- 1 x 0.025m^2 Van-Veen grab taken for benthic faunal analysis (3 samples).
- From this, a small amount of sediment was retained for Particle Size Analysis and Loss on Ignition Analysis. The remainder was retained for biological assessment.

10.4.1.4 Subtidal Video Survey

Fieldwork was carried out on the 27th January with a follow up survey undertaken on April 27th, 2012. All sampling stations were positioned using a GPS (Trimble Geo-XM). A complete list of stations sampled is presented in Tables 10.4.4 & 10.4.5 and these stations are displayed on maps (Figure 10.4.5 & Figure 10.4.6).

Table 10.4.4 Positions of shallow water sub-tidal video survey stations.

Station	Co-ordinates (Irish National Grid)		Station	Co-ordinates (Irish National Grid)	
	Easting (m)	Northing (m)		Easting (m)	Northing (m)
	Video Locations			Video Locations	
v01-1	97683.4	48278.4	v07-3	99085.9	49052.1
v01-2	97683.8	48260.2	v07-4	99096.6	49037.4
v01-3	97688.2	48243.9	v08-2	99180.1	49236.3
v01-4	97688.2	48232.5	v08-3	99188.0	49207.2
v02-1	98028.7	48282.9	v08-4	99186.4	49186.2
v02-2	98033.4	48263.9	v08-5	99183.5	49156.9
v02-3	98040.6	48251.0	v09-1	99286.8	49254.0
v02-4	98042.0	48237.5	v09-2	99298.0	49239.4
v03-mid1	99094.2	48521.6	v09-3	99301.5	49213.2
v03-mid2	99109.6	48502.3	v09-4	99307.6	49189.7
v03-mid3	98118.4	48487.9	v09-5	99317.9	49175.8
v06-1	98990.3	48695.6	v11-1	99031.3	49452.8
v06-2	99005.1	48692.1	v11-2	99047.8	49443.7
v06-3	99017.5	48689.1	v11-3	99053.8	49446.2
v07-1	99063.1	49073.4	v11-4	98997.0	49460.1
v07-2	99073.1	49060.9			

Table 10.4.5 Positions of shallow water sub-tidal follow up video survey stations

Station	Co-ordinates (Irish National Grid)		Station	Co-ordinates (Irish National Grid)	
	Easting (m)	Northing (m)		Easting (m)	Northing (m)
	Video Locations			Video Locations	
Drop 2	48609.5	98970.4	Drop 28	48301.8	97845.0
Drop 5	48566.0	98972.0	Drop 29	48257.6	97850.1
Drop 7	48479.0	98976.6	Drop 30	48267.3	97748.8
Drop 10	48614.6	98918.5	Drop 32	48323.7	97763.7
Drop 12	48542.2	98918.5	Drop 33	48311.8	97657.9
Drop 13	48695.5	98966.7	Drop 35	48650.0	98839.0
Drop 15	48692.0	98895.0	Drop 37	48720.8	98781.6
Drop 16	48648.0	98893.5	Drop 41	48792.5	98535.8
Drop 18	48566.5	98875.4	Drop 42	48699.0	98490.0
Drop 19	48689.0	98652.0	Drop 43	48625.0	98554.0
Drop 20	48630.0	98731.0	Drop 44	48541.0	98703.5
Drop 23	48257.0	97999.0	Drop 45	48432.9	99839.6
Drop 26	48252.9	97944.1	Drop 46	48439.8	97949.1
Drop 27	48314.0	97966.0	Drop 47	48654.0	98143.5

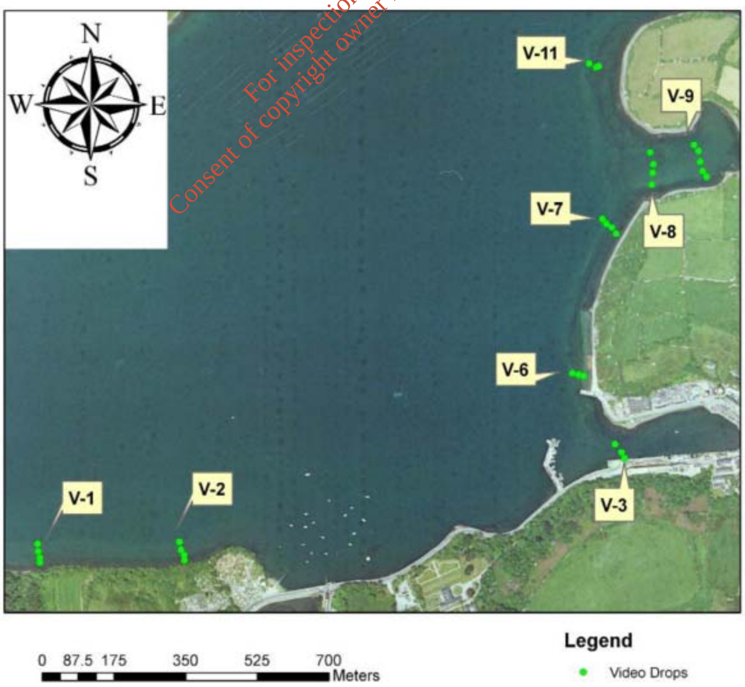


Figure 10.4.5 Map showing locations of shallow water sub-tidal video sampling positions – January 2012.

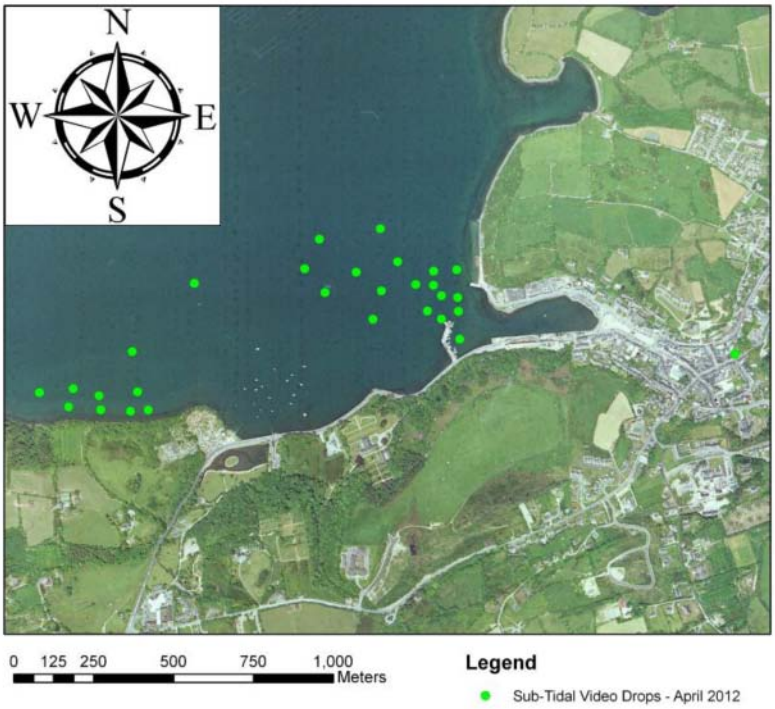


Figure 10.4.6 Map showing locations of sub-tidal video sampling positions – April 2012.

A total of 31 stations were sampled using a drop down video camera system during the initial survey, and an additional 28 stations were sampled in the follow up survey of April. Data was recorded as MPEG4 format files, recorded directly to a portable DV recorder.

At each station:

- A single recording was taken at each location. The video camera was lowered to above the sediment surface, and video imagery was recorded onto a portable DV recorder in mpeg4 format.

10.4.1.5 Sample Processing

Granulometric Analysis

Granulometric analysis was carried out on oven dried sediment samples from each station. The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The brass sieves chosen were 4mm, 2mm, 1mm, 500µm, 250µm, 125µm and 63µm. The sediments were then divided into three fractions: % Gravel (>2mm), % Sand (<2.0mm >63µm) and % Silt-Clay (<63µm). Further analysis of the sediment data was undertaken using the Gradistat package (Blott & Pye, 2001[1]).

[1] Blott SJ and K Pye, 2001, GRADISTAT, Earth Surf Proc and Landforms 26: 1237-1248

Organic Matter Analysis

Organic matter was estimated using the Loss on Ignition (LOI) method. One gram of dried sediment was ashed at 450˚C for 6 hours and organic carbon was calculated as % sediment weight loss.

Biological sample processing

On returning to the laboratory all faunal samples were sieved on a 0.5mm sieve within 24 hours of collection. Samples were preserved in 4% buffered formalin to which an organic dye (Rose-Bengal) had been added. All fauna were identified to the lowest taxonomic level possible using standard keys to north-west European fauna.

10.4.2 Results

<u>10.4.2.1 Inter-Tidal Hard-Benthos Survey</u>

Abbey Shore

The Abbey is a fairly uniform shingle and gravel shore with generally low levels of exposure and low or moderate tidal currents. The gradient is low, becoming almost flat at low water. The top of the shore is dominated by smooth boulders in the main, although at the town end there are the remnants of an old defensive wall with typical upper shore zonation patterns, which are absent elsewhere (Plate 10.4.1b). This comprises the black lichen *Verrucaria maura* on top, followed successively down the wall in narrow bands by the fucoid seaweeds *Pelvetia*, *Fucus spiralis*, *F. vesiculosus* and *Ascophyllum* (Plate 10.4.1a). Some parts of the shore are affected by groundwater seepage evidenced by locally heavier growths of the green seaweed *Enteromorpha*.

The lack of bedrock throughout the shore and the fairly unstable and or fine nature of the substrate mean that the cover of seaweed is much lower that might otherwise be the case.

During low spring tides the shore could be roughly divided into three zones, a lower zone where the substrate comprised sand or muddy sand (more dominant toward Transect 2) or pebbles covered in the sand binding red alga *Rhodothamniella* (more dominant toward Transect 2), with scattered small boulders or large cobbles covered in a fairly diverse range of red seaweed (Plate 10.4.1c). The latter also showed a range of encrusting organisms, including small saddle oysters (*Anomia* sp., bryozoans, keel worms (*Pomatoceros triqueter*), an occasional anemone and barnacles. Clumps of the orange sponge *Hymeniacidon perleve* were present in this zone around Transect 2 (Plate 10.4.1d). Overall, faunal diversity appeared low, possibly because of the slack currents. There were no laminariales (kelp) and or fucoids along this extreme low shore/upper infralittoral zone. This latter zone was around 5-10m wide depending on the tide. Immediately above this was a zone of about 15-20m in width where scattered clumps of *Fucus serratus* dominated in the lower half of the zone and *Fucus vesiculosus* dominated the upper half. *Ulva* was frequently encountered here also (Plate 10.4.1e). The substrate varied quite a bit in this section with sand and scattered pebble or small cobble in the lower third, sand and fine gravel or coarse sand in the mid to upper part and gravel and scattered small cobble in the upper section. Where fine gravel and or coarse sand dominated there was no seaweed cover. Finally the upper 10-15m of the shore was dominated in the lower half to two thirds by a coarser substrate in general comprising small cobble and gravel, with a sparse scattered cover of *Fucus vesiculosus* in the lower half along with what might be *Fucus spiralis*, but it wasn't easily distinguished from *F. vesiculosus*. The dominant species here however was the green *Enteromorpha* seaweed, which formed a widespread but sparse cover on the larger substrate elements. It was locally more luxuriant where freshwater seepage seems to have enhanced it (Plate 10.4.1f). Above this at the top of the shore the cobble – gravel substrate was barren.

The lack of rock or stable boulder or cobble meant that faunal diversity in general was low being confined to scattered Littorinid molluscs, *Elminius modestus* barnacles and encrusting worms (*Spirorbis*) and bryozoans on *Fucus* fronds.

The habitats present on the Abbey shore didn't fall neatly into the JNCC Marine Habitat Classification system[2] but broadly included the following: LS.LCS.Sh.BarSh (Barren littoral shingle) covering most parts of the shore without seaweed cover, particularly in the mid to upper shore; LR.LLR.F.Fves.X (*Fucus vesiculosus* on mid eulittoral mixed substrata), which described the mid-low shore area dominated by scattered F. vesiculosus (but only a poor example due to the lack of substrate stability) and finally LR.LLR.F.Fserr.X (*Fucus serratus* on full salinity lower eulittoral mixed substrata) in the lower shore dominated (loosely) by *Fucus serratus*. Toward the upper shore there is also a variant of LR.FLR.Eph.EphX (Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata) in areas where *Enteromorpha* dominates on shingle and there is evidence of freshwater seepage through the substrate - Plate 10.4.1 (e).

[2] Connor, D.W., Allen, J.H., Golding, N., Howell, K.L., Lieberknecht, L.M., Northen, K.O. and Reker, J.B. (2004). The Marine Habitat Classification for Britain and Ireland Version 04.05 JNCC, Peterborough. ISBN 1 861 07561 8 (internet version)

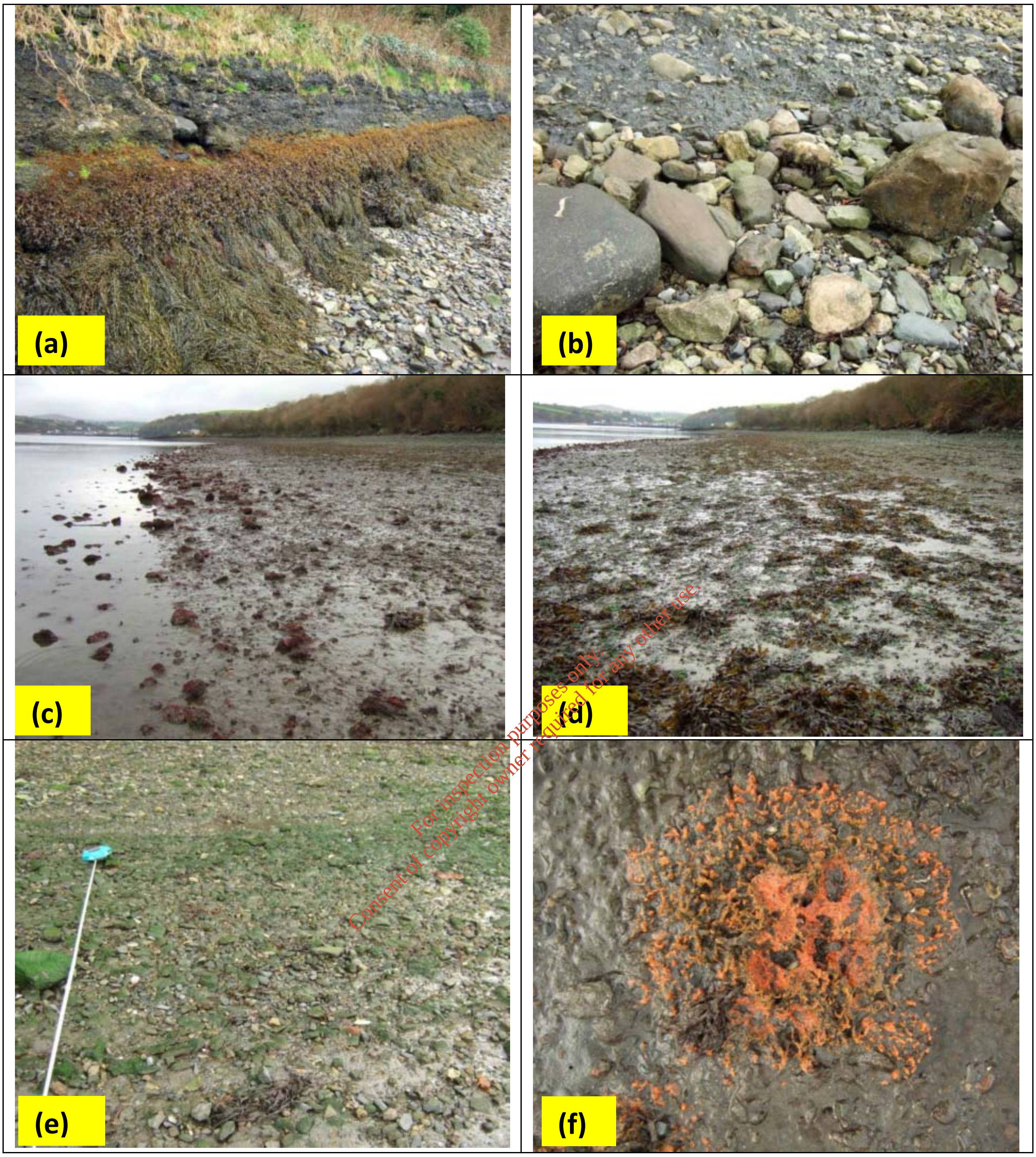


Plate 10.4.1 Abbey Shore

(a) top of shore wall with brown-seaweed zonation,
(b) top of shore bare boulder and cobble,
(c) extreme low water showing scattered boulders with red algae,
(d) mid shore with *Fucus* and *Ulva* cover over sandy gravel,
(e) upper shore dominated by *Enteromorpha*, and
(f) large patch of sponge (*Hymeniacidon perleve*) near Transect 2.

Transects

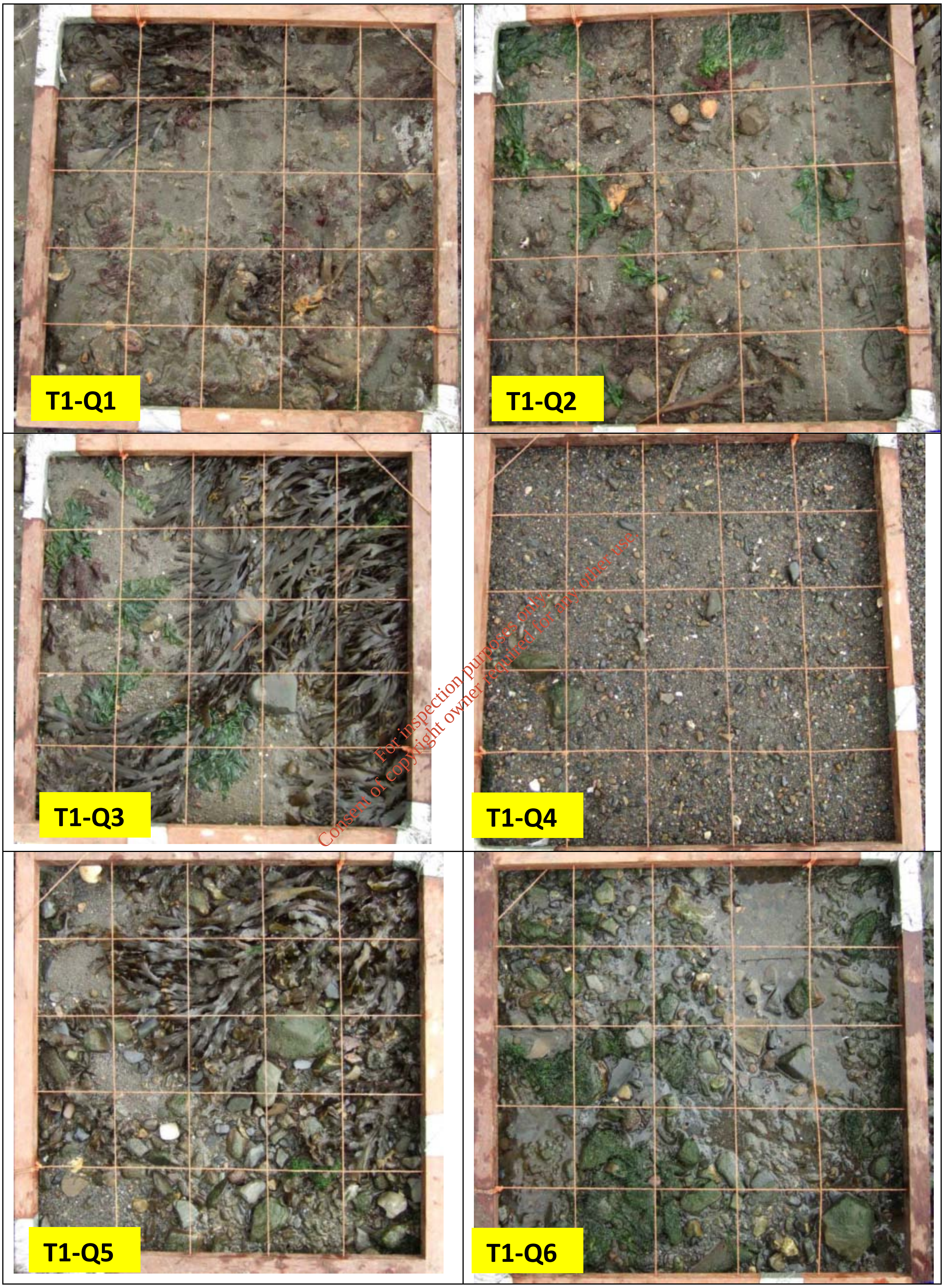
A transect line was run down the shore from the top of the barren shingle area to the tide line and 0.5m x 0.5m quadrats were examined at 5m to 10m intervals from the lower to upper shore to assess the algal cover and the abundance of any fauna observed. The results are presented in Tables headed by the relevant transect number below followed by photos of each quadrat analysed.

Table 10.4.6 Transect 1 (T1)

Quadrat No.	Description
1 (at low water)	Sand over scattered pebble and occasional small embedded cobble. Fine reds 10%, *Fucus serratus* 10%, *Chondrus crispus*, 2%. Arenicola marina 1 cast, *Potamocerous* tubes, occasional on embedded cobble.
2 (-5m)	Sand and scattered pebble. *Ulva* 14%, *F. serratus* 2%, Fine reds (*Ceramium/Polysiphonia*) 4%, bare substrate ~80%,
3 (-11m)	Sand. *Fucus vesiculosus* (56%), *F. serratus* 4%, *Ulva* 10%, *Ceramium* 4%, bare substrate 26%
4 (-20m)	Fine gravel/coarse sand 100%. *Enteromorpha* 2%
5 (-27m)	Sandy gravel. *F. vesiculosus/F .spiralis* 48%, *Enteromorpha* 4%, bare substrate 48%, *Spirorbis* frequent of *F. vesiculosus.*
6 (-32m)	Gravel and large pebble. Freshwater seepage. *Enteromorpha* 30%
7 (~-35m)	Cobble, gravel, sand. *Enteromorpha* 8%

Table 10.4.7 Transect 2 (T2)

Quadrat No.	Description
1 (-0m) LW	Sand and pebbles with sand-binding red algae (*Rhodothamniella floridula*). *F. serratus* 20%, Fine reds 6%, *Osmunda pinnatifida* +, *Ulva* +, *Gibbula cineraria* 3, *Balanus crenatus* 15, *Anomia* 5, *Pomatocerous* ~50, bare substrate ~70%.
2 (-5m)	Sand and fine gravel. *F. serratus* 36%, *F. vesiculosus* 56%, *Littorina obtusata* 10, *Elminius modestus* ~100, *Spirorbis* sp., very common
3 (-15m)	Fine gravel/coarse sand. *F. vesiculosus* 8%, bare substrate ~90%
4 (-20m)	Gravel and small cobble. *F. vesiculosus* 28%, *Enteromorpha* 8%, bares substrate ~74%
5 (~-25m)	Gravel and cobble 100%
Top of shore (-28m)	*Fucus spiralis* +, *Elminius modestus* few on boulders


T1-Q1
T1-Q2
T1-Q3
T1-Q4
T1-Q5
T1-Q6

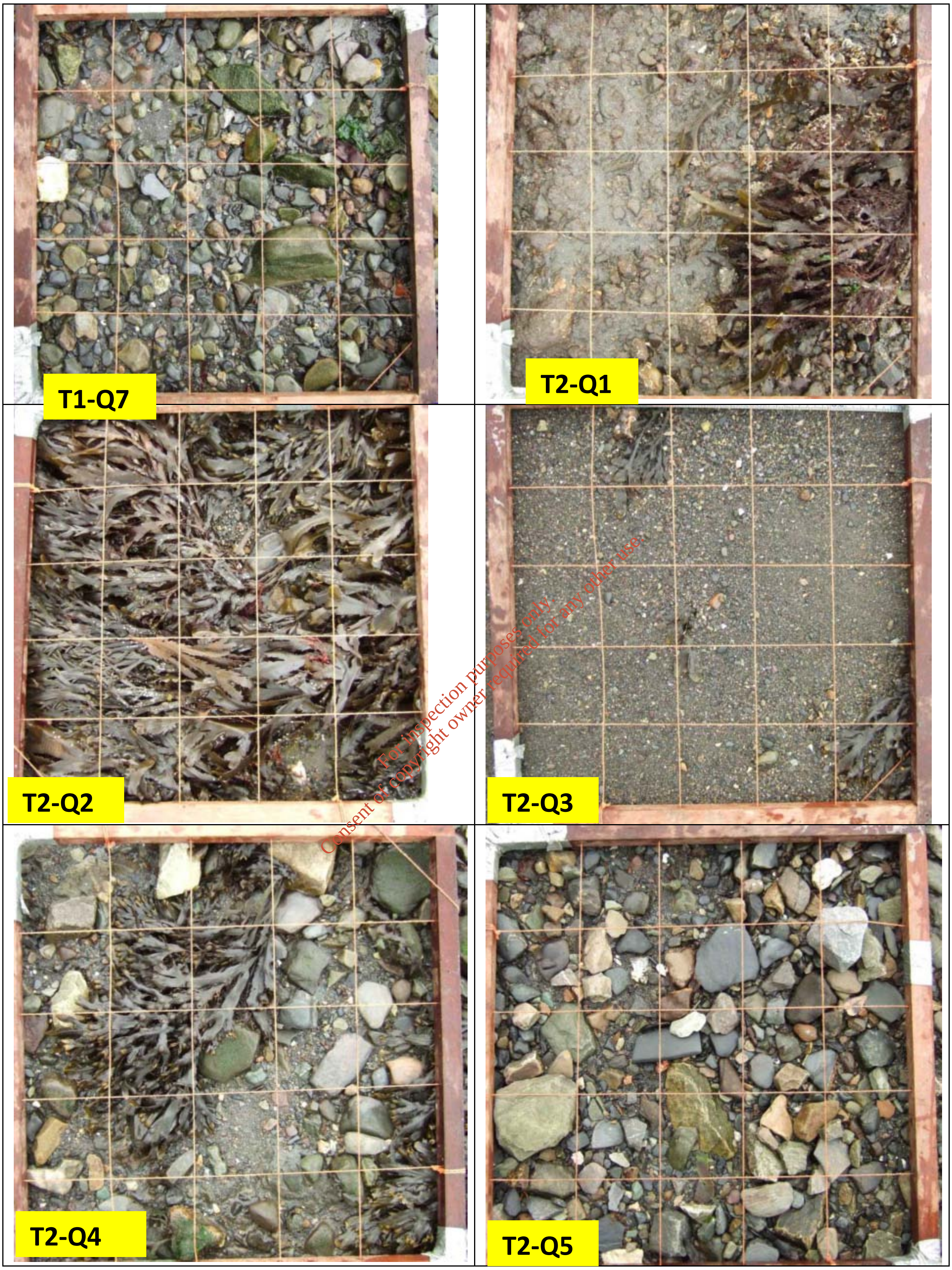


Plate 10.4.2 Quadrats - Transects 1 and 2

Cove Inlet & Becin Strand

Outer Shore – North West (Transect 11)

The outer shore to the north of Cove inlet faces due west and is dominated by cobble, gravel and pebble, with patches of exposed gravelly sand and gravelly clay in places (Plate 10.4.3). The absence of bedrock at the top of the shore means that the more typical Pelvetia / Fucus spiralis brown seaweed zonation patters of sheltered – moderately exposed upper shores is absent, with the upper shore fairly barren except for large numbers of amphipods beneath cobbles feeding on decaying seaweed litter. The mid to upper shore is dominated by Enteromorpha green seaweed forming a thin coating on cobbles and larger pebbles, with scattered small clumps of brown seaweed also present (Plate 10.4.3a). In the mid to lower shore there is substantial brown seaweed (Fucus) cover with Fucus vesiculosus dominant in the upper part of the zone (Plate 10.4.3b) and F. serratus more prominent in the lower part (Plate 10.4.3c). Also, in the lower part of the shore around low water, large rounded pebbles often covered in encrusting reds algae both calcareous and non-calcareous (Hildenbrandia) (Plate 10.4.3d). This area also occasional clumps of Chondrus crispus, Dumontia contorta and Ulva, present here along with occasional dog whelks (Nucella lapillus) and edible periwinkles (Littorina littorea) and top shells (Gibbula umbilicalis). The habitats present on NW Cove shore fall broadly into the following JNCC Marine Habitat Classification types: LS.LSa.St.Tal (Talitrids on the upper shore and strand-line) at the top of the shore / strand line; a variant of LR.FLR.Eph.EphX (Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata) in mid-upper shore where Enteromorpha dominates on cobble/shingle with scattered clumps of Fucus vesiculosus; a species poor variant of LR.LLR.F.Fves.X (Fucus vesiculosus on mid eulittoral mixed substrata) in the mid to lower shore and LR.LLR.F.Fserr.X (Fucus serratus on full salinity lower eulittoral mixed substrata) on the lower shore.

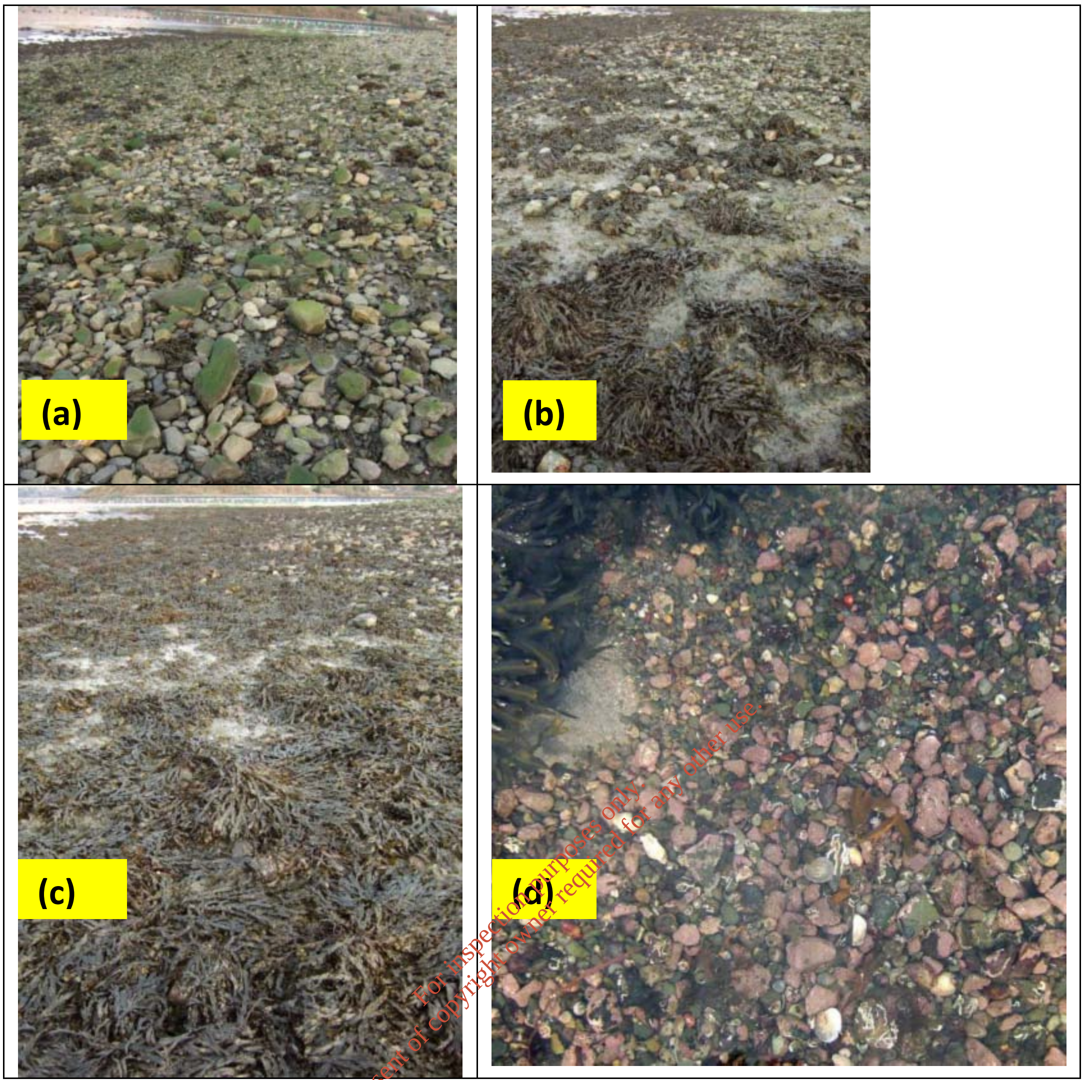


Plate 10.4.3 Outer Cove shore northern side near T11

(a) upper shore coarse substrate with Enteromorpha covering and scattered Fucus

(b) upper-mid shore showing start of F. vesiculosus dominance

(c) mid to lower shore with dominated by Fucus and

(d) pebble covered in calcareous encrusting red algae in shallow water in lower shore.

Table 10.4.8 Transect 11 (T11)

Quadrat No.	Description
1 (top of shore)	Boulder/cobble and gravel. No seaweed cover. Large numbers of amphipods underneath cobbles feeding on algal detritus.
2 (+11m)	Cobble and gravel. *F. vesiculosus* (stunted) 7%, very fine covering of *Enteromorpha* 16%. *Littorina saxatilis* 2, *Elminius* ~200.
3 (+21m)	Gravel, cobble, clay. *F. vesiculosus* 90%, *G.* umbilicalis 1, *Elminius* ~50
4 (+31m)	Gravel/pebble, small cobble and sand. *F. vesiculosus* 100%, *F. serratus* 16%, calcareous encrusting red algae 10%, *Mastocarpus stellatus* 4%,. *Lanice conchilega* 1, *L. littorea* 1, L. *obtusata* 6, *Gibbula umbilicalis* 1, *Pomatocerous* 10, *Spirorbis* frequent to common.

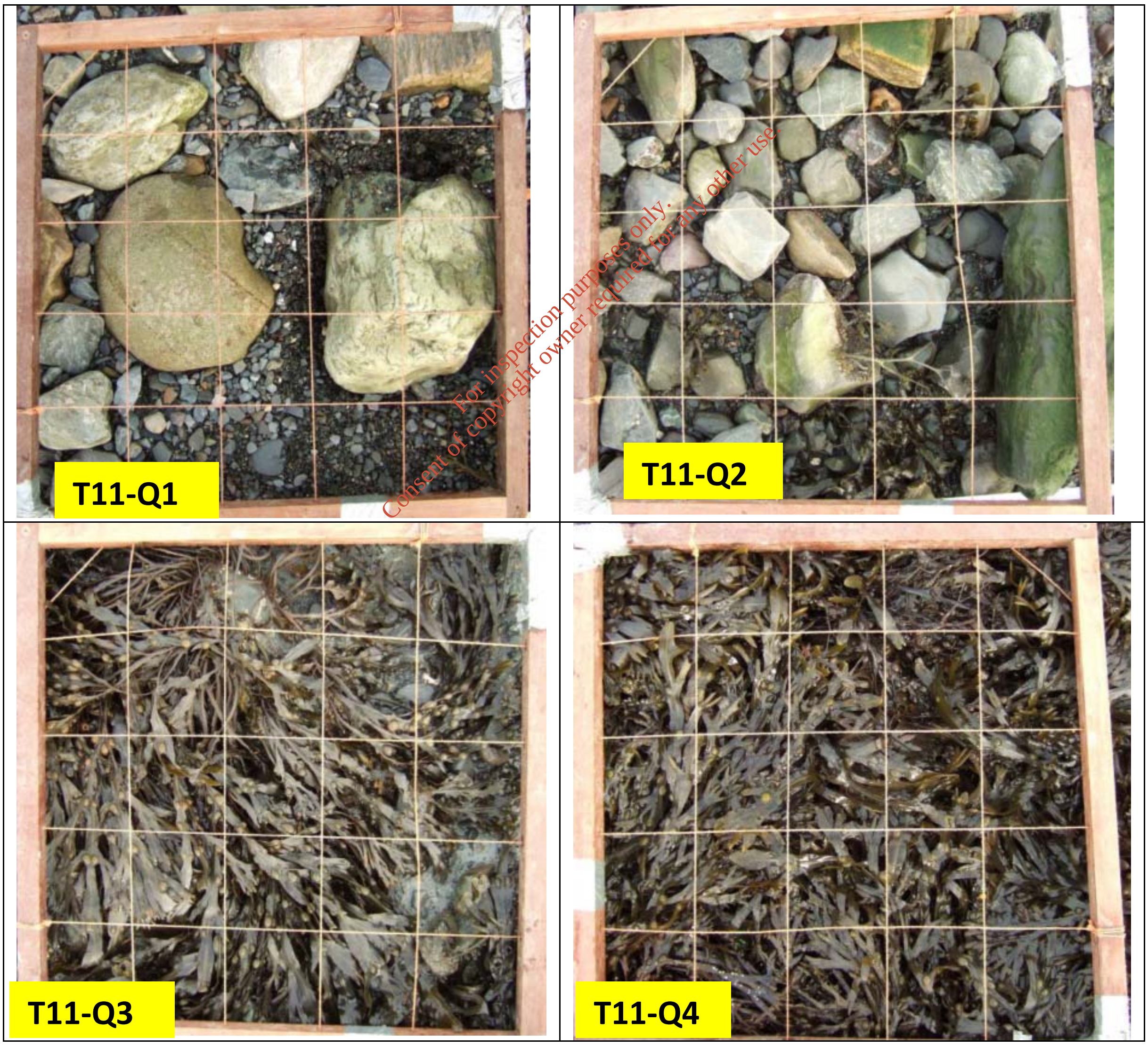


Plate 10.4.4 Quadrats – Transect 11

Transect 8A (T8A)

Overview Transect 8 shore - North

The outer part of the Cove inlet proper is marked by the position of Transect 8A. Here again the shore is composed of coarse mixed sediment grading from larger cobble and gravel on the upper to middle shore, leading on to pebble and sand on the lower shore. The upper coarser material is fairly devoid of seaweed, apart from scattered clumps of *F. spiralis* and *Pelvetia* (Plate 10.4.5a), whereas from the upper-middle to lower shore, Fucus vesiculosus and *F. serratus* dominate, (Plate 10.4.5b) giving way in the extreme lower shore to far more patchy *F. serratus* overlying increasing open areas of pebble covered in sand-binding red algae (*Rhodothamniella*) - (Plates 10.4.5c and 10.4.5d)

The habitats present in this part of the shore fall broadly into the following JNCC Marine Habitat Classification types: LS.LSa.St.Tal (Talitrids on the upper shore and strand-line) at the top of the shore / strand line; LR.LLR.F.Fspi.X (*Fucus spiralis* on full salinity upper eulittoral mixed substrata) in the upper shore; LR.LLR.F.Fves.X (*Fucus vesiculosus* on mid eulittoral mixed substrata) in the mid to lower shore and LR.LLR.F.Fserr.X (*Fucus serratus* on full salinity lower eulittoral mixed substrata) on the lower shore. Toward the lower shore end of the latter, the substrate was dominated by muddy-silt coated over large pebbles with fine sand-binding reds attached.

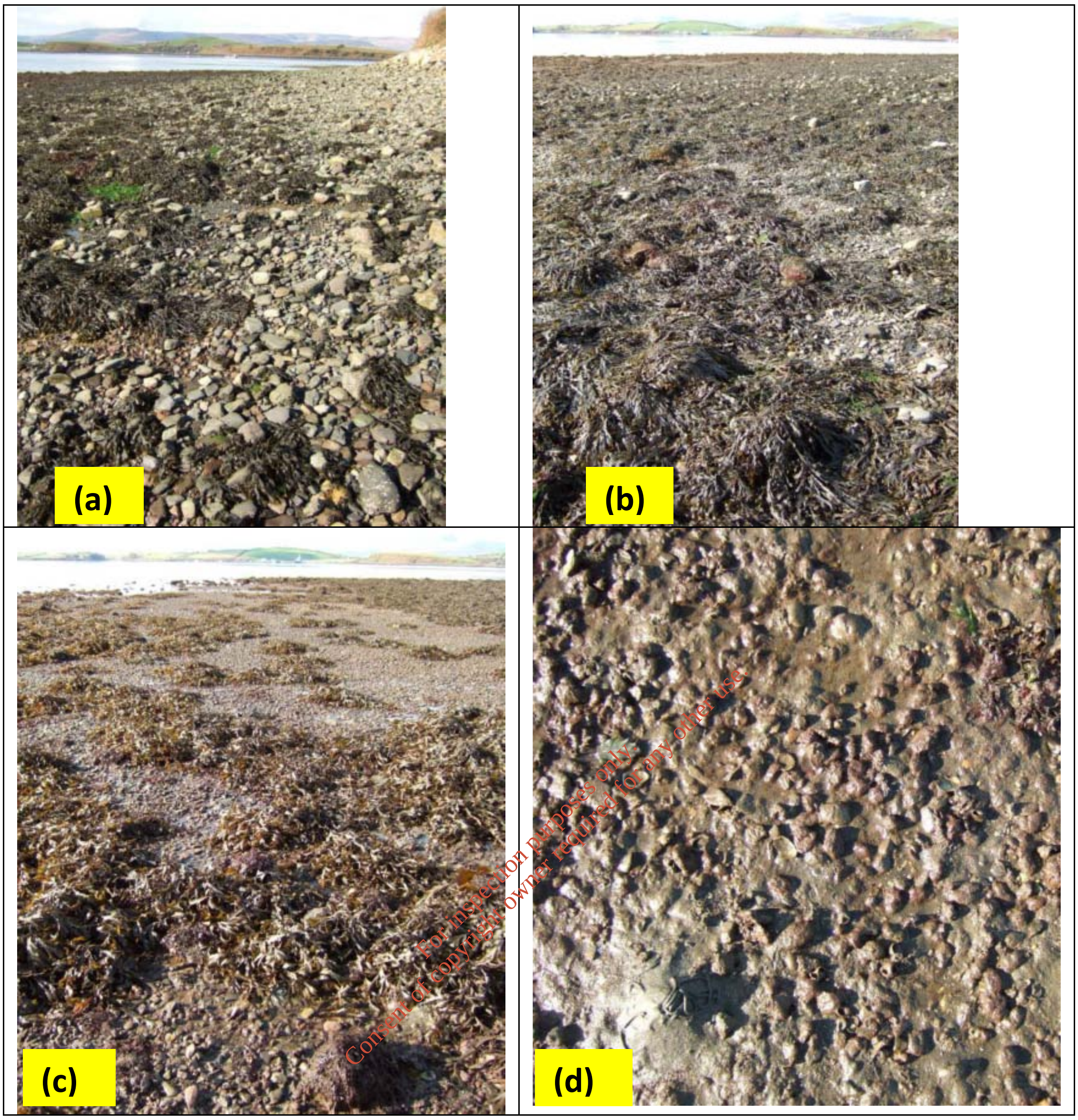


Plate 10.4.5 Area of Transect T8A showing

(a) cobble and gravel in the upper shore,

(b) F. vesiculosus at the top of the mid-shore,

(c) Scattered clumps of *F. serratus* over pebble in the extreme lower shore and

(d) a close up of the pebbles with sand-binding red algae covering them.

Table 10.4.9 Transect 8A (T8A)

Quadrat No.	**Description**
1 (at high water)	Gravel and cobble. No seaweed cover. Large numbers of amphipods underneath cobbles feeding on algal detritus.
2 (+10.4m)	Boulder, cobble, gravel and sand. *Fucus spiralis* 30%, *Pelvetia* 3%, *Enteromorpha* +, *Littorina saxatilis/rudis* 10.
3 (+20m)	Large pebble, gravel and cobble. *F. vesiculosus* 100%, *Gelidium pusillum* 3%, *Rhodothamniella* 1-2%, *Enteromorpha* 1%. *Patella vulgata* 1, *Osilinus lineatus* 1, *Elminius* 50-100.
4 (+30m)	Pebble, sand and cobble. *F. serratus* 4%, *F. vesiculosus* 78%, bare substrate 18%, *Hildenbrandia* 4%. *Actinia equine* 1, *Osilinus lineatus* 1, *L. littorea* 1, *G. umbilicalis* 1.
5 (+40m)	Small cobble and gravel on slightly muddy sand. *F. serratus* 86%, *F. vesiculosus* 8%, bare substrate 6%. *Chondrus crispus* <2%, Encrusting calcareous red algae on cobble and pebble 20%, *Rhodothamniella* 2%. *L. littorea* 1, *L. obtusata* 7, *Lanice* 1, *Verruca stroemia* 5
6 (+50m)	

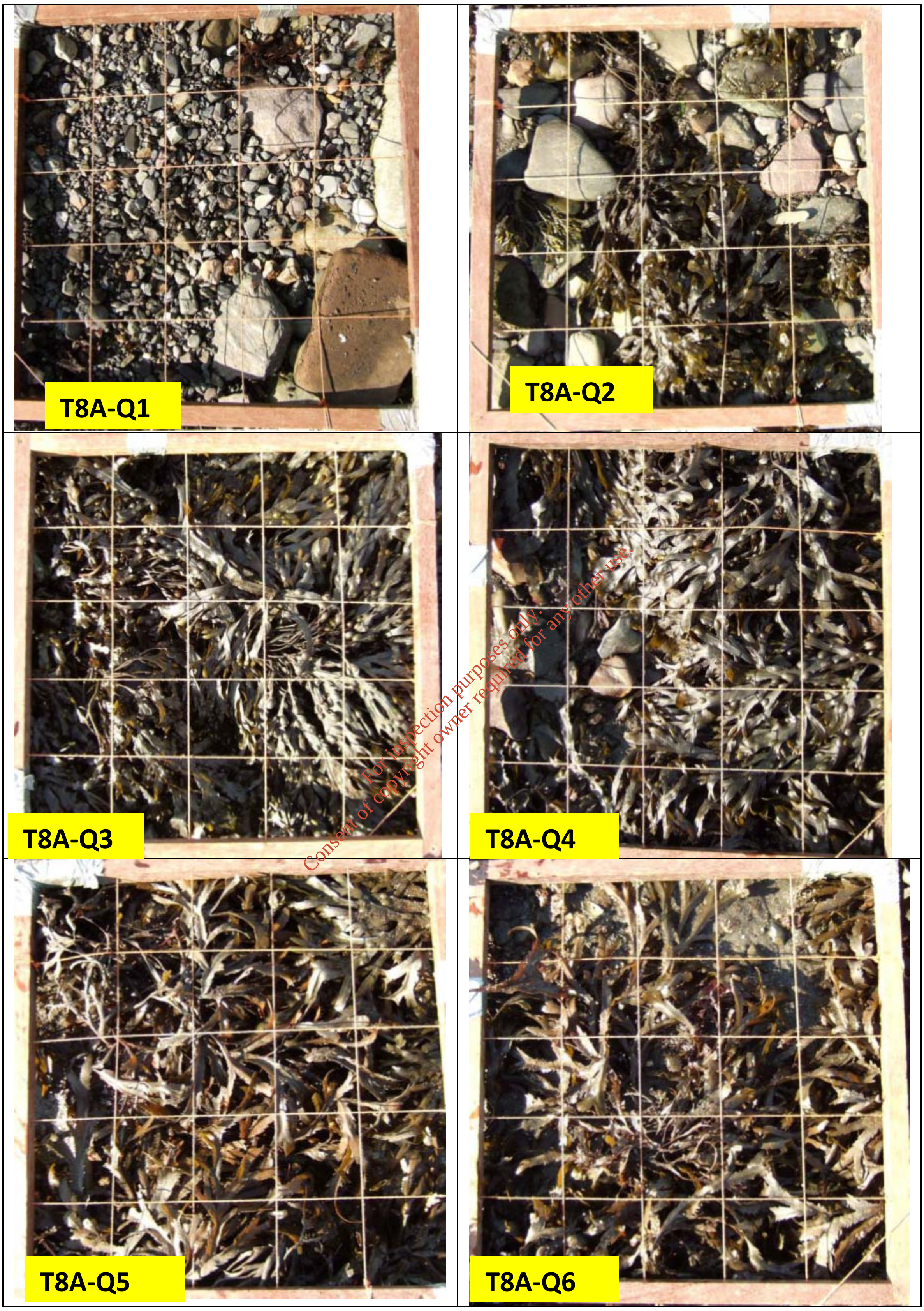


Plate 10.4.6 Quadrats – Transect 8A

Transect 9 – North (T9A)

Overview

The shore at T9A is similar to T8A but marginally more sheltered and ending in muddy sand. The top of the shore comprises barren small cobble and gravel, with the upper shore dominated by scattered *F. spiralis* and *Pelvetia* over small cobble and coarse gravel (Plate 10.4.7a). The middle and lower shores are dominated by the two main brown seaweeds on most of these shores i.e. *F. vesiculosus* and *F. serratus* (Plate 10.4.7b and 10.4.7c) with a very occasional clump of *Ascophyllum* attesting to the more sheltered nature of this area. The mid to lower shore is dominated by gravel which merges into sand in the mid-lower to extreme lower shore, the latter composed of an lugworm community (*Arenicola marina*) (Plate 10.4.7d). All of the same broad JNCC habitats present at transect 8A were present here also, however the extreme lower shore merged into an *Arenicola* community and didn't have the silt and red-algal covered band of pebble as much in evidence.

