REPORT

Millport Coastal Flood Protection Scheme: Environmental Statement

Chapter 8 Benthic and Intertidal Ecology

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Acronyms

Acronym	Acronym description
BAP	Biodiversity Action Plan
CCW	Countryside Council for Wales
CEMP	Construction Environmental Management Plan
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute for Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
EAP	Ecological Action Plan
EcIA	Ecological Impact Assessment
EcOW	Ecology Clerk of Works
EIA	Environmental Impact Assessment
ES	Environmental Statement
ES	Environmental Statement
GPS	Global Positioning System
JNCC	Joint Nature Conservation Committee
LDP	Local Development Plan
LNCS	Local Nature Conservation Site
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
NALBAP	North Ayrshire Local Biodiversity Action Plan

NPF	National Planning Framework
NPPG	National Pollution Prevention Guidelines
PAN	Planning Advice Note
PARC	Port and Resource Centre
SAC	Special Area of Conservation
SEPA	Scottish Environment Protection Agency
SLR	Single Lens Reflex
SMP	Shoreline Management Plan
SNH	Scottish Natural Heritage
SPP	Scotland's Planning Policy
SSSI	Site of Special Scientific Interest
SWSEIC	South West Scotland Environmental Information Centre
SWT	Scottish Wildlife Trust
TN	Target Note
UK	United Kingdom

Glossary

Glossary Term	Glossary Text
dB(A)	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Ecological Impact Assessment (EcIA)	EIA specifically for ecological receptors (i.e. habitats and species) which may be affected, following guidance published by the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (2018) as amended
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement.
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Millport Coastal Flood Protection Scheme	The scheme consists of offshore rock armour structures which will be built in the vicinity of the rock islets within Millport Bay. Onshore works will include flood walls, improvement works to existing coast protection structures, and works to raise the level of existing grass areas. Works on the foreshore include shore-connected rock armour breakwaters and rock armour revetments.

8 Benthic and Intertidal Ecology

8.1 Introduction

1. This chapter of the Environmental Statement (ES) considers the potential impacts of the proposed Millport Coastal Flood Protection Scheme (the proposed scheme) on Benthic and Intertidal Ecology

2. This chapter provides a summary description of key aspects relating to existing benthic and intertidal ecology followed by an assessment of the magnitude and significance of the effects upon the baseline conditions resulting from the construction, operation and decommissioning of the Proposed Scheme as well as those effects resulting from cumulative interactions with other existing or planned projects.

3. The potential effects on benthic and intertidal ecology are assessed conservatively using realistic worst-case scenarios for the proposed scheme.

4. All figures referred to in this chapter are provided in Volume II of this ES.

5. The assessment of potential effects has been made with specific reference to Scotland's National Planning Framework and Planning Policy (discussed further in **Chapter 2 Policy and Legislation**). These are the principal decision-making documents for flood protection schemes.

6. This chapter has been prepared by Royal HaskoningDHV in accordance with the relevant legislation and policies, adhering to the methodology for Environmental Impact Assessment (EIA), Ecological Impact Assessment (EcIA) and Cumulative Impact Assessment (CIA) as discussed in Section 8.4.

7. Due to the close association between benthic and intertidal ecology and other marine receptors, this chapter should be read in conjunction with **Chapter 6 Marine Geology, Oceanography and Physical Processes, Chapter 7 Marine Water and Sediment Quality, Chapter 9 Fish and Shellfish Resource, Chapter 10 Marine Mammals and Basking Shark, and Chapter 12 Commercial Fisheries**. Otters are considered in **Chapter 16 Terrestrial Ecology**.

8. Additional information to support the assessment of impacts on benthic and intertidal ecology is provided separately in the following appendices:

   - Appendix 8.1 Benthic Drop Down Video Survey Report (Volume III):
   - Appendix 8.2 Intertidal Survey Report (Volume III):

8.2 Policy, Legislation and Guidance

9. The policies and plans outlined throughout this section have also been reviewed for their relevance to benthic and intertidal ecology when undertaking the EcIA for the proposed scheme.

10. An overview of the relevant legislative context for the Project is provided in **Chapter 2 Policy and Legislation**.

8.2.1 Legislation

11. For benthic and intertidal ecology, relevant legislation is as follows:

12. International:
    - Habitats Directive Council (Directive 92/43/EEC) and other associated habitat regulations:
    - Birds Directive (Directive 2009/147/EC);
    - Ramsar Convention of Wetlands of International Importance;
    - Water Framework Directive (WFD) (EU Directive 200/60/EC);
    - Marine Strategy Framework Directive (MSFD); and
    - The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention 1992).
13. National:
    - Wildlife and Countryside Act 1981 (as amended) (includes amendments made via the Wildlife and Natural Environment (Scotland) Act 2011);
    - Marine and Coastal Access Act 2009;
    - Nature Conservation (Scotland) Act 2004;
    - Conservation (Natural Habitats, &c.) Regulations 1994 (as amended);
    - Marine (Scotland) Act 2010; and
    - Water Environment and Water Services (Scotland) Act 2003.

8.2.2 Planning Policy

14. For benthic and intertidal ecology, the following planning policies are relevant:

<u>National Planning Framework:</u>

15. Scotland's third National Planning Framework (NPF) (Scottish Government, 2014a) includes the following ambitions relevant to the marine environment at Millport, and these have been considered when undertaking the EIA for the proposed scheme:

16. *Para 4.10 The 2020 Challenge for Scotland's Biodiversity aims to promote and enhance Scotland's nature, and to better connect people with the natural world. Maintaining our natural capacity to provide services makes economic sense – to help achieve this, biodiversity in Scotland needs to be viewed at a landscape scale;*

17. And:

18. *The coast and islands will capitalise on their world-class environment.*
19. *Para 4.29 The environment of our coastal areas, on land and at sea, is an outstanding, internationally important resource. These natural assets support quality of life and underpin important economic sectors like tourism, outdoor recreation and food and drink.*
20. *Para 4.30 The marine environment, and its natural resources, are central to this. National and Regional Marine Plans will provide policies to achieve sustainable development, protection and, where appropriate, enhancement of the marine area. Onshore, land management practices, including crofting in the north and west and on the islands, help to sustain unique cultural and natural environments.*
21. *Para 4.31 As climate change impacts on Scotland's coastline, there will be a need to address the long-term resilience of some island and coastal communities.*

Natural Environment White Paper 2011

22. The paper was the first White Paper produced by the government in 20 years. The paper contains plans to reconnect nature, connect people and nature for better quality of life and capture and improve the value of nature.

A Green Future: Our 25 Year Plan to Improve the Environment 2018

23. The plan sets out 10 goals and a range of high-level policies aimed at helping "the natural world regain and retain good health". The key policies within the plan relevant for this chapter are:
    - Embedding an 'environmental net gain' principle for development, including housing and infrastructure;
    - Focusing on woodland to maximise its many benefits; and
    - Protecting and recovering nature (including improving biosecurity to protect and conserve nature).

Scottish Planning Policy

24. Scotland's Planning Policy (SPP) (Scottish Government, 2014b) contains the following Policy Principles with regards to Valuing the Natural Environment and these have been taken into consideration when undertaking the EcIA for the proposed scheme:

The planning system should:

- *Facilitate positive change while maintaining and enhancing distinctive landscape character;*
- *Conserve and enhance protected sites and species, taking account of the need to maintain healthy ecosystems and work with the natural processes which provide important services to communities;*
- *Promote protection and improvement of the water environment, including rivers, lochs, estuaries, wetlands, coastal waters and groundwater, in a sustainable and co-ordinated way;*
- *Seek benefits for biodiversity from new development where possible, including the restoration of degraded habitats and the avoidance of further fragmentation or isolation of habitats; and*
- *Support opportunities for enjoying and learning about the natural environment.*
- *The planning system should support an integrated approach to coastal planning to ensure that development plans and regional marine plans are complementary.*

Planning Advice Notes (PANS)

25. *Planning Advice Note (PAN) 1/2013: Environmental Impact Assessment* explains the role of individual planning authorities and that of the Consultation Bodies in EIA, as well as providing guidance on the ways in which EIA can be integrated into the overall development management process.

26. *PAN 60: Planning for Natural Heritage* provides advice on how development and the planning system can contribute to the conservation, enhancement, enjoyment and understanding of Scotland's natural environment and encourages developers and planning authorities to be positive and creative in addressing natural heritage issues. It complements the National Planning Policy Guideline on Natural Heritage (NPPG 14), with examples of good planning practice in relation to natural heritage drawn from across Scotland highlighted in a number of case studies.

National Planning Policy Guidelines (NPPG)

27. *National Planning Policy Guideline (NPPG) 14: Natural Heritage* gives guidance on how the Government's policies for the conservation and enhancement of Scotland's natural heritage should be reflected in land use planning. In this context, Scotland's natural heritage includes its plants and animals, its landforms and geology, and its natural beauty and amenity. Natural heritage embraces the combination and interrelationship of landform, habitat, wildlife and landscape and their capacity

to provide enjoyment and inspiration. It therefore encompasses both physical attributes and aesthetic values and, given the long interaction between human communities and the land in Scotland, has important cultural and economic dimensions.

Scotland's National Marine Plan: A Single Framework for Managing Our Seas

28. This Plan was published in 2015 and provides a comprehensive overarching framework for all marine activity in our waters. It enables sustainable development and use of our marine area in a way which will protect and enhance the marine environment whilst promoting both existing and emerging industries.

Clyde Regional Marine Plan

29. A pre-consultation on the draft Clyde Regional Marine Plan took place between 18th March and 27th May 2019. The first version of the SPP for the Clyde Regional Marine Plan was given Ministerial approval in December 2017. This version has since been updated to reflect changes in the pre-consultation draft phase. The most recent version was given Ministerial Approval in December 2018.

30. The Plan will create a framework for integrated, sustainable and co-ordinated planning and management of the Clyde Marine Region's environmental, economic and community resource.

Ayrshire Shoreline Management Plan

31. The Ayrshire Shoreline Management Plan (SMP) has been completed by North Ayrshire and South Ayrshire Councils. It was adopted by both councils in September 2018. The SMP is a large-scale assessment of the risks associated with coastal tides. It will help to inform the future management of these risks to land and people by delivering an action plan and includes the island of Great Cumbrae.

Local Development Plans

32. The proposed scheme falls within the North Ayrshire Council local authority boundaries.

33. The Proposed Scheme falls within the North Ayrshire Council local authority boundaries. North Ayrshire adopted its new Local Development Plan 2 in November 2019 (North Ayrshire Council, 2019).

34. The Ayrshire Joint Structure Plan 'Growing A Sustainable Ayrshire' (North Ayrshire Council, East Ayrshire Council and South Ayrshire Council, 2007) establishes a framework that brings together the aspirations of communities with those of business and industry, and the area's many supporting agencies and organisations, to provide a strategic land use context to the year 2025.

35. Table 8-1 provides details of the local planning policy documents and the relevant policies in respect to benthic and intertidal ecology. Designated areas which these policies may refer to are shown on Figure 8-2. These policy document have been considered when undertaking the EcIA for the Proposed Scheme.

Table 8-1 Relevant local planning policies

Document	Policy / Guidance	Policy / Guidance purpose	ES Reference
North Ayrshire Council Local Development Plan, November	Policy 16: Protection of our Designated Sites	To support development which would not have an unacceptable adverse effect on our valuable natural environment as defined by	Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6

Document	Policy / Guidance	Policy / Guidance purpose	ES Reference
2019 (North Ayrshire Council, 2019)		the following legislative and planning designations	
	Policy 22: Water Quality Environment	Protecting and enhancing the ecological status and riparian habitat, natural heritage, landscape values and physical characteristics of water bodies (including biodiversity and geodiversity);	Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6. See also **Chapter 7 Marine Water and Sediment Quality**
North Ayrshire Council Environmental Policy, 2012 (North Ayrshire Council, 2012)	Challenge 3: To protect and enhance the natural environment	Protecting and preventing loss of wildlife habitats, flora and fauna; Supporting the creation of new habitats and habitat networks in both the rural and urban environment through local biodiversity action planning; Conserving and enhancing the quality and character of the landscape; Promoting the value of ecosystem services, including green engineering technology; and Encouraging sustainable public access to and enjoyment of the outdoors.	Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6
Ayrshire Joint Structure Plan (2014)	ENV 7 Natural Heritage Designations	The three Ayrshire Councils shall: Recognise international and national natural heritage designations and the statutory protection afforded by them; Support the identification of additional Local Natural Reserves and continue to work with other stakeholders to implement the Ayrshire Local Biodiversity Action Plan Local plans shall include policies based on the Scottish Executive Model Policies for the protection for all sites of recognised international and national natural heritage importance.	Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6
	ENV 9 Water Framework Directive	The three Ayrshire councils shall work with other agencies to introduce the Water Framework Directive into Planning Policy.	Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6

Document	Policy / Guidance	Policy / Guidance purpose	ES Reference
	ENV 10 Integrated Coastal Zone Management	North and South Ayrshire Councils shall bring forward proposals for a coastal zone management plan for the Ayrshire coastline.	Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6

8.2.3 Best Practice and Guidance

36. The impact assessment has been based upon the following guidance and standards:
    - Chartered Institute of Ecology and Environmental Management (CIEEM) (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine;
    - CIEEM Guidelines for Ecological Report Writing (2nd Edition, December 2017).
    - A Handbook on Environmental Impact Assessment (SNH, 2002);
    - British Standard 42020:2013 –Biodiversity. Code of Practice for planning and development (British Standard, 2013);
    - CIRIA Guidance note C692 Environmental Good Practice on Site Guide (3rd edition) (CIRIA, 2010);
    - Joint Nature Conservation Committee Marine Monitoring Handbook (2001);
    - Planning Advice Note 1/2013: Environmental Impact Assessment (Scottish Government, 2013);
    - Scottish Biodiversity List (Biodiversity Scotland, undated);
    - National Planning Policy Guidance (NPPG) 14 Natural Heritage (Scottish Government, 1999);
    - Planning Advice Note (PAN) 60 (Planning for Natural Heritage) (Scottish Government, 2008).
    - Scottish Natural Heritage website: guidance on protected species (https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-species) (SNH, 2019);
    - GB Non-native Species Secretariat (2015) Species Information; and
    - Guidance for Pollution Prevention (GPP) as detailed in Chapter 7 Marine Water and Sediment Quality.

8.3 Consultation

37. To inform the ES, North Ayrshire Council has undertaken a thorough pre-application consultation process, which has included the following key stages:
    - Scoping Reports submitted to Marine Scotland and North Ayrshire Council (Royal HaskoningDHV 2017); and
    - Scoping Opinion received from Marine Scotland and North Ayrshire Council (2017).

38. Full details of the proposed scheme consultation process to date is presented within **Chapter 3 EIA Methodology and Consultation.**

39. A summary of the consultation carried out at key stages throughout the proposed scheme, of particular relevance to marine and intertidal ecology, is presented in Table 8-2.

Table 8-2 Consultation responses

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
Joint Nature Conservation	Scoping Response	This development proposal is not located within the offshore area, does not have any potential offshore nature conservation	Assessment on SSSI, SWT Sites, habitats and

Consultee	Date/ Document	Comment	Response / Where addressed in the ES
Committee (JNCC)		issues and is not concerned with nature conservation at a UK level. JNCC therefore does not have any comments to add to this consultation.	species are undertaken in Section 8.6
Scottish Natural Heritage (SNH)	Scoping Response	The report correctly identifies the key areas of concern to this organisation and these issues have been adequately described. The proposed measures for baseline surveys and completing the assessment of the potential impacts on the natural heritage should lead to a fair assessment of the project.	Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6
SNH	Scoping Response	Following consultation with Scottish Natural Heritage (SNH) it was agreed that benthic surveys were required to confirm the presence/absence of maerl in Kames Bay and to provide baseline information on the benthic environment to inform any further developments within the study area. These surveys included: • Drop-down video to facilitate biotope classification; and • Inter-tidal transects to identify biotopes along the shore.	The drop-down video surveys were conducted within 25 locations within Kame Bay and the intertidal habitats of the Eileans were also surveyed for characterisation of biotopes and are discussed in Section 8.5. Assessment on SSSI, SWT Sites, habitats and species are undertaken in Section 8.6
Scottish Environment Protection Agency (SEPA)	Scoping Response	Invasive species surveys should not be limited to *Sargassum miticum* as there are issues with *Styela* sea squirt and a non-native carpet sea squirt species *Didemnum vexillum* at Largs Yacht Haven.	Baseline data for all marine non-native invasive species is discussed in Section 8.5
SEPA	Scoping Response	Measures should be included to prevent the spread of marine non-native invasive species including action or mitigation (see Section 8 of the River Basin Management Plan for the Scottish River Basin District 2015 - 2017 and the UK Marine Pathway project)	Assessment on marine invasive non-native species is undertaken in Section 8.6

40. Following consultation with Scottish Natural Heritage (SNH) it was agreed that benthic surveys were required to confirm the presence/absence of maerl in Kames Bay and to provide baseline information on the benthic environment to inform any further developments within the Benthic Study Area. These surveys included:
    - Drop-down video to facilitate biotope classification; and
    - Inter-tidal transects to identify biotopes along the shore.

41. The drop-down video surveys were conducted within 25 locations within Kame Bay and the intertidal habitats of the Eileans were also surveyed for evidence of biotopes (Bunker *et al.,* 2018 Appendix 8.1).

8.4 Methodology

42. This section describes the methodology used to obtain baseline data, characterise the marine and intertidal of the area and undertake the EcIA. The primary study area (the Benthic Study Area) is Millport Bay, located between Millburn Street (west) (NS 15820 54609) and Kames Bay (east) (NS17233 54949), and is approximately 1.55 km^2 (Figure 8-1). Baseline data was obtained through a number of sources, namely:

- Desk study (Appendix 16.1);
- Drop down video survey (Appendix 8.1); and
- Intertidal survey (Appendix 8.2)

8.4.1 Baseline Data and Study Area

8.4.1.1 Data Sources – Desk Study

43. Biological records were obtained from the South West Scotland Environmental Information Centre (SWSEIC) in November 2017. The data search returned all records of statutory and non-statutory designated sites for nature conservation within the Desk Study Area – an area 2km of the Ecology Survey Area boundary described in **Chapter 16 Terrestrial Ecology**. The data search also searched for records of protected and notable species within 2km of the survey area boundary. Results of the search are presented in Appendix 16.1. Sties designated for marine or intertidal nature conservation within the 2km Desk Study Area are shown in Figure 8-2.

8.4.1.2 Data Sources – Site Specific Surveys and Reports

Intertidal survey of Great Cumbrae

44. The intertidal survey of the Great Cumbrae coastline is provided in Appendix 8.2 and was completed in conjunction with an Extended Phase 1 Survey (Appendix 16.1). The objectives of the survey were to:

- Identify the habitats and communities present within the survey area;
- Identify and locate the presence of any rare or protected species within the Intertidal Study Area, and
- Provide target notes (TN) of each biotope, including characterising, rare, protected and non-native species encountered.

45. The survey covered the intertidal habitats within the Intertidal Study Area presented in Figure 8-2, hereafter called the Intertidal Study Area. The survey was designed to include all intertidal areas which may be impacted by the Proposed Scheme. It extends from the old Lido in the west through Newtown Bay and Kames Bay and out towards Farland Point in the east. Due to access restrictions, it did not include the islands in the bay, which were accessed during the drop-down video surveys for completeness and discussed below.

46. The survey was conducted at low spring tide. Weather conditions were fair to good for the duration of the survey, with some light and heavy rain during the early afternoon. Wind conditions were slight

throughout the morning with increasing wind speed during the afternoon. The conditions did not inhibit the survey in any way. Sea state remained calm (sea state 1 or 2) throughout the majority of the survey rising to 3 in the afternoon. low water was at 9:27am BST and was 0.4m in height.

47. The field survey was completed by two experienced ecologists from Royal HaskoningDHV operating on foot, using a number of methods and techniques, based upon those specified in the Countryside Council for Wales (CCW) report 'CCW Handbook for marine intertidal Phase 1 mapping' (Wyn et al., 2000) and the 'Marine Nature Conservation Review: Rationale and methods' (Hiscock, 1996).

48. Target notes (Appendix 8.2) were recorded and photos taken at target note locations. Target notes were located wherever an obvious change in either the biological zonation or physiological conditions appeared to occur. A handheld tablet and Garmin Global Positioning System (GPS) were used to record data and provide positioning for each target note which were then mapped using ArcGIS 10.4 after the survey was completed. Photos were taken using the tablet and a digital Single Lens Reflex (SLR) camera. Appendix 8.2 primarily contains the photos taken using the tablet as well as some photos taken using the SLR (A full portfolio of all photos taken with the SLR are provided in digital format with this report).

49. A biotope code was assigned to each target note using the Marine Habitat Classification for Britain & Ireland (v15.03) (JNCC, 2015) and the boundaries where different sets of biotopes was also recorded. This was conducted using a combination of methods including the use of the Marine Habitat Classification online search facility available on the JNCC website.

50. The survey was subject to the following limitations:
    - As the survey was conducted during one tidal cycle and the Intertidal Study Area covers approximately 2.5km of coastline the lower shore was only accessed at a very limited number of locations. Intertidal areas which would be affected most by the proposed development were prioritised during low water, however as sediment samples also required collection at low water it was not possible to survey all the priority areas close to low water;
    - The end section of Millport pier located at target note 16 (Figure 8-3) has been deemed unsafe and access to the structure is prevented by a cordon, therefore the communities on this section of the pier were not surveyed; and
    - No infaunal investigations were carried out in sediment shores and these biotopes have been assigned at levels 2 and 3.

Intertidal survey of the Eileans

51. The intertidal biotopes on the Eileans outcrops were studied via two transects (see Appendix 8.1). Key habitats and species and general zonation patterns were recorded and supported by photographs. The surveys were undertaken on the 20th the January 2018 and comprised of a brief walk over the shores beginning at 0915hrs (an hour and 45minutes after low water). Both transects were walked from lower to upper shore. Due to the height of the tide, much of the lower shore was covered by 0915hrs. However, the boat was landed near Transect A and a rapid assessment of the shore biotopes was undertaken through the water where biotopes were hidden. The survey results were supported by photographs and notes.

52. A video transect (Site 26) was also undertaken running from the sublittoral sediment/rock interface below the Eileans to their shallow sublittoral at the bottom of the shores

Drop down video survey

53. The Benthic Study Area is located between Millburn Street (west) (NS 15820 54609) and Kames Bay (east) (NS 17233 54949), and is approximately 1.55 km^2 (Figure 8-4).

54. The survey was to focus on the offshore elements, with additional sample areas within the bay (Figure 8-4), using drop down video to study an area of seabed extending 400 m from the outer edge of the proposed works. The following methodology was employed:
    - High resolution video data was collected from a minimum of 25 stations within the area defined above;
    - The location of each station was recorded at the time of video deployment, using GPS, along with date, time and weather conditions (including sea state) at time of deployment;
    - Immediately before deployment at each station, the video was 'carded' with the video used to record footage of a board detailing station number, date and time;
    - At each station 2 minutes of stable and clear seabed footage was collected;
    - Video data collected at each station was sufficient to identify seabed characteristics and key epibenthic species sufficient to characterise benthic biotopes;
    - The constraints on identification of sediment biotopes using video were understood and biotopes were identified to the greatest level of detail possible using video and given conditions at time of survey; and
    - A key requirement at each station was confirmation of presence / absence of maerl and / or maerl beds.
    - If maerl beds were encountered; the surveyors were to determine the edges of the bed if possible. No maerl was recorded during the survey.

55. Two GoPro Hero4 (Black) 4K video cameras with dedicated lighting were mounted on a light-weight steel frame which could be easily lowered and raised by hand. The GoPros shared the drop-down frame with a bullet camera. The secondary camera provided a real-time view of the seabed on a screen on the boat, via an umbilical. This ensured the 4K GoPro footage was being taken through clear water and was of good quality. During each drifted drop, the frame was constantly landed on the seabed for several seconds to enable clear stable footage, and still images to be collected. By way of in-situ quality control, when the camera was back on the surface, a smart phone, paired with the GoPro, was used to review the footage, prior to manoeuvring to the next site.

56. A good quality hand-held GPS (Garmin Montana 610) was used, with the horizontal accuracy (as displayed on the GPS) being monitored at all times to ensure that it remains within ± 1m. Care was taken to deploy the camera so that it landed as close to the target position as possible, by taking account of the current and controlling speed and angle of the camera's descent.

57. The video was viewed on a 4K iMac computer using Apple Photos software and stills photos were exported where appropriate. Still photographs were then reduced in size for this report using Adobe Photoshop software.

58. During the video analysis, data was entered directly into an Excel spreadsheet. Biotopes were assigned to the video drops using the JNCC Marine Habitat Classification (JNCC, 2015).

59. The field data together with a summary of the video analysis was incorporated into QGIS software to create maps and export shape files.

8.4.1.1 Summary of Study Areas

60. A summary of the study areas outlines in Section 8.4.1 is presented below in Table 8-3.

Table 8-3 Study areas

Study Area	Distance from scheme boundary	Data type obtained
Desk Study Area: All habitats and species, including nature conservation designated sites	2km	Desk Study
Benthic Study Area	Millport Bay	Field Survey
Intertidal Study Area	Coastline of Millport Bay (great Cumbrae) plus two transects on the Eileans	Field Survey

8.4.2 Survey Limitations

61. During the intertidal survey, the end section of Millport pier, located at target note 16 (Figure 1), is deemed unsafe and access to the structure is prevented by a cordon, therefore the communities on this section of the pier were not surveyed.

62. Intertidal sediments were assessed by surface features.

63. The drop down video survey was undertaken in January and therefore many epibiota species were likely to be absent/ difficult to see during winter months.

8.4.3 Impact Assessment Methodology

64. General methods for EIA are discussed in **Chapter 3 EIA Methodology and Consultation.** The following sections describe the methodology used to assess the potential impacts of the proposed scheme on benthic and intertidal ecology in more detail.

65. The approach to determining the significance of an impact follows a systematic process for all impacts. This involves identifying, qualifying and, where possible, quantifying the sensitivity, importance and magnitude of all ecological receptors which have been scoped into this assessment. Using this information, a significance of each potential impact has been determined. Each of these steps is set out in the remainder of this section.

66. The EcIA has used professional judgement to ensure the assessed significance level is appropriate for each individual receptor, taking account of local values for biodiversity to avoid a subjective assessment wherever possible as per the CIEEM guidelines. As a result, the assessed significance level may not always be directly attributed to the guidance matrix detailed below.

