University of Redlands

**Finding Missing American Airmen: Using GIS for Mapping World War
II Aircraft Crash Locations in Papua and New Guinea**

A Major Individual Project submitted in partial satisfaction of the requirements
for the degree of Master of Science in Geographic Information Systems

by

Abdulelah A. Aljudibi

Douglas M. Flewelling, Ph.D., Committee Chair

Mark Kumler, Ph.D.

December 2016

Finding Missing American Airmen: Using GIS for Mapping World War II Aircraft Crash
Locations in Papua and New Guinea

Copyright © 2016

by

Abdulelah A. Aljudibi

The report of Abdulelah A. Aljudibi is approved.

A handwritten signature in black ink, appearing to read 'Mark Kumler', written above a horizontal line.

Mark Kumler, Ph.D.

A handwritten signature in black ink, appearing to read 'Douglas M. Flewelling', written above a horizontal line.

Douglas M. Flewelling, Ph.D., Committee Chair

December 2016

Acknowledgements

First of all, I thank Allah for all his blessing, and for giving me the opportunity to pursue and successfully finish my education.

I would like to extend my gratitude to my family who has always stood by my side, encouraged, and supported me. Many thanks to the MS GIS Program faculty members for sharing their expertise and knowledge with us. Special thanks to my advisor Dr. Douglas Flewelling for his guidance during the development of the project, and for taking the time to explain things clearly. I extend my gratitude to Dr. Mark Kumler who took the time to read and discuss my thesis. I want to take this opportunity to thank all my friends in Cohort 27.5 and Cohort 29 for the good days we spent together. I specially thank Fahad Dalbough who was always there to offer his help.

I would like to seize the opportunity to enormously thank my wife Montaha for her countless support and encouragement during the two years of the Program.

Abstract

Finding Missing American Airmen: Using GIS for Mapping World War II Aircraft Crash
Locations in Papua and New Guinea

by

Abdulelah A. Aljudibi

Searching for historical locations, most of the time, requires the search for related information in many documents. The Defense POW/MIA Accounting Agency (DPAA) works to locate War World II (WWII) aircraft wreckage locations in order to find and bring home United States missing in action (MIA) soldiers' remains. The DPAA has historical documents included tables and maps that provide information about WWII aircraft crash locations in Papua and New Guinea. Use of the documents is limited because they are in a portable document format (PDF) file, which does not allow users to interactively compare the data with other related datasets. Also, working with such documents require more resources and takes more time. Implementing a geographical information system (GIS) was the solution to bring the data into a reliable format that solved the addressed problems. A geodatabase within ArcGIS Desktop was built which allows users to query the data and view them in an interactive map. The new system allows the DPAA to add different datasets and compare them all together in one map. This project also provides analytical maps that may help the DPAA to plan for search and recovery missions as well as map series to be used in the field.

Table of Contents

Chapter 1 – Introduction	1
1.1 Client.....	1
1.2 Problem Statement.....	1
1.3 Proposed Solution	3
1.3.1 Goals and Objectives	3
1.3.2 Scope.....	4
1.3.3 Methods.....	4
1.4 Audience	5
1.5 Overview of the Rest of this Report	5
Chapter 2 – Background and Literature Review	7
2.1 Background.....	7
2.2 Aviation Archaeology	7
2.3 GIS and spatial analyses	8
2.4 Summary	11
Chapter 3 – Systems Analysis and Design.....	13
3.1 Problem Statement.....	13
3.2 Requirements Analysis	13
3.2.1 Functional Requirements	13
3.2.2 Non-functional Requirements.....	14
3.2.3 Technical Requirements.....	14
3.3 System Design	14
3.4 Project Plan	15
3.5 Summary	17
Chapter 4 – Database Design.....	19
4.1 Conceptual Data Model	19
4.2 Logical Data Model	19
4.3 Data Sources	20
4.4 Data Scrubbing and Loading	21
4.5 Summary	25
Chapter 5 – Implementation.....	27
5.1 Royal Australian Air Force Geodatabase	27
5.2 Spatial Statistical Analyses	30
5.2.1 Number of Crashes Per Province.....	31
5.2.2 Most Concentrated Provinces with Crashes	33
5.2.3 Number of Crashes Per Square Kilometer.....	36
5.2.4 Point Density Analysis.....	38
5.3 Map Series	40
5.4 Summary	46
Chapter 6 – Results and Analysis.....	47
6.1 Royal Australian Air Force Geodatabase	47
6.2 Interactive Map	47

6.3	Analytical Maps	48
6.3.1	Number of Crashes Per Province Map.....	48
6.3.2	Most Concentrated Provinces with Crashes Map	49
6.3.3	Number of Crashes Per Square Kilometer Map	49
6.3.4	Point Density Analysis Map	50
6.4	Map Series	51
6.5	Summary	52
Chapter 7 –	Conclusions and Future Work.....	53
7.1	Conclusion	53
7.2	Future Work.....	53
Works Cited		55
Appendix A.	Royal Australian Air Force Survey.	57

Table of Figures

Figure 1-1: A Portion of the Historical Records.....	2
Figure 1-2: Historical Map.....	3
Figure 2-1: Wreck Locations.....	8
Figure 2-2: Hot spots Analyses.....	10
Figure 2-3: Choropleth Map.....	11
Figure 3-1: System Design.....	15
Figure 4-1: Conceptual data model.....	19
Figure 4-2: Logical data model.....	20
Figure 4-3: Historical data sample.....	21
Figure 4-4: Unusable data.....	22
Figure 4-5: A Portion of three data versions.....	22
Figure 4-6: Aircraft Identification columns.....	23
Figure 4-7: Wrong locations of the data.....	24
Figure 5-1: RAAF Geodatabase.....	27
Figure 5-2: Data Loading.....	28
Figure 5-3: Symbolized Data Based on Country of Origin.....	29
Figure 5-4: Symbolized Data Based on US Designation Code.....	29
Figure 5-5: Project Tool.....	30
Figure 5-6: Dissolve Tool.....	31
Figure 5-7: Dissolve Area Result.....	32
Figure 5-8: Spatial Join Result.....	32
Figure 5-9: Number of Crashes Per Province Map.....	33
Figure 5-10: Most Concentrated Provinces Selection.....	34
Figure 5-11: Query Builder.....	34
Figure 5-12: Select By Location.....	35
Figure 5-13: Most Concentrated Provinces with Crashes.....	36
Figure 5-14: Calculate Geometry.....	37
Figure 5-15: Field Calculator.....	37
Figure 5-16: Number of Crashes Per Square Kilometer Map.....	38
Figure 5-17: Point Density Tool.....	39
Figure 5-18: Point Density Analysis Result.....	39
Figure 5-19: Map Layout.....	40
Figure 5-20: Overlapped Labels.....	41
Figure 5-21: Leader Lines.....	42
Figure 5-22: Three Map Series.....	42
Figure 5-23: Grid Index Features Tool.....	43
Figure 5-24: Data Driven Pages.....	44
Figure 5-25: Aircraft Locations Map.....	45
Figure 5-26: Location Map Clip at Full Size.....	45
Figure 6-1: Number of Crashes Per Province.....	48
Figure 6-2: Most Concentrated Provinces with Crashes Map.....	49
Figure 6-3: Number of Crashes Per Square Kilometer.....	50
Figure 6-4: Point Density Analysis Map.....	51

Figure 6-5: Map Series Symbolized by Country of Origin.....52

List of Tables

Table 3-1: Project Plan..... 16

List of Acronyms and Definitions

DPAA	The Defense POW/MIA Accounting Agency
GIS	Geographic Information System
MIA	Missing in Action
OCR	Optical Character Recognition
PDF	Portable Document Format
PNGMG	Papua and New Guinea Map Grid
POW	Prisoner of War
RAAF	Royal Australian Air Force
US	United States
UTM	Universal Transverse Mercator
WWII	World War II

Chapter 1 – Introduction

Historical documents are often rich with valuable data. However, it is difficult to fully benefit from them as they cannot be moved from one place to another without damaging them. They are also limited in how they can be used to extract the data. Therefore, the Defense POW/MIA Accounting Agency (DPAA) wanted the data in these documents to be converted to a reliable form that can be accessed remotely and interactively manipulated to support their mission. Implementing a geographic information system (GIS) will support the DPAA's need to more fully use the data.

1.1 Client

The Defense POW/MIA Accounting Agency (DPAA) was founded by the Department of Defense on January 30, 2015, to be responsible for the search, recovery, and accounting of missing service members from past conflicts. The DPAA's research and operational missions include collaboration with other countries around the world. Their objective is to inform the families of missing in action service members and the US government how and where their personnel were lost (Defense POW/MIA Accounting Agency, n.d.). The DPAA vision is to carry out the United States government's obligation by "maximizing the number of missing personnel accounted for while ensuring timely, accurate information is provided to their families" (Defense POW/MIA Accounting Agency, n.d.). Mr. Anthony Hewitt was the point of contact for this project and he provided the primary data that were used for creating the database.

1.2 Problem Statement

The client has historical documents that contain data of aircraft wreckage locations in Papua and New Guinea from World War II (WWII) in a portable document format (PDF) file. The documents also included 13 maps. These documents are of limited use for several reasons. First, the search for a record takes a long time due to the fact it is done manually and the records extend to several pages. Figure 1-1 shows a portion of the records.

- 4 - INDEX OF CRASHED AIRCRAFT IN TERRITORY OF PAPUA AND NEW GUINEA AND DUTCH NEW GUINEA					
SERIAL NO.	MAP REF SHEET	LAT. LONG.	AREA	AIRCRAFT IDENTIFICATION	REMARKS
1	12	09.05-147.47	Mt. Kanevi	RAAF Anson 1P 294	Located on Mountain Edge at 10,000'.
2	9	07.53-147.11	Garaina	RAAF Anson AX 120	Wreckage recovered in vicinity Garaina
3	12	08.40-148.24	Buna	RAAF Beaufighter A19-1	Wreckage recovered in swamp near Buna Village
4	9	06.42-147.00	Lae	RAAF Beaufighter A19-24	In jungle at end of Lae strip (Not recovered)
5	9	05.34-148.34	New Britain Borgen Bay	RAAF Beaufighter A19-33	Believed to be in jungle south of Borgen Bay (Not recovered)
6	9	05.30-148.30	Borgen Bay	RAAF Beaufighter A19-133	Wreckage recovered near coastal track Borgen Bay
7	9	06.44-147.01	Lae	RAAF Beaufighter A19-49	In sea 500 yards off Lae (Not recovered)
8	9	06.43-149.50	In sea	RAAF Beaufighter A19-53	30 miles off coast New Britain - last position
9	10	04.24-152.17	New Britain Tobera	RAAF Beaufighter A19-97	Last seen in vicinity Tobera - not recovered
10	10	06.54-151.10	In sea	RAAF Beaufighter A19-132	Ditched in sea - crew last seen in dinghy
11	10	05.33-150.54	Bangula Bay area	USAC P38 Lightning No. unknown	Wreckage located in jungle inland from Bangula Bay
12	10	05.33-150.54	Bangula Bay area	RAAF Beaufighter A19-139	In jungle - not recovered
13	10	05.07-151.08	Saddle Mountain	RAAF Beaufighter A19-141	Wreckage recovered
14	3	03.35-143.40	Boram	RAAF Beaufighter A19-146	Wreckage recovered 30 yards off western end of Boram Strip
15	3	03.24-143.38	Muschu Is	RAAF Beaufighter A19-185	Wreckage recovered in vicinity of Muschu Village
16	1	02.50-132.53	D.N.G.	RAAF Beaufighter A19-209	Wreckage recovered - burnt out. Bodies located at Idore
17	12	09.32-147.16	Bootless Bay area	RAAF Beaufort A9-52	Crashed in vicinity of Bootless Bay
18	12	09.32-147.15	Bootless Bay area	USAC Fortress B17 No. unknown	Crashed in Bootless Bay
19	12	10.08-148.01	Pelagi	RAAF Beaufort A9-89	Wreckage recovered in swamp near Pelagi
20	12	08.10-148.29	North of Buna	RAAF Beaufort A9-106	Believed crashed in sea 30 miles north of Buna
21	10	05.14-151.55	N.E. Jacquinot Bay	RAAF Dakota C.U.F.	Wreckage recovered on Mountain range N.E. of Jacquinot Bay
22	10	06.14-150.14	Au - Gasmata	RAAF Beaufort A9-183	Wreckage recovered 2 1/2 miles north of Au Village Gasmata
23	10	06.09-150.19	Gasmata	RAAF Beaufort A9-186	Recovered 7 - 10 miles north west of Gasmata
24	10	06.20-150.21	Gasmata	RAAF Beaufort A9-188	Crashed in sea 1/2 mile S.E. of Aravin Is Gasmata
25	13	09.53-152.03	In sea	RAAF Beaufort A9-197	Believed crashed in sea at this position
26	10	06.13-150.22	N.E. Gasmata	RAAF Beaufort A9-204	Wreckage recovered in swamp 3 miles N.E. Gasmata
27	10	04.14-152.10	Rabaul	RAAF Beaufort A9-211	Rabaul area - not recovered
28	10	06.30-154.02	In sea	RAAF Beaufort A9-225	Believed crashed in sea at this position
29	5	02.51-150.59	Rabaul	RAAF Beaufort A9-244	In sea in this approximate position
30	10	04.10-152.10	Rabaul	RAAF Beaufort A9-247	Rabaul area - not recovered
31	10	04.10-152.10	Rabaul	RNZAF Warhawk Believed NZ 3154	Wreckage recovered near North Daughter
32	10	04.10-152.10	Rabaul	RNZAF Avenger TBF No. unknown	Wreckage recovered near North Daughter
33	10	04.09-152.13	Rabaul	Japanese Zero	Located on Matupi Volcano
34	10	06.14-150.21	Gasmata	Japanese Zeke	Located on shore of Gasmata Harbour
35	10	05.26-150.25	Hoskins	RAAF Beaufort A9-256	Wreckage recovered off shore at Hoskins
36	10	04.14-152.10	Rabaul	RAAF Beaufort A9-262	In Simpsons Harbour

Figure 1-1: A Portion of the Historical Records.

Second, finding the corresponding data to this record— such as country name, province name, or town name—may require searching external datasets. Third, locating a point that represents an aircraft wreckage location in the maps is very difficult because there are many locations that are close to one another, as well as many overlapping locations (Figure 1-2).

Figure 1-2: Historical Map

Additionally, the inability to conduct spatial analyses on the data and compare them to other datasets is a great reason that this problem needs to be solved.

1.3 Proposed Solution

To solve these problems for the DPAA, the contents of these historical documents needed to be converted into a GIS platform. The solution allowed active interaction with the data since they were stored in a geodatabase. The geodatabase allowed storing spatial data and allowed conducting spatial analyses on them as they were mapped in the system. The records were stored in tables that allowed automated search for records.

1.3.1 Goals and Objectives

The project goals were to convert the historical data from a PDF format to a GIS format. In addition, designing and producing a series of maps that show the data is required. The project involved designing and creating a geodatabase, converting photos of historic tabular data into a GIS attribute tables to be stored in the geodatabase, creating a feature class to store the locations of the aircraft wreckage presented as points in maps, and to design and produce a map series to show the locations of aircraft wreckage.

By December of 2016, the three following project objectives were completed. First, a file geodatabase to store the feature class of the aircraft wreckage locations. The geodatabase design allowed users to differentiate country of origin and type of aircraft. Second, a point feature class showing the locations of aircraft wreckage was achieved by

converting the historic tabular data from the PDF file. Third, producing a map series to show the locations of the aircraft wreckage categorized by country of origin.

Achieving these objectives allowed the user to conduct different analyses on the data, one of which was a point density analysis to locate the concentrated areas of wrecks.

1.3.2 Scope

To meet the client's requirements, a project was developed to convert historical data into a GIS platform. The project included converting historic tabular data about missing aircraft wreckage in Papua and New Guinea from static images in a PDF file into GIS feature classes and tables. The process included the use of the following software: Adobe Acrobat, Microsoft Excel, and ArcGIS 10.3.1. A file geodatabase was designed and built to store the newly created feature classes and tables using ArcCatalog. The database would organize and relate the different feature classes and tables together for easier, faster data retrieval. Having the data in ArcGIS format allowed conducting analyses on them. Moreover, a series of maps of the data were designed and produced using ArcMap. Some of these maps represent the locations of the aircraft wreckage, and others show analyses on them.

1.3.3 Methods

This section discusses the methods that were used to accomplish the different components of the project. These components were divided into four phases.

Phase 1- Planning: The client's requirements were identified and implemented in the planning phase. The data were collected, including a PDF file that contained the client's historic tabular data of aircraft wreckage locations in Papua and New Guinea from WWII. A polygon shape file of the boundaries of the study area was acquired from GADM.org.

Phase 2- Data conversion: The data in the PDF file were converted into Excel format files in order to create a point feature class. Adobe Acrobat was used to convert the tabular data from images to text using the optical character recognition (OCR) capability. The records from the tables were moved manually by copying and pasting them into an Excel file. Next, ArcMap was used to convert the data from Excel to GIS format using the Add XY Data tool. A point shape file was created from these data. In addition, to install ArcGIS Desktop, the computer operating system had to be Windows.

Phase 3- Database Design and Development: A file geodatabase was developed using ArcCatalog. The database was designed to allow the user to distinguish aircraft type and country of origin. A point feature class was created and the data from the shape file were loaded to it. A polygon feature class of the study area was also created. Other tables were created to store non-spatial data: country of origin and aircraft general information. All the components of the database were related to each other using database relationships.

Phase 4- Map Design and Production: This component involved the design and production of a series of maps using ArcMap. Some of these maps show the locations of aircraft wreckage in Papua and New Guinea presented as points.

1.4 Audience

The intended audience for this report includes individuals with little to no GIS experience. The report provides methods to migrate data from PDF files to ArcGIS and how to build a geodatabase within ArcCatalog, which can be helpful for those who are new to these tools.

1.5 Overview of the Rest of this Report

The report consists of seven chapters. Chapter 2 discusses the background and literature review. It provides background information about the project's topic. It also addresses case studies about similar topics within the field of GIS.

Chapter 3 addresses the system analysis and design. It includes the problem statement, functional and non-functional requirements, technical requirements, system design, and the project plan. The system design describes the components used to complete the project.

