PERORMANCE-BASED NAVIGATION (PBN) PLAN – FIJI

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Acronyms

The following is a list of acronyms used in this document:

4DT	Four Dimensional Trajectories
ADS-B	Automatic Dependent Surveillance Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AFL	Airports Fiji Limited
ANSP	Air Navigation Service Provider
APCH	Approach
APV	Approach Procedures with Vertical Guidance
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
AWS	Automated Weather Station
Baro-VNAV	Barometric Vertical Navigation
CAAF	Civil Aviation Authority of Fiji
CAR	Civil Aviation Rules
CCO	Continuous Climb Operations
CDO	Continuous Descent Operations
CFIT	Controlled Flight into Terrain
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
CTA	Controlled Airspace
DME	Distance Measuring Equipment
FANS	Future Air Navigation System
FMS	Flight Management System
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
ILS	Instrument Landing
System INS	Inertial Navigation
System IRU	Inertial Reference Unit
NDB	Non- Directional Beacon
OCA	Oceanic Control Area
PBN	Performance Based Navigation
PBCS	Performance Based Communication & Surveillance
RAIM	Receiver Autonomous Integrity Monitoring
RCP	Required Communication Performance
RSP	Required Surveillance Performance
RNAV	Area Navigation
RNP	Required Navigation Performance

RNP AR	Required Navigation Performance Authorisation Required
SID	Standard Instrument Departure
STAR	Standard Instrument Arrival
TMA	Terminal Control Area
VOR	VHF Omni-directional Radio-range

1.0 Executive Summary

Fiji continues to implement performance-based navigation as the Pacific starts to recover from the after effects of the pandemic.

We have seen a steady increase in international passenger numbers, and these numbers have surpassed 90% of the passenger numbers for the same period in 2019, a very positive indication that we are on the road to recovery and a return to normalcy.

Fiji has been implementing in a slow manner ensuring that proper consultation and resources are in place prior to engaging in design projects.

The three-phase approach has been maintained with the revised dates now set to Short Term-2023-2026, Mid Term 2026 - 2028 and Long Term Beyond -2028

The implementation is with the full support of and close consultation with stakeholders in Fiji consisting of Local and International Airlines, Fiji Airports and Civil Aviation Authority of Fiji

Fiji plans to address the impact of traffic growth by increasing capacity and efficiency which will consequentially improve safety and reduce environmental impact. To achieve this mission Fiji is reviewing all conventional procedures to adopt RNP and RNAV concepts taking into account the advance aircraft technologies.

2.0 Purpose

The introduction of the PBN concept dispels other attempts to breed new specifications which would add confusion to the seemingly difficult task of implementing RNAV or RNP procedures. With clearly spelt out criteria, standards and operational requirements, ANSPs can now focus on areas for improvement and set appropriate target to reap maximum benefits for themselves as well as for airlines, thus reducing time and effort in trying out the various standards.

PBN harmonisation is global. This reassures international airlines to go for suitable fleet equipage depending on the regions that they operate or wish to operate. While navigation specifications may differ from region to region, certification and approval requirements for each specification have now been made consistent, operators having attained one type of PBN approval can expect interoperability with another region having the same PBN type as requirement. This enables airlines to look ahead and plan economically, resulting in savings in the long run. As for ANSPs, PBN harmonisation ensures smooth operation between airspaces. Regional air navigation planning should take shorter time than before, bringing forward improvements to route structures which in turn will motivate airlines to get the right equipage early.

Tactically, PBN could be employed to alleviate air traffic issues like TMA congestion. For example, RNAV1 navigation specification supports close track spacing that could be used to segregate traffic flows in different directions. For areas with limited surveillance coverage, RNAV1 is a good alternative.

3.0 Strategic Objectives

With the application of the ICAO PBN Concept, Fiji aims to achieve the following objectives:

Enhance Efficiency
Enhanced reliability, repeatability, and predictability of operations to increase air traffic throughput and smoother traffic flow. RNAV departures result in better climb profiles to optimum en-route altitudes thus reducing fuel burn, and reduced track distances. RNAV arrivals result in continuously descending path with minimum level flight segments to enable smooth aircraft deceleration and configuration prior to landing.

Enhance Capacity
Delays, congestion, and choke points at airports and in crowded airspace may be reduced because of new and parallel offset routes through terminal airspace, additional ingress/egress points around busy terminal areas, more closely spaced procedures for better use of airspace, and reduced or eliminated conflict in adjacent airport flows.

