

Western Basin Dredging and Disposal Project (EPBC 2009/4904)

Environmental Performance Report December 2022

For the attention of: The Department of Climate Change, Energy, Environment and Water



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Cover Photos :

1. Colin J. Limpus, Nancy N. FitzSimmons, and Milani Chaloupka (2021). Flatback Turtle, *Natator depressus*, Seven Year Review: 2013/14 – 2019/20 Breeding Seasons at Curtis, Peak and Avoid Islands. Brisbane: Department of Environment and Science, Queensland Government. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation’s Ecosystem Research and Monitoring Program.

2. Colin J. Limpus, Nancy N. FitzSimmons, Ian Anderson, Leisa Baldwin, Wayne Bennet, Leisa Fien, Fiona Hoffmann, Erwin Hoffmann, Duncan J. Limpus, and Trevor Turner (2021). Monitoring of eastern Australian flatback turtle, *Natator depressus*, breeding populations in the Gladstone region: 2020-2021 breeding season. Brisbane: Department of Environment and Science, Queensland Government. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation’s Ecosystem Research and Monitoring Program.

3. Pers. Communication Danielle Cagnazzi (Assessment of Toxicological Status of Australian Humpback and Australian Snubfin Dolphins in the Port Curtis and Port Alma, 2020)

Executive Summary

The 2022 Environmental Performance Report (EPR) has been prepared to comply with the following conditions of the Western Basin Dredging and Disposal Project (WBDDP) *Environmental Protection and Biodiversity Conservation Act* (EPBC Act) Approval 2009/4904:

Condition 36

Ecosystem and Research Monitoring Program (ERMP)

The person taking the action must submit to the Minister an Annual Environmental Performance Report covering the following topics:

- a) Dolphins, dugong and marine turtles, and other megafauna;*
- b) Migratory shorebirds; and*
- c) Seagrass.*

Condition 37

ERMP

12 Months from the date of approval, a report must be submitted outlining the initial environmental activities for the 12 month period. The report is to be called the Environmental Performance Report and must be submitted within 42 days of the 12 month activity period. The Environmental Performance Report must include proposed environmental management improvements to be implemented through the DCMP, WQMP and other Plans as relevant. Reports are required annually from thereafter.

The 2022 EPR covers the reporting period from 1 November 2021 to 31 October 2022 and includes the outcomes of the studies conducted under the ERMP (ERMP study area depicted in Appendix 1). This is the twelfth EPR being submitted. All the previous EPRs are published on GPC's website.

In 2021, progress of many projects and the submission of reports was impacted by restrictions imposed by COVID-19. Extensions were provided to some of the projects upon recommendation from the Ecosystem Research and Monitoring Program Advisory Panel (ERMPAP) (Appendix 2).

All on-going projects under the ERMP came to an end in October 2022 (Table 1). No formal meeting of the ERMPAP was held in the current reporting period, however all reports were reviewed by the subject matter experts from the ERMPAP and the Chair of the ERMPAP.

An outstanding action from the 2021 EPR (Table 2) which required completion of all programs by October 2022 has been achieved.

Table 1: Status update on the ERMP projects in the current reporting period (1 November 2021 to 31 October 2022)

Project Name	Objective	Timeline	Status	Documents
Marine turtle nesting populations: Avoid, Peak and Curtis Island Flatback Turtles.	To conduct an annual mid-season census (tagging census) of nesting flatbacks at index beaches within the Eastern Australian genetic stock in the Gladstone regions: Curtis, Wild Duck and Peak Islands	2013-2022	<p>This project ended in the current reporting period</p> <p>GPC received one (1) Annual Report for the 2020-2021 monitoring period and two (2) final whole of project Synthesis reports in this reporting period:</p> <p><u>Report Title: Monitoring Of Eastern Australian Flatback Turtle, Natator Depressus, Breeding Populations In The Gladstone Region: 2020-2021 Breeding Season</u></p> <ul style="list-style-type: none"> This report summarised the results of monitoring the Eastern Australian (eAust) Flatback turtle nesting population at Curtis, Peak and Wild Duck Islands during the 2020-2021 breeding season. A total of 95 nesting crawls from 67 individual tagged nesting Flatback turtles and 72 clutches of eggs were recorded at Curtis Island, 322 nesting crawls from 209 tagged individual nesting Flatback turtles and 190 clutches of eggs were recorded at Peak Island and a total of 432 nesting crawls from 329 individual nesting Flatback turtles and 291 clutches were recorded at Wild Duck Island during the census period (24 November – 7 December 2020). Curtis Island had the lowest level of recruitment since 2002, at 13.4%, during the census period. Most remigration intervals for nesting females at Curtis Island were two (2) four (4) years and three (3) years at 	<ul style="list-style-type: none"> Colin J. Limpus, Nancy N. FitzSimmons, Ian Anderson, Wayne Bennet, Leisa Baldwin, Leisa Fien, Fiona Hoffmann, Erwin Hoffmann, Duncan J. Limpus, and Trevor Turner (2021). Monitoring of eastern Australian Flatback turtle, Natator depressus, breeding populations in the Gladstone region: 2020-2021 breeding season. 64 pp.- (1807789) Colin J. Limpus, Nancy N. FitzSimmons, and Milani Chaloupka (2021). Flatback Turtle, Natator depressus, Seven Year Review: 2013-2014 to 2019-2020 Breeding Seasons

