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Managing Vegetation Disturbance in a 40-Year Old Oil Field

*Operating mobile GIS technology in an 'A'
class nature reserve to collect field data for
analyzing & reporting using geoprocessing
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Abstract

Off the west coast of Australia lies a unique island called Barrow Island, which is home to many diverse forms of flora and fauna. The island is unique because it hosts many species of fauna that have now become extinct on Australia's mainland. This fragile environment has been classified as an "A" class reserve. But what makes this place so remarkable is that it also plays host to a 40-year old oil production field.

In 2006 new government regulations will be put in place to manage all aspects of vegetation disturbance.

This paper will show how we as the operating company use ArcPAD in conjunction with the geoprocessing toolbox to not only create a detailed report enabling work crews to be deployed with the least impact to the environment, but to also allow auditing of impact on an ongoing basis.

Overview

Barrow Island is located 88 km north of Onslow, in the Carnarvon Basin on the North West Shelf (Figure 1), and is home to the largest oil field discovered to date in Western Australia. It also supports a diverse range of flora and fauna of high conservation value and is a Class 'A' Nature Reserve (Reserve No. 11648).

Barrow Island's oilfield commenced operation in 1964. It is similar to other onshore oilfields except that it is located within a Class 'A' Nature Reserve on a large offshore island remote from the mainland (Figure 1). The island is approximately 25 km long by 10 km wide and totals 23,400 hectares. It is a designated sanctuary of unique flora and fauna that was isolated from the mainland by rising sea levels about 8,000 years ago.

Therefore, a high standard of environmental management and quarantine is required to ensure weeds and pests that could threaten the island's ecology are not introduced to Barrow Island.

The operator has strict quarantine procedures in place for all incoming personnel, goods and equipment.



Figure 1: Barrow Island Location map

The Clearing Permit

Amendments to the Environmental Protection Act 1986 (EP Act) that came into force in July 2004, have increased the regulation of activities involving land clearing in Western Australia. Under the EP Act, all clearing of native vegetation is prohibited unless a clearing permit has been issued by the Department of Environment (DoE), or the clearing is authorised or exempt under the relevant provisions of the EP Act or associated regulations.

The definition of 'clearing' is broad enough to cover many activities undertaken by Chevron on Barrow Island, including off-road driving. Examples of clearing include:

- Rolling (off-road driving)
- Damaging

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- Removing
- Severing
- Burning
- Flooding
- Any other act that causes damage to native vegetation.

Much of the daily maintenance to cables, pipes, well pumps etc is undertaken with no disturbance to vegetation. However where off-road driving or any activity is likely to involve clearing, an application for a Permit to Work Certificate for Off-road/Vegetation Disturbance (PWC Application) shall be prepared describing the proposed activity, the location of the proposed activity, the likelihood that clearing will occur and the kind of clearing that is likely to occur. An Environmental Specialist or Environmental Technician shall determine whether the area to clear is classified as P1, P2, P3 or P4. With P1 being the most sensitive.

The challenge

The challenge has been how to capture and report accurate areas of vegetation disturbance broken down into their individual vegetation communities and sensitivity classification.

The DoE also require that, with each account of clearing a detailed report be produced describing the following:

- The total area of disturbance
- The area of disturbance broken down into individual vegetation communities
- The area of disturbance broken down into priority classifications P1, P2, P3, P4
- The vegetation communities shown as a percentage of the whole
- The area of vegetation remaining shown as a percentage.

All units of measurement to be in hectares and metres²

Another challenge is to reduce double handling of data. Filling out paper forms currently and transcribing to a digital interface is not only time consuming but potentially open to typographical errors.

The Solution

We have supplied the field environmental technicians with two Trimble Recon devices loaded with ArcPAD. The Recon's are fitted with a GPS card, a 4Gb flash storage card and a ruggedized cover. The GPS devices range in accuracy between 1 and 10 metres – sufficient for this type of work.



