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Birdlife near Hvítisandur

Research about the impacts of developing a bathing facility in Þórustaðir on local birdlife

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ABSTRACT

The proposed Hvítisandur bathing facility is planned for construction on the land of Þórustaðir in Önundarfjörður, adjacent to Innri-Hjarðardalur and Holt. The development includes a shoreline building, external baths, a pier, a parking lot, and access paths. Commissioned by Hvítisandur ehf., this study by Náttúrustofa Vestfjarða evaluates the facility's potential impacts on local bird populations through breeding bird surveys, shore censuses, and a literature review. This report contains detailed breakdowns of observed species and their abundances at various distances from the development, along with a comparison with published recommended disturbance setback distances.

The area in and around the proposed development (within 1,000 metres) supports at least 21 breeding bird species, 14 of which are listed on the Icelandic Red List. An additional 2 Red Listed species were surveyed in Holt beyond 1,000 metres. Direct impacts include the permanent displacement of 100 breeding pairs—98 black-headed gull, 1 common eider, and 1 Eurasian whimbrel—within the project's immediate footprint. Both the common eider and Eurasian whimbrel are on the Icelandic Red List. Indirect effects in the form of disturbance may impact a minimum of 482 additional breeding pairs across at least 12 species. These species were observed breeding closer than the disturbance and setback distances recommended by NatureScot (ranging from 50 to 900 metres depending on species-specific traits), potentially exposing them to elevated disturbances. Affected species include: 224 black-headed gull, a minimum of 184 common eider, 43 Arctic tern, 7 Eurasian whimbrel, 7 greylag goose, 6 red-throated loon, 5 common ringed plover, 2 European golden plover, and 1 each of common redshank, Eurasian oystercatcher, mallard, and redwing. Of these, 7 species (accounting for at least 244 pairs) are on the Red List: Arctic tern, common eider, common redshank, Eurasian oystercatcher, Eurasian whimbrel, European golden plover, and greylag goose. These birds face potential risks of chronic stress, reduced reproductive success, and declining breeding densities due to human presence. The facility and associated infrastructure will also likely fragment habitat, blocking access routes between nests and the sea—a particular concern for common eider broods. Peak visitor activity is expected to coincide with the critical breeding period. Other indirect impacts, though harder to quantify, are equally important to consider. Potential increased human presence beyond the facility (such as on the beach) will expand the disturbance radius, affecting eider colonies and other species in Innri-Hjarðardalur and Holt. Additional risks may include higher road mortality and a possible change in predator dynamics. Given the development's location within a rich bird area, human-wildlife conflicts are likely to occur, ranging from defensive attacks by black-headed gulls and Arctic terns to the presence of birds within the facility when not in operation and the generation of faecal matter.

Collectively, these pressures from the Hvítisandur development pose risks to local bird populations during the breeding season. While recommended mitigation measures could reduce some impacts, the scale of projected disturbance—direct, indirect, permanent, and seasonal—suggests that mitigation strategies may not fully prevent adverse effects on the area's avian biodiversity, particularly for Red Listed species and those recorded within disturbance distances.

ÚRDRÁTTUR

Hvítisandur ehf hyggist byggja upp baðstað við Holtsbryggju í landi Þórustaða í Önundarfirði, við hlið jarðanna Innri-Hjarðardals og Holts. Framkvæmdin felur í sér byggingu, útiböð, bryggju, bílastæði og aðkomustíga. Rannsóknin er unnin er af Náttúrustofu Vestfjarða. Útbreiðsla varpfugla var gróflega kortlögð og áhrif á fuglalíf metið ásamt því að skoðaðar voru heimildir. Þessi skýrsla fjallar um tilvist fugla á svæðinu, stofnstærð þeirra, fjarlæg þeirra frá framkvæmdarsvæðinu og eru niðurstöðurnar settar í samhengi við birtar rannsóknir.

Gerð var skráning á öllum fuglum í kring um fyrirhugað framkvæmdarsvæði fjórum sinnum, frá 13. maí – 14. júní 2024. Athugnarsvæðið náði yfir land Þórustaða, Innri- Hjarðadals og Holts innan 1.000 m frá fyrirhuguðu framkvæmdarsvæði, en í sumum tilvikum gerð athugun lengra frá. Svæðinu var skipt upp eftir fjarlægðarmörkum og voru fjarlægðir fuglanna frá framkvæmdarsvæðinu var flokkaðar sem hér segir: 0 metrar (innan framkvæmdarsvæðis), 1-50 metrar, 51-100 metrar, 101-250 metrar, 251-500 metrar, 501-1.000 metrar og >1.000 metrar. Einnig voru gerðar sjö talningar á strandlengjunni frá 14. apríl – 2. júlí 2024. Athuganirnar voru gerðar með kíkir úr fjarlægð til að fylgjast með notkun æðarfugla á ströndinni, þar sem ströndinni var skipt í hluta eftir eignamörkum, landslagsþáttum og í samræmi við fyrirhugaða framkvæmd.

Svæðið sem framkvæmdin nær til og næsta umhverfi þess (innan 1.000 m) hýsir að minnsta kosti 21 varpfuglategund, þar af 14 á válista Íslands. Tvær aðrar válista tegundir fundust í Holti utan þessa 1.000 m svæðis. Bein áhrif fela í sér varanlega tilfærslu um 100 varppara – 98 hettumáfa, 1 æðarfugls og 1 spóa – innan framkvæmdasvæðisins. Bæði æðarfugl og spói eru á válista Íslands.

Óbein áhrif, svo sem truflun vegna framkvæmdarinnar geta haft áhrif á að minnsta kosti 482 önnur varppör af a.m.k. 12 tegundum. Þessar tegundir voru skráðar við varp innan við þær rask- og fjarlægðarviðmiðanir sem NatureScot mælir með (á bilinu 50 til 900 m, eftir hegðunareinkennum tegunda) sem geta því orðið fyrir aukinni truflun.

Tegundirnar sem geta orðið fyrir áhrifum eru meðal annars: 224 hettumáfar, að minnsta kosti 184 æðarfuglar, 43 kríur, 7 spóar, 7 grágæsir, 6 lómar, 5 sandlóir, 2 heiðlóur og 1 af hverri eftirfarandi tegund: stelkur, tjaldur, stokkönd og skógarþröstur. Af þessum eru 7 tegundir — sem samanlagt telja að minnsta kosti 244 varppör — á válista Íslands: kría, æðarfugl, stelkur, tjaldur, spói, heiðlóa og grágæs. Þessir fuglar standa frammi fyrir hugsanlegri áhættu á langvarandi streitu, minnkuðum varpárangri og fækkun í varpþéttleika vegna nærveru manna. Framkvæmdasvæðið og mannvirkin geta rofið samfelld búsvæði og skert aðgengi fugla milli hreiðra og sjávar, sem er sérstaklega viðkvæmt æðarfuglum og ungum þeirra.
Gert er ráð fyrir að flestar gestakomur verði á sama tíma og varptímabilið stendur yfir, þegar fuglar eru hvað viðkvæmastir fyrir truflun.
Aðrir óbeinir þættir, þó erfiðara sé að meta þá, eru engu að síður mikilvægt að hafa í huga. Aukin mannaferð utan sjálfs baðsvæðisins (t.d. á ströndinni) mun auka áhrifasvæðið og geta þannig haft áhrif á æðarvarp og aðrar tegundir í Innri-Hjarðardal og Holti. Viðbótaráhætta gæti falist í auknum dauða fugla á vegum og breyttum vistfræðilegum samskiptum rándýra og bráðar.

Þar sem svæðið er ríkt fuglasvæði er líklegt að myndist átök milli manna og fugla, svo sem varnarhegðun hettumáfa og kría gagnvart gestum, eða fuglar sem dvelja innan svæðisins skilji eftir sig úrgang.

Þær mótvægisaðgerðir sem mælst er til ef til framkvæmdar kemur:

- Mælst er til að sett verði árstíðarbundnar takmarkanir á framkvæmdir, að framkvæmdir fari fram utan varptímabilsins.
- Að vernda strandlínuna og önnur búsvæði með að draga úr truflun manna utan baðstaðarins, greina og vernda lykilvarpsvæði og uppeldissvæði fyrir æðarfugla og aðrar tegundir sem verpa nálægt svæðum sem hafa umferð. Það gæti verið gert t.d. með að merkja gönguleiðir, setja upp skilti og fræðslu fyrir gesti um staðbundnar fuglategundir og mikilvægi þess að lágmarka truflun. Þetta gæti falið í sér merkingar og upplýsingabæklinga sem leggja áherslu á að virða lífríkið. Ef gestir eru hluti af stærri hópum, væri þátttaka leiðsögumanna í fræðslu um mikilvægi fuglalífsins mjög gagnleg, en einnig er hægt að kanna fleiri leiðir til að miðla upplýsingum, svosem með fjölbreyttari miðlunaraðferðir.
- Aðskilja friðland með takmörkuðum aðgangi manna á mikilvægum tímabilum, eins og fyrstu daganna eftir klak eggja þegar ungar eru hvað viðkvæmastir og fastsetja áhrifasvæði í kring um lykil varp og fæðusvæði fugla til að lágmarka truflun manna. Þessi svæði ættu að vera greinilega merkt og eftirlit með því að aðgangur verði óheimilaður.
- Vakta núverandi afránsþrýsting og aðlaga vöktun og aðgerðir eftir því til að draga úr aðdráttarafli rándýra, sérstaklega á viðkvæmar tegundir á varptíma. Aðgerðir geta t.d. verið rétt meðferð á úrgangi, fjarlægja allt rusl á svæðinu og markvisst halda rándýrum í skefjum (t.d. mink).
- Gera öryggisráðstafanir í kring um aðkomuveg, með því að setja upp merki, hraðahindranir og lækka hraðatakmarkanir á vegum sem leiða að baðstaðnum til að draga úr hættu á árekstrum á fugla, sérstaklega á varptíma þegar fuglar eru virkari nálægt vegum. Þessar aðgerðir gætu verið tímabundnar og fjarlægðar yfir vetrarmánuðina.
- Finna aðferðir til að leiða æðarfugla með unga í kring um baðstaðinn ofan í fjöru, þannig þeir leiti ekki á veginn, bílastæðið, slóða og þak baðstaðarins.
- Lagt er til langtímavöktun til að fylgjast með áhrifum framkvæmdarinnar á staðbundna fuglastofna og gæti falið í sér reglulegar athuganir, eftirlit með hreiðrum og söfnun gagna um varpárangur. Upplýsingarnar gætu verið mikilvægar til að bæta skilning á áhrifum framkvæmdarinnar og gætu verið notaðar til að aðlaga mótvægisaðgerðir.
- Bæta stöðu þekkingar á áhrifum framkvæmdir líkt og þessi geta haft á fuglalíf með því að innleiða mótvægisaðgerðirnar sem lýst er hér að ofan.