Project Name	Objective	Timeline	Status	Documents
			<p>Peak Island. At Wild Duck Island, accurate estimates of remigration were not possible due to the long gap in data collection. Re-sightings of turtles tagged several years ago included time spans of up to 38 years.</p> <ul style="list-style-type: none"> • Nesting success was 75.8% on Curtis Island, 72 % on Peak Island and 75.4% on Wild Duck Island. • Highest emergence rate was observed on Wild Duck Island (91%), followed by Curtis and Peak islands (84-80%). • The report highlighted that ongoing management of feral animals by Queensland Parks and Wildlife Service (QPWS) within the Curtis Island National Park is maintaining Flatback turtle clutch loss to predators such as pigs, dogs and foxes at a negligible level. <p><u>Report Title: Flatback Turtle, Natator Depressus, Seven Year Review: 2013-2014 To 2019-2020 Breeding Seasons At Curtis, Peak And Avoid Islands</u></p> <ul style="list-style-type: none"> • This report summarised the results of monitoring the eastern Australian (eAust) Flatback turtle nesting population at Curtis, Peak and Avoid Islands during a seven (7) year period from the 2012-2013 to the 2019-2020 breeding seasons. • For each of these seasons, a two (2)-week mid-season census was conducted at all three (3) islands. • During the 2016-2017 season, a near complete season census was conducted on Avoid Island and Curtis Island. Additionally, intermittent monitoring has been conducted on Curtis Island since 2017-2018. • Population trend analysis from 2013 to 2021 showed declines in number of nesting turtles at all the three (3) 	<p>at Curtis, Peak and Avoid Islands. 83 pp. (1793389)</p> <ul style="list-style-type: none"> • Limpus, C. J., Chaloupka, M., Ferguson, J., FitzSimmons, N. N. and Parmenter, C. J. (2020). The Flatback turtle, Natator depressus, in Queensland: population size and trends 58 pp. (1793425)

Project Name	Objective	Timeline	Status	Documents
			<p>islands.</p> <ul style="list-style-type: none"> • Extensive loss to nests resulted from Cyclone Dylan in 2014. Eroded dune surfaces from Cyclone Dylan continue to impact nesting on Avoid Island. • Extensive heatwave conditions persisted in Queensland between 2016-2017 and between 2018-2019. The report predicted that this may lead to a female biased hatchling sex ratios. • Key concerns/ recommendations included in the report were: <ul style="list-style-type: none"> ○ a predicted feminisation of the population due to a female biased hatchling production, ○ light pollution which is observed to affect turtles at the Curtis Island rookery, ○ need for continued monitoring of the nesting females to understand the apparent contradiction between the observed reductions in the number of nesting turtles versus the demographic analyses indicating increasing population trends. <p><u>Report Title: The Flatback turtle, Natator depressus, in Queensland: population size and trends</u></p> <ul style="list-style-type: none"> • This report analysed the long term nesting abundance at major nesting beaches in Queensland inclusive of: <ul style="list-style-type: none"> ○ Curtis Island within Port Curtis: 27 years of data, 1993-2019; ○ Peak Island adjacent to Port Curtis: 30 years of data. 1980-2019; ○ Avoid Island, a control site well removed from coastal development: Eight (8) years of data, 2012- 	

