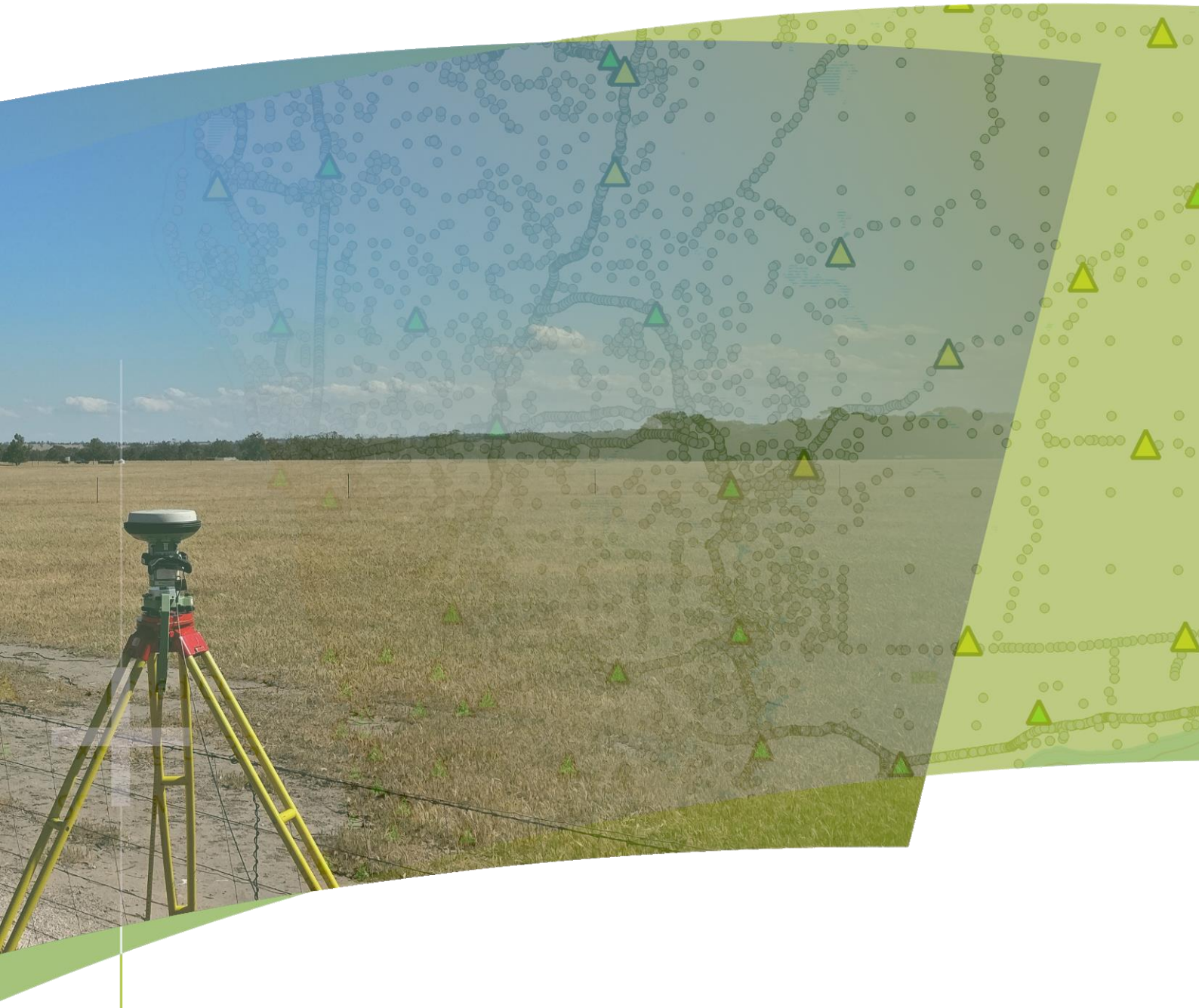
GOVERNMENT OF WESTERN AUSTRALIA

Landgate



Geodetic Strategy for Western Australia 2021-25

The foundation of location

January 2021, Location Services

Acknowledgement

Landgate respectfully acknowledges the Traditional Owners and ongoing Custodians of Country throughout Western Australia and their continuing connections to land, waters and communities.
We pay our respect to Western Australian Aboriginal cultures and Elders past, present and emerging.