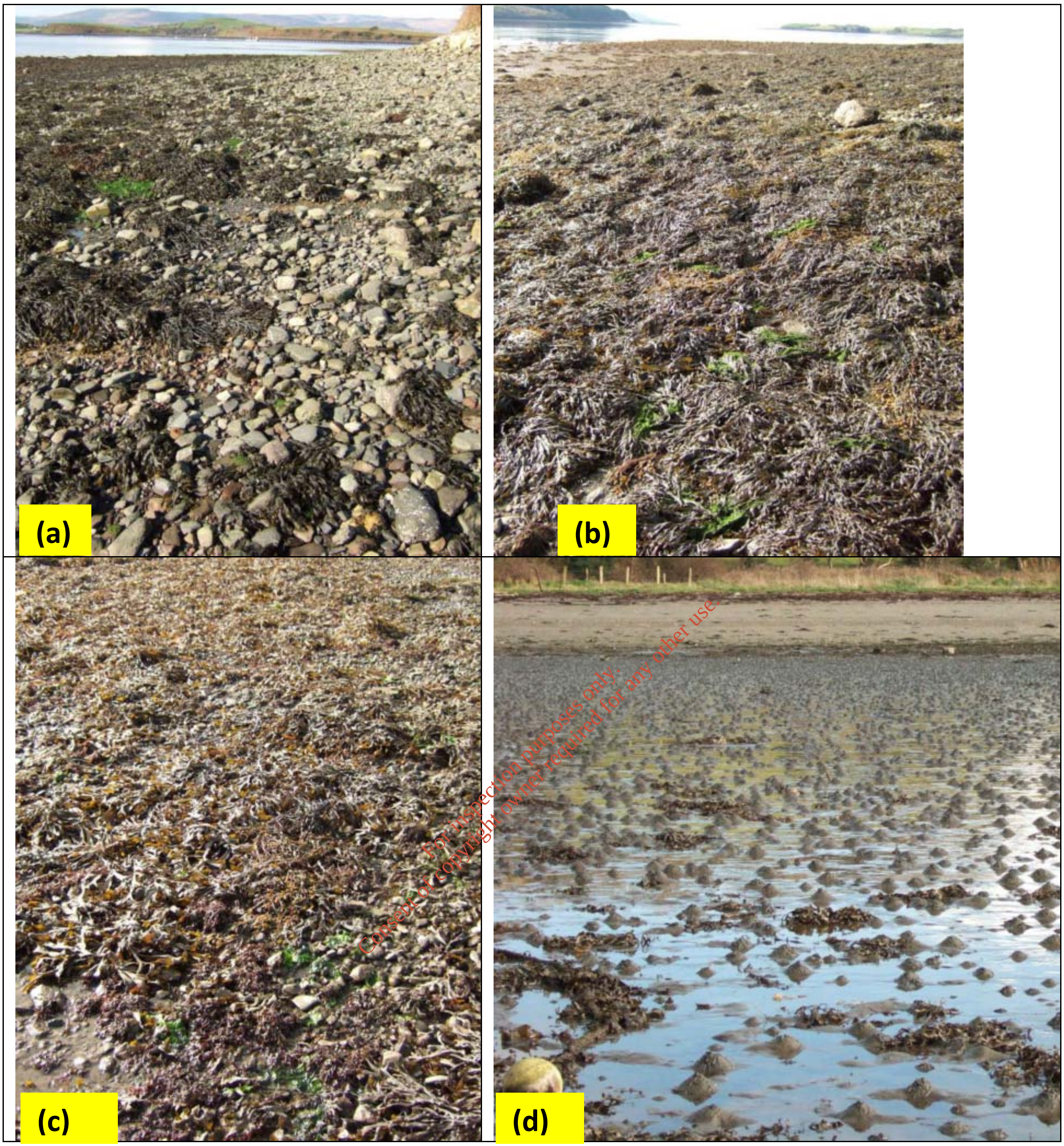


Plate 10.4.7 Area of Transect T9A north showing
(a) barren cobble and gravel in the upper shore along with scattered *F. spiralis* and *Pelvetia* just below,
(b) the *F. vesiculosus* dominated mid-shore,
(c) *F. serratus* and scattered reds on the lower shore and
(d) the extreme lower shore comprising an *Arenicola* community.

Table 10.4.10 Transect 9A (T9A)

Quadrat No.	**Description**
1 (top of shore)	Medium to fine gravel and drift seaweed. No plant cover; frequent amphipods in drift line.
2 (+10m)	Small cobble, gravel and pebble. *Pelvetia* 17%, *F. spiralis* 20%, bare substrate ~ 63%
3 (+20m)	Fine gravel and sand. *F. vesiculosus* 72%, *Enteromorpha* 3%, *M. stellatus* +, bare substrate ~28%. Amphipods occasional, *L. obtusata* 3, *L. littorea* 1
4 (+30m)	Sand and fine gravel (?). *F. serratus* 88%, *C. crispus* 12%, *Ascophyllum* +.
5 (+40m)	Sand. 96% *F. serratus*, bare substrate 4%. *Arenicola* cast, 1, *Palaemon* 3.

Transect 10 – North and South

This transect is situated at the head of the Cove embayment and is composed by two short upper and mid-shore sections one each at the northern and southern ends of the transect which are dominated by coarse substrate both leading down to a central lower mid shore / lower shore section comprising slightly muddy sand which links the two (Plate 10.4.8). There is a significant amount of surface and groundwater seepage reaching this end of the bay also. The northern hard-substrate section is dominated by decaying drift seaweed with little or no live plants.

Table 10.4.11 Transect 10A

Quadrat No.	**Description**
1 (top of shore)	Gravel and scattered cobble. Barren
2 (+5.2m)	Seaweed drift over gravel 100%
3 (+16m)	Muddy sandy gravel 100%

Plate 10.4.8 Area of Transect T10A

(a) Drift seaweed at head of shore,

(b) muddy sand at lower shore.

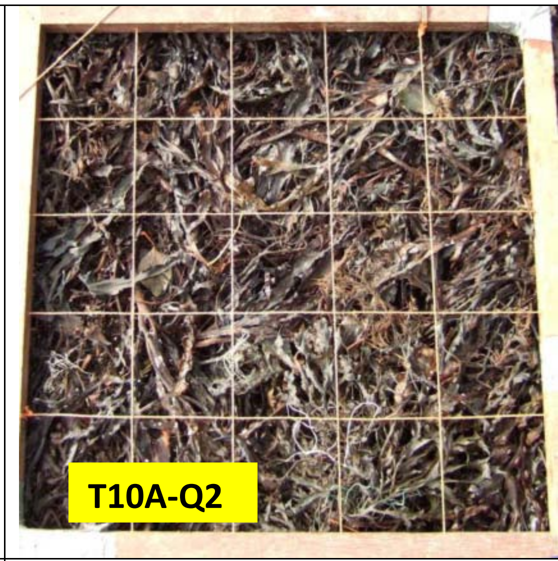


Plate 10.4.9 Quadrats – Transect 10A

Transect 10 –South (T10B)

The southern end of the transect traverses the same type of coarse substrate at the upper and upper middle end of this short shore and terminates also in muddy sand. The influence of freshwater seepage and run-off means that *Enteromorpha* is prominent in places (Plate 10.4.10), especially in the SSE corner of the bay near this transect. Unlike elsewhere where sand only dominates in the extreme the lower to extreme lower shore, here it appears in the lower middle shore overlying pebble also. In general both ends of Transect 10 (T10A & T10B) are very species poor.

Table 10.4.12 Transect 10B

Quadrat No.	**Description**
1 (top of shore)	Cobble and shingle – barren.
2 (+7m)	Gravel. *F. vesiculosus* 80%, bare substrate ~20%. *Elminius* ~50,
3 (+20m)	Gravel & large pebble, FW seepage. *Enteromorpha* 6%.
4 (+35m)	Muddy sand over gravel/pebble. *Enteromorpha* and *Ulva* +, *Arenicola* casts 6

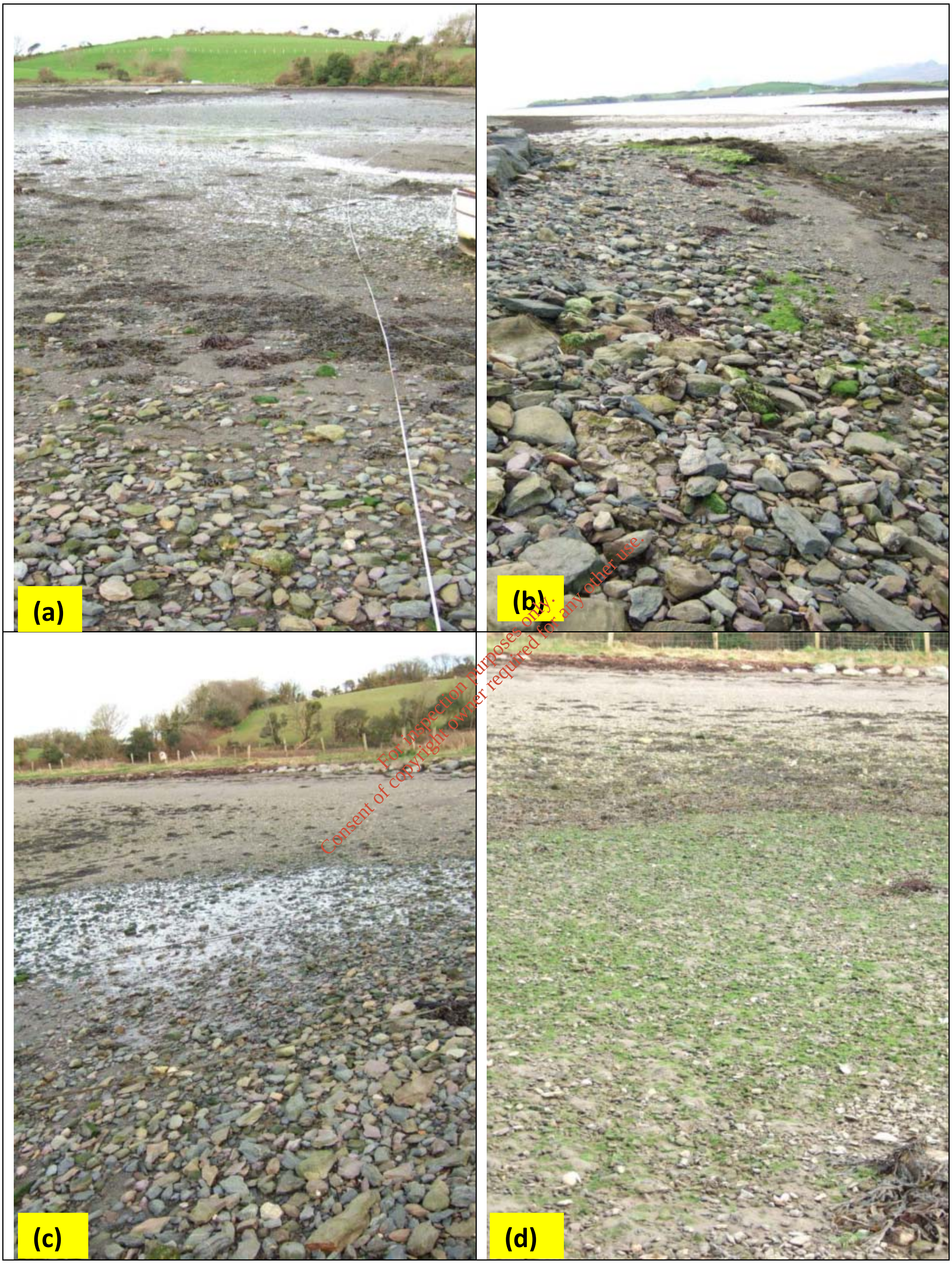


Plate 10.4.10 Area of Transect T10B south

(a) showing line of transect,

(b) top of the shore viewed to the west,

(c) top of the shore viewed to the ESE, note FW seepage and
(d) *Enteromorpha* over muddy sand and gravel at the eastern end of Cove – mid-shore.

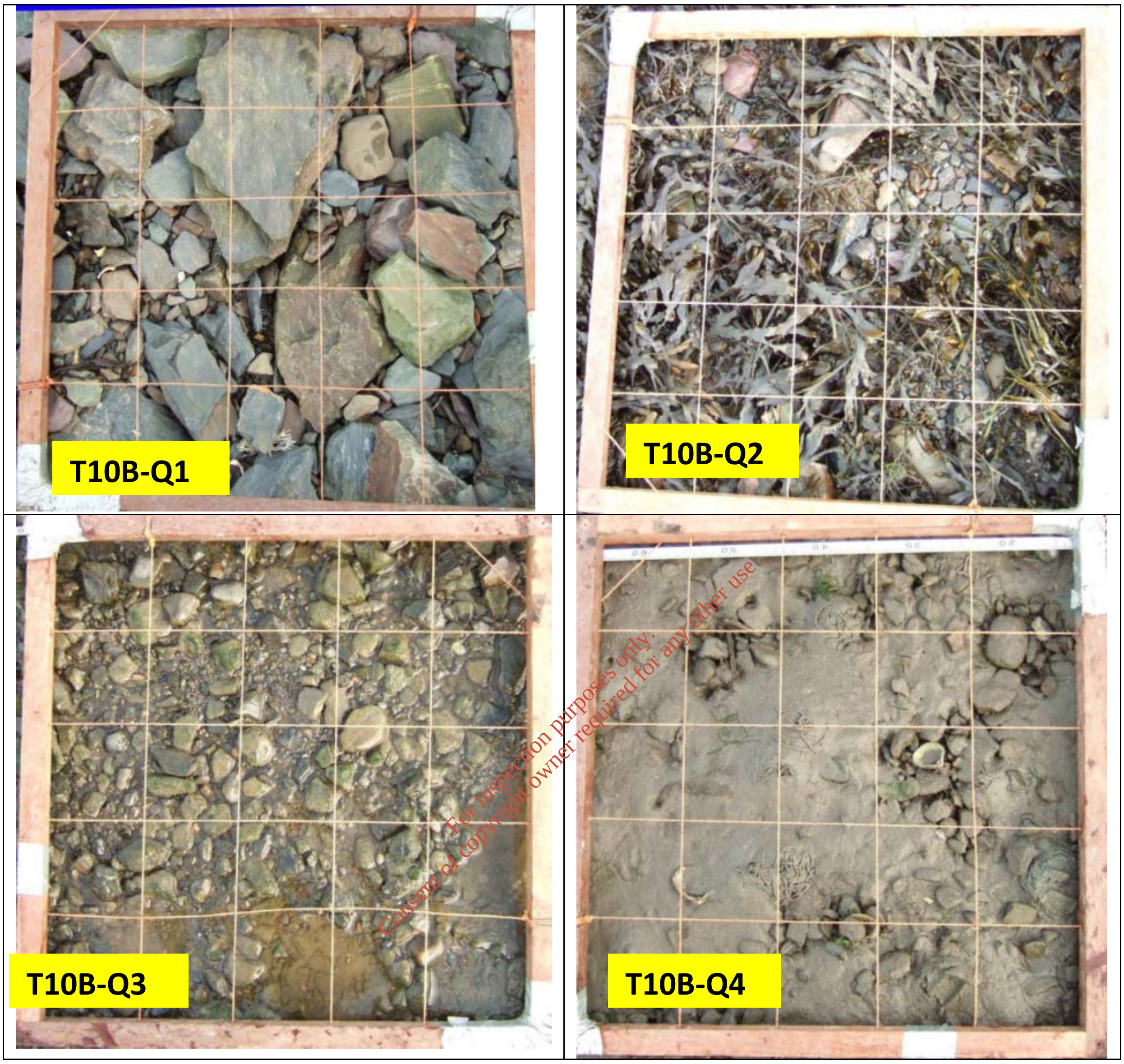


Plate 10.4.11 Quadrats – Transect 10B

Transect 9B –South

Transect 9B i.e. on the southern Cove shore, was similar in many respects to 10B with a barren top of shore with cobble and some gravel, followed by a mid to upper shore dominated by cobble and gravel with sparse to moderate *Enteromorpha* cover (Plate 10.4.12b), followed by a mid-shore dominated by F, *vesiculosus* (Plate 10.4.12c), a lower shore dominated by *F. serratus* (Plate 10.4.12d) and an extreme lower shore dominated by sand or muddy sand with *Arenicola* common and without seaweed (Plate 10.4.12e).

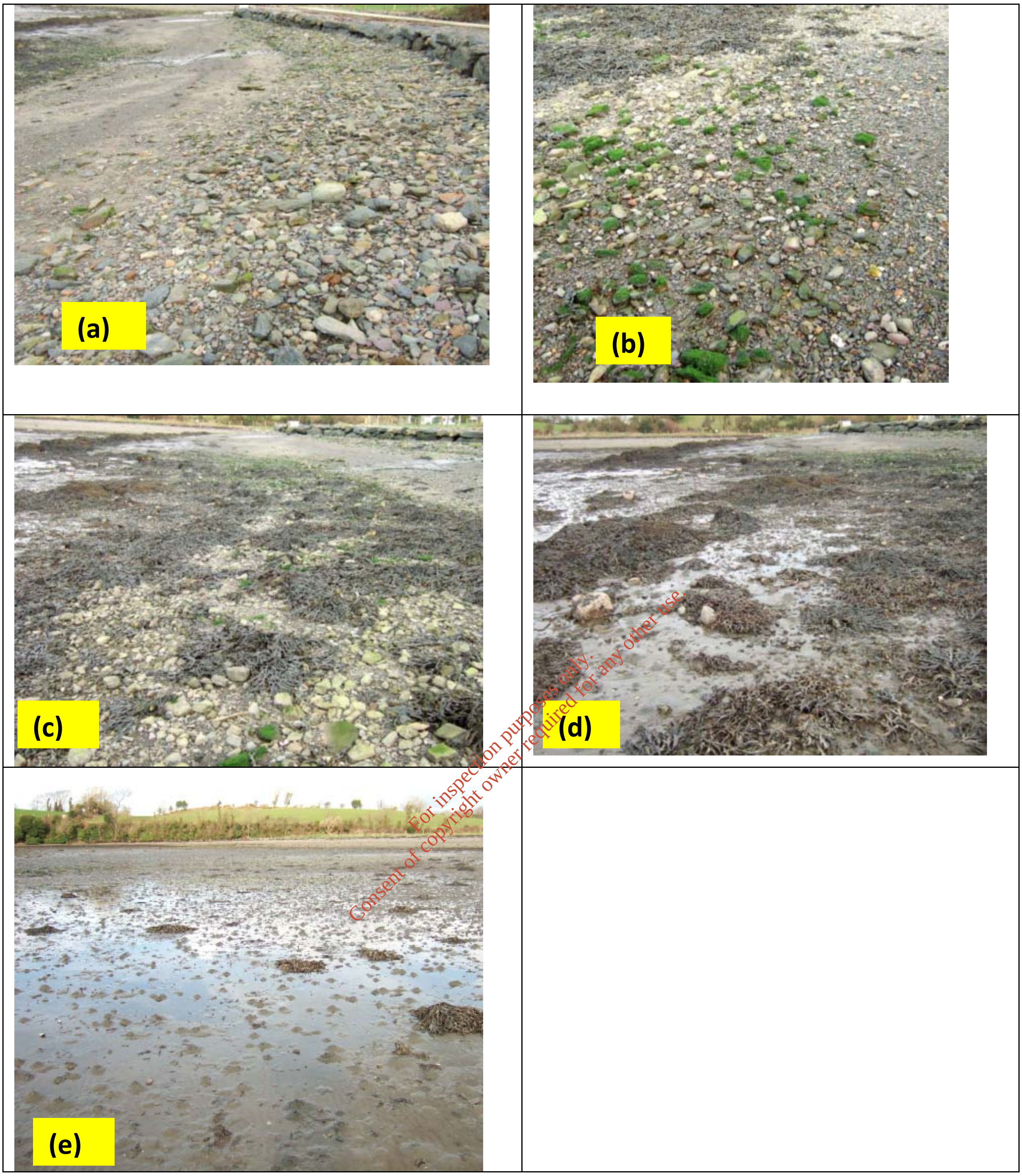


Plate 10.4.12 Area of Transect T9B

(a) extreme upper shore of barren shingle,
(b) upper shore with *Enteromorpha* on cobble,
(c) mid-shore with *Fucus vesiculosus*,
(d) lower shore with *F. serratus* and
(e) extreme lower shore with *Arenicola* burrows in muddy sand.

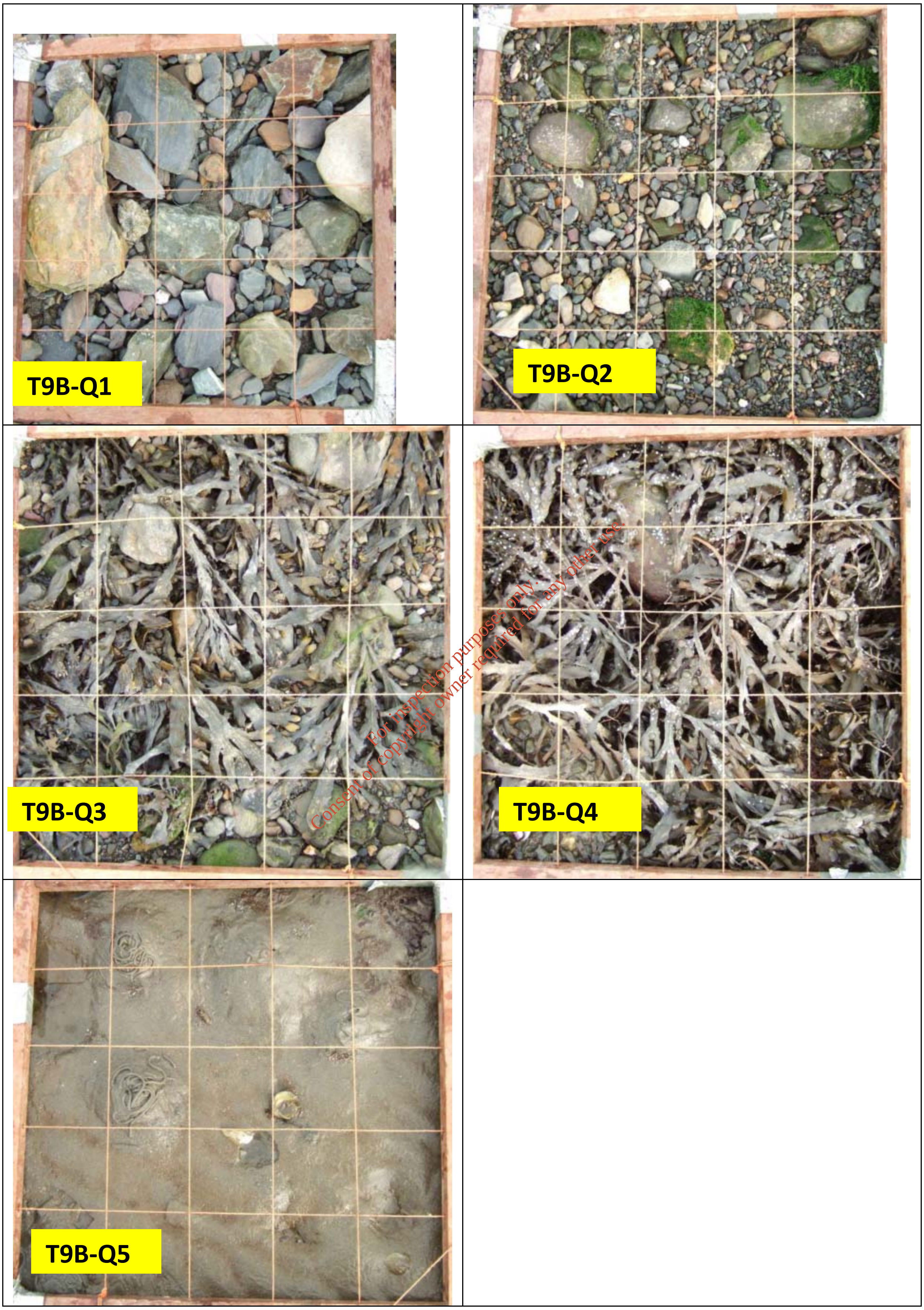


Plate 10.4.13 Quadrats – Transect 9B

Table 10.4.13 Transect 9B (South)

Quadrat No.	**Description**
1 (top of shore)	Cobble and shingle – barren, except for high numbers of amphipods under large cobbles.
2 (+10m)	Cobble and gravel. *Enteromorpha* 7%. ~93% bare substrate
3 (+13m)	Gravel and scattered cobble. 84% *F. vesiculosus*, 3% *Enteromorpha*, 16% bare substrate.
4 (+20m)	Cobble and gravel. *F. vesiculosus* 60%, *F. serratus* 38% (sand begins at 21m and gravels finishes there) Bare substrate 12%. *Spirorbis* common
5 (+30m)	Sand/muddy sand. Fine red algae +, 4 *Arenicola* casts

Transect 8B –South

Plate 10.4.14 Area of Transect T8B

(a & b) extreme upper shore / upper shore of barren shingle and cobble covered with with *Enteromorpha* in areas affected by freshwater seepage,

(c) mid-shore with *Fucus vesiculosus*,

(d) lower shore with *F. serratus*,

(e) extreme lower shore with *F. serratus* on clean sand with Lanice tubes and

(f) general view of Cove outer area – view from south shore to the WNW.

Transect 8B (South)

This transect was very similar to T9B except that the sand was clean and low in fines which is why it was dominated by *Lanice* rather than *Arenicola* at low water (Plate 10.4.14). In terms of JNCC Habitat Classifications the Transects 10 A & B, 9B and 8B have similar habitats including: LS.LCS.Sh.BarSh (Barren littoral shingle) covering parts of the upper shore without seaweed cover; LR.FLR.Eph.EphX (Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata) in areas where *Enteromorpha* dominates on shingle and there is evidence of freshwater seepage through the substrate, especially on upper to upper mid shore; LR.LLR.F.Fves.X (*Fucus vesiculosus* on mid eulittoral mixed substrata) in the mid to lower shore and LR.LLR.F.Fserr.X (*Fucus serratus* on full salinity lower eulittoral mixed substrata) on the lower shore, the latter two generally very species poor. The lower shore was dominated by slightly muddy sand dominated by Arenicola burrows while toward the outer section of Cove, less fines in the sand saw the appearance of *Lanice chonchilega*.

Table 10.4.14 Transect 8B (South)

Quadrat No.	Description
1 (low water)	Clean sand. *Lanice* tubes ~64
2 (-5)	Clean sand. *F. vesiculosus* 96%, *Ascophyllum* 4%, *F. serratus* 8%, *L. obtusata* 4, *Spirorbis* frequent.
3 (-15m)	Clean sand 7 occasional small cobble. *F. vesiculosus* 52% 21% *F. serratus*, *Ascophyllum* 12%, Enteromorpha +, *Arenicola* 1 cast, *Spirorbis* frequent, *Elminius* ~50. bare sand 15%.
4 (-25m)	Cobble, gravel and sand. *F. vesiculosus* 30%, *Enteromorpha* 12%. *Elminius* ~50
5 (-30m)	Cobble, gravel, sand. *Enteromorpha* 30%, *F. vesiculosus* / *F. spiralis* 4%. (small fish under stone). FW seepage onto shore
6 (top of shore) -- 35m	Cobble and shingle – barren, except for high numbers of amphipods under large cobbles; *Fucus* sp. 4%, *Enteromorpha* 4%.

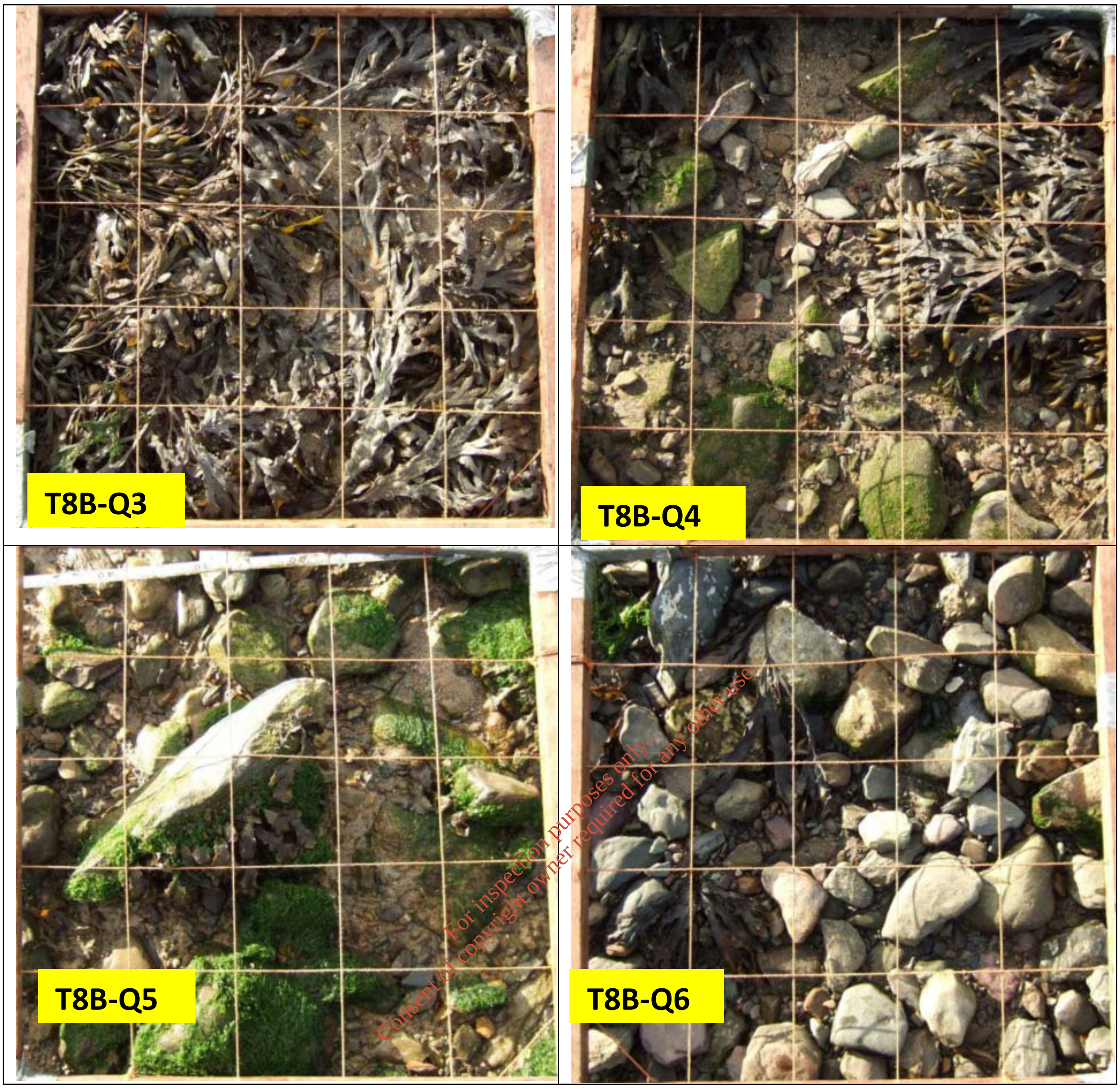


Plate 10.4.15 Quadrats – Transect 8B

Becin Strand (Transects 7 and 6)

Transect 7

Transect 7 is on the Cove end of Becin Strand (Plate 10.4.16). The tide was beginning to advance at the stage that this transect was started so that the 1st Quadrat is in the water, where the substrate comprised clean sand. Overall, there was a lower density of brown seaweed on the strand and no *Ascophyllum*, which both point to greater exposure along the strand.

Table 10.4.15 Transect 7 (T7)

Quadrat No.	Description
1 (low water)	Clean sand. *F. serratus* ~30%-40% Fine reds (*Ceramium /Polysiphonia*) ~2%. *L. obtusata* +, *Spirorbis* common. ~60-70% bare substrate.
2 (-5)	Cobble. *F. serratus* 90%, *F. vesiculosus* 10%. *L. obtusata* 3, *Spirorbis common*, *Pomatocerous* +.
3 (-10m)	Cobble. *F. vesiculosus* 75%, *Enteromorpha* +. *L. littorea* 4, *Gammarus* occasional, *Elminius* few. Bare substrate ~25%
4 (-20m)	Small cobble and gravel. *Enteromorpha* 6%.
5 (-26m) Top of shore	Gravel – barren.

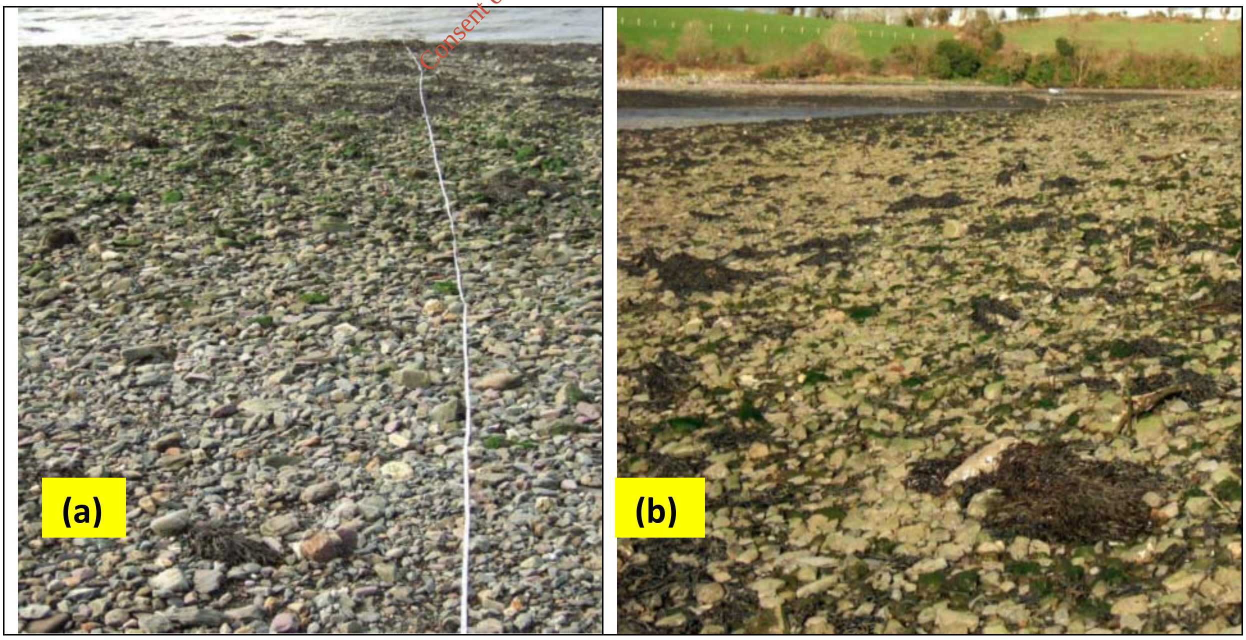


Plate 10.4.16 Area of Transect T7

(a) view down the transect from extreme upper shore and

(b) view across the shore (to the north) at upper to mid shore level.

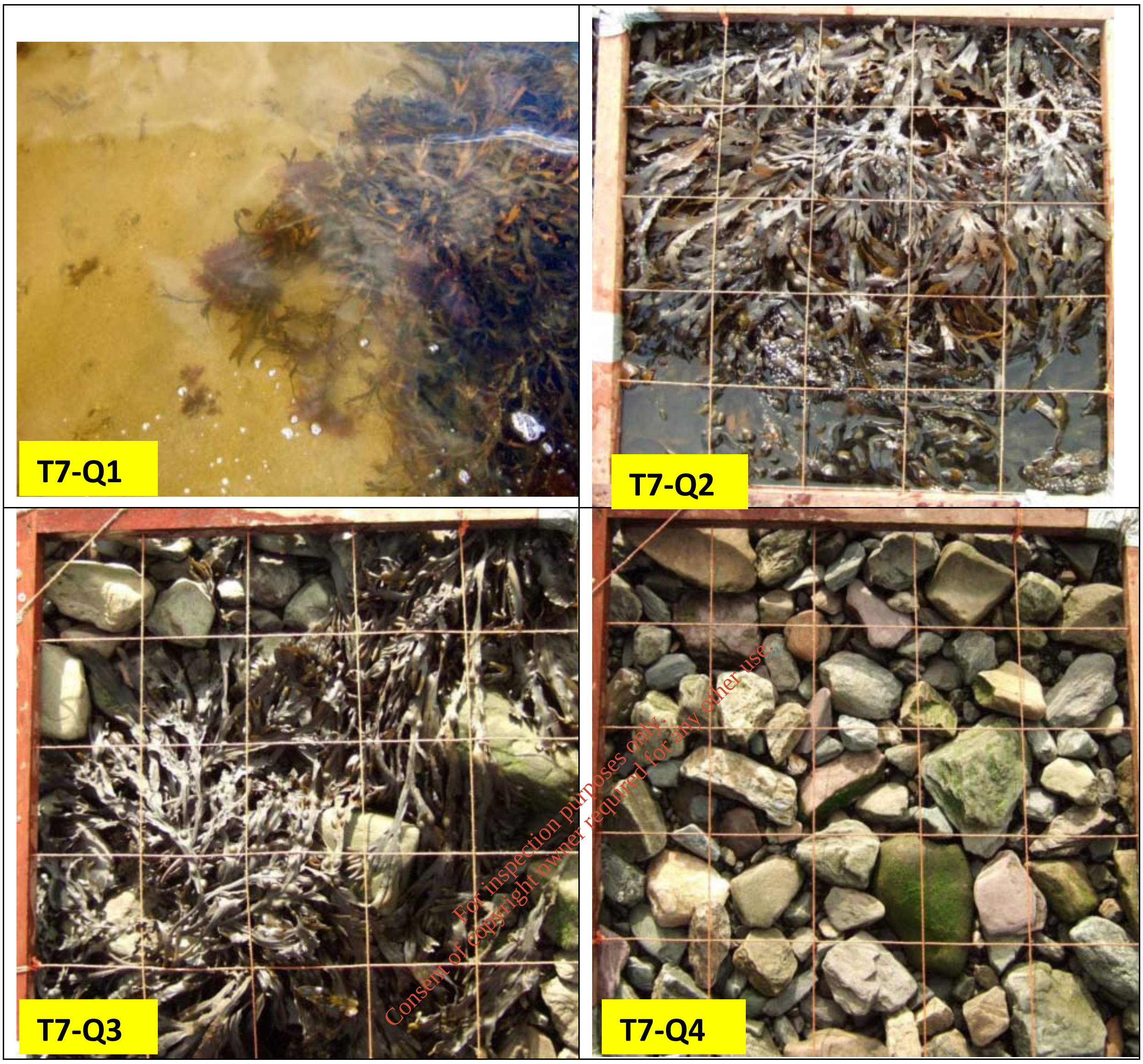


Plate 10.4.17 Quadrats – Transect 7

Transect 6.

Transect 6 is situated on the Bantry Town end of Becin Strand and it was composed of 100% fine gravel and clean sand with no seaweed cover and no surface fauna (Plate 10.4.18). The very lower shore had scattered clumps of *F. serratus* over fine gravel and clean sand.

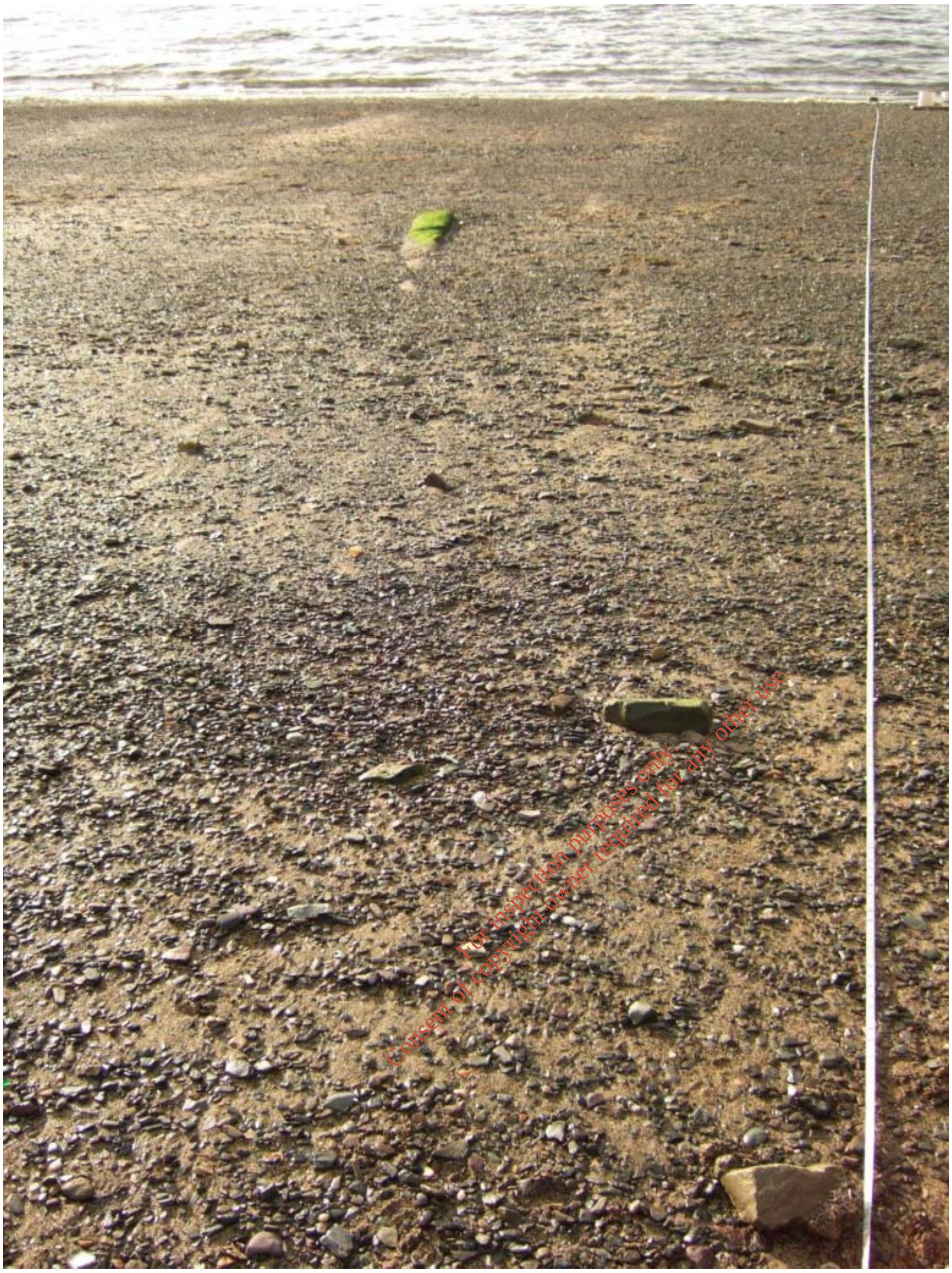


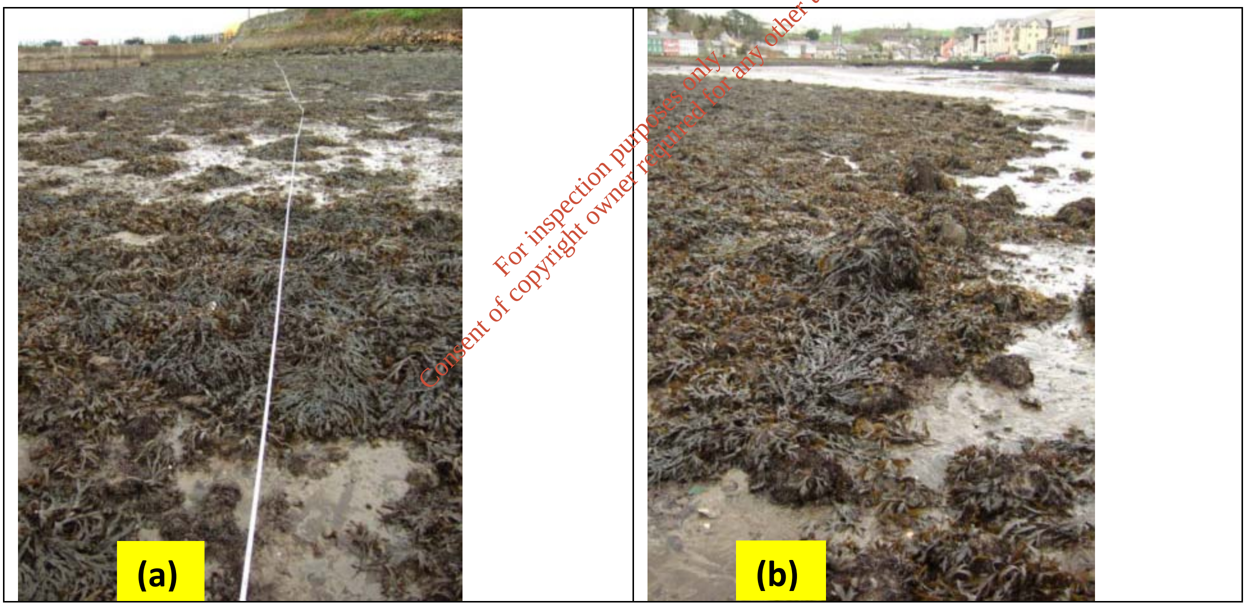
Plate 10.4.18 View of Transect 6 from the top of the shore

Transect 3A.

Transect 3 is at the outer tip of Bantry Harbour and the longest hard substrate intertidal area of the harbour. The top of the transect is dominated by large cobble, pebble and gravel, which gives way to increasing amounts of sand which dominates from mid to lower shore. The very bottom of the shore is influenced by the small river flowing through the town from the east. The shore is fairly sheltered and dominated by Fucus vesiculosus and F. serratus, with some cover of reds at low water and significant amounts of a thin cover of *Enteromorpha* in the upper shore.

