NATIONAL RADIO QUIET ZONE
FACT SHEET

Revised February 1985

The National Radio Quiet Zone (NRQZ) was established with FCC rulemaking Docket No. 11745, dated November 19, 1958, and enclosed an area of approximately 13,000 square miles of Virginia and West Virginia as shown on the map on the reverse side. The purpose of the NRQZ is to minimize possible harmful interference to the National Radio Astronomy Observatory (NRAO) at Green Bank, WV and the Navy's space receiving facility at Sugar Grove, WV. Applications for radio services within the NRQZ are reviewed for compliance with the criteria of the observatories, which are:

The computed power density the transmitter produces at the Observatory reference antenna should not exceed:

→ 1×10^{-8} W/m^2 for frequencies below 54 MHz;

→ 1×10^{-12} W/m^2 for frequencies from 54 to 108 MHz;

→ 1×10^{-14} W/m^2 for frequencies from 108 to 470 MHz;

→ 1×10^{-17} W/m^2 for frequencies from 470 to 1000 MHz; and

→ $f^2_{(GHz)} \times 10^{-17}$ W/m^2 for frequencies (f) above 1 GHz;

→ except CCIR-224 densities for the radio astronomy frequency bands plus narrow guard-bands.

All non-Federal-Government radio services are required to obtain an FCC license for each transmitter. For the radio services listed below, FCC rules require any applicant for new or modified fixed-station, simultaneously to filing, to notify:

Director (Interference Office)
National Radio Astronomy Observatory
P. O. Box 2
Green Bank, West Virginia 24944

in writing of the technical parameters of the application. The FCC will then consider comments or objections from NRAO. NRAO prefers that the notice consist of a copy of the completed FCC application form (which contains most of the technical parameters) plus a cover letter which states:

1. That it is a notice of FCC application, a copy of which is attached, and the date of filing.

2. Antenna directivity(ies): type, gain, horizontal pattern and its orientation in azimuth, sufficient to determine the effective radiated power (ERP) toward Green Bank, WV and Sugar Grove, WV for each antenna, including any control station antenna and its coordinates.

A copy of the cover letter should be attached to the original application when it is sent to the FCC.

The applicable FCC Rules and Radio Services are:

5.69	Experimental
21.113(a)	Domestic Public Fixed
22.113(a)	Public Mobile
23.20(b)	International Fixed Public
25.203(g)	Satellite Communications
73.1030(a)	Broadcast
74.12, 74.24(i) ...	Exp., Aux., & Special Broadcast
78.19(c)	Cable Television Relay
81.31(a)	On Land Maritime
87.37	Aviation
90.177(a),(b)	Private Land Mobile
94.25(f)	Private Operational Fixed Microwave
95.17(g)	General Mobile
97.85(f), 97.87(d) ...	Amateur (repeaters, beacons)
99.11(e)	Disaster Communications

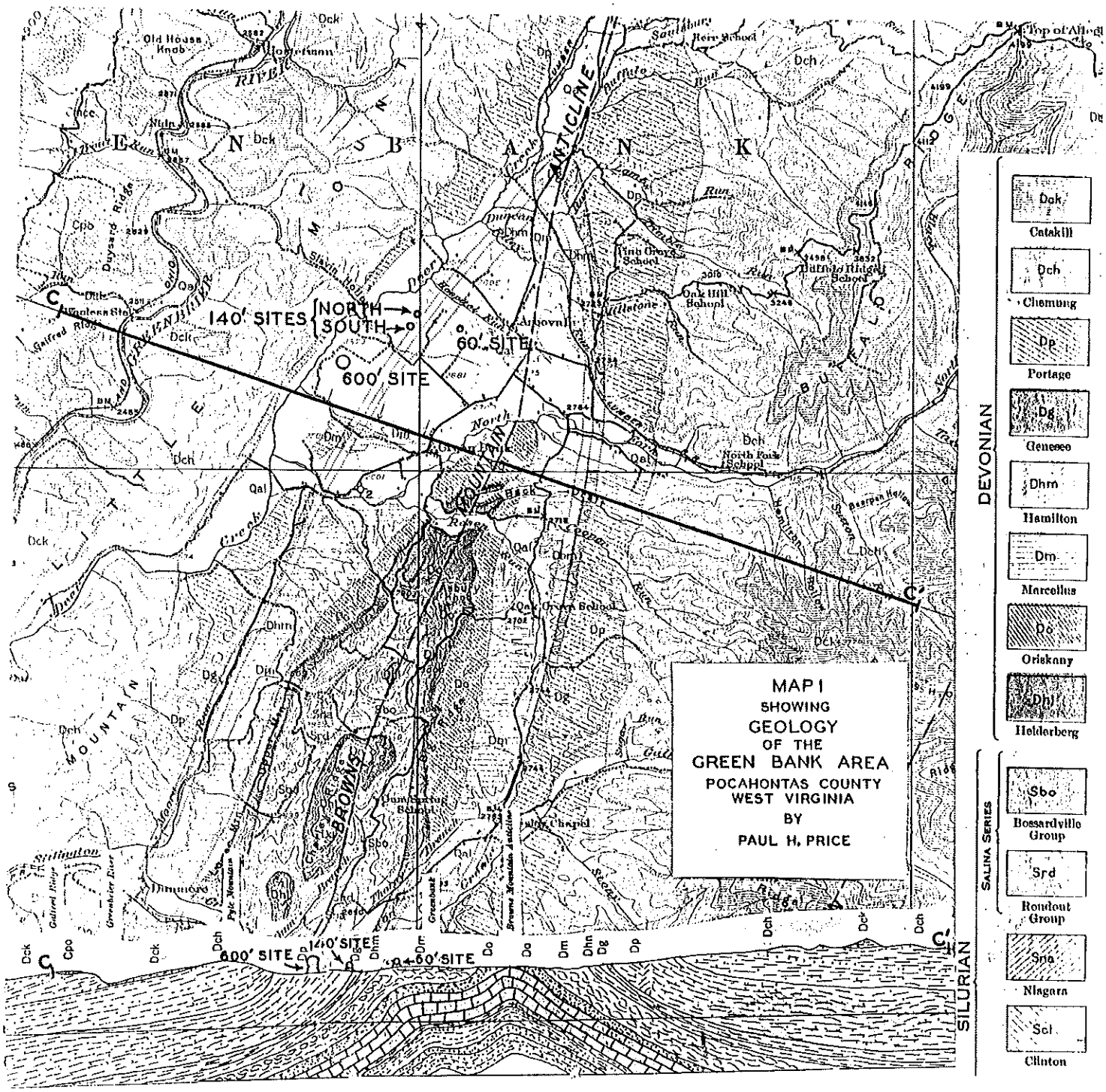
Requests for information and for preliminary evaluation of proposed stations for the ERP limit toward Green Bank and Sugar Grove should be sent to the Interference Office at the NRAO address above. Preliminary proposals should be stated as such and should include:

1. Name and address of proposer and future applicant.
2. Radio service.
3. Frequency of each transmitter.
4. Antenna location(s) in latitude and longitude to nearest second.
5. Antenna site ground elevation(s) above mean sea level (AMSL).
6. Antenna (radiation center) height(s) above ground level (AGL).

