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INTENSIVE ARCHITECTURAL HISTORY SURVEY OF HANGAR 101 FOR THE DULUTH INTERNATIONAL AIRPORT MASTER PLAN PROJECT

Duluth, St. Louis County, Minnesota

September 2021



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Duluth, St. Louis County, Minnesota

SHPO File No. Pending

106 Group Project No. 2566

SUBMITTED TO:

SEH

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September 2021

MANAGEMENT SUMMARY

During April through September 2021, 106 Group conducted an architectural history survey for the Duluth International Airport Master Plan Project (Project). The survey was conducted to assist in development of a master plan to inform future planning and redevelopment in the hangar area at the Duluth International Airport. The survey began as a reconnaissance architectural history survey, and once Hangar 101 was identified as having potential significance the survey proceeded to an intensive evaluation. The proposed Project includes demolition of Hangar 101 due to health and safety concerns. The proposed Project will require approval from the Federal Aviation Administration (FAA) and, therefore, would need to comply with Section 106 of the National Historic Preservation Act of 1966, as amended, as well as applicable state mandates governing cultural resources, including the Minnesota Field Archaeology Act and the Minnesota Historic Sites Act. This survey was conducted under contract for SEH. A concurrent reconnaissance architectural history survey for this Project was conducted, with funding coming from a separate source and, therefore, a separate report was prepared (Gallo et al. 2021).

The Project area is located in Section 2, Township 50, Range 15W, Duluth, St. Louis County, Minnesota. An appropriate area of potential effect (APE) for architectural history accounts for any physical, auditory, atmospheric, or visual impacts to historic properties. Based on the current Project plans, the recommended architectural history APE includes all standing structures located adjacent to Hangar 101. The recommended architectural history APE includes approximately 15.7 acres (6.4 hectares [ha]). The intensive architectural history survey consisted of historical research, field survey, and an evaluation for eligibility for listing in the National Register of Historic Places (NRHP). Saleh Miller, M.S., served as principal investigator for architectural history.

During the intensive architectural history survey, Hangar 101 was evaluated for eligibility for listing in the National Register of Historic Places (NRHP). Hangar 101 is recommended as eligible for listing in the NRHP for its significance under Criterion C, in the area of Architecture. The recommended period of significance is circa 1952, when Hangar 101 and its wings were constructed. The recommended property boundary is the footprint of the hangar and the wings.

“I certify that this investigation was conducted and documented according to the Secretary of the Interior’s Standards and Guidelines and that the report is complete and accurate to the best of my knowledge.”



Signature of Principal Investigator

September 10, 2021

Date

TABLE OF CONTENTS

1.0 INTRODUCTION.....	1
2.0 METHODS.....	3
2.1 Objectives.....	3
2.2 Area of Potential Effect.....	3
2.3 Background Research.....	3
2.4 Field Methods.....	3
2.5 Inventory Form.....	3
2.6 Evaluation.....	4
3.0 LITERATURE REVIEW.....	5
3.1 Previous Architectural History Studies.....	5
3.2 Property-Specific Historic Context.....	5
3.2.1 History of the Duluth International Airport, 1929 – present.....	5
4.0 RESULTS.....	10
4.1 Hangar 101, SL-DUL-3641.....	10
5.0 RECOMMENDATIONS.....	20
REFERENCES CITED.....	21

APPENDIX A: PROJECT PERSONNEL

LIST OF FIGURES

FIGURE 1. PROJECT LOCATION, APE, AND RESULTS.....	2
FIGURE 2. HANGAR 101, NORTH ELEVATION, FACING SOUTHEAST (106 GROUP, MAY 2021).....	11
FIGURE 3. HANGAR 101, FACING NORTHWEST, SHOWING COLLAPSING WINGS (106 GROUP, MAY 2021) ..	11
FIGURE 4. HANGAR 101, INTERIOR OF THE CENTRAL HANGAR, FACING NORTHEAST (SEH, MARCH 2021)	13
FIGURE 5. ELLSWORTH READINESS HANGAR, EXTERIOR (MCCORMICK AND HUFSTETLER 1994).....	17
FIGURE 6. ELLSWORTH READINESS HANGAR, INTERIOR WOODEN CRESCENT ARCHED TRUSSES (MCCORMICK AND HUFSTETLER 1994).....	17

LIST OF TABLES

TABLE 1. PREVIOUSLY NRHP-LISTED, ELIGIBLE, OR INVENTORIED ARCHITECTURAL HISTORY PROPERTIES WITHIN THE APE.....	5
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TABLE 2. PROPERTIES NOT RECOMMENDED FOR INTENSIVE SURVEY 10
TABLE 3. PROPERTIES NOT OF AGE IN THE APE..... 10

1.0 INTRODUCTION

During April through September 2021, 106 Group conducted an architectural history survey for the Duluth International Airport Master Plan Project (Project). The survey was conducted to assist in development of a master plan to inform future planning and redevelopment in the hangar area at the Duluth International Airport. The survey began as a reconnaissance architectural history survey, and once Hangar 101 was identified as having potential significance the survey proceeded to an intensive evaluation. The proposed Project includes demolition of Hangar 101 due to health and safety concerns. The proposed Project will require approval from the Federal Aviation Administration (FAA) and, therefore, would need to comply with Section 106 of the National Historic Preservation Act of 1966, as amended, as well as applicable state mandates governing cultural resources, including the Minnesota Field Archaeology Act and the Minnesota Historic Sites Act. This survey was conducted under contract for SEH. A concurrent reconnaissance architectural history survey for this Project was conducted, with funding coming from a separate source and, therefore, a separate report was prepared (Gallo et al. 2021).

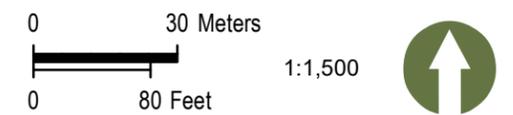
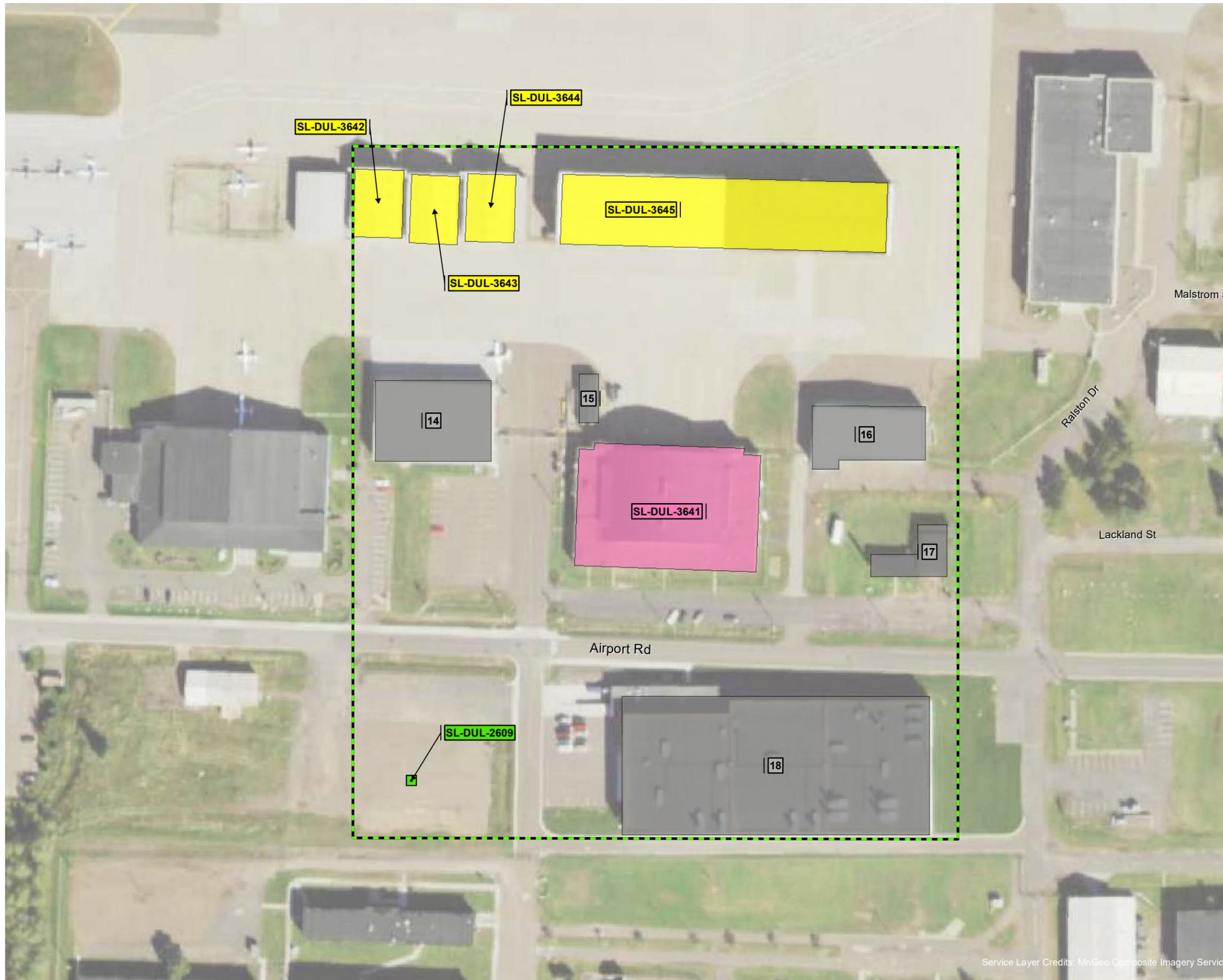
The Project area is located in Section 2, Township 50, Range 15W, Duluth, St. Louis County, Minnesota (Figure 1). An appropriate area of potential effect (APE) for architectural history accounts for any physical, auditory, atmospheric, or visual impacts to historic properties. Based on the current Project plans, the recommended architectural history APE includes all standing structures located adjacent to Hangar 101. The recommended architectural history APE includes approximately 15.7 acres (6.4 hectares [ha]). The intensive architectural history survey consisted of historical research, field survey, and an evaluation for eligibility for listing in the National Register of Historic Places (NRHP). Saleh Miller, M.S., served as principal investigator for architectural history.

