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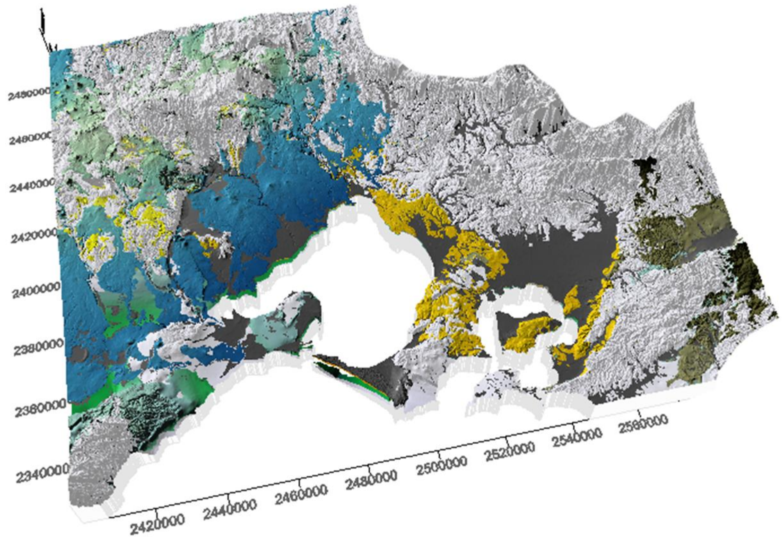

Department of Sustainability & Environment

Report on the Development of State-wide 3D Aquifer Surfaces

May 2012

Australian Government — National Water Commission

Australian Government — Bureau of Meteorology

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Executive Summary

The Department of Sustainability and Environment (DSE) engaged GHD Pty Ltd (GHD) and their partners Australian Water Environments (AWE) to develop seamless 3D aquifer surfaces based on the Victorian Aquifer Framework. The seamless mapping of aquifers across the state provides the fundamental framework for groundwater resource management, underpins development of a revised management framework for Victoria (Secure Allocation, Future Entitlement project funded by the National Water Commission) and contributes to the data needs of the Bureau of Meteorology National Groundwater Information System (NGIS).

The aquifer-based stratigraphical 3D map is based around a common terminology as defined by the 'Victorian Aquifer Framework Nomenclature' (VAF) (SKM, 2011a) and subsequently updated during the course of this project (GHD, 2012).

Using existing information, manual hydrogeological assessment of data, professional hydrogeological judgement as well as a series of automated scripts, aquifer surfaces (tops and bottoms) were produced for 15 layers consistent with the 'Aquifer' (and aquitard) definitions set out in the VAF.

The development of the state-wide surfaces was achieved by splitting the State into five main regions: 'North-West' Murray Basin, 'North East' Murray Basin, Otway Basin, Melbourne/Port Phillip Basins and the Gippsland Basin. During layer development focus was placed on the deep basin and valley regions that represent higher priorities for groundwater management. GIS datasets (e.g. polyline contours) and raster layers were developed for each Aquifer and Aquitard present in a region, then these were merged to produce state-wide seamless raster surfaces.

A number of challenges were encountered during the course of the project. Primarily, inconsistencies in stratigraphic interpretations contained in the State-wide Stratigraphic Database (SSD) hindered the initial development of geologically sensible surfaces. This resulted in the need to re-interpret bores or effectively ignore problematic bores if they could not be re-interpreted. Also known available data, such as Geological Unit information and non-groundwater related stratigraphic borehole interpretations were also missing from the SSD which placed limitations on the development of the layers. Some of this data was re-imported as it was seen to be critical to layer development; however it is likely that some remains omitted.

Throughout the development of the surfaces the input data, primarily the DSE supplied SSD, has been continually vetted for consistency based on professional hydrogeological judgement and supporting bore data and literature. The resultant database is considered to be an improved product, and also contains additional bore interpretations that were required to improve the spatial coverage. The Aquifer and Aquitard surfaces produced, as well as the input data, should be viewed as continually evolving. As new data becomes available it should be captured in future updates to the primary stratigraphic database as well as being reflected in future updates to the Aquifer and Aquitard surfaces.

It is expected that the 3D mapping products will be used to provide a consistent and standardised approach to the state-wide management of groundwater. It has real applications such as defining the (lateral and vertical) boundaries of Groundwater Management Units and supporting groundwater extraction license applications, as well as being an educational tool with respect to the conceptualisation of groundwater systems. Ultimately the information may be used to align state and national water management strategies.

1. Introduction

1.1 Project Background

The Department of Sustainability and Environment (DSE) is currently undertaking a range of groundwater investigation activities to enhance capacity for groundwater management in Victoria.

DSE engaged GHD and their partners AWE to develop seamless 3D aquifer surfaces based on the Victorian Aquifer Framework. The seamless mapping of aquifers across the state provides the fundamental framework for groundwater resource management, underpins development of a revised management framework for Victoria (Secure Allocation, Future Entitlement project funded by the National Water Commission) and contributes to the data needs of the Bureau of Meteorology National Groundwater Information System (NGIS).

The aquifer based stratigraphical 3D map is based around a common terminology as defined by the 'Victorian Aquifer Framework Nomenclature' (VAF) (SKM, 2011) and amended during the course of this project (GHD, 2012).

1.2 Objectives

The following objectives summarise the scope set out in DSE's RFT ('Tender 312798', March 2011):

1.2.1 Primary objectives (tasks and outputs)

- Provide topologically correct ArcGIS rasters describing the top and bottom of a minimum of 14 Aquifer layers (based on the Victorian Aquifer Framework). These will provide a 3D aquifer stratigraphic map of Victoria - extending from the top of the youngest Quaternary aquifers to the top of the relevant hydrogeological basement unit (the oldest formations);
- Base these rasters on previous mapping (e.g. SRW mapping, various Groundwater Resource Appraisals for the Rural Water Corporations) where this is available and otherwise extend the mapping into 'unmapped' areas;
- Where required, re-interpret bore data to separate out specific geological and hydrogeological units from previously mapped layers;
- Align basement (i.e. combined Aquifers 113 and 114) with the Geoscience Victoria's Crystalline Basement surface;
- That DSE have access to any project files used to produce the raster layers, to allow this mapping to be updated in the future.

1.2.2 Optional or Secondary requirements (tasks and outputs)

- Interpret lithology within bores, and present this in raster form for the areas beneath Port Phillip Bay and Western Port Bay;
- Separate out the Cretaceous and Permian Sediments (CPS – Aquifer 113) layer from the underlying Palaeozoic to Cretaceous Bedrock (BSE – Aquifer 114) layer;
- Conversion of the ArcGIS Raster layers to GoCAD format.

1.2.3 Requirements or preferences regarding method

- DSE indicated a strong preference that geological interpretation by geologists rather than automation by computers be at the forefront of the work method used in mapping;
- Re-interpretation, or addition, of bores to the State-wide Stratigraphic Bore Database ('SSD') should be kept to a minimum, and that re-interpretation of a significant number of bores should be unlikely as the database is currently to DSE's satisfaction;
- DSE have a requirement that the end products be ESRI ArcGIS products, and a preference that methods used are supported by ArcGIS or similar software.

1.3 Outputs and deliverables

DSE's brief clearly states that the project will be considered a success if the outputs/deliverables:

- Provide DSE with a consistent and common mapping of aquifer / aquitard stratigraphy across the State that has a high degree of reliability;
- Provide DSE and the Rural Water Corporations with a valuable information asset that can be used in conjunction with other datasets to better inform decision-making and protection of the groundwater resource;
- Can be easily accessed by those who require the information and can be readily maintained and updated in future years; and
- Assists the BoM in understanding and interpreting groundwater information in Victoria.

The specific products generated and reported in this document are:

- the aquifer / aquitard layers (i.e. GIS data);
- this report, and
- the supporting DSE interpreted database (updated during this project).

1.4 Purpose of this report

This report describes the construction of GIS raster layers that represent the top elevation of 15 hydro-stratigraphic units across the state of Victoria, as well as the bottom of the associated 14 hydro-stratigraphic units (no bottom of basement produced). This includes both a description of the input data used as well as the process undertaken to generate the rasters. It also provides commentary on differences to previous mapping products (where this has occurred), as well as ongoing uncertainties or issues associated with the mapping of these layers.

In addition to presentation of the data files and the surfaces, the report describes how the mapped aquifer layers have been defined with reference to the Victorian Aquifer Framework (VAF) and how these are incorporated in to the database. This is considered essential as the layers are based on geological understanding of the state and there is a need for them to be reproduced and updated in future based on clear definitions that are consistent with stakeholder understanding of the key groundwater management issues in the State.

A separate document detailing updates to the VAF arising from this project has been also been prepared (refer GHD, 2012).

2. Hydrogeological layers mapped

The layers mapped in this project are initially based on the approach developed in the VAF (SKM, 2009a, 2009b and updated in SKM, 2011a) that was established to generate a consistent nomenclature for the State's aquifers and aquitards. It is recognised that the original VAF was a first attempt and that there would likely be updates and revisions as the VAF was used in groundwater studies. The current version of the VAF is held by DSE, as documented in GHD (2012), and remains a 'live' or working document.

As per the project specification the sequence of aquifer and aquitards that was applied for this project is presented in Table 1 below. The details of the VAF and revisions found to generate hydrogeological correct and contiguous Aquifer / Aquitard layers are described elsewhere. Details of the layer extents and configuration and discussion of assumptions made in the construction of the layers are described in Section 5.

Table 1 VAF Aquifer / Aquitard layering

Layer	Aquifer Name		Aquifer Code	
1	Quaternary Aquifer		**QA**	**100**
2	Upper Tertiary / Quaternary Basalts		**UTB**	**101**
3	Upper Tertiary / Quaternary Aquifer		**UTQA**	**102**
4	Upper Tertiary / Quaternary Aquitard		**UTQD**	**103**
5	Upper Tertiary Aquifer (marine)		**UTAM**	**104**
6	Upper Tertiary Aquifer (fluvial)		**UTAF**	**105**
7	Upper Tertiary Aquitard		**UTD**	**106**
8	Upper Mid-Tertiary Aquifer		**UMTA**	**107**
9	Upper Mid-Tertiary Aquitard		**UMTD**	**108**
10	Lower Mid-Tertiary Aquifer		**LMTA**	**109**
11	Lower Mid-Tertiary Aquitard		**LMTD**	**110**
12	Lower Tertiary Aquifer		**LTA**	**111**
13*	(Lower) Tertiary Basalts*		**LTB***	**112**
14	Cretaceous and Permian Sediments		**CPS**	**113**
15	Cretaceous and Palaeozoic Bedrock	(basement)	**BSE**	**114**

*Note: the LTB layer has been split into LTB-A and LTB-B to represent the two main 'ages' or positions within the sedimentary sequence. LTB-B is 'older' in that it directly overlies the Aquifer 114 (Aq113 not present), and underlies Aquifer 111 (or younger unit), while LTB-A is 'younger' in that it overlies Aquifer 111 or even 110.
This layer has been provided as a unified GIS layer, as well as one GIS layer per component 'A' and 'B' stage.

2.1 Victorian Aquifer Framework

Details of the VAF are provided in the various VAF references (SKM, 2009a, 2009b, SKM, 2011a and GHD, 2012), and will not be repeated here. However, there is a requirement in reading this report to understand the basic structure of the VAF.

The VAF takes a hierarchical approach to setting out the stratigraphy of Victoria, with particular focus on groundwater. As illustrated in Figure 1 the VAF starts with the smallest units – 'Geological Units' (GUs) – then groups these GUs by age (firstly) and their general lithological characteristics or 'aquifer potential' (secondly) into 'Hydrogeological Units' (HGUs) which are subsequently grouped into the VAF 'Aquifers' (and Aquitards), which are the layers to be mapped (refer Table 1).

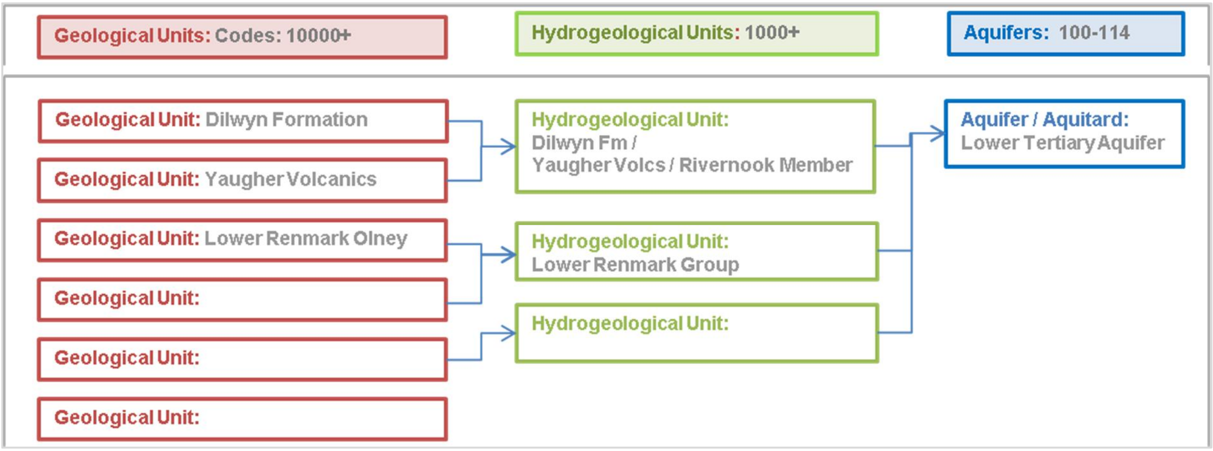


Figure 1 Example of hierarchy of units within the VAF

2.2 Geological Basins and mapping areas

The layers mapped essentially comprise the Cainozoic sequences that occur in the main sedimentary basins – i.e. the Otway, Port Phillip, Gippsland and Murray Basins[1]. Note that for this project, in the Murray Basin there is reference to the Riverine Plain (in north-eastern and northern Victoria) and the Basin Sequence (north-western Victoria). Figure 2 presents the general boundaries used during the project to separate the basins, which are primarily geologically-based, as well as the arbitrary boundary used within the Victorian part of the Murray basin (i.e. 'Northwest' versus 'Northeast').

[1] The smaller basins, Tarwin Basin, Moe Basin, Tyrendarra Embayment and so on are included within these main geological basins

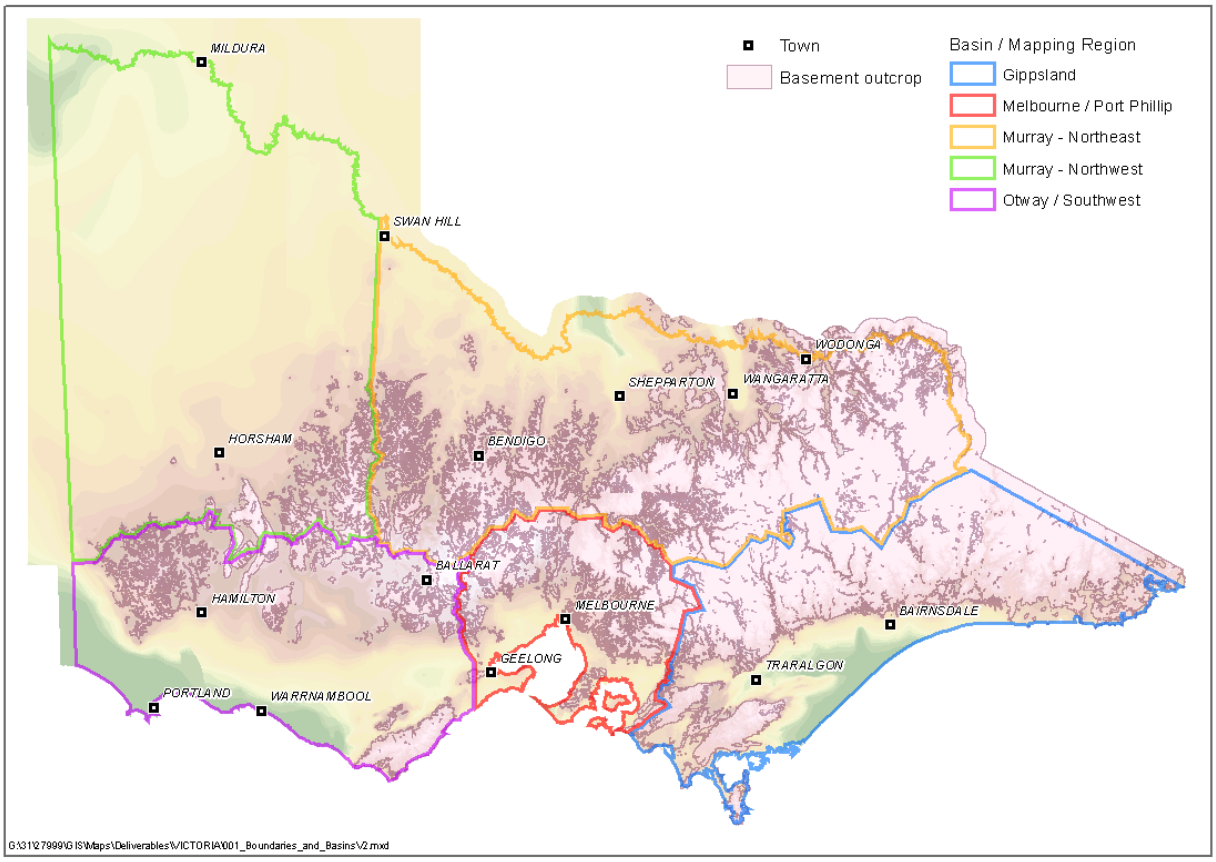


Figure 2 Geological basins and boundaries used for mapping

The surface of the “Groundwater Basement” (VAF Aquifer 114 = ‘BSE’) has been mapped according to its hydrogeological character as essentially a low permeability base to the overlying sedimentary sequences. It includes weathered profiles and crystalline rocks comprising Palaeozoic, including Permian, units across much of the state, and Lower Cretaceous strata in southern Victoria. It is noted that some Permian and Cretaceous sediments are mapped separately (Aquifer 113 based on their likely hydrogeological character; they are considered to have more consistent ‘aquifer potential’ than the underlying ‘Groundwater Basement’).

For the southern basins the mapped layers build on previous mapping projects with a number of additions to provide more detailed subdivision of the basin sequences in line with the current VAF. This includes the distinction of some aquitard units that have previously been referred to as aquifers (or lumped within larger ‘aquifer’ units), or units such as basalts that represent distinct lithology within an aquifer system.

Some of the key updates to the layers mapped in this project include:

- Separation of the Upper Tertiary Basalts from the Quaternary Alluvium layer in the southern basins;
- Separation of the fluvial and marine sediments in the Upper Tertiary Aquifer;
- Thick brown coal seams and associated fine grained sediments have been differentiated as aquitards in the Port Phillip and Gippsland basins where they are able to be distinguished from interbedded (‘interseam’) aquifer units;

- Differentiation of the distribution of "Older Volcanics" that are of varying Tertiary age across the state and often comprise important aquifers. In some cases these are able to be mapped as individual horizons (i.e. 'Lower' Tertiary Basalts: Aquifer 112), whereas elsewhere it has been necessary to include within other layers, most commonly the LTA (Aquifer 111);
- Differentiation of the different phases or ages of the 'Lower' Tertiary Basalts, which in the mapping process have fallen into two broad categories[2]:
    - Those mapped as the 'A' phase, which are considered younger than the Lower Tertiary Aquifer (Aquifer 111) (generally around the Moe and Tarwin Basins, and under Koo Wee Rup and Cranbourne) and some younger than the Lower-Mid Tertiary Aquitard (Aquifer 110) (generally occurring around Gellibrand);
    - Those mapped as the older 'B' phase, which are considered older than the Lower-Mid Tertiary Aquitard (Aquifer 110) and the Lower Tertiary Aquifer (Aquifer 111), and typically directly overlie basement.
- The shallow surficial aquifer comprising the Coonambidgal Formation that represents much of the recent alluvial sedimentary deposits has indistinct definition across much of the state and is defined largely by geological and geomorphic mapping. The exception is the well-defined Monoman Formation (or Channel Sand aquifer) that occurs along the Murray River that was split into a new HGU; and
- Distinction of the Cretaceous and Permian Sediments (CPS) in the Otway and Murray basins.

The geological and stratigraphic rationale behind the updates to the VAF that have arisen during the course of this project is provided in a separate document (refer GHD, 2012). They are also briefly summarised in Section 5, and the full VAF is presented in Appendix A.

[2] The extent (GIS polygon) file for the 112 LTB has been supplied to DSE and describes the location of the LTB (112) units. The attributes of this shapefile contain the VAF Aquifer Code of the unit that GHD believe underlies the basalts (or which at least, in mapping terms, needs to be considered and mapped prior to the top of that pocket of LTB should be mapped)

3. Data Sources and Collation

3.1 Databases

3.1.1 DSE Stratigraphic Database

The layers that have been mapped in this project were developed from data provided by DSE in the project specific DSE State-wide stratigraphic database (SSD). This represents the fundamental data set used to develop new and improve on existing layers, and is discussed in more detail in Section 4.

3.1.2 NGIS

The NGIS database represents a consolidated set of groundwater bore location information as well as lithology and stratigraphy. The 'best available' data has been used from a number of state-wide data sources to generate a single groundwater bore database based around unique GMS bore IDs. The development of the NGIS is documented in GHD (2011a) and SKM (2011b) (NGIS-A and NGIS-B respectively).

3.2 Existing Mapping

3.2.1 SRW Mapping Project

Raster layers have previously been produced for the southern parts of Victoria that are managed by the Southern Rural Water (SRW) (SKM and GHD, 2009). These layers covered the on-shore segments of the Otway, Port Phillip and Gippsland Basins.

A number of changes and updates to existing SRW layers were made, including splitting of some units in order for these to reflect the Victorian Aquifer Framework and to more accurately reflect the groundwater management and aquifer / aquitard relationships in these basins.

In some instances, the splitting of layers required further interpretation of stratigraphy to achieve adequate spatial coverage of data. To undertake the stratigraphic interpretations comprehensive knowledge of the geological units is needed. The SRW database provided for use in this project does not contain Geological Units, therefore it was often difficult and time consuming to obtain adequate level of information to confidently split layers.

3.2.2 DPI Crystalline Basement

The Department of Primary Industries (DPI) crystalline basement surface, generated with an interest in mineral and hydrocarbon exploration, was supplied to the project for use as the basement layer. A key issue with the use of this layer in the 3D aquifer surfaces project is the interpretation of crystalline basement compared to the interpretation of the configuration of the "groundwater basement" which may be sediments deposited or deeply weathered material overlying the crystalline, usually Palaeozoic basement rock.

Pre-Cainozoic geological units in the mapping project are generally considered to comprise the "groundwater basement" for the purposes of the 3D aquifer surfaces project as these units are typically limited aquifers for groundwater resource management.

In generating a groundwater basement surface it was found necessary to revert to the basement surface, derived from interpretation of drilling data that has been generated for a number of previous groundwater projects described below.

3.2.3 Outcrop Geology mapping (DPI, GSV)

The hydrogeological mapping undertaken in this project shows the relationships of the aquifers in relation to bedrock extent and distribution.

Outcrop geology has been adopted from the seamless geology layer provided by DPI that is based on many years of geological mapping by the (former) Geological Survey of Victoria. Data used included the extent of the bedrock to outline the extent of the major Tertiary sedimentary basins that are the focus of this work and the distribution of alluvial deposits. In addition it provided the extent of Tertiary aged geological units that occur in upland areas outside of the main basin sequences that may or may not be hydraulically connected to the aquifers that comprise the HGUs.

To the extent practical the outcrop geology mapping has been used directly in the project. There has been a need in some areas to amend the outcrop geology so as to be more consistent with the hydrogeological unit extents and the Victorian Aquifer Framework. Examples include:

- The extent of the White Hills Gravel near Bendigo, previously mapped as late Tertiary but likely to be significantly older; and
- Areas in eastern Victoria and in the Western Port area where contiguous outcrops have been named on adjacent geological maps as different formations on either side of the map boundary. The original geological maps and relevant explanatory notes, and the Geology of Victoria were used to obtain a consistent mapped formation and allow continuity of the relevant hydrogeological unit.

3.2.4 DEM

A state-wide Digital Elevation Model (DEM) with a 100 m grid was used to represent natural surface elevation. This was converted to 100 m from DSE's 20 m DEM, ensuring that it incorporated the pit floor of the Latrobe Valley mines (not all the state-wide topographic datasets incorporate these features). This was supplemented at the margins of the mapping boundaries, where the DEM was extended into SA and NSW for completeness using SRTM 90 m data (resampled to 100 m cells).

3.2.5 'ecoMarkets' Groundwater models

DSE's state-wide 'ecoMarkets' groundwater model programme has been used to assist with the definition of key layers of the major Cainozoic aquifers. The ecoMarkets models were produced for all areas of the state, however it is noted that the Mallee region model only assessed the upper intervals (i.e. to top of Geera Clay rather than to the pre-Cainozoic basement).

3.2.6 Latrobe Valley Coal Model

A detailed geological model of the coal seams in the Latrobe Valley (GHD, 2011b) was used to provide a framework for the hydro-stratigraphy in the western part of the Gippsland Basin. This geological model has been based on many years of geological analysis in the mine operation areas and beyond, and previous hydrogeological studies have demonstrated that the coal seams comprise important marker horizons in the region to define the geological and hydro-stratigraphic units. This work has been largely captured in the previous raster surfaces for the Gippsland Basin in SKM and GHD (2009).

Previously published maps of coal seams sub-cropping below overburden have also been used in this project to refine the extent of aquifers, particularly in areas where geological structure implies dipping coal and associated interseams strata beneath the younger Haunted Hill Formation (or other overburden).

3.2.7 DSE and RWC Groundwater Resource Appraisals

Rasters of the top elevation of most of the major aquifer systems have been prepared for catchment-scale Groundwater Resource Appraisal (GRAs) for G-MW in the Kiewa catchment (CH2M Hill, 2009), Ovens catchment (GHD, 2010a) and Goulburn-Broken catchment (GHD, 2010b), and hydrogeological mapping undertaken for the Loddon and Campaspe catchments (SKM, 2011c).

Where applicable these layers were used to assist with the generation of the 3D aquifer surfaces.

Kiewa Catchment

Mapping of the basement, Calivil Formation (or equivalent) and Shepparton Formation in the Kiewa and Indigo Creek valleys was undertaken by CH2M Hill (2009). Much of the mapping done in 2009 within the Kiewa Valley itself has been revised in this project.

Ovens and Goulburn-Broken Catchments

A number of changes to existing G-MW layers generated for the Ovens and Goulburn Broken projects were requested by DSE in order for these to reflect the Victorian Aquifer Framework. This included:

- Splitting the Shepparton Formation (Aquifer 102 – UTQA) from the overlying younger Aquifer 100 – Quaternary Alluvium (notably the Coonambidgal Formation);
- Also splitting the Newer Volcanics from the two alluvial aquifers mentioned in the previous point. This is less of an issue in the Goulburn-Broken catchment, but can be a problem because the Newer Volcanics are contemporary with the Shepparton Formation, and Shepparton Formation may be found below, above, and potentially between basalt flows;
- Previous mapping in the Goulburn catchment considered the 'Deep Leads', which could be either or both the Calivil Formation and Renmark Group, as a single unit – these have now been split into Aquifer 105 (UTAF) and Aquifer 111 (LTA); and
- Both the Ovens and Goulburn-Broken studies mapped basement as being all consolidated units of Cretaceous age or older. This required modification, splitting out the Permian units that are found within the Ovens Graben and Numurkah Trough.

Loddon and Campaspe Catchments

Mapping of surfaces in the Loddon and Campapse catchments using the VAF was undertaken by SKM (2010) and the data used in the surface generation was supported by data that has been incoroporated into the DSE stratigraphic database for this project.

Several changes have been required in this project based on some reinterpretation of aquifer extents to fit with outcrop geology, as well to split the Upper Tertiary Aquifers into those of marine origin (e.g. Loxton-Parilla Sand) and those of fluvial origin (e.g. Calivil Formation).

IN this area a combined bedrock of all units Cretaceous age or older was mapped by SKM, however they had interpreted a series of bores as intersecting Cretaceous and Permian Sediments (CPS) near Serpentine, in the Loddon valley. These bores have been used in this current project to split the CPS from the underlying BSE Aquifer unit.

Upper Wimmera and Grampians

The GRA completed by URS (2011a) for the Upper Wimmera and Grampians regions focused on the assessment of "high value" resources and was not developed using the VAF. Therefore the lithological logs presented in this GRA were reinterpreted into the VAF, guided by adjacent interpretations contained within the SSD and included in the SSD for assistance with layer development.

3.2.8 Basin in a Box / previous Murray Basin Hydrogeological Map series

A review of the 'Basin in a Box' (MDBC, 2002), the Murray Basin Hydrological Map Series (BMR, 1992) and the Murray-Darling Basin Groundwater Status 1990-2000: Summary Report (Ife and Skelt, 2004) was included as reference material when review of the distribution of the sediments of the Murray Basin was undertaken. The geological units were matched to the VAF. Refinement to the information contained within these sources was made by including recent drilling data.

3.2.9 Airborne Magnetic data

Airborne magnetic data was used to refine the subcrop extent of the Newer Volcanics (UTB) in the Otway and Port Phillip Basins, in the central highlands and down into the Loddon and Campaspe Valleys. The mapping used was the publicly available GIS raster data from DPI/Geological Survey of Victoria (DPI (2001)).

4. State-wide Bore Stratigraphy Database

4.1 Database description

A state-wide interpreted stratigraphic bore database containing approximately 20,000 interpreted bores was provided for the project. Throughout the course of project work, approximately 1,500 bores were either interpreted or reinterpreted. Table 2 provides a summary of the data currently contained within the SSD, including updates made through this project.

Table 2 Summary of data in the State-wide Stratigraphic Database

Table	Total # Bores
Borepoint (construction, location)	208,123
Lithology (drillers and geologists log)	109,116
Stratigraphy	21,752
Wells (screen)	52,403[1]

Table Notes:

1: Total number of bores with screen information contained in either the 'screen from' and/or 'screen to' fields. This *excludes* bores that have both 'screen from' and screen to' as equal to 0.

The SSD structure is documented well in SKM (2011b) and SKM and GHD (2009). A summary of the key table contained within it is provided in Table 3 below.

Table 3 Key tables within the State-wide Stratigraphic Database

Table Name	Content / Key Fields	Use in 3D mapping project
AQUIFER	List of the aquifer codes, names and numbers, including creation and retirement date	Reference only. Not used to link tables during layer development.
BOREPOINT	Contains bore location, elevation and depth as well as date of input and surface geology HGU	Primarily used for bore location information. Some new bores added, some incorrect/duplicate bores retired, some bore IDs corrected.
HYDROGEOLOGICAL UNIT	A lookup table that links the assigned HGU to Aquifer/Aquitard	Used as primary information source to link HGUs with aquifers. Any changes made to VAF with respect to structure of HGUs were reflected in this table. All stratigraphic interpretations were linked to this table to define assigned aquifer.
LITHOLOGY	Table of raw lithology information from drillers and geologists logs.	Lithology information linked to stratigraphy for reference when interpreting or re-interpreting bore stratigraphy. Some additional lithology data added during this state-wide mapping project. A new field also added to this table. Field is 'SIMPL_LITH' and classes the often unique lithological description in each bore interval into a simplified format (~80 standardised entries). This is for use in database/GIS analysis. Currently this field is ~48% populated.

Table Name	Content / Key Fields	Use in 3D mapping project
STRATIGRAPHY	Table of all stratigraphic interpretations compiled for the SSD, including corresponding HGU, all interpretation scenarios and flags to highlight whether the stratigraphic interpretation is currently in use	Used as primary source of stratigraphic information for the project. All new interpretations or reinterpretations made during the course of the project captured in this table.
STRATIGRAPHY_RAW	Contains original stratigraphic interpretations from previous studies, with no HGUs assigned	Used as reference only
WELL	Contains bore screen intervals, salinity and water level information	Used as reference only

As previously discussed there is no GU information contained within the SSD. This is seen as a current limitation of the database.

The SSD used as the basis for this project was provided to GHD and AWE on the understanding that it was an up to date interpreted database. This proved not to be the case and it is important to clarify the inconsistencies in some of the interpretations by various workers, where the data was found to be inconsistent with mapping and aquifer extents.

In particular this was noted with some of the original GEDIS interpretations that were included in the project database without being vetted against the geological extent of aquifers and formations and subsequently required re-interpretation to allow for inclusion in the mapped surfaces. In contrast, there are many GEDIS bores that have excellent geological data but are stratigraphic rather than groundwater bores and therefore have not always been included in the project database. However, these have been the basis on which the aquifer stratigraphy had been established previously and also are referred to in some of the key literature to support this project, e.g. Geology of Victoria (2003), amongst other reports. In many cases the former naming convention for some of these bores, based on Parish numbers, has not enabled inclusion in the SSD.

4.2 How the SSD was used in this project

The basic framework for layer development was to use the HGUs interpreted for the bores in the database to construct layer extents and Aquifer and Aquitard top elevations. Based on guidance in the tender documentation the interpretations of the HGUs in each bore provided were assumed in the first instance to be accurate and based on sound stratigraphic information. Figure 3 presents the approach taken to assessing the data contained in the SSD prior to layer development.

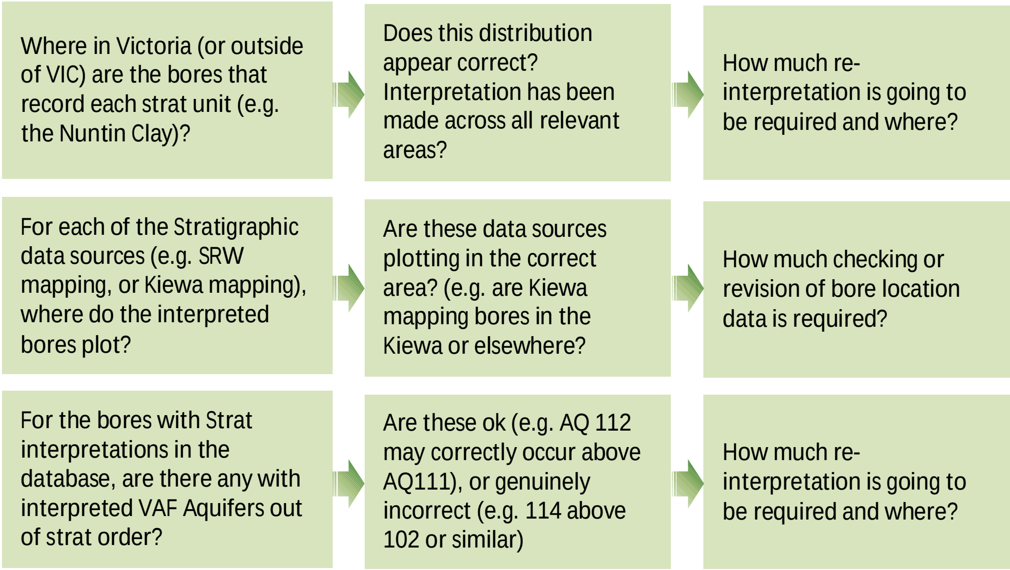
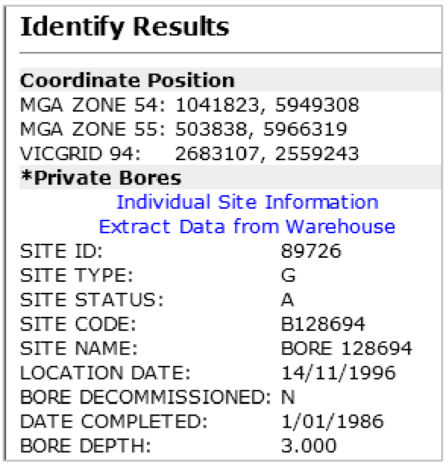


Figure 3 Approach taken to assessing SSD content and data prior to mapping

Based on these checks some systematic issues were found. Some of the issues encountered are described below as well as the steps taken to address them. It is hoped this will assist in avoiding similar difficulties in future work.

