UNSW SYDNEY

Model Studies of Final Launceston Levee Proposal. February 1962.

Author:
Munro, C. H.; Foster, D. N.

Publication details:
Report No. UNSW Water Research Laboratory Report No. 61

Publication Date:
1962

DOI:
https://doi.org/10.4225/53/57954615caace

License:
https://creativecommons.org/licenses/by-nc-nd/3.0/au/
Link to license to see what you are allowed to do with this resource.

Downloaded from http://hdl.handle.net/1959.4/56222 in https://unsworks.unsw.edu.au on 2024-04-25

The quality of this digital copy is an accurate reproduction of the original print copy

628.105
S
Sd 1

THE UNIVERSITY OF NEW SOUTH WALES

WATER RESEARCH LABORATORY

REPORT No. 61

https://doi.org/10.4225/53/57954615caace

Model Studies of Final Launceston Levee Proposal

by

C. H. Munro and D. N. Foster

FEBRUARY, 1962

THE UNIVERSITY OF NEW SOUTH WALES
WATER RESEARCH
LABORATORY

REPORT TO LAUNCESTON FLOOD PROTECTION BOARD ON MODEL STUDIES OF FINAL DIVERSION LEVEE PROPOSAL.

by

C.H.Munro and D.N.Foster

Report No.61

February 1962.

. . . . . .

Report to The Launceston Flood Protection Board on Model Studies of Plan C Alignment for the Diversion Levee.

1. Introduction

Model studies to investigate methods of mitigating floods at Launceston were reported on in Refs. 1, 2 and 3. Subsequent to these investigations, the Launceston Flood Protection Board, the constructing authority for the project, has finalized a general location and height for the proposed diversion levee according to that shown on Launceston Flood Protection Board Plan No. 3604, and reproduced in Figure 1 of this report. This figure shows the three alternate alignments; Plan C, Plan C1 and Plan C2; for this levee.

The series of tests dealt with within this report were undertaken to study each of these proposals and to make final recommendations as to the required levee heights.

2. Test Procedure

The diversion levee was placed on the model to each of the three proposed alignments (Plan C, Plan C1 and Plan C2) and to the design height. For a South Esk discharge of 250,000 c.f.s. corresponding to the estimated maximum probable flood, flood levels were measured for each alignment at all relevant points in the model. During the tests, measurements of velocities in the Upper Tamar River were also taken with an Ott midget current meter.

3. Test Results

3.1 Flood Levels

3.11 Flood Levels General. The test results showed that for each of the three proposals the general flood levels and consequent levee heights along the Upper North Esk and the Tamar River downstream of King's Wharf were unaltered from that given in Figure No.15 of Ref.3.

3.12 Flood Levels Against the Diversion Levee. Profiles of the peak surge level against the diversion levee for each of the three proposals are shown in Figure 2. It will be noticed from this figure that the peak surge height above the levee is approximately five feet for each proposal. This overlapping surge corresponds to the maximum permissible as previously determined, (Refs. 2 and 3), additional overtopping being found to produce an increase in flood levels along the North Esk channel.

Although this result indicates that the maximum height of the diversion levee cannot be altered, it will be noted from Figure 2 that for both the C1 and C2 alignment the height of the peak of the surge is substantially reduced between chainages 800 and 1600 from that which occur with the plan C profile. This is due to the easier curve promoting more rapid acceleration of the reverse eddy on the southern side of the South Esk jet thus producing a velocity head with a corresponding drop in the water surface. These results suggest that the levee profile could be lowered between these chainages to allow for additional overtopping. However, some care should be exercised in any adjustment of the levee height for the following reasons:-

(i) Scour during a flood could conceivably alter the direction at which the South Esk jet enters the Tamar River and consequently the chainage along the levee at which the peak surge occurs.

(ii) Scale effects in reproducing the exact alignment and spread of the South Esk jet on a distorted model could also alter the location of peak surge.

(iii) Scour developing during a flood could alter flow patterns and thereby produce slightly different acceleration effects resulting in a different distribution of velocity and velocity head from that shown on the model.

Notwithstanding the above arguments, some lowering of the levee between chainage 800 and 1600 would appear justified for proposals of C1 and C2 although the degree would need to be fixed more from subjective judgment than from the model results.

