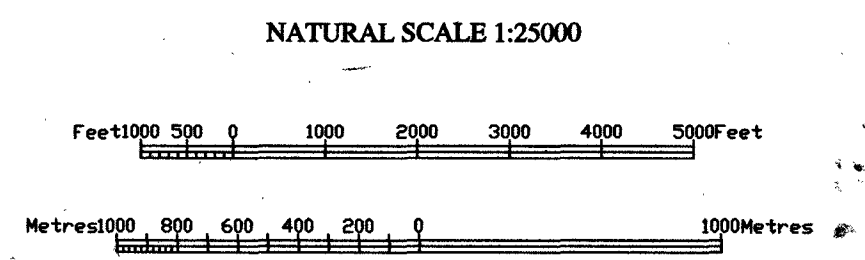


INDIA WEST COAST
GULF OF KACHCHH
KANDLA PORT TRUST
APPROACHES TO KANDLA CREEK
TIDAL STREAM OBSERVATION
EBB TIDE



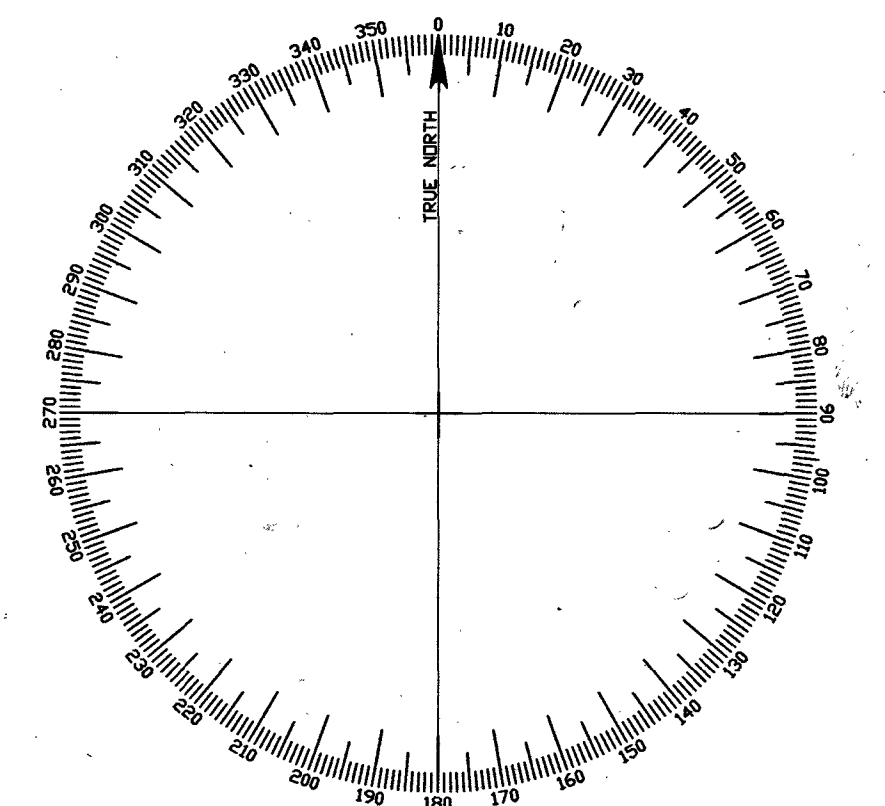
Deputy Conservator
For the Port of Kandla

Observation taken One hrs. after H.W.

Sl. No.	Date of Observation	Time of Starting	Time of Completion	Length of Float	Remarks
E 1	08-12-2009	0752 hrs.	1215 hrs.	12'	Time interval between two floats is 10 min OR otherwise mentioned.
E 2	07-12-2009	0711 hrs.	1200 hrs.	12'	Time interval between two floats is 5 min OR otherwise mentioned.
E 3	10-01-2010	1114 hrs.	1730 hrs.	12' & 8'	Time interval between two floats is 5 min OR otherwise mentioned. (Fls no 1-21 is 12', 22-31 is 6', 32-44 is 12' float)
E 4	12-01-2010	1347 hrs.	1910 hrs.	12'	Time interval between two floats is 10 min OR otherwise mentioned.