Table 10.4.16 Transect 3A

Quadrat No.	Description
1 (at low water)	Sand. *F. serratus* 4%, *M. stellatus* 4, *C. crispus* 6, *Gelidium pussilum* 3%. ~80% bare substrate.
2 (-5m)	Sand (mainly) and cobble. *F. vesiculosus* 77%, *F. serratus* 16%, *M. stellatus* 4%, *C. crispus* 2%. *L. littorea* 4, *L. obtusata* 4, Lanice 2, *Spirorbis* common.
3 (-15m)	Sand (mainly) and cobble. *Fucus vesiculosus* (20%), *F. serratus* 44%, Bare *substrate 26%. L. Obtusata* 6, *Arenicola* 1, *Lanice* 14, *amphipods 2, Spirorbis* frequent.
4 (-25m)	Gravelly sand. *F. vesiculosus* 40%, *Enteromorpha* 4%, bare substrate 60%. *L. obtusata* 1
5 (-35m)	Sandy gravel. *F. vesiculosus* 40%, *Enteromorpha* 8%, bare substrate 60%. L. obtusata 1.
6 (-45m)	Gravel and small cobble. *F vesiculosus / F. spiralis* 36%, bare substrate 64%.
7 (-56m)	Cobble, gravel. *Pelvetia* 2%, *F vesiculosus / F. spiralis* 10%, *Enteromorpha* 8%, amphipods ~40. Freshwater seepage in evidence.



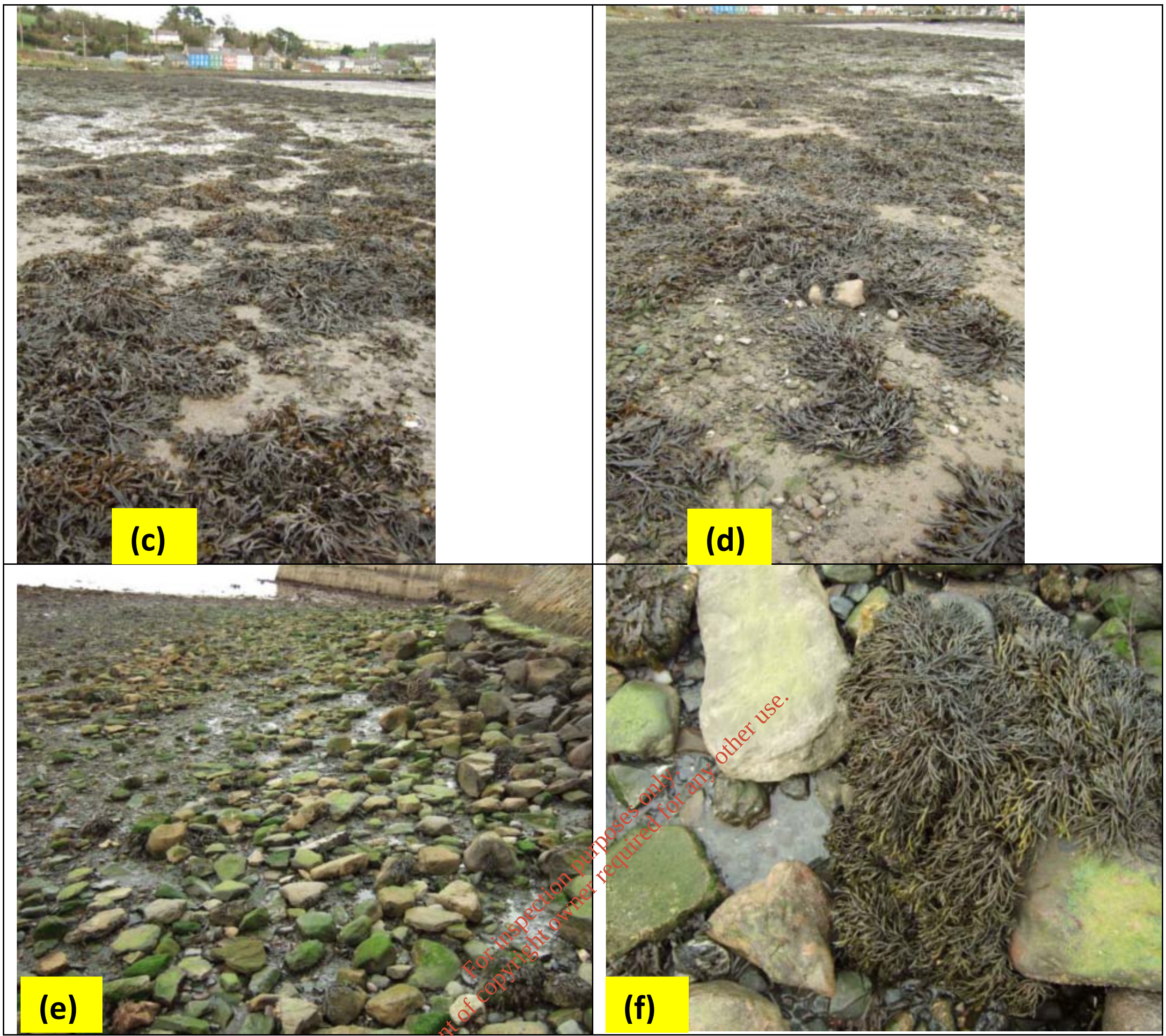
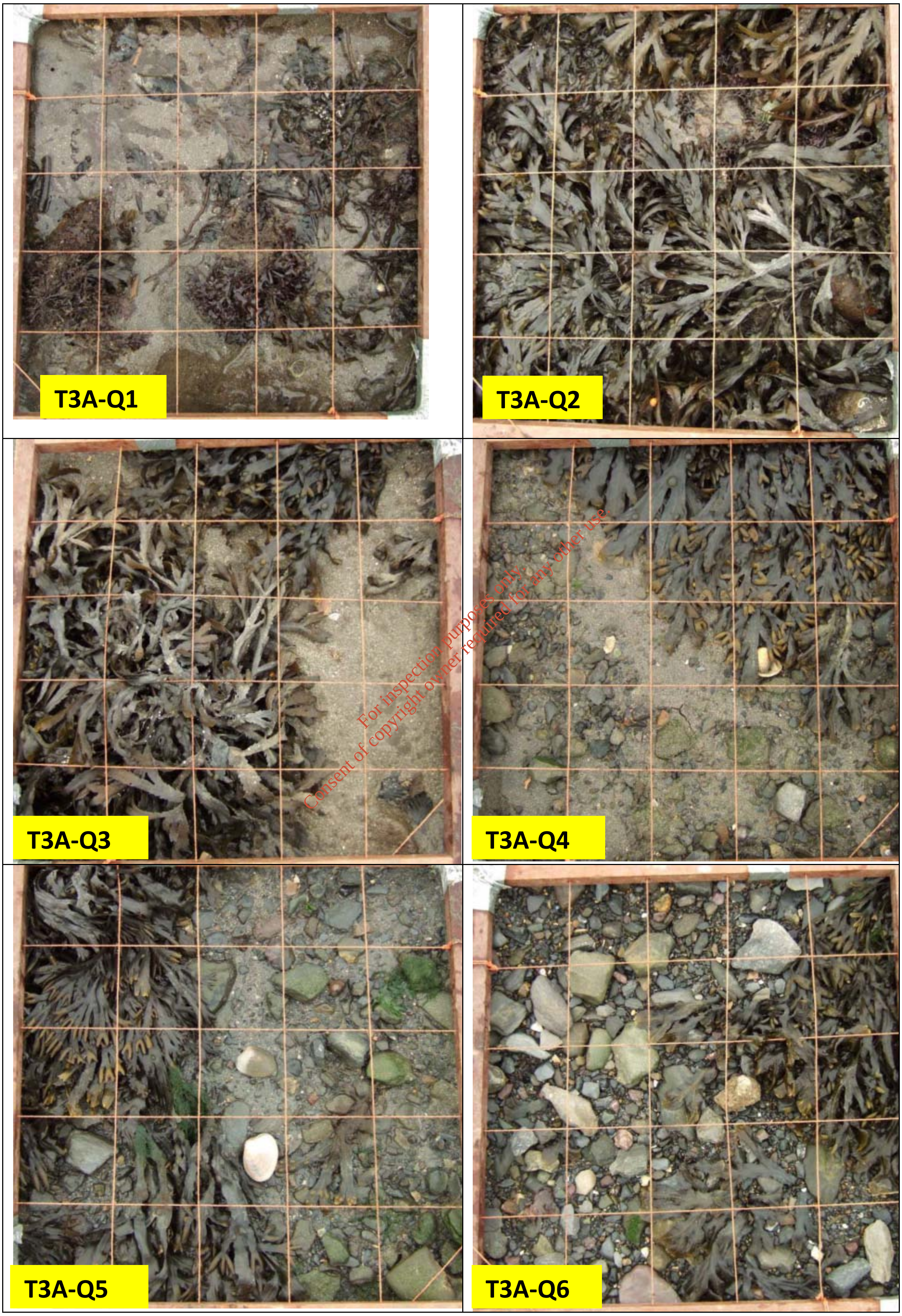


Plate 10.4.19 Area of Transect T3A north

(a) line of transect,
(b) low water,
(c) upper part of lower shore,
(d) upper mid shore,
(e) top of the shore and
(f) clump of *Pelvetia* on large cobbles in upper shore..


T3A-Q1
T3A-Q2
T3A-Q3
T3A-Q4
T3A-Q5
T3A-Q6

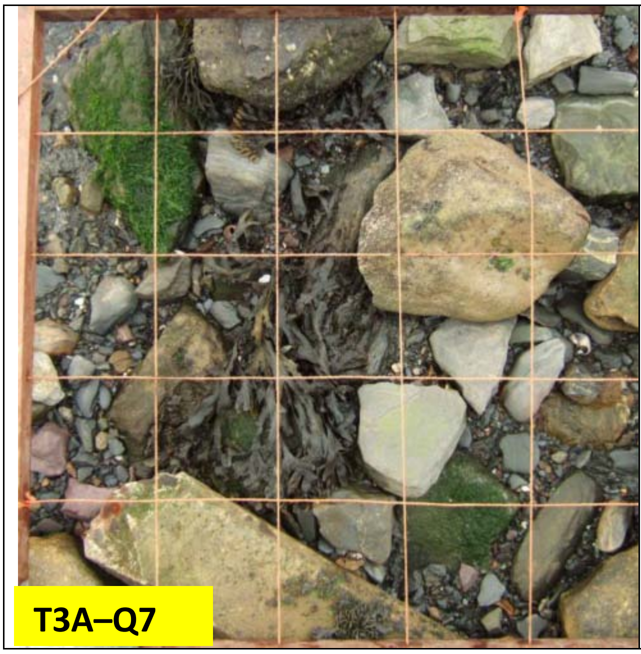


Plate 10.4.20 Quadrarts - Transect 3A

Transect 4A.

This transect is on the northern shore further into the harbour from Transect 4A and consequently is more sheltered. It's a much shorter shore with only about 8m of harder substrate, in this case mainly gravel, before reaching muddy gravel and muddy sand in the mid-shore area. The presence of *Ascophyllum* confirms the more sheltered nature of the site and the absence of *F. serratus* indicates that the lower shore proper is out in the soft sediment area.

Table 10.4.17 Transect 4A

Quadrat No.	Description
1 (at low water)	Gravelly, muddy sand. 100%
2 (-3m)	Gravel. *F. vesiculosus* 76%, *Ascophyllum* 24%, *Polysiphonia lanosa* ~3%.
3 (-7m)	Gravel. *Fucus vesiculosus* 68% Bare substrate 32%
4 (-8m)	Fine gravel 100%.

Plate 10.4.21 Area of Transect T4A north
(a) view down the shore and
(b) a view along the shore from the mid-shore area toward the ENE.

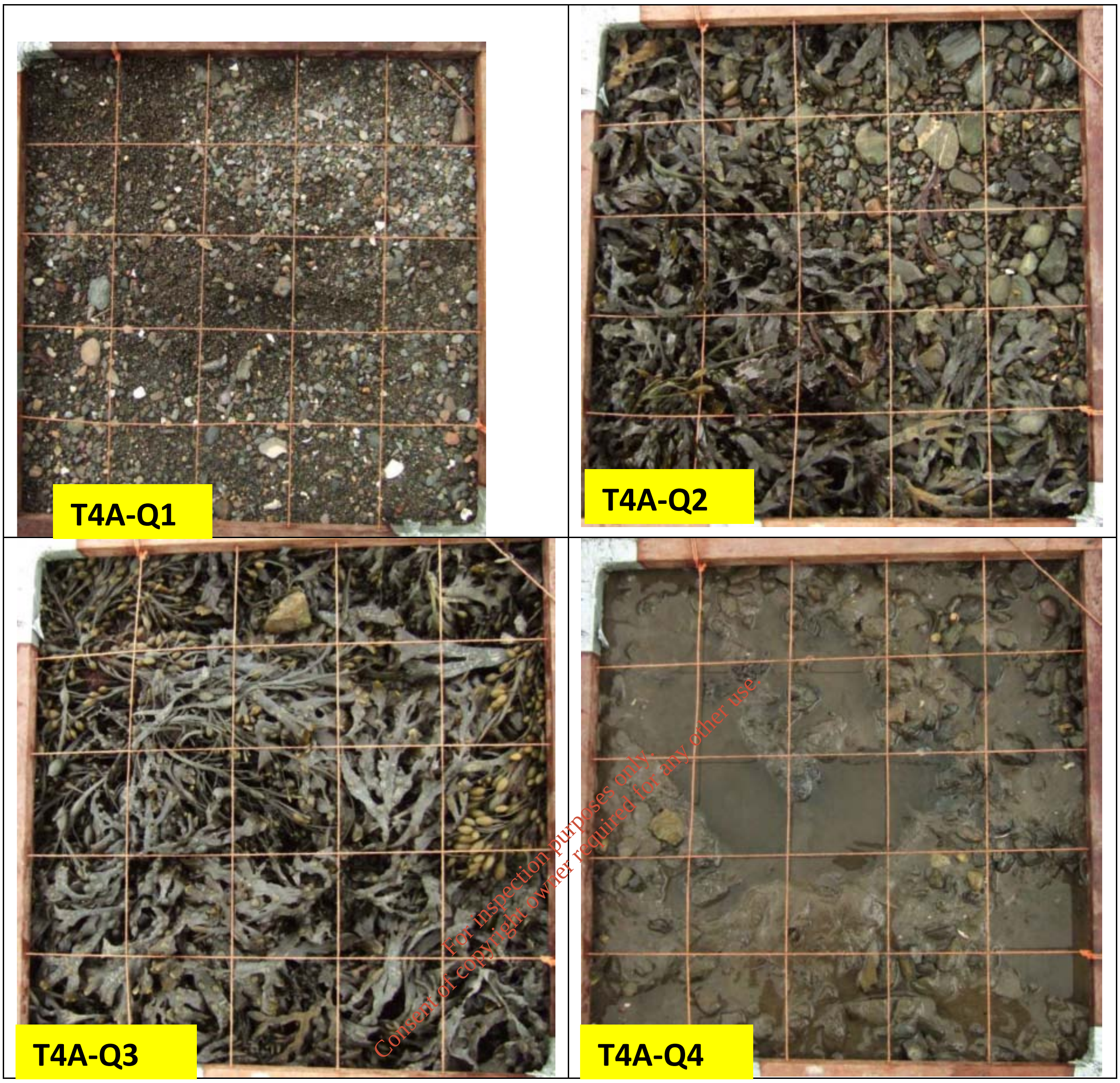


Plate 10.4.22 Quadrats – Transect 4A

Transect 5A - North Side of Inner Bantry Harbour

This was the innermost transect in Bantry Harbour where the base of the hewn stone quay wall (Plate 10.4.23) was in the mid-tide zone continuing on to a gravel base was just 4.5m wide before extending farther in a southerly direction onto muddy sand. The latter was sampled using stove-pipe corer and the results are reported in the intertidal soft-sediment section of this report (10.4.2.2). The short hard-substrate part of the shore was dominated (Plate 10.4.23a & 10.4.23b) virtually 100% by *Ascophyllum* reflecting its very sheltered position. A few scattered clumps of *Fucus ceranoides* (Plate 10.4.23c) indicated that the shore was also being influenced by freshwater inputs at this point. Beneath the *Ascophyllum* cover on the quay wall, *Polysiphonia lanosa* was evident along with blue frequent mussels (*Mytilus edulis*) frequent in places and occasional *Elminius modestus* (Plate 10.4.23d).

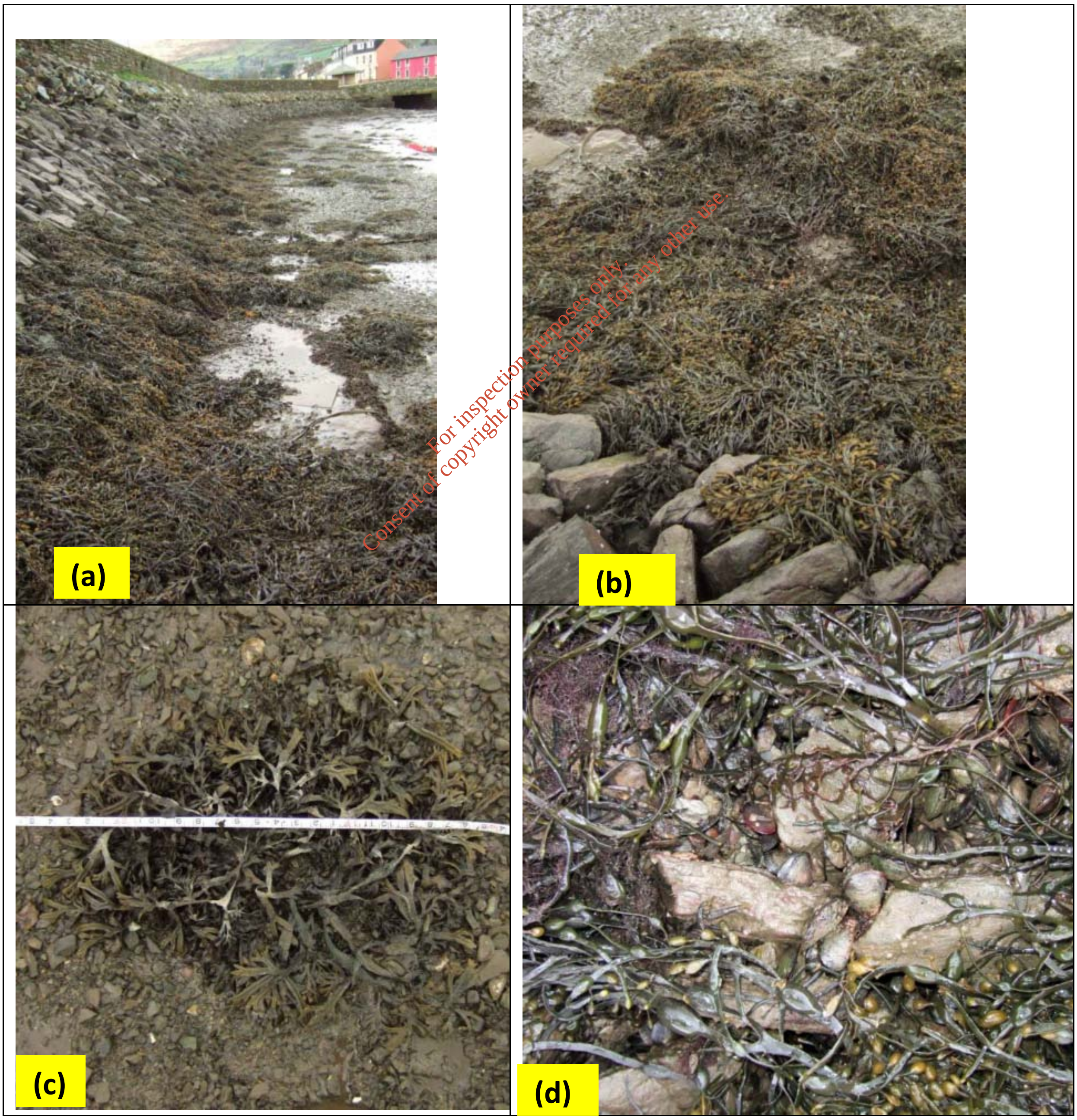


Plate 10.4.23 Area of Transect 5A

Transect 5B - South Side of Bantry Harbour (inner section)

The intertidal here comprises principally gravelly muddy sand stretching to the central low-tide channel (Plate 10.4.24). This is overlaid with scattered clumps of *Ascophyllum* and *Fucus ceranoides* close to the base of the quay wall. The base of the wall for about 1m is clothed in a total cover of *Ascophyllum*, with a very narrow band of F. spiralis above this with *Catanella* and occasional clumps of *Pelvetia* above again (Plate 10.4.24b). *Cladophora rupestris* and *Gelidium pussilum* were recorded beneath the *Ascophyllum*, along with scattered mussels and *Elminius*.

Plate 10.4.24 Area of Transect T5B south
(a) view down the shore and
(b) a view along the shore toward the east.

Transect 4B - South Side of Bantry Harbour (middle section)

The intertidal at T4B on the north side of the harbour comprised mainly intertidal gravelly muddy sand backed by a vertical stone quay wall, heavily covered in Ascophyllum and associated species (Plates 10.4.25 a and 10.4.25b). The top of the wall was dominated by a narrow band of *F. spiralis*, *Catanella* and Enteromorpha. Below this the *Ascophyllum* accounted for close to 100% cover. An understorey of reds and greens included *Gelidium* 30%, *Chondrus crispus* ~ 5%, *M. stellatus* ~1%, *Cladophora rupestris* 5%, *Polysiphonia lanosa* 5%, and about 3% *Ulva* (Plate 10.4.25c). Mussels and *Elminius* were frequent. (Plate 10.4.25d)

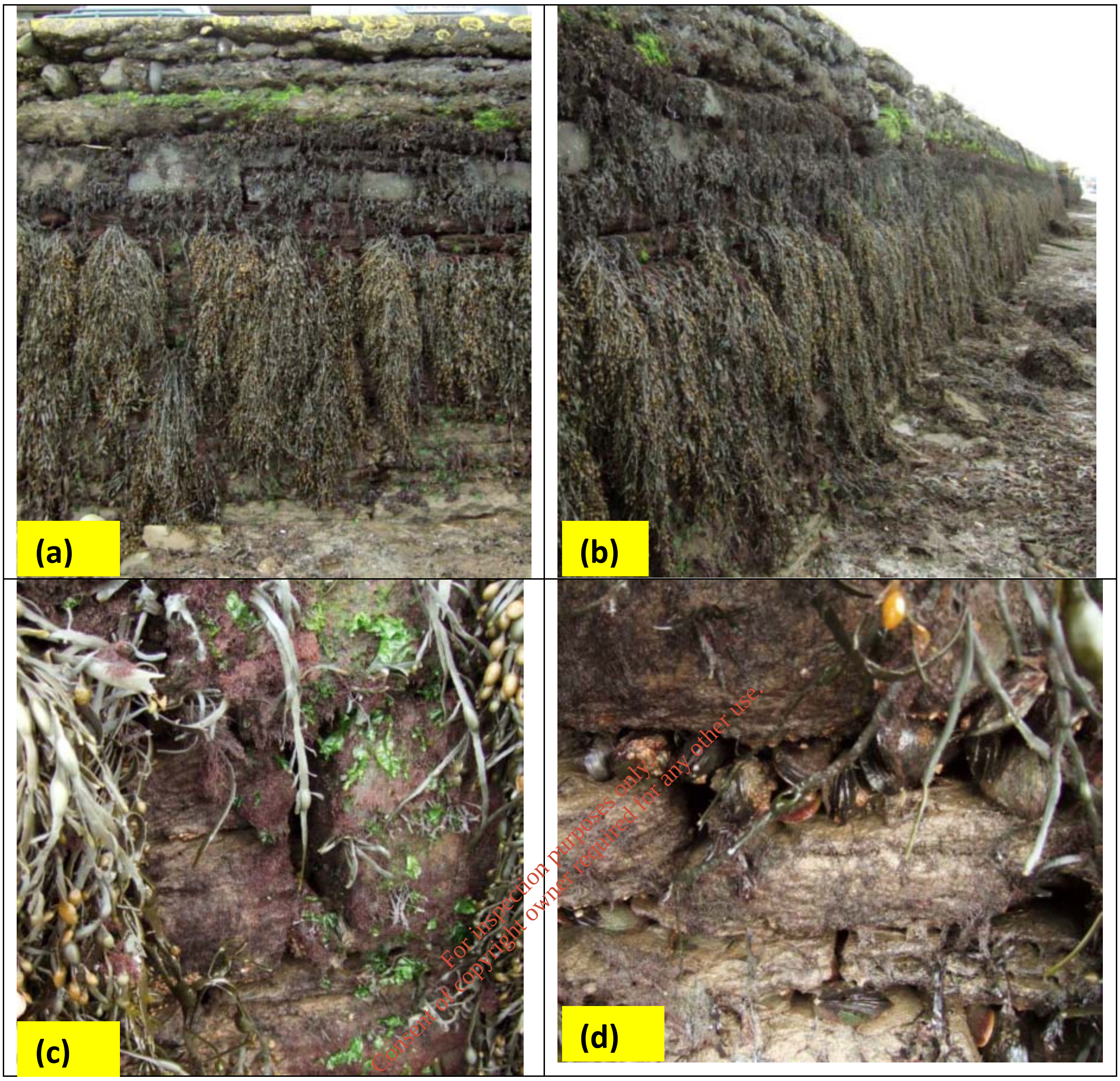


Plate 10.4.25 Area of Transect T4B

(a & b) quay wall heavily covered in seaweed,

(c) an understorey of red and green algae and

(d) mussels between stones.

10.4.2.2 Intertidal Soft-Benthos Survey

Physical Data

Results from the sediment analysis (Table 10.4.18 and Figure 10.4.7) indicate the site is dominated by mixed coarse sediments (sandy gravels and gravely sands). Organic carbon values are in keeping with muddy environments as identified in the intertidal areas of Bantry Harbour (Table 10.4.18).

Table 10.4.18 Sediment characteristics for intertidal core samples

Site	% Gravel	% Sand	% Mud	Textural Classification	% LOI
Core 1	2.6%	81.8%	15.6%	Slightly Gravelly Muddy Sand	5.60%
Core 2	0.6%	67.6%	31.8%	Slightly Gravelly Muddy Sand	5.36%
Core 3	0.0%	43.7%	56.3%	Sandy Mud	11.91%
Core 4	26.1%	43.7%	30.2%	Gravelly Muddy Sand	6.58%
Core 5	54.1%	34.8%	11.2%	Muddy Sandy Gravel	5.99%

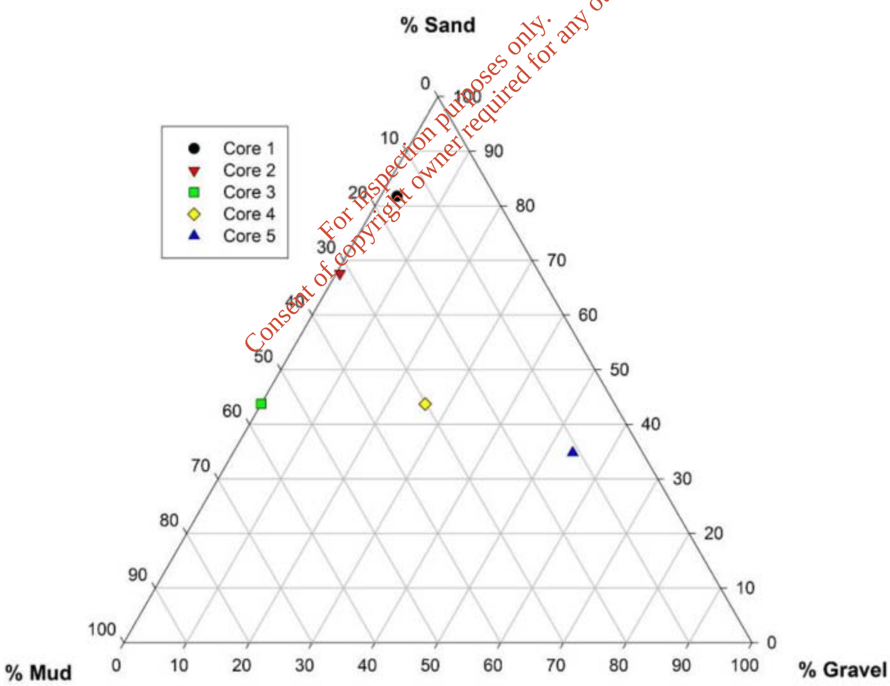


Figure 10.4.7 Ternary plot of particle size analysis at each of the intertidal sampling locations

Biological Data

A total of 13 taxa were encountered in the intertidal core samples (Table 10.19). In areas typical of highly enriched organic sediments, the fauna is dominated by the Oligochaete worms and *Capitella capitata*. These species, although not exclusively, are often found in areas of increased organic enrichment. Other species identified in the area are typical of muddy environments.

Primary and derived diversity indices are presented in Table 10.20. Overall the diversity indices recorded here are common for this type of intertidal muddy community. Core 3 contains only 2 species, dominated by the polychaete *Capitella capitata*. Core 5 contains 5 species but is dominated by a single taxa (*Oligochaetae* which account for 62 of the 69 individuals encountered).

Table 10.19 Species/Abundance table of species found in the intertidal core survey

	Core 1	Core 2	Core 3	Core 4	Core 5
Oligochaetae spp.	2	22	1	19	62
Capitella capitata	-	5	7	6	-
Nereis diversicolor	-	-	-	13	-
Eteone longa	-	2	-	5	-
Spio filicornis	2	-	-	4	-
Arenicola marina	-	3	-	-	1
Phyllodoce sp.	-	-	-	-	3
Scrobicularia plana	-	-	-	-	2
Cerastoderma edule	2	-	-	-	-
Nephtys hombergii	-	1	-	-	-
Chaetozone sp.	-	-	-	1	-
Glycera tridactyla	1	-	-	-	-
Pygospio elegans	-	-	-	-	1

Table 10.20 Primary and derived diversity indices (H' - Shannon-Wiener index; E - Pielou's evenness, C - Simpson's Dominance index)

	Core 1	Core 2	Core 3	Core 4	Core 5
Number of Species	4	5	2	6	5
Number of Individuals	7	33	8	48	69
H'	1.35	1.05	0.377	1.5	0.458
E	0.975	0.652	0.544	0.839	0.284
C	0.265	0.48	0.781	0.264	0.811

Habitat Classification

Two discrete faunal communities were identified in the present survey. Cores 1-3 all consisted of species which are present in the LS.LSa.MuSa (*Polychaete/bivalve-dominated muddy sand shores*) habitat complex. This is reflected in the species identified at these locations. Core 4 consisted of fauna which are consistent with the LS.LMx.GvMu.HedMx (Hediste diversicolor *in littoral gravelly muddy sand and gravelly sandy mud*) biotope, with the dominant species present being *Nereis (Hediste) diversicolor*. Core 5 contained similar fauna, but *N. diversicolor* were missing from the sample, and has been classified as the habitat LS.LMx (*Littoral Mixed Shores*)

Littoral Mixed Shores have been described as '*Shores of mixed sediments ranging from muds with gravel and sand components to mixed sediments with pebbles, gravels, sands and mud in more even proportions. By definition, mixed sediments are poorly sorted. Stable large cobbles or boulders may be present which support epibiota such as fucoids and green seaweeds more commonly found on rocky and boulder shores. Mixed sediments which are predominantly muddy tend to support infaunal communities which are similar to those of mud and sandy mud shores.*'

Hediste diversicolor in littoral gravelly muddy sand and gravelly sandy mud has been described as '*Sheltered gravelly sandy mud, subject to reduced salinity, mainly on the mid and lower shore. The infaunal community is dominated by abundant ragworms* Hediste diversicolor*. Other species of the infauna vary for the sub-biotopes described. They include polychaetes such as Pygospio elegans, Streblospio shrubsolii, and Manayunkia aestuarina, oligochaetes such as* Heterochaeta costata *and* Tubificoides *spp., the mud shrimp Corophium volutator, the spire shell Hydrobia ulvae, the baltic tellin Macoma balthica and the peppery furrow shell Scrobicularia plana. Sub-biotopes described in HedMx have equivalent communities in soft muddy sediments, but the sediment here is much firmer due to the gravel component. There are relatively few records in each sub-type, leading to uncertainty over the precise nature of the habitat, particularly regarding sediment type and salinity regime*.'

Polychaete/bivalve-dominated muddy sand shores has been described as '*Muddy sand or fine sand, often occurring as extensive intertidal flats on open coasts and in marine inlets. The sediment generally remains water-saturated during low water. The habitat may be subject to variable salinity conditions in marine inlets. An anoxic layer may be present below 5 cm of the sediment surface, sometimes seen in the worm casts on the surface. The infauna consists of a diverse range of amphipods, polychaetes, bivalves and gastropods*.'

10.4.2.3 Sub-Tidal Video Survey

Shallow Sub-Tidal Surveys (lower transect)

Video data was collected along the shallow water zones immediately adjacent to the 11 Intertidal transects collected. Information from these video drops were then used to identify habitats in the shallow sub-tidal zones of the transect lines.

Abbey Site

Two transects were surveyed in the Abbey Site, with several further sites surveyed during a broad habitat survey in the area.

Transect 1 (Plate 10.4.26)

The deeper parts of Transect 1 are dominated by muddy sands with *Virgularia mirabilis* common (the area has been classified as Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]) (V1-1_. As the transect becomes shallower, the sediment becomes coarser, with coarse sands and gravelly sands dominating. Fauna present in the area include the hermit crab, *Pagurus bernhardus*, and the tube dwelling polychaete *Spirorbis* spp. (V1-2). In addition, fucoids and occasional red and green algae are also present. The shallow water sites (V1-3 & V1-4) are similar to the habitats identified in the hard benthos intertidal survey.

Transect 2 (Plate 10.4.27)

The deeper parts of Transect 2 are dominated by muddy sands with occasional drift red algae present in the area (the area has been classified as Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]) (V2-1). Fauna identified in these locations include the hermit crab, *P. bernhardus*. Similar to Transect 1, as the transect becomes shallower, the sediment becomes more coarse, with coarse sands and gravelly sands dominating the sediment. Fauna present in the area include the keelworm, *Pomatoceros* sp. (V2-2). In addition, fucoids and occasional red and green algae are also present as well as coarse gravels and cobbles in the shallow areas, similar to the habitats identified in the intertidal hard-benthos survey (V2-3 & V2-4).

Broad Habitat Survey (Plate 10.4.28)

A total of 9 video drops were carried out during the follow up survey in April 2012 in the vicinity of the Abbey Site. The four shallowest locations (Drops 23, 26, 29 and 30) are similar. The sites are dominated by the presence of *Lanice conchilega* tubes and *Sabellid* worms in the area. An additional 4 stations were taken in slightly deeper water (Drops 27, 28, 32 & 33). These sites consisted of muddy sands, with drift algae present on the sediment surface and occasional Sabellid tubes present. A single drop was taken in deeper waters, approximately 200 meters off shore (Drop 46). This area consisted of muddy sands with the sea-pen *V. mirabilis* present.

Overall, the sub-tidal area of the Abbey Site is dominated by the Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]. This extends to the deeper waters offshore from the site. The shallower areas immediately adjacent to the mixed gravel intertidal shoreline are similar to that identified in the intertidal hard-benthos survey.

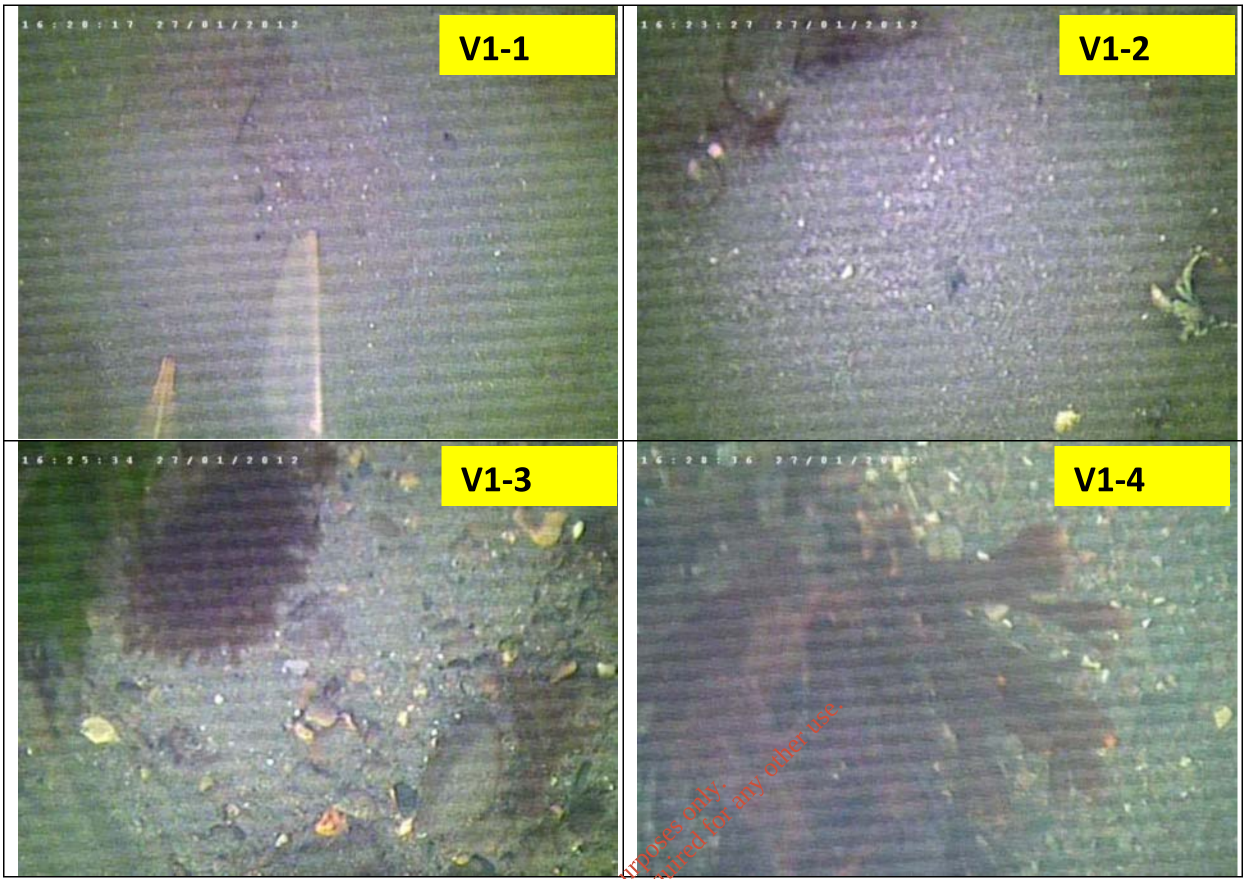


Plate 10.4.26 Imagery taken from video data collected along the sub-tidal elements of Transect 1

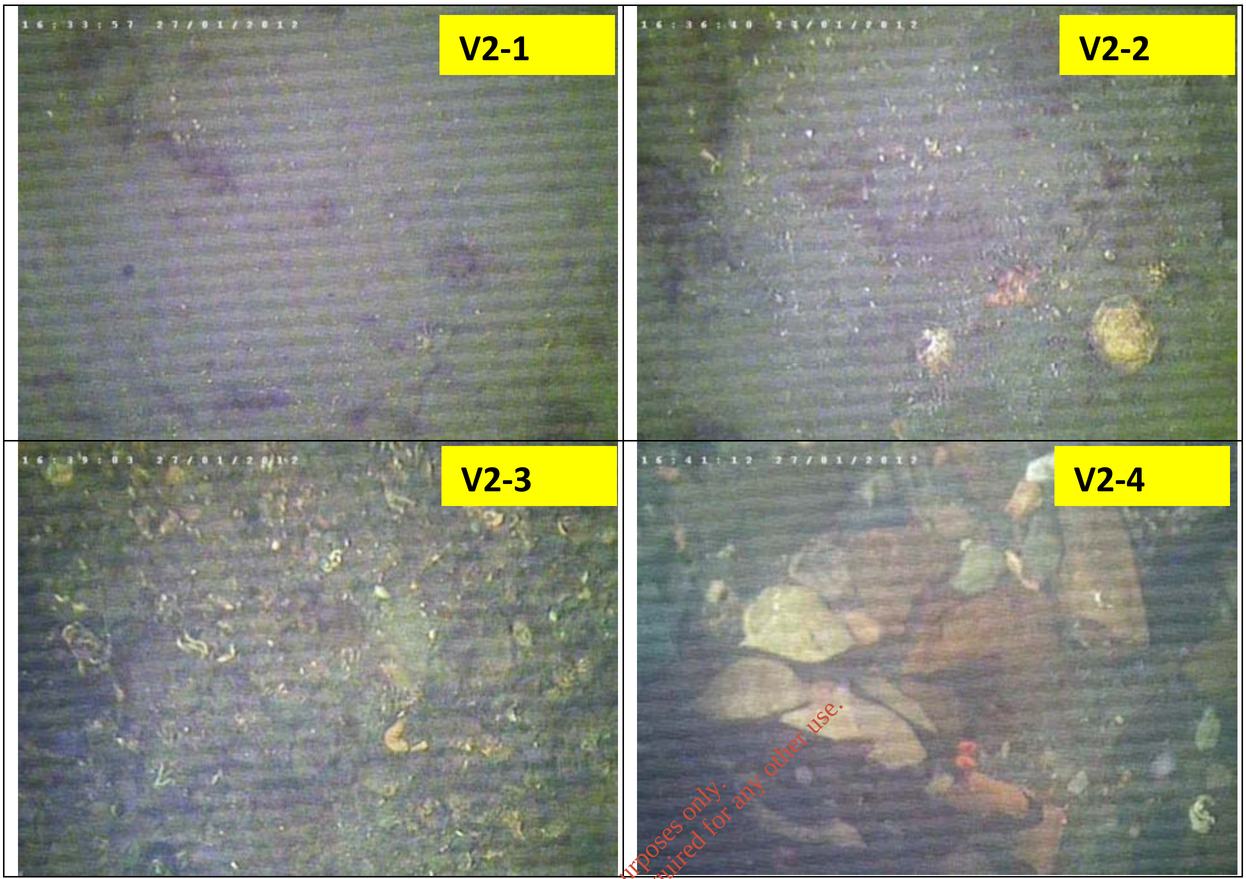
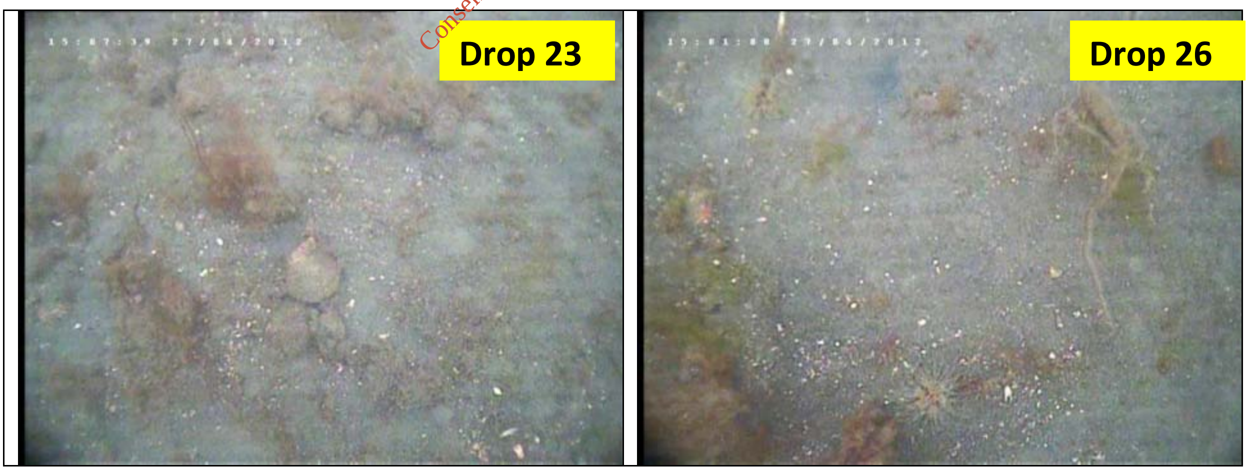


Plate 10.4.27 Imagery taken from video data collected along the sub-tidal elements of Transect 2.



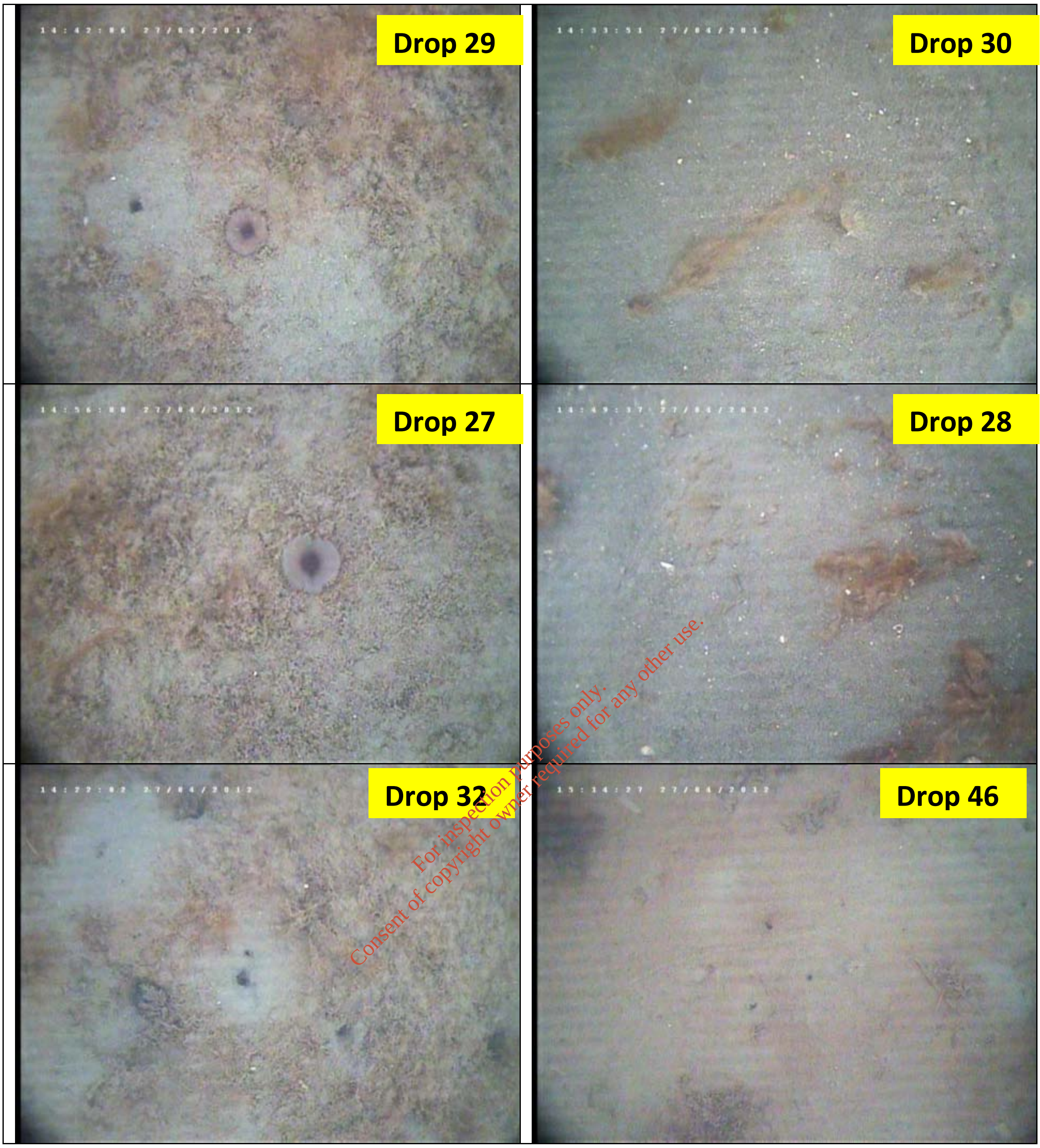


Plate 10.4.28 Imagery taken from video data collected within the extended Abbey Site sub-tidal area.