Between chainages 0 to 800 the model results indicate little difference in the peak flood levels for any of the proposals and results given in Figure 3 Ref. 3 indicate that no change in the levee profile should be made in this region.

Beyond chainage 1600 surge profiles for plans C and C1 are similar. From chainage 1600 to 1800 the results indicate a freeboard allowance between 2 and 3 feet. The velocity head in this area is, however, approximately 5 ft. on the model and this could be substantially higher than that which could occur in the prototype in this area at the time of the flood as a result of subsequent tree or other growth increasing roughness and reducing velocities. For this reason no lowering in the height of the levee is recommended. Beyond chainage 1900 some periodic surging over the levee occurs with Plans C and C1. However, the overtopping is relatively infrequent and of small amplitude and is not considered to be serious. This surge which occurs with these two plans is due to the sharp change in alignment in the levee at chainage 2400 and the consequent interference to flow which occurs at this point. In the prototype the disturbance to the flow by Ritchie's Flour Mill would reduce this effect. Plan C2 which produces a smoother re-entrant of the reverse eddy into the main flow of the South Esk jet markedly reduces the surge which occurs in the area near King's Bridge.

3.13 <u>Flood Levels against the surround levee section between King's Wharf and Charles St. Bridge.</u> For each of the three proposals some overtopping of the surround levees occurred in the vicinity of the Wheat Silos. These levees were constructed on the model according to the profile recommended in Fig.15 of Ref.3 for a curved diversion levee in Royal Park. The reason for the overtopping was that Plan C levees did not throw the main flow as far to the centre of the Tamar River as did the curved training levee, and consequently the surge in this locality was increased producing periodic overtopping.

Surge profiles along this section of the levee were approximately the same for C, C1 and C2, and are shown in Figure 3.

When considering whether a short section of the concrete levee in this area should be increased in height the following points should be considered.

(i) As a scour hole develops in this area during a flood, velocities will be substantially decreased. This will probably result in lower surge heights in the prototype from that shown on the model.

(ii) The levees over this section are in concrete and if scour protection works are provided at the toe on the northern side, considerable overtopping could be allowed without failure.

(iii) The design flood is the maximum probable flood which is unlikely, although not impossible, to occur during the economic life of the flood protection scheme. In the unlikely event of a maximum probable flood occurring resulting in severe overtopping of the levee in this isolated area, emergency measures of the type illustrated in Ref. 1 Vol. III (photographs) to raise the levee height could easily be made.

For these reasons increase in the levee heights above those given in Fig. 15 of Ref. 3 is not recommended.

3.14 Flood Levels in South Esk Jet. Flood levels at the top of the surge along the South Esk jet are shown in Fig.4 for the diversion levee modelled to Plan C. These levels are not altered significantly for either of the other two proposals.

3.2 Flow Patterns and Velocities

3.21 General. The flow pattern in the Upper Tamar River for Plan C is shown in Figure 5 and the flow velocities as measured at the 17 stations indicated on this plan are given in Figure 6.

Flow patterns were not taken for either plan C1 or C2 as there was no substantial difference from that shown in Figure 5. Velocities at critical points for Plans C1 and C2 are given in Figure 6.

3.22 Reverse Eddy along Patterson St. Levee. For all plans tested the velocity of the reverse eddy against the Patterson St. section of the diversion levee was 18 f.p.s. These results indicate a slight reduction in velocity from the 23 f.p.s. which occurs with a curved diversion levee (Ref. 3, Fig.8).

3.23 Velocities at downstream toe of the diversion levee. The velocity at the downstream toe of the diversion levee was measured at 25 f.p.s. for Plan C and 28 to 29 f.p.s. for Plans C1 and C2 as compared to 23 f.p.s.

for a curved diversion levee (Ref. 3, Fig.8). These results indicate that both Plan C1 and C2 are the next efficient type of diversion st cture so far tested with the exception of a breakwater located in the centre of the river as detailed in Ref. 2. However, because of the increased efficiency in diverting the South Esk jet, slightly higher scouring velocities result at the toe of the levee.

