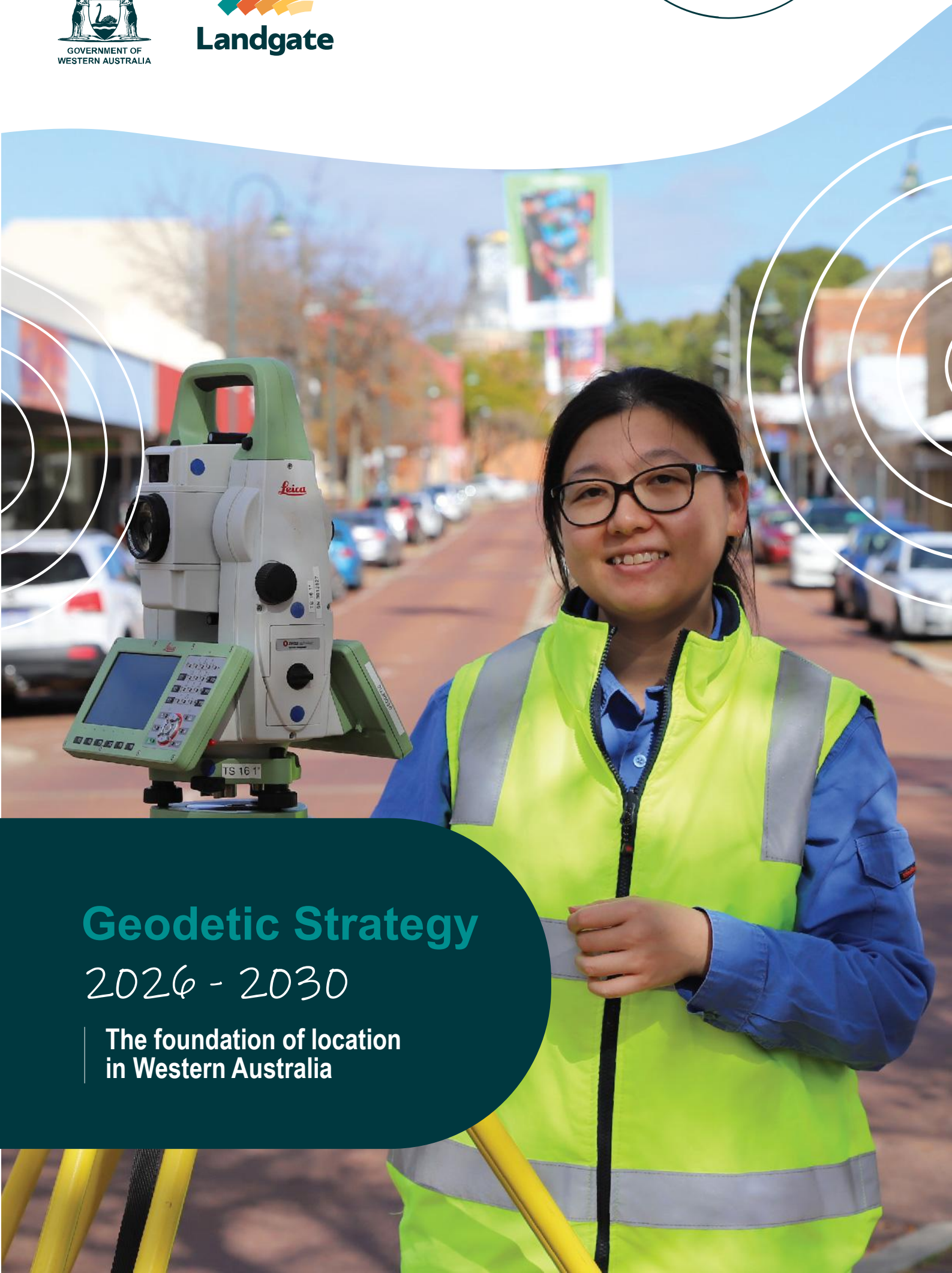
GOVERNMENT OF WESTERN AUSTRALIA

Landgate



Geodetic Strategy

2026 - 2030

The foundation of location in Western Australia

Acknowledgment of Country

Landgate respectfully acknowledges the Traditional Owners of the lands, waters and sky and their continuing connection to Country throughout Western Australia and pays respects to Elders past and present.