Disclaimer

Warning: Aboriginal and Torres Strait Islander people are advised this document may contain images of deceased persons which may cause sadness or distress.

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Foreword

Our State's first geodetic system was established in the late 19th century and has developed into a modern infrastructure asset supporting tangible economic, environmental, and social benefits. It allows for accurate location and/or tracing in space and time of built and natural features, as well as seamless integration of independently sourced spatial information.

Today the Western Australian (WA) geodetic system is an integral part of the Australian Geospatial Reference System, providing the underlying framework for all surveying, mapping and positioning applications across Australia. With the ubiquitous integration of Global Navigation Satellite Systems (GNSS) technology into mobile devices, the geodetic system supports millions of everyday users of location-based applications.

It is expected that readily available and accurate GNSS derived positioning, together with open data, advanced analytics, and cloud computing, will enable greater innovation and increased productivity. Accurate positioning facilitates improved spatial capability for current and emerging applications such as spatial digital twins and smart cities.

To ensure an accurate, reliable and relevant geodetic system for WA, Landgate will continue to maintain its ground infrastructure, improve positioning accuracy, and enhance data quality and access.

Dione Bilick

Surveyor General of Western Australia

Trish Scully

General Manager Location Services

Role

Landgate is responsible for the development and maintenance of geodetic infrastructure and services to support surveying, mapping and positioning in Western Australia (WA).

Vision

To provide an accurate, reliable and relevant geodetic system that enables delivery of trusted location data across WA.

Scope

This document sets out Landgate's strategic priorities for geodetic infrastructure and services from 2021 to 2025. It also describes national and state developments in the field of geodesy and positioning. The intended audience is both current and future users of the WA geodetic system.

Background

The WA geodetic system consists of:

- physical infrastructure of ground marks including Continuously Operating Reference Stations (CORS)
- the Geodetic Mark Register (GESMAR) that maintains geodetic data
- the Geodetic On-Line Access (GOLA) application for geodetic information access.

Landgate maintains two types of ground marks, being standard survey marks (SSM) and benchmarks (BM). Together with CORS, they provide access to the horizontal and vertical datum in WA, as well as Cocos (Keeling) and Christmas Islands. At the time of publication there are more than 65,000 ground marks, including 26 publicly available CORS that supplement various private CORS, distributed across WA.

Traditionally the geodetic system supported the survey industry primarily in the delivery of infrastructure and land development projects. These projects demand the highest quality and integrity of location information. Recent ANZLIC strategic initiatives elevated accuracy and integrity of all foundation spatial data, therefore the quality and integrity of our geodetic system becomes paramount.

To improve accuracy, integrity, and compatibility with space-based positioning technology, the Intergovernmental Committee on Surveying and Mapping (ICSM) decided to modernise the Australian Geospatial Reference System (AGRS). This modernisation commenced over a decade ago, when Landgate and Geoscience Australia (GA) partnered to build a network of 26 CORS across WA. This investment allowed for better determination, and later development, of the new Geocentric Datum of Australia 2020 (GDA2020) and AUSGeoid2020. In October 2017, GDA2020 replaced the Geocentric Datum of Australia 1994 (GDA94) becoming the new Australian Recognized-Value Standard (RVS) of Measurement of Position as determined by the National Measurement Institute.

To support users requiring real time precise positioning capability, the ICSM has also developed and introduced two additional elements to the AGRS:

- Australian Terrestrial Reference Frame 2014 (ATRF2014) - time dependent datum.
- Australian Vertical Working Surface (AVWS) - based on a national gravimetric geoid model as an alternative to the Australian Height Datum.

