5.1 Introduction

The Regional Monitoring Blueprint v0.3 describes the basis for aggregate extraction impact monitoring in the ECR. The document presents the theoretical basis for the specification and design of monitoring surveys and also methodologies proposed for monitoring of physical processes, seabed sediments and biological communities. The Blueprint also describes the reporting and review of data acquired during monitoring surveys and the methods of dissemination of the information.

The Regional Monitoring Blueprint v0.3 was issued in October 2005. During the survey works undertaken in 2005-2006 actual survey operations were compared with those described in the Blueprint to determine where it had been necessary to change proposed methods or survey specifications.

This section of the monitoring report describes the development of the Blueprint since the issue of v0.3 and presents a update of the schedule for monitoring over the next 12-18 months.

5.2 Modifications to the Methods Proposed for Monitoring as Presented in Blueprint v0.3

Part 1 of this report describes the survey operations, data analysis and results acquired during regional monitoring in 2005-2006.

A review of survey operations and changes from those proposed in Blueprint v0.3 is provided in **Appendix 1**.

Plume and tracer studies, incorporating an overspill/screening discharge assessment are planned for the next twelve months.

Summary of Modifications to Biological Monitoring Methods and Operations Proposed in Blueprint v0.3

- ☐ **Positioning tolerance was relaxed during grab/drop camera survey to within 50m of the target position.**
- ☐ **Initial specification that the grab should have a camera attached to investigate the nature of the seabed prior to sampling was adapted so that dual deployment of grab and camera was employed. Distance between grab and camera frame was limited to 10m.**
- ☐ **Minimum acceptable sample volume acquired by Hamon grab was reduced from 5 to 4 litres.**
- ☐ **Drop video deployed at all 2m beam trawl sites prior to deployment of trawl.**
- ☐ **At the majority of 2m beam trawl sites, a trawl distance of 500m, plus or minus 50m was obtained.**
- ☐ **Four scallop dredges were deployed, configured as two dredges per gang, one gang deployed from each quarter.**
- ☐ **Epibenthic species sampled using scallop dredge were recorded on the basis of presence or absence as it was found that it was impractical to apply the SACFOR to the epibenthos.**
- ☐ **Where large volumes were recovered using the 4m beam trawl a sub-sample was taken for epibenthos. This was standardised to 100 litres.**
- ☐ **During scallop dredge and 4 trawl surveys surface water temperature only was recorded.**
- ☐ **Some 4m beam trawl tows were outside the limits specified (10-20 minutes). Tow duration varied from 5 to 32 minutes. At some locations a 15 minutes tow was providing such a large catch volume that the vessel skipper was concerned about the integrity of the gear.**

5.3 Repeat Biological Monitoring 2006

In Blueprint v0.3 consideration was given to the requirements for repeat regional biological sampling in 2006. The following section describes the development of methodology for the repeat sampling undertaken in 2006

Regional Habitat and Biotope Survey

This aspect of regional monitoring was undertaken as it was completed in 2005 with swath and sidescan surveys of the regional transects and also the two study areas to the south west of Area 461.

Ground truthing of the sidescan using video was also repeated as per the 2005 operations.

Drop Camera and Hamon Grab Survey

Originally, in light of the fact that extraction may not have taken place in the previous twelve months, it was proposed that a reduced Hamon grab survey array could be targeted in 2006.

The proposed reduced grab survey would have sampled all reference sites and sites related to dredging permission areas that had been active in the previous twelve months. Due to delays in the issue of permissions, no extraction had occurred in the region by the time the repeat grab survey was due to take place.

Consequently, it was proposed that the 2006 survey would only sample reference areas and outlier sites in order to determine natural temporal variations in community structure and also to provide information regarding the spatial variability of communities at sites.

Following submission of the proposed repeat array to CEFAS for comment, discussions led to modification of the repeat sampling array.

The original arrangement with CEFAS, identified in the Blueprint v0.3, indicated that in intervening years, i.e. where dredging does not occur before survey commences; only the reference areas and context sites would be sampled. However, following discussions with CEFAS a revised array has been prepared to take account of some of the sites within the potentially impacted areas.

The rationale behind the array is based on the following requirements:

- ***Repeat surveying in clusters that were previously identified in the baseline survey***
- ***Repeat the reference areas that provided examples of clusters present in the potentially impacted areas.***
- ***Repeat sampling in the PIZ (ADZ where possible) and SIZ sites with an attempt to represent the range of clusters identified in the baseline analysis***
- ***Repeat of some of the context sites where appropriate (most were impossible to sample in, due to cobble/sensitive habitat presence)***

The objective is to determine if natural variation found in all the clusters, including those in the reference areas, is also represented in the potential impact areas. The proposed repeat array has been developed to ensure that all of the clusters identified will be re-sampled. Also a representative number of samples from each cluster will be sampled in each of the reference areas, with those samples potentially over-represented being reduced for this year.

Finally all PIZ and SIZ zones have representative example sites, generally based on the most prevalent cluster present in each area, with more emphasis in areas that will be subject to earlier dredging activity. Several context sites will also be sampled and attempts to survey using video only will be attempted where grabs have previously not been possible.

It should also be noted that reference site 3 will be replaced in its entirety with 14 new sites of which one will be a 5 times replicate. The final location of this reference area will be decided in the field following video observation of two example locations.

2m Beam Trawl Survey

The 2m trawl sampling has also been modified with 2 sites from reference area 3 deleted and replaced by 3 sites in a new reference area. A further sample site has been included to the west of the array to provide a more complete spatial cover. The final repeat Hamon grab and 2m beam trawl survey array is show below. This is a compromise as a result of the change in strategy suggested by Cefas, away from the previously agreed sampling in reference and context sites only. It should be noted that the resulting array comprises more samples than would have been required for reference and context only.

