THE HYDROGRAPHY & CARTOGRAPHY OF A GREAT SEAPORT

by

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The Port of London Authority exercises jurisdiction over that part of the Thames which flows from Teddington Lock (approximately) to a line joining Havengore Creek in Essex and Warden Point in Sheppey, Kent.

To depict the changes in the hydrography of the channels, creeks, wharves, bridges and dock entrances the survey of the river requires continuous attention.

CARTOGRAPHY.

Within the dock system a regular watch is kept to maintain depth, as a considerable amount of silt in suspension finds its way inside the tidal gates.

The triangulation and surveyor's working sheets are connected with those of the Ordnance Survey and are divided up into convenient lengths of river, more or less identified with the Reaches so well known to mariners.

The survey sheets and the scales on which they are projected are enumerated in the following table.

LIST OF SURVEYS — RIVER THAMES TIDEWAY

	Chart Section of River.	*Date of Survey*	*Scale*
1.	Teddington Lock to Cross Deep	1929	1/1056
2.	Cross Deep to Petersham Drawdock	1929	»
3.	Petersham Drawdock to Richmond Lock and Weir	1929	»
4.	Richmond Lock and Weir to Church Ferry, Isleworth	1928	»
5.	Church Ferry, Isleworth, to Kew Bridge	1928	»
6.	Kew Bridge to Kingston Creek	1927	»
7.	Kingston Creek to Barnes Railway Bridge	1926-7	»
8.	Barnes Railway Bridge to Chiswick Ferry	1926	»
9.	Chiswick Ferry to Hammersmith Bridge	1926	»
10.	Hammersmith Bridge to Fulham Railway Bridge	1926	»
11.	Fulham Railway Bridge, Broomhouse Dock (Supplementary Survey)	1928	»
11*a*.	Wandsworth Bridge to Battersea Railway Bridge	1931	»
12.	Battersea Railway Bridge to Albert Bridge	1931	»
13.	Albert Bridge to Victoria Railway Bridge	1931	»
13*a*.	Victoria Railway Bridge to Vauxhall Bridge	1931	»
14.	Vauxhall Bridge to Westminster Bridge	1925	»
15.	Westminster Bridge to Blackfriars Bridge	1928	»
16.	Blackfriars Bridge to London Bridge	1928	»

	Chart Section of River.	*Date of Survey*	*Scale*
17.	Upper Pool	1928-9	1/1056
18.	Lower Pool	1929	»
19.	Limehouse Reach (Upper part)	1929	»
20.	Limehouse Reach (Lower part)	1930	»
21.	Deptford Creek	1927	»
22.	Greenwich Reach (Upper part)	1930	»
23.	Greenwich Reach (Lower part) and Blackwall Reach	1930	»
24.	Bugsby's Reach with Bow Creek	1929	1/2500
25.	Woolwich Reach (Re-survey in progress)	1927	»
26.	Galleons Reach (Frequent channel surveys)	1927	»
27.	Barking Creek	1930	»
28.	Barking Reach (Frequent channel surveys)	1927	»
29.	Halfway Reach	1927	»
30.	Erith Reach	1927	»
31.	Erith Rands	1929	»
32.	Erith Rands and Upper Part Long Reach	1929	»
33.	Long Reach (from Hospital East)	1931	»
34.	St. Clement's or Fiddler's Reach	1931	»
35.	Northfleet Hope	1930-1	»
36.	Gravesend Reach	1930	»
37.	Lower Hope Reach (Channel Survey)	1930-1	»
38.	Sea Reach	1930-1	880' to 1"

DESCRIPTION.

To describe the entire watershed and valley way of the Thames is not necessary in a paper dealing with the tidal portion of the river, its navigability and its improvement, but a general reference to the head waters and the upland water-course controlled by lock is desirable.

Length of River.

From Thames Head Bridge in Gloucestershire, which is near the actual source, to London Bridge the length is 161 miles. From London Bridge to the Nore, 50 miles, making a total length of 211 miles.

Within that distance the Thames receives many tributaries including the Medway, providing in all a drainage area of 5,924 square miles. It is therefore physically the greatest river in England.

Flow.

Considerable variation in the volume of the fresh water flow of the River Thames has been recorded, reaching for a short period in 1894 20,000 million gallons per day and a fall almost to nil in winters of intense frost and or a summer of extreme drought.

