Improving groundwater governance using spatial intelligence

By

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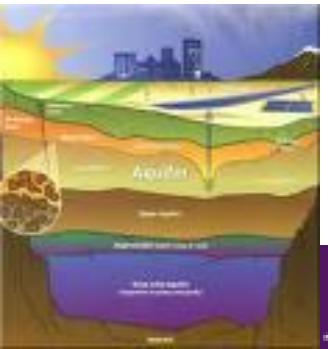
Practice Head, Spatial Information
Sinclair Knight Merz, Australia

www.globalskm.com

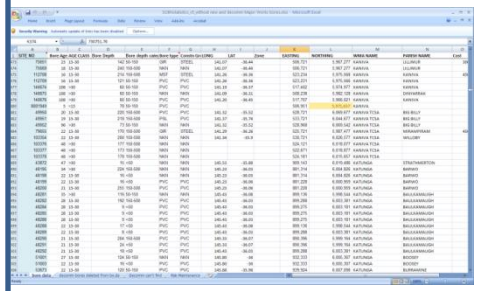
Geospatial World Forum 2012
Amsterdam



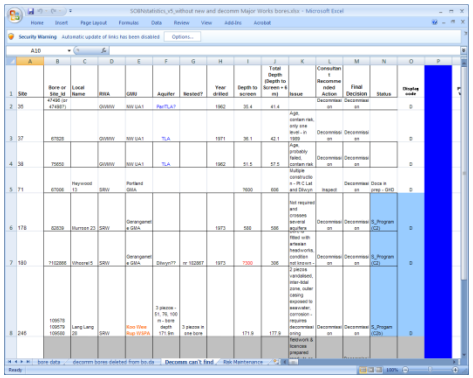
SKM SINCLAIR KNIGHT MERZ | achieve outstanding client success

Typical bore well data management ...

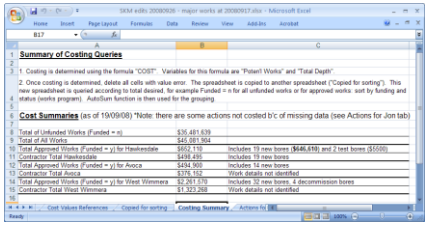
Bore data



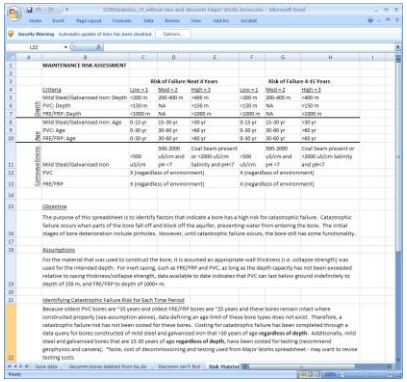
Decommissioned Can' t Find



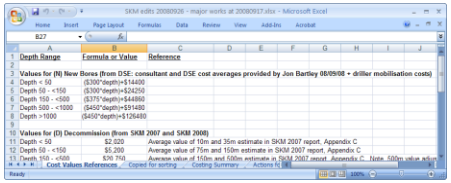
Costing Summary



Risk Maintenance



Cost value references



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State Observation Bore Network Data Catalogue

Data Source Summary_access2003 : Database (Access 2002 - 2003 file format) - Microsoft Access

Home | Create | External Data | Database Tools | Acrobat

full list

SOBN Data Catalogue

Bore ID: 100503 Exit

Bore ID:	100503
Rig No:	1/87/8
Easting:	TBC
Northing:	TBC
TOC Elevation (mAHD):	TBC
Monitored To:	27/08/1987
Monitored From:	11/02/2008
Current Bore Run:	ELV3
Historic Bore Run:	-
SKM - SOBN Audit 2006:	yes ok
SKM - Elevation Survey:	no ok
Thiess - SOBN Location Audit:	yes ok
Driller's Weekly Report:	yes ok
Driller's Daily Report:	no ok
GEDIS Lithology Logs:	yes ok
GEDIS Stratigraphy Logs:	no ok

Installation/ Completion Report:	
Reference:	
Pumping/ Summary/ General Report:	yes
Reference 1:	SKM: Pratt
Reference 2:	
Reference 3:	
Reference 4:	
Reference 5:	
Reference 6:	
Reference 7:	
REF File No 1:	487
REF File No 2:	
REF File No 3,4,5:	482
RWC REF Files:	yes
Photos:	yes
Mud_maps:	no ok
Topographic Maps:	yes ok

Pratt_1988_assessment_Leddon Avoca Plains.pdf - Adobe Acrobat Standard

Adobe Photoshop Album Starter Edition 3.0 - 100503_...

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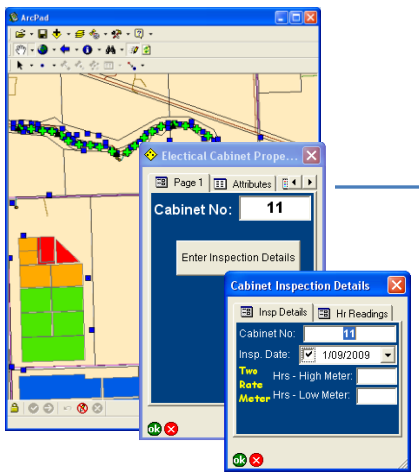
Record: 1 of 2699 No Filter Search

Form View

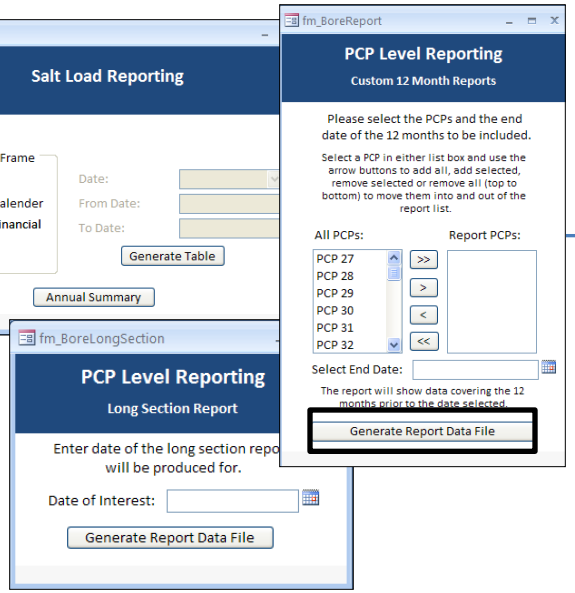
Pyramid Creek Salt Interception Scheme



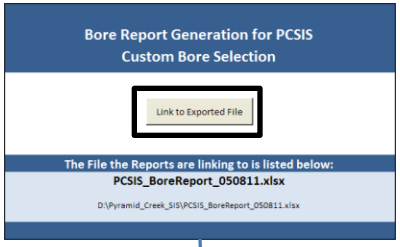
Mobile Database for PCSIS (Sprint DB Pro)