Chapter 4 illustrates the geodatabase design. Additionally, it addresses the data sources, data collection methods, data scrubbing and loading. In the data scrubbing and loading, it discusses in detail all the issues encountered with the data preparation.

Chapter 5 demonstrates how the different parts and analyses of the project were implemented. Chapter 6 discusses the results of the analyses. Chapter 7 provides the conclusion for this project, and it lists suggested future work.

Chapter 2 – Background and Literature Review

GIS is very useful in visualizing, analyzing, and manipulating spatial data. It facilitates further understanding of the data, and helps to find patterns and trends that contribute to decision-making. This chapter addresses a background of research on casualties from World War II (WWII) and the efforts to bring their remains home (section 2.1). Aviation Archaeology (section 2.2) discusses what is involved in recovering aircraft wreckage. GIS and spatial analyses address the capability of GIS dealing with spatial data (section 2.3). A summary provides the outcome from the literature review (section 2.4).

2.1 Background

Wars have always caused the loss of thousands of lives. During WWII alone, the United States lost more than 400,000 lives, and about 79,000 Americans remained unaccounted for when the war ended (Defense POW/MIA Accounting Agency, n.d.) Unaccounted for is a general term used to refer to those who were listed as Prisoner of War (POW), Missing in Action (MIA), killed in Action-Body Not Recovered, or Presumptive Finding of Death (Henning, 2006). From 1945 to 1951, more than 280,000 dead were identified and brought home for a proper burial within a program called The Return of the World War II Dead Program (Vento, 2012). This program ended in 1951, but efforts continued and by 2003, 546 more missing Americans were found and identified according to the Defense Prisoner of War/Missing Personnel Office (DPMO) as cited in *The Missing in Action (MIA) of World War II* by Vento (2012). Two hundred out of the 546 were found between the years from 1951 and 1976 primarily because of citizens' reports that contained evidence of American remains. The remaining 346 were found between 1976 to 2003 by the Army Central Intelligence Lab, that was charged with recovering WWII remains. According to the Defense POW/MIA Accounting Agency (DPAA) the unaccounted-for Americans from WWII, as of today, are more than 73,000 (Defense POW/MIA Accounting Agency, n.d.). The DPAA is still searching for over 3000 missing American servicemen lost in the defense of Papua and New Guinea during World War II (Port Moresby. Papua New Guinea - Embassy of The United States, 2016). According to the Royal Australian Air Force survey of aircraft wreckage in Papua and New Guinea, there were 455 US aircraft crash locations (1961). This indicates that there would be at least 455 airmen's remains to be recovered.

2.2 Aviation Archaeology

The search for and recovery of aircraft wrecks has been conducted by the US government for decades. The purpose of finding these wrecks is to gather information about the missing service members from WWII and other past conflicts and provide them to the deceased's families, as well as to moving their remains back to home to be reinterred. According to Bruce D. Callander, "finding remains of lost servicemen is a combination of science, detective work, and archeology" (2005, p. 69). For example, Project RECOVER uses the most advanced oceanographic technology combined with advanced archival research methods to find downed aircraft underwater. They collect and study

data on currents around a crash location to find out where the currents had possibly moved the aircraft. Then they use technologies such as scanning sonar, thermal cameras, and underwater robotics to locate the vessels (Dickerson, 2014). It takes a long time to find the crash site and recover it because “knowing that an airplane went down, and finding the actual crash site, are two different things” (Callander, 2005, p. 68). The process of finding a crash site involves several steps according to Chief of the Missing Persons Branch, Jim Russell (Callander, 2005). The first step is gathering information from documents which may not have enough information to lead to the exact location of a crash site. The second step is investigating in the country where the aircraft crashed. The last step is an archeological operation to excavate a crash site. In addition, finding a crash site depends on the nature of the search area. For instance, many wreck locations in Papua and New Guinea are in high mountains and heavy jungles (Figure 2-1). Therefore, wrecks can be covered by big bushes and trees or scattered behind mountain cliffs which blocks vision and as a result, it becomes a difficult task to recover the wrecks.

Figure 2-1: Wreck Locations.

2.3 GIS and spatial analyses

A geographic information system (GIS) is a useful technology for making decisions that are related to locations. “GIS is a system of hardware, software and procedures designed to support geographical decision-making through the acquisition, management, manipulation, analysis and display of spatially referenced information” (Church and

Murray, as cited in *Advances in Location Modeling: GIS Linkages and Contributions*, 2010). Moreover, GIS provides the ability to represent spatial locations accompanied by attribution of these locations (Murray, 2010) With this quality, GIS provides a variety of geoprocessing tools. “This begins with data collection (digitizing/editing) and load or transfer, integration, storage and management, proceeds through data maintenance, and ends with data query, analysis, and visualization/mapping” (Maguire, Batty, & Goodchild, 2005, p. 22) The capacity of GIS, especially spatial analysis, plays a big role in minimizing the time and effort to locate aircraft wrecks by applying different analyses on the data.

Representing aircraft wreck locations as points in GIS would show different patterns that can provide a further understanding of the spatial relationship of them. It would also allow for conducting different analyses on the data. Deciding on the analysis type depends on the question(s) asked or the problem that needs to be solved. For instance, a case study was conducted by Esri (2016a) to analyze violent crimes. The question was to determine if there is a relationship between violent crime and liquor establishment locations. The data were point layers for both the crime locations and the liquor establishment locations. Hot spot analyses were conducted on each of the layers, and the hot spot locations were compared to decide whether there was or there was not a correlation between the crimes and the liquor establishment locations. The result for each of the layers showed different hot spot locations which indicated that the crime locations are not correlated to the liquor establishment locations (Figure 2-2).

Another case study by Esri (2016b) showed tornado data in the United States. One question was to find how many tornadoes occurred in each state. The approach taken was aggregating tornadoes data to the states data. This was done by using Spatial Join tool. The result of this analysis added a field in the output feature class containing the count of the tornadoes in each state. The field was then used to symbolize the state data by giving them a color range where dark colors represent high numbers of tornadoes and light colors represent lower numbers of tornadoes (Figure 2-3).

Figure 2-3: Choropleth Map.

Furthermore, applying density analysis on the data would visually highlight these patterns. According to Krause, “one of the most common uses of the Kernel Density and Point Density tools is to smooth out the information represented by a collection of points in a way that is more visually pleasing and understandable” (2013, pg. 2). Determining the most concentrated areas to plan for search and recovery missions increases the likelihood of finding wreckage sites due to the fact that the probability of finding one location among many other locations is higher than finding one discrete location.

Terrain can be an influencing factor in determining the locations of wreckage sites. According to Shilpi Jain (2015),

Terrain plays an important role while calculating the impact of an accident, whether it is a car crash, an airplane crash, or any other. Different angles and directions of terrain can result in very different debris area even if all the other parameters are [the] same. (p.6)

Jain improved a mobile application that was developed by Janzen in 2012, Crash Site Debris Recovery Mobile Application (CSDRMA), to include the influence of terrain. While in his case the CSDRMA would help to find all debris, terrain data, if added to this project, could assist in locating the cockpit to search for human remains.

2.4 Summary

The purpose of this chapter was to review previous works and to gather information about the problem and how to solve it. It discussed the efforts involved in aviation archaeology and how it can be used to locate and recover aircraft wreckage. It also

addressed how GIS can be a useful tool for representing the data of such a project and applying different analyses to them to gain a more complete understanding to make the best decisions.

Chapter 3 – Systems Analysis and Design

3.1 Problem Statement

The Defense POW/MIA Accounting Agency work relies on extracting information from different data sources. The primary data sources used in this project was historical documents created in 1961 which contain information about aircraft wreckage locations in Papua and New Guinea from WWII. These documents were in a PDF file which limited their use for several reasons. First, extracting a piece of information about a wreck location takes a long time because it requires looking through approximately 800 rows of records manually. Second, finding corresponding data to a specific record may require searching external datasets. Third, a PDF lacks the ability to visualize spatial data in an interactive way and does not allow spatial analyses on them.

3.2 Requirements Analysis

A requirements analysis describes in detail the requirements a project needs to achieve its goal. These requirements are divided into functional and non-functional requirements. The functional requirements describe what the final product or the system will do; the non-functional requirements describe how the system does it. Defining these requirements ensures a system design that meets the client's needs.

3.2.1 Functional Requirements

The functional requirements defined what functions the system must provide for this project.

- The system must allow the user to store and add different feature classes and tables and relate them to one another in one place. The capacity of the file geodatabase had to be sufficient for the intended work. Storing all the feature classes and tables in one place allows faster retrieval of the data.
- The system should enable the user to select features by attribute. For instance, the attribute contains a field that stores aircraft names and the user only wants to select all the aircraft named Anson; using this functionality will allow selecting them all automatically. Selecting aircraft by country of origin and type of aircraft are parts of attribute selection. However, it needed to be stated separately because the client required them specifically. Thus, separate fields were created for them to achieve that.
- Select by location allows selecting features from one layer based on where they lie on another layer. For example, the user wants to select all the aircraft located at Moresby area; the function will allow selecting them based on the spatial relationship between the aircraft location layer and the area layer.
- The geodatabase shall allow the user to edit, add, and delete an entry because the work on finding the wrecks locations is still ongoing. Therefore, updating an attribute, such as the status of a wreck location whether it is recovered or not,

needs to be updatable. Furthermore, spatial analyses may result in the creation of new feature classes, so the system must allow the addition of derived data.

The system shall allow map design and creation. The client required a series of maps to be designed and produced. Therefore, the system shall provide the ability to design maps and provide the necessary tools, such as scale bar, legend, north arrow, etc. Also, the system shall allow exporting these maps to PDF files for sharing purposes or printing.

3.2.2 Non-functional Requirements

Non-functional requirements define measures to be used to assess how a system operates.

- Efficiency of the system: The system should take minimal time, effort, and resources to create the solution within one minute.
- Scalability of the system: The system can take a varying amount of data, which means that it can hold a much larger amount of data than the ones already loaded.

3.2.3 Technical Requirements

The technical requirements needed to produce the solution for this project consisted of hardware and software. These requirements were a computer run on Windows operating system with at least the minimum specs to operate ArcGIS for Desktop 10.3.1. ArcGIS for Desktop included ArcMap and ArcCatalog, which were the two main software packages used to develop the solution. Adobe Acrobat and Microsoft Excel were needed in the data migrating phase.

3.3 System Design

The system components were classified into three general parts, shown in Figure 3-1: input, process, and output. Input illustrates the data components. Process illustrates the software and methods used to produce the final products. Output illustrates the final products of the project.

Figure 3-1: System Design.

The input component is the data acquired for the project, which are images of tabular data and a shapefile for the study area. The images of tabular data were provided by the client in a PDF file which contained 14 tables of approximately 800 rows. Each row contained information about an aircraft's location, as well as aircraft name, type, and serial number. The shapefile represented the study area as polygons. It was acquired from gadm.org, a website that provides data of administrative areas of the world.

The process component consisted of the software and the file geodatabase used to process the data. The software that were used were Adobe Acrobat and Microsoft Excel to prepare the data from the PDF file to migrate them to ArcMap. ArcCatalog was used to build the file geodatabase and create the feature classes and non-spatial tables. ArcMap was used to process the data and run analyses on them to produce the final products. The output component consisted of the final products that were developed using the previous two components: a series of maps that cover the study area and show the aircraft wrecks locations; and analytical maps that show the results of the analyses conducted on the data.

3.4 Project Plan

This section presents the plan that was taken to accomplish the objectives of the project (see Table 2). Each task was given an estimated time to accomplish it. Three milestones were set to the project to track its progress. These milestones were the data converted and ready in Excel format, the file geodatabase including the feature classes and tables are created and reviewed, and the map series produced.

- Phase 1: Planning. The estimated time for this phase was two months. This phase determined the needs for proceeding with the work of the project. It included reviewing the client's requirements to decide what requirements this project would need and how long each task would take.
- Phase 2: Data conversion. The estimated time for this phase was two months. This phase included two tasks. The first one was converting the data from PDF file into Microsoft Excel. The second one was importing the data from Excel to ArcMap.
- Phase 3: Database design and development. This phase was estimated to be done in two months. It included the conceptual design of the database, the logical design, and developing it in ArcCatalog.
- Phase 4: Data loading and testing. This phase was estimated to take one month and followed the data conversion and the database development. It involved importing the data into the file geodatabase, then testing whether the database met the client's criteria. If not, it would be redeveloped to meet them.
- Phase 5: Map design and production. This phase was estimated to be finished in one month. It included designing and producing a series of maps.
- Phase 6: Completion of project. This phase was estimated to take two months. It included reviewing and delivering the project to the client, as well as finishing the project report and submitting it to the MS GIS department.

Table 3-1: Project Plan

WBS	Task Title	Duration	Start Date	End Date	Budgeted Hours
1	Planning Phase	2 Months	2/25/16	4/25/16	105
1.1	Confirm project scope and work plan	28 days	2/25/16	4/5/16	84
1.2	Data Evaluation	7 days	4/6/16	4/25/16	21
2	Data Conversion	2 Months	4/26/16	6/27/16	126
2.1	Convert from PDF to Excel	40 days	4/26/16	6/23/16	120
2.2	Import Excel to ArcMap	2 days	6/24/16	6/27/16	6
3	Database Design and Developing	2 Months	6/28/16	8/26/16	132
3.1	Conceptual data model	8 days	6/28/16	7/7/16	24
3.2	Logical data model	10 days	7/8/16	7/21/16	30
3.3	Develop the database in ArcCatalog	26 days	7/22/16	8/26/16	78
4	Data Loading and Testing	1 Months	8/29/16	9/30/16	66
4.1	data loading to geodatabase	5 days	8/29/16	9/2/16	15
4.2	Test the geodatabase	17 days	9/5/16	9/30/16	51
5	Map Designing and Production	1 Months	10/3/16	10/31/16	66
6	Completion of Project	2 Months	11/1/16	12/10/16	32
6.1	Deliver the project to the client and to MS GIS Department	32 days	11/1/16	12/10/16	32

3.5 Summary

This chapter presented the problem statement, requirements analysis, system design, and project plan. The project problem was restated in the problem statement. The requirements analysis included the system functional and non-functional requirements, as well as the technical requirements for the project. The system design included three components: input, process, and output. The input contained the acquired data needed for the project. The process discussed the software used to build the new system and what software would be used for what part of the project. The output defined the final products of the project, which are a series of maps of aircraft wrecks locations and analytical maps.

Chapter 4 – Database Design

This chapter discusses the database design, which involved creating the conceptual and logical data models. These models help the users understand the different entities of the database and the relationships between them. Furthermore, it addresses where the data were obtained and how they were collected. Lastly, it discusses data preparation needed before loading them into the database.

4.1 Conceptual Data Model

The conceptual data model provides a high-level understanding of the different entities of the data and the relationships between them. Figure 4-1 shows the conceptual data model of the geodatabase that was designed to solve the DPAA's problem.

Figure 4-1: Conceptual data model.

The database was comprised of two types of entities: feature classes, and non-spatial tables. The feature classes are Aircraft Locations and Area. Aircraft Locations is a point feature class that shows the locations of the aircraft wrecks, whereas the Area is a polygon feature class that shows the administrative areas in which aircraft wrecks are located. Aircraft General Information, Country of Origin, and Historical Maps are non-spatial tables that contain additional related information of the features about the Aircraft Locations. The data they hold were created in tables separate from the Aircraft Locations feature class to normalize the database. Furthermore, the relationship between Aircraft Locations and other entities is one to many, which means that, for instance, more than one aircraft wreckage can be located in one area, as well as many aircraft can belong to one country, and so on with the rest of the entities.

4.2 Logical Data Model

The logical data model adds to the conceptual data model by providing additional information about the entities in the database, including the field name for each entity and

the type of each field. Moreover, it shows the primary and foreign keys used to relate each entity with another. Figure 4-2 lays out the logical model for this project.

Figure 4-2: Logical data model.

The main feature class for the project is Aircraft Locations, which is why all the other entities are related to it. Country of Origin is associated with Aircraft Locations using the primary key Abbreviation in Country of Origin and the foreign key “Military_Acronym” in Aircraft Locations. The abbreviation and “Military_Acronym” fields contain military force names abbreviations such as RAAF, USAC, and RNZAF. They are used to indicate which aircraft wreckage belongs to which country by identifying it. The area is associated with Aircraft Locations using the primary key “ObjectID” and the foreign key “FID_Area.” This association allows the user to look up the name of the country, province, and town where an aircraft wreckage is located. Aircraft General Information contains data about the aircraft manufacturer, types, and engines, as well as the military purpose and other identification fields. “Aircraft_Name” primary and foreign keys were used to associate the Aircraft General Information and Aircraft Locations to each other. Historical Maps contains images (raster data) of historical maps that show the locations of the aircraft wreckages. It was suggested to the client that the historical maps be added to the geodatabase in case the users needed to extract some information from them. “Map_Ref_Sheet” primary and foreign keys were used to associate the Historical Maps and the Aircraft Locations to each other.

4.3 Data Sources

The data used in this project were obtained from the Defense POW/MIA Accounting Agency (DPAA) and GADM.org. The Aircraft Locations, Aircraft General Information, and Historical Maps feature class and tables were created from the PDF file provided by

the client. The PDF file is a survey of aircraft wreckage locations in Papua and New Guinea that was conducted by the Royal Australian Air Force (RAAF). The data in this survey were compiled from all the available records at Department of Air Canberra and is based on reports from searches that were conducted during WWII until 1961 (Royal Australian Air Force, 1961). The client provided GADM's website link where a shapefile of the whole world administrative areas was downloaded; then a feature class that covers the study area was derived from that shapefile. The Country of Origin table was created to store and relate country names to the associated military force abbreviations.

4.4 Data Scrubbing and Loading

The data for this project needed a great deal of preparation before they were ready for loading into the geodatabase. The data preparation involved two stages: converting the data from PDF file into Microsoft Excel, and importing them from Excel to ArcMap.

The PDF file included tables that contain records of approximately 800 aircraft wreckages (Figure 4-3).