- Non-unique bore IDs were identified when lithology and stratigraphy assigned to some bores was noticed to be inconsistent with the region. Following investigations into the issues it was apparent that a truncated version of many South Australian bore IDs had been incorporated into the SSD. This resulted in lithology and stratigraphy being assigned to incorrect bores, as the truncated SA bore ID was duplicated with old Victorian GMS bore IDs[3]. To rectify this, the original list of SA bore IDs and data was obtained and cross-checked against the data in the SSD. Bore IDs were subsequently updated to provide the full original nomenclature.

- Confusion between the true Bore_ID and other identifiers had occurred in previous studies and been carried through to the SSD. The issue is explained with the help of the image to the right. The image comes from the Victorian Water Resources site (http://nremap-sc.nre.vic.gov.au/MapShare.v2/imf.jsp?site=water) where each bore has a 'SITE ID' and a 'SITE CODE'. The 'SITE CODE' is analogous with the 'BORE_ID' in the SSD and the 'SITE' in the GMS. This links the bore location to a bore log and other bore construction details, water quality results etc. The 'SITE ID' is simply a GIS identifier, and because it has a similar format to the 'SITE CODE', can be


Identify Results

Coordinate Position
MGA ZONE 54: 1041823, 5949308
MGA ZONE 55: 503838, 5966319
VICGRID 94: 2683107, 2559243
*Private Bores
Individual Site Information
Extract Data from Warehouse

SITE ID:	89726
SITE TYPE:	G
SITE STATUS:	A
SITE CODE:	B128694
SITE NAME:	BORE 128694
LOCATION DATE:	14/11/1996
BORE DECOMMISSIONED:	N
DATE COMPLETED:	1/01/1986
BORE DEPTH:	3.000

[3] SA bores are typically identified by "map number"-"bore number", e.g. 7021-1022. While most of the SA bores in the SSD had the full ID, some IDs had been truncated to just the bore number (without the map number), , e.g. "1022", and this number sometimes duplicated a valid Victorian GMS or DPI bore ID, resulting in confusion between SA and VIC bore locations and stratigraphic interpretations.

confused with it. As an example, this could mean that a bore with a SITE ID 89726 could be linked with the bore log from a bore with the SITE CODE 89726. The two bores probably have different depths, and are potentially constructed in very different geologies. This had occurred within the SSD (not widespread, but a systematic problem within one of the previous studies used to populate the SSD), but has now been rectified.

Re-interpretations of stratigraphy were required to be able to generate consistent and geologically sensible surfaces, as well as the interpretation of additional bores to provide greater spatial coverage in some areas. Interpretation or re-interpretation could only occur where lithological information for the bore was also contained in the SSD. This was not often the case. This resulted in the need for additional iterations in both the layer generation and the population of the database.

Where uncertainties and inconsistencies were found, reference was made to available geological interpretations such as the Geology of Victoria (Birch, 2003) as well as the reports on the stratigraphic basis for the database generated in other projects (e.g. SRW mapping project (SKM and GHD, 2009) for the Gippsland, Otway and Port Phillip basins, Tickell and Humphrys (1987) for the Riverine Plain, Brown and Stephenson (1991) in Murray Basin). Where available, reference was also made to basin bio-stratigraphic data to confirm the interpretation of the HGU and GU. It is noted that some of the bores used in these studies were not specifically drilled as groundwater bores and therefore have not been captured in the SSD. Some were subsequently included in the SSD during the course of project work.

It was also evident that some useful data contained within datasets produced for previous studies had not been transferred into DSE's SSD. In particular this related to detailed geological/stratigraphic information that is essential for detailed analysis as well as producing work that is consistent and repeatable. As part of this state-wide project it was necessary to retrieve some of this information (essentially Geological Units) from historical datasets so as to be able to split layers as per the project requirements. It is strongly recommended that geological information be updated into the SSD so as to avoid the need to repeat this in future work.

4.3 Additions to the database provided

During the course of the project data was added to the SSD from the following sources:

- State Observation Bore network (SOBN) expansion in the Grampians Wimmera Mallee Water (GWMW) and Goulburn-Murray Water (G-MW) areas;
- Tickell and Humphrys stratigraphic interpretations (Tickell and Humphrys, 1985);
- Groundwater Resource Appraisal (GRA) of the Upper Wimmera and Grampians Area (URS, 2011a) air core drilling program stratigraphic interpretations;
- State Observation Bore Drilling Refurbishment – West Wimmera (URS, 2011b) stratigraphic interpretations and lithological descriptions; and
- Highlake Resources mineral exploration bores in Ovens Graben.

It is also noted that some data needed to be removed from the SSD to rectify the non-unique bore ID issue described in Section 4.2.

5. Development of State-wide Aquifer Surfaces

In order to develop a State-wide set of aquifer surfaces, the data were analysed separately in the following regions (also refer Figure 2) which reflect the different geology, structure, status of existing mapping and current groundwater management arrangements:

- **'North East'**: Victorian Murray Basin, mainly the Riverine Plain, parts of the Western Highlands as well as Southern Highlands;
- **'North West'**: including of the Wimmera and Mallee parts of the Victorian Murray Basin and some of Western Highlands;
- **Otway Basin**; encompassing the structural subdivisions of the Gambier Embayment, Dartmoor Ridge, Tyrendarra Embayment, Portland Trough, Warrnambool Ridge and Port Campbell Embayment;
- **Port Phillip** – encompassing the Central Coast Basins of Torquay, Port Phillip and Western Port; and
- **Gippsland Basin** – encompassing the Gippsland Basin, the Latrobe Valley, Moe and Tarwin Basins, the Seaspray Depression as well as the highlands and Far East Gippsland to NSW.

DSE stressed in the project brief that "there will be a requirement for geological interpretation of geological data in establishing layers. Technology can and will assist efficiency but is not a substitute for a hydrogeologist performing interpretations". GHD and AWE appreciate this concept, and for that reason developed database and GIS tools to speed up the data manipulation and mapping processes so as to increase the amount of time available to hydrogeologists to analyse and interpret the data. The method is described in Section 5.1.

Using the VAF, for each of the areas described in Section 2.2 the Aquifers and Aquitards present in that area were identified and surfaces for each were developed. For completeness, a degree of overlap between the mapping areas was maintained; therefore where some of the layers listed below may not truly fall within the formal basin, they have been mapped in the area overlap. Table 4 presents a summary of the HGUs considered to be present in each of the mapping regions.

Aquifer Name	Aquifer Code	Aquifer Number	Hydrogeological Units (HGUs) present				
			Otway Basin	Central Coast Basins	Gippsland Basin	Murray Basin - North West	Murray Basin - North East
Quaternary Aquifer	QA	100	Various aeolian deposits (1001), various fluvial, lacustrine, alluvial and colluvial sediments (1002)	Various aeolian deposits (1001), various fluvial, lacustrine, alluvial and colluvial sediments (1001), Quaternary sandy limestone, calcarenite and shell deposits (1003)	Various aeolian deposits (1001), various fluvial, lacustrine, alluvial and colluvial sediments (1002)	Various aeolian deposits (1001), various fluvial, lacustrine, alluvial and colluvial sediments (1002), Monoman Formation / Channel Sand (1140)	Various aeolian deposits (1001), various fluvial, lacustrine, alluvial and colluvial sediments (1002)
Upper Tertiary / Quaternary Basalt Aquifer	UTB	101	Quaternary stony rises, tuffs, undiff Quaternary basalt (inc Newer Volcanics) (1005),	Quaternary stony rises, tuffs, undiff Quaternary basalt (inc Newer Volcanics) (1005),	ABSENT	ABSENT	Undiff Quaternary basalt (inc Newer Volcanics) (1005), unnamed Quaternary trachyte (1004)
Upper Tertiary/Quaternary Aquifer	UTQA	102	ABSENT	ABSENT	Haunted Hill Formation (1015), Eagle Point Sand (1016)	Shepparton Fm (1008-1010)	Shepparton Fm (1008-1010)
Upper Tertiary/Quaternary Aquitard	UTQD	103	ABSENT	ABSENT	Boisdale Fm (Nuntin Clay) (1017), Jemmys Point Fm (1061), Sale Grp (1061)	Blanchetown Clay (1014)	ABSENT
Upper Tertiary Aquifer (marine)	UTAM	104	Whalers Bluff Formation (1049), Moorabool Viaduct Fm (1034), Hanson Plain Sand (1030), Dorodong Sand (1031), Grange Burn Formation (1032)	Moorabool Viaduct Formation (1034)	ABSENT	Loxton Parilla Sand (1019), Moorna Fm (1020), Chowilla Fm (1022)	Parilla Sand (1019)
Upper Tertiary Aquifer (fluvial)	UTAF	105	Unnamed duricrust (1028), undifferentiated Upper Tertiary Aquifer (fluvial) (1023)	Brighton Group (1033), Baxter Sandstone (1035)	Boisdale Fm (Wurruk Sand) (1036)	Calivil Fm (1023)	Calivil Fm (1024), undifferentiated Upper Tertiary Aquifer (fluvial) (1023)
Upper Tertiary Aquitard	UTD	106	ABSENT	ABSENT	Hazelwood Formation (1056), Yallourn Formation (1058)	Bookpurnong Fm (1038), Lower Loxton Clays (1039), Geera Clay (younger) (1134), Winnambool Formation (younger) (1135), Renmark Group (younger) (1136)	ABSENT
Upper Mid-Tertiary Aquifer	UMTA	107	Port Campbell Limestone (1050), Portland Limestone (1048), Gambier Limestone (1041), Bochara Limestone (1048), Heywood Marl (1048), Heytesbury Group (1048)	Batesford Limestone (1051), Sherwood Formation (1055), Yallock Formation (1129)	Balook Fm (1060), LVG: Yarragon Fm (1057), LVG: Morwell M1-2 aquifers (1059), Alberton Fm (1064), Cobia Subgroup (1053), Gurnard Fm (1053), Turrum Fm (1053)	Murray Group Limestone (1052), Nelson Fm (1052), Glenelg Group (1052), Duddo Limestone (1046), Morgan Limestone (1043), Winnambool Formation (interleaving) (1137)	ABSENT
Upper Mid-Tertiary Aquitard	UMTD	108	Gellibrand Marl (1068)	Torquay Group (1072), Fyansford Fm (1054), Newport Silt (1069), Maddingley Coal (1132)	Seaspray Group (1062), Lakes Entrance Fm (1063), Tambo River Fm (1062), Gippsland Limestone (1063), Giffard Sandstone Member (1062)	Winnambool Fm (1067), Geera Clay (1066), undifferentiated UMTA (interleaving - older) (1139)	ABSENT
Lower Mid-Tertiary Aquifer	LMTA	109	Clifton Fm (1074)	Maude Fm (1070)	LVG: M2C aquifer (1141), Seaspray Sand (1141)	ABSENT	ABSENT
(Lower) Tertiary Basalts	LTB	112	Phase 2 ('Gellibrand') Basalts (1081)	ABSENT	ABSENT	ABSENT	ABSENT
Lower Mid-Tertiary Aquitard	LMTD	110	Wangoom Sand (1079), Narrawaturk Marl (1080), Upper Mepunga Fm (1084), Sturgess Point Member (1083), Nirranda Group (1078)	Demons Bluff Group (1085), Anglesea Fm (1085)	Flounder Fm (1086)	Ettrick Fm (1076), Boga Silt (1077)	ABSENT
(Lower) Tertiary Basalts	LTB	112	Phase 2 Basalts (1081)	Phase 2 Basalts (1081), Mornington Volcanics (1111)	Thorpdale Volcanics (1112)	ABSENT	ABSENT
Lower Tertiary Aquifer	LTA	111	Lower Mepunga Fm (1100), Dilwyn Fm (1093), Yaugher Volcanics (1093), Pember Mudstone (1095), Pebble Point Fm (1097), Timboon Sand (1101), Rivernook Member (1093), Burrungule Member (1094), Moomowroong Sand Member (1098), Wiridjil Gravel Member (1099), Brucknell Member (1100), Wangerrip Group (1091), Dartmoor Fm (1091), Knight Group (1091)	Eastern View Fm (1096), Werribee Fm (1102), Yaloak Fm (1103), Childers Fm (1107)	Childers Fm (1107), M2 / M2C aquifer (when basal aquifer) (1142), Latrobe Group (1104), Traralgon Fm (1104), Burong Fm (1108), Honeysuckle Gravels (1106), Yarram Fm (1105)	Upper, Middle and Lower Renmark Group (inc Warina Sand, Olney Fm) (1087-09), White Hills Gravels (1071)	Upper, Middle and Lower Renmark Group (1087-09), White Hills Gravels (1071)
Lower Tertiary Basalts	LTB	112	Older Volcanic Group (Phase 1) (1110)	Mornington Volcanics (1111), Older Volcanic Group (Phase 1) (1110)	Carrajung Volcanics (1113), Older Volcanic Group (Phase 1) (1110)	ABSENT	Older Volcanic Group (Phase 1) (1110)
Cretaceous and Permian Sediments	CPS	113	Paaratte Fm (1119), Belfast Mudstone (1120), Flaxman Fm (1121), Nullawarre Greensand (1122), Waarre Fm (1123)	NOT MAPPED	NOT MAPPED	Monash Formation (1115), Millewa Group (1116)	Urana Formation (1117)
Mesozoic and Palaeozoic Bedrock	BSE	114	Eumeralla Fm (1125), Casterton Fm (1125), Crayfish subgroup (1125), all Palaeozoic Basement Rocks (1124-28)	Permian Glacial Sediments, all Palaeozoic Basement Rocks (1124-28)	Strzelecki Group (1125), all Palaeozoic Basement Rocks (1124-28)	all Palaeozoic Basement Rocks (1124-28)	Permian Glacial Sediments, Strzelecki Group (1125), all Palaeozoic Basement Rocks (1124-28)

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Table 4: Summary of VAF HGUs by Aquifer (mapping layer) across the major Sedimentary Basins

5.1 Method

The process followed to create the GIS input data and the final surfaces for most of the VAF Aquifer layers is presented in Figure 4.

For each area the following general method was applied for the generation of Aquifer and Aquitard surfaces. Multiple iterations of some of the steps were required during surface development and refinement. The constituent datasets used to produce the rasters, and some of the particular tools and steps are discussed in the following sub-sections.

5.1.1 Contours

Contours developed for this project, either 'from scratch' or based on previous mapping, have been combined into state-wide GIS polyline datasets and are supplied with the overall mapping products.

Contours were created for all Aquifers. It is noted however that initially the top of Aquifer 103 (UTQD) in the 'North West' area was not constructed using contours. Instead it was primarily constructed using bore data or a nominal 3 m depth below ground surface in sub-crop areas. However, in order to create seamless state-wide surfaces, contours were extracted from that Aquifer 103 raster (for the 'North West' mapping area) and these were merged with other UTQD contours for other parts of the state. This was then re-interpolated (with bore data, outcrop points etc.) to produce state-wide rasters.

5.1.2 Aquifer extents

A raster of outcrop geology was supplied by DSE/SKM at the beginning of this project, based on Victorian Geological Survey (GSV) Mapping (1:250,000). This has been used as the basis for this project, although some modifications have been made to the 100 m rasters that represent the GSV geological mapping as the relevant VAF Aquifer and HGU codes. These two rasters are supplied with the project mapping products.

Aquifer extents have been combined into state-wide datasets, and are supplied as ArcGIS polygon shapefiles (based on 100 m grid spacing, hence the 'blocky' appearance). Note that the aquifer extents provided on DVD also include the assumed extent of the relevant aquifers beneath Port Phillip and Western Port Bays. These are not based on bore data (refer Section 7.2), and the aquifer top and bottom rasters and top contours do not extend into these areas. The seaward extent under the bays has been provided as a starting point for future work (see Recommendations in 10.2.2).

The extent polygon for the Lower Tertiary Basalt (LTB-112) layer shows the broad 'ages' of the basalt flows, and the attributes indicates which aquifer layer(s) underlie that particular area of LTB. The details provided in this shapefile are to aid the mapping process, not to document detailed geological nomenclature.

5.1.3 Fault lines

Faults used in the interpolation process have either been carried through from previous hydrogeological mapping work done for DSE and the Rural Water Corporations (e.g. the SRW Mapping Project by SKM and GHD, 2009) or based upon Geological Survey mapping and bore data (e.g. as is the case for the 'North West' area). The faults that have been used in the interpolations do not represent all the faults that are present in reality, simply the significant ones currently identified and published that may or may not displace aquifers across them.

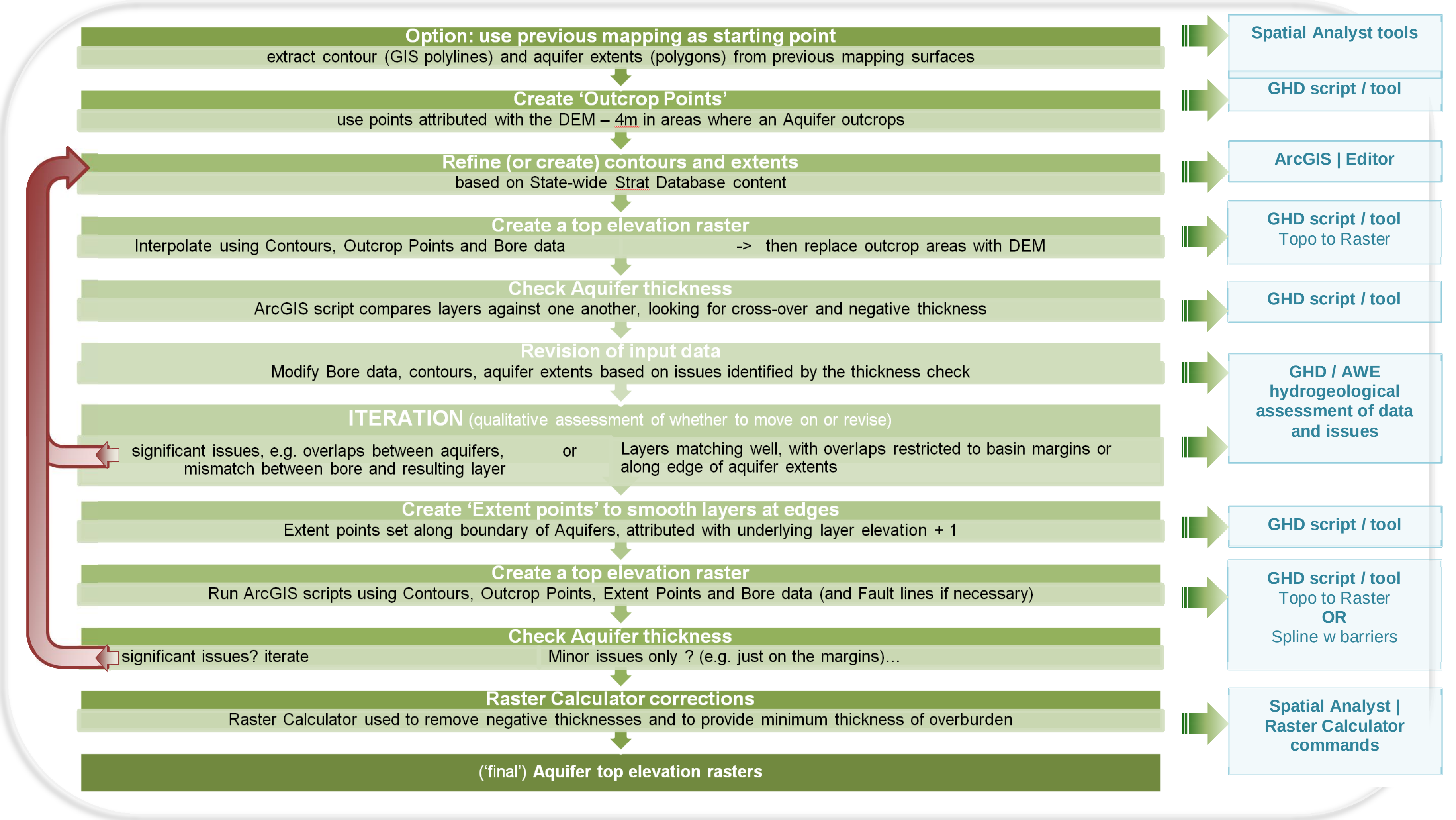

Figure 4 Hydrogeological mapping flow chart

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5.1.4 Interpolation Methods

ArcGIS Spatial Analyst 'Topo To Raster' tool was chosen as the default interpolation method for this project. It has three distinct advantages over the other methods within Spatial Analyst in that it:

- Accepts multiple input files (e.g. bore data in one file, 'Outcrop Points' in a second file etc.);
- Accepts a range of input 'z' (elevation values) allowing for exclusion of 'null' values; and
- Accepts contours as polylines in tandem with point datasets.

It handles producing geological surfaces from such datasets well except in the case where movement across faults require representation.

Faults cannot be represented by the 'Topo To Raster' tool hence the need to use a second method for some layers. 'Spline with Barriers', also in the Spatial Analyst toolbox, was used successfully to interpolate surfaces that were conceptualised as requiring faults to be represented. Those Aquifers created using Spline with Barriers were:

- Aquifer 114 (BSE);
- Aquifer 113 (CPS);
- Aquifer 111 (LTA);
- Aquifer 110 (LMTD);
- Aquifer 109 (LMTA);
- Aquifer 108 (UMTA)

This method is less convenient than the 'Topo To Raster' because it required all input data (Bore points, outcrop points, contours) to be converted to points if they were not already and then merged into a single GIS dataset. It is recommended that contours remain as the primary method of storing the interpreted topography (other than the bore data in the SSD and the rasters), and these be modified and refined in future as more data is added to the SSD; however the intermediate step to convert from polylines to points prior to raster creation will probably be required unless an interpolation method that can handle contours and faults ('break lines' or barriers) can be utilised.

5.2 Quality Assurance

A number of quality assurance (QA) measures were implemented to act as a series of checks on the layers being developed and identify inconsistencies to further address during layer refinement. These included both manual checks of surfaces and input data such as bore points and contours by experienced hydrogeologists, as well as semi-automated checks using GIS tools. The following QA measures were implemented:

5.2.1 Topologic Review

- Generation of aquifer thickness plots, including specific identification of areas of 'negative thickness' to assess isopachs and identify where 'older' layers overlie 'younger' layers. It is noted that there can be genuine instances of this due to the limitations of working within a framework, e.g. Aquifer 112 (Lower Tertiary Basalts) can correctly overlie Aquifer 110 or 111, although in general the Aquifer Code 100-114 does support the top-down stratigraphic sequence;
- Generation of cross-sections to assess whether extents pinch out to underlying/overlying unit;
- Where units outcrop, force surface elevation to match DEM; and
- Check of layer extents against current outcrop geology mapping and trimming of the extent should the layer extend into regions of older unit outcropping.

5.2.2 Hydrogeological Review

- Comparison of developed surfaces with published literature for consistency and verification of any deviations. Particular emphasis was placed on sources such as Geology of Victoria (Birch, 2003) and geological mapping (various sources);
- Comparison of developed surfaces with previously developed surfaces (SRW, 'ecoMarkets' etc.);
- Review of the surfaces by experienced hydrogeologists with extensive knowledge of the complex geological structures contained within the basins for checks on consistency of the layers with their general conceptual understanding of the region.
- Generation of cross sections to assess whether hydrogeological understanding of regions is being adequately represented in the relationship between the layers; and
- Review by stakeholders including DSE, Southern Rural Water, Goulburn-Murray Water and Grampians Wimmera Mallee Water (refer Appendix B).

It is noted that the hydrogeological reviews have identified some anomalies contained within the surfaces being used as the basis for layer development that cannot readily be explained by available data. For instance bullseyes appear in some of the SRW layers that cannot be explained by bore data contained within the stratigraphic database, nor controlled by geological structure. However as there was no data to support a change to these layers, and DSE has explicitly stated that changes to the SRW layers should only be undertaken where there is compelling data to do so, these anomalies have not been further investigated and addressed.

5.2.3 External Review

DSE engaged Spatial Vision to complete a review of the seamless state-wide layers. The review was focussed on checking the topological correctness of the layers rather than a hydrogeological review. The 1st review (early April) highlighted issues with the Lower Tertiary Basalts (particularly the 'A' or younger phase of these) and the Upper Tertiary Basalts in the Loddon Valley, as well as minor issues with other layers. These issues were corrected by GHD, and a 2nd review process by Spatial Vision (1st May) indicated that all topological issues had been corrected.

6. State-wide Aquifer maps

Individual layers were developed for each of the VAF Aquifers and Aquitards (as per Section 2) on an area-by-area basis as described in Section 5. GIS datasets were then developed in each area (extent polygons, contour lines) and these were combined or merged to allow the interpolation of the combined datasets into 'seamless' layers of the VAF Aquifers and Aquitards for the entire state. Discussion on the development of the layers for each area is provided in the following sections including issues encountered.

Where layers were developed based on existing mapping work done in the SRW or G-MW areas the aquifer extents and elevations were generally held true to those earlier layers unless the VAF warranted amendments or bore data supported changes.

Lower Tertiary Basalts

As detailed in Table 1 and Table 4, as well as the VAF Report (GHD, 2012), the Lower Tertiary Basalts span a greater time interval than just the 'Lower Tertiary'[4]. In almost all cases, the VAF Aquifer Code provides the correct stratigraphic order, however the fact that different phases are located at different vertical positions in the sedimentary pile means that the VAF Aquifer layer-cake structure does not accurately represent the stratigraphic profile in some places. For instance, in the eastern Highlands, the LTB directly overlies the Basement (Aquifer 114). In parts of the Gippsland Basin and around Western Port the same is true, and the LTB underlies the LTA (Aquifer 111). However in some parts of the Melbourne Basin the LTB *over*lies the LTA, and further west (near Gellibrand) it overlies the LMTD (Aquifer 110).

For this reason GHD have split the LTB into two broad stages, 'LTB-B' and 'LTB-A':

- the '**LTB-B**' stage represent the 'older' phase, and for the purposes of completing the mapping, is simply considered as overlying Aquifers 113-CPS and 114-BSE (although 113 absent), and being older or below the 111-LTA layer.
- the '**LTB-A**' stage represents the 'younger' phase, and for the purposes of completing the mapping, is simply considered as overlying Aquifers 111-LTA and older, and for the area of LTB near Gellibrand, also overlying the 110-LMTD.

The DVD accompanying this report contains a raster layer for the top of the LTB as a unified layer (and one for the bottom), as well as top and bottom rasters for each component stage; 'LTB-A' and 'LTB-B'.

6.1 'North East' (Murray Basin) Region

The term 'North East' is one used within this project, and is more extensive than definitions of North East Victoria as used elsewhere. The 'North East' mapping region essentially covers the G-MW area which is the eastern half of the Victorian Murray Basin, as presented in Figure 2. The region is essentially

[4] There are numerous Tertiary basalt intervals (as shown in *Geology of Victoria*) ranging in age from 22 million years old ('myo'), e.g. Thorpdale, Maude etc., some ~35-40 myo (Flinders, Aireys inlet), 55 myo (Carrajung) and perhaps as old as the Palaeocene or even late Cretacous (Ballan Graben and Poowong). .

dominated by three geological environments – the highlands in the east and along the southern fringe of this area, the riverine plain, and the basalt-filled valleys of the Loddon and Campaspe and Central Highlands.

Table 4 presents a list Aquifers and Aquitards in the 'North East' as well as the constituent HGUs.

Raster layers generated for the various GRAs and other projects for G-MW were used as the basis for layer development. Some of these layers were able to be used with only minor revision, however significant changes to some layers were required for consistency with the current VAF therefore some of the layers are not directly comparable. Table 5 below provides a summary of the modification made and the rationale for that change. Details of the changes to the VAF itself, and hence to the layers described here, is provided in the recent VAF update report (GHD, 2012).

Table 5 Summary of changes to G-MW Mapping layers in the 'North East' area

VAF Aquifer Code / No.	Primary Hydrogeological Unit(s)	Alteration	Rationale
QA - 100	Coonambidgal Formation	Split out recent/ Quaternary unit ('Coonambidgal Fm') from UTQA (Shepparton Fm) in Kiewa, Ovens, Goulburn-Broken	To separate out generally clayey QA from underlying sand/silt/clays of the Shepparton
UTB - 101	Newer Volcanics	Split out from UTQA/QA near mid-Goulburn.	
UTQA - 102	Shepparton Fm	See comments for QA above	
UTAM - 104	Loxton-Parilla Sand	Split marine sediments, the UTAM, (Loxton-Parilla Sand) from fluvial UTAF sediments (Calivil Fm) in the Loddon-Murray	
UTAF - 105	Calivil Formation	See comments for QA above. Also separate the LTA (Renmark Fm) from the UTAF (Calivil Fm) in the Goulburn-Broken – previously these had been mapped as combined 'Deep Leads'.	
UMTD - 108	Geera Clay		
LTA - 111	Renmark Group	Split out Tertiary volcanics from fluvial aquifers	Separate volcanics that can act as important aquifers in their own right
LTB - 112	Older Volcanics		
CPS - 113	Urana Formation	Split out Permian sediments, notably Urana Fm, from the underlying bedrock.	Based on updated VAF. Also to map consolidated units that might have greater 'aquifer potential' than other Palaeozoic units.
BSE - 114		See comment for CPS above.	

Where it has been considered necessary to provide further explanation some additional information regarding the development of some layers is provided below.

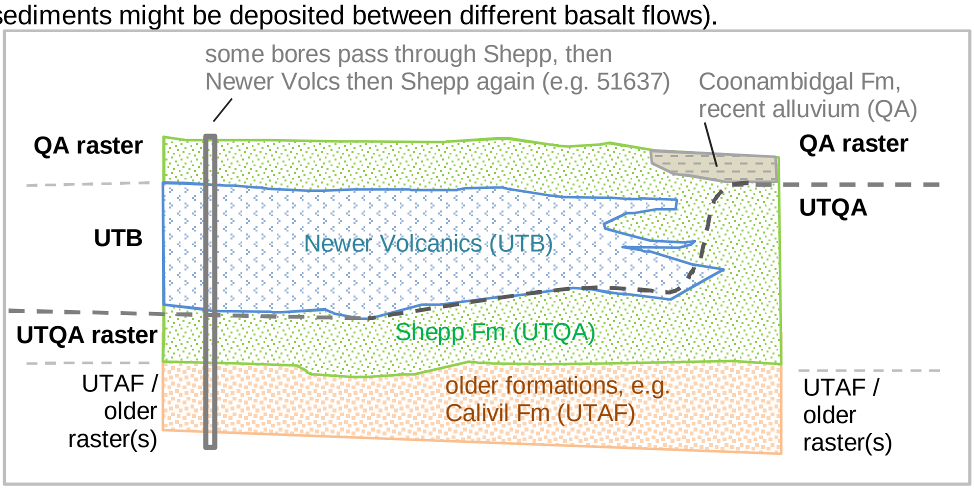
- In the Ovens Valley, the HGUs 'Lower Shepparton Formation' and 'Upper Shepparton Formation' have been used as much as possible to split the Shepparton Formation into two distinct units. This is because the in the Lower Ovens in particular, the upper 30-50m typically contains a much higher proportion of gravel (the 'Laceby Gravel') and sand than do lower the clayey horizons, except for the thinner Yalca Sand Member toward the base of the Shepparton Formation (often confused as being the top of the Calivil Formation / Pliocene Sand.

- The White Hills Gravel, initially set as UTAF (Aquifer 105) at the beginning of this project, has been shifted to the Lower Tertiary Aquifer (Aquifer 111) in keeping with its age. These have been treated as a 'hill capping' and generally unless there is nearby bore data to justify continuing the extent of the LTA between the hill capping and sub-crop present in the valleys, the two have been kept separate. The same general rule has been applied to much of the hill cappings of Upper Tertiary age.
- Splitting the CPS units from the BSE has been done primarily using the comments in the stratigraphic logs in Tickell and Humphrys (1985), Tickell (1977), GHD's interpretation based on lithology where this information is available, and a series of bores already interpreted with CPS intervals around Serpentine and Bridgewater on the Loddon (SKM, 2011c).

6.1.1 Key issues encountered during layer development

In the 'North East' mapping area, the main issues encountered were either a matter of geological interpretation (i.e. is one geological unit easily distinguished from another?) or GIS representation of the VAF layering system. These issues were:

- Distinguishing the Coonambidgal Formation (QA) from the older Shepparton Formation (UTQA), and mapping this split. Firstly, very few bores have QA interpreted – most are interpreted simply as Shepparton Formation (UTQA) from ground surface down to the next older unit (e.g. bedrock, Calivil Formation), and secondly there is little contrast between the description of the two in bore logs so it is difficult to make anything but a relatively arbitrary interpretation of the contact between the QA and UTQA.
- In the Loddon and Campaspe Valleys, the Newer Volcanics (UTB) is contemporary with the Shepparton Formation (UTQA). In some areas the Newer Volcanics occurs both over and under a thin horizon of Shepparton Formation (and if considering further detail, some Shepparton Formation sediments might be deposited between different basalt flows).



- The problem then arises in terms of whether the top elevation of the UTQA should map the top of the Shepparton Formation below the Volcanics, or above the Volcanics. SKM's mapping of the UTQA (SKM, 2011c) took the option of including the upper part of the Shepparton Formation within the QA (Aquifer 100) raster layer, rather than in the UTQA layer, where the Shepparton Formation was present above and below the Newer Volanics. GHD have not spent time considering the hydraulic importance of this – in some areas the thickness of Shepparton Formation lying between the basalts and the Calivil Formation ('Deep Lead') may not be significant enough to retard groundwater flow on anything but a short-term basis, however such consideration has been beyond the scope of this project and therefore the same method of mapping the 'lower' Shepparton Formation as the UTQA layer and the 'upper' Shepparton Formation within the QA layer has been applied here.