For the water supply of the London district approximately 276 million gallons per diem are abstracted from the river above Teddington and, with an additional supply from separate springs and wells, is passed through the domestic and commercial system, finally approximating 300 million gallons per diem it is passed into the tidal river 12 miles below London Bridge.

This daily discharge, which is in the form of sewage, is regulated in purity by the restrictions of the Port of London Authority under their powers as Conservators, has also the effect, by reason of the position of the outfalls, of introducing a fresher water content in a position further down the tidal river than would otherwise occur; a vessel having a draft of 30 ft. and over may expect to increase that draft by 6 inches on the passage to King George Dock by the change in specific gravity of the tide water.

The volume of fresh water passing over Teddington Weir and the intercepted supply which is abstracted above that Weir and passed into the middle reaches of the tideway are therefore the principal sources of fresh water contribution.

Tributaries.

The tributaries Crane, Brent, Beverley, Brook, Wandle, Ravensbourne, Lea, Ingerbourne, Roding, Beam and Darenth, which join the tideway, are not, except in times of heavy rain, serious factors in the provision of fresh upland supply. There has to be added however the important ex-catchment supply in the form of well water outside these drainage channels and which is of an increasing quantity. We have referred to this already.

Catchment.

Thus the normal contribution including wells may be estimated as follows, when the flow at -:

A. Teddington Weir, which varies considerably, = the September average of 375 million gallons per day.

B. Tributaries in tideway = approximately 105 million gallons per day September average.

C. Abstracted above Weir and returned through the domestic system of Metropolis to middle reaches = 300 million gallons per day, including wells and other sources.

Tidal portion.

The river is tidal for approximately 20 miles above London Bridge on Spring tides, but the inward flow is opposed by Teddington Lock and Weir, which is a short distance to seaward of the full Spring tide limit. In consequence the tideway may be considered to terminate at Teddington Lock near the Landward Limit of the Port and to extend seawards to the Nore or Seaward Limit of the Port Authority's jurisdiction, a total of 68 1/2 statute miles.

It should be noted that the plane of low tide level does not extend above Putney at Spring tides, thus the landward reach of the tide is variable according to the lunar phases. From this it will be noted that the tideway is actually fluvial for a considerable portion of the tidal period. (*i. e.* after 1/2 ebb to approximately 1/4 flood). The placing of super-power stations for electrical development has been governed by these considerations.

Estuary.

The estuary may be said to extend from North Foreland, on the South bank, to The Naze near Harwich on the North. It contains several sand banks submerged at High Water intersected longitudinally and transversely by deep channels — some of which change their situation and character from time to time.

Embankments.

Embankments have been constructed for approximately 57 miles of the tideway on North and South banks, their condition and levels are regulated by Commissioners and Local Authorities.

These embankments for the greater distance of the tidal stream control its direction, but sufficient limits of deviation exist in the river bed for curves of channel rectification and for suitable deepening to be undertaken by dredging.

Fall of bed or declivity of channel.

The Thames bed from Lechlade to London has a fall of a little less than 20 inches per mile — London Bridge to Gravesend a little less than 12 inches per mile.

Width	at	London Bridge	is	250 yards
»	»	Gravesend	»	700 »
»	»	Nore	»	6 miles (approximately)

Dredged channel.

The programme of channel development from the Nore to London Bridge was outlined shortly after the formation of the Port Authority in 1909. From London Bridge to Teddington the tideway is crossed by 22 bridges and the width and depth is much more limited than below London Bridge which is the head of navigation for the larger ocean-going vessels.

A conservative programme of dredging is consequently adopted from London Bridge upstream to Teddington.

The programme of dredging from the Seaward Limit to London Bridge is of much greater navigational importance and represents 50 statute miles of waterway which is regularly traversed by ocean-going steamers and serves one of the largest dock and wharf systems in the world. The dock system has a lineal quayage of 45 miles and there are one thousand wharves on the banks of the tideway.

The channel development was designed to provide depths deeper than the sill levels of the dock systems which the improved waterway would serve. This relation has proved practicable in dredging and convenient for shipping. Its development, together with lay-byes and special deepening has called for the removal of approximately 56 million cubic yards of material from the old river bed.

SIZE OF MODERN VESSELS.