KaioneSync

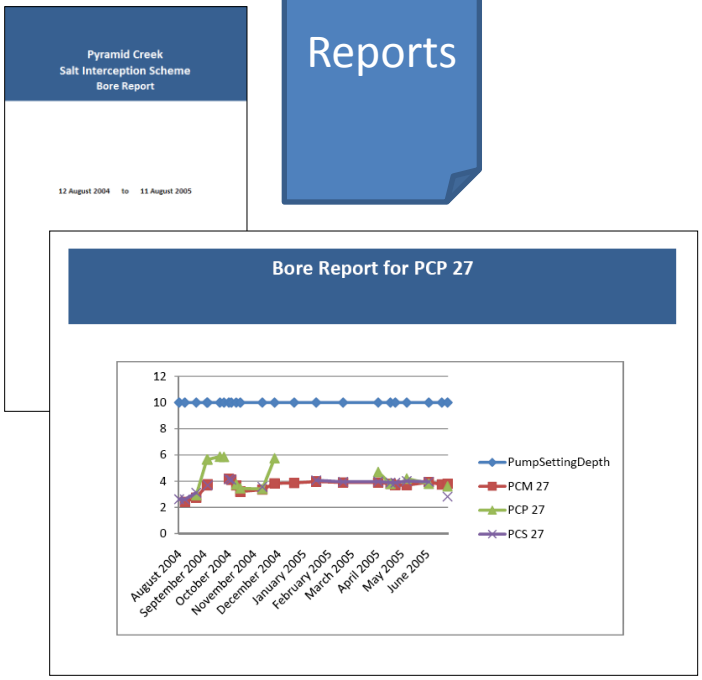
MS ACCESS Database for PCSIS



Data Extracts
Automatic Report Generation



Reports



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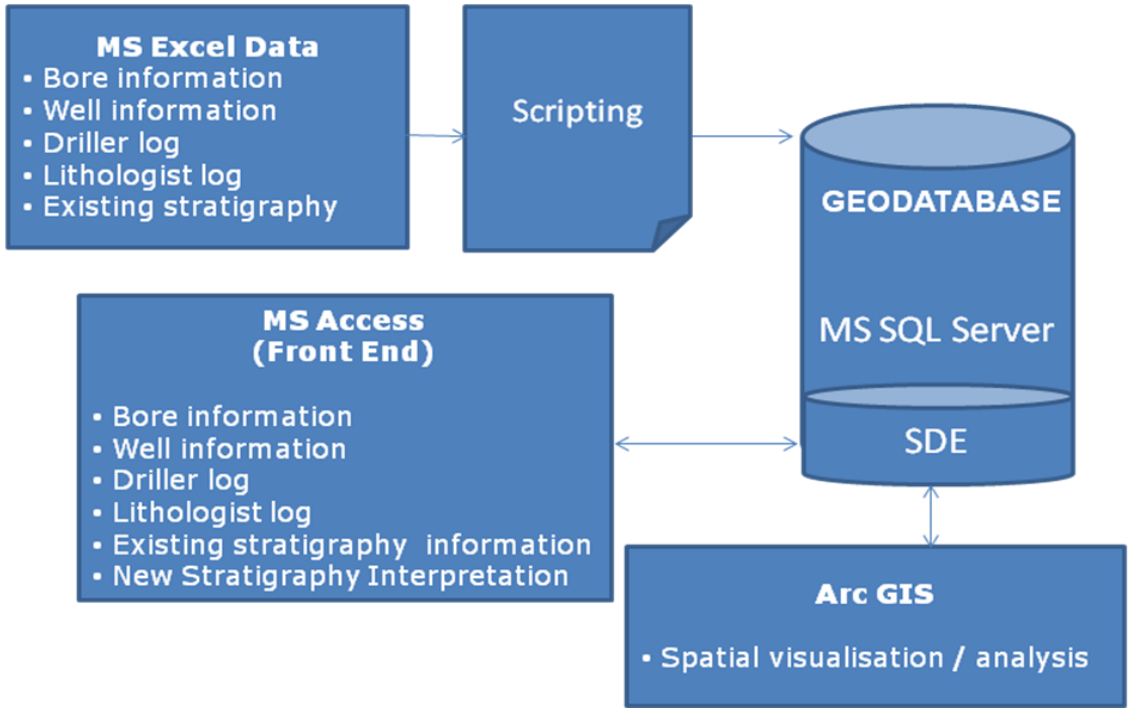
Hydrogeological mapping



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Hydrogeological mapping
STRATIGRAPHY INTERPRETATION TOOL

Bores for SRW Hydrogeology Mapping-Stand Alone Version

Home | Create | External Data | Database Tools | Acrobat

SRW Hydrogeology

Bores for Southern Rural Water Hydrogeology Mapping

Log Source	Depth From	Depth To	Description

Geologist's Log

Log Source	Depth From	Depth To	Description
GEDIS	.00000	1.52000	RED SANDY CLAY
GEDIS	1.52000	3.05000	LIMESTONE
GEDIS	3.05000	6.10000	WHITE SAND
GEDIS	6.10000	16.76000	YELLOW SAND
GEDIS	16.76000	21.34000	YELLOW CLAY
GEDIS	21.34000	23.17000	YELLOW SANDY CLAY
GEDIS	23.17000	37.80000	YELLOW SAND
GEDIS	37.80000	38.10000	YELLOW CLAY
GEDIS	38.10000	45.72000	YELLOW SAND
GEDIS	45.72000	47.55000	SANDSTONE
GEDIS	47.55000	50.90000	YELLOW SAND
GEDIS	50.90000	52.12000	SANDSTONE

Stratigraphy

Scenario	Author	Company	Stratigraphy Source	Stratigraphy Description	Depth From	Depth To	Hgu Code	Flag	Comments
1	SF	SKM	MELBOURNE_HYD		.00000	1.52000	101	1	MELBOURNE SUPERCEDES AT LOAD1
1	SF	SKM	MELBOURNE_HYD		1.52000	101.50000	110	1	MELBOURNE SUPERCEDES AT LOAD1
1	SF	SKM	MELBOURNE_HYD		101.50000	136.25000	303	1	MELBOURNE SUPERCEDES AT LOAD1
1	SF	SKM	MELBOURNE_HYD		127.10000	276.15000	404	1	MELBOURNE SUPERCEDES AT LOAD1
-1	SF	SKM	MELBOURNE_HYD		.00000	1.52000	101		
-1	SF	SKM	MELBOURNE_HYD		1.52000	101.50000	110		
-1	SF	SKM	MELBOURNE_HYD		101.50000	136.25000	303		
-1	SF	SKM	MELBOURNE_HYD		127.10000	276.15000	404		

Stratigraphy saved

Saved 4 rows

OK

Stratigraphy Interpretation

Author: ZAFFAR Company: SKM

Scenario: -1 Stratigraphy Source: MELBOURNE_HYDRO_I

Retire Stratigraphy

If the check box is enabled, the value recorded is

	Depth From:	Depth To:	HGU Code	HGU Name	
1.	0	1.52000	101	Unnamed alluvium	Stratigraphy F
2.	1.52000	101.50000	110	Bridgewater Formation	Stratigraphy F
3.	101.50000	136.25000	303	Brighton Group	Stratigraphy F
4.	136.25	276.15000	404	Fyansford Formation	Stratigraphy F
5.					Stratigraphy F
6.					Stratigraphy F
7.					Stratigraphy F
8.					Stratigraphy F
9.					Stratigraphy F
10.					Stratigraphy F
11.					Stratigraphy F
12.					Stratigraphy F
13.					Stratigraphy F
14.					Stratigraphy F
15.					Stratigraphy F

Clear Save

Comments:

This interpretation has corrected the basic depth from .0000 to 0

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au-d12364/pca_demo/

log out

Bore Interpretation System for Hydrogeology Mapping

View Bore/Well Data | Stratigraphic Interpretation

Enter a Bore ID: 101014 View

Bore Details

Bore Id	101014	Map Sheet	n/a			RLNS	n/a
Bore Source	GMS	Easting	2376480	Latitude	-36.99	RLNS DEM	207.04
Bore Depth	25.9	Northing	2500200	Longitude	143.612	RLNS Source	n/a
Completed Date	15/06/1971	Datum	GDA94				
		Projection	VICGRID94				
Bore Flag	1						

Well Details #1

Well Source	GMS	TDS	n/a	WL	n/a
SCRN From	0	TDS Date	01/01/1900	RWL	n/a
SCRN To	n/a	TDS Source	n/a	WL Date	01/01/1900
Aquifier Code		TDS Flag	n/a	WL Source	n/a
				WL Flag	n/a
EC	n/a	Date Created	23/06/2010		
EC Date	01/01/1900				
EC Source	n/a				
EC Flag	n/a				

Web Interface

au-d12364/pca_demo/

Enter a Bore ID: 101014 View

Map Sheet n/a Surface HGU 1005 Surface HGU Name Undifferentiated Quaternary Basalt

Driller's Log

Log Source	Depth From	Depth To	Description
GEDIS	0	2.44	RED BROWN CLAYS
GEDIS	2.44	4.57	DARK GREY CLAYS
GEDIS	4.57	12.19	MED TO SOFT GREY BASALT
GEDIS	12.19	13.41	BROWN HONEYCOMB BASALT
GEDIS	13.41	24.69	GREY BASALT
GEDIS	24.69	25.6	BROWN HONEYCOMB BASALT
GEDIS	25.6	25.91	LIGHT PUGGY GREY CLAY

Geologist's Log

Log Source	Depth From	Depth To	Description

Stratigraphy

Scenario	Author	Company	Stratigraphy Source	Stratigraphy Description	Depth From	Depth To	Hgu Code
-1	DPI_BENDIGO	DPI	DPI	Surface alluvium	0	5	1000
-1	DPI_BENDIGO	DPI	DPI	Tertiary Basalt (upper)	5	26	1005
1	DPI_BENDIGO	DPI	DPI	Surface alluvium	0	5	1000
1	DPI_BENDIGO	DPI	DPI	Tertiary Basalt (upper)	5	26	1005

Stratigraphy Interpretation

Scenario 1 Select Scenario

Author Company Stratigraphy Source DPI

☑ Stratigraphy Flag

☐ Retire Stratigraphy

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Hydrogeological mapping – Visualisation of Aquifers