If an ERP limit is not acceptable to the applicant, NRAO will assist in finding a mutually acceptable alternative.

```
C     ****************************************************************
      FUNCTION CRITER (F)
C
CC    CRITER RETURNS THE GREEN BANK QUIET ZONE CRITERIA, I.E.
CC      THE (MAXIMUM) ALLOWABLE POWER DENSITY GIVEN THE
CC      TX (TRANSMITTER) FREQUENCY.
CC    VARIABLES: F = FREQUENCY IN MHZ
CC    FUNCTIONS CALLED: FSQ = (FREQ IN GHZ) SQUARED * 1E-17
C
      IF (F.LT.13.34)                          CRITER = 1E-08
      IF (F.GE.13.34 .AND. F.LE.13.43)         CRITER = 1E-17
      IF (F.GT.13.43 .AND. F.LT.25.49)         CRITER = 1E-08
      IF (F.GE.25.49 .AND. F.LE.25.73)         CRITER = 1E-60
      IF (F.GT.25.73 .AND. F.LT.37.20)         CRITER = 1E-08
      IF (F.GE.37.20 .AND. F.LT.37.30)         CRITER = 1E-17
      IF (F.GE.37.30 .AND. F.LE.38.45)         CRITER = 1E-60
      IF (F.GT.38.45 .AND. F.LE.38.55)         CRITER = 1E-17
      IF (F.GT.38.55 .AND. F.LE.54.00)         CRITER = 1E-08
      IF (F.GT.54.00 .AND. F.LT.72.60)         CRITER = 1E-12
      IF (F.GE.72.60 .AND. F.LT.73.00)         CRITER = 1E-17
      IF (F.GE.73.00 .AND. F.LE.74.60)         CRITER = 1E-60
      IF (F.GT.74.60 .AND. F.LE.75.00)         CRITER = 1E-17
      IF (F.GT.75.00 .AND. F.LE.108.0)         CRITER = 1E-12
      IF (F.GT.108.0 .AND. F.LT.318.7)         CRITER = 1E-14
      IF (F.GE.318.7 .AND. F.LE.331.9)         CRITER = 4E-21
      IF (F.GT.331.9 .AND. F.LT.404.15)        CRITER = 1E-14
      IF (F.GE.404.15 .AND. F.LE.411.95)       CRITER = 1E-19
      IF (F.GT.411.95 .AND. F.LT.470.0)        CRITER = 1E-14
      IF (F.GE.470.0 .AND. F.LT.605.0)         CRITER = 1E-17
      IF (F.GE.605.0 .AND. F.LT.608.0)         CRITER = 3E-19
      IF (F.GE.608.0 .AND. F.LE.614.0)         CRITER = 1E-60
      IF (F.GT.614.0 .AND. F.LE.617.0)         CRITER = 3E-19
      IF (F.GT.617.0 .AND. F.LT.1000.0)        CRITER = 1E-17
      IF (F.GT.1000.0 .AND. F.LT.1300.0)       CRITER = FSQ(F)
      IF (F.GE.1300.0 .AND. F.LT.1400.0)       CRITER = 2E-20
      IF (F.GE.1400.0 .AND. F.LE.1427.0)       CRITER = 1E-60
      IF (F.GT.1427.0 .AND. F.LE.1455.0)       CRITER = 2E-20
      IF (F.GT.1455.0 .AND. F.LT.1609.0)       CRITER = FSQ(F)
      IF (F.GE.1609.0 .AND. F.LE.1615.4)       CRITER = 4E-20
      IF (F.GT.1615.4 .AND. F.LT.1655.0)       CRITER = FSQ(F)
      IF (F.GE.1655.0 .AND. F.LE.1675.0)       CRITER = 4E-20
      IF (F.GT.1675.0 .AND. F.LT.1717.1)       CRITER = FSQ(F)
      IF (F.GE.1717.1 .AND. F.LE.1723.9)       CRITER = 4E-20
      IF (F.GT.1723.9 .AND. F.LT.2633.0)       CRITER = FSQ(F)
      IF (F.GE.2633.0 .AND. F.LT.2690.0)       CRITER = 2E-18
      IF (F.GE.2690.0 .AND. F.LE.2700.0)       CRITER = 1E-60
      IF (F.GT.2700.0 .AND. F.LE.2722.0)       CRITER = 2E-18
      IF (F.GT.2722.0 .AND. F.LT.3257.0)       CRITER = FSQ(F)
      IF (F.GE.3257.0 .AND. F.LE.3270.0)       CRITER = 2E-19
      IF (F.GT.3270.0 .AND. F.LT.3329.0)       CRITER = FSQ(F)
      IF (F.GE.3329.0 .AND. F.LE.3356.0)       CRITER = 2E-19
      IF (F.GT.3356.0 .AND. F.LT.4700.0)       CRITER = FSQ(F)
      IF (F.GE.4700.0 .AND. F.LE.4990.0)       CRITER = 5E-19
      IF (F.GT.4990.0 .AND. F.LE.5100.0)       CRITER = 8E-18
      IF (F.GT.5100.0 .AND. F.LT.10550.0)      CRITER = FSQ(F)
      IF (F.GE.10550.0 .AND. F.LT.10680.0)     CRITER = 1E-16
```

```
      IF (F.GE.10680.0 .AND. F.LE.10700.0)  CRITER = 1E-60
      IF (F.GT.10700.0 .AND. F.LE.10750.0)  CRITER = 1E-16
      IF (F.GT.10750.0 .AND. F.LT.14455.0)  CRITER = FSQ(F)
      IF (F.GE.14455.0 .AND. F.LE.14515.0)  CRITER = 1E-17
      IF (F.GT.14515.0 .AND. F.LT.15325.0)  CRITER = FSQ(F)
      IF (F.GE.15325.0 .AND. F.LT.15350.0)  CRITER = 1E-17
      IF (F.GE.15350.0 .AND. F.LE.15400.0)  CRITER = 1E-60
      IF (F.GT.15400.0 .AND. F.LE.15425.0)  CRITER = 1E-17
      IF (F.GT.15425.0 .AND. F.LT.21770.0)  CRITER = FSQ(F)
      IF (F.GE.21770.0 .AND. F.LE.22740.0)  CRITER = 6E-17
      IF (F.GT.22740.0 .AND. F.LT.22790.0)  CRITER = FSQ(F)
      IF (F.GE.22790.0 .AND. F.LE.22880.0)  CRITER = 6E-17
      IF (F.GT.22880.0 .AND. F.LT.23050.0)  CRITER = FSQ(F)
      IF (F.GE.23050.0 .AND. F.LE.23140.0)  CRITER = 6E-17
      IF (F.GT.23140.0 .AND. F.LT.23400.0)  CRITER = FSQ(F)
      IF (F.GE.23400.0 .AND. F.LT.23600.0)  CRITER = 8E-17
      IF (F.GE.23600.0 .AND. F.LE.24000.0)  CRITER = 1E-60
      IF (F.GT.24000.0 .AND. F.LE.24200.0)  CRITER = 8E-17
      IF (F.GT.24200.0)                     CRITER = FSQ(F)
      RETURN
      END
C     ***************************************************************
C
C     ***************************************************************
      FUNCTION  FSQ(F)
C
C       FSQ RETURNS NRQZ-GB POWER DENSITY CRITERIA FOR
C       NON RADIO ASTRONOMY BANDS ABOVE 1000 MHZ,
C       WHICH ARE ((FREQ IN GHZ) SQUARED * 1E-17) WATTS / SQ METER.
C       VARIABLES: F = FREQUENCY IN MHZ
C
      FSQ = (F/1000.0)**2*1E-17
      RETURN
      END
C     ***************************************************************
```


MAP I
SHOWING
GEOLOGY
OF THE
GREEN BANK AREA
POCAHONTAS COUNTY
WEST VIRGINIA
BY
PAUL H. PRICE
140' SITES
NORTH
SOUTH
60' SITE
600' SITE
ANTICLINE
SYNCLINE
DEVONIAN
SILURIAN
SALINA SERIES
Dck
Cataklil
Dch
Chemung
Dp
Portage
Dg
Genesee
Dhm
Hamilton
Dm
Marcellus
Do
Oriskany
Dhl
Helderberg
Sbo
Bossardville Group
Srd
Rondout Group
Sno
Niagara
Scl
Clinton

NATIONAL RADIO ASTRONOMY OBSERVATORY
POST OFFICE BOX 2 GREEN BANK, WEST VIRGINIA 24944-0002
TELEPHONE 304 456-2011 TWX 710 938-1530

October 17, 1988

Dr. Rochus Vogt
Department of Physics
California Institute of Technology
Pasadena, California 91109

Dear Robbie:

I enclose a map of the NRAO site in Green Bank. We also have detailed contour maps, which we would be happy to share if you find our option worthy of more serious consideration.

We discovered in a preliminary examination that two perpendicular four-kilometer arms would not fit on the reasonably flat part of our property. However, the two arms could probably be fit into the valley we occupy by purchasing or leasing some adjacent land. One arm would have to cross a highway. Our history here has shown that re-routing highways can be accomplished.

You probably noticed that I used the term "reasonably flat" in the preceding paragraph. By that I mean there might be ~100 feet difference in elevation over four kilometers. Most of the elevation difference is a general tilt (as contrasted with innumerable humps and dips).

The advantages offered by using an existing site are manifest: roads, water, power, sewer, telephone already in place; shops, technical personnel, copy machines, computers, etc. also available. And, of course, the fact that radio observatories intentionally are sited where manmade activities are minimal is probably the same criterion gravity detectors require.

Please let met know if any additional information is required. I am told, for instance, that we might have seismic data. We are extremely interested in the science that is your goal and can perhaps be of assistance in achieving it.

Sincerely yours,

George

George A. Seielstad
Assistant Director for
Green Bank Operations

GAS/ss
Enclosure

OPERATED BY ASSOCIATED UNIVERSITIES, INC.,
UNDER CONTRACT WITH THE NATIONAL SCIENCE FOUNDATION

NATIONAL RADIO ASTRONOMY OBSERVATORY
POST OFFICE BOX 2 GREEN BANK, WEST VIRGINIA 24944-0002
TELEPHONE 304 456-2011 TWX 710 938-1530

October 26, 1988

Dr. Rochus Vogt
Department of Physics
California Institute of Technology
Pasadena, CA 91109

Dear Robbie:

I am still intrigued by the concept of a gravity wave detector, so I got out a more useful map than the last one I sent you.

It is conceivable a 4 km x 4 km L can be nestled into two approximately orthogonal valleys. See what you think.

Please let me know if there is any other information I could provide.

