Australian Hydrological Geospatial Fabric (Geofabric)

Product Guide

Geofabric Surface Cartography
Geofabric Surface Network
Geofabric Surface Catchments
Geofabric Hydrology Reporting Catchments
Geofabric Hydrology Reporting Regions

Version 3.0 – 2015

Australian Government
Bureau of Meteorology

Water Information
DATA · INFORMATION · INSIGHT

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Table of Contents

List of Tables

List of Figures

1 General information

The intent of this document is to inform the user about the components of Geofabric V3 Products, their foundation data inputs and how they are transformed to create derived data products.

1.1 Bureau of Meteorology – role in water information

The Bureau of Meteorology (the Bureau) is responsible for compiling and delivering comprehensive water information across the water sector. As part of the Water for the Future initiative (see www.environment.gov.au/water/australia/index.html), the Bureau was allocated $450 million by the Australian Government to administer the Improving Water Information Program. This program accurately monitors, assesses and forecasts the availability, condition and use of Australia's water resources. To achieve this, the Bureau is working with water managers, project partners and stakeholders across Australia to deliver high quality, national water information to government, industry and the community.

The Bureau has built the Australian Water Resources Information System (AWRIS) to provide high quality water information essential to managing Australia's valuable water resources.

AWRIS is spatially enabled using the Geofabric, providing a spatial framework for discovering, querying, reporting and modelling water information.

The Geofabric is a specialised set of spatial features within a Geographic Information System (GIS) platform that registers the spatial relationships between important hydrologic features such as rivers, lakes, water storages, monitoring points, aquifers and catchments.

The spatial dimensions of these surface hydrological features and how they are related show how water is stored, transported and used through the landscape.

The vision for the Geofabric is based on similar implementations, such as the National Hydrography Dataset plus (NHDPlus) in the United States (US) which is an integrated suite of application-ready hydrological geospatial data (Horizon Systems 2008). This vision has been realised with Geofabric phases 1 and 2, with phase 3 delivering improved resolution products that meet a wider range of user needs.

1.1.1 The Water Act 2007

The *Water Act 2007* came into effect on 3 March 2008 and gave the Bureau specific powers and obligations regarding water information in addition to its weather and climate functions under the *Meteorology Act 1955*.

The Bureau's statutory functions related to water information include:

- issuing national water information standards
- collecting and publishing water information
- conducting regular national water resources assessments
- publishing an annual National Water Account
- providing regular water availability forecasts
- advising on matters relating to water information
- enhancing understanding of Australia's water resources.

1.2 Project partners

The Geofabric is an ongoing project which is the result of considerable effort and consultation by several agencies, both within Australia and internationally. The project is being led by the Bureau in partnership with Geoscience Australia (GA), the Australian National University Fenner School of Environment and Society (ANU) and CSIRO Land and Water Flagship (CSIRO).

The partnership provides a collaborative mechanism for obtaining foundation hydrological data, maintaining and upgrading the data and improving the product suite over time. These activities are guided by industry best practice, then tested and made operational through research and development. The Bureau wishes to acknowledge the contributions of agencies in the continuing effort to develop and improve the Geofabric.

1.3 Licensing and conditions of use

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Geofabric products should be attributed as follows:

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1.4 Feedback

The Bureau welcomes feedback on any aspect of this product or its services. Please direct your comments or queries regarding this document or the associated data via email: ahgf@bom.gov.au

1.5 Release versioning

Versioning will follow a **Version X.Y.Z** protocol where X represents a major version release, Y represents a minor version release and Z represents a sub-minor version.

Major version – involves major changes to data scale or resolution, or updates that require significant changes to the database schema. This excludes maintenance of existing data.

Minor version – involves minor changes to the database that requires changes to the schema, including addition of new feature classes and feature types which don't significantly affect previous database functionality.

Sub-minor version – involves amendments to existing data (e.g. attribute correction) or the addition of single data entities within existing feature classes and other minor changes. The sub-minor version does not involve changes to the database schema.

1.6 Delivery phases

The Geofabric is a ten-year project that has evolved in phases:

Phase 1

- Geofabric V1.0 was released in October 2010.

Phase 2

- Geofabric V2.0 was released in November 2011.
- Geofabric V2.0.1 was released in December 2011.
- Geofabric V2.1 was released in September 2012
- Geofabric V1.5.0 Sample Toolset was released in April 2014
- Geofabric V2.1.1 was released in August 2014
- Subsequent Geofabric Phase 2 releases as required in parallel with Phase 3, until a National Phase 3 product is available.
- Geofabric V1.6.0 Sample Toolkset was released in March 2015

Phase 3

- Geofabric V3 iterative drainage division releases,with initial release of Pilbara-Gascoyne drainage division on 30 June 2015.
- National Version 3.Y.Z release at the culmination of Phase 3, planned for mid-2017

2 Geofabric V3 release notes

2.1 Introduction

2.1.1 General information

This section provides release notes to guide the use and adoption of the Geofabric V3.0 by describing the major differences between Phase 2 (Version 2.1.1) and Phase 3 (V3.0) Geofabric data products.

2.1.2 Differences between Phase 2 and Phase 3 Geofabric Product

As V3.0 data is being released as individual drainage divisions, each drainage division release will include features only within the extent of that drainage division. Phase 2 products provide a national coverage, which include features within the extent of Australia's coastline.

Phase 3 Geofabric products are based on improved multi-scale (1:25,000-1:250,000)mapped features and the 1 second digital elevation model (DEM), providing users with greatly improved catchment areas that better reflect the reality of regional catchment boundaries.

Phase 3 provides improved resolution and increased numbers of mapped features including rivers, lakes, water tanks and dams. Some features types and attribution will not initially be available.

Phase 2 products are based 1:250,000 mapped features and the 9 second DEM.

Phase 3 drainage division releases will not include a Groundwater Cartography product. When a National Phase 3 Geofabric is realised, it will include a Groundwater product. Groundwater data will be updated in Phase 2 products in parallel to Phase 3 drainage division releases.

Table 1 explains the major differences between V2.1.1 and V3.0 products.

Table 1 – Major differences between V2.1.1 and V3.0 products

Product	Phase 3 Differences
Surface Network (SH_Network)	The addition of a standalone AHGFGhostNodes feature class that represents stream gauge monitoring points and associated attribution on AHGF Network Streams, and not including them in the AHGF Network Node feature class. These monitoring point Ghost Node features are still built into the SH_Network Geometric network, enabling them to still be traced. These points have also been attributed as a Contracted Node. In V2.1.1 they are included as features in AHGFNetwork Node and require a look up table (LUT) to be joined to utilise monitoring point attribution.
Surface Cartography (SH_Cartography)	New MonitoringPoint feature class representing source location of stream gauge monitoring points. No Features in feature classes AHGFEstuary, AHGFSea and AHGFTerrainBreakLine. No AHGFStructure features currently representing bridges, fords or locks
Surface Catchments (SH_Catchments)	The NCBPfafstetter table attribution is incomplete with this release and doesn't contain any data relating to pfafstetter coding.
Hydrology Reporting Regions (HR_Regions)	AWRA Drainage Division feature class will only include one feature representing the specific drainage division release

	Similarly River Regions will only include features within the drainage division being released Smaller islands included in both feature classes
Groundwater Cartography (GW_Cartogrphy)	Not provided until a National Phase 3 product is released

3 About Geofabric V3.0

The Geofabric is a collection of hydrological geospatial entities (feature classes, tables and raster datasets), representing Australia's hydrology. Geofabric V3.0 provides improved resolution and builds in new information and functionality

The Geofabric is based on a set of integrated input data products, known as the foundation input data. It builds on these to produce a set of output products based on a defined set of user requirements. These user requirements are focused on the Bureau's need to meet its statutory requirements for water accounting, assessment and prediction under the Water Act 2007.

The Geofabric is publicly available and can be used as authoritative source data, suitable for a wide range of water information applications.