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Foreword

Western Australia's (WA) first network of survey control marks was established in the late 19th century and has developed into a modern infrastructure supporting tangible economic, environmental, and social benefits. It enables accurate positioning of built and natural features, as well as seamless integration of independently sourced spatial data.

WA's geodetic infrastructure is an integral part of the Australian Geospatial Reference System (AGRS). The AGRS provides the underlying framework for all surveying, mapping and positioning applications across Australia. Together with Global Navigation Satellite Systems (GNSS) technology, it enables accurate positioning for all location-based applications including land development, environmental monitoring, emergency response, resource management, transport, and agriculture.

Geodetic products and services, in combination with open data, advanced analytics, and cloud computing, drive innovation and increase productivity in WA. Reliable and accurate location enables improved spatial capability for current and emerging applications such as Spatial WA.

Landgate's Geodetic Strategy reaffirms our commitment to continue to enhance geodetic products and services over the next five years. With that, we have developed these strategic initiatives that consider technical and legislative requirements:

- Enhance geodetic products and services to meet the needs of WA users
- Support the development and implementation of national geodetic initiatives
- Expand geodetic system visibility and value
- Maintain and develop operational capabilities

Our focus on these strategic initiatives ensures Landgate's efforts and resources are aligned with national geodetic strategies and standards as well as evolving user needs.

Dione Bilick
General Manager Location Services /
Surveyor General of Western Australia

Dr Irek Baran
Principal Geodesist

1. Vision

Our vision is to provide accurate, reliable and authoritative geodetic products and services that enable the delivery of trusted location information supporting WA's social and economic priorities.

2. Mission

Our mission is to deliver, maintain and improve geodetic products and services by:

- Enhancing accuracy and accessibility of the state-wide geodetic control network
- Ensuring access to survey mark information is Findable, Accessible, Interoperable and Reusable (FAIR[1])
- Contributing to, and implementing, national geodetic initiatives that enable seamless integration of the WA geodetic infrastructure with the AGRS
- Adhering to industry standards, upholding a high level of quality
- Embracing innovative approaches that maximise user value
- Actively promoting the geodetic supply chain to government, industry and the community.

Our efforts are guided by legislative requirements, built upon decades of experience, technological progress, and strengthened through collaboration with our partners.

3. Scope

This document sets out Landgate's strategic initiatives, from 2026 to 2030, for delivering improved geodetic products and services. It also describes national and state developments in the field of geodesy and positioning. Its intended audience is current and future users of the WA geodetic products and services.

In October 2025 Medjil was recognised at the Excellence in Surveying & Spatial Information WA Awards.

[1]Ensuring FAIR Access to Precise Positioning by Improving Geodetic Data Interchange Standards, September 2020 report | Frontier SI

4. Geodetic products and services

Enabling accurate location information is critical for the effective land management, infrastructure development and economic growth of WA. Although often overlooked, geodetic products and services provide the essential framework, known as geodetic datum, that enables the determination of both absolute and relative 3D positions of any object, supporting a wide range of industries and applications.

In the early days, using simple surveying equipment, Landgate's predecessors established a wide network of survey control marks. Today, using modern surveying equipment, Landgate continues to maintain a vast network of survey control marks spread across the entire state and Indian Ocean Territory. These marks are fixed on the ground as physical monuments and are known as Standard Survey Marks (SSM), Benchmarks (BM) and Continuously Operating Reference Stations (CORS). These marks provide access to the horizontal and/or vertical datum, providing users a way to obtain 3D coordinates via direct survey observations.

Landgate is the custodian of the geodetic datum in WA. Our dedicated team of technical specialists are responsible for managing and improving all geodetic products and services as well as Electronic Distance Measurement (EDM) instrumentation calibration services.

