Miljøministeriet
Miljøstyrelsen

# Tillæg til miljøgodkendelse Halfdan Oil Re-Route og HBA-27

For:

**TotalEnergies EP Danmark A/S**

Miljøministeriet
Miljøstyrelsen

Ref. KABJE/MARIP

# Tillæg til miljøgodkendelse Halfdan Oil Re-Route og HBA-27

## For:

## TotalEnergies EP Danmark A/S

| | |
|---|---|
| Adresse: | Britanniavej 10, 6700 Esbjerg |
| Placering i Nordsøen: | 55° 28' 41.16'' N 5° 6' 19.98'' E |

| | |
|---|---|
| CVR-nummer: | 22757318 |
| P-nummer: | 1016529571 |
| Listepunkt nummer: | 1.1.c Forbrænding af brændsel i anlæg med en samlet nominel indfyret termisk effekt på 50 MW eller derover i fyringsanlæg på platforme på havet (off-shore) (s). |

J. nummer: 2025-132708

## Godkendelsen omfatter:

Halfdan Oil Re-Route og HBA-27

Dato: 8. september 2026

Godkendt: Karsten Borg Jensen

Annonceres den 8. september 2026
Klagefristen udløber den 6. oktober 2026
Søgsmålsfristen udløber den 8. marts 2027
Revurdering påbegyndes, når EU-kommissionen i EU-tidende har offentliggjort en BAT-konklusion, der vedrører virksomhedens hovedlistepunkt.

Miljøstyrelsen • Lerchesgade 35 • 5000 Odense C
Tlf. 72 54 40 00 • CVR 25798376 • mst@mst.dk • www.mst.dk

# Indhold

## Indholdsfortegnelse



## Bilag

# 1. Indledning

Baggrund
Miljøstyrelsen har i 2015 meddelt TotalEnergies E&P Danmark A/S miljøgodkendelse til 15 fyringsanlæg på offshoreplatformen Dan F.

Platformen er placeret i Nordsøen ca. 210 km vest for Esbjerg.

Miljøstyrelsen har 17. december 2024 meddelt revurdering af 9 af de 15 fyringsanlæg på platformen.

De 6 øvrige anlæg (DFBA-3550, DFBA-3560, DFCI-1610, DFCI-1620, DFCI-1630 og DFEY-3551) indgik ikke i revurderingen, da de ikke har været i drift i adskillige år. Miljøgodkendelsen for dem er derfor bortfaldet grundet kontinuitetsbrud.

Revurderingen omhandlede således 9 fyringsanlæg, som er installeret på Dan FC, Dan FF og Dan FG. Deres samlede indfyrede termisk effekt er på 357 MW.

Platformskomplekset Dan F består af 7 indbyrdes broforbundne platforme:
- Dan FA Brøndhovedplatform, som også understøtter et bromodul
- Dan FB Brøndhovedplatform
- Dan FC Beboelses- og behandlingsplatform med helikopterdæk
- Dan FD Afbrændingsplatform
- Dan FE Brøndhovedplatform, som også understøtter et bromodul
- Dan FF Brøndhoved- og behandlingsplatform
- Dan FG Behandlings- og afbrændingsplatform

Fyringsanlæggene, som er installeret på de indbyrdes broforbundne platforme Dan FC, FF og FG, har tilsammen en indfyret effekt større end 50 MW. Anlæggene er derfor omfattet af krav om miljøgodkendelse, jf. bekendtgørelse om visse luftforurenende emissioner fra fyringsanlæg på platforme på havet (herefter bekendtgørelsen om offshore fyringsanlæg).

De to fyringsanlæg DFFA-GT-4301 og DFGA-GT-4302 har en individuel indfyret effekt større end 50 MW (henholdsvis 62,9 og 91 MW). Anlæggene er derfor også omfattet af BAT-konklusionerne for store fyringsanlæg.

EU-Kommissionen har den 17. august 2017 offentliggjort BAT (Best Available Techniques) konklusionen nr. C (2017) 5225 for store fyringsanlæg. Offshore fyringsanlæg skal derfor revurderes med henblik på at kunne overholde kravene inden 4 år fra offentliggørelsen.

På baggrund af disse BAT-konklusioner meddelte Miljøstyrelsen 17. december 2024 revurdering af fyringsanlæggene på Dan F platformen.

Den 30. juni 2026 meddelte Miljøstyrelsen en vilkårsændring for DFG-4302 og for DAN-F. Vilkårsændringen omfattede ændret emissionsgrænseværdi og

midlingstid for $NO_x$ fra DFG-4302 samt ændrede årlige mængder $NO_x$ fra fyringsanlæg på DAN-F.

Ud over de generelle BAT-krav, er offshore fyringsanlæg omfattet af de specifikke BAT-konklusioner 52, 53 og 54. BAT 54 indeholder en BAT-AEL for luftemissioner af $NO_x$ for gasturbiner, der forbrænder gasformigt brændsel. Miljøstyrelsen fastsatte derfor en ny emissionsgrænseværdi for de to pågældende anlæg.

Den oprindelige godkendelse af 6. juli 2015 og revurderingen af 17. december 2024 omfattede kun fyringsanlæggene og emissionerne herfra, idet platformens øvrige tekniske installationer er omfattet af anden lovgivning. Det samme gælder for denne afgørelse.

Emissionerne til havet fra olie- og gasproduktionen er dækket af bestemmelser i havmiljøloven.

Fyringsanlæggene er alle gasturbiner, der driver generatorer til elproduktion til brug for blandt andet vandpumper og kompressorer.

Fyringsanlæggene er både dual fuel og single fuel, hvoraf brændslet enten er naturgas og/eller diesel.

Ansøgningen omfatter to projekter, det ene kaldes Halfdan Re-Route (HDAORR) og det andet er vedrørende en eksisterende brønd kaldet HBA-27. Begge projekter omfatter faciliteter, der er en del af HALFFDAN-, DAN- og GORM-felterne. Formålet med projektet HDAORR er at undgå rutinemæssig flaring (sikkerhedssystem, der kontrolleret brænder gas af). Projektet HBA-27 omhandler udbygning og vedligeholdelse af olie- og gasproduktionen i Halfdan-feltet.

Denne afgørelse

Denne afgørelse er udarbejdet på baggrund af en ansøgning af 22. december 2025 fra TotalEnergies EP Danmark A/S.

Ansøgningen er indsendt som følge af Miljøstyrelsens indskærpelse af 4. december 2025 angående lovliggørelsen af driftsændringer på fyringsanlæg i forbindelse med to tidligere gennemførte projekter.

Indskærpelsen blev meddelt efter, at Miljøstyrelsen ved gennemgang af virksomhedens reviderede ansøgning af 5. november 2025 konstaterede, at virksomheden havde foretaget ændringer i form af et re-routingprojekt på Halfdan og med åbning af en ny brønd på Halfdan. Det blev også konstateret, at ændringerne havde haft betydning for driften på Dan F fyringsanlæggene. Miljøstyrelsen lagde her til grund, at projekterne havde medført øget last på fyringsanlægget på Dan F med merudledning af $NO_x$ til følge.

Miljøstyrelsen har som tilsynsmyndighed pligt til at foranledige et ulovligt forhold bragt til ophør, jf. § 68 og § 69, stk. 1 i miljøbeskyttelsesloven[1].

[1] Lovbekendtgørelse om miljøbeskyttelse, nr. 1093 af 11. oktober 2024.

Miljøstyrelsen indskærpede derfor, at det ulovlige forhold skulle bringes til ophør, og at virksomheden skulle indsende en ansøgning om miljøgodkendelse af de driftsmæssige ændringer.

De ændrede emissioner af $NO_x$ fra DFG 4302 og øgede emissioner fra alle fyringsanlæg på DAN-F-platformene er omfattet af vilkårsændring meddelt 30. juni 2026. De øvrige fyringsanlæg er fortsat omfattet af revurdering af 17. december 2024.

**Afgørelse og vilkår**
På grundlag af oplysningerne i afsnit 3, ansøgning om miljøgodkendelse, samt bilagene til afgørelsen godkender Miljøstyrelsen hermed de allerede udførte driftsmæssige ændringer som følge af projekterne Halfdan Oil Re-Route og HBA-27.

Miljøgodkendelsen meddeles i henhold til § 33, stk. 1, i miljøbeskyttelsesloven.

Afgørelsen gives uden nye vilkår.

Afgørelsen tages dog op til revurdering i overensstemmelse med reglerne i miljøbeskyttelseslovens § 41a, stk. 2 og 3, herunder når EU-Kommissionen har offentliggjort en BAT-konklusion i EU-Tidende, der vedrører virksomhedens listepunkt.

I afgørelsen er anvendt populærnavne for love og bekendtgørelser. En samlet oversigt fremgår af bilag B.

## 1.1 Vilkår for miljøgodkendelsen

Da afgørelsen vedrører miljøgodkendelse af et allerede eksisterende forhold, fastsættes der ingen vilkår i afgørelsen.

# 2. Vurdering og begrundelse

## 2.1 Begrundelse for afgørelse

Denne afgørelse er udarbejdet på baggrund af ansøgningen af 22. december 2025 fra TotalEnergies EP Danmark A/S. Ansøgningen er indsendt som følge af Miljøstyrelsens indskærpelse af 4. december 2025 angående lovliggørelsen af driftsændringer på fyringsanlæg i forbindelse med to tidligere gennemførte projekter.

Indskærpelsen blev meddelt efter, at Miljøstyrelsen ved gennemgang af virksomhedens reviderede ansøgning af 5. november 2025 konstaterede, at virksomheden havde foretaget ændringer i form af et re-routingprojekt på Halfdan og med åbning af en ny brønd på Halfdan. Det blev også konstateret, at ændringerne havde haft betydning for driften på Dan F fyringsanlæggene. Miljøstyrelsen lagde her til grund, at projekterne havde medført øget last på fyringsanlægget på Dan F med merudledning af $NO_x$ til følge.

Miljøstyrelsen har som tilsynsmyndighed pligt til at foranledige et ulovligt forhold bragt til ophør, jf. § 68 og § 69, stk. 1 i miljøbeskyttelsesloven[2].

Miljøstyrelsen indskærpede derfor, at det ulovlige forhold skulle bringes til ophør, og at virksomheden skulle indsende en ansøgning om miljøgodkendelse af de driftsmæssige ændringer.

Det ansøgte projekt medfører øget fuel-gasforbrug på Dan F og en mindre gasafbrænding fra flare på Gorm-feltet.

Som følge af projektet kan den samlede årlige emission af $NO_x$ fra drift af kompressorerne DFg-4301 og DFG-4302 stige. Dette forhold er reguleret i vilkårsændring af 30. juni 2026.

Udledningen af $CO_2$ reduceres som følge af HDAORR projektet. Ansøger vurderer, at der årligt udledes 69,4 tons $NO_x$ mere som følge af projekterne. Den samlede udledning af $CO_2$ falder med 21.000 tons pr. år.

Det er Miljøstyrelsens vurdering, at de gennemførte driftsændringer i øvrigt kan godkendes, uden at der fastsættes nye vilkår.

[2] Lovbekendtgørelse om miljøbeskyttelse, nr. 1093 af 11. oktober 2024.

## 2.2 Udtalelser/høringssvar

### 2.2.1 Udtalelse fra andre myndigheder

Energistyrelsen har fremsendt høringssvar af 14. august 2026.

Høringssvaret er vedlagt og har ikke givet anledning til ændringer i afgørelsen.

### 2.2.2 Udtalelse fra borgere mv.

Ansøgningen om miljøgodkendelse har været annonceret på Miljøstyrelsens hjemmeside www.mst.dk den 2. juli 2026. Der er ikke modtaget henvendelser vedrørende ansøgningen.

### 2.2.3 Udtalelse fra virksomheden

Virksomheden har haft et udkast til afgørelse i høring. Virksomheden havde kun få tekstmæssige ændringer, der er indarbejdet i den endelige afgørelse.

# 3. Forholdet til loven

## 3.1 Lovgrundlag

Der er i afgørelsen anvendt populærnavne for love og bekendtgørelser mv. En oversigt over det anvendte lovgrundlag findes i bilag B.

### 3.1.1 Miljøgodkendelsen

Miljøgodkendelse gives i henhold til § 33, stk. 1, i miljøbeskyttelsesloven.

### 3.1.2 Listepunkt

1.1.c Forbrænding af brændsel i anlæg med en samlet nominel indfyret termisk effekt på 50 MW eller derover i fyringsanlæg på platforme på havet (off-shore) (s).

### 3.1.3 BAT

Virksomheder, der forurener, skal ifølge miljøbeskyttelsesloven begrænse forureningen, så det svarer til de bedste tilgængelige teknikker. På engelsk ”Best Available Techniques” eller BAT.
EU beslutter miljøkravene til de europæiske virksomheder ud fra, hvad der kan opnås med BAT. Miljøkravene bliver formuleret som BAT- konklusioner og indgår i de såkaldte BREF-dokumenter, som står for ”BAT reference documents”.
BREF-dokumenterne bliver revideret hvert 8. år, så nye teknikker kan blive del af lovgivningen.

BREF dokumenternes miljøkrav omfatter virksomhedernes udledninger og brug af ressourcer. BREF-dokumenterne er – jf. direktivet for industrielle emissioner ( ”direktivet for industrielle emissioner” ) (IED), som trådte i kraft i Danmark den 7. januar 2013 – bindende for virksomhederne, som får indarbejdet kravene i deres miljøgodkendelse. Virksomheder har pligt til at overholde de nye krav senest 4 år efter offentliggørelsen af BAT-konklusionerne.

### 3.1.4 Revurdering

Revurdering påbegyndes, når EU-kommissionen har offentliggjort en BAT-konklusion i EU-tidende, der vedrører virksomhedens hovedlistepunkt, eller senest inden 8-10 år.

## 3.2 Øvrige gældende godkendelser og påbud

Vilkår i følgende afgørelser gælder stadig:

- Revurdering for DAN-F af 17. december 2024
- Vilkårsændring, øget udledning af $NO_x$ fra vandinjektionsturbinerne for kalenderåret 2025 af 17. december 2025
- Vilkårsændring af 30. juni 2026

## 3.3 Tilsyn med virksomheden

Miljøstyrelsen er tilsynsmyndighed for virksomheden jf. miljøbeskyttelseslovens § 66

## 3.4 Offentliggørelse og klagevejledning

Miljøstyrelsens afgørelse offentliggøres udelukkende digitalt. Materialet kan tilgås på www.mst.dk.
Offentligheden har adgang til sagens øvrige oplysninger med de begrænsninger, der følger af lovgivningen.

Følgende kan klage over afgørelsen til Miljø- og Fødevareklagenævnet

- afgørelsens adressat
- enhver, der har en individuel, væsentlig interesse i sagens udfald
- kommunalbestyrelsen
- Styrelsen for Patientsikkerhed
- landsdækkende foreninger og organisationer i det omfang, de har klageret over den konkrete afgørelse, jf. miljøbeskyttelseslovens §§ 99 og 100
- lokale foreninger og organisationer, der har beskyttelse af natur og miljø eller rekreative interesser som formål, og som har ønsket underretning om afgørelsen, jf. miljøbeskyttelseslovens § 100, stk. 1.

Hvis du ønsker at klage over denne afgørelse, kan du klage til Miljø- og Fødevareklagenævnet. Du klager via Klageportalen, som du finder et link til på forsiden af www.naevneneshus.dk. Klageportalen ligger på www.borger.dk og www.virk.dk. Du logger på www.borger.dk eller www.virk.dk, ligesom du plejer, typisk med MitID.

Klagen sendes gennem Klageportalen til Miljøstyrelsen. En klage er indgivet, når den er tilgængelig for Miljøstyrelsen i Klageportalen. Når du klager, skal du betale et gebyr på kr. 900 for private og kr. 1.800 for virksomheder og organisationer. Du betaler gebyret med betalingskort i Klageportalen.

Du kan læse mere om gebyrordningen og klage på Miljø- og Fødevareklagenævnets hjemmeside (https://naevneneshus.dk/start-din-klage/miljoe-og-foedevareklage-naevnet/).

Miljø- og Fødevareklagenævnet afviser din klage, hvis du sender den uden om klageportalen, medmindre du er blevet fritaget for brug af klageportalen.
Hvis du ønsker at blive fritaget for at bruge klageportalen, skal du sende en begrundet anmodning til Miljø- og Fødevareklagenævnet via mail på mfkn@naevneneshus.dk. Nævnet afgør herefter, om du kan fritages for at bruge klageportalen.
Se betingelserne for at blive fritaget.

Klagen skal være modtaget senest den 8. marts 2027.

*Klage over afgørelsen om basistilstandsrapport*
Miljøstyrelsens afgørelse om basistilstandsrapport kan påklages sammen med klage over afgørelsen om miljøgodkendelse.

Følgende har mulighed for at klage over afgørelsen om basistilstandsrapport til Miljø- og Fødevareklagenævnet:

- afgørelsens adressat
- enhver, der har en individuel, væsentlig interesse i sagens udfald
- kommunalbestyrelsen
- Styrelsen for Patientsikkerhed

Fremgangsmåde og klagefrist fremgår ovenfor.

*Dette gælder mens en klage behandles*
Virksomheden vil kunne udnytte afgørelsen om miljøgodkendelse, mens Miljø- og Fødevareklagenævnet behandler en eventuel klage, medmindre nævnet bestemmer noget andet. Udnyttes afgørelsen indebærer dette dog ingen begrænsning for Miljø- og Fødevareklagenævnets mulighed for at ændre eller ophæve afgørelsen om miljøgodkendelse.

*Orientering om klage*
Hvis Miljøstyrelsen får besked fra Klageportalen om, at der er indgivet en klage over afgørelsen, orienterer Miljøstyrelsen virksomheden herom.
Miljøstyrelsen orienterer ligeledes virksomheden, hvis Miljøstyrelsen modtager en klage over afgørelsen fra en klager, som efter anmodning til Miljø- og Fødevareklagenævnet er blevet fritaget for at klage via Klageportalen.
Herudover orienterer Miljøstyrelsen ikke virksomheden.

*Søgsmål*
Hvis man ønsker at anlægge et søgsmål om afgørelsen ved domstolene, skal det ske senest 6 måneder efter, at Miljøstyrelsen har offentliggjort afgørelsen, jf. miljøbeskyttelseslovens § 101. På www.domstol.dk findes vejledning om at anlægge en retssag ved domstolene.

## 3.5 Liste over modtagere af kopi af afgørelsen

Energistyrelsen, ens@ens.dk
Styrelsen for Patientsikkerhed, stps@stps.dk
Danmarks Naturfredningsforening, dn@dn.dk
Greenpeace, hoering.dk@greenpeace.org
Friluftsrådet, fr@friluftsraadet.dk
Danmarks Sportsfiskerforbund, post@sportsfiskerforbundet.dk

# Bilag

## Bilag A. Ansøgning om miljøgodkendelse

# Ansøgning om tillæg til miljøgodkendelse

## 'Halfdan Oil Re-Route' og 'HBA-27'

TotalEnergies EP Danmark A/S

Dato: 19. december 2025

# Indhold

**Bilag 1**: Halfdan Oil Re-Route Project - Environmental Impact Assessment Screening Report, 2023

**Bilag 2**: Halfdan Tor NE and Ekofisk In-fill Wells Project - Environmental Impact Assessment Screening Report, 2023

# 1. Baggrund

TotalEnergies EP Danmark A/S (herefter TotalEnergies) modtog d. 4. december 2025 en indskærpelse fra Miljøstyrelsen angående lovliggørelsen af driftsændringer på fyringsanlæg i forbindelse med to tidligere gennemførte projekter. TotalEnergies har derfor bedt NIRAS om bistand til at udarbejde denne ansøgning om tillæg til miljøgodkendelsen i forbindelse med lovliggørelsen af projekterne. De to projekter omtales af og til under et her i ansøgningen som "det ansøgte projekt"

TotalEnergies har følgende eksisterende miljøgodkendelser for de fyringsanlæg, som bliver berørte af de ansøgte projekter.

- Miljøgodkendelse for fyringsanlæg på offshoreplatforme i Gorm-feltet fra 6. juli 2015.
- Miljøgodkendelse for fyringsanlæg på offshoreplatforme i Halfdan B-feltet fra 6 juli 2015.
- Revurdering af miljøgodkendelse for 9 fyringsanlæg på offshoreplatformkomplekset Dan F fra 17. december 2024.

Der er taget udgangspunkt i oplysningskravene til bilag 1-virksomheder i godkendelsesbekendtgørelsens bilag 3. Bekendtgørelsens tekst er i det følgende vist med kursiv og TotalEnergies oplysninger med almindelig skrift.

Før projekterne blev sat i gang, redegjorde TotalEnergies EP om miljøkonsekvenser, hvorefter Energistyrelsen godkendte projekterne. For at redegøre yderligere for projekternes baggrund, vedlægges som bilag 1 og 2 de to screeningsrapporter fra 2023, som blev fremsendt til Energistyrelsen.

# 2. A. Oplysninger om ansøger og ejerforhold

*1) Ansøgerens navn, adresse, telefonnummer og e-mail.*

TotalEnergies EP Danmark A/S
Britanniavej 10
6700 Esbjerg

Tlf. 75 45 13 66
E-mail: kim.rasmussen@totalenergies.com / louise.teilmann@totalenergies.com

*2) Virksomhedens navn, adresse og CVR- og P-nummer.*

TotalEnergies EP Danmark A/S, Britanniavej 10, 6700 Esbjerg
CVR-nummer: 22757318
P-nummer: 1016529571

*3) Navn, adresse og e-mail på ejeren af ejendommen, hvorpå virksomheden er beliggende eller ønskes opført, hvis ejeren ikke er identisk med ansøgeren.*

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*4) Oplysning om virksomhedens kontaktperson: Navn, adresse, telefonnummer og e-mail.*

Kim Rasmussen, Engineering & Construction Manager
Britanniavej 10, 6700 Esbjerg
Tlf. 29 36 22 91
E-mail: kim.rasmussen@totalenergies.com

Louise Teilmann, Regulatory Affairs Advisor
Britanniavej 10, 6700 Esbjerg
Tlf. 23 99 88 78
E-mail: louise.teilmann@totalenergies.com

## 3. B. Oplysninger om virksomhedens art

*5) Virksomhedens listebetegnelse, jf. bilag 1 og 2, for virksomhedens hovedaktivitet og alle biaktiviteter.*

1.1.c Forbrænding af brændsel i anlæg med en samlet nominel indfyret termisk effekt på 50 MW eller derover i fyringsanlæg på platforme på havet (off-shore) (s).

*6) Kort beskrivelse af det ansøgte projekt. Angivelse af om der er tale om ny-anlæg eller om driftsmæssige udvidelser og/eller ændringer af bestående virksomhed. Hvis der er tale om udvidelse af en ikke tidligere godkendt virksomhed, som bliver godkendelsespligtig på grund af udvidelsen, skal der gives oplysninger om hele virksomheden inkl. udvidelsen.*

Det to projekter, som indgår i det ansøgte projekt, omhandler ændringer af bestående virksomhed. Virksomhedens produktion omfatter 9 fyringsanlæg (jf. Revurdering af miljøgodkendelse for 9 fyringsanlæg på offshoreplatformkomplekset Dan F fra 17. december 2024). Nærværende ansøgning omfatter to projekter, det ene kaldes 'Halfdan Oil Re-Route' (HDAORR) og det andet 'HBA-27', hvor sidstnævnte er navnet på en eksisterende brønd. Begge projekter omfatter faciliteter, der er en del af HALFDAN-, DAN- og GORM-felterne i den sydøstlige del af den danske Nordsø, cirka 210 kilometer fra Danmarks vestkyst.

Projektet 'Halfdan Oil Re-Route' har til formål at eliminere rutinemæssig flaring (sikkerhedssystem der kontrolleret brænder gas af) på Gorm-anlæggene. Dette er i overensstemmelse med TotalEnergies' forpligtelse til "near-zero" rutinemæssig flaring og forbuddet mod rutinemæssig afbrænding i Danmark, der trådte i kraft i juli 2023. Det ses desuden som bedste tilgængelige teknik (BAT) at reducere flaring, se også afsnit om BAT. Herudover forventes Gorm-feltet at ophøre med produktionen i de kommende år. Halfdan Oil Re-Route-projektet vil derfor give en alternativ eksportvej for halvstabiliseret olie fra Halfdan.

Den kombinerede Halfdan-olieeksport skal således omledes fra Gorm til Dan F-anlægget ved at udnytte den eksisterende lavtryksgaseksport fra Halfdan A til Dan F med en lille gaseksportstrøm fra Halfdan A. Projektet består derfor hovedsagelig i omledning af væsker mellem virksomhedens driftshubs, omlægning af en eksisterende rørledning mellem Halfdan A og Dan F (serviceændring) og ændringer af faciliteterne på Halfdan A og Dan F-platformene. Se bilag 1 for flere oplysninger.

Projektet 'HBA-27' er som nævnt navnet på en brønd, der indgår i projektet 'Halfdan Tor NE and Ekofisk In-fill Wells'. Dette projekt omhandler udbygning og vedligeholdelse af olie- og gasproduktionen i Halfdan-feltet i

den danske del af Nordsøen, samt at bremse det faldende produktionsniveau ved at genanvende fire eksisterende brønde (slots), hvoraf en af dem er HBA-27. For flere oplysninger omkring projektet se Bilag 2.

De ændringer, som projekterne har medført, har vist sig at påvirke NOx udledningen fra visse turbiner på Halfdan og Dan, samt reducere flare fra Gorm-feltet. Denne ansøgning vedrører tillægsgodkendelse til den ændrede NOx udledning.

*7) Vurdering af, om virksomheden er omfattet af bekendtgørelse om kontrol med risikoen for større uheld med farlige stoffer.*

Af bekendtgørelse om kontrol med risikoen for større uheld med farlige stoffer[1] fremgår det af §3 at efterforskning efter og udvinding af mineraler offshore, herunder kulbrinter, ikke er omfattet. Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*8) Hvis det ansøgte projekt er midlertidigt, skal det forventede ophørstidspunkt oplyses.*

Projektet er varigt.

## 4. C. Oplysninger om etablering

*9) Oplysning om, hvorvidt det ansøgte kræver bygnings- eller anlægsmæssige udvidelser og/eller ændringer.*

Projektet ændrer ikke på fyringsanlæggene. Projektet anvender de allerede etablerede rørledninger. Projektet kræver derfor ikke bygnings- eller anlægsmæssige udvidelser og/eller ændringer. Se yderligere oplysninger i Bilag 1.

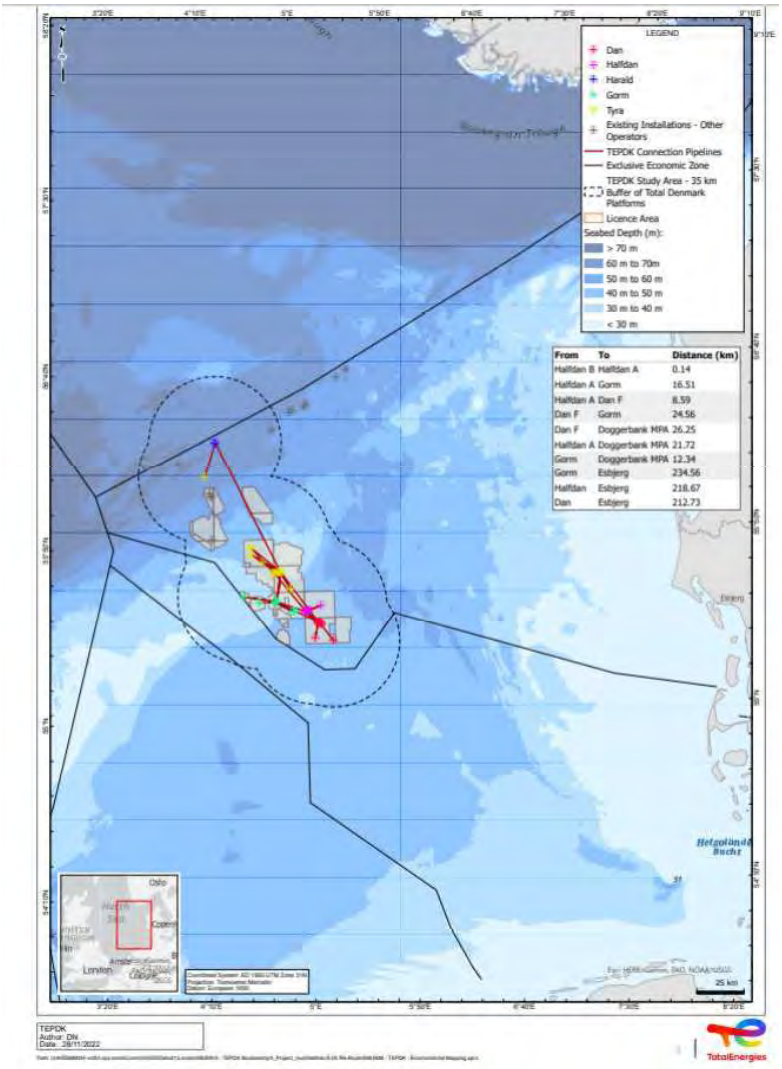
*10) Forventede tidspunkter for start og afslutning af bygge- og anlægsarbejder og for start af virksomhedens drift. Hvis ansøgningen omfatter planlagte udvidelser eller ændringer, jf. miljøbeskyttelseslovens § 36, oplyses tillige den forventede tidshorisont for gennemførelse af disse.*

Ikke relevant for det ansøgte projekt, da der ikke skal bygges eller anlægges.

## 5. D. Oplysninger om virksomhedens placering og driftstid

*11) Oversigtsplan i passende målestok med angivelse af virksomhedens placering i forhold til tilstødende og omliggende grunde. Planen forsynes med en nordpil.*

[1] BEK nr 372 af 25/04/2016




*12) Oplysning om virksomhedens daglige driftstid. Der angives desuden driftstid og -tidspunkter for de enkelte forurenende anlæg og aktiviteter, herunder støjkilder, hvis de afviger fra den samlede virksomheds driftstid. Hvis virksomheden er i drift på lørdage eller søn- og helligdage, skal dette oplyses.*

Anlægget drifter alle ugens dage. Der er jf. den revurderede miljøgodkendelse fra 2024 stillet vilkår om at anlægget kan drifte alle ugens dage. Der er ikke en begrænsning af driftstimer pr. døgn.

*13) Oplysninger om til- og frakørselsforhold samt en vurdering af støjbelastningen i forbindelse hermed.*

Dette punkt vurderes ikke at være relevant for det ansøgte projekt, da det er på havet.

## 6. E. Tegninger over virksomhedens indretning

*14) Den tekniske beskrivelse, jf. punkt F og H, skal ledsages af tegninger, der i relevant omfang viser følgende:*

*– Placering af alle bygninger og andre dele af virksomheden på ejendommen.*

*– Produktions- og lagerlokalers placering og indretning, herunder placering af produktionsanlæg m.v.*

*– Hvis der foretages arbejde udendørs, angives placeringen af dette.*

*– Placering af skorstene og andre luftafkast.*

*– Placering af støj- og vibrationskilder.*

*– Virksomhedens afløbsforhold, herunder kloakker, sandfang, olieudskillere, brønde og tilslutningssteder til spildevandsforsyningsselskabet*

*– Befæstede arealer.*

*– Placering af oplag af råvarer, hjælpestoffer og affald, herunder overjordiske såvel som nedgravede tanke og beholdere til olie og kemikalier samt rørføring.*

*– Interne transportveje.*

*Tegningerne skal forsynes med målestok og nordpil.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

## 7. F. Beskrivelse af virksomhedens produktion

*15) Oplysninger om samlet produktionskapacitet samt art og forbrug af råvarer, energi, vand og væsentlige hjælpestoffer, herunder mikroorganismer.*

Det ansøgte projekt medfører øget fuel-gasforbrug på (se i skema i afsnit 9.1) og en mindre gasafbrænding fra flare på Gorm-feltet.

*16) Systematisk beskrivelse af virksomhedens procesforløb, herunder materialestrømme, energiforbrug og -anvendelse, beskrivelse af de væsentligste luftforurenings- og spildevandsgenererende processer/aktiviteter samt affaldsproduktion. De enkelte forureningskilder angives på tegningsmaterialet.*

Det ansøgte projekt medfører øget fuel-gasforbrug på (se i skema i afsnit 9.1) og en mindre gasafbrænding fra flare på Gorm-feltet.

*17) Oplysning om energianlæg (brændselstype og maksimal indfyret effekt).*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*18) Oplysninger om mulige driftsforstyrrelser eller uheld, der kan medføre væsentlig forøget forurening i forhold til normal drift.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*19) Oplysninger om særlige forhold i forbindelse med opstart/nedlukning af anlæg.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

# 8. G. Oplysninger om valg af den bedste tilgængelige teknik (BAT)

*20) Redegørelse for, at der med de valgte teknikker med henblik på at begrænse råvare- og energiforbrug, affaldsfrembringelse og emissioner til luft, vand og jord er truffet de nødvendige foranstaltninger til at forebygge og begrænse forureningen ved anvendelse af BAT. Redegørelsen baseres på kriterierne i bilag 5.*

*I de tilfælde hvor der foreligger relevante BAT-konklusioner eller konklusioner i eksisterende BAT-referencedokumenter, jf. bilag 8, baseres redegørelsen på disse. En samlet oversigt over redegørelsens indhold findes på Miljøstyrelsens hjemmeside i form af BAT tjeklister.*

*Hvis der anvendes stoffer, som er optaget på "Listen over uønskede stoffer", skal der redegøres særskilt for, hvorfor disse ikke kan substitueres.*

Som nævnt medfører det ansøgte projekt øget fuel-gasforbrug som vist i skema i afsnit 9.1 og en mindre gasafbrænding fra flare på Gorm-feltet.

I og med der benyttes eksisterende turbiner, anses det ikke relevant at vurdere BAT for selve turbine-teknologierne ved denne ansøgning, og derfor heller ikke BAT-konklusionerne. Derfor redegøres der nedenfor i forhold til kriterierne i godkendelsesbekendtgørelsens bilag 5.

## 8.1 Anvendelse af teknologi, der resulterer i mindst muligt affald

Der dannes ikke affaldsstoffer fra gasfyring. Den væsentligste affaldsdannelse vil derfor være bortskaffelsen af selve turbineanlægget, når levetiden er slut. En lang levetid begrænser affaldsdannelsen og opnås ved regelmæssigt vedligehold, hvilket TotalEnergies sørger for via sine vedligeholdelsesplaner.

## 8.2 2) af mindre farlige stoffer

Mindre relevant, da der ikke anvendes farlige stoffer.

## 8.3 3) Fremme af teknikker til nyttiggørelse og genanvendelse af stoffer, der produceres og forbruges i processen, og i relevant omfang affald

Som beskrevet i afsnit 7.4.1.1 i BREF-dokumentet for store fyringsanlæg, anses forbrænding af gas via flare som et nødvendig alternativ, hvis bedre muligheder for anvendelsen af gassen ikke er muligt. Det anses derfor som en miljøfordel og BAT, hvis man kan begrænse denne flare, da man derved nyttiggør gas.

Det ansøgte projekt medfører som nævnt mindre brug af flare, se afsnit H.

## 8.4 4) Sammenlignelige processer, indretninger eller driftsmetoder, som er gennemprøvet med et tilfredsstillende resultat i industriel målestok.

Relevant i forhold til emissioner, se afsnit H.

## 8.5 Teknologiske fremskridt og udviklingen i den videnskabelige viden

Relevant i forhold til emissioner, se afsnit H.

## 8.6 De pågældende emissioners art, virkninger og omfang.

NOx reguleres af miljølovgivningen. NOx bidrager til smogdannelse og overgødskning og ønskes derfor generelt begrænset.

$CO_2$ reguleres af kvotehandelsreglerne, det bidrager til klimaeffekt og ønskes derfor generelt begrænset.

De to projekter påvirker driften af de eksisterende turbiner og de deraf følgende emissioner, som beskrevet i afsnit H.

### 8.7 Datoerne for nye eller bestående anlægs ibrugtagning.

Der er ikke tale om at nye eller bestående anlæg tages i brug, derfor ikke relevant.

### 8.8 Den tid, der er nødvendig for indførelse af BAT

Det vurderes ikke, at det er nødvendigt at indføre nye teknikker i forhold til BAT, derfor ikke relevant.

### 8.9 Forbruget og arten af råstoffer, herunder vand, der forbruges i processen, og energieffektiviteten.

Der er en direkte sammenhæng mellem fuel-gasforbrug og $CO_2$-emission. Samlet set sparer de to projekter på gasforbrug og $CO_2$-emission. Der forbruges ikke vand eller andre råstoffer.

### 8.10 Behovet for at forhindre eller begrænse emissionernes samlede risiko for påvirkning af miljøet til et minimum.

Relevant i forhold til emissioner, se afsnit H.

### 8.11 Informationer, som offentliggøres af offentlige internationale organisationer, herunder BAT-referencedokumenter, i det omfang disse er relevante for den pågældende type af virksomhed.

EU-Kommissionens BAT-konklusioner for store fyringsanlæg dækker turbiner med en samlet nominel indfyret effekt på mere end 50 MW. Som omtalt betyder de to projekter ikke at der ændres på fyringsanlæggene. Der ændres udelukkende på driften af dem. Derfor vurderes det ikke, at der er behov for at gennemgå BAT-konklusionerne i forhold til de to projekter.

## 9. H. Oplysninger om forurening og forureningsbegrænsende foranstaltninger

### 9.1 Luftforurening

*21) For hvert enkelt stof eller stofklasse angives massestrømmen for hele virksomheden og emissionskoncentrationen fra hvert afkast, som er nævnt under punkt 14. Der angives endvidere emissioner af lugt og mikroorganismer. For de enkelte afkast angives luftmængde og temperatur.*

*Stofklasser, massestrøm og emission angives som anført i Miljøstyrelsens gældende vejledninger om begrænsning af lugt- og luftforurening fra virksomheder.*

*For mikroorganismer oplyses det systematiske navn, generel biologi og økologi, herunder eventuel patogenicitet, samt muligheder for overlevelse/påvirkning af det ydre miljø. Koncentrationen af mikroorganismer i emissionen angives.*

*Beskrivelse af de valgte rensningsmetoder og rensningsgraden for de enkelte tilførte stoffer og mikroorganismer.*

Nedenstående tabel viser den ændrede emission fra de tre turbiner, der er påvirket af de to gennemførte projekter (HDAORR og HBA-27). Det ses, at der er en merudledning på 30,9 ton NOx pr. år fra turbinerne påvirket af HDAORR projektet, og 38,5 ton NOx pr. år fra turbinerne påvirket af HBA-27 projektet.

Herudover ses det, at der er en reduceret udledning af $CO_2e$ på 26.200 ton pr. år i forbindelse med HDAORR projektet. Dette skyldes, at anvendelsen af flare på Gorm platformen reduceres. Ligeledes ses det af tabellen, at der er en stigning på 5.100 ton $CO_2e$ pr. år for HBA-27 projektet.

Samlet set udledes der 69,4 ton mere NOx pr. år fra de tre turbiner der er påvirket af de to projekter. Den samlede udledning af $CO_2e$ reduceres med 21.100 ton pr. år.

| Påvirkede turbiner | HDAORR emission, ton NOx/år | HBA-27 emission, ton NOx/år | HDAORR $CO_2$ emission, GHG, ton $CO_2e$/år | HBA-27 $CO_2$ emission, GHG, ton $CO_2e$/år |
|---|---|---|---|---|
| **HDAF-A-4301 (Halfdan A)** | 23,1 | 0,0 | 5000 | 0 |
| **HBDC-A-4352 (Halfdan B)** | 0,0 | 0,0 | 0 | 0 |
| **DFG-A-4302 (Dan FG)** | 7,8 | 38,5 | 1000 | 5.100 |
| **Gorm flare (Gorm D)** | - | - | -32.300 | - |
| **Samlede emissioner** | **30,9** | **38,5** | **-26.233** | **5.072** |

*22) Oplysninger om virksomhedens emissioner fra diffuse kilder.*

Ikke relevant ift. det ansøgte projekt, da projektet ikke medfører diffuse kilder.

*23) Oplysninger om afvigende emissioner i forbindelse med opstart/nedlukning af anlæg.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*24) Beregning af afkasthøjder for hvert enkelt afkast med de beregningsmetoder, der er angivet i Miljøstyrelsens gældende vejledninger om begrænsning af lugt- og luftforurening fra virksomheder.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

## 9.2 Spildevand

*25) Hvis der søges om tilladelse til at aflede spildevand, skal virksomheden give følgende basisoplysninger for hver spildevandstype:*

*– Oplysning om oprindelse, herunder om der f.eks. er tale om produktionsspildevand, overfladevand, husspildevand, kølevand m.m.*

*– Oplysninger om maksimal mængde af spildevand afledt pr. døgn og pr. år samt variationen i afledningen over døgn, uge, måned eller år.*

*– Oplysning om, hvorvidt spildevandet ønsket afledt til spildevandsforsyningsselskabets spildevandsanlæg eller udledt direkte til vandløb, søer eller havet eller andet.*

*– Oplysninger om temperatur, pH og koncentrationer af forurenende stoffer samt oplysning om eventuelle mikroorganismer.*

*– Oplysning om art og kapacitet af renseforanstaltninger, herunder sandfang og olieudskillere.*

*– Beskrivelse af de valgte rensningsmetoder og rensningsgraden for de enkelte tilførte stoffer og mikroorganismer.*

Det ansøgte projekt ændrer ikke på de eksisterende forhold omkring spildevand.

*26) Hvis der søges om tilladelse til direkte udledning af stoffer til vandløb, søer eller havet, kan miljømyndigheden kræve yderligere oplysninger, jf. den til enhver tid gældende bekendtgørelse om krav til udledning af forurenende stoffer til vandløb, søer eller havet samt bekendtgørelse om spildevandstilladelser m.v. efter miljøbeskyttelseslovens kapitel 3 og 4.*

*Hvis virksomheden ønsker at udlede 22 tons kvælstof eller 7,5 tons fosfor pr. år eller derover til vandløb, søer eller havet, skal ansøgningen tillige ledsages af de oplysninger, der fremgår af den til enhver tid gældende bekendtgørelse om spildevandstilladelser m.v. efter miljøbeskyttelseslovens kapitel 3 og 4.*

Dette punkt er ikke relevant ift. det ansøgte projekt, da der ikke søges de omtalte tilladelser.

## 9.3 Støj

*27) Beskrivelse af støj- og vibrationskilder (inkl. lavfrekvent støj og infralyd), herunder intern kørsel og transport samt udendørs arbejde og materialehåndtering.*

Der er redegjort for støjforhold i forhold til det marine miljø i bilag 1 og 2.

*28) Beskrivelse af de planlagte støj- og vibrationsdæmpende foranstaltninger både for de enkelte støj- eller vibrationsfremkaldende anlæg, maskiner og køretøjer til intern transport og for virksomheden som helhed.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*29) Beregning af det samlede støjniveau i de mest støjbelastede punkter i naboområderne udført som »Miljømåling - ekstern støj« efter Miljøstyrelsens gældende vejledninger om støj.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

## 9.4 Affald

*30) Oplysninger om sammensætning og årlig mængde af virksomhedens affald, herunder farligt affald.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*31) Oplysninger om, hvordan affaldet håndteres og opbevares på virksomheden (herunder affald der indgår i virksomhedens produktion) og om mængden af affald og restprodukter, som oplagres på virksomheden.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

## 9.5 Jord og grundvand

*32) Beskrivelse af de foranstaltninger, der er truffet til beskyttelse af jord og grundvand i forbindelse med henholdsvis håndtering og transport af forurenende stoffer, oplagspladser for fast eller flydende affald samt nedgravede rør, tanke og beholdere. Der skal oplyses om typen af belægning (materialer og udførelse) for virksomhedens befæstede arealer.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*33) Redegørelse for om virksomheden er omfattet af kravet om udarbejdelse af basistilstandsrapport, jf. bekendtgørelsens § 15, og den til enhver tid gældende vejledning om basistilstandsrapport og ophørsforanstaltninger.*

Kravet om basistilstandsrapport i godkendelsesbekendtgørelsen vedrører virksomheder, som bruger, fremstiller eller frigiver relevante farlige stoffer, som påvirker jordens eller grundvandets tilstand med hensyn til forurening. De ansøgte projekter foregår på havet og vedrører derfor havbund, men ikke jord og grundvand. Punktet er derfor ikke relevant.

# 10. I. Forslag til vilkår om egenkontrol

*34) Virksomhedens forslag til vilkår og egenkontrolvilkår for virksomhedens drift, herunder vedrørende risikoforholdene.*

*Egenkontrolvilkår bør indeholde:*

*– Forslag til kontrolmålinger, herunder prøvetagningssteder samt moniteringsprogram for jord og grundvand.*

*– Forslag til rutiner for vedligeholdelse og kontrol af rensningsforanstaltninger.*

*– Forslag til metoder til identifikation og overvågning af de aktuelle mikroorganismer i produktionen og i omgivelserne.*

*– Forslag til overvågning af parametre, der har sikkerhedsmæssig betydning.*

*Hvis virksomheden har et miljøledelsessystem, opfordres til at koordinere forslag til egenkontrolvilkår med miljøledelsessystemets rutiner.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

# 11. J. Oplysninger om driftsforstyrrelser og uheld

*35) Oplysninger om særlige emissioner ved de under punkt 18 nævnte driftsforstyrrelser eller uheld.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*36) Beskrivelse af de foranstaltninger, der er truffet for at imødegå driftsforstyrrelser og uheld.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

*37) Beskrivelse af de foranstaltninger, der er truffet for at begrænse virkningerne for mennesker og miljø af de under punkt 18 nævnte driftsforstyrrelser eller uheld.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

## 12. K. Oplysninger i forbindelse med virksomhedens ophør

*38) Oplysninger om, hvilke foranstaltninger ansøgeren agter at træffe for at forebygge forurening i forbindelse med virksomhedens ophør.*

Det ansøgte projekt ændrer ikke på de nuværende forhold ift. dette punkt.

## 13. L. Ikke-teknisk resume

*39) Oplysningerne i ansøgningen skal sammenfattes i et ikke-teknisk resume.*

De to projekter medfører ændret drift af fyringsanlæg på platformene. Dette giver anledning til øget NOx emission fra nogle fyringsanlæg, men det reducerer samtidig afbrænding af gas via flare og dermed $CO_2$e-emissionerne.

## 14. Bilag

Bilag 1: Halfdan Oil Re-Route Project - Environmental Impact Assessment Screening Report, 2023

Bilag 2: Halfdan Tor NE and Ekofisk In-fill Wells Project - Environmental Impact Assessment Screening Report, 2023

# Halfdan Oil Re-Route Project

## Environmental Impact Assessment Screening Report

TotalEnergies EP Danmark A/S

31 January 2023

Project No.: 0663988

*The business of sustainability*

ERM

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## Signature Page

31 January 2023

# Halfdan Oil Re-Route Project

## Environmental Impact Assessment Screening Report

Matteo Veronesi
Project Director

Environmental Resources Management Limited
2nd Floor, Exchequer Court
33 St Mary Axe
London
EC3A 8AA

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## Acronyms and Abbreviations

| Name | Description |
|---|---|
| ALARP | As Low As Reasonably Practicable |
| BRL | Background Reference Level |
| BOEPD | Barrels of Oil Equivalent per Day |
| COP | Cessation of Production |
| DEA | Danish Energy Agency |
| DEPA | Danish Environmental Protection Agency |
| DSA | Danish Subsoil Act |
| DUC | Danish Underground Consortium |
| DWEA | Danish Working Environment Authority |
| EEZ | Exclusive Economic Zone |
| EIA | Environmental Impact Assessment |
| EIF | Environmental Impact Factor |
| EnS | Environmental Status |
| EPA | Environmental Protection Act |
| ERL | Effects Range Low |
| ESIS | Environmental and Social Impact Statement |
| EU | European Union |
| GES | Good Environmental Status |
| GHG | Greenhouse Gas |
| HDA | Halfdan A |

| Name | Description |
|---|---|
| HBA | Halfdan B |
| HCA | Halfdan C |
| HDB | Halfdan A Accommodation Platform |
| HDC | Halfdan A gas flare stack |
| HBA | Halfdan B Wellhead Platform A |
| HBB | Halfdan B Wellhead Platform B |
| HBC | Halfdan B Accommodation Platform |
| HBD | Halfdan B Processing Platform |
| HCA | Halfdan C Unmanned Wellhead Platform |
| HOCNF | Harmonised Offshore Chemical Notification Format |
| HP | High Pressure |
| IBAs | Important Bird Areas |
| MMbbls | Million Barrels |
| MMSR | Marine Mammal Sighting Reporting program |
| MPAs | Marine Protected Areas |
| MSFD | Marine Strategy Framework Directive |
| NOVANA | National Monitoring Program for Water Environment and Nature |
| OSPAR | Oil Spill Prevention, Administration and Response |
| PCB | Polychlorinated Biphenyls |
| PCV | Pressure Control Valve |
| PFOS | Perfluorooctane sulfonate |
| PLONOR | Poses Little or No Risk |
| PNEC | Predicted No-effect Concentration |
| ppm | Part per million |
| PR | Product Registry |
| SCI | Site of Community Importance |
| SPAs | Special Protection Area |
| TEPDK | TotalEnergies EP Danmark A/S |
| UK | United Kingdom |

# EXECUTIVE SUMMARY

The Halfdan Oil Re-Route project includes facilities that are part of the HALFDAN, DAN and GORM Fields in the south eastern part of the Danish North Sea, approximately 210 kilometers from the western coast of Denmark. TEPDK operates the facility on behalf of the Danish Underground Consortium (DUC).

This screening report describes the modifications required for the rerouting of Halfdan oil to Gorm for final stabilization and export, ceasing routine flaring on Gorm and reducing Green House Gas (GHG) emissions.

The project aims at eliminating routine flaring at the Gorm facilities. This is in line with the TotalEnergies commitment on near-zero routine flaring and the expected ban on routine flaring in Denmark by July 2023. In addition to the above, the Gorm Field is expected to cease production in the upcoming years. The Halfdan Oil Re-Route project will therefore provide an alternative production export route for Halfdan semi stabilised oil.

The combined Halfdan oil export shall thus be rerouted away from Gorm and to Dan F facility utilising the existing low pressure gas export from Halfdan A to Dan FF with a small gas export stream from Halfdan A spiked into the oil export system. Therefore, the project mainly consists in rerouting fluids between TEPDK operating hubs, repurposing an existing pipeline between Halfdan A and Dan F (service change), mothballing a pipeline between Halfdan A and Gorm, and facilities modifications on Halfdan A and Dan F platforms.

To facilitate this, the project will use the existing gas pipeline (12” P3013 LP) between HDA and Dan FF, whereby both Halfdan A and Halfdan B semi-stabilised oil production will be exported to the 12” P3013 pipeline on HDA instead of to the Gorm pipeline (E 14” P4301).

In addition to repurposing an existing pipeline, the project will involve minor modifications on Dan FF. The existing gas pipeline inlet (12” P3013 LP) will be modified to allow installation of an inlet valve for start-up and slug control, and to provide a single production path to the Dan FG High Pressure (HP) separator. The Halfdan A and B commingling semi-stabilised export oil and HDA $H_2S$ rich spike-gas will be separated in the Dan FG HP separator and Dan FF Low Pressure (LP) separator before it is pumped together with Dan stabilised oil via the Gorm 10” pipeline P3002 and exported to shore.

The 14” P4301 pipeline to Gorm and launcher will be isolated and left spare on HDA. Following this project, there will be no production export route between Halfdan A and Gorm.

The HDC end of pipeline 24” P4307 and launcher will be left spare on HDC.

The Tyra Redevelopment project will use part of this pipeline system to provide Gorm with fuel gas supply from Halfdan B.

## Requirements

Screening of the proposed Halfdan Oil Re-Route Project has been conducted according to measures described in the Environmental Impact Assessment (EIA) Directive 2014/52/EU and Directive 2011/92/EC and implemented by Denmark through the Environmental Assessment Act LBK number 4 of 3 January 2023.

The screening assessment in this report has been undertaken in the following stages:

- Review of the regulatory requirements of the EU and Denmark;
- Review of the environmental sensitivities of the site surroundings;
- Identification of the characteristics of the potential impacts;
- High level assessment of the scale and significance of the impacts; and
- Conclusions.

Impacts assessed due to the Halfdan Oil Re-Route project come under Annex II, where a screening report determines whether the impacts identified are likely to be significant and would require a full EIA.

## Sensitivities

The location of the existing facilities and the location of the proposed modifications is outside any of the following sensitive areas in the North Sea:

- Marine Protected Areas (MPAs);
- Nature Reserves, Natura 2000 sites;
- Important Bird Areas (IBAs); and
- Special Protection Areas (SPAs) of the North Sea.

The closest protected area is the Doggerbank Nature Reserve (MPA, Natura 2000) located approximately 17 km southwest of the Gorm facilities. Sensitive species that may be present in the waters near the Halfdan Oil Re-Route project area include breeding and non-breeding seabirds and migrating, and resident, whales and dolphins.

The North Sea is one of the busiest shipping areas in the world; vessel movement between ports and transit traffic account for most of this activity.

The fishing industry in the North Sea has a large economic influence on Norway, Denmark, the United Kingdom and the Netherlands. Fish species that support some fisheries, include cod, whiting, mackerel, sandeel and plaice, and have spawning areas around the site.

## Impacts

Potential causes of impacts due to the planned Halfdan Oil Re-Route project activities are:

- Discharges (eg. chemical);
- Emissions (positive impact for GHG emission reduction due to the cessation of routine flaring); and
- Restricted zones around the platforms.

## Conclusion

This screening assessment has considered the potential impacts due to the Halfdan Oil Re-Route project on the relevant receptors The likely environmental impacts due to the Halfdan Oil Re-Route project have been assessed in this screening report and the outcomes range from Negligible to Minor. A positive impact from GHG reduction due to the cessation of routine flaring at Gorm is also expected. None of the impacts from the Halfdan Oil Re-Route project activities will cause significant environment impacts of a magnitude which would require a standalone EIA.

The Halfdan Oil Re-Route activities will not take place within a sensitive area, as defined by EIA regulations, and will not increase the cumulative impacts due to activities around the Gorm, Dan and Halfdan facilities.

There will be no significant impacts on the Descriptors set by the EU's Marine Strategy Framework Directive, implemented in Danish law by the Marine Strategy Act (LBK 1161 of 25/11/2019); project's environmental impact will not hinder the achievement of good environmental status for the relevant descriptors.

# SAMMENFATNING

Halfdan Oil Re-Route projektet omfatter faciliteter, der er en del af HALFDAN-, DAN- og GORM-felterne i den sydøstlige del af den danske Nordsø, cirka 210 kilometer fra Danmarks vestkyst. TEPDK driver anlægget på vegne af Danish Underground Consortium (DUC).

Denne screeningsrapport beskriver de modifikationer, der kræves for at omdirigere Halfdan A (HDA) olien til Gorm med henblik på endelig stabilisering og eksport, standsning af rutinemæssig flaring på Gorm og reduktion af drivhusgasemissioner (GHG).

Projektet har til formål at eliminere rutinemæssig flaring på Gorm-anlæggene. Dette er i overensstemmelse med TotalEnergies' forpligtelse til ”near-zero” rutinemæssig flaring og det forventede forbud mod rutinemæssig afbrænding i Danmark i juli 2023. Ud over ovenstående forventes Gorm-feltets produktionophør (COP) i de kommende år Halfdan Re-Route projektet vil give en alternativ produktionseksportrute for Halfdan semistabiliseret olie.

Den kombinerede Halfdan-olieeksport skal således omledes fra Gorm og til Dan F-anlægget ved at udnytte den eksisterende lavtryksgaseksport fra Halfdan A til Dan FF med en lille gaseksportstrøm fra Halfdan A, der er spiket ind i olieeksportsystemet. Projektet består derfor hovedsagelig i omledning af væsker mellem TEPDK's driftshubs, omlægning af en eksisterende rørledning mellem Halfdan A og Dan F (serviceændring), nedlæggelse af en rørledning mellem Halfdan A og Gorm og ændringer af faciliteterne på Halfdan A og Dan F-platformene.

For at lette projektet vil man gøre brug af den eksisterende gasrørledning (12” P3013 LP) mellem HDA og Dan FF, hvorved både Halfdan A og Halfdan B's halvstabiliserede olieproduktion vil blive eksporteret til 12" P3013-rørledningen på HDA i stedet for til Gorm-rørledningen (E 14" P4301).

Ud over genanvendelsen af den eksisterende rørledning vil projektet indebære mindre ændringer på Dan FF.Den eksisterende gasrørledningsindgang (12” P3013 LP) vil blive modificeret for at tillade installation af en indløbsventil til opstart og slug-kontrol og for at skabe en enkelt produktionsvej til Dan FG High Pressure (HP) separatoren. Blandet semistabiliseret eksportolie fra Halfdan A og B og H2S-holdig spike-gas fra HDA vil blive separeret i Dan FG HP separatoren og Dan FF Low Pressure (LP) separatoren, før det pumpes sammen med stabiliseret olie fra Dan via Gorm 10" rørledning P3002 og eksporteres til land.

14” P4301-rørledningen til Gorm og pig launcher vil blive isoleret og efterladt som reserve på HDA. Efter dette projekt vil der ikke være nogen produktionseksportrute mellem Halfdan A og Gorm.

HDC-enden af 24" rørledningen P4307 og pig launcher vil blive efterladt som reserve på HDC.

Tyra Future-projektet har leveret Halfdan B brændstofgasforsyning til Gorm ved hjælp af en del af dette rørledningssystem.

## Lovkrav

Screening af det foreslåede Halfdan Re-Route projekt er udført i overensstemmelse med foranstaltninger beskrevet i VVM-direktivet 2014/52/EU og direktiv 2011/92/EF, som er implementeret af Danmark gennem lov om miljøvurdering LBK nr. 4 af 3. januar 2023.

Screeningsvurderingen i denne rapport er foretaget i følgende faser:

- Gennemgang af EU's og Danmarks lovgivningsmæssige krav;
- Gennemgang af de miljømæssige følsomheder i områdets omgivelser;
- Identifikation af karakteristika ved de potentielle påvirkninger;
- Vurdering på højt niveau af omfanget og betydningen af påvirkningerne;
- Konklusioner.

Vurderingen af påvirkninger fra Halfdan Re-Route projektet falder ind under Bilag II i miljøvurderingsloven, hvor en screeningsrapport afgør, om de identificerede påvirkninger sandsynligvis vil være betydelige og vil kræve en fuldstændig VVM.

## Følsomme områder

Placeringen af de eksisterende faciliteter og placeringen af de foreslåede ændringer ligger uden for følgende følsomme områder i Nordsøen:

- Marine beskyttede områder (MPA);
- Naturreservater, Natura 2000-områder;
- Vigtige fugleområder (IBA'er);
- Særlige beskyttelsesområder (SPA'er) i Nordsøen.

Det nærmeste beskyttede område er Doggerbanke naturreservat (MPA, Natura 2000) beliggende cirka 17 kilometer sydvest for Gorm-anlæggene. Følsomme arter, der kan være til stede i farvandet nær Halfdan Re-Route projektområdet, omfatter ynglende og ikke-ynglende havfugle og vandrende og fastboende hvaler og delfiner.

Nordsøen er et af de travleste skibsfartsområder i verden; skibsbevægelser mellem havne og transittrafik tegner sig for størstedelen af denne aktivitet.

Fiskeindustrien i Nordsøen har stor økonomisk indflydelse på Norge, Danmark, Storbritannien og Holland. Fiskearter, der understøtter nogle fiskerier, omfatter torsk, hvilling, makrel, tobis og rødspætte, og har gydeområder omkring stedet.

## Påvirkninger

Potentielle årsager til påvirkninger som følge af de planlagte Halfdan Re.Route projektaktiviteter er:

- Udledninger (f.eks. kemikalier);
- Emissioner (positiv effekt for reduktion af drivhusgasemissioner som følge af ophør af rutinemæssig flaring); og
- Begrænsede zoner omkring perronerne

## Konklusion

Denne screeningsvurdering har taget højde for de potentielle påvirkninger som følge af Halfdan Re-Route projektet på de relevante receptorer, og resultaterne spænder fra Ubetydelig til Mindre betydelig. Der forventes også en positiv effekt fra reduktion af drivhusgasser som følge af ophør med flaring på Gorm. Ingen af påvirkningerne fra Halfdan Re-Route-projektets aktiviteter vil forårsage væsentlige miljøpåvirkninger af en størrelsesorden, som ville kræve en selvstændig VVM.

Halfdan Re-Route aktiviteterne vil ikke finde sted inden for et følsomt område, som defineret af VVM-reglerne, og vil ikke øge de kumulative påvirkninger som følge af aktiviteter omkring Gorm-, Dan- og Halfdan-anlæggene.

Der vil ikke være væsentlige indvirkninger på Deskriptorerne fastsat af EU's havstrategirammedirektiv, implementeret i dansk ret ved havstrategiloven (LBK 1161 af 25/11/2019); projektets miljøpåvirkning vil ikke være til hinder for opnåelse af god miljøtilstand for de relevante deskriptorer.

# 1. INTRODUCTION

## 1.1 Proposed Activities

The HALFDAN, DAN and GORM Fields offshore Denmark are operated by TotalEnergies EP Danmark A/S (TEPDK) on behalf of the Danish Underground Consortium (DUC). TEPDK's operated share of the DUC is 43.2 percent (%), the other partners of the consortium are Noreco (36.8%) and Nordsøfonden (20%, owned by the Danish State).

The HALFDAN Field is located in the south-western part of the Danish North Sea, approximately 216 kilometers (km) west of Esbjerg. The Halfdan Complex comprises Halfdan A (HDA) and Halfdan B (HBA) and the satellite production platform Halfdan C (HCA) that are connected by subsea pipelines, through which produced water, oil and gas are transported from the Halfdan facilities to other field facilities for further processing and export.

The DAN Field is located in the south-western part of the Danish North Sea, approximately 210 km west of Esbjerg and 9 km south-east of HALFDAN Field. The water depth at the DAN Field ranges from approximately 41 to 44 m. The existing components at the DAN Field comprise the Dan F facilities and its satellite platforms Dan B, Dan E, Kraka and the decommissioned subsea wellhead Regnar.

The GORM Field is located 234 km west of Esbjerg and 17 km north-west of Halfdan A. Gorm Field started production in 1981 and today the production facilities consist of two wellhead platforms (Gorm A, Gorm B), a riser platform (Gorm E), a flare stack (Gorm D), a process/accommodation platform (Gorm C), and a process/wellhead platform (Gorm F). Internal bridges connect all Gorm platforms. The Skjold Field is a manned satellite platform consisting of two wellhead platforms and an accommodation platform (all bridge linked) which started production in 1982. It is the main oil export hub for the DUC facilities and is the primary location for DUC produced water injection. The Gorm hub provides final stabilization to Halfdan crude petroleum.

This screening report has been prepared to describe the modifications required for the Halfdan Oil Re-Route project which comprises rerouting Halfdan oil to Gorm for final stabilization and export, and eliminating routine (and overall) flaring on Gorm C thereby decreases GHG emissions.

## 1.2 Requirement for Screening

The Environmental Impact Assessment (EIA) Directive (2014/52/EU) requires a high-level review of the potential impacts a project may have on the environment during a screening stage to determine whether an EIA is necessary. Screening projects in the marine environment should consider the characteristics and technologies used to ensure a high level of environmental protection is afforded to marine habitats and species. This document provides the necessary information for the Danish Energy Agency (DEA) to carry out a materiality assessment, in reference to the offshore impact assessment order section 4, subsection 4, ref. subsection 1, or a screening decision in accordance with the Environmental Assessment Act section 21.

Various modelling and risk assessment studies cover impacts due to the activities of the currently existing HALFDAN, DAN and GORM Field facilities, including pipeline modifications, and other modifications. This screening report considers those previously approved (eg, discharge permits) and assesses any potential impact that could arise from this Project's activities.

This screening report describes the Halfdan Oil Re-Route project, which comprises pipeline rerouting to stop routine flaring at Gorm C, that is likely to have a significant effect on the environment. Further detail is provided in Section 2– Characteristics of the Project.

Impacts due to the Halfdan Oil Re-Route project assessed come under Annex II, where a screening report determines whether the impacts identified are likely to be significant and would require a full EIA.

## 1.3 Regulatory Framework

Screening is a set process under the EU Directive 2011/92/EC and implemented by Denmark through the Environmental Assessment Act LBK number 4 of 3 January 2023. The legal basis for the screening (The DEA has assessed that the proposed project is covered by the Environmental Assessment Act annex 2, paragraph 2, point (d), Deep drilling, and the Environmental Assessment Act, annex 2, paragraph 13, point (a), Changes or extensions of projects in the Environmental Assessment Act annex 2, which have already been approved, have been carried out or are in the making of being carried out, when they may have significant adverse effects on the environment). Thereby requiring a screening under LBK number 4 of 3rd January 2023. Factors to be considered at the screening stage are as follows:

- If the Project is an Annex 1 development, as described in the EIA Directive;
- If the Project is an Annex 2 development, whether:
  - any part of the Project is in a sensitive area;
  - the Project meets any threshold in Annex 2; or
  - there are likely to be significant effects on the environment.

This report's format is based on the EC Environmental Impact Assessment of Projects Guidance on Screening 2017 (Directive 2011/92/EU as amended by 2014/52/EU), which is implemented in Denmark through the Environmental Assessment Act LBK number 4 of 3rd January 2023.

### *1.3.1 EU Legislation*

#### *1.3.1.1 EU EIA Directive*

The Environmental Impact Assessment (EIA) process is legislated through the Environmental Assessment Regulations, the principal enactment within the Environmental Protection Act (EPA) (Consolidated Act no. 879, 26 June 2010) and the implementation of the EU EIA Directive 2014/52/EU. Annexes 1 and 2 of the Regulations provide lists of activities for which an environmental permit is required, and an EIA report is mandatory.

The EIA directive is currently implemented in Denmark, inter alia, through the Consolidated Act on the Use of the Danish Subsoil 1533 of December 2019 and the Offshore EIA Administrative Order BEK 1050/2020.

This screening report determines whether the impacts identified due to the Halfdan Oil Re-Route project are likely to be significant and would require a full EIA.

#### *1.3.1.2 EU Habitats Directive*

The EU Habitats Directive (92/43/EEC) is adapted in Danish legislation through Order 434/2017 on Impact Assessment on International Nature Conservation Areas and Protection of Certain Species in Preliminary Studies, Exploration and Extraction of Hydrocarbons, Subsoil Storage, Pipelines, etc. offshore. It provides for the protection of species of importance, and this is discussed further in Section 4.3.

#### *1.3.1.3 Marine Strategy Framework*

The aim of the Marine Strategy Framework Directive (MSFD) (Havstrategidirektive) is to achieve "good environmental status" of the EU marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. It is a directive that is implemented in Danish law through the Marine Strategy Act (see Section 1.3.2.4).

## *1.3.2 Danish Legislation*

### *1.3.2.1 Danish Subsoil Act*

The Danish Subsoil Act (DSA) sets out the basic legal framework for the exploration and recovery activities concerning raw materials and hydrocarbons in the Danish subsoil and on the Danish continental shelf. Several of the provisions in the DSA implement EU directives. The Danish Subsoil Act is based on the view that the exploration for and recovery of Denmark's raw materials covered by the Act require comprehensive societal management.

The Danish Subsoil Act covers prospecting, exploration, exploitation, supervision and the Danish government's rights of purchasing hydrocarbons and any other use of the subsoil. All reservoirs of raw materials including hydrocarbons covered by the Act belong to the Danish state.

### *1.3.2.2 Danish Offshore Safety Act*

The consolidated Offshore Safety Act LBK 125 of 2018 for installations and connected infrastructure, and pipelines is the basis upon which an operating permit has been granted to TEPDK pursuant to section 28 of the Act.

The purpose of this Act is to promote a high level of health and safety offshore which is in accordance with technical and social developments in society, and to create a framework that allows enterprises themselves to address health and safety issues offshore. Under the Act, licensees must ensure that health and safety risks associated with offshore oil and gas activities are identified, assessed and reduced to as low as reasonably practicable.

### *1.3.2.3 Danish Regulatory Requirements*

The EU EIA Directive is implemented in Denmark through the Environmental Assessment Act LBK number 4 of 3rd January 2023. This law has the purpose of ensuring a high level of environmental protection through environmental assessment of plans, programs and by regulating permitting for projects that can have a significant impact on the environment. Section 19 states that the operator must submit an environmental impact report. Section 21 includes the screening decision which the authority makes based on the client’s application and indicates it is dependent on the consideration of required criteria for environmental assessment and permit (cf. annex 6). The DEA applies the criteria set out in annex 6 of the Environmental Assessment Act when reviewing environmental reports.

