CoA Memo. No. 159

THE COLLEGE OF AERONAUTICS

TRANSPORT SHORT COURSE

8th - 19th July 1968

# PROJECT REPORT ON AIRPORT LOCATION

by

Members of the Short Course

# THE COLLEGE OF AERONAUTICS

## TRANSPORT SHORT COURSE 8th - 19th July, 1968

## PROJECT REPORT ON AIRPORT LOCATION

### PREFACE

1. An integral part of the two-week transport short course was a group project study by course members, applying material presented on the course to a practical problem in transport systems analysis. Airport location in Southern England was chosen as the example. The students were asked to put themselves in the position of a working party who had been given two weeks to prepare an initial paper for a Commission appointed to enquire into the location of a third London Airport. The purpose of this initial paper was to survey the problems which would need to be tackled, to make definite proposals for detailed studies which would need to be made, and to provide information on the scope and relative importance of such studies.

2. The Scenario as given to the students is attached. There were 13 students on the course drawn from industry, research organisations and government, who worked together for about 30 hours on the project. At the end of the course the group presented their findings to a panel of experts who commented in the subsequent discussion.

3. The panel were favourably impressed by the amount of ground covered in the project study and by the way in which many relevant but diverse factors had been brought together coherently in the short time available. Particular points raised during the discussion were:

   (a) Interdisciplinary team studies in a favourable environment lead to a group pattern of understanding which surpasses the individual contributions.

   (b) The Third London Airport should be considered as part of a national transport strategy. Allied to this conclusion was the need for further air travel demand information on a national basis.

   (c) A major airport is a major industry and generator for commercial activity. Siting must be considered within the context of regional planning.

   (d) In cost benefit studies complexity and elaboration should be held in check with emphasis on simplifying the issues linked to sensitivity analysis of general system models.

   (e) Travel demand surveys are critical both for estimating future air travel and for accessing the provision for surface transport links. Exact predictions were impossible but the likely ranges of variability should be explored and forecasts updated frequently.

   (f) Capacity restraints were present in many aspects of the problems affecting airport traffic, passenger handling and surface traffic. Interactions between cost and capacity would need to be identified, and evaluated so that unforeseen cost escalations are avoided.

(g) The process of system study and cost benefit analysis is essentially iterative in nature. The process starts from essentially individual studies which are brought together in a central analysis, the interaction enforced leading to modification of the individual studies and so on.

In the time available the initial studies only were brought together in the compilation of this report and the first interactions were not explored.

(h) Amenity assessment involves many more factors than airborne noise, although noise is likely to be dominant.

4. Preliminary assessments were made of the magnitude of the effort required for carrying out the studies suggested in the paper. These amounted to some 200 man years broken down as follows:

| | | |
|---|---|---|
| Air traffic forecasts | 10 | man years plus surveys |
| Regional planning | 10 | man years plus fieldwork |
| Air traffic control | 5 | man years |
| Amenity assessment | 10 | man years |
| Surface traffic forecasts | 10 | man years |
| Surface transport planning | 30 | man years |
| New surface modes | 10 | man years |
| Role of VTOL | 20 | man years |
| Airport and terminal layout | 5 | man years |
| Site investigations | 40 | man years |
| Overall systems analysis | 50 | man years |

The studies would include assessment of possible improvements to existing technology, but would not include the work involved in acheiving these improvements, e.g. modifying air traffic control equipment and procedures to acheive higher movement rates.

5. The project report is preceeded in this memorandum by the Scenario and terms of Reference presented to the students at the start of the course.

The views expressed in this report are those of the course members themselves, and not necessarly those of the College of Aeronautics, nor of the organisations which sent students.

# THE SCENARIO

## 1.0 1961 Hole Committee (1)

In November 1961 a Committee was set up by the Ministry of Aviation to consider the requirements for a Third London Airport, including timing and location. The Committee reported in June 1963. Its conclusions were:-

## 1.1 The Need for a Third Airport

Forecasts showed that Heathrow and Gatwick with two runways will, from about 1971, be unable to handle all London's air traffic. London must, therefore, have a third airport about 1975 if it is not to turn traffic away.

## 1.2 The Third Airport's Required Capacity

The estimate of London's air traffic growth after 1970 shows that the new airport should have a potential capacity similar to that of Heathrow, i.e. a site has to be found where two parallel runways can be built far enough apart to permit independent operation on each.

## 1.3 Type of Traffic Using the Third Airport

The new airport will be needed mainly for international short-haul passenger services which account for the greatest proportion of aircraft movement. It should also be able to take the largest jets on long-haul services, including supersonic airliners, without creating intolerable noise problems. The study work on the assumption that passenger aircraft in use in the early 1970's, including the Anglo-French supersonic transport, would not make greater demands of airport facilities than those in use today.

## 1.4 Road and Rail Access to and from Central London

Any London airport should be no more than one hour's journey from Central London. The airline traffic, even at a mojor airport, is not expected to be sufficient on its own to warrant the expense of providing special access other than a short link with an existing main railway line or road. A new airport must, therefore, be able to fit into the existing or already planned transport network for south-eastern England. There is at present no certainty that a fast and frequent connection with Central London could be provided solely or chiefly by rail; nor is it certain that, if such a connection were possible, it could run at a reasonable level of fares. Although therefore, the possibility of rail link is still open, the new airport should be placed where it can, if necessary, use the road system as its sole means of access.

## 1.5 A Fourth London Airport

The question of whether and when London should have a fourth airport should be taken up in about five year's time (i.e. 1968).

## 1.6 Sites Examined

Over a dozen sites on the eastern and western sides of London were examined. The study confirmed that to the west there is no site of the desired capacity within adequate reach of London. To the east Stansted, though not perfect, seems to be the only suitable site.

## 2.0 The Enquiry (2)

An enquiry was set up into the local objections to the proposed development of land at Stansted as the Third Airport for London. The enquiry took place between December 1965 and February 1966, and the report was issued in 1967. In assessing the merits of the proposal (Stansted) the Inspector drew attention to the necessity to balance pros and cons which could not be evaluated in the same units. The Inspector deduced that the proposal to site the airport at Stansted succeeded on the viability of air traffic, but that there were strong arguments against it on the grounds of :

(a) town and country planning

(b) bad ground access from London

(c) noise

(d) change of character of the neighbourhood

(e) loss of good agricultural land.

The Inspector recommended a review of the whole problem by a Committee equally interested in traffic in the air, traffic on the ground, regional planning and national planning, and furthermore, that the review should cover military as well as civil aviation.

## 3.0 May 1967 White Paper on the Third London Airport (3)

Of the alternative sites considered, it was deduced that of the Thames estuary sites, Sheppey was the most promising. Difficulty of access and interference with Ministry of Defence firing range at Shoeburyness was cited against it.

The area to the north west of London towards Birmingham was re-examined because of its particular attractiveness from the regional planning aspect. Of the sites considered, that of Silverstone had advantamtages on the grounds of regional planning in that it would fit in with the general sweep of planning for the region, being near to the planned expansions in north Buckinghamshire and Northampton area enabling employment generated by the airport to be geared to these expansions. The most serious disadvantage was the effect on military flying.

The White Paper deduced that "Stansted has indisputable advantages over the main alternatives on the scores of air traffic control, surface access, and costs; it is acceptable on grounds of noise; this terrain is good for airport development. Its acknowledged drawbacks are that the development would entail a loss of good agricultural land and disadvantages in local and regional planning. After a careful consideration of all possibilities, however, the Government believes that there is no alternative site for a Third London Airport that is superior to Stansted in its implications to agriculture and planning and is at the same time both technically suitable and capable of development at an acceptable cost."

## 4.0 The New Enquiry

In May 1968, the Government announced a new enquiry with the following terms of reference:

(a) to enquire into the timing of the need for a four runway airport to provide for the growth of traffic at existing airports serving the London area.

(b) to consider the various alternative sites and to recommend which site should be selected.

It is expected that the enquiry may last two years.

## THE GROUP STUDY

It is clear that a few people in a few hours can hope to contribute little in volume to the many words that have been and will be written on this issue. The fact that so much information is available, yet at the same time, so many questions remain unanswered, makes the subject a most interesting item for case study.

## 5.0 ~ of Reference

In order to align the task to the time available, the following terms of reference are proposed.

"A Working Party has been established to assist the enquiry by acting as a central focus for operational analyses and cost-benefit studies; members of the Working Party will serve in their personal capacities. The Working Party will draw upon outside organisations to conduct individual specialist studies.

The Working Party has been asked to submit a paper on Friday, 19th July giving a survey of the problems and it will have to tackle, and make definite proposals for studies that will be required. The Working Party has been asked to indicate by means of such analysis as is possible in the time the relative significance of the problems to be studied."

The Working Party has been given the following brief as a basis for preparing their paper:-

### 5.1 Defence Implications

All aspects of interference between civil aviation and defence, be it interference between Shoeburyness firing range, or with military airfields, or government research establishment airfields will be the subject of a separate study. This is not to say that these questions are not important and they may carry considerable weight in the final assessment. The initial programme of work for the Working Party will concentrate on evaluating the civil aviation aspects.

## 5.2 Interaction of Ground and Air Transport

Particular attention should be given to:

(i) the overall transportation problem from origin to final distribution,

(ii) the interaction and competition between air and surface transport,

(iii) the interaction between surface movement generated by car travel (including that of airport workers) and the surface transport system.

## 5.3 Sites

In the first instance, the Working Party is asked to consider the following :-

(a) Stansted - In particular, the effect of introducing four runways operating simultaneously at maximum capacity.