Landgate is leading the development and implementation of the AGRS modernisation program in WA by providing advice and assistance to other organisations with their technical and legislative challenges. Landgate has already updated its geodetic system to deliver GDA2020 coordinates and upgraded the Spatial Cadastral Database (SCDB) to maintain the WA spatial cadastre in GDA2020. Landgate has amended Regulations (Land Administration Regulations 1998, the Land Information Authority Regulations 2007) to prescribe GDA2020, and then the Land Surveyors Licensing Board introduced GDA2020 based project grids in their Survey Guidelines.

In 2018 the Australian Government committed to develop a real time, space-based, precise positioning capability for Australia, called Positioning Australia. This project is managed by Geoscience Australia (GA) and comprises two complementary streams:

- National Positioning Infrastructure Capability (NPIC) - a national network of ground infrastructure.
- Southern Positioning Augmentation Network (SouthPAN) - a system to deliver corrected positioning signals via satellite technology.

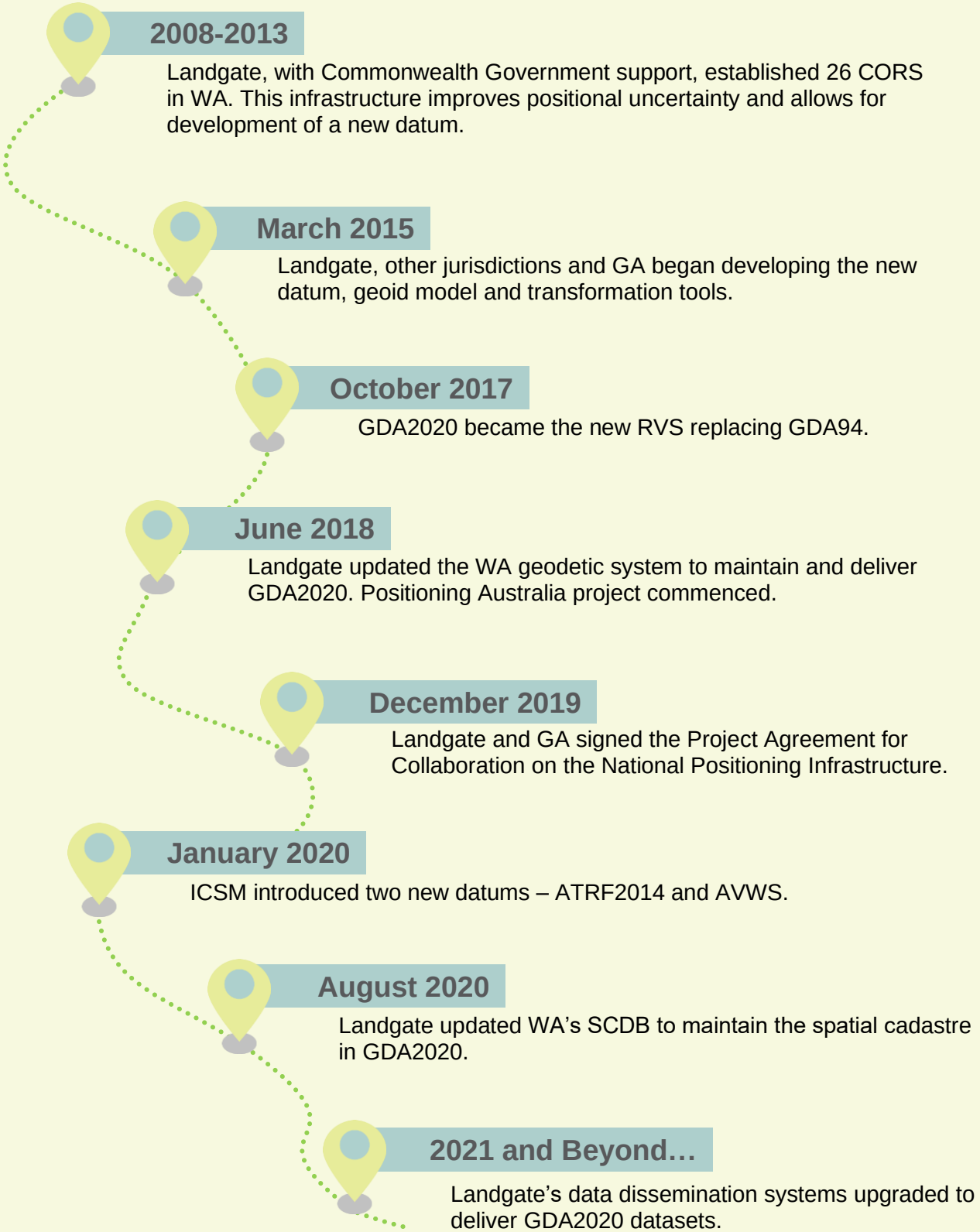
Once completed, the system will deliver 10cm positioning accuracy anywhere in Australian (including offshore) and 3-5cm in the areas of mobile network coverage. SouthPAN is expected to be fully operational and certified by 2025.