Þó að mælt sé með mótvægisaðgerðum til að draga úr áhrifum að þá bendir til að fyrirhugaðar framkvæmdir valdi beinum, óbeinum, varanlegum en árstíðabundnum áhrifum á fuglalíf svæðisins og er ekki líklegt að mótvægisaðgerðir geti fullkomlega vegið upp á móti vistfræðilegum afleiðingum sem baðstaðurinn og umhverfi hans getur haft á svæðið, og þá sérstaklega á válistategundir og þær sem verpa innan rasksvæðis.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. PURPOSE

Náttúrustofa Vestfjarða (NAVE) was commissioned by Hvítisandur ehf. to assess the impact of the proposed Hvítisandur bathing facility in Önundarfjörður on local birdlife. This report investigates the diversity and abundance of breeding birds in the area, evaluates potential impacts on sensitive species, and provides recommendations to mitigate some of the potential negative effects.

The construction of Hvítisandur is planned on the land of Þórustaðir and is adjacent to the lands of Holt and Innri-Hjarðardalur (Figure 1). The plan includes a building on the shore with external baths, a pier extending into the sea, a parking lot, and access paths. The construction area consists of sparsely vegetated zones, taller grasses, and partially vegetated sand dunes. Surrounding areas include mowed fields, coastal ecosystems, and additional sand dunes. The area where the main baths building is proposed was formerly used at times for sand extraction. A disused runway, now overgrown with sparse vegetation and moss, is also present in the project footprint (see report NV nr. 6-25, Hulda B. Albertsdóttir, 2025, for detailed vegetation information). These open habitats are preferred by several ground-nesting bird species for breeding, including Eurasian whimbrels (*Numenius phaeopus*), Eurasian oystercatchers (*Haematopus ostralegus*), Arctic terns (*Sterna paradisaea*), common ringed plovers (*Charadrius hiaticula*), and European golden plovers (*Pluvialis apricaria*). The landscape also features small waterbodies, streams, and drainage ditches, which are ideal habitats for various waterfowl, gulls, divers, and small waders such as the red-necked phalarope (*Phalaropus lobatus*). Common eiders (*Somateria mollissima*) are known to nest within these diverse habitats.

Figure 1. *Aerial depiction of the proposed development. Image: Hvítisandur ehf., 2024.*

The following report begins with a review of literature about the known impacts of disturbance on birdlife. Special attention was given to the common eider throughout the report, as concerns were raised regarding the effects on breeding colonies adjacent to the development site which are used for down collection. Information about the surveys conducted by NAVE and their findings is presented in the Methods and Results sections. The foreseen impacts on the local birdlife are reviewed in the Discussion. Finally, recommendations to minimise some of the impacts if the facility is built are suggested.

2. INTRODUCTION & BACKGROUND

2.1 Known impacts of disturbance on birdlife

Human activities, such as recreation, alterations of habitats, and infrastructure development, have profound effects on bird populations. Human disturbance arises simply from the presence of people in an environment and represents a widespread, yet often overlooked, form of disruption. While it may seem less obvious compared to more overtly destructive activities (e.g., habitat removal), the presence of humans can lead to subtle, gradual, and cumulative impacts over time (Price, 2008; Beale, 2004). Birds often respond to human disturbance by moving away, altering their behaviour, or abandoning habitats, which can negatively impact feeding, breeding, survival, and overall population dynamics (Burger & Gochfeld, 1998; Fernández-Juricic & Tellería, 2000; Finney et al., 2005; Gill, 2007; Borgmann, n.d.; Beale, 2004; Price, 2008). Disturbances can provoke a range of responses, including increased vigilance, elevated stress hormone levels, and anti-predator escape behaviours (Bötsch et al., 2017; Gill, 2007). The severity of these responses depends on factors such as species-specific traits, the type and intensity of human activity, environmental conditions, and the timing of disturbance relative to critical life stages (Bötsch et al., 2017; Price, 2008; Tablado & Jenni, 2015).

Effects on breeding success

Breeding success is particularly vulnerable to human disturbance. Nesting birds may abandon their nests or choose not to nest at all if disturbed during early stages of the breeding cycle (Korschgen & Dahlgren, 1992). Flushing incubating birds from their nests can expose eggs to the elements and increase embryo mortality, while unattended nests are more susceptible to predation (Korschgen & Dahlgren, 1992). Disturbances during the brood-rearing season can be detrimental to the survival of young, as human activities may cause broods to scatter or frighten parents into fleeing, leaving young vulnerable to predators, harsh weather, or starvation (Korschgen & Dahlgren, 1992). Frequent disturbances can also lead to chronic stress, compromising immune function and overall fitness (West et al., 2002). For instance, in gulls, human disturbance has been linked to lower breeding success, including increased nest failure, chick mortality, and reduced nest density (Robert & Ralph, 1975; Burger, 1981; Burger & Gochfeld, 1983; Price & Lill, 2011). In Iceland, it has been shown that even at low densities, anthropogenic structures in natural and semi-natural environments have a negative impact on densities of ground nesting birds (Palsdottir et al., 2024; Pálsdóttir et al,, 2022). Reijnen et al. (1996) found that disturbance from road traffic reduced breeding densities of various birds more than 1,000 metres from the road and especially affected black-tailed godwits and Eurasian oystercatchers (Reijnen et al., 1996). Holm & Laurson (2009) found that even low-level pedestrian activity reduced breeding densities of black-tailed godwits within 500 metres (Holm & Laursen, 2009). Changes may happen gradually and over a generational scale (Verhoeven et al., 2018; Gill et al., 2019; Gunnarsson et al., 2024). Many bird species (e.g., oystercatchers, black-headed gulls, common eiders, etc.) exhibit strong territorial fidelity or natal philopatry, returning to the same breeding sites year after year (van de Pol et al., 2014; Piro & Ornés, 2021; Ekroos et al., 2012). However, if these sites become degraded or disturbed, these species may experience reduced breeding outcomes over multiple seasons, as they continue to breed in suboptimal habitats (Merkle et al., 2022).

Habitat avoidance and disruption of foraging behaviour

Human disturbance frequently disrupts feeding behaviours. For example, waterfowl may be displaced from preferred feeding grounds due to human activities, increasing their energetic costs and reducing their ability to forage effectively (Korschgen & Dahlgren, 1992). Similarly, Arctic terns exposed to human presence have been observed to reduce their chick provisioning rates, compromising the survival of their young (Bogdanova et al., 2014). Brant geese in Great Britain spent significantly more time in flight and less time feeding when disturbed, with weekend recreation causing flight time to increase sevenfold (Korschgen & Dahlgren, 1992). In another example, pink-footed geese were disturbed at distances of up to 500 metres by road traffic, with as few as 10 cars per day discouraging habitat use (Korschgen & Dahlgren, 1992). Burton et al. (2002a) found lower densities of various waders utilising intertidal areas near footpaths and roads. Similarly, construction related activities were found to reduce densities and feeding activities of various species utilising the intertidal area (Burton et al., 2002b).

2.2 Impacts of disturbance on common eiders

Elevated predation risk

While human presence itself can act as a deterrent to some less bold predators (Murray, 2018), most studies indicate that common eider colonies experiencing frequent human disturbance exhibit lower breeding success compared to those with minimal disturbance (Stein & Ims, 2015). This is often due to the well documented link between human disturbance and predation (Åhlund & Götmark, 1989; Bolduc & Guillemette, 2003; Donehower & Bird, 2008; Tomlik, 2019).

Nest departures caused by human activity significantly increase the risk of egg predation, unlike natural recesses, which do not carry the same risk. When disturbed, female eiders fleeing from their nests often provide visual and auditory cues that predators can use to locate nests (Stein & Ims, 2015). Eiders are especially sensitive to disturbance during the early stages of incubation (Bédard et al., 2008; Bolduc & Guillemette, 2003). During this time, males are also present (Schamel, 1977; Goudie et al., 2000; Robertson, 2008), and disturbances can trigger a chain reaction—the flushing of a single male often causes neighbouring males and females to flee as well, making multiple nests vulnerable at the same time (Murray, 2018).

Shortly after hatching, females lead their broods away from nesting areas, undertaking a vulnerable journey across exposed terrain to reach water. During this transition, ducklings are highly susceptible to predators such as large gulls (Minot, 1980; Brooker-Carey et al., 2023). Even in undisturbed areas, gulls are a major source of duckling mortality (Mendenhall & Milne, 1985; Dwernychuk & Boag, 1972; Donehower & Bird, 2008; Tomlik, 2019), with ducklings being most vulnerable in the first 10 days after hatching (Ahlén & Andersson, 1970). While broods may eventually swim up to 20 kilometres along coastlines to reach favourable foraging habitats (Blinn et al., 2008), they initially concentrate near the nesting area before moving further (Diéval et al., 2011). Human disturbances during this period, including recreational activities, shoreline traffic, or coastal development, can increase likeliness of predation through scattering broods, prompting abandonment, and delaying movement of the broods to safer rearing habitats (Åhlund & Götmark, 1989; Keller, 1991; Brooker-Carey et al., 2023).

Site fidelity & ecological traps

Common eiders have high adult survival rates and a long life-expectancy, with some individuals living up to 21 years (Coulson, 1984; Krementz et al., 1996). Females exhibit strong natal philopatry and breeding site fidelity, often returning to the same nesting area where they were born and continuing to breed there in subsequent years (Goudie et al., 2000; Öst et al., 2011; Ekroos et al., 2012; Swennen, 1990; Tiedemann et al., 1999). Strong site fidelity makes common eiders susceptible to ecological traps, as they may continue to return to previously successful nesting sites even after present conditions have deteriorated (Robertson & Hutto, 2006; Igual et al., 2007; Ekroos et al., 2012). Ekroos et al. (2012) found that eiders subjected to high predation pressure from a recovering eagle population did not relocate, leading to significantly low duckling survival rates and contributing to population decline. This reluctance to abandon historically successful sites, despite changing environmental conditions, underscores the challenges eiders face in adapting to rapidly changing pressures.