(b) Thames Estuary - In particular the problems arising from locating an airport away f' m the area where the workers will live, with the increased load on local transportation; a site which is good from the noise and amenity point of view, but which raises problems over the cost of special transport links.

Although the White Paper prefers Sheppey, comment is particularly requested on the Foulness proposal (4).

(c) South Midlands - The setting aside of the defence objections would make Silverstone a most interesting possibility, in particular the links with other regions.

## 5.4 A Central London VTOL Airport

A high proportion of air traffic is short and medium haul and can come within the capabilities of a future generation of vertical take-off and landing aircraft.

Such aircraft, if acceptable on noise grounds, could opera from city centre to city centre. Such operation would have considerable effects both on overall travel times and on the space and cost requirements of the airport. Consideration is required of a VTOL site close to Central London and with good communications both by road and rail, i.e. it should have quick access to the proposed inner motorway box and to the underground transport network. One suggested site, which was considered by the Committee on helicopter sites, is the Nine Elms goods depot (notwithstanding the fact that Covent Garden is supposed to be moving there). Another suggested site is in the docks area, either St. Catherine or Surrey docks. Problems will arise on an air traffic control, that is how the aircraft can be operated in a manner that is compatible with the other airports and the noise levels that will have to be achieved to render such operation acceptable.

5.5 An Airport for Supersonic Aircraft If it is postulated that aircraft will not be able to fly supersonically over the main habited regions of the British Isles then it may be necessary to locate an airport for these aircraft at a coastal site. For trans-Atlantic traffic a site in the west of England would be appropriate and a high-speed link between this site and London is an obvious requirement.

## 6.0 Organisation of Study

A suggested organisation is a main steering group concerned with basic planning factors, definition of individual problems for study and two specialist groups, one concerned with surface movement and the other concerned with the aircraft and airport factors.

## References


1. Report of the Inter-departmental Committee on the Third London Airport June 1963 Ministry of Aviation C.A.D. 199 H.M.S.O. 1964.

2. Report of the Enquiry into Local Objections to the Proposed Development of Land at Stansted as the Third Airport for London. Ministry of Housing and Local Government H.M.S.O. 1967.

3. The Third London Airport Cmnd 3259 H.M.S.O. May 1967.

4. The Third London Airport - Foulness The Noise Abatement Society 1967.

5. Helicopter Stations in the London Area. CAP 173 H.M.S.O. 1961.

## COURSE MEMBERS

| Name | Firm or Organisation |
|---|---|
| CHAMPION, P.A. | British Aircraft Corporation Ltd. (Bristol) |
| DAVEY, B.J. | British Aircraft Corporation Ltd. (Bristol) |
| EASTON, G.J. | Tracked Hovercraft Ltd. |
| HARRIS, D.R. | British Aircraft Corporation Ltd. (Weybridge) |
| MERRITT, V.G. | British Airport Authority |
| PICKEN, J. | Ministry of Technology |
| POOLEY, R.A. | British Railways Board |
| ROMER, D.R.M. | Hawker Siddeley Aviation Ltd. (Hatfield) |
| WATERS, M.H.L. | Road Research Laboratory |
| WEBB, J.F. | Freeman, Fox and Partners |
| WIGENIUS, L. | Navigation School, Harnosand, Sweden |
| WILSON, R.E. | Essex County Planning Department |
| WIMHURST, J. | Hawker Siddeley Aviation Ltd. (Hatfield) |

## COLLEGE LECTURERS

| Name | Department |
|---|---|
| Professor A. Stratton | Mathematics |
| Professor D. Deith-Lucas | Design |
| K.D. Harris | Aerodynamics |
| D. Hodgetts | Advanced School of Automobile Engineering |
| D. Howe | Design |
| S.G. Lennox | Mathematics |
| A.J. Robertson | Advanced School of Automobile Engineering |
| J.J. Spillman | Aerodynamics |
| G.H. Tidbury | Advanced School of Automobile Engineering |
| D.G. Yeomans | Flight |

## OUTSIDE LECTURERS

| Name | Firm or Organisation |
|---|---|
| P.D. Cherry | Hawker Siddeley Aviation Ltd. (Hatfield) |
| R.H. Chowns | British European Airways |
| J. Dawson | National Physical Laboratory |
| R.O. Goss | Board of Trade |
| J.E. Iles | British Aircraft Corporation Ltd.(Bristol) |
| M. Newman | British Rail Research Laboratories |
| J.A.H. Paffett | National Physical Laboratory |

## PROJECT PRESENTATION PANEL

| Name | Firm or Organisation |
|---|---|
| V.G. Bonney | Hawker Siddeley Aviation Ltd. (Hatfield) |
| D.J. Farrar | British Aircraft Corporation Ltd.(Bristol) |
| Mr. Fawkes | Greater London Council |
| A. Stratford | A. Stratford and Associates |
| A.H. Wickens | British Rail Research Laboratory |

# CONTENTS

3.2.1.3 Sheppey

3.2.1.4 Foulness

3.2.1.5 Silverstone

3.2.1.6 Other sites

### 3.2.2 Rail

3.2.2.1 Airport demand in train units of 300 passengers per train on hourly basis.

3.2.2.2 Present train unit flow at point near airport site for each location for 1975 and 1980.

3.2.2.3 Interaction of commuter peaks and airport peak demand.

3.2.2.4 Peak load factors of 2-runway and 4-runway ultimate flows to assess ultimate demand on track capacity.

3.2.2.5 Means of increasing line capacity including advanced passenger train and inductive signalling systems.

3.2.2.6 Relative merits of each site.

3.2.2.7 Effects of choice of London terminal on trunk routes involved.

### 3.2.3 Tracked Hovercraft

3.2.3.1 Assessment of need for a specialised link.

3.2.3.2 Requirement for each of the four considered sites.

3.2.3.3 Availability of tracked hovercraft system.

### 3.2.4 Marine Hovercraft

3.2.4.1 Potential routes.

3.2.4.2 Studies required.

## Section 3 Other Transport Considerations

3.3.1 Transfer passengers

3.3.2 Transport for airport employees

3.3.3 Consideration of complete journey.

## Section 4 Baggage Handling and City Centre Terminals

### 3.4.1 Baggage Handling

3.4.1.1 Check-in at the town terminal.

4.2.4 Noise

4.2.5 VTOL

4.2.6 Transport systems

4.2.7 Matching ground and air traffic flows

4.2.8 Growth of travelling public

4.2.9 Town Terminals

4.2.10 Community considerations - local

4.2.11 Community considerations - regional

4.2.12 Cost-benefit studies

# PART I INTRODUCTION

## 1.1. Terms of Reference

### 1.1.1. The Committee

H.M. Government has appointed a Committee to consider:

* the timing of the need for a four-runway airport to provide for the growth of traffic beyond the capacity of existing airports serving the London area.
* the various alternative sites and to recommend which site should be selected

### 1.1.2. The Working Party

A Working Party has been established to assist the Committee in their enquiry by acting as a central focus for operational analyses and cost benefit studies. The names of the members of the Working Party are appended.

The terms of reference of the Working Party are to submit by Friday 19 July 1968 a paper giving:

* a survey of the problems to be tackled
* proposals for further studies
* an indication wherever possible of the relative significance of the problems.

The Working Party are to pay particular attention to:

* the overall transportation problem from origin to destination
* the interaction and competition between air and surface transport
* the interaction between surface transport modes.

At this stage the Working Party is to concentrate on civil aviation aspects rather than defence considerations.

Composition of Working Party: (Appendix A)

| | | Committee |
|---|---|---|
| | Mr. P.A. Champion B.A.C. (Filton) | Air |
| | Mr. B.J. Davey B.A.C. (Weybridge) | Air |
| | Mr. G.J. Easton Tracked Hovercraft Ltd. | Ground |
| * | Mr. D.R. Harris B.A.C. (Weybridge) | Steering |
| | Mr. V.G. Merritt B.A.A. | Ground |
| * | Mr. J. Picken Ministry of Technology | Air |
| | Mr. R.A. Pooley B.R.B. | Ground |
| | Mr. D.R.M. Romer H.S.A. (Hatfield) | Air |
| * | Dr. M.H.L. Waters Transport Research Assessment Group | Ground |
| | Mr. J.F. Webb - Freeman, Fox & Partners | Ground |
| | Mr. L. Wigenius Navigation School, Harnosand Sweden | Steering |
| | Mr. R.E. Wilson Essex C.C. (Planning) | Steering |
| | Mr. J. Winhurst H.S.A. (Hatfield) | Air |

* Chairmen

1.2.0 Summary

1.2.1. The Working Group began by considering the method by which the eventual aim, that of the selection of a site through the medium of a Cost Benefit Analysis could be achieved. This method is shown in the flow diagram in Figure 1, and stresses the importance of the interaction of various factors. It shows for example the crucial part which traffic forecasting and regional aspects play.

1.2.2. Within the time available, it has been impossible for the Working Group to produce more than a skeleton for an analysis; but this should not detract from the importance of carrying out the analysis.

1.2.3. For administrative reasons, the Group has been divided into a steering group and two specialist groups; and the sequence which follows reflects the grouping rather than the flow diagram referred to above. For example, community considerations appear in Part IV, although they must be considered at the onset.

1.2.4. Again, within the time available, it has been impossible to quantify the factors, and so a concise summary is impracticable. However, generalised recommendations are included at the end of this report.

## 1.3.0 Passenger Forecasts

### 1.3.1. Introduction

3.1.1. Before considering the factors affecting where the Third London Airport (TLA) should be sited, the Working Party considered the time-scale, in terms of saturation of existing airports and the need to provide new facilities.

