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FINAL ENVIRONMENTAL STATEMENT  
VERY LARGE ARRAY

Assistant Director for  
National and International Programs  
National Science Foundation  
Washington, D. C. 20550

October 6, 1972

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NATIONAL SCIENCE FOUNDATION  
ENVIRONMENTAL STATEMENT -- VLA

September 1972

SUMMARY STATEMENT

Responsible Agency: National Science Foundation, Washington, D.C. 20550

Administrative Action: Very Large Array

Brief Description: The Very Large Array is a major new instrument which will make possible important advances in radio astronomy. The VLA will consist of 27 dish-shaped radio antennas, each 82 feet in diameter, distributed along three arms consisting of double railroad tracks, arranged in the form of a wye, with 120 degrees between each arm. Two of the arms will be 13 miles long and the third, 11.8 miles. VLA construction and operations will directly affect approximately 3,500 acres, of which an estimated 2,800 acres are required for the three arms of the wye. The remaining acreage will be used for access roads; a central headquarters complex consisting of buildings, water supplies, sewage treatment facility, and a staging area for the field erection of antennas; and an aircraft landing area.

A site has been identified in New Mexico, fifty miles west of Socorro, in the counties of Socorro and Catron, in the eastern end of a broad valley known as the Plains of San Augustin. Approximately one-third of the land is presently owned by private individuals and another third is owned by the State of New Mexico. The remaining one-third is held for the Federal Government under the custodial care of the Bureau of Land Management.

Alternatives Considered: Six other sites were determined to meet the minimum requirements essential for VLA operation, but the Plains of San Augustin site was clearly superior technically and economically, and can be developed with a minimal environmental impact.

The following were requested to comment:

Department of Agriculture  
 Department of Commerce  
 Department of Defense  
 Department of the Interior  
 Department of Transportation  
 Environmental Protection Agency  
 Federal Power Commission  
 General Services Administration  
 State of New Mexico

Written comments received from:

Agriculture  
 Commerce  
  
 Interior  
 Transportation  
  
 GSA  
 New Mexico

A summary notice of the draft was published in the Federal Register July 19, 1972, to announce to State and local agencies and the public that copies of the draft were available from the Foundation.

The draft statement was made available to the Council on Environmental Quality on July 3, 1972. The final statement is made available to the Council on Environmental Quality on October 6, 1972 and a summary statement is being published in the Federal Register.

In response to the need of the scientific community for such a radio telescope, the NRAO undertook, in 1964, development and design studies for a new major antenna system. After some years of intensive effort, these studies were completed. The antenna system, which has become known as the Very Large Array (VLA), will consist of 27 dish-shaped radio antennas, each 82 feet in diameter, distributed along three long arms, arranged in the form of a wye, consisting of railroad tracks. Two of these arms are 13 miles long and a third, slightly shorter, is 11.8 miles in length.

This sensitive, high resolution, image-forming instrument is designed to produce pictures of radio sources in the sky comparable with the finest optical photographs. By positioning the antennas along their tracks, the field of view of the VLA may be varied within wide limits. In this respect the VLA is the radio equivalent of a zoom lens. At the two initially proposed operating frequencies of 2695 MHz (11.1 centimeters) and 8085 MHz (3.7 centimeters) the system will have resolutions of 1.0 and 0.35 seconds of arc, respectively.

The VLA will exceed by one to two orders of magnitude the sensitivity and angular resolution of any existing or proposed array. The antenna system will produce detailed two-dimensional maps of radio sources over most of the observable sky, including regions where most other arrays can resolve sources in only one direction. In addition, the VLA will have the ability to detect and measure the properties of the very faint radio sources. These sources are faint, either because of their low intrinsic brightnesses or their locations at remote distances. Radio astronomers also will be able to measure the properties of radio sources superimposed upon complex backgrounds such as the Milky Way. The VLA is expected to make major contributions to our understanding of the laws of gravity, physical processes in interstellar gases, the origin and evolution of stars, the universe, and life itself.

relay stations, military electronic activity and even a high density of local air traffic can be disturbing sources of interference for the VLA.

These criteria led NRAO to concentrate its search on sites located in the southwestern part of the continental United States, south of 42 degrees north latitude and west of the 100th west longitude meridian.

