



INTERNATIONAL ROAD COURSE MEASUREMENT SEMINAR

Vancouver, British Columbia

CANADA

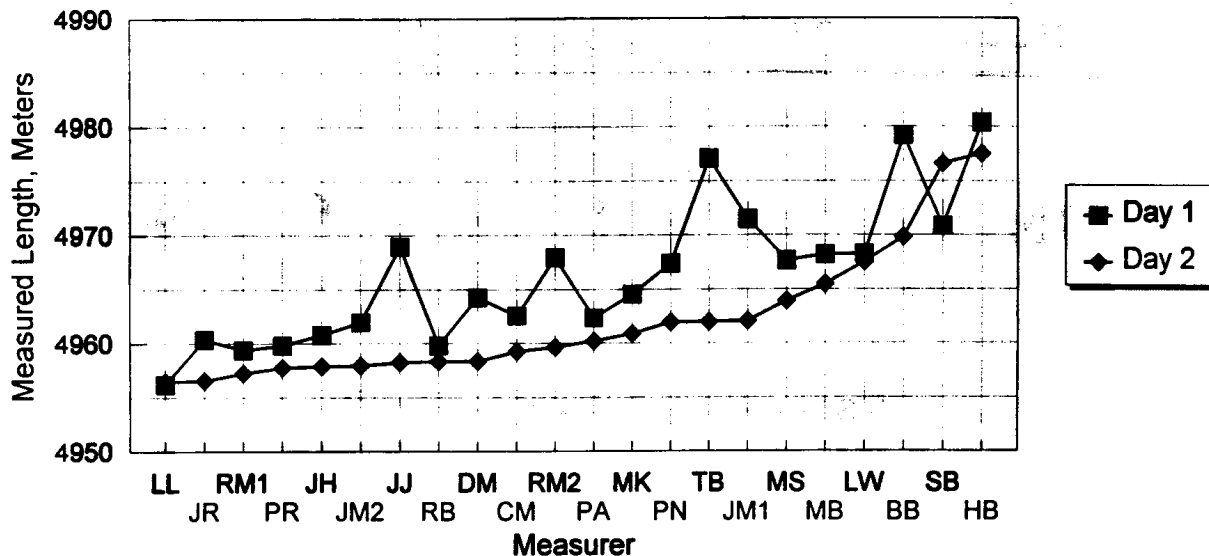
April 30 - May 1, 1999



RESULTS OF MEASUREMENTS

VANCOUVER MEASUREMENT SEMINAR

Results of Measurements



Measurer	Day 1	Day 2
LL	4956.2	4956.5
JR	4960.4	4956.6
RM1	4959.4	4957.2
PR	4959.8	4957.8
JH	4960.8	4957.9
JM2	4962.0	4958.0
JJ	4968.9	4958.3
RB	4959.8	4958.3
DM	4964.3	4958.4
CM	4962.6	4959.3
RM2	4967.9	4959.6
PA	4962.4	4960.2
MK	4964.6	4960.9
PN	4967.4	4962.0
TB	4977.1	4962.0
JM1	4971.5	4962.1
MS	4967.7	4964.0
MB	4968.2	4965.5
LW	4968.2	4967.5
BB	4979.2	4969.8
SB	4970.8	4976.6
HB	4980.4	4977.5

AIMS/IAAF INTERNATIONAL MEASUREMENT SEMINAR

Vancouver, British Columbia, CANADA

April 30 - May 1, 1999

Organization of the Seminar

Last fall I was asked by Gordon Rogers, AIMS Technical Director, whether I would be willing to come to Vancouver to give a measurement seminar. I responded with an enthusiastic "yes." Gordon put me in touch with Jerry Tighe, head of Run Canada, who was responsible for the general organization of the seminar. Jerry advertised, and 21 participants registered for the seminar. Of these, three were from the USA, one from Mexico, and the rest were Canadians.

