

Hampton Quay - River Arun

Site Visit Summary Document



Carcinus Reference: J0553_190701

Date: 04 November 2019

Carcinus Ltd – Document Control Sheet

Document Title	Hampton Quay – River Arun, Site Visit Summary Document
Document Number	J0553_190701
Client Contact	Emma Kingman
Issue Date	04 November 2019

Revisions

Revision No.	Date	Comment
1.0	04 July 2019	Issued to client
1.1	14 October 2019	Second Issue – Updated
2.0	04 November 2019	Final Version

Document Approval

	Name	Role	Date
Author	Matthew Crabb	Director (Carcinus Ltd)	04 July 2019
	Simon Bray	Director (AQASS Ltd)	14 October 2019
Checked	Despina Crabb	Quality Control	04 July 2019
Approved	Matthew Crabb	Director	04 November 2019

Every effort has been made to ensure the information contained within is as complete and valid as possible at the time of writing, it should be noted that additional information may exist that was not available or identified at the time or has subsequently been published after the date of this report.

Carcinus accepts no liability for any costs, losses or liabilities arising from the reliance upon or use of the contents of this report other than by its client.

Contents

1.	Introduction	4
2.	Site Visit	4
3.	Site Observations	4
3.1.	Habitats Present and Sensitivities	4
3.1.1.	North Site.....	4
3.1.2.	Middle Site.....	5
3.1.3.	South Site.....	6
3.2.	Other Observations	7
3.2.1.	Crab Tiling	7
3.2.2.	Vessel Activity	7
4.	Proposal Options	7
5.	Thoughts on Initial Proposal	8
5.1.	Introduction	8
5.2.	Creation of Lagoon – North Site	8
5.3.	Floating or Stilted Structures – North Site.....	8
5.4.	Riverside Pontoons and Moorings – Middle Site	9
5.5.	Recommendations.....	9
6.	Thoughts on Amended Proposals.....	10
6.1.	Introduction	10
6.2.	Proposal developments	10
6.3.	Recommendations.....	11
7.	Conclusion	11
	Appendix A – Site Visit Photographic Log – Additional Site Images	13

Table of Figures

Figure 1 - North Site: Looking south	5
Figure 2 - Middle Site: Looking north, truncated marsh with sea purslane <i>Atriplex portulacoides</i> , <i>Salicornia</i> spp. and <i>Spartina</i> spp.	6
Figure 3 - South Site: Steep hard engineered sea defence.....	6
Figure 4 - To the north of northern site boundary: Looking north, evidence of crab tiling / trapping activity.....	7
Figure 5 - North Site: Looking north east.....	13
Figure 6 - North Site: Looking north	13
Figure 7 - North Site: Looking south east.....	14
Figure 8 - North Site: Looking west, <i>Salicornia</i> spp.....	14
Figure 9 - North Site: <i>Salicornia</i> spp. and sea spurge <i>Euphorbia paralias</i>	15
Figure 10 - Middle Site: <i>Salicornia</i> spp.....	15

Figure 11 - Middle Site: Salicornia spp.....	16
Figure 12 - Middle Site: Lower shore, exposed mudflat backed with sea purslane Atriplex portulacoides; Salicornia spp. starting to establish	16
Figure 13 - Middle Site: Sea purslane Atriplex portulacoides;.....	17
Figure 14 - Middle Site: lower shore, exposed mudflat backed with sea purslane Atriplex portulacoides; Salicornia spp. starting to establish	17
Figure 15 - Middle Site: Spartina spp. present.....	18
Figure 16 - South Site: Steep hard engineered sea defence.....	18
Figure 17 - South Site: Lower shore with fucoids	19

1. Introduction

The specific objectives of this report are as follows:

- Provide details in relation to the site visit;
- Outline high level observations made during the visit;
- Discuss habitats present, their condition and brief details of their sensitivities;
- Summarise thoughts on the proposed development options in relation to habitats present; and
- Highlight likely areas of concern in relation to nature conservation objectives.

2. Site Visit

Matthew Crabb (Carcinus Ltd) and Dr Simon Bray (AQASS Ltd) attended a site visit at the proposed Hampton Quay development site on 3rd July 2019. During the site visit, a brief overview of the proposed development was provided by Mr Boyce and the different development options were discussed. Following discussions, an opportunity to undertake a site walkover was provided. Matthew and Simon carried out a high-level site habitat walkover to establish a broadscale understanding of the habitats present, their current condition and how the proposed development may interact with them.

3. Site Observations

3.1. Habitats Present and Sensitivities

3.1.1. North Site

The northern site comprises an area of saltmarsh habitat, recently created through managed retreat via the removal of an existing flood defence. The area is of a gentle gradient from the low tide mark to the terrestrial environment. The marsh area appears to be developing into a classic zoned marsh with clear development of pioneer species at the lower edge, fledgling creek systems and sediment trapping and raising gradient allowing development of mid and upper shore saltmarsh habitat. The upper marsh is slightly truncated due to rising morphology, however the site appears to be developing into a classic healthy saltmarsh.

