Economic Impact of a Pan-Pacific Unmanned Aircraft Systems Test Site – McDowell Group (2013)

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Economic Impact of a

Pan-Pacific Unmanned Aircraft Systems Test Site

May 2013

PREPARED FOR

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Executive Summary

Purpose and Scope

In March 2013, the University of Alaska Fairbanks Center for Unmanned Aircraft Systems contracted with McDowell Group to analyze the economic conditions for unmanned aircraft systems (UASs) in Alaska and measure the projected economic impact of developing a Federal Aviation Administration (FAA) test site for UAS in Alaska. The economic impact assessment (EIA) in this report provides annual projections of the direct, indirect, and induced impacts to employment and wages as well as projections of output and value added related to the test site, called the Pan-Pacific UAS Test Range Complex (PPUTRC) – with test ranges located in Alaska, Hawaii, and Oregon. The EIA focuses on the additional economic activity that is expected in response to the PPUTRC test site selection. Additional information is provided in this report on the economic impact of the commercialization of UAS specifically in Alaska once UAS flights are allowed in the National Airspace System (NAS).

Summary

- UAS represent a new industry that is set to quickly grow once new government regulations increase access to designated test sites and then to the National Airspace System (NAS), the system of air traffic control that enables safe and efficient flight activity in the U.S.
- UAS applications are far reaching for civilian and military purposes; ranging from environmental monitoring to search and rescue to pipeline or powerline inspections.
- The FAA has limited the authorized use of UASs in the U.S. to efforts focused on the public interest. There are currently two ways to operate a UAS with the approval of the FAA (both of these options require that the flight takes place outside of densely-populated areas):
    - Certificate of Waiver or Authorization (COA) for public UAS
    - Special airworthiness certificate for private sector (civil) UAS
- However, the FAA is scheduled to designate six UAS test sites in the U.S., as required under the FAA Modernization and Reform Act of 2012. The sites will operate from January of 2014 to February 13, 2017 to provide opportunities for government agencies, industry, and researchers to access this airspace to aid in the integration of UASs in the NAS.
- According to the Association of Unmanned Vehicle Systems International (AUVSI), integration of UASs into the NAS will generate some $82 billion in activity in the U.S. between 2015 and 2025; employment impacts are estimated at just over 100,000 jobs by 2025.

- In an effort to bring additional UAS activity and related economic benefits to Alaska, UAF is leading the PPUTRC Test Site application process for 13 ranges in Alaska, Hawaii, and Oregon.

- Existing UAS activity in Alaska, Hawaii, and Oregon benefits from unique assets and opportunities, including government facilities (e.g. numerous military bases, universities, and maritime assets), wide-open airspace in largely unpopulated areas, and geographic diversity (e.g. tropical to arctic climates, oceanic or mountainous landscapes, and up/down weather fronts).

- In total, designation of PPUTRC as a UAS test site would be expected to generate 1,065 direct, indirect and induced jobs in 2014, increasing to over 1,400 jobs by 2017. Total labor income would climb from $57 million in 2014 to about $76 million in 2017.

- Output in the PPUTRC states attributable to test site designation would climb from $265 million in 2014 to $333 million in 2017.

- Value added would climb from $109 million to $134 million over the same period.

- Designation of the PPUTRC will provide a four-year total of $20 million of income tax revenue to Hawaii and Oregon.

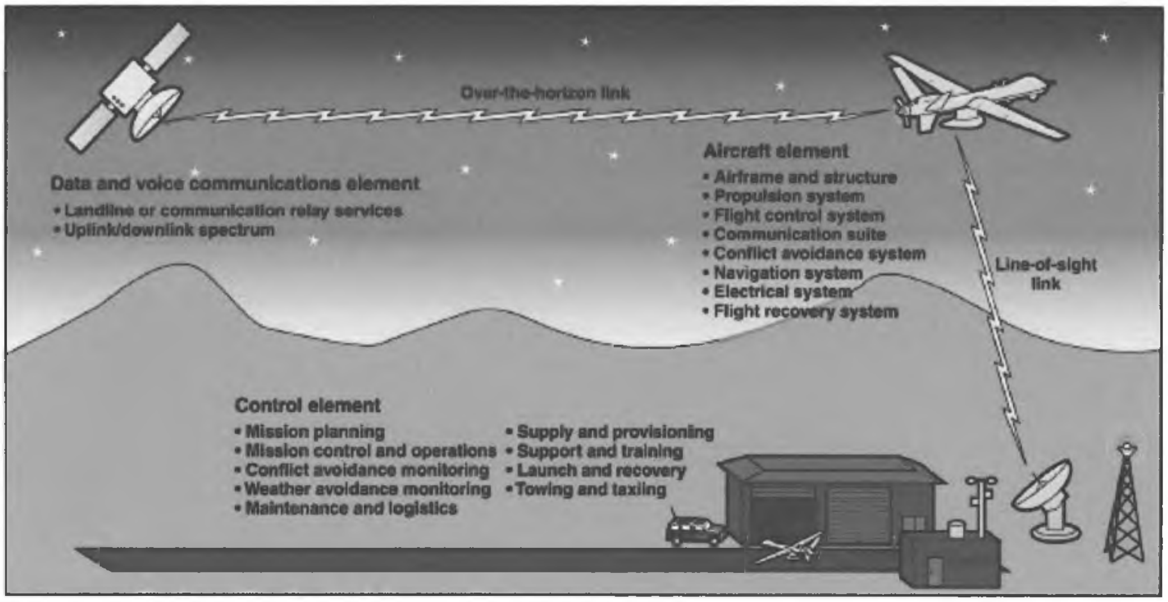
Chapter 1. Unmanned Aircraft Systems in the United States and the NAS

Background

Unmanned aerial vehicles (UAVs) were first described in the late-19th century. Early attempts to develop these UAVs, mostly for combat purposes, soon followed. These remotely piloted vehicles first entered U.S. combat in the mid-20th century to support missions focused on reconnaissance and surveillance, and sometimes they were also used as decoys. Throughout most of the 20th century UAVs lacked real-time data capability and instead focused on collecting images and video for surveillances purposes. Widespread adoption of the technology for U.S. military purposes did not begin until the 1990s and, to a much greater extent, the 2000s during the Afghanistan and Iraq conflicts. It was at this point that technological innovations related to onboard sensors, communication links, and data collection began drastically increasing the potential domestic uses of unmanned aircraft systems.

The increase in complexity for the UAVs required a systems approach to appropriately understand the interactions - and design each component from the start as an integratedsystem - among the on-the-ground control elements, the aircraft, and the communication links. This broader operational perspective is termed "unmanned aircraft system" (UAS). The image below provides a conceptual rendering of the interactions among key elements of a UAS flight.

Figure 1: Conceptual Rendering of an Unmanned Aircraft System



Source: GAO, 2013

UAS Applications

Unmanned aircraft often provide advantages in comparison to manned aircraft. For instance, flights that are dangerous or covert represent potential opportunities where an unmanned vehicle might be preferred over a manned vehicle. Similarly, dull tasks such as extended surveillance missions may be better suited for ground-based operators that can be relieved at the end of their shift. UAVs are often more fuel efficient, quieter, and less disruptive to their surroundings (in comparison to manned aircrafts) and, thus, can allow for fewer environmental disturbances as well as more accurate research results. Finally, initial costs, operating costs (e.g. maintenance costs, fuel costs, storage costs, etc.), and labor costs (e.g. wages, insurances, etc.) are all generally lower for UAVs (Source: Austin, 2010). UASs have already been shown to lead to arrests as well as saving lives during search and rescue missions (Source: The Verge, 2013).

The existing and potential applications for UASs are wide ranging for both civilian uses as well as for military purposes. The lists below provide an abbreviated look at how important this relatively new field may become to sectors throughout Alaska's economy (Source: Austin, 2010):

Civilian

- Aerial Photography - Film, video, stills, etc.
- Agriculture - Crop monitoring and spraying; herd monitoring and driving
- Coastguard – Search and rescue, coastline, and sea-lane monitoring
- Conservation – Pollution and land monitoring
- Customs and Excise – Surveillance for illegal imports
- Electricity Companies – Powerline inspection
- Fire Services and Forestry – Fire detection, incident control
- Fisheries – Fisheries protection
- Gas and Oil Supply Companies – Land survey and pipeline security
- Information Services – News information and pictures, feature pictures (e.g. wildlife)
- Lifeboat Institutions – Incident investigation, guidance, and control
- Local Authorities – Survey, disaster control
- Meteorological Services – Sampling and analysis of atmosphere for forecasting, etc.
- Oil Companies – Pipeline security
- Ordinance Survey – Aerial photography for mapping
- Police Authorities – Search for missing persons, security and incident surveillance
- Rivers Authorities –Water course and level monitoring, flood and pollution control
- Survey Organizations – Geographical, geological, and archaeological survey
- Traffic Agencies – Monitoring and control of road traffic
- Water Boards – Reservoir and pipeline monitoring

Military

- Navy
    - Shadowing enemy fleets

  - Decoying missiles by the emission of artificial signatures
  - Electron intelligence
  - Relaying radio signals
  - Protection of ports from offshore attack
  - Placement and monitoring of sonar buoys and possibly other forms of anti-submarine warfare
- Army
  - Reconnaissance
  - Surveillance of enemy activity
  - Monitoring of nuclear, biological, or chemical (NBC) contamination
  - Electronic intelligence
  - Target designation and monitoring
  - Location and destruction of land mines
- Air Force
  - Long-range, high-altitude surveillance
  - Radar system jamming and destruction
  - Electronic intelligence
  - Airfield base security
  - Airfield damage assessment
  - Elimination of unexploded bombs

UAS Categories

UASs are typically categorized based on the size or capability of the UAV. The five categories below provide a common categorization of UAS that helps simplify requirement assessments and costing estimates (Source: Teal Group, 2008):

- Micro or Mini – A small UAV that ranges in size from something that can be held in the palm of the hand to a UAV that can be carried on your back and launched by hand.

- Naval – A tactical UAV is generally operated with simpler systems over a radius between 100 and 300 km.

- Tactical – A reconnaissance UAV used by the Army for endurance missions ranging several hours over an operating radius up to 200 km.

- MALE – Medium Altitude Long Endurance reconnaissance UAVs fly between 5,000 and 15,000 meters in altitude for approximately 24 hours.

- HALE – High Altitude Long Endurance reconnaissance and surveillance UAVs are usually operated by Air Forces at altitudes over 15,000 meters for periods longer than 24 hours.

National Airspace System

The NAS was developed to allow for safe and efficient commercial aviation. However, commercial UAS flights are currently not allowed in the NAS due to concerns over (1) "the inability to detect, sense, and avoid other aircraft and airborne objects in a manner similar to 'see and avoid' by a pilot in a manned aircraft, (2) vulnerabilities in the command and control of UAS operations, (3) the lack of technological and operational standards needed to guide the safe and consistent performance of UAS, and (4) the lack of final regulations to accelerate the safe integration of UAS into the national airspace" (Source: U.S. GAO, 2012 and Waggoner, 2013).

The first authorized use of UASs in the NAS in the U.S. was permitted by FAA in 1990. Over the past 23 years, the FAA has limited the authorized use of UAS in the U.S. to efforts focused on the public interest. These missions have included border patrol, military training, disaster relief, firefighting, search and rescue, law enforcement, and testing and evaluation. According to the FAA, the Department of Homeland Security currently utilize UASs for border and port surveillance; NASA and NOAA utilize UAS to help with scientific research and environmental monitoring; law enforcement agencies utilize UASs to support public safety; and state universities use UASs to conduct research (Source: FAA Fact Sheet 2013). These efforts are limited to areas outside of major urban areas at elevations less than 50,000 feet. The aircraft range in size from a hummingbird to a wingspan as large as a Boeing 737; although many are the size of a remote-control plane or helicopter. Recreational use of airspace is allowed away from airports and air traffic and below 400 feet above ground level – informal flights for business purposes are specifically excluded (Source: FAA Advisory Circular 91-57).

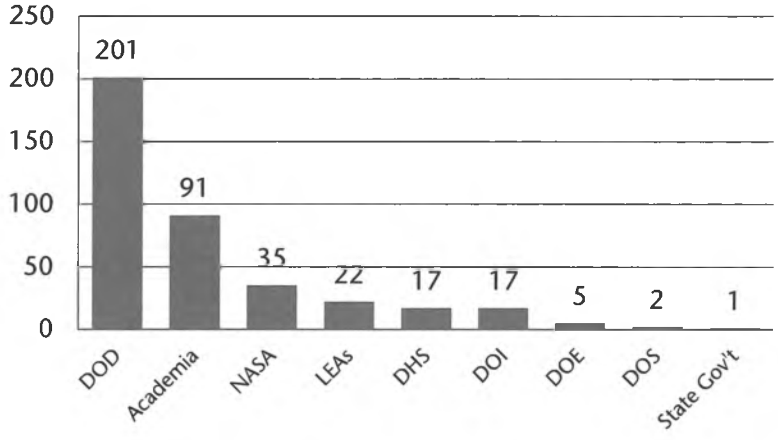
As of 2013, there are currently two ways to operate a UAS with the approval of the FAA: (1) Certificate of Waiver or Authorization (COA) for public UAS's and (2) special airworthiness certificate for private sector (civil) UAS's – both of these options require that the flight takes place outside of densely-populated areas.

Certificate of Waiver or Authorization (COA)

COAs allow public entities to fly UASs in a defined block of civil airspace. The FAA issued the first COAs in January 2007. With COAs, the UAV must remain in view, either of the ground crew or via a chase plane, since UAS technology cannot currently comply with 'See and Avoid' rules. COAs usually require between six and 24 months for approval and cost $40,000 to $60,000 (Source: Economic Development of Central Oregon, 2011). Most of the cost is for specialists in the testing protocols, documentation, and in managing the process through the FAA. Common applications by COA holders include firefighting, border patrol, disaster relief, search and rescue, military training, and other government operational missions (Source: FAA 2013b). The number of COAs issued has increased since 2009, with 146 in 2009, 298 in 2010, and 313 in 2011 (Source: FAA 2013b). In 2012, the FAA issued 391 COAs to 121 federal, state, and local government entities in the U.S. A total of 1,428 COAs have been issued since January of 2007 (Source: GAO 2013). As of February 15, 2013, there were 327 active COAs (Source: FAA 2013b).