Enhance Safety
Lateral and vertical track-keeping is much more accurate and reliable due to new three-dimensional guided arrival, approach, and departure procedures that cannot be defined by conventional navigational aids. PBN also reduces the flight crew's exposure to operational errors.

Reduce Environmental Impact:
Utilize PBN to reduce environmental impact from aviation through more efficient operations that result in a less fuel burn and noise emissions. Flying down the middle of a defined flight path means less throttle activity and better avoidance of noise-sensitive areas, so people on the ground perceive less jet noise and are exposed to fewer engine emissions.

4.0 PBN Concept

The PBN Concept is based on a shift from sensor-based navigation to performance based. The PBN concept specifies that aircraft area navigation system performance is defined in terms of accuracy, integrity, continuity and functionality. It details the performance-based RNAV and RNP navigation specifications that can be used on oceanic, en-route and terminal airspace, to improve safety, efficiency and capacity, as well as reduce the environmental impact. These specifications also identify the navigation sensors and equipment necessary to meet the performance requirement.

The application of a PBN specification depends on many factors – the navigation infrastructure, communications capability, surveillance capability, the operational requirement, the aircraft fleet capability and operational approvals etc. In determining which PBN specification to apply, these factors must be taken into consideration in consultation with all stakeholders.

For Fiji, the application of the PBN concept is geared towards to enhancing airspace safety, capacity and efficiency

4.1 Navigation Strategy

This plan also ensures that Fiji considers and adopt the revised navigation strategy for the Asia/Pacific to ensure that the following changes are implemented

a. Operators are qualified for PBN Operations
b. GNSS is the primary navigation system for RNP in Fiji
c. Convert from traditional terrestrial-based instrument flight procedures to PBN operations in accordance with the Asia/Pacific Seamless ATM Plan;
d. retain ILS as an ICAO standard system for as long as it is operationally acceptable and economically beneficial;
c) implement the use of APV operation in accordance with the Asia/Pacific Seamless ATM Plan;
e. implement GNSS with augmentation as required for APV and precision approach or RNP operations
f. rationalize terrestrial navigation aids, retaining a minimum network of terrestrial aids necessary to maintain safety of aircraft operations;
g. protect all the Aeronautical Radio Navigation Service (ARNS) frequencies through education, appropriate regulation and the active detection and elimination of intentional and unintentional interference sources.;

5.0 Current Implementation Status

5.1 Oceanic, Remote and Continental En-route

RNAV en-route operations in the Nadi FIR are based on RNP10 and RNP 4 requirements.

5.2 Terminal Area (SIDs and STARs)

Majority of SIDs in the terminal area are still on conventional mode using navigation aid (VOR/DME and NDB). Due to the introduction of RNP and RNAV concepts Fiji is now planning to publish RNP and RNAV SIDs to take advantage of aircraft tracking capabilities. RNP STARs were implemented in 2020 to support RNP AR operations for RWY 20 in Nadi due to airline requests.

The main driver now for the new RNP SIDs and STARs is to have a set of TMA routes to better facilitate air traffic management and reduce fuel burn.