Vessels of 27,000 tons gross and vessels having a draft of 36 to 37 ft. use these channels and make the passage at night to King George V Dock situated 40 miles above Southend.

TIDES.

Ranges of Tides.

A diagram of the rise and fall at several points in the tideway attached shews that the maximum range of tide lies near London Bridge, that the range decreases sharply above London Bridge owing to rise of the river bed and that it decreases gradually to seaward of London Bridge.

The Spring Tide Range at London Bridge is approximately 16 ft.

This natural feature of the tide providing extreme range in the dockised areas is of great value to shipping.

Regarding the time at which the high water makes at the several stations in the tideway — normally high tide occurs-:

Southend 1 1/2 hours before London Bridge,

Teddington 1 1/2 hours after London Bridge,

so that deep drafted vessels inward bound carry the high tide with them as they proceed to dock.

Period of navigation for deep drafted vessels.

The tidal curve for Tilbury shews that during a typical Spring tide the depth exceeds 40 ft. in the dredged 30 ft. channel for a period of approximately 5 3/4 hours, and during a neap tide the same depth prevails for approximately 6 hours.

As the useful speed for navigation in clear weather is about 9 knots, the deeper draft vessels have a wide range of time and depth with which to move about in the waterway.

Total duration of tide.

The duration of the rise and fall varies according to situation, but the ebb tide exceeds in duration the period of flood tide, viz-:

Southend	Flood	6	hrs.	0	mins.	Ebb 6	hrs.	40	mins.	Mean Spring Tides
London Bridge	»	5	»	15	»	» 6	»	40	»	
(*) Teddington	»	1	»	45	»	» 3	»	15	»	

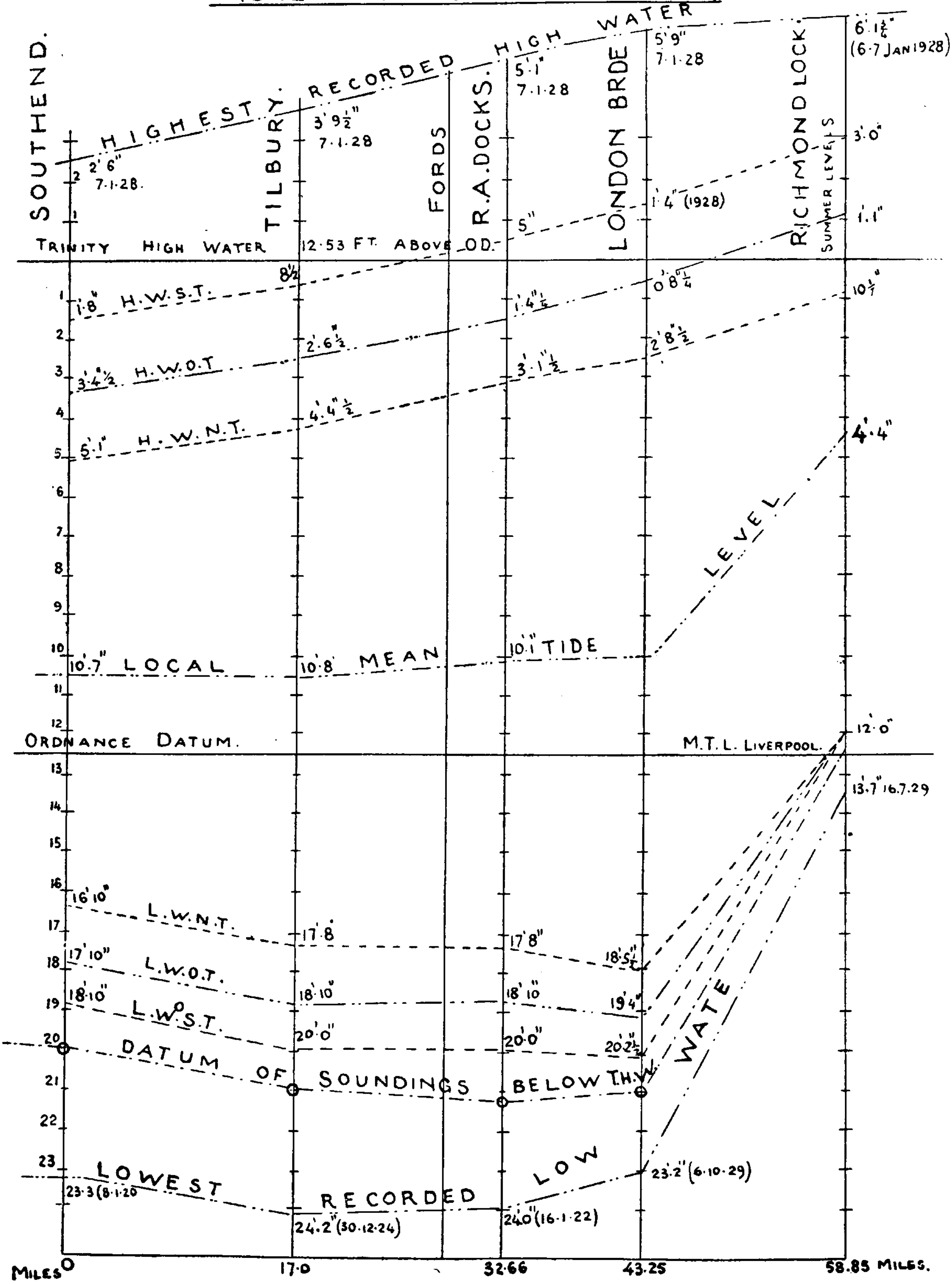
Velocity of Stream.