The graph below aggregates the 391 COAs issued in 2012 to nine types of entities: U.S. Department of Defense, academia, NASA, local law enforcement agencies, U.S. Department of Homeland Security, U.S. Department of the Interior, U.S. Department of Energy, U.S. Department of State, and state government.

Figure 2: Number of Approved COAs, 2012



Source: GAO, 2013

Special Airworthiness Certificate

Special airworthiness certificates are the only way for civil operators to fly UASs in the NAS at present. However, these certificates cannot be utilized to carry people or property for compensation or hire – they can only be issued for research and development, crew training, or market surveys (Source: FAA 2011).

Allowing UAS in the NAS

In recent years the FAA has made a concerted effort to integrate UAS regulations into the NAS. In 2009, the FAA, NASA, DoD, and the Department of Homeland Security began addressing pathways to integrating UAS regulations into the NAS through their UAS Executive Committee. Additionally, the FAA chartered a UAS Aviation Rulemaking Committee in 2011 to create operational procedures, regulatory standards, and policies related to UAS flights in the NAS. In 2012, the FAA Modernization and Reform Act of 2012 (FMRA of 2012) was passed by Congress to approve six test sites where UAS integration could be tested prior to a 2015 integration of UAS regulations in the NAS (Source: FAA 2012). Delays within the FAA due to technical, logistical, and public outreach concerns may contribute to a UAS integration date later than 2015. However, six test sites are still scheduled to run from January 1, 2014 to February 13, 2017.

SIX UAS TEST SITES

There is considerable competition over where test sites will be designated, since designation will provide immediate employment in the selected region and support a strong foundation for UAS activity prior to integration of UAS regulation in the NAS. As of March 5, 2013, 50 applicants from 37 states were granted access to the FAA test site application web portal (Source: FAA 2013b). The FAA will consider five key items when deciding the location of the six test sites: (1) geographic and climatic diversity, (2) location of ground infrastructure and research needs, (3) consultation with NASA and DOD, (4) population density and air traffic density of the surrounding area of any proposed location as well as the potential impact areas in the event of incidents, such as "Fly away" given potential safety mitigations; and (5) identification of specific goals and objectives to be accomplished. Additionally, the test sites are expected to provide an environment and opportunity to test conventional takeoff and landing capability, high speed flight (greater than 250 knots indicated air speed), maritime (launch/maneuver/recovery) capability, operations at extremely high altitudes (Class A airspace and above), and evaluation of dissimilar aircraft (including a mix of manned and unmanned aircraft) in multiple altitude structures (Source: FAA 2013a).

The six test sites that are selected will support the following operations and programs:

- Safe designation of airspace for integrated manned and unmanned flight operations in the national airspace system;
- Development of certification standards and air traffic requirements for unmanned flight operations;
- Coordinating with and leveraging the resources of NASA and the Department of Defense;
- Addressing both civil and public unmanned aircraft systems;
- Ensuring that the program is coordinated with the Next Generation Air Transportation System; and
- Ensuring the safety of unmanned aircraft systems and related navigation procedures before they are integrated into the national airspace system (Source: FAA, 2013b).

The test site operators will provide opportunities for government agencies, industry, and researchers to access this airspace to aid in the integration of UAS regulations in the NAS. Additionally, data collection will support development and operations research and professional development opportunities will be available for inspectors, airspace managers, air traffic controllers, and others. The specific goals described by the PPUTRC applicants include (Source: PPUTRC, 2013):

- Develop a set of standards for select unmanned aircraft categories, for aircraft state monitoring, and navigation. PPUTRC goals and objectives work will augment ongoing standards work with research on categories of UAS not yet addressed, and evaluations needed to refine emerging standards under consideration;
- Validate FAA acceptable risk thresholds or safety management system standards for UAS operations;

- Identify safety factors in UAS design; validate certification standards, including protocols for air traffic control interaction. Define and qualify underlying assumptions and a minimum set of air vehicle characteristics critical to safety, reliability, etc.;

- Develop effective, compliant 'sense and avoid' systems to satisfy regulatory guidance;

- Identify gaps in federal and state statutory and case law protections for privacy and recommend policies or legislation to remedy;

- Directly support the federal mandate for "Expanding Use of UAS in the Arctic" (in Sec 332(d) of Public Law 112-95);

- Design experiments and provide data to support American Society for Testing and Materials (ASTM) F38 and Radio Technical Commission for Aeronautics Special Committee (RTCA SC) 203 to evaluate minimum training and operator qualification standards for crew licensing.

Economic Impact of UAS in the U.S.

The economic implications of integrating UAS regulations into the NAS are substantial. According to a study conducted for the Association for Unmanned Vehicle Systems International (AUVSI), integration will generate $82 billion in activity between 2015 and 2025. Employment impacts are estimated at just over 100,000 jobs by 2025.

The direct economic impact of UAS development in the U.S. is expected to climb from $1.1 billion in 2015 to over $5 billion annually by 2025, measured in terms of output. Including indirect and induced effects, the annual economic impact is expected to rise from $2.3 billion in 2015 to $10 billion in 2025 (Source: AUVSI, 2013).

Areas selected as UAS test sites will have an advantage in capturing these economic benefits; thus the fierce competition among the 50 applicants.

Chapter 2. Pan-Pacific Test Range Complex

In 2012, the Alaska Center for UAS Integration (ACUASI) at the University of Alaska Fairbanks Geophysical Institute began collaborating with Oregon State University and the University of Hawaii to propose a Pan-Pacific Test Range Complex (PPUTRC) as one of the six FAA test sites. This proposed PPUTRC contains 13 test ranges located in Alaska, Hawaii, and Oregon. Of the 13 ranges, six ranges are in Alaska (Denali, Kodiak, North Slope, Oliktok, Poker Flat, and Wainwright), three ranges are in Hawaii (Humuula-R-3103, Makua-R-3109, and Maku-R-3110), and four ranges are in Oregon (Juniper MOA, Pendleton, Tillamook Coastal, and Warm Spring).

Existing UAS activity in Alaska, Hawaii, and Oregon benefits from unique assets and opportunities, including government facilities (e.g. numerous military bases, universities, and maritime assets), wide open airspace in largely unpopulated areas, and geographic diversity (e.g. tropical to arctic climates, oceanic or mountainous landscapes, and up/down weather fronts). The diverse testing environments for the PPUTRC are included in the Table 1 below:

Table 1: Diversity of Potential Testing Environments for the PPUTRC

360 degree oceanic airspace access	Arctic landscape	Extreme low temperatures
Oceanic and sea-ice access	High arctic winds	High sea-salt corrosion effect
Able to fully matrix UAS into NextGen and air traffic operating both VFR and IFR; high and low altitude	Operations in all classes and categories of military SUA	Operations in Classes A through F international airspace in the oceanic environment
Class C, D, & E airspace within 5-nautical miles of airports	High and low-land vegetation tundra	Numerous inland waterways and lakes
High density airports integration studies and testing	Class C, D, & E airspace airport approaches/departures	High-humidity high and low-altitude
Hot and cold high-desert testing	Littoral coastal region mountainous area	Class E (high) airspace
Jungle conditions	Class A airspace	Mountainous terrain
Volcanic	Glacier	Ship traffic including open ocean and ports

UAS Activity in Alaska, Hawaii, and Oregon

There are currently 15 active COAs in the PPUTRC area as well as eight in-process COAs and 20 expired COAs.

Alaska

ACUASI at the University of Alaska Fairbanks (UAF) is the lead organization for the proposed PPUTRC. The formal PPUTRC team includes over 80 businesses, universities, tribes, and economic development organizations in Alaska. UAF has actively managed UAS operations since 2004.

ACUASI was formed in 2012 to enhance UAS research in Alaska. ACUASI and the UAF Geophysical Institute have developed and flown a variety of in-situ and remote sensing instruments on various UASs in Alaska and throughout the world. Scientific and research campaigns undertaken in Alaska over the past decade include using UASs to support observation and monitoring of sea lions in the Aleutian Islands, weather forecasting, volcanic plume monitoring, atmospheric sampling during wildfires, monitoring of sea ice build ups, and oil spill mapping. Commercial applications trialed in Alaska include whale monitoring, cadastral mapping, maritime navigation support, industrial plant monitoring, and environmental clean-up. This experience, coupled with the FAA's UAS test site status, would leverage a variety of new economic activities in Alaska.

The following table, which summarizes ACUASI activity in 2012, illustrates the variety of UAS activity supported by the organization. The table also provides revenue and staffing data for each UAS campaign.

Table 2: UAS Campaigns Supported by the University of Alaska Fairbanks in 2012

Client	Flight Locations	Type of UAS	Purpose of Flights	Revenue for Site Operator	Site Operator Staff	Flight Operator Staff
Aleutians	Aleutian Islands, AK	Aeryon Scout and Puma	Seal observation	$314,200	2 pilots	1 observer
Idaho	Lewiston, ID	Aeryon Scout	Salmon nest observation	$115,000	1 pilot	1 observer
Eglin Air Force Base	Fort Walton Beach, FL	ScanEagle and Aeryon Scout	Controlled burn experiment	$413,000	4 pilots	3 observers
Prudhoe Bay	Prudhoe Bay, AK	Aeryon Scout	British Petroleum flare stack monitoring	$190,000	1 pilot	1 observer
Nome	Nome, AK	Aeryon Scout	Harbor Ice monitoring for USCG	$30,000	1 pilot	1 observer
Ugak Island	Ugak Island, AK	Aeryon Scout	Seal population monitor	$6,500	1 Pilot	1 observer
Fort Greely	Fort Greely, AK	ScanEagle and Aeryon Scout	Flight test	$25,000	2 pilots	2 observers
Chile	Santiago, Chile	Aeryon Scout	Glacier Ice monitor	$9,000	1 pilot	1 observer
Belgium	Belgium	Gatewing	Flight training	$16,000	2 pilots	1 observer
Anchorage	Fort Richardson, AK	Aeryon Scout	Flight test and demonstration	$1,000	2 pilots	1 observer
Fairbanks	Poker Flat Research Range	ScanEagle	Payload test	$347,000	2 pilots	1 observer
Fairbanks	Poker Flat Research Range	Aeryon Scout	Payload test and demonstration	$30,000	2 pilots	1 observer
Fairbanks	Poker Flat Research Range	Raven	Flight test for avionics	$5,000	2 pilots	2 observers
Hawaii	Offshore Hawaiian Islands	Puma	Tsunami debris tracking	$95,000	1 pilot	1 observer

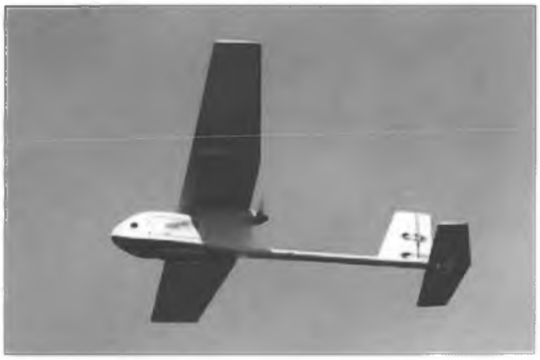
Sources: ACUASI, 2013

Figure 3: Types of UAS Flown in Alaska in 2012

Aeryon Scout

Boeing Insitu ScanEagle

AeroVironment Raven



Gatewing

AeroVironment Puma

Hawaii

Hawaii offers many unique qualities that make UAS operations appealing. These include: (1) expansive over-water areas unencumbered by other aviation uses, (2) proximity to U.S. Pacific Command – a significant user of future UAS systems, (3) opportunities for joint operations with the Pacific Missile Range Facility – a major test range on Kauai, and (4) opportunities for long-range point-to-point tests with partner ranges in Alaska and Oregon. The Hawaii ranges have proven an important focus for the development of scientific applications of UAS, with significant milestones including test flights of the Aerovironment Pathfinder; Pathfinder Plus; and Helios solar-hybrid propulsion high altitude, long endurance UAS, between 1997 and 2001. Scientific applications led by U.S. federal agencies have recently seen Hawaii emerge as a focal point for NOAA's exploration of UAS as a tool for marine park surveillance. NOAA has utilized UAS to monitor Papahanaumokuakea Marine National Monument since 2007 and performed initial trials using small hand launched systems in mid-2012.

Oregon

The Oregon-based PPUTRC team members include 16 businesses, universities, tribes, and economic development organizations. Additionally, six committed team partners will convert to formal team members upon FAA test site designation award to PPUTRC. Engagements are also planned with a wide ranging network in Oregon – including the 111 AUVSI members and numerous startup companies, primarily in sensor, robotics, and other supporting technologies. In comparison to Alaska and Hawaii, Oregon has historically been more engaged in design, development, and manufacture of UAV systems and subsystems.

The two largest Oregon UAS firms are Insitu (design, development, and manufacture of UAS systems) and FLIR Systems (remote sensors). The main Oregon firm involved in UAS applications has been Near Space Corporation (NSC). NSC uses very high altitude unmanned balloons and gliders to perform scientific and commercial test activities, ranging from data gathering on behalf of government agencies to near-space testing of hardware and sensors for commercial firms. NSC is opening a new $6 million flight test and operations facility at the Tillamook Airport on the Oregon coast. Existing UAS activity also includes the Oregon Army National Guard operations in Pendleton. Oregon's UAS efforts are synergistic with a separately funded ground vehicle innovation initiative, Drive Oregon, which requires systems that can be spun out of UAS: quiet, efficient motors, lightweight composite designs, and navigation systems. The potential economic benefits of the test sites, as well as NAS integration, are particularly strong for Oregon's already significant aircraft manufacturing sector.

Recent UAS Funding in Alaska, Hawaii, and Oregon

Since 2004, nine Alaska contractors have received direct U.S. federal agency contracts for UAS goods and services. The largest federal contract in Alaska is a 5-year standing services award, worth $47 million, from the U.S. Navy to the University of Alaska in 2010 for UAS payload integration and flight test services. The second major award made since 2004 to an Alaska firm consists of a series of pacts totaling $17 million from the U.S. State Department to Anchorage-headquartered Kuk Construction (subsidiary of Olgoonik Development, an Alaskan Native Corporation) for the provision of UAS-based security surveillance services in Iraq in partnership with KBR, Inc. UAF has collaborated with commercial entities, such as Idaho Power Company, and manufacturers including AeroVironment to conduct surveys and observe environmental impacts. Additionally, UAF has collaborated with BP for oil spill response and flare stack monitoring, as well as projects focused on detecting and locating gas and oil pipeline leaks and developing new sensors and processes to identify leaks.