5.3 Approach

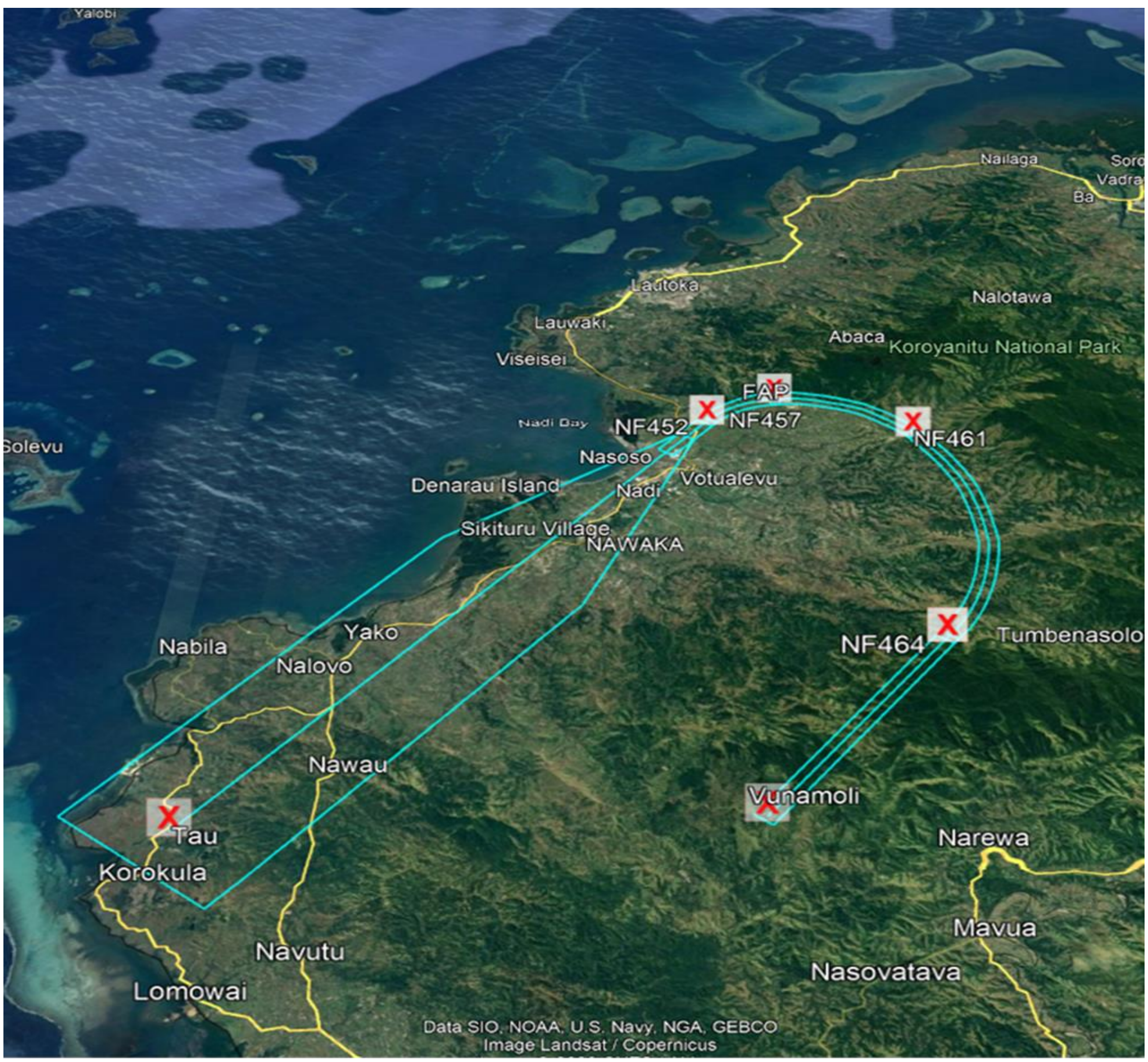
5.3.1 Nadi International Airport

There are two crossing runways used by civil aircraft at Nadi International Airport RWY02

Arrivals will typically conduct the approach into Nadi Airport on the ILS approach procedure, which are available for RWY02 as the predominant precision approach procedure. The RNP APCH procedure serve as the backup for Nadi RWY02 operations.

RWY20

This is one of the geographically challenged approach. Arrivals will typically conduct the approach into Nadi Airport on RWY20 using the RNP AR approach from the south. There are plans to explore the possibility of another RNP-AR approach from the north. There will be no backup since intermediate and final approach areas is mountainous and will result in undesired flight profiles.



RWY09
Arrivals will typically conduct the approach into Nadi Airport on RWY09 using the RNP APCH. Currently there is no back-up approach procedure from RWY09, however APV is now being planned for implementation to act as backup on RWY09 operations

RWY27
Nil approach to this runway end as high terrains are close by. The plan now is introducing RNP APCH with a higher MDA and can be backed up by offset Baro - VNAV to support operations for RWY27.

5.3.2 Nausori International Airport
There is a single runway used by civil aircraft at Nausori International Airport

RWY10
Arrivals will typically conduct the approach into Nausori Airport on the ILS approach procedure, which is available for RWY10 as the predominant precision approach procedure. The RNP APCH procedure serve as the backup for Nadi RWY10 operations.

RWY28
Arrivals will typically conduct the approach into Nausori Airport on RWY28 using the RNP APCH. The APV is now being designed to act as backup on RWY28 operations.

With the introduction of new instrument flight procedure design software, the implementation of instrument approaches with vertical guidance (APV) to all runway ends will be progressed. This has a significant safety impact, as non-precision approaches (dive and drive) with no vertical guidance can be removed. It has been proven that approach procedures with vertical guidance are 25% safer than procedures with no vertical guidance. Furthermore, PBN facilitates the design and implementation of APV to runways that do not currently have an approach capability, thus improving airport accessibility and flight operations efficiency.

