FINAL ENVIRONMENTAL ASSESSMENT

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

ELCOQUI SOUNDING ROCKET PROJECT

THE COMMONWEALTH OF PUERTO RICO

NASA GODDARD SPACE FLIGHT CENTER
WALLOPS FLIGHT FACILITY (WFF)
WALLOPS ISLAND, VIRGINIA
(804) 824-1000

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PREPARED BY: THE ENVIRONMENTAL SOLUTION, INC.

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THE EL COQUI SOUNDING ROCKET PROJECT

THE COMMONWEALTH OF PUERTO RICO

INTRODUCTION

NASA's Sounding Rocket Program, under the direction of the NASA Wallops Flight Facility (WFF), and in conjunction with the University of Puerto Rico at Mayaguez and Cornell University, is planning the launch of eight sounding rockets from two launch facilities at Tortuguero (North Shore area) and El Tuque (South Shore area) in the Commonwealth of Puerto Rico (Figure 1). These launches are part of NASA's study of equatorial ionospheric dynamics in the EL COQUI Project in conjunction with other launches to study naturally-occurring phenomena. This project in Puerto Rico would be a temporary activity in the July/August timeframe, and would not become an on-going program.

The material that follows documents the results of an Environmental Assessment of the proposed NASA action at the proposed launch facilities in Puerto Rico to be conducted in accord with the National Environmental Policy Act (NEPA) with its implementing regulations and the Regulation for Environmental Impact Statements, Environmental Quality Board, Commonwealth of Puerto Rico. The environmental effects are considered relative to those associated with the ongoing and planned activities of NASA in Puerto Rico, for the construction and operation of sounding rocket launch facilities and equipment in support of the EL COQUI Project (References 1, 2, 3, 4, 5, and 6).

I. SUMMARY AND CONCLUSIONS

As part of an eighteen (18) month international study program of the ionosphere, NASA plans to conduct a eight-launch sounding rocket project at temporary launch facilities at Tortuguero and El Tuque in the Commonwealth of Puerto Rico. These launches would be conducted coincident with and in support of the planned satellite chemical releases for Equatorial Ionospheric Studies Program, in the July/August,1991 timeframe. NASA also plans to use its two KC-135 aircraft, to be based at the San Juan Airport and the Naval Air Station at Roosevelt Roads, for conducting optical observations as well. NASA's Sounding Rocket program has existed for over 30 years. Principal launch sites used in the past include Wallops Island, VA, Fort Churchill, Canada, Kwajalein Island (USAKA), Poker Flat, AK (PFRR), and the White Sands Missile Range (WSMR), NM.

The proposed NASA sounding rocket project at Puerto Rico includes a total of eight launches. To accomplish the NASA program, a maximum of 70 support personnel will be brought into the launch area in Puerto Rico for the short period of the project. These personnel will be housed in available facilities in the surrounding areas of the two launch sites.

The effects of the proposed NASA action were assessed for air quality, water quality, waste water treatment, noise, solid waste management, toxics, pesticides, historical resources, radar emittance, potable water quality, health and safety, and animal and plant life (both terrestrial and aquatic). The buildup of facilities, equipment, and staff to conduct the launches and the launches themselves were considered. Very small effects upon air quality may result from launch of the sounding rockets. The increased number of NASA personnel in the area will yield a negligible increase in utilities usage (power, water, sewage). These effects are small and will be of short duration, and are therefore not considered significant environmental effects.

II. PURPOSE AND NEED

Solar-terrestrial research–the study of the influence of changes in the Sun on the solar wind; the Earth's magnetosphere, ionosphere, and atmosphere; and on weather and climate–has long been a major element of the NASA program of Space Science and Applications. Understanding the solar-terrestrial connection is critical to understanding both natural and human-induced changes in the Earth's atmosphere and oceans which, in turn, alter weather and climate and otherwise affect the environment in which we live. The program includes ground-based, sounding rocket, balloon, and spacecraft observations, theoretical research, and modeling. Individual and teams of scientists and engineers in academia, research institutes, industry, and government are active participants.

A key part of the program is the study of the ionosphere in the range of 300 to 450 kilometers (km), which can be reached only by sounding rockets. Profiles of atmospheric parameters are obtained by on-board sensors; and measurements of electrical and magnetic properties are obtained through the tracking of excited or ionized chemicals released from the sounding rockets. These are critical in determining upper atmospheric properties and in understanding the sun-atmosphere coupling.

The ability to correlate data from satellites with altitude-dependent data from sounding rockets requires, for many phenomena, equatorial locations for the sounding rocket range. Sounding rocket ranges available to United States researchers are located in Virginia (Wallops Island), Puerto Rico, Brazil (NATAL), and Kwajalein Island (USAKA). Of those listed, Puerto Rico, Brazil (NATAL), and Kwajalein are located close enough to the equatorial zone to provide data for correlation with equatorial satellites. The incoherent scatter radar at the Arecibo Observatory give it spectral capabilities to track the spatial and temporal dynamics of the released Barium (Ba) and Bromo-Trifluoro-Methane (CF_3Br) from the sounding rockets. This capability at Arecibo is the unique support for this sounding rocket project.

The NASA sounding rocket project at Puerto Rico would be particularly important to the Equatorial Ionospheric Studies Program, a NASA program whose objectives are to improve understanding of: (1) the interaction of plasmas with the magnetosphere, (2) coupling of the upper atmosphere with the ionosphere, and (3) structure and chemistry of the ionosphere. The program includes an equatorial ionospheric studies spacecraft launched in July 1990, the Pegsat spacecraft launched in April 1990, and a series of sounding rocket launches scheduled to support and complement ionospheric chemical releases in orbit. The first set of ionospheric chemical releases occurred over the South Pacific in August 1990; the NASA sounding rocket project at USAKA on Kwajalein Island coincided with these releases for comparative evaluation.

NASA is conducting the equatorial ionospheric studies to collect scientific data on charged particles, electric and magnetic fields, and waves. In addition to tracer chemical releases made from the satellite, measurements will be made through the release of very small amounts of Barium and Bromo-Trifluoro-Methane into the ionosphere from the sounding rockets. NASA selected Puerto Rico for consideration due to its location at an ideal latitude for these measurements taken in conjunction with the satellite ionospheric releases, as well as the unique opportunity to coordinate these launches with operations of the Arecibo Ionospheric Radar and Heater facilities. Both the Radar and the Heater are unique scientific ground facilities that are an essential part of the proposed scientific mission.

The essential functions performed by the Arecibo Observatory, part of the National Astronomy and Ionosphere Center are launch support, sensing, and tracking. Arecibo is home to the world's largest and most sensitive radio telescope and radar, along with its ionosphere heater observatory. Its location and support facilities would make it an ideal location to support the sounding rocket launches of the EL COQUI Project. A significant aspect of launch support at Arecibo involves the unique incoherent scatter radar. The incoherent scatter radar would be used to scan through the associated irregularities generated and to track the development of the heavy negative ion plasma cloud.

The Arecibo Observatory would play a crucial role in the EL COQUI experiments. Staff and graduate students from the University of Puerto Rico at Mayaguez, on a joint program with Cornell University, would take part in the project.

The effects of the EL COQUI Project sounding rocket releases would be studied with an extensive network of ground- and aircraft-based instruments. Central to the diagnostic effort would be the Arecibo Observatory operating as an ionospheric radar, mapping the chemical release effects with high precision. The observatory, administered by Cornell University for the National Science Foundation, is credited with many major discoveries.

Arecibo is also uniquely able to probe the upper atmosphere and ionosphere with radar beams. Using a technique developed there, pulses of radio waves are directed upward so as to interact with free electrons in the ionosphere, in a process known as incoherent scatter. Thus scientists can obtain vertical profiles of the characteristics of the ionosphere, and especially of its irregularities.

III. DESCRIPTION OF ALTERNATIVES

The preferred alternative is to prepare for and conduct the eight-launch NASA sounding rocket project in Puerto Rico in the July and August 1991 time frame. Alternatives have been conducted or have been planned to conduct sounding rocket projects at other equatorial locations, such as Kwajalein, Argentina, Brazil, or Chile. The no-action alternative is to conduct no sounding rocket launches in conjunction with the Summer 1991 ionospheric chemical releases. Each of these alternatives is described in the following sections.

A. Preferred Alternative (Proposed Action)

This eight rocket launch project would be conducted in July and August 1991 as part of a study of equatorial ionospheric dynamics. These rockets would contain chemicals for release at high altitude, along with instrumented payloads. All launches would be conducted during the nighttime hours of ionospheric instabilities, restricted to moon-down periods during the period. NASA would base its two KC-135 aircraft at the San Juan Airport and at the Naval Air Station at Roosevelt Roads on Puerto Rico for a series of flights to conduct optical observations

For scientific reasons, the EL COQUI chemical launches must take place at dusk (just after sunset) and/or dawn (just before sunrise) during the dark phase of the moon; and, therefore, limiting the launch period to approximately two weeks in each month. The ionospheric research rockets can be launched in either moon up or moon down conditions. The sounding rocket payloads would be launched over the ocean to an altitude of approximately 300-450 kilometers, through the Arecibo radar beam and would impact approximately 200 kilometers off shore (Figures 2,3). The Black Brant VC and the Black Brant IX rockets would be used. NASA's sounding rocket program has launched over 2,600 rockets in its 30 year history with an outstanding safety record and a success rate of over 90% throughout this period. These rockets are a portion of the 30 to 35 missions per year which NASA launches from various locations around the world.

The eight rocket launch project by NASA in Puerto Rico would be conducted as part of a study of equatorial ionospheric dynamics experiments in support of the satellite ionospheric chemical releases for the EQUIS Program, and other solar terrestrial research. Six of the EL COQUI Project support launches would include chemical releases, and two launches would also have instrumented payloads as well. Two launches would be strictly instrumented payloads.

The sounding rockets for the EL COQUI Project would be solid-fueled, unguided rockets that are the type used for scientific research. They are not the guided missiles that are generally associated with military operations or research. The same launcher would be used at both of the proposed launch sites.

Rocket launches for the EL COQUI Project would include the following types:

(a)	six Terrier-Black Brants (BBIX)	2 stage vehicles
(b)	one Nike-Tomahawk	2 stage vehicle
(c)	one Black Brant VC	1 stage vehicle

The specific science objectives can be broken down into the following areas of study:

1. EQUIS: This portion of study was completed in August 1990 at Kwajalein in the South Pacific. It measured the onset and evolution of equatorial plasma depletions using the Active Experiment Techniques (chemical releases of SF_6). This involves two experiments on separate nights, involving two launches each (one chemical payload followed thirty minutes later by one instrumented payload). Emphasis was on creating plasma depletions to initiate instabilities. Launch vehicles were the Taurus-Nike-Tomahawks (TNT) sounding rockets.

2. EL COQUI: Study of the onset and evolution of equatorial plasma depletions using the chemical releases of Barium - Ba and Bromo-Trifluoro Methane - CF_3Br (Halon 1301, as used in fire extinguishers). Emphasis would be on creating plasma enhancements to initiate instabilities. This launch would be in support of the ionospheric chemical releases in the equatorial ionospheric studies

3 Study the small-scale structure and turbulence in fully evolved, naturally occurring plasma bubbles. This is an instrumented payload. Measurements would be made by the unique incoherent scatter radar at the Arecibo Observatory in Puerto Rico.

4 Study DC and long-wavelength electric fields associated with density depletions within naturally occurring plasma bubbles and compare with shorter scale turbulence. Measurements would be made by the incoherent scatter radar at Arecibo.

Table (1) lists the eight sounding rocket launches by launch number for each experiment and payload.

One Black Brant IX launch vehicle chemical release payload is designed specifically to release 65 pounds of Bromo-Trifluoro-Methane (CF_3Br.) at an altitude (between 350 and 450 kms) chosen for the ionospheric properties. Table 1 shows the planned launch number and chemical release for the BBIX sounding rocket. The launch vehicle contains command/ignition systems, batteries, propellants, radar transponders, and power and arming devices. The BBIX would expel its chemical payload of CF_3Br at approximately 350 kilometers (km) for both the up leg and down

leg portions of its flight. The vehicle would also carry propellant, command/ignition systems batteries, radio transmitters. Table 1 also shows the planned launch number and chemical releases for the other BB IX and Nike-Tomahawk sounding rockets. The chemical release payloads are designed to release a total of 80 Kg. of Barium/Thermite (Ba) Vapor with small amounts of Dopants [Strontium (Sr), Lithium (Li), and Europium (Eu)] These trace metals comprise 0.56% (19 grams), 1.38% (38 grams), and 0.98% (130 grams) for Strontium, Lithium, and Europium, respectively, of the total Barium/Thermite payloads (80Kg). Each vehicle is equipped with a single Vega 302c radar transponder, and radar would be used to track and command chemical releases. Table 1 shows the launch number and instrumented payload for the Black Brant VC sounding rocket. Table 3 shows the propellant releases of each rocket motor for the proposed launches.

The existing radar equipment at the Arecibo Observatory in Puerto Rico will be used to support these NASA sponsored rocket launches. Temporary launch support facilities would be constructed at both the north shore area (Tortuguero) and the south shore area (El Tuque) sites. This would consist of concrete pads for rocket launches, radar and anemometer towers with associated supports. Construction would require some minor brush clearing of approximately one and one-half acres (see Figures 4,5,6).

A portable NASA 26-foot van containing a 550 MHz transmitter, C-Band radar, van, and tracking and command support equipment also be brought to each launch location when it is involved in an actual launch. Existing range and safety equipment at Puerto Rico launch sites, along with NASA's safety equipment, would be used (Reference 17). NASA/Wallops Flight Facility (NASA/WFF) would also bring electronic equipment interfacing into the existing Arecibo data line equipment to the sites. This equipment would facilitate buildup, checkout and launch of the rocket systems, plus telemetry support for launch vehicles. Other equipment would include two NASA KC-135 aircraft and dedicated ground communication lines, and radio transmission links. Existing network or display equipment at Arecibo would be used. Balloon support, as appropriate for rocket launches and ionospheric optical observations, would be provided .