Specifically, the lower shore is bare mudflat, transitioning into abundant *Salicornia spp.* with smaller isolated areas of *Spartina spp.* present and sea spurge *Euphorbia paralias*. At the upper shoreline, and the boundary of the development site, a range of upper saltmarsh species are present, transitioning into terrestrial flora.

Saltmarshes are complex systems with a variety of sensitivities to some extent poorly understood particularly in terms of sediment chemistry. Saltmarsh needs to develop with a natural slope and drainage systems which allows tidal inundation to drain away and not remain flooded over sites, thus care should be taken not to impede flows. Conversely, the plant species are obligate halophytes and require inundation by the tidal process. Where possible, drainage systems should not be impeded or altered.

Chemically, saltmarsh requires relatively aerated sediment which occurs through material being mobilised by infauna (e.g., polychaete worms) which facilitates oxygen permeation thus mitigating excessive build-up of anoxic material; though some lower saltmarsh species have evolved to tolerate high levels of anoxia (e.g. *Spartina spp.*). Notably, some man-made attempts at saltmarsh re-creation have faltered due to lack of oxygenating fauna (e.g., trials in USA). Where saltmarsh is shaded, this

can lead to loss of flora (unable to photosynthesise), loss of infauna and can lead to excessive build-up of anoxic gases which can create noxious odours. Furthermore, shaded areas reduce available foraging habitat for birds and fish as they interpret shading as possible predator activity / an inability to see predator approach.

Saltmarsh is vulnerable to pollution and wash associated with vessels thus prop wash and wake speed should be minimised. Erosional loss of forward edge of marshes can result in exposed cliffs of mid shore flora with the pioneer species absent.

With regard to pollution, whilst saltmarsh can tolerate to some extent heavy metals associated with, for example, antifoul paints (copper, zinc), however associated antifoul biocides can have a detrimental effect on saltmarsh flora. Saltmarsh is also vulnerable to smothering (thus unable to photosynthesise) by ephemeral green algae which can develop excessively where artificial nutrient enhancement occurs (e.g. faecal input). Finally, saltmarsh is somewhat tolerant to hydrocarbon effects though excessive smothering which permeates sediment causes significant loss. Thus, where vessels are proposed to be moored near to marsh, efforts should be made to ensure hydrocarbon loss / input is managed.



Figure 1 - North Site: Looking south

3.1.2. Middle Site

The marsh on the site has developed a marked cliff edge which has been to some extent stabilised by *Atriplex portulacoides* (sea purslane) growing vertically down the face. Some slumping of sediment material here has been colonised by pioneer low marsh species. Care should be taken to avoid exacerbating such erosion as the subsequent loss of marsh will reduce ecosystem service benefit of passive coastal protection. The area comprises a truncated marsh system, some sporadic lower marsh (*Salicornia* and *Spartina* spp.) occurs on areas where sediment has slumped from the cliffed mid marsh. On the slumped areas some *Salicornia* and *Spartina* spp. have colonised, however, in the main the marsh comprises an almost uniform stand of *Atriplex portulacoides* (some isolated other species are also present) which, as discussed, has somewhat stabilised the “cliff” face. This marsh area is providing an important coastal protection function, is suffering some erosion at its forward edge and is unable to migrate further inland due to the sudden rise in landform thus is suffering coastal squeeze.

This site may present an opportunity to encourage lower marsh growth through sediment retention systems thus enhancing coastal protection, it is evidently being eroded by tidal activity and possible vessel wash, though the mid-level marsh is very healthy and should be managed to this effect.



Figure 2 - Middle Site: Looking north, truncated marsh with sea purslane *Atriplex portulacoides*, *Salicornia* spp. and *Spartina* spp.

3.1.3. South Site

The south site comprises steep profile muds leading to man-made sea defences which appear to be macro-gravels with perhaps a bitumen underlay. The area is colonised by high shore marsh / intertidal flora species grading rapidly to fully terrestrial. There are isolated stands of intertidal algae associated with rocky shores such as *Fucus vesiculosus* and other *Fucus* species unable to be identified due to access constraints. These are largely inhabiting concrete structures associated with freshwater runoff drainage channels; note, it was not possible at this stage to assess resident fauna.



Figure 3 - South Site: Steep hard engineered sea defence

3.2. Other Observations

3.2.1. Crab Tiling

Immediately to the north of the development site, is an area of saltmarsh leading to intertidal mud on the lower foreshore. Within this area, evidence of 'crab tiling' was observed see Figure 4. Crab tiling comprises the placement of suitable habitat in the form of roofing tiles or tubes (in this case drainpipe) to encourage the common shore crab *Carcinus maenas* to inhabit the area. The 'tiles' are regularly checked by bait collectors during the late spring and summer, looking for crab about to enter their moulting / ecdysis life stage; at this time they are highly prized as fishing bait and have high commercial value. Crab tiling activity leads to a range of pressures and damage to the intertidal habitats, including changes in species assemblage, introduction of hard substrate within a typically soft substrate habitat and physical damage caused by the walking on habitats by the collectors.

