

GEOGRAPHIC INFORMATION SYSTEMS BASED TOOLS FOR MARINE POLLUTION RESPONSE

Oil and chemical spills in the marine environment can have widespread impact and long-term consequences on wildlife, fisheries, coastal and marine habitats, human health and livelihood, as well as recreational resources of coastal communities. In maritime emergency response the old adage stands true: 'Poor information makes bad decisions and good information makes better decisions.' It is vital that oil spill response organisations have access to good information and well-organised decision support systems.



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Since October 1973 Australia has had in place a pre-planned national strategy for responding to marine spills from vessels. The national contingency plan is known as the *National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances (National Plan)*.

The Australian Maritime Safety Authority, as managing agency for the National Plan, has recently completed a new initiative involving the development of a national Geographic Information System (GIS) to assist in oil and chemical pollution response in the marine environment. GIS systems provide a quick and efficient means of determining marine and coastal areas of environmental, economic and strategic sensitivity that could be impacted in the event of oil pollution incidents, and also provide a valuable resource and logistical information for combat authorities.

The Australian national GIS project is called the Oil Spill Response Atlas (OSRA). The major outcome of the OSRA project was to produce an integrated and uniform spill response atlas for Australia in a computerised GIS format able to be conveniently accessed and operated by spill response organisations, planning and clean up teams, environmental and wildlife agencies and other emergency organisations.¹ This brochure highlights some of the advantages of GIS based systems, the OSRA system details, features and potential uses in supporting the response to marine pollution incidents.

APPLICATIONS OF A GIS TO MARINE POLLUTION RESPONSE AND PLANNING

A GIS provides a consistent view of the information throughout the spill operations and provides a means of managing a wide range of data from a variety of sources. It gives response managers a fast and effective means of assessing the incident for answering the specific and changing needs of a response. It also provides a means of briefing spill response personnel, the media and the public to provide an up-to-date status and history of the response activities logged.

A GIS can be used for managing information related to pre-spill contingency planning, during a spill and for post-spill environmental damage assessment. A well developed GIS can be used for a variety of purposes including:

- Preparing site/ regional contingency plan maps.
- Helping to determine protection plans for shorelines.
- Assessing habitats affected or likely to be affected by the spill.
- Determining species likely to be impacted by marine pollution.
- Measuring affected shorelines.
- Visual presentation of response strategies and clean up operations.
- Management of environmental monitoring data.
- Calculating area of slicks from field GPS readings or landmarks.
- Keeping an historic record of equipment locations and deployment.

Australia is not alone in this trend towards the use of GIS technologies in marine pollution management. Integrated GIS based spill response systems have also

been developed internationally, with the US, Japan, Korea and the UK having fully operational decision support systems.^{2,3,4,5}

In the US and Canada, GIS based spill response systems have been successfully linked to Incident Command Systems (ICS) as well as shoreline assessment and treatment databases like SCAT and providing valuable clean up and spill command and control document management.^{6,7}

AUSTRALIA'S NATIONAL OIL SPILL RESPONSE ATLAS GIS

The Australian OSRA programme's prime aim was to systematically compile all relevant geographic and textual data into a standard GIS format for the majority of Australia's maritime and coastal environments. This will assist planners to identify resources at risk, allow quick assessment of response priorities for protection or clean up.

National OSRA data sets include:

- biological, environmental, wildlife and man-made resources present, Australiawide;
- geomorphological mapping and shoreline sensitivity to oil spills;
- human-use resource considerations; and
- logistical and infrastructure information to support a spill response.

The OSRA GIS includes maps, charts, satellite imagery, point, line and polygon digital data as well as databases and textual information in a user-friendly point/click format. A GIS provides efficient storage, retrieval, analysis and display of environmental and resource information to support a range of users in operations and planning. The user loads and displays only that information necessary for supporting decisions in the region of

the incident and at whatever scale the user requires. Data sets that have been acquired and collated for the OSRA GIS include, but are not restricted to, the following:

- Habitats both coastal and near shore marine.
- High definition coastlines.
- Bathymetry contours for selected depths.
- Nautical charts in scanned georeferenced format.
- Scanned topographical charts for all of Australia (100K).
- Marine parks, reserves and national parks.
- Biological resources and conservation status.
- Fisheries and aquaculture.
- Coastal and marine wildlife resources.

