

Project B-242

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THE AEROSPACE ADVANTAGES OF THE GEORGIA COAST

Prepared for
The Georgia Aeronautics and Space Administration

by
Wade McKoy

Industrial Development Division
Engineering Experiment Station
GEORGIA INSTITUTE OF TECHNOLOGY
March 1963

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Foreword

This preliminary appraisal of the potentials which the Georgia coastal area offers for the aerospace industry is part of the much broader study which the Industrial Development Division has been making of the aerospace industry potentials of the state as a whole.

Previously published reports deal with the "R & D" potentials of the Atlanta area and certain aspects of the transportation problems connected with the development of Georgia's coastal area as a major aerospace installation. Unpublished materials compiled as part of the over-all study focus on the "impact" problems which have affected existing space installations. These materials relate to the important problem of preventing major economic and social dislocations from occurring along the Georgia coast if that area develops as a major space center.

Further and more detailed studies are needed of the site possibilities which exist along the coast. Of particular concern here is the definite possibility that some of the tracts of land which offer the best potentials for attracting space installations which require isolation may be turned to other uses and be lost as an aerospace resource. The basic concern in this regard is the need for reserving for various possible uses those tracts of land which can best be allocated not just for testing or launch purposes, but for support and service operations, housing, recreation areas, and other purposes.

It is unfortunate that lack of funds has delayed the publication of this report. It is hoped that the additional studies required can be undertaken in the near future. Questions and comments are invited.

Kenneth C. Wagner, Chief
Industrial Development Division
GEORGIA INSTITUTE OF TECHNOLOGY

Summary and Conclusions

The Georgia coast offers significant advantages for the location of manufacturing, testing, and launching facilities in the aerospace field. Proper development and promotion of these advantages could lead to the growth of a major aerospace complex in the coastal area between Savannah and St. Marys.

Particularly important are the following:

1. Georgia's coast has a 50-year record of no major hurricane damage, while the coasts of neighboring states have relatively frequent incidence and significant damage.
2. The study area is conveniently located in relation to existing government and private aerospace facilities in the Southeast.
3. The coast of Georgia has three urban areas, ranging in population from 3,300 to 190,000, all with deepwater ports. The entire coastal area is served by the Atlantic Intracoastal Waterway, which provides a protected waterway from any Georgia coastal location to the existing East Coast space installations.
4. The three urban areas are separated by two large, sparsely populated areas of high, dry ground -- the largest such areas on the coast from southern Florida through North Carolina -- which can provide the isolation needed for aerospace operations.

Either of the isolated areas could provide an excellent site for rocket launching facilities. St. Catherines Island, in the center of the more northern area, has already received special attention by NASA as a possible launch site. In addition to offering advantages for manufacturing and testing, the Georgia coast lies in a latitude south of the 32nd parallel -- a latitude which would permit use of the Atlantic Missile Range tracking system and utilization of greater thrust from the earth's rotation than would be available at more northern locations.

Three types of operations offer opportunities for development in the study area. Thiokol Chemical Corporation's location in Camden County of its plant for the development and testing of large solid propellant rocket motors indicates the potentials that exist for attracting manufacturing and testing operations requiring isolation and access to water transportation. The

establishment of such facilities in turn should lead to the development of satellite industries to serve them.

An even more immediate possibility is the attraction of companies to supply goods or services to existing space installations along the East Coast. A longer range possibility is the eventual use of one of the islands off the Georgia coast, such as St. Catherines, as a rocket launching site. Although more remote, this possibility should receive full consideration in the over-all development plan for the area.

A positive program of action is needed if the Georgia coastal area is to capitalize on its potential for space-age growth. In anticipation of attracting additional manufacturing and testing facilities to the study area, and in preparation for the long-term possibility that launch facilities may be built in Georgia, work should begin at the earliest possible time on:

1. a detailed analysis of Georgia's coastal sites,
2. determination of the feasibility of zoning isolated areas for aerospace activities, including launch facilities, and
3. a continuing program to keep abreast of NASA's plans and developments and to keep public and private organizations informed of Georgia's aerospace potentials.