It is therefore recommended that the level of activity is monitored and that such activity should be prevented within the establishing saltmarsh within the northern part of the development site.



Figure 4 - To the north of northern site boundary: Looking north, evidence of crab tiling / trapping activity

3.2.2. Vessel Activity

The River Arun is utilised by a range of leisure vessels and river ferries. The bow waves and prop rotation created by passing vessels can lead to vessel wash, resulting in damage to sensitive intertidal habitats. Saltmarsh is a particularly sensitive habitat to such impacts, with excessive vessel wash resulting in erosion of saltmarsh and habitats loss and for example cliffing as seen in the mid site (though this may also be due to tidal movement and coastal squeeze). It is noted that the development is likely to increase the utilisation of vessels within the vicinity. As discussed above, consideration should be given to minimising the effects of vessel wash by limited areas of vessel usage and other management practices such as speed limits (already in effect).

4. Proposal Options

Stolon Studio prepared initial ideas for moorings and associated works around or near to the salt marsh area. This was presented to Arun District Council Development Team Meeting, dated 4th July 2019. These were then evolved based on comments and feedback from Carcinus through a number

of iterations before the proposal submitted to ADC for pre-application advice, dated 4th October 2019.

5. Thoughts on Initial Proposal

5.1. Introduction

The below information is provided in relation to ideas including pontoons, piling, and buildings on or near to saltmarsh areas, plus the suggestion of a lagoon system with an aim of enhancing site aesthetics and biodiversity. Carcinus were engaged to provide specific marine environmental / saltmarsh expertise.

The comments below are presented as a guide to assist the architects and developers in achieving a framework of better understanding for the complex functioning of saltmarsh systems and, where feasible, to work within that framework.

The comments below are developed based on the initial site proposal which, it is acknowledged, has been modified to better encompass saltmarsh systems and sensitivities.

Please see figure 18 for sketch of initial proposal provided to Carcinus to review.

5.2. Creation of Lagoon – North Site

The creation of a lagoon would necessitate diversion of one of the freshwater channels and retention of freshwater inflow. The result will be reduced salinity potentially encouraging development of a lagoon system. It is, however, felt this is unlikely due to the high salinity of the adjacent Arun, plus development of lagoon conditions will exclude saltmarsh species on the healthy developing marsh which require almost full salinity. Further to this, lagoon conditions, if developed, may result in colonisation by rare species which would subsequently require specific management to ensure a healthy population is maintained.

There is also some concern that restriction of flow and loss of the marsh with standing waters may lead to a stagnant water body with subsequent unpleasant odour. This effect has been noted in other man-made harbour systems where water circulation is reduced.

Overall, the creation of a lagoon is not recommended for the points noted above. The Arun is not a natural lagoon development area at this site (lagoons usually require almost full isolation from marine habitat with some seepage / small marine input) and whilst a worthy aspiration it is felt that significant detrimental ecological and potentially costly effects may result.

5.3. Floating or Stilted Structures – North Site

Comments with regards to floating or stilted structures in the lagoon, and boardwalk access over the marsh. Pontoons and stilted structures have the potential to create shade which will exclude photosynthesis. Designs should allow natural light should such plans be taken forward, however, note that shade and vessels associated with pontoons will result in marsh loss due to vessel settling, wash, and light loss. It is understandable that this is an aspiration for the site, however, it may have to be accepted that the developing marsh will not tolerate such impacts and may thus become fragmented; when and if this occurs, root material loss will result in loss of sediment through erosion (natural and vessel exacerbated).

With careful management, the marsh can be protected such that it continues to develop to some extent, however it will have to be accepted that vessel support structures (pontoons etc.) are generally not conducive to marsh well-being thus some loss will be evident.

Where shading may occur such as due to boardwalks, marsh die back due to lack of light is a common outcome plus this loses bird and fish foraging habitat (shade flight response) when the tide is in / out respectively. Should marsh flora die back occur, this will lead to loss of binding roots, and subsequent reduction in sediment material which will result in marsh erosion (feedback loop). Whilst the suggested board-walk may be at the upper edge of the marsh, saltmarsh relies on drainage channels for tidal inundation and saline water input (the plants are obligate halophytes). Therefore, for healthy marsh there will always be some water flow even at the upper marsh. Accordingly, erosion due to vegetation loss can be an issue even at high marsh levels.

5.4. Riverside Pontoons and Moorings – Middle Site

The effects noted in above remain largely similar for the middle site. However, if pontoons could be developed so that vessels remain to some extent in main channel flow, with limited small vessel mooring / activity on the inner face, then marsh effects would be significantly limited as the main channel area tidal movement naturally prevents marsh development.

Walkway and bridge structures have the potential to create shade, inhibiting photosynthesis. Designs should allow natural light where possible. Where shading does occur, marsh loss is likely to occur to some degree and the marsh may thus become fragmented, exacerbating erosion.

Further to the shading comments, where piles are driven in, these should, where possible, avoid being in the marsh area. Piles can create local hydrodynamic change leading to small scale eddies and erosive forces during the tidal cycle. These localised enhanced hydrodynamic forces can re-suspend sediment potentially again undermining / eroding marsh and this can be an iterative process (further negative feedback loop) leading to further possible binding vegetation loss.