Hawaii's large military presence has resulted in defense spending as the primary source of federal funding to UAS vendors in the state. Direct defense contracts accounted for 94 percent of all awards in terms of obligated amounts from 2004-2012, rising to 97 percent when including awards placed by the General Services Administration on behalf of the U.S. Air Force. The remaining awards were placed with Honolulu-based Referentia Systems by NOAA as part of the Papahanaumokuakea Marine National Monument monitoring project. Hawaii supports a dedicated UAS development and manufacturing company, Williams Aerospace, a small firm currently developing new platforms in the fixed-wing, hand launched micro and medium altitude endurance classes. The state is also working to create two commercial UAS services arms, addressing the defense, homeland security, and precision agriculture markets.

In Oregon, a consortium of industry, academia, and public entities has created a 7-year strategic plan to double the size of the UAS industry in the state, with the help of a $2.5 million State of Oregon grant scheduled for the 2013-14 biennium and additional investments of at least $1.15 million from other sources for a total of $3.65 million. The plan specifically creates UAS solutions for commercial applications, and safely integrating those UAS solutions into the NAS. Projects include emergency response; weather; firefighting; search and rescue; wildlife and habitat management; law enforcement; physical and resource surveys (land and water); management of agriculture, livestock, and public lands; and management of public and private infrastructure. Oregon State University (OSU) has already begun UAS flights based on these research objectives.

Leveraging Current Research Institutes, Community Colleges, and Training Centers

ACUASI is collaborating with the UAF College of Engineering and Mines (CEM) and the Community and Technical College (CTC) to integrate UAS engineering, science, and technology into UAF's teaching, research, and service activities. Additionally, ACUASI is working with the CEM to fill a full-time tenure track engineering faculty position with a professor focused on UAS engineering, science, and technology. ACUASI and CTC also intend to include UAS technology courses in CTC's aviation curricula to train UAS developers, technicians, and pilots as well as to improve outreach to remote Alaskan villages that could benefit from UAS technologies. Cooperation with the CTC at UAA will add air traffic controller participation, offer training for UAS operators, and ultimately build a maintenance program similar to the Aircraft and Powerplant program currently offered.

The University of Hawaii is testing UASs in several of its research programs, evaluating the utility and impact of UAS through analysis of coastal resource management, terrestrial and aquatic environmental monitoring, natural source management and inventory, and human impact studies. University of Hawaii is also developing programs to train students and research professionals on UASs, and plans to integrate this capacity into accredited degree programs.

The new OSU industry-university UAS consortium will depend on test site facilities for collaborative research and development in all phases of operations and applications. Through the Colleges of Engineering, Science, Agriculture, Forestry and Earth, Ocean and Atmospheric Sciences, OSU has expertise and supports ongoing research on control theory and robotics, flexible airframes and flight, sensors, and signal processing, and numerous applications in natural and environmental sciences and environmental monitoring, measuring, and management. OSU-Cascades, located in Central Oregon near the Warm Springs and Juniper test ranges, offers programs in energy engineering, computer science, natural resources, and business, and plans to add programs designed in conjunction with the UAS industry. OSU-Cascades can also provide on-site facilities for OSU-Corvallis researchers leading projects in the region. Central Oregon Community College (COCC) has one of the largest aviation flight training programs on the West Coast – both fixed wing and rotary. COCC offers certifications for UAS flight training and plans to develop a program for data analysis of sensors, building on the school's strong geographic information systems program. Additionally, Blue Mountain Community College (BMCC) in Pendleton, Oregon is developing a UAS curriculum for instructional delivery and course certification. Oregon Institute of Technology (OIT) offers a variety of degrees in engineering and engineering technology, composite engineering, computer and software systems engineering, and electrical engineering, including a master's degree in manufacturing engineering. It offers degrees in professional land surveying and geographic information systems. OIT is collaborating with Rockwell Collins, the aviation electronics company, on real-world projects at a joint campus outside Portland and offers similar hands-on collaborations with other aerospace firms in the northwestern U.S.

Expansion of Existing Businesses and Attracting New Business Investment

The University of Alaska has spun off at least two companies who intend to test their products on the Pan-Pacific test range. These companies were created by University graduate students who were expanding their research in sensors for testing in UASs. UA recently received $5 million from the State of Alaska to support the development of a sustainable high-tech industry in Alaska. Already two companies have established satellite offices in Alaska to improve collaboration with the ACUASI.

Placement of a UAS test site in Hawaii will promote growth within Hawaii and reduce development cycles for manufacturers and researchers. Additionally, it would reduce or eliminate costs to ship sensors, and send knowledgeable staff, to mainland test sites to operate and demonstrate systems. Close proximity to a test site in Hawaii will greatly benefit firms such as BAE Systems, Williams Aerospace, and others – including many military and government contractors working with the Honolulu Fire Department, Honolulu Police Department, U.S. Civil Air Patrol, U.S. Coast Guard, U.S. Department of Defense, U.S. Department of Homeland Security, U.S. National Guard, and others.

In Oregon, more than a dozen companies have said that they will begin testing their sensor packages, propulsion systems, and airframes in Oregon if the Pan-Pacific UAS Test Area is designated as a national test site. Additionally, two companies have informally pledged to open satellite offices at a state test range. The PPUTRC will benefit UAS businesses in the Columbia River Gorge. Over the past seven years, the Gorge's UAS industry grew from a small core of 30 people to an employment base of more than 1,400 employees. Many of these new jobs were created by the UAS companies' suppliers. The two largest Oregon UAS manufacturers are Insitu, manufacturer of UAS platforms and subsystems, and FLIR Surveillance Systems, a manufacturer of electro-optic and infrared imaging systems. Insitu is a major global supplier of high endurance, runway-independent UAS. FLIR Surveillance provides more ER and IR imaging systems for unmanned aircraft, unmanned ground, and unmanned maritime platforms than any other company. Activity in the Gorge from firms such as Insitu, FLIR Surveillance Systems, Cloud Cap Technology, and UTC Aerospace has spun off more than 20 local companies. Central Oregon's general aviation aircraft manufacturing industry had a similar growth pattern over a 15-year period, expanding from a core company of about 30 employees (Lancair) to a cluster of 25 companies that now employs nearly 1,200 people. It is anticipated the PPUTRC will help expand these existing businesses in the Gorge and Central Oregon.

Infrastructure

Alaska expects to invest $1.5 million to construct a test site center at its Poker Flat Research Range, as well as develop and acquire mobile test infrastructure such as fixtures, data collection devices, and monitoring systems similar to its internet-Portable Aerial Surveillance System (iPASS), a web-based application that merges track information from radar, GPS, and a transponder interrogator/receiver. Additionally, large data collection requirements are expected to drive development of a data center for processing and storage.

Hawaii's test ranges link to military/restricted areas used for current UAS operations. These sites include the Pohakuloa training area on the Island of Hawaii, Bradshaw and Wheeler Army Airfields on Oahu, and the Pacific Missile Range Facility on Kauai. Other areas under consideration include Upolu and Dillingham Airfields (on the Big Island and Oahu, respectively). Test points within the ranges would be utilized to support both shore and ship-based development, testing and certification of new UASs, training and crew certification of operational UASs, and development of expanded and joint capabilities involving existing communications systems and operations tactics using UAS.

The budget for the $2.5 million Oregon innovation grant envisions spending at least $1.2 million at test ranges for new equipment and/or infrastructure, with the grant providing $300,000, private enterprise providing $750,000, and public entities providing $150,000. Possible infrastructure development proposed with this funding includes: portable ground radar units; an automatic dependent surveillance-broadcast ground station or a similar 'sense and avoid' technology system; one or more operations management buildings housing computers, calibration components, baseline sensors with a range of capabilities, data analysis equipment, supporting software, maintenance facilities and machine shops; and ground control stations, an observation tower, and ITAR facilities as needed. Additionally, as noted earlier, Near Space Corporation is preparing to open a new $6 million flight test and operations facility at the Tillamook airport.

Chapter 3. Potential Economic Impacts of the PPUTRC

Designation as one of the nation's six UAS test sites promises to have significant economic impacts in the areas where flight activity occurs and support services are provided. Private and public sector UAS activity that has been constrained by restricted access and a restrictive federal authorizing process will have much greater opportunity to conduct UAV flight operations. In this chapter the potential economic impacts in Alaska, Hawaii, and Oregon related to serving as a test site are quantified.

The following economic impact projections were developed by McDowell Group, Inc. utilizing flight activity, flight cost, and flight-related staffing data provided by PPUTRC team members. Direct economic activity was measured by approximating preflight administrative costs, site fees per day, operating costs per day, and total flight days from historical data provided by the applicant. Sector-level information was obtained from the applicant concerning the number of UAS-related firms and jobs per firm. Direct employment estimates were then coupled with multipliers obtained from the IMPLAN economic impact model to estimate total direct, indirect, and induced economic effects. Annual projections from 2014 to 2017 were calculated for each of the 13 ranges utilizing growth rates based on funding forecasts from the Teal Group UAS market profile and forecast report, historical flight activity, and projected growth in flight activity, research, and UAS-related manufacturing as provided by the applicant.

In total, designation of PPUTRC as a UAS test site would be expected to generate 1,065 direct, indirect, and induced jobs in 2014, increasing to over 1,400 jobs by 2017. Total labor income would climb from$57 million in 2014 to about $76 million in 2017.

Table 3: Summary Impacts of PPUTRC Test Site Designation, 2012-2017
Combined Impacts in Alaska, Hawaii and Oregon

Impact of Test Site Designation	2014	2015	2016	2017
Total Employment	**1,065**	**1,260**	**1,335**	**1,429**
Direct Employment	490	571	602	642
Indirect Employment	198	243	259	279
Induced Employment	377	447	474	508
Total Labor Income ($ million)	**$56.9**	**$66.9**	**$70.8**	**$75.6**
Direct Labor Income ($ million)	$26.4	$30.5	$32.2	$34.2
Indirect Labor Income ($ million)	$10.4	$12.5	$13.3	$14.4
Induced Labor Income ($ million)	$20.1	$23.8	$25.3	$27.1
Output ($ million)	**$265.0**	**$301.8**	**$315.9**	**$333.5**
Total Value Added ($ million)	**$109.3**	**$121.9**	**$127.1**	**$133.5**
State Income Taxes ($ million)	$4.3	$5.0	$5.3	$5.6

Employment Resulting from UAS and Test Site Operations

In 2014, with designation of PPURTC as a test site, UAS activity in Alaska, Hawaii, and Oregon is expected to account for 581 direct jobs and a total of 1,254 jobs - including direct, indirect, and induced jobs. Approximately 85 percent of that total employment (1,065 jobs) is attributable to test site designation. The remaining 15 percent (189 jobs) is expected to occur in the absence of PPUTRC test site designation. By 2017, employment will rise to an estimated 904 direct jobs and 1,991 total jobs - with 72 percent of that total employment (1,429) attributable to test site designation. A significant number of these direct jobs are expected in smaller communities that tend to have higher unemployment – thus test site designation for the PPUTRC will help improve opportunities where they will provide the most benefits.

Table 4: Direct Employment, 2012-2017

	Direct Employment					
	2012	2013	2014	2015	2016	2017
Total Direct Employment						
PPUTRC	**74**	**82**	**581**	**712**	**801**	**904**
Alaska Ranges	43	47	129	142	157	173
Hawaii Ranges	-	-	-	72	95	126
Oregon Ranges	31	35	452	498	549	605
Impact of Test Site Designation						
PPUTRC	**-**	**-**	**490**	**571**	**602**	**642**
Alaska Ranges	-	-	77	82	86	91
Hawaii Ranges	-	-	-	72	95	126
Oregon Ranges	-	-	414	417	421	424

Oregon's relatively high direct employment numbers are due to the existing, well-developed aircraft manufacturing sector in Oregon. Oregon is well placed to supply the growing demand for UAS aircraft that will be triggered by UAS integration. Most of the new jobs created in Oregon due to PPUTRC designation include manufacturing jobs (many of which may be created due to designation of test sites anywhere in the U.S.). These numbers for Oregon are based on an analysis provided to McDowell Group by Economic Development for Central Oregon (EDCO).

In addition to direct jobs created from UAS firms, significant indirect and induced jobs will also be created. Indirect jobs represent jobs created throughout the supply chain to support the UAS industry and induced jobs represent jobs created due to changes in household consumption as a result of the UAS industry.

Table 5: Indirect Employment, 2012-2017

	Indirect Employment					
	2012	2013	2014	2015	2016	2017
Total Indirect Employment						
PPUTRC	**21**	**24**	**224**	**290**	**328**	**374**
Alaska Ranges	7	8	22	24	27	30
Hawaii Ranges	-	-	-	42	56	74
Oregon Ranges	14	16	202	223	246	271
Impact of Test Site Designation						
PPUTRC	-	-	**198**	**243**	**259**	**279**
Alaska Ranges	-	-	-	42	56	74
Hawaii Ranges	-	-	185	187	188	190
Oregon Ranges	-	-	13	14	15	16

Table 6: Induced Employment, 2012-2017

	Induced Employment					
	2012	2013	2014	2015	2016	2017
Total Induced Employment						
PPUTRC	**59**	**65**	**448**	**558**	**629**	**712**
Alaska Ranges	35	39	106	117	129	142
Hawaii Ranges	-	-	-	64	84	111
Oregon Ranges	24	26	342	377	416	459
Impact of Test Site Designation						
PPUTRC	-	-	**377**	**447**	**474**	**508**
Alaska Ranges	-	-	63	67	71	75
Hawaii Ranges	-	-	-	64	84	111
Oregon Ranges	-	-	313	316	319	321

Note: Summation of columns may not match the total due to rounding

Labor Income Resulting from UAS and Test Site Operations

In 2014, UAS activity in Alaska, Hawaii, and Oregon is expected to account for $31 million in direct labor income and $67 million in total labor income - including direct, indirect, and induced - assuming the PPUTRC is awarded test site designation. Approximately 84 percent of that total labor income ($57 million) is attributable to test site designation, while the remaining 16 percent ($10 million) is expected to occur even if the proposed PPUTRC does not become a test site. By 2017, labor income is expected to include $106 million in total direct, indirect, and induced labor income - with 71 percent of that total labor income ($76 million) attributable to test site designation.