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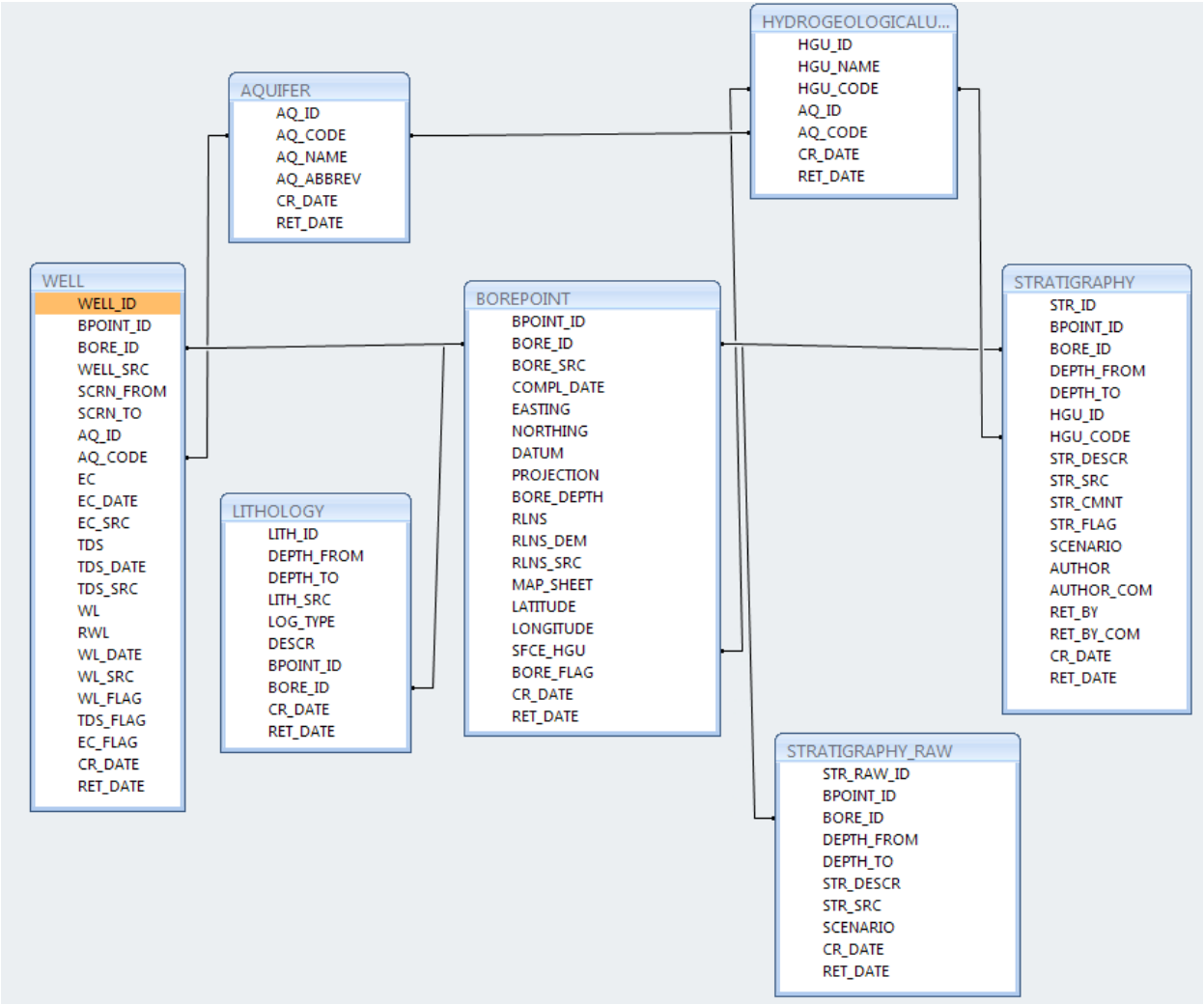
INTEGRATED SPATIAL DATA MODEL FOR MANAGING BORE STRATIGRAPHIC AND HYDROLOGICAL INFORMATION



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Mohamed-Ghouse, Z. Sadiq., Goodin, D. and H. Chaplin (2009).Integrated spatial data model for managing bore stratigraphic and hydrological information. In: Ostendorf B., Baldock, P., Bruce, D., Burdett, M. and P. Corcoran (eds.), Proceedings of the Surveying & Spatial Sciences Institute Biennial International Conference, Adelaide 2009, Surveying & Spatial Sciences Institute, pp. 857-862. ISBN: 978-0-9581366-8-6.

National Groundwater Information System (NGIS) – Phase 1

Relationships for NGIS_Prototype_Demo_DB
Tuesday, 27 April 2010

NGIS_HydroGeologicUnit
OBJECTID
HGUID
HGUCode
HGUName
Description
NGIS_AveHydraulicConductivity
NGIS_YieldAvailableEstimates
NGIS_AveTransmissivity
GlobalID

NGIS_Bore
OBJECTID
Shape
HydroID
HydroCode
LandElev
BoreDepth
AquiferID
AqCode
HGUID
FType
Lattitude
Longitude
Easting
Northing
Projection
Datum
ToC
WorksID
Legacy_WorksID
Max_Extraction_Volume
Max_Daily_Volume
Max_Annual_Volume
LicenceWaterExtractID

NGIS_ScreenLine
OBJECTID
SHAPE
HydroID
HydroCode
BoreID
TopElev
BotElev
HGUID
HGUCode
FType
NGIS_StrataDescription
NGIS_RecordCreateDate
NGIS_AquiferID
NGIS_AquiferUnitID
SHAPE_Length
NGIS_Lining_Material
NGIS_Inner_Diameter
NGIS_Outer_Diameter
NGIS_Aperture
NGIS_Filter_sock
NGIS_Length
NGIS_Width
NGIS_Lithology
NGIS_Trade_name
NGIS_FromDepth
NGIS_ToDepth

NGIS_AquiferUnit
OBJECTID
SHAPE
HydroID
HydroCode
Name
FType
NGIS_TotalVolume
NGIS_ConsumptivePool
NGIS_AverageKValue
SHAPE_Length
SHAPE_Area

NGIS_MonitoringPoint
OBJECTID
SHAPE
HydroID
HydroCode
FType
Name
JunctionID
NGIS_MonitoringPointID
NGIS_HydroPointID
NGIS_Lattitude
NGIS_Longitude
NGIS_Easting
NGIS_Northing
NGIS_Datum
NGIS_Projection
NGIS_MP_Capablility_WE
NGIS_MP_Capablility_WI
NGIS_MP_Capablility_WP
NGIS_MP_Capablility_FR
NGIS_MP_Capablility_Precip
NGIS_MP_Capablility_Temp
NGIS_MP_Capablility_ET
NGIS_MP_Capablility_WS
NGIS_MP_Capablility_WSal
NGIS_MP_Capablility_TDS
NGIS_MP_Capablility_Qual
NGIS_MP_Capablility_Cond
NGIS_MP_Capablility_SLG

NGIS_HydraulicConnection
OBJECTID
NGIS_HydraulicConnID
HGUID
HGUCode
AquiferID
AquiferCode
NGIS_CR_DATE
NGIS_RET_DATE
FType
NGIS_OriginHydroID
NGIS_DestHydroID
NGIS_FlowRate
NGIS_MonitoringPointID
NGIS_ConnectionProb

NGIS_LicenceWaterExtraction
OBJECTID
LicenceWaterExtractID
Legacy_S51_LicenceID
Legacy_S67_LicenceID
Licence_Type
Works_Type
Delivery_System
Water_System_Source
Method_of_Taking
Purpose
Permanent_Volume
Adjusted_Volume
Tenure_Type
Term
Expiry_Date
Period
Number_of_Bores
Use_Trading_Zone
Owner_Type
Tradability
Area_to_be_Irrigated
Plan
Lot
Parish
Section
Allotment
Land_Parcel_Address
Issue_Date
Legal_Owner
Debtor_Line1
Debtor_Line2
Debtor_Address
CulturalSignificanceCategory
ManagementZoneID
LicensedUseID

NGIS_BoreholeLog
OBJECTID
BoreID
RefElev
FromDepth
ToDepth
TopElev
BotElev
ElevUnits
HGUID
HGUCode
Material
NGIS_STR_DESCR
NGIS_STR_SRC
NGIS_STR_CMNT
NGIS_STR_FLAG
NGIS_SCENARIO
NGIS_CR_DATE
NGIS_RET_DATE
NGIS_RET_BY_COM
NGIS_RET_BY
NGIS_AUTHOR_COM
NGIS_AUTHOR
LogType
ZDataType
WellID
BottomElev

NGIS_BoreLine
OBJECTID
SHAPE
HydroID
HydroCode
BoreID
TopElev
BottomElev
BotElev
HGUID
HGUCode
FType
NGIS_StrataDescription
NGIS_RecordCreatDate
NGIS_AquiferID
NGIS_AquiferUnitID
SHAPE_Length

NGIS_Aquifer
OBJECTID
SHAPE
HydroID
HydroCode
Name
FType
NGIS_TotalVolume
NGIS_ConsumptivePool
NGIS_AverageKValue
SHAPE_Length
SHAPE_Area

NGIS_LithologyLog
OBJECTID
BoreID
RefElev
FromDepth
ToDepth
TopElev
BottomElev
ElevUnits
HGUID
HGUCode
LogType
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NGIS_DESCR
NGIS_BPOINT_ID
NGIS_CR_DATE
NGIS_RET_DATE
NGIS_Driller_Name
NGIS_Geologists_Name
NGIS_Lithology_Comment
NGIS_Lithology_Flag

NGIS_TimeSeries
OBJECTID
FeatureID
TSDateTime
TSValue_normalized
TSValue
TSTypeID

NGIS_ManagementZone
OBJECTID
SHAPE
HydroID
HydroCode
NGIS_TotalWaterUnderManagement
NGIS_ManagementBodyName
NGIS_StateTerritory
NGIS_ContactName
NGIS_ContactPhone
NGIS_ContactEmail
NGIS_Address
NGIS_ManagementZoneType
NGIS_ManagementRuleSetID
NGIS_ManagementBodyID
NGIS_TradingRuleSetID
SHAPE_Length
SHAPE_Area

NGIS_GeologicUnit
OBJECTID
GeologicUnitID
GeologicUnitCode
GeologicUnitName
Description
NGIS_GeologicalAge
NGIS_Density
NGIS_Conductivity

Concept: SKM and Continuum consulting
Client : Australian National Water Commission

