VICTORIA POLICE

GEOREFERENCE STANDARD

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GEOREFERENCE STANDARD
FOCUS GROUP ENDORSEMENT

We, the undersigned,

endorse the GEOREFERENCE STANDARD (Version 1.1, updated on 28 July 2009)

as an accurate

reflection of the collective input of the GEOREFERENCE STANDARD Focus Group and

representation of our understanding of Victoria Police business requirements for such a standard within the Terms of Reference specified in this document.

Business Area	Endorsed By	Focus Group Member
Region 2 (DIU – Horsham)	Gary Green On 20-08-2009	Greg Lambert
Traffic & Transit (Highway Unit)	Jeff Millar On 6/8/09	Ross Eldridge
Traffic & Transit (Traffic Drug & Alcohol)	Martin Boorman On 5/8/09	Peter Tester
Specialist Support (Search & Rescue; Water Police)	Stephen Guilmartin On 18/8/09	Ian Veitch Jason Ball
CSP (Performance & Bus. Intelligence)	Richard Grant Richard Grant, APM Superintendent On 30.7.09	Bernie Moloney
Intelligence & Covert Support (State Intelligence)	Leesa Johnson On 05/08/09	Lisa Cheong
BITS (CAD / MDN / GIS)	David Dettmann On 3/8/9	Matthew Anderson David James
BITS (Applications Mgt)	Grace Zielinski On 030/08/09	Neil Richardson (TIS) Graeme Ford (Link) Dominic Galati (LEAP)
BITS (Tech Stds & Architecture)	David Wyatt On 30-7-09	Rose Lee Jose Loyola

GEOREFERENCE STANDARD
EXECUTIVE ENDORSEMENT

We, the undersigned,

endorse the content of this document
(Version 1.1, updated on 28 July 2009)
as the Victoria Police GEOREFERENCE STANDARD
with the mandate for its use, as described in the Executive Summary.

Marshall Lee

Manager, Technical Standards & Architecture

On 31-8-2009

Shirley Huberts

Chair, BITS Board of Management

On 3/8/09

Keiran Walshe

Chair, Data Management Steering Committee

On 10.9.09

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1 EXECUTIVE SUMMARY

1.1 Background

> *Victoria's strategic framework is supporting the push toward greater availability of spatial information by stating explicitly that development of applications should enable data to be accessible by anyone anywhere; cater for all users; and enable data exchange, regardless of technology and formats.*

The above quote is sourced from the *VSIS (Victorian Spatial Information Strategy) 2008-2010 Information Paper*.

In the environment of such spatial initiatives, Victoria Police systems need to be readied to hold spatial data, where currently they may contain only textual data. This is the vision that has moved for the development of a GEOREFERENCE STANDARD for Victoria Police.

1.2 Business Goal

The business goal for accurate and inter-operable *Location* data is to equip the operational member with all relevant information associated with the *Site* BEFORE attending an *Incident*. Such relevant information (with their associated information system listed within brackets) include whether the property is :

- the registered storage address of what number and description of Firearm (from LARS)
- the residential/business/postal address of a Person, flagged with a Warning (from LEAP) for:
  - drugs association
  - licensed to carry weapon/s or firearms
  - a medical condition
  - being a vexatious litigant
  - violent behaviour
  - liquor-related interest
- the site of a drug-related traffic accident (from TIS)
- associated with any relevant intelligence (from Interpose)

1.3 Mandate[1]

The following is the sequence of endorsement steps taken for the GEOREFERENCE STANDARD to be incorporated into corporate policy :

(1) endorsement by manager of each member of the Focus Group
(2) endorsement by Manager of Technical Standards and Architecture
(3) endorsement by Chair, BITS Board of Management
(4) endorsement by Chair, Data Management Steering Committee (DMSC)
(5) hand-over to Corporate Policy for inclusion in the Victoria Police Manual

The following is the mandate behind the GEOREFERENCE STANDARD :

(1) the GEOREFERENCE STANDARD must be implemented in all new systems from <**ddmmyyyy – date to be provided by GIS Reference Group, as delegate for DMSC**>

[1] This mandate has been endorsed by Deputy Commissioner Kieran Walshe.

(2) non-compliant COTS (Commercial Off The Shelf) technical solutions, if procured post the above-mentioned date, must comply with data structures and processes in their design and implementation to map-over to the GEOREFERENCE STANDARD

(3) all other systems, which include :
- non-compliant current and "legacy" systems implemented prior to the above-mentioned date
- non-compliant COTS (Commercial Off The Shelf) technical solutions, procured before the above-mentioned date

need to be screened for compliance by the GIS Reference Group, for their significance in delivering operational data for *Locations of Interest* to policing services. Systems deemed to be significant are required to change-over within the time frame set by the GIS Reference Group.

1.4 Compliance Custodian

The GIS Reference Group, managed by CAD/MDN/GIS[2], has been formed recently. It is charged with the oversight of integrating the spatial initiatives, across all of Victoria Police, from business and practitioner perspectives.

As this Reference Group will be dealing with spatial systems for the business of policing services, it is the appropriate ***Compliance Custodian*** of the GEOREFERENCE STANDARD. This custodianship is in the mandate, endorsed by Deputy Commissioner Kieran Walshe.

1.5 Summary of the GEOREFERENCE STANDARD

There are only 3 Geographic Reference Systems (GRS) that are ***authorised*** as the **GEOREFERENCE STANDARD** for Victoria Police, namely :

[a] Geographic – GDA94
[b] VICGRID94
[c] MGA94

1. Concepts of Use

   Depending on the *Concept of Use* of the georeferenced data, a particular GRS may be more appropriate. (See discussion in section on "*Concepts of Use*".)

2. *Reference* and *Local* Databases

   The GRS apply to data structures and formats for storage of the georeferenced data in the back-end *Reference Database*.

   Local Databases may need to structure their georeferenced data in other GRS formats, according to work area specific requirements. (See definitions and details in section on "*Reference* versus *Local* Database".)