4.1. Historical perspective

The provision of geodetic infrastructure began in WA when the first Surveyor General established initial survey control marks and conducted geodetic survey observations to support land division and resource management for the Swan River settlement.

By the early 20th century, an expanding network of trigonometrical stations (survey marks) provided the tool needed for accurate mapping across the entire state. This paved the way for integration with other states and the development of Australia's first national datum, the Australian Geodetic Datum 1966 (AGD66), later improved by harnessing EDM technology (AGD84). Around the same time the National Mapping Council led the development of the Australian Height Datum (AHD) adopted in 1971.

Introduced in the 1970s, Global Positioning System technology was quickly adopted for geodetic surveying in 1980s, leading to development of modern Geocentric Datum of Australia 1994 (GDA94).

During the 2000s, the Intergovernmental Committee on Surveying and Mapping (ICSM) Geodesy Working Group introduced the AGRS to further modernise national geodetic infrastructure. This was possible by installing CORS and collecting long time series of GNSS data together with dedicated National GNSS Campaign Archive (NGCA), improved International GNSS Service (IGS) products as well as advancements in software and computational techniques.

In 2015 for the first time a single national geodetic network adjustment was undertaken that led to development of new and improved products such as the Australian Terrestrial

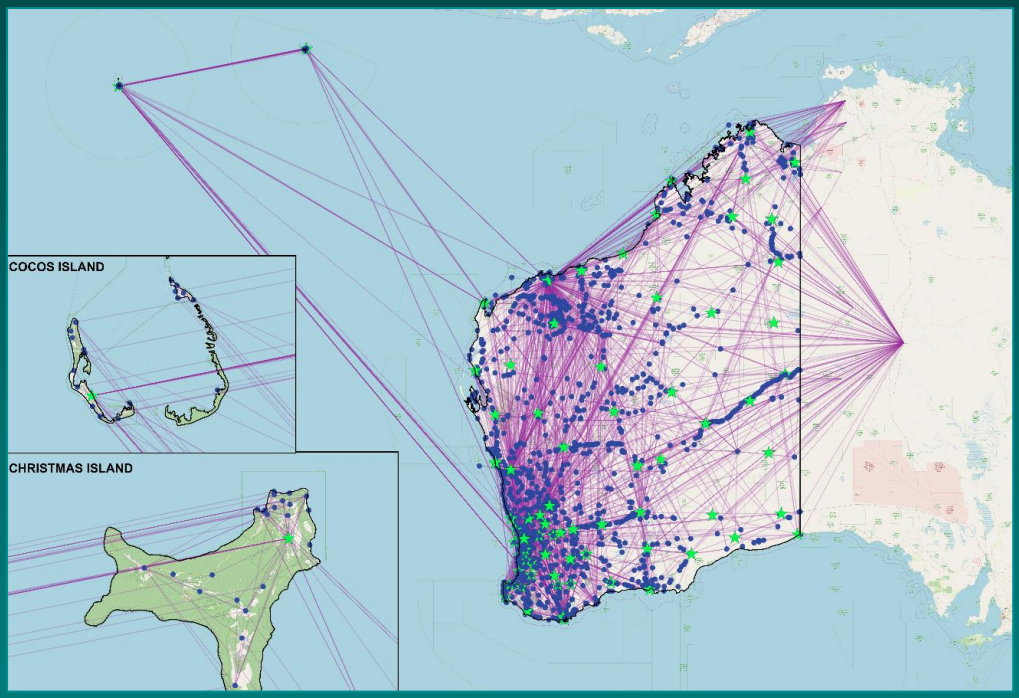
Reference Frame 2020 (ATRF2020), Australian Vertical Working Surface (AVWS), Australian Gravimetric Quasi-geoid (AGQG) model, Geocentric Datum of Australia 2020

(GDA2020), and a combined gravimetric-geometric geoid model with uncertainties (AUSGeoid2020). GDA2020 became Australia's official datum in 2017, and WA formally adopted it in 2020 through legislative amendments.

4.2. Current state

The WA geodetic physical infrastructure consists of approximately 65,000 survey marks (noting about 10,000 are flagged as not located). These marks (SSMs, BMs and CORS) are connected by a complex network of geodetic observations (i.e. distances, angles, height differences and GNSS baselines).