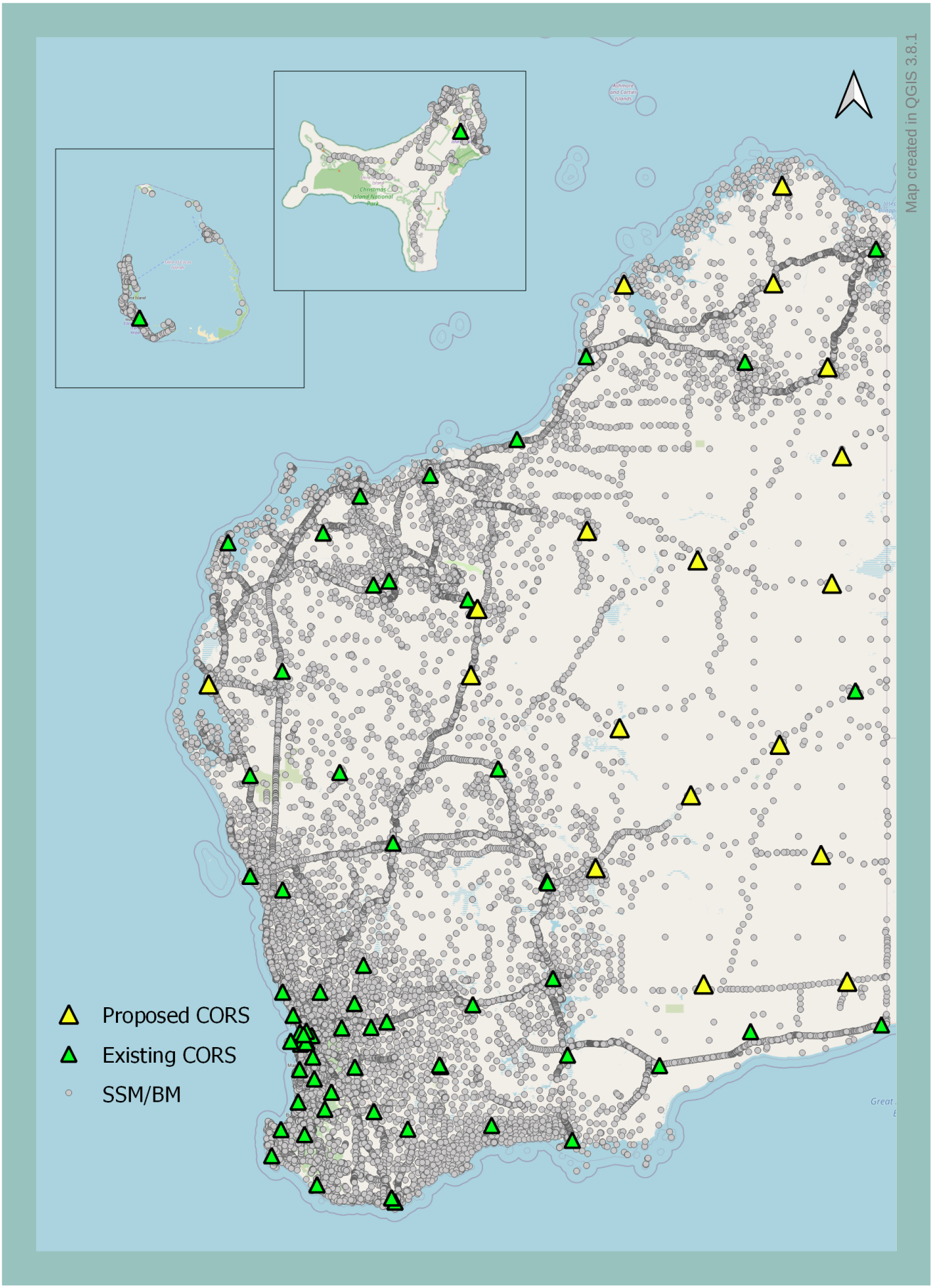
Landgate signed a Collaborative Project Agreement with GA to help deliver the NPIC. As part of this agreement, Landgate has transferred the ownership of all 26 CORS to GA, and GA now operates and maintains this important infrastructure. Over the next two years GA is planning to upgrade the existing CORS and build additional CORS across Australia, including 18 in WA. Landgate is assisting GA with the transition of existing CORS, site surveys for new CORS and securing best practice land access across both existing and new CORS sites in WA. This also involves coordinating activities of Landgate and other agencies as required.