Yours,

George A. Seielstad

GAS/ss
Enclosure

OPERATED BY ASSOCIATED UNIVERSITIES, INC.,
UNDER CONTRACT WITH THE NATIONAL SCIENCE FOUNDATION

CALIFORNIA INSTITUTE OF TECHNOLOGY

102-33 E. BRIDGE LABORATORY

LIGO PROJECT

October 28, 1988

George A. Seielstad, Assistant
Director for Green Bank Operations
National Radio Astronomy Observatory
Post Office Box 2
Green Bank, West Virginia 24944-0002

Dear George,

Thanks for your letter of 17 October and the enclosed material. I have passed it along to our chief engineer, Bill Althouse, with the suggestion that he follow up directly with you. I would be most pleased if your initiative were to lead to some tangible results in our site search.

Sincerely,

R. Vogt

RV/bb

PASADENA, CALIFORNIA 91125 TELEPHONE (818) 356-2129

NATIONAL RADIO ASTRONOMY OBSERVATORY
POST OFFICE BOX 2 GREEN BANK, WEST VIRGINIA 24944-0002
TELEPHONE 304 456-2011 TWX 710 998-1690

November 8, 1988

To: George Seielstad
From: Buck Peery
Subject: Site Information - Green Bank

Soils: The site is covered with alluvial overburden consisting of silty sand, clay-like sand, weathered sandstone, medium to large gravel and silty clay ranging from 10 to 15 feet deep over bedrock of medium to soft shale.

Water Table: The water table is at least 75 feet below the surface, as most wells around the site are over 100 feet deep. There are a few poorly drained areas on site that hold surface water in wet seasons.

Electric Power: The site is served by a dedicated 2500 KVA service. Our maximum demand is 900 to 1000 KVA, leaving over 1500 KVA for growth. The power is very stable and economical at approximately $0.04 per KWhr. The voltage is 4360 volts three phrase. This can be transformed down to any desired voltage.

Wind: The wind has never been a problem, usually very light. The site is protected on all sides by mountains. The estimated mean wind speed is around 10 miles per hour. The highest known winds were approximately 65 miles per hour. The telescopes cease operating when the winds reach 35 miles her hour. Approximately 48 hours per year of lost operating time due to wind is typical. The telescopes operate 24 hours a day.

Stream: The stream flowing through the site (Deer Creek) is a small tributary of the Greenbrier River, draining a very small area of fields and forest. The stream has a well-defined natural channel that contains most of the flow in times of extra heavy rains. It is estimated that the stream's maximum rise is 10 feet above normal flow levels. The stream did not cause any problems during the '85 flood in this area, which is believed to be a 100 year flood.

Traffic: The state road, running along one side of the site, carries mainly rural, local traffic. It is not a major highway. It is estimated the traffic would not exceed an average of 20 to 25 cars per hour over a 24-hour period.

Seismic Data: Seismic data has been taken several different times on site. Very little activity was recorded or shown to be occurring. The data, and published results, can be obtained by contacting Professor Bollinger in the Geology Department, VPI, Blacksburg, Virginia. The data does cover 0 to 30 Hz.

NATIONAL RADIO ASTRONOMY OBSERVATORY
POST OFFICE BOX 2 GREEN BANK, WEST VIRGINIA 24944-0002
TELEPHONE 304 456-2011 TWX 710 938-1530

November 10, 1988

Dr. Bill Althouse
Department of Physics
California Institute of Technology
Pasadena, CA 91109

Dear Ar. Althouse:

After our phone conversations of November 3 and 4, I asked Buck Peery, longtime NRAO engineer, some of the same questions you asked me. I enclose a copy of his memo.

The biggest change to what I told you concerns electric power. It appears we may have enough surplus capacity to supply your needs.

Let me know if you need any more information.

Yours,

George A. Seielstad

GAS/ss
Enclosure

OPERATED BY ASSOCIATED UNIVERSITIES, INC.
UNDER CONTRACT WITH THE NATIONAL SCIENCE FOUNDATION

NATIONAL RADIO ASTRONOMY OBSERVATORY
POST OFFICE BOX 2 GREEN BANK, WEST VIRGINIA 24944-0002
TELEPHONE 304 456-2011 TWX 710 998-1500

November 8, 1988

To: George Seielstad
From: Buck Peery
Subject: Site Information - Green Bank

Soils: The site is covered with alluvial overburden consisting of silty sand, clay-like sand, weathered sandstone, medium to large gravel and silty clay ranging from 10 to 15 feet deep over bedrock of medium to soft shale.

Water Table: The water table is at least 75 feet below the surface, as most wells around the site are over 100 feet deep. There are a few poorly drained areas on site that hold surface water in wet seasons.

Electric Power: The site is served by a dedicated 2500 KVA service. Our maximum demand is 900 to 1000 KVA, leaving over 1500 KVA for growth. The power is very stable and economical -- approximately $0.04 per KWhr. The voltage is 4360 volts three phrase. This can be transformed down to any desired voltage.

Wind: The wind has never been a problem, usually very light. The site is protected on all sides by mountains. The estimated mean wind speed is around 10 miles per hour. The highest known winds were approximately 65 miles per hour. The telescopes cease operating when the winds reach 35 miles her hour. Approximately 48 hours per year of lost operating time due to wind is typical. The telescopes operate 24 hours a day.

Stream: The stream flowing through the site (Deer Creek) is a small tributary of the Greenbrier River, draining a very small area of fields and forest. The stream has a well-defined natural channel that contains most of the flow in times of extra heavy rains. It is estimated that the stream's maximum rise is 10 feet above normal flow levels. The stream did not cause any problems during the '85 flood in this area, which is believed to be a 100 year flood.

Traffic: The state road, running along one side of the site, carries mainly rural, local traffic. It is not a major highway. It is estimated the traffic would not exceed an average of 20 to 25 cars per hour over a 24-hour period.

Seismic Data: Seismic data has been taken several different times on site. Very little activity was recorded or shown to be occurring. The data, and published results, can be obtained by contacting Professor Bollinger in the Geology Department, VPI, Blacksburg, Virginia. The data does cover 0 to 30 Hz.

OPERATED BY ASSOCIATED UNIVERSITIES, INC.,
UNDER CONTRACT WITH THE NATIONAL SCIENCE FOUNDATION

NATIONAL RADIO ASTRONOMY OBSERVATORY
POST OFFICE BOX 2 GREEN BANK, WEST VIRGINIA 24944-0002
TELEPHONE 304 456-2011 TWX 710 938-1530

October 17, 1988

Dr. Rochus Vogt
Department of Physics
California Institute of Technology
Pasadena, California 91109

Dear Robbie:

I enclose a map of the NRAO site in Green Bank. We also have detailed contour maps, which we would be happy to share if you find our option worthy of more serious consideration.

We discovered in a preliminary examination that two perpendicular four-kilometer arms would not fit on the reasonably flat part of our property. However, the two arms could probably be fit into the valley we occupy by purchasing or leasing some adjacent land. One arm would have to cross a highway. Our history here has shown that re-routing highways can be accomplished.

You probably noticed that I used the term "reasonably flat" in the preceding paragraph. By that I mean there might be ~100 feet difference in elevation over four kilometers. Most of the elevation difference is a general tilt (as contrasted with innumerable humps and dips).

The advantages offered by using an existing site are manifest: roads, water, power, sewer, telephone already in place; shops, technical personnel, copy machines, computers, etc. also available. And, of course, the fact that radio observatories intentionally are sited where manmade activities are minimal is probably the same criterion gravity detectors require.

Please let met know if any additional information is required. I am told, for instance, that we might have seismic data. We are extremely interested in the science that is your goal and can perhaps be of assistance in achieving it.

Sincerely yours,

George

George A. Seielstad
Assistant Director for
Green Bank Operations

GAS/ss
Enclosure

Notes
Site Visit by LIGO Team
1/17/89

Present: R. Vogt, Director
Bert Sweetser, JPL Retired, Construction
Fred Asiri, Construction (Civil Engineer)
Tony Riewe, JPL, Soils
Bill Althouse, Chief Engineer
Ernie Franzgrote, Asst to the Director

1) Vogt's story of his instructions from Bloch:
Determine whether LIGO could be constructed in GB (and at what cost).
Forget politics
Decision independent from question of radio telescope
Bloch emphasizes how WV is very low in receiving federal science funds
Vogt had obviously been sensitized by Bloch to not panic NRAO employees. Lots of closed-door conversations requested.
Warning by Vogt to avoid trading off a LIGo and a radio telescope. Two science groups shooting at each other kill each other. Each should just push for his project. (

2) Other factors that emerge from Vogt's comments:
Bloch thinks GB facility would not have lasted this long without the infrastructure.
Infrastructure has a lifetime of 20-50 years. (Bloch)
Possible that GB will get neither instrument, both, or one or the other; but decision out of Caltech's and NRAO's hands.
Funding purely out of physics at NSF; definitely not astronomy. LIGO would be a line item approved by Congress. (Is this true?)
Vogt could operate LIGO in ME, LA, WV, doesn't matter to him.
Vogt believes Bautz has plenty of influence with Bloch. As much as anyone at her level. He also does not badmouth Bloch. Thinks NSF is underfunded, and Bloch does as well as he can. He is combative, though, especially when he gets pressured.