All geodetic observations and survey mark information are managed using the GEodetic Survey MArk Register (GESMAR) application and disseminated to the public-facing web service called the Geodetic On-Line Access (GOLA). All geodetic products and services can be accessed from the Landgate website. Survey mark information is also accessible via the Landgate Map Viewer Plus online portal.



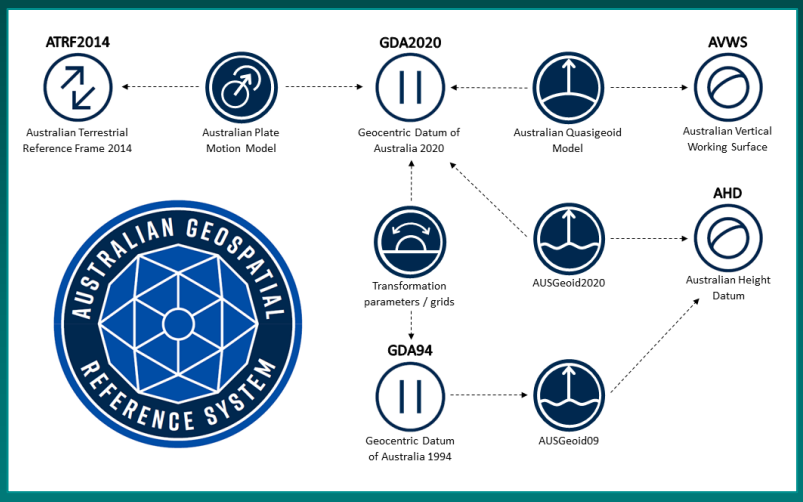
The "backbone" of GDA2020 in Western Australia, a network of CORS (green) and NGCA (blue) marks.

Collecting GNSS data to improve the geodetic network.

An example of a Standard Survey Mark and Benchmark that form part of the geodetic network physical infrastructure.

The WA geodetic infrastructure is an integral part of the AGRS and used by many organisations (both public and private) across WA and nationally, providing modern, accurate, and legally traceable positioning capability.

To ensure consistency and currency, Geoscience Australia (GA), together with all ICSM member agencies, including Landgate, maintain the AGRS under the GDA2020 National Adjustment project. As a result, new geodetic data are integrated into AGRS as soon as they become available.



Elements of AGRS consisting of datums, reference frames, models and tools enabling accurate and reliable 4D positioning.

The ICSM recently endorsed the implementation of a two-frame approach to heights in Australia. This approach maintains AHD as the official national height datum, while providing the AVWS as an alternative datum for applications requiring greater precision and consistency over longer distances. As AVWS is free of errors and biases existing in AHD, it has better absolute and relative accuracy over distances greater than 10 kilometres. Users can select from AHD or AVWS to address their specific requirements.

The ICSM recommends improving geoid models and AVWS with new geodetic survey observations and high accuracy gravity data available from airborne gravimetry surveys. In collaboration with states and territories, GA is leading this initiative by coordinating gravity data acquisition and developing products.

At the time of publishing this strategy, Victoria, New South Wales, and South Australia had completed airborne gravimetric surveys. This new gravity data is integrated and processed alongside existing datasets, with the goal of updating the AUSGeoid2020 and AGQG models by 2027. These improved models will provide better access to AHD and AVWS in their respective jurisdictions. Landgate plans to contribute to improving geoid models and AVWS over the Perth metropolitan area by acquiring airborne gravity data. A series of simulations, using area specific acquisition parameters indicate potential improvement in accuracy of the current gravimetric geoid model over the Perth metropolitan area from 4-8 cm to 1-2 cm.