Project Name	Objective	Timeline	Status	Documents
			<p>2019; and</p> <ul style="list-style-type: none"> ○ Woongarra Coast, a control site at the southern limit of Flatback turtle nesting in eastern Australia: 52 years of data, 1968-2019; ○ Flinders Beach at Mapoon, a control site within a different genetic stock and well removed from industrial development: 16 years of data, 2004-2019. <ul style="list-style-type: none"> ● None of the study populations showed a decline in nester abundance during the monitoring period ● High mean annual survivorship of adult female Flatback turtles was recorded at all five (5) index study sites. ● The results are indicative of stock wide population increases in adult Flatback nesting populations across northern and eastern Australia within the last two (2) decades. ● The mean size of the adult female Flatback turtles has been increasing at all study sites since their respective studies began. ● This report concluded that an examination of nester abundance, survival and recruitment estimates from the present study for Curtis Island when compared with those at Peak Island, Woongarra Coast and Avoid island, all within the eAust genetic stock, provided no indication of an anomalous population performance of the Curtis Island nesting population during or following the major dredging and infrastructure development within Port Curtis that occurred during 2011-2013. 	

Project Name	Objective	Timeline	Status	Documents
<p>Increase the Understanding of the Green Turtle Population in Port Curtis</p>	<p>To obtain information pertaining to Green turtles for the period from 2015 to 2019 inclusive of size, sex, maturity, growth rates, survivorship, recruitment and general health of the green turtle population in Port Curtis and the Narrows.</p>	<p>2016-2022</p>	<p>This project ended in the current reporting period</p> <p><u>Report Title: Understanding of the Green Turtle Population in Port Curtis, 2016-2019</u></p> <ul style="list-style-type: none"> • The study was completed satisfactorily with 1576 captures of 1232 separate Green turtles out of a total of 3423 recorded sightings of green turtles during 2016-2019. Captures occurred consistently at multiple study sites within the Port Curtis. • The Green turtle was the most abundant turtle in intertidal and shallow subtidal waters of Port Curtis. • Most turtles were captured via the turtle rodeo method. However, the use of a 300 m blocking net remained the only effective means for capture of turtles in turbid waters. • Foraging Green turtles aggregated primarily in five (5) areas within Port Curtis that were characterised by being adjacent to outflows from rivers and creeks or, in the case of the Pelican Banks, with outflow from the Port where there is regular reversal of strong tidal currents and associated settlement of sediments to form wide shallow flats supporting seagrass and algal pastures. • The majority of the Green turtles within Port Curtis forage over the intertidal and subtidal flats adjacent to outside and inside of the outflow areas of the estuaries of Colosseum Creek, Boyne River, South Trees Inlet, Calliope River and the entrance to the Port between Curtis and Facing Islands. This latter area includes the Pelican Banks. • The team was unable to locate any area with a concentration of foraging Green turtles within the turbid 	<p>Colin J. Limpus and Nancy N. FitzSimmons (2020). Increasing the Understanding of the Green Turtle Population in Port Curtis, 2016-2019. 244 pp (1793425)</p>

Project Name	Objective	Timeline	Status	Documents
			<p>waters of the Western Basin or at the southern end of The Narrows except in the vicinity of Wiggins Island.</p> <ul style="list-style-type: none"> • External examination of foraging turtles in Port Curtis identified only low incidence of compromised health among the turtles captured: <ul style="list-style-type: none"> ○ Partly or extremely emaciated turtles = 7.9% ○ Turtles fractured from vessel interactions = 3.2% ○ Entangled in fishing gear and marine debris = 0.7% ○ Fibropapillomatosis = 3.6%. • Observed fracture injuries to turtles were consistent with damage caused primarily by medium to large outboard powered vessels moving at speed, not from the larger commercial vessels such as tugs and freighters using the Port infrastructures. • Dietary samples were collected and analysed from 329 Green turtles captured while foraging at nine (9) sites within Port Curtis during 2015-2019. • The diet of the Green turtles varied strongly across the sampling sites within Port Curtis, with grouping of food items into higher-level taxonomic forage categories indicated: <ul style="list-style-type: none"> ○ A strong predominance of seagrass in turtle diets at Pelican Banks, South Trees, and off Wild Cattle Island. ○ Red algae were the dominant food items at Quoin Island ○ Green algae were the primary food ingested at 	