Therefore, Fiji in collaboration with the airspace users, now places a high priority on the design and implementation of PBN approach procedures with vertical guidance to comply with Assembly Resolution A37-11, to improve both safety and efficiency.

CDO is an aircraft operating technique which enables the pilot to execute an optimised
arrival descend profile utilising the onboard capability of the aircraft.

CDO is facilitated by appropriate instrument flight procedure design and air traffic control (ATC) procedures.

The vertical profile of CDO takes the form of a continuously descending path with minimum level flight segments to enable smooth aircraft deceleration and configuration prior to an ILS approach. The RNP STARs published for Nadi were constructed in accordance to ICAO Document 9931 CDO Manual and ICAO Document 8168 Procedures for Air Navigation, Aircraft Operations.

Continuous Descent Operation (CDO) is practiced every day since the traffic volumes is not so complex so as to warrant a separate CDO procedures for arrivals into Nadi and Nausori Airport. CDO operations is now enhanced with the introduction of ADS-B surveillance in the Domestic airspace (Terminal & Control Area)

6.0 Aircraft Fleet Capabilities

Currently, most aircraft operating in the Nadi FIR are already basic RNAV capable. To progress PBN in Fiji, Fiji has developed the Fiji PBN Implementation Plan considering fleet readiness, navigation infrastructure and airspace constraints.

Fiji Airways Fleet Size and PBN Capability					
	A350 -900	A330(300)	A330 (200)	B737 Max 8	B737-800
RNP 10	2	1	3	5	1
RNP 4	2	1	3	5	1
RNP 1	2	1	3	5	1
RNAV 10	2	1	3	5	1
RNAV 1	2	1	3	5	1
RNAV 2	2	1	3	5	1
RNAV 5	2	1	3	5	1
RNP APCH	2	1	3	5	1
RNP AR	*2	*1	*3	*5	*1

Note:
1. ***Data provided by Air Safety Department of CAAF***
2. ****Means capable but not yet approved.***

7.0 CNS/ATM Capabilities

The Nadi Area Control Centre (ACC) employs a full range of radio communications systems from VHF to HF radios to Controller Pilot Data Link Communications (CPDLC) for air-ground communications. VHF radio supports surveillance control services both within TMA and the En-route sectors within the VHF range. Beyond that, high quality HF radios, CPDLC data-link and SATPHONE (back-up) capability complete the communications solution.

The largely oceanic airspace inhibits the siting of ground navigational aids. As such, RNAV technology is widely used for en-route navigation. In the TMA however, there is are still NDB and VOR/DMEs and has served as the basis for instrument departure and arrival procedures for the aerodromes within the TMA for many years. With modern aircraft fleets getting equipped with more advance avionics which include satellite navigation capabilities, designing instrument procedures hinged on GNSS will become more and more pragmatic.

As for surveillance, ADS-B has been implemented in the Fiji Domestic Airspace with the vertical limits of 6500ft to FL600 which provide cover up to about 150NM radius from Nadi Airport.

8.0 Benefits of PBN and Global Harmonisation

PBN offers a number of advantages over the sensor-specific method of developing airspace and obstacle clearance criteria.

For example:

a) It reduces the need to maintain sensor-specific routes and procedures and their associated costs (e.g. VOR, NDB, DME);
b) Enhances safety by allowing for straight-in approach procedures with vertical guidance as a primary approach or back up to existing precision approach procedures;
c) Improves airport accessibility under all weather conditions;
d) Allows for more efficient use of airspace, thus increasing capacity;
e) Improves operational efficiency through reduced delays and holds, and enables continuous descent and continuous climb operations;
f) Lessens the environmental impact by contributing to reduced aircraft fuel burn and noise emissions.

9.0 Implementation Challenges

9.1 Safety

Safety challenges revolve largely around the safe operation of the ATM system during the transition of PBN operations. Safety gaps will inadvertently occur within the CNS/ATM system noting that PBN addresses only the navigation aspect of the system and advances in navigation may outpace advances in communications and/or surveillance. Safety challenges also include the following:

a) ATM system integration to support PBN;
b) Safety monitoring of ATM system;
c) Mixed operating environment;
d) Ensuring satisfactory Target Level of Safety (TLS);
e) Continues evolution of PBN navigation specifications and their deployment;
f) Education and training of stakeholders;
g) Naming and charting conventions; and
h) Aeronautical data integrity.

9.2 Efficiency and Capacity

Efficient operations challenges include the needs of other airspace users in a mixed operating environment. Effective collaboration with users such as general aviation community is taken to help the implementing PBN in Fiji.

