April 12, 1990

National Radio Astronomy Observatory Edgemont Road Charlottesville, VA 22903-2475

Attention: Mr. William Porter

GBT Business Manager

Subject: Preliminary Recommendations for the

New 100 meter diameter Radio Telescope

Green Bank, West Virginia Triad Project No. 90062

Gentlemen:

This letter presents our preliminary findings and recommendations for the planned radio telescope foundations. subsurface investigation for this project consisted of seven (7) drilled along the circumference and center of the test borings planned telescope base. The drilling was completed on April 11 and following recommendations are based on the data obtained from seven test borings as well as our past experience with similar subsurface conditions.

Subsurface materials encountered in the borings consisted alluvial overburden underlain by sedimentary rock. The upper stratum consisted of a topsoil and silty clay material to a depth of about 2 feet. The silty clay underlain by was a stratum of sandstone cobbles. The cobble stratum was found to vary thickness from about 8.5 to 13.0 feet in the seven test borings. cobble layer was underlain by a weathered shale bedrock. The weathered shale generally became more competent with depth and graded into a relatively hard shale.

understand that the planned telescope's foundations can undergo very little to no settlements due to the sensitive nature of the telescope. Ιt វន for this reason that we recommend that the telescope be founded on bedrock. The weathered shale bedrock is suitable for support of the telescope's foundations. Excavation depths of 15 feet below existing ground surface 12 to would be required to encounter this bearing stratum. Foundations in the weathered shale bedrock may be designed utilizing a allowable bearing pressure of 4,000 pounds per square foot. maximum foundations may also be founded on the hard shale bedrock which is present at depths ranging from 15 to 17 feet. We recommend that a maximum allowable bearing pressure of 15,000 pounds per square

National Radio Astronomy Observatory April 12, 1990 Page 2

foot be used for design of foundations bearing in the hard shale at the recommended depths.

Groundwater was encountered in the borings at depths ranging from 4.9 to 6.9 feet. Excavations to achieve recommended bearing levels will most likely encounter groundwater table. We recommend that groundwater interception trenches and sumps be utilized around the site to control the flow of groundwater into the foundation excavations. It is emphasized groundwater levels typically fluctuate and are generally dependent upon seasonal and climatic factors.

We hope that this information is sufficient for your current needs. Our completed report will be submitted one or two weeks following completion of the laboratory and seismic testing. If you have any questions or require any additional information, please do not hesitate to contact us.

Very truly yours,

TRIAD ENGINEERING CONSULTANTS, INC.

John E. Nottingham, E.I.T

Dennis C. Chambers, P.E.

cc: Mr. Bob Viers

Green Bank Radio Telescope

Core Sample From Boring B-6

Depth: 11.4 to 26.0 feet

1st run: 11.4 to 19.5 feet

2nd run : 19.5 to 26.0 feet

Triad Engineering Consultants, Inc Morgantown, WV 6/25/90 MEMO

To: Mr. Richard Flemming From: John Nottingham

RE: New Greenbank Telescope

have sent you the core samples from Boring B-6 as well six copies of the B-6 Boring Log. The core samples obtained from boring are generally representative of the upper bedrock strata this site. As the core box indicates, rock was cored in this from a depth of 11.4 ft. to 26.0 ft. in two core runs. boring run was from 11.4 ft. to 19.5 ft., and the second run was from first The first run of the core had a sample 26.0 ft. to 80% which indicates that approximately 1.6 feet of rock of: recovery recovered in this run. It is most likely that the 1.6 feet was not core occurred from depths 11.4 ft. to 15.0 ft. unrecovered rock where the bedrock is more weathered (softer).

Another important factor that any potential contractor should be aware of is the relatively high ground water level at this site. It is important to keep the groundwater out of the foundation excavations and doing so will require some skill and experience on the part of the contractor.

I hope the core samples meet your needs. Please do not hesitate to call if your need further assistance or have any questions.



BORING ND. B-6 SHEET 1 OF 2

BORING NO. B-6 SHEET 1 OF 2

TATION		O Radio To		PROJECT NO.: 900 ET: SURFACE ELEVATION: 101	.00
ATES:	START:	4-4-90		FINISH: 4-5-90 INSPECTOR:	
ATER I	LEVELS (I	EPTH/DAT	$E): \underline{6.9}$	9 ft./4-11-90)	
DEPTH (FT.)	SAMP. NO LENGTH TYPE	BLOW COUNTS RECOV.	STRATA DEPTH (FT.)	STRATA IDENTIFICATION	RO
	0. S-1		1.0	Topsoil	
	1.	5 4	2.0	Brown sandy clay, moist, soft	
	2. S-2 4.	21		Brown sandstone cobbles and sand, damp to wet, firm to dense	
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	S-3 6.	35 34			-
	7. S-4	22			-
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	11.		11.0	Brown and gray weathered shale, soft	
5.0	RC-1	80%	15.5		
				Gray shale, medium hard to hard	29
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BORING	ND.	B-6
HEET	2	OF 2