A total of 65 to 70 extra NASA support personnel would be added to the launch sites. These personnel are only expected to be present immediately before, during, and after the launches, from July through August 1991. All NASA personnel would be housed in local area facilities and not on site. In addition, NASA would contract with local construction firms. All construction crew personnel would be local; and, therefore, would not require temporary housing. Potable water would be brought in, and portable toilets would be used. All waste products would be contracted by NASA to local companies to be removed per applicable Puerto Rico regulations, permits and ordinances for proper disposal.

B. Project at Alternative Sites

This alternative is to conduct the sounding rocket project at other equatorial locations. Equatorial or near-equatorial sounding rocket ranges are located in Brazil (Natal), Kwajalein Island (USAKA), Argentina, and Chile. These other ranges are not satisfactory locations for the purpose of this sounding rocket project, because these alternative locations lack the incoherent scatter radar and heater beam that are unique to Arecibo. Kwajalein does have an incoherent scatter radar, but no heater beam. In addition, a new HF radar would need to be built at the alternate locations this year. This is impacted by funding, construction time and cost, and existing support facilities for the alternate sites. A baseline EIS exists for the Kwajalein location. The heater beam could not be built there financially, and additional personnel could not be accommodated due to logistical constraints. Facilities could not be built at Brazil, Argentina, or Chile due to financial and logistical reasons.This would result in a loss of vital diagnostic and spectral capabilities provided by the radar and the heater beam in conjunction with the equatorial ionospheric studies chemical releases and EL COQUI Project sounding rocket releases.

C. No-Action Alternative

The no-action alternative would rely on other on-going sounding rocket activities at locations such as Wallops Island, Virginia (WFF), and Poker Flat, Alaska (PFRR). WFF and PFRR are too far north of the equator to effectively support the objectives of the equatorial ionospheric studies. Each site also has logistical problems or constraints that preclude support as well. In particular, there would be constraints on building additional support facilities at both sites. Launches from these sites would not permit completion of the objectives of the equatorial ionospheric studies program, and would, therefore, seriously compromise the effectiveness of those of the EL COQUI Project.

D. Comparison of Alternatives

The Preferred Alternative (Proposed Action) offers the best location and support facilities for accomplishing the objectives of the Equatorial Ionospheric Studies under the EL COQUI Project this Summer. The combination of the incoherent scatter radar and the ionospheric heater beam at the Arecibo Observatory make the proposed launch sites at Puerto Rico the best alternative to meet the objectives of the equatorial ionospheric studies under the EL COQUI Project. Puerto Rico can provide the location, and support facilities and personnel. Kwajalein was used as a project site last Summer. It has an incoherent scatter radar, but no heater beam. Kwajalein also has logistical problems to accommodate additional launches there this year; It also has logistical constraints that preclude housing for support personnel and the building of additional facilities. The other alternative sites (Brazil, Argentina, and Chile) have logistical problems also that cannot be addressed within the necessary timeframe for launch support this Summer. Those sites under the No Action Alternative (Wallops

Island, Virginia and Poker Flat, Alaska) are too far north to meet the objectives of the equatorial ionospheric studies, and also support constraints that cannot be addressed in a timely fashion to cover the project.

IV. PREFERRED SITE DESCRIPTION

The EL COQUI Sounding Rocket Project would use two launch sites, one on the north shore area at Tortuguero, and the other one on the south shore area at El Tuque. Six sounding rocket launches would occur at Tortuguero, and two sounding rocket launches would occur at El Tuque. The proposed project would bring in approximately $800,000.00 to the local economy of Puerto Rico.

A. Tortuguero

1. Site Map

The site at Tortuguero on the north shore area is an old, abandoned Army and Air Force installation that is now under the control of the Sports and Recreation Department. Figure 7 shows the location of the proposed Tortuguero site in relationship to other locations within Puerto Rico.

2. Schematic Plan

Figures 4 and 5 show the schematic and site plans for the EL COQUI Project at the proposed Tortuguero location. Figure 4 shows the existing site plan and layout; and Figure 5 shows the proposed temporary support facilities and cleared areas.

3. Project Area

Figure 5 shows the overall project area at the proposed Tortuguero site. This includes the existing site and the proposed temporary support facilities with areas to be cleared and grubbed.

4. Existent Flora and Fauna

Tortuguero is a sensitive environmental ecological area. A site survey has been conducted in the area. The following rare or endangered species were found:

(a) *Schoetsia arenara.* This species grows in limestone deposits areas only. Since there are no such deposits at the Tortuguero site, then this species will not be impacted.

(b) *Cassia mirabilis.* This is a plant that grows in disturbed soil areas only. The proposed land clearing would have an advantageous impact on this species in that the clearing would remove competitive plants from the species habitat.

(c) *Pelicans.* This species is not expected to be impacted. The proposed launches would occur at night when the Pelicans are least active. In addition, the proposed launches would occur at that time of the year when nesting does not occur.

5. Soil Types

The soil around Tortuguero is well suited for cultivation and pastures. It has moderate permeability, with a high available water capacity. Runoff is slow. Reference 13 is the soil survey of the Arecibo area with a complete description of the soil types and area coverage. The area around Tortuguero has similar soil types.

6. Topographic Map

Figure 8 is the topographic map for the area around the proposed launch site at Tortuguero.

7. Geological Formations

Tortuguero is located on a narrow coastal plain with some marshy areas immediately surrounding the lagoon just southwest of the proposed launch site; and some upland hills rise just south of the site (Figure 8, Topographic Map).

8. Natural Existing Systems

For the Tortuguero site, there are no natural systems (caves, drains, etc.) existing in the project area or the surrounding adjacent areas that would impact the surrounding environment due to launch operations (Figures 4,5,7).

9. Proposed and Adjacent Land Uses

Land use around the proposed Tortuguero site is mainly residential and agricultural; there are no proposed changes to this land use mix.

10. Water Bodies

The Tortuguero site is located on a narrow coastal plain with the Atlantic Ocean located just to the north. There is a lagoon and surrounding marshy area located just west-southwest of the site (Figures 7,8).

11. Flood Elevations

The proposed launch site at Tortuguero has elevations that range from twelve (12) to sixteen (16) feet above mean sea level.

12. Available Infrastructure

Tortuguero is located just to the east of the proposed launch site. The available infrastructure would provide temporary housing and support facilities to handle the short duration (two months) addition of 65-70 NASA personnel at the launch site.

13. Actual Zoning

The areas around Tortuguero and the proposed launch site is zoned rural and agricultural. There are no known quiet zones in the area.

14. Distance to Nearest Residence

There are several small towns near the vicinity, and the nearest residences are approximately one-half kilometer away from the boundary of the proposed launch site.

15. Distance to Nearest Quiet Zone

There are no known quiet zones nearby the proposed launch site at Tortuguero.

16. Access Roads

Access roads are shown on the project maps (Figures 4,5,7) and the Topographic Map (Figure 8).

B. El Tuque

1. Site Map

The proposed site at El Tuque is part of a parkland area adjacent to the beach that is currently leased out to the City of Ponce by the Sports and Recreation Department for seasonal recreation purposed. Figure 1 shows the location of the proposed El Tuque site in relationship to other locations in Puerto Rico.

2. Schematic Plan

Figure 6 shows the schematic plan of the EL COQUI Project at the proposed El Tuque site location for the existing site plan and layout, and the proposed temporary support facilities.

3. Project Area

Figure 6 also shows the overall project area at the proposed El Tuque site.

4. Existing Flora and Fauna

The El Tuque site area was included in a site survey of the area flora and fauna. There were no rare or endangered species found.

5. Soil Types

The soil around El Tuque and Ponce consists of poorly drained, saline, nearly level soils on the coastal plain adjacent to the beach. These moderately fine to coarse textured sediment soils are rapidly permeable with low water availability and very low natural fertility. Runoff and natural drainage around the proposed launch site is very slow due to the slope of the land. The soil survey for the Ponce area is represented in Reference 14.

6. Topographic Map

Figure 10 is the Topographic Map for the area around the proposed launch site at El Tuque.

7. Geological Formations

The El Tuque proposed launch site is located on a gently sloping, narrow coastal plain less adjacent to the beach on the south shore. Gently rolling terrain is located just to the north and east of the site; and more hilly terrain is located several kilometers farther to the north and east of the site (Figure 10,Topographic Map).

8. Natural Existing Systems

For the El Tuque site, there are no natural systems (caves, drains, etc.) existing in the project area or the surrounding adjacent areas that would impact the surrounding environment (Figures 6,9,10).

9. Proposed and Adjacent Land Uses

Land use around the proposed El Tuque launch site ranges from rural and agricultural to residential in the City of Ponce just to the east. The El Tuque site is a parkland area leased out by the City of Ponce, Parks and Recreation Department, for seasonal recreational purposes. It is proposed that the City of Ponce will improve the site after the proposed launch activities. No other proposed changes to the land use mix are expected at this time.

10. Water Bodies

The El Tuque site is located on a narrow coastal plain on the south shore, just west of Ponce. The Caribbean Sea is located south and west of the site, and a lagoon is located just east of the site (Figures 9,10).

11. Flood Elevation

The proposed launch site at El Tuque ranges from three (3) to six (6) feet above mean sea level.

12. Available Infrastructure

The City of Ponce is located just to the east of the proposed El Tuque launch site. The available infrastructure would provide temporary housing and support services to handle the short duration (two months) of an additional 65-70 NASA personnel at the launch site.

13. Actual Zoning

The areas around El Tuque is zoned from rural and agricultural to residential in the City of Ponce.

14. Distance to Nearest Residence

The City of Ponce lies just to the east of the proposed El Tuque launch site. Closest residences are approximately one kilometer away (Figure 10, Topographic Map).

15. Distance to Nearest Quiet Zone

There are no known quiet zones nearby the proposed El Tuque launch site.

16. Access Road

Access roads to and from the proposed launch site are shown on the project and site maps (Figures 6,9) and the Topographic Map (Figure 10).

V. ENVIRONMENTAL IMPACT OF ALTERNATIVES

The scope of this EA includes assessment of those issues and impacts concerning the launches necessary to meet the goals and objectives of the EL COQUI Project. Three alternative actions were considered: (a) the proposed action, (b) the project at alternative sites, and (c) the no-action alternative. Actions (a) and (b) involve sounding rocket launches with chemical and/or instrumented payloads; and action (c) involves no sounding rocket launches.

A. Preferred Alternative (Proposed Action)

The proposed action is a project consisting of eight sounding rocket launches in Puerto Rico. These launches were analyzed for potential environmental impact from launch vehicle emissions from solid-fueled rocket motors, chemical payload releases, and electroexplosive devices, from radar emittance, construction of launch support facilities, from potentially toxic chemicals, and from the overall impact of additional personnel for launch support on the surrounding ecology. Noise levels were also evaluated for potential impacts. Construction waste, housing, and water and waste water impacts were also considered, as well as runoff and impacts on local flora and fauna.

These potential impacts were investigated and evaluated for each of the following media:

1. Air Quality

The use of chemical releases in space science experiments is by no means a new tool or technique. The most prevalent type of experiment is the release of Barium (Ba) vapor at ionospheric altitudes to measure ambient electric fields and to produce ionospheric density enhancements. Barium (Ba) is also present in the biosphere due to terrestrial sources such as wind-blown dust, sea spray, and the combustion of coal and other fossil fuels. Barium itself is toxic. The Ba would be contained in hermetically sealed metal containers to minimize the risk of exposure to release at low altitudes. No actual health hazards are expected from this release since it involves release of relatively small amounts at high altitudes (References 3,4,5,10,11). At high altitudes Ba quickly reacts with atmospheric chemicals to form carbohydrate, sulfate, and oxide compounds. As shown in Table (2), Chemicals and Gases, the maximum amount of Barium to be released through experiments is up to 80 Kg., and varies downward on each launch. These releases have been extensively studied and well documented over the past three decades of NASA sounding rocket programs (references 1,2,3,4,5,7,9,10,11). No adverse environmental effects have been identified resulting from these releases; and none would be expected as a result of the proposed sounding rocket experiments by NASA in Puerto Rico.

Bromo-Trifluoro-Methane - CF_3Br (Halon 1301, as used in fire extinguishers) is a tracer gas that also would be released . CF_3Br will also be contained in hermetically sealed metal containers to minimize low level releases. This is a colorless, non-toxic, non-poisonous, and non-flammable gas which does not constitute an environmental hazard in the lower atmosphere (References. 3,4,5,6,8,9). However, CF_3Br has been shown to be an Ozone (O_3) depleting chemical. This release would occur at very high altitudes where the concern for Ozone depletion would be a consideration. The release of CF_3Br is also extremely small; it is in a gaseous phase and will quickly dissipate in the atmosphere. The chemical releases would occur at altitudes (between 350 and 450 kilometers) that would preclude any effects at ground level; and the amounts released at planned altitudes would dissipate quickly and not affect the Ozone layer, which occurs around 30 kilometers. As shown in Table (2), the total amount of CF_3Br dispersed will be 65 pounds on one launch.

Due to safety procedures (Reference 17), and the use of self-contained, hermetically sealed metal containers for Ba and CF_3Br, there would be no accidental release due to malfunctions at low altitudes. The planned releases at high altitudes are scientific experiments that have been shown to have instantaneous reactions and dispersion in the atmosphere (References 9,10,11,12).

Other trace chemicals and gases may occur in support of the rocket launch activity. Table (2) lists these chemicals and gases that are expected with the sounding rocket launches for the EL COQUI Project in Puerto Rico. These amounts are relatively small, and will be dispersed in the atmosphere quickly with no impact (References. 1,2,3,4,5).