Breeding eiders may adjust their reproductive strategies in response to increased stress—whether real or perceived—by altering nesting timing, reducing clutch size, or abandoning eggs altogether (Hanssen et al., 2003; Travers et al., 2010; Zanette et al., 2011; Tomlik, 2019; Abbey-Lee & Dingemanse, 2019; Öst et al., 2022; Brooker-Carey et al., 2023). For example, Chaulk et al. (2007) observed delayed nest initiation in the presence of mammalian predators on nesting islands. In the cases where females did relocate from previous nest sites due to breeding failure, Öst et al. (2011) found that these females spent more time prospecting for safer nesting sites—delayed breeding is generally associated with poorer outcomes (Öst et al., 2011; Öst & Steele, 2010).

Recruitment to maintain populations

Eiders exhibit low overall fledgling production (Swennen, 1983, 1991; Åhlund & Götmark, 1989; Allen et al., 2008), although as populations can persist due to long lifespan, high adult survival, and occasional adult immigration (Coulson, 1984), changes may take years to become evident. Recruitment into colonies relies heavily on returning offspring, which only begin breeding at 2-3 years old (Hario & Rintala, 2009), and correlates strongly with periods of high duckling survival (Skene, 2013; Jonsson et al., 2013). In poor conditions, adults may skip breeding altogether

(Coulson, 1984; Tomlik, 2019), reducing future recruitment. This reliance on variable duckling survival renders eider colonies vulnerable to environmental changes (Bédard et al., 2008; Skene, 2013).

3. METHODS

3.1 Breeding bird survey

The area surrounding the development was surveyed over four days to identify breeding bird species and estimate the number of breeding pairs. The dates and details of the visits are listed in Table 1. The surveyed areas—Þórustaðir, Innri-Hjarðardalur, and Holt—are depicted in Figure 2. The areas were systematically walked to cover their extent within 1,000 metres of the proposed development, and in some instances beyond. At the property of Holt, the survey extended to the full property boundaries, exceeding 1,000 metres, as the habitat was treated as a continuous whole. Within the report, emphasis is put on species within 1,000 metres, but species found in Holt beyond this distance are also noted. In Holt, some sections were surveyed from a vehicle due to existing tracks providing a good overview. Farmland pastures west of the road (Valþjófsdalsvegur) were observed from a vehicle up to approximately 200 metres.

Table 1. *Details of field visits for the collection of data on breeding birds.*

Date	Time	Main area covered	Observers
May 13, 2024	13:00-14:00	Þórustaðir	CG, IB
June 5, 2024	12:00-16:00	Þórustaðir & Holt	CG, IB
June 13, 2024	13:00-17:00	Innri-Hjarðardalur & Þórustaðir	CG, IB
June 14, 2024	09:00-13:00	Holt	CG, IB

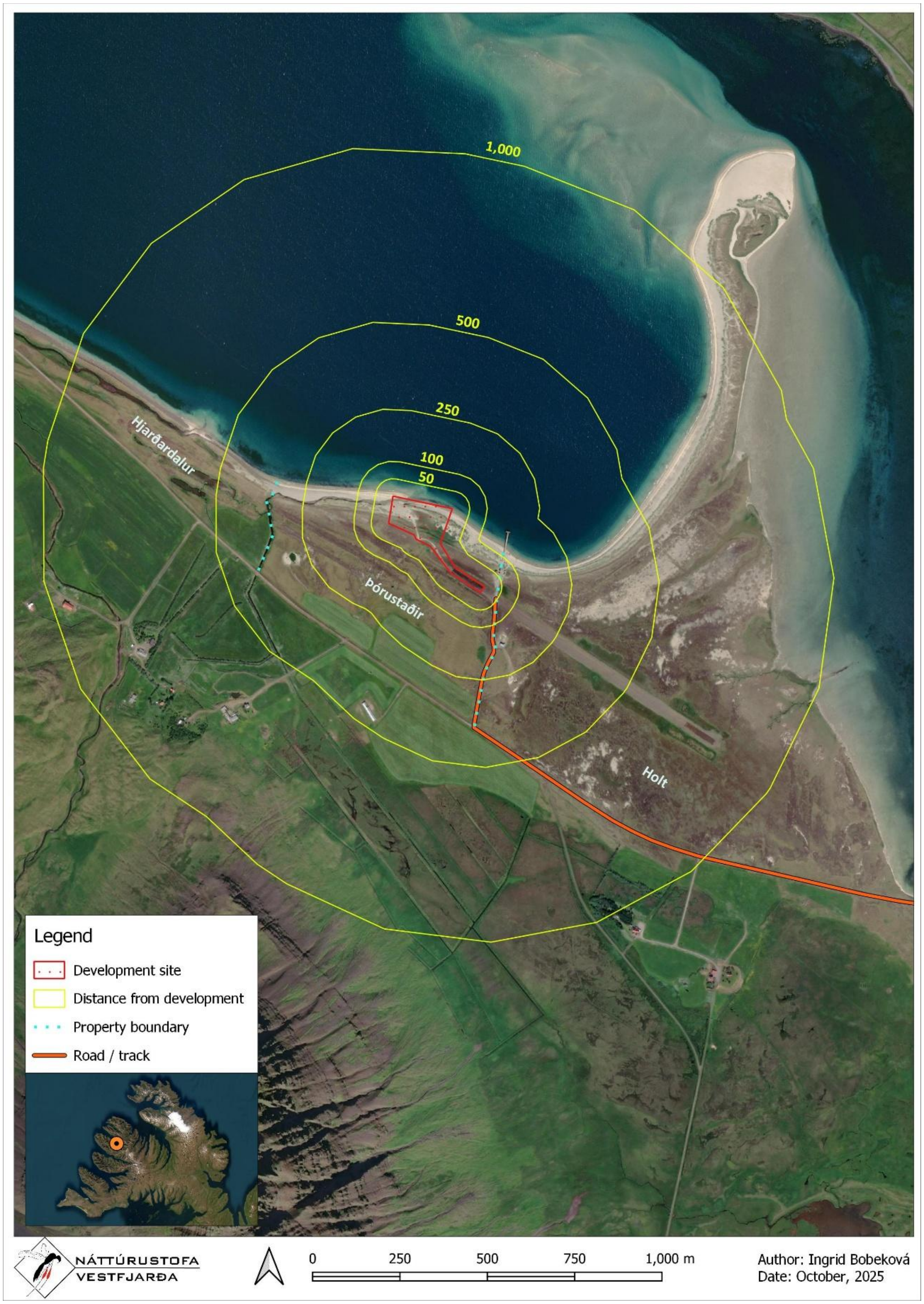

Figure 2. *The proposed development area (in red polygon) and distance delineations placed at 50, 100, 250, 500, and 1,000 metres from its extents. Property boundaries between Innri-Hjarðardalur, Þórustaðir, and Holt are identified with dashed lines, and the existing road accessing the area is shown in red.*

All birds present were counted, and breeding pairs were estimated based on behaviour and territory usage or confirmed by locating nests or young. Distances of the birds from the development were categorised as follows: 0 metres (within the development area), 1-50 metres, 51-100 metres, 101-250 metres, 251-500 metres, 501-1,000 metres, and >1,000 metres.

Information about common eider breeding colony sizes in Innri-Hjarðardalur, Holt, and Þórustaðir was obtained from the eiderdown collectors. Breeding eiders in the colony in Þórustaðir were additionally counted alongside other species during the visits mentioned in Table 1.

3.2 Shore census

A spotting scope (20-60x) was used from a distance to observe shore utilisation by common eiders. The shore of Þórustaðir and the adjacent area of Innri-Hjarðardalur were the focus of this data collection (Figure 3). A total of 7 separate observations were made between April 14 and July 2, 2024. The beach was divided into segments along property boundaries, landscape features, and in line with the proposed development.

Figure 3. *Sections of the shore in front of Þórustaðir and Innri-Hjarðardalur surveyed for the presence of common eiders. The proposed development is outlined in the red polygon.*

3.3 Acquisition of additional data

Due to ongoing research in Holt, detailed information on Eurasian whimbrels (Rannsóknasetur HÍ á Suðurlandi, unpublished dataset, 2021-2024), Arctic terns (Náttúrustofa Vestfjarða, unpublished dataset, 2021-2024; Gallo et al., 2023; Gallo & Sigurðardóttir, 2022), Eurasian oystercatchers (Rannsóknasetur HÍ á Suðurlandi & Bobeková, unpublished dataset, 2014-2024), common ringed plovers (Þórisson, 2013), as well as some other species was available. This data was used to cross-check breeding pair estimates for these species.

3.4 Assessing expected disturbance impacts

In 2022, NatureScot (Goodship & Furness, 2022) published a comprehensive review of disturbance distances for various bird species, synthesising available literature to assess sensitivity to human disturbance. NatureScot categorised the sensitivity of each species based on maximum recorded Alert Distance (AD) and Flight Initiation Distance (FID) values:

High sensitivity: Maximum AD/FID > 500 metres
Medium sensitivity: Maximum AD/FID between 50 and 500 metres
Low sensitivity: Maximum AD/FID < 50 metres

Based on their review, NatureScot suggested setback distances to mitigate disturbance during both breeding and non-breeding seasons. As there is no such information for Iceland, this review, which remains one of the most extensive to date, was used to evaluate the distance at which impacts of the proposed development could be felt on bird species present at the site. Distances were measured from the direct area of development (red polygon in Figure 2). For species which were not listed in this review, other literature was referred to where available.

4. RESULTS

4.1 Breeding bird survey

Twenty-three bird species were recorded in the vicinity of the development site. A full list of species and their breeding pair counts, recorded within a >1,000-metre radius of the development site, is provided in Table 2. An alternative table organising the data by species is available in the Appendix (Table 8). A list of species with their English, Icelandic, and scientific names is in Table 7 in the Appendix, along with their status on the Icelandic Red List. The following text summarises numbers which are within 1,000 metres, however birds observed in Holt over 1,000 metres from the development are also included in the table for reference.

Aside from common eiders, which are discussed in detail in section **4.2**, two colonially nesting birds were found in high abundance: black-headed gulls (813 breeding pairs; Figure 4) and Arctic terns (275 breeding pairs). Additional data from previous years (2020-2024) indicates that the Arctic tern colony has naturally fluctuated between approximately 300-500 pairs (Gallo & Sigurðardóttir, 2022; Náttúrustofa Vestfjarða, unpublished dataset, 2020-2024; Gallo et al., 2023). Prominent wader species, which typically breed less densely due to large territory requirements, were also observed, including Eurasian whimbrels (29 pairs), Eurasian oystercatchers (14 pairs), and common ringed plovers (20 pairs). Among waterfowl, the greylag goose was the most prominent, with 13 breeding pairs identified within 1,000 metres of the development.