3.24 Velocities against King's Wharf. For all plan C proposals the velocities against King's Wharf are substantially increased from that which occur with a curved diversion levee (Ref.3 Fig.8). The average velocity impinging on the wharf sheds is 25 to 28 f.p.s. for the Plan C proposals as compared to a velocity of less than 10 f.p.s. with a curved diversion levee. The velocities in this area can be reduced by projecting the diversion levee approx. 50 ft. into the Tamar River at the Northern end. However, because of the very low frequency of the maximum probable flood (estimated 1 in 10,000 yr.) it is extremely doubtful whether this could be justified economically by reduction in any damage that may occur to King's Wharf in the unlikely occurrence of a flood of this magnitude.

4. Conclusions

The results of the model tests carried out for Plans C, C1 and C2 of the proposed diversion levee lead to the following conclusions:-

(i) Of the three plans tested C1 and C2 were the most hydraulically efficient in diverting the South Esk jet. All three plans were more efficient than the curved diversion levees on Royal Park discussed in previous reports (Ref. 1, 2 and 3).

(ii) For Plans C1 and C2, model results indicated that the levee height could be lowered in certain sections below the heights shown on the Launceston Flood Protection Board's plan No. 3604. However, for reasons discussed fully in the report this lowering should not be to the full limit shown by the model. The degree of permissible lowering is a matter of arbitrary judgment.

(iii) Surge heights against the concrete surround levees adjacent to the Wheat Silos are increased for Plans C, C1 and C2. For reasons given in the report it is considered that any damage so caused, if the maximum probable flood ever occurs, will be minor, and could, if necessary, be avoided by emergency raising of the levee at time of flood.

(iv) Because of the increased efficiency of Plan C proposals, scouring velocities in the vicinity of the diversion levee are slightly increased. This increase is not considered to be serious.

(v) Velocities impinging against the wharf sheds on King's Wharf for a flood discharge of 250,000 c.f.s. are markedly increased from those for the curved diversion levees previously investigated, for the same reasons as described in (iii) above. However, because of the very low frequency of occurrence of a flood of this magnitude, it is not considered that any extension of the levee into the Tamar to avoid this effect is justified.

C.H.Munro

References

(1) Munro C.H. "flood Mitigation Measures for the City of Launceston" Report No.8 Water Research Laboratory, The University of New South Wales, Sept. 1959.

(2) Munro C.H. "Supplementary Report on Flood Mitigation Measures for the City of Launceston" Report No.9, Water Research Laboratory, The University of New South Wales, October, 1959.

(3) Munro C.H. and Foster D.N. "Model Studies of South Esk Diversion Structure at Launceston" Report No.47, Water Research Laboratory, The University of New South Wales, November 1961.

