



Technical Study for Water Bodies in Relation to the Thermal Treatment Facility EIA

As per for PA/O6O96/23

Report



WATER BODIES TECHNICAL STUDY
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1 INTRODUCTION

This technical study identifies and describes the impacts on water bodies to fulfil the Environmental Impact Assessment (EIA) Terms of Reference (TORs) issued by the ERA for PA/06096/23 in June 2024.

The proposed development, hereinafter referred to as the “Scheme”, involves the construction of a new Thermal Treatment Facility (TTF) for the incineration of hazardous waste. The proposed development will form part of the ECOHIVE Complex and will operate in conjunction with the other waste management facilities at Magħtab.

1.1 PROJECT DESCRIPTION

The proposed facility incorporates the development of a new TTF for the incineration of hazardous waste collected in Malta. The project involves the construction of a new plant with two independent lines, with potential for a third line in the future. Currently, the existing TTF in Marsa receives 130-150 waste delivery vehicles daily and processes 5,000-6,000 tonnes of hazardous waste annually, expected to increase. The waste includes various types like clinical, pharmaceutical, sewage, and more. Establishing a new plant aligns with EU waste policy, promoting self-sufficiency and proximity in waste treatment to reduce environmental impact from waste transportation.

The site boundaries of the proposed TTF encompass an aerial extension of 18,185m². The Scheme consisted of fallow agricultural fields bounded by rubble walls to contain arable land and control soil erosion (Figure 1). At the time of writing this report, the agricultural land had been stripped of the soil cover as part of the actions under the general development plan of the ECOHIVE Complex. In fact, this area is being subject to significant developments to improve the waste management targets of the Maltese Islands.

The ECOHIVE Complex at Magħtab is experiencing further expansion of waste treatment plants. In addition to the proposed TTF, the Anaerobic Digestion Plant (ADP) is currently operational while the following plants are planned for development:

- Waste to Energy (WtE);
- Materials Recovery Facility (MRF);
- Organic Processing Plant (OPP).

This Technical Study presents a report on Water Bodies (hydrology and hydrogeology) to fulfil the Terms of Reference issued by the ERA regarding the EIA for the proposed construction of a TTF at Magħtab. Cumulative impacts related to the development of the aforementioned waste management facilities will also be considered.



FIGURE 1: PROPOSED SITE FOR THE NEW THERMAL TREATMENT FACILITY (TTF)

2 TERMS OF REFERENCE

The Terms of Reference related to the study on land cover and land uses for the EIA were issued by the ERA in June 2024. They are replicated in Appendix 1 for reference.

3 METHODOLOGY

3.1 AREA OF INFLUENCE (AoI)

The Area of Influence (AoI) for the Water Bodies Technical Study is extended to a radius of around 600m from the site to include coastal areas as indicated in Figure 2. The AoI for the hydrogeology study focuses on the downstream part of the catchment of the site or in accordance with the regional groundwater flow model.

The AoI for water bodies analysis encompasses an aerial extension of about 1.5km². A well-defined watercourse is located within the AoI (Figure 2). Run-off patterns originated from the Scheme are likely drained to Wied ta' Kieli with outlet to the coastline in Qalet Marku.

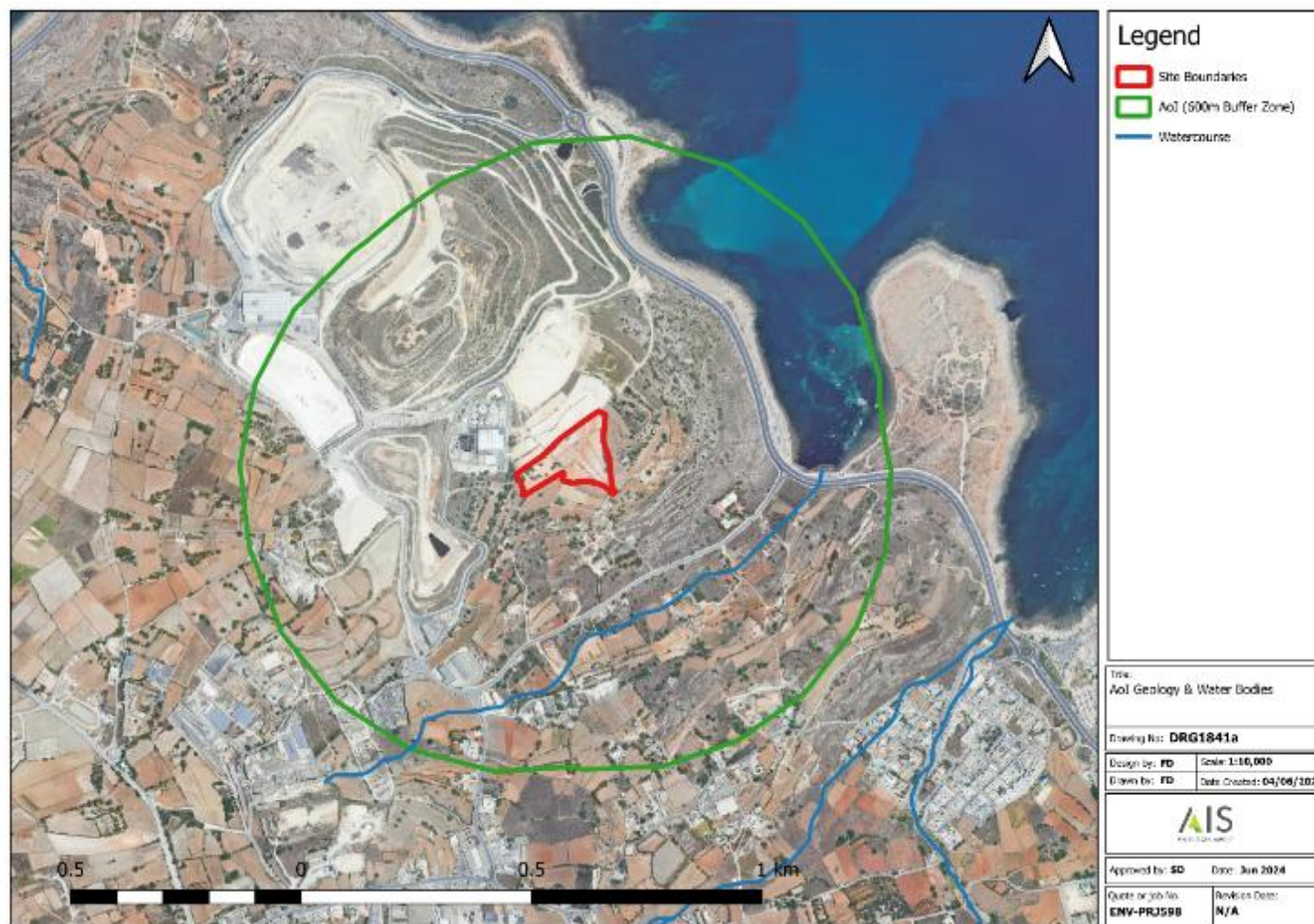


FIGURE 2: AREA OF INFLUENCE (AoI) FOR THE WATER BODIES STUDY

3.2 REGULATORY FRAMEWORK ASSESSMENT

3.2.1 The Water Framework Directive (WFD 2000/60/EC)

The EU WATER FRAMEWORK DIRECTIVE (WFD) provides a comprehensive framework for the protection and management of water resources within the European Union. The scope of the WFD is broad, encompassing inland surface waters, transitional waters, coastal waters, and groundwater. The directive promotes an integrated, holistic approach to water management, with a focus on the river basin as the fundamental unit of analysis and planning.

At the core of the WFD are the key objectives of achieving good ecological and chemical status for all water bodies by 2027, preventing the deterioration of water body status, and promoting sustainable water use based on the long-term protection of water resources. To achieve these objectives, the Directive requires EU Member States to undertake a thorough characterization of their water bodies, including the identification and delineation of surface water bodies (such as rivers, lakes, and coastal/transitional waters) and groundwater bodies.

The assessment of the current status of these water bodies, based on physical, chemical, and biological elements, is a crucial step in the WFD's implementation. The WFD also emphasizes the importance of monitoring, requiring Member States to establish comprehensive programs to assess the status of their water bodies, including both water quality and quantity parameters.

Incorporating these key elements from the EU Water Framework Directive into the regulatory framework assessment of the EIA will ensure that the protection and management of water bodies are comprehensively addressed in line with the overarching EU legislation on water resources.

3.2.2 Groundwater Quality Directive (GWD 2006/7/EC)

The GROUNDWATER QUALITY DIRECTIVE 2006/7/EC is a European Union Directive designed to protect groundwater resources across Member States. Its primary aim is to establish a framework for the monitoring, assessment, and management of groundwater quality, complementing the WFD. The Directive mandates that Member States monitor groundwater quality and assess the status of their groundwater bodies, focusing on identifying pollutants and their concentrations. It requires classification of groundwater bodies based on their chemical status, which includes evaluating the presence of specific contaminants.

Furthermore, the directive emphasizes the implementation of management measures to prevent or limit pollutant inputs into groundwater, setting thresholds for acceptable contaminant concentrations. It also highlights the importance of public information, requiring Member States to provide transparent access to data regarding groundwater quality, including monitoring results and assessments. The GROUNDWATER QUALITY DIRECTIVE serves as a vital regulatory framework aimed at ensuring the long-term sustainability and quality of groundwater resources in Europe.