Table 2. *Abundance of breeding pairs of birds observed at set distance intervals from the proposed development.*

Distance from development	Species	Breeding pairs
0 m (inside)	Black-headed gull	98
	Eurasian whimbrel	1
1-50 m	Black-headed gull	224
	Common ringed plover	1
	Eurasian whimbrel	1
	Eurasian teal	1
	European golden plover	1
	Greylag goose	2
	Mallard	1
	Redwing	1
	White wagtail	1
51-100 m	Arctic tern	11
	Black-headed gull	7
	Common ringed plover	1
	Eurasian whimbrel	2
101-250 m	Arctic tern	32
	Black-headed gull	48
	Common redshank	1
	Common ringed plover	3
	Eurasian oystercatcher	1
	Eurasian whimbrel	2
	Greylag goose	1
251-500 m	Arctic tern	127
	Black-headed gull	406
	Black-tailed godwit	1
	Common redshank	6
	Common snipe	2
	Eurasian oystercatcher	3
	Eurasian teal	1
	Eurasian whimbrel	7
	European golden plover	1
	Greylag goose	4
	Mallard	1
	Red-necked phalarope	2

	Red-throated loon	3
501-1,000 m	Arctic tern	105
	Black-headed gull	30
	Black-tailed godwit	2
	Common redshank	6
	Common ringed plover	15
	Common snipe	3
	Dunlin	3
	Eurasian oystercatcher	10
	Eurasian teal	1
	Eurasian whimbrel	16
	Eurasian wigeon	1
	European golden plover	6
	Greylag goose	6
	Mallard	3
	Red-necked phalarope	6
	Red-throated loon	3
	Tufted duck	1
>1,000 m	Black-headed gull	2
	Eurasian oystercatcher	3
	Eurasian whimbrel	4
	European herring gull	1
	Great black-backed gull	6
	Greylag goose	1

Additionally, in several cases birds were observed which could not be assumed or confirmed as breeding in the area, or their breeding area was unknown - these could have been individuals that were foraging or otherwise utilising the habitat, non-breeders, or mates of confirmed breeding birds utilising feeding areas away from their nesting territories. These sightings of individuals are listed in Table 3. An alternative presentation of the table listed by species is presented in the Appendix (Table 9).

Table 3. Abundance of individuals of unknown breeding status observed at set distance intervals from the proposed development.

Distance from development	Species	Unknown breeding status (individuals)
	Common snipe	1
	Great black-backed gull	1
	Greylag goose	22
	Red-necked phalarope	2
501-1,000 m	Black-tailed godwit	16
	Common redshank	25
	Common ringed plover	11
	Dunlin	13
	Eurasian oystercatcher	4
	Great black-backed gull	1
	Greylag goose	2
	Red-breasted merganser	2
	Red-necked phalarope	6
	Tufted duck	3
>1,000 m	European herring gull	3
	Great black-backed gull	10

Figure 4. *Black-headed gulls disturbed from their nests in the vicinity of the proposed development. Photo: Bobeková, 2024, Þórustaðir.*

4.2 Common eider breeding pairs

Common eider breeding pairs in Þórustaðir were surveyed by NAVE, with 260 nesting eiders counted (Table 5). However, the survey, which aimed to survey other birds that naturally breed later in the season, was conducted after some eider nests had already become empty, likely resulting in an underestimation. Þórustaðir is estimated to host approximately 400 pairs based on down collection (Björn Björnsson, personal communication, March 13, 2025). Most of the eiders nested within 101-250 metres of the proposed development site (Table 4).

Innri-Hjarðardalur hosted 1,618 breeding eider pairs in 2024 (Björgvin Sveinsson & Sólveig Bessa Magnusdóttir, personal communication, June 13, 2024), while Holt had approximately 560 pairs (Halla Signý Kristjánsdóttir, personal communication, February 12, 2025; Table 4). Counts from previous years are also included in the table. These numbers are also consistent with the 2017 study (Murray, 2018). Eiders in Innri-Hjarðardalur are located starting approximately 350 metres from the development, and in Holt from 120 metres.

Table 4. Common eider colony sizes if Innri-Hjarðardalur, Þórustaðir, and Holt.

Area	Total eider pairs (2024)	Distance from development	Comments
Innri-Hjarðardalur Æðarvarpsvæði	1,618	From approx. 350 m and beyond from the site of proposed development.	Numbers provided by landowners. Previous years: 1,217 (2023); 1,436 (2022); and 1,400 (2021) nests.
Þórustaðir	260* ~400	Between 0 and 390 m from site of proposed development. Highest concentration between 101-250 m.	Counted by NAVE. *Note that nests were counted late in breeding season. Number estimated by landowner: ~400 nests.
Holt Æðarvarpsvæði	560	Form approx. 120 m and beyond from the proposed development.	Number provided by landowners; Previous years: ~500 nests.

Table 5. Abundance of common eider nests observed in Þórustaðir at set distance intervals from the proposed development.

Species	Distance from development	Breeding pairs
Common eider	0 m (inside)	1
	1-50 m	35
	51-100 m	27
	101-250 m	134
	251-500 m	63
	total	***260***

4.3 Shore habitat used by eider ducks

Common eiders were observed on the shore between Holtsbryggja and Innri-Hjarðardalur during the pre-incubating, incubating, and post-hatching periods. Table 6 includes the counts, and sections in which they were observed are outlined in Figure 3. Usage of this habitat outside of the breeding season was not assessed, and thus further study is needed to understand the importance of this habitat during those times.

Table 6. *Common eiders observed utilising the shore between Holtsbryggja and Innri-Hjarðardalur. Sections in which they were observed are outlined Figure 3.*

Date	Area	Section	Observed eiders
14 April, 2024	Þórustaðir	1,2	12 (9 ♀ + 3 ♂)
	Innri-Hjarðardalur	4,5	30 in water
	Innri-Hjarðardalur	5	39 (18 ♀ + 21 ♂)
25 April, 2024	Þórustaðir	3	27 (17 ♀ + 10 ♂)
	Innri-Hjarðardalur	4	100 (♀ = ♂) + 30 in water
13 May, 2024	Þórustaðir	1,2,3	17 (♀)
	Þórustaðir	2	11 (2 ♀ + 9 ♂)
	Þórustaðir	3	21 (♀)
	Innri-Hjarðardalur	4	47 (♀)
	Innri-Hjarðardalur	5	42 (♀)
16 May, 2024	Þórustaðir	3	10 (♀)
	Innri-Hjarðardalur	4	22 (♀)
	Innri-Hjarðardalur	5	55 (♀)
21 May, 2024	Þórustaðir	1,2	15 (4 ♀ + 11 ♂)
	Þórustaðir	3	31 (9 ♀ + 22 ♂)
	Þórustaðir	3	1 (♂)
	Þórustaðir + Innri-Hjarðardalur	3,4	11 (4 ♀ + 7 ♂)
	Innri-Hjarðardalur	4	34 (13 ♀ + 21 ♂)
05 June, 2024	Þórustaðir	3	15 (♀) + young
	Innri-Hjarðardalur	4	11 (♀)
02 July, 2024	Innri-Hjarðardalur	4	16 (14 ♀ +2 ♂) + 7 young

4.4 Red List species

Of the twenty-three species identified within 1,000 metres of the development, fourteen have a status higher than Least Concern on the 2025 Icelandic Red List. Additionally, two species were identified outside of 1,000 metres in the northern spit of Holt, both of which are Red Listed. Refer to Appendix Table 7 for details (Náttúrufræðistofnun Íslands, 2025); and Tables 2, 3 and 5 for a breakdown of numbers of pairs and individuals sighted at each distance category.

Six observed species are listed as **Vulnerable (VU)**: Arctic tern, common redshank, dunlin, Eurasian oystercatcher, Eurasian whimbrel, and European golden plover. Three of these species are found breeding in high densities: Eurasian oystercatchers (14 pairs, with 3 additional beyond 1,000 metres) and Arctic terns (275 pairs) were primarily found on the Holt side, starting approximately 1-50 metres and 101-250 metres from the development, respectively, and whimbrels (29 pairs, with 4 additional beyond 1,000 metres) were found breeding at all distances, with majority found between 251-1,000 metres. Of the other species, the common redshank (13 pairs) was found breeding between 101-1,000 metres, with most between 251-1,000 metres; the dunlin (3 pairs) was found breeding between 501-1,000 metres; and the European golden plover (8 pairs) was found breeding between 1-1,000 metres, with most between 501-1,000 metres from the development.

Nine species are listed as **Near Threatened (NT)**: Black-tailed godwit, common eider, Eurasian teal, Eurasian wigeon, European herring gull, greylag goose, red-breasted merganser, red-necked phalarope, and tufted duck. Black-tailed godwits (3 pairs) were found breeding between 251-1,000 metres from the development. Common eiders (at minimum 2,438 pairs) were found in high density across all areas and at all distances from the development. Eurasian teal (3 pairs) and Eurasian wigeon (1 pair) were found breeding between 1-1,000 metres, and 501-1,000 metres, respectively. The European herring gull (1 pair) was only observed nesting on the northern spit of Holt, beyond 1,000 metres from the development. Greylag goose (13 pairs with 1 additional beyond 1,000 metres) was observed breeding at most distances from the development. The red-breasted merganser (2 individuals) was observed between 501-1,000 metres, however, was not confirmed where or if it was breeding, and the red-necked phalarope (14 pairs) was observed breeding 251-1,000 metres from the development. The tufted duck (1 pair) was observed breeding between 501-1,000 metres from the development.

The remaining seven species are listed as **Least Concern (LC)**: Black-headed gull, common ringed plover, common snipe, mallard, red-throated loon, redwing, and white wagtail. Additionally, in the extended survey beyond 1,000 metres in Holt, one additional species is listed as **Critically Endangered (CR)**: great black-backed gull, found breeding on the northern spit of Holt over 1,000 metres from the development.