### *1.3.2.4 Marine Strategy Act*

The EU MSFD is implemented in Denmark through the Marine Strategy Act LBK number 1161 of 25th November 2019, which aims to establish the framework for achieving or maintaining Good Environmental Status (GES) in marine ecosystems, and enable sustainable use of marine resources. The Marine Strategy II is part of the implementation of the EU MSFD and the Danish Marine Strategy Act. The overall strategy covers the years 2018-2024 and it is developed by the Danish Agency of Water and Nature Management, now the Environmental Protection Agency, which is currently under the jurisdiction of the Ministry of Environment and Food. It encompasses Danish Sea zones such as waterbeds, seabed territories and exclusive economic areas. The Marine Strategy II comprises three parts, each part being revised every six years:

- Part 1: Good environmental status, initial analysis, environmental targets:
  - Aims to define good environmental status, provides an overview of the status in the sea and sets targets for the achievement of good environmental status, which is done the for eleven descriptors (described in Marine Strategy Act Appendix 2): D1 Biodiversity, D2 Non-indigenous species, D3 Commercially exploited fish stocks, D4 Marine food webs, D5 Eutrophication, D6 Sea floor integrity, D7 hydrographical changes, D8 Contaminants, D9 Contaminants in seafood for human consumption, D10 Marine litter, D11 Underwater noise;

- Part 2: Monitoring program:
  - Assess the state of the marine environment in relation to the environmental target set out in Part 1 of the Strategy. The monitoring program is mainly based on monitoring activities in the National Monitoring Program for Water Environment and Nature (NOVANA);
- Part 3: Program of measures;
  - Aims to contain concrete actions to achieve the set environmental targets and thus ensure the good marine environment in the future.

The assessment of the project activities on the eleven descriptors can be found in Section 4.6.

# 2. CHARACTERISTICS OF THE PROJECT

Characteristics of the Project in accordance with LBK 4, Appendix 6, Point 1.

## 2.1 Dimensions and Design of the Project

The Gorm Field's Cessation of Production (COP) is planned to occur circa 2025. Therefore, the Halfdan Oil Re-Route project provides an alternative production export route for Halfdan semi-stabilised oil.

The project will use the existing 12" P3013 LP gas pipeline between HDA and Dan FF (Figure 2.1). The current use of the 12" LP gas pipeline is for balancing the Halfdan A production fluctuation and excess (spike) $H_2S$ rich gas is exported from HDA via this pipeline to Dan FF where it can flow to either the Dan FF or Dan FG HP separator and further treatment. This arrangement is shown schematically in Figure 2.2.

The Halfdan Oil Re-Route project will exchange both the Halfdan A and Halfdan B semi-stabilised oil production export route from the Gorm E 14" P4301 pipeline to the 12" P3013 pipeline on HDA. By commingling semi-stabilised export oil with HDA IP compressed $H_2S$ rich spike gas, the HDA production balancing feature, whereby excess gas is exported, is maintained. Halfdan A gas compression train shutdown will lead to production shutdown to avoid flaring.

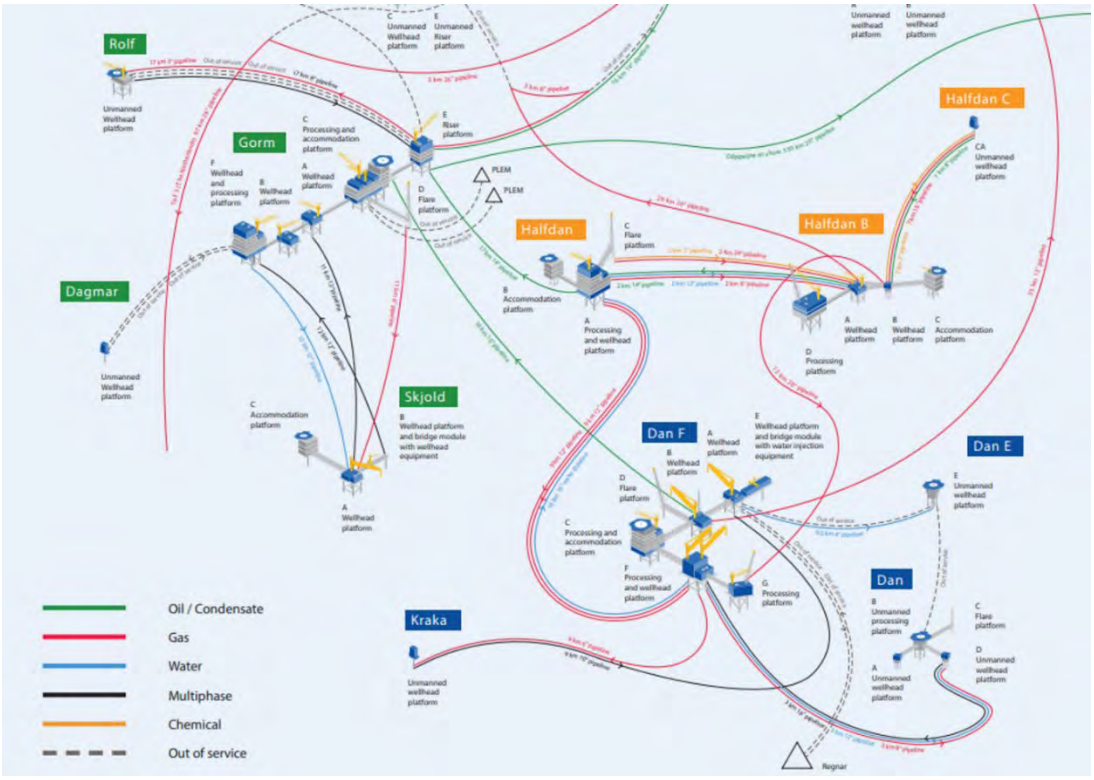
On Dan FF the existing 12" P3013 LP gas pipeline inlet will be modified to allow installation of an inlet valve for start-up and slug control and to provide a single production path to the Dan FG HP separator. The Halfdan A and B commingled semi-stabilised export oil and HDA $H_2S$ rich spike-gas will be separated in the Dan FG HP separator and the Dan FF LP separator before it is pumped together with the Dan stabilised oil via the Gorm 10" pipeline P3002 to shore.

The 14" P4301 pipeline to Gorm and launcher will be isolated and left spare on HDA. Following this project there will be no production export route between Halfdan A and Gorm.

The HDC end of the 24" P4307 pipeline and launcher will be left spare on HDC.

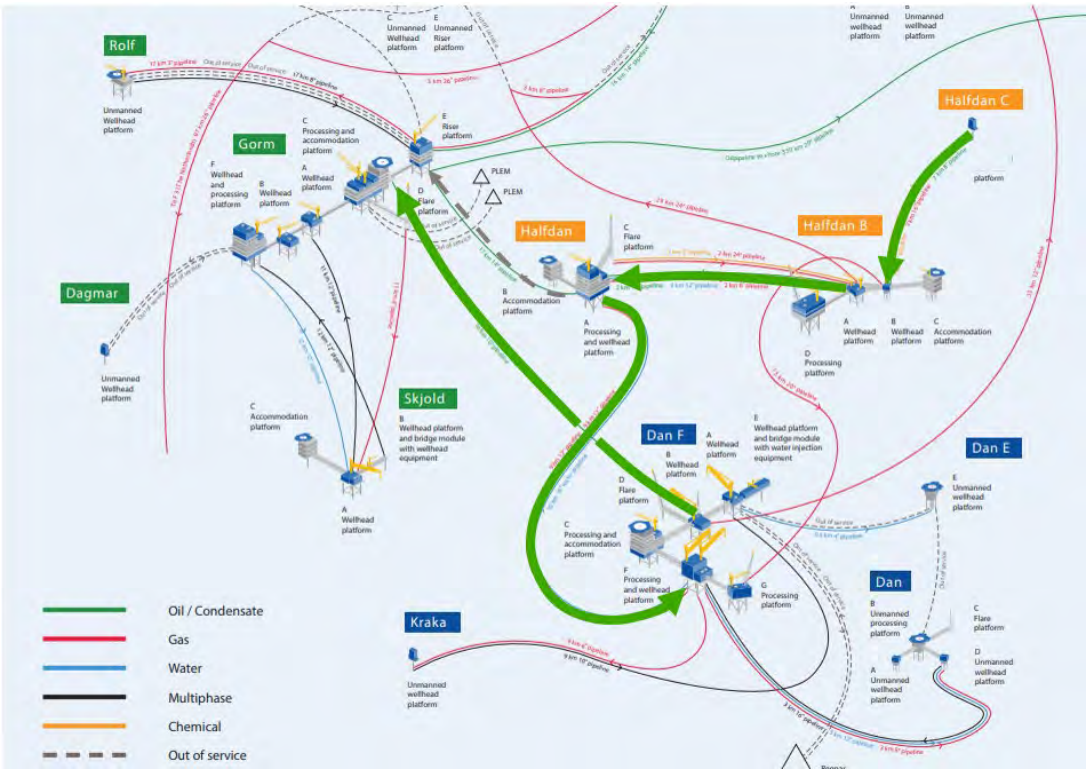
The Tyra Redevelopment project will use part of this pipeline system to provide Gorm with fuel gas supply from Halfdan B.

## Figure 2.1 Halfdan Export Before the Halfdan Oil Re-Route Project




Source: TEPDK, 2022

## Figure 2.2 Halfdan Export after the Halfdan Oil Re-Route Project




Source: TEPDK, 2022

### 2.1.1 HALFDAN Field Overview

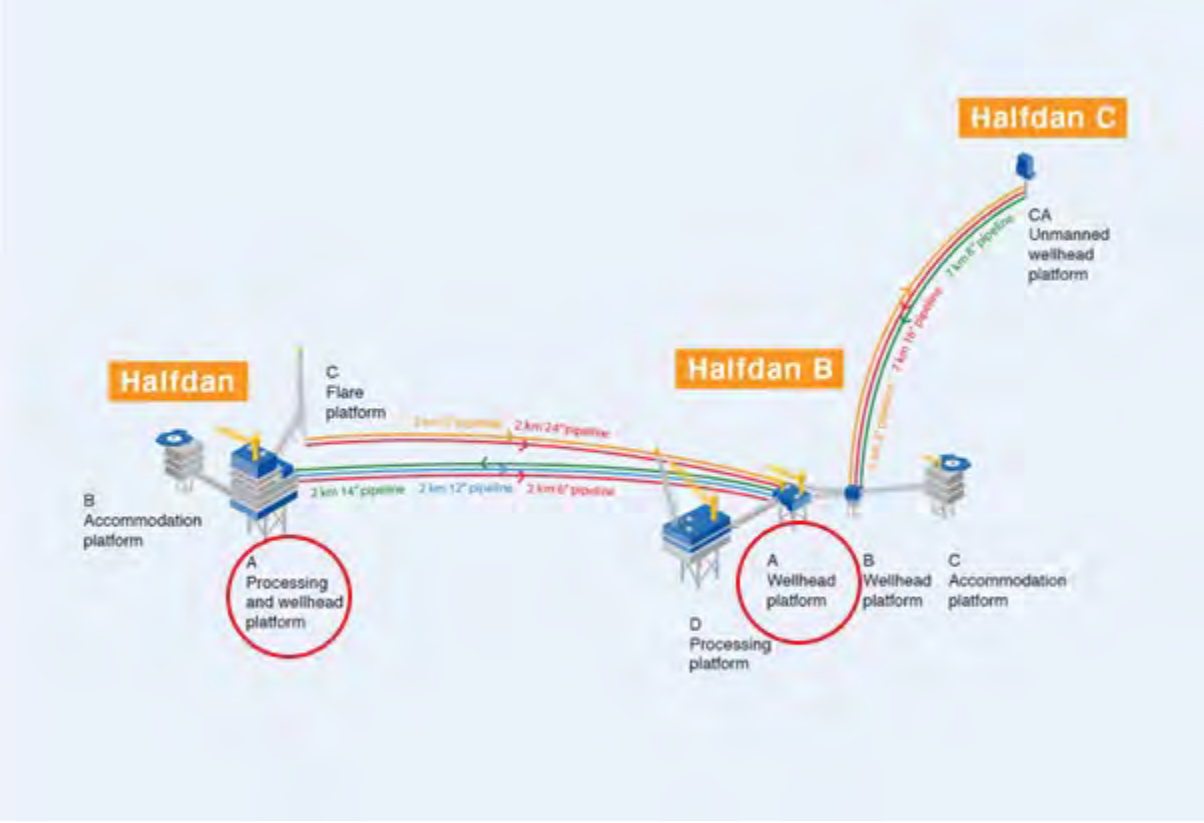
The Halfdan platforms include the main processing and production facilities, Halfdan A and Halfdan B, and the satellite platform Halfdan C. The Halfdan platforms are connected by subsea pipelines through which oil, gas and water are transported to Gorm and Tyra for further processing and export to shore (Figure 2.3) depicts an overview of the existing pipelines and infrastructure for the Halfdan Field.

The two main processes at the Halfdan facilities are the separation process and the gas compression and dehydration process conducted on Halfdan A and Halfdan B.

There are 82 wells in the Halfdan Field.

Figure 2.1 refers to the existing and planned activities at the production complex of HALFDAN, DAN and GORM Fields. The production facilities are connected by subsea pipelines, through which oil, gas and water are transported from the Halfdan facilities to other field facilities for further processing and export (Figure 2.3). Pipelines departing from the Halfdan, Dan and Gorm platforms are considered part of the Halfdan Oil Re-Route project activities. TEPDK operates the installations under the joint venture ownership of the Danish Underground Consortium (DUC).

**Figure 2.3 HALFDAN Field Map**




Source: TEPDK, 2022

### 2.1.2 Halfdan and Dan Platforms

The Halfdan and Dan platforms are located in the western part of the Danish North Sea approximately 17 km west of the Gorm hub. Halfdan was discovered in 1998 and further appraisal led to development and first oil in 2001. The Halfdan production was initiated at HDA in 1999, then later HBA in 2004 and HCA in 2007. Halfdan A comprises a combined wellhead and a processing platform

(HDA), one accommodation platform (HDB) and a gas flare stack (HDC). Halfdan B comprises a processing platform (HBD), a combined riser and wellhead platform (HBA), a combined riser and wellhead platform (HBB) and an accommodation platform (HBC). Halfdan C is an unmanned wellhead platform (HCA).

Halfdan produces oil and gas from both the Ekofisk and Tor reservoirs. The Tor reservoir is drilled from HDA, HBA and HBB platforms. Ekofisk gas is produced from wells drilled from the HBA and HCA platforms. Due to the Ekofisk and Tor location overlap, Ekofisk oil and gas is produced from HDA-09, HBB-04 and HBB-05 above the Halfdan Main oil development, and Tor oil and gas is produced from HBB-10 below the Halfdan Northeast gas development. The total annual production for the HALFDAN Field is now declining and is below the assessed and approved facilities production capacity.

Halfdan oil is currently exported from Halfdan A (HDA) to Gorm for final stabilization and export.

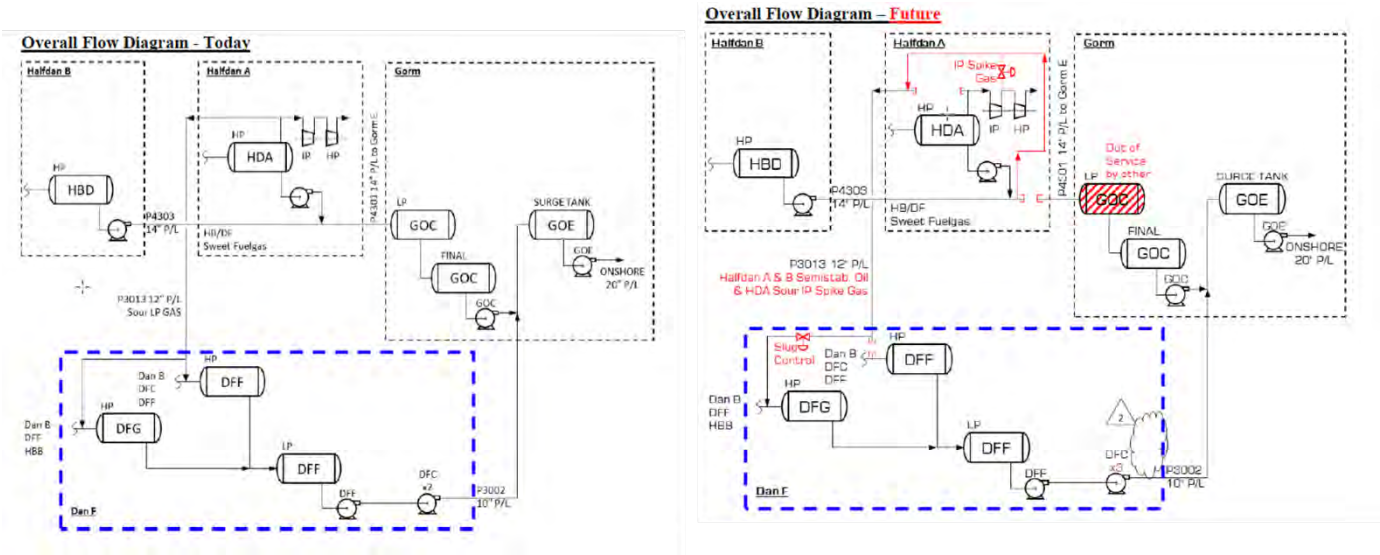
Currently the associated gas from Halfdan oil stabilized on Gorm C is flared and the Halfdan Oil Re-Route project will stop routine flaring on Gorm C and thereby significantly reduce GHG emissions.

The re-route project will swap both the Halfdan A and Halfdan B semi-stabilised oil production path from the Gorm E 14” P4301 pipeline to the 12” P3013 pipeline on HDA and commingled semi-stabilised export oil with HDA spike-gas is exported to DAN FF for final stabilization and export directly to Gorm E.

The exported capacities remain the same and the changed volume of semi-stabilised oil rerouted from the HALFDAN Field to Dan-F, will not exceed the Dan-F capacities.

The existing routing of Halfdan A LP gas to both the Dan FF and Dan FG HP separators will be re-used on Dan-F and one pressure control valve (PCV) will be installed to manage flow control during start up and continuous operation.

## Figure 2.4 Flow schematics of the Halfdan A Oil Re-Route



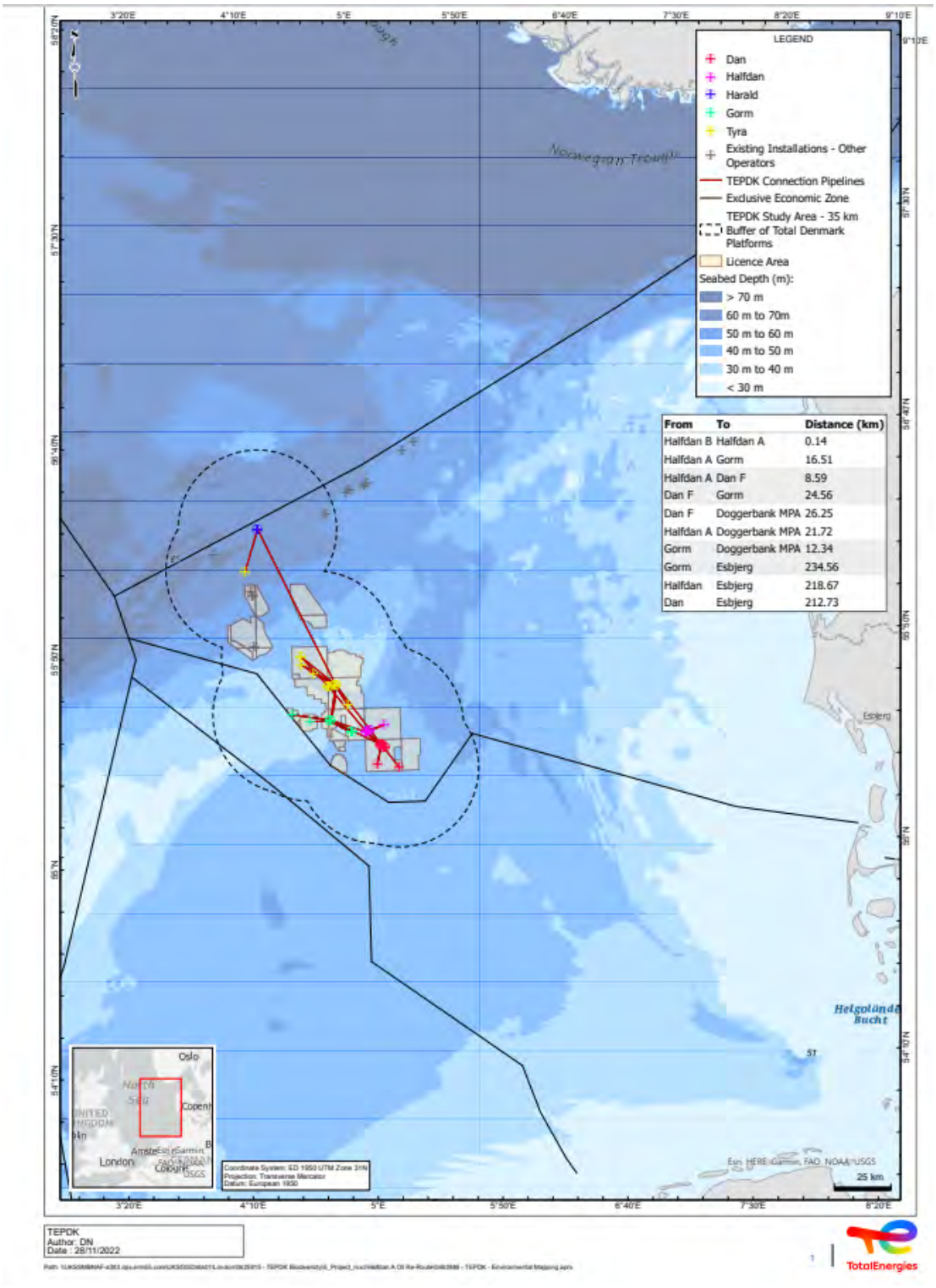

Source: TEPDK, 2022

This screening report has been prepared to describe the activities required to reroute the Halfdan A and Halfdan B semi-stabilised oil production path from the Gorm E 14” P4301 pipeline to the 12” P3013 pipeline on HDA and commingled semi-stabilised export oil with HDA spike-gas is exported to DAN FF for final stabilization and exported directly to Gorm E. The report compares the significance of any changes against historical modelling, environmental and risk assessment studies.

### *2.1.3 Location of the Halfdan Oil Re-Route Project Activities*

The HALFDAN Field and infrastructure is located in the south-western part of the Danish North Sea, approximately 216 km west of Esbjerg, Denmark (Figure 2.5). The water depth in the HALFDAN Field is 43 m.

**Figure 2.5 HALFDAN, DAN and GORM Fields Location**




Source: TEPDK, edited by ERM, 2022

### 2.1.4 Description of Proposed Activities

Halfdan oil is currently exported from HDA to Gorm for final stabilization and export. The scope of work is to re-route both Halfdan A and Halfdan B semi-stabilised oil production path from the Gorm E 14” P4301 pipeline to the 12” P3013 pipeline on HDA and commingled semi-stabilised export oil with HDA spike-gas is exported to DAN FF for final stabilization and exported directly to Gorm E.

Currently the associated gas from Halfdan A oil stabilised on Gorm C is flared. The Halfdan Oil Re-Route project will stop routine flaring on Gorm C and thereby significantly reduce Gorm C GHG emissions.

Most of the Halfdan A modifications are piping rerouting. Furthermore, since two launchers will no longer be in use, consequently venting of hydrocarbon will be slightly reduced. Some new valves will be added on Halfdan A level 3 north east area. The impact caused by the project installation on Halfdan A is very low and, in some cases, will reduce impacts.

Most of the Dan FF modifications are piping rerouting. Some new valves will be added on Dan FF level 1 wellhead/receiver area southeast and in the process area at Dan FF level 2.

#### 2.1.4.1 Modifications to Halfdan

##### Halfdan B Field HBD Crude Export

The Halfdan Oil Re-Route project will only have minimal impact on Halfdan B. However, due to the modified semi-stabilised crude routing from Gorm to the Dan FG HP separator, the export pressure at Halfdan B is expected to increase from 15-20 barg to 26 barg. The new higher export pressure matches previous Halfdan B export pressures and is within the existing export pumps capacities and pressure specifications.

##### Halfdan A Field HDA LP Gas Export

As the Halfdan Oil Re-Route project uses the LP gas export pipeline for semi-stabilised crude and IP gas export, it will not be possible to route LP gas from the HDA HP separator to Dan F when the IP/HP compression system is not in operation. HDA production will, therefore, have to stop during IP/HP compressor turbine wash or other process upsets causing shutdown of the IP/HP compression train as no alternative LP gas export path exists. This will cause production losses for HDA.

##### Halfdan A Field HDA Crude Export

Due to the modified semi-stabilised crude routing from Gorm to the Dan FG HP separator, the export pressure at Halfdan A is expected to increase from 15-20 barg to 26 barg. The new higher export pressure matches previous Halfdan A export pressures and is within the existing export pumps capacities. The existing connection from the HDA HP flare drum to the crude export system will be relocated to the new export system but is initially positively isolated by a spade in the line due to a potential for overpressure caused by backflow from the crude export system to the HP flare pumps suction system.

#### 2.1.4.2 Modifications to Dan

##### Dan FF Inlet Facilities for Halfdan Crude

The existing Halfdan LP gas pig receiver DFFA-EP-3805 will be used for the new mixture of Halfdan crude and IP gas. A new slug control valve will be installed as slugging may be an issue due to the gas/liquid flow in the pipeline. The valve is also used during start up after a potential shutdown to control flow and gradually lower the pressure in the pipeline to normal operating conditions.

The current possibility of routing the flow to either the Dan FF or the Dan FG HP separator will be removed and the Halfdan crude/gas can only be routed to the Dan FG HP separator. To facilitate future pressure vessel investigations (PVIs) of the Dan FG HP separator, a section of piping will be left in situ but disconnected from the process. This will facilitate re-routing of the Halfdan crude flow to the Dan FF HP separator during a PVI. Design verification will however be required prior to using this path.

### *Dan FG HP Separation*

The re-route of semi-stabilised crude to the Dan FG HP separator will increase the volume of crude to the separator. The DFG separator is a 3-phase separator that processes the oil, gas and water flow as per the below capacities:

- Total capacity of 994 $m^3$/hr gross liquid (150,000 bpd);
- Oil capacity up to 841 $m^3$/hr (127,000 BOEPD);
- Produced water capacity up to 497 $m^3$/hr (75,000 bwpd);
- Gas capacity of 223,300 $Nm^3$/hr (200 MMscfd).

With a forecast maximum amount of crude of approximately 50,000 BOEPD, the Dan FG separator will have enough capacity to treat the additional crude. Changes to gas and produced water volumes from the Halfdan Oil Re-Route project will be insignificant.

### *Dan FC Crude Export*

The maximum crude export capacity from the existing Dan FC crude export pumps is approximately 48,800 bpd based on 2 out of 3 pumps operating. The design capacity of one export pump is 37,736 bpd at a differential pressure of 27 bar and discharge pressure of 35 barg. However, an increase of the flow causes the backpressure to rise rapidly in the 25.6 km 10” pipeline to Gorm and hence the capacity increase with 2 pumps running is only approximately 30%.

### *Dan FG Produced Water Treatment*

The Halfdan Oil Re-Route project may cause a minor increase in the produced water volume to be separated/treated.

From January to October 2022, 951,000 $m^3$ of produced water was discharged at Dan FG. The Halfdan Oil Re-Route project may increase that volume by up to 13,000 $m^3$/year or 1%.

For 2022 to date, the average oil-in-water concentration for produced water being discharged at Dan FG is approximately 13 mg/l.

The fluids rerouted from Halfdan A and separated by the Dan-FG water treatment system, will be at a higher temperature (e.g. approximately 20°C higher) due to a faster flow and less temperature drop along the smaller diameter pipeline; therefore the oil-in-water concentrations are not expected to be higher in produced water discharged at Dan-FG due to the Halfdan Oil Re-Route project. Produced water discharged from Dan-FG will continue to be treated as per the legal and regulatory requirements summarised in the TEPDK production discharge permit and as described in the approved Dan Field ESIA (2011).

### *2.1.4.3 Subsea Infrastructures*

The Halfdan Oil Re-Route project will swap both the Halfdan A and Halfdan B semi-stabilised oil production path from the Gorm E 14” P4301 pipeline to the existing 12” P3013 pipeline on HDA and commingled semi-stabilised export oil with HDA spike-gas is exported to DAN FF for final stabilization and exported directly to Gorm E.

Pipeline P3013 connecting HDA and DAN FF is a LP gas pipeline. It will act as a multiphase pipeline after the Halfdan Oil Re-Route project. This pipeline has a nominal bore of 12" and is approximately 8.6 km long.

The 16.6 km oil export pipeline P4301 connecting HDA to Gorm will be isolated and left spare on HDA. The pipeline will be flushed mechanically with pigs and chemically by introducing a batch of mutual solvent followed by wash chemicals. Residual hydrocarbons will be removed to achieve the target level of <30 ppm oil-in-water. Flushed water will be piped to Fredericia for management and will not be discharged to the sea. The pipeline will then be filled with seawater and treated with biocide (2,000 ppm) and preserved for up to 3 years. There will be no production paths between Halfdan A and Gorm after the Halfdan Oil Re-Route project; however, future projects may re-establish the pipeline P4301 connection between Gorm and HDA.

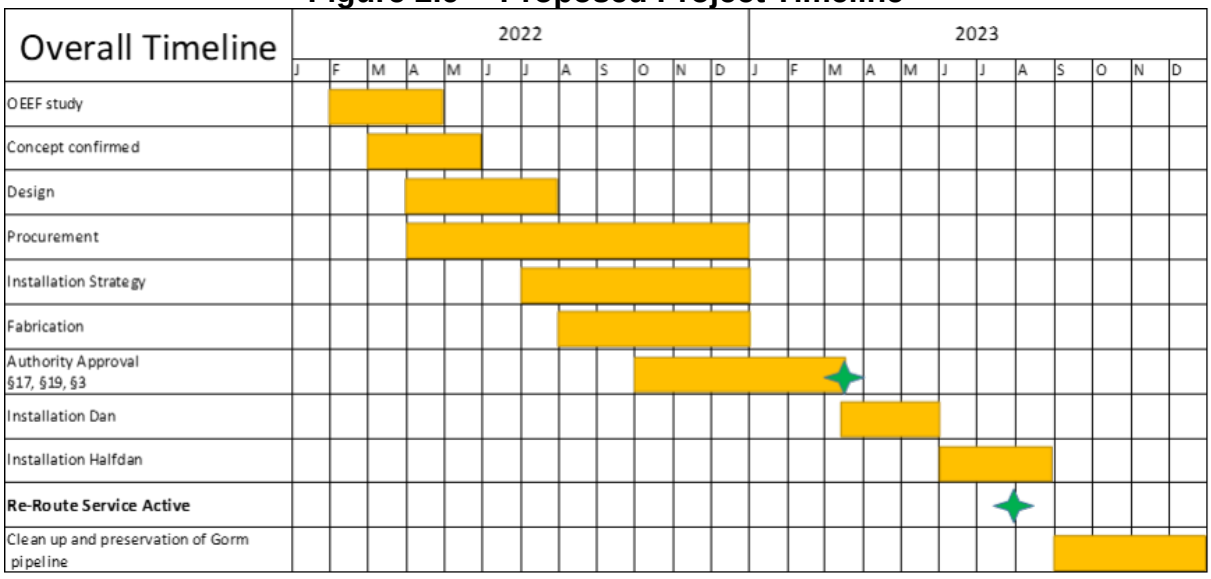
### *2.1.5 Schedule*

TEPDK plans to execute the necessary operation for the rerouting in Q1 and Q4 2023.

- Dan F facility modification is proposed for Q1-Q2 2023 and is estimated to necessitate 7,000 person-hours requiring shut down of the platform for 7 days;
- Halfdan A installation is foreseen in Q2 -Q3 2023 and requires 13,000 person hours and a shut-down of 14 days;
- Clean-up and preservation of the Gorm pipeline is foreseen in Q3 – Q4 2023.

The overall project activities schedule is presented in Figure 2.6.

**Figure 2.6 Proposed Project Timeline**




Source: TEPDK, 2022

## 2.2 Interaction with Other Projects

Table 2.1 presents a general schedule of the relevant activities in the DUC from November 2022 to early 2024, other than normal operational activities (e.g., field maintenance, water injection, produced water discharges, service vessel movements).

**Table 2.1 Schedule of Relevant Activities in the DUC**

| Location | Activity | Date | Approximate Distance to HDA platform (km) | Approximate Distance to Dan F platform (km) |
|---|---|---|---|---|
| HARALD Field | Geotechnical (CPT) Survey | Proposed 1 week Q4 2022 | 102 | 110 |
| HALFDAN Field | Geotechnical (CPT) Survey | Proposed 1 week Q4 2022 | 0 | 9 |
| Halfdan HDA-26, 27, 38, HBA-26, 21 | Workover | October – December 2022 | 0 | 9 |
| *Halfdan / Dan Fields* | *Seismic Survey* | *April – June 2023* | *>500 m* | *>500 m* |
| ***Halfdan A Oil Re-Route Project*** | ***Rerouting*** | ***Q1 2023 – Q4 2023*** | **-** | **-** |
| *South Arne Well Head Platform North* | *INEOS Solsort West Lobe project 2 new wells - 1 producer incl. optional gas lift and 1 water injector* | *Q1 to Q4 2023* | *>50* | *>50* |
| *North-western Danish EEZ* | *3D Seismic Survey* | *July-September 2023* | *66* | *75* |
| *Halfdan Tor NE and Ekofisk Project* | *Slot recovery and drilling of new trajectories* | *Q1 to Q4 2023 for Tor NE Q2 2024 to early 2025 for Ekofisk* | *0* | *9* |
| *HEMJ Project* | *Drilling of the HEMJ-1X exploration well* | *Q1 2024* | *102* | *110* |
| TYRA Field | Redevelopment (hook-up and commissioning activities) | Ongoing | 25 | 33 |

*Note: lines in italic denotes projects yet to be approved by the authorities, therefore, the dates are uncertain.*

No significant interactions are expected to occur between the Halfdan Oil Re-Route project and other existing and/or approved project as per cumulative impacts section (4.4).

## 2.3 Use of Natural Resources

In accordance with LBK 4 Appendix 5, point 3b, a description of all significant effects, where available information on such effects, which the project is likely to have on the environment due to the use of natural resources is relevant.

This section considers the use of natural resources, in particular land, soil, water and biodiversity in the Halfdan Oil Re-Route project.

The only predicted use of natural resources will come from the use of freshwater, seawater and fuel. There will be no consumption of land, soil nor biodiversity for the proposed activities in this report. The project will use freshwater during modification activities, seawater and fuel for transporting all the equipment. Given the volume of the North Sea, the amount of freshwater and seawater used will have a negligible impact on freshwater or seawater as a natural resource and it will not contribute to its depletion. The amount of fuel used to transport the equipment (also considering that this is necessary to further extract more hydrocarbons) will also be insignificant relative to world or national availability. Item (3b) is thus not addressed any further.

## 2.4 Waste Generation

Expected waste production from the Halfdan Oil Re-Route project activities include:

- The rerouting activities and platform modifications will produce negligible pipe waste which will be transported to the shore and recycled through an appropriate facility as per TEPDK´s waste management applicable to all offshore activities.
- Other discharges to sea (drainage discharge from bilge, sewage, grey water, food waste, etc.) from modification and installation vessels will be insignificant.
- Chemicals including additives for flushing/testing fluids and process optimization (emulsion breaker, scale inhibitors, corrosion control) used at Halfdan A and B and discharged in the Halfdan Oil Re-Route project are reported in Table 2.2 with an indication of the chemical classification of hazardous substances and materials recorded and monitored through the Danish Product Registry (see Appendix C for more details on the classification scheme).

## Table 2.2 Yearly Chemicals Use and Discharge Volumes at Halfdan B and Dan F

| Description | Usage Total Kg | Discharged at Halfdan B Total Kg | Routed to Dan F Total Kg | Discharged at Dan F Total Kg | Exported to onshore Total Kg |
|---|---|---|---|---|---|
| EB-80109 – Emulsion breaker | 16,097 | 4,292 | 11,804 | 354 | 11,450.0 |
| MB-5982 - Biocide | 91,250 | 90,748 | 502 | 497 | 5.0 |
| MB-544C - Biocide | 82,125 | 79,661 | 2,464 | 2,341 | 123.2 |
| SI-4126 – Scale inhibitor | 293,734 | 237,729 | 56,005 | 11,201 | 44,804.2 |
| KI-3345 - Scale/Corrosion inhibitor | 349,716 | 280,272 | 69,444 | 17,361 | 52,082.6 |
| KI-3130 - Corrosion inhibitor[1] | 110,157 | 90,880 | 19,277 | 3,855 | 15,422.0 |
| SI-4140W – Scale inhibitor | 202,940 | 200,911 | 2,029 | 2,029 | 0.0 |
| SI-41047 – Scale inhibitor | 197,100 | 194,144 | 2,956 | 1,478 | 1,478.2 |
| DF-99004 - Anti-Foaming | 12,136 | N.A | N.A | 1,214 | 10,922.6 |
| DF-99004 - Anti-Foaming | 24272.5 | 4854.5 | 19,418 | 1213.625 | 23,058.9 |
| Sandstorm 1– De-oiling chemical | 10,368 (l) | N.A | N.A | N.A | |
| J-Clean 1- De-oiling chemical | 4,176 (l) | N.A | N.A | N.A | |
| Ecosurf 10 (Pipesurf-10) - De-oiling chemical | 2,016 (l) | N.A | N.A | N.A | |
| MB-5982- Biocide | 3,311 (l) | N.A | N.A | N.A | N.A |

Source: TEPDK, 2022

[1] Classified as red as of 01/01/2021 due to surfactant properties, as per Miljøstyrelsen´s application of precautionary principle.

A description of all significant effects, where available information on such effects, which the project is likely to have on the environment due to the expected residues and emissions, and the expected waste production, where relevant, is required as per LBK 4 Appendix 5 Point 3a and more details on chemicals used and discharged is covered in section 4.2.

## 2.5 Pollution and Nuisance

Currently, Halfdan oil is stabilised on Gorm C and the off-gas from it is flared. The Halfdan Oil Re-Route project will stop routine flaring on Gorm C and thereby reduce GHG emissions and allow TEPDK to comply with upcoming legal bans on routine flaring.

Presently, the routine gas flared on Gorm is equivalent to approximately 210 BOEPD. The gas is flared due to lack of compression and export capacities on the aging Gorm facilities and therefore it is safer and more environmentally friendly to flare methane than vent it. The flaring of this gas produces approximately 66 $tCO_2$ per day. The Halfdan Oil Re-Route project would reduce the routine flaring on Gorm to zero BOEPD. However, there is a potential for increased safety flaring on Halfdan due to a higher likelihood of Halfdan production upsets when the compressor on Dan is shutdown. The corresponding safety flaring is estimated to happen four times per year at a rate of 50 BOE per shutdown event.

Halfdan Oil Re-Route project modifications will be undertaken during planned maintenance shutdowns. Therefore, the Halfdan Oil Re-Route project will not contribute to additional flaring due to a need for additional shutdowns.

Most of the Halfdan Oil Re-Route project modifications are piping rerouting and reduction in inventory and main dead-end piping, venting of hydrocarbon is slightly reduced and so is the workload from pig handling operations.

Emissions to air, noise generation and liquid discharges (eg. drainage, bilge, sewage) are expected from installation vessels during project activities. All vessels have equipment, systems and protocols in place to prevent oil, sewage and garbage pollution in compliance with MARPOL 73/78.

### *2.5.1 Gas emissions, discharges and nuisance are addressed in Assessment of Potential Impacts on MSFD Descriptors*

Table 4.8, Section 4.2 and the Marine Strategy Framework Directive (MSFD).

## 2.6 Risk of Major Accidents and/or Disasters

The risk of major accidents and/or disasters relevant to the project from accidental events was assessed for a range of categories including:

- Minor accidental events (eg. gas release, spill of chemical, diesel or oil); and
- Major accidental events (eg. oil spill or gas release).

Further detail is provided in Section 4.3 – Major Accidents, Unplanned Events. In the unlikely event of a major accident, TEPDK has an existing Oil Spill Contingency Plan (TEPDK-L2-PRO-HSE-0016) developed for managing hydrocarbon spills from all its offshore activities.

As per LBK 4 Appendix 6 Point 1, the risks of a major accident caused by climate change are considered irrelevant, considering the duration of the proposed activities.

## 2.7 Risk to Human Health

The risk to human health relevant to the project was assessed. None of the activities performed are expected to have a major or long-lasting impact on human health.

The project will last approximately 7,000 person-hours with platform shutdown for seven days for Dan F and 13,000 person-hours with a platform shutdown for 14 days for Halfdan A. The duration is

short and the project is approximately 210 km from the closest point on land and any large population centre.

Moreover, the Halfdan Oil Re-Route project will stop routine flaring and thereby reduce GHG emissions, which is a positive impact on human health and the environment

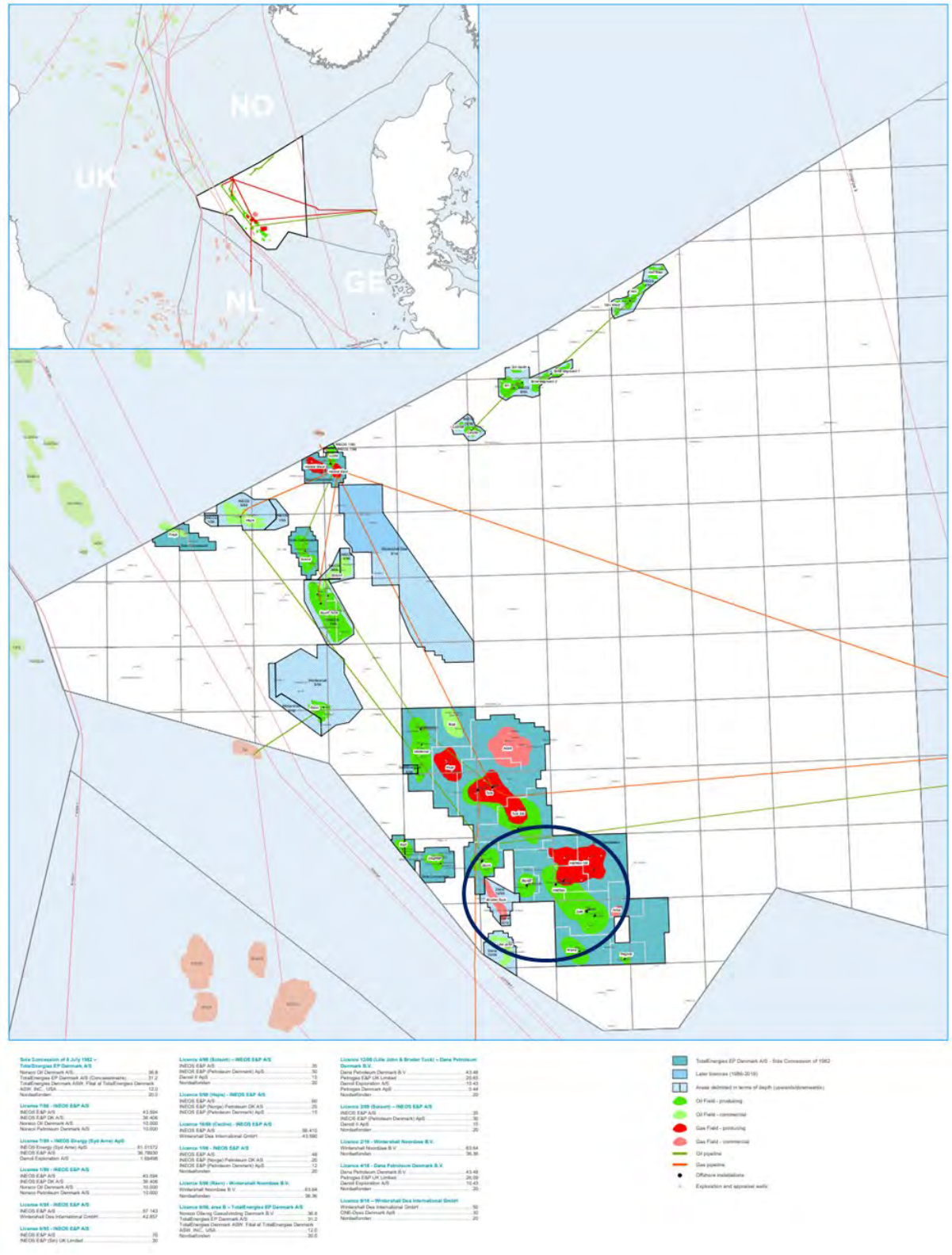
# 3. LOCATION OF THE PROJECT

This Chapter presents the environmental sensitivity of the Halfdan Oil Re-Route project area as defined in LBK 4, Appendix 6, Point 2.

## 3.1 Existing and Approved Land Use

The HALFDAN, DAN and GORM Fields are in a “Contiguous Area” and within the TotalEnergies EP Danmark A/S - Sole Concession of 1962 as described in https://ens.dk/sites/ens.dk/files/OlieGas/oliegaskort2021-10-13.pdf.

## Figure 3.1 Denmark block license map




Note: the dark blue circle highlights the HALFDAN Field area.

Source: DEA, 2021

## 3.2 Natural Resources

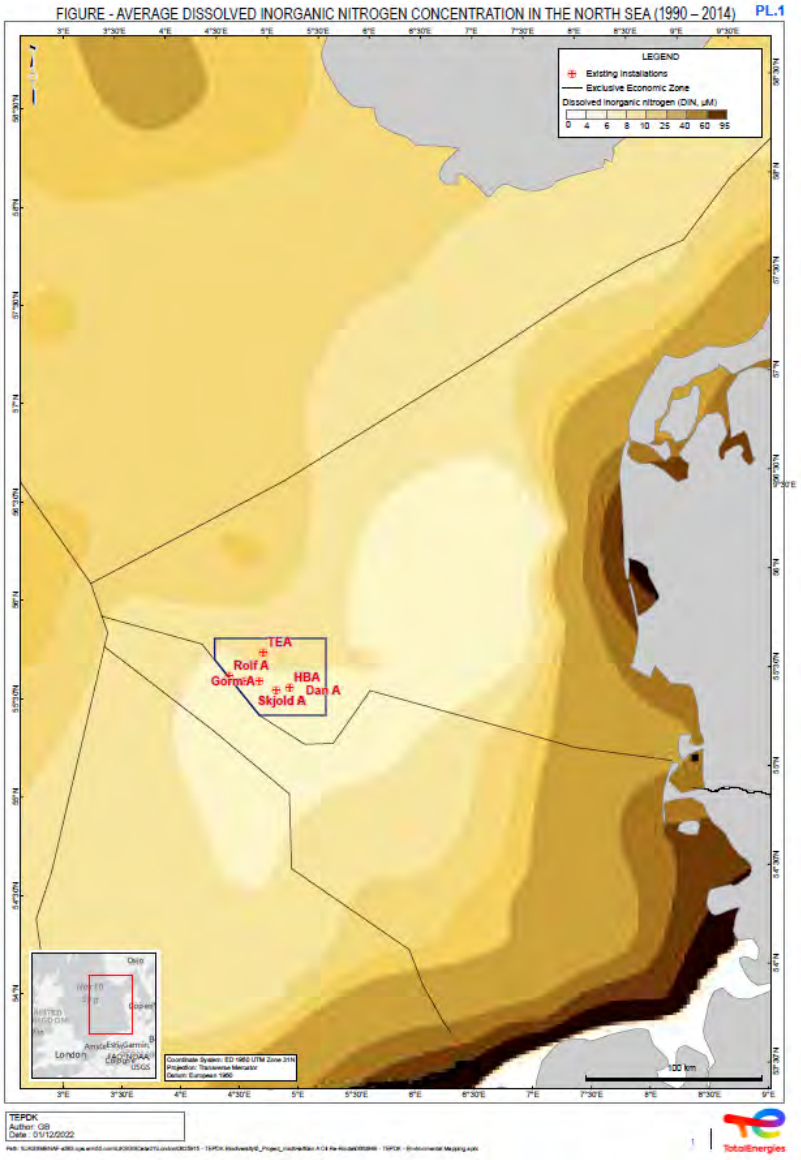
### *3.2.1 Seawater Quality*

Nitrogen, phosphorous and silicate are nutrients that reach the North Sea via land runoff, the atmosphere and rivers. Anthropogenic sources such as agriculture, aquaculture, combustion, and wastewater are the main contributors to these nutrient discharges. Measuring the levels of dissolved inorganic winter nutrient concentrations are a good indicator of such discharges (OSPAR, 2017).

Nitrogen originates from fertilizers as part of agricultural soil, phosphorus comes from effluent and sewage water while silicate travels to the oceans through chemical weathering of continental rock discharged at the coastal zone by rivers and groundwater. These nutrients promote significant growth of marine flora which can have harmful impacts on marine life. Algal blooms limit light penetration which can reduce growth and cause mortality of macro algae and decrease the success of predators that need light to catch pray. When these algal blooms eventually die, microbial decomposition results in excess oxygen consumption, creating hypoxic areas (known as ‘dead zones’) incapable of supporting marine life (Chislock et al., 2013).

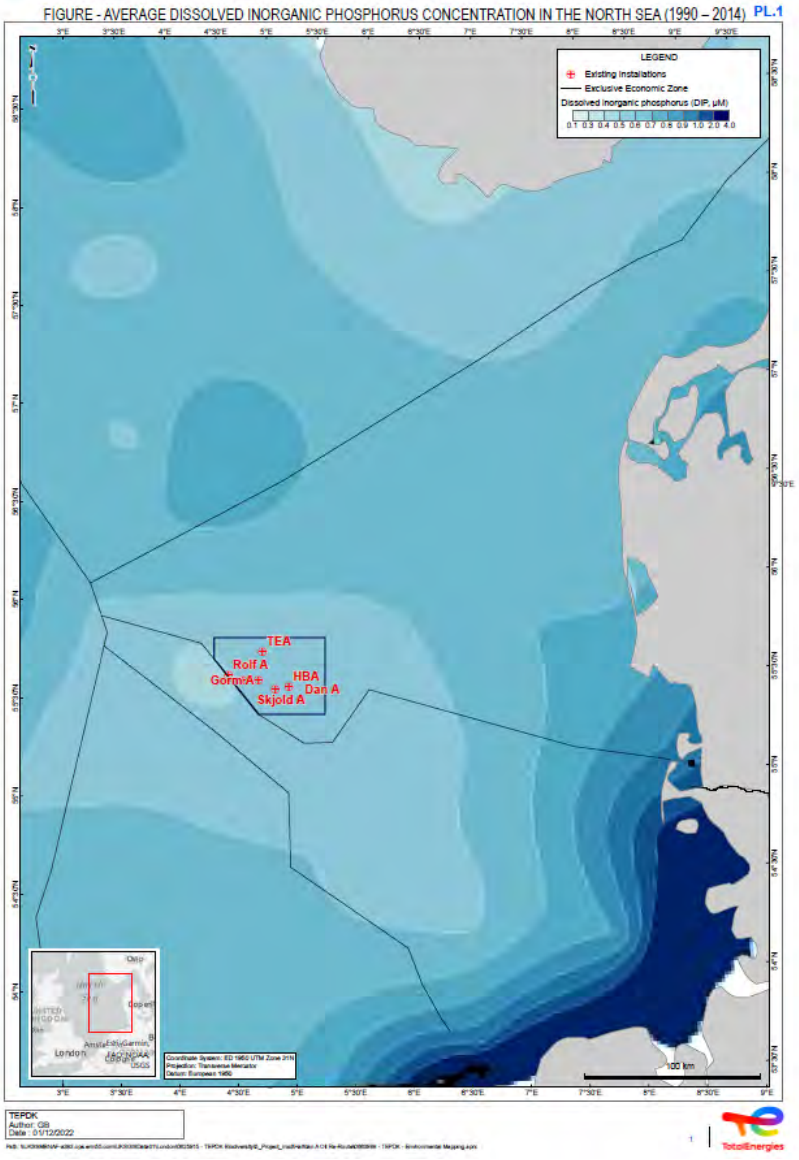
Concentrations of Dissolved Inorganic Nitrogen (DIN) and Dissolved Inorganic Phosphorous (DIP) in the North Sea and in the project area are shown in Figure 3.2 and Figure 3.3 respectively.

## Figure 3.2 Average Dissolved Inorganic Nitrogen Concentration in the North Sea (1990 – 2014)




Source: OSPAR, 2017

## Figure 3.3 Average Dissolved Inorganic Phosphorous Concentration in the North Sea (1990 – 2014)




Source: OSPAR, 2017

Concentrations of nutrients in the North Sea surface layer have been modelled. The modelled concentrations of nutrients in the North Sea are highest (>0.04 mg/l for phosphate, and >0.30 mg/l for nitrate) along the coastal areas, near output of large rivers. The concentrations in the surface layer in the Halfdan Oil Re-Route project area ranges between 0.025-0.035 mg/l for phosphate and between 0.1-0.15 mg/l for nitrate.

Water concentrations of metals in the North Sea for cadmium are 6-34 ng Cd/l, copper 140-360 ng Cu/l, lead 20-30 ng Pb/l, mercury 0.05-1.3 ng Hg/l and nickel 100-400 ng Ni/l. Metal cycles in the ocean are governed by seasonally variable physical and biological processes. The biologically driven metals (ie. Cd, Cu, Ni) follow nutrient-like distributions with higher concentration found in deep water. Certain metals, including Cd and Cu, exhibit higher concentrations near and on the shelf compared to the open sea areas (Ramboll, 2016).

As part of the DHI 2020 pipeline surveys, sediment sampling was conducted at 19 locations around the Gorm Field using a HAPS1 corer; the locations of these sample sites are presented Table 3.6. Contamination in the sediment was assessed in relation to MSFD Descriptor 8: Contaminants.

To assess the environmental status, the approach outlined in the MSFD requires that selected indicators are compared to reference conditions. Average historical values from reference stations measured at seabed monitoring campaigns from 1989-2015 were calculated for the northern and the southern North Sea, by dividing monitored platforms into the relevant region and averaging values within each group. For the current assessment, the southern reference is most relevant and is used to compare to the measured indicators at the pipeline surveys. Additionally, a background reference level (BRL) was obtained from a bootstrap analysis, conducted by Oil Gas Denmark of values measured at regional reference stations in the southern part of the North Sea. BRL is presented in and shown for all selected regional descriptors and indicators in Table 3.1.

The analytical results were scaled against the BRL and the Effect Range Low (ERL)[2] to arrive at index values between 0 and 100 (the results of the survey index scores are presented in Table 3.2), 100 being the conditions similar or superior to the reference conditions. For contaminants, the “one-out-all-out” (o-o-a-o)[3] principle from the Water Framework Directive is applied, and if any of the contaminants exceed the ERL-values, the contaminant indicator will score a zero for that station.

## Table 3.1 Regional Background Reference Level (BRL) based on Reference Stations of Southern Platforms and Effects Range Low (ERL) for Descriptor 8

| Indicators | BRL South | ERL |
|---|---|---|
| Contaminants - Metals (mg/kg dry weight) | | |
| Cd | 0.01 | 1.20 |
| Cr | 4.00 | 81.00 |
| Cu | 0.50 | 34.00 |
| Pb | 4.70 | 47.00 |
| Hg | 0.05 | 0.15 |
| Zn | 7.80 | 150.00 |
| Contaminants - Hydrocarbons (mg/kg dry weight) | | |
| PAH* | 52.8 | 3,340 |
| Naphthalene | 6.1 | 160 |
| Anthracene | 1.0 | 85 |
| Phenanthrene | 2.0 | 240 |
| Dibenzothiophene | 1.8 | 190 |
| Fluoranthene | 4.0 | 600 |
| Benzo(a)anthracene | 1.1 | 261 |
| Chrysene (incl. triphenylene) | 2.0 | 384 |
| Benzo(g,h,i)perylene | 8.8 | 85 |
| Benzo(a)pyrene | 2.0 | 430 |

[1] The HAPS frame supported corer is highly suitable for taking well defined, virtually undisturbed seafloor samples of soft and hard sediments.
[2] ERL indicates the concentration below which toxic effects are scarcely observed or predicted: the ERM indicates that above which effects are generally or always observed.
[3] The ‘one-out all-out’ principle is a key principle that reflects the Water Framework Directive (WFD(1)) integrated approach for the protection of water resources and associated aquatic ecosystems. Quality elements in the definition of ecological status provide a holistic picture of the health of the aquatic environment. The overall status would only be ‘good’ if all the elements are at least considered ‘good’.

| Indicators | BRL South | ERL |
|---|---|---|
| Indeno[1,2,3 - cd]pyrene | 12.0 | 240 |
| Pyrene/ thiphenylene | 12.0 | 665 |

Source: DHI 2020

Table 3.2 outlines the Environmental Status (EnS) Indices of all the stations sampled as part of the DHI 2020 surveys. The EnS for all stations on contaminants was 97, which is due to the estimated Cu load at all stations (Table 3.2). The Cu concentration was below detection range at all stations. As a default, half the concentration is then assumed resulting in a concentration of 1.5 mg/kg at all stations. However, the BRL at station south is 0.5, which results in a score of 97 at all stations. If this was disregarded, most stations would score 100 or 99. The concentrations of metals and hydrocarbons had an EnS score close to 100 and were low compared to indicators for Good Environmental Status.

The concentrations of heavy metals in the sediment samples are well below all targets for Good Environmental Status, although Barium may be present in concentrations which are above the potential effect level. This is likely caused by drilling activities (DHI, 2020).

## Table 3.2 Indices for Indicators, Descriptors and Environmental Status

| Survey | Station | Distance (m) | Contaminants | | | | | | | | | | | | | | | | | | ES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Metal* | | | | | | *PAH*[5] | | | | | | | | | | | | |
| | | | *Cd* | *Cr* | *Cu* | *Pb* | *Hg* | *Zn* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *D8* | *ES* |
| A | TyraE-S750 | 50.2 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 99 |
| A | TyraE-Ref.2 | 50.9 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 99 |
| A | Gorm-E750 | 78.8 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 97 |
| A | Gorm-N750 | 83.6 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| A | Gorm-N6250 | 101.8 | 99 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 99 |
| A | Gorm-N11900 | 103.3 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| A | Gorm-Ref.1 | 3,008.8 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 99 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |
| B | Halfdan-N750 | 50.6 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| B | Halfdan-W5000 | 104.1 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |
| B | Halfdan-W3000 | 230.1 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |
| B | Halfdan-W1500 | 336.1 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| B | DanF-W5000 | 1,743.2 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |
| B | DanF-Ref.1 | 4,952.9 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |
| C | Halfdan-N750 | 50.6 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| C | Gorm-E750 | 78.8 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 97 |
| C | Gorm-SE5100 | 99.9 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 99 |
| C | Halfdan-NW4800 | 103.9 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |
| C | DanF-W5000 | 1,743.2 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |
| C | Gorm-Ref.1 | 3,008.8 | 100 | 100 | 97 | 100 | 100 | 100 | 100 | 100 | 99 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |

[5] PAH1 naphthalene, PAH2 anthracene, PAH3 phenanthrene, PAH4 dibenzothiophene, PAH5 fluoranthene, PAH6 benzo(a)anthracene, PAH7 chrysene (incl. triphenylene), PAH8 benzo(g,h,i)perylene, PAH9 benzo(a)pyrene, PAH10 indeno[1,2,3-cd]pyrene, PAH11 pyrene/ thiphenylene.

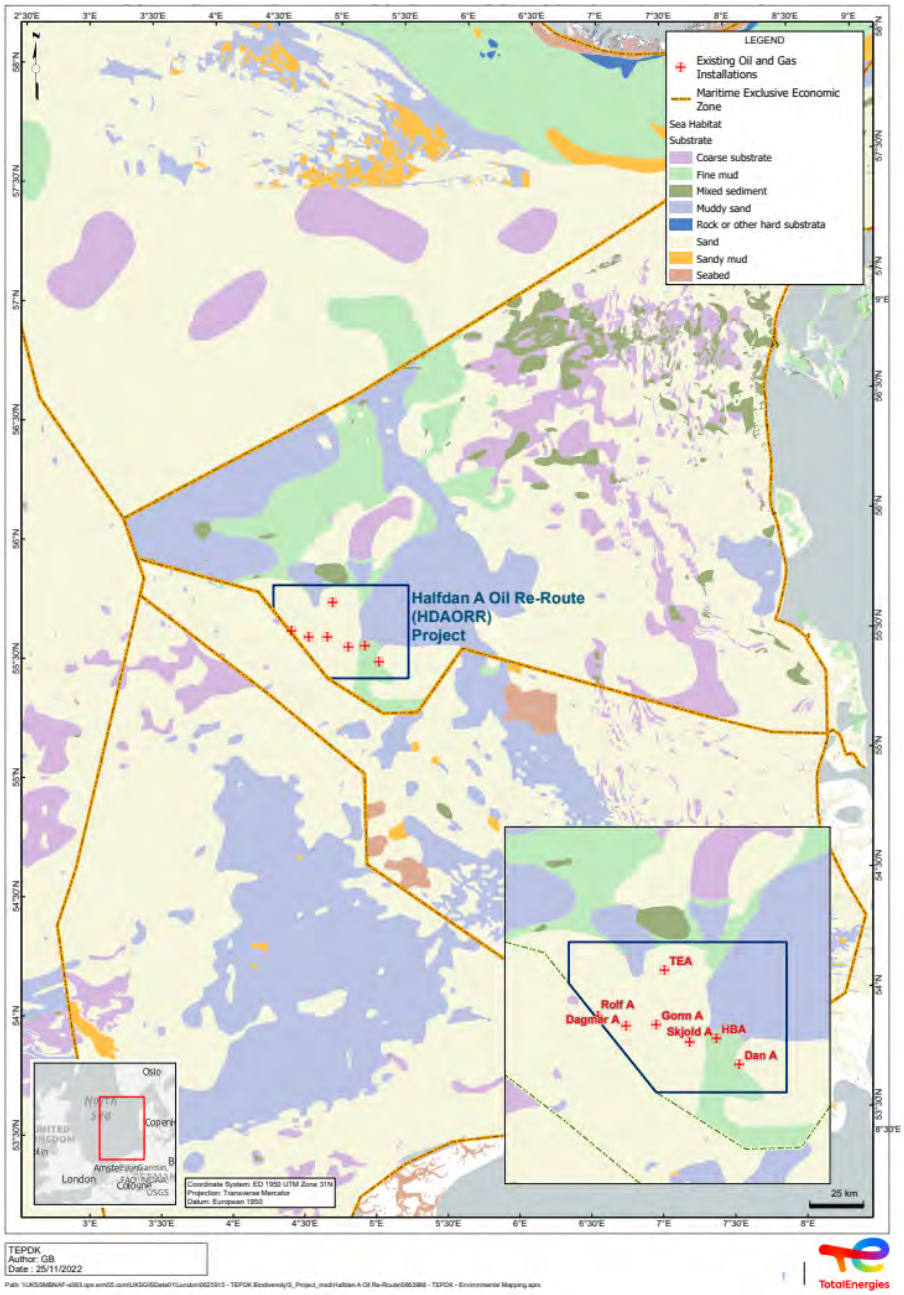
| Survey | Station | Distance (m) | Contaminants | | | | | | | | | | | | | | | | | | ES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Metal* | | | | | | *PAH*[5] | | | | | | | | | | | | |
| | | | *Cd* | *Cr* | *Cu* | *Pb* | *Hg* | *Zn* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* | *D8* | *ES* |
| D | Halfdan-SE2250 | 104.1 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| D | Halfdan-SE5000 | 107.6 | 100 | 98 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| D | Halfdan-S650 | 116 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| D | DanF-W750 | 334.4 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 98 |
| D | DanF-W5000 | 1,743.2 | 100 | 99 | 97 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 100 |

Source: DHI 2020

### *3.2.2 Sediment Quality*

The Danish region of the North Sea is generally characterized by a mixture of fine-grain sediment types (<2 mm in diameter, Ø grain size) consisting of sand, muddy sand and fine mud in offshore areas, with smaller patches of coarse and larger grained sediment deposits (>2 mm - 4 mm Ø) in the northern and eastern regions of the Danish Exclusive Economic Zone (EEZ). The HALFDAN, DAN and GORM Field areas are characterized by sand and fine muds. The broad-scale distribution of substrate type across the Danish EEZ is illustrated in Figure 3.4.

**Figure 3.4 Seabed Sediment Substrate Composition in the North Sea**




Source: EMODnet, 2020a

Sediment samples were collected from 7-11 June 2020 at 19 locations in the GORM, TYRA, SKJOLD, DAN and HALFDAN Fields.

Sediment in the Gorm and Halfdan areas consist of stratified, poorly sorted fine-medium sands, with a mean diameter of 0.12-0.22 mm Ø, with a 3-6 cm brown oxidized surface layer. Older surveys from DHI (2009, 2013) characterised the sediment characteristics at the Halfdan and Gorm platforms (Table 3.3, Table 3.4).

**Table 3.3 Halfdan Platform Sediment Characteristics Summary (2012)**

| Measured parameters | Characteristics |
|---|---|
| Surface sediment type | Fine sand (grain size 0.15 - 0.20 mm) |
| Fines content (silt and clay) | Low (0.04 – 0.74% dry matter) |
| Organic matter | 10 g/kg dry matter |
| Total Organic Carbon (TOC) | Low (0.66 – 2.0 g/kg dry matter) |

Source: DHI, 2013

**Table 3.4 Gorm Platform Sediment Characteristics Summary (2009)**

| Measured parameters | Characteristics |
|---|---|
| Surface sediment type | Fine sand (median grain size 0.136 – 0.188 mm) |
| Fines content (silt and clay) | Low (0.04 – 0.74% dry matter) |
| Organic matter | <1% dry matter |
| Total Organic Carbon (TOC) | Low (<0.5 – 1.4 g/kg dry matter) |

Source: DHI, 2009

THC concentrations recorded at the stations >1,000 m from the platforms in the GORM Field (1.7-2.3 mg/kg dry weight) were found to be consistent with the THC concentrations recorded at the reference stations (1.1- 2.4 mg/kg dry weight). However, THCs at the innermost sampling stations (i.e. 250-750 m) to the platform centres were found to be slightly-to-moderately elevated (1.7- 18.3 mg/kg dry weight) in the GORM Field (DHI, 2018).

Metals typical of sediment contaminated with drilling muds or cuttings are barium (Ba), chromium (Cr), lead (Pb) and zinc (Zn) (Neff, 2008). The most abundant metal in most drilling muds is Ba, found in the form of barite ($BaSO_4$). Generally, contamination by metals extends no further than 500 m from production platforms, but elevated concentrations of Ba are found within 500 - 1,000 m. Metal concentrations were measured during a sampling campaign (DHI, 2020) at 24 stations around the project location. Metal concentrations were found within expected background concentrations and fell below the potential ecotoxicological effect levels of aquatic organisms for all metals except for Ba. Maximum Ba concentrations were above the potential effect level of 130 mg/kg dry weight at three stations (i.e. Stations Gorm E750 (310 mg/kg dry weight), Halfdan N750 (290 mg/kg dry weight) and Dan FW750 (430 mg/kg dry weight)) of the 24 stations sampled along the pipeline alignments (DHI, 2020).