Project Name	Objective	Timeline	Status	Documents
			<p>Wiggins Island.</p> <ul style="list-style-type: none"> ○ Turtles at the mouth of the Boyne River primarily ate red algae and seagrass and ○ Turtles at Facing Island ate a diet of red algae and mangroves. <ul style="list-style-type: none"> ● A total of 77 blood samples were collected and analysed, from 37 individual Green turtles captured in at least two (2) different years throughout the study period, 2011-2018. ● Co, Cr, Mn, Mo, Ni - concentrations were generally low in 2011, followed by a spike in the concentrations in 2013/14, a return to low concentrations in 2016, and another spike (except Cr) in 2017/18, although there are signs of concentrations decreasing from 2017 to 2018 in some individuals. ● As, Ba, Cd, Cu, Fe, Pb, Sb, Se, Ti, V, Zn - concentrations were generally low in 2011, and remained low until a spike in 2017/18, although, again, signs of concentrations decreasing from 2017 to 2018 in some individuals. ● These general trends indicate that the exposure of Port Curtis Green turtles to trace elements has changed over this eight (8) year sampling period. ● It could not be ascertained what caused these changes to exposure, although extreme rainfall events (with associated high level flooding) and port activity suggest that climatic and/or anthropogenic activities could be involved. ● The overall four (4) year mean population size for the combined Pelican Banks-Boyne Island area sites was estimated at 1170 Green turtles. ● The study estimated that the total resident foraging population of Green turtles within Port Curtis may add up to 	

Project Name	Objective	Timeline	Status	Documents
			many thousands.	
Assessment of Toxicological Status of Australian Humpback and Australian Snubfin Dolphins in the Port Curtis and Port Alma	The objective of this study is to improve our understanding of the toxicological status of Australian Snubfin and Australian Humpback dolphins in Port Curtis and Port Alma survey areas.	2019-2022	<p>This project ended in the current reporting period</p> <ul style="list-style-type: none"> The scope of this study included collection of biopsy samples from Australian Humpback and Australian Snubfin dolphins in Port Curtis and Port Alma. These samples were to be tested for persistent organic pollutants inclusive of pesticides and heavy metals. Sampling for the project commenced in July 2020 and continued until October 2020. However, during this sampling period only three (3) biopsy samples could be collected though quite a few dolphins were observed but they were approached for sampling they went underwater and moved away outside the sampling perimeter. Despite repeated sampling efforts, no additional biopsy samples could be collected. In 2021, surveys were again planned in March, June and July however due to COVID -19 restrictions these surveys could not be completed. The ERMPAP recommended that from the three (3) biopsy samples collected no meaningful interpretation of the toxicological status of the dolphins could be assessed. A report on the population of the Australian Humpback and Australian Snubfin dolphins in Port Curtis and Port Alma has been delivered under this project. <p><u>Report Title: Population Dynamics of Humpback and Snubfin dolphins in Port Curtis and Port Alma 2020</u></p>	<ul style="list-style-type: none"> Env ERMP Report Population Dynamics of Humpback and Snubfin dolphins in Port Curtis and Port Alma 2020 (#1743947)

Project Name	Objective	Timeline	Status	Documents
			<ul style="list-style-type: none"> • In 2020, 500km² and 474km² of area was surveyed in Port Alma and Port Curtis respectively. • Additional surveys were completed in 2021, but the number of representative sightings recorded was too small to justify the inclusion of the data in capture-recapture analyses. • Total population estimates of humpback dolphins in 2020 were all smaller than historical estimates for humpback dolphins in the region. • In Port Alma, the total number of humpback dolphins dropped from 68 in 2014 to 35 in 2016 and remained similar in 2020 (N_{total} =35). • In Port Curtis the number of humpback dolphins declined from 68 in 2016 to 36 in 2020. • The number of snubfin dolphins in Port Alma appeared to be stable. • The report recommended that: More dedicated studies are required to assess the reactions of humpback and snubfin dolphins to the increasing source of disturbance in the region. 	
<p>Monitoring the survival and recovery of shorelines, specifically Tidal Wetlands (Mangroves/Saltmarsh/Salt pans)</p>	<p>The objective of the study is to generate essential baseline data, including comparisons with historical information, as the basis for</p>	<p>2014-2022</p>	<p>This project ended in the current reporting period <u>Report Title: Final Report: Port Curtis and Port Alma Coastal Habitat Archive and Monitoring Program</u></p> <ul style="list-style-type: none"> • This Final Report documented the key findings of the program (2014- 2019) which included monitoring of the 	<p>Duke N.C., J. Mackenzie, A. Canning, J. Kovacs, R. Cormier and Y. Castle. (2022) 'Final Report: Port Curtis and Port Alma Coastal Habitat Archive and Monitoring</p>

