FULL SCALE 30- X 60-FOOT TUNNEL

Withdrawal of National Historic Landmark Designation
Report

Designated: October 3, 1985

Location: Langley Research Center
Hampton (City), Virginia

Owner: Lesa B. Roe, Director
NASA Langley Research Center
Building 2101, Mailstop 300 A
Langley Research Center
Hampton, VA 23681-2199

State Historic Preservation Officer:

Ms. Kathleen Kilpatrick, SHPO
2801 Kensington Avenue
400 North Street
Richmond, Virginia 23221

Significance of the Landmark:

- Constructed in 1929-1931, this is the first full-scale wind tunnel the National Advisory Committee for Aeronautics (NACA) built. It was designed to test large-scale and full-scale aircraft at actual flight speeds, and during its 64 years of operation contributed to the design of an entire new generation of aircraft. Almost all World War II fighters were tested in what was then the world's largest wind tunnel. The National Aeronautics and Space Administration terminated its operations in 1995 and turned the facility over to Old Dominion University for use as an engineering research laboratory. This tunnel was designated a National Historic Landmark (NHL) as a result of the *Man in Space NHL Theme Study* done by the National Park Service in 1984.

Condition of the Landmark:

- The Full Scale 30- x 60-Foot Tunnel has been completely demolished.

Justification for Withdrawing Landmark Designation:

- Because of the complete demolition of the Full Scale 30- x 60-Foot Tunnel, the property no longer meets the criteria for designation because the qualities for which it was originally designated have been destroyed.

Recommendation:

- The National Historic Landmark designation for the Full Scale 30- x 60-Foot Tunnel should be withdrawn. In addition, the property should be removed from the National Register of Historic Places.

Full Scale 30- x 60-Foot Tunnel prior to demolition
Courtesy of NASA Langley Research Center

Full Scale 30- x 60-Foot Tunnel during demolition
Courtesy of NASA Langley Research Center

Former site of Full Scale 30- x 60-Foot Tunnel
Courtesy of NASA Langley Research Center

NPS Form 10-900
(7-81)

United States Department of the Interior
National Park Service

For NPS use only

received

date entered

National Register of Historic Places Inventory—Nomination Form

See instructions in *How to Complete National Register Forms*
Type all entries—complete applicable sections

1. Name

historic 30-by 60-Foot Tunnel

and/or common Full Scale Tunnel

2. Location

street & number Langley Research Center ___ not for publication

city, town Hampton ___ vicinity of congressional district

state Virginia code 51 county Hampton code 650

3. Classification

Category	Ownership	Status	Present Use	
___ district	X public	___ occupied	___ agriculture	___ museum
___ building(s)	___ private	___ unoccupied	___ commercial	___ park
X structure	___ both	___ work in progress	___ educational	___ private residence
___ site	**Public Acquisition**	**Accessible**	___ entertainment	___ religious
___ object	___ in process	X yes: restricted	X government	X scientific
	___ being considered	___ yes: unrestricted	___ industrial	___ transportation
		___ no	___ military	X other: Aeronautical Research

4. Owner of Property

name National Aeronautics and Space Administration (NASA)

street & number

city, town Washington ___ vicinity of state D.C. 20546

5. Location of Legal Description

courthouse, registry of deeds, etc. National Aeronautics and Space Administration (NASA)

street & number Real Property Management Office Code NXG

city, town Washington state D.C. 20546

6. Representation in Existing Surveys

title None has this property been determined eligible? ___ yes ___ no

date ___ federal ___ state ___ county ___ local

depository for survey records

city, town state

7. Description

Condition		Check one	Check one
X excellent	___ deteriorated	___ unaltered	X original site
___ good	___ ruins	X altered	___ moved date 1931
___ fair	___ unexposed		

Describe the present and original (if known) physical appearance

The Full Scale Tunnel is in building 643 in the East Area of Langley Research Center.

The general arrangement of the Full Scale Tunnel is shown in Appendix 1 at the rear of this report. The tunnel is a double return flow type with an open throat having a horizontal dimension of 60 feet and a vertical dimension of 30 feet. On either side of the test chamber is a return passage 50 feet wide, with a height varying from 46 to 72 feet. The entire equipment is housed in the structure, the outside walls of which serve as the outer walls of the return passages. The over-all length of the tunnel is 434 feet by 222 feet and the maximum height is 97 feet. The framework is on structural steel and the walls and roof are of 5/16-inch corrugated cement asbestos sheets. The entrance and exit cones are constructed of 2-inch wood planking, attached to a steel frame and covered on the inside with galvanized sheet metal as protection against fire.[1]

The test section in the open throat is 30 feet high and 60 feet wide and can accommodate airplanes or models having spans to about 40 feet. The tunnel is powered by two four-blade, 35.5 foot diameter fans, each driven by a 4000-horsepower electric motor. Airflow from the dual propellers is split right and left into two streams; doubling back between the test section and the building's wall, the streams are reunited prior to entering the throat of the test section.