The eight launches will also have emissions from the combustion of rocket propellants. Table (3), Rocket Motors, lists the type and amount of propellant for each rocket motor. These rocket motors are combined into stages for the following eight launch scenarios:

6	Black Brant IX	(2 stage)
1	Nike-Tomahawk	(2 stage)
1	Black Brant VC	(1 stage)

These eight launches are of short duration, and the propellant will be dispersed rapidly throughout the atmosphere. As referenced in the USAKA DEIS (ref. 1) for rocket motor emissions, there are no short-term guidelines for the primary rocket motor emissions of Hydrogen Chloride (HCl) and Aluminum Oxide (Al_2O_3), a particulate matter, that are the burned solid rocket motor propellant by-products.

These emissions are below the following U.S. Air Force impact criteria:

3,030 micrograms/cubic meter (30-mins.) – Public exposure limit

4,550 micrograms/cubic meter (30-mins.) – Emergency exposure limit

Table 3 describes the propellant makeup for rocket motor that would be used in the sounding rockets for the proposed launches.

There are a number of small electroexplosive devices aboard the planned sounding rockets that would be used for command, control, ignition, and stage separation. Any emissions from these devices would be small and would occur at an altitude where they will quickly disperse. No environmental impact would occur (References. 1,2). Table 4, Electroexplosive Devices, shows the expected rocket motor and explosive device emissions.

There will be an additional 65-70 NASA personnel that would be housed in the local area. This would result in a correspondingly small increase demand in power plant generation; and two portable diesel generators would be used at each launch site for power generation for launch support activities. Compared to the size of the existing population, any increase in emissions would be negligible.

There would be an increase of 20 to 30 cars per day at each launch site during the operation phase only. Construction vehicles and car during the construction phase would number about the same. The access road will be paved for each of the proposed launch sites. No measurable air quality impact is expected due to dust or vehicle emissions.

Clearing and grubbing of brush and trees for construction of concrete pads for support facilities equipment (support buildings, telemetry dishes, launcher pads, anemometer towers) and safety line-of-sight to the launch pads at both launch areas would be necessary (Figures 4,5,6). Construction activity would clear very little area, less than two (2) acres, and NASA would stabilize the existing roadways at the sites (Figures 4,5,6). NASA would be extremely careful not to destroy endangered or threatened flora or fauna, particularly at Tortuguero which is a sensitive environmental area. There would be little new clearing of land at these proposed sites, which are already existing facilities. No degradation of air quality due to dust or disposal of brush/trees would occur. NASA would contract with local firms to perform this work, and would stipulate that all applicable Puerto Rico regulations would be adhered to for construction waste removal (Regulation for landfill of construction waste, *DS 3 ,Disposal of Solid Waste*).

Land impact of a booster rocket motor would be highly unlikely. In this unlikely event, NASA would clean up according to its flight and safety plans (Reference 17) developed specifically for the EL COQUI Project.

2. Water Quality

The marine and inland water in and around Puerto Rico and its launch sites at Tortuguero and El Tuque have good water quality due to excellent ocean surface and subsurface mixing due to waves, tradewinds, solar mixing, and underwater topography.

The only possible emissions into these surrounding waters would occur in the rare event of a launch reentry due to a malfunction. A "worst case" accident scenario would involve an intact sounding rocket or booster motor in the water environment. Flight paths for the respective sounding rocket launches from the Tortuguero and El Tuque launch sites and the associated dispersion areas are shown in Figures 2,3. Barium (Ba) will react with sea water to form a soluble hydroxide, $Ba(OH)_2$, which may be toxic if ingested. However, the material would be quickly diluted and dissipated by ocean mixing and currents, and would pose only a very brief environmental threat to any marine life (Ref. 5). Bromo-Trifluoro-Methane (CF_3Br) gas is soluble in water. CF_3Br is considered physiologically inert, and therefore the introduction into seawater does not constitute an environmental hazard (Ref. 7). Wave and current actions will quickly mix and dissipate any chemical release to non-toxic levels in the ocean. Reentry of rocket booster motors on land or into the lagoon areas is highly unlikely; and the solid fuel is likely to be expended and thus pose no environmental threat.

Included in the sounding rocket payloads are batteries that are sources of power for instruments or other devices. These are very small and only present any sort of leakage into the environment if damaged during an unlikely vehicle reentry. Table (5) describes the types and number of batteries planned for this program.

3. Waste Water Disposal

To protect the water quality at the launch site areas, self-contained, portable chemical toilets would be used. These would be contracted by NASA with local firms to be removed and disposed of in accordance with all applicable Puerto Rico regulations regarding compliance for waste water containment and subsequent transportation to a waste water treatment plant.

The increase of an additional 65-70 NASA personnel would have no measureable increase in the demands for sewage treatment and discharge during July and August 1991 because of the use of portable toilets and their disposal. These portable toilets are temporary and will be removed at the end of launch support activities for the EL COQUI Project. Waste water generation would be up to thirty-five (35) gallons per day per person for the operational phase at each site. For the two month period for the NASA sounding rocket project, oceanic surface and subsurface water quality is not expected to degrade.

4. Noise

Past history shows that typical sound levels associated with launches at USAKA is 124 to 154 decibels (dBA) at 250 feet. These rocket launches generate maximum sound levels of 55 dBA for short durations at a distance of 16 to 26 miles (References. 1,2,3,4,5). Because of their relatively small size, the noise from the sounding rockets to be launched by NASA from Puerto Rico would be considerably less in intensity; these launch events would last approximately five (5) seconds burn time for the initial booster stage for launch. At higher altitudes for the upper booster stage the noise level would drop off dramatically. Figures 13, 14, 15, and 16 show the decibel sound level contours developed for the planned launches at their respective proposed launch sites. These were calculated from proven Overall Peak Sound Pressure Levels as specified in the FEIS for the NASA Sounding Rocket Program (Reference 4). The local populations are far enough from the proposed launch sites that noise would not pose any health effects.

No damage to buildings, plants, or wildlife has been observed due to noise over the past thirty years of NASA launches, and none is expected as a result of these sounding rocket launches (References. 1,2,3,4,5). Past history at the Wallops Flight Facility (WFF) at Wallops Island, Virginia has shown no adverse effects on nesting and population of endangered species of waterfowl at that location. The launches would not pose a danger from excessive noise to the wandering domestic animals around the launch sites. Noise from the launches would be of short duration (less than one-half minute), and would not disturb the bird population, particularly the waterfowl near the South Shore area. Launch activities would also be expected not to coincide with the nesting and mating periods of the local waterfowl and bird population.

Due to the temporary addition of 65-70 NASA personnel, there would be an insignificant increase in corresponding noise levels due to the use of equipment such as power plants, support facilities, generators, and motor vehicles.

5. Solid Waste Management

Adequate solid waste collection and disposal capacities exist on Puerto Rico for construction and municipal solid waste that is generated. The proposed actions by NASA to perform launch operations having potential impact to municipal and construction solid waste handling and disposal would be addressed through arrangements with local Puerto Rico companies to have all waste material removed from the sites and disposed of following all applicable Puerto Rico regulations and permits.

The temporary assignment of 65-70 NASA personnel would not significantly increase the quantity of municipal or solid waste generated. Hazardous materials, such as solid rocket boosters or other propellants, explosives, batteries, solvents, or chemicals release payloads will be stored properly in Puerto Rico following NASA

procedures for handling such material (References 15,16, and NASA Flight and Safety Plans currently under development). All materials would be properly removed at the end of the EL COQUI Project. Any rocket booster motor that malfunctions would be sent back to Wallops (WFF) for analysis, inspection, and evaluation.

6. Toxics

CF_3Br as a tracer gas will be released on a Black Brant IX launch (Figures 2,3,12, and Table 1). As stated earlier in this EA, this is a colorless, non-toxic and a non-flammable gas and does not constitute an environmental hazard of any kind (References. 1,2,3,7). Barium will be released on five Black Brant IX and one Nike-Tomahawk launches (Figures 3,11,12, Table 1). Barium itself is toxic; however, since a relatively small amount (up to a maximum of 80 Kg) would be introduced at a high altitude, it would quickly be converted by atmospheric chemical reactions into harmless, inert compounds of carbonates, sulfates, and oxides (References. 1,2,3,4,5). On the ground these gases would be stored in airtight, hermetically sealed metal containers, and would not pose any hazard. In the highly unlikely event of vehicle reentry, these gases would pose no toxicity hazard to the water environment if the very remote worst case of a cannister rupture occurred (see 1. Air Quality and 2. Water Quality in this report). The Bromo-Trifluoro-Methane (CF_3Br) is physiologically inert and soluble in water; and Barium (Ba) would quickly be dispersed by ocean currents.

The toxicity of rocket motor propellant is relatively low. In the case of a vehicle water reentry, the worst case toxic concentrations would occur only within a few meters of the source, and would disperse rapidly due to ocean mixing. The combustion products of the propellants do not constitute a toxic hazard to the atmosphere. For the past thirty years, NASA has been launching sounding rockets, and there have been no adverse effects (References. 1,2,3,4,5).

7. Transportation of Hazardous Materials

The sounding rocket and booster motors will be shipped into Puerto Rico at Roosevelt Roads and transported by truck to the proposed launch sites. These motors are solid-fueled and cannot leak onto the ground in the event of an accident. Ignition require a firing device that will preclude any accidental firing. All potentially hazardous materials such as chemical payloads, solvents, or pyrotecnics would be hermetically sealed in airtight, metal containers during transportation and site storage.

8. Pesticides

There are no pesticide chemicals associated with any of the sounding rocket launch experiments. There will be no increase in the use of pesticides as a result of the 65-70 NASA personnel present to avoid any remote possibilities of contamination at the two launch sites. Personal use of insect repellants that are available on the commercial market would not pose an environmental hazard.

9. Historical Resources

Archaeological and historical sites, which include current cultural residence or the material remains of human activity significant in history, prehistory, architecture, or archaeology, were evaluated and investigated for the proposed Puerto Rico launch areas. No archaeological or historical sites were found. The additional 65-70 NASA personnel would be housed in existing local facilities/units near the launch sites. Construction would be limited to launch support pads, anemometer towers,guy wires support blocks, telemetry dishes, and one small support building for each site (Figures 4,5,6). Launch support equipment would be in the NASA portable vans that would be removed at the end of the project. The North Shore site at Tortuguero is an old, abandoned Army and Air Force site; and has no archaeological impact. The South Shore site at El Tuque is parkland area currently leased out to the City of Ponce for recreational use; and there would be no archaeological impact at the site. The beach area would be closed during the launch activities.

10. Radar Emittance

Another environmental concern is electromagnetic radiation (EMR) and Radio Frequency (RF) emittance from radar installations. EMR and RF sources in Puerto Rico at the Arecibo Observatory are radar installations, microwave communication stations, and other communication equipment that emit electromagnetic radiation. The only other sources would be the portable C-Band radar, the telemetry (TM) uplink, and a small X-Band radar for NASA to support the EL COQUI sounding rocket launches. Compliance with range safety criteria would be strictly adhered to by the NASA sounding rocket project while at Puerto Rico. These criteria include range safety zone (Figures 4,5,6), shielding, and aircraft avoidance. These safety measures have ensured that there are no health and safety problems associated with RF radiation. This would also ensure that the slight additional increase in the total amount of RF radiation emitted by the sounding rocket projects would result in no health and safety impacts. Existing radar sources at Arecibo are not expected to impact safety and operations at the proposed launch sites. These sources at Arecibo have been operating with no safety or health effects. NASA has developed a specific safety plan for the proposed sounding rockets launches at the two sites; these plans address all concerns for radar emittance safety (Reference 17).

11. Potable Water Quality

The potable water system for the launch sites would be bottled water brought in for the additional 65-70 NASA personnel in the July to August time period.

12. Health and Safety

Any increase in launch activities has the potential to impact health and safety both for range personnel and the general public due to occupational accidents, exposure to toxic materials, or property damage. Based upon thirty years of launch experience in sounding rockets, an average of 97 percent of all sounding rocket launches are successful (Reference 1). The NASA sounding rocket project would require transportation and storage of rocket motor propellants, explosives, industrial raw materials, solvents, and chemical payloads. Temporary facilities at the launch sites would have the capability to safely store and handle propellants, explosives, chemicals, and equipment for the proposed sounding rocket project. No hazardous waste would be expected to be generated as a direct result of the NASA sounding rocket project as per the Hazardous Waste and Spill Contingency Plan (Reference 15). All NASA range and safety regulations would be followed for the sounding rocket launches (Reference 17).

The Emergency Preparedness Plan that would be followed would minimize hazards to human health or the environment from fires, explosions, or any unplanned releases of hazardous materials to the air, soil, ground water, or surface water. The provisions of the plan would be implemented immediately through the designated emergency coordinator/on-scene coordinator with the local Fire and Police Departments. The Emergency Preparedness Plan will then be followed at access any hazards to human health or the environment, to activate any necessary control procedures, to prevent any recurrence, and to implement post emergency clean up provisions.

13. Animal and Plant Life - Water and Terrestrial

The addition of the NASA personnel would not require the construction of new housing facilities, and therefore there would be no impact on either water or terrestrial plant and animal life. The eight rocket launches have the potential under "worst case" scenarios of launch reentry or abort to slightly impact water or terrestrial animal or plant life. As shown in Figures 4, 5, and 6, there would be a minimum of construction at the two launch sites for support facilities. Therefore, there would be minimal impact on plant and animal habitats.