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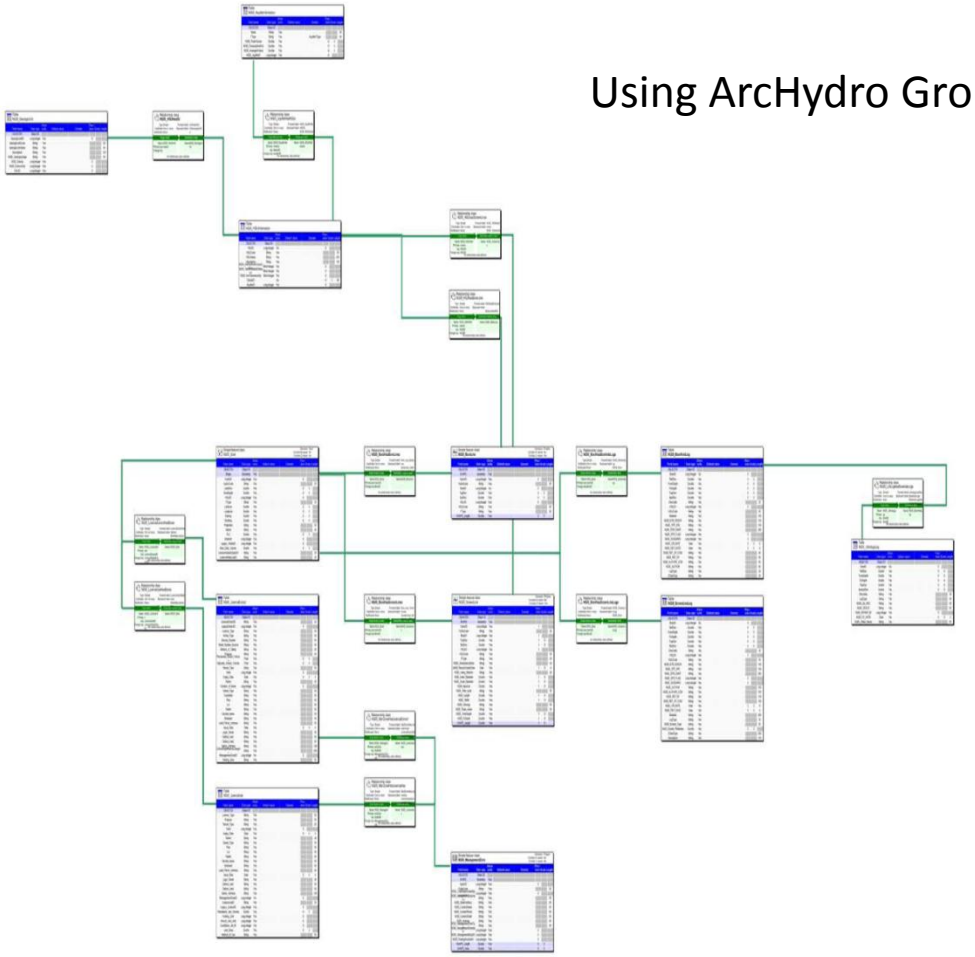
National Groundwater Information System (NGIS) – Phase 2

Australian Bureau of Meteorology

Using ArcHydro Groundwater Data Model



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Interim Groundwater Dataset as part of Australian Geofabric

•SKM was engaged by the Bureau of Meteorology to develop consistent national spatial groundwater datasets as part of the Geofabric.

•The project involved collecting and collating aquifer extent, salinity, elevation and uncertainty information and populating a pre-defined geodatabase.

•To address different definitions of the same aquifers across jurisdictional boundaries, it was necessary to develop a national aquifer framework to allow each of the jurisdictional datasets to be transferred into a nationally consistent dataset.

•The development of the framework included consultation with each of the relevant State and Territory jurisdictions in a series of workshops.

•The outcomes of the workshops and existing frameworks were simulated to develop a list of 24 aquifers across Australia.

•The project also involved developing a relationship between the geological units (both outcropping and sub-surface) to aquifers and using this relationship to develop a consistent GIS layer of the “Land Surface Aquifer” (surface expression of the aquifers whether saturated or not) and the “Watertable Aquifer” (extent of the first saturated aquifer).

•The extents of sub-surface aquifers, groundwater salinity and aquifer yield data provided by the jurisdictions was also translated into the nomenclature of the “interim aquifer framework”.

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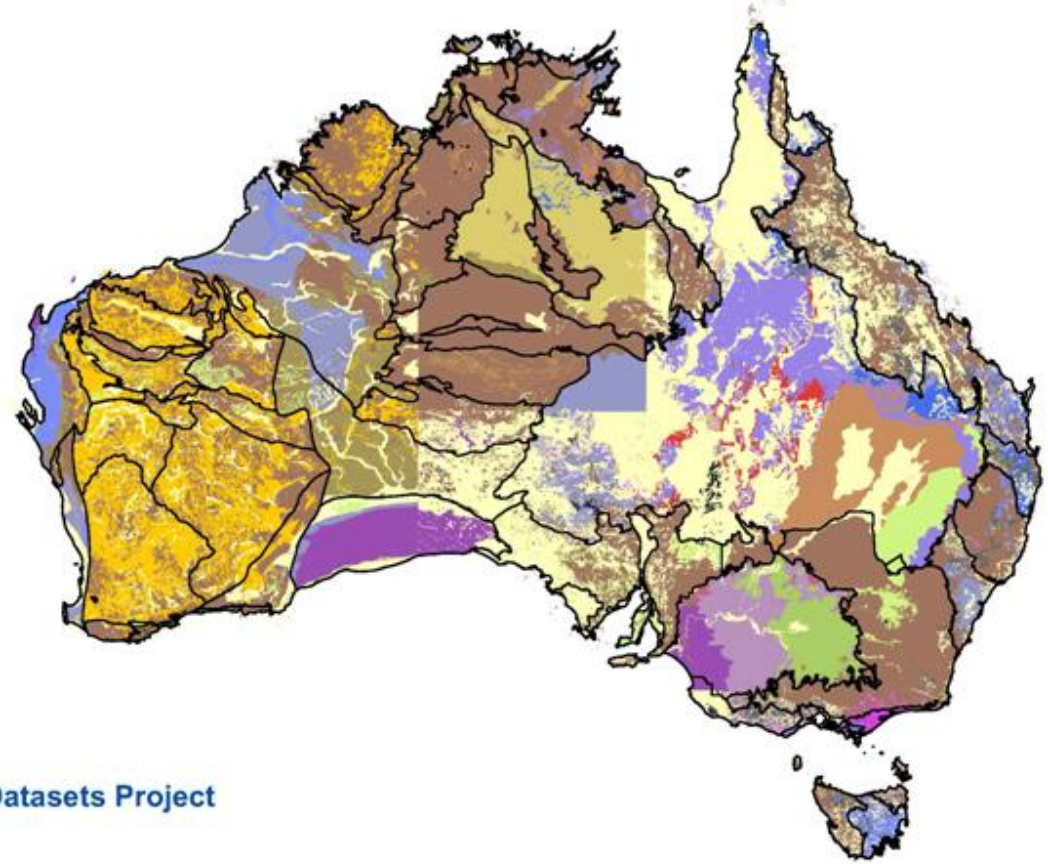
Interim Groundwater Dataset as part of Australian Geofabric



Interim Groundwater Datasets Project

DRAFT

Preliminary Watertable Aquifers, Australia

wta_240210 polygon

BOM_NAME

- Surficial sediment aquifer (porous media - unconsolidated)
- Upper Tertiary/Quaternary Aquifer (porous media - unconsolidated)
- Upper Tertiary/ Quaternary Aquitard (porous media - unconsolidated)
- Upper Tertiary Aquifer (porous media - unconsolidated)
- Upper Tertiary Aquitard (porous media - unconsolidated)
- Upper Mid-Tertiary Aquifer (porous media - unconsolidated)
- Upper Mid-Tertiary Aquitard (porous media - unconsolidated)
- Lower Mid Tertiary Aquifer (porous media - unconsolidated)
- Lower Mid Tertiary Aquitard (porous media - unconsolidated)
- Lower Tertiary Aquifer (porous media - unconsolidated)
- Tertiary Basalt Aquifer (fractured rock)
- Tertiary sediments (fractured rock)
- Mesozoic Sediment Aquifer (porous media - consolidated?)
- Mesozoic fractured rock Aquifer
- Jurassic (GAB intake beds) (porous media - consolidated)
- Cretaceous (GAB) (porous media - consolidated)
- Fractured and karstic rocks, local aquifers
- Fractured and karstic rocks, regional scale aquifers
- Palaeozoic and Pre-Cambrian Fractured Rock Aquifers (consolidated and partly porous)
- Palaeozoic and Pre-Cambrian Fractured Rock Aquifers (low permeability)
- Cainozoic Aquifer (porous media - consolidated)
- Uncertain Age Rocks of Low Permeability (fractured rock)
- Unassigned due to lack of codes