The maximum air-speed of the tunnel is about 100 mph. When this tunnel was first placed in operation in 1931, its maximum air-speed was equal to the top speed of many airplanes then flying. Since then, not only has the maximum speed of airplanes far surpassed that of the tunnel, but transonic and supersonic airplanes operate in realms into which low-speed data cannot be extrapolated. The design of these airplanes, however, has required wing shapes and airfoil sections that sometimes result in poor low speed characteristics. The Full Scale Tunnel is well suited to investigate means of alleviating these low speed problems because full or large scale hardware can be used, and the model or airplane is readily accessible.[2]

In addition to the testing capabilities of extensive flow measurement and visualization for large scale-models, the tunnel is equipped with shielded struts for six-component scale balance testing, and can also be used for free-flight testing of subscale models. These tests are particularly suited to the study of high-angle-of-attack flight dynamics for advanced fighter configurations.[3]

The Full Scale Tunnel was upgraded in 1973 and is scheduled to be upgraded in 1984. Work in both cases primarily involved work done on the electric motors that power the fans. At the current time, principal research for this facility is directed at the study of the low-speed aerodynamics, static and dynamic stability and control, and associated flow characteristics of military, general aviation, and commuter aircraft.[4]

8. Significance

Period	Areas of Significance—Check and justify below			
___ prehistoric	___ archeology-prehistoric	___ community planning	___ landscape architecture	___ religion
___ 1400–1499	___ archeology-historic	___ conservation	___ law	X science
___ 1500–1599	___ agriculture	___ economics	___ literature	___ sculpture
___ 1600–1699	___ architecture	___ education	X military	___ social/ humanitarian
___ 1700–1799	___ art	X engineering	___ music	___ theater
___ 1800–1899	___ commerce	___ exploration/settlement	___ philosophy	___ transportation
X 1900–	___ communications	___ industry	___ politics/government	X other (specify) Aeronautical Research Space Exploration
		___ invention		

Specific dates 1931-Present **Builder/Architect** Smith J. DeFrance

Statement of Significance (in one paragraph)

By 1929 the original NACA Langley wind tunnel complex was completed and turning out useful high quality aerodynamic research data. In spite of this achievement NACA engineers realized that there was a gap in their wind tunnel inventory. They needed a full scale wind tunnel.

Although the Variable Density Tunnel gave NACA engineers confidence in scaling up test results from models, several research areas could be explored only with full-scale models or with actual aircraft. The VDT was limited when the aerodynamic characteristics of a complete airplane were desired because it was practically impossible to build a model of the required size that is a true reproduction of a complete airplane. This difficulty is increased by the requirement that the model withstand large forces. Some of the questions that needed to be answered involved solving drag penalties due to external struts, surface gaps, air leaks, and engine cooling insulation. These questions could only be answered by using full scale aircraft. Models simply would not work. Previous experience with the Propeller Research Tunnel, which had a large scale test section, gave NACA engineers the confidence to attempt to build the Full Scale Tunnel.

Under the leadership of Smith J. De France, the design of the Full Scale Wind Tunnel began at Langley in 1929. With funds appropriated before the start of the Depression, NACA was able to buy materials and labor at bargain prices. In addition a large pool of talented but now unemployed aeronautical engineers was available to work on the project. The work progressed quickly and by 1931 the tunnel was complete.

The significance of the Full Scale Tunnel was immediately apparent to NACA engineers. Drag tests in the tunnel indicated surprisingly large performance penalities from external struts and other exposed aircraft parts. This information had been suspected by NACA engineers for some time but with the completion of the Full Scale Tunnel the engineers now had the data needed to correct the problem. Soon a large procession of military aircraft was dispatched to Langley for drag cleanup tests. Before and during World War II practically every high performance aircraft used by the United States was checked out at the Full Scale Tunnel. The tunnel operated 24 hours a day 7 days a week during the war performing drag cleanup tests for the military. For most of the war the Full Scale Tunnel was the only tunnel in the country and in the world capable of performing these tests. The importance of the tunnel was so evident that the United States built an even larger Full Scale Tunnel at the Ames Research Center in 1944.[5]

9. Major Bibliographical References

See continuation sheets

10. Geographical Data

Acreage of nominated property 434 feet x 222 feet

Quadrangle name Hampton **Quadrangle scale** 1:24,000

UMT References

	Zone	Easting	Northing		Zone	Easting	Northing
A	18	380740	4104700	B			
C				D			
E				F			
G				H			

Verbal boundary description and justification

The boundary of the Full Scale Tunnel is defined by the outside perimeter of Building 643 in the East Area of the Langley Research Center.

List all states and counties for properties overlapping state or county boundaries

state	code	county	code
state	code	county	code

11. Form Prepared By

name/title Harry A. Butowsky

organization National Park Service **date** May 15, 1984

street & number Division of History **telephone** (202) 343-8168

city or town Washington, D.C. 20240 **state**

12. State Historic Preservation Officer Certification

The evaluated significance of this property within the state is:

___ national ___ state ___ local

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

State Historic Preservation Officer signature

title **date**

For NPS use only

I hereby certify that this property is included in the National Register

date

Keeper of the National Register

Attest: **date**

Chief of Registration

The Full Scale Tunnel has proved to be a remarkably adaptive research tool. In recent years modern aircraft of all types have been tested in the tunnel. These aircraft include the Harrier VTOL fighter, the F-16, the American supersonic transport, the X-29A-a forward swept wing experimental fighter, the Space Shuttle, the Lunar Landing Test Vehicle, and many others.

Because of its unique performance the Full Scale Tunnel is of singular importance not only in the area of aeronautical research but also in the theme of support facilities that contributed the American victory in World War II. The superiority of American designed and built fighters and bombers was due in no small part to the testing that these aircraft received in the Full Scale Tunnel.

Footnotes

1. National Advisory Committee for Aeronautics, The N.A.C.A. Full-Scale Wind Tunnel-Technical Report 45 (Washington, D.C.: National Advisory Committee for Aeronautics, 1933), pp. 292-93.

2. National Aeronautics and Space Administration, Langley Test Highlights 1982-Technical Memorandum 84655 (Hampton, Va.: Langley Research Center, 1983), p. 3.

   Donald D. Baals and William R. Corliss, Wind Tunnels of NASA (Washington, D.C.: National Aeronautics and Space Administration, 1981), p. 23.

3. Ibid.

4. Langley Facilities Program Development Office, LaRC Data for Facilities Catalogue (Unpublished Internal Memorandum, August 4, 1983), p. 3.

