

## NATIONAL NETWORK OF REGIONAL COASTAL MONITORING PROGRAMMES

### SPECIFICATION FOR DATA MANAGEMENT AND DELIVERY SYSTEM

#### Record of Changes

Version	Date	Status	Modifications
1.0	11 August 2015	Final	-
1.1	11 August 2016	Final	Section 2.1.5 revised to include TRA Section 3.4.6 added (additional functionality) Section 3.5.3 revised to include additional data types
1.2	02 November 2020	Draft	Changes to reflect NEC4 terminology throughout. Section 2.1.4. Revised to allow provision for virtual meetings. Section 3.1.5 revised to require logging of data downloads. Section 3.1.6 & 3.5.1 Update metadata standard. Section 3.1.7 Require financial reporting. Section 3.2.1 Change to primary website address. Section 3.2.4 Revised to reflect changes in hardware requirements. Sections 3.3.3/4 Requirement for yearly time series graphs. Section 3.3.9 Removal of Argus camera requirements. Section 3.4.5-8 Clarification of Resources Pages and content. Section 3.5.3 Coastal protection assets added to data types. Section 3.2.7 Changes to user registration requirements. Table 2 updated.

## 1. PURPOSES AND OBJECTIVES OF DATA MANAGEMENT AND DELIVERY SYSTEM

- To provide a data management and delivery system for data collected within the National Network of Regional Coastal Monitoring Programmes (NNRCMP)
- To provide a website for dissemination of project data and public authority research data, using Open Government Licence and/or other licences
- To provide an online browsable GIS and metadatabase, and image gallery
- To provide real time data for use in coastal flood forecasting and warning
- To provide base line design statistics for future coastal and marine planning and projects
- To enable operational assistance in coastal construction projects
- To develop archival storage of real time and accumulated wave, tide and meteorological data in a consistent and publicly available format *e.g.* graphs, summary tables and raw data, and via the internet
- To assist the monitoring of severe weather conditions

## 2. GENERAL SPECIFICATIONS

2.1 General		
2.1.1	Support	The Consultant will provide Channel Coastal Observatory (CCO) personnel with work hours telephone/email access to relevant developers to facilitate iterative development/query/problem resolution
2.1.2	Software development	Provision shall be made available to enable a programmer to work on development of the project.
2.1.3	Intellectual property rights	The intellectual property rights of developments will be shared by the Consultant and the Client; both will be entitled to exploit the use of any developments made in the course of the programme delivery, in future applications. Source code files will be made available for ongoing application.
2.1.4	Project meetings	Project management meetings will be held approximately monthly via video conferencing, for the first 6 months of the contract and at 3-monthly intervals thereafter. In-person meetings will be held at least once per year, at the National Oceanography Centre, Southampton. Meetings should be attended by both the service manager and senior web programmer. The meeting duration will typically be 3 hours. Costs should allow for all disbursements including travel, subsistence and travelling time. Monthly reports will be provided to the CCO service manager detailing cost and task status.
2.1.5	Performance monitoring arrangements	In view of the importance of continuity of data, the Client reserves the right to conduct a Technology Readiness Audit (TRA) 2 weeks prior to the Consultant's assumption of responsibility and a further TRA 3 months later. One year after award of contract, and at annual intervals thereafter, a review will be undertaken by the Client to examine the performance of the Consultant during the contract period. If, during the

2.1 General		
		TRA or annual review, the Consultant is shown to be failing in his obligations to meet stated KPIs, or comply with the terms of the Contract, Specification or Scope, the Client may exercise his rights under clause 90 of the Conditions of Contract to terminate the contract.

### 3. PROJECT SPECIFICATIONS

3.1 General tasks		
3.1.1	Summary	<p>The Consultant will design, develop, install and maintain a web based delivery and data management system for coastal data and metadata.</p> <p>The Consultant will supply, install and manage webserver, data storage and backup system and associated server infrastructure.</p>
3.1.2	Software architecture	<p>The Consultant will provide a flexible and extensible software architecture that can support an iterative development process through continual customisation, and that is adaptable to evolving data structures</p> <p>All software applications are to be developed using e-gif/e-gov compliant open source code</p>
3.1.3	Website	<ul style="list-style-type: none"> <li>• Design, develop and host website</li> <li>• Setup Content Management System (CMS)</li> </ul>
3.1.4	Real-time data	<ul style="list-style-type: none"> <li>• Supply and maintain tools for real-time delivery of time series data</li> <li>• Develop online database of near real-time environmental data</li> <li>• Develop and manage delivery software for new locations and systems</li> <li>• Develop and manage delivery software for onward transmission of real-time data</li> <li>• Develop and manage an API facility for real-time data</li> </ul>
3.1.5	Online GIS	<ul style="list-style-type: none"> <li>• Develop online GIS interface to visualise and interact with data sets stored in metadatabase</li> <li>• Provide external interface to data via OGC compliant geospatial web services</li> <li>• Develop extensive shopping-basket style download system for metadatabase</li> <li>• Provide viewable base layers and information layers from external organisations</li> <li>• Provide logs of access to and downloads from website or OGC services</li> </ul>