3.1.2. Although not in the sequence of consideration and decision which the Committee is recommended to adopt, (see the cost benefit analysis method chart in the preceding section) the Working Party considered the forecast of traffic through London's airports contained in the White Paper (Cmnd 3259 Appendix I) first; and then gave thought to factors which would alter the forecast. These included factors which:

* may not have been given sufficient weight when the forecast was prepared
* may have materialised since
* may divert traffic to other modes

1.3.1.3 These points are discussed in the following chapters of this section. When an up-dated and more detailed forecast has been prepared, which the Committee is recommended to put in hand as a matter of urgency, it may be seen that the year by which a third airport is required has changed. In the event that the in-service date is later than hitherto assumed, more time can be given to a thorough investigation and the preparation of a Cost Benefit Analysis.

### 1.3.2. Forecast of Airport Saturation

1.3.2.1. The data used in this chapter, and the conclusions drawn from them, are taken from the White Paper "The Third London Airport" Appendix I to Cmnd 3259.

3.2.2. Figure 2 shows the forecast of air transport movements and terminal passengers through London's airports, for each of the three growth rates. Fig. 3 takes the "most likely" forecast movements and plots them in terms of Standard Busy Rates (SBR) According to this forecast, Heathrow and Garwick collectively will reach saturation point during 1973 which implies that TLA must come into operation in 1972. In Fig. 4, all three rates forecast are plotted against the SBR for six different cases. In this way, and accepting for this purpose the forecast traffic levels, the years when TLA, with various runway configurations, will itself become saturated can be estimated.

1.3.2.3. The Cases

Case A: assumes a second non-independent runway at Gatwick which would defer saturation from the period 1970-1972 to 1971-1974 (the "most likely" rate of growth indicates 1973).

Case B: as Case A, plus one runway at TLA, which would stave off saturation till 1976-1 (1979). This might be the case if Stansted were to be used at no greater level of aircraft movement than at present, providing the training flights currently operated from Stansted were to be carried out from another base.

Case C: with two non-independent runways at TLA, saturation would not be reached until 1977-1987 (1981).

Case D: if the two runways at TLA are independent, then the saturation year in the worst case would not be before 1980 (1985)

Case E: four non-independent runways at TLA imply saturation at about the end of 1981 at the highest growth rate forecast, in 1987 in the most likely case.

Case F: if two of the four runways are independent, then saturation is put off till 1983 in the worst case, or until the next decade in other cases, too far ahead for any reasonable degree of accuracy in forecasting.

1.3.2.4. Summary of Saturation Years (Most likely forecast)

| | |
|---|---|
| Heathrow and Gatwick, at present | 1971 |
| Second runway at Gatwick | 1973 |
| TLA - one runway | 1979 |
| - two runways | 1981-1985 |
| - four runways | 1983-199 (?) |

1.3.3. Amending the Forecast

3.3.1. The Forecast

Presented to Parliament in May 1967, the White Paper Cmnd 3259 contained a traffic forecast based on statistics which could not have been later than the first quarter of 1967, and in some cases were considerably older. Sufficient time has elapsed since then to warrant the preparation of a revised forecast, taking into account inter alia the following.

1.3.3.2. Passenger Traffic

The "upper limit" and "most likely"forecasts are at relatively straight line (logarithmic) growth rates, while the "lower limit" increases at a decreasing rate. It would appear that two, if not all, of the forecasts derive from trend analysis only, and that social, economic, and political factors have not been taken into account separately.

Since May 1967, there have been significant factors affecting the economies of the U.S.A., the U.K. and some European nations. These factors have had and are having varying effects on air travel generally and through London particularly. For example:

* devaluation of sterling
* the £50 travel allowance for pleasure travelling
* the probable decrease in U.K. discretionary spending resulting from increased taxation and wage restraint.
* President Johnson's exhortation to U.S. citizens to reduce their overseas travelling outside the Americas
* the reduction in the number of British and U.S. servicemen and their families in Europe.

These and other factors will tend to depress the traffic growth rate (note that BEA growth in 1967 was down from 14% to 6%)

It may be of significance that depressing the "most likely" forecast by 1% would cut the 1980 traffic back to 1979 forecast levels.

For comparison purposes, the passenger traffic growth rates used in the White Paper forecasts are shown below, together with other forecasts (average annual cumulative %)

| | | Cmnd 3259 | ICAO | Boeing | Lockheed |
|---|---|---|---|---|---|
| London | 1970-75 | 6.5-8.5-11.5 | | | |
| | 1975-80 | 5.25-8.5-11.5 | | | |
| Europe | 1970-75 | | | | 7.5 |
| | 1975-80 | | | | 5.5 |
| N. Atlantic | 1970-75 | | 13.8 | 10.5 | 6.7 |
| | 1975-80 | | | 5.0 | 8.0 |

### 1.3.3.3. Freight Traffic

In the White Paper, paragraphs 24.25 refer to the significance of freight traffic, concluding that the growth of passenger traffic by itself will neccessitate a third airport by the mid 1970's. This suggests that the forecast of air movements does not include movements of aircraft operating in the all freight role.

The volume of world air freight is expanding at a rate faster than that of passenger traffic. In terms of revenue freight traffic is expanding even more quickly. Freight traffic is discussed in more detail in the following section, showing that it is essential to make a careful study of the nature of air freight operations in order to establish:

* the growth rate of traffic through London's airports
* the quantity which will be carried by all-freight flights (currently about 40%)
* the rate at which all-freight movements will exceed the level of other movements used in the forecast, and therefore the number of extra movements which may have to be taken into account.

### 1.3.3.4. Aircraft Size

The average number of passengers per aircraft implied by the forecast (terminal passengers divided by movements) is plotted in Fig. 5. In summary, it shows:

| | Lower Limit | Most Likely | Upper Limit |
|---|---|---|---|
| Passengers per aircraft | | | |
| 1967-72 | 58-72 | 59-74 | 60-80 |
| 1972-80 | 72-89 | 74-101 | 80-122 |
| Annual cumulative increase | | | |
| 1967-72 | 4.4% | 4.5% | 5.9% |
| 1972-80 | 2.7% | 4.0% | 5.4% |

History shows that major carriers start to re-equip at intervals of about seven to nine years, and that the next major re-equipment phase is due in the early 1970's. This being so, the introduction of larger-capacity aircraft about 1972 will increase the growth of passengers per aircraft, rather than depress it (assuming that load factors remain constant and that frequencies are not allowed to increase out of proportion to traffic/capacity demands) as is the case in the table above.

A study of Size-Time Relationships(1) shows that, in terms of seats, short/medium haul aircraft have tended to increase in size at about 4%-5% per annum, and long haul aircraft at 6% - 8% . (The high capacity Boeing 747 follows a 8.5% growth trend). An appropriate rate for London's airports would appear to be about 5% - 6% instead of 4% in the "most likely" forecast assumptions. This could have the effect of delaying the saturation point by one to two years. It may be inferred from the study, by assuming an average load factor of 60%, that the weighted average number of passengers per movement is ten more than is implied by the data in the White Paper. This in itself would reduce the total movements by 13% per annum, having a three year delaying effect on saturation levels. However, it should be noted that the same study, concerned with a method for forecasting future airport demands and using London as a statistical example, predicted almost as many terminal passengers as in the "Upper Limit" forecast, but considerably more movements, even discounting third level carriers, all-cargo flights, general aviation and military movements.

### 1.3.3.5. A.T.C. Procedure

The possible effects of changes in A.T.C. procedures and runway techniques are examined in a later section (Part 2, Section 2). An increase of 5% in the

SBR for London's airports would have the effect of delaying saturation for one year.

1.3.3.6. Peak Spreading

This is also examined in the same section (Part 2, Section 2), showing how the peaks have tended to spread in recent times. Relative to Heathrow, Gatwick has more pronounced peaks, and consideration should be given to ways of inducing peak spreading, to make better use of the trough period. Fare differentials may provide a partial solution. Accepting the delays and difficulties this would present to IATA airlines, there may be a case for not requiring non-IATA airliners to observe the terms of Provision I. This the U.K. Government applies at the moment (with a temporary exception for devaluation) but is not the case in Sweden and Federal Germany.

A more detailed study should be made of the number of passengers who travel by; surface transport to London in order to reduce the cost of travel beyond the U.K. and who could be persuaded to fly from airports nearer their homes if, by the use of admissable fare differentials, the total journey cost were made more attractive.

13.3.7. Introduction of VTOL Aircraft

The ways in which the use of VTOL aircraft would affect the traffic levels and CTOL aircraft movements in London's airports are discussed in Part 2 Section 4. The use of new airports for VTOL aircraft will create new problems but may well delay the saturation points of the conventional airports for a significant period.

1.3.3.8. Other Factors

New or increased competition from other transport modes may cause a significant reduction in the growth rate of traffic through London's airports. This competition may come from:

* the Channel Tunnel, with a planned capacity of 90,000 passengers daily, could have a marked effect on short-haul movements.
* the introduction of high speed train services, the Advanced Passenger Train and Tracked Hovercraft, operating at speed of 150 mph or more
* more motorways and improved trunk roads.

Reference (1) "Future Demands on Airports and Airspace" - C. Henshaw Thomas and M.E.G. Butler, IATA Technical Conference, July 1967.