3.2.3 River Basin Management Plans (RBMPs) of the Maltese Islands

In compliance with the WFD, EU Member States are required to develop River Basin Management Plans (RBMPs) that outline the measures necessary to achieve the WFD's objectives. These RBMPs must include a comprehensive characterization of the river basin, the mapping of protected areas, the establishment of monitoring programs, and the identification of programs of measures to address pressures and maintain or improve water body status.

Due to the lack of large and permanent river systems on the Maltese Islands, inland surface water systems are small and linked to the dynamics of several dry river valleys and their associated catchments. Given their small size, the Maltese Islands were integrated into one water catchment district. This water catchment district consists of all hydrological sub-catchments, coastal waters up to one nautical mile from the baseline and all groundwaters. Water bodies for surface and groundwaters were initially identified in 2005 and revised during the formulation of the 1st catchment management plan published in 2011¹.

The 2nd RBMP for the Maltese Islands² was published in 2015. This plan represents a milestone achieved by Malta for the characterization and conceptualization of the natural water systems supplying the majority of water to the Maltese industrial, agricultural, commercial and domestic sectors. Furthermore, the ecological dependence to these water bodies was assessed, and water reuse encouraged as a measure to improve the quantitative and qualitative status of country's water bodies.

More recently in 2024, the 3rd RBMP for the Maltese Islands³ was issued. Understanding the physical and chemical external forces affecting the poor qualitative and quantitative status of the majority of the Maltese water bodies, this plan focuses on the achievement of good status for all the natural water systems. In line with this objective, several measures were identified, including the implementation of Managed Aquifer Recharge (MAR) schemes to increase recharge yields of underground bodies.

3.2.4 Preliminary Flood Risk Assessment (PFRA) for the Malta River Basin District

The scope of the Preliminary Flood Risk Assessment (PFRA) for the Malta River Basin District⁴ is to provide an assessment of the potential flood risk for each River Basin District (RBD) in compliance with the EUROPEAN FLOODS DIRECTIVE (2007/60/EC), locally transposed as L.N.264 of 2010. This assessment was carried out on available or

¹ [wcmp final \(europa.eu\)](#) Accessed on 25/06/2024.

² https://era.org.mt/wp-content/uploads/2019/05/2nd_Water_Catchment_Management_Plan-Malta_Water_in_Maltese_Islands.pdf Accessed on 08/10/2024.

³ <https://era.org.mt/wp-content/uploads/2024/05/Malta-3rd-River-Basin-Management-Plan.pdf> Accessed on 25/06/2024.

⁴ [Preliminary Flood Risk assessment for the Malta River Basin District \(gov.mt\)](#) Accessed on 08/10/2024.

readily deliverable information, such as records and studies on recent and long-term developments, the impact of Climate Change on the occurrence of floods.

Areas of Potentially Significant Flood Risk (APSFR), for which the potential significant flood risk already exists or might be considered likely to occur, were identified in the Malta River Basin District. Five receptors were chosen to assess the APSFRs: human loss, human health, economic activity, cultural heritage and environment.

The assessment of the risk showed an insignificant risk when considering a flood with high probability of occurrence of rainfall depth (or 5 year return period time rainfall event). Conversely, the exposure of the affected receptors at risk increases when a higher return period time rainfall event is considered.

It was finally concluded that the risk of flooding ranges from normal to high by taking into account 50-year return period time rainfall event. The same catchment basins were analysed under the extreme event scenario of a 200-year return period time rainfall event, and a significant risk was assessed for the majority of the sub-catchments.

3.2.5 Flood Hazard Maps and Flood Risk Maps (FHRM) for the Malta River Basin District

In accordance with the EU FLOODS DIRECTIVE (2007/60/EC), each Member State is required to undertake a series of actions to assess and manage flood risks within their territory. The directive, specifically Article 15(1) with reference to Articles 6 and 14(2), mandates that Member States prepare Flood Hazard maps and Flood Risk maps (FHRM) for areas identified as being at significant flood risk through a Preliminary Flood Risk Assessment (PFRA).

For these identified areas, Member States must prepare two key types of maps:

- Flood Hazard Maps: to predict the extent, depth, and other physical characteristics of potential flood events;
- Flood Risk Maps: to assess the potential adverse consequences of flooding, such as the impact on human health, the environment, cultural heritage, and economic activity.

Importantly, the flood hazard and risk maps must be based on the existing physical conditions in the identified flood risk areas and must also take into consideration the potential impacts of climate change on future flood patterns and severity. This ensures that the flood management plans developed by Member States are informed by the best available data and projections, helping to build resilience against the evolving threat of flooding.

The flood hazard and risk maps serve several key purposes. Firstly, they provide the foundation for the development of comprehensive flood risk management plans by Member States. Secondly, they help to raise public awareness of flood risks, enabling citizens and businesses to better prepare for and respond to potential flood events. Thirdly, the maps support decision-makers in identifying appropriate flood risk

mitigation and adaptation measures, such as the implementation of structural flood defences or land-use planning policies.

3.3 WATER CATCHMENT BASIN ANALYSIS

All precipitation falling on land is collected and drained into a common outlet, such as a watercourse or coastline. This area is characterized by the intermittent flow of surface water converging towards a single point, allowing for the assessment of hydrological processes within that region. A water catchment basin, also known as a drainage basin or catchment area, is defined as an area of land where all precipitation collects and drains into a single outlet, such as a river, lake, or ocean. This area is delineated by topographical features, such as hills or ridges, which direct the flow of surface water towards the outlet. The boundary between adjacent catchment basins is referred to as a drainage divide or watershed.

According to the Preliminary Flood Risk Assessment (PFRA), Malta consists of 76 hydrological surface sub-catchments. Due to its small size (1.4km²), the catchment area of Wied ta' Kieli encompassing the Scheme was not considered for the PFRA.

In order to assess potential impacts arising from ground impermeabilization induced by the proposed TTF, the Soil Conservation Service Curve-Number (SCS-CN) methodology is applied to analyse the hydrologic response of the catchment and estimate the additional stormwater runoff rate from various rainfall events. The SCS-CN method assumes a rainfall amount uniformly spread on the catchment over a specified time distribution. The total rainfall is converted to runoff by using the following formula:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

where Q is the runoff flow rate, P is the total rainfall, I_a is the initial abstraction that includes all the losses before runoff begins, such as water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration, S is the potential maximum retention after runoff begins. The initial abstraction is linked to the potential maximum retention S by the formula:

$$I_a = 0.2 S$$

and S, in turn, depends on the soil and cover conditions of the catchment through the runoff Curve Number (CN), a synthetic parameter which expresses the aptitude of a surface to develop a direct runoff from a precipitation event:

$$S = \frac{25400}{CN} - 254$$

The CN value has a range from 0 to 100. Under the same rainfall event, the greater the CN value is, the less permeable the surface is and the greater the runoff is.

Rainfall depths typical of the Maltese climate have been assessed by the Energy and Water Agency (EWA) through the FHRM, depending on the selected return period time of the precipitation event, namely the estimation of the likelihood of rainfall events to occur. Therefore, the design storms for the catchments have been selected following the development of Depth Duration Frequency (DDF) curves for return times of 5, 50 and 200 years based on the rainfall observations carried out by the Malta Airport MetOffice during the period between 2008 and 2018. Based on the time of concentration of each basin, that sets the duration of the design rainfall events, the rainfall intensities and, in turn, the rainfall depths have been calculated in order to determine the design hyetographs and consequently the flood hydrographs and peak flow discharges for the selected catchments.

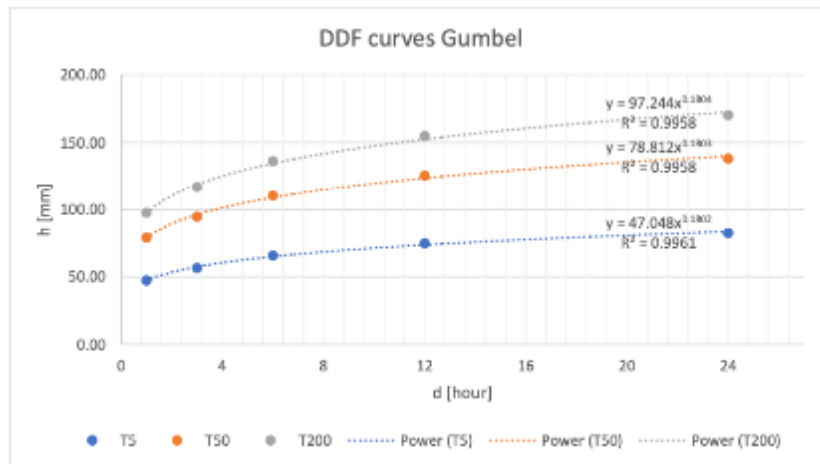


FIGURE 3: DEPTH DURATION FREQUENCY (DDF) CURVES FOR THE MALTA RIVER BASIN DISTRICT (SOURCE: FHRM)

Where x in the equations in Figure 3 is the time of concentration, which is a measure of the response of a water catchment to a rain event. It is defined as the time needed for water to flow from the most remote point in a watershed to the drainage outlet.

In order to calculate the time of concentration of a water catchment basin, the Viparelli formula shall be used. This formula reads as follows:

$$t_c = \frac{L}{3.6 V}$$

Where t_c is in hours, L is the length of the main watercourse in km and V is the mean flow channel velocity, with suggested values ranging between 1.0 and 1.5 m/s.

For those catchments where the time of concentration is lower than 1 hour, the Bell formula shall be used to compute the design rainfall depth. The Bell formula reads as follows:

$$h_{t,T} = h_{60,T}(0.54 t^{0.25} - 0.50)$$

where $h_{60,T}$ is the rainfall depth of duration of 1 hour obtained through the DDF curves (Figure 3) for a T-year return period time, and t is the time of concentration of the catchment.