67. For the impacts on benthic and intertidal ecology a number of discrete receptors can be identified. These include certain morphological features with ascribed inherent values, such as:

- Designated sites;
- Habitats; and
- Species.

8.4.3.1 Sensitivity, Importance, Magnitude

68. The sensitivity and importance of discrete receptors and the magnitude of effect are assessed using expert judgement and described with a standard semantic scale. These expert judgements of receptor sensitivity, importance and magnitude of effect are guided by the conceptual understanding of baseline conditions.

69. The sensitivity of a receptor (Table 8-4) is dependent upon its:

- Tolerance: the extent to which the receptor is adversely affected by an effect;
- Adaptability: the ability of the receptor to avoid adverse impacts that would otherwise arise from an effect; and
- Recoverability: a measure of a receptor's ability to return to a state at, or close to, that which existed before the effect caused a change.

Table 8-4 Definitions of Sensitivity Levels for a Morphological Receptor

Sensitivity	Definition
High	Tolerance: Receptor has very limited tolerance of effect Adaptability: Receptor unable to adapt to effect Recoverability: Receptor unable to recover resulting in permanent or long-term (greater than ten years) change
Medium	Tolerance: Receptor has limited tolerance of effect Adaptability: Receptor has limited ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the medium term (5-10 years)
Low	Tolerance: Receptor has some tolerance of effect Adaptability: Receptor has some ability to adapt to effect Recoverability: Receptor able to recover to an acceptable status over the short term (1-5 years)
Negligible	Tolerance: Receptor generally tolerant of effect Adaptability: Receptor can completely adapt to effect with no detectable changes Recoverability: Receptor able to recover to an acceptable status near instantaneously (less than one year)

70. In addition, a *importance* component may also be considered when assessing a receptor (Table 8-5). This ascribes whether the receptor is rare, protected or threatened.

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Table 8-5 Definitions of the Different Importance Levels for a Morphological Receptor

Importance	Definition
High	Importance: Receptor is designated and/or of national or international importance for benthic and intertidal ecology. Likely to be rare with minimal potential for substitution. May also be of significant wider-scale, functional or strategic importance
Medium	Importance: Receptor is not designated but is of local to regional importance for benthic and intertidal ecology
Low	Importance: Receptor is not designated but is of local importance for benthic and intertidal ecology
Negligible	Importance: Receptor is not designated and is not deemed of importance for benthic and intertidal ecology

Magnitude

71. The magnitude of the impact is assessed according to:
    - The extent of the area subject to a predicted impact;
    - The duration the impact is expected to last prior to recovery or replacement of the resource or feature;
    - Whether the impact is reversible, with recovery through natural or spontaneous regeneration, or through the implementation of mitigation measures or irreversible, when no recovery is possible within a reasonable timescale or there is no intention to reverse the impact; and
    - The timing and frequency of the impact, i.e. conflicting with critical seasons or increasing impact through repetition.

72. Table 8-6 summarises the definitions of magnitude that have been used for the onshore ecology receptors.

Table 8-6 Definitions of magnitude levels

Magnitude	Definition
High	Major impacts on the feature, which would have a sufficient effect to alter the nature of the feature in the short to long term and affect its long-term viability. For example, more than 20% habitat loss or damage.
Medium	Impacts that are detectable in short and long-term, but which should not alter the long-term viability of the feature. For example, between 10 - 20% habitat loss or damage.
Low	Minor impacts, either of sufficiently small-scale or of short duration to cause no long-term harm to the feature. For example, less than 10% habitat loss or damage.
Negligible / No Impact	A potential impact that is not expected to affect the feature in any way, therefore no effects are predicted.

Duration

73. The definitions of duration used within this EcIA are dependent on the individual ecological receptor, and how sensitive it is to effects over different timescales. However, in general terms the following definitions have been used:
    - **Short term**: effects which at most occur over a part of, or over a part of a key period of, a species' active season or a habitat's growing season, i.e. typically effects which occur over a matter of days or weeks;
    - **Medium term**: effects which occur over the full duration of a species' active season or a habitat's growing season, i.e. typically effects which occur over a matter of months or one year; and
    - **Long term**: effects which occur over the multiple active or growing seasons, i.e. typically effects which occur over more than one year.

74. Where deviations from these definitions are used within **Section** Error! Reference source not found., this is explained within the text.

8.4.3.2 Impact Significance

75. Following the identification of receptor importance and magnitude of the effect, it is possible to determine the significance of the impact.

76. Impacts are unlikely to be significant where features of low importance are subject to small scale or short-term effects. If an impact is found not to be significant at the level at which the resource or feature has been valued, it may be significant at a more local level.

77. Following the identification of receptor importance and magnitude of effect, the significance of the impact has been considered using the matrix presented in Table 8-7 below and knowledge of the ecological features affected.

78. The assessment of potential impacts has been undertaken assuming implementation of embedded mitigation and commitments for the proposed scheme. Residual impacts include any additional mitigation measures required. An assessment of residual impacts is then made, after assuming implementation of additional mitigation measures where required, i.e. the significance of the effects that are predicted to remain after the implementation of all committed mitigation measures.

Table 8-7 Impact significance matrix

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Minor	Negligible	Negligible	Negligible	Negligible	Minor	Minor

79. The impact significance categories are defined as shown in Table 8-8.

Table 8-8 Impact significance definitions

Impact Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.
Negligible	No discernible change in receptor condition.

Impact Significance	Definition
No Change	No impact, therefore no change in receptor condition.

80. Note that for the purposes of the EcIA, major and moderate impacts are deemed to be significant. In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

81. Embedded mitigation has been referred to and included in the initial assessment of impact. If the impact does not require mitigation (or none is possible) the residual impact remains the same. However, if mitigation is required, an assessment of the post-mitigation residual impact is provided.

82. For the purposes of this ES, 'major' and 'moderate' impacts are deemed to be significant (in EcIA terms). In addition, whilst 'minor' impacts may not be significant, it is important to distinguish these from other non-significant (negligible) impacts as they may contribute to significant impacts cumulatively.

83. Following initial assessment, if the impact does not require additional mitigation (or none is possible) the residual impact will remain the same. If, however, additional mitigation is proposed there will be an assessment of the post-mitigation residual impact.

8.4.3.3 Cumulative Impact Assessment

84. For an introduction to the methodology used for the Cumulative Impact Assessment (CIA), please refer to **Chapter 3 EIA Methodology and Consultation**. This chapter includes those cumulative impacts that are specific to benthic and intertidal ecology.

85. The CIA involves consideration of whether impacts on a receptor can occur on a cumulative basis between the Project and other activities, projects and plans for which sufficient information regarding location and scale exist.

86. The potential for cumulative effects has been considered for the construction, operation and decommissioning of the proposed scheme cumulatively with other projects.

87. It is assumed that any consented development would be subject to mitigation and management measures which would reduce impacts to non-significant unless there were exceptional circumstances, it is accepted that such projects or schemes may contribute to a wider cumulative impact.

88. In cases where this proposed scheme has negligible or no impact on a receptor (through for example avoidance of impact through routeing or construction methodology) it is considered that there is no pathway for a cumulative impact.

8.5 Existing Environment

8.5.1 Overview

89. The island of Great Cumbrae is located in the Firth of Clyde about 1.5km from the mainland. The majority of the coast of the island is characterised by an emergent rock platform, with isolated pocket

bays containing beaches. The rock foreshore is currently stable with low rates of change. Millport Bay is the part of the island coast that contains larger lengths of mobile beach sediment. The bay can be divided into three parts:

- Kames Bay located in the northeast corner of Millport which contains a 150m-wide sandy beach;
- A sandy beach (about 50m wide) on rock platform at Newtown Bay; and
- The rest of the Millport shore, which has a sand and gravel veneer overlying rock platform.

90. Millport Bay faces south, with Kames Bay (at the eastern end) aligned to the south-southwest. Within the bay, there are large rock outcrops, known as the Eileans, the Leug and the Spoig, which provide shelter to the central section of Millport Bay against waves from the south. The shelter provided by these outcrops has led to the deposition of sand in their lee along the Newtown Bay shoreline (i.e. forming a small salient).

91. The enclosed nature of the Firth of Clyde combined with the narrow fjords limits the wave fields affecting the coast of this area. As a result, both the height and direction of waves reaching the coast are highly dependent on wind direction. The waves in the Firth of Clyde are therefore mainly generated within the confines of the estuary. At Millport, the dominant wave direction in the nearshore area in terms of frequency is from the southwest. However, the dominant direction in terms of energy is from the more southerly sector. Within the bay itself the wave climate, both in terms of frequency and energy, varies, reflecting the importance of the local offshore islands.

8.5.2 Statutory and Non Statutory Nature Conservation Designated Sites

92. There are no internationally designated sites on Great Cumbrae.

93. There is one Site of Special Scientific Interest (SSSI) within the footprint of the Proposed Scheme, and two statutory designated sites within a 2km buffer. There are no National Nature Reserves on Great Cumbrae.

94. The statutory and non-statutory designated sites are shown on Figure 8-2 and are considered to be of medium ecological importance.

95. Marine Consultation Areas are identified by Scottish Natural Heritage as deserving particular distinction in respect of the quality and sensitivity of the marine environment within them. Their selection encourages coastal communities and management bodies to be aware of marine conservation issues in the area. The Study area lies within the Cumbraes Marine Consultation Area, which notes the tidal regime favours the development of rich algal and faunal communities on the shores, including the red seasweeds *Chondrus crispus* and *Mastocarpus stellatus*. The long-term monitoring of thin tellin *Angulus tenuis* at Kames Bay is also of note (British Oceanographic Data Centre, 2010). The MCA is considered to be of local ecological importance.

Kames Bay Site of Special Scientific Interest (SSSI)

96. Kames Bay SSSI is located within the footprint of the Proposed Scheme and is designated for it's biological (marine) coastline habitat, namely its sandflats. It has been studied for over one hundred years and is the classic Scottish site for the study of intertidal marine biology, having contributed more to the understanding of marine biology than any other stretch of beach in Scotland (SNH, 1985). The SSSI is a small sandy bay with rocky margins. The SSSI has a high faunal population including the

lugworm *Arenicola marina* and the bivalve *Tellina tenuis*. There are also wader species such as redshank and oyster catcher. Freshwater seepage allows the presence of estuarine species such as the ragworm *Nereis diversicolor* and the algae *Ulva intestinalis. Sargassum muticum*, also known as wireweed, is an invasive non-native species of seaweed which is highly competitive and readily outcompetes native species.

Ballochmartin Bay SSSI

97. Ballochmartin Bay SSSI is located approximately 1.7km north east from the Proposed Scheme on Great Cumbrae, and is also designated for its biological habitats. It contains a number of habitat types and is the most varied section of coastline in Great Cumbrae, and the fauna and flora of the intertidal areas have been intensively surveyed and studied (SNH, 2000). The beach is backed by herb-rich grassland and the roadside verges support slow worm *Anguis fragilis*. The site is also an important feeding area for waders (considered in **Chapter 11, Offshore and Coastal Ornithology**), common seal *Phoca vitulina* and grey seal *Halichoerus grypus* (considered in **Chapter 10, Marine Mammals and Basking Shark**).

Southannan Sands SSSI

98. Southannan Sands SSSI is located approximately 2km south east of the Proposed Scheme, on the Scottish mainland coastline, south of Largs. Southannan Sands comprises three discrete areas which together support one of the best examples of intertidal sandflats habitat, alongside associated flora and fauna including dwarf eelgrass *Zostera noltei*. The SSSI extends for over 4km and the mudflats and sandflats provide

Non Statutory Designated Sites

99. There are four marine non-statutory sites on Great Cumbrae within a 2km buffer of the Proposed Scheme (North Ayrshire Council, undated), but none are within the footprint of the scheme (Table 8-9). These sites are designated as Scottish Wildlife Trust (SWT) Wildlife Sites, and are shown on Figure 8-2. These sites are considered to be of medium ecological importance.

Table 8-9 Non Statutory Designated Sites

Site Name	Designation type	Grid reference	Distance from Proposed Scheme
Bell Bay to Whitebay	SWT Wildlife Site	NS166586	2.4 km
Farland Point	SWT Wildlife Site	NS172542	0.3 km
Fintray Bay to Portachur Point	SWT Wildlife Site	NS151555	0.4 km
Ballochmartin Bay, Great Cumbrae	SWT Wildlife Site	NS179570	1.7 km

8.5.3 Sediment Types

100. Sediment type is fully described in **Chapter 6 Marine Geology, Oceanography and Physical Processes**. The distribution of sediment is generally consistent with previous assessments, which concluded that in Kames Bay, the beach sediments range from fine sand to gravel, with the coarsest sand at the top of the beach and a few boulders on the lower shore.

101. ASML (2018) described the biotopes of the subtidal nearshore samples (Figure 6-4). For the purposes of this report, the analysis is simplified to describe generalised particle size only from the original descriptions (Table 6-9). The results show that the eastern part of Millport Bay (east of the Eileans)

is dominated by a fine sand substrate closer to shore and a muddy substrate further offshore. This type of substrate correlates with the relatively smooth bathymetry recorded across this area (Figure 6-6). Across the western part of the bay and within the vicinity of the Eileans the sea bed is either mixed sediment (Figure 6-13) or rock outcrop, which corresponds with the relatively coarse bathymetry in this area. Further south in the western part of the bay, the sea bed is muddy.

8.5.4 Benthic Environment

102. A total of 25 stations were studied using drop down video. A map showing the distribution of biotopes is showing in Figure 8-4 and the biotopes encountered are presented in Table 8-10. Biotopes found at each of the video drops in Kames Bay. Still pictures of the biotopes encountered are given in Appendix 8.1.

Table 3.1 Results of the drop down video survey

ID	Easting	Northing	Time	Depth m (bcd)	Biotopes	Notes
1	217075	653998	11:12	18.5	SS.SMx.CMx Circalittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment. Burrowing species include *Cerianthus lloydii*
2	217023	654179	11:20	18.1	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus* burrows
3	216787	654816	13:28	3.4	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Boulders, cobbles, pebbles and coarse gravelly sand with *Saccharina latissima* on cobbles and encrusting coralline algae and dark red crustose algae present
4	217062	654816	13:20	4.0	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral rippled sand with casts of *Arenicola*
5	217006	654387	11:26	10.0	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota. Much seaweed detritus evident
6	216521	654811	13:35	0.0	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota
7	216255	654583	12:45	0.0	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Clean cobbles, pebbles and coarse gravelly sand with *Saccharina latissima* on cobbles and encrusting coralline algae and dark red crustose algae present
8	216760	654170	11:44	26.8	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus burrows*
9	216735	653963	11:02	31.0	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus burrows*
10	216375	653924	10:51	20.0	SS.SMx.CMx Circalittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment
11	216510	654537	12:53	2.0	SS.SMx Sublittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment. Burrowing species include *Cerianthus lloydii*
12	216782	654597	13:00	11.4	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota
13	217020	654597	13:13	10.2	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota

ID	Easting	Northing	Time	Depth m (bcd)	Biotopes	Notes
14	216790	654364	11:34	22.5	? SS.SMu.CFiMu Circalittoral fine mud	A collection of drift algae on sediment. Seabed not visible so biotope offered as a suggestion based on depth and surrounding observations
15	216508	654290	12:28	10 to 15	IR.MIR.KR.Lhyp.GzPk Grazed *Laminaria hyperborea* park with coralline crusts on lower infralittoral rock & CR.MCR.EcCr.FaAlCr.Car *Caryophyllia smithii* with faunal and algal crusts on moderately wave-exposed circalittoral rock	*Saccharina latissima* and *Laminaria* spp. on grazed rock with extensive patches of crustose coralline algae and dark red encrusting alga & Silty bedrock and boulders below kelp forest with little conspicuous epibiota except for patches of crustose coralline algae, *Caryophyllia smithii*, *Spirobranchus* sp(p) and *Echinus esculentus*
16	216036	653916	10:40	31.0	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus* burrows
17	216519	654087	11:55	23.0	SS.SMx.CMx Circalittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment.
18	216316	654138	12:01	25.0	CR.HCR.XFa.FluHocu *Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata	Faunal turf here is not rich, possibly because epibiota (inc. hydroids and bryozoan) die back in the winter.
19	216267	654368	12:20	3.0	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Clean cobbles, pebbles and coarse gravelly sand with *Saccharina latissima* on cobbles and encrusting coralline algae and dark red crustose algae present
20	216111	654135	12:07	20.3	CR.MCR.EcCr.FaAlCr.Car *Caryophyllia smithii* with faunal and algal crusts on moderately wave-exposed circalittoral rock	Silty rock below kelp forest with little conspicuous epibiota except for patches of crustose coralline algae, *Caryophyllia smithii*, *Spirobranchus* sp(p) and *Echinus esculentus*
21	216050	654351	12:15	2.7 to 3.6	IR.MIR.KR.Lhyp.GzPk Grazed Laminaria hyperborea park with coralline crusts on lower infralittoral rock & IR.HIR.KSed	*Saccharina latissima* and *Laminaria* spp. on grazed rock with extensive patches of crustose coralline algae and dark red encrusting algae & Infralittoral rock with a covering of

ID	Easting	Northing	Time	Depth m (bcd)	Biotopes	Notes
					Sediment-affected or disturbed kelp and seaweed communities	sand and some *Saccharina latissima* and red foliose algae growing through
22	216253	654806	13:40	2.3	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Level infralittoral rock with a covering of sand and some red foliose algae growing through
23	215806	654280	10:23	12.0	SS.SCS.CCS Circalittoral coarse sediment	Silty pebbles and gravel with sediment. Little conspicuous epibiota.
24	215984	654556	12:38	2.2	SS.SMx.IMx Infralittoral mixed sediment	Waves of gravelly sand and shell with coarse material accumulated in troughs. Some algae present on hard substrata including ?*Polyides rotunda*
25	215903	654096	10:31	18.0	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes
26	216439	654629	14:17	0.0 to 2.0	LR.LLR.F.Asc.FS *Ascophyllum nodosum* on full salinity mid eulittoral rock LR.LLR.F.Fserr.X *Fucus serratus* on full salinity lower eulittoral mixed substrata & SS.SMx Sublittoral mixed sediment	Transect down the shore from intertidal rock with *Ascophyllum nodosum*, limpets and barnacles to *Fucus serratus* and red seaweeds on rock inundated by coarse sediment to a mixed sediment composed of pebbles, gravel and coarse sediment with crustose and foliose algae and *Sacharrina latissima*

103. The biotopes of Kames Bay range from mobile infralittoral sediment close to shore to circalittoral muds in deeper water. The rocky reefs surrounding the bay are dominated by kelp forest in the shallow subtidal and are frequently silted or inundated by sediment in deeper water.

104. The rocky habitats appear to be heavily grazed by the extensive cover of crustose coralline algae and non-calcaerous crustose red algae on the rock together, with a lack of foliose algae and the presence of numerous common urchin *Echinus esculentus*. The shallow sediment-rock interface is also sometimes populated by foliose algae such as (potentially) *Polyides rotundus* which are tolerant to sand scour. A full species complement could not be recorded due to the difficulty of identifying many algal species unless they are physically examined.

105. Mixed substrata habitats are common in Kames Bay and may well be rich in species in the summer months but in January at the time of survey, many epibiota species are absent.

106. No maerl biotopes were observed during the drop-down video survey. The nearest mearl beds are understood to be located in the area of the Tan- the strip of water which lays between Great and Little Cumbrae (Gardline Environmental Ltd, 2007, as cited in ABPmer (2017)).

8.5.5 Intertidal Environment

107. The intertidal zone, within the Intertidal Study Area on Great Cumbrae (Appendix 8.2), was composed of a mixture of substrates, ranging from solid bedrock in the more exposed locations, through to cobbles and sand in the more sheltered environments of Kames Bay and Newtown Bay. The range of habitats supported a large mixture of biotopes some of which such as the barren shingle and sand supported very few species while others such as the bedrock and boulder biotopes supported a large number of species.

108. A total of 44 target notes were recorded within the study area on Great Cumbrae during the intertidal survey, the locations of which are presented in Figure 8-3 with details of what was recorded at each target note provided in Appendix 8.2.

109. 26 different biotopes were recorded over the 44 different target notes (Table 8-11). Often multiple biotopes were recorded within a single target note and therefore 81 biotope positions were recorded. The locations of biotopes found during the survey are displayed in Figure 8-3.

110. Two transects were undertaken on the Eileans. Transect A was a sheltered north facing intertidal reef, whilst Transect B was moderately exposed and south facing. Both were approximately 20m in length. 11 biotopes were recorded on the transects on the Eileans, six of which were additional to those recorded on the Great Cumbrae coastline. These biotopes are presented in Table 8-12 and further details are provided in Appendix 8.1.

Table 8-11 List of biotopes recorded on Great Cumbrae (Appendix 8.1)

Biotope	Description	Number of Target note
IR.MIR.KR.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe	1
LR.FLR.Eph.BLitX	Barnacles and *Littorina spp*. on unstable eulittoral mixed substrata	3
LR.FLR.EphEnt	*Enteromorpha spp*. on freshwater-influenced and/or unstable upper eulittoral rock	1

Biotope	Description	Number of Target note
LR.FLR.Lic.Ver.B	*Verrucaria maura* and sparse barnacles on exposed littoral fringe rock	2
LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock	15
LR.FLR.Rkp	Rockpools	2
LR.FLR.Rkp.G *∞	Green seaweeds (*Enteromorpha spp*. and *Cladophora spp*.) in shallow upper shore rockpools	3
LR.HLR.MusB	*Semibalanus balanoides*, *Patella vulgata* and *Littorina spp*. on exposed to moderately exposed or vertical sheltered eulittoral rock	1
LR.HLR.MusB.Cht.Cht	*Chthamalus spp*. on exposed upper eulittoral rock	3
LR.HLR.MusB.MytB	*Mytilus edulis* and barnacles on very exposed eulittoral rock	1
LR.HLR.MusB.Sem.FvesR	*Semibalanus balanoides*, *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	1
LR.HLR.MusB.Sem.LitX	*Semibalanus balanoides* and *Littorina spp*. on exposed to moderately exposed eulittoral boulders and cobbles	4
LR.HLR.MusB.Sem.Sem	*Semibalanus balanoides, Patella vulgata* and *Littorina spp*. on exposed to moderately exposed or vertical sheltered eulittoral rock	8
LR.MLR.BF.FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock	3
LR.MLR.BF.PelB	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock	7
LS.LCS	Littoral coarse sediment	2
LS.LCS.Sh.BarSh	Barren littoral shingle	4
LS.LMp	Littoral macrophyte-dominated sediment	5
LS.LSa	Littoral sand	3
LS.LSa.FiSa.Po	Polychaetes in littoral fine sand,	1
LS.LSa.MoSa	Barren or amphipod-dominated mobile sand shore	1
LS.LSa.MuSa.MacAre	*Macoma balthica* and *Arenicola marina* in littoral muddy sand,	5
LS.LSa.St	Strandline	4

* UK Bap habitat, ∞ Habitats Directive.

Table 8-12 List of biotopes recorded on the Eileans (Appendix 8.2)

Biotope	Description
Transect A	
LR.MLR.BF.FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock
LR.LLR.F.Asc.FS	*Ascophyllum nodosum* on full salinity mid eulittoral rock
LR.LLR.F.Fspi	*Fucus spiralis* on moderately exposed to very sheltered upper eulittoral rock
LR.LLR.F.Pel	*Pelvetia canaliculata* on sheltered littoral fringe rock

Biotope	Description
LR.FLR.Eph.Ent	*Enteromorpha spp.* on freshwater-influenced and/or unstable upper eulittoral rock
LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock
Transect B	
LR.HLR.MusB.Sem.FvesR	*Semibalanus balanoides, Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock
LR.FLR.Rkp.Cor.Cor	*Corallina officinalis* and coralline crusts in shallow eulittoral rockpools
LR.MLR.BF.FspiB	*Fucus spiralis* on full salinity exposed to moderately exposed upper eulittoral rock
LR.HLR.MusB.Cht	*Chthamalus spp*. on exposed upper eulittoral rock
LR.FLR.Lic.Ver	*Verrucaria maura* on littoral fringe rock

111. A summary of the biotopes within the Cumbrae Intertidal Study Area is presented below and the details of all target notes recorded in the field are presented in Appendix 8.2. The summary below starts at the western end of the Intertidal Study Area and works east.

112. The western end of the Intertidal Study Area contained a disused lido (TN43) surrounded by patches of macrophyte-dominated sediment which were verging on pioneer saltmarsh (TN 42 and 44). To the east of the lido was a narrow bay (TN 22 and 45) which had a defined strandline at the high tide mark and was dominated by a coble and sand substrate.

113. The eastern side of the bay consisted of a mixture of concrete sea defences, armoured pipes and a jumble of broken bedrock outcrops the tops of which were dominated by lichen communities. Further east from the bay an exposed area of bedrock sloped down towards the sea. This section of the Intertidal Study Area followed a pattern of yellow and grey lichens communities on the upper shore *Verrucaria maura* and sparse barnacles on upper and mid shore and barnacle dominated communities with limpets and littorinids on the mid to lower shore.

114. At the eastern end of the exposed rock section was a small sand filled bay consisting of barren sand with occasional amphipods. Due to the exposed nature it is likely that sand here was very mobile.

115. On the far side of the small bay stands Millport pier. Much of the pier could not be accessed however from a distance it could be seen that the upper foundations were dominated by yellow lichen communities with the lower sections supporting barnacle communities (Figure 8-3).

116. Sheltered by the pier and large concrete walls is a small harbour (Figure 8-3). The harbour walls supported sparse clumps of *Fucus vesiculosus* and barnacle mosaics. The harbour floor consisted of littoral fine sand with evidence of polychaetes including *Arenicola marina*. A fucoid strand line was present in the upper shore (TN1).

117. At western end of Newtown Bay (TN 4 to 7) a boulder and cobble matrix was present on the lower shore with rocky outcrops also occurring. The mid shore consisted of gravel sand broken by rocky outcrops with the upper shore being formed by concrete sea defences. Due to the diverse nature of the substrate a number of different biotopes were recorded in this section of Newtown bay (TNs 4 to 11) including Littoral sand, barnacle and Littorinid communities on moderately exposed eulittoral boulders and cobbles and rock, rockpools and bladder wrack *Fucus vesiculosus* or channelled wrack *Pelvetia canaliculata* and barnacle communities on rock or boulders.