<b>3.1 General tasks</b>		
3.1.6	Metadatabase and data warehouse	<ul style="list-style-type: none"> <li>• Develop a flexible spatial metadata database able to store, validate, manage and search FGDC/ISO 19115 compliant metadata records using XML and XLSX formats within a spatial database</li> <li>• Provide a facility for online viewing of data and metadata</li> <li>• Develop procedures to enable automated loading of metadata to the database</li> <li>• Population of metadata records and upload data files to support system (approx. 250,000 new records are anticipated for a 5 year period)</li> <li>• Development of new data delivery and management tools</li> <li>• Develop online reports and simple data valuation model based on download statistics</li> <li>• Provide a facility for supply of INSPIRE-compliant survey-scale metadata to MEDIN</li> </ul>
3.1.7	Management	<ul style="list-style-type: none"> <li>• Provision of support</li> <li>• Provide monthly management and finance reports</li> </ul>
3.1.8	Hardware infrastructure	Provision and management of webserver and backup infrastructure
3.1.9	IT security	Services shall be provided in accordance with ISO 27001:2018

<b>3.2 Basic website structure</b>		
3.2.1	Initial website design	<p>The Consultant will design, develop and host the Coastal Monitoring website (<a href="http://www.coastalmonitoring.org">www.coastalmonitoring.org</a>, <a href="http://www.channelcoast.org">www.channelcoast.org</a>). Existing content will be migrated across to the new site to the style of web design and software architecture in accordance with the tenderers proposal and as subsequently agreed by the Client.</p> <p>The basic structure should allow as a minimum for delivery of all of the functionality and content available on the existing website at the time of the tender period.</p>
3.2.2	Content Management System	<p>The Consultant will setup a Content Management System (CMS) to separate and integrate: design, content, structure and interactive functionality.</p> <p>The basic website will include the following features:</p> <ul style="list-style-type: none"> <li>• search engine</li> <li>• site map</li> <li>• navigational aids</li> <li>• password protected pages</li> </ul>

<b>3.2 Basic website structure</b>		
		<ul style="list-style-type: none"> <li>• interactive website features</li> </ul> <p>Administration and access to the Content Management System will be provided to allow Channel Coastal Observatory (CCO) staff to update agreed pages of the website.</p>
3.2.3	Ongoing site development	<p>The Consultant will make provision for continuous addition of new web pages and functionality, by CCO staff or the development team. New content for the web site will be provided by CCO throughout the duration of the contract.</p> <p>Provision will be made for continuous development of the website and functionality following initial construction which will be in accordance with the Consultant's proposal</p>
3.2.4	Server requirements	<p>The Consultant will provide and maintain all infrastructure required to deliver the project as specified, including backup systems and servers. A schedule of proposed infrastructure should be provided within the project proposal. The Consultant should build in scalability and heterogeneity to enable the system to support project growth. The infrastructure should be designed to provide a robust and reliable system that will require minimal maintenance during the Contract period. High grade components should be specified. Any hardware will become the property of the Client.</p>
3.2.5	Additional hardware requirements	<p>The Consultant will provide additional hardware as specified. Costs of any additional hardware will be charged at the supplier's cost plus a defined percentage on cost.</p>
3.2.6	Backup	<p>The Consultant will be responsible for provision of backup and archiving facilities for all elements above (daily, weekly, monthly). Secure, off-site backup facilities will be provided in accordance with ISO 27001:2018.</p>

<b>3.3 Real-time web delivery</b>		
3.3.1	Real-time web delivery	<p>Develop and maintain an expandable software system to facilitate real-time web delivery of wave, tide and met data from remote locations.</p> <p>The Consultant will be provided with data from offshore stations, via real time radio telemetry systems, satellite communications (Iridium Short Burst Data), and standard logging software to shore based stations equipped with a broadband link. The broadband link for each site will be provided and maintained by the Client. Standard data output will be provided to the Consultant for each type of system. The system types</p>