- The previous mapping done within the Goulburn-Broken catchment (GHD, 2010b) defined the top of the Deep Lead(s), which could be either or both of the Calivil Formation (UTAF) and Renmark Group (LTA). The reasons for doing so were the known hydraulic connection between the two units, and the difficulty in distinguishing these from one another in many bore logs. Despite the requirement to map the two separately, the problem of distinguishing the two remains, and GHD have put considerable effort into making consistent and practical interpretations of where the contact between the two lies. Generally the appearance of 'coal' in a bore log has been taken to mean Renmark Group, although this is not an entirely consistent rule. Much guidance or direction has been provided by bores that have had stratigraphic interpretations by Tickell and Humphrys (1985), many of which do not have an available lithological log.
- In some areas, e.g. the Ovens Valley around Wangaratta, there is difficulty, even confusion distinguishing the sands within the lower part of the Shepparton Formation (UTQA), which Tickell referred to as the 'Yalca' Sand Member, and the sands of the underlying Calivil Formation (UTAF). Effort has been made to make consistent interpretations of these two, however it can be difficult to do this given spatial variability in the colour of the sand horizons and of the clays that overlie and separate these (colour is often the distinguishing feature of the Calivil Formation), as well as the variability in the descriptions given in lithology logs.

6.1.2 G-MW review of the Aquifer surfaces

In December 2011 hydrogeologists from Goulburn-Murray Water had the opportunity to review the aquifer surfaces produced for their area (the 'North East' mapping area). The comments received and the GHD responses and actions are presented in Appendix B.

6.2 'North West' (Murray Basin) Region

The extent of the 'North West' region covers the north-western portion of Victoria, including the Mallee and Wimmera regions to the South Australian and New South Wales borders. This is essentially the Grampians Wimmera Mallee Water (GWMW) and Lower Murray Water area. This region covers the majority of the thicker sequences of the Murray Basin within Victoria. Additional detail was focussed around the Murray Erosional Trench to establish the hydrogeological framework around the River Murray. A summary of the layers developed and their constituent HGUs is presented in Table 4.

As outlined in Section 5.1, the North West raster surfaces were developed 'from scratch'. The following existing resources were reviewed in preparation for this mapping:

'Basin in a Box', the Murray-Darling Groundwater Status 1990-2000: *Summary Report*, and the following Murray Basin Hydrogeological Map Series 1:250000 maps:

- Ana Branch
- Balranald
- Chowilla
- Horsham
- Mildura
- Ouyen
- Pinnaroo
- Pooncarie
- Renmark
- St Arnaud
- Swan Hill

In addition the 'ecoMarkets' groundwater models developed for DSE, covering the areas of the Mallee and Wimmera CMAs (Aquaterra 2010 and Hocking et al. 2010), were used to a limited degree to help define extents and surfaces. Detailed analysis of the similarities and differences between the CMA model has not been carried out as these surfaces were not wholly supplied during 3D mapping layer development. Table 6 outlines where the HGUs mapped in layers are comparable to the current VAF, therefore the surfaces developed may be comparable. However, as data sources and interpretations are likely to have differed over the projects, differences between the layers will be present even if the same HGUs are mapped. It is noted that only isopachs for the Wimmera model were provided during layer development.

Table 6 Comparison of 'North West' area with Mallee & Wimmera 'ecoMarkets' Layers

VAF Aquifer Code / No.	Mallee CMA Model Layer	Wimmera CMA Model Layer	Comment
QA - 100	Layer 1	Layer 1	CMA model layers not directly comparable to VAF other than top of QA and Layer 1, which is a product of the DEM anyway. Base of Mallee Layer 1 constructed assuming nominal 3 m thickness unless specific bore data available.
UTQA - 102	Layer 1	Layer 1	
UTQD - 103	Layer 1	Layer 1	
UTAM - 104	Layer 2	Layer 1	Mallee model HGUs (Parilla Sands) comparable to UTAM. Wimmera model is not.
UTAF - 105	NA	Layer 2	Wimmera model HGUs (Calivil Formation) comparable to UTAF. Mallee model is not.
UTD - 106	Layer 3	Layer 3	Mallee model Layer 3 combines elements of UTD, UMTA, UMTD and LTA therefore difficult to compare directly to any single VAF layer.
UMTA - 107	Layer 3	Layer 4	Wimmera model HGUs comparable to UMTA. Mallee model as per UTD.
UMTD - 108	Layer 3	Layer 5	Wimmera model combines elements of Ettrick Marl and Geera Clay (UMTD and LMTD) therefore comparable to these layers in some regions, except where Winnambool Formation is present. Mallee model as per UTD.
LMTD - 110	Layer 4	Layer 5	Neither layer comparable to VAF.
LTA - 111	Layer 4	Layer 6	Mallee model base of Layer 3 comparable in parts to top of LTA. Wimmera model Layer 6 comparable to LTA.
CPS - 113	NA		CPS not comparable to either model layer. No distinction in CMA models.
BSE - 114	NA	Layer 7, 8	Mallee model base of layer 4 potentially comparable to BSE. Wimmera model layers 7 and 8 comparable to BSE.

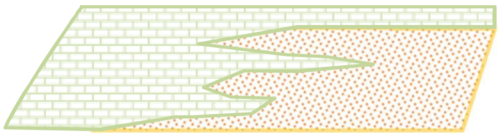
When the VAF was applied to this existing information, in general the extents of the layers presented in those previous studies were supported when considering the content of the SSD. Some amendments were required where aquifer extents were modified by new interpretations of underlying aquifer surfaces, specifically:

- The Cretaceous and Permian Sediments surface was remodelled to conform with the interpreted fault-controlled structures in the basement layer around the Danyo and Murrayville Faults;
- The Lower Tertiary Aquifer extent was remodelled to conform with the interpreted fault controlled structures associated with the Tyrrell Fault;

- The Upper Mid-Tertiary Aquitard and Upper Tertiary Aquitard were extended toward the east; and
- The Upper Tertiary/Quaternary Aquitard was modified to exclude any extent into the Murray Erosion Trench.

6.2.1 Key issues encountered during layer development

A recurrent issue was the consistency and spatial distribution of data contained within the SSD. The reinterpretation of many bores was required to generate sensible surfaces. Approximately 200 bores were interpreted or re-interpreted during the course of layer development. Specifically the following issues required addressing through updates to the VAF and bore database:


'interleaving' units

- Mapped areas where the aquifers interleave owing to transgression/regression history and how the database and VAF handles where 'older' and 'younger' layers repeatedly 'overlap' each other.
- The complexity of assigning interleaving sequences into the appropriate VAF layer considering the reporting tools used to relate the information. To account for this, new HGUs were added to the VAF and bores were reinterpreted according to the new framework;
- Pinching out of layers near edge of their extents. Often limited bore data was available to control layer thickness, particularly where deposition of sediments is projected into the narrow valleys adjacent the exposed basement;
- The interpretations and extent definition for Aquifer 103 were based on the following:
  - Work done by Aquaterra (2010) and AWE (2009a and 2009b) support the absence of Blanchetown Clay to near Red Cliffs (including the 'Wentworth' region) within the erosion trench that now contains the River Murray. During initial layer development all bores located within the bounds of the erosion trench that had Aquifer 103 stratigraphy assigned were ignored, therefore there is bore data contained within the SSD flagging the presence of Aquifer 103 that is considered to be incorrect. It was not within the scope of the project to reinterpret these bores. It is noted however that during work added to the original scope to split the Monoman Sand Formation from the Coonambidgal Formation, some of these bores were reinterpreted. Where bores within the erosion trench had Blanchetown Clay (Aquifer 103) nominated, typically this interval was reinterpreted as Coonambidgal Formation if in the shallow profile. Future work should continue to address these issues and complete the reinterpretations in the erosion trench.

- For the 'Werrimull' region, the extent of Blanchetown Clay (Aquifer 103) developed primarily spanned the South Australian border however was and extended into the Sunraysia area. The concepts of 'Lake Bungunnia' deposition of Blanchetown Clay from Bowler *et al* (2006) (*map to right)* and the 'ecoMarkets' extents (Hocking *et al*, 2010) were also considered and compared with bore data in the SSD. The boundary was redefined based on lithology log information, specifically at Site 103159/103160 where 103160 was used over 103159 for the upper section thus indicating Blanchetown Clay (Aquifer 103) is absent. Site 77030/77031 was omitted, giving preference to the original extent boundary as this also supported the omission of Blanchetown Clay at site 103160. In hindsight the extent can be moved south to include 77030 and would better match the Bowler *et.al* (2006) and Hocking extent. Note: Hocking placed the extent virtually on top of this site, whereas the log suggests a layer thickness of 24.5m. If this is a 'natural' depositional extinction of this layer it may thin out to zero thickness further south of this site.

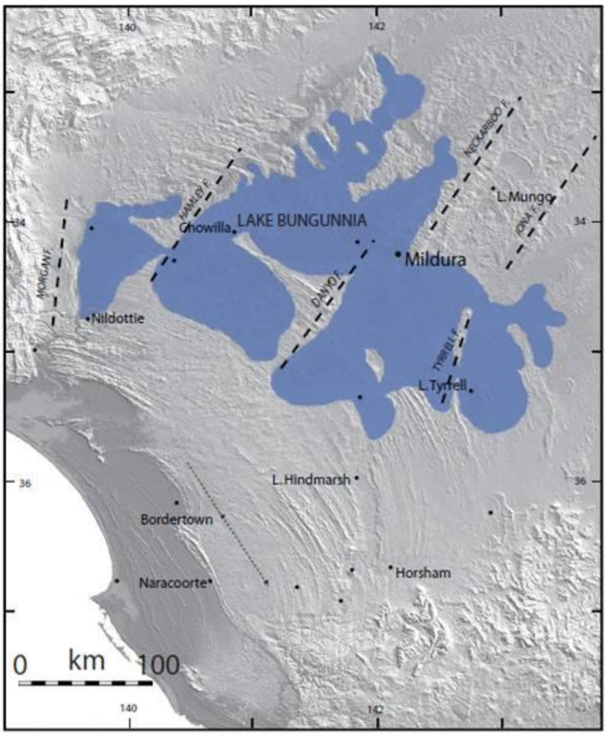


Fig. 8. Elevation diagram showing Lake Bungunnia near its maximum extent coincident with the 60 m contour. This does not take account of the fluvio-lacustrine sandy facies that probably extend beyond these boundaries. Note clear emphasis of north-easterly trending fault bounding controls.

- The southern/south-western mapped extent of Aquifer 103 follows interpretation of provided bore logs where Aquifer 103 is considered absent. This reduced the mapped extents presented by Bower *et.al* (2006) and Hocking *et al* (2010). Limited re-interpretation of bore log data was undertaken as this was outside of the project scope.

- Mapping of the basement structure to represent the interpreted faulting structures, including:
  - Renmark Trough aligns well with the Hamley Fault;
  - Netherbi Trough aligns moderately well with the Murrayville Fault. In assuming the faulting structure and then matching this with the data provided in the SSD, AWE did not interpret the Netherbi Trough structure to be as continuous as depicted in Knight *et al*. (1995);
  - (Balranald Trough) aligns poorly with the Tyrrell Fault – Tyrrell fault extending further south towards Stawell is supported by the database;

- Wentworth Trough aligns poorly with the Danyo Fault - also the Danyo fault appears to influence the Permian/deeper Tertiary sequences to the southwest and the shallower Tertiary sequences to the northeast;

Data gaps occur where the density of bore data is inadequate to control the mapping of aquifer extents and thicknesses, particularly at the expected 100 m grid spacing of the project. This can lead to the extrapolation of known data to areas of limited data that would exceed acceptable error bounds. As the reliability of surfaces provided is linked to the density of available data, areas of low density data therefore warrant greater extrapolation of surfaces/thicknesses, reducing the confidence in the reliability/accuracy of the surfaces.

6.2.2 GWMW review of draft Aquifer surfaces

In February 2012 hydrogeologists from Grampians Wimmera Mallee Water had the opportunity to review a draft of the aquifer surfaces produced for their area (the 'North West mapping area). The comments received and the GHD/AWE responses and actions are presented in Appendix B.

6.3 Otway and Southwest Region

The extent of Otway and Southwest region is presented in Figure 2. Focus was placed on the deeper Otway basin and units contained within this region, i.e. south of the divide. The aquifers and HGUs present in this region are outlined in Table 4.

The layers developed were based largely on the SRW mapping already completed, with the exceptions being where layers required splitting as per the tender specification, so as to be compliant with the VAF or where bore data and outcrop geology mapping specifically warranted changes to the existing SRW layers. Table 7 below outlines the basis for the developed of each layer, as well as highlighting the differences between the layers developed for the current project and those developed for SRW.

Table 7 Summary of Changes to SRW Mapping Layers in the Otway Region

VAF Aquifer Code / No.	Corresponding SRW Layer	Alteration	Rationale
QA - 100	A100	Extent correlates to outcrop geology of QA sediments, quaternary volcanics has been split out	For consistency with VAF and as per tender specification.
UTB - 101	A100	New layer created. Previously included in within QA. Extent based on outcrop geology, bore data, Bennetts (2005) and aerial magnetics	To separate the quaternary basalts that can represent significant shallow aquifers in their own right
UTAM - 104	A300	Marine deposits split from fluvial deposits. Additional extent in SW to capture outcrop geology and bore data supporting existence of UTAM.	Separate Upper Tertiary marine and fluvial aquifers as per the VAF.
UTAF - 105	A300	Fluvial deposits including split from marine deposits.	Separate Upper Tertiary marine and fluvial aquifers as per the VAF.
UMTA - 107	A400	Removal of Fyansford Fm at boundary with Port Phillip Basin	Fyansford considered to be an aquitard and in Aquifer 108 in VAF.
UMTD - 108	A500	Addition of Fyansford Fm at boundary with Port Phillip Basin	Fyansford considered to be an aquitard and in Aquifer 108 in VAF.

VAF Aquifer Code / No.	Corresponding SRW Layer	Alteration	Rationale
LMTA - 109	A600	No significant change. Extended slightly in region east of Cobden to allow layer to pinch out.	Bore data at boundary of layer suggests some thickness of LMTA.
LMTD - 110	A700	Lower Gambier Limestone not included in VAF – all classified in layer 107. Also split out Older Volcanics into layer 112 where possible.	To be consistent with VAF.
LTA - 111	A800	Tertiary basalts removed where able to be split. Yaugher Volcanics remains as LTA	As per tender specification and VAF.
LTB - 112	A800	New layer created. Tertiary basalts split from A800 where mappable.	Separate volcanics from sedimentary aquifer units as can be productive aquifers in own right.
CPS - 113	A900	New layer created. Split from BSE.	To distinguish sediments that have more aquifer-like characteristics than underlying basement rock.
BSE - 114	A900	Basement layer amended as needed based on bore data.	To facilitate seamless layer development.

Additional information regarding the development of some layers is provided below where it has been considered necessary to provide further explanation.

- The boundary used to split the SRW A300 layer into UTAM and UTAF was somewhat arbitrary due to sparse data, limited detail contained in lithology records to differentiate between fluvial and marine sediments, and the inherent difficulties of identifying a boundary of this nature, where there is little distinction between the lithologies. Basement contours were used to assist with defining the boundary, as well as drawing on knowledge of GHD hydrogeologists who have drilled these formations. The UTAM extent was extended beyond the SRW A300 boundary in the south west corner based on geology outcropping and interpreted bore data.
- Where the LTB was split from LTA this was based on bore data and outcrop mapping. Limited spatial extent of data to support the presence of the LTB in the Otway Basin has resulted in the surface being of limited extent, the boundaries of which are not clearly defined. It is noted that the Yaugher Volcanics (included in the Dilwyn Formation HGU) remains mapped as part of the LTA. Future work could investigate the feasibility of separating out the Yaugher Volcanics also.
- Split of CPS from BSE. This was based on CPS formation flags in the STRC_DESC field contained within the 'Stratigraphy' table in the SSD for bores with BSE HGUs, as well as a small number of bores already interpreted with CPS HGUs.

6.3.1 Key issues encountered during layer development

During layer development it became apparent that there were inconsistencies in the HGU code and name fields. This particularly related to HGU code 1073 (Undifferentiated Lower Mid Tertiary Aquifer) and HGU names Undifferentiated Lower Tertiary Aquifer (HGU 1087) and Undifferentiated Lower Tertiary Aquitard (this naming convention is no longer used in the VAF) that appear to have been used interchangeably. That is the HGU code of 1073 has multiple HGU names associated with it despite the fact they relate to different aquifers and aquitards. In some instances it was clear which field was correct and the bore was reinterpreted to assign the correct HGU code and HGU name, however where it was unclear which aquifer should be assigned the bore was flagged off. A small number of these instances were addressed in the database as it was outside the scope of the project, and future work should aim to address these inconsistencies. It is also recommended that other HGU code and name combinations be checked for similar issues.

Inconsistencies in some interpretations contained in the SSD when compared to surrounding bore interpretations, as well as when compared to SRW surfaces resulted in a number of undifferentiated UMTA (Aquifer 107) bore interpretations being flagged off in the stratigraphic database, especially in the south west corner of the Otway Basin. In particular this related to relatively recent interpretations of UMTA from the stratigraphy source of 'A Bush PhD 2010'. Further issues with Aquifer 107 were encountered due to the way in which the Gambier Limestones have been classified in previous studies and how this data is currently represented in the SSD.

There appears to be no separation of the Gambier Limestones (Upper, Middle and Lower) in the VAF or the SSD (all instances classified as HGU 1041 in Aquifer 107), however the SRW surfaces have split the Upper and Lower Gambier Limestones. It is noted that there are inconsistencies in the classification of the Gambier Limestone across the VAF, SSD and the SRW mapping layers.

For consistency with ongoing management of groundwater resources and as directed by DSE, the SRW mapping layers have taken precedence during the development of the 3D Aquifer Surfaces layer development.

Table 8 demonstrates the way in which the Gambier Limestones are currently represented in the VAF, stratigraphic database and SRW layers, as well as providing suggested changes to future versions of the database and VAF for consistency with the age-based stratigraphic nature of the VAF. The suggested amendments are primarily based on the correlations presented in Geology of Victoria (Birch, 2003).

Table 8 Current and recommended representation of Gambier Limestone

Data source→ Layer ↓	Stratigraphic DB (SSD)	VAF	SRW mapping	GHD suggested amendment
Upper Gambier	Layer 107	Layer 107	A400	Layer 108
Middle Gambier	Layer 107	Layer 107	Not represented	Layer 109
Lower Gambier	Layer 107	Not represented	A700	Layer 110

6.3.2 SRW review of draft surfaces

In February 2012 hydrogeologists from Southern Rural Water had the opportunity to review a draft of the aquifer surfaces produced for their areas (the Otway, Melbourne/Port Phillip and Gippsland regions). The comments received and the GHD responses and actions are presented in Appendix B. The SRW review session focussed on the Gippsland and Melbourne / Port Phillip regions and very little comment was received regarding the Otway region.

6.4 Melbourne / Port Phillip Region

The extent this region covers the Torquay, Port Phillip and Western Port basins in the central part of southern Victoria, as presented in Figure 2. A list of the aquifers and corresponding HGUs present within this mapped region is provided in Table 4.

Layer surfaces were initially developed using the SRW mapping layers as a basis however alterations to some of these layers were required to be complicit with the current VAF. The amendments made to the SRW layers are summarised below in Table 9.

Table 9 Summary of Changes to SRW Mapping Layers in the Port Phillip region

VAF Aquifer Code / No.	Corresponding SRW Layer	Alteration	Rationale
QA - 100	A100	Only includes Quaternary sediments. Newer Volcanics split out into own layer.	To separate out the often shallow sedimentary and basalt aquifer units.
UTB - 101	A100	Newer Volcanics split out from Quaternary sediments.	To separate out the often shallow sedimentary and basalt aquifer units.
UTAM - 104	A300	Marine deposits including Moorabool Viaduct Sand split from fluvial deposits.	Separate Upper Tertiary marine and fluvial aquifers as per the VAF.
UTAF - 105	A300	Fluvial deposits including Brighton Gp and Baxter Fm split from marine deposits.	Separate Upper Tertiary marine and fluvial aquifers as per the VAF.
UMTA - 107	A400	Only includes Sherwood Marl in Western Port basin.	Sherwood Marl considered aquifer under VAF.
UMTD - 108	A400, A500, A800	Comprises Fyansford Fm from the A400 in Port Phillip basin, Jan Juc Fm (A500), and Maddingley Coal (A800).	Represents changes to the VAF for the Upper-Mid Tertiary Aquitard.
LMTA - 109	A500 (Maude Fm only)	Only comprises the Maude Fm. Jan Juc Fm & Newport Silt assigned to UMTD.	Separate the LMTA from aquitards in the A500.
LMTD - 110	A700	Extended slightly eastwards beneath Nepean Peninsula.	Cross sections showed anomalies in previous interpretations close to Selwyn Fault.
LTA - 111	A800 (however Maddingley coal split out as per VAF)	The Maddingley Coal was removed where mappable as a distinct layer above the Werribee Fm.	Separate the Maddingley Coal from sand & gravel aquifer units incl. Werribee Formation.
LTB - 112	A800 (where outcropping)	Split from A800 where the volcanics outcrop, and also where mappable in Western Port basin.	Separate volcanics from sedimentary aquifer units.
BSE - 114	A900	Basement layer amended as needed based on bore data	To facilitate seamless layer development

As per the Otway Basin, the boundary established between the UTAM and UTAF is somewhat arbitrary. Further discussion on some of the differences between the SRW and current mapping layers is provided below:

- The UMTD was created by merging the SRW A400 within the Port Phillip basin (Fyansford Formation), part of the A500 layer (Jan Juc Formation), and the top of the A800 layer (Maddingley Coal) where this unit was mappable. The Maddingley Coal was mapped based on abundant bore interpretations and guided by stratigraphic work previously undertaken by Holgate and Gallagher (2003).

- Where the SRW A500 layer represented the Maude Formation this was split into the LMTA. This was done in accordance with the VAF, reflecting the distinction between this unit and the aquitards of the Fyansford Formation, Jan Juc Formation and Newport Silt.
- The SRW A800 layer was split into the Maddingley Coal (UMTD) as per the VAF, the LTA and the LTB where the LTB outcrops and the LTB in Western Port basin where it could be separated from the LTA.
- No distinction between the Cretaceous and Permian Sediments (Aquifer 113) and the basement was made in the Port Phillip region as this was not part of the project scope and these sediments are not understood to be extensive or act as an aquifer in this region.

A total of 261 bores were interpreted or reinterpreted within the SSD as part of work on the Port Phillip region layer development. This included a number of bores where the Maddingley Coal (UMTD) was split from the Werribee Formation (LTA). Additionally a number of bores in the southwest of the region that originally interpreted Upper Tertiary Aquifer sediments as Brighton Group (UTAF) were reclassified as Moorabool Viaduct Formation (UTAM) to reflect the likely depositional environment.

6.4.1 Key issues encountered during layer development

A number of difficulties in mapping the layers were encountered around Lethbridge, in particular the small area of the Maude Formation (layer 109) extent. This was a result of the complex geology of the area and combining of parts of the SRW A400 (Fyansford Formation) and SRW A500 (Jan Juc Formation) into the UMTD. Some minor modifications to the SRW layers were required (both extents and surface elevations e.g. where basement outcrops in river cuttings) to adequately represent the geology of the region, including lowering of the LTA where present in the region.

The Lower Tertiary Basalts layer was mapped from Chelsea to Cranbourne and in part of the Western Port basin centred around Koo Wee Rup based on bore data. In these areas the LTB (Aquifer 112) generally occurs above the Werribee Formation, Childers Formation or equivalent (LTA, Aquifer 111). Elsewhere where the LTB is either inter-bedded within the LTA or there was insufficient bore data to map it as a separate unit, therefore the LTB was not split out from the LTA, other than where it outcrops. This was the situation for most of the western side of Port Phillip Bay, where only limited bore data for the LTB exists.

It appeared that bore interpretations used for the SRW mapping layers near the southern extent of the Selwyn Fault on the Mornington Peninsula had misinterpreted the stratigraphy of some bores (e.g. limestone and marl interpreted as LTA). Based on the reinterpretations and on the cross-sections that were generated for quality/review purposes, the extent of Aquifer 110 (Demons Bluff Formation) was extended slightly further east, abutting the fault. It is noted that the final layers accompanying this report have some errors in the way the relevant layers abut the Selwyn Fault which affects an area within 1-2km west of the Fault on the Mornington Peninsula. If and when the layers are re-generated in future, the recommendation made in Section 10.2 should be considered.

Aquifer 105 was extended over some gaps present in the SRW A300 layer near the top of Western Port basin as this was supported by bore data. It was also supported by the cross-sections generated as part of the quality/review processes, which showed that the top of Aquifer 107 would have to be elevated considerably from surrounding levels and without any apparent structural control if the 105 Aquifer was not present in these gaps.

At several locations a lack of bore data, particularly for deeper units, reduces the reliability of the layer surfaces produced. This is apparent beneath the Nepean Peninsula where there are only a few bores that intersect the full sequence of Tertiary sediments, which can be over 1,000 m in thickness. This affects the surfaces produced for Aquifers 108, 110, 111, and 112. Around Lara, and towards Little River and Anakie, some gaps in bore coverage make the extent of the Upper Tertiary Aquifers (104 - marine and 105 - fluvial) uncertain, as well as that of the LTA.

6.5 Gippsland Region

The Gippsland region covers the Gippsland basin as presented in Figure 2. During layer development most effort was placed on the western part of the region that contain the deeper Gippsland Basin units that are more of a focus for groundwater management.

Table 4 presents a list of the VAF Aquifers and Aquitards in the Gippsland as well as the constituent HGUs.

Raster layers generated for the SRW mapping project (GHD and SKM, 2009) were used as a basis for layer development in this project. Significant changes to these layers were required for consistency with the current VAF therefore many of the layers are no longer directly comparable. Table 10 below provides a summary of the alterations made and the rationale behind the change. Detailed notes on the changes applied to the VAF, and hence to the layers described here, is provided in GHD (2012).

Table 10 Summary of changes to SRW Mapping Layers in the Gippsland Region

Aquifer Code / No.	Corresponding SRW Layer	Alteration	Rationale
QA - 100 UTQA - 102 UTQD - 103	A200	Split out Haunted Hill Formation and Nuntin Clay from recent/ Quaternary unit	To separate out clay and sand units and for consistency with VAF
UTAF - 105	A300	No alteration	N/A
UTD - 106 UMTA - 107 UMTD - 108 LMTA - 109	A400	Split Tertiary units into aquifers and aquitards	From a groundwater management perspective these units need to be managed separately
LTA - 111 LTB - 112	A800	Split out Tertiary volcanics from fluvial aquifers	Separate the volcanics that can act as important aquifers in their own right

6.5.1 Key issues encountered during layer development

- Many GEDIS-sourced bores in the SSD appeared to contain incorrect interpretations; the assumption of (in)correctness is based on the fact that individual bore points were distorting the layer surfaces and creating 'bulls-eyes' of very high or very low surface elevation in the rasters. Typically no supporting lithology information was contained in the database to assist with reinterpretation or verification of the existing interpretation. As a result many of these bores were 'flagged off', effectively removing them from the interpretation process, though many still remain as rectifying all these interpretations falls outside of the project scope. This issue was most prevalent in Aquifers 106, 108 and 111.

- The 'stratigraphic comment' field in the database generated by GHD in the SRW mapping project (SKM and GHD, 2009) was not imported into the stratigraphy table of the DSE stratigraphic database. This field included information on the different Morwell seams which made it impossible to split out the M2C aquifer without first importing this information back into the database. This also resulted in a number of bores flagged as 'Thorpdale Volcanics' being placed in the Lower Tertiary Aquifer as this information was not available when splitting the volcanic unit out.
- Jemmy's Point Formation and Lakes Entrance Formation / Gippsland Limestone contain similar lithology (marls and limestone) which has resulted in both layers being classified interchangeably. In areas where the top of Aquifer 108 rose above Aquifer 106 many of these bores were re-interpreted.
- A subcrop geology map with the overburden removed was used to define the extent of the 106, 107 and 108 Aquifers in the Latrobe Valley area. The base of the alluvials derived from the Latrobe Valley (LV) Coal Model (GHD, 2011b) was used to help define the top of Aquifer 106 where there was paucity in bore data (base of Aquifer 102 is assumed to be ceiling of Aquifer 106 as these layers are separated by a disconformity).
- Also the geometry of Aquifer 107 was compared with the M1A layer derived from the LV Coal Model. Generally the layers were consistent around the mines where there was extensive bore data, however, it was noted that some of the GEDIS bores had distorted the surface elevation of Aquifer 107. Variations between the two layers were also noted where there was an absence of bore data.
- There are very few bores intersecting the M2C around Darriman to guide the development of the top surface of Aquifer 109. Also the M2C aquifer may have been interpreted as Latrobe Valley group as the interpretation can be subjective.

A total of 288 bores were re-interpreted as part of the layer development for the Gippsland region, the majority of which were DPI GEDIS bores.

In addition the following changes were made to the supplied outcrop geology in the Gippsland region:

- Re-interpretation of a large outcrop of Aquifer 105 to Aquifer 102 between Metung and Tamboon. The Mallacoota 1:250,000 geology map sheet indicated that the unit was 'Haunted Hill Gravel in part' which is consistent with the stratigraphy further west (e.g. west of Orbost, around Bairnsdale)
- Re-interpretation of the floor of the Latrobe Valley mine pits as either Aquifer 106 or Aquifer 107 based on the following information provided by GHD geologists;
    - Loy Yang: Yallourn Formation in the NE corner of the mine, and Morwell Formation across most of the pit floor;
    - Hazelwood: Yallourn Formation in the NW corner of the mine, and Morwell Formation across most of the pit floor;
    - Yallourn: Yallourn Formation across most of the floor.
- Re-interpretation of outcropping Aquifer 102 to Aquifer 105 south of Longwarry. The Warragul 1:250,000 geology map sheet indicated that the unit included Baxter Sandstone, which is a constituent of Aquifer 105, near the boundary between the Gippsland and Port Phillip extents.

6.6 Seamless Aquifer and Aquitard layers

As described in Section 5 seamless rasters of the top and bottom of each 'Aquifer' and 'Aquitard' layer under the VAF were generated by combining the GIS datasets produced within each of the five basins/areas as described above. ArcGIS Spatial Analyst Interpolation Tools, either 'Topo to Raster' or 'Spline with Barriers' were then employed to carry out the state-wide interpolation of the merged datasets. Typically the older units have been affected by movement along faults, and for this reason most of the older Aquifer layers have been created using 'Spline with Barriers' (which better represents faults), while younger layers have been produced with the more convenient 'Topo to Raster' tool.

The state-wide maps for the top elevation of the 15 layers are presented in Figure 5 to Figure 19.

6.7 Cross-sections

Using the state-wide seamless aquifer layers a series of cross-sections through each of the basins were also generated within ArcGIS. Figure 20 presents the locations of the cross sections across Victoria in plan view and the cross sections are presented in Figure 21 to Figure 33. The section lines have been selected with the aims of:

- showcasing either deep basins or river valleys that are typically of more interest from a resource management perspective; and
- passing through numerous deep bores to demonstrate how the layers match to bores.

6.8 3D Models

3D models have been developed using the aquifer top layers produced for this project. These models are provided in Appendix C (DVD only). These models developed are described in Table 11 below.

Table 11 3D Models developed

Model area	Format / software	Contents
Victoria-wide	ArcScene	Aquifer top rasters
Port Phillip and Western Port	ArcScene	Aquifer top rasters
Port Phillip and Western Port	Surfer (v8 and v10)	Aquifer top rasters Roads Towns

ArcScene is typically more widely used than other packages, and completely compatible with the GIS products from this project.

The primary reason for also building a model in Surfer rather than only in more commonly used software such as ArcScene or MapInfo Discover was graphical quality and portability. It is noted however that Surfer does not appear to be as good at labelling[5] or for showing bores. While it is recognised that Surfer is no longer as widely used as it used to be and that some users may not have ready access to the software, Surfer provides better clarity for viewing the aquifer layers.

Both ArcScene and Surfer models allow the user to rotate and zoom through the model, as well as turn aquifer layers on and off.

[5] Based on the author's skills with Surfer, which may be a limitation

7. Lithology Rasters

One of DSE's requirements was for GHD to "interpret lithology and incorporate into appropriate raster layers for areas beneath Port Phillip and Western Port Bay". Rather than add an attribute to existing rasters, GHD have produced separate 'Lithology rasters' for each of the VAF Aquifers present.

7.1 Method

These rasters have been produced through the following steps:

1. Populating a 'Simplified Lithology' field in the SSD.

   This field has been added to the LITHOLOGY table in the MS SQL database by GHD, and the field is called 'SIMPL_LITH'. Each of the lithological descriptions provided by drillers and geologists for an interval in a bore log are potentially unique, with varying degree of detail (colour, texture, grainsize and mineralogy, moisture content and so on), and make it difficult or impossible for a computer to process in a meaningful fashion. GHD have applied a classification system to these descriptions, classing them into 80 or so groups (refer Appendix D). An example of the 'simplification' is provided below.

Material_Description	Simplified Lith Code
OLD STRATA : RIVER WASH(2), Unconsolidated, Gravel/Boulders/Conglomerate	GRAVEL
OLD STRATA : WET GRAVEL(4), Unconsolidated, Gravel/Boulders/Conglomerate	GRAVEL
\\GRAVEL	GRAVEL
alluvial gravel	GRAVEL
ALLUVIAL GRAVEL, Unconsolidated, Gravel/Boulders/Conglomerate	GRAVEL
ALLUVIAL GRAVELS	GRAVEL
ALLUVIAL GRAVELS, Unconsolidated, Gravel/Boulders/Conglomerate	GRAVEL
ANGULAR GRAVEL WASH, Unconsolidated, Gravel/Boulders/Conglomerate	GRAVEL
ANGULAR GRAVEL, Unconsolidated, Gravel/Boulders/Conglomerate	GRAVEL
ANGULAR QUARTZ GRAVEL, Unconsolidated, Gravel/Boulders/Conglomerate	GRAVEL
BAND OF GRAVEL STONE	GRAVEL
BIG BLACK & WHITE GRAVEL	GRAVEL

   Of the 1,187,930 lithology records in the database, 48% of these (571,457 records) have a 'simplified lithology' record (some from GEDIS, some from earlier projects (e.g. Ovens Valley GRA), and with an effort and collating this data in the NGIS-A work (GHD, 2011a).

2. Thickness assessment.

   Having assigned 'Simplified Lithology' attributes, the summation of the total thickness of each 'Simplified Lithology' against the interpreted VAF Aquifers in each bore was carried out.