B. Project at Alternative Sites

This alternative would require support for equatorial ionospheric studies at alternative sites such as Brazil or Chile. A new HF radar and heater beam would have to built at these alternate locations, along with launch support facilities. Funding is not available for these extra costs, and there are logistical problems that cannot be resolved in a timely manner. In addition to logistical problems, this alternative is not viable because the incoherent scatter radar at Arecibo is unique and vital to the

support and analysis of the experiments planned for the NASA sounding rocket project. This alternative action cannot be considered further.

C. No-Action Alternative

This alternative requires continued sounding rocket launch support at other worldwide sites (such as WFF or PFRR), without any equatorial launches in support of the equatorial ionospheric studies. Due to their locations, this would not permit completion of the objective of, and would seriously compromise the effectiveness of the EL COQUI Project. Each site would have logistical problems that would also preclude additional launch activities; there would be constraints on building the necessary launch support facilities. This alternative cannot be considered as viable.

D. Summary

Possible emissions could result from two main areas of activity associated with the NASA sounding rocket project at Puerto Rico: (a) launch and support of rocket vehicles, and (b) personnel increase directly related to the project. The eight launches planned for the July/August time frame would have minimum impact on the facilities themselves or on the environment. The launches proposed in the NASA sounding rocket project are the same type of sounding rocket launches that have been successfully campaigned last Summer at USAKA; these are first NASA sponsored sounding rockets to be launched from that site. Rocket motor emissions would be below U.S. Air Force criteria; and noise levels should last less than 20 seconds and not impact the general public. Chemical payloads on these launches have been shown by studies and actual launch history of the past thirty years not to pose any harm to air and water quality.

The addition of 65-70 personnel for two months at the Puerto Rico launch sites would have a negligible effect there. Specifically, the proposed action would increase slightly the overall demands for housing, potable water, sewage processing, solid waste disposal, and power plant generation demands. These are not expected to measureably affect air and water quality and noise levels. Potable water would be brought to each launch site. Self-contained portable toilets would be used and removed from the sites also at the end of launch support activities at that site. It is expected that the maximum of 70 personnel would only occur for a few weeks and that the existing infrastructure for services would be able to handle this small increase.

In conclusion, based upon history and experience at Wallops Flight Facility (WFF), thirty (30) years experience in the sounding rocket program, and the evaluation and analysis in this Environmental Assessment (EA) of the proposed NASA sounding rocket project at Tortuguero and El Tuque, Commonwealth of Puerto Rico, minimal environmental impacts are expected from the proposed action. Based on these findings, it is recommended that A Finding of No Significant Impact (FONSI) and a Determination of No Significant Environmental Impact (N - D) should be prepared by

the U.S. EPA and by the Commonwealth of Puerto Rico's Environmental Quality Board, respectively.

V. LIST OF AGENCIES AND INDIVIDUALS CONSULTED

NASA GSFC/WFF	Mr. Jay F. Brown, Campaign Manager
	Ms. Teresa Spagnuolo, Environmental Engineer
	Ms. Pam Whitman, Environmental Protection Specialist
Computer Sciences Corporation (CSC)	Mr. Mark Cording, Facilities Engineer
Puerto Rico Ports Authority	Mr. Jose' Taboas
Environmental Quality Board	Mr. Elio Delgado
Puerto Rico, Permits and Regulations Administration	Mr. Jose' B. Dueno, Director Final Plans Section

References:

1. *Environmental Assessment, NASA Sounding Rocket Campaign at the U.S. Army Kwajalein Atoll (USAKA), Republic of the Marshall Islands;* NASA, Washington, DC, April 1990.

2. *Draft Environmental Impact Statement (DEIS)*; Proposed Actions for the U.S.Army Facility at Kwajalein Atoll (USAKA). USASDC, June 1989.

3. *Final Environmental Impact Statement (FEIS)*; Proposed actions for the U.S.Army Facility at Kwajalein Atoll (USAKA). USASDC, October 1989.

4. *Final Environmental Impact Statement (FEIS)*; NASA, Office of Space Science Sounding Rocket Program, July 1973.

5. *FEIS - The Combined Release and Radiation Effects Satellite (CRRES) Program;* Finding on No Significant Impact; FR, Vol. 50, No. 200; Wednesday, October 16, 1985, Notice Number 85-68.

6. *Generic Environmental Assessment of STS Payloads (1982-1991)*; NASA, Office of Space Transportation Operations; Finding of No Significant Impact; May 7, 1984.

7. *Regulation for Environmental Impact Statements;* Environmental Quality Board, Office of the Governor, Commonwealth of Puerto Rico, June 4, 1984.\

8. *Implementing the Provisions of the National Environmental Policy Act;* NHB 8800.11, the National Aeronautics and Space Administration (NASA), April 24, 1980.

9. *Design Review for the Release of Bromo-Trifluoro-Methane Payload AA-4, Vehicle No. 36.065DE;* Franklin Research Center, Norristown, PA, October 1, 1990.

10. *Bromotrifluoromethane - CF3Br. Environmental Assessment;* prepared for the National Aeronautical Space Administration (NASA), Wallops Flight Facility (WFF), Franklin Research Center, October 1, 1990.

11. *Chemical Design Review for the Release of Barium Vapor with Dopants, Payload AA-2;* Franklin Research Center, Norristown, PA, October 1, 1990.

12. *Metallic Vapor Chemical Release Payload (Thermite) Environmental Assessment;* prepared for NASA, WFF, Franklin Research Center, October 1, 1990.

13. *Soil Survey of Arecibo Area Northern Puerto Rico;* United States Department of Agriculture Soil Conservation , in cooperation with College of Agricultural Sciences, University of Puerto Rico, Mayaguez Campus, 1979.

14. *Soil Survey of Ponce Area of Southern Puerto Rico;* United States Department of Agriculture Soil Conservation Service, in cooperation with the University of Puerto Rico, College of Agricultural Sciences, 1971.

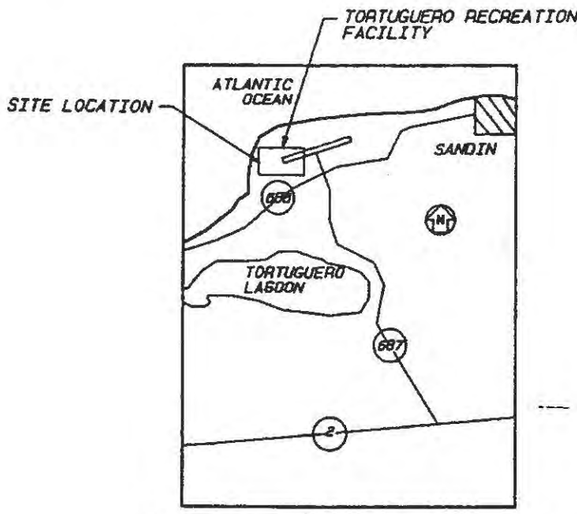
15. *Hazardous Waste Contingency Plan and Emergency Procedures, Open Burning Unit;* Wallops Flight Facility, Wallops Island, Virginia, 40 CFR 270.14 (B) (7), 40 CFR 264 Subpart D.

16. *Goddard Space Flight Center Environmental Handbook;* NASA Health and Safety Branch, NO. GHB 8800.2, April 14, 1989.

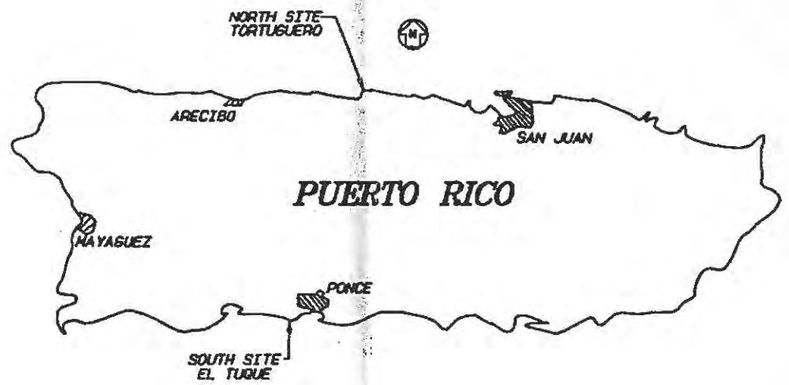
17. *Emergency Preparedness Plan EL COQUI Project;* NASA Goddard Space Flight Center, Wallops Flight Facility, March 1991.

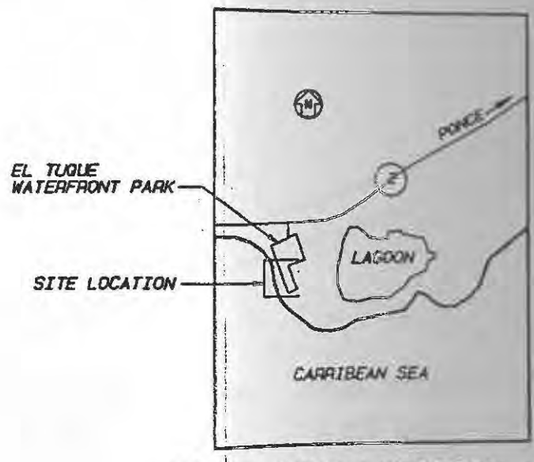
PROJECT EL COQUI

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MOBILE SOUNDING ROCKET CAMPAIGN