3.4 IMPACT ASSESSMENT

The Expert evaluated the potential impacts arising from the construction and operation of the proposed Scheme on water bodies. The potential impacts also provided a basis for comparison between the existing conditions and the new conditions established during the operation of the Scheme.

The following information, where available, has been provided for each of the identified impacts:

- Project phase (construction or operational phase)
- Policy importance
- Extent of effect (local, national or international)
- Duration (temporary or permanent)
- Type (beneficial or adverse)
- Reversibility (reversible or irreversible)
- Sensitivity of receptors (high, medium or low)
- Probability of occurrence (certain, likely, uncertain, unlikely or remote)
- Scope for mitigation or enhancement (very good, good or none)

Based on the above criteria, the significance level of each of the identified impacts was assessed. Different criteria were used for the different components of the study, as summarised in Table 1 to Table 9.

TABLE 1: DURATION OF IMPACT CRITERION DESCRIPTION

DURATION OF IMPACT

Permanent	Impact would still be detectable following decommissioning of project
Temporary	Impact would persist throughout the phase of project under consideration only

TABLE 2: EXTENT OF IMPACT CRITERION DESCRIPTION

EXTENT OF IMPACT

Widespread	Impact is expected to affect in the entire area of study and/or may extend beyond the boundaries of direct intervention into adjacent areas
Localised	Impact is expected to affect receptors in the immediate vicinity of its source

TABLE 3: CONSEQUENCES OF IMPACT CRITERION DESCRIPTION

CONSEQUENCES OF IMPACT

Direct	Changes that result from the cause-effect consequences of interactions between the environment and project activities
Indirect	Changes that result from cause-effect consequences of interactions between the environment and direct impacts
Cumulative	The cumulative consequences of environmental impact refer to the gradual and long-term effects that result from the combined impact of various disturbances or stressors on an ecosystem over time.

TABLE 4: EFFECT OF IMPACT CRITERION DESCRIPTION

EFFECT OF IMPACT

Adverse	A negative effect on the sustainability of the resource under consideration, which are distinguishable from background fluctuations
Beneficial	A positive effect on the sustainability of the resource under consideration, which are distinguishable from background fluctuations

TABLE 5: REVERSIBILITY OF IMPACT CRITERION DESCRIPTION

REVERSIBILITY OF IMPACT

Reversible	The state of the resource is expected to return to baseline state following cessation of the source of impact
Irreversible	The state of the resource is not expected to return to baseline state following cessation of the source of impact

TABLE 6: SENSITIVITY OF RESOURCES TO IMPACT CRITERION DESCRIPTION

SENSITIVITY AND RESILIENCE OF RESOURCES TO IMPACT

High	The resource under consideration is highly susceptible to a detectable deviation from the background state and its general dynamics
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SENSITIVITY AND RESILIENCE OF RESOURCES TO IMPACT

Moderate	The resource under consideration is vulnerable but able to tolerate a degree of detectable deviation from the background state and its general dynamics
Low	The resource under consideration is highly tolerant to a detectable deviation from the background state and its general dynamics

TABLE 7: PROBABILITY OF IMPACT OCCURRING CRITERION DESCRIPTION

PROBABILITY OF IMPACT OCCURRING

Inevitable	Impact will occur irrespective of any mitigation measures taken
Likely	Impact may occur despite the implementation of mitigation measures
Unlikely	Impact would only occur in cases of major mitigation failure
Remote	Impact would only occur in exceptional circumstances
Uncertain	Probability of impact cannot be predicted reliably due to missing information or unknown factors

TABLE 8: IMPACT SIGNIFICANCE CRITERION DESCRIPTION

IMPACT SIGNIFICANCE

Major	The effect on the existing state of the feature under consideration will lead to a high or large-scale change in its resilience
Moderate	The effect of the existing state of the feature under consideration will lead to an observable but contextually restricted change, which is sufficiently important for its long-term resilience
Minor	The effect on the existing state of the feature under consideration will lead to no, low or small-scale change that will not alter its resilience

TABLE 9: RESIDUAL IMPACT SIGNIFICANCE CRITERION DESCRIPTION

RESIDUAL IMPACT SIGNIFICANCE

Major	The effect on the existing state of the feature under consideration will lead to a high or large-scale change in its resilience after application of mitigation measures (if any) and impact cessation
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RESIDUAL IMPACT SIGNIFICANCE

Moderate	The effect of the existing state of the feature under consideration will lead to an observable but contextually restricted change, which is sufficiently important for its long-term resilience after application of mitigation measures (if any) and impact cessation
Minor	The effect on the existing state of the feature under consideration will lead to low or small-scale change that will not alter its resilience after application of mitigation measures (if any) and impact cessation
Negligible	The effect on the existing state of the feature under consideration will lead to no significant change that will alter its resilience after application of mitigation measures (if any) and impact cessation

4 BASELINE STUDY

4.1 SITE DESCRIPTION

The Scheme is entirely encompassed by the water catchment basin of Wied ta' Kieli (Figure 4). Another watercourse is present within the AoI at the North of the site, namely Wied tal-Ghallis. Due to their limited aerial extent, neither of these catchment basins was included in the Preliminary Flood Risk Assessment (PFRA) or the Flood Hazard Maps and Flood Risk Management (FHRM) for the Malta River Basin District.

The topography of the site gently dips toward the Wied ta' Kieli watercourse, with an altitude ranging between 30 and 37m above mean sea level (amsl). The highest elevations in the AoI, located to the West of the site, reach approximately 60 m amsl. This elevated terrain creates a drainage divide between two adjacent water catchment basins. Runoff is collected and directed through preferential stream paths or channels, ultimately converging toward watercourses situated in the valleys with outlet to the sea. This topography is characteristic of the horst and graben structures that define the Northern region of Malta.

Rainfall precipitated on the hills or from the Scheme partly infiltrates underground, evaporates and another percentage generates runoff. Heavy rainfall is likely to generate intermittent surface water bodies in Wied ta' Kieli, outflowing to Qalet Marku. Although specific historical data on flooding events in Wied ta' Kieli may not be extensively documented, the region's topography and hydrological conditions contribute to runoff that can lead to flash floods. The combination of steep slopes and urban development in the surrounding areas exacerbates the risk of flooding, as water is quickly funnelled into the watercourse. Moreover, the impact of climate change in the Central Mediterranean region is expected to give rise to an increased prevalence of high intensity rain events in short timeframes, exacerbating the risk of flood events. Climate change and urbanization highlight the vulnerability of this area to such natural phenomena.

The outlet of Wied ta' Kieli corresponds to Qalet Marku where surface water is drained into the Mediterranean Sea. The coastal area features flat limestone outcrops typical of the Eastern area of Malta. Qalet Marku is identified as a coastal unit limited by two cliffs at North and South. The intermittent surface water bodies generated during high precipitation events outflow into this coastal unit. In between these two outlets, a number of channels drain run-off throughout the coastline.

No natural freshwater resources are identified within the AoI. In fact, the groundwater qualitative status of freshwater-lens systems in areas near the coastline in Malta are highly saline due to seawater intrusion mechanisms and therefore not suitable for human or agricultural consumption. The only known source of groundwater is a public borehole located about 500m upstream from the site. The runoff or infiltration patterns generated from the site are unlikely to affect this borehole.