The following report describes project methodology, previous investigations, historic contexts, results, and recommendations for the Project area. An inventory form has been prepared and submitted separately to the Minnesota State Historic Preservation Office (SHPO). A list of Project personnel can be found in Appendix A.

Duluth International Airport Master Plan Project Intensive Architectural History Survey of Hangar 101

Duluth, St. Louis County, Minnesota

- Project Area / Architectural History APE
- No Longer Extant
- Not of Age
- Not Recommended for Intensive Survey
- Recommended Eligible



Project Location, APE, and Results

2.0 METHODS

2.1 Objectives

The primary objective of the architectural history survey was to determine whether Hangar 101 is eligible for listing in the NRHP. All work was conducted in accordance with the SHPO *Historic and Architectural Survey Manual* (SHPO 2017) and *The Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* [48 Federal Register 44716-44740] (National Park Service [NPS] 1983).

2.2 Area of Potential Effect

The APE for architectural history accounts for any direct (physical) or indirect (auditory, atmospheric, or visual) effects to historic properties. The proposed Project includes the demolition of Hangar 101. The potential effects from the proposed Project include temporary vibrations, noise, and traffic impacts during demolition of Hangar 101, permanent visual effects, and permanent physical effects due to the demolition. Therefore, the recommended APE includes all adjacent standing structures.

2.3 Background Research

In April 2021, 106 Group began a reconnaissance architectural history survey for the Project. Initial research suggested that Hangar 101 may be potentially eligible for listing in the NRHP, and therefore, this intensive architectural history survey was undertaken from August to September 2021. In May, staff from 106 Group conducted background research remotely at SHPO for information on previously inventoried properties and on surveys previously conducted within the recommended architectural history APE.¹ Research was also conducted at the Minnesota Historical Society, University of Minnesota libraries, Northwest Architectural Archives, and online repositories. Research included a review of aerial photographs; historic maps; newspaper articles; building drawings and plans; Historic American Buildings Survey documentation; history of the Duluth airport, Air National Guard unit, and Duluth Air Force Base; and *Architectural Record* and *Engineering News Record* articles.

2.4 Field Methods

The intensive architectural history survey of the Project area was conducted on May 25, 2021. Erin Que, M.A., and Steve Gallo, PhD, conducted the fieldwork (see Appendix A for a list of Project personnel). The exterior of Hangar 101 was documented with field notes and digital photographs. Supplemental interior photographs were provided by SEH.

2.5 Inventory Form

A Minnesota Individual Property Inventory Form was prepared for Hangar 101 for submittal to SHPO for its review.

¹ For background research regarding known historic properties and previously conducted cultural resource surveys, we rely primarily on the information on file at SHPO. 106 Group cannot guarantee the accuracy and reliability of the data provided.

2.6 Evaluation

Upon completion of the fieldwork, the eligibility of Hangar 101 for listing in the NRHP was assessed based on the property's significance and integrity. The NRHP criteria, summarized below, were used to help assess the significance of the property:

- Criterion A – association with the events that have made a significant contribution to the broad patterns of our history;
- Criterion B – association with the lives of persons significant in our past;
- Criterion C – embodiment of the distinctive characteristics of a type, period, or method of construction; representation of the work of a master; possession of high artistic values; or representation of a significant and distinguishable entity whose components may lack individual distinction; or
- Criterion D – potential to yield information important to prehistory or history (NPS 1997 [1995]).

The NPS has identified seven aspects of integrity to be considered when evaluating the ability of a property to convey its significance: location, design, setting, materials, workmanship, feeling, and association. The integrity of this property was assessed in regard to these seven aspects (NPS 1997 [1995]).

3.0 LITERATURE REVIEW

3.1 Previous Architectural History Studies

One architectural history survey has previously been conducted and one historic property has previously been inventoried within the recommended architectural history APE. In 2006, 106 Group conducted a cultural resources survey of the Duluth Air National Guard Base (Bradley et al. 2006). This survey documented all properties at the Duluth International Airport that were owned or leased by the 148th Fighter Wing of the Minnesota Air National Guard in 2006 (Figure 1; Table 1).

Table 1. Previously NRHP-Listed, Eligible, or Inventoried Architectural History Properties Within the APE

Inventory No.	Property Name	Address	NRHP Status
SL-DUL-2609	Commissary / Building 206	4970 Airport Road	Non-extant

3.2 Property-Specific Historic Context

For the purpose of this architectural history survey, and the concurrent reconnaissance architectural history survey for the Duluth International Airport Master Plan Project (Gallo et al. 2021), the following property-specific historic context was developed: “History of the Duluth International Airport, 1929 – present.”

3.2.1 History of the Duluth International Airport, 1929 – present

The Duluth International Airport (DIA) is a city-owned, public airport that is jointly used as a civil and military airport. It is located six miles northwest of downtown Duluth, Minnesota.

3.2.1.1 Establishment of DIA & Air Mail Service

DIA was originally established as the William-Johnson Municipal Airport (WJMA), which played a significant role in the early history of Minnesota-based Northwest Airlines, a major United States (U.S.) airline that was founded in 1926 and merged with Delta Airlines in 2008 (Sandvik 1986:93; Steenland 2008). Commercial flight in the U.S. was severely limited in the 1920s due to a combination of slow aircraft and preexisting railway networks that gave the public little incentive to travel by air.

Consequently, early air transportation in the U.S. was almost exclusively devoted to airmail deliveries directly run by the federal government. The effort to establish a national airmail network was boosted and augmented in 1925 when Congress passed the Air Mail Act, which authorized the Postmaster General to determine airmail routes, contract with private carriers, and pay them a subsidy. This caused the United States Postal Service (USPS) to seek bids from private companies to transport mail over their Contract Air Mail routes (CAMs) from late 1925 to early 1926. Northwest Airlines (called Northwest Airways, Inc., at the time) was awarded a contract for CAM #9, which ran from Chicago to the Twin Cities via Milwaukee and La Crosse. Such a contract was a vital means of keeping Northwest Airlines financially viable at a time when no airline could make a profit by carrying passengers alone (Sandvik 1986:89-95).

With CAM #9 secured, Northwest Airlines sought to expand its services for both airmail and passengers. For the remainder of the decade, the airline added more routes throughout the region. It became an early international airline in 1928 when it began weekly services between the Twin Cities and Winnipeg via Fargo (though the Fargo-Winnipeg service was suspended after three months due to opposition from the Canadian government). Services were also added to Green Bay, Fond du Lac, Oshkosh, Neenah-Menasha, and Appleton, Wisconsin that year. Flights to Rochester, Minnesota, began in 1929. While passenger numbers were slowly increasing during this period, profit was still derived from airmail contracts. As a result, these services carried passengers and mail cargo simultaneously (Northwest Airlines History Center 2021).

Duluth's civic leaders sought to stimulate the city's economy by establishing an airmail route to the city. While the city's economy was robust in the 1880s and 1890s from the shipping boom, it began to show signs of slowing by the 1920s (Eubank 1991:1-2). Community leaders of the era not only considered it a point of civic pride to be included in the USPS airmail routes, but there was a strong conviction among the commercial class that the new form of transportation would stimulate business much as the railways had (Sandvik 1986:89). The thought process was no different in Duluth. When the city began holding public meetings on the idea of issuing up to \$200,000 in bonds to establish a municipal airport in 1928, the plan quickly gained the support of the Duluth Chamber of Commerce as well as over 100 of the city's leading businessmen (Associated Press 5 June 1928:9; The Minneapolis Star 15 June 1928:7). The city purchased 640 acres of property from St. Louis County to establish a municipal airport in 1929 and held a public celebration to mark the completion of an aircraft hangar and administrative building on the site in 1930 (RS&H 2015:33; Associated Press 14 April 1930:13; The Minneapolis Tribune 14 September 1930:11). The airport featured three 2,650-foot turf runways. The runways were identified as Runway 3-21; Runway 9-27; and Runway 13-31. Runway 9-27 ran east-west, Runway 3-31 ran north-northeast to south-southwest, and Runway 13-31 ran northwest to southeast. All three runways intersected in the southeast quadrant of the airport (RS&H 2015:33). The three turf runways were paved and extended in 1942, with each runway measuring 4,000 feet long by 150 feet wide. Runways 9-27 and Runway 3-21 were extended by the U.S. Army Corps of Engineers in 1945, to 5,660 feet long (RS&H 2015:33).