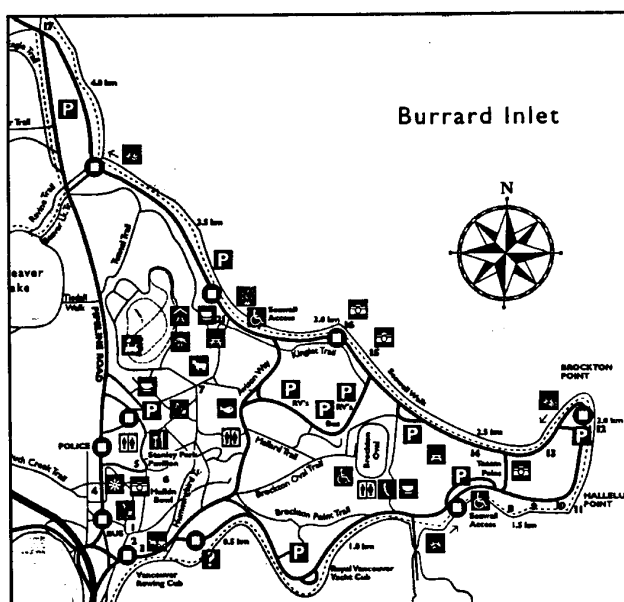
The Venue

The seminar was held in the Community Centre on Denman Street and on the eastern roadways of Vancouver's Stanley Park. Jerry supplied me with maps ahead of time so I could plan a test course. I had originally intended to use the bike path, but was talked out of it, as this path is always full of bikers and dog-walkers who sometimes get resentful when measured.

The course was approximately 5 km, making a loop beginning at the north end of Pipeline Road, heading south, and following the shoreline road eastward to Brockton Point, then northwest to the end of the loop.

Preliminary Preparation

Before the seminar, a general outline of the work, and a statement of requirements, was sent to Jerry. When I arrived everything was ready. Jerry had arranged with Alley Cat Bicycle Rentals for a fleet of mountain bikes to be made available for the seminar. Jerry mounted Jones/Oerth counters to most of the bikes so that everything would be ready when we were. Some attendees brought their own bikes.



Conduct of the Seminar

Friday, April 30 - Participants assembled at the Community Centre on Denman Street, near Stanley Park. I was introduced, made some preliminary remarks, and passed out copies of *Course Measurement Procedures*, the US measurement book, *The Measurement of Road Race Courses*, the IAAF book, and *Measurement News*. I explained briefly what I was going to do, and we left for Alley Cat to pick up our bikes.

We rode to Stanley Park, and proceeding north of the bridge which crosses the stream from Beaver Lake I laid out a 300 meter calibration course. I then asked the group to split up into teams and check the length of what I had laid out. I also asked a team to lay out a parallel calibration course on the other side of the road, so we would have two calibration courses and could use one-way traffic on them while calibrating, a necessity with many riders and short time. Agreement of all measurements was good, and I decided that we would call both calibration courses "300 meters" for instructional purposes. Temperature correction was mentioned. The students were advised to study the book. Complete

explanation is very time-consuming, and the time was better spent in practical measurement.

Once the calibration courses had been marked with a PK nail at each end, I asked the students to follow me on their bikes as I rode around the course. I asked them to note carefully the way I was riding - I was following the shortest possible route, from curb to curb. At the end of this ride we rode to the Community Centre for a good lunch.

After lunch we returned to Stanley Park, and we all calibrated our bikes. I laid out splits at 1, 2, 3, 4 and 5 km as well as a 1 mile split. The students followed me on this ride, each stopping at the same points where I had laid down a split. I told them not to do any calculation until they were done gathering data, as calculation slows things down. We had a lot of measuring to do, and little time. When all had completed the ride, we went to the Community Centre, where the measurers did their calculations.

I asked each measurer to give me his on-site estimate of the course length, and collected from each a copy of their raw data, for use in preparing this report.

I asked the measurers to try to read, or at least scan through, *Course Measurement Procedures*, so as to better understand what they had done and be better prepared for the next day.

Saturday, May 1 - On Saturday morning we met briefly at the Community Centre, where we discussed what we were going to do - individual measurements of the test course. The mood this day was much less nervous than on Friday. The measurers were much more sure of themselves, and the measurement results showed a great improvement. The spirit of competitiveness was present, and people appeared to be taking pleasure in the exercise. Once everybody had completed their measurement of the course we returned to the Community Centre for lunch.

After lunch I again asked everybody to record their data and give it to me, and to calculate their measured length of the course. Nearly everybody showed a significant improvement of the first day's measurement, indicating that they had a better understanding of how to follow the shortest possible route.

With that done, free-flowing discussions of various measurement topics followed. Considerable interest was expressed by some of the Canadian measurers in improving their course certification system. With such a large nucleus of measurers present, and the support of Run Canada, I expect they will find a way to improve things.