- 4 - INDEX OF CRASHED AIRCRAFT IN TERRITORY OF PAPUA AND NEW GUINEA AND DUTCH NEW GUINEA					
SERIAL NO.	MAP REF SHEET	LAT. LONG.	AREA	AIRCRAFT IDENTIFICATION	REMARKS
1	12	09.05-147.47	Mt. Kanevi	RAAF Anson LF 294	Located on Mountain Ridge at 10,000'.
2	9	07.53-147.11	Gairaina	RAAF Anson AX 120	Wreckage recovered in vicinity Gairaina
3	12	09.40-148.24	Buna	RAAF Beaufighter A19-1	Wreckage recovered in swamp near Buna Village
4	9	06.42-147.00	Lae	RAAF Beaufighter A19-24	In jungle at end of Lae strip (Not recovered)
5	9	05.34-148.34	New Britain Borgen Bay	RAAF Beaufighter A19-33	Believed to be in jungle south of Borgen Bay (Not recovered)
6	9	05.30-148.30	Borgen Bay	RAAF Beaufighter A19-133	Wreckage recovered near coastal track Borgen Bay
7	9	06.44-147.01	Lae	RAAF Beaufighter A19-49	In sea 500 yards off Lae (Not recovered)
8	9	06.43-149.50	In sea	RAAF Beaufighter A19-53	30 miles off coast New Britain - last position
9	10	04.24-152.17	New Britain Tobera	RAAF Beaufighter A19-97	Last seen in vicinity Tobera - not recovered
10	10	06.54-151.10	In sea	RAAF Beaufighter A19-132	Ditched in sea - crew last seen in dinghy
11	10	05.33-150.54	Bangula Bay area	USAC P38 Lightning No. unknown	Wreckage located in jungle inland from Bangula Bay
12	10	05.33-150.54	Bangula Bay area	RAAF Beaufighter A19-139	In jungle - not recovered
13	10	05.07-151.08	Saddle Mountain	RAAF Beaufighter A19-141	Wreckage recovered
14	3	03.35-143.40	Boram	RAAF Beaufighter A19-146	Wreckage recovered 30 yards off western end of Boram Strip
15	3	03.24-143.38	Muschu Is	RAAF Beaufighter A19-185	Wreckage recovered in vicinity of Muschu Village
16	1	02.50-132.53	D.N.G.	RAAF Beaufighter A19-209	Wreckage recovered - burnt out. Bodies located at Idore
17	12	09.32-147.16	Bootless Bay area	RAAF Beaufort A9-52	Crashed in vicinity of Bootless Bay
18	12	09.32-147.15	Bootless Bay area	USAC Fortress B17 No. unknown	Crashed in Bootless Bay
19	12	10.08-148.01	Pelagi	RAAF Beaufort A9-89	Wreckage recovered in swamp near Pelagi
20	12	08.10-148.29	North of Buna	RAAF Beaufort A9-106	Believed crashed in sea 30 miles north of Buna
21	10	05.14-151.55	N.E. Jacquinot Bay	RAAF Dakota C.U.P.	Wreckage recovered on Mountain range N.E. of Jacquinot Bay
22	10	06.14-150.14	Au - Gasmata	RAAF Beaufort A9-183	Wreckage recovered 2 1/2 miles north of Au Village Gasmata
23	10	06.09-150.19	Gasmata	RAAF Beaufort A9-186	Recovered 7 - 10 miles north west of Gasmata
24	10	06.20-150.21	Gasmata	RAAF Beaufort A9-188	Crashed in sea 1/2 mile S.E. of Arwin Is Gasmata
25	13	09.53-152.03	In sea	RAAF Beaufort A9-197	Believed crashed in sea at this position
26	10	06.13-150.22	N.E. Gasmata	RAAF Beaufort A9-204	Wreckage recovered in swamp 3 miles N.E. Gasmata
27	10	04.14-152.10	Babaul	RAAF Beaufort A9-211	Babaul area - not recovered
28	10	06.30-154.02	In sea	RAAF Beaufort A9-225	Believed crashed in sea at this position

Figure 4-3: Historical data sample.

These records had to be converted into Excel format in order to move them to ArcMap. Since the data were static images, the use of optical character recognition (OCR) tool was necessary. The OCR tool within Adobe Acrobat was used to convert the data to text so they could be exported to an Excel file automatically from Adobe Acrobat.

Unfortunately, the exporting result was not usable (Figure 4-4). Thus, the records had to be moved manually by copying them from the PDF file and pasting them into an Excel file.

	A	B	C	E	F	G	H	I	J	N	O	S	T	V	W	Y	Z	AA	AAA	AF	AG	
73	A	RAAF	Anson							AX	120											
74	f	'	ightner	A	19-																	
75																						
76	...		RAAF	Beaufighter	A	19-24																
77			RAAF	Beaufighter	A	19-33																
78			RAAF	Beaufighter	A	19-133																
79			RAAF	Beaufighter	A	19-49																
80			RAAF	Beaufighter	A	19-53																
81			RAAF	Beaufighter	A	19-97																
82			RAAF	Beaufighter	A	19-132																
83			USAC	P38	Lightning	No.unknown																
84			RAAF	Beaufighter	A	19-139																
85			RAAF	Beaufighter	A	19-141																
86			RAAF	Beaufighter	A	19-146																
87			RAAF	Beaufighter	A	19-185																
88			RAAF	Beaufighter	A	19-209																
89			RAAF	Beaufighter	A	19-52																
90			USAC	Fortreaa	B	17	Bo.unknown															
91			RAAF	Beaufort	A	9-89																
92			RAAF	Beaufort	A	9-106																
93			RAAF	Beaufort	A	9-197																
94			Located on Mountain Ridge at 10,000'.	Wreckage recovered in vicinity	Garaina																	
95			Believed to be in jungle south of Borgen Bay	(Not recovered)																		
96			Wreckage recovered near coastal track Borgen Bay																			
97			In eea 500 yards off Lae (Not recovered)																			
98			30 miles off coast New Britain - last position	Last seen in vicinity	Tobera																	

Figure 4-4: Unusable data.

To further illustrate the issue of the automation exporting, a portion from the original documents (scanned image from the PDF file), the result from the automated export in Excel, and the result from the manually exported Excel are presented next to one another (Figure 4-5).

<div> RAAF Catalina A24-20 RAAF Catalina A24-22 RAAF Catalina A24-34 RAAF Catalina A24-43 RAAF Catalina A24-49 RAAF Dakota A65-56 RAAF Dakota A65-61 RAF Dakota KN-344 </div>	<div> 84 >- RA.AF Beaul'ightner A19-141 85 - HAAF Beaufighter A19-146 86 - RA.AF Beauf'ightner A19-185 F 87 uSAC Fortreaa B17 Bo.unknown 88 RA.AF Beaufort A9-89 89 'vRAAF Beaufort A9-106 90 88 91 , RAAF Beaufort A9-197 </div>	<div> RAAF Catalina A24-20 RAAF Catalina A24-22 RAAF Catalina A24-34 RAAF Catalina A24-43 RAAF Catalina A24-49 RAAF Dakota A65-56 RAAF Dakota A65-61 RAF Dakota KN-344 </div>
Original Document	Automated Export	Manually Exported

Figure 4-5: A Portion of three data versions.

The same rows were captured in the three photos shown above. There were several issues with the automated export. First, it failed to keep the data organized. It can be noticed

when comparing the original document's photo with the automated export's photo that they do not present the same texts even though they were captured to present the same rows. Second, when the data were exported to the Excel sheet, some of the letters were incorrectly recognized, such as the "f" in "beaufighter" that was exported as "1". On the other hand, the manually exported data were the same as the original document data because they were controlled when they were moved to the Excel sheet.

As shown in Figure 4-3, the tables contained six columns: "Serial No.," "Map Ref Sheet," "Lat.Long.," Area, Aircraft Identification, and Remarks. "Serial No." gave a unique number to every record so they could be easily distinguished from one another. The PDF file had 13 maps, numbered from one to 13, that showed the records as points; the "Map Ref Sheet" defined on which map each record was presented. The "Lat.Long." column gave the X and Y coordinates for each point, which represent the aircraft wreckage locations. The latitude and longitude were separated into two different columns when they were moved to the Excel file to have them ready to be imported to ArcMap. The Area column provided the name of the area where a wreck is located. The provided names in this column could be a name of a province, a town, or simply a vague piece of information such as "In sea." The Area column was considered problematic for users who are not familiar with the study area. Therefore, in the geodatabase, the Area feature class attribute table was set to have a separate field for provinces and towns so to be easier to distinguish provinces from towns. Aircraft Identification column involved distinct data such as an acronym for the military force name which an aircraft belongs to, aircraft name, aircraft designation code, and aircraft serial number. Each of these distinct data was placed in a separate column after they were moved to the Excel file to normalize the data. Figure 4-4 shows the columns before and after the separation in the Excel file.

Aircraft_Identification	Abbreviation	Aircraft_Name	Designation_Code	Aircraft_Serial_No.
RAAF Anson LT 294	RAAF	Anson	LT	294
RAAF Anson AX 120	RAAF	Anson	AX	120
RAAF Beaufighter A19-1	RAAF	Beaufighter	A19	1
RAAF Beaufighter A19-24	RAAF	Beaufighter	A19	24
RAAF Beaufighter A19-33	RAAF	Beaufighter	A19	33
RAAF Beaufighter A19-133	RAAF	Beaufighter	A19	133
RAAF Beaufighter A19-49	RAAF	Beaufighter	A19	49
RAAF Beaufighter A19-53	RAAF	Beaufighter	A19	53
RAAF Beaufighter A19-97	RAAF	Beaufighter	A19	97
RAAF Beaufighter A19-132	RAAF	Beaufighter	A19	132
USAC P38 Lightning No. unknown	USAC	Lightning	P38	
RAAF Beaufighter A19-139	RAAF	Beaufighter	A19	139
RAAF Beaufighter A19-141	RAAF	Beaufighter	A19	141
RAAF Beaufighter A19-146	RAAF	Beaufighter	A19	146
RAAF Beaufighter A19-185	RAAF	Beaufighter	A19	185
RAAF Beaufighter A19-209	RAAF	Beaufighter	A19	209
RAAF Beaufort A9-52	RAAF	Beaufort	A9	52
USAC Fortress B17 No. unknown	USAC	Fortress	B17	
RAAF Beaufort A9-89	RAAF	Beaufort	A9	89
RAAF Beaufort A9-106	RAAF	Beaufort	A9	106
RAAF Dakota C.U.P.	RAAF	Dakota	C.U.P.	
RAAF Beaufort A9-183	RAAF	Beaufort	A9	183
RAAF Beaufort A9-186	RAAF	Beaufort	A9	186
RAAF Beaufort A9-188	RAAF	Beaufort	A9	188
RAAF Beaufort A9-197	RAAF	Beaufort	A9	197

Figure 4-6: Aircraft Identification columns.

It was also crucial to separate them to meet the client's requirement to have the ability to view the aircraft by their designation codes. In addition, aircraft names had to be in separate field to use them to relate the feature class Aircraft Locations to the table Aircraft General Information. The column Remarks contained descriptive information about the locations of the wreckage or the status of the wreckage such as that the aircraft wreckage is located on mountain ridge at 10,000 feet, wreckage was recovered, and wreckage was not recovered.

Following moving the data from the PDF file, it was time to import them to ArcMap. The Add XY data method was used to import the data to ArcMap. Esri's base map was added to see if the points were located where they were supposed to, but unfortunately, they were not at the correct place (Figure 4-5).

Figure 4-7: Wrong locations of the data.

Two issues were found with the latitude and longitude. First, they were in degrees, minutes, and seconds format, yet they were written as if they were decimal degrees. Second, the latitude values were positive even though the study area was south the equator. Consequently, the two issues were edited back in the Excel file and the data were imported to ArcMap again. Another issue was found with some of the aircraft wreckage locations, which occurred during the separation and conversion of their coordinates from degrees-minutes format into decimal-degrees format in the Excel file. When separating the degrees and minutes into two separated columns, the minutes' values that were for example, 10, 20, or 40 were written 1, 2, or 4 instead of the correct values, which caused having incorrect decimal-degrees values after the conversion

occurred. This problem happened because the degrees-minutes values were written as if they were decimal-degrees values and when the separation occurred the system omitted the zero on the right because it does not have a value in that format.

The shapefile Area, which was acquired from GADM.org, needed scrubbing. Initially, the administrative areas of the world were deleted except the study area. The attributes were then scrubbed by omitting fields that were not in English and by changing the names of the fields with meaningful names that described their contents.

4.5 Summary

This chapter addressed the conceptual and logical data model, data sources, and data scrubbing and loading. The conceptual data model defined the different feature classes and tables used in the system and their relationship to one another. The logical data model described the attribute fields for each feature class and table, and defined the fields that were used to relate every two entities to each other. The data sources addressed where the data were obtained from. The major work addressed in this chapter was data scrubbing and loading. It took a lot of time because it involved converting the data from a PDF file into Microsoft Excel, and then moving them to ArcMap as shapefiles before they were ready to be load into the geodatabase.

Chapter 5 – Implementation

This chapter discusses the implementation of the geodatabase and the analyses that were conducted on the data. The tools and methods that were used to conduct the analyses are also addressed. The developed geodatabase would help the Defense POW/MIA Accounting Agency (DPAA) to more efficiently compare the Royal Australian Air Force (RAAF) survey data with other datasets and records by combining them in ArcMap.

5.1 Royal Australian Air Force Geodatabase

The geodatabase for RAAF survey data was produced using ArcCatalog. The process involved creating the file geodatabase, then creating each of the feature classes and non-spatial tables individually. After all the feature classes and non-spatial tables were created, the relationships between them were created (Figure 5-1).

Figure 5-1: RAAF Geodatabase.

Following the creation of the geodatabase, the data that were moved from the PDF file into ArcMap were loaded into the Aircraft Locations feature class using the Simple Data Loader in ArcCatalog (Figure 5-2).

Figure 5-2: Data Loading.

The same method was used to load the data into the Area feature class and the table Aircraft General Information. The data in the Country of Origin table and Historical Maps were entered during an edit session in ArcMap. In the Country of Origin table, the field Country contains the country name for each military force acronym that exists in the data.

The Country of Origin table was created to meet the client's requirement to show the aircraft wreckage by country of origin. To accomplish this, the Country field was joined into the Aircraft Locations feature class and it was used to symbolize the data. The feature class was then saved as a layer file to retain the symbolized data. Figure 5-3 shows the data symbolized based on the country of origin.

Figure 5-3: Symbolized Data Based on Country of Origin.

Another layer file was created to show the aircraft locations with symbols based on the US designation code (Figure 5-4). The designation code is used to identify the aircraft type or purpose. It identifies whether an aircraft was a fighter, bomber, transporter, or used for other purposes.

Figure 5-4: Symbolized Data Based on US Designation Code.

5.2 Spatial Statistical Analyses

For spatial analyses, the data needed to be projected to an appropriate coordinate system that preserves distance and area to have reliable results; the Papua New Guinea Map Grid 1994 (PNGMG94) was used. Since the study area was large and the data were spread across three different Universal Transverse Mercator (UTM) zones, zone 55 was chosen because it covers most of the aircraft wreckage locations. Even though UTM is a conformal projection that preserves angles and distorts distance and area, the distortion for this data is minimal because the study area is very close to the equator. The data were projected by using the geoprocessing tool Project (Figure 5-5).

The screenshot shows the 'Project' tool window in ArcGIS. The title bar is yellow and says 'Project'. Below it, there are several input fields with labels and values:

- Input Dataset or Feature Class:** Aircraft locations
- Input Coordinate System (optional):** GCS_WGS_1984
- Output Dataset or Feature Class:** \\Mac\\Home\\Documents\\ArcGIS\\Default.gdb\\Aircraft_Locations_Project
- Output Coordinate System:** PNG94_PNGMG94_Zone_55
- Geographic Transformation (optional):** PNG94_To_WGS_1984_1

Figure 5-5: Project Tool.

Within the tool's window, the targeted feature classes—the Aircraft Locations and the Area—were selected as the input data and the output feature classes were set to be saved in a new file geodatabase created to contain the projected data. The purpose of this geodatabase was to use it for analyses and map production work, while leaving the original file geodatabase intact.

A variety of spatial statistical analyses were conducted on the data. Each analysis answers a question about the aircraft crash sites that are located on land. The first analysis provides information about the number of aircraft crashes in each province. The second analysis communicates which provinces have the highest number of crashes per square kilometer. The last analysis shows where US aircraft crashes are clustered in some of the provinces.

5.2.1 Number of Crashes Per Province

To spatially calculate the number of the aircraft crashes per province, two steps had to be taken. First, the Area feature class's features represented the cities of the study area so they needed to be dissolved into province areas. The attributes contained province data which made it an easy task. Using the Dissolve geoprocessing tool, a feature class representing the province areas was created (Figure 5-6).

Figure 5-6: Dissolve Tool.

The tool takes the data and aggregates the features based on the specified attributes, which was in this case the province field. The result of this process (Figure 5-7) allows using the province areas to calculate the number of aircraft per province.

Figure 5-7: Dissolve Area Result.

The Spatial Join geoprocessing tool was used to calculate the number of aircraft crashes for each province area by joining the Aircraft Locations features to the Province Areas features. The result of this process was a polygon feature class that contained the attributes from the Province Areas feature class with a new field named “Crash_Count” that included the number of joined features representing the number of crashes in each province (Figure 5-8).

Province_Areas_SpatialJoin				
	OBJECTID *	SHAPE *	Crash_Count	Province
	1	Polygon	52	Central
	2	Polygon	0	Chimbu
	3	Polygon	66	East New Britain
	4	Polygon	35	East Sepik
	5	Polygon	4	Eastern Highlands
	6	Polygon	1	Enga
	7	Polygon	1	Gulf
	8	Polygon	41	Irian Jaya Barat
	9	Polygon	54	Madang
	10	Polygon	1	Manus
	11	Polygon	20	Milne Bay
	12	Polygon	63	Morobe
	13	Polygon	3	New Ireland
	14	Polygon	51	North Solomons
	15	Polygon	36	Northern
	16	Polygon	21	Papua
	18	Polygon	6	Sandaun
	19	Polygon	0	Southern Highlands
	20	Polygon	17	West New Britain
	21	Polygon	2	Western
	22	Polygon	0	Western Highlands

Figure 5-8: Spatial Join Result.

The “Crash_Count” field was then used to symbolize the Province Areas features. A gradient color was used to visually show which province has the highest number of crashes by giving it the darkest color. A table was added to the Number of Crashes Per Province Map to show the number of crashes in each province (Figure 5-9).