The opening of DIA did not invigorate Duluth's economy as civic leaders had hoped, although it proved beneficial to Northwest Airlines. The city's economic growth stagnated along with the rest of the country during the Great Depression of the 1930s and was only revitalized by the production demands of World War II (Eubank 1991:2, 32). The USPS awarded Northwest Airlines a new airmail contract for a route between the Twin Cities and Duluth, in addition to one between Fargo and Bismarck, in May of 1931 (The Minneapolis Tribune 12 May 1931:21). Passenger services were offered on the Twin Cities-Duluth route at the same time. The airline initially intended to land on Lake Superior, purchasing two 8-passenger Sikorsky S-38 amphibian aircraft to service the route, but they switched the vehicles for a Hamilton model and began landing at DIA in December of 1931 when ice on the lake made water landings impractical and unsafe (Northwest Airlines History Center 2021; The Minneapolis Tribune 12 May 1931:21). Northwest's services to Duluth lasted until 1933, when the federal government took control of all airmail routes amidst suspicions of corruption. The airline was able to regain most of its routes the following year, but Duluth was not among them. Duluth remained without any airmail services

as late as August of 1935 (Northwest Airlines History Center 2021; Associated Press 28 August 1935:2). Northwest Airlines did not resume passenger service to the airport until 1940, when three 10-passenger planes carrying public and company officials took off from Minneapolis and landed in Duluth within an hour. They were greeted by a large crowd that had gathered to celebrate the route's inauguration (RS&H 2015:33; The Minneapolis Tribune 2 June 1940:31).

Despite the discontinuation of the Twin Cities-Duluth airmail route after only two years, it was nonetheless a critical component of Northwest Airline's financial success. It was one of several regional airmail routes that provided the company with the revenue needed to steadily expand its services westward and survive the economic tumult of the Great Depression. As a result, Northwest Airlines was able to strengthen its dominant position within the airline industry in the decade prior to World War II and thrive throughout the remainder of the twentieth century (Sandvik 1986:98).

3.2.1.2 DIA and Cold War Defense

The DIA played a notable role in the defense of the U.S., particularly during the Cold War period, through the establishment of both an Air National Guard unit as well as a U.S. Duluth Air Force Base at the DIA.

In 1948, an Air National Guard (ANG) unit was established in Duluth through the reactivation of the 179th Fighter Squadron, which was part of the 133rd Fighter Group that was headquartered in St. Paul. World War II veterans were recruited to join the new ANG unit in Duluth (Bradley et al. 2006:13). The ANG headquarters are located in the northeast quadrant of the airport, on the east side of Runway 3-21. The creation of the ANG unit coincided with the build-up of air defense capabilities at the beginning of the Cold War. At its inception, the 179th Fighter Squadron's main mission was to intercept bombers that might fly through Duluth and to identify unknown aircraft in the region near the U.S./Canada border. As Cold War tensions rose, the ports in Duluth were identified as resources that needed the highest priority for protection, as Duluth was the vital head of shipping on the Great Lakes (Bradley et al. 2006:18). Permanent facilities were built for the ANG between 1948 and 1951, and included taxiways, a main hangar, a heating plant, a sewage disposal facility, a water tank, the squadron operations and headquarters building, and more (Bradley et al. 2006:13-14). Air defense facilities and operations were scaled back in Minnesota in the 1970s, however, the ANG still operates to this day out of the DIA and is serviced by the 148th Fighter Wing of the Minnesota Air National Guard.

The U.S. Air Force also contributed to the development of the DIA. After World War II ended, the U.S. Air Force constructed permanent and semi-permanent buildings on the airport grounds, in the south/southwest area of the airport, south of Runway 9-27, and played a key role in the development of much of this area of the airport grounds. In August of 1950, Air Force officials considered the Williamson-Johnson Airport at Duluth as a location for a Fighter Squadron. Soon after the ANG unit at Duluth was called to active service, in 1951 the Central Air Defense Force of the Aerospace Defense Command (ADC) took jurisdiction over the airport at Duluth. At that time, the Air Force also had control of the Duluth ANG facilities while that unit was federalized. The Air Force began to develop a base in the area, located south of the main runway at the airport. The first facilities for the Air Base, constructed during 1951 and 1952, included a hangar, temporary shacks next to the hangar, a motor service building,

a crash and rescue station, and a heating plant. Within another year, a ground control approach and instrument landing system, aircraft hangars, exchange building, ammunition storage area, runway and taxiway extensions and improvements, mess facility, administration buildings, readiness building, and communication and utility systems were completed. A new base headquarters building was completed in 1954. A family housing facility was added to the base in 1956 (Bradley et al. 2006:20).

The Duluth Air Base was expanded in 1957 with the development of the Semi-Automatic Ground Environment (SAGE) facility, which was located west of the main portion of the base. The SAGE facility increased the base's role in the air defense mission and was responsible for monitoring a large area of the northern U.S. and Canada. The Duluth Air Base also was home to units who worked on strategic national defense operations like the North American Aerospace Defense (NORAD), in partnership with the Royal Canadian Air Force, and the Duluth Air Defense Sector (DUADS), which became operational in 1959 (Bradley et al. 2006:21). For much of the Cold War, Air Force Fighter Interceptor Squadrons (FIS) stood at alert on bases in Duluth and Minneapolis, ready to protect the U.S. from attack from foreign enemies (Bradley et al. 2006:20). During the Cold War, the Duluth Air Base had missions that were related to, but separate from, those of the Air National Guard. The main mission of the units stationed at the Duluth Air Base was air defense.

Through reorganization and reassignment of defense missions, the Duluth Air Base was deactivated in 1981 by the United States Air Force (Bradley et al. 2006:21). The ANG inherited portions of the Duluth Air Base and much of the area was converted into a Federal Prison Camp, which is still operational. The southwest quadrant of the airport is now the core area for general aviation, air cargo, and special aviation service organizations (RS&H:41-42).

3.2.1.3 Present-day DIA

In 1951, an air traffic control tower was erected and the original passenger terminal was constructed southwest of the intersection of Runways 3-21 and 9-27 in 1954. The airport was renamed DIA in 1961. In 1974, a 52,400-square-foot passenger terminal building and U.S. customs facility was constructed to the southeast of the runway intersection, east of the terminal constructed in 1954. Consequently, Runway 13-31 was shortened to 2,578 feet to accommodate building construction, then subsequently converted into a taxiway, and eventually closed in 1980. The former terminal building, located southwest of the runway intersection, was converted for use as offices for general aviation, and for use by the FAA and the U.S. Weather Bureau. In 1989, the three-story 1974 passenger terminal building was remodeled to form a single enclosure totaling 106,000 square feet (RS&H 2015:33).

After September 11, 2001, new federal security requirements deemed the passenger terminal functionally obsolete as the tails of parked airplanes extended too close to the runway airspace surfaces. Construction began on a new terminal in 2010, which opened in 2013, and included the replacement passenger terminal, an expanded apron, and new auto circulation and vehicle parking facilities. The new terminal was named the *James L. Oberstar Terminal* after late U.S. Representative Jim Oberstar, who represented the congressional district the airport lies within from 1975-2011 (RS&H 2015:33).

The DIA is Minnesota's third busiest airport, after Minneapolis-St. Paul International Airport (MSP) in Minneapolis, and Rochester International Airport in Rochester. Three airlines service the airport: Delta Airlines, United Airlines, and Sun Country Airlines, however, the largest sources of air traffic comes from general aviation, which is civilian aircraft not associated with commercial air transport. The Duluth Air National Guard Base is still located at the airport, as well as airplane manufacturer Cirrus, which makes single-engine light aircrafts.

4.0 RESULTS

Staff from 106 Group conducted fieldwork of the recommended APE on May 25, 2021. Saleh Miller, M.S., served as principal investigator (see Appendix A for a list of Project personnel). During the intensive architectural history survey, Hangar 101 was surveyed and recommended eligible for listing in the NRHP (Figure 1; see Section 4.1). Five properties within the recommended APE are undergoing a concurrent reconnaissance architectural history survey, and have not been recommended for intensive-level survey due to a lack of historical significance (Gallo et al. 2021) (Figure 1; Table 2). Five properties within the recommended APE are less than 45 years of age, and therefore, do not meet the criteria for survey (Figure 1; Table 3).

Table 2. Properties Not Recommended for Intensive Survey

Inventory No.	Property Name	Address	Date
SL-DUL-3642	Hangar 106	4525 Airport Approach Road	1960
SL-DUL-3643	Hangar 107	4525 Airport Approach Road	circa 1960
SL-DUL-3644	Hangar 105 / EAA 272	4525 Airport Approach Road	circa 1960
SL-DUL-3645	Hangar 104	4926 Malstrom Street	circa 1960

Table 3. Properties Not of Age in the APE

Field Number	Property Name	Address	Date ²
14	Hangar	4946 Airport Road	circa 2005
15	Prefabricated Trailer	4931 Airport Road	circa 2005
16	JetDuluth	4913 Airport Road	circa 2005
17	Hermantown Hydraulics	4905 Airport Road	circa 1980
18	Cirrus Finishing Center	4940 Airport Road	circa 2016

4.1 Hangar 101, SL-DUL-3641

Location:

4931 Airport Road, Duluth, St. Louis County, Minnesota

Description:

Hangar 101 is a single-bay, arched-roof hangar that is flanked by two-story, flat-roof maintenance and office wings on the east, south, and west elevations (Figures 2-3). The hangar is located in the southwest

² Build dates were based on County parcel data and aerial photographs.

quadrant of the DIA, along the south side of Runway 9-27. The hangar and the wings were constructed simultaneously, circa 1952 (Nationwide Environmental Title Research, LLC [NETR] 1952).