3. Assign lithology rating.

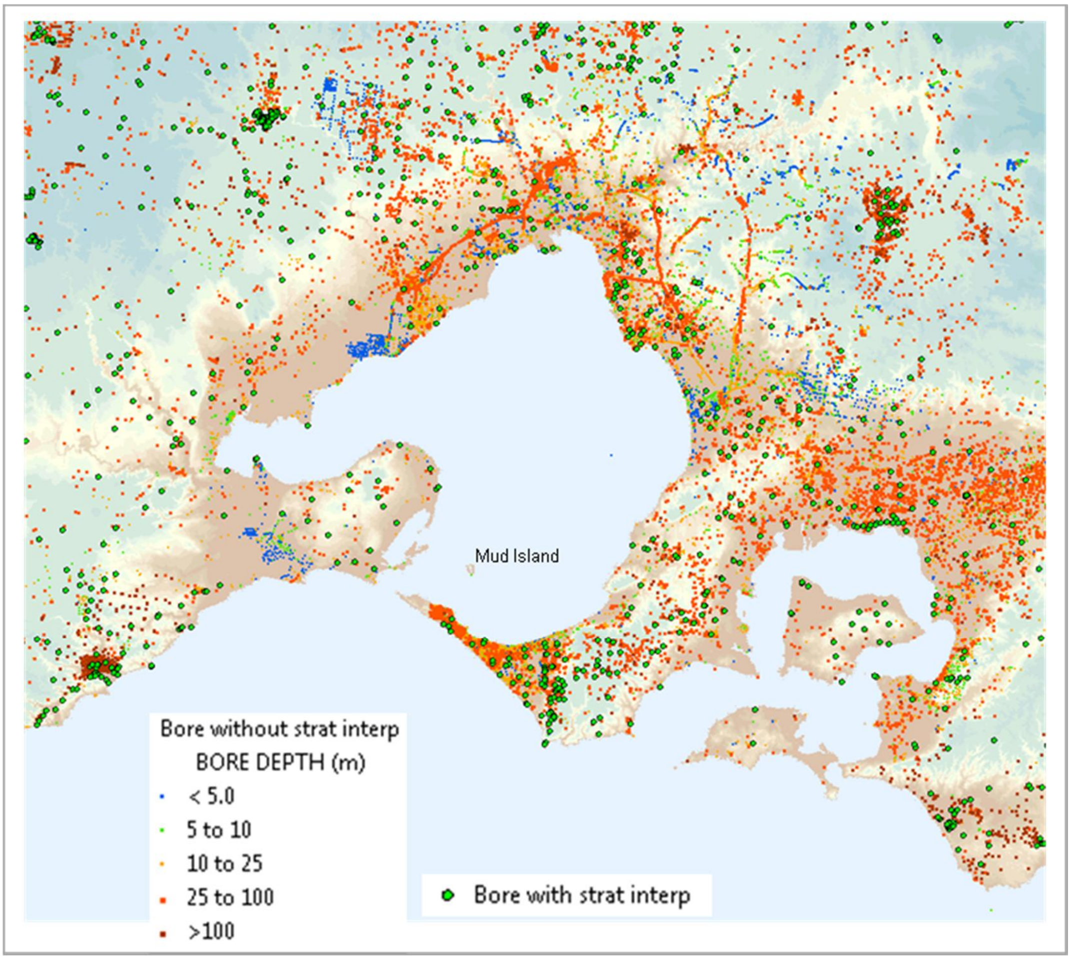
   Each lithology type was assigned a lithology rating, analogous to hydraulic conductivity, and a thickness-weighted average score produced for each Aquifer in each bore. Intervals of 'unknown' lithology or that were not populated with a 'Simplified Lithology' were ignored.

4. Interpolation.

   This score generated in Step 3 was then interpolated in ArcGIS using the Inverse Distance Weighting method.

7.2 Lithology outputs

These rasters, and the data points (bores) used to produce them, are presented in Figure 34 to **Error! Reference source not found.**. It is noted that no bores within the bays – Port Phillip and Western Port – have stratigraphic interpretations. The sketch map below shows the location of bores with stratigraphic interpretations and those without. This shows that there are very few bores located within the bays themselves: only two bores located within Port Phillip Bay, one of which is a 10 metre deep bore on Mud Island (this seems plausible and probably correct), while the other in the centre-east of Port Phillip Bay is probably an incorrect bore location.



This means that the Aquifer extents under the bays (drawn specifically for these lithology rasters) are extrapolations and not based on bore data.

8. Metadata and Mapping Products

8.1 Metadata

Metadata reports have been generated for key data sets created during the development of the 3D Aquifer Surfaces. The metadata files have been created using the 'ANZMet Lite' metadata collection tool which is consistent with ISO19115 requirements. Metadata records have been created for the following datasets:

- Aquifer Top Elevation;
- Aquifer Bottom Elevation;
- Aquifer Extent;
- Simplified Lithology;
- Aquifer Contours;
- Error Plot;
- Geologic Faults; and
- DEM.

The metadata documents for each dataset are presented in Appendix E. The files created for the Aquifer Top Elevation, Aquifer Bottom Elevation, Aquifer Extent, Simplified Lithology, Aquifer Contours and Error Plot datasets have been done as 'parent metadata files' which describe the general properties of the collection of data (i.e. the 15 raster surfaces contained within the Aquifer Top Elevation dataset). The metadata files for the Geologic Faults and DEM datasets have been created as unlinked metadata files as they are not a collection of datasets like the others.

8.2 GIS Mapping products

The mapping products themselves (i.e. raster layers, contours, bore points etc.) are included on a DVD accompanying this report (refer Appendix F). These are in both ESRI and GoCad format.

9. Data Gaps, Uncertainties and Reliability

Table 12 below summarises the data gaps and uncertainties associated with the input data used for the development of the seamless surfaces that have therefore carried through to the outputs. Where applicable recommendations have been made for ways in which these data gaps and uncertainties may be addressed in future work. Table 12 represents a concise summary of the issues discussed in detail in the preceding sections.

Table 12 Summary of data gaps and uncertainties

VAF Aquifer Code	Location	Issue	Recommendation / Resolution
QA – 100	North East Murray Region	Very few bores have QA interpreted (often only Shepparton Fm/UTQA) and lithological data does not assist to distinguish as there is little contrast between the units.	More detailed lithological data be collected in future drilling programs in targeted areas to assist with defining this boundary.
UTB – 101		No significant issues.	Subcrop extent should continue to be refined as new bore interpretations become available.
UTQA – 102	Ovens Valley	Distinguishing sands of the Shepparton Fm (i.e. Yalca Sand Member) from underlying Calivil Fm (UTAF)	Future drilling programs maintain detailed lithological logs to assist with stratigraphic interpretations.
UTD – 103	North West Murray Region	Bore data/interpretations in the SSD indicate the presence of Blanchetown Clay within Murray erosion trench however work completed in previous studies supports the absence of this HGU in the erosion trench.	Further work is required to provide a consistent conceptualisation of the presence or absence of this HGU in the Murray erosion trench. If absent, as is currently held belief, the SSD interpretations should be updated to reflect this
UTAM – 104	Otway / Port Phillip Basins	Lack of interpreted boreholes and lack of distinction in lithological descriptions to confidently identify marine or fluvial facies of the Upper Tertiary Aquifer sand units.	Requires additional bore interpretations if sufficiently detailed lithology information is available
UTAF – 105	Goulburn-Broken Catchment	Definition of boundary that forms the base of Calivil Formation (UTAF) and underlying top of Renmark Formation (LTA) due to indistinct lithology	Future drilling programs maintain detailed lithological logs to assist with stratigraphic interpretations.
	Otway / Port Phillip Basins	Lack of interpreted boreholes and lack of distinction in lithological descriptions to confidently identify marine or fluvial facies of the Upper Tertiary Aquifer sand units.	Requires additional bore interpretations if sufficiently detailed lithology information is available
UMTA – 107	Gambier Embayment	Lack of distinction between Upper, Middle and Lower Gambier Limestone units in VAF HGUs. All currently classified in VAF as HGU 1041 / Aquifer 107. This resulted in inconsistencies in the initially developed surfaces and bores had to be flagged off or reinterpreted for final surface development. Essentially this has created a data gap.	It is understood that this data is available through previous studies / historic data sources (SADWLBC and SRW mapping project). Recommend re-capturing this information in future revisions of the SSD and mapping layers.
	Otway Basin	Inconsistent bore interpretations in the SSD, particularly some deep bores in the south west corner of the Otway Basin. Distorted	Continually vet SSD for consistency

VAF Aquifer Code	Location	Issue	Recommendation / Resolution
		surfaces	
LMTA – 109	Otway Basin – SA border region	Significant thickness (>500m) of LMTA interpreted in SSD which is not consistent with or supported by other data sources (SADWLBC / Geol of Vic)	Investigate further and reinterpret bores as required.
	Gippsland Basin	Lack of bore data to confidently define top of M2C surface in Darriman region	Update surface as new data becomes available.
LTA – 111	Otway Basin	Inclusion of Yaugher Volcanics in the Dilwyn Formation HGU. May be appropriate to separate out to LTB Aquifer. Some confusion around the distinction between Yaugher Volcanics and general Tertiary aged 'Older Volcanics' / Phase 2 Basalts etc.	Update VAF and amend SSD interpretations according to management decision made.
LTB – 112	Otway and Port Phillip Regions	Scarcity of interpreted data for layer development therefore reduced confidence in layer extent boundaries. In some parts not enough bore data to separate out from LTA.	Future work should include the interpretation of additional bores that intersect the associated HGUs.
CPS – 113	North West	Lack of bore interpretation density in SSD	Future work should include the interpretation of additional bores that intersect the associated HGUs.
BSE – 114	Port Phillip / Western Port Region	Bore data indicates that the basement surface may be too high in several localised areas, although the main areas identified late in this project have since been rectified.	
All layers	State-wide	Inconsistent/conflicting stratigraphic interpretations contained within the SSD that do not appear to have been vetted / compared against existing interpretations prior to being incorporated.	Continually vet SSD. Reinterpret or flag off inconsistent bores.
		Omission of key stratigraphic bore data from old 'Parish' bores (e.g. nomenclature frequently used in *Geology of Victoria*)	Future versions of the SSD should include this information.
		Spatial distribution of bore interpretations limited the ability to control layer thickness, particularly near the edge of aquifer extents (i.e. where layers pinch out) and in narrow valleys adjacent to basement outcrop	Future interpretations should target regions identified in the reliability plots as having low confidence, especially those areas: • lying in WSPA/GMAs; • Near sensitive features, or other areas important for management.
		Lack of spatial distribution of deep bore interpretations across the full Tertiary sequence, especially in the deep basin regions, which can affect the reliability of the surfaces produced for some areas	Additional deep bore interpretations, e.g. on the Nepean Peninsula, would improve confidence in layer elevation, especially where thicknesses can be >1,000 m.
	Gippsland Basin	Incorrect stratigraphy interpretations from GEDIS sourced bores, assumed as bores created significant 'bulls eyes'. Many bores have no associated lithological information in the SSD to confirm interpretation.	Source original lithology information (if available, although it may not be) and reinterpret.

9.1 Reliability

The reliability of the raster surfaces produced with respect to the density of bore data and outcrop geology has been assessed through the development of prediction error plots for each layer. The plots are presented in Figure 39 to Figure 52[6] and represent the potential statistical error in the surface interpolation, created using the Kriging method and the ArcGIS Geostatistical Analyst tool.

The error plots display a raster of the prediction error margin (i.e. +/- *x* m) at each point on the predicted surface. The error is a function of the variance within the dataset (i.e. if the dataset has high random variability then there is more uncertainty in the extrapolation between points) and bore density (the scatter in the variogram used to produce the predicted surfaces generally increases with distance meaning that there is more uncertainty and hence an increased error margin the further the bores are apart).

The method for calculating the prediction error is:

- Interpolate the surface using all data points, in this case:
  bore points + outcrop points = *n* data points
- Re-interpolate the surface n times, each time using *n* – 1 data points, removing each data point once; and
- Calculate the difference at each data point, comparing the surface produced with all data points (the 'true value') and the surface produced without that data point (the 'predicted value').

It is noted that the prediction standard error of many of the layers is greatly increased by the fact that these plots were created on a state-wide basis, and few of the VAF aquifer layers are continuous between sedimentary basins. This means that the statistics of the relevant layer are calculated using bore and outcrop elevation data across the basins (and across fault zones) even though the elevation of an aquifer in say Gippsland is completely unrelated to the elevation of a unit within the same VAF Aquifer that lies in, for instance, the Murray Basin. The important information contained within the error plots is the identification of areas of relatively low or relatively high prediction standard error.

In addition to judgement by hydrogeologists, the error plots are a useful tool to inform where further borehole assessments would be beneficial (i.e. in areas where there is a high error and hence low confidence in the extrapolation), and where such areas are located within GMUs.

Table 13 below summarises the key inferences made from the reliability plots produced. A general comment is that error is generally greater in deeper layers, which is related to the rule that the deeper, older layers have a greater variability in the *z* range (elevation), e.g. BSE-114 elevation is -3000 to +2000 mAHD across the state, leading to a greater prediction error.

Table 13 Reliability Plot Summary

Layer	Region	Comment
UTB-101	Layer-wide	Based largely on outcrop geology therefore low error associated with layer elevation (although the DEM has its own associated error).
	Portland and Colac areas	Regions of higher prediction error have limited bore data and more interpreted bores are required to improve reliability (albeit these are relatively small regions).

[6] Note that no plot has been produced for the QA 100 layer, because the elevation of the top of this aquifer is based on the DEM combined with the outcrop geology mapping.

Layer	Region	Comment
UTQA-102	Layer-wide	Plot indicates good reliability of the surface (low prediction error).
UTQD-103	Layer-wide	Plot indicates good reliability of the surface (low prediction error).
UTAM-104	Layer-wide	Based largely on outcrop geology therefore low prediction error associated with layer elevation.
	Northern SA-Vic border	Slightly higher (although still low) regions of prediction error along SA-Vic border correlate to regions of very limited bore interpretations / scarcity of data. Additional interpretations likely to improve error.
UTAF-105	Layer-wide	Relatively good reliability (low prediction error) layer wide.
	North central and Gippsland	Slightly higher error regions in north central and coastal Gippsland regions where there is reasonable bore density indicate greater variability in *z*-data (elevation). QA/QC of this data for consistency likely to improve reliability of surface.
UTD-106	Layer-wide	Higher layer-wide error (relative to overlying layers) appears to be a function of sparse bore interpretations in most regions, particular the western Murray Basin.
UMTA-107	SA-Vic border, SW Vic	Medium level of prediction error where high bore density exists suggest high variability of the elevation data. QA/QC of this data for consistency will help to improve the reliability.
UMTD-108	Layer-wide	Reliability appears strongly related to bore density. Largely good reliability (low error). Interpretation of additional bores along outer extents of layer likely to improve reliability.
	North west	Particularly scarce bore data/interpretations hence higher prediction error
LMTA-109	Layer-wide	Reliability appears strongly related to bore density. Largely good reliability (low error). Interpretation of additional bores along outer extents of layer likely to improve reliability.
	Gippsland	Scarce bore data/interpretations along coastline hence higher prediction error
LMTD-110	Layer-wide	Reliability appears strongly related to bore density. Largely good reliability (low error). Interpretation of additional bores along outer extents of layer and in particular in the north west regions could improve reliability.
LTA-111	Layer-wide	Relatively good (low) prediction error across layers, particularly in southern regions.
	North west	Higher (medium to high) prediction error appears strongly related to scarcity of bore interpretations. Additional interpretations likely to increase reliability of the surface in these areas.
LTB-112	Layer-wide	Moderate to high prediction error reflects the variability of the data as a result of representing multiple ages/stages of the basalts resulting in highly variable data. Further refinement of this layer is required as well as additional bore data to improve the reliability.
CPS-113	Layer-wide	Good reliability where bore data exists. Interpolation extending beyond Victorian border where there is a lack of data results in high prediction error. Some of these issues may be addressed if similar projects are completed in neighbouring states.
BSE-114	Layer-wide	A large proportion of the layer is based on outcrop geology therefore low prediction error associated with it. For the rest of the state the error appears largely related to bore density, therefore will be improved by additional bore interpretations.

Additional to the reliability plots produced and the assessment of data gaps and uncertainties resulting from these, areas where issues are known to be present in the aquifer surfaces are:

- In many cases there is not bore data to define the contact between the QA-100 and underlying layers, particularly the UTQA-102 in the Murray Basin (i.e. the Shepparton Formation) which has a similar lithological composition to the overlying Coonambidgal Formation (QA-100. However on a regional scale the uncertainty in terms of +/- metres error is probably small.

- Some of the aquifer boundaries in this study and previous studies have used inconsistent extents along the coastline. Many of these extents have been improved in this study however inconsistent seaward aquifer boundaries remain. A recommendation is made in Section 10.2 to address this.
- In the Port Phillip region some layers incorrectly represent the manner in which they abut the Selwyn Fault on the Mornington Peninsula. The input data accompanying this report (bores, contours) are essentially correct and the error has arisen in the subsequent interpolation process. The interpolation process uses points along the outer extent of the aquifer to 'pin' the aquifer to the underlying layer. These should not have been used along the fault however this issue was only noticed immediately prior to the issue of the Final Report and has not been addressed in the mapping layers produced. It affects the length of the Selwyn Fault where this crosses the Mornington Peninsula, and affects the aquifer layers (105, 109, 111) immediately to the west of the fault to a distance of ~1-2km. A recommendation for further work is made in Section 10.2 to correct this.

10. Conclusions and Recommendations

Based on DSE's RFT, the project will be considered a success if the outputs/deliverables are as follows:

Objective	GHD response
Provide DSE with a consistent mapping of VAF aquifer/aquitard stratigraphy across the State that has a high degree of reliability	Objective met. The cross-sections demonstrate that the surfaces are a good match to bore data, and are topologically correct across the vast majority of the state.
Provide DSE and the Rural Water Corporations with a valuable information asset that can be used in conjunction with other datasets to better inform decision making and protection of the groundwater resource	Objective met. The state-wide mapping will help the RWCs (particularly those in the Murray Basin) and DSE better define GMUs and should form the basis of much of the analysis, conceptualisation and management in the future.
Can be easily accessed by those who require the information and can be readily maintained and updated in future years	Objective met. Updated SSD as well as GIS contour polylines and extent polygons provided to DSE to enable revision in the future.
Assists the Bureau of Meteorology in understanding and interpreting groundwater information in Victoria.	Objective met. Helps BoM meets its NGIS objectives of holding nation-wide information on aquifer geometry and characteristics, bores and management areas.

Furthermore, with reference to the specific requirements or optional outputs stated by DSE in their RFT (refer back to Section 1.2), GHD and their partners AWE have carried out the following:

Provide topologically correct ArcGIS rasters describing the top and bottom of a minimum of 14 Aquifer layers (based on the Victorian Aquifer Framework);	Done: these and supporting files are provided on the DVD in Appendix F.
Base these rasters on previous mapping (e.g. SRW mapping, various Groundwater Resource Appraisals for the Rural Water Corporations) where this is available and otherwise extend the mapping into 'unmapped' areas;	Done.
Where required, re-interpret bore data to separate out specific geological and hydrogeological units from previously mapped layers;	Done.
Align basement (i.e. combined Aquifers 113 and 114) with the Geoscience Victoria's Crystalline Basement surface;	Not done. Initial review of Crystalline Basement surface indicated that this was populated with real data in some areas (e.g. Gippsland, Otway Basins) but infilled with DEM in others. Rather than spend time determining the parts of that surface to use or not, this task was not carried out.

That DSE have access to any project files used to produce the raster layers, allow this to mapping be updated in future.	Done. (refer to DVD in Appendix F)
Interpret lithology within bores and their interpreted VAF Aquifers, and present this in raster form for the areas beneath Port Phillip Bay and Western Port Bay;	Done.
Separate out the Cretaceous and Permian Sediments (CPS – Aquifer 113) layer from the underlying Palaeozoic to Cretaceous Bedrock (BSE – Aquifer 114) layer;	Done.
Conversion of the ArcGIS Raster layers to GoCad format.	Done. (refer to DVD in Appendix F)
DSE indicated a strong preference that geological interpretation by geologists rather than automation by computers be at the forefront of the work method used in mapping;	Done.
Re-interpretation, or addition, of bores to the State-wide Stratigraphic Bore Database ('SSD') *should be kept to a minimum, and that re-interpretation of a significant number of bores should be unlikely as the database is currently to DSE's satisfaction;*	Significant amount of re-interpretation of bores, despite efforts not to have to do this. Approximately 1,500 bores interpreted or re-interpreted.
DSE have a requirement that the end products be ESRI ArcGIS products, and a preference that methods used are supported by ArcGIS or similar software.	Done. (refer to DVD in Appendix F)

In conjunction with the recommendations presented in Table 12, the following sections provide further recommendations for work to address identified uncertainties and improve the SSD and seamless layers in future revisions/versions.

10.1 Recommendations to resolve uncertainties

- Addition of GU information to stratigraphic database;
- As stated previously, some GEDIS-sourced bores in the SSD appeared to contain inconsistent interpretations with respect to other bores in the SSD in the Gippsland area, and while an effort was made to re-interpret these bores, many were simply 'flagged off' during this project. This issue was most prevalent in Aquifers 106, 108 and 111, and there may be merit in future in attempting to reconcile the different interpretations; and
- Use of the 'Upper' and 'Lower' Shepparton Formation HGUs (or GUs) to define Shepparton Formation that has been deposited above and below the Newer Volcanics in the Central Highlands and the Loddon and Campaspe valleys. This would require re-interpretation of the bores in that area, followed by mapping of the HGUs rather than the Aquifers.

10.2 Recommendations refine the SSD and mapping layers

These recommendations are made based on experience using and updating the database, comparing the database with previous mapping layers, and also from lessons learned during this project.

10.2.1 Database

- A similar issue to that found with some GEDIS interpretations in the Gippsland Basin was found in the Murray Basin and Central Highlands - a lot of DPI FFSR stratigraphic interpretations conflict with those bores that had previously been used in producing layers for SRW, Loddon-Campaspe and Goulburn-Broken layers. While many of these have been ‘flagged off’ or simply ignored (as is the case for many bores around Ballarat and the upper Loddon which are interpreted as having QA (Aquifer 100) in the upper intervals, even though they lie on outcropping Newer Volcanics) there are likely some that remain flagged ‘on’, and these bores have not been re-interpreted within this project; and
- There are many bores with entries in the Lithology table within the SSD that have intervals with a negative thickness, i.e. the ‘Depth From’ (in metres below the top of bore) is a larger number than the ‘Depth To’ entry. This is not a problem for manually mapping stratigraphy, but may be a problem if any analysis of the lithology within an aquifer is carried out. Many of these intervals have a ‘Depth To’ = 0, which probably (bit not always) indicates that the interval terminates at the bottom of the bore.
- There are a number of bores with entries in the Stratigraphy table within the SSD that have a NULL value in the ‘Depth To’ field. This is not a problem for mapping stratigraphy, but might be for future analysis (e.g. calculation of the thickness of bore / aquifer intervals, and can be a problem for GIS plotting of bores (the default assumption is that NULL = 0) It is likely that this could be infilled with the depth of the bottom of the bore; and
- There are a handful of bores located on the South Australian side of the border that have not got a ground surface populated in the database. Because of their distance west of the border this was not seen as an issue in this study, however this should be populated in future.

10.2.2 Aquifer mapping

- Mapping undertaken for this project was done using the best-available GSV (DPI) outcrop geology data at the time. DPI have since released their ‘Seamless Geology’ package which may have changed some of the outcrop mapping slightly from the previous 1:250k mapping used for this project. Checks between the two datasets should be undertaken to determine whether any changes to the mapping layers might be necessary in future, and how significant these might be.
- Mapping to be continued into offshore areas, notably:
  - offshore Gippsland Basin (relevant to the offshore oil and gas extractions);
  - offshore Otway Basin;
  - under Port Phillip Bay (requires data from sources beyond the current content of SSD); and
  - Western Port Bay (again this requires data from other sources).

  To start with, this would require extending the project DEM using bathymetry in the inlets and bays along the coastline, as well as offshore in the Otway and Gippsland Basins.

- Following on from the point above, some of the aquifer boundaries in this study and previous studies have used inconsistent extents along the coastline. To rectify this in future versions of the mapping layers the project boundaries could be extended offshore and a specific seaward extent set to ensure all relevant aquifer extents carry through to a consistent point offshore.
- In the Port Phillip region it is noted that some layers are incorrectly represented in the way they abut the Selwyn Fault on the Mornington Peninsula. The input data (bores, contours) are essentially correct and the error has arisen the from subsequent interpolation process. This issue was only noticed immediately prior to the issue of the Final Report and has not been addressed in the mapping layers produced for this project.
- Further investigation and analysis of the location and role of faulting beneath Western Port basin. There are some significant gradients in the bedrock surface, and even the Lower Tertiary units in this area and, currently, faulting is not used in the interpolation/surface creation in this area, other than the Koo Wee Rup fault (which is possibly only partially represented). Existing mapping of the Lang Lang Fault and possibly others might require some addition or modification, and then incorporation into the interpolation process. This may help improve layer 'stacking' and conceptualisation in this area;
- The mapping of the (Lower) Tertiary Basalts (Aquifer 112), which are of a variety of ages, has been problematic, especially given that the basalts themselves may occur entirely within other VAF Aquifers (e.g. within the LTA) or above or below other VAF aquifers in a way that is inconsistent with the VAF Aquifer numbering (refer back to Section 6). Further work could be done to improve:
    - the way the identification of these within the VAF so that it fits better with overlying and underlying units (which are not necessarily in VAF Aquifer order); and
    - the extents of these in the Port Phillip and Western Port Basins, and determination of the stratigraphic sequence (e.g. BSE-114 > LTB-112 > LTA-111, or BSE-114 > LTA-111 > LTB-112, which may not be consistent across these areas, but does lead to difficulties building topologically correct raster layers).
- On the northern edge of the Central Highlands, the extent of the Shepparton Formation (UTQA) could be amended between Kyneton and Redesdale. This is not considered to be important for the management of groundwater at this stage, however the current UTQA extent passes through bores that do not intersect it beneath the Newer Volcanics (e.g. bore 62710), and
- Analysis and interpretation of bores along the Mitchell River around Lindenow (Gippsland), and remapping of the relevant structure contours. Currently only some of the SOBN bores in that area have stratigraphic interpretations, and, if SRW desired better definition of the lower vertical boundary of the Wy Yung GMU, it would be important to map the QA ('Lindenow Gravel') contact with the underlying marls (or other geology)in greater detail than it is currently; and
- Similar analysis of the stratigraphy within SOBN bores within the Orbost GMA (Gippsland Region), , and remapping of the relevant structure contours to better define the boundary between the silts and gravels of the Quaternary Jarrahmond Formation and Curlip Gravel and the underlying Tertiary strata. Given the nature of the Quaternary units, a silt (10-30 m thick) overlying the gravel aquifer (+10 m thick), it may indeed be useful to map these separately which might also require a modification of the VAF.

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Figures

Figure 1 to Figure 4 in body of report

State-wide Aquifer top elevation

Cross-sections

Lithology Maps for Port Phillip and Western Port Basin

Reliability Plots

Appendix A

Victorian Aquifer Framework

Department of Sustainability and Environment

VICTORIAN AQUIFER FRAMEWORK V10 - Last Modified March 2012

GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
No_1:250K_geol_code		Undifferentiated Quaternary Sediments						10000	1000	Undifferentiated Quaternary Aquifer	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Simpson Sand		Sedimentary (Non-Marine)	Aeolian sand of inland dune fields	Quaternary (Holocene)	Quaternary (Pleistocene)	10001	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
Qd2		Unnamed dune deposits		Sedimentary (Non-Marine (Aeolian))	Aeolian: dune deposits: sand, clay, calcareous sand	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10002	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
Qdi	Qrd,Qd,Qo	Unnamed inland dune deposits		Sedimentary (Non-Marine (Aeolian))	Aeolian: source-bordering dune deposits: sand, silt, clay	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10003	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
Ql	Qu	Unnamed lunette deposits		Sedimentary (Non-Marine (Aeolian))	Aeolian: lunette deposits: sand, silt, clay	Quaternary (Holocene)	Quaternary (Pleistocene)	10004	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
Qxo	Ql	Lowan Sand		Sedimentary (Non-Marine (Aeolian))	Aeolian: dune sand, fine to medium grained	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10005	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
Qxr	Qpb,CQBR	Bridgewater Formation		Sedimentary (Non-Marine (Aeolian))	Aeolian: dune deposits; calcarenite	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10006	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
Qxw	Qw	Woorinen Formation		Sedimentary (Non-Marine (Aeolian))	Aeolian: dune sand, calcareous, clayey, palaeosols	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10007	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
Qxy	Qy	Yamba Formation		Sedimentary (Non-Marine (Aeolian))	Aeolianites and evaporites: fine-grained gypsum	Quaternary (Holocene)	Quaternary (Pleistocene)	10008	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Semaphore Sand Member (of the St Kilda Formation)						10009	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Bunyip Sand						10010	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Molineaux - Lowan Sands (NSW) or Molineaux Sand (SA VIC)						10011	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Bakara Calcrete, Ripon Calcrete and Loveday Soul (Qca)						10012	1001	Various Aeolian Deposits	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Malanganee Sand			Unconsolidated grey to white, fine-grained siliceous sand	Quaternary (Holocene)	Neogene (Pliocene)	10013	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Wannaeue Formation		Sedimentary (Marine)		Pleistocene (Late)	Pliocene (Early)	10014	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Na1		Unnamed incised alluvium		Sedimentary (Non-Marine (Alluvial))	Fluvial: post-Newer Volcanic hillwash: gravel, sand, silt	Quaternary (Pleistocene)	Neogene (Miocene)	10015	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Nc1	Qrc,Qpc,Tpc	Unnamed incised colluvium		Sedimentary (Non-Marine (Alluvial, Colluvial))	Fluvial: "gully" alluvium, colluvium: gravel, sand, silt	Quaternary (Pleistocene)	Neogene (Pliocene)	10017	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
-Pa	Pe,Te	Unnamed alluvium		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand	Palaeogene (Eocene)	Palaeogene (Eocene)	10018	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qa1	Qra,Qa,Qrt,Qc	Unnamed alluvium		Sedimentary (Non-Marine (Alluvial))	Fluvial: alluvium, gravel, sand, silt	Quaternary (Holocene)	Quaternary (Holocene)	10020	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qa2	Qpa	Unnamed alluvium		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10021	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qa3		Unnamed		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10022	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qa4		Unnamed		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10023	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qa5		Unnamed		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10024	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qa6		Unnamed		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10025	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qa7	Qp5,Qpa5	Unnamed		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10026	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qc1	Qrc,Qpc,Qc	Unnamed colluvium		Sedimentary (Non-Marine (Colluvial))	Fluvial: "gully" alluvium, colluvium: gravel, sand, silt	Quaternary (Holocene)	Quaternary (Holocene)	10027	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qc2	Qx	Unnamed scree deposits		Sedimentary (Non-Marine (Colluvial))	Scree deposits	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10028	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qdl1	Qrd,Qdl	Unnamed coastal dune deposits		Sedimentary (Marine, Non-Marine (Coastal))	Aeolian and littoral: coastal and inland dunes: dune sand, some swamp deposits, beach sand	Quaternary (Holocene)	Quaternary (Holocene)	10029	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qm1	Qrm,Qm	Unnamed swamp and lake deposits		Sedimentary (Non-Marine (Paludal))	Paludal: lagoon and swamp deposits: silt, clay	Quaternary (Holocene)	Quaternary (Holocene)	10030	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qyc		Coode Island Silt		Sedimentary (Estuarine (Lagoonal))	Paludal: lagoon deposits: black silt, clay	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10031	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qra, Qa, Qrt, Qc		Lindenow Gravel		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Quaternary (Holocene)	Quaternary (Holocene)	10702	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Jarrahmond Formation		Sedimentary (Estuarine)	Silt and silty sand			10033	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Curlip Gravel		Sedimentary (Non-Marine (Alluvial))	Gravel, sand, and some silt and clay			10032	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Coomandook Formation						10034	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Pooraka Formation						10035	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Padthaway Formation						10036	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Tyrell beds						10037	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Coonambidgal Formation						10038	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
No_1:250K_geol_code		St Kilda Formation (including Semaphore Sands)						10040	1002	Various fluvial/lacustrine/alluvial/colluvial sediments	100	QA	Quaternary Aquifer
Qxl		Lara Limestone		Sedimentary (Non-Marine (Lacustrine))	Lacustrine: limestone, minor sand	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10041	1003	Quaternary sandy limestone, calcarenite and shell deposits	100	QA	Quaternary Aquifer
Qc3		Unnamed slump deposits		Sedimentary (Non-Marine (Colluvial))	Landslide deposits: clay, clayey silt, rubble; poorly sorted and unconsolidated	Quaternary (Holocene)	Quaternary (Holocene)	10042	1004	Quaternary scree	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Monoman Formation / Channel sand		Sedimentary (Non-Marine (Alluvial))		Quaternary (Holocene)		10039	1140	Monoman Formation / Channel sand	100	QA	Quaternary Aquifer
No_1:250K_geol_code		Undifferentiated Quaternary Basalt						10045	1005	Undifferentiated Quaternary Basalt	101	UTB	Upper Tertiary/Quaternary Basalt
Qnp		Unnamed phreatomagmatic deposits		Igneous (Extrusive)	Tuff rings: pyroclastic base surge and fall deposits consisting of ash, lapilli, scoria, volcanic bombs and calcareous lithic fragments; well-bedded, well sorted, moderately consolidated	Quaternary (Holocene)	Quaternary (Holocene)	10043	1133	Quaternary stony rises, tuffs	101	UTB	Upper Tertiary/Quaternary Basalt
Qnt		Unnamed trachyte		Igneous (Extrusive)	Extrusive: alkaline series: trachyte, mugearite, hawaiite, benmoreite	Quaternary (Holocene)	Neogene (Pliocene)	10044	1133	Unnamed Quaternary trachyte	101	UTB	Upper Tertiary/Quaternary Basalt
Qn	Qvn,CXNV,Qv,Qvn1, Qvn2	Newer Volcanic Group		Igneous (Extrusive)	Extrusive: tholeiitic to alkaline basalts, minor scoria and ash	Quaternary (Pleistocene)	Neogene (Miocene)	10046	1005	Undifferentiated Quaternary Basalt	101	UTB	Upper Tertiary/Quaternary Basalt
Qno1	Qvn2	Unnamed sheetflow basalt	Newer Volcanic Group	Igneous (Extrusive)	Extrusive: tholeiitic to alkaline basalts, minor scoria and ash	Quaternary (Pleistocene)	Neogene (Miocene)	10047	1005	Undifferentiated Quaternary Basalt	101	UTB	Upper Tertiary/Quaternary Basalt
Qno2	Qvh,Qvh1,Qvh2,Qvh3	Unnamed stony rises	Newer Volcanic Group	Igneous (Extrusive)	Extrusive: stony rises	Quaternary (Pleistocene)	Neogene (Miocene)	10048	1005	Undifferentiated Quaternary Basalt	101	UTB	Upper Tertiary/Quaternary Basalt