5. DISCUSSION

5.1 Disturbance distances

To understand which and how many birds observed in the area are likely to experience impacts from the construction and operation of Hvítisandur, the publication "*Disturbance Distances Review: An updated literature review of disturbance distances of selected bird species.*" by NatureScot (Goodship & Furness, 2022) was used as a guide. This review synthesises available literature to inform on disturbance distances of various species and is the most comprehensive resource on this matter to date. For species which were not listed in this review, other literature was referred to where available. The following list describes the disturbance sensitivity and proposed setback distances during the breeding season for the species (in alphabetical order) which were counted in the survey area. Their abundances at different distances can be referred to in Tables 2 and 4.

Arctic tern (VU): The Arctic tern exhibits medium sensitivity to human disturbance during the breeding season, with a recommended buffer zone of 200 metres to protect nesting colonies, with larger buffers potentially required in areas with low habituation to humans (Goodship & Furness, 2022). The majority of nesting Arctic terns occur beyond 251 metres, however, approximately 43 of observed pairs fall within 200 metres from the development. Arctic terns have also been observed resting on the beach along Holt and outside Þórustaðir during both the pre-breeding and late breeding seasons.

Black-headed gull: There are no disturbance sensitivity and recommended setback distances for black-headed gulls currently published by NatureScot. However, studies showed that during the breeding season, pedestrian traffic at a site with unknown habituation levels resulted in a mean FID of 41 metres (Goodship & Furness, 2019). The current location of the facility is located within and surrounded by a black-headed gull nesting colony. The development will lead to the direct removal of nesting habitat for approximately 98 pairs, and thus that part of the colony will be displaced. Furthermore, large parts of the colony will be directly adjacent to the development (between 1-50 metres), accounting for approximately 224 additional pairs. It is not understood what will happen to the displaced pairs – whether they will relocate in the immediate vicinity or farther away from the development.

Black-tailed godwit (NT): The black-tailed godwit is considered to have medium sensitivity to human disturbance, particularly during the breeding season. A buffer zone of 100-200 metres is recommended to protect both breeding and non-breeding populations from pedestrian disturbance (Goodship & Furness, 2022). Black-tailed godwits were only found breeding 251 metres from the development and beyond.

Common eider (NT): The common eider is assessed as having medium to high sensitivity to human disturbance. This species may be affected on breeding, foraging, and roosting grounds. A buffer zone of 100-200 metres is recommended to protect nesting eiders (Goodship & Furness, 2022). Approximately 185 of observed pairs* of Þórustaðir fall within 200 metres 63 pairs* fall within 100 metres from the development, and 1 pair* falls within project footprint. **Likely underestimated due to timing of count.*

Common redshank (VU): The common redshank is considered to have medium sensitivity to human disturbance, with lower tolerance at roost sites. Buffer zones of 100-200 metres are suggested for nesting birds (Goodship & Furness, 2022). The closest breeding redshanks were found 101-250 metres from the development, with the majority occurring beyond 251 metres. Approximately 1 of observed pairs falls within 200 metres from the development.

Common ringed plover: The common ringed plover is highly sensitive to human disturbance, with potential impacts on breeding, foraging, and roosting grounds. Buffer zones of 100-200 metres are recommended for nesting birds (Goodship & Furness, 2022). An individual was observed breeding within 50 metres of the development, with the majority occurring beyond 501 metres. Approximately 5 of observed pairs fall within 200 metres from the development, with 2 pairs falling within 100 metres.

Common snipe: There are currently no disturbance sensitivity and setback distances during the breeding season published for this species by NatureScot. Common snipe was found breeding 251 metres and beyond from the development.

Dunlin (VU): The dunlin is assessed as having medium sensitivity to human disturbance. Buffer zones of 100-200 metres are recommended for nesting birds (Goodship & Furness, 2022). Dunlin were only found breeding 501 metres from the development and beyond.

Eurasian oystercatcher (VU): The Eurasian oystercatcher exhibits medium sensitivity to human disturbance. Buffer zones of 50-100 metres are recommended for nesting birds (Goodship & Furness, 2022). The majority of Eurasian oystercatchers were found breeding between 501-1,000 metres from the development. Only one of the observed pairs were breeding at approximately 100 metres from the development.

Eurasian teal (NT): There are currently no disturbance sensitivity and setback distances during the breeding season published for this species by NatureScot. Eurasian teal was found nesting less than 50 metres from the development, as well as at 251 metres and beyond.

Eurasian whimbrel (VU): The Eurasian whimbrel is assessed as having medium sensitivity to human disturbance, with potential impacts on breeding, foraging, and roosting grounds. While no specific buffer zones have been published by NatureScot for whimbrels, a minimum buffer of 100-300 metres is suggested based on studies of similar wader species (Goodship & Furness, 2022). Eurasian whimbrels were found breeding at all distances from the development, including within as well as directly adjacent to the site. Approximately 8 of observed pairs fall within 300 metres from the development, of which with 4 pairs fall within 100 metres, and 1 within the project footprint.

Eurasian wigeon (NT): The Eurasian wigeon is highly sensitive to human disturbance, particularly on roosting and foraging grounds during the non-breeding season. Buffer zones of 100-200 metres are recommended for nesting birds (Goodship & Furness, 2022). Eurasian wigeon was found breeding only over 501 metres from the development.

European golden plover (VU): The European golden plover is assessed as having medium sensitivity to human disturbance. Setback distances of 200-500 metres are recommended for both breeding and non-breeding birds (Goodship & Furness, 2022). European golden plover was found breeding less than 50 metres from the development, as well as between 250-500 metres. Many of the breeding pairs occurred between 500-1,000 metres. Approximately 2 of observed pairs fall within 500 metres from the development and 1 within 200 metres of the development.

European herring gull (NT): There are no current disturbance sensitivity and recommended distance setbacks published for this species during the breeding season by NatureScot. Foraging disturbance distances are assessed to be low (Goodship & Furness, 2019). European herring gulls were found nesting only over 1,000 metres from the development, on the northern spit of Holt.

Great black-backed gull (CR): There are no current disturbance sensitivity and setback distances during the breeding season specified for this species by NatureScot. Foraging disturbance sensitivity was assessed to be low (Goodship & Furness, 2019). A colony of nesting great black-backed gulls was found only over 1,000 metres from the development, on the northern spit of Holt.

Greylag goose (NT): The greylag goose exhibits medium sensitivity to human disturbance. While no specific setback distances have been published for this species, a minimum distance of 200-600 metres is suggested based on studies of similar goose species to protect both breeding and non-breeding populations (Goodship & Furness, 2022). Greylag geese were found nesting within 50 metres of the development and beyond, with the majority occurring between 251-1,000 metres. Approximately 7 of observed pairs fall within 600 metres from the development, with approximately 3 pairs falling between 200 metres.

Mallard: The mallard is assessed as having low to medium sensitivity to human disturbance. Setback distances of 50-100 metres are recommended for nesting birds (Goodship & Furness, 2022). 1 mallard pair was found breeding within 50 metres of the development; however, most were at further locations (251 metres and beyond).

Red-breasted merganser (NT): There are currently no disturbance sensitivity and setback distances during the breeding season published for this species by NatureScot (2022), however earlier reviews suggest that red-breasted mergansers might have medium sensitivity to shoreline disturbance (Goodship and Furness, 2019). Two individuals were observed between 501-1,000 metres from the development; however, it was not confirmed if or where they were breeding.

Red-necked phalarope (NT): The red-necked phalarope is considered to have low sensitivity to human disturbance. There are a lack of disturbance studies recording AD/FID values for red-necked phalarope. However, non-quantitative studies indicate that setback distance required to protect red-necked phalarope during the breeding season may be lower than those required for other waders. A setback distance of up to 50 metres is suggested to protect breeding birds (Goodship & Furness, 2022). Red-necked phalaropes were only found breeding 251 metres from the development, with the majority occurring beyond 501 metres.

Red-throated Loon: The red-throated loon is highly sensitive to human disturbance, particularly on breeding grounds. A buffer zone of 500-750 metres is recommended to protect breeding birds, with larger buffers of up to 900 metres advised for activities with high visual and auditory disturbance potential such as construction activities (Ruddock & Whitfield, 2007; Goodship & Furness, 2022). Red-throated loons were found breeding 251 metres from the development and beyond. Approximately 5 of observed pairs fall within 750 metres from the development, with 3 pairs within 500 metres, and 6 pairs within 900 metres.

Redwing: Sensitivity and setback distances during the breeding season are not currently published for this species by NatureScot. However, Whitfield et al.'s (2008) synthesis found that during the incubation period for this species, the AD is 50-300 metres and FID is 10-150 metres, while during chick rearing, the AD is 50-300 metres and FID is 100-150 metres. One redwing was found breeding within 50 metres of the development, thus falling within the disturbance area.

Tufted duck (NT): There are currently no disturbance sensitivity and setback distances during the breeding season published for this species by NatureScot. The tufted duck was found to be breeding between 501-1,000 metres from the development.

White wagtail: There are currently no disturbance sensitivity and setback distances during the breeding season published for this species by NatureScot. White wagtail was found to be breeding within 50 metres of the development.

It must be emphasised that distances from the *direct site of development* (See red polygon in Figure 2) were used to determine if a species falls within the disturbance area as per NatureScot's recommendations. Additional areas of indirect disturbances were not assessed; for instance, along the existing main road which will ultimately be used to access Hvítisandur, or the lengths of beaches which are already walked by visitors. Both could potentially see an increase in vehicle or pedestrian traffic. These potential indirect impacts will be discussed further in Section 5.4.

5.2 General impacts on birdlife

The construction and operation of Hvítisandur are expected to affect local bird species in the surrounding area through *direct* and *indirect impacts*, which will vary in duration from *temporary*, *seasonal*, to *permanent*.

Construction phase

Displacement is anticipated to be a *negative direct* and *permanent impact*, particularly for species breeding within or immediately near the development area. Construction will remove, alter or fragment nesting habitat for a substantial portion of the black-headed gull breeding colony, as well as common eider and Eurasian whimbrel, which currently occupy the project footprint.

The *indirect negative impacts* of construction in terms of noise and human activity are expected to be *temporary*. As per the developer's statements, structures will be prefabricated and assembled on site, thus minimising the time needed on site to complete the construction. The level of disturbance to bird life during the assembly/construction phase will depend on the time of year during which it is undertaken. It is stressed that the construction phase should not take place during or around the breeding season (April to August). Doing so would result in the destruction or failure of active nests and broods. It is also important to consider that if machinery and construction activities take place outside of the red polygon identified for the facility (as seen in Figure 2), which was the basis for measuring distances of birds from the facility when calculating disturbance distances, then the impacts of the construction phase may exceed current estimates in this report.