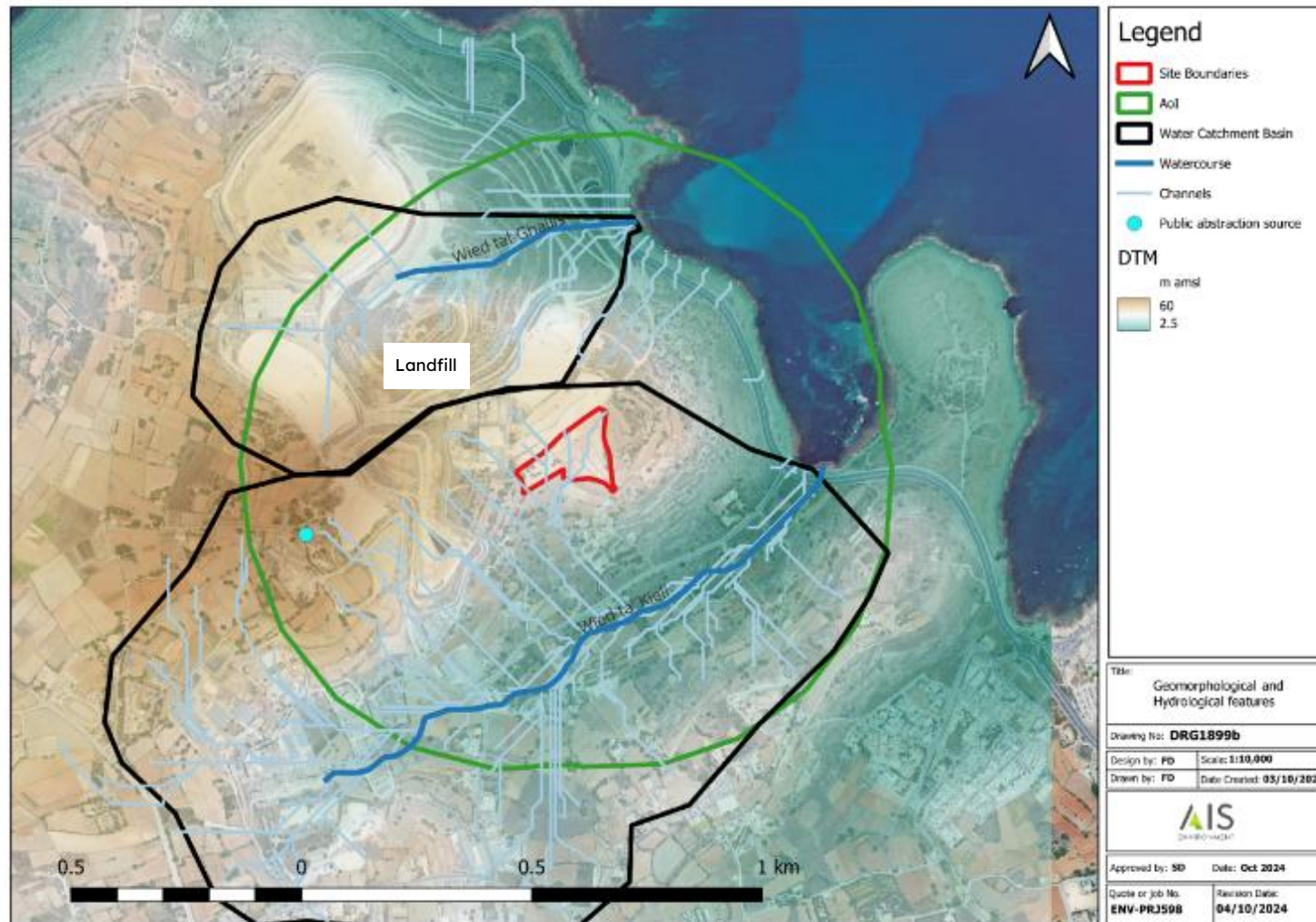


FIGURE 4: GEOMORPHOLOGICAL AND HYDROLOGICAL MAP

4.1.1 Hydrogeological conditions

Contaminants potentially infiltrated through the site are likely to percolate through the unsaturated zone and then follow the advective component of the groundwater flow. Groundwater in Malta flows through an interconnected pattern of fissures, fractures and voids altering the compact rock matrix of the carbonate aquifer.

The main geological formation bearing freshwater on the Maltese Island is the Lower Coralline Limestone (LCL). The LCL is a fissured and fractured formation with a porous matrix. In the LCL the main groundwater body is in equilibrium with brackish and seawater. If compared to the overlying Globigerina Limestone (GL) formation, LCL is more fissured and entails higher heterogeneity due to a different deposition environment.

The only hydrogeological feature underlying the Scheme is the Malta Mean Sea Level Aquifer (MSLA). The MSLA is the main water body bearing freshwater on the island, relying on winter rainfall events to recharge its underground storage. This groundwater body functions as a freshwater-lens system, floating on higher salinity water both marginally and at depth, while its upper surface level is graded to the sea along the coast.

A numerical model of the MSLA groundwater flow⁵ was developed through the LIFE16 IPE/MT/000008 project. Figure 5 indicates that the groundwater level heights around the Scheme are likely to range from 0.10 to 0.20m amsl. The hydraulic gradient generated by this difference in elevation forces groundwater to flow Northwest, opposing the surface water flow directed towards Wied Ta' Kieli. Due to its proximity to the coastline (approximately 500m), the qualitative status of the groundwater underlying the Scheme is likely to be brackish or salty. In fact, no groundwater abstraction sources are located downstream of the Scheme.

In accordance with the 3rd RIVER BASIN MANAGEMENT PLAN (RBMP) of the Maltese Islands, the Malta MSLA is characterized by poor quantitative and qualitative status. Nitrate and chloride pollution is sourced from excess use of fertilisers and nitrate, while over-pumping triggers groundwater height depletion and saltwater intrusion mechanisms. In order to achieve good status, mitigation measures are identified in the RBMPs. These measures include:

- Wastewater reuse in agriculture: wastewater treatment plants are designed to produce highly polished wastewater through Advanced Oxidation (AOPs) and Reverse Osmosis (RO) processes. The highly treated outflow, locally called New Water, can be reused in agriculture while taking over part of the groundwater demand.
- Managed Aquifer Recharge (MAR) techniques: freshwater can be injected underground to create a hydraulic barrier into aquifers which raises groundwater levels near the coast. New Water will be injected into the Pwales

⁵ Lotti et al., 2021, doi: [10.1007/s10040-021-02330-2](https://doi.org/10.1007/s10040-021-02330-2) Accessed on 11/10/2024

Valley aquifer system with the objective of flushing out nitrate pollution and creating a seawater intrusion barrier.

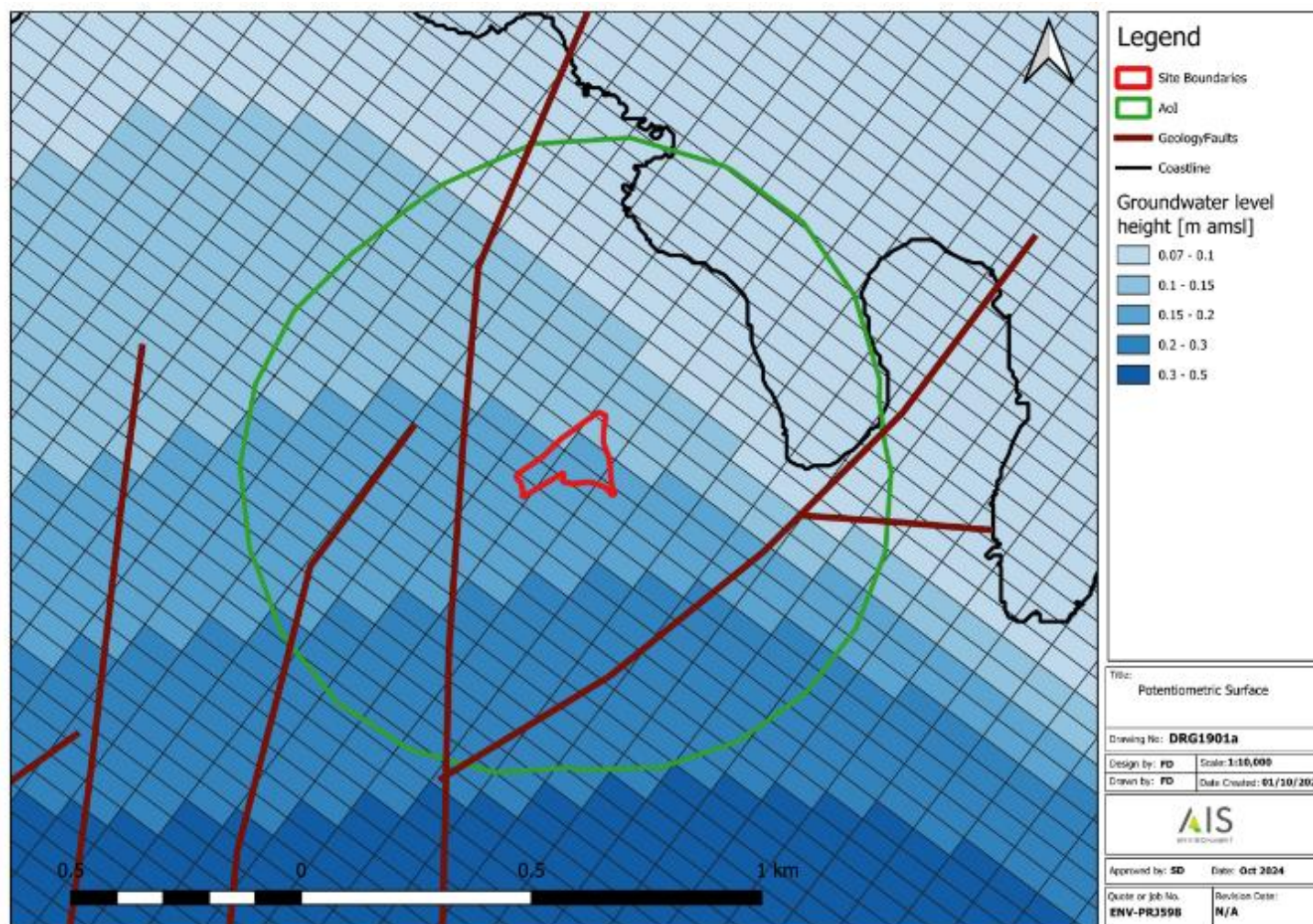


FIGURE 5: MEAN SEA LEVEL AQUIFER (MSLA) HYDRAULIC HEADS MAP

4.1.2 Protected Water Bodies within the Aol

Due to the topographical nature of drainage basins, valleys act as catchments for both water and sediment, generating nutrient-rich soils suitable for agriculture. The outlets of catchment basins are likely to give rise to wetlands rich in biomatter, contributing to the biodiversity of indigenous and endemic species.

At the discharge point of Wied ta' Kieli in Qalet Marku, there is a rectangular field which from the particularly profuse vegetation that covers this plot of land, it appears to form a transitional water body for some time during the rainy season. This intermittent wetland is locally called L-Ghadira s-Safra (Figure 6).

L-Ghadira s-Safra is a unique transitional coastal wetland supporting numerous rare organisms. It is particularly interesting since although primarily a saltmarsh it also supports animals normally found in freshwater. It is located between Qalet Marku and Ghallis in Naxxar within a gently sloping rocky shore composed of Lower Coralline Limestone outcrops. It supports floral and faunal assemblages that are typical of freshwater habitats during the wet season. It is one of only two localities for the locally endangered prickly grass (*Crypsis aculeata*), and the only known locality for the rare and endangered liverwort (*Riella helicophylla*). The ponds represent small artificial circular catchments that fill with run-off water directed from an unsurfaced country road that also catches the runoff coming from the eastern slopes of the landfill (Figure 6).