3) I asked that assumption be made that radio astronomy stays here, hopefully with a new radio telescope. Therefore their evaluation must include effects of LIGO on radio telescope: rfi? Also, will a large moving telescope swamp gravity waves.

4) Talk by Vogt about project.
NRAO people present were: Peery, Stone, Crews, Lacasse, GAS
a) Good salesman. Makes LIGO look appealing. Offers a bit of same hyperbole about opening up a new window on the universe so that a radical revolution equivalent to radio astronomy's might result.
Ultraprecision measurements have alluring sex appeal.
b) Detector tries to measure strain = $\Delta L/L$. Can now reach 10^{-18}. At 10^{-20}, <u>think</u> they will see things (Can and have calculated this sensitivity will detect gravity waves

from coalescing binary stars out to Virgo Cluster. At 10^{-23}, if nothing is seen then general relativity is wrong. LIGO will certainly reach 10^{-20} and probably 10^{-23}.

c) Of course the theoretical estimates could be off by many orders of magnitude, though always in the "bad" sense, since experiment proves 10^{-18} strain not there already.

d) "The one who finds graivty waves will get a Nobel Prize." But then the work of astrophysics begins.

e) Project is 2 LIGOs or nothing. Common management is Bloch's central theme. Must always have one one interferometer running at each LIGO, so maintenance scheduling, etc. must be coordinated.

f) Could build one of the LIGOs in Europe, but only if it also is under Vogt.

g) Couldn't build 1 US LIGO, let rest of world build others, according to this theorem of common management.

h) Edwards AFB not definitely the west coast site. Operating as if it will be, because it costs big money to make proper soil, seismic and other determinations. But means AF must agree to something, and who knows?

5) I can't help but note that Project schedule would permit construction of a large radio telescope first. Big money (~$25M per year) for LIGO would begin in 1991. First site LIGO completed in 1994, 2nd a year later. Operations at second site scheduled for 1996. Why not build radio telescope, then this 2nd LIGO?

6) If report by end-Jan. states that GB is a suitable site, NSF will visit in early Feb., with Vogt.

1/18/89

Finally got all cards on the table. Had planned to do so privately with Vogt, but, within a group, gut issues kept arising that needed NRAO's position spelled out. So I did so. In retrospect, better that more were there--all 6 Caltech people plus Peery and Stone--because I have witnesses for what was said.

1) My point was to make clear that NRAO (as well as myself) preferred buiding a radio telescope to LIGO; that NRAO would probably have nothing to do with LIGO.
Vogt's reaction: Of course. Best way is to make strongest case you can within astronomy community (and by the way, did you know that a new radio telescope in GB was controversial in that community? Citing Oct. '88 ACAST and his impression that next major instrument was supposed to be an optical telescope. My response was, LIGO is controversial too. Yes, says Vogt, but they're separate--physics vs. astronomy.)
Conclusion: We each do our best selling job within our communities. Caltech is clear about what we want.

2) Wanted to impress Vogt that Observatory was at a crisis point: Options:
a) Neither radio telescope nor LIGO. Result = NRAO gone within a few years.

b) LIGO but no radio telescope. Result = NRAO gone within a few years. But this impacts LIGO, because the only reason for even considering GB is because of exisitng infrastructure.
At this point, we got the figure of approx. 10 people needed for LIGO. (2nd time, and witnesses present) Caltech would be handed the whole site within a few years.
Vogt's reaction: Why do you think you would be shut down? (False naivete) I told him the 140 ft was begun before a telescope that just collapsed. Self-evident. Even if NSF pretends to want to keep funding 140 ft, AUI/NRAO will decide it's not worth it.
Second reaction was, Caltech would have to bring in additional projects to maintain the infrastructure.

c) Radio telescope but no LIGO (at least not in GB). Result = NRAO active here for decades.
Vogt's reaction: How do you know? Things change. I only commented that telescopes have immense lifespans, as witness the Mt. Wilson 100 inch.

d) Both radio telescope and LIGO. NRAO/AUI here for decades. This is a very pleasant outcome.
Vogt's reaction: Caltech would be delighted if this happened. While they will press for LIGO, they won't object if a radio telescope also materializes.

3) Why was I worried about this? (Vogt)
Because i had obligations to two groups:
a) Our user community
b) The GB infrastructure, which is a uniquely valuable national resource.

4) So what was the problem? (Vogt)
Option to decline cooperating with Caltech in its LIGO evaluation of GB site was not possible.
But cooperating is cited as evidence that I don't care whether GB gets a radio telescope or a LIGO. And I do care that GB get a radio telescope.
Vogt's reaction: Caltech won't say you don't care. We understand your preference.
But I repeated that NSF would distort my actions to fit their case. I described Bloch as an asshole.
Also, we both aired that we don't like being pawns in this game, manipulated by Bloch for whatever scheme he has in mind. However, we have no choice but to go along with our mutual evaluations.

5) Vogt sees what is happening in terms of US Govt. wanting to spend money in WV.

6) Vogt brought in fact that both Sens. Mitchell and Johnston want LIGO in their states. He, Vogt, of course will never get involved in the politics. He will just decide whether a LIGO can be built at any of the sites and then let NSF decide which one.
He also recognizes NSF's ability to distort in this way: If he reports LIGO can be built in GB but its the worst option by far and would cost a lot of extra money, and if NSF wants to build LIGO in GB anyway, NSF will say Caltech prefers the GB site.

7) Vogt reported that Bloch has been fully committed to LIGo for a long time, trying to find ways to fund it.
Perhaps it follows that Vogt's opinion of Bloch is higher than mine.

8) Conversation expired, hence field studies resumed. Two L's have been identified. Both cut across private property. Should they go to County Courthouse to investigate ownership? I gave my lecture about the sensitivity of the issue, and that anything they did would fuel a gossip mill. But go if you are convinced the Ls really are feasible.

9) I feel better that an open dialog has taken place and that several know what was said.

10) LIGO is not a true user facility. Detectors will be upgraded or changed a few times/year. Will operate more in Owens Valley mode than in National Observatory mode.

11) Not worried that radio astronomy activities would affect LIGO. Confident they can shield their electronics. Cars driving by, telescopes moving = no problem.

12) Clear they will conclude LIGO could be built in GB, but also clear it is not the best (and is probably the worst) option.

13) Vogt's lunchtime revelations:
a) Caltech president who succeeded Goldberger announced before he arrived that LIGO would be the "crown jewel" of his administration.
b) LIGO is at top of list of Caltech Trustee objectives.
c) Exceedingly complicated and detailed account of Vogt's departure as Provost.
4 years of fighting with Goldberger.
Goldberger was fired by Trustees, took revenge on Vogt.
Impossible to merge back into faculty.
Faculty sold Vogt out. Didn't know what had happened. Therefore were afraid to honor Vogt because they feared the trustees would be upset, and trustees = money.
3 college presidencies almost offered, but trustees refused to give recommendations because they wanted Vogt to stay at Caltech.

14) Interesting aside: Vogt's daughter is a 1st year grad student at Cornell, trying to decide whether to work with Martha Haynes or Jim Houck.

15) Skills/Personnel needed
1 Physicist in charge
1 sophisticated programmer
1 electronics engineer
1 mechanical engineer/technician?
1 vacuum technician
1 physical plant technician, which Vogt defined to mean one who services vacuum pumps, etc.
4 operators, to run 24h/d, 7d/wk

10 total

16) Easy to work out arrangements
E.g., pay for shop work done
Differing salary scales/benefits/holidays/vacations details that reasonably intelligent people can work out. "I can tell you one thing, the guy who bitches will be the Caltech employee."

1/19/89
Parting conversation with Robbie Vogt

1) Thanks expressed. We were very helpful. I replied I don't want us to be in competition but am afraid we are. Vogt replied each of us just has to give his best case.

2) Our problem in astro community is with optical astronomers. They think it is their turn. Vogt told me to work Bautz. She is tough (i was surprised to hear this) in the NSF infighting. I said she was no help so far. He said, don't give up; sometimes she doesn't hear things the first time.

3) Vogt recognizes that the infrastructure here is a fantastic asset to LIGO. I told him it's only here if we get a new telescope. He advised not to throw a tantrum. If you get nothing this year, maybe in a few years your idea will fly. I told him all the good people will leave before that time.
Point that we are better off together has sunk in, anyway. Is in fact ridiculous to put LIGO here if NRAO not here.

4) For LIGO, Vogt's opinion is this site is difficult, but not impossible. Two things surprised him: (a) places are flatter than they looked on a map, but (b) the population density is higher than he expected. And the homes aren't shacks. People have pride in them and won't want to sell.