For georeferenced data to be reliable, it is important that any transmission/translation process does not jeopardise the precision level of the original data capture. The quality and precision of the georeferenced data must be preserved and owned by the **sponsor of the application system** that is the source of the georeferenced data.

It is important that any application system, project or work unit purchasing GPS-enabled devices records the operational capabilities of the devices and **owns** the provision and management of a work "**Instruction Sheet**" on how the devices will be used within its scope of operations. This promotes the strategic thinking **before** procurement of the end-to-end use of the georeferenced data.

[2] Currently managed by Inspector Matthew (Randy) Anderson, and coordinated on the ground by Sergeant Peter Branca.

2 GEOREFERENCE STANDARD

2.1 Context

The GEOREFERENCE STANDARD is a component of the LOCATION DATA STANDARD (click on "A2. Location"), currently being developed for Victoria Police with an enterprise-wide approach. Any overview guidelines prescribed in the LOCATION DATA STANDARD, will apply to the GEOREFERENCE STANDARD, unless specifically stated otherwise.

2.2 Terminology

The following **definition of GEOREFERENCE** is adapted for Victoria Police usage, from an ANZLIC[3] glossary of terms, sourced from url http://www.anzlic.org.au/Glossary/Spatial+Information_Related+Terms/default.aspx#G accessed 30/8/11

> *GEOREFERENCE is the set of coordinates of an absolute **geographic reference system**, assigned to a **Geographic Feature** or a **Location of Interest** to Victoria Police.*

In March 2009, the Focus Group charged with the review of the GEOCODE STANDARD that was authorised in October 2007, endorsed "Georeference" as the more apt label. ("Geocode" may be colloquially used still, and feature in old documentation.)

2.3 Target Audience

This document has impact on any user or manager of georeferenced data in Victoria Police.

As geographic reference systems are specialist in nature, it is recommended that this document be used by an analyst, interacting with business system users to prescribe a system-specific "Instruction Sheet" on how to use/manage their georeferenced data for inter-operability across Victoria Police systems, currently or in the future. (Please refer to Appendix 1 for an example of such an "Instruction Sheet".)

2.4 Content of the GEOREFERENCE STANDARD

The GEOREFERENCE STANDARD contains *:*

1. **Definitions of the Attributes** of georeferenced data
   This serves to establish a common understanding of the meaning of the georeferenced data. It includes terminology used where colloquial usage may involve different nuances of meaning.
2. The **Geographic Reference Systems** for use in the GEOREFERENCE STANDARD
   Depending on the *Concept of Use* of the georeferenced data, different Geographic Reference Systems (GRS) are prescribed for use. Associated with each GRS are different *Attributes* and formats for storage in the back-end database.

   These formats for storage are expressed in *logical*[4] (rather than *physical*) formats. The only physical formats included in the GEOREFERENCE STANDARD relate to those attributes sourced from the *Vicmap* data set.

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3 The Spatial Information Council of Australia and New Zealand (formerly known as the Australia New Zealand Land Information Council).

3. **Implementation Guidelines**
   Where relevant, implementation guidelines are included which relate to data handling and precision.

Whilst the data standards are about formats for storage in the back-end database, the methods of data capture in the field and how the data is to be operationally used/translated/managed throughout its life cycle, are considered to define the data standard.

2.5 Terms of Reference

The following are **within the scope** of the GEOREFERENCE STANDARD :

1. Relevance for ALL Victoria Police Systems

   Whilst LEAP was the initial "focus" application to be "prepared" for georeferenced data, the GEOREFERENCE STANDARD must be appropriate for all application systems across Victoria Police, where there is **interchange** of georeferenced data. This is a critical requirement for georeferenced data to inter-operate between systems.

2. *Vicmap Address* as Data Source

   The *Vicmap Address* product is the authoritative source of Victorian property-related Addresses, and prescribed by VSIS. Therefore *Vicmap Address* is the data source of Victorian Addresses. As such, the GEOREFERENCE STANDARD includes attributes to facilitate future referencing of, and validation against, *Vicmap Address* (or other Vicmap product) data sets.

The following are **out of scope** for the GEOREFERENCE STANDARD :

1. Equipment and Technology Solutions

   Whilst some "implementation guidelines" are offered, they are data-related. Recommendations on technical solutions of whole systems or specific equipment are out of scope. Preferred models of supply are out of scope.

   Spatial database management systems are out of scope. Spatial object types (eg. "SDO_GEOMETRY" in Oracle Spatial systems) are out of scope.

   The "Preferred Features" of some geospatial-enabled devices (in *Appendix 1)* are from a business end user perspective, and are not technical recommendations.

2. Spatial User Interface and Georeferenced POINT/LINE/POLYGON

   The GEOREFERENCE STANDARD is about referencing the *GEOGRAPHIC LOCATIONs of interest* to Victoria Police. The systems, to which the standard will apply, relate to operational policing and are not about the management of spatial user interfaces.

   Therefore what are in scope for the GEOREFERENCE STANDARD are **point**s, that are used to reference *Locations of Interest* to Victoria Police. If the spatial object of interest is described, at higher levels of magnification, by a **line** (eg. train line or road) or a **polygon** (eg. building), more than one set of georeferences may be used to reference such objects. The related sets of georeferences that map to the line or polygon spatial objects are not in the scope of the GEOREFERENCE STANDARD.
   In other words, metadata is out of scope that :

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[4] ***Logical*** formats are expressed in terms which are not specific to technical solutions, whereas ***physical*** formats are technology-specific. Examples of *logical data types* are "numeric" and "alphanumeric" (used in *AS4590 - 2006 Interchange of Client Information*). The *logical data type* of "numeric" may be implemented as different *physical data types* in different technologies (listed here – within square brackets) and for different precision and scale (eg. "NUMBER1" [Oracle], "DECIMAL(1)" [DB2], "TINYINT" [MS SQL], "BYTE" [MS Access], "NUMERIC(1)" [Sybase]). The *logical data type* of "alphanumeric" may be implemented as "VARCHAR2" [Oracle], or "TEXT" [MS Access], to cite just two examples.
Spatial object types (eg. "SDO_GEOMETRY" of *Oracle Spatial* systems) are out of scope.
For more detail on *Oracle Spatial*, please refer to url
http://www.sc.ehu.es/siwebso/KZCC/Oracle_10g_Documentacion/appdev.101/b10826/sdo_intro.htm accessed 6/9/11

- serve to relate more than one georeference to the same spatial object, or
- are related to the mechanics of the spatial user interface.