Scallop Dredge and 4m Beam Trawl Survey

The scallop dredge and 4m trawl survey were repeated in their entirety as proposed in Blueprint v0.3. No modification of the survey was required.

5.4 Repeat Monitoring 2007

Biological Monitoring

Current understanding of the requirements for biological monitoring in 2007 are as follows:

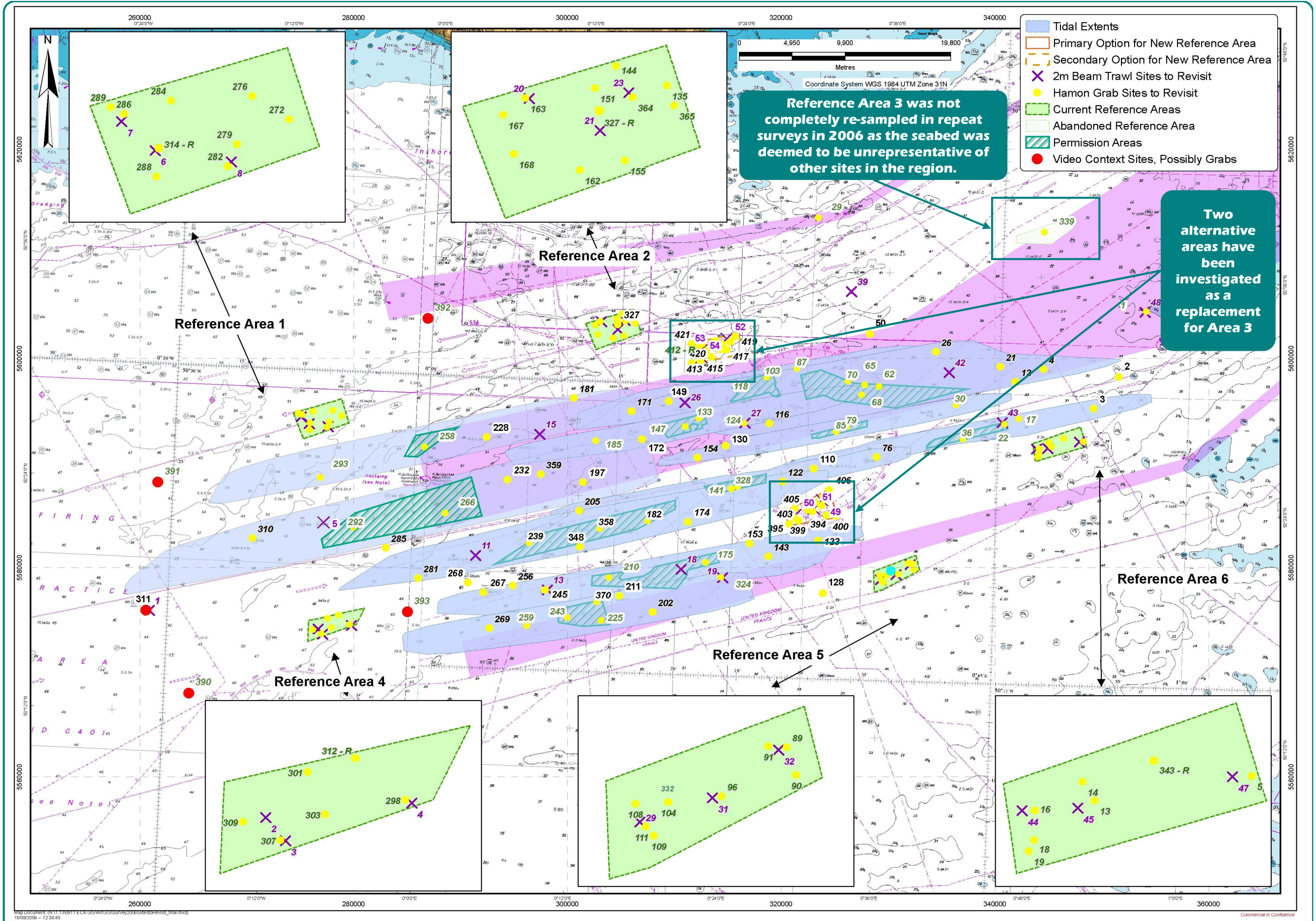
- ***Repeat of regional swath, sidescan and video habitat survey (transects and areas to the south west of Area 461)***
- ***Repeat drop camera and Hamon grab survey of all reference sites, sites within the tidal extents of active dredging permission areas and context sites as defined in 2006 repeat surveys.***
- ***Repeat of 2m beam trawl survey at all reference sites, sites within the tidal extent of active dredging permission areas and context sites as defined in 2006 repeat surveys.***
- ***Complete repeat of scallop dredge and 4m beam trawl survey.***

Timing for these survey is established as being between August and early October inclusive.

Physical Monitoring

- ***Repeat of Area 473 sidescan sonar survey preferably undertaken prior to sampling enable data review.***
- ***Repeat of Area 473 East baseline seabed sediment survey by end May 2007, to include drop camera, SPI survey, video transect survey and grab survey. PSA of cores taken from seabed samples is also required.***
- ***Repeat of Hamon grab sample particle size analysis for all regional sites sampled.***

The survey is likely to be undertaken between April and June, possibly during the same period as the tracer and plume studies. Combination of effort may be possible to reduce costs and should be investigated.



The repeat Hamon grab and 2m beam trawl sampling undertaken in 2006 was modified from that originally proposed in Blueprint v0.3 following discussions with Cefas. The modification resulted in more sites being sampled than would have been under the original proposals and will result in acquisition if data related to the natural variability in community structure at reference, context, primary and secondary impact sites. The revised array also ensures that information regarding all communities identified in the baseline survey will be acquired.