5) Vogt thought the argument that my helping (him+team) would be used as evidence that I didn't care which instrument GB got was silly. He didn't deny that Bloch might use it, but he thought it couldn't be decisive.

6) He promised to tell me anything he found out. Wanted us to keep in touch.

7) Vogt believes chances that NSF will move ahead on LIGO next year are somewhat less than 50-50. They just don't have their act together. They aren't organized, don't know how to work it into any budget.

8) Building LIGO in GB saves $400k/yr operations cost. Low electric rates account for saving.

9) My own immediate reactions:

I'm not sure Caltech is ready with the necessary technology yet. Putting LIGO on a super fast track catches neither NSF nor Caltech ready. Even on the optimistic Caltech schedule, and the optimistic NRAO schedule, we would be finishing the new antenna about the time serious work would start on LIGO. The combined efficiencies of personnel and facilities are pretty obvious.

10) My reaction to likely NSF visit first week in Feb.
Vogt claims the bureaucrats want a full LIGO presentation at one of its possible sites. I find the idea that we will host a meeting to discuss our main competitor is rubbing it in. It would certainly be claimed we were eager to get LIGO. This would just be one more step in a formal process justifying why NSF wanted until Feb. 23 to get its act together. LIGO would have passed another hurdle (would look good to NSBoard, etc.)
We should insist that NSF ask the question, in GB, is the site more suited for radio astronomy or for gravity wave detection? The radio telescope case be evaluated as well.

1/19/89

1) Sweetser and Riewe went to County Courthouse to get list of property owners who might be affected. (This will certainly start the rumor mill locally.)

1/20/89

Visit is over. Althouse, Franzgrote, and Asiri say goodby.

1) Thanks all around for the help. I invite them to call if they need more information.

2) I mention again it's unfortunate we are in competition. They affirm that NRAO's existence is vital to their project, would have to put that in their report.

3) Number of property owners affected = 7 on one route, about twice that on another option. This isn't bad; in Maine, it's 15.

4) GB not the best site (others are Maine and Louisiana). Might be 2nd best, but likely to be 3rd. Best in this context means easiest to lay flat, straight pipe.

5) I reauest copy of their report. They say that's up to Vogt.

LIGO

January 17, 1989

My advance questions are in normal type; answers I received are in *Italics.*

1) Effects on Radio Astronomy
   rfi? *Althouse is supposed to be an expert in this field. Vogt shrugs this one off as, of course you can always shield electronics.*
   Never did discuss rfi with Fisher as I requested.

2) Effects on GB site
   road moving? *Not necessary*
   earth excavation *Fair amount needed; quite a bit on the offsite part*
   fate of airport *No problem*
   infrastructure needed
      experimental building *Huge building (50 ft high, 100 x 200 ft floor space) at vertex; smaller buildings at end and halfway down of each arm of L.*
      offices
      lab space
      machine shop needs *Loved our shop*
      computing facilities *Heavy data analysis with very sophisticated algoriths off site. But plenty of computer control on the site, and enough data analysis to monitor instrument's performance.*
      living quarters
   limits on driving around site? *No problem. See comments below about antenna moving .*

3) Effects on County, State
   Highway 28
      reroute? *Never mentioned.*
      Bridge over vacuum pipe? *Pipe would probably run under the road.. Might be underground in several places. For example, one line runs t hrough Beaty's yard. Would have to be underground.*
   Protective legislation (a la NRQZ)?

4) Instrument
   Pipes above ground? *Yes*
   Covered? *Yes. At Edwards AFB, will build some cheap, ugly shelter over pipe, but in GB would probably want a dirt cover that would blend into environment.*
   Orientation critical? *The two LIGOs should have the same orientation. Edwards has a lot of flexibility. Note that gravitational radiation is quadrupole, so an L is sensitive to only one polarization. Another L is necessary at 45° to first, and, if signals are detected, would be constructed at one of the LIGOs.*
   Right angle necessary? *Preferable, but some deviation is permissible.*
   Effect if tilted? *No problem*
   Impact of hundreds of tons in motion on telescopes..*No problem. Everything makes the detectors move (reference to gravity gradient profiles).*
   Coinicidences eliminate a lot of noise. Also, slowly moving things generate low frequency "waves", to which instrument is not sensitive.
   West and East Coast detectors built serially? *About a 1 year delay between*

them. But definitely do not want to build only one and thoroughly shake it down before starting the secon.

Very large building is at vertex of L. Mirror buildings at 2 km and at 4 km on each arm.

5) People

Number of employees. *Approx. 10 is not disputed. Witnessed by Don Stone and Buck Peery.*
Skills
Difficulty of having side-by-side employees working for different organizations *These details can be worked out.*
How to share people *Discuss in future if relevant.*

6) Experiment

User oriented? *No. More like a university experimental facility than like a national observatory. Those who build detectors bring them, install them, and get them operating routinely. Then leave. Data monitoring on site will be enough to determine whether machine is working, but heavy analysis will require extremely sophisticated analysis on big computers. Data will be transferred over links.*
Experiments will change perhaps every three or more months.
National Laboratory? *Not in sense NRAO is, but scientists from elsewhere than Caltech and MIT will be involved.*
Lifetime of instrument, if nothing detected? *Handout claims minimum lifetime of 20 years.*

TELEFAX TO:	Dr. Paul vanden Bout
DATE:	February 13, 1989
SUBJECT:	Green Bank Site
FROM:	Laura P. Bautz National Science Foundation 202/357-9488
CONTACT PERSON:	Wanda Carroll 202-357-5079
NO. OF PAGES INCLUDING COVER PAGE:	07

Chron

LIGO CONSTRUCTION AT GREEN BANK SITE

Introduction and Summary

The NSF has requested that the LIGO Project explore the feasibility of building a 4-km LIGO installation at the National Radio Astronomy Observatory (NRAO) site near Green Bank, West Virginia. We have visited the site and identified two possible LIGO alignments. Although the Green Bank site is more difficult in terms of topographical complexity than others we have studied, we conclude that it is technically feasible to build a LIGO installation there. A physical description of the two alignments, estimated site-specific costs, and areas of concern are reviewed in the following paragraphs.

Physical Description

The two alignments described here are designated GB–1 and GB–2 (see the attached map, Figure 1, and the two vertical cross-sections, Figures 2 and 3):

GB–1:

	Latitude	Longitude	Tube Elevation
Corner	38° 26′ 12″	79° 50′ 24″	2640 ft
End of Southeast Arm	38° 25′ 03″	79° 48′ 05″	2770 ft
End of Southwest Arm	38° 24′ 33″	79° 52′ 10″	2545 ft
	Direction	**Slope of Tube**	
Southeast Arm	S 58° E	+10 milliradians	
Southwest Arm	S 39° W	−7 milliradians	

Opening Angle: 97°

Special features (See numbers in Figure 1):

1. Deer Creek
2. Highway 28
3. North Fork

Number of Private Land Owners: 14

GB–2:

	Latitude	Longitude	Tube Elevation
Corner	38° 26′ 10″	79° 50′ 18″	2670 ft
End of Northeast Arm	38° 27′ 07″	79° 47′ 51″	2670 ft
End of Southeast Arm	38° 24′ 17″	79° 48′ 58″	2670 ft
	Direction	**Slope of Tube**	
Northeast Arm	N 63° E	≈0 milliradians	
Southeast Arm	S 30° E	≈0 milliradians	

Opening Angle: 87°

Special features (See numbers in Figure 1):

4. Highway 28
5. North Fork
6. Highway 28

Number of Private Land Owners: 7

Estimate of Site-Specific Costs:

	Cost, M$	
	GB–1	GB–2
Earthwork	6.1	16.8
Accomodate special features (streams, etc.)	1.7	1.3
Clear and restore forested areas	0.2	0.3
Provide drainage	0.3	0.3
Concrete enclosure	4.1	4.5
TOTALS	12.4 M$	23.2 M$

In our previous cost planning we have budgeted approximately 5 M$ for earthwork at an average site, thus, the cost delta for GB–1 is 7.4 M$ and for GB–2 is 18.2 M$. These higher costs for Green Bank reflect not only the topographical complexity but also a major effort to reduce the visual effects on the land (by restoring farmland to a usable state, etc.) to make the plan more acceptable to the private landowners. These costs are best estimates based on our current knowledge of soil conditions; detailed geotechnical data will have to be obtained in order to refine these estimates. "Special Features," i.e. crossings of major public roads, streams, and other necessary accomodations, have been identified as a separate cost item. Because of the popularity of hunting in the area, a concrete enclosure to protect the vacuum tube from rifle bullets has been included as an additional cost for the exposed part of the tube outside the NRAO reservation. The cost of land outside the NRAO property is not included.