The velocity of the surface current at Springs varies according to locality, formation of channel, amount of freshet from uplands, but at the period of maximum run during the ebb it many be said to lie between 2,5 and 4 knots. This velocity combined with the longer duration of the ebb stream is a powerful factor in the self-maintenance of the dredged channels.

(*) Influenced considerably by the amount of catchment water.

RIVER THAMES

TIDAL AND DATUM DIAGRAM



To land passengers immediately on arrival and to reach dock with cargo vessels on the same tide as that on which the ship enters the Customs area is the aim at which efforts are now directed in the development of tidal ports, and conversely to enable the vessels undocking to get away to sea on the same tide. The semi-diurnal tide in dockised ports furnishes the means to that end, provided that the channel is dredged sufficiently to permit of movement of the deeper draft vessels over a reasonable period of the tide.

The function of the semi-diurnal tide.

Docking and undocking at low water or at half tide is now an accepted practice at Tilbury, but those tidal hours are more generally occupied in the handling of small craft such as barges, flats and their tugs which are important ancillaries to the deep sea freight vessels landing or receiving cargoes.

It may be broadly stated that the semi-diurnal tide by its rise, fall and period of flotation for large vessels serves a double purpose for shipping, one, to enable the vessel to pass through the several approach channels and to negotiate the acuter bends of the tideway with freedom of draft and, two, to assist in maintaining a level in the dock basins by admitting and releasing vessels about tide time, thus avoiding undue lowering of the level in the docks and so reducing pumping to maintain dock level.

The technical investigations and the hydrographic operations which have been necessary to secure the position which the waterway has now attained, are enumerated in the following pages.

SCIENTIFIC SURVEYS.

Three surveys — geological, hydrographical and meteorological — were necessary for the channel development and were undertaken in part or in their entirety according to the information needed for the development of the tideway.

The geological survey shewed where and under what laws the rock, chalk, sand and conglomerate might occur in the river bed, where these would be located, whether above or buried below the alluvium of ages, thus forming part of the "Thalweg" or buried channel of the ancient waterway, known to have suffered considerable deviation during the successive geological epochs.

Gravel beds of considerable thickness are found far from the present situation of the embanked channel, *e. g.* as much as four miles from the present tideway and there is strong presumptive evidence that the Mar Dyke Brook, now discharging into the Thames at Purfleet, flowed at one time in the opposite direction towards the North Sea.

The chalk cliffs which outcrop at Erith and at Purfleet, standing about 100 feet above datum level, were presumably joined by interrupted formations similar to the Needles of the Isle of Wight and these formations crumbled to become the Erith Rands now dredged to 30 feet at M.L.W.S.T.

Proceeding to the detailed use of the geological information, we found it necessary to examine the following characteristics-:

(1) The chalk terrace levels.
(2) Extent to which the waterway intersects the London Clay beds.
(3) Location of conglomerate, septaria and other rocks.
(4) The effect of (1), (2) and (3) in diverting or training the channel.

Borings.