With regard to mooring, it is advised that larger vessels be restricted to the main channel rather than be allowed to moor on the landward side of the pontoons. This is specifically in relation to prop wash and bow thruster use which will create forces on the fine sediment exacerbating erosion forces. Further to this, larger vessels will have antifoul and other contaminants which can be detrimental to marsh health. Retaining them in the main channel area will allow a greater tidal flushing effect, though at all times the suggested environmental management plan should seek to minimise contaminants to the system.

Upon consideration, we see limited difficulty if the landward side of the pontoons is used for small dinghies with small engines, such that this could be a tender mooring point and a good use for casual river users wanting to utilise the sites facilities though again, this would benefit from careful management and speed restrictions.

5.5. Recommendations

A summary of recommendations are given below:

- Remove the lagoon proposal;
- Omit the floating or stilted structures over the salt marsh;
- Re-locate moorings within main river channel;
- Limit small vessel mooring / activity on the inner face;
- Board-walks should be taken above terrestrial habitat rather than marsh / mudflat; and
- An environmental / habitat plan should be implemented during construction.

An environmental / habitat plan should be put in place for construction (as part of the Construction Environmental Management Plan [CEMP]) and use (residence) stages with regard to contaminants

from vessels (and users - e.g. plastics and antifoul) as well as physical effects. It is strongly advised that a marsh habitat monitoring scheme should be put in place. This should seek to ensure that erosion is managed / monitored against baseline levels (marsh height and extent) and corrective action is applied if necessary, should significant marsh impact be noted in relation to human activity. This is emphasised strongly as important for the site, the saltmarsh is providing passive coastal protection amongst other ecosystem services (e.g. pollution absorption, carbon sequestration and fish nursery habitat). The loss of such protection by the marsh will potentially necessitate expensive and intrusive engineering protection, which, at this site, has been partially removed already by the EA and subsequently the marsh has developed and is growing.

To consider the above, where feasible, linking walkways to in stream pontoons would ideally avoid traversing marsh habitat for the shading reasons given, the suggestion being that the available “spits” are utilised as they both jut into the river and are morphologically consolidated in comparison with the marsh areas.

6. Thoughts on Amended Proposals

6.1. Introduction

Following information presented by Carcinus the initial proposal was modified to encompass saltmarsh sensitivities more effectively. Stolon studio provided three further sketch options to discuss with Carcinus and AQASS. After initial discussions, a favoured approach was selected. The following section focuses on the discussions regarding the favoured option and how this could be developed further.

6.2. Proposal developments

The following list highlights the amendments made by Stolon Studio following comments from Carcinus and AQASS:

- Removal of lagoon proposal;
- Omission of floating or stilted structures over the salt marsh;
- Relocation of moorings within the river channel;
- Relocation of board-walks above terrestrial habitat, and within main river channel; and
- Prohibited small vessel mooring / activity on the inner face altogether

For the options presented it should be realised that human effects will not be positive for the marsh as more vessel use will not encourage marsh stability. However, with careful management and a clearly established baseline condition and an aim to work with the ecological system, encourage marsh stability and monitor change, the proposal can benefit from the marsh presence. This comment is made in relation to not only the highly valuable ecosystem service of passive coastal protection role that the saltmarsh system provides, but also as an interest factor for visitors regarding associated wildlife.

6.3. Recommendations

The points below from Carcinus and AQASS are recommendations to further minimise impact to the saltmarsh and mudflats. These are in addition to recommendations given in item 5.5.

Main Guidance:

- Avoid shading which may exacerbate marsh erosion and disturb foraging birds and fish;
- Avoid vessel wash and keep larger vessels away from the marsh as much as possible (bow thrusters to be minimised);
- Design pontoons to not constrain / accelerate flow as much as possible, this can lead to sediment re-suspension, loss and subsequent sediment slumping / loss of marsh and intertidal area;
- Try to avoid piling on the intertidal soft sediment areas as hydrodynamic associated changes (meso and microscale eddies) can erode fine sediments during construction and operation;
- Seek to enhance the mid-area of cliffed marsh with sediment retention structures of which semi-permeable membranes may be effective, but careful consultation on this should be undertaken;
- Maintenance and capital dredging for in channel mooring should be avoided as it can lead to slumping and subsequent marsh loss;
- If feasible, it is desirable that a baseline and ongoing monitoring scheme be put in place, against which marsh change can be considered and ameliorated as necessary; and
- Avoid disturbance of the northern marsh which is developing well as a juvenile classic zoned marsh system.

The pontoon structures will partly protect the marshes from excess vessel wash, though care should be exercised (through design) to avoid or mitigate accelerating tidal flow rates past the inshore side of pontoons through flow constriction as this will exacerbate marsh erosion through sediment re-suspension, leading to lower shore marsh slumping as it is eroded from the toe; note cliff erosion is already an issue at the mid site (see 3.1.2).