State Government Victoria
Department of Sustainability and Environment

VICTORIAN AQUIFER FRAMEWORK V10 - Last Modified March 2012

GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
Qno3	Qvh	Unnamed valley-filling basalt	Newer Volcanic Group	Igneous (Extrusive)	Extrusive: valley-filling basalts	Quaternary (Pleistocene)	Neogene (Miocene)	10049	1005	Undifferentiated Quaternary Basalt	101	UTB	Upper Tertiary/Quaternary Basalt
Qns	Qvs,Qvs1	Unnamed scoria deposits	Newer Volcanic Group	Igneous (Extrusive)	Extrusive: scoria	Neogene (Pliocene)	Quaternary (Holocene)	10050	1005	Undifferentiated Quaternary Basalt	101	UTB	Upper Tertiary/Quaternary Basalt
Nws	Qa,Qs,CMSH	Shepparton Formation	Wunghnu Group	Sedimentary (Non-Marine (Alluvial))	Fluvial: silt, sand, minor gravel	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10053	1008	Undifferentiated Upper Tertiary/ Quaternary Aquifer	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		Undifferentiated Upper Shepparton Formation						10054	1009	Upper Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		U Shepp: Kialla Member of Shepparton Formation						10055	1009	Upper Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		U Shepp: Katandra Member of Shepparton Formation						10056	1009	Upper Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		U Shepp: Quiamong Member of Shepparton Formation						10057	1009	Upper Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		U Shepp: Widgelli Pedoderm of Shepparton Formation						10058	1009	Upper Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		U Shepp: Mayrung Member of Shepparton Formation						10059	1009	Upper Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		Undifferentiated Lower Shepparton Formation						10060	1010	Lower Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		L Shepp: Kialla Member of Shepparton Formation						10061	1010	Lower Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		L Shepp: Katandra Member of Shepparton Formation						10062	1010	Lower Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		L Shepp: Quiamong Member of Shepparton Formation						10063	1010	Lower Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		L Shepp: Widgelli Pedoderm of Shepparton Formation						10064	1010	Lower Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		L Shepp: Mayrung Member of Shepparton Formation						10065	1010	Lower Shepparton Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		Cowra Formation (NSW)						10066	1011	Cowra Formation (NSW)	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		Narrabri Formation (NSW)						10067	1012	Narrabri Formation (NSW)	102	UTQA	Upper Tertiary/Quaternary Aquifer
Nxh	Nph,Tph,CXHH	Haunted Hill Gravel		Sedimentary (Non-Marine (Alluvial))	Fluvial: sand, silt, gravel, ferruginous sand	Neogene (Pliocene)	Neogene (Miocene)	10072	1015	Haunted Hill Formation	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		Eagle Point Sand						10073	1016	Eagle Point Sand	102	UTQA	Upper Tertiary/Quaternary Aquifer
No_1:250K_geol_code		Undifferentiated Upper Tertiary/Quaternary Aquitard						10068	1013	Undifferentiated Upper Tertiary/Quaternary Aquitard	103	UTQD	Upper Tertiary/Quaternary Aquitard
Qxb	Qb,Qn	Undifferentiated Blanchetown Clay		Sedimentary (Non-Marine (Fluvial))	Fluvial: clayey sand, sandstone, sand	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10069	1014	Blanchetown Clay	103	UTQD	Upper Tertiary/Quaternary Aquitard
No_1:250K_geol_code		Irymple Member						10070	1014	Blanchetown Clay	103	UTQD	Upper Tertiary/Quaternary Aquitard
No_1:250K_geol_code		Bungunnia Limestone Member						10071	1014	Blanchetown Clay	103	UTQD	Upper Tertiary/Quaternary Aquitard
No_1:250K_geol_code		Boisdale Formation (Nuntin Clay)						10074	1017	*Boisdale Formation (Nuntin Clay)*	103	UTQD	Upper Tertiary/Quaternary Aquitard
No_1:250K_geol_code		Undifferentiated Upper Tertiary Aquifer (marine)						10075	1018	Undifferentiated Upper Tertiary Aquifer (marine)	104	UTAM	Upper Tertiary Aquifer (marine)
Nxp	Npp,Np,Tmk,Tpp,CQPA,Tpl,Tps,Tp,Tp	Undifferentiated Parilla Sand		Sedimentary (Marine)	Sand, silt	Neogene (Pliocene)	Neogene (Miocene)	10076	1019	Loxton Parilla Sand	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Kerang Sand Member of the Loxton-Parilla Sand						10077	1019	Loxton Parilla Sand	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Tragowel Member of the Loxton-Parilla Sand						10078	1019	Loxton Parilla Sand	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Wandella Sandstone Member of the Loxton-Parilla Sand						10079	1019	Loxton Parilla Sand	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Upper Loxton Sands (SA)						10080	1019	Loxton Parilla Sand	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Lower Loxton Sands (SA)						10081	1019	Loxton Parilla Sand	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Moorna Formation						10082	1020	Moorna Formation	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Northwest Bend Formation (SA)						10083	1021	Northwest Bend Formation (SA)	104	UTAM	Upper Tertiary Aquifer (marine)

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
No_1:250K_geol_code		Chowilla Sand						10084	1022	Chowilla Sand	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Maretimo Member				Quaternary	Quaternary	10116	1049	Whalers Bluff Formation	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Werrikoo Member				Quaternary	Quaternary	10117	1049	Whalers Bluff Formation	104	UTAM	Upper Tertiary Aquifer (marine)
Nxa	Qph,CQWB,Qxh	Whalers Bluff Formation		Sedimentary (Marine, Non-Marine (Coastal))	Coastal: sandy limestone, calcarenite, shell beds, marl	Quaternary (Pleistocene)	Quaternary (Pleistocene)	10118	1049	Whalers Bluff Formation	104	UTAM	Upper Tertiary Aquifer (marine)
Nbh		Hanson Plain Sand		Sedimentary (Non-Marine)	Fluvial and minor shallow marine deposits: quartz sand, clayey sand, gravel, minor calcareous clay and limonite pisolites; surface may be lateritised	Neogene (Pliocene)	Neogene (Pliocene)	10092	1030	Hanson Plain Sand	104	UTAM	Upper Tertiary Aquifer (marine)
Nxd	Npd,Tpd,CXDS	Dorodong Sand		Sedimentary (Marine)	Marine: sand, sandstone, silt, cross-bedded, laterite	Neogene (Pliocene)	Neogene (Miocene)	10093	1031	Dorodong Sand	104	UTAM	Upper Tertiary Aquifer (marine)
Nxg	Npg,Tpg	Grange Burn Formation		Sedimentary (Marine)	Marine: shell beds, sandy limestone, calcareous sand	Neogene (Pliocene)	Neogene (Miocene)	10094	1032	Grange Burn Formation	104	UTAM	Upper Tertiary Aquifer (marine)
Nbm		Moorabool Viaduct Sand		Sedimentary (Marine)	Gravel, sand, silt	Neogene (Pliocene)	Neogene (Miocene)	10096	1034	Moorabool Viaduct Formation	104	UTAM	Upper Tertiary Aquifer (marine)
No_1:250K_geol_code		Undifferentiated Upper Tertiary Aquifer						10085	1023	Undifferentiated Upper Tertiary Aquifer (fluvial)	105	UTAF	Upper Tertiary Aquifer (fluvial)
Nwc	Nma,Tma,Nma	Calivil Formation	Wunghnu Group	Sedimentary (Non-Marine (Alluvial))	Fluvial: deep lead river deposits; gravel, sand, silt, clay	Cainozoic (Neogene)	Cainozoic (Neogene)	10086	1024	*Calivil Formation*	105	UTAF	Upper Tertiary Aquifer (fluvial)
No_1:250K_geol_code		Gunnedah Formation (NSW)						10087	1025	Gunnedah Formation (NSW)	105	UTAF	Upper Tertiary Aquifer (fluvial)
No_1:250K_geol_code		Lachlan Formation (NSW)						10088	1026	Lachlan Formation (NSW)	105	UTAF	Upper Tertiary Aquifer (fluvial)
No_1:250K_geol_code		Rufus Formation (NSW)						10089	1027	Rufus Formation (NSW)	105	UTAF	Upper Tertiary Aquifer (fluvial)
Czf	Czd,Czd/Npp,Tpl,Npl	Unnamed duricrust		Sedimentary (Non-Marine)	Deflational: laterite	Neogene (Pliocene)	Neogene (Miocene)	10090	1028	Unnamed duricrust	105	UTAF	Upper Tertiary Aquifer (fluvial)
No_1:250K_geol_code		Cubbaroo Gravels (NSW)						10091	1029	Cubbaroo Gravels (NSW)	105	UTAF	Upper Tertiary Aquifer (fluvial)
Nb		Brighton Group		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Neogene (Pliocene)	Neogene (Miocene)	10095	1033	Brighton Group	105	UTAF	Upper Tertiary Aquifer (fluvial)
Nxx		Baxter Sandstone		Sedimentary (Non-Marine (Fluvial))	Fluvial: sandstone, conglomerate, siltstone, ironstone	Neogene (Miocene)	Neogene (Pliocene)	10097	1035	Baxter Sandstone	105	UTAF	Upper Tertiary Aquifer (fluvial)
No_1:250K_geol_code		Boisdale Formation (Wurruk Sand)						10098	1036	*Boisdale Formation (Wurruk Sand)*	105	UTAF	Upper Tertiary Aquifer (fluvial)
Na2	Tp,Tp,Np	Unnamed		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, silt	Neogene (Pliocene)	Neogene (Miocene)	10016	1082	Unnamed Tertiary Sands, Gravels and Clays	105	UTAF	Upper Tertiary Aquifer (fluvial)
Na	Nm,Tp,Tm,Tp,Qar,Qpa	Unnamed incised alluvium		Sedimentary (Non-Marine (fluvial deposits))	Gravel	Neogene (Miocene)		10163	1082	Unnamed Tertiary Sands, Gravels and Clays	105	UTAF	Upper Tertiary Aquifer (fluvial)
Na10		Unnamed incised alluvium		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel	Neogene (Miocene)	Neogene (Miocene)	10164	1082	Unnamed Tertiary Sands, Gravels and Clays	105	UTAF	Upper Tertiary Aquifer (fluvial)
No_1:250K_geol_code		Undifferentiated Upper Tertiary Aquitard						10099	1037	Undifferentiated Upper Tertiary Aquitard	106	UTD	Upper Tertiary Aquitard
No_1:250K_geol_code		Bookpurnong Formation						10100	1038	Bookpurnong Formation	106	UTD	Upper Tertiary Aquitard
No_1:250K_geol_code		Lower Loxton Clays (SA)						10101	1039	Lower Loxton Clays	106	UTD	Upper Tertiary Aquitard
No_1:250K_geol_code		Hazelwood Formation		Sedimentary (Non-marine)				10126	1056	Hazelwood Formation	106	UTD	Upper Tertiary Aquitard
No_1:250K_geol_code		Yallourn Formation		Sedimentary (Non-marine)		Miocene	Miocene	10128	1058	Yallourn Formation	106	UTD	Upper Tertiary Aquitard
No_1:250K_geol_code		Jemmys Point Formation				Pliocene	Pliocene	10131	1061	Sale Group / Jemmys Point Formation	106	UTD	Upper Tertiary Aquitard
Nl	Nm-p,Tm-p	Sale Group (undifferentiated)		Sedimentary (Marine)	Marine, non-marine, gravel, sand	Neogene (Pliocene)	Neogene (Miocene)	10132	1061	Sale Group / Jemmys Point Formation	106	UTD	Upper Tertiary Aquitard
		Geera Clay (younger)						10704	1134	Geera Clay (younger)	106	UTD	Upper Tertiary Aquitard
		Winnambool Formation (younger)			Platform/lagoonal deposits	Miocene (Early)	Oligocene (Late)	10705	1135	Winnambool Formation (younger)	106	UTD	Upper Tertiary Aquitard
		Renmark Group (younger aquitard)						10706	1136	Renmark Group (younger aquitard)	106	UTD	Upper Tertiary Aquitard
		Undiff. Upper Mid-Tertiary Aquifer (interleaving - younger)						10707	1138	Undiff. Upper Mid-Tertiary Aquifer (interleaving - younger)	106	UTD	Upper Tertiary Aquitard
No_1:250K_geol_code		Undifferentiated Upper Mid Tertiary Aquifer						10102	1040	Undifferentiated Upper Mid Tertiary Aquifer	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Middle Gambier Limestone						10103	1041	Gambier Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
Nhc		Upper Gambier Limestone		Sedimentary (Marine)	Shallow marine and minor beach and near shore deposits: calcarenite, generally medium to coarse grained fragments of bryozoans, molluscs and echinoids, minor quartz and limonite sand; moderately bedded, alternating poorly and well-cemented beds	Miocene (Berdigalian)	Oligocene (Chattian)	10104	1041	Gambier Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Finniss Clay (SA)						10105	1042	Finniss Clay (SA)	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morgan Limestone						10106	1043	Morgan Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Cadell Marl						10107	1043	Morgan Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Glenforslan Formation (SA)						10108	1044	Glenforslan Formation (SA)	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Pata Limestone (SA)						10109	1045	Pata Limestone (SA)	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Duddo Limestone						10110	1046	*Duddo Limestone*	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Mannum Formation (SA)						10111	1047	Mannum Formation (SA)	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Bochara Limestone Member						10112	1048	Heytesbury Group / Portland Limestone / Heywood Marl / Bochara Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Heywood Marl		Sedimentary (Marine)		Oligocene	Oligocene	10113	1048	Heytesbury Group / Portland Limestone / Heywood Marl / Bochara Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Portland Limestone		Sedimentary (Marine)		Oligocene	Oligocene	10114	1048	Heytesbury Group / Portland Limestone / Heywood Marl / Bochara Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
Nh	Tmg,CMH,Nmn	Heytesbury Group		Sedimentary (Marine)	Marine: calcarenite, marl, silt	Neogene (Miocene)	Neogene (Miocene)	10115	1048	Heytesbury Group / Portland Limestone / Heywood Marl / Bochara Limestone	107	UMTA	Upper Mid-Tertiary Aquifer

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
Nhp		Port Campbell Limestone		Sedimentary (Marine)	Continental shelf deposit: calcarenite, minor calcilutite, generally fine-grained; bryozoan, mollusc, echinoid and brachiopod fragments, minor coarse-grained calcarenite, quartz sand and clayey silt; weakly cemented, moderately bedded	Miocene (Messinian)	Miocene (Langhian)	10119	1050	Port Campbell Limestone	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Batesford Limestone						10120	1051	*Batesford Limestone*	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Murray Group / Glenelg Group						10121	1052	Murray Group / Glenelg Group / Nelson Formation	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Nelson Formation						10122	1052	Murray Group / Glenelg Group / Nelson Formation	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Cobia Subgroup / Gurnard Formation / Turrum Formation		Sedimentary (Marine)		Oligocene	Eocene	10123	1053	Cobia Subgroup / Gurnard Formation / Turrum Formation	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Sherwood Formation						10125	1055	Sherwood Formation	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Yallock Formation						10689	1129	Yallock Formation	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Yarragon Formation				Miocene	Miocene	10127	1057	Yarragon Formation	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M1A Coal		Sedimentary (Non-marine)	Coals and ligneous clays	Miocene	Miocene	10691	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M1A Aquifer (interseam)		Sedimentary (Non-marine)		Miocene	Miocene	10692	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M1B Coal		Sedimentary (Non-marine)	Coals and ligneous clays	Miocene	Miocene	10693	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M1B Aquifer (interseam)		Sedimentary (Non-marine)		Miocene	Miocene	10694	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M2A Coal		Sedimentary (Non-marine)	Coals and ligneous clays	Oligocene	Oligocene	10695	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M2A Aquifer (interseam)		Sedimentary (Non-marine)		Oligocene	Oligocene	10696	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M2B Coal		Sedimentary (Non-marine)	Coals and ligneous clays	Oligocene	Oligocene	10697	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M2B Aquifer (interseam)		Sedimentary (Non-marine)		Oligocene	Oligocene	10698	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Formation M2C Coal		Sedimentary (Non-marine)	Coals and ligneous clays	Oligocene	Oligocene	10699	1059	Morwell Formation / Morwell seams	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Balook Formation						10130	1060	Balook Formation	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Alberton Coal Seam						10141	1064	Alberton Formation / Alberton Coal Seams	107	UMTA	Upper Mid-Tertiary Aquifer
		Winnambool Formation (interleaving)			Platform/lagoonal deposits	Miocene (Early)	Oligocene (Late)	10708	1137	Winnambool Formation (interleaving)	107	UMTA	Upper Mid-Tertiary Aquifer
No_1:250K_geol_code		Undifferentiated Mid Tertiary Aquitard						10142	1065	Undifferentiated Upper Mid Tertiary Aquitard	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Geera Clay						10143	1066	*Geera Clay*	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Winnambool Formation			Platform/lagoonal deposits	Miocene (Early)	Oligocene (Late)	10144	1067	Winnambool Formation	108	UMTD	Upper Mid-Tertiary Aquitard
Nhg		Gellibrand Marl		Sedimentary (Marine)	Continental shelf deposit: calcareous silty clay and clayey silt, minor fine to coarse grained shelly calcarenite beds, abundant bryozoans and molluscs, common echinoids, brachiopods, corals, crabs and shark teeth, locally abundant glauconite pellets	Miocene (Serravallian)	Oligocene (Chattian)	10145	1068	Gellibrand Marl	108	UMTD	Upper Mid-Tertiary Aquitard
Nhn		Newport Silt		Sedimentary (Marine)	Marine: glauconitic silt, marl, minor limestone	Neogene (Miocene)	Neogene (Miocene)	10146	1069	Newport Silt	108	UMTD	Upper Mid-Tertiary Aquitard
-Pxj		Jan Juc Formation						10149	1072	Torquay Group	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Point Addis Limestone						10150	1072	Torquay Group	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Puebla Clay						10151	1072	Torquay Group	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Zeally Limestone						10152	1072	Torquay Group	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Fyansford Formation						10124	1054	Fyansford Formation	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Maddingley Coal Seam				Oligocene	Early Miocene	10194	1132	Maddingley Coal Seam	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Giffard Sandstone Member						10133	1062	Seaspray Group /Tambo River Formation / Giffard Sandstone Member	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Seaspray Group						10134	1062	Seaspray Group /Tambo River Formation / Giffard Sandstone Member	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Tambo River Formation				Miocene (middle)	Miocene (middle)	10135	1062	Seaspray Group /Tambo River Formation / Giffard Sandstone Member	108	UMTD	Upper Mid-Tertiary Aquitard
Nsg		Gippsland Limestone		Sedimentary (Marine)	Marine: calcarenite, marl	Neogene (Miocene)	Neogene (Miocene)	10136	1063	Gippsland Limestone/Lakes Entrance Formation	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Lakes Entrance Formation				Miocene (middle)	Eocene (Late)	10137	1063	Gippsland Limestone/Lakes Entrance Formation	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Lake Wellington Formation						10138	1063	Gippsland Limestone/Lakes Entrance Formation	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Wuk Wuk Marl						10139	1063	Gippsland Limestone/Lakes Entrance Formation	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Bairnsdale Limestone						10140	1063	Gippsland Limestone/Lakes Entrance Formation	108	UMTD	Upper Mid-Tertiary Aquitard
		Undiff. Upper Mid-Tertiary Aquifer (interleaving - older)						10709	1139	Undiff. Upper Mid-Tertiary Aquifer (interleaving - older)	108	UMTD	Upper Mid-Tertiary Aquitard
No_1:250K_geol_code		Undifferentiated Lower Mid Tertiary Aquifer						10153	1073	Undifferentiated Lower Mid Tertiary Aquifer	109	LMTA	Lower Mid-Tertiary Aquifer

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
No_1:250K_geol_code		Clifton Formation						10154	1074	Clifton Formation	109	LMTA	Lower Mid-Tertiary Aquifer
-Pxm		Maude Formation		Sedimentary (Marine)	Marine: limestone, calcareous sandstone, intercalcated basalt			10147	1070	Maude Formation	109	LMTA	Lower Mid-Tertiary Aquifer
Nxi, Nv		Maude Basalt		Igneous (Extrusive)	Extrusive: olivine tholeiites			10690	1070	Maude Formation	109	LMTA	Lower Mid-Tertiary Aquifer
No_1:250K_geol_code		Morwell Fm M2C aquifer (interseam)		Sedimentary (Non-marine)		Oligocene	Oligocene	10700	1141	M2C Aquifer / Seaspray sand	109	LMTA	Lower Mid-Tertiary Aquifer
No_1:250K_geol_code		Seaspray Sand		Sedimentary (Non-marine)		Oligocene	Oligocene	10703	1141	M2C Aquifer / Seaspray sand	109	LMTA	Lower Mid-Tertiary Aquifer
No_1:250K_geol_code		Undifferentiated Lower Mid Tertiary Aquitard						10155	1075	Undifferentiated Lower Mid Tertiary Aquitard	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Ettrick Formation						10156	1076	Ettrick Formation	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Yanac Member						10157	1076	Ettrick Formation	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Boga Silt						10158	1077	Boga Silt	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Nirranda Group						10159	1078	Nirranda Group	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Wangoom Sand				Eocene (Bartonian)	Late Eocene	10160	1079	Wangoom Sand	110	LMTD	Lower Mid-Tertiary Aquitard
-Pnn		Narrawaturk Marl		Sedimentary (Marine)	Open marine (below storm wave base) deposits: calcareous mudstone, minor thin calcarenite beds; locally carbonaceous and burrowed, locally abundant glauconite pellets and polished quartz sand, foraminifers, bryozoans, brachiopods and molluscs	Oligocene (Rupelian)	Eocene (Bartonian)	10161	1080	Narrawaturk Marl	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Sturgess Point Member						10165	1083	Sturgess Point Member	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Upper Mepunga Formation						10166	1084	Upper Mepunga Formation	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Anglesea Formation				Eocene (Late)	Eocene (Late)	10167	1085	Demons Bluff Group / Anglesea Formation	110	LMTD	Lower Mid-Tertiary Aquitard
-Pnd		Demons Bluff Group		Sedimentary (Marine)	Marine: silt, fine sand, clay, carbonaceous, pyritic, burrowed	Palaeogene (Eocene)	Palaeogene (Eocene)	10168	1085	Demons Bluff Group / Anglesea Formation	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Flounder Formation				Late Eocene	Early Eocene	10169	1086	Flounder Formation	110	LMTD	Lower Mid-Tertiary Aquitard
No_1:250K_geol_code		Undifferentiated Lower Tertiary Aquifer						10170	1087	Undifferentiated Lower Tertiary Aquifer	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Upper Renmark Olney						10171	1088	Upper Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Upper Renmark Moorlands Lignite Member						10172	1088	Upper Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Middle Renmark Olney						10173	1089	Middle Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Moorlands Lignite Member						10174	1089	Middle Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Warina Sand				Paleocene (Late)	Eocene (Early)	10175	1090	Lower Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Lower Renmark Olney						10176	1090	Lower Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Compton Conglomerate						10177	1090	Lower Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Buccleuch Formation						10178	1090	Lower Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Jerilderie Formation						10179	1090	Lower Renmark Group	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Dartmoor Formation				Eocene (early)	Palaeocene (Late)	10180	1091	Wangerrip Group / Dartmoor Fm / Knight Gp	111	LTA	Lower Tertiary Aquifer
-Pw	Paw,Tab,CPW	Wangerrip Group / Knight Group		Sedimentary (Marine, Non-Marine)	Marine, fluvial: sandstone, minor conglomerate	Palaeogene (Palaeocene)	Palaeogene (Palaeocene)	10181	1091	Wangerrip Group / Dartmoor Fm / Knight Gp	111	LTA	Lower Tertiary Aquifer
-Pa		Unnamed alluvium		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand	Palaeogene (Eocene)	Palaeogene (Eocene)	10182	1092	Unnamed alluvium	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Yaugher Volcanics				Oligocene	Eocene	10183	1093	Dilwyn Formation / Yaugher Volcanics / Rivernook Member	111	LTA	Lower Tertiary Aquifer
-Pwd		Dilwyn Formation		Sedimentary (Marine)	Shallow marine, coastal barrier and back beach lagoonal deposits: sandy clay, silt; carbonaceous, burrowed, often laminated, cross-bedded, interbedded with quartz sand, clayey sand and minor coarse sand and gravel; massive to moderately bedded	Eocene (Lutetian)	Eocene (Lutetian)	10184	1093	Dilwyn Formation / Yaugher Volcanics / Rivernook Member	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Burrungule Member				Palaeocene (Ypresian)		10185	1094	Burrungule Member	111	LTA	Lower Tertiary Aquifer
-Pwdp		Pember Mudstone Member		Sedimentary (Marine)	Shallow marine (below and close to storm wave base) deposits: silty clay, clayey silt, fine quartz sand; carbonaceous, micaceous, pyritic, burrowed, with abundant arenaceous foraminifers, minor calcareous foraminifers and shelly fossils	Eocene (Lutetian)	Palaeocene (Thanetian)	10186	1095	Pember Mudstone	111	LTA	Lower Tertiary Aquifer
-Pwe		Eastern View Formation		Sedimentary (Non-Marine (Alluvial))	Fluvial: gravel, sand, clay, brown coal	Palaeogene (Palaeocene)	Palaeogene (Palaeocene)	10187	1096	Eastern View Formation	111	LTA	Lower Tertiary Aquifer
-Pwp		Pebble Point Formation / Bahgallah Formation		Sedimentary (Marine)	Near shore, shallow marine deposits: quartz sand, minor clay; micaceous, fine-grained, friable, generally massive; minor planar cross-bedding; minor gravel, minor volcanic and metamorphic lithic cobbles and pebbles	Palaeocene (Ypresian)	Late Cretaceous (Maastrichtian)	10188	1097	Pebble Point Formation	111	LTA	Lower Tertiary Aquifer
-Pwpm		Moomowroong Sand Member		Sedimentary (Marine)	Marginal marine and beach deposits: quartz sand, minor clay; micaceous, fine-grained, friable, generally massive; minor planar cross-bedding; minor gravel	Palaeocene (Ypresian)	Late Cretaceous (Maastrichtian)	10189	1098	Moomowroong Sand Member	111	LTA	Lower Tertiary Aquifer
-Pwpw		Wiridjil Gravel Member		Sedimentary (Non-Marine)	Fluvial braided stream deposits: quartz gravel, sand, minor pebble layers and clay clasts; carbonaceous, friable, minor volcanic and metamorphic lithic cobbles and pebbles; large-scale trough cross-bedding	Palaeocene (Ypresian)	Late Cretaceous (Maastrichtian)	10190	1099	Wiridjil Gravel Member	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Brucknell Member			Dark brown, carbonaceous clayey silt to silty clay, often burrowed; richly fossiliferous in places	Early Oligocene	Late Eocene	10191	1100	Mepunga Formation (lower) / Brucknell Member	111	LTA	Lower Tertiary Aquifer
-Pnm		Mepunga Formation (lower)		Sedimentary (Marine, Non-Marine)	Barrier island, beach and near shore, estuarine and lagoonal deposits: quartz sand, medium to coarse grained, iron-stained, minor detrital limonite, with gastropod and mollusc fragments. foraminifers; unconsolidated, locally cemented with calcite, in	Oligocene (Rupelian)	Eocene (Bartonian)	10192	1100	Mepunga Formation (lower) / Brucknell Member	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Timboon Sand / Curdies Formation						10193	1101	Timboon Sand	111	LTA	Lower Tertiary Aquifer
-Pxe		Werribee Formation		Sedimentary (Non-Marine (Alluvial))	Fluvial: sand, sandy and silty clay, carbonaceous, pyritic in part	Palaeogene (Eocene)	Palaeogene (Eocene)	10195	1102	Werribee Formation	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Yaloak Formation						10196	1103	Yaloak Formation	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		M2 (basal aquifer)		Sedimentary (Non-Marine)		Oligocene	Oligocene	10701	1142	M2 / M2C Aquifer (basal aquifer)	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		M2C (basal aquifer)		Sedimentary (Non-Marine)		Oligocene	Oligocene	10702	1142	M2 / M2C Aquifer (basal aquifer)	111	LTA	Lower Tertiary Aquifer

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
No_1:250K_geol_code		Latrobe Group (Upper, Middle and Lower)						10197	1104	Latrobe Group (Upper, Middle and Lower)	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Traralgon Formation						10198	1104	Latrobe Group (Upper, Middle and Lower)	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Yarram Formation						10200	1105	Yarram Formation	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Honeysuckle Gravels						10201	1106	Honeysuckle Gravels	111	LTA	Lower Tertiary Aquifer
-Pxc		Childers Formation		Sedimentary (Non-Marine (Alluvial))	Fluvial: sand, clay, gravel, conglomerate	Palaeogene (Oligocene)	Palaeogene (Palaeocene)	10202	1107	Childers Formation	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Burong Formation / Traralgon Seam				Eocene (Middle)	Oligocene (Early)	10203	1108	Burong Formation / Traralgon Seam	111	LTA	Lower Tertiary Aquifer
-Pxh	Ppw,Tlw,Plw	White Hills Gravel		Sedimentary (Non-Marine (Alluvial))	Fluvial: river deposits, colluvium; vein quartz gravel, sand, silt, clay	Cainozoic (Palaeogene)	Cainozoic (Palaeogene)	10019	1071	White Hills Gravels	111	LTA	Lower Tertiary Aquifer
No_1:250K_geol_code		Undifferentiated Lower Tertiary Basalts						10204	1109	Undifferentiated Lower Tertiary Basalts	112	LTB	Lower Tertiary Basalts
Nxi		Pintadeen Basalt (phase 2)						10148	1081	Phase 2 Basalts	112	LTB	Lower Tertiary Basalts
Nv		Undifferentiated basalt (phase 2)		Igneous (Extrusive)	Extrusive: olivine tholeiites	Neogene (Miocene)	Neogene (Miocene)	10162	1081	Phase 2 Basalts	112	LTB	Lower Tertiary Basalts
-Po	Pvo,Po,CEOV	Older Volcanic Group (Phase 1)		Igneous (Extrusive)	Extrusive: tholeiitic and minor alkaline basalts	Palaeogene (Oligocene)	Palaeogene (Eocene)	10205	1110	Older Volcanic Group *(Phase 1)*	112	LTB	Lower Tertiary Basalts
No_1:250K_geol_code		Mornington Volcanics						10206	1111	Mornington Volcanics	112	LTB	Lower Tertiary Basalts
No_1:250K_geol_code		Thorpdale Volcanics						10207	1112	Thorpdale Volcanics	112	LTB	Lower Tertiary Basalts
No_1:250K_geol_code		Carrajung Volcanics				Eocene	Palaeocene	10208	1113	Carrajung Volcanics	112	LTB	Lower Tertiary Basalts
No_1:250K_geol_code		Undifferentiated Cretaceous and Permian Sediments						10209	1114	Undifferentiated Cretaceous and Permian Sediments	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Pyab Member, Monash Formation						10210	1115	Monash Formation	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Merreti Member, Monash Formation						10211	1115	Monash Formation	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Coombool Member, Monash Formation						10212	1115	Monash Formation	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Taparoo Sandstone of Millewa Group						10213	1116	Millewa Group	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Morkalla Formation of Millewa Group						10214	1116	Millewa Group	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Urana Formation						10215	1117	Urana Formation	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Coorabin Coal Measures						10216	1118	Undifferentiated Permian Sediments	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Lane's Shaft Coal Member						10217	1118	Undifferentiated Permian Sediments	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Narrow Plain Formation						10218	1118	Undifferentiated Permian Sediments	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Loughmore Formation						10219	1118	Undifferentiated Permian Sediments	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Coreen Creek Coal Member						10220	1118	Undifferentiated Permian Sediments	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Nowrie Creek Formation						10221	1118	Undifferentiated Permian Sediments	113	CPS	Cretaceous and Permian Sediments
Kup		Paaratte Formation				Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10222	1119	Paaratte Formation	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Belfast Mudstone		Sedimentary (Non-Marine)		Cretaceous (Late Cretaceous)	Cretaceous (Late Cretaceous)	10223	1120	Belfast Mudstone	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Flaxman Formation		Sedimentary (Non-Marine)		Cretaceous (Late Cretaceous)	Cretaceous (Late Cretaceous)	10224	1121	Flaxman Formation	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Nullawarre Greensand				Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10225	1122	Nullawarre Greensand	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Waarre Formation		Sedimentary (Non-Marine)		Cretaceous (Late Cretaceous)	Cretaceous (Late Cretaceous)	10226	1123	Waarre Formation	113	CPS	Cretaceous and Permian Sediments
No_1:250K_geol_code		Undifferentiated Mesozoic and Palaeozoic Bedrock						10227	1124	Undifferentiated Mesozoic and Palaeozoic Bedrock	114	BSE	Mesozoic and Palaeozoic Bedrock
-Ca	Cs	St Arnaud Group		Sedimentary (Marine)	Marine: sandstone, siltstone, biotite schist	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10228	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Chl	Ehl	Lazy Bar Andesite	Heathcote Volcanic Group	Sedimentary (Marine)	Marine: andesite, volcanic sedimentary rocks	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10229	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Chm	Chw,Ehw,Cv	Mount William Metabasalt	Heathcote Volcanic Group	Sedimentary (Marine)	Extrusive, intrusive: basalt, andesite, boninite, rhyolite, gabbro, lithic sandstone, chert, shale, breccia	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10230	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Chs	Ehs	Sheoak Gully Boninite	Heathcote Volcanic Group	Sedimentary (Marine)	Marine: boninite, volcanic sedimentary rocks	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10231	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Cm	Cm,Cg	Moralana Supergroup		Sedimentary (Marine)	Marine: sandstone, siltstone	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10232	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Cng	Unk20,Cgl,Cgs,C6	Glenthompson Sandstone	Nargoon Group	Sedimentary (Marine)	Marine: sandstone, siltstone, shale	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10233	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Ctg	Cus	Garvey Gully Formation	Thiele Igneous Complex	Sedimentary (Marine)	Marine: chert, volcaniclastic sandstone, mudstone, limestone	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10234	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Cx	Cus	Undifferentiated Cambrian sedimentary rocks		Sedimentary (Marine)	Marine: chert, volcaniclastic sandstone, mudstone, limestone	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10235	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Cxg	Cug,Eug	Goldie Chert		Sedimentary (Marine)	Marine: chert, siliceous siltstone	Palaeozoic (Cambrian)		10236	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Cxk	Cmm,Cmk,Emk	Knowsley East Shale		Sedimentary (Marine)	Marine: shale, siltstone, chert, conglomerate, volcanic sandstone	Cambrian (Late Cambrian)	Cambrian (Middle Cambrian)	10237	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Cxo	Plu,Cu	Boorhaman Conglomerate		Sedimentary (Marine, Non-Marine)	Fluvioglacial, glaciomarine: tillite, diamictite, sandstone, mudstone, conglomerate	Carboniferous (Late Carboniferous)	Carboniferous (Late Carboniferous)	10238	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dad	Dd,Dl	Delatite Group	Avon Supergroup	Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive: rhyolite ignimbrite, minor andesite lava & volcaniclastics; Fluvial: red siltstone, minor sandstone, occasional conglomerate\n	Devonian (Late Devonian)	Devonian (Late Devonian)	10239	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dadm	Dam,Dum,Ddm	Moroka Glen Formation	Delatite Group (Avon Supergroup)	Sedimentary (Non-Marine (Alluvial))	Fluvial: sandstone, conglomerate	Devonian (Late Devonian)	Devonian (Late Devonian)	10240	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Damk	Dmt,Dak,Clt,Clk	Mount Kent Conglomerate	Avon Supergroup	Sedimentary (Non-Marine (Alluvial))	Fluvial: cobble conglomerate, pebbly sandstone, cross bedded sandstone	Devonian (Late Devonian)	Devonian (Late Devonian)	10241	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dams	Dmd,Das,Cl,Cls	Snowy Plains Formation	Mansfield Group (Avon Supergroup)	Sedimentary (Non-Marine (Alluvial))	Fluvial: red mudstone, micaceous sandstone, minor breccia, conglomerate	Devonian (Late Devonian)	Devonian (Late Devonian)	10242	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