Figure 2. Hangar 101, North Elevation, Facing Southeast (106 Group, May 2021)



Figure 3. Hangar 101, Facing Northwest, Showing Collapsing Wings (106 Group, May 2021)

The wings obscure the view of the arched-roof hangar sections such that the arched-roof hangar section is only visible above the two-story wings. Clerestory sections are located on the east and west elevations, above the two-story wings. The building is clad in horizontal wood siding and replacement vertical metal panels. The north elevation features a tall, 14-leaf sliding metal door that splits in the middle. Signs at the top of the arched section on the north and south elevations read “CAF.” The north elevation also features a small sign that reads “Aviation Museum” above the 14-leaf sliding door. Two wood-sided mechanical boxes are located at the top of the arched-roof hangar section. The two-story wings on the east, south, and west elevations have collapsed in several locations and the interior of the building is visible through these sections.

Fenestration on the north elevation includes the 14-leaf sliding metal door; three sets of 20-light windows in each door panel; and a 36-light metal window.

Fenestration on the east elevation includes three-light metal windows on the clerestory of the central hangar section. On the wing on the east elevation, fenestration includes a modern metal overhead garage door with three oval lights; single-light fixed metal windows; and single-leaf modern metal doors with single-lights.

Fenestration on the south elevation includes modern two-light sliding metal windows with transoms; single-leaf metal doors with single-lights; and single-light fixed metal windows.

Fenestration on the wing on the west elevation includes modern two-light sliding metal windows with transoms; single-leaf metal doors with single-lights; single-light fixed metal windows; and a modern overhead metal garage door. Fenestration on the clerestory of the central hangar section of the west elevation includes fixed metal windows.

The interior of the central hangar section consists of a large unobstructed open area with a poured concrete floor and poured concrete walls (Figure 4). On the east and west walls, the concrete walls extend from the floor to the bottom of the wooden crescent arches. On the south wall, the concrete wall stops halfway from the floor to the top of the crescent arch; above the concrete wall, the remainder of the wall is constructed of wood framing and cladding. The north wall is comprised of a pair of seven-leaf sliding doors. Each leaf is set on wheels, which move the leaves along seven parallel tracks inlaid into the concrete floor. When the doors are open, each leaf recesses behind the preceding leaf into a wood-clad pocket structure that extends beyond the width of the hangar.

The roof system of the hangar consists of seven, two-hinged, wooden crescent arch trusses (Figure 4). The trusses are approximately 164 feet from east to west, and are spaced approximately 23 feet apart, north to south (Google Earth 2021). Each truss is a crescent truss with an arched top and bottom chord and has wooden vertical and diagonal members arranged in a saw tooth pattern. Wooden lateral bracing between the trusses is in a vertical “X” pattern. The roof rafters span between the trusses and the rafters are sheathed with wooden boards laid at a diagonal. Each truss is bolted to concrete piers/buttresses embedded into the concrete walls on the east and west sides of the hangar.



Figure 4. Hangar 101, Interior of the Central Hangar, Facing Northeast (SEH, March 2021)

Integrity

This property retains excellent integrity of location as it remains in its original location on the south side of the main runway at the DIA. The integrity of setting has been slightly compromised by the expansion of the airport runways over time, the loss of some surrounding historic buildings, particularly the Readiness Building, which was historically immediately to the west of Hangar 101, and the addition of new buildings in the vicinity. The integrity of design remains good, as the building does not appear to have had any significant changes that have altered the historic form of the building. The building was originally constructed with the wings and it retains its historic configuration of the central arched hangar flanked by wings on the east, west, and south elevations. Additionally, the wooden crescent trusses on the interior of the central hangar section, which give the hangar its distinctive structural system, remain intact. The integrity of materials is fair due to the addition of some modern materials, particularly on the wings. Such non-historic materials include vertical metal panels, modern doors, and windows, as well as some sections of the wings that have collapsed on the east, south, and west elevations. However, the north elevation of the hangar still retains its original wood cladding and metal hangar doors, thus retaining its historic appearance on the prominent elevation. The integrity of workmanship is good, as the central hangar section retains its distinctive structural system. The integrity of feeling has been slightly compromised by the current vacant status of the building, lack of use as a military airplane hangar, and collapsing condition of the wings. However, the central hangar section of the building retains its open, unobstructed space, which allows the vastness of the structure and its use as a hangar to still be understood. The integrity of association is fair as the conversion of many of the surrounding building to a

federal prison minimizes the connection of the hangar to the former Duluth Air Base. Overall, this property retains fair integrity.

Statement of Significance:

Property History

This airplane hangar and its wings appear to have been constructed by 1952, when it is visible on historical aerial photographs (NETR 1952). In the DIA's 2015 Master Plan, this hangar is referred to as "Hangar 101," which is denoted as a "common hangar" and has an area of 20,000 square feet (RS&H 2015:52).

This hangar appears to have been constructed by the U.S. Air Force for the Duluth Air Base, which was operational from the 1950s to 1981. According to the DIA's Master Plan, the Air Force was responsible for developing much of the southwest quadrant of the DIA. Between 1951 and 1952, essential facilities for the Duluth Air Base were constructed, including "a hangar, temporary shacks next to the hangar, a motor service building, a crash and rescue station, and a heating plant" (Bradley et al. 2006:20).

Hangar 101 is one of the first buildings visible in historical aerial photographs of the area that was to become the Duluth Air Base, and is likely the "hangar" referenced in the essential facilities constructed by the Air Force in 1951-1952 (RS&H 2015:41-42; NETR 1952). In a 1952 historical aerial photograph of the Duluth Air Base, Hangar 101 is visible, along with a cross-shaped building immediately to the west of the hangar (NETR 1952). On construction site plans from 1954 for a different hangar – Hangar 103 – which is immediately west of the cross-shaped building, the cross-shaped building is identified as a "Readiness Building" and Hangar 103 is identified as "Maintenance Hangar with Shops A and B." However, Hangar 101 is not identified or named on the site plan for the Maintenance Hangar despite being depicted on the plans (Toltz, King & Day Inc. 1954). Plans, drawings, or historic names for this building, beyond the "Hangar 101" name established by the DIA, have not been found for Hangar 101.

Based on its location and function, the U.S. Air Force appears to have been responsible for the construction of Hangar 101 in the early 1950s. However, this was not able to be corroborated by primary source material. The history of airplane hangar design and construction in the U.S., and particularly hangar construction employed by the U.S. military and especially the Air Force, is inextricably tied to military aircraft advancements and the limitations on construction stemming from the U.S. military involvements from the early to mid-twentieth century. An airplane hangar is generally defined as a utilitarian structure that is used to house and service aircraft. Character defining features of a hangar include a large, unobstructed area that has sufficient space, which includes vertical clearance and floor space, to accommodate an aircraft, and an unobstructed opening that is tall and wide enough to allow an aircraft to pass through (McCormick and Hufstetler 1994:8). Increased attention to airplane hangar design and construction coincided with the growth and build-up of airfields throughout the U.S. during World War I. Hangars were necessary for airplane storage and as a place to do repair and maintenance work on aircraft. As such, during World War I, the U.S. Army created a standardized hangar design that could be easily adapted for each airfield. These early hangars were utilitarian in design and were rectangular, wooden structures that could house several aircraft. Wooden trusses were a popular solution for

structurally supporting roofs from the 1900s through the 1950s, especially in buildings where large, open spans were desired (Martinez et al. 2018). The hangars had low gambrel roofs and plain sliding doors at either end wall (McCormick and Hufstetler 1994:8). Larger, more technologically advanced aircraft were developed post-World War I and additional aviation advancements after World War II, including the development of jets, rockets, and helicopters, necessitated changes in hangar design and construction (NPS 1998:11). The post-World War II time period saw hangars being constructed of reinforced concrete or structural steel framing, which better accommodated the larger widths and heights of increasingly larger aircraft. Wings or lean-to additions also became common along one or both sides of the hangar to provide space for mechanical and auxiliary facilities. Banks of large windows were also found in hangars constructed during this time period to provide interior light and ventilation (McCormick and Hufstetler 1994:9).

Rising international tensions during the late 1930s prompted the first major build-up of Army air bases since 1918 and resulted in the construction of large hangars with clear-span interiors of 200 to 275 feet wide (McCormick and Hufstetler 1994:9). In 1941, as the need for more hangar space became critical, the Army turned to hangar designs that could be easily, quickly, and cheaply assembled. Hangars featured Warren-type roof trusses supported by steel columns; multi-leaf, sliding hangar doors that opened at one or both ends of the hangar; steel sash windows; fire resistant materials, such as asbestos-protected metal or corrugated asbestos siding; and wings along the sides of the hangar that provided needed auxiliary spaces (McCormick and Hufstetler 1994:9). World War II imposed restrictions on steel and other materials, and such limitations resulted in hangars being constructed with alternative materials, particularly wood trusses and reinforced concrete. A widely used design from this time featured a structural system that was formed by a series of closely spaced wooden ribs, of which one of three truss systems were employed: the arch rib, the bowstring arch, or the crescent arch. The bowstring arch featured an arched top chord and a straight bottom chord, while the crescent arch featured an arched top and bottom chord. The wooden members were constructed of small sections of laminated lumber, stacked together and bent to the curve of the arch radius, and then glued and spiked together (*Engineering News Record* 1944:118). Wooden arch trusses in either the bowstring arch or crescent arch configurations were supported on a system of concrete beam and buttressed columns (McCormick and Hufstetler 1994:9). For the most part, military hangars during World War II were used only for the storage and maintenance of aircraft (McCormick and Hufstetler 1994:10).