Cove Inlet & Becin Strand

The Cove Inlet consists of 2 subtidal transect lines (Transects 8 & 9). The subtidal regions within these transects lie between Transects 8A & 8B and 9A & 9B respectively.

Transect 8 (Plate 10.4.29)

The northern most part of the subtidal element of Transect 8 consists of coarse gravels and cobbles and associated epifauna (Pomatoceros spp.) and fucoids (mainly F. serratus) (V8-2). As the transect progresses south, the sediment becomes finer, dominated by mixed gravels with a lot of drift red algae and fucoids present (V8-3). In addition, burrowing anemones (Sagartion spp. or Cerianthus lloydi) are present. The habitats identified here are similar to those identified in the hard benthos intertidal surveys. The sandier, subtidal elements are located along the southern part of the subtidal transect (V8-4 & V8-5), with muddy sands dominated by Lanice conchilega and Arenicola marina (the area has been classified as Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]).

Transect 9 (Plate 10.4.30)

The subtidal element of Transect 9 consists of muddy sands with Arenicola marina and occasional drift algae present across the area. The area has been classified as Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu].

The Becin Strand area consisted of three transects (Transects 6, 7 & 11). Transect 11 is located to the north of the Cove Inlet, with Transects 6 & 7 located between the Cove Inlet and inner Bantry Harbour.

Transect 11 (Plate 10.4.31)

The shallower parts of Transect 11 are dominated by cobbles and boulders in sandy gravel. Kelp and red seaweeds are common, and starfish are present (V11-1 & V11-2). The sediment is finer, with a reduction in boulders and cobbles to large gravels, dominated by the keelworm, Pomatoceros spp. and occasional amounts of drift kelp and red & green algae present (V11-3). The deeper sections of the transect consist of bedrock, with starfish (Marthasterias glacialis) and bryozoan turf with sea squirts dominating (V11-4).

Transect 7 (Plate 10.4.32)

The deeper parts of Transect 7 are dominated by muddy sands, with occasional drift algae present in the area (V7-1). As the transect becomes shallower, the sediment becomes coarser, dominated by shell gravel and sands. Ensis sp. shells are present in the area with drift algae (V7-2). These areas have been classified as Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]. The shallow parts of the transect are similar to those identified in the intertidal hard benthos survey, dominated by cobbles and gravel with algae common (V7-3 & V7-4).

Transect 6 (Plate 10.4.33)

The deeper parts of Transect 6 consist of gravelly sands with scattered clumps of *Fucus serratus* and red and green algae present attached to shells within the sediment matrix. These areas have been classified as Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]. (V6-1 & V6-2). A coarse gravel community is present in the shallow elements of Transect 6 – similar to that identified in the intertidal hard benthos survey (V6-3).

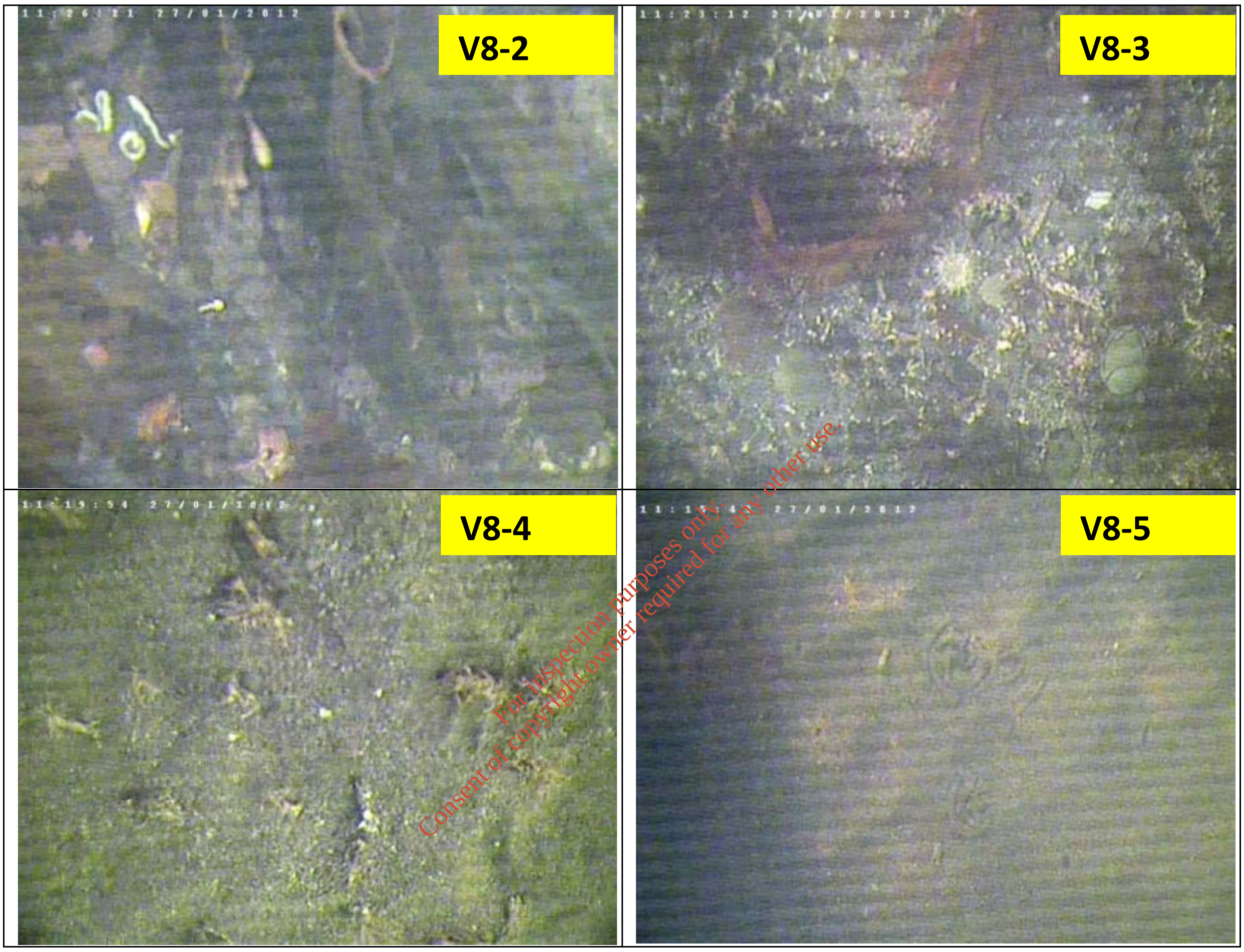


Plate 10.4.29 Imagery taken from video data collected along the sub-tidal elements of Transect 8

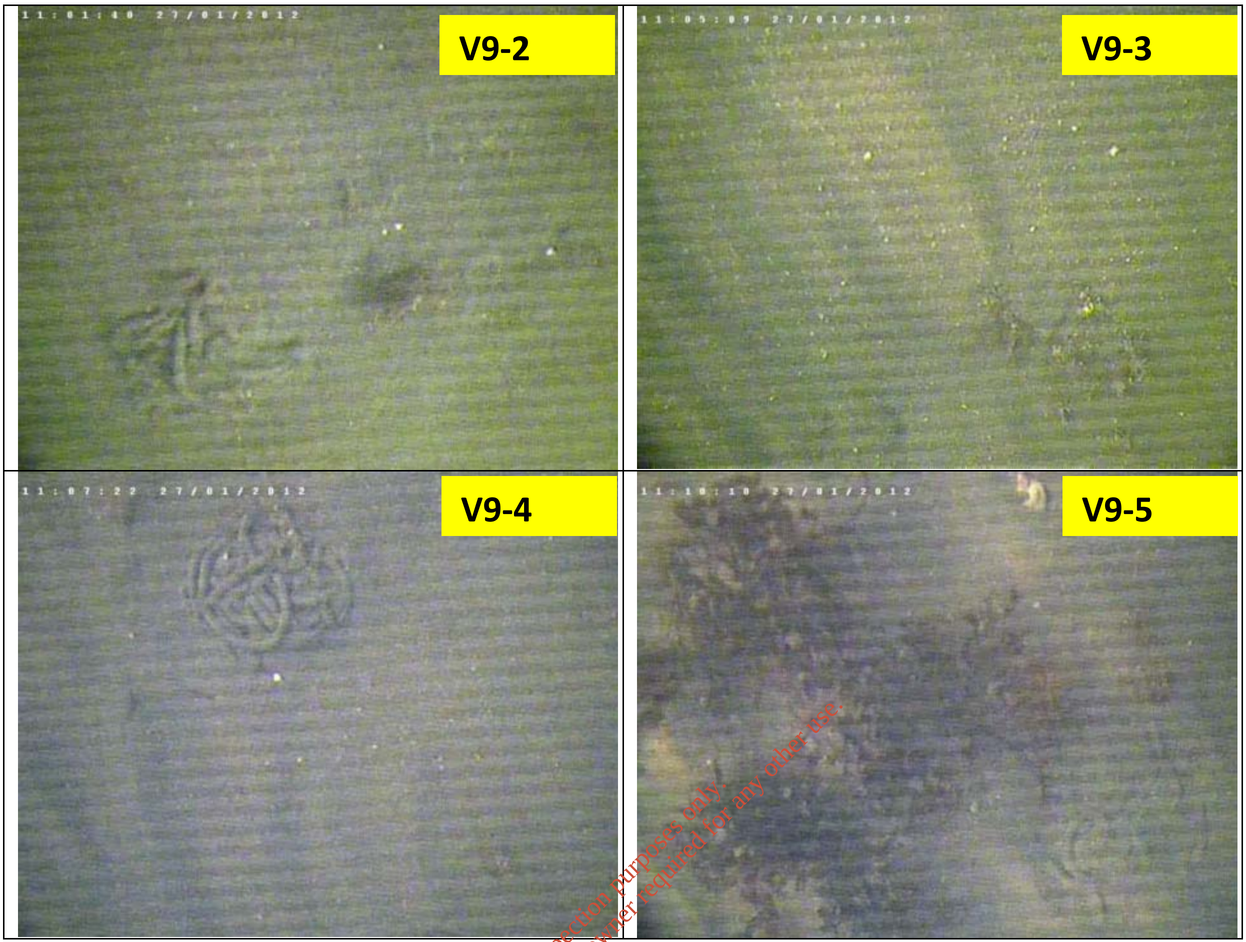


Plate 10.4.30 Imagery taken from video data collected along the sub-tidal elements of Transect 9

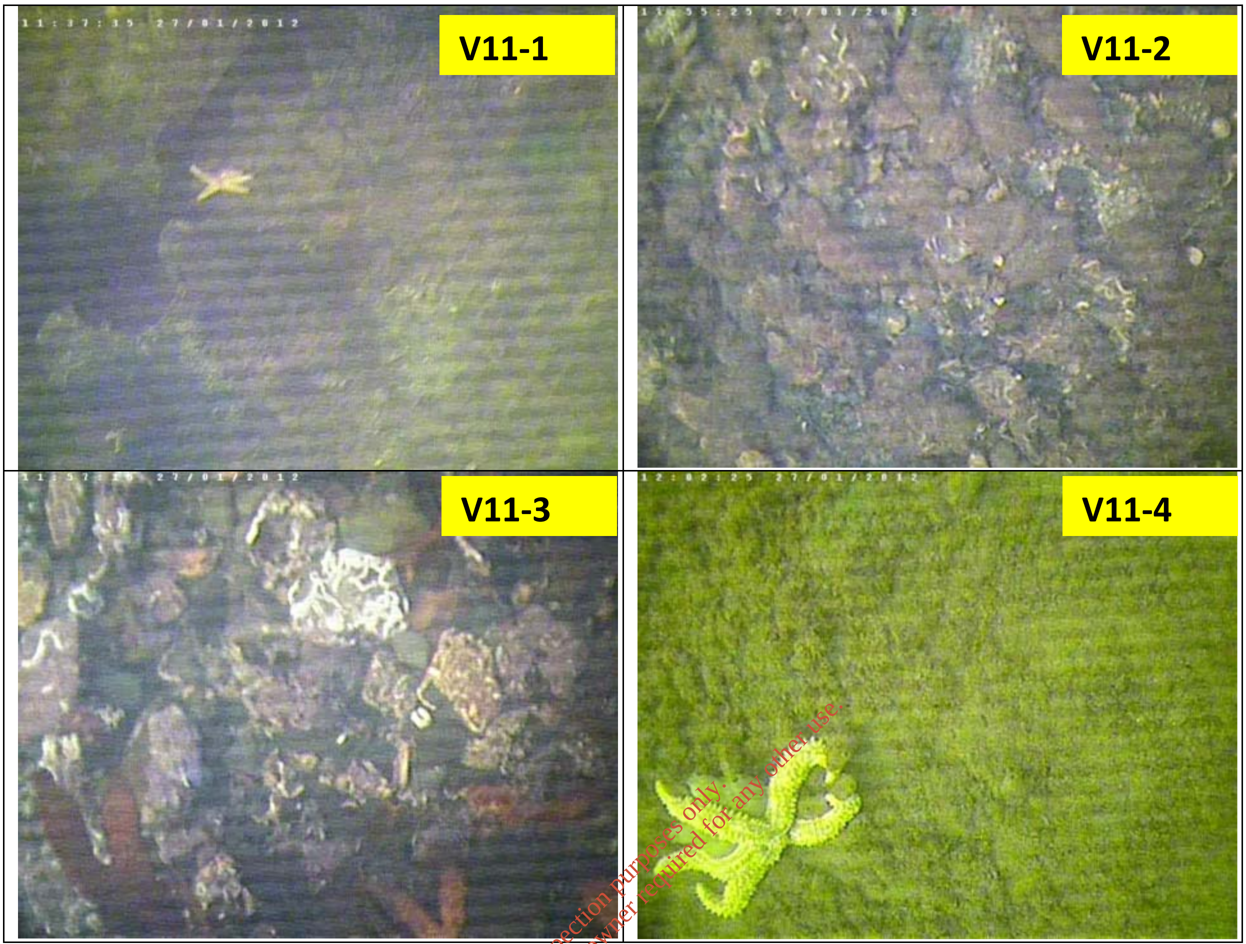


Plate 10.4.31 Imagery taken from video data collected along the sub-tidal elements of Transect 11

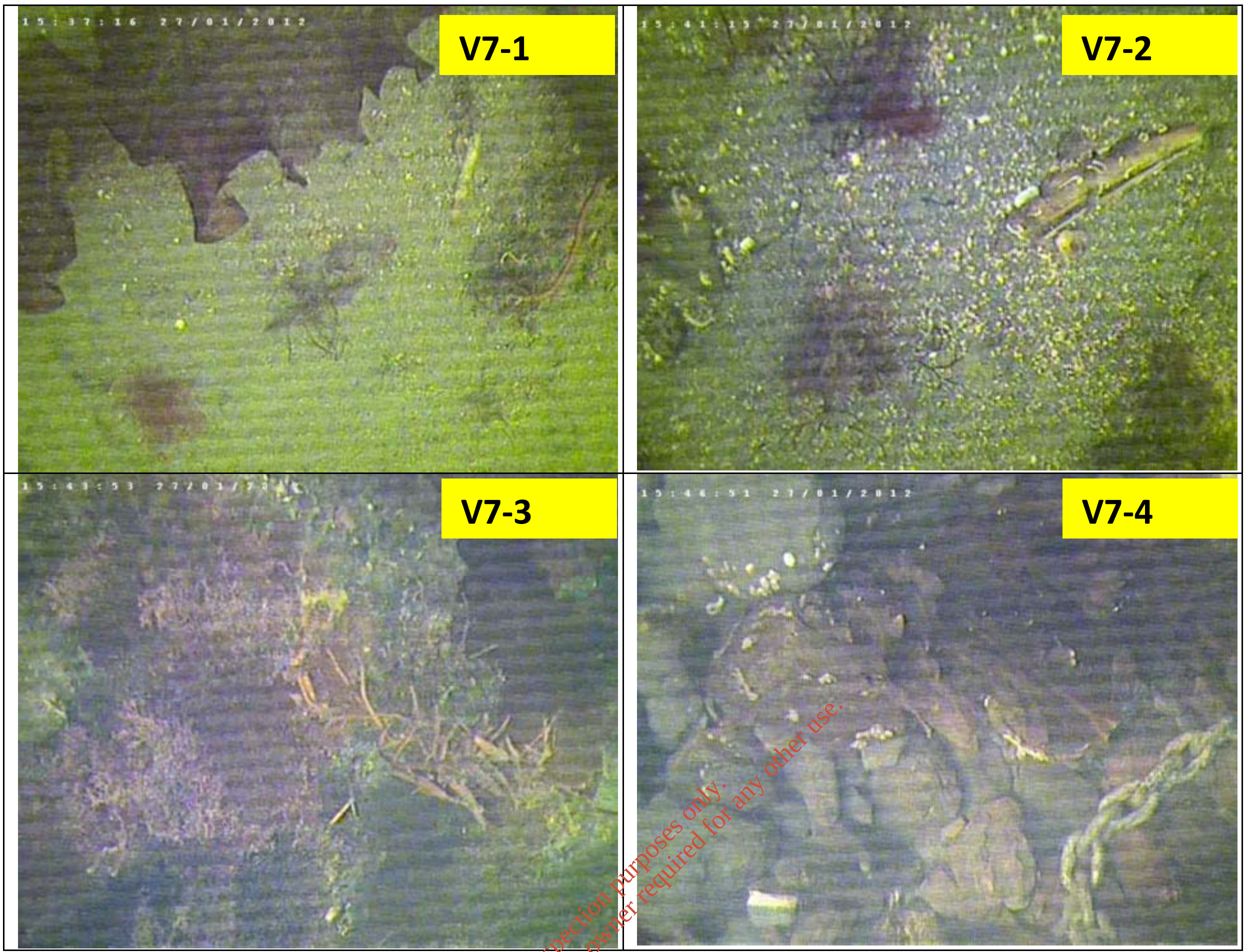


Plate 10.4.32 Imagery taken from video data collected along the sub-tidal elements of Transect 7

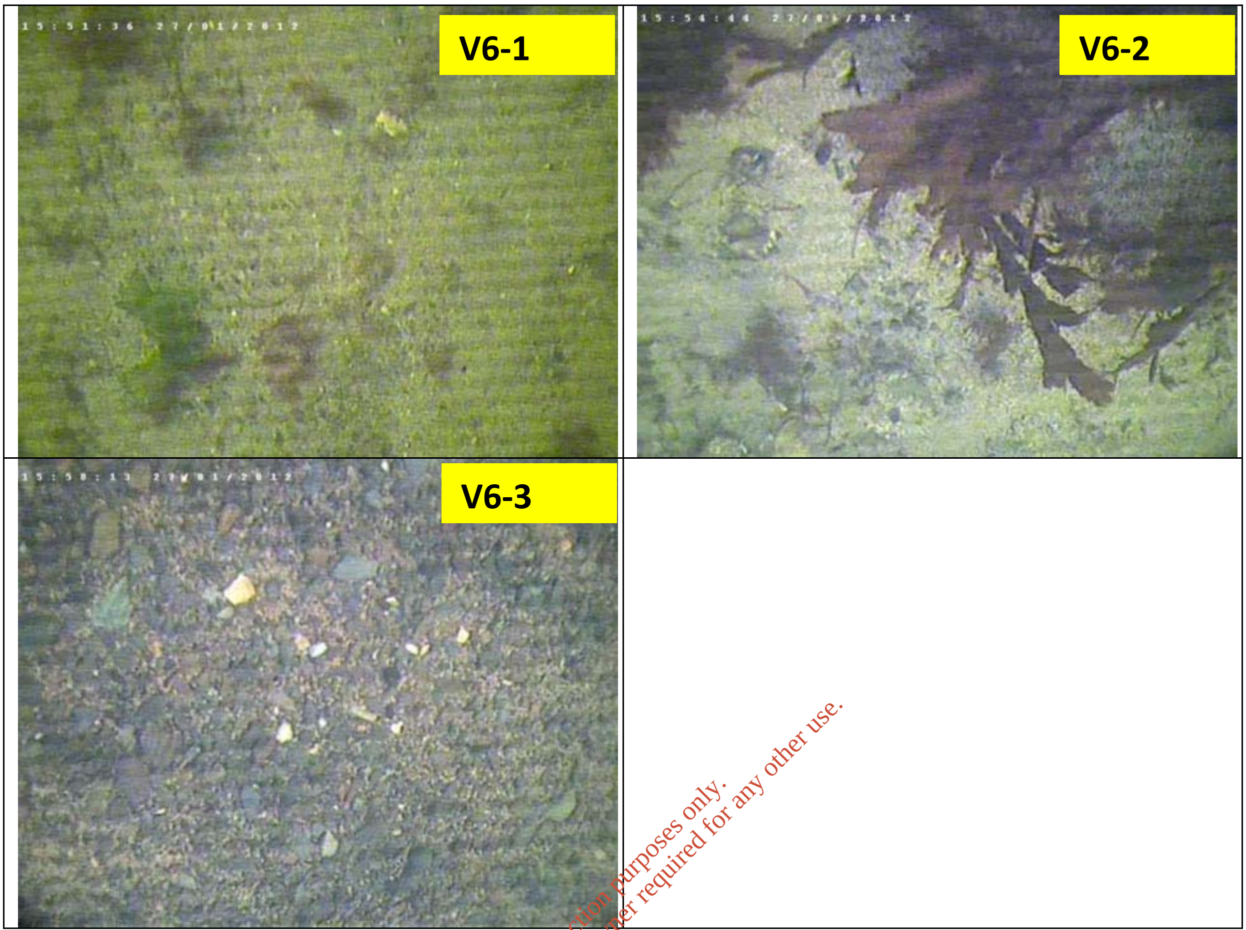


Plate 10.4.33 Imagery taken from video data collected along the sub-tidal elements of Transect 6

RPS

Inner Bantry Harbour

Only a single subtidal video transect (Transect 3) was present within the Inner Bantry Harbour area of the development.

Transect 3 (Plate 10.4.34)

The northern section of the subtidal element of Transect 3 consisted of rippled muddy sands with shell gravel sitting on the sediment surface (V3-Mid 1). This area has been classified as Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]. This gave way to sediment covered with large amounts of organic debris with no evidence of fauna present in the video (V3 – Mid 2). This gave way to gravels and bedrock with sponges (*Halichondria* sp.) and fucoids with red algae (V3 – Mid 3)

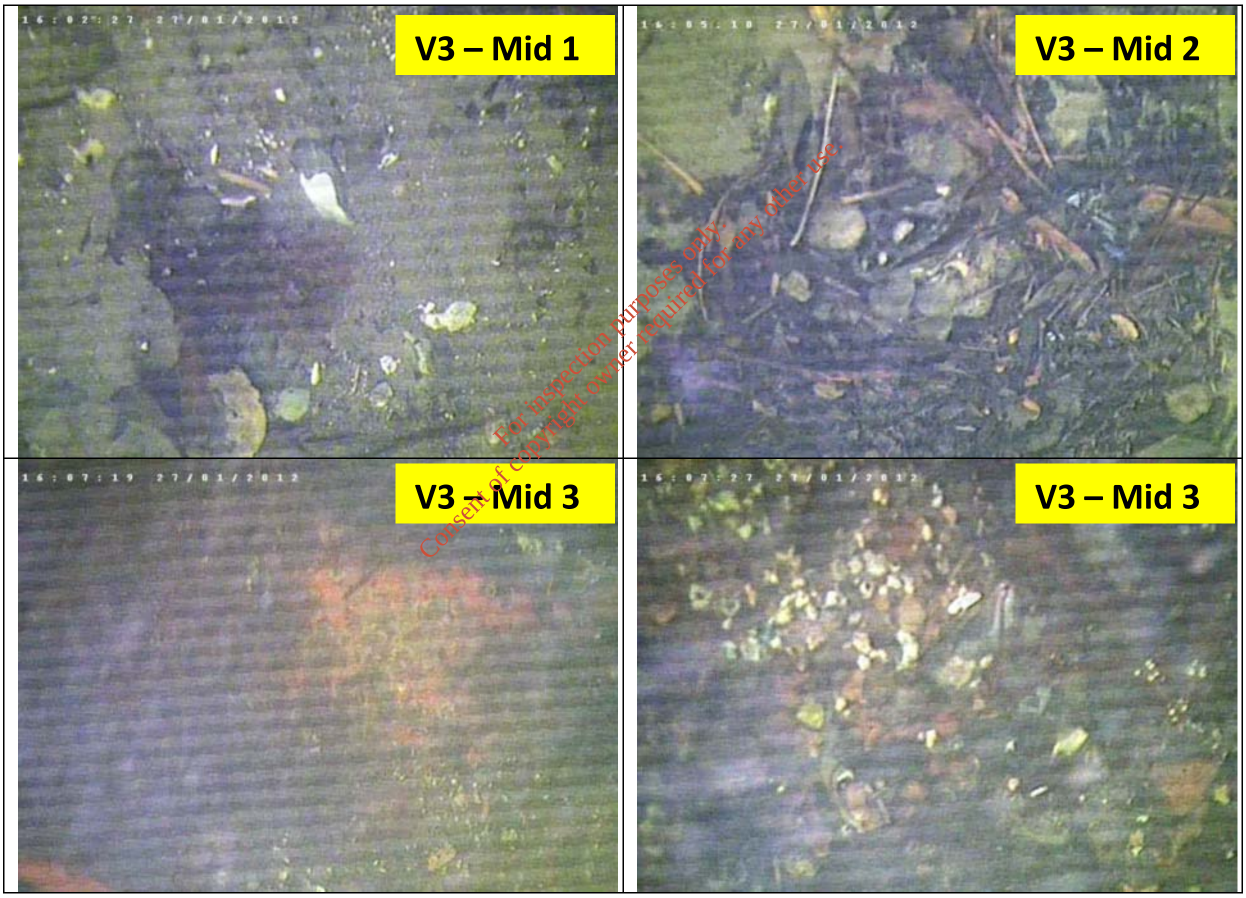


Plate 10.4.34 Imagery taken from video data collected along the sub-tidal elements of Transect 3.

Dredge Area

To facilitate the entrance to the proposed development in Bantry Harbour, an area to west of the Harbour entrance will be dredged to a depth of -6m C.D. A detailed survey of this dredge area was undertaken using the drop-down video system at 19 locations within and immediately adjacent the footprint of the proposed dredge area.

The predominant community present in the area is the muddy sand community dominated by the sea-pen *V. mirabilis* which was identified in 10 of the 19 video drops surveyed. Table 10.21 outlines the findings of the video survey in the proposed dredge area, with Plates 10.35, 10.36 & 10.37 showing imagery from the video survey.

Table 10.21 Summary of findings from the video survey

Site Code	Description	Classification
Drop 2	Large amounts of green and red algae present on muddy sands. *A. marina* common in the area.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 5	Large amounts of green and red algae present on muddy sands. *A. marina* common in the area.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 7	Rippled muddy sands with *Aernicola marina* casts common in the area. Occasional drift algae present.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 10	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface. Occasional red algae present.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 12	Large amount of debris on the sediment surface. Fish head skeletons and large amount of scallop shells identified on the sediment surface. A single *Aequipecten opercularis* identified in the area.	No Classification
Drop 13	Muddy sands with occasional drift algae. *A. rubens* and *P. bernhardus* present. Unidentified Sabellid worms present in the area	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 15	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface. Occasional red algae present.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 16	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface. Occasional drift algae present.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 18	Muddy sand, with drift algae present. *Pagurus bernhardus* and *Asterias rubens* present. Organic debris is present in the area.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 19	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface	Infralittoral Sandy Mud habitat complex

Site Code	Description	Classification
		[SS.SMu.ISaMu]
Drop 20	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 35	Muddy sand, with burrows present. *V. mirabilis* present. *Asterias rubens* present. Occasional drift *Ulva lactuca* also present	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 37	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface. Occasional drift algae present. *A. rubens* present.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 41	Muddy sand, with burrows present. Diatoms covering the sediment surface.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 42	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 43	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 44	Muddy sand, with burrows present. Diatoms covering the sediment surface with the burrowing anemone *Cerianthus lloydi* present. Red and green algae present in the area.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 45	Large amounts of green and red algae present on muddy sands. *A. marina* is common in the area.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]
Drop 47	Muddy sand, with burrows present. *V. mirabilis* present. Diatoms covering the sediment surface. Occasional drift algae present.	Infralittoral Sandy Mud habitat complex [SS.SMu.ISaMu]

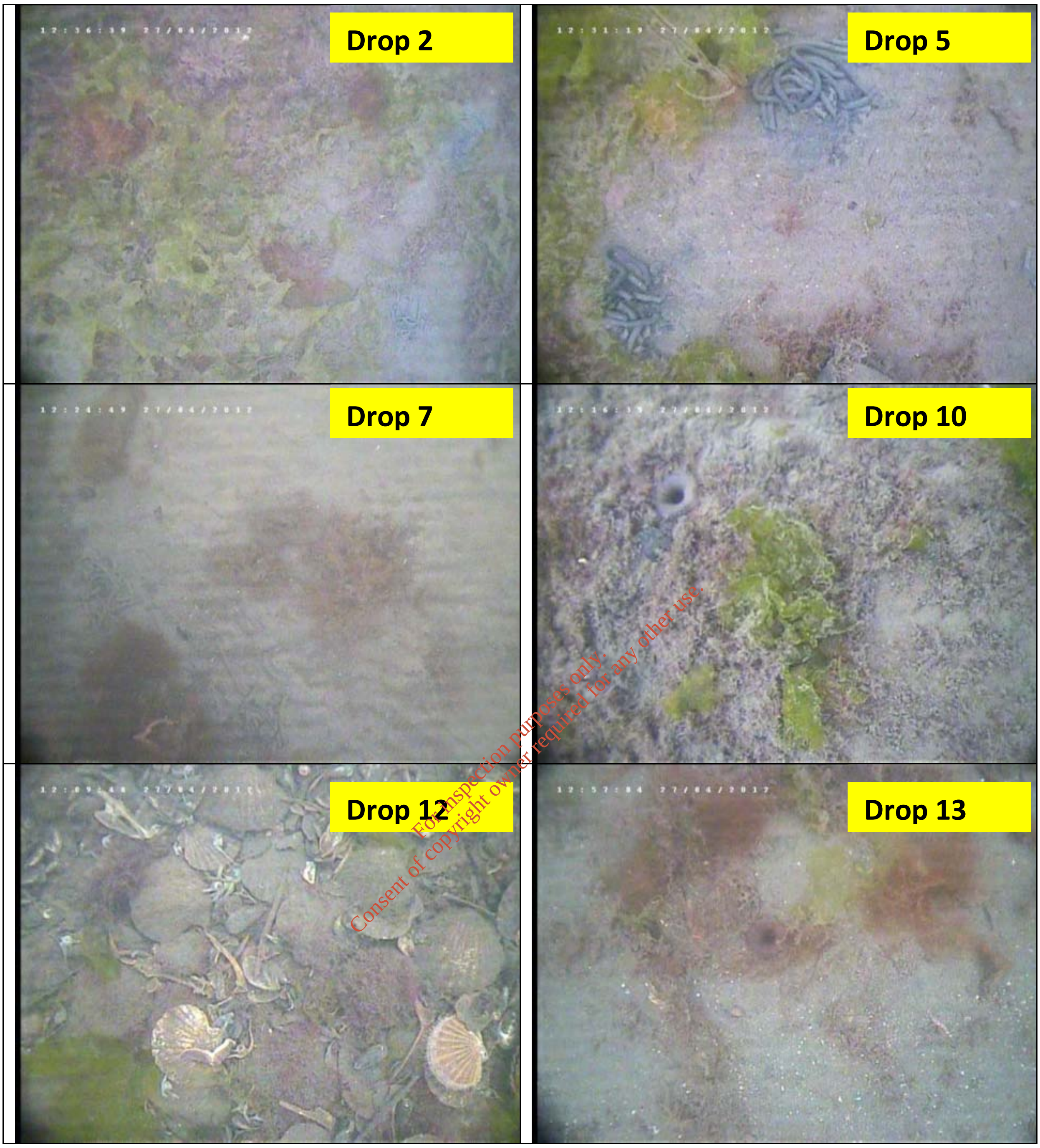


Plate 10.4.35 Imagery taken from video data collected along the sub-tidal elements of the proposed dredge area.

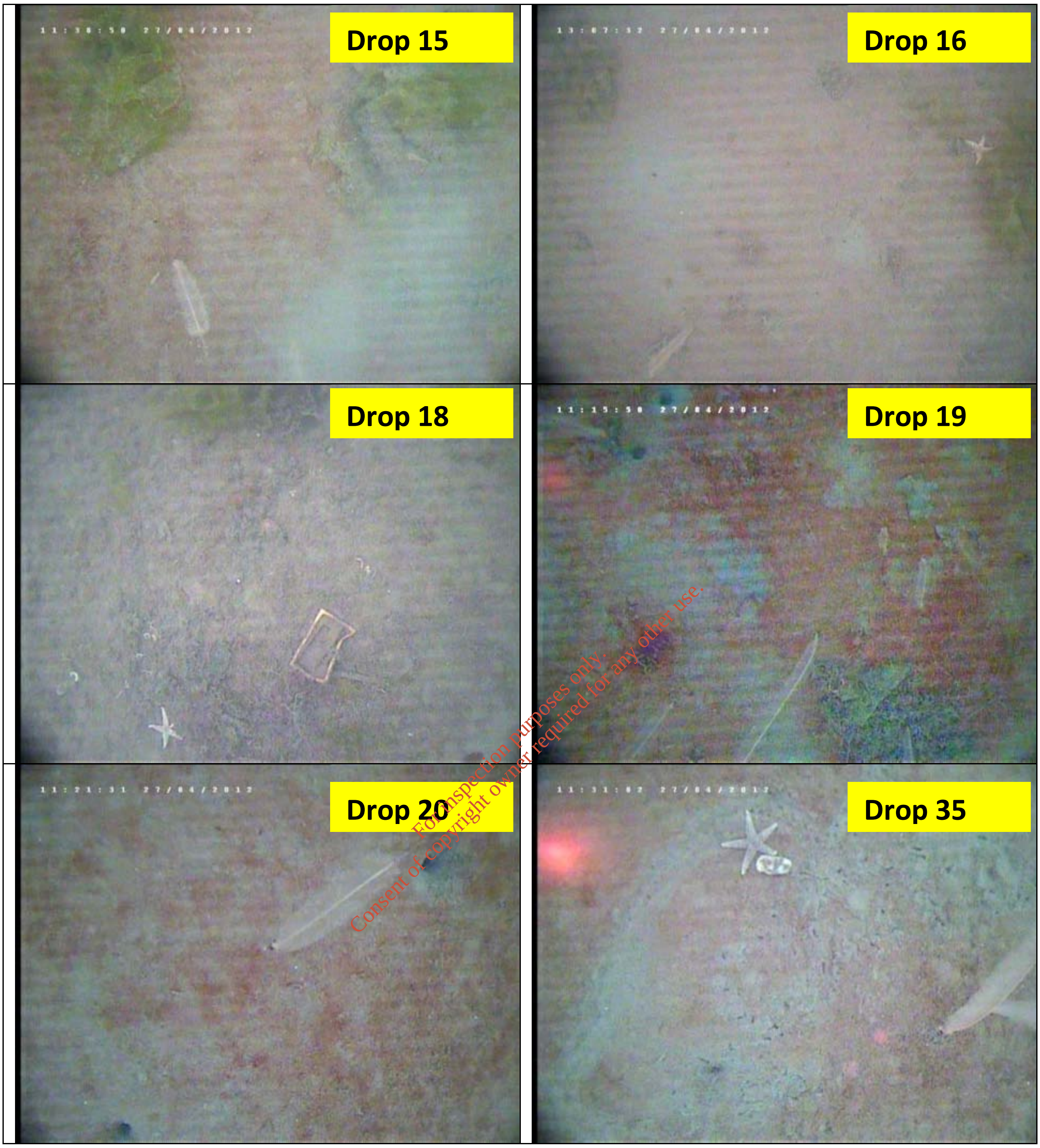


Plate 10.4.36 Imagery taken from video data collected along the sub-tidal elements of the proposed dredge area.

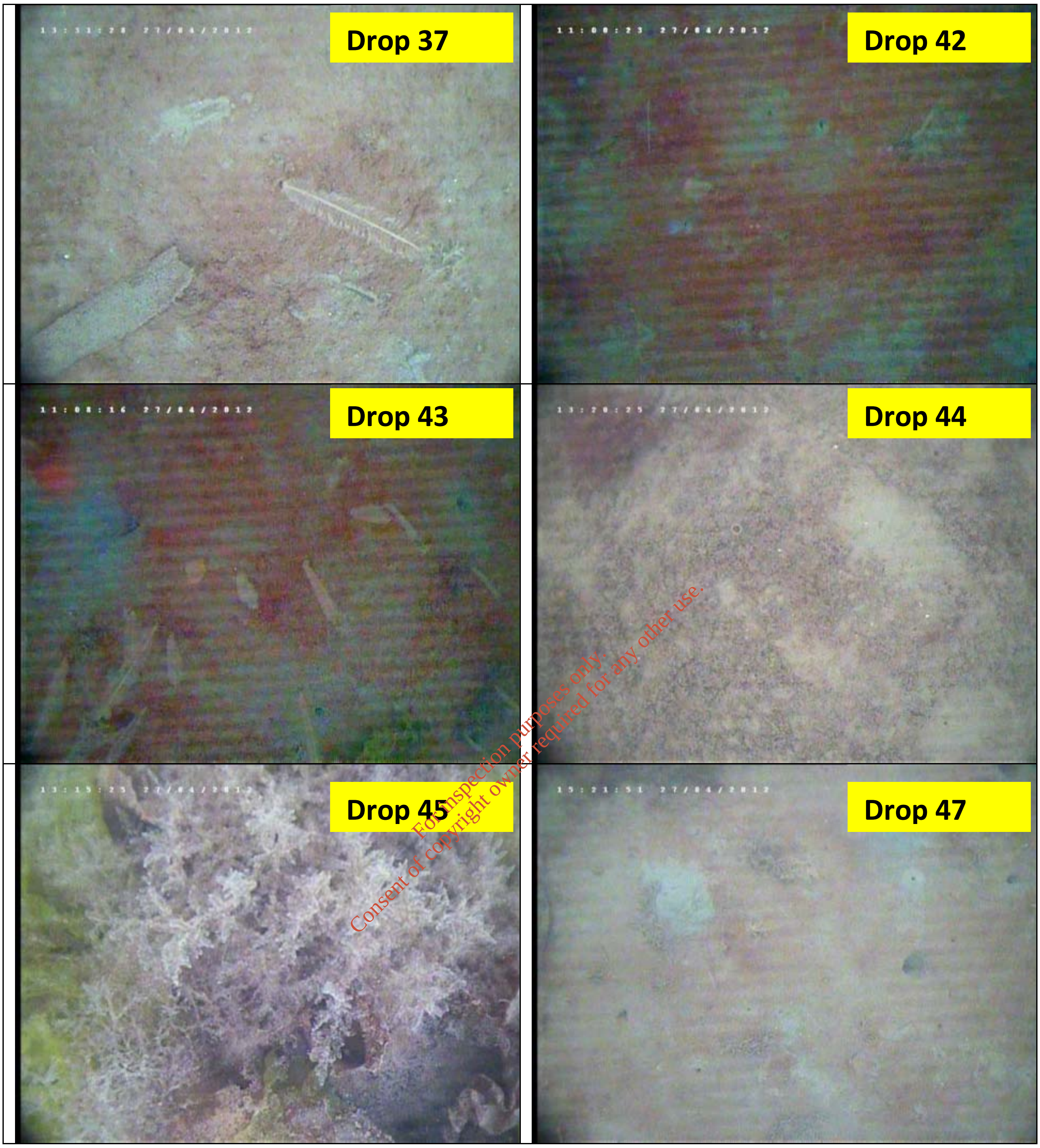


Plate 10.4.37 Imagery taken from video data collected along the sub-tidal elements of the proposed dredge area.

10.4.2.4 Sub-Tidal Grab Survey

Physical Data

Results from the sediment analysis (Table 10.22 and Figure 10.4.8) indicate the site is dominated by mixed fine sediments (muddy sands and sandy muds). LOI values are in keeping with mixed sediment environments as identified across the survey area (Table 10.22).

Table 10.22 Sediment characteristics for sub-tidal grab samples

Site	% Gravel	% Sand	% Mud	Textural Classification	% LOI
Grab 1	0.0%	41.1%	58.9%	Sandy Mud	7.70%
Grab 2	0.0%	67.6%	32.4%	Muddy Sand	7.44%
Grab 3	0.0%	83.0%	17.0%	Muddy Sand	3.02%
Grab 4	0.0%	37.6%	62.4%	Sandy Mud	9.70%
Grab 5	4.1%	25.7%	70.2%	Slightly Gravelly Sandy Mud	10.60%
Grab 6	25.8%	18.3%	55.9%	Gravelly Mud	9.92%
Grab 7	0.5%	48.8%	50.7%	Slightly Gravelly Sandy Mud	9.24%
Grab 8	0.0%	51.0%	49.0%	Muddy Sand	9.93%
Grab 9	1.1%	64.4%	34.5%	Slightly Gravelly Muddy Sand	6.49%

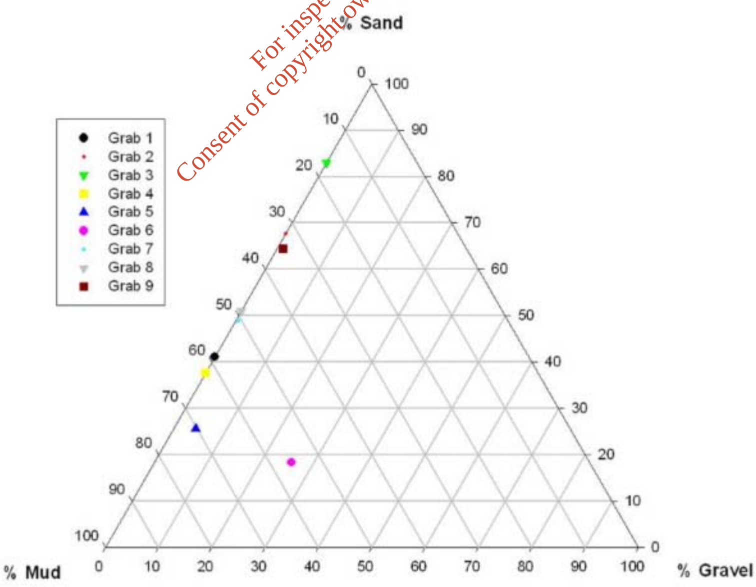


Figure 10.4.8 Ternary plot of particle size analysis at each of the sub-tidal sampling locations

Biological Data

A total of 47 taxa were encountered in the sub-tidal grab samples - Appendix 1. The most dominant species identified in the grab samples are the polychaete worms, *Ampharete balthica, Spio filicornis* and *Chaetozone* sp. In addition, Oligochaetes were common across the survey area, being present in all but 1 site. The sea-pen *Virgularia mirabilis* was identified at two locations – Grab 1 in close proximity to the Abbey Site and Grab 8 towards the mouth of Bantry Harbour. These sea-pens were also identified in the video survey across large parts of the survey area and are recorded for the south western Irish coast[3].

Primary and derived indices are presented in Table 10.23. Overall, abundances and diversity is quite high across large parts of the survey area. Grab's 2 and 3 returned the lowest species numbers and number of individuals in the survey area. Grab 4 returned the highest number of individuals and species numbers in the survey area.

Results from the present survey indicate that the species and habitats identified are common in Irish coastal waters. Diversity indices are as expected for the identified sediment communities.

Table 10.23 Primary and derived diversity indices

	Grab 1	Grab 2	Grab 3	Grab 4	Grab 5	Grab 6	Grab 7	Grab 8	Grab 9
Number of Species	17	5	8	25	15	13	6	11	13
Number of Individuals	134	31	18	190	73	136	32	72	35
H'	2.11	0.823	1.8	2.43	1.64	1.77	1.31	1.43	2.17
E	0.745	0.511	0.867	0.755	0.605	0.692	0.734	0.595	0.847
C	0.179	0.615	0.204	0.141	0.38	0.211	0.369	0.363	0.159

(H' - Shannon-Wiener index; E - Pielou's evenness, C - Simpson's Dominance index). [Note: Grabs 7, 8 & 9 were taken with a 0.025m2 Van-Veen Grab; Grabs 1-6 were taken with a 0.1m2 Van-Veen Grab)

3 http://www.marlin.ac.uk/speciesinformation.php?speciesID=4579#

Habitat Classification

Data obtained from the grab surveys were used to identify habitats based on the JNCC Marine Habitat Classification system. All sites contain species which are typical for the Infralittoral Sandy Mud habitat complex (SS.SMu.ISaMu).

This is described as '*Infralittoral, cohesive sandy mud, typically with over 20% silt/clay, in depths of less than 15-20m. This habitat is generally found in sheltered bays or marine inlets and along sheltered areas of open coast. Typical species include a rich variety of polychaetes including* Melinna palmata*, tube building amphipods (*Ampelisca *spp.) and deposit feeding bivalves such as* Macoma balthica *and* Mysella bidentata*. Sea pens such as* Virgularia mirabilis *and brittlestars such as* Amphiura *spp. may be present but not in the same abundances as found in deeper circalittoral waters.*' Further classification at each site isn't possible, due to the lack of key identifying species present in the grab samples at each site.

Overall, the dominant species which are present across all sites are similar, although the abundances and species compositions vary from site to site. Identification of biotopes and biotope complexes beyond the habitat level wasn't possible in the present dataset due to the absence of key identifying species in significant numbers, although obvious differences exist between the different sites.

10.4.3 Impact Assessment

10.4.3.1 Abbey Site

The development at the Abbey Site will involve the reclamation of approximately 9,000m^2 of mostly intertidal hard benthos from the fore-shore at the Abbey Site to create a 45m x 200m hardstand area. It is proposed to deposit dredge material into the area and use double layer rock armour to create a reinforced shoreline.

Potential Impacts

The main impact of this development will be the permanent removal of the habitat within the footprint of the proposed development. The majority of the habitat to be removed will be intertidal benthos consisting primarily of Barren Littoral Shingle (LS.LCS.Sh.BarSh), Fucoid dominated littoral mixed sediments (LR.LLR.F.Fves.X and LR.LLR.F.Fserr.X) as well as ephemeral green and red algae on mixed sediments (LR.FLR.Eph.EphX). Overall, species diversity in the intertidal is considered low, and all species identified in the area are common locally and in Irish coastal waters. As such, the loss of these habitats would be considered minor.

A narrow liner area of shallow sub-littoral will also be removed during the course of the development. This shallow sub-littoral is dominated by Infralittoral muddy sands (SS.SMu.ISaMu) with occasional sea-pens (*Virgularia mirabilis*). This habitat type extends further off-shore and the area to be removed during the development at the Abbey site is relatively be considered minor, and no significant impact is expected on the broader habitat type in the area.

Impact Significance

The impact of the proposed development, although locally severe, would be considered minor as the habitats which will be permanently removed are common locally and regionally, and no rare or unusual species have been identified in the present survey.

