CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 1	Option 1 Narrative (Do Nothing)	Option 2	Option 2 (Do Minimum)
Economy	Land Use and Third Party Assets		No land-take required as no works would occur.		No land-take required as no works would occur.
	Capital Expenditure		This Option would not include any capital costs		This Option would include minimal capital costs
	Maintenance Expenditure		No maintenance required for this option		This Option would rely on reactive maintenance, which would become more frequent and expensive over time
Safety	Health and Safety (Construction)		This Option would present the lowest Health and Safety risk for construction as no major works would take place.		This Option would result in localised remedial works being required. Minor works of this nature would be risk assessed by the contractor. However these works may be undertaken under poor working conditions due to immediate risk to the railway.
	Health and Safety (Design Life)		As the defences deteriorate over time, health and safety risks to the public increase as parts of the defences fail. Failure of the defences could be sudden and catastrophic as the Do Nothing scenario does not include any monitoring or maintenance of the defences. As the defences fail, parts of the failed defences will likely create debris on the foreshore and in publicly accessible areas. The defences themselves will also become hazards. Climate change will lead to increased overtopping and flooding of the railway line and the hinterland, which without intervention will become extremely dangerous.		This Option will involve maintaining the defences through reactive repairs. Therefore as there will be no proactive monitoring or maintenance, deterioration of the defences will occur and there are likely to be periods where there are Health and Safety risks in the defence prior to repair works being undertaken. The frequency and scale of the damage and repair works will increase over time. This Option does not include any improvement or upgrades to the defences to account for climate change therefore increased overtopping and flooding of the railway line will occur over time which poses Health and Safety Risks
Accessibility and Social Inclusion	Community		Any maintenance programmes currently taking place will cease under this scenario (however 'make safe' works would continue) with occurrences of coastal erosion and breach/collapse of existing erosion measures continuing and potentially getting worse in line with climate change predictions. Furthermore, the continuation of such coastal erosion has the potential to impact operational train services using the rail line in future years, until the point at which the line will have to be abandoned.		While any maintenance programmes currently taking place will continue under this scenario, occurrences of coastal erosion and breach/collapse of existing erosion measures will continue and potentially get worse in line with climate change predictions. Furthermore, the continuation of such coastal erosion has the potential to impact operational train services using the rail line in future years.
	Access		This Option is considered to have significant disadvantages over other options as the continuous erosion of the beach will result in the loss of bridge structures behind the beach which currently provide access.		This Option is considered to have some disadvantages over other options as the continuous erosion of the beach will result in the eventual loss of bridge structures behind the beach which currently provide access.
	Social and Recreation Facilities		This Option is considered to have significant disadvantages over other options as under this option there is an increased risk to the recreational facilities from climate change effects(i.e. beach amenity areas) in this CCA.		This Option is considered to have some disadvantages over other options as under this option as climate change effects will continue on existing social and recreational facilities (i.e. beach amenity areas) in this CCA.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 1	Option 1 Narrative (Do Nothing)	Option 2	Option 2 (Do Minimum)
Integration	Compatibility with Development Plans		Do Nothing would provide a significant disadvantage over other options as development/local area plans identify coastal zone management and protection of coastal area is important. Wicklow County Council have a number of Development Plan objectives relating to coastal defence/protection.		Do Minimum would provide some disadvantages over other options as coastal zone management and coastal area protection are identified as important within the relevant development plans. The disadvantage relating to this option is that the minimum works rely on repairs it would not fully achieve the objectives of the plans. 'Patching up' existing infra and not addressing long term climate issues doesn't address this.
	Compatibility with Climate Adaptation Plans		Do Nothing would provide significant disadvantages over other options as it would contravene climate objectives such as Eastern and Midlands Region RSES "RPO 7.3 EMRA will support the use of Integrated Coastal Zone Management (ICZM) to enable collaborative and stakeholder engagement approaches to the management and protection of coastal resources against coastal erosion, flooding and other threats."		Do Minimum would provide some disadvantages over other options as coastal zone management and coastal area protection are identified as important within the relevant development plans. The disadvantage relating to this option is that the minimum works rely on repairs, not a full upgrade would not fully achieve the objectives of the plans which include the need for climate adaptation. The Climate Action Plan 2023 sets out under 15.3.6 (Adaptation) the challenges related to the operation and resilience of the inter alia the rail network. There is a need to go beyond 'patching up' and to prepare for current and future change.
	Compatibility with Transport Plans		The NTA's Greater Dublin Area Transport Strategy 2022-2042 outlines the need to ensure resiliency of the public transport network to climate change effects, and specifically mentions potential flooding along the Dublin and Wicklow coastline. Do Nothing will mean no interventions being made to prevent flooding and coastal erosion, events of which may become increasingly more frequent in the future due to climate change. While there may be little short-term impact, in the longer term this will put increasing pressure on the public transport to accommodate passengers displaced from rail services. Disruptions to the rail service may result in an unreliable public transport system, causing a mode shift to car travel rather than public transport. This goes against the Transport Strategy's focus on facilitating increased use of sustainable modes.		Do Minimum is expected to involve disruptions to public transport in the short to medium term to conduct repairs as the need arises. The ad hoc repairs will address damage that may occur, but won't build longer-term resilience against potential impacts of flooding or erosion. As per Do Nothing, this is likely to put increasing pressure on the public transport system and challenge its reliability, going against the Transport Strategy's focus on facilitating increased use of sustainable modes.
	Biodiversity		Do Nothing would provide an advantage in the short to medium term as there would be no construction work and therefore no impact on biodiversity/ protected areas from habitat loss/degradation and disturbance (noise/pollution). There are no Ramsar sites, there is one SAC (The Murrough SAC), one SPA (The Murrough SPA) and one pNHA (The Murrough pNHA) within CCA6.1 that could be effected in a beneficial way in the short to medium term. Natural processes would not be constrained and European and Nationally designated habitats and species would not be impacted by construction or operational effects. In the long term there could be loss of habitats through erosion and exposure of the wetlands to tidal action. There is also the potential for pollution from oils etc. embedded in existing rail line contaminating the shore and sea.		Do Minimum would provide a slight disadvantage in comparison to Option 1 as there would be little/limited/targeted construction work and therefore minimal impact on biodiversity/ protected areas in the short to medium term. There are no Ramsar sites, there is one SAC (The Murrough SAC), one SPA (The Murrough SPA) and one pNHA (The Murrough pNHA) within CCA6.1 and repair works could cause disturbance to QI bird species and habitats for example. If unhindered, the natural process of habitat expansion will provide supporting habitat for SPA bird species of The Murrough SPA and foraging for breeding little tern. Limited impacts to QI species from construction are through impacts to habitats from habitat degradation and disturbance to birds and seals (QI of Lambay Island SAC) from noise.
	Landscape and Visual and Seascape		Continued degradation and coastal erosion as a result of no works being undertaken would result in significant deterioration and change of tracts of inland coastal landscape designated for their outstanding natural beauty. Notable potential to generate significant adverse landscape/seascape and visual effects. Significant disadvantages over all 'Do Minimum' options.		Continued reactive interventions would compromise the character and quality of this stretch of coastline, with ongoing works generating adverse landscape/seascape and visual effects. Given the scale of this section of coastline, this ongoing state of repair and disruption is comparatively less impactful than in other parts of the coastline.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 1	Option 1 Narrative (Do Nothing)	Option 2	Option 2 (Do Minimum)
Environment	Archaeology, Architectural and Cultural Heritage		Continued degradation and coastal flooding as a result of no works being undertaken would generate significant adverse Archaeology, Architectural and Cultural Heritage effects. Similar to, with disadvantages over Option 2 and significant disadvantages over all 'Do Minimum' options.		Continued degradation, and piecemeal, reactive interventions, would generate a coastline that is in a constant state of repair and disruption, with constant adverse Archaeology, Architectural and Cultural Heritage effects. Similar to, with advantages over option 1. Some disadvantages over 'Do Minimum' options 3-8
	Marine Archaeology		Do Nothing would provide some advantage as there would be no proposed construction and therefore no potential impact on archaeological features in the intertidal and marine elements.		Do Minimum would provide some advantage as there would be limited/targeted construction and therefore no potential impact on archaeological features in the intertidal and marine elements.
	Noise and Vibration		Do Nothing would provide some advantages as there would be no construction or maintenance works and therefore no construction related noise or vibration impacts on noise sensitive population receptors. The long term operational scenario would have some disadvantages compared to other options if rail services are suspended and road traffic on surrounding road network increases. Due to the longer term duration of potential impacts, this is weighted as less advantageous over other options		Do Minimum would provide some advantages due to absence of temporary - short term noise and vibration impacts from any construction works. The existing maintenance works will continue as necessary which will be of neutral impact, albeit these will likely intensify in frequency. The long term operational scenario is neutral compared to other options, although the rail service will likely be less reliable and has potential for increased traffic on surrounding road network. Due to the longer term duration of potential impacts, this is weighted as less advantageous over other options
	Air Quality		No construction phase impacts. Potential for long term local operational phase impacts should the rail line be suspended in future. If rail services are suspended this has the potential to increase local road traffic.		Lower or not significant construction phase impacts. General construction dust emissions and heavy Machinery have the potential to be used for reactive Do Minimum construction works, resulting sources of dust and air pollution. Potential for long term local operational phase impacts should the rail line be suspended in future. If rail services are suspended this has the potential to increase local road traffic.