Table 7: Direct Income, 2012-2017 ($ million)

Direct Income						
	2012	2013	2014	2015	2016	2017
Total Direct Income						
PPUTRC	**$4.0**	**$4.4**	**$31.3**	**$38.2**	**$42.9**	**$48.3**
Alaska Ranges	$2.3	$2.6	$7.0	$7.7	$8.5	$9.4
Hawaii Ranges	-	-	-	$3.7	$4.9	$6.4
Oregon Ranges	$1.7	$1.9	$24.2	$26.7	$29.5	$32.5
Impact of Test Site Designation						
PPUTRC	-	-	**$26.4**	**$30.5**	**$32.2**	**$34.2**
Alaska Ranges	-	-	$4.2	$4.4	$4.7	$5.0
Hawaii Ranges	-	-	-	$3.7	$4.9	$6.4
Oregon Ranges	-	-	$22.2	$22.4	$22.6	$22.8

Table 8: Indirect Income, 2012-2017 ($ million)

	Indirect Income					
	2012	2013	2014	2015	2016	2017
Total Direct Income						
PPUTRC	**$1.1**	**$1.3**	**$11.7**	**$15.0**	**$17.0**	**$19.3**
Alaska Ranges	$0.4	$0.4	$1.2	$1.3	$1.5	$1.6
Hawaii Ranges	-	-	-	$2.1	$2.7	$3.6
Oregon Ranges	$0.7	$0.8	$10.5	$11.6	$12.8	$14.1
Impact of Test Site Designation						
PPUTRC			**$10.4**	**$12.5**	**$13.3**	**$14.4**
Alaska Ranges	-	-	$0.7	$0.8	$0.8	$0.9
Hawaii Ranges	-	-	-	$2.1	$2.7	$3.6
Oregon Ranges	-	-	$9.6	$9.7	$9.8	$9.9

Table 9: Induced Income, 2012-2017 ($ million)

	Induced Income					
	2012	2013	2014	2015	2016	2017
Total Induced Income						
PPUTRC	**$3.5**	**$3.8**	**$24.4**	**$30.1**	**$34.0**	**$38.4**
Alaska Ranges	$2.2	$2.5	$6.7	$7.4	$8.2	$9.0
Hawaii Ranges	-	-	-	$3.3	$4.3	$5.7
Oregon Ranges	$1.2	$1.4	$17.6	$19.4	$21.4	$23.6
Impact of Test Site Designation						
PPUTRC	-	-	**$20.1**	**$23.8**	**$25.3**	**$27.1**
Alaska Ranges	-	-	$4.0	$4.3	$4.5	$4.8
Hawaii Ranges	-	-	-	$3.3	$4.3	$5.7
Oregon Ranges	-	-	$16.1	$16.3	$16.4	$16.6

Output, Value Added, & State Income Taxes Resulting from UAS and Test Site Operations

'Output' represents the value of industry production, and 'total value added' is the difference between an industry's total output and the cost of their intermediate inputs. Economic modeling conducted for the purposes of this study indicates output in the PPUTRC states attributable to test site designation would climb from $265 million in 2014 to $333 million in 2017. Value added would climb from $109 million to $134 million over the same period.

Table 10: Output, 2012-2017 ($ million)

	Output					
	2012	2013	2014	2015	2016	2017
Total Output						
PPUTRC	**$18.3**	**$20.2**	**$302.4**	**$366.8**	**$411.7**	**$463.6**
Alaska Ranges	$8.6	$9.5	$34.3	$37.8	$41.7	$46.0
Hawaii Ranges	-	-	-	$33.3	$44.1	$58.3
Oregon Ranges	$9.7	$10.7	$268.1	$295.6	$325.9	$359.3
Impact of Test Site Designation						
PPUTRC	-	-	**$280.1**	**$315.5**	**$328.4**	**$344.7**
Alaska Ranges	-	-	$23.8	$24.8	$25.8	$26.8
Hawaii Ranges	-	-	-	$33.3	$44.1	$58.3
Oregon Ranges	-	-	$256.3	$257.4	$258.5	$259.6

Table 11: Total Value Added, 2012-2017 ($ million)

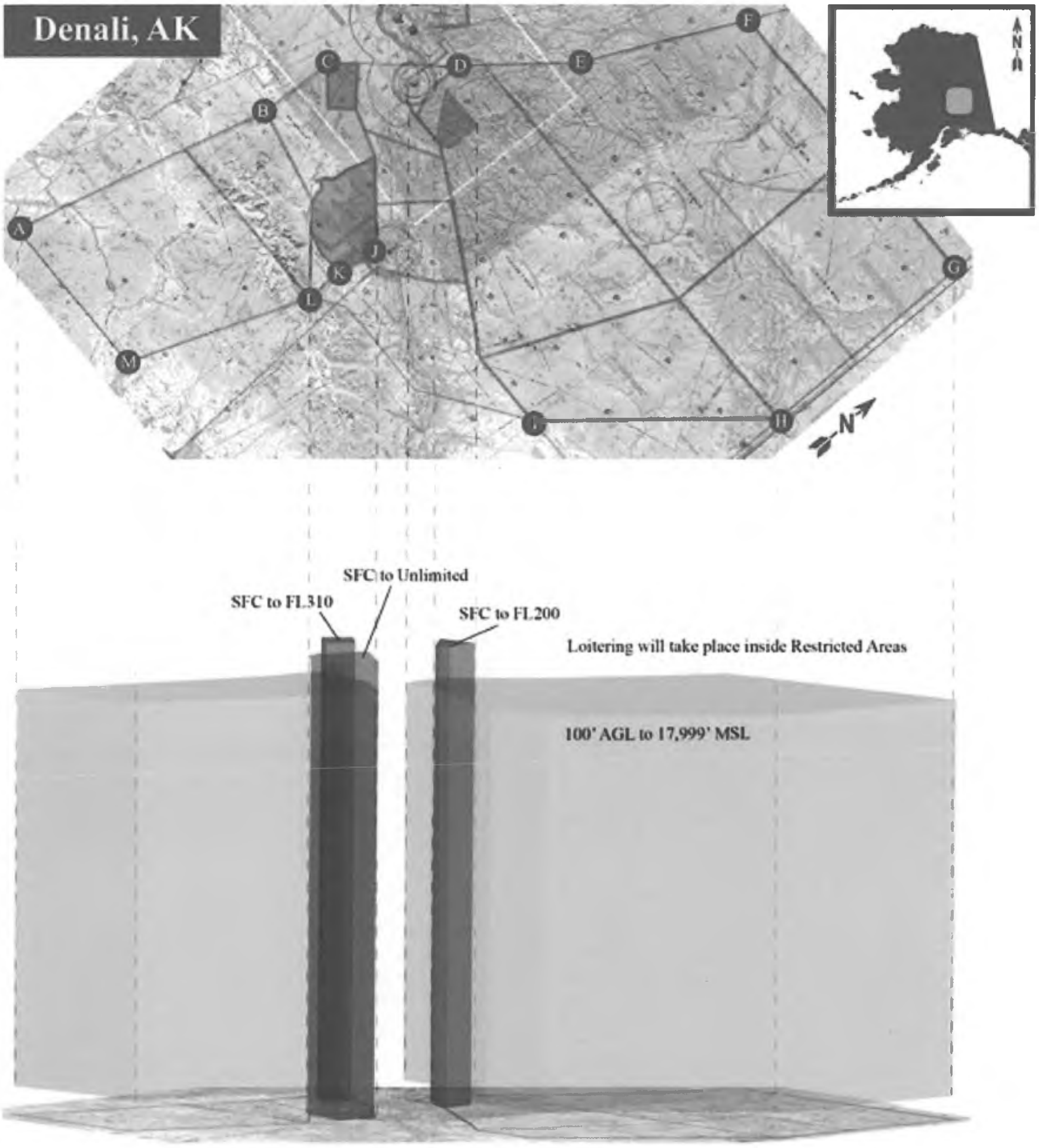
	Value Added					
	2012	2013	2014	2015	2016	2017
Total Value Added						
PPUTRC	**$9.5**	**$10.5**	**$127.7**	**$151.8**	**$169.7**	**$190.3**
Alaska Ranges	$5.7	$6.3	$22.7	$25.0	$27.6	$30.4
Hawaii Ranges	-	-	-	$10.9	$14.5	$19.1
Oregon Ranges	$3.8	$4.2	$105.1	$115.8	$127.7	$140.8
Impact of Test Site Designation						
PPUTRC	-	-	**$116.2**	**$128.2**	**$132.8**	**$138.5**
Alaska Ranges	-	-	$15.8	$16.4	$17.1	$17.7
Hawaii Ranges	-	-	-	$10.9	$14.5	$19.1
Oregon Ranges	-	-	$100.4	$100.9	$101.3	$101.7

Designation of the PPUTRC will provide a combined four-year total of $20 million in income tax revenue to Hawaii and Oregon. The effective income tax rate for these calculations was approximated as 7.5 percent for Hawaii, and 9 percent for Oregon (Alaska has no income tax).

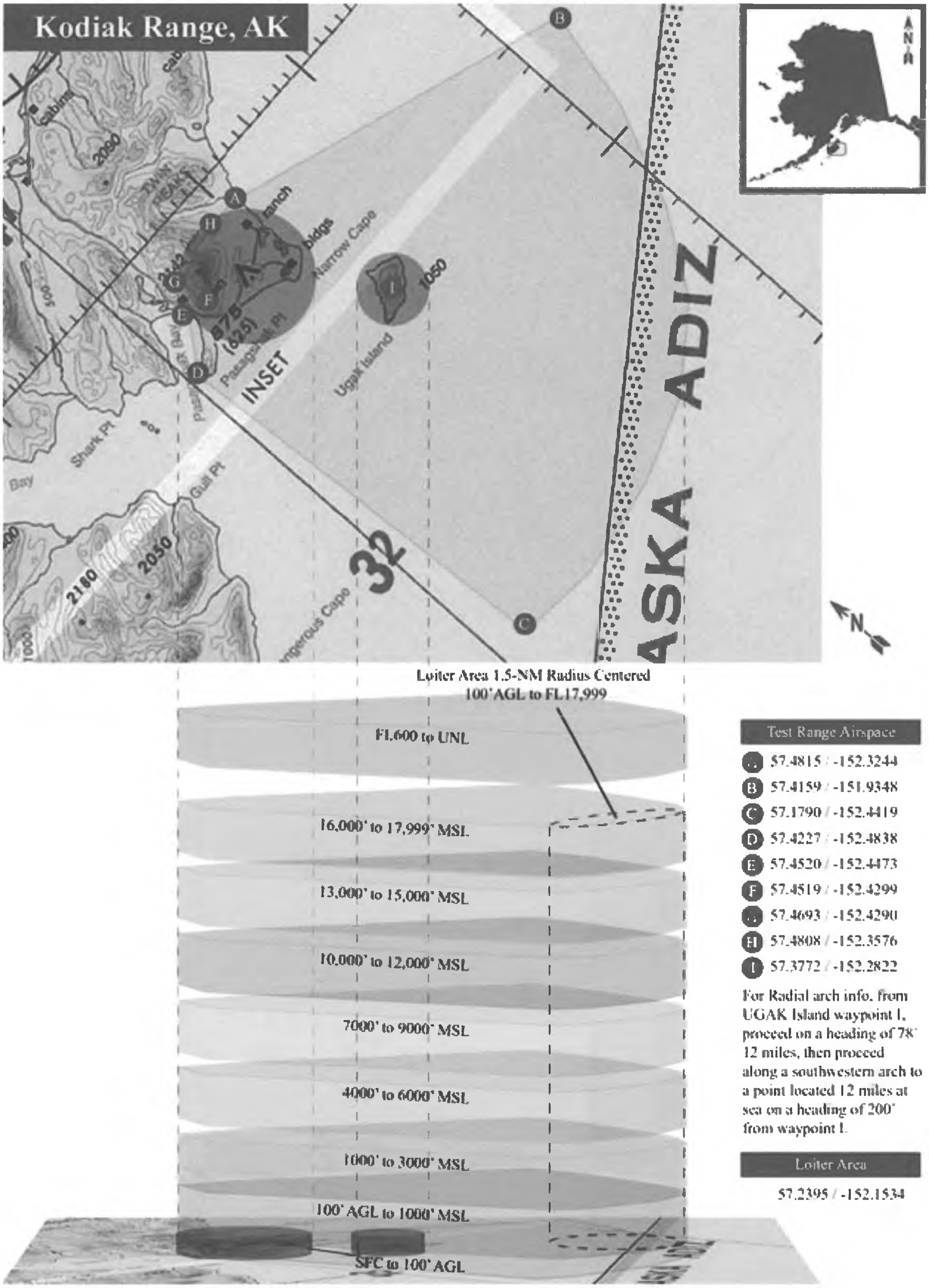
Table 12: State Income Taxes, 2012-2017 ($ million)

State Income Taxes						
	2012	2013	2014	2015	2016	2017
Total State Income Taxes						
PPUTRC	**$0.2**	**$0.2**	**$4.7**	**$5.9**	**$6.6**	**$7.5**
Alaska Ranges	-	-	-	-	-	-
Hawaii Ranges	-	-	-	$0.7	$0.9	$1.2
Oregon Ranges	$0.2	$0.2	$4.7	$5.2	$5.7	$6.3
Impact of Test Site Designation						
PPUTRC	-	-	**$4.5**	**$5.2**	**$5.5**	**$5.8**
Alaska Ranges	-	-	-	-	-	-
Hawaii Ranges	-	-	-	$0.7	$0.9	$1.2
Oregon Ranges	-	-	$4.5	$4.5	$4.6	$4.6

Appendix. Proposed Pan-Pacific Test Ranges



Test Range Airspace	
Ⓐ	62.5000 / -148.8500
Ⓑ	63.9653 / -148.0089
Ⓒ	64.3756 / -147.9803
Ⓓ	64.9000 / -146.9134
Ⓔ	65.3505 / -146.0719
Ⓕ	66.1668 / -145.0934
Ⓖ	66.1692 / -141.0817
Ⓗ	65.0000 / -141.0821
Ⓘ	64.0000 / -143.0159
Ⓙ	63.9364 / -145.8266
Ⓚ	63.7156 / -145.9051
Ⓛ	63.4974 / -145.9046
Ⓜ	62.5000 / -146.7279