5. Baals, pp. 22-3.

Major Bibliographic References

Anderton, David A. Sixty Years of Aeronautical Research: 1917-1977. Washington, D.C.: National Aeronautics and Space Administration, 1978.

Anderson, John D. Jr. Introduction to Flight: Its Engineering and History. New York: McGraw Hill Book Company, 1978.

Baals, Donald D., and Corliss, William R. Wind Tunnels of NASA. Washington, D.C.: National Aeronautics and Space Administration, 1981.

Characteristics of Nine Research Wind Tunnels of the Langley Aeronautical Laboratory. Washington, D.C.: National Advisory Committee for Aeronautics, 1957.

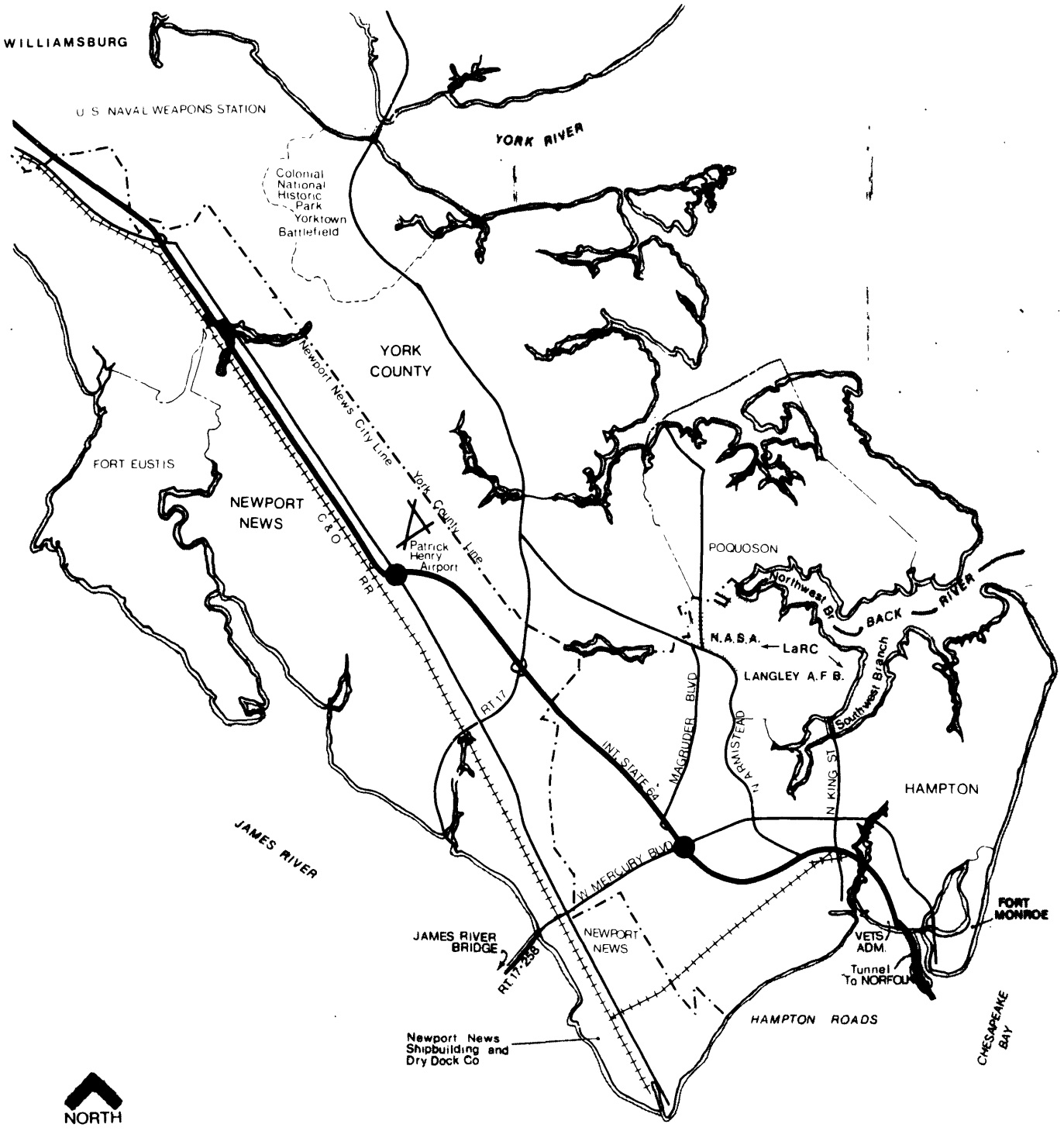
Gray, George W. Frontiers of Flight: The Story of NACA Research. New York: Alfred E. Knopf, 1948.

Langley Research Center Facilities Program Development Office. LaRC Data for Facilities Catalogue. Hampton, Va., Unpublished Internal Memorandum, August 4, 1983.

Langley Test Highlights 1982-Technical Memorandum 84655. Hampton, Va.: Langley Research Center, 1983.

N.A.C.A. Full Scale Wind Tunnel Technical Report 459. Washington, D.C.: National Advisory Committee for Aeronautics, 1933.

Pope, Alan and Harper, John J. Low-Speed Wind Tunnel Testing. New York: John Wiley & Sons, 1966.