118. At the eastern end of this section of Nerwtown Bay a concrete walkway bisects the shore. In the upper shore this forms a sheltered cobble filled bay in which a dense strand line (Figure 8-3) was present. Further down the walkway boulders on either side supported Channelled wrack and barnacle communities.

119. On the eastern side of the walkway the upper and mid shore became more dominated by sediment biotopes with barren shingle and *Arenicola marina* in littoral muddy sand being recorded (Figure 8-3) although lower and mid shore communities of channelled wrack and barnacles on boulders and cobbles did persist in the western end of this section (Figure 8-3).

120. The eastern boundary of this section of Newtown Bay was formed by a concrete pier (Figure 8-3). The armouring itself supported the barnacle, limpet and littorinid biotope (LR.HLR.MusB.Sem.Sem). From this location kelps were visible in the extreme lower shore. However, these were not accessed due to the state of the tide and therefore the biotope was not examined up close. A biotope of *Laminaria digitata* on moderately exposed sublittoral fringe was assigned here although there is a low confidence associated with this due to the fact that the lower shore was not directly accessed.

121. Moving round Long Point, towards Kames Bay rocky outcrops supported yellow lichen dominated communities with veneers of littoral sand overlaying the bedrock in places.

122. The majority of Kames bay (TN 30 to 33) was found to be clean fine sand with lug worm casts present in the mid and lower shore (Figure 8-3). A freshwater stream runs down across the centre of the bay within which occasional boulders supported small clumps of Gut weed (*Ulva intestinalis*).

123. Bordering Kames Bay to the east is an exposed stretch of coast which eventually forms Farland point. The rocky shore is backed by a road and the narrow hinterland has a row of houses built upon it. The biotopes recorded in this area were typical of steeply sloping exposed rocky shores (TN 24 to 29) with a pattern of barnacle dominated lower shore channelled wrack dominated mid shore and lichen dominated upper shore communities (Figure 8-3).

124. On flat sections of the very upper shore small patches of mocrophyes were present surrounding freshwater pools (Figure 8-3). However, these all occurred outwith the southern boundary of the Intertidal Study Area (Figure 8-3).

8.5.6 Habitats and Species of Note

125. One biotope of conservation importance was identified within the Intertidal Study area. However, although the biotope LR.FLR.Rkp.G has been identified as being of conservation importance, it is relatively common around the UK and although damage to this biotope should be avoided if possible, impacts to this biotope should not constrain the proposed development.

126. Few species of conservation importance were identified within the Intertidal Study Area. The dog whelk *Nucella lapillus*, an OSPAR species (on a list of threatened and/or declining species and habitats in the North-East Atlantic, created under the OSPAR Convention for the protection of the marine environment of the North East Atlantic), was found throughout the Intertidal Study Area and is recorded within the desk study data (Appendix 16.1). Dog whelk is a common species in the UK and is not protected under any other pieces of legislation.

127. Pioneer saltmarsh was recorded at the western extent of the Intertidal Study Area. Saltmarsh is protected under EU legislation including the Habitats Directive (European Commission 1992) and the Water Framework Directive (European Commission 2000; WFD). The Habitats Directive Article 6 (2) requires member states to avoid the deterioration of natural habitats within Special Areas of Conservation (SAC) s, Article 11 obliges states to undertake surveillance of conservation status and Article 17 obliges reporting in respect of Article 11. The Water Framework Directive identifies saltmarsh as an important component of the assessment of ecological status of associated water bodies. Coastal saltmarsh is a UK Biodiveristy Action Plan (BAP) priority habitat and is listed as a North Ayrshire Local Biodiversity Action Plan (NALBAP) 2019-2031 priority habitat.

128. No mearl was recorded during within the Benthic Study Area and it is assumed that mearl is absent from Millport Bay.

8.5.7 Non Native Invasive Species

129. Invasive Non-Native Species are species that have been introduced, either intentionally or unintentionally, to areas outside their natural range. Although many of these non-native species cause no apparent adverse impact, some cause negative impacts on native species and ecosystems due to competition and gradual replacement.

130. Marine invasive non-native species that are now widespread and well established in Scotland (Scottish Natural Heritage, 2019) include:

- Wireweed *Sargassum muticum*;
- Green sea-fingers *Codium fragile* subsp. t*omentosoide*s;
- Common cordgrass *Spartina anglica*;
- Red alga *Heterosiphonia japonica*;
- Acorn barnacle Austrominius modestus;
- Japanese skeleton shrimp *Caprella mutica*; and
- Leathery sea squirt *Styela clava*.

131. Invasive species found only in patchy locations within Scotland include:
- Carpet sea-squirt *Didemnum vexillum*; and
- Pacific oyster *Crassostrea gigas*.

132. From the results of the desk study (Appendix 16.1), wireweed has been recorded on Great Cumbrae at a number of locations since 2009, including Lion Rock and Farland Point. American slipper limpet *Crepidula fornicate* was recorded near Keppel Port (Figure 8-5) in 2009. Leathery sea squirt was recorded at Farland Point in 2016.The carpet sea squirt is well established at nearby Largs Yacht Haven having first been confirmed in 2009, as well as being recorded at Fairlie, Quay Jetty, Fairlie moorings and Clydeport Jetty (Beveridge et al., 2011). It is also present at Loch Creran (MARLIN, 2018). This is a great concern for both Scottish waters and the waters of the UK due to its ability to successful invade and establish.

133. The following invasive non-native species are known to be established to some extent int the Clyde (Mills, 2010) and the environmental and socio-economic risk scores outlined in Table 8-13 are based on information in the Great Britain Non-Native Species Secretariat risk assessments for species where completed (available at www.nonnativespecies.org) and on the experience of the impact of these species in other parts of the UK and in the Firth of Clyde to date:

Table 8-13 invasive non-native species within the Clyde (Mills, 2010)

Common name	Latin name	Environmental risk	Socio-economic risk
A bryzoan	*Tricelleria inopinata*	Medium	Low
A hydroid	*Cordylophora caspia*	Low	Low
Acorn barnacle	*Elminus modestus*	Low	Low
An orange sheath tunicate	*Botrylloides violaceus*	Low	Low
carpet sea squirt	*Didemnum vexillum*	High	High
Common cord-grass	*Spartina anglica*	Medium	Low
Green sea fingers	*Codium fragile*	Low	Low
Japanese skeleton shrimp	*Caprella mutica*	Medium	Low
Leathery sea squirt	*Styela clava*	Low	Medium
Orange tipped sea squirt	*Corella eumyota*	Low	Medium
Wireweed	*Sargassum muticum*	Medium	Low

134. No marine non-native invasive species were recorded on site during the intertidal or drop down surveys.

8.5.8 Anticipated Trends in Baseline Conditions

135. It is important to recognise that the baseline physical environment is not static, but instead will exhibit considerable variability due to cycles or trends of natural change and seasonal trends. It is likely that greater benthic species diversity would be present in the summer months, particularly for epibiota species.

136. There is potential for the pioneer saltmarsh habitat to develop over time, which may lead to increased biodiversity on a local level. Increased storm events or raising sea temperatures may also impact upon distribution of benthic habitats and prevalence of particular species at a local level.

137. Continued movement of vessels in the Clyde area, along with other anthropogenic influences such as fishing, along with natural tidal and atmospheric influences, has potential to lead to the spread of non-native invasive species locally within the marine environment.

8.6 Impact Assessment

8.6.1 Overview of Potential Impacts

138. Following the methodology presented in Section 8.4.3 above, the impacts associated with the benthic and intertidal receptors described in Section 8.5 have been assessed and are presented in this section. Where measures over and above the embedded mitigation described in Section 8.6.2 are required to avoid, reduce, remedy/compensate or enhance the adverse impacts of the proposed scheme, this information has been provided.

8.6.2 Embedded Mitigation

139. Embedding mitigation into the proposed scheme design is a type of primary mitigation and is an inherent aspect of the EcIA process. A full account of embedded mitigation measures is contained in **Chapter 5 Project Description.** Where embedded mitigation measures have been developed into the design of the proposed scheme with specific regard to benthic and intertidal ecology, these are described in Table 8-14. Additional mitigation measures are also included to follow best practice and policy requirements. These mitigation measures are described in Table 8-15.

Table 8-14 Embedded mitigation measures through scheme design

Parameter	Mitigation measures embedded into the scheme design
Footprint	Localised reduction of the width of the Proposed Working Area where practical and adherence to strict footprint of works to minimise temporary construction impacts on neighbouring habitats
Consultation	Ongoing consultation with local community and other relevant stakeholders
Opportunities for benefits	Ongoing opportunities will be sought to enhance the design of the offshore elements of the proposed scheme for the benefit of the local benthic ecology.

Table 8-15 Embedded mitigation through Best Practice and Policy

Parameter	Mitigation measures through Best Practice and Policy
Pollution prevention	Guidance for Pollution Prevention GPP 5: Works and maintenance in or near water (Netregs, undated)
Pollution prevention	Supporting Guidance WAT-SG-53 on Environmental Quality Standards and Standards for Discharges to Surface Waters (SEPA, 2019); GPP5: Works and maintenance in or near water (Northern Ireland Environment Agency (NIEA), Department for Agriculture the Environment and Rural Affairs (DAERA, SEPA and Natural Resources Wales (NRW), 2018); GPP21: Pollution incident response planning (NIEA, SEPA and NRW, 2017) GPP22: Dealing with spills (NIEA, DAERA, SEPA and NRW, 2018a).
Pollution prevention	The following Pollution Prevention Guidance (PPG) or updated equivalent (Netregs, undated): PPG 6: Working at construction and demolition sites; PPG 1 Understanding your environmental responsibilities – good environmental practices; PPG 14: Marinas and crafts.
Construction good practice	CIRIA Coastal and marine environmental site guide (2nd edition) (C744)
Construction good practice	CIRIA Guidance note C692 Environmental Good Practice on Site Guide (3rd Edition).
Pollution prevention	SEPA Pollution Prevention Guidelines.

Parameter	Mitigation measures through Best Practice and Policy
Invasive non-native species	SEPA guidance: Biosecurity and management of invasive non-native species for construction sites and controlled activities River Basin Management Plan for the Scottish River Basin District 2015 – 2027 Firth of Clyde Biosecurity Plan 2012 - 2016

140. As part of this best practice, several mitigation measures will be implemented as part of the project embedded mitigation to manage and minimise the risk of a pollution event occurring during construction activities:

- Development of an Emergency Response Cooperation Plan (ERCoP) using relevant guidance including GPP21, GPP22, set out by Maritime and Coastguard Agency (MCA) in Marine Guidance Note (MGN) 543 issued and approved by MCA;
- Development of a Marine Pollution Contingency Plan and Vessel Management Plan, which would include the following measures:
    - Notice to Mariners to be issued to reduce collision risks;
    - Vessels associated with all Project operations will comply with IMO/MCA codes for prevention of oil pollution and any vessels over 400 GT will have on board SOPEPs;
    - Vessels associated with all Project operations will carry on-board oil and chemical spill mop up kits; and
    - Where possible, vessels will avoid working in poor weather conditions.

8.6.3 Ecological Action Plan

141. All mitigation measures proposed in relation to the impacts identified for each receptor below will be incorporated and detailed in an overarching Ecological Action Plan (EAP). Where mitigation or management plans are mentioned in the mitigation sections below, these will be incorporated into the EAP also.

142. The EAP will form part of the Construction Environmental Management Plan (CEMP) and will cover the ecological requirements of the pre-, during and post-construction stages of the Proposed Scheme. The EAP will be a live document and will be updated throughout each of these phases. The EAP will take into account any planning obligations and conditions attached to the Proposed Scheme should consent be granted. The EAP will be submitted to and agreed with the North Ayrshire Council, SNH and other stakeholders, where appropriate, based upon the final design of the Proposed Scheme. The EAP will include the principal requirements of mitigation, including:

- Pre-construction ecological surveys;
- Habitats or species directly affected by the Proposed Scheme;
- Method statements (where necessary);
- Tool box talks;
- Licensing requirements (where necessary);
- Habitat re-instatement plan (if applicable);
- Overall strategy for delivery of the mitigation proposed in this EcIA; including
- Programme for delivery of mitigation; and
- Responsibilities attributed to the relevant parties to deliver the plan.

143. An Ecological Clerk of Works (ECoW) will audit the implementation of the EAP. This would be a desk-based and site-based role. It should be noted that the mitigation measures presented below are based on the individual receptor, therefore in some cases there may be a conflict between the requirements of one receptor over another (or indeed with other priorities, e.g. tourism and recreation). The ECoW will have suitable expertise to develop and find pragmatic solutions to any potential conflicts in consultation with the relevant consultees.

8.6.4 Potential Impacts during Construction

144. This section discusses the potential impacts which may occur to benthic and intertidal ecology receptors during activities associated with the construction of the proposed scheme. Impacts to terrestrial ecology, including otters are considered in **Chapter 16 Terrestrial Ecology**. Impacts to fish are considered in **Chapter 9 Fish and Shellfish Resource**. Impacts to marine mammals are considered in **Chapter 10 Marine Mammals and Basking Shark**.

145. Three potential impacts on benthic and intertidal receptors resulting from the construction stage have been identified. These are:
- Direct habitat loss;
- Physical disturbance of intertidal habitats during and following construction; and
- Spread of marine non-native invasive species following construction;

8.6.4.1 Construction Impacts 1: Direct habitat loss

146. The installation of the breakwater, new flood walls, shore-connected breakwater and revetment structures will lead to direct habitat loss within the footprint. The area of natural seabed lost will be very small in relation to the overall area of similar habitats likely to exist within the Intertidal Study Area.

147. The working footprint of the marine construction phase of the development has been calculated as follow:

- Permanent intertidal habitat loss on Great Cumbrae due to construction of breakwater below MHWS: 1100m^2;
- Permanent intertidal habitat loss on Great Cumbrae due to construction of rock revetment below MHWS: 1140m^2;
- Permanent intertidal habitat loss on The Spoig, The Leug and South Eilean due to construction of offshore breakwater below MHWS: 2700m^2; and
- Permanent seabed habitat loss due to construction of offshore breakwater: 11,270m^2

148. **Chapter 5 Project Description** provides further details on the offshore infrastructure. The footprint of habitat loss will be relatively small compared to the available resource of similar habitats in the Benthic Study Area and as part of the embedded mitigation care will be taken to minimise impacts to the surrounding habitats and associated seaweeds and benthos during construction of the offshore and intertidal infrastructure. The seabed is generally characterised as mobile infralittoral sediment close to shore to circalittoral muds in deeper water with heavily grazed rocky habitats also present. The intertidal habitat on the small islands in the footprint of the offshore breakwater is rocky shore, whilst the intertidal habitat on the Great Cumbrae coastline was found to be composed of a mixture of substrates, ranging from solid bedrock in the more exposed locations, through to cobbles and sand in the more sheltered environments of Kames Bay and Newtown Bay. The range of habitats supported a large mixture of biotopes some of which such as the barren shingle and sand supported very few

species while others such as the bedrock and boulder biotopes supported a large number of species. Existing coastal defence infrastructure is also present upon Great Cumbrae.

149. Pioneer saltmarsh was identified at the western edge of the Intertidal Study Area near to the lido, close to the western most proposed flood wall. Saltmarsh is protected under EU legislation including the Habitats Directive (European Commission 1992) and the Water Framework Directive (European Commission 2000; WFD). The Habitats Directive Article 6 (2) requires member states to avoid the deterioration of natural habitats within SACs, Article 11 obliges states to undertake surveillance of conservation status and Article 17 obliges reporting in respect of Article 11. The Water Framework Directive identifies saltmarsh as an important component of the assessment of ecological status of associated water bodies. Coastal saltmarsh is a UK BAP priority habitat and is listed as a NALBAP 2019-2031 priority habitat. As such, the pioneer saltmarsh habitat at Millport is considered to be of medium importance. Other areas of pioneer saltmarsh at the eastern side of Millport Bay is outwith the construction footprint and will not be affected by the proposed scheme.

150. Saltmarsh is a fragile habitat and plays an important role in cycling nutrients and may be damaged directly through trampling by equipment or machinery during construction activities, or indirectly through impacts to water quality or smothering. Measures to control run-off and accidental spillages to the marine environment are already embedded into the design of the Proposed Scheme (Section 8.6.2). Habitat loss to the saltmarsh during construction activities would constitute a medium-term impact as pioneer species are likely to recover quickly (within 5 years), and the magnitude of this impact is considered to be magnitude of medium on the habitat in the vicinity of the western proposed flood wall. As part of the embedded mitigation, a toolbox talk will be provided to construction personnel prior to activities commencing, detailing the importance of this habitat. Overall, a **moderately adverse** impact is anticipated to occur on the pioneer saltmarsh locally present at Millport.

151. Kames Bay SSSI is designated at a national level and will be bordered by proposed sea wall and modifications to the existing promenade and grass areas. Although the habitats in the bay are not unusual or rare, The SSSI is valuable as has been studied for intertidal marine biology over the last 100 years and has contributed more to the understanding of marine biology than any other stretch of beach in Scotland (SNH, 1985) and therefore impacts to the site may affect long term studies. There is potential for the working footprint to extend into the SSSI during construction of the proposed sea wall, leading to disturbance of the intertidal sediments and associated benthos. Measures to control run-off and accidental spillages to the marine environment are already embedded into the design of the Proposed Scheme (Section 8.6.2). Impacts to the SSSI are likely to be low magnitude and temporary and reversible, on a receptor of high importance. As part of the embedded mitigation, a toolbox talk will be provided to construction personnel prior to activities commencing, detailing the importance of this designation. Overall, the impact to Kames Bay is assessed to be **moderately adverse**.

152. No other benthic habitats or species of local national or European importance were identified in the site or are expected to be impacted. Therefore the sensitivity of the bay outwith the footprint of Kames Bay SSSI and saltmarsh habitat is assessed as negligible and the impact of habitat loss from the construction of the offshore breakwaters is anticipated to be of medium magnitude. The impact of habitat loss outwith the saltmarsh and SSSI designation is anticipated to be permanent and **minor adverse** upon benthic and intertidal ecology.

Mitigation

153. To minimise the impact to the saltmarsh habitat and Kames Bay SSSI, the boundary of the salt marsh habitat and designated site will be fenced off and access closed to construction personnel to prevent being trampled by people, vehicles, or lay down of plant or materials. Should any works be required within the footprints of these habitats they will be minimised as far as practicably possible.

Residual Impact

154. Following the mitigation identified above, the residual impact to the local saltmarsh and Kames Bay SSSI will be reduced to **minor adverse**.

8.6.4.2 Construction Impact 2: Physical disturbance of habitats or species during and following construction

155. The risk of spillage of contaminants from the construction vessels during installation has been considered. Collision of vessels could result in spillages of contaminants, such as diesel.

156. The risk of pollution events will be minimised by following standard good practice, discussed in Section 8.6.2.

157. All materials used during construction will require prior approval through the Marine Licensing. Installation contractors will have in place appropriate Environmental Management Plans and Pollution Control and Spillage Response Plans prior to offshore construction activities commencing. These plans will act to reduce the potential for accidental pollution, manage the material allowed on site, and in the unlikely event of a pollution incident, they will ensure a rapid and appropriate response.

158. Given the management strategies and controls proposed it is expected that, should a spill occur, its scale and the nature of the contaminant will result only in a temporary and localised impact before dilution and dispersion, with effects therefore of negligible magnitude in the short to medium term. Due to the dynamic and dispersive nature of the environment at the site, any material accidentally discharged would be rapidly dispersed and diluted, with the sensitivity of the receptor considered to be low to spill events for the majority of the habitats and medium sensitivity for saltmarsh and high sensitivity for Kames Bay SSSI. Therefore, taking account of the embedded mitigation, the overall effect of a pollution incident on the benthic ecology is likely to be of **negligible** significance for the majority of the study area and **minor adverse** and Kames Bay SSSI.

159. With the mitigation outlined in **Chapter 19 Noise and Vibration**, the construction phase, Kames Bay SSSI will be subject to short term and non-continuous noise disturbance of 60-65 decibels (dB(A)) in the upper shore, and less than 60 dB(A) in the mid shore and less than 55dB(A) in the lower shore. The benthic and intertidal features of Kames Bay SSSI are considered to be of low sensitivity to noise and construction related noise is considered to be negligible in magnitude. Effects of construction related noise are anticipated to be **negligible** on the SSSI. Birds are assessed in **Chapter 11 Offshore and Coastal Ornithology**, whilst otter are considered in **Chapter 16 Terrestrial Ecology**.

160. Assessments made in **Chapter 9 Marine Geology, Oceanography and Physical Processes** conclude changes in suspended sediments concentration during construction of the Proposed Scheme would be very minor enhancements over a small geographical area. **Chapter 7 Marine Water and Sediment Quality** concludes all potential impacts to water quality to be negligible. Any sediment disposition associates with construction plumes are highly likely to become re-entrained by waves and transported away and given the dynamic nature of the local environment, predicted thickness of sediment resting on the sea bed initially would only amount to a maximum of less than a millimetre. After this initial deposition, this sediment would be continually re-suspended to reduce the

thickness even further. This would be the longer-term outcome, once the sediment supply from construction activities has ceased. Smothering impacts from the settlement of suspended sediments and associated habitat disturbance and impacts to infauna are anticipated to be short term, temporary and reversible on the benthic and intertidal environment, constituting a negligible magnitude effect on Kames Bay SSSI and Farland Point SWT site (high importance), saltmarsh (medium sensitivity) and benthic habitats and species (low importance). Overall, the impact of disturbance is assessed to be of up to **minor adverse** significance in the context of a dynamic environment in the short term, and reversible in nature. Additionally, the works are short term (up to three weeks) and would not be undertaken continuously. No other designated sites are anticipated to be impacted due to their proximity from the pathway of any changes associated with the construction of the Proposed Scheme.

Mitigation

161. No additional mitigation is required.

Residual impact

162. The impact of habitat disturbance on the benthic and intertidal ecology during construction will remain of **minor adverse** significance in the short term.

8.6.4.3 Construction Impact 3: Potential introduction / spread of invasive non-native species

163. During the construction stages of the proposed scheme, there is the potential for the introduction and spread of invasive non-native species, particularly as Clyde is considered a focal point for INNS due to a high number of hotspots around its coast. Wireweed and American slipper limpet have been recorded in the vicinity of the proposed scheme. The carpet sea squirt has been established in Largs since 2009, representing the first confirmed record of the species in Scotland. This record sparked concern due to the potential vigorous growth which could occur in both artificial aquaculture facilities and in the natural environment. The leathery sea squirt has also been recorded at Largs (SEPA scoping response).

164. There are several mechanisms by which vessels associated with the Proposed Scheme may introduce invasive non-native species to waters within and around the proposed scheme:
- Attached to equipment such as anchors/anchor chains;
- Fouling on hulls;
- Seawater in pipework; and
- Ballast water and within sediment within ballast tanks.

165. Introductions may present themselves from vessels from foreign waters, and from within Scotland. Therefore, there is the potential for the introduction of both new invasive non-native species and an increased range for those which are established within the marine environment within Scotland.

166. Given the complex interaction between the introduction of a non-native species into an environment and establishment within Millport or Scotland, the magnitude of the impact has been assessed with caution as medium.

167. Based on the above, the introduction/spread of invasive non-native species within Millport and around the Clyde is plausible, however it is unlikely that this will lead to alterations in the benthic habitats or communities due to the current level of hard substrate naturally available through rock outcrops, sea walls and buoy ropes. Therefore, the project associated infrastructure will increase the amount of

hard substrate within Millport, as the breakwater will be placed upon a predominantly a soft sediment area. There is therefore potential that the level of risk associate with the new infrastructure and/or the project construction activities will lead to more habitat resource and therefore greater levels of invasive non-native species, of medium magnitude.

168. Given the current possible risk held by the receptor (the benthic habitats surrounding Millport), the sensitivity has been assessed as medium. Overall, a **moderate adverse impact** is predicted via the potential introduction/spread of invasive non-native species.

169. Project embedded mitigation measures are proposed to minimise the risk of non-native invasive species and their successful invasion within Millport and wider region (**Chapter 4, Project Description**), including compliance with relevant guidance regarding ballast water and non-native invasive species risk assessment prior to each deployment to identify mechanisms behind risk identified and appropriate mitigation measures. This can be undertaken once installation vessels and construction ports have been identified through maintenance of an Invasive Species and Biosecurity Management Plan (ISBMP), any following guidance outlined in Section 8 of the River Basin Management Plan for the Scottish River Basin District 2015 – 2027 (SEPA 2015) including adherence to the preventable actions outlined in the marine biosecurity plans for the Firth of Cyde (Mills, 2010) and the UK Marine Pathway project). If the embedded mitigation is followed and measures put in place to assess the possible likelihood of non-native invasive species invasion based on project vessels, the likelihood of introducing invasive non-native species to Millport and the wider area will be reduced to low magnitude to and re-assessed to **minor adverse** significance.

Mitigation

170. No additional mitigation is required.

Residual impact

171. The impact of invasive non-native species on the benthic and intertidal ecology during construction will remain of minor adverse significance in the short term.

8.6.5 Potential Impacts during Operation

8.6.5.1 Operation Impact 1: Habitat alteration

172. The presence of scheme, particularly the breakwaters, has the potential to alter the baseline wave regime, with respect to wave heights and directions, through reflection, refraction and diffraction. Any changes in the wave regime may have the potential to contribute to changes in the distribution of benthic habitats and species due to alteration of sediment transport patterns and to change erosion/accretion patterns along the coast.

173. Wave modelling (discussed in **Chapter 6 Marine Geology, Oceanography and Physical Processes**) at Millport Bay predicts that potential changes to wave heights along the coast between West Bay and Newtown Bay would be small once the scheme is implemented. The predicted changes to significant wave heights within the nearshore zone and at the coast (Figure 6-14 and Figure 6-15) caused by the breakwaters are (from west to east):

- The predicted wave heights at West Bay and immediately north of the bay would change very little because the breakwaters have little effect on the passage of waves west of the Leug;

- The breakwater would result in a reduction in wave heights west of the Eileans and between the pier and the western half of Newtown Bay Beach; and
- The predicted wave heights along the eastern half of Newtown Bay Beach and at Kames Bay Beach would change very little because the structures have little effect on the passage of waves east of the Eileans.