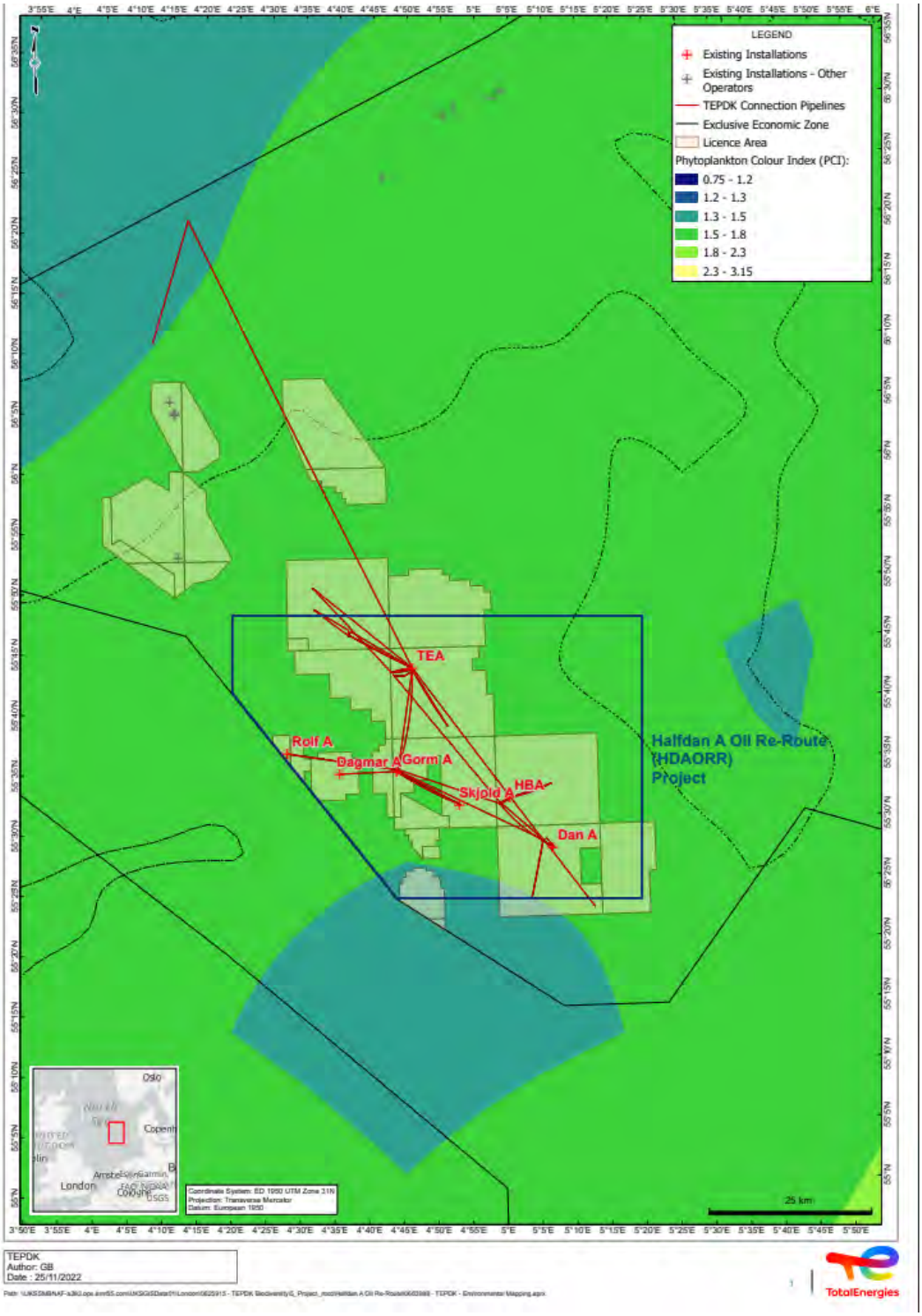
### *3.2.3 Biodiversity in the Area*

#### *3.2.3.1 Plankton*

#### *Phytoplankton*

The phytoplankton in the North Sea is mainly light-limited in winter and nutrient-limited in the water above the thermocline in summer. Figure 3.2 shows the phytoplankton colour index (PCI) for the North Sea during the year. PCI is a visual estimation of the biomass and abundance of the phytoplankton. The highest phytoplankton biomass and abundance is found in the eastern and southern parts of the North Sea.

## Figure 3.5 Phytoplankton Colour Index (PCI) of the Study Area




Source: ERM, 2022

## *Zooplankton*

Generally, zooplankton abundance varies between areas owing to differences in production, predation, and transport. Nevertheless, the species diversity of the zooplankton community in the central North Sea is generally homogeneous (SAHFOS, 2001).

The North Sea zooplankton communities in terms of biomass and productivity are dominated by copepods, particularly *Calanus* species such as *C. finmarchicus* and *C. helgolandicus*. Calanoid

copepods are relatively large planktonic crustaceans which range in size between 0.5 – 6 mm and are important prey for many species at higher trophic levels. In the Gorm area, the abundance of copepods is intermediate compared to the North Sea, with 5.5 – 9.5 individuals per $m^3$ (ind/$m^3$) of *C. finmarchicus* and 9 - 12 ind/$m^3$ for *C. helgolandicus* (Maersk, 2014).

**Table 3.5 Common zooplankton species in the North Sea**

| Zooplankton |
|---|
| Total copepods |
| Echinoderm larvae |
| *Pseudocalanus* spp. |
| *Acartia* spp. |
| *Temora longicornis* |
| *Evadne* spp. |
| *Pseudocalanus* adult. |
| *Oithona* spp. |
| *Calanus traverse* |
| *Podon* spp. |

Source: Maar et al., 2016

### *3.2.3.2 Benthos*

The water depth at the Halfdan, Dan and Gorm platforms ranges from 33 to 44 m. At this depth, it is highly unlikely that any macrophytes (macroalgae and higher plants) grow due to a lack of light. The legs of the platforms offer substrate for brown and red macroalgae to grow up to a certain depth. This kind of flora however has a negligible contribution to primary production compared to that of passing plankton (Maersk, 2017).

The legs of the platforms however offer a hard substrate for brown and red macroalgae to grow up to a certain depth. This kind of flora has a negligible contribution to primary production compared to that of passing plankton (Maersk, 2017).

The benthic fauna consists of epifauna and infauna (i.e., organisms living on or in the seabed, respectively) such as crustaceans, molluscs, annelids (ringed worms), and echinoderms. Figure 3.4 shows the benthic substrate of the area, and

Figure 3.6 shows the benthic fauna assemblages in the North Sea and across the project area. All of the Halfdan platforms lie in an area classified as MD62: Atlantic offshore circalittoral mud. The Halfdan platform locations are characterised by the benthic fauna assemblages, as indicated by the presence of the polychaete worm *Nephtys cirrosa,* the echinoderm *Echinocardium cordatum* and the crustacean *Urothoe poseidonis.* Most of the Dan platforms (including the Kraka platform) lie in an area classified as MD62: Atlantic offshore circalittoral mud. The eastern most Dan platforms are located in an area classified as MD52: Atlantic offshore circalittoral sand. Both the eastern and western Dan platforms are characterised by the benthic fauna assemblages IIa – IIb indicated by the presence of the bivalve *Nucula nitidosa*, crustaceans *Callianassa subterranean* and *Eudorella truncatula* and the polychaete worms *Ophelia borealis* and *Nephtys longosetosa.* Regnar and Kraka are characterised by the benthic fauna assemblage Iia indicated by *Nucula nitidosa*, *Callianassa subterranean* and *Eudorella truncatula.* The GORM Field lies in an area classified as MC52: Atlantic circalittoral sand. The wider area is characterised by the benthic fauna assemblage IIb indicated by the presence of the polychaete worms *Ophelia borealis* and *Nephtys longosetosa.*

Recent (2019-2020) broadscale benthic habitat surveys of the Danish tail of the Dogger Bank covered the location of all TEPDK assets apart from the Svend and Harald platforms. The most abundant species recorded during these surveys were, amongst others, the polychaetes *Lanice conchilega*, *Spiophanes bombyx* and *Galathowenia oculatamens*. Polychaetes, malacostracans and bivalves were the most abundant classes of benthic organisms recorded (Miljøstyrelsen, 2021).

The assessment examined two distinct environments which were present across the imagery – (i) the rig framework, including pile columns and well assets and (ii) the seabed.

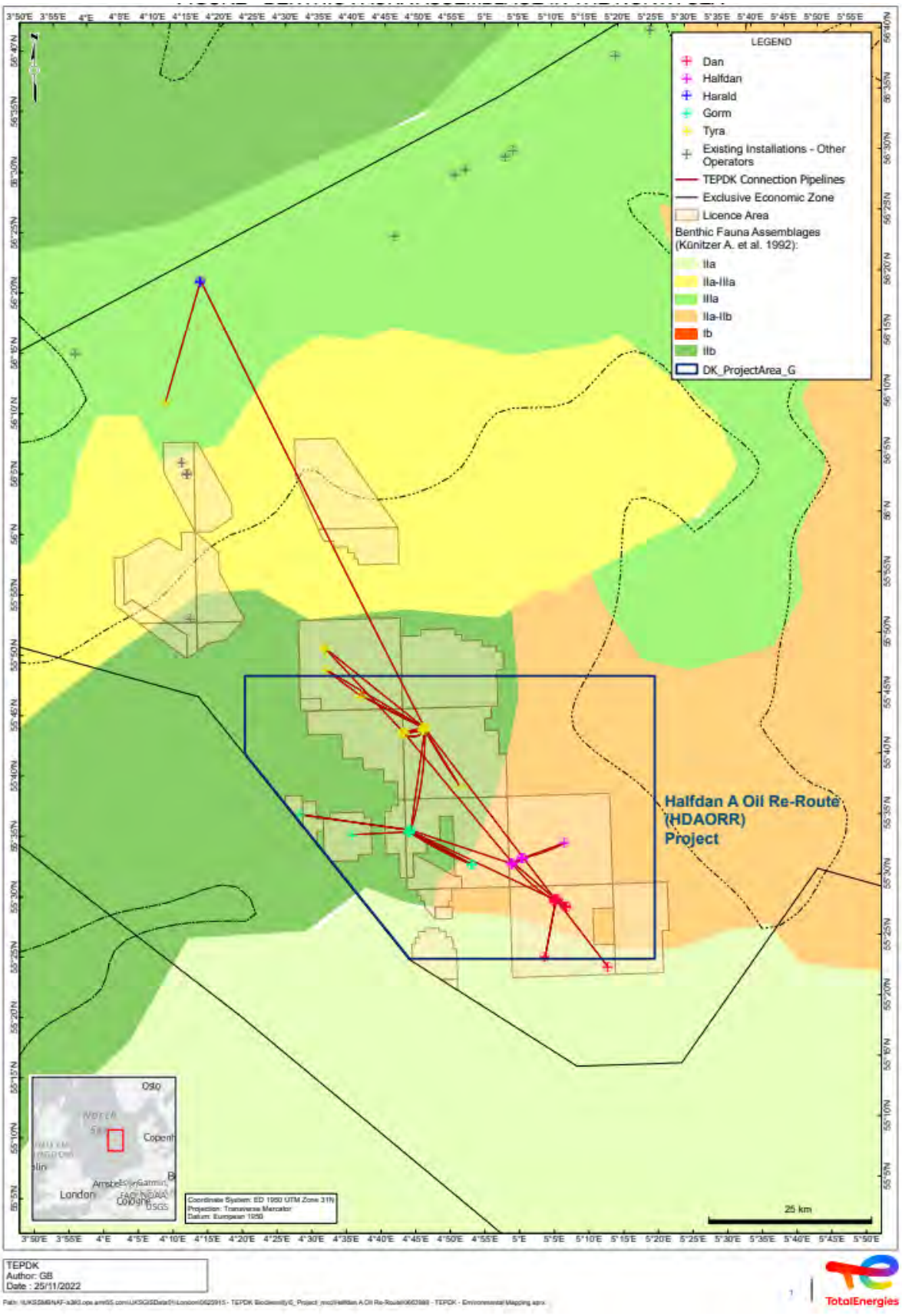
Five broad scale habitats were identified:

- High energy littoral rock - Rig structure near to surface with high exposure to wave and tidal forces.
- Features of circalittoral rock - Midwater rig structure.
- Sublittoral coarse sediment - Coarse gravel and cobble seabed with little to no shell hash.
- Sublittoral mixed sediment - Mixed seabed with a wide range of sediment types.
- Deep-sea mixed substrata - Seabed with heavy shell hash cover.

The most recorded habitat was classified as circalittoral rock, which was identified from video analysis of the midwater rig structures. Video analysis of the seabed, on which the structures were located, comprised mainly sublittoral mixed sediments and deep-sea mixed substrata comprising heavy shell hash cover.

From these five broadscale habitats, four more specific communities were identified to European Nature Information System (EUNIS) classification level relating to mussel beds (A1.11 mussel and or/barnacle communities and A4.24 mussel beds on circalittoral rock), algae communities (A3.72 Infralittoral fouling seaweed communities) and fouling poriferans and anemone communities (A4.721 Dead man's fingers *(Alcyonium digitatum)* and *Metridium senile* on moderately wave-exposed circalittoral steel wrecks).

## Figure 3.6 Benthic Fauna Assemblage in the North Sea




Source: ERM, 2022

In the Dan and Halfdan area, the survey conducted in 2021 provides an overview of the most important species based on their abundance, showing the polychaeta *Galathowenia oculata* to have the highest contribution (15.1%). Other abundant species include the polychaeta *Lanice conchilega*, *Pectinaria* (*Lagis*) *koreni*, *Owenia fusiformis*, *Scoloplos armiger*, and *Spiophanes bombyx*, and species from the taxa Echinodermata (*Amphiura filiformis*), Bivalvia (*Thyasira flexuosa*), Phoronida (*Phoronis muelleri*) and Edwardsiidae (*Edwardsia* sp.). ROV video survey undertaken at Dan F and Harald platforms found the following species:

**Table 3.6 Benthic Habitat Overview at Dan and Halfdan Platforms as Identified Through the 2021 Seabed Monitoring Survey**

| Platform | Seabed Benthos |
|---|---|
| Halfdan A | *Echinocardium* sp. *(*sea urchin)<br>*Spiophanes bombyx (*polychaete*)*<br>Sand mason *(Lanice conchilega)*<br>*Ophiuroids* (brittle stars)<br>*Scoloplos armiger* (polychaete*)*<br>Trumpet worm *(Lagis koreni)*<br>*Phyllodoce groenlandica* (polychaete)<br>*Goniada maculata (*polychaete)<br>*Ophelia borealis (*polychaete)<br>*Thyasira flexuosa (*bivalve) |
| Halfdan B | *Echinocardium* sp. *(*sea urchin)<br>*Spiophanes bombyx (*polychaete)<br>Sand mason *(Lanice conchilega)*<br>*Ophiuroids* (brittle stars)<br>*Scoloplos armiger (*polychaete)<br>Trumpet worm *(Lagis koreni)*<br>*Phyllodoce groenlandica (*polychaete)<br>*Goniada maculata (*polychaete)<br>*Ophelia borealis (*polychaete)<br>*Thyasira flexuosa (*bivalve) |
| Halfdan C | *Echinocardium* sp. *(*sea urchin)<br>*Spiophanes bombyx(*polychaete)<br>Sand mason *(Lanice conchilega)*<br>*Ophiuroids* (brittle stars)<br>*Scoloplos armiger (*polychaete)<br>Trumpet worm *(Lagis koreni)*<br>*Phyllodoce groenlandica (*polychaete)<br>*Goniada maculata (*polychaete)<br>*Ophelia borealis (*polychaete)<br>*Thyasira flexuosa (*bivalve) |
| Dan F | *Galathowenia oculata*<br>*Lanice conchilega*<br>*Pectinaria koreni*<br>*Owenia fusiformis*<br>*Scoloplos armiger*<br>*Amphiura filiformis*<br>*Thyasira flexuosa*<br>*Spiophanes bombyx*<br>*Phoronis muelleri*<br>*Edwardsia* sp. |

### *3.2.3.3 Fish*

The Halfdan, Dan and Gorm hub are in an area designated as a relatively important spawning ground for cod (*Gadus morhua*) in winter with a peak in February and March and whiting (*Merlangius merlangus*) from January to June (Maersk, 2014). Atlantic mackerel (*Scomber scombrus*) are also known to be spawning in the area although the Halfdan area is not considered as an important spawning ground for this species based on the 2014 Maersk Oil Atlas.

The ICES International Bottom Trawl Surveys (IBTS) have been undertaken yearly since 1970 and the International Bottom Trawl Survey Working Group (IBTSWG) subsequently publishes reports. The main findings (Figure 3.7) provide a representation of the fish biomass distribution derived from the IBTS undertaken in quarter one (Q1) of 2021 (ICES, 2021). This can serve as a general indicator of the species abundance in different areas. The southern North Sea generally shows lower abundance levels than the northern North Sea. This is particularly reflected in the Gorm area where the distribution of fish biomass is 45 kg/ hour according to the Q1 2021 IBTS and in Halfdan and Dan where the distribution of fish biomass is 160 and 200 kg/ hour respectively. In contrast, fish biomass measures over 7,000 kg/ hour in the northern part of the North Sea.

## Figure 3.7 Distribution of Fish Biomass (kilograms/hour) in IBTS Hauls by Grid Square

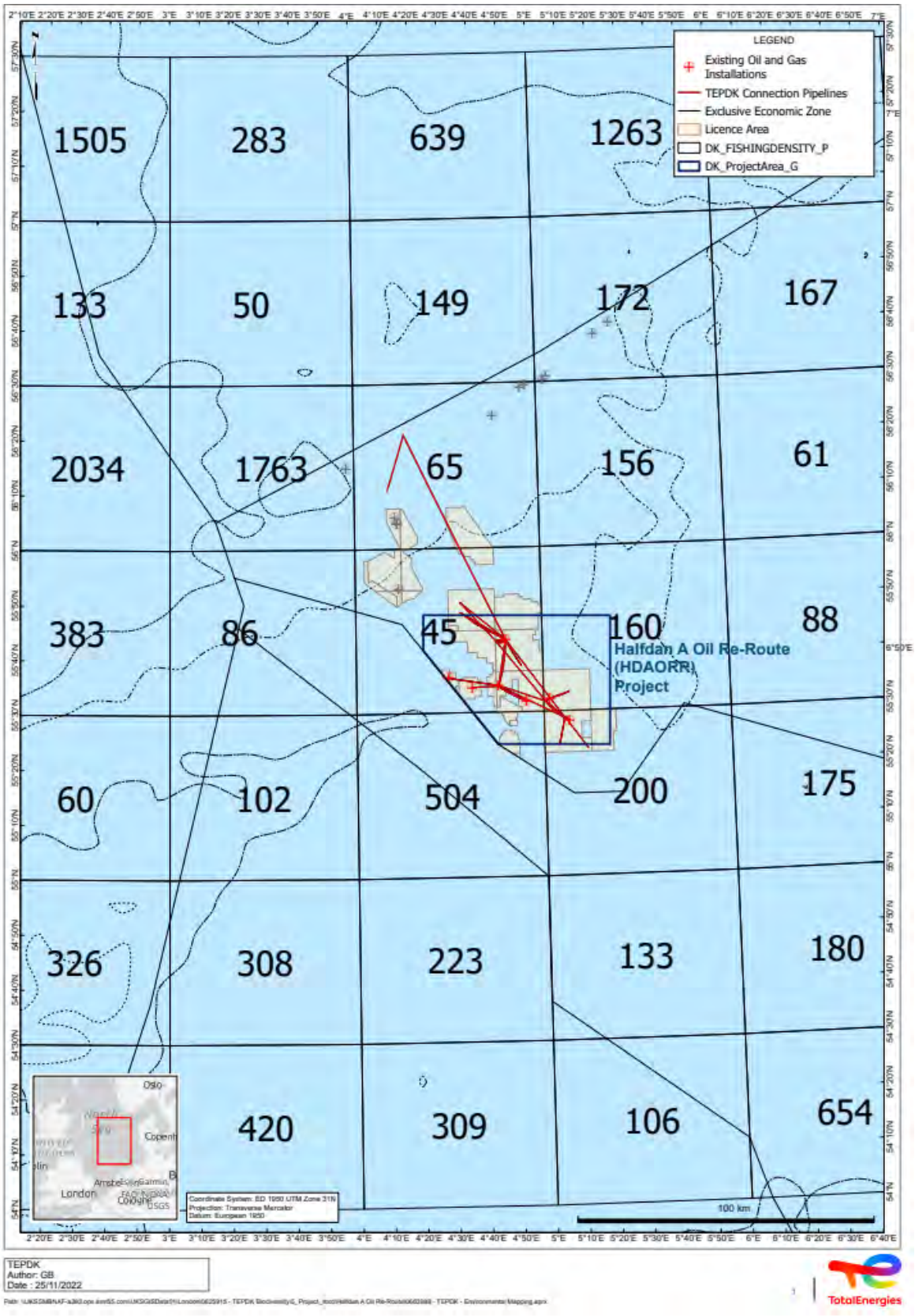



Table 3.7 presents the number of fish caught per trawl hour in the project area, compared to the maximum number of fish caught per trawl hour in the North Sea.

## Table 3.7 Catch per trawl hour at the Project Area by Fish Species (2014 Data for Summer and Winter)

| Fish species | Catch per trawl hour at the Dan area | Catch per unit effort – no. of fish per trawl hour at the Halfdan area | Catch per trawl hour at the Gorm area | Maximum catch per trawl hour in the North Sea |
|---|---|---|---|---|
| Herring *(Clupea harengus)* | 400 – 1,000 | 200 – 400 in winter, 400 – 1,000 in summer | 1 – 100 | 1,000 – 6,500 |
| Sprat *(Sprattus sprattus)* | 1,000 – 4,000 | 200 – 1,000 in winter, 1,000 – 4,000 in summer | 1 – 200 | 12,500 – 25,000 |
| Cod *(Gadus morhua)* | 1 – 2 | 2 – 5 | 1 – 2 | 20 – 44 |
| Haddock *(Melanogrammus aeglefinus)* | 1 – 10 | 1 – 10 | 1 – 10 in winter, 0 in summer | 150 – 300 |
| Whiting *(Merlangius merlangus)* | 1 – 20 | 1 – 20 in winter, 20 – 100 in summer | 1 – 20 | 800 – 1,100 |
| Saithe *(Pollachius virens)* | 0 in winter, 1 – 5 in summer | 0 in winter, 1 – 5 in summer | - | 50 – 172 |
| Norway pout *(Trisopterus esmarkii)* | 0 in winter, 1 – 200 in summer | 1 – 200 in winter, 0 in summer | - | 5,000 – 12,700 |
| Atlantic mackerel *(Scomber scombrus)* | 1 – 10 in winter, 50 – 200 in summer | 0 in winter, 1 – 10 in summer | 0 in winter, 50 – 200 in summer | 200 – 600 |
| Grey gurnard *(Eutrigla gurnardus)* | 1 – 10 in winter, 20 – 50 in summer | 1 – 10 in winter, 20 – 50 in summer | 10 – 20 in winter, 100 – 220 in summer | 100 – 220 |
| Hooknose *(Agonus cataphractus)* | 1 – 2 | 1 – 2 | 1 – 2 in winter, 0 in summer | 12 – 17 |

| Fish species | Catch per trawl hour at the Dan area | Catch per unit effort – no. of fish per trawl hour at the Halfdan area | Catch per trawl hour at the Gorm area | Maximum catch per trawl hour in the North Sea |
|---|---|---|---|---|
| Lumpsucker *(Cyclopterus lumpus)* | 0.2 – 0.5 in winter, 0 in summer | 0.1 – 0.2 in winter, 0 in summer | 0.2 – 0.5 in winter, 0 in summer | 1.2 – 2 |
| American plaice *(Hippoglossoides platessoides)* | 1 – 10 | 10 – 20 in winter, 20 – 50 in summer | 1 – 10 in winter, 0 in summer | 100 – 170 |
| Common dab *(Limanda limanda)* | 50 – 100 in winter, 100 – 300 in summer | 50 – 100 in winter, 20 – 50 in summer | 20 – 50 in winter, 50 – 100 in summer | 300 – 900 |
| Lemon sole *(Microstomus kitt)* | 1 – 2 in winter, 2 – 5 in summer | 2 – 5 | 2 – 5 in winter, 5 – 10 in summer | 18 – 28 |
| European flounder *(Platichthys flesus)* | 0.1 – 0.5 in winter, 0 in summer | 0.1 – 0.5 in winter, 0 in summer | 0.1 – 0.5 in winter, 0 in summer | 4 – 15 |
| European plaice *(Pleuronectes platessa)* | 20 – 50 | 5 – 10 in winter, 1 – 5 in summer | 1 – 5 | 50 – 120 |
| Common sole *(Solea solea)* | 0.2 – 0.5 | - | 0 in winter, 0.1 – 0.2 in summer | 4 – 8 |

Source: ICES, 2014

### *3.2.3.4 Marine Mammals*

In the Halfdan area, pinniped (seal) species include the grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*). The resident cetacean species present in the Halfdan area are minke whale (*Balaenoptera acutorostrata*), harbour porpoise (*Phocoena phocoena*), and white-beaked dolphin (*Lagenorhynchus albirostris*), which are typical species of the North Sea. Less common cetacean species include short-beaked common dolphin (*Delphinus delphis*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), long-finned pilot whale (*Globicephala melas*), orca (*Orcinus orca)* and Risso's dolphin *(Grampus griseus*) (Waggitt et al., 2019). According to Waggitt et al., (2019), the harbour porpoise (*Phocoena phocoena*) and white-beaked dolphin (*Lagenorhynchus albirostris*) show

the highest population density in the central and southern North Sea, compared to that of other marine mammals that inhabit more northern waters past North Scotland and the Atlantic.

**Table 3.8 Characteristics of the Most Represented Marine Mammal Species in the Project Area**

| Species | Global Red List IUCN Status/ European Red List Status/local population trend | Biology and Geographical Distribution |
|---|---|---|
| Grey seal (*Halichoerus grypus*) | Least Concern<br>Least Concern<br>Increasing | **Food:** Their feeding behaviour can be demersal or benthic. Ammodytidae (Sandeels), cod (*Gadus morhua*) and saithe (*Pollachius virens*) all account for a typical grey seal (*Halichoerus grypus*) diet, which varies depending on availability.<br>**Habitat:** Present in the North Atlantic continental shelf, in cold temperate waters. Population size is estimated at 315 000 adults.<br>**Breeding and Pupping:** Breeding takes place in the autumn with a clockwise cline in mean birth date around the UK and European coasts: August-September in SW Britain, September-November in Scotland and Scandinavia and November-December in eastern England and January – March in mainland Europe. |
| Harbour seal (*Phoca vitulina*) | Least Concern<br>Least Concern<br>Increasing | **Food:** Fish, cephalopods and crustaceans caught at the water surface, mid waters and on the sea bottom.<br>**Habitat:** Typically in the coastal waters of continental shelf and slopes. Population size is estimated at 600,000 individuals.<br>**Breeding and Pupping:** Pupping occurs on land from June to July. |
| Minke whale (*Balaenoptera acutorostrata*) | Least Concern<br>Least Concern<br>Stable | **Food:** Minke whale (*Balaenoptera acutorostrata)* exploit a variety of prey depending on availability, but usually consume a considerable amount of Euphausiacea (krill).<br>**Habitat:** The minke whale (*Balaenoptera acutorostrata*) is found in all oceans, and part of the population is believed to migrate to warmer latitudes every winter. Total population estimates reach 200,000 individuals.<br>**Breeding and Calving:** Mating and calving occurs during the winter. There is limited information available on breeding and calving behaviour and location. |
| Harbour porpoise (*Phocoena phocoena*) | Least Concern<br>Vulnerable<br>Stable | The species is listed in Appendix II of CITES.<br>**Food:** Wide variety of fish and cephalopods.<br>**Habitat:** Typically found in continental shelf waters in cold temperate to sub-polar waters of the northern hemisphere. They frequently visit shallow waters of estuaries, tidal channels and shallow bays. The Atlantic population comprises 700,000 individuals, although it is declining, and the global population is estimated at well over one million individuals.<br>**Breeding and Calving:** The mating and calving season ranges from May to August. Coastal areas of Germany and Denmark are thought to be important calving areas. |
| White-beaked dolphin (*Lagenorhynchus albirostris*) | Least Concern<br>Least Concern<br>Stable | **Food:** Small pelagic fish, cephalopods and crustaceans.<br>**Habitat:** Typically found in waters less than 200 meters deep, lives in cold temperate to subpolar zones. Total Atlantic populations are estimated at more than 100,000.<br>**Breeding and Calving:** Calving season takes place in the summer. Calves are sighted from June to September. |

Source: Prepared by ERM with data extracted from: IUCN, 2020; JNCC, 2003; OSPAR 2017; Hammond et al., 2017; Schick et al., 2020; Teilmann et al., 2008.

The five marine mammal species presented in Table 3.8 are protected by the EU Habitats Directive (Annex II and/or Annex IV or V) and so are particularly important when conducting impact assessments in Danish waters (Tougaard, 2016). During the Marine Mammal Sighting Reporting program (MMSR), a hundred and thirty-one sightings around Danish hydrocarbon installations were reported. The most sighted species were harbour porpoise (*Phocoena phocoena*) (41%) and minke whale (*Balaenoptera acutorostrata*) (31%) (Delefosse et al., 2017). During regular activities at the Halfdan platforms, twenty harbour porpoise (*Phocoena phocoena*) and nine minke whales (*Balaenoptera acutorostrata*) were sighted between 2013 and 2021, as recorded in TEPDK monitoring records. In addition, two white-beaked dolphin (*Lagenorhynchus albirostris*), one harbour seal (*Phoca vitulina*), and thirteen grey seals (*Halichoerus grypus*) were also recorded. At the Dan and Gorm platforms, around twenty harbour porpoise (*Phocoena phocoena*) and around ten minke whales (*Balaenoptera acutorostrata*) were sighted between 2013 and 2021, as recorded in TEPDK monitoring records. In addition, few short beaked common dolphins (*Delphinus delphis*), harbour seal (*Phoca vitulina*), and around ten grey seals (*Halichoerus grypus*) were also recorded. Fifteen delphinidae, cetacean and pinniped individuals were sighted but not identified at species level.

Large-scale surveys for cetaceans in the North Sea were carried out in 1994 (SCANS I – Small Cetaceans Abundance in the North Sea), 2005 (SCANS II) and 2016 (SCANS III). The SCANS III data provides estimates of cetacean abundance in European Atlantic waters in the summer of 2016 from aerial and shipboard surveys (Hammond et al., 2017).

The 2016 SCANS III survey found that the observed distribution of minke whale (*Balaenoptera acutorostrata*), harbour porpoise (*Phocoena phocoena*) and white-beaked dolphin (*Lagenorhynchus albirostris*) in 2016 was similar to that observed in SCANS-II in 2005 (Hammond et al., 2017). One notable difference was that there were more sightings of harbour porpoise (*Phocoena phocoena*) throughout the English Channel (block C) in 2016 than previously *(*Hammond et al., 2017).

Comparing results from the three surveys has allowed analysis of trends of abundance over the years. In the North Sea in general, harbour porpoise (*Phocoena phocoena*), white-beaked dolphin (*Lagenorhynchus albirostris*) and minke whale (*Balaenoptera acutorostrata*) abundance has not changed since 1990 (Hammond et al., 2017). However, there are regional changes, with recent studies of harbour porpoise (*Phocoena phocoena*) abundance in the German North Sea identifying an overall decline over the last 20 years, with a larger decrease in northern waters and a slight increase in southern waters *(*Nachtsheim et al., 2021*).*

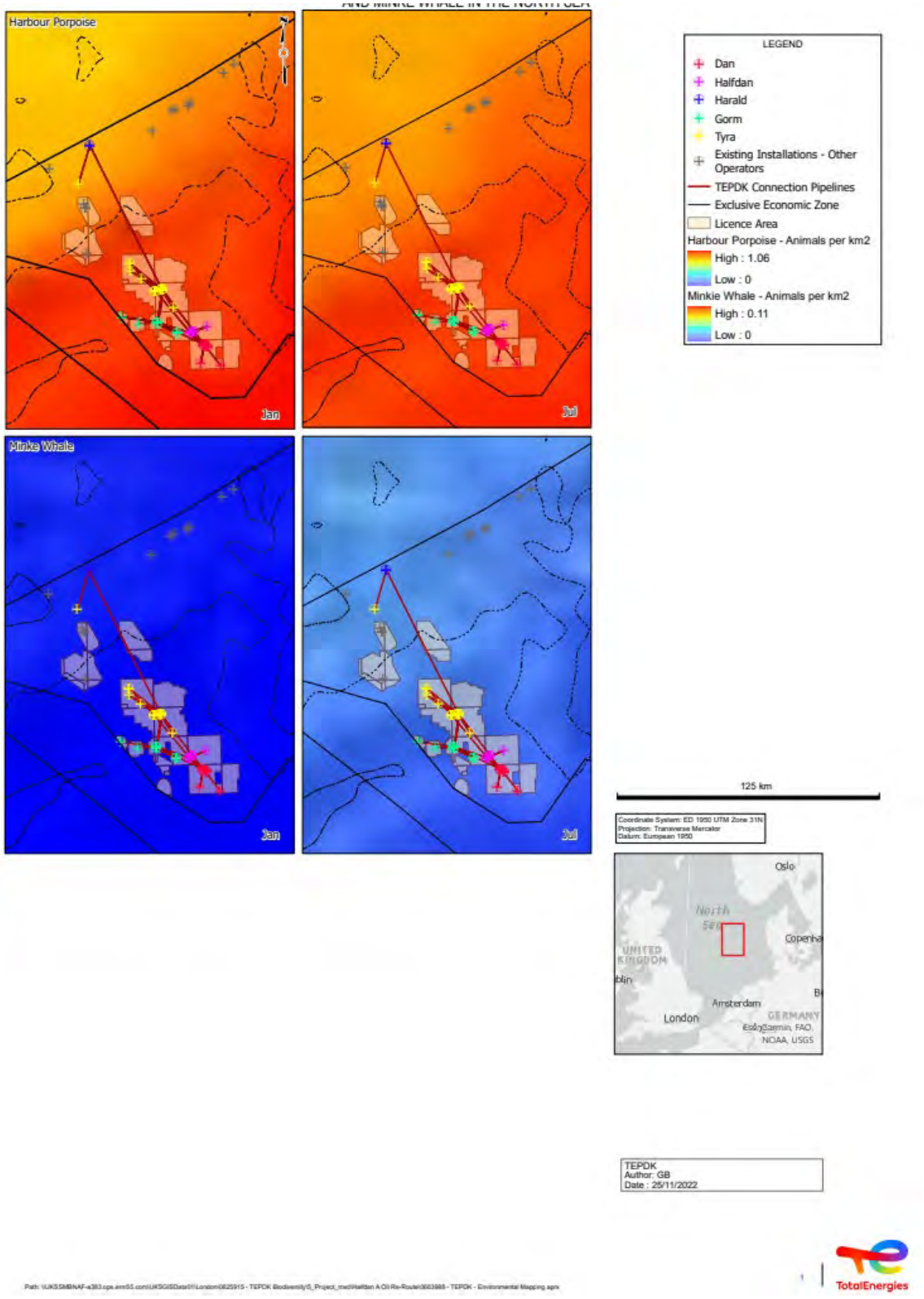
Distribution of harbour porpoise (*Phocoena phocoena*) and minke whale (*Balaenoptera acutorostrata*) from the 2016 SCANS III survey in the North Sea are presented in Figure 3.8.

More recent abundance and distribution estimates for minke whale (*Balaenoptera acutorostrata*), white-beaked dolphin (*Lagenorhynchus albirostris*) and harbour porpoise (*Phocoena phocoena*) in the North Sea and Halfdan area based on survey data from 1980 and 2018 (Waggit et al., 2019) are shown in Figure 3.9.

There are very little data regarding seasonality of these species, however observations between 1980 and 2018 showed that most cetacean species found in the Halfdan area (i.e., minke whale (*Balaenoptera acutorostrata*), white-beaked dolphin (*Lagenorhynchus albirostris*), harbour porpoise (*Phocoena phocoena*), short beaked dolphin (*Delphinus delphis*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), and Risso's dolphin *(Grampus griseus*)) are more abundant in the North Sea during summer compared to winter (Waggitt et al., 2019). Orca (*Orcinus orca*) and long-finned pilot whale (*Globicephala melas*) show no seasonality pattern. Harbour porpoise (*Phocoena phocoena*) has a localised seasonality pattern within the North Sea. Clausen et al. (2021) investigated harbour porpoise (*Phocoena phocoena*) seasonality for areas surrounding Danish offshore oil and gas structures, including the Halfdan, Dan and Gorm area. Two distinct activity periods of harbour porpoise around oil and gas platforms were observed. During July-January, relatively high densities of harbour porpoise (*Phocoena phocoena*) were recorded around Dan F (up to 800 m) compared to stations located further away. During February to June, harbour porpoise (*Phocoena phocoena*) densities were generally lower and more evenly distributed across the distance gradient. This is consistent with a similar study conducted in the central North Sea area (Gillies et al., 2016).

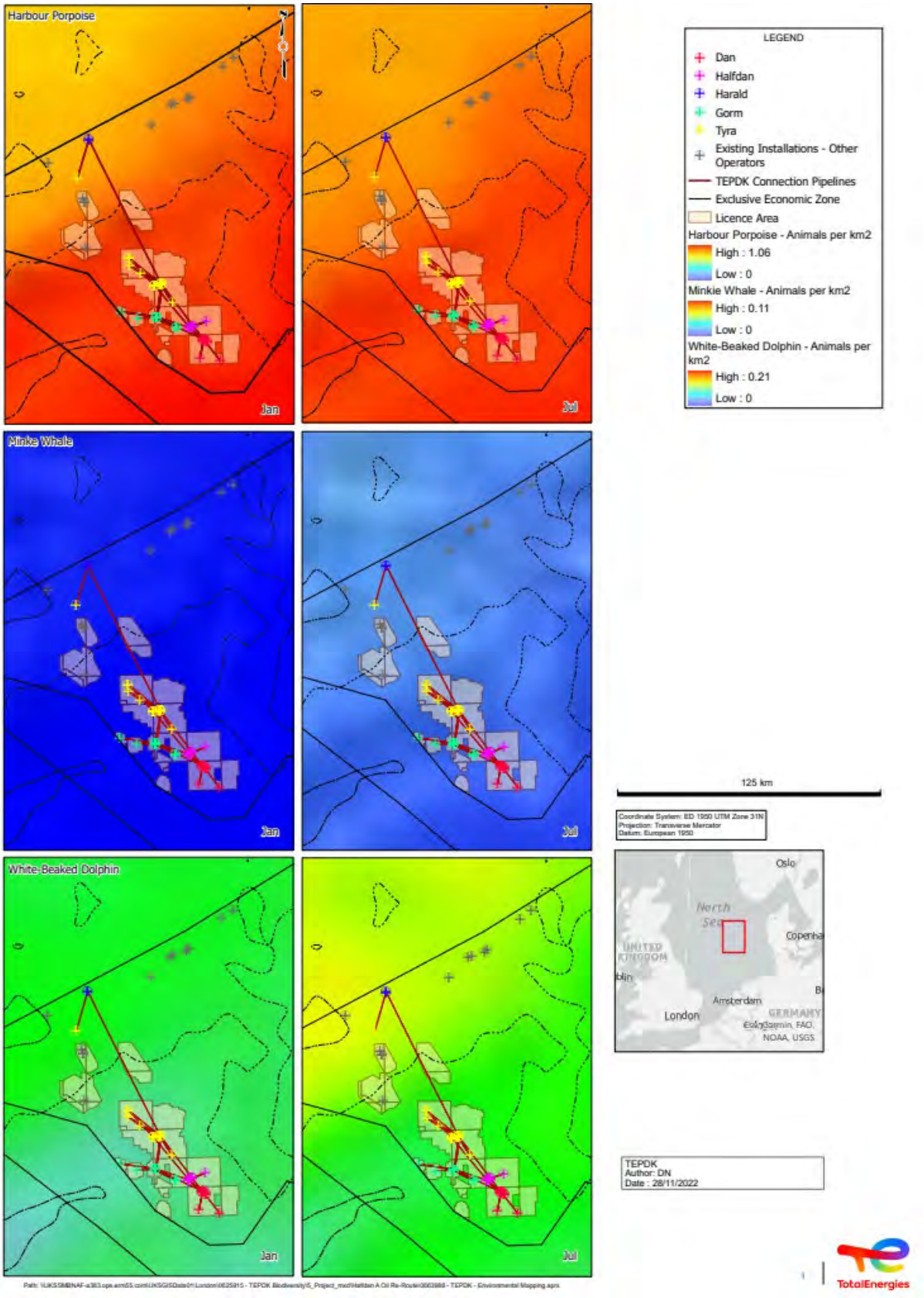
A study by Clausen et al. (2021) on echolocation activity of harbour porpoise (*Phocoena phocoena)* around the Dan F platform shows seasonal artificial reef attraction despite elevated noise levels close to oil and gas platforms. The results of the study suggest a general attraction to the platforms due to the motivation to find food from a predictable food source close to the platforms. It is expected that this behaviour may be similar at other platforms in the TEPDK Fields, including the HALFDAN and GORM Fields.

## Figure 3.8 Estimated Density in Survey Blocks of (a) Minke Whales (*Balaenoptera acutorostrata*) and (b) Harbour porpoise




Source: Hammond et al., 2017

## Figure 3.9 Density and Distribution of Harbour Porpoise, White-beaked Dolphin and Minke Whale




Source: Hammond et al., 2017

### *Species of Conservation Concern*

All regularly occurring marine mammal species in the North Sea are listed as of Least Concern (LC) on the IUCN Red List. All the cetaceans are protected under Annex IV of the EU Habitats Directive, and harbour porpoise (*Phocoena phocoena*), harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*) are protected under Annex II of the EU Habitats Directive. Two cetacean species that are infrequent visitors to the North Sea are listed as EN on the Red List, set out in Table 3.9. Neither of these species is likely to occur regularly within the Halfdan, Dan and Gorm area.

**Table 3.9 Cetaceans of Conservation Concern Infrequently Occurring in the North Sea and Halfdan area**

| Species | IUCN Red List Status/ European Red List Status/local population trend | Biology and Geographical Distribution |
|---|---|---|
| Blue whale (*Balaenoptera musculus*) | Endangered<br>Endangered<br>Increasing | Found in all oceans but absent from some regional seas such as the Mediterranean Sea. They feed both at the surface and at depths of up to 300 m almost exclusively on Euphausiacea (krill). Migration patterns are not well understood, but appear to be diverse, with some groups migrating between productive feeding areas at higher latitudes. There is a western North Atlantic population, but individuals are rare in the North Sea. |
| Sei whale (*Balaenoptera borealis*) | Endangered<br>Endangered<br>Increasing | Occurs in the North Atlantic, North Pacific, and Southern Hemisphere, typically with an offshore distribution. They feed on a wide range of prey species. Uncommon in the North Sea. |

Source: IUCN, 2022; Temple & Terry, 2007.

### *3.2.3.5 Birds*

The coastlines of the North Sea are habitat for seabirds that inhabit estuaries, rocky coasts and cliffs. Coastal birds and winter migratory species from the north and east use the waters of the North Sea for feeding (ICES, 2020). Fifty-five seabird species are present on the Danish coast and may use the waters of the Danish EEZ (Table 3.10).

The seabirds identified during a three-year offshore aerial seabird monitoring survey in 2006-2008 covering the Gorm area are highlighted in yellow in Table 3.10 (Skov & Piper, 2009).

There is a clear seasonal pattern in seabird species found in the Gorm area. Black-legged kittiwake (*Rissa tridactyla)*, European herring gull (*Larus argentatus)*, common guillemot (*Uria aalge)*, and razorbill (*Alca torda)* are more commonly sighted in the North Sea during winter while lesser black-backed gull (*Larus fuscus)*, northern fulmar (*Fulmarus glacialis)*, great skua (*Stercorarius skua),* and northern gannet (*Morus bassanus)* are more commonly sighted in the North Sea during summer (Waggitt et al., 2019).

## Table 3.10 Seabirds of Denmark

| Scientific name | English name | Birds Directive Status | Global IUCN Red List Status | Scientific name | English name | Birds Directive Status | Global IUCN Red List Status |
|---|---|---|---|---|---|---|---|
| ***Clangula hyemalis*** | Long-tailed Duck | | VU | ***Larus hyperboreus*** | Glaucous Gull | | LC |
| ***Fratercula arctica*** | Atlantic Puffin | | VU | ***Larus marinus*** | Great Black-backed Gull | | LC |
| ***Hydrobates leucorhous*** | Leach's Storm-petrel | Annex 1 | VU | ***Larus melanocephalus*** | Mediterranean Gull | Annex 1 | LC |
| ***Melanitta fusca*** | Velvet Scoter | | VU | ***Larus michahellis*** | Yellow-legged Gull | | LC |
| ***Podiceps auritus*** | Horned Grebe | Annex 1 | VU | ***Larus ridibundus*** | Black-headed Gull | | LC |
| ***Rissa tridactyla*** | Black-legged Kittiwake | | VU | ***Melanitta nigra*** | Common Scoter | | LC |
| ***Alca torda*** | Razorbill | | LC | ***Mergus merganser*** | Goosander | | LC |
| ***Ardenna grisea*** | Sooty Shearwater | | NT | ***Mergus serrator*** | Red-breasted Merganser | | LC |
| ***Gavia adamsii*** | Yellow-billed Loon | | NT | ***Morus bassanus*** | Northern gannet | | LC |
| ***Somateria mollissima*** | Common Eider | | NT | ***Phalacrocorax carbo*** | Great Cormorant | | LC |
| ***Alle alle*** | Little Auk | | LC | ***Phalaropus lobatus*** | Red-necked Phalarope | | LC |
| ***Aythya marila*** | Greater Scaup | | LC | ***Phalaropus fulicarius*** | Red Phalarope | | LC |
| ***Bucephala clangula*** | Common Goldeneye | | LC | ***Podiceps grisegena*** | Red-necked Grebe | | LC |
| ***Cepphus grylle*** | Black Guillemot | | LC | ***Podiceps cristatus*** | Great Crested Grebe | | LC |
| ***Chlidonias niger*** | Black Tern | Annex 1 | LC | ***Podiceps nigricollis*** | Black-necked Grebe | | LC |
| ***Fulmarus glacialis*** | Northern Fulmar | | LC | ***Puffinus puffinus*** | Manx Shearwater | Annex 1 | LC |
| ***Gavia stellata*** | Red-throated Diver | Annex 1 | LC | ***Somateria spectabilis*** | King Eider | | LC |
| ***Gavia arctica*** | Black-throated Diver | Annex 1 | LC | ***Stercorarius longicaudus*** | Long-tailed Jaeger | | LC |
| ***Gavia immer*** | Common Loon | Annex 1 | LC | ***Stercorarius parasiticus*** | Arctic Jaeger | | LC |
| ***Gelochelidon nilotica*** | Common Gull-billed Tern | Annex 1 | LC | ***Stercorarius pomarinus*** | Pomarine Jaeger | | LC |
| ***Hydrobates pelagicus*** | European Storm-petrel | Annex 1 | LC | ***Stercorarius skua*** | Great Skua | | LC |
| ***Hydrocoloeus minutus*** | Little Gull | | LC | ***Sterna hirundo*** | Common Tern | | LC |

| Scientific name | English name | Birds Directive Status | Global IUCN Red List Status | Scientific name | English name | Birds Directive Status | Global IUCN Red List Status |
|---|---|---|---|---|---|---|---|
| ***Hydroprogne caspia*** | Caspian Tern | Annex 1 | LC | ***Sterna paradisaea*** | Arctic Tern | Annex 1 | LC |
| ***Larus argentatus*** | European Herring Gull | | LC | ***Sternula albifrons*** | Little Tern | Annex 1 | LC |
| ***Larus canus*** | Mew Gull | | LC | ***Thalasseus sandvicensis*** | Sandwich Tern* | Annex 1 | LC |
| ***Hydrobates pelagicus*** | European Storm-petrel | | LC | ***Uria aalge*** | Common guillimot* | Annex 1 | LC |
| ***Larus fuscus*** | Lesser Black-backed Gull | | LC | ***Xema sabini*** | Sabine's Gull | | LC |
| ***Larus glaucoides*** | Iceland Gull | | LC | | | | |

*Legend: LC: Least Concern, NT: Near threatened, VU: Vulnerable.*

Source: Birdlife International 2020; Skov & Piper, 2009

### *Species of Conservation Concern*

Seabirds included on the IUCN (International Union for Conservation of Nature) Red List of Threatened Species which regularly occur within the project area include the black-legged kittiwake (*Risa tridactyla*), listed as vulnerable. Additionally, the northern fulmar (*Fulmarus glacialis*), which regularly occurs, is listed as endangered at a European level. Regularly occurring species included in the IUCN Red List of Threatened Species are shown in Table 3.11. Of these species, black-legged kittiwake (*Risa tridactyla*) and northern fulmar (*Fulmarus glacialis*) are likely to regularly occur within the Gorm area.

Various species that occur within the area are listed on Annex I of the EU Birds Directive (identified in Table 4.8), meaning that member states have an obligation to identify Special Protection Areas (SPAs) to protect key areas for their survival. Member states are also obliged to identify SPAs for regularly occurring migratory species, which are not listed by species in the Birds Directive, but which include all seabirds because of their migratory and congregatory behaviour. Denmark has identified SPAs for both Annex I and migratory species within its waters.

Denmark has now designated 113 SPAs under the EU Birds Directive across the country and EEZ for the protection of Annex 1, migratory or congregatory birds (EU Biodiversity, 2022). The closest SPA to TEPDK infrastructure within Danish waters is Sydlige Nordsø situated 122 km south east of Gorm.

**Table 3.11 Seabirds of Conservation Concern with Published Distributions overlapping the Gorm Area**

| Species | IUCN Red List Status/European Red List Status/ local population trend | Biology and Geographical Distribution |
|---|---|---|
| Northern fulmar (*Fulmarus glacialis*) | Least Concern<br>Endangered<br>Declining | Listed as LC globally but considered EN at a European level due to ongoing population declines.<br><br>Northern fulmar (*Fulmarus glacialis*) has a large foraging range and is recorded throughout the North Sea during summer, with higher concentrations in the northern North Sea around Norway in the winter. |
| Black-legged Kittiwake *(Rissa tridactyla)* | Vulnerable<br>Vulnerable<br>Declining | The black-legged kittiwake *(Rissa tridactyla)* is listed as VU on the IUCN list, as its population has been decreasing over the past three generations.<br>There are colonies on the Danish, UK and Norwegian coasts. The largest concentrations are found near these breeding areas.<br>In summer, the species is concentrated primarily in the western North Sea. Outside the breeding season, the species occurs throughout the North Sea with varying densities (Bogdanova et al., 2011). |

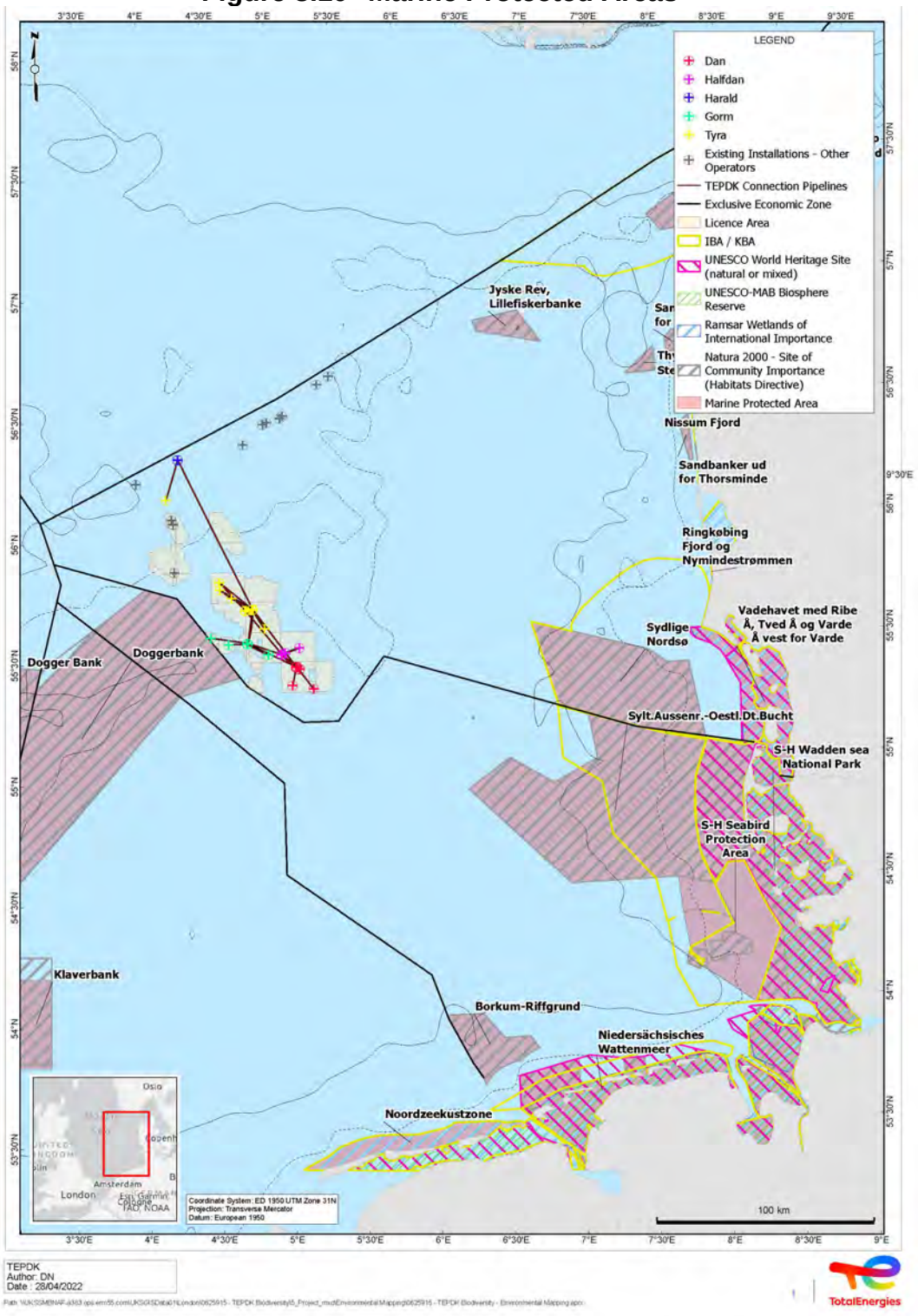
Source: Birdlife International 2020; Maersk, 2016.

### *3.2.3.6 Protected and recognized sites*

Protected areas within the North Sea include Natura 2000 sites, Ramsar sites, Key Biodiversity Areas (KBAs) UNESCO world heritage sites and nationally designated areas. Within the Study Area, the only protected areas are Natura 2000 sites. Protected and recognized sites in relation to the Study Area are shown in Figure 3.10. Other marine protected areas are currently under consultation as part of Denmark's Marine Spatial plan which was established in March 2021. The closest of these is approximately 100 km east of the HALFDAN Field.

Details on Natura 2000 sites in Denmark and other nature reserves, parks and protected areas are further assessed in Sections 3.3.5 and 3.3.6.

**Figure 3.10 Marine Protected Areas**




Source: ERM, 2022

### *3.2.3.7 Invasive Species*

The Danish EPA published in 2017 their "Action plan against invasive species" (DEPA, 2017). The report indicates that marine alien species can be introduced, for example, through ballast water and fouling from ships. To reduce the threat from invasive species, Denmark has implemented the Ballast Water Management Convention with the Marine Environment Act which requires ships to manage ballast water by minimising and ultimately eliminating transfer of invasive species. The Ballast Water Management Convention entered into force on 8 September 2017.

DEPA used a scoring system for the Action Plan where the 'invasiveness' of alien species i.e. the damage they cause to biodiversity and related ecosystem services, is assessed based on a scoring system. This scoring system evaluates species based on the adverse impacts they cause or may cause. The scores are either high (3), medium (2) or low (1) for each of the six categories: 'Dispersal potential', 'colonisation of high conservation value habitats', 'adverse impacts on native species', 'alteration of ecosystem functions' and 'economic effects and health effects'. All alien species thereby receive a score between 6 and 18, and this score used to inform proposed management actions. The scoring of the individual parameters for each species was carried out by experts in the various species. In order for a species to be designated as invasive, it must have received a total score of at least 7, with a score of at least 2 in the categories 'effect on indigenous species' and 'effect on ecosystem functions'.

The Danish Action Plan against invasive species lists 66 invasive species assessed to have the greatest adverse impact in Denmark (having a total score of 14-18 for a highly damaging impact on the environment, human health and the economy). Nineteen of the invasive species identified are marine species.

With respect to the species listed in the Danish Action Plan (DEP, 2017) only six plankton species (*Alexandrium minutum*, *Alexandrium tamarense*, *Chattonella verruculosa*, *Heterosigma akashiwo*, *Karenia mikimotoi*, *Pseudochattonella farcimen*) and the Ctenophore *Mnemiopsis leidyi* are considered possibly present in pelagic waters of the Halfdan Oil Re-Route project area. All other species are considered unlikely to be present at the Halfdan Oil Re-Route project area due to their ecological characteristics and the current knowledge of benthic colonization of TEPDK offshore structures. These 12 species are:

- Algae:
  - *Prorocentrum minimum*
  - *Gracilaria vermiculophylla,*
  - *Sargassum muticum*, Japweed,
  - *Undaria pinnatifida*, Wakame;
- Anellid (worms)
  - *Marenzelleria neglecta*, red-gilled mud worm,
  - *Marenzelleria viridis*
- Crustacean:
  - *Eriocheir sinensis*, Chinese mitten crab,
  - *Paralithodes camtschaticus*, Red king crab;
- Fish: *Neogobius melanostomus*, Round goby;
- Ctenophore: *Beroe ovata*, Brown comb jellyfish.
- Mollusc: *Crassostrea gigas*, Pacific oyster
- Tunicate: *Didemnum vexillum*

TEPDK conducted sediment and biological monitoring campaigns with no clear evidence of invasive benthic species presence. However, no specific monitoring studies have been conducted specifically focusing on invasive species and sampling of plankton and analysis of ROV footage to identify invasive crabs, molluscs or algae potentially fouling submerged TEPDK structures has not been undertaken.

## 3.3 Carrying Capacity of the Natural Environment

### *3.3.1 Wetlands, Areas along Banks, Estuaries*

HALFDAN and the other fields included in the Halfdan Oil Re-Route project are located approximately 210 km from the Danish coast. Even though wetlands and estuaries and fauna associated with these habitats are highly sensitive environments, the project activities will not interact with them.

### *3.3.2 Coastal Areas and the Marine Environment*

The closest coastline is the Danish coast, which is approximately 210 km from the project site. The key physical (sediments and water) and biodiversity features of the marine environment are described in Section 3.2. The project does not cause any modification to the structure or any modification to the seabed and will have no interaction with the coastline.

### *3.3.3 Assessment of Potential Impacts on MSFD Descriptors*

Table 4.8 for The Marine Strategy Framework Directive outlines 11 descriptors to assess the good environmental status of the marine environment under the European Union and Danish legislations (Marine Strategy Framework Directive 2008/56/EC and Act no. 615 of 8 June 2016, Danish Maritime Agency) and further describe the impacts on the marine environment.

### *3.3.4 Mountain and Forest Areas*

The project will take place more than 200 km from the Danish coast in the North Sea. Mountains and forests are found inland and will not interact with project activities.

### *3.3.5 Nature Reserves and Park*

The project area and the fields interested in the Halfdan Oil Re-Route project are located approximately 210 km from the Danish coast. Even though Denmark has five national parks of which the closest to the project area are Vadehavet and Thy located on the eastern coast of Denmark. Both of these are important for the wetlands and the coastal area, however the distance is such that any project disturbance is expected to not extend to the park.

The impacts from the project on nature reserves and parks are assessed in Section 4.2.3.

### *3.3.6 Registered or Protected Territories*

The existing Halfdan facilities and upgrades are not located within any Marine Protected Areas (MPAs), Nature Reserves, Natura 2000 sites, Important Bird Areas (IBAs) or Special Protection Areas (SPAs) of the North Sea. Protected areas are shown in Figure 3.10.

The closest protected areas to the Halfdan Oil Re-Route project area are the Doggerbank (DE1003301) site designated as a SCI, which lies approximately 22 km west of the Halfdan Oil Re-Route Project area and the Doggersbank SCI (NL2008001) which lies 50 km to the west of the Halfdan Oil Re-Route Project area.

Marine species of conservation interest in the Doggerbank SCI include the marine mammals harbour porpoise (*Phocoena phocoena*), harbour and grey seal (*Phoca vitulina* and *Halichoerus grypus*) and the birds northern fulmar (*Fulmarus glacialis*), lesser black-backed gull (*Lesser farus*), northern gannet (*Morus bassanus*), black-legged kittiwake (*Rissa tridactyla*) and common murre (*Uria aalge*).

Sensitive species which may be present in the waters near the proposed development include seabirds, migrating and resident whales and dolphins (notably Minke whale, harbour porpoise, white-beaked dolphin, and bottlenose dolphin) and resident seals (grey seal and harbour seal). Harbour porpoises are present in relatively high numbers and their abundance has been stable with no evidence of any decline over the last 30 years. Harbour porpoise (*Phocoena phocoena*) and white-beaked dolphin (*Lagenorhynchus albirostris*) show the highest population density of these species in the central and southern North Sea; harbour porpoise in particular exhibit high densities in the project area (Sveegaard, 2018), compared to that of other marine mammals who inhabit more northern waters past North Scotland and the Atlantic (Waggit et al*.,* 2020). The abundance of harbour porpoise has been stable with no evidence of any decline over the last 30 years (Hammond et al*.*, 2017).

Five marine mammal species are of particular importance for impact assessments in Danish waters. They are protected by the EU Habitats Directive (Annex II and/or Annex IV). The protected species are harbour porpoise, white-beaked dolphin, Minke whale, harbour seal and grey seal (Tougaard, 2016), however, other species are present in the area in lesser densities including, but not limited to, white-beaked whales (Waggit et al*.,* 2020).

Table 3.12 provides a seasonal sensitivity matrix of selected marine species, including Annex IV species, present in the area. The offshore installation at Dan and Halfdan is planned to start in the first quarter of 2023 ending in the third quarter of the same year for 10 months. No impact is expected for marine species breeding onshore (i.e., birds, seals), and negligible impact for marine species spawning/calving in the water column (i.e., fish and cetaceans) considering the negligible toxicity of discharges in the water column for the proposed activities.

## Table 3.12 Seasonal Sensitivities of Marine Species

| Species Name *(Scientific Name)* | J | F | M | A | M | J | J | A | S | O | N | D | Location of breeding / spawning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH and FISHERIES | | | | | | | | | | | | | |
| Cod (*Gadus morhua*) | ■ | ■ | ■ | ■ | | | | | | | | | Water column |
| Haddock (*Melanogrammus aeglefinus*) | | ■ | ■ | ■ | ■ | | | | | | | | Water column |
| Whiting (*Merlangius merlangus Actinopterygii*) | | ■ | ■ | ■ | ■ | ■ | | | | | | | Water column |
| Norway Pout (*Trisopterus esmarkii*) | ■ | ■ | ■ | ■ | | | | | | | ■ | ■ | Water column |
| Herring (*Clupea harengus*) | ■ | | | | | | | | | | ■ | ■ | Coarse or hard benthic substrate |
| Sprat (*Sprattus sprattus*) | | | | | ■ | ■ | ■ | ■ | | | | | Inshore waters |
| Mackerel (*Scomber scombrus*) | | | | | ■ | ■ | ■ | ■ | | | | | Water column |
| Sandeel (Genus: *Hyperoplus*) | ■ | ■ | | | | | | | | | ■ | ■ | Sand habitat |

| Species Name *(Scientific Name)* | J | F | M | A | M | J | J | A | S | O | N | D | Location of breeding / spawning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Saithe (*Pollachius virens*) | | | | | | | | | | | | | Water column |
| Plaice (*Pleuronectes platessa*) | | | | | | | | | | | | | Water column |
| BIRDS | | | | | | | | | | | | | |
| Black-legged kittiwake (*Rissa tridactyla)* | | | | | | | | | | | | | Onshore |
| Northern fulmar (*Fulmarus glacialis)* | | | | | | | | | | | | | Onshore |
| Gannet (*Morus bassanus)* | | | | | | | | | | | | | Onshore |
| Razorbill (*Alca torda)* | | | | | | | | | | | | | Onshore |
| Little auk (*Alle alle*) | | | | | | | | | | | | | Onshore |
| Black-throated diver (*Gavia arctica*) | | | | | | | | | | | | | Onshore |
| Red throated diver (*Gavia stellata*) | | | | | | | | | | | | | Onshore |
| Little gull (*Larus minutus*) | | | | | | | | | | | | | Onshore |
| Common scoter (*Melanitta nigra*) | | | | | | | | | | | | | Onshore |
| Eider (*Somateria mollissima*) | | | | | | | | | | | | | Onshore |
| Great skua (*Stercorarius skua*) | | | | | | | | | | | | | Onshore |
| Guillemot (*Uria aalge*) | | | | | | | | | | | | | Onshore |
| MARINE MAMMALS | | | | | | | | | | | | | |
| Grey seal (*Halichoerus grypus*) | | | | | | | | | | | | | Onshore |
| Harbour seal (*Phoca vitulina*) | | | | | | | | | | | | | Onshore |
| Harbour porpoise (*Phocoena phocoena*) | | | | | | | | | | | | | Water column |
| Minke whale (*Balaenoptera acutorostrata*) | | | | | | | | | | | | | Water column |
| White-beaked dolphin (*Lagenorhynchus albirostris*) | | | | | | | | | | | | | Water column |

*Note: Sensitive seasons consider breeding, mating, and when species are most likely to be in the central North Sea.*

Source: ERM, 2022.

### 3.3.7 Environmental Quality Standards

LBK 4 Appendix 6 addresses areas where the environmental quality standards laid down in EU legislation relevant to the project have not been successfully achieved or in respect of which it is considered that they have failed.

There is international, regional and European legislation addressing environmental protection which together form the framework for protecting the environment of the North Sea (refer to Section 1.3.1 for regulatory framework). The applicable legislation for marine pollution includes the EU EIA Directive

and EU Habitats Directive at European level, at a regional level the Marine Strategy Framework Directive implemented through the Marine Strategy Act of the Danish Nature Agency, the Bonn Agreement and the OSPAR Convention, and at international level the MARPOL Convention.

Due to these various legislative measures, it is expected that areas where the environmental quality standards laid down in EU legislation will be met, as the North Sea is strictly controlled to reduce marine pollution. OSPARs latest press release assesses a wide range of potential impacts including historical cuttings piles, discharges of produced water, drilling fluids and chemicals. Where potential impacts may still occur, OSPAR measures have ensured that these have been reduced, for example reduction in the amount of dispersed oil in produced water discharges and the phase out and reduction of discharge of hazardous chemicals and drilling fluids. Evidence from monitoring and reporting indicates that the overall effect of these OSPAR measures and their implementation by Contracting Parties has been to significantly improve the overall quality status of the Greater North Sea where there are high levels of oil and gas activity.

TotalEnergies has biodiversity commitments such as voluntary exclusion zones, biodiversity action plans for any new sites located in an area of interest for biodiversity (eg. International Union Conservation of Nature (IUCN) Protected Areas I to IV and Ramsar areas) and any existing environmentally significant site which is ISO14001 certified, and promotion of biodiversity through biodiversity released awareness programs, youth education and research actions. The Marine Strategy Framework Directive (MSFD) is a directive that is implemented in Danish law through the Marine Strategy Act, which outlines 11 descriptors used to assess good environmental status of the environment (refer to Section 4.6). The assessment of the potential impacts from the Halfdan Oil Re-Route project on these eleven descriptors is presented in Table 4.8.

Therefore, this will not be assessed further.