Project Name	Objective	Timeline	Status	Documents
	<p>evaluations of environmental condition and change in mangroves and Tidal wetlands from Port Alma to Rodds Bay.</p>		<p>condition, survival and recovery of shorelines, specifically tidal wetlands within the Port Curtis Port Alma (PCPA) region extending from Port Alma to Rodds Harbour and included three subregions of Port Alma, Port Curtis and Rodds Harbour. Western Basin and Gladstone Harbour were included in the Central Port Curtis subregion.</p> <ul style="list-style-type: none"> • Tidal wetlands of the PCPA region occupy an area of around 59,501 ha, consisting of 24,608 ha of mangrove forests and thickets and 34,892 ha of tidal saltmarsh and saltpan. • In 2016, the total living plant carbon biomass of mangrove trees alone amounted to around 21 Mt. • Mangroves form the dominant structural element of tidal wetland habitat of the PCPA region, made up of 16 plant species. The most dominant, occupying more than 65% of mangrove areas, is the Stilt-Root Mangrove, <i>Rhizophora stylosa</i>. Five other species (31% of the total) occur at their southern-most distributional limits, including <i>Acanthus ilicifolius</i>, <i>Bruguiera exaristata</i>, <i>Bruguiera dungarra</i>, <i>Pemphis acidula</i> and <i>Xylocarpus moluccensis</i>. The mean height of mangrove trees in the region is around 4 m, with a maximal height closer to 10 m. The more diminutive tidal saltmarsh species comprise about 18 macrophyte species. • The report identified the following threats that may impact condition of tidal wetlands in the PCPA: <ul style="list-style-type: none"> ○ Coastal development leading to altered hydrology ○ Damage by vehicles, livestock, pollutants, bush fires, storm hail, flooding, 	<p>Program (PCPA CHAMPY'. 167 pp. including Appendices (1801780)</p>

Project Name	Objective	Timeline	Status	Documents
			<ul style="list-style-type: none"> ○ Shoreline Erosion ○ Shifting sediments ○ Rising sea levels leading to terrestrial retreat ○ Declining rainfall ○ Roosting fruit bats ○ Extensive insect herbivory <ul style="list-style-type: none"> ● The report evaluated the condition of protected mangrove forests surrounding the Western Basin Reclamation Area. It was observed that while these mangroves were impacted during the period of dredging (~2011 to 2013), there was no noticeable loss of trees, and the trees impacted recovered their lost canopy condition (from ~30% loss) by 2021. However, the fact that these trees displayed some level of impact (not noticed in the contracted monitoring programs) suggests that future monitoring strategies need to be improved upon. 	
<p>Migratory Shorebird Monitoring:</p> <p>Correlates of changing shorebird numbers</p>	<p>Design and conduct an analysis to determine how changing environmental conditions are related to the changing abundances and distributions of migratory shorebirds</p>	<p>2021-2022</p>	<p>This project ended in the current reporting period</p> <p><u>Report Title: Migratory Shorebird Monitoring: Correlates of changing shorebird numbers</u></p> <ul style="list-style-type: none"> ● The study investigated whether project activities in the WBDDP were associated with changes in shorebird numbers in the ERMP Survey Area (encompassing Port Alma, Port Curtis and Rodds Bay) between 2011 and 2020. ● This was attempted to be achieved by (i) analysing change in shorebird numbers in relation to time series data on water quality (turbidity) and change in extent of intertidal habitat, 	<p>Fuller RA, Woodworth BK, Shi X & Baxter PWJ (2022) – Migratory Shorebird Monitoring: Correlates of changing shorebird numbers. Final report to Gladstone Ports Corporation.120pp (1824452).</p>

Project Name	Objective	Timeline	Status	Documents
	<p>within the study area over the data collection period (2011 to 2020), involving (i) distinguishing local drivers of change (those operating within the ERMP region) from remote drivers (those operating outside the region, including overseas), and (ii) determining which drivers best explain changing numbers</p>		<p>and (ii) comparing shorebird trends in areas close to the project footprint between 2011 and 2013 with more distant areas.</p> <ul style="list-style-type: none"> • A rapid decline of three (3) species (Whimbrel, Eastern Curlew, Bar-tailed Godwit), and provisional declines of two (2) species (Great Knot, Sanderling) was detected in the ERMP Survey Area. • The study compared shorebird trends in the central zone of the ERMP Survey Area, which experienced direct project impacts, with trends in the northern and southern zones. • Overall shorebird numbers in the central zone did not decline, and no species declined more rapidly in the central zone than in the northern or southern zone. • Two (2) of the three (3) species declining in the ERMP Survey Area were also observed to be declining nationally, and for the Whimbrel, which was declining strongly in the ERMP Survey Area as a whole, the decline was mostly occurring in the northern zone, which was not directly impacted by project activity. • The Eastern Curlew is the only species significantly declining in the central zone immediately adjacent to the development precinct • Six (6) species did not decline in the ERMP Survey Area even though they were undergoing national declines (Terek Sandpiper, Common Greenshank, Curlew Sandpiper, Ruddy Turnstone, Pacific Golden Plover and Sharp-tailed Sandpiper). • The study recommended that: 	