Discussion of Results

Results of the measurements are shown following this report. Included are:

- 1) List of Measurers
- 2) Measurement of the calibration course
- 3) Measurement results from day 1
- 4) Measurement results from day 2

On return home, I used the counts obtained by each measurer to correctly calculate each distance, using a computer. Sometimes the computer value does not agree with the value that was calculated by the measurer. In these cases, the measurer made some sort of mistake. Some common mistakes were:

- Transposing numbers, or incorrect recording. I made this mistake myself in laying out the 5 km split. I correctly calculated a count of 108690 but wrote it down as 106890, and stopped at that count. That caused the general error in the 5 km split.
- Rounding off calibration figures prematurely
- Incorrect calculation of calibration figures
- Incorrect calculation of distances
- Loose riding - failure to follow the shortest possible route.

The small (about 9 meters) error in the placement of the 1 mile split happened because the split would have fallen in the

middle of a tangent crossing the road, and I did not wish everybody to stop there. Accordingly, I stopped at the last available curbside position. I also did this at 4 km.

Each measurer should study his numbers, and compare them to the computer calculations. Where there is a difference, checking the calculations will discover the reason for the difference.

What is the length of the course? No one can say with certainty, but my estimate is about 4958 meters. There is no clearly-defined way to calculate course length when many measurements exist. One method is to throw away the obvious outliers and use the median measurement of the rest. This is generally reliable. Other methods have been proposed, but ultimately some judgement must be used.

Most of the measurers had numbers in reasonable agreement with this. The rest of the measurers will improve with more practice. **In only one day we saw an enormous improvement - more riding practice will certainly improve each measurer's riding.**

I believe that all participants have now learned the most important part of course measurement - the riding of a tight, correct line. All the calculation in the world cannot correct a bad measurement. The participants are ready for more measurement work. And all are now officially proclaimed as IAAF/AIMS measurers, grade "C."

Upgrading from "C" to "B"

Each measurer was given a copy of the US measurement book *Course Measurement Procedures*. In this book are instructions and forms. Students are encouraged to submit measurements to me using these forms, as if applying for USATF certification of their courses. After a student has successfully applied for and been granted 4 or 5 USATF certificates, I will see that they are upgraded from "C" level to "B" level.

A Personal Note

I had a wonderful time conducting this seminar. All of the measurers were enthusiastic and eager to learn, and many perceptive questions were asked. This is a good sign - an inquiring mind will learn quickly. The improvement between Day 1 and Day 2 was impressive. I was very happy to see it. I am confident that as the measurers work in their countries they will improve. In many cases little improvement is possible, as the results showed they are already well along.

My thanks to Jerry Tighe and Gordon Rogers, without whose work this seminar would not have happened. I'd have hated to miss it.



Peter S. Riegel
IAAF Road Course Measurement Area Administrator
Americas

Copies of this report sent to:

All seminar participants
Jerry Tighe, BC Athletics
Gordon Rogers, Chairman, AIMS Technical Committee
Hugh Jones, Secretary, AIMS
Pierre Weiss, General Director, IAAF
IAAF Area Measurement Administrators
Jean-Francois Delasalle
John Disley
Dave Cundy

VANCOUVER MEASUREMENT SEMINAR

DATA AND CALCULATIONS FROM APRIL 30, 1999

PA	RB	MB	HB	BB	SB	TB	JH	JJ	MK	LL
Paul	Randy	Mike	Helen	Bob	Steve	Todd	Jim	Jim	Milos	Laurent
Adams	Bannister	Bjelos	Brewer	Britton	Brown	Byers	Helten	Jones	Kostic	Lacroix

Calibrations are based on a calibration course of 300 meters. The resultant average of the four rides is divided by 300, and the answer then multiplied by the 1.001 "short course prevention factor." This yields the "constant," expressed in counts per meter.

Pre-measurement calibrations

	3608	2896	2849	3487	3525	3417	3541	2842.5	3615	3550.5	2898.5
	3607	2895.5	2848	3483	3525	3419	3542	2842	3614	3551.5	2899.5
	3608	2896	2848	3482	3526	3416	3541	2841.5	3615	3550.5	2899.5
	3608	2896	2848	3483	3525	3417	3541	2843	3615	3550.5	2899
Average	3607.75	2895.875	2848.25	3483.75	3525.25	3417.25	3541.25	2842.25	3614.75	3550.75	2899.125
Counts/meter	12.03786	9.66257	9.503661	11.62411	11.76258	11.40222	11.81597	9.483641	12.06122	11.84767	9.673414