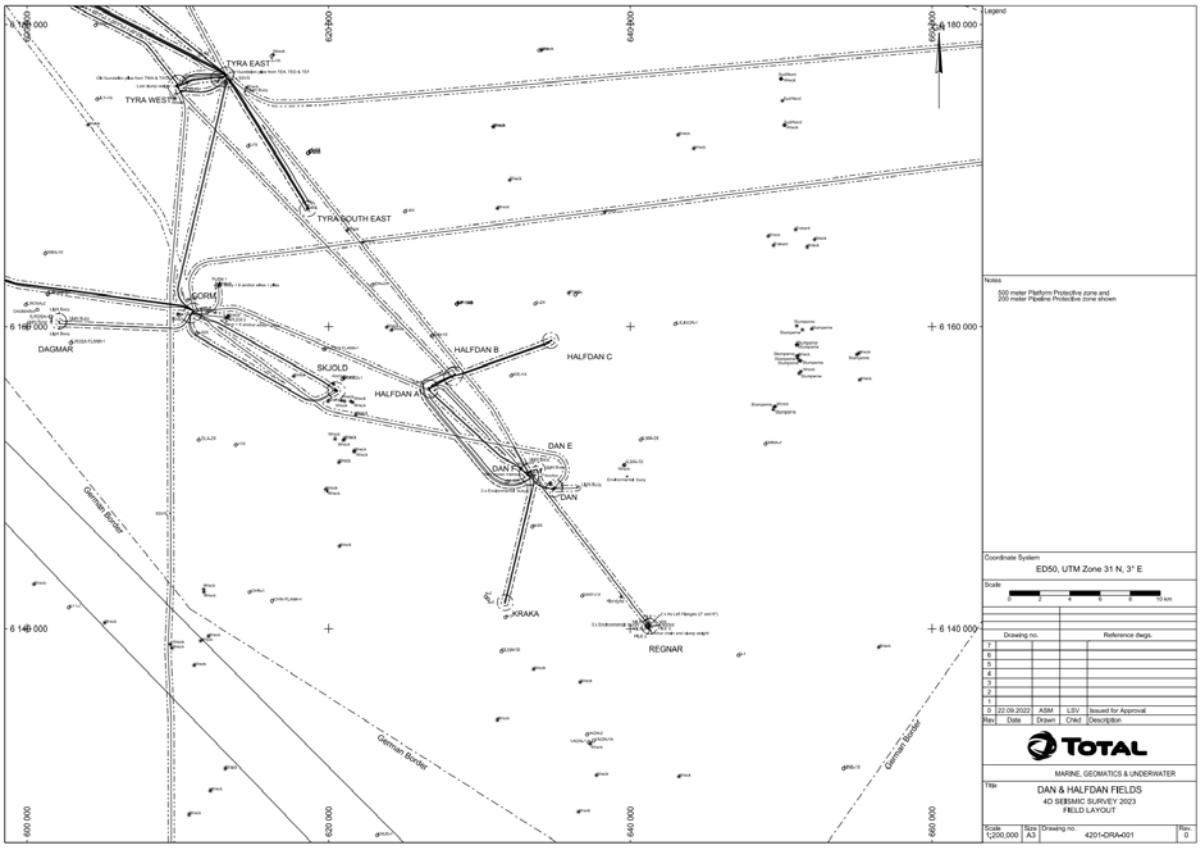
### *3.3.8 Densely Populated Areas*

No densely populated areas are present near the project, which is located approximately 210 km from land in the Danish North Sea. The closest densely populated area to the project is the City of Esbjerg, which has an urban population of approximately 71,000 people. Given that the project activities will take place in the sea, there will be no interaction between densely populated areas and the project. Part of the labour force will likely be inhabitants of Esbjerg; therefore, the project will provide jobs to the local population, however, the vessels and platforms have a very small number of people on them.

### *3.3.9 Landscapes and Sites of Historical, Cultural or Archaeological Significance*

The project area is not located near to landscapes and sites of historical, cultural, or archaeological significance, as the project area is approximately 210 km from land in the Danish North Sea (Figure 3.11). There is no record of sunken ships or other wrecks near to the Halfdan, Dan or Gorm platforms.

## Figure 3.11 Nearby Wrecks and Other Obstructions in Relation to the Halfdan Oil Re-Route Project Area




Source: TEPDK, 2022

# 4. NATURE AND CHARACTERISTICS OF THE POTENTIAL IMPACT ON THE ENVIRONMENT

## 4.1 Assessment Method

### *4.1.1 Overall Approach*

All work conducted for the Halfdan Oil Re-Route project Environmental Screening have considered the EU and Danish guidelines on EIA Screening as defined in:

- the European and Danish legislations:
  - The EIA Directive 2011/92/EU 'On the assessment of the effects of certain public and private projects on the environment'6/7,
  - the Danish EIA Act LBK number 4 of 3rd January 2023 'Promulgation of the Act on Environmental Assessment of Plans and Programs and of Specific Projects (EIA)'[8],
- TotalEnergies' and ERM standards and guidelines:
  - GS EP ENV 001 (May, 2015) by TEPDK 'Environmental requirements for projects design and E&P activities',
  - GS EP ENV 120 (December, 2019) by TEPDK 'Environmental impact assessment of E&P activities',
  - The ERM Impact Assessment Standard v1.1 August 2012 (ERM, 2012).

The following paragraphs briefly present how TEPDK and ERM EIA standards were adapted to the Danish Environmental Screening process and specifically to the Danish EIA Act LBK number 4/2023 Appendix 6.

### *4.1.2 Impact Identification*

The first stage of the environmental impact screening process involves identifying the potential impacts of the proposed activities that require further investigation. The screening phase includes the systematic consideration of the potential for interaction between activities involved in this project and aspects of the physical and biological environment that may be affected. This step of the Screening is carried out through the systematic analysis of the characteristics of the project as described in Chapter 2 in line with LBK 4 Appendix 6 *'Selection criteria referred to in § 21 (Annex III of the EIA Directive (Amendment Directive)) (Criteria for determining whether projects covered by Appendix 2 must be subjected to an Environmental Impact Assessment)',* Point 1 'Characteristics of projects'.

### *4.1.3 Impact Characterization*

In line with Annex III of the EIA Directive and LBK 4, Appendix 6, Point 3, the project's expected significant effects on the environment are evaluated in relation to the sensitivity of the environment (as defined in Chapter 3 'Project Location' that present the baseline information) and considering the following criteria and impact aspects:

- (a) the magnitude and spatial extent of the impact (e.g. geographical area and number of persons expected to be affected);
- (b) the nature of the impact;
- (c) the transboundary nature of the impact;
- d) the intensity and complexity of the impact;

[6] EIA Directive 2011/92/EU in English : https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32011L0092&from=DA#d1e32-15-1
[7] EIA Directive 2011/92/EU in Danish https://eur-lex.europa.eu/legal-content/DA/TXT/HTML/?uri=CELEX:32014L0052&from=EN#d1e117-15-1
[8] Danish EIA Act LBK number 4 of 3rd January 2023 https://www.retsinformation.dk/eli/lta/2023/4

- e) the probability of the impact;
- (f) the expected occurrence, duration, frequency and reversibility of the impact;
- (g) the cumulation of the effects of the project with the effects of other existing and / or approved projects;
- (h) the possibility of actually limiting the effects.

The ERM's Standard Methodology on Impact Assessment is based on the determination of the significance of an impact a result of the impact magnitude (assumed in this case as the results of *Extent*, *Duration* and other impact descriptors such as *Type*, *Scale* and *Frequency*) and the sensitivity characteristics of resources and receptors.

The impact characteristic terminology used in the ERM/TEPDK IA method is summarised in Table 4.1 with "crosswalks" to the Danish LBK 4/2023.

## Table 4.1 Impact Characteristic Terminology and Definitions used in the Screening Report

| Characteristic | Definition | Designations | LBK Appendix 6 Point 3 reference |
|---|---|---|---|
| Type | A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect). | Direct<br>Indirect<br>Induced | *(b) the **nature of the impact*** |
| Extent | The "reach" of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc). | Local<br>Regional<br>International | *(a) the magnitude and **spatial extent of the impact (e.g. geographical area and number of persons expected to be affected*** |
| Duration | The time period over which a resource / receptor is affected. | Temporary<br>Short-term<br>Long-term<br>Permanent | *(f) **the expected** occurrence**, duration,** frequency and reversibility of the impact* |
| Scale | The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc) | It has no fixed designations and defined on a case by case to support the extent definition | *(a) **the magnitude** and spatial extent of the impact (**e.g. geographical area and number of persons expected to be affected*** |
| Frequency | A measure of the constancy or periodicity of the impact. | It has no fixed designations and defined on a case by case to support the duration definition | *(f) **the expected** occurrence**, duration,** **frequency** and reversibility of the impact* |

| Designations | Definition |
|---|---|
| ***Type*** | |
| Direct | Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected). |
| Indirect | Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land). |
| Induced | Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce). |
| ***Extent*** | |
| Local | Defined on a resource/receptor-specific basis |
| Regional | |
| International | |
| ***Duration*** | |
| Temporary | Defined on a resource/receptor-specific basis |
| Short-term | |
| Long-term | |
| Permanent | |

| Likelihood of an accidental event | Definition |
|---|---|
| Unlikely | The event is unlikely but may occur at some time during normal operating conditions. |
| Possible | The event is likely to occur at some time during normal operating conditions. |
| Likely | The event will occur during normal operating conditions (i.e., it is essentially inevitable). |
| The Likelihood characteristic usually pertains only to unplanned events (e.g., traffic accident, accidental release of oil/gas, etc.). The likelihood of an unplanned event occurring is designated using a qualitative (or semi-quantitative, where appropriate data are available) scale, | |

As described in Table 4.1 most of the descriptors set in LBK 4/2023 Appendix 6 are captured in the standard methodology. To completely cover the LBK 4/2023 Appendix 6 descriptor the Screening table will also define the following definitions and designations:

- (c) *the transboundary nature of the impact*: the transboundary nature of an impact depends on the spatial extent and on the distance from neighboring countries. The Screening table defines its applicability (yes/no) and provide a cross reference to the specific Paragraph presenting the assessment;
- e) *the probability of the impact*: as explained in Table 4.1, the probability or likelihood is used in the context of the accidental events. In this Screening, impacts from planned activities are usually considered as 'certain' and therefore subject to the assessment aimed at defining its significance;
- (f) *the expected … reversibility of the impact:* impacts can be defined as reversible (in the short or long term) or completely irreversible (thus with permanent duration);
- *(g) the cumulation of the effects of the project with the effects of other existing and / or approved projects*: a cumulative impact arises from project impacts interacting with an impact from another activity to create an additional impact. How the impacts and effects are assessed is strongly influenced by the status of the other activities (e.g. already in existence, approved or proposed) and how much data is available to characterize the magnitude of their impacts. The approach for assessing cumulative impacts and effects due to the project and another activity affecting the same resource/receptor is based on a consideration of the approval/existence status of the 'other' activity and the nature of information available to aid in predicting the magnitude of impact from the other activity. The Screening table defines its applicability (yes/no) and provides a cross reference to the specific Paragraph presenting the assessment;
- *(h) the possibility of actually limiting the effects*: the Screening report indicates whether the Project embeds control actions limiting each specific effect directly within the project design or in the management procedures.

Once the impact characteristics are understood, these characteristics are used (in a manner specific to the resource/receptor in question) to assign each impact an 'overall magnitude'. The present Screening report applies the ERM IA standard universal magnitude designations listed below:

- Positive;
- Negligible;
- Small;
- Medium;
- Large.

The 'overall magnitude' of impacts takes into account all the various dimensions of a particular impact to make a determination as to where the impact falls on the spectrum (in the case of adverse impacts) from negligible to large. Some impacts cause changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be regarded as essentially having no impact and should be characterised as having a negligible magnitude. This concept is comparable to the LBK 4/2023 descriptor 'd) intensity and complexity of the impact' and it

is used in this Screening report to evaluate the impact significance, as detailed in the following Section 4.1.4.

### *4.1.4 Evaluation of Significance*

The next step in the assessment is to take the information on the magnitude of impacts and explain what this means in terms of its importance to the environment. This is to enable decision makers and stakeholders to understand how much weight should be given to the issue in deciding on their view of a project. This is referred to as Evaluation of Significance. This recognizes that evaluation requires an exercise of judgment and that judgments may vary between parties in the process.

Significance is evaluated considering the "overall magnitude" of impact and the sensitivity / vulnerability / importance of the affected resource or receptor. The "Overall Magnitude" is defined across the various dimensions described in the previous paragraph (i.e. magnitude/spatial extent, nature, transboundary and cumulative effects, intensity and complexity, probability, duration, frequency and reversibility and the availability of control and mitigation measure to minimize the overall magnitude.

The value of a resource is judged considering its quality and its importance as represented, e.g., by its local, regional, national or international designation, its importance to the local or wider community, or its economic value. The universal sensitivity/vulnerability/importance designations are low/medium/high.

Significance is evaluated considering the magnitude of impact and the value or sensitivity of the affected resource or receptor. Magnitude and sensitivity / vulnerability / importance are addressed in combination to evaluate whether an impact is significant and if so its degree of significance (Table 4.2).

**Table 4.2 Evaluation of Significance of Impacts in the Environmental Screening Process**

| | | **Sensitivity/Vulnerability/Importance of Resource/Receptor *(LBK 4/2023 App. 6.2)*** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| ***Overall Magnitude of Impact / (LBK 4/2023 App. 6.3 d) intensity and complexity of the impact*** | **Negligible** | **Negligible** | **Negligible** | **Negligible** |
| | **Small** | **Negligible** | **Minor** | **Moderate** |
| | **Medium** | **Minor** | **Moderate** | **Major** |
| | **Large** | **Moderate** | **Major** | **Major** |

Source: ERM, 2022 (adapted from ERM, 2012 'ERM Standard IA Methodology').

The definition of the levels of overall significance of impact are separated for receptors (Table 4.3).

## Table 4.3 Classification of Overall Significance of Negative Impacts

| Overall significance | Impacts on receptors |
|---|---|
| **Negligible** | No measurable impacts on the structure or function of the receptor. |
| **Minor** | The impact on the structure or function of the receptor is localised and immediate or short-term. When the activity ceases, the impacted area naturally restores to pre-impact status. |
| **Moderate** | The impact on the structure or function of the receptor is local or regional and over short to medium-term. The structure or ecosystem function of the receptor may be partially lost. Populations or habitats may be adversely impacted, but the functions of the ecosystem are maintained. When the activity ceases, the impacted area restores to pre-impact status through natural recovery or some degree of intervention. |
| **Major** | The impact on the structure or function of the receptor is regional, national or international and medium-to long-term. Populations or habitats and ecosystem function are substantially adversely impacted. The receptor cannot restore to pre-impact status without intervention. |

## 4.2 Assessment of Potential Impact from Planned Project Activities

### *4.2.1 Screening of the Potential Impacts*

Table 4.4 presents the results of the Environmental Screening process undertaken following the method described in Section 4.1. The MSFD descriptors as defined in section 1.3.2.4 are also indicated alongside with receptors for each proposed project activities‘ potential impacts.

The Overall Significance outcomes form the basis of the screening assessment: impacts can be “screened-out” directly as “not significant” where the analysis of impact characteristic allows or is defined according to the designation summarized in Table 4.4. The column ‘*Notes and References*” provides a brief statement and rational to support the decision and to cross-reference to Paragraph 4.2.2 presenting the ‘Assessment of Impacts’

## Table 4.4 Screening of Activities and their Impacts

| | Impact Identification | | Environmental vulnerability of the geographical areas (*LBK 4/2023 App. 6.2)* | | Nature and characteristics of the potential impact on the environment *(LBK 4/2023 App.6.3)* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Activity** | **Potential Impact** | **Receptor (MSFD Descriptor)** | **Receptor Sensitivity** | **Nature of Impact [3 (b)]** | **Spatial extent [3 (a)]** | **Transboundary [3 (c)]** | **Probability of Impact [3 (e)]** | **Occurrence, duration, frequency and reversibility [3 (e)]** | **Cumulative impact [3 (g)]** | **Impact reduction measures [3 (h)]** | **Intensity and complexity of Impact [3 (d)]** | **Overall Significance** | **Notes and Reference to the following section** |
| **1** | **Installation Phase** | | | | | | | | | | | | | |
| 1.1 | Atmospheric emissions from operation of support and supply vessels | Reduction in ambient air quality | Air quality | Low | Direct | Local | No | Certain | Short-term Reversible | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | Atmospheric emissions of pollutants (NOx, SOx and particulates) to the atmosphere from project vessels will not materially affect air quality due to the well-mixed airshed of the offshore environment and the distance of Halfdan Oil Re-Route Project activities to designated coastal area (approximately 210 km). Thus, impact on air quality from project vessels is evaluated as **not significant**. |
| 1.2 | GHG emissions from support vessels | Reduction in ambient air quality and contribution to climate change | Climate change | High | Direct | Local | Yes | Certain | Short-term Irreversible | No | Embedded within Project Design and Management | Negligible | **Minor** | Emissions of GHG from the project vessels will not make a significant contribution to climate change.<br>Due to the sensitivity of climate change in Denmark and globally, all impacts on the contribution to climate change will be assessed further in Section 4.2.2. |
| 1.3 | Reduction of GHG emissions from routine flaring at Gorm E | Improvement in ambient air quality and Reduction in contribution to climate change | Climate change | High | Direct | Local | Yes | Certain | Long-term Irreversible | No | N/A | Positive | **Positive** | The reduction in routine flaring at Gorm E will significantly reduce Gorm Field´s GHG emissions and positively impact ambient air quality and reduce the project's contribution to climate change. Refer to Section 4.2.2. |
| 1.4 | Drainage discharge from vessels (bilge water, ballast, etc.) and solid waste (food, cleaning, maintenance) | Potential reduction in seawater quality | Seawater quality (D5, D8, D9, D10) | Low | Direct | Local | No | Certain | Short-term Reversible | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | Wastewater discharges from the project vessels will be managed in accordance with MARPOL 73/78 – Annex I Regulations for the Prevention of Pollution by Oil. The dilution and assimilative capacity of the water would be expected to minimize any adverse impacts from these vessel discharges. All marine litter will be returned to land for appropriate management as per TEPDK´s waste management applicable to all offshore activities. Thus, the impact on water quality is evaluated as **not significant**. |
| 1.5 | Underwater noise from the operation of support and supply vessels | Marine Mammals, Fish and Seabirds Disturbance | Marine Mammals, Fish and Seabirds (D1, D3, D4, D11) | Low | Direct | Local | No | Certain | Short-term Reversible in the short term | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | Noise produced is typically broadband noise, with some low tonal peaks and is not impulsive noise. It is therefore not expected to have a significant impact on sensitive receptors from support and supply vessels. Thus, the overall impact on the receptors is evaluated as **not significant**. |
| 1.6 | Disturbance from the artificial lighting from the vessels | Seabird disturbance | Seabirds (D1) | Medium | Direct | Local | No | Certain | Short-term Reversible in the short term | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | The artificial lighting from the presence and movement of vessels may disturb seabirds and cause behavioural changes. Birds attracted to the light may collide with the infrastructure and be injured. The closest protected area to the project area is 22 km west. Considering the existing platforms and relatively small scale of the project, it represents a negligible and localized impact; thus the impact to seabirds are evaluated as **not significant**. |
| 1.7 | Interference of marine activities from vessel movements | Marine Mammals and Fish | Marine spatial use (D1, D3, D9) | Low | Direct | Local | No | Certain | Short-term Reversible | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | The movement of vessels will not increase the interference of marine activities as there are already vessel movements in the area. Halfdan Oil Re-Route Project activities will be in the existing safety exclusion zone of 500 m around |

| | Impact Identification | | Environmental vulnerability of the geographical areas (*LBK 4/2023 App. 6.2)* | | Nature and characteristics of the potential impact on the environment *(LBK 4/2023 App.6.3)* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Activity** | **Potential Impact** | **Receptor (MSFD Descriptor)** | **Receptor Sensitivity** | **Nature of Impact [3 (b)]** | **Spatial extent [3 (a)]** | **Transboundary [3 (c)]** | **Probability of Impact [3 (e)]** | **Occurrence, duration, frequency and reversibility [3 (e)]** | **Cumulative impact [3 (g)]** | **Impact reduction measures [3 (h)]** | **Intensity and complexity of Impact [3 (d)]** | **Overall Significance** | **Notes and Reference to the following section** |
| | | | | | | | | | | | | | | platforms. Thus, it is evaluated as **not significant.** |
| 1.8 | Introduction of Invasive Species from ballast water exchange from support vessels | Impacts on Protected Areas | Protected Areas (D2) | High | Direct | Local | No | Unlikely | Short-term Irreversible in case of spreading | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | Non-indigenous / invasive marine species may be introduced to the local environment in project vessel ballast water and vessel fouling. Such species can out-compete and displace native marine species, disrupt food chains and imbalance the local marine ecosystem. All project vessels have been operating solely in the North Sea. These vessels are unlikely to present a source of non-native / invasive species in vessel fouling during the proposed Halfdan Oil Re-Route Project activities.<br>All vessels follow the International Maritime Organization (IMO) Ballast Water Management Convention and are unlikely to have non-native / invasive marine species in their discharged ballast water. Therefore, the impact magnitude is not significant.<br>The overall impact on the receptors is **not significant.** |
| 1.9 | Modification to the top-site facilities on Halfdan A and Dan F during installation | Potential reduction in seawater quality | Seawater quality (D10) | Low | Direct | Local | No | Certain | Short-term Reversible | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | The modifications to the topsides will produce negligible pipe waste which will be transported to the shore and recycled through an appropriate facility as per TEPDK´s waste management applicable to all offshore activities. Thus, it is evaluated as **not significant.** |
| **2** | **Operations** | | | | | | | | | | | | | |
| 2.1 | Increase in pigging frequency of P3013 pipeline (Halfdan A-Dan F | Potential reduction in seawater quality | Seawater quality (**D10**) | Low | Direct | Local | No | Certain | Long-term Reversible | No | Embedded within Project Design and Management | Not Significant | **Not Significant** | The increased frequency of pigging will not compound the impact of pigging happening on the project and thus is evaluated as not significant |
| 2.2 | Discharge of chemicals | Potential reduction in seawater quality | Seawater quality (D1, D3, D4, D6, D8, D9) | Low | Direct | Local | No | Certain | Long-term (short-term for pipeline flushing chemicals) Reversible | No | Embedded within Project Design and Management | Small | **Negligible** | Some chemicals used in the process will be discharged through the produced water system at Halfdan and Dan facilities. Refer to Section 4.2.2.<br>Chemicals used for the pipeline flushing will be piped onshore for management and will not be discharged to sea. |
| 2.3 | Discharge of Produced Water | Potential reduction in seawater quality | Seawater quality (D1, D3, D4, D6, D8, D9) | Low | Direct | Local | No | Certain | Long-term Reversible | No | Embedded within Project Design and Management | Small | **Negligible** | The Halfdan Oil Re-Route Project will not modify the produced water from the DAN Field wells. Up to 13,000 $m^3$ of produced water from Halfdan will be added to the DAN Field produced water, thus slightly increasing the produced water discharge from Dan FG (maximum 1%).<br>Refer to Section 4.2.2. |

### *4.2.2 Assessment of Potential Impacts from Planned Activities*

#### *4.2.2.1 Installation Phase*

#### *Impact on Climate Change*

GHG emissions from the Halfdan Oil Re-Route project vessels during installation phase will not make a significant contribution to climate change as activities will be intermittent over 5-6 months. Increased vessel emissions, as part of installation, will be temporary and limited. Thus, the magnitude is assessed as Negligible.

The sensitivity of receptors has been assessed as High given that the Danish Government has recently defined ambitious greenhouse gas reduction targets and there is global pressure to reduce greenhouse gases entering the atmosphere. Thus, considering the embedded control measures, the significance of impacts on climate change is assessed as **Minor**.

#### *4.2.2.2 Operations Phase*

#### *Impact on Climate Change*

During operations post modifications, GHG emissions will be reduced due to the cessation of routine flaring at Gorm. Presently, the routine gas flared on Gorm is equivalent to approximately 210 BOEPD. The gas is flared to remove the methane and produces approximately 66 $tCO_2$ per day. The Halfdan Oil Re-Route project would reduce the routine flaring on Gorm to zero BOEPD. However, the safety flaring may increase due to the Halfdan production stop when the compressor on Dan is shutdown. The corresponding safety flaring is estimated to happen four times per year at a rate of 50 BOE, leading to flaring of up to 200 BOE per year. The reduction in GHG emissions will reduce the project's contribution to climate change, thus the impact magnitude is assessed as **Positive**.

The sensitivity of receptors has been assessed as High given that the Danish Government has recently defined ambitious greenhouse gas reduction targets and there is a global pressure to reduce greenhouse gases emissions to the atmosphere. The significance of impacts on climate change is assessed as **Positive**.

#### *Impacts from Chemical Use and Discharge*

Amounts and types of chemical use and their discharge to sea are only permitted after authorization from the Danish Environment Protection Agency (DEPA). TEPDK uses typical production chemicals to optimize the processes of fluid production, separation and transport. Chemicals discharged through the produced water system on the Halfdan and Dan facilities include emulsion breaker, antifoam, scale inhibitors, corrosion control chemicals and biocide.

The specific name, amount and colour classification of chemicals is informed in the application for their use and discharge, which also includes a review of the impact assessment for the amount sought and it is reported in Table 4.5. The process fluids will contain yellow chemicals (and one red chemical) that are covered under TEPDK's 2022 discharge permit (DEPA, 2021). Chemical classification and the implementation of OSPAR are reported in Annex A.

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## Table 4.5 Estimated Chemical Use and Discharge at Halfdan and Dan after rerouting

| Description | Colour Code | Product | Usage | Discharged at Halfdan B | Routed to Dan F | Discharged at Dan F | Exported to onshore | Permitted Use at Halfdan | Permitted Use at Dan | Permitted discharge at Halfdan | Permitted discharge at Dan | Permitted Discharge of Corresponding Chemical at Halfdan (%) | Permitted Discharge of Corresponding Chemical at Dan (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total Kg | Total Kg | Total Kg | Total Kg | Total Kg | Total Kg | Total Kg | Total Kg | Total Kg | | |
| EB-80109 consumption Halfdan | Yellow | Emulsion Breaker | 16,097 | 4,292 | 11,804 | 354 | 11,450.0 | 42,600.00 | 24,700 | 8,500 | 2,700 | 50 | 13 |
| MB-5982 consumption Halfdan | Yellow | Biocide | 91,250 | 90,748 | 502 | 497 | 5 | 15000 | 25,000 | 15000 | 70,000 | 605 | 1 |
| MB-544C consumption Halfdan | Yellow | Biocide | 82,125 | 79,661 | 2,464 | 2,341 | 123.2 | 90000 | 108,000 | 72,000 | 30,000 | 111 | 8 |
| SI-4126 consumption Halfdan | Yellow | Scale Inhibitor | 293,734 | 237,729 | 56,005 | 11,201 | 44,804.20 | 393,000.00 | 507,000 | 341,100 | 468,900 | 70 | 2 |
| KI-3345 consumption Halfdan | Yellow | Scale/ Corrosion Inhibitor | 349,716 | 280,272 | 69,444 | 17,361 | 52,082.60 | 440,000.00 | 100,000 | 374,500 | 80,000 | 75 | 22 |
| KI-3130 consumption Halfdan | Red | Corrosion Inhibitor | 110,157 | 90,880 | 19,277 | 3,855 | 15,422.00 | 107,300.00 | 38,000 | 92,700 | 100,000 | 98 | 4 |
| SI-4140W consumption Halfdan | Yellow | Scale Inhibitor | 202,940 | 200,911 | 2,029 | 2,029 | 0 | 82800 | 97,200 | 82,800 | 87,500 | 243 | 2 |
| SI-41047 consumption Halddan | Yellow | Scale Inhibitor | 197,100 | 194,144 | 2,956 | 1,478 | 1,478.20 | 345,600.00 | 220,000 | 345,600 | 200,000 | 56 | 1 |
| Added DF-99004 injection DFF/DFG | Yellow | Anti-Foaming | 12,136 | N.A | N.A | 1,214 | 10,922.60 | 39,400.00 | 60,000 | 7,900 | 15,000 | | 8 |
| DF-99004 consumption Halfdan | Yellow | Anti-Foaming | 24272.5 | 4854.5 | 19,418 | 1213.625 | 23,058.90 | 39,400.00 | 60,000 | 7,900 | 15,000 | 61 | 8 |

The anticipated used quantities are within the total quantities permitted for the HALFDAN and DAN Field stated in TEPDK's 2022 discharge permit (DEPA, 2021) except for a few updated chemicals, for which TEPDK will apply for a use and discharge permit accordingly.

The chemicals used for the 16.6 km oil export pipeline P4301 connecting HDA to Gorm that will be disconnected and flushed mechanically with pigs and chemically by introducing a batch of mutual solvent followed by wash chemicals, are reported in Table 4.6. TEPDK will apply for the chemical permit accordingly. Flushed water will be piped to Fredericia for management and will not be discharged to the sea. The pipeline will be filled with seawater and treated with biocide (2,000 ppm) following the de-oiling pig train and preserved for up to three years

**Table 4.6 Chemicals Use in the P4301 Pipeline**

| Description | Colour Code | Product | Use |
|---|---|---|---|
| | | | Liters |
| MB5982 | Yellow | Biocide | 3,331 |
| Sandstorm 1 | Yellow | Deoiling chemical | 10,368 |
| J-Clean 1 | Yellow | De-oiling chemical | 4,176 |
| Ecosurf -10 (Pipesurf-10) | Yellow | De-oiling chemical | 2,016 |

The amount of chemicals used and discharged as part of the Halfdan Oil Re-Route project activities will be continuously monitored and optimized through a Risk Based Approach (RBA) in accordance with OSPAR Recommendation 2012/5 for a Risk-Based Approach to the Management of Produced Water Discharges from Offshore Installations and supporting guidelines 2012/7. This guidance has been transcribed by DEPA into the guideline: Proposed Paradigm for Reporting RBA Calculations, September 2018 that describes how the RBA should be applied.

There will be changes to water discharges as part of the Halfdan Oil Re-Route project. Conservative estimates suggest that there could be a risk to some species from a plume up to a maximum of 15 km from the produced water discharges, based on hydrodynamic dispersion modelling of produced water for the HALFDAN Field (IRIS, 2014). However, IRIS (2014) monitoring data in other areas of the North Sea have demonstrated that the environmental impacts of produced water discharges are local, with an impact to the water column up to approximately 1-2 km from the outlet, and that environmental impacts associated with produced water discharges are low. The closest protected area to the main Halfdan Oil Re-Route project site is the Doggerbank (DE1003301) area, which is designated as a Site of Community Importance (SCI), and which is approximately 22 km west of the Halfdan Oil Re-Route project area.

Any potential impacts on marine mammals are thus confined to the local environment near the platforms and vessels. Considering the mobility of the five species of particular importance in the area (i.e., harbour porpoise, white-beaked dolphin, minke whale, harbour seal and grey seal) the risk to species in the area is moderate (Waggit et al*.,* 2020). There will be no additional risk of bioaccumulation to species in the area from the activities due to the Halfdan Oil Re-Route project.

Considering the volumes discharged, the low dissipated concentrations and the use of only yellow classified substances (except one red listed chemical), the magnitude is assessed as **Small**. The assessment considered a **Low** sensitivity for marine species and thus the impact to water quality as **Negligible**.

### *Produced Water Discharges*

Produced water from the DAN Field wells will not change. The Halfdan Oil Re-Route project may increase the produced water volume discharged by up to 13,000 $m^3$/year or 1%.

For 2022 to date, the average oil-in-water concentration for produced water being discharged at Dan FG is approximately 13 mg/l.

The fluids rerouted from Halfdan A and separated by the Dan-FG water treatment system, will be at a higher temperature (e.g. approximately 20°C higher) due to a faster flow and less temperature drop along the smaller diameter pipeline; therefore the oil-in-water concentrations are not expected to be higher in produced water discharged at Dan-FG due to the Halfdan Oil Re-Route project.

Hydrodynamic dispersion modelling results generally suggests that the discharges are diluted relatively rapidly (IRIS, 2013). There is a risk of affecting the water quality from the current discharges of produced water at Dan F up to 31 km to the north east of the outlet. These calculations are highly conservative and monitoring data in other areas of the North Sea have demonstrated that the environmental impacts of produced water discharges are local, with an impact to the water column up to approximately 3 km from the outlet, and that environmental impacts associated with produced water discharges are low, thus the magnitude is assessed as **Small**.

The assessment considered a **Low** sensitivity for marine species and thus the impact to water quality as **Negligible**.

### *4.2.3 Protected Areas*

#### *4.2.3.1 Environmental Impact on Protected Areas*

Potential causes of environmental impacts due to the planned activities for the rerouting activities are:

- Vessel traffic;
- Modification to the top-site facilities and discharges;
- Pipeline closure;
- Chemical discharges;
- Increased pigging frequency.

As the Doggerbank protected area is 22 km away from the project area and the wider area is habitat for various sensitive marine species, the sensitivity of the receptors is assessed as **High,** as assessed previously in Section 3.3.4.

Underwater noise from vessel movements during installation phase is expected.

Water depth can strongly influence sound propagation, with sound in shallow waters causing stronger attenuation. In deeper waters, there are fewer sound interactions with the seabed, thus its noise impact on the seabed will be negligible, as the water depth at Halfdan Field is approximately 42 m. Such underwater noise is unlikely to affect any species in the Doggerbank protected area 22 km to the west. Therefore, the impact magnitude is assessed as **Negligible.**

Thus, as the sensitivity of the receptors is **High** and the impact magnitude is **Negligible**, the resulting impact significance of underwater noise on protected areas is assessed as **Negligible.**

A hydrodynamic dispersion model of produced water for the Halfdan project suggests that produced water discharges are diluted relatively rapidly (IRIS, 2014). Any discharges are likely to be small, will disperse as a plume towards the north-east and will dilute rapidly. They are unlikely to reach the closest protected area of the Doggerbank, 22 km to the west and the species that inhabit it. The resulting impact magnitude is therefore assessed as **Negligible**.

As the sensitivity of the receptors is **High** and the impact magnitude is **Negligible**, the resulting impact significance of discharges on protected areas is assessed as **Negligible.**

## 4.3 Assessment of Potential Impacts from Major Accidents, Unplanned Events

This section presents the risk of major accidental events relevant to the project, according to requirements from Annex III of the amended EIA Directive (selection criteria referred to in Article 4, section 1. characteristics of projects). Management of major environmental events is also covered by

the Danish Offshore Safety Act for oil and gas activities. Major accidental events shall be identified, assessed and reduced to a level As Low As Reasonably Practicable (ALARP) with embedded control measures.

Minor accidental events when the spilled volume is finite could be a chemical or diesel spill occurring from a vessel collision with the Halfdan or Dan platforms or another vessel.

Major accidental events could result from an uncontrolled loss of a large volume of oil. The main cause of a major spill is a well blowout Based on International Association of Oil and Gas Producers (IOGP, 2019), the probability of a blowout associated with pipeline and process system modifications is very unlikely. No further assessment of impacts is therefore considered necessary.

## 4.4 Cumulative Impacts

The interaction of the Halfdan Oil Re-Route project with other existing and/or approved projects that could cause cumulative impact is considered.

A cumulative impact arises from project impacts interacting with an impact from another activity to create an additional impact. Cumulative impacts are the additional impacts that may be generated due to a combination of developments or activities near the Halfdan Oil Re-Route project, that when added to the impacts of the proposed project, cause a greater impact. Such impacts may arise due to spatial overlap (e.g., overlap in the spatial extent of air or water quality changes) or temporal overlap (e.g., noise impacts caused by construction activities at the same time from various sources).

How the impacts and effects are assessed is strongly influenced by the status of the other activities (e.g., already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach for assessing cumulative impacts and effects due to the project and another activity affecting the same resource/receptor is based on a consideration of the approval/existence status of the ‘other’ activity and the nature of information available to aid in predicting the magnitude of impact from the other activity.

Based on Table 2.1, there are several concurrent activities in the Danish EEZ with the Halfdan Oil Re-Route Project ; the DUC Halfdan / Dan seismic survey, the 3D seismic survey in the North-Western Danish EEZ, the Halfdan Tor NE Ekofisk project, and the ongoing TYRA Field redevelopment, and the INEOS Solsort West Lobe project.

Cumulative impacts may occur if Halfdan Oil Re-Routing project activities take place at the same time as other activities in the HALFDAN Field, leading to increased vessel movements. There are no seismic nor drilling activities associated with the Halfdan Oil Re-Route Project. The TYRA Field redevelopment currently involves hook-up and commissioning activities that include installation of a J-tube on existing underwater structure, burial of integrated cable in the seabed, installation of mechanical protection (rock dump) and installation of underwater pipe section. The outstanding work will include vessel movements but excludes additional discharges, drilling or pile driving. Underwater noise from vessels is low intensity, broadband noise that is confined to the areas around the vessels. No cumulative spatial overlap between TYRA Field activities and the Halfdan Oil Re-Route project activities is expected (distance >25 km).

As part of normal working practice, the Halfdan Tor NE and Ekofisk project (slot recovery and drilling of new trajectories) will involve a jack-up rig and supporting vessels. The increase in vessel movements is predicted to be of minor significance, with impacts of small intensity, local extent and short-term duration, so no cumulative impacts are expected.

No significant cumulative impacts are expected to occur as part of the Halfdan Oil Re-Route project and no cumulative impacts will adversely affect any Annex I habitats, Annex II and IV species, bird species identified under the EU Birds Directive and Natura 2000 sites, the closest of which is over 22 km away, (i.e., Doggerbank (DE1003301) in Germany).

TEPDK has no further knowledge of other oil, gas or wind farm projects in the area that could potentially have cumulative impact with the proposed Halfdan Oil Re-Route project activities.

## 4.5 Summary of Transboundary Impacts

Under the Espoo Convention, concerned parties are to be informed of potential transboundary adverse significant impacts and to be provided with possibilities for making comments or objections on the proposed activity.

There are no relevant anticipated transboundary impacts from the proposed Halfdan Oil Re-Route project activities. The only potential transboundary impacts identified are to climate and air quality. There will be no significant changes to air emissions from the Halfdan Oil Re-Route project activities during the installation phase; emissions would be negligible and short-term and will not cause significant impacts at international borders. During operations post modifications, GHG emissions will be reduced due to the cessation of flaring at Gorm.

No other significant and predictable transboundary impacts have been identified for the proposed activities.

Accidental oil or chemical spills may occur, but the risk of such accidents is very unlikely, refer to Section 4.3.

Since there are no significant cumulative impacts, there are also no significant transboundary cumulative effects.

## 4.6 Marine Strategy Framework Directive

As reported in the Danish Marine Strategy II (Danish Ministry of Environment, 2019):

> "Targets for achieving good environmental status have been set for each topic. There are 68 environmental targets in the Danish Marine Strategy II, of which 29 are operational environmental targets. The latter are either specific actions to support achievement of the other targets, or they clarify further work to set more precise targets in the future. Both types of environmental targets are legally binding for the authorities. This means, for example, that authorities may not grant authorisation to activities or discharges that are incompatible with achieving the targets."

The assessment of the potential impacts from the Halfdan Oil Re-Route project on the eleven MSFD descriptors is presented in Assessment of Potential Impacts on MSFD Descriptors

Table 4.8. The assessment is based on the impacts described in Section 4.2 relevant for the activities planned for the Halfdan Oil Re-Route project.

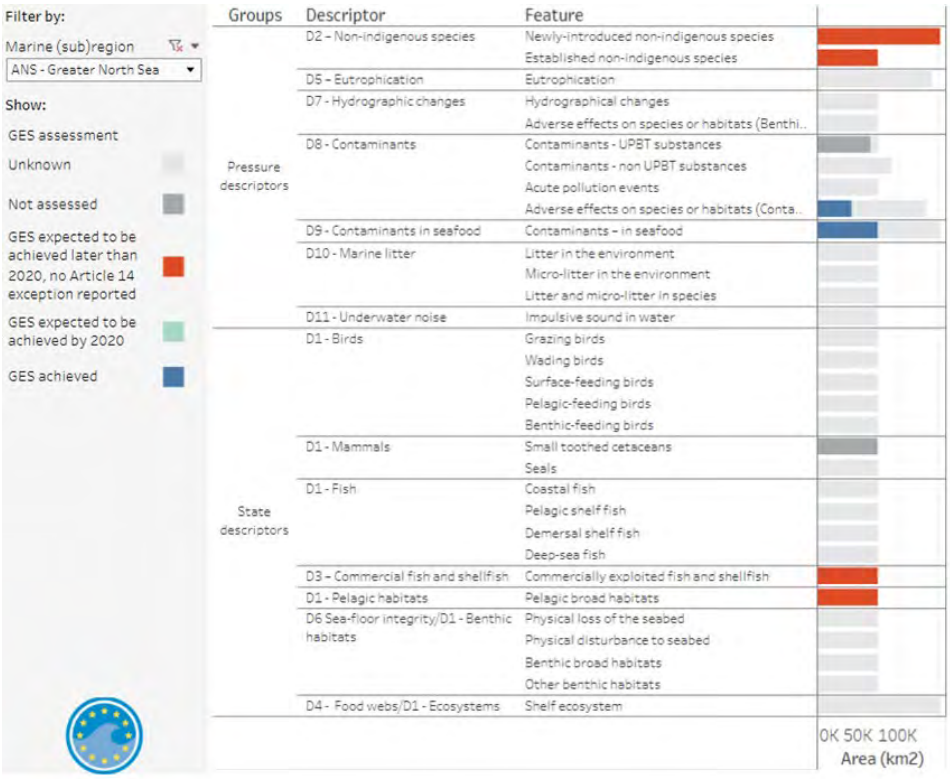
### *4.6.1 Current Environmental Status*

In a recent press release[9], OSPAR communicated that evidence from monitoring and reporting indicates that the overall effect of OSPAR measures and their implementation by Contracting Parties has been to significantly improve the overall quality status of the Greater North Sea where there are high levels of oil and gas activity.

A summary of the GES for each descriptor in the Greater North Sea area is published in the WISE Portal. Denmark has assessed the environmental status various features per descriptor under the 2018 update of MSFD Article 8, which were reported electronically to the European Commission. The following Figure 4.1 shows the marine waters' area where, for those features, the GES has been achieved, not yet achieved or is unknown or not assessed.

[9] OSPAR: Impacts of offshore oil and gas industry on the marine environment shown to have decreased in the North-East Atlantic: https://www.ospar.org/news/oicassessment

## Figure 4.1 GES Assessment in the Greater North Sea Area




Source: WISE Portal, 2023

As Part 1 of the Danish Marine Strategy II, a report was published in 2019 by the Ministry of Environment and Food providing an overview of the status of and impacts on the environment as well as established environmental targets. Table 4.7 summarises the state of each descriptor in the North Sea presented in the "Danish Marine Strategy II – Part 1" report (Ministry of Environment and Food Denmark, 2019 and 2020). It should be noted that targets are not defined for all descriptors. The remaining targets are defined as trends that describe a positive development or descriptive target.

## Table 4.7 Extracted Summary of Environmental Status of Descriptors

| Descriptor | | Status for the North Sea | |
|---|---|---|---|
| | | Group | Status |
| D1 | Biodiversity (birds) | ■ Herbivorous and foraging in water column | ■ Stable or increasing |
| | | ■ Wading and foraging in the water surface | ■ Less than 75% of species are stable or increasing |
| | | ■ Overwintering | ■ Majority of species are stable, increasing or fluctuating |
| D1 | Biodiversity (marine mammals) | ■ Harbour seal | ■ GES |
| | | ■ Grey Seal | ■ Increasing population (no GES in 2013) |
| | | ■ Harbour porpoise | ■ Stable population with favourable conservation status |

| Descriptor | | Status for the North Sea | |
|---|---|---|---|
| | | **Group** | **Status** |
| D1 | Biodiversity (fish that are not exploited commercially) | ■ 14 species assessed | ■ Less than 25% have good status<br>■ Population density- below 50% have good status |
| D1 | Biodiversity (pelagic habitat) | ■ Phytoplankton biomass | ■ Steady decline (but slight increase in 2012) |
| | | ■ Zooplankton | ■ Insufficient data to assess development |
| D2 | Non-indigenous species | ■ Insufficient data, but likely that GES has not been achieved | |
| D3 | Commercially exploited fish stocks | ■ 22 selected stocks of fish, crustaceans and shellfish | ■ Ten stocks have GES<br>■ Eight stocks not good status |
| D4 | Marine food webs | ■ Despite assessment of individual sub-elements in the food web, it is currently not possible to assess when the food web as a whole will be in good environmental status. However, it is expected that the balance in the marine food web will improve as environmental targets for pressure factors and status under the other topics/descriptors are achieved | |
| D5 | Eutrophication | ■ Open marine areas far from the coast | ■ GES |
| | | ■ Open marine areas close to the coast | ■ GES not achieved yet |
| D6 | Sea floor integrity | ■ No set threshold values for GES, but analysis indicates that there is not good status for the sea floor in relation to disturbance and similarly in relation to loss for certain habitat types<br>■ There is not sufficient knowledge to assess when good environmental status will be achieved | |
| D7 | Hydrographical changes | ■ Threshold values have not yet been set and there is not sufficient knowledge to assess when good environmental status will be achieved | |
| D8 | Contaminants (concentrations and species health) | ■ PFOS and Benzo(a)pyrene | ■ GES |
| | | ■ Mercury or the group of brominated flame retardants | ■ GES not achieved |
| D8 | Contaminants (acute pollution events) | ■ GES cannot be assessed for acute pollution events in the North Sea, as there are large annual variations over the period for oil and chemicals spills from oil and gas installation not possible to derive a trend over the years. | |
| D9 | Contaminants in seafood for human consumption | ■ concentrations of the heavy metals lead, cadmium, mercury, as well as benzo(a)pyrene in seafood for human consumption | ■ GES |
| | | ■ Concentrations of dioxins and PCB | ■ Above the maximum residue values have been found in mackerel, cod liver and salmon. |
| D10 | Marine litter | ■ No set threshold values, there is no scientific basis for assessing quantitatively when good environmental status will be achieved | |
| D11 | Underwater noise | ■ No set threshold values for levels of underwater noise compatible with good environmental status | |

Source: Ministry of Environment and Food Denmark, 2019 and 2020

### 4.6.2 Assessment of Potential Impacts on MSFD Descriptors

**Table 4.8 Potential Impacts of Halfdan Oil Re-Route Project on the MSFD Descriptors**

| Descriptors Based on the MSFD | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment |
|---|---|---|---|---|
| **Descriptor 1 - Biodiversity:**<br>The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions. | Underwater noise from vessels;<br>Artificial lighting;<br>Vessel movements; and<br>Discharge of chemicals and produced water during operations. | Underwater noise:<br>■ No significant impact on sensitive receptors from vessels (broadband noise, no impulsive) (see activity 1.5 Table 4.4)<br>Seabird disturbance:<br>■ No significant impact on seabird disturbance from artificial lighting from vessels (see activity 1.6 Table 4.4)<br>Interference of marine activities:<br>■ Project activities within existing safety exclusion zone (see activity 1.7 Table 4.4)<br>Discharges:<br>■ Chemicals used for the pipeline flushing not discharged to sea (see activity 2.2 Table 4.4)<br>■ Slight increase of produced water discharge (see activity 2.3 Table 4.4 and section 4.2.2.2)<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement or the maintenance of good environmental status for Descriptor 1 | Section 3.2.3 |
| **Descriptor 2 – Non-indigenous species:**<br>Introduced by human activities are at levels that do not adversely alter the ecosystems. | Non-native / invasive marine species introduced from ballast water or ship fouling may colonize subsea structures and out-compete native marine species and upset local food chains and ecosystem balance. | ■ Vessels operating solely in North Sea and following IMO Ballast Water Management Convention are an unlikely source of invasive species (see activity 1.8 Table 4.4)<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 2 | Section 3.2.3.7 |
| **Descriptor 3 - Commercial fish and shellfish:**<br>Populations of commercially exploited fish and shellfish exhibit a population age and size that is indicative of a healthy stock. | Underwater noise from vessels;<br>No-fishing zone around project vessels and platforms; and<br>Discharge of chemicals and produced water during operations. | Underwater noise:<br>■ No significant impact on sensitive receptors from vessels (broadband noise, no impulsive) (see activity 1.5 Table 4.4)<br>Interference of marine activities:<br>■ Project activities within existing safety exclusion zone (see activity 1.7 Table 4.4)<br>Discharges:<br>■ Chemicals used for the pipeline flushing not discharged to sea (see activity 2.2 Table 4.4)<br>■ Slight increase of produced water discharge (see activity 2.3 Table 4.4 and section 4.2.2.2)<br>**No or negligible impact** | Populations of commercially exploited fish and shellfish will be unaffected; Project activities will not affect established environmental targets;<br>The Project's environmental impact will not hinder the achievement or the maintenance of good environmental status for Descriptor 3 | Section 3.2.3 |
| **Descriptor 4 - Food webs:**<br>All elements of the marine food webs occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity. | Temporary effect from underwater noise due to vessel movements on plankton, fish and marine mammals; and<br>Discharge of chemicals and produced water during operations. | Underwater noise:<br>■ No significant impact on sensitive receptors from vessels (broadband noise, no impulsive) (see activity 1.5 Table 4.4)<br>Discharges:<br>■ Chemicals used for the pipeline flushing not discharged to sea (see activity 2.2 Table 4.4)<br>■ Slight increase of produced water discharge (see activity 2.3 Table 4.4 and section 4.2.2.2)<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 4 | Section 3.2.3 |
| **Descriptor 5 - Eutrophication:**<br>Human-induced eutrophication is minimized, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters. | Waste discharges (i.e., treated sewage) platform, and support vessels. | Drainage discharge from vessels:<br>■ Wastewater discharges from project vessels in accordance with MARPOL 73/78-Annex 1 (see activity 1.4 Table 4.4)<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the maintenance of good environmental status for Descriptor 5 | Section 3.2.1 |

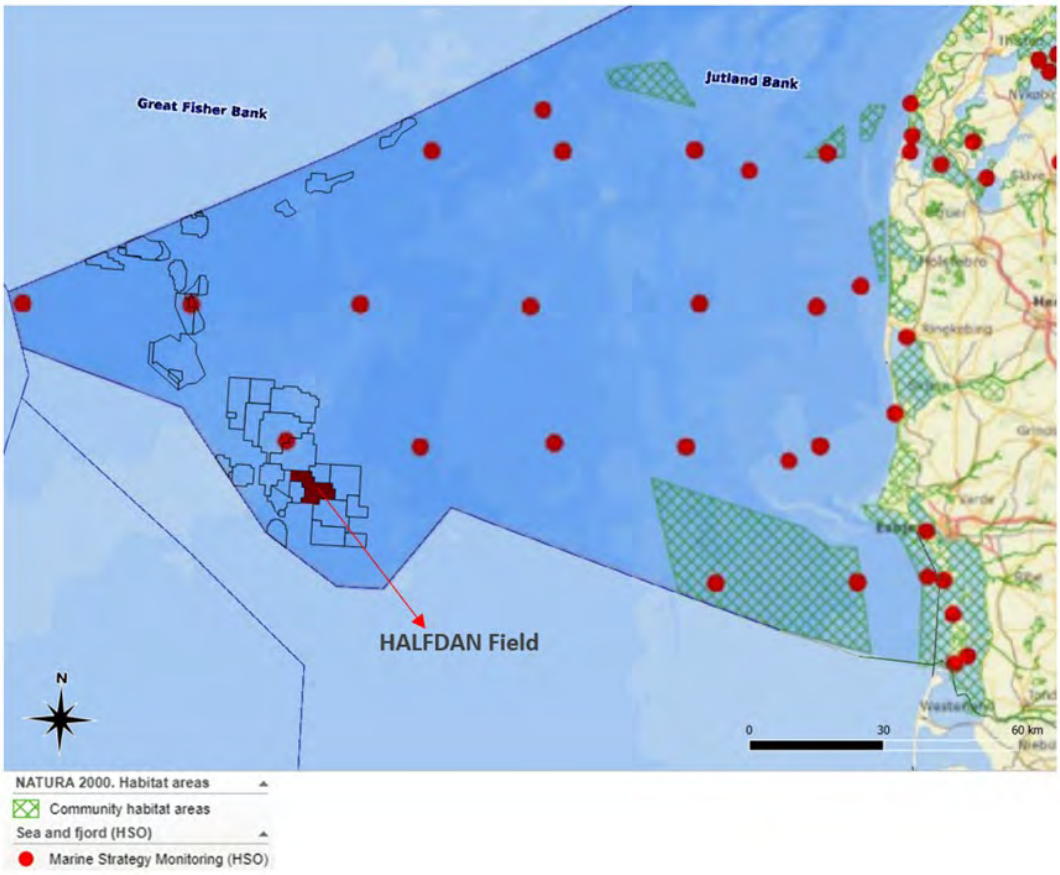
| Descriptors Based on the MSFD | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment |
|---|---|---|---|---|
| **Descriptor 6 - Seafloor integrity**: Seafloor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected. | Discharge of chemicals and produced water. | Discharges:<br>■ Chemicals used for the pipeline flushing not discharged to sea (see activity 2.2 Table 4.4)<br>■ Slight increase of produced water discharge (see activity 2.3 Table 4.4 and section 4.2.2.2)<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 6 | Section 3.2.2, 3.2.3 |
| **Descriptor 7 - Hydrographical conditions:** Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems. | N/A (proposed activities for the project do not affect hydrographical conditions in the area) | N/A | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 7 | N/A |
| **Descriptor 8 - Contaminants:** Their concentrations are at levels not giving rise to pollution effects. | Wastewater discharges from project vessels; and Discharge of chemicals, produced water during operations. | Drainage discharge from vessels:<br>■ Wastewater discharges from project vessels in accordance with MARPOL 73/78-Annex 1 (see activity 1.4 Table 4.4)<br>Discharges:<br>■ Chemicals used for the pipeline flushing not discharged to sea (see activity 2.2 Table 4.4)<br>■ Slight increase of produced water discharge (see activity 2.3 Table 4.4 and section 4.2.2.2)<br>**Negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 8 | Section 3.2.1 |
| **Descriptor 9 - Contaminants in seafood:** Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards. | Wastewater discharges from project vessels, and Short term effect, negligible bioaccumulation[10]<br>No fishing zone exists around the project activities; and Discharge of chemicals, produced water during operations. | Drainage discharge from vessels:<br>■ Wastewater discharges from project vessels in accordance with MARPOL 73/78-Annex 1 (see activity 1.4 Table 4.4)<br>Interference of marine activities:<br>■ Project activities within existing safety exclusion zone (see activity 1.7 Table 4.4)<br>Discharges:<br>■ Chemicals used for the pipeline flushing not discharged to sea (see activity 2.2 Table 4.4)<br>■ Slight increase of produced water discharge (see activity 2.3 Table 4.4 and section 4.2.2.2)<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement or the maintenance of good environmental status for Descriptor 9 | N/A |
| **Descriptor 10 - Marine litter:** Properties and quantities of marine litter do not cause harm to the coastal and marine environment. | All marine litter will be returned to land for appropriate management as per TEPDK´s waste management applicable to all offshore activities. | Solid waste:<br>■ Solid waste will be returned to land for appropriate management (see activity 1.4 Table 4.4)<br>Topside modifications:<br>■ Modifications to the topsides will produce negligible pipe waste which will be transported to the shore and recycled through an appropriate facility (see activity 1.9 Table 4.4<br>Pigging frequency:<br>■ Increased frequency of pigging will not compound the impact of pigging happening on the project and thus is evaluated as not significant (see activity 2.1 Table 4.4)<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 10 | Section 3.2.1 |
| **Descriptor 11 - Energy including underwater noise:** Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment. | Temporary impact on marine mammals, fish and plankton from underwater noise produced during vessel movements. | Underwater noise:<br>■ No significant impact on sensitive receptors from vessels (broadband noise, no impulsive) (see activity 1.5 Table 4.4)<br>**No or negligible impact** | Given the temporary nature of the underwater noise, negligible impacts will not affect established environmental targets; the Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 11 | N/A |

[10] Beyer, J. et al., (2020) and Williams and Cooper (2014).

### *4.6.3 Potential Impacts from Project Activities on NOVANA program*

The marine strategy's monitoring program 2021-2026 is mainly based on monitoring activities of NOVANA - sub-program for seas and fjords 2017-2021 (DEPA, 2017). New activities in the marine strategy's monitoring program 2021-2026, which either supplement already existing monitoring or represent completely new activities within a subject area, have effect since 2021 and will also be incorporated in the future NOVANA program for sea and fjords after its revision made in 2021. The offshore monitoring stations under the NOVANA Program are shown in the NOVANA GIS Portal and presented in Figure 4.2 with the HALFDAN Field identified.

**Figure 4.2 NOVANA - National Monitoring Program 2017-2021 – Marine Monitoring Stations and Location of the HALFDAN Field**




Source: ERM (2023) modified from NOVANA GIS Portal[12]

The Project activities involve HALFDAN, DAN and GORM Fields as described in Section 2.1. The closest platform within the proposed Project activities to NOVANA program station (see Figure 4.2) is Gorm E with approximately 12 km. This station monitored soft-bottom fauna, hydrographic profile measurements, and nutrients and chlorophyll in water in 2017-2021. In 2021, samples of the water chemistry, which included salinity, temperature, sight depth, chlorophyll and fluorescence, were taken, as well as soft-bottom fauna samples (Hansen et al., 2021). The assessments in Table 4.4 and Table 4.7 show that the project activities have no significant or negligible impact on seawater quality (Table 4.4) and no significant or negligible impact on seafloor integrity (Table 4.7). Due to the distance and the assessment, it can be assumed that there is no or negligible impact of the project activities on the NOVANA monitoring stations.

[12] GIS Portal: https://miljoegis.mim.dk/cbkort?profile=novana2017-21

# 5. CONCLUSIONS

Screening of the proposed Halfdan Oil Re-Route project activities has been conducted according to the measures described in Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment and as implemented in the LBK 973/2020 Executive Order on Environmental Assessment of Plans and Programs and of Specific Projects (EIA). The process has followed the guidelines and looked at the receptors stated in Annex 6 of LBK 4.

Potential health and safety impacts have been considered in accordance with the Danish Offshore Safety Act for oil and gas activities. These have been assessed and are minimised where applicable by embedded control measures within project activities.

This environmental screening has considered the potential effects on the relevant receptors of the Halfdan Oil Re-Route project planned and unplanned activities.

The likely environmental impacts due to the Halfdan Oil Re-Route project range from **Negligible to Minor**. A positive impact from GHG reduction due to the cessation of flaring at Gorm is also expected. Therefore, the Halfdan Oil Re-Route project activities will not cause significant environmental impacts of a magnitude which would require a standalone EIA. The project activities will not take place within a sensitive area as defined by EIA regulations, will not have significant transboundary impacts and will not increase the cumulative impacts. There will be no significant impacts on the Descriptors set by the EU's Marine Strategy Framework Directive, implemented in Danish law by the Marine Strategy Act (LBK 1161 of 25/11/2019); project's environmental impact will not hinder the achievement of good environmental status for the relevant descriptors.

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# APPENDIX A CHEMICAL CLASSIFICATION AND THE IMPLEMENTATION OF OSPAR IN DENMARK

## IMPLEMENTATION OF OSPAR IN DENMARK

Hazardous substance and materials, including chemicals used in the offshore oil and gas industry, are recorded and monitored through the Danish Product Registry. This is a joint registry under the Danish Working Environment Authority and the Danish Environmental Protection Agency (DEPA) (DWEA, 2020). In total, around 38,000 chemicals are registered, of which 350 are actively used offshore.

All substances listed in the Product Registry are given a PR number, and information such as composition and use are listed. When the registration is approved, the chemical will receive the PR number. Chemicals used in the offshore oil and gas industry are also covered by OSPAR guidelines, and, as such, additional information is required for registration in accordance with Annex 1 of OSPAR Recommendation 2010/3 on a Harmonized Offshore Chemical Notification Format (HOCNF) (as amended). The application must include the exact composition of the substance and its ecotoxicological properties according to OSPAR guidelines, and chemicals must be re-notified every three years. DEPA uses the information in the Product Registry when an operator applies for a discharge permit for offshore chemicals.

DEPA follows the "colour classification" for rating chemicals made in OSPAR Recommendation 2019/04 on Harmonised Pre-screening Scheme for Offshore Chemicals. The Danish Ministry of Environment has, in some cases, grouped the classifications from OSPAR as Black, Red, Yellow and Green according to Appendix 1 of OSPAR Recommendation (2019/04). To facilitate proper implementation of the regulation, TEPDK has its own Chemical Management Plan (TEPDK-L2-PRO-HSE-0028-E; TEPDK, 2020) compliant with OSPAR and applicable Danish regulations.

As a Danish operator, TEPDK follows the OSPAR colour classification (NORCE, 2019) and the system used by the Danish Ministry of Environment. The colour classification is as follows:

**Black**: Chemicals containing one or more components registered in OSPAR's 'List of Chemicals for Priority Action', and their use is prohibited except in special circumstances;

**Red:** Chemicals containing one or more components that, for example, accumulate in living organisms, are toxic, or slow to naturally degrade in the marine environment;

**Yellow**: Chemicals that can normally be discharged without specific conditions, although their use is monitored by DEPA; and

**Green:** Chemical components that pose little or no risk to the environment according to OSPAR's PLONOR (Poses Little or No Risk) classification.

Chemicals that are neither PLONOR nor candidates for substitution includes those that are:

- Inorganic with LC50 or EC50 greater than 1 mg/l; and
- Yellow (ranking chemicals), which includes substances ranked according to OSPAR Recommendation 2000/4 and which do not fall into another category.

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# Halfdan Tor NE and Ekofisk In-fill Wells Project

## Environmental Impact Assessment Screening Report

TotalEnergies EP Danmark A/S

08 February 2023

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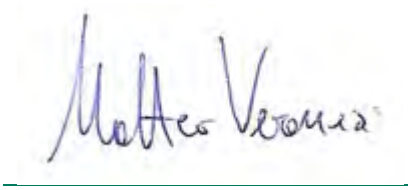
08 February 2023

# Halfdan Tor NE and Ekofisk In-fill Wells Project

## Environmental Impact Assessment Screening Report



Matteo Veronesi
Project Director

Environmental Resources Management Limited
2nd Floor, Exchequer Court
33 St Mary Axe
London
EC3A 8AA

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## Acronyms and Abbreviations

| Name | Description |
|---|---|
| ALARP | As Low As Reasonably Practicable |
| Ba | Barium |
| CAJ | Controlled Acid-Jet |
| CBL | Cement Bond Logging |
| DEA | Danish Energy Agency |
| DEPA | Danish Environmental Protection Agency |
| DNA | Deoxyribonucleic Acid |
| DREAM | Dose related Risk and Effect Assessment Model |
| DSA | Danish Subsoil Act |
| DUC | Danish Underground Consortium |
| DWEA | Danish Working Environment Authority |
| EEZ | Exclusive Economic Zone |
| EIA | Environmental Impact Assessment |
| EIF | Environmental Impact Factor |
| EnS | Environmental Status |
| EPA | Environmental Protection Act |
| ESIS | Environmental and Social Impact Statement |
| EU | European Union |
| GES | Good Environmental Status |
| GHG | Greenhouse Gas |
| GIS | Geographic Information System |
| HBA | Halfdan B |
| HCA | Halfdan C |
| HDNTNEE | Halfdan Tor NE and Ekofisk |
| HDA | Halfdan A |
| HELCOM | Helsinki Commission |
| HOCNF | Harmonised Offshore Chemical Notification Format |
| IBAs | Important Bird Areas |
| kJ | Kilojoules |
| kT | Kilotonnes |
| MMbbls | Million Barrels |
| MMO | Marine Mammal Observers |
| MMSR | Marine Mammal Sighting Reporting program |
| MPAs | Marine Protected Areas |
| MSFD | Marine Strategy Framework Directive |
| MSY | Maximum Sustainable Yield |
| MT | Metric Ton (tonne) |

| | |
|---|---|
| NATO | North Atlantic Treaty Organization |
| NE | North East |
| NGOs | Non-Governmental Organisations |
| NOVANA | National Monitoring Program for Water Environment and Nature |
| OOC | Oil on Cuttings |
| OSPAR | Oil Spill Prevention, Administration and Response |
| OSRL | Oil Spill Response Limited |
| PAM | Passive Acoustic Monitoring |
| PBDE | Polybrominated Diphenyl Ethers |
| PCB | Polychlorinated Biphenyls |
| PEC | Predicted Environmental Concentration |
| PFOS | Perfluorooctane sulfonate |
| PLONOR | Poses Little or No Risk |
| PNEC | Predicted No-effect Concentration |
| POP | Persistent Organic Pollutant |
| ppm | Part per million |
| PR | Product Registry |
| PSI | Perforate, Stimulate, Isolate |
| PTS | Permanent Threshold Shifts |
| PW | Produced Water |
| RBA | Risk Based Approach |
| RMS | Root Mean Square |
| SCI | Site of Community Importance |
| SEL | Sound Exposure Level |
| SPAs | Special Protection Area |
| SPL | Sound Pressure Level |
| SSD | Sliding Sleeve Door |
| TEPDK | TotalEnergies EP Danmark A/S |
| TSS | Total Suspended Solids |
| TTS | Temporary Threshold Shifts |
| UK | United Kingdom |
| WARP | Weighting Agent Reduction Particle |
| WBM | Water-based Mud |

# 1. INTRODUCTION

## 1.1 Proposed Activities

The HALFDAN Field offshore Denmark is operated by TotalEnergies EP Danmark A/S (TEPDK) on behalf of the Danish Underground Consortium (DUC). TEPDK's operated share of the DUC is 43.2 percent (%), the other partners of the consortium are Noreco (36.8%) and Nordsøfonden (20%, owned by the Danish State).

The HALFDAN Field is located in the south-western part of the Danish North Sea, approximately 209 kilometers (km) west of Esbjerg. The Halfdan Complex comprises Halfdan A (HDA) and Halfdan B (HBA) and the satellite production platform Halfdan C (HCA) that are connected by subsea pipelines, through which produced water, oil and gas are transported from the Halfdan facilities to other field facilities for further processing and export.

Current production levels are well below approved capacities of the existing processing facilities and the project aims to decelerate this decline by recovering the slots of four existing wells and drilling four new trajectories (from the recovered slots); two from HBA in the Tor Northeast (NE) reservoir and two from HDA in the Ekofisk reservoir.

This screening report has been prepared to describe the modifications required for the Halfdan Tor NE Ekofisk Well In-fill project (HDNTNEE) and the potential environmental impacts from slot recovery and drilling (construction phase) and from any resulting changes to the existing operations within the HALFDAN Field.

## 1.2 Regulatory Requirements

The Environmental Impact Assessment (EIA) Directive (2014/52/EU) requires a high-level review of the potential impacts a project may have on the environment during a screening stage to determine whether an EIA is necessary. Screening is a set process under the EU Directive 2011/92/EC and implemented by Denmark through the Environmental Assessment Act LBK number 4 of 3rd January 2023. The legal basis for the screening (The DEA has assessed that the proposed project is covered by the Environmental Assessment Act annex 2, paragraph 2, point (d), Deep drilling, as well as environmental assessment Act, annex 2, paragraph 13, point (a), Changes or extensions of projects in the environmental assessment Act annex 2, which have already been approved, have been carried out or are in the making of being carried out, when they may have significant adverse effects on the environment). Thereby requiring a screening under LBK number 4 of 3rd January 2023. Factors to be considered at the screening stage are as follows:

- If the Project is an Annex 1 development, as described in the EIA Directive;
- If the Project is an Annex 2 development, whether:
  - any part of the Project is in a sensitive area;
  - the Project meets any threshold in Annex 2; or
  - there are likely to be significant effects on the environment.

Screening projects in the marine environment should consider the characteristics and technologies used to ensure a high level of environmental protection is afforded to marine habitats and species. This document provides the necessary information for the Danish Energy Agency (DEA) to carry out a materiality assessment, in reference to the offshore impact assessment order section 4, subsection 4, ref. subsection 1, or a screening decision in accordance with the Environmental Assessment Act section 21.

Various modelling and risk assessment studies cover impacts due to the activities of the currently existing HALFDAN Field facilities, including well infill activities, and other future projects. This

screening report considers those previously approved (ie discharge permits) and assesses any potential impact that could arise from this Project's activities.

This screening report describes the project, which comprises drilling four new trajectories from four slot recoveries. Further detail is provided in Section 0 – Characteristics of the Project.

This report's format is based on the EC Environmental Impact Assessment of Projects Guidance on Screening 2017 (Directive 2011/92/EU as amended by 2014/52/EU), which is implemented in Denmark through the Environmental Assessment Act LBK number 4 of 3rd January 2023.

## 1.3 EU Legislation

### *1.3.1 EU EIA Directive*

The Environmental Impact Assessment (EIA) process is legislated through the Environmental Assessment Regulations, the principal enactment within the Environmental Protection Act (EPA) (Consolidated Act no. 879, 26 June 2010) and the implementation of the EU EIA Directive 2014/52/EU. Annexes 1 and 2 of the Regulations provide lists of activities for which an environmental permit is required, and an EIA report is mandatory.

The EIA directive is currently implemented in Denmark, *inter alia*, through the Consolidated Act on the Use of the Danish Subsoil 1533 of December 2019 and the Offshore EIA Administrative Order BEK 1050/2020.

This screening report determines whether the impacts identified from the HDNTNEE project are likely to be significant and would require a full EIA.

### *1.3.2 EU Habitats Directive*

The EU Habitats Directive (92/43/EEC) is adapted in Danish legislation through Order 434/2017 on Impact Assessment on International Nature Conservation Areas and Protection of Certain Species in Preliminary Studies, Exploration and Extraction of Hydrocarbons, Subsoil Storage, Pipelines, etc. offshore. It provides for the protection of species of importance, and this is discussed further in Section 3.3.

### *1.3.3 Marine Strategy Framework*

The aim of the Marine Strategy Framework Directive (Havstrategidirektiv) is to achieve "good environmental status" of the EU marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. The Marine Strategy Framework Directive is implemented in Danish law through the Marine Strategy Act (see Section 1.4.4) and administered by the Danish Nature Agency. It encompasses Danish Sea zones such as waterbeds, seabed territories and exclusive economic areas.

