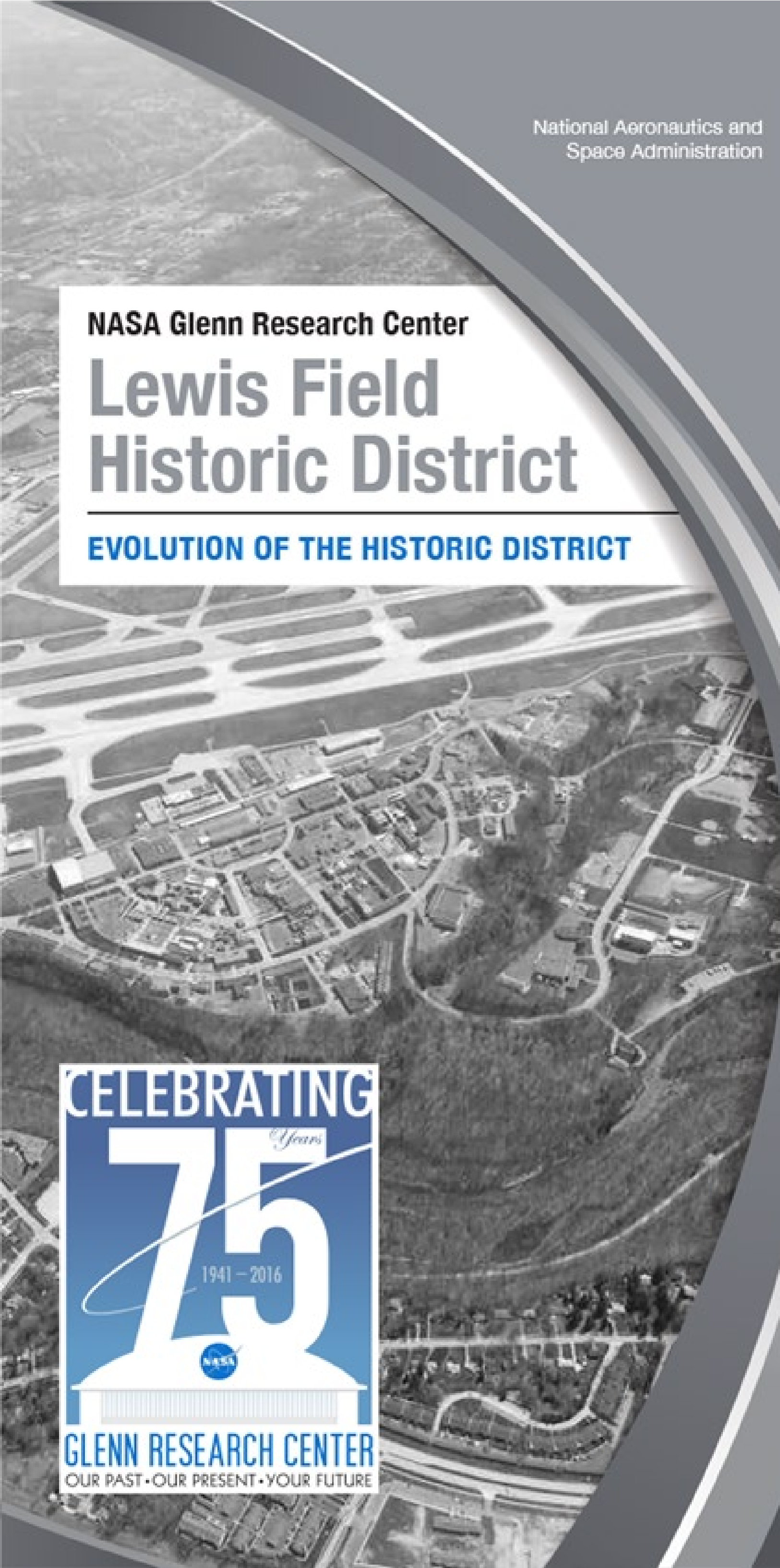
National Aeronautics and
Space Administration