Project Name	Objective	Timeline	Status	Documents
			<p>Given the decline of Eastern Curlew in the central zone proximal to the project impact, it is recommended that (i) targeted management actions are designed and implemented urgently through a rapid assessment process perhaps similar to that recently carried out by Healthy Land and Water in Moreton Bay, (ii) field studies are carried out to understand why the Eastern Curlew is declining and measure the impact of management, and (iii) a strategic plan is created for the region in which highly structured shorebird monitoring is continued to enable the impacts of natural and anthropogenic threats to be robustly assessed against a solid baseline.</p>	
<p>ERMP Synthesis Report</p>	<p>The purpose of this report is to synthesise the findings and outcomes of the ERMP that can be used to identify any potential impacts and inform adaptive management responses.</p>	<p>2019-2022</p>	<ul style="list-style-type: none"> • As mentioned in the above section, several longterm studies under the ERMP pertaining to nesting Flatback turtles, foraging Green Turtles, Humpback Dolphins, migratory shorebirds and tidal wetlands, came to an end in 2022. • Though the intent was to generate a standalone ERMP synthesis report, each of these project reports have synthesised the findings from the ERMP and highlighted whether any impact from the project could be detected. • The reports have also included some recommendations (as presented in this report) which will be considered as future projects. • These individual project reports (below) met the intent of the ERMP synthesis report hence a standalone ERMP synthesis report has not been prepared. • Colin J. Limpus, Nancy N. FitzSimmons, and Milani Chaloupka (2021). Flatback Turtle, <i>Natator depressus</i>, Seven Year Review: 2013-2014 to 2019-2020 Breeding Seasons at 	

Project Name	Objective	Timeline	Status	Documents
			<p>Curtis, Peak and Avoid Islands. (#1793389)</p> <ul style="list-style-type: none"> • Limpus, C. J., Chaloupka, M., Ferguson, J., FitzSimmons, N. N. and Parmenter, C. J. (2020). The Flatback turtle, <i>Natator depressus</i>, in Queensland: population size and trends (#1793425) • Colin J. Limpus and Nancy N. FitzSimmons (2020). Increasing the Understanding of the Green Turtle Population in Port Curtis, 2016-2019. (#1793422). • Duke N.C., J. Mackenzie, A. Canning, J. Kovacs, R. Cormier and Y. Castle. (2022) 'Final Report: Port Curtis and Port Alma Coastal Habitat Archive and Monitoring Program (PCPA CHAMP)'. • Fuller RA, Woodworth BK, Shi X & Baxter PWJ (2022), Migratory Shorebird Monitoring: Correlates of changing shorebird numbers. • Env ERMP Report Population Dynamics of Humpback and Snubfin dolphins in Port Curtis and Port Alma 2020 	