## 1.4 Danish Legislation

### *1.4.1 Danish Subsoil Act*

The Danish Subsoil Act (DSA) sets out the basic legal framework for the exploration and recovery activities concerning raw materials and hydrocarbons in the Danish subsoil and on the Danish continental shelf. Several of the provisions in the DSA implement EU directives. The Danish Subsoil Act is based on the view that the exploration for and recovery of Denmark's raw materials covered by the Act require comprehensive societal management.

The Danish Subsoil Act covers prospecting, exploration, exploitation, supervision and the Danish government's rights of purchasing hydrocarbons and any other use of the subsoil. All reservoirs of raw materials including hydrocarbons covered by the Act belong to the Danish state.

### 1.4.2 Danish Offshore Safety Act

The consolidated Offshore Safety Act LBK 125 of 2018 for installations and connected infrastructure as well as pipelines is the basis upon which an operating permit has been granted to TEPDK pursuant to section 28 of the Act.

The purpose of this act is to promote a high level of health and safety offshore which is in accordance with technical and social developments in society, and to create a framework that allows enterprises themselves to address health and safety issues offshore. Under the Act, licensees must ensure that health and safety risks associated with offshore oil and gas activities are identified, assessed and reduced to as low as reasonably practicable.

### 1.4.3 Danish Regulatory Requirements

The EU EIA Directive is implemented in Denmark through the Environmental Assessment Act LBK number 4 of 3rd January 2023. This law has the purpose of ensuring a high level of environmental protection through environmental assessment of plans, programs and by regulating permitting for projects that can have a significant impact on the environment. Section 19 states that the operator must submit an environmental impact report. Section 21 includes the screening decision which the authority makes based on the client's application and indicates it is dependent on the consideration of required criteria for environmental assessment and permit (cf. annex 6). The DEA applies the criteria set out in annex 6 of the Environmental Assessment Act when reviewing environmental reports.

### 1.4.4 Marine Strategy Act

The EU MSFD is implemented in Denmark through the Marine Strategy Act LBK number 1161 of 25th November 2019, which aims to establish the framework for achieving or maintaining Good Environmental Status (GES) in marine ecosystems, and enable sustainable use of marine resources. The Marine Strategy II is part of the implementation of the EU MSFD and the Danish Marine Strategy Act. The overall strategy covers the years 2018-2024 and it is developed by the Danish Agency of Water and Nature Management, now the Environmental Protection Agency, which is currently under the jurisdiction of the Ministry of Environment and Food. It encompasses Danish Sea zones such as waterbeds, seabed territories and exclusive economic areas. The Marine Strategy II comprises three parts, each part being revised every six years:

- Part 1: Good environmental status, initial analysis, environmental targets:
  - Aims to define good environmental status, provides an overview of the status in the sea and sets targets for the achievement of good environmental status, which is done the for eleven descriptors (described in Marine Strategy Act Appendix 2): D1 Biodiversity, D2 Non-indigenous species, D3 Commercially exploited fish stocks, D4 Marine food webs, D5 Eutrophication, D6 Sea floor integrity, D7 hydrographical changes, D8 Contaminants, D9 Contaminants in seafood for human consumption, D10 Marine litter, D11 Underwater noise;
- Part 2: Monitoring program:
  - Assess the state of the marine environment in relation to the environmental target set out in Part 1 of the Strategy. The monitoring program is mainly based on monitoring activities in the National Monitoring Program for Water Environment and Nature (NOVANA);
- Part 3: Program of measures;
  - Aims to contain concrete actions to achieve the set environmental targets and thus ensure the good marine environment in the future.

The assessment of the project activities on the eleven descriptors can be found in Section 3.8.2.

## 1.5 Applicability to Proposed Activities

In accordance with LBK number 4 of 3rd January 2023, this report considers the following method when assessing impacts, per annex 6, point 3 “Nature and characteristics of the potential impact on the environment”:

- the magnitude and spatial extent of the impact (eg geographical area and number of persons likely to be affected);
- the nature of the impact;
- the cross-border nature of the impact;
- the intensity and complexity of the impact
- the likelihood of impact;
- the expected onset, duration, frequency and reversibility of the impact;
- the cumulation of the impact of the project with the impact of other existing and/or approved projects; and
- the possibility of effectively limiting impacts.

The method used to define impacts is explained in Appendix A of this report and follows legislation LBK 4 of 3rd January 2023. Table 1 presents a summary of the main environmental aspects to consider and their location of analysis. This table is a summary of the required assessments listed in LBK 4 Annex 6 which lists the criteria for determining whether projects covered by annex 2 should be subject to an environmental impact assessment.

## Table 1.1 Summary of the Required Assessments listed in Appendix 6 of LBK 4/2023

| Item | Applicable to HDNTNEE | Assessment |
|---|---|---|
| 1 Characteristics of project | | |
| (a) the dimensions and design of the entire project. | Applicable | Described in Chapter 2 Characteristics of the Project, Section 2.5 |
| (b) cumulation with other existing and/or approved projects. | Applicable | Described in Chapter 3 Environmental Screening, Section 3.6 Cumulative Impacts |
| (c) the use of natural resources, in particular land, soil, water and biodiversity. | Applicable | Described in Chapter 3 Environmental Screening, Section 3.2 (See Table 3.2) |
| (d) the generation of waste. | Applicable | Assessed in Table 3.20, Descriptor 5 |
| (e) pollution and nuisance. | Applicable | Described in Chapter 3 Environmental Screening, Section 3.2<br>Refer also to Table 3.20, Descriptor 8 |
| (f) the risk of major accidents and/or disasters relevant to the project concerned, including those caused by climate change, in accordance with scientific knowledge. | Applicable | Described in Chapter 3 Environmental Screening, Section 3.5 Major Accidents / Unplanned Events |
| (g) the risk to human health (eg from water or air pollution). | Applicable | Described in Chapter 3 Environmental Screening, Section 3.2 and Section 3.5 |
| 2. Location of projects | | |
| (a) the existing and approved land use. | Applicable | HALFDAN Field Licence area is in “Contiguous Area” as described in https://ens.dk/sites/ens.dk/files/OlieGas/oliegaskort2021-10-13.pdf |
| (b) the relative richness, abundance, quality and regeneration capacity of | Applicable | Described in Chapter 3 Environmental Screening, Section 3.2 |

| Item | Applicable to HDNTNEE | Assessment |
|---|---|---|
| natural resources (including soil, land, water and biodiversity) in the area and its subsoil. | | |
| (c) the carrying capacity of the natural environment, paying particular attention to the following areas:<br>(i) wetlands, areas along banks, estuaries. | Not Applicable | The project is located approximately 190 km from the Danish coast. Even though wetlands and estuaries are sensitive environments, the project activities will not interact with them. Therefore, even if the receptor (e.g., wetlands, areas along banks and estuaries, animals associated with these habitats) has a high sensitivity, the magnitude of the impact will be negligible as there is no possible interaction with the project site located more than 190 km away. The impact will be of **negligible** significance and therefore not addressed further. |
| (ii) coastal areas and the marine environment. | Applicable for marine environment<br>Not Applicable for coastal areas | The marine environment is assessed in Table 3.20.<br>The closest coastline is located approximately 190 km from the project site. The project consisting of drilling 4 new trajectories from recovered slots, will have no interaction with the coastline, ensuring that the magnitude of any potential impact from planned activities would be negligible. Regardless of the receptor's sensitivity, there will be no interaction between project activities and coastal environments, consequently the impact will be **negligible.** |
| (iii) mountain and forest areas. | Not Applicable | The project will take place more than 190 km from the Danish coast in the North Sea. Mountains and forests are found inland and will not interact with project activities. Consequently, the magnitude of any impact will be negligible and regardless of receptor sensitivity the impact will be **negligible,** therefore not assessed further. |
| (iv) nature reserves and parks. | Applicable | Described in Chapter 3 Environmental Screening, Section 3.3 Assessment of Impacts |
| (v) territories registered or protected by national law; Natura 2000 sites designated by Member States in accordance with Directive 92/43/EEC and Directive 2009/147/EC. | Applicable | Described in Chapter 3 Environmental Screening, Section 3.3 Assessment of Impacts |
| (vi) areas where the environmental quality standards laid down in EU | Not Applicable | There is international, regional and European legislation addressing environmental protection which together form the framework for protecting the environment of the North Sea (refer to Section 1.3 for regulatory framework). The applicable legislation for marine pollution includes the EU EIA Directive and EU Habitats |

| Item | Applicable to HDNTNEE | Assessment |
|---|---|---|
| legislation relevant to the project have not been successfully achieved or in respect of which it is considered that they have failed. | | Directive at European level, at a regional level the Marine Strategy Framework Directive implemented through the Marine Strategy Act of the Danish Nature Agency, the Bonn Agreement and the OSPAR Convention, and at international level the MARPOL Convention. Because of these various legislative measures, it is expected that areas where the environmental quality standards laid down in EU legislation will be met, as the North Sea is strictly controlled to reduce marine pollution. This will not be assessed further. |
| (vii) densely populated areas. | Not Applicable | No densely populated areas are present near the project, which is located approximately 190 km from land in the Danish North Sea. The closest densely populated area to the project is the City of Esbjerg, which has an urban population of approximately 71,000 people. Given that the project activities will take place in the sea, there will be no interaction between densely populated areas and the project. Part of the labour force will likely be inhabitants of Esbjerg, therefore the project will provide jobs to the local population, however, the vessel, rig and platforms have a very small number of people on them. Regardless of receptor sensitivity the only potential interaction will be positive due to the increase in jobs and commerce in the area, however, this **positive** impact will be **negligible** and therefore not assessed further. |
| (viii) landscapes and sites of historical, cultural or archaeological significance. | Not Applicable | The project area is not located near to landscapes and sites of historical, cultural, or archaeological significance, as the project area is approximately 190 km from land in the Danish North Sea. There is no record of sunken ships or other wrecks nearby. Therefore, there is no receptor to assess, and the magnitude of the impact will be negligible. The project's planned activities will have no or **negligible** impact on landscapes and sites of historical, cultural or archaeological significance. This will not be assessed further. |

# 2. CHARACTERISTICS OF THE PROJECT

## *Screening in Accordance with LBK 4 Appendix 5 Point 1 and Appendix 6 Point 1*

In accordance with LBK 4 Appendix 5 Point 1, this section describes the physical characteristics of the project. For a description of the project location please refer to Section 2.4 and for reference to geographically sensitive areas and their relationship with the project refer to Figure 3.2 (as requested per Appendix 5, 1 (b)). This Section also addresses the requirements from Appendix 6, Point 1, a through g, an omission of their description indicates that the project will not have an impact on that characteristic. These characteristics are the following:

a) the dimensions and design of the entire project

b) cumulation with other existing and/or approved projects (Described in Section 3.6).

c) the use of natural resources, especially land, soil, water and biodiversity.

d) waste production.

e) pollution and nuisance (Described in Section 3.3).

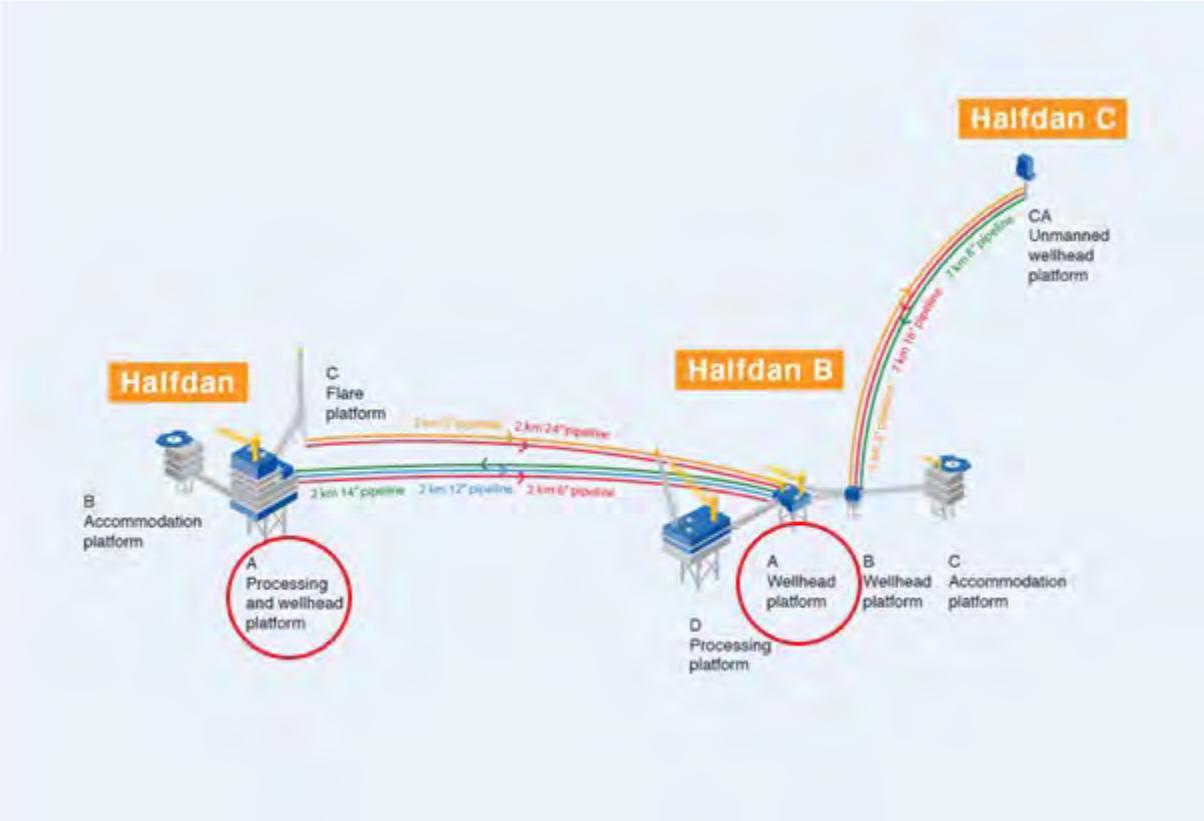
f) the risk of major accidents and/or disasters relevant to the project in question, including those caused by climate change, in accordance with scientific knowledge (Described in Section 3.5).

g) the risk to human health (e.g., due to water or air pollution) (**None**).

## 2.2 HALFDAN Field Overview

The HALFDAN Field (Figure 2.1) refers to the existing and planned activities at the main production complex of HDA and HBA and the satellite production platform HCA. The production facilities are connected by subsea pipelines, through which oil, gas and water are transported from the Halfdan facilities to other field facilities for further processing and export. Pipelines departing from the Halfdan platforms are considered part of the HALFDAN Field activities. TEPDK operates the installations under the joint venture ownership of the Danish Underground Consortium (DUC).

**Figure 2.1 HALFDAN Field Map**




Source: TEPDK, 2022

## 2.3 HALFDAN Platforms (HDA and HBA)

The Halfdan platforms are located in the western part of the Danish North Sea approximately 17 km west of the Gorm hub. Halfdan was discovered in 1998 and further appraisal led to development and first oil in 2001. The Halfdan production was initiated at HDA in 1999, then later HBA in 2004 and HCA in 2007. Halfdan A comprises a combined wellhead and a processing platform (HDA), one accommodation platform (HDB) and a gas flare stack (HDC). Halfdan B comprises a processing platform (HBD), a wellhead platform (HBA), a combined riser and wellhead platform (HBB) and an accommodation platform (HBC). Halfdan C is an unmanned wellhead platform (HCA).

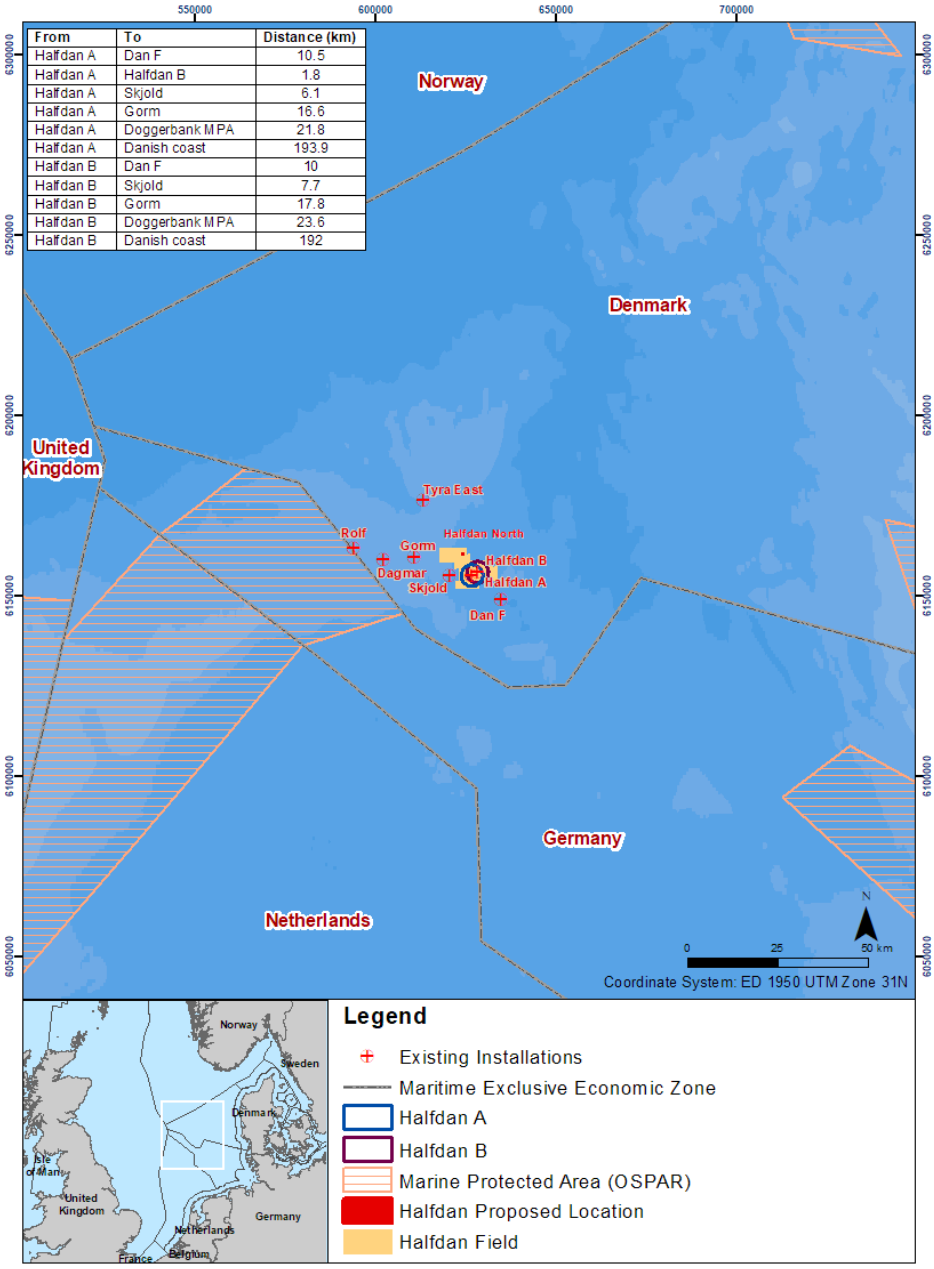
Halfdan produces oil and gas from both the Ekofisk and Tor reservoirs. The Tor reservoir is drilled from HDA, HBA and HBB platforms. Ekofisk gas is produced from wells drilled from the HBA and HCA platforms. Due to the Ekofisk and Tor location overlap, Ekofisk oil and gas is produced from HDA-09, HBB-04 and HBB-05 above the Halfdan Main oil development, and Tor oil and gas is produced from HBB-10 below the Halfdan Northeast gas development. The total annual production for the HALFDAN Field is now declining and is below the assessed and approved facilities production capacity.

This screening report has been prepared to describe the activities required to drill four new trajectories from recovered pre-existing slots (HBA-15, HBA-27, HDA-25 and HDA-35) and to compare the significance of any changes against historical modelling and risk assessment studies.

## 2.4 Location of the Proposed HALFDAN Drilling Activities

The HALFDAN Field and infrastructure is located in the south-western part of the Danish North Sea, approximately 209 km west of Esbjerg, Denmark (Figure 2.2). The water depth in the HALFDAN Field is 43 m.

**Figure 2.2 Halfdan Location**




Source: TEPDK edited by ERM 2022

## 2.5 Overview of Activities

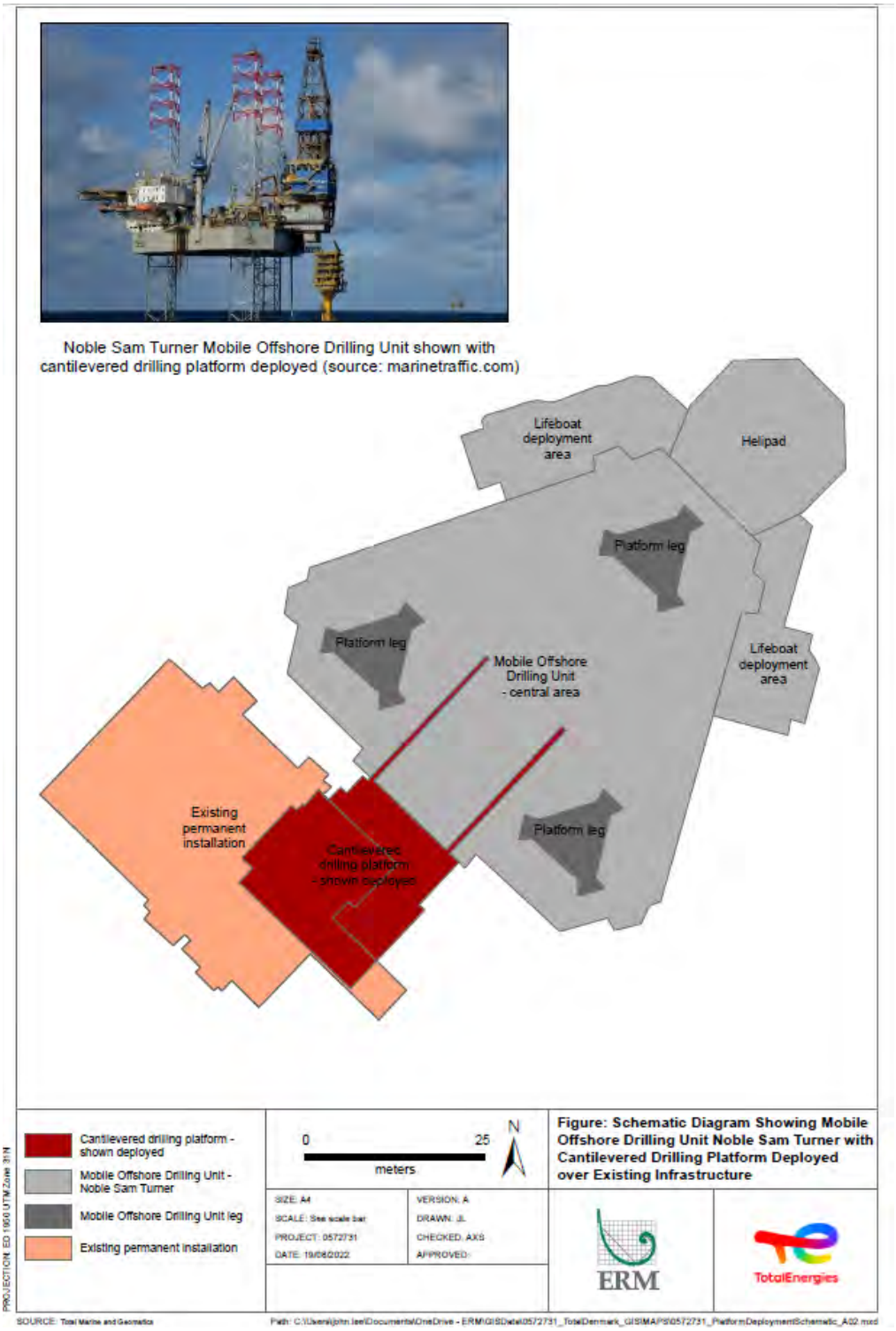
The scope of work is to drill four new well trajectories from four recovered pre-existing slots, two producers from HBA, in the Tor NE reservoir and one injector and one producer from HDA in the Ekofisk reservoir to recover declining production from the existing Halfdan platforms operating below capacities. Recent well studies demonstrated that well slot recovery is technically feasible, would decelerate production decline and would emit negligible Greenhouse Gases (GHG). The new wells are considered to be maintaining permitted production of the HALFDAN Field.

### 2.5.1 Halfdan Tor NE and Ekofisk In-fill Well Drilling Operations – General Case

For slot recovery and drilling purposes, a 3-legged jack-up rig will be used. The recovery of an existing well slot will start with re-entering the well and cutting and retrieving the existing top completion. The casing annular cement will then be evaluated by logging. Cement plugs will be placed to ensure full isolation of the old wellbore and the casing retrieved above the seabed. Additional activities may entail casing milling operations, in case of poor annular cement coverage being evaluated during logging.

Drilling new trajectories from the recovered slot and installation of new conductor pipes is planned for the new wells. This procedure applies for each of the four recovery slots, two at Halfdan B (HBA) for Tor NE and two at Halfdan A (HDA) for Ekofisk. The drilling program includes conductor pipe driving, drilling fluid use, cuttings production and cementing, well logging, and well completion. Support vessels and services are expected to be required. All activities during the operations will be carried out on the platform or on the jack-up rig (Figure 2.3).

**Figure 2.3 Representative Schematic Showing the Proximity of the Jack-up Rig, During the Operations**

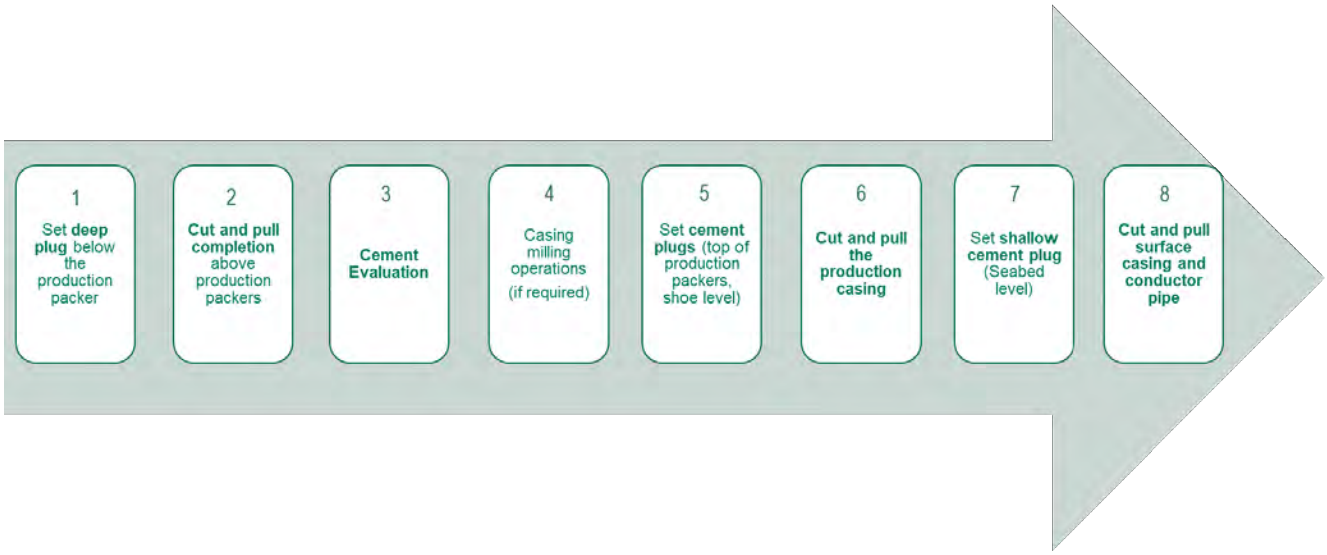



Source: ERM 2022

## 2.5.2 Slot Recovery Procedure

The approach for slot recovery of existing wells is summarized in Figure 2.4 and described thereafter.

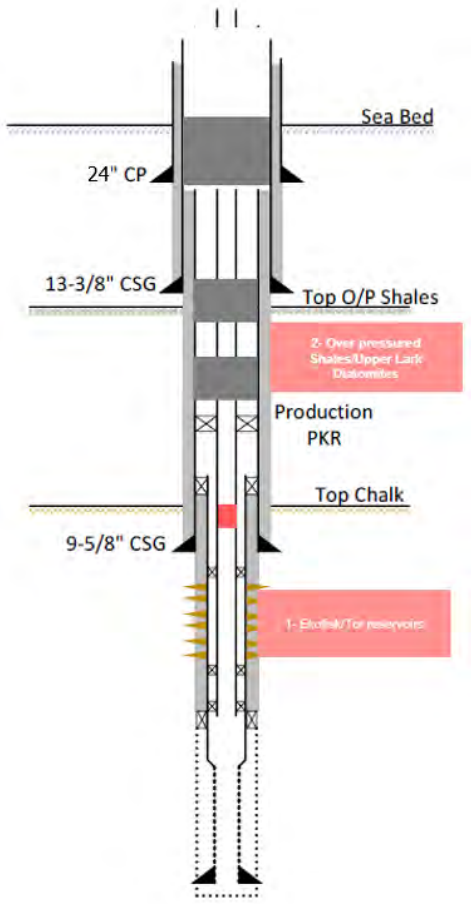
## Figure 2.4 Slot Recovery Approach




Source: TEPDK, edited by ERM 2022

Recovery will start with re-entering the well, cutting and retrieving the existing top completion. The retrieved tubing is transported back onshore for inspection prior to storage, reuse, or scrapping (depends on the evaluation). The casing annular cement is then evaluated by logging, and in the event of poor annular cement coverage, it might be necessary to carry out casing milling operations (refer to Section 2.5.2.1). Cement plugs will then be placed to ensure full isolation of the old wellbore. A casing multi-string cut will be performed near the seabed where all casing strings will be retrieved and brought to shore for appropriate handling as per TEPDK's waste management plan. If no casing milling is required, it is anticipated that the tubing retrieval and cementing operations will be carried out using seawater as the fluid medium in the well. A sectional view of the old wellbore is represented in Figure 2.5. This is followed by installing a conductor whipstock at the top of the casing stump and driving a new conductor to drill new trajectories from recovered slots.

**Figure 2.5 Sectional View of Existing Wellbore**




Source: TEPDK, 2022

### *2.5.2.1 Milling (if required)*

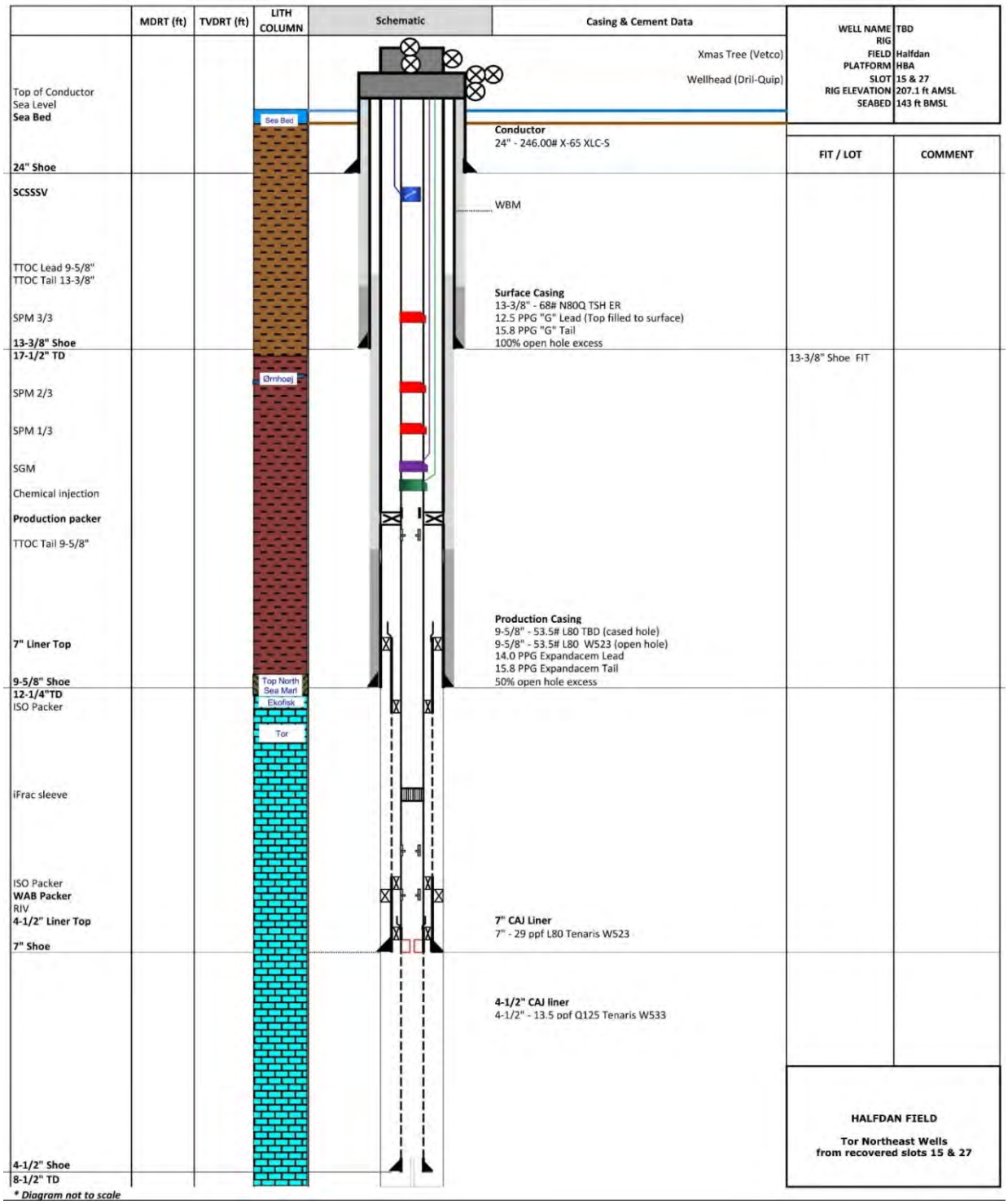
Milling of the casing depends on the condition of the casing annular cement. If section milling is to be carried out, an inhibited water-based mud (WBM) may be used as milling fluid. WBM comprises a specially formulated mixture of natural clays, polymers, weighting agents and/or other materials suspended in a fluid medium. Typically, the major ingredients that comprise over 90% of the total mass of the WBMs are freshwater or seawater, barium sulphate (barite), bentonite clay, liquid viscosifiers and caustic soda. Other substances are added to gain the desired density and drilling properties.

A swarf (milled solids) unit will be present on the surface to handle any metal returns from milling operations and the waste metal will be brought to shore for processing, the milled solids are removed from the WBM and the WBMs recycled. Swarf will be retained and returned to shore for processing and disposal, ie swarf will not be discharged during milling operations.

## *2.5.3 Drilling Program*

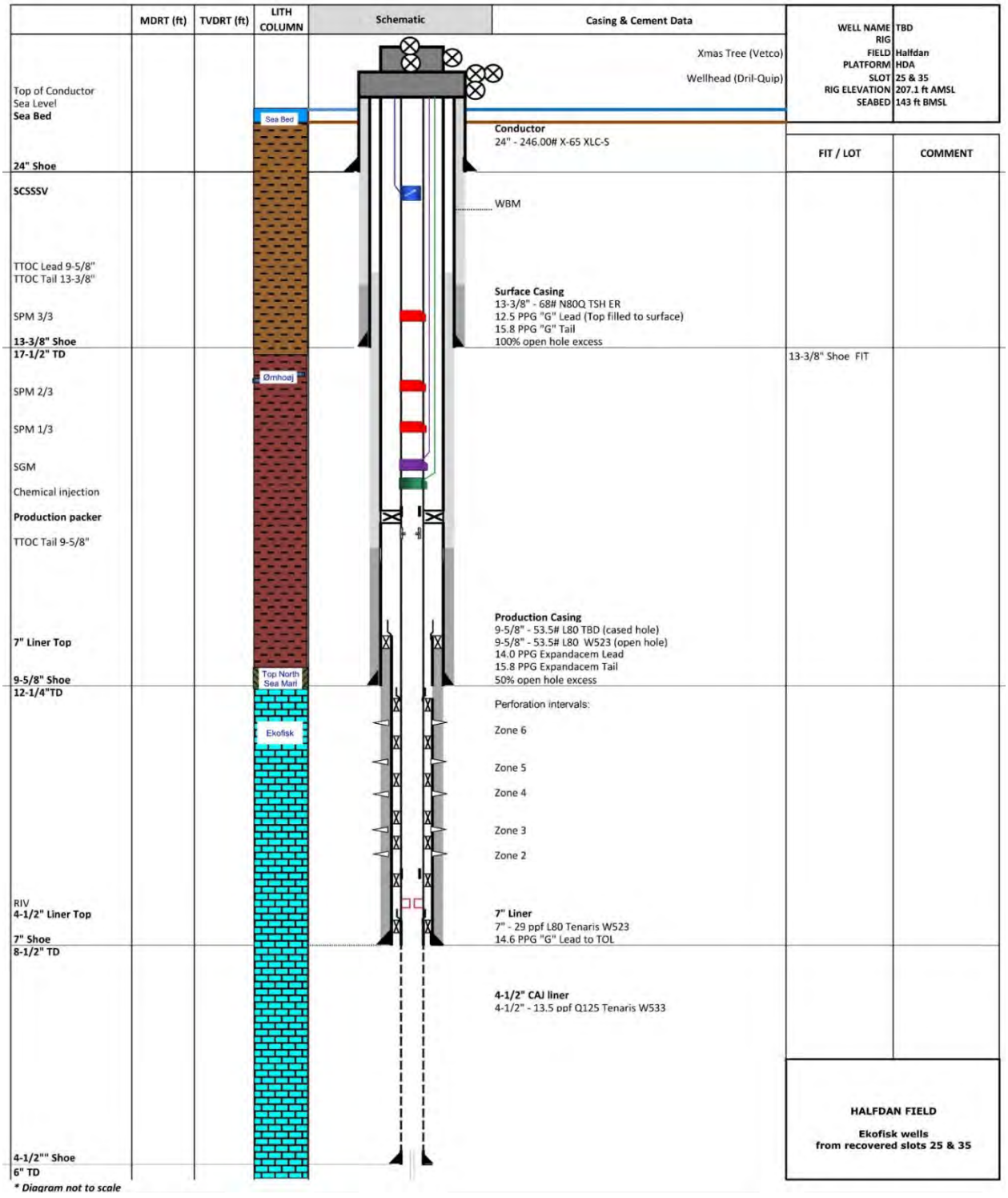
Four new trajectories from four recovered pre-existing slots (two producers from HBA for the 2 Tor NE wells and one injector and one producer from the 2 Ekofisk wells) will be drilled by a jack-up rig. As the well is drilled, metal casing is placed inside the well to line it and stabilize the wellbore to prevent it from caving in. The casing also isolates aquifers and hydrocarbon-bearing zones through which the well passes, thus preventing liquids or gases from entering the well prematurely. After each casing string is installed, it is cemented in place. The lengths and diameters of each casing section of the well are established prior to drilling. The exact details are determined by the geological conditions through which the well is drilled and is driven by the final desired hole diameter to drill the reservoir section. The proposed well design is provided in Figure 2.6 for Tor NE wells and Figure 2.7 for Ekofisk wells.

## Figure 2.6 TOR NE Well Profile




Source: TEPDK, 2022

## Figure 2.7 Ekofisk Well Profile




Source: TEPDK, 2022

### *2.5.3.1 Conductor Pipe Driving*

Conductor pipe driving will occur for all four wells. The conductor pipe serves as a support during drilling operations, to prevent flowback returns during drilling and cementing of the surface casing, and to prevent collapse of the loose soil near the surface and washout into the sediment. Only a minimal amount of cement is expected to overflow the conductor stump and be discharged to the environment. Most of the cement is expected to be taken back to the rig. Conductor pipes will have a diameter of 24". The hammer energy is expected to be approximately 90 kilojoules (kJ) with a maximum blow rate of approximately 40

strikes per minute, driving conductors to a depth of 350 ft below sea level. A period of 8 to 10 hours is typical for the installation of one conductor.

### 2.5.3.2 Drilling Fluids

During the drilling process, drilling fluids and muds are pumped into the drill pipe down to the drill bit, where it exits at the drill bit and is flushed back up the borehole to the surface. The purpose of drilling fluids is to optimize drilling performance and drill bit integrity. Wells for the Halfdan Tor NE and Ekofisk (HDNTNEE) project will be drilled with WBMs.

The main functions of drilling fluids include, but are not limited to:

- Removal of drilled rock cuttings from the bottom of the well and from the well bore and transportation of these cuttings to the drilling rig at the surface;
- Control of formation pressures and prevention of formation fluids entering the well bore (ie 'primary well control');
- Transmission of hydraulic horsepower to the drill bit;
- Provision of hydrostatic pressure and chemical stability to the rock to maintain the integrity of the wellbore and prevent hole collapse;
- Provide lubricity to the drill string to avoid "stuck pipe";
- Corrosion control of the metal components of the drilling tools; and
- Lubrication and cooling of the drill bit.

The physical and chemical properties of drilling fluids are monitored continuously and adjusted based on conditions encountered (ie, a variation of formation pressures within the well bore with different depths). Weighting materials (eg Barite) are used to induce necessary changes of physical attributes of WBM. For HDNTNEE, pre-hydrated bentonite/seawater lime and WBM, and a water-based WARP[1] mud system will be used during drilling, as follows (quantities for each well):

- Prehydrated bentonite/Seawater: 12,600 $m^3$;
- Water Based Mud: 2,700 $m^3$; and
- Water Based WARP Mud: 6,800 $m^3$.

Per Appendix 5, 3 (a) and (b) the resource used during drilling will be seawater.

### 2.5.3.3 Cuttings

The mud and cuttings mixture is returned to the surface drilling facility via the wellbore to be separated. Before being released at sea, cuttings need to go through an oil separation system. The cuttings are separated from the mud system using a combination of shale shakers, hydrocyclones and centrifuges on the rig. Samples are then taken from the separated mud every 500 feet of wellbore depth or a minimum of twice daily. The oil, water, and solids content ratio are then measured using retort process. The cuttings are then discharged to sea if the hydrocarbon content is an average of <1% dry weight. If the hydrocarbon content exceeds this limit, the cuttings will be contained and sent onshore for treatment.

### 2.5.3.4 Cementing

During drilling operations, cement is required to secure the casing in the wellbore and to provide a barrier, preventing upward migration of hydrocarbons between the well casing and the wellbore. During cementing operations, required volumes of cement are pumped into the space between borehole and casing to stabilize the borehole and provide structural support to well integrity. The cement volumes for drilling of the

1 WARP: Weighting Agent Reduction Particle; it is a material with high-quality barite specially manufactured as a micronized weighting agent for fluid systems to minimize sag potential (barite or weight material sag is a problem of drilling mud and it occurs when the weighting material (barite, etc) separates from the liquid phase and settles down.

four wells is estimated to be 1,980 tonnes (including contingency to cater for circulating out an entire slurry volume in the case of a major issue). Before cementing activities occur, the cement volume likely to be required for each unique well is calculated based on the well dimensions. Slight variations in down-hole or casing diameters can however have implications for the calculated volumes due to well length dimension. The specific cement volume is then mixed from raw ingredients on the rig, all of which would be on the approved list of chemicals for TEPDK´s drilling and wells activities, in line with the OSPAR convention. Based on TEPDK's experience in the area, the typical scenario entails the discharge of approximately 22-23 MT used cement for an entire well (TEPDK, 2023). Unmixed raw ingredients, not used during the well activities, are retained on the rig and are returned to shore.

### *2.5.3.5 Well Logging*

Well logging is the practice of creating a detailed record of the geological formation during the drilling of the borehole. Once drilling operations have been completed, well logging operations will commence to provide information on the potential type and quantities of hydrocarbons present in the target formations. The record is called the well log. A well log is prepared by either taking samples through visual inspections or with the aid of measuring instruments lowered into the borehole and is performed by technicians employed by a specialist logging contractor. Logs prepared using visual inspections are called geological logs whereas logs prepared with the help of inspection instruments are called geophysical logs. For HDNTNEE, logging is only planned for the production casing if a poor cement job is detected. If good conditions are encountered, Cement Bond Logging (CBL) might be performed for zonal isolation. For slot recovery activities, CBL is anticipated to be conducted on the production casing.

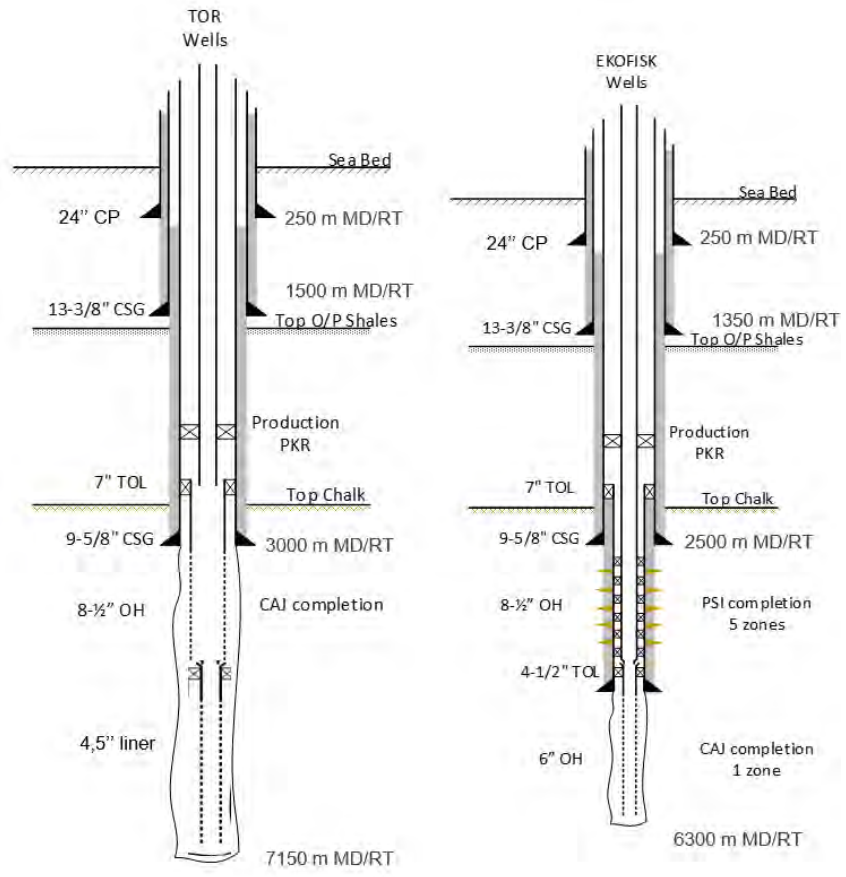
Well testing will not be required for this operation and thus not be evaluated in this assessment.

### *2.5.3.6 Well completion*

The wells will be completed with a monobore upper completion for the Tor NE and Ekofisk wells. The lower completion will be:

- **For Tor NE**: CAJ (Controlled Acid-Jet) lower completion. CAJ is a non-cemented liner, with a limited number of unevenly spaced holes which ensures efficient acid stimulation of the complete reservoir section. Since there is offset from the main field waterflood, there is no need of selectivity in the lower completion (Figure 2.8 Left).
- **For Ekofisk wells**: PSI (Perforate, Stimulate, Isolate) - CAJ lower completion. The PSI part is a cemented and perforated liner with SSD (Sliding Sleeve Door) to have zonal isolation. Zonal isolation is required due to potential water break-through and is achieved with the SSD status (open or closed). Coiled tubing can be used to shift the SSD (Figure 2.8 Right).

**Figure 2.8 Tor NE Well Architecture (Left) - Ekofisk Well Architecture (Right)**




Source: TEPDK, 2022

## 2.5.4 Support Vessels and Services

Vessels and helicopters for the HDNTNEE project are required for the following services:

- Routine maintenance;
- Two supply vessels per week for workover;
- Three supply vessels per week for drilling;
- A standby vessel;
- A jack-up rig; and
- Five helicopters / week for crew change.
- Esbjerg will be the main hub for logistic support activities.

Waste production from the jack-up rig and support vessels is expected (i.e., liquid discharges from sewage, grey water, drainage and solid waste). Liquid discharge to sea will meet the applicable international waste discharge conventions. All solid waste/litter will be returned to land as per TEPDK´s Waste Management Plan, which is applicable to all offshore activities.

## 2.5.5 Schedule

TEPDK plans to commence the drilling operations in:

March (Q1) 2023 for TOR NE:

- The slot recovery duration is estimated to be 27 days per well;
- The drilling duration is estimated to be 67 days per well; and

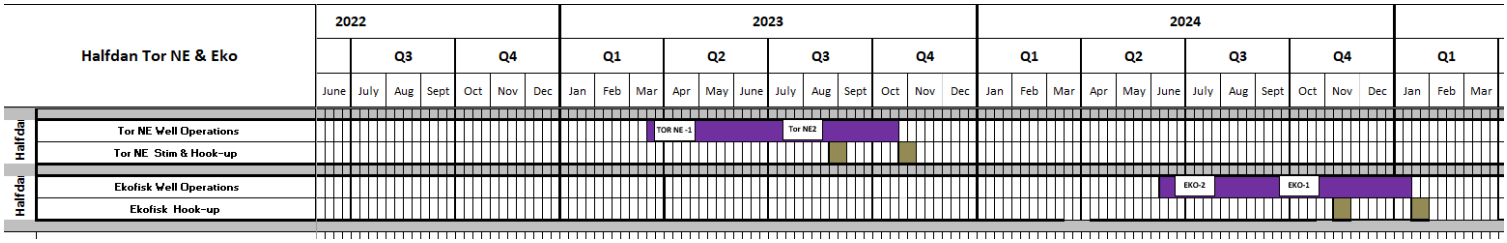
- One rig movement (around ten days) will take place to the first Tor NE well (Tor NE-1) and a second rig movement will take place between Tor NE-1 and Tor NE-2.

Starting June (Q2) 2024 for Ekofisk:

- The slot recovery duration is estimated to be 25 days per well;
- The drilling duration is estimated to be 80 days per well; and
- One rig move will take place (around ten days) to move to the Ekofisk well (Eko-1). There will be no rig move between Eko-1 and Eko-2.

The overall project activities schedule is presented in Figure 2.9.

## Figure 2.9 Proposed Project Timeline




Source: TEPDK, 2022

# 3. SCREENING AND ASSESSMENT OF IMPACTS

## 3.1 Impact Assessment of Activities in Accordance with LBK 4, Appendix 6, Point 3

According to Danish legislation LBK 4, the project's expected significant effects on the environment must be addressed against the criteria listed under points 1 and 2 of Appendix 6 of the legislation and accounting for the project's impact on those in section 20, subsection 4, mentioned factors. Table 3.1 assesses the project activities and potential impacts as per Appendix 6 point 3. The MSFD descriptors, as defined in section 1.4.4, are also indicated alongside with receptors for each proposed project activities‘ potential impacts..

## Table 3.1 Assessment of Activities and their Impacts as per LBK 4, Appendix 6, Point 3

| ID | Activity **Appendix 6 Point 3** | Potential impact | Magnitude **Appendix 6 Point 3 (a)** | Receptor/Nature of impact (MSFD Descriptor) **Appendix 6 Point 3 (b)** | Spatial extent **Appendix 6 Point 3 (a)** | Transboundary **Appendix 6 Point 3 (c)** | Intensity and complexity of impact **Appendix 6 Point 3 (d)** | Probability of impact **Appendix 6 Point 3 (e)** | Occurrence, duration, frequency and reversibility **Appendix 6 Point 3 (e)** | Cumulative impact **Appendix 6 Point 3 (g)** | Impact reduction measures **Appendix 6 Point 3 (h)** | Refer to the following section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | Jack-up rig and vessels | Noise from Jack-up rig movement (propellers) | Negligible | Noise (D1, D3, D4, D6, D11) | Local | No (refer to Section 3.7) | Low | N/A (planned event) | Short-term | No (refer to Section 3.6) | Not needed/ negligible impact | Table 3.2 (Marine mammals & Fish and Plankton) |
| 1.2 | | Air emissions from propulsion engines | Negligible | Air quality | Local | No (refer to Section 3.7) | Low | N/A (planned event) | Short-term | No (refer to Section 3.6) | Embedded within project design | Table 3.2 (Air quality and climate change), Section 3.3.2 |
| 1.3 | | Liquid (drainage, ballast discharge, sewage, grey water) and solid waste (food, cleaning, maintenance) | Negligible | Water quality (D5, D8, D9, D10) | Local | No | Low | N/A (planned event) | No impact | No | Embedded within project design | Table 3.2 (Water Quality & Invasive marine species & Seabirds) |
| 1.4 | | Interference of marine activities from vessel movements | Negligible | Marine spatial use (D1, D3, D9) | Local | No | Low | N/A (planned event) | Short-term | No (refer to Section 3.6) | Embedded within project design | Table 3.2 (Marine Spatial Use) |
| 1.5 | | Interference with vessels | Minor | Risk of collision between marine mammals and vessels (D1) | Local | No | Low | Very Low | Short-term | No | Embedded within project design | Table 3.2 (Marine mammals) |
| 1.6 | | Seabed disturbance from jack-up spud cans | Minor | Seabed disturbance (D1, D6, D7, D8, D9) | Local | No | Low | N/A (planned event) | Short-term | No (refer to Section 3.6) | Embedded within project design | Table 3.2 (Hydrographic Environment & Plankton & Benthic Communities & Fish & Sediment type and quality) |
| 1.7 | | Disturbance from the artificial lighting from the Jack-up rig and vessels | Negligible | Seabirds disturbance (D1) | Local | No | Low | N/A (planned event) | Short-term | No | Not needed/ negligible impact | Table 3.2 (Seabirds) |
| 1.8 | | Introduction of Invasive Species from ballast water exchange from vessels | Negligible | Protected Areas (D2) | Local | No | Low | Unlikely | Short-term Irreversible in case of spreading | No | Embedded within Project Design and Management | Table 3.2 (Non-Indigenous / Invasive marine species) |
| 2.1 | Slot Recovery | Noise from cutting the existing top completion | Negligible | Noise (D1, D3, D4, D11) | Local | No (refer to Section 3.7) | Low | N/A (planned event) | Short-term | No (refer to Section 3.6) | Not needed/ negligible impact | Table 3.2 (Marine mammals & Fish and Plankton) |
| 2.2 | | Liquid (WBM in case of milling) and solid waste (existing top completion, swarf in case of milling) | Negligible | Water quality (D1, D3, D4, D6, D8, D9, D10) | Local | No | Low | N/A (planned event) | Short-term | No | Embedded within project design (no discharge) | Table 3.2 (Water Quality & Marine mammals) |

| ID | Activity **Appendix 6 Point 3** | Potential impact | Magnitude **Appendix 6 Point 3 (a)** | Receptor/Nature of impact (MSFD Descriptor) **Appendix 6 Point 3 (b)** | Spatial extent **Appendix 6 Point 3 (a)** | Transboundary **Appendix 6 Point 3 (c)** | Intensity and complexity of impact **Appendix 6 Point 3 (d)** | Probability of impact **Appendix 6 Point 3 (e)** | Occurrence, duration, frequency and reversibility **Appendix 6 Point 3 (e)** | Cumulative impact **Appendix 6 Point 3 (g)** | Impact reduction measures **Appendix 6 Point 3 (h)** | Refer to the following section |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 | Drilling | Noise from drilling and conductor-driving | Negligible | Noise (D1, D3, D4, D6, D11) | Local | No (refer to Section 3.7) | Medium | N/A (planned event) | Short-term | No (refer to Section 3.6) | Embedded within project design | Table 3.2 (Marine mammals & Fish & Plankton and Benthic Communities & Protected Areas), Section 3.3.1 |
| 3.2 | | Seabed disturbance from drilling | Negligible | Seabed disturbance (D6) | Local | No | Low | N/A (planned event) | Short-term | No | Embedded within project design | Table 3.2 (Benthic Communities & Sediment type and quality) |
| 3.3 | | Reduced water quality from discharge of drill cuttings and used cement | Minor | Water Quality (D1, D3, D4, D6, D8, D9) | Local | No | Low | N/A (planned event) | Short-term | No | Embedded within project design | Table 3.2 (Water Quality & Plankton & Fish & Marine mammals), Section 3.3.3 |
| 4.1 | Operations | Discharge of produced water | Minor | Water Quality (D1, D3, D4, D6, D8, D9) | Local | No | Low | N/A (planned event) | Long-term | No (refer to Section 3.6) | Embedded within project design | Table 3.2 (Water Quality), Section 3.3.3 |

## 3.2 Environmental Screening Based on Receptor as per LBK 4, Appendix 5, Point 2

The environmental screening, specifically Table 3.2, addresses the relevant HDNTNEE project activities and potential impacts. The first stage of the process involved identifying the potential impacts of the proposed activities that require further investigation. The screening phase includes the systematic consideration of the potential for interaction between activities involved in the project and aspects that may be affected.

The aim of the screening is to focus the assessment on impacts that may be of significance. Those that could be significant were then identified considering the professional judgment of the specialists within the team and knowledge of the project-affected area.

## Table 3.2 Comparison of Activities, Impacts and Significance –-HDNTNEE Project

| Receptor | Applicable Sections in Legislation: LBK 4 of 3rd January 2023 | Activities / Impacts / Significance | Significant impact (Y/N) | Assessed Further |
|---|---|---|---|---|
| Hydrographic Environment (D7) | Chapter 7 (Section (§) 20 and § 15), Appendix 7 (point 4). | No pipelines or structures will be added or removed during the slot recovery and drilling operations. The legs of the jack-up rig may temporarily alter local hydrography. However, the hydrography will quickly revert to its previous state once the rig leaves. Due to this, the magnitude will be **small**, the hydrographic sensitivity will be **low**. The potential impacts of the activities being undertaken for the slot recovery and drilling will not exceed those described in this report and the impact is assessed as of **negligible** significance. | No | No |
| Air quality and Climate change | Chapter 7 (§ 20 and § 15), Appendix 6, Appendix 7 (point 4). | Atmospheric emissions of pollutants ($NO_x$, $SO_x$ and particulates) and greenhouse gases (GHG) from project activities will not affect air quality due to their temporary nature, the well-mixed airshed of the offshore environment and the distance from project activities to shore. The magnitude, therefore, will be **negligible**, and the sensitivity will be **high**, therefore the overall impact is assessed as **negligible**. | No | **Yes, in section:** 3.3.2 Emissions to Air |
| Water Quality (D5, D8, D9, D10) | Chapter 4 (§ 8), Annex 1, Annex 2, Chapter 7 (§ 20). | Drill cuttings will be discharged during the drilling phase and incremental produced water will be discharged during operational activities. The slot recovery and drilling activities may also involve small volumes of used cement to be discharged. Cement discharges will be as fluid into the sea at the surface with some suspended solids. The cement fluids will generally disperse in the water column and should not settle on the seabed as a lump or layer. Wastewater discharges from the project vessels (e.g. drainage, ballast, sewage, grey water) will be managed in accordance with MARPOL 73/78 – Annex I Regulations for the Prevention of Pollution by Oil. In case of milling milled solids (swarf) are removed from WBM. Used milling WBM and swarf are retained and returned to shore for processing and disposal. Considering the drilling activities will be intermittent and the impact is localized, the magnitude will be **medium**, and the sensitivity of water quality will be **low**, therefore, the overall impact is assessed as of **minor** significance. | No | **Yes, in section:** 3.3.3 Impacts from Chemical Use and Discharges for Production Activities |

| Receptor | Applicable Sections in Legislation: LBK 4 of 3rd January 2023 | Activities / Impacts / Significance | Significant impact (Y/N) | Assessed Further |
|---|---|---|---|---|
| Sediment Type and Quality (D6, D8) | Appendix 6. | There will be minor, temporary interaction with the seabed during the well slot recovery and drilling activities; jack-up rig legs will disturb the seabed.<br>Disturbance of small areas of sandy sediments is expected to be short term, as sand rapidly re-settles in the disturbed areas due to natural erosion, deposition and resuspension. The impact to sediment type and quality was assessed to be of small intensity, local extent and of a short-term duration.<br>The overall magnitude of potential impact is **small,** and the sensitivity is **low** therefore, the overall impact is assessed as of **negligible** significance | No | No |
| Plankton (D1, D4) | Chapter 7 (§ 20), Appendix 4, Appendix 5, Appendix 6, Appendix 7. | The main factors which influence phytoplankton production are light and nutrient availability. Possible turbidity from jack up rig spud cans and drilling or discharges associated with the project could decrease light availability and cause a reduction in phytoplankton availability. Any impact will be temporary and limited to slot recovery and drilling activities. It is not expected that the conductor driving and drilling at HALFDAN will have a significant impact on plankton. Based on the abundance, productivity and size of planktonic populations and their high reproductive rate, plankton is expected to recover after disturbance. The magnitude of impact is **small** and the sensitivity is **low**, therefore the overall impact is assessed as of **negligible** significance | No | No |
| Benthic Communities (D6) | Chapter 7 (§ 20), Appendix 4, Appendix 5, Appendix 6, Appendix 7. | The project could have the potential to adversely impact benthic receptors either through excessive underwater noise or through smothering and sedimentation. The benthic fauna composition in the HALFDAN Field is dominated by polychaetes, crustaceans and bivalves. Underwater noise was identified to have a negligible effect on benthic communities through behavioural and physiological effects, as this should only affect organisms within a few meters of high noise. Noise impacts during operations are from vessel activities, including the jack up rig and the diving support vessel, and from drilling and conductor driving.<br>Any increased turbidity or smothering will be restricted to the discharge of drill cuttings and jack up rig activities, and will therefore be **small** scale and temporary.<br>The overall magnitude of impact to benthic communities is small and the sensitivity is **low**, therefore, the overall impact is assessed as of **negligible** significance. | No | No |

| Receptor | Applicable Sections in Legislation: LBK 4 of 3rd January 2023 | Activities / Impacts / Significance | Significant impact (Y/N) | Assessed Further |
|---|---|---|---|---|
| Fish (D1, D3) | Chapter 4 (§ 8), Annex 1, Annex 2. | Activities from slot recovery and drilling new trajectories in existing wells with the potential to impact fish are mostly due to excessive underwater noise. Modelling was performed by Genesis (2022) to estimate underwater noise-related impacts on fish near the HDNTNEE project.<br>The magnitude of impact on fish of drilling operations for HDNTNEE are considered **negligible**, while the sensitivity of the receptor is classified as **low**. The overall impact is evaluated as **negligible**. Conductor driving activities are likely to have adverse impacts on fish near the driving site. As fish are relatively unaffected by underwater noise if distances are larger than 20 m, the magnitude of impact is considered **negligible**. The sensitivity of the receptors is assessed as **low**, as fish are generally insensitive to underwater noise and can flee the immediate area of impact. Overall, the significance of impacts on fish due to conductor driving is evaluated as **negligible**.<br>Physical disturbance of the seabed will have a negligible impact on fish as the disturbance will be limited to the temporary jack up rig leg sites during slot recovery and drilling activities. Any disturbance of the seabed during the project activities is expected to be of short duration, as works are expected to be completed within 110-120 days per well.<br>The overall magnitude of impact is **negligible,** and the sensitivity is **low**, therefore, the overall impact is assessed as of **negligible** significance. | No | **Yes, in section:** 3.3.1 Impacts from Drilling and Conductor Driving |
| Marine Mammals (D1) | Chapter 7 (§ 20), Appendix 4, Appendix 5, Appendix 6, Appendix 7. | Vessel activity and operation of machinery for the slot recovery and drilling new trajectories will cause underwater noise that could cause minor impacts on mammals, specifically the harbour porpoise (*Phocoena phocoena*) and Annex IV species, which may be encountered in the project area. Sources of underwater noise for the drilling activities and conductor driving are temporary.<br>Genesis (2022) undertook underwater noise modelling of drilling and conductor driving. The modelling was used to assess the potential negative impacts on marine mammals. The magnitude of impact of drilling noise for marine mammals is evaluated as **negligible**, while the sensitivity of the receptors (harbour porpoises, seals, and other marine mammals) is considered **medium**. Therefore, the significance of impacts due to drilling noise for marine mammals is assessed as **negligible**. | No | **Yes, in section:** 3.3.1 Impacts from Drilling and Conductor Driving |

| Receptor | Applicable Sections in Legislation: LBK 4 of 3rd January 2023 | Activities / Impacts / Significance | Significant impact (Y/N) | Assessed Further |
|---|---|---|---|---|
| | | With regards to conductor driving, marine mammals are considered to flee noise sources. Thus, the magnitude of impact for marine mammals with the HDNTNEE project for conductor driving is assessed as **negligible**. The sensitivity of receptors is considered **high**, which results in an overall impact assessment for conductor driving activities in the HDNTNEE project for marine mammals of **negligible**.<br>There is a risk that collision between mammals and vessels given that species, such as harbour porpoises, may occur in the area, but no collisions have been recorded during DUC activities to date. Additional vessel movements for project activities will be temporary. The magnitude is **small**, and the sensitivity of marine mammals is **medium**. Therefore, due to the low likelihood of collision, the overall impact is assessed as of **minor** significance. | | |
| Seabirds (D1) | Chapter 7 (§ 20). | Discharges and excessive light may impact seabirds. There will only be a minor impact on water quality due to discharges. Light impacts will be limited to vessel activity. The sensitivity of this receptor is **medium** however the magnitude of impact is **negligible**. Therefore, the overall impact is assessed as of **negligible** significance. | No | No |
| Protected Areas | Appendix 6. | The HDNTNEE project area is 22 km from the nearest Natura 2000 site. The distance to other Natura 2000 sites, including the Wadden Sea, is more than 100 km, and the distance to the nature reserves along the west coast of Denmark is more than 200 km. The Genesis (2022) modelling for HDNTNEE project predicts that the underwater noise levels within the German EEZ and the German Doggerbank SAC is below the suggested thresholds. Therefore, the magnitude is **negligible**, and, although the sensitivity of protected areas is **high**, impact on the conservation objectives of the habitat types or species in the Natura 2000 sites is assessed as of **negligible** significance. | No | **Yes, in section:** 3.4 Protected Areas |
| Marine Spatial Use (D3) | Chapter 4 (§ 8), Annex 1, Annex 2. | There will be no additional impact on marine spatial use from the existing restricted zones around the HBA and HDA platforms, including the slot recovery and drilling activities. The jack-up rig is temporary and when the HDNTNEE project will be completed, the structures will be removed. However, safety zones will remain in place around existing structures. The magnitude therefore will be **small**, and the sensitivity of marine spatial use is **low**; the overall impact is assessed as of **negligible** significance. | No | No |

| Receptor | Applicable Sections in Legislation: LBK 4 of 3rd January 2023 | Activities / Impacts / Significance | Significant impact (Y/N) | Assessed Further |
|---|---|---|---|---|
| Fishery (D3, D4) | Chapter 4 (§ 8), Annex 1, Annex 2. | Disturbance of small areas of sandy sediments from the jack-up rig will be short term. Underwater noise for the slot recovery and conductor driving will be temporary and may cause fish to temporarily move away from the sound source. However, safety zones will remain in place due to wells. The magnitude therefore, will be **negligible**, and the sensitivity of the fishery is assessed as **medium**, the overall impact is assessed as of **negligible** significance. | No | No |
| Natural Resources | Appendix 6. | The main natural resources consumed for this project will be freshwater, seawater and oil. These natural resources are of **low** sensitivity. The consumption for this project will be **small**, therefore the magnitude of the impact is negligible. The WBMs will use seawater, freshwater will only be used on the ships. Therefore, the impact will be of **negligible** significance. | No | No |
| Human Health | LBK 4 of 3rd January 2023. | None of the activities performed are expected to have a major or long-lasting impact on human health. The project will last approximately 110-120 days per well and will therefore have a short duration, therefore the impacts to water and air quality are of a **small** magnitude. The sensitivity to water quality and air quality for humans is **medium**. Due to the short duration and small impact on aspects that could affect human health the overall significance of the impact is assessed as **minor**. | No | No |
| Non-indigenous / Invasive marine species (D2) | Chapter 7 (§ 20), Appendix 4, Appendix 5, Appendix 6, Appendix 7. | Non-indigenous / invasive marine species may be introduced to the HALFDAN Field and the local environment in project vessel / rig ballast water and vessel fouling. Such species can out-compete and displace native marine species, disrupt food chains and imbalance the local marine ecosystem. All project vessels and the Noble Sam Turner jack-up rig have been operating solely in the North Sea. These vessels are unlikely to present a source of non-native / invasive species in vessel fouling during the proposed HDNTNEE activities.<br>All vessels follow the International Maritime Organization (IMO) Ballast Water Management Convention and are unlikely to have non-native / invasive marine species in their discharged ballast water. Therefore, the impact will be of **negligible** significance. | | |

## 3.3 Assessment of Potential Impacts from Planned Activities

### *3.3.1 Impacts from Drilling and Conductor Driving*

#### *3.3.1.1 Underwater Noise – General Description*

The driving of conductor pipes impacts marine biodiversity from exposure to excessive underwater noise resulting in behavioural disturbances (eg fleeing from a source and general avoidance of an area, changes in foraging and breeding activities). Exposure to underwater noise can also induce physical damage (eg damage to hearing organs, soft tissues) to species when they are near a loud noise source. Key species susceptible to noise in the North Sea are mainly marine mammals (cetaceans and pinnipeds) and fish.