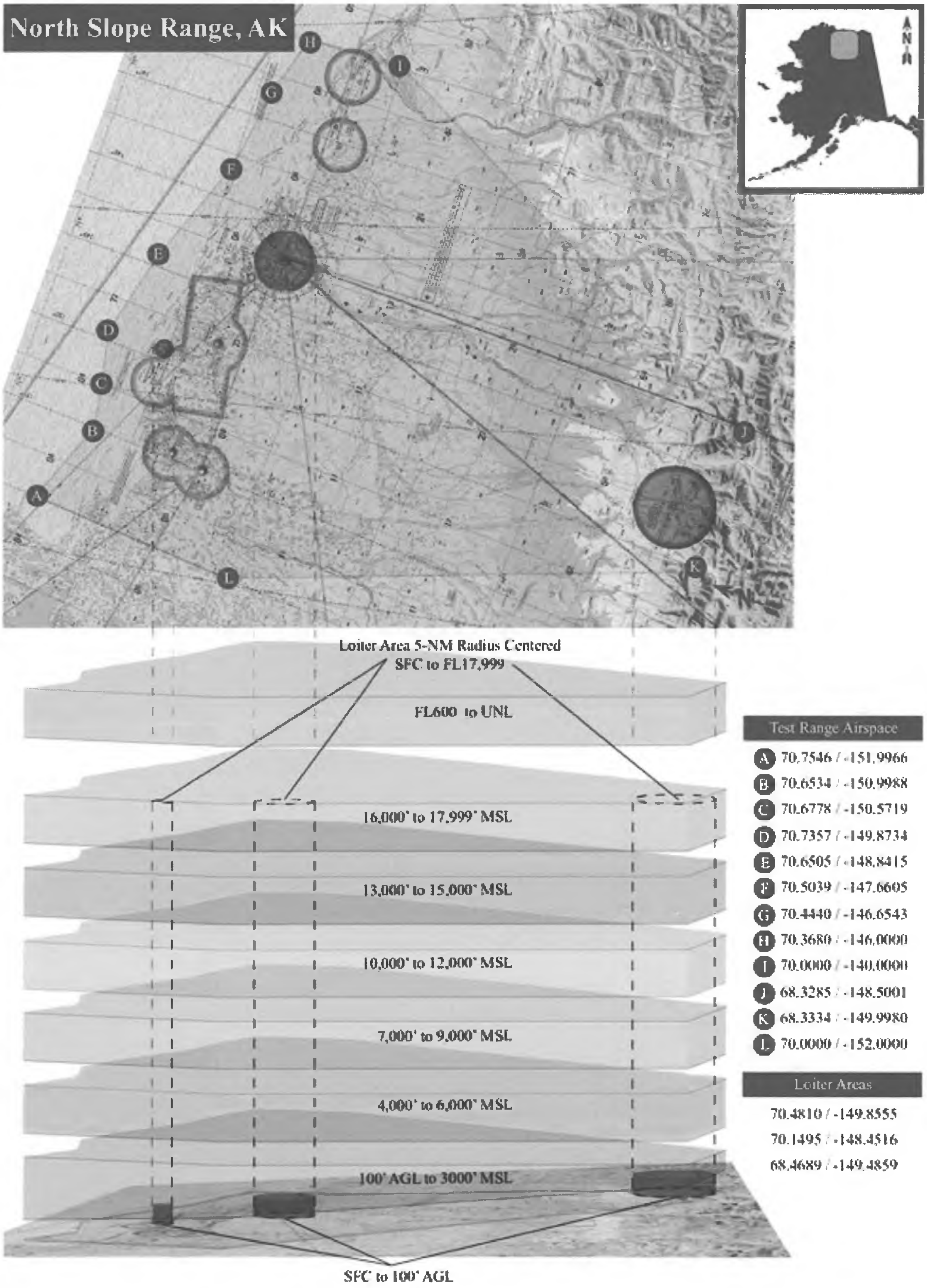
Test Range Airspace

A	57.4815 / -152.3244
B	57.4159 / -151.9348
C	57.1790 / -152.4419
D	57.4227 / -152.4838
E	57.4520 / -152.4473
F	57.4519 / -152.4299
G	57.4693 / -152.4290
H	57.4808 / -152.3576
I	57.3772 / -152.2822

For Radial arch info. from UGAK Island waypoint I, proceed on a heading of 78° 12 miles, then proceed along a southwestern arch to a point located 12 miles at sea on a heading of 200° from waypoint I.

Loiter Area

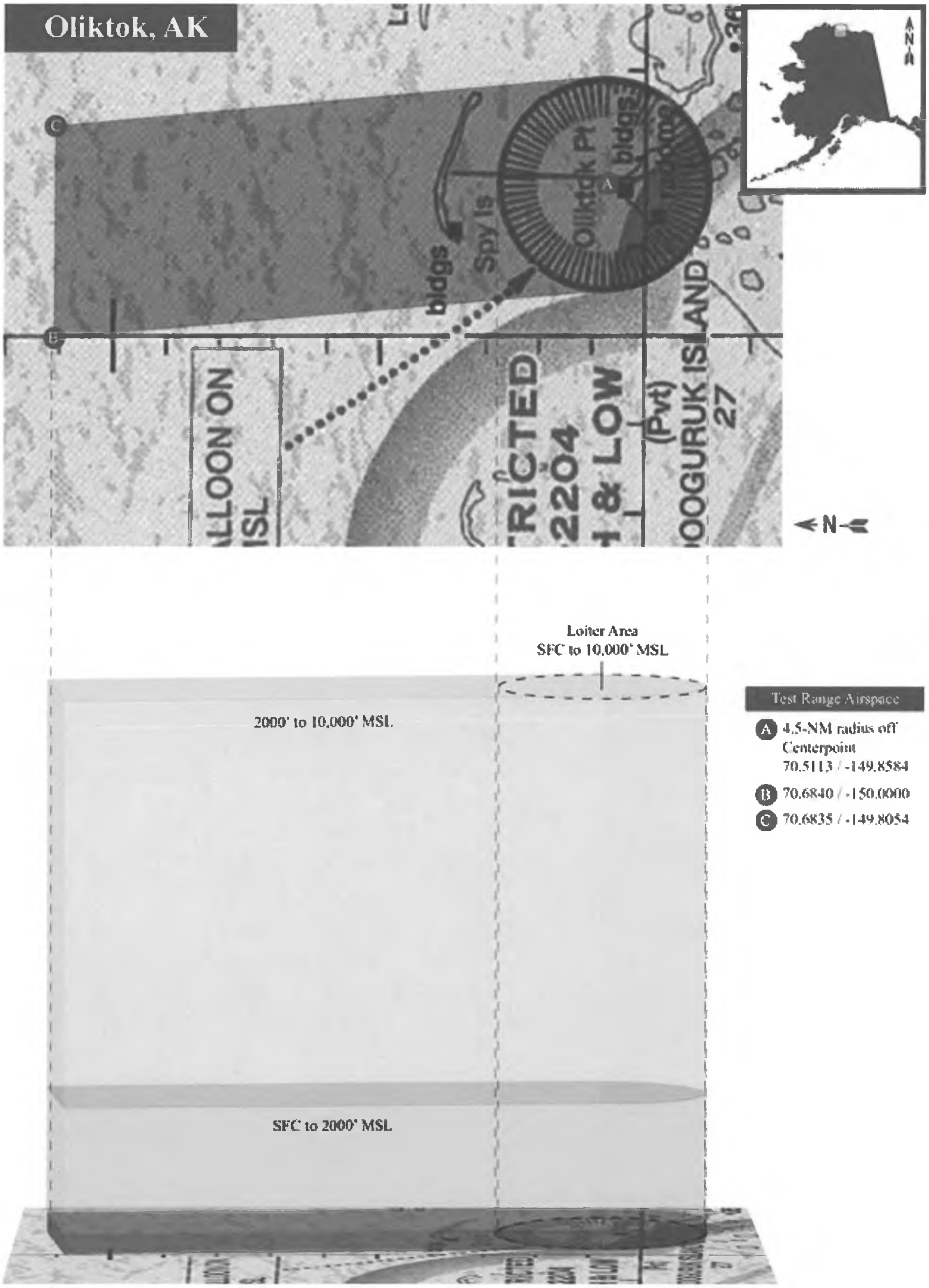
57.2395 / -152.1534



Test Range Airspace	
A	70.7546 / -151.9966
B	70.6534 / -150.9988
C	70.6778 / -150.5719
D	70.7357 / -149.8734
E	70.6505 / -148.8415
F	70.5039 / -147.6605
G	70.4440 / -146.6543
H	70.3680 / -146.0000
I	70.0000 / -140.0000
J	68.3285 / -148.5001
K	68.3334 / -149.9980
L	70.0000 / -152.0000

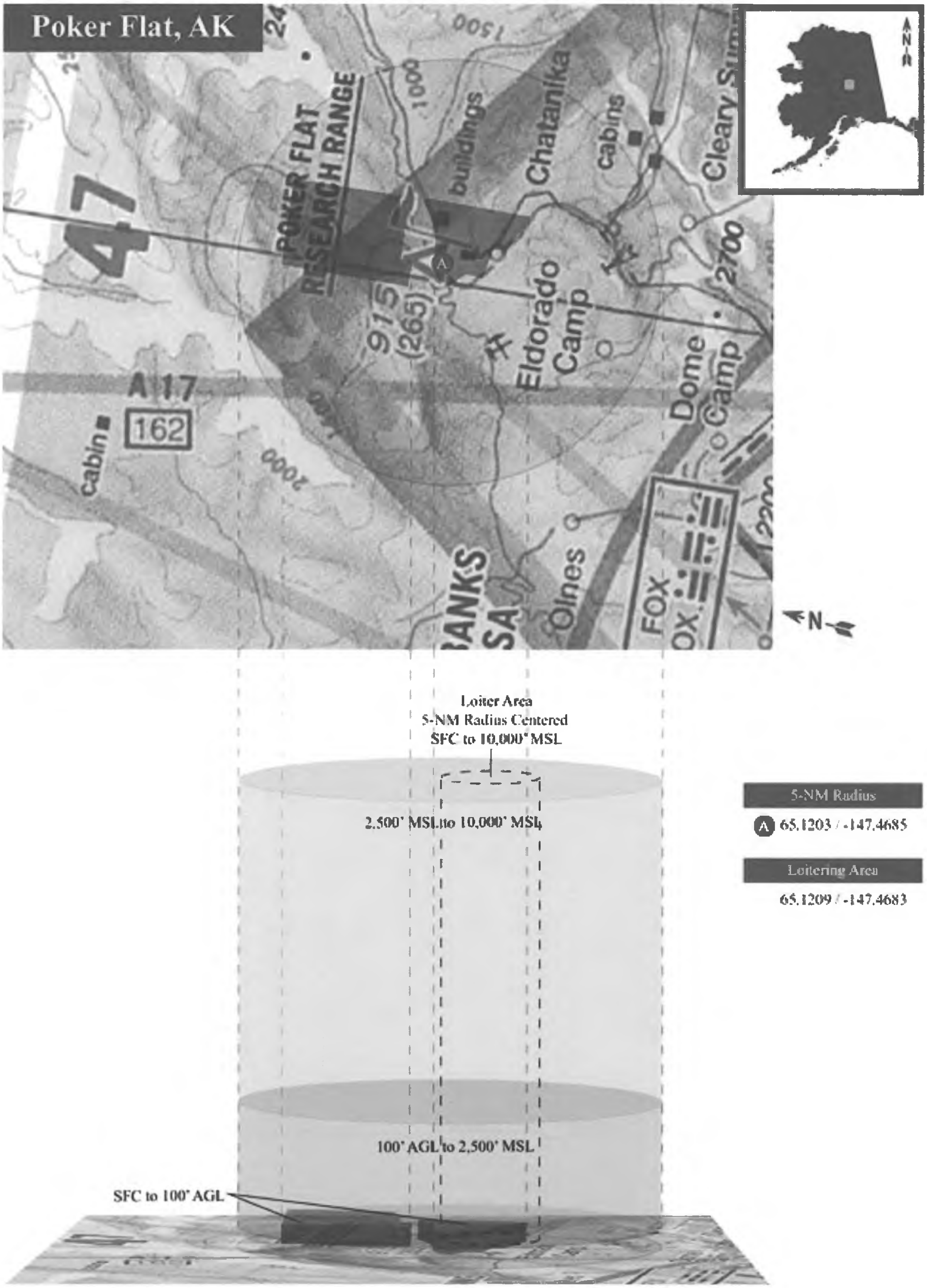
Loiter Areas
70.4810 / -149.8555
70.1495 / -148.4516
68.4689 / -149.4859