3. Precision Mechanisms

   The application system that uses georeferenced data needs to consider specific processes and methods to ensure the highest precision of the georeferenced data, from data capture, through to any translation/transmission processes to/from presentation/transmission layers and the storage database. These precision mechanisms and procedures are out of scope of the GEOREFERENCE STANDARD.

   The same application system must also ensure that the original precision/accuracy of the georeferenced data at data capture is not diminished in future downloads from or uploads to the storage database. This can occur in the presentation, translation and transmission (or messaging) layers. Such precision/accuracy mechanisms and procedures are out of scope of the GEOREFERENCE STANDARD.

4. Evidentiary Considerations

   The legal ramifications surrounding georeferenced data being presented as evidence in the courts[5] is out of scope. Implications from incorrect handling of the GPS-enabled devices and additional attributes to enable referencing of external georeferences to validate or cross-check internal georeferenced data have not been considered.

2.6 Concepts of Use

The following aspects of Geographic Reference Systems (GRS) are relevant for the different types of *Concept of Use* of georeferenced data in Victoria Police :

1. ***DATUM***

   The Geocentric Datum of Australia, **GDA94**[6], is the standard for the *DATUM* for Victoria Police.

   Therefore, if georeferences are obtained in another *datum* (eg. WGS84[7] and AGD[8]), they are required to be transformed to GDA94, before storage in systems where georeferenced data is interchanged between systems or work units. (Note that if operational requirements do not

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5 Some relevant reading include :
Geocode Documents\Legal Ethical Implications.pdf
Geocode Documents\Geo-information_as_court_evidence.ppt

6 From various internet sources, including : http://www.cage.curtin.edu.au/~will/datum.html accessed 6/9/11

It was recommended at the inaugural meeting of the Inter-governmental Committee on Surveying and Mapping (ICSM) in July 1988 that the new earth-centred datum, Geocentric Datum of Australia, **GDA,** will be used for future mapping and nautical charting of Australia and its offshore islands. Further, its nation-wide implementation was recommended by the year 2000.

The main advantage of GDA94 is that the coordinates are immediately compatible with global coordinates obtained from GPS (Global Positioning System) and with other coordinate systems adopted in many parts of the world. GDA94 also provides a single uniform coordinate system within Australia, enabling the production of a homogeneous series of Australian maps and nautical charts which meets international navigation requirements. This reduces problems caused by different states using different datums. It allows more efficient and more confident exchange of spatial information between digital systems.

7 If precision is NOT a concern (where operational requirements allow a precision worse than 0.000033 degrees or 3 metres), **GDA94** and **WGS84** (World Geodetic System, the datum of **GPS**, Global Positioning System) coordinates are "practically" the same. The difference is of the order of 80 cm, increasing by about 7 cm per year. The GDA uses a more accurate model, which is endorsed by the **IAG (**International Association of Geodesy), and to which WGS84 has been aligned.
For practical tips for GDA-WGS conversions, please refer to http://www.icsm.gov.au/icsm/gda/wgs84fact.pdf accessed 6/9/11
For precise positioning services with a precision of less than a metre, refer to http://www.ssc2007.com/abstract/163.htm accessed 6/9/11

8 Both the 1966 and 1984 versions of the Australian Geodetic Datum (**AGD**) have been replaced by Geocentric Datum of Australia (GDA94) accessed 6/9/11. All government mapping agencies and authorities were scheduled to adopt GDA94 by 2000. Please refer to http://www.icsm.gov.au/icsm/gda/gdabroc2.pdf accessed 6/9/11

dictate a high level of precision, WGS84 coordinates can be approximated to GDA94 coordinates – see WGS84 footnote.)

GDA94 has been adopted as the coordinate framework for Australia. Hence it is a necessary ***alignment to enable inter-agency exchange of georeferenced data***.

2. ***Geographic versus Map Projection***[9].

With GDA94 as the overarching *datum*, various geographic and map projection systems can be used, depending on the *concept of use* that is significant for the application or the operational area. Below is a listing of each GRS that features in the GEOREFERENCE STANDARD and associated *concept of use* :

[a] **Geographic-GDA94**

Geographic coordinates go with the domain of referencing *geographic* features and sites of interest. The terminology revolves around *latitudes* and *longitudes* (colloquially abbreviated to *lats* and *longs).*

Concept of Use : Geographic view

(1) Need to reference *Geographic Locations* **without** associated need to ***measure distances*** *between 2 or more Locations*.

(2) Need to ***interchange georeferences*** with other agencies or Victoria Police work units, where there is already a high usage of Geographic-GDA94.

[b] **VICGRID94**

VICGRID94 uses GDA94 and the Lambert Conical map projection (easting and northing), for the land mass that is the state of Victoria. This is the Victorian standard that allows a SINGLE coverage of the whole of Victoria.

Concept of Use : Mapping; State-wide view

(1) Need to ***measure distances*** *between 2 or more* ***distant*** *Locations*, especially where they fall into different Zones in the MGA format.
A scenario is the need to overview all of Victoria for a state-wide initiative.

(2) Need to ***interchange georeferences*** with other Victorian agencies, where there is already a high usage of VICGRID94.
Spatial Information Infrastructure (SII) of the Department of Sustainability & Environment (DSE) uses VICGRID94.