Department of Sustainability and Environment

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
Dbb	Dla,PDBC	Buchan Caves Limestone	Buchan Group	Sedimentary (Marine)	Marine: limestone, dolomite, well-bedded dark grey recrystallized	Devonian (Early Devonian)	Devonian (Early Devonian)	10243	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dbm		Murrindal Limestone		Sedimentary (Marine)	Marine: massive limestone, pale grey, recrystallized	Devonian (Early Devonian)	Devonian (Early Devonian)	10244	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dbt		Taravale Marlstone		Sedimentary (Marine)	Marine: marlstone, dark grey-green, nodular limestone	Devonian (Early Devonian)	Devonian (Early Devonian)	10245	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dc	Damk,Dk,Dmk	Cathedral Group		Sedimentary (Non-Marine (Alluvial))	Fluvial: sandstone, conglomerate, red sandstone, siltstone	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10246	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ddd	Dvdd,Dldd,Dldc	Dart River Volcanic Breccia	Dartella Volcanic Group	Sedimentary (Non-Marine)	Fluvial, lacustrine?: black siltstone, volcanogenic sandstone, slate breccia	Devonian (Early Devonian)	Devonian (Early Devonian)	10247	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Deo		Boulder Flat Limestone		Sedimentary (Marine)	Marine: limestone, massive dark grey recrystallized to stylobrecciated, black shale	Devonian (Early Devonian)	Devonian (Early Devonian)	10248	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Deu		Bungywarr Formation		Sedimentary (Marine)	Marine: sandstone, volcanogenic polymictite, minor rhyolite lava	Devonian (Early Devonian)	Devonian (Early Devonian)	10249	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dh		White Monkey Volcanic Group		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive, fluvial: felsic ignimbrite, minor conglomerate, sandstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10250	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dn		Walhalla Group / undifferentiated Walhalla Group		Sedimentary (Marine)	Marine: undiff'd: sandstone, mudstone, minor conglomerate	Devonian (Early Devonian)	Devonian (Early Devonian)	10251	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dnm	Dwam,Dlwm,Dwm,Dnl	Montys Hut Formation	Walhalla Group	Sedimentary (Marine)	Marine: thin-bedded sandstone, siltstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10252	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dnn	Dwan,Dlwn,Dwn	Norton Gully Sandstone	Walhalla Group	Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, minor conglomerate, limestone lenses	Devonian (Early Devonian)	Devonian (Early Devonian)	10253	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dq		Merimbula Group / undifferentiated Merimbula Group		Sedimentary (Marine, Non-Marine)	Fluvial; marine: sandstone, conglomerate, siltstone, quartzite, shale	Devonian (Late Devonian)	Devonian (Late Devonian)	10254	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsb		Timbarra Subgroup		Sedimentary (Non-Marine)	Extrusive, fluvial, marine: ignimbrite, lava, conglomerate, sandstone, polymictite	Devonian (Early Devonian)	Devonian (Early Devonian)	10255	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsc		Wombargo Subgroup		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive, fluvial: conglomerate, sandstone, felsic ignimbrite	Devonian (Early Devonian)	Devonian (Early Devonian)	10256	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsd		White Monkey Subgroup		Sedimentary, Igneous(Non-Marine, Extrusive())	Extrusive, fluvial: felsic ignimbrite, minor conglomerate, sandstone	Lower Devonian		10257	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dse		Marroo Subgroup		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive, fluvial: felsic ignimbrite, minor conglomerate, sandstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10258	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsf		Berrmarr Subgroup		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive, fluvial: felsic ignimbrite, megabreccia, minor rhyolite lava	Devonian (Early Devonian)	Devonian (Early Devonian)	10259	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsj		Trendale Formation		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive, fluvial: ignimbrite, ashstone, sandstone, mudstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10260	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsk		Little River Subgroup		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive, fluvial: felsic ignimbrite, felsic to mafic lava, ashstone, conglomerate, sandstone, mudstone, chert	Devonian (Early Devonian)	Devonian (Early Devonian)	10261	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsn		Ninnie Subgroup		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive, ignimbrite, sandstone, conglomerate	Devonian (Early Devonian)	Devonian (Early Devonian)	10262	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsv		Devils Den Conglomerate		Sedimentary (Non-Marine (Alluvial))	Fluvial: conglomerate, sandstone, minor mudstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10263	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dwt		Tabberabbera Formation		Sedimentary (Marine)	Marine: siltstone, sandstone, minor limestone	Devonian (Early Devonian)	Devonian (Early Devonian)	10264	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dww		Wild Horse Formation		Sedimentary (Non-Marine)	Transgressive: conglomerate, pebbly sandstone, quartzite	Devonian (Early Devonian)	Devonian (Early Devonian)	10265	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dx	Dl,Dxe	Undifferentiated Devonian sedimentary rocks		Sedimentary	Fluvial: conglomerate, sandstone, mudstone	Devonian (Late Devonian)	Devonian (Late Devonian)	10266	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxc		Combyingbar Formation		Sedimentary (Non-Marine (Alluvial))	Fluvial: conglomerate, sandstone, mudstone	Devonian (Late Devonian)	Devonian (Late Devonian)	10267	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxh	Dlh	Humevale Siltstone		Sedimentary (Marine)	Marine: siltstone, minor sandstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10268	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxl		Liptrap Formation		Sedimentary (Marine)	Marine: sandstone, siltstone, minor conglomerate	Devonian (Early Devonian)	Devonian (Early Devonian)	10269	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxmc	Dlmc	Cornella Member	Mount Ida Formation	Sedimentary (Marine)	Marine: turbidite deposits; siltstone, thin bedded sandstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10270	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxmd	Dlmd	Dealba Member	Mount Ida Formation	Sedimentary (Marine)	Marine: thin to thick bedded quartz sandstone, minor conglomerate	Devonian (Early Devonian)	Devonian (Early Devonian)	10271	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxms	Dlms	Stoddart Member	Mount Ida Formation	Sedimentary (Marine)	Marine: thin bedded mudstone, shale, sandstone, conglomerate	Devonian (Early Devonian)	Devonian (Early Devonian)	10272	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxp	Dlp,Dlpu	Puckapunyal Formation		Sedimentary (Marine)	Marine: turbidite deposits; siltstone, thin bedded sandstone	Silurian (Pridoli)	Silurian (Pridoli)	10273	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxr	Dlf	Waranga Formation		Sedimentary (Marine)	Marine: siltstone, minor sandstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10274	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxw		Waratah Limestone		Sedimentary (Marine)	Marine: limestone, massive mid-grey recrystallized	Devonian (Early Devonian)	Devonian (Early Devonian)	10275	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Koe	Kle,Klm,Kl,MCEV,KL	Eumeralla Formation	Otway Group	Sedimentary (Non-Marine)	Fluvial: lithic sandstone, siltstone, minor conglomerate, coal	Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10305	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ksw		Wonthaggi Formation		Sedimentary (Non-Marine (Alluvial))	Fluvial: lithic sandstone, siltstone, minor conglomerate, coal	Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10306	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Casterton Beds				Jurassic	Cretaceous (Early Cretaceous)	10307	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Crayfish Subgroup				Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10308	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Geltwood Beach Formation			Volcanogenic Sandstones	Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10309	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Heathfield Sandstone Member				Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10310	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Laira Formation				Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10311	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Otway Group / Merino Group				Jurassic	Cretaceous (Early Cretaceous)	10312	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Pretty Hill Formation			Volcanogenic Sandstones	Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10313	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Sherbrook Group		Sedimentary (Non-Marine)		Cretaceous (Late Cretaceous)	Cretaceous (Late Cretaceous)	10314	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
No_1:250K_geol_code		Skull Creek Member				Cretaceous (Campanian)	Cretaceous (Campanian)	10315	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Strzelecki Group		Sedimentary (Non-Marine)	Interbedded non-marine greywackes, mudstones, sandstones, conglomerates, minor coals and volcanics.	Cretaceous (Albian)	Cretaceous (Berremian)	10316	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
No_1:250K_geol_code		Windermere Formation		Sedimentary (Non-Marine (Alluvial))	Fluvial, braided stream deposits: volcanolithic sandstone, siltstone, mudstone, with feldspar and quartz grains, fine to medium grained	Cretaceous (Early Cretaceous)	Cretaceous (Early Cretaceous)	10317	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
TRxc		Council Trench Formation		Sedimentary (Non-Marine (Alluvial))	Fluvial: conglomerate, sandstone, siltstone	Mesozoic (Triassic)	Mesozoic (Triassic)	10318	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Oah		Howqua Chert / Howqua Shale		Sedimentary (Marine)	Marine: black shale, siliceous shale, mafic sandstone	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10319	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Oap	Oap,Oa,Oli,Op	Pinnak Sandstone	Adaminaby Group	Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, minor chert	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10320	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ob	Oub	Bendoc Group / undifferentiated Bendoc Group		Sedimentary (Marine)	Marine: black shale, cherty shale, stripy thin-bedded sandstone and siltstone, laminated siltstone	Ordovician (Late Ordovician)	Ordovician (Middle Ordovician)	10321	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Oc	Ol	Castlemaine Group		Sedimentary (Marine)	Marine: sandstone, siltstone, shale, chert	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10322	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ocb	Olb	Castlemaine Group - Bendigonian	Castlemaine Group	Sedimentary (Marine)	Sandstone, siltstone, shale, chert; Bendigonian	Early Ordovician (Bendigonian)	Early Ordovician (Bendigonian)	10323	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Occ	Olc	Castlemaine Group - Castlemainian	Castlemaine Group	Sedimentary (Marine)	Marine: sandstone, siltstone, shale, chert; Castlemainian	Middle Ordovician (Castlemainian)		10324	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ocd	Olm,Ola	Castlemaine Group - Darriwilian	Castlemaine Group	Sedimentary (Marine)	Marine: sandstone, siltstone, shale, chert. Darriwilian	Middle Ordovician (Darriwilian)	Middle Ordovician (Darriwilian)	10325	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Och	Olh	Castlemaine Group - Chewtonian	Castlemaine Group	Sedimentary (Marine)	Marine: sandstone, siltstone, shale, chert; Chewtonian	Early Ordovician (Chewtonian)		10326	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ochc	Ola	Castlemaine Group		Sedimentary (Marine)	Marine: Sandstone, siltstone, shale, chert, Castlemainian + Chewtonian	Middle Ordovician (Castlemainian)	Early Ordovician (Chewtonian)	10327	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ocl	Oll	Castlemaine Group - Lancefieldian	Castlemaine Group	Sedimentary (Marine)	Sandstone, siltstone, shale, chert; Lancefieldian	Early Ordovician (Lancefieldian/Warendia	Early Ordovician (Lancefieldian/Warendia	10328	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ocr		Romsey Subgroup		Sedimentary (Marine)	Marine: sandstone, thick bedded, siltstone, shale, chert	Early Ordovician (Bendigonian)	Early Ordovician (Lancefieldian/Warendia	10329	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ocy	Oly	Castlemaine Group - Yapeenian	Castlemaine Group	Sedimentary (Marine)	Marine: sandstone, siltstone, shale, chert; Yapeenian	Middle Ordovician (Yapeenian)	Middle Ordovician (Yapeenian)	10330	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ok	Ovk	Kiandra Group		Sedimentary, Igneous (Marine, Extrusive)	Marine: basalt lava, agglomerate, sandstone, chert	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10331	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Okb	Ouu	Blueys Creek Formation	Kiandra Group	Sedimentary (Marine)	Marine: chert, volcaniclastic sandstone	Ordovician (Late Ordovician)	Ordovician (Late Ordovician)	10332	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Osb		Bolinda Shale		Sedimentary (Marine)	Marine: black shale, thin bedded sandstone, calcareous siltstone	Ordovician (Late Ordovician)	Ordovician (Late Ordovician)	10333	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Osr		Riddell Sandstone		Sedimentary (Marine)	Marine: sandstone, thin to thick bedded, shale, mudstone, minor conglomerate	Ordovician (Late Ordovician)	Ordovician (Late Ordovician)	10334	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ox	Ou,O-S,O/S	Undifferentiated Ordovician sedimentary rocks		Sedimentary (Marine)	Marine: sandstone, mudstone, quartzite	Ordovician (Late Ordovician)	Ordovician (Late Ordovician)	10335	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Oxd		Digger Island Limestone		Sedimentary (Marine)	Marine: limestone, calcareous siltstone	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10336	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Oxe	Oue	Mount Easton Shale		Sedimentary (Marine)	Marine: black shale, minor sandstone	Ordovician (Late Ordovician)	Ordovician (Late Ordovician)	10337	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Pxb	P,P,Pxw,Pw	Bacchus Marsh Formation		Sedimentary (Non-Marine (fluvioglacial deposits))	Fluvioglacial, glaciomarine: tillite, diamictite, sandstone, mudstone, conglomerate	Palaeozoic (Permian)	Palaeozoic (Permian)	10338	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sc	Oc	Cobbannah Group		Sedimentary (Marine)	Marine sandstone, mudstone	Silurian (Wenlock)	Silurian (Llandovery)	10339	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sec	Seq,Suq	Cowombat Siltstone	Enano Group	Sedimentary (Marine)	Marine: siltstone, laminated, minor sandstone, limestone lenses	Silurian (Pridoli)	Silurian (Ludlow)	10340	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Seg	Seg1-5,Sug	Gibsons Folly Formation	Enano Group	Sedimentary, Igneous (Marine, Intrusive, Extrusive)	Marine, extrusive, intrusive: siltstone, andesite	Silurian (Pridoli)	Silurian (Ludlow)	10341	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Set	Svt,Smvt	Thorkidaan Volcanics	Enano Group	Sedimentary, Igneous (Marine, Extrusive)	Marine, extrusive: felsic ignimbrite, porphyry, minor sediments	Silurian (Wenlock)	Silurian (Llandovery)	10342	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sj	SDj	Jordan River Group		Sedimentary (Marine)	Marine: undiff'd sandstone, mudstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10343	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjb	SDjb	Bullung Siltstone	Jordan River Group	Sedimentary (Marine)	Marine: massive to banded siltstone, minor sandstone	Silurian (Wenlock)	Silurian (Llandovery)	10344	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjd	SDjd	Donnellys Creek Siltstone	Jordan River Group	Sedimentary (Marine)	Marine: siltstone, finely banded	Silurian (Wenlock)	Silurian (Llandovery)	10345	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sje	SDje	Eildon Sandstone	Jordan River Group	Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, fine grained, siltstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10346	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sji	Sjg,SDjg	Wilson Creek Shale	Jordan River Group	Sedimentary (Marine)	Marine: black shale, black siltstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10347	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjl	SDjl	Lazarini Siltstone	Jordan River Group	Sedimentary (Marine)	Marine: siltstone, bioturbated and banded, minor thin quartz sandstone	Silurian (Wenlock)	Silurian (Llandovery)	10348	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjm	SDjm,PSMS	McAdam Sandstone	Jordan River Group	Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, shale	Silurian (Wenlock)	Silurian (Llandovery)	10349	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjn	SDjn	Murderers Hill Siltstone	Jordan River Group	Sedimentary (Marine)	Marine: siltstone, banded, minor thin-bedded fine sandstone Marine: quartz- and lithic sandstone, siltstone, black shale	Silurian (Wenlock)	Silurian (Llandovery)	10350	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjo	SDjo	Boola Formation	Jordan River Group	Sedimentary (Marine)	Marine: siltstone, lithic sandstone, conglomerate, limestone lenses	Devonian (Early Devonian)	Devonian (Early Devonian)	10351	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjr	SDjr	Serpentine Creek Sandstone	Jordan River Group	Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, shale	Silurian (Wenlock)	Silurian (Llandovery)	10352	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjs	SDjs	Sinclair Valley Sandstone	Jordan River Group	Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, shale	Silurian (Pridoli)	Silurian (Ludlow)	10353	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sju	SDju	Wurutwun Formation	Jordan River Group	Sedimentary (Marine)	Marine: siltstone, lithic sandstone, conglomerate, limestone lenses, black shale	Devonian (Early Devonian)	Devonian (Early Devonian)	10354	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sjw	SDjw	Whitelaw Siltstone	Jordan River Group	Sedimentary (Marine)	Marine: siltstone, finely banded, minor sandstone	Silurian (Pridoli)	Silurian (Ludlow)	10355	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sk	SDr,Sr,PCGZ,Sr	Grampians Group		Sedimentary	Marine, Fluvial: sandstone, minor conglomerate, siltstone	Palaeozoic (Silurian)	Palaeozoic (Silurian)	10356	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
Sm		Murrindindi Supergroup		Sedimentary (Marine)	Marine: mudstone, sandstone	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10357	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
St	Dut,Dt	Mount Tambo Group		Sedimentary, Igneous (Marine, Non-Marine, Extrusive)	Fluvial, marine, extrusive: conglomerate, sandstone, mudstone, ignimbrite	Devonian (Early Devonian)	Devonian (Early Devonian)	10358	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sw	Suw,Suw	Wombat Creek Group		Sedimentary (Marine)	Marine: conglomerate, sandstone, siltstone, limestone	Silurian (Pridoli)	Silurian (Ludlow)	10359	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sx		Undifferentiated Silurian Sedimentary Rocks / undifferentiated Palaeozoic (Silurian)		Sedimentary (Marine)	Marine: volcanics, mudstone, sandstone	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10360	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxa	Sla	Andersons Creek Formation		Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, minor conglomerate	Silurian (Wenlock)	Silurian (Llandovery)	10361	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxb	Sub	Broadford Formation		Sedimentary (Marine)	Marine: thin to thick bedded siltstone, sandstone, conglomerate	Silurian (Pridoli)	Silurian (Ludlow)	10362	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxc	Slc,Slc	Costerfield Siltstone		Sedimentary (Marine)	Marine: thin bedded siltstone, minor sandstone	Silurian (Llandovery)	Silurian (Llandovery)	10363	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxd		Deep Creek Siltstone		Sedimentary (Marine)	Marine: siltstone, thin-bedded, minor sandstone, conglomerate	Silurian (Wenlock)	Silurian (Llandovery)	10364	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sx-Dx	SDl,Sm	Undifferentiated Silurian-Devonian Rocks		Sedimentary (Marine)	Marine: undifferentiated sandstone, mudstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10365	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxg	Sud	Dargile Formation		Sedimentary (Marine)	Marine: siltstone, thin-bedded sandstone	Silurian (Pridoli)	Silurian (Ludlow)	10366	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxi	Sui	McIvor Sandstone		Sedimentary (Marine)	Marine: sandstone, mudstone, thick to thin bedded	Silurian (Pridoli)	Silurian (Ludlow)	10367	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxih	Suih	Hylands Member	McIvor Sandstone	Sedimentary (Marine)	Marine: turbidite deposits; siltstone, thin bedded sandstone	Silurian (Pridoli)	Silurian (Ludlow)	10368	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxk		Kilmore Siltstone		Sedimentary (Marine)	Marine: siltstone, sandstone, thin bedded	Silurian (Pridoli)	Silurian (Ludlow)	10369	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxm	Sum	Melbourne Formation		Sedimentary (Marine)	Marine: sandstone, mudstone, medium to thin bedded	Silurian (Pridoli)	Silurian (Ludlow)	10370	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxn		Sardine Conglomerate		Sedimentary (Marine)	Marine: conglomerate, sandstone, limestone	Silurian (Pridoli)	Silurian (Ludlow)	10371	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxr		Kerrie Conglomerate		Sedimentary (Non-Marine)	Fluvial, lacustrine: conglomerate, massive, sandstone, siltstone	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10372	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxs		Springfield Sandstone		Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, conglomerate	Silurian (Wenlock)	Silurian (Llandovery)	10373	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxt	Smvm,Smv,Svm,MMV,Sm	Mitta Mitta Rhyolite		Sedimentary, Igneous (Marine, Intrusive, Extrusive)	Marine, extrusive, igneous: rhyolite lava ash	Silurian (Wenlock)	Silurian (Llandovery)	10374	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sxw	Slp	Wapentake Formation		Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, conglomerate	Silurian (Wenlock)	Silurian (Llandovery)	10375	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sy		Yalmy Group / undifferentiated Yalmy Group		Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone	Silurian (Wenlock)	Silurian (Llandovery)	10376	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sys		Seldom Seen Formation		Sedimentary (Marine)	Marine: chert conglomerate, minor sandstone	Silurian (Wenlock)	Silurian (Llandovery)	10377	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Syt	Slw	Towanga Sandstone	Yalmy Group	Sedimentary (Marine)	Marine: sandstone, thick to thin bedded, siltstone, minor conglomerate	Silurian (Wenlock)	Silurian (Llandovery)	10378	1125	Undifferentiated Sedimentary Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Cxv	Cv	Unnamed Cambrian 'greenstone'		Igneous (Extrusive, Intrusive)	Extrusive, intrusive: basalt, andesite, boninite, rhyolite, gabbro, lithic sandstone, chert, shale, breccia	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10379	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dab		Unnamed basalt	Avon Supergroup	Igneous (Extrusive)	Extrusive: basalt	Devonian (Late Devonian)	Devonian (Late Devonian)	10380	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Daw	Dvw,Duw	Wellington Volcanic Group	Avon Supergroup	Igneous (Extrusive)	Extrusive: rhyolite and rhyodacite ignimbrite	Devonian (Late Devonian)	Devonian (Late Devonian)	10381	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ddm	Dvdm,Dldm	Murtagh Creek Ignimbrite	Dartella Volcanic Group	Igneous (Extrusive)	Extrusive, fluvial: felsic ignimbrite, agglomerate, minor siltstone	Devonian (Early Devonian)	Devonian (Early Devonian)	10382	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dds	Dvds,Dlds,Dvds	Sheevers Spur Rhyodacite	Dartella Volcanic Group	Igneous (Extrusive)	Extrusive: felsic ignimbrite, minor andesite	Devonian (Early Devonian)	Devonian (Early Devonian)	10383	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Di1	Dvv1	Unnamed	Violet Town Volcanic Group	Igneous (Extrusive)	Extrusive: rhyolite ignimbrite	Devonian (Late Devonian)	Devonian (Late Devonian)	10384	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Di2	Dvv2	Unnamed	Violet Town Volcanic Group	Igneous (Extrusive)	Extrusive: rhyodacite ignimbrite	Devonian (Late Devonian)	Devonian (Late Devonian)	10385	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Di3		Unnamed		Igneous (Extrusive)	Extrusive: hornblende dacite (Mt Martha)	Devonian (Late Devonian)	Devonian (Late Devonian)	10386	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Djc		Coldstream Rhyolite		Igneous (Extrusive)	Extrusive: rhyolite lava, coherent flow-banded to autobrecciated	Devonian (Late Devonian)	Devonian (Late Devonian)	10387	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dje		Mount Evelyn Rhyodacite		Igneous (Extrusive)	Extrusive: rhyolite to rhyodacite ignimbrite, welded	Devonian (Late Devonian)	Devonian (Late Devonian)	10388	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Djf		Ferny Creek Rhyodacite		Igneous (Extrusive)	Extrusive: biotite-hypersthene rhyodacite ignimbrite, recrystallized	Devonian (Late Devonian)	Devonian (Late Devonian)	10389	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Djk		Kalorama Rhyodacite		Igneous (Extrusive)	Extrusive and lacustrine: garnet-bearing rhyodacite ignimbrite, recrystallized; siltstone	Devonian (Late Devonian)	Devonian (Late Devonian)	10390	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dl		Mount Elizabeth Caldera Complex / undifferentiated Mt Elizabeth Caldera Complex		Igneous (Extrusive)	Extrusive, ignimbrite	Devonian (Early Devonian)	Devonian (Early Devonian)	10391	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dmh		Hesket Ignimbrite		Igneous (Extrusive)	Extrusive: rhyolite ignimbrite, welded	Devonian (Late Devonian)	Devonian (Late Devonian)	10392	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dmw		Willimigongong Ignimbrite		Igneous (Extrusive)	Extrusive: biotite-hypersthene rhyodacite ignimbrite, recrystallized	Devonian (Late Devonian)	Devonian (Late Devonian)	10393	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dr	Dvr,Dlvr,Dvrp,Dvra,Dvr	Rocklands Volcanic Group		Igneous (Extrusive)	Extrusive: rhyolite lava, flow banded, ignimbrite	Devonian (Early Devonian)	Devonian (Early Devonian)	10394	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Ds	Ds,Dls,PDSR	Snowy River Volcanic Group		Igneous (Extrusive)	undifferentiated volcanics, sediments, intrusives	Devonian (Early Devonian)	Devonian (Early Devonian)	10395	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsg		Mount Dawson Subgroup		Igneous (Extrusive)	Extrusive, fluvial: felsic ignimbrite, mostly densely welded	Devonian (Early Devonian)	Devonian (Early Devonian)	10396	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsh		Tulloch Ard Ignimbrite		Igneous (Extrusive)	Extrusive: felsic ignimbrite, mostly densely welded	Devonian (Early Devonian)	Devonian (Early Devonian)	10397	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dso		Tara Range Subgroup		Igneous (Extrusive)	Extrusive, ignimbrite, main flow deposits	Devonian (Early Devonian)	Devonian (Early Devonian)	10398	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsz		Unnamed rhyolite lava		Igneous (Extrusive, Intrusive)	Extrusive, intrusive: rhyolite lava, flow-banded to autobrecciated	Devonian (Early Devonian)	Devonian (Early Devonian)	10399	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
Dth	Dvth,Dvt1b	Hollands Creek Rhyodacite	Mount Tambo Group	Igneous (Extrusive)	Extrusive: rhyolite to rhyodacite ignimbrite, welded	Devonian (Late Devonian)	Devonian (Late Devonian)	10400	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dtr	Dvtr,Dvt2	Ryans Creek Rhyolite	Tolmie Igneous Complex	Igneous (Extrusive)	Extrusive: rhyolite ignimbrite, welded to recrystallized	Devonian (Late Devonian)	Devonian (Late Devonian)	10401	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dtt	Dvtt,Dvt3	Toombullup Ignimbrite	Tolmie Igneous Complex	Igneous (Extrusive)	Extrusive: rhyolite and rhyodacite ignimbrite, welded	Devonian (Late Devonian)	Devonian (Late Devonian)	10402	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dxv	Dlv	Unnamed		Sedimentary, Igneous (Non-Marine, Extrusive)	Extrusive/fluvial: rhyolitic ignimbrite, lava, quartzite	Devonian (Early Devonian)	Devonian (Early Devonian)	10403	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dyad	Dvad,Dvc5	Donna Buang Rhyodacite	Acheron Subgroup (Marysville Group)	Igneous (Extrusive)	Extrusive: biotite-hypersthene rhyodacite ignimbrite, recrystallized	Devonian (Late Devonian)	Devonian (Late Devonian)	10404	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dyay	Dvay,Dvc4	Ythan Creek Rhyodacite	Acheron Subgroup (Marysville Group)	Igneous (Extrusive)	Extrusive: rhyolite to rhyodacite ignimbrite, recrystallized	Devonian (Late Devonian)	Devonian (Late Devonian)	10405	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dycl	Dvcl,Dvc3	Lake Mountain Rhyodacite	Cerberean Subgroup (Marysville Group)	Igneous (Extrusive)	Extrusive: rhyolite to rhyodacite ignimbrite, recrystallized	Devonian (Late Devonian)	Devonian (Late Devonian)	10406	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dycr	Dvcr,Dvc2	Rubicon Rhyolite	Cerberean Subgroup (Marysville Group)	Igneous (Extrusive)	Extrusive: rhyolite ignimbrite, recrystallized	Devonian (Late Devonian)	Devonian (Late Devonian)	10407	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dyt	Dvt,Dvc1	Taggerty Subgroup	Marysville Group	Igneous (Extrusive)	Extrusive, fluvial: felsic ignimbrites, basalt and andesite lavas, conglomerate, sandstone	Devonian (Late Devonian)	Devonian (Late Devonian)	10408	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Jc	Jt,Jvc	Coleraine Volcanic Group		Igneous (Extrusive, Intrusive)	Intrusive: sanidine-bearing trachyte lava	Mesozoic (Jurassic)	Mesozoic (Jurassic)	10409	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Jxk	Jvb	Kangaroo Gully Volcanic Breccia		Igneous	Pyroclastic (?) deposits: conglomerate with clasts of monchiquite and clasts of Ordovician and Permian sedimentary rocks	Mesozoic (Jurassic)	Mesozoic (Jurassic)	10410	1126	Undifferentiated Extrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
-Cmg	Cm,Cg,Cm,Cg,GRC	Glenelg River Metamorphic Complex		Metamorphic	Metamorphic: biotite schist, staurolite schist	Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10411	1127	Undifferentiated Metamorphic Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dz		Unnamed Devonian Fault Rocks		Fault	fault rock, cataclasite	Devonian (Early Devonian)	Devonian (Early Devonian)	10412	1127	Undifferentiated Metamorphic Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
H	Duh,Dmh	unnamed hornfels		Metamorphic (Contact)	Metamorphic: hornfels	Devonian (Late Devonian)	Devonian (Middle Devonian)	10413	1127	Undifferentiated Metamorphic Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sog	G175,Sog,OSn,G175, Oapg	Omeo Metamorphic Complex gneiss	Omeo Metamorphic	Metamorphic (Regional)	Metamorphic: gneiss	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10414	1127	Undifferentiated Metamorphic Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sos	Sos,OSs	Omeo Metamorphic Complex schist	Omeo Metamorphic Complex	Metamorphic (Regional)	Metamorphic: schist, spotted schist, phyllite	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10415	1127	Undifferentiated Metamorphic Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Su		Kuark Metamorphic Complex		Metamorphic (Regional)	Metamorphic: biotite schist, spotted schist, phyllite, spotted slate	Ordovician (Early Ordovician)	Ordovician (Early Ordovician)	10416	1127	Undifferentiated Metamorphic Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Sz	Sy	Fault Rock / undifferentiated Silurian (Llandovery)		Fault	mylonite, fault rock	Silurian (Wenlock)	Silurian (Llandovery)	10417	1127	Undifferentiated Metamorphic Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
F	Dud,Dyke3,FELSIC_DYK	Unnamed felsic dyke		Igneous (Intrusive)	Intrusive: felsic dykes	Devonian (Late Devonian)	Devonian (Late Devonian)	10276	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G193	G193	Woolshed Valley Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10277	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G194	G194	Morilla Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10278	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G195	G195	Beechworth Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10279	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G196	G196	Golden Ball Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10280	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G197	G197	Byawatha Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10281	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G198	G198,G198	Everton Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10282	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G199	G199,G199	Murmungee Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10283	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G200		Lurg Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10284	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G201		Kelly Gap Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10285	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G202		Glenrowan Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10286	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G203		Warby Springs Granite		Igneous (Intrusive (Granite S-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10287	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G204		Taminick Gap Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10288	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G205		Mount Bruno Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10289	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G206		Killawarra Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10290	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G207		Almonds Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10291	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G208		Youarang Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10292	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G209	G209,G209	Camview Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10293	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G210		Bungeet West Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10294	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G211		Chesney Vale Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10295	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
G215		Swanpool Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10296	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G216	G216	Barjarg Granite		Igneous (Intrusive (Granite S-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10297	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G286		Commissioners Flat Granodiorite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10298	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G288		Mount Black Granite		Igneous (Intrusive (Granite S-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10299	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G289		Crosbie Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10300	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G290	G294,G294	Harcourt Granodiorite	Harcourt Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Late Devonian)	Devonian (Late Devonian)	10301	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G293		Baringhup Granodiorite	Harcourt Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Late Devonian)	Devonian (Late Devonian)	10302	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G295	G295	Pyramid Hill Granite		Igneous (Intrusive (Granite S-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10303	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G296		Erindale Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10304	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dg	Dlg,Dug,Dmg,Dlt,Dgd	Undifferentiated Devonian granite		Igneous (Intrusive)		Palaeozoic (Devonian)	Palaeozoic (Devonian)	10418	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dp	Dp,Dlp,Dq	Unnamed ring dyke		Igneous (Intrusive)	Intrusive: granite/granodiorite porphyry	Devonian (Early Devonian)	Devonian (Early Devonian)	10419	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Dsy		Unnamed porphyry dykes		Igneous (Intrusive)	Intrusive: porphyry dykes: quartz-feldspar (-hornblende) porphyry	Devonian (Early Devonian)	Devonian (Early Devonian)	10420	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G1		Gabo Island Granite		Igneous (Intrusive (Granite Unassigned))	Intrusive: biotite-amphibole granite, medium to fine grained, pink	Devonian (Early Devonian)	Devonian (Early Devonian)	10421	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G10		Skerries Granite / Skerries		Igneous (Intrusive (Granite Unassigned))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10422	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G101	G101	Koetong Granite		Igneous (Intrusive (Granite S-type))	Two-mica cordierite granite: bluish grey, coarse grained biotite muscovite granite; mostly equigranular but centre is porphyritic and parts of margins are fine grained; locally abundant enclaves; S-type; nonmagnetic	Silurian (Pridoli)	Silurian (Wenlock)	10423	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G102		Thologolong Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10424	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G103	G103	Granya Granite		Igneous (Intrusive (Granite Unassigned))		Silurian (Wenlock)	Silurian (Llandovery)	10425	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G105	G105	Adjie Granodiorite		Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)	Silurian (Llandovery)	10426	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G106	G106	Charlestown Creek Tonalite	Bingo Munjie Suite	Igneous (Intrusive (Granite I-type))	Hornblende-biotite-(pyroxene) quartz diorite: I-type, evenly medium-grained, dark bluish to greenish grey	Devonian (Early Devonian)	Devonian (Early Devonian)	10427	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G108	G108,G108	Eustace Creek Granodiorite		Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)	Silurian (Llandovery)	10428	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G11		Everard Granite / Everard Adamellite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite adamellite	Silurian (Wenlock)	Silurian (Llandovery)	10429	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G110	G110	Banimboola Quartz Monzodiorite	Boggy Plain Supersuite	Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10430	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G111	G111	Mount Wills Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10431	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G113		Post Office Granite	Bingo Munjie Suite (Boggy Plain Supersuite)	Igneous (Intrusive (Granite I-type))	Granite, mainly granite soil; I-type, may be felsic phase of G81	Silurian (Wenlock)	Silurian (Llandovery)	10432	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G1137		Rileys Creek Granodiorite		Igneous(Intrusive(I-type))	Intrusive:	Lower Silurian		10433	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G114		Anglers Rest Granite		Igneous(Intrusive(I-type))	Intrusive: leucocratic granite, medium grained, pink	Lower Devonian		10434	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G114		Anglers Rest Granite	Boggy Plain Supersuite	Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10435	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G115	G115	Taylor Crossing Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10436	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G116		Lower Tableland Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10437	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G117		Connleys Track Granodiorite / Sam Hill		Igneous (Intrusive (Granite Unassigned))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10438	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G12		Tonghi Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende-biotite granodiorite, coarse grained leucocratic	Silurian (Wenlock)	Silurian (Llandovery)	10439	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G120		Marengo Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10440	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G121		Bindi Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: medium to coarse grained, pale grey, granite-granodiorite with cordierite, muscovite	Silurian (Wenlock)	Silurian (Llandovery)	10441	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G122		Forlorn Hope Granite	Bullenbalong Suite	Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10442	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G123		Mount Nugong Tonalite / Mount Nugong		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10443	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G125		Nunniong Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite-cordierite granodiorite, fine to medium grained, grey	Silurian (Wenlock)	Silurian (Llandovery)	10444	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G126		Mount Elizabeth Granodiorite / Mt Elizabeth Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive	Devonian (Early Devonian)	Devonian (Early Devonian)	10445	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G127		Mellick Munjie Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite-cordierite granodiorite, pale grey, coarse-medium grained	Silurian (Wenlock)	Silurian (Llandovery)	10446	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G128		Reedy Flat Tonalite / Eumana (Reedy Flat) Granite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite-hornblende tonalite/quartz diorite, coarse grained, pale grey	Devonian (Early Devonian)	Devonian (Early Devonian)	10447	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G129		Kenny Creek Diorite		Igneous (Intrusive (Granite I-type))	Intrusive	Silurian (Wenlock)	Silurian (Llandovery)	10448	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G13		Tamboon Granite / Tamboon Adamellite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite adamellite	Silurian (Wenlock)	Silurian (Llandovery)	10449	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
G130		Colquhoun Granite		Igneous (Intrusive (Granite I-type))	Intrusive:	Devonian (Early Devonian)	Devonian (Early Devonian)	10450	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G131		Sarsfield Granite / Sarsfield Granite (Clifton Creek)		Igneous (Intrusive (Granite S-type))	Intrusive: biotite-muscovite leucogranite, fine to medium grained, cream-white	Devonian (Late Devonian)	Devonian (Late Devonian)	10451	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G132		Mount Taylor Granite / Mount Taylor Granite Porphyry		Igneous (Intrusive (Granite S-type))	Intrusive: cordierite-garnet granite porphyry, coarsely K-feldspar phyric, mid-grey	Devonian (Late Devonian)	Devonian (Late Devonian)	10452	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G133		Saint Patricks Creek Granite		Igneous (Intrusive (Granite I-type))	Intrusive:	Devonian (Early Devonian)	Devonian (Early Devonian)	10453	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G134		Tambo Crossing Tonalite		Igneous (Intrusive (Granite I-type))	Intrusive:	Devonian (Early Devonian)	Devonian (Early Devonian)	10454	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G135		Connors Creek Tonalite / Ensay Tonalite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende quartz-diorite, medium grained, strongly foliated	Silurian (Wenlock)	Silurian (Llandovery)	10455	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G136		Old Sheep Station Granodiorite / Angora (Old Sheep Station)		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10456	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G137		Rileys Creek Granodiorite		Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)	Silurian (Llandovery)	10457	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G138		Pheasant Creek Granite / Pheasant Creek		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10458	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G139		Mount Baldhead Granite / Mount Baldhead		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10459	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G14		Burglar Gap Granite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite adamellite	Silurian (Wenlock)	Silurian (Llandovery)	10460	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G140		Dargo Granodiorite / Dargo		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10461	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G141		Mount Blomford Granite / Mount Blomford		Igneous (Intrusive (Granite S-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10462	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G142		Castleburn Granite / Castleburn		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10463	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G143		Mungobabba Tonalite / Tongio Gap		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10464	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G148		Halletts Road Tonalite	Polar Star Suite	Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10465	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G15		Noorinbee Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite granodiorite	Silurian (Wenlock)	Silurian (Llandovery)	10466	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G151	G151,G151	East Kiewa Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10467	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G152		Big Hill Quartz Diorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10468	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G153		Niggerheads Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10469	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G154	G154	Pretty Valley Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10470	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G155		Rocky Valley Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10471	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G156	G156	Timms Spur Leucogranite		Igneous (Intrusive)		Palaeozoic (Silurian)		10472	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G158	G158	Mount Selwyn Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10473	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G159	G159	Barry Mountains Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10474	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G16		Drummer Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende granodiorite	Silurian (Wenlock)	Silurian (Llandovery)	10475	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G160	G160	Mount Angus Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10476	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G161	G161	Mount Buffalo Granite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10477	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G162	G162,G162,Dge	Mount Emu Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10478	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G168		Bundara Tonalite		Igneous (Intrusive)		Devonian (Early Devonian)		10479	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G17		Derndang Granite		Igneous (Intrusive (Granite I-type))	Intrusive	Silurian (Wenlock)	Silurian (Llandovery)	10480	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G172	G172	Yabba Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10481	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G173	G173	Lockhart Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10482	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G176		Baranduda Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10483	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G177	G177,G177	Yackandandah Granite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10484	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G18		Yoke Up Creek Granite		Igneous (Intrusive (Granite Unassigned))	Intrusive: biotite (hornblende) granodiorite	Silurian (Wenlock)	Silurian (Llandovery)	10485	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G180	G180	Kergunyah Granite		Igneous (Intrusive (Granite S-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10486	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G182	G182,G182,G182	Barnawatha Gneissic Granodiorite		Igneous (Intrusive (Granite S-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10487	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G183	G183	Mount Stanley Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10488	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G184		Mount Stirling Granodiorite		Igneous (Intrusive (Granite Unassigned))		Devonian (Middle Devonian)	Devonian (Middle Devonian)	10489	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G185		Bindaree Diorite		Igneous (Intrusive (Granite Unassigned))	Intrusive: diorite, gabbro, medium grained, dark green-grey	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10490	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G186		Mirimbah Granodiorite		Igneous(Intrusive((Unassigned)))	Intrusive: hornblende granodiorite, medium to coarse grained	Middle Devonian		10491	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G19		Nungatta Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive	Silurian (Wenlock)	Silurian (Llandovery)	10492	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
G192		Shippen Gully Porphyry		Igneous (Intrusive)	Quartz-feldspar porphyry, strongly porphyritic, phenocrysts of quartz, plagioclase, perthitic orthoclase, biotite and garnet in a fine-grained granoblastic groundmass of quartz, plagioclase and orthoclase, occasional cordierite. Nonmagnetic, S-type.	Palaeozoic (Devonian)	Palaeozoic (Devonian)	10493	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G2		Howe Range Granite		Igneous (Intrusive (Granite Unassigned))	Intrusive: biotite-amphibole adamellite, medium to fine grained	Devonian (Early Devonian)	Devonian (Early Devonian)	10494	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G20		Loomat Granite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite adamellite	Silurian (Wenlock)	Silurian (Llandovery)	10495	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G21		Beehive Granite		Igneous (Intrusive (Granite I-type))	Intrusive: leucocratic adamellite, pinkish	Silurian (Wenlock)	Silurian (Llandovery)	10496	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G217	G217,G217	Strathbogie Granodiorite		Igneous(Intrusive(S-type))	Intrusive: biotite granite, coarse grained porphyritic, with cordierite	Upper Devonian		10497	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G22		Buldah Gap Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende Granodiorite, mottled grey	Silurian (Wenlock)	Silurian (Llandovery)	10498	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G221		Mount Disappointment Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10499	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G222		Glenvale Granodiorite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10500	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G223		Black Range Granodiorite		Igneous (Intrusive (Granite Unassigned))	Intrusive: biotite granodiorite, generally porphyritic	Devonian (Late Devonian)	Devonian (Late Devonian)	10501	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G225		Keppel Creek Granodiorite		Igneous (Intrusive (Granite Unassigned))	Intrusive: microgranodiorite, medium to fine grained saccharoidal, porphyritic	Devonian (Late Devonian)	Devonian (Late Devonian)	10502	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G226	G226	Toole-Be-Wong Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive:	Devonian (Late Devonian)	Devonian (Late Devonian)	10503	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G227	G227	Mount Stinton Granodiorite		Igneous (Intrusive (Granite Unassigned))	Intrusive: biotite granodiorite, medium grained subequigranular	Devonian (Late Devonian)	Devonian (Late Devonian)	10504	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G23	G235	Fiddlers Green Granodiorite		Igneous (Intrusive (Granite Unassigned))	Biotite-minor hornblende granite	Devonian (Early Devonian)	Devonian (Early Devonian)	10505	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G235		Warburton Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite granodiorite, fine grained equigranular, medium grey	Devonian (Late Devonian)	Devonian (Late Devonian)	10506	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G236	G236	Baw Baw Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite-hornblende granodiorite, medium grained, bluish grey	Devonian (Late Devonian)	Devonian (Late Devonian)	10507	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G237		Tanjil Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Devonian (Late Devonian)	Devonian (Late Devonian)	10508	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G238	G238	Toorongo Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite-hornblende granodiorite, medium grained, bluish grey	Devonian (Late Devonian)	Devonian (Late Devonian)	10509	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G239	G239	Tynong Granite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite granite, medium grained, porphyritic, pale grey	Devonian (Late Devonian)	Devonian (Late Devonian)	10510	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G24		Weeragua Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende granodiorite, medium grained, slightly porphritic	Silurian (Wenlock)	Silurian (Llandovery)	10511	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G240		Silvan Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10512	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G241	G241	Lysterfield Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite-hornblende granodiorite, medium grained grey	Devonian (Late Devonian)	Devonian (Late Devonian)	10513	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G25		Cann Mountain Granodiorite / Cann Mountain Granite		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10514	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G251		Cliffy Island		Igneous(Intrusive(S-type))	Intrusive:	Middle Devonian		10515	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G252		Kanowna Island		Igneous (Intrusive (Granite S-type))	Intrusive:	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10516	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G253		Glennie Granite / Glennie Adamellite		Igneous (Intrusive (Granite S-type))	Intrusive: cordierite-biotite adamellite, coarse grained subequigranular	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10517	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G254		Yanakie Granite / Yanakie		Igneous (Intrusive (Granite S-type))	Intrusive:	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10518	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G255		Mount Norgate Granite / Mount Norgate		Igneous (Intrusive (Granite Unassigned))	Intrusive:	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10519	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G256		Lilly Pilly Granite / Lilly Pilly		Igneous (Intrusive (Granite S-type))	Intrusive:	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10520	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G257		Mount Singapore Granite / Mount Singapore Adamellite		Igneous (Intrusive (Granite S-type))	Intrusive: cordierite-biotite adamellite, medium to coarse grained, creamy grey	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10521	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G258		Sealers Cove Granite / Sealers Cove Adamellite		Igneous (Intrusive (Granite S-type))	Intrusive: cordierite-biotite adamellite, fine grained to porphyritic	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10522	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G259		Vereker Granite		Igneous (Intrusive (Granite S-type))	Intrusive: leucocratic granite, medium to coarse grained with garnet and cordierite	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10523	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G26		Blue Gum Tonalite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende tonalite, medium to coarse grained, hornblende phyric	Silurian (Wenlock)	Silurian (Llandovery)	10524	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G260		Wilsons Promontory Granite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite granite, coarse grained porphyritic, with some garnet	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10525	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G261		Woolamai Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10526	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G262		Dromana Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10527	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G263		Mount Martha Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10528	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G264		Mount Eliza Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10529	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G27		Ino Creek Granodiorite / Ino Creek Granite		Igneous (Intrusive (Granite I-type))	Intrusive	Silurian (Wenlock)	Silurian (Llandovery)	10530	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G275		Morang Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10531	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G276		Bulla Granodiorite		Igneous (Intrusive (Granite S-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10532	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G277		You Yangs Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10533	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
G278		Dog Rocks Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10534	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G279		Ingliston Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10535	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G28		Tumberluck Diorite		Igneous(Intrusive(I-type))	Intrusive: hornblende diorite, coarse to medium grained, dark green-grey, foliated	Lower Silurian		10536	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G280		Mount Egerton Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10537	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G282		Barringo Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10538	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G283		Pyalong Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Late Devonian)	Devonian (Late Devonian)	10539	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G284		Baynton Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10540	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G285		Beauvallet Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10541	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G29		Sandpatch Point Granite / Sandpatch Point		Igneous (Intrusive (Granite Unassigned))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10542	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G297		Colbinabbin Diorite		Igneous (Intrusive)	Diorite: highly-magnetic, fine- to medium-grained, subophitic growths of plagioclase and augite.	Palaeozoic (Cambrian)		10543	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G30		O'Mearas Granite / O'Meara's		Igneous (Intrusive (Granite Unassigned))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10544	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G305		Illoura Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10545	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G306		Wallinduc Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10546	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G307		Tiac Granite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10547	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G308		Mount Bute Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10548	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G309		Warrawidgee Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10549	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G31		Maramingo Granite		Igneous(Intrusive(I-type))	Intrusive:	Lower Silurian		10550	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G310		Chepstowe Granodiorite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10551	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G312		Ercildoun Granite		Igneous (Intrusive (Granite I-type))		Devonian (Late Devonian)	Devonian (Late Devonian)	10552	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G321		Lake Boga Granite		Igneous (Intrusive)	Intrusive: two-mica granite; medium to coarse grained; porphyritic	Devonian (Early Devonian)	Devonian (Early Devonian)	10553	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G33		Bee Tree Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: two-mica granodiorite, medium to fine grained, dark grey	Silurian (Wenlock)	Silurian (Llandovery)	10554	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G332	G332	Wycheproof Granite	Glenloth Suite	Igneous (Intrusive (unassigned intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10555	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G333	G333	Hemleys Granite	Glenloth Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10556	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G334		Jeffcott Granite	Glenloth Suite	Igneous (Intrusive (unassigned intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10557	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G335		Teddywaddy Granite	Glenloth Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10558	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G336	G336	Buckrabanyule Granite		Igneous (Intrusive (S-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10559	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G337	G337	Mount Egbert Granite		Igneous (Intrusive (S-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10560	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G34		Goonmirk Rocks Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: mostly hornblende granodiorite, medium grained, moderately foliated	Devonian (Early Devonian)	Devonian (Early Devonian)	10561	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G341	G341,G341,Unk5	Cochranes Creek Granodiorite		Igneous (Intrusive (unassigned intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10562	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G345	G345,G343,G343,G346,G346	Wedderburn Granodiorite	Mount Cole Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10563	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G347	G347	Kooyoora Granite		Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10564	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G349	G349,G349	Rheola Gabbro		Igneous (Intrusive (unassigned intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10565	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G35		Tommy Roundhead Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: two-mica granodiorite and biotite tonalite, variably foliated	Silurian (Wenlock)	Silurian (Llandovery)	10566	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G350	G350	Moliagul Granite		Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10567	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G351	G351,G348,G352,G352	Tarnagulla Granite		Igneous (Intrusive (unassigned intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10568	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G353		Bealiba Granodiorite		Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10569	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G354	G354,G354,G342,G354m	Natte Yallock Granite	Mount Cole Suite	Igneous (Intrusive)		Devonian (Early Devonian)	Devonian (Early Devonian)	10570	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G355	G355,G355m	Dalgenon Granite	Mount Cole Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10571	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G356	G356,G356n	Carapooee Granodiorite	Mount Cole Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10572	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G357	G357,G357n	Kooreh Granite	Mount Cole Suite	Igneous (Intrusive (unassigned intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10573	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G358	G358,G358m	Berrimal Granite	Coonooer Suite	Igneous (Intrusive (unassigned intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10574	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G359		Coonooer Granite	Coonooer Suite	Igneous (Intrusive (S-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10575	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G36		Kanuka Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite granodiorite and adamellite, foliated to strongly rodded	Silurian (Wenlock)	Silurian (Llandovery)	10576	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
G361		Richmond Granite	Coonooer Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10577	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G362	G362,G362	Yeungroon Granite	Coonooer Suite	Igneous (Intrusive (S-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10578	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G363		Wychitella Granite	Mount Cole Suite	Igneous (Intrusive (I-type intrusion))		Devonian (Early Devonian)	Devonian (Early Devonian)	10579	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G365		Tailor Creek Tonalite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10580	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G367		Powncebys Tonalite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10581	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G368		Ben Major Granite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10582	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G37		Ellery Granite / Ellery Adamellite		Igneous (Intrusive (Granite A-type))	Intrusive: biotite-amphibole adamellite, coarse to medium porphyritic	Devonian (Early Devonian)	Devonian (Early Devonian)	10583	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G370		Lexton Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10584	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G371		Mount Lonarch Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10585	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G372		Glenlogie Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10586	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G374		Ben Nevis Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10587	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G375		Eversley Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10588	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G376		Langi Ghiran Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10589	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G377		Buangor Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10590	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G378		Mount Cole Granite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10591	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G379		Stawell Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10592	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G38		Arte Gabbro / Arte Gabbro Complex		Igneous (Intrusive (Granite I-type))	Intrusive: two-pyroxene norite, fine to medium, layered, dark grey to green-black	Silurian (Wenlock)	Silurian (Llandovery)	10593	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G380		Ararat Granodiorite		Igneous (Intrusive (Granite Unassigned))		Devonian (Middle Devonian)	Devonian (Middle Devonian)	10594	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G381		Burrumbeep Granodiorite		Igneous (Intrusive (Granite Unassigned))		Devonian (Middle Devonian)	Devonian (Middle Devonian)	10595	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G383		Dunneworthy Granodiorite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10596	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G384		Hickman Creek Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10597	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G385		Ballyrogan Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10598	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G39		Murrungowar Granodiorite / Murrungowar Adamellite		Igneous (Intrusive (Granite A-type))	Intrusive: biotite adamellite, coarse grained, foliated, S-C foliated	Silurian (Wenlock)	Silurian (Llandovery)	10599	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G395		Bushy Creek Granodiorite		Igneous (Intrusive (Granite I-type))		Palaeozoic (Cambrian)	Palaeozoic (Cambrian)	10600	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G396		Mafeking Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10601	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G397	G397	Epacris Hills Granite	Mafeking Suite	Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10602	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G398		Mackenzie River Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10603	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G399	G399,G399,G400,G401	Victoria Valley Granite	Victoria Valley Batholith	Igneous (Intrusive (Granite A-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10604	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G4		Xmas		Igneous(Intrusive(I-type))	Intrusive:	Lower Silurian		10605	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G40		Enfield Granite		Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)		10606	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G407	G407,Og407	Harrow Granodiorite		Igneous (Intrusive (Granite S-type))		Palaeozoic (Ordovician)	Palaeozoic (Ordovician)	10607	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G408	G408,G408	Nangkita Granite		Igneous (Intrusive (Granite Unassigned))		Palaeozoic (Ordovician)	Palaeozoic (Ordovician)	10608	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G409		Hassalls Creek Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10609	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G41		Tarlton Granite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite tonalite, coarse grained, sheared	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10610	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G42		Cape Conran Granite		Igneous (Intrusive (Granite I-type))	Intrusive: two-mica granite, coarse grained	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10611	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G420	G420	Konong Wootong Granodiorite		Igneous (Intrusive (Granite I-type))		Devonian (Early Devonian)	Devonian (Early Devonian)	10612	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G421	G421	Wando Tonalite		Igneous (Intrusive (Granite I-type))		Palaeozoic (Ordovician)	Palaeozoic (Ordovician)	10613	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G422	G422,G422,G422	St Elmo Granodiorite		Igneous (Intrusive (Granite I-type))		Palaeozoic (Ordovician)	Palaeozoic (Ordovician)	10614	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G423	G423	Ferres Creek Tonalite		Igneous (Intrusive (Granite Unassigned))		Palaeozoic (Ordovician)	Palaeozoic (Ordovician)	10615	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G424	G424,G424	Dergholm Granite		Igneous (Intrusive (Granite A-type))		Palaeozoic (Ordovician)	Palaeozoic (Ordovician)	10616	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G43		Mount Raymond Granite		Igneous (Intrusive (Granite A-type))	Intrusive: riebeckite adamellite/granite, sheared, blue	Devonian (Early Devonian)	Devonian (Early Devonian)	10617	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G44		Orbost Tonalite / Orbost Trondhjemite		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10618	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G45		Jarrahmond Granite / Jarrahmond Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10619	128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