Operation phase

Disturbance from the facility's daily operation poses a potentially broader impact on breeding birds across the surrounding area. These *negative indirect impacts* will be *permanent* but *seasonal*, however coinciding with the birds' sensitive breeding period. Species nesting within a certain perimeter of the development may abandon their territories, determined by their tolerance for proximity to infrastructure or related disturbance. Additionally, many species were observed breeding closer than the setback distances recommended by NatureScot (discussed in detail in Section 5.1). Distances at which they may be disturbed vary on the species, from 50 to 900 metres.

The *indirect effects* of this disturbance may be far-reaching, sometimes subtle, and not immediately apparent (Price, 2008; Beale, 2004). The severity of responses (e.g., abandonment of nests or territories, higher alert level, reduced nest or brood attendance, increased defensive behaviour…) remains difficult to predict as it is contingent on species-specific and individual-specific traits, pre-existing habituation to human presence, and cumulation with other stress factors (Bötsch et al., 2017; Price, 2008; Tablado & Jenni, 2015). It is also largely dependent on human behaviour (e.g., where visitors will walk, whether they will also visit nearby areas such as the beach, whether they will trespass into breeding areas, group sizes (Remacha et al., 2011), etc.) and the *realistic* visitation rates and seasonal timings, which at this point cannot be known for certain.

For affected species, disturbances may lead to multiple consequences: Flushing incubating birds can expose eggs to predation or environmental stress (Korschgen & Dahlgren, 1992). Disruptions during brood-rearing may cause broods to scatter or frighten parents into fleeing, leaving young vulnerable to predators, harsh weather, or starvation (Korschgen & Dahlgren, 1992). Chronic stress from frequent disturbances could further compromise fitness (West et al., 2002). Species with breeding site fidelity (e.g., Eurasian whimbrel (Ausems et al. 2023; Ruthrauff et al., 2021); common eider (Ekroos et al., 2012); black-headed gull (Piro & Ornés, 2021); common ringed plover (Þórisson, 2013); Eurasian oystercatcher (van de Pol et al., 2014)) may be more reluctant to relocate even if present breeding conditions in their historic territories have deteriorated, exacerbating poor breeding outcomes over time. Another key concern is the seasonal mismatch in disturbance intensity. Pairs initiating nests in April-May—when human activity is expected to be lower—will base nest site selection on current conditions. However, peak tourist visitation in summer will coincide with incubation and chick-rearing. Thus, their early spring assessment of habitat suitability will not account for later seasonal disruptions. Even if birds do not abandon nests, increased human activity may force them to raise chicks under greater stress, likely reducing breeding success. In the long term, the density of various breeding birds within a radius of the facility could be expected to decrease due to the presence of new human structures and human disturbance (Palsdottir et al., 2024; Pálsdóttir et al., 2022; Reijnen et al., 1996; Holm & Laurson, 2009).

5.3 Impact on common eider colonies

The construction and operation of Hvítisandur is expected to affect local common eider colonies in the surrounding area through *direct* and *indirect impacts*, which will be *temporary*, *seasonal*, or *permanent*. Impacts will be particularly strong on the Þórustaðir population due to its proximity to the development.

Direct negative impacts include nesting habitat loss, displacement, and fragmentation. These effects will be *permanent*. Nesting habitat within the project footprint will be removed, physically displacing breeding pairs. Additionally, pairs nesting in the immediate proximity of the facility may also potentially abandon their territories due to presence of new infrastructure and sustained human activity in their vicinity, even if their nesting ground remains intact. The presence of the building, parking lot, and footpaths will also create a barrier of access between the sea and the breeding grounds which are inland, thus potentially impeding safe passage and fragmenting the colony.

Increased disturbance will be a *permanent* but *seasonal indirect impact*, however coinciding with the sensitive breeding period (April-August). A seasonal mismatch may exist between nest-site selection and peak human activity. Eiders prospect for nests in early spring, when visitation rates to the baths could be expected to be low, but summer tourism will peak during late incubation and chick-rearing. This disconnect means breeding pairs may settle in areas that later experience unanticipated disturbance, potentially leading to higher stress levels, and reduced breeding outcomes. A critical concern is the movement of eiders between nesting sites and the sea, particularly during brood-rearing. Directly after hatching, females must lead ducklings from inland nests to coastal waters, and in some cases will have to navigate around the facility and its peripherals. This transition represents the most vulnerable life stage for ducklings. Hindrances in the form of infrastructure, vehicles, and people, as they try to navigate to the sea, could prove deadly to the young, as they are at high risk for being predated, or scattered and abandoned if disturbed or frightened at this time (Korschgen & Dahlgren, 1992, Åhlund & Götmark, 1989; Keller, 1991; Brooker-Carey et al., 2023). This could affect a large portion of the ~400 nesting pairs of Þórustaðir, especially those in line with or to the east of the main facility, as that area will be blocked by the parking lot and access path. Ducklings on land face higher predation risks than those in water (Ahlén & Andersson, 1970; Keller, 1991), and duckling productivity tends to decline near large gull colonies (Mawhinney et al., 1999; Blinn et al., 2008). Notably, a breeding population of great black-backed gulls (*Larus marinus*) resides ~1 km from the site, and while the exact foraging range of these gulls is unknown, this species is a known predator of eider ducklings, and their presence could compound risks (Figure 5). If the colonies of Innri-Hjarðardalur, Þórustaðir, and Holt are considered as a continuous whole, then the development will result in fragmentation of the colony. Colonial nesting in eiders and other species presents various advantages such as predator defence (Schmutz et al., 1983; Coulson, 2002). The consequences of splitting the colony in this sense are not well understood.

The brood-rearing areas associated with the colonies near Hvítisandur are not known, however, it can be inferred that the ducklings will be closest to the disturbance (especially those of Þórustaðir) at their youngest and most vulnerable life stage, as they will ultimately emerge from their breeding sites which are adjacent to the proposed development. Broods roosting at high tide are easily displaced by human intrusions; Keller (1991) observed that disturbed broods flee to the water, interrupting rest and foraging, and often take substantial time to return to shore. Notably, broods on land react to approaching humans at distances three times greater than those in water, underscoring their sensitivity to shoreline disturbances (Keller, 1991).

Figure 5. *A great black-backed gull hatchling next to its nest with one yet-unhatched egg, and an eider duckling which had been delivered as prey. Photo: Bobeková, 2024, Holt.*

Common eiders exhibit strong breeding-site fidelity, although limited relocations may occur in response to disturbance (Swennen, 1990; Steiner & Gaston, 2005; Öst et al., 2011). A study in Iceland (Skene, 2013) suggests that eiders may gradually shift nests away from heavily disturbed areas. While some continue nesting in disturbed zones, most avoid high human activity, preferring quieter locations (Skene, 2013). Eiders nesting near frequently used areas may become less sensitive to human presence, whereas those in undisturbed areas often react strongly when approached—especially by people straying from established paths (Nisbet, 2000; Skene, 2013). Stein & Ims (2015) found that disturbance in areas newly exposed to recreational activities can significantly reduce nesting success. Skene's (2013) study in Dyrhólaey found that 79% of eiders in undisturbed areas responded to human presence, compared to just 24% in habituated, disturbed areas, with alert distances notably greater in undisturbed zones. These two adaptation strategies indicate a degree of behavioural flexibility in response to environmental pressures. Over time, this could lead eiders near the Hvítisandur development to gradually shift to more distant areas. However, there is also a documented instance in Iceland where eiders completely deserted a site following the destruction of their breeding grounds, without integrating into any nearby colonies (Jón Einar Jónsson (director of HÍ Research Centre Snæfellsnes), personal communication, February 12, 2025, regarding alterations of the land at the airport in Akureyri). If the three colonies

(Innri-Hjarðardalur, Þórustaðir, Holt) function as a continuous population, habitat fragmentation caused by the facility may disrupt ecological connectivity, although the long-term consequences are not well understood and it is difficult to predict the changes.

5.4 Other considerations for possible indirect impacts

Some *indirect impacts* of Hvítisandur's development and operation are more challenging to quantify. As noted in Section **5.1**, disturbance distances were measured from the construction site itself (red polygon in Figure 2), but if human presence increases across a broader area—including access roads and pedestrian traffic on the beach and surrounding natural areas—then the radius of impact will expand there as well. This section explores some of these potential impacts in greater detail.

Potential changes in vehicle traffic

Vehicle traffic to and from the facility poses a risk to birds, particularly those with breeding and feeding territories near roads. Bird mortalities have already been observed on the road leading to this area (Author's observation, 2022-2024; Figure 6). Increased traffic may elevate these risks. However, little information is known about current mortality levels, which species are most affected, hotspots for strikes, or baseline traffic data.

Figure 6. *Common redshank is one of several species which has been struck by a vehicle on the road approaching Holt in the summer of 2024. Photo: Bobeková, 2024, Valþjófsdalsvegur.*

Potential changes in visitation patterns

The Holtsbryggja area is already a relatively popular destination in the Westfjords, particularly during the summer, with uncontrolled visitor traffic from tour groups, independent travellers, and locals. Most visitors stop at Holtsbryggja, but some also walk along or utilise the beach adjacent to Holt, which hosts many of the breeding birds. The new Hvítisandur facility could increase overall visitation to the area through both direct visitors to the baths and indirect visitors attracted by marketing and increased regional awareness.

Wider area use, trespassing, and visitor awareness: Increased visitation may lead to greater recreational use of the beach and nearby areas, expanding the zone of disturbance beyond the immediate development site. While some species, like the common eider, can become somewhat habituated to controlled disturbances—such as those caused by down collectors who are typically mindful of their impact and avoid sensitive periods (Murray, 2018)—tourists may pose a different risk. Unlike the predictable and limited activities of down collectors, tourist disturbances are often less mindful timing and location.

Studies have found that visitors of natural areas frequently fail to recognize or disregard behavioural cues from disturbed or distressed wildlife (van Polanen Petel et al., 2012; Gruas et al., 2020; Aas et al., 2023). Additionally, awareness may not consistently translate into responsible behaviour (van Polanen Petel et al., 2012; Weston et al., 2015); even when people know they should avoid disturbing birds, studies find that rules are often deliberately broken to fulfil personal desires—such as crossing barriers or approaching birds for photographs (Aas et al., 2023). Visitors may deflect responsibility, believing that their individual actions have minimal impact while attributing larger disturbances to other visitor groups (Le Corre et al., 2013; Gruas et al., 2020; Gruas et al., 2023). This mindset may lead to a collective underestimation of cumulative harm, as continual human presence—rather than isolated incidents—creates sustained pressure on birdlife.