Additional criteria relating to such environmental questions as natural hazards, human factors, utilities access and natural resources development were also applied. These include:

1. Natural hazards to the VLA caused by weather phenomena such as floods, high winds, and hail should be minimal. The site should be located away from earthquake-prone regions such as fault zones and regions of high seismic activity.

2. No developable natural resources should exist in the area of the site whose exploitation would affect adversely the VLA performance.

3. The site should be within reasonable commuting distances of towns or cities having adequate housing, schools, shopping facilities and medical services for the observatory staff.

4. Raw materials for construction, an ample water supply and electrical power for the facility should be locally available.

In addition, several miscellaneous factors, such as the ease of acquiring the site, labor costs, and road construction requirements, were considered in evaluating the relative merits of various sites.

Using these site selection criteria, the NRAO team produced a basic list of 34 possible sites.<sup>1/</sup> Closer examination of these 34 sites using topographic maps, meteorological data, and site visits reduced this list to seven. These

<sup>1/</sup> A Proposal for a Very Large Array Radio Telescope Vol. IV. Green Bank, West Virginia: National Radio Astronomy Observatory, December, 1971.

is no tree cover and only occasional scattered growths of small sagebrush add to the expanse of grama grass. The land is used for cattle grazing and is estimated to carry about ten head per section (640 acres). Water for livestock is obtained from wells and stored in steel tanks and open ponds.

The Plains area and the surrounding mountains have been extensively explored in past years for copper, uranium, lead, zinc, and silver. No developable deposits were found.<sup>2/</sup> The Kelly District, on the eastern slope of San Mateo Mountains near Magdalena, has been, in the past, a big producer of lead and zinc. There is no mining activity at present.

Seismic and gravity techniques have been used by oil companies to gain information about underground structures and explore opportunities for oil and gas production. A well was drilled to bedrock (Precambrian) at a depth of 12,284 feet at a site some six miles west of the Augustine station by the Sun Oil Company in 1966. The test well proved to be dry and was abandoned.

<sup>2/</sup> Mineral and Water Resources of New Mexico, New Mexico State Bureau of Mines and Mineral Resources, Bulletin 87, 1965.

its supporting gravel ballast will be designed to carry combined antenna and transporter weights as high as 225 tons. The maximum allowable track grade at any point is 2%. The transporters will move at speeds less than five miles per hour.

Each of the observing stations will consist of a small square parcel of land, one quarter of an acre in extent, with its center located approximately 125 feet from the center line of the main tracks. Each station will contain three concrete foundations, one for each of the antenna support legs, electrical power connections, and a small maintenance shed. A short railroad spur, intersecting the main track at right angles, will provide access to the observing station. Because of the need to prevent livestock interference in telescope operations and the hazard of exposed high voltage power connections, each observing station will be enclosed with a four-foot high open mesh stock fence. Two fifteen-foot gates across the railroad spur will lock together at the spur center line when closed.

Electric power in the general vicinity of the site is supplied by the Socorro Electric Cooperative, Inc. The Cooperative has a 69 kilovolt circuit, with overhead static protection, running from Socorro to Magdalena, New Mexico. From a transformer station in Magdalena a 25 kilovolt circuit runs west to the Arizona state line, passing close to the proposed headquarters building complex. This power source provides a reliable electrical service base that has proven satisfactory for existing users and will be adequate for the VLA. The Socorro Electric Cooperative plans to upgrade its service to the area and will have a 69 kilovolt circuit running past the site by 1974. The Cooperative has confirmed that the existing 25 kilovolt circuit is capable of meeting



VLA users when the antenna system becomes operational, including scientists, engineers, and support personnel. In FY 1981 and beyond, as many as 40 visiting scientists are expected during the course of a year. They will stay on the site for periods of time ranging from a few days to several weeks.

When the system becomes fully operational in FY 1981, a VLA operational support staff will be located at the site. It is anticipated that the group will include 25 scientists, engineers, and technicians, 17 administrative personnel, and a shop maintenance group of 20 individuals. The support staff will be built up gradually from an initial group of 12 at the time partial operations begin in FY 1976.