National Aeronautics and Space Administration

Langley Research Center
Hampton, Virginia
23665

FIGURE 1-1
Regional Map

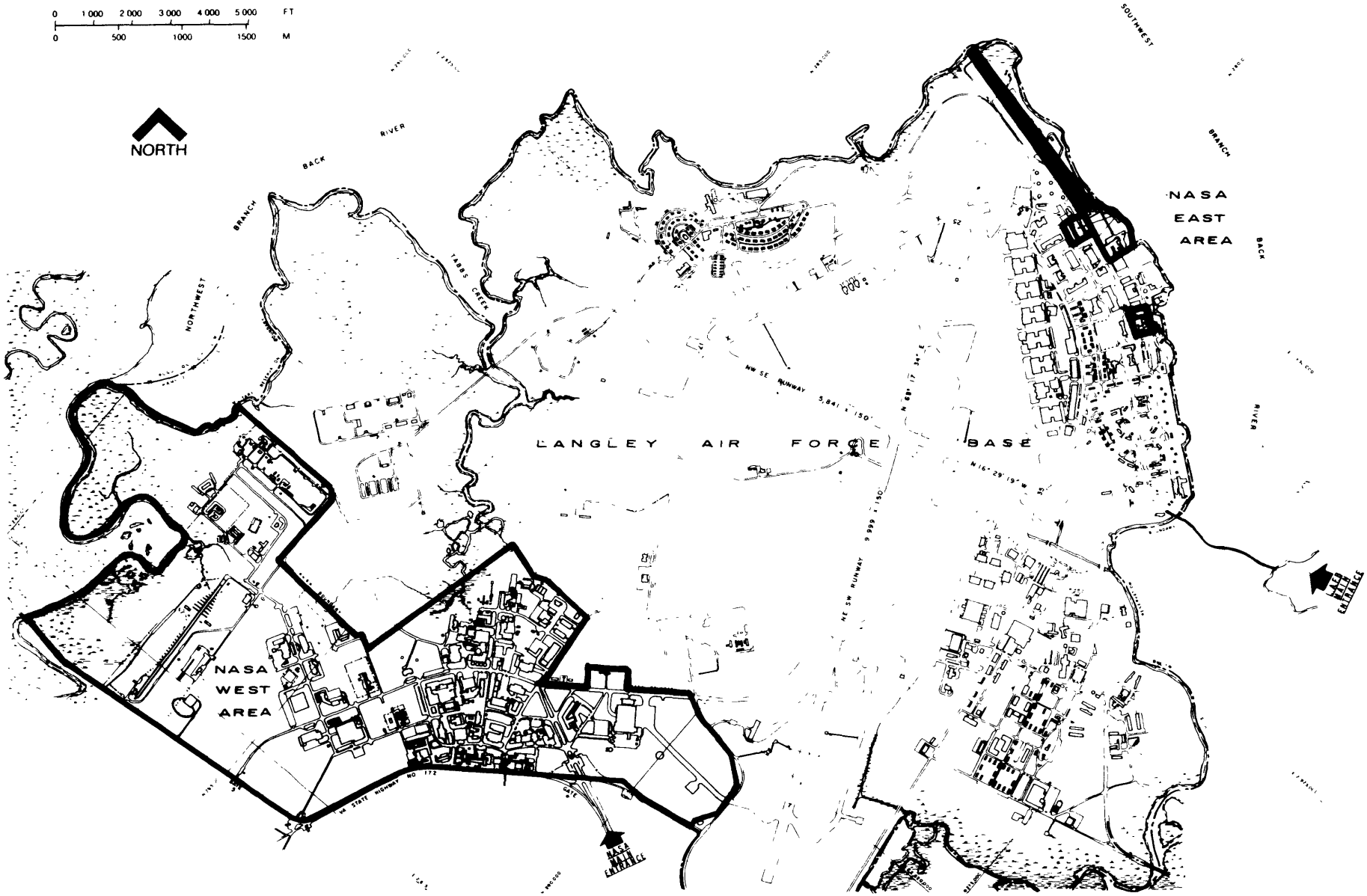


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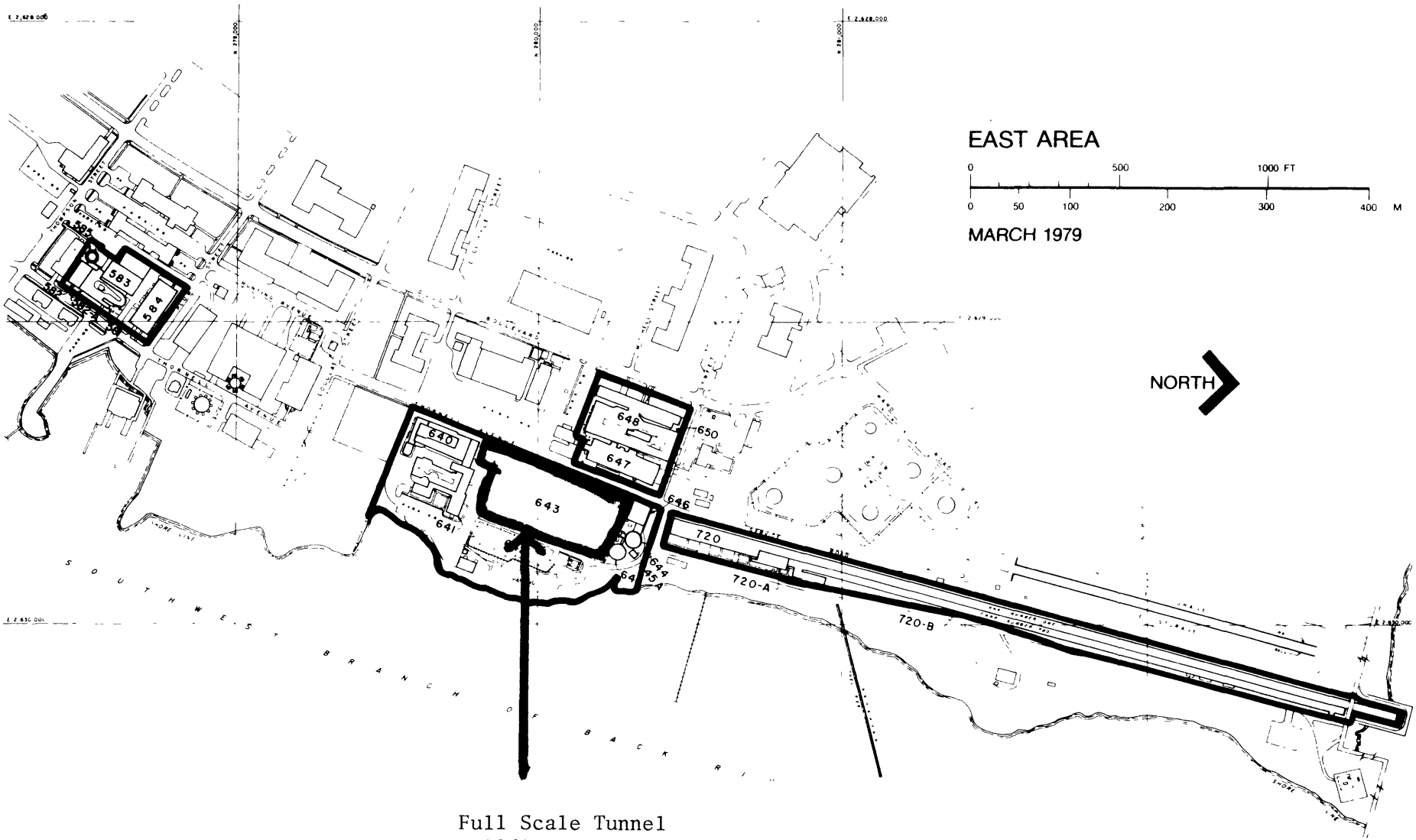
FIGURE 1-2
Combined East & West Area



