-tank	Contamination of soil and groundwater.	Diesel System		●	●					Covered by standard design processes.	Minor	Unlikely	Low			
ENV 20	Contaminated drains	●			Continuous	Cross contamination of wastewater and effluent streams	Contamination of soil and groundwater.	Drainage systems		●	●					Solvent and other contaminated water drains will be separated and contained in alignment with waste stream segregation BAT. Covered by standard design processes.	Minor	Unlikely	Low			
ENV 21	Other oil spills	●	●	●	Intermittent	Spills and leaks of lube oil and hydraulic fluids	Contamination of soil and groundwater.	Lube oil system		●	●					Covered by standard design processes.	Minor	Unlikely	Low			

Ref	Issue	Scenario			Type (Continuous, Intermittent)	Details of Environmental Aspect		Responsible Equipment / system / element	Receptor						Existing Mitigation	Risk Matrix			Actions/ Recommendations		
		Normal	Planned	Unplanned		Cause	Impact		Air	Land	Water	Communities	Workforce	Fauna / Flora		Local Species	Severity	Likelihood	Risk Ranking	ENVID Action	Description
ENV 22	Fire-fighting water		●	●	Intermittent	Contamination from firewater during tests and emergency events	Contamination of soil and groundwater.	Firewater system / drainage		●	●				Appropriate segregation and holding pond testing (prior to 3rd party disposal) in alignment with BAT. Covered by standard design processes.	Minor	Unlikely	Low			
ENV 23	Hot Condensate	●			Continuous	Release of hot condensate from steam traps	Contamination of soil and groundwater.	Steam System		●	●				Covered by standard design processes.	Minor	Unlikely	Low			
ENV 24	Stormwater	●			Intermittent	Contamination from stormwater run off	Contamination of soil and groundwater.	Stormwater system/drains		●	●				Stormwater (groundwater) treatment is in design. Water reused not discharged. Covered by standard design processes.	Minor	Unlikely	Low			
ENV 25	Hydrotest Water		●		Intermittent	Large volume of hydrotest water during commissioning.	Hydrotest water may be lightly chlorinated. Improper handling may lead to soil and groundwater contamination	Hydrotesting		●	●				Covered by standard design processes.	Minor	Unlikely	Low			
ENV 26	Rinse Water		●		Intermittent	Absorber and Regenerator require multiple rinses during shutdown (for vessel entry) and before start-up (to clean preservation oil off packing). Large volumes of clean water required to be sourced and effluent disposed of.	Contaminated rinse water poses risk of soil and ground water contamination with amine residue and oil if not properly handled.	Rinse water		●	●					Minor	Possible	Medium	Action 2	Review the requirements for rinse water for removing amine before vessel entry, and for cleaning fresh packing before start-up. Also consider how to dispose of the contaminated rinse water.	Worley / MHI - Process
ENV 27	Solid Wastes		●		Intermittent	Solid wastes produced during operation: Used catalysts/absorbent Used filter materials	Improper disposal will result in contamination of soil and groundwater.	Wastes		●	●				Appropriate 3rd party disposal required. Covered by standard design processes.	Minor	Unlikely	Low			
ENV 28	Liquid Wastes	●			Intermittent	Identified liquid wastes a) Slurry from filtration unit filter cake b) Reclaimed waste amine c) Sewage from control room facilities d) Used lube oil or hydraulic oil	Improper disposal will result in contamination of soil and groundwater.	Wastes		●	●				a) Sent to cement plant calciner b) sent to cement plant c) tie-in to existing sewage system d) appropriate disposal via 3rd party waste handler	Minor	Unlikely	Low			
ENV 29	Hazardous Wastes	●			Intermittent	Degraded reclaimed solvent wastes	Potential human and environmental toxins	Wastes		●	●			●				TBC	Action 3	Review the composition of the degraded solvent waste from the Reclaimer to identify potential toxins/carcinogens to humans and the environment. Advise the company on any measures required to mitigate health hazards.	MHI
ENV 30	Energy use	●			Continuous	Use of energy through plant for machinery, heating, lighting.	Increased emissions from system due to heat requirements. Increased emissions from purchase of electricity due to power requirements	Energy Efficiency	●						Optimisation of energy use of facility to be covered as part of standard design process.	Minor	Unlikely	Low			
ENV 31	Fuel Use	●			Continuous	Use of fuel in fleet vehicles	Emissions from vehicle use.	Vehicles	●						Part of operational management.	Minor	Unlikely	Low			