Borings for civil engineering purposes and particularly for wells adjacent to the tideway have been used to reveal a general condition of strata in guidance for dredging, but it was found necessary to use the snapper lead also supplemented by actual dredging samples to determine accurately the character of the river bed.

The hydrographical investigations therefore covered the situation and character of the modern channels, shoals, banks and deeps; examination of currents, their direction, duration and velocity; tidal levels at each station; sampling of surface layers by snapper sounding lead and by dredger, triangulation and charting of tideway.

The plans for dredging were of a scale sufficient for fixing by sextant angles to secure an accurate dredged cut.

Sounding.

The modern method of acoustic sounding was adopted more recently by the Port Authority for survey operations, the instrument being the Admiralty Direct Echo pattern.

Meteorological data.

The meteorological data embodied:

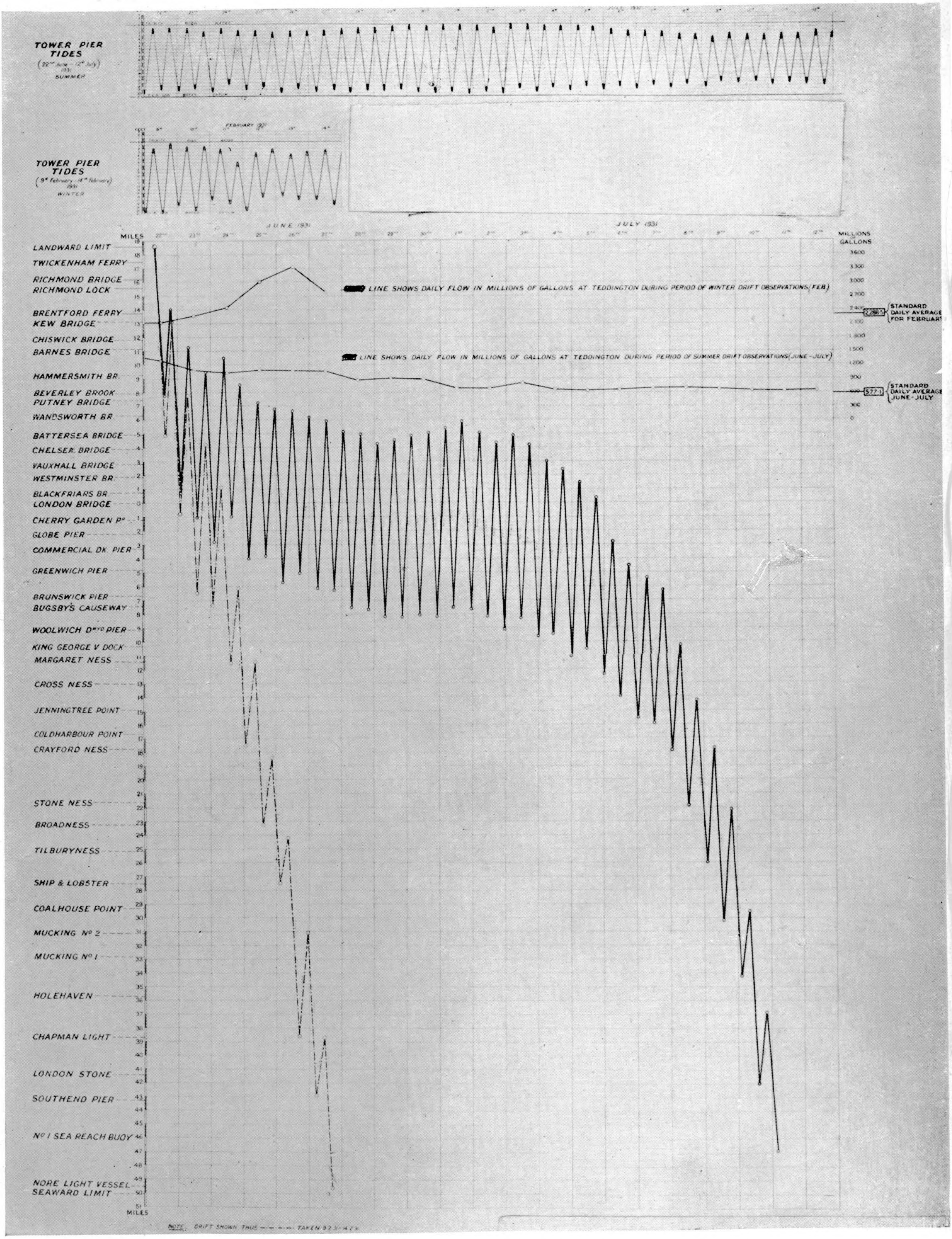
(*a*) Data published in the *North Sea Pilot* giving frequency of gales and percentage of occurrence of winds of certain force, in Sea Reach, etc... ;
(*b*) Reports from meteorological stations on the estuary which shewed local variables in wind and fog.