During the nine-year construction phase, a project management group also will be located at the site. It is anticipated that this group will number 17 in FY 1973, rise to a maximum of 28 in fiscal years 1975 and 1976, and fall to zero at the end of the project in fiscal year 1981. In addition, approximately 100 contractor employees will be working at the site during the VLA construction. They will include engineering and construction personnel, and technical and supervisory specialists. Members of the operational support and project management groups and contractor personnel are expected to live away from the site in communities where adequate housing, shopping facilities, schools, and medical facilities exist. The nearest such community of any size is Socorro, New Mexico, a town with a population of 6,000 located 50 miles east of the site. Detailed studies of the economics and available facilities in Socorro, New Mexico, indicate that the community can readily absorb 60 families without placing undue stress upon existing housing, schools and community services.

for the field erection of antennas during construction and as a maintenance area afterwards. It will be approximately 800 feet long and 300 feet wide and have antenna spur railroad tracks extending its length. The area will have a hard stand for crane operation and assembly, and a 12,000 square foot building for final antenna assembly, repair and maintenance.

base flow, and precipitation into the site planning. Consultations were held with specialists of the U.S. Departments of the Interior and Commerce, drainage engineers of the New Mexico State Department of Highways, and hydrologists from the University of New Mexico. The conclusions were that the site itself has good overall drainage characteristics, and that proper placement of culverts and other drainage control measures will prevent any water control or flooding problems arising from the presence of the VLA. The NRAO project management team will work closely with the architects, engineers, local soil conservation personnel, and subcontractors during VLA construction to ensure that proper measures are taken to eliminate potential drainage problems.

The northern branch of the wye has almost a flat grade, rising only 50 feet in the first eleven miles of its length. Only a modest amount of filling is necessary over limited portions of this branch. This branch will cross a major highway, U.S. 60, about two miles north of the wye apex. The crossing will conform to American Railway Engineering Association standards.

The extreme end of the northern branch encounters an irrigation project currently being undertaken by a local property owner. NRAO scientists have found that termination of this branch at 11.8 miles, rather than the originally proposed 13 miles, will avoid interference with the irrigation project without seriously affecting VLA operations. The southwestern branch crosses the normal undisturbed drainage lines from the surrounding run-off area and has a low gradient for practically its entire length. The drainage demands on this branch are expected to be light except where sheet flooding enters from the hills on the northern side. Culverts and drainage channels will be used for

## PART V

ADVERSE ENVIRONMENTAL EFFECTS

The presence of the VLA is not expected to alter drainage patterns in the Plains of San Augustin in a way to adversely affect the environment. The NRAO architects and engineers will work closely with professional hydrologists and erosion specialists during the development of the site to assure that no drainage problems will arise.

Because of the limited fencing and sloping embankments on the arms of the wye, the impact of the VLA upon the free and natural movement of livestock and wildlife is expected to be minimal. The Plains of San Augustin have a fairly limited amount of fauna, consisting primarily of birds, prairie dogs, ground squirrels, coyotes, rabbits, lizards, snakes and an occasional antelope.

VLA operations require the absence of local sources of disturbing electromagnetic interference. Certain types of industrial, manufacturing and mining development in the Plains of San Augustin are undesirable, unless steps are taken to keep interference at a very low level. This can be accomplished in most instances by proper shielding of motors, generators, welding equipment, and other radio emitting sources. Vehicular traffic on nearby U.S. Highway 60 poses no problem for radio astronomy observations since the effects that vehicle electrical systems introduce into the observational data can be readily removed.

The American Telephone and Telegraph company operates a microwave relay system in the vicinity of the Plains of San Augustin. One link of this system crosses the Plains and includes a 318-foot high relay tower

PART VI  
ALTERNATIVES

In addition to the Plains of San Augustin site, six other sites in the southwestern United States were found to meet the minimum requirements established. However, all six are at much lower elevations, a characteristic that would adversely affect the ability of the VLA to operate at short wavelengths because of the greater amount of water vapor in the atmosphere at lower elevations. In addition, the alternate sites have one or more of the following characteristics: 1) difficult local terrain, 2) severe air pollution, 3) poor weather, and 4) extremely remote location. At three of the alternate sites, the extensive earth excavation required during construction would be prohibitively expensive and have a major environmental impact on the surrounding terrain. Two of the sites suffer from persistently troublesome levels of dust and haze in the atmosphere and from severe hailstorms. In the case of four of the six sites, no town exists within a reasonable commuting distance that could accommodate the families of the VLA operations and maintenance staff.