Trimble Recon Device

The area of disturbance

Using ArcPAD and a vegetation disturbance custom tool bar (figure 2a) and form (figure 2b) the environmental technician is able to pre-populate attributes before arriving at location. The workflow for capturing data would play out as follows. The technician would first survey the area where likely clearing was to take place. The technician would walk the proposed route and mark its course by leaving a trail of flags for vehicles to follow (figure 3). Upon reaching the destination where the work is to be carried out the technician would acquire satellite connection using ArcPAD and stream polyline data back to the where the vehicle/s would enter off-road. Once terminating the streaming the technician would amend any attribute fields, add comments and save the polyline with its attributed data.

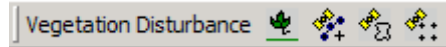


Figure 2a: Vegetation Disturbance Toolbar

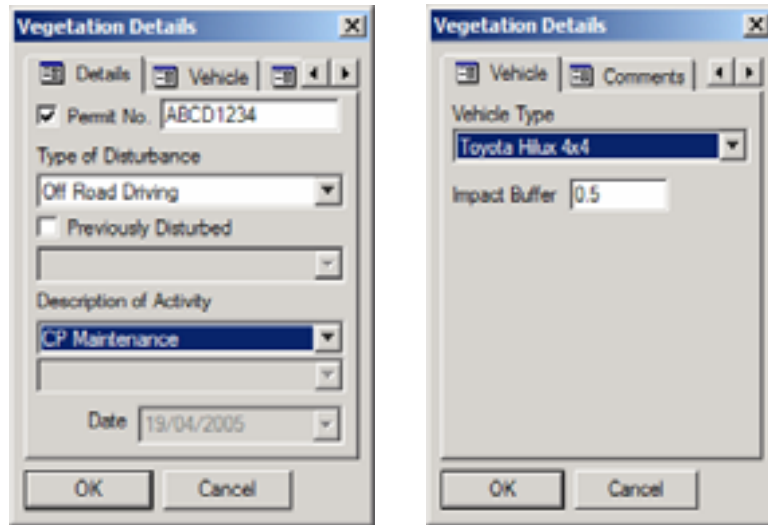


Figure 2b: Vegetation Disturbance Form

Note the Permit No. This number is taken from the Permit to Work Certificate (PWC Application) and is the primary key for this record.



Figure 3: Environmental Technician surveying area for off-road driving

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The Analysis

The captured field data is downloaded onto the technician's desktop PC and overlaid with other feature data sets using ArcMAP (figure 4). At a glance the technician can QC the area to be impacted prior to running the Geoprocessing model (figure 5). The technician can zoom into the area being affected, display layers of interest and make any notes pertinent to the work being undertaken. A copy of this map is supplied to the work-crew along with authorization to commence the work.