ERA scheduled L-Ghadira s-Safra as a *Level 1 Area of Ecological Importance* and *Level 1 Site of Scientific Importance* with an associated *Level 3 buffer zone* as per Government Notice No. 288/95 in the Government Gazette dated May 5, 1995.



FIGURE 6: PHOTOGRAPHS SHOWING PART OF THE WETLAND ALONG TRIQ IL-KOSTA AT THE DISCHARGE OF THE WATERCOURSE

4.2 SURFACE VULNERABILITY FEATURES

In order to identify the features that represent a threat to the sustainability of the water bodies described in the previous chapters, the degree to which Wied Ta' Kieli surface water body is connected to the Mean Sea Level Aquifer (MSLA) systems need to be considered.

Rainfall in a water catchment basin plays a crucial role in determining the hydrological dynamics of the area, including patterns of contaminants associated to the spillage on the ground of hazardous substances. Rainfall events can vary widely in intensity and duration. High-intensity, short-duration storms typical of summer seasons may lead to rapid surface runoff, while the low-intensity and prolonged rainfall events occurring during winter can enhance infiltration into the soil.

When rain falls on a catchment area, a portion infiltrates the soil, depending on factors such as soil type, moisture content, and vegetation cover, reaching the groundwater body. Excess rainfall that cannot infiltrate or evaporate contributes to surface runoff. This runoff flows over the land surface, collecting in streams and watercourses that eventually discharge into the sea. The speed of this runoff is influenced by topography; steep slopes tend to facilitate quicker movement toward water bodies. The hydraulic gradient created by elevation differences of water in different sections drives water toward lower areas, including coastal outlets.

The ability of rainfall to infiltrate into the ground is largely determined by soil characteristics. Conversely, impermeable surfaces, such as urban areas with concrete, lead to increased runoff and reduced infiltration. Infiltrated water contributes to groundwater recharge. This process provides a source of freshwater for human use. The presence of impermeable surfaces increases runoff volumes during rainfall events, reducing the amount of water that can infiltrate into the ground. This can lead to higher flood risks and negatively impact water quality as pollutants are washed into nearby water bodies.

In compliance with the WFD and GWD, each EU Member State is required to achieve and maintain a “good” qualitative status of groundwater bodies. However, the qualitative status of the MSLA is established to be affected by a poor status as assessed through the 3rd RBMP of the Maltese Islands. Contaminated runoff patterns flowing on the surface can find a quick way down to the underground through surface vulnerability features.

The vulnerability features identified within the AoI which represent a high connection from the surface to the groundwater body are shown in Figure 7 and listed below:

- Geological faults: can create pathways for water and contaminants to move rapidly from the surface into the groundwater. Faults disrupt the natural layers of soil and rock, allowing for increased permeability and direct connections between surface water and groundwater. This means that any pollutants on the surface can quickly infiltrate through these faults, posing a risk to groundwater quality.

- Lower Coralline Limestone (LCL) outcrops: due to its diagenetic conditions, the LCL formation results more fissured and fractured than the Globigerina Limestone (GL). When water flows, it can easily infiltrate through the LCL outcrops making this geological formation particularly vulnerable, as contaminants from surface runoff can easily percolate through these limestone formations into the groundwater.
- Tributaries to Wied Ta' Kieli originated with the scheme: channels that flow into watercourses like Wied ta' Kieli can serve as conduits for surface water to enter the groundwater system. If these tributaries are connected to areas where contaminants may be originated, there is a heightened risk of those contaminants reaching the groundwater with extended travel time.

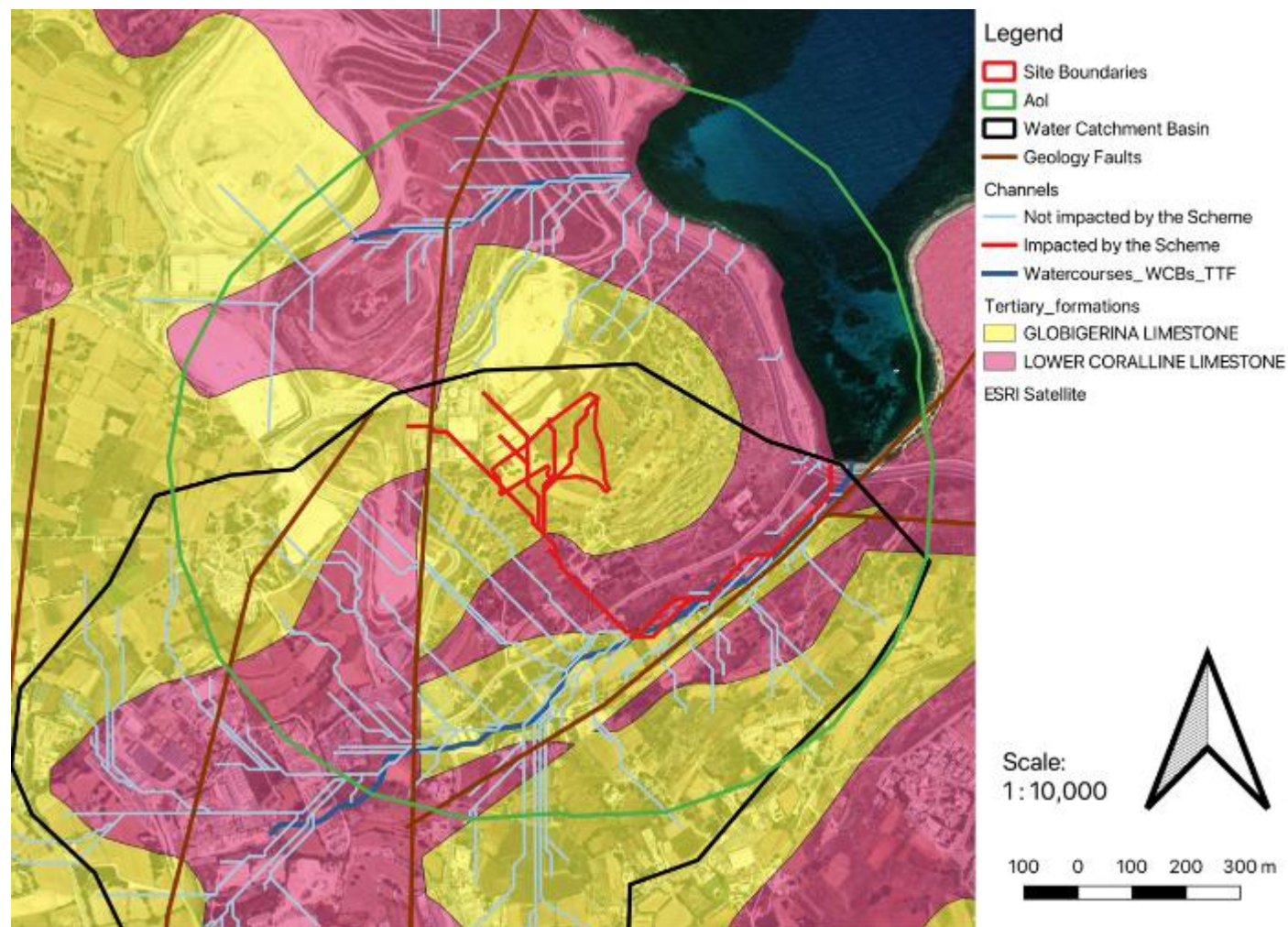


FIGURE 7: VULNERABILITY MAP OF THE PROPOSED TTF. RUNOFF PATTERNS IMPACTED BY THE SCHEME ARE HIGHLIGHTED IN RED

4.3 RUNOFF RATE ASSESSMENT

The water catchment basin of Wied Ta' Kieli encompasses a total area of about 1.4km². This catchment is characterized by a topographic gradient from Southwest to Northeast, while the watercourse (1.7km long) tilts in the same direction. The time of concentration of the basin is about 23 minutes. Currently, most of the catchment is rural (71%) while the 21% of the area is built-up. The remaining 8% is occupied by the landfill. This configuration corresponds to a CN value of 78. The cumulative impact of the development of the ECOHIVE Complex, including the proposed TTF will be analysed in the impact assessment chapter and is accounted for 5% of rural area.

In order to calculate the current runoff rate at the discharging outlet of Wied Ta' Kieli in Qalet Marku, the SCS-CN methodology described in chapter 3.3 was applied. Table 10 reports the flood discharge values at the outflow of the basin for return time periods of 5 years (high probability of occurrence), 50 years (medium probability) and 200 years (low probability). The return period value for a specific flood event is indicative given that flood events do not occur at fixed timeframes.

TABLE 10: DISCHARGING RATES OF WIED TA' KIELI CATCHMENT FOR DIFFERENT PROBABILITIES OF OCCURRENCE

Q(T = 5 YEARS)	Q(T = 50 YEARS)	Q(T = 200 YEARS)
3.45 m ³ /s	13.82 m ³ /s	21.62 m ³ /s

5 IMPACT ASSESSMENT

5.1 CONSTRUCTION PHASE

The potential impacts arising from the construction of the proposed facility on water bodies can be listed as follows:

- Paving of the site will render it impermeable. This activity is accompanied by generation of runoff and loss of recharge to the Mean Sea Level Aquifer (MSLA).
- Pesticides and fertilisers may be applied for maintenance of landscaped areas. Such activities may have a negative impact on the MSLA during operation of the site.
- Contamination of the Malta Mean Sea Level Aquifer (MSLA) via percolation of contaminants through surface vulnerability features is likely to be minor because of the brackish nature of the freshwater-lens system in this area and the lack of downstream groundwater abstraction sources.
- Spreading of contamination through Wied ta' Kieli and its tributaries originated with the Scheme (red channels in Figure 7) is likely to be moderate adverse due to the relatively high residence time of the surface water flow.
- If pollutants reach L-Għadira s-Safra and the coastal area at Qalet Marku, degradation of these coastal water bodies are likely to occur. Moderate adverse impacts are forecasted on the receptors if precautionary measures to minimize the risk of pollution are not undertaken.