The official vertical datum in WA is the Australian Height Datum. Landgate will concentrate its effort on maintaining the vertical datum while introducing and improving AVWS. To enable accurate GNSS based height determination in WA, Landgate recognises the importance of developing a national deformation model and further improving the geoid model. Landgate intends to increase collaborative efforts to improve these models (e.g. by capturing airborne gravity data over targeted regions of WA and contributing survey observations to the National GNSS Campaign Archive).

CORS established in 2011 and located on Wongutha Country (Leonora, WA). Artwork by the Wongutha children with Landgate, the Ngalia Foundation and the Walkatjurra Cultural Centre.

AGRS Modernisation Timeline





Geodetic infrastructure illustrating distribution of current SSMs/BMs and CORS as well as proposed CORS to be constructed under the NPIC project.

Statutory requirements

The WA geodetic system, which consists of geodetic survey marks referenced to the Geocentric Datum of Australia 2020, is prescribed as fundamental land information under the Land Information Authority Regulations 2007 (*Land Information Authority Act 2006*). Landgate, on behalf of the WA government, is the custodian of the geodetic system which carries obligations to provide a geodetic datum as one of the public utility services under the Land Administration Regulations 1998. Landgate will continue to maintain and improve this important infrastructure for the benefit of the survey industry and the broader geospatial community. All geodetic marks have been erected and are protected under the *Standard Survey Marks Act 1924*.

Electronic Distance Measurement (EDM) instruments are commonly used in the surveying industry for measuring length. Regular calibration of these instruments is required to ensure the distances measured are legally traceable back to the national standard, currently provided by the *National Measurement Act 1960.* In accordance with the Licensed Surveyors (General Surveying Practice) Regulations 1961, Regulation 20(2), the Surveyor General provides an EDM baseline calibration standard. Landgate will continue to maintain EDM calibration facilities and provide timely certification of baselines, as required by National Measurement Regulation 1999, Regulation 73.

Landgate will also apply and provide standards, guidelines and policies designed to maintain the geodetic system integrity and ensure legal traceability of position and survey measurements (e.g. Special Publication 1, eGeodesy, FAIR data principles). These standards and guidelines will underpin location data in WA as per statutory requirements and enable national harmonisation of location information as outcomes of the overarching national strategies.