9.3 Regulatory

Fiji have developed and published national regulatory material to address the PBN applications relevant to Nadi FIR or relevant to operations conducted in another State by the operators in accordance to regulations of that State and aircraft registered in that State. The regulations are categorized by operation, flight phase, area of operation and/or navigation specification. Approvals for commercial operations should require specific authorization.

Instrument flight procedures (IFP) design is an essential component of PBN development and implementation. ANSP handles the Flight Procedure Design Office (FPDO) has been established in Fiji since 2005 to develop PBN IFP and review existing IFPs. Flight procedure designers in Fiji use advance planning and designing tools to fully reap the benefits of PBN.

9.4 Aircraft Operations

The aircraft fleet mix operating in Nadi FIR can be categorised into the following wake turbulence category – Light, Medium, Heavy and Super.

9.5 Infrastructure

The Nadi FIR comprises mainly "oceanic" airspace and introduction of any ground-based navigation aids to enhance safety or capacity will be difficult. Fiji is exploring other means of airspace enhancements that leverage on emerging technologies and aircraft navigation capabilities.

ADS-B capable aircrafts use GPS to determine its position and by means of Mode S 1090 ES broadcasts that position at rapid intervals combined with identity, altitude, velocity and other data to ADS-B ground stations which receive and distribute the data to ATM automation systems. The processed data is displayed at

the air traffic controller work position (CWP) enabling the provision of a surveillance control service.

The basic concept of ADS-B involves the broadcasting of surveillance information from aircraft via a data link. To support the ADS-B application, the overall ADS-B avionics system, herein referred to as "ADS-B System", needs to provide the following functions:

- Adequate surveillance data provision capability;
- ADS-B message processing (encoding and generation);
- ADS-B message transmission (Mode S 1090 MHz ES airborne surveillance data-link).

Whereas the latter two functions are incorporated in the Mode S 1090 MHz ES ADS-B transmit system, the surveillance data provision is realised through various on-board surveillance data sources (e.g. horizontal position source, barometric altimetry, ATC transponder control panel). The horizontal position accuracy and integrity requirements of the ADS-B application are associated with quality indicators which form part of the air-to-ground ADS-B message.

9.6 Environment (Noise and Emissions)

Environmental challenges include minimising the impact of noise and carbon emissions on both the communities in the proximity of the airport and the global environment. Nadi International Airport is surrounded with highly rated resorts with tourist from all over the world enjoying their holidays. Few of these hotels are designated as noise sensitive areas.

The inclusion of new PBN procedures will help alleviate noise issues in these areas PBN will support the achievement of these goals while preserving aviation safety and efficiencies in the ATM system, but a collaborative approach will be essential to deliver these objectives.

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10.0 Implementation

10.1 Short Term (2023-2026)
In line with the ICAO Asia Pacific Seamless ATM Plan, the time frame for short term implementation has been revised to 2023-2026.
Fiji's concept for the PBN implementation in the short term for the respective areas is listed as follows. (whatever is documented in here should be shown in appendix
Terminal Area (SIDs and STARs)
♣ RNAV1 SIDs and STARs for Nadi Airport (check appendix B)

Approach
♣ RNP APCH with vertical guidance (Baro-VNAV) to be implemented for remaining Nadi and Nausori Airport runway ends (check appendix B)

Route re-structure
Refer to Appendix C

10.2 Medium Term (2026-2028)
In line with the ICAO Asia Pacific Seamless ATM Plan, the time frame for medium term implementation has been revised to 2026. Fiji's concept for the PBN implementation in the medium term for the respective areas is listed as follows.

Oceanic, Remote and Continental En-route
♣ Surveillance ¬ RNAV5 routes whenever feasible
♣ Procedural ¬ RNAV10 routes ¬ RNP4 wherever feasible (refer appendix C)

Terminal Area (SIDs and STARs)

♣ RNAV1 SID and STAR for Nausori Airport (check appendix B)

Approach

♣ RNP APCH with vertical guidance (Baro-VNAV)

10.3 Long Term (beyond 2028)

In line with the ICAO Asia Pacific Seamless ATM Plan, the time frame for long term implementation is 2026 and beyond. In this phase, GNSS is expected to be a primary navigation infrastructure for PBN implementation. States should work

cooperatively on a multinational basis to implement GNSS in order to facilitate seamless and inter- operable systems. Fiji's concept for the PBN implementation in the far term for the respective areas is listed as follows.