[c] **MGA94**

The Map Grid of Australia, MGA94, is the national standard for series topographic mapping and other map-based products. It uses GDA94 as the *datum*. It adopts the Universal Transverse Mercator (UTM[10]) map projection (easting, northing and zone).

Concept of Use : Series Mapping; Local view

(1) Need to ***measure distances*** *between 2 or more* ***local*** *Locations.*
If these *Locations* are in different *Zones*, VICGRID94 should be used.

(2) Need for ***map-based inputs or outputs*** in relation to local terrain.

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[9] Geographic coordinates (Latitude and Longitude) are angles, not distances, measured from the centre of a datum. The process of transforming from *Geographic* into *Cartesian Coordinates* (Easting and Northing) is known as *Map Projection* (see "Construction of a map projection" in http://en.wikipedia.org/wiki/Map_projection#Construction_of_a_map_projection accessed 6/9/11)

[10] Specific work areas or units may use '**UTM**' without any qualification of the datum. The datum is a "known fact" for their operations, which may use maps based on :

- GDA94 (the current national standard)
- WGS84 (the datum of Global Positioning Systems, GPS); WGS72 (prior to GPS)
- AGD84 (in 2000, replaced by GDA94 as the national standard); AGD66 (prior to 2000, but some old AGD66 maps may still be used, as they provide richer topographic detail)
- Clarke 1858 (prior to 1972)

It is to be noted that if the UTM coordinates use a *datum* other than GDA94, they MUST be transformed to MGA94 format, before they are supplied to other work units or stored in a *Reference Database*.

A scenario is maps used by Search and Rescue for searches of missing persons in the bush.

City of Melbourne's *Property Mapbase* uses MGA94 coordinates.

It is to be noted that :

(1) There are only 3 GRS that are in the ***authorised GEOREFERENCE STANDARD*** for Victoria Police, namely :
   [a] Geographic – GDA94
   [b] VICGRID94
   [c] MGA94

   Operational requirements may dictate handling of georeferenced data in other GRS formats. These must be converted to the above three GRS formats, prior to storage in the back-end database, if the database is to be used as a source of interchangeable georeferenced data (see following section on "*Reference* versus *Local* Databases").

(2) when geographical coordinates are used to produce maps, **extreme** distortions occur for area, distance and angles.

3. ***Metrics***

   The metrics associated with each GRS will be dealt in detail in the *Tables of Georeference Attributes*.

   The operational metrics for *Land Navigation* **(decimal degrees)** may differ from *Nautical Navigation* **(degrees decimal minutes** or **degrees minutes seconds** [11]**)**.
   For Geographic-GDA94, if the georeferenced data is captured in degrees, minutes and seconds, it should be converted to **decimal degrees** before storage in *Reference Databases* (see section below), irrespective of whether it is for *Land Navigation* or *Nautical Navigation***.**

2.7 "Reference" versus "Local" Databases

A *Reference Database* is one, where typically more than one *Client Application* source/supply their data. In other words, a *Reference Database* contains georeferenced data, which is, or has the potential to be, interchangeable between systems and other work units/areas.

On the other hand, a *Local Database* is one, which serves the specialist functions of a work unit/area, and is not (or will not be) sourced by, or interchanged with, other work areas or applications. As such, *Local Databases* have very local impact, specific to work units. If *Local Databases* provide data to other work units or applications in the future, they have evolved to *Reference Databases.*

1. **Reference Database**

   The database in the vision for a ***DataBase of Record*** *for Location* is the ultimate in terms of *Reference Databases*.

   In Victoria Police, the practical reality may be more than one *Reference Databases* containing *Locations of Interest*. For example, a traffic-centric *reference database* is very likely.

   Whether the *Reference Database* stores 1 or all 3 GRS, namely :
   [a] Geographic – GDA94
   [b] VICGRID94
   [c] MGA94

   depends on the geospatial capability of the technical implementation.

   Map projection (ie. conversion of [a] to [b] or [c]) is onerous with a manual process[12].

[11] Water Police may require metrics of "degrees decimal minutes" for their operative precision.

If the geospatial technology can convert between GRS, and the application system has processes to ensure such transformation does not jeopardise the precision associated with the ORIGINAL data capture, then the *Reference Database* needs to store in only ONE GRS, but can deliver the georeferenced data in any of the other 2 formats. Note that there is no single GRS that is the *mandatory default.*

If the geospatial capability is limited and any conversion between GRS is MANUAL, then storage in all THREE GRS formats in the *Reference Database* is recommended (but not mandated) for the following reasons :

- Minimise time for retrieval of the georeferenced data
  (Scenario : the georeferenced data is required for the officer's *Attendance* at an *Incident.)*
- Maximise accuracy of any conversion [13].
- Maximise resolution of any conversion issues
  Validation and quality assurance procedures are most effective closest to the point of data capture as the sources for checking location precision are freshest or more readily available then.

2. **Local Database**

Generally, a *Local Database* serves the work unit/area needs in a localised or specialist way. As the database is only of local impact, the GRS that best serves the *concept of use* of the georeferenced data is to be used. Search and Rescue, for example, is reliant on map-based products for their operations. Search and Rescue teams use MGA in preference to other GRS. They may also use old AGD66 maps where these are still available, for example in searches of missing persons in the bush.

Therefore, applications with *Local Databases* of georeferenced data should decide on the appropriate GRS, with consideration of :

- priority of *Concept of Use* of the georeferenced data
- the need for interchange of the georeferenced data across applications and agencies.

Once a *Local Database* becomes a *Reference Database,* it must comply with the 3 authorised GRSs.

2.8 Formats of Vicmap-Related Attributes

In the preceding section on ***Terms of Reference***, *Vicmap Address* and other *Vicmap* product data sets have been identified as ***in scope*** data sources. As such, the GEOREFERENCE STANDARD includes attributes to facilitate future referencing of, and validation against, *Vicmap Address* (or other Vicmap product) data sets.