Table 2: Action from the 2021-2022 Environmental Performance Report

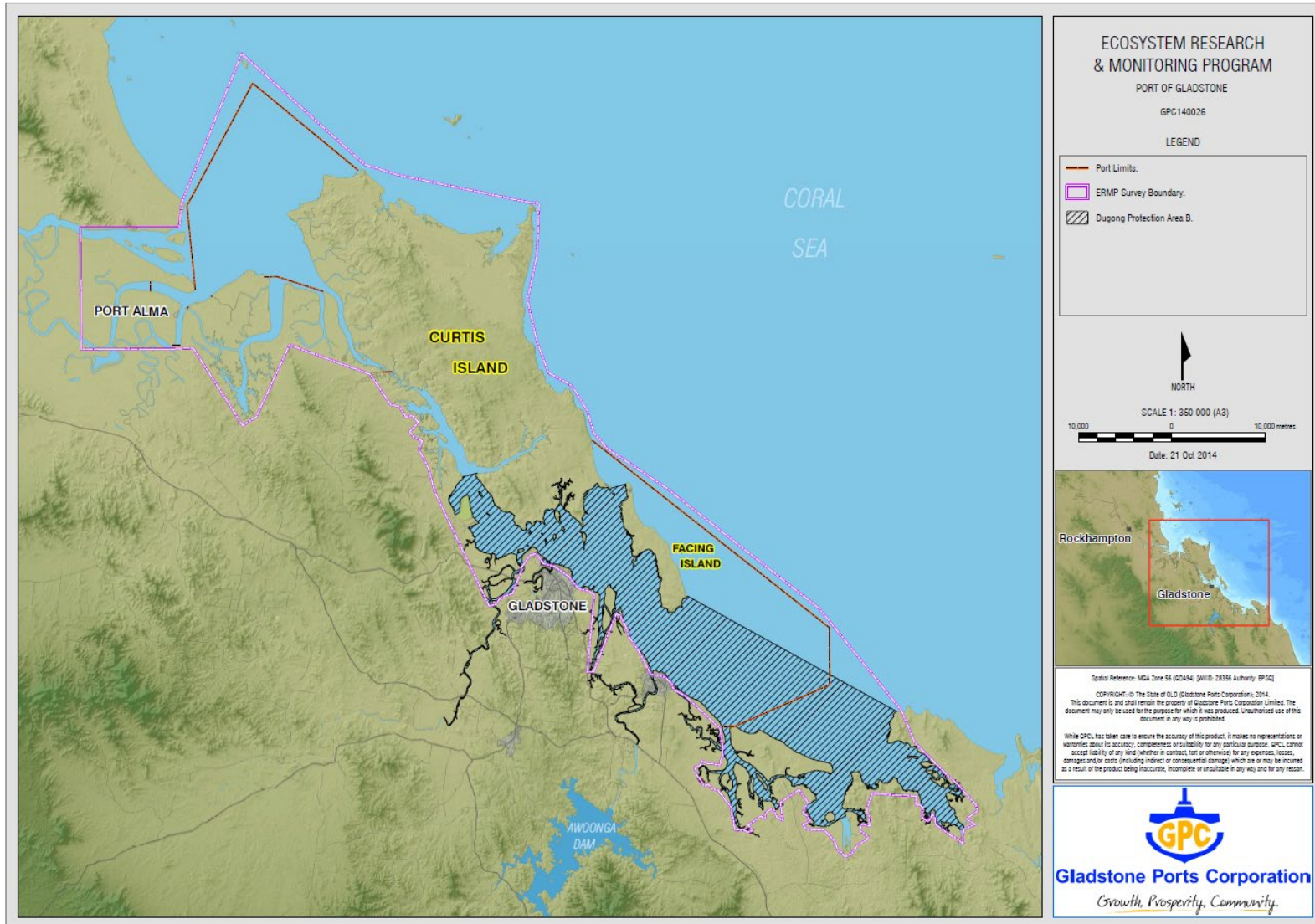
Action	Date	Status
Completion of all ERMP programs	22 October 2022	This has been achieved

Table 3: Publications

The ERMP studies also contributed towards the following publications in peer reviewed journals and reports:

- Abhik, S., P. Hope, H.H. Hendon, L.B. Hutley, S. Johnson, W. Drosowsky, J.R. Brown and N.C. Duke. 2021. Influence of the 2015-16 El Niño on the record-breaking mangrove dieback along northern Australia coast. *Scientific Reports* 11(20411): 12 pp.
<https://doi.org/10.1038/s41598-021-99313-w>
- Amir, A. A., and N. C. Duke 2019. Distinct characteristics of canopy gaps in the subtropical mangroves of Moreton Bay, Australia. *Estuarine Coast Shelf Science* 222: 66-80. DOI: 10.1016/j.ecss.2019.04.007
- Bergstrom, D.M., B.C. Wienecke, J. van der Hoff, L. Hughes, D.L. Lindemayer, T.D. Ainsworth, C.M. Baker, L. Bland, D.M. J. S. Bowman, S.T. Brooks, J.G. Canadell, A. Constable, K.A. Dafforn, M.H. Depledge, C.R. Dickson, N.C. Duke, K.J. Helmstedt, C.R. Johnson, M.A. McGeoch, J. Melbourne-Thomas, R. Morgain, E.N. Nicholson, S.M. Prober, B. Raymond, E.G. Ritchie, S.A. Robinson, K.X. Ruthrof, S.A. Setterfield, C.M. Sgro, J.S. Stark, T. Travers, R. Trebilco, D.F.L. Ward, G.M. Wardle, K.J. Williams, P.J. Zylstra and J.D. Shaw. 2021. Ecosystem collapse from the tropics to the Antarctic: an assessment and response framework. *Global Change Biology* 27: 1692-1703. <https://doi.org/10.1111/gcb.15539>
- Duke, N.C. 2020. Mangrove harbingers of coastal degradation seen in their responses to global climate change coupled with ever-increasing human pressures. *Human Ecology Journal of the Commonwealth Human Ecology Council – Mangrove Special Issue* 30: 19-23.
- Duke, N.C., and A.W.D. Larkum 2019. Mangroves and seagrasses. Chapter 18 in ‘The Great Barrier Reef: Biology, Environment and Management.’ 2nd Edition. P.A. Hutchings, M.J. Kingsford and O. Hoegh-Guldberg. Collingwood, VIC, CSIRO Publishing: 219-228. ISBN: 9781486308194
- Kimberly A. Finlayson a,*, Colin J. Limpus^b, Jason P. van de Merwe a,c Temporal changes in chemical contamination of green turtles (*Chelonia mydas*) foraging in a heavily industrialised seaport <https://www.sciencedirect.com/journal/science-of-the-total-environment>
<https://doi.org/10.1016/j.scitotenv.2021.152848>

