Sanitary Survey - Review

Holy Island – 2024

Document No. – *J0591/23/08/21*

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Client	Food Standards Agency (FSA)
Project Title	Sanitary Survey Review
Document Title	Sanitary Survey Review of Holy Island
Document Number	J0591/23/08/21
Revision	3.0
Date	26 February 2024

Revisions

Revision No.	Date	Comment
0.1	22 August 2023	Draft for internal review
1.0	31 August 2023	Draft for client review
2.0	14 November 2023	Draft for secondary consultation
3.0	26 February 2024	Final

Document QA and Approval

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Initial Consultation

Consultee	Date of consultation
Northumberland Inshore Fisheries and Conservation Authority	July 2023
Northumberland County Council	July 2023
Environment Agency	July 2023
Northumbrian Water	August 2023

Consultation on draft report

Consultee	Date of consultation
Northumbrian Water	December 2023

A sanitary survey relevant to the bivalve mollusc beds in Holy Island was undertaken in 2014 in accordance with Regulation (EC) 854/2004 (which was replaced by retained EU Law Regulation (EU) 2017/625, with sanitary survey requirements now specified in retained EU Law Regulation (EU) 2019/627). This provided appropriate hygiene classification zoning and monitoring plan based on the best available information with detailed supporting evidence. In line with regulatory and EU guidance the Food Standards Agency undertake targeted sanitary survey reviews to ensure public health protection measures continue to be

appropriate. This report provides a review of information and recommendations for a revised sampling plan if required. Carcinus Ltd. (Carcinus) undertook this work on behalf of the FSA. Carcinus Ltd accepts no liability for any costs, losses or liabilities arising from the reliance upon or use of the contents of this report other than by its client.

Dissemination

Food Standards Agency, Northumberland County Council. The report is publicly available via the Carcinus Ltd. website.

Recommended Bibliographic Citation:

Carcinus Ltd., 2022. Review of the Holy Island 2014 Sanitary Survey. Carcinus report on behalf of the Food Standards Agency, to demonstrate compliance with the requirements for classification of bivalve mollusc production areas in England and Wales under retained EU Law Regulation (EU) 2019/627.

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1 Introduction

1.1 Background

The Food Standards Agency (FSA) is responsible for carrying out sanitary surveys in classified production and relay areas in accordance with Article 58 of retained (EU) Regulation 2019/627 and the EU Good Practice Guide (European Commission, 2021). In line with these requirements, sanitary surveys must be reviewed to ensure public health protection measures continue to be appropriate. Carcinus is contracted to undertake reviews on behalf of the FSA.

The report considers changes to bacterial contamination sources (primarily from faecal origin) and the associated loads of the faecal indicator organism *Escherichia coli* (*E. coli*) that may have taken place since the original sanitary survey was undertaken. It does not assess chemical contamination, or the risks associated with biotoxins. The assessment also determines the necessity and extent of a shoreline survey based on the outcome of the desktop report and identified risks. The desktop assessment is completed through analysis and interpretation of publicly available information, in addition to consultation with stakeholders.

1.2 Holy Island Review

This report reviews information and makes recommendations for a revised sampling plan for existing Pacific oyster (*Crassostrea gigas*) classification zones in Holy Island (Figure 1.1). This review explores any changes to the main microbiological contamination sources that have taken place since the original sanitary survey was conducted. Data for this review was gathered through a desk-based study and consultation with stakeholders.

An **initial consultation** with Local Authorities (LAs), Inshore Fisheries and Conservation Authorities (IFCAs) and the Environment Agency (EA) responsible for the production area was undertaken in July and August 2023. This supporting local intelligence is valuable to assist with the review and was incorporated in the assessment process.

Following production of a draft report, a wider **external second round of consultation** with responsible Local Enforcement Authorities (LEAs), Industry and other Local Action Group (LAG) members was undertaken in December 2023. It is recognised that dissemination and inclusion of a wider stakeholder group, including local industry, is essential to sense-check findings and strengthen available evidence. The draft report is reviewed taking into account the feedback received.

The review updates the assessment originally conducted in 2014 and sampling plan as necessary and the report should read in conjunction with the previous survey.

Specifically, this review considers:
(a) Changes to the shellfishery (if any);
(b) Changes in microbiological monitoring results;
(c) Changes in sources of pollution impacting the production area or new evidence relating to the actual or potential impact of sources;

(d) Changes in land use of the area; and
(e) Change in environmental conditions

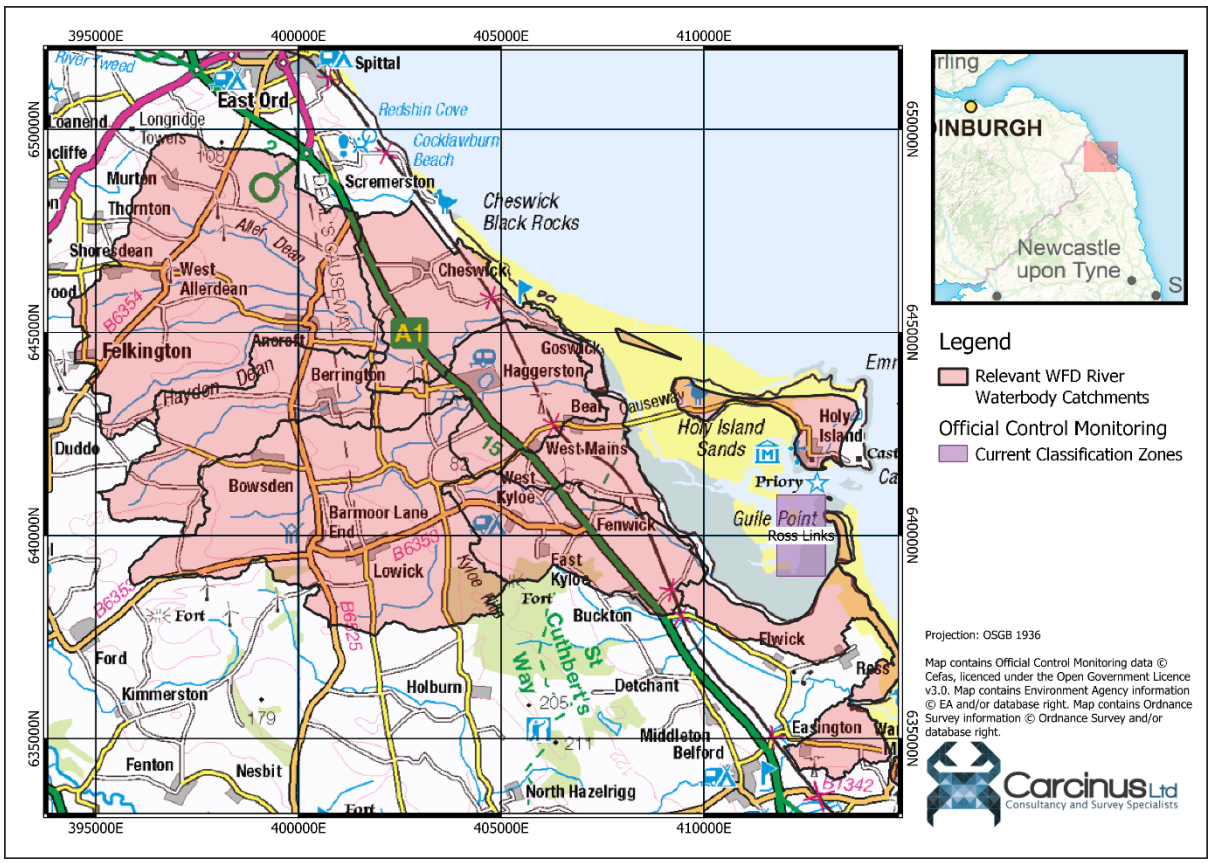

Figure 1.1 Location of the Holy Island BMPA in northeast England.

Sections 2 - 6 detail the changes that have occurred to the shellfishery, environmental conditions and pollution sources within the catchment since the publication of the original sanitary survey. A summary of the changes is presented in section 7 and recommendations for an updated sampling plan are described in section 8.

1.3 Assumptions and limitations

This desktop assessment is subject to certain limitations and has been made based on several assumptions, namely:

- Accuracy of local intelligence provided by the Local Authorities and Environment Agency
- The findings of this report are based on information and data sources up to and including July 2023;
- Only information that may impact on the microbial contamination was considered for this review; and
- Official Control monitoring data have obtained through a request to Cefas, with no additional verification of the data undertaken. The data are also available directly

from the Cefas data hub[1]. Results up to June 2023 have been used within this study. Any subsequent samples have not been included.

2 Shellfisheries

2.1 Description of Shellfishery

The Holy Island BMPA is located within the expanse of sand and mud flats that separates Holy Island from the northeast coast of England (Figure 1.1). There are no other classified BMPAs within 50 km of the Holy Island BMPA.

The Local Enforcement Authority for this fishery for food hygiene Official Control Purposes (including sampling) is Northumberland County Council. During initial consultations, Northumberland Inshore Fisheries and Conservation Authority (N-IFCA) indicated that the fishery is private. No N-IFCA byelaws apply to the harvest of shellfish in the area. Natural England impose several byelaws within the Lindisfarne National Nature Reserve (NNR) (within which the BMPA is located). Under these byelaws, "digging, collection and/or removal of bait" from within the NNR is prohibited.

The 2014 Sanitary Survey made recommendations for the creation of Classification Zones for both mussels and Pacific oysters, but noted at the time that formal classification for mussels was not required on at that time, and that the species was last commercially harvested in 2010. There is currently only one active classification for Pacific oysters. A summary of the fishery for this species is summarised in the following paragraphs.

2.1.1 Pacific oyster

The 2014 Sanitary Survey describes that the fishery for Pacific oysters is based on trestle culture, with hatchery seed grown on in bags until reaching marketable size. The nature of the fishery is unchanged since the 2014 report was published. The 2014 report also describes that the annual production is in the region of 50 tonnes, but during initial consultations the LEA stated that the current output is approximately 100 tonnes per annum. the LEA also confirmed there is no interest in expanding or changing the current operations of the Pacific oyster aquaculture site.

2.1.2 Other species

There is a historic, naturally occurring mussel bed within the area of the Holy Island BMPA, although during initial consultations, N-IFCA stated that the population size has seen a 99% decline since 2006. The current boundary of this mussel bed is provided in Figure 2.1. This species has been declassified since 2011 and it is considered unlikely to require formal classification in the near future.

[1] Cefas shellfish bacteriological monitoring data hub. Available at: https://www.cefas.co.uk/data-and-publications/shellfish-classification-and-microbiological-monitoring/england-and-wales/.

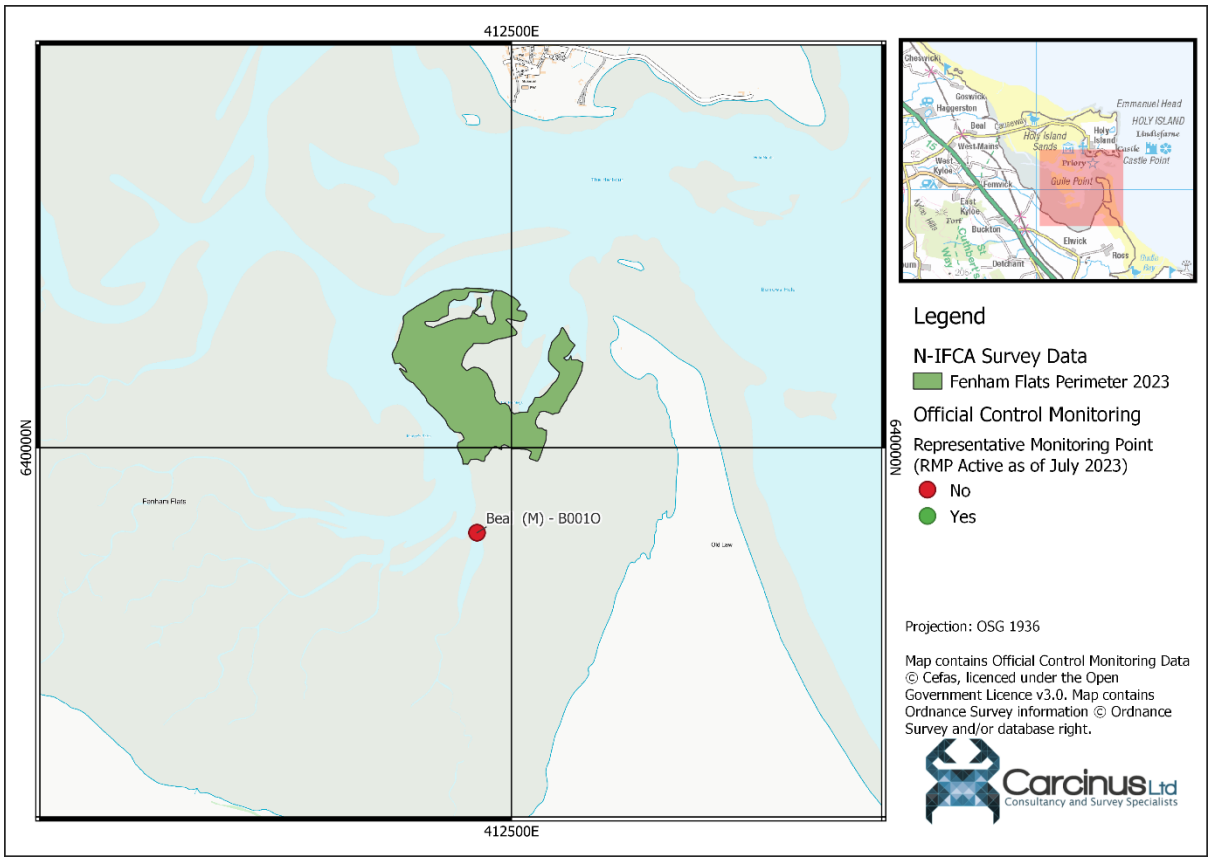

Figure 2.1 Current boundary of the Fenham Flats mussel bed, based on 2023 N-IFCA survey data.