	Carbon Management		GHG emissions from embodied carbon is lower due to no construction. However, the potential for long term local operational phase impacts should the rail line be suspended in future. If rail services are suspended this has the potential to increase local road traffic.		GHG emissions from embodied carbon is minimised lower due to no construction. However, the potential for long term local operational phase impacts should the rail line be suspended in future. If rail services are suspended this has the potential to increase local road traffic.
	Water Resources		Do Nothing would provide a significant advantage as there would be no construction work and therefore no impact on groundwater		Do Minimum would provide a significant advantage as there would be minimal construction work and therefore negligible impact on groundwater
	Geology and Soils		In the short term, there will be no significant impacts to geological resources. However, the effects of climate change may result in the erosion of the local geology in the medium to long term.		In the short term there will be no significant impacts to geological resources. However, frequent works may be required to address erosion of geological resources.
	Material and Circular Economy		Do Nothing would provide significant advantages over other options as it avoids the consumption and use of material resources. However, some materials would still be consumed in managing the HSE risks of the structures failing (e.g. signage or fencing to prevent access).		Do Minimum would provide significant advantages over other options as it minimises the consumption and use of material resources through maximising the use of existing assets to reduce the extent of any new construction required (i.e. during the current maintenance regime of ongoing monitoring and reactive repairs).
	Waste		Do Nothing would provide significant advantages over other options as it avoids the generation and disposal of waste. However, waste is still likely to be generated during any future works involved with managing the HSE risks of the structures failing (e.g. targeted removal of existing site assets).		Do Minimum would provide significant advantages over other options as it minimises the generation and disposal of waste through maximising the use of existing assets to reduce the extent of any new construction required (i.e. during the current maintenance regime of ongoing monitoring and reactive repairs).
	Traffic and Transport		Potential for significant disruption to transport in the longer term if no intervention is made. As the road network is further inland than the rail line in this CCA, rail service impacts would leave passengers with limited alternative travel options, leading to increased congestion on the wider road network and possible overcrowding on buses.		Potential unexpected disruptions to transport to make ad hoc repairs. As the road network is further inland than the rail line in this CCA, rail service impacts would leave passengers with limited alternative travel options, leading to increased congestion on the wider road network and possible overcrowding on buses.
	Constructability		Do Nothing requires no construction works (other than making the area safe)		This Option is likely to require ad hoc emergency repairs to the wall alongside the railway. Localised emergency works may also be required after significant weather events.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 1	Option 1 Narrative (Do Nothing)	Option 2	Option 2 (Do Minimum)
Engineering/Technical	Rail Service Impact		Do Nothing requires no construction works (other than making the area safe)		This Option is likely to require ad hoc and emergency works to the wall alongside the railway, which may impact rail operations. It will be difficult to plan ahead for these works as there will be no strategy in place for routine maintenance works.
	Reliance on Maintenance Maintenance burden		No requirement for maintenance or adaptation but significant monitoring would be required to keep the public safe.		This Option would rely heavily on monitoring and maintenance.
	Adaptation		No opportunity for adaptation.		Minimal opportunities for adaptation
	Residual Risk		Defence will likely slowly degrade and would then fail very quickly/catastrophically during an event.		This Option would not eliminate weaknesses in the existing hard defence, which could lead to rapid failure.
Planning Risk	Consenting Risk		Do Nothing would provide a significant advantage as it would require no consents.		Do Minimum would provide a significant advantage as it would require no consents.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 4	Option 4 (Rock Revetments with wave wall where needed)	Option 5	Option 5 (Concrete Armour Unit Revetment (B to C) Rock Revetment (A, D and E))
Economy	Land Use and Third Party Assets		This Option has significant disadvantages as there would be impacts on third party land-owners with potential CPO required.		This Option has significant disadvantages as there would be impacts on third party land-owners with potential CPO required.
	Capital Expenditure		This Option has some advantages over other options as all construction could be land based. It is assumed that the rock would be delivered from overseas by barge and stockpiled directly onto the beach (depending on vessel draught it may come in smaller or larger barges depending on the contractors methodology).		This Option has disadvantages as the concrete amour units would need to be fabricated 'on-site', most likely on the quayside and then transported to the workface via flat top barges. Heavy marine plant would be needed to handle them and also sizeable mobile cranes landside. Specialist contractors and skillsets would be needed to install them. The concrete units would be fabricated under a sub license contract from the armour unit designers increasing cost and stakeholders to the project. In addition to the concrete amour unit a significant amount of rock amour would still be needed for the underlayers which would also need to be transported by barge.
	Maintenance Expenditure		Operational maintenance costs for this option should be relatively low. Some maintenance in the form of repositioning rocks may be required within the design life but this should be infrequent. Repair works could be undertaken from the beach with excavators mitigating the need for specialist or marine based plant.		The maintenance costs for this option would be slightly higher than for Option 4. Although maintenance should be infrequent, maintenance of the concrete armour unit revetments would be more complex and therefore more expensive than the rock revetments.
Safety	Health and Safety (Construction)		This Option has significant advantages over other options as the rock armour can be handled exclusively by proprietary marine equipment and should not require land based handling and transportation. The revetment will be constructed by land based equipment although some marine works will be required to transport the rock to the workface. The construction of rock revetments is also less complex than detached breakwaters and concrete structures.		This Option has disadvantages compared to Option 4 due to the transportation and handling of heavy concrete armour units from land. Most of the works would be marine based and require large equipment to transport, handle and place heavy concrete armour units and rock armour.
	Health and Safety (Design Life)		This Option has advantages over other options as the potential Health and Safety risks posed by this option can be more easily managed. This Option could pose some Health and Safety risks of people climbing on the rock revetments and becoming trapped. Warning signs should be installed to mitigate this. The revetments will significantly reduce the useable area of the beach in which could lead to people becoming trapped by the tides. This can be mitigated through increased access points through the revetments.		This Option is very similar to Option 4. The concrete armour unit revetments will result in very similar Health and Safety risks as the rock revetments.
Accessibility and Social Inclusion	Community		This Option is considered to have disadvantages to other options as it would place rock revetment along the entire coastline, which would likely have a detrimental effect on the local community. This is because the rock revetment would be placed along the length and breadth of the existing beach area, restricting its use and general amenity value for the local community. This Option is likely to be less attractive to the public than other options.		This Option is very similar to Option 4 but with a concrete armour unit revetment rather than rock and therefore is considered to have the same disadvantages
	Access		This Option is considered to have some disadvantages to other options as while there will be the imposition of rock revetments (and/or wave walls where needed) along the entirety of this CCA, access steps will be incorporated into the revetment to ensure any formal/informal access points to the beach amenity that currently exist and used by members of the public (for example the formal accesses to the beach amenity area from Kilcoole Train Station and the former Newcastle Train Station) are maintained but access along the beach will be restricted.		This Option is considered to have disadvantages over other options as while there will be the imposition of concrete armour unit revetment, rock revetments along the majority of this CCA, access steps will be incorporated into these revetments to ensure any formal/informal access points to the beach amenity that currently exist and used by members of the public (for example the formal accesses to the beach amenity area from Kilcoole Train Station and the former Newcastle Train Station) are maintained. Beach nourishment is not likely to have any impact on existing informal or formal accesses within the vicinity in which is it proposed.