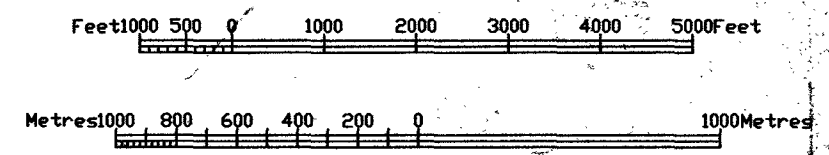
Actual Tide at Kandla

Sl. No.	Date of Observation	H.W.		L.W.	
		Time	Tide	Time	Tide
E 1	08-12-2009	0648 hrs.	6.65 m	1341 hrs.	1.24 m
E 2	07-12-2009	0558 hrs.	6.26 m	1255 hrs.	1.30 m
E 3	10-01-2010	1025 hrs.	5.32 m	1713 hrs.	1.10 m
E 4	12-01-2010	1250 hrs.	5.32 m	1925 hrs.	0.92 m



INDIA WEST COAST
GULF OF KACHCHH
KANDLA PORT TRUST
APPROACHES TO KANDLA CREEK
TIDAL STREAM OBSERVATION
FLOOD TIDE

NATURAL SCALE 1:25000



Deputy Conservator
For the Port of Kandla

Observation taken One hrs. after L.W.

Sln. No.	Date of Observation	Time of Starting	Time of Completion	Length of Float	Remarks
F 1	23-01-2010	1450 hrs.	1930 hrs.	12'	Time interval between two floats is 10 min OR otherwise mentioned.
F 2	21-01-2010	1335 hrs.	1845 hrs.	12'	Time interval between two floats is 10 min OR otherwise mentioned.
F 3	22-01-2010	1405 hrs.	1910 hrs.	12'	Time interval between two floats is 10 min OR otherwise mentioned.
F 4	21-02-2010	1415 hrs.	1930 hrs.	12'	Time interval between two floats is 10 min OR otherwise mentioned.
F 5	28-01-2010	0745 hrs.	1330 hrs.	12'	Time interval between two floats is 15 min OR otherwise mentioned.
F 6	27-01-2010	0700 hrs.	1200 hrs.	12'	Time interval between two floats is 15 min OR otherwise mentioned.

Actual Tide at Kandla

Sln. No.	Date of Observation	L.W.		H.W.	
		Time	Tide	Time	Tide
F 1	23-01-2010	1344 hrs.	1.20 m	1958 hrs.	5.73 m
F 2	21-01-2010	1230 hrs.	1.19 m	1818 hrs.	5.80 m
F 3	22-01-2010	1305 hrs.	1.20 m	1901 hrs.	5.72 m
F 4	21-02-2010	1309 hrs.	1.06 m	1915 hrs.	5.96 m
F 5	28-01-2010	0725 hrs.	2.37 m	1248 hrs.	5.93 m
F 6	27-01-2010	0618 hrs.	2.62 m	1127 hrs.	5.99 m