PROJEC:	r: NARC) Radio T	elescope		PROJECT	ND.: 90062	
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BORING	ND.	B	- 6	
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BORING NO. B-6 SHEET 1 OF 2

STATION	: NARO		OFFS	PROJECT NO.: 90 SET: SURFACE ELEVATION: 10	062 1.00
DATES: VATER L	START: 4 EVELS (DE	-4-90 PTH/DAT	E): 6.5	SET: SURFACE ELEVATION: 10 FINISH: 4-5-90 INSPECTOR: 9 ft./4-11-90)	
DEPTH (FT.)	SAMP. NO. LENGTH TYPE	BLOW COUNTS RECOV. (%)	STRATA DEPTH (FT.)	STRATA IDENTIFICATION	RQI
	0.0 S-1	3	1.0	Topsoil	
	1.5	4	2.0	Brown sandy clay, moist, soft	
	2.5 S-2 4.0	18 21 22		Brown sandstone cobbles and sand, damp to wet, firm to dense	
5.0	5.0	25	,		-
	S-3 6.5	35 34			-
	7.5 S-4	29 22 31		.	
10.0	10.0 S-5	10	11.0	·	-
	11.4		11.0	Brown and gray weathered shale, soft	
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15.0	RC-1	80%	15.5		
				Gray shale, medium hard to hard	29%
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20.0	19.5 19.5 REMARKS:	-			



BORING NO.B-6 SHEET 2 OF 2

PROJECT	: NARO	Radio T	elescope	PR	DJECT ND.: 90062	
STATION	l :		OFFS	PR SET: SURFACE FINISH: 4-5-90 6.9 ft /4-11-90	ELEVATION: 101.0	0
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GENERAL REMARKS:



BORING NO. B-6 SHEET 1 OF 2

BORING NO. B-6 SHEET 1 OF 2

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BORING	ND.	B-6
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BORING	ND.		-6	
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BORING NO. B-6 SHEET 1 OF 2

ROJECT STATION	NARO	Kadio 1	orescope OFF5	PROJECT NO.: 90 SET: SURFACE ELEVATION: 10	
DATES:	START: L	I-4-90		SET: SURFACE ELEVATION: 10 FINISH: 4-5-90 INSPECTOR: 9 ft./4-11-90)	
JATER I	EVELS (DE	PTH/DAT	E): 6.9	9 ft./4-11-90)	Marie de Marie Verre H. Marie y
DEPTH (FT.) 0.0	SAMP. NO. LENGTH TYPE	BLOW COUNTS RECOV.	STRATA DEPTH (FT.)	STRATA IDENTIFICATION	RQD
	0.0 S-1		1.0	Topsoil	
	1.5	4	2.0	Brown sandy clay, moist, soft	
	2.5 S-2 4.0	18 21 22		Brown sandstone cobbles, and sand, damp to wet, firm to dense	
5.0	5.0		,		_
	S-3 6.5	35 34			
	7.5 S-4 9.0	29 22 31		. , , , , , , , , , , , , , , , , , , ,	
10.0	10.0 S-5	17	11.0	•	_
	11.4	50/.4	,	Brown and gray weathered shale, soft	-
15.0	RC-1	808	15.5		
				Gray shale, medium hard to hard	29%
20.0	19.5				Γ



BORING NO.B-6 SHEET 2 OF 2

PROJECT	r: NARO	Radio T	elescope	PR	OJECT No.: 9006	2
STATION	V:	· · · · · · · · · · · · · · · · · · ·	OFFS	SET: SURFACE FINISH: 4-5-90	ELEVATION: 101,	00
DATES:	START: 4-	4-90		FINISH: 4-5-90	INSPECTOR:	
WATER I	LEVELS (DE	PTH/DAT	E):	6.9 ft./4-11-90		
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	SAMP. NO.	BLOW	CTDATA			1
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				Gray shale (contid.)		
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	RC-2	95%				29%
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BORING NO. B-6 SHEET 1 OF 2

BORING NO. B-6 SHEET 1 OF 2

	r: NARO			PROJECT No.: 900	
DATEC.	V: START: 4	- /I- 90	OFFE	SET: SURFACE ELEVATION: 101 FINISH: 4-5-90 INSPECTOR:	ومدد مد تصفح الرجوون، محمد مدافقة تخسط ألماء
UATER 1	LEUELS (DE	PTH/DAT	E): 6.5	FINISH: 4-5-90 INSPECTOR: 9 ft./4-11-90)	