INTRODUCTION

Surveying the American aerospace industry has been compared to looking into the large end of a megaphone and viewing a narrowing perspective toward the other end. In the space industry the many companies serve a single customer, the United States government, whose main contracting agencies are the National Aeronautics and Space Administration (NASA), the Atomic Energy Commission (AEC), and the departments of the Air Force, the Army, and the Navy.

Another characteristic of the aerospace industry is that a large amount of research, design, and development goes into the products, quantities of production are small, and a high degree of reliability is required.

The United States government is planning to spend \$5 billion per year to develop a moon rocket. This is approximately equivalent to the 1960 personal income of all Georgians. Other southern states (Florida, Alabama, Mississippi, Louisiana, and Texas) are benefiting tremendously from the space program.

This study is concerned with determining the advantages of the Georgia coast for aerospace operations. The research has concentrated on identifying those assets for which documentation is not readily available elsewhere. Another report, resulting from the same research and issued in advance of this report, showed how advantage could be taken of the topography of the state to create an inland, protected waterway which would connect the Gulf and Atlantic Intracoastal Waterways, thus facilitating barge transportation of large rocket parts.^{1/}

^{1/} Wade McKoy, A Cross-Georgia Waterway to Serve the Space Age, Industrial Development Division, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, Georgia, February 1963.

ADVANTAGES OF GEORGIA COASTAL SITES

The coast of Georgia has three urban areas, all with deepwater ports -- one at the border of South Carolina, one at the Florida border, and one in between. Separating these cities are two large but sparsely populated areas on high, dry ground. The Atlantic Intracoastal Waterway serves all five areas, permitting barge service to aerospace installations at Wallops Island and Norfolk, Virginia; Charleston, South Carolina; and Cape Canaveral, Florida. The entire coastal area is virtually free from wind and tide damage associated with hurricanes. This combination of features makes the Georgia coast particularly attractive to the location of manufacturing, testing, and launching facilities in the aerospace field.

Freedom from Hurricane Damage

The Georgia coast has a 50-year record of no major hurricane damage. Georgia has experienced fewer hurricanes than any other state on the Atlantic Coast. The Florida portion of the Atlantic Coast north of Miami has had approximately five times as many hurricanes per mile of coast as Georgia. North Carolina has had approximately six times as many, and South Carolina has had approximately three times as many. The area from Miami south has had 11 times as many hurricanes.

Florida is the most exposed of all states, since hurricanes approach from the Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico. Also, Florida experiences hurricanes which, on the average, are more intense because it extends geographically farther southward than any other state. Hurricanes actually are an important factor in the Florida economy because of their frequency and severity.

Hurricane occurrence for the 58-year period from 1900 through 1957 is shown for sections of the Atlantic and Gulf coasts in Table 1. The areas are listed in ascending order of frequency of hurricanes per unit of smoothed coast line.

Table 1
 OCCURRENCE OF HURRICANES FOR SECTIONS
 OF THE ATLANTIC AND GULF COASTS
 1900-1957

<u>Area</u>	<u>Hurricane Frequency Per Unit Length of Smoothed Coast Line</u>
Georgia	1
New York and New England	1.4
Maryland, Delaware, and New Jersey	1.6
South Carolina	2.8
Florida West Coast (south of Apalachee Bay and north of Cape Sable)	3.4
Virginia	3.6
Louisiana and Mississippi	3.6
Eastern Florida (north of Greater Miami)	4.7
North Carolina	5.6
Texas	6.5
Alabama and northwest Florida	6.9
Extreme southern Florida (Miami- Cape Sable southward through Florida Keys)	10.9

Note: The length of the smoothed Georgia coast line is used for the unit length.

Source: G. E. Dunn and B. I. Miller, Atlantic Hurricanes, Louisiana State University Press, Baton Rouge, Louisiana, 1960.