While efforts to manage human behaviour at Hvítisandur are already planned—such as guided guests, delineated areas with fences, and a designated spot for bird watching—the precise details of implementation are not yet specified (e.g., exact placement of fences and signage, timing and consistency of guiding, types of tools, types of information provided, strictness to adherence of rules, etc.). Therefore, this section addresses some foreseen challenges to consider when designing visitor management strategies. Fully addressing disturbance remains challenging, as evidenced by the following experiences: Marschall (2015) found that signage at an Icelandic wildlife site, intended to reduce visitor impacts on seals, had a positive but limited effect. For instance, 37.7% of visitors did not look at the signs, and fewer than half stopped to read for more than three seconds. Moreover, it is not uncommon to see visitors disregarding fences (a universal "no entry" signal), ignoring posted warnings, or creating informal paths that damage sensitive habitats or encroach on areas intended to protect wildlife (Figure 7; Aas et al., 2023; Marschall, 2015; Authors' observation; Náttúrustofa Vestfjarða, Vöktun Likilþátta, 2023-2025). These behaviours highlight the difficulty of relying solely on passive measures to prevent ecological disturbances and should be kept in mind when designing infrastructure and mitigation measures. When assessing the *indirect impacts* of Hvítisandur, the likelihood of people approaching or trespassing into birds' territories must be considered. Even areas that would otherwise remain relatively undisturbed by the construction and operation of the facility itself may face increased pressure from additional visitors. Consequently, disturbance distances should be re-evaluated and carefully considered from multiple perspectives to account for these indirect effects. Presently, this is difficult to quantify as there is no baseline data for current use of the Holtsbryggja area, and it is likewise difficult to accurately project the increased human traffic after Hvítisandur is built.

Figure 7. *Example of disregard for signage and rope barriers at a popular tourist site in the Westfjords. Photo: Bobeková, 2023, Dynjandi.*

Potential for positive management outcomes: Conversely, the addition of this facility to the area, along with full-time employees, if done with care and consideration for sensitivity of the natural surroundings, could lead to better management of pedestrian traffic. A portion of the clientele will arrive via tour buses, which are intended to be guided and supervised by staff, as per statements from the developer. Furthermore, if pedestrian traffic is managed well—through increased education about sensitive nature and birdlife, clear access areas, and closures of certain areas, there is potential for positive changes from which the birds would benefit. These points are further discussed in the Recommendations section of this report.

Potential of future human-bird conflicts and their management

Interactions between birdlife and people are expected, given the density of nesting birds in proximity to the facility. Conflicts may potentially arise from various avenues: For instance, black-headed gulls are raucous, densely colonial, and engage in dive-bombing behaviour when intruders approach their nesting colony. Arctic terns are also very defensive of their breeding territories and will divebomb and physically attack intruders. Additionally, birds potentially roosting on or near structures and even the pools themselves could deposit faecal matter on surfaces and the water, which may be undesirable. Such interactions may eventually lead to the consideration of deterrents (e.g., acoustic devices) to manage so-called “nuisance” species. Mitigation efforts have been used in locations where bird and human activities clash (e.g., the use of acoustic deterrents and other measures in Ísafjörður aimed at discouraging Arctic terns from nesting in certain areas). This could potentially have unintended consequences for other bird populations in the area, as non-target species may be affected by these measures, leading to broader negative ecological impacts. Any active efforts made to remove species from a certain area could potentially increase the area of impact beyond that which was assessed in this report. While plans to use deterrents are not intended by the developers, this matter is raised so that it is kept in consideration if conflicts were to arise in the future during the operation of the baths.

Potential changes in predator dynamics

Increased human activity and infrastructure may alter predator dynamics in ways that are difficult to predict, as the direction and magnitude of such changes are highly site-specific. For instance, Watson & Moss (2004) observed that human presence near a ski development in Scotland led to increased carrion crow activity, correlating with declined ptarmigan productivity within a four-mile radius. Similarly, Pálsdóttir et al. (2024) found that anthropogenic infrastructure in semi-natural habitats negatively impacted several lowland bird species in Iceland, potentially due to altered predator activity. Conversely, Liebezeit et al. (2009) documented highly varied relationships between human infrastructure and nest survival in Alaska, suggesting outcomes depend on local environmental conditions, predator demographics, and the bird communities involved. Morelli et al. (2014) further note that human structures can both reduce and increase predation pressure by either deterring predators or providing perches and shelter for them.

In terms of the Hvítisandur development, the displacement of black-headed gulls introduces further uncertainty, as their relocation could alter existing predator-prey relationships given their role as predators of smaller birds such as Arctic terns (Fuchs, 1977). Likewise, it is uncertain if or how the great black-backed gull colony over 1,000 metres away may react to the development – if they will be exploiting the potential disturbance of eiders for prey or avoiding the area. Additionally, a potential concern is that increased human activity and resulting waste could attract generalist predators such as gulls, ravens, foxes, and mink, exacerbating predation risks for nesting birds. While Hvítisandur's planned environmental certification includes stricter waste management to minimize such attractants, as per developers’ statements, monitoring post-development will be essential to identify and address any emerging trends in predator dynamics.

6. RECOMMENDATIONS

If the Hvítisandur facility is constructed and operates as described by the developer in the current plan, the following recommendations are suggested to address potential impacts on birdlife. This list is not exhaustive, and it should be noted that the implementation of these actions will not negate all impacts of the facility and its operation on local birdlife.

Seasonal restrictions on construction: Construction activities should be scheduled outside of the breeding season (i.e., prospecting, incubation, and chick-rearing periods). Undertaking construction during the breeding season would result in the active destruction of nests and elevated levels of disturbance to birds in the vicinity, possibly causing nest abandonment or reduced breeding success. Even with prefabricated components that may shorten construction duration, it remains critical that all work is completed outside of the breeding period.

Shoreline and other habitat protection: Implement measures to reduce human disturbance within and outside of the facility boundaries, such as designated walking paths, guided visitor access, and fencing or barriers in sensitive areas. While such measures are already planned for the facility itself according to the developer's statements, it is recommended to extend these protections through close collaboration with neighbouring properties to identify and safeguard key nesting and brood-rearing habitats for common eiders and other species located near potentially high foot-traffic zones. Specific measures should include the establishment of sanctuaries with restricted human access during critical periods, particularly the early post-hatching stage when ducklings are most vulnerable. Additionally, buffer zones should be implemented around key nesting and foraging areas to minimise human disturbance, with clear marking and enforcement to prevent unauthorised access. This kind of management of the currently unmanaged beach visitation would provide beneficial conservation outcomes by addressing preexisting disturbances in the area, therefore helping to offset the additional pressures introduced by the development.

Public awareness and education: Educate visitors (and staff themselves) about the local bird species and the importance of minimising disturbance. Educational materials could include signage, informational materials, and guided interpretation that emphasise the need to respect wildlife. Participation of tour guides in education and guiding their guests would be particularly beneficial. Further, exploring alternative methods of information communication (e.g., a study found that using signs drawn by children were more effective than traditional signs aimed at protection of shorebirds; Comber & Dayer, 2019) to boost information uptake and that translate to changed visitor behaviour. This principle should inform the design and planning of the visitor experience. It is recommended to engage designers with expertise in capturing reader attention and communicating messages in both factual and evocative ways to maximise information uptake and behavioural change.

Safe passage for eiders: Common eiders typically follow the most direct route to the sea. In the case of a portion of the eiders of Þórustaðir, the facility, parking lot, access road, and walking paths will stand between the nesting ground and the sea. Where the facility obstructs this path, ducklings leaving the nest with their mothers may become confused, frightened, or stranded by human disturbance. Designing visual or physical guidance features around the facility—rather than through parking lots, pathways, and the vegetated roof overlooking the pools—could help mitigate risks during this vulnerable period for freshly hatched ducklings. This represents a creative design challenge that will likely require consultation with environmental designers, landowners, and institutions holding data on current inland eider nesting locations and projected movement patterns to the sea. Alternatively, temporary closures during this sensitive period, with timing established in consultation with experienced eider farmers, would address this concern.

Road safety measures: Install signage, speed reduction measures (e.g. lower posted speed limits, speed bumps, speed measure signs) along Valþjófsdalsvegur to reduce the risk of bird strikes, particularly during the breeding season when birds are more active in the area, including near roads. These measures may be temporary and removed during winter months to facilitate snow clearing and maintain easy access to residents. While this is a public road serving multiple users beyond the Hvítisandur development, such implementation would benefit birds overall in this sensitive area and help offset risks introduced by elevated traffic associated with the facility.

Predator management: If necessary, implement measures to reduce predator attraction through proper waste management, litter removal, and targeted predator control (e.g., mink, foxes) to minimise predation pressure on vulnerable species, particularly during the breeding season. High-level eco-friendly certification may help prevent such impacts. While environmental certification of construction and buildings should address these concerns, the situation should be closely monitored and adaptive solutions implemented as needed. Predator dynamics following facility introduction are difficult to predict, making ongoing vigilance essential.

Long-term monitoring: Establish a long-term monitoring program to track the impacts of the development on local bird populations. This should include regular population surveys and nest monitoring, collection of data on breeding success and survival rates, monitoring of predator activity, as well as the assessment of human use patterns to identify temporal and spatial human-wildlife conflicts. Data collected should be used to refine and adapt mitigation measures for improved effectiveness.

Adaptive management: Adjust conservation strategies as needed based on the outcomes of the monitoring. Different bird species respond variably to similar disturbances, highlighting the complexity of these interactions and the need for species-specific conservation strategies. Addressing these challenges requires a nuanced understanding of species-specific responses and the implementation of targeted conservation measures to mitigate human impacts on vulnerable bird populations.