As a sub note, if possible, avoid polystyrene floats as they can crack and polystyrene loss can smother marsh. This issue is receiving increasing attention and the UK Government is currently investigating polystyrene use and possible restrictions. Whether this will expand to use in marina floats is unknown, but if feasible, galvanised metal floats may be preferable and show a commitment to plastics use reduction in marine systems.

If possible we would recommend that as part of site management, a discussion is had regarding placement of sediment retention methods as an aim to engage fledgling / remnant development of low marsh species (*Spartina* and *Salicornia*) which have settled on slumped material from the cliffed morphology. Such retention must not be solid barriers but be semi permeable to allow tidal inflow behind which reduced water flow allows fine particles to settle. If carefully considered, this will seek to create developing fine substrate to be colonised by low shore marsh species, further enhancing the cliffed area stability.

7. Conclusion

Following previous advice provided to Stolon Studio, Carcinus were appointed to provide further feedback on the pre-application proposal. Please see figure 19 for your reference.

It is acknowledged that following on from detail presented in this report that the design has:

- *Shifted the pontoons further into the main river channel allowing them to move up and down with the tide;*
- *Piles [are planned to] be located within the river bed therefore [avoiding] the marsh area;*
- *Moved the main points of access to the 'spits' to avoid shading over the saltmarsh; and*
- *Seeks to reduce existing erosion through the pontoon design. However, note that Carcinus and AQASS advised that a saltmarsh retention programme may be more effective.*

Please note, other aspects advised on above, can be discussed with the Carcinus and AQASS team as and if appropriate.

Appendix A – Site Visit Photographic Log – Additional Site Images

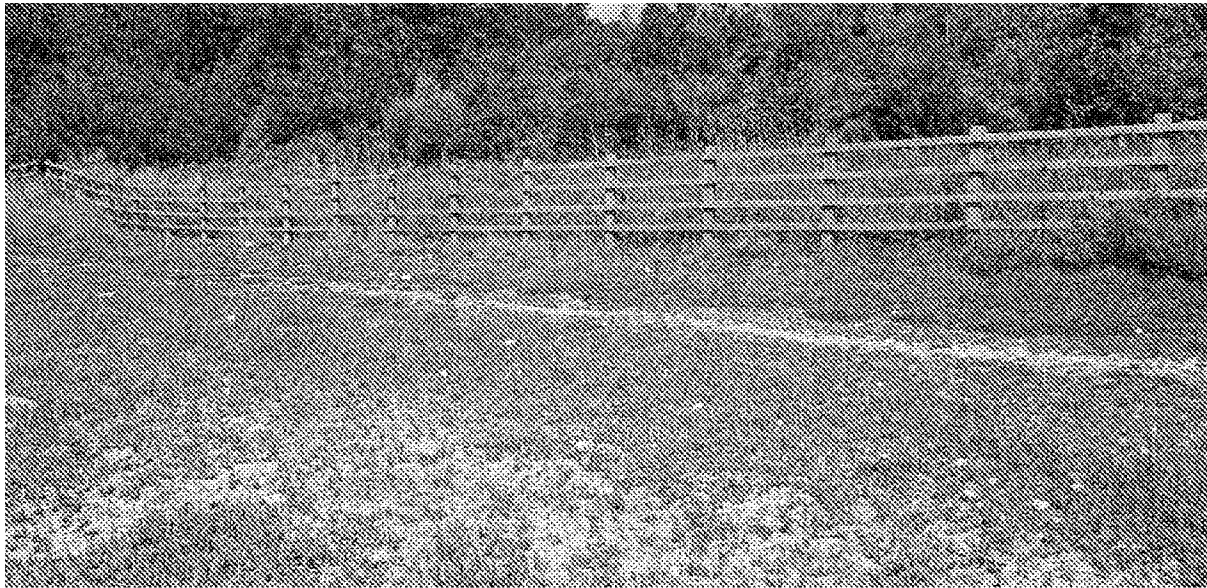


Figure 5 - North Site: Looking north east



Figure 6 - North Site: Looking north



Figure 7 - North Site: Looking south east



Figure 8 - North Site: Looking west, Salicornia spp.



Figure 9 - North Site: *Salicornia* spp. and sea spurge *Euphorbia paralias*



Figure 10 - Middle Site: *Salicornia* spp.



Figure 11 - Middle Site: *Salicornia* spp.