	Social and Recreation Facilities		This Option is considered to have some disadvantages over other options as rock revetment will be placed along the majority of the coastline within this CCA, which will likely limit or remove the use of the beach amenity area for recreational purposes.		This Option is considered to have some disadvantages over other options as concrete armour revetment will be placed along the majority of the coastline within this CCA, which will likely limit or remove the use of the beach amenity area for recreational purposes.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 4	Option 4 (Rock Revetments with wave wall where needed)	Option 5	Option 5 (Concrete Armour Unit Revetment (B to C) Rock Revetment (A, D and E))
Integration	Compatibility with Development Plans		This Option would have some disadvantages. It aligns with coastal protection, coastal area management objectives and protection of the rail line objectives within the development plans. No enhancement of the areas or utilisation of naturally occurring green infrastructure, impacting natural habitats, significant amount of hard standing, no provision of coastal recreation amenities or incorporation of pedestrian/cycling infrastructure. Indicative Green Route, Protected Views and Prospects, PNHA, SPA and SAC. Within open space zoning. Within Wicklow County Council Development Plans Marine Cells 4,5 and 6 - Note that Wicklow County Council Dev Plan Cell 4 (Greystones Town) has an objective for a "high quality integrated harbour/marina mixed development linked to a linear coastal public park and any future heritage park." It goes on to say "The development shall provide a link to the coastline with public access and coastal protection works provided to preserve the landscape from further erosion." It also specifies an objective to "facilitate the development and enhancement of visitor and recreational facilities along the coastal area." Cell 5 (Greystones to Kilcoole) - "To protect all listed views and prospects along the R761 and coast in this cell. To facilitate the development of a coastal walk (having due regard to environmental designations and compliance with the EU Habitats Directive) and to restrict development that interferes with the achievement of this objective." "To facilitate and support the upgrading of Kilcoole train station and associated facilities. "To facilitate coastal protection works (natural, soft and hard engineered), to protect both the ecological and amenity value of the coastline and the significant economic and social value of the railway line." Cell 6 (Kilcoole, Wicklow Town) also includes the following, "No development will be permitted that has an adverse impact on the environmental and ecological quality of The Murrough cSAC. The Planning Authority will have particular regard to the impact that all developments have on the integrity of the cSAC, including development that is within the cSAC and development that is not within a designated area, but which is likely to have an effect thereon. Draft Greystones-Delgany and Kilcoole Local Area Plan 2019 = Area of geological and geomorphological interest to the immediate east of Greystones. Proposed Natural Heritage Area to the NE of Kilcoole. SAC east and SE of Kilcoole		This Option would be similar to other options. It aligns with high level coastal protection and coastal area management objectives within the development plans. The disadvantages relating to this option are: Indicative Green Route, Prosects, PNHA, SPA, SAC and Open Space Zoning. Within the same Cell areas under the Wicklow County Council as Option 4. Advantage includes: enhancement of the area with beach amenity and coastal recreation amenity, elements of green infrastructure. This Option appears to require less volume of materials but appears to have more concrete.
	Compatibility with Climate Adaptation Plans		This Option would have some advantages compared to other options as it would align with the Transport Climate Change Sectoral Adaptation Plan (Transport Climate Change Sectoral Adaptation Plan) by protecting the existing rail infrastructure. However, it would also involve a significant volume of materials for the rock revetments to be brought to site and transport of same.		This Option would have some disadvantages compared to Option 4 due to the significant volume concrete in addition to large volumes of rock also being required for the underlayers. It would align with the Transport Climate Change Sectoral Adaptation Plan (Transport Climate Change Sectoral Adaptation Plan) by protecting the existing rail infrastructure through a complete upgrade of existing defences.
	Compatibility with Transport Plans		This Option will improve the protection of the rail line against climate change impacts, in line with the Transport Strategy's aim to "provide a sustainable, accessible and effective transport system for the Greater Dublin Area which meets the region's climate change requirements, serves the needs of urban and rural communities, and supports economic growth". The Greater Dublin Area Cycle Network Plan proposes a National Cycle Route, the East Coast Trail, with an indicative route along part of the coastline between Greystones and Wicklow Town. Providing the intervention works can accommodate the East Coast Trail, this option will support the Transport Strategy.		This Option will improve the protection of the rail line against climate change impacts, in line with the Transport Strategy's aim to "provide a sustainable, accessible and effective transport system for the Greater Dublin Area which meets the region's climate change requirements, serves the needs of urban and rural communities, and supports economic growth". The Greater Dublin Area Cycle Network Plan proposes a National Cycle Route, the East Coast Trail, with an indicative route along part of the coastline between Greystones and Wicklow Town. Providing the intervention works can accommodate the East Coast Trail, this option will support the Transport Strategy.
	Biodiversity		This Option has disadvantages over other options as construction effects include disturbance to QI species and habitat degradation. A significant amount of rock armour would be required which would be transported to site by barge. Night time works could be needed causing disturbance. Operational effects include loss of QI species and habitats under the footprint of the revetment. Potential for change to hydrology causing erosion from hard infrastructure on seaward side. Changes to land-ward side wetland habitats unknown and Priority habitat of Calcareous fens present in this area. There is one SAC (The Murrough SAC), one SPA (The Murrough SPA) and one pNHA (The Murrough pNHA) within CCA6.1. On the seaward side of the shingle bank which runs along The Murrough Wetlands SAC site drift line vegetation and previously rare and legally protected Oyster plant (Mertensia maritima) (Flora (Protection) Order, 1999) has been recorded on the gravelly shore (now considered extinct). Drift lines extend along entire length and perennial vegetation mainly in south. Salt meadows (Glauco-Puccinellietalia maritime) to west of rail line in two distinct and small locations which contains 80-100% cover. The shingle ridge at Kilcoole is a traditional nesting area for Little Tern, and the site now supports one of the largest colonies in the country. The birds nest along the entire stretch of the shore line. Light-bellied Brent Goose occurs here in internationally important numbers. Seals (QI of Lambay Island SAC) haul out here.		This Option has disadvantages over other options as construction effects include disturbance to QI species and habitat degradation. A significant amount of rock armour would be required (for the underlayers) which would be transported to site by barge. Night time works could be needed causing disturbance. Operational effects include loss of QI species and habitats under the footprint of the revetment. Potential for change to hydrology causing erosion from hard infrastructure on seaward side. Changes to land-ward side wetland habitats unknown and Priority habitat of Calcareous fens present in this area. There is one SAC (The Murrough SAC), one SPA (The Murrough SPA) and one pNHA (The Murrough pNHA) within CCA6.1. On the seaward side of the shingle bank which runs along The Murrough Wetlands SAC site drift line vegetation and previously rare and legally protected Oyster plant (Mertensia maritima) (Flora (Protection) Order, 1999) has been recorded on the gravelly shore (now considered extinct). Drift lines extend along entire length and perennial vegetation mainly in south. Salt meadows (Glauco-Puccinellietalia maritime) to west of rail line in two distinct and small locations which contains 80-100% cover. The shingle ridge at Kilcoole is a traditional nesting area for Little Tern, and the site now supports one of the largest colonies in the country. The birds nest along the entire stretch of the shore line. Light-bellied Brent Goose occurs here in internationally important numbers. Seals (QI of Lambay Island SAC) haul out here.
	Landscape and Visual and Seascape		As a natural material, rock revetements would tie in comparatively successfully with the natural qualities of this long stretch of coastline, that is already influenced by existing rock revetements and the shingle beach material present. The placement of material would be more robust and considered than reactionary measures, and as such would complement and enhance those rock revetements already present. When used consistently, the continuous feature will have a scale and uniformity that will complement the large sweeping nature of this stretch of coastline, moderating landscape and visual effects. In places they require a large land take, which will result in the loss of a large areas of beach which is considered adverse.		The use of concrete along this stretch of coastline is considered inappropriate and incongruous with its designated natural and scenic qualities. Together with rock revetements, a mix of treatments that would be detrimental in terms of perceived character.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 4	Option 4 (Rock Revetments with wave wall where needed)	Option 5	Option 5 (Concrete Armour Unit Revetment (B to C) Rock Revetment (A, D and E))
Environment	Archaeology, Architectural and Cultural Heritage		This Option is similar to other options as no potential direct impacts or indirect setting and visual impacts on SMR Sites have been identified, there is the potential for direct impacts to occur on previously unrecorded archaeological heritage. There is the potential for indirect setting and visual impacts to occur on four NIAH Sites (16304027; House, 16304058; Railway Station, 16304095; Library/Archive and 16401912; Station master's house) three of which are also RPS Sites (16304058; RPS ref 08-63, 16304095; RPS ref 08-24 and 16401912; RPS ref 13-38) and one further RPS Site (19-12; Five Mile Point). There is also the potential for significant direct impacts to occur on previously unrecorded material culture. Significant advantages over Options 1 and 2.		This Option is similar to other options as no potential direct impacts or indirect setting and visual impacts on SMR Sites have been identified, there is the potential for direct impacts to occur on previously unrecorded archaeological heritage. There is the potential for indirect setting and visual impacts to occur on four NIAH Sites (16304027; House, 16304058; Railway Station, 16304095; Library/Archive and 16401912; Station master's house) three of which are also RPS Sites (16304058; RPS ref 08-63, 16304095; RPS ref 08-24 and 16401912; RPS ref 13-38) and one further RPS Site (19-12; Five Mile Point). There is also the potential for significant direct impacts to occur on previously unrecorded material culture. Significant advantages over Options 1 and 2.
	Marine Archaeology		There are no direct impacts on previously unrecorded wrecks, paleoenvironmental landscapes and material culture, and therefore no potential impact on archaeological features in the intertidal and marine elements.		This Option has disadvantages compared to Option 4 due to the beach nourishment in sub cell A. There is the potential for significant direct impacts to occur on previously unrecorded wrecks, paleoenvironmental landscapes and material culture within the intertidal zone in connection to beach nourishment with the use of plant such as dredgers and associated activities during the transfer of shingle onto the beach.