Hurricanes are characterized by their high winds, but the greatest danger to a coastal area is from the high waters and the hurricane tides which are driven with great destructive force by the winds. Structures of practical design can withstand the hurricane winds, but not the destructive water. More than three-fourths of all lives lost in hurricanes have been due to flooding.

The ability of a coastal area to develop a true storm wave (also called tidal wave) depends upon the contour of the coast line and the slope of the ocean bed. The Gulf and South Atlantic coasts cannot develop storm waves as great as those that occur on the New England and the Middle Atlantic coasts. Places along the New England coast have experienced 12-, 18-, and

25-foot storm waves. The Georgia coast, however, has had very little destruction from hurricane water.

Proximity to Existing Aerospace Facilities

Location of aerospace operations in the Georgia coastal area would promote economy and efficiency because of Georgia's proximity to existing government and private aerospace facilities in other southeastern states. Map 1 shows the location of major military, NASA, and AEC installations and airframe manufacturing plants in the Southeast.

Availability of Water Transportation

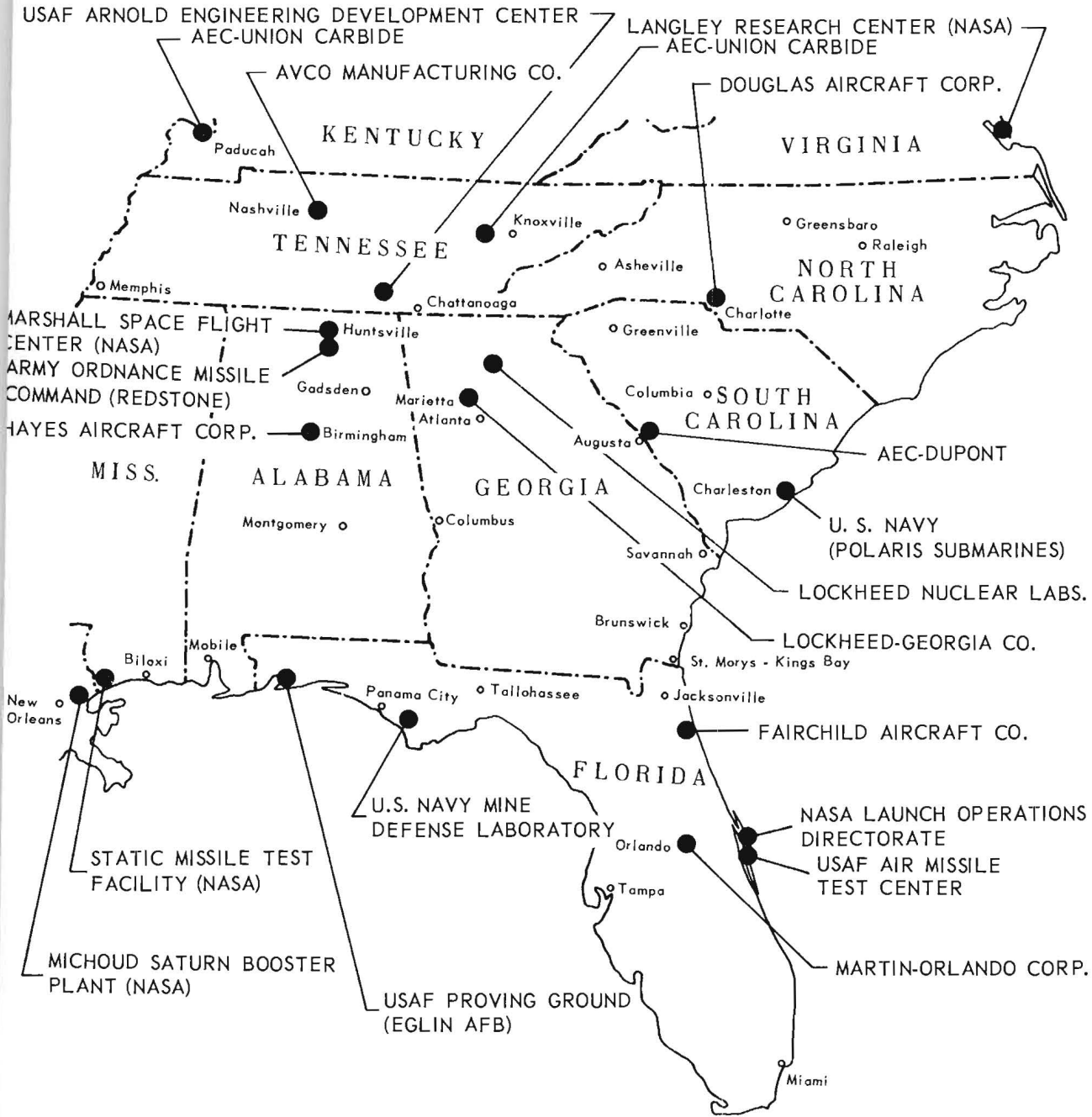
The Atlantic Intracoastal Waterway, which traverses the Georgia coast, is located between the Georgia coastal islands and the mainland, as shown in Map 2. Water transportation is therefore available for plants whose raw materials or products must be shipped by water. Since major rocket parts must be transported between manufacturing sites, to testing facilities, and to launch facilities entirely by water, accessibility to the Intracoastal Waterway and to deepwater ports is a decided advantage.