Full Scale Tunnel
Building 643
18/380740/410700

National Aeronautics and
Space Administration

Langley Research Center
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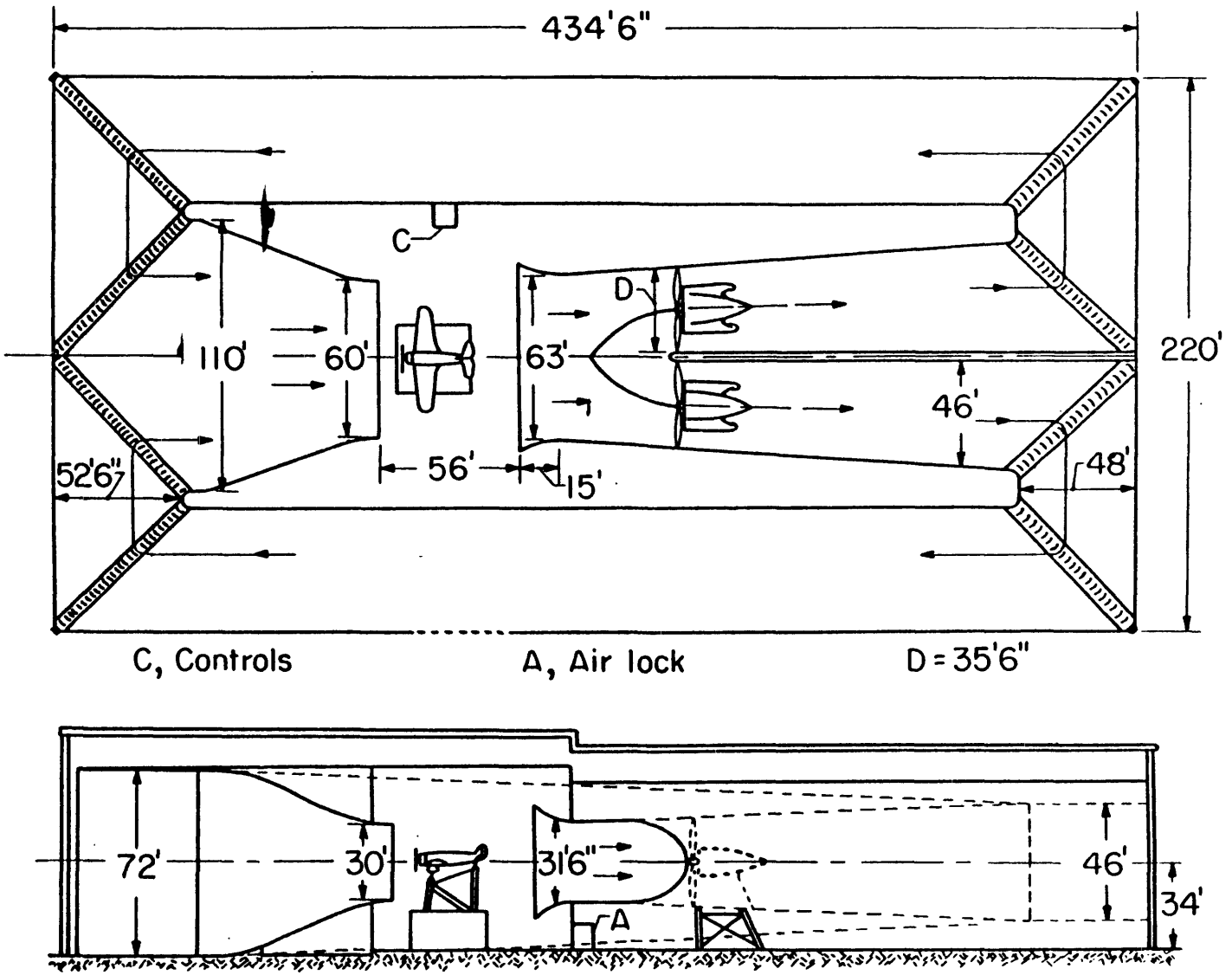
23665