Post-measurement calibrations

	3607	2895.5	2847	3485	3524	3417	3542	2841	3615	3550	2899.5
	3606	2896.5	2848	3475	3525	3415	3542	2838	3618	3546	2899.5
	3606	2896	2847	3485	3525	3415	3546	2841.5	3616	3549	2899
	3608	2896	2847	3485	3525	3416	3545	2839	3617	3549	2899
				3484							
Average	3606.75	2896	2847.25	3484.75	3524.75	3415.75	3543.75	2839.875	3616.5	3548.5	2899.25
Counts/meter	12.03452	9.662987	9.500324	11.62745	11.76092	11.39722	11.82431	9.475716	12.06706	11.84016	9.673831

Day's constant (average of precal and postcal)

Counts/meter	12.03619	9.662778	9.501993	11.62578	11.76175	11.39972	11.82014	9.479679	12.06414	11.84392	9.673622
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COUNTER READINGS OBTAINED DURING THE MEASUREMENT

Start	54700	45000	72609	58669	50690	53219	53700	90500	55573	54240	57000
1 km	66724	54659	82110	70302	62457	64627	65524	99977	67631	66072	66674.5
1 mi	73947.5	60463	87826	77347	69573	71494	72628	105670	74897	73194	72460
2 km	78782.5	64310	91650	82016	74298	76078	77392	109470	79746	77943	76330.5
3 km	90814.5	73997	101175	93656	86125	87520	89305	118957	91849	89811	86001
4 km	102832.5	83624	110647	105237	97874	98893	101081	128400.5	103870	101609	95637
5 km		91843	118746	115124	107895	108603	111159	136465.5	114139	111695	103866
End	114428	92925.5	119817	116570	109254	109885	112530	137526.5	115519	113040	104944.5

LENGTHS OF SEGMENTS EXPRESSED IN COUNTS

Start											
1 km	12024	9659	9501	11633	11767	11408	11824	9477	12058	11832	9674.5
1 mi	7223.5	5804	5716	7045	7116	6867	7104	5693	7266	7122	5785.5
2 km	4835	3847	3824	4669	4725	4584	4764	3800	4849	4749	3870.5
3 km	12032	9687	9525	11640	11827	11442	11913	9487	12103	11868	9670.5
4 km	12018	9627	9472	11581	11749	11373	11776	9443.5	12021	11798	9636
5 km		8219	8099	9887	10021	9710	10078	8065	10269	10086	8229
End	11595.5	1082.5	1071	1446	1359	1282	1371	1061	1380	1345	1078.5

LENGTHS OF SEGMENTS EXPRESSED IN METERS

Start											
1 km	999.0	999.6	999.9	1000.6	1000.4	1000.7	1000.3	999.7	999.5	999.0	1000.1
1 mi	600.1	600.7	601.6	606.0	605.0	602.4	601.0	600.5	602.3	601.3	598.1
2 km	401.7	398.1	402.4	401.6	401.7	402.1	403.0	400.9	401.9	401.0	400.1
3 km	999.7	1002.5	1002.4	1001.2	1005.5	1003.7	1007.9	1000.8	1003.2	1002.0	999.7
4 km	998.5	996.3	996.8	996.1	998.9	997.7	996.3	996.2	996.4	996.1	996.1
5 km		850.6	852.3	850.4	852.0	851.8	852.6	850.8	851.2	851.6	850.7
End	963.4	112.0	112.7	124.4	115.5	112.5	116.0	111.9	114.4	113.6	111.5
Total	4962.4	4959.8	4968.2	4980.4	4979.2	4970.8	4977.1	4960.8	4968.9	4964.6	4956.2
On-site estimate	4962.3	4959.8	4968.2	4935.5	4978.5	4970.8	4977.1	4960.8	4969.8	4963.2	4849.6
Precal - postcal counts/kilometer	3.3	-0.4	3.3	-3.3	1.7	5.0	-8.3	7.9	-5.8	7.5	-0.4

 Anomalous value. Not used in calculations

VANCOUVER MEASUREMENT SEMINAR

DATA AND CALCULATIONS FROM APRIL 30, 1999

RM1 Rodolfo Martinez	CM Catherine Mather	JM1 John McBean	DM David McVicker	RM2 Ron Mierau	JM2 Jack Miller	PN Peter Nishihama	JR James Richards	PR Pete Riegel	MS Mark Smith	LW Les Wright
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Calibrations are based on a calibration course of 300 meters. The resultant average of the four rides is divided by 300, and the answer then multiplied by the 1.001 "short course prevention factor." This yields the "constant," expressed in counts per meter.