Thresholds for behavioural changes in marine species can be classified as Temporary Threshold Shifts (TTS) or Permanent Threshold Shifts (PTS). TTS indicates an increased hearing threshold due to a high noise level which can be recovered over time (Finneran, 2015). PTS describes an increased hearing threshold that is irreversible and constitutes permanent damage. For this assessment, relevant species groups (ie, cetaceans, pinnipeds and fish) are sorted into sub-categories based on hearing capabilities, hearing ranges and associated threshold criteria.

The impact of underwater noise on marine mammals can be divided into the following four broad categories that largely depend on the individual's proximity to the sound source, including detection, masking, behavioural changes, and physical damages:

- Detection is when the marine mammals can hear the noise. Detection ranges depend on background noise levels and species-specific audible threshold profiles.
- Masking is when the noise conceals other sounds, eg communication between individuals. The impact on communication is not well understood.
- Behavioural changes are difficult to evaluate. They range from very strong reactions, such as avoidance, to more moderate reactions where the marine mammal may orient itself towards the sound or move slowly away. However, the marine mammals' reaction may vary greatly depending on season, behavioural state, age, sex, and the intensity, frequency and time structure of the sound causing behavioural changes.
- Physical damage to marine mammals is damage to the hearing apparatus. Physical damage to the hearing apparatus may lead to permanent changes in the animal's detection threshold (TTS/PTS, as described above). For PTS and TTS, the sound intensity and profile is an important factor for the degree of hearing loss, as is the frequency, the exposure duration, and the length of the recovery time.

Genesis (2022) undertook underwater noise modelling for this project, which addresses potential impacts on marine mammals and fish due to excessive underwater noise from drilling activities and conductor driving.

The following impact assessment applies control measures recommended by the Danish Environmental Agency Strategic Environmental Assessment (DEA, 2013) and the "Guidelines for minimising the risk of injury to marine mammals from pile-driving noise" (JNCC, 2017).

#### *Marine Mammals*

Marine mammals use sound in various contexts, including social interactions and foraging (Southall et al*.,* 2007; Southall et al., 2019). The range of sounds used by marine mammals is broad, and ranges from the low frequency calls <10 hertz (Hz) of the blue whales to the ultrasonic clicks of 145 Hz in harbour porpoise (Villadsgaard et al*.,* 2007). The hearing of marine mammals spans an equally wide range of frequencies as the emitted sounds and can range from <1 kilohertz (kHz) to 180 Hz (Richardson et al*.,* 1995; Southall et al*.,* 2007).

Underwater noise impacts on marine mammals can be behavioural (eg anthropogenic noise masks the noises used by cetaceans for communication) or physiological (eg very loud anthropogenic noise can damage the internal hearing organs). The conductor driving creates sound levels capable of inducing TTS in marine mammals, depending on their proximity to the underwater noise source. Five marine mammal species are commonly observed in Danish waters, all of which are of importance for impact assessments. These species are the harbour porpoise, white-beaked dolphin, minke whale, harbour seal and grey seal (Waggitt et al, 2019). Harbour porpoises are considered a species with special conservation interest.

Genesis (2022) applied thresholds from Tougaard (2021), who applied the cumulative SEL (sound exposure level) thresholds of Southall et al. (2019). These thresholds are established for impulsive and non-impulsive noise impacts. Reference criteria for PTS and TTS used for the modelling by Genesis (2022), based on Southall et al. (2019), are divided into four different groups (ie LF cetaceans = low frequency, HF cetaceans = high frequency, VHF cetaceans = very high frequency, Phocid pinnipeds), and which are described in Table 3.3.

**Table 3.3 Marine Mammal PTS and TTS Thresholds Adopted in this Assessment**

| Hearing Group | Relevant Species | Cumulative SEL Threshold (dB re 1 µPa$^2$s) | | | |
|---|---|---|---|---|---|
| | | Impulsive Noise | | Non-impulsive Noise | |
| | | PTS | TTS | PTS | TTS |
| LF cetaceans | Minke whale | 183 | 168 | 199 | 179 |
| HF cetaceans | White-beaked dolphin, Pilot whale | 185 | 170 | 198 | 178 |
| VHF cetaceans | Harbour porpoise | 155 | 140 | 173 | 153 |
| Phocid pinnipeds | Harbour seals, Grey seals | 185 | 170 | 201 | 181 |

Source: Genesis, 2022 based on Southall et al. (2019) and Tougaard (2021)

Modelling also includes marine mammal behavioural disturbance thresholds applied for drilling activities (ie, non-impulsive sounds) for the HDNTNEE project, as sound on lower levels than those required to induce PTS or TTS can still alter behaviours and thus create adverse impacts. Most immediate reactions are flight, leading to a variety of possible secondary effects (eg increased stress and reduced fitness leading to increased foraging activities due to displacement of preferred foraging grounds; exhaustion, mortality). Other possible effects are altered social behaviour or motion that could lead to reduced chances of reproductive success and long-term survival (Genesis, 2022). Applied thresholds for this screening are given in Table 3.4.

**Table 3.4 Marine Mammal Behavioural Disturbance Thresholds Adopted in this Assessment**

| Species | Sound Type | Behaviour Disturbance Threshold[1] |
|---|---|---|
| All Marine Mammals | Impulsive | 145 dB re 1 $\mu Pa^2s$ (single-pulse unweighted SEL) |
| | Non-Impulsive | 120 dB re 1 µPa (unweighted rms SPL) |

[1] Different behavioural disturbance thresholds are adopted in this assessment based on sound type (ie impulsive or non-impulsive noise). The impulsive threshold is adopted for assessing potential impact on marine mammals from the conductor-driving, whilst the non-impulsive threshold is adopted for assessing potential impact on marine mammals from drilling.

Source: Genesis, 2022

## *Fish*

Approximately 230 fish species have been recorded in the North Sea (Walday & Kroglund, 2020). Behavioural effects in fish have been observed from 182 – 207 dB re: 1 µPa (rms) and from 160 –186 dB re: 1 µPa (peak) (Pearson *et al*. 1992; McCauley *et al*. 2000; Wardle *et al*. 2001), which represent threshold levels unlikely to be exceeded by potential conductor driving activities.

Popper et al. (2014) have defined criteria for injury to fish based on a review of publications related to impacts to fish, fish eggs, and larvae from various high-energy sources. Popper et al. (2014) is the most comprehensive review available for potential impacts to fish species. The hearing capability of fish largely depends on the presence or absence of a swim bladder. Different injury thresholds are derived by Popper et al. (2014) for:

- Fishes with no swim bladder or other gas chamber;
- Fishes with swim bladders in which hearing involves a swim bladder or other gas volume;
- Fishes with swim bladders in which hearing does not involve the swim bladder or other gas volume; and
- Fish eggs and larvae.

The thresholds for mortality and potential mortal injury proposed by Popper *et al*. (2014) are shown in Table 3.5. The thresholds shown in Table 3.5 are suggested for assessing potential impacts to fish species from seismic surveys and piling.

All fish species are expected to demonstrate moderate behavioural reactions at intermediate distances (within hundreds of meters from the source), and low reactions further away. Applied thresholds for physical injuries are given in Table 3.5.

**Table 3.5 Thresholds for Potential Injury to Fish**

| Fish Group | Injury Thresholds | |
|---|---|---|
| | Zero-to-peak SPL (dB re 1 µPa) | Cumulative SEL (dB re 1 $\mu Pa^2s$) |
| Fishes with no swim bladder | 213 | 219 |
| Fishes with a swim bladder involved in hearing | 207 | 207 |
| Fishes with a swim bladder not involved in hearing | 207 | 210 |
| Eggs and larvae | 207 | 210 |

Source: Genesis, 2022

Documented behavioural effects of sound on fish behaviour are variable, ranging from no discernible effect (Wardle *et al.,* 2001) to startle reactions followed by immediate resumption of normal behaviour

(Wardle *et al*., 2001; Hassel *et al*., 2004). Avoidance of airgun array sound has also been observed (Hassel *et al*., 2004). However, there are no well-established thresholds for assessing behavioural disturbance to fish. It was concluded by Popper *et al*. (2014) that there lacked sufficient evidence to recommend specific thresholds that correspond to behavioural disturbance for fish.

### *3.3.1.2 Underwater Noise due to Conductor Driving*

Noise disturbances during conductor pipe driving activities may reach significantly high levels as the conductor driving hammer energy is expected to be 90 kJ with a maximum strike rate of approximately 40 strikes per minute. The $SPL_{(peak)}$ level from conductor driving is estimated to be 219 dB re µPa at 1 m from the source[2]. A period of 8 – 10 hours is typical for the hammering of one conductor. Four conductors will be driven to depths of 350 ft below sea level, in four periods spread over 1.5 years (refer to Figure 2.9).

### *Control Measures for Noise Impacts due to Conductor Driving*

The following control measures (JNCC, 2017; DEA, 2013) for conductor driving activities at HDNTNEE are implemented as Best Environmental Practice (BEP) by TEPDK and are a DEA requirement:

- The hammer size will be reduced to as low as technically possible to complete the conductor-driving;
- A soft-start/ramp-up of hammer energy will be employed when the hammer commences at a low energy at the start of conductor-driving and will be gradually increased throughout the conductor-driving duration. The soft-start/ramp-up will be conducted for at least 60 minutes;
- A qualified, trained and equipped marine mammal observer (MMO) will be present and dedicated to the observation of marine mammals;
- The MMO will carry out a survey of a 500 m safety zone prior to commencing the conductor driving and, if an animal is detected, the conductor driving will be delayed until all marine mammals vacate the 500 m safety zone; and
- When conditions preclude visual surveys (at night or at low visibility), passive acoustic monitoring (PAM) will be operated to detect marine mammal presence.

### *Marine Mammals*

Genesis (2022) underwater noise modelling undertaken for conductor driving operations for the HDNTNEE project predicts distances for TTS and PTS for marine mammals. PTS is possible for phocid pinnipeds within 1,500 m, and for VHF cetaceans within 3,600 m, if animals remain stationary within these spatial constraints. Thresholds for LF cetaceans are estimated at 7,100 m, while 100 m was established for HF cetaceans. TTS thresholds are generally longer and range between 17.3 km for LF cetaceans and 1.2 km for HF cetaceans (Table 3.6).

2 Conference presentation of measured results from piling from Subacoustech at Offshore Wind Programme Board – Barriers to Deployment. Underwater Noise Workstream: Understanding the NOAA Guidance and the implications for UXO detonations and pile driving in the UK: October 2018.

**Table 3.6 Predicted Distance from the Conductor Driving Location where the Adopted Unweighted Cumulative SEL Thresholds are Exceeded for Stationary Marine Mammals.**

| Hearing Group | Relevant Species | Cumulative SEL Threshold (dB re 1 µPa$^2$s) | | Distance to Threshold Exceedance (km)[1] | |
|---|---|---|---|---|---|
| | | PTS | TTS | PTS | TTS |
| LF cetaceans | Minke whale | 183 | 168 | 7.1 | 17.3 |
| HF cetaceans | White-beaked dolphin, Pilot whale | 185 | 170 | 0.1 | 1.2 |
| VHF cetaceans | Harbour porpoise | 155 | 140 | 3.6 | 10.4 |
| Phocid pinnipeds | Harbour seals, Grey seals | 185 | 170 | 1.5 | 7.7 |

[1] Predicted distances have been rounded up to the nearest 0.1 km.

Source: Genesis, 2022

Genesis (2022) notes that there is uncertainty involved with larger distances and longer exposure times for marine mammals, as TTS and PTS thresholds are usually derived from limited exposure times near to the noise source. There is no clear scientific consensus on whether the same principles can be applied to individuals being exposed to sound at longer distances.

As marine mammals are likely to swim away from conductor driving, the cumulative SEL received would be much lower. The modelling included predictions for received cumulative SEL at different swim speeds away from the underwater noise source. The modelling predicts that the PTS thresholds will not be exceeded for any marine mammals that are more than 10 m from the conductor driving location at the start of installation, provided they swim away from the conductor driving location.

Genesis (2022) assumes soft-start procedures for hammering based on the above stated JNCC (2017), amongst other control measures. When this is applied, initial impulses create much lower SELs compared to impulses in later stages of conductor driving. Soft-start procedures, a 500 m safety zone and MMOs reduce the risk of inducing TTS or PTS in marine mammals to low.

The threshold (ie 145 dB for a single, unweighted SEL) for behavioural disturbances, such as temporary displacement, may be exceeded within 5.1 km from the underwater noise source (Table 3.7). Given the planned soft-start / ramp-up of approximately 60 minutes, any potentially nearby slower-swimming marine mammals would swim away from the conductor piling and reach the 5.1 km temporary displacement threshold distance where underwater noise impacts are negligible.

**Table 3.7 Predicted Distance and Area where the Adopted Unweighted SEL Threshold for Disturbance to Marine Mammals is Exceeded During the Conductor Driving.**

| Species | Behavioural Disturbance Threshold | Hammer Energy (kJ) | Distance to Threshold (km) | Area of Threshold Exceedance (km$^2$) |
|---|---|---|---|---|
| All marine mammals | 145 dB re 1 µPa$^2$s (single-pulse unweighted SEL) | 90 | 5.1 | 82 |

Source: Genesis, 2022

Surveys conducted during pile-driving operations at the Alpha Ventus Offshore Windfarm with a 500 kJ hammer showed displacement of harbour porpoises at approximately 10 km from the

underwater noise source (Dähne et al., 2013). The HDNTNEE project will use a smaller hammer with an energy of 90 kJ, therefore the distances of displacement will likely be significantly less. Field observations by Dähne et al. (2013) are consistent with the 5.1 km value generated by Genesis (2022).

Given that studies on pile-driving have indicated that noise-displaced marine mammals quickly return to the area once pile-driving has stopped (Brandt et al., 2016, Brandt et al., 2018) and that the proposed conductor pipe driving is expected to last one or two days (with 8-10 hours actual hammering), animals are likely to return to the area following the completion of operations and conductor driving will therefore have a temporary impact on marine mammals.

Thus, the magnitude of impact for marine mammals due to conductor driving during the HDNTNEE project is assessed as **Negligible** considering the embedded control measures. The sensitivity of receptors is considered **High**, which results in an overall impact assessment for conductor driving activities during the HDNTNEE project for marine mammals of **Negligible**.

### *Fish*

Genesis (2022) applied zero-to-peak SPL for underwater noise modelling of conductor driving. Maximum distances until thresholds are exceeded are 10 m for fish without a swim bladder at 213 dB SPL, and 20 m for fish with a swim bladder, eggs and larvae. (Table 3.8).

**Table 3.8 Predicted Distances from the Conductor Driving where Zero-to-peak SPL Thresholds for Injury to Fish are Exceeded (Popper et al. ,2014).**

| Fish Group | Zero-to-peak SPL Injury Threshold (dB re 1 µPa) | Maximum Distance to Threshold Exceedance (m)[1] |
|---|---|---|
| Fishes with no swim bladder | 213 | 10 |
| Fishes with a swim bladder involved in hearing | 207 | 20 |
| Fishes with a swim bladder not involved in hearing | 207 | 20 |
| Eggs and larvae | 207 | 20 |

[1] Predicted distances have been rounded up to the nearest 10 m.

Source: Genesis, 2022

Modelling solutions by Genesis (2022) indicate that zero-to-peak levels from conductor driving will likely not exceed thresholds for fish set by Popper et al. (2014), as soft-start procedures are assumed to drive fish away from the underwater noise source. Eggs and larvae, when present within a 20 m radius around the conductor driving site, might be susceptible to injury as they are immobile.

As cumulative SEL thresholds for fish are not exceeded during conductor driving operations at HDNTNEE and predicted distances from the noise source at which thresholds for fish are attributed with the potential for negative impact are small, the magnitude of impact is considered **Negligible**. The sensitivity of the receptors is assessed as **Low**, as fish are relatively insensitive to noise and can flee the immediate area of impact. Overall, the significance of impacts on fish due to conductor driving is evaluated as **Negligible**.

## *3.3.1.3 Underwater Noise due to Drilling*

Drilling introduces underwater noise with relatively low energy and thus limited spatial sound propagation (ie high levels only very close to the source) into the water column. While the impact to the surrounding environment is relatively contained, drilling operations occur over long periods of time and often drilling is conducted for over 24 consecutive hours. Drilling the wells at HDA for Ekofisk is expected to last 80 days per well, while drilling at HBA for Tor NE is estimated to be completed after

67 days per well. For each well at both HDA and HBA the total drilling days includes 15 days that will be non-drilling but running completion.

### *Control Measures for Noise Impacts due to Drilling*

Noise levels during drilling activities are generally much lower than those generated through conductor driving. Modelling (Genesis, 2022) results indicate that the risk of PTS for marine mammals is low, as is the risk of physical damage to fish for the HDNTNEE project. Therefore, no further control measures are necessary.

### *Marine Mammals*

Modelling by Genesis (2022) did show that PTS thresholds would only be reached if harbour porpoises (ie VHF cetaceans) were exposed to drilling noise longer than 24 hours and remain near (ie <10 m) the underwater noise source for the entire 24 hours. For all other groups (ie LF cetaceans, HF cetaceans and Phoci pinnipeds), PTS thresholds were not exceeded in the modelling, therefore marine mammals in these hearing groups will not be affected by project activities

For TTS, the applicable threshold for VHF cetaceans is <110 m to the underwater noise source for a consecutive period of over 24 h, which is highly unlikely. For LF cetaceans, the predicted threshold for TTS is <40 m to the underwater noise source, while the relevant value for HF cetaceans and Phocid pinnipeds is <10 m. As mentioned earlier, to exceed thresholds would require all groups of marine mammal species subject to this assessment to remain stationary for 24 h inside the stated distances from the noise source. Such behaviour is highly unlikely. Predicted distances from the underwater noise source (ie drilling location) for each group are given in Table 3.9.

**Table 3.9 Predicted Distances from the Drilling Location where the Adopted Cumulative SEL Thresholds for Non-impulsive Noise are Exceeded for Stationary Marine Mammals.**

| Hearing Group | Relevant Species | Cumulative SEL Threshold (dB re 1 µPa$^2$s) | | Distance to Threshold Exceedance (m)[1] | |
|---|---|---|---|---|---|
| | | PTS | TTS | PTS | TTS |
| LF cetaceans | Minke whale | 199 | 179 | Not exceeded | 40 |
| HF cetaceans | White-beaked dolphin, Pilot whale | 198 | 178 | Not exceeded | 10 |
| VHF cetaceans | Harbour porpoise | 173 | 153 | 10 | 110 |
| Phocid pinnipeds | Harbour seals, Grey seals | 201 | 181 | Not exceeded | 10 |

[1] Predicted distances have been rounded up to the nearest 10 m.

Source: Genesis, 2022

The modelling solutions indicate that marine mammals present near the HDNTNEE project are unlikely to receive SELs high enough to cause significant negative impacts. This is because it is reasonably assumed that marine mammals will move away from the underwater noise source when exposed to drilling sounds in the HDNTNEE project area, and this is considered the primary behavioural response.

With respect to behavioural responses, modelling suggests that noise generated with the HDNTNEE project would only be able to induce impacts if mammals remained within 650 m of the underwater noise source for an extended period of time (Table 3.10). Even though drilling times are estimated to last (up to 120 days, impacts are confined to a small area. It is reasonable to expect mammals to

immediately move away from the noise source when exposed to drilling noise and to only be temporarily displaced from the project area.

**Table 3.10 Predicted Distance and Area where the Adopted Unweighted Rms SPL Threshold for Disturbance to Marine Mammals is Exceeded During Drilling.**

| Species | Behavioural Disturbance Threshold | Distance to Threshold (m)[1] | Area of Threshold Exceedance ($km^2$)[2] |
|---|---|---|---|
| All Marine Mammals | 120 dB re 1 µPa (unweighted rms SPL) | 650 | 1.5 |

[1] Predicted distance has been rounded up to the nearest 10 m.
[2] Predicted area has been rounded up to the nearest 0.1 $km^2$.

Source: Genesis, 2022

Due to the limited spatial scope of exposure and the low risk of marine mammals to remain near the two HDNTNEE drilling sites, the magnitude of impact of underwater drilling noise for marine mammals is evaluated as **Negligible,** while the sensitivity of the receptors (harbour porpoises, seals and other marine mammals) is considered **Medium.** Therefore, the significance of impacts due to drilling noise for marine mammals is assessed as **Negligible.**

### *Fish*

Modelling by Genesis (2022) has tested if drilling sounds are likely to exceed thresholds set by Popper et al. (2014) for fish, with the potential to physically harm individuals. It was estimated that thresholds will not be exceeded, thus injury to any fish species (including larvae and eggs) is considered unlikely.

Therefore, the magnitude of impact of drilling operations at HDNTNEE with respect to fish are considered **Negligible**, while the sensitivity of the receptor is classified as **Low**. The overall impact is therefore evaluated as **Negligible**.

## *3.3.2 Emissions to Air*

Project vessels and the jack-up rig may emit various gases to the atmosphere, particularly from the combustion of diesel fuel. TEPDK predicted the emissions for drilling per well (Table 3.11) and compared the emissions with those for the HDNTNEE project (Table 3.12). The GHG emission intensity will be reduced due to removal of a water injector and replacement of high water cut wells with low water cut wells.

**Table 3.11 Estimated Emissions for Drilling.**

| Activity (frequency) | Duration | Emissions (tonnes) | | | | | |
|---|---|---|---|---|---|---|---|
| | | $CO_2$ | $NO_X$ | $N_2O$ | $SO_X$ | $CH_4$ | NmVOC |
| Drilling | | | | | | | |
| Drilling (4 wells in free slots, 20 new wells, 6 redrill) | Per well (120 days) | 8,450 | 150 | 0.6 | 6 | 0.6 | 7 |

*Note: The maximum emissions from the Halfdan project ESIS (Rambøll, 2016) have been used. Rambøll calculated estimates based on input from Maersk Oil.*

Source: Halfdan project ESIS (Rambøll, 2016).

GHG emission calculations for the HDNTNEE project drilling activities and production (ie removal of a water injection well and replacement of less efficient wells) can be seen in Table 3.12.

**Table 3.12 Greenhouse Gas Emissions from HDNTNEE Project.**

| Activity | GHG emissions (kT $CO_2$ e) |
|---|---|
| Drilling | 21.70 |
| Production | 3.74 |
| Total | 25.44 |

*Note: Kilotonnes (kT).*

Source: TEPDK, 2022

Emissions for the in-fill of four wells on HDNTNEE will be around 25,440 MT $CO_2$ equivalent, which is considerably less than the total emissions for the HALFDAN Field. Total Danish $CO_2$ emissions in 2018 accounted for 33.13 million tonnes, representing 0.09% of the world total (Crippa et al., 2019). The emissions from the HDNTNEE project represent a total of 0.08% of Denmark's annual emissions.

Although all GHG emissions will contribute to climate change, considering the low percentage contribution of the project's GHGs emissions to the total Danish emissions, the impact magnitude is assessed as **Negligible**.

The sensitivity of receptors has been assessed as High given that the Danish Government has recently defined ambitious greenhouse gas reduction targets and there is a global pressure to reduce greenhouse gases emissions to the atmosphere. The significance of impacts on climate change is assessed as **Negligible**.

### *3.3.3 Impacts from Chemical Use and Discharge*

Amounts and types of chemical use and their discharge to sea are only permitted after authorization from the Danish Environment Protection Agency. The specific name, amount and color classification of chemicals is informed in the application for their use and discharge, which also includes a review of the impact assessment for the amount sought. Chemical classification and the implementation of OSPAR is described in Appendix C.

#### *3.3.3.1 Chemical Use and Discharges for Drilling Activities*

#### *Discharges Associated with Slot Recovery*

If no casing milling is required, it is anticipated that the tubing retrieval and cementing operations will be carried out using seawater as the fluid medium in the well.

If section milling is to be carried out, an inhibited WBM may be used. The milled solids (swarf) are removed from the WBM and the WBMs recycled. A swarf unit will be present on the surface to handle any metal returns from milling operations and the waste metal will be brought to shore for processing. All WBMs and swarf will be retained and returned to shore for processing and disposal, ie, WBMs and swarf will not be discharged under normal operations.

The estimation of cement volumes required for slot recoveries is 180 MT including contingencies. Any cement which is already mixed, including dead volumes and hose volumes will be discharged overboard. This discharge volume estimation is 20 MT.

#### *Discharges Associated to Drilling Fluid and Cuttings*

Wells at Halfdan will be drilled (Section 2.5.3) with WBMs (Table 3.13). The mud and cuttings mixture will be discharged to the sea if the oil on cuttings level is <1%. The total quantity of drilling muds to be

discharged is expected to be 28,200 $m^3$ for all the four wells. The estimated total volume of drill cuttings discharged for all the four wells for HDNTNEE is 2,060 $m^3$. The drilling fluids will contain yellow and green chemicals that are covered under TEPDK's 2022 discharge permit (DEPA, 2021).

The supplier for drilling fluids will be determined closer to operations, therefore the product name may change, but the description and use are expected to remain the same. The anticipated discharge quantities are within the total discharge quantities permitted for the HALFDAN Field stated in the 2022 discharge permit except for a few updated chemicals for which TEPDK will apply for a discharge permit accordingly.

The fluid is circulated down the well through the drill string and back to the surface carrying the cuttings. At the surface, the cuttings will be separated from the fluid via a multistep system with shakers, traps and potentially centrifuges. The cuttings discharged into the sea will be water wet with drilling fluid, ie the cutting surface will still be covered with a thin layer of fluid.

## Table 3.13 Drilling Fluids and Estimated Use and Discharge per Well

| Section | Colour Code | Product | Description | Estimated use per well | Estimated discharge per well | Total Estimated Use (4 wells) | Total Estimated discharge (4 wells) | Permitted Use | Permitted Discharge | Unit | Permitted Discharge of Corresponding Chemical (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Prehydrated Bentonite/Seawater lime | Green | BARITE | Weighting additive | 225.0 | 255.0 | 900.0 | 1020.0 | 3333.30 | 3000.00 | MT | 34.0 |
| | Green | BENTONITE | Viscosifier | 80.0 | 72.0 | 320.0 | 288.0 | 66.70 | 60.00 | MT | 480.0 |
| | Yellow | DEFOAM PLUS NS | Defoamer | 0.2 | 0.2 | 0.8 | 0.8 | 12.80 | 6.40 | $m^3$ | 12.5 |
| | Green | LIME | pH modifier | 25.0 | 25.0 | 100.0 | 100.0 | 200.00 | 180.00 | MT | 55.6 |
| | Green | SODA ASH | pH modifier | 1.0 | 1.0 | 4.0 | 4.0 | 33.57 | 33.57 | MT | 11.9 |
| | Green | XANTHAN GUM | Viscosifier | 0.2 | 0.2 | 0.8 | 0.8 | 49.85 | 39.88 | MT | 2.0 |
| | Yellow | MB-5111 | Biocide | 0.5 | 0.5 | 2.0 | 2.0 | 9.02 | 9.02 | $m^3$ | 22.2 |
| WBM: EMS-3100/HYDRAGLYDE OPTIMA | Green | NaCl Brine 10.0 ppg | Weighting additive | 768.0 | 690.0 | 3072.0 | 2760.0 | 4800.00 | 2400.00 | $m^3$ | 115.0 |
| | Yellow | KLA-HIB NS | Shale control agent | 3.2 | 2.9 | 12.8 | 11.6 | 219.34 | 219.34 | $m^3$ | 5.3 |
| | Green | M-I PAC ELV | Viscosifier | 3.0 | 2.0 | 12.0 | 8.0 | 100.00 | 93.30 | MT | 8.6 |
| | Green | DUO-TEC NS | Viscosifier | 1.0 | 1.0 | 4.0 | 4.0 | 66.70 | 53.30 | MT | 7.5 |
| | Yellow | ACRETE-BLOK | Anti accretion | 12.0 | 10.0 | 48.0 | 40.0 | 183.30 | 183.30 | $m^3$ | 21.8 |
| | Green | SODA ASH | pH modifier | 1.0 | 1.0 | 4.0 | 4.0 | 33.57 | 33.57 | MT | 11.9 |

| Section | Colour Code | Product | Description | Estimated use per well | Estimated discharge per well | Total Estimated Use (4 wells) | Total Estimated discharge (4 wells) | Permitted Use | Permitted Discharge | Unit | Permitted Discharge of Corresponding Chemical (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yellow | DEFOAM PLUS NS | Defoamer | 0.2 | 0.2 | 0.8 | 0.8 | 12.80 | 6.40 | $m^3$ | 12.5 |
| | Green | CITRIC ACID | pH modifier | 5.0 | 4.0 | 20.0 | 16.0 | 66.67 | 13.33 | MT | 120.0 |
| | Green | SODIUM BICARBONATE | Drilling fluid additive | 5.0 | 4.0 | 20.0 | 16.0 | 100.00 | 66.70 | MT | 24.0 |
| | Yellow | MB-5111 | Biocide | 0.5 | 0.5 | 2.0 | 2.0 | 9.02 | 9.02 | $m^3$ | 22.2 |
| | Green | G-SEAL (70ppb) | Plugging agent | 0.3 | 0.3 | 1.2 | 1.2 | 33.30 | 30.00 | MT | 4.0 |
| | Green | CaCO3 M (15ppb) | Weighting additive | 1.0 | 1.0 | 4.0 | 4.0 | 200.00 | 66.70 | MT | 6.0 |
| | Green | SAFE-CARB | Weighting additive | 5.0 | 5.0 | 20.0 | 20.0 | 200.00 | 166.70 | MT | 12.0 |
| | Green | NUTSHELL F (20ppb) | Lost circulation material | 1.0 | 1.0 | 4.0 | 4.0 | 10.70 | 10.70 | MT | 37.4 |
| Water Based WARP | Green | DUO-VIS PLUS NS | Viscosifier | 1.1 | 1.0 | 4.2 | 3.8 | 13.30 | 10.00 | MT | 38.0 |
| | Green | LO-FLOSS | Fluid loss control | 25.0 | 25.0 | 100.0 | 100.0 | 66.70 | 53.30 | MT | 187.6 |
| | Yellow | SAFE-COR EN | Corrosion inhibitor | 6.0 | 6.0 | 24.0 | 24.0 | 149.88 | 135.88 | $m^3$ | 17.7 |
| | Green | NaCl Brine 10.0 ppg | Weighting additive | 632.0 | 615.0 | 2528.0 | 2460.0 | 4800.00 | 2400.00 | $m^3$ | 102.5 |

| Section | Colour Code | Product | Description | Estimated use per well | Estimated discharge per well | Total Estimated Use (4 wells) | Total Estimated discharge (4 wells) | Permitted Use | Permitted Discharge | Unit | Permitted Discharge of Corresponding Chemical (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yellow | WARP WB CONC | Weighting additive | 608.0 | 602.0 | 2432.0 | 2408.0 | 2300.00 | 1840.00 | $m^3$ | 130.9 |
| | Yellow | ACRETE-BLOK (3% for drill-out) | Anti-accretion | 9.0 | 8.0 | 36.0 | 32.0 | 183.30 | 183.30 | $m^3$ | 17.5 |
| | Yellow | KLA-HIB NS (3% for drill-out) | Shale control agent | 8.0 | 7.0 | 32.0 | 28.0 | 219.34 | 219.34 | $m^3$ | 12.8 |
| | Yellow | STARGLIDE (2% to all volume) | Lubricant | 36.0 | 36.0 | 144.0 | 144.0 | 190.00 | 126.67 | $m^3$ | 113.7 |
| | Yellow | DEFOAM PLUS NS | Defoamer | 2.0 | 2.0 | 8.0 | 8.0 | 12.80 | 6.40 | $m^3$ | 125.0 |
| | Green | CITRIC ACID | pH modifier | 3.0 | 3.0 | 12.0 | 12.0 | 66.67 | 13.33 | MT | 90.0 |
| | Green | SODIUM BICARBONATE | Drilling fluid additive | 2.0 | 2.0 | 8.0 | 8.0 | 100.00 | 66.70 | MT | 12.0 |
| | Green | XANTHAN GUM | Viscosifier | 3.0 | 3.0 | 12.0 | 12.0 | 49.85 | 39.88 | MT | 30.1 |

*Note: Permitted use and discharge refers to the 2022 Permit.*

Source: TEPDK, 2022

## *Discharges Associated with Cement*

The cement volume required for drilling operations is approximately 1,980 MT, including contingency, to cater for circulating out an entire slurry volume in the case of a major issue. Before cementing activities occur, the cement volume likely to be required for each unique well is calculated based on the well dimensions. Slight variations in down-hole or casing diameters can however have implications for the calculated volumes due to well length dimension. The specific cement volume is then mixed from raw ingredients on the rig, all of which would be on the approved list of chemicals for TEPDK´s drilling and wells activities (DEPA, 2021), in line with the OSPAR convention. Unmixed raw ingredients, not used during the well activities, are retained on the rig and are returned to shore; they are not dumped overboard. Dumping is not in line with TEPDK and TotalEnergies internal procedures and policies.

The supplier for cement products will be determined closer to operations, therefore, the product name may change, but the description and use are expected to remain the same (Table 3.14). The anticipated discharge quantities are within the total discharge quantities permitted for the HALFDAN Field stated in TEPDK's 2022 discharge permit except for a few updated chemicals, for which TEPDK will apply for a discharge permit accordingly.

TEPDK clarifies that 100 MT is the expected amount to cater for circulating out an entire slurry volume in the case of a major issue and therefore the potential discharge of this amount is not expected under normal circumstances. Based on TEPDK's experience in the area, the typical scenario entails the discharge of approximately 22-23 MT cement for an entire well (TEPDK, 2023). The surface discharge of cement (mixed with water) for each well is therefore very small. To understand the potential impacts from this discharge better, TEPDK commissioned a recent modelling exercise in collaboration with the NORCE Norwegian Research Centre for another TEPDK project; the Dagmar Well Suspension (located 26 km north-west from HBA). The draft NORCE report (July 2022) presented the outcomes of the modelling for approximately 15 MT discharge of inhibited water, containing chemicals, barite and Class G cement. Environmental Impact Factor (EIF) calculations were performed using DREAM (Dose related Risk and Effect Assessment Model) to simulate a discharge of chemicals and particulates at Dagmar. The model calculates the fate of different concentrations of the components of a discharge and calculate the environmental risk using the Predicted Environmental Concentration (PEC) as modelled in DREAM and comparing it to the Predicted No Effect Concentration (PNEC). Theoretically, the calculated EIF (PEC/PNEC) is a reflection of the volume of seawater/area of sediment in which PEC exceeds PNEC, and therefore the volume where harmful effects could occur as a result of the discharge to sea. The EIF is a measure of the potential environmental risk intended as the potential damage on marine organisms from a discharge to sea.

### Impact to Sediments

Based on the results of the model, it can be assumed that the used cement discharge for the four wells planned for the HDNTNEE have no risk to the sediment (EIF = 0). Results from the simulation showed an area of influence of approximately 2-3 km just north of the discharge point showing a change in grain size, sediment thickness and change in oxygen in the sediment. The model shows sediment deposition is below 0.1 kg/m$^2$ up to 2.5 km from the discharge point and decreases to very low values (<0.01 kg/m$^2$) beyond 2.5 km from the discharge point.

### Impacts to the Water Column

Based on the results of the model, it can be assumed that the used cement discharge for the four wells planned for the HDNTNEE could have the highest risk in the water column 16-20 hours after the discharge. From the PEC calculation, the risk in the water column shows a temporary impact of up to 5-6 km in the direction of the main current (NW to NE as commonly observed in the TEPDK licence

areas). Based on the DREAM model, the risk remains in the water column from the suspended particulates and the chemicals 24-36 hours after the discharge.

### Impact Assessment

Accounting for the predicted small extent of impacts due to the planned discharge activities and that the area that has been exposed to other drilling operations in the past and the relatively short timeframe of activities, the magnitude of impact is considered **Small**.

The predominant sediment type at the HDNTNEE project area is mud / sandy mud. The area has been subject to drilling activities in the past, thus deposition of WBM from new campaigns impacts an already altered habitat. Newly deposited WBM are unlikely to alter the present sediment composition. Therefore, the sensitivity is classified as **Low**.

Therefore, the impact to the seawater quality, seabed sediment and associated benthic communities due to the used cement discharge is evaluated to be of **Negligible Significance**.

### Possible Flow of Cement on the Seabed

As presented in Section 2.5.3.4 (Cementing), during drilling operations, cement is required to secure the casing in the wellbore and to provide a barrier, preventing upward migration of hydrocarbons between the well casing and the wellbore. During cementing operations, required volumes of cement are pumped into the space between borehole and casing to stabilize the borehole and provide structural support to well integrity. As the surface casing will be cemented inside the conductor, which extends to surface, the cement returns will be taken to the rig and not discharged to the seabed (TEPDK, 2023). Therefore, no impacts to the seabed integrity and to seawater quality are expected during cementing operations for the conductor.

## Table 3.14 Cement Products and Quantities to be used for the HDNTNEE Project

| Colour Code | Product | Description | Estimated use per well | Estimated discharge per well | Total Estimated Use (4 wells) | Total Estimated discharge (4 wells) | Permitted Use | Permitted Discharges | Unit | Permitted Discharge of Corresponding Chemical (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Green | Class G Cement | Cement | 269 | 21.5 | 1076.00 | 86.00 | 666.70 | 533.30 | MT | 16.13 |
| Green | ExpandaCem | Cement Additive | 61 | 4.9 | 244.00 | 19.60 | 466.70 | 200.00 | MT | 9.80 |
| Green | Calcium Chloride | Brine | 0.4 | 0.1 | 1.60 | 0.40 | 200.00 | 66.70 | $m^3$ | 0.60 |
| Green | HR-4L | Cement Additive | 4.2 | 0.3 | 16.80 | 1.20 | 28.10 | 5.60 | $m^3$ | 21.43 |
| Yellow | SCR-100 Liquid | Cement Retarder | 1.1 | 0.1 | 4.40 | 0.40 | 7.17 | 1.43 | $m^3$ | 27.97 |
| Yellow | CFR-8L | Cement dispersant | 2.8 | 0.2 | 11.20 | 0.80 | 7.98 | 1.60 | $m^3$ | 50.00 |
| Yellow | Halad-400L | Fluid Loss additive | 6.4 | 0.5 | 25.60 | 2.00 | 26.59 | 3.32 | $m^3$ | 60.24 |
| Green | Gascon III | Light weight cement additive | 10.8 | 0.9 | 43.20 | 3.60 | 18.25 | 2.92 | $m^3$ | 123.29 |
| Green | Econolite Liquid | Resin | 5.0 | 0.4 | 20.00 | 1.60 | 32.60 | 5.60 | $m^3$ | 28.57 |
| Green | Tuned Spacer E+ | Cement Additive | 2.1 | 1.1 | 8.40 | 4.40 | 20.00 | 20.00 | MT | 22.00 |
| Yellow | NF-6 | Defoamer | 0.7 | 0.1 | 2.80 | 0.40 | 3.31 | 3.31 | $m^3$ | 12.08 |
| Yellow | BridgeMaker™ | LCM Product | 1.5 | 0.1 | 6.00 | 0.40 | 2.67 | 1.33 | MT | 30.08 |

*Note: Permitted use and discharge refers to the 2022 Permit.*

Source: TEPDK, 2022

### 3.3.3.2 Chemical Use and Discharges for Production Activities

#### Produced Water Volumes

The expected cumulative production forecast for produced water is an additional 20.90 million barrels (MMbbls) at the Tor NE wells due to 21.51 MMbbls produced from new wells and a reduction of 0.57 MMbbls because of the shut-in of two existing water producers where slots will be reused. At the Ekofisk wells, there will be a reduction of 9 MMbbls of PW. 5.87 MMbbls will be produced by the new wells and the shut-in of one water producer well will reduce the PW by 14.9 MMbbls (replacing the high water cut well with a low water cut well) (Table 3.15). An additional water injector is not considered at this time; therefore, any additional produced water will be discharged to the sea after treatment.

**Table 3.15 Cumulative Production Forecast for Oil, Gas and Produced Water for the New Wells**

| Location | Oil (MMbbls) | Gas (BScf) | Water (MMbbls) |
|---|---|---|---|
| Tor Northeast | + 4.9 | + 15.2 | + 20.9 |
| Ekofisk | + 5.8 | + 26.1 | - 9.0 |

Source: TEPDK, 2022

#### Produced Water Discharge

Chemical types and amounts used and discharged to sea during production are permitted by the Danish Environment Protection Agency (DEPA; Miljøstyrelsen) in accordance with OSPAR (2002-6). TEPDK reports chemical use and discharge to DEPA annually.

TEPDK uses typical production chemicals to optimize the processes of fluid production, separation and transport. Chemicals discharged through the Halfdan produced water system may include antifoam, demulsifiers, scale inhibitors, corrosion control chemicals, water clarifiers, methanol and biocide new chemicals are unlikely to be used once the HDNTNEE project is complete.

A hydrodynamic dispersion model of produced water for the HALFDAN Field suggests that produced water discharges are diluted relatively rapidly (IRIS, 2014). However, the IRIS (2014) modelling also states there is a risk of affecting the water quality from the current discharges of produced water at Halfdan for up to 15 km. These calculations are highly conservative and monitoring data in other areas of the North Sea have demonstrated that the environmental impacts of produced water discharges are local, with an impact to the water column up to approximately 1-2 km from the outlet, and that environmental impacts associated with produced water discharges are low.

#### Environmental Impact Factor of Produced Water

Produced water discharge can be quantified using the Environmental Impact Factor (EIF). The EIF corresponds to the volume of seawater where Predicted Environmental Concentration (PEC)/Predicted No-effect Concentration (PNEC) 1<1 was estimated (IRIS, 2013; Table 3.16). Further modelling carried out in 2018 showed a reduction in the produced water risk after several chemical substitutions and improvement in data quality for PEC and PNEC (NORCE, 2019). The model generally predicted a rapid dispersion of the produced water with a maximum distance of 14 km to reach PEC/PNEC 2<1 from the discharge.

The HDNTNEE project is expected to increase produced water by approximately 261 $m^3$ per day, out of 19,651 $m^3$ per day for HDA and HBD (HALFDAN Field) combined, hence representing a 1.31% increase in produced water. Therefore, HDNTNEE will not significantly increase produced water discharges.

## *Chemical Use*

DEPA permits the amounts and types of chemical use and discharge to the sea. The specific name, amount and colour classification of chemicals is informed in the application for their use and discharge, which also includes a review of the impact assessment for the amount sought.

TEPDK uses typical production chemicals to optimize the processes of fluid production, separation and transport. Chemicals discharged through the produced water system at Halfdan facilities include antifoam, demulsifiers, scale inhibitors, corrosion control chemicals, water clarifiers, methanol and biocide.

The 2021 discharge before the planned activities is shown in Table 3.16. TEPDK is frequently reviewing the possibility to substitute with alternative yellow or green chemicals. Red classified chemicals are also integrated in the EIF calculation and generally contribute less than 3% to the overall EIF (RBA, 2018).

**Table 3.16 Chemical Discharge at HALFDAN**

| Discharge Type | Discharge as tonnes per year | |
|---|---|---|
| | 2021 (Actual)* | 2021 (Max** Discharge permit) |
| **Green** (eg Acid, Hydrate Inhibitor) (Tonnes) | 1.28 | 267.9 |
| **Yellow** (eg Acid, Corrosion Inhibitor, Demulsifier, $H_2S$ Scavenger, Scale Inhibitor, Water Clarifier) (Tonnes) | 1,747 | 2,348.8 |
| Produced water (barrels per day) | 157,346 | 188,400 |

** As reported to DEPA in TEPDK's annual reporting.*

*** According to Discharge Permit J.nr 2020-61820 from DEPA.*

Source: TEPDK, 2021

Table 3.16 shows many chemicals have a yellow colour designation. This is precautionary as, in some cases, the actual chemical to be used, the manufacturer and exact chemical composition is not yet known. During production, manufacturers may change the chemical composition of their products. TEPDK will choose the exact chemical depending on its use purpose. Yellow chemicals may also represent substances that have not yet been approved or allowed into PLONOR (Pose Little or No Risk) since they have not been assessed.

## *Oil in Produced Water*

DEPA permits the volume of oil in produced water that is discharged to the to sea. TEPDK monitors oil discharges daily and reports to DEPA each month.

The four new wells proposed as part of the HDNTNEE project are anticipated to increase the total produced water production by approximately 0.6 MMbbls (or 95,392 $m^3$) per year, which would increase the amount of oil in water. The total volume of produced water at the HALFDAN facilities from 2019, 2020 and 2021 was 21,119,774 $m^3$ and averaged 7,039,925 $m^3$ each year. The anticipated increase of PW through HDNTNEE (ie. 1.36%) is negligible compared to the permit (J.nr. 2020-61820), which grants over 8.2 million $m^3$ in PW for 2023 and 8.4 million $m^3$ in PW for 2024.

## *Produced Water Management*

The amount of chemicals used and discharged as part of HALFDAN Field activities will be continuously monitored and optimized through a Risk Based Approach (RBA) in accordance with OSPAR Recommendation 2012/5 for a Risk-Based Approach to the Management of Produced Water

Discharges from Offshore Installations and supporting guidelines 2012/7. This guidance has been transcribed by DEPA into the guideline: Proposed Paradigm for Reporting RBA Calculations, September 2018 that describes how the RBA should be applied.

There will be changes to discharges as part of the HDNTNEE project. Conservative estimates suggest that there could be a risk to some species from a plume up to a maximum of 15 km from the produced water discharges, based on hydrodynamic dispersion modelling of produced water for the HALFDAN Field (IRIS, 2014). However, IRIS (2014) monitoring data in other areas of the North Sea have demonstrated that the environmental impacts of produced water discharges are local, with an impact to the water column up to approximately 1-2 km from the outlet, and that environmental impacts associated with produced water discharges are low. The closest protected area to the main HDNTNEE project site is the Doggerbank (DE1003301) area, which is designated as a Site of Community Importance (SCI), and which is approximately 22 km west of the HDNTNEE project area.

Any potential impacts on marine mammals are thus confined to the local environment near the platforms and vessels. Considering the mobility of the five species of particular importance in the area (ie harbour porpoise, white-beaked dolphin, minke whale, harbour seal and grey seal) the risk to species in the area is moderate (Waggit et al*.,* 2020). There will be no additional risk of bioaccumulation to species in the area from the activities at HDNTNEE.

#### *3.3.3.3 Environmental Impact from Chemical Discharges*

Chemical discharges for HDNTNEE will come from drill cuttings, however they will only be discharged if the oil present on cuttings is <1%. Cement may also be discharged during non-normal drilling operations.

All component chemicals rated yellow and green (Table 3.16) are already approved under the 2022 discharge permit issued to TEPDK.

Dispersion modelling from drilling shows that the chemical discharges to the sea form plumes that dilute rapidly (NORCE, 2019). Bakke et al. (2013) states that offshore discharges of WBMs will have little or no harmful effect on water column organisms, based on the rapid dilution in the water column and low toxicity of WBM to marine organisms.

For HDNTNEE, 12,600 $m^3$ of pre-hydrated Bentonite/Seawater lime, 2,700 $m^3$ of WBM and 6,800 $m^3$ of a water-based WARP mud system will be used during drilling. Dissolved chemicals will disperse in a similar way to produced water and suspended sediments will settle faster due to their greater density. The discharged volumes during drilling activities (approximately 858 $m^3$ of inhibited seawater) are smaller than the produced water discharge volumes and dissolved production chemicals are a suitable analogue for any dissolved chemicals in inhibited seawater.

Considering the volumes discharged, the low dissipated concentrations and the use of only green and yellow classified substances, the magnitude is assessed as **Small**. The assessment considered a **Low** sensitivity for marine species and thus the impact to water quality as **Minor**.

It is unlikely, that any discharged chemical components during drilling and production activities have the potential to impact marine life adversely in the HALFDAN Field. Impacts on the Doggerbank (DE1003301), which is located approximately 22 km west of HDNTNEE, are separately assessed in Section 3.4.

### *3.3.4 Impacts from Jack-Up Rig Spud Cans*

#### *3.3.4.1 Impacts on the Seabed*

The HDNTNEE project foresees the recovering of the slots of four existing wells and drilling four new trajectories (from the recovered slots): two from HBA in the Tor Northeast (NE) reservoir and two from HDA in the Ekofisk reservoir.

Impacts related to the direct habitat loss and potential sediment resuspension due the positioning and the presence of the rig and its spud cans are described in the following Section 3.3.4.2.

Concerning the drilling operations and related discharges, as indicated in this Screening Report, wells at Halfdan will be drilled with WBMs. The mud and cuttings mixture will be discharged to the sea if the oil on cuttings level is <1%. The total quantity of drilling muds to be discharged is expected to be 28,200 $m^3$ for all the four wells. The estimated total volume of drill cuttings discharged for all the four wells for HDNTNEE is 2,060 $m^3$. The drilling fluids will contain yellow and green chemicals that are covered under TEPDK's 2022 discharge permit (DEPA, 2021).

Following the common drilling best practice in the region, the fluid is circulated down the well through the drill string and back to the surface carrying the cuttings. At the surface, the cuttings will be separated from the fluid via a multistep system with shakers, traps and potentially centrifuges. The cuttings discharged into the sea will be water wet with drilling fluid, i.e. the cuttings surface will still be covered with a thin layer of fluid. Any increased turbidity or smothering will be restricted to the discharge of drill cuttings and jack up rig activities, and therefore will be small scale and temporary. Drilling discharges may influence the benthic habitat and physical seabed properties. With mud and cuttings discharged at the sea surface, deposited materials will disperse as a particle plume that is expected to settle in the local environment. The specific extent always depends on operational parameters (e.g., discharge density, produced volumes, particle size) of the WBM discharged. Deposition thickness is much lower when discharges happen on the sea surface compared to discharges on the seabed.

Sediment particle concentration in the water column due to resuspension, residence time in the water column and fallout of resuspended sediment on the seabed the impacts can be assessed using TEPDK's experience from previous projects and modelling. For example, modelling of the discharge of drill cuttings carried out by TEPDK for the proposed equivalent Halfdan North (ERM, 2020) new platform and wells project established that the total suspended solids (TSS) concentrations added to the ocean were predicted to exceed the 35 mg/l threshold at the surface exclusively in an area immediately surrounding the discharge point (drilling rig). The model showed the TSS concentrations exceeding the 35 mg/l threshold at the surface in an area less than 0.063 $km^2$ (indicatively 140 m radius from the discharge point), with patches exceeding the threshold approximately 250 m in diameter travelling up to a kilometre from the platform during strong currents. This is consistent with the results from the 2020 environmental surveys (Section 3.8.1) that detected BA at 750-1500 m from HBA.

With reference to the potential presence of hydrocarbons, oil on cuttings from the reservoir may only appear once the bottom hole is reached; this is most likely to occur in the last few meters, since this oil reservoir is confined and under pressure. Drilling will stop once oil is reached, therefore very few meters of drill cuttings will have retained oil from the reservoir. Accounting for the small fraction of the cuttings potentially contaminated by reservoir fluid at the conclusion of a well's drilling, the impacts associated with these cuttings are assumed to be primarily from any adverse effects of smothering or suspended solids increase more so than hydrocarbon toxicity. During drilling, cuttings are monitored regularly for oil content (cuttings are analysed onboard with specific tests) and only cuttings with <1% oil are discharged to sea. All other cuttings are retained onboard, stored in mud cuttings skips and then shipped with supply vessels to shore for the final treatment and disposal. This measure therefore will minimize the amount of oil discharged at sea. Guidance from OSPAR, permits discharge of cuttings produced using WBM freely into the environment.

As a result of the predicted small extent of impacts due to the drilling of the four wells; the fact that the area has been pre-exposed to other drilling operations in the past; and the relatively short timeframe of new drilling activities, the magnitude of impact is considered **Small**.

The predominant sediment type at the HDNTNEE project area is mud / sandy mud. The area has been subject to drilling activities in the past and also modified by bottom currents dispersing sediments from previous drilling operations, thus deposition of WBM from new campaigns impacts an

already altered habitat. Newly deposited WBM is unlikely to alter the present sediment composition. Therefore, the sensitivity is classified as **Low**.

Therefore, accounting for the embedded control measures (use of WBM, onboard WBM and cutting treatment, no discharge of mud and cuttings mixture if the oil on cuttings level is >1%) the impact to the seawater quality, seabed sediment and associated benthic communities is assessed as of **Negligible Significance**.

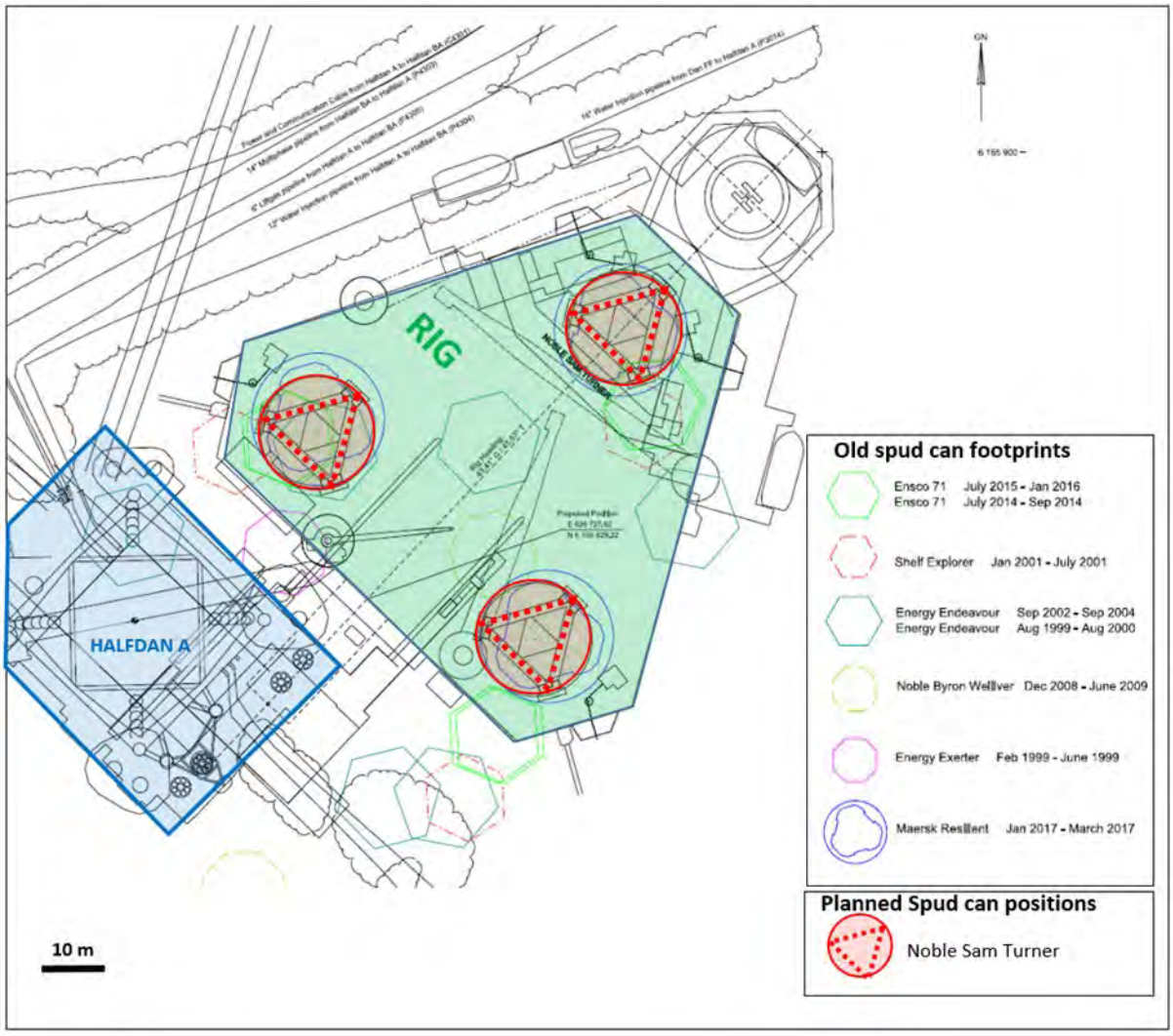
### *3.3.4.2 Impacts from Possible Release of Hazardous Substances Due to the Sediment Resuspension Caused by the Jack-Up Rig Spud Cans*

This section elaborates on impacts from the direct habitat loss and potential sediment resuspension due to the positioning and the presence of the rig and its spud cans.

The rig will be a three-legged jack-up and will be onsite for approximately 7 months for each platform (HBA and HDA). The positioning and demobilization of the spud cans will impact a small area of seabed and associated benthic communities near the existing platforms HBA and HDA previously used by rigs to drill the existing wells and for maintenance operations. Once in position, there will be no further disturbance to the sediment and seabed from the presence of the jack-up rig. During drilling, the discharge of WBM and cuttings will impact the area close to the platforms (see Section 3.3.4.1). On demobilization of the jack-up rig, jacking up the spud cans and legs will have a similar impact to positioning of the rig and, once offsite, the benthic communities will be able to recolonize naturally in the seabed sediment with bottom currents gradually moving seabed sediments and filling the depressions. To quantify the temporary habitat loss due to the Project, in addition to that presented in this Screening Report, TEPDK clarifies that the footprints of the jack-up rig (formerly Noble Sam Turner, now Shelf Drilling Winner) are approximately 314 $m^2$ per spud can (total area of 942 $m^2$). Once the jack-up rig demobilizes, craters left by the spud cans will fill in with sediment naturally due to seabed currents and the seabed will return to pre-existing conditions. The total area disturbed by the spud cans equals approximately 5,400 $m^2$ considering the positioning and demobilization and three rig movements.

Figure 3.1 shows the old spud can footprints and the planned spud can positions near HDA (similar layout is planned for HBA): the rig will impact three areas of the seabed previously used for past drilling operations in January and March 2017 and other maintenance operations.

## Figure 3.1 Planned Spud Can Positions




Source: adapted from TEPDK (2022)

The distance from the existing platform is small (tens of meters) therefore no detailed baseline information is available for these areas. As described earlier, these areas of the seabed are likely modified by TEPDK operations (previous rig positioning activities and drilling WBM/cutting discharges).

As discussed earlier, the positioning of the jack-up rig will disturb a limited portion of the seabed and associated benthic communities near the existing platforms. The temporary habitat loss (approximately 5,400 $m^2$) due to the physical presence of the rig is deemed of negligible magnitude thus not posing a significant risk to the Danish marine ecosystems and achievement or maintenance of GES.

With reference to the potential resuspension of sediments, the jack-up positioning and spud can penetration is commonly performed at low and controlled speeds to ensure the accuracy and guarantee the stability of the rig. The potential mobilization of sediments therefore is limited and will depend on the actual penetration of the spud can into the seabed (data from previous rig-moves with Noble Sam Turner at HBA indicate a spud can penetration <4 m (TEPDK, 2023)) and hydrodynamic conditions. Most of the seabed material will be compressed or pushed to the side of the spud can positions and only minimal surface layers of sediments may be resuspended.

As previously reported, the HDNTNEE project foresees three rig movements: two at HBA and one HDA. As described in Section 3.8.1, no specific sediment quality baseline data are available for the seabed at the planned spud can positions but data from the monitoring stations located close to HBA (650-750 m) showed the presence of muddy and sandy bottoms affected by previous WBM and cutting discharges. According to DHI seabed monitoring (2020), sediments around the previous past drilling activities are characterized by the presence of barium due to drilling activities, concentration of heavy metals, hydrocarbons and organic compounds. The 2020 survey results showed that the offshore areas within the TEPDK licenses have not been significantly affected by past construction and drilling activities.

Based on the spud can dimensions and sediment type, during the positioning of the jack up rig it is expected that suspended sediment will only impact the water column close to the seabed layer and near the existing platforms. Coarse sandy sediments will settle close to the jack up legs while fine muddy particles will travel some distance from the contact point. The sediment resuspension and sedimentation will affect the same area in which the WBM and cuttings from the planned drilling activities will be discharged and whose impacts are described in Section 3.3.4.1 as being of Negligible Significance.

Accounting for the predicted small extent of impact due to the planned rig mobilisation/demobilisation and drilling activities in an area that has been pre-exposed to other drilling operations in the past and the relatively short timeframe of activities, the magnitude of impact is assessed as **Small**.

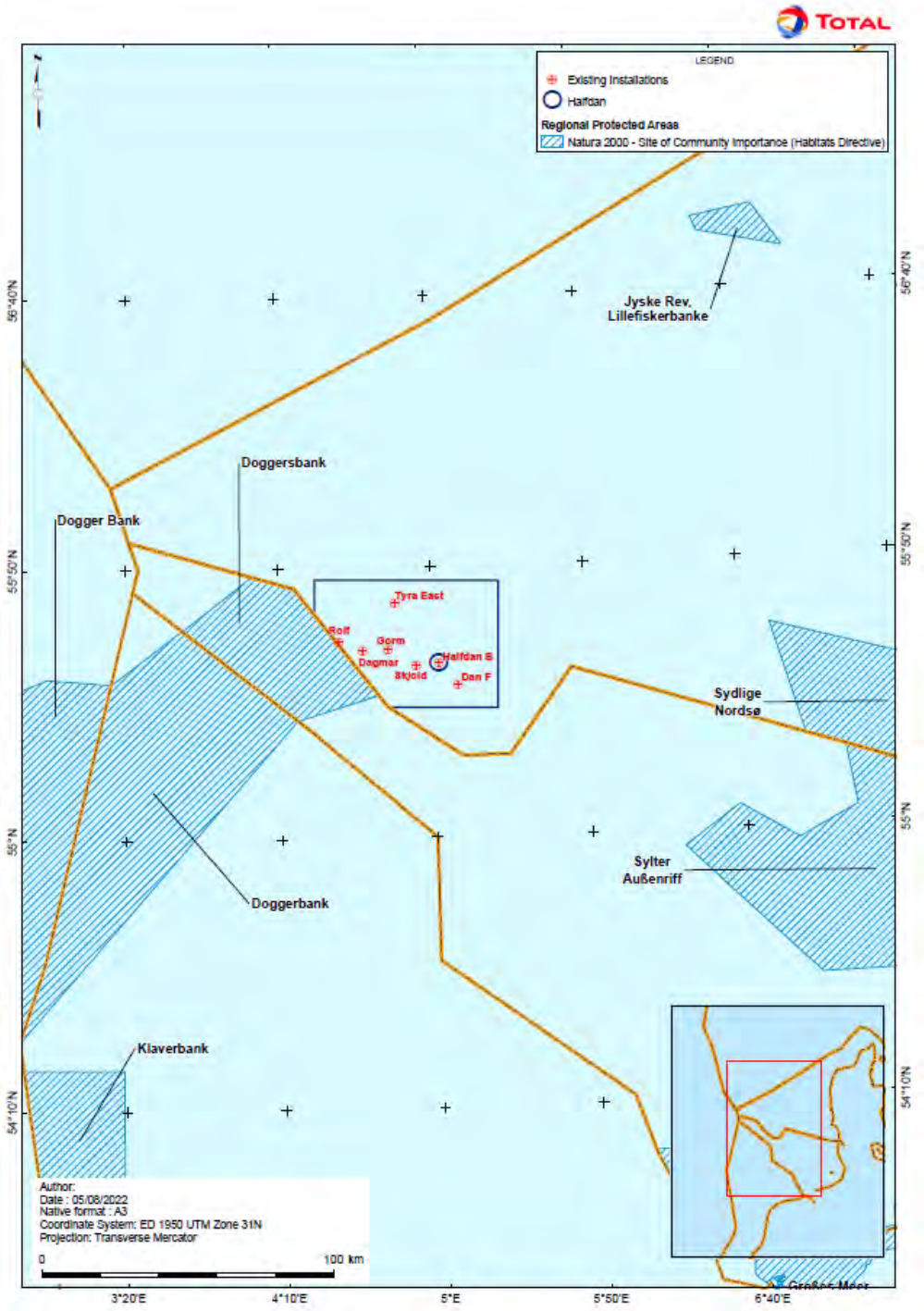
The predominant sediment type at the HDNTNEE project area is mud / sandy mud. The area has been subject to drilling activities in the past, thus deposition of WBM from new campaigns impacts an already altered habitat. Newly deposited WBM are unlikely to alter the present sediment composition. Therefore, the sensitivity is classified as **Low**.

Therefore, the impact to the seabed sediment and associated benthic communities is assessed to be of **Negligible Significance**.

## 3.4 Protected Areas

The existing Halfdan facilities and upgrades are not located within any Marine Protected Areas (MPAs), Nature Reserves, Natura 2000 sites, Important Bird Areas (IBAs) or Special Protection Areas (SPAs) of the North Sea. Protected areas are shown in Figure 3.2.

## Figure 3.2 Protected Areas Relevant to Halfdan




Source: ERM, 2022

The closest protected areas to the HDNTNEE project area are the Doggerbank (DE1003301) site designated as a SCI, which lies approximately 22 km west of the HDNTNEE project area and the Doggerbank SCI (NL2008001) which lies 50 km to the west of the HDNTNEE project area..

Marine species of conservation interest in the Doggerbank SCI include marine mammals such as harbour porpoise (*Phocoena phocoena*), harbour and grey seal (*Phoca vitulina* and *Halichoerus grypus*) and birds such as northern fulmar (*Fulmarus glacialis*), lesser black-backed gull (*Lesser farus*), northern gannet (*Morus bassanus*), black-legged kittiwake (*Rissa tridactyla*) and common murre (*Uria aalge*).

Sensitive species which may be present in the waters near the proposed development include seabirds, migrating and resident whales and dolphins (notably Minke whale, harbour porpoise, white-beaked dolphin, and bottlenose dolphin) and resident seals (grey seal and harbour seal). Harbour porpoises are present in relatively high numbers and their abundance has been stable with no evidence of any decline over the last 30 years. Harbour porpoise (*Phocoena phocoena*) and white-beaked dolphin (*Lagenorhynchus albirostris*) show the highest population density of these species in the central and southern North Sea; harbour porpoise in particular exhibit high densities in the project area (Sveegaard, 2018), compared to that of other marine mammals who inhabit more northern waters past North Scotland and the Atlantic (Waggit et al*.,* 2020). The abundance of harbour porpoise has been stable with no evidence of any decline over the last 30 years (Hammond et al*.*, 2017).

Five marine mammal species are of particular importance for impact assessments in Danish waters. They are protected by the EU Habitats Directive (Annex II and/or Annex IV). The protected species are harbour porpoise, white-beaked dolphin, Minke whale, harbour seal and grey seal (Tougaard, 2016), however, other species are present in the area in lesser densities including, but not limited to, white-beaked whales (Waggit et al*.,* 2020).

Table 3.17 provides a seasonal sensitivity matrix of selected marine species, including Annex IV species, present in the area. The slot recovery and drilling activities are planned to start in the first quarter of 2023 for wells at HBA and will last for approximately 95 to 105 days per well. Well recovery and drilling activities will commence for the wells at HDA for the same duration after a rig move. No impact is expected for marine species breeding onshore (i.e. birds, seals), and negligible impact for marine species spawning/calving in the water column (i.e. fish and cetaceans) considering the negligible toxicity of discharges in the water column for the proposed activities.