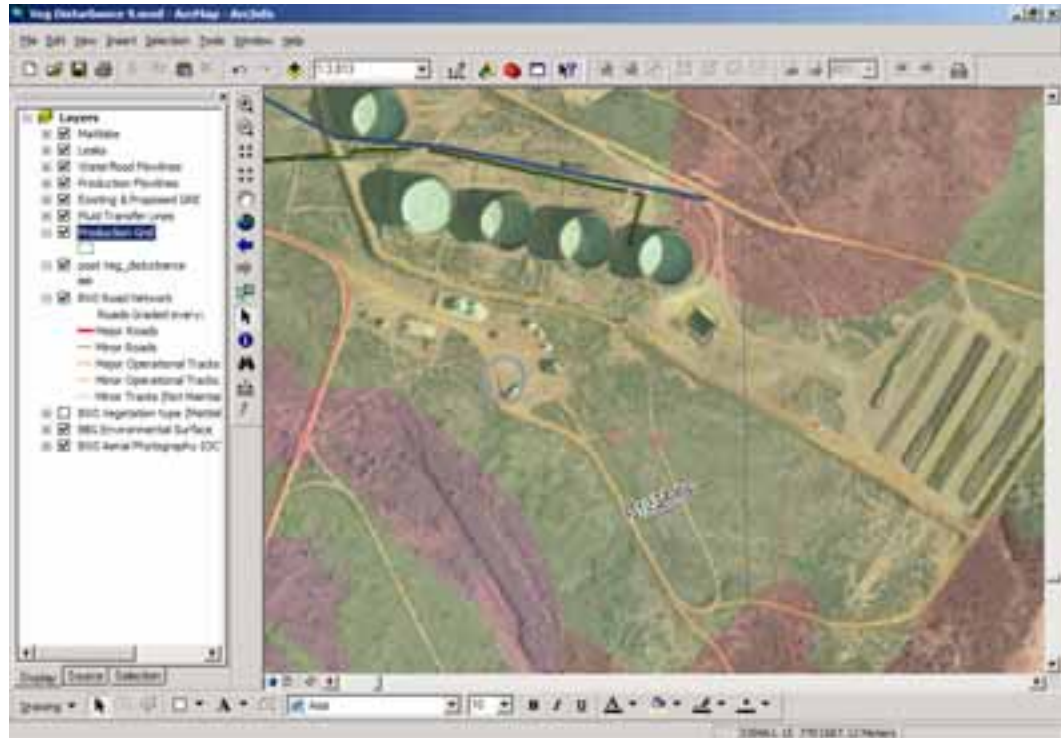


Figure 4: ArcMAP showing location of proposed area to drive off-road

To obtain a detailed report highlighting all vegetation communities and priority areas, it is necessary to run a custom geoprocessing model (figure 5). The model is broken into several sections:

- Buffering the line of impact (based on vehicle used)
- Intersect buffer with vegetation communities
- Intersect buffer with sensitivity priority areas
- Calculate areas
- Run custom python script to generate report
- Save data in central GeoDatabase