NASA Glenn Research Center

Lewis Field Historic District

EVOLUTION OF THE HISTORIC DISTRICT



CELEBRATING
75 Years
1941 – 2016
GLENN RESEARCH CENTER
OUR PAST • OUR PRESENT • YOUR FUTURE

How It All Began

In 1903, the Wright Brothers demonstrated the first powered, controlled flight of aircraft. In spite of this achievement, the United States would soon lag behind the international community in aeronautics research. While Germany, France, the United Kingdom, and even Russia were launching their own government supported programs, aeronautics innovations in the U.S. were largely initiated by amateur enthusiasts. However, in 1911 sentiment for creating a government funded national aeronautics laboratory in the U.S. was gaining momentum in the scientific and aeronautics communities. The need for U.S. support of aeronautical research was escalated by the outbreak of World War I. In 1915, the U.S. Congress passed legislation that led to the creation of the National Advisory Committee for Aeronautics or the NACA.

This group consisted of 12 volunteers from government, military, and education backgrounds. A modest $5,000 a year was appropriated by Congress to fund their research and administrative expenses. Although created too late to have much of an impact on World War I, the NACA's role in the post-war era would be significantly expanded. In 1917, the committee established its first national civil aeronautics laboratory in Hampton, Virginia. The NACA's new lab was named the Langley Memorial Aeronautical Laboratory after Samuel P. Langley, a former Secretary of the Smithsonian Institute and aeronautical enthusiast. The lab's mission was to study new aircraft designs and address anticipated aeronautical problems for the civil aviation industry.

George W. Lewis

Frederick C. Crawford

By the late 1920s, the NACA was attracting the best and brightest minds from across the country and earning a reputation as a leader in aeronautical research. This was, in part, due to the shrewd recruiting skills of the committee's Executive Officer, George W. Lewis. However, by the mid-1930s, apprehension was growing once again over European aeronautical advancements. Of particular concern: Germany's massive military build-up and the possibility of another war. Executive Director of the NACA, Dr. Joseph Ames urged for additional funding to build a second laboratory and expand the NACA facilities. In 1939, before World War II began in Europe, the committee felt it wise to disperse the government's aeronautical assets in an effort to avert potential enemy attacks. As a result, the site selected for a second NACA facility was a naval airship station at Moffett Field on the shore of the San Francisco Bay. The new lab opened in 1940 and became known as the Ames Aeronautical laboratory. The Ames lab served as an extension of the Langley facility; however, Ames would also later address challenges in the areas of high-speed and supersonic flight.

While the Ames facility was still being authorized by Congress, a group of supporters, which included famous aviator and NACA committee member Charles Lindbergh, advocated for a third lab that specialized in aircraft engine research. They argued that such a facility would help American aircraft compete with the high-performance, liquid-cooled engine designs of German, French, and British military airplanes. In June 1940, Congress approved funding for the NACA's Aircraft Engine Research Laboratory. Spearheading the effort to convince the NACA to bring its third lab to Cleveland were the Industrial Commissioner of the Cleveland Chamber of Commerce, Clifford Gildersleeve, and local businessman, Frederick C. Crawford. Crawford headed Thompson Products Incorporated, which manufactured automotive and aircraft engine parts. The company would later become TRW. An aviation enthusiast, Crawford organized and ran the National Air Races. The air races attracted crowds as large as 100,000 from all over the country and were held annually at the Cleveland Municipal Airport, which later became known as the Cleveland Hopkins International Airport. Crawford's first contact with the NACA came through his association with John Victory. Victory visited Cleveland frequently as an official of the National Air Races Association Committee and served as secretary for the NACA.