<b>3.3 Real-time web delivery</b>		
		<p>listed in Table 1 must be supported, both for near-real-time <i>e.g.</i> 10 minutes and real-time data streams <i>e.g.</i> ~1 Hz.</p> <p>Example data files can be downloaded from the Data Catalogue. Incoming data will be formatted, transferred and broadcast on the project website in an agreed format.</p> <p>All real time data sets will be stored and archived, to be available on the project metadatabase and database. Archiving in an agreed archive file format will be conducted monthly. All wave spectra files and raw data files shall be downloadable directly from the real-time pages.</p> <p>Facilities shall be made to enable transfer of real-time data to external users in near real-time.</p> <p>Provision will be made for the addition of real-time links to new sites within the network as required. These will be established with the full data manipulation and presentation functionality as defined for the existing sites.</p>
3.3.2	Time series data delivery	<p>Develop an online database of near real-time environmental data, linked to GIS, include tabular and live graph data on website. Provide a GIS front end interface that enables a direct link to real-time graphing of all remote wave, tide and met measurement sites. A total of 47 sites are within the current network, plus visualization for 2 third party sites</p> <p>The online front end will link to the following outputs for each measurement site:</p> <ul style="list-style-type: none"> <li>• Tabulated time series text data</li> <li>• Time series graphs</li> <li>• Instrument maintenance history</li> <li>• Data download facility</li> <li>• Deployment statistics</li> </ul> <p>The web site update rate for web site delivery of real time records for the tabulated time series text data and time series data shall be at least every 30 minutes for each wave buoy site and at least every 10 minutes for each tide gauge and met station site. Real-time data for the "latest" data page will be updated at least every 5 seconds. ~1Hz data shall be averaged every 10s and transferred to the UNESCO tsunami warning service run by VLIZ. Wave data shall also be transferred to a CEFAS secure FTP site.</p>

<b>3.3 Real-time web delivery</b>		
3.3.3	Time series graphs	<p>An online graphing facility will be provided for each instrument site to enable key hydrodynamic parameters to be displayed and updated online. Time series graphs will be presented in a clear style.</p> <p>Time series of the variables shown in Table 2 will be plotted for each measurement site. Both graphs and tables of tide data shall be capable of being transformed from/to Ordnance Datum and Chart Datum.</p> <p>The start date for time series graphs will be user-selectable and the output for all graphs will be selectable online to enable the following choices of x axis data time range output:</p> <ul style="list-style-type: none"> <li>• Day</li> <li>• Week</li> <li>• Month</li> <li>• Year</li> </ul> <p>The "Latest readings" will be displayed; a graph of the latest 5 minutes of real-time (~1Hz) data shall also be provided.</p>
3.3.4	Time series text tables	<p>Time series data for the variables listed in Table 2, plus Latitude and Longitude, will be presented in tabular form. Records will show for each 30 minute period for wave data and for every 10 minute period for tidal elevations and met data.</p> <p>The highest single recorded value of the year will be shown for the significant wave height, water level, wind speed and barometric pressure variables, as appropriate.</p> <p>The start date for time series tables will be user-selectable and the output for all graphs will be selectable online to enable the following choices of time range output:</p> <ul style="list-style-type: none"> <li>• Day</li> <li>• Week</li> <li>• Month</li> <li>• Year</li> </ul>
3.3.5	Wave spectra and raw data	<p>Wave spectra and heave (1Hz) data shall be displayed as graphs, with provision to select any file since deployment. Wave spectra shall be split on the fly into sea and swell components, and wave parameters derived separately for each section. The location of the split frequency shall be user-customisable.</p>