## 1.4. Air Freight

### 1.4.1. Introduction

Annual tends; actual

Air freight in general is rapidly increasing - faster than other modes of freight transport. It is also noteworthy that air freight tends to take the cream off the milk. Roughly one per cent of freight by weight to and from UK is carried by air at present, representing some ten per cent by value. Thus, air freight to a higher proportion consists of goods with high interest costs, valuables,& perishables.

Air freight capacity is also rapidly increasing by better use of an increasing number of suitable aircraft both on regular passenger service and on special freight services. This is achieved by planning (co-ordination) and by running freight service in non peak hours. Some aircraft are designed to meet increased freight demands by being convertible and able to carry either passengers or freight e.g. special air freight containers.

Evidently airfreight so far is in its infancy but some significant figures may be quoted to illustrate its overall growth, fig. 6.

Table I showing air freight and growth rate 1957-66 BOAC & BEA

| YEAR | BOAC AIR FREIGHT sh. tons | + % | BEA AIR FREIGHT Sh. tons | +% |
|---|---|---|---|---|
| 1957 | 12568 | | 32100 | |
| | | 3.0 | | 11.2 |
| 1958 | 12945 | | 35700 | |
| | | 14.1 | | 21.0 |
| 1959 | 14846 | | 43200 | |
| | | 25.2 | | 17.8 |
| 1960 | 18675 | | 50900 | |
| | | 18.7 | | - 1.2 |
| 1961 | 22136 | | 50300 | |
| | | 11.1 | | 20.0 |
| 1962 | 27600 | | 61400 | |
| | | 11.7 | | 16.2 |
| 1963 | 27480 | | 71300 | |
| | | 21.0 | | 21.6 |
| 1964 | 33262 | | 86700 | |
| | | 27.8 | | 27.0 |
| 1965 | 41332 | | 107500 | |
| | | 27.8 | | 17.6 |
| 1966 | 52815 | | 126400 | |

Increments in Air Freight, average annual increase 1957 - 1966

| | |
|---|---|
| BOAC | + 17.6% |
| BEA | + 16.6% |
| World (ICAO) | +14.7% |

General trends; forecast

The table below shows forecasts in air freight growth obtained from various sources.

Table II

| PERIOD | SOURCE | | |
|---|---|---|---|
| | 1* | 2** | 3*** |
| 1965 | 18.7% | 18.5% | 17.8% |
| 1970 - 75 | 25.6% | 13.5-25.5% | |
| 1975 - 80 | --- | 10.5-15.0% | |

* Boeing Air Traffic Forecast, S-1355 2/68

** Air Cargo Market Analysis, Washington 66

*** ICAO

4.2. Factors for consideration

Among these effects on airport location which ought to be studied or discussed in connection with air freight are the following:

1) air freight volume through London
2) ground freight traffic through or in London in connection with air freight
3) effects on layout of airport with respect to air freight

4.2.1. Air freight volume through London

Air freight through London is mostly handled by London Airport (Heathrow) but air freight through other airports is not insignificant, fig.7.

Table III

Showing round figures for Heathrow, Gatwick and Southend and all London.

| Year | Heathrow | | | Gatwick & Southend | All London | % Increase % | |
|---|---|---|---|---|---|---|---|
| | Cargo | Mail | Total | Cargo & Mail | | Heathrow | All London |
| 1957 | 50 | 11 | 61 | 7 | 68 | 14.7 | 23.1 |
| 1958 | 58 | 12 | 70 | 14 | 84 | 22.8 | 26.1 |
| 1959 | 75 | 12 | 87 | 20 | 106 | 27.3 | 15.1 |
| 1960 | 92 | 16 | 108 | 14 | 122 | 13.0 | 13.1 |
| 1961 | 103 | 19 | 122 | 16 | 138 | 18.0 | 16.0 |
| 1962 | 120 | 22 | 144 | 16 | 160 | 16.0 | 25.3 |
| 1963 | 144 | 23 | 167 | 34 | 201 | 21.0 | 20.9 |
| 1964 | 178 | 24 | 202 | 41 | 243 | 21.0 | 20.2 |
| 1965 | 220 | 26 | 246 | 46 | 292 | 16.7 | 16.8 |
| 1966 | 258 | 29 | 287 | 54 | 341 | | |
| | | | | | | 10 years average | |
| Short tons x $10^3$ | | | | | | 18.4 | 19.6 |

Statistics show that actual air freight growth through Heathrow and all London agrees with or even exceeds the general trend in world in air freight growth rate.

Thus is appears reasonable to predict an increase in air freight through London in accordance with the world trend.

Taking actual average growth rates as the most probable figures, the following table was compiled showing thousands of short tons of air freight to be handled at Heathrow and all London.

Table IV

of predicted air freight at Heathrow and all London (000's of short tons)

| Year | Heathrow +18.4% | All London +19.6% | |
|---|---|---|---|
| 1966 | 287 | 341 | ACTUAL |
| 1967 | 334 | 408 | FORECAST |
| 1968 | 395 | 488 | |
| 1969 | 467 | 585 | |
| 1970 | 578 | 691 | |
| 1971 | 649 | 835 | |
| 1972 | 758 | 991 | |
| 1973 | 898 | 1194 | |
| 1974 | 1063 | 1426 | |
| 1975 | 1259 | 1705 | |
| 1976 | 1494 | 2039 | |
| 1977 | 1766 | 2438 | |
| 1978 | 2091 | 2916 | |
| 1979 | 2462 | 3488 | |
| 1980 | 2919 | 4171 | |

Comments: The immense figures thus derived give rise to some doubts, about constancy of growth rate at least for the latter parts of the period considered. BAC in a Market Development Report (no] 30 July 1967) gives 11.7% as annual growth rate for all London air freight during 1965-80. Comparing this with world air freight predictions (Table II) a relatively wide range in growth rate must be allowed for.

The following table gives air freight predictions based on Low Growth rate (10%) and High Growth Rate (20%) in 000's of short tons, see fig.8.

TABLE V

| | Year | Heathrow | | All London | |
|---|---|---|---|---|---|
| | | Low | High | Low | High |
| ACTUAL | 1966 | 287 | 287 | 341 | 341 |
| FORECAST | 1967 | 316 | 347 | 375 | 409 |
| | 1968 | 348 | 412 | 413 | 491 |
| | 1969 | 387 | 494 | 454 | 587 |
| | 1970 | 421 | 591 | 449 | 705 |
| | 1971 | 463 | 709 | 549 | 876 |
| | 1972 | 509 | 851 | 604 | 1015 |
| | 1973 | 560 | 1021 | 664 | 1218 |
| | 1974 | 616 | 1225 | 730 | 1462 |
| | 1975 | 678 | 1470 | 803 | 1754 |
| | 1976 | 746 | 1764 | 883 | 2104 |
| | 1977 | 821 | 2116 | 971 | 2525 |
| | 1978 | 903 | 2539 | 1068 | 3029 |
| | 1979 | 993 | 3047 | 1175 | 3635 |
| | 1980 | 1094 | 3656 | 1293 | 4362 |

Comments: To show their significance, the figures derived might be expressed in terms of average air freight load per movement.

| | HEATHROW | | | | |
|---|---|---|---|---|---|
| Year | LOW | | HIGH | | ← Growth Rate |
| | 64 | 128 | 64 | 128 | ← SBR |
| 1966 | .5 | .3 | .5 | .3 | |
| 1970 | .8 | .4 | 1.1 | .6 | |
| 1975 | 1.2 | .6 | 3.1 | 1.6 | |
| 1980 | 2.2 | 1.1 | 6.6 | 3.3 | |

TABLE VI - Short tons per movement

Conclusion: Definitely air freight will have a great influence on air traffic at Heathrow as well as in all London. The table above shows, for example, that with the 1966 level of airport utilisation, the necessary air freight load per movement in some seven or eight years doubles itself even at LOW GROWTH RATE. Whether this can be coped with or not requires thorough consideration.