5.5 Development of Remaining Aspects of Monitoring Proposed in Blueprint v0.3

There are two aspects of the works proposed in the Blueprint that are currently under development; the tracer study and the plume study. Survey design work is ongoing and this section of the report provides an update regarding progress.

5.6 Tracer Study

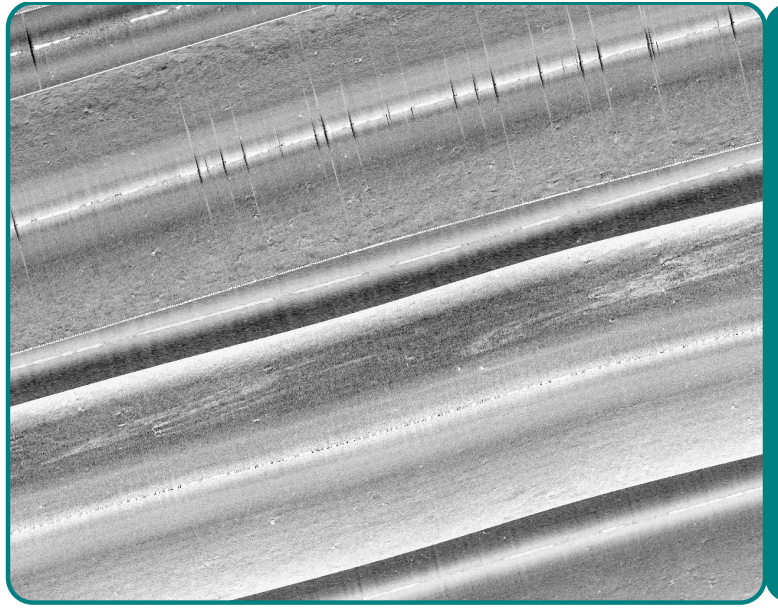
The tracer study will be undertaken at Area 473 East, the regional physical monitoring 'type site'.

Development of the methodology for the tracer study is being undertaken by Emu Ltd on behalf of the ECA. The aim of the tracer study, as presented in the Blueprint v0.3 is:

To provide data and advance knowledge and understanding in the following key area;

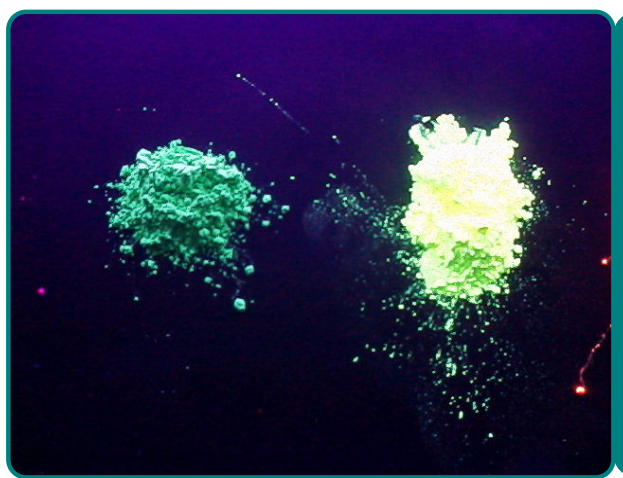
- ***Sediment movement at the seabed – specifically the way in which the distribution of discharged material at the seabed alters through time as a consequence of the complex interaction of processes such as dispersion, advection and burial.***

Work on the tracer study has now progressed to investigating natural background fluorescence in seabed sediments, developing the tracer injection methods and developing the sampling rationale.



The nature of seabed sediment within Area 473 East was investigated during the design of background fluorescence study so that the sampling array could be adjusted if required. The review of sidescan showed a largely uniform sand and gravel seabed.

Vibrocore samples from Area 473 East have been assessed to determine the nature of the seabed prior to sampling during ECR physical process monitoring (seabed sediment survey, tracer study and plume study).



Particles coated in fluorescent paint will be used during the tracer study. The particles are inert in the natural environment and will not significantly impact the biological communities in the area where they are released.

Background Fluorescence Study

It is important that the tracer particles used in the proposed study are easily distinguishable from indigenous material at the study site. If this is not the case then serious errors can arise during measurement of the tracer distribution at the seabed. It is known that certain types of shell and seaweed fluoresce.

Hence, prior to coating any of the tracer it is important that samples of the bed sediments from across study area are collected and tested to establish whether they contain any fluorescent material.

Existing sidescan sonar data have been used to identify the different types of seabed that exist over the area to be dredged and the near-field region (i.e. the area where sediment movement is predicted to occur to the NE and SW.

Having identified the different bed types, the sample grid has been set up to ensure that these are sampled representatively (i.e. the number of samples collected corresponds to the total area occupied by that bed type; and, sample sites are distributed evenly over each region). It is envisaged that of the order of 50 samples will be required but this number is dependent upon the variability exhibited by the samples themselves during recovery.

Samples will most likely be collected using a large clamshell grab. Upon recovery, the samples will be sub-sampled by coring them (this will also allow them to be depth referenced) and will then be shipped as rapidly as possible to a laboratory where they will be scanned with a UV light to identify any fluorescent particles present. If fluorescent material is found then this will be photographed to allow its colour to be compared to the colours of fluorescent coating that are available.

Once it has been photographed the fluorescent material will be dried in an oven at 80ºC (the temperature used for drying sediment prior to particle size analysis) to establish if this alters the character of the fluorescence, once cooled the material will be re-photographed.

In addition, 24 vibrocores taken in the vicinity of the licence area have been scanned with a UV light to investigate the presence and distribution of any fluorescent material.