	Noise and Vibration		Noise impact will be from mobile plant when working in proximity to Noise Sensitive Locations in CCA6.1 A and B. Specific instances of elevated noise will be localised and temporary. Remainder of works are set back from population Noise Sensitive Locations with potential for any significant noise or vibration impacts. There will be periods of night-time works required to work around tides. No significant vibration impacts from this proposal. Overall this option is similar to other options. All impacts are temporary to short-term. No long term operational noise or vibration impacts.		Noise impact will be from mobile plant when working in proximity to Noise Sensitive Locations in CCA6.1 A and B and in smaller areas of CCA6.1 C. Specific instances of elevated noise will be localised and temporary in this area but will require more frequent works into the future. Remainder of works are set back from population Noise Sensitive Locations with potential for any significant noise or vibration impacts. There will be periods of night-time works required to work around tides. No significant vibration impacts from this proposal. Overall this option is similar to other options. No long term operational noise or vibration impacts.
	Air Quality		No operational phase impacts, with the assumption that maintenance requirement is very low hence some advantages. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term. Potential for construction phase impacts associated with potentially dusty activities and construction vehicle emissions. Higher preference due to no ongoing maintenance. Construction phase impacts would be likely considered short term and dust mitigation can be put in place.		This Option would need ongoing monitoring and maintenance requirements to maintain the beach nourishment to the design levels. The maintenance has the potential for dust emissions but can be mitigated. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term. Potential for construction phase impacts associated with potentially dusty activities such as sea wall construction and beach nourishment having a higher potential for dust. This Option would have a potential dust impact on sensitive receptors in proximity to the works being carried out of which beach nourishment and armour unit revetment installation use heavy Machinery to carry out. Options 5 and 9 are similar due to an ongoing requirement of beach nourishment maintenance in the more populated area near Greystones. Construction phase impacts would be likely considered short term and dust mitigation can be put in place.
	Carbon Management		Whole Life Carbon (tonnes CO2e) was 122% of average across 9 options, therefore it has some advantages over other options. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term.		Whole Life Carbon (tonnes CO2e) was 109% of average across 9 options, therefore it has some advantages over other options. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term.
	Water Resources		This Option is similar to other options as there should be minimal impacts on groundwater		This Option is similar to other options as there should be minimal impacts on groundwater
	Geology and Soils		Rock revetment with wave walls where needed are anticipated to cause minimal/moderate disturbance to geological resources throughout CCA6.1. There is also potential that shallow excavations to facilitate the wave walls in CCA6.1-A could result in the remobilisation of contamination.		The adoption of beach nourishment at CCA6.1-A will cause moderate disturbance to geological resources and potential remobilisation of contamination. Rock revetment is expected to cause minimal/moderate disturbance to geological resources in CCA6.1-D and CCA6.1-E. Concrete armour unit revetment will cause moderate/ high disturbance of geological resources in CCA6.1-B and CCA6.1-C.
	Material and Circular Economy		This Option would provide significant advantages over other options due to its comparatively low materials consumption score (1,151,656t). The materials consumption score has been calculated based on the application of the Ellen MacArthur Foundation's Material Circularity Indicators (a value between 0 and 1 where higher values indicate a higher circularity) to the quantities of each material that is likely to used in constructing the option. The Material Circularity Indicator provides a measure of how circular/restorative the material flows of a material/product is likely to be.		This Option would provide some advantages over other options due to its comparatively low materials consumption score (1,810,844t).
	Waste		This Option would be similar to options 6 and 7. Minimal waste would be generated from the removal of existing structures (where rock revetments currently exist, the majority of the rock will be reused within the new revetments). In addition, this option is likely to be associated with comparatively low wastage (584t). Wastage from damaged materials has been estimated based on the application of material-specific wastage rates to the quantities of concrete materials that are likely to used in constructing the option.		This Option would provide some disadvantages over other options. Minimal waste would be generated from the removal of existing structures (where existing rock revetments are replaced with concrete revetments the rock will be reused within the new revetments). In addition, this option is likely to be associated with comparatively high wastage (8,041t).
	Traffic and Transport		Minimal operational impact expected to traffic and transport; the intervention works will be localised to the coast and are not anticipated to affect transport systems or travel demand.		Minimal operational impact expected to traffic and transport; the intervention works will be localised to the coast and are not anticipated to affect transport systems or travel demand.
	Constructability		This Option has advantages over other options as although it requires significant volumes of rock armour the construction is relatively simple but would be slow due to the scale of the works. Several work fronts could be opened up to improve construction duration. It is assumed that rock armour will be delivered by marine plant.		This Option would be challenging to construct. Production, handling and placing of concrete armour units would need to be facilitated from land, increasing onshore footprint of the project. Placing of concrete armour units can be challenging. Depending on the size/weight of the units and will require specialist plant and experience in placing. Interlocking of units is required and replacement of broken units is difficult, especially at or near the toe.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 4	Option 4 (Rock Revetments with wave wall where needed)	Option 5	Option 5 (Concrete Armour Unit Revetment (B to C) Rock Revetment (A, D and E))
Engineering/Technical	Rail Service Impact		Minimal impact on operation of railway line. Irish Rail will require to be notified of works as adjacent to the railway line but this is expected to be low risk.		Minimal impact on operation of railway line as works are adding to existing infrastructure so no excavation is needed. Irish Rail will require to be notified of works as adjacent to the railway line but this is expected to be low risk.
	Reliance on Maintenance Maintenance burden		This Option has significant advantages over other options as the revetments only require routine and post storm monitoring but should require minimal maintenance during the design life. This Option is a hard defence and would be designed to accommodate future lowering of beach levels and climate change. Therefore maintenance of the beach would be less important.		This Option has significant advantages over other options as the revetments only require routine and post storm monitoring but should require minimal maintenance during the design life. This Option is a hard defence and would be designed to accommodate future lowering of beach levels and climate change. Therefore maintenance of the beach would be less important.
	Adaptation		This Option would be designed to account for predicted climate change. Changes to the beach levels to account for any additional changes could be undertaken but changes to the hard defences would be challenging		This Option has disadvantages compared to Option 4 because changes to a concrete armour unit revetment would be more challenging than a rock revetment due to the need for bespoke made armour units and the interlocking nature of the units
	Residual Risk		This Option is similar to other options. It relies on hard engineering structures at the shoreline but failure of a rock revetment is very unlikely to be sudden, failure would be progressive in the form of some loss of rock from the structure or slumping/settlement of the revetment which would compromise its performance but would not lead to sudden or catastrophic failure.		This Option is similar to other options. It relies on hard engineering structures at the shoreline but failure of a revetment is very unlikely to be sudden, failure would be progressive in the form of some loss of armour units from the structure or slumping/settlement of the revetment which would compromise its performance but would not lead to sudden or catastrophic failure.
Planning Risk	Consenting Risk		A full upgrade of existing defences would protect the area for a longer time in line with planning policy. Works are carried out in Natura 2000 site with potential for temporary and permanent impacts on qualifying interests which could invoke IROPI. Works will likely require a Maritime Area Consent.		A full upgrade of existing defences would protect the area for a longer time in line with planning policy Works are carried out in Natura 2000 site with potential for temporary and permanent impacts on qualifying interests which could invoke IROPI. Works will likely require a Maritime Area Consent.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 6	Option 6 (Detached breakwaters with beach nourishment and concrete splash wall where required)	Option 7	Option 7 (Detached breakwaters with beach nourishment and concrete splash wall where required (A, D and E) Rock revetment (B and C)
Economy	Land Use and Third Party Assets		This Option has significant disadvantages as there would be impacts on third party land-owners with potential CPO required.		This Option has significant disadvantages as there would be impacts on third party land-owners with potential CPO required.
	Capital Expenditure		This Option has significant disadvantages over other options due to the significant amount of marine based construction that would be required to construct the detached breakwaters. In addition, this option requires a significant volume of beach nourishment material which would need to be dredged and pumped ashore which would further increase the costs of this option		This Option has disadvantages compared to Option 4 as it is likely to require a similar quantity of rock armour but approximately 50% of the rock armour would be required for the detached breakwaters which would require marine plant for placement. In addition, this option also requires beach nourishment.
	Maintenance Expenditure		This Option is expected to have the highest maintenance costs. The detached breakwaters should only require occasional maintenance (if any) throughout the design life but if maintenance is required this would require marine based plant which would be significantly more expensive than the land based plant required for the revetments. Frequent monitoring and regular maintenance of the nourished beaches would be required. This would use land based plant to reposition the beach material		This Option is expected to have higher maintenance costs than Option 4 due to the requirement to monitor and maintain the beach and potential higher maintenance costs of the detached breakwaters. It has advantages over Option 6 as there is less beach and less detached breakwaters to maintain, therefore reducing the costs associated with these.
Safety	Health and Safety (Construction)		This Option includes offshore breakwaters which may be challenging to construct in open water and would require the exclusive use of marine equipment to construct and carry increased safety risks. Beach nourishment would require specialist marine equipment, however this would be considered as a low safety risk.		This Option is similar to options 5 and 6 however the detached breakwater elements would carry the same risk as Option 6 but over a lower length.