1.4.2.2. Ground Freight Traffic

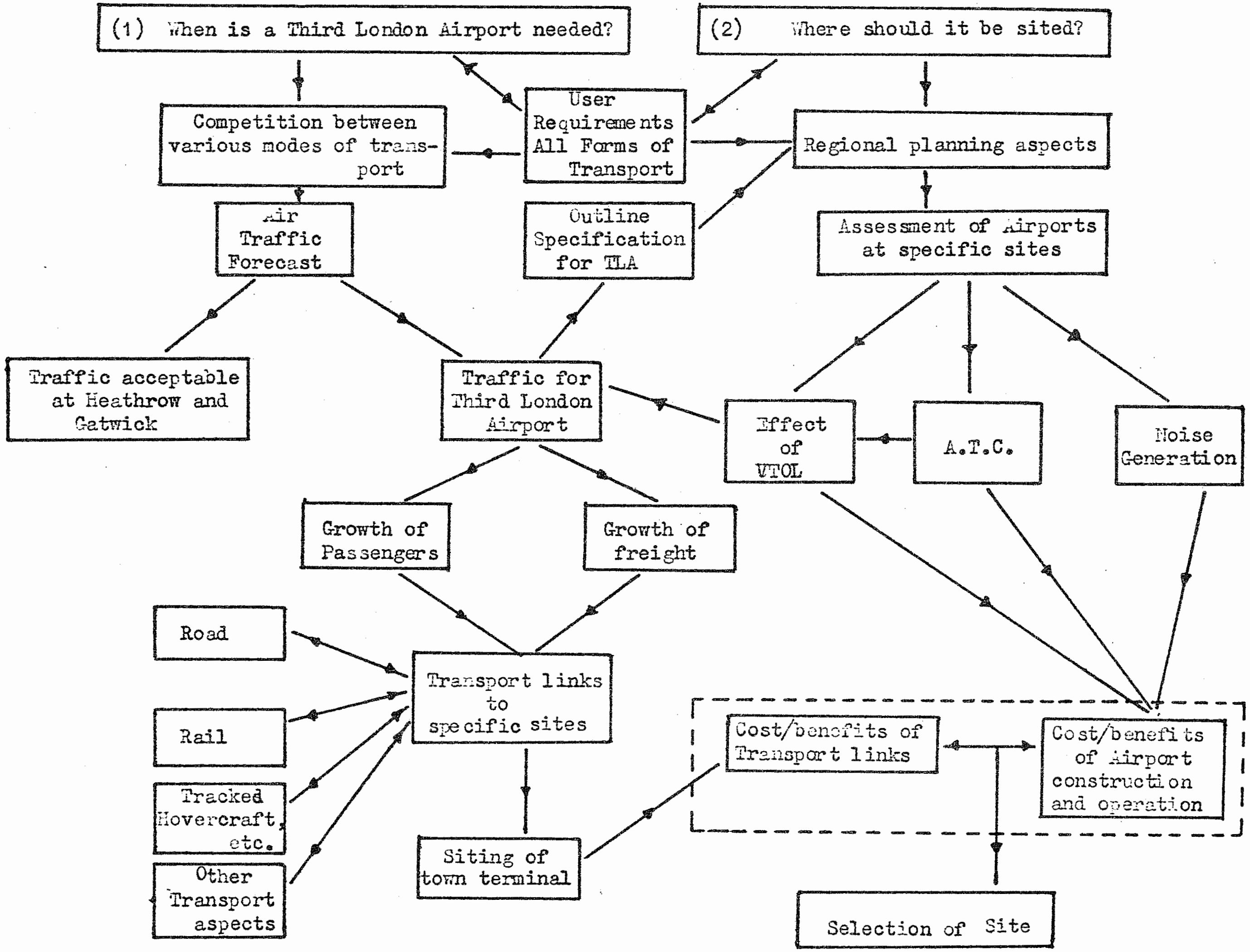
Undoubtedly air freight volume will have its effect on connected ground freight traffic volume through or in London in the future. Whether or not air freight containers can be made suitable for ground traffic handling must so far be left as an open question, though connected ground traffic modes might be highly dependent on this aspect.

1.4.2.3. Airport Layout

Air freight handling facilities to cope with the increasing air freight demand will most certainly greatly affect airport layout and the problem must be studied thoroughly.

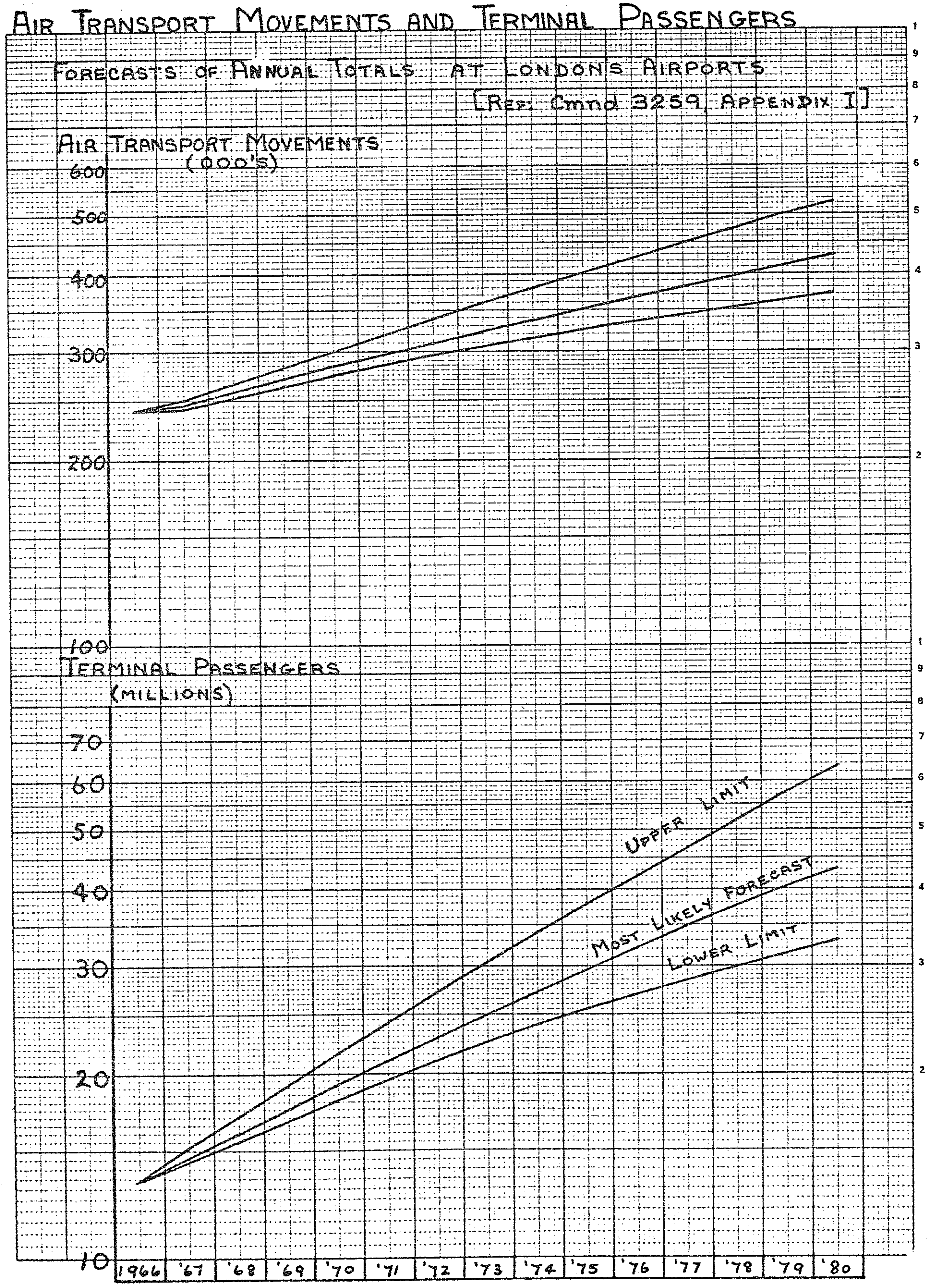
FLOW DIAGRAM FOR METHOD OF COST-BENEFIT ANALYSIS

OF A THIRD LONDON AIRPORT

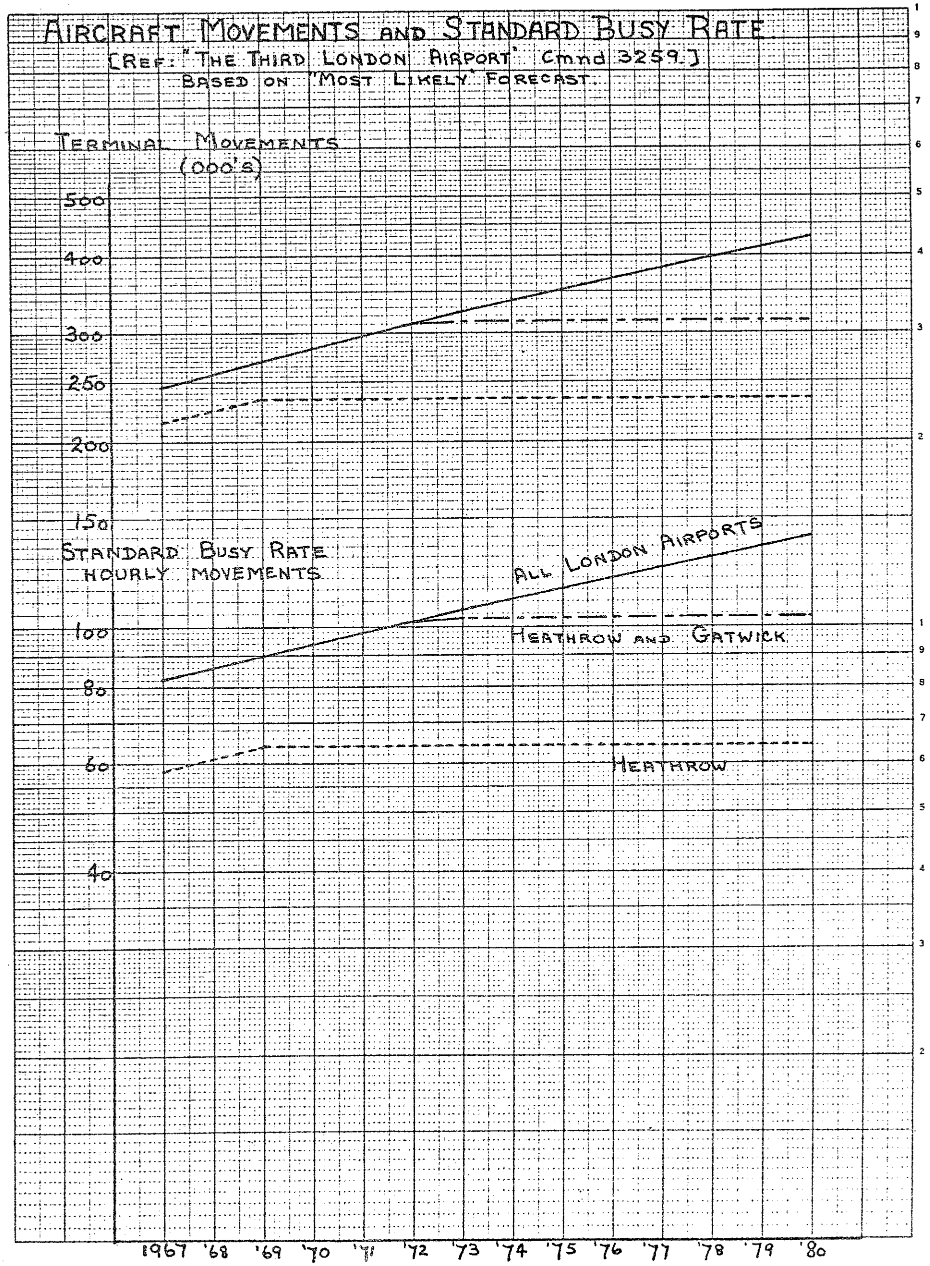



PART 1. FIG. 1.

