appendix 1

Final report of the Ground-Based Navigation Aids Review Panel

The GBNA Review Panel

The purpose of the Ground-Based Navigation Aids (GBNA) Review Panel is to determine the minimum national distribution of GBNAs that will provide the functions of:

- a Minimum Operating Network (MON), that will ensure that IFR aircraft can be recovered to the ground in the case that GNSS positioning is not available for navigation (for whatever reason)
- a Contingency Network that will allow some operations to continue on main trunk routes during an extended GNSS outage.

The Panel met in October 2020 to finalise its recommendations

The fifth meeting of the Ground-Based Navigation Aids Review Panel was held on 16 October 2020. The intention of this meeting was to take a high-level strategic approach to assess evidence of the need for additional GBNAs. This was based on new technical information provided to the Panel after stakeholder workshops were facilitated by the Civil Aviation Authority (CAA).

The concern was that the performance characteristics of some aircraft, especially helicopters, would make it difficult for them to operate under the proposed MON and rule amendments. Where these aircraft provide emergency medical services or other important work, this would be unacceptable, and extra GBNAs may be required.

Helicopters are used in many roles for their overall flexibility, but they must trade off limited payloads, fuel capacity and range. They are often unable to fly to altitude due to icing. And when used for medical services, they may have other operational limits due to the condition of patients. These limitations mean that operators far from GBNAs, or in coverage gaps, may not be able to use GBNAs to recover to the ground, or to specify feasible alternates.

The Review Panel endorsed the proposal that the coverage that would be provided by 8 additional GBNAs would allow Helicopter Emergency Medical Services and other helicopter services to continue to operate. However, it recommended that further technical work be undertaken to test whether fewer GBNAs, perhaps at new locations, could provide the same effective coverage.

appendix 1

Previous recommendations

April 2018 – First recommendations

The first recommendations of the GBNA Review Panel were released in April 2018. These recommendations entail that there should be VOR/DMEs at each of the following 20 aerodromes (or nearby, for Dunedin).

1. Kaitaia
2. Whenuapai
3. Auckland
4. Hamilton
5. Tauranga
6. Rotorua
7. Gisborne
8. Napier
9. New Plymouth
10. Ohakea
11. Palmerston North
12. Wellington
13. Nelson
14. Woodbourne
15. Hokitika
16. Christchurch
17. Queenstown
18. Dunedin
19. Invercargill
20. Chatham Island

Airways has agreed to support this network of GBNAs, with the exception of the GBNA on Chatham Island, which it does not own. The Review Panel's recommendation that there be a VOR/DME on Chatham Island still stands.[1]

The Panel found that the network required for the MON would also provide the Contingency Network and, in fact, its coverage is sufficient to allow some other operations, beyond the main trunk, to continue during an extended GNSS outage.

However, the Review Panel was also aware that there were gaps in the coverage provided by this network, and that there could be issues for some kinds of aircraft or operation. In particular, the Panel had been alerted that there might be issues for some Helicopter Emergency Medical Services.

The Panel's first recommendations acknowledged the following limitations:

- the Panel was not tasked with determining what sort of aviation operations should be feasible
- the forthcoming regulatory framework would affect the function of the MON
- operators could not assess the effect on themselves of forthcoming regulation, so the Panel could not effectively consult with them.

The Panel also noted that the implementation of its recommendations should take account of regulatory changes and practical implications to ensure that the objectives of its review were met.

[1] The aircraft that Air Chathams currently flies to the Islands are obsolete, and the airport needs significant work to accommodate alternative aircraft. The government has provided funding to extend the airport, and it is expected that it will have a GBNA appropriate to the aircraft that use it.

July 2019 – Second recommendations

In June 2019 the GBNA Review Panel reconvened to review new information and to address concerns that the MON would restrict the operation of some helicopters and small fixed-wing aircraft that are used for emergency medical services.

Airways confirmed its plans for GBNAs, which are consistent with the recommended MON, with the exception of Chatham Island.

The new information included more-detailed maps of the modelled signal coverage for the GBNAs comprising the proposed MON. It also included feedback from working groups hosted by the CAA to gather information about the impact of a Performance-Based Navigation (PBN) environment, including a reduction in the number of GBNAs, for rotary and fixed-wing aircraft.

The Panel agreed that it would be unacceptable for the MON, in conjunction with forthcoming regulation, to restrict the operation of emergency medical services or other essential services. However, it concluded that if PBN regulation was reasonably flexible, the MON would not result in unacceptable restrictions.