Oceanic, Remote and Continental En-route

♣ Surveillance ¬ RNAV5 routes whenever feasible ¬ RNAV2 routes whenever feasible

♣ Procedural ¬ RNAV10 routes ¬ RNP4 wherever feasible ¬ RNP2 wherever feasible (refer appendix C)

Terminal Area (SIDs and STARs)

♣ Basic-RNP 1 for Nausori Airport (check appendix B)

Approach

♣ RNP AR for RWY27 Nadi RWY 10 Nausori Airport (check appendix B)

11.0 End State

The end state of the PBN Implementation Plan is to meet the objectives of Resolution A37-11. The goal towards building a seamless sky can only be achieved by the active cooperation, collaboration and participation of all aviation stakeholders. Under the ICAO Aviation System Block Upgrades (ASBU) framework, PBN is in Block 0 which includes capabilities or modules that are available currently. This will form the foundations of other future Block Upgrades. Fiji shall continue to build on existing capabilities and continue to cooperate and engage the other stakeholders to ensure a harmonised and coordinated PBN implementation in the Asia Pacific region.

12.0 Technology Recommendations

Aircraft equipment and ATM requirements will change as PBN is implemented with new technology needing to be utilised in the aviation system. These include the following which will be reviewed by the PBN technical groups to set specific timeframes and requirements.

GBAS and SBAS Technology is gaining widespread reputation. Numerous vendors and suppliers have been discussing with Fiji proposed way forward for the proposed technology. Progress will largely depend on user requirements and expertise.

13.0 GNSS Equipment

These requirements will be determined based on new equipment availability and industry developments. There will be a transition from single GPS to multi-constellation GNSS equipment.

14.0 ATC Transponder

Transponder requirements is mandatory for Fiji Registered aircraft with Mode-S Elementary (minimum) and Mode-S Enhanced (recommended). Additionally, ADS-B using Modes-S 1090Mhz extended squitter (DO260A or later) is currently recommended for international carriers.

15.0 ADS-B OUT Exclusive Airspace

An aeronautical information circular has been issued by the state informing the aircraft operators and aviation industry on Fiji's mandate for Automatic Dependent Surveillance Broadcast (ADS-B) Out Exclusive Airspace within the Fiji Domestic Sector by the 13th July 2023.

16.0 Safety Assessment and Monitoring Requirements

To ensure that the introduction of PBN applications within Nadi FIR is undertaken in a safe manner, in accordance with relevant ICAO provisions, implementation shall only take place following conduct of a safety assessment that has demonstrated that an acceptable level of safety will be met and risk associated with specific PBN implementations are acceptable. Additionally, ongoing periodic safety reviews will be undertaken where required in order to establish that operations continue to meet acceptable levels of safety.

The Authority will ensure that a safety assessment and, where required, ongoing monitoring of the PBN implementations are conducted.

Appendices

Appendix A - Implementation Schedule for En-Route, Terminal and Approach Procedures

Nadi Airport		
RWY 02	2025	• RNP APCH with Baro VNAV for South Arrival •
RWY 09	2025	RNP APCH with Baro VNAV
RWY 27	2025	Explore RNP APCH with Baro VNAV including option for offset
RWY 20	Complete 2020	• RNP-AR Implemented
	Beyond 2028	• RNP-AR for north arrival to be explored (Beyond 2028)
Precision Approach	2026	• CAAF, AFL and Fiji Airways to study feasibility of GBAS for Nadi
STAR 20	Complete	RNAV 1
STAR 02	2026	RNAV 1
SID 20	2025	RNP 1
SID 27	2025	RNAV 1
SID 02	2025	RNAV 1
SID 09	2025	RNAV 1

Nausori Airport		
RWY 28	2023	RNP APCH with BARO V-NAV
RWY 10	2025	RNP APCH with BARO V-NAV
STAR 10	2028	RNAV 1
SID 10	2028	RNAV 1
SID 28	2028	RNAV 1

APPENDIX B - Route Re-Structure

Flight Phase	Short Term 2023-2026	Mid Term 2026-2028	Long Term Beyond 2028	Comments
Enroute	Implement Contingency RNAV Routes	Domestic En-route to be laterally separated.	RNP 2	**The Authority to monitor**
Terminal Areas	Implement Off-set Baro Vnav on RWY27	STAR RWY02	RNAV 1 STAR for Nausori and Nadi RWY09/27	**The Authority to monitor**
Helicopter Operations	Development of helicopter RNAV 5 routes and PinS procedure for specific locations – 2023 -2026			