View of enlarged parking lot

Parking Lot of Air Races, future AERL site

Winning the contract for the NACA's new Aircraft Engine Research Laboratory would not be easy. Cleveland was up against 19 other sites in 13 cities. Working in Cleveland's favor was its strategic, remote location away from the nation's coastline making it less vulnerable to potential enemy attacks. The city also had a solid industrial base that provided relatively easy access to coal, iron, and steel, all of which would be needed to build the new lab. Cleveland was a hub of transportation. The city is in close proximity to one of the busiest major airports and has access to six major railroads, highway connections, and Lake Erie's fresh water supply, owned and maintained by the city. In addition, a number of aircraft components and parts manufacturers were within 500 miles, scientific and technical universities were local to graduate young engineers, and the electricity was plentiful and dependable. All of these factors made Cleveland an extremely competitive candidate for the NACA's new Aircraft Engine Research Laboratory.

Drawbacks for the Cleveland site included strong union representation and unusually high rates for electrical power. To help ensure Cleveland's success in securing the new lab, Fred Crawford personally took part in the negotiations between the NACA and the Illuminating Company. His proposal was for the NACA to receive reduced monthly electrical rates, and in exchange, the lab would operate its large test facilities during the evening so a strain would not be created on the city's energy supply. Although the Illuminating Company initially resisted, all parties came to an agreement. Furthermore, the City of Cleveland offered the NACA 200 acres of land for the new lab at a reduced price of a dollar per acre. The Cleveland business community hoped this would cinch the deal. On November 15, 1940, the city's efforts paid off. The NACA announced its decision. The location for the new Aircraft Engine Research Laboratory would be in Cleveland, Ohio. The lab would be built adjacent to the Cleveland Municipal Airport on land previously used as a parking lot for the National Air Races.

In the Early Days

On January 23, 1941, a small groundbreaking ceremony for the new Aircraft Engine Research Laboratory or AERL took place. The NACA's Director of Aeronautical Research, George Lewis, standing on the right, was joined by General George Brett seen holding the shovel, and to the general's right stood Fredrick C. Crawford. The men were joined by local officials and NACA leaders.

Groundbreaking, 1941

The design work for the new AERL was well under way by the time the January groundbreaking ceremony took place. Engineers at Langley were working feverishly to complete the designs. As construction progressed the lab's first two employees, construction engineer and inspector, Charles Herrmann and Secretary, Helen Ford, temporarily set up offices in a small, off-site "radio house" when they first arrived from Langley. In July of that year, they relocated to what was referred to as the Farmhouse, a white clapboard structure overlooking the Rocky River. The "farm house" served as the original administration building until the new administration building was completed. Ford immediately began work addressing a number of administrative details, and Herrmann supervised the construction of the Hangar and the Engine Propeller Research House, known as the "Prop House." Construction at the AERL began in the lab's first quadrant. Over the next four years, the following facilities were completed: the Hangar, the first building completed, the Engine Research Building, the Fuels and Lubricants Building, the Administration Building, the Icing Research Tunnel, the Prop House, a Heating Plant, a Substation, the Technical Services Building, the guard station and the Altitude Wind Tunnel, known as the AWT.

The Farmhouse

In August 1941, George Lewis called upon Edward Raymond Sharp, or Ray, as he was better known, to transfer from Langley to Cleveland to serve as construction administrator for the AERL. Shortly after the attack on Pearl Harbor, Sharp was joined by his new design group from Langley. They occupied offices in the Farmhouse and the newly constructed Hangar. Ray reviewed contracts, established relationships with city officials, smoothed relations with engine companies, and kept the NACA's Washington office informed of progress. In May 1942, the Prop House was the lab's first major test facility ready for use. When it was first opened, the Prop House was primarily used to study issues such as cooling on full-scale World War II aircraft engines. Also completed in 1942, the Technical Services Building, located adjacent to the Hangar, was equipped with a large machine shop. Here, workers made all the parts needed to perform a variety of lab tests.