There are three deepwater ports on the Georgia coast: the highly developed port of Savannah, with facilities and sailings equal to or greater than Charleston, Jacksonville, or Mobile; Brunswick, a small but growing port with two state docks and several private docks; and St. Marys-Kings Bay, with a small volume of business in a sparsely populated area and with docking facilities built by the government toward the end of World War II for the handling of explosive items.

Sparsely Populated Areas

The three port cities on the Georgia coast are separated by two large, sparsely populated areas. These areas provide the isolation needed for operations that have extremely high noise levels or that are otherwise obnoxious or dangerous. Map 2 and its accompanying overlay indicate the size of the sparsely inhabited areas. The average number of people per square mile outside of the corporate limits of the towns is shown for each area.

MAP 1
 LOCATIONS OF MAJOR MILITARY, NASA, AND AEC INSTALLATIONS AND
 AIRFRAME MANUFACTURERS IN THE SOUTHEAST



MAP 2

GEORGIA'S ATLANTIC COASTAL AREA

Location of the Intracoastal Waterway and Future Interstate Highway are Shown



The area lying in Camden and Glynn counties between St. Marys and Brunswick contains approximately 830 square miles and has an average rural population density of seven people per square mile. The smoothed coast line is 28 miles long.

The area lying in McIntosh, Liberty, Bryan, and Chatham counties between Brunswick and Savannah contains approximately 850 square miles and has an average rural population density of 13 people per square mile. The smoothed coast line is 60 miles long. The least populated census county division in this area is Townsend in McIntosh County with an average of nine people per square mile over an area of approximately 230 square miles.