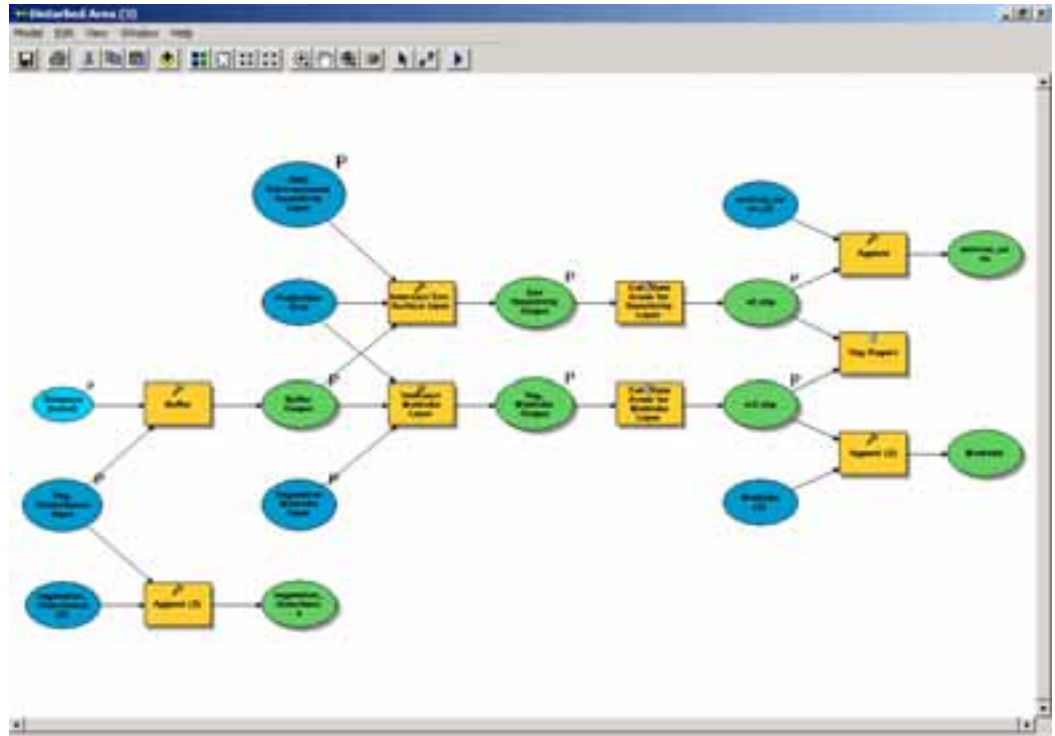


Figure 5: Geoprocessing model to obtain detailed report

Native Vegetation Clearing Incident Report

The report is generated by a python script querying the feature data classes and calculating the breakdown of areas impacted. Once the model has run the report is launched in an internet browser window and automatically saved in the reports directory. The report itself is broken down into several sections.

Incident Number	0152
Period of Clearing	05/16/06 00:00:00 mm/dd/yy HH:MM:SS
Production Grid Block in which clearing occurred	L
Purpose of Clearing	Clearing of Vegetation at: Flowlines: Maintenance
Total Area Disturbed	0.00ha (28.27m ²)

Incident header section:

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The vegetation Communities are described by their Mattiske (1993) vegetation unit.

Vegetation Unit	Area cleared
V1 x1	0.003ha (27.64m ²)

V1: Hummock Grassland of *Triodia wiseana* with mixed emergent shrub species on valley slopes

The priority areas on Barrow Island are broken down into four categories.

P1: Exclusion zone

- Vegetation containing floristic components of particular vulnerability and/or with high sensitivity to disturbance (eg coastal dunes).
- The area immediately surrounding important habitat to protected fauna sensitive to disturbance.
- Areas immediately surrounding important heritage, Anthropological and Fossil sites.
- Landform susceptible to impact from indirect impacts of leaks/spills (eg Caves, fissures)

P2: High impact

- Vegetation with lower sensitivity to disturbance, or where important floristic components are highly visible. Vegetation types containing components with particular importance to fauna and/or low ability to regenerate (eg Melaleuca).

P3: Moderate Impact

- Widely distributed vegetation .

P4: Low Impact

- Very widely distributed vegetation or widely distributed vegetation with high regeneration capacity.

Category P1	Category P2	Category P3	Category P4
0.00ha (0.00m ²)	0.00ha (0.00m ²)	0.00ha (0.00m ²)	0.01ha (149.79m ²)

Other sections of the report describe the method of clearing and information associated with the PWC Application.

Off Road Driving

Previously disturbed vegetation	N/A
Pristine vegetation	As Detailed Above
Unplanned events	N/A

Maintaining the Priority sensitivity feature class

The priority areas are derived from many individual feature classes.

- Bettong warrens
- Brahminy Kite nests
- Sea-eagle nests

- Osprey nests
- Stygofauna in caves/sinkholes\
- Herritage Sites
- Anthropological sites
- Fossil Sites
- Caves
- Fissures
- High priority plant species

The priority sensitivity feature class (figure 6) is built using a geoprocessing model (figure 7) and refreshed regularly to capture new areas of sensitivity being captured in the field. The habitats and sites of significance are assigned a buffer value to protect them from disturbance. (eg Bettong warrens + 100metres)