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COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

Comments received have been taken into account in preparing this final environmental statement. These comments are attached as follows:

ANNEX

- A Department of Agriculture
- B Department of Commerce
- C Department of the Interior
- D Department of Transportation
- E General Services Administration
- F State of New Mexico



DEPARTMENT OF AGRICULTURE  
OFFICE OF THE SECRETARY  
WASHINGTON, D. C. 20250

JUL 13 1972

Mr. T. O. Jones  
National and International Programs  
National Science Foundation  
1800 G Street, N. W., Room 703  
Washington, D. C. 20550

Dear Mr. Jones:

We have had the draft environmental statement on the Very Large Array (VLA) reviewed in the Department of Agriculture and have no questions or comments regarding this proposed development.

Sincerely,

A handwritten signature in cursive script, appearing to read "T. C. Byerly".

T. C. BYERLY  
Coordinator, Environmental  
Quality Activities





**THE ASSISTANT SECRETARY OF COMMERCE**  
Washington, D.C. 20230

July 31, 1972

Mr. T. O. Jones, Deputy Assistant Director  
National and International Programs  
National Science Foundation  
1800 G. Street, N. W., Room 703  
Washington, D. C. 20550

Dear Mr. Jones:

The draft environmental impact statement for the Very Large Array which accompanied your letter of July 3, 1972, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comments to offer for your consideration.

One possible adverse effect of the Very Large Array project of potential but unevaluated significance is the prevention of further industrial development and mineral exploitation in the Plains of San Augustin Valley in order to prevent interference with the proper operation of the project. The draft environmental statement does not contain any information on anticipated future economic development without the project. Nor does the environmental statement describe current industrial activity or the presence of mineral resources that could be exploitable at some future time.

Another subject of concern that occurred to us that was not dealt with relates to the presence of Highway U. S. 60 crossing the array. Automobile engines generate radio-frequency interference. We can conceive of future requirements that automobile traffic in the area be



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240

ER 72/833

SEP 11 1972

Dear Mr. Jones:

The draft environmental statement for the Very Large Array (VLA) seems oriented towards the technical reasons for selection of the Plains of San Augustin as the proposed site. The list of criteria for site selection does not contain those relating to the environmental effects of VLA. The existing environment and environmental impacts could be more adequately described and discussed.

The Site

One criterion for site selection was that the site be removed from sources of human activity that create sources of electromagnetic interference. Included within this criterion were mining and gas drilling. While there is little evidence that any known mineral resource would be affected by the project and there are few indications of mineral potential in the adjoining area, a discussion of the mineral resources would be helpful in evaluating the effects of the project.

Another requirement is that the site be located away from fault zones and regions of high seismic activity. The last major earthquake in the area was in the 1880's. Since considerable damage was sustained in Socorro, the epicenter was probably near Ladron or the Socorro Mountains. According to local residents, major cracks (one to three feet wide) developed over the entire San Augustin Plains. Minor tremors have been felt since then.

Another requirement was that the site be within commuting distance of a city having adequate housing and public facilities. Socorro, the nearest city, has a population of 6000 people. During the nine year construction phase, assuming an average family size of only two, the population will increase by 300 people because of VLA. The statement indicates that facilities are adequate. Are these facilities presently under-utilized? A more complete assessment of any possible dislocation to Socorro's economy and infrastructure could be made in the statement. The region is economically depressed.

The State Liaison Officer for Historic Preservation for New Mexico is the Acting State Planning Officer, State Capitol, 403 Capitol Building Santa Fe, New Mexico 87501.

The statement does not consider the impact of the proposed facility upon possible archeological resources of the area. Since significant archeological remains are known to exist elsewhere in the Plains of San Augustin, it is recommended that a survey of the area involved be conducted by competent archeologists and that the survey findings be incorporated into the statement. Whenever the presence of archeological resources is indicated, the statement should outline the procedures to be followed to locate, identify, and preserve or salvage such resources in advance of construction activity.

The Museum of New Mexico, Santa Fe, or the University of New Mexico, Albuquerque could provide archeological assistance for such a survey.