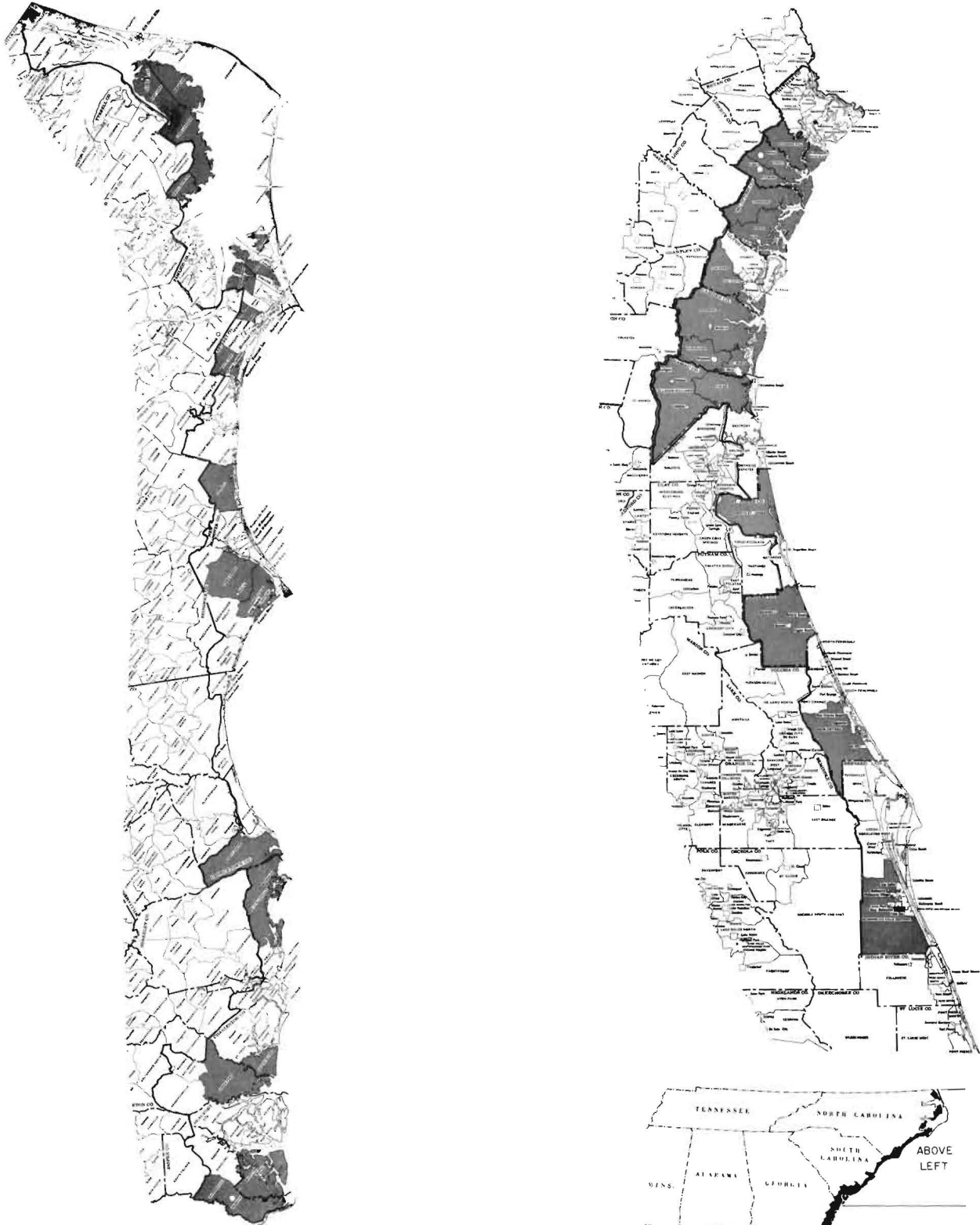
The population concentration on the Georgia coast is compared in Map 3 and Appendix 1 with the population density along the Atlantic Coast from lower Florida through North Carolina. Georgia's sparsely populated coastal areas are the largest on the Atlantic coast. Important also is the fact that they are not dominated by large swamps as is the case in other areas of low population concentration.

Favorable Latitude

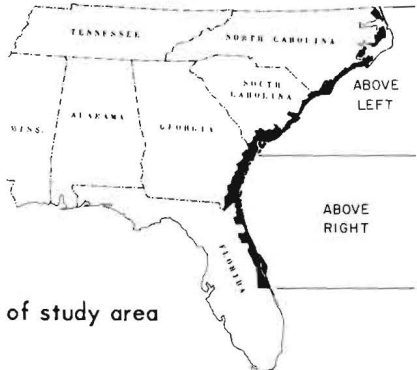
Latitude south of the 32nd parallel makes the Georgia coast an advantageous location for possible rocket launching facilities. A launching site in Georgia would permit use of the Atlantic Missile Range tracking system, yet would prevent overcrowding Cape Canaveral's launching facilities. The tracking equipment used in the manned space flight program is located at Cape Canaveral and down-range on the Bahama Islands; other tracking stations are located around the world. Usefulness of the present stations would decrease the farther north a launching site is established.