DEPTH	SAMP. NO. LENGTH	BLOW COUNTS	1 3	CTDATA IDENTIFICATION	
(FT.) 0.0	TYPE	RECOV.	DEPTH (FT.)	STRATA IDENTIFICATION	ROD
	0.0 S-1	3	1.0	Topsoil	
	1.5	4	2.0	Brown sandy clay, moist, soft	
	2.5 S-2	18 21	-	Brown sandstone cobbles, and sand, damp to wet, firm to dense	
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5.0				,	
	5.0 S-3 6.5	25 35 34			-
	7.5	29		· · · · · · · · · · · · · · · · · · ·	
	S-4 9.0	22			
10.0	10.0	10			
	S-5	17	11.0		
	11.4	50/.4		Brown and gray weathered shale, soft	
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15.0					
	RC-1	808	15.5		
				Gray shale, medium hard to hard	29%
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	40 -				
20.0	19.5 19.5	-			
	. REMARKS:				



BORING NO.B-6 SHEET 2 OF 2

PROJECT	r: NARC	Radio T	elescope	PR	DJECT NO.: 9006	2
STATION	۷:		OFFS	PRISET: SURFACE DEFINISH: 4-5-90	ELEUATION: 101.	00
DATES:	START: 4-	4-90		FINISH: 4-5-90	INSPECTOR:	
WATER I	LEVELS (DE	PTH/DAT	E):	6.9 ft./4-11-90		دوب و در من و من شد المناطقة
		BLOW		WIE		Т
	SAMP. NO.		STRATA			
DEPTH			DEPTH	STRATA IDENTIFICATION		ROD
(FT.)	TYPE	RECOV.	(FT.)			
20.0		(%)				
				Charachala (contld)		
			;	Gray shale (cont'd.)		-
	RC-2	95%				29%
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25.0						
	20.0					
	26.0		26.0			<u> </u>
				End of Boring @ 26.0 ft		
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BORING ND. B-6 SHEET 1 OF 2

BORING NO. B-6 SHEET 1 OF 2

PROJEC:	r: NARO	Radio T	elescope	PROJECT NO.: 900	062
STATIO			OFFS	SET: SURFACE ELEVATION: 10	
DATES:	START: 4	-4-90		FINISH: 4-5-90 INSPECTOR:	
WATER I	LEVELS (DE	PTH/DAT	E): 6.5	9 ft./4-11-90j	
		BLOW			
DEPTH	SAMP. NO.	COUNTS	STRATA		
(FT.)	LENGTH TYPE	RECOV.	DEPTH (FT.)	STRATA IDENTIFICATION	ROD
0.0		ርሄን			
	0.0	2	4 0	Topsoil	
	S-1 1.5	3 4	1.0		
			2.0	Brown sandy clay, moist, soft	
	2.5	18 .		Brown sandstone cobbles and sand, damp	
	S-2	21		to wet, firm to dense	
!	4.0	22			
5.0					1
	5.0				
	S-3	35			
	6.5	34			
				•	-
	7.5 S-4	29			<u> </u>
	9.0	31			
10.0					<u> </u>
10.0	10.0	10			
	S-5	17	11.0		
	11.4	50/.4		Brown and gray weathered shale safe	
				Brown and gray weathered shale, soft	-
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					-
15.0	P.C. 1	80%	45 5		-
	RC-1	808	15.5		-
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	;			Gray shale, medium hard to hard	_ 29%_
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20.0	19.5 19.5	7			
ENERAL	REMARKS:				



BORING NO.B-6 SHEET 2 OF 2

PROJECT	:NARO	Radio T	elescope	PROJECT No.: 90062	2
STATION	:		OFFS	PROJECT NO.: 90062 SET: SURFACE ELEVATION: 101.0 FINISH: 4-5-90 INSPECTOR: 6.9 ft./4-11-90	0
DATES:	START: 4-	4-90		FINISH: 4-5-90 INSPECTOR:	
WATER L	EVELS (DE	PTH/DAT	E):	6.9 ft./4-11-90	******************
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		BLOW			
	SAMP. NO.	COUNTS	STRATA		
	LENGTH	BEGGI	DEPTH	STRATA IDENTIFICATION	ROD
CFT.)	TYPE	RECOV.	(71.)		
20.0		(%)			ļ
				Gray shale (cont'd.)	
				Gray Shale (Conf.d.)	-
	RC-2	95%			- 29왕 -
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25.0					
23.0					-
	26.0		26.0		1
				End of Boring @ 26.0 ft.	
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