Department of Sustainability and Environment
State Government Victoria

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
G46		Broken Leg Granite / Broken Leg Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10620	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G47		Feltis Farm Tonalite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende tonalite, medium grained to hornblende-phyric	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10621	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G48		Dysentery Tonalite		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10622	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G49		Brodribb Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite granodiorite, medium grained, greyish blue	Silurian (Wenlock)	Silurian (Llandovery)	10623	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G5		Croajingalong Granite / Croajingalong		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Ludlow)	Silurian (Wenlock)	10624	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G50		Goongerah Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende-biotite granodiorite, medium grained, bluish grey	Silurian (Wenlock)	Silurian (Llandovery)	10625	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G501		Yarak Granite		Igneous (Intrusive (Granite I-type))		Palaeozoic (Devonian)	Palaeozoic (Silurian)	10626	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G502		Watchmaker Granodiorite		Igneous (Intrusive (Granite I-type))		Palaeozoic (Devonian)	Palaeozoic (Silurian)	10627	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G505		Scrubby Flat Gabbro		Igneous (Intrusive (Granite Unassigned))		Silurian (Wenlock)	Silurian (Llandovery)	10628	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G506		Mount Jack Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10629	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G507		Kent Road Granodiorite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10630	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G508		Ocean View Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10631	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G509		Rocky Jack Granite		Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)	Silurian (Llandovery)	10632	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G51		Jungle Creek Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite granodiorite, coarse grained, pale to greenish grey	Silurian (Wenlock)	Silurian (Llandovery)	10633	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G512		Cooney Ridge Granodiorite		Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)	Silurian (Llandovery)	10634	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G513		Case Granite		Igneous (Intrusive (Granite I-type))	Intrusive:	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10635	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G514		Mollys Plain Granite		Igneous (Intrusive (Granite I-type))	Intrusive:	Devonian (Middle Devonian)	Devonian (Middle Devonian)	10636	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G52		Bonang Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10637	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G53		Woollybutt Quartz Monzodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: actinolitic quartz monzodiorite, porphyritic, dark green	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10638	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G530		Whitegum Tonalite		Igneous (Intrusive)	Biotite-minor hornblende tonalite	Devonian (Early Devonian)	Devonian (Early Devonian)	10639	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G54		Iona Tonalite		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10640	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G549		Cobungra Granite / Mount Livingstone		Igneous (Intrusive (Granite S-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10641	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G55		Eleven Bob Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10642	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G554		Beloka Gap Granite		Igneous (Intrusive (Granite Unassigned))		Mesozoic (Triassic)		10643	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G56		Double Bull Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10644	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G57		Bete Bolong Granodiorite		Igneous (Intrusive (Granite I-type))		Palaeozoic (Devonian)	Palaeozoic (Silurian)	10645	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G58		Towzer Creek Granite		Igneous (Intrusive (Granite S-type))	Intrusive:	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10646	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G59		Postman Spur Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite-cordierite granodiorite, medium grained, abundant inclusions	Silurian (Wenlock)	Silurian (Llandovery)	10647	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G6		Wangarabell Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: leucocratic hornblende granodiorite medium to coarse grained	Silurian (Wenlock)	Silurian (Llandovery)	10648	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G60		Rodger River Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive: biotite-augite granodiorite, slightly K-feldspar phyric	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10649	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G61		Waratah Flat Granite		Igneous (Intrusive (Granite Unassigned))	Intrusive: two-feldspar hornblende granite, fine grained, porphyritic	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10650	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G62		Bull Run Gap Granite		Igneous (Intrusive (Granite S-type))	Intrusive: felsic biotite adamellite, medium grained	Silurian (Wenlock)	Silurian (Llandovery)	10651	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G65		Mount McLeod Tonalite		Igneous (Intrusive (Granite I-type))	Intrusive: hornblende tonalite, medium grained, green-grey	Palaeozoic (Devonian)	Palaeozoic (Silurian)	10652	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G66		Campbells Knob Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10653	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G67		Cabanandra Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite granodiorite, medium grained, quartz pyhric	Silurian (Wenlock)	Silurian (Llandovery)	10654	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G69		Hobbs Adamellite		Igneous(Intrusive(I-type))	Intrusive: biotite-hornblende adamellite, fine to medium grained	Lower Silurian		10655	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G7		Genoa Peak Granite		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10656	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G70		Dellicknora Granite / Dellicknora Adamellite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite-cordierite adamellite, medium grained, quartz pyhric	Silurian (Wenlock)	Silurian (Llandovery)	10657	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G71		Amboyne Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite-cordierite granodiorite, medium grained, abundant inclusions	Silurian (Wenlock)	Silurian (Llandovery)	10658	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G74		Suggan Buggan Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite-cordierite granodiorite, coarse grained, quartz phyric	Silurian (Wenlock)	Silurian (Llandovery)	10659	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G76		Chilpin Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive: biotite granodiorite, very fine to medium grained	Silurian (Wenlock)	Silurian (Llandovery)	10660	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G77		Barrabilly Granite / Barrabilly Granodiorite		Igneous (Intrusive (Granite Unassigned))	Intrusive: biotite-cordierite adamellite, fine to medium grained, dark grey	Silurian (Wenlock)	Silurian (Llandovery)	10661	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G78		Staggs Creek		Igneous(Intrusive((Unassigned)))	Intrusive:	Lower Silurian		10662	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

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GEOLOGICAL UNITS									HYDROGEOLOGICAL UNITS		AQUIFER		
1:250K_Geol_Code	OLDMAPSYMB	UNIT_NAME	PARENTS	UNIT_DESC	UNIT_LITH	AGEYOUNG	AGEOLD	GU_Code	HGU_code	HGU_Name	Aquif_code	Aquifer Letter	Aquif_Name
G8		Betka Granodiorite		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10663	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G83		Penderlea Granite		Igneous (Intrusive)	Granitic intrusive of uncertain composition: S-type?; weathered granite and granitic soil	Silurian (Wenlock)	Silurian (Wenlock)	10664	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G84		Wattle Grove Granite		Igneous (Intrusive (Granite Unassigned))	Muscovite granite: S-type; foliated, medium-grained, grey; margins rich in metasedimentary enclaves	Silurian (Wenlock)	Silurian (Wenlock)	10665	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G85		Mac Creek Granodiorite		Igneous (Intrusive)	Muscovite granite: S-type; foliated, medium-grained, grey; margins rich in metasedimentary enclaves	Silurian (Wenlock)	Silurian (Wenlock)	10666	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G86	G86,G86,G86	Greggs Granodiorite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10667	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G87	G87,G87	Buckwong Granodiorite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10668	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G88	G88	Butchers Block Granite		Igneous (Intrusive (Granite Unassigned))		Silurian (Wenlock)	Silurian (Llandovery)	10669	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G89	G89	Tom Groggin Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10670	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G9		Wingan Granite		Igneous (Intrusive (Granite I-type))	Intrusive:	Silurian (Wenlock)	Silurian (Llandovery)	10671	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G90	G90,G90,G90,G90,G90	Boebuck Granodiorite	Boggy Plain Supersuite	Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)	Silurian (Llandovery)	10672	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G91		Bunroy Hut Granite		Igneous (Intrusive (Granite I-type))		Silurian (Wenlock)	Silurian (Llandovery)	10673	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G92		Corryong Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10674	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G94		Nariel Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10675	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G95	G95	Wabba Granite		Igneous (Intrusive (Granite S-type))		Silurian (Wenlock)	Silurian (Llandovery)	10676	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic
G96	G96,G96	Burrungabugge Granodiorite		Igneous (Intrusive (Granite I-type))	Hornblende granodiorite: dark green, medium grained; epidote alteration common; I-type; highly magnetic	Devonian (Early Devonian)	Devonian (Early Devonian)	10677	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G98		Mount Mittamatite Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10678	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G99	G99,G99	Pine Mountain Granite		Igneous (Intrusive (Granite Unassigned))		Devonian (Early Devonian)	Devonian (Early Devonian)	10679	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic
Sg		Undifferentiated Silurian granite		Igneous (Intrusive)		Palaeozoic (Silurian)	Palaeozoic (Silurian)	10680	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
TRI	Unk32	Mount Leinster Igneous Complex		Igneous (Extrusive, Intrusive)	Intrusive: granite porphyry, syenites, syenite porphyry	Mesozoic (Triassic)	Mesozoic (Triassic)	10681	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
Unk32		undifferentiated Mount Leinster Igneous Complex		Igneous(Intrusive())	Intrusive: granite porphyry	Triassic		10682	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G218		Trawool Granite		Igneous (Intrusive (Granite S-type))	Intrusive	Devonian (Late Devonian)	Devonian (Late Devonian)	10683	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G219		King Parrot Creek Granodiorite		Igneous (Intrusive (Granite S-type))	Intrusive	Devonian (Late Devonian)	Devonian (Late Devonian)	10684	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G220	G220	Flowerdale Granodiorite		Igneous (Intrusive (Granite Unassigned))	Intrusive	Devonian (Late Devonian)	Devonian (Late Devonian)	10685	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G287	G287	Glenaroua Microgranite		Igneous (Intrusive (Granite S-type))	Intrusive	Devonian (Late Devonian)	Devonian (Late Devonian)	10686	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G315	G315	Tullaroop Granodiorite	Harcourt Suite	Igneous (Intrusive (Granite I-type))	Intrusive	Devonian (Late Devonian)	Devonian (Late Devonian)	10687	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock
G373	Dlg373	Elmhurst Granite	Mount Cole Suite	Igneous (Intrusive (Granite Unassigned))	Intrusive	Devonian (Early Devonian)	Devonian (Early Devonian)	10688	1128	Undifferentiated Intrusive Basement Rocks	114	BSE	Mesozoic and Palaeozoic Bedrock

Appendix B

Outcomes of external reviews of draft layers

Project: Development of State-wide 3D Aquifer Surfaces
Subject: Review of G-MW Layers
Date: 21 December 2011
Location: DPI offices, Tatura

Attendees:

DSE:	Chris McAuley	Steve Chalkley	Simon Baker
G-MW:	Matt Hudson	Meg Humphrys	Karina Joy
GHD:	Paul Bolger	Will Minchin	
DPI:	Bruce Gill	Don Cherry	

Area	Figure	Issues Identified	Action Required	GHD comment
Kiewa	Figure 6	GHD to check that they have all SOBN bores in the statewide strat database ('SSD'). 4 x contouring issues marked to be looked at: - "gap in top of UTQA" x 2 - "UTQA above surface" x 1 - Bedrock above sediment x 1	Advise DSE about SOBN bores Respond to or fix contouring issue	GHD checked with G-MW, received SOBN location and log data (Jan 2012). GHD added location data to the SSD for 31 sites, and added Strat interps for a selection of the 86 sites that did not previously have Strat interps. GHD have corrected overlaps (e.g. UTQA above surface) and interpolation method now better at smoothing surfaces at edge of their extent.
Ovens	Figure 5	Confirm interpretation around Myrtleford	Advise DSE of outcomes	No action required. Bores 83228 ('Myrtleford 9' drought relief bore) and the new bore WRK053285 both show 27m thickness of sands and gravels beneath ~6-13m of black clay, so we are very comfortable that the mapped thickness shown on the Ovens Valley cross-section (Figure 5) in this area is ok.
Yarrawonga to Wodonga	Figure 3	North of Rutherglen - Should be 1 or 2 more sites that intersect Calivil to bedrock	Check and advise DSE of outcome	WRK054555 is the only G-MW SOBN bore GHD had info on in this area at the time. GHD have since interpreted bores WRK054555-6 and WRK054826 (although of the three, only WRK054555 intersects Calivil & bedrock in this area)

Area	*Figure*	*Issues Identified*	*Action Required*	*GHD comment*
Mansfield to Maroopna	Figure 2	GHD to shift section	GHD to shift section line in order to provide a better representation	Yes, GHD to move section line to pass through additional deep bores. More significantly, GHD added Tickell & Humphrys bores to SSD, and sections/surfaces now better controlled through having more deep bores.
Campaspe (Kyneton to Echuca)	Figure 8	LTA - check if Deep Lead is all Calivil or does contain Renmark (e.g. at Elmore).	GHD to make comment to DSE. If the existing interpretations clearly support the current layers, DSE agree that no change is required. However, if this is not supported, then DSE would expect the layers to reflect this.	GHD checked G-MW re: bore IDs at Elmore and checked that these are in database and check litho and strat interp. GHD subsequently added bore data, strat interps and found that: Bore WRK059870 too shallow to confirm presence (or absence) of LTA at this location. Refer to nearby bores, e.g. 62592 which have consistent Renmark Fm interpretations.
		Comment re: where is bottom of the basalt	GHD to check	Due to difficulty in mapping UTB and two horizons of Shepparton Formation (UTQA) in some areas around Barnadown, the basalts are allowed to grade laterally into the UTQA. This is not considered important for management.
			GHD to also check bore 62710 (and surrounding).	62710 and nearby bore 137829 do not show Shepp Fm. GHD used previous mapping extent and did not amend. **Future action**: inspection of bores between these two and WRK017612 (about 4km north) should be carried out to revise UTQA extent.
			Also to address other minor issues noted on Fig 8.	Minor issues should have been addressed in subsequent revisions (through use of 'extent point' method which pins the edge of one layer to the top of the underlying.

Area	*Figure*	*Issues Identified*	*Action Required*	*GHD comment*
Goulburn River	Figure 7	Question over variability in the layers. There are some nominated bores for GHD to have a look at (between Violet Town and Murchison)	GHD to have a look and make comment to DSE GHD to add and interpret new SOBN bores.	GHD have looked at the 'variability' of the layers and will respond to DSE regarding this. However we don't think it an issue. GHD has now interpreted four new SOBN bores WRK017771-2 and WRK053354-5 (near Miepoll/Murchison).
Yarrawonga to Echuca	Figure 4	Check west of bore 127015. Is this real? Confirm 'rise' in UTAF (Calivil)) surface in this area. There are 2 new SOBN bores here. Check that they are in database (Will Minchin has marked this) G-MW have data on NSW bores above the Barmah Forest (I think)	GHD to review and provide comment to DSE GHD to track down more bore data and/or add interps	GHD to check near 127015 (nth of Katamatite). Interpretation has been revised (as it has been for 51050) But surface rise is supported by bores 109566 and 304080. WRK059813-6 and WRK061880 were not in the database supplied - GHD have found location data for each of these except WRK059816 (abandoned), so G-MW to supply location data for this bore, plus lithology logs for all. GHD has added these 5 bores to the SSD and Strat interpreted in each. GHD has added interpretation of SOBN bores 84016 & 84021 (nested) and 88009, plus two new deep NSW bores west of Barmah.
Glenrowan to Mitiamo	Figure 9	Same issue around Rochester with the Renmark (same as Figure 8).	GHD to make comment to DSE.	GHD to check whether Renmark present in Deep Lead. Check shows that there are approximately 20 bores interpreted with LTA (Renmark Fm) in area just west of Rochester (e.g. bore 89656), so have left mapping/interpretation as is.
Echuca to Nyah	Figure 10	Just check that the Aquitard matches up to the West	Noting this for when layers/areas are joined	GHD have noted this point.