Pre-measurement calibrations

	3558	3512	3531	3535	3433	3532	3471.5	3026	3519	3505	3514
	3557	3513	3528	3534	3431	3527	3472.5	3027	3517	3503	3512
	3558	3512	3535	3532	3431	3532	3473.5	3030	3518	3503	3514
	3557	3510	3529	3530	3432	3529	3471.5	3027	3517	3504	3512
							3025				
Average	3557.5	3511.75	3530.75	3532.75	3431.75	3530	3472.25	3027	3517.75	3503.75	3513
Counts/meter	11.87019	11.71754	11.78094	11.78761	11.45061	11.77843	11.58574	10.10009	11.73756	11.69085	11.72171

Post-measurement calibrations

	3557	3512	3530	3531	used	3528	3470.5	3028	3515	3505	3514
	3558	3513	3530	3529	another	3529	3473.5	3027	3517.5	3504	3510
	3557	3511	3528	3530	bike	3529	3470.5	3026	3517	3510	3514
	3558	3511	3528	3531		3532	3514	3033	3519	3508.5	3512
								3033			
Average	3557.5	3511.75	3529	3530.25		3529.5	3471.5	3029.4	3517.125	3506.875	3512.5
Counts/meter	11.87019	11.71754	11.7751	11.77927	11.45061	11.77677	11.58324	10.1081	11.73547	11.70127	11.72004

Day's constant (average of precal and postcal)

Counts/meter	11.87019	11.71754	11.77802	11.78344	11.45061	11.7776	11.58449	10.10409	11.73652	11.69606	11.72088
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COUNTER READINGS OBTAINED DURING THE MEASUREMENT

Start	57906	49817	51650	53741	61646	69030	50143	15302	50000	52005	40380
1 km	69767	61526	63423	65514	73094	80799	61717.5	25402	61738	63692	52106
1 mi	76885	68559	70506	72577	80025	87866	68670.5	31468		70738	59139
2 km	81635	73256	75227	77307	84626	92591	73320	35517	73476	75432	
3 km	93516	84996	87036	89133	96088	104389	84947.5	45627	85214	87154	75617
4 km	105349	96677	98774	100880	107501	116116	96493.5	55694	96900	98813	87299
5 km	115434	106651	108794	110913	117241	126129	106349	64291	106890	108770.5	97280
End	116775	107966	110204	112237	118532	127470	107688	65422	108211	110107	98612

LENGTHS OF SEGMENTS EXPRESSED IN COUNTS

Start											
1 km	11861	11709	11773	11773	11448	11769	11574.5	10100	11738	11687	11726
1 mi	7118	7033	7083	7063	6931	7067	6953	6066		7046	7033
2 km	4750	4697	4721	4730	4601	4725	4649.5	4049	11738	4694	
3 km	11881	11740	11809	11826	11462	11798	11627.5	10110	11738	11722	16478
4 km	11833	11681	11738	11747	11413	11727	11546	10067	11686	11659	11682
5 km	10085	9974	10020	10033	9740	10013	9855.5	8597	9990	9957.5	9981
End	1341	1315	1410	1324	1291	1341	1339	1131	1321	1336.5	1332

LENGTHS OF SEGMENTS EXPRESSED IN METERS

Start											
1 km	999.2	999.3	999.6	999.1	999.8	999.3	999.1	999.6	1000.1	999.2	1000.4
1 mi	599.7	600.2	601.4	599.4	605.3	600.0	600.2	600.4		602.4	600.0
2 km	400.2	400.9	400.8	401.4	401.8	401.2	401.4	400.7	1000.1	401.3	
3 km	1000.9	1001.9	1002.6	1003.6	1001.0	1001.7	1003.7	1000.6	1000.1	1002.2	1405.9
4 km	996.9	996.9	996.6	996.9	996.7	995.7	996.7	996.3	995.7	996.8	996.7
5 km	849.6	851.2	850.7	851.4	850.6	850.2	850.7	850.8	851.2	851.4	851.6
End	113.0	112.2	119.7	112.4	112.7	113.9	115.6	111.9	112.6	114.3	113.6
Total	4959.4	4962.6	4971.5	4964.3	4967.9	4962.0	4967.4	4960.4	4959.8	4967.7	4968.2
On-site estimate	4959.4	4962.6	4971.5	4962	4967.9	4961.9	4959.8	4938.6	4959.8	4967.7	

Precal - postcal counts/kilometer	0.0	0.0	5.8	8.3	0.0	1.7	2.5	-8.0	2.1	-10.4	1.7
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 Anomalous value. Not used in calculations

VANCOUVER MEASUREMENT SEMINAR

DATA AND CALCULATIONS FROM MAY 1, 1999

PA	RB	MB	HB	BB	SB	TB	JH	JJ	MK	LL
Paul	Randy	Mike	Helen	Bob	Steve	Todd	Jim	Jim	Milos	Laurent
Adams	Bannister	Bjelos	Brewer	Britton	Brown	Byers	Helten	Jones	Kostic	Lacroix

Calibrations are based on a calibration course of 300 meters. The resultant average of the four rides is divided by 300, and the answer then multiplied by the 1.001 "short course prevention factor." This yields the "constant," expressed in counts per meter.