It further agreed that if it was not possible for the regulation to have this flexibility, the Panel would meet again to reassess the MON. It was noted that in this case, it might be necessary to consider specific potential routes for operators that might be affected.

In July 2019, the Panel confirmed recommendations to be issued to the PBN Regulatory Framework project, intended to avoid operational problems.

Finalising the GBNA Review Panel's recommendations

The CAA held technical Workshops to assess the effects of the MON

In September 2020, prior to the meeting of the GBNA Review Panel, the CAA hosted two further technical workshops for operators of fixed-wing and rotary aircraft. Whereas previous workshops had canvassed the views of stakeholders, these workshops assessed the actual activities of operators who were concerned that the combined effect of the MON, the proposed PBN rule amendments and the performance characteristics of their aircraft would restrict their operations.

Attendees included Helicopter Emergency Medical Services, flight schools, Defence, and other operators of small or rotary aircraft. The National Ambulance Sector Office (NASO) from the Ministry of Health also attended. The CAA provided guidance material about the proposed rule amendments to assist the analysis.

For each region of the country, the workshops considered the effect of the proposed MON, given the proposed rules, for a number of different kinds of operation. It was concluded that fixed-wing operations would not be limited, but that some helicopter operations would be limited. This was especially the case in the South Island, where there are gaps in GBNA coverage, and large distances between GBNAs.

NASO presented an impact statement estimating that if Air Ambulance Helicopter Services are unable to operate in IFR conditions, then around 500 medical flights per annum would be negatively impacted, and this number would increase.

As a result of these stakeholder workshops, a technical report was provided to the GBNA Review Panel, which recommended that a further 8 GBNAs be added to the MON.

1. Whangārei
2. Taupō
3. Whanganui
4. Westport
5. Kaikōura
6. Mt Mary
7. Timaru
8. Alexandra

Objectives of the GBNA Review Panel meeting to finalise recommendations

The meeting had 3 specific objectives for finalising its recommendations:

1. agreement on final MON disposition to allow for recommendations to be made to GBNA owners or operators
2. agree and initiate work on a simple supporting route structure
3. determine a process for ongoing future reviews.

Objective 1: agreement on final MON disposition to allow for recommendations to be made to GBNA owners or operators

This objective involved consideration of the technical report that was provided to the panel, and which recommended that 8 additional GBNAs be included in the MON.

The proposed additional GBNAs are not part of Airways' business plan and it could not be assumed that Airways would take responsibility for their provision. The cost of the additional GBNAs was estimated at $12 million CAPEX + OPEX. As before, the Panel was tasked with identifying the need for GBNAs, not with solving funding issues; however, the Panel was mindful that its recommendations needed to be based on national interests.

The Panel agreed that the operations covered by the report – helicopter operations to provide emergency medical services and Defence operations – should not be unreasonably restricted by the MON.

The Panel also agreed to accept the report's finding that 8 additional GBNAs would ensure that essential operations were not restricted. It was also acknowledged that while the additional GBNAs were not required for fixed-wing operations, some of those aircraft would also benefit from them.

However, the Panel noted that the report had reached its conclusions by analysing localised operational issues caused by gaps in GBNA coverage, or by the distance of operations from GBNAs. The proposed additional GBNAs would also affect the network as a whole, possibly creating redundancy. Furthermore, the first recommendations of the Panel had taken as a starting point Airways' existing plan to maintain GBNAs at (then) controlled aerodromes. So that review had also not been concerned with redundancy.

It was agreed that additional technical work should be carried out to test whether the coverage provided by the 20 GBNAs comprising the originally recommended MON, plus the proposed 8 additional GBNAs, could be effectively provided by fewer than 28 GBNAs. This work should consider the possibility of GBNAs at new sites, which may not be located at aerodromes. It was acknowledged that the 8 proposed GBNAs were at existing sites, and that a completely new site might be more expensive than upgrading an existing one, but this cost could be offset if fewer were required.

Objective 2: agree and initiate work on a simple supporting route structure

The MON is a network of GBNAs that will enable the recovery of aircraft to the ground if GNSS is lost. In order for it to do this, there must be a corresponding system of approved tracks that would allow pilots on PBN routes to move to routes associated with GBNAs that will bring them to suitable aerodromes.

Aircraft operators may also need knowledge of this route structure before they are able to formulate alternative means of compliance with rules.

The Panel considered the needs of various operators if GNSS were lost.