The Cold War era that followed World War II necessitated a change in hangar function from one of storage and maintenance to one of facilitating national defense capabilities. During the 1950s, the newly-created U.S. Air Force established air bases at strategic locations through the country to defend the country from any possible threats and attacks; the Duluth Air Base is one such example. As part of the air base development, specialty hangars were developed to house fighters, tankers, and other military aircraft at “readiness,” meaning they were ready to take off at a moment’s notice to defend the base and the surrounding area from an outside attack (McCormick and Hufstetler 1994:10). These specialty hangars were typically constructed at locations that would provide quick access to an air base’s runway and fell into one of two categories: an “alert” hangar and a “readiness” hangar. They are defined as follows:

Alert hangars were designed to hold aircraft that could be manned and airborne within 90 seconds. The standard alert hangar plan featured four separate hangar “pockets,” each designed to shelter a single plane and equipped with fast-operating hangar doors at both ends. The pockets were configured in pairs on both sides of a central block, which contained maintenance facilities and waiting rooms for the flight crews (McCormick and Hufstetler 1994:10).

In contrast, a readiness hangar was intended as a more multi-purpose facility. First, it provided a space where planes could be kept under cover and warm, and taken out to the runway with considerable dispatch, although not quite as quickly as from an alert hangar. Second, it acted as an aircraft maintenance shop. Readiness hangars typically utilized the form of a standard World War II aircraft hangar: a central hangar space flanked on both sides by wings housing workshops, a boiler room, and other facilities. Such buildings typically had sufficient clearance and floor space to accommodate all but the largest bombers of the 1950s era (McCormick and Hufstetler 1994:10).

While the first function of a readiness hangar was to house planes at the “ready,” the second function of a readiness hangar is maintenance. Indeed, as described in a 1952 issue of the *Architectural Record*, “[t]here is no thought, however, that planes would be kept lined up for instant service, or that they would actually flown out of the hangar. The readiness hangar is also a maintenance shop for anything short of major overhaul. It is quite possible to use the hangar for both readiness and service at the same time” (Architectural Record 1952:99).

Hangar 101 is designed with a large arched-roof hangar section in the center of the building and wings flanking the central hangar space along the east, south, and west elevations. In the interior of the hangar space, the hangar was designed using the crescent arch support system, a commonly used truss system stemming from material shortages during World War II (McCormick and Hufstetler 1994:9). The wooden crescent trusses are constructed with arched top and bottom chords that support the distinctive arched roof of the hangar. These trusses are braced by vertical bracing in a “V” pattern between the top and bottom chords. The use of such trusses allowed for an unobstructed interior hangar space to accommodate aircraft inside the hangar. The wings are two stories tall and likely provided auxiliary, office, and storage space for the hangar.

Architectural drawings and plans specific to Hangar 101 have not been found, nor has an architect or engineer of record. However, Hangar 101 is remarkably similar to the now-demolished Readiness Hangar that was constructed at Ellsworth Air Force Base in South Dakota in 1952 (see Figures 5-6). Like Hangar 101, the Ellsworth Readiness Hangar was a single-bay, arched-roof hangar flanked on the sides by shed-roof wings. The interior roof system of the Ellsworth hangar was constructed of seven, two-hinged wooden crescent arched trusses (McCormick and Hufstetler 1994:13). Hangar 101 is also constructed of seven, two-hinged wooden crescent arched trusses, and, like the Ellsworth Hangar, is of nearly the same dimensions: 160 feet by 118 feet. Also like Hangar 101, the Ellsworth Readiness Hangar was constructed in line with the Air Force’s efforts to improve the nation’s defense capabilities during the onset of the Cold War. The Ellsworth Readiness Hangar was documented by the Historic American Building Survey

(HABS) in 1994 prior to its demolition; that documentation noted that the hangar was a “significant representation of period military hangar architecture...and its configuration typifies the basic form preferred for a readiness hangar by military planners of the early 1950s” (McCormick and Hufstetler 1994:2). While documentation has not been found on the historic use of Hangar 101, it is possible that the structure served as a readiness hangar for the Duluth Air Force Base, as both the Duluth Air Force Base and the Ellsworth Air Force Base both served air defense missions during the Cold War era.



Figure 5. Ellsworth Readiness Hangar, Exterior (McCormick and Hufstetler 1994)



Figure 6. Ellsworth Readiness Hangar, Interior Wooden Crescent Arched Trusses (McCormick and Hufstetler 1994)

The Duluth Air Base was closed in 1981. At that time, many of the buildings of the Duluth Air Base were converted into a federal prison. The Duluth ANG also took ownership of many buildings. It is not known how or by whom Hangar 101 was used after this time. However, the north and south elevations of the hangar feature signs that read “CAF.” The Confederate Air Force, now known as the Commemorative Air Force (CAF), occupied the building beginning at an unknown date, until 2018. The CAF acquires, restores and preserves a collection of combat aircraft that were flown by all military services of the U.S. The CAF used Hangar 101 as their maintenance shop and aviation museum until they moved to a new location in Superior, Wisconsin, in 2018 (CAF 2021). Since 2018, Hangar 101 has remained vacant.

Significance

Hangar 101 was evaluated within the context “History of the Duluth International Airport, 1929-present” (see Section 3.2.1). The U.S. Air Force operated an air base at the DIA from the 1950s to 1981; during this time the Air Force built multiple structures to support their operations. Based on its location and function, Hangar 101 was likely constructed by the U.S. Air Force at a time of growth and expansion of the airport, in the early 1950s. This hangar appears to be one of the first structures constructed by the Air Force as part of this expansion. As the key role of the Duluth Air Base during this time was air defense, it is possible Hangar 101 was constructed as a readiness hangar and could have played an integral role in the Air Base’s ability to fulfill its mission. Indeed, constructing a hangar as one of the first buildings on the new Air Base suggests that the hangar likely played a needed role in air defense while other strategic defense equipment, such as the SAGE system, were still under construction. However, documentation as to Hangar 101’s historic name, use, or role within the air defense mission of the Duluth Air Base has not been found within the archives of the Minnesota Historical Society, the Northwest Architectural Archives, or in the records at the DIA. Online research regarding this hangar and the Duluth Air Base also yielded little information. As such it is not possible at this time to definitively evaluate Hangar 101’s significance in the defense mission of the Duluth Air Base. Further research into the historic role of Hangar 101 is necessary to determine any potential significance under NRHP Criterion A.

This property is not known to be associated with significant individuals and, therefore, does not have significance under NRHP Criterion B.

National Register Bulletin #43 notes that air-related facilities may be eligible for the National Register of Historic Places (NRHP), in the area of Architecture, if they are good representations of a type, period, or method of construction (NPS 1998:46). Hangar 101 was constructed with a central arched-roofed hangar section that is flanked on the east, west, and south elevations by shed-roof wings. The central hangar section is an open expanse created by seven wooden crescent arches with arched top and bottom chords. The remarkably similar Readiness Hangar at the Ellsworth Air Force Base was a documented standard plan hangar designed by the Air Force. Based on the design of this hangar, it is likely Hangar 101 was a standard military plan designed by the U.S. Army Corp of Engineers, which played a key role in the drafting and standardization of military hangars and buildings during this time period. Such Air Force standard plan hangars included character defining features such as unobstructed hangar space, maintenance and auxiliary spaces flanking the hangar area, and large doors that allowed aircraft to pass through. These types of hangars serve as significant representations of a period military airplane hangar architecture, as the building’s form and design were preferred by the military for new hangar construction

during World War II and influenced hangar design through the Cold War. Additionally, Hangar 101 was constructed using wooden crescent trusses, which is a somewhat unusual construction material for a post-World War II hangar. Wartime material shortages had eased by the time Hangar 101 was constructed and hangars constructed in the 1950s typically relied on heavy steel framing for the structure and cladding; as exemplified by Hangar 103 (the Maintenance Hangar with Shops A and B) at the DIA, which was constructed around 1954 (McCormick and Hufstetler 1994:11). The reason for Hangar 101's wood construction is not known, although it could be theorized that the wooden arch design was less expensive than a steel design, or may have allowed for the use of an already-existing blueprint. While wooden construction hangars were popular in early hangar construction, a 2011 report on hangar construction from World War I through the Cold War noted that few wooden hangars survive, with many having been demolished (such as the Ellsworth Readiness Hangar) and extant ones scheduled for demolition (Aaron 2011:77). Therefore, Hangar 101 is a rare example of a diminishing number of wooden Air Force designed hangars. As such, Hangar 101 has significance under NRHP Criterion C, in the area of Architecture, for its embodiment of typical period military airplane hangar construction, its unique wooden crescent truss method of construction used during a time period of heavy steel construction, and its likely association as an Air Force standard plan hangar. The recommended period of significance is circa 1952, when the hangar and its wings were constructed. The recommended property boundary is the footprint of the hangar and the wings.

This property has not yielded, nor is likely to yield, information important in prehistory or history. Therefore it does not appear to have significance under NRHP Criterion D.

Recommendation

Hangar 101 is recommended as eligible for the NRHP under Criterion C, in the area of Architecture. The recommended property boundary is the footprint of the hangar and the wings.

5.0 RECOMMENDATIONS

During the intensive architectural history survey, 106 Group recommended Hangar 101 as eligible for listing in the NRHP under Criterion C, in the area of Architecture. The proposed demolition of this historic structure would be considered an adverse effect, and therefore, consultation with FAA and SHPO is recommended in order to determine an appropriate form of mitigation.

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APPENDIX A: PROJECT PERSONNEL

LIST OF PERSONNEL

Project Manager

Saleh Miller, M.S.

Principal Investigator

Saleh Miller, M.S.

Historians

Kelli Andre Kellerhals, M.S.

Steve Gallo, PhD

Saleh Miller, M.S.

Erin Que, M.A.