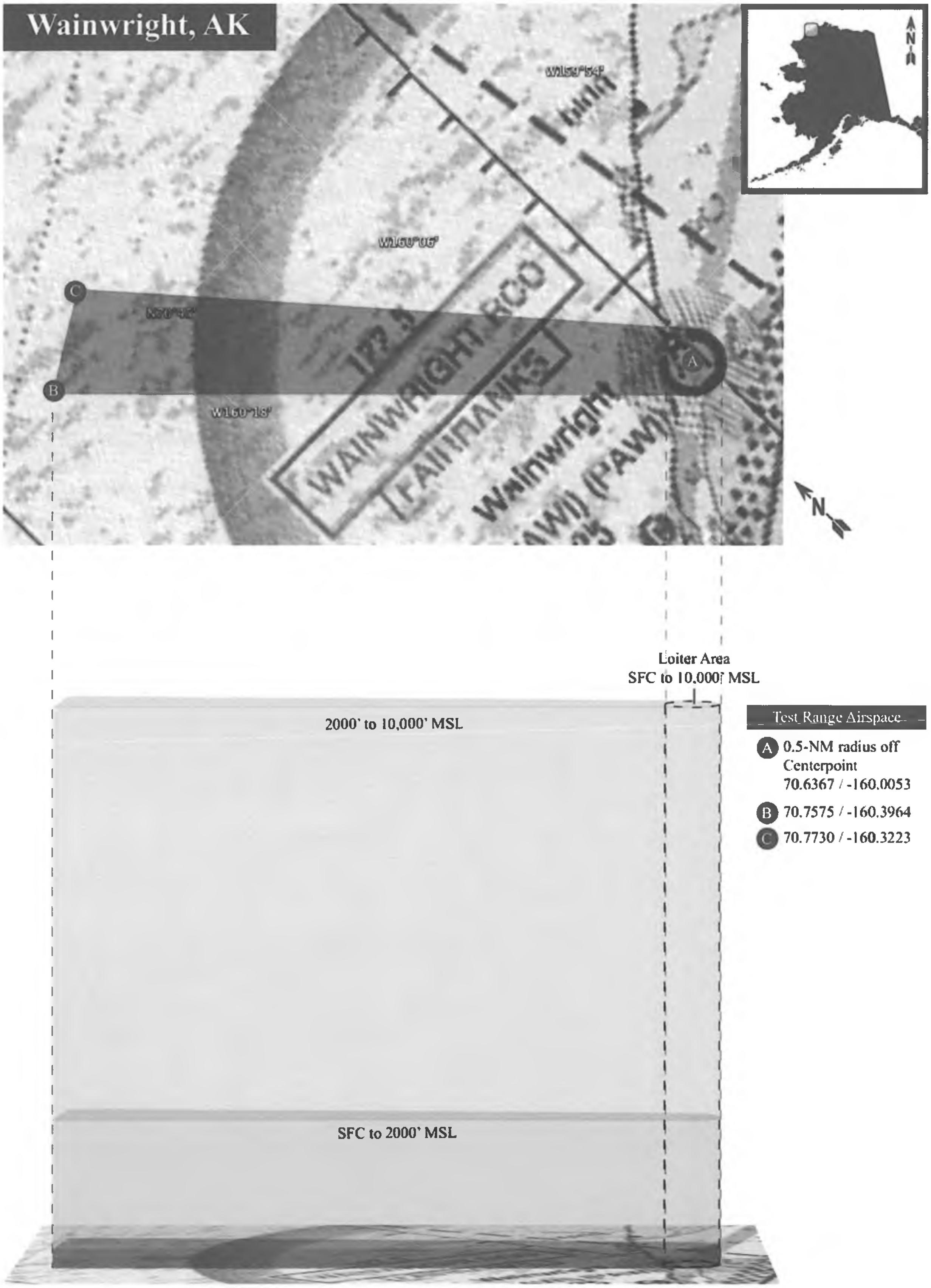
Oliktok, AK



Test Range Airspace

A	4.5-NM radius off Centerpoint 70.5113 / -149.8584
B	70.6840 / -150.0000
C	70.6835 / -149.8054

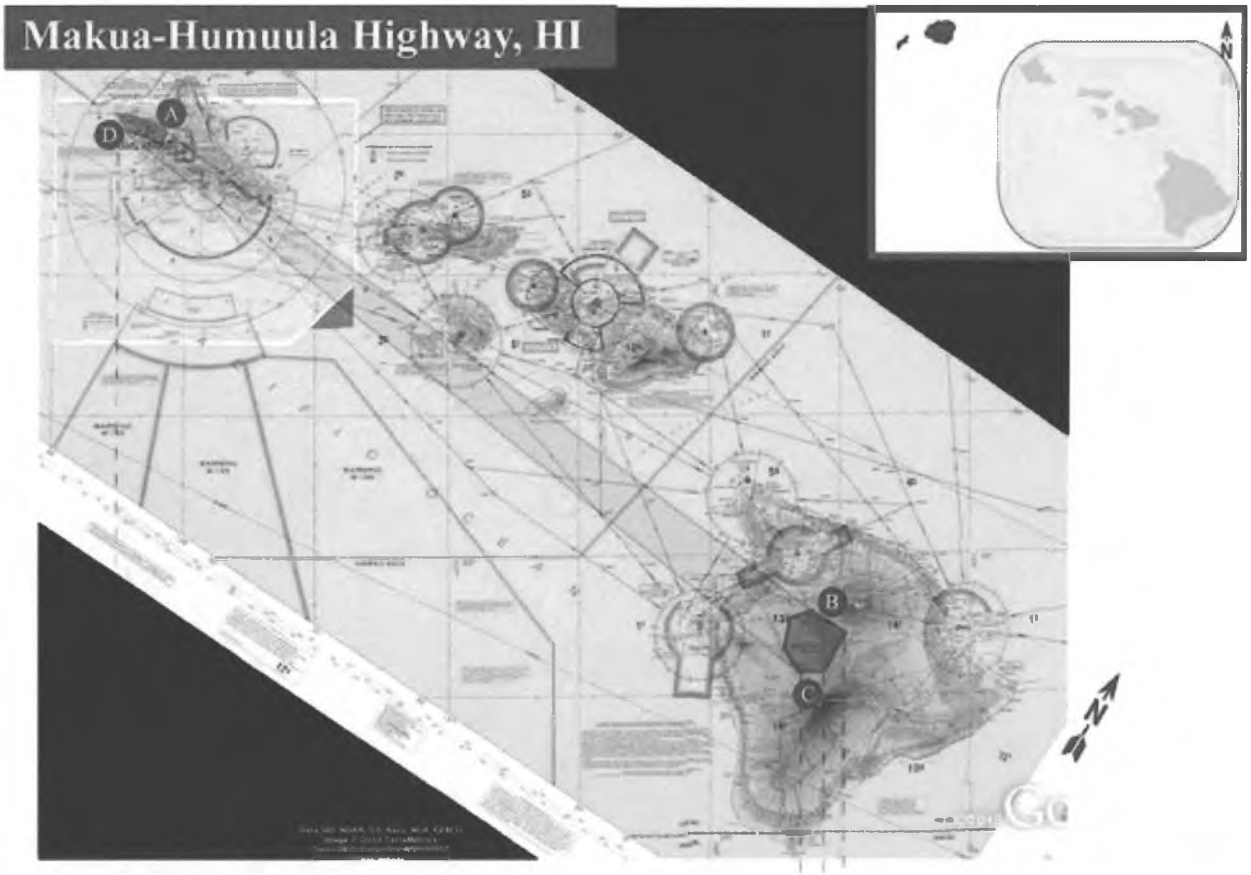

Poker Flat, AK
POKER FLAT RESEARCH RANGE
buildings
Chatanika
cabins
Cleary Su
Eldorado Camp
Dome Camp
Olnes
FOX
cabin
A 17
162
47
915 (265)
1500
1000
2000
2700
N
Loiter Area
5-NM Radius Centered
SFC to 10,000' MSL
2,500' MSL to 10,000' MSL
100' AGL to 2,500' MSL
SFC to 100' AGL
5-NM Radius
A 65.1203 / -147.4685
Loitering Area
65.1209 / -147.4683

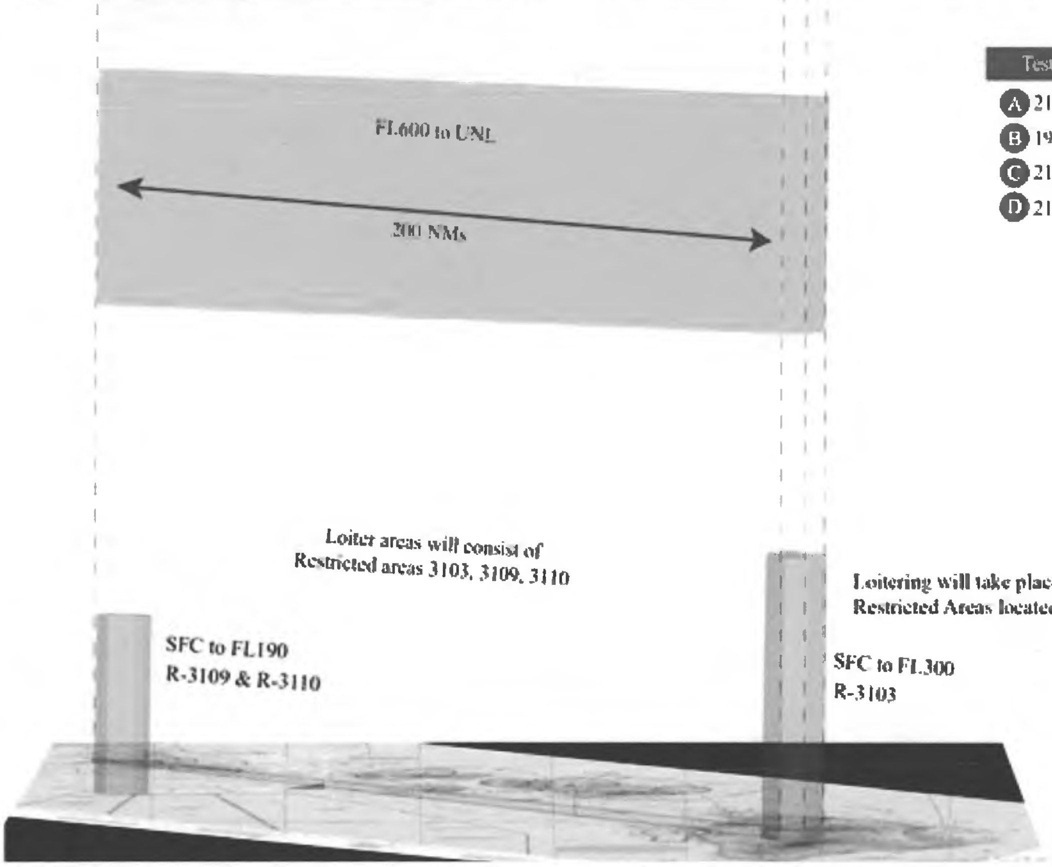


Test Range Airspace

A	0.5-NM radius off Centerpoint 70.6367 / -160.0053
B	70.7575 / -160.3964
C	70.7730 / -160.3223

Makua-Humuula Highway, HI



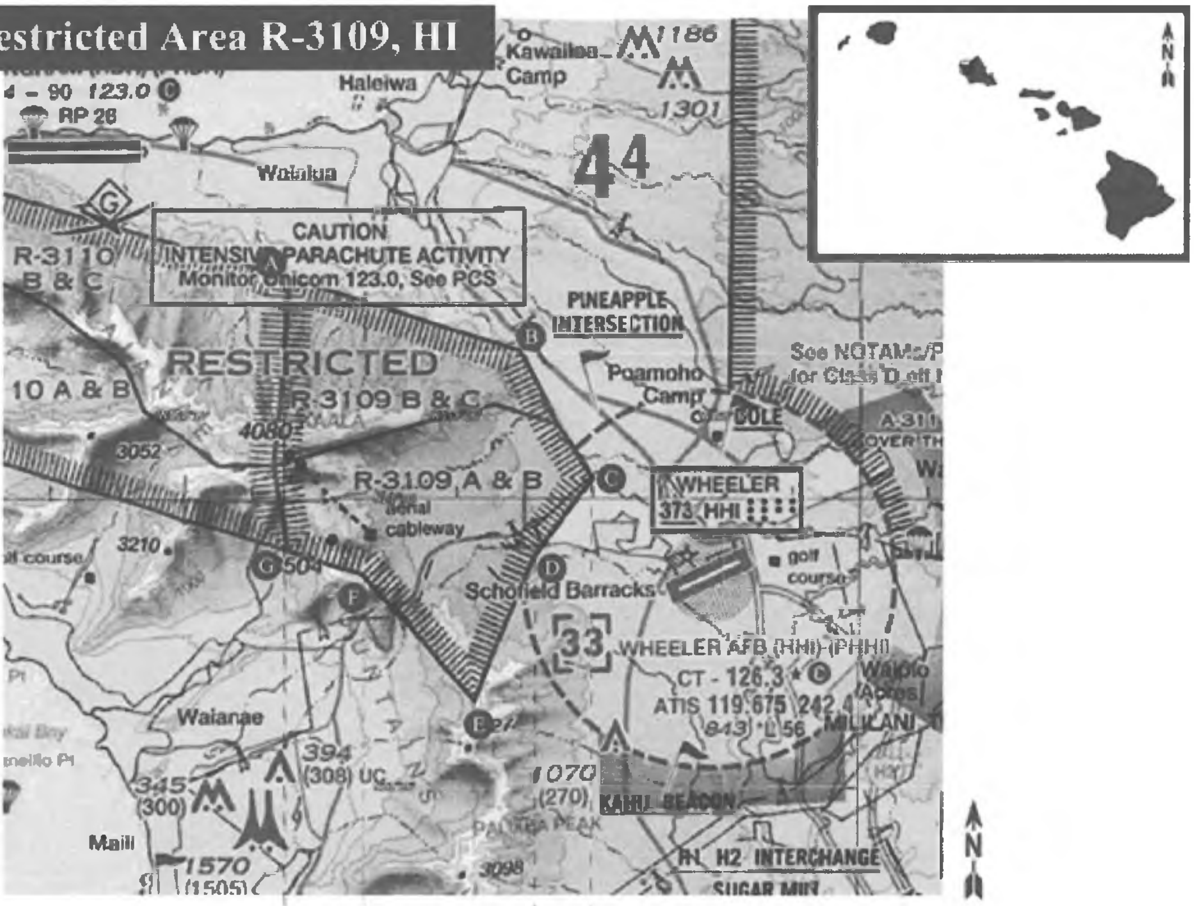


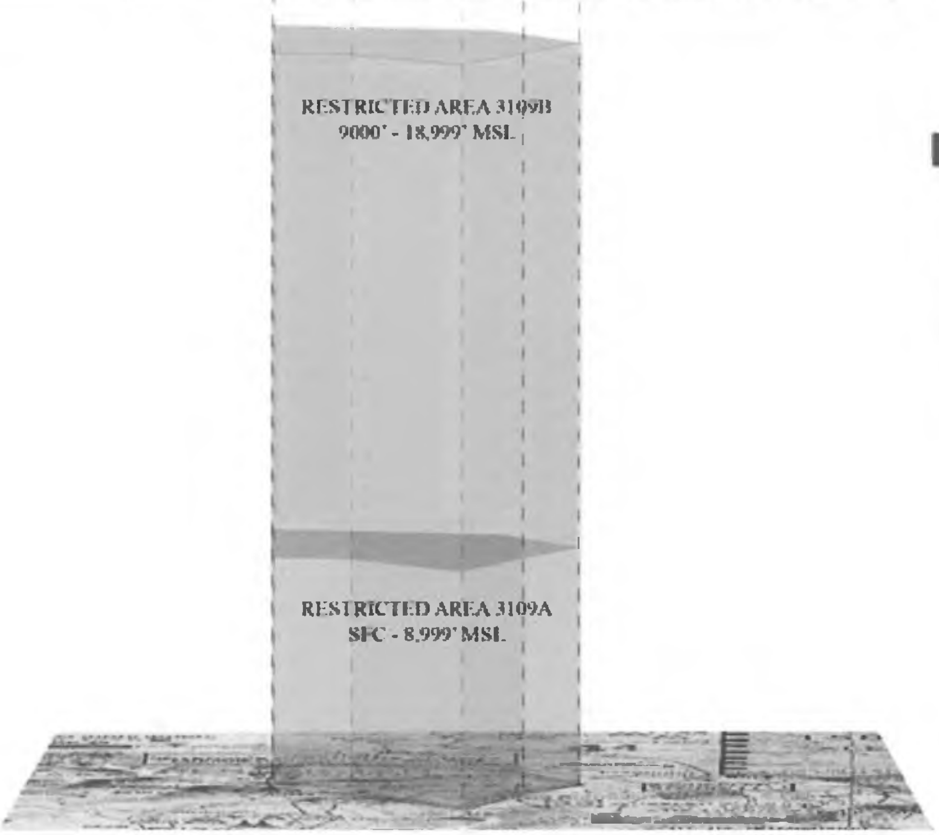
Loiter areas will consist of Restricted areas 3103, 3109, 3110