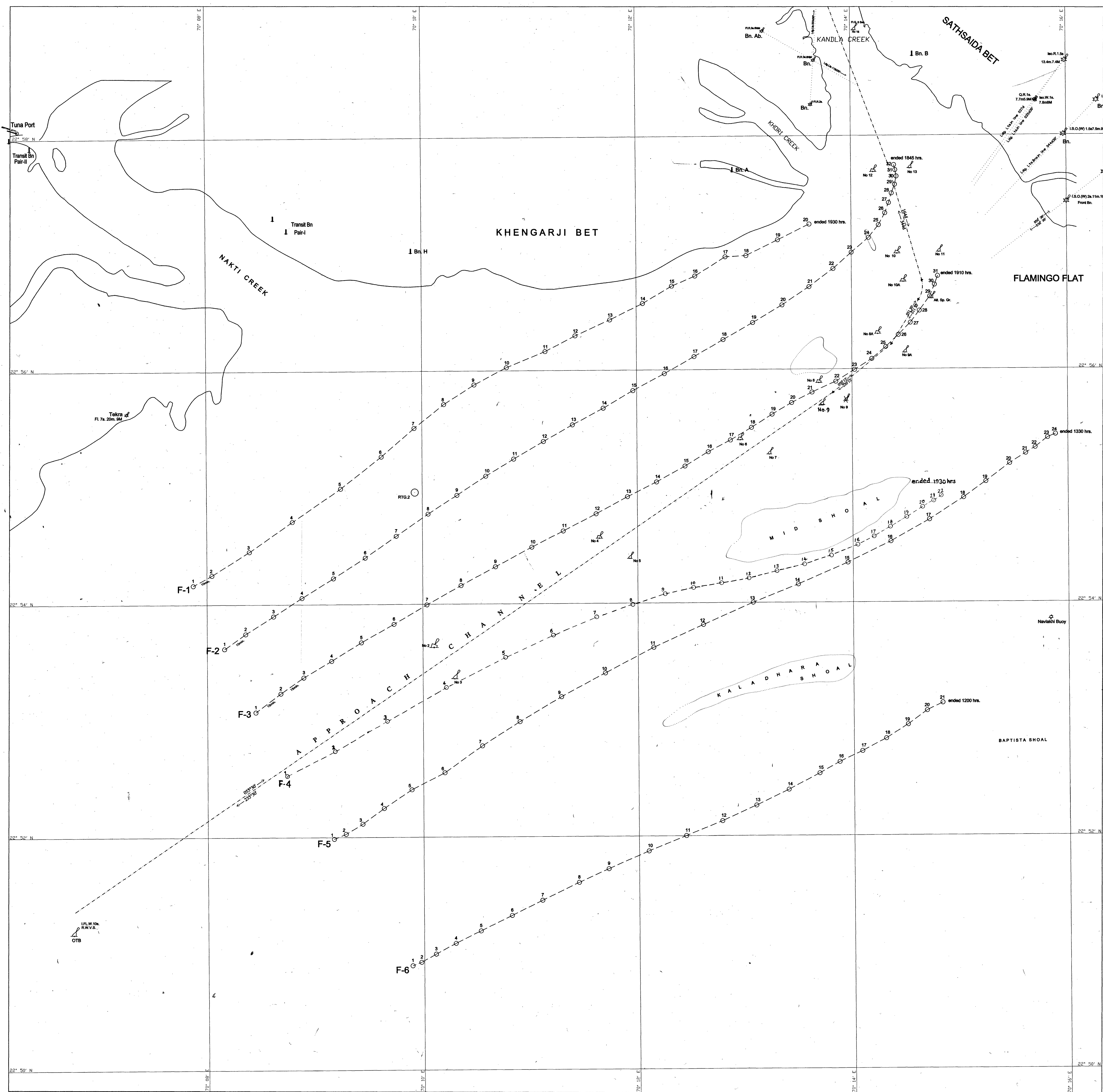
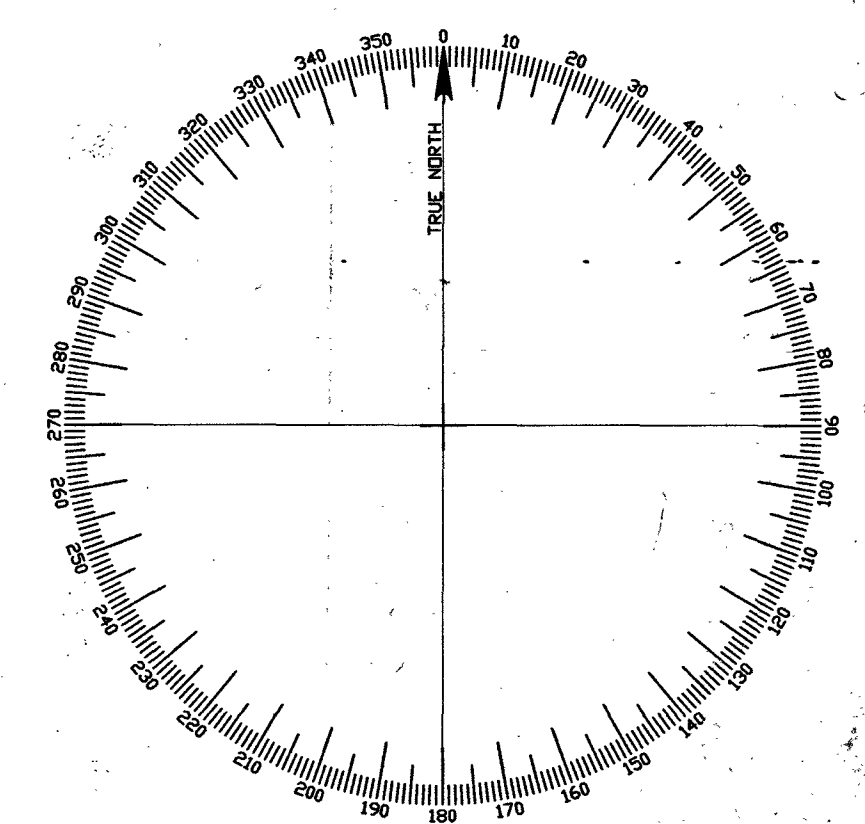