Helen Ford in center and Charles Herrmann on right

Initially, progress on the AERL's construction was slow, in part, because World War II created competition for many of the lab's needed supplies. However, as the war dragged on and the AERL's expertise was in greater demand to help solve problems related to the war, construction resources became more readily available. As the building design evolved, the AERL took on a college campus feel with its low-slung symmetrical simple shaped buildings and uniform tan brick exteriors. Other building characteristics are centered entries flanked by banded windows, flat roofs, similar setbacks and little to no ornamentation. The building design is most closely related to the International Style architecture that emerged in the 1920s and 1930s during the formative decades of modern architecture. A memorandum drawn up by the NACA Secretary,

Model of new NACA Aircraft Engine Research Laboratory

John F. Victory, on August 15, 1942 called for the lab’s street names to be named in honor of NACA leaders, such as: Dr. David W. Taylor, Dr. Charles D. Walcott, Dr. Joseph S. Ames, Dr. William F. Durand, Rear Admiral William A. Moffett and Major General Oscar Westover.

Construction of Research Facilities

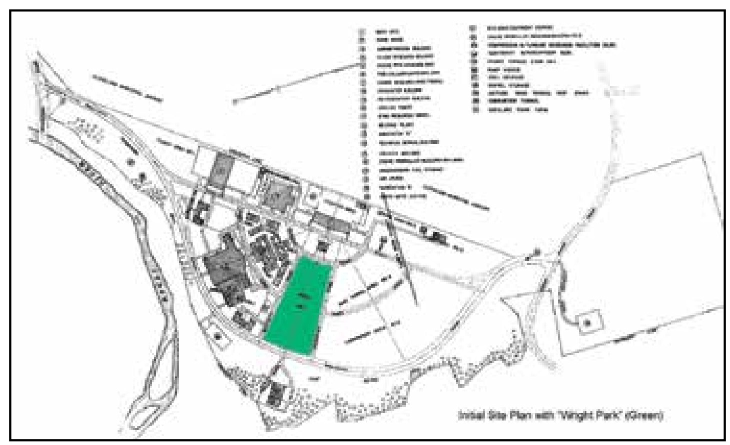
As construction continued, the AERL was tasked to improve piston engine aircraft performance during the war, including that of the Wright R-3350s which powered the B-29 Superfortress. One of the lab’s efforts was to advance the turbo supercharger. Developed by General Electric, the turbo supercharger initially worked with piston engines to help improve performance. However, cooling and knocking issues resulted from the use of the turbo superchargers, a problem the lab also worked to resolve. Another significant contribution the AERL made during the war was its research in aircraft icing. The lab’s Icing Research Tunnel or IRT, which became operational in 1944, helped the NACA and the military better understand and solve problems associated with in-flight icing conditions. This was important because hundreds of aircrafts were being lost due to icing conditions during the re-supply missions over the Burma Hump. As a result of the AERL’s research, de-icing solutions were developed to help solve some of these problems for later aircraft.

In the early 1940s, Westinghouse and General Electric developed the first U.S. turbojet engines. GE’s A engine, the first turbojet built in the U.S., was based on the designs of Great Britain’s Whittle engine. GE’s Lynn Massachusetts team specifically designed a 2-cell test bed at the AERL to test the A and subsequent GE engines. This facility was known as the Jet Propulsion Static Lab. Although the A engine did not perform well enough to be mass-produced, it led the way for more powerful designs, such as the J33 and the J47. Over the next decade, these engines and nearly all emerging models of U.S. turbo jet engines would be tested in the AERL’s Altitude Wind Tunnel, the nation’s first wind tunnel capable of testing jet engines under simulated flight conditions. Although none of the turbojet engines tested at the AERL were ever used in combat during World War II, the research conducted at the lab made significant contributions to the war effort.