Part I. Fig. 2.

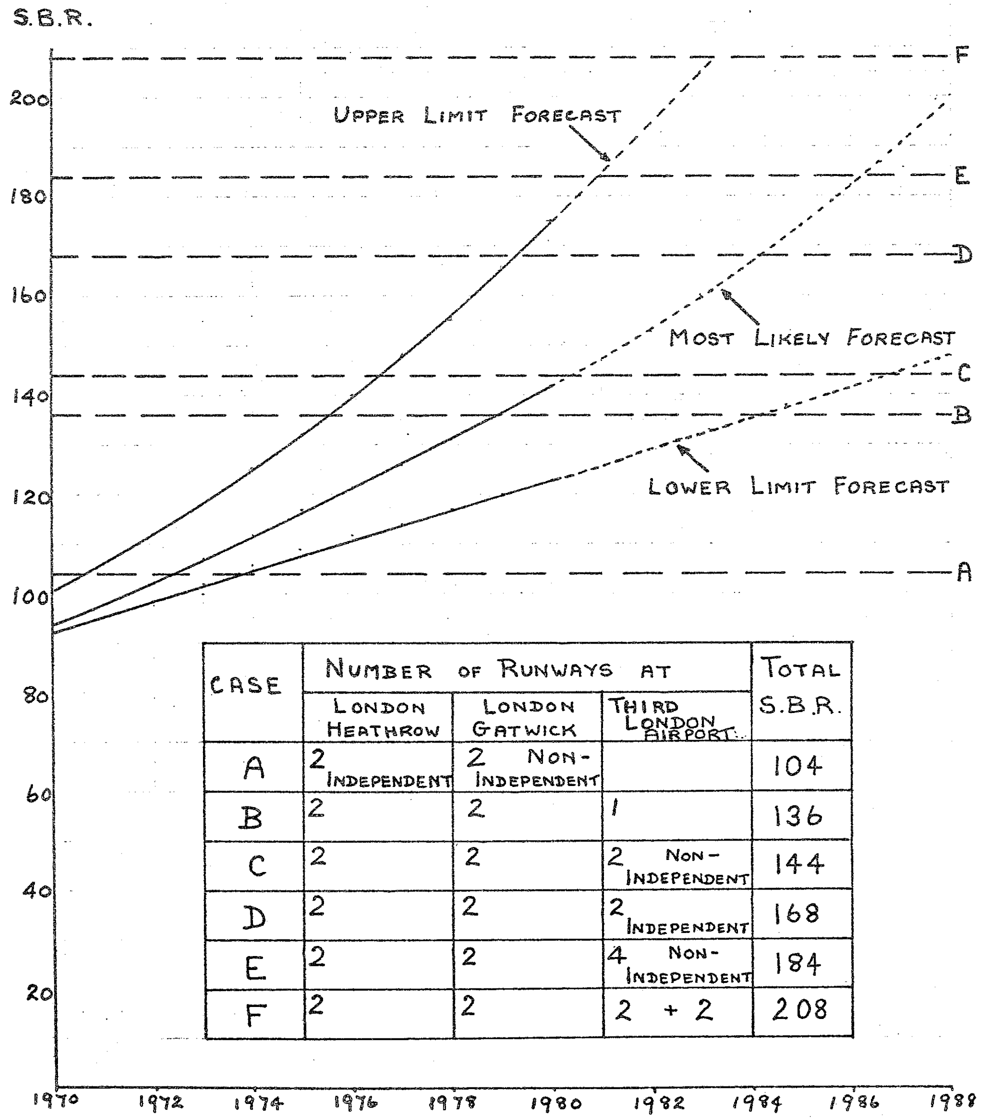



Part I. Fig: 3.



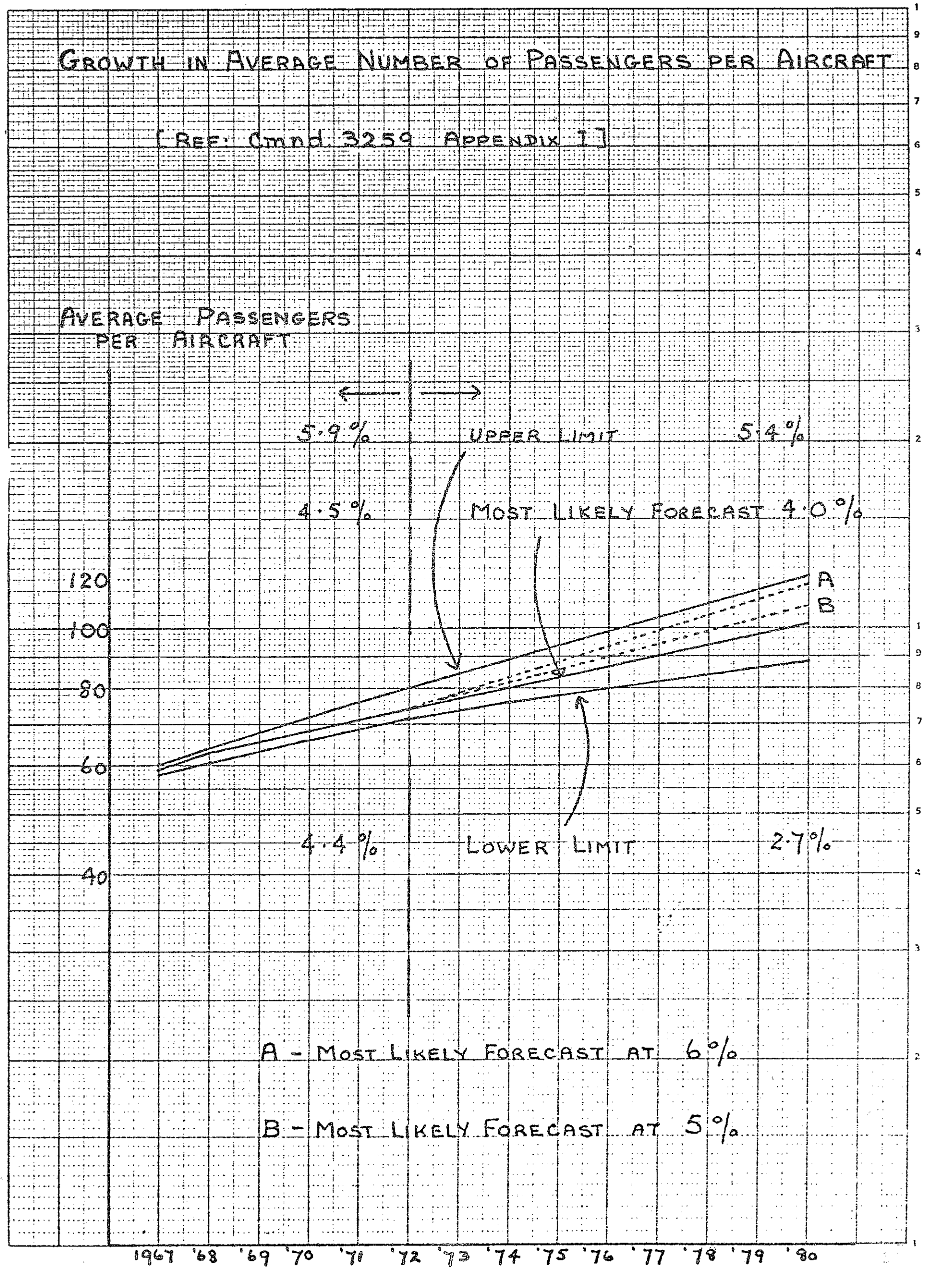
PART I. FIG: 4.

## FORECAST OF AIRPORT SATURATION
### BY AIRCRAFT MOVEMENTS




| CASE | NUMBER OF RUNWAYS AT | | | TOTAL S.B.R. |
|---|---|---|---|---|
| | LONDON HEATHROW | LONDON GATWICK | THIRD LONDON AIRPORT | |
| A | 2 INDEPENDENT | 2 NON-INDEPENDENT | | 104 |
| B | 2 | 2 | 1 | 136 |
| C | 2 | 2 | 2 NON-INDEPENDENT | 144 |
| D | 2 | 2 | 2 INDEPENDENT | 168 |
| E | 2 | 2 | 4 NON-INDEPENDENT | 184 |
| F | 2 | 2 | 2 + 2 | 208 |

PART I. FIG: 5.