Figure 19 Drifters track during ebb tides on 21st and 23rd Feb 2018



Figure 20 Drifters track during flood tides on 21st and 23rd Feb 2018

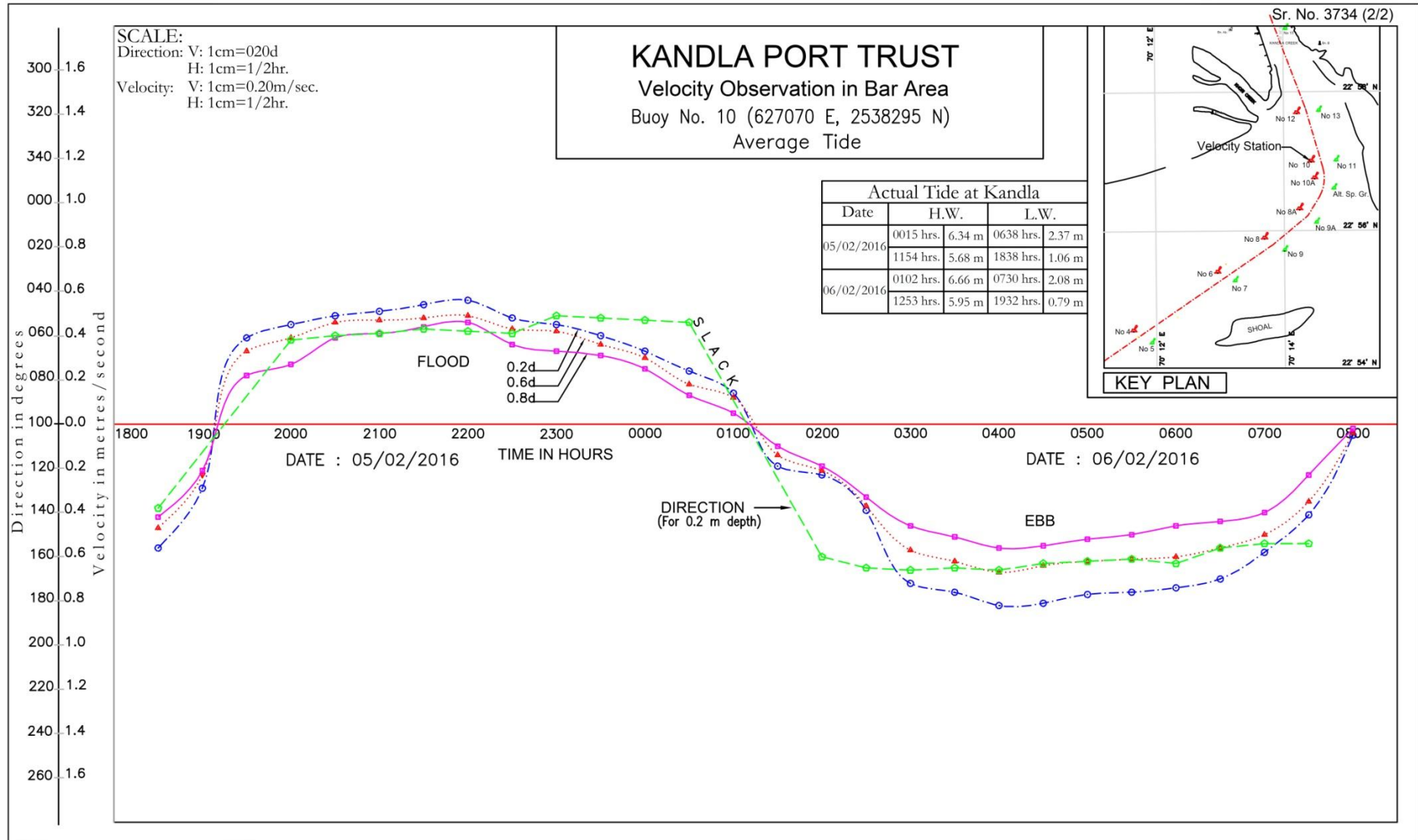


Fig. 11 Typical variations of current speed and direction during average tide

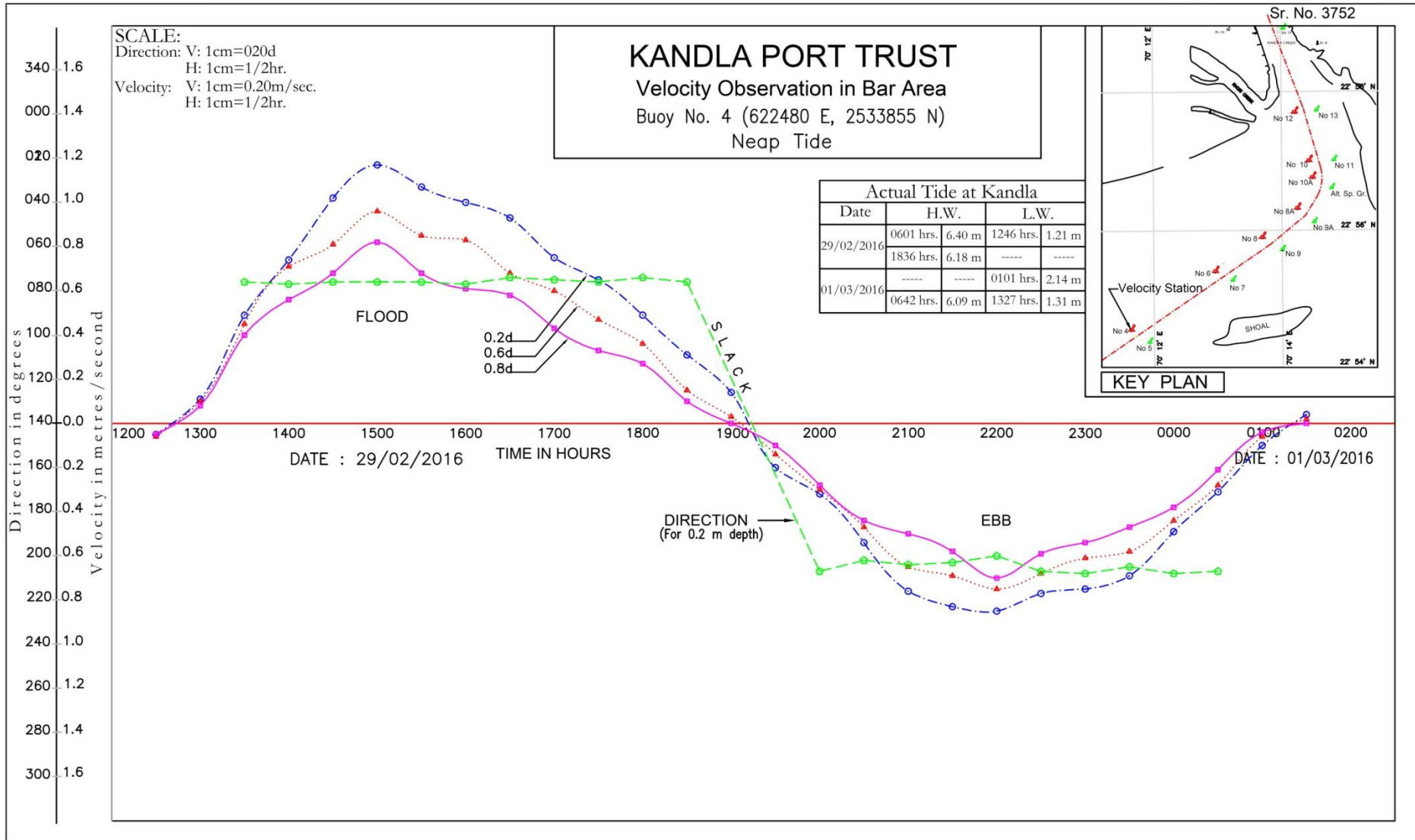


Fig. 12 Typical variations of current speed and direction during neap tide

Suspended Sediment Collection

Initially, the sample collection points from the creek to end of the navigation channel were marked on the GPS (till Buoy no.3). On 20/02/2018, water samples were collected from the creek side (Fig. 4.18) and on 22/02/2018, from along the navigation channel (Fig. 4.19) using the Niskin samplers. Nearly four samples were collected from different depths over the same proposed location, that are water sample from the surface and at depths $0.2*D$, $0.6*D$ and $0.8*D$, where D is total water depth from the surface.