Graphics and GIS

Molly McDonald, MGIS

Minnesota Individual Property Inventory Form

Please refer to the Historic and Architectural Survey Manual before completing this form.

Must use Adobe Acrobat Reader to complete and save this form. Adobe Acrobat Reader can be downloaded at: <https://get.adobe.com/reader/?promoid=KLXME>

General Information

Historic Name: Hangar 101
Other Names: _____
Inventory No: SL-DUL-3641
Associated MN Multiple Property Form (Name and Inventory No.): _____
New or Updated Form: New Review and Compliance No.: _____
Extant: Yes Agency Proj No.: _____
Survey Type: Intensive (Phase II) Grant No.: _____

Location Information

Street Address: 4931 Airport Rd
County(s): Saint Louis City/Twp(s): Duluth

Total Acres: 0.833203

USGS 7.5 Quad Name(s): Duluth Heights, 1993

UTM Coordinates:

Datum: NAD 83

TOWNSHIP	RANGE	E/W	SECTION	QQQ	QQ	Q
50	15	West	2		SE	SE

UTM Zone	Easting	Northing
15N	561173.119243	5187451.89946

Urban:

Subdivision: AIRPORT DIVISION
Block(s): 4
Lot(s): 2

Property Identification Number (PIN): 010-0148-00210

Previous Determinations

Previous Individual Determination:

- National Register Listed
- NPS DOE
- State Register Listed
- CEF
- SEF
- Locally Designated
- Not Eligible

Previous District Determination:

District Name: _____
 Within a National Register-Listed District
Contributing Status: _____
 Within a State Register-Listed District
Contributing Status: _____
 Within a CEF District
Contributing Status: _____

Within a SEF District
Contributing Status: _____
 Within a Locally Designated District
Contributing Status: _____

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

Classification

Associated Properties (Name and Inventory No.): _____

Property Category : Building

Number of Resources on the Property:

Buildings: 1 Structures: _____ Sites: _____ Objects: _____

Function or Use

Historic:

Function/Use Category	Function/Use Subcategory
Transportation	air-related

Function/Use Category (if other) _____

Function/Use Subcategory (if other) _____

Current:

Function/Use Category	Function/Use Subcategory
Vacant/Not in use	

Function/Use Category (if other) _____

Function/Use Subcategory (if other) _____

Description

Provide full Narrative Description on Continuation Sheet.

Architectural Style: No Style

Architectural Style (if other): _____

Exterior Material: Wood

Exterior Material (if other): _____

Significance

Provide full Statement of Significance on Continuation Sheet.

Applicable National Register of Historic Places Criteria:

Criterion A: Property is associated with significant events. Yes No More Research Recommended

Criterion B: Property is associated with the lives of significant persons. Yes No More Research Recommended

Criterion C: Property has significant architectural characteristics. Yes No More Research Recommended

Criterion D: Property may yield important information in history/prehistory. Yes No More Research Recommended

Criteria Considerations? No Yes

If yes, describe in Statement of Significance on Continuation Sheet.

Area of Significance: Architecture

Additional or Other Area(s) Significance: _____

Period(s) of Significance: c. 1952

Date(s) Constructed: c. 1952

Other Significant Construction Dates: _____ *Discuss in Statement of Significance on Continuation Sheet.*

Date Source(s): Aerial photographs

Architect/Builder/Engineer: Unknown

Architect/Builder/Engineer Documentation: _____

Bibliography

Complete Bibliography on Continuation Sheet.

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

Additional Documentation

For all properties, the following additional documentation must be submitted with the inventory form. Refer to the Historic and Architectural Survey Manual for guidance.

1. Photographs
2. Maps

Preparer's Information and Recommendation

Preparer Name and Title: Kelli Andre Kellerhals, Sr. Architectural Historian

Organization/Firm (if applicable): 106 Group

Date Inventory Form Prepared: 9/9/2021

Recommended Individual Evaluation:

- Eligible for the National Register
- Not Eligible for the National Register
- More Information Needed for Evaluation

- Eligible for Local Designation
- Not Eligible for Local Designation
- More Information Needed for Local Designation

Recommended District Evaluation:

- Within a National Register-Eligible District
 - Contributing Status: _____
 - District Name: _____
 - District Inventory Number: _____

- Within a Locally-Eligible District
 - Contributing Status: _____
 - District Name: _____
 - District Inventory Number: _____

Minnesota Historic Preservation Office Comments (MnHPO Use Only)

Initials: _____ Date: _____

Individual Recommendation (NRHP)

- Concur Does Not Concur More Information Needed

Historic District Recommendation (NRHP)

- Concur Does Not Concur More Information Needed

Contributing/Noncontributing Status Recommendation

- Concur Does Not Concur More Information Needed

Comments:

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

Narrative Description

Hangar 101 is a single-bay, arched-roof hangar that is flanked by two-story, flat-roof maintenance and office wings on the east, south, and west elevations. The hangar is located in the southwest quadrant of the DIA, along the south side of Runway 9-27. The hangar and the wings were constructed simultaneously, circa 1952 (Nationwide Environmental Title Research, LLC [NETR] 1952).

The wings obscure the view of the arched-roof hangar sections such that the arched-roof hangar section is only visible above the two-story wings. Clerestory sections are located on the east and west elevations, above the two-story wings. The building is clad in horizontal wood siding and replacement vertical metal panels. The north elevation features a tall, 14-leaf sliding metal door that splits in the middle. Signs at the top of the arched section on the north and south elevations read "CAF." The north elevation also features a small sign that reads "Aviation Museum" above the 14-leaf sliding door. Two wood-sided mechanical boxes are located at the top of the arched-roof hangar section. The two-story wings on the east, south, and west elevations have collapsed in several locations and the interior of the building is visible through these sections.

Fenestration on the north elevation includes the 14-leaf sliding metal door; three sets of 20-light windows in each door panel; and a 36-light metal window.

Fenestration on the east elevation includes three-light metal windows on the clerestory of the central hangar section. On the wing on the east elevation, fenestration includes a modern metal overhead garage door with three oval lights; single-light fixed metal windows; and single-leaf modern metal doors with single-lights.

Fenestration on the south elevation includes modern two-light sliding metal windows with transoms; single-leaf metal doors with single-lights; and single-light fixed metal windows.

Fenestration on the wing on the west elevation includes modern two-light sliding metal windows with transoms; single-leaf metal doors with single-lights; single-light fixed metal windows; and a modern overhead metal garage door. Fenestration on the clerestory of the central hangar section of the west elevation includes fixed metal windows.

The interior of the central hangar section consists of a large unobstructed open area with a poured concrete floor and poured concrete walls. On the east and west walls, the concrete walls extend from the floor to the bottom of the wooden crescent arches. On the south wall, the concrete wall stops halfway from the floor to the top of the crescent arch; above the concrete wall, the remainder of the wall is constructed of wood framing and cladding. The north wall is comprised of a pair of seven-leaf sliding doors. Each leaf is set on wheels, which move the leaves along seven parallel tracks inlaid into the concrete floor. When the doors are open, each leaf recesses behind the preceding leaf into a wood-clad pocket structure that extends beyond the width of the hangar.

The roof system of the hangar consists of seven, two-hinged, wooden crescent arch trusses. The trusses are approximately 164 feet from east to west, and are spaced approximately 23 feet apart, north to south (Google Earth 2021). Each truss is a crescent truss with an arched top and bottom chord and has wooden vertical and diagonal members arranged in a saw tooth pattern. Wooden lateral bracing between the trusses is in a vertical "X" pattern. The roof rafters span between the trusses and the rafters are sheathed with wooden boards laid at a diagonal. Each truss is bolted to concrete piers/buttresses embedded into the concrete walls on the east and west sides of the hangar.

Integrity:

This property retains excellent integrity of location as it remains in its original location on the south side of the main

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

runway at the DIA. The integrity of setting has been slightly compromised by the expansion of the airport runways over time, the loss of some surrounding historic buildings, particularly the Readiness Building, which was historically immediately to the west of Hangar 101, and the addition of new buildings in the vicinity. The integrity of design remains good, as the building does not appear to have had any significant changes that have altered the historic form of the building. The building was originally constructed with the wings and it retains its historic configuration of the central arched hangar flanked by wings on the east, west, and south elevations. Additionally, the wooden crescent trusses on the interior of the central hangar section, which give the hangar its distinctive structural system, remain intact. The integrity of materials is fair due to the addition of some modern materials, particularly on the wings. Such non-historic materials include vertical metal panels, modern doors, and windows, as well as some sections of the wings that have collapsed on the east, south, and west elevations. However, the north elevation of the hangar still retains its original wood cladding and metal hangar doors, thus retaining its historic appearance on the prominent elevation. The integrity of workmanship is good, as the central hangar section retains its distinctive structural system. The integrity of feeling has been slightly compromised by the current vacant status of the building, lack of use as a military airplane hangar, and collapsing condition of the wings. However, the central hangar section of the building retains its open, unobstructed space, which allows the vastness of the structure and its use as a hangar to still be understood. The integrity of association is fair as the conversion of many of the surrounding building to a federal prison minimizes the connection of the hangar to the former Duluth Air Base. Overall, this property retains fair integrity.

Statement of Significance

Property History:

This airplane hangar and its wings appear to have been constructed by 1952, when it is visible on historical aerial photographs (NETR 1952). In the DIA's 2015 Master Plan, this hangar is referred to as "Hangar 101," which is denoted as a "common hangar" and has an area of 20,000 square feet (RS&H 2015:52).