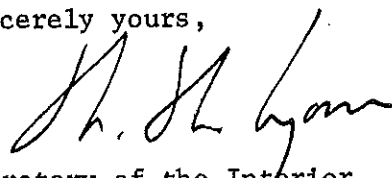
Alternatives

The statement does not describe the seven alternative sites that were considered and does not consider the alternative of not developing the project. The environmental impacts of each alternative are not discussed.

The statement doesn't include a discussion of the relationship of short-term use to the maintenance and enhancement of long-term productivity.

The section on irreversible and irretrievable commitment of resources does not discuss the possible loss of mineral resource values.

Sincerely yours,



Deputy Assistant

Secretary of the Interior

Mr. T.O. Jones  
Deputy Assistant Director  
National and International Programs  
National Science Foundation  
Washington, D.C. 20550



U. S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION

117 U. S. Court House  
Santa Fe, New Mexico 87501

IN REPLY REFER TO

Mr. T. O. Jones  
Deputy Assistant Director  
National and International Programs  
National Science Foundation  
1800 G Street, N. W., Rm. 703  
Washington, D. C. 20550

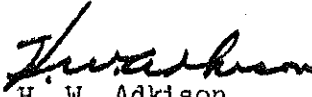
Dear Mr. Jones:

Your draft environmental statement on the Very Large Array (VLA) has been reviewed in this office, and we find there are no adverse impacts of national significance with respect to the highways of the area.

The New Mexico State Highway Department is the coordinating agency to contact in the development of plans for the intersection of your access road with US 60 and the crossing of the highway by the railroad tracks for the north branch wye.

We appreciate being afforded the opportunity to review your draft environmental statement.

Sincerely,

  
H. W. Adkison  
Division Engineer

UNITED STATES OF AMERICA  
GENERAL SERVICES ADMINISTRATION  
WASHINGTON, D.C. 20405



AUG 30 1972

Mr. T.O. Jones  
Deputy Assistant Director  
National and International Programs  
National Science Foundation  
Washington, D.C. 20550

Dear Mr. Jones:

As requested in your recent letter, the General Services Administration has reviewed the draft environmental impact statement for Very Large Array.

Our review of this draft environmental statement discloses no problems of concern to this agency.

Sincerely,

A handwritten signature in cursive script that reads "Rod Kregar".

ROD KREGGER  
Deputy Administrator

STATE OF NEW MEXICO



## STATE PLANNING OFFICE

SANTA FE

OFFICE OF DIRECTOR

July 25, 1972

Mr. T.O. Jones  
Deputy Assistant Director  
National and International  
Programs  
National Science Foundation  
1800 G Street, N.W., Room 703  
Washington, D.C. 20550

Dear Mr. Jones:

I have carefully reviewed your Draft Environmental Statement, Very Large Array, and commend you on what appears to be a very objective analysis.

Many important points were discussed in our May 15, 1972, meeting in Magdalena, New Mexico, with representatives of your office, the National Radio Astronomy Observatory, and the land owners of the San Augustine Plains. Most of the issues covered in that meeting have been included in your statement; however, I have noticed that a few points have been omitted. With the interests of the land owners in mind, I would like to see the following four items also implemented in your final draft:

1. Assurance that if any grassland is destroyed it will be replaced,
2. A statement that no tourists will be allowed along the arms of the array,
3. A statement that no roads will be constructed alongside the arms of the array, and
4. A statement to insure that additional land will not be required at a later date.

I feel as though we have established a good working relationship with these land owners, and in an effort to maintain this alliance, and keep them fully informed of all action, I have forwarded each of them a copy of your draft statement and my comments. I have also advised them to inform my office of any major discrepancy they may find in your statement that has not been covered by my remarks.

STATE OF NEW MEXICO



# STATE PLANNING OFFICE

SANTA FE

OFFICE OF DIRECTOR

August 4, 1972

Mr. T. O. Jones, Deputy Assistant Director  
National Science Foundation  
1800 G. Street, Room 703  
Washington, D.C. 20550