2.2 Classification History

The 2014 Sanitary Survey recommended the creation of two Classification Zones within the Holy Island BMPA, one for Pacific oysters and one (should classification have been requested) for mussels. The Pacific oyster CZ has been classified continually since 2014 but the mussel zone never received a formal request for classification.

The location and classification status of the active CZ, along with all RMPs sampled in the BMPA since 2010, is presented in and Figure 2.2.

Table 2.1 Summary of all currently active classification zones in the Holy Island BMPA.

Classification Zone	Species	Current Classification (as of June 2023)
Ross Links – R9	Pacific oysters	Seasonal A/B (*Class A season 01 November – 31 July inclusive, reverting to Class B at all other times*)

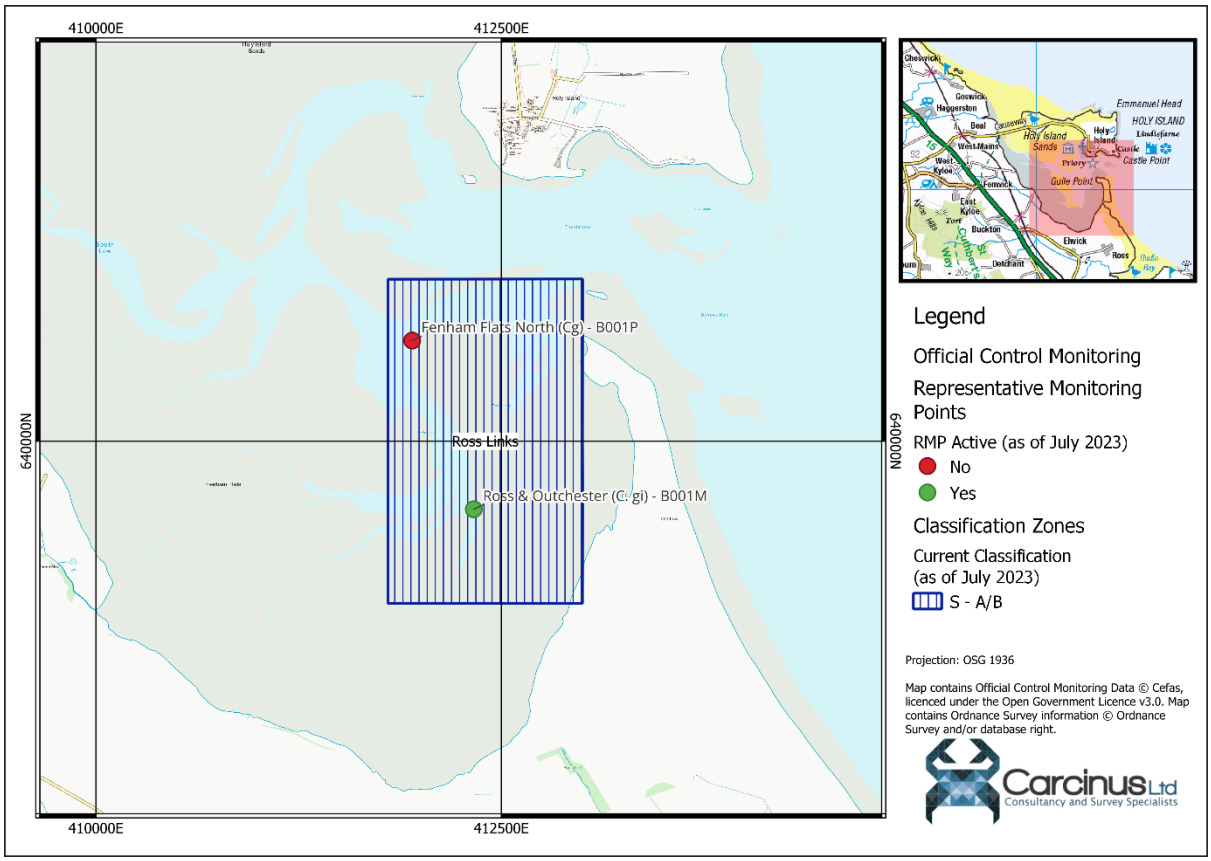

Figure 2.2 Current Classification Zones and associated Representative Monitoring Points in the Holy Island BMPA.

3 Pollution sources

3.1 Human Population

The 2014 Sanitary survey cites population data for the catchment based on the 2011 Census of the United Kingdom. A subsequent Census was conducted in March 2021 and so the results of those two surveys have been compared to give an indication of the population trends across the catchment in the last 10 years. Human population density at the 2011 and 2021 Censuses within Census Output Areas wholly or partially contained within the Holy Island Catchment are presented in Figure 3.1.

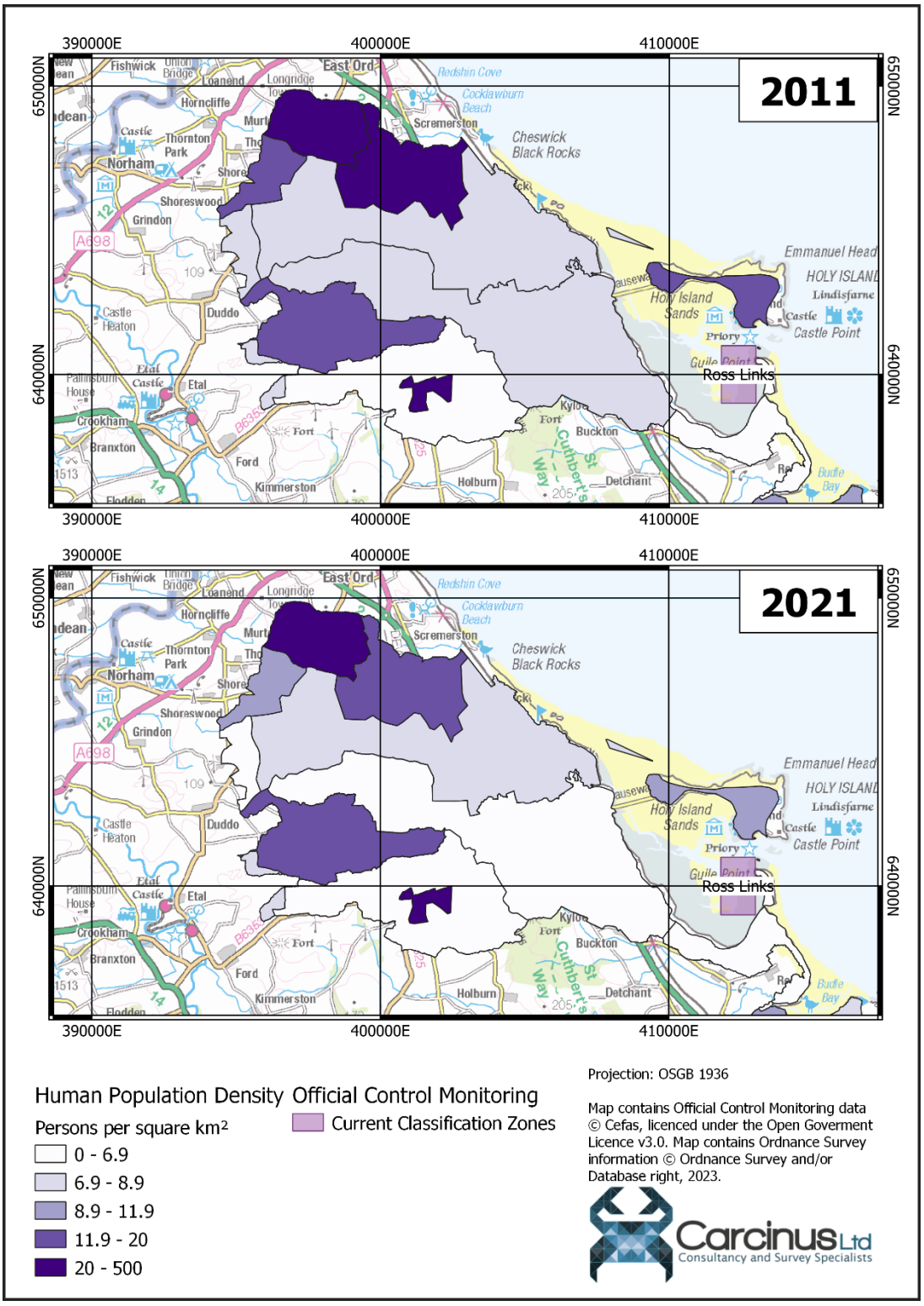

Figure 3.1 Human population density in Census Output Areas wholly or partially contained within the Holy Island catchment in 2011 and 2021.

Figure 3.1 shows that the catchment of the Holy Island BMPA is very rural, with the highest population density in any Census Output Area being 303 people per square kilometre in 2021, and all others having fewer than 70 people per square kilometre. There are no

significant population centres, the only settlements being small hamlets. At the 2011 Census, the estimated population within the catchment was approximately 3716, and at the 2021 Census, this had fallen to 3,470 people, a decrease of 6.6%. The Shellfish Water Action Plan for the Holy Island Shellfish Water classifies the overall contribution of various sources of contamination to the shellfish water but considers that there is no impact of urban diffuse contamination. There have been no new significant housing developments within the area since the 2014 Sanitary Survey was published.

The 2014 Sanitary Survey states that there were an estimated 500,000 visitors to Holy Island and the surrounding coastal areas in 2012. The current estimated number of visitors has increased to 650,000 (Lindisfarne.org.uk, 2023). The majority of these visitors are likely to arrive in summer months, and may cause additional loading to the wastewater treatment network during these times. During initial consultations, the authors of this review were advised that there had been significant growth at Haggerston Castle Caravan Park, which is likely to receive a significant proportion of the seasonal increase in population numbers. In 2018, a 10% expansion in the number of caravans on the park was approved (Northumbrian Gazette, 2018). No information has been received to suggest that the existing wastewater treatment network is insufficient to handle this increase. Full details of the changes to the wastewater treatment network are discussed in the next section.

Analysis of changes to Census data for the catchment suggests that the area continues to be very rural, with the risk of contamination from urban sources being virtually nil. Overall, the recommendations made in the 2014 Sanitary Survey to account for the impact of human populations remains valid.

3.2 Sewage

Details of all consented discharges in the vicinity of the Holy Island BMPA were taken from the most recent update to the Environment Agency's national permit database at the time of writing (June 2023 update). The locations of these discharges within the catchment and near the Classification Zone are shown in Figure 3.2.