Figure 5-9: Number of Crashes Per Province Map

5.2.2 Most Concentrated Provinces with Crashes

The five most concentrated provinces from the previous result were selected from the attribute table using their names (Figure 5-10). The selected provinces were then exported as a new layer and symbolized gradually based on the number of crashes. The number of crashes for each country was calculated in two steps. First, using Query Builder to only show the targeted country data (Figure 5-11). Second, Select By Location to select the crashes in the targeted province, which can be done by selecting the province first and then selecting the crashes that intersect with the selected province (Figure 5-12).

Table

Province_Areas

	OBJECTID *	SHAPE *	Province_ID	Country	Province	SHAPE_Length	SHAPE_Area
▶	1	Polygon	1	Papua New Guinea	Central	1823368.826947	29683872123.916737
	2	Polygon	2	Papua New Guinea	Chimbu	455396.722162	6144552631.806941
	3	Polygon	3	Papua New Guinea	East New Britain	1187449.899813	15443399651.755022
	4	Polygon	4	Papua New Guinea	East Sepik	1635870.107067	43834031839.339127
	5	Polygon	5	Papua New Guinea	Eastern Highlands	501190.720148	11143385630.356262
	6	Polygon	6	Papua New Guinea	Enga	509422.761966	11768493661.922771
	7	Polygon	7	Papua New Guinea	Gulf	2939048.798836	34837494476.240524
	8	Polygon	8	Indonesia	Irian Jaya Barat	14863519.577863	101890550457.64977
	9	Polygon	9	Papua New Guinea	Madang	1364414.798703	28943328818.7952
	10	Polygon	10	Papua New Guinea	Manus	1202659.815296	2239703840.900695
	11	Polygon	11	Papua New Guinea	Milne Bay	4528171.780635	14424659120.41744
	12	Polygon	12	Papua New Guinea	Morobe	1639466.651037	33943295578.496231
	13	Polygon	13	Papua New Guinea	New Ireland	2605746.854058	9742370700.518551
	14	Polygon	14	Papua New Guinea	North Solomons	1165395.815327	9598836498.401566
	15	Polygon	15	Papua New Guinea	Northern	1156620.120224	22700511383.950096

Figure 5-10: Most Concentrated Provinces Selection.

Query Builder

Aircraft_Locations_Land.Province_ID

Aircraft_Locations_Land.Province

CountryofOrigin.OBJECTID

CountryofOrigin.Abbreviation

CountryofOrigin.Country

=

< >

Like

>

> =

And

<

< =

Or

_ %

()

Not

Is

In

Null

Get Unique Values

Go To:

NULL

'Australia'

'Japan'

'New Zealand'

'United Kingdom'

'United States'

SELECT * FROM Aircraft_Locations_Land_CountryofOrigin WHERE:

CountryofOrigin.Country = 'United States'

Figure 5-11: Query Builder.

Figure 5-12: Select By Location.

The number of crashes for each country and the province names were imported to Excel to represent them in a bar chart. The bar chart was then brought to ArcMap and a map that shows statistical information about the five most concentrated provinces was produced (Figure 5-13).

Figure 5-13: Most Concentrated Provinces with Crashes.

5.2.3 Number of Crashes Per Square Kilometer

Dividing the number of crashes by the area gives a normalized value that indicates the number of crashes per areal unit. In this analysis, the areal unit used was square kilometers because the study area was relatively large. To establish the work on the normalized values, the area in square meters for each province needed to be converted. A field named “Area_km2” was added into the attributes of the “Province_Areas_SpatialJoin” feature class to calculate the area in square kilometers. Calculate Geometry was used to calculate the area in square kilometers (Figure 5-14).

Figure 5-14: Calculate Geometry.

After calculating the area in square kilometers, another field was added to contain the normalized values. Using Field Calculator, the normalized values were calculated by dividing the “Crash_Count” field by the “Area_km2” field (Figure 5-15).

Figure 5-15: Field Calculator.

This new field containing the normalized values was used to symbolize the data to show which provinces had the highest number of crashes per square kilometer (Figure 5-16).

Figure 5-16: Number of Crashes Per Square Kilometer Map.

5.2.4 Point Density Analysis

The aircraft locations were distributed all over the study area. However, many of them were clustered in different parts of the study area. To visualize the clustered areas, the Point Density tool was used (Figure 5-17).

Point Density

Input point features
US_Plane_LandLocations

Population field
NONE

Output raster
\\Mac\Home\Documents\ArcGIS\Default.gdb\Density_USplanes_Land

Output cell size (optional)
5000

Neighborhood (optional)
Circle

Neighborhood Settings
Radius: 10000.000000
Units: ☐ Cell ☒ Map

Area units (optional)
SQUARE_KILOMETERS

Figure 5-17: Point Density Tool.

The radius was set to 10000 meters because search and recovery missions cover about 5 to 10 kilometers in one area and so it was intended to visualize the clustering of the data in such a radius. The result of the Point Density tool shows the highly clustered areas in orange. Each of these areas is about 10 square kilometers (Figure 5-18).

Figure 5-18: Point Density Analysis Result.

5.3 Map Series

The client required a map series to be produced for the aircraft crash sites. Some issues needed to be addressed before producing the maps: the scale, page size, base map, and map elements. The scale for the maps was set to 1:1,000,000 so it matched the scale of the historical maps the client provided. To decide on the page size, two aspects were considered. One was that the study area was large and the page needed to be large enough so that the map series covered the study area with a minimal number of pages. Second, the page needed to be small enough so it could be used in the field while searching for aircraft wreckage. Therefore, a page size of 27 x 22 inches was chosen to serve the addressed aspects. The client needed maps showing basic terrain and major rivers, so a topographic base map was used in the series. Deciding on the elements that go in the map layout did not take much time. However, deciding on the place for each one needed to be examined. Thus, all the elements—title, scale in text, scale bars, legend, coordinate system and projection information, north arrow, map index, and the producer info—were added to the map and after several placements a decision on the design was made (Figure 5-19).

Figure 5-19: Map Layout.

Once the map template was designed, the map series could be produced. The aircraft crash locations (points) data were added into the map and the labels that show the serial number of each point were turned on. Yet there was a problem of having too many labels overlapping each other because the points in many locations were too close to each other in 1:1,000,000 scale, and in many other locations there were overlapped points (Figure 5-20).

Figure 5-20: Overlapped Labels.

To solve this problem, all the available options within the Label Engine and the Maplex Label Engine were used, yet the problem was not easy to solve. One method used was the leader lines (Figure 5-21).

Figure 5-21: Leader Lines

Therefore, it was decided to produce three map series: all crash locations, single crash locations, and multiple crash locations. The first series would show all aircraft crash locations without the point serial number labels, differentiating the multiple crash locations by giving them a squared symbol instead of circular. It also showed labels of the number of overlapped aircraft in each crash location. The second series would show single aircraft crash locations with labels, and the third would show multiple aircraft locations (Figure 5-22).

Figure 5-22: Three Map Series.

Automated map production required the use of two tools: the Grid Index Features geoprocessing tool and the Data Driven Pages tool. The Grid Index Features tool was used to create indexes of the extent of the aircraft locations data (Figure 5-23).

Grid Index Features

Input Features (optional)

Aircraft locations

☒ Generate Polygon Grid that intersects input feature layers or datasets (optional)

☒ Use Page Unit and Scale (optional)

Map Scale (optional) 1000000

Polygon Width (optional) 24.5925 Inches

Polygon Height (optional) 17.6503 Inches

Polygon Grid Origin Coordinate (optional)

X Coordinate -1419217.6271 Y Coordinate 8668819.1315

Number of Rows (optional) 3

Number of Columns (optional) 5

Starting Page Number (optional) 1

☐ Start Labeling from the Origin (optional)

OK Cancel Environments... << Hide Help

Figure 5-23: Grid Index Features Tool.

The extent of each of these indexes was used to produce a map by using the Data Driven Pages tool, which defines the indexes that were created using Grid Index Features tool as pages and uses the single layout that was designed for all the maps (Figure 5-24).

Figure 5-24: Data Driven Pages.

Once the pages were defined, each of the single and all aircraft crash locations series were exported using the defined pages, which allowed exporting all the maps together for each series. However, it could not be used to export the maps in the multiple aircraft crash locations all at once because there was another problem of having overlapped labels. Consequently, the labels had to be manually typed for each point in the layout and each map extent was exported individually. A sample map from the map series is shown here and the rest are saved in the DVD accompanying this report because the scale of the maps is designed for a larger page size. (Figure 5-25). A clip at full size is shown in Figure 5-26.

Figure 5-25: Aircraft Locations Map.

Figure 5-26: Location Map Clip at Full Size.

5.4 Summary

Chapter Five addressed the implementation of the database and the data loading method. It explained visualizing the aircraft locations according to the client's needs, which were categorized based on the country of origin and the US designation code. The analyses that were conducted on the data and the tools used were explained, as well. The map production and the difficulties encountered in producing them were also addressed.

Chapter 6 – Results and Analysis

This chapter describes the results and analysis for this project. There are four major components' results addressed and discussed in this chapter. The first component is the geodatabase. The second component is the interactive map. The third component is the analytical maps. The fourth component is the map series. Each component is addressed and analyzed to gauge its contribution to this project.

6.1 Royal Australian Air Force Geodatabase

The main purpose of this project was to convert the historical data from a PDF file to a format that allows data visualization and manipulation, as well as to have them stored in one container, a geodatabase, for faster retrieval of the data. The geodatabase was successfully designed and built to meet the client's requirements. The client can now perform different inquiries on the data such as automatically searching by attributes and viewing related information because all the tables in the geodatabase are connected to each other. This solved a problem the client had, which was searching over many pages, sometimes different documents, to find related information.

Not only was the database designed to hold the Royal Australian Air Force (RAAF) survey data, but it also was designed to use its schema to hold similar datasets. The database was normalized to ensure the consistency of the data and to avoid data duplication. This was accomplished by creating separate tables for data that are shared by many objects in other tables and by associating them by relationships. For example, instead of adding a field in the Aircraft Locations' table for the historical maps and adding each historical map multiple times for each related object, a table holding all the historical maps was created and related to the Aircraft Locations' table using a common field. The database was tested and it performed as expected to serve the client's needs.

6.2 Interactive Map

Integrating the RAAF's data into ArcGIS Desktop format allowed the client to view the data in ArcMap. The client was able to view the aircraft wreckage locations in an interactive map and categorize them by country of origin, as well as categorize them by US designation code (Figure 5-3 and 5-4). The ability to categorize them based on the country of origin allowed the user to quickly distinguish United States aircraft from other countries' aircraft. The user was also able to view the aircraft wreckage of only one country without the others being plotted on the map, which made it easier to exclusively conduct analyses on US aircraft (Section 6.3.3).

Moreover, having this data used in ArcMap, the client became able to add other aircraft wreckage datasets in the future, and visually compare them. The geoprocessing tools within ArcMap allowed performing different analyses on the data, which were not available when the data were in the PDF file. This offered a huge advantage to benefit from these data.

6.3 Analytical Maps

Some analyses were conducted on the data to aid the employees at the Defense POW/MIA Accounting Agency (DPAA) do the planning of search and recovery missions more efficiently. Each analysis result answers a unique question. How many crashes per province? How many crashes per square kilometer in each province? Where are the areas concentrated with US aircraft wreckage?

6.3.1 Number of Crashes Per Province Map

As addressed in Chapter 5, the Spatial Join tool was used to calculate the number of aircraft in each province. Then, the province areas were symbolized based on the field resulting from that join. A choropleth map was created to show the relative numbers of aircraft crashes in each province, and a table with the actual numbers was added to the map (Figure 6-1).

Figure 6-1: Number of Crashes Per Province.

This map gives a high value for the provinces with a high number of crashes on land by giving them dark colors and low value for the provinces with a low number of crashes on land by giving them light colors. It also provides the number of crashes in each province.

While this information was useful in general, it was not in this specific case because the analysis did not take into consideration the size of each province. This may lead the map user to think that the chances of finding aircraft wreckage in provinces with high values is greater. To solve this issue, another analysis was conducted to give each province its value while taking the area into consideration (Section 6.3.2).

6.3.2 Most Concentrated Provinces with Crashes Map

This map provides statistical data about the aircraft crashes count for each country in the five most concentrated provinces (Figure 6-2). The outcome from this map can help the Defense POW/MIA Accounting Agency (DPAA) to know how many aircraft wreckages belong to the United States and how many to the other countries in each province. The DPAA could use this information to decide on collaborating with other countries to search and find aircraft wreckage.

Figure 6-2: Most Concentrated Provinces with Crashes Map.

6.3.3 Number of Crashes Per Square Kilometer Map

This analysis solved the issue that may have been caused by the Number of Crashes Per Province analysis. The map in Figure 6-3 shows the number of aircraft per square kilometer.

Figure 6-3: Number of Crashes Per Square Kilometer.

The number of crashes for each province was normalized by the province area which provided the number of crashes per square kilometer. Now a small province with fewer crashes may have a higher value than a larger province with more crashes. For example, the province Manus had a lower value than the province Papua in the first analysis, but it has a higher value in the second analysis. This approach provides a better result that can increase the chances of finding aircraft wrecks.

Even though the Number of Crashes Per Square Kilometer Map provided better information that can increase the likelihood of finding wrecks than the Number of Crashes Per Province Map, neither provided information about a specific search area in each province. Therefore, a density analysis for the wreckage locations was conducted to show specific areas of concentrations.

6.3.4 Point Density Analysis Map

The use of the Point Density tool was necessary to show the concentrated areas with aircraft crashes in each province. Showing the concentrated areas helps the client to decide on the search area for the search and recovery missions. The points in the data represented the crashes locations at sea and on land for all the participating countries. For this analysis, the data were filtered to only represent the US on land aircraft crashes to

comply with the client interest. The concentrated areas with aircraft crashes are shown in Figure 6-4.

Figure 6-4: Point Density Analysis Map.

The concentrated areas of the US on land aircraft crashes are in 6 provinces: East New Britain, Central, Morobe, Madang, East Sepik, and Irian Jaya Barat. The concentrated areas are represented by orange color. The radius for each concentrated area was set to 10 square kilometers, which approximates a standard search area for the client. The result showed which parts of the provinces are crowded with crashes and that was better than the previous analysis which only indicated the concentrated provinces. Now, not only can the client decide on the province destination, but also on a specific area within each province.

6.4 Map Series

There were three map series produced for the data. All the map series showed the data on a topographic base map to help the client in the field work. The topographic base map provides terrain and river information. This information can help the map user to predict wrecks' locations. For example, if a crash site was shown to be at a mountain ridge, the user can assume that the aircraft shattered downhill and so the searchers should search for the wrecks downhill.

Each of the map series shows all countries' aircraft. However, one series exclusively shows single aircraft locations with labels that show the points serial numbers. The second series shows multiple aircraft locations with labels that show the points serial numbers. The third series shows single and multiple aircraft locations without the points' serial numbers, but it shows labels indicating the number of aircraft in each multiple aircraft location. These maps are helpful to the client because they represent the aircraft crash locations by the aircraft country of origin (Figure 6-5).

Figure 6-5: Map Series Symbolized by Country of Origin.

The client can rapidly know the aircraft belonging to the US without the trouble of going back to the attribute table to find out that piece of information. This map's quality also visually shows the areas that are crowded by other countries' aircraft as well as US aircraft to allow the client to know which areas to avoid and which areas to target.

While these maps serve the client needs and requirements, smaller scale maps would have provided better information about the environment around the crash sites and would have helped the client more efficiently.

6.5 Summary

This chapter discussed each of this project's results individually. The discussion of building the geodatabase addressed how the geodatabase solved the problem the DPAA had of not fully benefiting from the RAAF's survey data because they were in a PDF file. The advantages of having an interactive map included how the interactive map helped to conduct analyses on the data. This was followed by a discussion of how the analytical maps might assist the client in the planning for recovery missions and how the map series might contribute in the field.

Chapter 7 – Conclusions and Future Work

7.1 Conclusion

The main goal of this project was to integrate the Royal Australian Air Force (RAAF) survey data into a geographic information system (GIS) so the Defense POW/MIA Accounting Agency (DPAA) employees can conduct analyses on them and compare the data to other datasets. The work involved building a geodatabase for the data. The geodatabase was designed in a way that ensures the consistency of the data, avoids data redundancy, and allows the client to use its schema for other similar datasets. By integration into a GIS, the functional requirements required by the client were met. The client can now:

- Categorize the data to view the aircraft in ArcMap by country of origin and by the aircraft's designation code.
- Search automatically for records through the tables.
- Search for records by their locations.
- Add, delete, and edit the data.
- Conduct analyses on the data.
- Create maps

Moreover, the client can add other datasets as different layers to visually compare them and to conduct analyses on them.

A variety of analyses were conducted on the data to help the client in the planning for search and recovery missions. The results of these analyses allow the client to minimize the time taken for planning for the search and recovery missions and so it would reduce costs. The map series produced will allow the user in the field to make better decisions about which specific areas the team should search for aircraft wrecks by providing terrain and river information. They also show the aircraft categorized by the country of origin which allows the client to focus on US aircraft crash locations and avoid other countries' aircraft crash locations.

In conclusion, this project was the first step to have the Royal Australian Air Force survey data in a form that allows data manipulation and allows automation dealing with the data so the Defense POW/MIA Accounting Agency (DPAA) employees can use them efficiently to do their mission.

7.2 Future Work

Integrating RAAF survey data into ArcGIS was a milestone that opened up the horizon for many other future projects. An expanding work for this Major Individual Project could be integrating terrain data and creating an aspect layer to determine the directions of the slopes. Knowing the aircraft crash site, this would aid the searcher to predict the locations of the aircraft wrecks.

Another extension to this project can be creating a mobile application. The Royal Australian Air Force geodatabase included descriptive information about the locations of the aircraft crash sites that can help the user to find the crash locations. Accessing the

geodatabase from the field can provide all the related data to the aircraft the user is searching for.

Since this project included World War II aircraft crash location data from the RAAF survey, other datasets about aircraft crash locations from other forces could be acquired to conduct comparison analyses to study common locations. This could increase the chances of finding aircraft wreckage.