The attributes that relate to Vicmap data in the GEOREFERENCE STANDARD contain formats that reflect the **current** Vicmap implementation. Therefore, it is to be noted that the Vicmap formats presented in this document are **indicative only**, and the client application should re-confirm the formats at application development for currency.

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[12] For example, the Redfern conversion formula to convert geographic to cartesian coordinates is several pages long.

[13] "*Note that coordinate conversion can be time-consuming and prone to mistakes when staff are under pressure.*" - sourced from Section 2.4.2, on page 42 of 115 : Manual of Emergency Management GIS for New Zealand.

2.9 Implementation Guidelines

1. Initial versus Validated Values

   Some Victoria Police applications may need to preserve *initial* georeference values (for example, coordinates off a mobile phone, reported by a passing witness of a drowning incident) as well as *validated* values.

   It is strongly recommended that :

   - **The *initial* georeference values are *validated* BEFORE preservation in the back-end database.**
     (This is especially so, if the design of the client application dictates that only ONE GRS is to be stored on the database.)
   - Validation is actioned as close to the point of receipt or the point of data entry of the georeferenced information. This is because the sources for checking location precision are freshest or more readily available then.

2. Precision Levels

   Generally the georeference capture system should cater for the maximum possible precision (to the millimetre level). Without this as the overarching *modus operandi*, the **business goal** – to equip the operational member with all relevant information associated with the *Site* BEFORE attending an *Incident* – cannot be achieved with RELIABLE data.

   In practical terms, precision may be dictated to by the time constraints surrounding the georeference capture and should be appropriate for the task in hand or the requirements of the client application using the georeferenced data.

   Recorded precision should not exceed the precision achievable, by equipment or method.

   The numbers of decimal places associated with precision levels are as follows :

METRICS	PRECISION LEVELS of		
	Kilometre	Metre	Millimetre
Decimal Degrees	3 decimal places of <Degrees>	6 decimal places of <Degrees>	9 decimal places of <Degrees>
Degrees Decimal Minutes	1 decimal place of <Minutes>	4 decimal places of <Minutes>	7 decimal places of <Minutes>
Degrees Minutes Decimal Seconds		2 decimal places of <Seconds>	5 decimal places of <Seconds>

   For more detail on Precision Levels, please refer to Geocode Documents\NRichardson 090415 Precision.xls.

3. Translation Errors

   The meaning of the georeferenced data and the precision levels associated with the ORIGINAL data capture must not be jeopardised in any translation or transmission process. This responsibility must be owned by the APPLICATION SYSTEM involved with the georeferenced data.

   Examples of the APPLICATION SYSTEM processes include :
   - the upload process from data capture to storage database
   - the client application process which may extract georeferenced data from a *Reference Database,* present the data on the desktop of a Victoria Police user, transfer via a web-enabled facility to an external agency for specialist input, before re-load into the back-end

database. This may occur at the level of a record instance, or for whole data sets which then may involve intermediate databases.

It is flagged that potential translation errors can occur if technology, like Excel, is used to import/export data between the GPS-enabled device and the backend database (as well as intermediate databases). Excel can drop off decimal values permanently, leading to loss of precision. Such errors can compound, if the rounding of decimal places is undetected, across different layers of translation/transmission.

4. Link to Asset Register

A GPS-enabled device is inventoried in an Asset Register, which may be a computerised database or a manual system, like the Portable & Attractive Items Register (PAIR) for local asset checks. Data on *Model/Make* and installation procedures should be stored in such asset-related databases. Hence the associated Asset Register may provide additional information to define precision levels, where a GPS-enabled device has been used for data capture.

The reason for storing its *Asset ID* is to enable the link to the Asset Register.

2.10 GPS Devices – Preferred Features and Use

Appendix 1

Appendix 1 provides overview operational user requirements for work areas in Victoria Police. The first is collated for in-car navigation devices[14] from DIU Horsham and Highway Unit.

It also provides an example of a "GPS Instruction Sheet" for that specific work area.

Appendix 1 is meant to be a check-list for new users of geospatial-enabled devices to confirm their requirements before procuring them. It does not present device models and makes, nor recommend particular brands that may be currently offered by the industry.

Appendix 2

Appendix 2 provides links to publications, related to geospatial systems, from peers and experts in the industry.

The Appendices will grow with time, as they will be added to with increasing geospatial maturity in Victoria Police, and with increasing diversity of business use of georeferenced data.

These updates do not detract from the body of the GEOREFERENCE STANDARD document, but serve to provide more detail on *Implementation Guidelines.*

2.11 Geographic Reference System (GRS) Attributes

The ***authorised*** GEOREFERENCE STANDARD for Victoria Police stipulates the following 3 GRS for storing georeferenced data in the back-end *Reference Database*, namely :

[a] Geographic – GDA94
[b] VICGRID94
[c] MGA94

The following Tables [1 – 4] describe the *Attributes* associated with each GRS.

[14] With Victoria Police maturity in geospatial systems, *Appendix 1* will grow when user requirements in other operational work areas using other geospatial device types are defined.