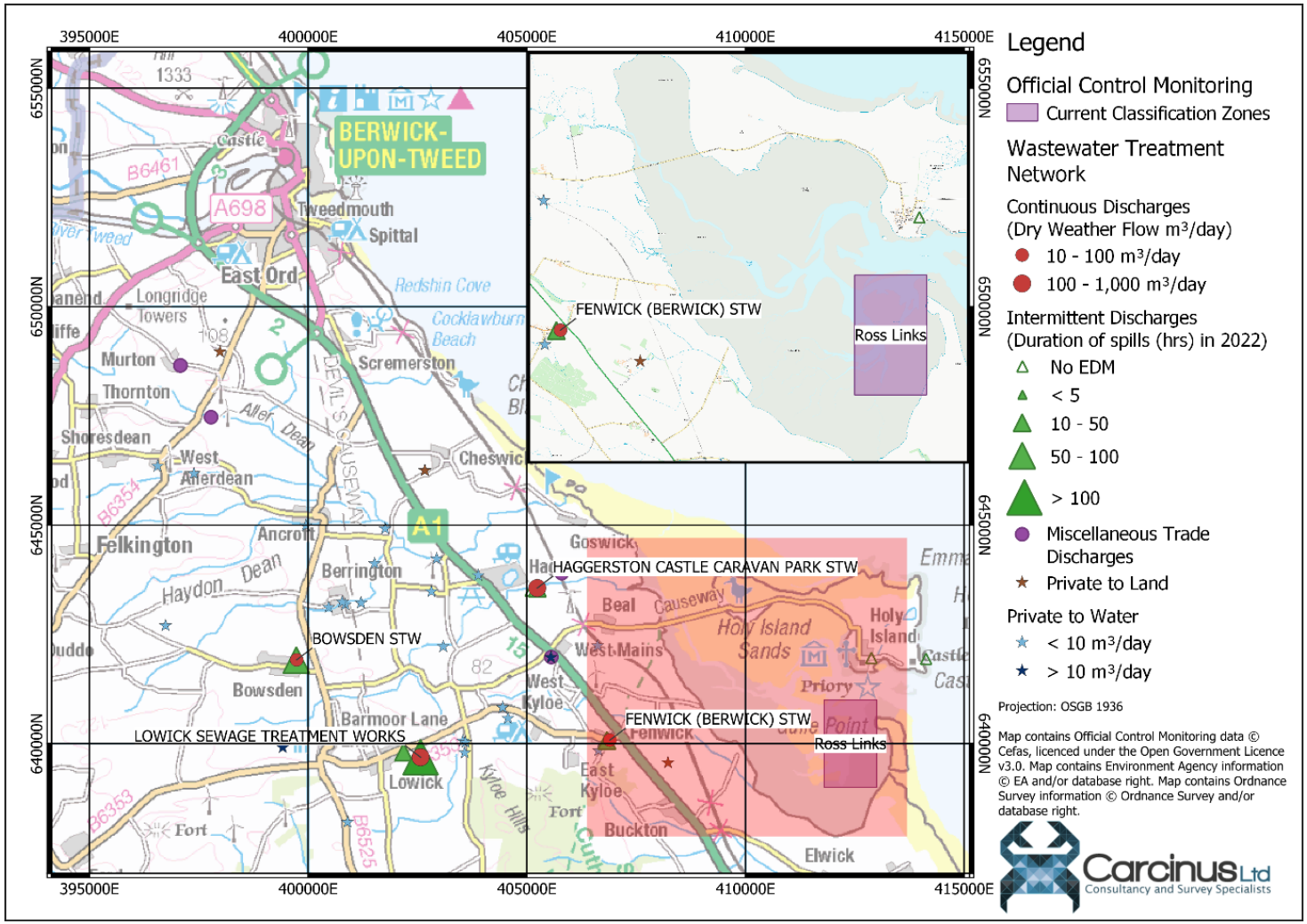

Figure 3.2 Locations of all consented discharges in the vicinity of the Holy Island catchment. Details of continuous discharges are provided in Table 3.1.

Table 3.1 Details of water company owned continuous discharges within the Holy Island BMPA. Discharges that have seen either a reduction in consented spill volume or upgrade in treatment methodology are highlighted in green.

Discharge Name	Permit Number	Receiving Water	Outlet NGR	Treatment Description	DWF (m^3/day)	Distance to CZ (km)
HOLY ISLAND STW	221/1016	NORTH SEA	NU1413041940	BIOLOGICAL FILTRATION	102	1.4
FENWICK (BERWICK) STW	221/0968	FENWICK BURN	NU0690140080	NONE	27	4.9
WAREN MILL STW	221/1014	WAREN BURN LEADING TO N SEA	NU1463734394	PACKAGE TREATMENT PLANT	216	6.4
HAGGERSTON CASTLE CARAVAN PARK STW	210/A/0849	SOUTH LOW	NU0524043560	BIOLOGICAL FILTRATION	250	7.34
LOWICK SEWAGE TREATMENT WORKS	210/A/0854	TRIBUTARY OF THE LOW	NU0257239688	BIOLOGICAL FILTRATION	105	9.27
BOWSDEN STW	210/0038	BOWSDEN	NT9973941917	UNSPECIFIED	28	12.17
SHORESDEAN STW	210/0882	ALLERDEAN MILL BURN, TRIBUTARY	NT9546045910	SEPTIC TANK	Unspecified	17.32

All six continuous water company owned discharges described in the 2014 Sanitary Survey are still active, but only one (Lowick Sewage Treatment Works (STW)) has seen a reduction in consented spill volume. In the 2014 report, this discharge is described as having a consented discharge volume of 149 m^3/day, whereas the current volume is 105 m^3/day. The 2014 Sanitary Survey identifies that the contamination from Lowick, Bowsden, Shoresdean and Haggerston Castle Caravan Park STWs will enter the coastal waters via the network of streams and drains that discharge north of the tidal causeway that separates Holy Island from the mainland. The 2014 Sanitary Survey identified that the population served by the caravan park sewage works would be highly seasonal, but no information has been received to date to suggest that the existing capacity is insufficient, and monitoring conducted by Northumbrian Water supports this conclusion. Contamination from the Fenwick and Holy Island STWs may cause some contamination of the shellfish beds as they are located geographically closest to the shellfishery, but any contamination is likely to be minimal as the consented discharge volumes from both discharges are small. No upgrades to water company owned continuous discharges are planned for either the current (AMP7 2020 – 2025) or next (AMP8 2025 – 2030) Asset Management Periods (AMPs). An investigation into the impact of Northumbrian Water assets on the shellfish beds under the Water Industry National Environment Programme (WINEP) is planned, and will be delivered by April 2027. Any contamination from the Waren Mill STW (not included in the 2014 survey) is considered to have no impact on the BMPA as it will primarily affect Budle Bay, 5 km south of the entrance to the Holy Island embayment.

In addition to the continuous discharges, the 2014 sanitary survey identified a number of intermittent discharges with the potential to impact the bacteriological health of the BMPA. Intermittent discharges comprise Combined Storm Overflows (CSOs), Storm Tank Overflows (STOs), Pumping Station Emergency Overflows (PSs), and Sewer Pumping Stations (SPSs). During AMP6 and AMP7, Event Duration Monitoring (EDM) was installed at several of the discharges within the catchment. Summary data for 2020, 2021 and 2022 was published by the Environment Agency in March 2021, March 2022 and March 2023 respectively (Environment Agency, 2023). A summary of the EDM return for 2022 is presented in Appendix I. In most instances, these intermittent discharges continue to be co-located with the continuous water company owned discharges, and there is a limited impact pathway given the hydrological distance between the discharge location and the Classification Zones. No EDM data is presented within the 2014 Sanitary Survey and so no comparison is possible.

Table 3.2 and Table 3.3 present the summary of Event Duration monitoring at the two nearest intermittent discharges with EDM to the CZ of the Holy Island BMPA, Haggerston Castle Caravan Park and Fenwick STW Storm Overflows. The data suggest that the frequency of spills from intermittent discharges is declining, which would mean a reduction in faecal contamination to the BMPA. There is an intermittent discharge on the south side of Lindisfarne, Inlet and Outlet SPS (Permit Ref 221/1017), less than 1 km from the CZ of the BMPA, but no EDM data is available. Should spills occur from this discharge, potentially

significant contamination of the BMPA could occur. The position of this discharge should be taken into account in any updated sampling plan.

Table 3.2 Event Duration Monitoring summary for the Haggerston Castle Caravan Park Storm Overflow (7 km from the nearest CZ).

Year	No. Spills (12 – 24 hr counting method)	Total duration of spills (hrs)
2020	No Data	No Data
2021	18	97.4
2022	7	31.9

Table 3.3 Event Duration Monitoring summary for the Fenwick STW Storm Overflow (4.9 km from the nearest CZ).

Year	No. Spills (12 – 24 hr counting method)	Total duration of spills (hrs)
2020	8	35.8
2021	45	454.96
2022	13	48.3

During initial consultations, Northumbrian Water (NW) confirmed that during AMP7 (2020 – 2025), improvements to Haggerston STW are scheduled to occur that would result in an increased capacity and a reduction in storm spills. Furthermore, during AMP8 (2025 – 2030), a water industry national environment programme (WINEP) investigation to understand the impact of NW assets on the Holy Island shellfish water will be completed by 2027. Further improvements to storm overflows are also planned, and septic tanks that discharge to surface waters will be upgraded to provide secondary treatment.

In addition to the water company owned infrastructure, there continues to be many privately owned discharges throughout the catchment, but the majority have consented discharge volumes of less than 10 m^3/day. Limited details of these discharges can be provided due to data protection requirements, but the assessment of the impact from these discharges is considered to be small compared to other sources of contamination discussed elsewhere in this report.

The wastewater treatment network in the area contains more assets than would usually be expected for a catchment and population of this size, reflecting the significant seasonal fluctuation in population size. The Shellfish Water Action Plan for the Holy Island Shellfish Water concludes that water company discharges have a 'low'[2] contribution to contamination in the area, and the findings of this desktop assessment support that conclusion. The overall impact of this source of contamination continues to be small, although it is likely there has been a reduction in faecal loading. No significant updates to

[2] 'Low' contribution: estimated to account for <10% of total contamination sources.

the sampling plan are necessary, as the recommendations made in the 2011 sanitary survey to account for the impact of this source of pollution remain valid. Consideration should still be given to the presence of intermittent and continuous discharges in the vicinity of the CZs.

3.3 Agricultural Sources

The 2014 Sanitary Survey cites livestock population data for the Holy Island catchment basted on the 2010 Livestock Census. To provide an indication of changes in the livestock population of the catchment, a data request was made to the Farming Statistics Office for the Department for Environment, Food and Rural Affairs (DEFRA) for livestock populations within the catchment presented in Figure 1.1 for 2013 and 2021 based on the June Survey of Agriculture and Horticulture[3]. Figure 3.3 presents the changes in livestock populations within the Holy Island catchment. Data on pig populations at the 2013 Census were suppressed to prevent disclosure about individual holdings, although in practice this suggests that populations are small and unlikely to prevent a significant contamination risk to the shellfish production area.

The data presented in Figure 3.3 shows that cattle and sheep are the dominant livestock group in terms of total population size, but that the population of both groups fell slightly between 2013 and 2021. Poultry populations within the catchment continue to be very small (fewer than 150 animals in 2021), and there are approximately the same number of pigs as cattle. No comparison of pig population data is possible. It should be noted that the June Survey represents a snapshot of livestock populations in a single day, but populations will vary throughout the year. Highest numbers of animals will occur in spring, following the birthing season, and the lowest in autumn and winter when animals are sent to market.

[3] June Survey of Agriculture and Horticulture. Further information available at: https://www.gov.uk/guidance/structure-of-the-agricultural-industry-survey-notes-and-guidance#june-survey-of-agriculture-and-horticulture-in-england.