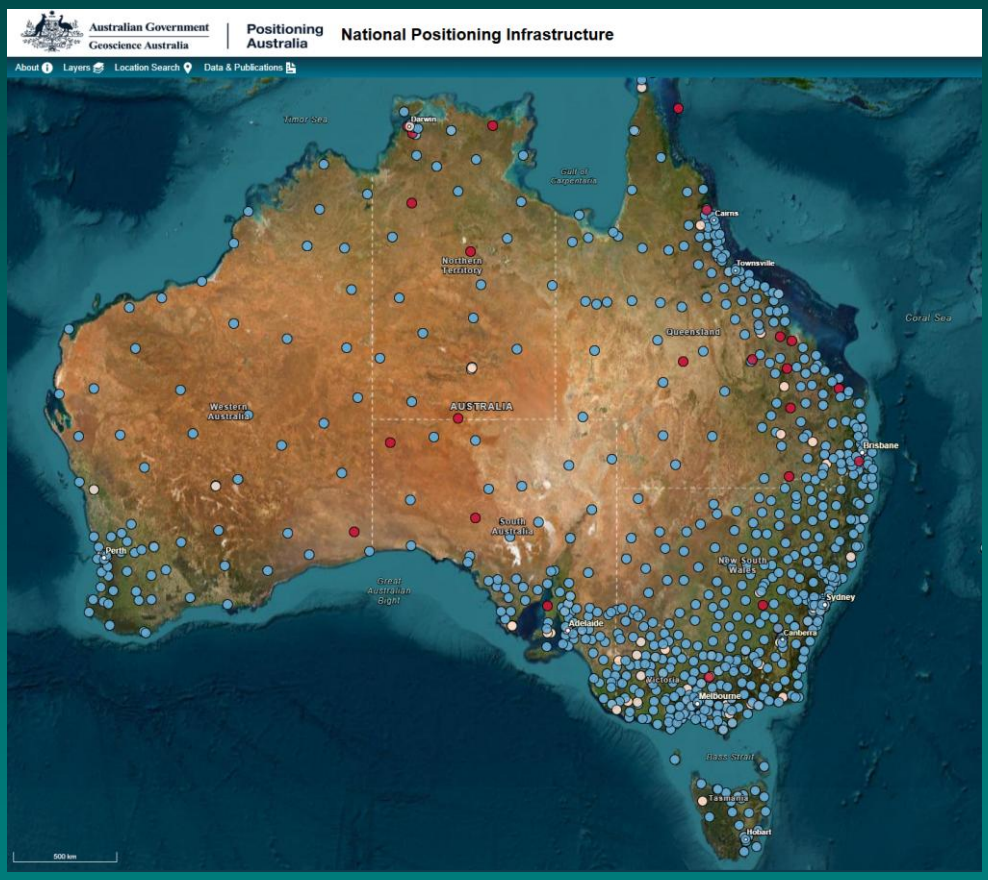
Recognising value[2] of the real time positioning service, especially for non-traditional users of positioning technology, the Australian federal government developed the National Positioning Infrastructure Capability (NPIC) and Satellite-Based Augmentation System, collectively called the Southern Positioning Augmentation Network (SouthPAN). Both projects are managed by GA and are complementing WA geodetic infrastructure.

At the time of publication, NPIC consists of approximately 200 government and more than 500 privately operated CORS across Australia freely accessible to the public. The NPIC infrastructure includes approximately 80 CORS available across WA, of which 26 were developed by Landgate and now owned and operated by GA under the collaborative project agreement.

NPIC real-time GNSS data streams (corrections) deliver centimetre accuracy positioning services across WA in areas with mobile phone coverage. NPIC hardware and data is managed by high-quality software (Ginan) ensuring highest accuracy, quality and availability. All services are free and available 24/7 for surveying, mapping and other applications via online GNSS portal.

SouthPAN aims to provide positioning accurate to within 10 cm across Australia (and 3-5 cm with mobile coverage), and it should be fully operational and certified for safety of life and aviation applications by 2028.

[2] Economic Benefits of High Resolution Positioning Services, Nov 2008 report | Allen Consulting Group



NPIC portal displaying available CORS. Not visible but available are two additional CORS located on Cocos and Christmas Islands.