Mitigation

It isn't possible to mitigate the loss of these habitats, although the development of a new reinforced shoreline of rock armour immediately adjacent to the hardstand area will result in the development of a new habitat type in the area, which will partially off-set the loss of habitat in question. It is expected that this habitat will consist of Fucoid dominated communities, similar to those present in the mixed sediment currently existing in the intertidal area.

10.4.3.2 Cove & Becin Strand

The development at Cove involves the deposition of dredged material from the Inner Bantry Bay development into the Cove area of Bantry Bay. This sediment will be deposited by means of barge into the Cove embayment. The sediment to be deposited will be uncontaminated material from the deeper sediment from Bantry Harbour. In addition, 2 rock-armour breakwaters will be constructed at the mouth of the Cove inlet to reduce the potential from re-suspension and further deposition of this material.

The habitats identified within the Cove inlet are similar to those identified along the Becin Strand. These include Talitrids on the upper shore and strand-line (LS.LSa.St.Tal) present across large parts of the area; Barren littoral shingle (LS.LCS.Sh.BarSh) along large parts of the upper shore without weed cover; *Fucus spiralis* eulittoral mixed substrata (LR.LLR.F.Fspi.X) present across the upper shore in parts; *Fucus vesiculosus* on mid eulittoral mixed substrata (LR.LLR.F.Fves.X); Ephemeral green and red algae on eulittoral mixed substrata (LR.FLR.Eph.EphX) in areas where *Enteromorpha* dominates on shingle and there is evidence of freshwater seepage through the substrate and *Fucus serratus* on eulittoral mixed substrata (LR.LLR.F.Fserr.X) across the lower shore. The soft sediment areas of the Cove inlet are dominated by Infralittoral muddy sands (SS.SMu.ISaMu) with *Lanice conchilega* and *Arenicola marina* common in the areas. Finally, occasional areas of intertidal muddy sands are present along the inner margins of the Cove inlet (principally LS.LSa.MuSa - Polychaete/bivalve-dominated muddy sand shores).

Potential Impacts

The deposition of large amounts of inert material into the Cove inlet will result in the complete removal of all benthic habitats within the Cove inlet. It is expected that the deposition of 81,500 cubic meters of dredge material from the Bantry Harbour development will result in the conversion of sub-tidal areas to intertidal soft-sediment and terrestrial as the deposited sediments will raise the level of the shore. In addition, as the majority existing intertidal habitats consist of coarse gravel and shingle based communities, it is expected that these will be permanently removed from the development area as the sediment to be deposited into the Cove inlet will comprise much finer sediment in general. In addition, sections of the intertidal and sub-tidal will be permanently removed under the footprint of the two proposed breakwaters at the mouth of the Cove inlet. These breakwaters will also allow for the recolonisation of hard-benthos communities on the rock-armour intertidal stretches. It is expected that these communities will be broadly similar in nature to those covering on the cobble/shingle area within the Cove inlet area currently.

It is not expected that the proposed reclamation of the Cove inlet will have any impact on the Becin Strand area of Bantry Bay, as all impacts are expected to be localised within the Cove inlet area.

Impact Significance

The impact of the proposed development on both the intertidal and sub-tidal communities within the Cove inlet can be described as locally severe, as the benthic habitats will be permanently removed from the area. Overall however, given that the communities present in the area are common locally and regionally, it is not considered that the loss of this amount of habitat will impact significantly on the integrity or functioning of the remaining intertidal and shallow sub-tidal habitats in Inner Bantry Bay. In addition, the proposed breakwaters will allow for the development of hard-benthos communities on its intertidal sections, which will in time partially off-set the loss of hard-benthos intertidal in the Cove site as it becomes fully colonised with marine macroalgae and encrusting and other invertebrates associated with such substrates and tidal conditions.

Mitigation

It isn't possible to mitigate against the loss of these habitats, although the development of two rock-armour breakwaters immediately at the mouth of the Cove will partially mitigate the habitat losses predicted.

10.4.3.3 Inner Bantry Harbour

The development in Bantry Harbour will involve the dredging of all of the Inner Harbour and approaches, as well as the construction of a hard-stand area to the north of the Harbour, the development of a breakwater along the northern edge of the Harbour and the construction of a heavy-vehicle turning area at the head of the existing main pier at the mouth of the harbour.

The habitats identified in the area are typical of sheltered marine systems (dominated by *Ascophyllum nodosum*), which are subjected to variable salinity. The soft sediment habitats identified in the lower intertidal consist of LS.LSa.MuSa (*Polychaete/bivalve-dominated muddy sand shores*), LS.LMx.GvMu.HedMx (Hediste diversicolor *in littoral gravelly muddy sand and gravelly sandy mud*) and LS.LMx (*Littoral Mixed Shores*).

The sub-tidal communities identified within the footprint of the proposed development consist primarily of Infralittoral muddy sands (SS.SMu.ISaMu). This habitat type extends beyond the area of the proposed dredge limits.

Potential Impacts

The inner Bantry Harbour will be dredged to depths ranging from -2m to -3m Chart Datum to facilitate the mooring of vessels to associated pontoons. This will result in the removal of 120,000 m^3 of sediment from within Bantry Harbour. It will also involve the loss of all intertidal habitats from the area to be dredged. In areas of hard-benthos, it is expected that this removal will be permanent. In areas of soft sediment, it is expected that the sediment will become finer in nature, and the present muddy sand will become muddier over time. This will be reflected in the infaunal communities which are expected to colonise the sediment over time. In addition, it is expected that these communities will reflect the variable salinity which is present in the area, resulting in the probable development of a lower-estuarine benthic community.

Intertidal and subtidal communities and habitats will be permanently removed from the footprint of the proposed development (in areas of the proposed new breakwater and hard-stand areas to the north and the development of the existing pier-head to the south). These areas consist of intertidal hard benthos located on existing substrates and structures as well as stretches of intertidal and sub-tidal soft-sediment which are present throughout the area. The dredging will result in all of the current intertidal area within the harbour becoming sub-tidal as well as a deepening of the current sub-tidal areas in the harbour and it's approaches. The new areas of hard-benthos (i.e. the walls of the proposed and the proposed breakwater, be recolonized by communities broadly similar to those which are present in the area currently.

Within the footprint of the dredge area, i.e. inside the harbour and at its approaches, the faunal communities will be initially removed. If the substrate which remains is similar in nature to the sediment which will be removed, re-colonisation of this sediment would be expected to commence relatively quickly, due to the presence of similar habitats close by with the replacement community becoming re-established to pre-dredge levels within 2 to 4 years.

Sedimentation from the dredging activities is expected to be very localised, with heaviest levels of sedimentation occurring within the immediate dredge zones. Modelling of sedimentation beyond this area indicates sedimentation rates of between 0 and 5mm extending up to 50m away from the dredging activities. Benthic soft sediment communities, by their nature, are quite resilient to re suspension and deposition of sediments. The deposition of up to 5mm sediment of a similar nature is not expected to have any long-term negative impact on the benthos in these localised deposition areas.

Impact Significance

The proposed development will see the dredging of 120,000 m^3 of material from the inner parts of Bantry Harbour. The impacts of this, although locally severe, would be considered minor to moderate in the wider context, as the habitats and communities identified are common locally and regionally. In addition, no protected or rare species or communities have been identified in the area. Moreover, the loss of intertidal habitat through dredging will be partly off-set by an increase in sub-tidal habitat approximately equivalent in area to the sub-tidal area being removed.

The proposed development will require the construction of hard-stand area and a breakwater area to the north of Bantry Harbour and the extension of the existing pier-head to create a vehicle turning circle. The resulting loss of habitats from the construction of these structures, although locally severe, would be considered minor to moderate as the habitats and communities identified are common locally and regionally.

It is also proposed to undertake dredging along the approaches to the new development at the mouth of Bantry Harbour. This will result in the removal of large areas of soft-sediment, sub-tidal communities. The impact, although locally severe, would be considered minor as recovery of the habitats within the footprint of the dredge area would commence quite quickly, and recovery would occur within 2-4 years post dredging. In addition, in areas where sediment deposition from the dredging activities occurs, the impact would be considered minor, as high levels of sediment deposition are very localised, and far field impacts are limited to deposition levels of between 0-5mm of sediment, within 50-100m of the dredging area. This level of deposition would not be expected to cause any significant effect on the infaunal communities present in the area.

Mitigation

It isn’t possible to mitigate against the loss of any habitats by means of dredging or development of hard-stand areas within the development footprint. The extension of the existing pier, as well as the development of a new breakwater and hardstand area to the north will result in the creation of new hard-benthos habitats along the walls of the developments and these and the development of similar habitats on the proposed marina structures will partially offset the loss of hard benthos intertidal habitats. The adoption of environmental dredging methods will reduce the amount of sediment displaced during the dredging effort.

10.5 Appropriate Assessment Screening Exercise

An Appropriate Assessment Screening exercise was carried out to determine the effects, if any, the proposed development will have on a number of Natura 2000 sites identified as having potential to be impacted by the proposed development. In addition the screening exercise assessed if any of the predicted impacts have the potential to have significant adverse effects on the qualifying interests or on the conservation objectives of these Natura 2000 sites.

The Screening Report produced as an output of the screening exercise is presented in full in Appendix 3B of this EIS.

The report concluded that there will be no significant effects on any Natura 2000 site as a result of the proposed development. Therefore a Stage 2 Appropriate Assessment is not required.

11.0 AQUACULTURE AND FISHERIES

This chapter of the EIS assesses the impact of the proposed development on aquaculture and fisheries.

11.1 Aquaculture

11.1.1 Mussels

Rope grown blue mussels (*Mytilus edulis*) are the second most important aquaculture undertaking in Bantry Bay after salmon farming, with a production in 2010 of 1,923 tons and point of sale value of Euro 1.087M, employing 19.3 full-time equivalents (data Mr. John Denis, BIM). Mussel farms in the inner bay are concentrated along the eastern shore of Whiddy Island with other farms situated just north west of Cove (Figure 11.1). There are 34 sites configured in several contiguous blocks licensed to 8 operators, while in Glengarriff Harbour there are a further 10 sites licenses to 2 operators. The nearest mussel farm license areas to the proposed development are ~810m to the Abbey shore, ~940m to Bantry Harbour Pier and ~340m to the Cove site respectively.

Mussels spawn in April and May and at this time operators put out collector ropes to capture the spat settling from the plankton. These then grow up to 10-25mm by October and in October/ November they are put into cotton socks, at the rate of 350-400 per foot of rope. These are then removed the following July when they have grown significantly and are de-clumped and thinned out to 250 per foot for continued growth to market size, which may arrive in December/January giving a growth cycle of 18-20 months. However, in 2011, the growth was poor and growing had to be extended.

The industry in Bantry used to process most of its production locally but now it relies mainly on live exports to Europe, where it is at the mercy of the vagaries of the various European markets.

A key challenge to mussel production in Ireland, including in Bantry, is the presence of a range of toxins, which mussel concentrate from certain phytoplankton species. The severity of the problem varies from year to year and has a seasonal component. In the summer DSP (Diarrhetic Shellfish Poison) and PSP (Paralytic Shellfish Poison) tend to be more prevalent, while later in the year another toxin AZP (Azaspiracid Shellfish Poison) is more frequent. Mussels from all the growing areas are tested by the Marine Institute for toxins on a weekly basis throughout the year. In addition, phytoplankton counts are undertaken locally to give the growers an early warning about the numbers of certain problem phytoplankton species in the water column. When toxins are found to be present in mussel flesh above certain prescribed concentrations, the areas affected are closed and mussels cannot be harvested in order to protect consumers' health. These closures can be economically very damaging for producers.

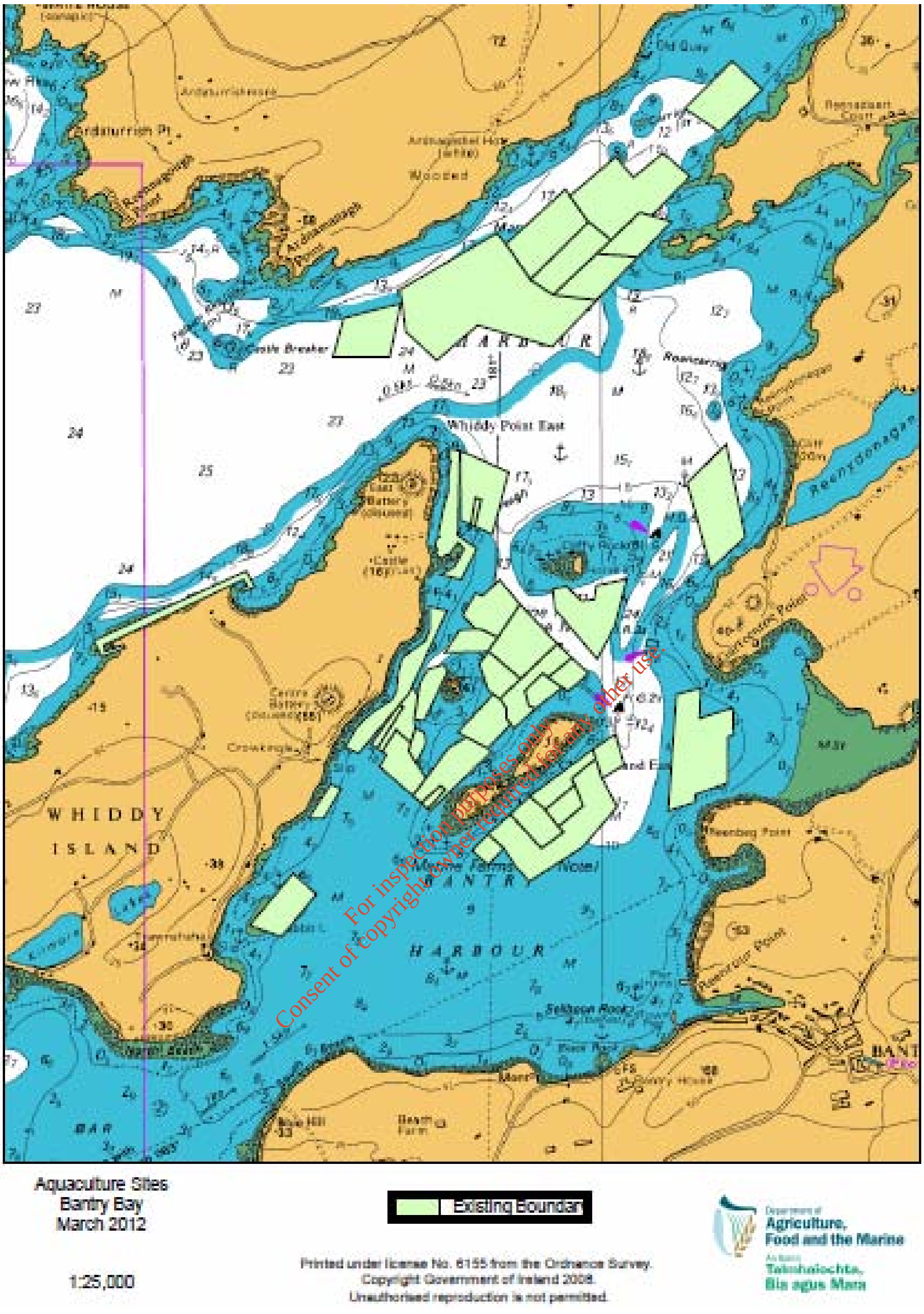


Figure 11.1 Aquaculture sites in Inner Bantry Bay, March 2012.
(Data courtesy Mr. Rafael Crowley: DAFM – Tralee Office)

11.1.2 Other species

In the last few years a limited amount farming for scallop (Pecten maximus) is being undertaken, where native seed is placed in suitable habitats along the eastern shoreline of Whiddy Island. These take 3 to 4 years or longer to reach marketable size depending on growth rates; they are harvested by divers. Although yet in it's early days, this new venture looks as if it may be successful. The scallops are grown in 4-5 licensed areas, mainly just off the eastern shore of the island.

Pacific oysters (Crassostrea gigas) are also grown at Newtown and a salmon farm is present farther out the bay at Gerahies has operated for many years at that site.

11.1.3 Importance of the Industry to Bantry

Data received from BIM for the 2010 production of aquaculture from Bantry highlight the importance of rope mussels and salmon for the local economy, both in terms of revenue but also in terms of employment. It is also clear that in the national context, the Bantry industry is also significant for the sector (Table 11.1).

Table 11.1 Employment, production and value of rope mussel and salmon production in Bantry Bay in 2010.
(Data supplied by Mr John Denis, BIM)

		Species		% of National Figures	
		Rope Mussels	**Salmon**	**Rope Mussels**	**Salmon**
Employment	Fulltime	12	10	18.5	9.0
	Part-time	9	16	11.0	30.2
	Casual	17	0	15.3	0.0
	Male	29	19	12.0	12.9
	Female	8	7	50.0	41.2
	Total	37	26	14.3	15.9
	FTE	19.3	18	15.5	13.1
Production	Volume (tonnes)	1,923	1,882	21.9	12.0
Sales	Value(€)	1,087,014	8,972,640	17.0	12.7

11.2 Commercial Fisheries

11.2.1 Shrimp (*Palaemon serratus*)

There are about 5 in-shore fishing boats operating in the area, mainly for shrimp and prawns. Apart from the odd set of pots that might be set at the end of the old railway pier or at the outer side of the main pier, generally there is no commercial fishing in the Inner Harbour or its immediate approaches. Outside the harbour, pots could be set anywhere as far as Whiddy Island depending on the season, with pots closer to the Bantry shore in the August to November period and then generally being moved farther out between November and March, which marks the end of the season. Some fishermen may not move their pots farther out in November. A small amount of velvet crabs are taken from time to time also.

Shrimp (*P. serratus*) are the most important target species for the local commercial fishermen who also take pot for prawn (*Nephrops norvegicus*). The following account of the shrimp's biology is from biology, from Kelly *et al.*, (2008).

Palaemon serratus is a relatively short-lived decapod crustacean, with a lifespan of approximately two years. Females begin to carry eggs in October and November and by December the majority are berried. The time required for embryo development is dependent on the ambient water temperature and generally takes 2.5 to 3 months in Irish waters (Philips, 1971). By the start of April half of the mature females have hatched their eggs. The planktonic larvae remain in the water for approximately one month before metamorphosing into post larvae and settling into intertidal and shallow subtidal habitats at a total length of approximately 1cm. These young shrimp grow rapidly during their 1st summer and recruit to the fishery in October at a total length of approximately 5cm. Mature berried females undertake small-scale migrations to deeper water during the winter months and they return to shallow inshore areas and estuaries prior to larval release. (from Kelly et al, 2008)

In 2006, 322 tons of shrimp were landed nationally with a point of sale value of Euro 4.5 million, making it the third most valuable crustacean fishery after brown crab (*Cancer pagurus*) and lobster (*Homarus gammarus*).

Prawns (*Nephrops norvegicus*) are potted in Inner Bantry Bay from January to April.

11.3 Other Issues – Pier Access

Both aquaculture operators and commercial fishermen complain about the lack of depth at the main pier due to the decades of silt accumulation, which restricts access at high water and to only part of the pier. This problem has persisted for many years and at times severely hampers the smooth operation of the industry in the area both for those involved in aquaculture and commercial fisheries. It limits both the number of boats which can load and unload at the pier and the stage of the tide when this can occur. The extension in the size of the pier combined with the increased in depth following dredging will increase the number of vessels which can be accommodated and extend the period of access to the full tidal cycle. Moreover, the provision of a turning area at the head of the pier for the first time will mean that large trucks will be able to access and exit the pier without serious obstruction, which has on occasion under the present configuration resulted in trucks being unable to unload or load resulting to serious disruption and in some cases consequential financial losses. Accordingly, the proposed upgrade to the pier and the proposed dredging are viewed very positively by all pier users.

11.4 Potential Impacts

The following potential impacts have been assessed:

Construction Phase; (i) impacts of dredging and dredge spoil re-use on aquaculture and commercial fisheries, (ii) impacts of dredging and dredge spoil re-use on other species

Operation Phase: (i) impacts of new marina, Cove and Abbey sites on aquaculture and commercial fisheries and (ii) impacts new marina, Cove and Abbey sites on other species.

11.4.1 Bantry Harbour – CONSTRUCTION PHASE

<u>11.4.1.1 Dredging – Heavy Metal Release</u>

The presence of heavy-metal contaminated sediments in Inner Bantry Harbour means that the dredging proposed as part of this development poses a potential risk to the environment due to the release of sediment-bound contaminants during the dredging process and subsequent cycling of these contaminants into the food chain. Elevated levels of mercury pose a potential risk, as does TBT and to a lesser extent copper, zinc and lead.

The release of metals from sediment during dredging depends on a wide range of site-specific factors including: the nature and particle size distribution of the sediment, the specific chemistry of the sediment, especially the levels of sulphides present, the total metal load, salinity, pH, temperature, amount of organic matter in the sediment and the degree of oxygenation of the sediment during the dredging etc. Given this wide array of influential factors, trying to predict the concentration of each metal likely to be released during the process would be difficult. What is certain is that the levels of all contaminants are likely to increase in both dissolved and especially particulate form in the water column in the vicinity of the dredging operation. There they may impact directly on juvenile stages in the plankton and be available to disperse into the wider environment and food chain, albeit in ever decreasing concentrations with distance from the site.

The known toxicity of mercury and TBT and the historical knowledge of the ecological damage associated with these metals combined with the locally elevated levels of both (particularly mercury) in the Bantry inner harbour sediments, single them out for particular consideration.

Mercury

Due to its toxicity and its propensity in certain forms to bioaccumulate up the food chain, mercury has been examined in more detail than the other potential contaminants. Mercury enters the environment through (i) deposition from the atmosphere where the sources are natural (e.g. volcanoes and forest fires, or anthropogenic – e.g. the burning of fossil fuels) and (ii) anthropogenic industrial point sources. Although the industrial use of mercury has decreased substantially in recent decades, high concentrations are still present in marine and freshwater sediments as a legacy of previous industrial use and atmospheric circulation is still much higher than in pre-industrialised times.

Mercury is very toxic to aquatic organisms both in its organic and inorganic forms, with organic forms such as methyl mercury being significantly more toxic than the inorganic forms. Organic mercury is also the form which bioaccumulates most efficiently in the food chain, being capable (in some instances) of accumulation in concentrations 10,000 – 100,000 times its water concentration. In fish flesh, most mercury is in the organic (methyl mercury) form.

Inorganic forms of mercury can be transformed in sediments to organic methyl mercury by sulphur reducing bacteria under anaerobic or near anaerobic conditions in a process known as methylation. Under aerobic conditions in oxic sediments methylation cannot take place and the reverse process (demethalation) can occur. The methylation process generally takes place in the surface layers of the sediment as these are the most biologically active. However, in deeper layers it may cease completely because of inhibition due to a build up of excess sulphide, while at the surface, where conditions are oxygenated it also ceases. Biologically active sediments also contain the highest levels of organic carbon, which is required for methylation; organic matter may also provide a source of bound inorganic mercury for methylation. The depth of metyhlation is often determined by the degree of mixing of the surface layers either with more vertically disturbed sediments having a higher rate of methylation than stable non-mixed sediments.

Flux of methyl mercury from sub-surface anoxic sediment may be inhibited by an oxic surface layer and some sediments have a very low methymercury flux rate. However, diffusion into overlying water may be facilitated by the presence of macroinvertebrate infauna e.g. polychaete worms. Anoxic conditions in the water overlying contaminated sediments also facilitates the flux of methylmercury into the watercolumn. In Bantry, because the conditions probably rarely if ever are anoxic in the overlying water column in the inner harbour, flux of methylmercury from the sediments is likely to be lower than if anoxic conditions prevailed in the overlying waters. This would seem to be borne out by the heavy metal monitoring results for mussel flesh in Inner Bantry Bay, which are generally at or below the national average and well below limits considered safe for human consumption. (Table 11.2).

In a study of mercury burdens in bivalve flesh along the French coast the average % of total mercury in mussels and oysters contributed by methyl mercury ranged from 11%-88% with an average of 43%. (Claisse *et al.*, 2001)

In general, the amount of methyl mercury in a sediment is about 0.1-2% of its total mercury content, although a simple correlation between sediment total mercury and methyl mercury is often not observed in sediments probably because of the very site / sediment - specific factors controlling methyl mercury formation and breakdown. In a study across the full Seine estuary an average figure of 0.5% of total mercury was present in the methyl form with percentages at the marine end of the estuary slightly lower. (Mikac *et al.*, 1999)

Methyl mercury can also occur in porewater, generally at concentrations less than 10ng/l (often less than 1ng/l) except in very contaminated sediments. Inorganic mercury by contrast may be present in higher concentrations, e.g. in the Seine estuary survey up to 300µg/l at the sediment surface. (Mikac *et al.*, 1999).

Both inorganic and organic mercury are strongly associated with organic matter within sediments and these act as a source of dissolved mercury (organic and inorganic) due to bacterial degradation of organic matter. Both forms in solution in the overlying water column are rapidly adsorbed to particulate matter, especially where the later is high in organic content. Inorganic mercury tends to be more strongly bound to particulates than organic forms.

Sediment re-suspension can facilitate methylation (conversion to methyl mercury) as well as the release of inorganic mercury from pore-water and sediment bound mercury (following oxidation). The rate of methylation appears to be seasonal with lower rates occurring during winter. Increased rates have been associated also with the normal spring phytoplankton peak.

Table 11.2 Heavy metal levels in Bantry Bay mussels (mg/kg wet weight) (2004-2008) – MI
(McGovern et al., 2011)

Year	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
2008	0.09	0.09	1.46	<0.02	<0.13	0.11	21.9
2007	0.16	0.09	1.26	<0.02	<0.13	0.12	23.5
2006	0.11	0.15	1.62	<0.02	0.18	0.18	20.8
2005	0.18	0.09	1.41	<0.02	<0.13	0.08	19.8
Bantry (mean)	**0.135**	**0.105**	**<1.438**	**<0.020**	**<0.143**	**0.123**	**21.5**
Irish (mean)	0.17	0.24	1.79	0.03	0.24	0.20	17.6
Shellfish Consumption Standards (EU & OSPAR)	1.0	n/a	20	0.50	n/a	1.5	[1]50

[1] UK - guidance value only

Sediment bound methyl mercury can be an important source of Hg to suspension feeding mussels (and appears to be assilimable from all major sedimentary components), with a significantly greater efficiency than for inorganic mercury. In experiments 1-9% (mean 5.5%) of inorganic mercury and 5-89% (mean 45.4%) of methyl mercury were taken up from suspended sediment. Mussel uptake of inorganic mercury from phytoplankton is also reported to be low ~5%, while mussels exposed to inorganic and organic mercury in solution over 2 weeks assimilated each form of the element, directly concentrating it by 2000 times for the organic and about 1000 for the inorganic form. While the rate of assimilation of the inorganic form was declining toward the end of the 2-week period, organic mercury continued to be adsorbed by about 160 times the water concentration per day (Gagnon and Fisher, 1997).

Therefore, dissolved mercury (both inorganic and organic) is concentrated very appreciably by mussels, and dissolved mercury inorganic is relatively more abundant as compared to methyl mercury, and should be considered a potential source for mussels from the proposed works. However, in turbid coastal waters, dissolved mercury commonly constitutes only a small proportion of the total mercury in the water column, which may mean that if mercury is mainly assimilated from suspended solids, then the uptake rate of inorganic would be lower than if it were mainly in the dissolved form in waters.

Particulate sinking is the ultimate removal mechanism of dissolved methyl mercury from waters.

Phytoplankton can rapidly adsorb both organic and inorganic mercury from the water column but both forms are partitioned differently with the majority of the inorganic form within the cell membrane and the organic form within the cytoplasm. When grazed by zooplankton, the organic form within the cytoplasm is far more readily taken up than the inorganic forms.
There is a large disparity between the toxicity of mercury (as $HgCl_2$) to different species but often a much greater disparity between the larvae and adults within the same species. Larvae of the native oyster (Ostrea edulis) have a 48Hr LC50 of 1.0-3.3µg/l, while the corresponding value for the adult is 4,200 µg/l (4.2 mg/l). Embryos of the Pacific oyster (C. gigas) have a similarly low 48hr LC50, of 5.7µg/l. The commercially caught shrimp in Bantry (Palaemon serratus) has 1st larval stage 72-hr LC50 of 74µg/l whereas the adult 24hr LC50 is >2400µg/l. Juvenile rainbow trout (O. mykiss) have a 96-Hr LC50 of between 200-400µg/l. In contrast, common goby (Pomatoschistus microps), probably a locally common fish in Bantry Harbour, has 96hr LC50 of 62µg/l, while adult flounder have a 48hr LC50 of 3,300µg/l. Polychaete larvae also reflect this adult / larval disparity in sensitivity: 96-hr LC50 Capitella capitata 14µg/l (larva), >100µg/ (adult). (Boening, 2000)

Mercury in the Bantry Context

The published features of mercury behaviour in sediment and the water column suggest that for Bantry, most of the mercury potentially generated by the dredging process will be in the inorganic form with a smaller percentage (possibly ~0.1-2%) in the organic methyl form, depending on local sediment chemistry, temperature etc. Furthermore, the majority of both total and dissolved mercury (inorganic and organic) will be associated with suspended solids.

Dissolved mercury (inorganic and organic) will be present in highest concentrations during the dredging process and thereafter decline as it is adsorbed onto suspended solids and organic matter in the water column. Most of the solids generated in this way will settle to the bottom in the vicinity of the dredger or within the inner harbour. Residual, dissolved mercury present within the water column (i.e. that fraction not immediately adsorbed to suspended solids) will be adsorbed by phytoplankton, zooplankton and benthic filter and deposit feeders (worms and bivalves) and fish depending on the density of individually in the latter trophic levels present at the time. It is clear from other studies, that the amounts of mercury present in the sediment environment and the associated trophic (food chain) levels tends to decline away from the source of contamination and this is also likely to be the case in Bantry. So that most if any evidence of enhanced mercury levels in biota are most likely identified within the Inner Harbour and it's approaches. Mercury present in the small amounts of suspended solids predicted to reach the site of aquaculture installations during the dredging process will be mainly in the inorganic form and therefore assimilate at significantly lower rates by mussels than if they were in the organic form. It is important to note that while mercury and heavy metals re-mobilised during dredging of heavily contaminated harbour sediments may accumulate in the flesh of filtering bi-valves to levels significantly above those in un-dredged reference sites, that does not necessarily mean that it will either increase mortality rates or reduce growth rates in the affected species (Bellas et al., 2007; Hedge et al., 2009).

As part of the present assessment, the dispersal of mercury from the dredging at the mouth of the harbour was modelled, making the assumption that all of the mercury re-suspended by the dredging would be in dissolved form (see Chapter 11.0). This simulation predicted that the highest concentrations, which would be experienced by mussels at the nearest rope mussel aquaculture sites, would be between 0 and 0.0025µg/l. If we make the assumption that the figure would be the upper end of this range i.e. 0.0025µg/l, then taking a conservative bioconcentration factor of x3000 (Gagnon and Fisher 1997) for the 2-month period during which the dredging will take place, the maximum increase in mercury in mussel flesh would amount to 0.0075mg/kg wet weight. Currently the figure is on average <0.02mg/kg wet weight (McGovern et al., 2011). Assuming it were 0.02 mg/kg, this would give a post dredging maximum concentration of about 0.0275mg/kg-wet weight. This is over an order of magnitude lower (x18) than the level of 0.5mg/l wet weight, which is set for mercury content in shellfish for human consumption by the EU.

TBT

The use of TBT as a very efficient antifouling agent derived from its high toxicity and it's use was banned in the late 1980's for use on small craft <25m when it became apparent that it was causing widespread ecological damage, especially to marine molluscs. It was subsequently banned by the IMO for use on all marine craft in 2003. Since these bans, the ambient levels of TBT in boat marinas and harbours has declined very markedly. However, TBT strongly binds to sediment and only degrades slowly and therefore significant reservoirs remain in ports harbours and marinas. In the Inner Harbour at Bantry significantly elevated levels of TBT are confined to two spots along the southern quay and one in the angle of the pier and the quay wall. At these points the concentrations hovers around 0.7mg/kg, which is the cut-off point above which the Marine Institute does not permit disposal of dredge spoil at sea. In the same general area there are several more sites where the levels are still elevated but mainly at or a little above the 0.2mg/kg level below which disposal of sediment at sea is permitted. The highest recorded level in Bantry was in the MI's 1997 survey when a concentration of 0.789 mg/kg was recorded in a surface sample at the head of the pier (Nixon, 1997). These levels of contamination therefore could be described as locally significant but in general not excessive by the standards of some ports internationally.

The toxicity of TBT is such that even in extremely low concentrations it causes serious reproductive disorders in marine snails, exemplified by the dog-whelk which declined or became extinct in parts of many harbours and in proximity to heavily used marinas around the UK and Ireland, indeed, the effects were documented before TBT in water could be analyses to the low levels which were capable of causing this problem i.e. around 1-2 nanograms per litre (= 0.001-0.002µg/l). Bivalves are also very susceptible to TBT and oyster spat (*Crassostrea gigas*) are all killed after exposure to 0.18µg/l over a period of 12 days exposure, while 50% of mussel larvae die after exposure to 0.04 µg/l TBT (as TBTO) for 15 days. Chronic exposure to just 0.01 µg/l aversely affects the growth rate of oyster spat while mussel (*Mytilus edulis*) spat growth are adversely affected by 7-day exposure to 0.4 µg/l. (Fent, 1996).

Another very sensitive species is the purple urchin (*Paracentrotus lividus*) the growth of whose larvae is reduced by 25% by exposure to TBT concentrations of 0.2µg/l (Bellas, 2005).

Another group, which is susceptible (although slightly less so) to TBT toxicity, are early stage of fish, with rainbow trout larvae (*Oncorhynchus mykiss*) experiencing 50% mortality when exposed to 3.5µg/l and 100% mortality when exposed to 1.8µg/l over 12 days. Chinook salmon larvae (*Oncorhynchus tshawytscha*) experienced 50% mortality after a 4-day exposure to just 0.8µg/l TBT (as TBTO), while larvae of minnow (*Phoxinus phoxinus*) experienced skeletal deformation when exposed to concentrations greater than 3-4µg/l TBT. (Fent, 1996)

In contrast, decapod crustaceans (crabs and shrimps) are one of the most tolerant groups to TBT exposure and early stage larvae of the shrimp *Palaemon serratus* (the species commercially fished in Bantry) have an acute toxicity concentration of 17.5µg/l (48-hr LC50), (Bellas, 2005).

TBT release during dredging

The amount of TBT, which will be desorbed into the water column, is very site specific and dependent on the mineral composition of the sediment (i.e. it's clay mineral composition in particular), the organic matter content of the sediment, the ambient salinity, temperature and pH. A combination of all these factors means that attempting to predict the precise concentration of TBT likely to evolve during dredging is very difficult. It has been shown using caged mussels that the species (M. edulis) can accumulate significant body burden of TBT when placed in areas where dredging is taking place, indicating that dredging does result in the release of TBT into the environment (Bellas, 2007).

There is a strong likelihood that TBT released during dredging in Bantry Harbour will accumulate in benthic infauna, algae and fish within the harbour itself. This may result in sub-lethal impacts such as reduced growth, increased stress and reduced immunity. However, direct acute toxicity is not anticipated. Impacts to the aquaculture industry beyond the Inner harbour, will depend on the spread of suspended and dissolved TBT to these outer locations during which time suspended solids will deposit, and dissolved TBT will dilute, factors which will tend to reduce their potential impact.

The models used for the current study to predict the spread of solids beyond the inner harbour during dredging indicate that most solids generated remain within the harbour, while the equivalent model for suspended solids and dissolved mercury developed for the dredging of the outer harbour predicted a localised deposition of sediment and a slightly wider but still localised spread of dissolved metals which dilutes to very low concentrations by the time it reaches the middle of the Inner bay where aquaculture is based. Given these predicted outcomes the likelihood of adverse accumulation of TBT in mussels at aquaculture sites is considered to be low. However, mussels can bioconcentrate TBT from the water column very rapidly, and by large factors in the space of a few weeks, at contaminated sites undergoing dredging (Bellas et al, 2007), so that some accumulation of TBT in Bantry mussels cannot be ruled out. For example, (Devier et al, 2005) reported the highest ever range of TBT Bioconcentration Factors (BCF) (~61,000 - 285,000 wet weight) in a 1-year study where they monitored the accumulation of TBT in re-laid caged mussels from clean areas into Arcachon Bay in France. If we assume that the growing areas in Bantry were to be exposed to TBT in the same range of concentrations predicted by the dispersion model for mercury (i.e. up to 2.5 ng/l) (Chapter 15 of this EIS) then using the range of BCF's quoted above in Devier et al, (2005), tissue concentrations of TBT in mussels in Bantry could rise to 0.15-0.71mg/kg wet weight. The upper range of these concentrations would be at the lower range of concentration reported by Widdows & Page (1993) to begin to adversely affect the growth rate of mussels i.e. 0.6-1.0 mg/kg TBT, wet-weight. It is important to point out, however, that for these concentrations to be reached, a series of worst case scenarios would have to coincide as follows: (i) the output of TBT in dissolved form during dredging would be as high as that predicted for mercury (i.e. 0.0-2.5ng/l), (ii) the higher end of the exposure concentration (i.e. 2.5ng/l, TBT) would have to prevail at the mussel aquaculture sites throughout the 4-week outer harbour dredging period and (iii) the highest concentration factor as reported in Devier et al., (2005) i.e. 285,000, would also have to obtain throughout the period. Even with this occurring, the resultant concentration would remain at the lower end of the concentration range at which sublethal impacts (i.e. reduced growth) were reported to begin (Widdows and Page, 1993). TBT is excreted by mussels with a reported half-life of 40 to 69 days (Zuolian & Jensen, 1989 and Page et al., 1995 respectively) so that the level accumulated will begin to reduce as soon as dredging ceases. . In order to reduce these potential impacts to a minimum, resuspension of solids and mixing of dredge spoil in the water column during dredging will need to be minimised and measures taken to reduce the escapement of solids from the dredge area.

General Community Impacts

There is a great paucity of field-based studies assessing the impact of dredging at a community level. One such carried out in an Australian estuary (Knott et al, 2009), noted that during a dredging operation, there was a virtual collapse in recruitment of a local barnacle species within the confined inner harbour where dredging of heavily contaminated sediment was undertaken. There was some suggestion from the data that other sessile organisms may also have been affected but that was not statistically significant. The cause of the impacts was attributed to increased levels of contaminants associated with the dredging. The authors noted that only the larvae in the plankton or very early settled larvae were impacted, not the already settled adult barnacles. This impact was confined to an inner sheltered harbour, while in the outer harbour, the site of deposition of a large quantity of moderately contaminated sediment, recruitment was normal. These impacts may not have been predicted had they been based on the levels of dissolved metals measured at the time of dredging as, apart from manganese these did not show a clear increase in ambient concentration. The authors however suggest that sediment bound metals (associated with increased turbidity during dredging) could have been the pathway of metal impact as these could have been released in the gut after ingestion. In support of this they refer to a parallel study undertaken at the same time, which showed increased metal accumulation in rock oysters during dredging (Hedge et al, 2009).

Suspended solids

Apart from the levels of contaminants they may contain, suspended solids in themselves are a source of environmental risk as they can reduce light penetration thereby reducing photosynthesis and growth for seaweeds and phytoplankton, contribute to sediment build-up on the seabed which can smother burrowing infauna if the depth of sediment is sufficient, while the gills of filter feeding bivalves can be clogged either causing mortality (in extreme cases) or reduced growth at lower concentrations. Fish can also be adversely impacted by suspended solids e.g. by damage to gills giving rise to gill disease and stress-related sub-lethal impacts also. Within the Inner Harbour itself, because all of the habitat will be ultimately removed, the deposition of suspended solids during dredging will be of a lower significance, the greater being the habitat removal (see Chapter 10 of this EIS). Beyond the harbour, the dispersal of solids due to dredging should be much reduced and therefore pose little risk to aquaculture installations. Bivalves are extremely tolerant of elevated suspended solids levels especially adults and to a lesser larvae, probably because some estuarine and coastal sites can naturally experience large variations in suspended solids levels. For example oyster larvae (*Crassostrea gigas*) exposed for 2 days to over 1000mg/l suspended showed no signs of mortality, while adult mussels (*M. edulis*) exposed to concentrations of over 10,000 for 20 days showed no mortality (see review by Wilber and Clarke, 2001). Furthermore bivalves have the ability to select food particles (phytoplankton) from mixtures of inorganic particles and phytoplankton and to discard much of the inorganic particles as pseudofaeces, thus counteracting the impact of inorganic solids diluting the food content of particulates filtered from the water column. At small amounts of silt (~5mg/l) there is no impact on growth rate in mussels (Clause and Riisgard, 1996) but high levels may give rise to reduced growth rates (Garen *et al.*, 2004; Bayne and Worrall, 1980).

The models used for the current study to predict the impact of dredging both within Bantry Harbour and just at the harbour approaches both predicted increases in suspended solids to be effectively confined to within the harbour itself or within a small radius of the outer harbour. Concentrations of suspended solids in the water column at the nearest mussel growing sites will amount to no more than a few mg/l and therefore pose no threat to the aquaculture growing areas in Bantry Bay.

11.4.2 Pier Dredging and Enlargement

Mussel aquaculture operators and commercial fishermen indicated that the proposed dredging would be very beneficial for their use of the main pier. Currently the pier is badly silted up such that it no longer functions as an all-tides facility, only being accessible during certain tidal heights. This will allow boats to load and unload at any time, greatly increasing the efficiency of usage. In combination with this and the provision of a truck turning area at the head of the pier will make it more convenient for exporters to move their stock with fewer interruptions. Parking on the pier can be a major problem from time to time for trucks trying to load and unload and this may also help to ease that situation. The modest enlargement of the pier will also provide increased berthage. These developments will have positive economic more than environmental benefits.

11.4.3 Bantry Harbour – Operation Phase

The new harbour will see an estimated 200 leisure craft using the Inner Harbour, including an estimated 50 craft coming from the wider Bantry Bay area along with an anticipated 150 local boats using the facility. Of these, it is expected that about 100 will be long-stay with 50 vessels short stay.

These have the potential to have the following impacts on the receiving environment:

(i) Increased leaching of copper, zinc and booster biocides from antifouling paints and marina fixtures.

(ii) Increased risk of fuel spillage due to re-fuelling.

<u>11.4.3.1 Impact due to Antifouling and Routine Boat Maintenance</u>

TBT was banned for use on boats <25m in length in the late 1980's and on larger vessels by the IMO in 2003. Since that time alternative antifouling coatings have been used based almost exclusively on copper salts as the main biocide mostly in combination with so-called booster biocides, which are organic in nature. A number of these 'new' antifouling biocides including in particular Irgarol, Diuron and Sea Nine (DCOIT) have all been restricted in their use in several countries, for example in the UK, Irgarol and Sea Nine were withdrawn for use on boats of <25m while Diuron was banned for use on all vessels. The situation in Ireland, while not subject to the same restrictions in relation to these booster biocides, seems nevertheless to have followed the very same trends as the UK as neither Irgarol nor Diuron are included in the biocide product register (last updated in November 2011) while several in common usage in the UK are included in the register. An examination of the register can give us a reasonable indication of the trend in biocide usage in antifouling paints in Ireland.

According to the Register:

> *The Department of Agriculture Food and the Marine (DAFM) is the Competent Authority responsible for the implementation of the biocides legislation in Ireland. The Biocidal Products Directive 98/8/EC is given effect in Irish law by Statutory Instrument S.I. No. 625 of 2001*
>
> *The Irish legislation requires that all biocides on the market in Ireland must be notified to the Department of Agriculture, Food and the Marine. This notification process is a transitional measure, which will allow the products concerned to remain on the market pending completion of the EC biocides review programme specified in Directive 98/8/EC. A list of products that are currently notified to the Department of Agriculture, Food and the Marine are contained in the Biocidal Products Register (Date: November 2011). This register will be updated on a regular basis, to reflect new notifications and non-inclusions/product withdrawals. Only biocidal products that are notified to DAFM may be legally placed on the Irish market.*

The biocidal products on the register which are used in antifouling paints/formulations are presented in Table 11.3 along with their chemical formulae and chemical names (gleaned from the web) and their concentrations in the antifoulant products on the register listed on the register. The table also lists the number of products which contain each of these biocides, which should give a crude indication of their likely level of usage and therefore potential for release into the environment.

Table 11.3 Biocides permitted for sale on the Irish Market

Biocide Name in Register	Chemical Formula	Alternative Name	[2]Concentration (g/kg)	No. of Products containing this biocide
Dicopper Oxide	Cu_2O	Copper oxide, cuprous oxide, Copper(1) oxide	83.37 - 511.43	193
Bis (1-hydroxy-1H-pyridine-2-thionato-O,S)copper	$C_{10}H_8CuN_2O_2S_2$	Copper Pyrithione(CuPT)	13.0 - 43.17	60
Zinc pyrithione	$C_{10}H_8N_2O_2S_2Zn$	bis(2-pyridylthio)zinc 1,1'-dioxide	25.6-50.6	48
Zineb	$C_4H_6N_2S_4Zn$	zinc ethane-1,2-diylbis(dithiocarbamate)	42.0 – 72.47	39
Dichlofluanid	$C_9H_{11}Cl_2FN_2O_2S_2$	N-	11.7 - 32.13	55

[2] As given in registered formulations

Biocide Name in Register	Chemical Formula	Alternative Name	[2]Concentration (g/kg)	No. of Products containing this biocide
		Dichlorofluoromethylthio-N' N'-dimethyl-N-phenylsulfamide		
Copper thiocynate	CCuNS	Cuprous thiocyanate	154.4-225.7	30
4,5-Dichloro-2-octyl-2Hisothiazol-3-one	$C_{11}H_{17}Cl_2NOS$	DCOIT, SEA-NINE	9.7-24.9	5
Disodium octaborate tetrahydrate	$Na_2B_8O_{13}.4H_2O$	DOT	39.14	1

Of the list in Table 11.3, copper oxide is used in the majority of antifouling paints on the Irish market as the main biocidal agent except where it may be replaced by copper thiocyanate. Copper oxide is often used as the only active ingredient but more generally with a second ('booster') biocide, e.g. copper pyrithione (Bis (1-hydroxy-1H-pyridine-2-thionato-O,S)copper), zinc pyrithione, zineb, or dichlofluanid. Note that SEA NINE (DCOIT) and DOT (Disodium octoborate tetrahydrate) are only contained in 5 and 1 product respectively and may therefore not figure significantly in Irish marinas as a potential contaminant.

The register lists 6 distributors in Ireland who handle the business for 8 authorisation holders (usually product manufacturers).

Environmental occurrence, toxicity and bioaccumulation

Given that most of these biocides (with the exception of copper and zinc metallic components) are relatively late arrivals in the marine environment there has been fairly limited research undertaken and that which has been done relates mainly to (i) their occurrence in the environment, often with apparently contradictory reports and (ii) to lab-based toxicity studies of individual biocides to a limited range of non-target organisms, while very little is known about their occurrence in biota in the field and whether or not they bioaccumulate.

As mentioned, since the ban on the use of TBT copper-based antifoulants have dominated the market, often in formulations where they are complimented by one or less often two of the booster biocides listed above. These biocides have been chosen because of their efficacy and generally rapid degradation in the environment all of them having fairly short half-lives ranging from hours to days depending on environmental variables and the medium e.g. light levels (depth), and whether in the water column or in sediment. Copper oxide, Sea Nine 211 (DCOIT), zinc and copper pyrithione and dichlofluanid are all reported to have half-lives in seawater of less than 24hours (Thomas and Brooks, 2010), meaning that they degrade into their constituent components or other generally less toxic by-products.