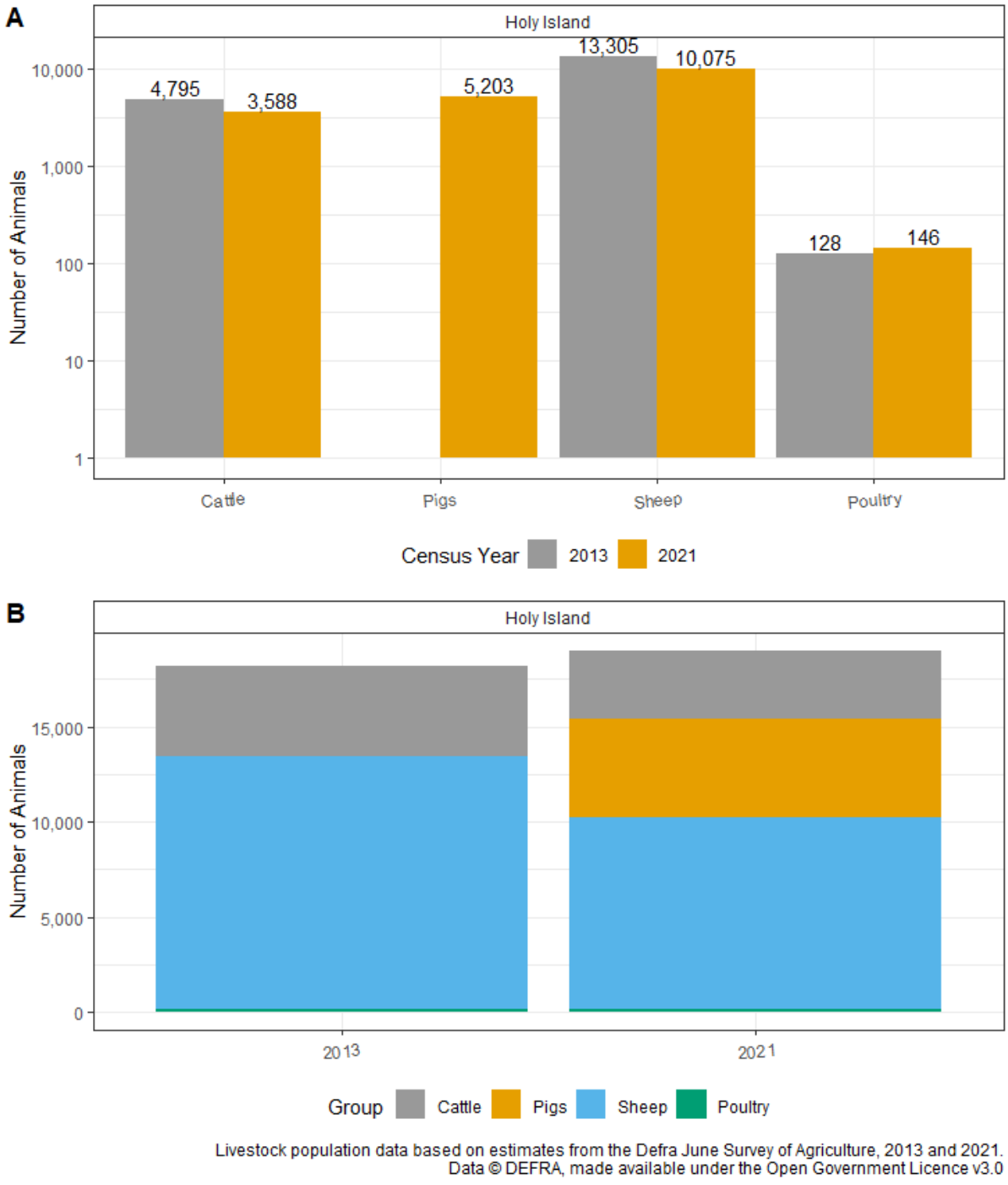

Figure 3.3 Changes in livestock populations within the Holy Island catchment. Panel A shows populations broken down by different livestock groups and Panel B shows the aggregated population.

The principal route of contamination of coastal waters by livestock is surface runoff carrying faecal matter. The change in land cover of the Holy Island catchment between 2012 and 2018 is shown in Figure 3.4.

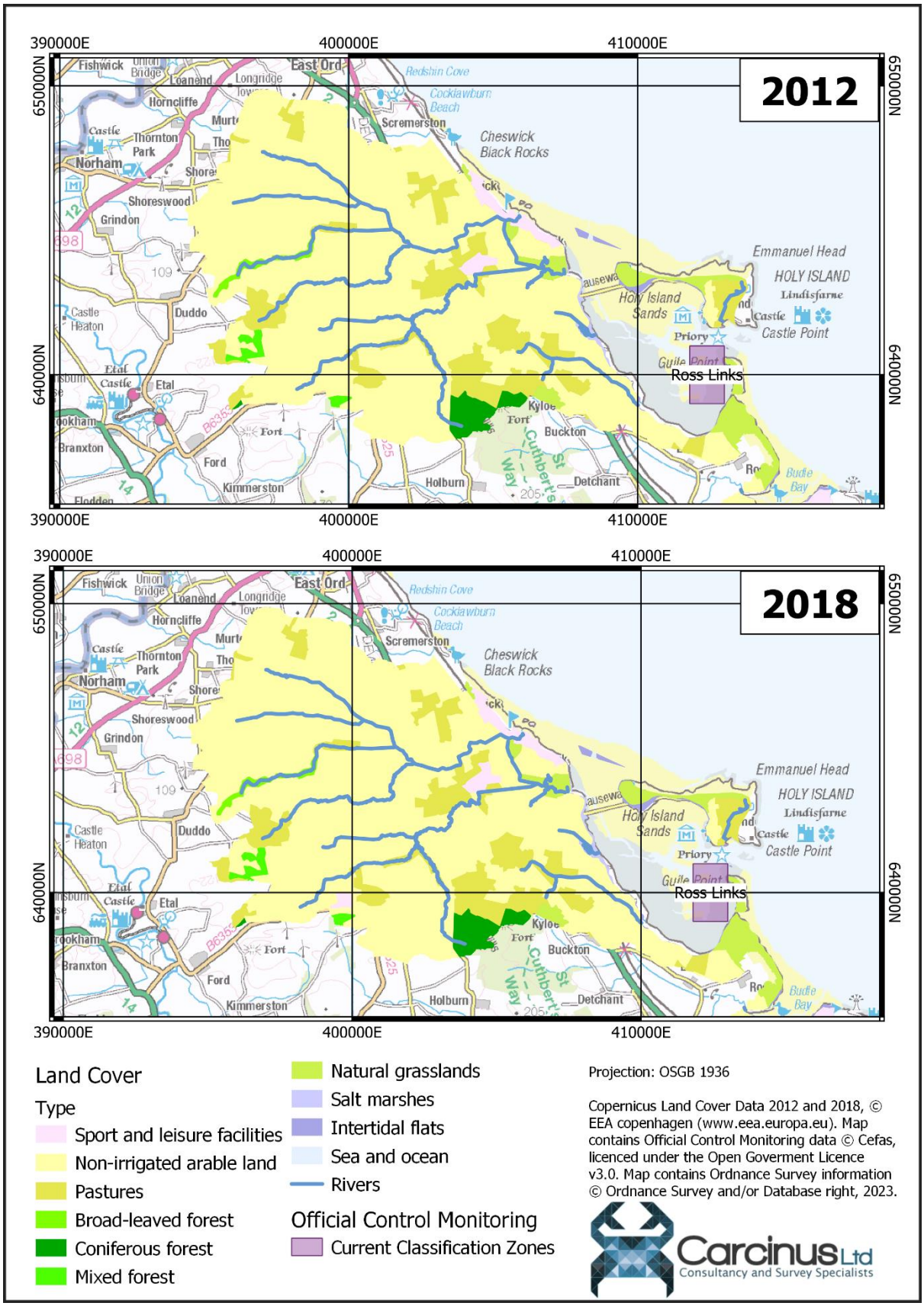

Figure 3.4 Land cover in the Holy Island catchment in 2012 and 2018.

The maps presented in Figure 3.4 confirm the findings of Section 3.1, in that the catchment is very rural, dominated by either pasture or arable farmland. The minimum mapping unit of the land cover data accessed is 25 ha, meaning that all of the small villages and hamlets present are less than 25 ha in area. The 2014 Sanitary Survey describes that grazing livestock were observed all around the perimeter of the embayment, but were contained within fenced fields with no direct access to the shoreline. There was evidence of direct grazing north of the tidal causeway as well as on Holy Island itself. Pasture areas adjacent to shorelines represent the greatest contamination risk to the classification zones. This is due to run-off from the land travelling less distance before reaching the CZ, resulting in less dilution and *E. coli* die off. Run-off from rivers further up the catchment will have a lower risk of contamination to the CZ, because the increased distance will result in further dilution and greater *E. coli* die off. These may however contribute to background levels of contamination in the CZ, particularly following significant rainfall events.

Arable farmland can also represent a risk to the bacteriological health of a shellfishery, particularly where slurry is applied to fields. The spreading of slurry is controlled under the Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018, known as the Farming Rules for Water, which came into force in April 2018. This legislation lays out a set of rules that require good farming practice, so that farmers manage their land both to avoid water pollution and benefit their business. Rules include requiring farmers to judge when it is best to apply fertilisers, where to store manures and how to avoid pollution from soil erosion. Furthermore, silage and slurry storage for agricultural purposes is subject to The Water Resources (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010 (SSAFO). All farmers must comply with the SSAFO regulations when building new slurry stores, or substantially altering (e.g., enlarging) existing ones. All stores must be built at least 10 m from any watercourse, including field drains or ditches, and be built or altered to last for at least 20 years with proper maintenance. Since 2021, the EA now has ART (Agricultural Regulatory Taskforce) Officers that have all been assigned a catchment and will engage, inspect, advise and if necessary, enforce the Silage, Slurry and Agricultural Fuel Oil regulations and the new (2018) Farming Rules for Water. In theory, these legislative changes should have reduced the pollution that this activity causes to shellfish beds. During initial consultations, the EA confirmed that there are no specific local byelaws that relate to slurry activity, but the Shellfish Water Action Plan does confirm that EA and Natural England officers in the area are working with farmers as part of the Catchment Sensitive Farming (CSF) initiative to enhance farming practices and reduce runoff from farmland. No further information regarding the location of these activities was made available.

The Environment Agency undertook monitoring of the waterbody within which the Holy Island BMPA is located in 2020, aiming to understand the causes of deterioration in water quality in terms of levels of Dissolved Inorganic Nitrogen (DIN) and macroalgae. This investigation found that agricultural runoff was leading to a deterioration in water quality within the watercourses that drain to the BMPA, but this was generally related to high levels of DIN rather than increased faecal loading. Faecal contamination of the shellfish beds

remains possible, particularly following high rainfall events and in areas where livestock graze immediately adjacent to watercourses, but there are additional concerns relating to eutrophication and other water quality issues.

The Shellfish Water Action Plan for the Holy Island shellfish water assesses that agricultural contamination has a 'medium'[4] contribution to contamination levels in the area. This desktop assessment supports that conclusion as the majority of the catchment is farmland, and all rivers and watercourses are likely to be affected by agricultural runoff to varying degrees, particularly following significant rainfall events.

3.4 Wildlife

The 2014 Sanitary Survey describes that the land and waters around the Holy Island BMPA contain a variety of habitats, including saltmarshes and intertidal mud and sand flats. The land cover maps presented in Figure 3.4 suggest that extensive areas of these habitats remain. These habitats support a significant diversity of wildlife, including waterbirds. Overwintering and wading birds often represent a potentially significant source of microbiological contamination to shellfisheries because avian species frequently forage (and therefore defecate) directly on intertidal shellfish beds.

The Wetland Brid Survey (WeBS) provides waterbird count data for Lindisfarne (the alternative name for Holy Island). Figure 3.5 shows the temporal trend in waterbird counts at this location from the winter of 2003/2004 to 2021/2022 (the most recent for which data are available).

[4] 'Medium' contribution: Accounting for 10 – 30% of contamination in the shellfish water.

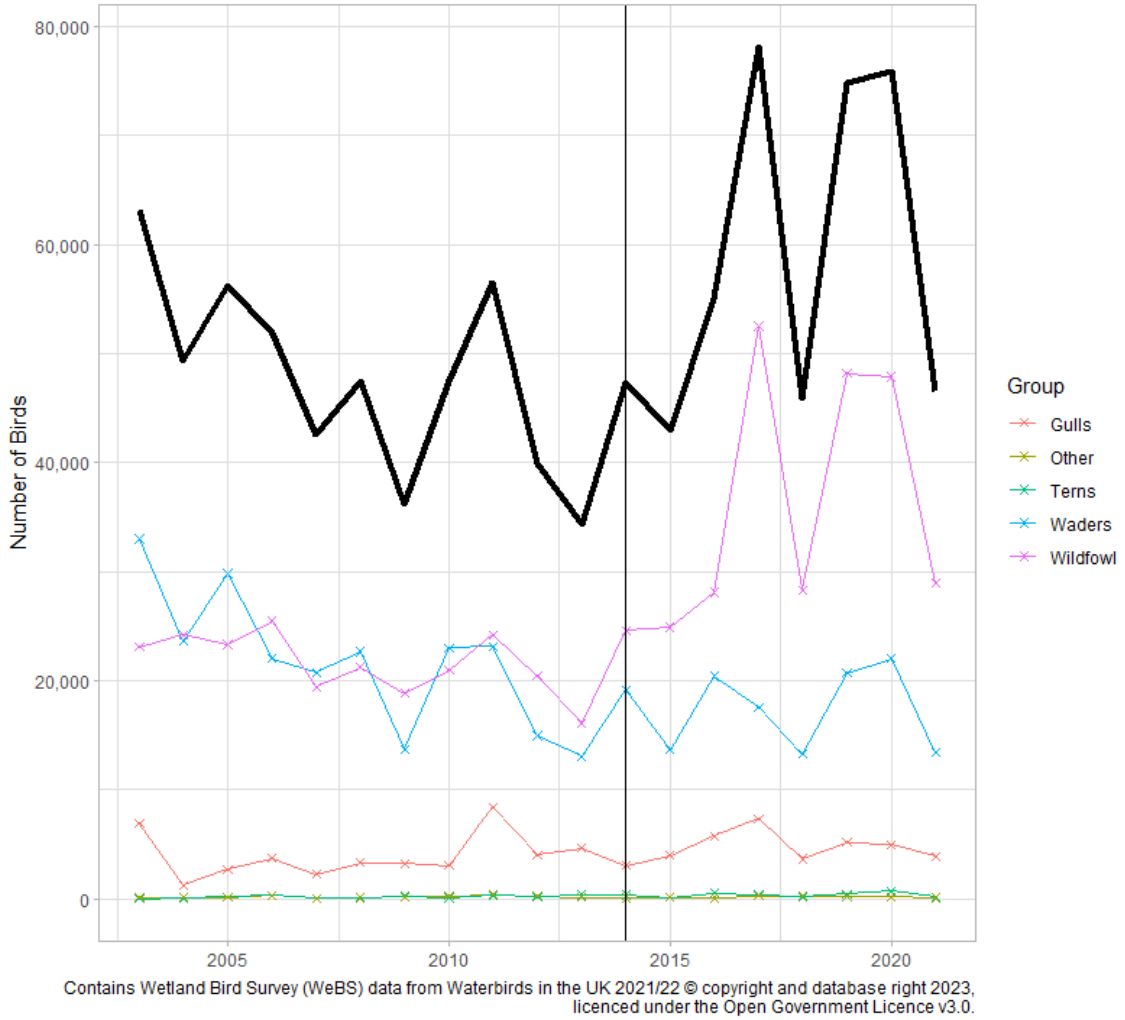

Figure 3.5 Temporal trend in waterbird counts from Lindisfarne. Data from the Wetland Birds Survey (Austin et al.*, 2023). Solid black line is the total of all groups combined.*