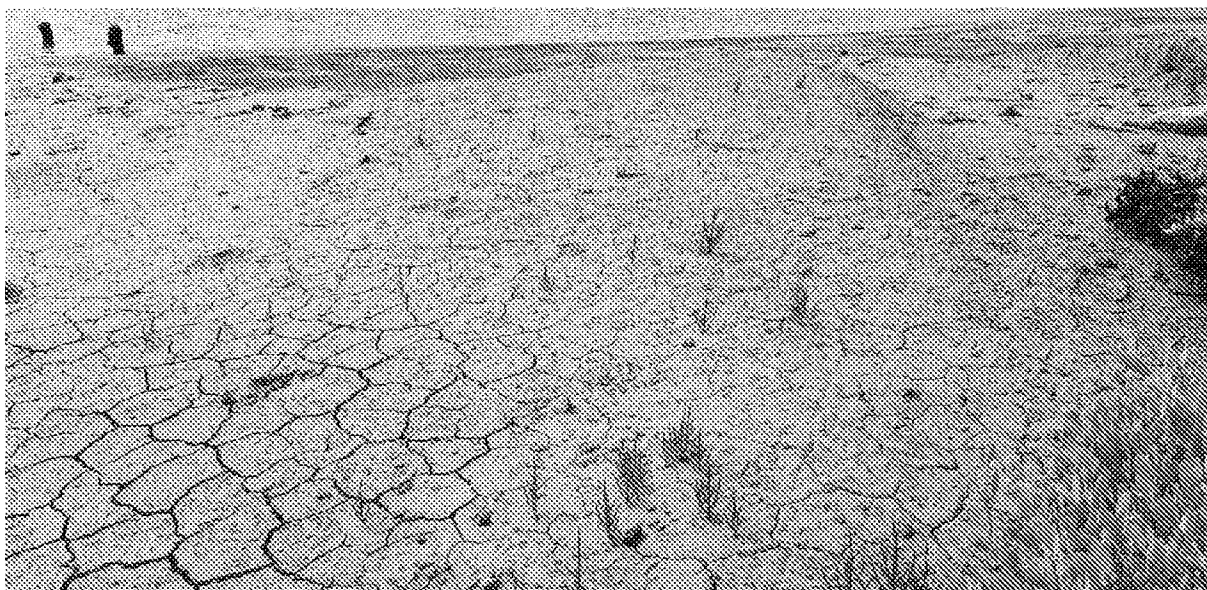


Figure 12 - Middle Site: Lower shore, exposed mudflat backed with sea purslane *Atriplex portulacaoides*; *Salicornia* spp. starting to establish

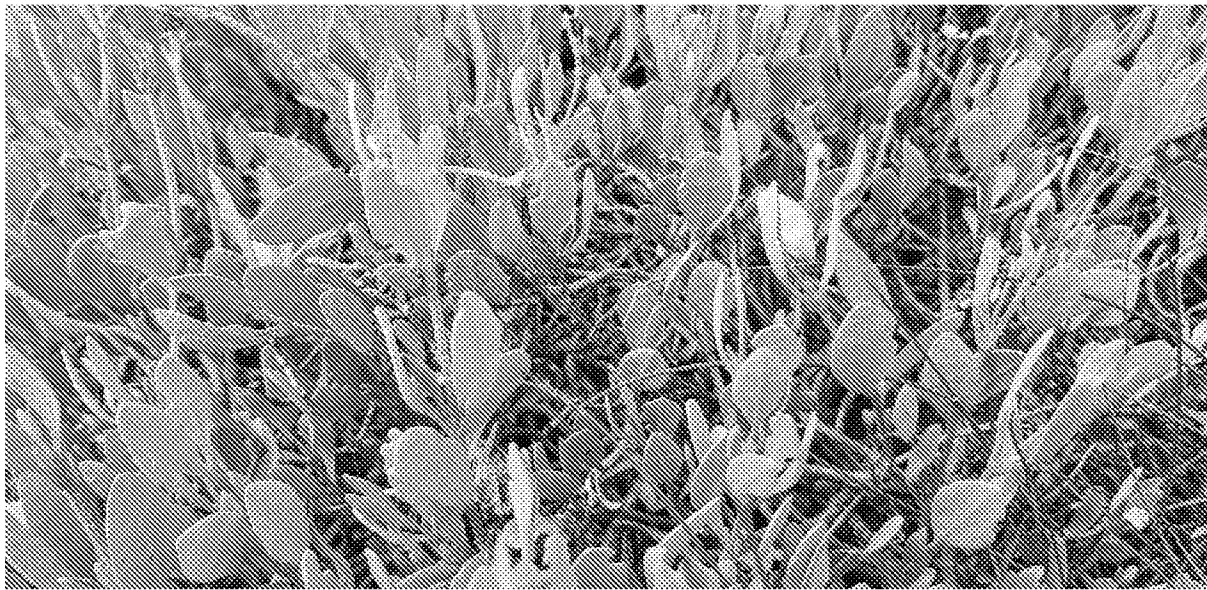


Figure 13 - Middle Site: Sea purslane *Atriplex portulacoides*;