By carrying out the Background Fluorescence Study the risk of the results being compromised as a result of naturally occurring fluorescent particles will be minimised.

Rationale for Background Sampling Design

Key Background Information

- ***Based on data from previous studies, it is anticipated that sediment (tracer) mixing depths on site will, primarily, be controlled by the amplitude of any bedforms present. If no bedforms are present then mixing depths due to physical processes will be shallow (<5cm anticipated).***
- ***At present, the bed is armoured with varying amounts of shingle. Beneath the shingle the sediments are hard and compact, it has been suggested that this may be due to them having been exposed, sub aerially at some time in their past.***
- ***The REA predicts that the sand sheet / bedform field which will develop as a result of the dredging will extend approximately 2.2km to the NE of the active dredge zone and will measure ~200m around the remaining three boundaries of the zone. It is also predicted that the sheet / bedform field sediments will be 10-25cm in thickness.***

Choice of Vibrocore Samples for Background Analysis

Given that there is a well developed armoured layer present and that the sediments are hard and compact, it is considered highly unlikely that any bedforms present during the tracer study will extend below the current level of the seabed. As a consequence, the background fluorescence checks on bed sediments outside the active dredge area need only consider the upper few centimetres (~5cm) of sediment

Hence, there is no requirement to check vibrocores collected from beyond the active dredge area, instead, clamshell grab samples can be used. All vibrocores collected from the proposed active dredge area will be scanned for background fluorescence. The cores will be scanned over their full depth.

Clamshell Grab Sampling Array

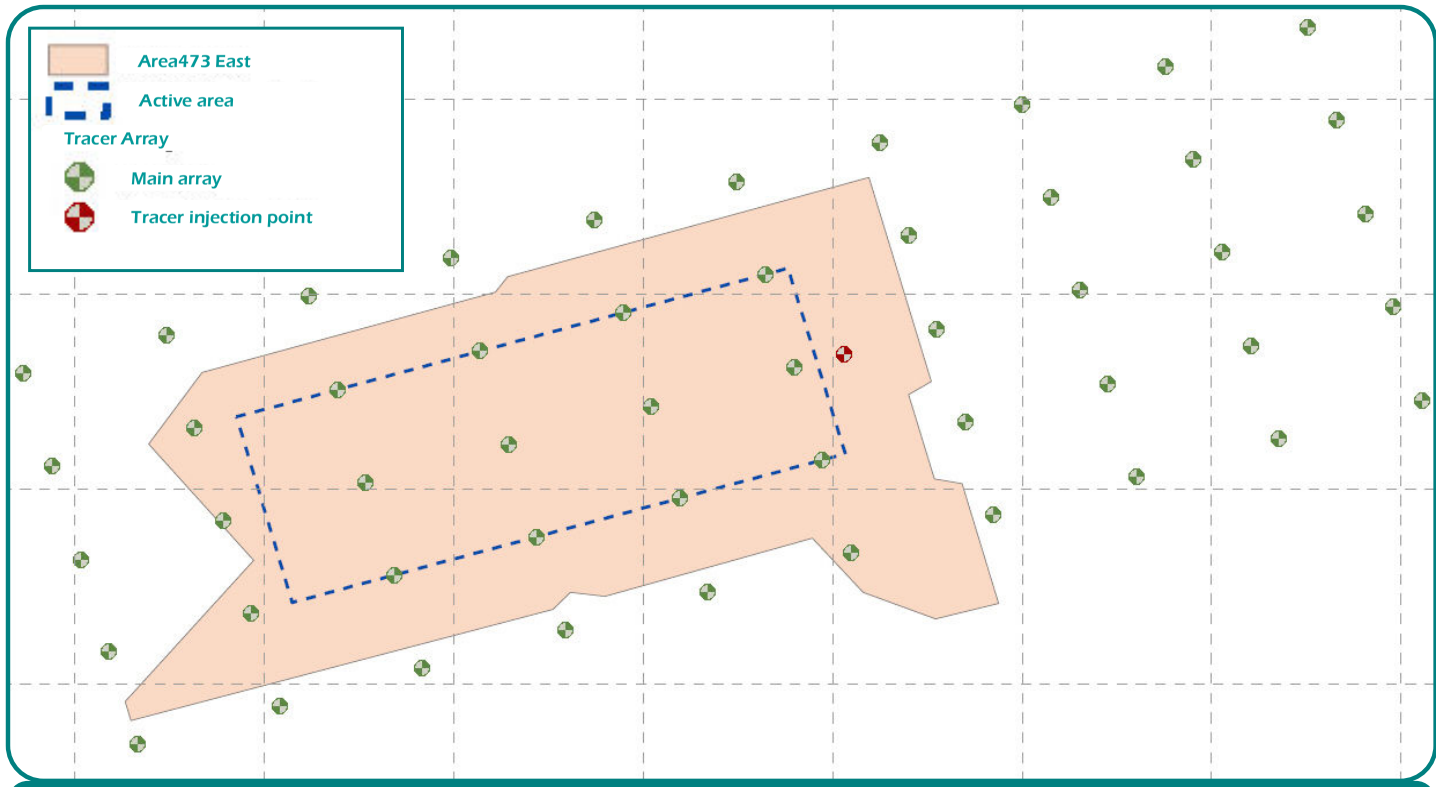
A following data have been reviewed in order to gain an understanding of the character of the seabed over the area it is predicted that sediment from the dredging activities will be distributed in the short to medium term:

- ***Side-scan sonar data.***
- ***Clamshell grab sediment samples.***
- ***Hamon grab sediment samples.***
- ***Drop down camera data.***
- ***Seabed profile image camera data.***
- ***Bathymetric data.***

The review of the available data has shown that there is little variability in the character of the seabed over the area of interest. The data do not reveal any pathways along which the dredge sediment is likely to preferentially travel once it reaches the seabed, nor do they show any areas where there is a significantly higher likelihood of sediment deposition and accumulation occurring.