N

0 162.5 325 650 km

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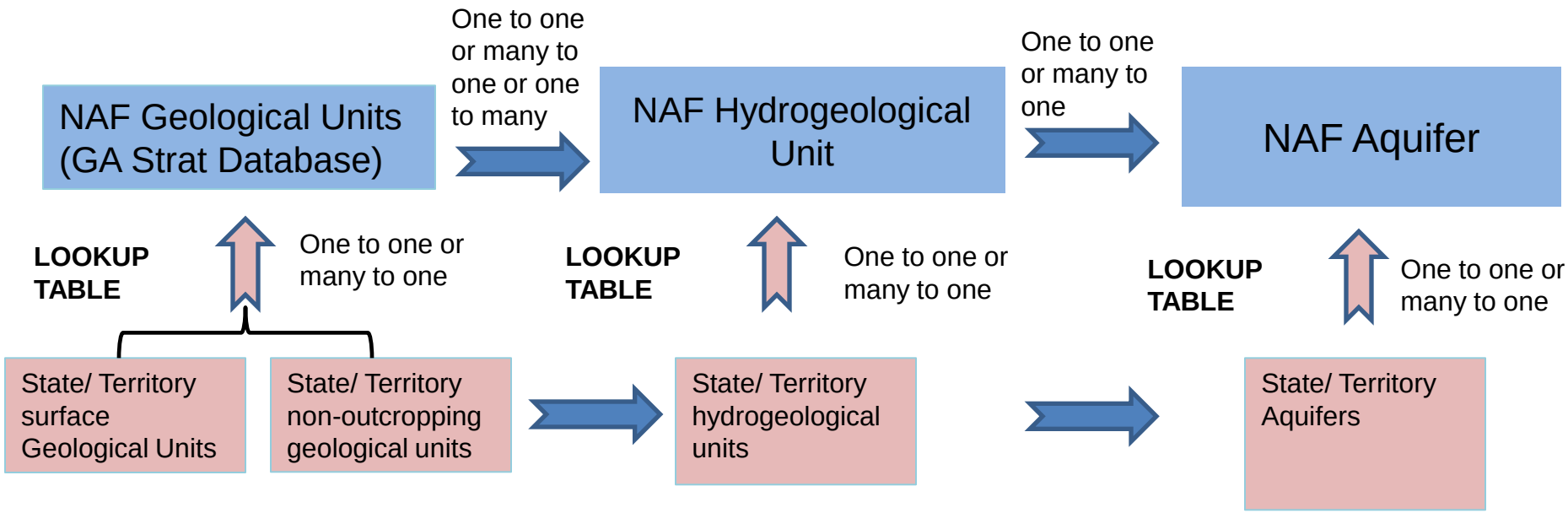
National Aquifer Framework (NGIS – Phase 2)

Australian Bureau of Meteorology



Link between State/Territory frameworks and NAF

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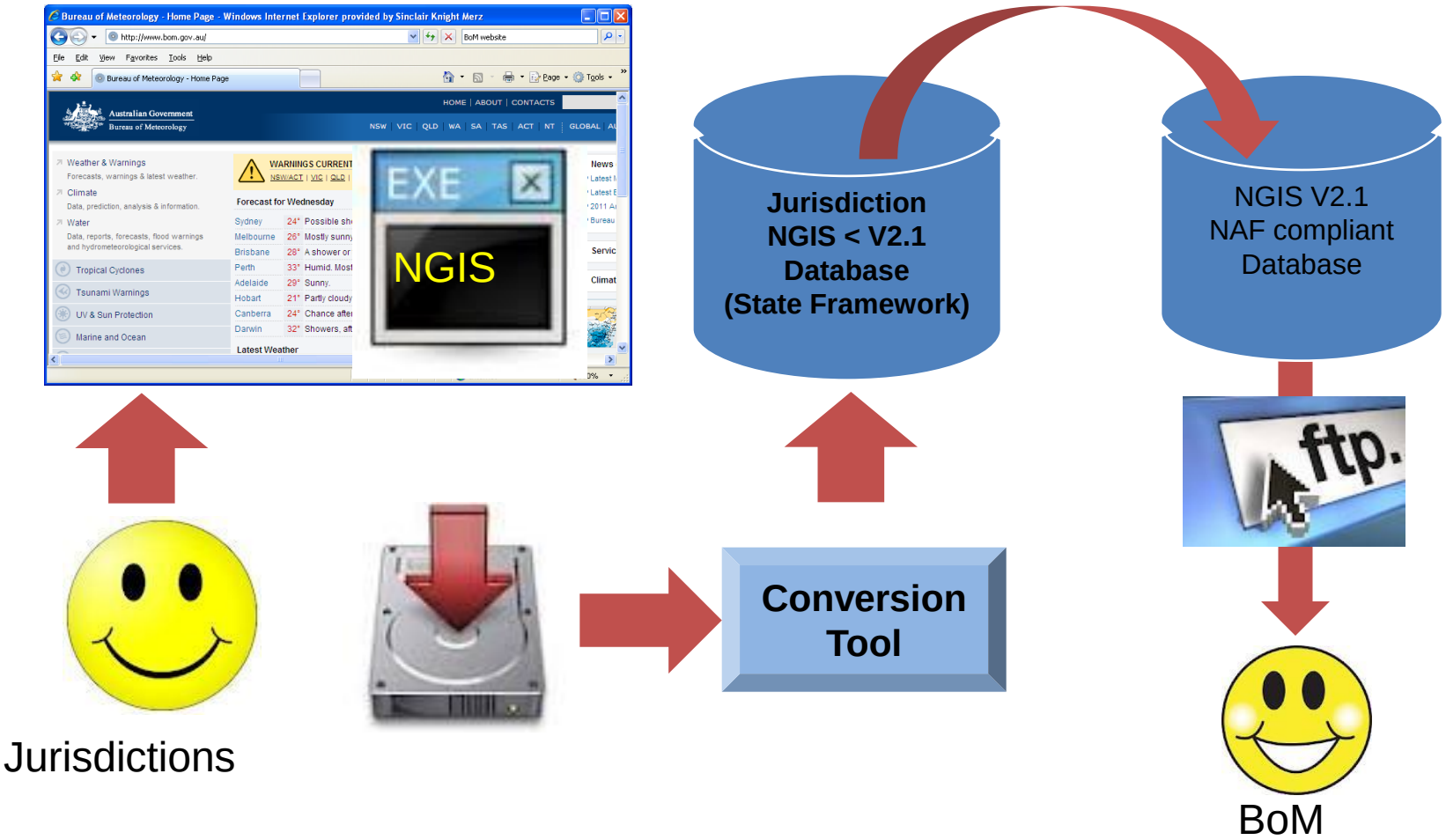
National Aquifer Framework (NGIS – Phase 2)



GDE Atlas Home: Water Information: Bureau of Meteorology - Windows Internet Explorer provided by Bureau of Meteorology

http://wdev.bom.gov.au/water/groundwater/gde/index.shtml

File Edit View Favorites Tools Help

Australian Government
Bureau of Meteorology

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Bureau Home » Water Information » GDE Atlas Home

Water Information Regulations Standards News and events About

Atlas of Groundwater Dependent Ecosystems

About the GDE Atlas

The National Atlas for Groundwater Dependent Ecosystems addresses a critical knowledge gap in the understanding and management of Groundwater Dependent Ecosystems.

The GDE Atlas is part of NWC's Groundwater Action Plan, which aims to improve our understanding of the impact of water management and external influences on GDEs.

As a key tool the GDE Atlas helps informed decision making that influences the future of GDEs by bringing the identification and assessment of the water needs of GDEs into the planning and allocation process.

GDE Atlas

- About
- Glossary
- Open GDE Atlas
- Open GDE Atlas (accessible version)

The scope of the GDE Atlas

The Atlas captures the current state of knowledge of GDEs across Australia. The Atlas provides a central portal to present existing information on GDEs, to help identifying location and characteristics of GDEs which have not previously been identified and to help identifying GDEs which occur on lists of important ecosystems, and the ecosystem services provided by the GDEs.

The Atlas includes terrestrial vegetation, wetlands, baseflow, estuarine and subsurface GDEs.

Related links

- Rain, River & Storage Data

Water links

- Water Act 2007
- Water Regulations 2008
- Water Market Reports
- Water Dictionary
- Publications
- News
- Contact Us