The Niskin sampler (Fig. 4.20) or bottle is a tube, usually made of plastic, opened to the water at both ends. A bronze solid weight known as messenger is used to keep both end caps shut and to seal the tube with the water at the required depth. All the samples were transferred into one-liter water sampler (Fig. 4.21) collection bottles with proper labeling for further analysis in laboratory. The collected samples were transferred to laboratory located in the Seva Sadhan-3 building for the analysis.

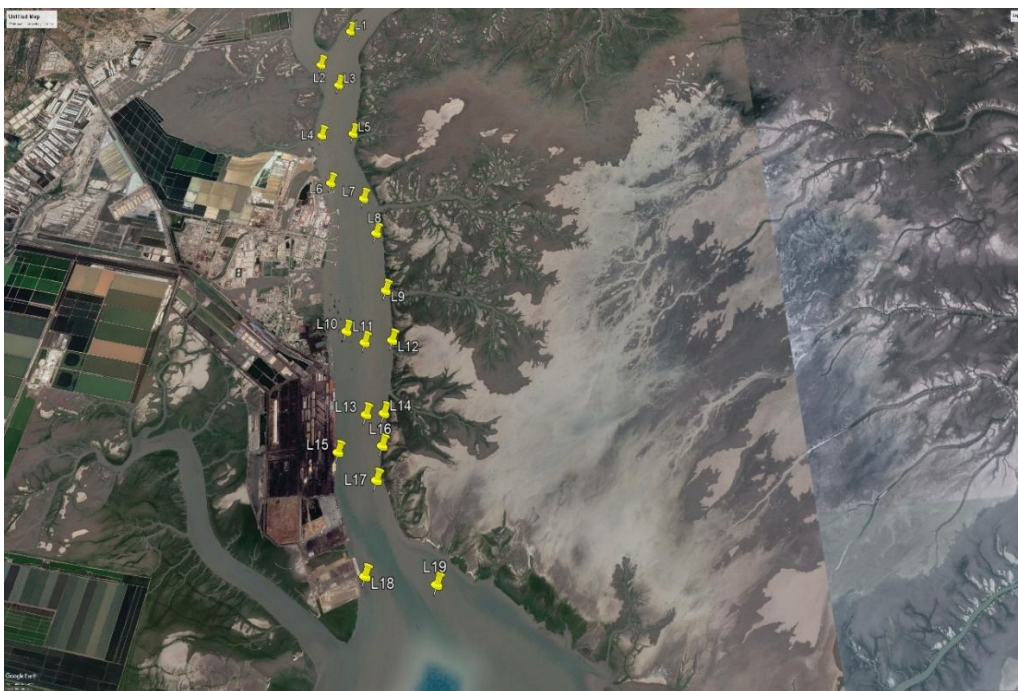


Fig. 4.18 Locations of water sample collection on 20/02/2018



Fig. 4.19 Locations of water sample collection on 22/02/2018



Fig. 4.20 Typical view of a Niskin sampler

Table 4.2 Data of samples collected on 19/02/2018

Location	Longitude (X)	Latitude (Y)	Time	Depth(m)	F.P wt (g)	(F.p + S)wt (g)	SSC (mg/l)
L1	6252287.93	2552209.08	5.16pm	surface	0.08126	0.11345	321.9
				2.1	0.08125	0.11454	332.9
10.5m	6252287.93	2552209.08	5.16pm	6.3	0.08156	0.1166	350.4
L2	624678.71	2511368.04	10.23am	surface	0.07955	0.1078	282.5
				3	0.0819	0.1118	299
5.7m	624678.71	2511368.04	10.23am	4.5	0.07945	0.11248	330.3
L3	625100.63	2550852.35	10.00am	surface	0.07945	0.10741	279.6
				2.2	0.08165	0.11023	285.8
11m	625100.63	2550852.35	10.00am	8	0.08129	0.10784	265.5
L4	624806.95	2549642.91	10.57am	surface	0.0818	0.10505	232.5
				2	0.08182	0.1056	237.8
9m	624806.95	2549642.91	10.57am	8	0.08153	0.11121	296.8
L5	625473.92	2549666.93	5.00pm	surface	0.0868	0.11843	316.3
				7.9	0.08544	0.1178	323.6
13.3m	625473.92	2549666.93	5.00pm				