Loitering will take place inside Restricted Areas located at either end

Test Range Airspace
Ⓐ 21.5046 / -158.0664
Ⓑ 19.7776 / -155.6973
Ⓒ 21.4834 / -158.1236
Ⓓ 21.4534 / -158.0960

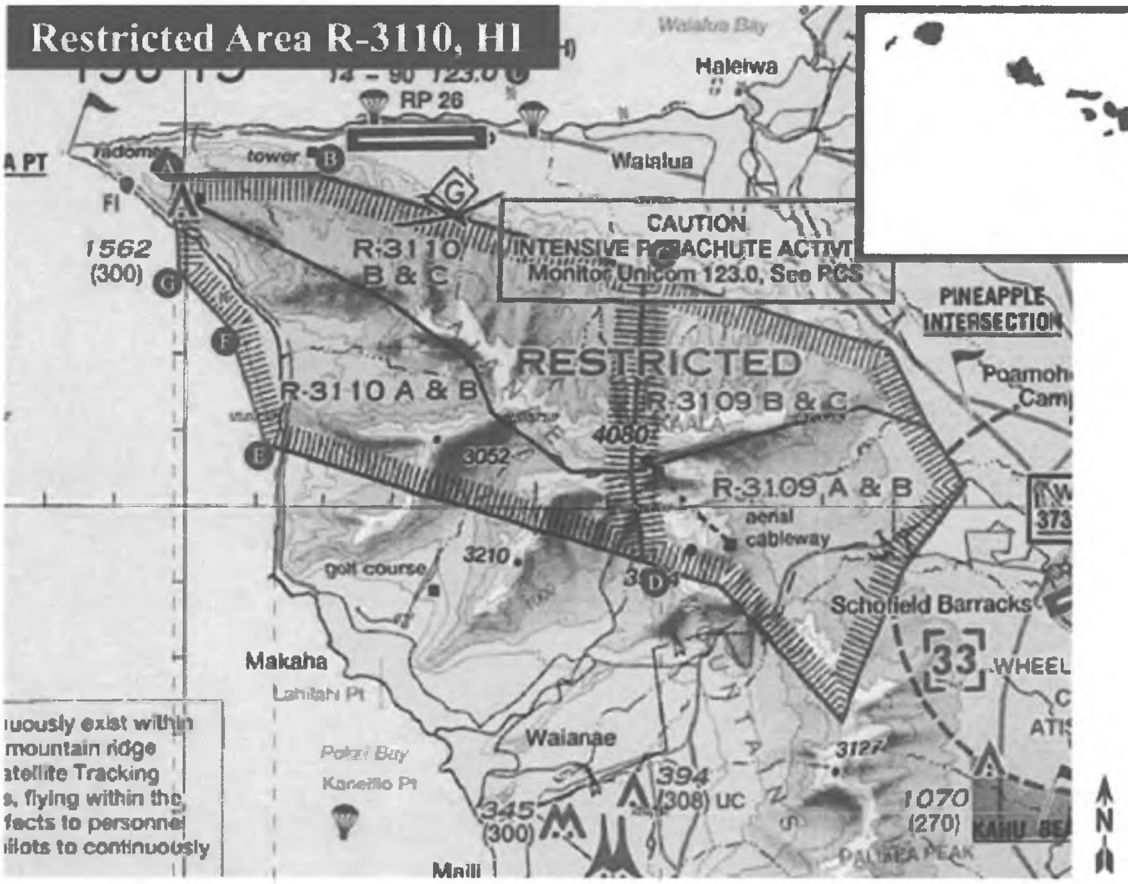
Restricted Area R-3109, HI

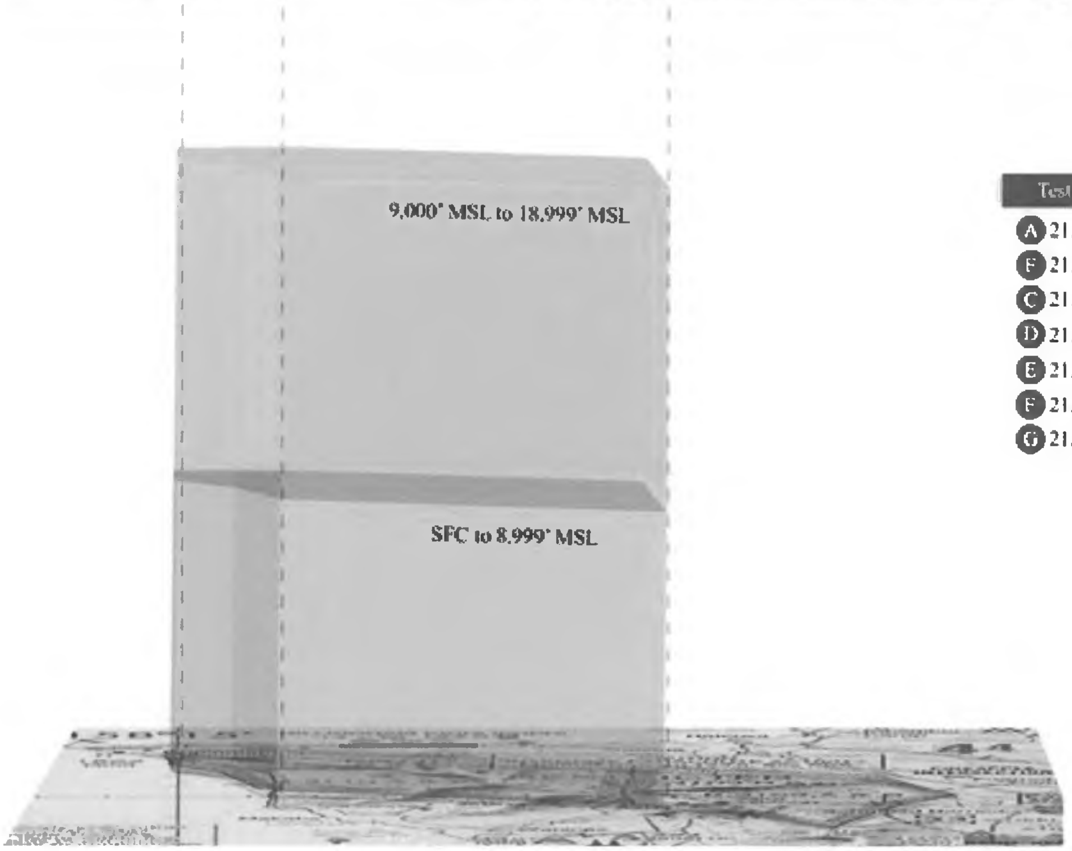




Test Range Airspace
Ⓐ 21.5500 / -158.1411
Ⓑ 21.5337 / -158.0842
Ⓒ 21.5046 / -158.0664
Ⓓ 21.4860 / -158.0807
Ⓔ 21.4534 / -158.0960
Ⓕ 21.4834 / -158.1236
Ⓖ 21.4886 / -158.1433

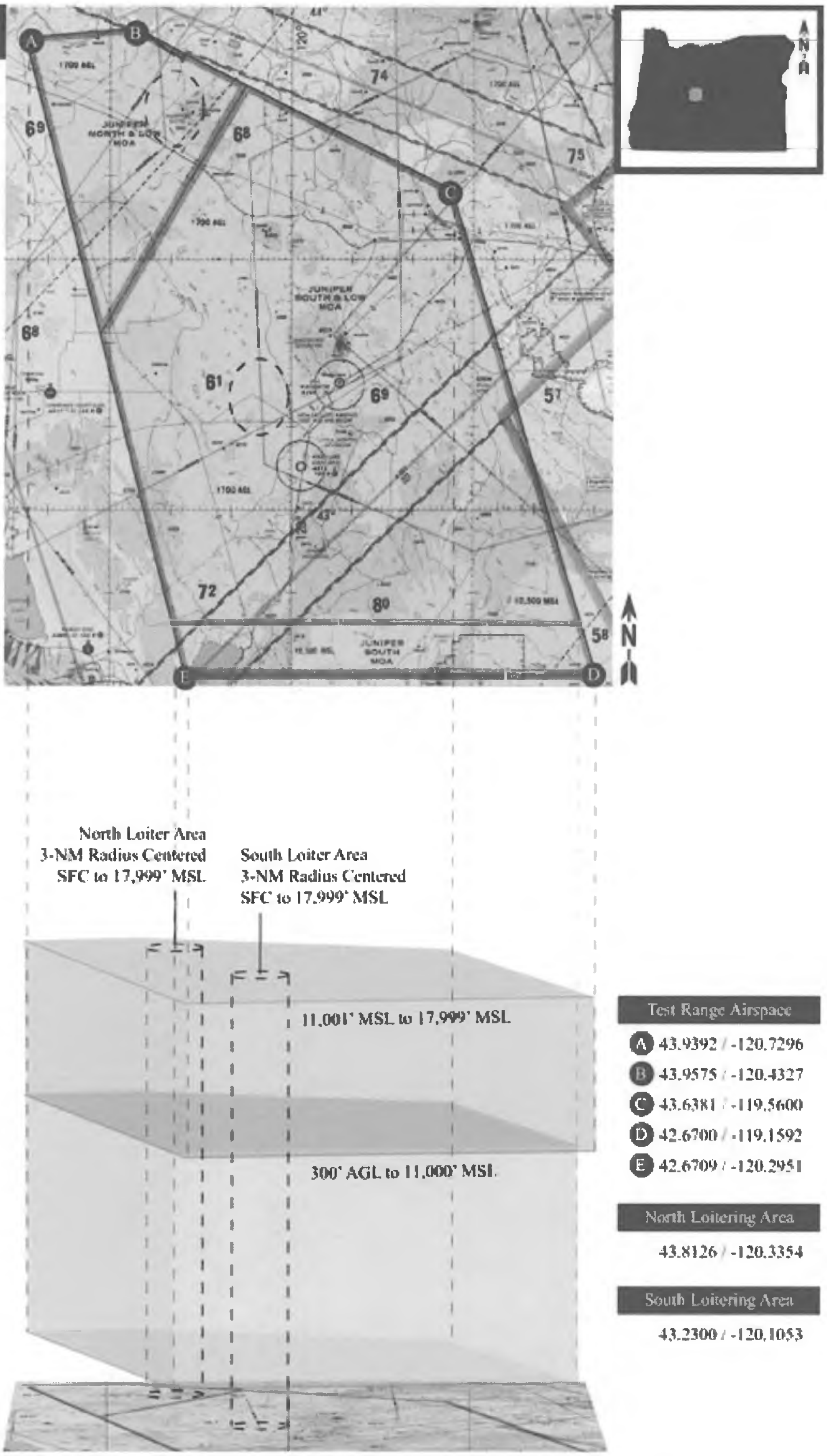
Restricted Area R-3110, HI





Test Range Airspace
Ⓐ 21.5713 / -158.2515
Ⓑ 21.5716 / -158.2181
Ⓒ 21.5334 / -158.0844
Ⓓ 21.4876 / -158.1431
Ⓔ 21.5130 / -158.2300
Ⓕ 21.5379 / -158.2394
Ⓖ 21.5501 / -158.2510