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Done

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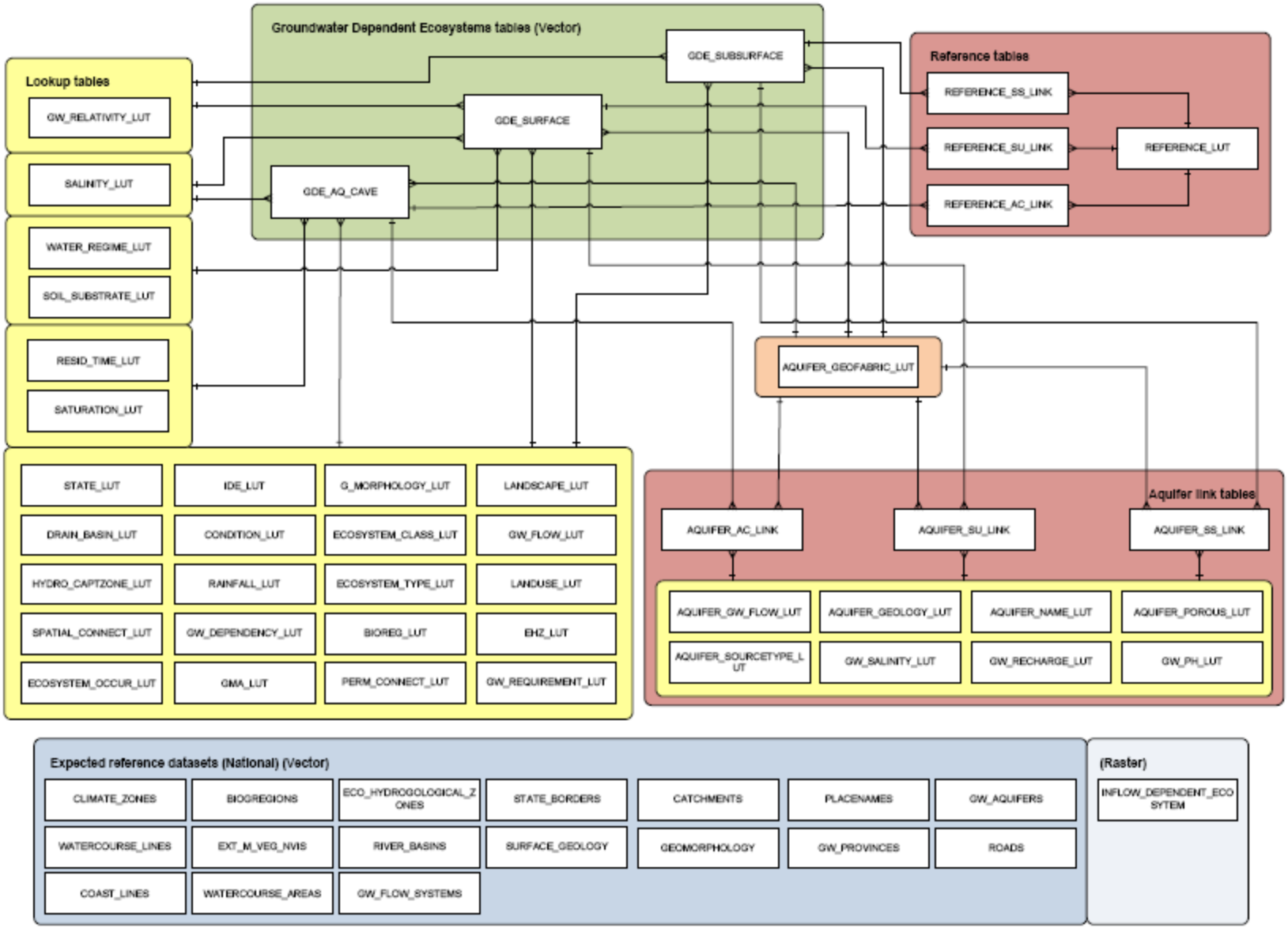
National Atlas of Groundwater Dependent Ecosystems (GDE)



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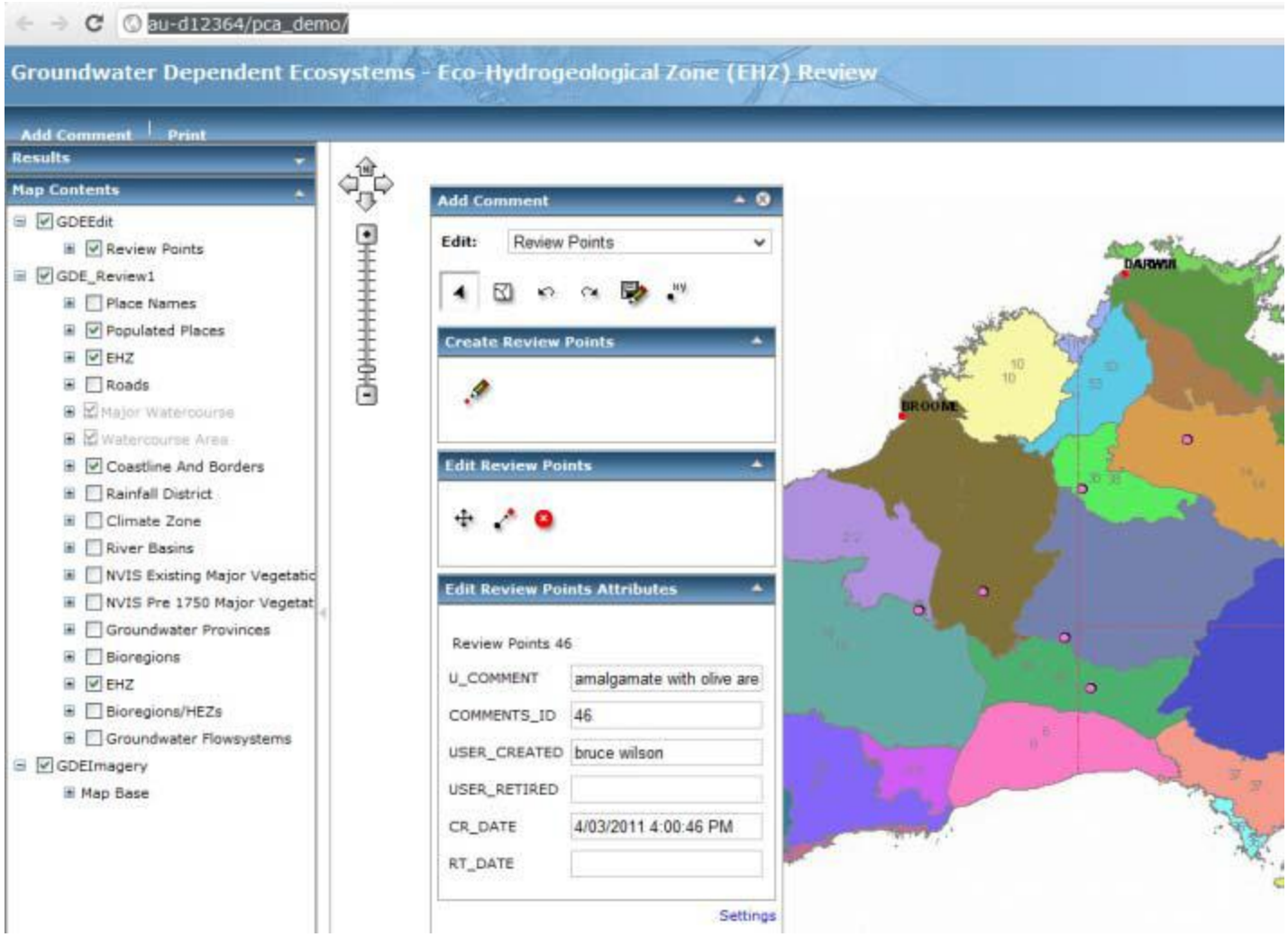
Concept: SKM

Client : Australian National Water Commission

National Atlas of Groundwater Dependent Ecosystems (GDE)