The foundation input data for Geofabric V3.0 includes:

- Topologically connected surface water hydrology, known as AusHydro2 based on best available multi-scale mapped features (1:25,000 – 1:250,000) aggregated and maintained by Geoscience Australia (GA) from multi-jurisdictional data providers.
- Drainage enforced Digital Elevation Model (DEM) based on ANU and GA's SRTM 1 second Digital Elevation Model (DEM-1S)
- Topologically connected flow direction streamlines, known as DEM Derived Streams as developed by ANU and GA using ANUDEM[1] that were cross-referenced and additionally informed by AusHydro2 vector streamlines.
- Physically-based stream segment catchments, known as the Catchment Boundaries Vector, derived from the above mentioned DEM Derived Streams and the DEM-1S.Monitoring points as reported by Water providers to the Bureau which are loaded into AWRIS and associated with topologically connected flow direction streamlines.

[1] ANUDEM is a computer program developed by the ANU Fenner School of Environment & Society for processing data into a digital elevation model.

From these foundation data, a suite of integrated data products are being developed. These are:

- **Geofabric Surface Cartography**
  Geofabric Surface Hydrology Cartography
  SH_Cartography
  Cartographic representation of hydrological features
- **Geofabric Surface Network**
  Geofabric Surface Hydrology Network
  SH_Network
  Network representation of hydrological features, including monitoring points
- **Geofabric Surface Catchments**
  Geofabric 1 second Catchments
  SH_Catchments
  Stream segment catchments derived from DEM-1S
- **Geofabric Hydrology Reporting Catchments**
  Geofabric Hydrology Reporting Catchments
  HR_Catchments
  Contracted nodes and contracted catchments derived from identification of important hydrological features
- **Geofabric Hydrology Reporting Regions**
  Geofabric Hydrology Reporting Regions
  HR_Regions
  Topographic Drainage Division and River Region reporting units, based on contracted catchments.

The Geofabric system is based on a conceptual architecture designed to produce a suite of data products at various spatial resolutions, using different representations of features, from a single maintenance environment. This is required to support the disparate needs of users. Key to this design are formal data product specifications that describe each product. Underpinning the Geofabric is a formal, modular conceptual model that allows for direct mapping between the input datasets and products. Figure 1 illustrates the Geofabric conceptual architecture.

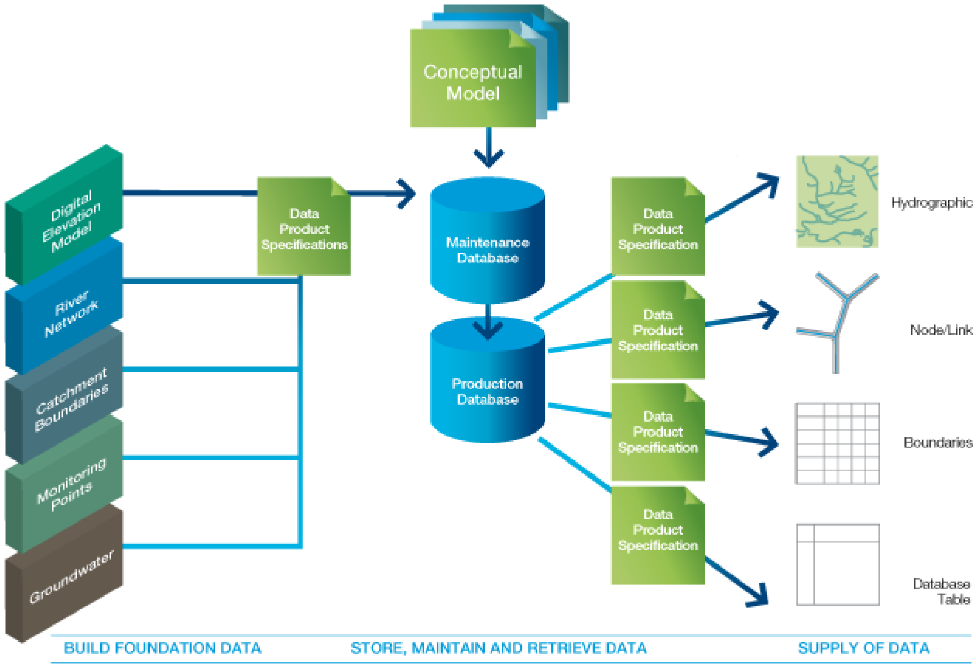

Figure 1 – Geofabric conceptual architecture showing data workflows

(source: Water Information Research and Development Alliance)

3.1 Special features of Geofabric V3.0

Traditionally, spatial products and datasets are created from traditional hard copy maps or via the digitisation of features by hand from aerial photography or satellite imagery. The representation of geographic features on paper maps requires that features be presented at certain scales, with certain symbology or legends. They are limited in accuracy to the scale to which they are printed and reproduced.

Similarly, the accuracy of data digitised from imagery depends upon the resolution of the imagery and the processes used for data capture. This means that the derived digital spatial products are also limited in both scale and accuracy. When higher levels of data accuracy are required, there is often inconsistent representation of the data between scales. For example, a water body feature location might be represented as a point location at one scale of map and its boundary represented as a polygon on a higher resolution map.

Additionally, paper maps often amalgamate both the geometry (how something looks or is represented), and the topology (how the features on the map might be connected or related spatially), of the represented features. Digital spatial data products are not necessarily organised by the traditional confines of a cartographic representation on a paper map. Spatial data products are organised by categories of specific types of information, usually within a

Geographic Information System (GIS). This allows the user to amalgamate, layer or superimpose varying types of information in a way that is meaningful. The user is only restricted by the accuracy, precision and relevant content of the digital data.

The design and development of the Geofabric recognises the inherent problems of function, scale and accuracy in representing spatial data. The Geofabric product suite attempts to distinguish between the functional requirements of both topological and geometric representations of hydrological features. Topologically consistent spatial features are those that show connectivity, e.g. consistent direction, node-link connectivity, schematic networks and feature relationships. Geometric spatial features are those that are represented by points, lines or polygons (in ESRI's ArcGIS environment) and are commonly described as the blue lines for streams and the associated water features (e.g. cartographic representations).

Users can choose the most appropriate Geofabric product to suit their requirements. The user may also select one product to conduct analyses and then adopt the sister product to accomplish an associated task, such as cartographic representation of the same set of features. The value-add of the Geofabric products lies in the ability to reliably apply the products or inter-relate them in a repeatable way.

The products are ascribed to provide cross product integration by the use of related feature IDs, consistent naming conventions, and the application of contracted nodes that carry identity across products and between versions.

Figure 2 shows a model of the relationships between the features in the five V3.0 Geofabric products providing an overview as to how these products both relate and, in some cases, overlap with one another.