Sea Nine and dichlofluanid also have half-lives in sediment of less than 24hours, Sea Nine appears to be more persistent (half-life = 10days) when associated in sediment with paint particles. The effect is less pronounced in dichlofluanid with a half life of just 1.4days when associated with paint particles. The fate of zineb seems to be less well known, but it too is thought to undergo rapid degradation through hydrolysis and photolysis (in the water column). It appears, however, that some biocides in nature may not degrade as rapidly as reported e.g. due to poor light penetration in deeper waters or in shaded situations such as yacht marinas and harbours.

The occurrence of the chemicals in the environment is very variable depending on the biocide in question. As one might expect, copper is widely reported from the marine environment due to run off from land and anthropogenic sources in general. In addition, some of the higher concentrations reported have been associated with enclosed harbours and marinas with low water exchange and high boat densities. Total dissolved copper however, is a poor measure of copper bioavailability as it is the free ion, which is considered the most toxic form. The latter species was shown to comprise just 10-30% of total dissolved copper in a survey of levels in UK ports, harbours and marinas (Jones and Bolam, 2007). Dissolved organic carbon in the water column binds with labile copper (free ion and inorganic copper) to make it non-bioavailable.

Sea Nine in the water column has been detected in Mediterranean marinas, and in a Danish port but according to Thomas and Brooks (2010) it is difficult to clearly state that it occurs at elevated concentrations in areas frequented by ships and boats since there are insufficient data available. It has also been detected in very low concentrations in sediment in Spain. The same situation seems to apply to dichlofluanid, which is rapidly transformed to DMSA and aniline. However, it has been detected in sediment in Japan and the UK, sometimes in elevated levels, which would appear to fit with its chemical properties. Some authors suggest that dichlofluanid, contrary to earlier interpretations, may accumulate in sediments (Voulvoulis *et al.*, 2002) which would potentially make it more bioavailable to the food-chain e.g. initially within the benthos and later for scavengers and predators at higher trophic levels (e.g. fish and crustacea). Dichlofluanid was the most widely occurring booster biocide noted in a study of antifouling paint particles in the UK (Parks *et al.,* 2010).

In the case of zinc and copper pyrithione, both of which are very difficult to analyse and which are unstable in seawater, data for their environmental occurrence appears to be very limited. The same is true of zineb. As these biocides become more widely used and monitored and chemical tests become better established, a clearer picture of the occurrence of each of these biocides will emerge.

Toxicity

As might be expected the toxicity of all biocides tends to be high, however there is a great deal of variation in the degree to which particular species are impacted by each.

48-hr EC50 values of ZnPT, based on inhibition of embryonic development to the sea urchin *Paracentrotus lividus* and the blue mussel *Mytilus edulis* were 2.4 µg/l and 2.5 µg/, respectively (Bellas *et al.*, 2005b).

The toxicity of Sea-Nine 211 to ecologically relevant species has been summarized (Shade *et al.*, 1993). The 96-h LC50 value of the compound to rainbow trout was reported to be 2.7 µg/l, with a range of 1.8–3.3 µg/l at the 95% confidence interval (CI) for a flow-through test, and 9.7 µg/l with a range of 6.9–14.0 µg/l at the 95% CI for a static test.

Bellas (2006) showed that the embryonic development of *Mytilus edulis* larvae were affected by Dichlofluanid concentrations of 52 µg/l (EC10) and 81µg/l (EC50). The corresponding concentrations for the purple urchin (*Paracentrotus lividus*) and the Ascidian (*Cliona intestinalis* were 277µg/l and 627µg/l (EC10 and EC50 for *P. lividus*) and (282 µg/l, EC50, *C. intentinalis*). The author gives a predicted no-effect concentration (PNEC) for dichlofluanid of 5.2µg/l for mussel embryogenesis and 28µg/l for urchin embryo impacts and indicates that in the case of the mussel PNEC that this level could be reached in heavily contaminated marinas.

Bellas (2006) showed that the embryonic development of *Mytilus edulis* larvae were affected by Sea Nine concentrations of 7.1 (µg/l)(EC10) and 11 (µg/l)(EC50). The corresponding concentrations for the purple urchin (*Paracentrotus lividus*) and the Ascidian (*Cliona intestinalis* were 5.9µg/l and 12.1µg/l (EC10 and EC50 for *P. lividus*) and (105µg/l, EC50, *C. intentinalis*).

The author gives a predicted no-effect concentration (PNEC) for SEA NINE of 0.71µg/l for mussel embryogenesis and 0.59µg/l for urchin embryo impacts and 0.17 for larval growth effects and suggest that at these concentrations, mussels and purple urchins are likely to be adversely impacted in the more contaminated marinas. It is clear from these examples that while both dichlofluanid and Sea Nine are both toxic to invertebrate larvae, Sea Nine is significantly more toxic for the examples in the Bellas (2006) study.

No data on the toxicity of zineb or disodium octaborate tetrahydrate was obtained.

Bioaccumulation

Very little is known about the capacity of the biocides listed above to bioaccumulate, but studies to date on fish indicate low rates of bioaccumulation for Sea Nine and zineb. The fact that dichlofluanid has a very low solubility in water and high affinity to sediment is suggested by some as indicating a possible propensity for this biocide to bioaccumulate; a degree of bioaccumulation has also been indicated for and Zn-Pt. While to date there is a paucity of data on bioaccumulation of these biocides in the marine environment, it would be safer to assume that they all have at least a moderate capacity for bioaccumulation.

Summary of Biocides in relation to the proposed development

The increase in leisure craft numbers in the proposed development is expected in time to pose a moderate adverse environmental impact to the ecosystem functioning of the inner harbour due in particular to the benthic accumulation of copper and to a lesser extent zinc from antifouling paints used on the projected 100 craft using the facility. The accumulation of booster biocides in the sediment is also likely, although, due to more rapid degradation, these may well be in fairly low concentrations. These accumulations will likely result in alterations to the community composition of the benthic infauna e.g. a reduction in diversity and a possible reduction in biomass in areas where sufficient contaminant accumulates. While the harbour is sheltered, the significant tidal range in Bantry (as in Ireland in general) means that the system will be relatively well flushed, say in comparison to many Mediterranean marinas, such that water column concentrations of biocides (including copper) are unlikely to cause acute toxic impacts for any organisms and indeed sub-lethal impacts are also considered unlikely, although the latter cannot be ruled out at this stage. Beyond the inner harbour itself, it is expected that the environmental impacts of antifouling biocides will be negligible, due mainly to the fact that most sedimentation will occur within the harbour and that any water column borne biocides will be well diluted and degraded as they disperse beyond the harbour. An increased risk factor, which would alter these predictions, would be if un-controlled boat maintenance activities were to be permitted within the Inner Harbour. The accumulation of antifouling paint particles in sediments associated with boat cleaning is considered a major pathway of the pollutants to the environment and one, which should be strongly controlled. Were uncontrolled boat maintenance to be permitted, greater ecological impacts can be expected with significantly higher sediment bound contaminants arising, which would in turn act as a larger reservoir for diffusion of these chemicals into the overlying water column under certain conditions and for incorporation into the food chain.

Oil

Oil spills and leaks as well as being unsightly can adversely affect the biota and in the Bantry context in particular taint shellfish. The most likely sources of significant oil spills are from poorly designed, maintained, managed or equipped pier-side storage and dispensing facilities and greatest attention should be paid to this aspect of marina management. In addition, the dispensing of fuel to vessels either from a fixed refuelling point or using mobile bowsers are all potential sources of oil. In addition poorly maintain boats can be a source of oil e.g. from fuel leaks or through the discharge of oil-contaminated bilge. The likelihood of these occurrences are not expected to be any higher at Bantry than it would be at any marina and all can be significantly minimised through adequate mitigation.

11.4.4 Cove Site Impacts

The Cove Site will see the importation of large amounts of the deeper non-contaminated sediment from Bantry Harbour so that the impacts are expected to be confined to the inert solids, which will be deposited in the intertidal and shallow sub-tidal of this small embayment. The construction of two rock-armour breakwaters at the entrance to the Cove will insure that impacts beyond this point will be minimal. If significant amounts of suspended solids were to reach the nearest mussel long-line facility some 400-500m north east of the Cove then this could result in adverse impacts on the mussels (e.g. reduced growth rates) if suspended solids were sufficiently high (see Section 2.1.1.2 for discussion of potential impacts from suspended solids). Within the Cove itself, the main impact will be associated with the smothering of the intertidal and sub-tidal communities in the Cove (see Chapter 10 of this EIS for more details).

The alteration to the profile of the shore as well as the placement of breakwaters at the entrance to the Cove will not adversely impact the commercial fishing activity (mainly potting) within Inner Bantry Bay A very slight reduction in the area of sub-tidal habitat caused by the increase in intertidal area should have only a very slight change in the usage of the area by fish i.e. by reducing the foraging time available, as the shoreline in the Cove will be exposed for a longer period. This will be offset by the increase in sub-tidal area created by the dredging of the Inner Harbour.

11.4.5 Abbey Site impacts

11.4.5.1 Construction Phase

Suspended solids

The Abbey site will require the construction of a rock-armour bund behind which will be placed uncontaminated dredge spoil from the Bantry Harbour dredging. The bund will be about 200m along the shore and 45m down the shore. It is expected that placement of large rock elements in the shallow subtidal either from a barge or from the shore will generate a localised increase in suspended sediment. This however is unlikely to cause any adverse impact either to aquaculture or to commercially fisheries (i.e. potting) in Inner Bantry Bay. A geotextile placed behind the rock armour bund is designed to contain fines from the deposited spoil placed behind the bund from escaping to Bantry Bay.

Cement

The bund will be capped with concrete to create a hard standing area. Spillage of bulk liquid concrete into the harbour at this point could give rise to localised fish kills and invertebrate losses in the area, as would run-off of highly alkaline surface water from uncured concrete. Best practice for construction sites can reduce the potential impacts to minor local.

Oil & Fuel

Oil from construction plants and vehicles leaking or spilled into the Bay during construction could give rise to death of plants and invertebrates as well as tainting of mussels in the aquaculture industry. The risk of this occurring however is very low, provided that basic good engineering practice for construction sites is adopted.

11.4.5.2 Operation Phase

Habitat Removal and Change

The construction of the Abbey Site will see the removal of a approximately 200m of shingle and gravel shoreline with a scattered cover of brown algae (fucoids) and it's replacement by a much shorter and steeper intertidal comprised of rock armour. In terms of linear length this accounts for about 0.7% of the Inner Bay intertidal length and approximately 0.12% of the whole bay shoreline and in that context would constitute a very minor change. In terms of plant biomass the existing intertidal area has quite a patchy cover of brown seaweed due to the fairly unstable substrate present, with large areas of fine gravel being entirely devoid of seaweed. Furthermore, this instability means that much of the intertidal had few if any invertebrates in evidence at the time of surveying. In this context, it is likely that the rock armour perimeter will off-set most if not all of the losses of brown seaweed biomass arising from the change, as evidenced by the heavy growths that have developed on the recently installed armouring for the nearby slipway to the east. The rock armour will also provide some refuge for juvenile crab and other invertebrates. This very stable replacement habitat may also develop an Laminaria zone in the shallow subtidal, which is not currently present in the extreme low water of spring tides, probably because the only substrate there is a mixture of pebble with a coating of fine sand-binding red algae on muddy sand. This latter habitat will be changed with the placement of the rock armour and consequently there may be a localised reduction in species diversity, as the rock armour will present a more uniform and less diverse habitat. Overall this change can be described as locally moderate adverse and permanent.

Fisheries

Much of the current intertidal area unlike for example a rocky shore or boulder shore, has little in the way of habitat diversity (e.g. rock pools, overhangs, crevices etc.) as well as a low faunal biomass, all of which suggests that it's fisheries diversity and carrying capacity is probably not high. The shore may be used by foraging gobies and other shore fish, as well as shrimp (*Palaemon serratus*) and green crab when the tide is in, particularly the mid to lower portion where there is generally greater seaweed cover and longer tidal immersion. It's loss, however, given the relatively small area involved in the context of the Inner Bay, are unlikely to result in any significant change in local fish diversity or biomass and no adverse impact on the local shrimp potting fishery is expected. The gradual maturation of the intertidal habitat comprising the steep rock-armour shore will only partly offset the reduction in foraging associated with this part of the development. Overall this change can be described as locally moderate adverse and permanent.

Water and Sediment Pollution

It has been suggested that one of the activities, which might be pursued at the Abbey site when it is completed is as a boat maintenance facility. No details of the nature of this facility have been provided, so nothing definite can be suggested with regard to its impact. It is important to note however, that boat maintenance areas are associated with a localised build-up of antifouling paint chips, which can leach copper, zinc and other heavy metals, as well as a range of booster biocides, into the marine environment if these are not adequately contained. In view of the presence of aquaculture sites in relative proximity to the Abbey site, it would be a cause for concern if such a facility were to be considered for the site unless very stringent control measures were put in place to prevent pollution of the marine environment.

11.5 Mitigation

11.5.1 Bantry Harbour – Construction Phase

11.5.2 Dredging

Timing

Dredging of the most contaminated sediments within and at the approaches to Bantry Harbour should be carried out during the months November to March inclusive. At this time of year, the cold water temperatures mean that there will be lowest methylation of mercury occurring when sediments are disturbed during dredging, slower chemical activity rates in general and least numbers of larvae in the plankton exposed to potential toxic affects. Furthermore, it will be outside the more sensitive mussel spawning and the shrimp settlement seasons.

Quantities Dredged

Dredging in the most contaminated areas must be to sufficient depth to remove all the contaminated sediment even if this means dredging to a deeper level than the average 1m depth indicated as the depth of contamination.

Method of Dredging

The method of dredging chosen must be environmentally friendly ensuring least loss of sediment and least mixing of sediment in the water column. This method need only be used in those areas which have been shown to be heavily contaminated, outside these areas less stringent methods can be considered.

Silt Curtains

Silt curtains to contain the spread of suspended sediments should be employed at each of the sediment contamination hotspots in order to reduce the spread of contaminated sediment beyond the dredging footprint.

Dredge Spoil Stabilisation

Appropriate stabilisation of dredge spoil should be undertaken following best international practice. As cement will be used in this process, all high-alkaline water draining from the facilities must be neutralised in a settlement area before being discharged, after settlement, back into Bantry Harbour, preferably toward the inner end of the harbour. These measures are designed to prevent leaching of heavy metals (i.e. via stabilisation), avoid the adverse impacts of highly alkaline discharges (neutralisation) and minimise of the discharge of suspends solids (settlement) with each of their attendant adverse impacts.

11.5.3 Bantry Harbour – Operation Phase

The new marina at Bantry Harbour should be operated following good management guidelines in order to prevent pollution from oil spills and antifouling paints in particular. A suitable set of guidelines was issued by the UK Environment Agency, SEPA and EHS: Pollution Prevention Guidelines: Marinas & Craft PPG14 (http://www.doeni.gov.uk/niea/ppg14.pdf). This addresses topics such as Fuel and Oil, Refuelling facilities, Sewage, Boat Hull Cleaning, Painting and Antifouling. The following summarised abbreviated quotes are taken directly from that publication – they shouldn't be taken as an exhaustive list:

Fuel & Oil

All powered craft should be properly maintained and the speed limits observed in order to minimise emissions both to the atmosphere and to water.

Portable fuel tanks and spare fuel containers should be filled away from the water's edge and never overfilled, as spillage and bilge contamination will result.

A small quantity of oil absorbent material should be kept on the craft at all times for use in the event of a spill.

Fixed fuel tanks should be carefully filled adjacent to the fuel supply facility, ensuring that no fuel is discharged over the side or into any part of the vessel.

Inboard engines must have either a drip tray under the engine and gearbox, to prevent contamination of the bilge, or oil-tight structural members fore and aft of the engine.

Refuelling Facilities

Fuel installations should be well maintained and all delivery hoses, pipework and trigger nozzles kept to a high standard and secured to prevent unauthorised interference. "Trigger" delivery nozzles with automatic cut-off on release should be used. It is recommended that a notice be clearly displayed providing advice on how to avoid spillages and what to do if they occur.

Above ground fuel and oil storage tanks should be fully bunded and pipework protected against failure, accidental impact, theft and vandalism.

Waste oils should be kept in a bunded tank or in sealed drums in a secure dedicated store or surrounded with a kerb bund.

"Spill kits" containing absorbents and other materials should be kept readily available to contain and remove any spillage that has occurred, either directly into the water or onto the ground.

Bowsers should be maintained to a high standard. Where fuel is to be delivered by pump, an anti-syphon valve should be incorporated in the delivery line. When not in use, bowsers should be kept securely locked, preferably in a bunded compound well away from the water's edge or surface water drains.

Boat Hull Cleaning, Painting and Antifouling

Where possible, all maintenance and blasting should be carried out in dry dock or in a specifically designed wash-down area with provision for the retention and collection of waste water from scrubbing.

Avoid any spillage of paint, solvent or antifoulant onto land, into drains or watercourses. Take specialist advice on the choice of paint, bearing in mind local conditions and then apply the recommended product in accordance with the manufacturer's instructions. Use only approved products and apply safely, following the relevant Health and Safety guidance.

If possible, remove your craft from the water. When cleaning or hosing off, never use more abrasion than necessary.

The maintenance and management of the new facility should be such that there is a clear chain of command and responsibility covering all key environmental issues outlined above, so that the facility can be run to the highest international standards and that users are made fully aware of the environmental sensitivities of the facility and the wider Bantry Bay area.

11.5.4 COVE – construction phase

The breakwaters should be installed prior to any spoil being placed in the intertidal area
Only uncontaminated spoil (i.e. spoil which would be below the Marine Institutes Action 1 contaminant levels) should be deposited in Cove.

Only sediment with low levels of silt should be used in order to minimise sediment dispersion beyond the breakwaters.

Construction vehicles should operate only within the footprint of the spoil deposition area in order to prevent damage to adjoining intertidal habitats.

Construction traffic should not traverse Becin Strand on the way to Cove for spoil deposition, in order to avoid damage to the intertidal.

11.5.5 Abbey – construction phase

Timing

In order to minimise impact on shrimp larvae settling out of the plankton into shallow and intertidal waters, we would recommend that the rock armour bund be in place after the end of November and before the end of April.

The primary objectives should be to (i) to reduce the escapement of solids from the works, (ii) prevent spills of hydrocarbons and cement, and (iii) prevent damage to adjacent intertidal and sub-tidal habitat outside the immediate footprint of the development.

Suspended Solids

Only clean, rock-fill without fines should be used for the core of the rock armour facing bund, The phasing and method of the work should be designed to minimise contact between the tidal waters of the bay and any fines associated with the fill materials being used in the construction. The use of geotextile in this context both directly beneath the main rock armour and bedding material and the rock fill, and between the rock fill and the spoil being stored behind the bund should be effective in reducing or eliminating solids escapement.

All dewatering should be pumped to suitably sized settlement in order to prevent solids escaping to the bay.

Hydrocarbons

No works vehicles should be re-fuelled on the shore or within the footprint of the development. Fuel or other chemicals should not be stored in close proximity to the shore unless on impervious ground in a suitably sized bunded and locked enclosure to prevent vandalism and to adequately contain contaminants in the event of a spill.

All plant e.g. generators, compressors and pumps should be standing on suitably sized and placed drip-trays to prevent leaks reaching the shore.

Cement

If bulk liquid concrete is to be used in the development, this carefully shuttered to prevent spills into the marine environment and only poured during periods when the weather indicates that the concrete will be fully cured before rainfall leads to surface run-off. All pouring operations must be carefully monitored and supervised so that in the event of a spill, the supply can be shut off immediately and any escaped cement collected before entering marine waters.

11.5.6 Abbey – Operation phase

Surface water run-off from the Abbey site should be directed to gully traps before discharge to the bay.

Boat maintenance should not be undertaken at the Abbey site unless in a specially built facility (e.g. dry-dock or equivalent) with all the necessary containment and treatment facilities necessary to prevent contaminated effluent or run-off reaching the bay. Antifouling coatings and old paint chippings and dust generated during (i) re-painting / coating and (ii) hull cleaning and maintenance are the main contaminants of concern in this context as they can be a source of heavy metals and organic biocides in the marine environment around boat maintenance facilities if strict pollution prevention controls are adopted.

11.6 Monitoring

Mercury and heavy metals levels should be measured in representative samples of the mussels in Inner Bantry Bay at the sites closest to the proposed development (i) immediately before, (ii) 2 weeks after and (iii) 3 months after dredging. The exact same methods used by the Marine Institute to do their heavy metal surveillance of shellfish sites around the country should be employed and preferably the work should be contracted to the Marine Institute.

12.0 HUMAN BEINGS

The well-being of the local and wider community within the Bantry area has been comprehensively addressed throughout this EIS. This chapter of the EIS details the human environment of the hinterland surrounding the harbour area in terms of population profile and trends, employment and community aspects. It also discusses the impact of the proposed harbour development on the overall amenity of the area.

12.1 Baseline information

12.1.1 Population and Demographics

The immediate area surrounding Bantry Harbour comprises the Bantry Urban Electoral Division (ED), while the Cork Electoral Area (County and City) constitutes 398 other Electoral Divisions (Figure 12.1)

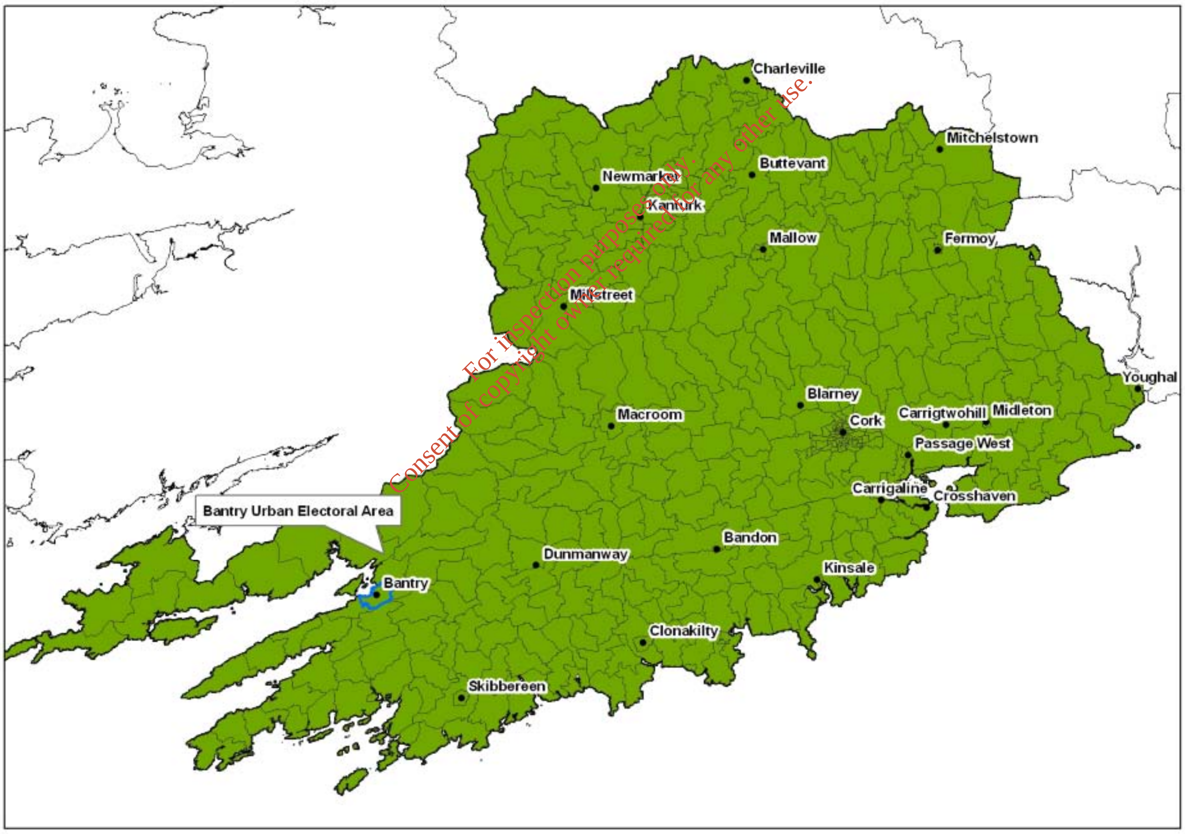


Figure 12.1 Cork Electoral Division Areas

Baseline information with respect to the demographic and employment characteristics of the resident population within the catchment area was sourced from Census of Population 2006 and 2011 (where available). The data included information on population, structure, age profile, household size, number of persons at work and unemployment profile. Table 12.1 and Table 12.2 outline the population changes since the 2002 census.

Table 12.1 Population Figures

	2002	2006	2011
State	3,917,203	4,239,848	4,588,252
Cork (County and City)	447,829	481,295	518,128
Cork City	123,062	119,418	118,912
Bantry Urban ED	3,150	3,307	3,348

Source: Census of Population 2002, 2006 and 2011

Table 12.2 Growth Rate of Population Figures (%)

	2002-2006	2006-2011	2002-2011
State	8.24	8.22	17.13
Cork (County and City)	7.47	7.65	15.70
Cork City	-2.96	-0.42	-3.37
Bantry Urban ED	4.98	1.24	6.29

Source: Census of Population 2002, 2006 and 2011

The census data indicates that the State and County Cork are showing much higher rates of growth than within the Bantry Urban ED. The census data shows that the population within Bantry Urban ED has grow at a slower rate in more recent years (2006-2011) than in previous years (2002-2006).

Age Profile

Table 12.3 below outlines the age profile of the population in terms of dependent age cohorts (0-14 and 65+) and working age cohorts (15-64) based on 2011 census data. The actual age cohorts of the population are then outlined in Table 12.4. The age structure is important to examine as this will have implications for housing demand, schools and health care services. This assessment indicates a much higher proportion of dependents (0-14 and 65+) living within the Bantry Urban ED in comparison to both the wider County Cork and the State. There is a lower percentage of independents (15-64) living within the Bantry Urban ED in comparison to the State and County Cork which has a relatively high % of independents. The population of people falling into childbearing years is also much lower than the State and county Cork.

Table 12.3 Population Demographics

Area	0-14 and 65+ years	15-64 years	15-44 years
State	33.0%	67.0%	44.3%
Cork County	34.1%	65.9%	42.7%
Cork City	29.7%	70.3%	47.4%
Bantry Urban ED	37.6%	62.4%	37.5%

Source: Census of Population 2011

Table 12.4 Age Cohorts

Area	0-14 years	15-24 years	25-44 years	45-64 years	65+ years
State	21.3%	12.6%	31.6%	22.7%	11.7%
Cork County	23.0%	11.4%	31.3%	23.2%	11.1%
Cork City	14.7%	16.8%	30.6%	22.9%	15.1%
Bantry Urban ED	18.5%	10.8%	26.7%	24.9%	19.1%

Source: Census of Population 2011

Table 12.4 provides a clear indication that the Bantry Urban ED has a higher proportion of people aged 65+ compared to the national average or the County Cork average. The population of 0-14 year olds is slightly lower than the national average and County Cork average. Therefore with a significantly lower population of people of childbearing age, this cohort is likely to have decreased over time. In addition the population of 15-24 year olds and 25-44 year olds is slightly lower than the national and county averages, while the 45-64 year age group is slightly higher than the national and county averages. This suggests that Bantry has an ageing population.

12.2 Employment

12.2.1 Receiving Environment

ESRI Quarterly Economic Commentary (Winter 2011/Spring 2012)

The Economic and Social Research Institute (ESRI) prepares an economic commentary for each quarter of the year and the most recent publication is from winter 2011/spring 2012.

The Quarterly Economic Commentary analyses current economic trends and provides macro economic forecasts for the current and following year. This report is extremely useful in comparing the national trends from previous census data to the current situation which is likely to have changed dramatically.

The ESRI Quarterly Economic Commentary for Winter 2011/Spring 2012 addresses some key issues concerning Ireland's situation.

The ESRI expects that:

1. GNP will grow by 0.1% in 2012, while GDP will grow by 0.9%.
2. GNP will grow by 1% in 2012, while GDP will grow by 2.3%.
3. Employment levels will average 1.78m in 2012, which is down 27,000 from 2011, a 1.5% fall. The rate of unemployment will average 14% for 2012.
4. For 2013, the number of people employed will average 1.76m and unemployment will average 13.7%.

These figures indicate an expected decrease in actual employment levels and an expected decrease in unemployment rates. This suggests a decrease in the actual number of people in the labour force and suggests that there is a national trend of emigration.

Trends in numbers of people at work

Economic and employment figures were sourced from the Census of Population 2006, as this section of the 2011 Census is not due for publication until late July 2012. These figures will be reviewed and amended as necessary based on the most up-to-date information when available.

Table 12.5 outlines employment figures from the 2006 census. These figures are expected to be extremely outdated and the current situation is expected to be considerably different from the 2006 baseline. Results from the 2011 census in relation to employment are not yet available; however; a general trend of higher unemployment in line with the ESRI Economic Commentary are expected to be relevant for Bantry Urban ED. Overall the figures highlight a strong local economy in 2006 with relatively low unemployment figures; however, the unemployment rate was higher than County Cork in general.

Table 12.5 Employment figures

Area	At Work	Unemployed	Total	Unemployment Rate (%)
State	1,930,042	150,084	2,080,126	7.2%
Cork County	167,092	8,646	175,738	4.9%
Cork City	48,892	5,317	54,209	9.8%
Bantry Urban ED	1389	101	1,490	6.8%

Source: Census of Population 2006

Table 12.6 outlines the principal economic status of people over the age of 15 from the 2006 census data. This provides an insight into the demographics of Bantry Urban ED in comparison to both the wider area and the state. Based on 2006 data it is evident that Bantry has a much higher population of retired people in comparison to the wider County Cork and indeed the State. In 2006 17.3% of the population within this Electoral Division were retired, while there was a smaller proportion of people at work in comparison to the State and wider County Cork. This reinforces the observation of a higher proportion within the age cohort of 65+, which suggests that Bantry is an important location for retirees. There are also evident trends in a lower proportion of people at work and students in comparison to County Cork or the state.

Table 12.6 Principal Economic Status of Persons over 15 years of age (2006)

Principal Economic Status	City	County	Bantry	State
At work	48.3%	59.0%	51.9%	57.2%
Looking for first regular job	1.1%	0.6%	0.7%	0.9%
Unemployed, having lost or given up previous job	5.3%	3.1%	3.8%	4.4%
Student	14.1%	9.9%	7.4%	10.4%
Looking after home/family	11.3%	12.7%	12.7%	11.5%
Retired	13.2%	10.7%	17.3%	11.2%
Unable to work due to permanent sickness or disability	6.4%	3.7%	5.8%	4.1%
Other	0.4%	0.3%	0.3%	0.4%

Source: Census of Population 2006

Sectoral Composition of Employment

In 2006, the key sectoral employment areas for people at work within the Bantry Urban ED were professional workers (17.1%) and services workers (15.7%). There are significant contrasts between the biggest employment sectors for male and female workers as construction was by far the biggest sector within Bantry for male workers (25.2%) followed by manufacturing (19.6%). For female workers professional workers (23.8%) and services workers (23.8%) were the largest sectors followed by sales workers (17.9%). These results indicate that the economic downturn after the 2006 census is likely to have had a significant impact upon sectoral composition of employment. Updated figures based on the 2011 census are not yet available; therefore it is not possible to determine the level of impact caused by the change in economic conditions on Bantry. However, in line with national trends it is expected that there will have been impacts upon the level of employment and the sectoral composition of employment, particularly in relation to construction and manufacturing.

12.2.2 Community Aspects

Resident Community

Census data indicates that Bantry Urban ED has a relatively stable resident population as growth has been quite limited in comparison to other areas of the State. A growth rate of 6.29% for Bantry between 2002 and 2011 is notably lower than the observed growth of 17.13% for the State and 15.7% for County Cork over the same period. This suggests that Bantry has not experienced the extremely rapid expansion observed in other areas of Ireland. In addition it is clear that the area has a higher proportion of people in the 65+ age cohort with a lower proportion of people in the cohorts younger than 44, when compared to the national statistics.

Visiting Community

There are high numbers of visitors to the Bantry area, with tourism becoming an important aspect to the local economy over the past number of years. This is highlighted through the large proportion of people working in the services sector.

Amenity and Tourist facilities

Bantry is a historic town with claims made that the first people to come to Ireland landed near the town. The area is has a number of sites of historical and archaeological interest from wedge tombs to those of more recent origin.

Bantry offers a range of sporting and recreational activities including horseriding & trekking, golfing, swimming, sailing and yachting, GAA, soccer, rugby, shore angling and lake fishing. Within two miles of the town can be found the championship 18 hole Bantry Bay Golf Club and Bantry Bay Sailing Club where the Harbour Commissioners have made available 12 moorings for visiting yachts. There are also various scenic walks and designated cycle routes. Some of the major tourist and visitor attractions are outlined below.

Bantry House and Gardens is an important tourist attraction in the area (Figure 12.2), with an estimated 37,000 people visiting between March to October 2006. The house was originally built in 1690, and purchased by Richard White in 1739. The first Earl of Bantry, Richard White (1797-1851) received his title for the part he played in defending against the invasion of the French Armada in 1796. The House has a collection of tapestries, furniture and art treasures which the 2nd Earl of Bantry mainly collected during his travels through Europe in the 1800s. Since 1946 the house containing its important collection has been open to the public. The Gardens have been restored and are home to sub-tropical plants and shrubs. The house is also the venue for the annual West Cork Chamber Music Festival.

**Figure 12.2 Bantry House and Gardens
(Photo – visitcountycork.com)**

Bantry Bay Golf Club is a popular 18 hole course a short distance from Bantry town, with spectacular views and fourteen holes overlooking the bay (Figure 12.3). It is popular with both local residents and visiting populations.

Figure 12.3 Bantry House and Gardens
(Photo - Bantry.ie)

Bantry Bay Sailing Club is situated on the Abbey Road. Facilities include storage, shower and toilet facilities, navtext, phone, waste bin and water. With over 70 motorboat and sail members, it has approximately 50 moorings which can only be accessed by boat. Up to 75 boats visit the Club annually.

Bantry Rowing Club has been in existence for over 40 years. In that time regattas have been held in the inner harbour, using traditional West Cork gigs and yawls. However, the regatta course has been seriously impeded by the proliferation of moorings in the vicinity of the Abbey Point, causing the races to be moved out to rougher water. The numbers of crews participating in regattas has increased and the Bantry Club though there is a shortage of slipping, launching and shore facilities.

A heritage trail has been produced by Bantry Tourism Association which follows some of the historical developments in Bantry and the surrounding areas. A series of Information boards tells the story of the town of Bantry, of its development and of its buildings (Figure 12.4). The boards, which are located at various points in the town, contain many photographs and explanatory text which help to bring the history of Bantry alive. The Trail can be followed in 2 or more stages. The first stage takes you on a leisurely stroll around the town, through some of the laneways and smaller streets, and ends at Wolfe Tone Square. The first part can be finished here and continue another day or, you can continue on the footpath along by the old cobblestone quays to the pier. You then pass the entrance to Bantry House, which can be visited another day, and arrive at the garden area near the Abbey Cemetery where the final information board is displayed, a distance of 1.3km.

Figure 12.4 Bantry Heritage Trail – Information Board
(Photo - Bantry.ie)

Bantry Museum is situated near the fire station on Wolfe Tone Square in the town. The museum consists of a collection built up by the local historical society. Among the exhibits are furniture, kitchen utensils and other pieces from domestic life. Newspapers record mundane events and trivia from Bantry's past. The curators entertain visitors with a mix of historical facts and folklore. Bantry was once used as a port by the British Royal Navy and Spanish fishing vessels. There is information about the failed French armada of 1796 that accompanied Irish patriot Wolfe Tone. The museum is run by the Bantry Historical Society.

There are many additional amenities and attractions in the wider West Cork area that draw visitors to stay in Bantry and the surrounding areas. This includes Mizen Head & Mizen Head Visitor Centre which is located at the most south westerly point of Ireland.

Whiddy Island is located just off the mainland and offers many interesting historical remains including the ancient Church and Graveyard of Kilmore, Reenavanig Castle the first residence of the White family, locations of 'Fish Palaces' when the fishing industry was booming during the 18th Century and three gun batteries which were some of the O'Sullivan Beres fortifications. The site of the First Wold War American Sea Plan base is still visible. From May to September a regular ferry operates from Bantry Pier to the island.

Beaches

The nearest long stretches of golden or silvery sandy beaches are a 40 minute drive from Bantry. However, there are numerous small secluded local beaches which are not readily accessible and as such are under utilised as an amenity for the local population or visitors to the area.

Shoreline enhancement has been proposed for one of these small secluded beaches as part of the proposals for this project. This would make use of uncontaminated sediment dredged from the harbour, which would enhance the amenity of a nearby secluded beach known as the Cove (Figure 12.5). The Cove site to the north of Bantry has significant potential to be enhanced, which could be accessed by Beicin Strand, a narrow linear beach around 700metres in length with a walkway that connects to the harbour.

Figure 12.5 Cove site

Beicin Stand itself has not been proposed for enhancement due to the significant costs and works that would be required to maintain the beach material, as it is relatively exposed to wave action. Enhancement of the cove site would provide a publically accessible beach for use by residents and visitors which would provide a significant boost to tourism in the area.

An alternative scheme is one of land reclamation along the frontage at Abbey to the west of Bantry. This land reclamation scheme would involve placing the granular dredged material behind an armoured bund to provide a reclaimed area on the foreshore to the west of the harbour. The area would then be available for winter storage and repairs to boats. Figure 12.6 outlines the locations of these two sites in relation to Bantry harbour.

Figure 12.6 Locations proposed for shoreline enhancement

Restaurants, Pubs & Shops

Bantry's central location provides easy access to a very large catchment area that takes in a large part of West Cork, including the main peninsulas, the coastal towns along the N71 from Cork to Killarney and the Lee Valley to Macroom. The town benefits from a very diverse mix of manufacturing, service and retail businesses providing a well established local economy.

The Bantry Business Association has been established for over 15 years and represents over 100 family and independently owned businesses and is leading the expansion of commercial activity in the area. The Association is a very powerful lobbying group at regional, County and National levels tackling the promotion of current commercial activity as well as the development of new businesses in Bantry. In addition to the very large influx of tourists during the summer season, Bantry remains a thriving market town throughout the year and includes the farmers markets, festivals, sporting events. The town offers a very diverse mix or retail, service and manufacturing activity, meeting the requirements of the local communities and visitors alike. Bantry has numerous high quality and competitively priced restaurants, bars, boutiques, jewellers and shops that stock up-market and well-known brands.

Accommodation

There is a great deal of accommodation available within Bantry with a number of large hotels including the Bantry Bay Hotel and Westlodge Hotel which between them offer over 100 guestrooms. The Maritime Hotel has also recently been completed and offers 112 guestrooms. There are also a wide range of Bed and Breakfast establishments in the area.

Existing harbours

There are four main industries active within the Port of Bantry: Aquaculture; Oil Transhipment; Stone Export; and Tourism. The majority of ships calling at the port are bulk cargo and tankers. A number of cruise liners anchor either off Glengarriff or in Bantry Inner Harbour. The harbour is an amenity for both local residents and the visiting community; however, the harbour lacks adequate depth to be fully utilised by all vessels that could potentially make use of the berthing facilities.

Figure 12.7 Inner Harbour with the tide in

Photo - Raymond Burke Consulting)

Figure 12.8 The Inner Harbour with the tide out Photo - Raymond Burke Consulting)

Tourism figures

The importance of tourism and employment is highlighted within the Cork County Development Plan 2009, which states that Bantry is a District Employment Centre for a large hinterland and a principal tourist attraction hub.

It is not possible to determine visitor numbers at the Electoral Division level, however, Fáilte Ireland have prepared tourism figures for the South West region, which can be illustrate the trends in tourism within the region. Tourism figures from 2009 show that there were 3.3 million tourist visits to the South West region, generating €1 billion in revenue. 1.5 million of these were overseas visitors, generating €628 in revenue. Preliminary figures are available for 2010 which indicate a very slight decrease in the number of overseas visitors between 2009 and 2010. This mirrors the national trend of a reduction in the number of overseas visitors since 2006 and 2007 as a result of worldwide economic trends.

However, there are a number of issues limiting the potential for additional tourist visits, or limiting the stay for tourist visits. According to a report entitled "The Economic Case for Dredging the Inner Harbour at Bantry Bay" prepared by Ray Burke Consulting (2006) anecdotal evidence suggests that the condition of the inner harbour and associated smell when the tide goes out are off-putting for tourists and visitors.

12.3 Potential Impacts of the proposal

There are a range of potential impacts that may arise as a result of the proposals for Bantry Harbour, including both temporary impacts as a result of the construction phase and long-term impacts from the development.

12.3.1 Construction Phase

The main adverse impacts upon human beings as a result of the proposals are likely to be as a result of the construction phase. The works within the harbour area as well as transport of materials to and from the site has the potential to impact upon the resident population as well as disturbing tourists visiting the area.

The key negative impacts include:

- Increase in HGV traffic in the area;
- Increase in noise and dust generated as a result of the construction works;
- Temporary restrictions in access and use of the harbour area;
- Widening and improvements to the fishing pier will negate the use of the pier for a significant period.

However, there are also likely to be some short-term positive impacts for the area, including:

- Increase in employment in construction and related industry;
- Increase in revenue for services sector as a result of spending by construction workers.

Although there will be some temporary impacts upon the resident population and tourists visiting the area, these impacts will be limited to a short time period. The construction phase is considered to only have a moderate short-term impact on the residential and working communities in the area.

The potential impacts associated with dust and noise during the construction phase of this development are described in detail in Chapters 5 and 6 respectively of this EIS. Appropriate mitigation measures are also presented within these Chapters.

Alternative arrangements will need to be put in place to deal with the issue of the harbour and pier not being available. Completion of the reclamation area adjacent to the pier could provide a temporary facility (before placement of pontoons) subject to suitable harbour management.

12.3.2 Operational Phase

The operation of the harbour following construction is not likely to present any significant adverse impacts upon human beings in the area. As a result the only likely impacts are long-term positive impacts for the area.

Potential positive impacts include:

- Support employment within the fishing and shellfish aquaculture in the area;
- Support the development of further water-based tourist activities, which make use of the harbour;
- Increase the range of vessels which can make use of the harbour;
- Increased trade within local shops, pubs and restaurants from employees at the harbour and visitors to the area;
- Potentially increase visitor numbers to the area as a result of the shoreline enhancement at the Cove site, or provide a valuable area for winter boat storage at the Abbey site (depending on the option taken);
- Improve the visual amenity and reduce complaints in relation to odour during times of low tide at the harbour;

These impacts would potentially be beneficial to a wide range of people including the residential, working and visiting communities.

In addition the development of the harbour has the potential to support increases in tourist numbers in general, as the development of marinas and harbours often creates a tourist attraction in itself. This has been the case with other harbour and marina developments such as Bangor, Co. Down, which is the biggest marina in Northern Ireland (Figure 12.9). It is now the setting for a variety of major sailing and tourist events each year. All the marina facilities are open 24 hours a day 365 days a year and along with over 400 resident customers, the marina welcomes around 1500 visiting boats each year. It is likely that a much more visually attractive and accessible harbour will make the area much more appealing to visitors, who may travel specifically to see the marina.

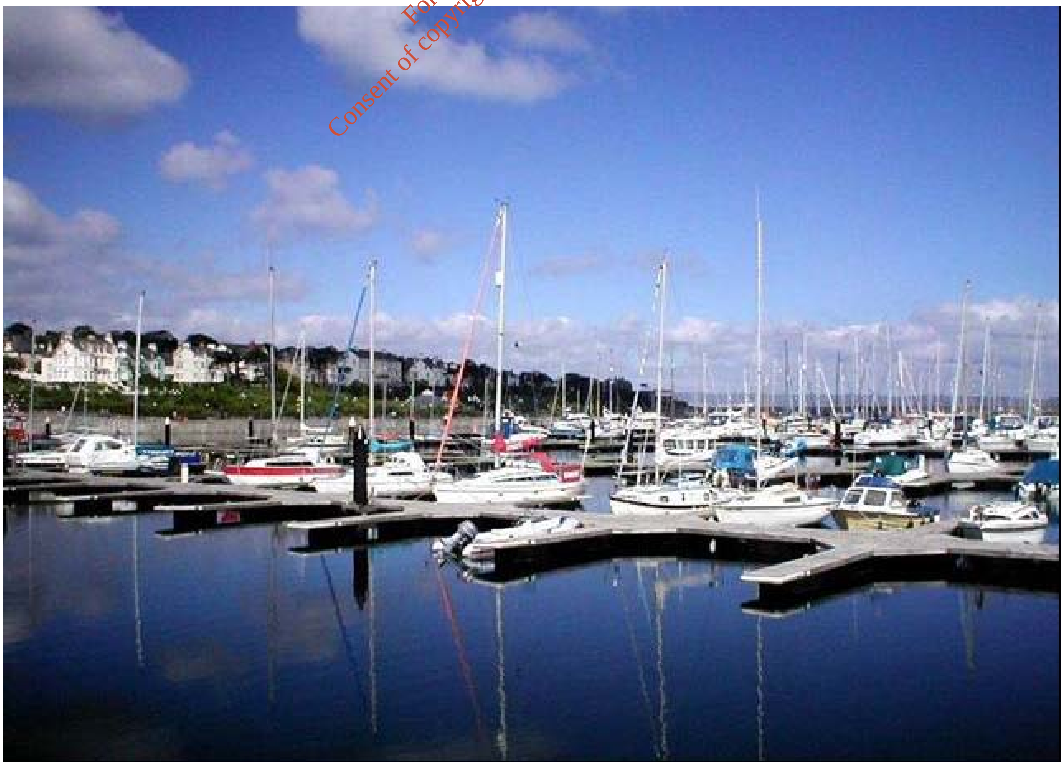


Figure 12.9 Bangor Marina – tourist attraction in itself

12.3.3 Mitigation Measures

Mitigation measures will be required for during the construction phase, particularly in relation to alternative arrangement as a result of restricting access for vessels to the harbour and pier. It may be possible to make use of a temporary facility in the reclamation area adjacent to the pier (before placement of pontoons) subject to suitable harbour management. Mitigation measures in relation to dust and noise are dealt with in Chapters 5 and 6 of this EIS.

No significant impacts upon human beings are expected as a result of the operation of the harbour once works are completed. The improved harbour will be a valuable asset to the local and regional economy. Therefore no mitigation measures are proposed for the operational phase, as no adverse impacts are expected on the residential, working and visiting communities from the operation of the harbour.

13.0 ROADS AND TRAFFIC

13.1 Introduction

This Chapter of the EIS assesses the impact of the proposed development on roads and traffic in Bantry and the surrounding hinterland.

13.2 Existing Situation

Bantry is a rural town located approximately 90 km west of Cork City. It is located along the N71 National Secondary Route from Cork to Killarney. Figure 13.1 shows the location of Bantry in a regional context.