A 2023 study by ACIL Allen[3] estimates that NPIC will deliver $44 million of net economic benefits to Western Australia between 2019 and 2038. The most significant economic impact and productivity gains from NPIC-enabled precise positioning will be realised across a range of sectors, including agriculture, construction, mining, surveying and mapping, transport, and infrastructure planning.

4.3. Future developments

According to 2025 data from the Australian Bureau of Statistics (ABS), the WA economy was growing faster than any other Australian jurisdiction, driving demand for expansion and development in many sectors, including infrastructure, housing, mining and agriculture. WA also has the fastest population growth, with a corresponding increase in demand for all services including accurate location information.

[3] Economic impact of the National Positioning Infrastructure Capability program, May 2023 report | ACIL Allen

To support WA's economic growth and strategic priorities, particularly housing and infrastructure development, Landgate will continue to maintain and enhance the quality and accessibility of geodetic products and services. This will be achieved through internal improvements, as well as strategic collaboration with GA, state government agencies and industry partners.

Landgate will invest in the capture of new survey data, installation and maintenance of ground marks, support for new CORS installation, tide gauge surveys and maintenance of EDM instrumentation calibration facilities. Landgate will also contribute to national efforts designed to enhance the AGRS by sharing new geodetic data.

It is essential for Landgate to invest in the capture of airborne gravity data over the Perth metropolitan area. This investment is expected to significantly improve accuracy of the existing geoid models and further improve GNSS based height determination. This initiative is expected to have a significant positive impact on the survey industry as accurate gravimetric geoid models, together with GNSS, have the potential to replace traditional spirit levelling surveys for most applications, reducing the cost and time of survey operations.

In addition, Landgate will invest in the replacement of its aging geodetic applications, GESMAR and GOLA, with modernised architecture, streamlined state and national data processing and FAIR data access enabled.

Satellite-based Positioning, Navigation, and Timing (PNT) technology, such as SouthPAN is already proving to be effective, however with challenges and risks[4] that need to be address in the future. According to the report[5] by FrontierSI, resilient and sovereign PNT requires a system-of-systems architecture as no single solution is sufficient on its own. Terrestrial and alternative technologies are essential to complement GNSS-based PNT technology.

According to FrontierSI[6], emerging Low Earth Orbit (LEO) PNT is promising more resilient positioning capabilities in the future. Unlike traditional GNSS systems operated by the state, LEO PNT is being developed as a collaboration of government and commercial stakeholders and is being driven by market demand. Over the next two to five years, multiple organisations around the globe are promising to deploy several hundred dedicated LEO PNT satellites. This includes support from GNSS receiver manufacturers.

As these initiatives are still in their early stages, it remains to be seen how emerging LEO PNT service providers will shape the future of positioning. Landgate will closely monitor these advancements and actively seek opportunities to leverage new technologies as they evolve.

[4] Australia's Navigation and Timing Challenges on Hazards, Operations, and Resilience (ANCHOR), Feb 2026 report | FrontierSI
[5] Beyond GPS: Charting Australia's PNT Future in an Uncertain World, May 2025 report | FrontierSI
[6] State of the Market Report Low Earth Orbit Positioning Navigation and Timing – 2024 Edition, Jan 2025 report | FrontierSI

5. Legislative requirements

The WA geodetic infrastructure comprises a network of survey marks referenced to the GDA2020 and 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 all geodetic products and services in WA which carries obligations to provide a geodetic datum as one of the public utility services under the Land Administration Regulations 1998. Landgate is committed to maintaining this important infrastructure for the benefit of the survey industry and the broader geospatial community. All geodetic marks are established, maintained, and protected under the *Standard Survey Marks Act 1924*.

Electronic Distance Measurement Instrumentation (EDMI) is commonly used in the survey industry for measuring length. Regular calibration of these instruments is required to ensure the distances measured are legally traceable to the national standard, currently provided by the *National Measurement Act 1960* and regulated by Regulation 1999, Reg. 73. To fulfil this legislation, the Licensed Surveyors (General Surveying Practice) Regulations 1961, Reg. 20(2), directs Landgate and the Surveyor General to provide calibration facility (EDM Baselines), the standard (certified distances) and a calibration system to allow surveyors to regularly calibrate their surveying instrumentation.