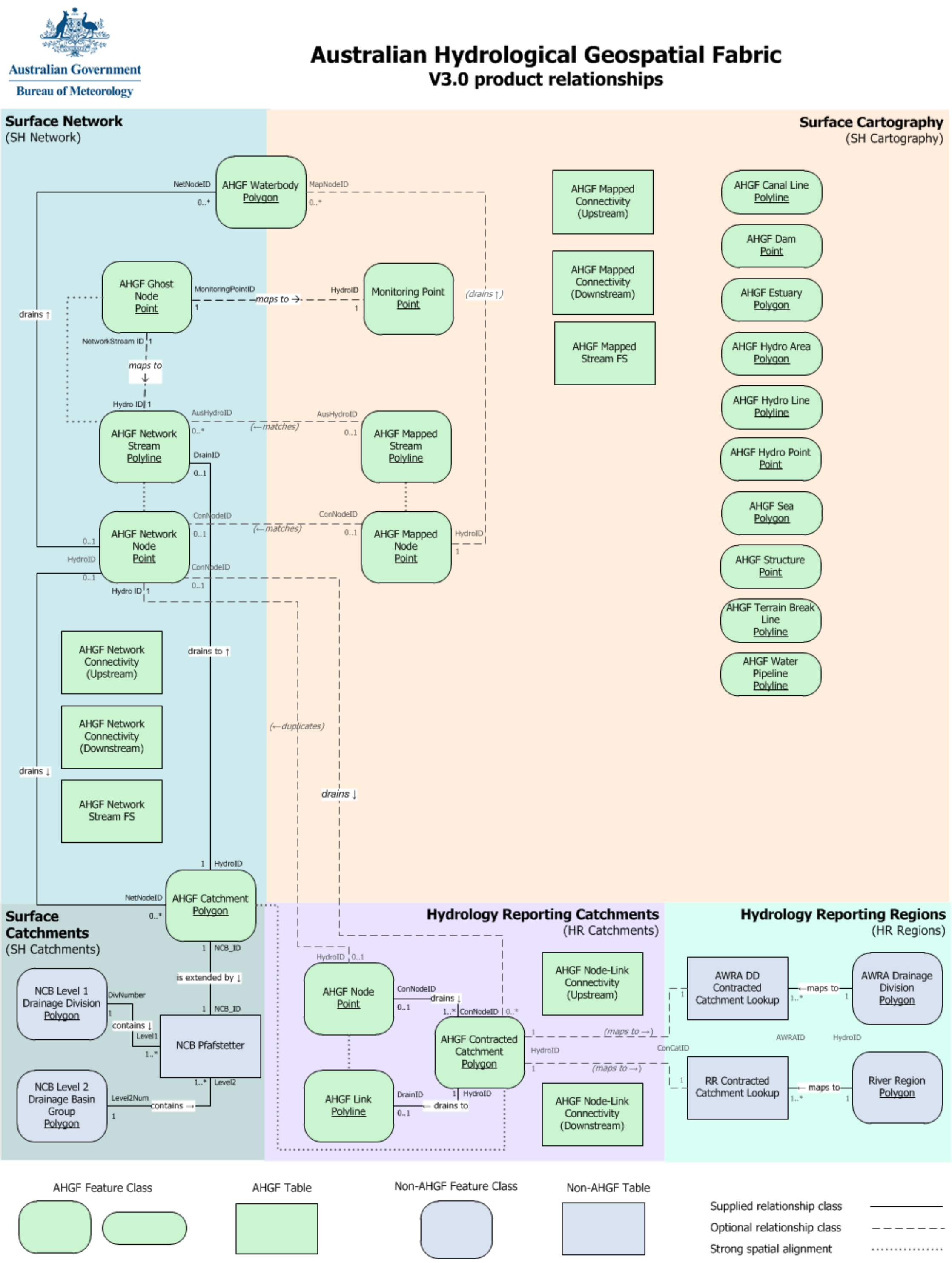

Figure 2 – Geofabric V3.0 relationships

(a high resolution version of this schema can be found at [www.bom.gov.au/water/geofabric/documentation.shtml)](www.bom.gov.au/water/geofabric/documentation.shtml)

3.2 Conceptual model supporting the Geofabric design

A conceptual model is an abstraction of phenomena, or features, in the real world. It describes the essential features, captures their relationships, and may also represent behaviour. The design of the Geofabric is based around a flexible and evolvable information model. This design requires:

- A modular conceptual information model, capable of supporting many use cases and associated implementations as discussed in Atkinson et al (2008). This is the foundation on which implementations are developed.
- Consistent use of standardised Data Product Specifications (DPS) describing both the dataset inputs and the derived data products output from the Geofabric.
- Adoption of a nimble, iterative, requirements-focused development methodology that covers all aspects of the data product lifecycle and allows for evolution of technology, data products and user requirements.

The Geofabric design goal is to develop a single platform independent conceptual model that can be mapped to different implementation models as required. These implementation models can be structured to specifically support particular use cases.

The value of the conceptual model is that it is not influenced by the limitations of a chosen GIS implementation. Model development can focus on the phenomena being examined, how they are to be used and represented and their relationships to other phenomena. This means the underlying design of the Geofabric is based upon a repeatable information model and that the products are well documented and consistent in their behaviour over time.

The Geofabric conceptual model was developed according to International Organization for Standardization (ISO) conceptual modelling principles with a focus on modularity and re-use. It is specified in the Unified Modelling Language (UML) model with re-usable components clearly packaged. The Geofabric is the result of a physical implementation realising the concept model. Issues with data not being adequately expressed in the implementation (model) trigger a review of the conceptual model. Any redefinitions from this process flow to any derived data products. This ensures that any products derived from any platform specific implementation are able to rely on that product’s consistency and feature behaviour.

In Geofabric V3.0, there is only one platform specific implementation model that is based upon ArcGIS software using ESRI’s definitions of geodatabase models, schema, feature classes and relationship classes, etc. The products described in this Product Guide are derived from this implementation. Geofabric V3.0 conforms to the underlying conceptual model via the inclusion of a derived set of logical features, which represent contracted behaviours designed to persist over time.

4 Product overview

4.1 Product components

Geofabric Phase 3 products consist of five distinct, yet related, geospatial datasets that are derived from the foundation input data and delivered in an ESRI File Geodatabase format. Specific spatial feature classes created by the Bureau also form a key part of the products. A list of the product geodatabase names and their file sizes by drainage division is given in Table 2.

Table 2 – Product file sizes by drainage division

Drainage Division	Product	~ File size (MegaBytes)
Pilbara-Gascoyne (PG)	SH_Cartography.gdb	88
	SH_Network.gdb	385
	SH_Catchments.gdb	291
	HR_Catchments.gdb	15
	HR_Regions.gdb	4

The products are represented at a nominal scale of 1:100,000 in ESRI ArcGIS vector format and are delivered in an ESRI File Geodatabase format.

The products use the following geographic coordinate system:

Datum: Geographic Datum of Australia (GDA 94)

Geographic coordinate units: decimal degrees

Latitude resolution: 0.0000005

Longitude resolution: 0.0000005

A complete description of the data products' spatial and geographic identifiers will be contained within their accompanying Data Product Specification (DPS), when completed for Phase 3. In the interim Phase 2 documentation can be utilised. The specifications are a formal description of the key features and attributes of each product and are based on the AS/NZS ISO 19131:2008 Geographic information – Data product specifications standard.

While the Geofabric products are delivered in a geographic coordinate system, it is recognised that users may need the data products to satisfy applications requiring differing units of measurement. For more information on selecting, reprojecting and using differing coordinate systems, please see:

http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=About%20coordinate%20systems%20and%20map%20projections

The Geofabric is organised in a manner that reflects the standard spatial data hierarchy of the ESRI ArcGIS product suite for geodatabases. The Data Dictionaries and Data Product Specifications adhere to the standard ESRI data hierarchy nomenclature and conventions.

This documentation assumes that the user is familiar with this data structure, hierarchy and its components, such as geodatabase (the overall delivery data package), including:

- feature dataset (a container for feature classes with shared properties and behaviours):
  - feature class by feature type (e.g. stream or water body represented by points, lines or polygons)
  - subtypes within the feature class (e.g. different types of water bodies within a water body feature class), i.e.:
    - attribution fields per each feature class and feature class subtype (the data fields that contain feature specific details)
    - attribute domains associated with feature class attributes to standardise the values for a given attribute field.

4.2 Relationships between Geofabric Surface Cartography and Geofabric Surface Network

Geofabric Surface Cartography and Geofabric Surface Network complement one another. Both are created from spatial data inputs that share definitions for stream segments and some feature attribution. The stream segmentation rules are based upon surface topographic features that are most likely to be common to both products. Whilst each product has its own set of unique attributes, the common attributes are limited to the simplest set of descriptors, e.g. common linked feature IDs, stream names and stream hierarchy. This means that the user can easily identify a stream segment in either product by a common ID, stream name (if it exists) or stream hierarchy (if it exists).

Geofabric Surface Network is intended to be used for the selection of hydrological observation points (if they exist) and as the source of stream segments for geoprocessing and hydrological modelling, whereas Geofabric Surface Cartography is intended for the production of maps which present the results of analyses.

Where there are equivalent mapped segments in Geofabric Surface Cartography to network segments in Geofabric Surface Network, an attempt was made to relate these through attribution. A complete set of attribution relationships is described in the individual sections of this Guide:

- Section 5.1 Geofabric Surface Cartography
- Section 5.2 Geofabric Surface Network
- Section 5.3 Geofabric Surface Catchments
- Section 5.4 Geofabric Hydrology Reporting Catchments
- Section 5.5 Geofabric Hydrology Reporting Regions.

Also see Figure 2 - Simplified View of V3.0 product relationships.

4.3 Spatial feature identifiers (IDs)

The field attribution of the five Geofabric products includes a number of distinct identifier fields which serve different purposes. Each category of identifier can be described as follows:

SourceID/AusHydroID

All foundation input data products were supplied with a set of their own feature IDs. In order to maintain the link between the Geofabric and input features, these IDs are preserved as part of the feature level Geofabric metadata in an attribute field called SourceID.