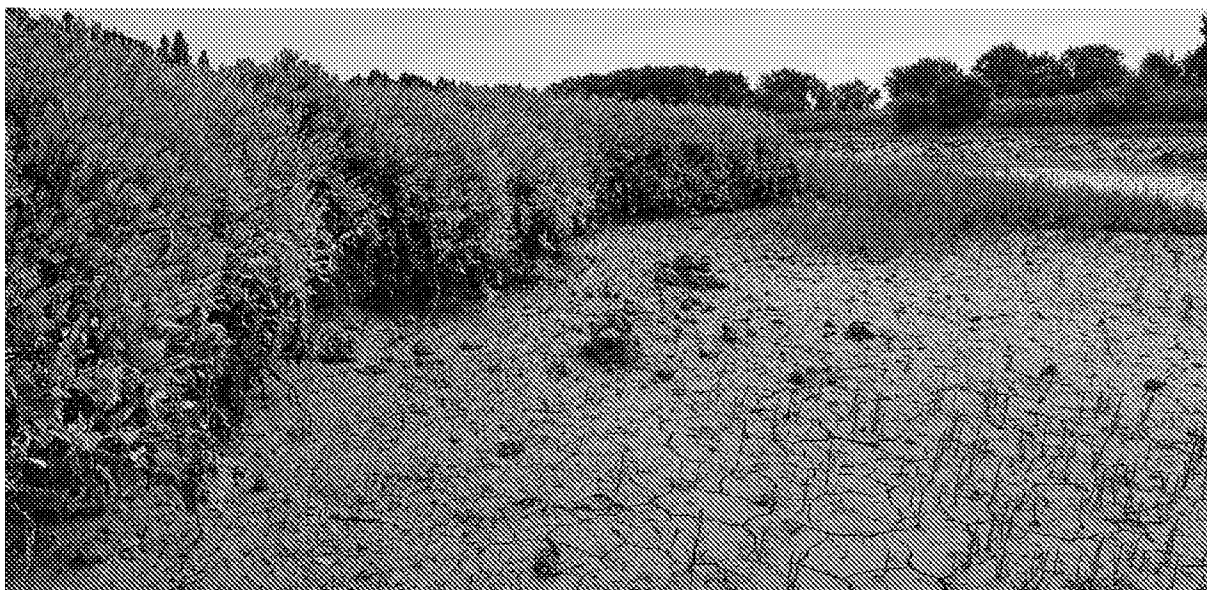


Figure 14 - Middle Site: lower shore, exposed mudflat backed with sea purslane *Atriplex portulacoides*; *Salicornia* spp. starting to establish