174. As the physical pathway that links the source of the impact (change to wave height) to the beaches of Kames Bay and the coast at Farland Point is changed very little, there is **negligible** impact on Kames Bay SSSI and the nearby Farland Point SWT Site.

175. As discussed in **Chapter 6 Marine Geology, Oceanography and Physical Processes**, although there are predicted changes to the nearshore waves and tidal currents caused by the scheme, their effect on sediment transport is minimal. There would be little change in predicted wave heights and only small and local changes to tidal currents in Kames Bay and at Kames Bay Beach. The scheme would reduce or accelerate tidal current velocities locally, but given the baseline currents are already low velocity, these local changes would not influence the wider sedimentation patterns in Kames Bay or the designations of Kames Bay SSSI. This means that the natural seasonal variations in beach elevation and cross-shore transport would be unaffected.

176. With an anticipated decrease in the magnitude of wave energy inshore of the offshore breakwaters, it is expected that the density of kelp in the inshore/shallow subtidal area may slightly increase, as will the amount and species richness of the associated flora and fauna. Changes to epibiota (attached to the kelp) will be mirrored below the kelp with similarly increased density and species richness of biota on rock surfaces. Although the changes outlined above may be of considerable interest and significance biologically, the species and habitats located west of the Eileans and between the pier and the western half of Newton Bay Beach are of negligible sensitivity (identified as clean cobbles, pebbles and coarse gravelly sand with *Saccharina latissima* on cobbles and encrusting coralline algae and dark red crustose algae present), as not containing species or habitats of conservation importance, regionally or locally. It is likely that such changes will be well within natural levels of fluctuation and are likely to be indiscernible from adjacent areas.

177. The offshore structures themselves are also likely to become colonised, as no antifouling coating will be used. The structures will therefore potentially act as an artificial reef. It is expected that the species colonising the offshore structures will be littoral seaweed and benthos communities similar to those currently found on The Leug, The Spoig and the Eileans. They may provide some suitable habitat for juvenile lobster, crabs and other crustaceans. However, as noted above, with slight decreasing wave energy, a greater density of kelp and associated biota may be anticipated.

178. No benthic species or habitats of local, regional, national or European importance are expected to be lost, or to change substantially. Consequently, the receptor sensitivity is assessed as negligible. However, the potential for changes in the wave energy present inshore of the devices may cause slight and local changes to ecology, and while the magnitude of these is unknown, is assessed as potentially being of between low and medium magnitude. Based upon negligible sensitivity and medium magnitude the significance of the impact is assessed as **minor adverse.**

Mitigation

179. No further mitigation is required.

Residual impact

180. As no mitigation is suggested to reduce the impact of habitat alteration on the benthic ecology during operation/maintenance will it will remain of **negligible** significance.

8.6.6 Potential Impacts during Decommissioning

181. No decision has been made regarding the final decommissioning policy for the onshore infrastructure of the proposed scheme as it is recognised that industry best practice, rules and legislation change over time.

182. The structures forming the coastal flood prevention scheme will be designed to have a life of at least 50 years. As the purpose of the proposed scheme is for flood protection, it is unlikely that it will be decommissioned in entirety; it is more likely that the scheme will be repaired, or sections replaced or improved if needed in the future. To ease the process of decommissioning should it be required, the project design will aim to avoid excavation or drilling into the bedrock for the toe of the rock structures. Decommissioning of the flood walls are anticipated to require a similar process to that discussed above for the construction phase. Prior to any decommissioning activities taking place, consultation will take place will all relevant statutory stakeholders and any potential impacts will be assessed using best practice and guidance relevant at that time.

As discussed in **Chapter 5 Project Description**, a decommissioning plan will be submitted for approval by the regulatory authorities prior to construction. As such, for the purposes of a worst-case scenario, impacts no greater than those identified for the construction phase are expected for the decommissioning phase.

8.7 Cumulative Impact Assessment

183. This section describes the CIA for benthic and intertidal ecology, taking into consideration other plans, projects and activities. This has been undertaken as a two-stage process, with the first stage comprising assessing all the impacts from the previous sections for the potential to act cumulatively with other projects or schemes. This summary assessment is set out in Table 8-16 below.

Table 8-16 Potential Cumulative Impacts

Impact	Potential for Cumulative Impact	Data confidence	Rationale
Construction			
Impact 1: Direct habitat loss	Yes	Medium	Other projects in Millport Bay may contribute to direct habitat loss
Impact 2: Physical disturbance of habitats or species during and following construction	Yes	Medium	Other projects in Millport Bay may contribute to physical disturbance of habitats and species during construction
Impact 3: Potential introduction / spread of invasive non native species	Yes	Medium	Other projects in nearby waters may exacerbate the risk from invasive species within the country

Impact	Potential for Cumulative Impact	Data confidence	Rationale
Operation			
Impact 1: Habitat alteration	Yes	Medium	Other projects in Millport Bay may contribute to habitat alteration.
Decommissioning As a flood prevention scheme, the Proposed Scheme is anticipated to be maintained rather than removed, and therefore decommissioning activities are currently unknown. This will be assessed at the time of any decommissioning activities required.			

184. The second stage of the CIA is an assessment of whether there is spatial or temporal overlap between the extent of potential effects of the proposed schemes onshore area, and the extent of potential effects of other projects scoped into the CIA on the same receptors. To identify whether this may happen, the potential nature and extent of effects arising from all projects scoped into the CIA have been identified and any overlaps between these and the effects identified above. Where there is an overlap, an assessment of the cumulative magnitude of effect is provided.

185. Table 8-17 summarises the projects which have been scoped into the CIA due to their temporal or spatial overlap with the potential effects arising from the proposed scheme. The remainder of the section details the nature of cumulative impacts against all those receptors scoped in for cumulative assessment.

186. Due to the small-scale nature of the Proposed Scheme those projects at a greater distance than 10 km away have also been scoped out. Furthermore, as discussed in **Chapter 6 Marine Geology, Oceanography and Physical Processes**, impacts upon habitat disturbance or alteration associated with the Proposed Scheme are anticipated to be localised and short term, whilst permanent habitat loss will be confined to the footprint of the offshore breakwaters. No other projects are anticipated to occur within Millport Bay and the Benthic Study Area, and therefore cumulative impacts associated with habitat loss or alteration of habitats is scoped out of the CIA.

Table 8-17 Summary of projects considered for the CIA in relation to benthic and intertidal ecology

Project	Status	Distance from the proposed scheme (km)	Project data status	Included in CIA	Rationale
Hunterston Port and Resource Centre (PARC)	No EIA or planning permission required for works, however EIA screening opinion and licence being sought for associated dredging	2km	Low	Yes	Potential for cumulative impacts regarding spread of invasive non-native species

Project	Status	Distance from the proposed scheme (km)	Project data status	Included in CIA	Rationale
Great Cumbrae Solar farm	Permission granted	1.5 km	Medium	No	No connectivity with benthic and intertidal sites, habitats and species
Mill Burn, Millport Flood Scheme	Option Appraisal	Within Proposed Scheme Area	Low	No	No connectivity with benthic and intertidal sites, habitats and species

8.7.1.1 Cumulative impacts during construction

Cumulative Impact 1: Potential introduction / spread of invasive non-native species

Hunterston PARC

187. The majority of the works associated with Hunterston PARC are terrestrial, however dredging activities are required and a Marine Licence is being sought for these works (Peel Ports Group,2019). A number of invasive non-native species, including carpet sea squirt, leathery sea squirt and wireweed, are known to be present in the vicinity of Hunterston PARC. Embedded mitigation incorporated into the Proposed Scheme will manage the risk of invasive non-native species within acceptable levels, and it is anticipated that any Marine Licences required for the development of Hunterston PARC will be subject to the same or similar conditions, requirements and best practice measures. As such, the Proposed Scheme is not anticipated to cumulatively increase the risk of invasive non-native species in the Clyde and wider marine environment.

8.8 Inter-Relationships

188. Table 8-18 lists out the inter relationships between other chapters within the ES.

Table 8-18 inter-topic relationships

Topic	Related Chapter	Where addressed in this chapter	Rationale
Terrestrial ecology	16	Section 8.6	Both chapters consider the potential effects of the Proposed Scheme on habitats at the coastal fringe.
Offshore and coastal ornithology	11	Section 8.6	Both chapters consider the potential effects on habitats which may support birds.
Marine Geology, Oceanography and Physical Processes	6	Section 8.6	The Benthic and Intertidal Ecology assessment takes account of the assessments made in Chapter 6 Marine Geology, Oceanography and Physical Processes which consider potential impacts to marine water quality to assess any associated impacts to designated sites and habitats
Marine Water and Sediment Quality	7	Section 8.6	The Benthic and Intertidal Ecology assessment takes account of the assessments made in Chapter 7, Marine Water and Sediment Quality which consider potential impacts to marine water quality to assess any associated impacts to designated sites and habitats.

8.9 Interactions

189. The impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts as a result of that interaction. The worst-case impacts assessed within this chapter take these interactions into account and for the impact assessments are considered conservative and robust. For clarity, the areas of interaction between impacts are presented in Table 8-19 along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 8-19 Potential interactions between impacts on benthic and intertidal ecology

Potential interaction between impacts			
Construction	**Impact 1: Direct habitat loss**	**Impact 2: Physical disturbance of habitats or species during and following construction**	**Impact 3: Potential introduction / spread of invasive non-native species**
Impact 1: Direct habitat loss		Yes	No
Impact 2: Physical disturbance of habitats or species during and following construction	Yes		no
Impact 3: Potential introduction / spread of invasive non-native species	no	no	
Operation	Impact 1: habitat alteration		
Impact 1: habitat alteration			
Decommissioning	As a flood prevention scheme, the Proposed Scheme is anticipated to be maintained rather than removed, and therefore decommissioning activities are currently unknown. This will be assessed at the time of any decommissioning activities required.		

8.10 Summary

190. The main potential impacts of the Proposed Scheme on benthic and intertidal receptors have been identified.

191. Three potential impacts during construction have been identified. Kames Bay SSSI and pioneer saltmarsh habitat will be protected from direct habitat loss by fencing and toolbox talks will inform all construction personnel of the importance of these features and staying outwith the fenced areas.

192. Benthic and intertidal habitat loss will be permanent within the footprint of the offshore breakwaters where no protected or notable habitats and species were recorded.

193. The potential for suspended sediments to impact Kames Bay SSSI and Farland Point SWT site are assessed in **Chapter 6 Marine Geology, Oceanography and Physical Processes** to be short temp, reversible and negligible, and any impact to the ecology of these sites is also assessed to be negligible.

194. Embedded mitigation measures will control the risk of marine pollution incidents and the potential spread of invasive non-native species throughout the Benthic Study Area, including the designated sites.

195. During operation of the Proposed Scheme, no significant habitat alteration is expected to occur within the Kames Bay SSSI or Farland Point SWT site. The presence of the offshore breakwaters will create more shelters waters inshore, which may lead to an increase in kelp habitat. There is potential for marine species to colonise the new marine structures and marine fauna to seek refuge in the new artificial reef created.

196. On the assumption that other projects in the vicinity of the Proposed Scheme will be subject to the same conditions and requirements to prevent the spread on invasive non-native species there is not anticipated to be any cumulative effects on the marine and intertidal environment at Millport.

197. A summary of the potential impacts and proposed mitigation is presented in Table 8-20.

Table 8-20 Potential Impacts Identified for benthic and intertidal habitats and species

Potential Impact	Receptor	Importance / sensitivity	Magnitude	Significance	Examples of Potential Mitigation Measures	Residual Impact
Construction						
Impact 1: Direct habitat loss	Kames Bay SSSI	High	Low	Moderately adverse	Fencing off and no access onto Kames Bay	Minor adverse
	Pioneer saltmarsh	Medium	Medium	Moderately adverse	Fencing off and no access onto saltmarsh habitat.	Minor adverse
	Other habitats	Negligible	Medium	Minor adverse	None required	Minor adverse
Impact 2: Physical disturbance of habitats or species during and following construction	Marine Pollution incidents	Low - High	Negligible	Minor adverse	Embedded mitigation	Minor adverse
	Suspended sediments	Medium – high	Negligible	Minor adverse	None required	Minor adverse
Impact 3: Potential introduction / spread of invasive non native species	Invasive non-native species	Medium	Low	Minor adverse	Embedded mitigation	Minor adverse
Operation						
Impact 1: habitat alteration	Kames Bay SSSI and Farland Point SWT Site	High	Negligible	Negligible	None required	Negligible
	Other habitats	Negligible	Medium	Minor adverse	None required	Minor adverse
Decommissioning						

Potential Impact	Receptor	Importance / sensitivity	Magnitude	Significance	Examples of Potential Mitigation Measures	Residual Impact
As a flood prevention scheme, the Proposed Scheme is anticipated to be maintained rather than removed, and therefore decommissioning activities are currently unknown. This will be assessed at the time of any decommissioning activities required.						

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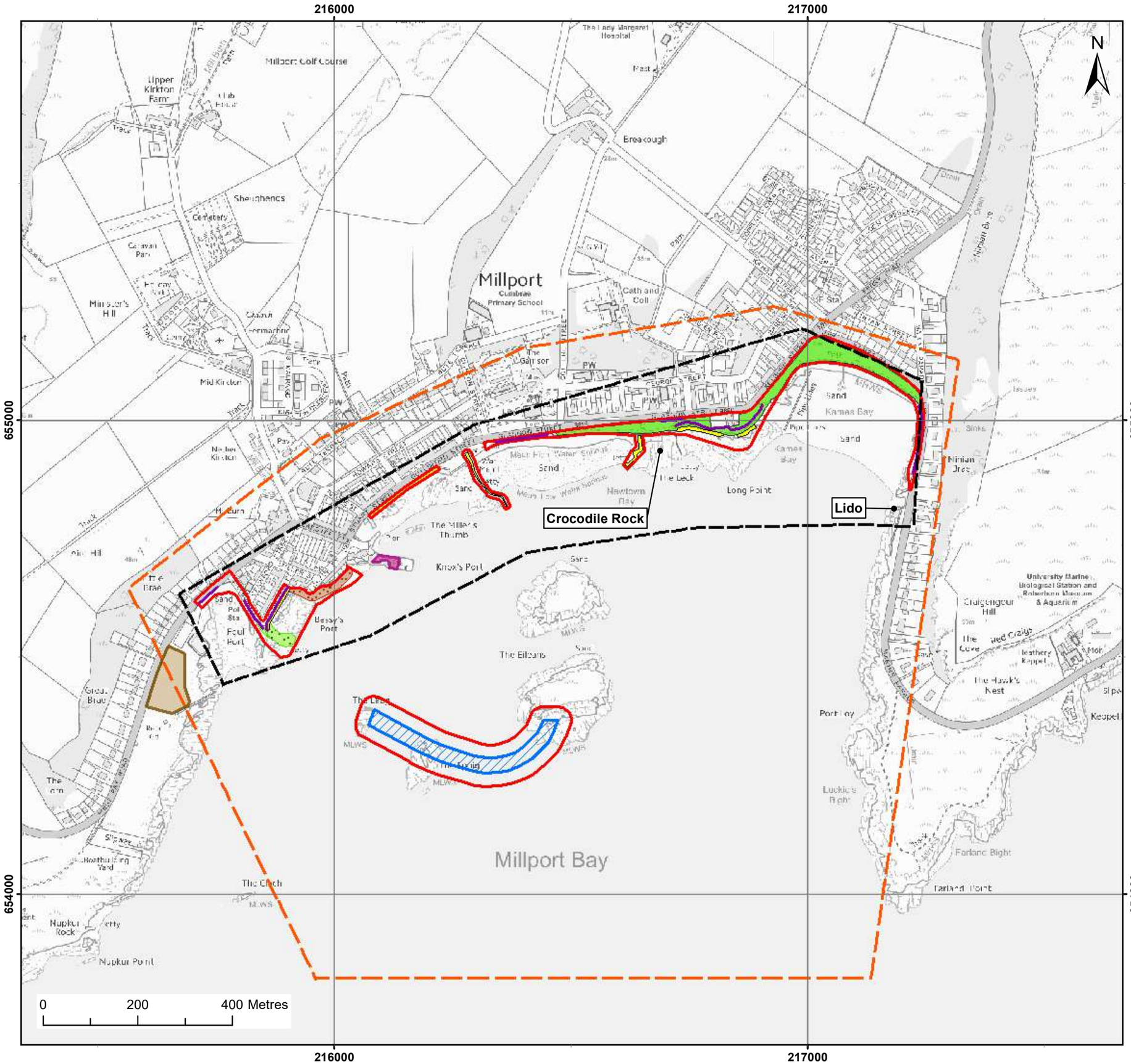

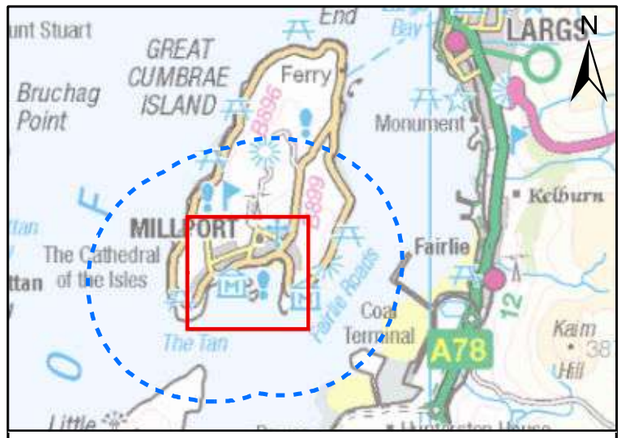

Legend

- Redline Boundary
- Desk Study Area
- Benthic Study Area
- Intertidal Study Area
- Potential Site Compound
- Potential Materials Storage
- Flood Walls
- Rock Breakwater
- Rock Revetment
- Modifications to existing coast protection structures
- Modifications to existing promenade and grass areas
- Offshore Breakwater

Client:	Project:
North Ayrshire Council	Millport Flood Protection Scheme - EIA Report

Title: Benthic and Intertidal Study Areas

Figure: 8.1 | Drawing No:

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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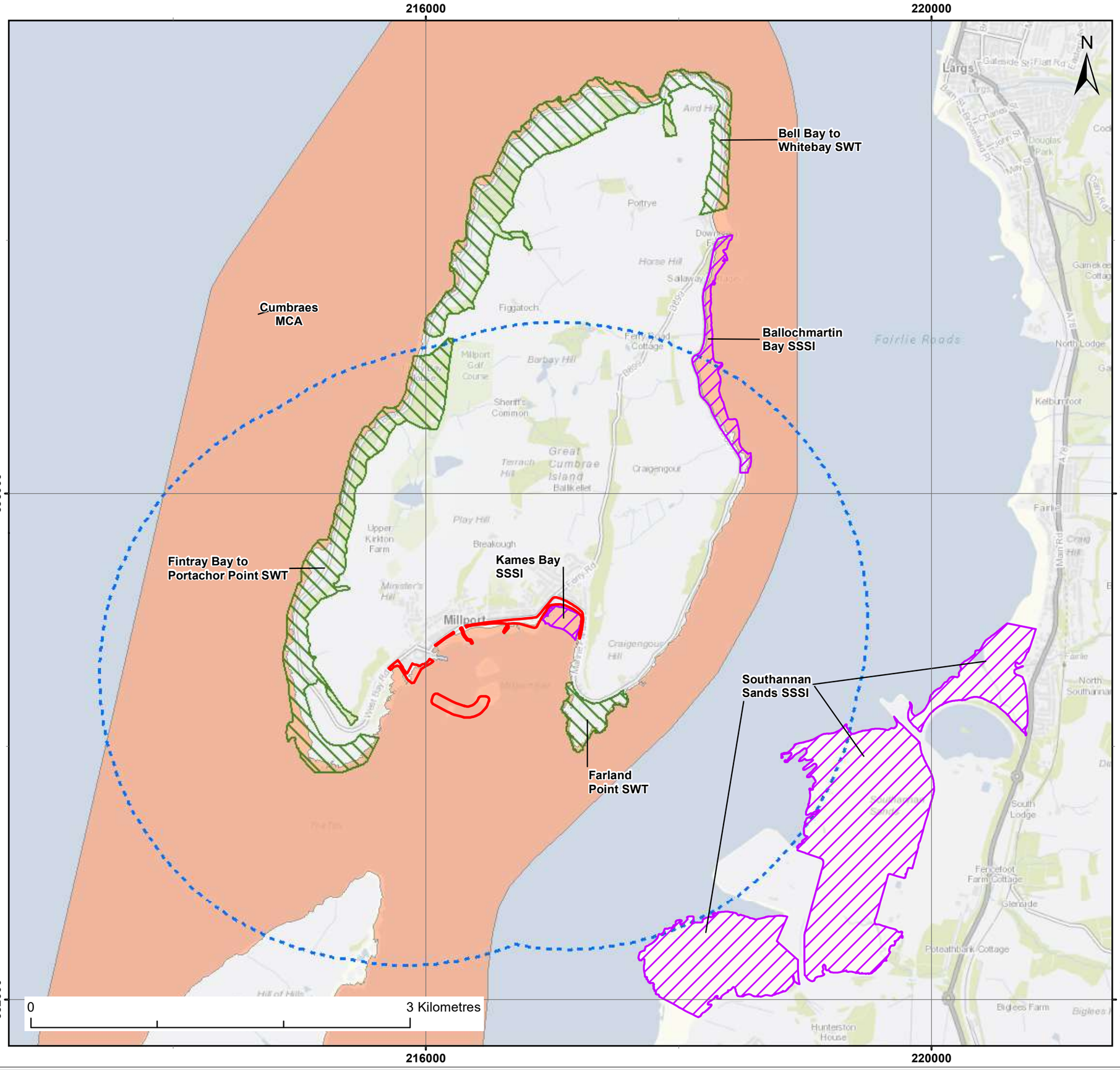

Legend

- Desk Study Area
- Redline Boundary
- Site of Special Scientific Interest (SSSI)
- Wildlife Site (SWT)
- Marine Consultation Area (MCA)

Client:	Project:
North Ayrshire Council	Millport Flood Protection Scheme - EIA Report

Title: Marine nature conservation designated sites

Figure: 8.2 | Drawing No:

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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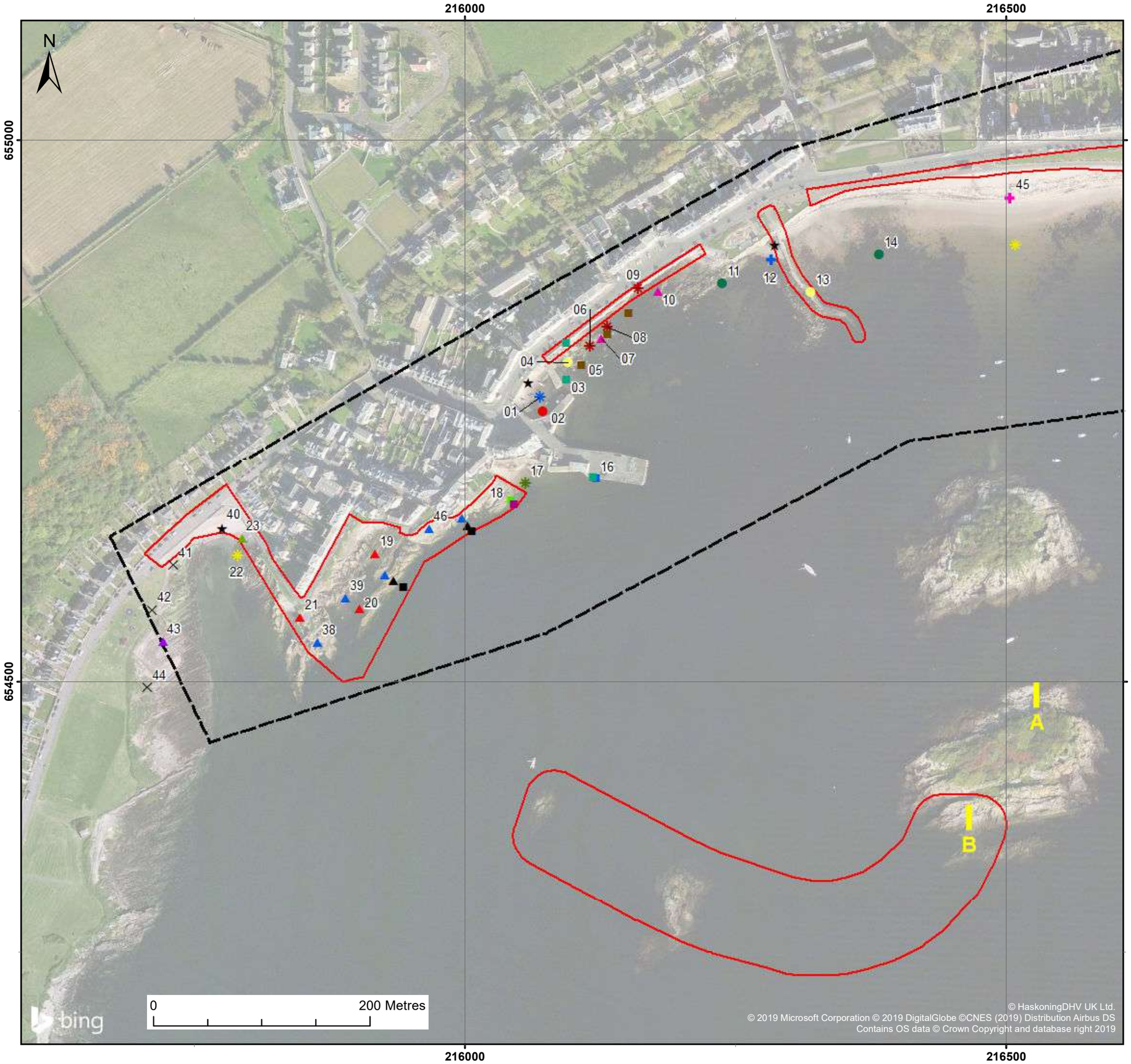

Legend

- Redline Boundary
- Intertidal Study Area
- Benthic Intertidal Transects[1]

Biotope[2]

- LR.FLR.Eph.BLitX
- LR.FLR.EphEnt
- LR.FLR.Lic.Ver.B
- LR.FLR.Lic.YG
- LR.FLR.Rkp
- LR.FLR.Rkp.G
- LR.HLR.MusB
- LR.HLR.MusB.Cht
- LR.HLR.MusB.MytB
- LR.HLR.MusB.Sem.FvesR
- LR.HLR.MusB.Sem.LitX
- LR.HLR.MusB.Sem.Sem
- LR.MLR.BF.FspiB
- LR.MLR.BF.FvesB
- LR.MLR.BF.PelB
- LS
- LS.LCS
- LS.LCS.Sh.BarSh
- LS.LCS.sh.BarSh
- LS.LMp
- LS.LSa
- LS.LSa.FiSa.Po
- LS.LSa.MoSa
- LS.LSa.MuSa.MacAre
- LS.LSt.St
- Lido

[Where Biotope coincides with Target Note it has been numbered.]