The AusHydroID field included in the AHGFMappedStream and AHGFNetworkStream feature classes is a special case of SourceID. This ID provides one way of mapping stream features between Geofabric Surface Cartography and Geofabric Surface Network. While these IDs provide a useful way of locating the same stream segment in the two networks, these IDs are not persistent and may change between the Geofabric versions. The AusHydroIDs are further documented in the attribution of the Data Dictionaries.

HydroID

HydroIDs are specific and unique across the Geofabric products. They are created in the process of loading and post-processing the foundation data inputs into the Geofabric Maintenance Geodatabase. While these IDs are unique across all geodatabases within a Geofabric release, these IDs again are not persistent and are likely to change between the Geofabric versions. For more information on ArcHydro go to: http://resources.arcgis.com/en/communities/hydro/01vn0000000s000000.html

SegmentNo

The input foundation data products used to create the AHGFNetworkStream and AHGFCatchment feature classes included an identifier called SegmentNo. This identifier may be used to map AHGFNetworkStream features to related AHGFCatchment features or to relate vector features back to equivalent raster stream segments and catchments in the input foundation data products. Please note that no raster based Geofabric products are released by the Bureau, with Geoscience Australia making these available as the custodian of raster input foundation data products.

ConNodeID (Contracted Node ID)

A process of identifying important hydrological features was used to determine a set of logical nodes which could be identified in both the stream networks within Geofabric Surface Cartography (AHGFNetworkNode) and Geofabric Surface Network (AHGFMappedNode). Each of these nodes was then assigned a unique identifier and a confidence level. These IDs (ConNodeID) and confidence levels (ConLevel) were attributed back to the corresponding representations of these nodes in the two stream networks, allowing identification of the logical nodes in both feature classes. The idea of identifying a set of logical nodes and assigning them with a persistent identifier is aimed at providing the end-user with a set of contracted features that are likely to persist over time, regardless of any changes to the resolution and scale of future Geofabric product versions. The ConNodeID and ConLevel attributes are also assigned to the AHGFContractedCatchment feature class in Geofabric

Hydrology Reporting Catchments. These features represent the sub-catchment areas drained by key contracted nodes.

4.4 Attributes common to all feature classes

As well as standard feature class metadata, each feature class also carries a standard set of attribute-level metadata, providing valuable information linking features to the foundation data. This allows the user to understand the data lineage and metadata that is available for the input products.

The following attributes, shown in Table 3, are common to all feature classes in the Geofabric products.

Table 3 – Feature class attributes common to all the Geofabric products

Field name	Alias name	Reference from data input
HydroID		Geofabric feature identifier, unique across all geodatabases within an AHGF release
AHGFFType	AHGFFeatureType	Feature type within the AHGF Data Model (e.g. 1: AHGFNetworkStream)
SrcFCName	SourceFeatureClassName	Feature class name from the input data source (e.g. Reservoirs)
SrcFType	SourceFeatureType	Feature type from the input data source (e.g. TownRuralStorage)
SrcType	SourceType	Feature subtype (numeric code) from the input data source (e.g. 2)
SourceID		Unique identifier for individual feature in the input data source (e.g. 3023726)
FeatRel	FeatureReliability	Reliability date of spatial object. Adjusted during spatial change/verification
FSource	FeatureSource	Name of agency that originally captured the spatial object
AttrRel	AttributeReliability	Reliability date of attribute object. Adjusted during attribute change/verification
AttrSource	AttributeSource	Name of agency that originally captured the attribute object
PlanAcc	PlanimetricAccuracy	Standard deviation of the horizontal positional accuracy in metres (e.g. 100)
Symbol		No longer provided in Phase 3 input data. Was the symbol number for feature used in GA's GEODATA product
TextNote		Text note to accompany the feature

4.5 Geometric networks

Geometric networks are collections of line (edge) and point (junction) feature classes in a feature dataset that possess a connectivity relationship. Geometric networks provide extra behaviour to component features classes, in particular, an awareness that they are topologically connected to each other. Edges connect to other edges at junctions and in the network the flow from one edge to another is transferred through the junctions. When flow direction is set, flow can occur in only one direction.

A geometric network was built for Geofabric Surface Cartography, Geofabric Surface Network and Geofabric Hydrology Reporting Catchments. The networks are constructed from the respective node and stream (link for Geofabric Hydrology Reporting Catchments) feature classes, default parameters were used and flow direction was set.

Further information about geometric networks can be found at:
http://resources.arcgis.com/en/help/main/10.1/index.html#//002r00000001000000

4.6 Relationship classes

Relationship classes help ensure referential integrity between feature classes and allow for the query of related features.

The Geofabric contains a number of relationship classes and an example from the Geofabric Surface Network product is the relationship class CatchmentDrainsToSegment. This defines a drainage relationship between the (polygon) AHGFCatchment and (line) AHGFNetworkStream feature classes.

Further information about relationship classes can be found at:

http://resources.arcgis.com/en/help/main/10.1/index.html#//004t00000003000000

4.7 Attribute domains

Attribute domains define rules for the allowable values for a specific attribute field. They help to enforce data integrity. Attribute domains can be either a range or coded value type. Range domains specify a valid range of values for a numeric domain, such as elevation. A coded value domain specifies a list of allowable values such as confidence levels (high, good, low, etc).

Further information about attribute domains can be found at:

http://resources.arcgis.com/en/help/main/10.1/index.html#//001s00000001000000

4.8 Attribute subtypes

A data subtype is a subset of features in a feature class which share the same allowable attributes or relationships. The use of subtypes allows for the allocation of an attribute domain and/or the definition of a relationship class to a subset of features within a feature class. The AHGFNetworkNode feature class within Geofabric Surface Network is an example of a feature class containing a number of subtypes.

Further information about subtypes can be found at:

http://resources.arcgis.com/en/help/main/10.1/index.html#//005r00000001000000

5 Product descriptions

The Geofabric V3.0 release comprises five products. Each of these products, and guidance on use, are described below.

5.1 Geofabric Surface Cartography

Geofabric Surface Cartography provides a set of related feature classes to be used as the basis for production of consistent hydrological cartographic maps. This product contains a geometric representation of the surface water features of Australia (excluding external Territories). These are largely natural surface hydrology features but some artificial features; notably dams, pipelines, reservoirs, canals, monitoring points and other hydrographic features, are also included.

The product may be used for visualisation of surface hydrology within a GIS to support the selection of features for inclusion in cartographic map production.

The product’s geometry is largely derived from a foundation input data product called AusHydro2. Geofabric Surface Cartography includes water bodies such as swamps, reservoirs and lakes, as well as the stream lines and their connectors through water bodies. Table 4 shows the Geofabric Surface Cartography feature class terminology and subtypes.

In addition, Geofabric Surface Cartography includes a set of contracted node attributes (embedded within AHGFMappedNode), which identify a subset of features common to both the cartographic stream network (AHGFMappedStream) and the topological stream network (AHGFNetworkStream). These attributes indicate the likely level of persistence for these features between Geofabric versions. The unique value-added feature of the contracted nodes is created by the Bureau and represents a persistent and coincident juncture between associated hydrologic features throughout the suite of products.

5.1.1 Understanding and using Geofabric Surface Cartography

Geofabric Surface Cartography is fully topologically correct. That is, the stream segments connect and flow in the correct direction (in relation to the overall stream line). Geofabric Surface Cartography represents the traditional sinuous blue line network and is designed to be used as a cartographic representation of Australian rivers and streams.

This product is suitable for users who need to analyse accurate stream length at a nominal scale of 1:100,000.

The nomenclature for the Geofabric Surface Cartography stream network and accompanying hydrological feature classes conforms to the Geofabric Surface Cartography data dictionary. The feature class nomenclature of Geofabric Surface Cartography is based upon the AusHydro2 data input.

Geofabric Surface Cartography can be used for any general GIS mapping or cartographic analysis available within the ArcGIS desktop environment. Features may be selected by specific areas as described in Geofabric Surface Catchments, by boundaries, or by user-specified attributes such as stream names. Additionally, the geometric network supplied within the geodatabase can be used to do stream tracing operations.

Some applications of this product include:

- producing maps for reporting
- determining the locations of surface water features
- determining the relationship of surface water features with one another and with other natural features in the landscape
- intersecting areas of surface water features with gridded datasets to extract data
- finding associated hydrological observations in a river network, i.e. determining where monitoring stations are located in relation to surface water features
- running stream tracing operations using the geometric network.