- Some aircraft, such as GA and Q300 passenger aircraft, would likely have to climb using dead reckoning in order to get above minimum safe altitude and acquire a GBNA signal.
- Larger passenger aircraft can continue on RNAV routes, using GBNAs, without GPS.
- Some operators would need to continue operating through an extended GNSS outage.

In order to reach a safe altitude, pilots could use Grid MORAs (minimum off-route altitude). These are already published. Pilots could also use VOR/DME MRA Sectors (VORSEC) charts to ensure that they are clear of terrain and able to receive GBNAs. These would be especially important for aircraft unable to reach minimum safe altitude. Most VORSEC charts are published, but it would be useful if they were at least available around each GBNA and around the main trunk airports.

It was agreed that there needs to be a simple route structure to support the recovery of aircraft to the ground, and that this could include VORSEC charts and route minimum safe altitudes.

Objective 3: determine a process for ongoing future reviews

It was agreed that a 3-yearly meeting of the GBNA Review Panel would be sufficient to review the effectiveness of GBNA coverage in achieving the MON and contingency network.

However, it was envisaged that changes could occur, such as to regulation, practice or technology, which mean that the assumptions underlying the Panel's recommendations are no longer valid. In that case, the MON or contingency network might fail, and GBNA coverage should immediately be reassessed.

Examples of such events were suggested:

- unexpected implications of the forthcoming rules regulating Performance-Based Navigation
- future rule changes that affect what aircraft operations are possible
- the availability of a dual frequency multiple constellation (DFMC) capability in the future
- the failure of Panel recommendations to be properly implemented.

It was agreed that anything that prevented the Panel's recommendations from having the intended effect, with respect to GBNA coverage, should trigger a meeting of the Panel to review the new circumstances.

The Panel also considered whether it was necessary to have 3-yearly meetings if meetings would be triggered by relevant changes in circumstances. However, it was agreed that regular reviews would still have value, and noted that this would mean the next scheduled meeting would occur conveniently at the end of the New Southern Sky programme.

It was suggested that the Ministry of Transport lead future meetings, and this was recorded as a recommendation, though it was not discussed further. The Ministry may regard the ongoing maintenance of GBNA coverage, subsequent to the New Southern Sky programme, as more appropriately led as part of operational policy.

The date of the next scheduled meeting of the GBNA Review Panel was set for October 2023.

Other business discussed by the GBNA Review Panel

A dissenting view

It was noted that the New Zealand Defence Force had dissented from the Review Panel's original recommendations. Its view had been that the Panel's high-level approach was inadequate to determine the MON or New Zealand's security and resilience needs, and that the Panel needed better information about GBNA coverage, and a formal risk analysis.

The Member of the Review Panel representing the New Zealand Defence Force was asked whether the Panel's subsequent work resolved his concerns. The Member stated that the original dissenting position should stand, and agreed that Defence would raise its remaining concerns with the Governance Group and, where appropriate, through the rule development process.

Previous recommendations

It was agreed that the Panel's second set of recommendations, from July 2019, which was framed specifically for the PBN Regulatory Framework project, should be shared with the New Southern Sky Governance Group.

Recommendations

The MON

1. The MON should provide coverage and capability consistent with the originally recommended 20 VOR/DME plus the 8 additional VOR/DME that were proposed by the technical panel.
2. Further technical work should be undertaken to test whether the coverage and capability of the proposed 28 VOR/DME can be provided by an optimised network comprising fewer GBNAs.

Route structure

3. There should be a simple supporting route structure design that provides enough information to support a pilot to use the MON to recover to the ground.
4. To achieve this, the route structure design could include, but need not be limited to, the provision of sufficient VORSEC charts and route MSAs.

The GBNA Review Panel

5. The GBNA Review Panel should meet every 3 years, under the leadership of the Ministry of Transport.
6. The next meeting of the GBNA Review Panel should be in **October 2023**.
7. The GBNA Review Panel should reconvene if an event occurs that:
    - undermines the assumptions on which these recommendations are based, or;
    - prevents these recommendations from having their intended effect.
8. The Panel's second set of recommendations, from July 2019, which was formulated for the PBN Regulatory Framework project, should be submitted to the New Southern Sky Governance Group. [See appendix 4.]