Based on this information, the sampling array for the background fluorescence assessment will be regularly spaced. As already described, the model for the behaviour of the sediments released by dredging predicts that the material will accumulate in an area which extends approximately 2.2km to the NE of the active dredge zone and is approximately 400m wider than it (200m wider on each side). The model also predicts that around the remaining three sides of the active dredge zone, sediment will extend approximately 200m.

To encompass this area, it is proposed to take background clamshell grab samples over an area which extends 3km to the NE of the proposed active dredge area, 1km to the SW of it and 0.5km to the NW and SE. The planned sampling array is presented in Figure 1. As can be seen, the intention is to collect 51 background samples. The samples will be collected using a hydraulic clamshell grab, the expected depth penetration is ~0.20m.



The design of the sampling array for the tracer study considered the results of previous studies (sidescan, bathymetry, seabed sediment). This review resulted in a uniform positioning of sampling sites across the area as the seabed exhibited little variation in character.

Planned Development of Tracer Study

Development of the tracer study is ongoing. A draft specification and operating procedure for the field work is being produced and this will be circulated for review to relevant TWG members prior to operations.

It is anticipated that the field operations for the first tracer injection and sampling will be undertaken in June 2007 if conditions permit. The current plan for the study dictates two tracer injections with the operations for the second injection being modified following analysis of the result from the first injection. This will ensure that the first injection is approached with caution to ensure best use of the invested resources. As described above, a repeat of the Area 473 East seabed sediment survey is planned for this time and combination of effort may be possible to reduce costs and increase the value of the data acquired.

The logistical aspects of the study are significant. Discussions have taken place to determine the possibility of combining tracer and plume field work which may have benefits in terms of reducing costs through sharing of survey platforms. It will also be of benefit in that combination of the data generated by each study will have been considered.

Queries regarding the development of the tracer study can be directed to Dr Mark Lee, Emu Limited, who is responsible for the survey design, planning and data acquisition.

5.7 Plume Study

The development of the plume study has been undertaken in tandem with the tracer study to ensure that data from the two studies are, as far a possible, interrelated and compatible. At present development of the plume study is concentrating on determining the engineering and logistical issues related to sampling of the screening and overflow water/sediment mixtures.

Development of the methodologies that will be applied during the work is being undertaken by HR Wallingford. The current progress towards development is described below.

Overflow Spillway Sampling

In order to determine the nature of the sediment returned to the environment during extraction operations, sampling of the discharge from screening chutes will be undertaken. It is proposed that this could be achieved by directing the discharge from the chute into the hopper with the "target material" being discharged over the side of the vessel. However, there will also be a requirement to determine representative samples of the overflow spillway discharge over the period of loading for both screened and all-in cargoes. The methodology for safe and representative sampling is being devised in conjunction with the ECA based on the layout of the target vessel(s) selected for monitoring and the operational procedures that these vessels will adopt whilst dredging in the Eastern English Channel.

Whilst previous "bucket" sampling of deck level overflow spillways combined with video imaging of spillway discharge achieved acceptable results (as undertaken aboard the Arco Severn during previous studies) it is assumed that this approach needs to be reviewed from a reliability point of view and, in particular from an HSE point of view, particularly in terms of safe accessibility if the target vessel(s) are fitted with twin suction pipes. Other sampling options that have been considered; these include drawing off of samples from specially provided tapping points suitably located in close proximity to the spillways (i.e. assuming that the water/solids mixture at the tapping point is representative of what might discharge over the spillway) and the use of large scale pumped sampling from the hopper with the control of the pumping units and sample take-off location being at a suitable working point on the vessel. Other options may also exist. In order to examine the feasibility of such options a phased approach has been proposed by HR Wallingford as follows:

Phase 1

Initially a visit will be made to a "target" vessel to examine and discuss the feasibility of different options with a Technical Manager and ships crew. Following this shore-based visit, observations will be made of a typical loading/overflow operation at sea. Subsequent discussions will focus on the possibility of making engineering modifications to the vessel to enable effective sampling during the actual screening and overflow study.

Phase 2

Following the Phase 1 discussions and visit to the vessel plans for a suitable sampling methodology will be drawn up and a draft protocol for use developed. A suitable opportunity for trialing the sampling equipment and methodology will be agreed and a trial at sea carried out. If these trials involve engineering modifications to the vessel (e.g. the provision of tapping points etc) then it is essential to ensure that the trial vessel used becomes (one of) the target vessel(s) for the monitoring campaign to be undertaken in spring/early summer 2007. A small number of samples will be analysed at this stage to examine performance of the methodology used.