Figure 15 - Middle Site: Spartina spp. present



Figure 16 - South Site: Steep hard engineered sea defence



Figure 17 - South Site: Lower shore with fucoids

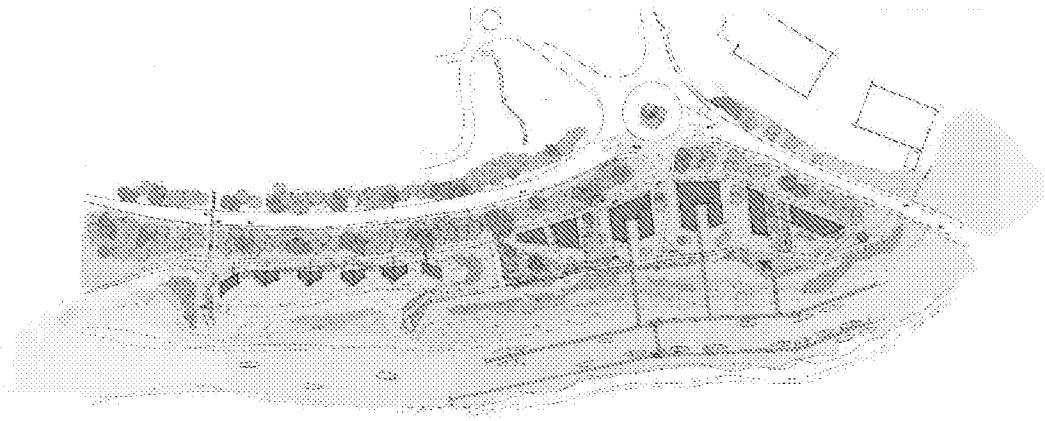


Figure 18 -- Initial Proposal

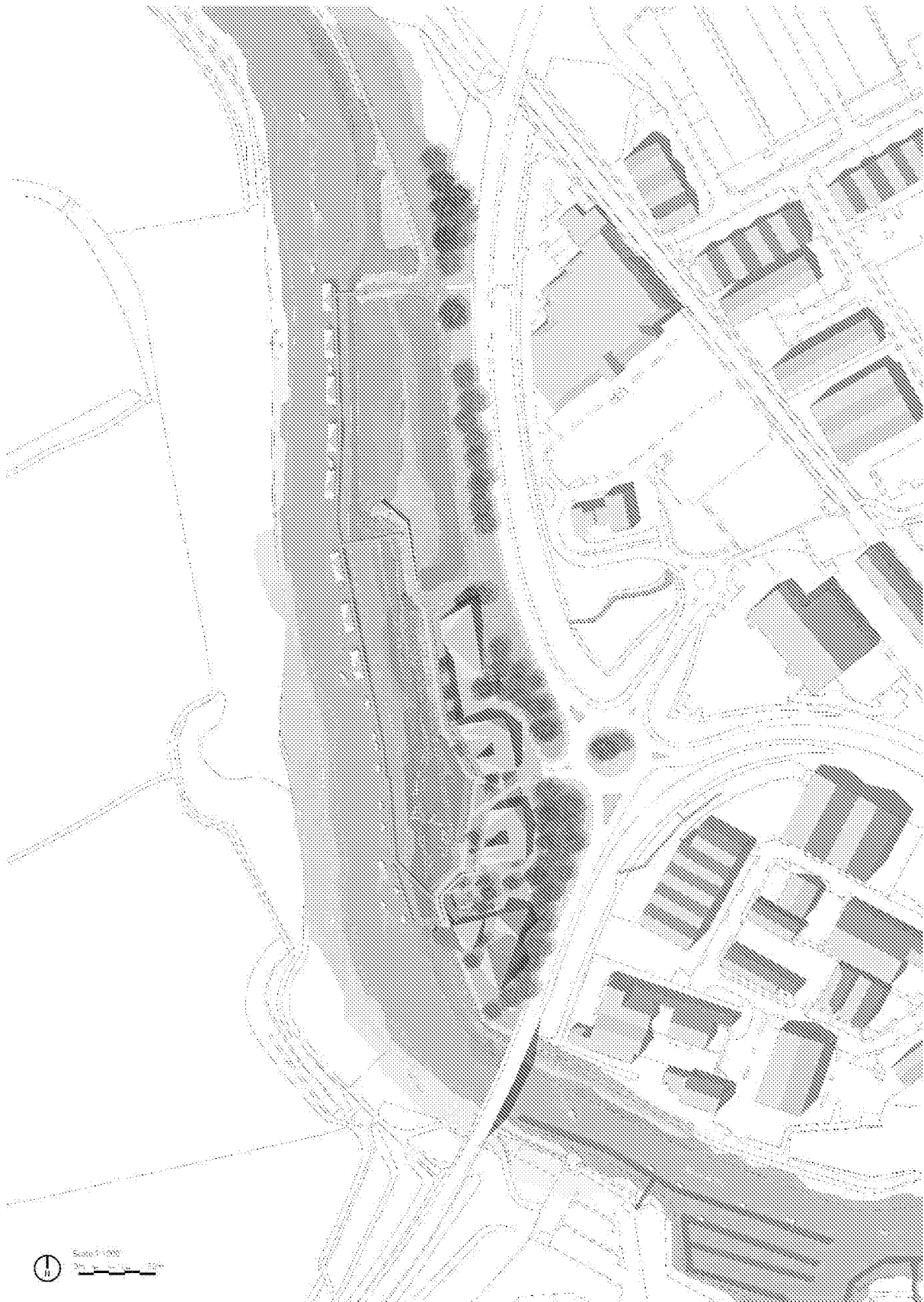


Figure 19 --- Pre-application Proposal

About Carcinus Ltd

Carcinus Ltd is a leading provider of aquatic environmental consultancy and survey services in the UK.

Carcinus was established in 2016 by its directors after over 30 years combined experience of working within the marine and freshwater environment sector. From our base in Southampton, we provide environmental consultancy advice and support as well as ecological, topographic and hydrographic survey services to clients throughout the UK and overseas.

Our clients operate in a range of industry sectors including civil engineering and construction, ports and harbours, new and existing nuclear power, renewable energy (including offshore wind, tidal energy and wave energy), public sector, government, NGOs, transport and water.

Our aim is to offer professional, high quality and robust solutions to our clients, using the latest techniques, innovation and recognised best practice.

Contact Us

Carcinus Ltd

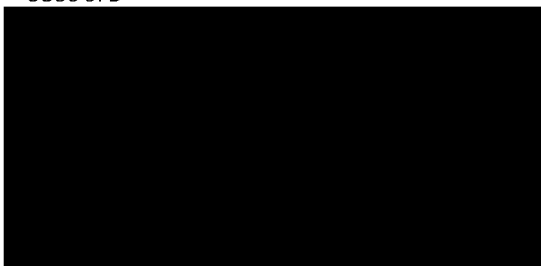
Wessex House

Upper Market Street

Eastleigh

Hampshire

SO50 9FD



Environmental Consultancy

Carcinus provides environmental consultancy services for both freshwater and marine environments. Our freshwater and marine environmental consultants provide services that include scoping studies, Environmental Impact Assessment (EIA) for ecological and human receptors, Habitats Regulations Appraisal (HRA), Water Framework Directive (WFD) assessments, project management, licensing and consent support, pre-dredge sediment assessments and options appraisal, stakeholder and regulator engagement, survey design and management and site selection and feasibility studies.

Ecological and Geophysical Surveys

Carcinus delivers ecology surveys in both marine and freshwater environments. Our staff are experienced in the design and implementation of ecological surveys, including marine subtidal and intertidal fish ecology and benthic ecology, freshwater fisheries, macro invertebrate sampling, macrophytes, marine mammals, birds, habitat mapping, River Habitat Surveys (RHS), phase 1 habitat surveys, catchment studies, water quality and sediment sampling and analysis, ichthyoplankton, zooplankton and phytoplankton.

In addition, we provide aerial, topographic, bathymetric and laser scan surveys for nearshore, coastal and riverine environments.

Our Vision

"To be a dependable partner to our clients, providing robust and reliable environmental advice, services and support, enabling them to achieve project aims whilst taking due care of the sensitivity of the environment"