GEOREFERENCE STANDARD

TABLE 1 OF GEOREFERENCE ATTRIBUTES [GRS : GEOGRAPHIC – GDA94]

CONCEPT OF USE : GEOGRAPHIC VIEW

UPDATED ON : 28 JULY 2009

Attribute	Definition (Adapted from Source : *AS4590 – 2006*)	Format	Dependencies (if present)	Recommendations for Data Handling/Processing
1. **LATITUDE**	The geographic latitude of the point on the earth, as measured in degrees north or south of the Equator, with **GDA94** (Geocentric Datum of Australia 1994) as the reference *datum*. Latitudes north of the Equator are expressed as a positive number; south of the Equator as a negative. Note : This is equivalent to the **Y Coordinate** entry into a *Geographic Information system (GIS)*.	Data Type : Numeric Field Size : 13 Representation Layout : S 9 9.9 9 9 9 9 9 9 9 9 where "S" holds the sign Metrics : Decimal Degrees Example : -36.123456789	This attribute is associated with the next attribute, LONGITUDE.	For Geographic-GDA94, if the georeferenced data is captured in *degrees, minutes and seconds*, it should be converted to ***decimal degrees*** before storage in *Reference Databases.* If there is a need to move georeferences across different file formats (eg. data import/export), the client application which effects the translation should prescribe the considerations to minimise errors in translation. Whilst 9 decimal places are feasible and should be aimed for, the client application should prescribe the rounding that is appropriate for the level of precision required for the business needs and within the capability of the technical equipment : - 9 decimal places achieves "millimetre precision" (eg. *Crash Maps* for court evidence) - 6 decimal places achieves "metre precision" - 3 decimal places achieves "kilometre precision" The 1-character prefix to hold the sign ("S" in the *Representation Layout*) The (positive or negative) sign must be stored in the 1-character prefix. This caters for national and international georeferences, if required in the future. All points within the state of Victoria have a **negative LATITUDE value**. The client application may auto-fill the sign, without the need for manual data entry. The positive sign (if absent, on presentation) is implicit.
2. **LONGITUDE**	The geographic longitude of the point on the earth, as measured in degrees east or west of the Greenwich Meridian, with **GDA94** (Geocentric Datum of Australia 1994) as the reference *datum*. Longitudes east of Greenwich are expressed as a positive number; west of Greenwich as a negative. Note : This is equivalent to the **X Coordinate** entry into a GIS.	Data Type : Numeric Field Size : 14 Representation Layout : S 9 9 9.9 9 9 9 9 9 9 9 9 where "S" holds the sign Metrics : Decimal Degrees Example : 142.123456789	This attribute is associated with the previous attribute, LATITUDE.	As above, but in relation to the 1-character prefix to hold the sign : - all points within the state of Victoria have a **positive LONGITUDE value**. Like the **LATITUDE** value, the positive sign (if absent, on presentation) is implicit. The client application may auto-fill the sign, without the need for manual data entry.

Attribute	Definition (Adapted from Source : *AS4590 – 2006*)	Format	Dependencies (if present)	Recommendations for Data Handling/Processing
3. **EASTINGS-VICGRID94** (aka **X-VICGRID94 COORDINATE)**	The distance of the point on the earth, as measured in metres east of the origin, with **VICGRID94** as the map projection system.	Data Type : Numeric Field Size : 11 Representation Layout : 9 9 9 9 9 9 9.9 9 9 Metrics : Decimal Metres Valid Range for land mass of Victoria : 1,500,000 – 3,500,000	This attribute is associated with the next attribute, NORTHINGS-VICGRID94.	**VICGRID94 (GDA94** datum) is an optional GRS for storage on the database. It should be used if the georeferenced data is involved with mapping distances or interchange with other Victorian agencies. Please refer to section "Concepts of Use". If there is a need to move georeferences across different file formats (eg. data import/export), the client application which effects the translation should prescribe the considerations to minimise errors in translation. Whilst 3 decimal places are allowed, the business process should prescribe the rounding that is appropriate for the level of precision required. All points within the state of Victoria have a **positive EASTINGS/ NORTHINGS value** in the VICGRID94 format. A prefix to hold the sign value is not required.
4. **NORTHINGS-VICGRID94** (aka **Y-VICGRID94 COORDINATE)**	The distance of the point on the earth, as measured in metres north of the origin, with **VICGRID94** as the map projection system.	Data Type : Numeric Field Size : 11 Representation Layout : 9 9 9 9 9 9 9.9 9 9 Metrics : Decimal Metres Valid Range for land mass of Victoria : 1,500,000 – 3,500,000	This attribute is associated with the previous attribute, EASTINGS-VICGRID94.	As above An example of VICGRID94 coordinates -- for Frankston : (x, y) = (2514311.897, 2374602.216)

GEOREFERENCE STANDARD

TABLE 3 OF GEOREFERENCE ATTRIBUTES [GRS : MGA94]

CONCEPT OF USE : SERIES MAPPING; LOCAL VIEW

UPDATED ON : 28 JULY 2009

Attribute	Definition (Adapted fr Source: *AS4590 – 2006*)	Format	Dependencies (if present)	Recommendations for Data Handling/Processing
5. **EASTINGS-MGA94** (aka **X-MGA94 COORDINATE)**	The distance of the point on the earth, as measured in metres east of the origin, with **MGA94** as the Geographic Reference System (which adopts the Universal Transverse Mercator projection accessed 6/9/11).	Data Type : Numeric Field Size : 11 Representation Layout : 9 9 9 9 9 9.9 9 9 Metrics : Decimal Metres Valid Range for land mass of Victoria: Please see *Recommendations* for attribute NORTHINGS-MGA94	This attribute is associated with the next 2 attributes, NORTHINGS-MGA94 and ZONE-MGA94.	**MGA94** is an optional GRS for storage on the database. It should be used if map-based inputs or outputs are required in relation to the georeferenced data. Please refer to section "Concepts of Use". If there is a need to move georeferences across different file formats (eg. data import/export), the client application which effects the translation should prescribe the considerations to minimise errors in translation. Whilst 3 decimal places are allowed, the client application should prescribe the rounding that is appropriate for the level of precision required. A prefix to hold the sign value is not required. All Values are positive (as value of 500,000 metres is added as a false origin) This projection is an angular conformal projection that also limits distortion to less than 0.4% when lest than 5 degrees from the central meridian. Not suitable for polar regions. Length distortion scale factor ranges from 0.9996 at the central meridian to up to 1.001 (1.00071 in Victoria) and the zone boundary For an example fof MGA94 computation, please refer to : http://www.ga.gov.au/geodesy/datums/redfearn_grid_to_geo.jsp and http://www.ga.gov.au/geodesy/datums/redfearn_geo_to_grid.jsp accessed 6/9/11
6. **NORTHINGS-MGA94** (aka **Y-MGA94 COORDINATE)**	The distance of the point on the earth, as measured in metres north of the origin, with **MGA94** as the GRS.	Data Type : Numeric Field Size : 11 Representation Layout : 9 9 9 9 9 9 9.9 9 9 Metrics : Decimal Metres Valid Range for land mass of Victoria: Please see *Recommendations*	This attribute is associated with the attributes, EASTINGS-MGA94 and ZONE-MGA94.	A prefix to hold the sign value is not required. All Values are positive (as value of 10,000,000 metres is added as a false origin). For Victoria, valid coordinate ranges are : - Zone 54 : Easting 590,000 - 763,000 Northing 6,225,000 - 5,695,000 - Zone 55 : Easting 228,000 - 764,000 Northing 6,062,000 - 5,669,000
7. **ZONE-MGA94**	Zones are related to the Universal Transverse Mercator projection accessed 6/9/11 and used to map the earth. Victoria is covered by zones 54 and 55. The zones are 6 degrees of longitude wide with zone 1-60 covering the world.	Data Type : Alphanumeric Field Size : 3 Representation Layout : 99A Example : 54H	This attribute is associated with the previous 2 attributes, EASTINGS-MGA94 and NORTHINGS-MGA94.	The boundary between Zones 54 and 55 goes through the middle of Winchelsea. Caution coordinates are repeated from zone to zone. Third Character of Attribute : "H" applies to all zones within the state of Victoria, so the third character of the attribute is optional. If appropriate, the client application may auto-fill or provide a default value.