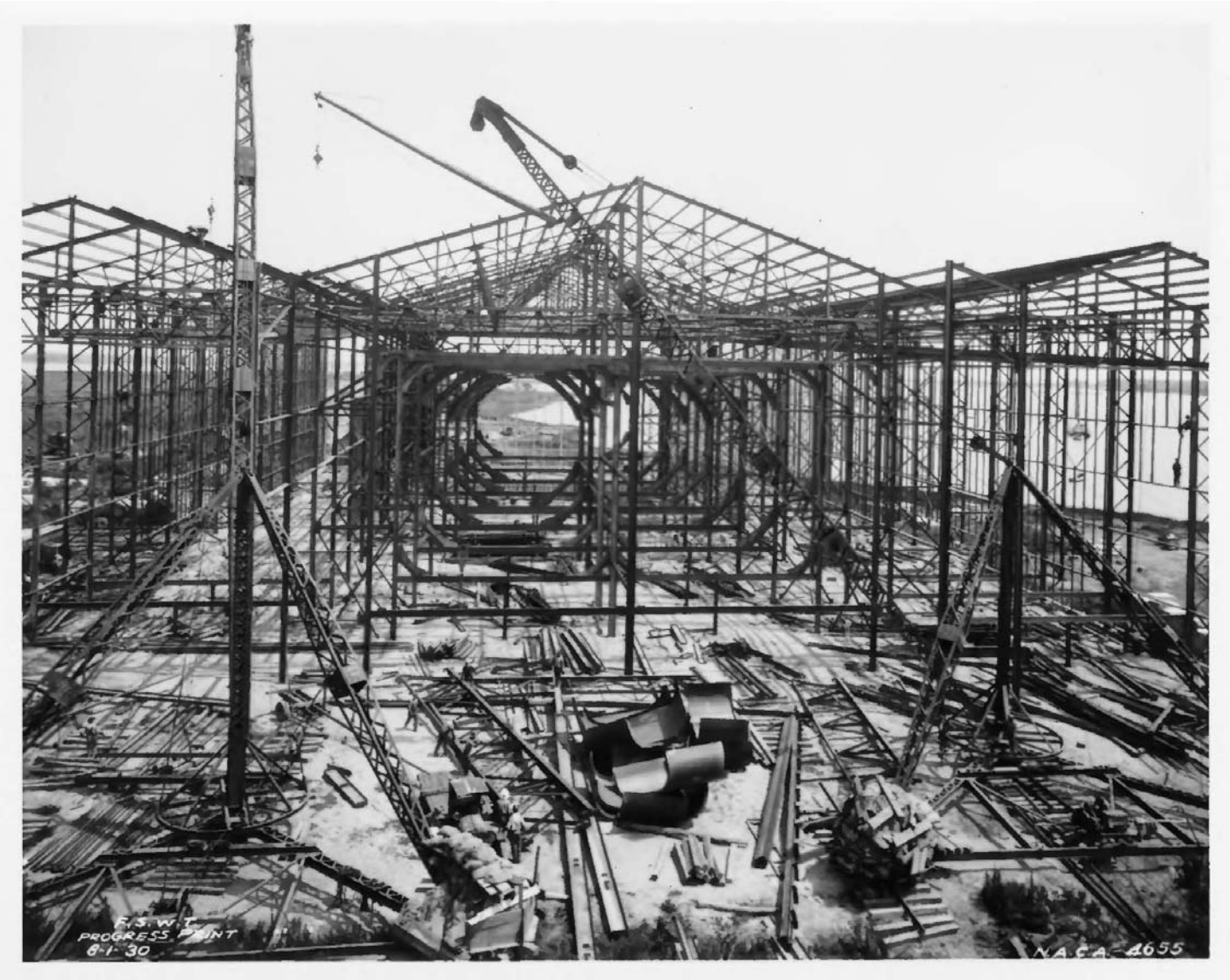
FIGURE 1-3
East Area

Appendix 1

Plan and elevation sketch of the Langley full-scale tunnel.