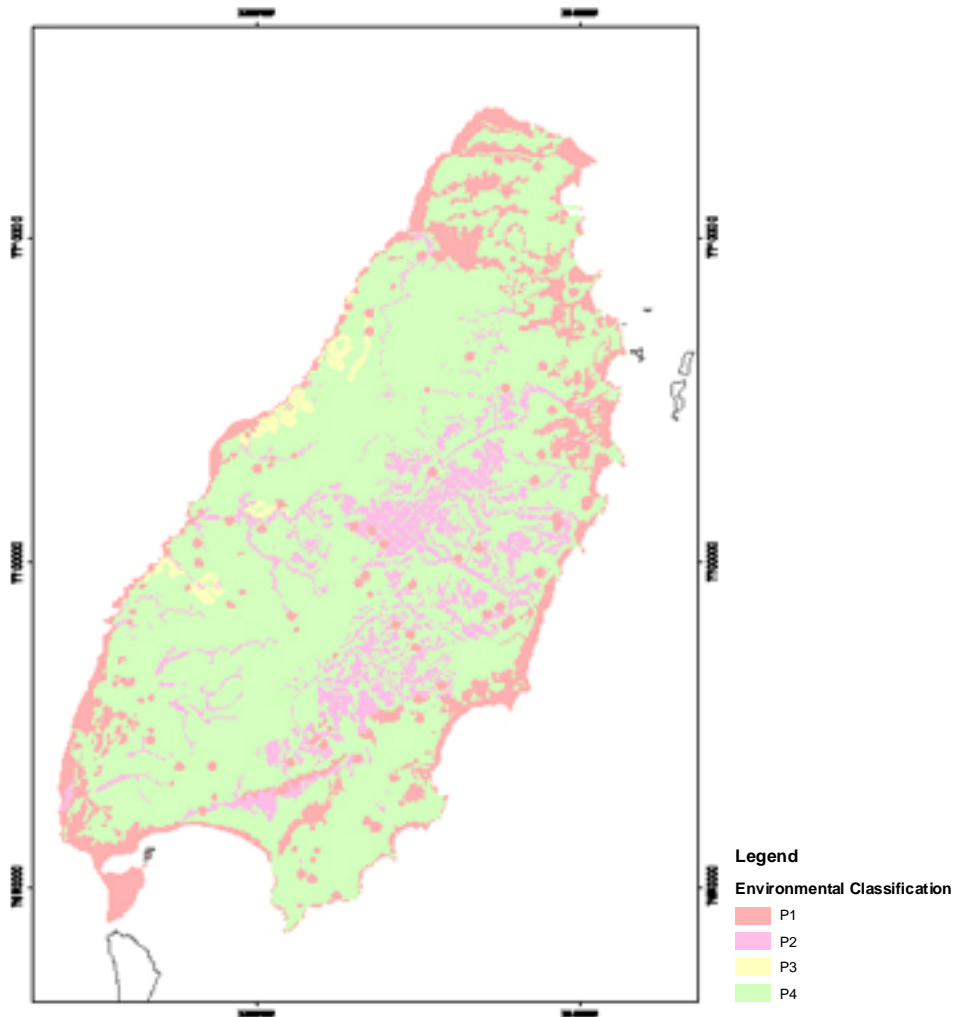


Figure 6: Priority sensitivity feature class



Figure 7: Priority sensitivity geoprocessing model

Maintaining the Vegetation Communities feature class

The existing surveyed vegetation community feature class derives from the 'Flora and Vegetation of Barrow Island E/M. Mattiske & Associates November 1993' (figure 8). It has been noted that this survey is general in most areas and it is planned to build up more accuracy from independent surveys conducted on the island by botanists whilst working on isolated projects. (eg Pipeline remediation project)