## Table 3.17 Seasonal Sensitivities of Marine Species

| Species Name *(Scientific Name)* | J | F | M | A | M | J | J | A | S | O | N | D | Location of breeding / spawning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH and FISHERIES | | | | | | | | | | | | | |
| Cod (*Gadus morhua*) | | | | | | | | | | | | | Water column |
| Haddock (*Melanogrammus aeglefinus*) | | | | | | | | | | | | | Water column |
| Whiting (*Merlangius merlangus Actinopterygii*) | | | | | | | | | | | | | Water column |
| Norway Pout (*Trisopterus esmarkii*) | | | | | | | | | | | | | Water column |
| Herring (*Clupea harengus*) | | | | | | | | | | | | | Coarse or hard benthic substrate |
| Sprat (*Sprattus sprattus*) | | | | | | | | | | | | | Inshore waters |
| Mackerel (Scomber scombrus) | | | | | | | | | | | | | Water column |

| Species Name *(Scientific Name)* | J | F | M | A | M | J | J | A | S | O | N | D | Location of breeding / spawning |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sandeel (Genus: *Hyperoplus*) | ■ | ■ | | | | | | | | | ■ | ■ | Sand habitat |
| Saithe (*Pollachius virens*) | ■ | ■ | ■ | ■ | | | | | | | | | Water column |
| Plaice (*Pleuronectes platessa*) | ■ | ■ | ■ | | | | | | | | | ■ | Water column |
| BIRDS | | | | | | | | | | | | | |
| Black-legged kittiwake (*Rissa tridactyla)* | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ | ■ | Onshore |
| Northern fulmar (*Fulmarus glacialis)* | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Onshore |
| Gannet (*Morus bassanus)* | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Onshore |
| Razorbill (*Alca torda)* | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ | ■ | Onshore |
| Little auk (*Alle alle*) | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ | ■ | Onshore |
| Black-throated diver (*Gavia arctica*) | ■ | ■ | ■ | | | | | | | ■ | ■ | ■ | Onshore |
| Red throated diver (*Gavia stellata*) | ■ | ■ | ■ | | | | | | | ■ | ■ | ■ | Onshore |
| Little gull (*Larus minutus*) | | | | | | | | | ■ | ■ | ■ | | Onshore |
| Common scoter (*Melanitta nigra*) | ■ | ■ | ■ | | | | | | | ■ | ■ | ■ | Onshore |
| Eider (*Somateria mollissima*) | ■ | ■ | ■ | | | | | | | ■ | ■ | ■ | Onshore |
| Great skua (*Stercorarius skua*) | | | | | | | | | ■ | ■ | ■ | | Onshore |
| Guillemot (*Uria aalge*) | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ | ■ | Onshore |
| MARINE MAMMALS | | | | | | | | | | | | | |
| Grey seal (*Halichoerus grypus*) | | | | | | | | | ■ | ■ | ■ | ■ | Onshore |
| Harbour seal (*Phoca vitulina*) | | | | | | ■ | ■ | | | | | | Onshore |
| Harbour porpoise (*Phocoena phocoena*) | | | | | ■ | ■ | ■ | ■ | ■ | | | | Water column |
| Minke whale (*Balaenoptera acutorostrata*) | ■ | ■ | ■ | | | | | | | ■ | ■ | ■ | Water column |
| White-beaked dolphin (*Lagenorhynchus albirostris*) | | | | | | ■ | ■ | ■ | ■ | | | | Water column |

*Note: Sensitive seasons consider breeding, mating, and when species are most likely to be in the central North Sea.*

Source: ERM, 2022.

### *3.4.1 Environmental Impact on Protected Areas*

Potential causes of environmental impacts due to the planned activities for the HDNTNEE activities are:

- Underwater noise (eg vessel movements, deployment and operation of machinery);

- Discharges (physical, eg solid waste, and chemical, eg drill cuttings, produced water);
- Emissions (eg greenhouse gases from diesel engines); and
- Restricted zones around the platforms.

As the Doggerbank protected area is 22 km away from the Project area and the wider area is habitat for various sensitive marine species, the sensitivity of the receptors is assessed as **High,** as assessed previously in Section 3.3.

Underwater noise from vessel movements, conductor-driving, and drilling for the well in-fill activity is expected. A targeted underwater noise modelling study for the HDNTNEE project was therefore undertaken (Genesis, 2022).

Water depth can strongly influence sound propagation, with sound in shallow waters causing stronger attenuation. In deeper waters, there are fewer sound interactions with the seabed, thus its noise impact to the seabed will be negligible as the water depth at HALFDAN Field is approximately 42 m. Furthermore, the underwater noise is relatively short term and temporary in nature, with drilling activities lasting up to 95 to 105 days per well and conductor driving lasting one to two days (Genesis, 2022). Any marine mammals displaced by underwater noise are likely to return to the area within approximately three days once the activity causing the underwater noise has ceased (Brandt et al*.,* 2016). Such underwater noise is unlikely to affect any species in the Doggerbank protected area 22 km to the west. Therefore, the impact magnitude is assessed as **Negligible.**

Thus, as the sensitivity of the receptors is **High** and the impact magnitude is **Negligible**, the resulting impact significance of underwater noise on protected areas is assessed as **Negligible.**

Only green and yellow categorised chemicals, WBM, produced water, cuttings and cement may be released to the environment, while any hydrocarbons coming out of the closed wells will be contained at the surface. The mud and cuttings mixture will only be discharged if the oil on cuttings level is <1%.

A hydrodynamic dispersion model of produced water for the Halfdan project suggests that produced water discharges are diluted relatively rapidly (IRIS, 2014). Any discharges are likely to be small, will disperse as a plume towards the north-east and will dilute rapidly. They are unlikely to reach the closest protected area of the Doggerbank, 22 km to the west and the species that inhabit it. The resulting impact magnitude is therefore assessed as **Negligible**.

As the sensitivity of the receptors is **High** and the impact magnitude is **Negligible**, the resulting impact significance of discharges on protected areas is assessed as **Negligible.**

As GHGs are emitted to the atmosphere and the Project area is far from protected areas, air emissions and GHGs will not have an impact, as assessed in Section 3.3.2.

## 3.5 Major Accidents / Unplanned Events

This section presents the risk of major accidental events relevant to the project, according to requirements from Annex III of the amended EIA Directive (selection criteria referred to in Article 4, section 1. characteristics of projects). Management of major environmental events is also covered by the Danish Offshore Safety Act for oil and gas activities. Major accidental events shall be identified, assessed and reduced to a level As Low As Reasonably Practicable (ALARP) with embedded control measures.

The risks of a major accident caused by climate change are considered irrelevant, considering the duration of the proposed activities.

TEPDK has an existing Oil Spill Contingency Plan (TEPDK, 2020) developed for managing accidental hydrocarbon spills from all its offshore activities. Additionally, all spills to sea are reported to the authorities and then analysed for causes to ensure they do not recur.

Minor accidental events when the spilled volume is finite could be a chemical or diesel spill occurring from a vessel collision with the HBA or HDA platforms or another vessel.

Major accidental events could result from an uncontrolled loss of a large volume of oil. The main cause of a major spill is a well blowout Based on International Association of Oil and Gas Producers (IOGP, 2019), the probability of a blowout associated with drilling a well is very unlikely, ie 2.4 x $10^{-4}$ per operation. No further assessment of impacts is therefore considered necessary.

## 3.6 Cumulative Impacts

Cumulative impacts are the additional impacts that may be generated due to a combination of developments or activities near the HDNTNEE project, that when added to the impacts of the proposed project, cause a greater impact. Such impacts may arise due to spatial overlap (eg overlap in the spatial extent of air or water quality changes) or temporal overlap (eg noise impacts caused by construction activities at the same time from various sources).

Table 3.18 presents a general schedule of the relevant activities in the DUC from October 2022 to December 2023, other than normal operational activities (eg produced water discharges, service vessel movements).

**Table 3.18 Schedule of Relevant Activities in the DUC**

| Location | Activity | Date | Approximate Distance to HBA platform (km) | Approximate Distance to HDA platform (km) |
|---|---|---|---|---|
| HARALD Field | Geotechnical (CPT) Survey | Proposed 1 week Q4 2022 | 102 | 102 |
| HALFDAN Field | Geotechnical (CPT) Survey | Proposed 1 week Q4 2022 | 0 | 0 |
| *Halfdan HDA-26, 27, 38, HBA-26, 21* | *Workover* | *October - December 2022* | *0* | *0* |
| ***Halfdan / Dan Fields*** | ***Seismic Survey*** | ***April – June 2023*** | ***>500 m*** | ***>500 m*** |
| ***HDNTNEE Project*** | ***Slot recovery and drilling of new trajectories*** | ***Q1 to Q4 2023 for Tor NE<br>Q2 2024 to early 2025 for Ekofisk*** | ***0*** | ***0*** |
| TYRA Field | Redevelopment | Ongoing | 25 | 25 |

*Note: lines in italic denotes projects yet to be approved by the authorities, therefore, the dates are uncertain.*

Based on the above, there are several concurrent activities in the DUC with the HDNTNEE project; the Halfdan / Dan seismic survey and the ongoing TYRA Field redevelopment, which is approximately 25 km away. There is also a potential cumulative impact from increased vessel activity.

The TYRA Field redevelopment involves vessel movements but excludes additional discharges, drilling or piling. Underwater noise from vessels is low intensity, broadband noise that is confined to the areas around the vessels. No cumulative spatial overlap between TYRA Field activities and the HDNTNEE project activities is expected.

Cumulative impacts may occur if HDNTNEE project activities take place at the same time as other activities in the HALFDAN Field, leading to increased vessel movements. The support vessels and jack-up rig are used for each slot recovery and drilling activities progressively so there is no multiplication of vessels and jack-up rigs around the HBA and HDA platforms.

Seismic surveys are anticipated to be conducted in the DAN and HALFDAN Fields during the HDNTNEE project activities; however, survey acquisition is scheduled to occur in the months between the two brief periods of conductor driving, when the loudest underwater noise impacts are expected.

As part of normal working practice, the seismic acquisition will be timed to avoid overlap with the conductor driving activities of the HDNTNEE project. This avoids any cumulative impact. Increase in vessel movements is predicted to be of minor significance, with impacts of small intensity, local extent and short-term duration, so no cumulative impacts are expected.

No significant cumulative impacts are expected to occur as part of the HDNTNEE project and no cumulative impacts will adversely affect any Annex I habitats, Annex II and IV species, bird species identified under the EU Birds Directive and Natura 2000 sites, the closest of which is over 22 km away, (i.e., Doggerbanke (DE1003301) in Germany). TEPDK has no further knowledge of other Oil & Gas or wind farm projects in the area that could potentially have cumulative impact with the proposed slot recovery and drilling activities.

## 3.7 Summary of Transboundary Impacts

Under the Espoo Convention, concerned parties are to be informed of potential transboundary adverse significant impacts and to be provided with possibilities for making comments or objections on the proposed activity.

There are no relevant anticipated transboundary impacts from the proposed planned activities for the HDNTNEE project activities. The only potential transboundary impact identified is to climate and air quality. There will be no significant changes to air emissions from the HDNTNEE activities, emissions would be negligible and short-term and will not cause significant impacts at international borders. Modelling of underwater noise from drilling and conductor driving activities for the HDNTNEE project has been carried out (Genesis, 2022) to predict sound levels as the underwater noise levels can be significant for these activities. The modelling predicts that sound levels from conductor driving at the HBA and HDA platforms will adhere to thresholds applicable to German EEZ (i.e., Sound Exposure Levels (SELs) above 140 dB re 1 $\mu Pa^2s$ must not cover more than 10 % of the German EEZ area). Although the threshold is not intended to be used for non-impulsive sources such as drilling, the predicted cumulative SEL from drilling activities has been compared to the threshold for completeness and concludes that drilling activities will not have any impact on the German EEZ or Doggerbanke SAC.

No other significant and predictable transboundary impacts have been identified for the proposed activities.

Accidental oil or chemical spills may occur, but the risk of such accidents is very unlikely, refer to Section 3.5.

Since there are no significant cumulative impacts, there are also no significant transboundary cumulative effects.

## 3.8 Marine Strategy Framework Directive

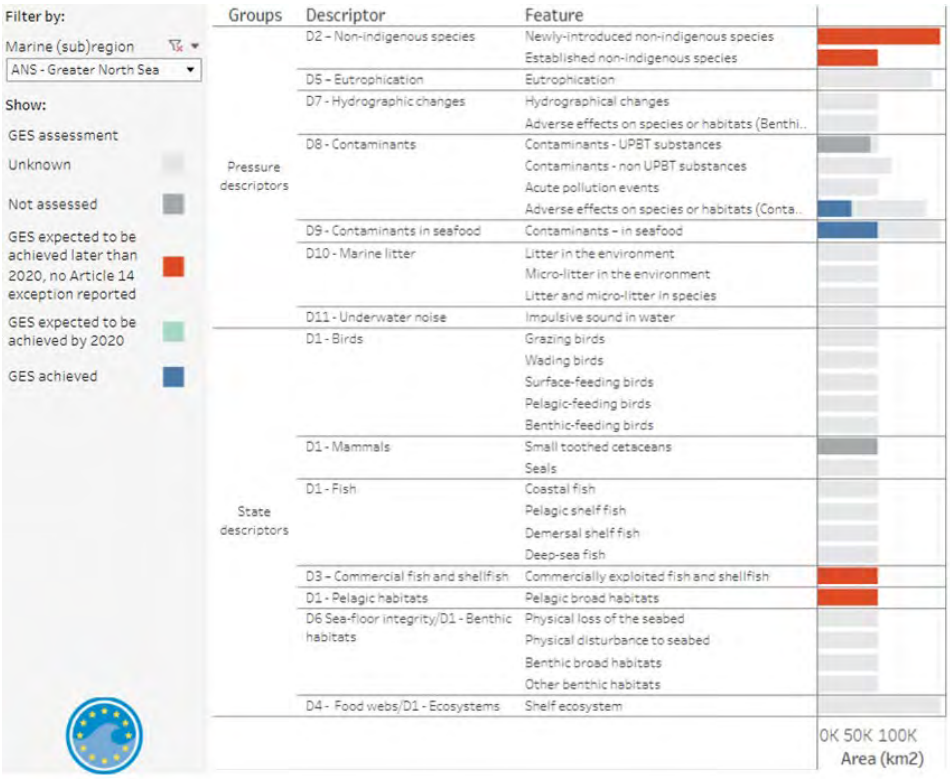
The aim of the Marine Strategy Framework Directive (MSFD) (Havstrategidirektiv) is to achieve “good environmental status” of the EU marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. It is a directive that is implemented in Danish law through the Marine Strategy Act and is developed by the Danish Agency of Water and Nature Management, now the Environmental Protection Agency, which is currently under the jurisdiction of the Ministry of Environment and Food. It encompasses Danish Sea zones such as waterbeds, seabed territories and exclusive economic areas. The MSFD outlines eleven descriptors used to assess the good environmental status of the marine environment. The assessment of the potential impacts from the HDNTNEE project on these eleven descriptors and the 68 environmental targets in the Danish Marine Strategy II is presented in Table 3.20. The assessment is based on the impacts described in Section 3.3 relevant for the activities planned for the HDNTNEE project.

### *3.8.1 Current Environmental Status*

In a recent press release[3], OSPAR communicated that evidence from monitoring and reporting indicates that the overall effect of OSPAR measures and their implementation by Contracting Parties has been to significantly improve the overall quality status of the Greater North Sea where there are high levels of oil and gas activity.

A summary of the GES for each descriptor in the Greater North Sea area is published in the WISE Portal. Denmark has assessed the environmental status various features per descriptor under the 2018 update of MSFD Article 8, which were reported electronically to the European Commission. Figure 3.3 shows the marine waters' area where, for those features, the GES has been achieved, not yet achieved or is unknown or not assessed.

**Figure 3.3 GES Assessment in the Greater North Sea Area**




Source: WISE Portal, 2023

As Part 1 of the Danish Marine Strategy II, a report was published in 2019 by the Ministry of Environment and Food providing an overview of the status of and impacts on the environment and established environmental targets. Table 3.19 summarises the state of each descriptor in the North Sea presented in the “Danish Marine Strategy II – Part 1” report (Ministry of Environment and Food Denmark, 2019 and 2020). Targets are not defined for all descriptors. The remaining targets are defined as trends that describe a positive development or descriptive target.

[3] OSPAR: Impacts of offshore oil and gas industry on the marine environment shown to have decreased in the North-East Atlantic: https://www.ospar.org/news/oicassessment

## Table 3.19 Extracted Summary of Environmental Status of Descriptors

| Descriptor | | Status for the North Sea | |
|---|---|---|---|
| | | Group | Status |
| D1 | Biodiversity (birds) | Herbivorous and foraging in water column | Stable or increasing |
| | | Wading and foraging in the water surface | Less than 75% of species are stable or increasing |
| | | Overwintering | Majority of species are stable, increasing or fluctuating |
| D1 | Biodiversity (marine mammals) | Harbour seal | GES |
| | | Grey Seal | Increasing population (no GES in 2013) |
| | | Harbour porpoise | Stable population with favourable conservation status |
| D1 | Biodiversity (fish that are not exploited commercially) | 14 species assessed | Less than 25% have good status<br>Population density- below 50% have good status |
| D1 | Biodiversity (pelagic habitat) | Phytoplankton biomass | Steady decline (but slight increase in 2012) |
| | | Zooplankton | Insufficient data to assess development |
| D2 | Non-indigenous species | Insufficient data, but likely that GES has not been achieved | |
| D3 | Commercially exploited fish stocks | 22 selected stocks of fish, crustaceans and shellfish | Ten stocks have GES<br>Eight stocks not good status |
| D4 | Marine food webs | Despite assessment of individual sub-elements in the food web, it is currently not possible to assess when the food web as a whole will be in good environmental status. However, it is expected that the balance in the marine food web will improve as environmental targets for pressure factors and status under the other topics/descriptors are achieved | |
| D5 | Eutrophication | Open marine areas far from the coast | GES |
| | | Open marine areas close to the coast | GES not achieved yet |
| D6 | Sea floor integrity | No set threshold values for GES, but analysis indicates that there is not good status for the sea floor in relation to disturbance and similarly in relation to loss for certain habitat types<br>There is not sufficient knowledge to assess when good environmental status will be achieved | |
| D7 | Hydrographical changes | Threshold values have not yet been set and there is not sufficient knowledge to assess when good environmental status will be achieved | |
| D8 | Contaminants (concentrations and species health) | PFOS and Benzo(a)pyrene | GES |
| | | Mercury or the group of brominated flame retardants | GES not achieved |
| D8 | Contaminants (acute pollution events) | GES cannot be assessed for acute pollution events in the North Sea, as there are large annual variations over the period for oil and chemicals spills from oil and gas installation not possible to derive a trend over the years. | |
| D9 | Contaminants in seafood for human consumption | Concentrations of the heavy metals lead, cadmium, mercury, as well as | GES |

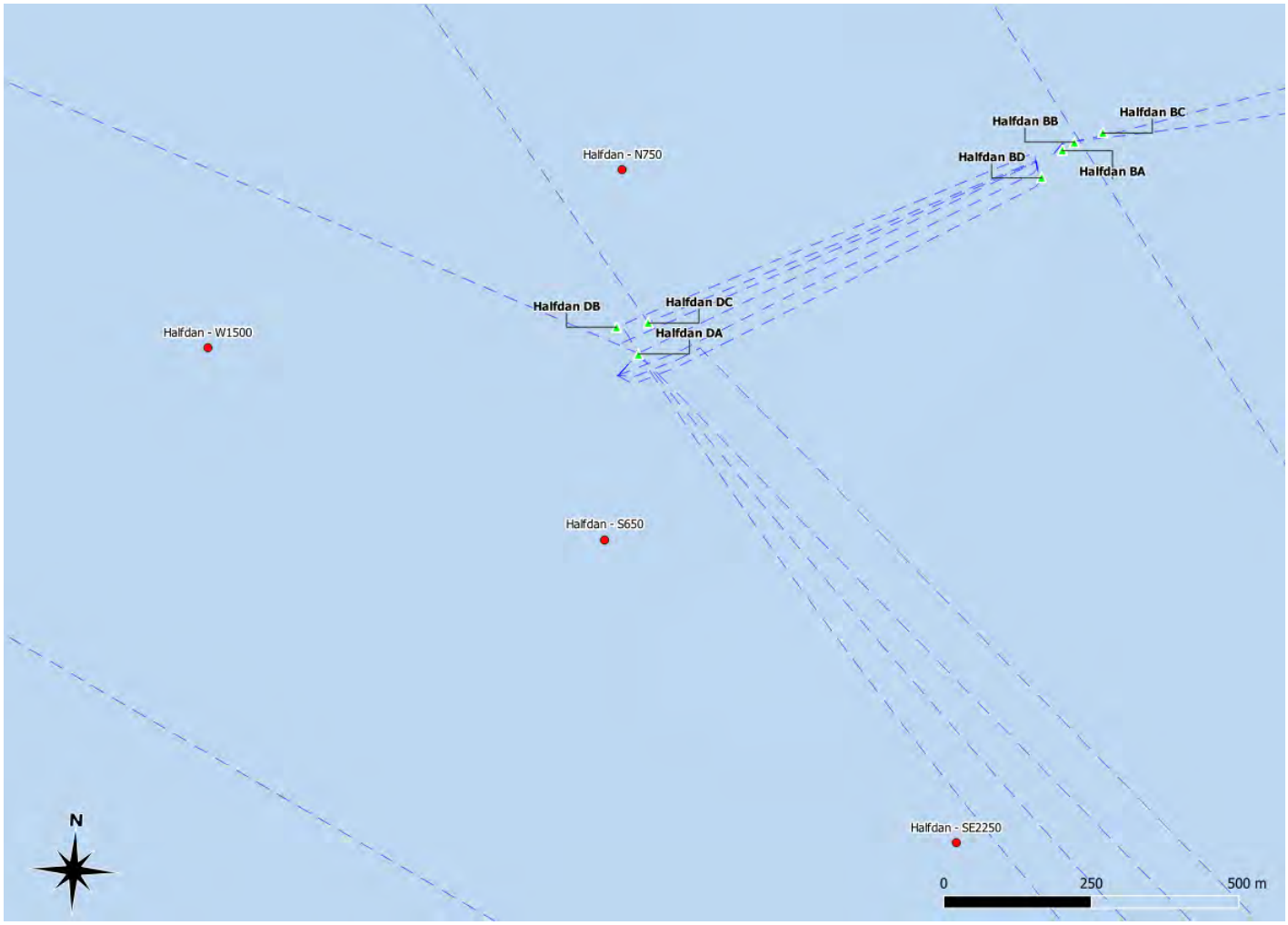
| Descriptor | | Status for the North Sea | |
|---|---|---|---|
| | | Group | Status |
| | | benzo(a)pyrene in seafood for human consumption | |
| | | Concentrations of dioxins and PCB | Above the maximum residue values have been found in mackerel, cod liver and salmon. |
| D10 | Marine litter | No set threshold values, there is no scientific basis for assessing quantitatively when good environmental status will be achieved | |
| D11 | Underwater noise | No set threshold values for levels of underwater noise compatible with good environmental status | |

Source: Ministry of Environment and Food Denmark, 2019 and 2020

In 2020, DHI conducted a baseline monitoring of the seabed around and along existing and new pipeline alignments between Halfdan and other fields (namely Gorm and Dan) (TEPDK-DHI, 2020): 91 taxa were identified to species level at the stations leading to Gorm, and 85 taxa to Dan. Fourteen (14) Phyla were identified comprising a wide variety of species classified as crustaceans, molluscs, annelids and echinoderms. The most abundant species observed along the pipelines were polychaeta (bristle worms) followed by crustacean (shellfish) and bivalvia (mussels) (TEPDK-DHI, 2020).

The TEPDK-DHI (2020) monitoring concludes that overall, the results from the survey provided a comprehensive dataset for each pipeline survey area and thus provide a solid baseline for each area. The survey near Halfdan was carried out at four stations (Halfdan - N750, Halfdan - W1500, Halfdan - S650, Halfdan - SE5000) (Figure 3.4).

## Figure 3.4 Environmental Monitoring Near Halfdan (2020) (TEPDK-DHI, 2020)




Source: ERM (2023) from DHI (2020)

It was concluded that the concentrations of heavy metals in the sediment samples were well below all targets for GES, although Barium (Ba) may be present in concentrations above the potential effect level, which is likely caused by drilling activities. With respect to organic compounds, all samples meet the criteria for GES. The environmental status (EnS) score for each pipeline survey area was high and consistent between surveys.

Overall, the concentrations of heavy metals and hydrocarbons had an EnS close to 100 and were low compared to indicators for GES and also low compared to potentially toxic levels, with one exception (i.e., Ba).

The 2020 survey results showed that the offshore areas within the TEPDK licenses have not been significantly affected by past construction and drilling activities. The presence of Ba in sediments near oil or gas platforms and drilling rigs is well documented in literature (Haanes et al., 2023; Celis-Hernandez et al., 2018; Lepland and Mortensen, 2008; Lepland et al., 2000) and neither barite ($BaSO_4$) nor dissolved Ba in seawater are considered to be toxic to marine organisms (Neff, 2002; Neff et al., 1995).

### 3.8.2 Assessment of Potential Impacts on MSFD Descriptors

**Table 3.20 Potential Impacts of the HDNTNEE on the MSFD Descriptors**

| Descriptors Based on the MSFD | Target | | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|---|
| **Descriptor 1 - Biodiversity:** The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions (see Table 3.1 item Benthic Communities, Fish, Marine Mammals, Seabirds). | Birds | 1.1 | Incidental by-catch of birds is at a level that does not threaten the species in the long term. | N/A | N/A | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement or the maintenance of good environmental status for Descriptor 1 | Sections 2, 3, 4, 5 |
| | | 1.2 | Populations and habitats for birds are conserved and protected in accordance with objectives under the Birds Directive. | Artificial lighting<br>Discharges: see target 1.8 | <u>Seabird disturbance:</u><br>■ No significant impact on seabird disturbance from artificial lighting from vessels (see Table 3.2 Seabirds).<br>**Negligible impact** | | |
| | | 1.3 | The Ministry of Environment and Food contributes to regional work regarding establishment of threshold values and determination of good environmental status, and works to ensure that the status for biological diversity is in accordance hereto. | Threshold values are established by the Ministry of Environment and Food. | N/A | | |
| | | 1.4 | *More knowledge about by-catch of seabirds is collected pursuant to the relevant monitoring programmes. | N/A | N/A | | |
| | Marine Mammals | 1.5 | * Need for protection initiatives for HELCOM and OSPAR Red List species is assessed. If there are any Red List species that are endangered or not sufficiently protected, the Ministry of Environment and Food will assess specifically the need for further initiatives in collaboration with relevant ministries. | See target 1.8. | See target 1.8. | | |
| | | 1.6 | Incidental by-catch of harbour porpoise is reduced as much as possible, and as a minimum to a level below 1.7% of the total population. | N/A | N/A | | |
| | | 1.7 | Incidental by-catch of seals is at an adequately low level that does not threaten populations in the long term. | N/A | N/A | | |
| | | 1.8 | Harbour porpoise, harbour seal and grey seal achieve favourable conservation status in accordance with the timeline laid down in the Habitats Directive | <u>Underwater noise from:</u><br>■ Jack-up rig and vessels;<br>■ Drilling and conductor pipe driving; and<br>■ Cutting the existing top completion during slot recovery. | <u>Underwater noise:</u><br>■ Sources of underwater noise are temporary and the significance of impact was assessed as negligible based on underwater noise modeling study conducted for drilling and conductor driving phase (see Table 3.2 Marine Mammals and Section 3.3.1).<br><u>Interference with vessels:</u> | | |

| Descriptors Based on the MSFD | Target | | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|---|
| | | | | Interference of marine activities with vessels.<br>Discharge of:<br>■ Drill cuttings and used cement during drilling activities; and<br>■ Produced water during operations.<br>Waste:<br>■ Liquid (WBM in case of milling) and solid waste (existing top completion, swarf in case of milling) during slot recovery. | ■ Project activities within safety exclusion zones (see Table 3.2 Marine Spatial Use); and<br>■ Low likelihood of collision (see Table 3.2 Marine Mammals).<br>Discharges:<br>■ Drilling performed with WBM, cuttings discharged to sea only if oil content is <1% (see Section 3.3.3);<br>■ Cement fluids will generally disperse in the water column (see Table 3.2 Water Quality); and<br>■ Slight increase of produced water discharge (see Table 3.1 Activity 4.1 and Section 3.3.3).<br>Waste:<br>■ In case of milling milled solids (swarf) are removed from WBM. Used milling WBM and swarf are retained and returned to shore for processing and disposal.<br>**Negligible to minor impact** | | |
| | | 1.9 | * The Ministry of Environment and Food contributes to setting population-specific threshold values for by-catches of harbour porpoise in a regional context with a view to subsequently setting environmental targets for vulnerable populations of harbour porpoise. | N/A | N/A | | |
| | | 1.10 | * More knowledge about by-catches of marine mammals is collected pursuant to the relevant monitoring programmes. | N/A | N/A | | |
| | | 1.11 | * The Ministry of Environment and Food carries out an analysis of by-catches of shark and ray in Danish marine areas, and the possibility of a DNA-based approach to determining species is investigated. | N/A | N/A | | |
| | Fish | 1.12 | * The Ministry of Environment and Food establishes a national indicator to evaluate the status of Danish fish that are not exploited commercially, and the opportunities to further develop regional indicators are investigated. | Indicators are established by the Ministry of Environment and Food.<br>See also target 3.1. | See target 3.1. | | |
| | Plankton | 1.13 | The abundance of plankton follows the long-term average. | Seabed disturbance from:<br>■ Jack-up spud cans;<br>■ Drilling.<br>Underwater noise from:<br>■ Jack-up rig and vessels;<br>■ Drilling and conductor pipe driving, and<br>■ Cutting the existing top completion during slot recovery.<br>Discharge of:<br>■ Drill cuttings and used cement during drilling activities; and<br>■ Produced water during operations.<br>Waste:<br>■ Liquid (WBM in case of milling) and solid waste (existing top completion, swarf in case of milling) during slot recovery. | The project activities could decrease light availability and cause a reduction in phytoplankton production. Any impact will be temporary and limited to slot recovery and drilling activities (see Table 3.2 Plankton).<br>Waste:<br>■ In case of milling milled solids (swarf) are removed from WBM. Used milling WBM and swarf are retained and returned to shore for processing and disposal.<br>**Negligible impact** | | |

| Descriptors Based on the MSFD | Target | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|
| | 1.14 | * The Ministry of Environment and Food is tracking developments and improving the knowledge base about plankton through monitoring. | Refer to monitoring stations in the HDNTNEE area (see Section 3.8.3.) | N/A | | |
| **Descriptor 2 – Non-indigenous species:** Introduced by human activities are at levels that do not adversely alter the ecosystems (see Table 3.2 item Benthic Communities, Fish, Marine Mammals, Seabirds). | 2.1 | The number of new non-indigenous species introduced through ballast water, ship fouling and other relevant human activities is decreasing. | Non-native / invasive marine species introduced from ballast water or ship fouling may colonize subsea structures and out-compete native marine species and upset local food chains and ecosystem balance. | Vessels operating solely in North Sea and following IMO Ballast Water Management Convention are an unlikely source of invasive species (see Table 3.2 non-indigenous species).<br>**No or negligible impact** | Project activities will not affect established environmental targets. The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 2. | Section 8 |
| | 2.2 | The distribution of certain invasive species is, as far as possible, at a level so that significant adverse effects are stable or decreasing. | See target 2.1. | See target 2.1. | | |
| | 2.3 | The Ministry of Environment and Food contributes to regional work regarding establishment of threshold values and determination of good environmental status, and works to ensure that the number of new non- indigenous species and impacts from invasive species are in accordance hereto. | Threshold values are established by the Ministry of Environment and Food. | N/A | | |
| **Descriptor 3 - Commercial fish and shellfish:** Populations of commercially exploited fish and shellfish exhibit a population age and size that is indicative of a healthy stock (see Table 3.2 item Benthic Communities, Fish, Fishery) | 3.1 | The number of commercially exploited fished stocks regulated pursuant to the MSY principles in the Common Fisheries Policy is increasing. | <u>Underwater noise from:</u><br>■ Jack-up rig and vessels;<br>■ Drilling and conductor pipe driving, and<br>■ Cutting during slot recovery.<br>Interference of marine activities from vessel movements.<br>Seabed disturbance from jack up spud cans.<br><u>Discharge of:</u><br>■ Drill cuttings and used cement during drilling activities; and<br>■ Produced water during operations.<br><u>Waste:</u><br>■ Liquid (WBM in case of milling) and solid waste (existing top completion, swarf in case of milling) during slot recovery. | <u>Underwater noise</u>:<br>■ Source of underwater noise are temporary and the significance of impacts negligible based on underwater noise modeling study conducted for drilling and conductor driving phase (see Table 3.2 Fish and Section 3.3.1).<br><u>Interference of marine activities</u>:<br>■ No-fishing zone around project vessels and the HBA and HDA platforms.<br><u>Seabed disturbance</u>:<br>■ Any disturbance during project activities is expected to be of short duration (see Table 3.2 Fish).<br><u>Discharges</u>:<br>■ Drilling performed with WBM, cuttings discharged to sea only if oil content is <1% (see Section 3.3.3);<br>■ Cement fluids will generally disperse in the water column (see Table 3.2 Water Quality); and<br>■ Slight increase of produced water discharge (see Table 3.1 Activity 4.1 and Section 3.3.3).<br><u>Waste:</u><br>■ In case of milling milled solids (swarf) are removed from WBM. Used milling WBM and swarf are retained and returned to shore for processing and disposal.<br>**Negligible impact** | Populations of commercially exploited fish and shellfish will be unaffected;<br>Project activities will not affect established environmental targets;<br>The Project's environmental impact will not hinder the achievement or the maintenance of good environmental status for Descriptor 3 | Section 4 |
| | 3.2 | Within the framework of the Common Fisheries Policy, fish mortality (F) is at levels that can ensure a maximum sustainable yield (Fmsy). | See target 3.1. | See target 3.1. | | |
| | 3.3 | Within the framework of the Common Fisheries Policy, spawning biomass (B) exceeds the level that can ensure a maximum sustainable yield (MSY Btrigger). | See target 3.1. | See target 3.1. | | |
| **Descriptor 4 - Food webs:** All elements of the marine food webs occur at normal | 4.1 | The Ministry of Environment and Food contributes to regional work regarding establishment of threshold values and determination of good environmental status, and works to ensure that the anthropogenic impacts on the food web are in accordance hereto. | Threshold values are established by the Ministry of Environment and Food.<br>See targets 1.2, 1.8, 1.13, 3.1 and 6.3. | As stated in the targets 1.2, 1.8, 1.13, 3.1, and 6.3 the impacts on all components of the marine ecosystem due to the HDNTNEE project have been evaluated as minor or negligible. With the implementation of control and mitigation measures described in Section 3.3, no significant impacts on the elements of the marine food webs are expected to occur. Minor/Negligible impacts will not negatively impact the normal | Project activities will not affect established environmental targets; The | Sections 2, 3, 4, 5 |

| Descriptors Based on the MSFD | Target | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|
| abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity (see Table 3.2 item Benthic Communities, Fish, Marine Mammals, Seabirds). | | | | abundance, diversity and levels capable of ensuring the long-term abundance of the species and their full reproductive capacity.<br>**Negligible or minor impact** | Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 4 | |
| | 4.2 | * The Ministry of Environment and Food contributes to regional knowledge and methodology development on marine food webs | N/A | N/A | | |
| | 4.3 | * The Ministry of Environment and Food is tracking the development in the food web through monitoring the individual sub-elements of the web | Refer to monitoring stations in the HDNTNEE area (see Section 3.8.3) | N/A | | |
| **Descriptor 5 - Eutrophication:** Human-induced eutrophication is minimized, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters (see Table 3.2 item Water Quality, Sediment Type and Quality). | 5.1 | The Ministry of Environment and Food contributes to regional work regarding establishment of threshold values and determination of good environmental status for the North Sea, including the Skagerrak, and works to ensure that anthropogenic eutrophication and its effects are in accordance hereto. | Discharges (runoff drainage, ballast discharge, sewage, grey water) from jack-up rig and vessels. | <u>Wastewater discharge from vessels:</u><br>■ Wastewater discharges from project vessels in accordance with MARPOL 73/78- Annex 1 (see Water Quality in Table 3.2).<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the maintenance of good environmental status for Descriptor 5 | N/A |
| | 5.2 | Danish inputs of nitrogen and phosphorus (TN, TP) comply with the maximum acceptable inputs stipulated under HELCOM. | See target 5.1. | See target 5.1. | | |
| | 5.3 | Coastal waters: Target loads and needs for measures for fjords, estuaries and coastal waters determined in accordance with the Water Framework Directive are complied with. Targets and needs are described in the Danish river basin management plans. | N/A | N/A | | |
| **Descriptor 6 - Seafloor integrity**: Seafloor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected. | 6.1 | The Ministry of Environment and Food contributes to work regionally and in the EU regarding establishment of threshold values and determination of good environmental status, and works to ensure that losses, physical disturbance and adverse effects on the sea floor are in accordance hereto. | Threshold values are established by the Ministry of Environment and Food. | N/A | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 6 | Section 3 |
| | 6.2 | * The knowledge base about the Danish sea floor, as well as the abundance and the location of the benthic habitats and their status, is improved pursuant to the monitoring programme (NOVANA). | Refer to monitoring stations in the HDNTNEE area (see Section 3.8.3). TEPDK contributes to the knowledge of the benthic fauna through seabed monitoring surveys (see Appendix A Section 3.1). | See Section 3.8.3<br>N/A | | |
| | 6.3 | * Through regional work and the work in the EU, better understanding of the impacts on the sea-floor in relation to losses, disturbances and adverse effects is achieved. | Underwater noise from jack up rig, vessels, drilling and conductor pipe driving;<br>Seabed disturbance from the jack-up rig spud cans and drilling.<br><u>Discharge of:</u> | <u>Underwater Noise:</u><br>■ Negligible effect on benthic communities (see Benthic Communities in Table 3.2).<br><u>Seabed disturbance:</u><br>■ Interaction with the seabed will be minor and temporary (see Sediment Type and Quality in Table 3.2) and Section 3.3.4. | | |

| Descriptors Based on the MSFD | Target | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|
| | | | ■ Drill cuttings and used cement during drilling activities; and<br>■ Produced water during operations.<br>Waste:<br>■ Liquid (WBM in case of milling) and solid waste (existing top completion, swarf in case of milling) during slot recovery. | Discharge:<br>■ Any increased turbidity or smothering will be small scale and temporary (see Benthic Communities in Table 3.2);<br>■ Drilling performed with WBM, cuttings discharged to sea only if oil content is <1% (see Section 3.3.3);<br>■ Cement fluids will generally disperse in the water column (see Table 3.2 Water Quality);<br>■ Slight increase of produced water discharge (see Table 3.1 Activity 4.1 and Section 3.3.3).<br>Waste:<br>■ In case of milling milled solids (swarf) are removed from WBM. Used milling WBM and swarf are retained and returned to shore for processing and disposal.<br>**Negligible impact** | | |
| | 6.4 | * In connection with licensing activities at sea requiring an environmental impact assessment (EIA), the approval authority encourages assessment and reporting to the Danish Environmental Protection Agency (monitoring programme) of the extent of physical losses and physical disturbances of benthic broad habitat types. | See target 6.3. | See target 6.3. | | |
| | 6.5 | The marine habitat types under the Habitats Directive achieve favourable conservation status in accordance with the timeline laid down in the Habitats Directive. | See target 6.3. | See target 6.3. | | |
| | 6.6 | The northern Sound is designated as a marine protected area pursuant to the Marine Strategy Framework Directive, and new licences to extract mineral resources are stopped. This will not result in any changes in relation to the existing fisheries regulation. | N/A | N/A | | |
| | 6.7 | The most important habitats contain the typical species and communities for Danish marine areas. | See target 6.3. | See target 6.3. | | |
| | 6.8 | * When threshold values for losses, disturbances and adverse effects are established through cooperation at regional and Union level, the Ministry of Environment and Food will initiate a project to form the basis for establishing environment targets in accordance with the thresholds and good environmental status. | N/A | N/A | | |
| | 6.9 | * Need for protection initiatives for HELCOM and OSPAR Red List habitats is assessed. If there are any natural habitats on the Red Lists that are endangered or not sufficiently protected, the Ministry of Environment and Food will assess specifically the need for further initiatives in collaboration with relevant ministries. | See target 6.3. | See target 6.3. | | |
| | 6.10 | * The need for additional marine protected areas or other initiatives in the Baltic Sea and the North Sea is assessed, and a similar assessment is subsequently carried out for the Danish Straits. | N/A | N/A | | |

| Descriptors Based on the MSFD | Target | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|
| **Descriptor 7 - Hydrographical conditions:** Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems. | 7.1 | Anthropogenic activities that are particularly associated with physical loss of the sea floor, and which cause permanent hydrographical changes<br>■ only have local impacts on the sea floor and in the water column, and<br>■ are designed to take account of the environment and what is technically possible and financially reasonable to prevent harmful effects on the seabed and in the water column. | Alterations to hydrographical conditions due to the jack-up rig legs. | The legs of the jack-up rig may temporarily alter local hydrography. However, the hydrography will quickly revert to its previous state once the rig leaves (see Hydrographic Environment in Table 3.2).<br>**Negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 7 | N/A |
| | 7.2 | In connection with licensing activities at sea requiring an environmental impact assessment (EIA), the approval authority is encouraging reporting to the Danish Environmental Protection Agency (monitoring programme) of hydrographical changes and the adverse effects of these. | See target 7.1. | See target 7.1. | | |
| **Descriptor 8 - Contaminants:** Their concentrations are at levels not giving rise to pollution effects (see Table 3.2 item Water Quality, Sediment Type and Quality, Hydrographic Environment). | 8.1 | Discharges of contaminants in the water, sediment and living organisms do not lead to exceeding of the environmental quality standards applied in current legislation. | Discharge of:<br>■ Liquid (drainage, ballast discharge, sewage, grey water) from jack-up rig and project vessels;<br>■ Drill cuttings and used cement during drilling activities; and<br>■ Produced water during operations.<br>Waste:<br>■ Liquid (WBM in case of milling) and solid waste (existing top completion, swarf in case of milling) during slot recovery;<br>■ Solid waste (food, cleaning, maintenance) from jack-up rig and project vessels.<br>Temporary resuspension of any sediment-bound contaminants disturbed by the jack-up rig spud cans. | Discharges:<br>■ Wastewater discharges from project vessels in accordance with MARPOL 73/78- Annex 1 (see Water Quality in Table 3.2);<br>■ Drilling performed with WBM, cuttings discharged to sea only if oil content is <1% (see Section 3.3.3);<br>■ Cement fluids will generally disperse in the water column (see Water Quality in Table 3.2);<br>■ Slight increase of produced water discharge (see Table 3.1 Activity 4.1 and Section 3.3.3).<br>Waste:<br>■ All solid waste/litter will be returned to land for appropriate management as per TEPDK´s waste management applicable to all offshore activities;<br>■ In case of milling milled solids (swarf) are removed from WBM. Used milling WBM and swarf are retained and returned to shore for processing and disposal.<br>Only minimal surface layers of sediment may be resuspended (see Section 3.3.4.2).<br>**Negligible or minor impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 8 | N/A |
| | 8.2 | Emissions, discharges and losses of PBDE and mercury are ceased or phased out | Project will not discharge PBDE and mercury (including produced water) | N/A | | |
| | 8.3 | The Ministry of Environment and Food contributes to work regionally and in the<br>EU regarding establishment of threshold values and determination of good environmental status, and works to ensure that the quantities of contaminants are in accordance hereto. | HDNTNEE project will implement DEPA conditions stated in the general permit for use, discharge and other disposal of substances and materials, including oil and chemicals. | N/A | | |
| | 8.4 | There is a gradual decrease in the levels of imposex/intersex in marine gastropods | N/A | N/A | | |
| | 8.5 | * By 2021, a process has been carried out to trace the source of the most polluting substances which prevent meeting the environmental targets laid down for surface water bodies in the Water Framework Directive. If necessary, the relevant licences and permits will be revised as far as possible. | Refer to monitoring stations in the HDNTNEE area (see Section 3.8.3) | N/A | | |

| Descriptors Based on the MSFD | Target | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|
| | 8.6 | * The Ministry of Environment and Food is working to ensure that more indicators for contaminants are established. | See target 8.3 | N/A | | |
| | 8.7 | * The Ministry of Environment and Food ensures increased coordination between policy areas/directives when new national environmental quality requirements are set for selected substances in matrices, where there is monitoring data. | See target 8.3 | N/A | | |
| | 8.8 | * The Ministry of Environment and Food is working to develop additional regional joint tests for biological impacts. | See target 8.3 | N/A | | |
| | 8.9 | The spatial extent and duration of acute pollution events is gradually reduced as much as possible through prevention, monitoring and risk-based scaling of contingency and response facilities. | Major accidental event | Acute pollution events are assessed in Section 3.5. The probability of a major accidental event is very unlikely, mitigation measures are embedded in the project design to prevent and manage all sources of acute pollution. | | |
| | 8.10 | Adverse effects on marine mammals and birds from acute pollution events are prevented and minimised as much as possible. For example, this may be secured by means of floating booms as well as through contingency plans for marine mammals and birds injured in oil spills. | See target 8.9 | See target 8.9. TEPDK Oil Contingency Plan includes wildlife response. | | |
| | 8.11 | * Up to the next monitoring programme (2020), the Danish Environmental Protection Agency will examine how the adverse effects of the most significant pollution events can be monitored and registered in the specific cases. | See target 8.9 | See target 8.9. All spills to sea are reported to the authorities. | | |
| **Descriptor 9 - Contaminants in seafood:** Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards (see Table 3.2 item Water Quality, Sediment Type and Quality, Benthic Communities, Fish). | 9.1 | Emissions of contaminants generally do not lead to exceeding of the maximum residue levels applicable in the food legislation for seafood | <u>Discharge of</u>:<br>■ Liquid (drainage, ballast discharge, sewage, grey water) from jack-up rig and project vessels;<br>■ Drill cuttings and used cement during drilling activities; and<br>■ Produced water during operations.<br><u>Waste</u>:<br>■ Solid waste (food, cleaning, maintenance) from jack-up rig and project vessels;<br>■ Liquid (WBM in case of milling) and solid waste (existing top completion, swarf in case of milling) during slot recovery.<br>Interference of marine activities from vessel movements.<br>Short term effect, negligible bioaccumulation[4].<br>Temporary resuspension of any sediment-bound contaminants disturbed by the jack-up rig spud cans. | <u>Discharges:</u><br>■ Wastewater discharges from project vessels in accordance with MARPOL 73/78- Annex 1 (see Water Quality in Table 3.2);<br>■ Drilling performed with WBM, cuttings discharged to sea only if oil content is <1% (see Section 3.3.3);Cement fluids will generally disperse in the water column (see Water Quality in Table 3.2);<br>■ Slight increase of produced water discharge (see Table 3.1 Activity 4.1 and Section 3.3.3).<br><u>Waste:</u><br>■ All solid waste/litter will be returned to land for appropriate management as per TEPDK´s waste management applicable to all offshore activities;<br>■ In case of milling milled solids (swarf) are removed from WBM. Used milling WBM and swarf are retained and returned to shore for processing and disposal.<br><u>Interference of marine activities:</u><br>■ No-fishing zone exists around the slot recovery and drilling activities.<br>Only minimal surface layers of sediment may be resuspended (see Section 3.3.4.2).<br>**Negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement or the maintenance of good environmental status for Descriptor 9 | N/A |
| | 9.2 | The trend in total Danish dioxin emissions into the air is not increasing. | N/A | N/A | | |

4 Beyer, J. et al., (2020) and Williams and Cooper (2014).

| Descriptors Based on the MSFD | Target | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|
| | 9.3 | * The Danish Environmental Protection Agency is monitoring developments in relation to emissions of POPs (including dioxins) from wood-burning stoves to assess the need for further initiatives | N/A | N/A | | |
| | 9.4 | * The Danish Environmental Protection Agency is gradually improving emission estimations of POPs into the air | N/A | N/A | | |
| | 9.5 | * The Danish Veterinary and Food Administration is inspecting concentrations of contaminants, particularly dioxins and PCBs in order to monitor developments in organisms at risk of containing high concentrations. | HDNTNEE project will implement DEPA conditions stated in the general permit for use, discharge and other disposal of substances and materials, including oil and chemicals. | N/A | | |
| **Descriptor 10 - Marine litter:** Properties and quantities of marine litter do not cause harm to the coastal and marine environment. | 10.1 | The amount of marine litter is reduced significantly in order to achieve the UN goal that marine litter is prevented and significantly reduced by 2025. | <u>Waste</u>:<br>■ Solid waste (food, cleaning, maintenance) from jack-up rig and project vessels;<br>■ Solid waste (existing top completion, swarf in case of milling) during slot recovery. | All solid waste/litter will be returned to land for appropriate management as per TEPDK´s waste management applicable to all offshore activities (see Section 2.5.4).<br>**No or negligible impact** | Project activities will not affect established environmental targets; The Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 10 | N/A |
| | 10.2 | The Ministry of Environment and Food contributes to work regionally and in the EU regarding establishment of threshold values and determination of good environmental status, and works to ensure that the quantities of marine litter are in accordance hereto. | Threshold values are established by the Ministry of Environment and Food. | N/A | | |
| | 10.3 | Losses of fishing gear in Danish waters are prevented in order to achieve the UN goal that marine litter is prevented and significantly reduced by 2025. | N/A | N/A | | |
| | 10.4 | * The Ministry of Environment and Food implements the National Plastics Action Plan and the associated Political Agreement on collaboration of 30 January 2019, with a view to improving recycling of plastic and reducing plastic litter and pollution from plastic litter. | N/A | N/A | | |
| | 10.5 | * The Ministry of Environment and Food is working to develop indicators and measurement methods for microplastics in seabed sediments and the water column. | Indicators are established by the Ministry of Environment and Food. | N/A | | |
| | 10.6 | * The Danish Fisheries Agency draws up an estimate of the amount of lost fishing gear in Danish marine areas up to 2020. | N/A | N/A | | |
| | 10.7 | * The Ministry of Environment and Food prepares a catalogue of potential and targeted measures to prevent marine litter. | Catalogue is established by the Ministry of Environment and Food. | N/A | | |
| **Descriptor 11 - Energy including underwater noise:** | 11.1 | As far as possible, marine animals under the Habitats Directive are not exposed to impulse sound which leads to permanent hearing loss (PTS). The limit value for PTS is | <u>Underwater noise from</u>:<br>■ Jack-up rig and vessels;<br>■ Drilling and conductor pipe driving, and | Temporary impact on marine mammals, fish and plankton from underwater noise produced during vessel movements, drilling and conductor driving (see Marine Mammals, Fish, Plankton in Table 3.2). TEPDK carried out specific underwater noise | Given the temporary nature of the | N/A |

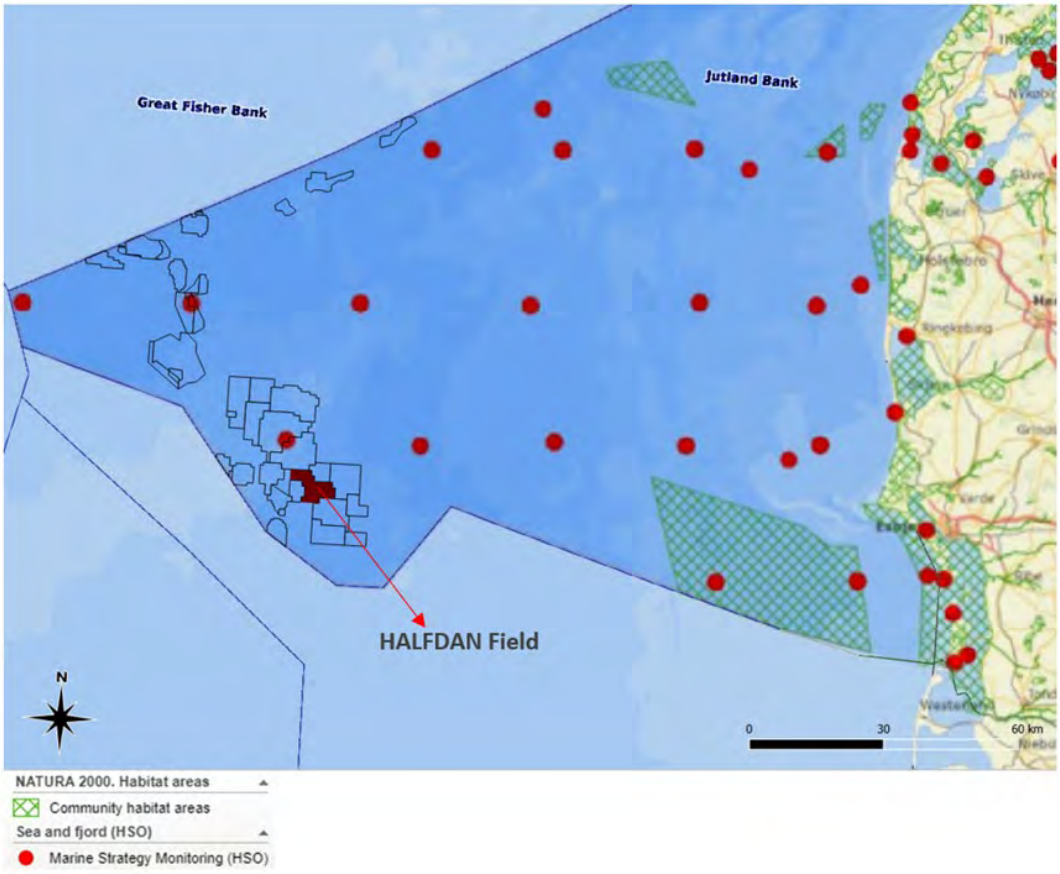
| Descriptors Based on the MSFD | Target | Target Description | Source of Impact | Overall Impact Assessment | Impacts to Environmental Targets | Location of Baseline Assessment in Appendix B |
|---|---|---|---|---|---|---|
| Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment (see Table 3.2 item Benthic Communities, Fish, Marine Mammals, Seabirds). | | currently assessed as 200 and 190 dB re.1 uPa2s SEL for seals and harbour porpoise, respectively. The best knowledge currently available is on these species. However, it is likely that these limits will be revised as new knowledge on the area becomes available. The values are the sound-exposure level accumulated over two hours. | ■ Cutting during slot recovery. | modelling study for drilling and conductor driving phase Best practice control measures will be adopted by the Project (see Section 3.3.1).<br>**Negligible or minor impact** | underwater noise, negligible impacts will not affect established environmental targets; the Project's environmental impact will not hinder the achievement of good environmental status for Descriptor 11 | |
| | 11.2 | Anthropogenic activities causing impulse sound are planned such that direct adverse effects on vulnerable populations of marine animals from the spatial distribution, temporal extent, and levels of anthropogenic impulsive sound are avoided as far as possible and such that these effects are assessed not to have long-term adverse effects on population levels. | See target 11.1. | See target 11.1. | | |
| | 11.3 | Activities by the authorities under the Ministry of Defence that cause impulse noise in the marine environment are, as far as possible, being assessed and adapted to reduce possible adverse effects on marine animals under the Habitats Directive, provided this does not conflict with national security or defence objectives. Defence Command Denmark applies current NATO standards when carrying out environmental assessments. | N/A | N/A | | |
| | 11.4 | When conducting preliminary seismic studies, adequate remedial action is taken in accordance with the Danish Energy Agency's guidelines on standard terms and conditions for preliminary studies at sea. | The project does not include seismic studies | N/A | | |
| | 11.5 | The Ministry of Environment and Food contributes to work regionally and in the EU regarding establishment of threshold values and determination of good environmental status, and is working to ensure that the level of underwater noise is in accordance hereto. | Threshold values are established by the Ministry of Environment and Food. | N/A | | |
| | 11.6 | * In connection with licensing offshore activities requiring an environmental impact assessment (EIA), the approval authority is encouraging reporting to the Danish Environmental Protection Agency (monitoring programme) of registrations of impulse noise. | See target 11.1. | See target 11.1. | | |
| | 11.7 | * Through increased monitoring, the Ministry of Environment and Food is improving knowledge about the extent and levels of low-frequency noise in the Baltic Sea and the North Sea. | N/A | N/A | | |

*Note: There is a total of 68 environmental targets in the Danish Marine Strategy II, of which 29 are operational environmental targets (marked with *). The latter are either specific actions to support achievement of the other targets, or they clarify further work to set more precise targets in the future (*

### *3.8.3 Potential Impacts from Project Activities on NOVANA Program*

The marine strategy's monitoring program 2021-2026 is mainly based on monitoring activities of NOVANA - sub-program for seas and fjords 2017-2021 (DEPA, 2017). New activities in the marine strategy's monitoring program 2021-2026, which either supplement already existing monitoring or represent completely new activities within a subject area, have effect since 2021 and will also be incorporated in the future NOVANA program for sea and fjords after its revision made in 2021. The offshore monitoring stations under the NOVANA Program are shown in the NOVANA GIS Portal and presented in Figure 3.5 with the HALFDAN Field identified.

**Figure 3.5 NOVANA - National Monitoring Program 2017-2021 – Marine Monitoring Stations and Location of the HALFDAN Field**




Source: ERM (2023) modified from NOVANA GIS Portal[5]

The Project activities involve HALFDAN Field as described in Section 2.4. All platforms belonging to the HALFDAN Field are approximately 20 km from the closest NOVANA program station (Figure 3.5). This station monitored soft-bottom fauna, hydrographic profile measurements, and nutrients and chlorophyll in water in 2017-2021. In 2021, samples of the water chemistry, which included salinity, temperature, sight depth, chlorophyll and fluorescence, were taken, as well as soft-bottom fauna samples (Hansen et al., 2021). The assessments in Table 3.1,Table 3.2 and Table 3.20 show that the project activities have no significant or negligible impact on seawater quality (Table 3.2) and no significant or negligible impact on seafloor integrity (Table 3.20). Due to the distance and the assessment, it can be assumed that there is no or negligible impact of the project activities on the NOVANA monitoring stations.

[5] GIS Portal: https://miljoegis.mim.dk/cbkort?profile=novana2017-21

# 4. CONCLUSIONS

## 4.1 Review of Regulatory Requirements of the EU and Denmark

Screening of the proposed HDNTNEE project activities has been conducted according to the measures described in Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment and as implemented in the LBK 973/2020 Executive Order on Environmental Assessment of Plans and Programs and of Specific Projects (EIA). The process has followed the guidelines and looked at the receptors stated in Annex 6 of LBK 4.

Potential health and safety impacts have been considered in accordance with the Danish Offshore Safety Act for oil and gas activities. These have been assessed and are minimised where applicable by embedded control measures within project activities.

## 4.2 Impact Assessment

This environmental screening has considered the potential effects on the relevant environmental and social receptors of the HDNTNEE project planned and unplanned activities. A summary of the potential impacts is presented in Table 4.1.

**Table 4.1 Summary of Impacts – HDNTNEE Screening**

| Receptor | Potential Impact – HDNTNEE project |
|---|---|
| Planned Events | |
| Hydrographic environment | Negligible |
| Air Quality and climate change | Negligible |
| Water quality | Minor |
| Sediment type and quality | Negligible |
| Plankton | Negligible |
| Benthic communities | Negligible |
| Fish | Negligible |
| Marine mammals | Minor |
| Seabirds | Negligible |
| Cultural heritage | No impact |
| Protected areas | Negligible |
| Natural resources | Negligible |
| Human health | Minor |
| Employment and tax revenue | Positive |
| **Unplanned/Accidental Events** | |
| **Event** | **Risk Classification** |
| Oil and/or chemical spill | ALARP |

The likely environmental impacts due to the Halfdan Tor NE and Ekofisk In-fill Well project range from No impact / Negligible to Minor. Therefore, the HDNTNEE project activities will not cause significant environmental impacts of a magnitude which would require a standalone EIA. The HDNTNEE activities will not take place within a sensitive area as defined by EIA regulations, will not have

significant transboundary impacts and will not increase the cumulative impacts at the Halfdan facilities. The positive benefits to employment and tax will continue. There will be no significant impacts on the Descriptors set by the EU's Marine Strategy Framework Directive, implemented in Danish law by the Marine Strategy Act (LBK 1161 of 25/11/2019); project's environmental impact will not hinder the achievement of good environmental status for the relevant descriptors.

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# APPENDIX A IMPACT ASSESSMENT METHOD

# 1. INTRODUCTION

An impact is any change to a resource or receptor caused by the presence of a project component or by a project-related activity. Impacts can be negative or positive.

The potential impacts of the HDNTNEE Project at HBA and HDA platforms in the HALFDAN Field on the environmental receptors are assessed for both planned and unplanned events.

## 1.1 Impact identification

The first stage of the impact assessment process involves identifying the potential impacts of the proposed activities that require further investigation. The screening phase includes the systematic consideration of the potential for interaction between activities involved in this project and aspects of the physical and biological environment that may be affected.

## 1.2 Planned Events

Planned events are those that are expected to take place during the project's activities.

In line with Annex III of the EIA directive, impacts are evaluated based on their nature, type, reversibility, intensity, extent and duration in relation to each environmental receptor. The impact can be direct or indirect, cumulative with that of other existing or approved/ planned projects, and transboundary.

### *1.2.1 Magnitude of impact*

The magnitude of predicted impacts encompasses the following dimensions:

- The nature of the change (what is affected and how);
- Its size and scale;
- Its geographical extent and distribution; and
- Its duration.

An overall grading of the magnitude of impacts is provided, considering all those various dimensions involved. These dimensions will determine whether an impact is of Negligible, Small, Medium or Large magnitude.

This scale is defined differently according to the type of impact depending on the circumstances. For example, for readily quantifiable impacts such as noise, numerical values are typically used whilst for other topics a more qualitative classification is often necessary.

### *1.2.2 Evaluation of significance*

The next step in the assessment is to take the information on the magnitude of impacts and explain what this means in terms of its importance to the environment. This is to enable decision makers and stakeholders to understand how much weight should be given to the issue in deciding on their view of a project. This is referred to as Evaluation of Significance. This recognizes that evaluation requires an exercise of judgment and that judgments may vary between parties in the process.

Criteria for assessing the significance of impacts are clearly defined for each topic area and types of impact taking into account whether the project will:

- Cause legal or accepted environmental standards to be exceeded, e.g., vessel wastewater discharges, or make a substantial contribution to the likelihood of exceedance;
- Adversely affect marine and/or protected areas or features, or valuable resources, such as nature conservation areas, rare or protected species, important sources of ecosystem services; or

- Conflict with established government policy, e.g., to recycle waste.

Significance is evaluated considering the magnitude of impact and the sensitivity / vulnerability / importance of the affected resource or receptor. Magnitude is defined across the various dimensions described in the previous sub-section.

The value of a resource is judged considering its quality and its importance as represented, e.g., by its local, regional, national or international designation, its importance to the local or wider community, or its economic value.

Significance is evaluated considering the magnitude of impact and the value or sensitivity of the affected resource or receptor. Magnitude and sensitivity / vulnerability / importance are addressed in combination to evaluate whether an impact is significant and if so its degree of significance (Figure A 1).

**Figure A 1 Evaluation of Significance**

| | | Sensitivity/Vulnerability/Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

Source: ERM, 2012.

### *1.2.3 Overall Significance*

The definition of the levels of overall significance of impact are separated for environmental and social receptors (Table A 1).

**Table A 1 Classification of Overall Significance of Impacts**

| Overall significance | Impacts on environmental receptors |
|---|---|
| Positive | Positive impacts on the structure or function of the receptor. |
| Negligible | No measurable impacts on the structure or function of the receptor. |
| Minor | Impact to the structure or function of the receptor is localised and immediate or short-term. When the activity ceases, the impacted area naturally restores to pre-impact status. |
| Moderate | Impact to the structure or function of the receptor is local or regional and over short- to medium-term. The structure or ecosystem function of the receptor may be partially lost. Populations or habitats may be adversely impacted, but the functions of the ecosystem are maintained. When the activity ceases, the impacted area restores to pre-impact status through natural recovery or some degree of intervention. |
| Major | Impact to the structure or function of the receptor is regional, national or international and medium- to long-term. Populations or habitats and ecosystem function are substantially adversely impacted. The receptor cannot restore to pre-impact status without intervention. |

### *1.2.4 Cumulative impacts*

A cumulative impact arises from project impacts interacting with an impact from another activity to create an additional impact.

How the impacts and effects are assessed is strongly influenced by the status of the other activities (e.g. already in existence, approved or proposed) and how much data is available to characterize the magnitude of their impacts.

The approach for assessing cumulative impacts and effects resulting from the project and another activity affecting the same resource/receptor is based on a consideration of the approval/existence status of the ‘other’ activity and the nature of information available to aid in predicting the magnitude of impact from the other activity.

# APPENDIX B BASELINE FOR THE HALFDAN FIELD

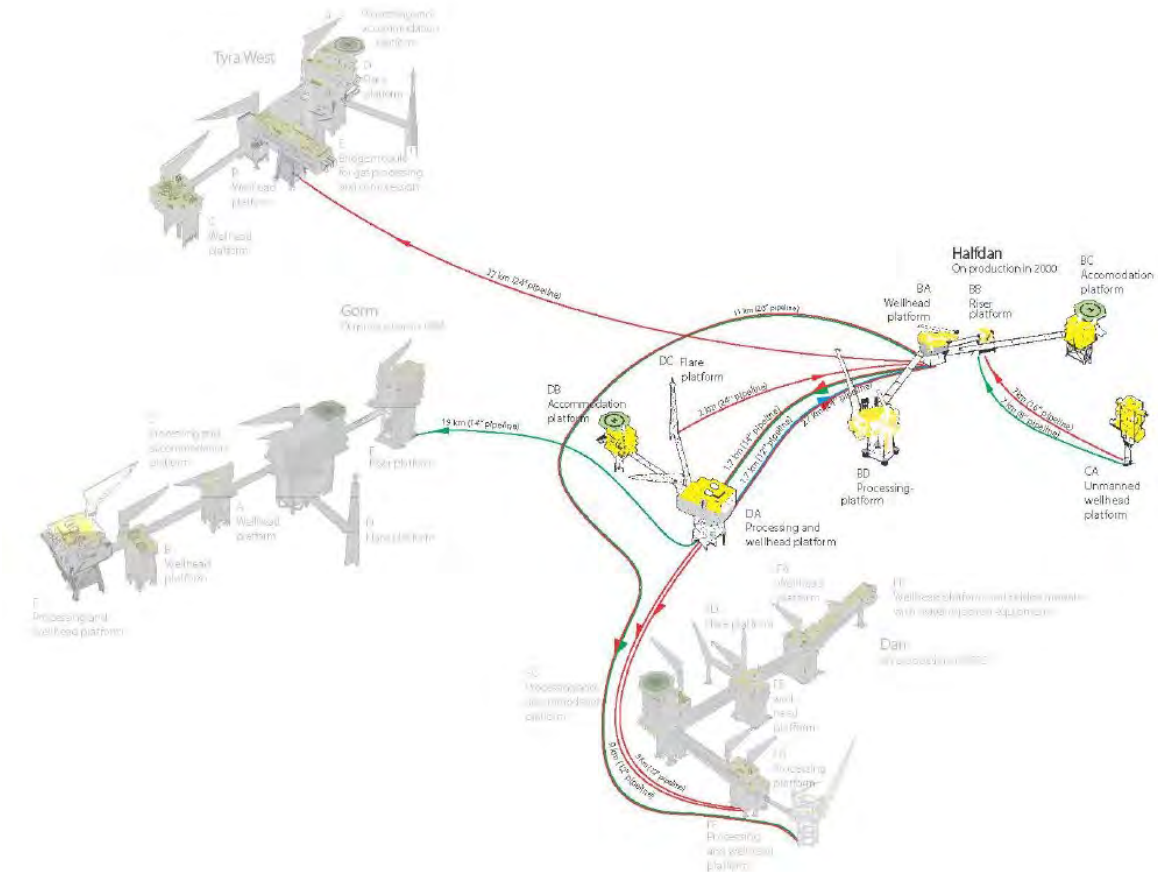
# 1. INTRODUCTION

This Appendix comprises baseline information on biodiversity aspects and protected and designated sites for the HALFDAN Field. The information is extracted from Biodiversity Assessment performed on TEPDK's assets in 2021.

## 1.1 Halfdan Hub Overview

The Halfdan platforms include the main processing and production facilities, Halfdan A and Halfdan B, and the satellite platform Halfdan C. The Halfdan platforms are connected by subsea pipelines through which oil, gas and water are transported to Gorm and Tyra for further processing and export to shore. Figure B 1 depicts an overview of the existing pipelines and infrastructure for the Halfdan hub.

**Figure B 1. Overview of Existing Facilities at the Halfdan Hub**




Source: TEPDK

The two main processes at the Halfdan facilities are the separation process and the gas compression and dehydration process conducted on Halfdan A and Halfdan B.

- Halfdan A comprises a combined wellhead and processing platform (HAD), an accommodation platform (HDB) and a gas flare stack (HDC).
- Halfdan B comprises a processing platform (HBD), a wellhead platform (HBA), a combined riser and wellhead platform (HBB) and an accommodation platform (HBC).
- Halfdan C is an unmanned wellhead platform (HCA).

There are a total of 82 wells in the Halfdan Field.