5.1.2 Feature classes, feature types, related tables and key attributes

Table 4 – Feature classes and tables for Geofabric Surface Cartography

ObjectClass Name	Type	Geometry	Subtype
SH_Cartography			
AHGFCanalLine	Simple Feature Class	Polyline	-
AHGFDam	Simple Feature Class	Point	-
AHGFEstuary	Simple Feature Class	Polygon	-
AHGFHydroArea	Simple Feature Class	Polygon	CanalArea Flat ForeshoreFlat PondageArea RapidArea WatercourseArea
AHGFHydroLine	Simple Feature Class	Polyline	CliffLine DamWall Levee RapidLine Shoreline ShorelineJunction Spillway Tunnel
AHGFHydroPoint	Simple Feature Class	Point	Bay GnammaHole NativeWell Pool Rockhole Soak Spring Waterhole WaterTank
AHGFMappedNode	Simple Feature Class	Point	MappedArtificialNode MappedCliffNode MappedGhostNode MappedHeadNode MappedJunctionNode MappedTerminusNode MappedWaterAreaNode
AHGFMappedStream	Simple Feature Class	Polyline	MappedArtificialFlowSegment MappedFlowSegment MappedWaterAreaSegment
AHGFSea	Simple Feature Class	Polygon	-
AHGFStructure	Simple Feature Class	Point	Bridge Ford Lock Waterfall
AHGFTerrainBreakLine	Simple Feature Class	Polyline	-

ObjectClass Name	Type	Geometry	Subtype
SH_Cartography			
AHGFWaterbody	Simple Feature Class	Polygon	Lake Reservoir Swamp
AHGFWaterPipeline	Simple Feature Class	Polyline	-
MonitoringPoint	Simple Feature Class	Point	-
Stand Alone ObjectClass(s)			
AHGFMappedConnectivityDown	Table	-	-
AHGFMappedConnectivityUp	Table	-	-
AHGFMappedSegment_FS	Table	-	-

Of the feature classes within Geofabric Surface Cartography, AHGFMappedNode is entirely created by the Bureau (from AHGFMappedStream) during the data input process. Both AHGFMappedNode and AHGFMappedStream feature classes contain Bureau designed subtypes which categorise the stream nodes and segments by type. AHGFMappedNode features represent the beginning or end node of a particular type of stream segment and are used to designate the transition of stream segment types. They generally indicate a specific break point in the stream network or the heads and termini of streams. The only AHGFMappedNode subtype which does not break the stream network segments is the MappedGhostNode.

Table 5 – Bureau generated feature classes (FC) nodes and streams included for Geofabric Surface Cartography

Feature class name	FCGeometry	Feature class subtype	Description
AHGFMappedNode	Point	MappedArtificialNode	Represents the boundary where a MappedFlowSegment/ MappedWaterAreaSegment changes to/from a MappedArtificialFlowHydroArea feature
		MappedCliffNode	Represents the locational break of a MappedStream segment intersection with an AHGFCliffline or AHGFTerrainBreakLine
		MappedGhostNode	Used for building spatial relationships to hydrological features of interest. This is the only mapped node feature which does not coincide with a physical break in the stream segment network
		MappedHeadNode	The starting point of a MappedStream segment in the headwaters
		MappedJunctionNode	Any confluence/bifurcating node of two or more stream segments
		MappedTerminusNode	Represents the terminal end point of any MappedStream (i.e. coastal outlet or inland sink)
		MappedWaterAreaNode	Represents the entry or exit of a MappedArtificialFlow/ MappedArtificialFlowSegment into or out of an AHGFWaterbody or AHGFHydroArea feature
AHGFMappedStream	Polyline	MappedArtificialFlowSegment	Stream flow connectors that are not watercourse lines, i.e. connectors introduced to maintain certain key stream connectivity
		MappedFlowSegment	Watercourse lines
		MappedWaterAreaSegment	Stream flow connectors that pass through a water area polygon
MonitoringPoint	Point		Represents source location of stream gauge monitoring points

The following tables describe the key attributes for Geofabric Surface Cartography.

Table 6 – Key attributes of the AHGFMappedNode feature class for Geofabric Surface Cartography

Key attribute	Alias	Description
NextDownID	NextDownID	The HydroID for the next downstream stream mapped node
ConNodeID	ContractedNodeID	Persistent unique identifier of related logical AHGF contracted node
ConLevel	ContractLevel	Confidence level of related logical AHGF contracted node
NetNodeID	NetworkNodeID	The HydroID of the equivalent node in AHGFNetworkNode

Table 7 – Key attributes of the AHGFMappedStream feature class for Geofabric Surface Cartography

Key attribute	Alias	Description
From_Node	From_Node	The HydroID for the AHGFMappedNode
To_Node	To_Node	The HydroID for the next downstream AHGFMappedNode
NextDownID	NextDownID	The HydroID for the next downstream AHGFMappedStream segment

Table 8 – Key attributes of the AHGFMappedConnectivityDown (downstream) table for Geofabric Surface Cartography

Key attribute	Alias	Description
From_ID	From_ID	The HydroID for the AHGFMappedNode
To_ID	To_ID	The HydroID for the next downstream AHGFMappedNode
Segment_ID	Segment_ID	The HydroID for the corresponding AHGFMappedStream segment

Table 9 – Key attributes of the AHGFMappedConnectivityUp (upstream) table for Geofabric Surface Cartography

Key attribute	Alias	Description
From_ID	From_ID	The HydroID for the AHGFMappedNode
To_ID	To_ID	The HydroID for the next upstream AHGFMappedNode
Segment_ID	Segment_ID	The HydroID for the corresponding AHGFMappedStream segment

Table 10 – Key attributes of the AHGFMappedStream_FS table for Geofabric Surface Cartography (flow split table for use with ArcHydro tools)

Key attribute	Alias	Description
FeatureID	FeatureID	The HydroID for an AHGFMappedStream segment
NextDownID	NextDownID	The HydroID for the next downstream AHGFMappedNode

5.2 Geofabric Surface Network

Geofabric Surface Network is based upon the input from DEM Derived Streams, which is the vectorised version of the one second DEM derived raster streams product. The ANUDEM algorithm is informed by the AusHydro2 foundation input data used to populate the AHGFMappedStream feature class in Geofabric Surface Cartography and thus is inherently related to this product.

Geofabric Surface Network is intended to be used in stream flow tracing operations, which utilise its full topological connection. The product can support the spatial selection of associated hydrological features (such as water bodies, monitoring points and catchments) as inputs for spatial analysis/modelling. Table 11 shows the Geofabric Surface Network feature class terminology and feature subtypes.

As with Geofabric Surface Cartography, the network product includes a set of contracted node attributes (embedded within AHGFNetworkNode), which identify a subset of features common to both of the two stream networks (AHGFNetworkStream and AHGFMappedStream). These attributes indicate the likely level of persistency for these features between the Geofabric versions.

5.2.1 Understanding and using Geofabric Surface Network

The Geofabric Surface Network stream network is related to, but distinct from, the stream network contained within Geofabric Surface Cartography. The network product represents the flow direction of Surface Cartography streams over the surface of the terrain, based upon a 1 second DEM-. It is more generalised and represents the main channels of the streams, particularly in areas where streams are heavily anabranched or disconnected.

In addition, the stream connectivity of Geofabric Surface Network represents a stream flow over the terrain, regardless of the presence of a corresponding Geofabric Surface Cartography stream segment. This means that Geofabric Surface Cartography may represent a stream as an interrupted or intermittent feature, whereas Geofabric Surface Network represents the same stream as a continuous connected feature, i.e. the path that stream would take (according to the terrain model) if sufficient water were available for flow.

Some applications for this product include:

- locating associated hydrological observations (monitoring points) in a river network
- creating a monitoring point stream link network
- tracing connectivity between hydrological features
- stream flow modelling
- selecting related features up or downstream of a point such as water bodies, monitoring points or catchments
- accumulating attribute values of upstream or downstream related features, e.g. calculating average stream heights upstream of a point.