Juniper, OR



Test Range Airspace

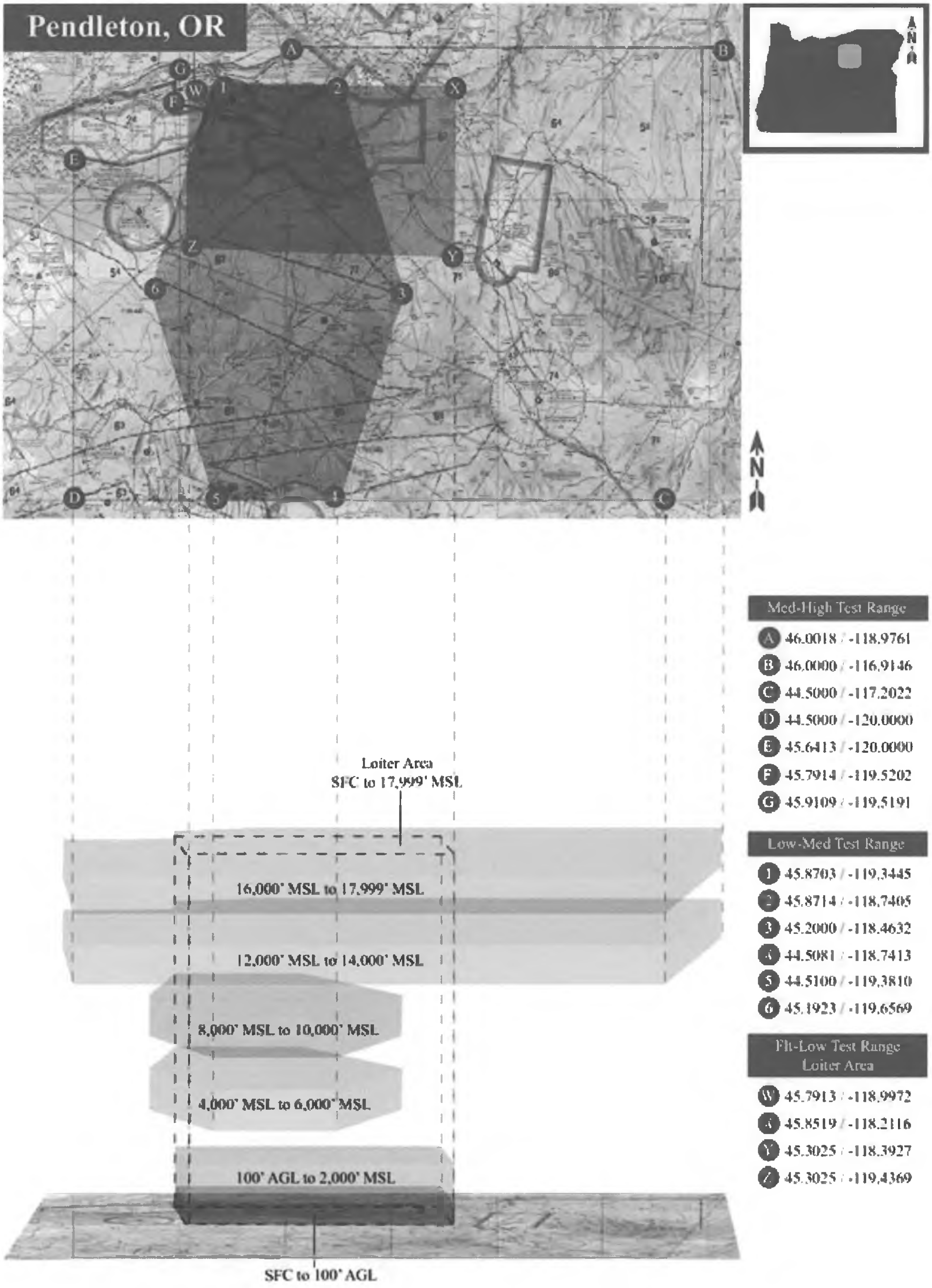
A	43.9392 / -120.7296
B	43.9575 / -120.4327
C	43.6381 / -119.5600
D	42.6700 / -119.1592
E	42.6709 / -120.2951

North Loitering Area

43.8126 / -120.3354

South Loitering Area

43.2300 / -120.1053

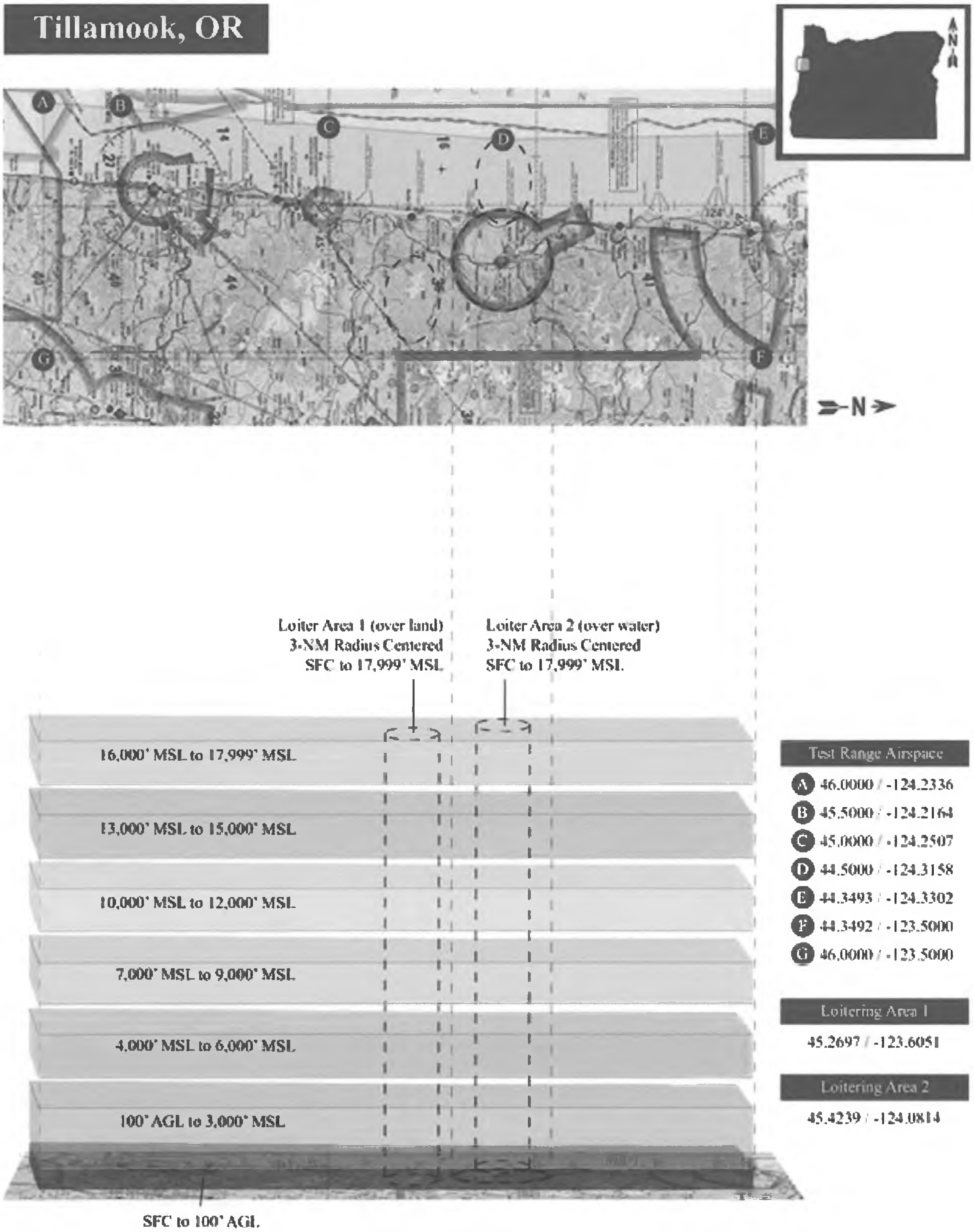


Med-High Test Range	
A	46.0018 / -118.9761
B	46.0000 / -116.9146
C	44.5000 / -117.2022
D	44.5000 / -120.0000
E	45.6413 / -120.0000
F	45.7914 / -119.5202
G	45.9109 / -119.5191

Low-Med Test Range	
1	45.8703 / -119.3445
2	45.8714 / -118.7405
3	45.2000 / -118.4632
4	44.5081 / -118.7413
5	44.5100 / -119.3810
6	45.1923 / -119.6569

Flt-Low Test Range Loiter Area	
W	45.7913 / -118.9972
X	45.8519 / -118.2116
Y	45.3025 / -118.3927
Z	45.3025 / -119.4369

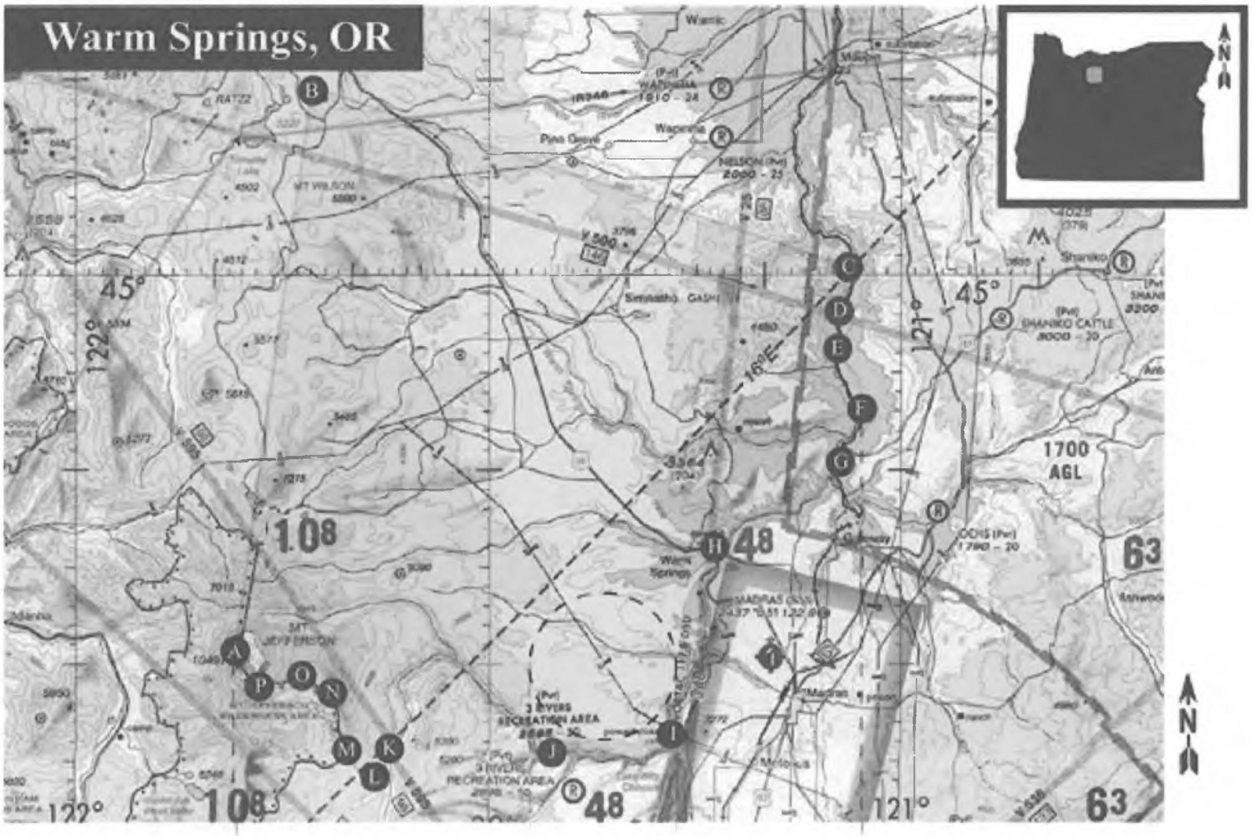
Tillamook, OR

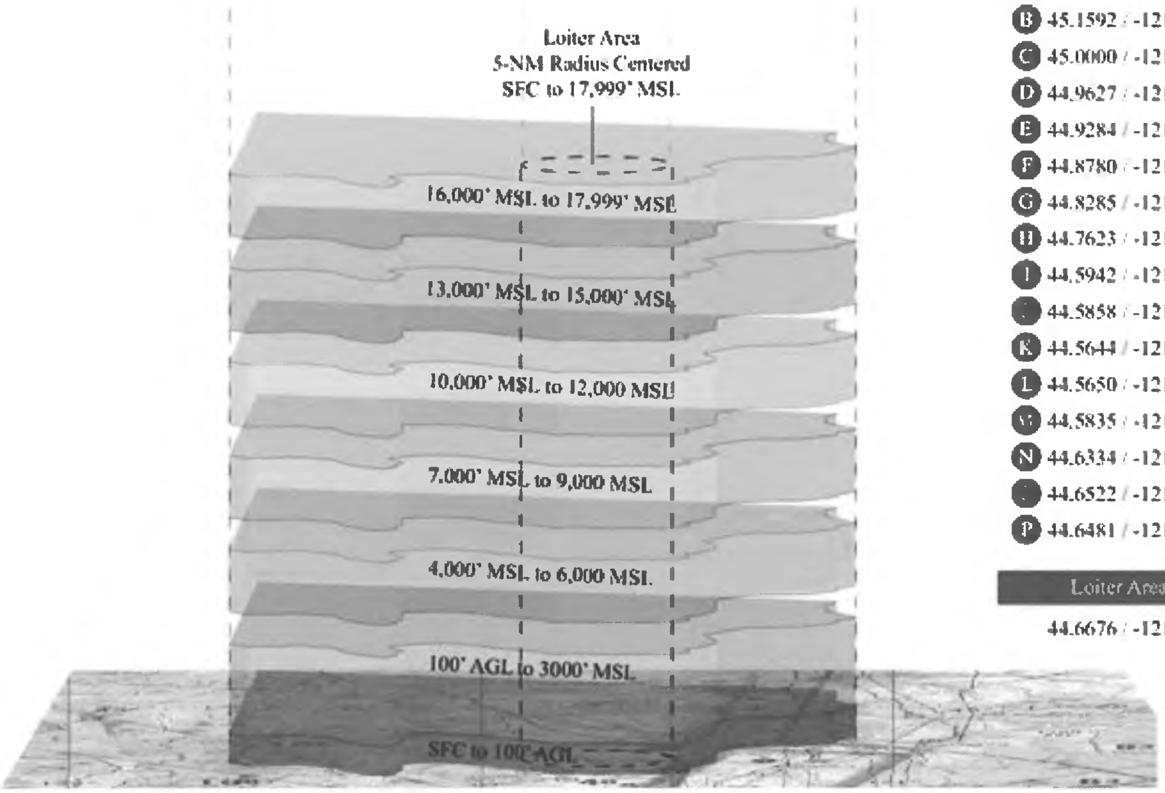


Test Range Airspace	
A	46.0000 / -124.2336
B	45.5000 / -124.2164
C	45.0000 / -124.2507
D	44.5000 / -124.3158
E	44.3493 / -124.3302
F	44.3492 / -123.5000
G	46.0000 / -123.5000

Loitering Area 1
45.2697 / -123.6051

Loitering Area 2
45.4239 / -124.0814





Test Range Airspace	
A	44.6740 / -121.8028
B	45.1592 / -121.7153
C	45.0000 / -121.0574
D	44.9627 / -121.0760
E	44.9284 / -121.0778
F	44.8780 / -121.0458
G	44.8285 / -121.0784
H	44.7623 / -121.2245
I	44.5942 / -121.2846
J	44.5858 / -121.4328
K	44.5644 / -121.6200
L	44.5650 / -121.6396
M	44.5835 / -121.6672
N	44.6334 / -121.6878
O	44.6522 / -121.7155
P	44.6481 / -121.7830

Loiter Area
44.6676 / -121.3566

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