GEOREFERENCE STANDARD

TABLE 4 OF GEOREFERENCE ATTRIBUTES [GRS : ALL 3 GRS]
(GEOGRAPHIC-GDA94; VICGRID94; MGA94)

UPDATED ON : 28 JULY 2009

Attribute	Definition (Adapted from Source : *AS4590 – 2006*)	Mandatory/ Optional [15]	Format	Dependencies (if present)	Recommendations for Data Handling/Processing
8. **GEOREFERENCE HEIGHT**	The height of the point on the earth, as measured in metres **above or below sea level**, with **AHD71** (Australian Height Datum 1971), as the reference datum. Heights above sea level are expressed as a positive number; heights below sea level as a negative.	O	Data Type : Numeric Field Size : 9 Representation Layout : S 9 9 9 9.9 9 9 where "S" holds the sign Metrics : Decimal Metres		The requirement for "height **above ground level**" (eg. "4th Floor") should be held in the property-related *Address* descriptor.
9. **GEOREFERENCE CAPTURE METHOD**	This is the **method of data capture** of the georeference, and is intended to provide an indicator of the confidence level of the georeferenced data.	M	Data Type : Alphanumeric Field Size : 2		The codeset is to be determined by the client application. The following values serve to illustrate the flavour of the requirements :

Code	Description	Associated Confidence Level
00	Not Known	
01	Address Point	
02	Address Range	
03	Near Address	
04	Intersection	
05	Near Intersection	
06	Feature / Common Place	
07	Melway / VicRoads	
08	Street	
09	Suburb	
10	Response Zone	
11	GPS-enabled device	

If appropriate, the client application may auto-fill or provide a default value

[15] The "**Mandatory/Optional**" refers to the **inclusion** of the attribute for storage in the back-end database. A "**Mandatory**" attribute can contain a ***null*** value (see the last attribute of "**UPDATE DATETIME**").

10. **ASSET ID / ASSET REGISTER (or local PAIR system)**	The identifier of the GPS-enabled device and the associated asset register, where inventoried. * This is a mandatory attribute, if the georeference capture is via a GPS-enabled device.	O (M, if *)	Data Type : Alphanumeric Field Size : 50	This attribute may be associated with the previous attribute, if the georeference capture is via GPS-enabled device.	This attribute enables fine tuning the precision level of the georeference, by reference to details, hopefully captured in or can be tracked via the asset register: • Make/model/year of the GPS-enabled device • Where/how the associated antenna is installed (eg installation on roof, rather than beside windscreen, increases the precision of the GPS reading) If appropriate, the client application may auto-fill or provide a default value. The asset database may be an electronic asset inventory or a manual system, like the Portable & Attractive Items Register (PAIR) for local asset checks.
11. **VICMAP DATA SET NAME**	The name of the Vicmap digital Data Set. Examples include Address, Property, Transport, Administration, Elevation, Hydro, Features, Planning.	**O**	Data Type : Alphanumeric Field Size : 30	This attribute is associated with the next two attributes, UFI and PFI.	Store if the georeference is sourced from a Vicmap product. This enables future mapping to Vicmap data.
12. **UFI**	The Unique Feature Identifier as used by Vicmap.	**O**	Data Type : Numeric *Vicmap Address* Implementation: Biginteger (8)	This attribute is associated with the next attribute, UFI and relates to attribute 11.	Useful to store, if available, for future mapping to Vicmap data. Note that the Vicmap-implemented formats are indicative only. The client application should re-confirm the formats at application development.
13. **PFI**	The Persistent Feature Identifier as used by Vicmap.	**O**	Data Type : Alphanumeric *Vicmap Address* Implementation: Varchar (10)	This attribute is associated with the previous attribute, PFI and relates to attribute 11.	As above.
14. **CREATE DATETIME**	The Date and Time stamp of the creation of the Georeference.	**M**	Data Type : Date and Time	This attribute associated with the next attribute, UPDATE DATETIME, enables future trace of lineage.	Useful to store, for future trace of lineage.
15. **UPDATE DATETIME**	The Date and Time stamp of the update of the Georeference.	**M**	Data Type : Date and Time	This attribute associated with the next attribute, UPDATE DATETIME, enables future trace of lineage.	As above. Can be a *Null* value (eg. when record is first created).