5.2 OPERATIONAL PHASE

The operation of the proposed Thermal Treatment Facility (TTF) presents several potential environmental and safety concerns that require thorough examination and mitigation strategies. These impacts range from moderate to major in severity and encompass various environmental aspects.

Due to the water scarcity conditions typical of Mediterranean countries, the proposed TTF was designed with the twofold objective of reducing environmental impacts and minimizing water demand required for the operation of the plant. In particular, the implementation of alternative water resource techniques has been sought to supply the facility with water streams that supplement the public distribution system. While wastewater reuse will be encouraged, rainwater harvesting techniques will be implemented to collect rainfall during the wet season and reuse it when required.

An overview of the water balance at the proposed TTF is provided in Table 11.

TABLE 11: WATER BALANCE OVERVIEW

WATER BALANCE OVERVIEW	RAINWATER INCLUDED		WITHOUT RAINWATER
	ANNUUM FLOW RATE [M ³ /YEAR]	DAILY FLOW RATE [M ³ /DAY]	DAILY FLOW RATE [M ³ /DAY]
Total need for potable water	2,333	6	18
Total water recovery	10,086	27.6	15.8
Total reject produced	1,670	4.6	3.8

Potential impacts arising from the operation of the proposed TTF are listed below:

- Spillage of hazardous liquids represents a moderate adverse impact on the MSLA and nearby coastal water bodies. This impact arises from the handling and storage of various chemicals and substances including hazardous waste. Potential scenarios include accidental releases during transfer operations, leaks from storage tanks or pipelines, and overflow incidents due to equipment malfunction.
- Major accidents could generate major impacts on sensitive receptors in the surrounding area. These accidents might include large-scale fires or explosions, significant chemical releases, and structural failures leading to widespread contamination.
- Pesticides and fertilisers are likely used in landscaped areas for pest control, aesthetic maintenance, and vegetation management. Excessive use of pesticides and fertilisers poses a moderate adverse impact due to the potential release of such contaminants into the environment. This impact may extend beyond the landscaped area at the TTF and target watercourses, groundwater, and wildlife.
- The impermeabilization of rocky outcrops reduces the area available for natural water infiltration, potentially exacerbating existing groundwater depletion issues. In coastal areas, this can lead to saltwater intrusion into freshwater aquifers, compromising water quality and availability for both human use and ecosystem functioning. This impact is likely to be major adverse.
- The cumulative impact on additional runoff volumes generated through land impermeabilization of the ECOHIVE Complex is a critical aspect that is addressed in detail in the subsequent chapter. This impact is linked to the overall design and footprint of the facility as part as the thorough development at Maghtab, affecting hydrological patterns and potential flood risks in the surrounding area.

As part of the air dispersion model carried out in this EIA, a 6-week air quality monitoring campaign was undertaken with the objective of identifying the average daily concentrations of PM₁₀ and NO₂. This study revealed that the forecasted annualization factors of 0.85 and 0.96, for PM₁₀ and NO₂ respectively achieved a Corrected Annual Average (CAA) significantly lower than the Annual Limit Value (ALV). Moreover, the development of the deposition fallout model at a stack height of 25m shows that there are no significant variations in the impacts on air quality. The only receptor worth mentioning corresponds to an agricultural land (35°56'22.21"N, 14°26'45.34"E) located 0.43km away from the chimney stack. However, the forecasted impact is minor adverse.

5.3 CUMULATIVE IMPACT

As previously mentioned, 5% of the total area of Wied Ta' Kieli water catchment basin will be converted from agricultural to industrial area following the full development of the ECOHIVE Complex, which includes the proposed TTF. Although rainwater will be harvested and reused to the extent possible, the capacity of the storage tanks and water treatment facilities may be exceeded during intense storm events, and hence, discharged into the environment. In this chapter, the impact of flooding is assessed by considering the worst-case scenario where no rainfall is harvested.

The cumulative impact of increased runoff volumes induced by the impermeabilization of land was assessed as part of this study and compared to current flood discharge values. This land use scenario at the catchment level leads to an increase in the CN value from 78 to 82. According to Table 12, the full development of the ECOHIVE Complex is likely generate more than 2 m³/s at the outlet of the catchment basin for rainfall events of high probability of occurrence. Increased runoff rates decrease with less likely probabilities of rainfall depths occurrence.

Therefore, the resulting impact of land impermeabilization on runoff flow rates is likely to be moderate adverse generating flash floods.

TABLE 12: COMPARATIVE ANALYSIS OF RUNOFF RATES BETWEEN CURRENT AND FUTURE DEVELOPMENT SCENARIOS

	Q(T = 5 YEARS)	Q(T = 50 YEARS)	Q(T = 200 YEARS)
No development or current scenario	3.45 m ³ /s	13.82 m ³ /s	21.62 m ³ /s
Full development of the ECOHIVE Complex	5.63 m ³ /s	18.25 m ³ /s	27.17 m ³ /s
Percentage of increase	63%	32%	26%

6 MITIGATION MEASURES

6.1 CONSTRUCTION PHASE

The LEGAL NOTICE 340 OF 2022 - CONSTRUCTION MANAGEMENT SITE REGULATIONS, 2022 should be enforced to avoid the aforementioned impacts from being generated in the first place and to ensure that environmental degradation is kept as low as possible. These regulations provide details on the containment and transportation measures for loose construction material on site and in transit, and other measures to prevent carrying out and/or depositing particulate matter.

Some of the proposed mitigation measures related to construction best practices are highlighted below:

- Silt Traps: Utilize silt traps and sediment control measures to prevent soil erosion and manage runoff effectively.
- Hazardous substances storage area: Store hazardous materials and liquids (paints, solvents, sealants, oils, etc.) in designated areas equipped with secondary containment measures, such as spill containment pallets.

6.2 OPERATIONAL PHASE

To mitigate impacts on Water Bodies during the operation of the proposed TTF, several operational measures can be implemented. These include:

- Leak monitoring and containment: Monitoring of potential leaks through pipelines and set impermeable storage areas for waste.
- Spill prevention and control: The facility design prevents spillage from entering the ground. Storage tank leaks are contained within the tank farm, avoiding contamination of rocks or soil. Overflows are also directed to the tank farm. Additionally, spill kits facilitate immediate response to hazardous liquid spills, while hazardous substance storage areas ensure safe containment of materials, and bunding systems effectively contain leaks.
- Controlled pesticides and fertilisers application: Use of pesticides and fertilisers at required concentrations and frequency.
- Rainwater harvesting: Rainwater is collected from surfaces and stored in tanks. The harvested rainwater will be utilized for industrial purposes.
- Wastewater reuse: process wastewater will be collected in drain pit and leachate pit to be treated and reused.
- Surface waterproofing: the protection of the underground structure against water from the ground and all workmanship required for waterproofing works shall be in accordance with their relevant EN standards. Where required, further waterproofing system shall consist of a flexible adhesive water and vapor proof single-ply polymeric membrane, suitable for use for sub-structures in hot climates.
- Hazardous substances storage area: use of bunding systems for tanks.

In accordance with Table 12, the cumulative impact induced by the progressive land impermeabilization of the ECOHIVE Complex may generate moderate flooding impacts especially when current precipitation depths are compared to the impacts of Climate Change. Climate Change impacts are foreseen to generate more intense precipitation during lower rainfall events than the values currently available. In order to reduce the risk of flooding, mitigation measures have been sought but were found to be unfeasible for the study area. Stormwater retention basins are normally considered; however, the lack of soil availability to host such structures downstream of the Scheme impedes their correct functioning. On the other hand, injecting treated water from industrial drains or runoff underground, particularly near a hazardous waste treatment facility, may result in residual hazardous substances remaining. Any offset in the water treatment process, or any delayed detection of contaminants, could result in irreversible contamination of the groundwater qualitative status.

7 RESIDUAL IMPACTS

Residual impacts are the effects that are expected to persist after the implementation of the proposed mitigation measures. Despite the comprehensive adoption of these strategies, several unavoidable residual impacts are anticipated during both construction and operational phase of the project.

During the construction phase, the primary residual impact of concern is the potential for runoff contamination due to the storage of hazardous substances. Even with proper storage protocols and containment measures in place, the risk of accidental releases or leaks is unlikely to be entirely eliminated, potentially affecting local water quality and ecosystems. The integrity of impermeable storage areas containing hazardous materials (paints, solvents, sealants, and oils) must be regularly checked for spills.

During the operational phase, spillages resulting from the handling and storage of chemicals and hazardous waste remain a persistent risk. While stringent safety procedures and containment systems significantly reduce the likelihood of such incidents, the potential for human error or equipment failure means that small-scale spills or leaks may still occur occasionally. The risk of major accidents, though greatly minimized through safety measures, cannot be completely discounted. These could include large-scale fires or explosions, significant chemical releases, or structural failures. While the probability of such events is low, their potential consequences necessitate ongoing risk management and emergency preparedness.