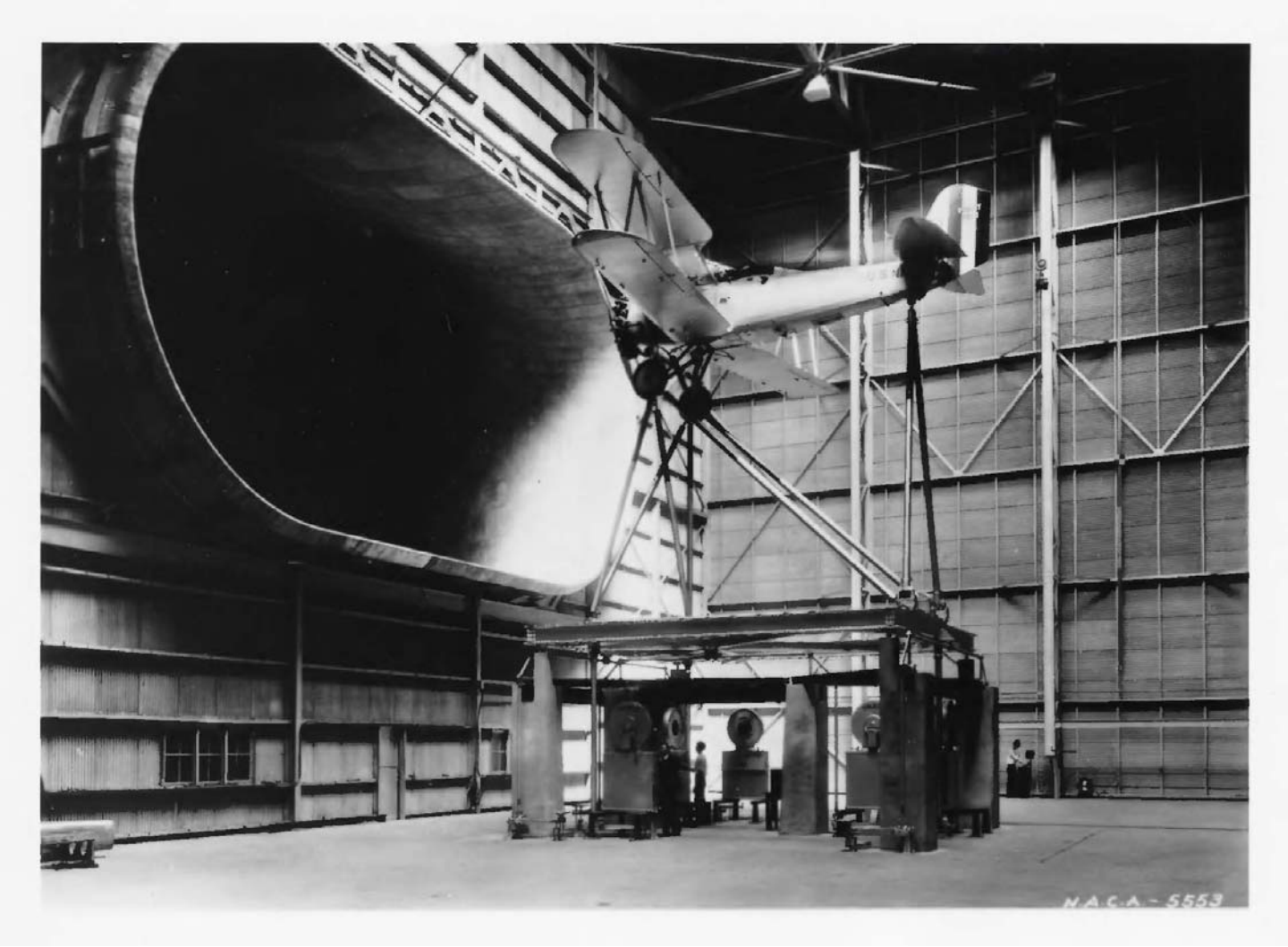
Source Characteristics of Nine Research Wind Tunnels of the Langley Aeronautical Laboratory (Washington, D. C.: National Advisory Committee for Aeronautics 1957), p. 99.



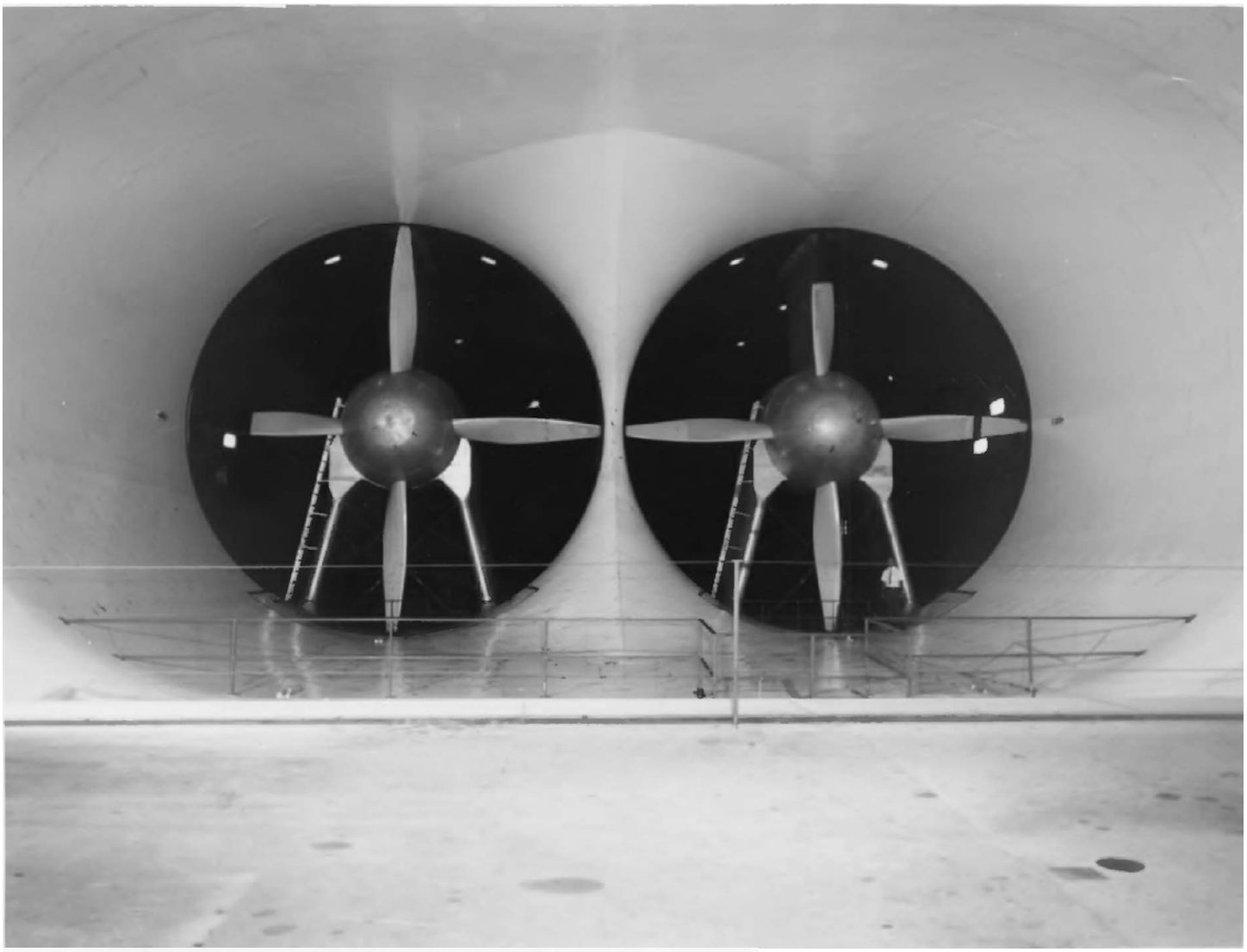
Construction of the 30- x 60-Foot Tunnel, 1930
Courtesy of National Aeronautics and Space Administration Historic Photo; Photo No. NACA 4655