Address knowledge gaps: Several knowledge gaps currently limit the full understanding of development impacts on birdlife and the ability to provide specific mitigation recommendations. The following areas should be addressed to enable more comprehensive understanding of impacts and tailored mitigation strategies:

- **Update population trends of common eiders**: Current consolidated and published information about the Iceland-wide distribution and colony sizes of common eiders is over 25 years old. This needs to be updated to understand the relative scale of impacts on eiders in the Westfjords and Icelandic context.
- **Identify and map the key brood-rearing habitats**: Post-hatching movement patterns of common eider broods in this area are unknown. Obtaining this knowledge would facilitate understanding of potential impacts during this life stage and inform recommendations for buffer zones to mitigate human disturbance.
- **Effect of eider colony fragmentation**: Colonial breeding in birds is typically driven by evolutionary advantages, such as predator protection. However, the consequences of the spatial division of a continuous eider colony are not well understood.
- **Understand current predator dynamics:** Baseline information on predator presence, predation levels, and affected species is needed. This baseline can be used to monitor changes in predator activity resulting from the development.
- **Effects of ambient noise pollution on breeding birds**: Investigate the effect of increased noise, particularly during the incubation and chick-rearing periods. This could help predict impacts, as well as help inform measures to minimise noise disturbance.
- **Understand current road mortalities and predict expected changes**: While anecdotal evidence exists of bird mortalities on the road accessing Holtsbryggja (Valþjófsdalsvegur), quantitative data are lacking. Understanding current traffic patterns and collision hotspots would enable modelling of expected changes with increased traffic and inform targeted mitigation measures at the most appropriate locations.
- **Quantify indirect impacts of the development**: As mentioned in the previous sections, disturbance distances were measured only from the direct area of development. The effect of increased vehicle uses on the main access road and potentially increased pedestrian traffic on the beach as well as other areas were not quantified. Doing so would be necessary to understand the realistic impacts brought by Hvítisandur, which are likely not limited just to the space where the facility will be constructed.

7. CONCLUDING SUMMARY

The area surrounding the proposed Hvítisandur development (within 1,000 metres) is a breeding site for at least 21 bird species, 14 of which are listed on the Icelandic Red List. An additional 2 Red Listed species were surveyed in Holt beyond 1,000 metres. The construction and operation of this facility will likely have negative and multifaceted impacts on ecologically significant bird populations (and economically significant populations in the case of the common eider).

Effects on bird life will manifest as both direct and indirect impacts that are permanent, temporary, or seasonal. Direct and permanent impacts include the removal of nesting grounds and displacement of at least 100 breeding pairs within the project footprint: 98 are black-headed gull, 1 Eurasian whimbrel, and 1 common eider. Both the common eider and the Eurasian whimbrel are on the Icelandic Red List. Indirect effects in the form of disturbance may impact a minimum of 482 additional breeding pairs across at least 12 species. These species were observed breeding closer than the disturbance setback distances recommended by NatureScot (ranging from 50 to 900 metres depending on species-specific traits), potentially exposing them to elevated disturbances. Impacts on these species are likely to be permanent but seasonal, coinciding with the birds' sensitive breeding period. Excluding pairs within the project footprint, affected species include: 224 black-headed gull, at minimum 184 common eider, 43 Arctic tern, 7 Eurasian whimbrel, 7 greylag goose, 6 red-throated loon, 5 common ringed plover, 2 European golden plover, and 1 each of common redshank, Eurasian oystercatcher, mallard, and redwing. Of the listed, 7 species (accounting for at least 244 pairs) are on the Red List; Arctic tern, common eider, common redshank, Eurasian oystercatcher, Eurasian whimbrel, European golden plover, and greylag goose. These numbers are likely higher when accounting for species that do not have published disturbance thresholds as well as the likely underestimation of Þórustaðir common eider pairs.

As discussed above, displacement and disturbance of birds may result in various adverse impacts. Displacement from traditional breeding habitats may reduce reproductive success and population viability. Human presence during the breeding season has been shown to disrupt feeding, nesting, and brood-rearing behaviours, potentially leading to nest abandonment, lower chick survival, and in some cases, long-term population declines. Chronic stress from disturbance can delay nest initiation, reduce clutch sizes, or cause birds to forgo breeding entirely. Strong site fidelity and natal philopatry compel some species to return to degraded habitats, further reducing reproductive success. Additionally, birds may initially perceive the area as suitable during early spring prospecting but face heightened human activity during critical breeding stages, leading to mismatches in habitat suitability. These impacts are not isolated; they interact with existing environmental stressors – such as habitat degradation and climate change—creating compounding threats that could destabilise regional biodiversity. Even minor disruptions can have cascading consequences.

Various recommendations are provided to help minimise some of these effects, including mitigation measures both within and outside of the direct project footprint. Implementing these recommendations, especially outside of the project footprint, may help offset overall impacts and could also benefit local bird populations if applied appropriately. However, given the scale and nature of the projected impacts, mitigation strategies may not fully prevent adverse effects on the area's avian biodiversity, particularly for Red Listed species.

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APPENDIX A – Red List for birds

*Table 7. Conservation status (in Iceland, Europe, and globally) of birds observed in vicinity of the proposed development. CR (Critically Endangered), EN (Endangered), VU (Vulnerable), NT (Near Threatened), and LC (Least Concern). *Status may be subject to change after this report's publication.*

English name	Latin name	Icelandic name	Iceland status	Europe status	Global status
Arctic tern	*Sterna paradisaea*	Kría	VU	LC	LC
Black headed gull	*Chroicocephalus ridibundus*	Hettumáfur	LC	LC	LC
Black-tailed godwit	*Limosa limosa*	Jaðrakan	NT	NT	NT
Common eider	*Somateria mollissima*	Æðarfugl	NT	EN	NT
Common redshank	*Tringa totanus*	Stelkur	VU	VU	LC
Common ringed plover	*Charadrius hiaticula*	Sandlóa	LC	LC	LC
Common snipe	*Gallinago gallinago*	Hrossagaukur	LC	VU	LC
Dunlin	*Calidris alpina*	Lóuþræll	VU	LC	NT
Eurasian oystercatcher	*Haematopus ostralegus*	Tjaldur	VU	VU	NT
Eurasian teal	*Anas crecca*	Urtönd	NT	LC	LC
Eurasian whimbrel	*Numenius phaeopus*	Spói	VU	LC	LC
Eurasian wigeon	*Mareca penelope*	Rauðhöfðaönd	NT	LC	LC
European golden plover	*Pluvialis apricaria*	Heiðloa	VU	LC	LC
European herring gull	*Larus argentatus*	Silfurmáfur	NT	LC	LC
Great black-backed gull	*Larus marinus*	Svartbakur	CR	LC	LC
Greylag goose	*Anser anser*	Grágæs	NT	LC	LC
Mallard	*Anas platyrhynchos*	Stokkönd	LC	LC	LC
Red-breasted merganser	*Mergus serrator*	Toppönd	NT	NT	LC
Red-necked phalarope	*Phalaropus lobatus*	Óðinshani	NT	LC	LC
Red-throated loon	*Gavia stellata*	Lómur	LC	LC	LC
Redwing	*Turdus iliacus*	Skógarþröstur	LC	LC	NT
Tufted duck	*Aythya fuligula*	Skúfönd	NT	NT	LC
White wagtail	*Motacilla alba*	Mariuerla	LC	LC	LC

APPENDIX B – Observed birds listed by species

Table 8. *Abundance of breeding pairs of birds observed at set distance intervals from the proposed development; Listed by species. Pairs observed over 1,000 metres from the development are included in parentheses.*

Species	Distance from development	Breeding pairs
Arctic tern	51-100 m	11
	101-250 m	32
	251-500 m	127
	501-1,000 m	105
	total	***275***
Black-headed gull	0 m (inside)	98
	1-50 m	224
	51-100 m	7
	101-250 m	48
	251-500 m	406
	501-1,000 m	30
	>1,000 m	(2)
	total	***813 (815)***
Black-tailed godwit	251-500 m	1
	501-1,000 m	2
	total	***3***
Common redshank	101-250 m	1
	251-500 m	6
	501-1,000 m	6
	total	***13***
Common ringed plover	1-50 m	1
	51-100 m	1
	101-250 m	3
	501-1,000 m	15
	total	***20***
Common snipe	251-500 m	2
	501-1,000 m	3
	total	***5***
Dunlin	501-1,000 m	3
	total	***3***

Eurasian oystercatcher	101-250 m	1
	251-500 m	3
	501-1,000 m	10
	>1,000 m	(3)
	total	***14 (17)***
Eurasian teal	1-50 m	1
	251-500 m	1
	501-1,000 m	1
	total	***3***
Eurasian whimbrel	0 m (inside)	1
	1-50 m	1
	51-100 m	2
	101-250 m	2
	251-500 m	7
	501-1,000 m	16
	>1,000 m	(4)
	total	***29 (33)***
Eurasian wigeon	501-1,000 m	1
	total	***1***
European golden plover	1-50 m	1
	250-500 m	1
	501-1,000 m	6
	total	***8***
European herring gull	>1,000 m	(1)
	total	***(1)***
Great black-backed gull	>1,000 m	(6)
	total	***(6)***
Greylag goose	1-50 m	2
	101-250 m	1
	251-500 m	4
	501-1,000 m	6
	>1,000 m	(1)
	total	***13 (14)***
Mallard	1-50 m	1

	251-500 m	1
	501-1,000 m	3
	total	***5***
Red-necked phalarope	251-500 m	2
	501-1,000 m	12
	total	***14***
Red-throated loon	251-500 m	3
	501-1,000 m	3
	total	***6***
Redwing	1-50 m	1
	total	***1***
Tufted duck	501-1,000 m	1
	total	***1***
White wagtail	1-50 m	1
	total	***1***

***Table 9**. Abundance of individuals of unknown breeding status observed at set distance intervals from the proposed development; Listed by species. Pairs observed over 1,000 metres from the development are included in paratheses.*

Species	Distance from development	Unknown breeding status (individuals)
Black-tailed godwit	501-1,000 m	16
	total	***16***
Common redshank	501-1,000 m	25
	total	***25***
Common ringed plover	501-1,000 m	11
	total	***11***
Common snipe	251-500 m	1
	total	***1***
Dunlin	501-1,000 m	13
	total	***13***

Eurasian oystercatcher	501-1,000 m	4
	total	***4***
European herring gull	>1,000 m	(3)
	total	***(3)***
Great black-backed gull	251-500 m	1
	501-1,000 m	1
	>1,000 m	(10)
	total	***2 (12)***
Greylag goose	251-500 m	22
	501-1,000 m	2
	total	***24***
Red-breasted merganser	501-1,000 m	2
	total	***2***
Red-necked phalarope	251-500 m	2
	501-1,000 m	6
	total	***8***
Tufted duck	501-1,000 m	3
	total	***3***