Subsequent work

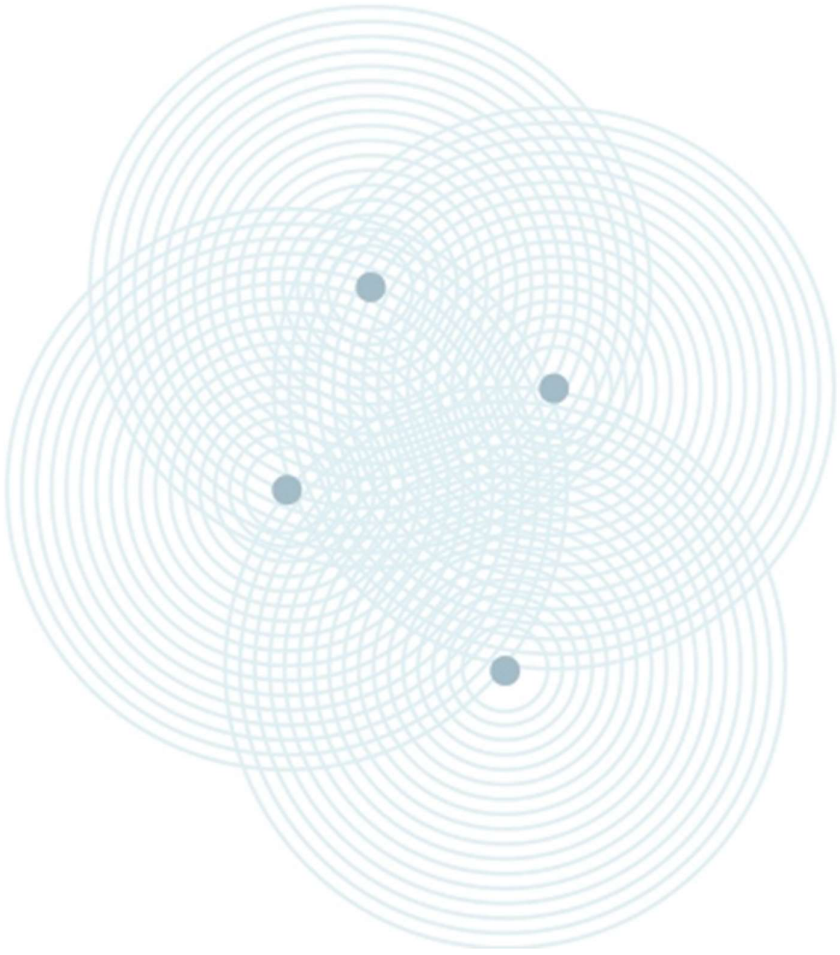
In fulfilment of recommendation 2, a further technical review of the proposed 28 VOR/DME MON found that sufficient coverage and capability could be achieved with only 25 VOR/DME (see Appendix 2 – GBNA Technical Panel VOR/DME Report). Of the additional 8 VOR/DME, 5 were found to be justified, and 3 were found not to be justified.

On the basis of this advice, recommendation 1 therefore entails that the MON should be a network of 25 VOR/DME, comprising the 20 VOR/DME originally proposed, plus the following 5 additional VOR/DME.

1. Whangārei
2. Taupō
3. Westport
4. Timaru
5. Alexandra

appendix 2

GBNA Technical Panel VOR/DME Report



new southern sky

V1.5

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Abbreviations

AMOC	Alternative Means of Compliance
DME	Distance Measuring Equipment GBNA (provides distance information to aircraft with reference to the GBNA)
FAA	Federal Aviation Administration
GBNA	Ground Based Navigation Aid
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HEMS	Helicopter Emergency Medical Services
IFR	Instrument Flight Rules
MON	Minimum Operating Network
NDB	Non-Directional Beacon (obsolete GBNA that provides less accurate azimuth information to aircraft with reference to the GBNA – these sites are being withdrawn)
PBNRF	Performance Based Navigation Regulatory Framework
VFR	Visual Flight Rules
VOR	Very High Frequency Omnidirectional Range GBNA (provides azimuth information to aircraft with reference to the GBNA)
VOR/DME	Co-located VOR and DME GBNA

Executive Summary

The Ground Based Navigation Aid (GBNA) Infrastructure Strategy (Nov 2016) determined that the primary purpose of the Minimum Operational Network (MON) was to recover IFR aircraft safely to an aerodrome in the event of the loss of GPS/GNSS navigation. The GBNA Technical Panel evaluation has determined that five of the eight locations recommended by the GBNA Review Panel meet this criterion. Three locations (Whanganui, Mount Mary, and Kaikoura), could not be supported due to their proximity to neighbouring VOR/DMEs, or the high approach minima, and subsequent VFR component.