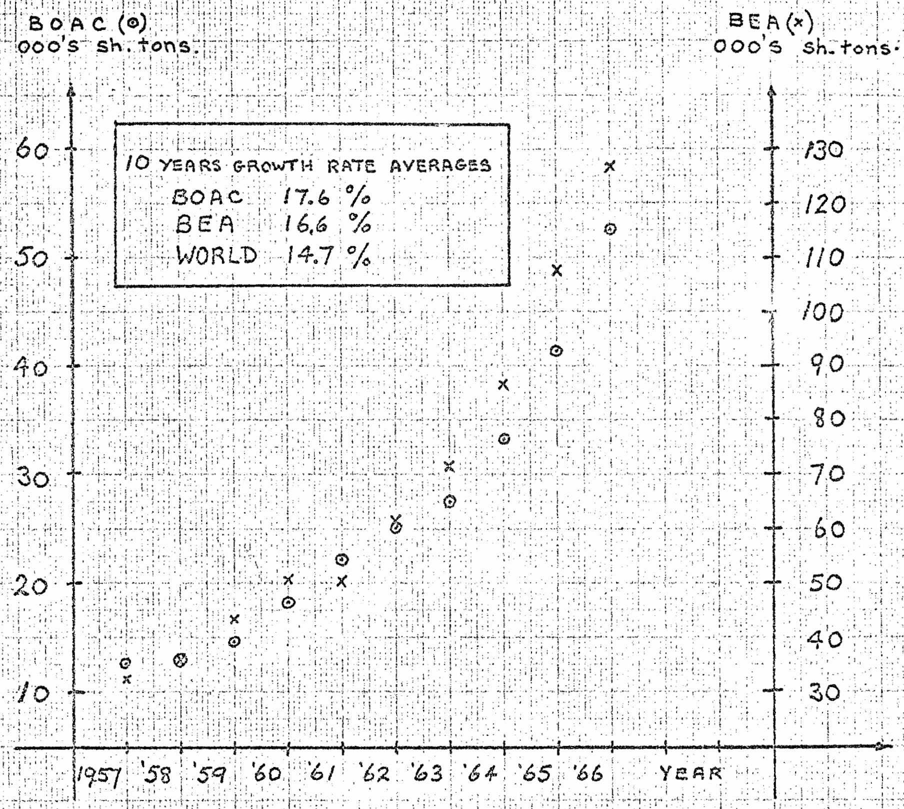



ILLUSTRATION TO TABLE I, PART I, SECTION 4.

PART I. FIG.

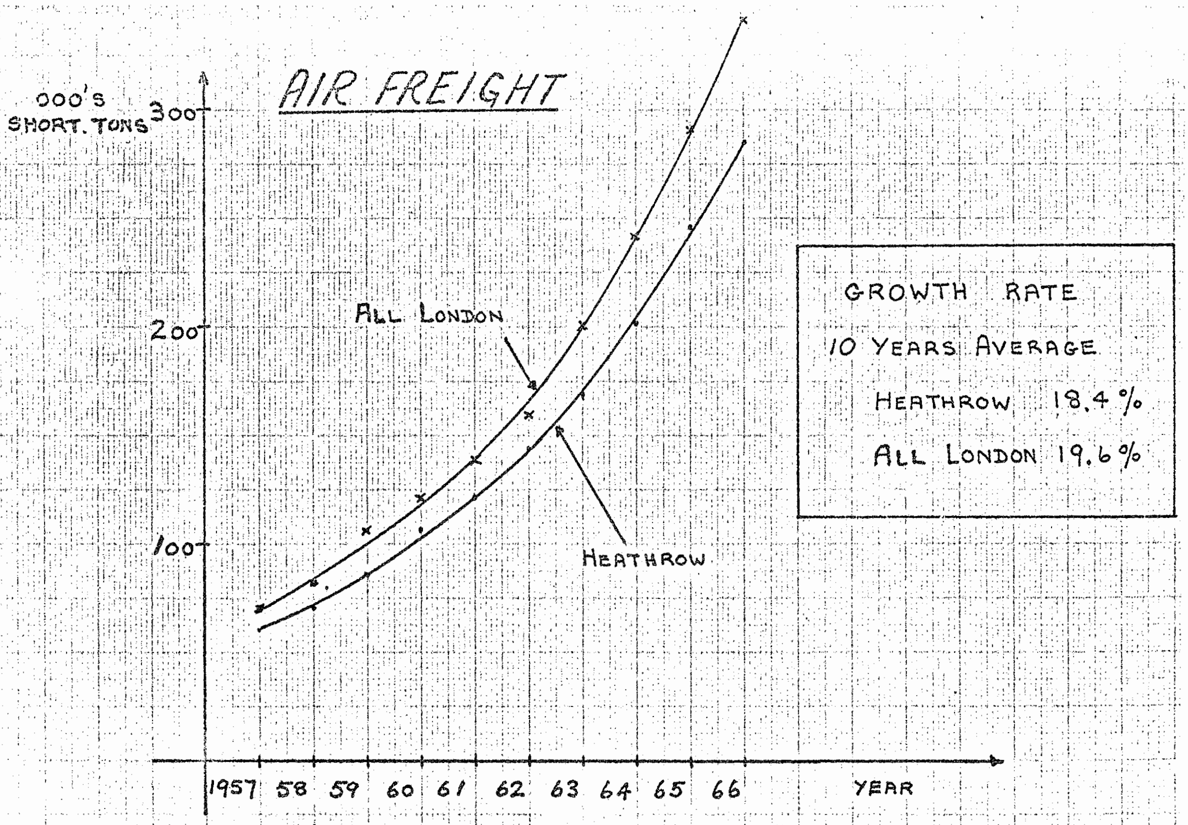



ILLUSTRATION TO TABLE III, PART I, SECTION 4

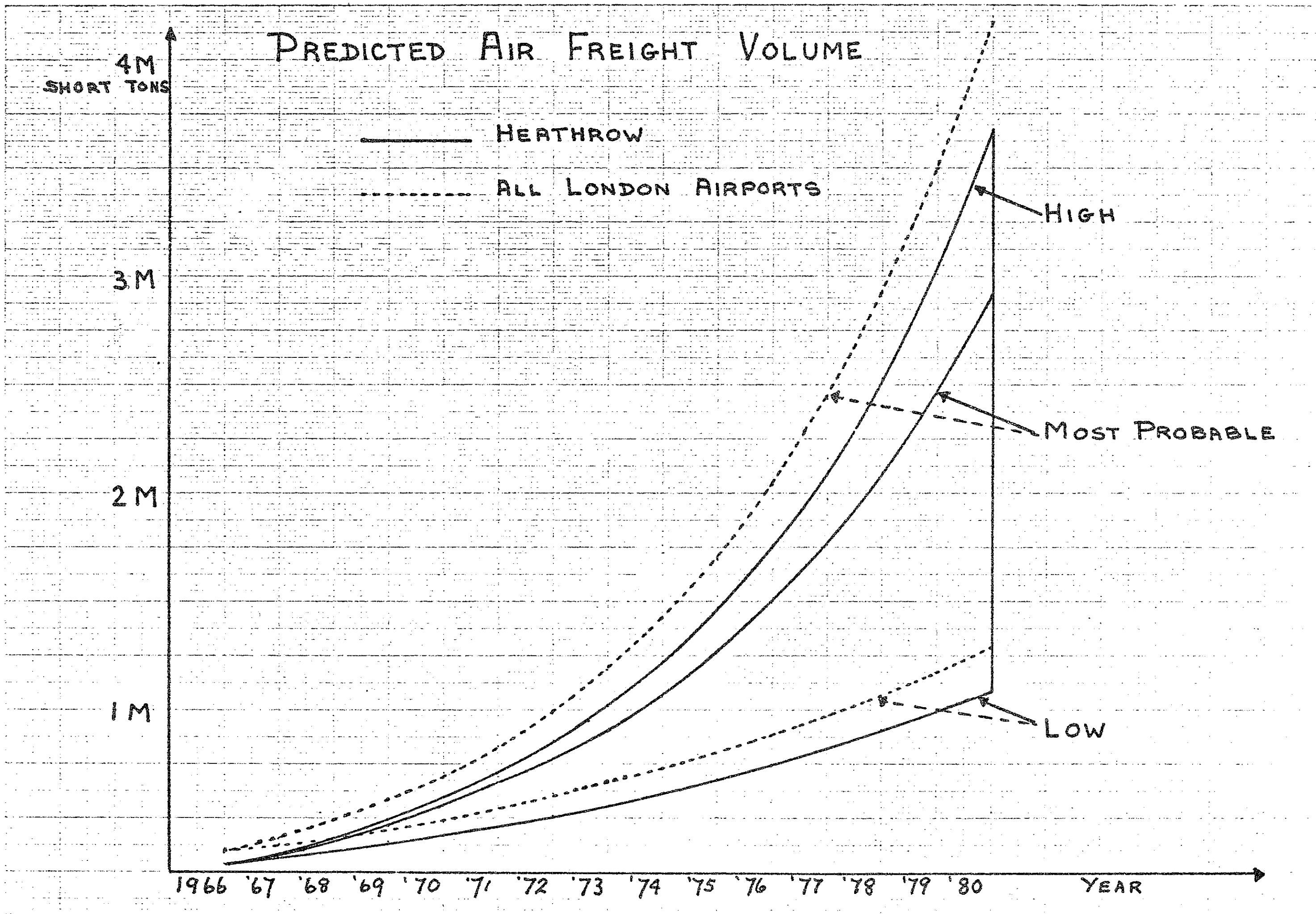



ILLUSTRATION TO TABLES IV AND V, PART I, SECTION 4.

PART 1, FIG: 8.

# PART 2. AIR MOVEMENT ASPECTS

## 2.1 Airport Location

### 2.1.1. General Considerations

The Working Party has been asked to consider four sites in the first instance, viz:

Stansted
Sheppey
Foulness
Silverstone

Considerations has also been given to a site on the Welsh Grounds, near Newport, suggested by the University of Salford in connection with studies of a Severn Barrage.