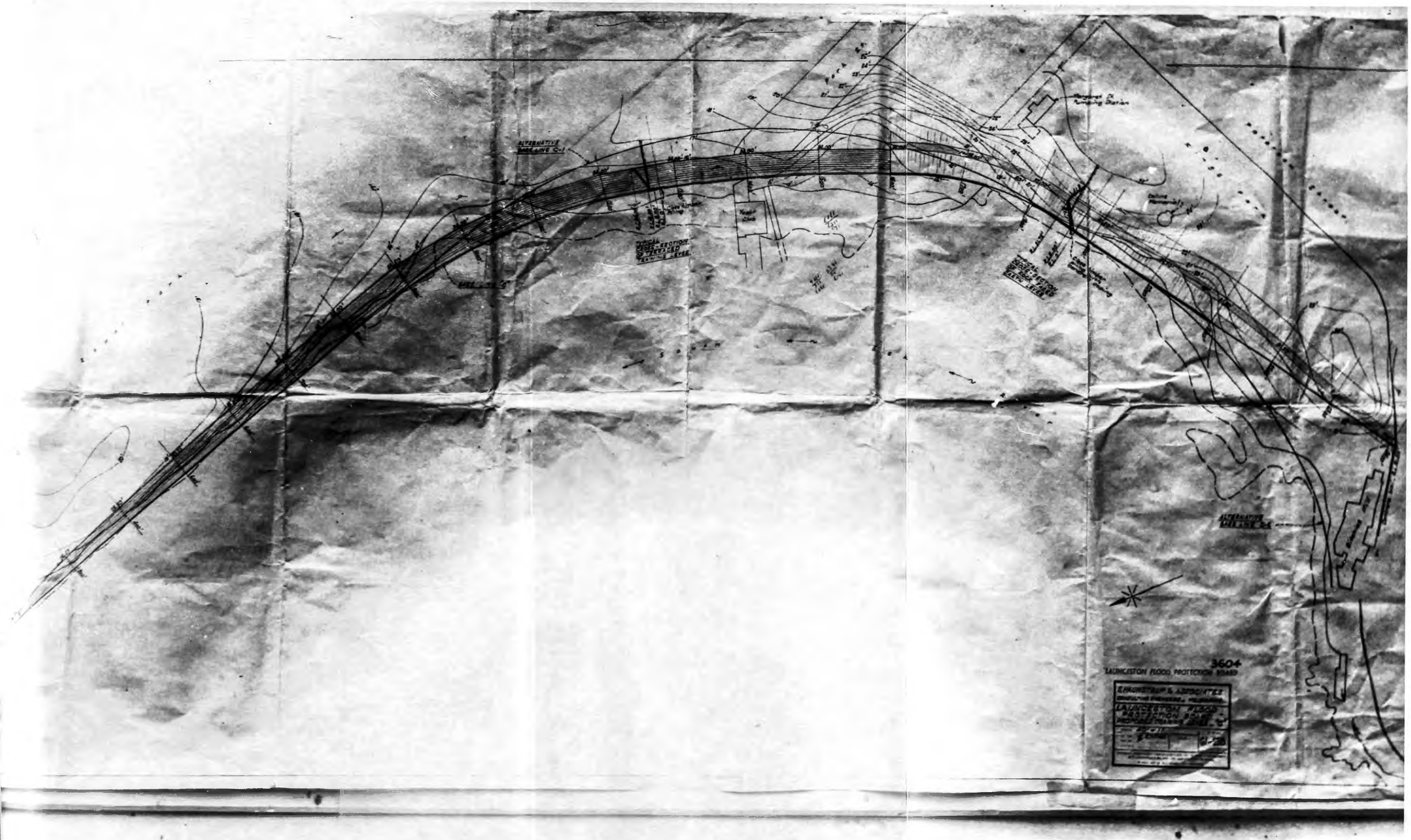