Works Cited

- Advances in Location Modeling: GIS Linkages and Contributions. (2010, January 14). *Journal of Geographical Systems*, 12-3(1435-5930), 341. Retrieved September 4, 2016, from https://www.researchgate.net/profile/Alan_Murray6/publication/46459772_Advances_in_Location_Modeling_GIS_Linkages_and_Contributions/links/542183f80cf2ce3a91b78f7b.pdf.
- Australia–Japan Research Project. (1975). *Remembering the war in New Guinea*. Retrieved November 25, 2016, from Australia–Japan Research Project: <http://ajrp.awm.gov.au/ajrp/remember.nsf/Web-Printer/58EBD6D993E15CE8CA256D05002671FD?OpenDocument>
- Callander, B. D. (2005, June). The Search Goes On. *Air Force Magazine*, p. 69.
- Defense POW/MIA Accounting Agency. (n.d.). *Vision-Mission-Values*. Retrieved from Defense POW/MIA Accounting Agency: <http://www.dpaa.mil/About/Vision-Mission-Values/>
- Defense POW/MIA Accounting Agency. (n.d.). *World War II*. Retrieved from Defense POW/MIA Accounting Agency: <http://www.dpaa.mil/Our-Missing/World-War-II/>
- Dickerson, K. (2014, November 11). *Project Recover Searches for Long-Lost World War II Heroes*. Retrieved October 7, 2016, from Live Science: <http://www.livescience.com/48724-project-recover-missing-soldiers.html>
- Esri. (2016a). Case studies. In *Analyzing violent crime*. Retrieved from <http://desktop.arcgis.com/en/analytics/case-studies/broken-bottles-1-overview.htm>
- Esri. (2016b). Case studies. In *Twister! United States tornadoes*. Retrieved from <http://desktop.arcgis.com/en/analytics/case-studies/twister-analyzing-us-tornadoes.htm>
- Henning, C. A. (2006, June 1). *POWs and MIAs: Status and Accounting Issues*. Retrieved from Federation of American Scientists: <https://www.fas.org/sgp/crs/natsec/RL33452.pdf>
- Jain, S. (2015). Recovery of Crash Site Web Application (Master's thesis, University of Redlands). Retrieved from http://inspire.redlands.edu/gis_gradproj/226
- Janzen, N. R. (2012). Crash Site Debris Recovery Mobile Application (Master's thesis, University of Redlands). Retrieved from http://inspire.redlands.edu/gis_gradproj/53
- Krause, E. (2013, May 28). *How should I interpret the output of density tools?* Retrieved September 8, 2016, from ArcGIS Blog: <https://blogs.esri.com/esri/arcgis/2013/05/28/how-should-i-interpret-the-output-of-density-tools/>
- Maguire, D. J., Batty, M., & Goodchild, M. F. (2005). *GIS, spatial analysis, and modeling*. Redlands, CA, USA: ESRI Press.
- Murray, A. T. (2010, January 14). Advances in Location Modeling: GIS Linkages and Contributions. *Journal of Geographical Systems*, 12-3(1435-5930).

- Royal Australian Air Force. (1961). *Survey of World War II and Post War Aircraft Wreckage in Papua and New Guinea and Dutch New Guinea*. Royal Australian Air Force.
- United States Embassy in Papua and New Guinea. (2016, May 13). *Repatriation Ceremony Honors WWII American Servicemen*. Retrieved November 25, 2016, from Port Moresby. Papua and New Guinea - Embassy of The United States: <https://portmoresby.usembassy.gov/repatriation.html>
- Vento, C. S. (2012, May 28). *The Missing in Action (MIA) of World War II*. Retrieved from Defense Media Network: <http://www.defensemedianetwork.com/stories/the-missing-in-action-mia-of-world-war-ii/>

Appendix A. Royal Australian Air Force Survey.

SURVEY OF
WORLD WAR II AND POST WAR
AIRCRAFT WRECKAGE

IN
TERRITORY OF PAPUA AND NEW GUINEA

AND
DUTCH NEW GUINEA

CONTENTS

Foreword	Page 1
Amendment Sheet	Page 2
Aircraft General Data	Page 3
Index of Aircraft	Pages 4 to 16
Map of Search Area	Page 17
Aeronautical Charts of -	
Cerum Island	Map 1
Geelvink Bay	Map 2
Hollandia	Map 3
Admiralty Island	Map 4
Kavieng	Map 5
Aroe Island	Map 6
Flamingo Bay	Map 7
Huon Gulf	Map 8
Lae	Map 9
Rabaul	Map 10
Torres Strait	Map 11
Port Moresby	Map 12
Woodlark Island	Map 13

PERIOD

This survey of World War II allied aircraft crashes in Papua, New Guinea, New Britain, New Ireland, Admiralty and Solomon Islands, and Dutch New Guinea, has been compiled from all available records at Department of Air Canberra and is based on reports received resulting from organised searches conducted in the above areas by the Royal Australian Air Force during and since World War II. Aircraft mentioned are Royal Australian Air Force, Royal Netherlands Air Force, United States Army Air Corps, United States Navy and United States Marine Corps. In addition, some Japanese aircraft and post war civil aircraft are recorded.

The index to crashed and missing aircraft includes, where known, the type, serial number, nationality and location of each aircraft together with a brief history of the case. Each wreck is plotted on World Aeronautical Charts 1 - 1,000,000 reduced in size by photographic processing. As well as giving an overall coverage of the search areas separate sheets are included for easy reference.

In addition to "pin pointing" known aircraft wrecks, this survey includes likely locations of known allied aircraft still missing. These missing aircraft are believed to be in proximity to the respective geographical positions indicated; such assumptions being based on other information extracted from Department of Air records. For these reasons such "spot locations" relating to unaccounted aircraft should be accepted with reserve.

This survey would not be complete without aircraft general data, therefore a brief description of each type of aircraft recorded therein is provided in order to assist in aircraft identification. Whilst it is not practicable to cover all aspects of aircraft identification in this survey, the following information together with the above referred aircraft general data will serve as a guide in determining individual aircraft identity.

Aircraft of the Royal Australian Air Force (RAAF). World War II aircraft have the RAAF roundel painted on the fuselage and wings. The aircraft serial number is stencilled on both sides of the fuselage, forward of the tail plane. The serial number is usually prefixed with the letter "A" eg A9-660.

Aircraft of the Royal New Zealand Air Force (RNZAF). Similar to RAAF markings and serial number is located in the same place and is generally prefixed by the letter "NZ" eg NZ5402. Past experience of the RAF Search Organisation in New Britain has indicated that many New Zealand aircraft located bore American markings i.e. a five pointed star which had not been obliterated fully. The key to identification is the prefixed letters "NZ" on the serial number.

Aircraft of the Royal Air Force (RAF). Similar markings to RAAF with serial number located in the same place and is generally prefixed by a letter or letters eg EN 341.

Aircraft of the United States Forces. A white five pointed star is usually painted on each side of the fuselage and on the wings. The aircraft model, designation and serial number are stencilled on the left side of the fuselage, forward of the front cockpit eg B24-42-4443. When the cockpit is in the rear of the fuselage the markings are placed in the rear of the cockpit. Stabilisers of an aircraft may also bear certain markings from the serial number or radio call number of the aircraft.

Aircraft of the Royal Netherlands Air Force (RANF). Blue, white and red markings on stabilisers, serial numbers stencilled on both sides of the fuselage and usually prefixed by a letter eg N5-228.

Generally all aircraft of American manufacture have a data plate placed within the aircraft, usually in the cockpit or pilot's compartment. Information on the plate gives the type, aircraft serial number, order number and date accepted. A manufacturer's name plate measuring 3 by 4 to 6 inches is placed on each aircraft. It is mounted on a main structural member of the aircraft and in a location plainly visible when looking into the cockpit from the left hand side. The name plate carries model and serial numbers, contract number, and date accepted.

Should wreckage of a previously unaccounted aircraft be located it is desirable that it be reported to the Department of Air, Canberra ACT who will take appropriate action with the Service concerned. A warning based on past experience of the RAF Search Organisation is issued concerning the possible existence of unexploded bombs in aircraft wreckage and therefore extreme precautions should be taken when examining wreckage of crashed aircraft.

20th October 1961

(W.L. BRILL)
Group Captain
For Air Member for Personnel

AMENDMENT SHEET

[illegible]

- 3 -
AIRCRAFT GENERAL DATA

NAME	RAF DESIG- NATION	US ARMY OR NAVY DESIG- NATION	OTHER SERVICES DESIG- NATION	TYPE	MANUFACTURE	PURPOSE	ENGINE
Albacora		P39		Single Engine Monoplane	Bell	Fighter	V12 (12) Gen Motors Allison
Avenge		TFP		Single Engine Monoplane	Grumman	Torpedo Bomber	14 cyl (Rad) Pratt and Whitney
Anson	A4		RN2AF NZ	Twin Engine Monoplane	A.V. Roe	Reconnaissance	7 cyl (Rad) Cheestah
Beaufighter	A8			Twin Engine Monoplane	Bristol	Strike	14 cyl (Rad) Bristol Hercules
Beaufort	A19			Twin Engine Monoplane	Dep./C Prod.	Strike	14 cyl (Rad) Bristol Hercules
Betty	A9			Twin Engine Monoplane	Dep./C Prod.	Medium Bomber	14 cyl (Rad) Pratt and Whitney
Black Widow		P61	GAMI JAPAN	Twin Engine Monoplane	Mitsubishi	Medium Bomber	14 cyl (Rad) Pratt and Whitney
Boomerang	A46			Twin Engine Monoplane	Northrop	Light Fighter	18 cyl (Rad) Pratt and Whitney
Boston	A28	A20		Single Engine Monoplane	C.A.C.	Fighter	14 cyl (Rad) Pratt and Whitney
Canberra			RAF	Twin Engine Monoplane	Douglas	Medium Bomber	14 cyl (Rad) Wright
Catalina	A24	PBY5		Twin Engine Monoplane	Eng. Electric	Medium Bomber	Axial Flow Rolls Royce
Commando		C46		Twin Engine Monoplane	Consolidated	Reconnaissance	14 cyl (Rad) Pratt and Whitney
Corsair		F4U	RN2AF NZ	Single Engine Monoplane	Curtiss	Transport	14 cyl (Rad) Pratt and Whitney
Dakota	A65	C47	RAF KN	Twin Engine Monoplane	Vought	Fighter	14 cyl (Rad) Pratt and Whitney
Dauntless		A24		Single Engine Monoplane	Douglas	Transport	14 cyl (Rad) Pratt and Whitney
Dewar			Civil JMA3	Three Engine Monoplane	Douglas	Torpedo Bomber	14 Cyl (Rad) Wright
Ford Tri Motor			Civil	Four Engine Monoplane	De Havilland	Transport	3 x 4 cyl (1L) De Havilland
Fortress		B17		Four Engine Monoplane	Ford	Transport	3 x 9 cyl (Rad) Wright
Fox Moth			DH 83	Single Engine High Wing	Boeing	Heavy Bomber	14 cyl (Rad) Wright
Havoc		P70		Twin Engine Monoplane	Douglas	Communications	4 cyl (1L) Gipsy Major
Hudson	A16	A28		Twin Engine Monoplane	Douglas	Attack	14 cyl (Rad) Wright
Kittyhawk	A29	P40	RN2AF NZ	Single Engine Monoplane	Lockheed	Bomber	14 cyl (Rad) Pratt and Whitney
Liberator	A72	E24		Four Engine Monoplane	Curtiss Wright	Fighter	V12 (12) Gen Motors Allison
Lightning	A55	P38		Twin Engine Monoplane	Lockheed	Heavy Bomber	14 cyl (Rad) Pratt and Whitney
Marauder		E26		Twin Engine Monoplane	Lockheed	Fighter	V12 (12) Gen Motors Allison
Mitchell	A47	E25		Twin Engine Monoplane	Martin	Medium Bomber	18 cyl (Rad) Pratt and Whitney
Norman	A71	L6		Single Engine High Wing	North American	Medium Bomber	14 cyl (Rad) Wright
Piaggio	A2		Civil	Twin Engine High Wing	Northrop	Army Co-op	9 cyl (Rad) Pratt and Whitney
Seagull				Single Engine Biplane	Piaggio	Transport	Fiat 6 cyl Lycoming
Sentinel	A58	L5		Single Engine High Wing	Supermarine	Ship Patrol	9 cyl (Rad) Bristol Pegasus
Spartan				Single Engine Monoplane	Stinson	Army Co-op	Fiat 4 cyl Lycoming
Thunderbolt		P47		Single Engine Monoplane	Vickers S'Marine	Fighter	V12 (12) Rolls Royce Merlin
Tiger Moth	A17			Single Engine Biplane	Republic	Fighter	14 cyl (Rad) Pratt and Whitney
Tony			JAPAN	Single Engine Biplane	De Havilland	Communications	4 cyl (1L) Gipsy Major
Ventura			RN2AF NZ	Single Engine Monoplane	Kawasaki	Fighter	Inverted V12 Kawasaki
Vulture Vengeance	A27	A35		Twin Engine Monoplane	Lockheed	Reconn. Bomber	18 cyl (Rad) Pratt and Whitney
Warhawk	A2	P40	RN2AF NZ	Single Engine Monoplane	Lockheed	Drive Bomber	14 cyl (Rad) Wright
Walrus				Single Engine Monoplane	Vultee	Fighter	V12 (12) Gen Motors Allison
Warraway	A20			Single Engine Biplane	Curtiss	Ship Patrol	9 cyl (Rad) Pegasus
Zero			A6M5 JAPAN	Single Engine Monoplane	C.A.C.	Fighter	9 cyl (Rad) Pratt and Whitney
				Single Engine Monoplane	Mitsubishi	Fighter	14 cyl (Rad) Nakajima

- 4 -
INDEX OF CRASHED AIRCRAFT

TERRITORY OF PAPUA AND NEW GUINEA AND DUTCH NEW GUINEA

SERIAL NO.	MAP REF SHEET	LAT. LONG.	AREA	AIRCRAFT IDENTIFICATION	REMARKS
1	12	09.05-147.47	Mt. Kanevi	BAAF Anson LT 294	Located on Mountain Ridge at 10,000'.
2	9	07.53-147.11	Garsina	BAAF Anson AX 120	Wreckage recovered in vicinity Garsina
3	12	08.40-148.24	Buna	BAAF Beaufighter A19-1	Wreckage recovered in swamp near Buna Village
4	9	06.42-147.00	Lae	BAAF Beaufighter A19-24	In jungle at end of Lae strip (Not recovered)
5	9	05.34-148.34	New Britain Borgen Bay	BAAF Beaufighter A19-33	Believed to be in jungle south of Borgen Bay
6	9	05.30-148.30	Borgen Bay	BAAF Beaufighter A19-133	Wreckage recovered near coastal track Borgen Bay
7	9	06.44-147.01	Lae	BAAF Beaufighter A19-49	In sea 500 yards off Lae (Not recovered)
8	9	06.43-146.59	In sea	BAAF Beaufighter A19-49	30 miles off coastal track Borgen Bay
9	10	06.43-146.59	In sea	BAAF Beaufighter A19-49	30 miles off coastal track Borgen Bay
10	10	06.54-151.10	In sea	BAAF Beaufighter A19-27	30 miles off coastal track Borgen Bay
11	10	05.33-150.54	Bangula Bay area	USAC P38 Lightning No. unknown	Wreckage located in jungle inland from Bangula Bay
12	10	05.33-150.54	Bangula Bay area	BAAF Beaufighter A19-139	Wreckage recovered
13	10	05.07-151.08	Saddle Mountain	BAAF Beaufighter A19-144	Wreckage recovered 30 yards off western end of Boream Strip
14	3	03.35-143.40	Muschu Is	BAAF Beaufighter A19-146	Wreckage recovered in vicinity of Muschu Village
15	3	03.24-143.38	Boream	BAAF Beaufighter A19-185	Wreckage recovered - burnt out. Bodies located at Idore
16	1	02.50-132.53	D.N.G.	BAAF Beaufighter A19-209	Crashed in vicinity of Boream Bay
17	12	09.38-147.16	Boortless Bay area	BAAF Beaufort A9-52	Crashed in vicinity of Boortless Bay
18	12	09.38-147.16	Boortless Bay area	USAC Fortress B17 No. unknown	Believed crashed in sea at this position
19	12	08.10-146.29	N.E. of Jacquinot Bay	BAAF Beaufort A9-106	Wreckage recovered in swamp near Pelagi
20	12	08.10-146.29	N.E. of Jacquinot Bay	BAAF Dakota C-117	Believed crashed in swamp near Pelagi
21	10	06.14-150.14	As - Gamata	BAAF Beaufort A9-183	Wreckage recovered on Mountain range N.E. of Jacquinot Bay
22	10	06.09-150.19	Gamata	BAAF Beaufort A9-186	Recovered 7 - 10 miles north of Au Village Gamata
23	10	06.20-150.21	Gamata	BAAF Beaufort A9-188	Crashed in sea 3 miles S.E. of Arawin Is Gamata
24	13	09.53-152.03	In sea	BAAF Beaufort A9-197	Believed crashed in sea at this position
25	13	06.13-150.22	N.E. Gamata	BAAF Beaufort A9-204	Wreckage recovered in swamp 3 miles N.E. Gamata
26	10	04.14-152.10	Reboul	BAAF Beaufort A9-211	Reboul area - not recovered
27	10	06.30-154.02	In sea	BAAF Beaufort A9-225	Believed crashed in sea at this position
28	5	02.51-150.59	Reboul	BAAF Beaufort A9-244	Reboul area - not recovered
29	5	04.10-152.11	Reboul	BAAF Beaufort A9-247	Wreckage recovered near North Daughter
30	10	04.10-152.10	Reboul	BAAF Beaufort A9-247	Wreckage recovered near North Daughter
31	10	04.10-152.10	Reboul	BAAF Beaufort A9-247	Wreckage recovered near North Daughter
32	10	04.10-152.10	Reboul	BAAF Beaufort A9-247	Wreckage recovered near North Daughter
33	10	04.09-152.13	Reboul	BAAF Beaufort A9-247	Wreckage recovered near North Daughter
34	10	06.14-150.21	Gamata	BAAF Beaufort A9-256	Located on shore of Gamata Harbour
35	10	05.26-150.25	Hokkins	BAAF Beaufort A9-262	Wreckage recovered off shore at Hokkins
36	10	04.14-152.10	Reboul	BAAF Beaufort A9-282	In Slepsons Harbour
37	10	04.13-152.12	Gamata	BAAF Beaufort A9-313	Believed lost in vicinity of Lakaumi
38	10	06.16-150.21	Gamata	BAAF Beaufort A9-374	In sea 500 yards west of Gamata Strip
39	13	09.28-150.20	Mud Bay	BAAF Beaufort A9-376	Crashed in Moresby Strait
40	3	03.10-142.53	Reboul	BAAF Beaufort A9-493	In sea - collided with Beaufort A9-667
41	3	03.10-142.53	Reboul	BAAF Beaufort A9-493	In sea - collided with Beaufort A9-493
42	10	05.35-151.29	Jacquinot Bay	BAAF Beaufort A9-517	Crashed in mangrove swamp in Mindam Area
43	4	03.48-144.20	Murik Lakes	BAAF Beaufort A9-571	Wreckage recovered in mangrove swamp in Mindam Area
44	3	03.23-143.13	But	BAAF Beaufort A9-599	Ditched 20 yards from beach in front of Mission
45	3	02.30-142.00	In sea	BAAF Beaufort A9-625	Wreckage recovered disintegrated near But
46	3	03.24-143.14	But	BAAF Beaufort A9-630	Last seen in this position
47	3	02.15-142.30	Tedji	BAAF Beaufort A9-660	Wreckage recovered on mountain ridge N.E. of Nyola
48	12	09.05-147.44	Kanevi	USAC Mitchell B25	Wreckage recovered in clearing at Kanevi
49	12	09.07-147.41	Nyola	USAC Mitchell B25	Wreckage recovered in clearing at Nyola
50	12	09.07-147.41	Nyola	USAC Mitchell B25	Wreckage recovered on mountain ridge at 10,500'
51	12	09.07-147.42	Nyola	USAC Mitchell B25	Wreckage recovered on mountain ridge at 10,500'
52	12	09.06-147.42	Kanevi	USAC Mitchell B25-41-30531	Located on ridge 9,500'
53	12	09.06-147.43	Kanevi	USAC Mitchell B25-41-30531	Wreckage recovered near Girua Plantation
54	12	08.49-148.13	Popondetta	USAC Dakota C47-41-19568	Wreckage recovered in Yodda Valley
55	12	08.49-147.38	Yodda	USAC Kittyhawk P40	Wreckage recovered on mountain N.E. of gap
56	12	08.58-147.47	Kokoda	BAAF Anson	