The foregoing information governed the placing of dredgers in the exposed waters of the estuary and enabled a selection of season to be made to avoid delays and working losses. Rainfall data was utilised together with the Teddington Weir flow and figures furnished by the Thames Conservancy to amplify the tide level information, particularly at London Bridge, and to gauge the limits of scour of which the upland water may be capable.

Hydraulic and tidal phenomenon.

Four fundamental conditions apply to the Thames tideway and to other tidal rivers of similar type:

(1) That, as the fall of river bed from source to sea is fixed, improvements in depth between those points should be truly intermediate in character ;
(2) That erosion is more prevalent in the high fresh water reaches, siltation will be more prevalent in the lower ;



River Thames
Movements of Mid-Surface Water
from Teddington to the Nore

Tamise
Mouvements de l'eau de surface médiane
de Teddington à The Nore

(3) Periodic silt transportation exists, in successive stages throughout the waterway ;

(4) Flood tide stream and ebb tide stream are unequal in duration with a semi-diurnal tide, the ebb being longer and flood shorter ; which, with fall, configuration and cross section, form the principal elements to be considered with the hydraulic mean depth and theoretical laws for improvements.

In a tideway 70 statute miles in length the oscillation of the tidal water requires a separate study from the vertical rise and fall as indicated by tide gauges. The Thames is no exception to the general rule that the fresh water discharge being of lighter specific gravity overlies the salt water layers which pass inward underneath on the flood tide and during the ebb tide with more mixed consistency lie in similar superficial layers. In order therefore to determine the surface oscillations float experiments have been conducted which are shewn on a zig-zag graph.

At high water slack a surface float was placed in the tideway at Teddington and followed to sea night and day. These experiments disclosed a wide seasonal variation, the summer floats requiring a period three times longer than the winter period — due to the greater head of fresh water coming down-stream in winter and the prevalence of South-Westerly winds which induce a surface velocity to the floats not inherent during the summer conditions.

Similar tidal conditions were chosen so as to prevent any variation from tidal conditions. The diagram shews in the upper section the tidal levels of each tide and in the squared portion the river discharge.

It will be noted that there was a sharp rise in the river flow from 2,100 million gallons to 3,300 million gallons in winter or February discharge.

The zig-zag course downstream and then upstream of the surface float is shewn for winter in a dotted zig-zag and for summer in a continuous black line.

It was found that the flood and ebb formation in restricted channels appeared to follow the THOMPSON theory of convex and concave formation at the bends and between these points the elements of M. GIRARDON and M. FARGUE's researches were applicable. Experience has since strengthened these observations and several bends of the tideway have been improved in width and depth by rectification of the curves and realignment of the dredged channels. The "Retention of the sinuous rivers course" implies pools at the bends which continue for some distance above or below the vertex of the curve according to whether the formation be due to ebb or flood tide action respectively.

Bars or crossings thereupon form between the heads of the pools which rise and fall in accord with (*a*) volume of tidal and upland water, (*b*) the degree of channel training maintained. In other words, siltation to a natural controlled level is preferred to obviate constant dredging, with conditions governed by the fall of the river bed.

The foregoing refers to the more sinuous sections of the waterway of N° 123 cross section at Barking, but in the lower sections of the estuarial bed, where the curves are flat, by float observations and dredging we have been able to determine the "error" of deviation. This error lies between 3° and 10° of the truly designed channel.

At 3° the refilling or reformation tendency is slight.

At 10° the reaction is serious and causes much abortive dredging if not corrected in alignment.

It has been ascertained that in all sections of the Thames tideway:

(1) The duration of the ebb or outgoing stream on Spring tides is greater than the duration of flood or incoming stream;

(2) The velocity of the ebb or outgoing stream at all levels exceeds in mean values that of the flood or incoming stream.