NORTH SITE LOCATION MAP





SOUTH SITE LOCATION MAP

Figure 1. EL COQUI Project - Puerto Rico

3/12/91

	EL COQUI	N.T.S.	
	TITLE SHEET		D-30-00825

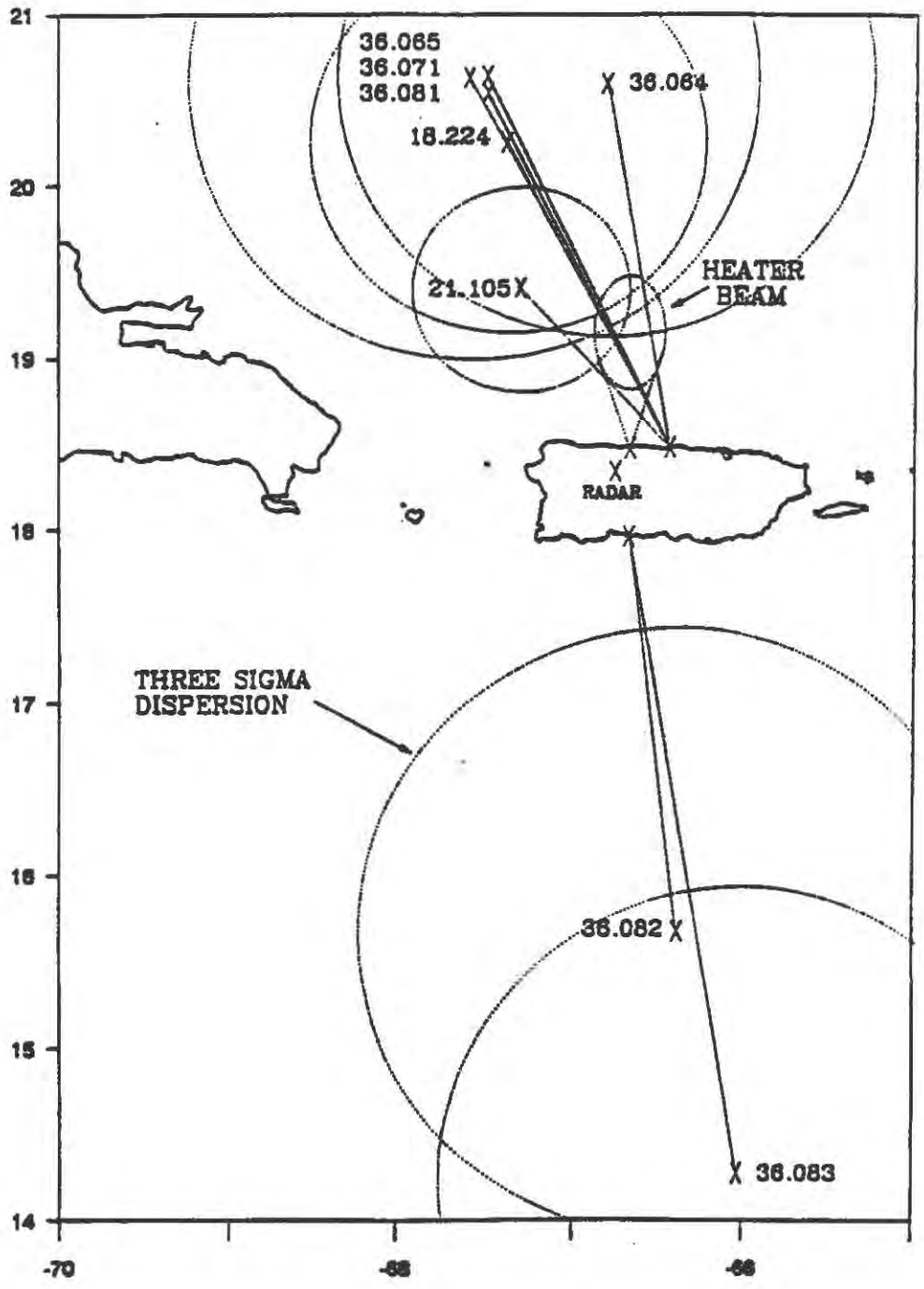


Figure 2. EL COQUI Project Dispersion

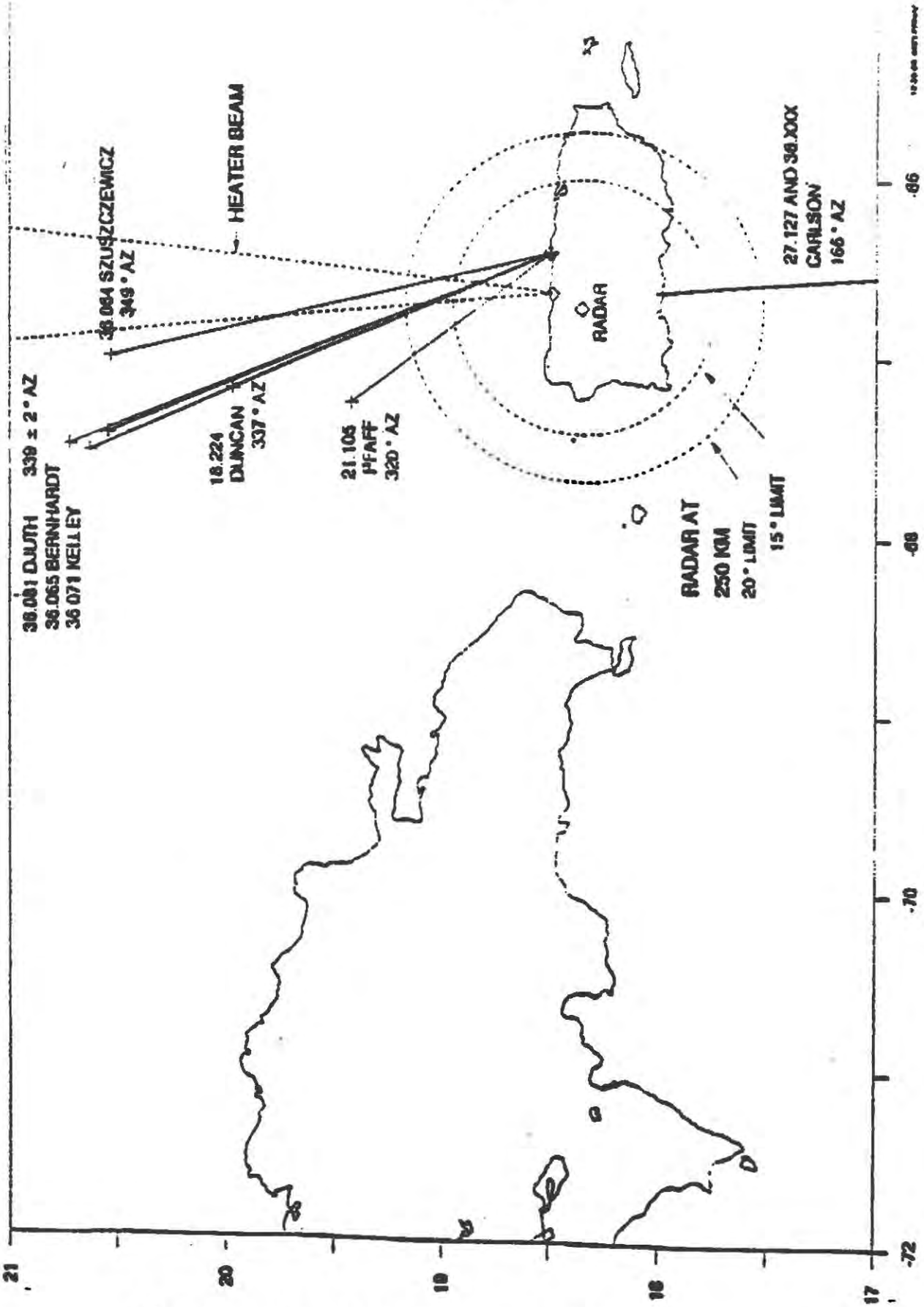


Figure 3. Ba and CF_3Br Chemical Release Payloads

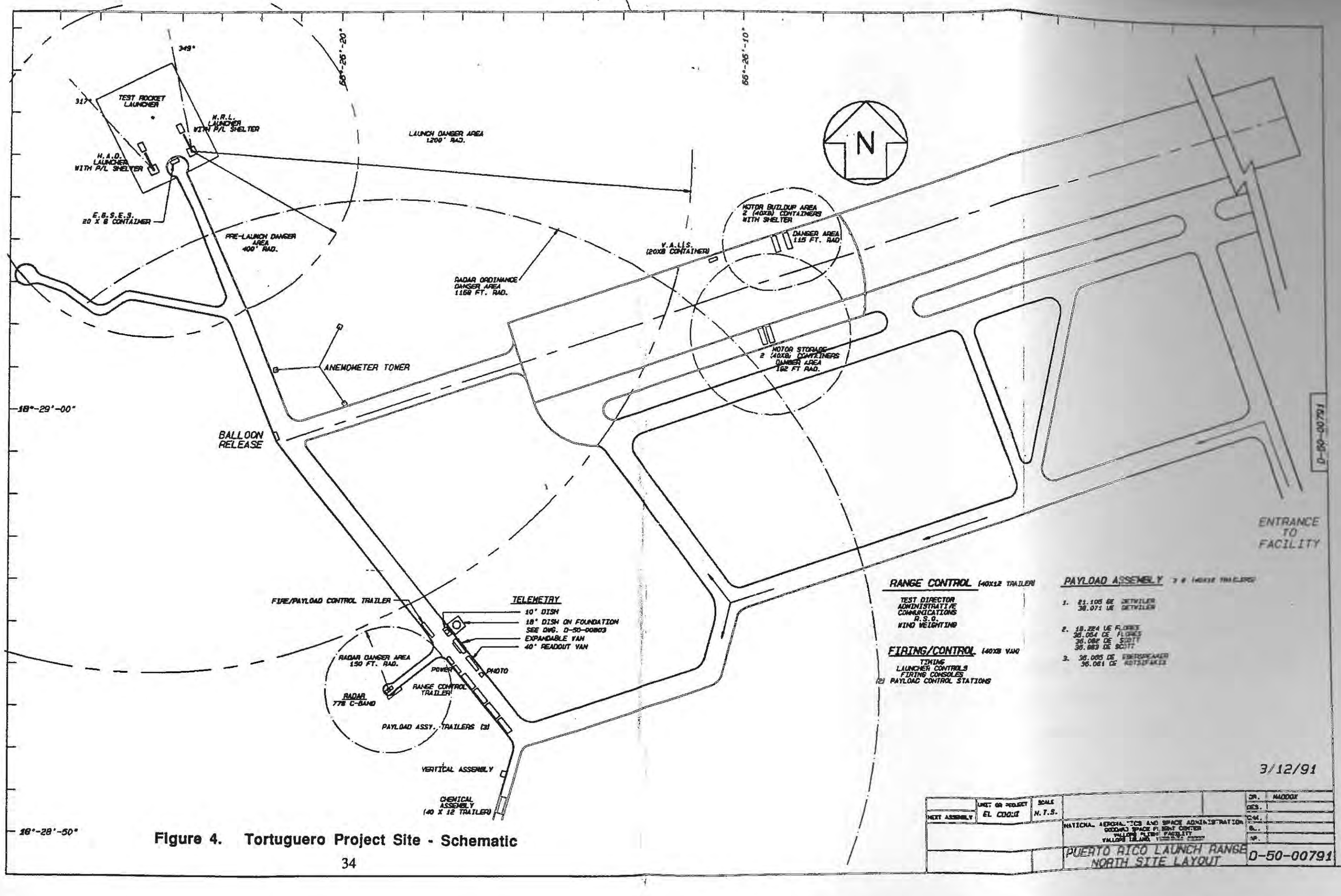
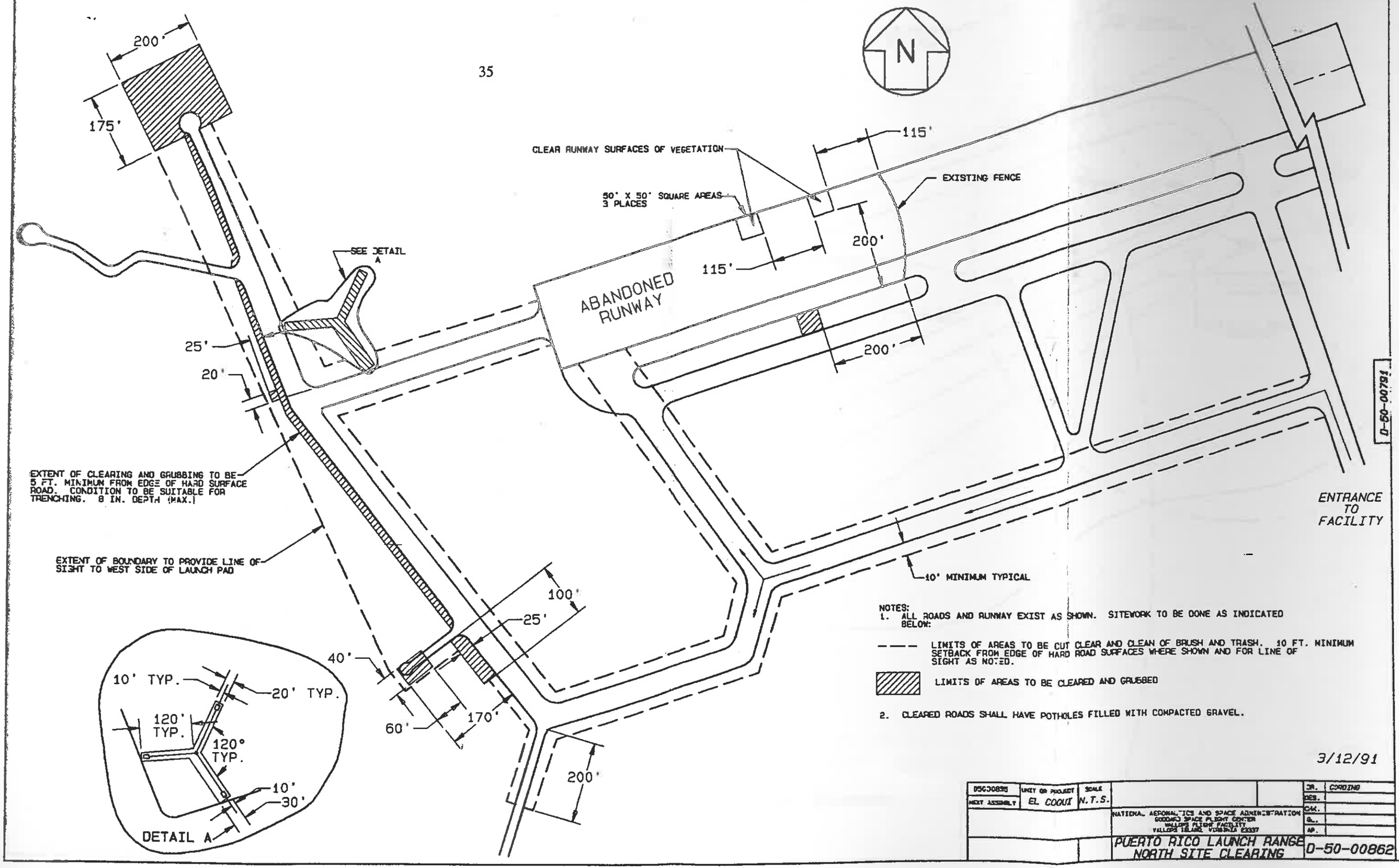