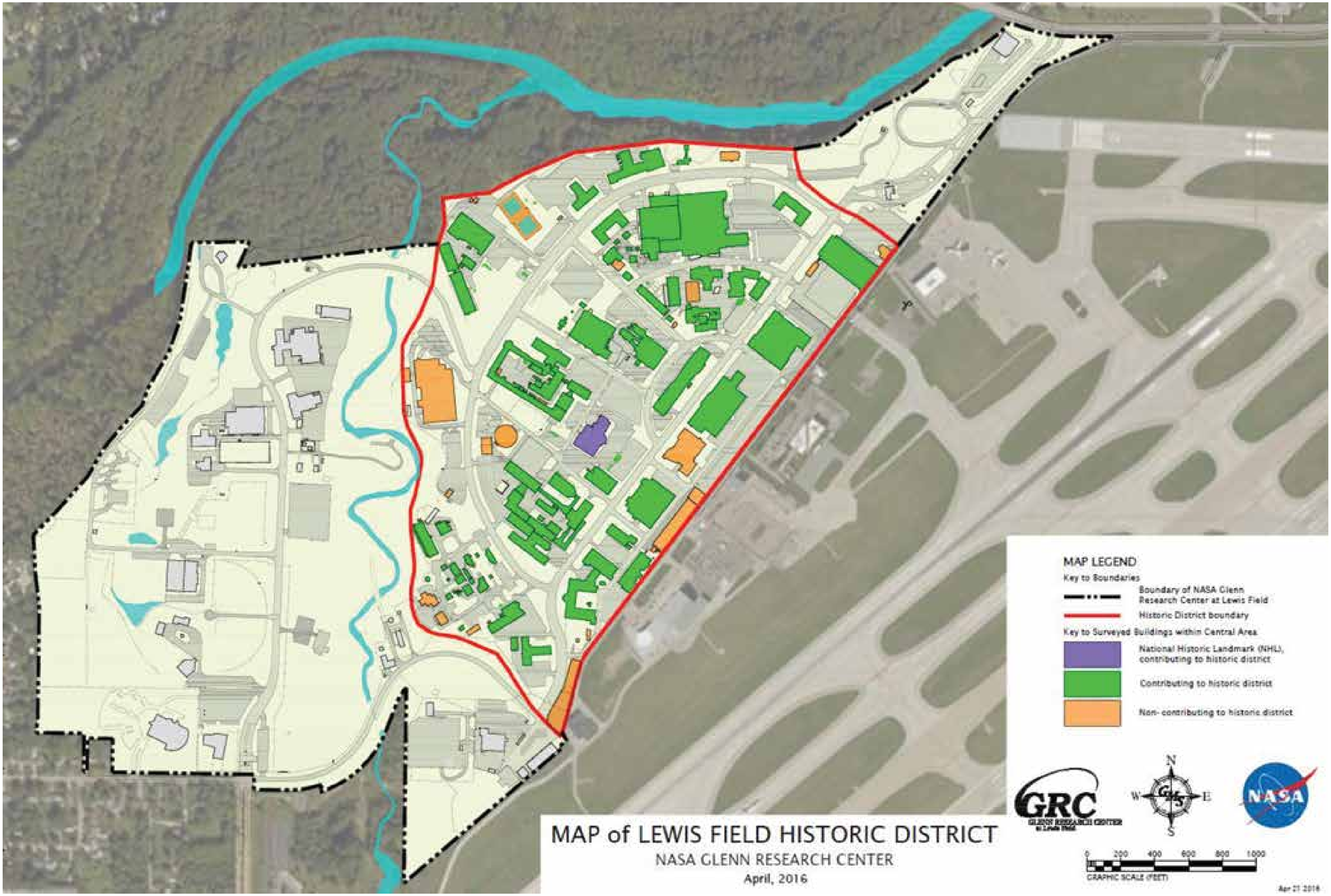
*On **April 11, 1946**, General Dwight D. Eisenhower visited the AERL to personally thank the staff for their role in supporting the Allied air forces.*

The end of the war quickly brought about a reorganization of the entire lab in 1945, referred to as the “Big Switch.” The lab now focused its efforts almost entirely on jet propulsion and high-speed flight. In 1947, the AERL was renamed the NACA Flight Propulsion Research Laboratory to reflect this change. A year later, following the death of George Lewis, the lab’s name was changed again to the NACA Lewis Flight Propulsion Laboratory in honor of his many contributions. After the reorganization, the lab initiated a wide-range study of ramjet engines for missile applications, expanding its aircraft icing research program, and began its research with rocket propellants. As a result of Germany’s use of rockets at the end of the war, the NACA initiated rocket engine research at the AERL. To support this effort, rocket test cells were built south of Walcott Road near the Taylor Road intersection. The lab’s work with rocket propellants in the 1950s helped to prove that the lightweight and highly reactive liquid hydrogen could be safely used as a rocket engine fuel. The lab also led a presidentially mandated effort to reduce fatalities in low-speed aircraft crashes. Findings from these crash tests, conducted at the Ravenna Arsenal, eventually led to aircraft safety improvements.