Comparison of the Two Alignments, GB–1 and GB–2

Significantly less earthwork is required for Alignment GB–1 than for GB–2. This can be obtained, however, only by tilting the GB–1 arms at a slope of about 10 milliradians. This slope from horizontal is an order of magnitude higher than slopes considered for other sites. Calculations indicate that this tilt would limit low-frequency interferometer performance at the highest expected sensitivities unless new suspension systems, whose feasibility has not yet been demonstrated, could be developed.

GB–2 represents a level alignment that would avoid the low-frequency reduction in performance. Its main disadvantage is increased cost. Advantages of GB–2, in addition to minimum slope, include avoidance of the largest stream (Deer Creek), an alignment within 6 degrees of the optimum for that being considered for the Edwards Air Force site, and the possibility of easier land acquisition (7 private owners compared with 14 for GB–1).

Land Ownership and Acquisition

The feasibility of building a LIGO installation at Green Bank ultimately depends on the cooperation of local land owners. Approximately half of the LIGO installation would be on NRAO property; the other half would be on property now privately owned. While we anticipate no problem with the part located on the NRAO reservation, we would have to buy or lease the remaining land from private owners. We would hope for support from state and local officials in the acquisition of this land. Approximately 100 acres could be affected. The following is a sequence of events required to obtain use of the private land:

1. Determine 2-ft contours for the land in private ownership in order to develop the layout and present the impact of LIGO construction on private property. This would require aerial stereo photography, contour plotting, and identification of land ownership on the plots. Estimated time: 16 to 20 weeks.

2. Evaluate contour data and select exact alignment. Estimated time: 4 to 8 weeks.
3. Engineer the placement of the LIGO on the private land and provide descriptive material for negotiations with the owners. Estimated time: 8 to 12 weeks.
4. Contact and negotiate with owners.

An additional complication is that we probably will not be able to make preliminary geotechnical measurements early in the sequence because this would require permission of the owners before we would be ready to discuss with them the exact alignments and impacts of construction.

Pasadena, January 31, 1989

R. E. Vogt, P.I./P.D.

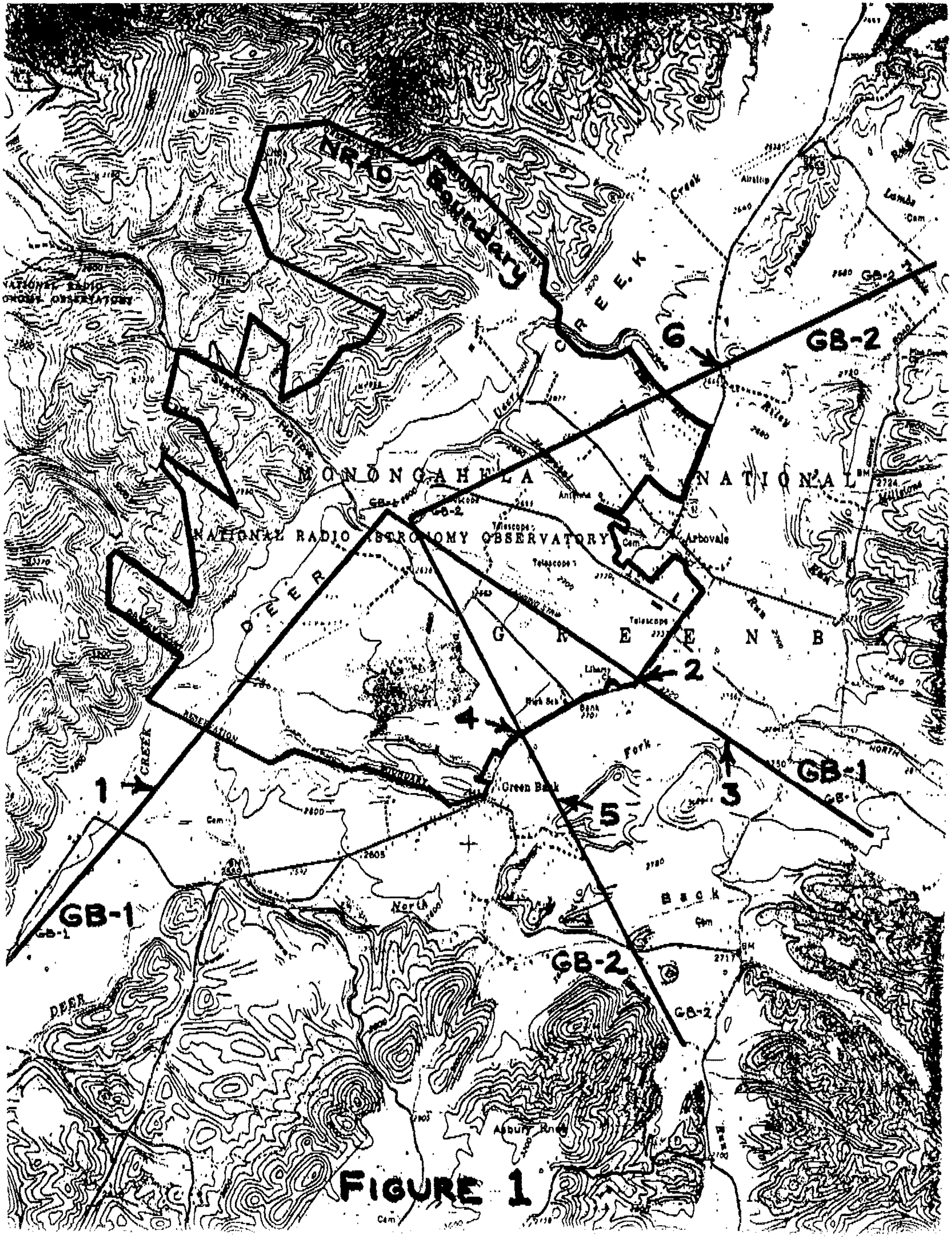
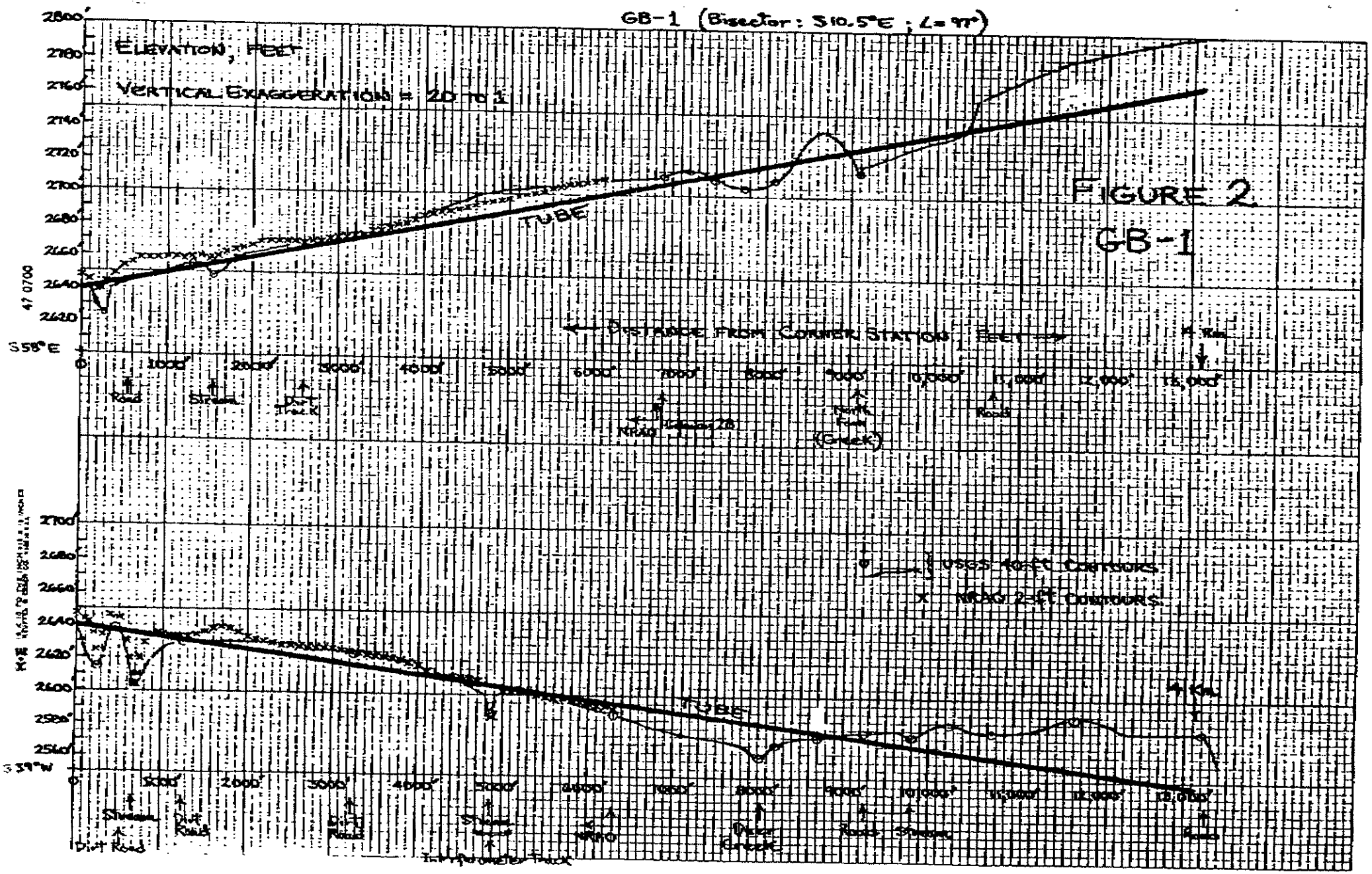
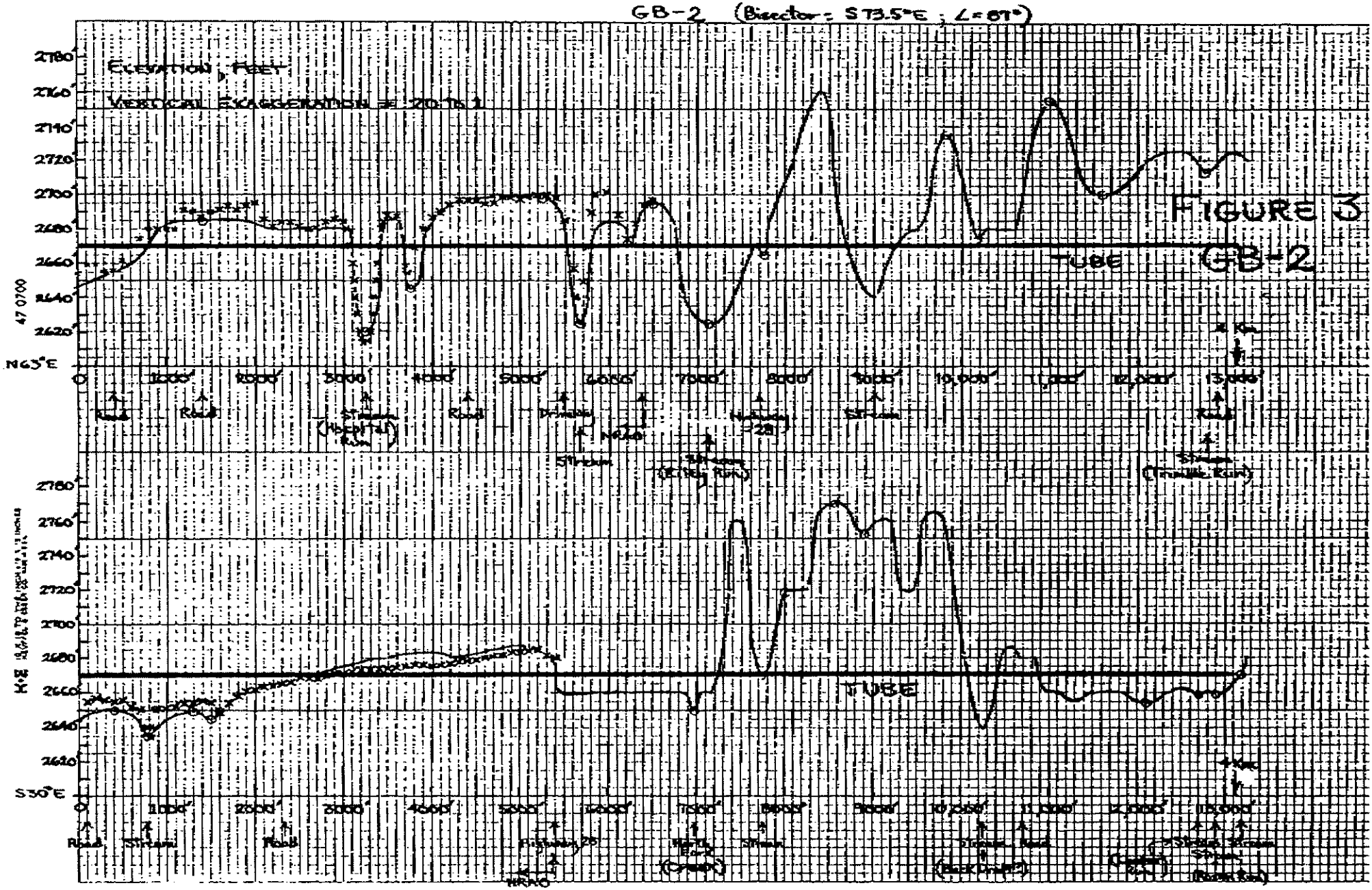