Optional Phase 3

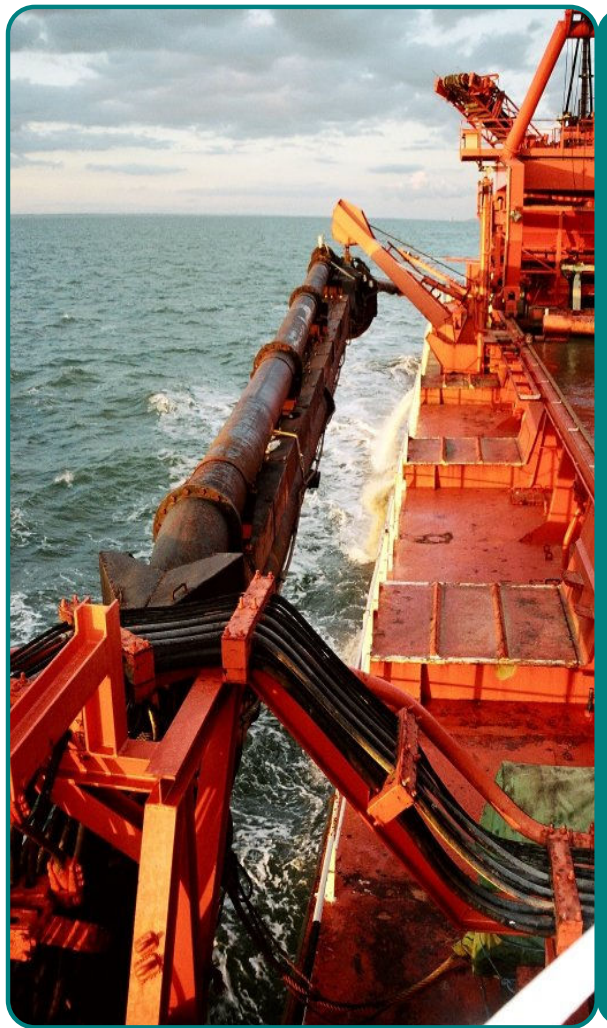
Depending on the outcome of the field trials of equipment and protocols undertaken in Phase 2 it may be necessary to agree a revised sampling methodology to improve reliability or the representability of the samples collected. The revised equipment and methodology will be trialed at sea on a suitable "target" vessel.

Preparation of Methodology for Plume Monitoring

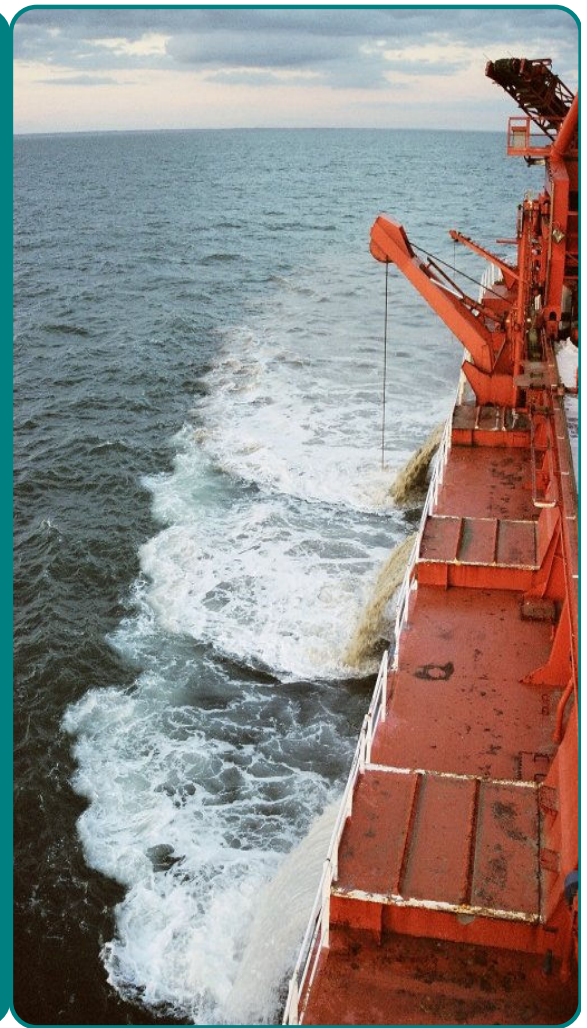
The plume monitoring campaign will be a complex offshore field programme. It may require the use of up to three survey vessels and may involve monitoring of two different dredgers over a period of 3 to 4 days. The logistics of the survey will need careful planning and co-ordination. For the survey to have maximum value it will need to coincide with a time when the dredgers which are being used on the site are carefully logging most of their activities along with records of the quality of the loads being discharged ashore. Clearly the survey activity will be weather dependent and it will be necessary to consider the available windows for the monitoring activity over perhaps a 6-8 week period in April and May 2007.

The development of the methodology for the monitoring needs to take place over time so that all parties are aware of the requirements upon them. This will be achieved through careful iteration of the methodologies and programme proposed. However, early planning relating to vessel numbers and vessel availability will play an important role in shaping the methodology.

There is a possibility of combining aspects of the plume monitoring campaign with the tracer study, or indeed repeat seabed sediment sampling operations. Discussions are ongoing regarding the practicalities of this. The alternative approach, as discussed, is to keep the plume monitoring campaign as an independent activity in terms of its timing.



Sampling of the spillway and screening discharge from dredgers will provide basic information regarding the nature of fine sediment being returned to the environment during extraction operations in the ECR.



5.8 ECR Regional Monitoring Project Plan

A project Gantt chart was presented in Blueprint v0.3.