51	09-06-147.54	Kanavi	USAC Liberator B24	Located on mountain slope
52	08-01-146.52	Bubu	USAC Mitchell B25-41-12485	Recovered in Upper Bubu Valley at 9,000' - 518 same as 51 and location.
53	09-17-147.10	Brown River	USAC P47 Thunderbolt	Wreckage located in swamp area
54	09-17-147.11	Brown River	USAC Dakota C47	Wreckage located in swamp area
55	09-16-147.09	Brown River	USAC Portress B17	Wreckage recovered in swamp area
56	09-16-147.11	Brown River	USAC Liberator B24	Wreckage recovered in swamp area
57	09-30-147.16	Boatless	USAC Commando C46	Wreckage located in Boatless Inlet
58	09-30-147.17	Boatless	BAAF Bombering A46-109	Wreckage located in water in Boatless Bay
59	09-06-148.25	Pongani Area	BAAF Bombering A46-112	Believed lost in this area - not recovered
60	06-41-147.15	Busa River	BAAF Bombering A46-116	Wreckage recovered in vicinity of Busa River
61	06-41-147.15	Hopoi	USAC Alrocoobra P38	Located in sea off Hopoi
62	04-42-145.38	North of Alexishafen	BAAF Bombering A46-116	Lost seen in this position
63	05-44-146.02	At House	BAAF Bombering A46-116	Wreckage recovered on Mt. House in Finisterre Range with A46-146
64	04-39-144.18	Wewak Area	BAAF Bombering A46-116	Wreckage recovered on Mt. House in Finisterre Range with A46-119
65	01-38-143.35	Wewak Area	BAAF Bombering A46-181	Wreckage recovered in scrub
66	05-50-154.55	Bougainville	BAAF Bombering A46-189	Believed lost in this area
67	06-15-155.02	Bougainville	BAAF Bombering A46-216	Crashed in sea just off shore
68	07-03-147.03	Salamau	BAAF Boston A28-3	Wreckage located in sea in Salamau Harbour
69	06-44-147.03	Lae	BAAF Boston A28-14	Believed lost in this area
70	06-20-150.02	Abilngi Harbour	BAAF Boston A28-16	Wreckage located in sea in Abilngi Harbour
71	06-46-146.24	Gamata	BAAF Boston A28-22	Wreckage recovered on east bank Kabu River New Britain
72	06-00-151.01	Kabu River	BAAF Boston A28-27	Believed lost in this area
73	04-09-152.11	Rabaul	BAAF Catalina A24-13	Crew recovered in Mass Grave in Rabaul
74	08-00-155.00	Coral Sea	BAAF Catalina A24-18	Believed shot down in this position
75	10-40-152.29	In sea	BAAF Catalina A24-20	Ditched on reef - no news of crew
76	07-00-150.19	On reef	BAAF Catalina A24-34	Wreckage located on land
77	05-40-151.32	Bougainville	BAAF Catalina A24-49	Believed lost in this area
78	05-52-154.55	Milne Bay	BAAF Catalina A24-49	Wreckage located in sea in Milne Bay
79	03-52-134.03	Vegekop	BAAF Dakota A65-56	Believed lost in this area
80	10-23-150.22	Samari Area	BAAF Dakota A65-61	Wreckage recovered in this general area
81	04-00-137.04	Makurapu Plantation	USAC Portress B17-41-2439	Wreckage recovered in Makurapu Plantation
82	10-17-150.22	Robora	USAC Mitchell B25-41-12485	Wreckage recovered 23 miles S.W. Robora airstrip
83	04-24-152.10	Warungoi River	USAC Navy Avenger TBF 2503	Wreckage recovered on bank of Warungoi River
84	04-28-152.13	Elkoma	USAC Lightning P38-42-6657	Wreckage recovered in rain forest
85	04-28-152.21	Elkoma	USAC Portress B17-41-2536	Wreckage located at Elkoma
86	07-20-147.32	In sea	USAC Portress B17-41-2536	Believed lost in this general area
87	09-06-147.44	Kanavi	USAC Portress B17-41-24543	Recovered 3 miles from Olmit Village
88	04-24-151.57	Mandras Plantation	BAAF Hudson A16-91	Wreckage recovered on reef in Gamata Harbour
89	06-16-150.16	Gamata	BAAF Hudson A16-101	Wreckage recovered in Gamata Harbour
90	06-17-150.18	Gamata	BAAF Hudson A16-126	Believed lost in this area
91	06-18-150.19	Gamata	BAAF Hudson A16-126	Wreckage recovered near Telad
92	06-19-150.19	Ubaia Island	BAAF Hudson A16-169	Wreckage recovered near strip at Tineka
93	06-19-150.19	Tineka D.N.G.	BAAF Hudson A16-181	Believed lost in this area
94	04-40-136.30	Salamau Area	BAAF Hudson A16-193	Believed lost in this area
95	07-03-146.50	Salamau Area	BAAF Hudson A16-216	Believed lost in this area
96	06-19-155.31	Kaita	BAAF Hudson A16-246	Wreckage recovered in this area
97	07-11-146.36	In sea	BAAF Kittyhawk P40	Wreckage recovered near Jacobsons Plantation
98	06-42-147.00	Lae	USAC Lightning P38 No. unknown	Believed lost in this area
99	06-59-146.59	Lae	USAC Lightning P40 A29-15	Wreckage recovered in this area
100	07-02-146.59	Boboda	USAC Lightning P38	Wreckage recovered in this area
101	06-41-147.02	Lae	BAAF Kittyhawk A29-16	Crashed in this area
102	09-16-147.04	Moresby	USAC Thunderbolt P47 No. unknown	Wreckage recovered in this area near Haina
103	09-16-147.04	Moresby	USAC Thunderbolt P47 No. unknown	Wreckage recovered at waters edge on coast near Anti
104	09-16-147.04	Moresby	USAC Alrocoobra P39	Wreckage recovered on beach at Kwon Point
105	06-11-150.34	Auti	BAAF Kittyhawk A29-201	
106	07-03-147.03	Salamau	BAAF Kittyhawk A29-38	

64

181	11	09.25-138.30	In sea	RAF Vulture Vengeance A27-209	Seen to crash in sea at this position
182	9	04.09-144.51	Hansa Bay	RAF Vulture Vengeance A27-275	Wreckage located on shore of Hansa Bay
183	9	05.03-145.39	Aber Village	RAF Vulture Vengeance A27-275	Wreckage recovered in mountains 4 miles from Aber
184	3	03.24-143.28	Karasau Island	RAF Walrus X9559	Sunk by enemy gunfire 20 yards off shore
185	10	06.15-155.02	Fiva	RAF Walrus X9559	Wreckage recovered at Fiva
186	12	06.01-145.38	Pineterrre Range	RAF Walrus X9559	Wreckage recovered at Pineterrre Range
187	12	06.01-145.38	Pineterrre Range	RAF Walrus X9559	Wreckage recovered at Pineterrre Range
188	12	06.38-146.19	Tapa	RAF Walrus X9559	Wreckage recovered at Tapa
189	12	06.38-146.19	Tapa	RAF Walrus X9559	Wreckage recovered at Tapa
190	12	08.16-148.12	Gona Area	RAF Walrus X9559	Wreckage recovered at Gona Area
191	12	08.16-148.12	Ambasi Mission	RAF Walrus X9559	Wreckage recovered at Ambasi Mission
192	12	08.40-148.24	Buna	RAF Walrus X9559	Wreckage recovered at Buna
193	12	09.00-146.39	Borio	RAF Walrus X9559	Wreckage recovered at Borio
194	12	08.31-147.20	Waitape District	RAF Walrus X9559	Wreckage recovered at Waitape District
195	12	08.33-146.53	Tapani Area	RAF Walrus X9559	Wreckage recovered at Tapani Area
196	12	08.40-146.24	Buna	RAF Walrus X9559	Wreckage recovered at Buna
197	12	09.14-147.08	Brown River	RAF Walrus X9559	Wreckage recovered at Brown River
198	12	09.30-147.02	Fishermans Island	RAF Walrus X9559	Wreckage recovered at Fishermans Island
199	12	09.48-147.32	Rigo	RAF Walrus X9559	Wreckage recovered at Rigo
200	9	07.52-147.42	Bau	RAF Walrus X9559	Wreckage recovered at Bau
201	9	05.16-146.30	In sea	RAF Walrus X9559	Wreckage recovered in sea
202	9	03.16-142.45	Mesani	RAF Walrus X9559	Wreckage recovered at Mesani
203	3	03.16-142.45	Mesani	RAF Walrus X9559	Wreckage recovered at Mesani
204	3	03.24-143.36	Muechu	RAF Walrus X9559	Wreckage recovered at Muechu
205	2	02.30-133.17	Tofo	RAF Walrus X9559	Wreckage recovered at Tofo
206	2	02.19-133.37	Bentoni Bay	RAF Walrus X9559	Wreckage recovered at Bentoni Bay
207	3	01.35-134.06	Mesani	RAF Walrus X9559	Wreckage recovered at Mesani
208	3	01.51-138.41	Sarni	RAF Walrus X9559	Wreckage recovered at Sarni
209	3	03.35-143.40	Boran	RAF Walrus X9559	Wreckage recovered at Boran
210	3	03.34-143.35	Popondetta	RAF Walrus X9559	Wreckage recovered at Popondetta
211	12	08.39-146.17	Nivani Island	RAF Walrus X9559	Wreckage recovered at Nivani Island
212	13	10.42-152.23	Nivani Island	RAF Walrus X9559	Wreckage recovered at Nivani Island
213	13	10.42-152.23	Nivani Island	RAF Walrus X9559	Wreckage recovered at Nivani Island
214	13	11.37-153.47	Sud Est Island	RAF Walrus X9559	Wreckage recovered at Sud Est Island
215	13	09.13-152.45	Woodlark Island	RAF Walrus X9559	Wreckage recovered at Woodlark Island
216	13	09.13-152.45	Woodlark Island	RAF Walrus X9559	Wreckage recovered at Woodlark Island
217	13	10.37-151.01	Basilaki Island	RAF Walrus X9559	Wreckage recovered at Basilaki Island
218	13	10.37-151.01	Basilaki Island	RAF Walrus X9559	Wreckage recovered at Basilaki Island
219	13	10.41-152.44	Misima Island	RAF Walrus X9559	Wreckage recovered at Misima Island
220	13	10.41-152.44	Misima Island	RAF Walrus X9559	Wreckage recovered at Misima Island
221	13	11.23-154.18	Cape Deliverance	RAF Walrus X9559	Wreckage recovered at Cape Deliverance
222	10	04.24-152.17	Tobera	RAF Walrus X9559	Wreckage recovered at Tobera
223	10	04.10-152.10	Rabaul	RAF Walrus X9559	Wreckage recovered at Rabaul
224	2	00.33-133.11	Sadekrom	RAF Walrus X9559	Wreckage recovered at Sadekrom
225	2	00.39-133.18	Kairoi	RAF Walrus X9559	Wreckage recovered at Kairoi
226	2	00.44-133.30	Sidai	RAF Walrus X9559	Wreckage recovered at Sidai
227	2	00.43-133.34	Mesani	RAF Walrus X9559	Wreckage recovered at Mesani
228	12	00.44-133.44	Kanosa	RAF Walrus X9559	Wreckage recovered at Kanosa
229	12	09.00-146.57	Kanosa	RAF Walrus X9559	Wreckage recovered at Kanosa
230	12	09.16-147.04	Legaba	RAF Walrus X9559	Wreckage recovered at Legaba
231	12	09.21-147.09	Hansa	RAF Walrus X9559	Wreckage recovered at Hansa
232	12	09.21-147.09	Hansa	RAF Walrus X9559	Wreckage recovered at Hansa
233	12	04.11-152.12	Rabaul	RAF Walrus X9559	Wreckage recovered at Rabaul
234	10	04.12-152.13	Kaimana	RAF Walrus X9559	Wreckage recovered at Kaimana
235	2	03.40-133.45	Warren (Seri)	RAF Walrus X9559	Wreckage recovered at Warren (Seri)
236	2	01.39-134.06	Babo	RAF Walrus X9559	Wreckage recovered at Babo
237	2	02.34-133.24	Kasira	RAF Walrus X9559	Wreckage recovered at Kasira
238	2	02.40-133.29	Doenier	RAF Walrus X9559	Wreckage recovered at Doenier
239	2	02.33-134.24	Wau Area	RAF Walrus X9559	Wreckage recovered at Wau Area
240	9	07.27-146.37	Wau Area	RAF Walrus X9559	Wreckage recovered at Wau Area
241	9			RAF Walrus X9559	Wreckage recovered at Wau Area