NRAO Boundary
CREEK
Creek
Airstrip
GB-2
6
MONONGAHELA NATIONAL
NATIONAL RADIO ASTRONOMY OBSERVATORY
Arbovale
Telescope
Antenna
Riley
Run
DEER
CREEK
G R E E N B
Library
2
High Sch
Bank
4
Fork
Green Bank
5
3
GB-1
NORTH
1
Cem
2605
North
Back
BM
2717
GB-2
DEER
Asbury Knob

FIGURE 1


GB-1 (Bisector: S10.5°E ; ∠= 97°)
ELEVATION, FEET
VERTICAL EXAGGERATION = 20 TO 1
FIGURE 2
GB-1
TUBE
DISTANCE FROM CORNER STATION 1, FEET
S58°E
S39°W
Road
Stream
Dirt Track
Creek
Dirt Road
Stream
Dirt Road
Interpreted Track
Dirt Creek
Road
Stream
Road
4 Km.
4 Km.
USGS 40-ft Contours
NRAO 2-ft Contours


GB-2 (Bisector: S 73.5°E ; ∠ = 61°)
ELEVATION, FEET
VERTICAL EXAGGERATION = 20 TO 1
TUBE
TUBE
FIGURE 3
GB-2
N65°E
S30°E

GBT Memo No. 27

December 7, 1989

To: George Seielstad
From: Buck Peery
Subj: Comments regarding utilities and other physical requirements for proposed sites 3, 4 & 5 for the GBT.

GENERAL: Providing utilities to the sites appears very little different between the sites, except for the question of drainage at site 4 and the advantage that site 5 would have, in that the existing electric circuit to the 300-ft. control building could become a dedicated circuit for the GBT. A list of comparative requirements and a site map is attached.

The final decision will probably be determined by the horizon requirements or RFI.

With regard to horizon, a more detailed study is under way. The visual impression is that site 3, due to its elevation and small number of trees to be cut, would be the first choice, with site 5 second choice because of the number of trees to be cut.

RFI is somewhat different: Site 4 is screened by trees, if too many are not cut, from everything except the 140-ft. However, due to the height of the telescope, it is difficult to predict how effective this screening will be. Site 3 is close and in plain view of the Works Area (2000 ft.) and the main site buildings. Again, the effect is difficult to predict. Sites 3 and 4 are about the same distance from the highway, (Site 5 is in between the Interferometer Control Building and the 140-ft. and in plain view. Site 5 is farther from the highway, with some screening.) The height of the telescope is such that it is very probable the dish and apex will be visible from most of the highway east of the site.

All three sites will have about the same exposure to the wind, as there are no high points or other barriers nearby to shield them. They are near the center of the valley between the mountains to the east and west of the site.

The philosophy of operation, which is yet to be determined, might eliminate the need for a building at the telescope. If the building is not needed, a well and septic system will not be needed. Other utilities would not be affected.

Site 3:

Access Road: Approximately 450 ft. Off paved main-site road. No major obstacles.

Drainage: Very good. Well above nearby stream. Pintle bearing room could use gravity drain.

Power: Estimated demand 525 KVA. Approximately 400 ft. to the existing East End Feeder or 3000 ft. to main substation - East End Feeder present load is approximately 225 KVA, 22 percent loaded. If the GBT were added, the circuit would be approximately 75 percent loaded. If the service is taken from the main substation, the circuit would be designed to serve just the GBT, thus a dedicated circuit. The East End Circuit serves the Works Area,

Lab Building, Residence Hall and Warehouse. The main substation (2500 KVA) is approximately 32 percent loaded. Adding the GBT will increase this to approximately 53 percent loaded.

Telephone: Approximately 700 ft. to access to the underground conduit for the existing telephone system. Circuits available at this point are unknown.

Sewerage: Very probably a septic tank and drain field will be required. The site sewage plant is 2000 ft. away, but it is doubtful it is accessible because of the terrain.

Water: Water could be taken from the site system near the Works Area gate approximately 3000 ft. away, or by drilling a well.

Soil: Alluvial overburden somewhere between 15 and 50 ft. deep over bedrock consisting of medium to soft shale. The overburden has an approximate bearing capacity of 4000 lbs. per sq. ft., and the bedrock 8000 lbs. per sq. ft. or better. A complete soils investigation and report should be made for the site chosen.

Elevation: Approximately 2700 ft. at ground level.

Air Strip: The site is approximately 2200 ft. north and east of the airstrip and out of approach zone.