5.2.2 Feature classes, feature types, related tables and key attributes

Table 11 - Feature classes and tables for Geofabric Surface Network

ObjectClass Name	Type	Geometry	Subtype
SH_Network			
AHGFCatchment	Simple FeatureClass	Polygon	-
AHGFNetworkNode	Simple FeatureClass	Point	NetworkArtificialNode NetworkCliffNode NetworkGhostNode NetworkHeadNode NetworkJunctionNode NetworkTerminusNode NetworkWaterAreaNode
AHGFGhostNode	Simple FeatureClass	Point	NetworkGhostNode
AHGFNetworkStream	Simple FeatureClass	Polyline	NetworkArtificialFlowSegment NetworkFlowSegment NetworkWaterAreaSegment
AHGFWaterbody	Simple FeatureClass	Polygon	Lake Reservoir Swamp
Stand Alone ObjectClass(s)			
AHGFNetworkConnectivityDown	Table	-	-
AHGFNetworkConnectivityUp	Table	-	-
AHGFNetworkStream_FS	Table	-	-

Of the feature classes within Geofabric Surface Network, AHGFNetworkNode and AHGFGhostNode are entirely created by the Bureau, from AHGFNetworkStream and MonitoringPoints during the data input process.

AHGFNetworkNode, AHGFGhostNode and AHGFNetworkStream feature classes contain Bureau designed subtypes and field attribution which categorise the stream nodes and segments by type and facilitate their use in stream network analysis.

AHGFNetworkNode features represent the beginning or end node of a particular type of stream segment and are used to designate the transition of stream segment types. They generally indicate a specific break point in the stream network or the heads and termini of streams. The only AHGFNetworkNode subtype that does not break the stream network segments is the NetworkGhostNode.

AHGFGhostNode features represent monitoring points on a stream segment and are all of the subtype NetworkGhostNode. This feature class also includes monitoring point attribution, including Station Name, Station Number, Confidence and URL Link to Water Data Online (WDO).

Table 12 – Bureau generated feature classes (nodes and streams) included for Geofabric Surface Network

Feature class name	FCGeometry	Feature class subtype	Description
AHGFNetworkNode	Point	NetworkArtificialNode	Represents the boundary where a NetworkFlowSegment/ NetworkWaterAreaSegment changes to/from a NetworkArtificialFlowHydroArea feature
		NetworkCliffNode	Represents the locational break of a NetworkStream segment intersection with an AHGFCliffline or AHGFTerrainBreakLine
		NetworkGhostNode	Used for building spatial relationships to important hydrological features, eg dam outlet where a NetworkWaterAreaNode doesn't exist . This is the only network node feature which does not coincide with a physical break in the stream segment network
		NetworkHeadNode	The starting point of a NetworkStream segment in the headwaters
		NetworkJunctionNode	Any confluence/bifurcating node of two or more stream segments
		NetworkTerminusNode	Represents the terminal end-point of any NetworkStream segment (i.e. coastal outlet or inland sink)
		NetworkWaterAreaNode	Represents the entry or exit of an AHGFNetworkStream into or out of an AHGFWaterbody or AHGFHydroArea feature
AHGFNetworkStream	Polyline	NetworkArtificialFlowSegment	Stream flow connectors that are not watercourse lines, i.e. derived connectors which maintain the stream network connectivity between NetworkFlowSegment features but have no corresponding feature in AHGFMappedStream
		NetworkFlowSegment	DEM vectorised stream segments that correspond to MappedFlowSegment features
		NetworkWaterAreaSegment	Stream flow connectors that pass through a water area polygon and coincide with a MappedFlowSegment in AHGFMappedStream
AHGFGhostNode	Point	NetworkGhostNode	Used for building spatial relationships to monitoring points. This is the only node feature subtype which does not coincide with a physical break in the stream segment network

The following tables describe the key attributes for Geofabric Surface Network.

Table 13 – Key attributes of the AHGFNetworkNode feature class for Geofabric Surface Network

Key attribute	Alias	Description
NextDownID	NextDownID	The HydroID for the next downstream stream network node
ConNodeID	ContractedNodeID	Persistent unique identifier of related logical AHGF contracted node
ConLevel	ContractLevel	Confidence level of related logical AHGF contracted node
MapNodeID	MappedNodeID	The HydroID of the equivalent node in AHGFMappedNode

Table 14 – Key attributes of the AHGFNetworkStream feature class for Geofabric Surface Network

Key attribute	Alias	Description
SegmentNo	SegmentNo	Identifier of related raster stream segment in input data source
DrainID	DrainID	The HydroID for the AHGFCatchment in to which the AHGFNetworkStream drains
From_Node	From_Node	The HydroID for the AHGFNetworkNode
To_Node	To_Node	The HydroID for the next downstream AHGFNetworkNode
NextDownID	NextDownID	The HydroID for the next downstream AHGFNetworkStream feature

Table 15 - Key attributes of AHGFGhostNode feature class for Geofabric Surface Network

Key attribute	Alias	Description
STATIONNO	STATIONNO	Reference number of monitoring station as given by the Water Provider
StationName	StationName	Reference name of monitoring station as given by the Water Provider
	MonitoringPointID	The HydroID of the source mapped MonitoringPoint
WDO_URL	WDO_URL	URL link to the station page on Water Data Online
	NetworkStreamID	The HydroID of the network stream segment the point reside on
ConNodeID	ContractedNodeID	Persistent unique Geofabric identifier of a monitoring point

Table 16 – Key attributes of the AHGFNetworkConnectivityDown (downstream) table for Geofabric Surface Network

Key attribute	Alias	Description
From_ID	From_ID	The HydroID for the AHGFNetworkNode
To_ID	To_ID	The HydroID for the next downstream AHGFNetworkNode
Segment_ID	Segment_ID	The HydroID for the corresponding AHGFNetworkStream feature

Table 17 – Key attributes of the AHGFNetworkConnectivityUp (upstream) table for Geofabric Surface Network

Key attribute	Alias	Description
From_ID	From_ID	The HydroID for the AHGFNetworkNode
To_ID	To_ID	The HydroID for the next upstream AHGFNetworkNode
Segment_ID	Segment_ID	The HydroID for the corresponding AHGFNetworkStream feature

Table 18 – Key attributes of the AHGFNetworkSegment_FS table for Geofabric Surface Network (flow split table for use with ArcHydro tools)

Key attribute	Alias	Description
FeatureID	FeatureID	The HydroID for an AHGFNetworkStream segment
NextDownID	NextDownID	The HydroID for the next downstream AHGFNetworkNode

5.3 Geofabric Surface Catchments

The feature class contained within this data product is based upon the stream segment level catchments of the Catchment Boundary Vector - foundation input data. These data define a catchment for every stream segment contained within Geofabric Surface Network (AHGFNetworkStream) according to the1 second DEM. It is these catchments which serve as direct input into the AHGFCatchment feature class. Table 19 shows the Geofabric Surface Catchments feature class terminology and feature subtypes.

5.3.1 Understanding and using Geofabric Surface Catchments

The AHGFCatchment feature class is designed to represent geographic surface boundaries that have a hydrological relationship to surface water features. These catchment boundaries in their current form may not completely satisfy legislative or local government requirements, but they may be used for surface hydrological analysis. Some of these applications include:

- providing a system boundary for surface water modelling
- identifying areas of interest for reporting
- producing maps for reporting
- creating contributing catchment areas for a point of interest in combination with AHGFNetworkStream tracing, i.e. monitoring point catchments
- aggregating small catchments to form required hydrological modelling boundaries.

5.3.2 Feature classes, feature types, related tables and key attributes

Table 19 – Feature classes and tables for Geofabric Surface Catchments

ObjectClass Name	Type	Geometry	Subtype
SH_Catchments			
AHGFCatchment	Simple FeatureClass	Polygon	-
NCBLevel1DrainageDivision	Simple FeatureClass	Polygon	-
NCBLevel2DrainageBasinGroup	Simple FeatureClass	Polygon	-
Stand Alone ObjectClass(s)			
NCBPfafstetter	Table	-	-

The following tables describe the key attributes for Geofabric Surface Catchments.