Construction continued down Walcott Road into the second quadrant of the lab where, in 1949, the lab’s first large, high-speed wind tunnel was built at the corner of Walcott and Westover Roads. The effort to build the 8' x 6' Supersonic Wind Tunnel, known as SWT, was led by the head of the AERL’s Wind Tunnels and Flight Division, Dr. Abe Silverstein, known as Abe. Silverstein had a well-established expertise in aerodynamics and wind tunnels. When first hired at Langley, he helped design the lab’s Full-Scale Tunnel. In 1943, he came to the AERL where he was head of the Altitude Wind Tunnel and later named head of the Wind Tunnels and Flight Division. Research performed in the new 8' x 6' wind tunnel made significant contributions to the development of missiles and supersonic aircraft and is now individually eligible for listing in the National Register of Historic Places.



Wright Park



MAP LEGEND
Key to Boundaries
Boundary of NASA Glenn Research Center at Lewis Field
Historic District boundary
Key to Surveyed Buildings within Central Area
National Historic Landmark (NHL), contributing to historic district
Contributing to historic district
Non- contributing to historic district
N
W
E
S
GRC
NASA
0 200 400 600 800 1000
GRAPHIC SCALE (FEET)
Apr 21 2016
MAP of LEWIS FIELD HISTORIC DISTRICT
NASA GLENN RESEARCH CENTER
April, 2016

The third quadrant of the lab, known as Wright Park, was initially set aside as green space. However, as the need for another research facility arose, this was the only space large enough to accommodate another research structure. Construction of the Propulsion Systems Laboratory 1 and 2, known as PSL, took place where Walcott, Westover, Durand, and Moffett Roads formed a rectangle. Construction of this facility was completed in 1952. PSL was capable of testing larger and more powerful engines than any other facility in the nation. Support structures, such as offices and a fabrication shop were built in conjunction with the research facilities in the of the lab. When the space program began in the 1950s, the PSL 1 and 2 was used to study complex rocket engines, including the Pratt & Whitney RL-10 that was used to power the Centaur rocket and Saturn I upper stages. In the mid-1960s, the PSL's work returned to jet engines, which grew in size and performance.

In the mid-1950s, the lab also began to study nuclear propulsion for both rockets and aircraft. To conduct this research, the NACA leased 500 acres of land, known as the Plum Brook Station, in Sandusky, Ohio. Over the next two decades, the lab would expand both its capabilities and size. In 1958, the Cleveland campus acquired an additional 115 acres of land adjacent to the main campus on the southwest side. On this land, six additional facilities were built over the next several years. This section was known as the West Area.

Located in the second quadrant at the intersection of Walcott and Taylor Roads, a 10' x 10' Supersonic Wind Tunnel known as SWT, was constructed and completed in 1955. The 10' x 10' SWT was the most powerful wind tunnel at the center and the largest research facility. It was designed to test supersonic propulsion components and full-scale engines at airspeeds ranging from Mach 2 to Mach 3.5. This meant that engines and components could be subjected to airspeeds that were 2 to 3 ½ times the speed of sound. Simultaneously, the 10' x 10' SWT could simulate altitude conditions ranging from 50,000' to 154,000'. The tunnel, later named the Abe Silverstein 10' x 10' Wind Tunnel, aided in the development of the Atlas-Centaur, Saturn and Atlas-Agena class launch vehicles, as well as the Space Shuttle. It is now individually eligible for listing in the National Register of Historic Places.