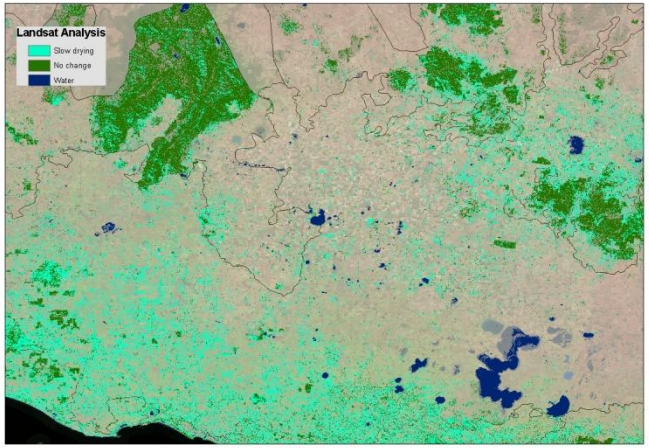


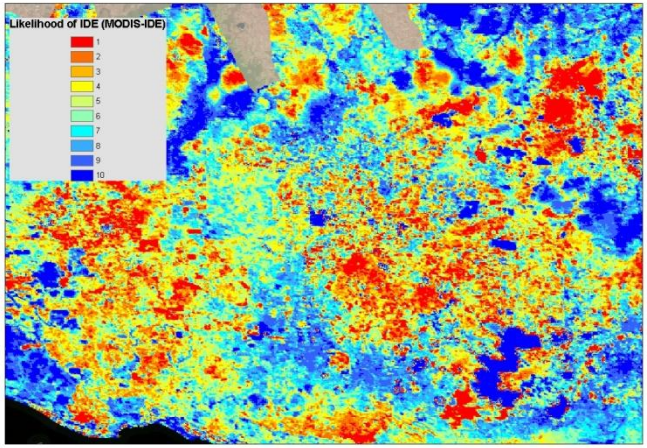
Concept: SKM

Client : Australian National Water Commission

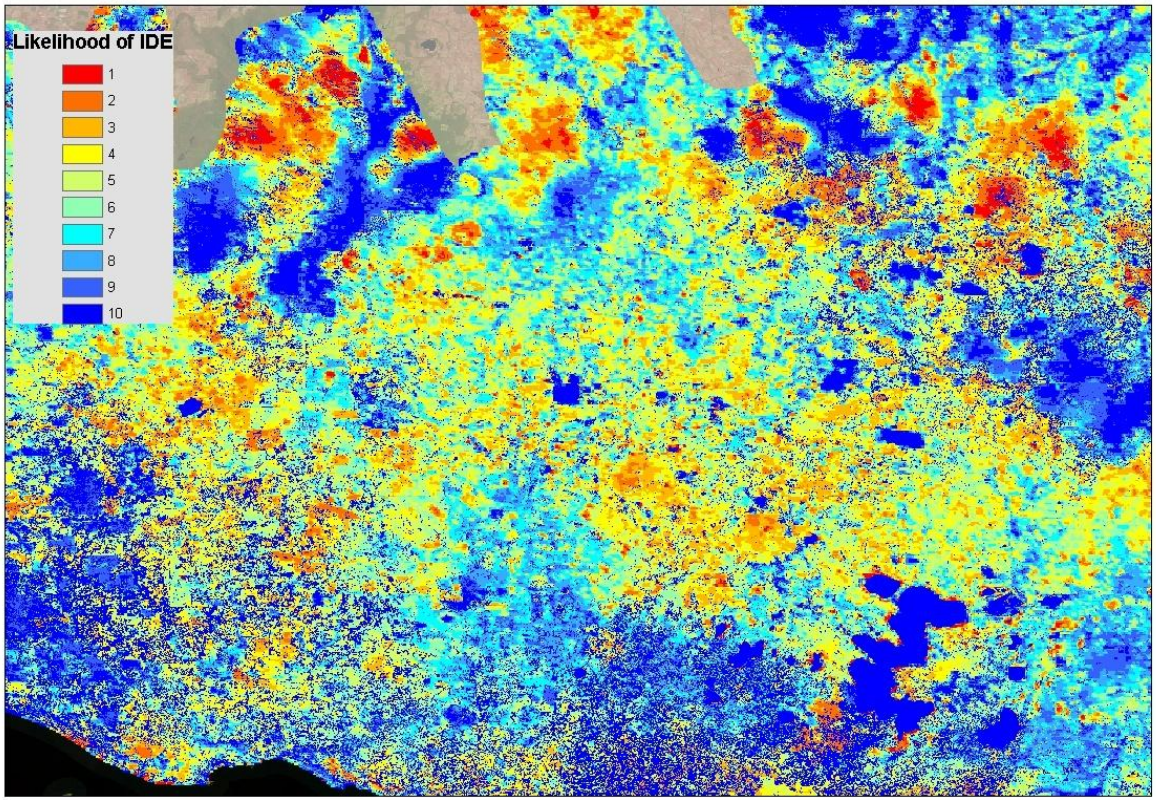
Single Inflow Dependent Ecosystem Layer for GDE Atlas

Combination of Landsat and MODIS analysis based on rules





Modis Analysis 2001 – 2010 (CSIRO)



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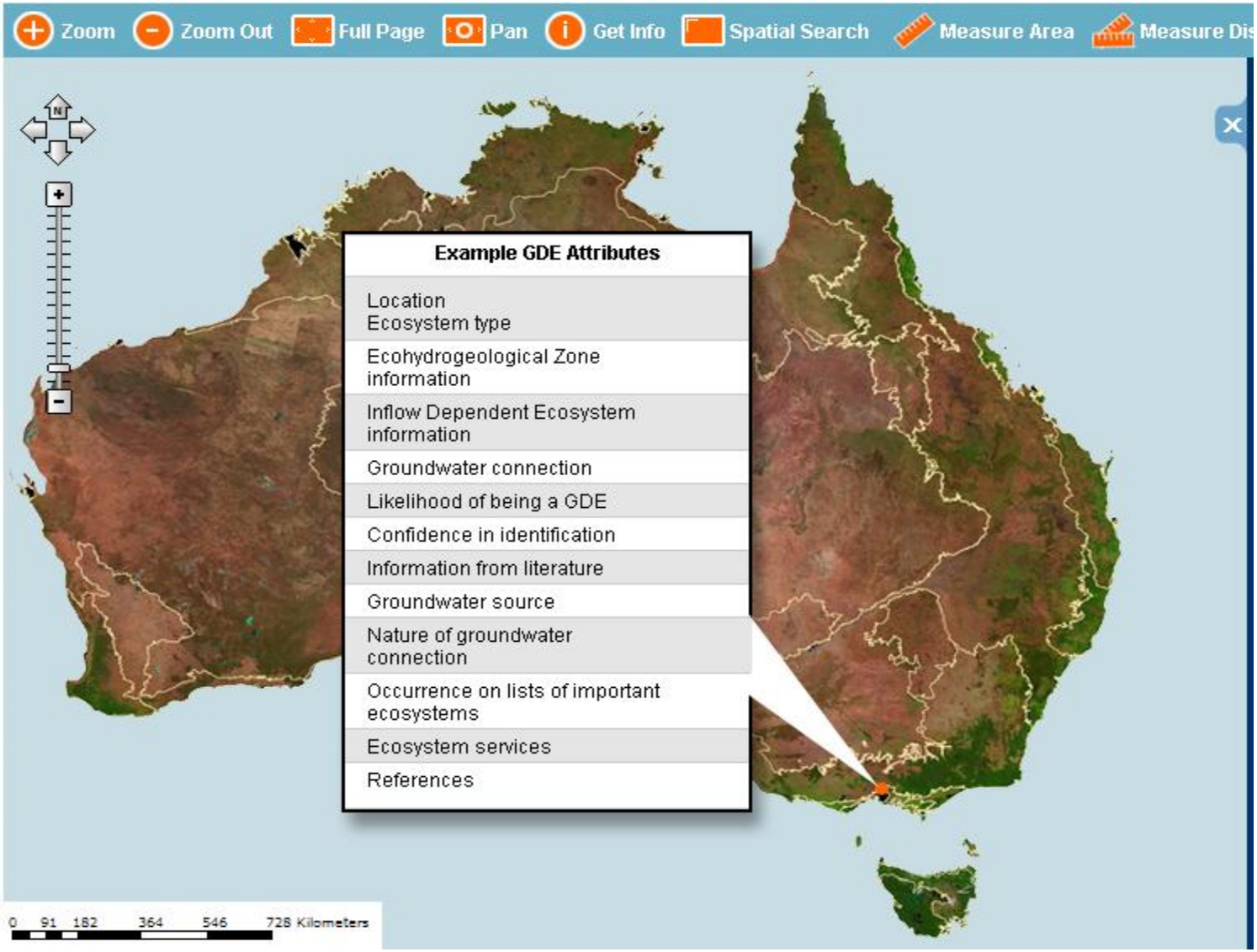

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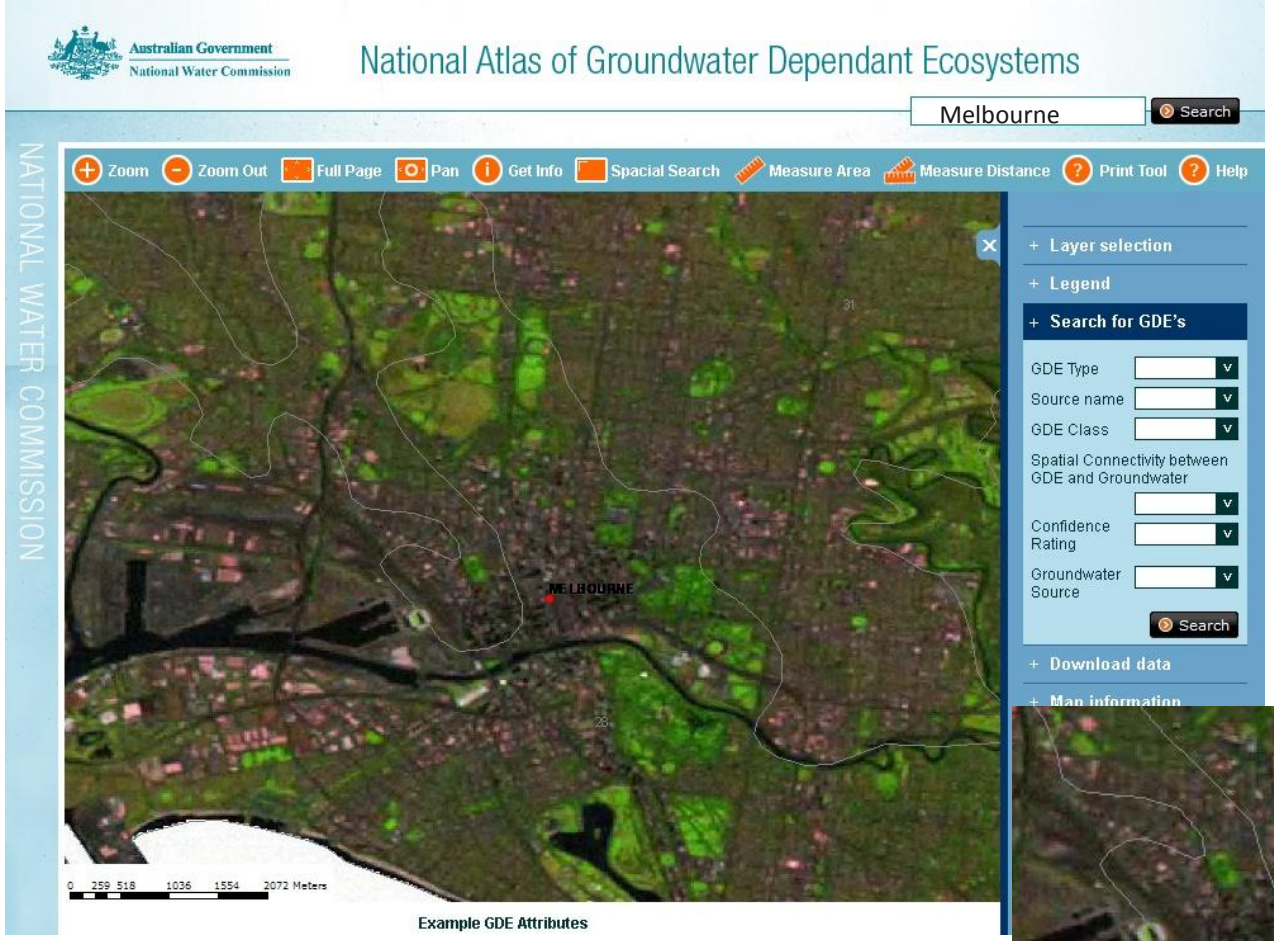
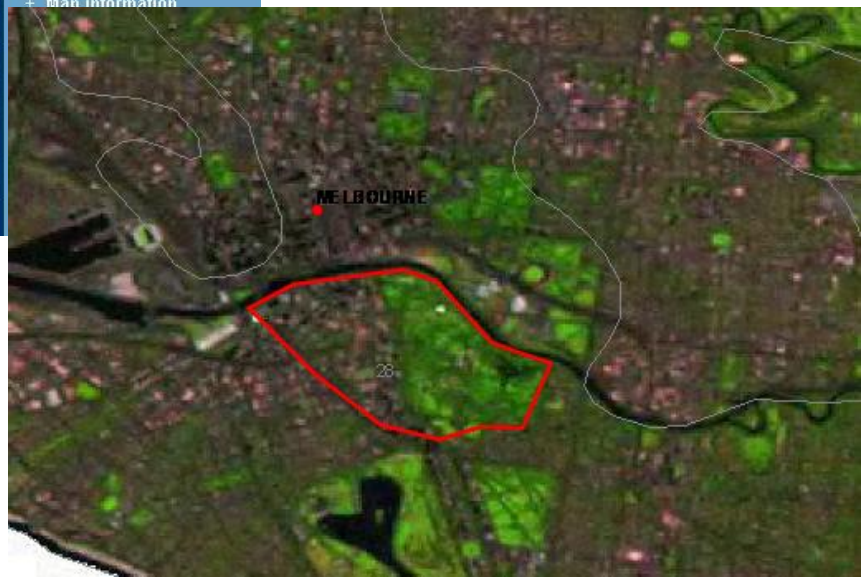
Location Search