To meet these requirements Landgate maintains its role as the verifying authority for measurement verification for length in WA under the National Measurement Regulations 1999, Reg.13, and provides EDM calibration facilities, certified distances and a newly developed Landgate calibration portal (Medjil). Landgate will continue to maintain and enhance Medjil's capabilities to improve user experience and maintain alignment with legislative requirements and industry standards.

EDM Baseline located at Cutin University - one of three EDM calibration facilities in WA maintained by Landgate.

6. Strategic alignment

This Geodetic Strategy for Western Australia 2026-2030 has been aligned with two overarching strategies:

1. The ICSM Geodesy Working Group Strategy 2026-2030 which aims to deliver nationally consistent, accessible, accurate and reliable geospatial reference system that underpins all surveying, mapping and positioning by ensuring:

- Geospatial reference systems meet the needs of current and emerging users.
- National products and services are FAIR.
- Expert knowledge and advice on geodesy and positioning.

Landgate represents WA on the Geodesy Working Group providing critical input and contributing to the development and adoption of all national products and strategies. Landgate is committed to supporting these national initiatives which are designed to progress national harmonisation of geodetic standards, products and services.

2. Landgate's Strategic Development Plan (SDP) 2025/26-2029/30, which aims to "fully harness the value of where to power a thriving Western Australia" by playing key roles in securing land title, valuing property and providing authoritative location information.

This strategy aligns with these four SDP themes:

- Contribute to a strong and sustainable WA economy by delivering reliable products and services that support state development and economic growth.
- Meet evolving customer and community needs by delivering improved products and services.
- Drive outcomes in the interest of WA by providing leadership in location information, industry forums and maintaining standards and practices.
- Enable our people to thrive by investing in teams, technology and processes.

The strategic initiatives will ensure continued delivery of improved geodetic products and services to support the State, local government, industry and broader community over the next five years and beyond.

While Landgate's efforts to maintain the geodetic survey ground infrastructure will continue for the foreseeable future, Landgate will monitor the uptake of the Positioning Australia initiative and the way users access positioning information. This will provide valuable insights and set the direction for a future Geodetic Strategy.

7. Strategic initiatives and actions

Developed in consideration of technical development and legislative obligations, the Geodetic Strategy for Western Australia outlines four strategic initiatives to guide the priorities of Landgate's geodetic team from 2026 to 2030. It focuses on ensuring that geodetic products and services remain current, accurate, reliable and accessible, while aligning with the evolving technical, environmental, and societal expectations of government, industry and the wider community.

Serving as a roadmap for excellence in geodetic services, the strategy supports collaboration, fosters innovation and underpins the consistent delivery of high-quality outcomes to meet WA's needs.

Strategic initiatives	Actions
Enhance geodetic products and services to meet the needs of WA users	• Maintain and protect geodetic physical infrastructure (survey marks) to enable access to horizontal and vertical datums. • Install new survey marks and capture survey data to improve spatial coverage, density and positional uncertainty of the geodetic datums in priority areas. • Enhance workflow to assist with the quality-control, processing, storage and integration of new survey data. • Develop and implement analytical tools and streamline processes to improve the quality of geodetic products and services. • Capture airborne gravity data to enhance geoid models and height determination over the Perth metropolitan area. • Maintain survey instrumentation calibration and testing facilities to meet statutory requirements and user needs.
Support the development and implementation of national geodetic initiatives	• Lead the implementation of the AGRS in WA. • Conduct tide gauge levelling connections to GNSS sites to monitor sea level variations. • Contribute survey data to the NGCA to improve vertical datum determination. • Promote the two-frame approach for heights and develop technical solutions to access AVWS on survey marks. • Contribute to the National Adjustment initiative by providing data, automating and integrating state network adjustment workflow. • Lead and advocate for WA's interests through active participation in ICSM Geodesy Working Group meetings and technical working groups.