Silt carrying powers of a stream are approximately proportional to the sixth power of its velocity, so that if the velocity be doubled (without variation in other directions, such as cross section), the silt carrying power is increased sixty-four times.

The energy, however, may be expended either in erosion or silt transportation. If the total energy is consumed in transporting a full load of sediment, then the river bed cannot be eroded. Energy not used for silt transportation may be applied to vertical or lateral erosion, that is, the valley may be deepened or widened.

It therefore follows that, as the high water period approaches and tidal energy is relaxed, scour becomes less, deposition occurs and conversely greater scour takes place at the beginning of the flow and or about 1/2 to 3/4 ebb tide. If this latter condition is proved by observation and current gauging, an important issue then follows which is to ascertain the *direction and duration* of these stronger and more energetic currents, and design the channels accordingly.

CENTRAL DREDGED ENTRANCE CHANNEL IN SEA REACH.

Estuarial Treatment.

The principle of channel formation, adopted for the estuary where the navigable channel no longer has the confined support of the river banks, was to ascertain the line and hydraulic curves of the natural forces and to develop a deep water dredged channel unsupported by revetments or artificial means other than dredging.

This central channel, which takes its name from the local surroundings, is termed the "Yantlet Dredged Channel". It was completed in 1924 and compares favourably with the Ambrose Channel into New-York Harbour, the Southampton, or Mersey dredged channels and has not required dredging for eight years.

Formation of estuarial channels and action of flood tide.

On the ebb tide in Sea Reach the discovery was made that the surface layers spread fanwise in directions not consistent with the contours of the chart but the layers of the tidal stream close to the bed were consistent and followed the midstream 24 feet contour, this proving that the run of contour forming the side was not by the shorter surface route but by the devious contour of the submarine banks. This applies with special force between the Chapman Lighthouse and the Nore Lightship.

The gradual constriction of flood cul-de-sac channels in estuaries demonstrates that as the flood stream fills the pocket a corresponding diminution of energy follows, the rising flood stream dispersing and welling over on to the foreshores and continuing to do so until the minor creeks and backwaters are level with tidal water.

During this period, the main tidal supply in the case of Sea Reach is forcing its way inland between the 24 feet contours of the Leigh Middle Bank and the Nore Sandbank — this is the midstream of tidal flow which assists to scour the dredged channel by its inflow.

Dredging plant employed in the operations.

Considerable effort has been necessary to effect these improvements, In dredging, the Autho·ity had in service at one time a fleet of 30 vessels — dredgers, hoppers and tenders for river development alone.

These have been reduced in number to half-a-dozen craft due to the accomplishment of the dredging programme and from the fact that about 80 % of the improved channel is virtually self-maintained.

To the dredging fleet requires to be added the service of the hydrographic survey vessels employed on the cartography of the river channels.

The bucket dredgers of the heavier type employed by the Port Authority were and are capable of dealing with conglomerate, chalk, septaria, greensand, stiff clay, in addition to alluvium, sand or commercial silt. The bucket dredgers of lesser capacity were also capable of breaking up and raising rock formations of the conglomerate type.

Some performances are shewn on the following table:

OUTPUT OF PORT OF LONDON AUTHORITY'S DREDGERS.

Output over one day — Working 24 hours. Includes stoppages and getting hoppers alongside.

DREDGER.	*Bucket capacity cu. ft.*	MATERIAL IN CU. YDS.				
		Silt.	*Chalk.*	*Hard Sand.*	*Ballast.*	*Clay.*
Nos 6 & 7 *	27	7,500	4,500	2,250	7,000	2,500
"India"	15	4,500	2,700	1,200	2,950	1,650
No 10 (See Note)	14	—	—	—	4,000	—
Nos 4 & 5	10	4,000	2,600	1,125	2,750	1,600
"Tilbury"	7	2,800	Nil	Nil	2,100	Nil
Grab No 14	65 (heaped)	500	—	—	—	—
3 Cranes	—	—	—	—	—	—

(*) Averaging 40,000 cu. yds. per working week under favourable conditions.

Notes : Dredger No 10 specifically built for dealing with ballast into small craft.
Includes time occupied in running to and from spoil ground for dumping load and for straight forward working with no delays.