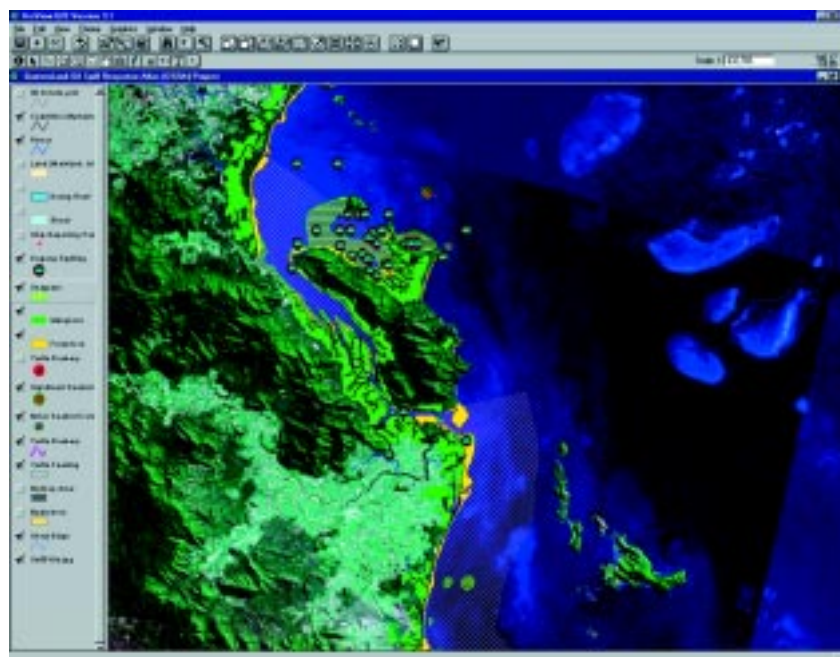


Figure 1 OSRA output for selected environmental data for Hinchinbrook Island region, Queensland.

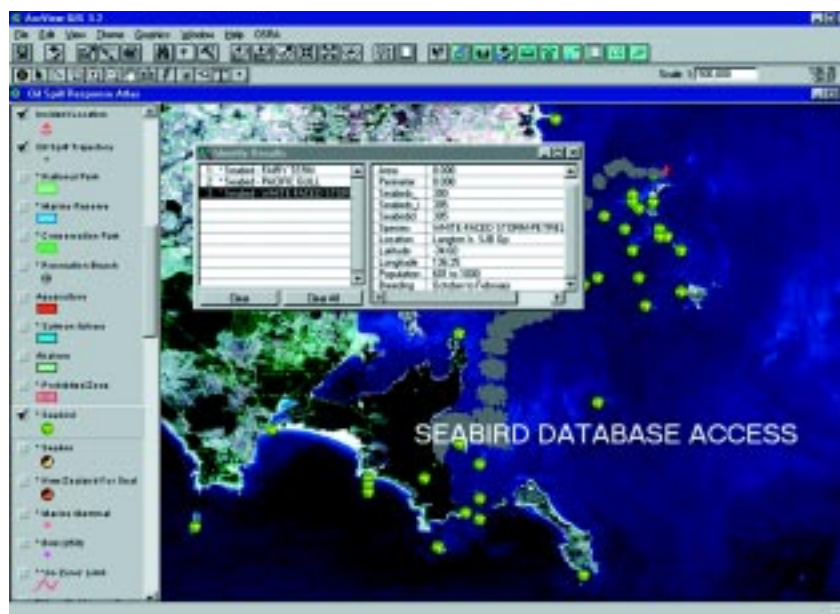


Figure 2 South Australian OSRA overlaid on a satellite image, with the locations of significant sea bird colonies near a hypothetical spill site, Port Lincoln area.