Figure 3.5 shows that the dominant group in terms of population size are wildfowl, particularly in the years following the publication of the 2014 sanitary survey. It also suggests that waterbird populations are increasing. In the five winters to 2013/2014, the average total count of waterbirds (including gulls and terns) was 39,124. In the five winters to 2021/2022 this had increased by 51% to 61,499. The area contains internationally significant populations of Brent Goose, Wigeon and Ringed Plover, as well as nationally significant populations of several others.

The 2014 Sanitary Survey and Shellfish Water Action Plan both conclude that the contamination from avian faeces is a potentially significant source of microbiological contamination to the Holy Island BMPA. That conclusion is supported by the findings of this desk top assessment. The largest aggregations of waterbirds, and therefore the highest risk of contamination, will occur in winter months. The distribution of waterbirds within the estuary will be driven by the aggregations of their foraging resource, which will shift from year to year. As a consequence, it is challenging to define RMPs which reliably capture this

source of pollution. This situation has not changed since the original sanitary survey was published.

The 2014 Sanitary Survey notes that there are notable populations of both grey and harbour seals in the waters around the Holy Island BMPA, and that the animals frequently haul out on the sand flats. Recent monitoring suggests that the area continues to support significant populations (Carter *et al.*, 2020; SCOS, 2022), and this finding was echoed during initial consultations. Seal populations may present a source of microbiological contamination to the shellfishery, but the areas used by the populations are unchanged since the 2014 Sanitary Survey was published. No update to the sampling plan is necessary on this basis.

3.5 Boats and Marinas

The discharge of sewage from boats is a potentially significant source of contamination to the shellfish beds of the Holy Island BMPA. Boating activities in the area have been derived through analysis of satellite imagery and various internet sources, and compared to that described in the 2014 Sanitary Survey. Their geographical positions are presented in Figure 3.6.

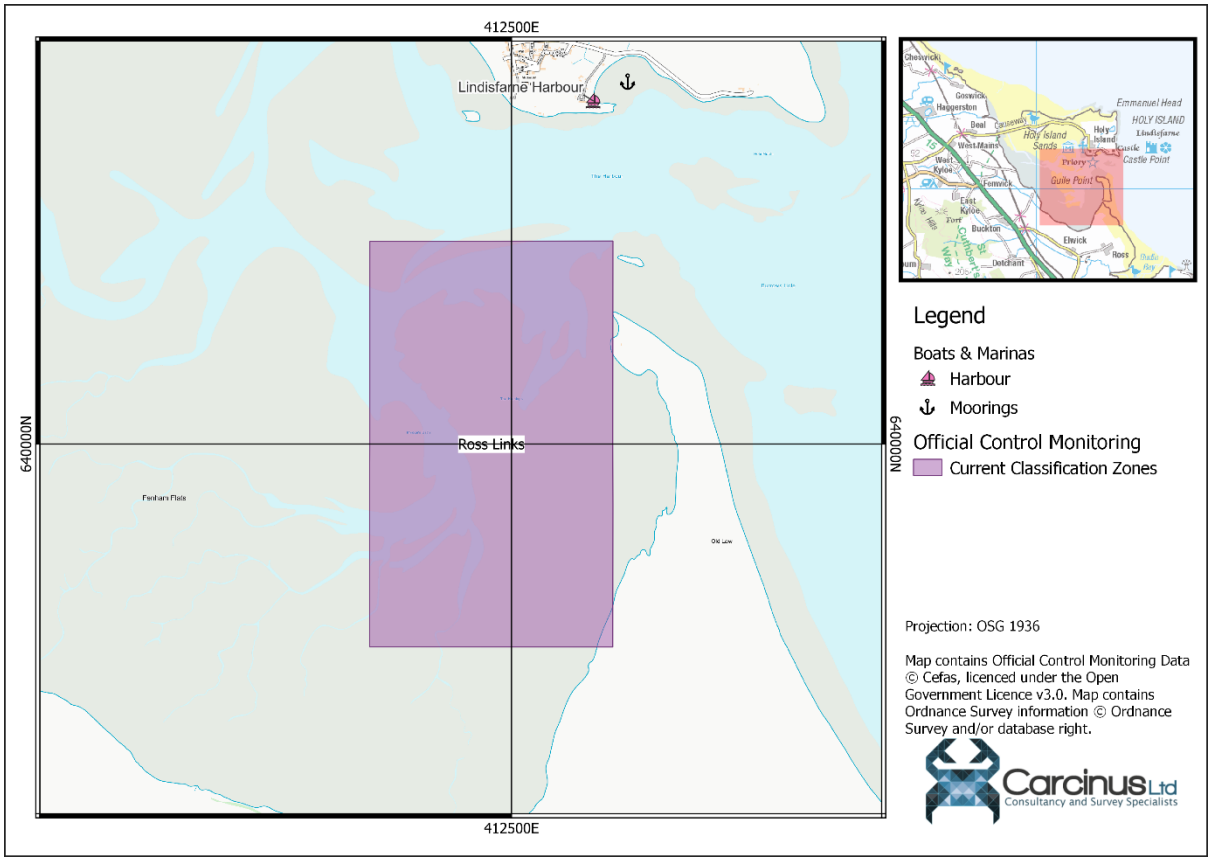

Figure 3.6 Locations of boats, marinas and other boating activities in the vicinity of the Holy Island BMPA.

There is considered to be no significant merchant shipping traffic within the Holy Island embayment, and no contamination from this source is expected.

A small fishing fleet operates in the area, with three vessels under 10 m overall length and two vessels over 10 m overall length listing Holy Island as their home port (gov.uk, 2023). No significant contamination from this source is expected.

There continue to be a few swinging and drying moorings located outside of the Lindisfarne Harbour. Overboard discharges are prohibited whilst vessels are staying at the harbour, but it is possible that discharges do occur from time to time. Overboard discharges from vessels of a sufficient size to contain onboard toilets may also occur when moving through the main navigational channels. The greatest impacts are likely to occur in summer months, when vessel numbers are at their highest. On balance, the impact of overboard discharges from boats in the harbour are likely to be minor in comparison to other sources of contamination to the Holy Island BMPA.

3.6 Other Sources of Contamination

Utility misconnections are when foul water pipes are wrongly connected and enter surface waters without treatment, potentially putting raw sewage directly into watercourses via surface water drains. The Shellfish Water Action Plan for the area does not consider misconnections to be a source of contamination to this area.

4 Hydrodynamics/Water Circulation

The Holy Island BMPA is contained within the embayment that separates Holy Island from the mainland of northeast England. The embayment is shallow and largely intertidal, with some subtidal channels. There are two connections to the north sea, one via the tidal causeway between Holy Island and the mainland, and then a larger connection between the southern tip of Holy Island and the Old Law dunes. Analysis of freely available nautical chart data suggests that water depths and subtidal channel locations are unchanged from the situation described in the 2014 Sanitary Survey.

The only freshwater inputs in the area are small watercourses such as Fenham Burn, North Low and South Low, and tidal circulation will be the dominant force controlling water movement in the BMPA. Tidal ranges in the area are large, and the flooding tide may carry contamination from the Holy Island STW through the main entrance, with the ebbing tide carrying contamination from shoreline sources over the shellfish beds. The dilution potential will be greatest in the subtidal channels than the intertidal areas, where contamination may persist for longer.

5 Rainfall

A complete record of rainfall data from the Belford rain gauge at NGR: NU 09300 33140 (ID: 000900) was downloaded from the Environment Agency's hydrology data explorer[5]. This station was chosen as it is the closest monitoring station to the BMPA, 4.5 km south west of the *Ross Links* CZ. The data were subdivided into 2008 – 2014 (pre-sanitary survey) and 2015

[5] Environment Agency's Hydrology Data Explorer. Available at: https://environment.data.gov.uk/hydrology/explore#/landing.

– present (post sanitary survey) and processed in R (R Core Team, 2021). These data were used to determine whether any changes in rainfall patterns had occurred since the original sanitary surveys were published. The rainfall levels per month are shown in Figure 5.1 and the data are summarised in Table 5.1

Table 5.1 Summary statistics for rainfall preceding and following the 2014 Sanitary Survey.

Period	Mean Annual Rainfall	Percentage Dry Days	Percentage Days Exceeding 10 mm	Percentage Days Exceeding 20 mm
2008 - 2014	699.3714	43.995	25.408	16.503
2015 - 2023	650.9778	44.416	23.946	14.355

The data show that rainfall levels in the catchment have fallen by nearly 50 mm per year, with the percentage of dry days increasing and the percentage of days with heavy (>10 mm/day) rainfall decreasing. Two sample t-tests indicated that there was no significant difference ($p > 0.05$) in the mean daily rainfall per month for the 2008 – 2014 and 2015 – 2023 periods.

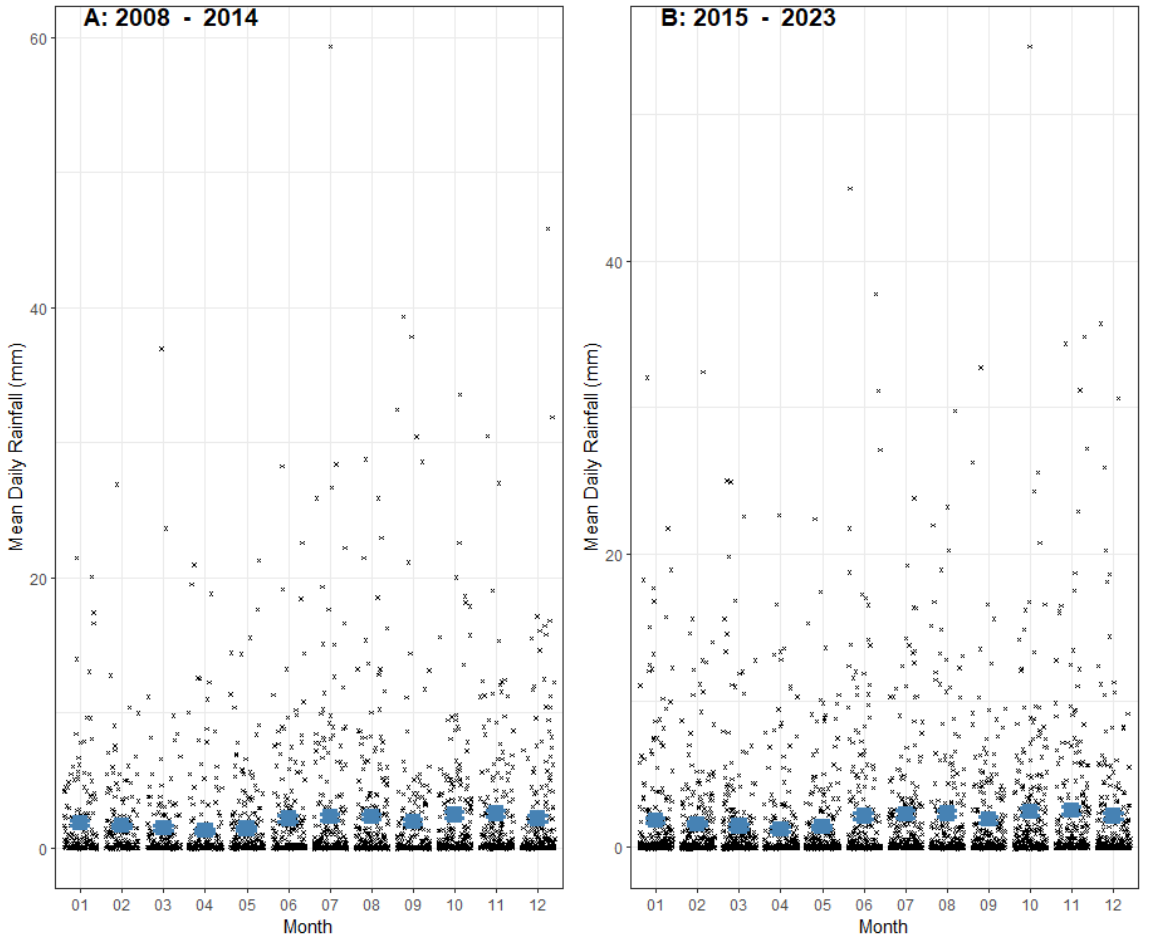

Figure 5.1 Mean daily rainfall per month at the Belford monitoring station (NGR: NU 09300 33140) for the period (A) 2008 – 2014 and (B) 2014 – 2023.