Maintaining vertical datum on Christmas Island.

Strategic alignment

The vision and priorities for Landgate's Geodetic Strategy for Western Australia have been developed in the context of the ANZLIC National Policy and Strategic Plan 2020-24. This plan highlights modernisation of the AGRS as one of the major five-year initiatives. It also recognises positioning as the fundamental layer of foundation spatial information used by government, business and the community. This national program is being delivered through the ICSM of which Landgate is a member organisation and represents WA on the ICSM Geodesy Working Group.

This Geodetic Strategy is also closely aligned with Landgate's Strategic Development Plan 2020/21>25 and aims to deliver better geodetic services to enable the State, Local Government and industry to improve services to the public using location information. The geodetic system is the foundation of location and to maintain its quality and integrity as well as deliver efficient services, Landgate regards collaboration with industry, academia and other government organisations as an essential component of this strategy. Landgate will participate in the ICSM Geodesy Working Group and continue to provide support for national initiatives designed to progress national harmonisation of geodetic standards, systems and services. Landgate will also pursue new local, national and international collaborative opportunities and research initiatives designed to enhance geodesy and positioning capabilities.

While Landgate's effort to maintain the geodetic system ground infrastructure will continue for the foreseeable future, Landgate will monitor the uptake of the Positioning Australia initiative and the way customers access positioning information. This will provide valuable insights and set directions for a future geodetic strategy.

This document sets out four strategic priorities for Landgate to ensure the WA geodetic system is accurate, reliable, and relevant to its current and future users. Landgate will deliver these objectives with regard to broader government priorities and its stakeholders needs, and it will do it in the most economical way.

GNSS survey to improve regional geodetic network.

Strategic priorities

Landgate commits to delivering the stated actions for each of its four strategic priorities, to ensure an accurate, reliable and relevant geodetic system for WA.

1. Maintain and enhance geodetic system physical infrastructure and data by:

(a) Protecting existing and installing new ground marks, including standard survey marks and benchmarks, to deliver the appropriate mark density required to support strategic State initiatives as well as the survey and spatial industry requirements.
(b) Evaluating historical and capturing new survey measurements between ground marks to improve geodetic system accuracy and integrity.
(c) Integrating new CORS into the WA geodetic system to ensure legal traceability of position and rigorous propagation of uncertainties.
(d) Maintaining high quality survey data and metadata as a single source of truth.
(e) Capitalising on collaborative opportunities to maintain geodetic infrastructure.

2. Support modernisation and implementation of the AGRS by:

(a) Modernising GESMAR and GOLA to allow for delivery of all elements of the AGRS, seamless integration with the WA spatial cadastre, and new data delivery formats that support automation and improve user experience.
(b) Improving automation of the state-wide geodetic network adjustment processes and contributing data and technical expertise to maintain the AGRS.
(c) Enabling accurate GNSS based height determination by supporting geoid model improvements.
(d) Leading the implementation of GDA2020, ATRF and AVWS in WA.

3. Provide expert advice, maintain standards and specifications by:

(a) Providing expert knowledge on matters related to geodesy and positioning.
(b) Contributing to development and supporting survey standards that are aligned with best practice and national and international standards.
(c) Contributing to the development of open-source geodetic software and data.
(d) Maintaining survey instrument calibration facilities, both EDM and barcoded staff, and provide certification.

4. Strengthen our leadership, collaboration and strategic engagement by:

(a) Collaborating with GA to improve the National Positioning Infrastructure.
(b) Participating in national and international developments and forums aimed to enhance positioning capabilities.
(c) Sharing data, knowledge and resources with research and educational organisations focusing on innovation and developing future capabilities.
(d) Engaging with government, industry, and academia to promote and maximise the value of geodesy and positioning for the WA economy.