NACA to NASA

Located on the southern end of Walcott Road, NACA built another research facility, Rocket Engine Test Facility or RETF. Its construction was close to being operational when the Soviet Union successfully launched its Sputnik Satellite on October 4, 1957. At the time, the RETF was the largest facility performing sea level testing of high-energy rocket propellants in the United States. The RETF played a significant role in the development of liquid hydrogen as a rocket fuel. The facility also aided in the development of the Pratt & Whitney RL-10 engine for the Centaur

NACA changing to NASA

rocket, the J-2 engine for the second stage of the Saturn V Rocket and the hydrogen-oxygen engines used on the Space Shuttle. The unique research that RETF discovered designated it as a National Historic Landmark.

Following the Soviet Union's launch of Sputnik, the U.S. Congress passed the National Aeronautics and Space Act of 1958, creating a new civilian space agency. President Dwight D. Eisenhower opted to base the new agency, known as NASA, on the NACA laboratories while adding other groups, such as the Jet Propulsion Laboratory and the Redstone Arsenal, later changed to Marshall Spaceflight Center. As a result, on October 1, 1958, the lab was renamed the NASA Lewis Research Center.

The Lewis Research Center played an important role in NASA's first major manned space program, Project Mercury. The Lewis team converted the AWT, as use of the wind tunnel was now in decline, to house the Multiple Axis Test Inertia Facility or MASTIF, a test system better known as the gimbal rig. The gimbal rig simulated tumbling maneuvers and provided valuable training for all seven Project Mercury astronauts, as well as a female pilot who passed the physical tests given to candidate astronauts for the Mercury project.

Landing on the Moon

On May 25, 1961, just three weeks after Alan Shepard made his historic flight as the first American to journey into space, President John F. Kennedy announced the national goal of landing Americans on the Moon before the end of the decade. This declaration would transform NASA, as well as the Lewis Research Center.

Going to space meant that Lewis researchers would first need to understand the behavior of fluids and gases in a microgravity, or near-weightless, environment. In 1961, Lewis began conducting microgravity experiments using the center's Drop Tower that was built in 1948. Converted from an old jet propulsion fuel laboratory, this tower allowed researchers, for the first time, to conduct free-fall experiments lasting 2.2 seconds. In 1966, Lewis expanded its microgravity capabilities with the construction of its Zero Gravity Research Facility in quadrant 2. A large, low-pressure shaft more than five-hundred feet deep, the Zero G Facility now gave researchers the ability to test experiments to free-fall for more than five seconds. Researchers also now had the ability to accurately determine the behavior of fluids and gases in a more rigorous, space-like environment. This research lead to the Zero Gravity Research Facility to be designated as a National Historic Landmark – NHL in 1985.

Centaur

By the early 1960s, the center was receiving strong Congressional support for the new space program, giving it the resources needed to expand its workforce and facilities once more to accomplish President Kennedy's directive. Similar in magnitude to the "Big Switch" in 1945, the center was once again reorganized. Silverstein, now director of the NASA Lewis Research Center believed that it was important to separate research from the development and mission side of the agency. As a result, the center was divided into two distinct parts, Research and Development.

This philosophy was reflected in the center's next major expansion. NASA purchased 9.8 acres on the north side of Brookpark Road, just outside the main gate, and constructed two new office buildings; the Developmental Engineering Building or D.E.B. and its annex, both constructed in 1964. Together the buildings provided office space for 1,100 employees to support the work for some of the lab's largest development programs, such as Agena, M-1 and the Centaur second stage rocket engines. The Centaur program required the center to once again convert its AWT, now known as the Space Power Chambers. This renovated test facility simulated the space environment. The Space Power Chambers helped ensure the success of the Centaur program, which sent Surveyors to the Moon, paving the way for Apollo.

*On **July 20, 1969**, American astronauts Neil Armstrong, Buzz Aldrin, and Michael Collins landed on the moon, accomplishing and exceeding the challenge set forth by President John F. Kennedy in less than a decade.*

Armstrong took mankind's first steps 240,000 miles away from Earth onto the surface of the Moon. This three-stage, 363-foot rocket that carried the men into space used liquid hydrogen. It is the fuel that Lewis Research Center pioneered to propel the rocket's upper stages. The use of this liquid hydrogen would prove vital to many future NASA missions, such as the Space Shuttle.