Introduction

The GBNA Review Panel re-convened to assess input from fixed and rotary wing operators that had been obtained through focused industry workshops. From the GBNA Review Panel 8 further locations for VOR/DMEs were proposed with the following qualification:

'The Panel has identified that the coverage and capability that can be delivered by the proposed additional 8 VOR/DME is what is required for a MON consisting of the original 20 VOR/DME and the additional 8 VOR/DME proposed.

This may need to be evaluated to provide an optimal solution that would determine the final number of VOR/DME.'

GBNA Technical Panel

To respond to this output from the GBNA Review Panel and evaluate the effectiveness of the additional 8 VOR/DMEs, the GBNA Technical Panel was established. The panel was made up of the following suitably qualified SMEs:

- James Black (NSS) - Chair
- David Wills (CAA)
- Katrina Witney (CAA)
- Ryan Nicholl (CAA)
- Stefan Brandt (Aeropath)

Refer to Appendix A for the full Technical Panel terms of reference.

The Technical Panel met on the following dates:

10 December 2020
19 January 2021

Methodology

To review the coverage and capability of the proposed VOR/DME locations, the GBNA Technical Panel investigated two key properties of each location:

1) **Coverage:** How close is the proposed VOR/DME site to other GBNA in the MON? Is the neighbouring VOR/DME accessible and have an easily flown approach, with an effective minima?

When the FAA conducted a similar exercise, their aim was to ensure that there would be at least one VOR/DME within 100nm[2]. In New Zealand the average distance between navigation aids is 60 – 80 NM. The Panel used 60NM as a rule of thumb, and highlighted locations that had another VOR/DME closer than this.

2) **Capability:** How effective would a VOR/DME approach be? Would it enable a safe approach, with an effective minima?

The Panel felt that locations that had a high minimum (e.g. 1000ft), were restricted to daylight hours only, or had a VFR segment between the end of the approach and the runway, would only afford limited value to the MON.

2 https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/transition_programs/vormon/

VOR/DME Locations

For reference, the additional VOR/DME locations that were recommended by the 2018 GBNA Review Panel are listed in Appendix B.

The further VOR/DME locations recommended by the 2020 GBNA Review Panel are listed below:

	Name	Closest VOR/DME	Likely Approach	Notes
1	Whangarei	Kaitaia 70 NM Whenuapai 60 NM	Circling CAT A B OCA < 1000ft	• Aeropath confirm a single VOR/DME could replace the two NDBs
2	Taupo	Rotorua 40 NM Napier 55 NM	Runway Aligned CAT A B C OCA < 1000ft	• Close to Rotorua and Napier, but is isolated by high terrain
3	Whanganui	Ohakea 20NM Palmerston North 35 NM	Runway Aligned CAT A B C OCA < 1000ft	• Very Close to Ohakea and Palmerston North
4	Westport	Hokitika 65 NM Nelson 80 NM	Runway Aligned CAT A B C OCA < 1000ft	• Isolated location
5	Kaikoura	Woodbourne 55 NM Christchurch 80 NM		• High minima 960ft – 5km • Restricted to daylight hours • VFR Component
6	Mt Mary	Timaru 40NM Alexandra 70NM		• High minima 3500ft – 8km • Restricted to daylight hours • VFR Component
7	Timaru	Hokitika 95 NM Christchurch 75NM	Runway Aligned CAT A B C OCA < 1000ft	• Used extensively as an alternate by airlines too
8	Alexandra	Queenstown 30 NM Dunedin 55 NM	Circling CAT A B OCA < 1000ft	• NZQN complex location to divert to • Alexandra is isolated by high terrain

Locations that failed the Key Properties methodology

Three locations that were tested under the two key properties methodology employed by the Technical Panel did not meet the coverage and capability criteria.

Whanganui
Whanganui Is located very close to two neighbouring VOR/DMEs. Palmerston North is 35 NM away, and Ohakea is only 20NM. Given this close proximity, and that only a single operator has requested a VOR/DME at Whanganui, the GBNA Technical Panel cannot support the request for a VOR/DME at that location.

If for flight planning, the distance to Ohakea or Palmerston is too far, the operator could look at an Alternative Means of Compliance (AMOC).

Mount Mary
Mount Mary was previously an en-route VOR/DME, that had an approach into Glentanner aerodrome 15NM away. The approach had a minima of 3500ft (1700ft AGL), and only allowed for an aircraft to proceed VFR during daylight hours only. VOR and associated approach was removed in 2009. Given the high minima, distance from the airfield (17NM), VFR segment, and restriction to daylight hours only, the GBNA Technical Panel does not see any value in providing a VOR/DME at Mount Mary

Kaikoura
The NDB is located on the Kaikoura peninsular, and was used as an en-route navigation aid for traffic between Christchurch and Wellington, with a “shuttle descent in a racetrack” approach to the aerodrome located 4NM away. The minima for the approach is 960ft /5km and is to enable an aircraft to establish visual reference and continue on a visual approach to the airfield. With a non-standard approach, high minima, large visual segment, the GBNA Technical Panel does not see value in replacing the Kaikoura NDB with a VOR/DME.