Mercury Capsule in the 30- x 60-Foot Tunnel, 1959
Courtesy of National Aeronautics and Space Administration Historic Photo; Photo No. L- 59-336

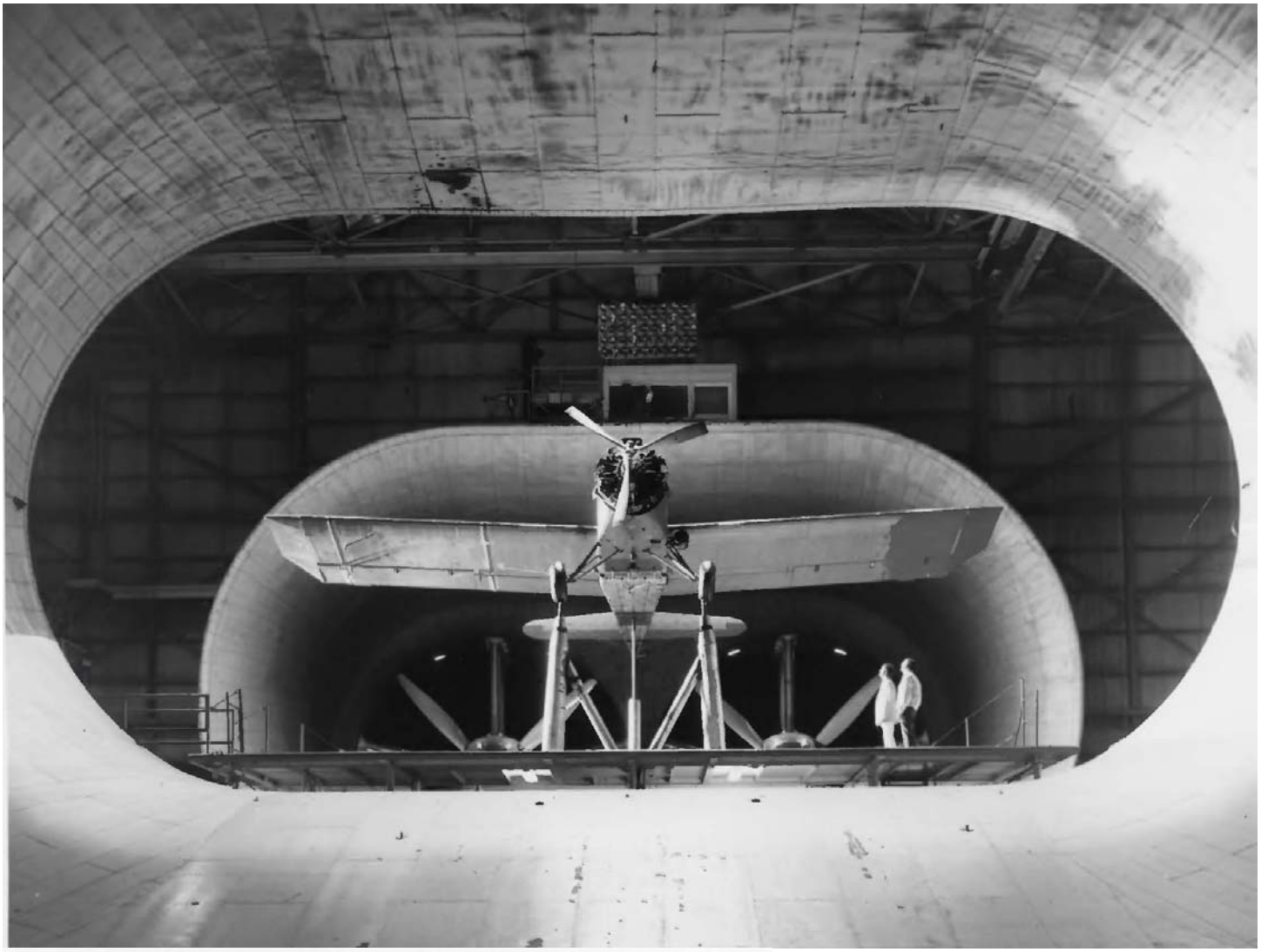
Vought F4U-1 Corsair tested in the 30- x 60-Foot Tunnel
Courtesy of National Aeronautics and Space Administration Historic Photo; Photo No. LMAL 30652



Vought Corsair airplane test in the 30- X 60-Foot Tunnel
Courtesy of National Aeronautics and Space Administration Historic Photo; Photo No. NACA 5553



1. Full Scale Tunnel
2. Hampton, Virginia
3. NASA
4. 1983
5. NASA, Langley Research Center Facilities Office
6. Modern view of the two four-blade fans that power the Full Scale Tunnel
7. 3-B



1. Full Scale Tunnel
2. Hampton, Virginia
3. NASA
4. 1978
5. NASA, Langley Research Center Facilities Office
6. Modern interior view of test section
7. 3-A

1. Full Scale Tunnel
2. Hampton, Virginia
3. NACA
4. 1950
5. NASA, Langley Research Center Archives
6. Interior view of test section with submarine Albacore
7. 3

1. Full Scale Tunnel
2. Hampton, Virginia
3. NASA
4. 1981
5. NASA, Langley Research Center Facilities Office
6. Exterior view
7. 4