The earth's rotation gives extra thrust when rockets are launched to the east, with maximum benefits possible at the equator. Since this benefit diminishes the farther north the launching occurs, Georgia's coast would be preferable as a launching site to other possible sites more to the north.

MAP 3
 COAST LINE MAP FROM SOUTHERN FLORIDA
 THROUGH NORTH CAROLINA SHOWING POPULATION DENSITY



NOTE: Shaded areas contain less than 20 people per square mile.



Location of study area

AEROSPACE OPPORTUNITIES FOR THE GEORGIA COAST

Manufacturing and Testing Operations

The immediate possibilities in Georgia for manufacturing and testing operations in the aerospace field are: (1) the attraction to one of the sparsely populated areas on the Georgia coast of additional industries requiring isolation and use of the Intracoastal Waterway, as well as plants to serve them, and (2) the attraction to the coast of companies to supply goods or services to those space installations now on the East Coast.

Thiokol Chemical Corporation is in the process of constructing in Camden County, Georgia, a plant for the development of large solid propellant rocket motors, an operation requiring isolation and access to water transportation. The site is located within the sparsely populated area between Brunswick and St. Marys and on the Intracoastal Waterway. The following statement by a company spokesman includes a listing of the factors which contributed to the selection of the Georgia coast as the site for the new facility:

Construction of first phase of the plant will cost approximately \$10.5 million and is already underway. Completion date is scheduled for the first quarter of 1964.

The plant site is located directly on the coastal-inland waterway in an area of more than 50,000 uninhabited acres in southeast Georgia. Increasing the buffer zone is the large expanse of water bordering the plant site. Huge motors generating thrust levels higher than 10,000,000 pounds can be safely produced, tested, and transported from the site by barge through the adjacent deepwater channels to Cape Canaveral, 170 miles away.

Situated near the hub of southeastern transportation facilities, the plant is easily accessible for delivery from major suppliers of inert components and raw material either by rail, truck, or water.

Initial planning for the rocket facility began in June 1961. Thiokol survey teams investigated more than 60 sites along the Atlantic Seaboard and Gulf Coast prior to the May 1962 announcement that Thiokol had optioned the present site from the Brunswick Pulp and Paper Company, Brunswick, Georgia. Primary factor in the selection of the site was the 50-year record of no major hurricane damage in the area. Other factors contributing to the site selection were available labor supply, proximity to Cape Canaveral, immediate deepwater access to the intracoastal waterway, soil structure, adequate

available acreage and buffer zone, community attitude, rail and highway transportation systems, and ready accessibility to major suppliers.

Construction will include a casting pit, propellant mixing buildings, buildings for a completely automated propellant mixing system, an inert parts preparation building, bunkered buildings for remote control operations, a quality control laboratory, a ballistic test motor preparation building, and administration spaces. The casting pit, 50 feet in diameter and 120 feet deep, will be equipped for casting, curing, and static testing the full-scale motors. The vertical propellant mixers for the initial facility will have a combined capacity of seven and three quarters million pounds of propellant per month.

The three urban areas along the coast could be service centers for an aerospace complex. There is commercial air service directly to Savannah and Brunswick and close to St. Marys-Kings Bay through either Brunswick or Jacksonville, Florida. Rockets and other heavy equipment being shipped by sea from California would find excellent port facilities at Savannah, Brunswick, or Kings Bay.

Savannah and Brunswick already have diversified metalworking industries and Savannah has a good electronics service industry. Both would be good locations for aerospace industry not requiring isolation. A Lockheed plant, for example, could be installed in or near Savannah to service the Charleston Navy Yard, Wallops Station, Langley Research Center, or Cape Canaveral. At present, Polaris missiles are shipped all the way from Lockheed's California plant for installation in the Charleston Navy Yard. If the missiles do not check out, they are shipped back to California, repaired, and returned to Charleston. A company locating its plant on the Georgia coast now may be situated even more closely to NASA launching facilities in the future, since this area is a logical location for additional launch facilities.