With reference to Table 12, the cumulative impact of flooding resulting from the land impermeabilization at the ECOHIVE Complex shall not be overlooked. Flooding events may pose a significant threat to the infrastructure located downstream to the site once the designed waste treatment facilities will be constructed.

These residual impacts underscore the importance of maintaining rigorous safety protocols, regular monitoring, and adaptive management strategies throughout the project's lifespan to ensure environmental protection and operational safety.

8 MONITORING PROGRAMME

The following monitoring programme is designed to ensure the effective oversight of water bodies potentially impacted by the construction and operation of the new TTF.

Construction Phase:

- Fluid quantity monitoring:
 - » Recording of all fluids imported to the site;
 - » Reconciliation of fluid volumes against storage capacity;
 - » Immediate reporting of any discrepancies or near-overflow situations.

Operational phase:

- Fluid management:
 - » Automated monitoring of fluid levels in all storage tanks;
 - » Real-time alerts for abnormal fluid level changes;
 - » Audits of fluid input-output balance.
- Pipeline and storage pits integrity:
 - » Continuous monitoring via pressure sensors and flow meters;
 - » Comprehensive pipeline integrity assessments;
 - » Immediate shutdown and investigation protocols for detected anomalies.
- Groundwater quality:
 - » Sampling and analysis of groundwater from monitoring wells around the facility in line with current practices at already established points;
- Trend analysis of groundwater data with the aim of identifying potential upwards and/or downwards trends of groundwater parameters.
- Surface runoff:
 - » Inspection of drainage systems and sediment traps.

This monitoring programme should be regularly reviewed and updated based on operational experience and any changes in regulatory requirements. All monitoring activities shall be documented, and reports shall be submitted to relevant authorities as required.

9 SPECIMEN IMPACT TABLE

IMPACT TYPE AND SOURCE			IMPACT RECEPTOR		EFFECT AND SCALE							PROBABILITY OF IMPACT OCCURRING (INEVITABLE/ LIKELY/ UNLIKELY/ REMOTE/ UNCERTAIN)	OVERALL IMPACT SIGNIFICANCE	PROPOSED MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE	OTHER REQUIREMENTS
IMPACT TYPE	SPECIFIC INTERVENTION LEADING TO IMPACT	PROJECT PHASE	RECEPTOR TYPE	SENSITIVITY & RESILIENCE TOWARDS IMPACT	DIRECT/ INDIRECT/ CUMULATIVE	BENEFICIAL/ ADVERSE	SEVERITY	PHYSICAL/ GEOGRAPHIC EXTENT OF IMPACT	SHORT/ MEDIUM/ LONG TERM	TEMPORARY/ PERMANENT	REVERSIBLE/ IRREVERSIBLE					
Contamination of Malta Mean Sea Level Aquifer (MSLA)	Percolation of contaminants through surface vulnerability features	Construction	Ground water body	Low	Direct	Adverse	Moderate	Localised	Short	Temporary	Reversible	Likely	Minor	Installation of silt traps	Negligible	-
Runoff contamination	Storage of hazardous substances	Construction	Wied ta' Kieli watercourse	Moderate	Direct	Adverse	Moderate	Downstream catchment of the site	Medium	Temporary	Reversible	Uncertain	Moderate	Hazardous substance storage area, bunding systems.	Minor	An emergency plan in case of spillage should be followed
Contamination of coastal water bodies	Spillage of hazardous fluids	Construction	Qalet Marku and L-Ghadira s-Safra	Low	Direct	Adverse	Moderate	Coastal waters	Short	Temporary	Reversible	Remote	Moderate	Monitor quantities of fluids imported onsite to prevent overflow	Negligible	-
Spillages	Handling and storage of chemicals and hazardous waste	Operation	Water Bodies	Moderate	Direct	Adverse	High	Localised	Short	Temporary	Reversible	Unlikely	Moderate	The facility is designed to prevent spillage from entering the ground. Monitor potential leaks through pipelines and storage areas	Minor	Monitor the qualitative status of water bodies

IMPACT TYPE AND SOURCE			IMPACT RECEPTOR		EFFECT AND SCALE							PROBABILITY OF IMPACT OCCURRING (INEVITABLE/ LIKELY/ UNLIKELY/ REMOTE/ UNCERTAIN)	OVERALL IMPACT SIGNIFICANCE	PROPOSED MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE	OTHER REQUIREMENTS
IMPACT TYPE	SPECIFIC INTERVENTION LEADING TO IMPACT	PROJECT PHASE	RECEPTOR TYPE	SENSITIVITY & RESILIENCE TOWARDS IMPACT	DIRECT/ INDIRECT/ CUMULATIVE	BENEFICIAL/ ADVERSE	SEVERITY	PHYSICAL/ GEOGRAPHIC EXTENT OF IMPACT	SHORT/ MEDIUM/ LONG TERM	TEMPORARY/ PERMANENT	REVERSIBLE/ IRREVERSIBLE					
														impermeability		
Major accidents	Large-scale fires or explosions, significant chemical releases, and structural failures	Operation	Water Bodies	Low	Direct	Adverse	High	Widespread	Medium	Temporary	Reversible	Remote	Major	Spill kits, hazardous substance storage areas, bunding systems, oil-water interceptors, surface waterproofing	Minor	An emergency plan should be followed
Excessive use of pesticides and fertilisers	Maintenance of landscape areas	Operation	Water Bodies	Moderate	Direct	Adverse	Moderate	Localised	Short	Temporary	Reversible	Uncertain	Moderate	Use of pesticides and fertilisers shall be controlled at required concentrations and frequency	Negligible	-
Groundwater salinization	Paving agricultural areas – depletion of groundwater recharge	Operation	Mean Sea Level Aquifer	High	Indirect and cumulative	Adverse	High	Widespread (upstream)	Long	Temporary	Reversible	Likely	Moderate	The sought mitigation measures result unfeasible.	Moderate	-
Public water network stress	Water demand for the operation of the plant	Operation	Mean Sea Level Aquifer	High	Direct and cumulative	Adverse	Moderate	Widespread (countryside)	Long	Temporary	Reversible	Likely	Moderate	Alternative water resource techniques like wastewater	Negligible	-

IMPACT TYPE AND SOURCE			IMPACT RECEPTOR		EFFECT AND SCALE							PROBABILITY OF IMPACT OCCURRING (INEVITABLE/ LIKELY/ UNLIKELY/ REMOTE/ UNCERTAIN)	OVERALL IMPACT SIGNIFICANCE	PROPOSED MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE	OTHER REQUIREMENTS
IMPACT TYPE	SPECIFIC INTERVENTION LEADING TO IMPACT	PROJECT PHASE	RECEPTOR TYPE	SENSITIVITY & RESILIENCE TOWARDS IMPACT	DIRECT/ INDIRECT/ CUMULATIVE	BENEFICIAL/ ADVERSE	SEVERITY	PHYSICAL/ GEOGRAPHIC EXTENT OF IMPACT	SHORT/ MEDIUM/ LONG TERM	TEMPORARY/ PERMANENT	REVERSIBLE/ IRREVERSIBLE					
														reuse and rainwater harvesting		
Flooding	Paving agricultural areas - increase of runoff flow rates	Operation	Water Catchment	Moderate	Indirect and cumulative	Adverse	Moderate	Widespread (catchment)	Short	Temporary	Reversible	Likely	Moderate	The sought mitigation measures result unfeasible.	Moderate	-

APPENDIX I

ERA TERMS OF REFERENCE

3.0 A DESCRIPTION OF THE SITE AND ITS SURROUNDINGS (I.E. ENVIRONMENTAL BASELINE)

The existing environmental features, characteristics and conditions, in and around the proposed development site as well as in all locations likely to be affected by the development or by ancillary interventions and operations, are to be identified and described in sufficient detail, with particular attention to the aspects elaborated further in the next sections.

The consultants should also identify (and justify) wherever relevant:

- 1. The geographic area (e.g. viewshed or other area of influence) that needs to be covered by each study;*
- 2. The relevant sensitive receptors vis-à-vis the environmental parameter under consideration (e.g. residential communities, other users, natural ecosystems, specific populations of particular species, or individual physical features);*
- 3. The location of the reference points or stations (e.g. viewpoints, monitoring stations, or sampling points (including depth of multiple sampling points at a single sampling point in the case of water media and sediment, where applicable) to be used in the study; and*
- 4. Other methodological parameters of relevance, also noting that the assessment will normally require both desk-top studies and on-site investigations (including visual observations and sampling, as relevant).*

Note: It is recommended that these details are discussed in advance with the ERA prior to commencement of the relevant parts of the studies, in order to pre-empt (as much as possible) later-stage issues.

Wherever relevant to the environmental aspects under discussion, reference to legislation, policies, plans (including programmes and strategies) standards and targets, should also be made, such that the compatibility (or otherwise) of the proposal therewith is also factored into the assessment required by Section 4 below. The discussion should cover the following aspects, in the appropriate level of detail:

- 1. Supra-national (e.g. European Union; United Nations; or other international or regional) legislation, directives, policies, conventions, protocols, treaties, charters, plans and obligations;*
- 2. National legislation, policies and plans (e.g. Structure Plan; National Environment Policy); and*
- 3. Sub-national legislation, policies and plans (e.g. local plans, site-specific regulations, action plans, management plans, and protective designations such as scheduling or Natura 2000).*

Note: In addition to already in-force legislation, policies and plans, the discussion should also cover any foreseeable future updates (or new legislation, policies and plans) likely to be fulfilled, affected or compromised by the proposed project. Furthermore, it should be noted that some cross-cutting legal/policy instruments (e.g. Water Framework Directive and Marine Strategy Framework Directive) may need to be factored into more than one aspect of the discussion.