Site 4:

Access Road: Approximately 500 ft. Off paved main-site road. No major obstacles.

Drainage: Questionable, due to nearby stream and areas of swamps to the east of the site drained by this stream. A sump pump will be required for the pintal bearing room.

Power: Estimated demand 525 KVA. Approximately 300 ft. to the existing Interferometer Feeder, or 2900 ft. to the main substation. The Interferometer feeder load is approximately 85 KVA, 9 percent loaded. If the GBT were added, the circuit would be approximately 61 percent loaded. If the service is taken from the main substation, the circuit would be designed to serve just the GBT, thus a dedicated circuit. The Interferometer circuit serves the Interferometer control building, 85-2 and 85-3. The main substation (2500 KVA) is approximately 32 percent loaded. Adding the GBT will increase this to approximately 53 percent loaded.

Telephones: Approximately 600 ft. to access to the underground conduit for the existing telephone system. Circuits available at this point are unknown.

Sewerage: A septic tank and drain field will be required.

Water: Drilling a well will be required.

Soil: Alluvial overburden somewhere between 15 and 50 ft. deep over bedrock consisting of medium to soft shale. The overburden has an approximate bearing capacity of 4000 lbs. per sq. ft. and bedrock 8000 lbs. per sq. ft. or better. A complete soils investigation and report should be made for the site chosen.

Elevation: Approximately 2660 ft. at ground level.

Air strip: The site is approximately 700 ft. southwest of the west approach center line, just outside the clear zone and higher than the slope path. Due to the closeness and height of Little Mountain off the west end of the runway, it is necessary to turn soon after takeoff to the west. This means a turn over or to the west of this site. A turn in the opposite direction would be over or west of the 140-ft. telescope. The 140-ft. is east of, just outside of, and higher than the clear zone slope path.

Site 5:

Access Road: Approximately 400 ft.. Off paved main-site road. No major obstacles.

Drainage: Fair. The site slopes to the west can get gravity drain out of pintle bearing room.

Power: Estimated demand 525 KVA. Approximately 500 ft. to the existing 300-ft. feeder (auxiliary power line) or 2100 ft. to the main substation. 300-ft. feeder present load approximately 50 KVA about 5 percent loaded. If the GBT were added, the circuit would be approximately 57 percent loaded. If the service is taken from the main substation, the circuit would be designed to serve just the GBT, thus a dedicated circuit. The 300-ft. circuit serves the 300-ft. control building only. It is indefinite as to future use of the building. The main substation (2500 KVA) is approximately 32 percent loaded. Adding the GBT will increase this to approximately 53 percent loaded.

Telephone: Approximately 1000 ft. to access to the underground conduit for the existing telephone system. Circuits available at this point are unknown.

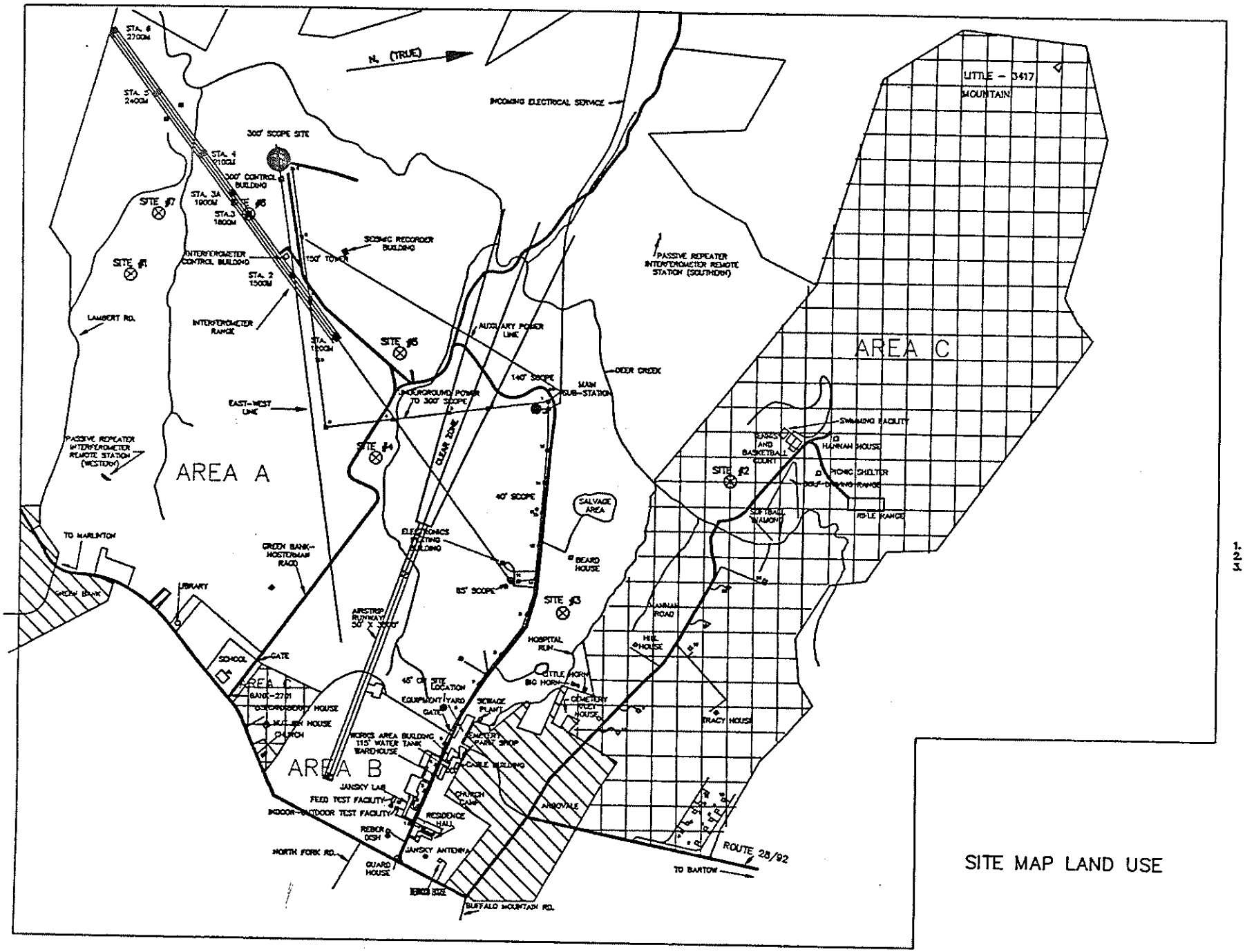
Sewerage: A septic tank and drain field will be required.

Water: Drilling a well will be required.

Soil: Alluvial overburden somewhere between 15 and 50 ft. deep over bedrock consisting of medium to soft shale. The overburden has an approximate bearing capacity of 4000 lbs. per sq. ft. and bedrock 8000 lbs. per sq. ft. or better. A complete soils investigation and report should be made for the site chosen.

Elevation: Approximately 2647 ft. at ground level.

Air Strip: The site is approximately 1000 ft. southwest of the west approach center line just outside the clear zone and higher than the slope path. Due to the closeness and height of Little Mountain off the west end of the runway it is necessary to turn soon after takeoff to the west. This means a turn over the site. A turn in the opposite direction would be over or west of the 140-ft. telescope. The 140-ft. is east of and just outside and higher than the clear zone slope path.



SITE MAP LAND USE

NATIONAL RADIO ASTRONOMY OBSERVATORY

EDGEMONT ROAD CHARLOTTESVILLE, VIRGINIA 22903-2475
TELEPHONE 804 296-0211 TWX 910 997-0174 FAX 804 296-0278

April 10, 1990

Dr. Joe Weber
Dept. of Physics and Astronomy
University of Maryland
College Park, MD 20742-4111

Dear Dr. Weber:

Thank you for your letter of April 3 expressing concern over NSF's gravitational wave program and its possible impact on funding for astronomy.

It was appropriate for me to discuss the merits of locating the Laser Interferometer Gravity-Wave Observatory (LIGO) at the NRAO Green Bank WV site in late 1988/early 1989 when I was requested to join discussions between the NSF and the U.S. Senators from West Virginia concerning the future of Green Bank, following the collapse of the 300-foot Telescope. But I do not think it is appropriate for me to offer new, unsolicited comments on the scientific merits and feasibility of a project well-removed from NRAO, despite the potential budget impact on astronomy.

A small point--Dr. Bautz chairs a Joint Working Group for Ground-Based Astronomy that identifies large projects suitable for international cooperation. The report of that group recommended four "cornerstone" projects, of which gravity-wave detectors was one. It is not my understanding that this implies that gravity-wave research is the top priority for U.S. (NSF) astronomy. Perhaps she can clarify this for you.

Sincerely,

P. A. Vanden Bout
Director

OPERATED BY ASSOCIATED UNIVERSITIES, INC.,
UNDER COOPERATIVE AGREEMENT WITH THE NATIONAL SCIENCE FOUNDATION