	Health and Safety (Design Life)		This Option has advantages over other options as the breakwaters will lead to a build up of the beach material creating larger wider beaches. This will improve access along the beach and reduce the changes of people being cut off by the tide. Warning signs should be installed to deter people from accessing the breakwaters. The breakwaters could also lead to changes in currents and swimming conditions in the area. The renourished beaches may require reprofiling or renourishing during the design life which will require plant on the beach which would need to be managed to mitigate Health and Safety risks with the public.		This Option has disadvantages over Options 4 to 6 as it combines the risks associated with these options
Accessibility and Social Inclusion	Community		This Option is considered to have significant advantages over other options as it would provide an enhanced beach amenity area for the local community all along the coast. This would contribute positively to the amenity value of the area as well as the general public perception of the area.		This Option is considered to have some advantages over other options as it would provide an enhanced beach amenity area for the local community along the majority of the coast (including Greystones south beach). This would contribute positively to the amenity value of the area as well as the general public perception of the area. Rock revetment is also proposed along the northern part of this CCA as part of this option, which will likely limit any benefits of this option to the local community.
	Access		This Option is considered to have significant advantages over other options as it (for the most part) does not remove/curtail any formal or informal existing access points to the beach amenity area along its length and should improve access along the beach due to the increased size of beaches. Locations of proposed concrete splash walls are expected to be limited and therefore impacts on existing informal or formal points of access are also expected to be limited.		This Option is considered to have some advantages over other options as while there will be the imposition of rock revetment (and concrete splash walls where necessary) along a considerable stretch of the coastline of this CCA, access steps will be incorporated into these revetments to ensure any formal/informal access points to the beach amenity that currently exist and used by members of the public (for example the formal accesses to the beach amenity area from Kilcoole Train Station) are maintained. Beach nourishment is not likely to have any impact on existing informal or formal accesses within the vicinity in which is it proposed. Locations of proposed concrete splash walls are expected to be limited and therefore impacts on existing informal or formal points of access are also expected to be limited.
	Social and Recreation Facilities		This Option is considered to have significant advantages over other options as it provides additional and improved beach amenity areas all along the coastline of this CCA. However, this option also has disadvantages as the imposition of breakwaters may result in the creation of difficult and unsafe conditions for water-based recreational activities, such as swimming, sailing, etc.		This Option is considered to have some advantages over other options as it would provide for enhanced beach amenity areas along the majority of the coastline of this CCA, which would improve the environment for shore-based recreational activities. However, the placement of breakwaters may result in the creation of difficult and safe conditions for water-based recreational activities, such as swimming, sailing, etc. This Option has further disadvantages as the placement of rock revetment will likely remove or limit the recreational use of the northern-most section of the coastline within this CCA.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 6	Option 6 (Detached breakwaters with beach nourishment and concrete splash wall where required)	Option 7	Option 7 (Detached breakwaters with beach nourishment and concrete splash wall where required (A, D and E) Rock revetment (B and C)
Integration	Compatibility with Development Plans		This Option would have some disadvantages. It would impact on Marine Policy /Map based objectives such as cSPA, pNHA, SAC Advantage includes: enhancement of the area with beach amenity and coastal recreation amenity, elements of green infrastructure. This Option appears to require much less concrete than other options. Prospects appear to be retained from the DART line which options 4 and 5 don't facilitate. Significant amount of risk required for breakwaters and sand for beach nourishment.		This Option would have some disadvantages. It aligns with high level coastal protection and coastal area management objectives within the development plans. The disadvantages relating to this option are: Impacts relating to Indicative Green Route, Prosects, PNHA, SPA, SAC and Open Space Zoning. The profile of the concrete rock armour appears to be much more pronounced than other options. Significant volumes of materials required for revetments and breakwaters. Within the same Wicklow County Council Cell areas as Options 4, 5, and 6. Advantage includes: enhancement of the area with beach amenity and coastal recreation amenity, elements of green infrastructure.
	Compatibility with Climate Adaptation Plans		This would have some disadvantages as it has potentially negative based marine based impacts as well as requiring a significant volumes of rock to be transported offshore for the breakwaters. It also requires significant volume of beach nourishment to be transported to site. However it requires less concrete than Option 5. It generally aligns with Transport Climate Change Sectoral Adaptation Plan in terms of protecting the coastline and transport assets.		This Option would have disadvantages to other options as it would involve a significant volume of materials for the rock revetments to be brought to site as well as the potential for marine based impacts. It generally aligns with Transport Climate Change Sectoral Adaptation Plan in terms of protecting the coastline and transport assets.
	Compatibility with Transport Plans		This Option will improve the protection of the rail line against climate change impacts, in line with the Transport Strategy's aim to "provide a sustainable, accessible and effective transport system for the Greater Dublin Area which meets the region's climate change requirements, serves the needs of urban and rural communities, and supports economic growth". The Greater Dublin Area Cycle Network Plan proposes a National Cycle Route, the East Coast Trail, with an indicative route along part of the coastline between Greystones and Wicklow Town. Providing the intervention works can accommodate the East Coast Trail, this option will support the Transport Strategy.		This Option will improve the protection of the rail line against climate change impacts, in line with the Transport Strategy's aim to "provide a sustainable, accessible and effective transport system for the Greater Dublin Area which meets the region's climate change requirements, serves the needs of urban and rural communities, and supports economic growth". The Greater Dublin Area Cycle Network Plan proposes a National Cycle Route, the East Coast Trail, with an indicative route along part of the coastline between Greystones and Wicklow Town. Providing the intervention works can accommodate the East Coast Trail, this option will support the Transport Strategy.
	Biodiversity		This Option has significant disadvantages due to the loss of habitat from the construction of the detached breakwaters and beach nourishment. Construction effects include disturbance to QI species and habitat degradation. Short term disturbance from construction of breakwaters. Operational effects include loss of QI species and habitats under nourishment. Presence of Annex I species (annual vegetation drift lines) known to be present would be destroyed. In a sand/shingle community the niches between substrates are quite important and 'wave deposited sediment' (or human deposited sediment in this case) can reduce seed germination, change the arrangement of wave sorted sediments and lead to burial of seeds. Long term disturbance from future nourishments. Nourishment could encourage more people to the larger beach areas encouraging more disturbance. Potential for change to hydrology from breakwaters. Loss of SPA habitat under breakwaters. Changes to landward side wetland habitats unknown and Priority habitat of Calcareous fens present in this area. There are no Ramsar sites, there is one SAC (The Murrough SAC), one SPA (The Murrough SPA) and one NHA (The Murrough NHA) within CCA6.1. On the seaward side of the shingle bank which runs along The Murrough Wetlands SAC site drift line vegetation and previously rare and legally protected Oyster plant (Mertensia maritima) (Flora (Protection) Order, 1999) has been recorded on the gravelly shore (now considered extinct). Drift lines extend along entire length and perennial vegetation mainly in south. Salt meadows (Glauco-Puccinellietalia maritime) to west of rail in line two distinct and small locations which contains 80-100% cover. The shingle ridge at Kilcoole is a traditional nesting area for Little Tern, and the site now supports one of the largest colonies in the country. The birds nest along the entire stretch of the shore line. Light-bellied Brent Goose occurs here in internationally important numbers. Seals (QI of Lambay Island SAC) haul out here.		This Option would have significant disadvantages similar to Option 6. Although there are less detached breakwaters, there would still be significant loss of habitat from the breakwaters combined with the beach nourishment and revetments.
	Landscape and Visual and Seascape		Beach nourishment applied consistently along the stretch of coastline has the potential to have a positive influence. However, detached breakwaters applied consistently along the length of the coastline within the local coastal waters would be conspicuous, and would generate significant adverse landscape/seascape and visual effects.		Beach nourishment has potential to enhance the character and amenity of large sections of coastline and maintain a foreshore context. However, although to a lesser extent than Option 6, detached breakwaters within the local coastal waters would be conspicuous, and would generate significant adverse landscape/seascape and visual effects. The use of rock revetements along this stretch of coastline is considered an advantage over Option 8 due to its more natural qualities in line with the designated natural and scenic qualities, and is consistent with rock use along this coastal edge.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 6	Option 6 (Detached breakwaters with beach nourishment and concrete splash wall where required)	Option 7	Option 7 (Detached breakwaters with beach nourishment and concrete splash wall where required (A, D and E) Rock revetment (B and C)
Environment	Archaeology, Architectural and Cultural Heritage		This Option is similar to other options as no potential direct impacts or indirect setting and visual impacts on SMR Sites have been identified, there is the potential for direct impacts to occur on previously unrecorded archaeological heritage. There is the potential for indirect setting and visual impacts to occur on four NIAH Sites (16304027; House, 16304058; Railway Station, 16304095; Library/Archive and 16401912; Station master's house) three of which are also RPS Sites (16304058; RPS ref 08-63, 16304095; RPS ref 08-24 and 16401912; RPS ref 13-38) and one further RPS Site (19-12; Five Mile Point). There is also the potential for significant direct impacts to occur on previously unrecorded material culture. Significant advantages over Options 1 and 2.		This Option is similar to other options as no potential direct impacts or indirect setting and visual impacts on SMR Sites have been identified, there is the potential for direct impacts to occur on previously unrecorded archaeological heritage. There is the potential for indirect setting and visual impacts to occur on four NIAH Sites (16304027; House, 16304058; Railway Station, 16304095; Library/Archive and 16401912; Station master's house) three of which are also RPS Sites (16304058; RPS ref 08-63, 16304095; RPS ref 08-24 and 16401912; RPS ref 13-38) and one further RPS Site (19-12; Five Mile Point). There is also the potential for significant direct impacts to occur on previously unrecorded material culture. Significant advantages over Options 1 and 2.