Launching Operations

The National Aeronautics and Space Administration's plans for the moon shot have advanced to the stage where all anticipated site needs have been met. However, it appears likely that future programs will require additional launch sites to relieve the manned space flight launching traffic jam eventually expected at Cape Canaveral. A wide range of advanced manned programs are under consideration by NASA. Included are a large 20- to 30-man space

station laboratory which could be operational before 1970, a lunar logistics vehicle, a lunar base, an aerospace plane, and exploration of Mars and Venus. Vehicles for manned exploration of the nearby planets are expected to be operational in the period between 1970 and 1975 and will involve a total cost of at least \$20 billion. Many launchings will be centered around the planned aerospace plane, a vehicle system that will be a means of transportation and logistics support for earth-orbiting space stations.

Either of the sparsely populated areas along the Georgia coast would be excellent for rocket launching facilities. St. Catherines Island, which is centrally located between Savannah and Brunswick, is considered by many the most desirable coastal island for deep space operations. The island has a 10-mile front on the Atlantic Ocean and approximately 7,000 acres of high ground. The area adjacent to St. Catherines, which would be needed as a buffer zone, is mostly low-value forest or marsh land requiring a minimum relocation of people. Hunter Air Force Base, Fort Stewart, and Glynco Naval Air Station are nearby, and there are several isolated sections on the mainland suitable for supporting industry.

APPENDIX

Appendix 1

ANALYSIS OF POPULATION DENSITY FOR ATLANTIC COASTAL COUNTIES
FROM SOUTHERN FLORIDA THROUGH NORTH CAROLINA

The tabulation on the following pages shows population density per square mile for rural areas in counties on the Atlantic Coast in Florida, Georgia, South Carolina, and North Carolina.

Calculations were made from information found in the "Number of Inhabitants" section of the 1960 Census of Population. To find how much of the population of each census county division^{1/} (or township) was rural, the populations of cities, towns, villages, and unincorporated places located within the division were subtracted from the total for the division. Areas for the divisions were determined from the large census county division maps by the use of a planimeter. The division area was then determined as a percentage of the county area. Division area in square miles was obtained by multiplying this percentage by the county's land area in square miles.

^{1/} A census county division is a subdivision of a county made for census purposes.

POPULATION DENSITY IN RURAL AREAS ON ATLANTIC COAST
FROM SOUTHERN FLORIDA THROUGH NORTH CAROLINA

<u>Census County Division Rural Area</u>	<u>Approximate Land Area in Sq. Miles</u>	<u>Rural Population</u>	<u>People per Sq. Mile</u>
FLORIDA			
Brevard County:			
Cocoa Beach-Merritt Island	110	12,291	112
Cocoa-Rockledge West	152	3,645	24
Indialantic-Melbourne Beach	17	10,136	596
Melbourne-Eau Gallie Southwest	446	5,069	11.4
Titusville	228	10,184	44.7
Duval County:			
Eastport	112	6,996	62.5
Southside Estates	123	11,247	91.4
Flagler County:			
Bunnell	478	1,718	3.6
Nassau County:			
Callahan-Hilliard	338	3,861	11.4
Fernandina Beach	17	1,698	99.9
Yulee	186	2,451	13.2
St. Johns County:			
Matanzas	74	1,542	20.8
North St. Johns	258	5,020	19.5
Volusia County:			
New Smyrna	304	3,910	12.9
North Peninsula	3	324	108
Ormond	83	11,053	133
Port Orange	91	3,263	35
South Peninsula	2	539	270
GEORGIA			
Bryan County:			
Pembroke	138	2,776	20.1
Richmond Hill	124	2,000	16.1
Camden County:			
Kingsland	177	949	5.4
St. Marys	78	561	7.2
Woodbine	389	2,812	7.2
Chatham County:			
Montgomery	52	4,212	81
Savannah Beach-Wilmington	46	1,892	41.2
Vernonburg-White Bluff	73	1,065	14.6
Glynn County:			
Dock Junction	13	3,848	296
Everett	140	3,899	27
St. Simons	48	2,147	45
Thalman	189	1,741	9.2
Liberty County:			
Midway	136	1,901	14
Riceboro	92	1,788	19.4