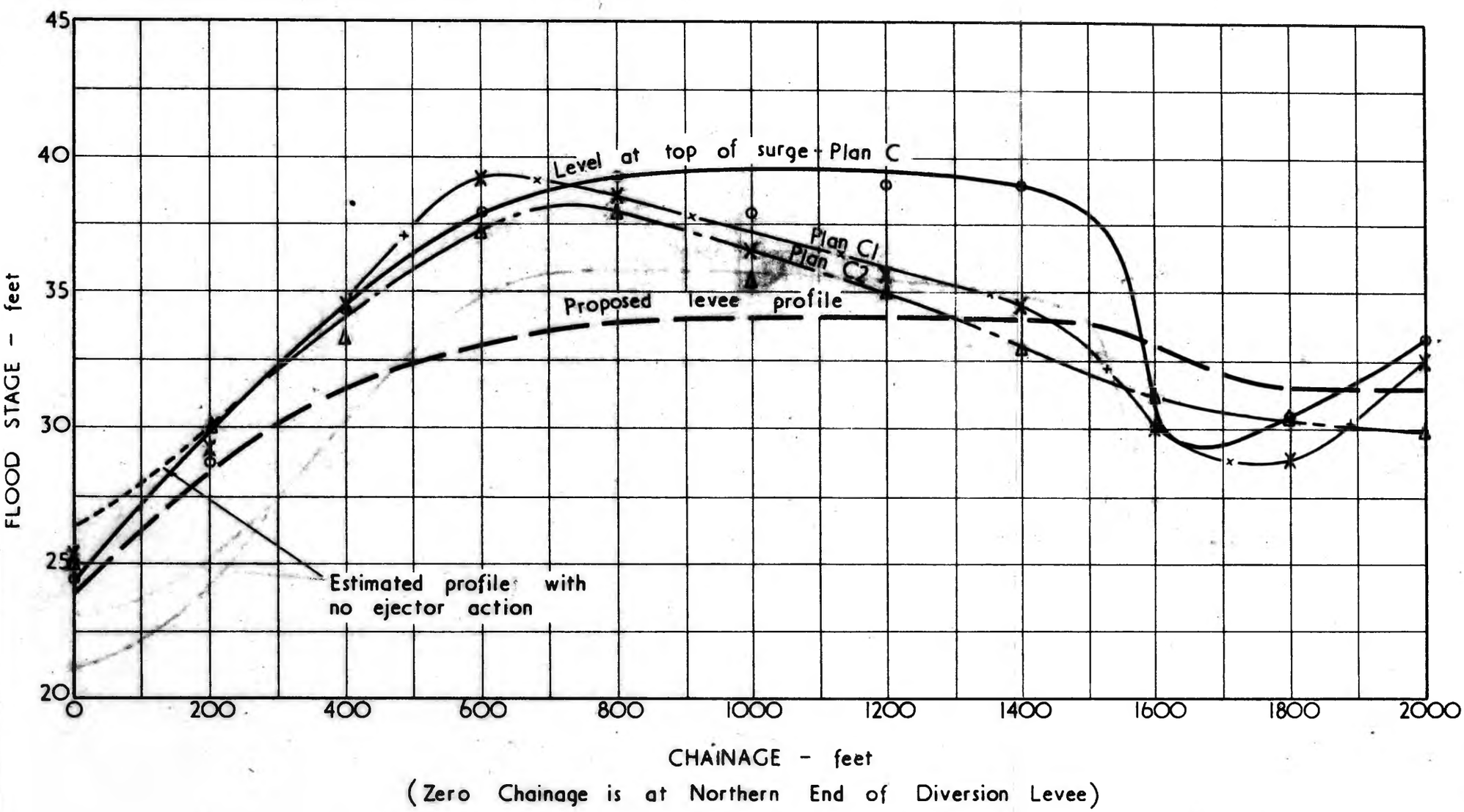