Funding for NASA and the Lewis Research Center was drastically cut as the Apollo years came to a close. NASA HQ cancelled the nuclear propulsion and power programs and re-allocated funds to other centers more involved with the design of the Space Shuttle. During the 1970s, a number of facilities at Lewis Field and its satellite location Plum Brook Station shut down. Although Plum Brook would eventually reopen closed facilities in the 1980s, approximately 1,500 acres of land on the station's perimeter were sold. Facilities such as the Space Power Chambers and PSL 1 and 2 shut down and remain closed until their eventual demolition.

After the Space Race

Funding for many programs was cancelled and the Lewis Research Center turned its efforts toward renewable energy, such as solar and wind power. The center also helped to improve fuel efficiency and noise reduction of aircraft engines. The renewable energy research with jet engines was successful enough that another facility was built at Lewis, the Propulsion Systems Laboratory 3 and 4. It occupied the remainder of Wright Park area near its predecessor PSL 1 and 2. The new facility allowed the center to test larger and more powerful jet engines at simulated altitudes during all phases of flight. In the 1980s and 1990s, Lewis secured roles in mainstream programs, such as the upper-stage propulsion system for the Space Shuttle, the development of the power system for the International Space Station and the Advanced Communications Technology Satellite. In more recent years, the center was involved in the Orion spacecraft and aeronautics programs such as Advanced Subsonic Technology, Ultra Efficient Engine Technology, and the Aviation Safety Program.

In 1999, the center was renamed once again. Following John Glenn's return to flight on STS-95 aboard Space Shuttle Discovery, the Lewis Research Center became the NASA John H. Glenn Research Center, sometimes known as the Glenn Research Center or GRC, in honor of the Ohio-born American astronaut and Ohio Senator. To keep the honoring of George Lewis's efforts and to separate the Sandusky location, the official naming was NASA John H. Glenn Research Center at Lewis Field and NASA John H. Glenn Research Center at Plum Brook Station.

Downsizing and Rightsizing

With the retirement of the Space Shuttle, NASA began to downsize and remove older research facilities that no longer supported current missions. NASA also realized its oldest centers were reaching fifty years of age and now having to comply with the National Historic Preservation Act of 1966. The agency's headquarters created a Historic Preservation Program for all its centers to follow and provided funding to help properly remove underutilized buildings and structures, construct new buildings, as well as rehabilitate buildings and structures to remain.

In 2003, the Glenn Research Center began re-examining all of its facilities and infrastructure and initiated a plan to reduce the size of the center, rightsizing. The same year, the RETF was demolished to allow for the expansion of a Cleveland Hopkins International Airport runway. In 2012, the DEB and its annex were put up for surplus and sold. As demolition occurs, significant buildings and structures have been extensively documented or books written telling the story of the facility. The central section of the Glenn Research Center's campus is recognized as the most historically significant area of the lab and is now identified as an historic district. Its period of significance is from 1941, the year construction of the facility began, to 1972 the end of the Space Technology and Civil

Rehabilitation of Business Service Center

Aeronautics period. A study was completed to support that the historic district is eligible for listing on the National Register of Historic Places under Criteria A and Criteria C. The historic district is named Lewis Field Historic District in memory of George Lewis.

From its roots as an Aircraft Engine Research Laboratory in the 1940s, the NASA John H. Glenn Research Center at Lewis Field and Plum Brook Station has become a national resource for advancements in aeronautics and spaceflight capabilities. The center's long history of innovation and research has helped the nation improve life on Earth, soar into the skies, and explore the universe.

The center's continued commitment to the preservation of its history and the heritage of its structures, which allowed our nation to accomplish such goals, will create a lasting legacy for generations to come.

Construction Quadrant Map

National Aeronautics and
Space Administration

Glenn Research Center
21000 Brookpark Road
Cleveland, OH 44135

www.nasa.gov

PS-01901