Area	*Figure*	*Issues Identified*	*Action Required*	*GHD comment*
Loddon Ballarat to Murray	Figure 1	Look at White Hills Gravel near Bridgewater	See overall White Hills Gravel comment below	Yes, will need to confirm action re: White Hills between DSE and GHD. Work now done by GHD to map WHG within LTA.
Thickness Map for UTAF	Thickness Map for UTAF (Fig 1)	Bedrock high at Torrumbarry (bore 97149)	GHD to check and provide comment to DSE	GHD to check for other local bores. Will report back. No other bores to support or contradict this. We have kept the current interpretation as while this feature seems out of place, bedrock highs like this exist across the riverine plain (e.g. at Pyramid Hill, Lake Boga, Cohuna). The best way to confirm would be to re-drill at this site
		Is Calivil really thinner near Mathoura/north of Barmah?	GHD to investigate.	Area of thin UTAF Calivil supported on VIC side of border by one bore (55938), but further north there is no data in the SSD to support/contradict. Given that it lies in NSW GHD have not pursued further.
			GHD to also address other issues noted on this figure.	-McMahons Rd/Boorhaman – GHD added bore data and Strat interp for WRK053418. -GHD added bore data and Strat interps near Miepoll/Murchison as noted elsewhere in this review doc.
Thickness Map for LTA	Thickness Map for LTA (Fig 1)	Check of G-MW drilling logs around Elmore and Echuca.	GHD to check and provide comment to DSE	No action required. WRK059860-1 bores are only 54m and 16m deep respectively, which is not deep enough to confirm presence of LTA at this location. e.g. SOBN61957 at Echuca has been interpreted as having Renmark Fm at 109mBG. Other nearby bore 102821 interpreted with Renmark at 117 mBG.

Area	***Figure***	***Issues Identified***	***Action Required***	***GHD comment***
Elevation Maps for various layers	Elevation Maps	Check LTA and UTAF at Torrumbarry (to do with bedrock high)	A couple of minor comments on UTQA map to address. Check LTA and UTAF at Torrumbarry (to do with bedrock high) Check LTA at Elmore. Thickness and elev of LTA and UTAF near Mathoura.	-"check interpretation" – this depression in the top of the Shepp Fm surface is based on DEM data. No further action required. -"connect surface system" – I assume this refers to the channels/watercoruses flowing in parallel to each other near Rochester. This mapping is VicMap data and beyond the scope of this project to check (let along fix, albeit I think it is probably correct). See comment regarding Torrumbarry bore above. Until new field data can confirm/deny this, suggest leaving as is. See comment above re: bores at Elmore. Also work is based on SKM's mapping, and seems to be based on good data/science, although it is beyond the scope of this project to re-examine all the previous work. UTAF and LTA elevation based on limited bores at Mathoura (on VIC side) and because this 'anomaly' exists primarily on the NSW side of the border, GHD have not pursued further. Requires addition and interp of NSW bores to SSD to check this.
G-MW Layers	All	Discussion around removing White Hills Gravel outcrops from the Calivil Formation. It was generally agreed that this would improve the contours and layers.	DSE would realistically like this removed and the contours 're-run. However, it is know that this will be a variation and DSE need to be advised of cost and time impact before this is undertaken.	Yes. To confirm action (i.e. what to move WHG to which AQ layer) and then remove from UTAF. Cost to be advised – and work now done.

Review of Grampians Wimmera Mallee Water area ('North West') layers

Project: Development of State-wide 3D Aquifer Surfaces
Subject: Review of NW layers - Friday 03 February 2012
Date: Friday 03 February 2012
Location: AWE office, Adelaide

Attendees:
Scott Evans (AWE)
Yvonne Weir (AWE)
Kate Morrison (GWMW)
Brigid Moriarty (GHD)

Refer GHD doc 31\27999\206445.docx for full meeting minutes

Minute Item (Summary)	Action	DSE Response	Outcome
Background on AWE layer development	New HGU created to facilitate representation of Geera Clay in interleaving regions. New HGU to be confirmed with DSE prior to layer finalisation. As with other mapping areas, GHD/AWE are still determining most appropriate way to deal with uppermost surfaces and negative thickness issues. DSE to be advised.	Is this a new HGU, or has part of an existing HGU been put into another existing HGU that was not previously represented.	This is a new HGU. This, and other new HGUs introduced to represent interleaving regions confirmed with DSE via email correspondence dated 9/2/2012 and as discussed in the meeting between GHD and DSE on 17/2/2012. Refer to main report for the manner in which the upper layer negative thicknesses were addressed.
Inclusion of recent SOBN data from URS report *SOB Refurbishment – West Wimmera* dated 29 November 2011	DSE to advise whether they want this recent drilling data captured and strat DB/NW surfaces updated to include it.	If the drilling data contains lithological logs, then yes it is to be interpreted and incorporated.	This interpretations and lithological descriptions reported by URS were updated to the SSD and used to develop the NW surfaces.
Potential for discrepancies in interpretations	None - to note only	The LTA is to be mapped incorporating the URS data. The zones of high and low permeability within the LTA do not need to	The URS lithological logs were interpreted by considering the existing interpretations of adjacent

Minute Item (Summary)	Action	DSE Response	Outcome
between URS GRA and NW layers due to differences in approach to / purpose of interpretation		be mapped. Overall, the interpretation in the 3D layer project will be consistent with the URS data.	drillholes as provided in the SSD. It is noted that the URS interpreted high and low permeability layer cross sections do not appear to reflect the VAF.
Additional x-sections to be produced	AWE to update sections lines as per marked up map provided by GWMW	Provide cost is agreed in advance.	Agreed between DSE and GHD at meeting held on 17/2/2012 that no further cross sections would be developed.
Avoca SOBN data	GWMW to confirm source of data so assessment can be made as to whether already in strat DB.	If it contains lithological data then it is to be incorporated into the Strat database and included.	Avoca stratigraphic data already contained within SSD. Lithological data not included as outside of project scope.

Review of Southern Rural Water area layers

Project: Development of State-wide 3D Aquifer Surfaces
Subject: Review of SRW Layers – Wednesday 01 February 2012
Date: 1 February 2012
Location: DSE Nicholson St offices

Attendees:
Chris McAuley (DSE)
Terry Flynn (SRW)
Paul Bolger (GHD)
Kate Morrison (GWMW)
Nigel Binney (GWMW)

Refer GHD doc 31\27999\206592.docx for full meeting minutes

Minute Item (Summary)	Action	DSE Response	Outcome
GWMW review	GHD to forward pdf by large file transfer to G-WMW GHD to coordinate meeting with AWE GHD to provide details of the interleaving and layer interleaving to DSE	Nil	All completed. Refer review notes for NW region for specific items addressed for region.
SRW review	Provide SRW with PDF versions of all layers for review	Nil	All PDFs sent to DSE for distribution
	GHD to clarify differences from 2009 mapping with current 3D mapping layers and document in the project report	Nil	Done. Refer Section 6 in report.
	GHD to review representation of complex boundaries at Selwyn Fault	Nil	Done. Findings captured in raster surfaces.
	GHD to recommend layer nomenclature for the basal aquifer in Gippsland basin	Nil	DSE and GHD agreed on nomenclature and representation as per GHD's proposed structure emailed to Chris McAuley on 9/2/2012

Appendix C

3D models (DVD only)

Appendix D

‘Simplified Lithology’ classes

(contents of new SSD table 'SIMPLIFIED_LITHO_CODES')

Simpl_Lith	Abbrev_Lith
	Blank
Asphalt	Asph
Basalt	Basalt
Bedrock (igneous extrusive)	igexBedrock
Bedrock (igneous intrusive)	iginBedrock
Bedrock (metamorphic)	metBedrock
Bedrock (sedimentary)	sedBedrock
Bedrock (undifferentiated)	undiffBedrock
Carbonaceous CLAY	carbClay
Carbonaceous Mudstone	carbMudstone
Carbonaceous Sandstone	carbSandstone
Cemented alluvium	cement
CLAY	Clay
Clay Ironstone	clIronstone
Clayey GRAVEL	clGravel
Clayey MARL	clMarl
Clayey SAND	clSand
Clayey SILT	clSilt
Coal (or Lignite or Wood)	CoalLig
COBBLES	Cobbles
Coral	Coral
Drift	Drift
Fill	Fill
Granite	Granite
GRAVEL	Gravel
Gravelly CLAY	grClay
Gravelly MARL	grMarl
Gravelly MUD	grMud
Gravelly SAND	grSand
Gravelly SILT	grSILT
Ironstone	Ironstone
Ligneous CLAY	LigClay
Ligneous SAND	ligSand
Ligneous Sandy CLAY	LigSaClay
Ligneous SILT	ligSilt
Limestone	Limestone
Marl	Marl
Marlstone	Marlstone

Simpl_Lith	Abbrev_Lith
MUD	Mud
Mudstone	Mudstone
Overburden	Overburden
Peat	Peat
Pebbles	Pebbles
Pebbly CLAY	pbClay
Quartz	Quartz
Quartzite	Quartzite
Reef	Reef
SAND	Sand
Sandstone	Sandstone
Sandy CLAY	saClay
Sandy GRAVEL	saGravel
Sandy MARL	saMarl
Sandy MUD	saMud
Sandy Mudstone	saMudstone
Sandy SHALE	saShale
Sandy SILT	saSilt
Sandy Slate	saSlate
Schist	Schist
Scoria	Scoria
Shale	Shale
Shells/Grit	Shells/Grit
SILT	Silt
Siltstone	Siltstone
Silty CLAY	siClay
Silty GRAVEL	siGravel
Silty MARL	siMarl
Silty Mudstone	siMudstone
Silty SAND	siSand
Slate	Slate
Topsoil	Topsoil
Tuff	Tuff
Unknown	Unknown
Wash	Wash
Weathered bedrock (igneous extrusive)	igexWBR
Weathered bedrock (igneous intrusive)	iginWBR
Weathered bedrock (sedimentary)	sedWBR
Weathered bedrock (undifferentiated)	undiffWBR

Appendix E

Metadata

DATASET NAME: TOP ELEVATION	
Title	State-wide Aquifer Top Elevation
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*
DESCRIPTION	
Abstract	*This State-wide aquifer top elevation raster dataset comprises the top elevation of 15 hydrostratigraphic 'Aquifer' units across the state of Victoria.* *These 15 layers form part of an aquifer based stratigraphical 3D map for the State of Victoria, extending from the top of the youngest Quaternary aquifers to the top of the relevant hydrogeological basement unit (the oldest formations).* *This map is part of Victoria's contribution to groundwater management at a national scale through Bureau of Meteorology to develop the National Groundwater Information System. The fifteen aquifer top elevation layers are based on the approach developed in the 'Victorian Aquifer Framework Nomenclature' (VAF). The sequence of 15 aquifers is detailed below:* - 100QA__topVIC = AQUIFER CODE 100, Quaternary Aquifer, top elevation (mAHD) - 101UTB_topVIC = AQUIFER CODE 101, Upper Tertiary Basalts, top elevation (mAHD) -102UTQAtopVIC = AQUIFER CODE 102, Upper Tertiary-Quaternary Aquifer, top elevation (mAHD) -103UTQDtopVIC = AQUIFER CODE 103, Upper Tertiary-Quaternary Aquitard, top elevation (mAHD) - 104UTAMtopVIC = AQUIFER CODE 104, Upper Tertiary Aquifer -105UTAFtopVIC = AQUIFER CODE 105, Upper Tertiary Aquifer (fluvial), top elevation (mAHD) -106UTD_topVIC = AQUIFER CODE 106, Upper Tertiary Aquitard, top elevation (mAHD) -107UMTAtopVIC = AQUIFER CODE 107, Upper-Mid Tertiary Aquifer, top elevation (mAHD) -108UMTDtopVIC = AQUIFER CODE 108, Upper-Mid Tertiary Aquitard, top elevation (mAHD) - 109LMTAtopVIC = AQUIFER CODE 109, Lower-Mid Tertiary Aquifer, top elevation (mAHD) - 110LMTDtopVIC = AQUIFER CODE 110, Lower-Mid Tertiary Aquitard, top elevation (mAHD) - 111LTA_topVIC = AQUIFER CODE 111, Lower Tertiary Aquifer, top elevation (mAHD) - 112LTBAtopVIC = AQUIFER CODE 112, Lower Tertiary Basalts A (A = probably 'younger than LTA or LMTD'), top elevation (mAHD) across VICTORIA 112LTBBtopVIC = AQUIFER CODE 112, Lower Tertiary Basalts B (B = probably 'older than LTA or LMTD'), top elevation (mAHD) - 113CPS_topVIC = AQUIFER CODE 113, Cretaceous and Permian Sediments, top elevation (mAHD) - 114BSE_topVIC = AQUIFER CODE 114, Palaeozoic and Cretaceous Basement, top elevation (mAHD) The 15 surfaces forming part of the aquifer-based stratigraphical 3D map of Victoria provide a consistent and standardised approach to the state-wide management of groundwater. Among its applications are defining the (lateral and vertical) boundaries of Groundwater Management Units and supporting groundwater extraction license applications, as well as being an educational tool with respect to the conceptualisation of groundwater systems

Search Word(s)	Geology, Hydrogeology, Groundwater
Geographic Extent Name(s)	*NA*
Geographic Extent Polygon(s)	North Bounding Latitude: -34.9, South Bounding Latitude: -39.1 *West Bounding Longitude: 140.6, East Bounding Longitude: 150.0*
DATA CURRENCY	
Begin Date	1/06/2012
End Date	Current
DATASET STATUS	
Progress	Complete
Maintenance & Update Frequency	As required
ACCESS	
Stored Data Format	DIGITAL Raster. Cell size: 100 m
Available Format Type	
Access Constraint	
DATA QUALITY	
Data Originality	Derived
	These 15 State-wide surfaces were created from existing information, manual hydrogeological assessment of data, professional hydrogeological judgement and a series of automated scripts. In the process of creating these surfaces a number of quality assurance measures were implemented including topologic and hydrogeological reviews. The primary data sources for the creation of these surfaces include databases and previous mapping: - DSE State-wide Stratigraphic Database (SSD) containing approximately 20,000 interpreted bores. - National Groundwater Information System (NGIS): set of groundwater bore location information as well as lithology data. - Outcrop Geology mapping (DPI): adopted from the 1:250k geology mapsheets produced by Victorian Geological Survey. -Southern Rural Water (SRW) Mapping project: raster layers previously produced for the southern parts of Victoria that are managed by SRW. These layers covered the on-shore segments of the Otway, Port Phillip and Gippsland Basins. - Department of Primary Industries (DPI) crystalline basement surface. - A state-wide Digital Elevation Model (DEM) with a 100 m grid (converted from the DSE's 20 m DEM) was used to represent natural surface elevation. The DEM was extended into SA and NSW for completeness using SRTM data).

Lineage	– Latrobe Valley Coal Model: used to provide a framework for the hydro-stratigraphy in the western part of the Gippsland Basin. The State-wide set of aquifer surfaces were developed from data analysed separately in five regions: 'North-East', 'North West', Otway Basin, Port Philip Basin and Gippsland Basin. These regions reflect the different geology, structure, status of existing mapping and current groundwater management arrangements. Refer to GHD project 31/27999 (GHD and AWE, 2012).
Positional Accuracy	There is no valid measurement of 'accuracy' due to this dataset having been derived from a group of datasets of varying and not always known accuracy. The aquifer extents have been derived from VIC Geol Survey 1:250k outcrop geology mapping, as well as from a variety of bore data. Bore data has a variable positional accuracy: observation bores have quite accurate records, while some D&S bores (if used) have poor accuracy.
Attribute Accuracy	Shown on Prediction Error Plot
Logical Consistency	Has been reviewed by independent reviewer for topological consistency between the aquifer layers, and has passed these checks.
Completeness	Coverage: complete Classification: complete Verification: complete
CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
Contact Organisation	Department of Sustainability & Environment (Groundwater Resource Assessment and Planning)
Contact Position	TBD
Mail Address 1	PO Box 500
Mail Address 2	
Suburb or Place or Locality	East Melbourne
State or Locality 2	Victoria
Country	Australia
Postcode	3002
Telephone	
Facsimile	
Electronic Mail Address	Chris.McAuley@dse.vic.gov.au Jill.McNamara@dse.vic.gov.au
METADATA DATE	
Metadata Date	9-May-12
ADDITIONAL METADATA	
Additional Metadata	Additional metadata is available from GHD project 31/27999 (GHD and AWE, 2012).

DATASET NAME: BOTTOM ELEVATION	
Title	State-wide Aquifer Bottom Elevation
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*
DESCRIPTION	
Abstract	*This State-wide aquifer bottom elevation dataset comprises the bottom elevation of 14 of the 15 hydrostratigraphic 'Aquifer' units across the state of Victoria. These 15 layers form part of an aquifer based stratigraphical 3D map for the State of Victoria, extending from the top of the youngest Quaternary aquifers to the top of the relevant hydrogeological basement unit (the oldest formations). This map is part of Victoria's contribution to groundwater management at a national scale through Bureau of Meteorology to develop the National Groundwater Information System. The sequence of 15 aquifers is detailed below:* *- '100QA__botvic', comprising the bottom of Quaternary Aquifer (AQUIFER CODE 100);* *- '101UTB_botvic', comprising the bottom of the Upper Tertiary Basalts (AQUIFER CODE 101);* *-'102UTQAbotvic', comprising the bottom of the Upper Tertiary-Quaternary Aquifer (AQUIFER CODE 102);* *- '103UTQDbotvic', comprising the Upper Tertiary-Quaternary Aquitard (AQUIFER CODE 103);* *- '104UTAMbotvic', comprising the bottom of the Upper Tertiary Aquifer (marine) (AQUIFER CODE 104);* *- '105UTAFbotvic', comprising the bottom of the Upper Tertiary Aquifer (fluvial) (AQUIFER CODE 105);* *- '106UTD_botvic', comprising the bottom of the Upper Tertiary Aquitard (AQUIFER CODE 106);* *- '107UMTAbotvic', comprising the bottom of the Upper-Mid Tertiary Aquifer (AQUIFER CODE 107);* *- '108UMTDbotvic', comprising the bottom of the Upper-Mid Tertiary Aquitard (AQUIFER CODE 108);* *- '109LMTAbotvic', comprising the bottom of the Lower-Mid Tertiary Aquifer (AQUIFER CODE 109),* - '110LMTDbotvic', comprising the bottom of the Lower-Mid Tertiary Aquitard (AQUIFER CODE 110); - '111LTA_botvic', comprising the bottom of the Lower Tertiary Aquifer (AQUIFER CODE 111); - '112LTBAbotvic', comprising the bottom of the Lower Tertiary Basalts A (A = probably 'younger than LTA or LMTD') (AQUIFER CODE 112); '112LTBBbotvic ', comprising the bottom of the Lower Tertiary Basalts B (B = probably 'older than LTA or LMTD') (AQUIFER CODE 112); - '113CPS_botvic', comprising the bottom of the Cretaceous and Permian Sediments (AQUIFER CODE 113). - no bottom elevation produced for Aquifer 114 – BSE) *The 15 surfaces forming part of the aquifer-based stratigraphical 3D map of Victoria provide a consistent and standardised approach to the state-wide management of groundwater. Among its applications are defining the (lateral and vertical) boundaries of Groundwater Management Units and supporting groundwater extraction license applications, as well as being an educational tool with respect to the conceptualisation of groundwater systems.*

Search Word(s)	Geology, Hydrogeology, Groundwater
Geographic Extent Name(s)	*NA*
Geographic Extent Polygon(s)	North Bounding Latitude: -34.9, South Bounding Latitude: -39.1 *West Bounding Longitude: 140.6, East Bounding Longitude: 150.0*
DATA CURRENCY	
Begin Date	1/06/2012
End Date	Current
DATASET STATUS	
Progress	Complete
Maintenance & Update Frequency	As required
ACCESS	
Stored Data Format	DIGITAL Raster. Cell size 100 m
Available Format Type	
Access Constraint	
DATA QUALITY	
Data Originality	Derived
Lineage	The Bottom Elevation surfaces were derived from the State-wide Aquifer Top Elevation set of surfaces. Processing method: The bottom of each aquifer is derived from the top elevation surface of the aquifer or aquifers immediately below. Refer to GHD project 31/27999 (GHD and AWE, 2012).
Positional Accuracy	There is no valid measurement of 'accuracy' due to this dataset having been derived from a group of datasets of varying and not always known accuracy.
Attribute Accuracy	Shown on Prediction Error Plot
Logical Consistency	Has been reviewed by independent reviewer for topological consistency between the aquifer layers, and has passed these checks.
Completeness	Coverage: complete Classification: complete Verification: complete

CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
Contact Organisation	Department of Sustainability & Environment
Contact Position	TBD
Mail Address 1	PO Box 500
Mail Address 2	
Suburb or Place or Locality	East Melbourne
State or Locality 2	Victoria
Country	Australia
Postcode	3002
Telephone	
Facsimile	
Electronic Mail Address	
METADATA DATE	
Metadata Date	9-May-12
ADDITIONAL METADATA	
Additional Metadata	Additional metadata is available from GHD project 31/27999 (GHD and AWE, 2012).

DATASET NAME: AQUIFER EXTENT	
Title	State-wide Aquifer Extent
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*
DESCRIPTION	
Abstract	*The Aquifer Extent polygon layer defines the lateral boundary of the Victorian Aquifer Framework (VAF) Aquifers and Aquitards.* *It defines each aquifer area, both outcrop and subcrop, to be later combined into a 'seamless' layer for the entire state*
Search Word(s)	Geology, Hydrogeology, Groundwater
Geographic Extent Name(s)	*NA*
	Datum WGS84
Geographic Extent Polygon(s)	North Bounding Latitude: -34.9, South Bounding Latitude: -39.1
	West Bounding Longitude: 140.6, East Bounding Longitude: 150.0
DATA CURRENCY	
Begin Date	1/06/2012
End Date	Current
DATASET STATUS	
Progress	Complete
Maintenance & Update Frequency	As required
ACCESS	
Stored Data Format	Vector- Polygon.
Available Format Type	
Access Constraint	

DATA QUALITY	
Data Originality	Derived
Lineage	These aquifer extents were based on outcrop geology mapped by the Victorian Geological Survey Mapping (1:250,000). The extents may have been added to or modified after hydrogeological assessment, changes made to the VAF or changes supported by bore data from DSE's State-wide Stratigraphic Bore database. Refer to GHD project 31/27999 (GHD and AWE, 2011-12).
Positional Accuracy	There is no valid measurement of 'accuracy' due to this dataset having been derived from a group of datasets of varying and not always known accuracy. The aquifer extents have been derived from VIC Geol Survey 1:250k outcrop geology mapping, as well as from a variety of bore data. Bore data has a variable positional accuracy: observation bores have quite accurate records, while some D&S bores (if used) have poor accuracy.
Attribute Accuracy	Not applicable
Logical Consistency	Not known
Completeness	Coverage: complete Classification: complete Verification: complete
CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
Contact Organisation	Department of Sustainability & Environment (Groundwater Resource Assessment and Planning)
Contact Position	TBD
Mail Address 1	PO Box 500
Mail Address 2	
Suburb or Place or Locality	East Melbourne
State or Locality 2	Victoria
Country	Australia
Postcode	3002
Telephone	
Facsimile	
Electronic Mail Address	Chris.McAuley@dse.vic.gov.au Jill.McNamara@dse.vic.gov.au
METADATA DATE	
Metadata Date	9-May-12
ADDITIONAL METADATA	
Additional Metadata	Additional metadata is available from GHD project 31/27999 (GHD and AWE, 2012).

DATASET NAME: CONTOURS

Title	Aquifer Top Elevation Contours
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*
DESCRIPTION	
Abstract	*These polyline contour datasets represent the top elevation contours for the relevant Victorian Aquifer Framework (VAF) Aquifers and Aquitards across the state.* *The contours were created as an intermediate step in the interpolation of the aquifer top elevation raster, and can be used a starting point for future revision to the state-wide mapping data*
Search Word(s)	Geology, Hydrogeology, Groundwater
Geographic Extent Name(s)	*NA*
Geographic Extent Polygon(s)	*Datum WGS84* North Bounding Latitude: -34.9, South Bounding Latitude: -39.1 *West Bounding Longitude: 140.6, East Bounding Longitude: 150.0*
DATA CURRENCY	
Begin Date	1/06/2012
End Date	Current
DATASET STATUS	
Progress	Complete
Maintenance & Update Frequency	As required
ACCESS	
Stored Data Format	Vector- Polyline
Available Format Type	
Access Constraint	

DATA QUALITY	
Data Originality	Derived
Lineage	The contours were based on previous hydrogeological mapping or 'hand-contoured' from bore data (held by DSE's State-wide Stratigraphic Database) and then merged and re-interpolated along with bore data and outcrop points to create a state-wide raster of the top elevation for each VAF Aquifer. Refer to GHD project 31/27999 (GHD and AWE, 2012).
Positional Accuracy	There is no valid measurement of 'accuracy' due to this dataset having been derived from a group of datasets of varying and not always known accuracy. The aquifer extents have been derived from VIC Geol Survey 1:250k outcrop geology mapping, as well as from a variety of bore data. Bore data has a variable positional accuracy: observation bores have quite accurate records, while some D&S bores (if used) have poor accuracy.
Attribute Accuracy	Shown on Prediction Error Plot
Logical Consistency	Not known
Completeness	Coverage: complete Classification: complete Verification: complete
CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
Contact Organisation	Department of Sustainability & Environment (Groundwater Resource Assessment and Planning)
Contact Position	TBD
Mail Address 1	PO Box 500
Mail Address 2	
Suburb or Place or Locality	East Melbourne
State or Locality 2	Victoria
Country	Australia
Postcode	3002
Telephone	
Facsimile	
Electronic Mail Address	Chris.McAuley@dse.vic.gov.au Jill.McNamara@dse.vic.gov.au
METADATA DATE	
Metadata Date	9-May-12
ADDITIONAL METADATA	
Additional Metadata	Additional metadata is avaiable from GHD project 31/27999 (GHD and AWE, 2012).

DATASET NAME: DEM

Title	State-wide Digital Elevation Model
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*

DESCRIPTION

Abstract	*This State-wide digital elevation dataset (DEM) represents a 100 metre grid of the natural surface elevation. This dataset was created as part of the aquifer-based stratigraphical 3D map of Victoria.* *This DEM was used to interpolate and populate the top elevation raster in areas where the relevant geology outcrops.*
Search Word(s)	Geology, Hydrogeology, Groundwater, Topography
Geographic Extent Name(s)	*NA*
Geographic Extent Polygon(s)	*Datum WGS84* North Bounding Latitude: -34.9, South Bounding Latitude: -39.1 *West Bounding Longitude: 140.6, East Bounding Longitude: 150.0*

DATA CURRENCY

Begin Date	1/06/2012
End Date	Current

DATASET STATUS

Progress	Complete
Maintenance & Update Frequency	Not Planned

ACCESS

Stored Data Format	Raster. Cell size: 100 m
Available Format Type	
Access Constraint	

DATA QUALITY	
Data Originality	Derived
Lineage	This state-wide Digital Elevation Model was created from DSE's 20 m DEM, it was converted to a 100 m grid, and edited to include the pit floor of the Latrobe Valley mines. At the margins of the mapping boundaries, where the DEM extends into Southern Australia and New South Wales, 90m data (resampled to 100 m cells) from SRTM was incorporated into this DEM.
Positional Accuracy	There is no valid measurement of 'accuracy' due to this dataset having been derived from a group of datasets (see lineage) which are of varying a accuracy.
Attribute Accuracy	Not relevant
Logical Consistency	Not known
Completeness	Coverage: complete Classification: complete Verification: complete

CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
Contact Organisation	Department of Sustainability & Environment (Groundwater Resource Assessment and Planning)
Contact Position	TBD
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METADATA DATE	
Metadata Date	9-May-12

ADDITIONAL METADATA	
Additional Metadata	Additional metadata is available from GHD project 31/27999 (GHD and AWE, 2012).

DATASET NAME: FAULTS VIC	
Title	Geologic Faults
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*
DESCRIPTION	
Abstract	*This polyline geologic faults dataset represents the significant faults currently identified and published in the area. The dataset does not represent all the faults present in reality.* *These faults were used for the interpolation of the top elevation of 15 hydrostratigraphic 'Aquifer' units across the state of Victoria.which form part of an aquifer based stratigraphical 3D map for the State of Victoria, extending from the top of the youngest Quaternary aquifers to the top of the relevant hydrogeological basement unit (the oldest formations).*
Search Word(s)	Geology, Hydrogeology, Groundwater
Geographic Extent Name(s)	*NA*
Geographic Extent Polygon(s)	*Datum WGS84* North Bounding Latitude: -34.9, South Bounding Latitude: -39.1 *West Bounding Longitude: 140.6, East Bounding Longitude: 150.0*
DATA CURRENCY	
Begin Date	1/06/2012
End Date	Current
DATASET STATUS	
Progress	Complete
Maintenance & Update Frequency	As required
ACCESS	
Stored Data Format	Vector. Polyline. Scale: 1:100,000
Available Format Type	
Access Constraint	

DATA QUALITY	
Data Originality	Derived
Lineage	These faults have been carried through from previous hydrogeologic mapping work done for the Department of Sustainability and Environment and the Rural Water Corporations, or based upon Victorian Geological Survey mapping and bore data from DSE's Stratigraphic Bore Database.
Positional Accuracy	The faults in this dataset have been based on GSV 1:250k mapping (i.e. generally accurate to 1:250,000), however some are based on bore data, which is of variable spatial accuracy.
Attribute Accuracy	Not relevant
Logical Consistency	Not known
Completeness	Coverage: complete Classification: complete Verification: complete

CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
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METADATA DATE	
Metadata Date	9-May-12

ADDITIONAL METADATA	
Additional Metadata	Additional metadata is available from GHD project 31/27999 (GHD and AWE, 2012).

DATASET NAME: SIMPLIFIED LITHOLOGY	
Title	Simplified Lithology Grid
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*
DESCRIPTION	
Abstract	*The simplified lithology grids are raster datasets containing interpreted lithology classes. A lithology raster is available for each of the 'Aquifer' surfaces present within the Port Phillip/Western Port parts of the aquifer based stratigraphical 3D map of Victoria*
Search Word(s)	Geology, Hydrogeology, Groundwater
Geographic Extent Name(s)	*Port Phillip and Western Port Basins*
Geographic Extent Polygon(s)	*Datum WGS84* North Bounding Latitude: -37.2, South Bounding Latitude: -39.1 *West Bounding Longitude: 144.1, East Bounding Longitude: 146.1*
DATA CURRENCY	
Begin Date	1/06/2012
End Date	Current
DATASET STATUS	
Progress	Complete
Maintenance & Update Frequency	As required
ACCESS	
Stored Data Format	Raster. Cell size: 100 m
Available Format Type	
Access Constraint	

DATA QUALITY	
Data Originality	Derived
Lineage	The simplified lithology grids were interpolated from interpreted borehole information contained in the DSE's State-wide Stratigraphic Database. This database contains approximately 20,000 boreholes with stratigraphic interpretations, as well as material descriptions for most of the borehole logs. The lithological descriptions provided by drillers and geologists for downhole intervals in bore logs were reclassified into one of ~80 'simplified lithology' classes. Each lithology type was assigned a lithology rating (analogous to hydraulic conductivity) and was then interpolated to create continuous surfaces for each of the Victorian Aquifer layers present within the Port Phillip and Western Port Basins. More information about the stratigraphical 3D map of Victoria available in the metadata files of the 'Aquifer Top Elevation' datasets. Refer to GHD project 31/27999 (GHD and AWE, 2012).
Positional Accuracy	There is no valid measurement of 'accuracy' due to this dataset having been derived from a group of datasets of varying and not always known accuracy. The aquifer extents have been derived from VIC Geol Survey 1:250k outcrop geology mapping, as well as from a variety of bore data. Bore data has a variable positional accuracy: observation bores have quite accurate records, while some D&S bores (if used) have poor accuracy.
Attribute Accuracy	Approximate. This dataset has been created using approximate values of hydraulic conductivity to represent the general lithology or 'aquifer potential' of each aquifer. These are not based on field testing.
Logical Consistency	Not known
Completeness	Coverage: complete Classification: complete Verification: complete
CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
Contact Organisation	Department of Sustainability & Environment (Groundwater Resource Assessment and Planning)
Contact Position	TBD
Mail Address 1	PO Box 500
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METADATA DATE	
Metadata Date	9-May-12
ADDITIONAL METADATA	
Additional Metadata	Additional metadata is available from GHD project 31/27999 (GHD and AWE, 2012).

DATASET NAME: ERROR PLOT	
Title	State-wide Error Plot for Aquifer Top Elevation
Custodian	*Department of Sustainability and Environment*
Jurisdiction	*Victoria*
DESCRIPTION	
Abstract	*The error plots rasters represent the possible error margin (i.e. +/- xx m) at each point on each of the 15 predicted Victorian aquifer surfaces. The error plot raster form part of an aquifer-based stratigraphical 3D map for the State of Victoria, extending from the top of the youngest Quaternary aquifers to the top of the relevant hydrogeological basement unit (the oldest formations). This map is part of Victoria's contribution to groundwater management at a national scale through Bureau of Meteorology to develop the National Groundwater Information System.*
Search Word(s)	Geology, Hydrogeology, Groundwater
Geographic Extent Name(s)	*NA*
Geographic Extent Polygon(s)	*Datum WGS84* North Bounding Latitude: -34.9, South Bounding Latitude: -39.1 *West Bounding Longitude: 140.6, East Bounding Longitude: 150.0*
DATA CURRENCY	
Begin Date	1/06/2012
End Date	Current
DATASET STATUS	
Progress	Complete
Maintenance & Update Frequency	As required
ACCESS	
Stored Data Format	Raster. Cell size: 100 m
Available Format Type	
Access Constraint	

DATA QUALITY	
Data Originality	Derived
Lineage	The variogram and subsequent error plots have been produced by considering only bore data and geological outcrop elevation. The error is a function of the variance within the dataset (i.e. if the dataset has high random variability then there is more uncertainty in the extrapolation between points) and bore density (the scatter in the variogram used to produce the predicted surfaces generally increases with distance meaning that there is greater uncertainty and hence an increased error margin the further the bores are apart). Refer to GHD project 31/27999 (GHD and AWE, 2012).
Positional Accuracy	There is no valid measurement of 'accuracy' due to this dataset having been derived from a group of datasets of varying and not always known accuracy. The aquifer extents have been derived from VIC Geol Survey 1:250k outcrop geology mapping, as well as from a variety of bore data. Bore data has a variable positional accuracy: observation bores have quite accurate records, while some D&S bores (if used) have poor accuracy.
Attribute Accuracy	Not Applicable
Logical Consistency	Not known
Completeness	Coverage: complete Classification: complete Verification: complete
CONTACT INFORMATION (DSE will fill out once a custodian is agreed)	
Contact Organisation	Department of Sustainability & Environment (Groundwater Resource Assessment and Planning)
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METADATA DATE	
Metadata Date	9-May-12
ADDITIONAL METADATA	
Additional Metadata	Additional metadata is available from GHD project 31/27999 (GHD and AWE, 2012).

Appendix F

Mapping products (DVD only)

GHD

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B.Moriarty W.Minchin S.Evans	M.Mozina	[signature]	M.Mozina	[signature]	18/5/2012