ALTERNATIVE
TYPICAL
CROSS-SECTION
OF PROPOSED
FLOOD WALL
3604
LAUNCESTON FLOOD PROTECTION BOARD

FIGURE No. 1.



LEGEND - PLAN C ⊙ ———
PLAN C1 X —×—
PLAN C2 Δ —·—

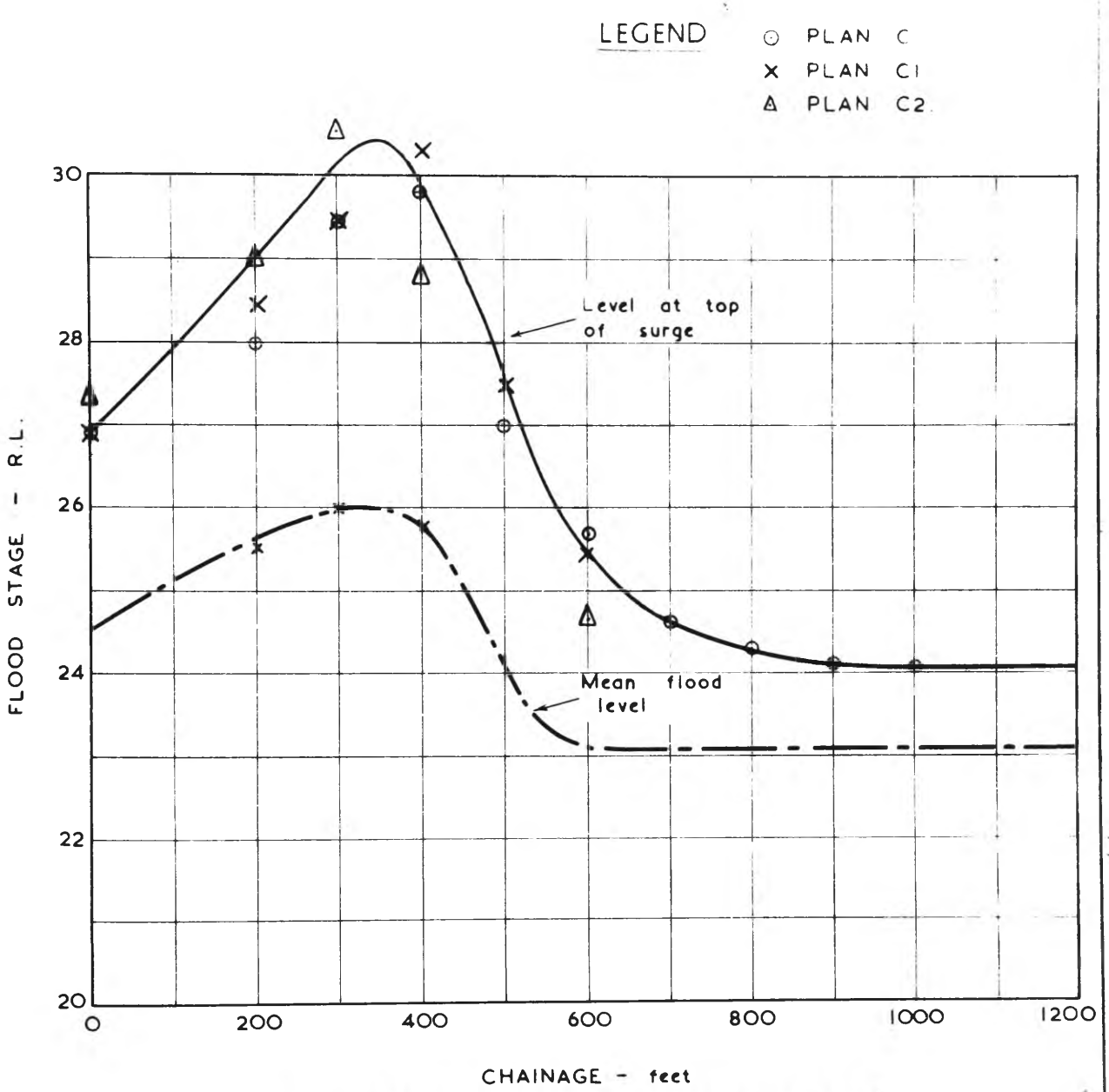
LAUNCESTON FLOOD PROTECTION INVESTIGATION

FLOOD LEVELS AGAINST DIVERSION LEVEE LOCATED TO PLANS C, C1, C2.