This hangar appears to have been constructed by the U.S. Air Force for the Duluth Air Base, which was operational from the 1950s to 1981. According to the DIA's Master Plan, the Air Force was responsible for developing much of the southwest quadrant of the DIA. Between 1951 and 1952, essential facilities for the Duluth Air Base were constructed, including "a hangar, temporary shacks next to the hangar, a motor service building, a crash and rescue station, and a heating plant" (Bradley et al. 2006:20).

Hangar 101 is one of the first buildings visible in historical aerial photographs of the area that was to become the Duluth Air Base, and is likely the "hangar" referenced in the essential facilities constructed by the Air Force in 1951-1952 (RS&H 2015:41-42; NETR 1952). In a 1952 historical aerial photograph of the Duluth Air Base, Hangar 101 is visible, along with a cross-shaped building immediately to the west of the hangar (NETR 1952). On construction site plans from 1954 for a different hangar – Hangar 103 – which is immediately west of the cross-shaped building, the cross-shaped building is identified as a "Readiness Building" and Hangar 103 is identified as "Maintenance Hangar with Shops A and B." However, Hangar 101 is not identified or named on the site plan for the Maintenance Hangar despite being depicted on the plans (Toltz, King & Day Inc. 1954). Plans, drawings, or historic names for this building, beyond the "Hangar 101" name established by the DIA, have not been found for Hangar 101.

Based on its location and function, the U.S. Air Force appears to have been responsible for the construction of Hangar 101 in the early 1950s. However, this was not able to be corroborated by primary source material. The history of airplane hangar design and construction in the U.S., and particularly hangar construction employed by the U.S. military and especially the Air Force, is inextricably tied to military aircraft advancements and the limitations on construction stemming from the U.S. military involvements from the early to mid-twentieth century. An airplane hangar is generally defined as a utilitarian structure that is used to house and service aircraft. Character defining features of a hangar include a large, unobstructed area that has sufficient space, which includes vertical clearance and floor space, to accommodate an aircraft, and an unobstructed opening that is tall and wide enough to allow an

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

aircraft to pass through (McCormick and Hufstetler 1994:8). Increased attention to airplane hangar design and construction coincided with the growth and build-up of airfields throughout the U.S. during World War I. Hangars were necessary for airplane storage and as a place to do repair and maintenance work on aircraft. As such, during World War I, the U.S. Army created a standardized hangar design that could be easily adapted for each airfield. These early hangars were utilitarian in design and were rectangular, wooden structures that could house several aircraft. Wooden trusses were a popular solution for structurally supporting roofs from the 1900s through the 1950s, especially in buildings where large, open spans were desired (Martinez et al. 2018). The hangars had low gambrel roofs and plain sliding doors at either end wall (McCormick and Hufstetler 1994:8). Larger, more technologically advanced aircraft were developed post-World War I and additional aviation advancements after World War II, including the development of jets, rockets, and helicopters, necessitated changes in hangar design and construction (NPS 1998:11). The post-World War II time period saw hangars being constructed of reinforced concrete or structural steel framing, which better accommodated the larger widths and heights of increasingly larger aircraft. Wings or lean-to additions also became common along one or both sides of the hangar to provide space for mechanical and auxiliary facilities. Banks of large windows were also found in hangars constructed during this time period to provide interior light and ventilation (McCormick and Hufstetler 1994:9).

Rising international tensions during the late 1930s prompted the first major build-up of Army air bases since 1918 and resulted in the construction of large hangars with clear-span interiors of 200 to 275 feet wide (McCormick and Hufstetler 1994:9). In 1941, as the need for more hangar space became critical, the Army turned to hangar designs that could be easily, quickly, and cheaply assembled. Hangars featured Warren-type roof trusses supported by steel columns; multi-leaf, sliding hangar doors that opened at one or both ends of the hangar; steel sash windows; fire resistant materials, such as asbestos-protected metal or corrugated asbestos siding; and wings along the sides of the hangar that provided needed auxiliary spaces (McCormick and Hufstetler 1994:9). World War II imposed restrictions on steel and other materials, and such limitations resulted in hangars being constructed with alternative materials, particularly wood trusses and reinforced concrete. A widely used design from this time featured a structural system that was formed by a series of closely spaced wooden ribs, of which one of three truss systems were employed: the arch rib, the bowstring arch, or the crescent arch. The bowstring arch featured an arched top chord and a straight bottom chord, while the crescent arch featured an arched top and bottom chord. The wooden members were constructed of small sections of laminated lumber, stacked together and bent to the curve of the arch radius, and then glued and spiked together (Engineering News Record 1944:118). Wooden arch trusses in either the bowstring arch or crescent arch configurations were supported on a system of concrete beam and buttressed columns (McCormick and Hufstetler 1994:9). For the most part, military hangars during World War II were used only for the storage and maintenance of aircraft (McCormick and Hufstetler 1994:10).

The Cold War era that followed World War II necessitated a change in hangar function from one of storage and maintenance to one of facilitating national defense capabilities. During the 1950s, the newly-created U.S. Air Force established air bases at strategic locations through the country to defend the country from any possible threats and attacks; the Duluth Air Base is one such example. As part of the air base development, specialty hangars were developed to house fighters, tankers, and other military aircraft at "readiness," meaning they were ready to take off at a moment's notice to defend the base and the surrounding area from an outside attack (McCormick and Hufstetler 1994:10). These specialty hangars were typically constructed at locations that would provide quick access to an air base's runway and fell into one of two categories: an "alert" hangar and a "readiness" hangar. They are defined as follows:

"Alert hangars were designed to hold aircraft that could be manned and airborne within 90 seconds. The standard alert hangar plan featured four separate hangar "pockets," each designed to shelter a single plane and equipped with fast-operating hangar doors at both ends. The pockets were configured in pairs on both sides of a central block, which contained maintenance facilities and waiting rooms for the flight crews" (McCormick and Hufstetler 1994:10).

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

"In contrast, a readiness hangar was intended as a more multi-purpose facility. First, it provided a space where planes could be kept under cover and warm, and taken out to the runway with considerable dispatch, although not quite as quickly as from an alert hangar. Second, it acted as an aircraft maintenance shop. Readiness hangars typically utilized the form of a standard World War II aircraft hangar: a central hangar space flanked on both sides by wings housing workshops, a boiler room, and other facilities. Such buildings typically had sufficient clearance and floor space to accommodate all but the largest bombers of the 1950s era" (McCormick and Hufstetler 1994:10).

While the first function of a readiness hangar was to house planes at the "ready," the second function of a readiness hangar is maintenance. Indeed, as described in a 1952 issue of the *Architectural Record*, "[t]here is no thought, however, that planes would be kept lined up for instant service, or that they would actually flown out of the hangar. The readiness hangar is also a maintenance shop for anything short of major overhaul. It is quite possible to use the hangar for both readiness and service at the same time" (*Architectural Record* 1952:99).

Hangar 101 is designed with a large arched-roof hangar section in the center of the building and wings flanking the central hangar space along the east, south, and west elevations. In the interior of the hangar space, the hangar was designed using the crescent arch support system, a commonly used truss system stemming from material shortages during World War II (McCormick and Hufstetler 1994:9). The wooden crescent trusses are constructed with arched top and bottom chords that support the distinctive arched roof of the hangar. These trusses are braced by vertical bracing in a "V" pattern between the top and bottom chords. The use of such trusses allowed for an unobstructed interior hangar space to accommodate aircraft inside the hangar. The wings are two stories tall and likely provided auxiliary, office, and storage space for the hangar.

Architectural drawings and plans specific to Hangar 101 have not been found, nor has an architect or engineer of record. However, Hangar 101 is remarkably similar to the now-demolished Readiness Hangar that was constructed at Ellsworth Air Force Base in South Dakota in 1952. Like Hangar 101, the Ellsworth Readiness Hangar was a single-bay, arched-roof hangar flanked on the sides by shed-roof wings. The interior roof system of the Ellsworth hangar was constructed of seven, two-hinged wooden crescent arched trusses (McCormick and Hufstetler 1994:13). Hangar 101 is also constructed of seven, two-hinged wooden crescent arched trusses, and, like the Ellsworth Hangar, is of nearly the same dimensions: 160 feet by 118 feet. Also like Hangar 101, the Ellsworth Readiness Hangar was constructed in line with the Air Force's efforts to improve the nation's defense capabilities during the onset of the Cold War. The Ellsworth Readiness Hangar was documented by the Historic American Building Survey (HABS) in 1994 prior to its demolition; that documentation noted that the hangar was a "significant representation of period military hangar architecture...and its configuration typifies the basic form preferred for a readiness hangar by military planners of the early 1950s" (McCormick and Hufstetler 1994:2). While documentation has not been found on the historic use of Hangar 101, it is possible that the structure served as a readiness hangar for the Duluth Air Force Base, as both the Duluth Air Force Base and the Ellsworth Air Force Base both served air defense missions during the Cold War era.

The Duluth Air Base was closed in 1981. At that time, many of the buildings of the Duluth Air Base were converted into a federal prison. The Duluth ANG also took ownership of many buildings. It is not known how or by whom Hangar 101 was used after this time. However, the north and south elevations of the hangar feature signs that read "CAF." The Confederate Air Force, now known as the Commemorative Air Force (CAF), occupied the building beginning at an unknown date, until 2018. The CAF acquires, restores and preserves a collection of combat aircraft that were flown by all military services of the U.S. The CAF used Hangar 101 as their maintenance shop and aviation museum until they moved to a new location in Superior, Wisconsin, in 2018 (CAF 2021). Since 2018, Hangar 101 has remained vacant.