[1] Bunker et al, 2018 [2] Royal HaskoningDHV, 2017b

Client:	Project:
North Ayrshire Council	Millport Flood Protection Scheme - EIA Report

Title: Intertidal habitats and species

Figure: 8.3a Drawing No:

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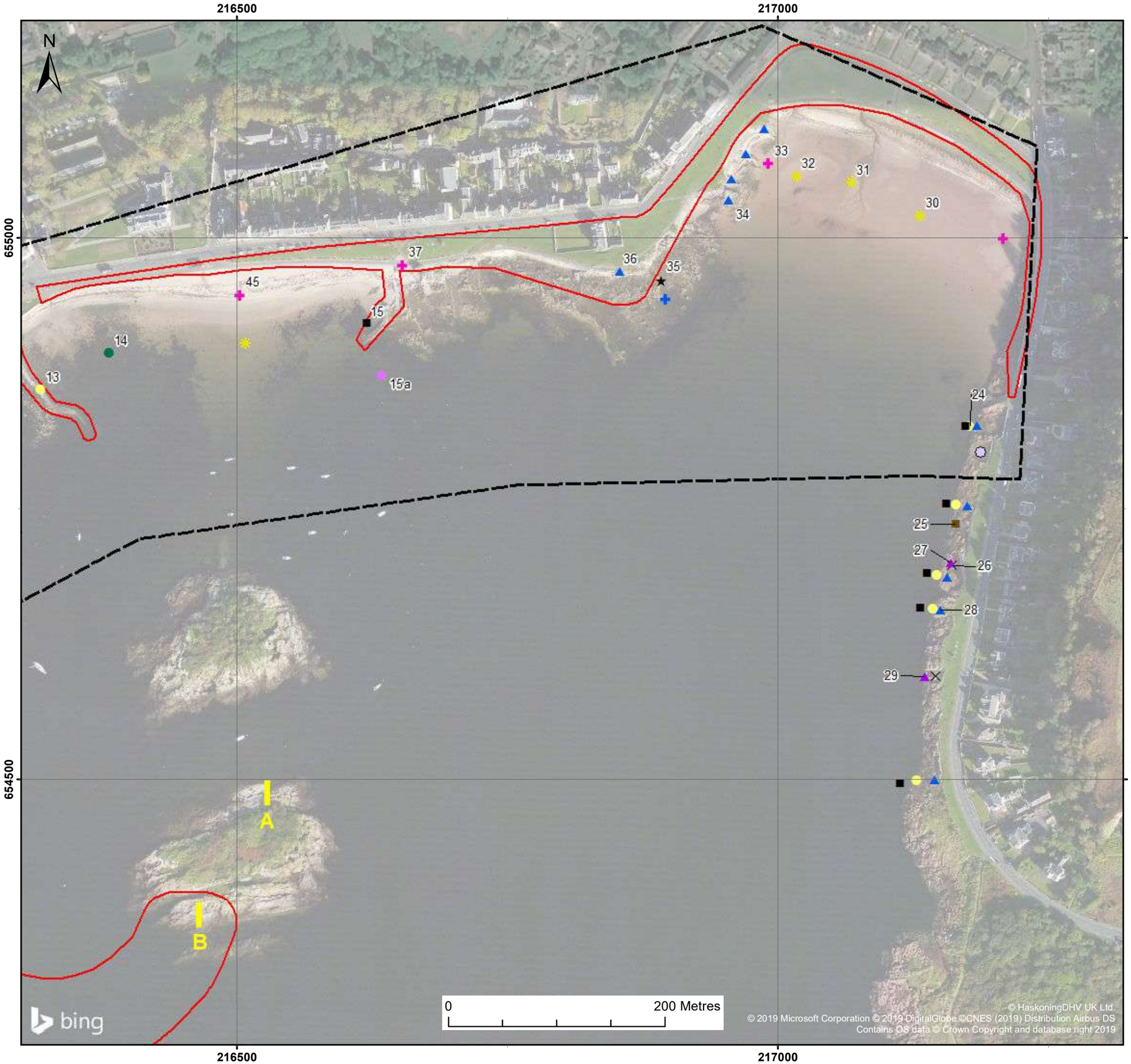

Legend

- Redline Boundary
- Intertidal Study Area
- Benthic Intertidal Transects[1]

Biotope[2]

- IR.MIR.KR.Ldig
- LR.FLR.Eph.BLitX
- LR.FLR.EphEnt
- LR.FLR.Lic.Ver.B
- LR.FLR.Lic.YG
- LR.FLR.Rkp
- LR.FLR.Rkp.G
- LR.HLR.MusB
- LR.HLR.MusB.Cht
- LR.HLR.MusB.MytB
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- LR.HLR.MusB.Sem.Sem
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- LS.LMp
- LS.LSa
- LS.LSa.FiSa.Po
- LS.LSa.MoSa
- LS.LSa.MuSa.MacAre
- LS.LSt.St
- Lido

[Where Biotope coincides with Target Note it has been numbered.]

[1] Bunker et al, 2018 [2] Royal HaskoningDHV, 2017b

Client:	Project:
North Ayrshire Council	Millport Flood Protection Scheme - EIA Report

Title: Intertidal habitats and species

Figure: 8.3b Drawing No:

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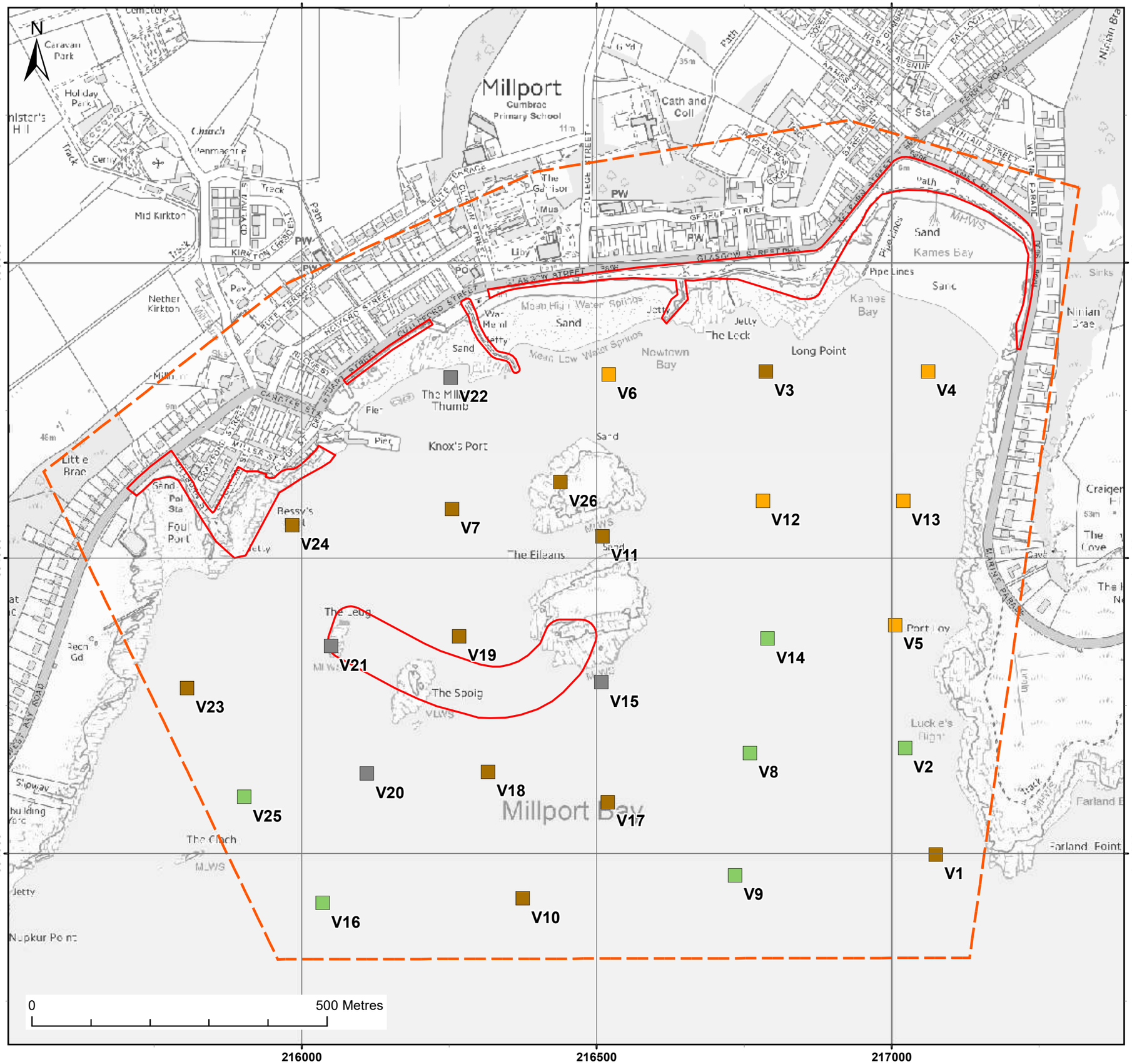

Legend

- Benthic Study Area
- Redline Boundary

Video Drop-down Locations[1]

- Fine Sand
- Mixed Sediment
- Mud
- Rock

[1] Bunker et al, 2018

Client:	Project:
North Ayrshire Council	Millport Flood Protection Scheme - EIA Report

Title: Drop down video surveys results

Figure: 8.4 | Drawing No:

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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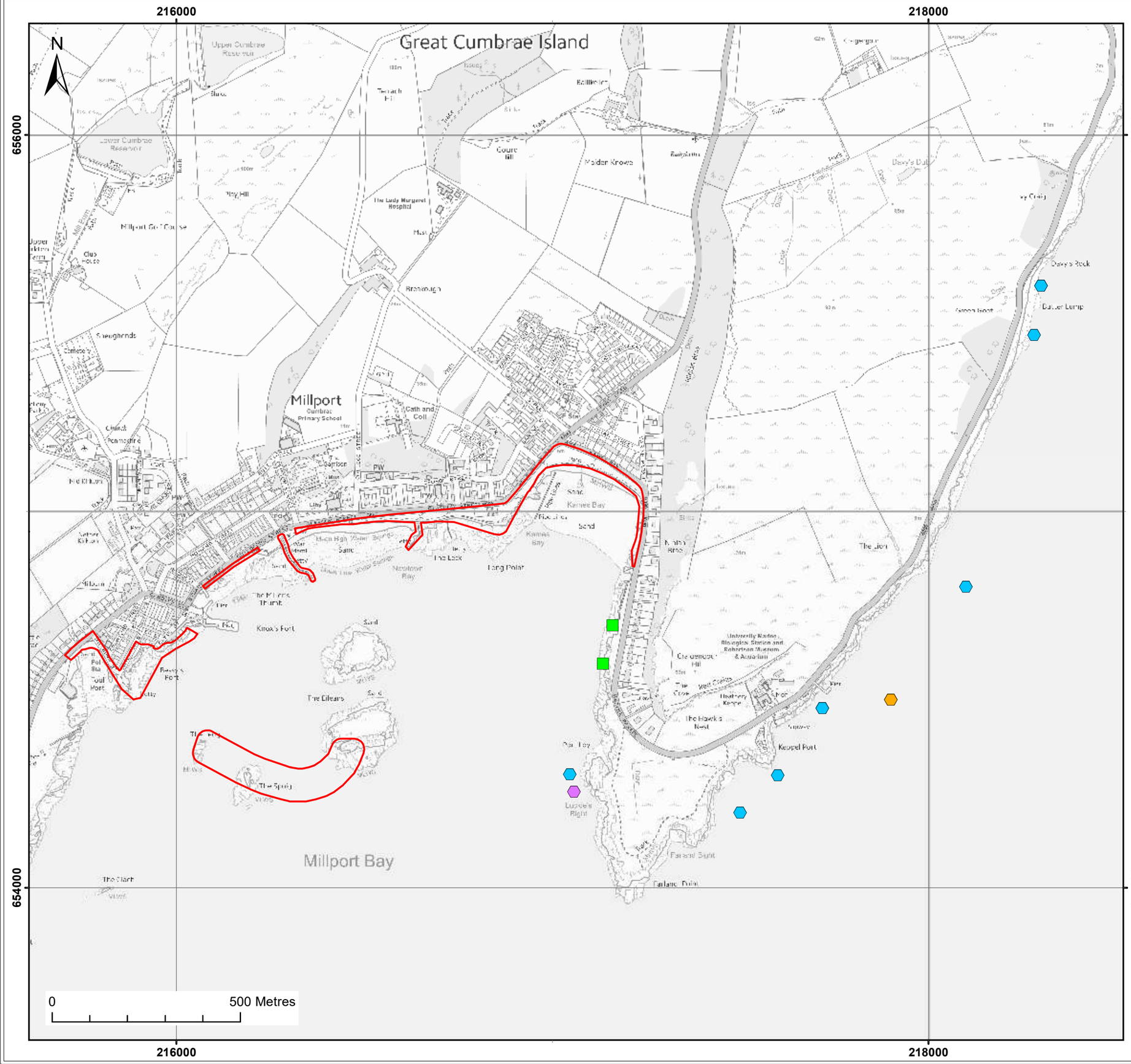

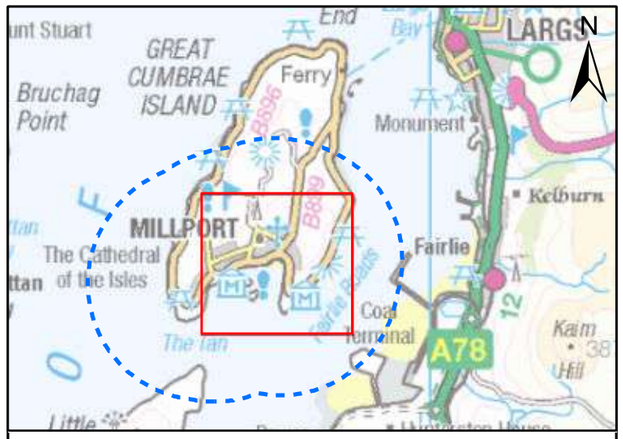

Legend

- Redline Boundary
- Pioneer Saltmarsh[1]

Invasive non-native Species[2]

- Crepidula fornicata
- Sargassum muticum
- Styela clava

[1] Royal HaskoningDHV 2017a
[2] SWSEIC, 2017

Client:	Project:
North Ayrshire Council	Millport Flood Protection Scheme - EIA Report

Title:

Protected or Noteworthy Species and Habitats

Figure: 8.5 | Drawing No:

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REPORT

Millport Coastal Flood Protection Scheme: Environmental Statement

Appendix 8.1 Benthic Drop-Down Video Survey Report

Client: North Ayrshire Council

Reference: PB4749-RHD-ZZ-XX-RP-Z-0008.1

Status: Final/F01

Date: 31 January 2020

Royal HaskoningDHV

Enhancing Society Together

Millport Flood Protection Scheme – Drop Down Video Survey Report

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Contents

1 Introduction

The following introduction is taken from the work scope document produced by Royal HaskoningDHV.

Millport is located on the southern end of the island of Great Cumbrae, which is located approximately 2.5 km west of the coast of North Ayrshire (Figure 1). Millport is a town which is built within a narrow low-lying coastal strip, with properties located to the landward side of the coastal road. Tourism is a strong component of the local economy of Millport. Furthermore, the area contains a number of important areas of ecological interest such as Kames Bay and Ballochmartin Bay, which are designated as Sites of Special Scientific Interest (SSSI). Millport is at risk from coastal flooding due to wave overtopping. This poses a risk to residential and commercial properties which are within the flood risk zone. This will lead to serious economic damage, in excess of £44 million over the next 100 years. North Ayrshire Council has recently focused on the regeneration of Millport, and investment into flood defences will further encourage additional economic development in Millport, whilst improving facilities for leisure boat traffic within the inner harbour area.

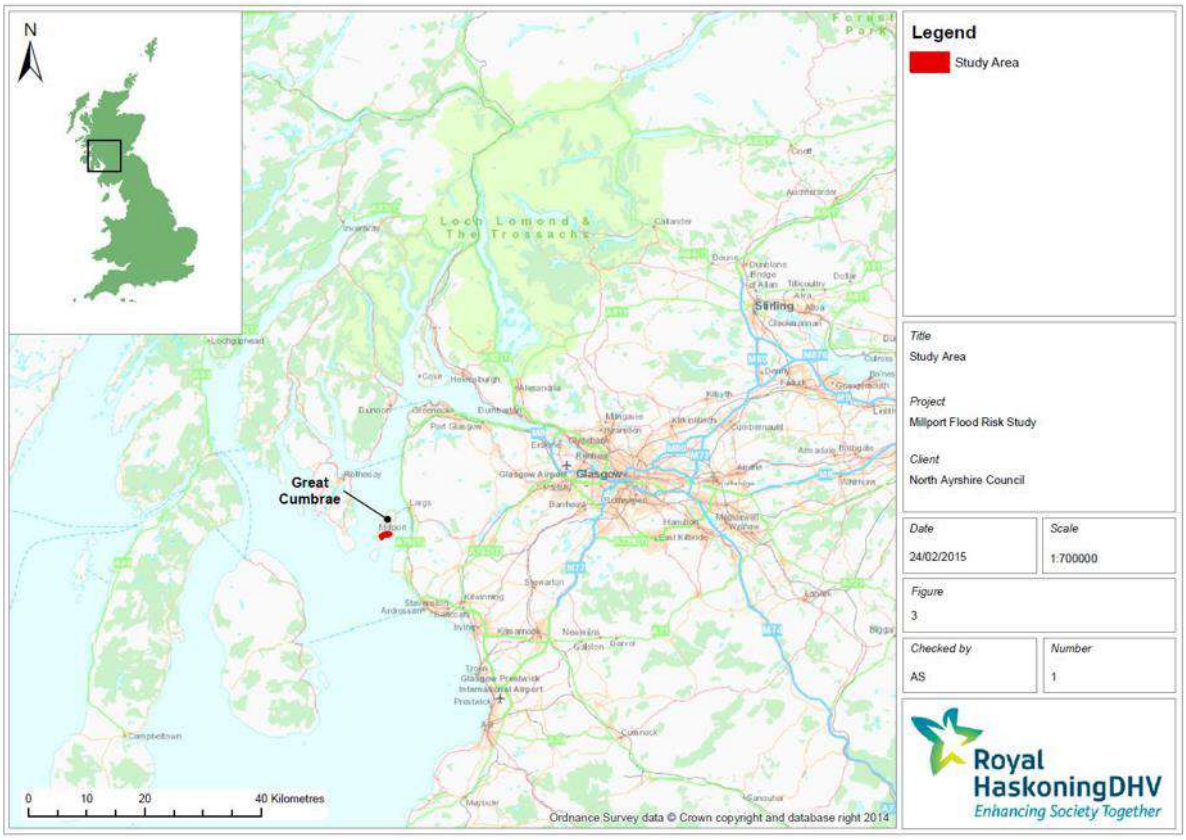


Figure 1 Geographical location of Great Cumbrae

Royal HaskoningDHV DHV were commissioned by North Ayrshire Council to undertake a coastal flood risk assessment and provide a subsequent appraisal of management options for Millport. The Scheme includes works on land, works on the foreshore and one of three options for works within the coastal waters at Millport Bay. There are three options currently being considered for offshore flood protections: □

Option 1: a rock armour breakwater extension to Millport Pier; □

Option 2 and 3: offshore rock armour structures in the vicinity of the rock islets within the bay (two alternative alignments of offshore breakwaters are being considered).

Following consultation with Scottish Natural Heritage (SNH), it was agreed that a benthic survey was required, to confirm the presence / absence of maerl in Kames Bay to provide baseline information on the benthic environment prior to any developments.

1.1 Study area

The study area is located between Millburn Street (west) (NS 15820 54609) and Kames Bay (east) (NS 17233 54949), and is approximately 1.55 km2 (Figure 2).

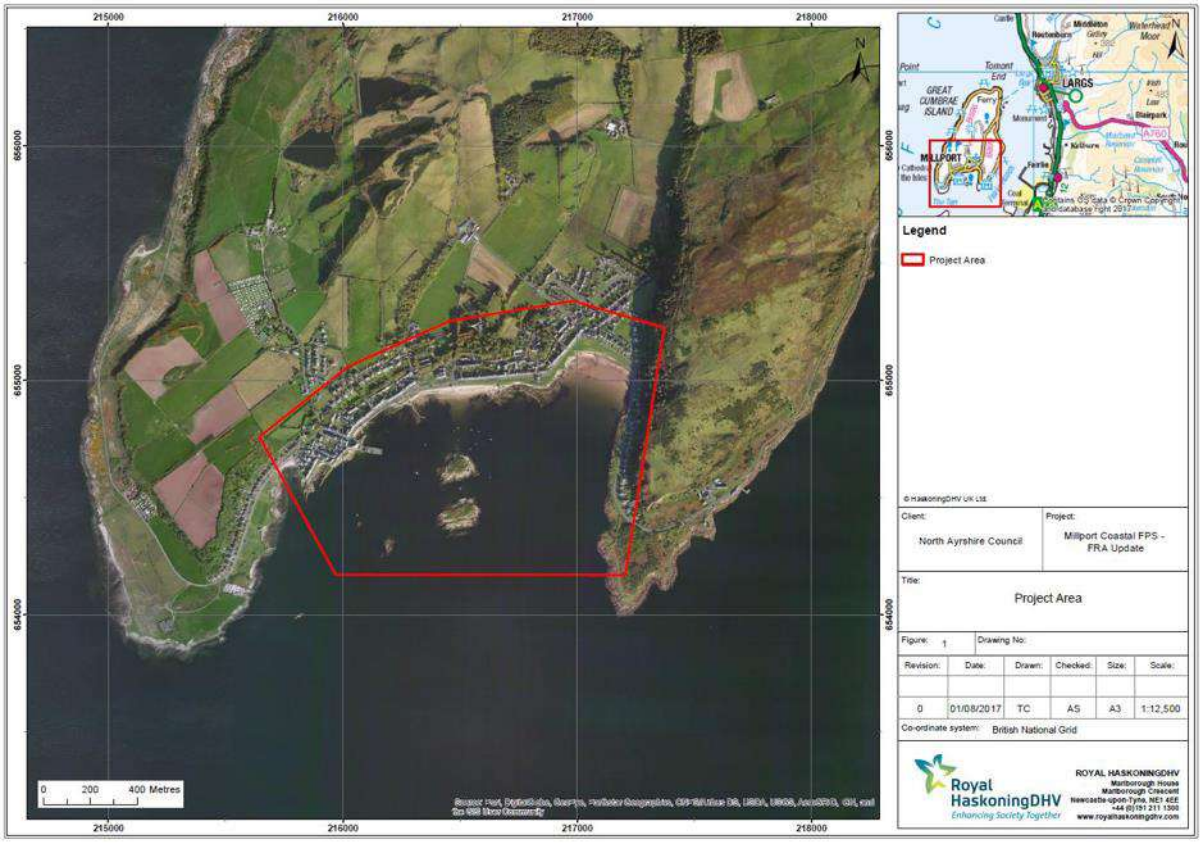


Figure 2 Survey area of Millport and Kames Bay

1.2 Existing environment

Kames Bay SSSI is a designated nature conservation site which has a high faunal population including the lugworm *Arenicola marina* and the bivalve *Tellina tenuis*. There are also wader species such as redshank and oyster catcher. Freshwater seepage allows the presence of estuarine species such as the ragworm *Nereis diversicolor* and the algae *Ulva intestinalis*. *Sargassum muticum*, also known as wireweed, is an invasive non-native species of seaweed which is highly competitive and readily outcompetes native species. Several records of *Sargassum muticum* have been made on Great Cumbrae. There is a potential for this species to be

present within the footprint of the development and also potential for the species to settle on the new project elements in the lower intertidal and shallow subtidal areas.

Scottish Natural Heritage Consultation with Scottish Natural Heritage (SNH) in February 2017 highlighted that there is potential for maerl beds within the area.

1.3 Survey scope

The survey was to focus on the offshore elements, with additional sample areas within the bay (Figure 2), using drop down video to study an area of seabed extending 400 m from the outer edge of the proposed works (to include all three options – see above).

2 Methods

The following survey methods were specified by Royal HaskoningDHV:

- High resolution video data to be collected from a minimum of 25 stations within the area defined above (Figure 2).
- The location of each station to be recorded at the time of video deployment, using GPS, along with date, time and weather conditions (including sea state) at time of deployment.
- Immediately before deployment at each station, the video should be 'carded' with the video used to record footage of a board detailing station number, date and time.
- At each station 2 minutes of stable and clear seabed footage to be collected. This may require collection of more than 2 minutes of footage overall at each station.
- Video data collected at each station to be sufficient to identify seabed characteristics and key epibenthic species sufficient to characterise benthic biotopes.
- The constraints on identification of sediment biotopes using video are understood and biotopes should be identified to the greatest level of detail possible using video and given conditions at time of survey.
- A key requirement at each station is confirmation of presence / absence of maerl and / or maerl beds.
- If maerl beds are encountered; the surveyors should determine the edges of the bed if possible.

2.1 Health and safety

A risk assessment was produced prior to the survey and passed to both Royal HaskoningDHV and North Ayrshire Council.

2.2 Mobilisation

Through contacts on Gt Cumbrae, ASML monitored water quality and weather and mobilised for the survey on January 19th 2018, undertaking the survey on January 20th.

2.3 Drop down video

Two GoPro Hero4 (Black) 4K video cameras with dedicated lighting were mounted on a light-weight steel frame which could be easily lowered and raised by hand. The

GoPros shared the drop-down frame with a bullet camera. The secondary camera provided a real-time view of the seabed on a screen on the boat, via an umbilical. This ensured the 4K GoPro footage was being taken through clear water and was of good quality. During each drifted drop, the frame was constantly landed on the seabed for several seconds to enable clear stable footage, and still images to be collected. By way of in-situ quality control, when the camera was back on the surface, a smart phone, paired with the GoPro, was used to review the footage, prior to manoeuvring to the next site.