<b>3.3 Real-time web delivery</b>		
3.3.6	Instrument maintenance history	A web page will be maintained that provides details of maintenance activities and a site description of each instrumented site. Provision will be made for CCO staff to update this page to reflect the history of maintenance.
3.3.7	Statistics	<p>Annual statistics will be presented for each variable and for each year of deployment, based on archive data. Data will be presented in both tabular and graphical form for each of the following variables. Graphs will provide monthly statistics for each variable listed in Table 2.</p> <p>Rose diagrams will be generated for the following combinations of variables on a 3-monthly basis:</p> <ul style="list-style-type: none"> <li>• Significant wave height against wave direction</li> <li>• Mean wave period against wave direction</li> <li>• Peak wave period against wave direction</li> </ul>
3.3.8	Real-time system management	<p>An automated text and email alert system will be established and maintained to provide system management information for each remote instrument site. Automated emails and SMS texts will be provided to defined system users with the following information:</p> <ul style="list-style-type: none"> <li>• Buoy movements outside of spatially defined bounding polygons. This will be based upon the wave buoy GPS signal</li> <li>• Notification of out of range data</li> <li>• Wave conditions at any defined site exceeding defined threshold conditions</li> <li>• Failure of any system to provide and update within a defined time frame</li> </ul> <p>A system shall be provided for any registered user to receive self-defined email, text or tweet alerts for one or a combination of wave/tide/met conditions.</p>
3.3.9	RINEX stations (GPS)	Facilities shall be provided to receive, display and archive hourly data from 7 RINEX stations with the potential to add additional stations as needed. Users shall be able to select RINEX data since the deployment, for a user-defined period.
3.3.10	Development of transfer protocols and graphing for new systems	The Consultant will develop real time data handling routines for any new as yet undefined systems. The Consultant will develop additional statistical tables and graph routines as required.
3.3.11	Development of custom dashboard	A system shall be provided for users to generate a personalised, custom-designed dashboard of real-time data involving multiple sites and parameters



<b>3.4 Additional functionality</b>		
3.4.1	Other online delivery system	The Consultant will develop and maintain facilities to archive and display a hierarchical photo gallery with metadata, including bulk and individual upload processes. An online geo-referenced map and metadata will be developed for external users to upload photographs of <i>e.g.</i> wave overtopping or landslides. Development of an "app" for smart phones will form part of the upload process.
3.4.2	Programme pages	A series of web pages will be provided for CCO personnel to load information, news features <i>etc.</i>
3.4.3	Regional pages	A series of web pages will be provided for each Region to upload newsletters and other information, including regional contact details. The pages will be accessed via a front page map, allowing users to select a region. Separate passwords will be available for each region to upload information. A password-protected page will be provided for information for regional partners.
3.4.4	Contacts	A generic website "contact us" email facility will be provided. A feedback facility will be provided for website users, to include link of relevant user page. Both contact us email and feedback will be accessible to Consultant and CCO personnel.
3.4.5	Resources pages	Webpages will be provided for provision of programme wide information such as data specifications, QC procedures and other useful resources. Options will be provided to expand the website with additional pages for coastal research projects
3.4.6	Online analytical models	A facility to run an online profile model "Shingle-B" will be provided and maintained, including management of input and output files, and user statistics. A facility to display forecasts from the SWEEP OWWL Operational Wave and Water Level Model will be provided, with map based site selection.
3.4.7	API	Develop and manage an SPI facility for real-time data. The API should provide users with the latest wave data at 30 minute intervals and the latest tide and meteorological data every 10 minutes.
3.4.8	WMS	Provision of Web Map Service web viewer layers to include: Ortho-rectified aerial photography (RGB and FCIR), Lidar, Swath Bathymetry; Habitat mapping; GPS control points; wave buoy, tide gauge and met station positions; OSGB grid. Variable scale layers may be required for some datasets. Wave buoys, tide gauges and GPS control points should be queryable to display real-time data. Lidar and Bathymetry data should be queryable for point elevation data.

<b>3.5 Spatial metadata content management system</b>		
3.5.1	General requirements	<p>The Consultant will develop a flexible online spatial metadata database able to store, validate, manage and search FGDC/ISO 19115 compliant metadata records using XML and XLST formats within a spatial database.</p> <p>The current Channel Coastal Observatory online database is compliant with the technical delivery requirements. This is populated with in excess of 350,000 data sets and accompanying metadata records. The existing database will form part of the new system, either in its current form or by migration of the data sets to the proposed system, in accordance with the Consultants proposal. A database system will be developed that is expandable and which will cover the UK coastline and Channel Islands. The new database will provide, as a minimum, the full functionality of the existing database and delivery front end, but with search facilities and keywords to reflect the new extents of the database.</p> <p>Required features of the meta-database include:</p> <ul style="list-style-type: none"> <li>• Online viewing of metadata records</li> <li>• Online viewing of spatially referenced data files in GIS</li> <li>• Searchable database</li> <li>• Download facility</li> </ul>
3.5.2	Metadata standards	<p>The metadata system will provide output that is compliant with FGDC or ISO 19115 standards. Templates will be provided that enable metadata forms to be completed online and metadata to be generated to FGDC/ISO 19115 standards.</p>
3.5.3	Reading, uploading and validating new records	<p>The Consultant will provide functions for reading and converting data sets dynamically and in batch so as to provide information to auto-complete metadata fields.</p> <p>Standard metadata templates/forms will be prepared for each of the following basic data types, which are prepared to consistent specifications (examples of completed metadata forms are available on the project website):</p> <ul style="list-style-type: none"> <li>• Ortho-rectified aerial and False Colour Infra-red imagery</li> <li>• Non-rectified aerial imagery</li> <li>• Oblique imagery</li> <li>• Bathymetry data</li> <li>• Lidar</li> <li>• Photogrammetric profile data</li> <li>• Topographic survey data</li> <li>• Waves</li> <li>• Tides</li> <li>• Meteorological data</li> </ul>