Example GDE Attributes



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Updating GDE Atlas

Adding or Replacing Layers

- Import to SDE with PostGres as backend DB
- Export the PostGres Table to an archive file format
- If a replacement delete the existing table from the Web Server Database (PostGres)
- Import archive file to Web Server Database (PostGres)

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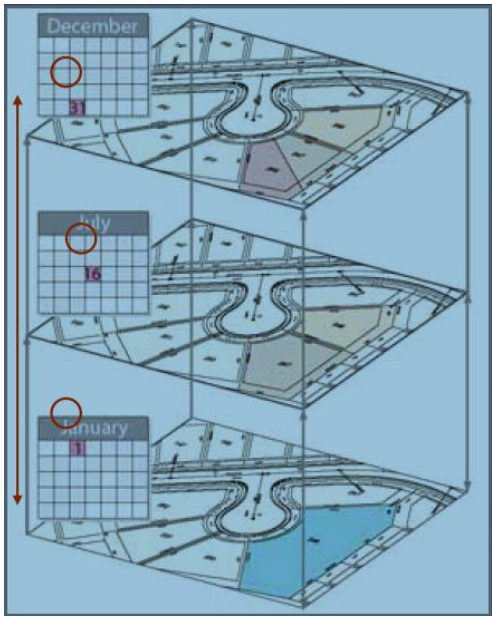
Updating GDE Atlas



- Export existing GDE data to an ESRI Geodatabase format (This would preferably be ArcSDE within PostGres. ArcSDE within MS SqlServer, etc would require extra steps to convert to PostGIS format.

- Use Arc Map to do the edits (spatial or attribute edits).

- For large bulk replacements features would be deleted using Arcmap in an edit region and loaded from other feature datasets as supplied by jurisdictions.

- ArcSDE is used to maintain Version Control and be used to assign the create_date and retire_date columns of respective GDE Layers in the data model.

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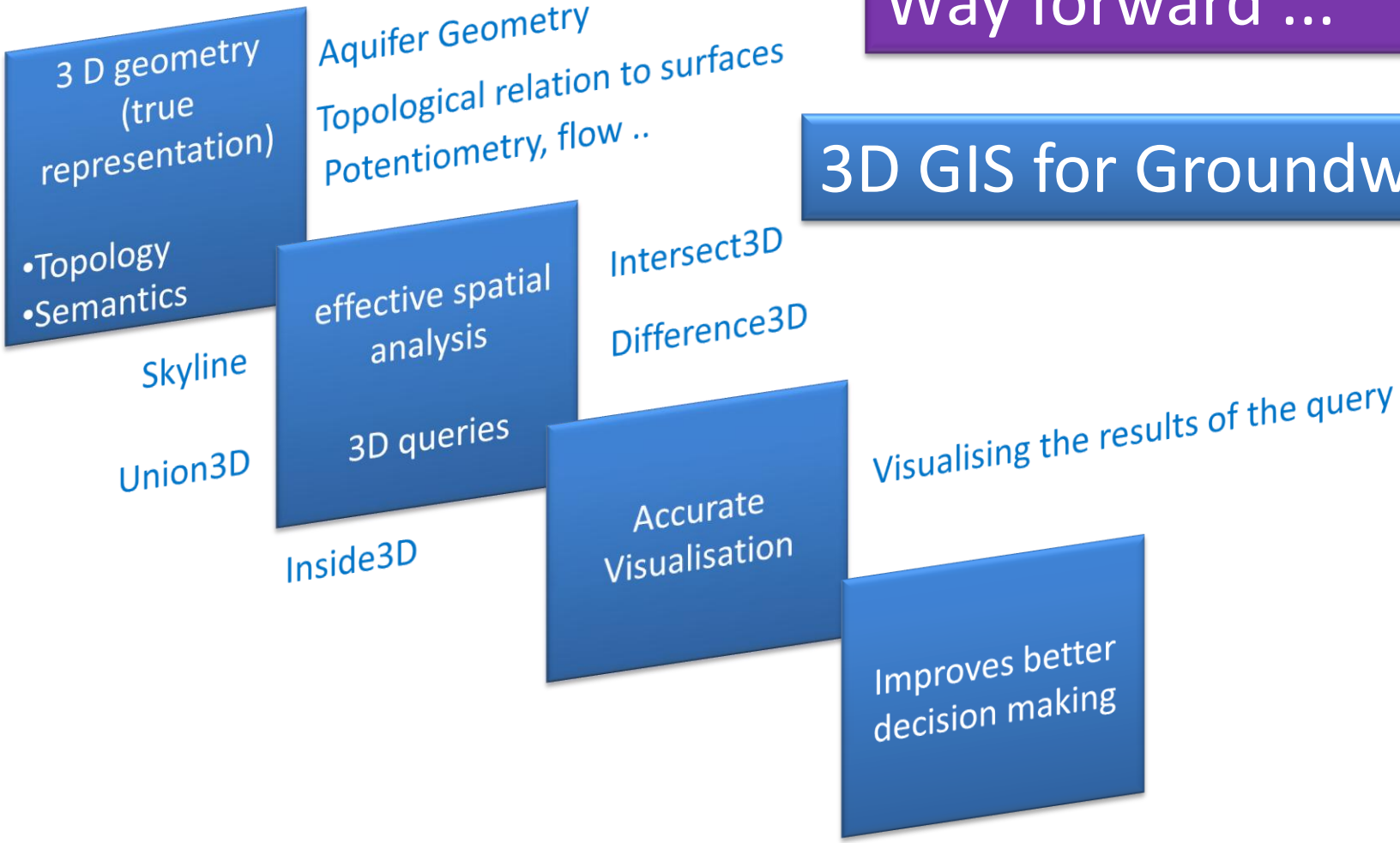
Way forward ...

3D GIS for Groundwater



3D GIS for Groundwater comprises of 3D geometry, 3D topology, semantics and appearance

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Way forward ...

- Representing 3D geometry from a spatial database perspective for groundwater data has been a challenge.

- Although, 3D geometry has been well represented for above surface features for eg. 3D city models , but there are limitations in representing subsurface features such as groundwater data in 3D geometry.

- There are data models such as ArcHydro groundwater with 2.5 D representation, still the true 3D geometry which includes 3D topology for groundwater related features from a spatial database perspective has to be explored.

- By representing true 3D geometry the users will be able to analyse (query) the spatial data from a 3D perspective and generate better visualisation from true 3D.

- Absence of remote sensors to depict the reality below ground and limited data models across the 3rd dimension for sub surface features are the problems across this area.

- Another interesting problem in groundwater related 3D features is the spatial semantics

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Thank You

Questions?

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