Regarding the working of large bucket dredgers in an open sea-way like Sea Reach, long cables were found to be essential to avoid too frequent moving of anchors and to enable the dredger to have adequate spring on the cables in the sea-way. The ahead cable with wire extension reached 1/2 a mile upstream when dredging at the Nore.

The type of bucket dredger employed in those waters was that of Nos 6 and 7 of the Port of London Authority.

Dimensions, viz-:

Length.	*Breadth.*	*Depth.*	*Draft.*	*Ladder frame.*	*Dredging depth below L. W.*	*Capacity of Bucket*
BP. 214' OA. 215'9"	moulded 40'	moulded 12'6"	8'1"	123'9"	55'	27 cu. ft.

Hatch coamings and companion ways of the dredger were raised to withstand the shipping of water in rough seas — a powerful dredging tug was invariably within hail or signal distance — for emergency. During a heavy gale it was necessary, owing to the cross seas, to distribute oil by hoppers cruising around the dredger.

Since the inception of the Port Authority a cubic capacity survey of the low water channel shews that an improvement of 56 million cubic yards has been made within the Port limits.

EFFECT OF IMPROVEMENT TO CHANNELS ON TIDES.

The increased volume of tidal water which sluices the tideway following on the removal of shoals and general deepening of the tideway by dredging has had the effect of:

(*a*) Advancing the time of High Water at London Bridge ;
(*b*) Producing a general increase of tidal range throughout the development ;
(*c*) Maintaining a more uniform rise and fall ;
(*d*) Removing tide irregularities in the horizontal flow ;
(*e*) Augmenting by scour in certain reaches the improvement to river bed created artificially.

TIDE GAUGES OF THE THAMES TIDEWAY.

The tide gauge instruments for recording graphically and visually the tidal rise and fall are situated at Southend, Tilbury, Royal Albert Dock, Tower Pier and Richmond. Each of those stations has a graphic record of the tide. At Tilbury and Purfleet visual gauges illuminated to shew the depth for night navigation are working. These instruments are chiefly for Pilotage facilities.

Southend being an outpost, it is utilised as a flood warning station, and an instrument of the hydrostatic type has been established.

SILTATION.

Although 80 % of the tideway channels are self-maintaining, some are by their cross section and general configuration liable to silt. The eroding power of the stream conforms closely to the scouring velocities laid down by Professor RANKINE in his work on Civil Engineering — thus proving that the Thames in practice is in accord with that theoretical basis.

The amount of silt in suspension varies considerably, some of the outer basins leading to the docks having an excess over normal from recent observations.

It must always be regarded as a sedimentary tideway owing to-:

(1) The fact that the river runs through chalk and London clay for a large part of its course;

(2) That the colloid deposits inseparable from sewerage discharge are continuous and inevitable.

ANCHORAGES.

Southend, Hole Haven, Thames Haven, Gravesend and Long Reach Anchorages are well known, but it may be said that the entire waterway can be used in emergency as an anchorage for suitable vessels, a feature which few large commercial tideways or harbours possess.

TRAFFIC.

It is well known that the volume of Port of London traffic is considerable.

The recent weekly total of dues paying vessels entering and or leaving the Port of London amounted to 1,200, in addition to which there is a large volume of unrecorded traffic in the form of barges and small vessels amounting in the aggregate to 1,000 vessels per diem passing Gravesend outward and inward.

Tonnage of the river traffic.

Translated into figures of tonnage the enormous increase in the shipping of the Port since the formation of the Port of London Authority appears thus:

Total net register tonnage of vessels which arrived and departed with cargoes and ballast from and to Foreign countries and British Possessions and coastwise during the years ended 31st December, 1909 and 1929 was:

	1909	38,511,000	tons	approx.
	1929	57,540,136	»	»
Increase:		19,029,136	»	»

In seeking for some comparison, other than European seaports, some of which have continental through traffic and therefore do not provide in and out traffic figures based on net registered tonnage, the Suez Canal may be taken. The figures for 1929 are 33,466,014 tons and therefore it will be seen that the stream of tonnage using the Port of London exceeds that of the Suez Canal by a considerable margin.

For many years the size of vessels using the Suez Canal influenced construction of dock works and channel development in the Port of London, but the situation has changed and provision has been made for deeper drafted vessels than those using the Suez Canal, both in dock accommodation and channel dredging.