	Marine Archaeology		There is the potential for significant direct impacts to occur on previously unrecorded wrecks, paleoenvironmental landscapes and material culture both within the sub-tidal areas within the footprint of the breakwaters and associated construction activity; and in connection with beach nourishment with the use of plant such as dredgers and associated activities during the transfer of shingle onto the beach.		There is the potential for significant direct impacts to occur on previously unrecorded wrecks, paleoenvironmental landscapes and material culture both within the sub-tidal areas within the footprint of the breakwaters and associated construction activity (section D - E); and in connection with beach nourishment with the use of plant such as dredgers and associated activities during the transfer of shingle onto the beach (section A - B and section D- E).
	Noise and Vibration		Noise impact will be from mobile plant when working in proximity to Noise Sensitive Locations in CCA6.1 A and B. Specific instances of elevated noise will be localised and temporary in this area but will require more frequent works into the future. Short term from construction noise underwater during construction of breakwaters along full extent of CCA6.1		Noise impact will be from mobile plant when working in proximity to Noise Sensitive Locations in CCA6.1 A and B . Specific instances of elevated noise will be localised and temporary in this area but will require more frequent works into the future. Lower density of Noise Sensitive Locations CCA6.1 C to E. There will be periods of night-time works required to work around tides for all proposed works. No significant vibration impacts from this proposal. Overall this option is similar to other options. No long term operational noise or vibration impacts.
	Air Quality		This Option would need ongoing monitoring and maintenance requirements to maintain the beach nourishment to the design levels along full length of scheme, hence some disadvantage. The maintenance has the potential for dust emissions but can be mitigated. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term. Potential for construction phase impacts associated with potentially dusty activities such as beach nourishment having a higher potential for dust. Assumption that all rock armour would be delivered by barge. This Option would have a potential dust impact on sensitive receptors in proximity to the works being carried out of which beach nourishment and breakwater installation use heavy Machinery to carry out. This Option is lower preference due to ongoing maintenance associated with beach nourishment of which there is much more than Option 5 and 9. Construction phase impacts would be likely considered short term and dust mitigation can be put in place.		This Option would need ongoing monitoring and maintenance requirements to maintain the beach nourishment to the design levels along full length of scheme, hence some disadvantage. The maintenance has the potential for dust emissions but can be mitigated. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term. Potential for construction phase impacts associated with potentially dusty activities such as beach nourishment having a higher potential for dust. Assumption that all rock armour would be delivered by barge. This Option would have a potential dust impact on sensitive receptors in proximity to the works being carried out of which beach nourishment and breakwater installation use heavy Machinery to carry out. This Option is lower preference due to ongoing maintenance associated with beach nourishment of which there is much more than Option 5 and 9. Construction phase impacts would be likely considered short term and dust mitigation can be put in place.
	Carbon Management		Whole Life Carbon (tonnes CO2e) was 126% of average across 9 options, therefore it has some advantages over other options. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term.		Whole Life Carbon (tonnes CO2e) was 117% of average across 9 options, therefore it has some advantages over other options. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term.
	Water Resources		This Option is similar to other options as there should be minimal impacts on groundwater		This Option is similar to other options as there should be minimal impacts on groundwater
	Geology and Soils		The combination of detached and beach nourishment will cause moderate disturbance to onshore geological resources throughout the cell. Where required concrete splash walls are expected to cause moderate disturbance to geological resources and may result in the remobilisation of contamination in CCA6.1-A. The introduction of a detached breakwater at CCA6.1-A may result in the remobilisation of contamination associated with a historic dredged material disposal site, although the site is not considered to be significantly contaminated. Similar to Option 7 due to anticipated level of disturbance.		The adoption of beach nourishment at CCA6.1-A and from CCA6.1-D to CCA6.1-E (with detached breakwaters) will cause moderate disturbance to geological resources. Where required concrete splash or wave walls are expected to cause moderate disturbance to geological resources and may result in the remobilisation of contamination in CCA6.1-A. Rock revetment in CCA6.1-B and CCA6.1-C is expected to cause minimal/moderate disturbance to geological resources. Similar to Option 6 due to anticipated level of disturbance.
	Material and Circular Economy		This Option would provide significant disadvantages over other options due to its comparatively high materials consumption score (10,839,355t).		This Option would provide some disadvantages over other options due to its comparatively high materials consumption score (6,303,271t).
	Waste		Minimal waste would be generated from the removal of existing structures (existing revetments will remain in place). In addition, this option is likely to be associated with comparatively low wastage (258t).		Minimal waste would be generated from the removal of existing structures (where rock revetments currently exist, the majority of the rock will be reused within the new revetments). In addition, this option is likely to be associated with comparatively low wastage (381t).
	Traffic and Transport		Minimal operational impact expected to traffic and transport; the intervention works will be localised to the coast and are not anticipated to affect transport systems or travel demand.		Minimal operational impact expected to traffic and transport; the intervention works will be localised to the coast and are not anticipated to affect transport systems or travel demand.
	Constructability		Challenging to construct in open water and depending on water depth at high tide bottom dumping of material to form the core may not be possible. Will require specialist marine equipment and knowledge of building similar structures. Weather risk is higher and general risk profile for construction is higher in comparison to other options. Material may need to be stockpiled on land or marine which results in double handling increasing cost and reducing efficiency.		Challenging to construct in open water and depending on water depth at high tide bottom dumping of material to form the core may not be possible. Will require specialist marine equipment and knowledge of building similar structures. Weather risk is higher and general risk profile for construction is higher in comparison to other options. Material may need to be stockpiled on land or marine which results in double handling increasing cost and reducing efficiency. The rock revetment and beach nourishment works are considered to be relatively straight forward, however the inclusion of detached breakwaters increases the complexity of these works considerably.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 6	Option 6 (Detached breakwaters with beach nourishment and concrete splash wall where required)	Option 7	Option 7 (Detached breakwaters with beach nourishment and concrete splash wall where required (A, D and E) Rock revetment (B and C)
Engineering/Technical	Rail Service Impact		No impact on railway during construction of the detached breakwaters. Minimal impact during beach nourishment. Some potential impact during the wall raisings		No impact on railway during construction of the detached breakwaters. Minimal impact during beach nourishment. Some potential impact during the wall raisings
	Reliance on Maintenance Maintenance burden		This Option has disadvantages compared to other options as it would require ongoing monitoring and maintenance requirements to maintain the beach to the design levels. The detached breakwaters should require minimal maintenance but routine inspections and post storm inspections should be undertaken.		This Option has advantages over Option 6 as the areas of beach requiring ongoing monitoring and maintenance are reduced
	Adaptation		This Option does allow for some future adaptation of the beach levels through additional beach nourishment. However, this would be limited by the height of the seawalls (beach levels could not be higher than the wall levels). Adaptation of the detached breakwaters is not practical		This Option does allow for some future adaptation of the beach levels through additional beach nourishment. However, this would be limited by the height of the seawalls (beach levels could not be higher than the wall levels). Adaptation of the detached breakwaters is not practical.
	Residual Risk		Breakwaters will reduce wave energy at the shoreline, making shoreline structures less likely to fail quickly. Breakwater failure is generally slow and not catastrophic.		This Option has some advantages over other options as the presence of detached breakwaters and beach nourishment will reduce the risk of failure of structures at the shoreline. However this option has revetments along some sections of the frontage giving it less advantages than Option 6
Planning Risk	Consenting Risk		A full upgrade of existing defences would protect the area for a longer time in line with planning policy Works are carried out in Natura 2000 sites with potential to require IROPI. Potential for significant landscape and visual effects. Marine based elements require planning (Maritime Area Consent) (Foreshore Licence) (Minister Consent). Could be considered to 'feel' more like an amenity space and integrate more appropriately.		A full upgrade of existing defences would protect the area for a longer time in line with planning policy Works are carried out in Natura 2000 sites with potential to require IROPI. Potential for significant landscape and visual effects. Marine based elements require planning (Maritime Area Consent) (Foreshore Licence) (Minister Consent). Could be considered to 'feel' more like an amenity space and integrate more appropriately.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 8	Option 8 (Detached breakwaters with beach nourishment and concrete splash wall where required (A,D and E) Concrete armour revetment (B and C))	Option 9	Option 9 (Phased option through rock toe protection to vegetation and maintenance and repairs to existing revetments)
Economy	Land Use and Third Party Assets		This Option has significant disadvantages as there would be impacts on third party land-owners with potential CPO required.		This Option has significant disadvantages as there would be impacts on third party land-owners with potential CPO required.