MON ‘In Place’ Observation

The National Airspace and Air Navigation Plan (NAANP) envisaged the use of GNSS as the primary means of IFR air navigation in New Zealand, with a full PBN environment achieved by 2023. GBNA would be ‘a contingency in case of emergencies and equipment failures’ for the safe recovery of aircraft. This was amplified in the GBNA Infrastructure Strategy of 2016 which stated that ‘The GBNA infrastructure that supports the recovery of aircraft will be known as the MON.’

The GBNA Infrastructure Strategy also stated (Page 5) in regard of the scope of this work, that ‘There may be GBNA that are not required to meet the safety requirements of the MON and the process needs to enable this assessment.

In the course of their assessment, the Technical Panel observed that, with the MON in place, as recommended by the GBNA Review Panel, consisting of 25 VOR/DME and within the context of a mature PBN system, that this would allow for the utility of other GBNA outside the MON to be considered further.

Accordingly, the Technical Panel has also recorded that while Queenstown and Rotorua have VOR/DMEs, both are better served by more effective RNAV approaches. Assuming the MON is established as recommended by this report, they will ultimately be located close to neighbouring airfields with much more effective VOR/DME approaches. This would allow the GBNA Review Panel to consider further recommendations in 2023, regarding these particular GBNA.

Appendix A: GBNA Technical Panel Terms of Reference

Aim

The aim is to determine if the coverage and capability represented by the proposed 28 VOR/DME MON can be provided by fewer VOR/DME sites.

GBNA Technical Panel – Terms of Reference

1) Check validity of original conclusions on sites selected against evidence (not opinion).

2) Determine what is the optimal solution (numbers of VOR/DMEs).

Assumptions/Constraints

- GBNA Review Panel (Oct 2020) has provided optimal coverage for all operations, including IFR helicopters.
- The MON is primarily for recovery operations (GBNA Infrastructure Strategy 2016 refers). Although some aircraft/operators may choose not to equip with PBN, the MON is not an alternative to GNSS.
- The MON is secondarily for contingency operations on the main trunk of airways routes between Auckland, Wellington and Christchurch (GBNA Infrastructure Strategy refers). The ability or inability of an aerodrome to support subsequent operations by aircraft that have landed for recovery reasons is therefore not relevant.
- Military VOR/DME are available on an emergency 'get me on the ground' basis following a GPS failure of any sort, unless declared as otherwise by NZDF[3].

Out of scope

- Cost of VOR/DME (both purchase price, and operational)
- Green field locations

In Scope

- Brown field locations i.e. NDB sites with the ability to support future VOR/DME operations

[3] The arrangement would need to be confirmed with NZDF. Currently, most wide-body international arrivals nominate Ohakea as an alternate.

Appendix B: The additional VOR/DME locations that were recommended by the 2018 GBNA Review Panel

For reference, the additional VOR/DME locations that were recommended by the 2018 GBNA Review Panel are listed below:

	Name	Closest VOR/DME	Likely Approach	Notes
1	Kaitaia	Whangarei 70 NM Whenuapai 125 NM	Runway Aligned CAT A B C OCA < 1000ft	• Would be used by search and rescue aircraft
2	Tauranga	Rotorua 25 NM Hamilton 40NM	Runway Aligned CAT A B C OCA < 1000ft	• Very close to Rotorua. However, Rotorua has very high minima • Current NDB to be replaced by a VOR
3	Hokitika	Westport 65 NM Christchurch 85 NM	Runway Aligned CAT A B C OCA < 1000ft	• Isolated location
4	Chatham Island	nil	Circling CAT A B C OCA < 1000ft	• Remote location

appendix 3

PROCESS TO SUPPORT THE GBNA REVIEW PANEL DELIBERATIONS ON THE MINIMUM OPERATING NETWORK (MON) AND CONTINGENCY OPERATIONS

Background

1. The role of the GBNA Review Panel is first to determine a MON and then to agree what is required to support a GBNA contingency capability (reference GBNA Strategy Paper). The analysis requirements for the two are different. The purpose of the MON is to provide a fallback capability to allow aircraft to recover safely to an airfield with a GBNA in the event of a GNSS failure (aircraft system failure, regional failure, national failure or global failure). The contingency capability is to provide for continued, though reduced, aviation activity if the GNSS service is unavailable for a period of time.