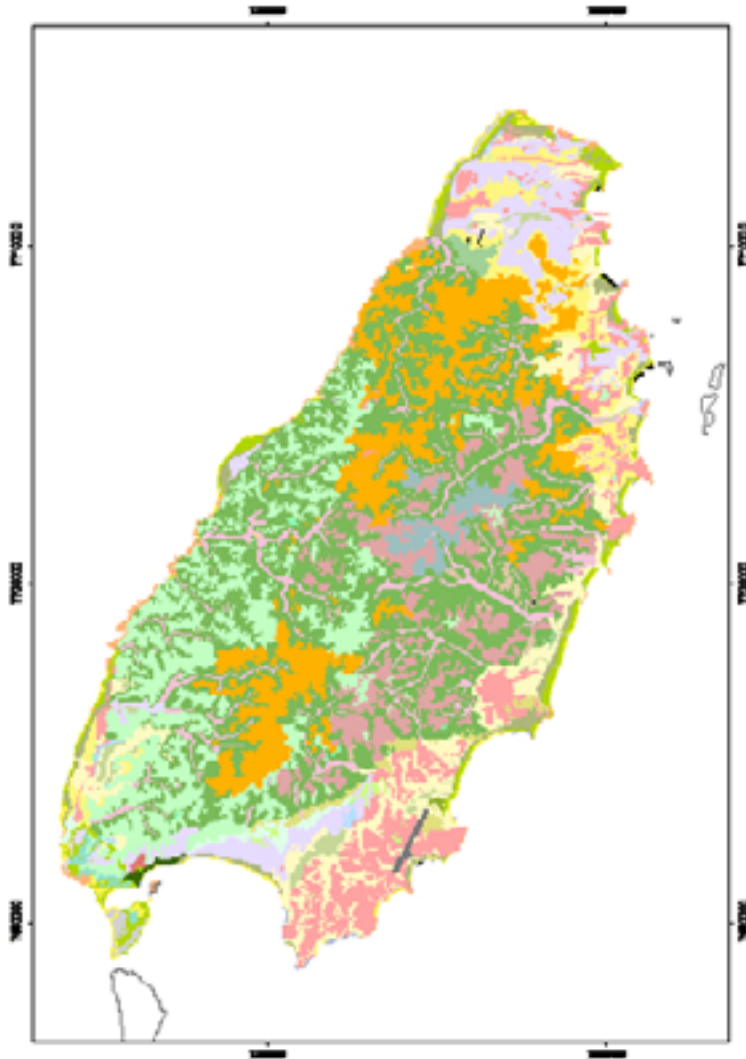
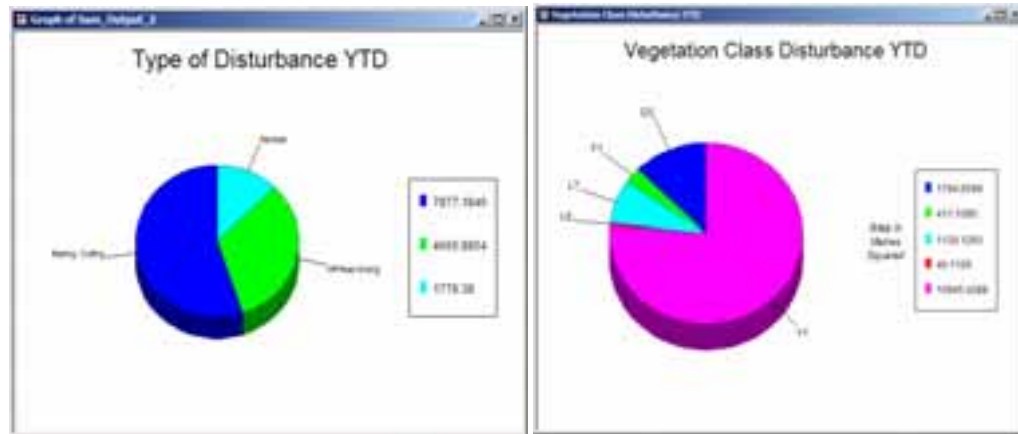


Figure 8: Mattiske vegetation feature class

Centrally Managing the Data

The final piece in managing this data is to load this data to our business unit's spatial database (SDE). Due to Barrow Island's remote location it has become inefficient to maintain the central database in a dynamic fashion. It is necessary therefore to populate the SDE instance in geoprocessing script over nightly.

Making the data available in our SDE instance has also realized opportunities to other business solutions already present in our business unit. (eg: The ability to graph disturbance Year-to-Date (YTD) in Health, Environment and Safety (HES) web portals)



Conclusion

The system has been in place since early-mid 2006 and is now incorporated as part of the environmental technician's daily workflow.

There are a few steps involved in maintaining this system. Some of which are carried out independent of each other and by different people. Therefore there is the potential risk of error if process and QA checks are not followed.

The use of mobile GIS on Barrow Island has opened up opportunities to improve efficiency and reliability in capturing data tangent to this project. (eg: Flora & Fauna custom forms)

Acknowledgments

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- Barrow Island Operations Annual Environment Report July 2004 - June 2005
- Government of Western Australia Department of Environment (DoE) Clearing Permit

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