GEOREFERENCE STANDARD

APPENDIX 1 : PREFERRED FEATURES FOR IN-CAR NAVIGATION DEVICE

Collated by : Greg Lambert (DIU Horsham) & Ross Eldridge (Highway Unit)

GPS Instruction Sheet : Used at DIU Horsham

GPS Units

- Graphics Display needs to be a "Moving Map" display as used by most car navigation devices, with a widescreen display.
- GPS Units must also be capable of standalone operation as not all vehicles have, or will probably ever will have, a MDT
- Ability to easily navigate to obtain information relating to trip information, eg: maximum speed, distance, time, static time and averages of speed & times
- GPS Unit and its mapping software must be easily upgradeable
- Mapping software must be Australia wide, not limited to Victoria
- The device must have the ability to enable the **GPS Default Format** to be set as,
  - Decimal Degrees,
  - UTM, and
  - Degrees, Minutes and Seconds
- Settings like *System Date* and *Geographic Reference System* cannot be changed by operator, only by *System Administrator*.

Display

- Current speed and direction of travel
- Zoom in / out on map page
- Touch Sensitive Screen - To allow ease of data entry and navigation.
- Ready Access to GPS Position Data. The GPS location information needs to be readily avaliable, in the main navigation screen. The best way would be by touching a "Where Am I" icon or the Vehicle Icon. This would then open a new page which displays the current GPS Location. The numerical GPS Location information needs to be displayed in one format - Decimal Degrees - with two other icons giving the user the option of selecting the other two formats, in this example that would be UTM and Degrees Minutes and Seconds.

Precision

- Waypoints saved to 6 decimal points (ie. metre precision) - as a minimum for **most** applications [9 decimal points for millimetre precision]

Routes

- Ability to plan routes and to import / export routes & waypoints both to & from a VicPol networked desktop
- Ability to give route directions to the user, both on screen and audibly
- Address Location - "Goto Mode"
  - Members need to be able to enter a destination by,
  - Address, (123 Smith Street, Collingwood)
  - Intersection (Western Highway and Northern Grampians Road, St Helens Plains)
- GPS Reference (-36.123456, 142.345678) - This option would require that the format can be changed from THIS screen from one format to another.

Data Storage

- Ability to save waypoints and name them as required. The unit should capable of storing at least 500 waypoints and preferably this would be on an additional storage medium, eg:SD Card or similar, rather than the internal memory of the GPS Unit
- Ability for the user to download the stored data onto a VicPol networked PC so that the data can be utilised for mapping purposes etc

- **Tim Mashford, State Intelligence – Geospatial Analysis Unit**
  – Recommendations for a Victoria Police Geocode Standard :

  ..\Research Documents\TMashford Geocode Std Recommend.pdf

- **Department of Sustainability and Environment**
  – GPS Guide for Users :

  http://www.land.vic.gov.au/CA256F310024B628/0/4A6A885CAF3F2078CA257452000327C5/$File/GPS_AGuideForUsers.pdf accessed 6/9/11

- **VicRoads**
  – Guidelines for Use of GPS :

  Geocode Documents\VicRds GPS Guidelines.pdf

- **Working Group on Emergency Management GIS, New Zealand**
  – GIS for Emergency Management (A Guide to Good Practice for GIS Users) :

  Manual of Emergency Management GIS for New Zealand

- **Department of Sustainability and Environment**
  – Why worry about a centimetre shift when the data is only accurate to ten metres? :

  Geocode Documents\PrecisionVictorian.pdf

- **Free Geography Tools**
  – Improve Position Measurement Accuracy in Consumer-Grade GPS Receivers :

  http://freegeographytools.com/2008/improving-position-measurement-accuracy-in-consumer-grade-gps-receivers-part-ii accessed 6/9/11

- **Abbas Rajabifard & Ian Williamson : Dept of Geomatics, University of Melbourne**
  – Spatial Data Infrastructure and Capacity Building :

  SDI Development and Capacity Building

GEOREFERENCE STANDARD

APPENDIX 3 : GEOREFERENCED LOCATION FOR FLINDERS PEAK

The following example, for the same *Geographic Location* of FLINDERS PEAK, illustrates

- **the various ways of recording GEOREFERENCEs in the three different Geographic Reference Systems**
- **the corresponding representation for storage in the back-end database**

Geographic – GDA94 :

Georeferences Recorded as :

- Degrees Minutes Seconds (-37° 57' 03.7203", 144° 25' 29.5244") or
- Degrees Minutes Seconds (S 37° 57' 03.7203", E 144° 25' 29.5244") or
- Decimal Degrees (-37.96033417°, 144.424867889°) or
- Decimal Degrees (S 37.96033417°, E 144.424867889°) or
- Degrees Decimal Minutes (-37° 57.062005' , 144° 25.4920733')
- Degrees Decimal Minutes (S 37° 57.062005' , E 144° 25.4920733')

Georeferences Stored as :

Attribute 1.	**LATITUDE**	(=Y Coordinate)	-37.96033417
Attribute 2.	**LONGITUDE**	(=X Coordinate)	144.424867889

VICGRID94 :

Georeferences Recorded as :

Coordinates in decimal metres (generally 2 decimal places)

Eastings 2,449,452.24; Northings 2,394,306.53

Georeferences Stored as :

Attribute 3.	**EASTINGS-VICGRID94**	2449452.24
Attribute 4	**NORTHINGS-VICGRID94**	2394306.53

MGA94 :

Georeferences Recorded as :

Coordinates in zone number and *decimal metres*

Zone 55; Eastings 273,741.297; Northings 5,796,489.777

(with Convergence -1°35' 03.65" and Point scale factor 1.000 230 56)

Georeferences Stored as :

Attribute 5.	**EASTINGS-MGA94**	273741.297
Attribute 6.	**NORTHINGS-MGA94**	5796489.777
Attribute 7.	**ZONE-MGA94**	55H