Figure 4. Tortuguero Project Site - Schematic

Figure 5. Tortuguero Project Site - Clearing & Grubbing



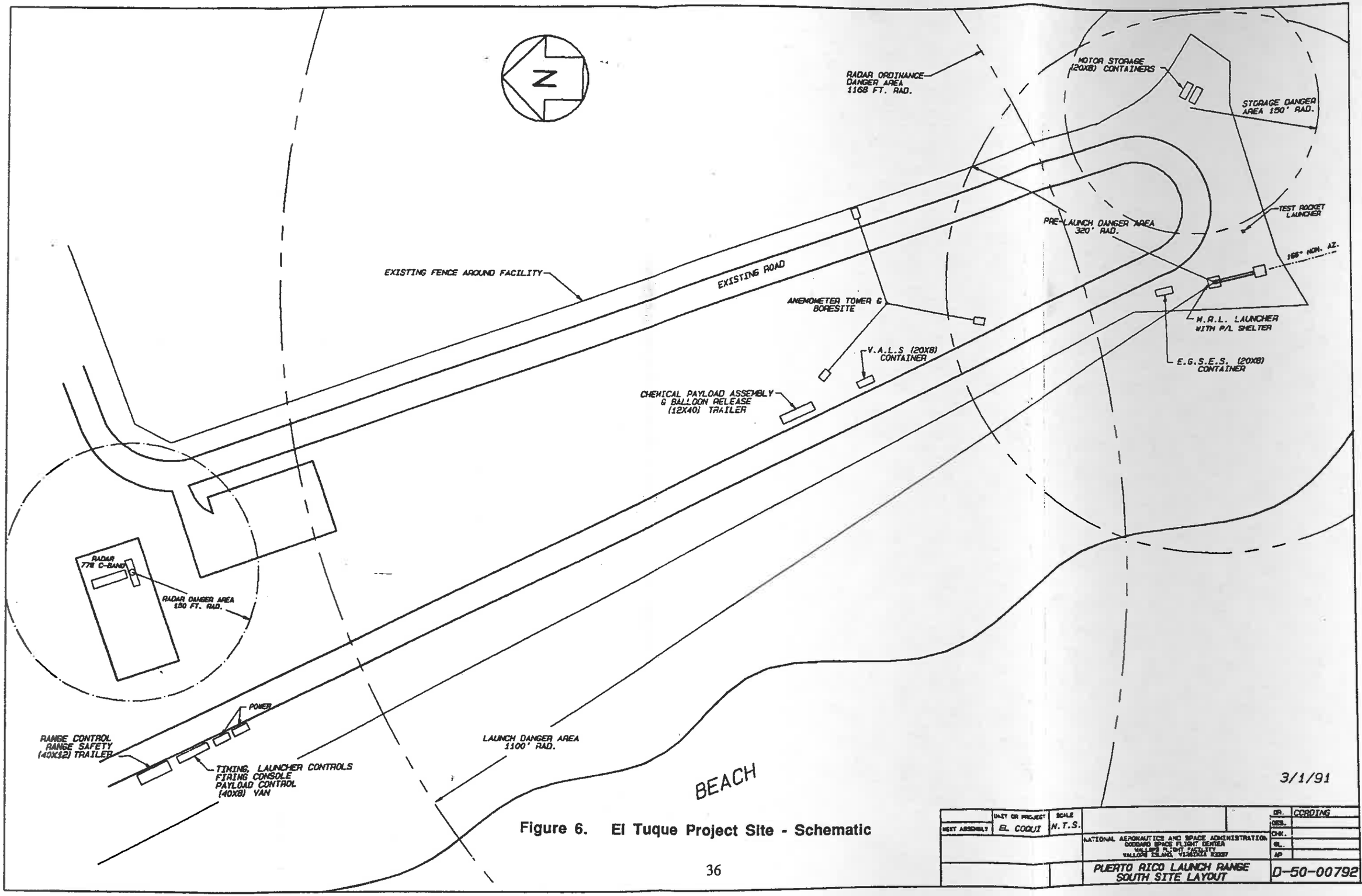


Figure 6. El Tuque Project Site - Schematic

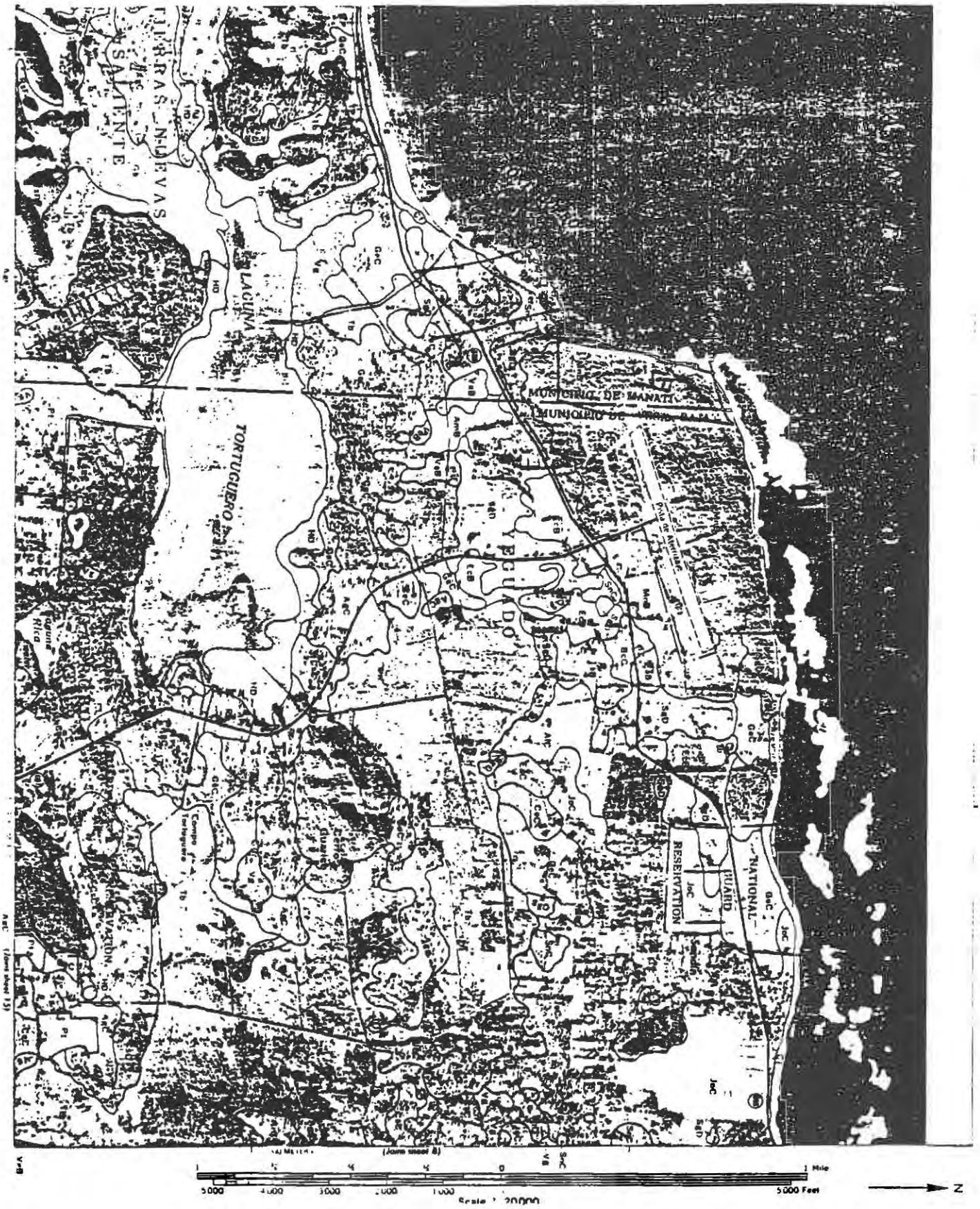


Figure 7. Site Map - Tortuguero

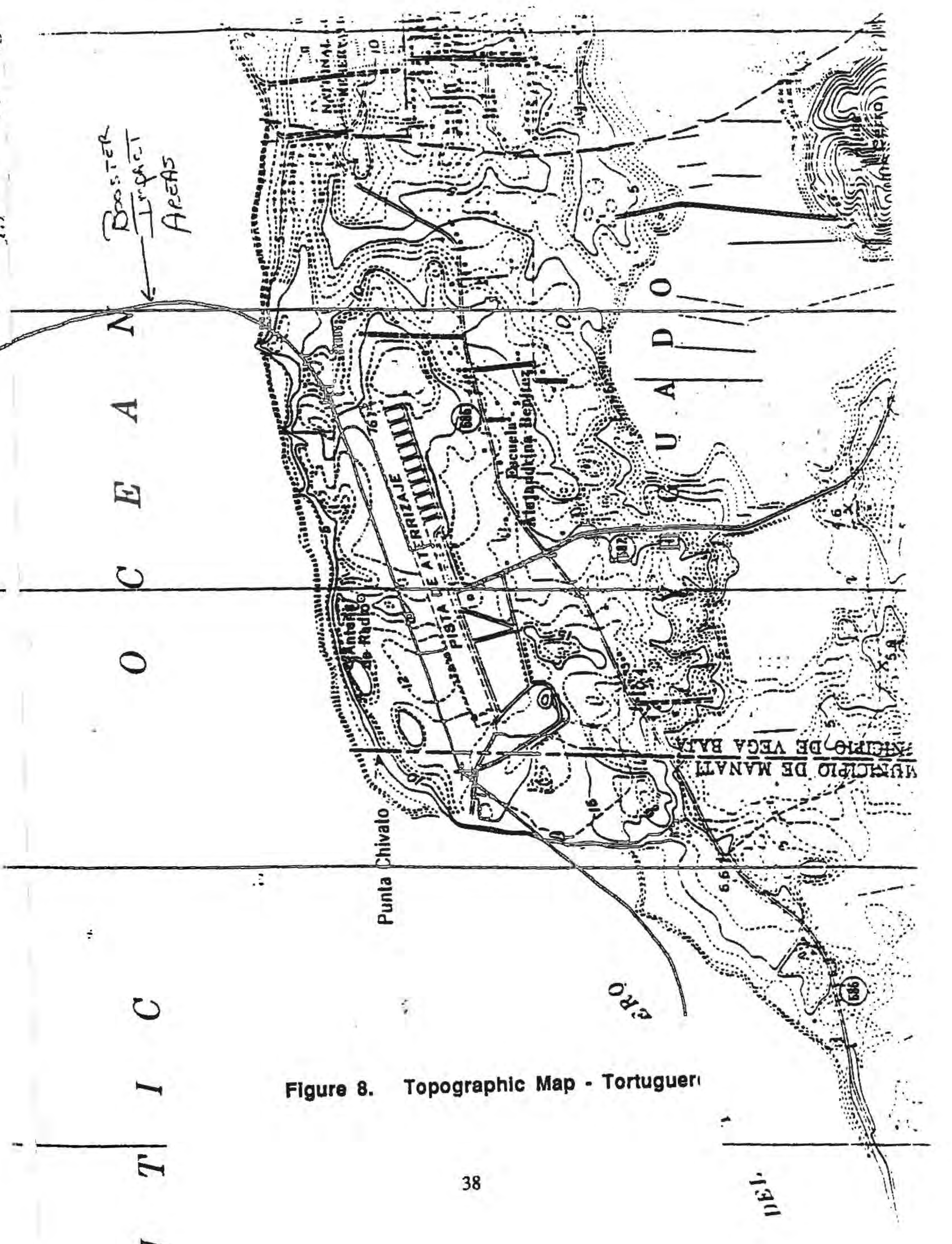


Figure 8. Topographic Map - Tortuguer

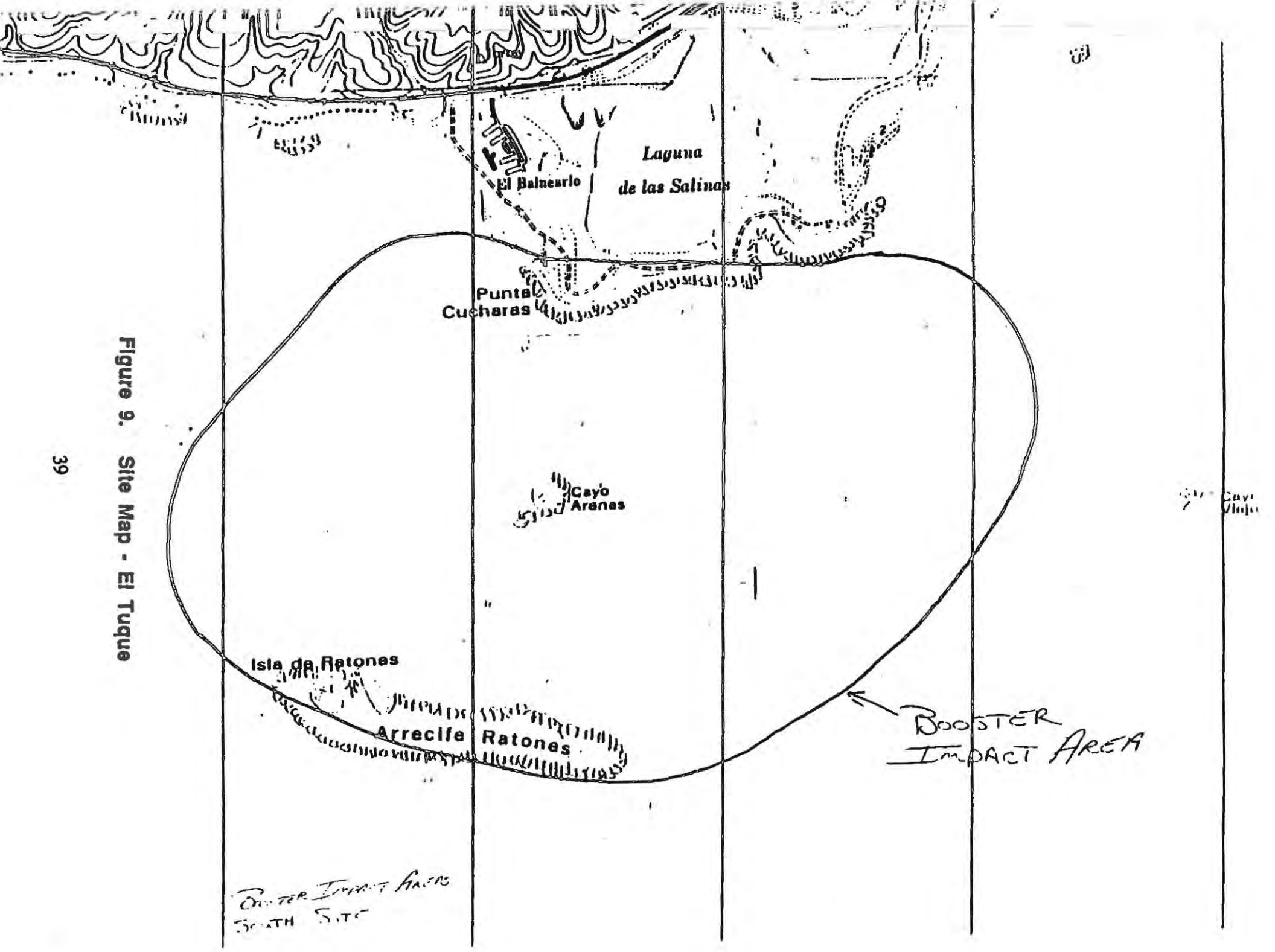


Figure 9. Site Map - El Tuque

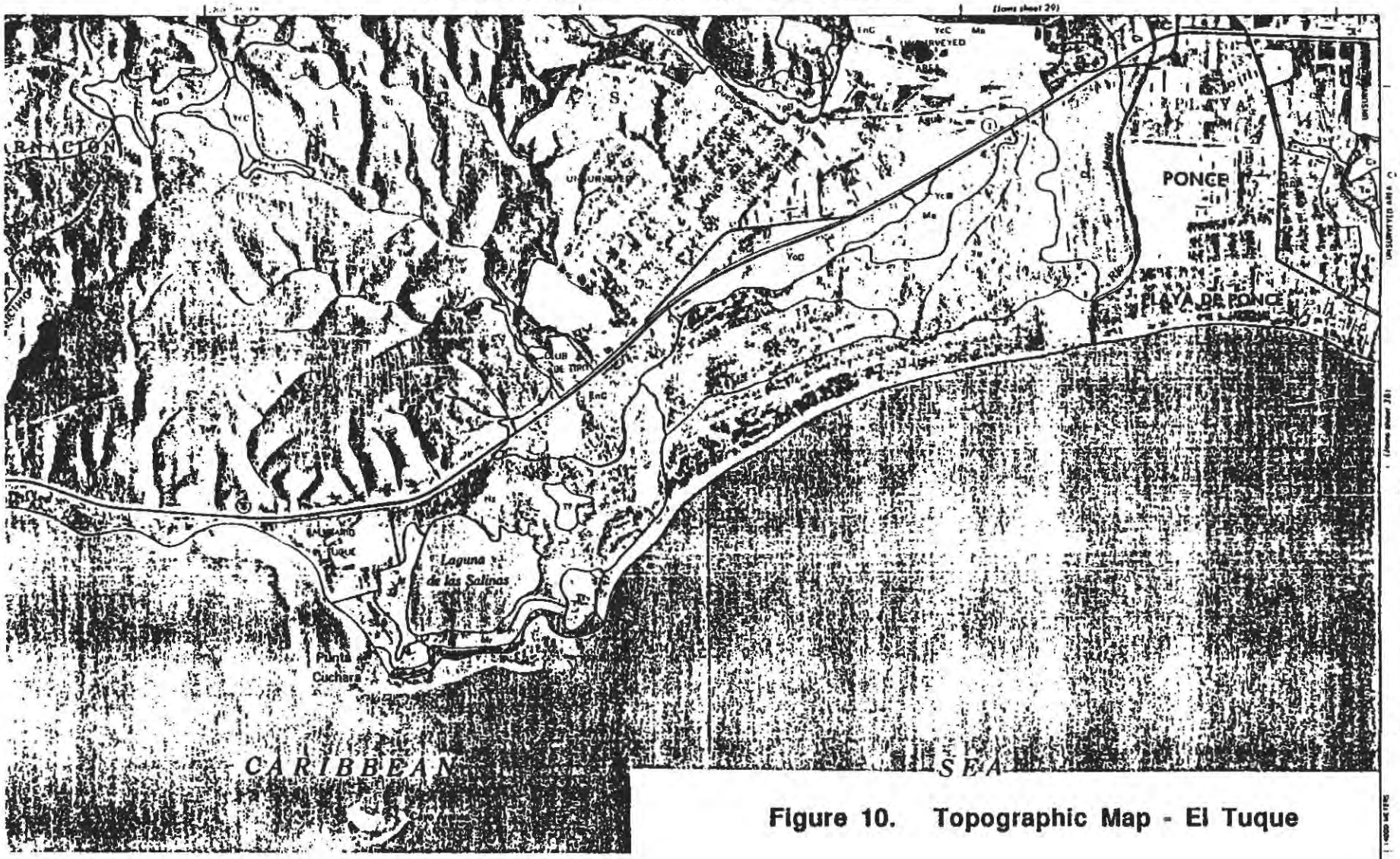


Figure 10. Topographic Map - El Tuque

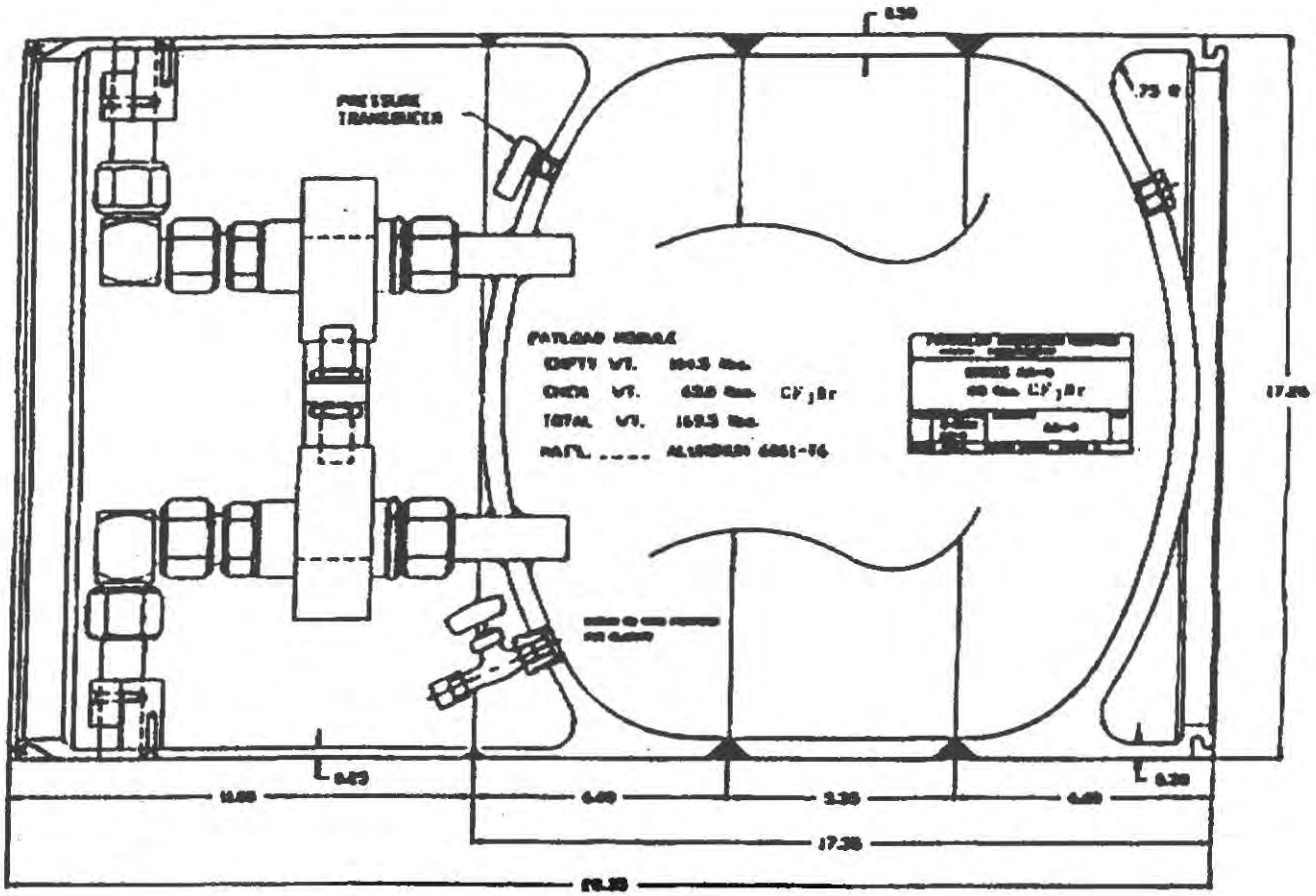


Figure 11. Ba Chemical Release Payload

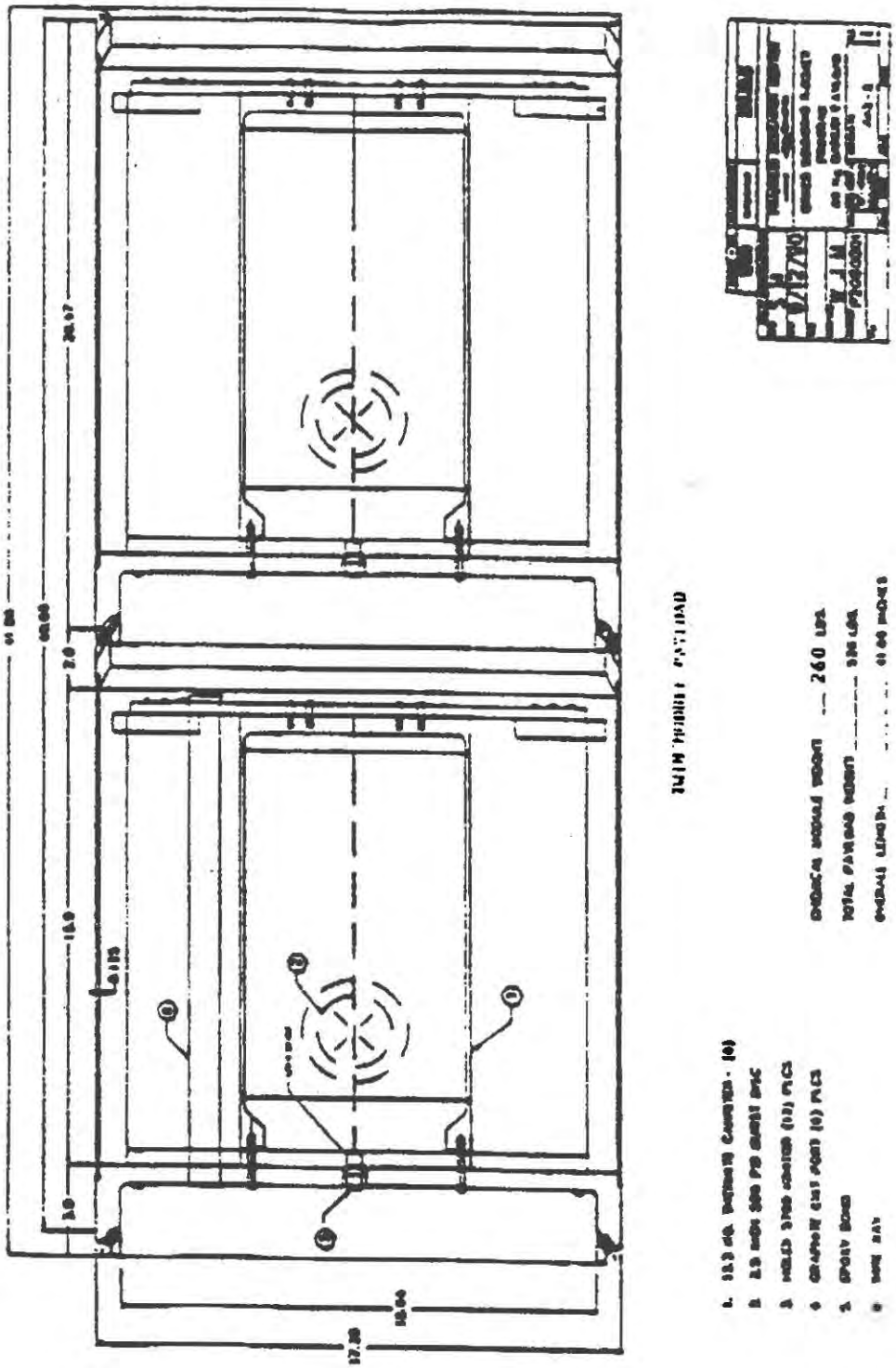


Figure 12. Ba and CF_3Br Chemical Release Payloads

140 dB	50 feet
130 dB	170 feet
120 dB	530 feet
110 dB	1600 feet
100 dB	5200 feet

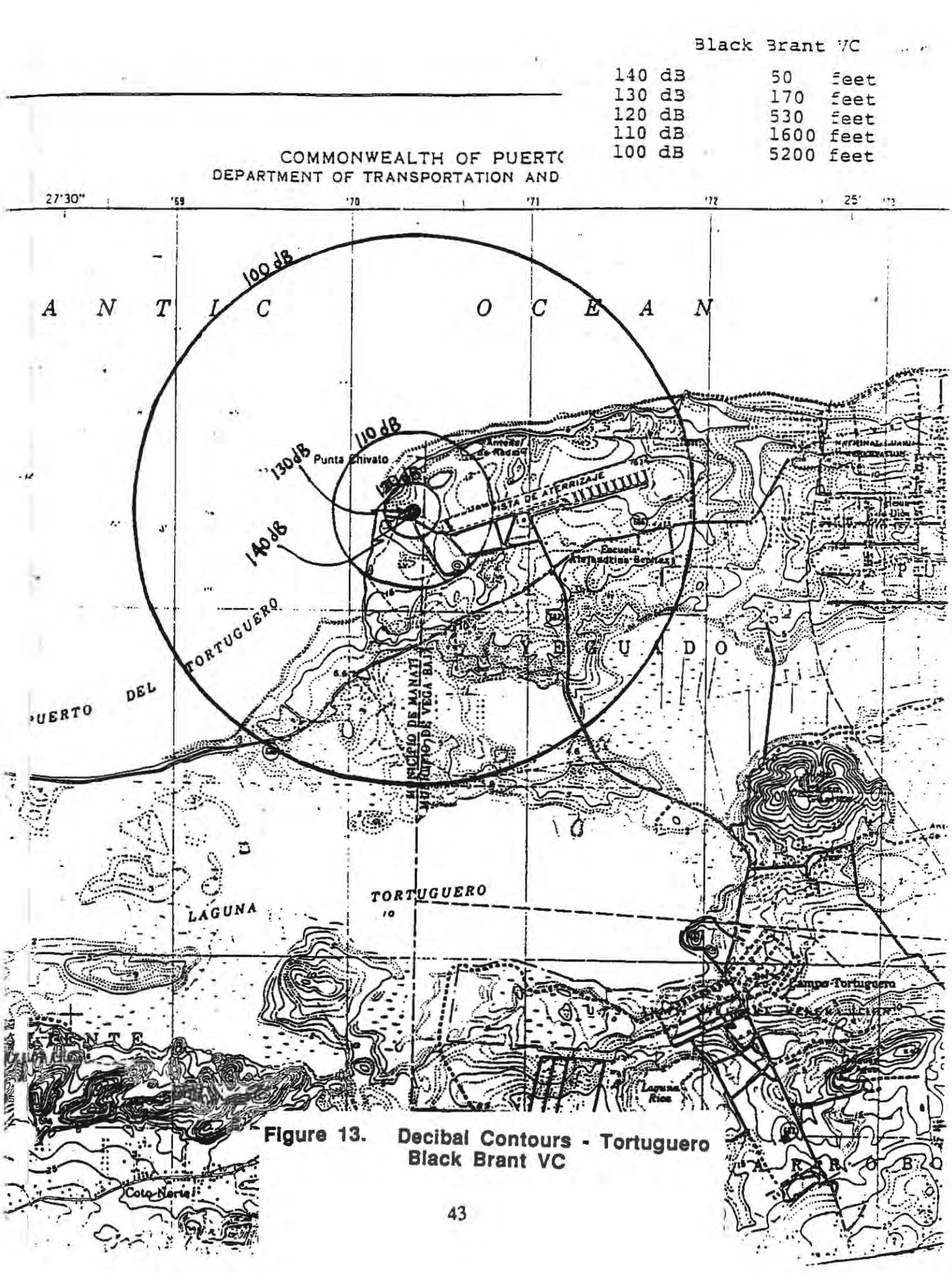


Figure 13. Decibal Contours - Tortuguero Black Brant VC

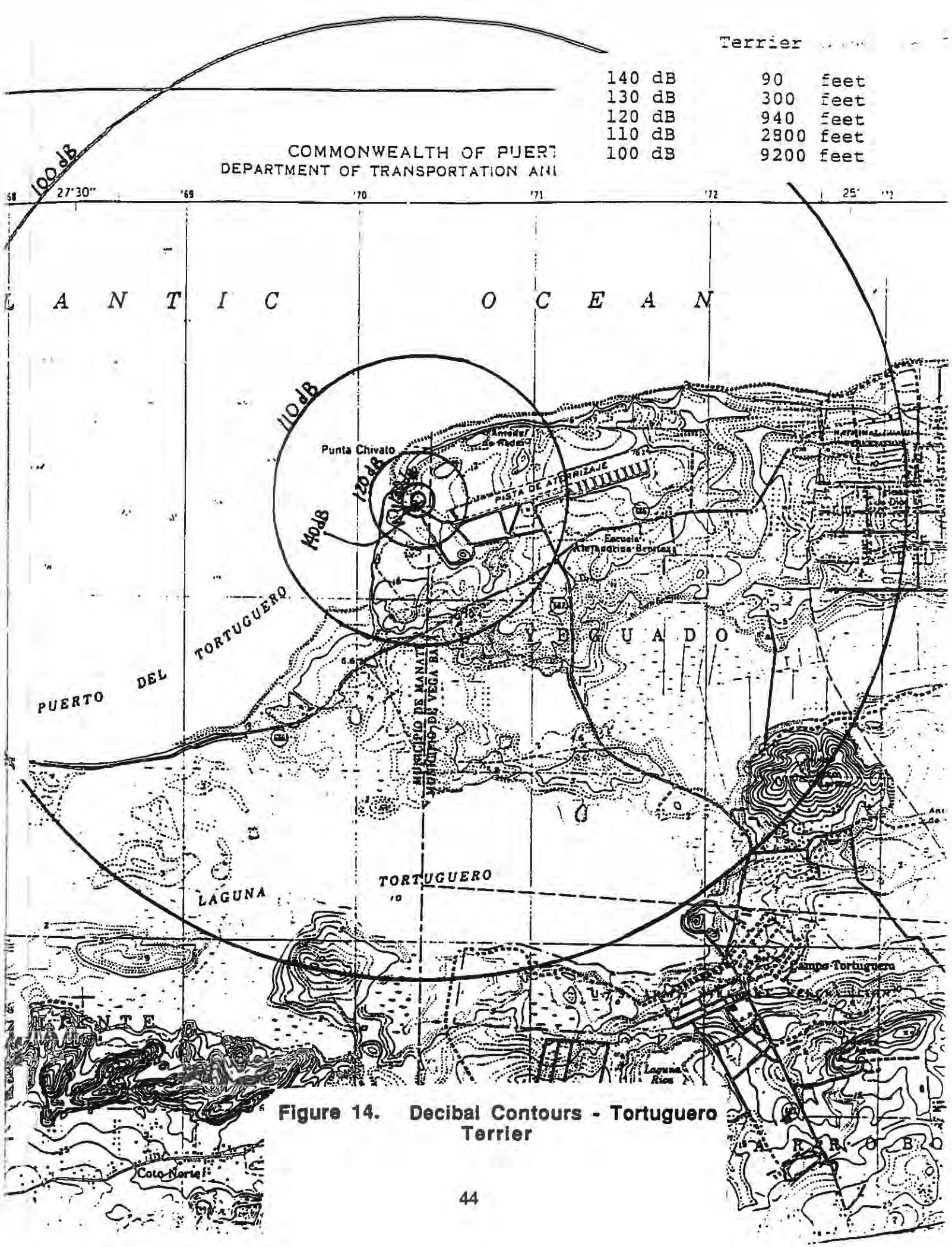


Figure 14. Decibal Contours - Tortuguero Terrier

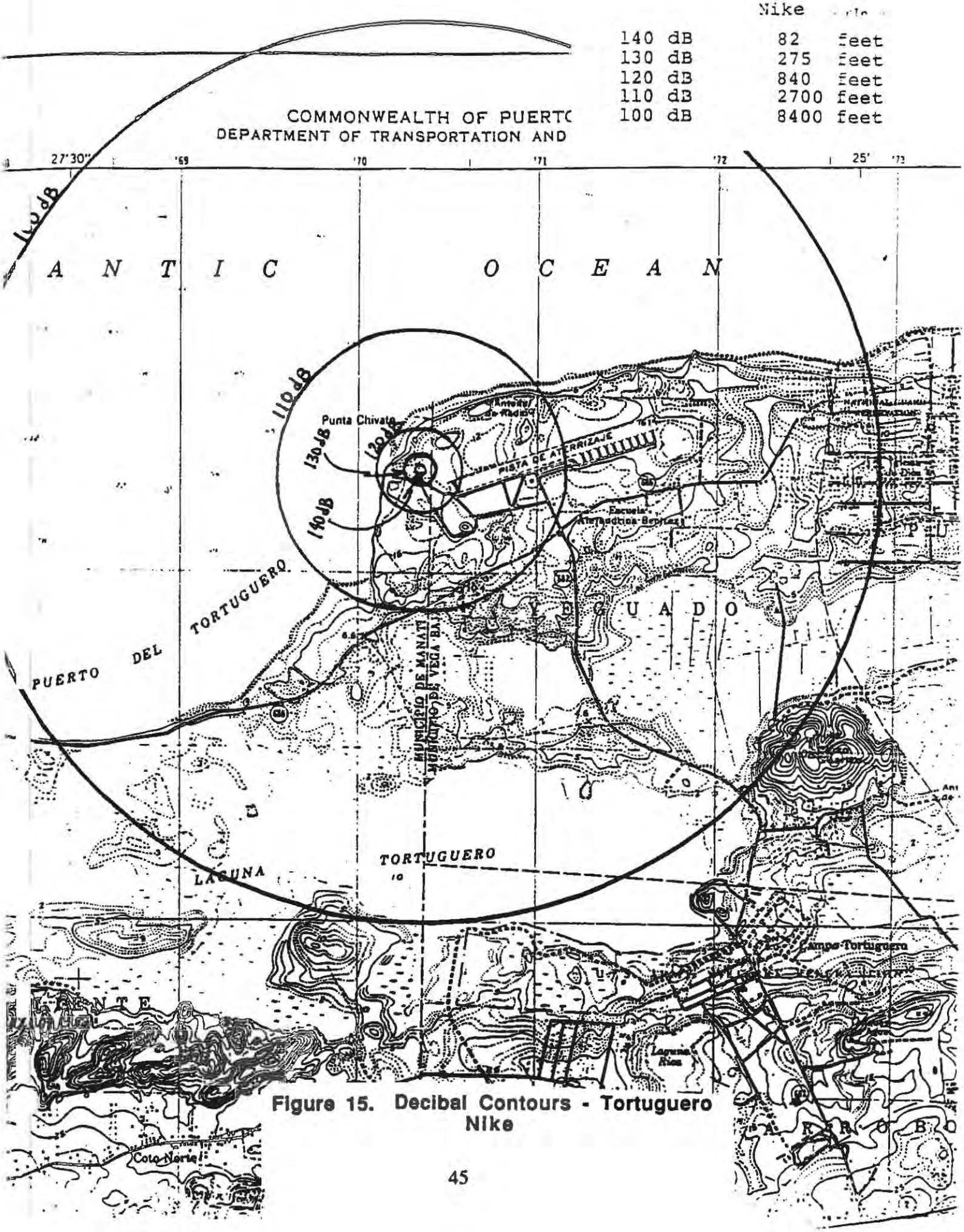


Figure 15. Decibal Contours - Tortuguero Nike

140 dB	90 feet
130 dB	300 feet
120 dB	940 feet
110 dB	2800 feet
100 dB	9200 feet

Figure 16. Decibel Contours - El Tuque Terrier

Table 1

Launch/Experiment Scenario

Launch Number	Experimenter	Vehicle Type	Stage	Payload
36.081	Djuth	BBIX	2	Chemical - Ba.
36.064	Szuszczewicz	BBIX	2	Chemical - Ba. & Instrumented
36.082	Carlson	BBIX	2	Chemical - Ba.
36.065	Bernhardt	BBIX	2	Chemical - CF_3Br/Ba & Instrumented
36.083	Carlson	BBIX	2	Chemical - Ba.
36.071	Kelley	BBIX	2	Instrumented
18.224	Duncan	N-T	2	Chemical - Ba
21.105	Pfaff	BB VC	1	Instrumented

N-T - Nike-Tomahawk sounding rocket
BBIX - Terrier-Black Brant IX sounding rocket
BB VC - Black Brant VC sounding rocket

Table 2

Chemicals & Gases

Type	Quantity	Comments