	Capital Expenditure		This Option has significant disadvantages as it requires marine based construction for a number of detached breakwaters in addition to beach nourishment and concrete armour unit revetments which are significantly more expensive to construct than rock armour revetments.		This Option has significant advantages because it requires significantly less rock volumes than other options. All construction could be land based.
	Maintenance Expenditure		This Option is similar to Option 7 but with the disadvantage and increased maintenance costs of the concrete armour unit revetment compared to the rock revetment.		This Option would have disadvantages as some of the rock berms may require more frequent maintenance as they approach the end of their design life (in the longer term)
Safety	Health and Safety (Construction)		This Option is similar to Option 7 but with a concrete armour revetment rather than exclusively rock armour. The inclusion of concrete armour units increases the safety risk as these units are heavy and challenging to construct, transport and place.		This Option requires works exclusively at the shoreline rather than open water. The rock toe works would be similar in nature to Option 4. The exclusive use of rock reduces the safety risk as all work could be executed by marine equipment.
	Health and Safety (Design Life)		This Option has disadvantages over Options 4 to 6 as it combines the risks associated with these options		This Option is similar to Option 4 but with less rock armour
Accessibility and Social Inclusion	Community		This Option is considered to have some advantages over other options as it would provide an enhanced beach amenity area for the local community along the majority of the coast (including Greystones south beach). This would contribute positively to the amenity value of the area as well as the general public perception of the area. Rock revetment is also proposed along the northern part of this CCA as part of this option, which will likely limit any benefits of this option to the local community.		This Option has some advantages over other options as it provides rock revetment and rock toe protection along the majority of this coastline of this CCA. While similar to other options with the placement of rock revetment along a considerable portion of the coastline, the beach amenity area will still be available for public use where rock toe protection is proposed. Furthermore, beach nourishment is proposed at Greystones south beach which will enhance this existing amenity for public use. As such, the impact on the amenity value and general public perception of the area as a result of this option is considered to be limited.
	Access		This Option is considered to have some advantages over other options as while there will be the imposition of concrete armour revetment (and concrete splash walls where necessary) along a considerable stretch of the coastline of this CCA, access steps will be incorporated into these revetments to ensure any formal/informal access points to the beach amenity that currently exist and used by members of the public (for example the formal accesses to the beach amenity area from Kilcoole Train Station) are maintained. Beach nourishment is not likely to have any impact on existing informal or formal accesses within the vicinity in which is it proposed. Locations of proposed concrete splash walls are expected to be limited and therefore impacts on existing informal or formal points of access are also expected to be limited.		This Option is considered to have some advantages over other options as while there will be the imposition of rock revetment along a considerable stretch of the coastline of this CCA, access steps will be incorporated into these revetments to ensure any formal/informal access points to the beach amenity that currently exist and used by members of the public (for example the formal accesses to the beach amenity area from Kilcoole Train Station) are maintained. Beach nourishment and rock toe protection are not likely to have any impact on existing informal or formal accesses within the vicinity in which is it proposed.
	Social and Recreation Facilities		This Option is considered to have some advantages over other options as it would provide for enhanced beach amenity areas along the majority of the coastline of this CCA, which would improve the environment for shore-based recreational activities. However, the placement of breakwaters may result in the creation of difficult and safe conditions for water-based recreational activities, such as swimming, sailing, etc. This Option has further disadvantages as the placement of concrete armour revetment will likely remove or limit the recreational use of the northern section of the coastline within this CCA.		This Option is considered to have some advantages over other options as the placement of rock revetment along the majority of the coastline within this CCA will likely limit or remove its use for recreational purposes. However, with only rock toe protection proposed for the southern-most section of the coastline of this CCA, recreational use of the shore and water at this location will largely remain unchanged.

CCA6.1 Emerging Preferred Option Multi Criteria Analysis

Core Criteria	Sub Criteria	Option 8	Option 8 (Detached breakwaters with beach nourishment and concrete splash wall where required (A,D and E) Concrete armour revetment (B and C))	Option 9	Option 9 (Phased option through rock toe protection to vegetation and maintenance and repairs to existing revetments)
Integration	Compatibility with Development Plans		This Option would have some disadvantages. It aligns with high level coastal protection and coastal area management objectives within the development plans. The disadvantages relating to this option are: Indicative Green Route, Prosects, PNHA, SPA, SAC and Open Space Zoning. Significant volumes of materials required for revetments and breakwaters. More Concrete required than Option 7. Within the same Cell areas as Options 4-to 7. Advantage includes: enhancement of the area with beach amenity and coastal recreation amenity, elements of green infrastructure. This Option appears to require less volume of materials.		This Option would have some advantages. It would impact on Marine Policy /Map based objectives such as SAC, PNHA, SPA and Open Space Zoning. Within the same Wicklow County Council Cell areas 4 and 5 BUT only a very small section is within Cell 6 at Kilcoole. Advantage includes: enhancement of the area with beach amenity and coastal recreation amenity, elements of green infrastructure. This Option appears to require much less concrete and hard infrastructure area than other options. Prospects may be impacted. Generally less impacts along the length of the coastline on comparison with other options
	Compatibility with Climate Adaptation Plans		This would have some disadvantages compared to other options as it would also involve a significant volume of rock and concrete. It generally aligns with Transport Climate Change Sectoral Adaptation Plan in terms of protecting the coastline and transport assets.		This Option has some advantages it requires less material than other options. It generally aligns with Transport Climate Change Sectoral Adaptation Plan in terms of protecting the coastline and transport assets.
	Compatibility with Transport Plans		This Option will improve the protection of the rail line against climate change impacts, in line with the Transport Strategy's aim to "provide a sustainable, accessible and effective transport system for the Greater Dublin Area which meets the region's climate change requirements, serves the needs of urban and rural communities, and supports economic growth". The Greater Dublin Area Cycle Network Plan proposes a National Cycle Route, the East Coast Trail, with an indicative route along part of the coastline between Greystones and Wicklow Town. Providing the intervention works can accommodate the East Coast Trail, this option will support the Transport Strategy.		This Option will improve the protection of the rail line against climate change impacts, in line with the Transport Strategy's aim to "provide a sustainable, accessible and effective transport system for the Greater Dublin Area which meets the region's climate change requirements, serves the needs of urban and rural communities, and supports economic growth". The Greater Dublin Area Cycle Network Plan proposes a National Cycle Route, the East Coast Trail, with an indicative route along part of the coastline between Greystones and Wicklow Town. Providing the intervention works can accommodate the East Coast Trail, this option will support the Transport Strategy.
	Biodiversity		This Option would have significant disadvantages similar to Option 7.		This Option would have some disadvantages. The footprint of the rock revetments is reduced compared to other options but the beach nourishment would lead to additional long term disturbances. Construction effects include disturbance to QI species and habitat degradation. A significant amount of rock armour would be needed for the underlayers which would also need to be transported by barge. Night time works could be needed causing disturbance. Operational effects include loss of QI species and habitats under the footprint of the revetment. Presence of Annex I species (annual vegetation drift lines) known to be present would be destroyed. In a sand/shingle community the niches between substrates are quite important and 'wave deposited sediment' (or human deposited sediment in this case) can reduce seed germination, change the arrangement of wave sorted sediments and lead to burial of seeds. Likely impacts somewhat reduced from toe protection as footprint smaller. Changes to landward side wetland habitats unknown and Priority habitat of Calcareous fens present in this area. On the seaward side of the shingle bank which runs along The Murrough Wetlands SAC site drift line vegetation and previously rare and legally protected Oyster plant (Mertensia maritima) (Flora (Protection) Order, 1999) has been recorded on the gravelly shore (now considered extinct). Drift lines extend along entire length and perennial vegetation mainly in south. Salt meadows (Glauco-Puccinellietalia maritime) to west of rail in line two distinct and small locations which contains 80-100% cover. The shingle ridge at Kilcoole is a traditional nesting area for Little Tern, and the site now supports one of the largest colonies in the country. The birds nest along the entire stretch of the shore line. Light-bellied Brent Goose occurs here in internationally important numbers. Seals (QI of Lambay Island SAC) haul out here.