Glossary

Acronym	Definition
Accuracy	Accuracy refers to the degree of certainty, conformity or closeness of a measurement or position to the "true" value.
AGRS	Australian Geospatial Reference System is the collection of: datums (e.g. GDA2020, AHD), infrastructure (e.g. survey marks, CORS), models (e.g. AusGeoid2020, Australian Plate Motion Model), and standards (e.g. SP1, ISO, GeodesyML). For details, refer to ICSM AGRS website.
Australian Height Datum	Australian Height Datum is the official national vertical datum for Australia and refers to Australian Height Datum 1971 (AHD71; Australian mainland), as well as Christmas (CIHD) and Cocos - Keeling (CKIHD) vertical datums.
ANZLIC	ANZLIC - the Spatial Information Council is the peak intergovernmental group of senior officials providing leadership on all aspects of spatial service delivery and information.
ATRF	Australian Terrestrial Reference Frame. At the time of publication ATRF2014 is the current realisation of ATRF.
AUSGeoid2020	Australian Geoid Model 2020 is a combine gravimetric-geometric geoid model with uncertainties developed to support the improved determination of AHD.
AVWS	Australian Vertical Working Surface is a new reference surface for heights in Australia.
Benchmark	A ground mark for which accurate height information has been established.
Collaborative Project Agreement	Project agreement for collaboration on the National Positioning Infrastructure Capability signed in December 2019 between Landgate and the Commonwealth of Australia represented by GA.
CORS	Continuously Operating Reference Station consists of a permanent installation of a GNSS receiver and antenna, a power supply and modem that transmits the GNSS data 24x7 to a central processing centre. CORS is also considered as a standard survey mark.
Datum	A spatial reference system or surface to which measurements and/or coordinates upon the Earth can be defined and related.
EDM	Electronic Distance Measurement is a method capable of determining length by utilising electromagnetic waves propagation principles. In surveying EDM often relates to a survey instrument.
FAIR	FAIR data principles: Findable, Accessible, Interoperable and Reusable.
GDA2020	Geocentric Datum of Australia 2020 is the current Recognized-Value Standard of Measurement of Position in Australia.

Acronym	Definition
Geoid	The geoid is a model (surface) of global mean sea level extended over land that is used to measure elevations.
GESMAR	Geodetic Mark Register is a system to maintain geodetic data.
GNSS	Global Navigation Satellite Systems is a generic term for satellite navigation systems (e.g. GPS).
GOLA	Geodetic On-Line Access is a customer facing application for access to WA geodetic information.
ICSM	Intergovernmental Committee on Surveying and Mapping is a standing committee of ANZLIC, which coordinates and promotes the development and maintenance of key national spatial data.
NPIC	National Positioning Infrastructure Capability project seeks to develop a national network of ground infrastructure designed to improve positioning capability across Australia. More information about NPIC and Positioning Australia program can be found on GA website: https://www.ga.gov.au/scientific-topics/positioning-navigation/positioning-australia.
SCDB	Spatial Cadastral Database is a seamless digital cadastral base map that contains land parcel boundaries and tenure information for all crown and freehold lands in WA.
SouthPAN	The Southern Positioning Augmentation Network is a satellite-based augmentation system built on NIPC and designed to deliver corrected (improved) positioning signals directly to a user via satellite technology.
SSM	Standard survey mark is a ground mark for which accurate horizontal coordinates (and usually height) have been established.
Positional Uncertainty	Horizontal and/or vertical Positional Uncertainty of a location (point in space) is defined in metres at 95% confidence level with respect to the defined reference frame (datum).
RVS	Recognized-Value Standard of Measurement of Position (GDA2020). For details refer to the NMI determination.

Contacts

Landgate Survey Services
1 Midland Square, Midland WA 6056
PO Box 2222, Midland WA 6936

Telephone: +61 (0)8 9273 7111
Email: geodesy@landgate.wa.gov.au

landgate.wa.gov.au/