Rainfall leads to increased faecal loading through two factors: elevated levels of surface runoff and increased spill events from intermittent discharges, particularly during periods of heavy rain. Rainfall levels during both periods were greatest in winter months (November – February), and so levels of runoff and storm spills would be expected to be greatest during this time. However, as the rainfall patterns have remained (statistically) similar across the two time periods, significantly altered bacterial loading due to these factors is unlikely and as such RMP recommendations made in the original sanitary survey to capture the influence of runoff and spill events remain valid.

6 Microbial Monitoring Results

6.1 Official Control Monitoring

6.1.1 Summary Statistics and geographical variation

Mean Official Control monitoring results for *E. coli* concentrations at RMPs sampled in the Holy Island BMPA since 2010 are presented spatially in Figure 6.1 and summary statistics are presented in Table 6.1. This data was obtained through a request to Cefas, but is freely available on the datahub.

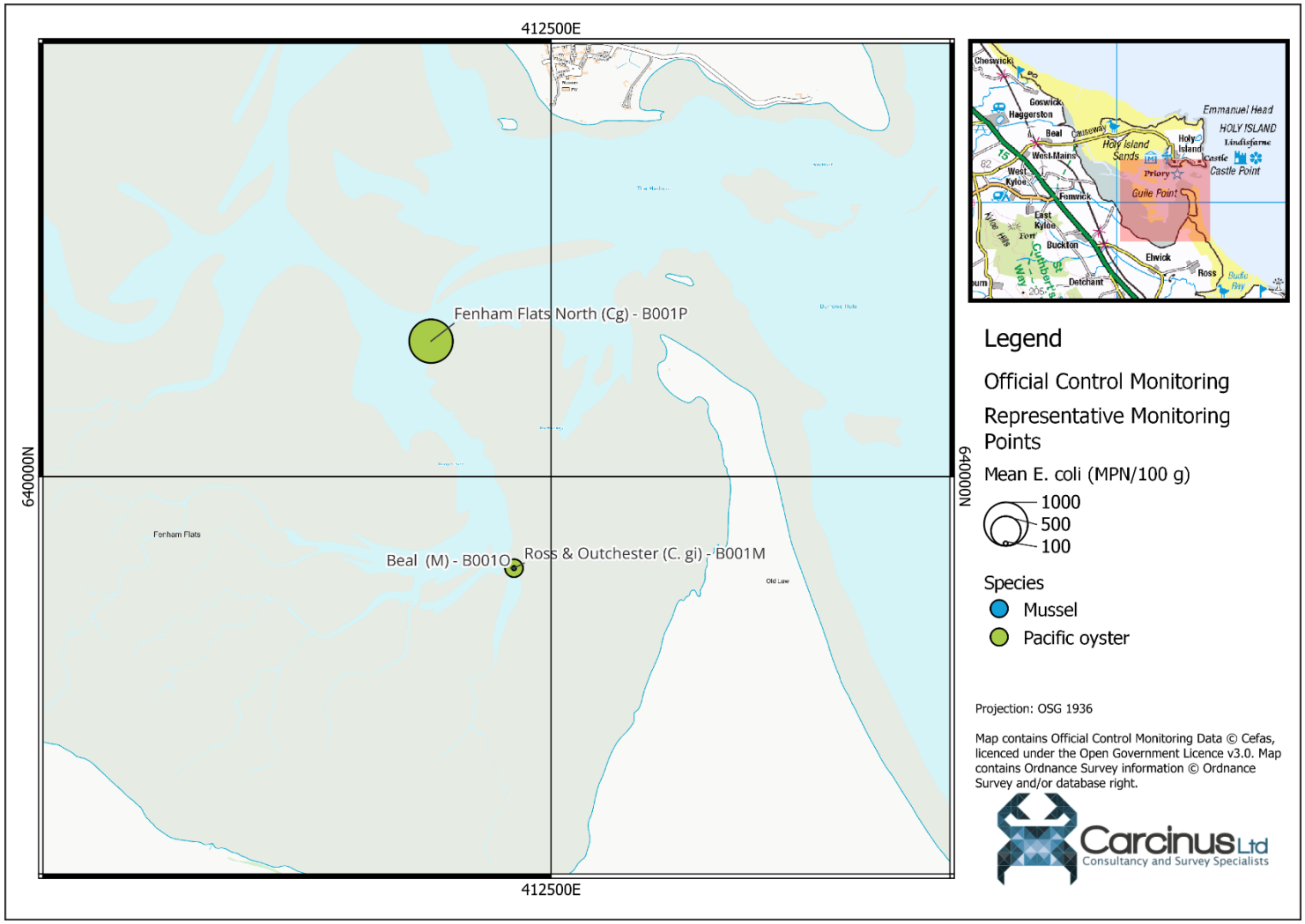

Figure 6.1 Mean E. coli results from Official Control monitoring at bivalve RMPs in the Holy Island BMPA.

Table 6.1 Summary statistics of Official Control monitoring at bivalve RMPs in the Holy Island BMPA.

RMP (Species)	NGR	Species	No. Samples collected	First Sample	Last Sample	Mean	Min Value	Max Value	% > 230	% > 4,600	% > 46,000
Beal (M) - B001O	NU12333958	Mussel	8	18/01/2010	09/08/2010	143.75	20	490	25.00	0.00	0.00
Fenham Flats North (Cg) - B001P	NU11954062	Pacific oyster	5	06/06/2016	02/09/2019	911.6	18	3300	60.00	0.00	0.00
Ross & Outchester (C. gi) - B001M	NU12333958	Pacific oyster	161	18/01/2010	04/06/2023	263.34	18	4900	19.25	0.62	0.00

A total of three RMPs have been sampled within the Holy Island BMPA. The RMP recommended in the 2014 Sanitary Survey, Fenham Flats North B001P, was only sampled 5 times between June 2016 and September 2019. Sampling at the mussel RMP Beal B001O stopped in August 2010. The Ross & Outchester B001M RMP was has been sampled continually between 2010 and 2023. The Fenham Flats RMP B001P has returned higher results than the Ross & Outchester RMP, possibly due to its greater proximity to point sources of contamination on Holy Island as well as greater exposure to contamination from north of the tidal causeway and the main entrance to the embayment. The Ross & Outchester B001M and Beal B001O RMPs are co-located; the B001M RMP has returned higher concentrations of *E. coli* in samples, although limited comparisons can be drawn since only eight samples from the mussel RMP (B001O) were included in the dataset analysed in this report.

Figure 6.2 and Figure 6.3 presents box and violin plots of *E. coli* monitoring at RMPs within the Holy Island BMPA. One-way analyses of variance (ANOVA) tests were performed on the data to investigate the statistical significance of any differences between the monitoring results from the two RMPs. Significance was taken at the 0.05 level. All statistical analysis described in this section was undertaken in R (R Core Team, 2021).

Figure 6.2 shows the monitoring data from Pacific oyster RMPs illustrating that the Fenham Flats North RMP (B001P) has returned a higher median result than the Ross and Outchester B001M RMP. The results from Fenham Flats are significantly greater than the Ross and Outchester RMP ($p = 0.03$), although only five samples were collected from the Fenham Flats RMP so the inference that can be drawn from this result is reduced. No comparison of the mussel data presented in Figure 6.3 is possible as it is not appropriate to compare the results of RMPs for different species due to the differences in rates of *E. coli* uptake.

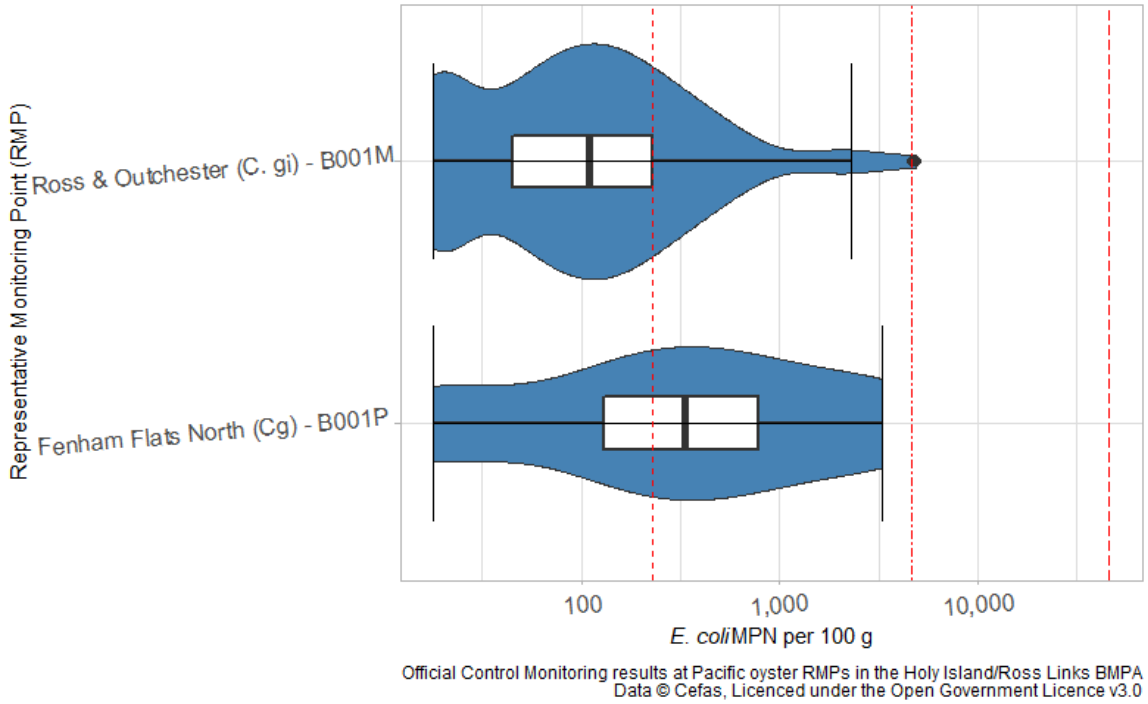

Figure 6.2 Box and violin plots of E. coli monitoring at Pacific oyster RMPs in the Holy Island BMPA. Central line indicates median value, box indicates lower-upper quartile range and whisker indicates minimum/maximum values, excluding outliers. Boxplots are overlaid on the distribution of the monitoring data. Horizontal dashed lines indicate classification thresholds at 230, 4,600 and 46,000 E. coli MPN/100 g.