3.4. Water bodies (including Terrestrial, Underground and Marine water bodies, as relevant)

The study should identify the hydrological, hydromorphological and physicochemical characteristics of the water bodies, water resources and aquatic environments in the area under investigation, including (as relevant):

- 1. The hydrology of the site and its surroundings, including all relevant features and dynamics, such as: aquifers; springs; surface waters; wetlands; watercourses; valley catchments; etc, including a description of any potential linkages between different water bodies (i.e. groundwater linkages to surface waters, coastal water linkages to inland surface waters), also cross-referring to hydrogeological factors (see Section 3.3 above) as relevant;*
- 2. The type, size and physical characteristics of any aquifers and surface water bodies within the area of influence of the site, including: the nature of the water body (e.g. aquifer, flowing surface water, marine, etc.); whether the water body is ephemeral or permanent; and other characteristics such as depth/bathymetry; type of bottom and topography; prevailing currents and wave exposure; as well as physical and chemical characteristics of the water column which are deemed relevant for determination of hydrological characteristics such as nutrient status, temperature, salinity, dissolved oxygen and pH.*
- 3. Natural and anthropogenic dynamics including groundwater recharge patterns; pumping and abstraction patterns; on-site and off-site drainage patterns; pipe/culvert connectivity between water bodies, run-off patterns; and flood risks; and*
- 4. Water quality (salinity, pollutant load, sediment load and characteristics, microbiological load, BOD & COD, transparency, temperature, etc.), with particular reference to any established quality parameters (e.g. legally-established bathing water quality parameters; effluent discharge parameters; objectives and requirements of the Water Framework Directive, Marine Strategy Framework Directive and related instruments).*
- 5. The study should provide a sufficiently detailed baseline to enable assessment of the effects of the proposal on the quality of the water body (terrestrial, underground and marine), the extent of area affected by hydrographical changes (terrestrial and marine), the nature of the changes (whether temporary or permanent) and effects of such changes on the ecological features and functions as described in line with Section 3.5. Such assessment should be undertaken in line with indicators used/established by relevant EU policy.*

4.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS AND ENVIRONMENTAL RISKS

All likely significant effects and risks posed by the proposed project on the environment during all relevant phases (including construction/excavation/demolition, operation and decommissioning) should be assessed in detail, taking into account the information emerging from Sections 1, 2 and 3 above. Apart from considering the project on its own merits (i.e. if taken in isolation), the assessment should also take into account the wider surrounding context and should consider the limitations and effects that the surrounding environmental constraints, features and dynamics may exert on the proposed development, thereby identifying any incompatibilities, conflicts, interferences or other relevant implications that may arise if the project is implemented.

In this regard, the assessment should address the following aspects, as applicable for any category of effects or for the overall evaluation of environmental impact, addressing the worst-case scenario wherever relevant:

1. *An exhaustive identification and description of the envisaged impacts;*
2. *The magnitude, severity and significance of the impacts;*
3. *The geographical extent/range and physical distribution of the impacts, in relation to: site coverage; the features located in the site surroundings; whether the impacts are short-, medium- or long-range; and any transboundary impacts (i.e. impacts affecting other countries);*
4. *The timing and duration of the impacts (whether the impact is temporary or permanent; short-, medium- or long-term; and reasonable quantification of timeframes);*
5. *Whether the impacts are reversible or irreversible (including the degree of reversibility in practice and a clear identification of any conditions, assumptions and pre-requisites for reversibility);*
6. *A comprehensive coverage of direct, indirect, secondary and cumulative impacts, including:*
 - *interactions (e.g. summative, synergistic, antagonistic, and vicious-cycle effects) between impacts;*
 - *interactions or interference with natural or anthropogenic processes and dynamics;*
 - *cumulation of the project and its effects with other past, present or reasonably foreseeable developments, activities and land uses and with other relevant baseline situations; and*
 - *wider impacts and environmental implications arising from consequent demands, implications and commitments associated with the project (including: displacement of existing uses; new or increased pressures on the environment in the surroundings of the project, including pressures which may be exacerbated by the proposal but of which effects may go beyond the area of influence; and impacts of any additional interventions likely to be triggered or necessitated by situations created, induced or exacerbated by the project);*
7. *Whether the impacts are adverse, neutral or beneficial;*

8. *The sensitivity and resilience of resources, environmental features and receptors vis-à-vis the impacts;*
9. *Implications and conflicts vis-à-vis environmentally-relevant plans, policies and regulations;*
10. *The probability of the impacts occurring; and*
11. *The techniques, methods, calculations and assumptions used in the analyses and predictions, and the confidence level/limits and uncertainties vis-à-vis impact prediction.*

The impacts that need to be addressed are detailed further in the sub-sections below.

5.0 REQUIRED MEASURES, IDENTIFICATION OF RESIDUAL IMPACTS, AND MONITORING PROGRAMMES

5.1 Mitigation Measures

A clear identification and explanation of the measures envisaged to prevent, eliminate, reduce or offset (as relevant) the identified significant adverse effects of the project during all relevant phases including construction, operation and decommissioning [see Section 1.2.3 above].

As a general rule, mitigation measures for construction-phase impacts should be packaged as a holistic Construction Management Plan (CMP). Whilst the detailed workings of the CMP may need to be devised at a later stage (e.g. after the final design of the project has been approved and/or after a contractor has been appointed), the key parameters that the CMP must adhere to for proper mitigation need to be identified in the EIA. Broadly similar considerations also apply vis-à-vis operational-phase impacts [which may need to be mitigated through an operational permit] and decommissioning-phase impacts [see Section 5.4 below], where relevant.

Mitigation measures for accident/risk scenarios should be packaged as a holistic plan that includes the integration of failsafe systems into the project design as well as well-defined contingency measures.

The recommended measures should be feasible, realistically implementable to the required standards and in a timely manner, effective and reliable, and reasonably exhaustive. They should not be dependent on factors that are beyond the developer's and ERA's control or which would be difficult to monitor, implement or enforce. The actual scope for, and feasibility of, effective prevention or mitigation should also be clearly indicated, also identifying all potentially important pre-requisites, conditionalities and side-effects.

5.2 Residual Impacts

Any residual impacts [i.e. impacts that cannot be effectively mitigated, or can only be partly mitigated, or which are expected to remain or recur again following exhaustive implementation of mitigation measures] should also be clearly identified.

5.3 Additional Measures

Compensatory measures (i.e. measures intended to offset, in whole or in part, the residual impacts) should also be identified, as reasonably relevant. Such measures should be not considered as an acceptable substitute to impact avoidance or mitigation.

If the assessment also identifies beneficial impacts on the environment, measures to maximise the environmental benefit should also be identified.

In both instances, the same practical considerations as indicated vis-à-vis mitigation measures should also apply.

5.4 Decommissioning Plan

A decommissioning plan (DP) should also be proposed to address the following circumstances, as relevant:

- 1. Removal of any temporary or defined-lifetime development (or of any structures, infrastructure or land use required temporarily in connection with it) upon the expiry of their permitted duration; and*
- 2. Removal of the development (or of any secondary developments, infrastructure or land use ancillary to it) in the event of redundancy, cessation of operations, serious default from critical mitigation measures, or other overriding situations that may emerge in future.*

The DP should also include, as relevant, a phasing-out plan, proposals for site remediation or decontamination, and methodological guidance on site reinstatement or appropriate after-use.

5.5 Monitoring Programme

A realistic and enforceable programme for effective monitoring of those works envisaged to have an adverse or uncertain impact. The monitoring programme should include:

- 1. Details regarding type and frequency of monitoring and reporting, including spot checks;*
- 2. The parameters that will be monitored, their units of measurement, the monitoring indicators to be used; and standard analytical methods in line with relevant EU policy;*
- 3. An effective indication of the required action to address any exceedances, risks, mitigation failures or non-compliances for each monitoring parameter;*
- 3. An evaluation of forecasts, predictions and measures identified in the EIA; and*
- 4. An indication of the nature and extent of any additional investigations (including EIAs or ad hoc detailed investigations, if relevant) that may be required in the event of any contingencies, unanticipated impacts, or impacts of larger magnitude or extent than predicted.*

The programme should address all relevant stages, as follows:

- a. Where relevant, monitoring of preliminary on-site investigations that may entail significant disturbance or damage to site features (e.g. archaeological excavations, geological sampling, or any works that require prior site clearance or any significant destructive sampling); [Note: Official written consent from the competent authorities (e.g. Superintendence of Cultural Heritage) may also be required for such interventions.]*
- b. Monitoring of the construction phase, including the situation before initiation of works (including site clearance), during appropriate stages of progress, and after completion of works;*
- c. Monitoring of the operational phase, except where otherwise directed by ERA (e.g. where monitoring would be more appropriately integrated into an operating permit); and*
- d. Where relevant, monitoring of the decommissioning phase, including the situation before initiation of works, during appropriate stages of progress, and after completion of works.*

5.6 Identification of required authorisations

The assessment should also identify all environmentally-relevant permits, licences, clearances and authorisations (other than the development permit to which this EIA is ancillary) which must be obtained by the applicant in order to effectively implement the project if development permission is granted. Any uncertainty, as to whether any of these pre-requisites is applicable to the project, should be clearly stated.

Note on Sections 5.1 to 5.6 above:

The expected effects, the proposed measures, the residual impacts, the proposed monitoring etc. should also be summarised in a user-friendly itemised table that enables the reader to easily relate the various aspects to each other. An indicative specimen table is attached in Appendix 3 – attached to Method Statement as Appendix 1.