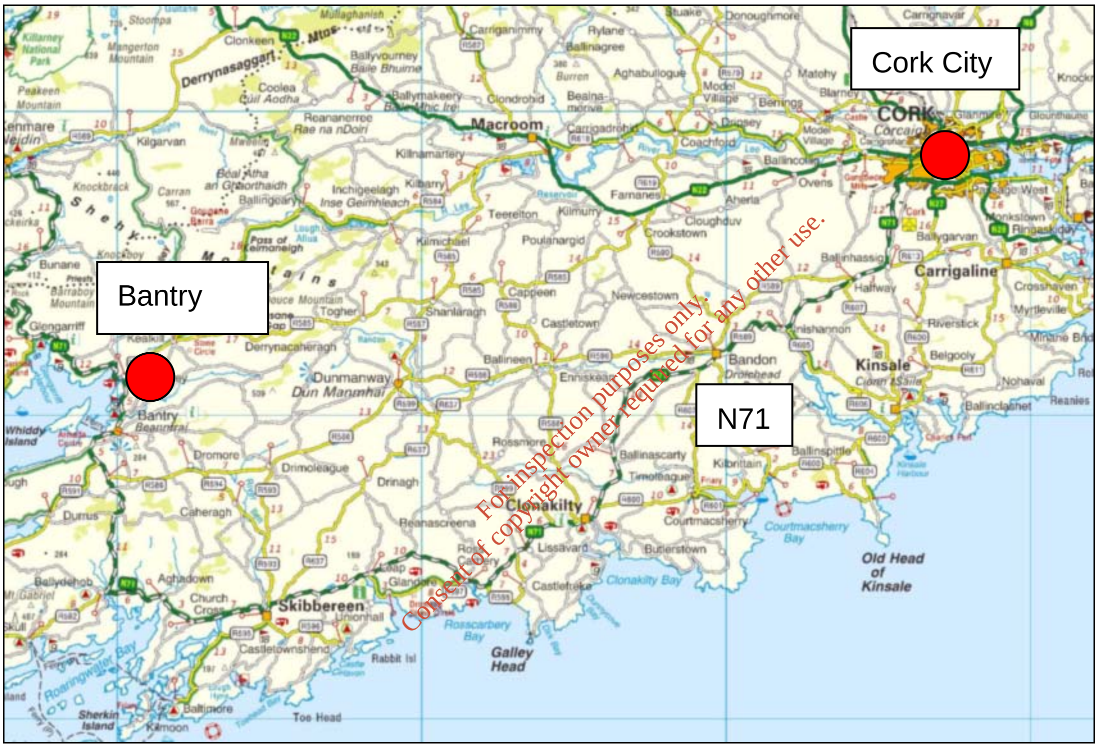


Figure 13.1 Location of Bantry in Regional Context

Cork County Development Plan 2009

Bantry is classified within the 2009 Cork County Development Plan as a ‘county town’. Within the development plan, the objective for Bantry is set out as thus:

- **Objective SET 3-15:** It is an objective of this plan to develop Bantry as a significant District Employment Centre, an important centre of population with potential for enhanced employment and transport links for future tourism, marine and port related activity and protect its natural and built heritage so as to protect and improve quality of life. It is important that the objectives contained in the Marine Leisure Infrastructure Strategy for West Cork are implemented.

- **Objective RCI 16-5:** Marine Leisure – It is an objective to support the development of rural Cork's inland and coastal marine leisure facilities, where this is compatible with the long-term well-being of the environment and local livelihood.

The County Development Plan goes on to state that 'Bantry will need to provide employment opportunities to sustain the future population growth planned not only for the town but also for much of the rural hinterland. Key sectors will be tourism, artisan foods, marine fishing, aquaculture and services."

The Development Plan indicates that Bantry has a population of 3,309 in 2006, with this targeted for increase to 5,484 by 2020.

The Development Plan further states that 'Bantry is a small urban centre serving a large rural hinterland, with marine related industry and services and tourism functions, with an attractive setting and town centre. There are potential town centre redevelopment opportunities, subject to land assembly."

With regard to transport and infrastructure, the development plan states that:

- **Objective INF 4-2(b):** It is an objective to improve port and harbour infrastructure in the County and to safeguard lands in the vicinity of the ports and harbours against inappropriate uses that could compromise the long-term economic potential (including access) of the port or harbour.

Bantry Electoral Area Local Area Plan (Interim Version, August 2011)

The Blarney Electoral Area LAP is designed to provide a suitable framework for the proper planning and development of the Blarney Electoral Area, in accordance with the governing guidelines set out in the County Development Plan. The main objectives of the LAP are:

- Encourage balanced population growth so that the main towns can achieve their full economic potential.
- Develop Bantry as an important centre of population, employment, services, marine and tourist facilities.
- Develop Castletownbere's employment function with a particular focus on fishing and marine and tourism related activities.
- Develop Schull as a Principal Tourist Attraction incorporating marine and tourism related attractions.
- Capitalise on the attractive landscape setting of the Bantry Electoral Area, in particular the hills, lakes and coastal landscapes.
- Development in villages and rural areas will complement the planned growth in the towns at a scale that respects the setting and character of each village.

It is clear that the Electoral Area LAP and the Cork County Development Plan both seek to promote the proper development of Bantry, with particular emphasis on developments that enhance the existing tourism appeal of the town.

Cork Marine Leisure Infrastructure Strategy

The Cork Marine Leisure Infrastructure Strategy, at it's heart, has the overall vision that 'Marine Leisure in West Cork is developed in a coherent and sustainable manner making the best use of existing and planned infrastructure and resources'.

There are a number of key objectives that the plan sets out in order to achieve this goal:

- The rejuvenation of existing facilities
- The creation of opportunities for new development
- The promotion of the marine leisure product in West Cork

It is envisaged that these objectives within the strategy by way of the following key action:

- The **clustering** of development around primary, secondary and tertiary hubs. Primary hubs include Baltimore, Schull, Bantry and Castletownbere.

Bantry Town Centre & Existing Inner Harbour Location

Bantry itself, at its' centre, consists of a gyratory loop of the N71, with an associated one-way system around the town centre, known as Wolfe Tone Square, as shown in Figure 13.2 below. The existing Inner Harbour is accessed via Harbour View, located directly off the N71, at the north-western extreme of the gyratory. The remaining roads in the vicinity of the town centre are a combination of local roads and residential access roads.

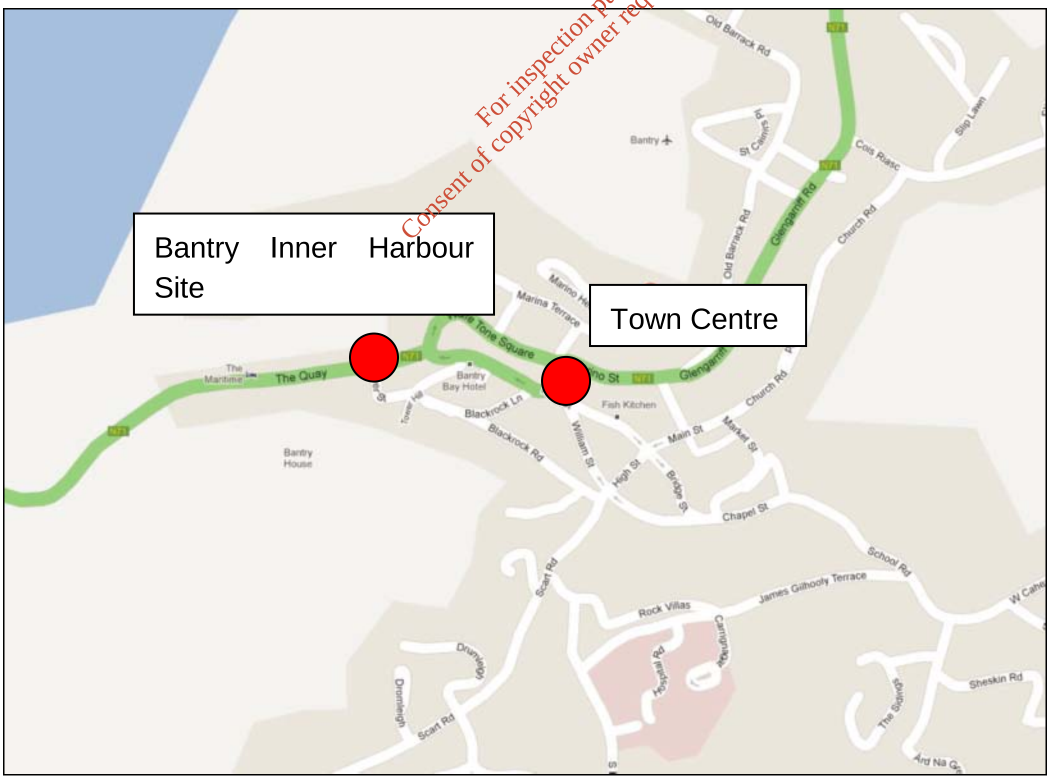


Figure 13.2 Bantry Town Centre and Inner Harbour Site

Existing Town Centre Layout

The existing gyratory system around Wolfe Tone Square operates in a similar manner to a conventional roundabout, although in some locations circulating arms must yield to entering arms, in order to maintain the priority of the N71 route through the town centre. There are traffic signals provided at a number of locations, but these are primarily for pedestrian crossings and are generally infrequent in terms of stopping circulating traffic.

Figure 13.3 below shows the layout of the western end if Wolfe Tone Square, showing the N71 entering the gyratory and the access off to Harbour View Road. Figures 13.4 and 13.5 below show the junction off to Harbour View Road from the existing gyratory.

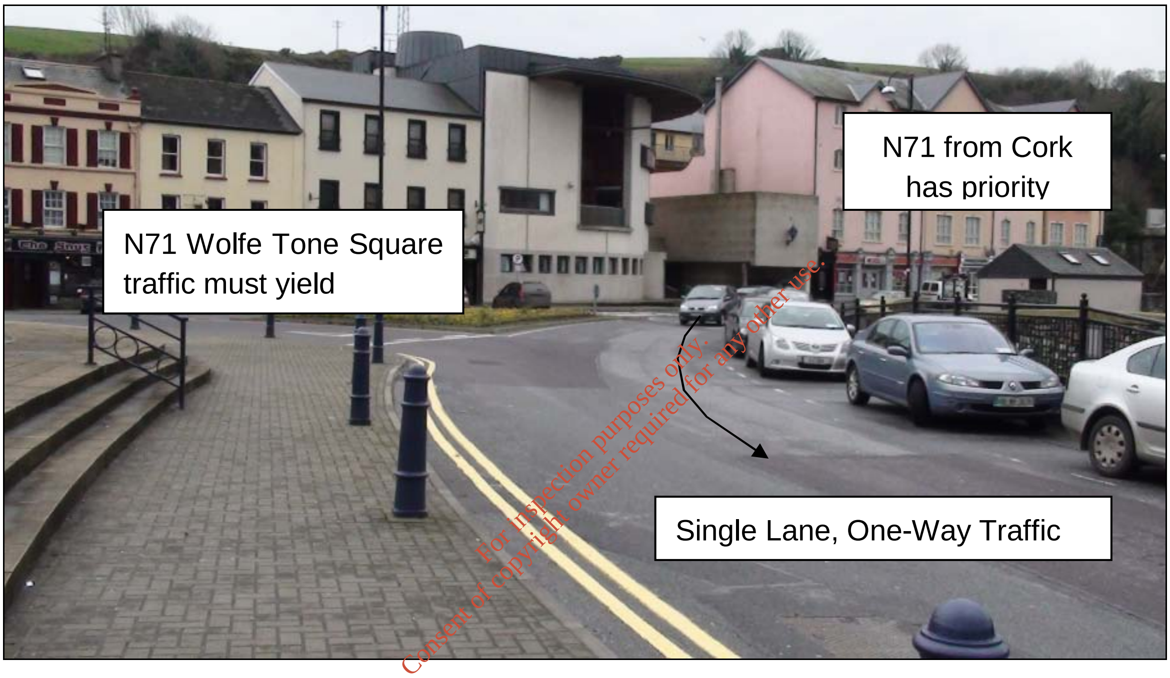


Figure 13.3 **Entry to Wolfe Tone Square from N71 Cork approach**

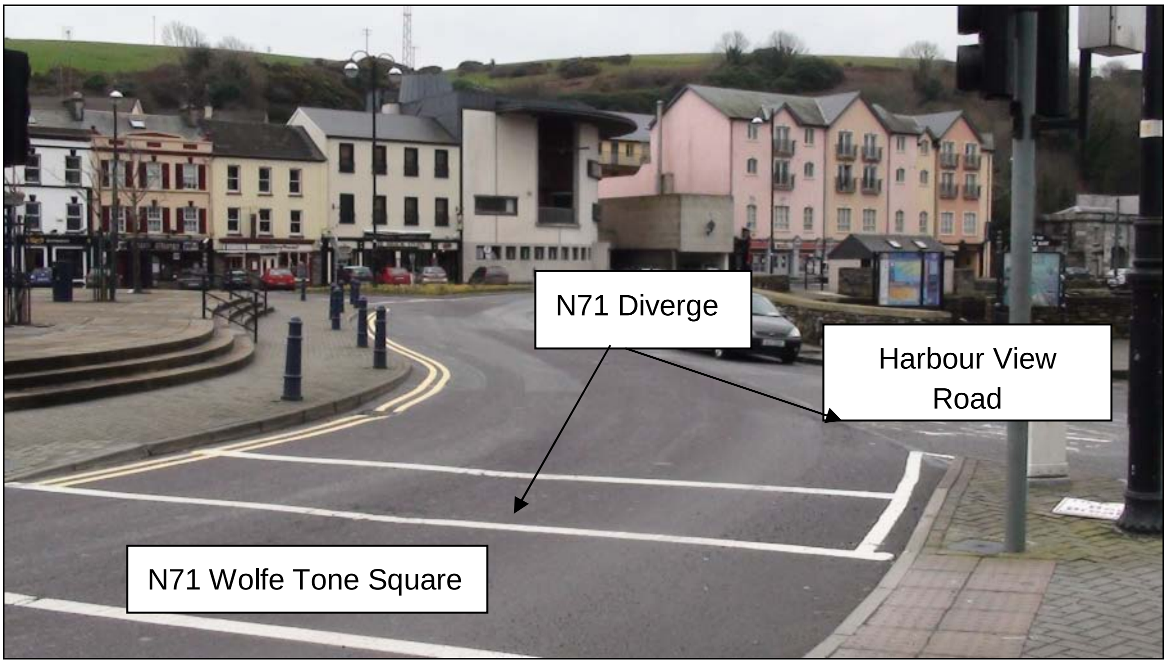


Figure 13.4 **Wolfe Tone Square & Harbour View Road Junction**

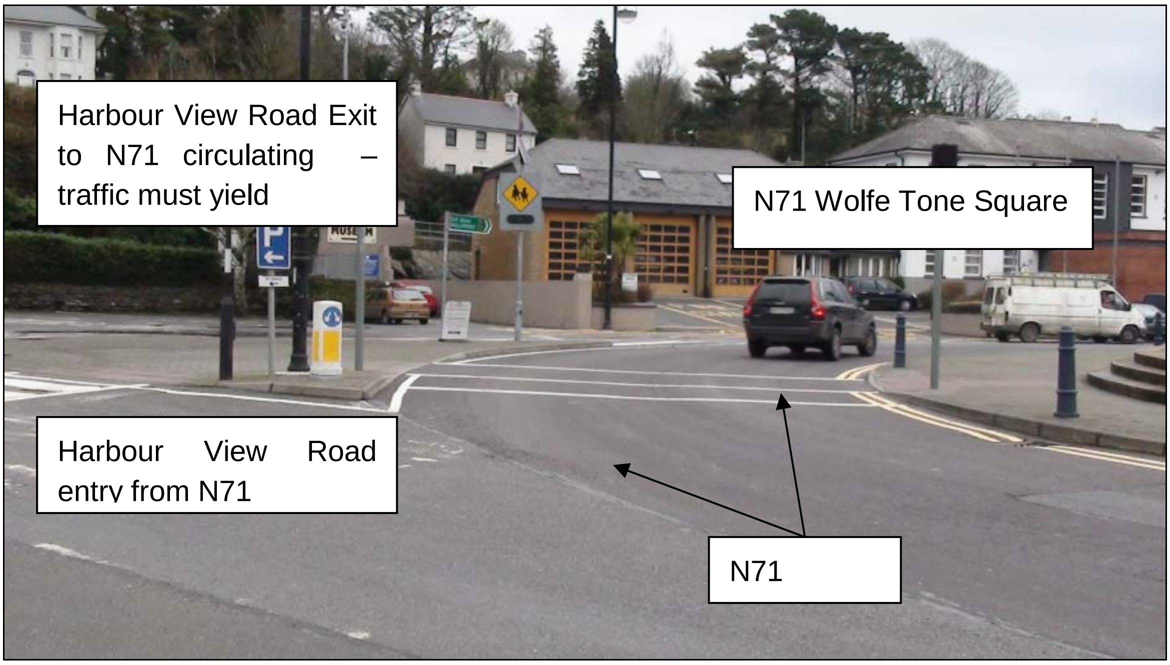


Figure 13.5 Wolfe Tone Square & Harbour View Road Junction

There is substantial parking both on-street and off-street within the town centre core area. Circulating the main town centre gyratory, there is on-street parking perpendicular to the entire main town centre island, while there are various parallel and perpendicular parking locations on the opposite sides of the gyratory. There are also some off-street parking areas, for example between the N71 entry to the town centre and the exit of Harbour View road there is an off-street car park, which houses approximately 70 parking spaces. There is an additional Public Car Park further along Harbour View road also. Figure 13.6 shows the off-street car parking located in the vicinity of the site.

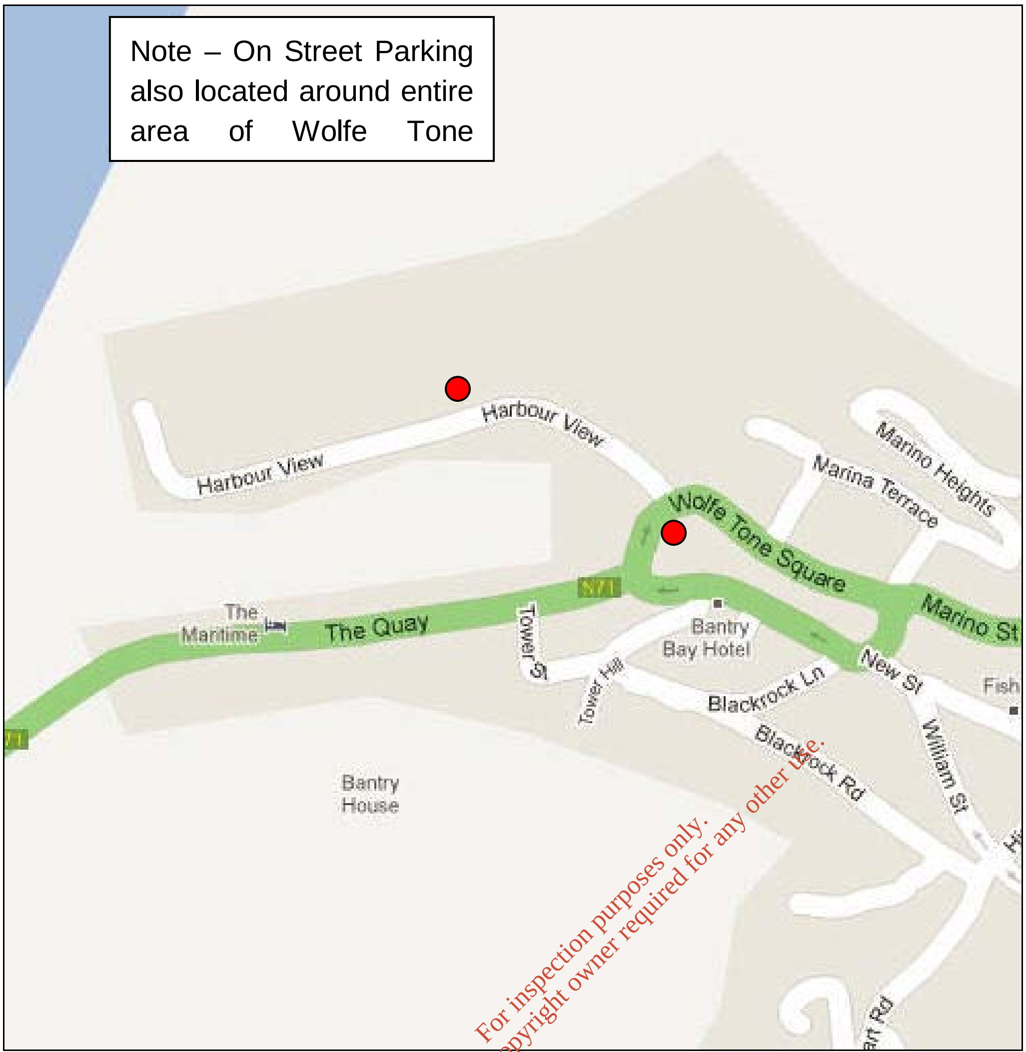


Figure 13.6 Car Parking in the vicinity of site

There are ancillary streets located around Wolfe Tone Square, such as Main Street, High Street, New Street, William Street and Blackrock Road, which all are typified by narrow on-street width, and on-street parking. In addition, there are sections of the N71 leaving Wolfe Tone Square, along Marino Street and Glengariff Road, which have reduced road width and on-street parking.

Existing Traffic Conditions

A preliminary site visit was undertaken on Tuesday January 31st 2012, in order to carry out traffic check-counts and to observe traffic conditions within the town centre. During the site visit, which was for the entire duration of the day, it was noted that Wolfe Tone Square was heavily occupied with vehicular parking for the entire day. The ancillary streets such as New Street, Main Street, etc. were also all seen to be heavily occupied with parked cars. On-street car parking appears to be a preference, as a number of the off-street car parks were not seen to have the same levels of occupancy throughout the day.

Traffic circulation around the town centre was seen to be mostly quite efficient, with little or no congestion observed around Wolfe Tone Square throughout the day. The presence of vehicles continuously manoeuvring into and out of parking spaces around Wolfe Tone Square helps to slow vehicle speeds, and traffic flow was seen to be easily accommodated within Wolfe Tone Square. There were also a number of HGV vehicles and large Coaches observed throughout the day passing through the town centre.

The majority of the route around Wolfe Tone Square is 2-lane carriageway, with the exceptions of the sections at either extremity of the gyratory, where there are single-lane carriageway alignments.

A second site visit was undertaken on Saturday February 18th 2012 to observe weekend traffic flows and to undertake traffic surveys in the vicinity of the site.

Harbour View Road

During the site visit, Harbour View Road was seen to experience little or no traffic flow throughout the day. There are a number of properties along Harbour View Road; however the majority of the route to the existing pier head is unoccupied or occupied with some large developments. A fuel depot is located along Harbour View Road, with a small number of fuel delivery vehicles observed. On-street parking was seen to occur in the vicinity of the junction with the N71 only; the remainder of Harbour View Road was seen to be unoccupied with car parking.

Approximately 300 metres from the junction of Harbour View with the N71, a large off-street car park was noted. However, throughout the entire day of the site visit, this car park was completely unoccupied. A small number of large coaches were seen parked along Harbour View during the site visit, however there were typically no more than 2-3 seen during the day.

At the existing pier head, a small number of cars were seen to park on the pier head during the day, with pedestrians then using the existing walkway along the strand between the Inner Harbour and the further-north Cove Strand. No more than 4-5 vehicles were seen parking at the existing pier during the day.

As outlined above, there is a further off-street car park located off the N71 gyratory, between the entry to the town centre from Cork and the next exit to Harbour View Road. This car park was noted to contain 69 spaces, and throughout the day was occupied to approximately 50% of capacity, with approximately 30 vehicles observed. This car park is accessed directly from the N71 gyratory, but can only be exited at the rear of the car park, onto Harbour View Road.

NRA Traffic Counter Flow Data

As Bantry is a coastal town with strong tourism trends, traffic flow patterns are subject to change during the typical year, with an increase in traffic during the summer months to be expected. The National Roads Authority operated a traffic counter on the N71, approximately 3km north of Bantry, at Ballylickey. This counter was discontinued in 2003, and the only available data covering a typical year was for the year 2002. A renewal and replacement program for traffic counters on the national road network is due to be undertaken in Summer 2012, which will include the replacement of the currently discontinued traffic counter.

Interrogation of the data for 2002 on the N71 shows a number of traffic patterns. The traffic counter recorded all daily movements over a given year, and this data would then be used to give an indication of average daily traffic flows. The Annual Average Daily Traffic (AADT) data for the year shows that AADT levels are at their lowest in the winter months, with January being the lowest, with an average two-way AADT of approximately 3,800 vehicles. During the summer months, as expected, traffic flows are seen to substantially increase on the N71, with August recording the highest two-way average AADT, of approximately 6,500 vehicles. Thus between the winter trough and summer peak of traffic flows, there is an increase of approximately 70%.

Over the entire year of data for 2002, the average AADT from the recorded traffic counts is ~5,000 vehicles, with a deviation of approximately 25-30% from this average to both the recorded minimum and maximum AADT values.

Figure 13.7 below shows AADT monthly averages for the year 2002 along the N71 in the vicinity of Bantry town.

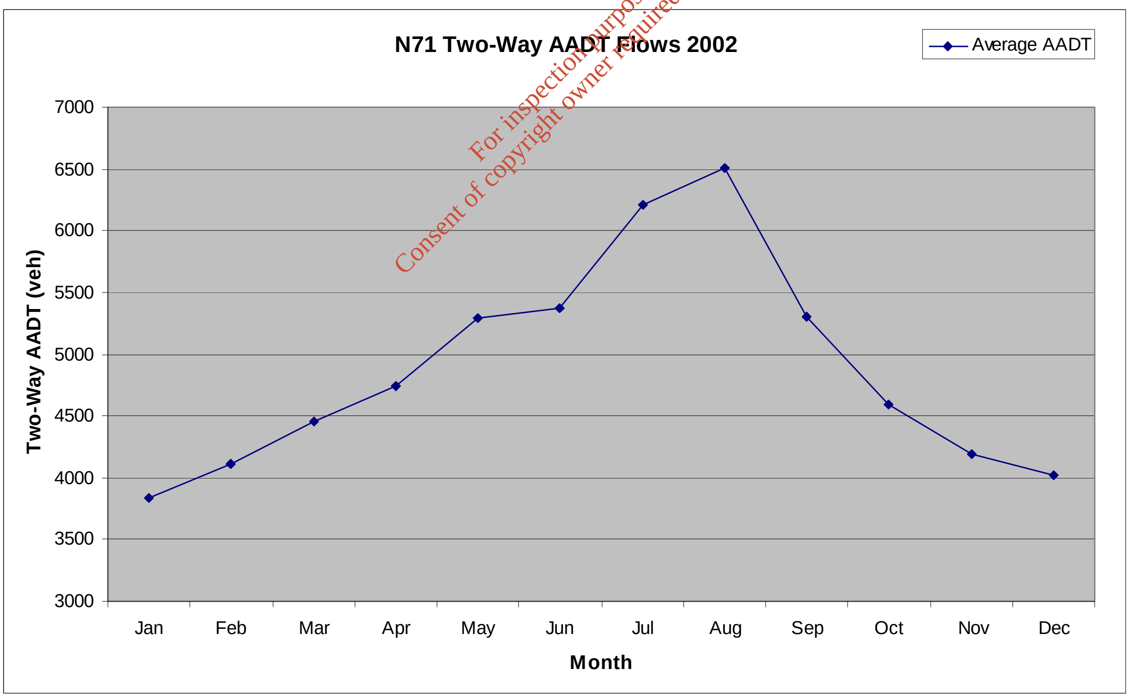


Figure 13.7 N71 Monthly AADT Averages for 2002

A further trend in traffic patterns evident from the NRA counter data for 2002 is the split of AADT traffic in either direction. The data showed that over the entire years' worth of counted data (a total of 340 days of traffic data), the traffic flows were evenly split in both directions.

Figure 13.8 below shows the directional AADT traffic flows for 2002, and clearly shows the even balance between both directions.

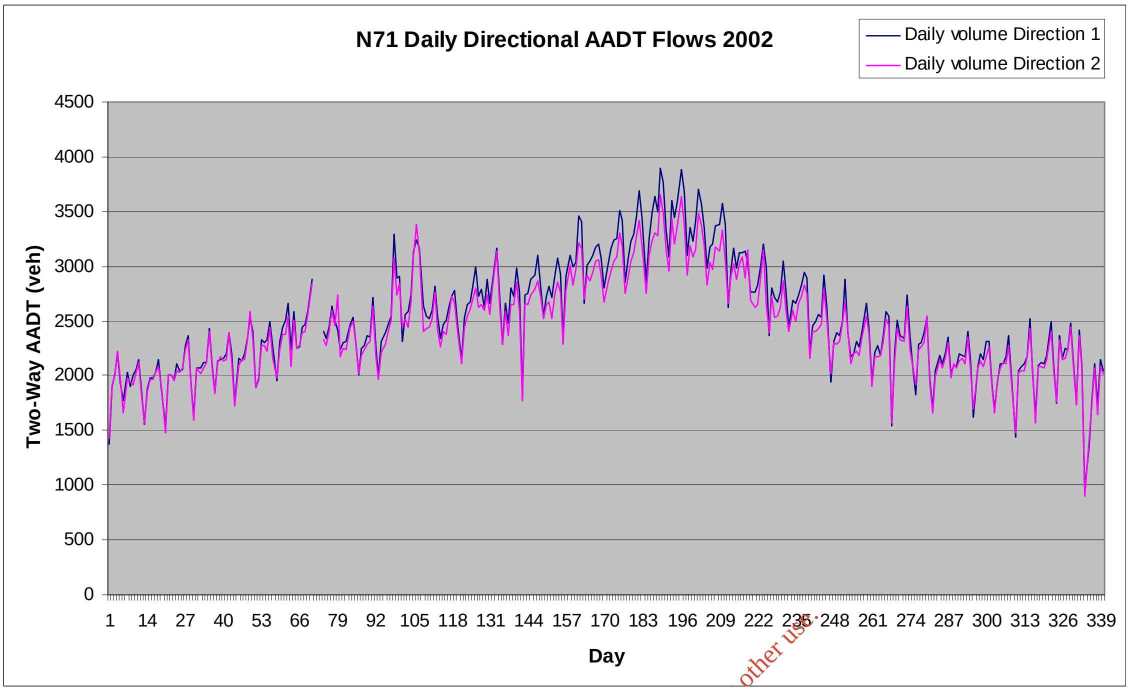


Figure 13.8 N71 Daily AADT Directional Flows for 2002

Whilst traffic flows from 2002 are not particularly reliable as a barometer for current traffic flows given their historical age, they are nevertheless crucial in identifying summer traffic growth trends and for quantifying the directional split in AADT traffic on the N71.

National Roads and Traffic Flow Reports – 2000 to 2004

From 2000 to 2004 the National Roads Authority published a series of annual reports on traffic flows recorded on National Roads, based on a combination of traffic counts and expansion assumptions. At this time, there were approximately 1,000 locations which were subjected to traffic counts.

Approximately 1/3 of the 1,000 locations were subjected to annual counts, over a 7-hour period, which was then factored up to give an AADT estimate, using appropriate growth rates. This was undertaken in rotation; using this rotation approach a junction would be counted once every four years. The interim years were subjected to growth rates derived from the NRA Future Traffic Forecast growth rates. A count was undertaken in Bantry in 2000 and 2004, and the years 2001, 2002 and 2003 were estimated using NRA growth rates.

In 2000, the AADT in Bantry was estimated to be 8,145 vehicles, based on a traffic count on-site. In 2001, this was factored to 8,643 vehicles. In 2002, this was increased to 8,981 vehicles using NRA growth rates. In 2003, the estimate was increased to 9,856 vehicles. Finally, in 2004 a new count was undertaken, and the AADT was estimated to be 7,793 vehicles from the on-site count.

Therefore, the traffic growth estimated from 2000 to 2003 using NRA growth rates was approximately 21%, from 8,145 to 9,856 vehicles. However, a revised traffic count in 2004 shows an AADT estimate of 7,793 vehicles, which is a representative reduction of 21%. Thus the traffic counts in 2000 and 2004 indicate no nett growth in AADT traffic flows on the N71 in Bantry. It is clear therefore, that growth normally set out in line with NRA Growth Rates may not be realised on-site.

There are no traffic surveys available from the NRA in this location since 2003, and no full years' data since 2002.

Proposed Infrastructure Upgrades

The Bantry Electoral Area LAP, which is currently at interim stage (August 2011), identifies a potential relief route to remove through traffic from the N71 Cork-Killarney route from the town centre. The plan states that the relief road is designed and CPO of lands has been finalised. However, the plan also acknowledges that in the short to medium term, this project is unlikely to obtain sufficient funding to proceed (in the next 5-10 years).

The LAP refers to the town centre of Bantry suffering from periodic traffic congestion in the compact town centre, which forms the basis for the proposal and development of the relief road within previous plans. Given that the proposal has been advanced to a significant extent, and that progression of the scheme is purely a financial matter at this time, it is reasonable to assume that there is a very strong possibility of this scheme progressing in the future. The Bantry Electoral Area LAP shows an indicative route for this relief road in its' zoning map. Figure 13.9 below shows the indicative relief road route, which proposes to route through traffic around the town to the east, before re-joining the existing N71 north of the town centre.

Despite the apparent likelihood of this scheme progressing, it has not been included within this assessment as it does not represent a committed scheme going forward, and as such the future year scenarios do not have any reductions in traffic associated with this scheme incorporated into them.

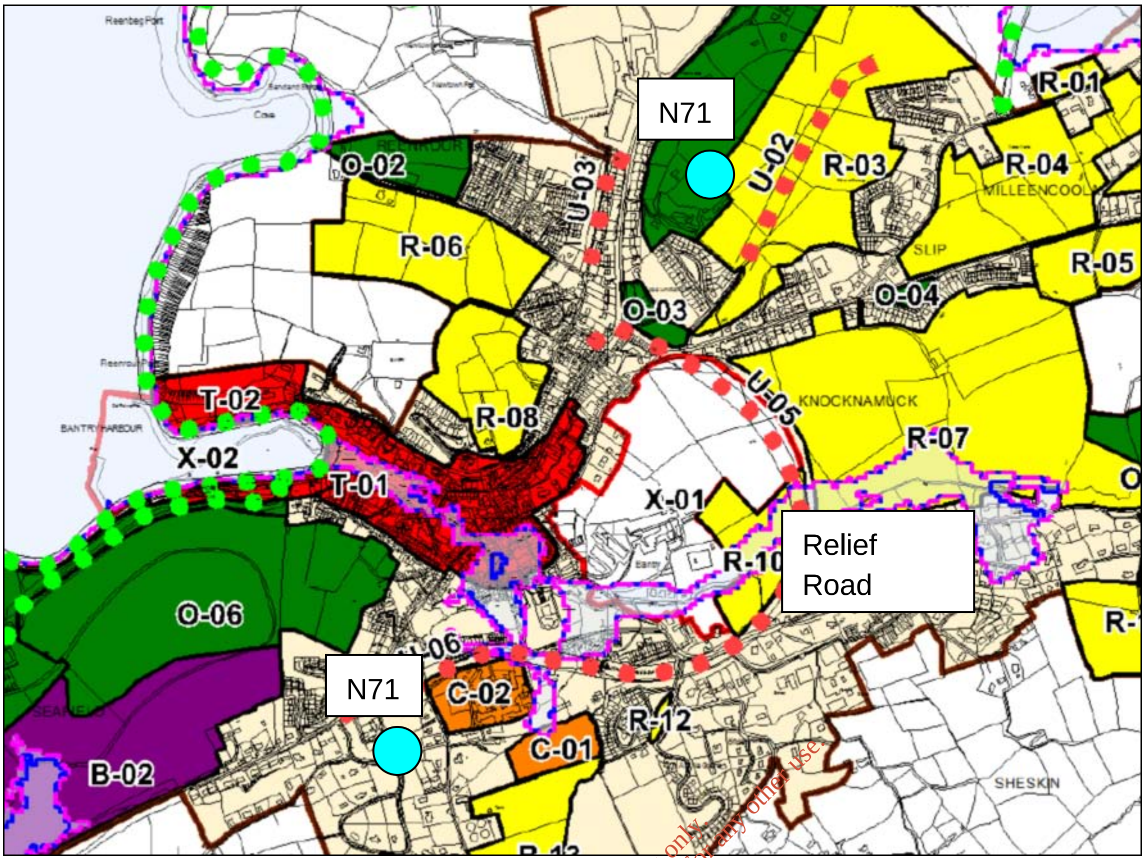


Figure 13.9 Proposed N71 Relief Route for Bantry

Road Safety

Interrogation of the Road Safety Collision Mapping available at www.rsa.ie shows that there have been a minor amount of incidents in and around the town centre, as indicated in Figure 13.10 below. The majority of incidents have been minor in nature only, with a small number of serious incidents.

Based on site visits and observations, significant pedestrian activity occurs around Wolfe Tone Square; with car parking on both sides of the carriageway this is to be expected. Generally vehicle speeds were observed to be quite low. There are a number of signalised pedestrian crossings located around Wolfe Tone Square; however a number of pedestrians cross at locations elsewhere.

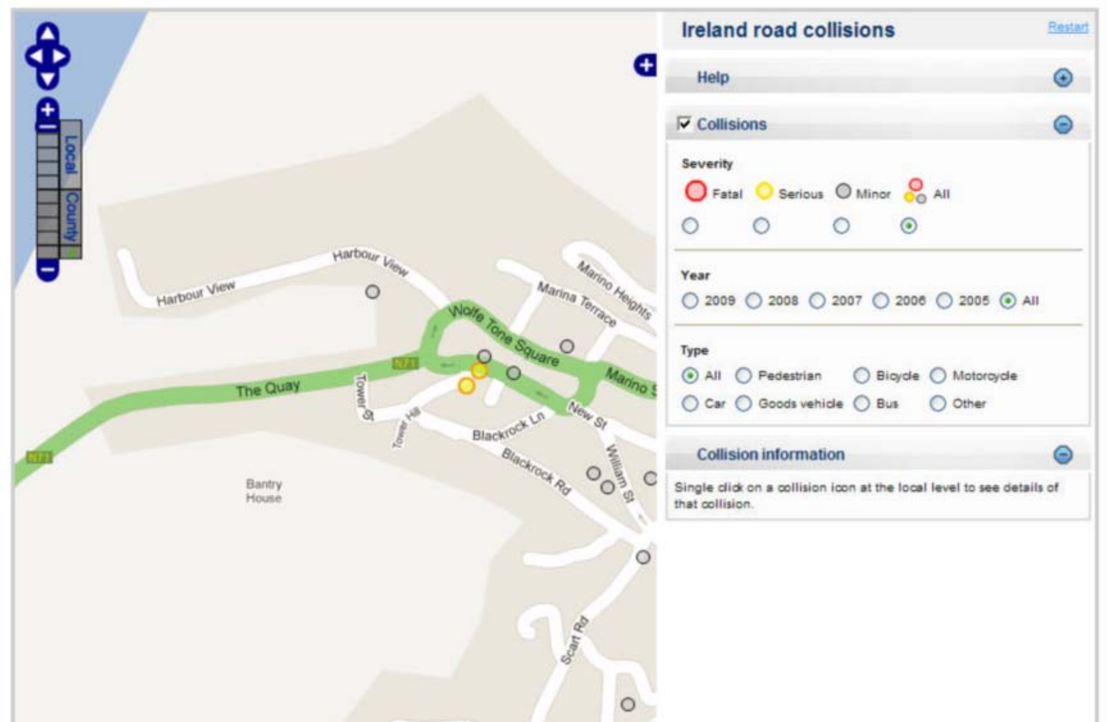


Figure 13.10 – Road Safety Authority Incident Mapping

13.3 Proposed development

Inner Harbour Development

As outlined previously in this report, the Inner Harbour Development proposal involves the dredging and reclamation of a portion of the existing inner harbour area in order to provide improved amenity areas, and to facilitate the construction of a marina consisting of approximately 230 berths, which will create a more sustainable and vibrant community facility and will promote and enhance the attractiveness of the inner harbour. An indicative layout of the proposed development is shown in Figure 13.11 below.

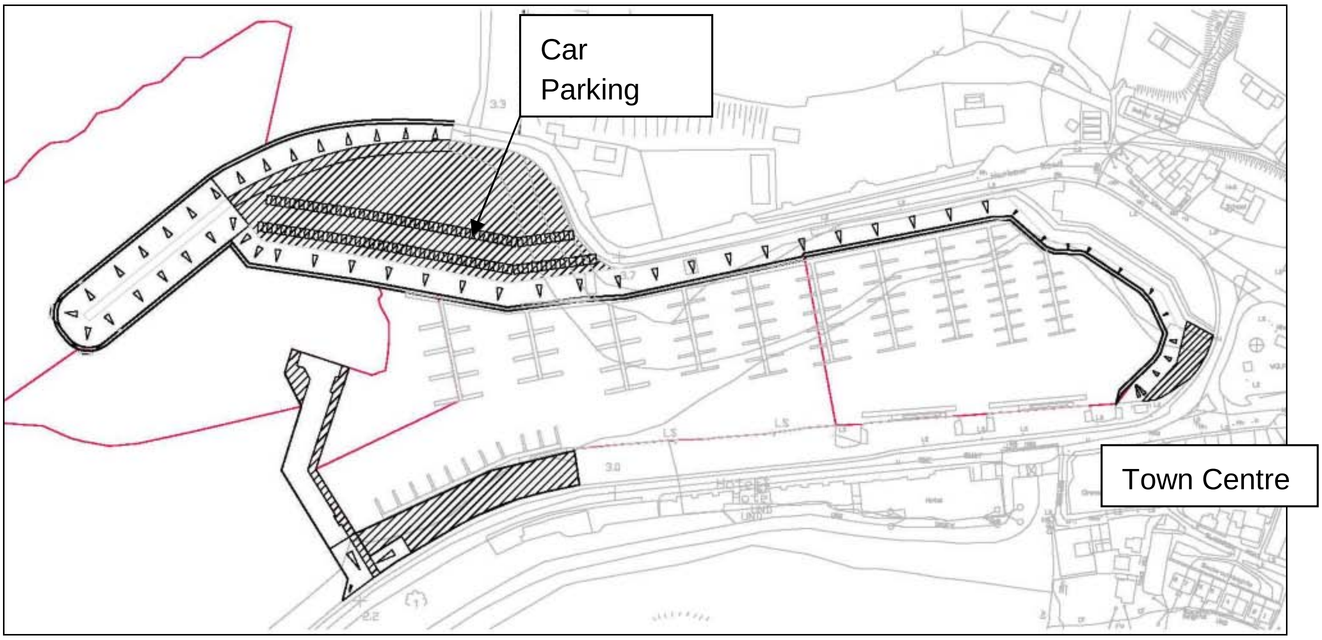


Figure 13.11 Indicative Scheme Layout (Source – RPS)

The proposed scheme will involve the dredging of the existing inner harbour area, and the deposition of dredged material at a number of sites in the vicinity of the inner harbour site. To the north lies the Cove Strand, and to the west lies the beach area at Abbey. Figure 13.12 below shows the locations of all three sites. Between the Bantry Inner Harbour and Cove sites lies Beicin Strand. The dredged material is to be used for land reclamation or beach nourishment purposes. The Cove site and Beicin Strand have been identified as suitable sites for beach nourishment, as the Cove site is located quite close to the main harbour site and has a high quality beachfront pedestrian walking route along Beicin Strand.

The Abbey site is an alternative for land reclamation purposes, as the site can serve as a boat storage facility ancillary to the inner harbour during the winter and can also facilitate a boat repair facility. The Abbey site is deemed to be secondary to the Cove and Beicin sites, but nevertheless a portion of dredged material is likely to be accommodated at this site. Figure 13.13 below shows the road network in the environs of the four sites.

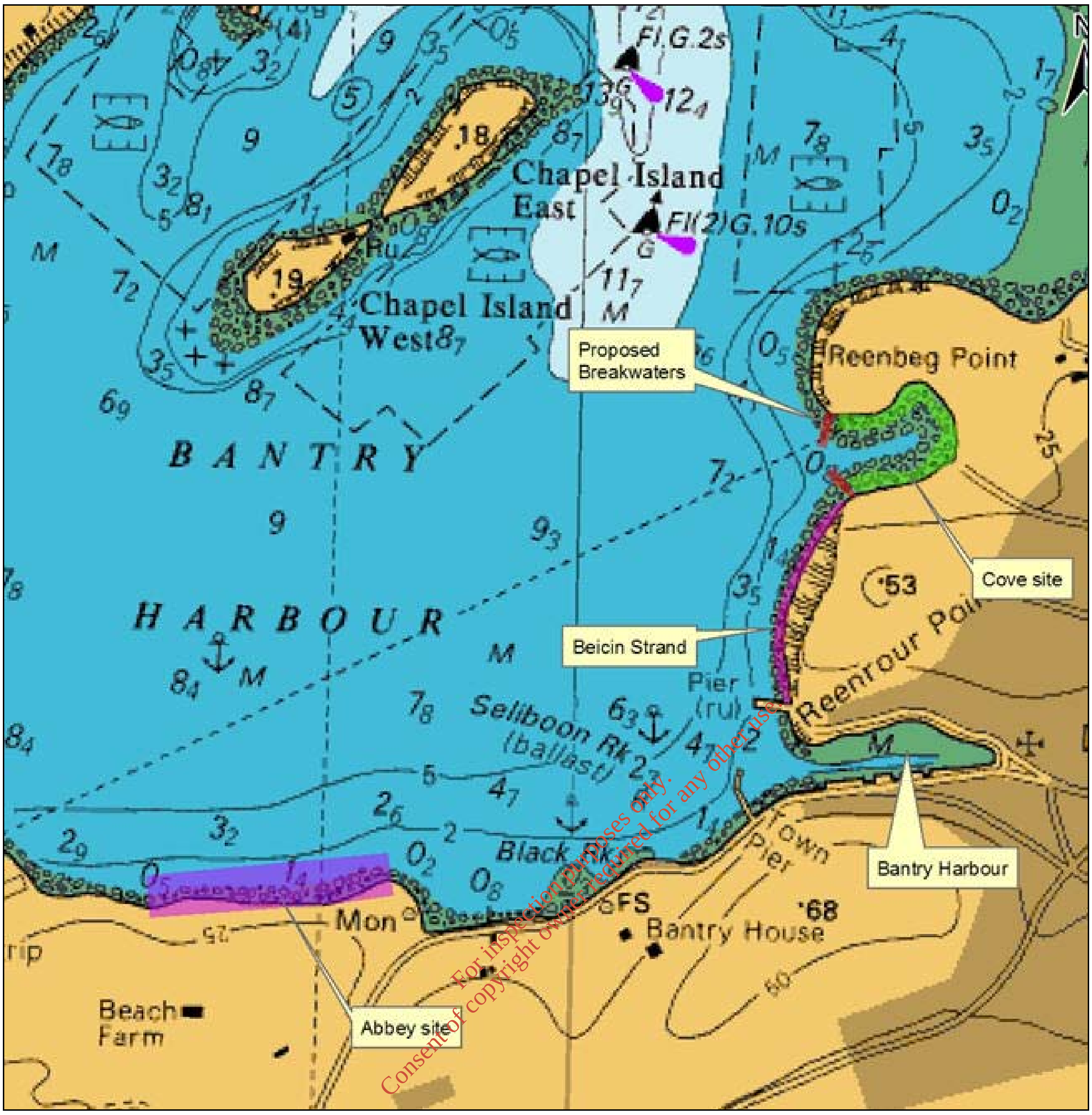


Figure 13.12 Locations of Works Areas (Source – RPS)

Figure 13.13 Road Networks & Site Locations (Source – Google Maps)

13.4 Traffic Survey

Traffic Surveys of N71 in Bantry

ILTP undertook traffic counts at the site for the AM and PM peaks during the site visit on January 31st 2012, and also undertook a weekend peak count on Saturday February 18th 2012. The locations of the survey counts are shown in Figure 13.14 below, and the results of these counts are show in Figures 13.15 – 13.17 below.