A good quality hand-held GPS (Garmin Montana 610) was used, with the horizontal accuracy (as displayed on the GPS) being monitored at all times to ensure that it remains within ± 1m. Care was taken to deploy the camera so that it landed as close to the target position as possible, by taking account of the current and controlling speed and angle of the camera's descent.

Figure 3 Dropdown video cameras and lights used in this study

2.4 Analysis

The video was viewed on a 4K iMac computer using Apple Photos software and stills photos were exported where appropriate. Still photographs were then reduced in size for this report using Adobe Photoshop software.

During the video analysis, data was entered directly into an Excel spreadsheet. Biotopes were assigned to the video drops using the JNCC Marine Habitat Classification (JNCC, 2015).

The field data together with a summary of the video analysis was incorporated into QGIS software to create maps and export shape files.

2.5 Intertidal studies

The intertidal biotopes on the Eileans outcrops were studied via two transects (see Figure 4). Key habitats and species and general zonation patterns were recorded and supported by photographs.

The surveys were undertaken on the 20th the January 2018 and comprised of a brief walk over the shores beginning at 0915hrs (an hour and 45minutes after low water). Both transects were walked from lower to upper shore.

Due to the height of the tide, much of the lower shore was covered by 0915hrs. However, the boat was landed near Transect A and a rapid assessment of the shore biotopes was undertaken through the water where biotopes were hidden. The survey results were supported by photographs and notes.

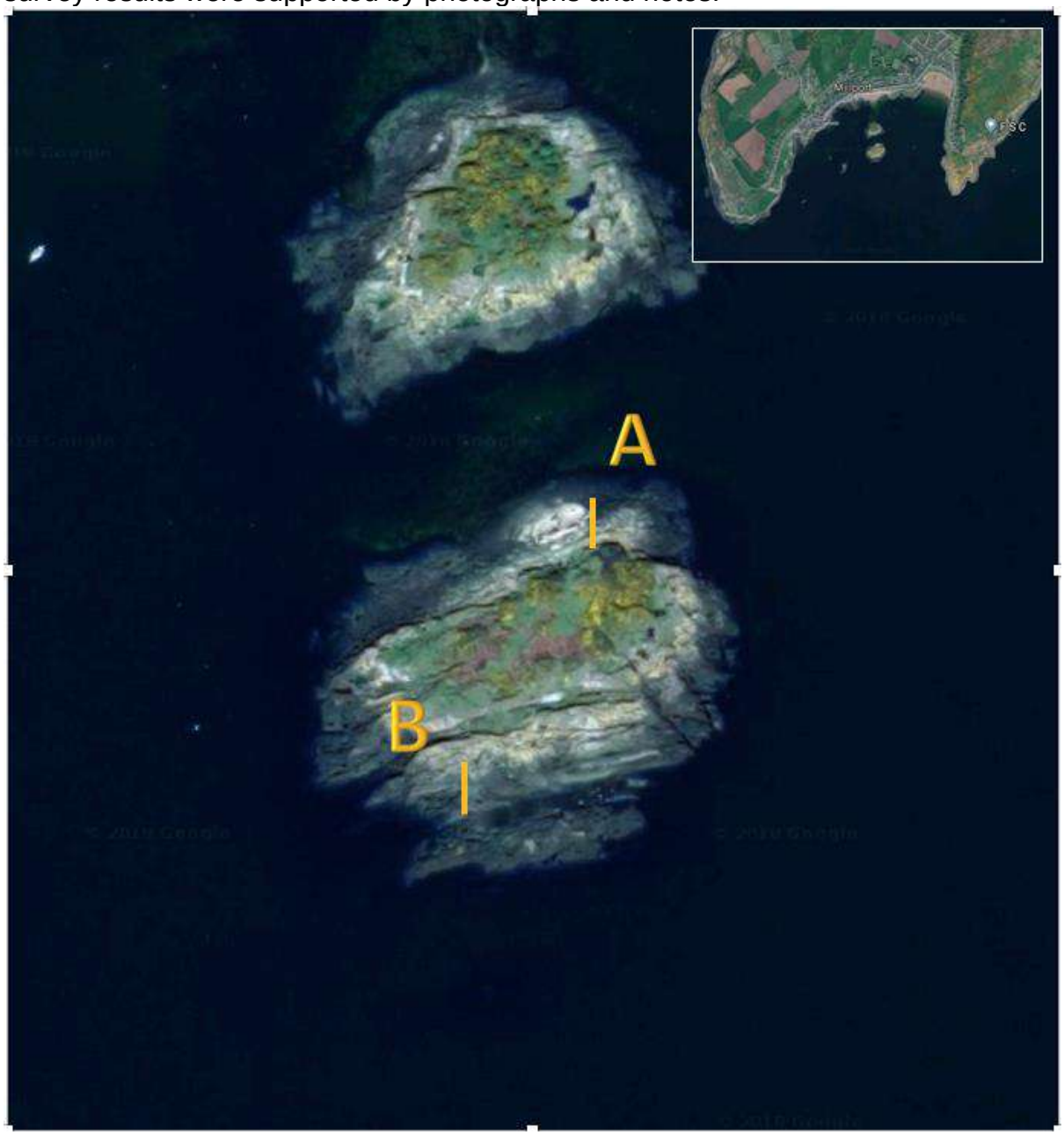


Figure 4 Aerial view of Eileans showing locations of the A and B transects.

A video transect (Site 26) was also undertaken running from the sublittoral sediment/rock interface below the Eileans to their shallow sublittoral at the bottom of the shores

2.6 Outputs as specified by Royal HaskoningDHV

Outputs from the survey to include the following:

1. Raw video footage in high resolution video (MPEG or similar) format for each station. One video file should be provided per station, with each file named in a way that clearly identifies the station number recorded on that file.
2. An edited video file of minimum 2 minutes per station, labelled appropriately, as detailed above.
3. Stills from the video footage at each station, to illustrate the biotope identified at each station.
4. A report detailing the locations surveyed and biotopes identified at each station, illustrated with stills as appropriate.
5. A map showing biotopes identified at each station should also be provided in GIS shapefile format (a polygon habitat map of the seabed was not required).

2.7 Tidal information

Millport tides 20th January 2018 (based on Admiralty tide tables).
02:00 3.1 m
07:30 0.7 m
14:20 3.3 m
20:00 0.5 m

3 Results

The results of the drop down video and intertidal surveys are given below.

3.1 Drop down video

A total of 25 stations were studied using drop down video. The position of these stations are shown in Figure 5 and the northing and eastings are given in Table 1.

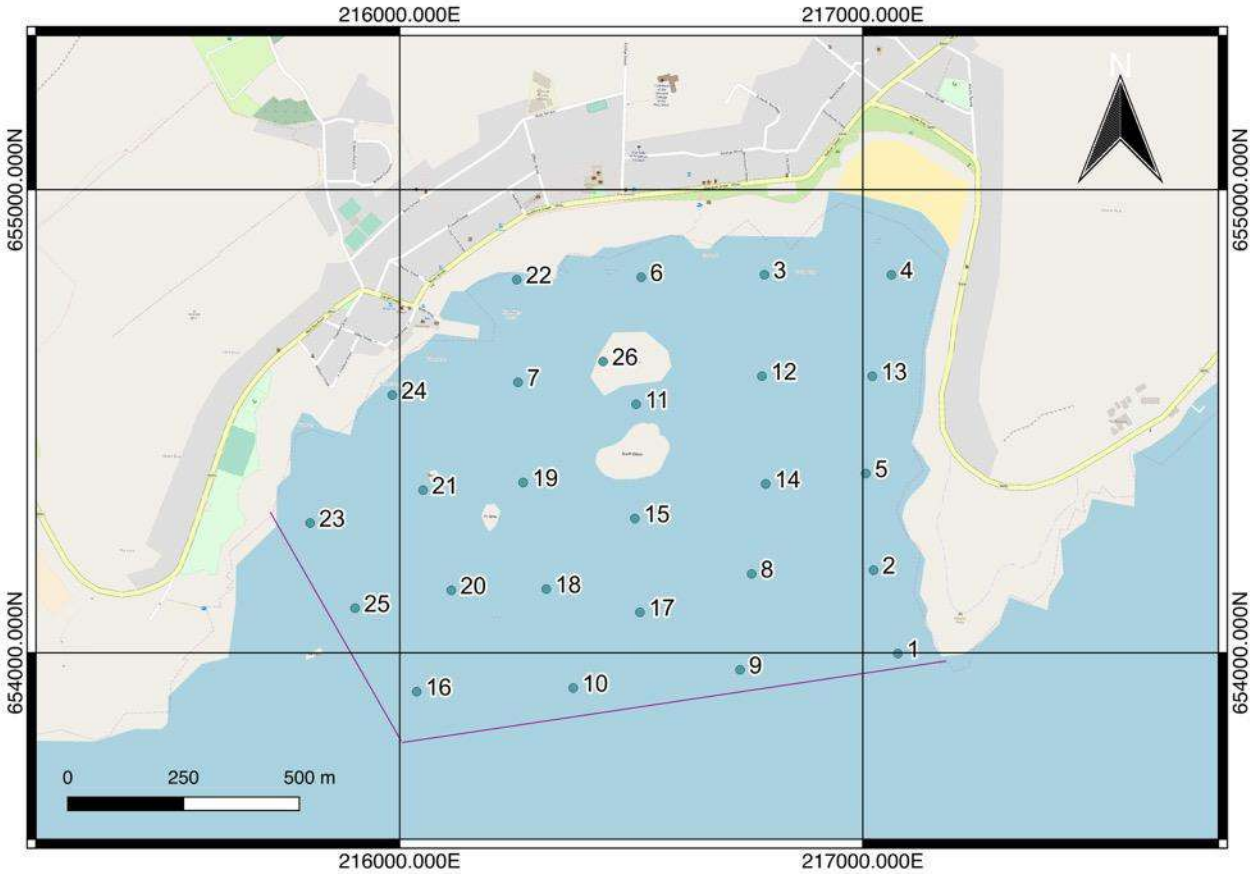


Figure 5 Drop down video locations within Kames Bay. The line offshore represents the limits of the survey area.

A map showing the distribution of biotopes is showing in Figure 6 Biotopes found at each of the video drops in Kames Bay. Still pictures of the biotopes encountered are given in Figure 7 to Figure 36.

Table 1 Results of the drop down video survey showing eastings, northings, depths and biotopes encountered at each drop

ID	Easting	Northing	Time	Depth m (bcd)	Biotopes	Notes
1	217075	653998	11:12	18.5	SS.SMx.CMx Circalittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment. Burrowing species include Cerianthus lloydii
2	217023	654179	11:20	18.1	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus* burrows
3	216787	654816	13:28	3.4	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Boulders, cobbles, pebbles and coarse gravelly sand with *Saccharina latissima* on cobbles and encrusting coralline algae and dark red crustose algae present
4	217062	654816	13:20	4.0	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral rippled sand with casts of *Arenicola*
5	217006	654387	11:26	10.0	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota. Much seaweed detritus evident
6	216521	654811	13:35	0.0	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota
7	216255	654583	12:45	0.0	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Clean cobbles, pebbles and coarse gravelly sand with *Saccharina latissima* on cobbles and encrusting coralline algae and dark red crustose algae present
8	216760	654170	11:44	26.8	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus burrows*
9	216735	653963	11:02	31.0	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus burrows*
10	216375	653924	10:51	20.0	SS.SMx.CMx Circalittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment
11	216510	654537	12:53	2.0	SS.SMx Sublittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment. Burrowing species include *Cerianthus lloydii*
12	216782	654597	13:00	11.4	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota
13	217020	654597	13:13	10.2	SS.SSa.IFiSa Infralittoral fine sand	Infralittoral fine rippled sand with no conspicuous epibiota
14	216790	654364	11:34	22.5	? SS.SMu.CFiMu Circalittoral fine mud	A collection of drift algae on sediment. Seabed not visible so biotope offered as a suggestion based on depth and surrounding observations

ID	Easting	Northing	Time	Depth m (bcd)	Biotopes	Notes
15	216508	654290	12:28	10 to 15	IR.MIR.KR.Lhyp.GzPk Grazed *Laminaria hyperborea* park with coralline crusts on lower infralittoral rock & CR.MCR.EcCr.FaAlCr.Car *Caryophyllia smithii* with faunal and algal crusts on moderately wave-exposed circalittoral rock	*Saccharina latissima* and *Laminaria* spp. on grazed rock with extensive patches of crustose coralline algae and dark red encrusting alga & Silty bedrock and boulders below kelp forest with little conspicuous epibiota except for patches of crustose coralline algae, *Caryophyllia smithii*, *Spirobranchus* sp(p) and *Echinus esculentus*
16	216036	653916	10:40	31.0	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes and *Nephrops norvegicus* burrows
17	216519	654087	11:55	23.0	SS.SMx.CMx Circalittoral mixed sediment	Cobbles, pebbles and shell in a matrix with fine sandy sediment.
18	216316	654138	12:01	25.0	CR.HCR.XFa.FluHocu *Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata	Faunal turf here is not rich, possibly because epibiota (inc. hydroids and bryozoan) die back in the winter.
19	216267	654368	12:20	3.0	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Clean cobbles, pebbles and coarse gravelly sand with Saccharina latissima on cobbles and encrusting coralline algae and dark red crustose algae present
20	216111	654135	12:07	20.3	CR.MCR.EcCr.FaAlCr.Car *Caryophyllia smithii* with faunal and algal crusts on moderately wave-exposed circalittoral rock	Silty rock below kelp forest with little conspicuous epibiota except for patches of crustose coralline algae, *Caryophyllia smithii*, *Spirobranchus* sp(p) and *Echinus esculentus*
21	216050	654351	12:15	2.7 to 3.6	IR.MIR.KR.Lhyp.GzPk Grazed Laminaria hyperborea park with coralline crusts on lower infralittoral rock & IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	*Saccharina latissima* and *Laminaria* spp. on grazed rock with extensive patches of crustose coralline algae and dark red encrusting algae & Infralittoral rock with a covering of sand and some Saccharina latissima and red foliose algae growing through
22	216253	654806	13:40	2.3	IR.HIR.KSed Sediment-affected or disturbed kelp and seaweed communities	Level infralittoral rock with a covering of sand and some red foliose algae growing through
23	215806	654280	10:23	12.0	SS.SCS.CCS Circalittoral coarse sediment	Silty pebbles and gravel with sediment. Little conspicuous epibiota.
24	215984	654556	12:38	2.2	SS.SMx.IMx	Waves of gravelly sand and shell with coarse material

ID	Easting	Northing	Time	Depth m (bcd)	Biotopes	Notes
					Infralittoral mixed sediment	accumulated in troughs. Some algae present on hard substrata including ?*Polyides rotunda*
25	215903	654096	10:31	18.0	SS.SMu.CFiMu Circalittoral fine mud	Fine muddy sediment with some tubes
26	216439	654629	14:17	0.0 to 2.0	LR.LLR.F.Asc.FS *Ascophyllum nodosum* on full salinity mid eulittoral rock LR.LLR.F.Fserr.X *Fucus serratus* on full salinity lower eulittoral mixed substrata & SS.SMx Sublittoral mixed sediment	Transect down the shore from intertidal rock with *Ascophyllum nodosum*, limpets and barnacles to *Fucus serratus* and red seaweeds on rock inundated by coarse sediment to a mixed sediment composed of pebbles, gravel and coarse sediment with crustose and foliose algae and *Sacharrina latissima*

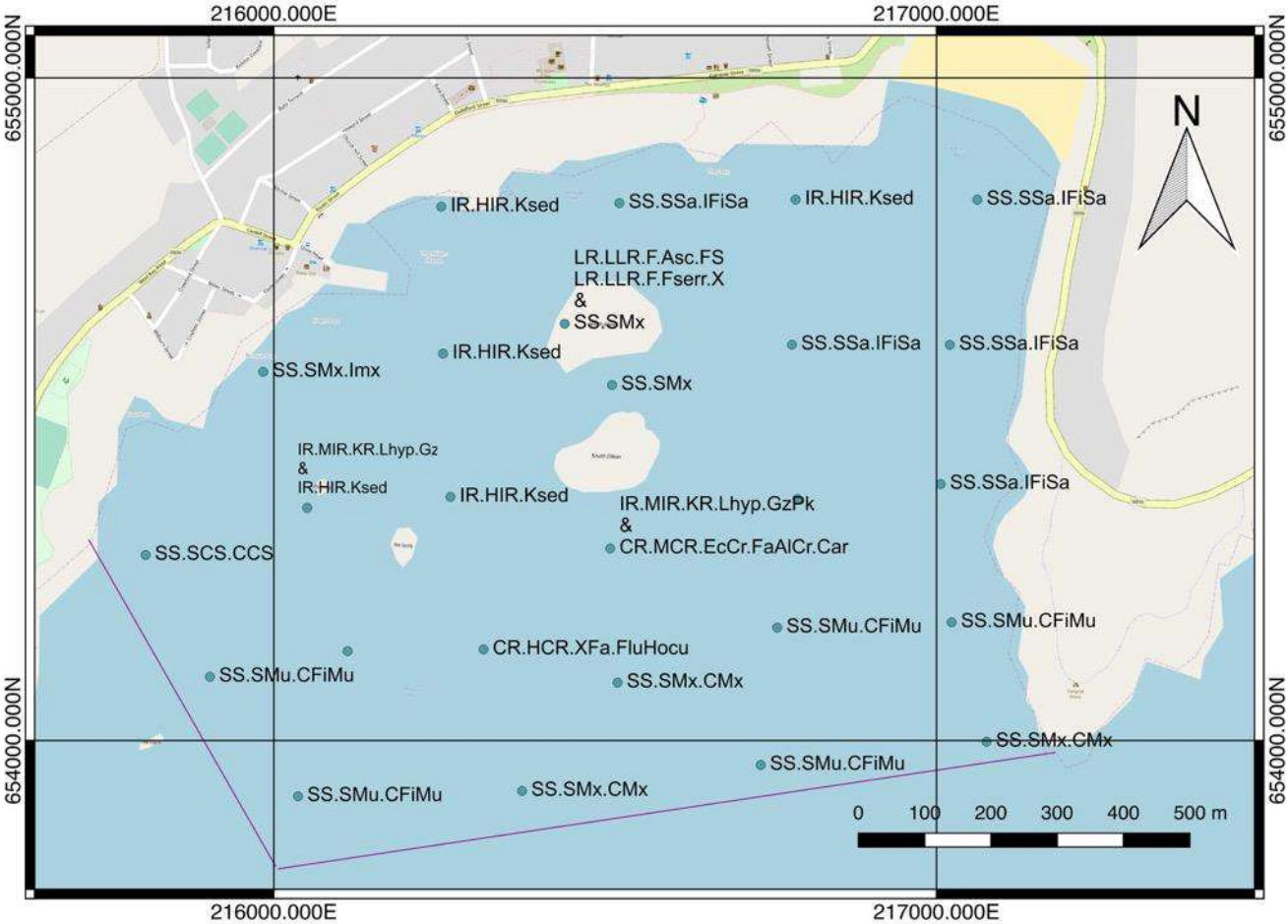


Figure 6 Biotopes found at each of the video drops in Kames Bay

Figure 7 Biotope *SS.SMx.CMx.* Circalittoral mixed sediment

Figure 8 Biotope *SS.SMu.CFiMu*. Circalittoral fine mud

Figure 9 Site 3 Biotope IR.HIR.KSed. Sediment-affected or disturbed kelp and seaweed communities

Figure 10 Site 4 Biotope SS.SSa.IFiSa. Infralittoral fine sand

Figure 11 Site 5 Biotope SS.SSa.IFiSa. Infralittoral fine sand

Figure 12 Site 6 Biotope SS.SSa.IFiSa. Infralittoral fine sand

Figure 13 Site 7 Biotope IR.HIR.KSed. Sediment-affected or disturbed kelp and seaweed communities

Figure 14 Site 7 Biotope IR.HIR.KSed. Sediment-affected or disturbed kelp and seaweed communities

Figure 15 Site 8 Biotope SS.SMu.CFiMu. Circalittoral fine mud

Figure 16 Site 8 Biotope SS.SMu.CFiMu. Circalittoral fine mud

Figure 17 Site 10 Biotope SS.SMx.CMx. Circalittoral mixed sediment

Figure 18 Site 11 Biotope SS.SMx.CMx. Circalittoral mixed sediment

Figure 19 Site 12 Biotope SS.SSa.IFiSa. Infralittoral fine sand

Figure 20 Site 12 Biotope SS.SSa.IFiSa Infralittoral fine sand

Figure 21 Site Site 12 Biotope SS.SSa.IFiSa Infralittoral fine sand

Figure 22 Site 14 Biotope ? SS.SMu.CFiMu. Circalittoral fine mud covered with drift algae.

Figure 23 Site 15 Biotope IR.MIR.KR.Lhyp.GzPk. Grazed *Laminaria hyperborea* park with coralline crusts on lower infralittoral rock

Figure 24 Site 15 Biotope. CR.MCR.EcCr.FaAlCr.Car. *Caryophyllia smithii* with faunal and algal crusts on moderately wave-exposed circalittoral rock

Figure 25 Site 16 Biotope. SS.SMu.CFiMu. Circalittoral fine mud

Figure 26 Site 17 Biotope. SS.SMx.CMx. Circalittoral mixed sediment

Figure 27 Site 18 CR.HCR.XFa.FluHocu. *Flustra foliacea* and *Haliclona oculata* with a rich faunal turf on tide-swept circalittoral mixed substrata

Figure 28 Site 19 Biotope. IR.HIR.KSed. Sediment-affected or disturbed kelp and seaweed communities

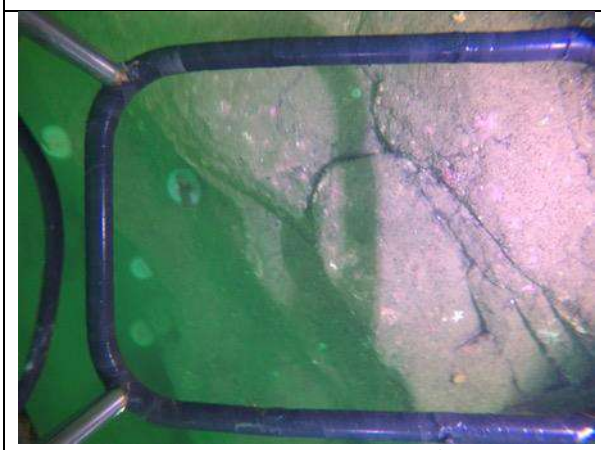


Figure 29 Site 20 Biotope CR.MCR.EcCr.FaAlCr.Car. *Caryophyllia smithii* with faunal and algal crusts on moderately wave-exposed circalittoral rock

Figure 30 Site 21 Biotope IR.MIR.KR.Lhyp.GzPk*. Grazed Laminaria hyperborea* park with coralline crusts on lower infralittoral rock

Figure 31 Site 21 Biotope 2 IR.HIR.KSed. Sediment-affected or disturbed kelp and seaweed communi

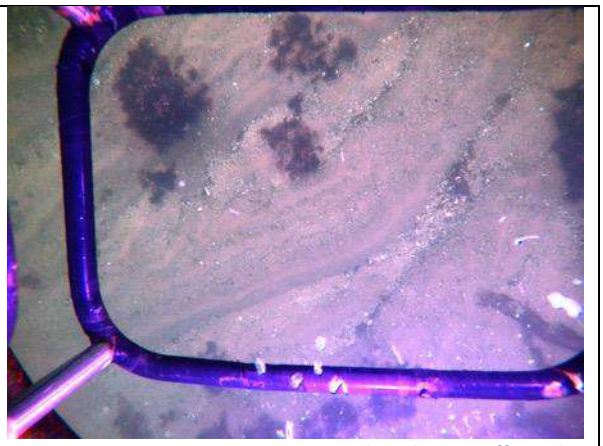


Figure 32 Site 22 Biotope IR.HIR.KSed. Sediment-affected or disturbed kelp and seaweed communities

Figure 33 Site 23 Biotope SS.SCS.CCS. Circalittoral coarse sediment

Figure 34 Site 24 Biotope SS.SMx.IMx. Infralittoral mixed sediment

Figure 35 Site 24 Biotope SS.SMx.IMx. Infralittoral mixed sediment

Figure 36 Site 25 Biotope SS.SMu.CFiMu. Circalittoral fine mud

Figure 37 Site 26 Biotope LR.LLR.F.Asc.FS *Ascophyllum nodosum* on full salinity mid eulittoral rock

Figure 38 Site 26 Biotope LR.LLR.F.Fserr.X *Fucus serratus* on full salinity lower eulittoral mixed substrata

Figure 39 Biotope SS.SMx Sublittoral mixed sediment

3.2 The shores of the Eileans

Table 2 and Table 3 provide descriptions of Transects A and B respectively (see also Figure 4).

Information pertaining to a video transect from the shore to the shallow subtidal (see Figure 5) is given in Table 1 with pictures illustrating the biotopes in Figure 37 to Figure 39

Table 2 Transect A – sheltered north facing intertidal reef with a horizontal extent of approximately 20m.