242	9	07.22-146.44	Wau	USAC Alraobra P39	Wreckage located in vicinity of Wau
243	5	07.22-146.44	Wau	USAC Alraobra P39	Wreckage located in vicinity of Wau
244	5	02.35-150.49	Kavling	USAC Portress B17F 518	Shot down in vicinity of Kavling
245	9	04.58-151.54	Gazelle	USAC Portress B17B-41-2430	Shot down in vicinity of Gazelle
246	9	06.45-147.35	Hanisch Harbour	USAC Mitchell B25B-41-962	Shot down in vicinity of Hanisch Harbour
247	10	04.33-152.20	Put Put	USAC Portress B17B-41-9011	Wreckage recovered
248	10	04.35-152.18	Gazelle Peninsula	USAC Portress B17B-41-9244	Shot down in Gazelle Peninsula
249	10	04.25-152.00	Mokupewa	USAC Portress B17-12643	Wreckage recovered at Mondasil Plantation
250	10	05.26-151.47	Hong Kong Mt.	USAC Portress B17-12643	Wreckage recovered at Mondasil Plantation
251	10	05.46-147.41	Pinschafen Area	USAC Portress B17-12643	Wreckage recovered at Mondasil Plantation
252	10	08.05-147.41	Gazelle	USAC Portress B17-12643	Wreckage recovered at Mondasil Plantation
253	10	04.14-152.00	New Britain	USAC Portress B17-44-3381	Wreckage located off shore of Okaba
254	9	05.09-145.06	Sinlap	USAC Kittyhawk F4N-42-10486	Wreckage recovered 5 miles N.E. of Sinlap
255	9	05.05-145.06	Sinlap - Madang District	USAC Kittyhawk F4N-42-10486	Crashed at Cape Bora
256	3	03.35-143.40	Bora	USAC Liberator B24D-41-23716	Wreckage recovered at Lake Sentani
257	3	02.37-140.37	Lake Sentani	USAC Liberator B24D-42-40477	Wreckage recovered in swamp
258	8	04.01-143.32	Chambian	USAC Liberator B24D-42-40348	Wreckage recovered at Sami
259	3	01.51-136.45	Sami	USAC Liberator B24B-44-40422	Believed lost in this area
260	9	07.15-146.30	Owen Stanleys	USAC Liberator B24D-42-40886	Wreckage recovered on Sile Creek
261	9	07.21-146.47	Wau Area	USAC Liberator B24	Wreckage recovered at approximately 4,000'
262	12	09.02-147.25	Moresby Area	USAC Liberator B24D-42-40904	Crashed in sea off Gazelle
263	10	06.19-150.18	Gazelle	USAC Liberator B24D-42-40904	Crashed in sea off Gazelle
264	10	03.46-144.18	Wau Area	USAC Liberator B24D-42-40904	Crashed in sea off Gazelle
265	9	03.46-144.18	Wau Area	USAC Liberator B24D-42-40904	Crashed in sea off Gazelle
266	9	03.30-143.30	Wau Area	USAC Liberator B24D-42-40904	Crashed in sea off Gazelle
267	2	02.31-133.15	Kasar D.N.G.	USAC Liberator B24D-42-41225	Wreckage located in this area
268	2	04.10-143.50	Sepik	USAC Liberator B24D-42-41225	Believed lost in this area
269	9	05.10-146.20	Finisterre	USAC Liberator B24D-42-73185	Wreckage recovered near Sissano Lagoon
270	3	03.03-142.05	Sissano Lagoon	USAC Liberator B24D-42-10018	Crashed in sea approximately 15 miles off coast
271	1	00.15-132.55	D.N.G. Coastal	USAC Liberator B24D-42-10034	Aircraft shot down in this area
272	10	04.26-152.20	Gazelle Area	USAC Lightning P38-42-387	Last seen in this area
273	9	07.03-146.54	Salamaua Area	USAC Lightning P38-42-387	Wreckage recovered 7 miles east of Wardo
274	2	01.02-135.55	Plak	USAC Lightning P38-42-387	Shot down in sea 5 miles east of Bora
275	3	03.35-143.46	In sea	USAC Lightning P38-42-66539	Last seen over N. tip of Muschu Island
276	3	03.35-143.46	Muschu Island	USAC Lightning P38-42-66539	Crashed in sea off coast of Muschu Island
277	3	03.35-143.46	Pinschafen	USAC Lightning P38-42-66539	Crashed in sea off coast of Pinschafen
278	3	05.02-145.48	Alaxishafen	USAC Lightning P38-42-66539	Crashed in sea off coast of Alaxishafen
279	3	03.33-143.36	Karu	USAC Lightning P38-42-66539	Crashed in sea off coast of Karu
280	4	03.47-144.24	Alaxishafen	USAC Lightning P38-42-66539	Crashed in sea off coast of Alaxishafen
281	9	05.06-145.48	Bora Area	USAC Lightning P38-42-66539	Crashed in sea off coast of Bora
282	3	03.35-143.46	Bora Area	USAC Lightning P38-42-66539	Crashed in sea off coast of Bora
283	9	05.54-149.08	Arwa Area	USAC Lightning P38-42-66539	Crashed in sea off coast of Arwa
284	9	06.44-147.00	Lae	USAC Lightning P38-42-66539	Crashed in sea off coast of Lae
285	10	05.27-154.39	Sabono	USAC Lightning P38-42-66539	Crashed in sea off coast of Sabono
286	10	04.20-152.10	Bitagap Area	USAC Lightning P38-42-66539	Crashed in sea off coast of Bitagap
287	10	04.22-152.23	Kap Kap (Near Babaul)	USAC Lightning P38-42-66539	Crashed in sea off coast of Kap Kap
288	10	04.24-152.11	Varzin (Gazelle)	USAC Lightning P38-42-66539	Crashed in sea off coast of Varzin
289	9	06.51-147.39	Lu	USAC Lightning P38-42-66539	Crashed in sea off coast of Lu
290	9	06.51-147.39	Lu	USAC Lightning P38-42-66539	Crashed in sea off coast of Lu
291	12	09.02-149.03	Poeleok Harbours	USAC Lightning P38-42-66539	Crashed in sea off coast of Poeleok
292	9	07.12-147.25	In sea	USAC Lightning P38-42-66539	Crashed in sea off coast of In sea
293	2	01.40-137.25	Fol River	USAC Lightning P38-42-66539	Crashed in sea off coast of Fol River
294	12	06.15-147.51	Bura Area	USAC Lightning P38-42-66539	Crashed in sea off coast of Bura
295	12	10.09-147.51	In sea	USAC Lightning P38-42-66539	Crashed in sea off coast of In sea
296	3	03.33-143.40	In sea	USAC Lightning P38-42-66539	Crashed in sea off coast of In sea
297	3	06.23-146.39	Krep River	USAC Lightning P38-42-66539	Crashed in sea off coast of Krep River
298	4	03.46-144.12	Murik Area	USAC Lightning P38-42-66539	Crashed in sea off coast of Murik
299	9	04.40-144.21	Angai Area	USAC Lightning P38-42-66539	Crashed in sea off coast of Angai
300	9	05.11-145.49	Madang	USAC Lightning P38-42-66539	Crashed in sea off coast of Madang
301	9	05.15-145.53	In sea	USAC Lightning P38-42-66539	Crashed in sea off coast of In sea
302	9	05.32-146.16	In sea	USAC Lightning P38-42-66539	Crashed in sea off coast of In sea

04.42.5 144 24 E 5/19/56
 679

6/4/51

33	0	04.26-152.04	Rabaul	USAC Mitchell B25D-41-30239	Wreckage recovered in Rabaul Area
34	3	03.33-143.58	In sea	USAC Mitchell B25D-41-30255	Shot down in sea 15 miles out from Wewak
35	0	04.21-152.16	Kokopo	USAC Mitchell B25D-41-30312	Wreckage recovered at Kokopo
36	3	03.35-143.59	Wewak	USAC Mitchell B25D-41-30319	Shot down in sea off Wewak
37	3	03.35-143.42	In sea	USAC Mitchell B25D-41-30434	Crashed in sea off this position
38	3	03.10-144.57	In sea	USAC Mitchell B25D-41-30732	Crashed in sea 2 miles off Makow
39	3	03.13-143.40	In sea	USAC Mitchell B25D-41-30636	Crashed in Wewak Harbour
40	9	05.13-145.50	In sea	USAC Mitchell B25D-41-30771	Crashed in sea 1000 yards off Cape Kuseerow, S. Madang
41	9	04.10-144.45	Nubia area	USAC Liberator B24-42-41188	Wreck located 5 miles west of Nubia Village
42	9	04.30-145.25	Ullingen	USAC Mitchell B25D-42-64766	Wreckage recovered on Northern side of Ullingen Harbour
43	9	04.30-145.25	Ullingen	USAC Mitchell B25D-42-64766	Wreckage recovered on Northern side of Ullingen Harbour
44	12	11.08-147.11	In sea	USAC Mitchell B25D-42-64810	Believed crashed in sea in this position 37 miles south of Moresby
45	3	05.01-145.40	Aber	USAC Mitchell B25D-42-64827	Wreckage recovered near Aber Village
46	8	04.05-143.40	Sepik	USAC Mitchell B25D-42-64835	Wreckage located in Kuni patch near Charapa
47	10	06.19-150.19	Aravin Island	USAC Mitchell B25D-42-64846	Wreckage recovered on Aravin Island Gamata
48	9	06.28-146.38	Chivrasing	USAC Mitchell B25D-42-64852	Wreckage located in Markham Valley
49	9	04.53-144.38	Annaberg	USAC Thunderbolt P47-42-22662	Wreckage recovered near Annaberg
50	9	04.53-144.38	Annaberg	USAC Thunderbolt P47-42-22662	Wreckage recovered 5 miles from Annaberg
51	9	04.53-144.38	Annaberg	USAC Thunderbolt P47-42-22662	Believed lost in this area
52	9	04.53-144.38	Annaberg	USAC Thunderbolt P47-42-22662	Believed lost in this area
53	9	05.01-145.46	Nobuab	USAC Thunderbolt P47-42-22709	Wreckage located in this area
54	4	03.40-144.30	In sea	USAC Thunderbolt P47D-42-22820	Force landed in sea off south of Sepik River
55	3	03.33-143.36	Wewak	USAC Thunderbolt P47D-42-22848	Believed lost in this area
56	3	00.57-131.12	In sea	USAC Mitchell B25	Wreckage recovered in Wewak area
57	12	04.19-152.08	Gona	USAC Mitchell B25	Crashed in sea off Sorong D.N.G.
58	10	09.21-142.26	Vunakumu	USAC Fortress B17	Wreckage recovered near Gona Mission
59	11	09.21-142.26	In sea	USAC Mitchell B25	Wreckage located at Vunakumu
60	9	06.46-147.03	In sea	USAC Douglas C47	Crashed in sea 4 miles from Lee
61	3	03.35-143.47	In sea	USAC Lightning P38-42-67152	Crashed with Tony and crashed into sea 5 miles east of Borum
62	3	03.35-143.47	In sea	Japanese Tony	Collided with lightning and crashed into sea 5 miles east of Borum
63	3	04.29-152.20	Wat Nat	USAC Lightning P38-42-66665	Wreckage believed to be this aircraft located at Wat Nat
64	10	04.20-152.00	Rabaul Area	USAC Mitchell B25D-41-30694	Crashed at Rabaul area - crew captured
65	3	03.15-145.42	Madang Area	USAC Mitchell B25	Crashed at Madang area - crew captured
66	3	03.15-145.42	Madang Area	USAC Mitchell B25	Wreckage recovered at Madang
67	3	04.07-144.52	Awar Point	USAC Mitchell B25	Wreckage recovered at north end of Vunakumu
68	9	04.07-144.52	Awar Point	USAC Mitchell B25	Believed lost in this area
69	3	03.31-143.35	Cape Wom	USAC Mitchell B25	Last seen here and believed crashed
70	3	06.43-147.12	Bum River	USAC Mitchell B25	Wreckage recovered in Rabaul area
71	10	04.21-152.12	Gazelle Peninsula	USAC Mitchell B25	Believed lost in this area
72	10	04.21-152.12	Gazelle Peninsula	USAC Mitchell B25	Believed missing this area - General Walker's aircraft
73	10	04.25-152.10	Moresby	USAC Mitchell B25	Believed lost over this area
74	12	04.12-152.11	Matupi Strip	USAC Mitchell B25	Wreckage recovered at Bung Mountain
75	9	06.48-146.51	Kumung	USAC Mitchell B25	Wreckage recovered near Kunua
76	9	05.43-154.41	Kunua - Bouganville	USAC Mitchell B25	Wreckage recovered
77	10	04.20-152.06	Vuvu Plantation	USAC Mitchell B25	Wreckage recovered in Mup Area 1 mile from other P38 (see 349)
78	9	05.44-146.08	Saidor Area	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
79	9	06.19-147.05	Ullimong Mountains	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
80	9	05.43-146.08	Saidor Area	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
81	10	04.18-152.08	Rabaul Area	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
82	10	04.20-152.09	Rabaul Area	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
83	5	02.57-151.00	New Ireland	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
84	9	05.07-145.44	Near Hobbes Village	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
85	9	05.20-145.17	Musak - Bamu Valley	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
86	9	05.17-145.17	Musak	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
87	9	05.15-145.19	Wabusark	USAC Mitchell B25	Wreckage recovered in Rabaul Area by Americans
88	9	03.49-144.12	Murik Lakes	USAC Mitchell B25	Wreckage located near village
89	4	03.15-143.20	Wallis Island	USAC Mitchell B25	Wreckage located in water Murik Lakes
90	3			USAC Mitchell B25	Wreckage recovered on Wallis Island (Walif)

423 A	9	06.30-146.34	Nadab area	USAC Boston A200-43-21415	Missing on route Cairns - Nadab probable location(not recovered)
422	13	09.37-150.46	Sumari area	USAC Boston A200-42-54082	Believed missing in Sumari area
423	9	05.39-146.28	Saidor area	USAC Boston A200-42-54082	Believed missing Saidor area
424	9	06.05-149.00	Saidor area	USAC Boston A200-42-54088	Believed missing Saidor area
425	9	05.39-146.28	Saidor area	USAC Boston A200-42-54117	Believed missing Saidor area
426	9	06.05-149.00	Saidor area	USAC Boston A200-42-54117	Believed missing Saidor area
427	9	06.13-141.24	Dumai Valley area	USAC Boston A200-42-54117	Believed lost in this area
428	2	01.03-134.54	Dumai Valley area	USAC Boston A200-42-54723	Believed lost in this area
429	9	05.10-145.35	Nomfoor area	USAC Boston A200-42-54723	Believed missing in Nomfoor area
430	2	01.12-136.07	Sepik River	USAC Catalina OA-104-44-38899	Believed missing this area - Sepik - Dumai
431	9	05.39-146.38	Saidor area	USAC Curtis Commando C46D-44-78490	Believed missing in this area
432	9	06.38-147.51	Finchhafen area	USAC Curtis Commando C46D-42-01046	Believed missing in this area
433	3	02.25-140.34	In sea	USAC Curtis Commando C46D-42-01046	In sea off Hollandia
434	3	02.25-140.34	In sea	USAC Curtis Commando C46D-42-01046	In sea off Hollandia
435	12	06.05-146.00	At sea	USAC Douglas C47A-43-16013	Believed lost in this approximate position between Cooktown-Moreby
436	9	06.38-147.51	Finchhafen	USAC Douglas C47A-43-16013	Believed missing in Nomfoor - no further news
437	2	01.12-136.07	Blak	USAC Douglas C47A-43-16114	Believed missing in this area
438	12	08.30-145.30	D.M.C.	USAC Douglas C47A-43-16224	Believed lost in this general area
439	2	08.30-145.30	D.M.C.	USAC Douglas C47A-43-16230	Believed lost in this general area
440	9	05.45-147.00	Over sea	USAC Douglas C47A-42-23695	Possible missing this area. Departed Samarap for Blak
441	3	05.45-147.00	Over sea	USAC Douglas C47A-42-24226	Lost seen 700 feet over water between Finchhafen and Saidor
442	3	02.34-140.49	Bumbold Bay	USAC Douglas C47A-42-24226	Believed missing in Bumbold Bay
443	9	03.14-143.21	Wenak area	USAC Douglas C47A-42-24262	Missing between Nomfoor and Finchhafen,unconfirmed in Wenak area
444	13	10.05-150.37	Milne Bay area	USAC Douglas C47 A-42-93504	Believed missing in this general area
445	12	10.06-146.15	Over sea	USAC Douglas C47-42-23487	Believed lost this area on route Cooktown - Moreby
446	3	03.11-142.27	Tadji	USAC Douglas C47-42-93499	No news after take off Nadab for Blak-course 320° to Tadji -
447	13	12.00-151.50	Coral Sea	USAC Douglas C47-42-93499	Believed lost Tadji area
448	13	09.37-147.30	Wenak area	USAC Douglas C47-42-93499	Lost over Coral Sea (approximate area only)
449	9	09.15-145.00	Wenak area	USAC Douglas C47-42-93499	Believed lost this area - departed for Bogia from Saidor
450	12	09.15-145.00	Bogia area	USAC Douglas C47-42-93499	Believed lost this area - departed for Bogia from Saidor
451	9	06.43-147.01	Lee	USAC Kittyhawk P40	Missing between Moreby and Lee - probably in Gap area
452	9	06.43-147.01	Lee	USAC Kittyhawk P40	Believed missing in this area
453	9	06.43-147.01	Lee	USAC Kittyhawk P40	Believed missing in this area
454	10	06.05-153.45	Solomons area	USAC Liberator B24D-41-11903	Believed missing in this area
455	9	06.05-153.45	Solomons area	USAC Liberator B24D-41-11903	Believed missing in this area
456	5	03.30-150.30	Blak area	USAC Liberator B24D-42-40475	Believed missing in Blak area
457	9	06.34-146.37	Nadab	USAC Liberator B24D-42-40475	Believed missing in Nadab area
458	13	10.25-150.34	Milne Bay	USAC Liberator B24 D-42-40627	Missing Nadab area local training flight
459	4	03.49-144.00	Murik area	USAC Liberator B24D-42-40627	Last seen over Milne Bay
460	13	02.35-140.32	Hollandia area	USAC Liberator B24D-42-40627	Last sighted 10 miles west of Murik Swamp
461	3	08.28-151.07	Kirivina	USAC Liberator B24D-42-40957	Believed missing this area
462	9	06.05-149.00	D.M.C.	USAC Liberator B24D-42-40957	Missing in this area
463	2	01.03-134.54	D.M.C.	USAC Liberator B24D-42-40982	Believed missing in this area
464	10	04.20-152.09	Enbual area	USAC Liberator B24D-42-41081	Believed missing in this area
465	3	02.35-140.32	Hollandia area	USAC Liberator B24D-42-41081	Missing in this area
466	9	04.10-144.51	Hansa Bay	USAC Liberator B24D-42-41135	Believed missing this area
467	3	02.34-140.49	Sumbold Bay	USAC Liberator B24D-42-54178	Believed missing this area
468	9	07.00-148.07	Solomons Sea	USAC Liberator B24D-42-72709	Believed missing this area
469	9	04.00-146.00	Siamark Sea	USAC Liberator B24D-42-72709	Believed missing this area
470	9	05.13-145.48	Enbual area	USAC Liberator B24D-42-72709	Believed missing this area
471	9	05.13-145.48	Enbual area	USAC Liberator B24D-42-72709	Believed missing this area
472	2	01.12-136.07	Blak	USAC Liberator B24D-42-100225	Believed missing this area