3609	2896.5	2849	3489	3532	3394.5	3543	2841	3642	3556	2899.5
3609	2895.5	2849	3487	3532	3395	3544	2838	3640	3555	2899.5
3610	2896	2849	3488	3530	3395.5	3544	2841.5	3640	3556	2899
3607	2896	2849	3489	3533	3394	3543	2839	3638	3556	2899

Pre-measurement calibrations

Average	3608.75	2896	2849	3488.25	3531.75	3394.75	3543.5	2839.875	3640	3555.75	2899.25
Counts/meter	12.0412	9.662987	9.506163	11.63913	11.78427	11.32715	11.82348	9.475716	12.14547	11.86435	9.673831

3609	2897	2850	3488	3531	3395	3544	2841	3639	3558	2900
3610	2895.5	2850	3490	3531.5	3393	3545	2843	3639	3556	2900
3608	2896	2850	3488	3530.5	3395	3544	2841.5	3637	3558	2900
3610	2896	2850	3489	3531	3395.5	3544	2839.5	3641	3556	2899.5
										2900.5

Post-measurement calibrations

Average	3609.25	2896.125	2850	3488.75	3531	3394.625	3544.25	2841.25	3639	3557	2900
Counts/meter	12.04286	9.663404	9.5095	11.6408	11.78177	11.32673	11.82598	9.480304	12.14213	11.86852	9.676333

Day's constant (average of precal and postcal)

Counts/meter	12.04203	9.663195	9.507832	11.63996	11.78302	11.32694	11.82473	9.47801	12.1438	11.86644	9.675082
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COUNTER READINGS OBTAINED DURING THE MEASUREMENT

			0.390656	3774.985	104232.5						
Start	50800	85000	85061	5530	52220	93500	96800	52130	87423	93247	76665
1 km	62829	94659	94569	17169	63999	104835	108623	61601	99557	105103	
1 mi	70063	100457.5	100282	24212	71083	111686.5	115716	67287	106834	112233	92129
2 km	74891	108325	104095	28885	75816		120454	71083	111702	116988	96000
3 km	86944	113988	113624	40596	87654	127618	132294	80562	123851	128867	105675.5
4 km	98941	123614	123103	52194	99397	138939.5	144075	89999	135945	140692	115313.5
5 km	109182	131831.5	131202	62156	109453	148596	154133	98059	146269	150778	123541.5
End	110531	132913.5	132272	63468	110779	149870	155474	99121	147635	152115	124619.5

LENGTHS OF SEGMENTS EXPRESSED IN COUNTS

Start											
1 km	12029	9659	9508	11639	11779	11335	11823	9471	12134	11856	
1 mi	7234	5798.5	5713	7043	7084	6851.5	7093	5686	7277	7130	15464
2 km	4828	7867.5	3813	4673	4733		4738	3796	4868	4755	3871
3 km	12053	5663	9529	11711	11838	15931.5	11840	9479	12149	11879	9675.5
4 km	11997	9626	9479	11598	11743	11321.5	11781	9437	12094	11825	9638
5 km	10241	8217.5	8099	9962	10056	9656.5	10058	8060	10324	10086	8228
End	1349	1082	1070	1312	1326	1274	1341	1062	1366	1337	1078

LENGTHS OF SEGMENTS EXPRESSED IN METERS

Start											
1 km	998.9	999.6	1000.0	999.9	999.7	1000.7	999.9	999.3	999.2	999.1	
1 mi	600.7	600.1	600.9	605.1	601.2	604.9	599.8	599.9	599.2	600.9	1598.3
2 km	400.9	814.2	401.0	401.5	401.7		400.7	400.5	400.9	400.7	400.1
3 km	1000.9	586.0	1002.2	1006.1	1004.7	1406.5	1001.3	1000.1	1000.4	1001.1	1000.0
4 km	996.3	996.2	997.0	996.4	996.6	999.5	996.3	995.7	995.9	996.5	996.2
5 km	850.4	850.4	851.8	855.8	853.4	852.5	850.6	850.4	850.1	850.0	850.4
End	112.0	112.0	112.5	112.7	112.5	112.5	113.4	112.0	112.5	112.7	111.4
Total	4960.2	4958.3	4965.5	4977.5	4969.8	4976.6	4962.0	4957.9	4958.3	4960.9	4956.5
On-site estimate	4960.2	4958.4	4965.5	4977.6	4969.8	4977.5	4962	4957.9	4958.3	4960.9	4967.5
Precal - postcal counts/kilometer	-1.7	-0.4	-3.3	-1.7	2.5	0.4	-2.5	-4.6	3.3	-4.2	-2.5