Barium Thermite Solid	80 Kg.(Max) varies with payload	Composition by Weight - Titanium 38.2%; Boron 17.1%; Barium 43%; Strontium 1.7%.
Bromo-Trifluoro-Methane Gas	65 lbs.	Composition - Bromo-Trifluoro-Methane.
Argon Gas	May Vary	Used on Attitude Control Systems. Quantity used may vary depending on test performed & number of pressurizations.
Nitrogen Gas	May Vary	Used on Attitude Control Systems. Also will be used for payload purge on all payloads. Amount used will vary depending on test performed, number of pressurizations, and time of purge.
Isopropyl Alcohol	May Vary	Small amounts will be used during vehicle & payload assembly for cleaning purposes.
Trichloroethane (Penetone Inhibsol)	May Vary	Small amounts will be used during vehicle & payload assembly for cleaning purposes.
Xylene and/or Toluene	May Vary	Small amounts will be used during (Paint Remover) vehicle & payload assembly for cleaning purposes.
Silicone Elastomer (RTV 3145)	May Vary	Small amounts will be used during vehicle & payload assembly for sealing or insulating purposes.

Table 3

Solid-fueled Rocket Motors

Type	Quantity	Comments
Black Brant	7	Composition - Ammonium Perchlorate/Polyurethane/Aluminum; Propellant Weight 2201 lbs. each.
Nike	1	Composition - Nitrocellulose/ Nitroglycerine/Triacetine; Propellant Weight 740 lbs. each.
Terrier	6	Composition - Nitrocellulose/ Nitroglycerine/Triacetin w/Aluminum; Propellant Weight 1244 lbs. each.
Tomahawk	1	Composition - Ammonium Perchlorate/Carboxyl-Terminated Polybutadiene/Aluminum; Propellant Weight 389 lbs.

Table 4

Electroexplosive Devices

Type	Quantity	Comments
Holex 9293-1 Initiator	6	Black Brant Ignition
S.D.I. 103377-119 Initiator	6	Terrier Ignition
Holex 3300 Initiator	1	Nike Ignition
Flare Northern F-ND 209 Initiator	1	Tomahawk Ignition