541	2	01.53-13.04	Vogelkop	USAC believed Thunderbolt P47	Believed missing this area
542	2	01.53-13.04	Vogelkop	USAC believed Thunderbolt P47	Believed missing this area
543	2	01.12-13.07	Biak	USAC believed Thunderbolt P47	Missing from this area
544	12	06.46-16.25	Buna Area	USAC bomber probably B25	Believed missing in this area
545	12	06.46-16.25	Buna Area	USAC bomber probably B25	Believed missing in this area
546	9	05.38-16.28	Saidor	USAC believed Aircobra P39	Believed missing Saidor area
547	9	05.38-16.28	Saidor	USAC believed Aircobra P39	Believed missing Saidor area
548	9	05.38-16.28	Saidor	USAC believed Aircobra P39	Believed missing Saidor area
549	9	05.38-16.28	Saidor	USAC believed Thunderbolt P47	Believed missing Saidor area
550	3	01.34-13.38	Weak	USAC believed Thunderbolt P47	Believed missing Weak area
551	3	01.34-13.38	Weak	USAC believed Thunderbolt P47	Believed missing Weak area
552	3	01.34-13.38	Weak	USAC believed Aircobra P39	Believed missing Weak area
553	3	01.34-13.38	Weak	USAC believed Aircobra P39	Believed missing Weak area
554	9	05.38-16.38	Saidor	USAC believed Aircobra P39	Believed missing Saidor area
555	9	05.38-16.38	Saidor	USAC believed Aircobra P39	Believed missing in this area
556	9	05.38-16.38	Cape Clouetier	USAC bomber believed B25	Believed missing in this area
557	9	06.35-17.51	Pinschafen	USAC believed Thunderbolt P47	Believed missing in this area
558	9	06.35-17.51	Pinschafen	USAC bomber believed B25	Believed missing in this area
559	9	06.43-17.01	Lee	USAC bomber believed B25	Believed missing in Lee area
560	9	06.43-17.01	Lee	USAC believed Aircobra P39	Believed missing in Lee area
561	12	08.40-14.25	Buna	USAC believed Aircobra P39	Believed missing in this area
562	12	08.40-14.25	Buna	USAC believed Aircobra P39	Believed missing in Buna area
563	12	08.40-14.25	Buna	USAC believed Aircobra P39	Believed missing in this area
564	12	08.40-14.25	Buna	USAC believed Aircobra P39	Believed missing in this area
565	12	08.40-14.25	Buna	USAC believed Aircobra P39	Believed missing in this area
566	12	08.40-14.25	Buna	USAC believed Aircobra P39	Believed missing in Buna area
567	12	08.40-14.25	Buna	USAC believed Aircobra P39	Believed missing from this area
568	12	09.03-16.53	Korebay	USAC believed Aircobra P39	Believed missing from this area
569	12	09.03-16.53	Korebay	USAC bomber believed B25	Believed missing from this area
570	12	09.03-16.53	Korebay	USAC bomber believed B25	Believed missing from this area
571	12	09.03-16.53	Korebay	USAC believed Aircobra P39	Believed missing from this area
572	12	09.03-16.53	Korebay	USAC believed Aircobra P39	Believed missing from this area
573	13	10.32-15.04	Minne Bay	USAC believed Aircobra P39	Believed missing in this area
574	13	10.32-15.04	Minne Bay	USAC believed Aircobra P39	Believed missing in this area
575	13	10.40-15.43	Louisiade Archipelago	USAC believed Kittyhawk P40	Believed missing in this area
576	13	10.40-15.43	Louisiade Archipelago	USAC believed Aircobra P39	Believed missing from this area
577	10	07.20-15.39	Korebay	USAC believed Aircobra P39	Believed missing from this area
578	10	07.20-15.39	Korebay	USAC believed Aircobra P39	Believed missing from this area
579	10	04.20-13.09	Babel	USAC believed Aircobra P39	Believed lost in this area
580	10	06.19-15.018	Gasmata	USAC believed Aircobra P39	Believed lost in this area
581	10	06.19-15.018	Gasmata	USAC believed Aircobra P39	Believed lost in this area
582	10	06.19-15.018	Gasmata	USAC believed Aircobra P39	Believed lost in this area
583	10	06.19-15.018	Gasmata	USAC believed Aircobra P39	Believed lost in this area
584	10	06.19-15.018	Gasmata	USAC believed Aircobra P39	Believed lost in this area
585	9	06.47-14.03	Lee	USAC believed Douglas C47-CPX	Crashed into sea 48 miles from Lee
586	10	06.25-15.50	Solonara	USAC believed Mitchell B25	Believed lost on Bougainville Island - no set location
587	12	09.03-16.53	Korebay	USAC Aircobra P39-53	Missing from this area
588	12	09.03-16.53	Korebay	USAC Aircobra P39-53	Missing from this area
589	12	09.03-16.53	Korebay	USAC Aircobra P39-53	Missing from this area
590	9	07.12-14.36	Weak area	USAC Liberator B24-42-10963	Believed missing in Weak area
591	3	07.12-14.36	Weak	USAC Liberator B24-42-10963	Believed missing in Weak area
592	12	08.40-14.25	Buna	USAC Mitchell B25-42-64807	Believed missing in this area
593	12	08.40-14.25	Buna	USAC Mitchell B25-42-64807	Wreckage located around strip area
594	10	06.50-15.44	Kanili (Buin)	Numerous Japanese aircraft	Wreckage recovered at Segitosa Creek at 2000' on Simbar Mountain
595	3	01.29-13.10	Bagu area	USAC Lightning P38-42-66572	Wreckage located on west slopes of South Baugher
596	1	04.14-13.24	Bagu area	USAC Corsair P40-37114	Wreckage located just north of Bagu
597	1	07.17-14.06	Namau Bay	BAF Bomber B24-42-104205	Wreckage located just north of Namau Bay
598	12	08.06-16.58	Babu River	USAC Mitchell B25-42-12405	Wreckage recovered at 9,000' in upper Babu Valley - Mt. Strong area
599	9	04.28-14.03	Malala Village	BAF Kittyhawk A29	Wreckage located on Mt. Clouetier
600	2	02.31-14.03	Hollandia	USAC B-24	Wreckage located on Mt. Cyclops

601	2	01.57-138.54	Tor River	BAAP Kittyhawk A29	Wreckage located this area
602	2	01.16-135.47	Amus Island	BAAP Kittyhawk A29	Ditched in water 200 yards off Amus Island
603	2	01.12-136.07	Bisk	Japanese Oka	Wreckage located in sea
604	2	01.12-136.07	Bisk	BAAP Kittyhawk A29	Wreckage located in vicinity of Mohner
605	2	02.55-138.27	D.N.G.	BAAP Kittyhawk A29	Ditched in sea 4 miles off Mandakari
606	12	00.54-134.07	Manokeni	BAAP Beaufort A29	Wreckage located in sea near Manokeni
607	12	09.02-148.33	Pongani	BAAP Beaufort A29	Ditched in sea near Wapigalia Mission
608	12	03.13-147.13	Wapigalia	BAAP Beaufort A29	Wreckage located in sea near Wapigalia Mission
609	12	03.17-147.00	Manik	BAAP Beaufort A29	Explosion over target at Manik West
610	12	09.00-148.00	Asini Area	USAC Alacobra P19	Wreckage recovered at 1,800' towards Kumai River
611	12	09.24-147.55	Owen Stanleys	USAC believed Mitchell B25	Wreckage recovered at 7,790 feet near headwaters of Kemp Welch River
612	12	09.30-148.10	Mt Oheue	USAC Fortness B17E-41-2905	Wreckage located on hill (Lookout) in Koreby
613	12	09.28-147.11	Moresby	BAAP Catalina A24	Wreckage recovered in this area
614	2	04.02-138.47	Saltem Valley	BAAP Douglas C47 48-38	Located in sea just off shore
615	2	04.02-138.47	Saltem Valley	BAAP Beaufort A29-253	Located in sea just off shore
616	13	08.58-151.55	Gawa Island	BAAP Hudson A16-201	In sea 3 miles East of Gawa Island
617	9	06.40-147.22	Eawlinson Range	BAAP Beaufort A29-253	Wreckage recovered at 3,000' on southern slope Eawlinson Range
618	12	08.38-148.21	Cape Killerton	BAAP Kittyhawk A29-108	Wreckage recovered near Popogo Village
619	13	10.15-150.10	Arada River	BAAP Kittyhawk A29-108	Wreckage recovered in vicinity Arada River
620	13	10.01-150.20	In sea	BAAP Kittyhawk A29-108	Believed located in sea in this position
621	2	01.13-134.29	In sea	BAAP Kittyhawk A29-108	Located in sea mile East of Pamasoren Strip
622	2	01.28-134.29	Manik	BAAP Kittyhawk A29-108	Wreckage located in sea near Manik
623	9	06.34-146.41	Kadab	BAAP Kittyhawk A29-108	Wreckage located 2 miles east of No. 4 Strip
624	13	09.41-150.47	Salamo	BAAP Walrus HU-865	Sank on take off near Salamo
625	12	08.44-147.33	Mt. Victoria	BAAP Winway A20-51	Wreckage recovered on Mt Victoria
626	10	02.34-150.47	Kavieng	BAAP Catalina A24-11	Crashed on take off from Kavieng
627	9	07.16-147.08	Nassau Bay	BAAP Boston A28-21	Located in 5 fathoms in Nassau Bay
628	10	05.28-150.25	Hokins Island	BAAP Bombering A46-45	Wreckage located in vicinity of Hoskins
629	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
630	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
631	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
632	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
633	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
634	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
635	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
636	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
637	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
638	10	04.15-152.12	Matupi Island	USAC type unknown	Believed lost in this area
639	10	04.24-152.24	Kulon	USAC type unknown	Wreckage located near Kulon
640	10	04.24-152.24	Kulon	USAC type unknown	Located on reef at Kulon
641	10	04.16-152.11	Karauli	USAC type unknown	Located at Karauli near Kokopo
642	13	03.29-142.08	Stapsons Harbour	BAAP believed Corsair D-567399	Report of wreckage to be investigated
643	13	03.29-142.08	Stapsons Harbour	BAAP believed Corsair D-567399	Wreckage located off Palm Point
644	13	03.29-142.08	Stapsons Harbour	BAAP believed Corsair D-567399	Wreckage located off Palm Point
645	5	03.24-143.17	Legaua	USAC Mitchell B25	Believed lost in this area
646	10	05.39-151.28	Palmaimal	USAC Mitchell B25	Sank in water off Legaua
647	10	04.12-152.09	Wunawutung	BAAP Boston A28	Wreckage located near Palmaimal
648	10	06.16-150.16	Gasemata	USAC Mitchell B25	Located in deep water in Gamma Harbour
649	12	01.38-134.09	Boeni West	BAAP Kittyhawk A29	Wreckage located near Boeni West
650	12	01.38-134.09	Boeni West	BAAP Kittyhawk A29	Wreckage located near Boeni West
651	10	04.28-154.13	Green Island	BAAP Beaufort A29	Crashed in sea in this position
652	10	06.12-155.36	In sea	BAAP Beaufort A29	Crashed in sea in this position
653	10	05.25-154.41	Bougan-Buka area	BAAP Beaufort A29	Crashed in sea in this position
654	10	06.00-154.42	In sea	BAAP Beaufort A29	Crashed in sea in this position
655	10	04.35-153.05	New Ireland	BAAP Beaufort A29	Crashed in sea in this position
656	10	06.13-155.41	In sea	BAAP Beaufort A29	Crashed in sea in this position
657	10	07.04-156.09	Caravat	BAAP Beaufort A29	Crashed in sea in this position
658	10	07.04-156.09	Caravat	BAAP Beaufort A29	Crashed in sea in this position
659	10	04.42-152.23	Sum Sum	BAAP Beaufort A29	Crashed in sea in this position
660	10	05.51-154.51	Imperor Range	BAAP Beaufort A29	Crashed in sea in this position

661	10	05.10-152.51	In sea	BNZAF Corsair NZ 5450	Crashed in sea
662	10	05.29-154.41	Bougainville	BNZAF Corsair NZ 5336	Believed lost in this area
663	10	07.07-155.27	In sea	BNZAF Kittyhawk P40-NZ 3169	Crashed in sea in this position
664	10	04.11-152.37	New Ireland	BNZAF Warhawk NZ 3153	Believed missing in this area
665	10	04.13-152.24	Ulu Island	BNZAF Corsair NZ 5402	Wreckage recovered on Ulu Island
666	10	04.15-152.08	Rabaul Area	BNZAF Kittyhawk No. unknown	Believed lost over Rabaul
667	10	04.15-152.08	Rabaul Area	BNZAF Kittyhawk NZ 3141	Believed lost over Rabaul
668	10	04.15-152.08	Rabaul Area	BNZAF Kittyhawk No. unknown	Believed lost over Rabaul
669	10	04.15-152.08	Rabaul Area	BNZAF Kittyhawk NZ 5423	Crashed in sea in this position
670	5	03.54-153.49	In sea	BNZAF Corsair NZ 5408	Crashed in sea in this position
671	5	03.54-153.49	In sea	BNZAF Corsair NZ 5412	Believed lost over Rabaul
672	5	04.23-152.16	Tobora	BNZAF Kittyhawk No. unknown	Believed lost over Rabaul
673	10	04.23-152.16	Tobora	BNZAF Kittyhawk NZ 3121	Crashed in sea east of Batana
674	10	04.23-152.16	Rabaul	BNZAF Kittyhawk NZ 3186	Believed lost over Rabaul
675	10	04.15-152.08	Rabaul	BNZAF Kittyhawk NZ 3183	Believed lost over Rabaul
676	10	04.15-152.08	Rabaul	BNZAF Kittyhawk NZ 3200	Crashed in St. George's Channel
677	10	04.15-152.08	Rabaul	BNZAF Kittyhawk NZ 3120	Crashed in St. George's Channel
678	10	04.16-152.30	In sea	BNZAF Kittyhawk NZ 3126	Believed lost in this area
679	10	03.30-153.17	Malendok Island	BNZAF Catalina PB75	Believed lost over this area
680	5	03.30-153.17	Lakunai	BNZAF Avenger NZ 5090	Believed crashed in sea 1/2 mile off Lakunai
681	10	04.14-152.11	Lakunai	BNZAF Avenger NZ 5051	Believed crashed 1 1/2 miles N.E. of Tulaga
682	10	04.13-152.11	Lakunai	BNZAF Corsair NZ 5205	Believed lost over this area
683	10	06.39-155.44	Bougainville	BNZAF Corsair NZ 5276	Wreckage recovered at Tongalai
684	10	04.52-152.51	Cape St. George	BNZAF Kittyhawk NZ 3188	Believed lost over this area
685	10	06.49-155.44	Buin Area	BNZAF Hudson NZ 2033	Missing from this general area
686	10	06.50-155.42	Kahiki-Buin	BNZAF Ventura NZ 4522	Believed crashed in sea near coast
687	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5376	Believed crashed this location
688	10	06.49-155.26	In sea	BNZAF Corsair NZ 5379	Crashed in sea near Torikina Reef
689	10	06.43-155.01	In sea	BNZAF Corsair NZ 5255	Wreckage recovered in this position
690	10	06.43-155.01	Kara	BNZAF Corsair NZ 5287	Crashed in target area
691	10	04.14-153.54	In sea	BNZAF Corsair NZ 5281	Crashed in sea east of Cape St. George
692	10	04.12-152.08	Tallil Bay	BNZAF Kittyhawk NZ 3215	Believed lost 5 miles inland from coast
693	10	04.52-152.52	In sea	BNZAF Corsair NZ 5317	Believed crashed in this position
694	10	04.20-152.47	New Ireland	BNZAF Warhawk NZ 3155	Crashed in sea at this position
695	10	06.15-154.54	In sea	BNZAF Kittyhawk NZ 3137	Crashed on coral reef east of Shortland Island
696	10	04.31-152.23	In sea	BNZAF Corsair NZ 5400	Believed located 500 yards inland (unidentified)
697	10	07.05-155.56	Shortland Island	BNZAF Corsair NZ 5274	Believed crashed and exploded 1 mile N.W. of Vunapope
698	10	04.12-152.09	Kurakakul Plantation	BNZAF Corsair NZ 5429	Crashed and exploded at Rabul Plantation
699	10	04.19-152.13	Vunapope Area	BNZAF Ventura NZ 4609	Believed crashed in jungle 2 miles south of Tallil
700	5	03.25-152.07	New Ireland	BNZAF Corsair NZ 5241	Crashed in sea at this position
701	5	04.14-152.08	Tallil Area	BNZAF Corsair NZ 5292	Crashed in sea at this position
702	10	06.48-155.54	In sea	BNZAF Corsair NZ 5306	Crashed in sea at this position
703	10	04.14-153.54	In sea	BNZAF Corsair NZ 5271	Crashed in sea at this position
704	10	06.12-154.96	In sea	BNZAF Corsair NZ 5204	Crashed in sea at this position
705	10	06.00-147.32	In sea	BNZAF Corsair NZ 5236	Crashed in sea 90 feet from shore
706	4	02.00-147.32	In sea	BNZAF Corsair NZ 5236	Believed missing from Bougainville - place unknown
707	4	02.00-147.32	Henry Reid Bay	BNZAF Corsair NZ 5236	Believed missing from Bougainville - place unknown
708	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
709	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
710	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
711	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
712	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
713	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
714	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
715	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
716	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
717	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
718	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
719	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown
720	10	06.14-155.03	Bougainville	BNZAF Corsair NZ 5399	Believed missing from Bougainville - place unknown

721	10	06.14-155.03	Bouganville	XENZAF Corsair NZ 5266	Believed missing from Bouganville - place unknown
722	10	06.14-155.03	Bouganville	XENZAF Corsair NZ 5268	Believed missing from Bouganville - place unknown
723	10	06.14-155.03	Bouganville	XENZAF Corsair NZ 5269	Believed missing from Bouganville - place unknown
724	10	06.14-155.03	Bouganville	XENZAF Corsair NZ 5271	Believed missing from Bouganville - place unknown
725	10	06.14-155.03	Bouganville	XENZAF Corsair NZ 5272	Believed missing from Bouganville - place unknown
726	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3239	Believed missing from Bouganville - place unknown
727	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3237	Believed missing from Bouganville - place unknown
728	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
729	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
730	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
731	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
732	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
733	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
734	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
735	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
736	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
737	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
738	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
739	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
740	10	06.14-155.03	Bouganville	XENZAF Kittyhawk NZ 3197	Believed missing from Bouganville - place unknown
741	4	01.38-149.56	Bairau Island	XENZAF Corsair NZ 5430	Believed missing this location
742	4	01.38-149.56	Bairau Island	XENZAF Corsair NZ 5430	Believed missing this location
743	4	01.38-149.56	Bairau Island	XENZAF Corsair NZ 5437	Believed missing this location
744	4	01.38-149.56	Bairau Island	XENZAF Corsair NZ 5437	Believed missing this location
745	10	05.38-151.28	Jacquinet Bay	XENZAF Corsair NZ 5438	Believed missing this location
746	10	05.38-151.28	Jacquinet Bay	XENZAF Corsair NZ 5438	Believed missing this location
747	10	04.29-154.13	Green Island	XENZAF Corsair NZ 5463	Believed missing this location
748	10	04.29-154.13	Green Island	XENZAF Corsair NZ 5463	Believed missing this location
749	10	04.29-154.13	Green Island	XENZAF Corsair NZ 5294	Believed missing this location
750	10	04.29-154.13	Green Island	XENZAF Corsair NZ 5303	Believed missing this location
751	10	04.29-154.13	Green Island	XENZAF Corsair NZ 5413	Believed missing this location
752	10	04.29-154.13	Green Island	XENZAF Corsair NZ 5409	Believed missing this location
753	4	02.04-147.28	Mamus	XENZAF Corsair NZ 5235	Believed missing this location
754	10	05.38-151.28	Jacquinet Bay	XENZAF Corsair NZ 5402	Believed missing this location
755	12	01.18-149.08	Brown River	USMC Battered A44 43-445	Believed missing this location
756	4	06.35-147.24	Kio Valley	USMC Battered A44 43-445	Believed missing this location
757	8	04.43-148.96	Maung Aua	USMC Battered A44 43-445	Believed missing this location
758	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
759	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
760	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
761	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
762	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
763	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
764	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
765	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
766	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
767	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
768	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
769	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
770	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location
771	12	09.28-147.22	SOBANI AUA	USMC Battered A44 43-445	Believed missing this location

SOUTHWEST PACIFIC
SHOWING AREAS COVERED BY SEARCHES