Position	Description	Biotope	Typical photo
1	A sheltered, mixed fucoid lower middleshore reef and boulder biotope, dominated by *Fucus vesiculosus* and *F. serratus* with sparse growths of *Ascophyllum nodosum*. Beneath the fucoid cover were small foliose red algae such as *Mastocarpus stellatus* and *Gelidium sp*. as well as the green alga *Cladophora sp*. The rock surface was frequently colonised by the red crust *Hildenbrandia rubra*. Fauna present included Patella vulgata, *Nucella lapillus*, *littorina obtusata* and the common barnacle *Semibalanus balanoides*.	LR.MLR.BF.FvesB Fucus vesiculosus and barnacle mosaics on moderately exposed mid eulittoral rock	
2	Patches of dense Ascophyllum nodosum with Vertebrata lanosa epiphyte growths sparse *Fucus vesiculosus* and *F. serratus* with *Mastocarpus stellatus* and *Gelidium sp*. as well as the green alga *Cladophora sp*. The rock surface was frequently colonised by the red crust *Hildenbrandia rubra* and pads of *Rhodothamniella floridula*. Fauna present included Patella vulgata, *Nucella lapillus*, *littorina obtusata* and the common barnacles *Semibalanus balanoides* and *Austrominius modestus*.	LR.LLR.F.Asc.FS Ascophyllum nodosum on full salinity mid eulittoral rock	
3.	A narrow band of Fucus spiralis with an undergrowth of *Catanella caespitosa* and *Hildenbrandia rubra,* the common barnacle species *Semibalanus balanoides* and *Austrominius modestus* inhabit the rock surface with sparse *Patella vulgata* and *Littorina saxatilus* agg.	LR.LLR.F.Fspi Fucus spiralis on moderately exposed to very sheltered upper eulittoral rock	

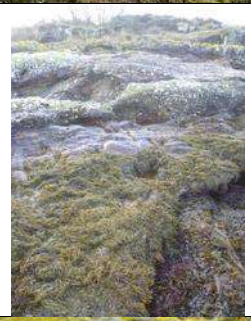
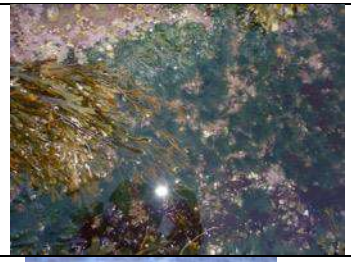
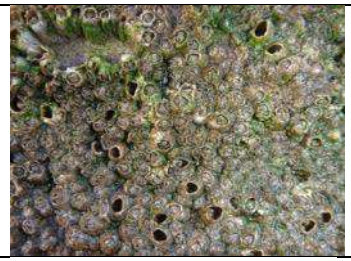
4.	A band of surprisingly dense and large *Pelvetia canaliculata* thalli with an undergrowth of *Catanella caespitosa, Hildenbrandia rubra* and *Verrucaria maura* type lichen. Occasional *Austrominius modestus* and *Semibalanus balanoides* barnacles on the rock surface.	LR.LLR.F.Pel Pelvetia canaliculata on sheltered littoral fringe rock	
5.	Band of fine green algae with *Verrucaria maura* type lichen growing on a conglomerate red sandstone containing abundant quartz pebbles.	LR.FLR.Eph.Ent Enteromorpha spp. on freshwater-influenced and/or unstable upper eulittoral rock	
6.	Yellow and grey lichen zone, with *Caloplaca marina*, *Xanthoria parietina, Ramalina siliquosa, Ochrolechia parella Lecanora atra* and *Anaptychia fusca.*	LR.FLR.Lic.YG Yellow and grey lichens on supralittoral rock	

Table 3 Transect B – Moderately exposed south facing intertidal reef with a horizontal extent of approximately 20m.

Position	Description	Biotope	Typical photo
1.	A grazed middleshore reef with patches of *Semibalanus balanoides, Mytilus edulis, Fucus vesiculosus var. linearis*, coralline crusts, *Chondrus crispus* and *Palmaria palmata* colonising the rock. Occasional limpets graze the algal film of diatoms and *Hildenbrandia rubra* on the surface, resulting in an open community.	LR.HLR.MusB.Sem.FvesR Semibalanus balanoides, Fucus vesiculosus and red seaweeds on exposed to moderately exposed eulittoral rock	
2.	Middle shore rockpools with *Corallina officinalis* and coralline crusts, *Cladophora sp, Chondrus crispus, Mastocarpus stellatus*. Abundant *Littorina littorea* and *Electra pilosa* dominate the faunal component .	LR.FLR.Rkp.Cor.Cor Corallina officinalis and coralline crusts in shallow eulittoral rockpools	
3.	Narrow band of *Fucus spiralis*, limpets and *Semibalanus balanoides* barnacles.	LR.MLR.BF.FspiB Fucus spiralis on full salinity exposed to moderately exposed upper eulittoral rock	

	Band of *Chthamalus montagui* and *Semibalanus balanoides* with small *Littorina saxatilus agg.* periwinkles and sparse tufts of *Pelvetia canaliculata* in a dense band above the middleshore fucoids.	LR.HLR.MusB.Cht Chthamalus spp. on exposed upper eulittoral rock	
4.	Black lichen (*Verrucaria maura* type) zone above the barnacles.	LR.FLR.Lic.Ver Verrucaria maura on littoral fringe rock	
5.	A slippery zone of green algae on the crest of the uppershore reef, occasional patches of *Porphyra sp.* present.	LR.FLR.Lic.Pra Prasiola stipitata on nitrate-enriched supralittoral or littoral fringe rock	
6.	Yellow and grey lichen zone, with *Caloplaca marina*, *Xanthoria parietina, Ramalina siliquosa, Ochrolechia parella Lecanora atra* and *Anaptychia fusca.*	LR.FLR.Lic.YG Yellow and grey lichens on supralittoral rock	

3.3 Transect from littoral to sublittoral

4 Discussion

The biotopes of Kames Bay range from mobile infralittoral sediment close to shore to circalittoral muds in deeper water. The rocky reefs surrounding the bay are dominated by kelp forest in the shallow subtidal and are frequently silted or inundated by sediment in deeper water.

The rocky habitats appear to be heavily grazed by the extensive cover of crustose coralline algae and non-calcaerous crustose red algae on the rock together with and a lack of foliose algae and the presence of numerous *Echinus esculentus*. The shallow sediment-rock interface is sometimes populated by foliose algae such as *Polyides rotundus* which are tolerant to sand scour. A full species complement cannot be given due to the difficulty of identifying many algal species unless they can be physically examined.

Mixed substrata habitats are common in Kames Bay and may well be rich in species in the summer months but in January many epibiota species are absent.

No maerl biotopes were observed during the drop-down video survey.

5 References

JNCC 2015. The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. [Date: 20180206]. Available from: jncc.defra.gov.uk/MarineHabitatClassification

REPORT

Millport Coastal Flood Protection Scheme: Environmental Statement

Appendix 8.2 Intertidal Survey Report

Client: North Ayrshire Council

Reference: PB4749-RHD-ZZ-XX-RP-Z-0008.2

Status: Final/F01

Date: 31 January 2020

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Document title: Millport Coastal Flood Protection Scheme: Environmental Statement

Document short title:
Reference: PB4749-RHD-ZZ-XX-RP-Z-0008.2
Status: F01/Final
Date: 31 January 2020
Project name: Millport Coastal Flood Protection Scheme
Project number: PB4749-RHD-ZZ-XX RP-Z-0007.1
Author(s): [Author]

Drafted by: Click here to enter text.

Checked by:

Date / initials:

Approved by:

Date / initials:

Classification
Project related

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Document title:	Millport Flood Protection Scheme EIA
Document short title:	Intertidal Survey
Reference:	I&BPB4749R001D0.1
Status:	1.0/Final
Date:	24-Oct-17
Project name:	
Project number:	PB4749
Author(s):	David Tarrant

Drafted by:	David Tarrant
Checked by:	Kerrie Craig
Date / initials:	27/03/2017 KC
Approved by:	Kerrie Craig
Date / initials:	27/03/2017 KC

Classification
Open

Table of Contents

1 Introduction

Royal HaskoningDHV were commissioned by North Ayrshire Council to undertake a coastal flood risk assessment and provide a subsequent appraisal of management options for Millport. As part of this work an intertidal survey was required to inform the Environmental Impact Assessment (EIA). This document reports on that intertidal survey which was carried out on the 10th October 2017.

1.1 Objectives

The objectives of the survey were to:

- Identify the habitats and communities present within the survey area (**Figure 1.1**);
- Identify and locate the presence of any rare or protected species within the study area boundaries, and
- Provide target notes (TN) of each biotope, including characterising, rare, protected and non-native species encountered.

This survey was completed in conjunction with an Extended Phase 1 Survey (Royal HaskoningDHV, 2018), which records the terrestrial habitats, inshore of the intertidal study area (**Figure 1**).

A dedicated otter survey was also conducted simultaneously, and is reported in (Royal HaskoningDHV, 2018).

All intertidal species names, both scientific and common, are taken from the Marine Life Information Network MarLIN (www.marlin.ac.uk) or in the case of seaweeds, from the Seasearch Guide to Seaweeds of Britain and Northern Ireland (Bunker *et. al*., 2010) unless otherwise stated.

1.2 The proposed development

At the time of the survey the scheme includes works on land, works on the foreshore and one of three options for works within the coastal waters at Millport Bay. The works onshore include the establishment new flood defence walls, works to existing coastal defences and the installation of rock revetment and a rock breakwater.

The three options currently being considered for offshore flood protection include:

- Option 1: a rock armour breakwater extension to Millport Pier;
- Option 2 and 3: offshore rock armour structures in the vicinity of the rock islets within the bay (two alternative alignments of offshore breakwaters are being considered).

1.3 Study area.

The survey covered the intertidal habitats within the study area presented in **Figure 1**. The survey was designed to include all intertidal areas which may be impacted by the proposed scheme. It extends from an old Lido in the west through Newtown bay and Kames bay and out towards Farland Point in the east.

1.4 Conditions during the survey

The survey was completed by David Tarrant (lead intertidal surveyor) and Charlotte Clements (lead Phase 1 and otter surveyor), who are both experienced ecologist. David has undertaken numerous intertidal surveys for Royal HaskoningDHV many of which have been conducted on the west coast of Scotland. David is a chartered environmentalist, Associate member of CIEEM and a Full member of IEMA. The survey was completed at low spring tide on the 10th October 2017. The survey was run in parallel with the phase 1, otter and archaeology surveys to avoid lone working on the site. Weather conditions were fair to good for the duration of the survey, with some light and heavy rain during the early afternoon. Wind conditions were slight throughout the morning with increasing wind speed during the afternoon. The conditions did not inhibit the survey in any way.

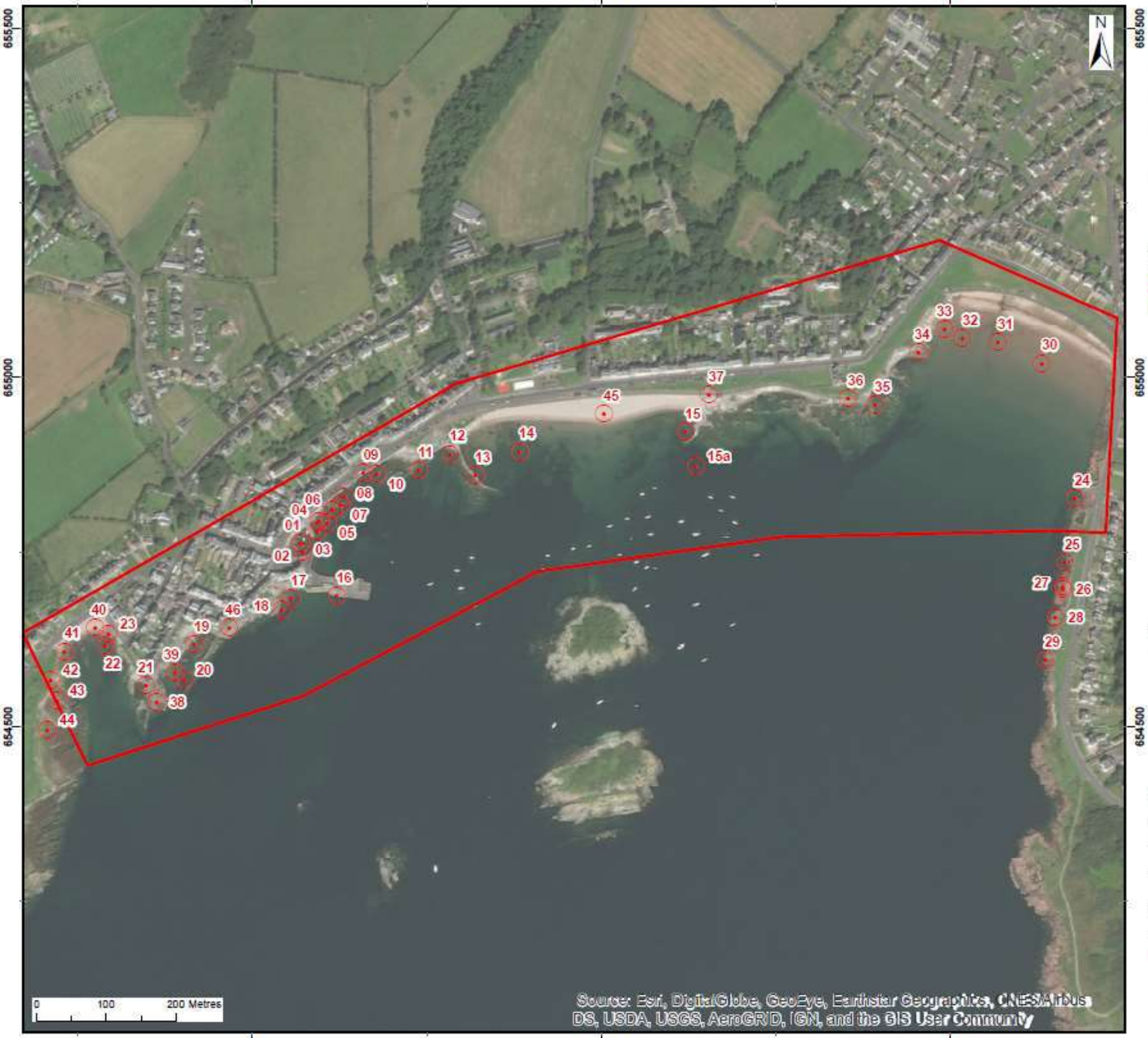
Sea state remained calm (sea state 1 or 2) throughout the majority of the survey rising to 3 in the afternoon. low water was at 9:27am BST and was 0.4m in height.

1.5 Limitations

As the survey was conducted during one tidal cycle and the study area covers approximately 2.5km of coastline the lower shore was only accessed at a very limited number of locations. Intertidal areas which would be affected most by the proposed development were prioritised during low water, however as sediment samples also required collection at low water it was not possible to survey all the priority areas close to low water.

The end section of Millport pier located at target not 16 (**Figure 1**) has been deemed unsafe and access to the structure is prevented by a cordon, therefore the communities on this section of the pier were not surveyed.

Due to time constraints no infaunal investigations were carried out in sediment shores. Therefore, these biotopes have only been assigned at levels 2 and 3.



Legend:

Study Area

Target Notes

Client:	Project:
North Ayrshire Council	Millport Flood Prtection Scheme

Title:

Intertidal Survey Target Note Locations

Figure: 1 | Drawing No: PB4749-103-102-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	12/02/2018	GC	DT	A4	1:8,000

Co-ordinate system: British National Grid

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2 Methodology

The field survey was completed by two experienced ecologists operating on foot, using a number of methods and techniques, based upon those specified in the Countryside Council for Wales (CCW) report 'CCW Handbook for marine intertidal Phase 1 mapping' (Wyn *et al*., 2000) and the 'Marine Nature Conservation Review: Rationale and methods' (Hiscock, 1996).

Target notes (Appendix A) were recorded and photos taken at target note locations. Target notes were located wherever an obvious change in either the biological zonation or physiological conditions appeared to occur. A handheld tablet and Garmin Global Positioning System (GPS) were used to record data and provide positioning for each target note which were then mapped using ArcGIS 10.4 after the survey was completed. Photos were taken using the tablet and a digital Single Lens Reflex (SLR) camera. Appendix 1 primarily contains the photos taken using the tablet as well as some photos taken using the SLR (A full portfolio of all photos taken with the SLP are provided in digital format with this report).

A biotope code was assigned to each target note using the Marine Habitat Classification for Britain & Ireland (v15.03) (JNCC, 2015) and the boundaries where different sets of biotopes was also recorded. This was conducted using a combination of methods including the use of the Marine Habitat Classification online search facility available on the JNCC website.

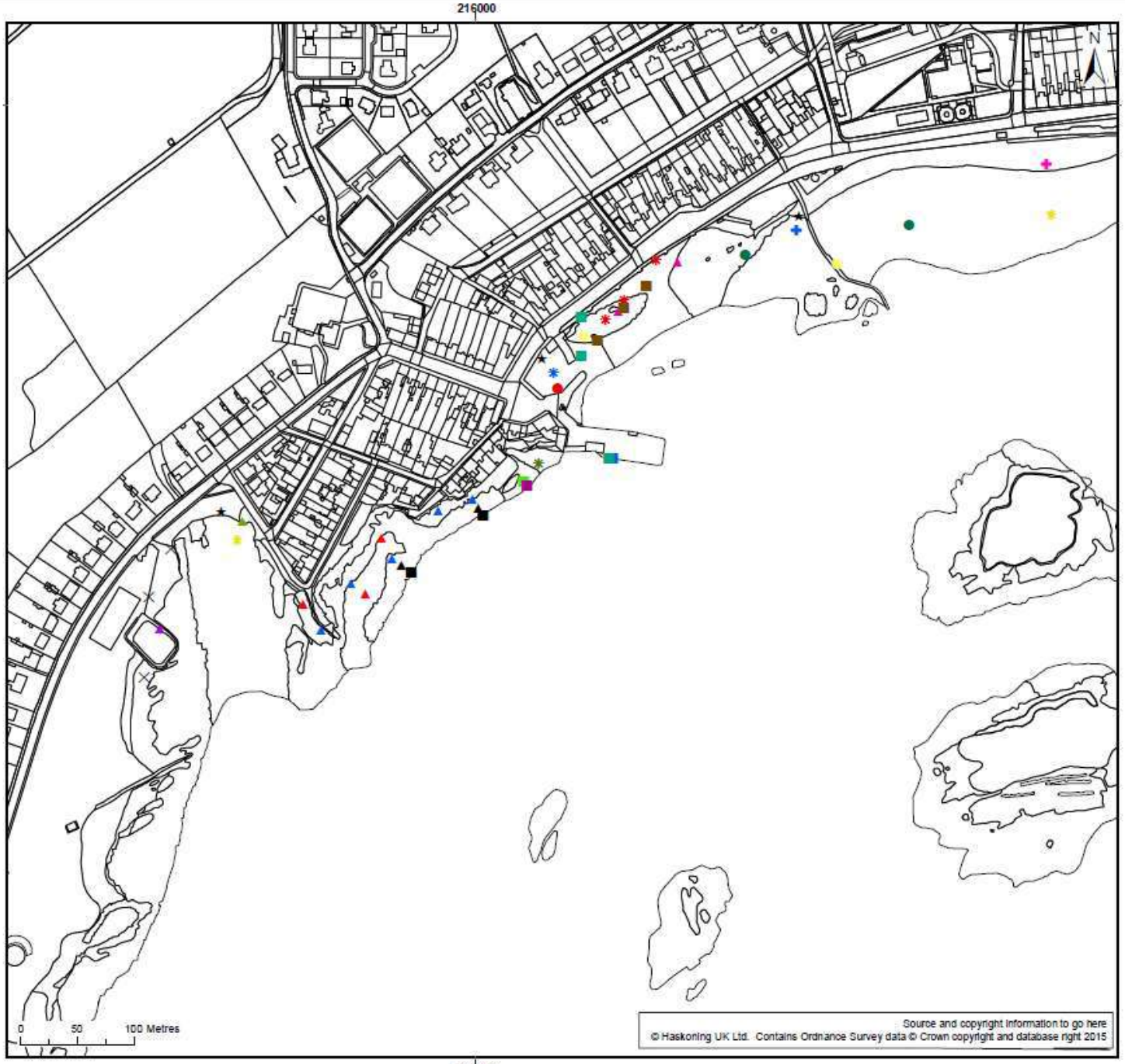
3 Results

A total of 44 target notes were recorded within the study area during the intertidal survey, the locations of which are presented in **Figure 1** with details of what was recorded at each target note provided in **Appendix A**.

The intertidal zone, within the study area, was composed of a mixture of substrates, ranging from solid bedrock in the more exposed locations, through to cobbles and sand in the more sheltered environments of Kames Bay and Newtown Bay. The range of habitats supported a large mixture of biotopes some of which such as the barren shingle and sand supported very few species while others such as the bedrock and boulder biotopes supported a large number of species.

3.1 Biotope mapping

26 different biotopes were recorded over the 44 different target notes (**Table 3.1**). Often multiple biotopes were recorded within a single target note and therefore 81 biotope positions were recorded. The locations of biotopes found during the survey are displayed in **Figures 2a** to **2c** below.



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Biotope

- IR.MIR.KR.Ldig
- LR.FLR.Eph.BLitX
- LR.FLR.EphEnt
- LR.FLR.Lic.Ver.B
- LR.FLR.Lic.YG
- LR.FLR.Rkp
- LR.FLR.Rkp.G
- LR.HLR.MusB
- LR.HLR.MusB.Cht
- LR.HLR.MusB.MytB
- LR.HLR.MusB.Sem.FvesR
- LR.HLR.MusB.Sem.LitX
- LR.HLR.MusB.Sem.Sem
- LR.MLR.BF.FspiB
- LR.MLR.BF.FvesB
- LR.MLR.BF.PelB
- LS
- LS.LCS
- LS.LCS.Sh.BarSh
- LS.LCS.sh.BarSh
- LS.LMp
- LS.LSa
- LS.LSa.FiSa.Po
- LS.LSa.MoSa
- LS.LSa.MuSa.MacAre
- LS.LSt.St
- Lido

Client:	Project:
North Ayrshire Council	Millport Flood Protection scheme

Title: Intertidal survey biotopes

Figure: 2a | Drawing No: 9X4749-103-102-004

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	27/10/17	DT	GC	A4	1:4,975

Co-ordinate system: British National Grid

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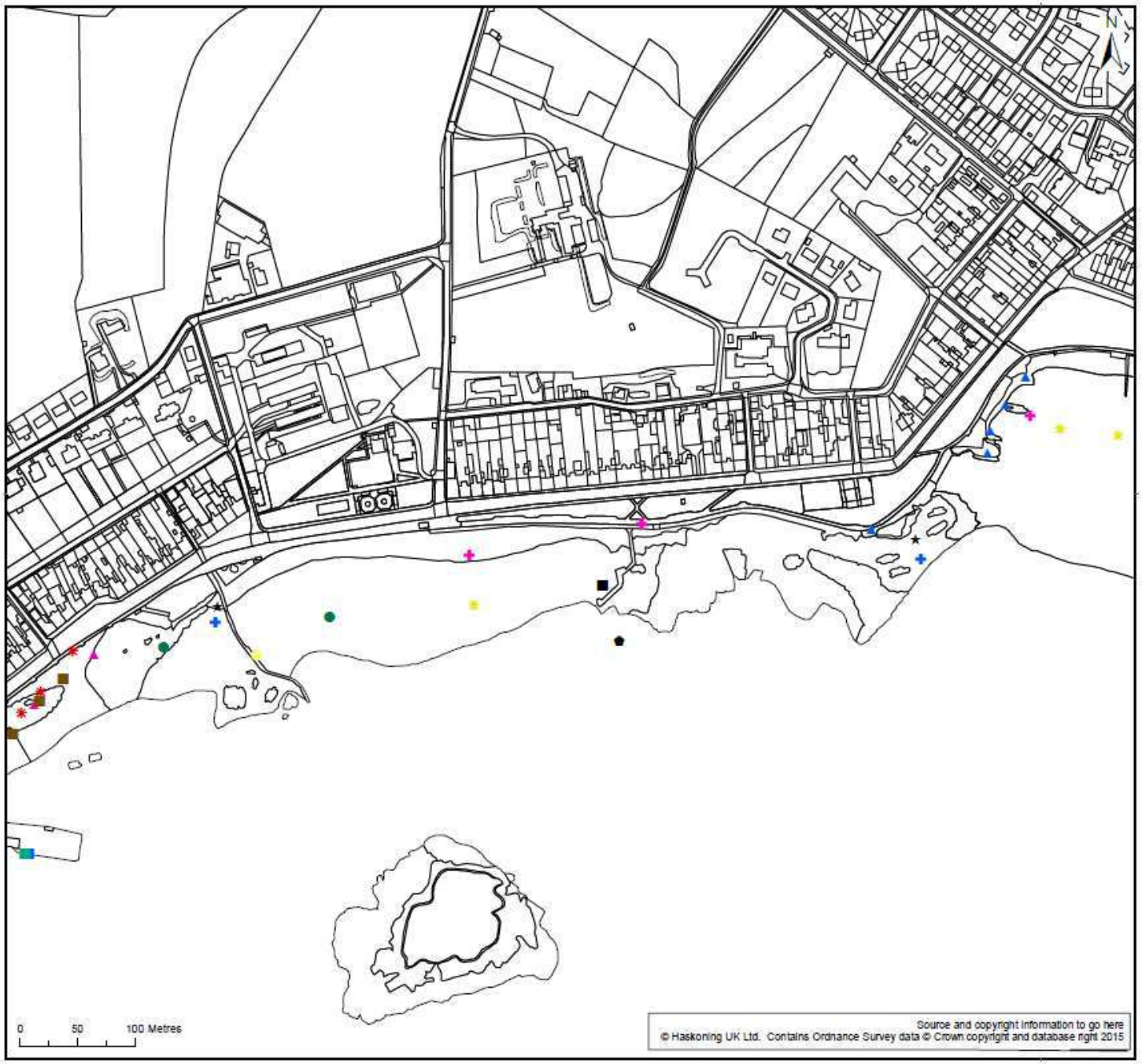

Legend:

Biotope

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- LR.FLR.Eph.BLitX
- LR.FLR.EphEnt
- LR.FLR.Lic.Ver.B
- LR.FLR.Lic.YG
- LR.FLR.Rkp
- LR.FLR.Rkp.G
- LR.HLR.MusB
- LR.HLR.MusB.Cht
- LR.HLR.MusB.MytB
- LR.HLR.MusB.Sem.FvesR
- LR.HLR.MusB.Sem.LitX
- LR.HLR.MusB.Sem.Sem
- LR.MLR.BF.FspiB
- LR.MLR.BF.FvesB
- LR.MLR.BF.PelB
- LS
- LS.LCS
- LS.LCS.Sh.BarSh
- LS.LCS.sh.BarSh
- LS.LMp
- LS.LSa
- LS.LSa.FiSa.Po
- LS.LSa.MoSa
- LS.LSa.MuSa.MacAre
- LS.LSt.St
- Lido

Client:	Project:
North Ayrshire Council	Millport Flood Protection scheme

Title:

Intertidal survey biotopes

Figure: 2b

Drawing No: 9X4749-103-102-004

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	27/10/17	DT	GC	A4	1:4,975

Co-ordinate system: British National Grid

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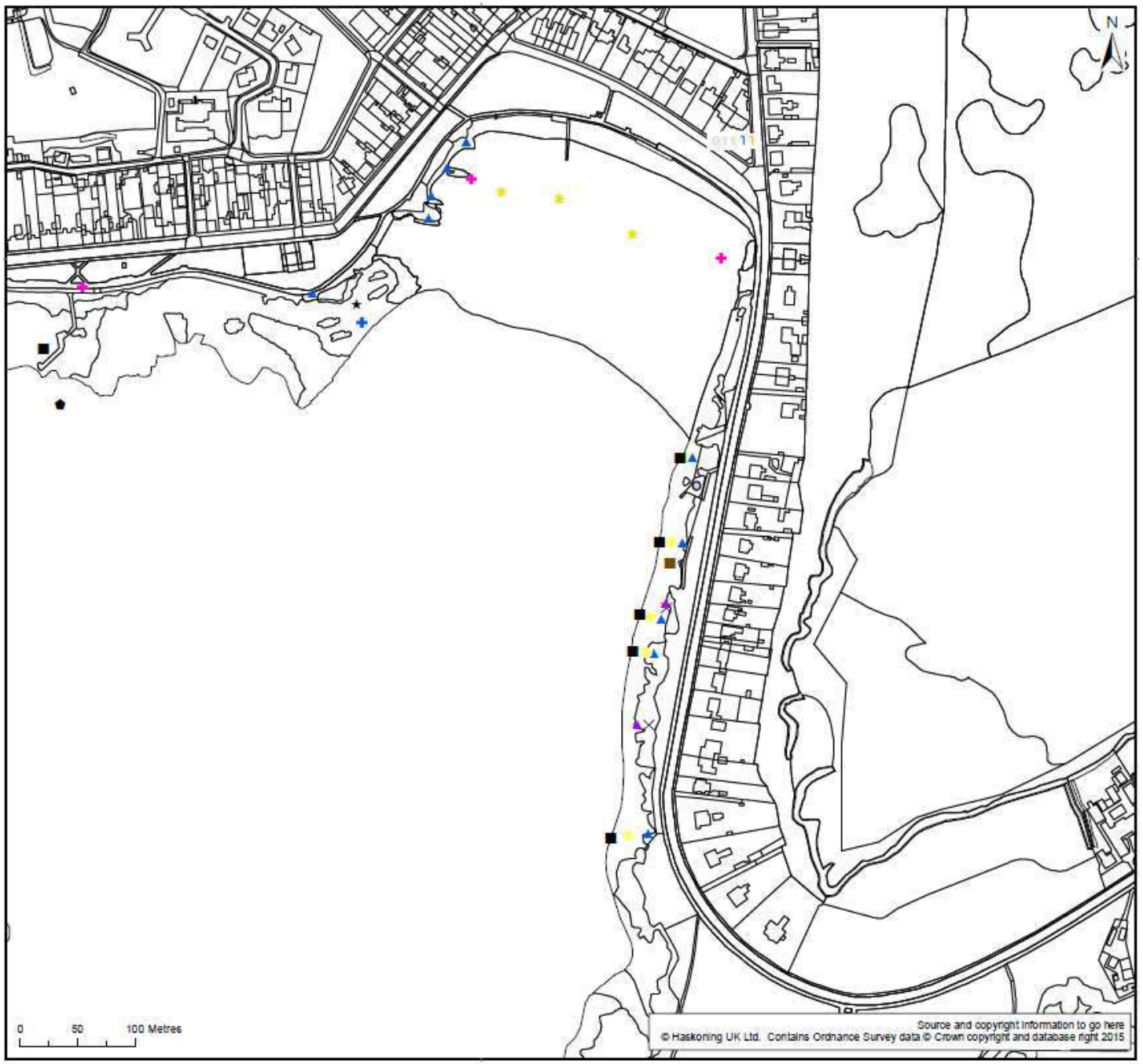

Legend:

Biotope

- IR.MIR.KR.Ldig
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- LR.FLR.EphEnt
- LR.FLR.Lic.Ver.B
- LR.FLR.Lic.YG
- LR.FLR.Rkp
- LR.FLR.Rkp.G
- LR.HLR.MusB
- LR.HLR.MusB.Cht
- LR.HLR.MusB.MytB
- LR.HLR.MusB.Sem.FvesR
- LR.HLR.MusB.Sem.LitX
- LR.HLR.MusB.Sem.Sem
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- LR.MLR.BF.FvesB
- LR.MLR.BF.PelB
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- LS.LCS
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- LS.LMp
- LS.LSa
- LS.LSa.FiSa.Po
- LS.LSa.MoSa
- LS.LSa.MuSa.MacAre
- LS.LSt.St
- Lido

Client:	Project:
North Ayrshire Council	Millport Flood Protection scheme

Title:

Intertidal survey biotopes

Figure: 2b

Drawing No: 9X4749-103-102-004

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A list of all biotopes assigned following the survey (see section 2 for methodology) is provided in Table 1.

Table 1 List of biotopes recorded

Biotope	Description	Number of Target note
IR.MIR.KR.Ldig	*Laminaria digitata* on moderately exposed sublittoral fringe	1
LR.FLR.Eph.BLitX	Barnacles and *Littorina spp*. on unstable eulittoral mixed substrata	3
LR.FLR.EphEnt	*Enteromorpha spp*. on freshwater-influenced and/or unstable upper eulittoral rock	1
LR.FLR.Lic.Ver.B	*Verrucaria maura* and sparse barnacles on exposed littoral fringe rock	2
LR.FLR.Lic.YG	Yellow and grey lichens on supralittoral rock	15
LR.FLR.Rkp	Rockpools	2
LR.FLR.Rkp.G *∞	Green seaweeds (*Enteromorpha spp*. and *Cladophora spp*.) in shallow upper shore rockpools	3
LR.HLR.MusB	*Semibalanus balanoides*, *Patella vulgata* and *Littorina spp*. on exposed to moderately exposed or vertical sheltered eulittoral rock	1
LR.HLR.MusB.Cht.Cht	*Chthamalus spp*. on exposed upper eulittoral rock	3
LR.HLR.MusB.MytB	*Mytilus edulis* and barnacles on very exposed eulittoral rock	1
LR.HLR.MusB.Sem.FvesR	*Semibalanus balanoides*, *Fucus vesiculosus* and red seaweeds on exposed to moderately exposed eulittoral rock	1
LR.HLR.MusB.Sem.LitX	*Semibalanus balanoides* and *Littorina spp.* on exposed to moderately exposed eulittoral boulders and cobbles	4
LR.HLR.MusB.Sem.Sem	*Semibalanus balanoides, Patella vulgata* and *Littorina spp*. on exposed to moderately exposed or vertical sheltered eulittoral rock	8
LR.MLR.BF.FvesB	*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock	3
LR.MLR.BF.PelB	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock	7
LS.LCS	Littoral coarse sediment	2
LS.LCS.Sh.BarSh	Barren littoral shingle	4
LS.LMp	Littoral macrophyte-dominated sediment	5
LS.LSa	Littoral sand	3
LS.LSa.FiSa.Po	Polychaetes in littoral fine sand,	1
LS.LSa.MoSa	Barren or amphipod-dominated mobile sand shore	1
LS.LSa.MuSa.MacAre	*Macoma balthica* and *Arenicola marina* in littoral muddy sand,	5
LS.LSa.St	Strandline	4

* UK Bap habitat, ∞ Habitats Directive.

A summary of the biotopes within the study area is presented below and the details of all target notes recorded in the field are presented in Appendix A. The summary below starts at the western end of the study area and works east. Note the target notes within Appendix A do not follow this pattern; they presented in the chronological order of recording which was determined by the need to prioritise area which could be impacted by the project (see section 1.5).

The western end of the study area contained a disused lido (TN43 in Appendix A) surrounded by patches of macrophyte-dominated sediment which were verging on pioneer saltmash (Plate 1, TN 42 and 44). To the east of the lido was a narrow bay (TN 22 and 45) which had a defined strandline at the high tide mark and was dominated by a coble and sand substrate (Plate 2)

Plate 1 Macrophyte dominated sediment near to old lido

Plate 2 Narrow bay with sand and coble substrate.

Plate 3 Eastern side of narrow bay

Plate 4 Exposed eulitoral rock

The eastern side of the bay consisted of a mixture of concrete sea defences, armoured pipes and a jumble of broken bedrock outcrops the tops of which were dominated by lichen communities. Further east from the bay an exposed area of bedrock sloped down towards the sea. This section of the study area followed a pattern of yellow and grey lichens communities on the upper shore *Verrucaria maura* and sparse barnacles on upper and mid shore and barnacle dominated communities with limpets and littorinids on the mid to lowershore (Plate 4).

At the eastern end of the exposed rock section was a small sand filled bay (Plate 5) consisting of barren sand with occasional amphipods. Due to the exposed nature it is likely that sand here was very mobile.

On the far side of the small bay stands Millport pier. Much of the pier could not be accessed (see section 1.5) however from a distance it could be seen that the upper foundations were dominated by yellow lichen communities with the lower sections supporting barnacle communities (Figure 2a and Plate 6).

Sheltered by the pier and large concrete walls is a small harbour (Figure 2a). The harbour walls supported sparse clumps of *Fucus vesiculosus* and barnacle mosaics (Plate 7). The harbour floor consisted of littoral fine sand with evidence of polychaetes including *Arenicola marina.* A fucoid strand line was present in the upper shore (TN1 in appendix A).

Plate 5 Small sand filled bay

Plate 6 Foundations of pier dominated by yellow lichens and barnacle communities

Plate 7 Harbour walls with clumps of Fucus and barnacle mosaics

Plate 8 mid and upper shore at Newtown bay.

At western end of Newtown Bay (TN 4 to 7) a boulder and cobble matrix was present on the lower shore with rocky outcrops also occurring. The mid shore consisted of gravel sand broken by rocky

outcrops with the upper shore being formed by concrete sea defences (Plate 8). Due to the diverse nature of the substrate a number of different biotopes were recorded in this section of Newtown bay (Figure 2a and TNs 4 to 11) including Littoral sand, barnacle and Littorinid communities on moderately exposed eulittoral boulders and cobbles and rock, rockpools and Bladder wrack (*Fucus vesiculosus*) or Channelled wrack (*Pelvetia canaliculata*) and barnacle communities on rock or boulders.

At the eastern end of this section of Nerwtown Bay a concrete walkway bisects the shore (Plate 10). In the upper shore this forms a sheltered cobble filled bay in which a dense strand line (Figure 2a) was present (Plate 9). Further down the walkway boulders on either side supported Channelled wrack and barnacle communities (Plate 11).

Plate 9 Fuciods and kelps washed up in small bay

Plate 10 Walkway

Plate 11 Boulders supporting LR.MLR.BF.PelB biotope

Plate 12 Fucoid communities in the lower and mid shore with sediment dominated habitats in the upper shore

On the eastern side of the walkway the upper and mid shore became more dominated by sediment biotopes with barren shingle and *Arenicola marina* in littoral muddy sand being recorded (Figure 2b) although lower and mid shore communities of channelled wrack and barnacles on boulders and cobbles did persist in the western end of this section (Figure 2b and Plate 12).

The eastern boundary of this section of Newtown Bay was formed by a concrete pier (Figure 2b and Plate 13). The armouring itself supported the barnacle, limpet and littorinid biotope (LR.HLR.MusB.Sem.Sem).

From this location kelps were visible in the extreme lowershore. However, these were not accessed due to the state of the tide and therefore the biotope was not examined up close. A biotope of *Laminaria digitata* on moderately exposed sublittoral fringe was assigned here although there is a low confidence associated with this due to the fact that the lower shore was not directly accessed.

Moving round Long Point, towards Kames Bay rocky outcrops supported yellow lichen dominated communities with veneers of littoral sand overlaying the bedrock in places (Plate 14).

Plate 13 Small Pier consisting of boulders in cement matrix

Plate 14 Exposed rock with patches of sand veneer

Plate 15 Kames Bay

Plate 16 Fresh water stream running down Kames bay

The majority of Kames bay (TN 30 to 33) was found to be clean fine sand with lug worm casts present in the mid and lower shore (Figure 2c and Plate 15). A freshwater stream runs down across the centre of the bay within which occasional boulders supported small clumps of Gut weed (*Ulva intestinalis*) (Plate 16)

Bordering Kames Bay to the east is an exposed stretch of coast which eventually forms Farland point. The rocky shore is backed by a road and the narrow hinterland has a row of houses built upon it. The biotopes recorded in this area were typical of steeply sloping exposed rocky shores (TN 24 to 29) with a pattern of barnacle dominated lower shore channelled wrack dominated mid shore and lichen dominated upper shore communities (Figure 2c and Plate 17).

On flat sections of the very upper shore small patches of mocrophyes were present surrounding freshwater pools (Figure 2c and Plate 18). However, these all occurred outwith the southern boundary of the study area (Figure 1).

Plate 17 steep rocky shores supporting barnacle and Pelvitia dominated communities as well as lichen communities in the upper shore

Plate 18 Fresh water pools in the upper shore with macrophyte communities surrounding them.

4 DISCUSSION

4.1 Habitats

One biotope of conservation importance was identified within the study area. This is displayed in Table 1. However, although the biotope LR.FLR.Rkp.G has been identified as being of conservation importance, it is relatively common around the UK and although damage to this biotope should be avoided if possible, impacts to this biotope should not constrain the proposed development.

4.2 Species

A list of all species identified during the survey is provided in Section **Error! Reference source not found.** below. Few species of conservation importance were identified within the intertidal study area. The dog whelk *Nucella lapillus,* an OSPAR species (on a list of threatened and/or declining species and habitats in the North-East Atlantic, created under the OSPAR Convention for the protection of the marine environment of the North East Atlantic), was found throughout the survey area. Dog whelk is a common species in the UK and is not protected under any other pieces of legislation.

5 Species List

All common names are sourced from the marine life information network (MarLIN) website (Marlin, undated.) or in the case of Seaweeds The Seasearch guide to Seaweeds of Britian and Ireland (Bunker *et. al*., 2012).

Common name	Latin name
Beadlet anemone	*Actinia equina*
Saddle oyster	*Anomia ephippium*
lug worm	*Arenicola marina*
Knotted wrack	*Ascophyllum nodosum*
Star ascidian	*Botryllus schlosseri*
Carrageen	*Chondrus crispus*
A green seaweed	*Cladophora rupestris*
Coral weed	*Corallina officinalis*
toothed wrack	*Fucus serratus*
Spiral wrack	*Fucus spiralis,*
Bladder wrack	*Fucus vesiculosus*
Oarweed	*Laminaria sp.*
Sand mason worm	*Lanice conchilega*
common periwinkle	*Littorina littorea*
Common mussel	*Mytilus edulis*
Dog whelk#	*Nucella lapillus*
Common hermit crab	*Pagurus bernhardus*
Limpet	*Patella sp.*
Channelled wrack	*Pelvetia canaliculata*
red epiphytic seaweed	*Polysiphonia lanosa*
A tubeworm	*Pomatoceros*
Flat tope shell	*Steromphala umbilicalis*
Gut weed	*Ulva intestinalis*
Sea oak	*Halidrys siliquosa*
A dulse	*Palmaria palmata*

OSPAR species of conservation importance

6 References

Bunker, F., Brodie J,A., Maggs, C. A., Bunker A (2012) Seaweeds of Britain and Ireland.

JNCC (2015) The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. [Date accessed]. Available from: jncc.defra.gov.uk/MarineHabitatClassification

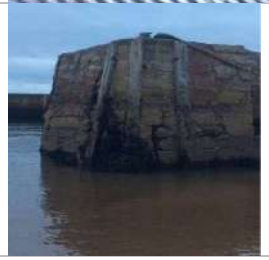
MarLIN, undated. Website, available at: http://www.marlin.ac.uk/

Wyn, G, Brazier, P and McMath, A J (2000). CCW handbook for marine intertidal Phase 1 survey and mapping. CCW Marine Sciences Report: 00/06/01.

Hiscock, K (ed.) (1996). Marine Nature Conservation Review: rational and methods. Coasts and seas of the United Kingdom. MNCR Series. Joint Nature Conservation Committee, Peterborough.

Appendix A Target Notes

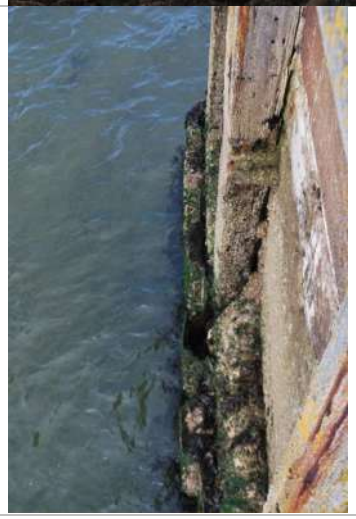
( ) = SACFOR system (S)= Super abundant (A)= Abundant (C) Common (F) Frequent (O)= Occasional (R)= Rare

TN	Description	Photos
1	Description: Small harbour, sandy with a fucoid strandline, live fucoid present as well attached to cobbles in the sediments, Littorinids attached to fucoids; *Fucus serratus* and *Fucus vesiculosus*, *Arenicola marina* British National Grid: N: 654763.5 E: 216068.6	
2	Inner Harbour Seawall; *Pelvetia canaliculata*, *Fucus spiralis*, *Ascophyllum nodosum*, barnacles (A), Littorina littorea (F); *Patella spp*; *Mytilus edulis (in cracks (R)*, *Nucella lapillus* British National Grid: N: 654749.9 E: 216072.3	 
3	Outer sea wall: Dominated by barnacles British National Grid: N: 654779.2 E: 216093.1	

TN	Description	Photos
4	Description: Boulder cobble matrix in lower shore, with rock outcrops, mid shore is sand and gravel with rocky outcrops. Upper shore is the Seawall. Mid shore; Pelvetia, Fucus spiralis, Patella sp. (R), barnacles (A), *Ascophyllum, Ulva.* Rocky outcrops surrounding the pool support barnacles (S), littorinids. British National Grid: N: 654795 E: 216095	
5	Description: Lower shore; Boulder/cobbler matrix, common littorinids, *Gibbula umbilicalis* present, barnacles (S), Fucus vesiculosus, Fucus spiralis present on tops of boulders. *Patella sp.*(R), *Nucella lapillus* (C) *Polysiphonia lanosa* British National Grid: N: 654792 E: 216107	
6	Description: Anoxic sediments present in pockets in rocky outcrop, arthropods present British National Grid: N: 654810 E: 216114	
7	Description: Rock pool; *Botryllus schlosseri*, *bryozoan spp.*, large *Patella, Pagurus bernhardus*, saddle oysters *Anomia ephippium*, *Pomatoceros, Pelvetia* (C). Barnacles (S) around rock pool. British National Grid: N: 654818 E: 216126	
8	Description: Embayment surrounded by rocky outcrops; on rocky outcrop – barnacles (S), *Actinia equina* (C), Littorinids (C), *Gibbula* (A), *Nucella lapillus* (C), large *Mytilus clump*. Fucoid (S), small littorinids (A) British National Grid: N: 654828, E: 216131	 

TN	Description	Photos
		 
09	Description: Sand ripples adjacent to seawall; drains present in wall British National Grid: N: 654867, E: 216157	  
10	Large rock pool, *Corallina officinalis*, Fucoids (A), Patella (C) littorinids (A) within the rock pool, Rocky outcrops surrounding the pool support barnacles (S) British National Grid: N: 654862 E: 216178	 

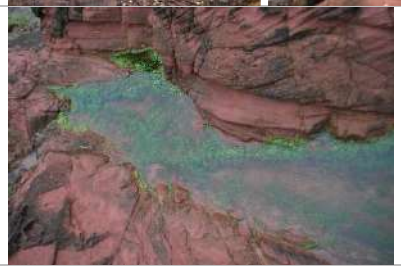
TN	Description	Photos
		
11	Description: Fucoid dominated cobbles and boulders in a gravel matrix, SLR Photos 140-142 British National Grid: N: 654868 E: 216238	
12	Description: Species poor upper shore, cobbles and pebbles, *Ulva intestinalis* and fucoids growing on boulders, barnacles (R), Laminaria dominated strand line at top of bay, SLR Photos 144-147 British National Grid: N: 654890, E: 216283	 
13	Description: To west of rocky pier, *Pelvetia* and *Ascophyllum* dominated large boulders. SLR Photo 149 British National Grid: N: 654860 E: 216319	 
14	Description: Fucus vesiculosus (A) and spiralis, small littorinids (A), barnacles (C) on tops of boulders, *Lanice conchilega* in rock pools between cobbles, evidence of Arenicola	

TN	Description	Photos
	marina in sediments British National Grid: N: 654894, E: 216382	
15	Description: Small Pier consisting of Boulders in cement matrix. Western side has barnacles (S), Nucella (C), littorinids (O), *Actinia equina* in crevice (SLR photos 164-167) Laminaria just visible on the very low shore (SLR Photo 171) British National Grid: N: 654922 E: 216619	
16	The Pier by the Royal George hotel. Barnacles (S) in upper and mid shore, Ulva intestinalis and fucoids in lower shore (173-175) British National Grid: N: 654693 E: 216113	

TN	Description	Photos
17	Description: Sandy embayment bordered by bedrock, 10inch pipe present. Relatively barren sand (178-180) British National Grid: N: 654683 E: 216055	 
18	Description: Barnacles (S), Patella sp (A), Fucoids (C), *Rhodophyta spp*., *Halidrys siliquosa*, *Palmaria palmata Corallina officinalis*,; *Ulva intestinalis*, Polysiphonia, *Actinia equina* (C) in crevices, Gibbula (A) in crevices, *Nucella lapillus* (O), *Chondrus crispus,* (SLR Photos 181-189) British National Grid: N: 654668, E: 216042	   
19	Description: Inlet sheltered by rocky outcrops; pebbles, gravel veneer on bedrock, abundant Fucus vesiculosus. Bed of inlet consists of soft, clayey rock, common littorinids. British National Grid: N: 654618, E: 215916.78940000013	

TN	Description	Photos
20	Description: Cobbles, boulders and pebbles. Barnacles (S), Patella (C), littorinids (A), Fucoids (O), Nucella (A) in patches again clay on bed of bay British National Grid: N:654573 E:215888	 
21	Description: Reinforced pipe (SLR Photo 194) British National Grid: N: 654560 E: 215848	
22	Description: Sandy bay w cobbles and pebbles, abundant Arenicola, common fucoids on cobbles/pebbles, abundant barnacles on cobbles/pebbles/bedrock (197-203) British National Grid: N: 654616 E: 215790	

TN	Description	Photos
23	Description: Freshwater inputs (pipes) along wall x2 with abundant Ulva intestinalis SLR photos 204-205) British National Grid: N: 65463 E: 215794	 
24	Description: Steeply sloping exposed Bedrock. Barnacle dominated with Patella (C), Littorinids. Mid-shore; Fucoids and *Pelvetia, Actinia equina* and *Chondrus crispus, Cladophora ruptures* (Photos SLR 207-209). Upper shore; lichen dominated tops of boulders (211) British National Grid: N: 654827 E: 217177	    

TN	Description	Photos
	Description: Lido (SLR photo 213-214) British National Grid: N: 654799 E: 217181	
25	Description: Small bay filled w boulders, super abundant fucoids, barnacles on exposed boulders, abundant patella, abundant Nucella, Ascophyllum (220-222), frequent litorinids, spirobids on fucoids British National Grid: N: 654736 E: 217163	
26	Description: Small patches of saltmarsh/emergent habitat (SLR Photos 223-227) British National Grid: N: 654698 E: 217160	 
27	Description: Upper shore rock pools filled with *Ulva intestinalis* (228-230) British National Grid: N: 654700 E: 217159	

TN	Description	Photos
28	Description: Rock type changes from red sandstone to hard conglomerate, biotope remains the same (231) British National Grid: N: 654657 E: 217149	
29	Description: Large upper shore pool, frequent *Ulva intestinalis* (237-238) pioneer saltmarsh above British National Grid: N: 654596 E: 217135	 
30	Description: The Majority of Kames bay is clean fine sand with *Arenicola marina* casts (SLR photos 243-245)	  

TN	Description	Photos
31	Description: Fresh water input burn photo 247 looking north British National Grid: N: 655051, E: 217067	
32	Description: Abundant Arenicola SLR photos 248, 249 British National Grid: N: 655057 E: 217017	
33	Description: Rocky outcrops extruding from the beach cobbles and boulders at base of outcrops with Ulva intestinalis (A) Fucoids (C) British National Grid: N: 655069 E: 216991	

TN	Description	Photos
34	ID: Target No: 34 Description: Rocky outcrop lichen dominated rock (SLR photo 253) British National Grid: N: 655036 E: 216954	
35	Description: Small embayment lots of washed up seaweed. Sand pebbles and cobbles SLR (Photos 254 – 256) British National Grid: N: 654961 E: 216892	
36	Description: Lichen dominated rocks in the upper shore (SLR photo 257-259) British National Grid: N: 654970 E: 216853	

TN	Description	Photos
37	Description: Pipe (SLR Photo 260) British National Grid: N: 654975, E: 216653	
38	Description: Lichen dominated upper shore of bedrock and boulders on outer side of bay. (SLR Photos 268 to 271) British National Grid: N: 654536 E: 215863	
39	Description: Upper shore dominated by lichens photo 266 to 268 British National Grid: N: 654568 E: 215901	
40	Description: Cobbles and pebbles on sand and gravel (SLR Photos 272 – 274) British National Grid: N: 654648 E: 215775	

TN	Description	Photos
41	Description: Pioneer saltmarsh (SLR Photo 275 – 279) British National Grid: N: 654608 E: 215731	
42	Description: Large armored pipe (SLR Photo 280) British National Grid: N: 654566 E: 215712	
43	Description: Discussed lido. Bedrock with cobbles frequent fucoids Ulva intestinalis on soft rock. Photo 281 and 282 British National Grid: N: 654537 E: 215721	

TN	Description	Photos
44	Description: Pioneer saltmarsh with outcrops of rock. On rock Pelvetia and *Verrucaria mucosa* as well as other lichens. Photos 283 to 286 British National Grid: N: 654495 E: 215707	
45	Description: Uppershore. Barron Coarse sand and pebbles. Strong strand line lots of kelps photos 261 to 265 Lowershore clean find sand with sand ripples British National Grid: N: 654948 E: 216503	
46	Description: Mid and upper shore Barron rock with many lichen species (SLR Photos 266 - 268 British National Grid: N: 654642 E: 215967	