	Landscape and Visual and Seascape		Beach nourishment has potential to enhance the character and amenity of a section of coastline. However, whilst recognised to be of a lesser extent than Option 6, detached breakwaters within the local coastal waters would be conspicuous, and would generate significant adverse landscape/seascape and visual effects. The use of concrete along this stretch of coastline is also considered inappropriate and incongruous with its designated natural and scenic qualities, and the mix of treatments employed would generate an inconsistent character that would be detrimental in terms of perceived character.		As a natural material, rock revetements would tie in comparatively successfully with the natural qualities of this long stretch of coastline, that is already influenced by existing rock revetements and the shingle beach material present. The placement of material would be more robust and considered than reactionary measures, and as such would complement and enhance those rock revetements already present. When used consistently, the continuous feature will have a scale and uniformity that will complement the large sweeping nature of this stretch of coastline, moderating landscape and visual effects. Rock toe protection is anticipated to have a comparatively reduced land take, facilitating a greater retention of the shoreline

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Environment	Archaeology, Architectural and Cultural Heritage		This Option is similar to other options as no potential direct impacts or indirect setting and visual impacts on SMR Sites have been identified, there is the potential for direct impacts to occur on previously unrecorded archaeological heritage. There is the potential for indirect setting and visual impacts to occur on four NIAH Sites (16304027; House, 16304058; Railway Station, 16304095; Library/Archive and 16401912; Station master's house) three of which are also RPS Sites (16304058; RPS ref 08-63, 16304095; RPS ref 08-24 and 16401912; RPS ref 13-38) and one further RPS Site (19-12; Five Mile Point). There is also the potential for significant direct impacts to occur on previously unrecorded material culture. Significant advantages over Options 1 and 2.		This Option is similar to other options as no potential direct impacts or indirect setting and visual impacts on SMR Sites have been identified, there is the potential for direct impacts to occur on previously unrecorded archaeological heritage. There is the potential for indirect setting and visual impacts to occur on four NIAH Sites (16304027; House, 16304058; Railway Station, 16304095; Library/Archive and 16401912; Station master's house) three of which are also RPS Sites (16304058; RPS ref 08-63, 16304095; RPS ref 08-24 and 16401912; RPS ref 13-38) and one further RPS Site (19-12; Five Mile Point). There is also the potential for significant direct impacts to occur on previously unrecorded material culture. Significant advantages over Options 1 and 2.
	Marine Archaeology		There is the potential for significant direct impacts to occur on previously unrecorded wrecks, paleoenvironmental landscapes and material culture both within the sub-tidal areas within the footprint of the breakwaters and associated construction activity (section D - E); and in connection with beach nourishment with the use of plant such as dredgers and associated activities during the transfer of shingle onto the beach (section A - B and section D- E).		There are no direct impacts on previously unrecorded wrecks, paleoenvironmental landscapes and material culture, and therefore no potential impact on archaeological features in the intertidal and marine elements.
	Noise and Vibration		Noise impact will be from mobile plant when working in proximity to Noise Sensitive Locations in CCA6.1 A and B . Specific instances of elevated noise will be localised and temporary in this area but will require more frequent works into the future. Lower density of Noise Sensitive Locations CCA6.1 C to E. There will be periods of night-time works required to work around tides for all proposed works. No significant vibration impacts from this proposal. Overall this option is similar to other options. No long term operational noise or vibration impacts.		Noise impact will be from mobile plant when working in proximity to Noise Sensitive Locations in CCA6.1 A and B . Specific instances of elevated noise will be localised and temporary in this area but will require more frequent works into the future. Higher noise emissions will be occur during rock toe protections works however these are proposed in areas with a low density of Noise Sensitive Locations CCA6.1 D to E set back from the works. There will be periods of night-time works required to work around tides for all proposed works. No significant vibration impacts from this proposal. Overall this option is similar to other options. No long term operational noise or vibration impacts.
	Air Quality		This Option would need ongoing monitoring and maintenance requirements to maintain the beach nourishment to the design levels along much of the length of scheme, hence some disadvantage. The maintenance has the potential for dust emissions but can be mitigated. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term. Potential for construction phase impacts associated with potentially dusty activities such as beach nourishment having a higher potential for dust. Assumption that all concrete armour units would be precast to reduce impacts. This Option would have a potential dust impact on sensitive receptors in proximity to the works being carried out of which beach nourishment and concrete armour units installation use heavy Machinery to carry out. This Option is lower preference due to ongoing maintenance associated with beach nourishment. Construction phase impacts would be likely considered short term and dust mitigation can be put in place.		This Option would need some ongoing monitoring and maintenance requirements to maintain the beach nourishment to the design levels. The maintenance has the potential for dust emissions but can be mitigated. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term. Potential for construction phase impacts associated with potentially dusty activities such as beach nourishment having a higher potential for dust. This Option would have a potential dust impact on sensitive receptors in proximity to the works being carried out of which beach nourishment and toe rock units installation use heavy Machinery to carry out. Options 5 and 9 are similar due to an ongoing requirement of beach nourishment maintenance in the more populated area near Greystones. Construction phase impacts would be likely considered short term and dust mitigation can be put in place.
	Carbon Management		Whole Life Carbon (tonnes CO2e) was 199% of average across the 10 options, therefore it is one of the less preferable of the options. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term.		Whole Life Carbon (tonnes CO2e) was 20% of average across the 9 options, therefore it is one of the most preferable of the options. This Option would facilitate operational phase reliance on public transport and reduce reliance on private vehicles for the long term.
	Water Resources		This Option is similar to other options as there should be minimal impacts on groundwater		This Option is similar to other options as there should be minimal impacts on groundwater
	Geology and Soils		The adoption of beach nourishment at CCA6.1-A and from CCA6.1-D to CCA6.1-E (with detached breakwaters) will cause moderate disturbance to geological resources. Where required concrete splash or wave walls are expected to cause moderate disturbance to geological resources and may result in the remobilisation of contamination in CCA6.1-A. Concrete armour unit revetment will cause moderate/ high disturbance of geological resources in CCA6.1-B and CCA6.1-C.		Rock revetment and wave walls are anticipated to cause minimal/moderate disturbance to geological resources in CCA6.1-A, and CCA6.1-D, with remobilisation of ground contamination associated with historical and current contaminative land features in CCA6.1-A. Rock toe protection to vegetation in CCA6.1-D and CCA6.1-E is anticipated to cause minimal disturbance to geological resources and areas of potential ground contamination.
	Material and Circular Economy		This Option would provide some disadvantages over other options due to its comparatively high materials consumption score (6,323,763t).		This Option would provide some advantages over other options due to its comparatively low materials consumption score (1,501,714t).
	Waste		This Option would provide some disadvantages over other options. Minimal waste would be generated from the removal of existing structures (where rock revetments currently exist, the majority of the rock will be reused within the new revetments). In addition, this option is likely to be associated with comparatively high wastage (8,441t).		This Option would provide some advantages over other options. Minimal waste would be generated from the removal of existing structures. In addition, this option is likely to be associated with comparatively low wastage (31t).
	Traffic and Transport		Minimal operational impact expected to traffic and transport; the intervention works will be localised to the coast and are not anticipated to affect transport systems or travel demand.		Minimal operational impact expected to traffic and transport; the intervention works will be localised to the coast and are not anticipated to affect transport systems or travel demand.
	Constructability		Challenging to construct in open water and depending on water depth at high tide bottom dumping of material to form the core may not be possible. Will require specialist marine equipment and knowledge of building similar structures. Weather risk is higher and general risk profile for construction is higher in comparison to other options. Material may need to be stockpiled on land or marine which results in double handling increasing cost and reducing efficiency. The inclusion of a concrete armour breakwater further increases the complexity of these works considerably and makes this option much more challenging to construct.		This Option would be relatively easy to construct as all works are at the shoreline and not open water. Works could be done exclusively by marine equipment and not require a significant landside footprint (depending on the source of the rock armour). This Option has advantages over Option 4 as it requires less works

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Engineering/Technical	Rail Service Impact		No impact on railway during construction of the detached breakwaters. Minimal impact during beach nourishment. Some potential impact during the wall raisings		No impact on railway during construction of the revetments Some potential impact during the wall raisings
	Reliance on Maintenance Maintenance burden		This Option has advantages over Option 6 as the areas of beach requiring ongoing monitoring and maintenance are reduced		This Option would require regular monitoring during the first 25 years prior to implementing the full scheme. The revetments would require a routine and post storm monitoring plan but should require minimal maintenance during the design life
	Adaptation		This Option does allow for some future adaptation of the beach levels through additional beach nourishment. However, this would be limited by the height of the seawalls (beach levels could not be higher than the wall levels). Adaptation of the detached breakwaters is not practical		This Option does allow for future adaptation as the main works will not be implemented until approximately 2055 so variations in climate change could be accounted for in the design of the works. Future adaptation following implementation of the main works would be limited to changes in the beach profiles.
	Residual Risk		This Option has some advantages over other options as the presence of detached breakwaters and beach nourishment will reduce the risk of failure of structures at the shoreline. However this option has revetments along some sections of the frontage giving it less advantages than Option 6		This Option would use new hard engineering to manage risk, with less reliance on a beach (which could be stripped out quickly in a significant event). If the new defence was compromised, failure could be rapid.
Planning Risk	Consenting Risk		A full upgrade of existing defences would protect the area for a longer time in line with planning policy Works are carried out in Natura 2000 sites with potential to require IROPI. Potential for significant landscape and visual effects. Marine based elements require planning (Maritime Area Consent) (Foreshore Licence) (Minister Consent). Could be considered to 'feel' more like an amenity space and integrate more appropriately.		Works are carried out in Natura 2000 sites but to a lesser extent than other options - less risk of IROPI. Marine based elements require planning (Maritime Area Consent) (Foreshore Licence) (Minister Consent). This is a 'soft engineering' approach that could be more preferable to potential third party objectors. Could be less visual impacts and could be considered to 'feel' more like an amenity space and integrate more appropriately.