 **Expand geodetic system visibility and value**	• Redevelop geodetic applications GESMAR and GOLA. • Develop new tools and processes to enable FAIR access for users to geodetic data and metadata. • Support state government agencies and Geoscience Australia in expanding GNSS positioning capabilities. • Support adoption of Spatial WA and other government initiatives. • Educate stakeholders through extended engagement with surveying, geospatial and other industries. • Promote Positioning Australia services while monitoring and leveraging new developments. • Develop new and improve existing standards to enhance geodetic products and services. • Recognise the rights of First Nation peoples when conducting survey activities. • Collaborate with education organisations to promote the surveying profession and support research and development.
 **Maintain and develop operational capabilities**	• Provide leadership in geodesy and positioning activities in WA. • Continue to strengthen critical expertise to maintain business continuity. • Enhance geodetic team capability through professional and technical development opportunities. • Conduct periodic reviews and audits of products and services to remain relevant and effective. • Review and recommend changes to relevant legislation.

Glossary

The following terms and acronyms are used within this document:

Term/Acronym	Definition
ABS	Australian Bureau of Statistics.
Accuracy	Accuracy describes how closely a measurement or position matches 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).
AHD	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 Island (CIHD) and Cocos-Keeling Island (CKIHD) vertical datums.
ATRF2020	Time-dependent Australia's Terrestrial Reference Frame 2020. It is designed as a densification of the International Terrestrial Reference Frame for the Australian region and underpins modern positioning applications.
AUSGeoid2020	Australian Geoid Model 2020 is a combined gravimetric-geometric geoid model with uncertainties developed to support the improved determination of AHD using GNSS technology.
AGQG	AGQG is the Australian Gravimetric Quasi-geoid is a gravity model that provides the offset between the GDA2020 ellipsoid and the Australian quasi-geoid.
AVWS	The Australian Vertical Working Surface is a modern height reference surface designed to complement the AHD.
BM	A survey ground mark for which accurate height information has been established.
CORS	A Continuously Operating Reference Station is a ground fixed monument with permanently installed GNSS receiver, antenna and communication equipment continuously receiving and transmitting GNSS data to a processing centre to improve position accuracy for the end user. CORS is also considered a standard survey mark.

Term/Acronym	Definition
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 determines length using electromagnetic wave propagation and, in surveying, typically refers to a dedicated survey instrument.
EDMI	Electronic Distance Measurement Instrumentation refers to a combination of EDM device and prism.
FAIR	Findable, Accessible, Interoperable and Reusable. For FAIR data principles refer to https://www.go-fair.org/fair-principles/.
GDA2020	Geocentric Datum of Australia 2020 is the current Recognized-Value Standard of Measurement of Position in Australia.
Geoid	The geoid is a model (surface) of global mean sea level extended over land that is used to measure elevations.
GESMAR	Geodetic Survey Mark Register is a Landgate application that stores and maintains records of geodetic data in WA.
GNSS	Global Navigation Satellite Systems is a generic term for satellite navigation systems.
GOLA	Geodetic On-Line Access is a customer facing application to provide access to geodetic mark information.
ICSM	Intergovernmental Committee on Surveying and Mapping is a government committee made up of representatives from all Australian states and territories, the Commonwealth, and New Zealand.
LEO	Low Earth Orbit refers to the region of space approximately 160–2,000km above Earth, where satellites orbit relatively close.
Medjil	Word adopted from Whadjuk Noongar language meaning ‘accurate’ and adopted as the name of the survey instrumentation calibration portal.
NGCA	National GNSS Campaign Archive is a subset of geodetic marks that have been observed using GNSS for a minimum of six hours.
NPIC	The National Positioning Infrastructure Capability is a national GNSS ground network of CORS that enhances positioning capability across Australia.

Term/Acronym	Definition
PNT	Positioning Navigation and Timing services.
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).
SouthPAN	The Southern Positioning Augmentation Network is a satellite-based augmentation system that delivers improved, corrected positioning signals directly to users.
SSM	Standard Survey Mark is a survey ground mark for which accurate horizontal coordinates (and usually height) have been established.

Contact us

To find out more about WA's geodetic products and services please visit our website or contact the geodetic team.

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