104235 would make things come out better. Possible misrecording

VANCOUVER MEASUREMENT SEMINAR

DATA AND CALCULATIONS FROM MAY 1, 1999

RM1	CM	JM1	DM	RM2	JM2	PN	JR	PR	MS	LW
Rodolfo	Catherine	John	David	Ron	Jack	Peter	James	Pete	Mark	Les
Martinez	Mather	McBean	McVicker	Mierau	Miller	Nishihama	Richards	Riegel	Smith	Wright

Calibrations are based on a calibration course of 300 meters. The resultant average of the four rides is divided by 300, and the answer then multiplied by the 1.001 "short course prevention factor." This yields the "constant," expressed in counts per meter.

3562	3521	3533	3537	3435	3532	3462.75	3031	3523.5	3513	3523
3564	3519	3533	3537	3433	3531	3466.75	3031	3522	3513	3523
3562	3521	3532	3533	3434	3532	3463.5	3030	3523	3510.5	3522
3564	3517	3533	3534	3433	3530	3462.5	3030	3522	3512	3524
							3029		3511	

Pre-measurement calibrations

Average	3563	3519.5	3532.75	3535.25	3433.75	3531.25	3463.875	3030.2	3522.625	3511.9	3523
Counts/meter	11.88854	11.7434	11.78761	11.79595	11.45728	11.7826	11.5578	10.11077	11.75383	11.71804	11.75508

3566	3519	3532	3534	3436	3532	3465.5	3029	3522.5	3510	3525
3565	3521	3533	3535	3436	3533	3465.5	3032	3524.5	3512	3525
3566	3519	3533	3533	3436	3530	3462.5	3041	3523	3511	3525
3565	3522	3533	3532	3436	3533	3466	3032	3523	3511.5	3524
							3037		3511.5	

Post-measurement calibrations

Average	3565.5	3520.25	3532.75	3533.5		3532	3464.875	3034.2	3523.25	3511.2	3524.75
Counts/meter	11.89689	11.7459	11.78761	11.79011	11.45728	11.78511	11.56113	10.12411	11.75591	11.7157	11.76092

Day's constant (average of precal and postcal)

Counts/meter	11.89271	11.74465	11.78761	11.79303	11.45728	11.78386	11.55946	10.11744	11.75487	11.71687	11.758
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COUNTER READINGS OBTAINED DURING THE MEASUREMENT

Start	40368	89145	50700	98359	13802	13178	94728	11373	76850	51965	56170
1 km	52249	100887	62483	110147.5	25257	24952	106312	21478	88598	63674	67925
1 mi	59372	107931	69575	117208.5	32121	32014	113240	27550	95651	70725	75034
2 km	64130	112638	74306	121927.5	36712	36735	117884	31602	100357	75425	79750
3 km	76027	124393	86107	133729.5	48177		129451	41714	112111	87166	91527
4 km	87874	136089.5	97840	145482	59598	60260	140961	51781	123818	98839	103241
5 km	97986	146076	107868	155515	69345	70280	150789.5	60381	133814	108813	113245
End	99323	147390	109191	156833	70626	71602	152085.5	61521	135128	110127	114578

LENGTHS OF SEGMENTS EXPRESSED IN COUNTS

Start											
1 km	11881	11742	11783	11788.5	11455	11774	11584	10105	11748	11709	11755
1 mi	7123	7044	7092	7061	6864	7062	6928	6072	7053	7051	7109
2 km	4758	4707	4731	4719	4591	4721	4644	4052	4706	4700	4716
3 km	11897	11755	11801	11802	11465		11567	10112	11754	11741	11777
4 km	11847	11696.5	11733	11752.5	11421	23525	11510	10067	11707	11673	11714
5 km	10112	9986.5	10028	10033	9747	10020	9828.5	8600	9996	9974	10004
End	1337	1314	1323	1318	1281	1322	1296	1140	1314	1314	1333