# 2. PLANKTON

Plankton communities can be categorised in two groups: marine algae (phytoplankton) and marine animal organisms (zooplankton). Plankton constitutes the main primary and secondary biomass in marine ecosystems and plays a fundamental role in marine food webs.

## 2.1 Phytoplankton

In the North Sea, the phytoplankton is mainly light-limited in winter and nutrient-limited in the water above the thermocline in summer. Figure B 2 shows the PCI for the North Sea during the year. PCI is a visual estimation of the biomass and abundance of the phytoplankton. The highest biomass and abundance of phytoplankton is found in the eastern and southern parts of the North Sea.

Phytoplankton biomass and abundance around the Halfdan hub are well within the normal range for the North Sea. The phytoplankton community is dominated by dinoflagellates and diatoms. Phytoplankton which may be present within the Halfdan area are listed in Table B 9.

## 2.2 Zooplankton

Generally, zooplankton abundance varies between areas owing to differences in production, predation, and transport. Nevertheless, the species diversity of the zooplankton community in the central North Sea is generally homogeneous (SAHFOS, 2001).

The zooplankton communities in the North Sea are dominated in terms of biomass and productivity by copepods, particularly Calanus species such as C. finmarchicus and C. helgolandicus. Calanoid copepods are relatively large planktonic crustaceans which range in size between 0.5 – 6 mm and are an important prey item for many species at higher trophic levels. In the Halfdan area, the abundance of copepods is intermediate compared to the North Sea, with 5.5 – 9.5 ind/m3 of C. finmarchicus and 6.5 – 9 ind/m3 for C. helgolandicus (DHI/Ramboll. 2014). ). Zooplankton, which may be present within the Halfdan area, are listed in Table B1.

# 3. BENTHOS

## 3.1 Overview

The water depth at the Halfdan platforms is about 43 m. At this depth, it is highly unlikely that any macrophytes (macroalgae and higher plants) grow due to lack of light. The legs of the platforms however offer substrate for brown and red macroalgae to grow up to a certain depth. This kind of flora however has a negligible contribution to primary production compared to that of passing plankton (*Maersk, 2017*).

The benthic fauna consists of epifauna and infauna (organisms living on or in the seabed, respectively) such as crustaceans, molluscs, annelids, echinoderms.

Figure B 3 shows the benthic substrate, and Figure B 4 shows the benthic fauna assemblages in the North Sea and across the Halfdan area. All of the Halfdan platforms lie in an area of MD62: Atlantic offshore circalittoral mud. The locations of all of the Halfdan platforms are characterised by the benthic fauna assemblages as indicated by the presence of the polychaete worm *Nephtys cirrose,* the echinoderm *Echinocardium cordatum* and the crustacean *Urothoe poseidonis.*

Recent (2019-2020) broadscale benthic habitat surveys of the Danish tail of the Dogger Bank covered the location of all TEPDK assets apart from the Svend and Harald platforms. The most abundant species recorded during these surveys were, amongst others, the polychaetes *Lanice conchilega*, *Spiophanes bombyx* and *Galathowenia oculatamens*. Polychaetes, malacostracans and bivalves were the most abundant classes of benthic organisms recorded (*Miljøstyrelsen, 2021*).

In the Halfdan area, benthic grab samples were taken in the context of offshore chemical and biological seabed monitoring around the platform. The latest offshore chemical and biological seabed monitoring survey was conducted in 2012. Prior to that, monitoring surveys were conducted in 2002.

Biological monitoring in the Halfdan area in 2012 shows that polychaetes were the most abundant taxa and accounted for 57.1% of the average abundance. Following that, echinoderms accounted for 39% of benthic abundance, bivalves 1.7% and crustaceans 1.6%. Since the 2002 survey, the average abundance of the benthic fauna increased by about four times due to natural changes in the populations of the benthic fauna around the platform. However, the sensitive brittle star *Amphiura filiformis* was very scarce in 2012 decreasing since 2002. This is accounted to the natural change in recruitment success of the species in the 2012 monitoring survey report (*DHI, 2013*).

## 3.2 Overview by Platforms/Structure

In the Halfdan area, biological surveys have been undertaking in 2002 and 2012. The results for the 2012 survey (*DHI, 2013*) are presented in Table B 1.

**Table B 1. Benthic Habitat Overview at Halfdan platforms as identified through the 2012 seabed monitoring survey**

| Platform | Seabed Benthos | Benthos encrusting/ colonising TEPDK structures |
|---|---|---|
| Halfdan A | *Echinocardium* sp.<br>*Spiophanes bombyx*<br>*Lanice conchilega*<br>*Ophiuroidea indet.*<br>*Scoloplos armiger*<br>*Lagis koreni*<br>*Phyllodoce groenlandica* | No survey data available |

| | | |
|---|---|---|
| | *Goniada maculata*<br>*Ophelia borealis*<br>*Thyasira flexuosa* | |
| Halfdan B | *Echinocardium* sp.<br>*Spiophanes bombyx*<br>*Lanice conchilega*<br>*Ophiuroidea indet.*<br>*Scoloplos armiger*<br>*Lagis koreni*<br>*Phyllodoce groenlandica*<br>*Goniada maculata*<br>*Ophelia borealis*<br>*Thyasira flexuosa* | No survey data available |
| Halfdan C | *Echinocardium* sp.<br>*Spiophanes bombyx*<br>*Lanice conchilega*<br>*Ophiuroidea indet.*<br>*Scoloplos armiger*<br>*Lagis koreni*<br>*Phyllodoce groenlandica*<br>*Goniada maculata*<br>*Ophelia borealis*<br>*Thyasira flexuosa* | No survey data available |

From baseline monitoring of the seabed around and along existing and new pipeline alignments between Halfdan and other fields (namely Gorm and Dan), a total of 91 taxa was identified to species level at the stations leading to Gorm, and 85 taxa to Dan. These organise into 14 Phyla (Table B 2**)** (*DHI, 2020*). These comprise a wide variety of species classified as crustaceans, molluscs, annelids and echinoderms. The most abundant species observed along the pipelines were polychaeta (bristle worms) followed by crustacean (shellfish) and bivalvia (mussels).

**Table B 2. No. of Species of Benthos Identified along pipelines between Halfdan and other platforms**

| Group | Common name | Survey from Dan to Halfdan | Survey from Gorm to Halfdan |
|---|---|---|---|
| | | Number of species | Number of species |
| Cnidaria | Polyp animals | 2 | 1 |
| Anthozoa | Coral animals | 1 | 1 |
| Hydrozoa | Polyp animals | 1 | 0 |
| Bivalvia | Mussels | 14 | 11 |
| Gastropoda | Snails | 3 | 5 |
| Crustacea | Shellfish | 15 | 20 |
| Echinodermata | Sea urchins | 8 | 8 |
| Ophiuroidea | Brittle star | 1 | 1 |
| Polychaeta | Bristle worms | 35 | 40 |
| Enteropneusta | Acorn worms | 1 | 1 |
| Plathyhelminthes | Flatworms | 1 | 0 |
| Phoronida | Horseshoe worms | 1 | 1 |

| Group | Common name | Survey from Dan to Halfdan | Survey from Gorm to Halfdan |
|---|---|---|---|
| | | Number of species | Number of species |
| Priapulida | Penis worms | 1 | 1 |
| Nemertea | Ribbon worms | 1 | 1 |

## 3.3 Habitats and Species of Conservation Concern

No benthic species on the IUCN Red List of Threatened Species (IUCN Red List) species have been identified in the vicinity of the Halfdan Field, although very few European benthic species have been assessed for inclusion on the IUCN Red List. The Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention) has identified a list of threatened and declining species and habitats, some of which occur in the North Sea (OSPAR). None of the OSPAR threatened and declining habitats have been identified in TEPDK areas in Danish waters, however one habitat, sea-pen and burrowing megafauna communities has been recorded in German waters in similar habitats to those present in TEPDK areas. The closest recorded location is approximately 15 km from the Danish EEZ. The OSPAR threatened and declining benthic species Arctica islandica has a distribution that overlaps TEPDK areas, however its conservation status has not been evaluated by IUCN at a global or European level.

The EU Habitats Directive Annex I habitat *Sandbanks* has been mapped within German waters within the Doggerbank Site of Community Interest (see Protected Areas and Designated Sites) approximately 22 km from the Halfdan Field. However, no Annex I habitats have yet been mapped.

## 4. FISH

The Halfdan hub is in an area designated as a relatively important spawning ground for cod (*Gadus morhua*) in winter with a peak in February and March, whiting (*Merlangius merlangus*) from January to June (*Maersk Oil Atlas 2014*). Mackerel (*Scomber scombrus*) are also known to be spawning in the area although the Halfdan area is not considered as an important spawning ground for this species based on the 2014 Maersk Oil Atlas.

The ICES International Bottom Trawl Surveys (IBTS) have been undertaken yearly since 1970 and the International Bottom Trawl Survey Working Group (IBTSWG) subsequently publishes reports. The main findings (Figure B 7) provide a representation of the fish biomass distribution derived from the IBTS surveys undertaken in quarter one (Q1) of 2021 (ICES, 2021). This can serve as a general indicator of the species abundance of different areas. The southern North Sea generally shows lower abundance levels than the northern North Sea. This is particularly reflected in the Halfdan area where the distribution of fish biomass is of 45 kg/ hour according to the Q1 2021 IBTS surveys. In contrast, fish biomass reaches over 7,000 kg/ hour in the northern part of the North Sea.

Table B 3 presents the number of fish per trawl hour by fish species in the Halfdan area, against the maximum catch per unit effort in the North Sea.

**Table B 3. Catch per Unit Effort (No of Fish per Trawl Hour) at the Halfdan Area by Fish Species (2014 Data for Summer and Winter)**

| Fish species | Catch per unit effort –no. of fish per trawl hour at the Halfdan area | Maximum catch per unit effort in the North Sea |
|---|---|---|
| *Clupea harengus (herring)* | 200 – 400 in winter, 400 – 1,000 in summer | 1,000 – 6,500 |
| *Sprattus sprattus (sprat/ bristling)* | 200 – 1,000 in winter, 1,000 – 4,000 in summer | 12,500 – 25,000 |
| *Gadus morhua (cod)* | 2 – 5 | 20 – 44 |
| *Melanogrammus aeglefinus (haddock)* | 1 – 10 | 150 – 300 |
| *Merlangius merlangus (whiting)* | 1 – 20 in winter, 20 – 100 in summer | 800 – 1,100 |
| *Pollachius virens (saithe)* | 0 in winter, 1 – 5 in summer | 50 – 172 |
| *Trisopterus esmarkii (Norway pout)* | 1 – 200 in winter, 0 in summer | 5,000 – 12,700 |
| *Scomber scombrus (mackerel)* | 0 in winter, 1 – 10 in summer | 200 – 600 |
| *Eutrigla gurnardus (grey gurnard)* | 1 – 10 in winter, 20 – 50 in summer | 100 – 220 |
| *Agonus cataphractus (hooknose)* | 1 – 2 | 12 – 17 |
| *Cyclopterus lumpus (lumpsucker)* | 0.1 – 0.2 in winter, 0 in summer | 1.2 – 2 |
| *Hippoglossoides platessoides (American plaice)* | 10 – 20 in winter, 20 – 50 in summer | 100 – 170 |
| *Limanda limanda (common dab)* | 50 – 100 in winter, 20 – 50 in summer | 300 – 900 |
| *Microstomus kitt (lemon sole)* | 2 – 5 | 18 – 28 |
| *Platichthys flesus (European flounder)* | 0.1 – 0.5 in winter, 0 in summer | 4 – 15 |
| *Pleuronectes platessa (European plaice)* | 5 – 10 in winter, 1 – 5 in summer | 50 – 120 |

Source: based on the charts of the Maersk Oil Atlas 2014

Variability in fish stocks in the Halfdan Field is primarily due to the variation in egg and larval survival, which is regulated by factors including sea temperature and currents responsible for larval drift to

nursery grounds. Predation on larva and eggs is also a factor to consider. Most species show annual or inter-annual movements related to feeding and spawning.

## 4.1 Species of Conservation Concern

According to species distribution data for species listed in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN Red List), there are four critically endangered (CR) and two endangered (EN) fish species that could occur in the Halfdan area. These species are presented in Table B 4. All of these species are rare shark, skate or ray species. Eleven fish species are listed as vulnerable (VU) on the IUCN Red List which have distributions that overlap with the Halfdan area, two of which (Atlantic horse mackerel (*Trachurus trachurus*) and Atlantic cod (*Gadus morhua*)) are commercially exploited. Of these species, only Atlantic horse mackerel and Atlantic cod are likely to regularly occur within the Halfdan area.

**Table B 4. Fish Species of Conservation Concern with Published Distributions overlapping the Halfdan Field: source IUCN Red List (*IUCN, 2020*), *Nieto et al., 2015*.**

| Species | IUCN Red List Status/ European Red List Status/ local population trend | Biology and geographical distribution |
|---|---|---|
| Angel shark (*Squatina squatina*) | Critically Endangered<br>Critically Endangered<br>Declining | A bottom-dwelling shark of the continental shelves of Europe and the Mediterranean basin, occurring on or near the bottom from close inshore in the shallow sublittoral (<1 m deep) to at least 150 m deep. It prefers sandy substrates. It is considered possibly extinct from the southern North Sea. Threatened as bycatch from demersal trawling activities. |
| Tope (*Galeorhinus galeus*) | Critically Endangered<br>Vulnerable<br>Declining | A bentho-pelagic species of temperate waters on continental and insular shelves and upper to mid slopes from shallow inshore to well offshore. It most frequently occurs to depths of 200 m. Has a large distribution in temperate seas in both the northern and southern hemispheres. Threatened by bycatch and targeted fisheries. |
| Flapper skate (*Dipturus intermedius*) | Critically Endangered<br>Not Evaluated<br>Declining | Occurs in the Northeast Atlantic from French Waters to Iceland and Norway and throughout the North Sea. It is demersal on the continental shelf and slope to depths of 20–1,500 m, although it is primarily found within the 200 m depth range. Targeted as an important component of demersal fisheries which has led to population declines. |
| Common blue skate (*Dipturus batis*) | Critically Endangered<br>Critically Endangered<br>Declining | Similar distribution to flapper skate and occurs in the northeast Atlantic from French waters to Iceland, Norway and the Faroe Isles and throughout the North Sea. It is demersal on the continental shelf and slope to depths of 20–1,500 m, although it is primarily found within the 200 m depth range. Targeted as an important component of demersal fisheries which has led to population declines. |
| Basking shark (*Cetorhinus maximus*) | Endangered<br>Endangered<br>Declining | A planktivorous coastal-pelagic species. In temperate waters it is typically encountered swimming slowly at the surface but it also vertically migrates to depths of 1,264 m, typically in tropical waters. It occurs mainly in the Atlantic and Pacific Oceans; in the Indian Ocean, it is reported only from southern Australia, Indonesia, and South Africa. |
| Angular roughshark (*Oxynotus centrina*) | Endangered<br>Vulnerable<br>Declining | The Angular Roughshark is found in the Northeast and Eastern Atlantic Ocean (from Norway to South Africa) and the Mediterranean Sea. It is found in the northern half of the North Sea. It is demersal on the continental shelf and upper slope at depths of 35–805 m. Threatened by deep water trawling fisheries, predominantly off north and west Africa. |

## 5. MARINE MAMMALS

In the Halfdan area, pinniped (seal) species include the grey seal (Halichoerus grypus) and harbour seal (Phoca vitulina). The resident cetacean species present at the Halfdan area are minke whale (Balaenoptera acutorostrata), harbour porpoise (Phocoena phocoena), and white-beaked dolphin (Lagenorhynchus albirostris), which are typical species of the North Sea. Less common cetacean species include short-beaked common dolphin (Delphinus delphis), Atlantic white-sided dolphin (Lagenorhynchus acutus), long-finned pilot whale (Globicephala melas), killer whale (Orcinus orca) and Risso's dolphin (Grampus griseus) (Waggitt et al, 2019). According to Waggitt et al., (2019), the harbour porpoise and white-beaked dolphin show the highest population density in the central and southern North Sea, compared to that of other marine mammals that inhabit more northern waters past North Scotland and the Atlantic.

**Table B 5. Characteristics of the Most Represented Marine Mammal Species in the Halfdan Area**

| Species | Global Red List IUCN Status/ European Red List Status/local population trend | Biology and geographical distribution |
|---|---|---|
| Grey seal (*Halichoerus grypus*) | Least Concern<br>Least Concern<br>Increasing | **Food:** Their feeding behaviour can be demersal or benthic. Sandeels, cod and saithe all account for a typical grey seal diet, which varies depending on availability.<br>**Habitat:** Present in the North Atlantic continental shelf, in cold temperate waters. Population size is estimated at 315,000 adults.<br>**Breeding and Pupping:** Breeding takes place in the autumn with a clockwise cline in mean birth date around the UK and European coasts: August-September in SW Britain, September-November in Scotland and Scandinavia and November-December in eastern England and January – March in mainland Europe. |
| Harbour seal (*Phoca vitulina*) | Least Concern<br>Least Concern<br>Increasing | **Food:** Fish, cephalopods and crustaceans caught at the water surface, mid waters and on the sea bottom.<br>**Habitat:** Typically in the coastal waters of continental shelf and slopes. Population size is estimated at 600,000 individuals.<br>**Breeding and Pupping:** Pupping occurs on land from June to July. |
| Minke whale (*Balaenoptera acutorostrata*) | Least Concern<br>Least Concern<br>Stable | **Food:** Minke whale exploit a variety of prey depending on availability, but usually consume a considerable amount of krill.<br>**Habitat:** The minke whale is found in all oceans, and part of the population is believed to migrate to warmer latitudes every winter. Total population estimates reach 200,000 individuals.<br>**Breeding and Calving:** Mating and calving occurs during the winter. There is limited information available on breeding and calving behaviour and location. |
| Harbour porpoise (*Phocoena phocoena*) | Least Concern<br>Vulnerable<br>Stable | The species is listed in Appendix II of CITES.<br>**Food:** Wide variety of fish and cephalopods.<br>**Habitat:** Typically found in continental shelf waters in cold temperate to sub-polar waters of the northern hemisphere. They frequently visit shallow waters of estuaries, tidal channels and shallow bays. The Atlantic population comprises 700,000 individuals, although it is declining, and the global population is estimated at well over one million individuals.<br>**Breeding and Calving:** The mating and calving season ranges from May to August. Coastal areas of Germany and Denmark are thought to be important calving areas. |

| Species | Global Red List IUCN Status/ European Red List Status/local population trend | Biology and geographical distribution |
|---|---|---|
| White-beaked dolphin (*Lagenorhynchus albirostris*) | Least Concern<br>Least Concern<br>Stable | **Food:** Small pelagic fish, squid and crustaceans.<br>**Habitat:** Typically found in waters less than 200 meters deep, lives in cold temperate to subpolar zones. Total Atlantic populations are estimated at more than 100,000.<br>**Breeding and Calving:** Calving season takes place in the summer. Calves are sighted from June to September. |

Source: Prepared by ERM with data extracted from: IUCN, 2020; JNCC, 2003; OSPAR 2017; Hammond et al., 2017, Schick et al., 2020.

The five marine mammal species presented in Table B 5 are protected by the EU Habitats Directive (Annex II and/or Annex IV or V) and so are particularly important when conducting impact assessments in Danish waters (*Tougaard, 2016*). During the Marine Mammal Sighting Reporting program (MMSR), 131 sightings around Danish hydrocarbon installations were reported. The most sighted species were harbour porpoise (41%) and minke whale (31%) (*Delefosse et al., 2017*). In fact, during regular activities at the Halfdan platforms, one hundred twenty-six harbour porpoises and twenty-one minke whales were sighted between 2013 and 2021, as recorded in TEPDK monitoring records. Seven white-beaked dolphins, two killer whales, six harbour seal, and three grey seals were also recorded.

Large-scale surveys for cetaceans in the North Sea were carried out in 1994 (SCANS I - Small Cetaceans Abundance in the North Sea), 2005 (SCANS II) and 2016 (SCANS III). The SCANS III data provides estimates of cetacean abundance in European Atlantic waters in the summer of 2016 from aerial and shipboard surveys (*Hammond et al., 2017*).

The 2016 SCANS III survey found that the observed distribution of minke whale, harbour porpoise and white-beaked dolphin in 2016 was similar to that observed in SCANS-II in 2005 (*Hammond et al., 2017*). One notable difference was that there were more sightings of harbour porpoise throughout the English Channel (block C) in 2016 than previously (*Hammond et al., 2017*).

Comparing results from the three surveys has allowed analysis of trends of abundance over the years. In the North Sea in general, harbour porpoise, white-beaked dolphin and minke whale abundance has not changed since 1990 (*Hammond et al., 2017*). However, there are regional changes with recent studies of harbour porpoise abundance in the German North Sea identifying an overall decline over the last 20 years, with a larger decrease in northern waters and a slight increase in southern waters (*Nachtsheim et al., 2021*).

Distributions for harbour porpoise and minke whale from the 2016 SCANS III survey in the North Sea are presented in

Figure B 5. More recent abundance and distribution estimates for minke whale, white-beaked dolphin and harbour porpoise in the North Sea and Halfdan area based on survey data from 1980 and 2018 (*Waggitt et al., 2019*) are shown in Figure B 76.

There are very little data regarding seasonality of these species, however observations between 1980 and 2018 showed that most species of cetacean found in the Halfdan area (i.e., minke whale, white-beaked dolphin, harbour porpoise, short beaked dolphin, Atlantic white-sided dolphin, and Risso's dolphin) are more abundant in the North Sea during summer compared to winter (*Waggitt et al., 2019*). Killer whale and long-finned pilot whale show no seasonality pattern. Harbour porpoise, in particular, has a localised seasonality pattern within the North Sea. Clausen et al. (2021) investigated

harbour porpoise seasonality for areas surrounding Danish offshore oil and gas structures, including the Halfdan area. Two distinct activity periods of harbour porpoises around oil and gas platforms were observed. During July-January, relatively high densities of harbour porpoise were recorded around Dan F (up to 800 m) compared to stations located further away. During February to June, harbour porpoise densities were generally lower and more evenly distributed across the distance gradient. This is consistent with a similar study conducted in the central North Sea area (*Gillies et al., 2016*).

A study by Clausen et al. (2021) on echolocation activity of harbour porpoises (*Phocoena phocoena)* around Dan F platform shows seasonal artificial reef attraction despite elevated noise levels close to oil and gas platforms. The results of the study suggest a general attraction to the platforms resulting from the motivation to find food from predictable food source close to the platforms. It is expected that this behaviour may be similar at other platforms in the TEPDK Fields, including Halfdan Field.

## 5.1 Species of Conservation Concern

All regularly occurring species of marine mammals in the North Sea are listed as of Least Concern (LC) on the IUCN Red List. All of the cetaceans are protected under Annex IV of the EU Habitats Directive, and harbour porpoise, common seal and grey seal are protected under Annex II of the EU Habitats Directive. Two cetacean species that are infrequent visitors to the North Sea are listed as EN on the Red List, set out in Table B 6. Neither of these species is likely to occur regularly within the Halfdan area.

**Table B 6. Cetaceans of Conservation Concern Infrequently Occurring in the North Sea and Halfdan area**

| Species | IUCN Red List Status/ European Red List Status/local population trend | Biology and geographical distribution |
|---|---|---|
| Blue whale (*Balaenoptera musculus*) | Endangered<br>Endangered<br>Increasing | Found in all oceans but absent from some regional seas such as the Mediterranean Sea. They feed both at the surface and at depths of up to 300 m almost exclusively on krill. Migration patterns are not well understood, but appear to be diverse, with some groups migrating between productive feeding areas at higher latitudes. There is a western North Atlantic population, but individuals are rare in the North Sea. |
| Sei whale (*Balaenoptera borealis*) | Endangered<br>Endangered<br>Increasing | Occurs in the North Atlantic, North Pacific, and Southern Hemisphere, typically with an offshore distribution. They feed on a wide range of prey species. Uncommon in the North Sea. |

Source: IUCN, 2022; Temple & Terry, 2007.

## 6. BIRDS

The coastlines of the North Sea are habitat for seabirds that inhabit estuaries, rocky coasts and cliffs. Coastal birds and winter migratory species from the north and east use the waters of the North Sea for feeding (*ICES, 2020*). Fifty-five seabird species are present on the Danish coast and may use the waters of the Danish Exclusive Economic Zone (EEZ) (Table B 7).

The seabirds identified during a three-year offshore aerial seabird monitoring survey in 2006-2008 covering the Halfdan area are highlighted in green in Table B 7 (*Skov & Piper, 2009*).

There is a clear seasonal pattern in seabird species found in the Halfdan area. Black-legged kittiwake, European herring gull, common guillemot, and razorbill are more commonly sighted in the North Sea during winter while lesser black-backed gull, northern fulmar, great skua, and northern gannet are more commonly sighted in the North Sea during summer (*Waggitt et al., 2019*).

**Table B 7. Seabirds of Denmark**

| Scientific name | English name | Birds Directive Status | IUCN Red List Status | Scientific name | English name | Birds Directive Status | IUCN Red List Status |
|---|---|---|---|---|---|---|---|
| ***Clangula hyemalis*** | Long-tailed Duck | | VU | ***Larus hyperboreus*** | Glaucous Gull | | LC |
| ***Fratercula arctica*** | Atlantic Puffin | | VU | ***Larus marinus*** | Great Black-backed Gull | | LC |
| ***Hydrobates leucorhous*** | Leach's Storm-petrel | Annex 1 | VU | ***Larus melanocephalus*** | Mediterranean Gull | Annex 1 | LC |
| ***Melanitta fusca*** | Velvet Scoter | | VU | ***Larus michahellis*** | Yellow-legged Gull | | LC |
| ***Podiceps auritus*** | Horned Grebe | Annex 1 | VU | ***Larus ridibundus*** | Black-headed Gull | | LC |
| ***Rissa tridactyla*** | Black-legged Kittiwake | | VU | ***Melanitta nigra*** | Common Scoter | | LC |
| ***Alca torda*** | Razorbill | | LC | ***Mergus merganser*** | Goosander | | LC |
| ***Ardenna grisea*** | Sooty Shearwater | | NT | ***Mergus serrator*** | Red-breasted Merganser | | LC |
| ***Gavia adamsii*** | Yellow-billed Loon | | NT | ***Morus bassanus*** | Northern gannet | | LC |
| ***Somateria mollissima*** | Common Eider | | NT | ***Phalacrocorax carbo*** | Great Cormorant | | LC |
| ***Alle alle*** | Little Auk | | LC | ***Phalaropus lobatus*** | Red-necked Phalarope | | LC |
| ***Aythya marila*** | Greater Scaup | | LC | ***Phalaropus fulicarius*** | Red Phalarope | | LC |
| ***Bucephala clangula*** | Common Goldeneye | | LC | ***Podiceps grisegena*** | Red-necked Grebe | | LC |
| ***Cepphus grylle*** | Black Guillemot | | LC | ***Podiceps cristatus*** | Great Crested Grebe | | LC |
| ***Chlidonias niger*** | Black Tern | Annex 1 | LC | ***Podiceps nigricollis*** | Black-necked Grebe | | LC |
| ***Fulmarus glacialis*** | Northern Fulmar | | LC | ***Puffinus puffinus*** | Manx Shearwater | Annex 1 | LC |

| Scientific name | English name | Birds Directive Status | IUCN Red List Status | Scientific name | English name | Birds Directive Status | IUCN Red List Status |
|---|---|---|---|---|---|---|---|
| ***Gavia stellata*** | Red-throated Diver* | Annex 1 | LC | ***Somateria spectabilis*** | King Eider | | LC |
| ***Gavia arctica*** | Black-throated Diver* | Annex 1 | LC | ***Stercorarius longicaudus*** | Long-tailed Jaeger | | LC |
| ***Gavia immer*** | Common Loon | Annex 1 | LC | ***Stercorarius parasiticus*** | Arctic Jaeger | | LC |
| ***Gelochelidon nilotica*** | Common Gull-billed Tern | Annex 1 | LC | ***Stercorarius pomarinus*** | Pomarine Jaeger | | LC |
| ***Hydrobates pelagicus*** | European Storm-petrel | Annex 1 | LC | ***Stercorarius skua*** | Great Skua | | LC |
| ***Hydrocoloeus minutus*** | Little Gull | | LC | ***Sterna hirundo*** | Common Tern | | LC |
| ***Hydroprogne caspia*** | Caspian Tern | Annex 1 | LC | ***Sterna paradisaea*** | Arctic Tern | Annex 1 | LC |
| ***Larus argentatus*** | European Herring Gull | | LC | ***Sternula albifrons*** | Little Tern | Annex 1 | LC |
| ***Larus canus*** | Mew Gull | | LC | ***Thalasseus sandvicensis*** | Sandwich Tern* | Annex 1 | LC |
| ***Hydrobates pelagicus*** | European Storm-petrel | | LC | ***Uria aalge*** | Common Murre* | Annex 1 | LC |
| ***Larus fuscus*** | Lesser Black-backed Gull | | LC | ***Xema sabini*** | Sabine's Gull | | LC |
| ***Larus glaucoides*** | Iceland Gull | | LC | | | | |

*Legend: LC: Least Concern, NT: Near threatened, VU: Vulnerable.*

Source: Birdlife International 2020; Skov & Piper, 2009

## 6.1 Species of Conservation Concern

There are no regularly occurring IUCN Red List globally CR or EN seabird species within the Halfdan area. The European regionally EN northern fulmar occurs regularly, as do the globally VU Atlantic puffin and black-legged kittiwake. Regularly occurring species of IUCN (International Union for Conservation of Nature) concern are shown in Table B 8. Of these species, black-legged kittiwake and northern fulmar are likely to occur regularly within the Halfdan area. A number of species that occur within the area are listed on Annex I of the EU Birds Directive (identified in Table 4.8), meaning that member states have an obligation to identify Special Protection Areas (SPAs) to protect key areas for their survival. Member states are also obliged to identify SPAs for regularly occurring migratory species, which are not listed by species in the Birds Directive, but which include all seabirds because of their migratory and congregatory behaviour.

**Table B 8. Seabirds of Conservation Concern with published distributions overlapping the Halfdan Area**

| Species | IUCN Red List Status/European Red List Status/ local population trend | Biology and geographical distribution |
|---|---|---|
| Northern fulmar (*Fulmarus glacialis*) | Least Concern<br>Endangered<br>Declining | Listed as LC globally but considered EN at a European level due to ongoing population declines. |

| Species | IUCN Red List Status/European Red List Status/ local population trend | Biology and geographical distribution |
|---|---|---|
| | | Northern fulmar has a large foraging range and is recorded throughout the North Sea during summer, with higher concentrations in the northern North Sea around Norway in the winter. |
| Atlantic puffin (*Fratercula arctica*) | Vulnerable<br>Endangered<br>Declining | Listed as VU globally but considered EN at a European level due to ongoing population declines.<br>In Europe principally breeds in Iceland, the Faroe Isles, Norway and the UK. Has a relatively short foraging range during the breeding season and is usually found closer to land. Occurs in lower densities further from shore and may occasionally occur within Danish waters.<br>In winter, Atlantic puffins is predominantly found in UK waters. |
| Black-legged Kittiwake *(Rissa tridactyla)* | Vulnerable<br>Vulnerable<br>Declining | The black-legged kittiwake is listed as VU on the IUCN list, as its population has been decreasing over the past three generations.<br>There are colonies on the Danish, UK and Norwegian coasts. The largest concentrations are found near these breeding areas.<br>In summer, the species is concentrated primarily in the western North Sea. Outside the breeding season, the species occurs throughout the North Sea with varying densities (*Bogdanova et al., 2011*). |

Source: Birdlife International 2020; Maersk, 2016.

# 7. PROTECTED AREAS AND DESIGNATED SITES

Protected areas within the wider north include Natura 2000 sites, Ramsar sites, Key Biodiversity Areas (KBAs) UNESCO world heritage sites and nationally designated areas. Within the Study Area, the only protected areas are Natura 2000 sites. Protected and recognised sites in relation to the Study Area are shown in Figure B 7. A number of other marine protected areas are currently under consultation as part of Denmark's Marine Spatial plan. The closest of these is approximately 100 kilometers east of the HALFDAN Field.

## 7.1 Natura 2000 Sites

The Natura 2000 network comprises:

- Habitats Directive Sites (Sites of Community Importance (SCIs) and Special Areas of Conservation (SACs)) designated by Member States for the conservation of habitat types and animal and plant species listed in the Habitats Directive.
- Bird Directive Sites (SPAs) for the conservation of bird species listed in the Birds Directive as well as migratory birds.

The Natura 2000 conservation sites in the North Sea in relation to the Halfdan area are presented in Figure B 7. The closest site near the Halfdan hub area is located at approximately 20 km west of Halfdan, in the German EEZ. This area is named Doggerbank SCI (site code DE1003301). It comprises a submerged sandbank, which is designated as an Annex 1 habitat. It is also designated for supporting internationally important populations of harbour porpoise, common seal, northern fulmar, lesser black-backed gull, northern gannet, black-legged kittiwake and common guillemot.

The next nearest Natura 2000 conservation site is the Doggersbank SCI (NL2008001). It shares a boundary with the Doggerbank (DE1003301) and the Dutch EEZ. It is approximately 52 km west of the Halfdan area. It comprises a submerged sandbank, which is designated as an Annex 1 habitat. It has an abundance of marine species, including *Halichoerus grypus, Phoca vitulina* and *Phocoena phocoena*.

## 7.2 Coastal Designated Sites

Coastal designated sites of international importance include Ramsar sites, UNESCO world heritage sites, and key biodiversity areas including Important Bird and Biodiversity Areas. All coastal designated sites are at least 100 km away from Halfdan area.

# 8. INVASIVE SPECIES

The Danish Environmental Protection Agency (DEPA) published on 2017 the “Action plan against invasive species” (DEPA, 2017). The Report indicates that a large number of marine alien species can be introduced to the Danish North Sea, for example, through ballast water and fouling from ships. Denmark has implemented the Ballast Water Management Convention with the Marine Environment Act which requires ships to manage ballast water by minimising and ultimately eliminating transfer of invasive species. The Ballast Water Management Convention entered into force on 8 September 2017.

DEPA used a scoring system for the Action Plan where the ‘invasiveness’ of alien species - i.e. the damage they cause to biodiversity and related ecosystem services - is assessed based on a scoring system. This scoring system evaluates species based on the adverse impacts they cause or may cause. The scores are either high (3), medium (2) or low (1) for each of the six categories: ‘Dispersal potential’, ‘colonisation of high conservation value habitats’, ‘adverse impacts on native species’, ‘alteration of on ecosystem functions’, ‘economic effects and health effects’. All alien species thereby receive a score between 6 and 18, and this score can be used as a management tool. The scoring of the individual parameters for each species was carried out by experts in the various species. In order for a species to be called invasive, it must have a total score of at least 7, with a score of at least 2 in the categories ‘effect on indigenous species’ and ‘effect on ecosystem functions’.

The Danish Action Plan against invasive species lists 66 invasive species assessed to have the greatest adverse impact in Denmark (having total score of 14-18 for a highly damaging impact on the environment, human health and the economy). For HALFDAN Field, TEPDK conducted sediment and biological monitoring campaigns with no clear evidence of invasive benthic species presence. However, no specific monitoring studies have been conducted specifically focusing on invasive species in the vicinity of Halfdan facilities. Sampling data of plankton and visual monitoring activities for crabs, as well as for algae and molluscs potentially fouling the submerged structures at HALFDAN Field is not available.

With respect to the species listed in the Danish Action Plan (DEP, 2017) only plankton species (*Alexandrium minutum*, *Alexandrium tamarense*, *Chattonella verruculosa*, *Heterosigma akashiwo*, *Karenia mikimotoi*, *Pseudochattonella farcimen*) and the Ctenophore *Mnemiopsis leidyi* are considered possibly present in pelagic waters of HALFDAN Field. All other species are considered not likely present due to their ecological characteristics and the current knowledge of benthic colonization of TEPDK offshore structures:

- Algae:
  - Gracilaria vermiculophylla,
  - Sargassum muticum, Japweed,
  - Undaria pinnatifida, Wakame;
- Anellid (worms)
  - *Marenzelleria neglecta*, red-gilled mud worm,
  - *Marenzelleria viridis*
- Crustacean:
  - *Eriocheir sinensis*, Chinese mitten crab,
  - *Paralithodes camtschaticus*, Red king crab;
- Fish: Neogobius melanostomus, Round goby;
- Ctenophore: *Beroe ovata*, Brown comb jellyfish.

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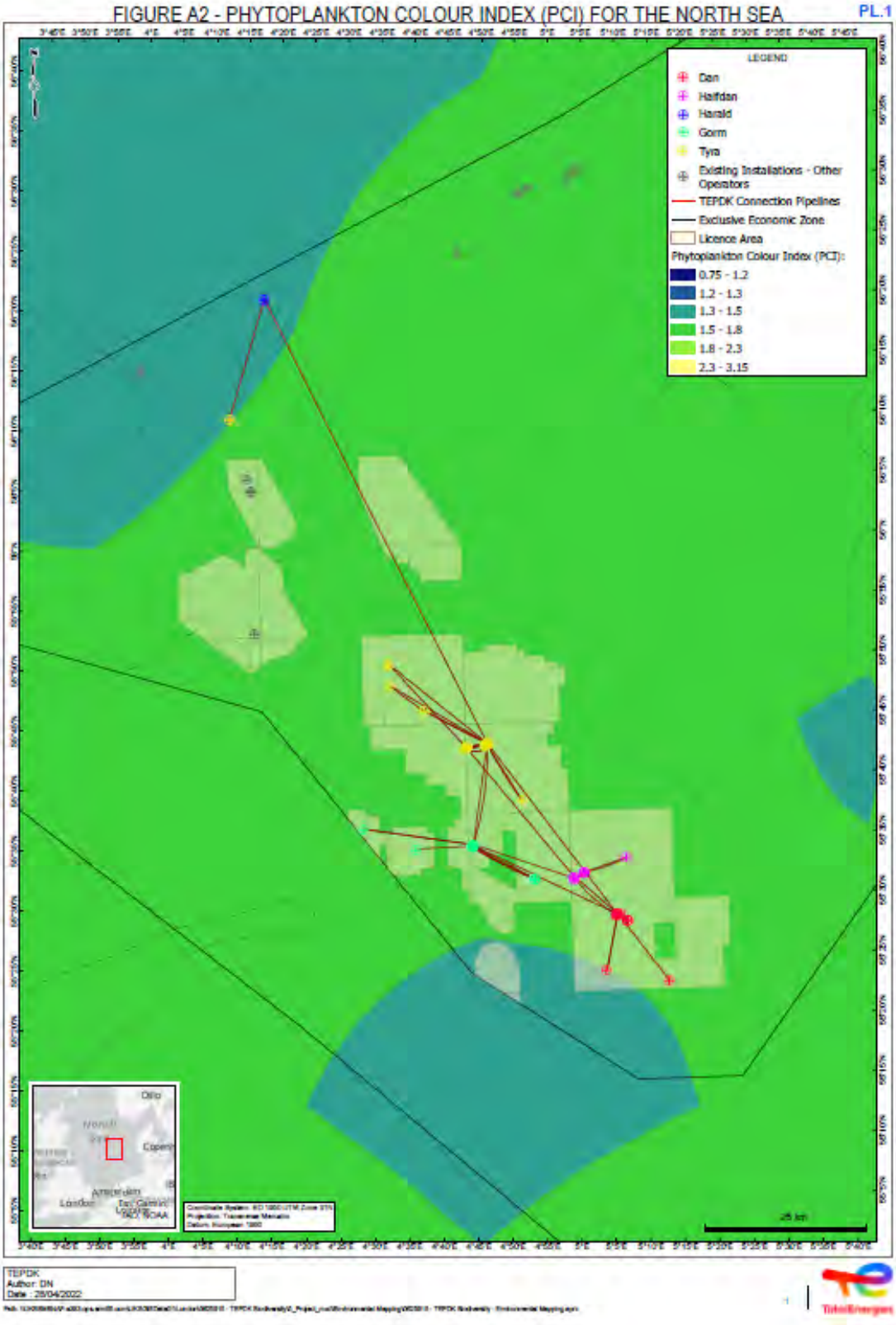
## 10. REFERENCES (FIGURES)

**Figure B 2. Phytoplankton Colour Index (PCI) of the Study Area**



## Figure B 3. Benthic Substrates

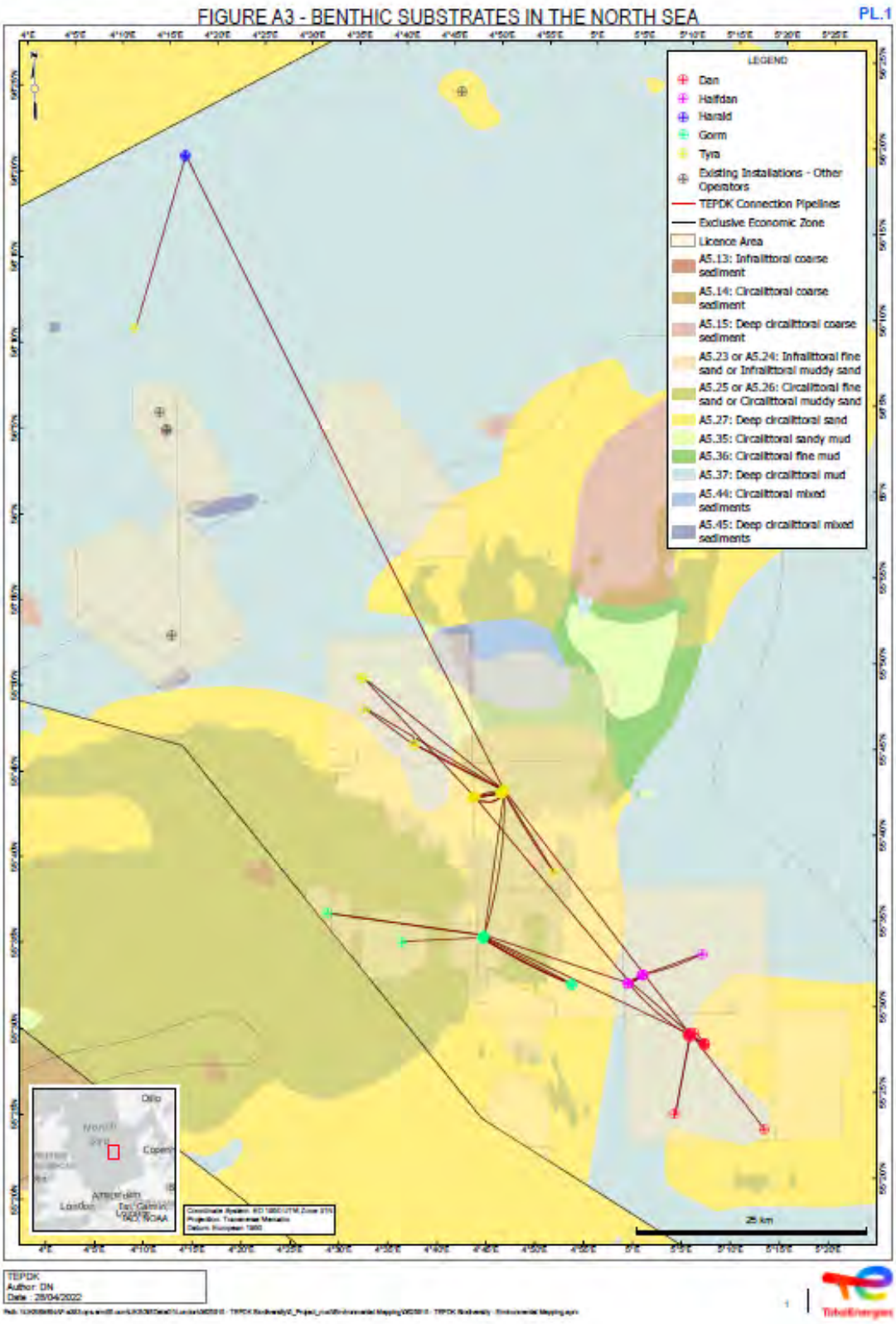


**Figure B 4. Benthic Fauna Assemblage in the North Sea**

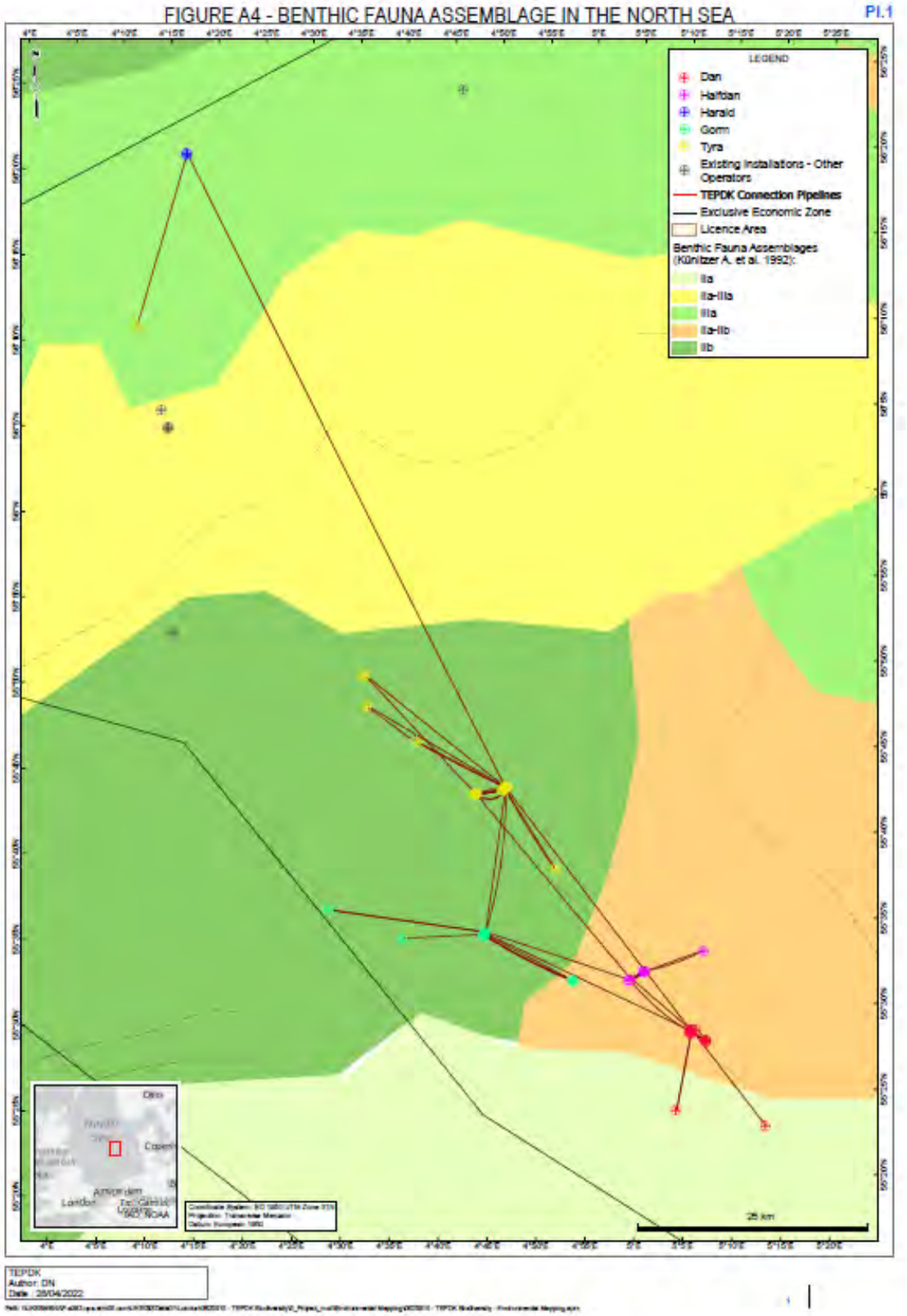
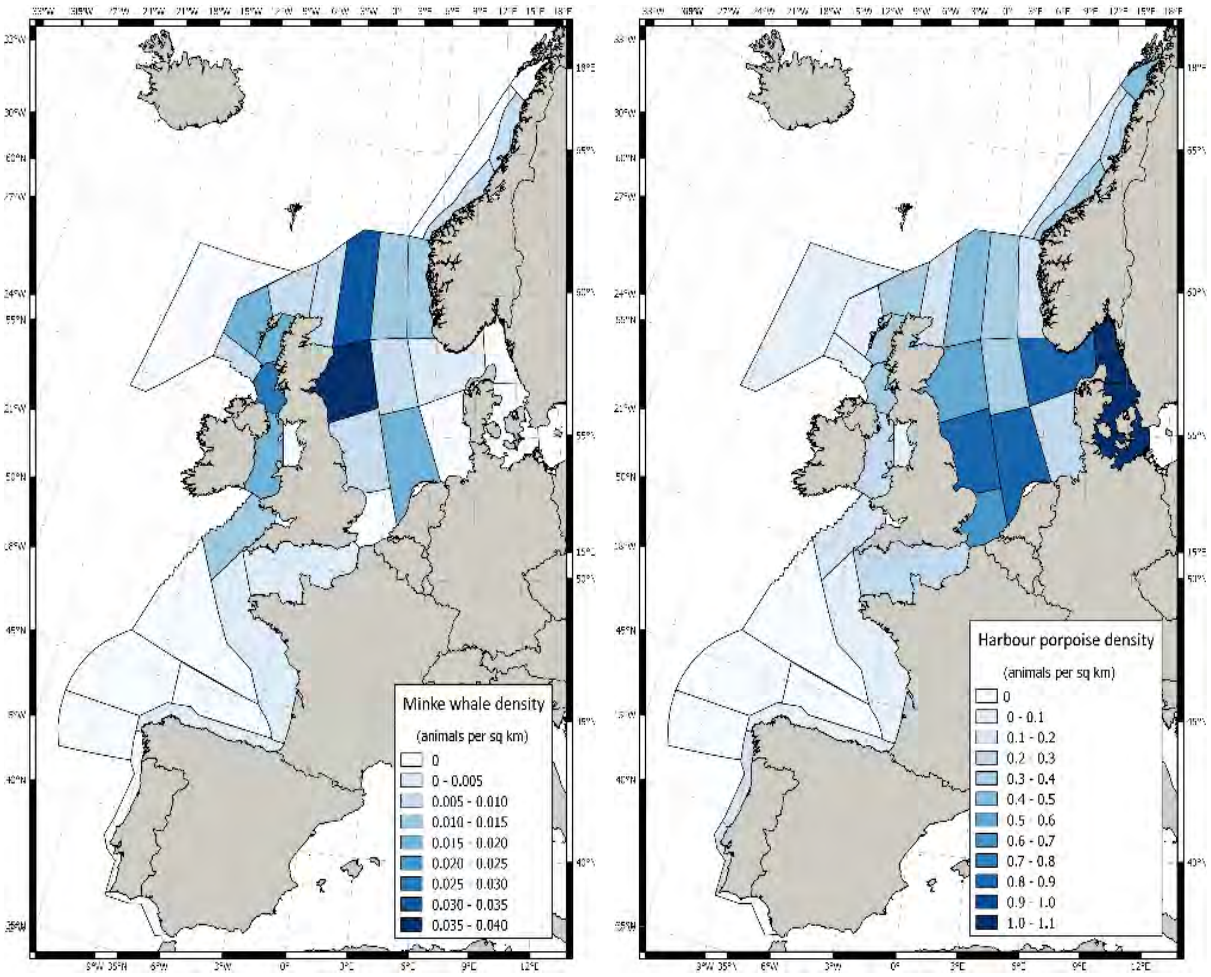
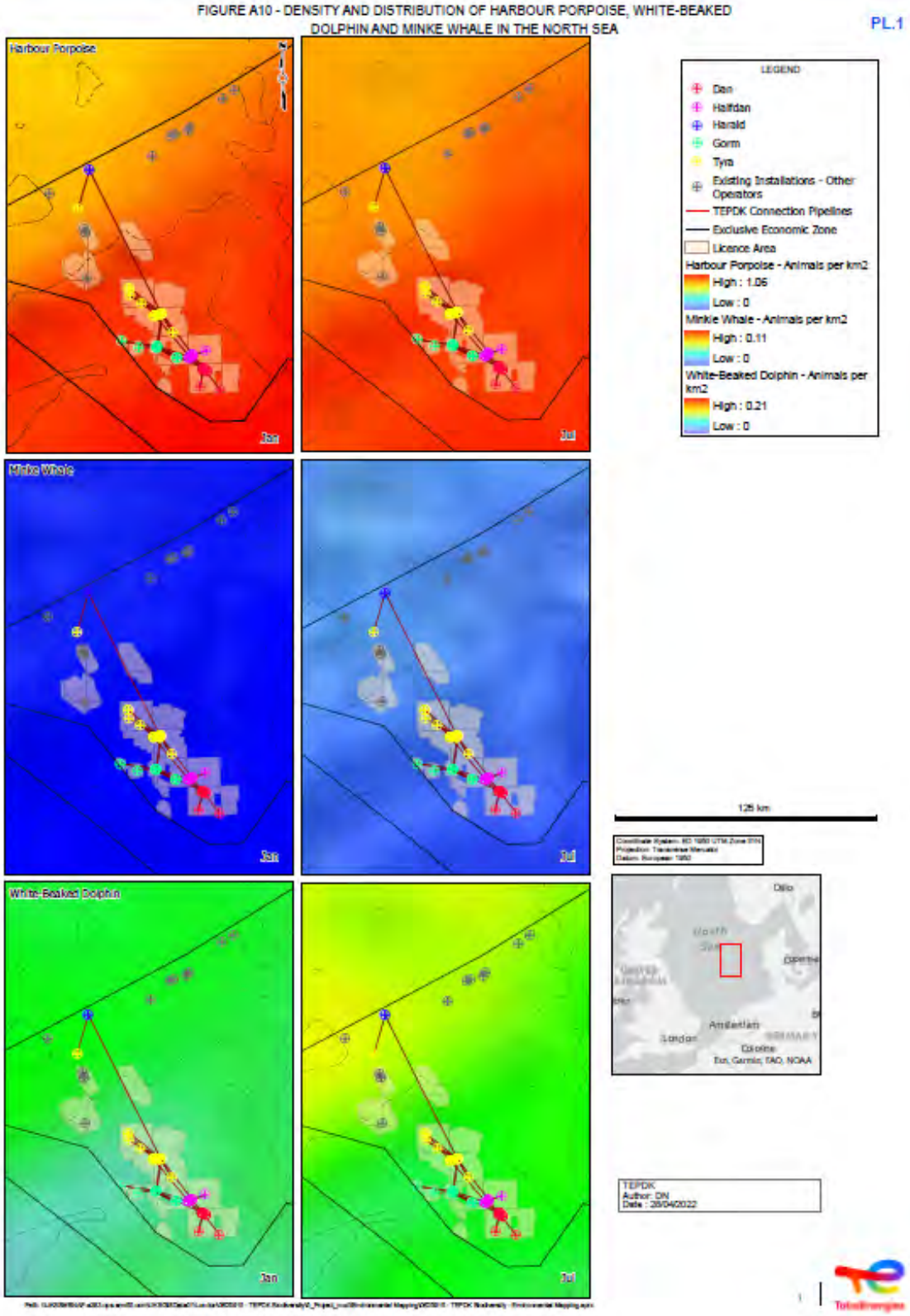


**Figure B 5. Estimated Density in Survey Blocks of (a) Minke Whales and (b) Harbour Porpoises**

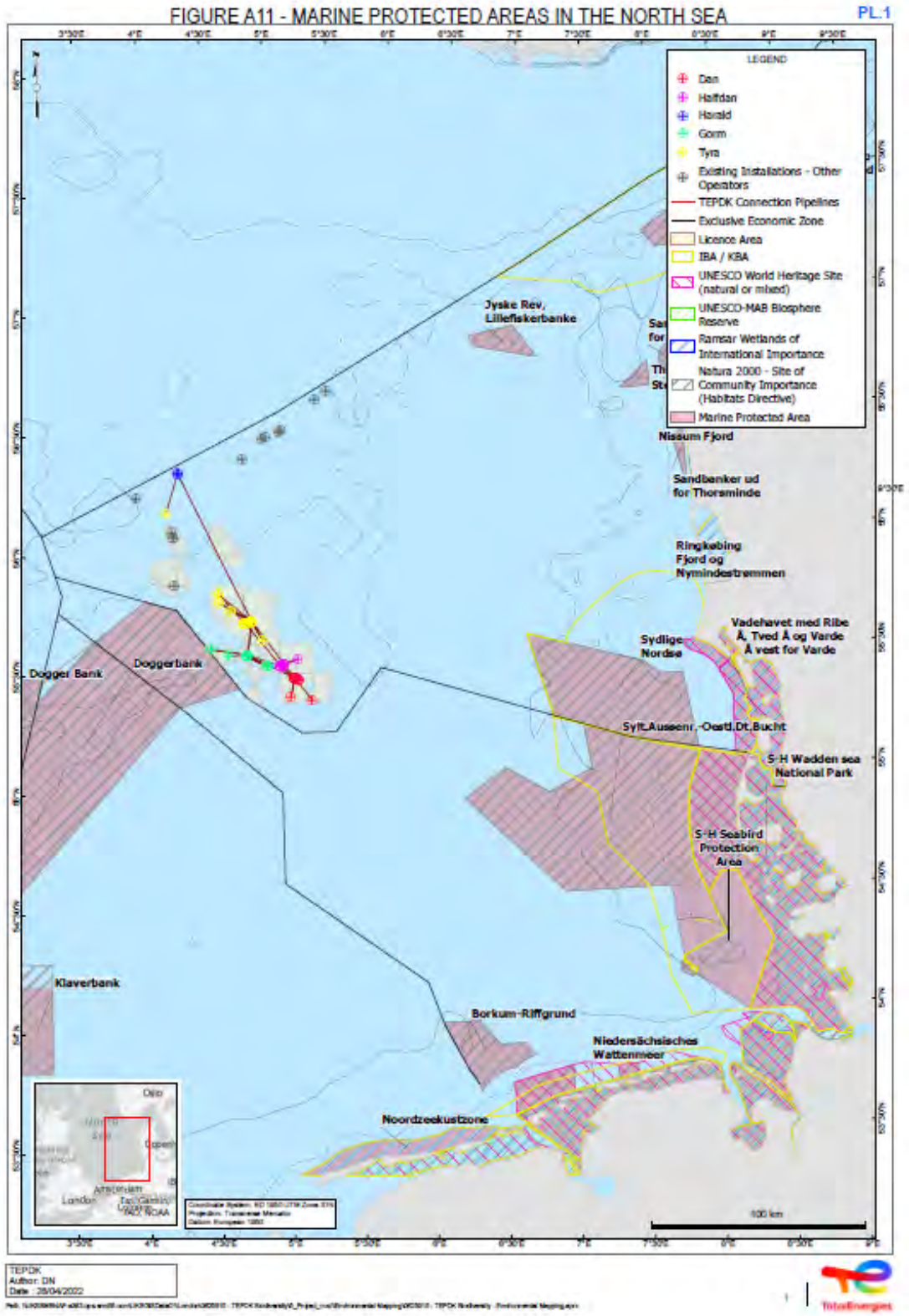



Source: Hammond et al., 2017

## Figure B 6. Density and Distribution of Harbour Porpoise, White-Beaked Dolphin and Minke Whale



## Figure B 7. Marine Protected Areas



## 11. REFERENCES (TABLES)

### Table B 9. Phytoplankton and Zooplankton in the Southern North Sea.

| Phytoplankton | Zooplankton |
|---|---|
| *Ceratium fusus* | *Total copepods* |
| *Ceratium furca* | *Echinoderm larvae* |
| *Ceratium tripos* | *Pseudocalanus spp.* |
| *Chaetoceros (Phaeoceros) spp.* | *Acartia spp.* |
| *Chaetoceros (Hyalochaete) spp.* | *Temora longicornis* |
| *Ceratium macroceros* | *Evadne spp.* |
| *Thalassiosira spp.* | *Pseudocalanus adult.* |
| *Protoperidinium spp.* | *Oithona spp.* |
| *Ceratium horridum* | *Calanus traverse* |
| *Ceratium longipes* | *Podon spp* |

Source: Maar et al., 2016

# APPENDIX C CHEMICAL CLASSIFICATION AND THE IMPLEMENTATION OF OSPAR IN DENMARK

## IMPLEMENTATION OF OSPAR IN DENMARK

Hazardous substance and materials, including chemicals used in the offshore oil and gas industry, are recorded and monitored through the Danish Product Registry. This is a joint registry under the Working Environment Authority and Danish Environmental Protection Agency (DWEA, 2020). In total, around 38,000 chemicals are registered, of which 350 are actively used offshore.

All substances listed in the Product Registry are given a PR number, and information such as composition and use are listed. When the registration is approved, the chemical will receive the PR number. Chemicals used in the offshore oil and gas industry are also covered by OSPAR guidelines, and, as such, additional information is required for registration in accordance with Annex 1 of OSPAR Recommendation 2010/3 on a Harmonized Offshore Chemical Notification Format (HOCNF) (as amended). The application must include the exact composition of the substance and its ecotoxicological properties according to OSPAR guidelines, and chemicals must be re-notified every three years. The Danish Environmental Protection Agency uses the information in the Product Registry when an operator applies for a discharge permit for offshore chemicals.

The Danish Environmental Protection Agency follows the "colour classification" for rating chemicals made in OSPAR Recommendation 2019/04 on Harmonised Pre-screening Scheme for Offshore Chemicals. The Danish Ministry of Environment has, in some cases, grouped the classifications from OSPAR as Black, Red, Yellow and Green according to Appendix 1 of OSPAR Recommendation (2019/04). To facilitate proper implementation of the regulation, TEPDK has its own Chemical Management Plan (TEPDK-L2-PRO-HSE-0028-E; TEPDK, 2020) compliant with OSPAR and applicable Danish regulations.

As a Danish operator, TEPDK follows the OSPAR colour classification (NORCE, 2019) and the system used by the Danish Ministry of Environment. The colour classification is as follows:

**Black**: Chemicals containing one or more components registered in OSPAR's 'List of Chemicals for Priority Action', and their use is prohibited except in special circumstances;

**Red:** Chemicals containing one or more components that, for example, accumulate in living organisms, are toxic, or slow to naturally degrade in the marine environment;

**Yellow**: Chemicals that can normally be discharged without specific conditions, although their use is monitored by the DEPA; and.

**Green:** Chemical components that pose little or no risk to the environment according to OSPAR's PLONOR (Poses Little or No Risk) classification.

Chemicals that are neither PLONOR nor candidates for substitution includes those that are:

Inorganic with LC50 or EC50 greater than 1 milligram per liter; and

Yellow (ranking chemicals), which includes substances ranked according to OSPAR Recommendation 2000/4 and which do not fall into another category.

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## Bilag B. Lovgrundlag – Referenceliste

*Miljøbeskyttelsesloven (MBL):*
*Lovbekendtgørelse om miljøbeskyttelse*, nr. 1742 af 22. december 2025.

*Miljøvurderingsloven (MVL):*
Lovbekendtgørelse om miljøvurdering af planer og programmer og af konkrete projekter (VVM), nr. 4 af 3. januar 2023.

*Havmiljøloven:*
Bekendtgørelse af lov om beskyttelse af havmiljøet nr. 147 af 19. februar 2024.

*Bekendtgørelse af offshoresikkerhedsloven:*
Bekendtgørelse af offshoresikkerhedsloven LBK nr. 125 af 6. februar 2018.

*Offentlighedsloven:*
Bekendtgørelse af lov om offentlighed i forvaltningen, nr. 145 af 24. februar 2020.

*Forvaltningsloven:*
Lovbekendtgørelse om forvaltning, nr. 433 af 22. april 2014.

**Bekendtgørelser**

*Godkendelsesbekendtgørelsen (GBK):*
Bekendtgørelse om godkendelse af listevirksomhed, nr. 1027 af 2. september 2024.

*Store fyr-bekendtgørelsen:*
Bekendtgørelse om begrænsning af visse luftforurenende emissioner fra store fyringsanlæg, nr. 1940 af 4. oktober 2021.

*MCP-bekendtgørelsen:*
Bekendtgørelse om miljøkrav for mellemstore fyringsanlæg, nr. 1408 af 27. november 2023.

*Bekendtgørelse om visse luftforurenende emissioner fra fyringsanlæg på platforme på havet:*
Bekendtgørelse om visse luftforurenende emissioner fra fyringsanlæg på platforme på havet BEK nr. 1449 af 20. december 2012.

Bekendtgørelse om indberetning i henhold til lov om beskyttelse af havmiljøet BEK nr. 874 af 27. juni 2016.

Bekendtgørelse om tilsyn, gebyr m.v. for olie- og gasanlæg:
Bekendtgørelse om tilsyn, gebyr m.v. for olie- og gasanlæg BEK nr. 908 af 10. juli 2015.

**Vejledninger fra Miljøstyrelsen**

*Miljøgodkendelsesvejledningen:*
Miljøgodkendelsesvejledningen

*BREF-noter*
Se oversigt på: https://mst.dk/erhverv/groen-produktion-og-affald/industri/bat-bref/liste-over-alle-bref-dokumenter

## Bilag C

Energistyrelsens høringssvar

Energistyrelsen

Miljøstyrelsen
Att. Karsten Borg Jensen

**Kontor/afdeling**
Indvinding og miljø

**Dato**
14-08-2026

**J nr.** 2026 - 10019

/LSM

**Høringssvar til Miljøstyrelsen vedr. ansøgning om tillæg til miljøgodkendelse for Halfdan Oil Re-Route og HBA-27**

Energistyrelsen har den 2. juli 2026 modtaget en høring fra Miljøstyrelsen vedr. en ansøgning fra TotalEnergies om tillæg til miljøgodkendelse for Halfdan Oil Re-Route og HBA-27 (Halfdan infill).

Energistyrelsen har følgende bemærkninger til ansøgningen:

Energistyrelsen kan oplyse, at Energistyrelsen den 3. marts 2023 i medfør af miljøvurderingslovens § 21 traf afgørelse om, at arbejder forbundet med Halfdan Oil Re-Route projektet ikke er omfattet krav om miljøvurdering, da de ansøgte arbejder ikke vurderes at have væsentlige skadelige indvirkninger på miljøet. Afgørelsen blev truffet på baggrund af de oplysninger, der fremgår af screeningsrapporten *Halfdan Oil Re-Route Environmental Screening Report* dateret den 2. december 2022 indsendt af TotalEnergies. Afgørelsen kan læses her.

Merudledning af NOx-emissioner har ikke været omfattet af det projekt, som Energistyrelsen har miljøvurderet. Energistyrelsen vil på denne baggrund rette henvendelse til TotalEnergies med henblik på nærmere håndtering efter miljøvurderingsreglerne.

Energistyrelsen kan yderligere oplyse, at Energistyrelsen den 1. marts 2023 i medfør af miljøvurderingslovens § 21 traf afgørelse om, at arbejder forbundet med etablering af fire nye produktionsboringer på Halfdan feltet ("Halfdan Infill Wells") – herunder HBA-27- og samtidig sløjfning af fire eksisterende brønde ikke er omfattet af krav om miljøvurdering, da de ansøgte arbejder ikke vurderes at have væsentlige skadelige indvirkninger på miljøet. Afgørelsen blev truffet på baggrund af de oplysninger, der fremgår af screeningsrapporten *Halfdan Tor NE and Ekofisk Infill Wells Project – Environmental Impact Assessment Screening Report* dateret den 22. november 2022 samt supplerende materiale i form af dels støjmodelleringsmodel og mere detaljeret tidsplan indsendt af TotalEnergies. Afgørelsen kan læses her.

**Energistyrelsen**

Carsten Niebuhrs Gade 43
1577 København V

Niels Bohrs Vej 8
6700 Esbjerg

T: +45 3392 6700
E: ens@ens.dk

www.ens.dk

Energistyrelsen

Energistyrelsen kan derudover oplyse, at Energistyrelsen i øjeblikket behandler TotalEnergies' ansøgning om sløjfning af de eksisterende brønde HDA-35 og HDA31 samt bore to nye brønde i henhold til undergrundslovens § 10, stk. 3. (to ud af de fire Halfdan Infill brønde), og at Energistyrelsen i den forbindelse har vurderet, at det ansøgte tillige er omfattet af VVM-reglerne i miljøvurderingsloven. Energistyrelsen vil sende den fuldt oplyste miljøkonsekvensrapport i offentlig høring, samt orientere Miljøstyrelsen, når Energistyrelsens afgørelse foreligger.

Energistyrelsen kan endeligt oplyse, at rutinemæssig flaring er forbudt efter metanforordningen (forordning (EU) 2024/1787), jf. artikel 15.

Med venlig hilsen

Laura Strøm Magner