2·2 62

CE-D-2456

FIG No. 2



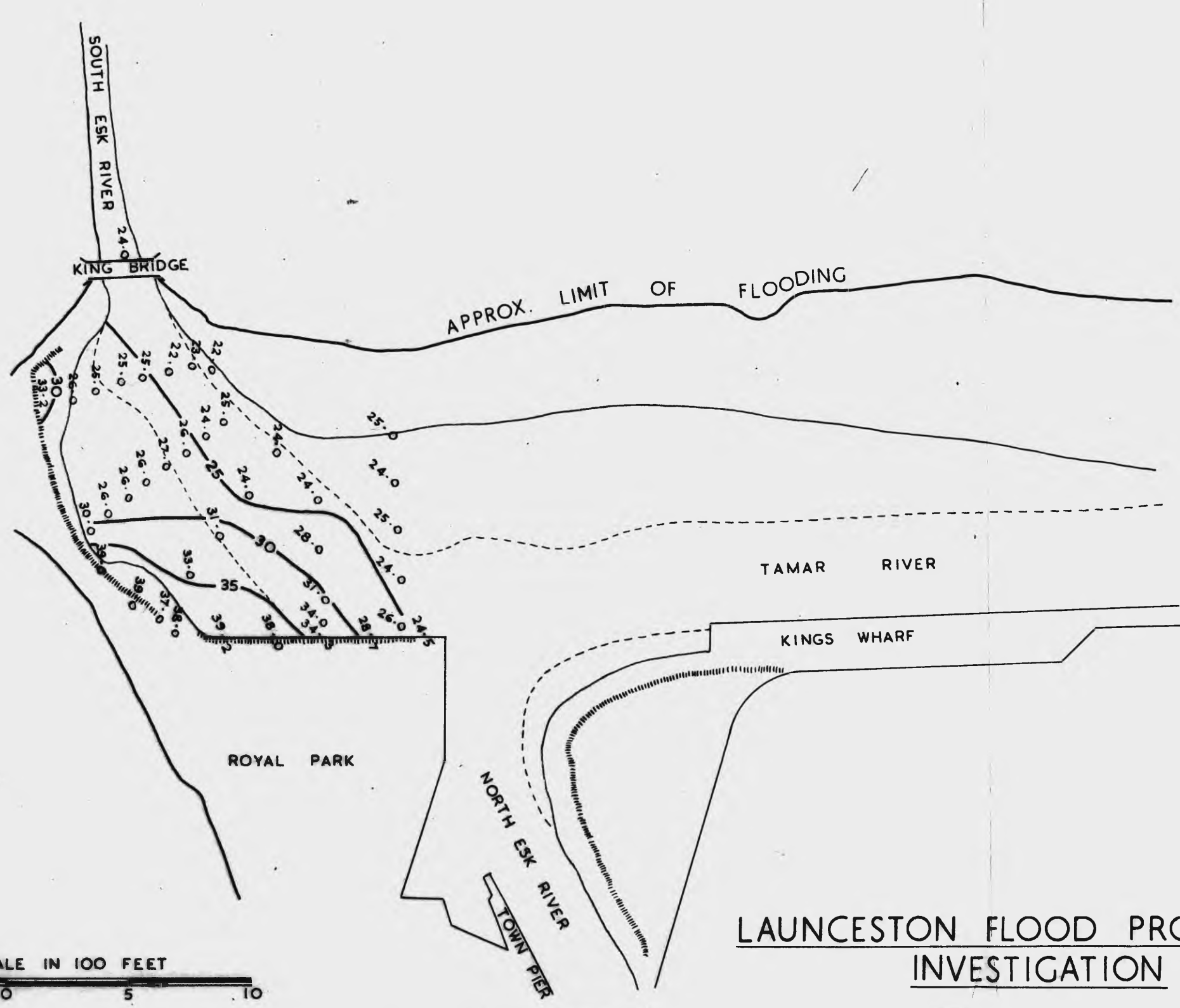
(Zero Chainage is at the Southern End of Kings Wharf at Access Gate to Wheat Silos)

LAUNCESTON FLOOD PROTECTION INVESTIGATION

FLOOD LEVELS AGAINST LEVEE SECTION BETWEEN KINGS WHARF & CHARLES ST. BRIDGE WITH DIVERSION LEVEE LOCATED TO PLANS C, C1, C2.