L6	625065.14	2548546.42	11.17am	surface	0.08071	0.10502	243.1
				2.4	0.08066	0.10841	277.5
12m				7.4	0.08061	0.114	333.9
				10	0.08111	0.1095	283.9
L7	625768.61	25486.5	4.50pm	surface	0.08459	0.11764	330.5
				3.56	0.08549	0.12098	354.9
17.8m				10.68	0.086	0.1219	359
L8	626051.47	2547427.42	4.30pm	surface	0.08305	0.106	229.5
				3.2	0.08438	0.1176	332.2
16m				9.6	0.08481	0.1187	338.9
L9	626284.06	2546241.23	4.20pm	surface	0.08304	0.1182	351.6
				2.2	0.08316	0.1192	360.4
11m				6.6	0.08262	0.118	353.8
				8.8	0.08015	0.115	348.5
L10	625552.03	2545460.78	11.45am	surface	0.08237	0.1014	190.3
				1.6	0.0795	0.0992	197
9.7m				5.8	0.08139	0.0994	180.1
				7.7	0.08207	0.10731	252.4
L11	625913	2545234.82	11.59am	surface	0.08206	0.1049	228.4
				2.1	0.0804	0.105	246

12m				6.5	0.07938	0.1088	294.2
				9.6	0.07936	0.10726	279
L12	626440.345	2545262.93	12.10pm	surface	0.07901	0.10167	226.6
				2	0.08167	0.1079	262.3
12m				7	0.07947	0.11546	359.9
				8	0.07955	0.11603	364.8
L13	625995.62	2543904.35	12.10pm	surface	0.07965	0.10817	285.2
				2.3	0.08146	0.11666	352
11.5m				6.9	0.08128	0.11326	319.8
				9.2	0.08111	0.11632	352.1
L14	626330.20	2543917.37	3.47pm	surface	0.08275	0.11314	303.9
				2	0.0828	0.11815	353.5
7.5m				4.5	0.08185	0.11793	360.8
				6	0.08181	0.11727	354.6
L15	625513.03	2543256.08	12.55pm	surface	0.08031	0.09792	176.1
				3	0.08026	0.11535	350.9
15m				9	0.08117	0.11458	334.1
				12	0.08063	0.11687	362.4
L16	626315.24	2543346.02	3.31pm	surface	0.08132	0.11495	336.3
				3.74	0.08112	0.11731	361.9
18.7m				11.2	0.08107	0.11641	353.4
				15	0.08193	0.11912	371.9

L17	626234.78	2542760.77	2.06pm	surface	0.0815	0.11275	312.5
				3	0.081	0.10854	275.4
14.5				5.8	0.0805	0.10651	260.1
				8.7	0.0805	0.1124	319
L18	626091.94	2541219.29	2.29pm	surface	0.08115	0.118	368.5
				1.8	0.08171	0.11727	355.6
9m				5.4	0.08148	0.12052	390.4
L19	627336.2	2541054.29	3.10pm	surface	0.08204	0.11402	319.8
				1	0.08187	0.10854	266.7
5m				3	0.08207	0.12528	432.1
				4	0.0816	0.12222	406.2

Table 4.3 Data of samples collected on 21/02/2018

Locati on	Longitude (X)	Latitude (Y)	Time	Depths(m)	F.P wt (g)	(F.p + S)wt (g)	SSC (mg/l)
L20	62615.24	2539659.9 1	9.50a m	surface	0.08614	0.1219	357.6
				1.1	0.08555	0.12027	347.2
5.5m				3.3	0.08783	0.1249	370.7
				4.4	0.08766	0.12313	354.7
L21	2539625	627064	9.30a m	surface	0.08298	0.11041	274.3
				2.5	0.0824	0.11274	303.4

12.5m				7.5	0.08298	0.11997	369.9
				10	0.08581	0.1278	419.9
L22	2538822.70	626955.29	10.01a m	surface	0.08772	0.11252	248
				7	0.08138	0.12622	448.4
8.5m							
L23	2538947	628713	5.46p m	surface	0.07992	0.1058	258.8
				4	0.07986	0.1062	263.4
5m							
L24	2537256.17	627268.25	10.20a m	surface	0.08307	0.1104	273.3
				2.5	0.08309	0.11967	365.8
12.7m				7.6	0.08342	0.12252	391
				10.1	0.08165	0.1148	331.5
L25	2537380.65	626870.39	10.11a m	surface	0.08257	0.11715	345.8
				1.3	0.08233	0.12083	385
6.5m				3.9	0.08039	0.11875	383.6
L26	2535207.07	627588.6	5.21p m	surface	0.08033	0.10997	296.4
				1.5	0.08021	0.1106	303.9
8m				4.8	0.08244	0.11268	302.4
				6.4	0.08053	0.1085	279.7