Conax 1808-076-03 Pin-Puller	1	Nike/Tomahawk Separation
Holex 6104 Pressure Cartridge	16	Nose Cone Separation & Payload Separation
Holex 5800 Guillotine	6	Payload Sensor Cover Removal
Holex 5801 Guillotine	1	Payload Despin
Holex 2801 Guillotine	18 total	Despin; Doors & Boom Release.
Holex 3702 Pressure Cartridge	6	Chemical Cannister Separation.
Holex 5700 Ignition Cartridge	2	Initiate Barium Thermite Canister.
Conax Con-O-Cap 1832-118-01 Explosive Valve	7	Payload Chemical Release

Table 5

Vehicle/Payload Batteries

Type	Quantity	Comments
Nickel Cadmium Size "AF" cells	TBD	Payload Power/Events
Nickel Cadmium Size "C" cells	TBD	Primary Power
Nickel Cadmium Size "D" cells	TBD	Primary Power
Silver Zinc HR5DC-9 cells	TBD	Primary Power
Silver Oxide S41 Button cells	TBD	Ignition Events

Table 6

EMR and RF/RFI Emittance Sources

Type	Quantity	Comments
C - Band, 550 MHz. Radar	1	Portable, one NASA 26' Van moved to each launch site for launch operations only
Telemetry Uplink (TM)	1	
X-Band Radar	1	Small tracking radar

Appendix A. Acronyms and Abbreviations

Ba	•	Barium
BBIX	•	Terrier-Black Brant IX sounding rocket
CF_3Br	•	Bromo-Trifluoro-Methane
dBA	•	decibels
DC	•	Direct Current
DEIS	•	Draft Environmental Impact Statement
DOD	•	Department of Defense
EA	•	Environmental Assessment
EIS	•	Environmental Impact Statement
EMR	•	Electromagnetic Radiation
FEIS	•	Final Environmental Impact Statement
FY	•	Fiscal Year
GSFC	•	NASA's Goddard Space Flight Center
Kg	•	Kilograms
km.	•	kilometer
NASA	•	National Aeronautics and Space Administration
NEPA	•	National Environmental Policy Act
RF	•	Radio Frequency
RFI	•	Radio Frequency Interference
N-T	•	Nike-Tomahawk sounding rocket
USAKA	•	U.S. Army at Kwajalein Atoll
WFF	•	Wallops Island Flight Facility