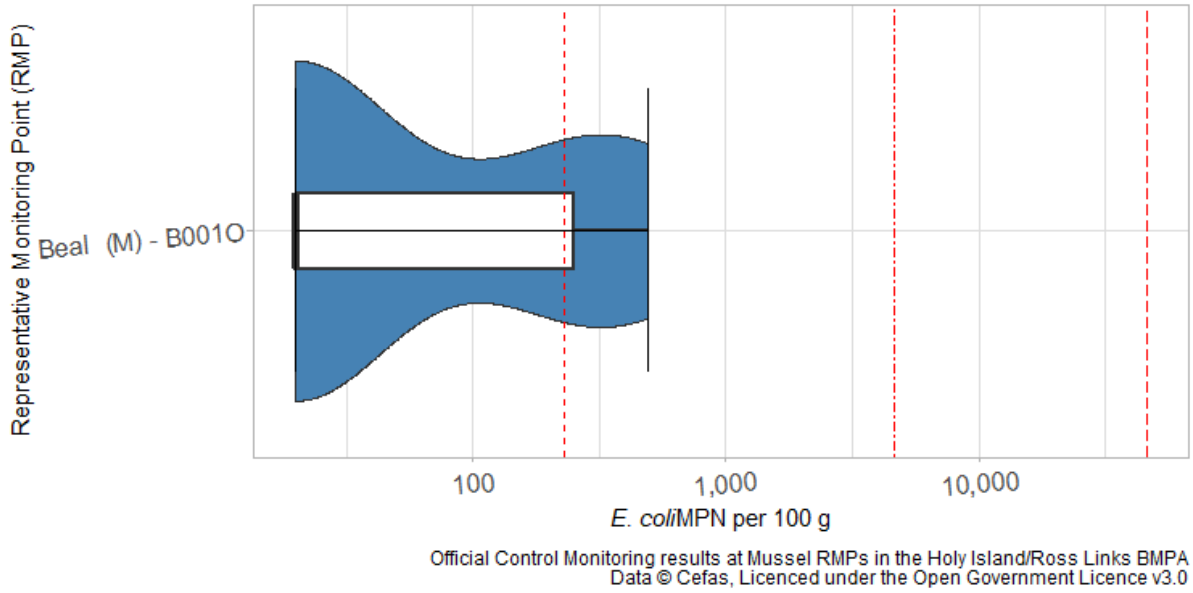

Figure 6.3 Box and violin plots of E. coli monitoring at mussel RMPs in the Holy Island BMPA. Central line indicates median value, box indicates lower-upper quartile range and whisker indicates minimum/maximum values, excluding outliers. Boxplots are overlaid on the distribution of the monitoring data. Horizontal dashed lines indicate classification thresholds at 230, 4,600 and 46,000 E. coli MPN/100 g.

6.1.2 Overall temporal pattern in results

The overall temporal pattern in shellfish flesh monitoring results within the Holy Island BMPA are shown for Pacific oysters in Figure 6.4 and for mussels in Figure 6.5.

The monitoring data from the Ross & Outchester RMP do show that the results have been very consistent, with the trend line consistently falling below the Class A threshold of 230 MPN/100 g (Figure 6.4). No real inference can be drawn from the monitoring data from the Fenham Flats (B001P) RMP as only five samples were collected, two in 2016 and three in 2019.

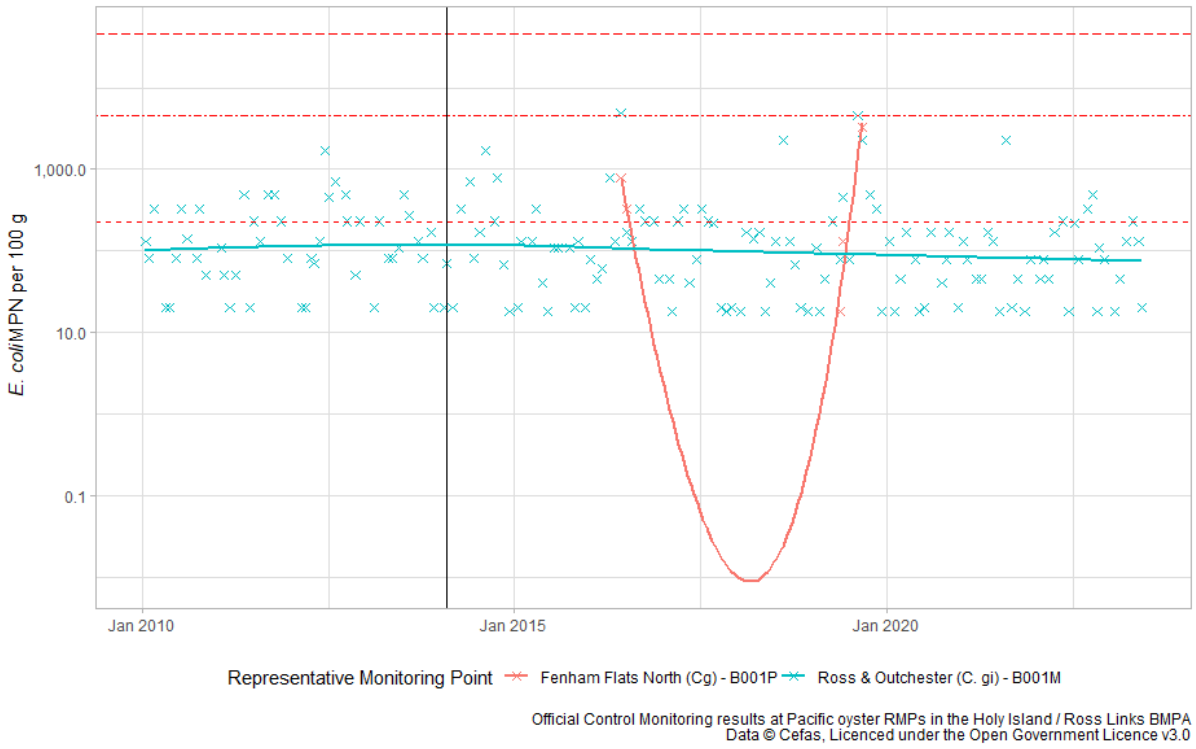

Figure 6.4 Timeseries of E. coli levels at Pacific oyster RMPs sampled in the Holy Island BMPA since 2010. Scatter plots are overlaid with a loess model fitted to the data. Horizontal lines indicate classification thresholds at 230, 4,600 and 46,000 E. coli MPN/100 g respectively.

Limited inference can be taken from the monitoring data presented in Figure 6.5, as no samples have been collected since August 2010, although the data do show that concentrations of *E. coli* were low at that time.

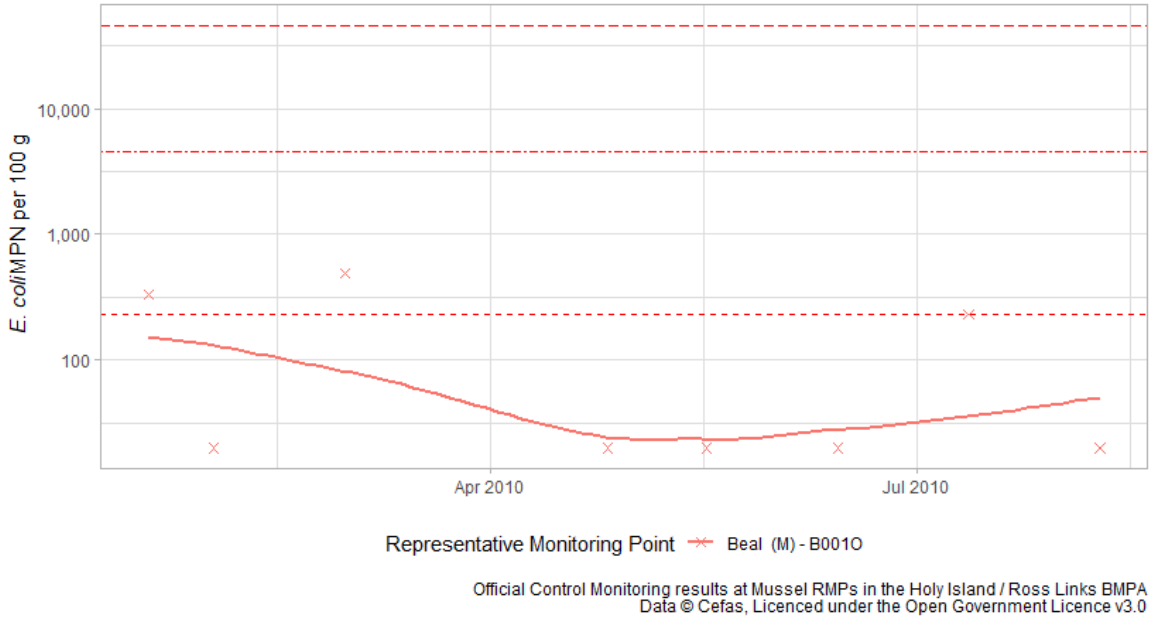

Figure 6.5 Timeseries of E. coli levels at mussel RMPs sampled in the Holy Island BMPA since 2010. Scatter plots are overlaid with a loess model fitted to the data. Horizontal lines indicate classification thresholds at 230, 4,600 and 46,000 E. coli MPN/100 g respectively.

6.1.3 Seasonal patterns of results

Seasonal patterns of *E. coli* levels at RMPs in the Holy Island BMPA were investigated and are shown for Pacific oysters in Figure 6.6. The data for each year were averaged into the four seasons, with, spring from March – May, summer from June – August, autumn from September – November and winter comprising data from December – February the following year. Two-way ANOVA testing was used to look for significant differences in the data, using both season and RMP (if there is more than one RMP for a given species) as independent factors (i.e., pooling the data across season and RMP respectively), as well as the interaction between them (i.e., exploring seasonal differences within the results for a given RMP). Significance was taken at the 0.05 level.

The monitoring data show that samples collected in summer months returned significantly higher concentrations of *E. coli* than samples collected in either spring ($p = 0.03$) or winter ($p = 0.01$).

No seasonal comparison for mussels is possible as there are insufficient datapoints.

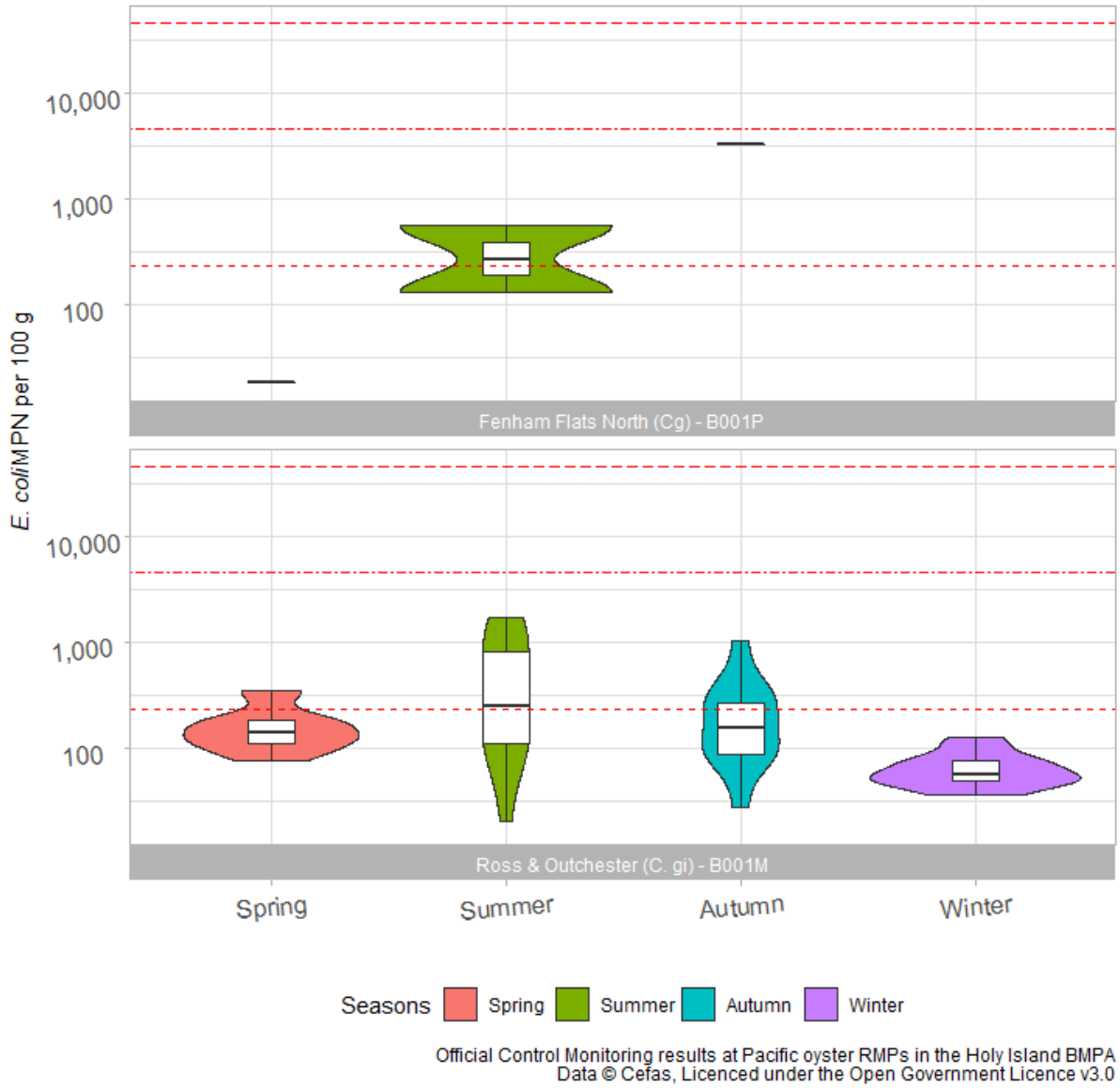

Figure 6.6 Box and violin plots of E. coli levels per season at Pacific oyster RMPs sampled within the Holy Island BMPA since 2010. Horizontal lines indicate classification thresholds at 230, 4,600 and 46,000 E. coli MPN/100 g.