<u>Census County Division Rural Area</u>	<u>Approximate Land Area in Sq. Miles</u>	<u>Rural Population</u>	<u>People per Sq. Mile</u>
GEORGIA (continued)			
McIntosh County:			
Darien	201	2,719	13.5
Townsend	228	2,076	9.1
SOUTH CAROLINA			
Beaufort County:			
Beaufort and Port Royal	73	24,727	339
Bluffton	222	2,779	12.5
St. Helena	146	6,048	41.4
Sheldon	139	3,275	23.6
Charleston County:			
Edisto Island	83	1,589	19.1
James Island	38	12,735	335
Johns Island	95	6,252	65.8
McClellanville	263	4,124	15.7
Mount Pleasant	56	6,178	110
St. Andrews	65	25,887	398
St. Pauls	191	7,911	41.4
Wadmalaw Island	44	2,326	52.9
Colleton County:			
Green Pond	257	3,027	11.8
Hendersonville	192	4,002	20.8
Walterboro South	95	4,131	43.5
Georgetown County:			
Sampit-Santee	254	3,576	14.1
Waccamaw	94	2,614	27.8
Horry County:			
Little River	56	2,893	51.7
Myrtle Beach	82	9,785	119
Jasper County:			
Hardeeville	225	2,477	11.0
Ridgeland	190	3,965	20.9

Township Rural Area

NORTH CAROLINA			
Brunswick County:			
Lockwoods Folly	159	3,871	24.3
Northwest	86	2,169	25.2
Shalotte	118	4,143	35.1
Smithville	138	1,130	8.2
Town Creek	226	4,162	18.4
Waccamaw	135	1,892	14
Carteret County:			
Atlantic	11	902	82
Beaufort	40	3,324	83.1
Cedar Island	24	255	10.6
Davis	57	446	7.8

<u>Township Rural Area</u>	<u>Approximate Land Area in Sq. Miles</u>	<u>Rural Population</u>	<u>People per Sq. Mile</u>
NORTH CAROLINA (continued)			
Carteret County (continued):			
Harlowe	33	629	19.1
Marshallberg	1	416	416
Merrimon	64	344	5.4
Morehead	30	7,897	263.2
Newport	72	1,783	24.8
Portsmouth	12	8	0.7
Sea Level	9	389	43.2
Smyrna	20	597	29.9
Stacy	7	291	41.6
Straits	39	1,070	27.4
White Oak	86	1,698	19.7
Currituck County:			
Crawford	93	2,332	25.1
Fruitville	28	440	15.7
Poplar Branch	76	2,622	34.5
Dare County:			
Atlantic	24	596	24.8
Croatan	146	545	3.7
East Lake	140	115	0.8
Hatteras	17	1,217	71.6
Kennekeet	23	434	18.9
Nags Head	33	2,173	65.8
Hyde County:			
Lake Landing	211	2,453	11.6
Swan Quarter	64	1,121	17.5
New Hanover County:			
Cape Fear	76	4,238	55.8
Federal Point	21	1,749	83.3
Harnett	52	8,184	157.4
Masonboro	27	3,592	133.0
Onslow County:			
Stump Sound	117	4,755	26.9
Swansboro	98	17,072	174.2
Pamlico County:			
Township 2	76	1,359	17.9
Township 3	64	2,172	33.9
Township 4	38	945	24.9
Township 5	64	1,681	26.3
Pender County:			
Topsail	157	2,431	15.5