<b>3.5 Spatial metadata content management system</b>		
		<ul style="list-style-type: none"> <li>• Current data</li> <li>• Terrestrial ecological mapping</li> <li>• Seabed mapping</li> <li>• Coastal Protection Assets</li> <li>• Documents</li> </ul> <p>The Consultant will provide a facility to enable bulk and individual upload of files by CCO staff. Facilities will be provided to enable CCO staff to:</p> <ul style="list-style-type: none"> <li>• Create a new metadata template form</li> <li>• Edit existing form types</li> <li>• Create metadata from a template form</li> </ul>
3.5.4	Validation procedure	An automated validation procedure will be developed that enables all metadata to be checked and all fields within the form to be validated prior to entry to the system.
3.5.5	Population of database with existing data sets	The Consultant will populate the database with metadata and survey data, migrated from the current system. This comprises approximately 350,000 records.
3.5.6	Population of database and metadatabase	The Consultant will populate the database with metadata and survey data on a regular basis. During the course of the contract the Consultant will be expected to upload and provide storage facilities for at least 250,000 new data files (approximately 3TB storage). A metadata file will be prepared and uploaded to the system to accompany each data file; these will be prepared by the Consultant. Each metadata file will be populated with the full data sets required to achieve compliance with the FGDC (or ISO 19115) standard. Example forms for each data category are available on the project website. Data will be validated on upload to the system.
3.5.7	Customisation of upload facilities	Provision will be made for programming to facilitate occasional addition of new data types, customisation of metadata forms, validations and auto-completion mechanisms.
3.5.8	INSPIRE metadata	INSPIRE-compliant survey-scale metadata for new data added to the database shall be provided to MEDIN quarterly.
3.5.9	Search facility	<p>A search facility will be linked to a geographical front end. The search and download components of the system must be simple to use with clear online instructions that can be followed by non-technical users, and should be operable via conventional internet browsers, with no requirement for additional software.</p> <p>A facility will be provided for users to store customised search parameters, and to be notified when new data are added.</p>

<b>3.5 Spatial metadata content management system</b>		
3.5.10	Primary search facility	The primary search facility will provide a map front end with GIS-style selection and navigation tools. Navigation tools will include zoom and pan. A reference map will be provided to identify the location of the search area.
3.5.11	Secondary search facility	Facilities will be provided to refine the data search, using selectable combinations of data type, Selectable date range, and keywords. Keywords will be established for spatially referenced management unit areas and place names.
3.5.12	Search results summary	A results summary will be provided; this will indicate in table form the number of records in each data type category, within area selected at each stage in the search process. The date range of selected data sets will be shown in table form, for each data type. A reference map will be provided which shows the extent and location of selected data.
3.5.13	Viewable metadata	A facility for online viewing of metadata will be provided
3.5.14	Project performance measurement	<p>A tool will be developed that enables measurement of web site usage and downloads. This tool will be held in the password protected administration area of the website. An online reporting and simple remuneration model will be developed based on download statistics linked to the meta-database download records and end user registration details. A download log will be produced that identifies cumulative valuation statistics for each of the data types downloaded, over various periods of time. Data types are those listed in section 3.5.3.</p> <p>Valuations will be based upon figures determined by the CCO for each data type. Several categories of valuation will be used. A value will be assigned to each data type by CCO:</p> <ul style="list-style-type: none"> <li>• Rate per Management/Survey Unit</li> <li>• Rate per tile</li> <li>• Rate per site, per year</li> <li>• Rate per report</li> </ul> <p>Valuations of downloads shall be produced for separate pre-defined regions:</p> <ul style="list-style-type: none"> <li>• Northeast</li> <li>• East Riding of Yorkshire</li> <li>• Anglia</li> <li>• Southeast</li> <li>• Southwest</li> <li>• Northwest</li> </ul>