Appendix 1: Geographical boundary of the ERMP



Appendix 2: ERMP timeline

ERMP timeline	2011	2012	2013	2014	2015	2016	2017	2018	2019		2020		2021		2022	
									Jan to June	July to Dec	Jan to June	July to Dec	Jan to June	July to Dec	Jan to June	July to Oct
<u>Projects</u>																
Baseline Studies																
Baseline Light Monitoring of Marine Turtles																
Shorebird Monitoring																
Marine Megafauna and Acoustic Monitoring																
Tier 1 gap Analysis Studies																
Central Queensland Corals and Associated Benthos: Monitoring review and gap Analysis																
Migratory Shorebird Monitoring Review																
Research, monitoring and management of seagrass ecosystems adjacent to port developments in central Queensland: Literature Review and Gap analysis																
Review of Water Quality Studies																
Review of Coastal Dolphins in Central Queensland, particularly Port Curtis and Port Alma regions																
Status of the dugong population in the Gladstone area																
Monitoring of Coastal Sea turtles Reports 1-6																
Loggerhead																

Environmental Performance Report 2022

ERMP timeline	2011	2012	2013	2014	2015	2016	2017	2018	2019		2020		2021		2022	
									Jan to June	July to Dec	Jan to June	July to Dec	Jan to June	July to Dec	Jan to June	July to Oct
<u>Projects</u>																
Green																
Hawksbill																
Olive Ridley																
Flatback																
Leatherback																
Tier 2 Projects																
Green Turtle population and Health study																
Monitoring Seagrass Seedbank Density and Viability within Port Curtis																
Monitoring the survival and recovery of shorelines, specifically Tidal Wetlands (Mangroves/Saltmarsh/Salt pans)																
Dugong feeding ecology and habitat use (dugong feeding trail assessment)																
Dugong tagging in collaboration with Green Turtle tagging and turtle population and health studies																
Migratory Shorebird Monitoring: Understanding Ecological Impact																
Migratory Shorebird Survey																
Dolphin Monitoring																
Turtle Nesting Populations on Curtis, Peak and Avoid Islands																
Green Turtle Satellite Telemetry																

Environmental Performance Report 2022

ERMP timeline	2011	2012	2013	2014	2015	2016	2017	2018	2019		2020		2021		2022	
									Jan to June	July to Dec	Jan to June	July to Dec	Jan to June	July to Dec	Jan to June	July to Oct
<u>Projects</u>																
Flatback Turtle Satellite Telemetry																
Green Turtle Blood analysis																
Monitoring of Coastal Lighting Effects on Marine Turtles																
Aquatic Ambient Noise Monitoring																
Study on the cause and health condition of beached dugong																
Monitoring of Australian humpback dolphins at Agnes Water to investigate distribution and movement patterns adjacent to the Gladstone Ports Corporation ERMP study area																
ERMP Synthesis Report																
Assessing the impact of Reclamation Activities on Migratory Shorebirds at the Western Basin Reclamation Area																
Toxicological assessment of Australian humpback and Australian Snubfin Dolphins																
Migratory Shorebird Monitoring: Correlates of changing shorebird numbers																
	Completed															