2. It therefore follows that the criteria considered by the Panel will be different for each network. The MON considerations are fundamentally about safety of flight and therefore operational conditions. The contingency factors are broader and also need to include national security and resilience issues, any regional economic impacts and any impact on health or other vital services. As they may be different , it makes sense to delay recommendations on the MON and contingency requirements to the decision makers until both have been determined. The Review Panel may wish to consider making recommendations in two stages, the North Island followed by the South Island.

3. In the meantime, it is recommended that the Review Panel continues to consider the MON, based upon its initial deliberations over Northland, and captures assumptions and recommendations for review and testing. As the key issue for the MON is safety of flight, the CAA should test the recommendations against the NSS Safety Criteria. The CAA is represented on the Review Panel, so the recommendation going to the CAA should be reasonably mature. The operating community could then validate the recommendations before they are released to the decision makers. The recommended process and scheduling is included in this note.

Segmented Approach

4. While it was possible to address the Northland assessment in one sitting as it is geographically distinct and separate, it may not be possible to analyse the rest of the North Island in one sitting. Even from Ardmore south, the North Island is a big area. It may be easier to deal with it in bite-sized chunks. The recommended chunks are:

- Ardmore/Hamilton – Waikato
- Taranaki
- Manawatu and Wairarapa (Palmerston North/Ohakea/Wellington/Masterton)
- Bay of Plenty (Tauranga/Taupo)
- East Coast (Gisborne/Napier)

5. The South Island can be similarly divided into:

appendix 3

- Nelson/Blenheim
- West Coast
- Christchurch Region
- Wanaka/Queenstown/Invercargill/Dunedin

appendix 3

MON Evaluation

6. The Review Panel reached the following conclusions at meeting #2

Ser	Criteria				Comments
1	Weather Suitability	Pros	Cons	Show Stopper	KK's elevation makes it susceptible to low cloud.
	WR	Y			
	KK		×		
	KT	Y			
2	Terrain Masking of GBNA signal				WR's terrain masks GBNA signals in a number of inland quadrants for those operating in the lower airspace (particularly impacts helo ops)
	WR		×		
	KK	Y			
	KT	Y			
3	Meets NSS System Safety Criteria	Yes or No from the Review Panel.			Will be validated by the CAA.

7. This template for the MON can be used for further evaluations. Review Panel members are invited to offer any other criteria that they think should be considered..

8. Our preliminary analysis suggests that the following assumptions are approprate. Review Panel members are invited to provide feedback on these at the next meeting, including any disagreements or proposed alternatives.

Ser	Assumption
1	Existing resource consents for siting and operation of NDBs would accomodate VORs if these were required to replace NDBs
2	In Northland, where there are currently 4 GBNA, one GBNA is sufficient to support the MON
3	If an aerodrome loses a GBNA, it will be replaced by a PBN procedure
4	In order to fulfill their fallback role, MON GBNA will be located at aerodromes
5	The new GNSS rules will permit GNSS Primary navigation outside the navigation cover of GBNA

6	CAA will arrange for the removal of KT NDB from the ICAO regional Air Navigation Plan.

MON REVIEW PROCESS

Contingency evaluation

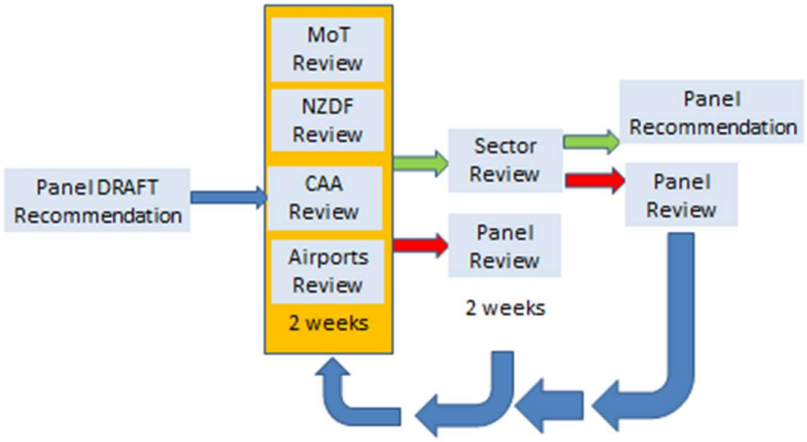
9. The contingency evaluation requires additional considerations. Firstly, it should be assumed that the recommended MON solution is in place.