CE-E-2453

traced 2.2.62



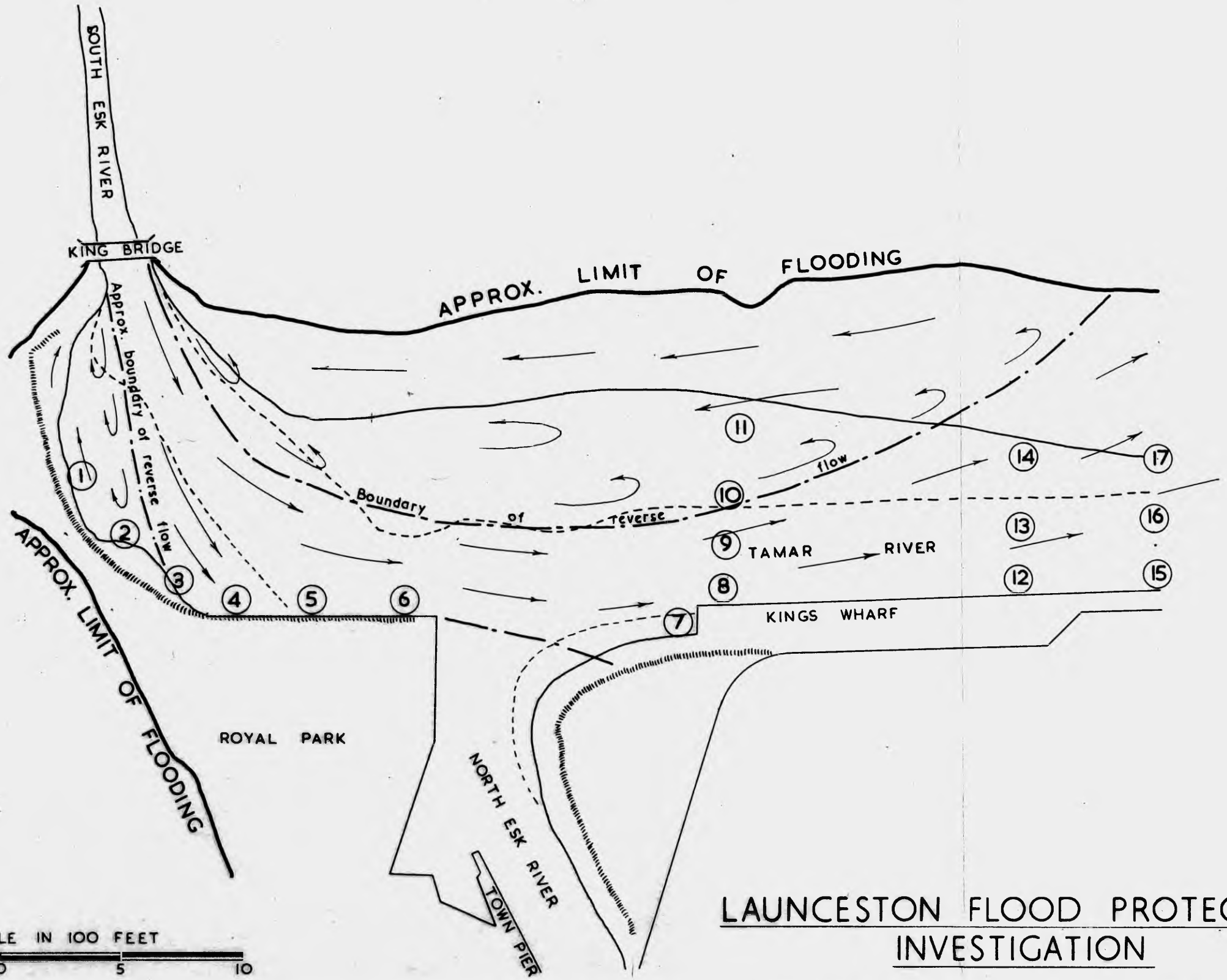
LAUNCESTON FLOOD PROTECTION INVESTIGATION

FLOOD LEVELS AT TOP OF SURGE IN UPPER TAMAR FOR MAX. PROBABLE FLOOD WITH DIVERSION LEVEE TO PLAN C PLUS ALL SURROUND LEVEES.

Date traced 6·2·62

CE-D-2457

FIG. No. 4



LAUNCESTON FLOOD PROTECTION INVESTIGATION

FLOW PATTERN FOR MAX. PROBABLE FLOOD SHOWING LOCATION OF VELOCITY STATIONS

PROTECTION ATTAINED BY DIVERSION LEVEE TO PLAN C PLUS SURROUND LEVEES

CE - D - 2454

traced 5·2·62

FIG. No. 5

FIG. No. 6.

FLOW VELOCITIES IN UPPER TAMAR RIVER WITH PROBABLE MAX. FLOOD FOR DIVERSION LEVEES TO PLANS C, C1 & C2 TOGETHER WITH ALL SURROUND LEVEES

STATION No.	VELOCITY IN f.p.s.		
	PLAN C	PLAN C1	PLAN C2
1	18 · 3	18 · 4	18 · 4
2	12 · 4	–	–
3	7 · 1	–	–
4	11 · 9	–	–
5	26 · 0	–	–
6	30 · 8	31 · 8	32 · 1
7	18 · 0	20 · 7	21 · 0
8	25 · 2	–	–
9	25 · 1	28 · 4	28 · 8
10	8 · 4	–	–
11	N.S.V.	–	–
12	N.S.V.	–	–
13	21 · 2	–	–
14	16 · 7	–	–
15	N.S.V.	–	–
16	12 · 4	–	–
17	19 · 2	–	–

NOTE :- N.S.V refers to points where velocities were less than the minimum velocity which can be measured by the Ott midget current meter. This velocity corresponds to approx. 6 ft./sec.

CE-E-2464