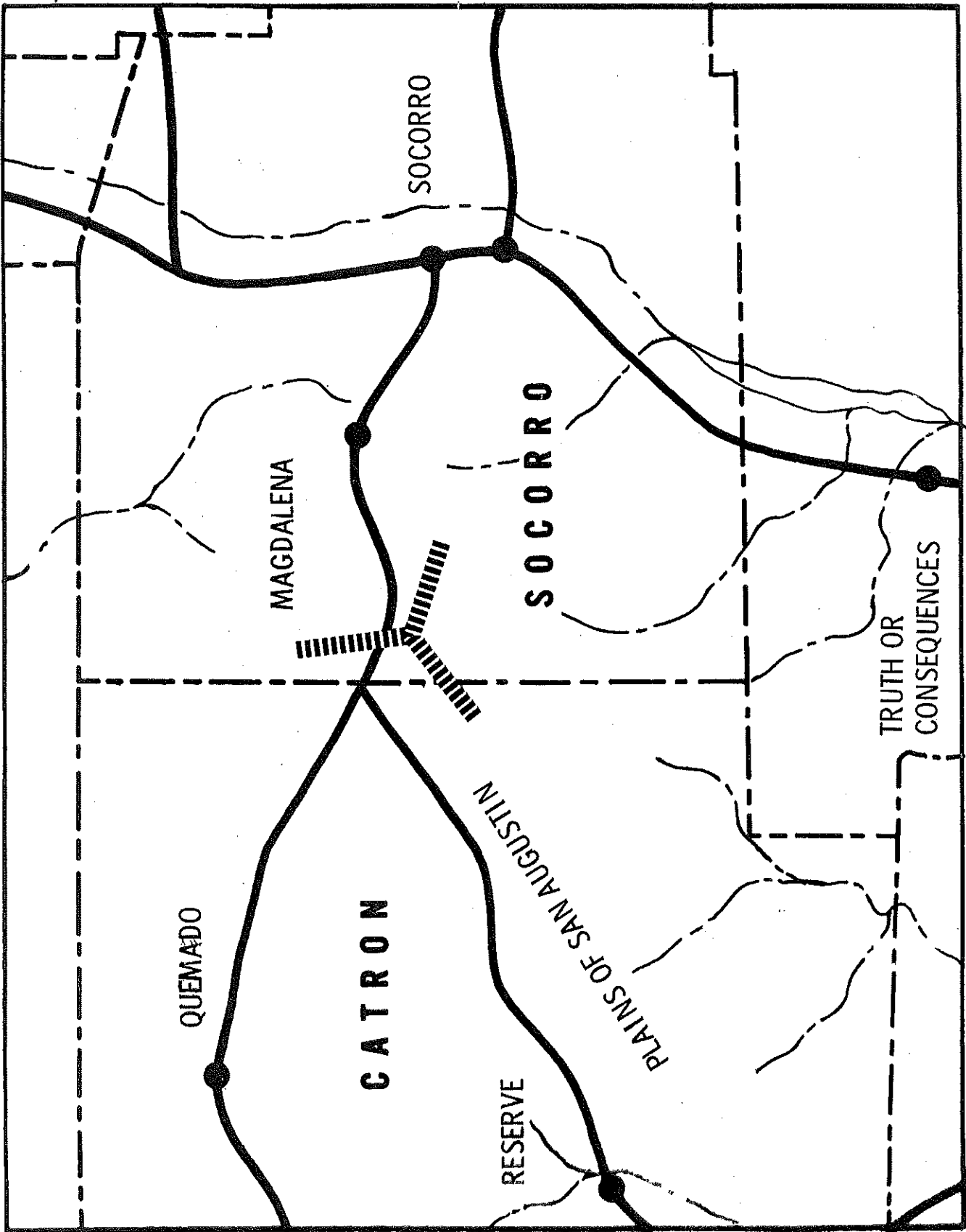
Dear Mr. Jones:

In reference to the National Science Foundation's proposed Very Large Array project to be constructed in the San Augustine Plains of New Mexico, it has been brought to my attention by one of the property owners, Mr. Marvin Ake, that the National Science Foundation plans to restrict the ranchers from any development on their private land, as this might interfere with reception.