Figure 13.14 Traffic Count Locations

The traffic counts were undertaken at the entry to Wolfe Tone Square from Cork, along the N71, and at the adjoining junction to Harbour View Road.

An indicative traffic survey was undertaken during the Weekday AM Peak, from 08:00 to 09:00 AM, with a more comprehensive survey undertaken during the Weekday PM Peak, from 16:00 to 18:00. The results showed that the Weekday PM Peak is between 17:00 and 18:00, and is the more critical of the two Weekday Peak periods assessed, with an increase in traffic flows of over 50% compared to the AM Peak in the vicinity of the site access.

The Weekend Peak was seen to occur between 12:30 and 13:30, and is similar to the Weekday PM Peak in terms of traffic flows.

Traffic flows approaching the exit on to Harbour View Road were seen to be closely split between entering traffic and circulating traffic, with the split generally being slightly more towards traffic entering from the Cork approach.

The percentage of Heavy Goods Vehicles (HGV's) observed during the count was quite low, with ~4% observed in the AM Peak, ~2% observed in the PM peak, and ~1% observed during the Weekend peak.

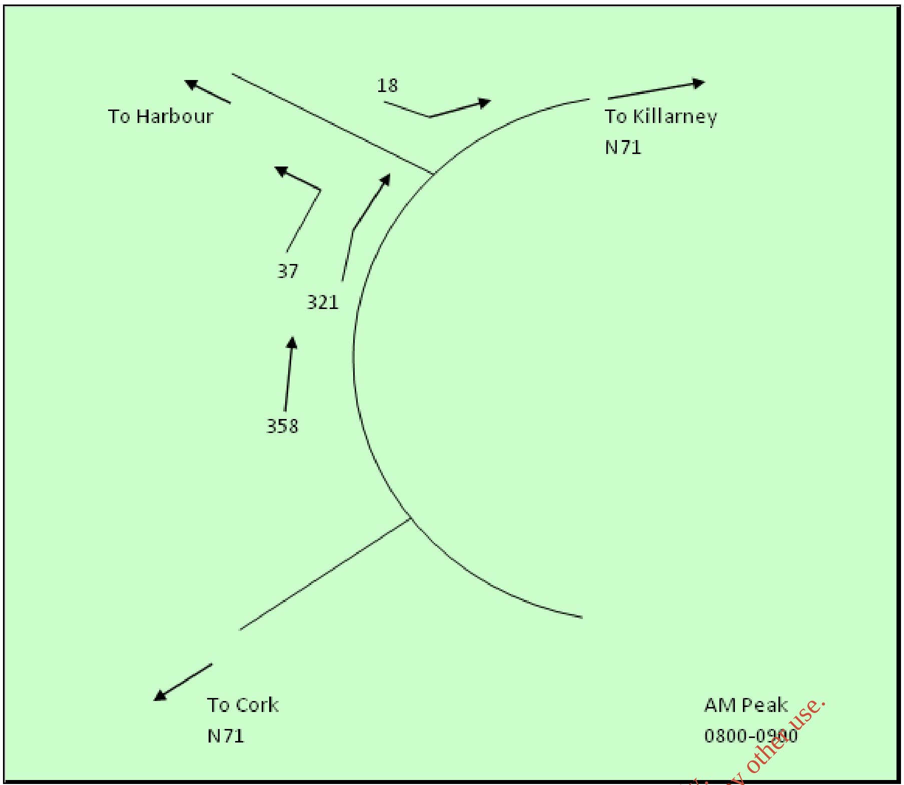


Figure 13.15 AM Peak Survey Results

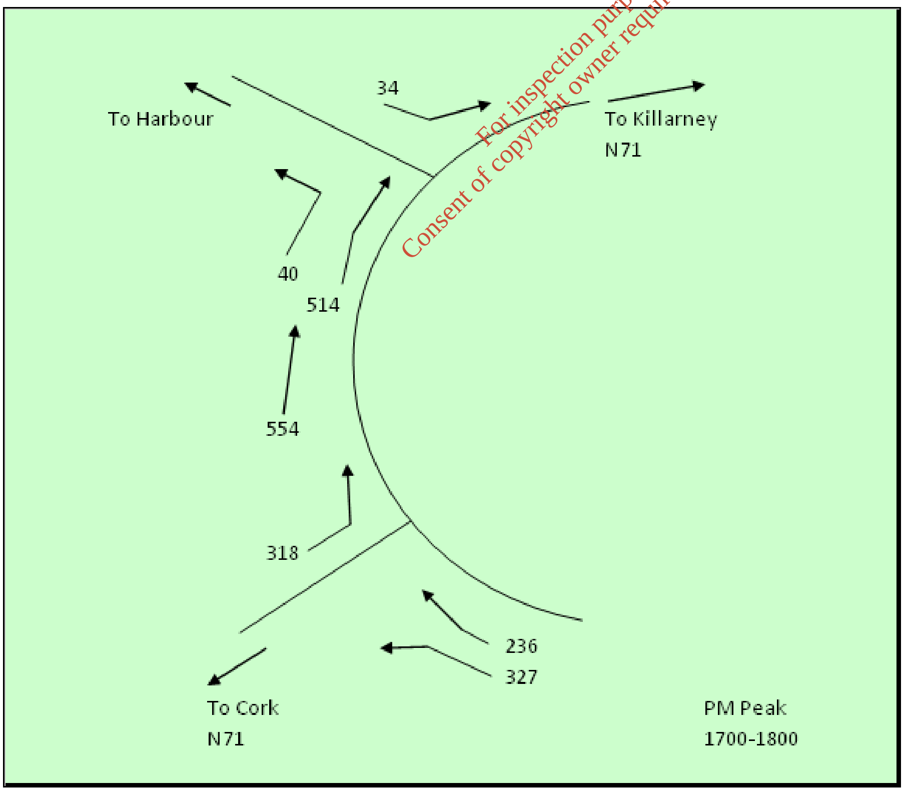


Figure 13.16 PM Peak Survey Results

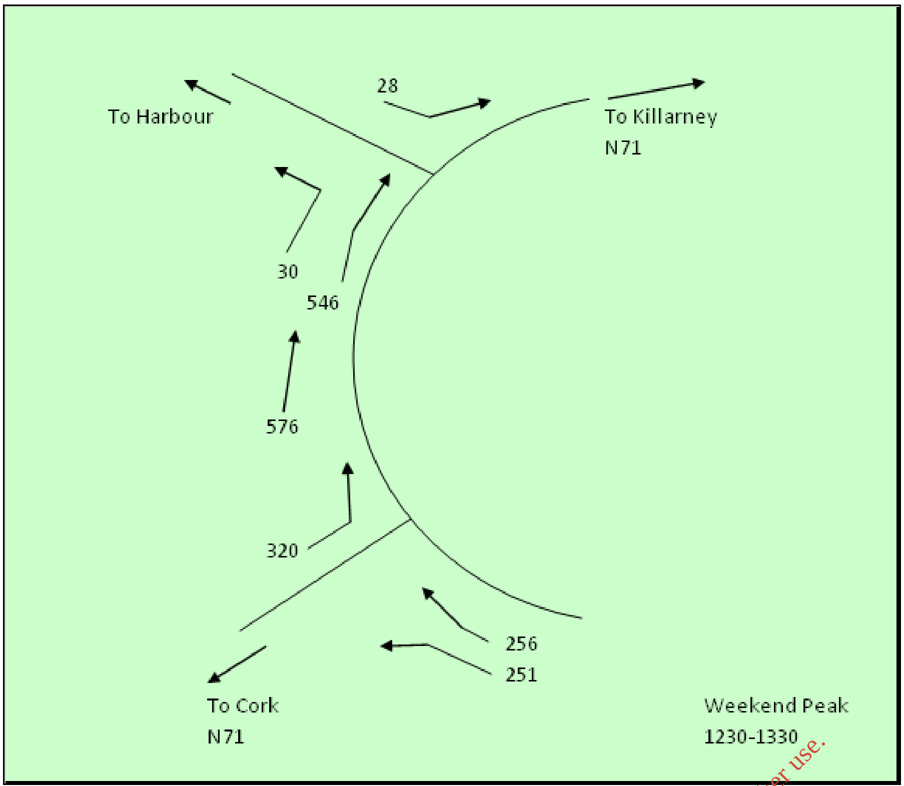


Figure 13.17 Saturday Peak Survey Results

13.5 Traffic Impact Assessment – Operational Phase

Trip Generation

Trip generation calculations have been obtained by interrogation of the *Trip Rate Information Computer System* (TRICS) database. The TRICS database contains trip generation rates relating to a variety of land uses from sites throughout the UK and Ireland. Through careful selection of input parameters relating to a variety of criteria (such as land use, location and public transport provision) the TRICS database allows an estimate to be made of the probable trip generation rates for a proposed development.

Figure 13.18 below shows the relevant Trip Rates applicable to the development, with the trip rates applicable per berth.

AM Peak		PM Peak		Saturday	
In	Out	In	Out	In	Out
0.02	0.02	0.04	0.04	0.25	0.12

Figure 13.18 Trip Generation Rates

It can be seen that the Weekday AM and PM Peak Periods have little trip generation associated with them, with the Weekday PM Peak being the larger of the two. The Saturday Peak is by far the most critical, and represents the worst-case scenario in terms of trip generation.

Figure 13.19 below shows the actual trips generated by the proposed development, using the above trip rates.

AM Peak		PM Peak		Saturday	
In	Out	In	Out	In	Out
4	4	8	8	53	25

Figure 13.19 Trips Generated by Proposed Development

For the purposes of this assessment, and to ensure robustness of assessment, it has been assumed that the entirety of the trips generated by the proposed development will be new trips (i.e. no pass-by or diverted trips). In the AM Peak the 4 additional trips into the site represent a traffic increase of ~1.1% on the surrounding road network. In the PM Peak, the 8 additional trips represent a traffic increase of ~1.4% on the surrounding road network. During the Weekend Peak, the additional 53 trips represent an increase of ~9.2% on the surrounding road network.

The AM and PM Weekday peaks are therefore seen to be unaffected in any significant capacity by the additional flows associated with the development, with the Weekend Peak being the most critical.

Existing Carriageway Carrying Capacity

The N71 carriageway as it circulates Wolfe Tone Square is 2-lane circulating for the majority of the route. However, between the entry to Wolfe Tone Square from Cork and the adjacent exit to Harbour View Road the N71 is single-lane, one-way carriageway. This section of the N71 is used to determine the carrying capacity of the carriageway between these two arms of the gyratory, where all traffic to the development will have to route.
The width of the carriageway at this location is 8.7m. However there is also on-street car parking, which reduces the effective width by ~3.0m. Thus, the single-lane width available at this location is ~5.7m, which, if doubled would correspond to a two-lane carriageway width of 11.4m. Therefore the one-way carriageway at this location is quite wide, which would also imply that this section has good carrying capacity for vehicle flows.

TA 79/99 – Traffic Capacity of Urban Roads sets out guidance for evaluating carriageway lengths in urban areas in order to evaluate the carrying capacity of the carriageway. Factors such as carriageway width, speed limit, presence of side roads, roadside access from shops and residences, and the frequency of pedestrian crossings and bus stops can all be incorporated into the guidance to aid the appraisal.

Based on the various criteria that apply to this site, and based on a two-lane UAP4 road type (from Table 2 of TA 79/99), with a conservative two-lane carriageway width estimate of 10.0m, the carrying capacity of a single lane per hour is estimated at 1,410 vehicles. This is deemed to be a realistic estimate of the carrying capacity of the N71 carriageway at this location.

Adopting this carriageway capacity of 1,410 vehicles, the Weekday AM Peak traffic flow of 358 vehicles means that the carriageway is at 25.4% carrying capacity. The Weekday PM traffic flow of 554 vehicles means that the carriageway is at 39.2% carrying capacity. Finally, the Weekend Peak traffic flow of 576 vehicles means that the carriageway is at 40.8% carrying capacity.

The addition of development traffic in the AM Peak means that the carriageway is at 25.6% carrying capacity, an increase of 0.2%. The PM Peak development traffic increases the capacity to 39.8% of capacity, an increase of 0.6%. The addition of the Weekend Peak development traffic increases the capacity of the link to 44.6%, an increase of 3.8%. Thus, even the most significant impact from the development traffic on carriageway carrying capacity, in the design year, is an additional 3.8%. The development is not therefore deemed to significantly affect the carrying capacity of the adjoining road network.
For junction analyses, the Weekday PM Peak and Weekend Daytime Peak were assessed using junction assessment software. This is discussed in more detail later.

Trip Assignment

As outlined above, the traffic flows observed from the on-site surveys, as well as an analysis of the historical traffic flow data obtained from the NRA shows that two-way flow on the N71 is typically split evenly between both directions on the N71. As a result, an even split was applied to the trips generated by the proposed development, with 50% assumed to come from the N71 from the Cork direction, and 50% to approach from the N71 Killarney approach.

Future Traffic Growth

Base Year 2012 traffic flows from on-site surveys were factored up to an Opening Year of 2014, and a Design Year of 2029, using NRA Growth Rates contained in the NRA Project Appraisal Guidelines, using a medium-growth scenario. Figure 13.20 below shows the Low, Medium and High growth rates for the base year, opening year and design scenarios.

Year	LOW		MEDIUM		HIGH	
	LV	HV	LV	HV	LV	HV
2012	1.000	1.000	1.000	1.000	1.000	1.000
2014	1.022	1.012	1.026	1.018	1.044	1.038
2029	1.200	1.085	1.236	1.128	1.420	1.308

Figure 13.20 NRA Growth Rates

2014 Opening Year

The development has been assumed to be substantially completed and operational by 2014. Background traffic from the 2012 surveys was factored up to 2014 using the NRA Growth Rates detailed above, and the development traffic was added to the network. Figures 13.21 and 13.22 below show the traffic flows in the Weekday PM Peak and Weekend Daytime Peak respectively for the 2014 Opening Year, with development traffic added.

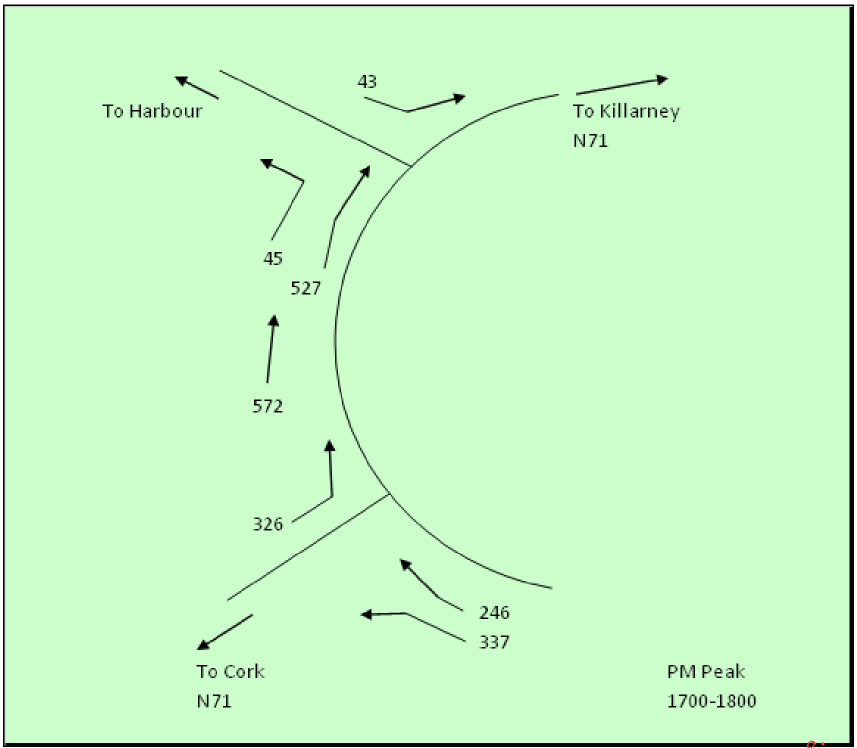


Figure 13.21 2014 Opening Year PM Peak Traffic Flows with Development

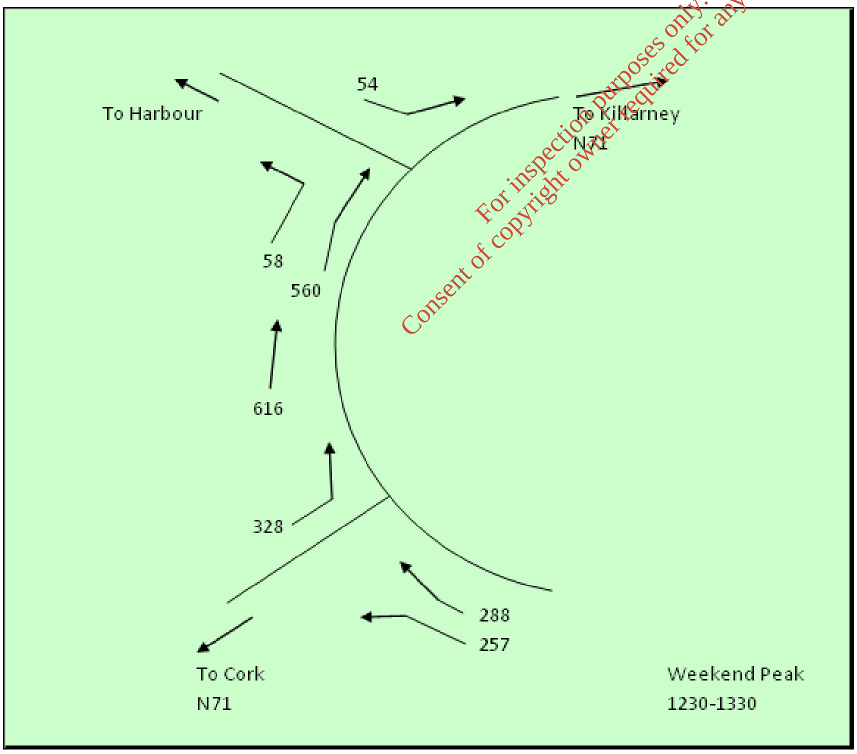


Figure 13.22 2014 Opening Year Weekend Peak Traffic Flows with Development

2029 Design Year

In line with NRA Traffic Impact Assessment Guidelines, a Design Year occurring 15 years following the Opening Year is required for impact analyses. Background traffic from the 2012 surveys was factored up to 2029 using the NRA Growth Rates detailed above, and the development traffic was added to the network. Figures 13.23 and 13.24 below show the traffic flows in the Weekday PM Peak and Weekend Daytime Peak respectively for the 2029 Design Year, with development traffic added.

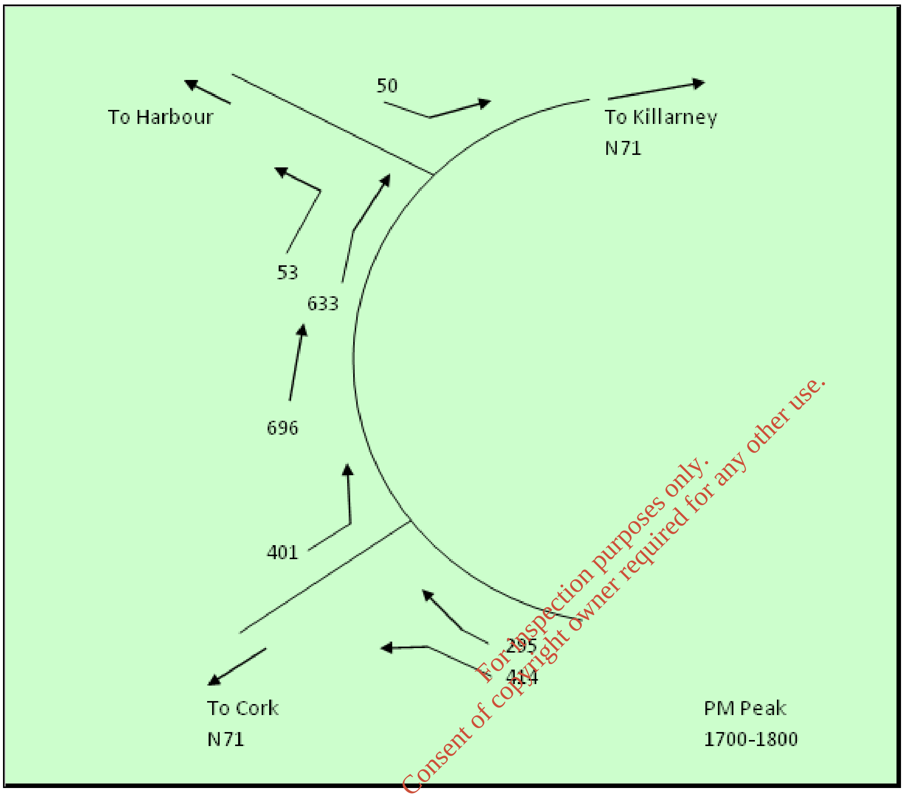


Figure 13.23 2029 Design Year PM Peak Traffic Flows with Development

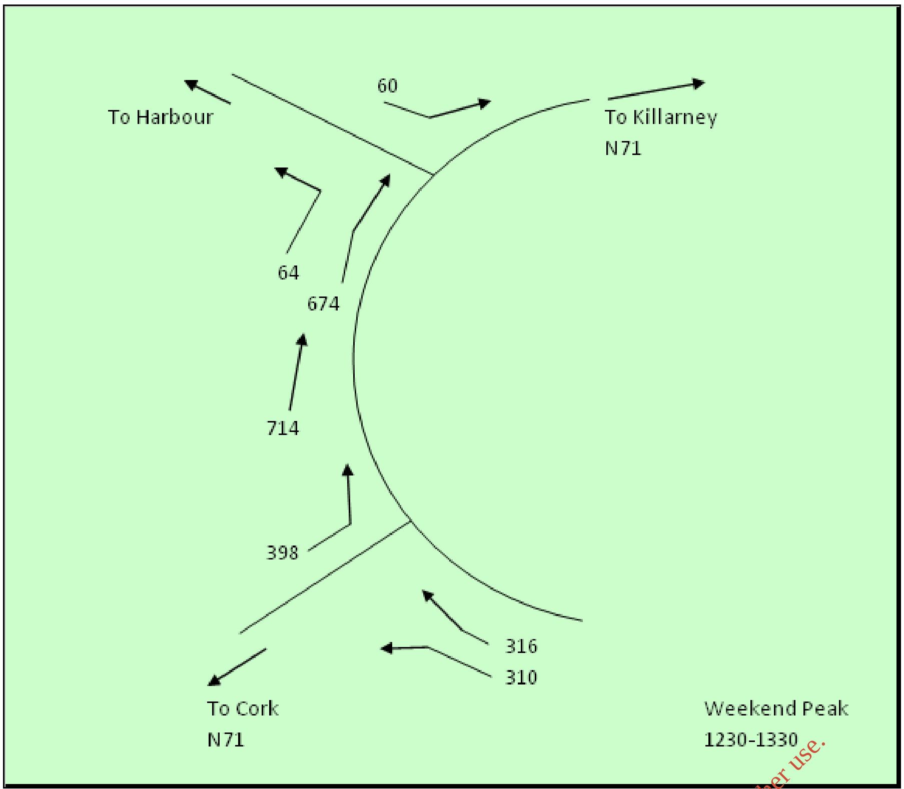


Figure 13.24 2029 Design Year Weekend Peak Traffic Flows with Development

13.6 Junction analyses

PICADY Junction Analysis

The junctions shown in Figure 13.25 below were subjected to junction analyses using PICADY analysis software. By inputting junction data such as geometry, visibility, etc. and traffic flow criteria it is possible to derive an estimation of the capacity of a given junction using PICADY.

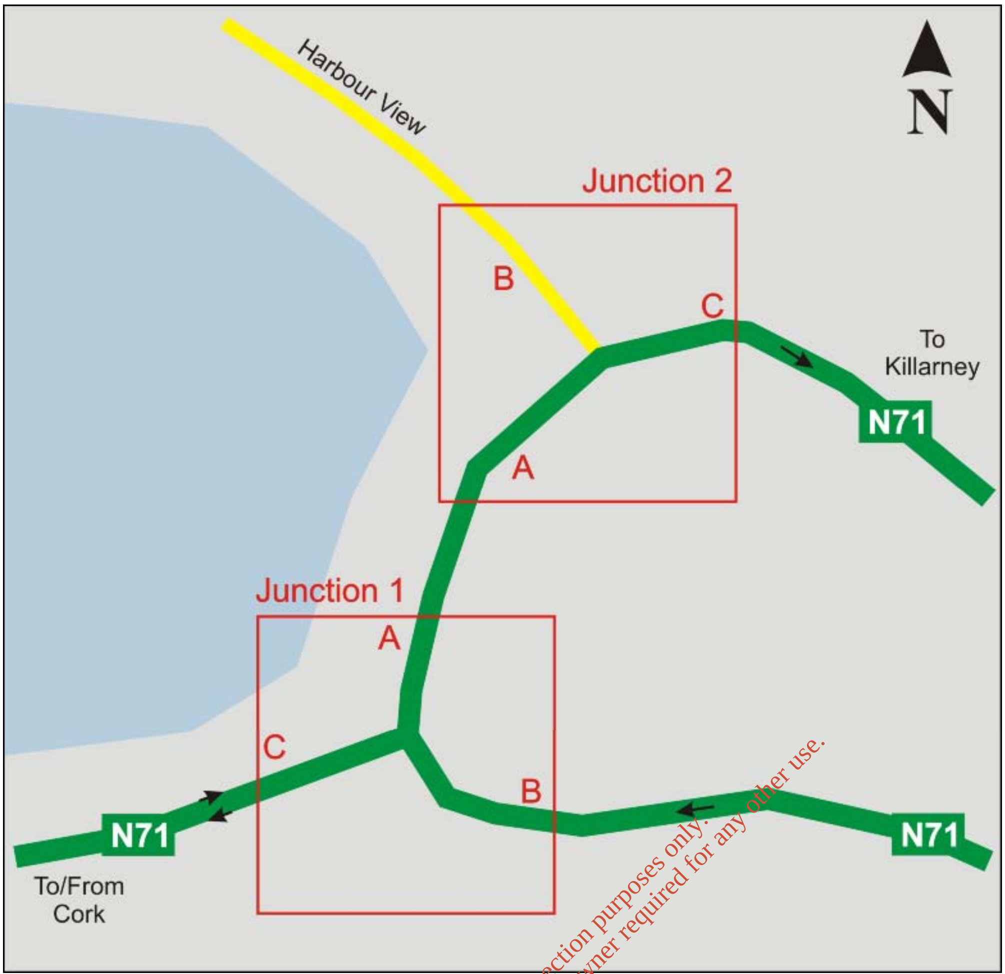


Figure 13.25 Junctions Assessed using PICADY

A key measurement of a junction operation is the Ratio of Flow to Capacity (RFC). This is a ratio which identifies the current capacity that a junction operates at, based on recorded traffic flows and theoretical capacity flows for a given junction. Generally, a junction is seen to be operating within capacity with an RFC value of 0.85 or less – i.e. the junction is carrying 85% of what it can carry at full capacity.

Values over 85% indicate a junction beginning to approach capacity, and which would begin to experience operational problems. RFC values over 1.00 would indicate a junction operating over capacity, with no capability to accommodate additional traffic.

The PICADY results for the junctions show that they are operating at miniscule levels of capacity, with RFC values virtually zero, and no observed queuing. There are a number of explanations for these results, which appear to be unrepresentative of on-site conditions.

Firstly, the junctions are both effectively operating in a manner similar to the arms of a roundabout. For each junction there are three possible movements of traffic. For example, at junction 1, the movements are:

- N71 entering Wolfe Tone Square from Cork
- N71 circulating around Wolfe Tone Square
- N71 exiting from Wolfe Tone Square to Cork

However, of these three movements, only one must yield, the N71 circulating movement, which must yield to the N71 entering from Cork movement. A similar arrangement is in place at Junction 2. Thus two of the three traffic flows have free-flow through the junctions. The relatively wide geometry and the relatively low flows combined result in RFC estimations in PICADY that indicate substantial capacity at both junctions. The full PICADY analysis results are contained in Appendix 4A.

A further consideration is that PICADY can only evaluate junctions individually. It cannot therefore examine the effect of congestion at a junction on an adjacent junction. This is also an apparent factor in the PICADY results shown above.

These results were therefore deemed unrealistic by the traffic consultants for junction analyses purposes. Consequently, ILTP decided to build a microsimulation model also and evaluate the junctions collectively, as PICADY only looks at single junctions.

Bantry S-Paramics Model Construction

In order to assess the impact of the development on the adjacent road network and to test the road layout and transport proposals of the development it was considered necessary to construct a microsimulation model of the scheme, as outlined above. The microscopic traffic simulation programme S-Paramics was used to model the impact of the proposed development on the surrounding network.

S-Paramics Microsimulation Software

S-Paramics is a suite of high performance software tools for microscopic traffic simulation. It represents a radical new approach to the understanding, representation and analysis of road traffic. Individual vehicles are modeled in fine detail for the duration of their entire trip, providing the accurate traffic flow information necessary for the analysis of congested road networks.

Because S-Paramics represents traffic flow from the standpoint of the individual driver, traffic engineers are able to distinguish between minor sub-optimal design variations without resorting to deterministic proxy. All known components likely to significantly affect traffic flows are represented, across the full range of road network types.

S-Paramics is sensitive to junction layout, including junction type, lane markings, lane widths, turning radii and conflicting movements. It is a tool, which can assist in the analysis, operational assessment and design of junctions, both conventional and innovative, where no accepted modeling methodology exists.

Network Build

The first stage of the S-Paramics model development was to replicate the study area road network as accurately as possible. ILTP obtained topographical survey information for the study area, which was used to 'trace' the road network and junction layouts. This ensured that geometry throughout the network was replicated in the S-Paramics model. This is important since vehicle behavior is determined in part by the road layout itself.

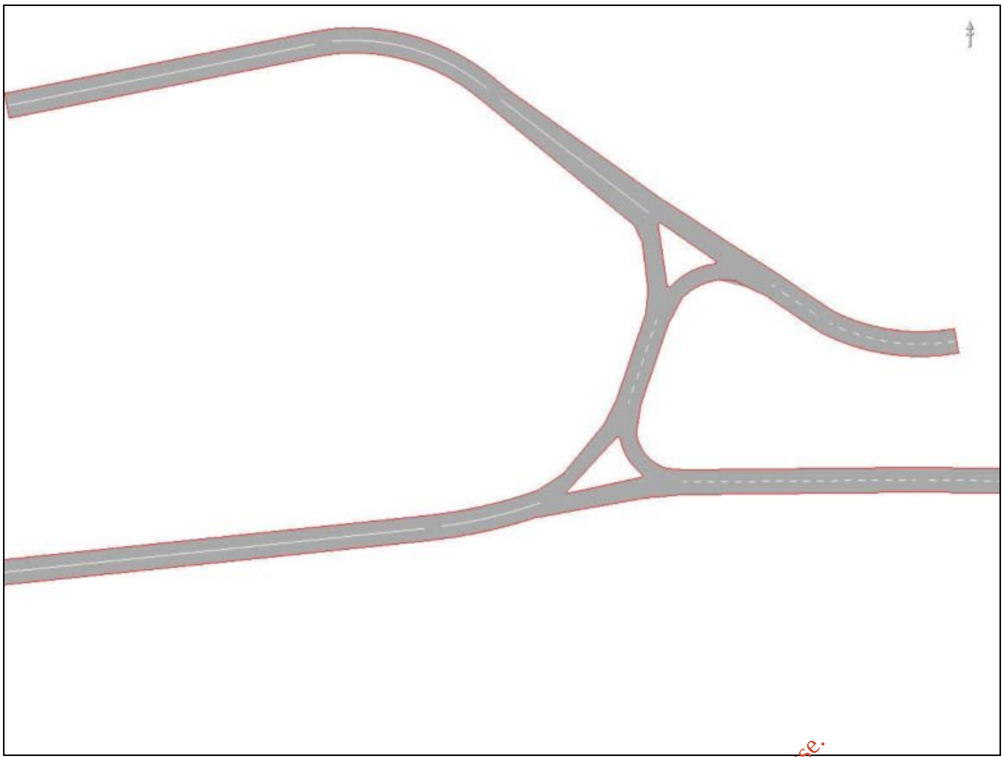


Figure 13.26 S-Paramics Microsimulation Model of Study Area

The S-Paramics Microsimulation model was then used to evaluate the capacity of the junctions collectively as a network. By increasing the junction traffic flow in small increments, the model can be observed until it begins to break down. The model is then deemed to be at capacity.

Sensitivity Test

In line with growth in traffic during the summer months, the capacity assessment was also undertaken with background traffic growthed by 50% in order to allow additional assessment of the development impact during the summer months, in order to accommodate seasonal increases in traffic flows, and to ensure that the assessment is robust and not under-representative of peak traffic conditions on site.

The junctions were assessed using S-Paramics collectively as a localised network. The results of the capacity assessments are contained in Figure 13.26 below. The results show that the worst-case scenario – the 2029 Weekend Peak Period, with an additional 50% increase in background traffic flows, and the development traffic flows included – is operating within capacity.

Scenario	2012 Existing Scenario	2014 Opening Year	2029 Design Year	2029 Design Year + 50%
PM	36%	37%	44%	66%
Weekend	40%	41%	49%	73%

Figure 13.26 S-Paramics Network Capacity Assessment Results

13.7 Car Parking Assessment

Cork County Development Plan Parking Standards

The Cork County Development Plan does not contain specific criteria for the provision of parking spaces for a marina development. However, recent applications with the County Council have adopted a consensus that a parking space rate of 0.6 spaces per berths is adequate, based on international experience in Marina design.

For a 230 berth marina development, the paring requirement would therefore be 138 spaces.

Proposed Development Parking Schedule

The proposed development will have a total of 138 parking spaces at surface level, as indicated in Figure 13.27 below.

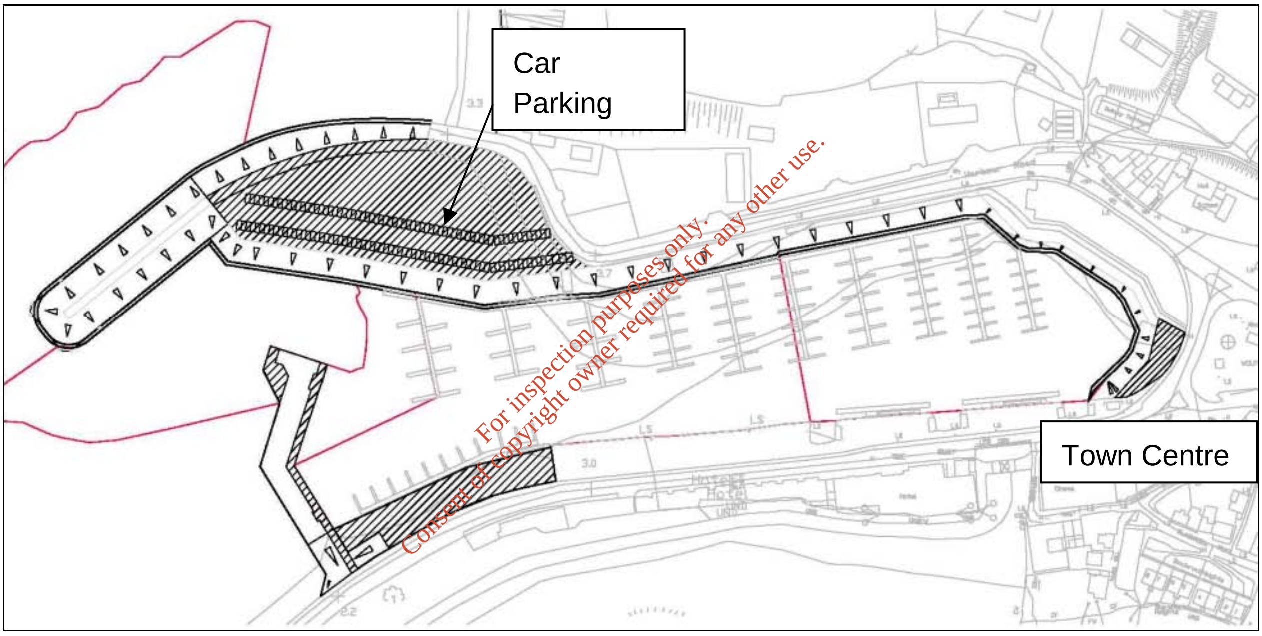


Figure 13.27 Indicative Scheme Layout (Source – RPS)

In addition, there are a number of off-street car parks, and substantial on-street parking around the Town Centre. During the site visits, occupancy of the two off-street car parks close to the site was seen to be approximately 50% in one car park, while the other car park was seen to be unoccupied during the entire day.

13.8 Traffic Impact - Construction Phase

Construction Elements

The main elements of the construction programme will involve the dredging and removal of beach material, the placement of rockfilling material and rock armour, and the movements of construction related vehicles, such as plant, etc.

Dredged Material

The dredged material from the Bantry Inner Harbour site, estimated at some 77,000m^3 of material, will to a large extent be deposited at the northern Cove Beach site. It is proposed to transport this material by sea between the two sites, given their relative proximity.

The Abbey site, located west of the inner harbour will also house a portion of dredged material which will be brought by sea.

Construction Timeline

Construction of the scheme is envisaged to occur over a 30-month programme. Certain construction-related movements will have no net effect on the surrounding roads and local area as they will be undertaken within the works area only. All dredged material will be transported by sea between the site and the Cove and Abbey sites due to their proximity.

In order to ensure robustness of assessment, all (excluding dredged) materials associated with the works are assumed to be transported to the site via road. The construction programme is assumed to be a single-phase scheme only, in order to ensure that a worst-case scenario is examined.

Construction Phases

The construction of the scheme will involve a number of specific phases, comprising:

- Breakwater Construction
- Pierside Reclamation
- Amenity Area
- Northern Embankment
- Wolfetone Square
- Fishing Docks
- Cove Site Nourishment
- Fishing Pier Improvements
- Pontoon Infrastructure
- Abbey Site Development
- Quay Structures

A number of the phases can run concurrently, such as dredging at numerous locations, piling works, etc.

The most intensive section of the works programme occurs between months 5 and 6, with significant elements of rockfilling and rock armour placement occurring, which will generate high levels of vehicular activity.

There are three main sites for construction activity, the main Inner Harbour site, the Abbey Site and the Cove Site. The Cove site will be the least trafficked of the three sites, with minor levels of rockfilling, armour rock placement and dredging, etc. It is proposed that the scheduling of the works will be arranged so that the intensive elements of the works at the Inner Harbour site and at the Abbey site do not happen concurrently.

There will be a number of specific vehicular movements associated with the site, namely:

- Concrete Delivery Vehicles
- Plant
- Rockfilling Material
- Rock Armour delivery

Construction Movements

Figure 13.28 below shows a graphical representation of the construction stage of the scheme, showing the construction traffic flows for the entire works duration, as well as highlighting the most intensive months of the work programme.

It is seen in the below figure that the most intensive portion of the works (months 5 and 6) will result in a maximum of 2,000 vehicle movements per month, which equates to a maximum of 10 vehicles per hour (assuming an 8-hour working day). These movements will be primarily related to the main Inner Harbour site, and will be largely associated with placement of rockfilling material and rock armour.

The above figures are for vehicle deliveries only, therefore the movements must be doubled in order to correctly ascertain the total number of movements. The most intensive element of the works will therefore result in an additional 10 movements to the works site and 10 movements from the works site in a peak construction hour.

For the purposes of this assessment, as a worst-case scenario, the construction is assumed to be undertaken over 8-hour days, as opposed to 10-hour days.

The second most intensive portion of the construction is the works at the Abbey site, in months 12 and 13, with a maximum of ~600 movements per month to and from the Abbey site, which equates to approximately 3 movements to and 3 movements from the Abbey site in a typical peak hour.

At the Cove site, the works undertaken are programmed for months 19 to 27. However, the movements expected at the Cove site in this portion are quite small, with a maximum of 127 movements per month expected. This would equate to less than one movement per peak hour to and from the site.

Therefore, the most intensive elements of the works will result in a total of 20 additional (2-way movements) to and from the main Inner Harbour site, 6 two-way trips at the Abbey site, and approximately one trip associated with the Cove site during a typical peak hour.

The above additional traffic flows generated by construction traffic are deemed to be acceptable within the capacity of the surrounding road network.

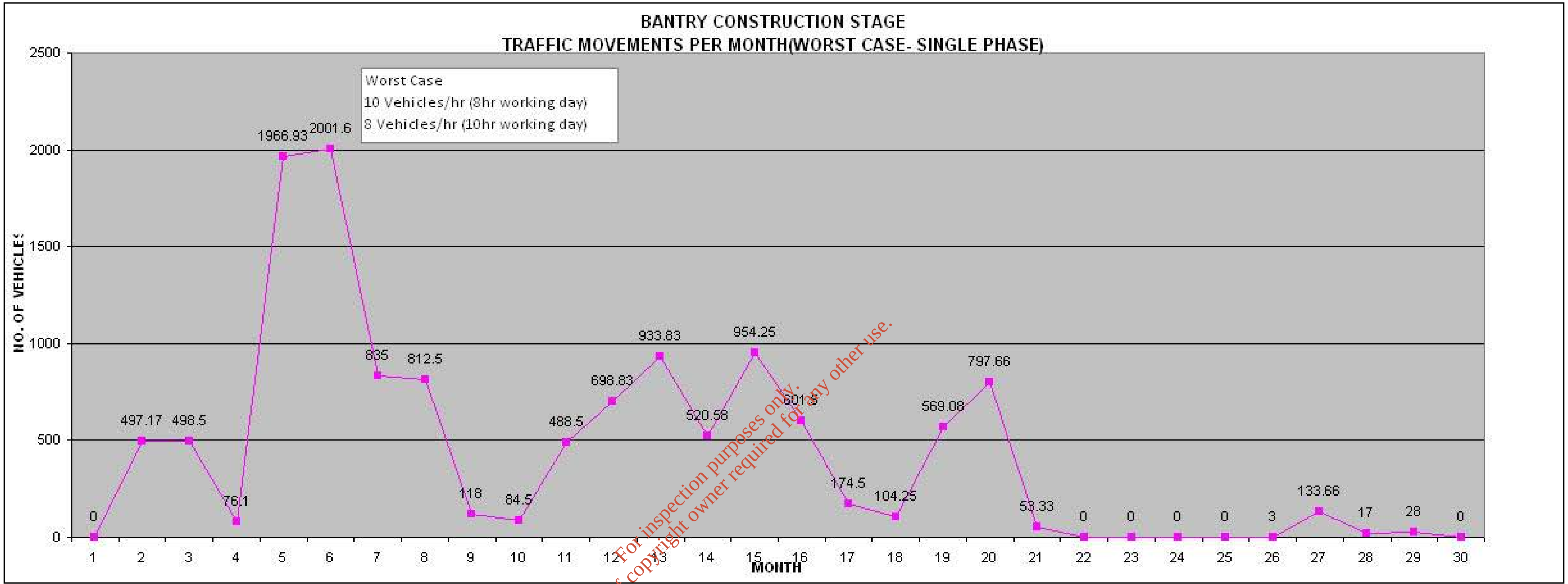


Figure 13.28 **Construction Stage Traffic Movements/Month**

The main sites for construction are the Inner Harbour site and the Abbey site. The Inner Harbour site is accessed directly via Wolfe Tone Square from the existing N71. Traffic accessing the Inner Harbour site will use Harbour View Road. There are no issues relating to road surfacing or width etc. for vehicles accessing this site.

The Abbey site is located west of the town centre, along the N71 on the approach to the site from Cork. The existing Abbey beach area has a direct access from the N71, and is located immediately at the commencement of the existing 50 kph speed limit into Bantry. The existing access to the Abbey beach area is directly adjacent to a large public cemetery. Again, at this location within the urban speed limit of the town centre, the local road network is capable of accommodating these flows.

The more northern Cove site is accessed via Old Barrack Road, which itself is accessed from the N71 on the northern exit from the town, on the N71 Glengariff Road. The route along Old Barrack Road is characterised by sections of poor surfacing, reduced road width and sections with steep gradients and poor visibility. There are a number of community facilities also along the haul route, such as a primary school and Church; in addition the route is primarily populated with residential developments. The Cove site and access route represents the most sensitive of the three main sites.

Mitigation Measures

There are a number of proposed mitigation measures that will be implemented to minimise the impact of construction related traffic on the surrounding area. Firstly, the commencement of construction will be scheduled in a manner that ensures that the most intensive months, months 5 and 6, will not occur in parallel to the traditional summer peak in traffic activity within the town centre.

Intensive elements of the works will be scheduled with regard to the wider town area and residents, businesses, etc. in order to minimise the impact of construction on the town centre area. Construction routes will be heavily signed in order to advise road users of the presence of HGV vehicles. It is likely that the entire Inner Harbour site and the associated car park will be closed to the general public, as these facilities will be main areas of the scheme works. Pedestrians will therefore be restricted from entering Harbour View Road at the construction access point, in the interests of safety.

The Inner Harbour site will be accessed from Harbour View Road, and the Abbey site will be accessed at the existing N71 entry point. The Abbey site will be provided with a dedicated access junction, with dedicated lighting and signage to warn of the presence of the works site. Both the Inner Harbour and Abbey sites will be provided with wheel wash facilities to ensure that debris, etc. from construction works do not impact on the wider road network.

The most sensitive route and site is the Cove site, due to the various physical constraints along the route to the site. However, the Cove site is also the least intensive of the three sites, with approximately one single HGV movement predicted per hour. The Cove route will be facilitated with flagmen to ensure the safe and efficient movement of vehicles to and from this site, as well as ensuring the safety of other road users and pedestrians in the vicinity of the site. The deficient sections of the route will also be surfaced to a suitable standard to accommodate construction vehicles, and will be subject to an ongoing inspection and maintenance programme. Upon completion of the scheme, the route will be restored to a suitable standard for road users.

13.9 Conclusions

The proposed development will not adversely affect traffic conditions in the town centre upon opening, and into the longer term. Even with future traffic growth based on NRA forecasts, and a significant allowance of an additional 50% growth to represent the busy summer months, the development is not seen to have an adverse effect on the site and its environs.

14.0 LANDSCAPE AND VISUAL

14.1 Introduction

This chapter examines the potential landscape and visual impact of the proposed development on the landscape and visual resources of Bantry town and the wider Bantry Bay area.

This chapter seeks to:

a) Establish the baseline conditions -
Record and analyse the existing character, quality and sensitivity of the landscape and visual resource. This should include elements of the landscape such as:

Landform;
Land cover including the vegetation, the slopes, drainage, etc;
Landscape character;
Current landscape designations and planning policies; and
Site visibility, comprising short, medium and long distance views.

b) Analyse baseline conditions –
Comment on the scale, character, condition and the importance of the baseline landscape, its sensitivity to change and the enhancement potential where possible.

A visual analysis (illustrated by photographic material) describing characteristics which may be of relevance to the impact of the design and to the method of mitigation.

c) Describe the development

d) Identify the Impacts of the Development on the Landscape and Visual Resource –
Identify the landscape and visual impacts of the development at different stages of its life cycle, including:

- Direct & indirect *landscape impacts* of the development on the landscape of the site and the surrounding area; and
- *Visual impacts* including: the extent of potential visibility; the view and viewers affected; the degree of visual intrusion; the distance of views; and resultant impacts upon the character and quality of views.

e) Assess the significance of the landscape and visual impacts in terms of the sensitivity of the landscape and visual resource, including the nature and magnitude of the impact.

f) Detail measures proposed to mitigate significant residual detrimental landscape and visual impacts and assess their effectiveness.