L27	2535934.16	625885.25	10.39a m	surface	0.08211	0.1128	306.9
				1.5	0.08475	0.1165	317.5
5.3m				4.6	0.08337	0.1177	343.3
				6.2	0.08505	0.1205	354.5
L28	2536170.07	625038.59	10.54a m	surface	0.08529	0.11293	276.4
				1	0.08588	0.11583	299.5
5.3m				3	0.08395	0.1269	429.5
				4	0.08234	0.12758	452.4
L29	2534238.1	625355.48	5.08p m	surface	0.08138	0.116	346.2
				4	0.08164	0.1166	349.6
5m							
L30	2534332.42	624348.81	11.41a m	surface	0.08583	0.11815	323.2
				1.3	0.08589	0.11442	285.3
6.5m				3.9	0.08602	0.12165	356.3
				5.2	0.08729	0.12366	363.7
L31	2535315.9	623584.89	11.11a m	surface	0.08227	0.11994	376.7
				1.6	0.08186	0.11775	358.9
8.3m				4.9	0.08706	0.12918	421.2
				6.6	0.08717	0.1316	444.3
L32	253376.46	622828.86	12.00p m	surface	0.0811	0.10237	212.7
				0.94	0.08135	0.10315	218

4.7m				2.8	0.08161	0.10495	233.4
				3.7	0.08243	0.11305	306.2
L33	2533212.64	621399.56	4.43p m	surface	0.08748	0.11547	279.9
				3	0.08099	0.10962	286.3
15m				9	0.08714	0.1188	316.6
				12	0.08246	0.11596	335
L34	2531643.58	622154.88	4.24p m	surface	0.08566	0.1185	328.4
				2.7	0.08503	0.11731	322.8
13.4m				8	0.08549	0.12201	365.2
				11	0.085	0.12001	350.1
L35	2531779.17	623683.22	4.01p m	surface	0.08711	0.13211	450
				2.5	0.08577	0.1315	457.3
10.8m				6.5	0.08209	0.12782	457.3
				8.5	0.08458	0.12962	450.4
L36	2531712.08	621011.8	12.35p m	surface	0.0851	0.12576	406.6
				1.96	0.08238	0.13012	477.4
9.5m				5.7	0.08388	0.13195	480.7
				7.6	0.08215	0.13305	509
L37	2530485.24	621960.98	3.48p m	surface	0.084	0.11157	275.7
				1.8	0.084	0.11591	319.1
9.4m				5.6	0.08433	0.1319	475.7
				7.5	0.08515	0.13784	526.9

L38	2530330.05	620559.07	3.23p m	surface	0.08225	0.1138	315.5
				2	0.0834	0.116	326
10m				6	0.08386	0.1346	507.4
				8	0.08366	0.13601	523.5
L39	2529013.17	621039.73	3.08p m	surface	0.08206	0.0957	136.4
				3	0.08471	0.1029	181.9
11.2m				7	0.0825	0.12103	385.3
				9	0.08246	0.13728	548.2
L40	2527995.51	619926.23	2.41p m	surface	0.08379	0.09863	148.4
				2.4	0.08516	0.10035	151.9
11.7m				7.2	0.08515	0.1327	475.5
				9.6	0.0849	0.13161	467.1
L41	2528001.98	621068.1	2.54p m	surface	0.08335	0.0973	139.5
				2.74	0.08373	0.10145	177.2
13.7m				8.2	0.08411	0.12809	439.8
				11	0.08421	0.139	547.9

Drifter Experiment

Drifter is small spherical buoy with an inbuilt GPS system that can be used to calculate the surface velocity of the flow as well as trajectory, based on its own position. The whole system consists of 3 sub-systems, i.e. (i) The drifter, (ii) The coastal relay station sub-system for data transmitting, (iii) Real-time data display and management sub-system that support the in-situ operation. The drifters (Fig. 4.24) with the diameter of 12cm, were found to exhibit good surface flow following capacity. The drifters were capable enough to transmit