- Recreational resources.
- Locations of National Plan equipment stockpiles.
- Aerial photography of selected regions.
- National LandSat remote sensing (colour 50m).
- Oblique photography linked geographically for selected regions.
- High resolution SPOT imagery for all harbours, ports and marine parks.
- Landmarks and features.
- Shoreline access and roads.
- Airports, marinas and boat ramps.
- Logistic and other infrastructure information.⁸

Figure 1 shows a screen display of a typical output from OSRA for the Hinchinbrook region of Queensland showing the locations of mangroves, seagrass beds, dugong sightings and turtle feeding areas overlaid on a LandSat image of the region.

In Figure 2 an OSRA screen output has been reproduced for the Port Lincoln area showing a hypothetical spill and overlaid on a satellite image, with the locations of significant sea bird colonies near the spill site. Icons representing a specific sea bird colony can be 'clicked' and a database on species, numbers, protection status and seasonal aspects can be accessed. One of the major advantages of the OSRA GIS is the ability to allow the oil spill trajectory model, run centrally from Canberra, to be sent directly to remote locations as an email attachment and displayed directly onto the incident information and environmental data on screen by the user.

The OSRA project incorporates the complete Australia-wide set of scanned and GIS-ready nautical charts. This also includes those nautical charts available for offshore and remote Australian

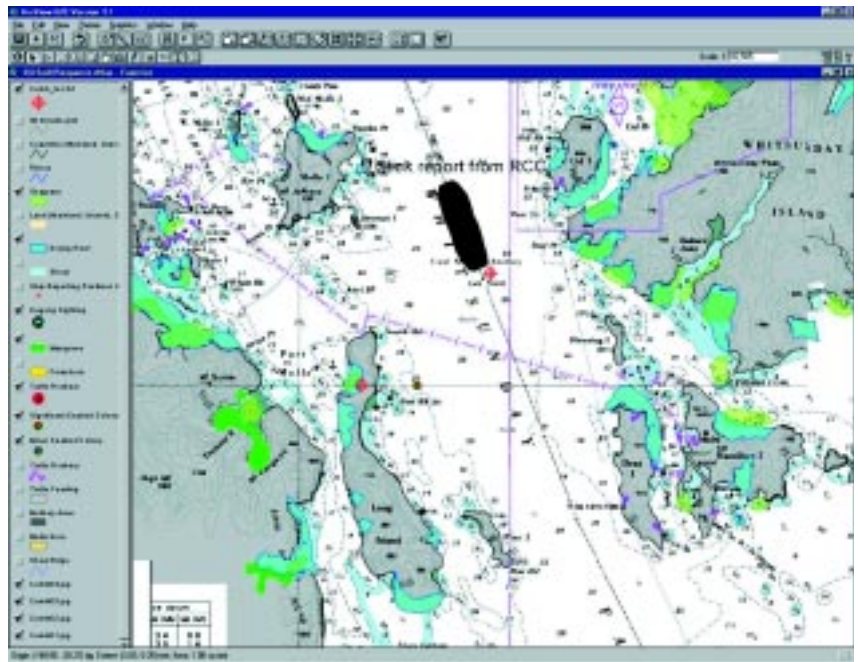


Figure 3 OSRA output using a nautical chart overlaid with environmental information and reported slick position for Exercise Cumberland



Figure 4 Example of the detail available in the SPOT imagery for Brisbane River

Islands and Territories. An example of the incorporation of offshore and foreshore information, e.g. reefs, mangroves and sea grass beds, over a scanned nautical chart of the Whitsunday Islands is shown in Figure 3, along with the position of a hypothetical oil slick from field reports during Exercise Cumberland in Queensland.

High resolution SPOT satellite imagery for all major ports, harbours and environmentally significant areas of the

Australian coast has been obtained and loaded onto the OSRA GIS. An example of the detail obtained in the high resolution SPOT satellite imagery is shown in Figure 4, which is a segment of one image tile of the entrance to Brisbane River Queensland.

The OSRA initiative now provides Australian State, Territory and Commonwealth agencies with vital environmental resource information in a direct and easily manageable form to allow more efficient and effective response to oil and hazardous chemical spills.

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