LENGTHS OF SEGMENTS EXPRESSED IN METERS

Start											
1 km	999.0	999.8	999.6	999.6	999.8	999.2	1002.1	998.8	999.4	999.3	999.7
1 mi	598.9	599.8	601.6	598.7	599.1	599.3	599.3	600.2	600.0	601.8	604.6
2 km	400.1	400.8	401.4	400.2	400.7	400.6	401.7	400.5	400.3	401.1	401.1
3 km	1000.4	1000.9	1001.1	1000.8	1000.7		1000.7	999.5	999.9	1002.1	1001.6
4 km	996.2	995.9	995.4	996.6	996.8	1996.4	995.7	995.0	995.9	996.3	996.3
5 km	850.3	850.3	850.7	850.8	850.7	850.3	850.3	850.0	850.4	851.3	850.8
End	112.4	111.9	112.2	111.8	111.8	112.2	112.1	112.7	111.8	112.1	113.4

Total	4957.2	4959.3	4962.1	4958.4	4959.6	4958.0	4962.0	4956.6	4957.8	4964.0	4967.5
On-site estimate	4961	4959.3	4962.1	4958.4	4961	4958	4960.2	4957.8	4957.8	4963.5	4967.3

Precal - postcal counts/kilometer	-8.3	-2.5	0.0	5.8	0.0	-2.5	-3.3	-13.3	-2.1	2.3	-5.8
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CALIBRATION COURSE LENGTH

Two parallel calibration courses were created, one on the east side of Pipeline Road and one on the west side. Pete Riegel led the team which measured the first one on the east side. A team of four then laid out a similar 300 meters along the west side.

We had four tapes, two each of 50 meters and 30 meters. Teams of four used these tapes, estimating proper tension "by feel" to check the lengths already laid out. After measuring one side, the teams switched tapes with other teams, so that each team used both a 50 meter and a 30 meter tape, and measured both of the calibration courses.

There was some confusion about what to do when the other end of the calibration course was reached. Most teams established their own idea of where 300 meters lay instead of simply measuring the distance between the two nails already put in place. There was also some amount of confusion about the proper reading of a metric tape. I have encountered this in several places. The metric system may have advantages over the Imperial one, but it is definitely easier and more error-free to read a tape in decimal feet than in meters.

In any case, good agreement was obtained in the taping. As none of the measurements was an obvious "outlier" the average of all measurements was chosen as the best estimate of length.

	East Course	West Course
	300.00	300.00
	299.974	299.976
	300.03	299.98
	300.005	300.02
	299.975	
Average	299.9968	299.994

Temperature was about 10C. It was estimated, not measured.

Temperature correction = $.0000116 * (\text{Temp C} - 20) * (\text{measured length}) = .000016 * (10 - 20) * (299.99)$

Temperature correction = **-0.048 meters**

Final measured Lengths

East Course	West Course	
299.9488	299.946	or 299.95 meters for each.

A length of 300 meters was used in all on-site calculations and in this report.

ADJUSTMENTS TO THE COURSE

Here is an example of making adjustments to the intermediate marks to produce the final course. The measurement of Jim Helten on May 1 is used in this example.

When only two measurements exist, the one which yields the shorter measured value is used. In this case, Jim's measurement is representative of a "good" measurement.

Assuming the start is fixed:

	Interval Meters	Cumulative Meters	Desired Meters	Adjustment Meters	
Start		0.0	0.0	0.0	
1 km	999.3	999.3	1000.0	0.7	
1 mi	599.9	1599.2	1609.3	10.2	
2 km	400.5	1999.7	2000.0	0.3	
3 km	1000.1	2999.8	3000.0	0.2	
4 km	995.7	3995.5	4000.0	4.5	
5 km	850.4	4845.8	5000.0	154.2	* * *
End	112.0	4957.9	5000.0	42.1	

* * * the 5 km mark laid down by Pete was in error, so the end point is the easier one to adjust.

Assuming the finish is fixed at the "End" point:

	Interval Meters	Cumulative Meters	Desired Meters	Adjustment Meters	
Start		42.1	0.0	-42.1	
1 km	999.3	1041.4	1000.0	-41.4	
1 mi	599.9	1641.3	1609.3	-31.9	
2 km	400.5	2041.8	2000.0	-41.8	
3 km	1000.1	3041.9	3000.0	-41.9	
4 km	995.7	4037.6	4000.0	-37.6	
5 km	850.4	4888.0	5000.0	112.0	* * *
End	112.0	5000.0	5000.0	0.0	

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