<b>3.5 Spatial metadata content management system</b>		
		<ul style="list-style-type: none"> <li>• All regions</li> </ul> <p>And for pre-defined user categories:</p> <ul style="list-style-type: none"> <li>• Local Authority/Environment Agency (2 categories)</li> <li>• Education (3 categories)</li> <li>• Commercial (3 categories)</li> <li>• Government Trading Fund</li> <li>• Conservation Organisation</li> <li>• Other</li> </ul>

<b>3.6 Online GIS</b>		
3.6.1	Map Viewer and online GIS browser	<p>A map viewer will be provided that enables the user to view maps, high resolution aerial photographs, lidar surface models, bathymetry surface models and other coastal survey data sets online.</p> <p>An online GIS interface will be developed to data sets stored in the metadatabase. An external interface to the data will be provided via OGC compliant geospatial web services.</p> <p>The online GIS browser will provide zoom, pan, feature select and a hierarchical layer display. The GIS will allow for addition of new background or metadata GIS layers with facilities for direct control by CCO staff. Tools will be provided for printing of screenshot, and a measuring tool. The online GIS browser will have a facility for dual windows.</p>
3.6.2	Development of online GIS browser	<p>Provision will be made for programming to facilitate further development of the GIS browser with the occasional addition of new data types and customisation of the viewer. Programmers will be made available to facilitate such developments as required.</p>

<b>3.7 Data download system</b>		
3.7.1	Download	<p>Data download procedures will be developed to enable online delivery of all available data sets. The end user will be able to add data to a shopping basket at any stage in the search process. The total size of the data in the basket will be shown. The end-user will be provided with the facility to download up to 5GB of data on each download. Future modification will include larger download limits. Each downloaded data file will be accompanied by a complete metadata record.</p>

<b>3.7 Data download system</b>		
3.7.2	User registration	Users will not be required to register to download data. Users will have the option of registering for an account, which will provide access to a personalised dashboard and realtime data alerts. The download process will block download of restricted data sets e.g. those in ownership or copyright of others (this will be flagged within the metadata ownership records) and will provide only records of contact details of the data owners.
3.7.3	Registration and login	An online application will be developed for data download. The form will record basic details such the type of organisation worked for, funding source and proposed use of the data. Email addresses will be recorded for delivery of data.
3.7.4	Management of users	Registered users will be assigned privileges against a hierarchy to include Normal Users and Super Users. A list of user details as submitted on registration will be maintained (this will be hidden in a password protected administration area).
3.7.5	Licencing	A system will be provided to deliver data online using at least 2 separate licences, populated with site-specific copyright and acknowledgement information.

Data type	Instrument type	No. of existing sites
Waves	Datawell Directional Waverider	44
Tides and waves	WaveRadar REX	6
	Etrometa step gauge	4
Tides	Valeport pressure transducer	5
	Valeport VRS20 wave radar	1
Met	Campbell Scientific, OMC, Vaisala	17

Table 1: Real-time data

Data type	Parameters	Comments
Waves	<ul style="list-style-type: none"> <li>• Date-Time</li> <li>• Latitude</li> <li>• Longitude</li> <li>• Significant wave height</li> <li>• Maximum wave height</li> <li>• Mean wave period</li> <li>• Peak wave period</li> <li>• Wave direction</li> <li>• Wave spreading</li> <li>• Sea surface temperature</li> </ul>	
Tides	<ul style="list-style-type: none"> <li>• Date-Time</li> <li>• Measured tidal elevation</li> <li>• Predicted tidal elevation</li> </ul>	Predicted tides for each site will be provided to the Consultant.
Met	<ul style="list-style-type: none"> <li>• Date-Time</li> <li>• Wind speed</li> <li>• Wind gust</li> <li>• Wind direction</li> <li>• Barometric pressure</li> <li>• Air temperature</li> <li>• Rainfall</li> <li>• Erythematous radiation, UV index</li> <li>• Humidity</li> </ul>	The y axis must display wind data in both $\text{ms}^{-1}$ and knots, and wind direction data in degrees and compass points. Exact parameter display may be site dependant.

Table 2: Real-time parameters