Table 20 – Key attributes of AHGFCatchment feature class for Geofabric Surface Catchments

Key attribute	Alias	Description
NetNodeID	NetworkNodeID	HydroID of the AHGFNetworkNode feature to which the catchment drains
NCB_ID	NCB_ID	Unique NCB identifier. Can be used to join Pfafstetter attribution
SegmentNo	SegmentNo	Identifier of related raster stream segment in input data source
StreamName	StreamName	Name of the associated stream segment in AHGFNetworkStream

Table 21 – Key attributes of NCBLevl1DrainageDivision feature class for Geofabric Surface Catchments

Key attribute	Alias	Description
DivNumber	DivisionNum	1 second DEM Drainage Division Number
Division	Division	1 second DEM Drainage Division Name

Table 22 – Key attributes of NCBLevel2DrainageBasinGroup feature class for Geofabric Surface Catchments

Key attribute	Alias	Description
DivNumber	DivisionNumber	1 second DEM Drainage Division Number
Level2num	Level2Number	NCB Level 2 number (internal 1 second basins merged with basins draining to the coast or into Lake Eyre, aggregated to approximate the AWRC Basins)
Level2name	Level2name	NCB Level 2 name (based on AWRC basin names)

5.3.3 NCBLevel1DrainageDivison and NCBLevel2DrainageBasinGroup

Geofabric Surface Catchments provides a hierarchy of nested catchments from drainage divisions at the top level all the way down to a separate catchment for every stream segment in Geofabric Surface Network.

The top two levels of this hierarchy, Level 1 and Level 2, have been extracted as separate feature classes. The NCBLevel1DrainageDivision feature class will eventually consist of 12 topographically defined drainage divisions that represent the highest level of the catchment hierarchy.

At the next level down, the NCBLevel2DrainageBasinGroup represent catchment units approximating the Australian Water Resources Management Committee (WRMC) river basins as described in GA (1997).

5.4 Geofabric Hydrology Reporting Catchments

Geofabric Hydrology Reporting Catchments comprises two related views of hydrological catchments to be used for analysis and reporting purposes. Firstly, a topological network view of hydrological catchments represented as a simplified node-link network using a subset of the contracted nodes (AHGFNode) and the links (AHGFLink) between them; and secondly, a catchments view of the hydrology using the contracted catchments (AHGFContractedCatchment).

The AHGFNode feature class contains contracted nodes that are points of hydrological significance that carry identity. They include the confluence of major named streams, coastal stream termini, waterbody inflow and outflows and inland sinks. It also contains a new class of node called diffuse nodes that represent diffused flow from groups of nodes at coastal, delta or inter-catchment outlets.

The AHGFLink feature class provides the topological connectors between a subset of contracted nodes that participate in the simplified node-link network.

The AHGFContractedCatchment feature class contains catchment polygons (that are aggregations of AHGFCatchments) for the subset of contracted nodes that participate in the simplified node link network. These catchments are part of a hierarchy that can be aggregated based on upstream relationships. Table 23 shows the Geofabric Hydrology Reporting Catchments feature class terminology and feature subtypes.

The AHGFContractedCatchments can be subdivided by type as follows:

- **ContractedArea** – the upstream catchment area draining to a contracted node that participates in the simplified node-link network. It identifies the area upstream that will drain to that node (bounded wherever other upstream contracted nodes are encountered).
- **NonContractedArea** – the upstream catchment area draining to areas with contracted nodes of low confidence level (i.e. catchments containing AHGFNetworkStream features without corresponding AHGFMappedStream features)
- **NoFlowArea** – areas lacking both related network stream features and sensible catchments with which to be merged such as small islands.

5.4.1 Understanding and using Geofabric Hydrology Reporting Catchments

Geofabric Hydrology Reporting Catchments is designed to meet two specific use cases. Firstly, the contracted catchments are designed to build stable reporting regions and secondly, the simplified node-link network is designed to be used as input to hydrological modelling environments, to identify nodes, reporting reaches and their associated catchments.

The AHGFContractedCatchment feature class is designed to represent geographic surface boundaries that have a hydrological relationship to surface water features. These catchment boundaries in their current form may not completely satisfy legislative or business requirements, but are intended to provide the building blocks for reporting regions such as those given in Geofabric Hydrology Reporting Regions. The AHGFNode and AHGFLink feature classes provide a simplified, dendritic node link network for input into hydrological models.

Some applications of Hydrology Reporting Catchments include:

- identification of important and persistent hydrological features
- providing a system boundary for surface water modelling
- providing a simplified, dendritic, node-link network for input into hydrological models
- aggregation of contracted catchment units into stable reporting regions.

5.4.2 Feature classes, feature types, related tables and key attributes

Table 23 – Feature classes and tables for Geofabric Hydrology Reporting Catchments

ObjectClass Name	Type	Geometry	Subtype
HR_Catchments			
AHGFContractedCatchment	Simple FeatureClass	Polygon	ContractedArea NoFlowArea NonContractedArea
AHGFLink	Simple FeatureClass	Polyline	-
AHGFNode	Simple FeatureClass	Point	NetworkArtificialNode NetworkCliffNode NetworkGhostNode NetworkHeadNode NetworkJunctionNode NetworkTerminusNode NetworkWaterAreaNode
Stand Alone ObjectClass(s)			
AHGFNodeLinkConnectivityDown	Table	-	-
AHGFNodeLinkConnectivityUp	Table	-	-

The following tables describe the key attributes for Geofabric Hydrology Reporting Catchments.

Table 24 – Key attributes of AHGFContractedCatchment feature class for Geofabric Hydrology Reporting Catchments

Key attribute	Alias	Description
ConNodeID	ContractedNodeID	Persistent unique identifier of related logical AHGF contracted node
ConLevel	ContractLevel	Confidence level of related logical AHGF contracted node
TConNodeID	ToContractedNodeID	The next downstream ConNodeID
NetNodeID	NetworkNodeID	HydroID of node that represents the contracted node in AHGFNetworkNode
MapNodeID	MappedNodeID	HydroID of node that represents the contracted node in AHGFMappedNode

Table 25 – Key attributes of AHGFLink feature class for Geofabric Hydrology Reporting Catchments

Key attribute	Alias	Description
FConNodeID	FromContractedNodeID	The next upstream ConNodeID
TConNodeID	ToContractedNodeID	The next downstream ConNodeID
DrainID	DrainID	The HydroID for the AHGFCatchment into which the AHGFLink drains

Table 26 – Key attributes of AHGFNode feature class for Geofabric Hydrology Reporting Catchments

Key attribute	Alias	Description
ConNodeID	ContractedNodeID	Persistent unique identifier of related logical AHGF contracted node
ConLevel	ContractLevel	Confidence level of related logical AHGF contracted node
MapNodeID	MappedNodeID	HydroID of node that represents the contracted node in AHGFMappedNode
NextDownID	NextDownID	The HydroID for the next downstream AHGFNode

Table 27 – Key attributes of AHGFNodeLinkConnectivityDown table for Geofabric Hydrology Reporting Catchments

Key attribute	Alias	Description
From_ID	From_ID	The next upstream AHGFNode ID
To_ID	To_ID	The next downstream AHGFNode ID
Link_ID	Link_ID	HydroID of the Link feature

Table 28 – Key attributes of AHGFNodeLinkConnectivityUp table for Geofabric Hydrology Reporting Catchments

Key attribute	Alias	Description
From_ID	From_ID	The next downstream AHGFNode ID
To_ID	To_ID	The next upstream AHGFNode ID
Link_ID	Link_ID	HydroID of the Link feature

5.4.3 Description of Geofabric Hydrology Reporting Catchments data

All contracted catchment features of type ContractedArea are aggregations of the AHGFCatchment units that participate in a relationship of common geographic extent based upon the location of a contracted node from both Geofabric Surface Cartography and Geofabric Surface Network or a data sink as defined within the DEM-1S. Levels of confidence for contracted nodes are further described in the following section of the Geofabric Product Guide.

Each ContractedArea is assigned with the contracted node identifier (ConNodeID) and the confidence level (ConLevel) of the contracted node to which they drain. The ContractedArea features are the drainage areas of a combination of Levels 1 and 2 contracted nodes. These drainage areas also incorporate catchment areas where there is no discernable flow (at 1:250,000 scale) in the form of stream flow segment features. The allocation of no flow areas to contracted catchments is performed based on the most likely destination of water falling in these areas in flood type conditions.

Contracted catchment hierarchy

In previous versions of the Geofabric, the set of contracted catchment features provided a collection of drainage areas for a set of persistent contracted nodes. In V2.1 these areas have been further processed to aggregate these features into a contracted catchment hierarchy. This hierarchy of contracted catchments includes only those catchments for key contracted nodes taken from a full set of contractible river confluences, sinks, monitoring points and the inflow and outflow points of water storages. These key contracted nodes form a stable, logical, dendritic hierarchy of catchments that can be reliably reproduced when moving to higher resolution or larger scaled data. The contracted catchment hierarchy provides a reliable and stable set of catchments that, among other things, can be mapped to a number of types of water reporting areas (depending on the use case) as exemplified by the stable reporting regions given in Hydrology Reporting Regions.