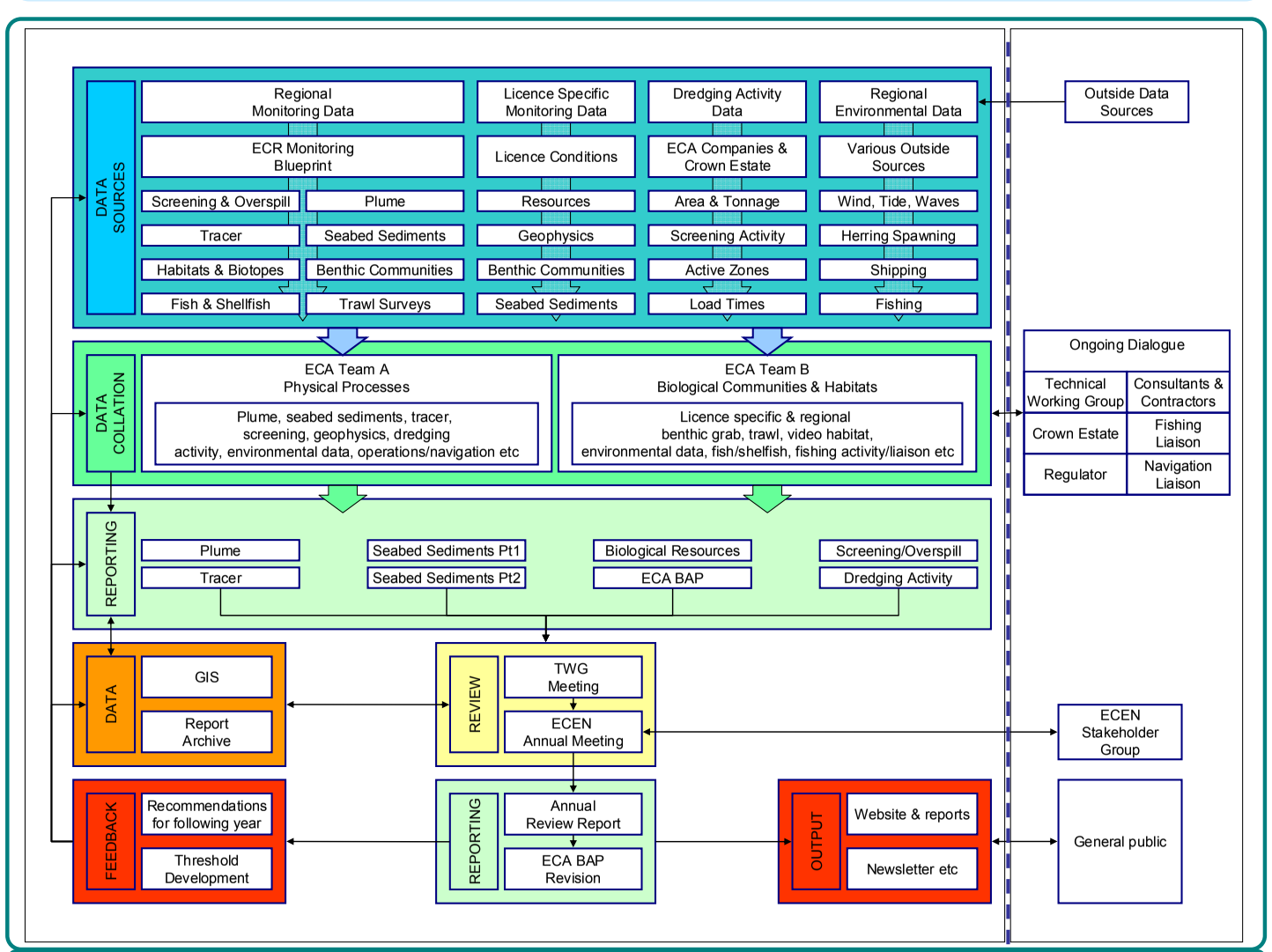
Modification of timings due in part to delays in start of extraction operations has resulted in a requirement to modify the plan presented. In addition to this, discussions during TWG and ECEN meetings suggested that modification of the timings of annual meetings may be required and that additional 'interim' meetings of the TWG would be of benefit in directing the monitoring activity.

Therefore, revised project plans for the following 12-18 months monitoring and management activity are presented in on **pages 124** and **125**.

Principle modifications include:

- ***Change in the timing of tracer, plume and repeat seabed sediment surveys due to delay in the initiation of extraction at Area 473 East.***
- ***Change in the timing of submission of annual draft regional report to the TWG prior to the 8 week review period.***
- ***Addition of interim TWG meetings at the end of January and during week 5 of the 8 week review period.***
- ***Change in the timing of the ECEN meeting to an earlier date than that of the 2006 meeting.***

The Gantt chart will be reviewed and amended periodically the following 12 months and a revised version presented at the end of 2007.



The process of data collation, reporting and review was presented in the Blueprint v0.3 & provides the framework for adaptive management of the regional activities.

5.9 Reporting and Review

The Blueprint v0.3 proposed a reporting and review programme for activities in the ECR.

The original proposals have been adhered to as far as possible within the time and logistical constraints encountered during the first 18 months of activity.

This document is the first regional report and contains the information that has been gathered and analysed over the previous 18 months.

The monitoring organogramme, as shown below, was presented in the Blueprint v0.3 and provides the basic description of the process of reporting and review necessary under the terms of the regional monitoring programme. The organogramme, and Blueprint, specifies the following aspects of reporting:

1. ***Seabed sediment – Part 1***
2. ***Seabed sediment – Part 2***
3. ***Plume***
4. ***Tracer***
5. ***Screening/Overspill***
6. ***Dredging Activity***
7. ***Biological Resources***
8. ***ECA BAP***

It is clear from review of the information presented in this report that since the submission of the Blueprint v0.3, the reporting carried out to date complies with, and exceeds, this original proposal. Extension of the reporting has been undertaken to include aspects such as fishing activity and herring spawning, and development of the regional reporting scope will need to occur throughout the lifetime of the operations.

This initial report has been collated to provide the best available view of the progress of monitoring and management activities in the region in order that stakeholders can make informed comment regarding the continuation of both the extraction activities and the monitoring programme.

Modification of the report format will possibly be required as the monitoring programme progresses, due to several factors:

- ***Some of the individual facets of regional monitoring may become substantial enough to warrant individual reports to be produced.***
- ***The timing of reporting may warrant submission of interim report outside of the schedule of the main reporting schedule.***
- ***The format of the report may not be suitable as understanding of the nature of the regional monitoring programme improves.***

It is hoped that the stakeholders who receive this report will provide feedback regarding the format, scope and findings so that future reports can be modified accordingly. It should be borne in mind however that creation of a document that satisfies the requirements of all parties may not be achievable in the short term. Adaptation of the annual report format and scope, up to the issue of the second REA in year 5, is likely to be part of the process. This should be considered a valuable opportunity to determine what should be thought of essential for inclusion and the aspects that are of interest but which add little to the decision making process. Submission by stakeholders of focussed, relevant advice will assist in the ongoing process of review and revision and enable the ECA to periodically reassess and improve outputs.