ENV 32	Water Use	●			Continuous	Water use in the plant for cooling, washing etc	Increased demands on local water supply. Potential to exasperate future water scarcity events.	Water systems			●	●			Project philosophy is to maximise water recovery and reuse in design. Incorporated in design premise.	Minor	Unlikely	Low			
ENV 33	Land Use and raw material use	●			Continuous	Land use by plant and materials required in construction	Larger footprint means Increased disturbed area, increased potential for soil contamination and increased raw material requirements during construction.	Site footprint		●					Plot area is to be minimised as far as practically (safely) possible and material waste to be reduced. Covered by existing design processes and procurement practices.	Insignificant	Likely	Low			
ENV 34	Processed Materials, chemicals, solvents and consumables	●			Continuous	Process / project requires sizable quantities of solvents, chemicals and other processed items during operation.	Increased demand on supply chain (energy, water, raw materials) and associated emissions, effluents and wastes to produce and deliver materials.	Supply chain	●	●	●				Covered by existing design processes and procurement practices.	Insignificant	Likely	Low			
ENV 35	Noise from Steam Venting		●		Intermittent	Steam Venting during start up and upsets.	Increased noise levels during venting. Risk of noise nuisance complaints from local residents or businesses	Steam vents				●			Silencer on steam vent line (note, not on PSVV)	Major	Possible	High	Action 4	Review any significant sources of noise following the planned initial noise modelling study, to identify early design changes that may be required. Consider Steam and CO2 venting (continuous and emergency) and major machinery noises as a minimum. Note that Vendor noise information will not be available until detailed design.	RSK
ENV 36	Noise from CO2 venting		●		Intermittent	CO2 Venting during start up and upsets.	Increased noise levels during venting. Risk of noise nuisance complaints from local residents or businesses	New Stack				●			Orifice downstream of vent valve.	Major	Possible	High	Action 4	Review any significant sources of noise following the planned initial noise modelling study, to identify early design changes that may be required. Consider Steam and CO2 venting (continuous and emergency) and major machinery noises as a minimum. Note that Vendor noise information will not be available until detailed design.	
ENV 37	Noise levels from machinery	●			Continuous	Noise from new machinery	Increased noise levels during operation. Risk of noise nuisance complaints from local residents or businesses	Machinery (i.e., compressors)				●			Existing design processes	Major	Possible	High	Action 5	Consider undertaking an additional tonal noise study later in the design process for significant sources of noise that have been identified in the initial noise modelling study. Note that Vendor noise information will not be available until detailed design.	RSK

Ref	Issue	Scenario			Type (Continuous, Intermittent)	Details of Environmental Aspect		Responsible Equipment / system / element	Receptor							Existing Mitigation	Risk Matrix			Actions/ Recommendations		
		Normal	Planned	Unplanned		Cause	Impact		Air	Land	Water	Communities	Workforce	Fauna / Flora	Local Species		Severity	Likelihood	Risk Ranking	ENVID Action	Description	Responsible
ENV 38	Odour Emissions	●			Continuous	Odours from ammonia storage bullet vents and amine solvent storage.	Potential for bad odour complaints from local residents or businesses	Ammonia Storage and Amine Storage				●					Minor	Likely	Medium	Action 6	Review sources of odour and consider a full model is required or just a Qualitative report	RSK
ENV 39	Disturbance of Habitats and Species	●			Continuous	Project construction and operation	Project construction may disturb habitats and displace/endanger protected species	Facility						●	●		Insignificant	Unlikely	Low			
ENV 40	Cultural Heritage	●			Continuous	Project construction and operation	Damage to areas of cultural heritage	Facility				●					Minor	Remote /Rare	Low			
ENV 41	Visual Impact	●			Continuous	New plant may causes visual impact	Visual impact for local community including disturbing view of horizon or lighting of the night sky	Facility				●					Minor	Unlikely	Low			
ENV 42	Amenity	●			Continuous	Location of new plant in area	Potential impact from plant location on pathways	Facility				●					Insignificant	Likely	Low			