5.4.4 Contracted nodes and confidence attribution

Contracted node attributes are a special feature of the Geofabric that identify important hydrological features such as stream confluences, stream coastal outlets, inland sinks and inflow and outflow of water storages. Once identified, a contracted node is given a persistent identifier across the suite of products that is designed to persist through subsequent versions. As the products evolve, and the base information becomes more detailed, more contracted nodes will be added.

The business rule for the creation of a candidate contracted node is that the stream segments flowing into a node must be attributed according to a series of contracted confidence levels and be identifiable in both products (AHGFNetworkStream and AHGFMappedStream). For example, a confluence node of two or more streams that have attributes of both NAMED (i.e. the name attribute is populated) and MAJOR (a hierarchy classification of Major), and exist in both Geofabric Surface Cartography and Geofabric Surface Network, will be designated as a contracted node of the highest confidence level. Therefore, this contracted node and its Attribute ID (ConNodeID) will be highly likely to persist and have representations within both Geofabric Surface Cartography and Geofabric Surface Network, regardless of future product updates. Refer to the contracted node creation business rules in Tables 29 and 30 below for further details.

Table 29 – Candidate contracted node creation rules for stream confluences and stream coastal outlets

Contracted confidence level			Stream confluences				Stream coastal outlets	
			Stream segment 1		Stream segment 2 or more		Stream segment 1	
Node attribute	**Confidence rank**	**Usage**	**Name attribute**	**Hierarchy attribute**	**Name attribute**	**Hierarchy attribute**	**Name attribute**	**Hierarchy attribute**
Level 1	highest	recommended	named	major	named	major	named	major
Level 2		usable	named	major	named	minor/empty	named	minor/empty
Level 2		usable	named	minor/empty	named	minor/empty	named	minor/empty
Level 3		marginal	unnamed	major	unnamed	major	unnamed	major
Level 3		marginal	named	major	unnamed	major	unnamed	major
Level 4	lowest	not recommended	unnamed	minor/empty	unnamed	minor/empty	unnamed	minor/empty

Table 30 – Candidate contracted node creation rules for water bodies and inland sinks

Contracted confidence level			**Water body inflow and outflow**		**Inland sinks**		
			Water body	**DEM-1S Data sink**	**Stream segment 1**		**DEM-1S Data sink**
Node attribute	**Confidence rank**	**Usage**	**Name attribute**	**Sink confidence level**	**Name attribute**	**Hierarchy attribute**	**Sink confidence level**
Level 1	highest	recommended	Named	1	named	major	1
Level 1		usable	Named	2	named	minor/empty	2
Level 2		usable	Unnamed	1	named	minor/empty	1
Level 2		usable	Named	Null	unnamed	major	2
Level 2		usable	Unnamed	2			

5.5 Geofabric Hydrology Reporting Regions

Geofabric Hydrology Reporting Regions are derived from aggregations of contracted catchments from Geofabric Hydrology Reporting Catchments. This product contains two candidate reporting regions, namely AWRA Drainage Division for national scale reporting purposes and River Region for regional scale reporting purposes. More reporting regions may be added in future releases based on user requirements.

The AWRA Drainage Division is defined for the purpose of providing a stable set of reporting regions specifically for the purpose of the Bureau's Australian Water Resources Assessment and are referred to as the 2010 and 2012 Assessment Reporting Regions.

The River Regions were based on a specification developed by Bureau hydrologists involved in water resources assessment in consultation with the Geofabric team and scientists from CSIRO and ANU. These boundaries were developed for use in regional scale reporting and hydrological modelling. The River Region boundaries were not used in the Australian Water Resources Assessment 2010 and 2012 but may be considered in the future as the resolution of reporting increases.

Though the Geofabric Hydrology Reporting Regions have been developed for the purposes of the Australian Water Resources Assessment, it is envisaged that these units can be used more generally as a standard for hydrological reporting at the national and regional scale, and thus replace the Australia River Basins 1997 (http://www.ga.gov.au/metadata-gateway/metadata/record/gcat_42343).

Table 31 shows the Geofabric Hydrology Reporting Regions feature class terminology and feature subtypes.

5.5.1 Understanding and using Geofabric Hydrology Reporting Regions

The purpose of Geofabric Hydrology Reporting Regions is to provide a stable set of reporting boundaries at both the national and regional scale. It contains two levels of hydrological reporting regions. The first delineates national level drainage divisions and the second delineates regional level river regions across Australia.

While the Geofabric Hydrology Reporting Regions were developed on the basis of Bureau requirements for water resources assessment, it is envisaged that these units can be more generally used as the standard for hydrological reporting at the national and regional scale and thus replace GA's River Basins (1997).

The Reporting Region products exist as polygon feature classes and can be used for reporting hydrological phenomena within a given catchment or catchments. Alternately, the contracted catchment features can be accessed through a lookup table, namely AWRADDContractedCatchmentLookup or RRContractedCatchmentLookup tables.

Some applications for this product include:

- use of the AWRADrainageDivisions for national scale hydrological reporting
- use of the RiverRegions for regional scale hydrological reporting
- aggregation of data or statistics according to hydrological significant units
- presentation of information for maps which make comparisons across reporting regions. For example, a map of water availability by region
- use as a boundary layer for searching and locating data of interest within a given region.

5.5.2 Feature classes, feature types, related tables and key attributes

Table 31 – Feature classes and tables for Geofabric Hydrology Reporting Regions

ObjectClass Name	Type	Geometry	Subtype
HR_Regions			
AWRADrainageDivision	Simple FeatureClass	Polygon	-
RiverRegion	Simple FeatureClass	Polygon	-
Stand Alone ObjectClass(s)			
AWRADDContractedCatchmentLookup	Table	-	-
RRContractedCatchmentLookup	Table	-	-

The following tables describe the key attributes for Geofabric Hydrology Reporting Regions.

Table 32 – Key attributes of AWRADrainageDivision feature class for Geofabric Hydrology Reporting Regions

Key attribute	Alias	Description
DivNumber	DivisionNumber	The number assigned to the AWRADrainageDivision
Division	Division	The name assigned to the AWRADrainageDivision

Table 33 – Key attributes of RiverRegion feature class for Geofabric Hydrology Reporting Regions

Key attribute	Alias	Description
Division	Division	The corresponding AWRADrainageDivision name
RivRegName	RiverRegionName	The name assigned to the RiverRegion

Table 34 – Key attributes of AWRADDContractedCatchmentLookup table for Geofabric Hydrology Reporting Regions

Key attribute	Alias	Description
ConCatID	ContractedCatchmentID	The HydroID for a contracted catchment
AWRADDID	AWRADDID	Numeric ID of the Drainage Divisions
ConNodeID	ContractedNodeID	ConNodeID corresponding to AHGFNode
CCHydroID	ContractedCatchmentHydroID	HydroID of the contracted catchment

Table 35 – Key attributes of RRContractedCatchmentLookup table for Geofabric Hydrology Reporting Regions

Key attribute	Alias	Description
ConCatID	ContractedCatchmentID	The HydroID for a contracted catchment
RRID	RRID	Numeric ID of the River Regions
ConNodeID	ContractedNodeID	ConNodeID corresponding to AHGFNode
CCHydroID	ContractedCatchmentHydroID	HydroID of the contracted catchment

6 Data Product specifications, Database Schemas and Data Dictionaries

Phase 2 data product specifications, database schemas and data dictionaries are available for each product and can be used in the interim while Phase 3 documentation is being developed:

These are available: www.bom.gov.au/water/geofabric/documentation.shtml

Please refer to section 2.1.2 of this product guide to take note of the differences between Phase 2 and Phase 3 products. Overall Phase 3 data product specifications, product database schemas and data dictionaries will closely match those of Phase 2, with the exception of additional Phase 3 features classes and higher resolution foundation input data in Phase 3. Also within existing Phase 2 documentation, references to V2.1, dates, scales, product identifiers and geographic extent cannot be relied upon when viewed for Phase 3 purposes

If you require assistance with understanding Phase 3 products please contact the Bureau via email: ahgf@bom.gov.au

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