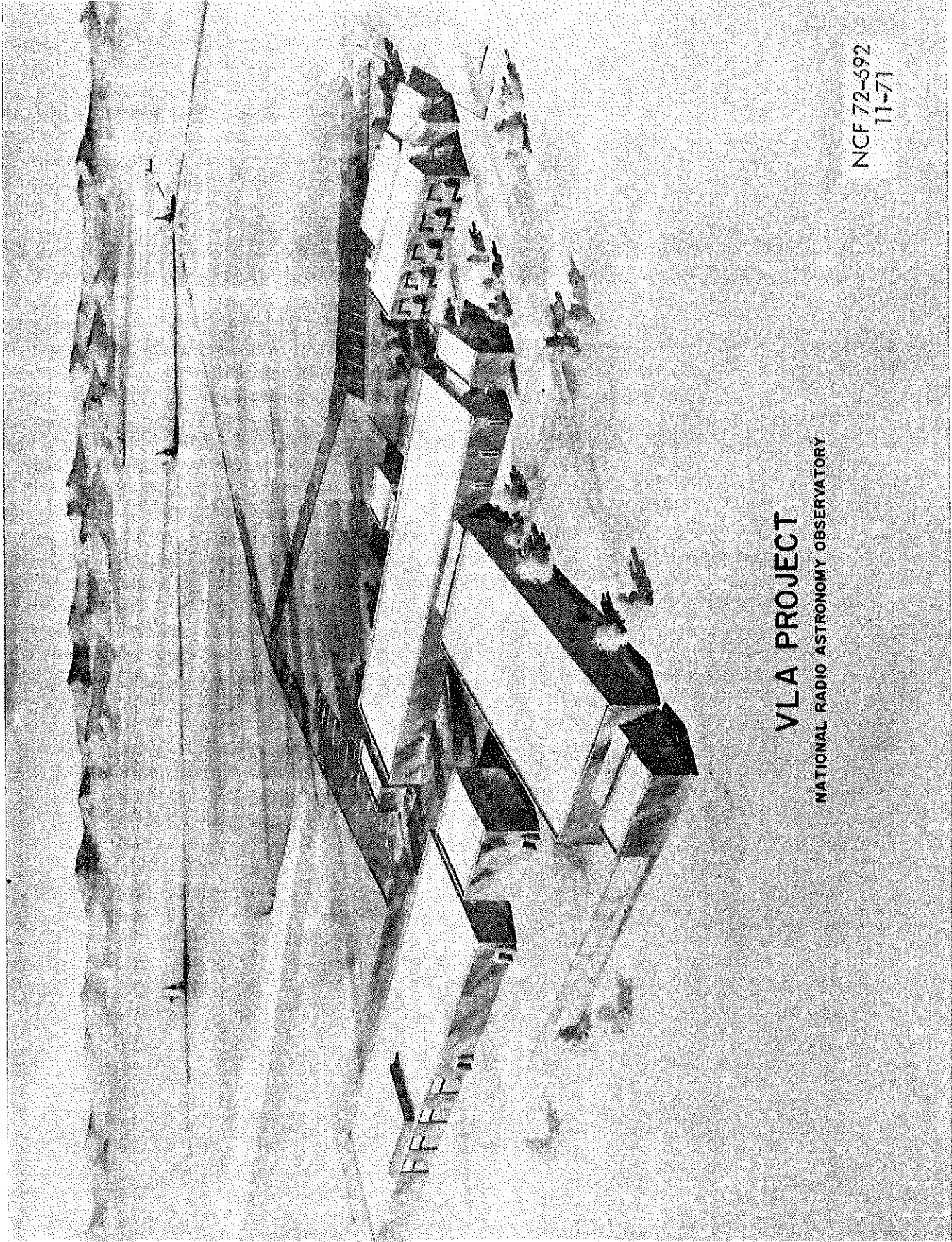
You have stated in your draft environmental statement on page 11:

"Because VLA operations require a low population density, low levels of human activity and the absence of local sources of electromagnetic interference, further industrial development of the Plains of San Augustine would be curtailed. Mining and manufacturing activities or development that would produce electromagnetic radiation could not be permitted in the valley because they would preclude successful radio astronomy observations."

For my personal knowledge, and on behalf of the property owners to be affected, I would appreciate it very much if you would elaborate on this situation, explaining exactly what type and size industrial development, mining, and manufacturing activities, at what distances from the Array, and to what degree they would be curtailed. I feel the ranchers' right to develop their land in the most advantageous manner must be protected. Would you please forward this information to my office at your earliest convenience, and also include it in your final environmental statement.







**VLA PROJECT**  
NATIONAL RADIO ASTRONOMY OBSERVATORY

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