6.2 Bathing Water Quality Monitoring

The status of EC bathing waters near to and within the BMPA may be of relevance to sanitary assessments. However, there are no bathing water quality monitoring points within the embayment itself, and the closest are at Spittal, 15 km further north up the coastline, and at Bamburgh, 8 km further south down the coastline . Monitoring data from these locations therefore have no bearing on the sampling plan for the Holy Island BMPA.

6.3 Action States

No Action States have been triggered within the Holy Island BMPA since the 2014 Sanitary Survey was published.

7 Conclusion and overall assessment

The Holy Island BMPA is situated within the semi-closed embayment that separates Holy Island from the northeast coast of England. There are no other BMPAs within 50 km. The 2014 Sanitary Survey recommended the creation of Classification Zones for an aquaculture based Pacific oyster fishery, as well as a wild mussel fishery (should formal classification have been requested). There is currently only one active Classification Zone for Pacific oysters.

The results of the 2021 Census were compared to that of the 2011 Census to give an indication of changes in human population across the catchment. At the 2021 Census, the estimated population was 3,470 people, a decrease of 6.6% on the 2011 number. There are no significant urban areas within the catchment, with only small villages and hamlets distributed throughout the area. The area receives a significant volume of tourism each year, but monitoring undertaken by the water company suggests the existing wastewater treatment network is sufficient to handle this increase.

The wastewater treatment network contains more assets than would usually be expected for a catchment and population of this size, reflecting the significant seasonal fluctuation in population size. There are no planned upgrades to the continuous discharges in the area, but several upgrades to intermittent discharges are planned for AMP8 (2025 – 2030). These upgrades are designed to reduce the frequency of storm overflows. EDM data suggests that the frequency of spills from intermittent discharges has been decreasing in recent years, but any updated sampling plan should still take the presence of these discharges into account.

Agricultural pollution from both arable farmland and areas of pasture is considered to be one of the more significant contributors to bacteriological water quality in the catchment. The vast majority of the catchment is reserved for either pasture or arable farmland. There have been no significant faecal pollution incidents attributed to agriculture in this catchment.

Waterbird counts for Lindisfarne suggest that there are internationally significant aggregations of waterbirds throughout the area. These are likely to represent one of the more significant causes of microbiological contamination within the Holy Island BMPA, particularly in winter months. It remains hard to reliably account for this source of pollution however, as the aggregations of birds will shift from year to year based on the distributions of their prey.

There is considered to be no impact from merchant shipping as there are no commercial ports within Holy Island. There is a small fishing fleet that operates out of Lindisfarne Harbour, but the main pollution risk from boating activities will continue to come from pleasure craft. There are no marinas in the area, but there are some moorings associated with Lindisfarne harbour. Comparison with the situation described in the 2014 Sanitary Survey suggests that overall, the level of recreational boating activity in the area remains high, and there is a chance that the main navigational channels and areas of moorings will

receive some contamination, particularly in the summer. However, the recommendations made in the 2014 report remain valid as the areas at risk have not changed.

Monitoring data available for three RMPs sampled in the Holy Island BMPA since 2010, although at two of these fewer than 10 samples were collected. Whilst significant differences were found between the two Pacific oyster RMPs, limited inference can be drawn as at one of the RMPs (Fenham Flats (B001P)), only five samples were collected between 2016 and 2019. Monitoring results collected in summer months were found to be significantly greater than those collected in both spring and winter months.

Based on the information available, there do not appear be any significant knowledge gaps that would justify a shoreline survey. There have been no notable changes to sources of pollution or deterioration in classification since the 2014 Sanitary Survey was published.

Having reviewed and compared the findings of the desk-based study with the original sanitary survey in 2014, the FSA is content that a shoreline assessment is not required.

8 Recommendations

A recommendation for the current active classification zone within the Holy Island BMPA are summarised below and a recommended sampling plan is provided in Table 9.1.

8.1 Pacific oyster

Ross Links

This CZ covers an area of 2.4 km and is situated on the eastern side of the embayment, 3 km from the tidal causeway and 500 m from the southern side of Holy Island. The 2014 Sanitary Survey recommended placing the RMP at Fenham Flats NU 1195 4062 to capture contamination from Fenham Burn, South Low/Beal Cast as well as the seal haul out sites. This RMP was placed at the north western part of the CZ, at the edge of the northern most oyster trestle. However only five samples were ever collected at this RMP, and to date the Ross & Outchester RMP, located at NGR NU 1233 3958, at the southern end of the oyster trestles, is used to classify the CZ.

It is unclear why this recommendation was not followed. Comparison of monitoring data collected on identical days from both the Ross & Outchester RMP and Fenham Flats RMP indicates that the Fenham Flats position returned consistently higher concentrations of *E. coli* within samples, and is therefore indicative of the worst case scenario in terms of faecal contamination. We propose to revert to using this RMP (B001P) to classify the *Ross Links* CZ, provided that the oyster trestles do not extend any farther north than this location. Consultation with the LEA as to the farthest north extent of accessible trestles for RMP placement is ongoing. Table 9.1 (sampling plan) recommends the Fenham Flats B001P RMP for use moving forward. If this RMP is not accessible, a new RMP should be placed as far north within the *Ross Links* CZ as possible. The sampling protocol (i.e. monthly samples, collected by hand from within 10 m of the RMP location) should be unchanged.

9 General Information

9.1 Location Reference

Production Area	**Holy Island**
Cefas Main Site Reference	M001
Ordnance survey 1:25,000	Explorer 340
Admiralty Chart	111

9.2 Shellfishery

Species	Culture Method	Seasonality of Harvest
Pacific oyster (*Crassostrea gigas*)	Cultured (trestles)	Year Round

9.3 Local Enforcement Authority(s)

Name	**Northumberland County Council** Public Health Protection Unit West Hartford Business Park Cramlington NE23 3JP
Website	www.northumberland.gov.uk
Telephone number	0345 600 6400
E-mail address	publicprotection@northumberland.gov.uk

9.4 Sampling Plan

*Table 9.1 Proposed sampling plan for the Holy Island BMPA. Suggested changes are given in **bold red** type.*

Classification Zone	RMP	RMP Name	NGR (OSGB 1936)	Lat / Lon (WGS 1984)	Species Represented	Harvesting Technique	Sampling Method	Sampling Species	Tolerance	Frequency
Ross Links	**B001P**	**Fenham Flats North**	**NU 1195 4062**	**55° 39.538'N 01° 48.698'W**	Pacific oysters	Hand	Hand	*C. gigas*	10 m	Monthly

10 References

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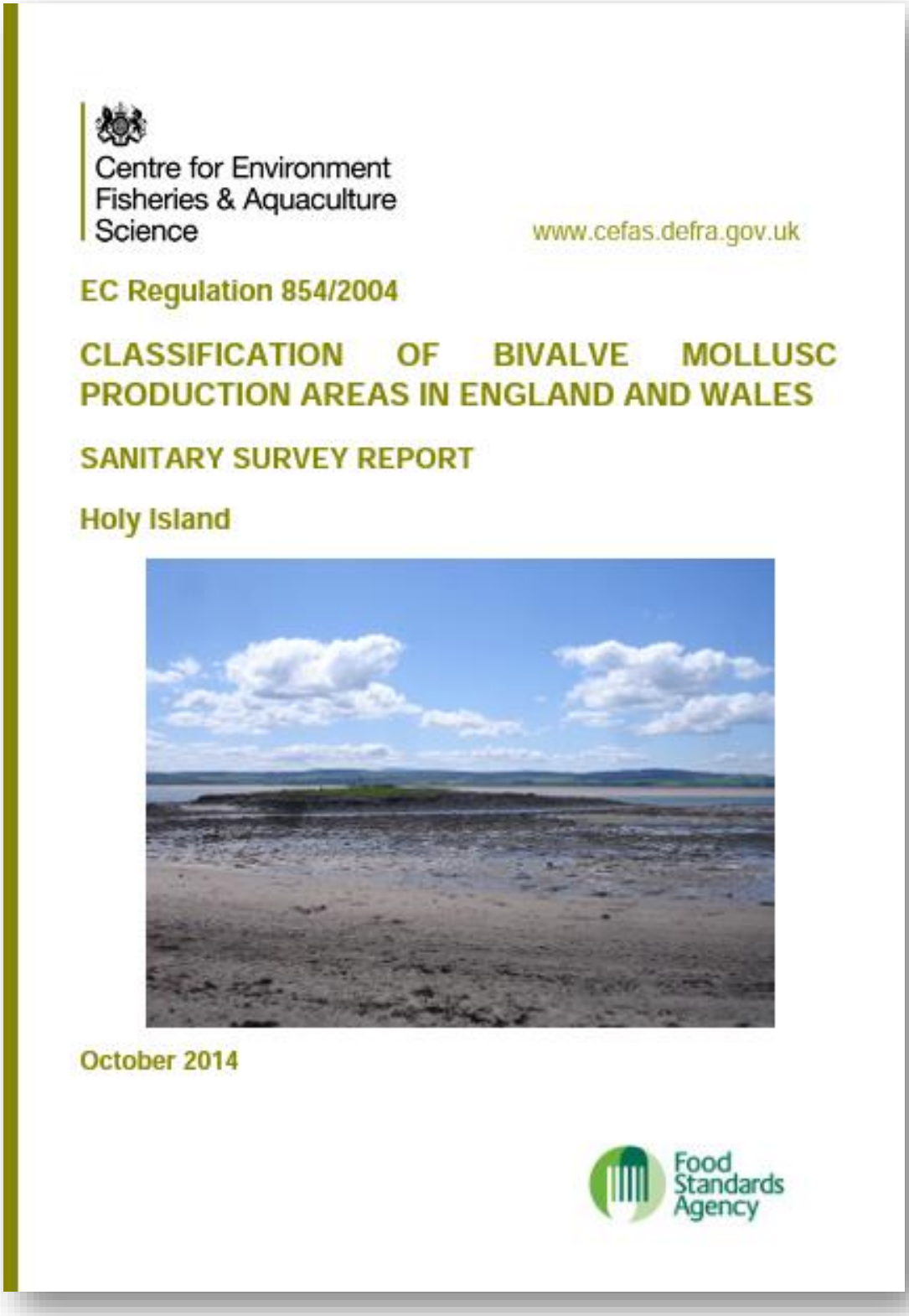
Appendices

Appendix I. Event Duration Monitoring Summary for 2022

Site Name (EA Consents Database)	Storm Discharge Asset Type	Outlet Discharge NGR (EA Consents Database)	Total Duration (hrs) all spills prior to processing through 12-24h count method	Counted spills using 12-24h count method
CSO INLET AT BOWSDEN SEWAGE TREATMS	Inlet SO at WwTW	NT9973041910	89.84	61
HAGGERSTON CASTLE CARAVAN PARK STW	Inlet SO at WwTW	NU0524043560	31.79	7
KYLOE VIEW SSO	SO on sewer network	NU0218339803	14.75	15
LOWICK SEWAGE TREATMENT WORKS CSO INLET	Inlet SO at WwTW	NU0257239688	2.38	27
LOWICK SEWAGE TREATMENT WORKS Storm Tank	Storm tank at WwTW	NU0257239688	157.15	23
BELFORD INDUTRIAL ESTATE PS.	Storm discharge at pumping station	NU1260033560	0.00	0
BELFORD SEWAGE TREATMENT WORKS CSO INLET	Inlet SO at WwTW	NU1171033885	527.86	84
BELFORD SEWAGE TREATMENT WORKS CSO Storm Tank	Storm tank at WwTW	NU1171033885	380.17	28
FENWICK (BERWICK) STW	Inlet SO at WwTW	NU0683240072	48.34	13
HOLY ISLAND STW	Inlet SO at WwTW	NU1413041940		
MCLAREN DRIVE CSO HALL LODGE	SO on sewer network	NU1121033610	32.25	18



Centre for Environment
Fisheries & Aquaculture
Science

www.cefas.defra.gov.uk

EC Regulation 854/2004

CLASSIFICATION OF BIVALVE MOLLUSC PRODUCTION AREAS IN ENGLAND AND WALES

SANITARY SURVEY REPORT

Holy Island

October 2014

Follow hyperlink in image to view full report.

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