Monitoring Project Plan 2007 – mid 2008

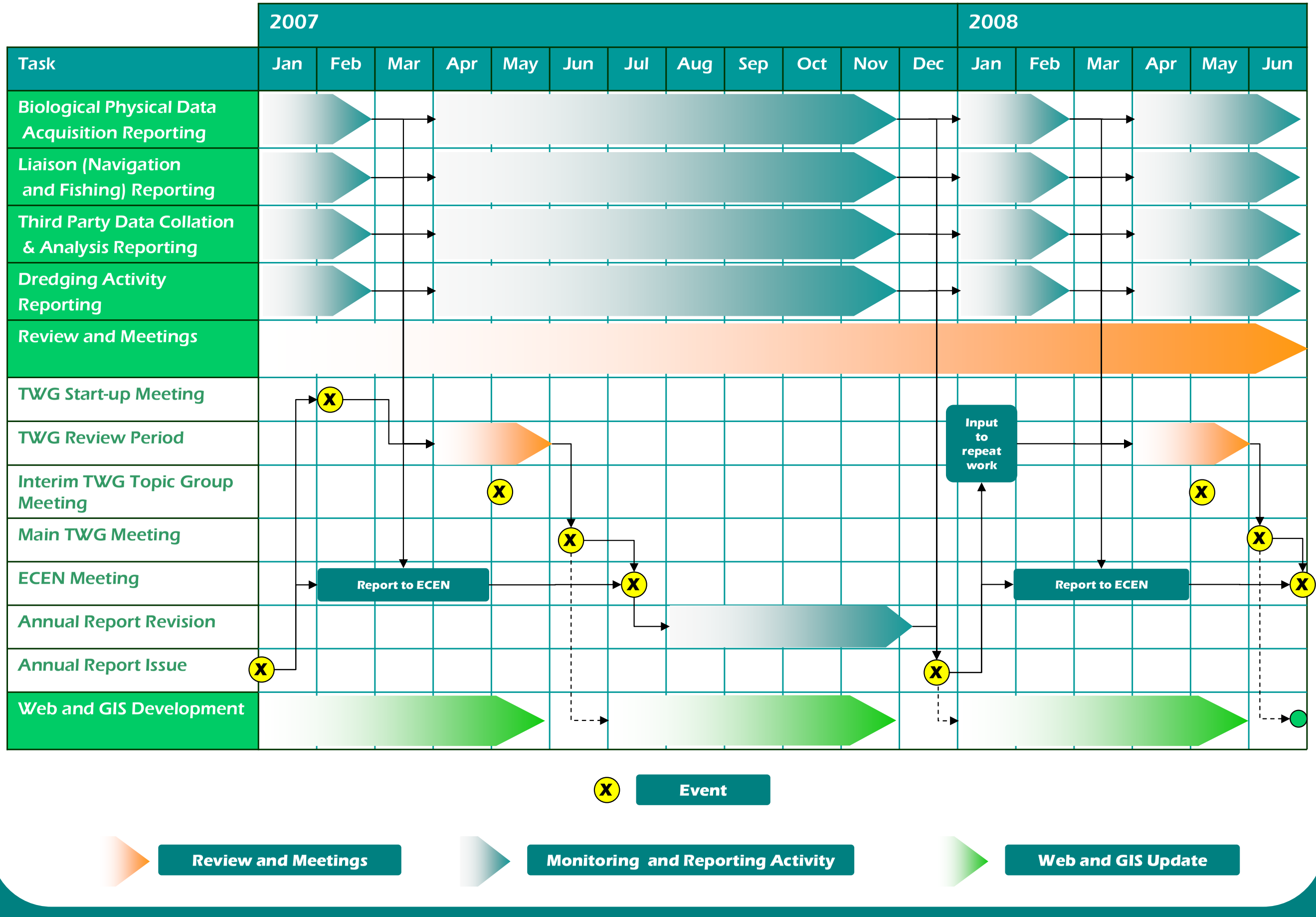
Task	2007 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2008 Jan	Feb	Mar	Apr	May	Jun
Repeat Biological Monitoring	▶			▶		▶					▶		▶			▶		▶
Field work								→	→	→								
Sample processing	→	→									→		→	→				
Data analysis & reporting	→	→	→		→	→	→						→	→	→		→	→
Seabed Sediment Survey Area 473 East	▶			▶		▶					▶		Review of survey frequency			▶		▶
Survey planning	→	→	→					→	→	→							→	→
Field work – sidescan/swath				→							→							
Field work – grab						→						→						
Data analysis & Reporting					→	→	→	→	→	→		→	→	→	→			
Tracer Study	▶			▶		▶					▶		Dependant on results of first injection			▶		▶
SOP, background study and tracer manufacture	→	→	→	→	→							⇢	⇢	⇢	⇢	⇢		
Tracer injection and sampling						→	→									⇢	⇢	
Review and reporting							→	→	→	→								⇢
Plume Study	▶			▶		▶					▶		▶			▶		
SOP and logistical studies	→	→	→	→	→													
Plume field work						→	→											
Review and reporting							→	→	→	→			→	→	→			

▶ Report to TWG and ECEN

▶ Monitoring Activity

▶ Input to Annual REMM Report

Management Project Plan 2007 – mid 2008



Notes: