



# MEASUREMENT NEWS

July

1988

Issue #30



WOMEN'S OLYMPIC TRIALS MARATHON MEASURING TEAM

This month's cover picture appeared on the cover of *Running Journal*, June 1988. Team members (front row, left to right): Sally Nicoll, team leader; Wayne Nicoll, advisor; Carol Langenbach of Seattle, WA; Betsy Hughes of Orlando, FL; Amy Morss of Syracuse, NY; and Susan Baskin of Greenville, SC. (Photo by Jay Walters)

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5005 METERS OR 5 KM?

Some certificates have been coming in with "includes 1.001 SCPF" in tiny letters under the race distance, which is then entered as 5005 meters for a 5k. This causes confusion. It is true that we ask people to lay down that extra 5 meters, but because of uncertainty we can certify only that the course is a 5 km (or 5000 m if you prefer) course. If you've been putting distances down like this, please stop, since you're in a tiny minority and our certs ought to be reasonably uniform. Just enter the nominal distance as it's certified to be. Remember that you're not certifying the course to be 5005 meters, but 5000 meters.

NEW APPOINTMENTS

Felix Cichocki is now NM certifier as well as AZ. In addition, he has been appointed Final Signatory. Congratulations, Felix.

David Poppers has been appointed Colorado certifier. Welcome aboard, David!

Kevin Lucas has moved from Texas to New York, and is now the New York certifier. New York has been an administrative problem for years, and with Kevin bringing in his big-state experience we look forward to improved certification procedures in the Empire state.



3354 Kirkham Road · Columbus, Ohio 43221

Joan Riegel

May 9, 1988

Hello -- I'm your new course registrar. I look forward to keeping the course list current and making order out of ancient certificates.

Over the years, I've had the pleasure of meeting many of you at various meetings and seminars. By way of introduction: I've taught needlework for the past 20 years; written a textbook on quilting for the Embroiderers' Guild; had my own TV show in 1973; and wrote radio commercials as a first job.

I don't run -- but most mornings I walk with a friend along a scenic river path. We walk approximately 5 miles. Don't wear a watch -- but I'm pretty sure that some days we walk somewhat faster than others.

Your courses are in good hands!

Let me know how I may help you.

Regards --

The Rundown  
By Wayne B. Nicoli  
Technical Correspondent  
3535 Gleneagles Drive  
Augusta, GA 30907

FROM  
RUNNING JOURNAL  
JUNE 1988

Starting this column on a very positive note , many of you will be happy to hear that Sally Nicoli passed her post - chemotherapy evaluation with flying colors and we are now back in our home in GA trying to re-establish some semblance of a normal routine.

As I predicted, late April turned out to be very exciting for both of these road running technical buffs. I went to Jersey City the week before the Men's Olympic Trials Marathon and worked on a measurement verification of the NJ Waterfront Marathon course. Brian Smith, the SC certifier, and Mike Wickiser, the newly appointed reviewer for Indiana, both volunteered to assist with the work. Rounding out the team was Dan Brannen, the measurer of record and NJ certifier.

Those of you who watched the Men's Trials will recall the extensive amount of grassed area in Liberty State Park, the site of the start and finish. Much of that area had to be steel taped because the surface was so soft that bikes would not roll smoothly over it. Dan said that on race day morning the unpaved portion was rolled with a mechanical paving roller. The surface soil appeared to be mostly cinders and Dan explained that we were working on the site of the rail yards where the trains assembled to take the immigrants from Ellis Island to begin their new lives in America. As we stood on that cold, wind blown plain one could not help but ponder its' historical significance. From the plain you have a superb panorama of the Manhattan skyline and I was struck by the contrast of the openness-no one within 400 meters of us as we worked- and yet millions of people were living and working within that huge concrete and steel city across the Hudson. I also felt a little tug of envy for my friends who were present at the Ekiden Relay being run at that very moment in Manhattan.

The night measurement went smoothly, despite the fact we were working without police escort in a fairly harsh and unfamiliar environment for three country boys. The course passed through seven separate police jurisdictions, making any arrangements for police support of our night measurement impractical. That particular part of NJ is not very attractive, consisting largely of dreary commercial areas, low and middle income neighborhoods that have that same run down appearance as much of New York City. The weather did not help my attitude, as it remained cloudy, cold and windy throughout our measurement. Since the first 10K of the course was also the last 10K, with the exception of the different paths in the park, we only had to measure that 10K section once, reducing our night ride to 20 miles. The results were as we predicted - it turned out to be accurate and fair in length.

It was a valuable experience since I had never met Brian Smith, whom I have worked with for several years on course certification

matters. Brian has a special charm with his South African accent and varied life experience. I was surprised to learn that Brian and Basil Honikman, also a certifier and the national record keeper, are both South African by birth, about the same age, have a strong interest in computer applications in road racing, and yet they have never met!

And then it was on to Pittsburgh with the TAC/USA Women's Measurement Team. This was a special project that was planned over a two year period. Pete Riegel, the chairman of the Road Running Technical Committee (RRTC), appointed Sally Nicoll as the organizer and team leader. She was a good choice because she is well organized (in contrast to her husband) communicative, and possesses a thorough knowledge of urban measurement demands and big time racing politics. Sally was nice enough to appoint me as her team technical advisor, a role I willingly accepted and thoroughly enjoyed. A lot of obstacles were met and overcome, including Sally's personal battle with cancer, and it was only three weeks before the scheduled measurement date that we knew we had the resources and support in Pittsburgh to pull it off.

We arrived in Pittsburgh on Thursday of the weekend before the Women's Trials. It is always good to conduct a measurement close to the event because the race staff and volunteers are hyped up and anxious to get on with the preparations. The weather report did not look favorable for Saturday, the original planned date to measure, so we moved the measurement up to Friday night, putting considerable pressure on all concerned. During Friday we located two sites and laid 1000 foot calibration courses at the start and finish. While preparing to lay one of the courses at the Zoo parking lot near the start, we were approached by a policewoman who told us that if we planned to steel tape where we were we could be killed. Needless to say, that got our attention. Seems we were in the middle of a police pursuit training course where the students were on lunch break. We moved over to a parallel street overlooking the parking lot and we taped our course amidst the roar of engines, screaming tires and wailing sirens.

The original concept for the project called for a measurement verification of the marathon course, just as was done in NJ. However, we learned that there was a request from the Women's Long Distance Running Committee that the 5 kilometer splits be marked on the course. This changed the team's mission from the relatively simple job of verifying a measurement to one of completely re-measuring the course. This meant a total of 37 marks needed to be determined, marked and recorded.

We assembled at midnight, and ran final checks on our equipment and supplies. We calibrated on the calibration course laid near the race hotel, stopped at the hotel to calculate the 35 split locations, and rode the bikes downtown for a 2 AM start from the finish line at Point State Park in downtown Pittsburgh.

Although we were professionally escorted by two police patrol cars and assisted by several volunteers, the need to collect data from four bikes at 35 points required us to move along the course slowly. We

continued around the course until 7 AM when we conferred with 5 miles to go. All were in favor of continuing and a tired but happy band of measurers pulled up at the new start line at 8:15 AM. We re-calibrated on the calibration course near the Zoo and retired to a great breakfast hosted by the marathon committee. We slept through the middle of the day, and in early evening gathered to review the data and assess our efforts. The women riders, despite the fatigue of a long air flight and the tension of being the first all woman group in the history of the sport to participate in a team measurement of a high profile event, came through like champions. All four riders were in solid agreement in their results and Pete Riegel has stated, after feeding the data into his computer, that it is one of the best sets of results he has ever seen from a measurement team!

The points were located but they still had to be conspicuously marked so the city marking team could lay down the official painted marks on the pavement. We assembled on Sunday morning at 5 AM and drove over the course from start to finish, marking the splits with a PK nail, plastic tape, and spray paint, and recording their exact locations. We finished up at 10 AM, just in time to assist the first of the team members with their departure. Those of us left gathered to watch the Men's Trials race and endure a few comments from me on how tough the NJ measurement was. You would think this would have been a subdued crew by this time but I have rarely seen such genuine enthusiasm and joy expressed by runners over a technical project. They had accepted an intellectually and physically demanding challenge and all of them had proven themselves. And they knew that in one week many of their friends would go for an Olympic berth on, as they put it, their course!

It is hard to put in words why we were left so exhilarated from this experience. I guess I would have to say it was the people. Sally did a great job of selecting the team - Amy Morss of Storrs,CT; Betsy Hughes of Orlando; Susan Baskin of Greenville,SC; and Carole Langenbach of Seattle WA. All of the women were selected for their contributions as grass roots workers in the sport and their knowledge of the technical side of road racing. It was not until we gathered that we learned that Carole had served on the organizing committee of the first Women's Olympic Trials held in 1984 in Olympia,WA. Everyone in Pittsburgh who had any role in the event treated us with kindness and respect. Jay Walters of the Marathon Committee, served as our host and provided us with many of the same items given to the marathon participants. The escorting police officers were volunteers who run, and more importantly, had experience in escorting measuring bikes at night. The bike shop owner, whose shop was at the 11 mile mark of the marathon, loaned brand new bikes and personally fitted them for each rider. A news reporter photographed our work and had a picture in the morning paper, and a TV crew filmed the bicycle preparations for the evening news. Len Duncan, the city marathon liaison officer, and Bill Phelps, the president of Three Rivers Association of TAC/USA, volunteered to spend the night on the road assisting us. And most of all, it was the people of Pittsburgh, who have created one of the friendliest, safest, cleanest, and most architecturally beautiful cities in America. The sport did well in its selection of Pittsburgh to host the Women's Trials.

US WOMEN'S OLYMPIC TRIALS MARATHON MEASUREMENT  
 PITTSBURGH - 23 APRIL 1988  
 MEASURERS: AMY MORSS, BETSY HUGHES, SUSAN BASKIN, CAROLE LANGENBACH  
 ADMINISTRATION: SALLY NICOLL, WAYNE NICOLL

PRECAL READINGS				PRECAL COUNTS			
AMY	BETSY	SUSAN	CAROLE	AMY	BETSY	SUSAN	CAROLE
43200	19000	40000	7225				
46131	22084	42947	10161	2931	3084	2947	2936
49064	25173	45898	13095	2933	3089	2951	2934
51995	28258	48846	16031	2931	3085	2948	2936
54928	31348	51796	18964	2933	3090	2950	2933

POSTCAL READINGS				POSTCAL COUNTS			
90600	89000	88000	53965				
93531	92084	90948	56900	2931	3084	2948	2935
96462	95168	93896	59837	2931	3084	2948	2937
99392	98254	96845	62773	2930	3086	2949	2936
02323	101338	99792	65708	2931	3084	2947	2935

COUNTS PER KILOMETER BY VARIOUS CALIBRATIONS

	AMY	BETSY	SUSAN	CAROLE
HI	9622.703	10137.79	9678.477	9635.826
PRE	9619.422	10127.95	9675.196	9628.444
AVG	9617.372	10123.85	9673.556	9630.085
POST	9615.321	10119.75	9671.916	9631.725
LO	9612.860	10118.11	9668.635	9622.703

OFFICIAL TAC LAYOUT CONSTANT

AMY	BETSY	SUSAN	CAROLE	
9619.422	10127.95	9675.196	9631.725	WITHOUT 1.001 SCPF
9629.041	10138.08	9684.872	9641.357	WITH 1.001 SCPF

COUNTS OBTAINED ON COURSE

ELAPSED COUNTS OVER INTERVALS

	AMY	BETSY	SUSAN	CAROLE	AMY	BETSY	SUSAN	CAROLE
FINISH	78000	54300	73000	40522				
26 M	81390	57869	76410	43931	3390	3569	3410	3409
25 M	96887	74180	91999	59452	15497	16311	15589	15521
40 K	99137	76552	94265	61706	2250	2372	2266	2254
24 M	112384	90499	107587	74973	13247	13947	13322	13267
23 M	127881	106812	123172	90501	15497	16313	15585	15528
22 M	143378	123126	138756	106024	15497	16314	15584	15523
35 K	147283	127239	142686	109931	3905	4113	3930	3907
21 M	158875	139441	154347	121542	11592	12202	11661	11611
20 M	174372	155752	169928	137063	15497	16311	15581	15521
19 M	189869	172065	185522	152584	15497	16313	15594	15521
30 K	195430	177918	191120	158155	5561	5853	5598	5571
18 M	205366	188378	201115	168113	9936	10460	9995	9958
17 M	220863	204690	216699	183639	15497	16312	15584	15526
16 M	236360	221009	232296	199158	15497	16319	15597	15519
25 K	243577	228612	239565	206393	7217	7603	7269	7235
15 M	251857	237334	247900	214686	8280	8722	8335	8293
14 M	267354	253650	263498	230208	15497	16316	15598	15522
HMAR	281156	268177	277384	244031	13802	14527	13886	13823
13 M	282851	269964	279093	245730	1695	1787	1709	1699
20 K	291724	279307	288022	254617	8873	9343	8929	8887
12 M	298348	286283	294688	261236	6624	6976	6666	6619
11 M	313845	302587	310273	276745	15497	16304	15585	15509
10 M	329342	318900	325862	292265	15497	16313	15589	15520
15 K	339871	329985	336457	302809	10529	11085	10595	10544
9 M	344839	335215	341457	307787	4968	5230	5000	4978
8 M	360336	351533	357049	323306	15497	16318	15592	15519
7 M	375833	367847	372641	338827	15497	16314	15592	15521
10 K	388018	380665	384893	351029	12185	12818	12252	12202
6 M	391330	384151	388231	354353	3312	3486	3338	3324
5 M	406827	400463	403824	369878	15497	16312	15593	15525
4 M	422324	416775	419425	385411	15497	16312	15601	15533
5 K	436165	431348	433352	399284	13841	14573	13927	13873
3 M	437821	433096	435029	400951	1656	1748	1677	1667
2 M	453318	449407	450619	416480	15497	16311	15590	15529
1 M	468815	465721	466210	432005	15497	16314	15591	15525
START	484312	482040	481803	447535	15497	16319	15593	15530

TOTAL COUNTS ON COURSE

406312 427740 408803 407013

OFFICIAL TAC METERS

42196.51 42191.41 42210.46 42215.32

NEEDED TO ADD 3.582088 METERS  
11.75225 FEET

DID ADD 16.67 FEET  
5.064346 METERS

ELAPSED METERS OVER INTERVALS USING AVERAGE CONSTANT

	AMY	BETSY	SUSAN	CAROLE
FINISH				
26 M	352.5	352.5	352.5	354.0
25 M	1611.4	1611.1	1611.5	1611.7
40 K	234.0	234.3	234.2	234.1
24 M	1377.4	1377.6	1377.2	1377.7
23 M	1611.4	1611.3	1611.1	1612.4
22 M	1611.4	1611.4	1611.0	1611.9
35 K	406.0	406.3	406.3	405.7
21 M	1205.3	1205.3	1205.5	1205.7
20 M	1611.4	1611.1	1610.7	1611.7
19 M	1611.4	1611.3	1612.0	1611.7
30 K	578.2	578.1	578.7	578.5
18 M	1033.1	1033.2	1033.2	1034.1
17 M	1611.4	1611.2	1611.0	1612.2
16 M	1611.4	1611.9	1612.3	1611.5
25 K	750.4	751.0	751.4	751.3
15 M	860.9	861.5	861.6	861.2
14 M	1611.4	1611.6	1612.4	1611.8
HMAR	1435.1	1434.9	1435.5	1435.4
13 M	176.2	176.5	176.7	176.4
20 K	922.6	922.9	923.0	922.8
12 M	688.8	689.1	689.1	687.3
11 M	1611.4	1610.5	1611.1	1610.5
10 M	1611.4	1611.3	1611.5	1611.6
15 K	1094.8	1094.9	1095.3	1094.9
9 M	516.6	516.6	516.9	516.9
8 M	1611.4	1611.8	1611.8	1611.5
7 M	1611.4	1611.4	1611.8	1611.7
10 K	1267.0	1266.1	1266.5	1267.1
6 M	344.4	344.3	345.1	345.2
5 M	1611.4	1611.2	1611.9	1612.1
4 M	1611.4	1611.2	1612.7	1613.0
5 K	1439.2	1439.5	1439.7	1440.6
3 M	172.2	172.7	173.4	173.1
2 M	1611.4	1611.1	1611.6	1612.6
1 M	1611.4	1611.4	1611.7	1612.1
START	1611.4	1611.9	1611.9	1612.7

HAS ANYBODY  
SEEN MORE  
CONSISTENT  
DATA?



COURSE LENGTH USING VARIOUS CONSTANTS AFTER ADDITION OF 5.1 METERS

	AMY	BETSY	SUSAN	CAROLE
HI	42229.4	42197.7	42243.5	42244.7
PRE	42243.8	42238.7	42257.8	42277.0
AVG	42252.8	42255.8	42264.9	42269.8
POST	42261.8	42272.9	42272.1	42262.6
LO	42272.6	42279.8	42286.5	42302.3

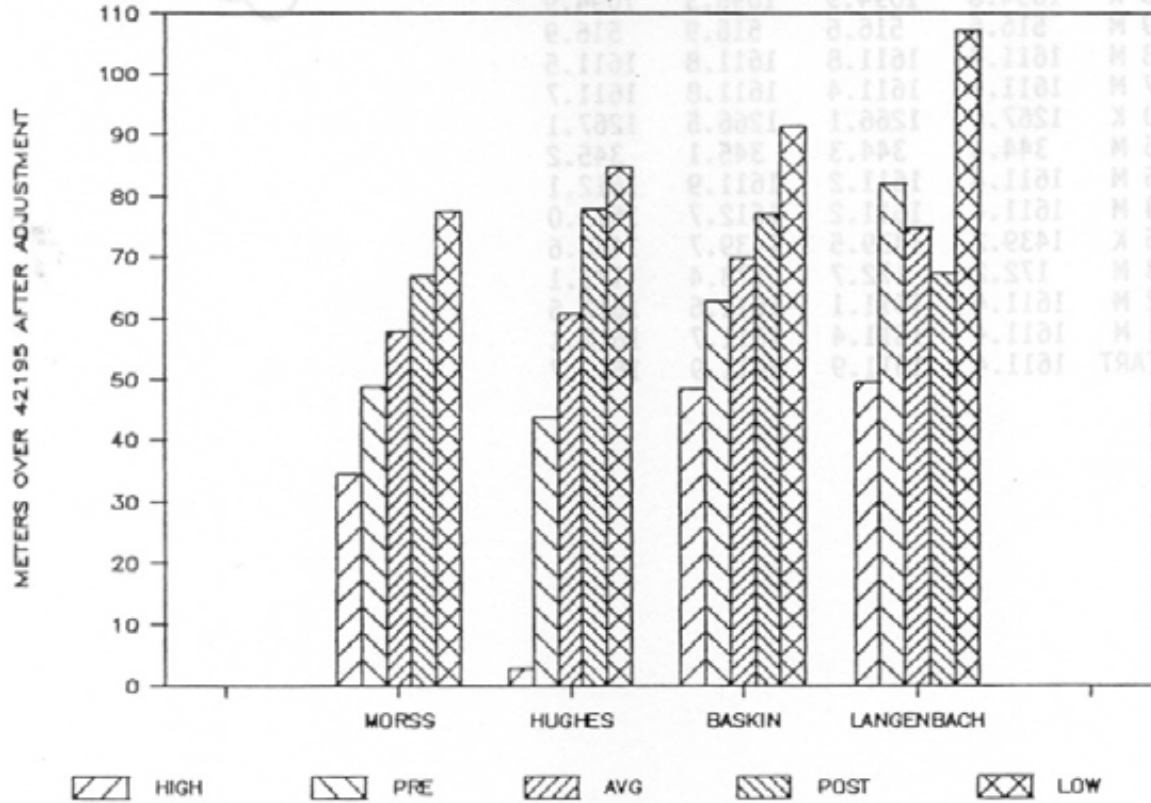
METERS OVER 42195 AFTER ADDITION OF 5.1 METERS

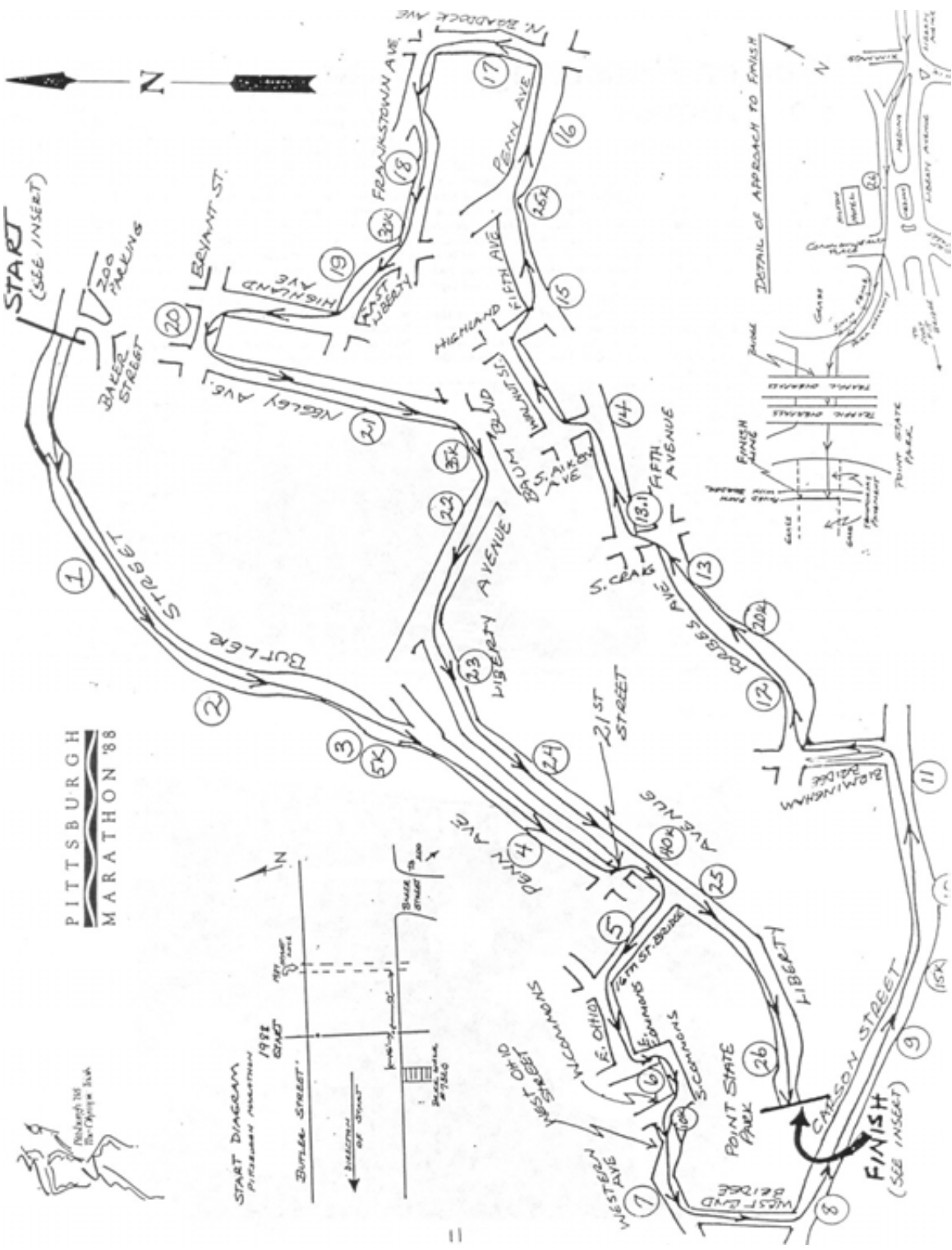
	AMY	BETSY	SUSAN	CAROLE
HI	34.4	2.7	48.5	49.7
PRE	48.8	43.7	62.8	82.0
AVG	57.8	60.8	69.9	74.8
POST	66.8	77.9	77.1	67.6
LO	77.6	84.8	91.5	107.3

HAS A MORE CONSISTENT PATTERN

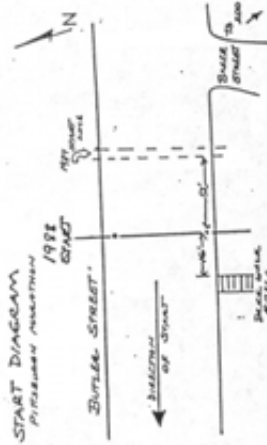
US WOMEN'S OLYMPIC TRIALS MARATHON

MEASUREMENT, 23 APRIL 1988





**PITTSBURGH  
MARATHON '88**



# Women Measuring For Women

By Carole Langenbach

**I**t has been four years since the Pacific Northwest Athletics Congress and Olympia hosted the first Women's Olympic Marathon Trials. I was president of the PNAC at that time. As the local TAC association, we had been awarded the event and were responsible for it.

Imagine my excitement when I was invited to participate in the next Women's Marathon Trials, the Pittsburgh Marathon on May 1. I would be a member of the historic, first all-women's team to measure the course.

I had one concern: riding 26 miles, 385 yards without wobbling too much. The validity of the bicycleJones counter method of course measuring rests on being able to ride the shortest possible route the runners can take. That means keeping your front wheel straight and not wobbling, even up the hills. By the weekend of April 22, I felt ready.

I arrived in Pittsburgh on Friday afternoon. Since a storm was expected over the weekend, our measuring ride had been moved up to that night. We assembled at midnight in the lobby with our bikes. There

were six of us: Sally Nicoll of Georgia, as team leader; her husband, Wayne, who would bike with us and record our counts at each stop; and the four measurers. The first step was to calibrate each bike on the 1000 ft. calibration course which the team had laid out by hand with a steel tape the day before.

After a brief gathering in the lobby, we rode to the finish line in Point Park, where three rivers meet. Our two police escorts, the

city engineer, a newspaper photographer, and two marathon officials were waiting for us.

By 1:30 a.m. we were on our way. One police car with the city engineer guided us around the course, and the other protected us from the rear. Since the finish line was a pre-determined point, we were to ride the course backwards and make any adjustments at the start.

We only got 385 yards before our first stop. Each measurer read her counts to Wayne who recorded them and handed the paper to Sally in the rear police car. A marathon official recorded the landmark information so the locations could be recorded on the certification document.

This procedure continued for 35 splits, until 8 a.m. when we reached the start. There had been one coffee break at about 4 a.m. when a third police car delivered large cups of steaming coffee for everyone. My shoulders ached after 5 miles, but I didn't mind. The camaraderie and commitment to the task at hand kept me high all night. I thought of Carl Glatze, who had measured the first women's marathon trials course in Olympia, and knew he would have been proud of me. By daylight, traffic began to be a problem, and both police cars were kept busy leap-frogging from one intersection to another with lights flashing and sirens blaring to protect us from motorists.

When we were finished, we calibrated our bikes again, this time on a calibration course near the start. That afternoon, Wayne examined our data and declared that the measurements of all four women were in agreement by TAC certification standards—a remarkable result!

On Sunday morning, the six of us drove the course together, pounding in PK nails at every split and labeling the street with big silver numbers for the benefit of the women runners who would come after us. Later that day, we said goodbye, grateful for new friendships, personal growth, and the roles we played in one more historic midnight ride. [AMM]



The measurement team. Carole Langenbach is second from right.

46 Northwest Runner June, 1988



WICKISER SMITH BRANNEN

THE MEN'S TEAM

(SEE COVER FOR WAYNE NICOLL)

$$\frac{dP}{P} = - \frac{g}{R_d T} dz$$

$$g = 980 \text{ cm/sec}^2$$

$$R_d = 2.87 \times 10^6 \text{ erg/(g} \cdot \text{°K)}$$

T in °K (temperature)

pressure P in whatever units you wish (units cancel)

height Z in cm

FROM KEN YOUNG  
 HOW TO DETERMINE  
 CHANGE IN ELEVATION  
 BETWEEN START &  
 FINISH - AT LEAST  
 TO ± 5 FT

a good aneroid barometer can determine pressure changes to ± .005 inches (0.2 mb)

e.g. T = 27°C (300°K)      P = 29.9 inches Hg - near sea level

ΔP = .005 inches Hg

$$\frac{\Delta P}{P} = 1.138 \times 10^{-6} \Delta Z$$

$$\Delta Z = 147 \text{ cm} \sim 4.8 \text{ feet}$$

procedure to determine difference in elevation between start and finish -

read P at start, carry barometer (rapidly, within 10 minutes if possible) to finish, read P at finish. Difference in pressure = ΔP, total pressure P = (P<sub>sr</sub> + P<sub>fin</sub>)/2.

Use formula to calculate ΔZ - good to ± 5 ft

It is best to perform measurements ~ 10 AM or ~ 4 PM to minimize diurnal pressure variations influence. Do NOT do this under stormy weather conditions.

New Jersey Waterfront Marathon:  
1988 Men's USA Olympic Trials and TAC/USA National Championship  
TAC/USA Pre-race Measurement Verification Report  
-by Dan Brannen

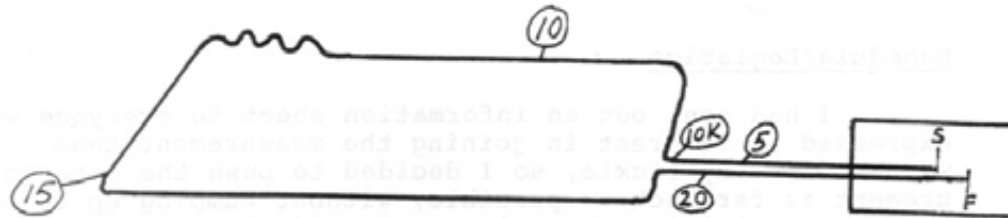
Background

The New Jersey Waterfront Marathon runs through 7 different municipalities in Hudson County, NJ, one of the most densely populated counties in the country. Parking is especially at a premium, with rampant street parking (much of it illegal). In this respect it is similar to Manhattan. The course contains some sizeable hills, the most notable of which is a climb of over 150 feet within a kilometer at 17-18 km. Some of the streets are in poor condition, with potholes, lumpy patchups and trash (including lots of broken glass) aplenty.

Perhaps the most formidable challenge facing a course measurer (I think the single most difficult stretch I've ever faced in nearly 100 measurements) is a 3 km stretch of 4-lane, undivided, extremely serpentine roadway (with parked cars on both sides) running along the edge of the eastern escarpment of the Hudson River Palisades on Kennedy Blvd. East (see map between miles 12 and 14). It's one of those roads on which everyone tries to beat what few traffic lights there are while flirting with loss of control on every turn. It's also the only avenue on which North-South traffic moves at more than a crawl during the day, and hence it can't be closed down for a measurement. Over the 3 km stretch, I would estimate that the difference between ideal SPR and the natural edge of the roadway is a healthy 150 meters.

(It was primarily this stretch which dictated the unusual measurement schedule of the RRTC team on its verification ride. I had discovered that the only feasible time to measure this stretch is between 3:30 and 4:30 AM. Since we had planned to take readings every 5 miles, and since I wanted to make sure the measurement team hit this stretch at the right time, we rode the 10-15 mile segment first, fitting the others in by convenience as we got to them.)

Finally, a word about the local political atmosphere. The seven municipalities in question have often been referred to as "fiefdoms." One in particular is rumored to be the final resting place of Jimmy Hoffa (it was the setting for the film "On the Waterfront"). Politics is a real vaudeville show in these parts. It's a miracle that the event has managed to coordinate the seven police departments (often with much weeping and gnashing of teeth, to put it mildly) on race day itself. In conjunction with some key folks in upper race management, I decided it would be hopeless--and possibly counterproductive--to try to arrange a police escort (with seven "handoff zones?") for the RRTC measurement team. With the expert and extremely helpful counsel (not to mention equipment) of Wayne Nicoll, I decided that we had best get out there on our own and be totally self-sufficient. It worked wonderfully, thanks in no small part to the dedication, cooperation, and just plain brilliance of Wayne, Brian Smith, and Mike Wickiser.



### The Course

The schematic diagram above shows the course as basically a keyhole. The first 10 km and last 10 km are identical, except that the Finish stretch breaks away and extends beyond the Start. The diagram also highlights the serpentine stretch between 10 and 15 miles. The course is flat for the first 4 and last 4 miles. It is basically uphill from 4 miles to 10 km (where the loop portion starts), steeply downhill from 10 km to 8 miles, flat from 8 miles to 11 miles, uphill in varying degrees from 11 miles to 16 miles (with a rolling section at the serpentine stretch), very mildly rolling (but gradually downhill) from 16 miles to 30 km, wonderfully and steadily downhill from 30 km to 22 miles, then flat to the Finish.

The Start and Finish areas are in Liberty State Park, which sticks out into the mouth of the Hudson River where it meets New York Bay and gets ready to become the Atlantic Ocean. To put it bluntly, Liberty State Park is one of the windiest places on earth. The race's technical director, Chris Tatreau, has taken to wearing an aviator's hat and a parka whenever he goes there. The Start (about 150 meters wide) is on a huge lawn. The first half mile of the race runs on this lawn. The last kilometer of the race runs across the same lawn, onto an asphalt path at the North edge of the lawn, then back onto the lawn for a final 200 meter Finish on grass.

In this age of record attempts and the ubiquitous "flat and fast" designation, the course has taken its share of criticism. Over the last two years I've gotten to know it inside and out, and the more familiar I get with it the more I like it. It is a real "racer's" course which should appeal to old-school, high-mileage, cross-country types. It is a strategist's dream, a thinking man's course. And I'm still not convinced that (wind aside) it is necessarily a slow course. Take another look at your ABC videotape of the event. Check out all the old-fashioned footracing going on in there. The course made a lot of that happen.

## Schedule/Logistics

I had sent out an information sheet to everyone who had expressed an interest in joining the measurement team. Spring weather is very fickle, so I decided to push the date of the measurement as far back as possible, without bumping up too close to the race activities themselves. The ideal weekend turned out to be April 8-9-10. Ironically, in our measurement we wound up riding along the west bank of the Hudson River in New Jersey at almost the same moment the Ekiden Relay teams were running up the east bank in Manhattan. For those of you who saw that race on TV, yes, it was cold and windy.

Wayne Nicoll arrived from New Hampshire, Brian Smith from South Carolina, and Mike Wickiser from Ohio (all by personal auto, which simplified logistics tremendously) late afternoon Thursday, April 7. My wife, Joyce Hayes, put out a nice pasta feast for us (does this qualify as carbo-loading?). Mike and Brian stayed at a local motel and Wayne stayed with us.

Friday morning we headed to Liberty State Park to review the Start and Finish areas. Then we drove the course, returning to the park to take measurements on the lawn. At this point I refer to Wayne's preliminary report in his April 10 letter to Pete Riegel, and to my course map and the detail maps of Liberty State Park. Wayne, Mike, and Brian wrapped up the Liberty State Park measurements and we headed back to the ranch for an early turn-in.

Saturday morning we set out at 2:30 AM for our road measurements. Wayne's report summarizes our activities. During the measurement Wayne assumed the burden of lead rider, followed by Brian, and then Mike. I drove Wayne's pickup truck with flashing lights to do what I could to fend off what little traffic we would encounter. Using my judgment, sometimes I would ride behind the riders, sometimes ahead. Wayne and I wore radio headsets so I could keep him posted on approaching vehicles and try to warn him of upcoming sections where the ideal SPR would be difficult to follow. We got through it all without much difficulty, except for a cold headwind during the first hour and some traffic buildup during the last hour.

To simplify subsequent interpretation of the numbers, here's how we measured (refer to schematic diagram above): We calibrated on a 1,000-footer located between the 8 and 9 mile marks in Hoboken, then rode to the 10 mile mark. We started our measurement at the 10 mile mark, rode to 15 miles and took readings. Then we rode almost to the the 20 mile mark, but stopped to take a reading at the 10 km mark (the 10 km and 20 mile marks are on the same out-back section). We then followed the course from 10 km to 10 miles to complete the "loop" part of the course and get out of the worst potential traffic as early as possible. The bikes were then transported back to the 10 km mark, so that all we had to do was ride from 10 km back to the park. On our way in we took readings at 20 miles and 5 miles. Unfortunately we were all so tired that we forgot about the 25 mile mark so we didn't get a reading there--not that it really matters. At the end of the next section of this report the numbers are shuffled back into place to give totals at 5-mile intervals.



**The  
Athletics Congress  
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Running and Race Walking for  
men and women and boys and girls  
at all age levels.*

**WAYNE B. NICOLL**  
Ragged Mountain Club  
Potter Place, New Hampshire 03265  
(603) 224-0413  
(603) 735-5284

10 April 1988

Peter S. Riegel  
3354 Kirkham Rd  
Columbus, OH 43221

Dear Pete,

Here is an informal report on the measurement verification project of the Waterfront Marathon course, the site of the Mens 1988 Olympic Trials. I have not followed any particular format since this is neither a validation nor a certification.

The project was well planned and executed by Dan Brannen, the course measurer. The volunteer participants were Brian Smith, the SC certifier; Mike Wickiser, a measurer from Akron OH; and me. We traveled on Thursday, 7 April, and Brian and Mike were quartered in a motel several miles from Dan's apartment. I stayed at Dan's place. On Thursday evening we had dinner at Dan's and all got acquainted. Joyce is a wonderful hostess and excellent cook. On Friday morning we assembled at the motel, proceeded to Liberty State Park (the start/finish area), walked over the outgoing and incoming measured paths, and took a drive over the course.

We spent the afternoon steel taping and wheel measuring the outgoing and incoming paths from the point they leave the paved road surface to the start or finish points. This area is a huge, flat, grassy plain and the surface is rough and soft. The underlying soil is mostly cinders in content since this is the former railyard where trains assembled to transport the immigrants away from Ellis Island. One could not help but pause and reflect on the deep significance of this windswept plain. We measured the diagonal sections on grass by steel tape but with an asphalt path running east-west along the north edge of the park we were able to check the parallel east-west grass sections with a calibrated bike wheel. Dan had laid a 1000 foot calibration course along this paved path, which we checked and found to be 1000.14 feet in length. We completed all measurements and proceeded to Hoboken where we laid a 1000 foot course convenient to the start of our measurements the next morning. We returned to the motel and apartment. That evening we suspended our social activities to be ready for the task ahead.

On Saturday we assembled at 2:30 AM at the motel, proceeded to Hoboken, calibrated and measured the course. Since the race passes through eight separate jurisdictions, coordination for police escort in this politically charged environment was not attempted. We measured the most dangerous portion first, from 10 miles to a common point at the



beginning of the out-back part of the course. This point coincided with the 10K mark so the second segment was from the 10K mark to the 10 mile mark where we started. We then transported the bikes back to the common point/10K mark and rode the out-back portion back to the start area. We took readings at the start, 5, 10, 15, 20 mile and the point where the course leaves the grass. We recalibrated on the 1000 foot course at the park and went off to a much deserved breakfast. During breakfast and later at the motel we all participated in the calculations of the rides and the taping and rolling measurements of the day before. We were very pleased with the results.

The data we developed at the park will not necessarily coincide exactly with the figures that will be on Dan's certificate since we used different reference points. The final calculations should be close. We did not take time to make any comparison since Dan's data was still in rough form. There are a couple of figures in the park that perhaps need an explanation. The asphalt path from the last pole to the start line has one bend in it that increases the path length over the straight line east-west distance by 4.2 feet. We steel taped the bend and a straight section parallel to it to determine the difference. At those points where I was tempted to eyeball across from the path to the points on the grass, Mike and Dan insisted on applying a right angle triangulation process and on one of my figures they added 11.2 feet! They used the same technique to move the Hoboken calibration course ends from the road edge to a point on the road surface where we could easily calibrate the next morning. I will leave the explanation of that process to Dan to cover in MN.

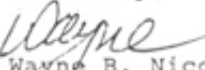
In the park to obtain calibrated wheel measurements we used my "Nicolli Wheel", a bike wheel complete with handle, hand brake, Jones counter, and bike computer. Since no one was riding, Brian and I took turns on the calibrations and "rides". Our figures are remarkably close throughout. My figures were 2821 each and his was 2820 each but we each had a mid-course calibration figure of 2820 so we used that figure in our calculations. There was only a one count difference in our two "rides"! We did not perform a recalibration since the last mid-course calibration occurred only seconds before we finished.

The only unusual event in this project was Mike's experience with his front tire equipped with an Eliminator plastic tube. Mike had his bike destroyed by a truck while he was measuring a short time before this project. The truck actually left the road and demolished the bike while Mike watched helplessly. He was able to salvage the Eliminator and mounted it on his new bike but it had no mileage on it since then. As expected, his 5 mile segment figures reveal dramatically the adjustment of the tube in the first 5 miles. What really helped was a short stretch of roadway that was paved over a rail bed with crossties. It was washboard for several hundred meters. Your number crunching should really point it out.

I was pleased with the final results. I rode the course as I would normally ride a validation, being careful to be fair to the course. Dan, however, wanted us to ride it tightly, so I encouraged Brian and Mike to slice away at my path as they followed, and they did. Although the course appears by Mike's figures to be about 27 meters over the length of a marathon with SCPF, there are some spots on the course where automobiles will not be allowed to park on race day. Dan feels this could account for as much as 25 meters. In any event, the course is in great shape for the Trials.

Finally, I want to express my heartfelt thanks to Dan, Joyce, Brian, and Mike for making this measurement project such a success. The conditions were certainly difficult, as we faced raw, cloudy, windy weather and the difficult urban conditions of the greater New York area. Despite these difficulties, we were able to finish the work by Saturday noon and each of us were on our way home that afternoon.

Sincerely,



Wayne B. Nicoll  
VC East, RRTC

April, 25, 1988

Pete,

As you recommended, I have graphed performance of my new "eliminator" plastic inner tube. The graph shows a "breaking in" period from March 18 thru April 13th of this year. That represents about 75 miles of riding, not more than half of which on smooth roads. In fact, I believe the measuring of the New Jersey Waterfront Marathon well hammered the front tire on my bike into some consistency as that course contains some rather bumpy sections.

I know that first using this "hard" tube replacement, my opinion was less than favorable because it didn't seem to conform, it would shrink in size although the air temperature would go up 8-10 degrees.

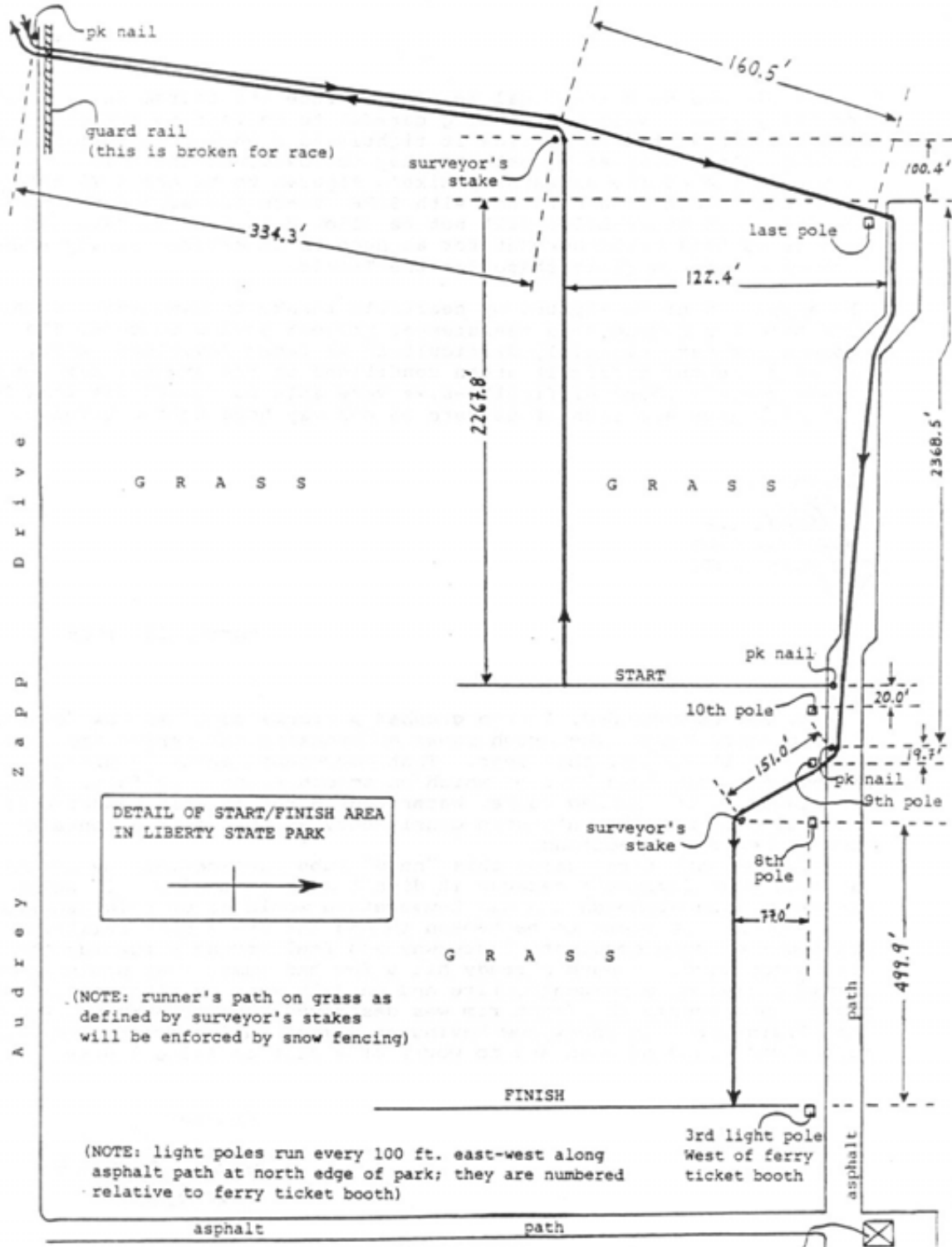
Now that it seems to be broken in and the pre & post calibrations are becoming more constant, I see why you feel strongly towards the eliminator tube. I have already hit a few bad bumps that would have caused a flat on a pneumatic tire and on 3-28 when my bike was hit while measuring a course the front rim was destroyed, but no harm was done to the eliminator. In short, now having an almost bullet proof front tire sure gives peace of mind and no worry of a flat spoiling a days work.

Regards,



Mike Wickiser

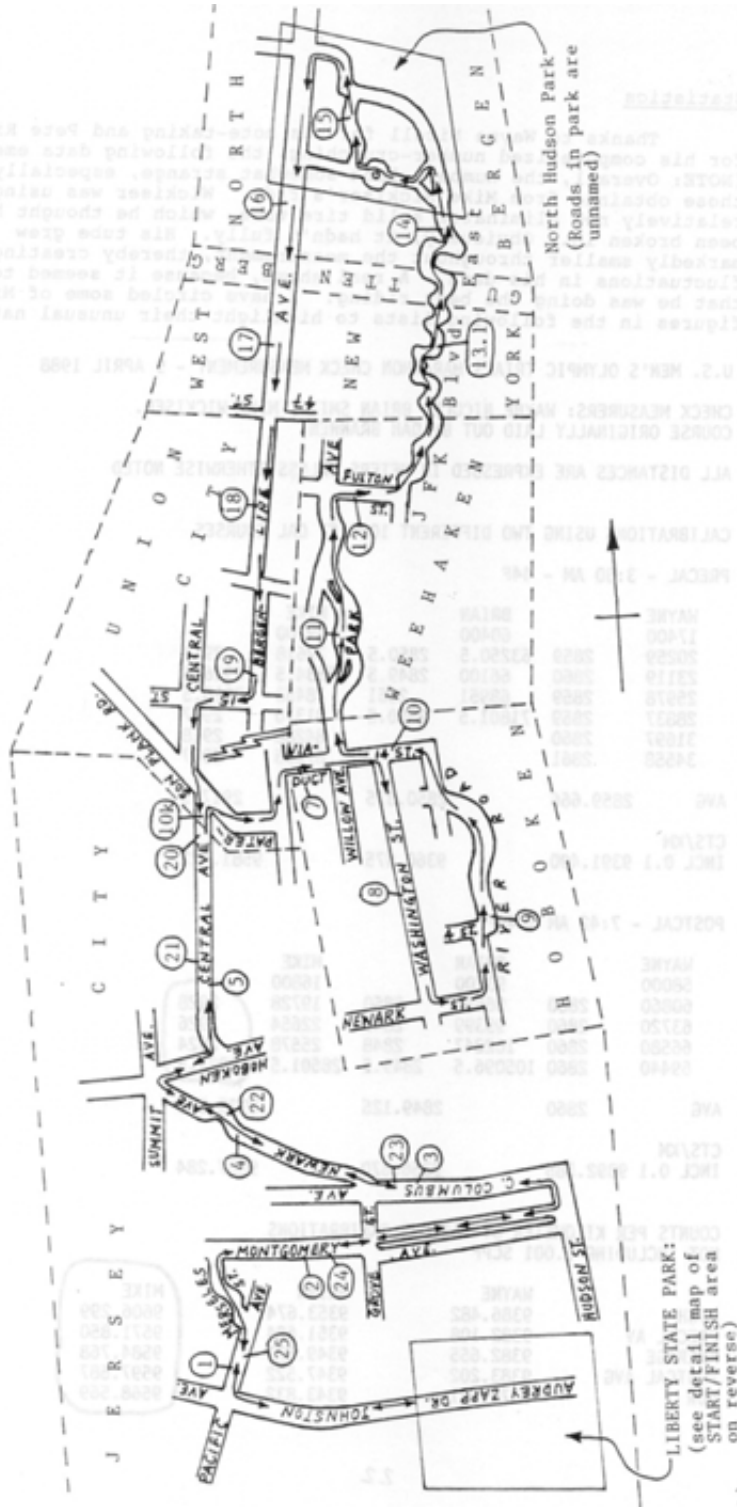
Dan Brannen's final certificate  
 diagram of START/FINISH area  
 in Liberty State Park



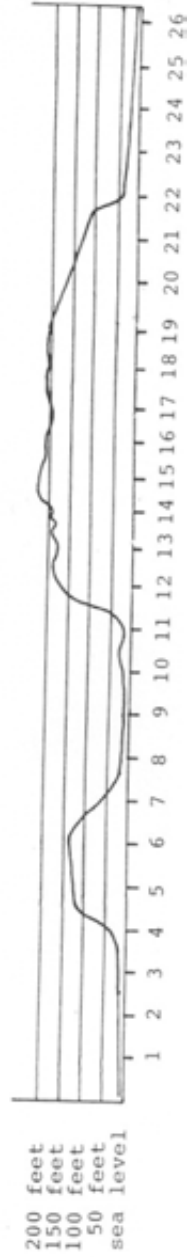
A u d r e e y 2 a a p p D r i v e

NEW JERSEY WATERFRONT MARATHON 1988  
 Liberty State Park, Jersey City, NJ

Map & Certification by  
 Dan Brannen, TAC/RRTC  
 TAC certification #NJ88005DB



COURSE ELEVATION PROFILE



Statistics

Thanks to Wayne Nicoll for his note-taking and Pete Riegel for his computerized number-crunching, the following data emerge (NOTE: Overall, the numbers look somewhat strange, especially those obtained from Mike Wickiser's ride. Wickiser was using a relatively new eliminator solid tire tube, which he thought had been broken in. Obviously, it hadn't fully. His tube grew markedly smaller throughout the measurement, thereby creating wild fluctuations in his data. A real shame, because it seemed to me that he was doing the best riding. I have circled some of Mike's figures in the following lists to highlight their unusual nature):

U.S. MEN'S OLYMPIC TRIALS MARATHON CHECK MEASUREMENT - 9 APRIL 1988

CHECK MEASURERS: WAYNE NICOLL, BRIAN SMITH, MIKE WICKISER.  
COURSE ORIGINALLY LAID OUT BY DAN BRANNEN

ALL DISTANCES ARE EXPRESSED IN METERS UNLESS OTHERWISE NOTED

CALIBRATIONS USING TWO DIFFERENT 1000 FT CAL COURSES

PRECAL - 3:30 AM - 44F

WAYNE		BRIAN		MIKE	
17400		60400		69700	
20259	2859	63250.5	2850.5	72618	2918
23119	2860	66100	2849.5	75534.5	2916.5
25978	2859	68951	2851	78453	2918.5
28837	2859	71801.5	2850.5	81370	2917
31697	2860			84288	2918
34558	2861			87205	2917
AVG	2859.666		2850.375		2917.5
CTS/KM					
INCL 0.1	9391.490		9360.975		9581.422

POSTCAL - 7:42 AM - 44F

WAYNE		BRIAN		MIKE	
58000		93700		16800	
60860	2860	96550	2850	19728	2928
63720	2860	99399	2849	22654	2926
66580	2860	102247	2848	25578	2924
69440	2860	105096.5	2849.5	28501.5	2923.5
AVG	2860		2849.125		2925.375
CTS/KM					
INCL 0.1	9392.585		9356.870		9607.284

COUNTS PER KILOMETER BY VARIOUS CALIBRATIONS  
NOT INCLUDING 1.001 SCPF

	WAYNE	BRIAN	MIKE
HIGH	9386.482	9353.674	9606.299
PRECAL AV	9382.108	9351.624	9571.850
AVERAGE	9382.655	9349.573	9584.768
POSTCAL AVG	9383.202	9347.522	9597.687
LOW	9379.921	9343.832	9568.569

MEASUREMENT - COUNTS OBTAINED

	WAYNE		BRIAN		MIKE	
10M	61000		98400		14300	
15M	136700	75700	173808	75408	91411	77111
10KM	210050	73350	246841	73033	166211	74800
10KM	210050		246841		166211	
10M	267379	57329	303889	57048	224705	58494
10KM	267500		304000		224800	
20M	269792	2292	306284	2284	227143	2343
5M	285843	16051	322274	15990	243545	16402
PARK	353883	68040	389977	67703	313061	69516

INTERVAL COUNTS ALONG ENTIRE COURSE

	WAYNE	BRIAN	MIKE
PARK			
5M	68040	67703	69516
20M	16051	15990	16402
10K	2292	2284	2343
10M	57329	57048	58494
15M	75700	75408	77111
10K	73350	73033	74800
20M	2292	2284	2343
5M	16051	15990	16402
PARK	68040	67703	69516
TOTAL	379145	377443	386927

OFFICIAL TAC BIKED LAYOUT DISTANCES INCLUDING LARGER CONSTANT AND 1.001

WAYNE	40366.41
BRIAN	40320.90
MIKE	40274.33

TAPED DISTANCES IN PARK

AT START	2700.17 FEET	823.0118 METERS
AT FINISH	3517.67 FEET	1072.185 METERS
TOTAL TAPED DISTANCE		1895.197 METERS
(TAPED DISTANCE)/1.001		1893.304 METERS

TOTAL ACTUAL MEASURED DISTANCE INCLUDING TAPED DISTANCES  
DOES NOT INCLUDE 1.001 SCPF.

	WAYNE	BRIAN	MIKE
HIGH	42287.85	42247.57	42173.66
PRECAL AV	42306.68	42256.42	42318.62
AVERAGE	42304.33	42265.27	42264.14
POSTCAL AVG	42301.97	42274.13	42209.80
LOW	42316.11	42290.08	42332.48

METERS OVER 42195

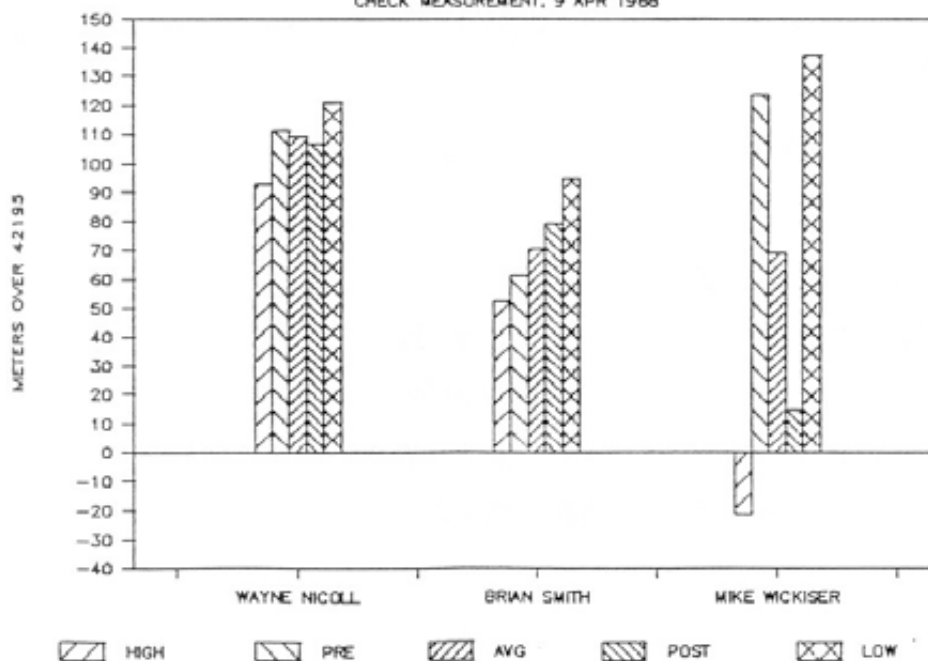
	WAYNE	BRIAN	MIKE
HIGH	92.9	52.6	-21.3
PRECAL AV	111.7	61.4	123.6
AVERAGE	109.3	70.3	69.1
POSTCAL AVG	107.0	79.1	14.8
LOW	121.1	95.1	137.5

METERS MEASURED ON COURSE USING AVERAGE CONSTANT

	WAYNE	BRIAN	MIKE	SOSS
START				
PARK (TAPED)	823.0	823.0	823.0	823.0
5M	7251.7	7241.3	7252.8	7241.3
20M	1710.7	1710.2	1711.3	1710.2
10K	244.3	244.3	244.5	244.3
10M	6110.1	6101.7	6102.8	6101.7
15M	8068.1	8065.4	8045.2	8045.2
10K	7817.6	7811.4	7804.0	7804.0
20M	244.3	244.3	244.5	244.3
5M	1710.7	1710.2	1711.3	1710.2
PARK	7251.7	7241.3	7252.8	7241.3
FINISH (TAPED)	1072.2	1072.2	1072.2	1072.2
TOTAL	42304.3	42265.3	42264.1	42237.7

## US MEN'S OLYMPIC TRIALS MARATHON

CHECK MEASUREMENT, 9 APR 1988



### Evaluation of the Statistics

In conclusion, it is safe to say that the RRTC measurement verification team found my certified course to be approximately 55 meters longer than the true marathon distance, and at least 13 meters longer than they would have laid it out to be. If you throw out Wickiser's first two segments (i.e., 10-15 miles; 15 miles-10 km) because of the probability of maximum tire shrinkage there, and use Smith's figures instead, the more likely difference between the measurement team's layout and my own layout is along the lines of 25-30 meters. After doing my own turn-by-turn review of the measurement ride, I suspect that those 25-30 meters can just about be accounted for by my practice of offsetting to the curb every time I encountered parked cars at turns. As team leader, Wayne decided not to do this but rather to be fair to the course as he encountered it, and Brian and Mike followed his lead. Because so much was at stake with the level of competition and prize money, and because it was impossible to know in advance how successful the police were likely to be in clearing the course of parked cars, I had decided to play safe and do the offsets as if there would be no cars on the course during the race, even though I knew there would be some. The only exception was on the 3-km serpentine stretch between 10 and 15 miles, where I knew it would be absolutely impossible to clear cars because of the population density in that area. After reviewing the ABC videotape of the race a few times afterward, I concluded that the shortest route actually available to the runners during the race was about half-way between mine and Wayne's. I don't think things could have turned out much better.

### Final Comments

Although Wayne comes out looking like the worst measurer, I must say in his defense that being "on the point" in the dark on a cold, windy morning, and having to respond to my radio messages put him in an impossible position. Having seen the course only cursorily the day before, he had to guess at the SPR in numerous cases where the course went over a hill and around a bend at the same time. He was also the note-taker and was in fact the executive director of the whole operation. Might as well make him the sacrificial rabbit as well.... Thanks, Wayne.... Brian rode fairly close behind Wayne, but kept enough distance that he could use the figure of Wayne up ahead to focus in better on the SPR. I noticed that Mike stayed further behind Brian and seemed to make a real, competitive effort to win the SPR contest. It's a shame Mike didn't have Wayne's tire. Those numbers I would have liked to see.

More on Mike's tire: We heard that a few weeks after this measurement Mike's eliminator tube finally settled in. A quick look at Pete Riegel's computer-generated graph of the measurement shows just what that tire did to the numbers. One other strange result was Mike's postal measurements. On a 1,000 footer they decreased by 2 counts per ride, with a high-low variation of 4.5 counts. The only logical explanation would be horrendous riding, yet it seemed to me that Mike rode this cal course as carefully as he had ridden the entire morning. I can't figure it out.



I'm really glad Mike was able to join the team because--and I know Wayne shares this sentiment--he turned out to be a real "find." He was so damn good at every aspect of the measurement game (from having the right bike repair equipment ready at hand to knowing some surveyor's tricks which none of us knew) that I found it hard to believe he hasn't been brought into the fold as a certifier. You just can't be much better at this game than he is.

ED. NOTE - MIKE IS NOW INDIANA CERTIFIER.

Triangulation: in a couple of cases during our work the old Pythagorean transfer was appropriate, but we were pretty much set to just eyeball it. But Mike really pushed for triangulation on a 3-4-5 ratio, so we got out two tapes and did it. In one case in particular the difference between accurate triangulation and eyeballing it was amazing. We had to locate a surveyor's stake way out on the grass lawn of Liberty State Park relative to the end of the asphalt path which runs along it's North edge. In laying out the course I had pulled a 200-foot tape from the stake to a point which I judged to be even with the end of the path, then swung a few yards in either direction along the circumference of the arc of which the tape was the radius. I located my reference point at the spot which yielded the longest radius. I can't recall exactly how we did it during the measurement check, but it was some combination of this method and simple eyeballing. Following Mike's suggestion, we did a Pythagorean transfer with two tapes and found that the mark we had made was 11 feet off! I wonder how much this calls into question our standard practice of offsetting across roadways to avoid traffic....

In closing I want to say a word of thanks and praise to Chris Tatreau. Chris may well be the most prominent behind-the-scenes guy in road running. He was overall technical director of the Men's Olympic Trials marathon, a position which he also holds with Chicago and Cleveland-Revco, as well as countless shorter events. Chris made it very clear to me that measurement/certification is not his game, but he respects the process and wanted no shortcuts taken, either for political or for budgetary reasons. He really went to bat for the certification process with race management. He put me in touch with the lead vehicle drivers to make sure they understood the concept of SPR so they would drive it instead of the natural traffic lanes the police escorts and press trucks would likely drive. He brought me in on race day, gave me an official van loaded with cones and volunteers, and sent me out on the course 10 minutes in advance of the race to do whatever I had to in order to make sure the race was run "as certified." Everything turned out just right, but if there had been any glitches (of the kind which have negated some records in the past), the mechanism was in place to fix them. It's a damn good idea and one whose implementation we should try to push for in more major events.

FINISH LINES	
TIME	PLACE
0:43:21	788

Finish Line Sub-Committee  
 Alan Jones, Chairman  
 3717 Wildwood Drive  
 Endwell, NY 13870  
 (607) 754-2339  
 July 1988

**THE FINISH LINE BOOK**

Recently Pete Riegel informed me that TAC is almost out of the **TAC Road Race and Finish Line Management** manual. He asked if it should be rewritten as is being done with the **TAC Course Measurement Procedures** manual. I told Pete that the manual is still very much up-to-date. About the only item that could be improved is in the use of computers. Computers were only beginning to be used in 1985 when the manual was written.

I got my copy of the **Finish Line Management** manual out and perused it recently. I still agree with the opinion that I gave Pete-- that it is well done and quite complete. However, with all such documents, we will have to face up to rewriting it in the future. Be thinking about what should be changed, what should be deleted, and what should be added. Ken Young, with the help of Paul Christensen, David Katz, Judy Stolpe, Jack Moran, Bob Baumel, Nancy Blankman, Gabriel Duguay, C. E. George, Jennifer Hesketh-Young, Carl Johnson, George Kleeman, Wayne and Sally Nicoll, Peter Riegel, Allan Steinfeld, and Phil Stewart really did a nice job. The only problem with the manual is that it isn't used enough. Copies can still be obtained from:

TAC/USA Book Order Dept.  
 Box 120  
 Indianapolis, IN 46206  
 Price: \$6.00

**TIMING PRECISION ON 5K RACES**

In my correspondence with Lawrie Robertson of the TAC Officials Committee, the question was raised of timing 5K races to the tenth of a second. Lawrie says that the current

rule is quite clear that, "events run partially or wholly outside the stadium are to be timed to the nearest whole second." The quote is from Lawrie's correspondence, not from the TAC rule book. The rule book (TAC Rule 37.8) states that ALL non-zero fractions of seconds must be raised to the next slower full second. However, that is not the point I am making here which is that times for races outside the stadium must be timed to the second. However, in the **Finish Line Manual** is the statement (page 7), "An exception should be made for 5 kilometers (road) where times should be reported to tenths of seconds, i.e., raise non-zero hundredths of seconds to the next slower tenth. This recommendation (not a rule) has been carried over to TACSTATS recommendations. I personally agree with the rule -- i.e., times on road races should be rounded up to the next second. Other opinions?"

**TAC RULES AND JUMPING THE GUN**

The **Finish Line Manual** states that, "since it is not practical to recall a false start for a road race with thousands of runners, the timers **MUST** be prepared to start their watches (or timing devices) **WHEN THE FIRST RUNNER BREAKS.**" Lawrie has pointed out to me that this practice is not allowed according to the rules. It would seem that this rule **must** be changed. Lawrie states that, "it would be helpful to address the obvious problem the current rule creates in the LDR competitive situation where calling back a false start is impractical."

## RRCA CONVENTION

The RRCA Convention, held in Indianapolis May 5-8, was well supported by TAC and the RRTC. Wayne and Sally Nicoll gave a talk on Pace Course Design. Alan Jones held a hands-on workshop on Utilizing Computers for Your Club. Basil and Linda Honikman presented State Record Keeping (TACSTATS). TAC sponsored a Delegates' Breakfast, at which Ollan Cassell and Alvin Chriss spoke a few light-hearted and humorous words.

During an afternoon break, Wayne Nicoll and Pete Riegel validated the TAC National Championship Race Walk course.

Many times during the weekend, the current harmony and good will between RRCA and TAC was noted by various speakers. No one could have asked for a more congenial and supportive atmosphere.



## LAYOUT MEASUREMENTS VS VALIDATION MEASUREMENTS

### Layout Measurements

Who does them?.....anybody at all  
How many?.....minimum of two, lowest value official  
What constant is used.....larger of precal or postcal  
Size of SCPF.....1 meter per kilometer

The purpose of the layout measurement is to establish a road race course that can survive a validation measurement by not being found short.

### Validation Measurements

Who does them?.....RRTC expert measurer  
How many?.....at least one  
What constant is used?.....average of precal and postcal  
Size of SCPF.....none used - actual distance is measured

The purpose of a validation measurement is to estimate the true length of a preexisting course.

When we discuss the results of measurements we sometimes get confused. The confusion is caused by the inclusion of the short course prevention factor (SCPF) in the calculations. To eliminate the confusion, I am going to try to report all measurements in MN as actual distances, with no 1.001 included in the constant.

The layout procedure is only that - a procedure. It was set up to allow a measurer to incorporate the SCPF in the layout measurement in a way that's not too confusing, and doesn't require lots of adjustments to the splits once the layout is done.

When you see that a marathon course came out to 42204 meters it means that by the validation standard that's how long it came out. It does not imply the presence or absence of any SCPF at all - it is simply a statement that 42204 is the best estimate of the length of the course.

The 1.001 SCPF belongs in the layout procedure, but it does not belong in the analysis of the measurement because it adds confusion. Thus all the meters you see in MN are actual meters, unless noted to the contrary.

## DID KOREA WIN THE MEASURING OLYMPICS?

When the Koreans laid out the Seoul course they adopted the methodology we used in Los Angeles, right down to using 13 measurers. Their report is very similar to our own - a big fat document with lots of different ways of figuring the distance. Like us, they used multiple calibration courses laid down at intervals along the race course. And, like us, their calibration data can be analyzed.

In May MN we analyzed the Los Angeles data. The EDM distance of each calibration course was compared to the same distance as determined by bicycle measurement. It was seen that average errors for 13 measurers approached 5 meters in 10 km.

This month we'll look at how the individual calibrations came out. In Los Angeles we had 13 riders measuring 6 different calibration courses, for a total of 78 separate measurements of straight-line distances. In Seoul 13 riders measured 11 different calibration courses, for a total of 143 separate measurements. What do the numbers tell us?

First, the Korean measurements are more tightly grouped, and more normally distributed (bell-shaped curve). Because the Koreans had no experienced measurers the team leaders painted a line for the entire distance of the course. They trained experienced bicycle riders to follow the line, while others collected and analyzed their data. In Los Angeles the choice of line was left to the individual measurers. It has been argued that our way was better because the measurements were thus "independent". On the other hand, if a painted line is not straight it is obvious to all and easy to correct before it is measured. I believe the Korean procedure was superior to our own. At the same time, I'm certainly not ashamed of how we did, and the Koreans must have felt the same way, since they followed our method to the letter, while adding the painted-line refinement. Thus is progress made.

Second, the measurements show that an expertly-measured straight-line distance is just as likely to measure out short as long. The measured distance depends to a large extent on who does the measuring and what calibration course is used.

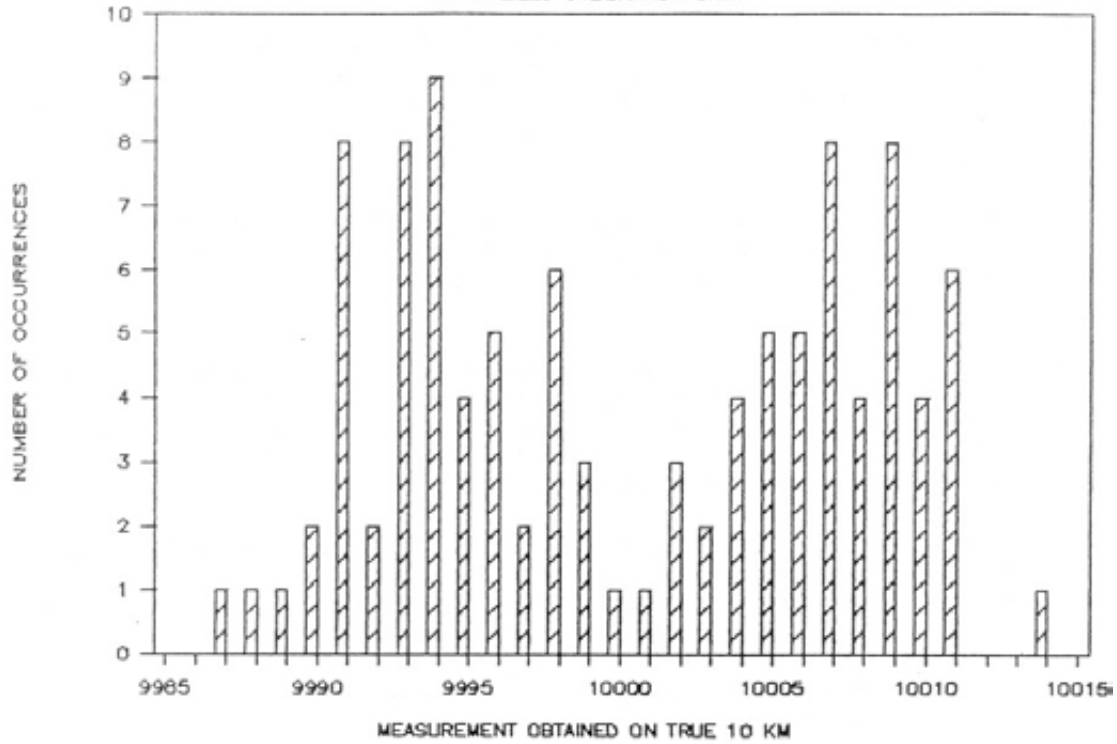
The reason for the greater spread in the Los Angeles data is that morning calibrations were made in cool/drizzly conditions, while in the afternoon it was warm and clear. In Seoul conditions were clear and dry with little temperature change. Both measurements reflected conditions we find when we measure and validate courses.

## THE TAC CONVENTION

It will be held November 28-December 3, 1988, at the Sheraton-Phoenix Hotel, in Phoenix, AZ. The RRTC meetings will take place on Wednesday, November 30, 8:30-11 PM and Thursday, December 1, 8-11 PM. Anyone wanting a complete schedule of events (as of April 29), or further information, please write to TAC/USA, PO Box 120, Indianapolis, IN 46206.

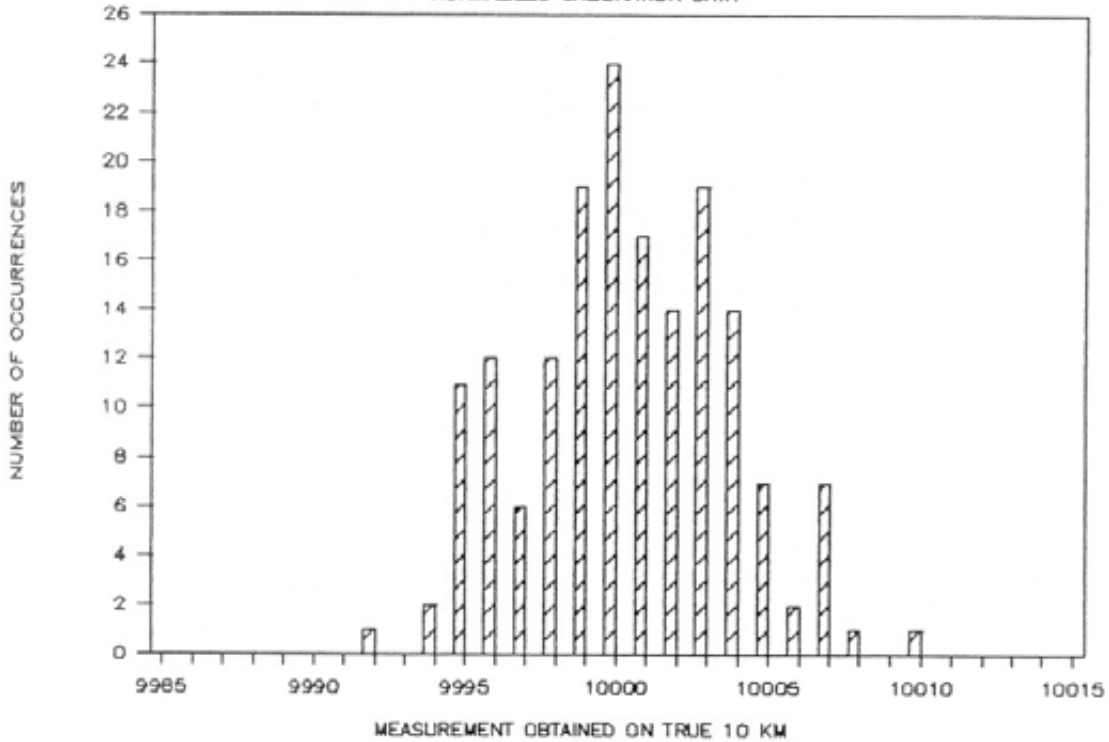
## LOS ANGELES OLYMPIC MARATHON COURSE

NORMALIZED CALIBRATION DATA



## SEOUL OLYMPIC MARATHON COURSE

NORMALIZED CALIBRATION DATA



## VALIDATION OF THE SEOUL OLYMPIC MARATHON COURSE

It's almost certain that the Seoul course won't be checked, even if someone should run very fast. The race is not an AIMS race, nor is it under TAC jurisdiction. IAAF and the IOC are in charge here, as they were at the 1984 Olympic Marathon in Los Angeles. To my knowledge IAAF has no requirement regarding marathon course length, except that it is supposed to be in the 42195 to 42237 meter range. No checking of an IAAF marathon course (let alone the Olympic Marathon) is yet required.

Both the Los Angeles and the Seoul courses were meticulously measured, each by 13 riders. Numerous on-course baselines were used, and conservative analytical methods were used to determine the actual measured length with great accuracy. Then a SCPF was added, and it was not a full 0.1 percent. Those in charge of both measurements concluded that a lesser SCPF was justified. In the case of Los Angeles, the SCPF was 25 meters. For Seoul it's 13 meters.

Both justified the smaller SCPF with statements that if the remeasurement was conducted as well as the layout, then the probability of the course being found short was negligible. This much is true. Both courses are almost certainly greater than 42195 meters in length.

Courses like these can cause problems in validation measurements. Why? Because it's extremely unlikely that any validator would be able to take the same pains with his checking as the original people did with their layout. It's most likely that a single validator would use a single calibration course, and do a standard 4 precal rides and 4 postcal rides, with a ride of the marathon course sandwiched in between.

A marathon with a 13 meter SCPF is like a 10k that's laid out at 10003 meters. Based on what we know about calibration variation, there's a fair chance that the Seoul course would flunk a validation check with such a skimpy SCPF. On the other hand, it's almost certainly not short.

There are many reasons why marathon courses come out with only 13 meters of SCPF. Usually it's because the original measurer intended to add 42 meters, but through bad procedure the course came out only 13 meters oversize. But bad procedure or good procedure, the course is still OK.

Does this example contain a hint concerning how validations should be interpreted? Would anyone seriously consider disallowing a WR on this course based on a borderline remeasurement by a single rider? Why not? Because we know, from the comprehensive measurement data that the course is almost certainly OK. On the other hand, if the remeasurement showed a conclusive difference, then disallowing the records might be justified.

Any course that has been approved as accurate by a governing body should receive the same consideration. A course should be considered as accurate until it is shown to be short or long. This leads to the need for a negative allowance on validation measurements, to take into consideration the accuracy of the method. It is silly to pretend to achieve accuracy beyond our means.

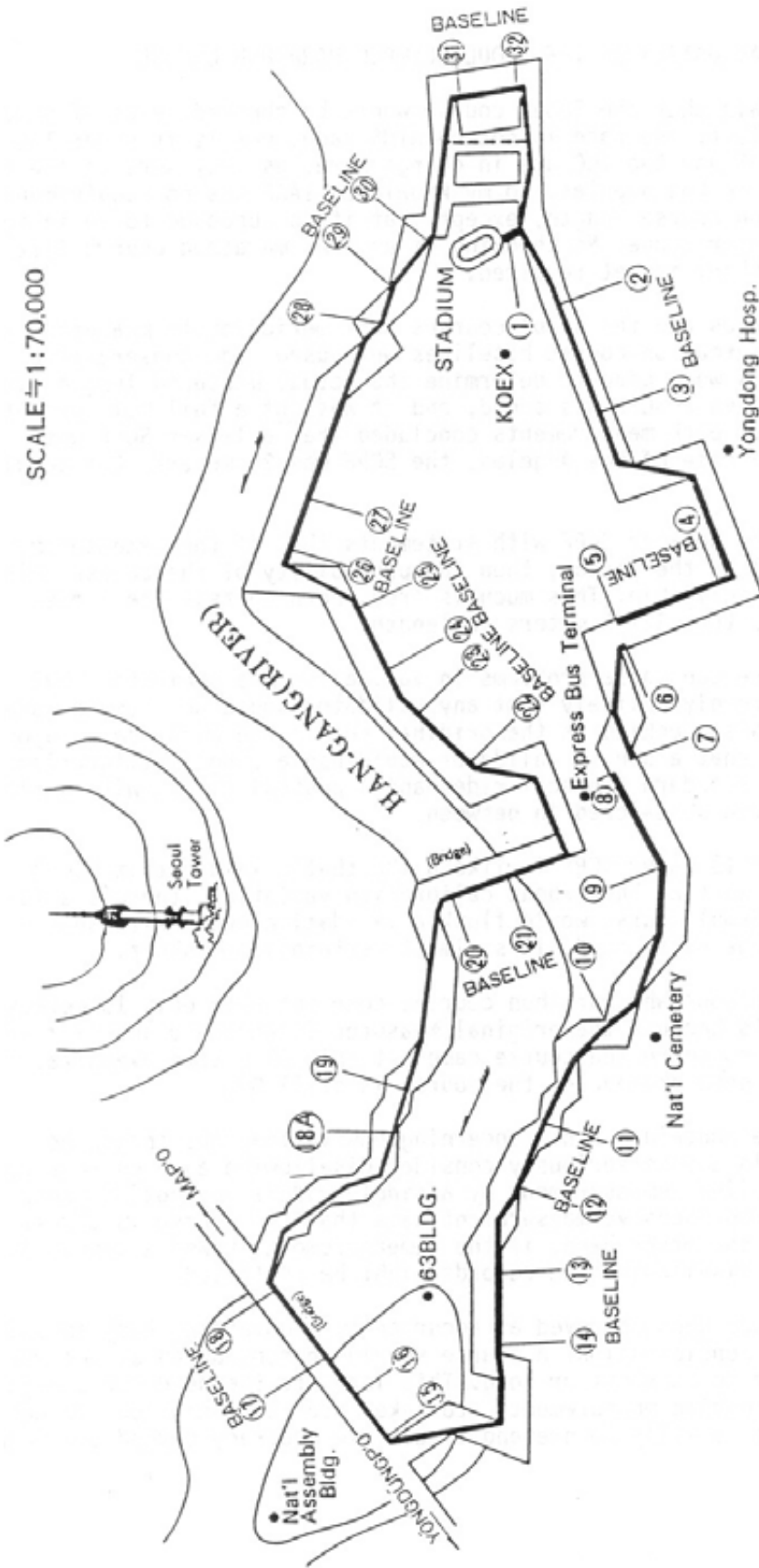


Fig 2-1 1988 SEOUL OLYMPIC MARATHON COURSE LOOP IS RUN CLOCKWISE

## "PLANNING ROAD RACES FOR THE COMPETITIVE RUNNER"

The above is the title of a short (39 pages) book written in 1980 by Ben Buckner. In the early 1970's Ben was one of the few people around who was adept at measuring courses and getting them certified. "Measured by Ben Buckner" on the race flyer meant the runner could count on an accurate course, such was his reputation. At one time all the accurate courses in central Ohio were measured by Ben, who has since moved to Tennessee and dropped out of course measurement.

Dr. Buckner instilled in me the knowledge of the value of an accurate course, and I owe him a lot for his advice over the years. He's an educator by profession (Geodetic Science) and a registered Professional Engineer and Surveyor. He has planned and laid out many race courses, and his book is a distillation of his experience as a measurer, road racer and race director.

Ben prefers the small local races to the mega-races, and his book is written with this in mind. It contains simple, common-sense instructions on how to do all the things that will make a race a good experience for the runner.

Some readers will take exception to some of his opinions. This is to be expected. The book was not written to please everybody, but to express his own experience and opinions concerning what makes a race good. Don't dismiss the book because of its minor flaws. It's the absolute best how-to-do-it guide to a director of a small race that I have ever seen. It's not complicated and it makes a lot of sense. Many of us old-timers could benefit from a look at it too.

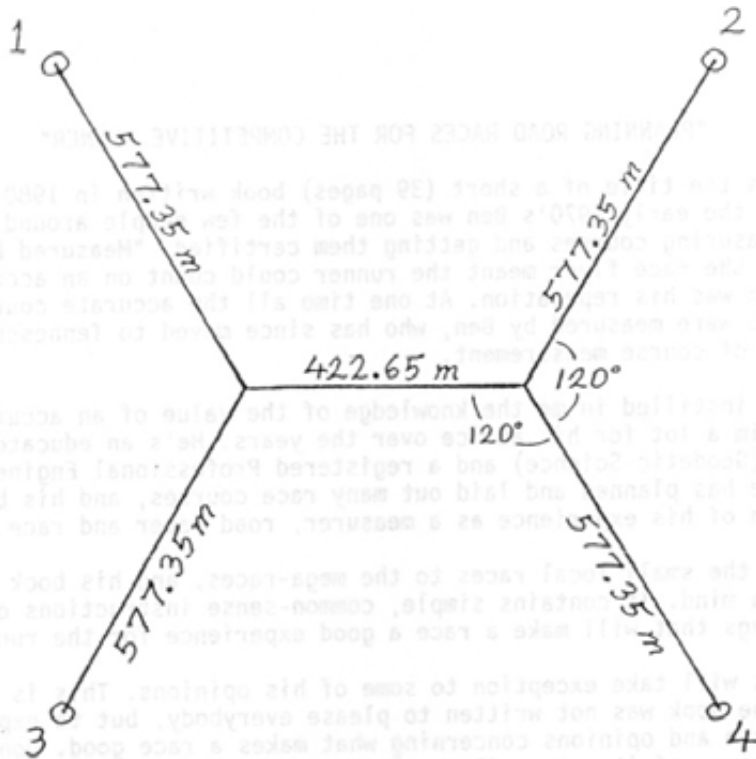
Because it's too good to languish in obscurity, I asked Ben if RRTC could reprint it for such distribution as we can give it. He said yes, and it's now available. For a copy, send \$5.00 to: Pete Riegel - 3354 Kirkham Road - Columbus, OH 43221. You won't be sorry.

## LAST MONTH'S PUZZLE

First answer received was from Alan Jones, who handed it to me at the RRCA convention the day after I handed him the May MN. The first mailed answer came from Chris English, who did it as a last-minute thing before he left for marriage and honeymoon. Good to see a puzzler with proper priorities. Both Chris and Alan used the "soap bubble analogy" to find the key geometry. Chris assumed it was correct and Alan proved it using calculus, for the assumed configuration. Brian Smith sent in an iterative solution that came up with the same answer. Next Bob Edwards sent in the correct solution, also using calculus to minimize length. Almost at press time, Dave Yaeger came in under the wire with the correct answer, although he didn't send a sketch of the path.

Bob BaumeI went one step further. Last month he introduced readers to "Fermat's Principle", and correctly deduced that the Editor did not have a clear grasp of it. This month Bob's physics lesson is the principle of "spontaneously broken symmetry", which was the subject of his PhD thesis. Like Alan, Bob noted the 120 degree angles and obtained the correct path length of  $2000\sqrt{2}$ . Since his solution was the prettiest, you see it here.





Notes: The Lengths labelled 577.35 m are actually  $1000/\sqrt{3}$  meters.  
 The Length labelled 422.65 m is actually  $1000 - 1000/\sqrt{3}$  meters.

The total path length in the above solution is approximately 2732.05 m, or  $1000 + 1000\sqrt{3}$  meters to be exact. I'm not sure whether this is truly the minimum path length solution, but it certainly does better than the two diagonals (total length about 2828.43 m, or  $2000\sqrt{2}$  meters to be exact).

The above solution is very interesting because of its close analogy to modern theories of elementary particle physics: First because it looks a lot like a "Feynman diagram", but more importantly, because it's a nice example of "spontaneously broken symmetry".

The problem as originally stated possesses all the symmetry of a square. The proposed solution formed by the two diagonals still has all the symmetry of a square, but doesn't have minimum path length. The solution depicted above has *less* symmetry than a square: Note that you can travel between houses 1 and 3, or between houses 2 and 4, by shorter paths than between any other pair of houses.

In addition to the solution depicted above, there's a second (inequivalent) solution obtained by rotating it 90°. In the rotated solution, you get the shortest trip between houses 1 and 2, or between houses 3 and 4. The contractor must choose which of the two solutions to actually build (perhaps based on how much the residents of the houses bribe him, according to the trips they want to take most often).

It is believed that the fundamental theory describing the interactions of elementary particles possesses more symmetry than is actually observed in nature. But when we look for the minimum energy solution (known as the "vacuum state"), we find not a single solution with all the symmetry of the originally stated theory, but a whole family of solutions, each "breaking" the symmetry in a different "direction". Nature has presumably chosen one solution from that family.

Bob Baumel

## MEASURERS FROM OUTER SPACE SEEK RRTC HELP!

A California measurer wrote with a special problem. She relates:

"While measuring a course late at night to avoid traffic I became aware of bright lights behind me. I pulled over to let them pass me safely, but soon found myself being approached by what I can only describe as a UFO. I was taken aboard, and after calming down was informed by the captain (a good-looking humanoid guy with a cute dimple) that since I was familiar with TAC measurement procedures, they wished me to perform a service for them.

The captain said 'RRTC is renowned throughout this galaxy for the accuracy of its techniques and the acumen of its practitioners. We have followed your measurement instructions to the letter and cannot make our course come out right. There is something strange about your earth that is keeping us from getting the course we need.'

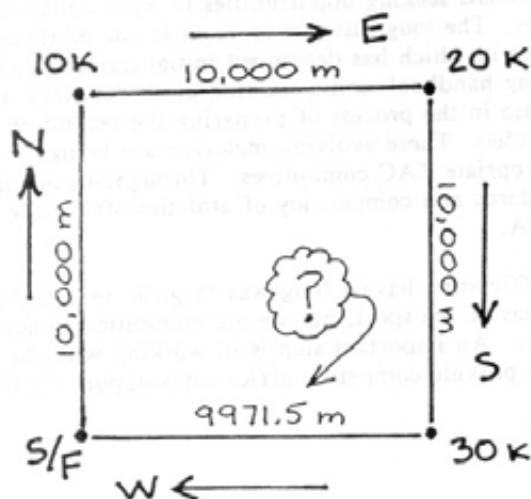
I asked what the problem was, and he said 'We want a 40 km course with a common start/finish. We used perfectly accurate bikes and perfect earth compasses. Starting at the S/F, we went 10000 meters north to the 10 km mark. Then we went 10000 meters east to the 20 km mark. Then we went 10000 meters south to the 30 km mark. Then we went west back to the S/F, but it only took 9971.5 meters to get there from the 30 km mark! Our course is short!!!

I explained some of the characteristics of our earth, and told him that their course was located at one specific point on it. He did not believe me, and said they required independent confirmation.

Help, RRTC buddies! The food is OK but the Aliens won't let me off this UFO to finish measuring my course until some bright measurer confirms the location of their course. Where is it?"

She further notes that the UFO folks will be reading MN for the answer, so have at it, puzzle maniacs. She needs our help!

HINT - Use 40000 km as Earth's circumference. The course is on dry land.  
SECOND HINT - Once you have have the answer you will never forget it.



WHERE  
ON EARTH  
IS THIS  
COURSE?



# The Athletics Congress of the USA

National Governing Body for Athletics in the U.S.

National Athletics  
Officials Committee

May 22, 1988

Mr. Peter S. Riegel  
Chairman  
Road Running Technical Committee  
3354 Kirkham Road  
Columbus, Ohio 43221

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Chairman  
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(413) 773-5512

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Redmond, WA 98052  
(206) 885-5325

Charles M. Ruter  
Administrator  
P. O. Box 91053  
Fern Creek, KY 40291  
(502) 239-5256

Dear Pete:

Thank you for your prompt response to the draft handbook. In your letter to Jennifer you implied a hope (and expectation) that my motives were properly intended. In assuring you of this, I thought it would be useful to summarize the evolution of events and decisions leading us to the present course of action.

When this project was started, it was initially intended to be used in training the 2,700 volunteers for the 1984 Women's Olympic Marathon Trials. In 1985, I was elected to the responsibility of coordinating training for TAC's National Athletics Officials Committee (NAOC). Under our Committee's bylaws this position is responsible for developing training materials and clinic aids covering all aspects of TAC officiating. Since then, we have sought to achieve this objective.

The 1985 election was a watershed event for NAOC. Up to that time, Committee officers were appointed by the President of TAC. This arrangement had led to an erosion of association participation and interest in the development of a national athletics officiating program. Realizing that it was time for TAC officials to take charge of their destiny, to become more fully integrated within the body of TAC, and to develop a national officiating training program, NAOC received TAC's blessing to implement a new set of bylaws. These bylaws restructured the Committee and gave association representatives the primary role in the selecting Committee officers.

This combination of a revised mission and a desire for a more integrated approach has resulted in the officials seeking opportunities to work collaboratively with other TAC committees. The long distance segment is one of three areas our Training Subcommittee in which has developed initial training guides. The others are a race walk judging handbook and a training guide for track and field officiating. We are also in the process of preparing the second of three editions of a four-unit training video. These evolving materials are being developed in conjunction with appropriate TAC committees. Throughout, our primary goal has been to raise the standards and competency of athletics officiating in all venues governed by TAC/USA.

In all candor, we in officiating have a long way to go in re-establishing our credibility in some areas of the sport, but we are committed to actively playing our part in this process. An important step is in working with the long distance running community to provide competent officiating support for high profile TAC sanctioned events.

Mr. Peter S. Riegel  
May 22, 1988

We recognize the sensitivities in this area of endeavor and are willing to proceed carefully. It is clear that there are many who would find it more helpful if TAC's NAOC stayed completely out of the long distance environment. This perspective appears to prefer a more informal approach to governing road races. However, I think that it is useful to consider the following points:

1. The stakes and profile of long distance running events are getting higher. Performance-related prize money, endorsement opportunities, ranking systems and team selections are changing the nature of long distance running. With these changes come increased expectations on the race organization and the sport's governing body.
2. To avoid chaos and ensure fair competitive opportunities for all, every major sport, including long distance running, has developed a set of competition rules with procedures for their enforcement.
3. If rules are to be fair and credible, there must be a means for their objective and competent enforcement.

Consequently, if we accept that there is a need for officials, then these officials should receive the highest quality training and support we can provide. Such an approach offers the best assurance that in a race situation the individual official is prepared to objectively and competently carry out her/his duties and responsibilities. It is to this end that NAOC is implementing its training charge and the current plan of action.

That is the *sales pitch*, clear and simple.

Our hope and expectation is that we can get across that we are not interested in any power plays or feel that it is appropriate for the central authority of the race director to be undermined. In all our training information, we directly address the danger of the "supercop" mentality in officiating. Instead, we stress that our role is to be complementary and supportive. The clinic handbook specifically notes that in long distance running the official is to work under the direction and authority of the race director. I would sincerely welcome any recommendations you have to further reduce the level of concern.

Again, thank you very much for your investment of time, effort, and common sense recommendations and advice. By working together we can accomplish much while sustaining that which is special in our sport. Let's keep in touch!

Sincerely,



Lawrie G. Robertson  
Vice-Chairman for Training  
TAC/USA National Athletics Officials Committee

cc: Ken Caouette  
Jennifer Hesketh Young

CORREDORES DE RUA DO



**O DIA**

26 de junho 1988

Andy Galloway  
Secretary  
Association of International Marathons  
P.O. Box 10-106  
Hamilton  
New Zealand

Rio, 23rd September 1987

Dear Andy,

The Rio de Janeiro Road Runners Club are proud of their new marathon with its new starting time and new course - an extremely varied authentic loop course proved also to be fast by the new Brazilian female record of 2:42:31 established by Angelica de Almeida, and by Walmir de Carvalho's reasonable winning time (considering he led the race the whole way without being threatened) of 2:18:38.

We are enclosing the following documents:

1. Official certificate of standard quilonetre.
2. Detailed map of course.
3. Start and Finish Area inside stadium (Sambadrome).
4. Details of course certification.
5. Official results.

From now on the "Maratona da Cidade" (popular name for our race) is registered under the organisation of the Rio de Janeiro Road Runners' Club together with other important races in our city which will, at the first opportunity, become affiliated to AIMS, They are:

1. Carnival Race - 5 miles 02/11/88.
2. Rio-Niterói Bridge Race (Half Marathon) 05/29/88.
3. Barra da Tijuca Half Marathon 07/31/88.

Our organisation has been organising road races in Rio de Janeiro over the last seven years with a calendar of approximately twelve races a year, involving some 8,000runners.

By coincidence, this week we organized the second international road mile race in this city, connected with the annual Ford-Adidas Meet that takes place in São Paulo (hoping to be included in the International Grand Prix).

Concerning our certification, we believe we had ideal work conditions and police protection on the night of July 2nd.

Therefore, observing the results, it would appear that the measurement obtained by the cyclists was so close to the ideal that we can discard up to 31 meters of the safety margin we had thrown in, as you were not here before the marathon.

Peter Riegel will be pleased to know that our Gabriel Monteiro continues to improve from one course measurement to the next.

We believe that this is the result of a long job of planning and studying course details, always taking the runners into consideration. For five months we made studies assisted by the Traffic Department in an effort to minimize the interference with city life on a totally flat course, with only three ascents and descents on fly-overs (4.5m high) at 2, 7 and 26 k and a stretch of downhill between 29 and 30 k.

Other subjects:

1. We would like to receive the Buenos Aires Marathon certification report and course alterations. We take this opportunity to greet the young cyclist Alberto as an AIMS measurer, and would like his address for exchange of information.

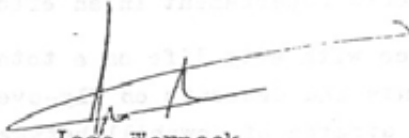
2. As an AIMS representative Rodolfo observed the Rio Marathon on the 22nd August. He didn't notice any change in the course in relation to the certification Allan Steinfeld did in 1985. But for 1988 there will be changes requested by the Copacabana Residents Association, and by the Police for better traffic control, making it necessary to have a new course measurement and certification.

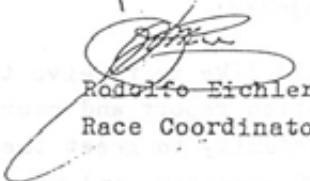
3. Another piece of news we would like to mention is the most recent request for affiliation of a well organized South American Marathon, with a point to point course. The name of the race is the Blumenau Marathon which will take place on October 12th and coincides with the festivities of the October Fest'87 (programme enclosed) of the German colony of the city of Blumenau in the State of Santa Catarina (approximately 600 km from São Paulo and 1.000 km from Rio). Jose will send the payment and the official affiliation request as soon as possible and the course measurement will take place next week.

From the foregoing news you can get some idea of the growth of our movement in this continent.

We await news of the Board of Directors meeting in Glasgow.

Best regards.

  
Jose Werneck.  
Race Director.

  
Rodolfo Eichler.  
Race Coordinator.

Rio, May, 4, 1988

Dear Pete,

If my letter is printed in your "letters" columns, I would like to make myself available to help any AIMS or TAC measurer who is planning to run a Marathon in Brazil. I could help them with advise, accomodation, etc.

Looking forward to hearing from you.

Rodolfo Eichler

  
coordenator

CITY OF RIO DE JANEIRO MARATHON



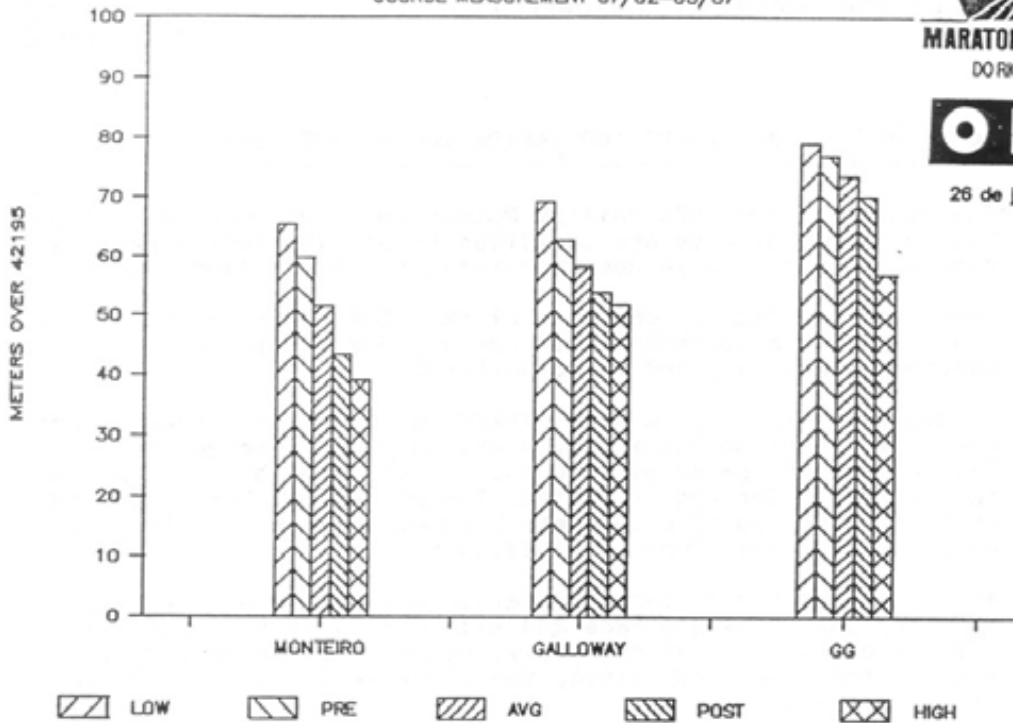
MARATONA DA CIDADE  
COURSE MEASUREMENT 07/02-03/87



MARATONA DA CIDADE  
DO RIO DE JANEIRO

**O DIA**

26 de Junho 1988



METERS OBTAINED ON COURSE USING DAYS AVERAGE CONSTANT

	GM	AG	GG
0			
5	5005.870	5007.013	5006.703
10	5005.558	5005.247	5006.703
15	5006.495	5007.428	5007.755
20	5007.120	5007.532	5009.333
25	5008.057	5007.740	5009.438
30	4980.982	4981.557	4984.304
35	5025.863	5027.378	5027.946
40	5006.911	5008.571	5013.118
42.195	2199.700	2201.049	2203.433
TOTAL	42246.56	42253.51	42268.73

MEASURED DISTANCE ON COURSE, METERS

BASED ON	GM	AG	GG
LOW	42260.31	42264.49	42274.29
PRECAL	42254.81	42257.91	42272.07
DAYS AVG	42246.56	42253.51	42268.73
POSTCAL	42238.31	42249.12	42265.40
HIGH	42233.91	42246.93	42252.07



DIPL.-ING. HELGE IBERT  
BERATENDER INGENIEUR FÜR BAUWESEN VBI

WESTENDALLEE 100 D  
D - 1000 BERLIN 19  
TEL. (030) 304 08 71

POST-RACE REMEASUREMENT AND VALIDATION OF THE 1988 ROTTERDAM MARATHON

---

The course of the 1988 Philips Rotterdam Marathon held on Sunday, April 17, had not been measured and certified by an AIMS course measurer before the race as it should have been according to IAAF & AIMS regulations.

Therefore Ted Paulin, chairman of the AIMS Technical Committee, arranged a post-race remeasurement with Mario Kadiks, Rotterdam Race Director, by sending John Disley and me to Rotterdam.

On Saturday, May 14, we were picked up at the Amsterdam airport by Mario Kadiks and went to Rotterdam, where we first checked the calibration course laid out on the paved bicycle path of the Kade by Mr H. H. Andrik, head of the Rotterdam Surveyor's Office. The course had been measured by EDM, and checking it by using a 50 m steel tape, we found a sufficient accordance with the official length of 1088.54 m.

Afterwards in the Rotterdam Marathon Office, we watched the video film which showed the whole race and all details of the course like coned lanes, U-turns and so on. Unfortunately, no good course maps were available where these details had been fixed, therefore we had to rely on our notes taken while watching the film.

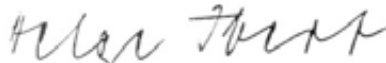
John got a fine bicycle from Mr Dick van Maaren to mount his special solid tyre front-wheel, and I mounted my Jones Counter on a rented Dutch bicycle without gear-change and without front-wheel brake.

After a very short night we went out at 2:00 a.m. on Sunday, calibrated the bicycles in the dark in presence of officials of the Dutch Track and Field Federation, and then started measuring at 3:40 a.m., well protected by two policemen with their motorcycles, accompanied and guided by Mario Kadiks and Jos Hermens.

Along the course we had no problems with traffic, parking cars or other obstacles, and so we reached the finish line about 6:40 a.m. and went to the calibration course again. During the measurement all the figures were read and recorded by the officials of the Dutch Federation.

The values can be found in the attached data sheets and summary. Obviously, the local measurers had not used a proper short course prevention factor, because the results of our measurement are very close to the margin. On the other hand, due to the excellent conditions during the remeasurement we may suppose the course is not short.

Signed: \_\_\_\_\_



Date: \_\_\_\_\_

MAY 17, 1988

Helge Ibert, IAAF & AIMS Course Measurer  
Westendallee 100 d, D-1000 Berlin 19 (FRG), Phone (030) 304 08 71

## CERTIFICATION OF ROAD RACE COURSES

Validation Measurement using the Calibrated Bicycle Method (Jones Counter)

Race: PHILIPS MARATHON ROTTERDAM 1988 Race Day: April 17, 1988  
 Start: Coolsingel (East side), 80 m north of the finish line  
 Finish: Coolsingel (East side), in front of Town Hall

1. Measurer: Helge Ibert, Berlin (FRG), AIMS & IAAF Course Measurer  
 2. Measurer: John Disley, London (GBR), AIMS & IAAF Course Measurer  
 Local Measurer: Dick van Maaren, Rotterdam Marathon, Technical Committee

Calibration Course: Rotterdam, Doen Kade (bicycle path) Length: 1088.54 m

		Counts for Measurer # 1	Counts for Measurer # 2
Pre-Cal.	2:20 a.m. 20°C	ø 10118.00	ø 10081.75
Post-Cal.	7:00 a.m. 16°C	ø 10119.25	ø 10081.75
		Average 10118.63	Average 10081.75
Constant for the Day:		per km 9295.59	per km 9261.72

Split Point	Recorded Digits	Elapsed Digits	Distance (m)	Recorded Digits	Elapsed Digits	Distance (m)
Start	70 000			08 000		
km 5	116 535	46 535	5006.14	54 343	46 343	5003.72
km 10	163 085	46 550	5007.75	100 722	46 379	5007.60
km 15	209 512	46 427	4994.51	146 976	46 254	4994.11
km 20	255 935	46 423	4994.09	193 222	46 246	4993.24
km 25	302 454	46 519	5004.41	239 558	46 336	5002.96
km 30	348 932	46 478	5000.00	285 871	46 313	5000.48
km 35	495 390	46 458	4997.85	332 182	46 311	5000.26
km 40	441 887	46 497	5002.05	378 506	46 324	5001.66
Finish	462 312	20 425	2197.28	398 850	20 344	2196.57
<b>Total</b>		<b>392 312</b>	<b>42204.08</b>		<b>390 850</b>	<b>42200.60</b>

**Conclusions:**

The measured distance is correct within the interval 42195.0 to 42237.2 m. In accordance with IAAF & AIMS regulations it is highly recommended that at least 35 m be added to the present course length if the course is to be used for future races.

Signed: Helge Ibert Date: MAY 15, 1988  
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