Ser	Criteria	Comments	Lead Evaluator
1	Regional Economic Impact		NZ Airports
2	National Security and Resilience Impacts		MoT/NZDF
3	Air Ambulance Services		NEST and Lifeflight?

Given that the MON needs to be considered first, there is time to refine the criteria and assessment needs of the contingency system.

However, the process suggested below would allow 2 weeks for Lead Evaluators to test the proposals against safety (CAA), Security (NZDF/MoT), Regional Economic Impact (Airports) and Health Service Implications (MoT).

Once a recommendation is agreed, it would go out for Sector review over a further 2 week period. If the Sector review endorses the recommendation it will be passed on to the decision makers. If the Sector rejects the recommendation, it will come back to the Panel for re-casting and be put through the process again.



CONTINGENCY REVIEW PROCESS

appendix 4

GBNA Review Panel Recommendations

On 13 June 2019, the Ground Based Navigation Aid Review Panel reconvened for a meeting to consider information that has become available since the Panel's recommendations were issued on 26 April 2018.

- Airways released its pricing proposals on 30 May 2019, which set out its intention to implement the recommendations of the GBNA Review Panel (with the exception of upgrading the GBNA at Chatham Islands, which Airways does not own).
- Airways provided the Panel with new more detailed maps showing the modelled coverage of the Minimum Operating Network of GBNAs recommended by the GBNA Review Panel (the 'MON').
- The CAA hosted working groups to gather information about the impact of a PBN environment, including a reduced GBNA network, for rotary and fixed wing aircraft.
- Concerns have been raised that reducing the GBNA network to the MON would restrict the operation of low performance aircraft, including the helicopters and small fixed-wing aircraft used for emergency medical services.

The GBNA Review Panel did not specify a level of service that the MON should enable, but it would not be acceptable to constrain emergency medical services.

At the meeting, the panel considered the new detailed coverage maps and heard about the practical concerns of operators of emergency medical services. The Panel concluded that the recommended MON would not in itself result in unacceptable operational restrictions, but that forthcoming amendments to the Civil Aviation Rules covering PBN operations could create issues. Not knowing what these requirements would be was a stated limitation of the Panel's original recommendations.

The Panel agreed to provide the following advice to the PBN Regulatory Framework project on how operational problems may be avoided.

The Panel recommends that the PBN Regulatory Framework take a flexible, performance-based approach to safe navigation procedures for non-normal operations.

If such a flexible approach is not found to be possible, and if low altitude PBN IFR operators are required to rely on a GBNA for recovery, then the GBNA Panel will meet again to reassess whether the MON would support non-normal aircraft recoveries when GNSS navigation is lost. This assessment could require analysis of potential routes for affected operators, including empirical research of actual practical GBNA coverage.

appendix 4

This table outlines the recommended requirements.

Operating conditions	**Rule Part**	**Requirements**
Equipment required on board.	91	VHF, VOR, GNSS
	119 et.al	2 VHF, 2 VOR, 2 GNSS
Recovery of an aircraft to the ground in the case of a GNSS outage or equipment fault. (The rules should acknowledge that 'recovery' of an aircraft is a 'non-normal' procedure.)	91	Pilots should be trained to cope with losing GNSS and should have a specific plan for recovery, which may include dead reckoning, Visual Flight Rules, GBNA, ATC Surveillance, or climbing to receive a GBNA signal.
	119 et.al	Pilots should be trained to cope with losing GNSS and should have a specific plan for recovery, which may include dead reckoning, Visual Flight Rules, GBNA, ATC Surveillance, or climbing to receive a GBNA signal.
If a weather Alternate is required by Part 91.405	91	Part 91 DEST & ALTN GNSS Only or VMC or GBNA
	119 et.al	Either the destination or the alternate aerodrome must have a GBNA approach unless the aircraft GNSS is FDE equipped. If FDE equipped, both the destination and alternate aerodromes may be GNSS or GBNA or VMC only.

The Panel further recommends that consistency of recovery plans is ensured by providing detailed instructions via an AC.

The Panel assumes that requirements updating the current Part 19 will be included in the amended Part 91.

The Panel notes that helicopters have many more options for recovering to the ground safely than fixed-wing aircraft and that performance-based requirements could take account of relative risk.

The Panel also notes that work on the possible toolbox of recovery capabilities – that is: safe navigation options for non-normal procedures -- is ongoing under New Southern Sky.