CORRECTED REPORT ON SITE VISIT

REFLECTING COMMENTS OF SURINAME RECEIVED 24 JULY 2007 AND COMMENTS OF GUYANA RECEIVED 25 JULY 2007 AND PURSUANT TO PROCEDURAL ORDERS No. 7 & 8

GUYANA – SURINAME MARITIME BOUNDARY ARBITRATION

1. In compliance with the Tribunal's Procedural Orders No. 7 and 8, the following group assembled at Ogle Airstrip, Georgetown, Guyana for a flight to New Amsterdam, Guyana at 8:30 a.m. 31 May 2007:
Mr. David Gray, Tribunal's Hydrographer;
Mr. Brooks Daly, Tribunal's Registrar;
Ms. Sarah Altschuller, representing Guyana;
Mr. Galo Carrera, Guyana's technical expert;
Mr. Hans Lim A Po, Co-agent for Suriname;
Mr. Coalter Lathrop, Suriname's technical expert;
Mr. McGregor, a surveyor from Guyana;
an assistant to Mr. McGregor.
The Director General of Guyana's Ministry of Foreign Affairs, Ambassador Elizabeth Harper, met the aircraft upon landing at New Amsterdam Airstrip and arranged transportation by vehicles to the various sites visited throughout the day.

2. The group arrived at the site of the marker that Guyana alleges to be Marker "B" at 10:45 a.m. and was conducted across a field of rotting watermelon plants for a distance of 300 feet ± (100 metres ±) to two buried and one exposed concrete blocks. The buried blocks had been exposed by digging out the sandy soil either that morning or the previous day upon the request of the Tribunal's Hydrographer.

Data Gathered

3. The block more deeply buried was 16 inches by 16 inches (40 cm x 40 cm), square, had "B" and "1936" impressed into its top, a flat surface, and a 5/8 inch (16 mm) diameter brass bolt set vertically into the block at the centre of the block's top surface. The "B" and "1936" were oriented so that they were readable if one were standing south of the concrete block, and the "B" was north of the bolt and "1936" was south of the bolt. The block was buried about 36 inches (90 cm) in damp sandy soil, the soil being interlaced with roots throughout its depth particularly at the 2-foot (60 cm) depth. Roots were woody, up to ¾ inch (2 cm) in diameter and were probably from nearby trees. The vertical dimension of the block was not measured for fear of moving it. The hole was 3 ½ feet by 2 ½ feet (1.1 m x 0.8 m) and oval shaped. Ground water quickly seeped into the hole near its bottom such that almost constant bailing was required to keep the top of the block exposed.

4. The second buried concrete block's top surface was just below the ground surface. In the morning visit, only the top 13 inches (33 cm) had been exposed. The block was square in plan view, with a pyramid-like top (i.e., four sloping sides) such that the sides were 16 inches (40 cm) long and the pyramid was 2 inches (5 cm) high. Below the pyramid top, the concrete block sloped outwards. The Tribunal's Hydrographer

requested that more of the block be exposed and on re-visiting the site in the afternoon, the block was revealed to be 19 inches (48 cm) wide at a depth of 19 inches (48 cm) below the edge of the pyramid-like top. The block was oriented such that a diagonal of the block in plan view pointed towards the block described in paragraph 3. On its south-east face, the letter "B" was impressed and on its southwest face "1936". Both impressions were 14 inches (36 cm) below the edge of the pyramid-like top.

5. The third block was triangular in plan view, with faces to the east (38 inches or 96 cm), to the south (41 inches or 104 cm) and to the northwest (42 inches or 107 cm) and protruded from the ground by 8 inches (20 cm). The top had a sloping rectangular hole suitable for a 7 ½ inch by 4 ½ inch (19 cm x 11 cm) timber. There were rusty nails from the concrete into the hole from the east side of the hole and the remains of an iron bolt that had gone close to vertically downwards through the hole and had been imbedded into the concrete at both ends. The hole sloped downwards to the southeast as if the timber had been a sloping leg or a diagonal brace going upwards to the northwest. There were also corrugated steel panels beside the block and the shed nearby was roofed and partially sided by the same type of panels.

6. The following distance measurements were made by steel tape between these concrete blocks:

Deeply buried block – Pyramid-topped block	9 feet 10 ¼ inches (3.003 m)
Deeply buried block – Triangular block	107 feet 9 inches (32.8 m)
Pyramid-topped block – Triangular block	98 feet 1 inch (29.9 m)

7. The following magnetic bearings were measured by prismatic compass. The true bearings are provided by subtracting the publicly available magnetic deviation:

Pyramid topped block to Deeply buried block	025° Magnetic (009° True)
Triangular block to Deeply buried block	017° Magnetic (001° True)

8. A Magellan ProMark 3, single frequency, GPS receiver was set up on a tripod 2.053 m (6 feet, 8 $^{7}/_{8}$ inches) above the brass bolt in the deeply buried concrete block. This GPS receiver was run for 4 ½ hours and acted as the base station for the other GPS receiver so that differential corrections could be applied to the results from the second receiver.

9. GPS data observed at the base station (at the deeply buried concrete block) resulted in a World Geodetic System 1984 (WGS-84 ITRF05[1]) position of:

Latitude	=	5° 59′ 46.2059″N	(± 0.077 metres)
Longitude	=	57° 08′ 50.4824″W	(± 0.101 metres)
Ellipsoid Height	=	-24.022 metres	(± 0.180 metres)

The full analyses of the results are in the attached Annex 1.

[1] Specifically, the International Terrestrial Reference Frame – 2005 version of WGS-84.

10. The GPS data observed over a period of 49 minutes at the pyramid-topped concrete block, differentially corrected for the observations at the base station, resulted in a position of:
Latitude = 5° 59′ 46.11″N
Longitude = 57° 08′ 50.50″W

11. The GPS data observed over a period of 23 minutes at the triangular concrete block, differentially corrected for the observations at the base station, resulted in a position of:
Latitude = 5° 59′ 45.14″N
Longitude = 57° 08′ 50.52″W

12. These values were computed using the Geodetic Survey of Canada's on-line Precise Point Positioning software and are based on the GPS satellite orbital parameters as derived from actual observations taken at tracking stations world-wide. The final values for the orbital parameters became available 21 days after the day on which the observations were taken.

13. Survey data (magnetic bearings and distances) were collected to facilitate the preparation of a plan showing the area near these concrete blocks. See the plan in Annex 2.

14. Several locations were visited to facilitate the determination of the shift in latitude and the shift in longitude between the WGS-84 as given by the GPS equipment and the geodetic datums used for both the Netherlands chart 2228 and British Admiralty chart 99.

15. Beacon or "Houten Baken" on the Dutch chart:
Triangular concrete block (presumed to be the SE footing of a triangular wooden beacon whose legs were reported to be 10 metres apart in the shape of an equilateral triangle):

	5° 59′ 45.140″N	57° 08′ 50.522″W
Eccentric correction	+0.120″	+0.144″
	5° 59′ 45.260″N	57° 08′ 50.666″W
For NL 2228		
Beacon	5° 59′ 45.260″N	57° 08′ 50.666″W
Chart	5° 59′ 56″N	57° 08′ 43.5″W
Difference	-10.7″	+7.2″
For BA 99		
Beacon	5° 59′ 45.260″N	57° 08′ 50.666″W
Chart	5° 59′ 43″N	57° 08′ 51.5″W
Difference	+2.3″	-0.8″

16. Bridge at Leeds:

GPS at SW Corner	6° 02′ 42.936″N	57° 10′ 41.521″W
Eccentric correction to centreline of bridge and centreline of ditch	+0.327″	-0.026″
Corrected position	6° 02′ 43.263″N	57° 10′ 41.495″W
For NL 2228:		
Centreline of bridge & centreline of ditch	6° 02′ 43.263″N	57° 10′ 41.495″W
Chart	6° 02′ 57″N	57° 10′ 33″W
Difference	-13.7″	+8.5″

The bridge is not shown on BA chart 99.

17. Sixty Three Rest House:

A search was made for the British Astronomical Point described in Major Phipps and Admiral Kayser's 1936 report but it was not found. The probable location is now a derelict well or in-ground cistern or possibly a septic tank. Also, the probable location does not now meet the requirements of an astronomical observing point in the fact that the building obstructs much of the view of the stars along the meridian. Therefore a GPS point was observed south of the building where the sky was visible.

GPS South of Building	5° 58′ 57.333″N	57° 08′ 51.041″W
Eccentric correction to centre of building	+0.560″	+0.053″
	5° 58′ 57.893″N	57° 08′ 51.094″W
For NL 2228:		
"Politiepost 63"	5° 58′ 57.893″N	57° 08′ 51.094″W
Chart	5° 59′ 06″N	57° 08′ 36″W
Difference	-8.1″	+15.1″
For BA 99:		
"Sixty-Three"	5° 58′ 57.893″N	57° 08′ 51.094″W
Chart	5° 58′ 53″N	57° 08′ 42″W
Difference	+4.9″	+9.1″

See the discussion in paragraph 36 concerning this building.

18. Bridge over Anamormisi Creek (a secondary channel, not the main channel):

GPS at SE corner of bridge	5° 58′ 09.247″N	57° 09′ 02.165″W
Eccentric correction to centreline of bridge and centreline of ditch	+0.346″	+0.165″
Corrected position	5° 58′ 09.593″N	57° 09′ 02.330″W
For NL 2228:		
Centre of Bridge	5° 58′ 09.593″N	57° 09′ 02.330″W
Chart	5° 58′ 20″N	57° 08′ 55″W
Difference	-10.4″	+7.3″
For BA 99:		
Centre of Bridge	5° 58′ 09.593″N	57° 09′ 02.330″W
Chart	5° 58′ 07″N	57° 09′ 04.5″W
Difference	+2.6″	-2.2″

19. Bridge over Unnamed Ditch:

GPS at SE corner of Bridge	5° 54′ 46.870″N	57° 08′ 47.495″W
Eccentric correction to centreline of bridge and centreline of ditch	-0.040″	+0.117″
	5° 54′ 46.910″N	57° 08′ 47.612″W
NL 2228:		
Centre of Bridge	5° 54′ 46.910″N	57° 08′ 47.612″W
Chart	5° 55′ 00″N	57° 08′ 42″W
Difference	-13.1″	+5.6″
BA 99:		
Centre of Bridge	5° 54′ 46.910″N	57° 08′ 47.612″W
Chart	5° 54′ 46″N	57° 08′ 49″W
Difference	+0.9″	-1.4″

20. NE Corner of Skeldon Pier:

Skeldon Pier (Mr. Carrera's GPS receiver)	5° 52′ 34.8″N	57° 08′ 14.6″W
For NL 2228:		
Skeldon Pier	5° 52′ 34.8″N	57° 08′ 14.6″W
End of Pier on chart	5° 52′ 48″N	57° 08′ 10″W
Difference	-13.2″	+4.6″
For BA 99:		
Skeldon Pier	5° 52′ 34.8″N	57° 08′ 14.6″W
End of Pier on chart	5° 52′ 34″N	57° 08′ 17″W
Difference	+0.8″	-2.4″

21. The GPS receiver that was being used at these various secondary points would not function at the Skeldon Pier. Following the visit to the Skeldon Pier, I considered that more than enough GPS data had been collected and so returned to the base station to collect the GPS equipment there.

22. The GPS receiver was collected from the base station, the pyramid topped concrete block was inspected (as noted in paragraph 4) and the group went to an airstrip south of Skeldon to meet the aircraft to fly back to Georgetown. The group arrived in Georgetown at approximately 6:00 p.m. Messrs. Lim A Po and Lathrop opted to travel by road to Georgetown. As my goals for the site visit were achieved, it was not necessary to return to the site the following day.

23. To confirm that the GPS receivers were working correctly during the survey, a precisely known geodetic point in Ottawa, Geodetic Survey of Canada station "RESERVOIR" was occupied before and after the work in Guyana. RESERVOIR had been established and positioned by first-order triangulation and trilateration methods in 1965, used as a test site on numerous occasions and positioned by long-duration GPS occupation with high accuracy, dual frequency receivers. Its WGS-84 (ITRF) coordinates are:

Latitude	45° 22′ 20.7114″N (± 0.005 metres)
Longitude	75° 44′ 35.7294″W (± 0.004 metres)
Ellipsoid Height	80.008 metres (± 0.036 metres)

24. On May 26, 2007, GSC RESERVOIR was occupied by one receiver for over an hour and the following WGS-84 (ITRF) position was obtained:

Latitude (WGS-84 (ITRF)): 45° 22′ 20.7117″N (± 0.272 metres)
Longitude (WGS-84 (ITRF)): 75° 44′ 35.7213″W (± 0.182 metres)
Ellipsoidal Height (WGS-84 (ITRF)): 78.677 metres (± 0.433 metres)
This position is 0.9 cm in latitude, and 17.6 cm in longitude away from the accepted value for the station.
The other receiver was set up 1.100 metres away and its GPS position was:
Latitude (WGS-84 (ITRF)): 45° 22′ 20.6756″N (± 0.286 metres)
Longitude (WGS-84 (ITRF)): 75° 44′ 35.7055″W (± 0.195 metres)
Ellipsoidal Height (WGS-84 (ITRF)): 78.666 metres (± 0.459 metres)
The computed distance between the coordinate values is 1.166 metres (versus 1.100 metres as measured).

25. On June 3, 2007, GSC RESERVOIR was occupied by one receiver for over an hour and the following position was obtained:

Latitude (WGS-84 (ITRF)): 45° 22′ 20.7170″N (± 0.208 metres)
Longitude (WGS-84 (ITRF)): 75° 44′ 35.7208″W (± 0.148 metres)
Ellipsoidal Height (WGS-84 (ITRF)): 79.382 metres (± 0.413 metres)
This position is 17.3 cm in latitude and 18.7 cm in longitude away from the accepted value for the station.
The other receiver was set up 0.995 metres away and its GPS position was:
Latitude (WGS-84 (ITRF)): 45° 22′ 20.6878″N (± 0.212 metres)
Longitude (WGS-84 (ITRF)): 75° 44′ 35.6999″W (± 0.151 metres)
Ellipsoidal Height (WHS-84 (ITRF)): 79.262 metres (± 0.422 metres)
The computed distance between the coordinate values is 1.009 metres (versus 0.995 metres as measured).
That second receiver was also set up on top of GSC RESERVOIR for about a half hour and the following position was obtained:
Latitude (WGS-84 (ITRF)): 45° 22′ 20.7124″N (± 0.315 metres)
Longitude (WGS-84 (ITRF)): 75° 44′ 35.7233″W(± 0.230 metres)
Ellipsoidal Height (WGS-84 (ITRF)): 80.003 metres (± 0.699 metres)
This position is 3.1 cm in latitude and 13.2 cm in longitude away from the accepted value for the station.

Analysis of Data

26. In order to verify whether the buried concrete blocks are the ones described in Major Phipps and Admiral Kayser's boundary report of 1936 [Guyana Memorial Annex 11], it is necessary to compare the evidence gathered with the information in their report. The triangular block can be compared to the information about the beacon in the letter from Admiral Edgell, British Admiralty, to the Colonial Secretary in Georgetown [Guyana Memorial Annex 15].

27. The deeply buried concrete block is compared to Marker "B" as described by Phipps and Kayser:

Element	Site Visit Data	Phipps & Kayser
Size	40 cm x 40 cm	40 cm x 40 cm
Depth of block	not measured	40 cm
Shape of block	Cube, although depth unknown	cube
Lettering on Top	"B" and "1936"	"B" and "1936"
Brass Bolt	At centre	At centre
Size of bolt	5/8 inch diameter	not stated
Depth buried	90 cm	10 cm
Apparent increase in depth of soil	80 cm	

28. The pyramid topped concrete block is compared to Pillar "B" as described by Phipps and Kayser:

Element	Site Visit Data	Phipps & Kayser
Size of top	40 cm x 40 cm	40 cm x 40 cm
Shape of top	Pyramid	Pyramid
Height of pyramid	5 cm	5 cm
Size at 60 cm below top edge	50.27 cm (calculated assuming constant slope)	50 cm
Engraved on SE face	"B"	"B"
Engraved on SW face	"1936"	"1936"
Distance from engravings to top edge	36 cm	less than 60 cm
Distance from ground to extreme top	just buried	65 cm
Apparent increase in depth of soil	65 cm	
Orientation with respect to Marker "B"	Diagonal points to block	Diagonal points to Marker B
Distance to Marker	3.003 metres (taped) 2.997 metres (GPS)	3 metres
Direction to Marker	25° Mag (9° True) 10° 17′ (GPS)	10°

29. The triangular concrete block is compared to what is known about the Wooden Beacon ("Houten Baken"):

Element	Site Visit Data	Phipps & Kayser
Material for beacon	Wood	Wood
Distance from Marker "B" to SE footing	32.8 metres (taped) 32.762 m (GPS)	33.265 m (calc'd.)
Direction from Marker "B" to SE footing	197° Mag (1° True) 182° 09′ (GPS)	181° 21′ (calc'd.)

30. Major Phipps and Admiral Kayser's 1936 report gives the astronomic position of Marker "A", from which one can compute the astronomic position of Marker "B" as:
Latitude 5° 59′ 46.747″N
Longitude 57° 08′ 54.542″W
That astronomic position can be converted into a WGS-84 position by applying the deflection of the vertical corrections in latitude and longitude. The program used is publicly available from the Geodetic Survey of Canada and is accurate to ±5 seconds, according to tests against Canadian sites where both observed astronomic and geodetic coordinates are known. The resulting WGS-84 position is:
Latitude 5° 59′ 43.45″N
Longitude 57° 08′ 55.36″W
The observed GPS position (as in paragraph 9) is:
Latitude = 5° 59′ 46.2059″N (± 0.077 metres)
Longitude = 57° 08′ 50.4824″W (± 0.101 metres)

31. Sarah Altschuller's affidavit of 13 February, 2007 provides the GPS position of the deeply buried block of:
Latitude = 5° 59′ 57.9″N
Longitude = 57° 08′ 45.7″W
and of the pyramid topped block of:
Latitude = 5° 59′ 57.8″N
Longitude = 57° 08′ 45.8″W

32. Mean datum shift for British Admiralty Chart 99:

Beacon	+2.3″	-0.8″
Rest House 63	+4.9″	+9.1″
Bridge over Anamormisi Creek	+2.6″	-2.2″
Bridge over unnamed ditch	+0.9″	-1.4″
Skeldon Pier	+0.8″	-2.4″
Mean	+2.30″	+0.46″
Standard Deviation	± 1.66″	± 4.87″

33. Mean datum shift for Netherlands chart 2228:

Beacon	-10.7″	+7.2″
Bridge at Leeds	-13.7″	+8.5″
Rest House 63	-8.1″	+15.1″
Bridge over Anamormisi Creek	-10.4″	+7.3″
Bridge over unnamed ditch	-13.1″	+5.6″
Skeldon Pier	-13.2″	+4.6″
Mean	-11.53″	+8.05″
Standard Deviation	± 2.18″	± 3.70″

34. The data for Rest House 63 in both cases are too much at a variance with respect to the others. I therefore consider that the data for Rest House 63 need to be rejected, which leads to the following mean datum shifts:

For BA 99	Mean	+1.65″	-1.70″
	Standard Deviation	± 0.93″	± 0.74″
For NL 2228	Mean	-12.22″	+6.64″
	Standard Deviation	± 1.54″	± 1.57″

35. On 29 January 2007, Mr. Lathrop provided the Tribunal's hydrographer with the datum shift information for the Netherlands chart 2228, and others, as requested by the Tribunal's hydrographer on 9 December 2006 at the preliminary meeting of hydrographers. The information from Mr. Lathrop was given as shifts in the X, Y, Z Cartesian coordinates, rotations about the three axes, and a scale change;[2] these values convert to a change in latitude and longitude coordinates of -11.58″ in latitude and +6.64″ in longitude (same algebraic sense as in Paragraph 34).

36. Assuming that the GPS receiver was working correctly while at the point near Rest House 63, it appears that the wrong building was visited. Given the mean datum shifts in paragraph 34, the building that should have been visited was some 900 feet (275 metres) farther east and 350 feet (100 metres) farther south. Thus the building would have been on the south side of the road, and not the north side. The astronomical station would have been on the road side of the building and not behind the building. Therefore, I consider it wrong to conclude that the astronomical station is lost, because the search apparently was being made in the wrong location.

Conclusions

37. The Tribunal's hydrographer is of the opinion that there is no evidence that Marker "B" or Pillar "B" has been disturbed or moved since being constructed in 1936. There is evidence that there has been the accretion of wind blown sandy soil since their construction.

38. The British Astronomical station near Rest House 63, referred to in Major Phipps and Admiral Kayser's 1936 report, was not found because the wrong area was searched.

39. The Tribunal's hydrographer is of the opinion that his GPS receivers were working correctly during the visit to Guyana because they produced valid results both before and after the work in Guyana at a known point in Canada during the same time of day, and hence many of the same GPS satellites, as were being used in Guyana.

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[2] Information provided by Mr. Lathrop for chart NL 2228 was: ΔX = -295. m., ΔY = 173 m., ΔZ = -371 m., rotation about the three axes was zero, and the scale change was 1.0000000 (i.e., no change in scale). The ellipsoid used in the 1956 Provisional South American [geodetic] Datum was presumed because these shifts in Cartesian coordinates are close to the values listed in the International Hydrographic Organization's *Handbook on Geodetic Datums* for Guyana and Suriname when using the 1956 PSAD.

40. The 1936 astronomic position supports the observed GPS position within the limits of the observing accuracy of an astronomic position and of the calculation of the deflection of the vertical.

41. The Tribunal's hydrographer has no explanation for the discrepancy between the GPS positions observed by Sarah Altschuller and those observed on this site visit.

42. The GPS survey of Marker "B" provides a WGS-84 of:
Latitude = 5° 59′ 46.2059″N (± 0.077 metres)
Longitude = 57° 08′ 50.4824″W (± 0.101 metres)
Given the indicated accuracy of the results, it would be appropriate to round off the results to:
Latitude = 5° 59′ 46.21″N
Longitude = 57° 08′ 50.48″W

43. Messrs. Lathrop and Carrera were aware of the instantaneous GPS positions being computed by my GPS equipment at Marker "B" and it is my understanding that Mr. Carrera and Mr. Lathrop were getting GPS readings similar to mine at the site.

44. The horizontal datum shift for the British Admiralty chart 99 to bring charted coordinates into WGS-84 means that one must add 1.6 seconds to charted latitudes and subtract 1.7 seconds from charted longitudes (West being positive).

45. The horizontal datum shift for the Netherlands chart 2228, as computed from these surveys, to bring charted coordinates into WGS-84 means that one must subtract 12.2 seconds from charted latitudes and add 6.6 seconds to charted longitudes (West being positive).

46. Since my survey data supports the datum shift for Netherlands chart 2228 as provided by Mr. Lathrop, those datum shift mathematical constants and methodology would be appropriate to use if there were to be a requirement to know the WGS-84 position of features derived from this chart.

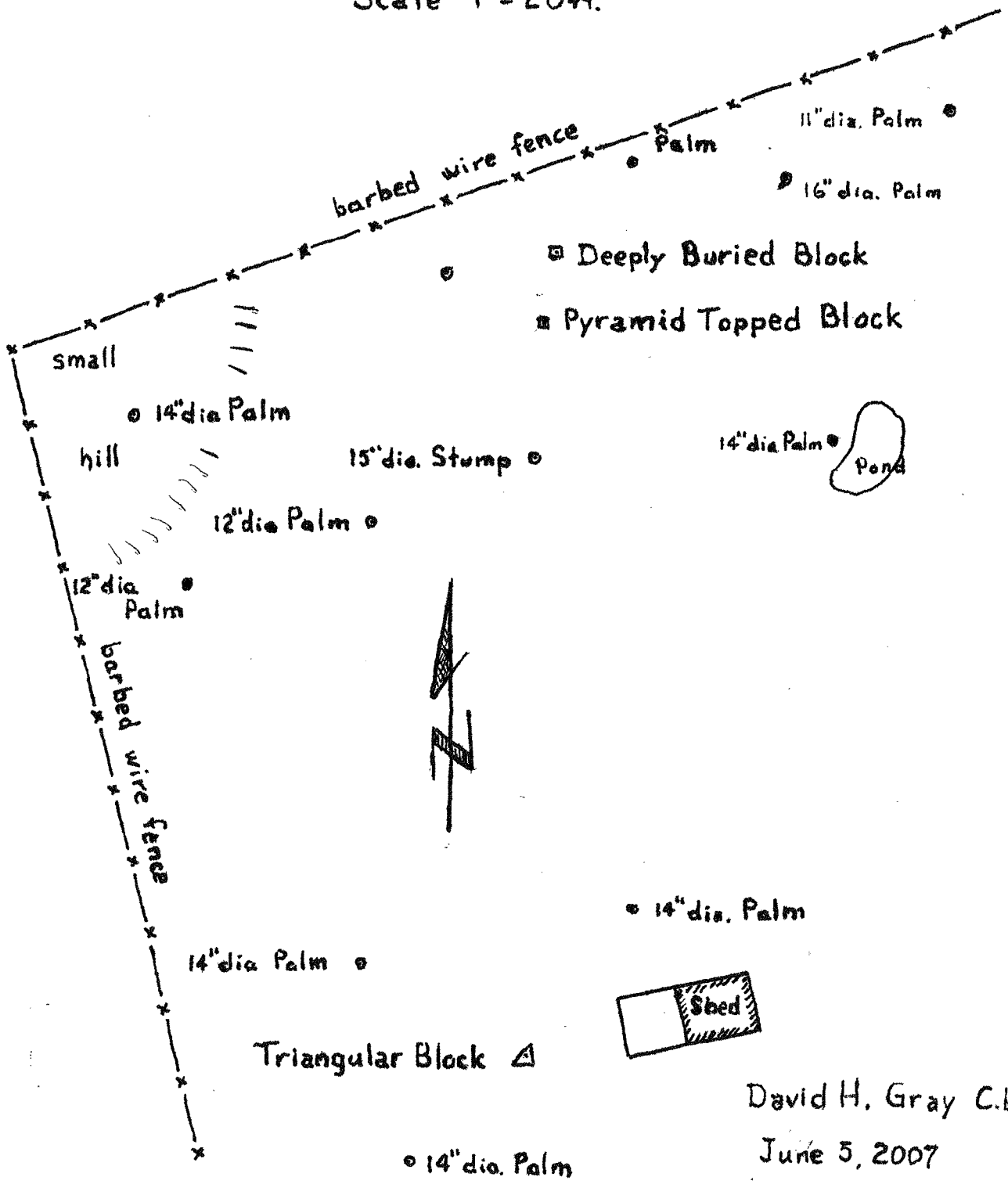
David H. Gray, M.A.Sc., P.Eng., CLS
30 July 2007

Plan Showing

Procedural Order 7 & 8 Site

Guyana - Suriname Arbitration

Scale 1" = 20ft.



David H. Gray C.L.S.

June 5, 2007