Significance:

Hangar 101 was evaluated within the context "History of the Duluth International Airport, 1929-present" that was developed by the 106 Group in 2021 (Miller et al. 2021). The U.S. Air Force operated an air base at the DIA from the

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

1950s to 1981; during this time the Air Force built multiple structures to support their operations. Based on its location and function, Hangar 101 was likely constructed by the U.S. Air Force at a time of growth and expansion of the airport, in the early 1950s. This hangar appears to be one of the first structures constructed by the Air Force as part of this expansion. As the key role of the Duluth Air Base during this time was air defense, it is possible Hangar 101 was constructed as a readiness hangar and could have played an integral role in the Air Base's ability to fulfill its mission. Indeed, constructing a hangar as one of the first buildings on the new Air Base suggests that the hangar likely played a needed role in air defense while other strategic defense equipment, such as the SAGE system, were still under construction. However, documentation as to Hangar 101's historic name, use, or role within the air defense mission of the Duluth Air Base has not been found within the archives of the Minnesota Historical Society, the Northwest Architectural Archives, or in the records at the DIA. Online research regarding this hangar and the Duluth Air Base also yielded little information. As such it is not possible at this time to definitively evaluate Hangar 101's significance in the defense mission of the Duluth Air Base. Further research into the historic role of Hangar 101 is necessary to determine any potential significance under NRHP Criterion A.

This property is not known to be associated with significant individuals and, therefore, does not have significance under NRHP Criterion B.

National Register Bulletin #43 notes that air-related facilities may be eligible for the National Register of Historic Places (NRHP), in the area of Architecture, if they are good representations of a type, period, or method of construction (NPS 1998:46). Hangar 101 was constructed with a central arched-roofed hangar section that is flanked on the east, west, and south elevations by shed-roof wings. The central hangar section is an open expanse created by seven wooden crescent arches with arched top and bottom chords. The remarkably similar Readiness Hangar at the Ellsworth Air Force Base was a documented standard plan hangar designed by the Air Force. Based on the design of this hangar, it is likely Hangar 101 was a standard military plan designed by the U.S. Army Corp of Engineers, which played a key role in the drafting and standardization of military hangars and buildings during this time period. Such Air Force standard plan hangars included character defining features such as unobstructed hangar space, maintenance and auxiliary spaces flanking the hangar area, and large doors that allowed aircraft to pass through. These types of hangars serve as significant representations of a period military airplane hangar architecture, as the building's form and design were preferred by the military for new hangar construction during World War II and influenced hangar design through the Cold War. Additionally, Hangar 101 was constructed using wooden crescent trusses, which is a somewhat unusual construction material for a post-World War II hangar. Wartime material shortages had eased by the time Hangar 101 was constructed and hangars constructed in the 1950s typically relied on heavy steel framing for the structure and cladding; as exemplified by Hangar 103 (the Maintenance Hangar with Shops A and B) at the DIA, which was constructed around 1954 (McCormick and Hufstetler 1994:11). The reason for Hangar 101's wood construction is not known, although it could be theorized that the wooden arch design was less expensive than a steel design, or may have allowed for the use of an already-existing blueprint. While wooden construction hangars were popular in early hangar construction, a 2011 report on hangar construction from World War I through the Cold War noted that few wooden hangars survive, with many having been demolished (such as the Ellsworth Readiness Hangar) and extant ones scheduled for demolition (Aaron 2011:77). Therefore, Hangar 101 is a rare example of a diminishing number of wooden Air Force designed hangars. As such, Hangar 101 has significance under NRHP Criterion C, in the area of Architecture, for its embodiment of typical period military airplane hangar construction, its unique wooden crescent truss method of construction used during a time period of heavy steel construction, and its likely association as an Air Force standard plan hangar. The recommended period of significance is circa 1952, when the hangar and its wings were constructed. The recommended property boundary is the footprint of the hangar and the wings.

This property has not yielded, nor is likely to yield, information important in prehistory or history. Therefore it does not appear to have significance under NRHP Criterion D.

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

Recommendation:

Hangar 101 is recommended as eligible for the NRHP under Criterion C, in the area of Architecture. The recommended property boundary is the footprint of the hangar and the wings.

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Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

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**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____

Property Photograph(s)



SL-DUL-3641 - 3/29/2021 - South Elevation, Facing North (SEH)

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 5/25/2021 - South & East Elevations, Facing Northwest

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 3/29/2021 - East Elevation, Facing West (SEH)

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 5/25/2021 - North Elevation, Facing Southeast

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 3/29/2021 - North Elevation, Facing South (SEH)

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 5/25/2021 - North & East Elevations, Facing Southwest

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 3/29/2021 - West Elevation, Facing East (SEH)

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 3/29/2021 - Interior of Central Hangar, Facing Northeast (SEH)

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 3/29/2021 - Interior of Central Hangar, Facing Southeast (SEH)

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



SL-DUL-3641 - 9/9/2021 - Ellsworth Readiness Hangar, Exterior (McCormick and Hufstetler 1994)

**Minnesota Individual Property
Inventory Form**

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



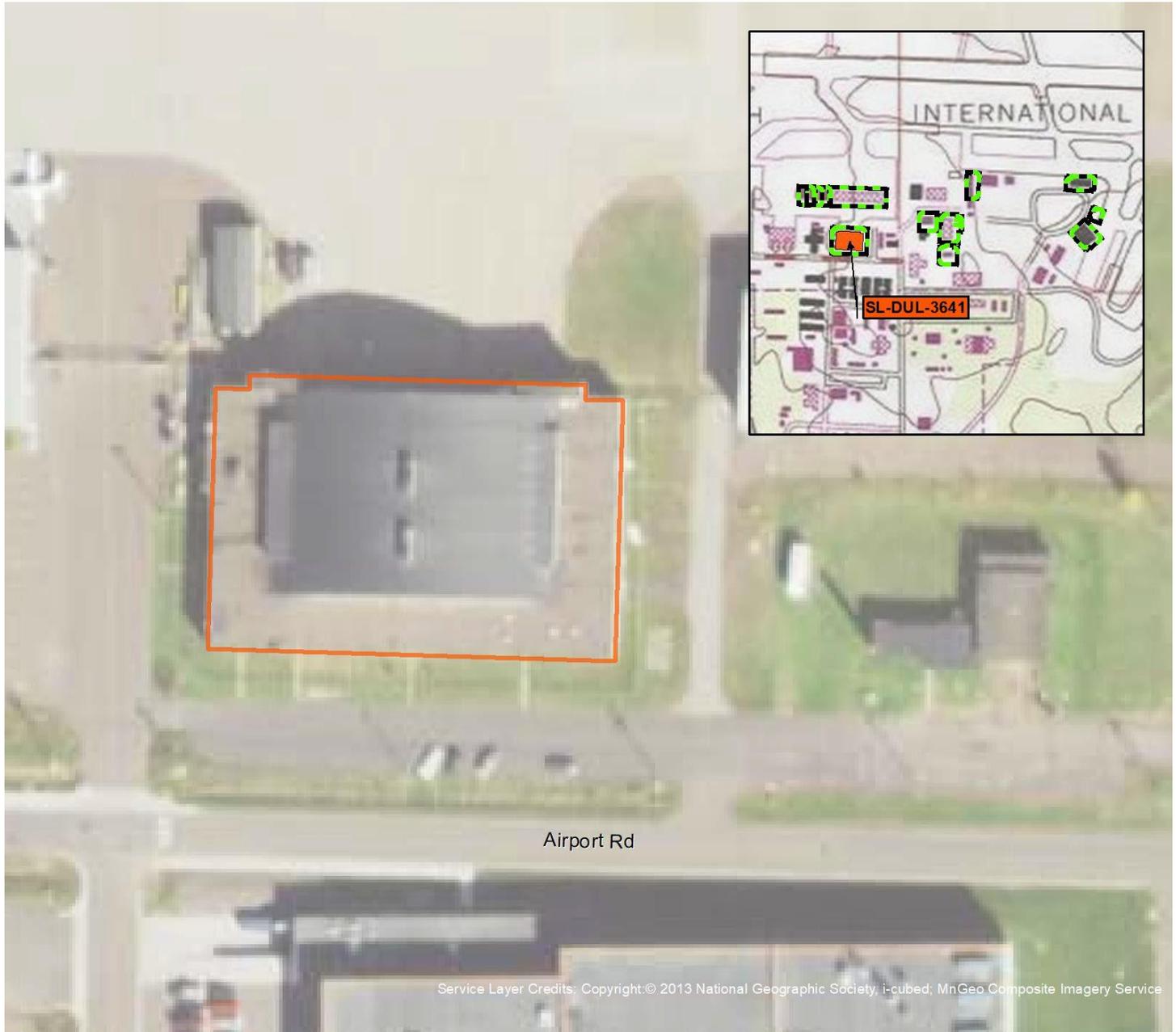
SL-DUL-3641 - 9/9/2021 - Ellsworth Readiness Hangar, Interior (McCormick and Hufstetler 1994)

Minnesota Individual Property Inventory Form

Historic Name: Hangar 101

Inventory No: SL-DUL-3641

Associated MN Multiple Property Form (Name and Inventory No): _____



Source: 106 Group, SEH

Map Produced by 106 Group 9/9/2021

Duluth International Airport Master Plan Project

Duluth, St. Louis County, Minnesota

SL-DUL-3641

4931 Airport Road

Duluth, St. Louis County, Minnesota

0 20 Meters
0 50 Feet

1:1,000



-  Survey Area
-  Inventoried Property

Map 1