The first question which needs examination is whether it is in fact desirable to situate a third airport near London at all. Any site whose ground links involve travel through London will clearly result in increased congestion in that city, with resulting economic consequences, both for the traveller in terms of the value of his time, and for society generally.

The case for siting near London rests on a number of considerations, including
- ease and speed of access to London
- ease of interchange with other London airports
- operating economics for short and medium haul airlines which constitute about 60% of the current traffic at Heathrow and Gatwick, and use primarily the S.E. airlane.
- convenience for the majority of travellers: studies have shown that about 80% of the non-transfer passengers departing from Heathrow originate in the London area, but this result clearly includes passengers originating from the hotel areas in Central London. These are, in fact, the majority, and it is worth investigating the original starting points of such passengers.

It is quite possible, in fact, that the traffic demands on the London airports arise to some extent because the airports are at London, in a self-sustaining process. Furthermore, a site west of London is advantageous for trans-Atlantic operations: this suggests the possibility of segregating trans-Atlantic traffic wholly to a new westerly airport. SST's are unlikely to merit an exclusive airport until after 1980 at least, but a westerly site would be particularly advantageous for these aircraft in view of their characteristically high payload-range sensitivity.

Finally, both National and Regional planning aspects should be considered: an airport not only satisfies transport demands but also creates it, with consequent stimulation of industrial and business activities in its area.

### 2.1.2. Location and Capacity of the Five Sites (Fig 1)

Ground access to Sheppey and Foulness is essentially via London. Stansted is less limited in this respect, while Silverstone is well situated for access to many areas, being roughly in the middle of the major population belt between London and Manchester. The Welsh Grounds site is attractive in that it is situated at the westerly corner of the M1-M5-M4 motorway triangle, with London and Manchester airports at the other corners. Its most evident drawback is the distance from London (120 miles).

All sites considered appear capable of accommodating even a BAA 'ideal' airport, with four 15000 ft runways, the outermost runways being 15000 ft apart the difficulties of so doing, however, vary considerably from site to site. Although it is unlikely that four runways will in fact be required before at least 1980, it is considered that the problems of extension to this size should be taken into account from the start in order to avoid, or at least defer, the search for a fourth airport site at a later date.

On present limited evidence the runway orientations quoted below are satisfactory from the point of view of sidewind limitations on aircraft operations.

2.1.3. The Individual Sites

2.1.3.1. Stansted (Fig 2)

Substantial noise problems are likely with any runway orientation at this site: the most practicable orientation from this point of view is probably NNE-SSW, as in the official realignment proposals. These problems will be particularly severe in the case of SST's, with their comparatively wide, though short, noise profiles. The land is of high agricultural quality, and will require levelling, especially in the NE area of the site.

2.1.3.2. Sheppey (Fig 3)

A site on the eastern half of the island appears practicable, with, possibly, some minor reclamation work. Levelling requirements are probably similar to those for Stansted. The land is of poor agricultural quality. Again, any runway orientation is likely to result in some noise problems, but the most practicable direction is probably E.W. (approx).

2.1.3.3. Foulness (Fig 4)

A two runway site could be accommodated without reclamation of substantial areas of the Foulness Sands, but a four-runway airport would need to be situated partly or wholly on reclaimed land. The land is of good agricultural quality, and there is scope here for an optimisation study on the exact siting, taking into account both reclamation costs and the possible effects of noise at Shoeburyness if the airport is partly on existing land.

With a SW-NE runway orientation, noise problems are minimal or non-existent.

2.1.3.4. Silverstone (Fig 5)

This site is not as level as Stansted: levelling costs will be correspondingly increased. Noise problems exist, but are probably less severe than those at Stansted with a NE-SW runway orientation. The land quality is moderate, and the site altitude is approximately 400 feet.

2.1.3.5. Welsh Grounds (Fig 6)

This site is largely dependent on reclaiming the Welsh Grounds, which lies some 10-15 ft below high water_ it can be considered a possibility even in the absence of a Severn Barrage. With NE-SW runways, moise problems are insignificant however, the Severn Bridge will constitute an obstacle under the approach path, the piers lying some 1000-1500 feet below the aircraft on a 3$^{\circ}$ approach path. Development of this site could be part of an integrated plan with both the Barrage, and possible dock facilities.

2.1.4. Direct Airport Cost Factors

These include:

- land acquisition costs
- losses in agricultural production
- airport construction costs
- costs of relocating displaced communities

- costs attributable to noise nuisance
- costs of supplying fuel and energy to the airport
- aircraft operating cost increases and decreases relative to London (Heathrow) Airport
- weather: costs of delays and diversions
- direct and indirect costs of travel to and from the airport

The cost figures already in existence for Stansted and Foulness are either somewhat notional, or disregard many of these factors, or both (1, 2). There seems no point in adding a further set of notional figures at this stage.

2.1.5. Recommendations for Detailed Studies

Studies under the above headings should be made for each of the sites considered under two assumptions
a) that the Third airport is exclusively long haul
b) that the Third Airport is for both long and short haul traffic

These studies can then be combined with the results of investigation into other aspects of the problem, including traffic forecasts, ground links, VTOL aircraft effects on Defence activities, etc. A balanced decision can then be made in the light both of the estimates so derived, and the desirability of the various sites from national and regional planning aspects.

REFERENCES:


1. Cmnd 3259 - The Third London Airport
2. The Third London Airport - Foulness (Noise Abatement Society)

## 2.2 Air Traffic Control

### 2.2.1 The Present ATC System

To comply with present air traffic regulations, incoming and outgoing aircraft must pass through three phases of control.

(1) En-route assignment to an airlane.

(2) Acceptance in the terminal area.

(3) Precise control within the arrival or departure airport control zone.

In the first case, the three criteria during this phase of flight are the lateral separation (120 n.m currently); horizontal separation (15 minutes); vertical separation of 1000 ft. In the second case, the area controller dictates both the speed and altitude of the aircraft, with a minimum 3 n.m. radar controlled separation.

In the third case, airport approach control dictates the time, speed and altitude at which an aircraft leaves the stack, the route to the intersection of the glide slope, and the time and place of intersection.

### 2.2.2 Deficiencies and Limitations of the Present System in the Terminal Area

2.2.2.1 Acceptance in a Terminal Area - The efficiency with which this control task can be performed is limited many ways. Some of the more important ones are listed below:

(a) the data given to the controller by radar is limited to an approximate plan position with no aircraft identification or height information.

(b) aircraft are incapable, at present, of navigating with sufficient accuracy from the point of entering the terminal area to touchdown. The controller must therefore be in constant contact with the aircraft to advise him in correcting aircraft track and height.

(c) peak hour scheduling of arrivals and departures causes bunching of traffic - hence stacks, which themselves suffer from the drawbacks of (a) and (b).

(d) the wide disparity in speed capabilities of differing types of aircraft (and indeed the same types!) makes the controllers tasks more complex than would otherwise be necessary.

2.2.2.2 Airport Control Zone

The object here is to achieve the maximum capacity of the runway(s). The major factors influencing the actual achieved rate are:

(a) the information to allow the controller to call the aircraft from the stack at the optimum time is too imprecise to be made up completely by path stretching.

(b) the separation between aircraft deteriorates after final alignment since not only do differing types of aircraft fly at different approach speeds but also according to circumstances, the same types fly at different speeds.

The summation of these deficiencies give rise to certain detrimental characteristics - the most wasteful and uneconomic being time lost due to stacking and the airspace taken by stacking and path stretching.

2.2.3 Possible Improvements in ATC in the Terminal Area

The majority of present ATC development concerns automatic aircraft tracking, thus relieving the controller of the need to ask the aircraft for its position and speed. This would save a considerable amount of time on the R.T. which is of value since one of the critical limitations of the present ATC system is saturation of the R.T.

Improvements of the aircraft navigation systems by means of Decca-type area coverage and inertial guidance techniques will enable aircraft to obey the controllers' instructions much more accurately. Radar will be improved by using a tracking system with much greater discrimination powers than the present types.

However, these improvements will only benefit the Air Traffic Controllers by reducing their workload - thus reducing the R.T. saturation. Because of these improvements, there is a definite possibility that the air separation distance (3 n.m.) could be reduced - this then would allow total runway capacity to become the now firm limiting factor on the acceptance rate.

2.2.4 Other Factors affecting Airport Capacity

Improvements in the S.B.R. and hence airport capacity can be gained with advances in ATC. Further improvements could be realised by many other factors, the most important being runway utilisation, and peak spreading.

2.2.4.1 Runway Utilisation The most efficient way of using two parallel runways, (at least 5000 ft. apart) is to operate mixed landings and take offs from each, thus operating them entirely independently. The main bottlenecks with such a system appear to be the following items:

(a) The time that the departing aircraft takes in lining up on the runway after the arriving aircraft has crossed the threshold. (The mean time at Heathrow for this operation is 60 seconds).*

(b) The time between issue of clearance & take-off to the departing aircraft to roll (at Heathrow the mean figure is 21.5 seconds).*

and (c) If (a) could be reduced to less than 45 seconds, then the runway occupancy time of the arriving aircraft becomes critical. (45 seconds at Heathrow *).

How can these times be improved upon? Due to the considerable length of time that departures take to line up on the runway after the preceding aircraft has crossed the threshold, it seems likely that some gains in service rate would be available if each departure could line up for take-off at a position which is outside the line of approach of the arrival. This would be possible if an intersecting runway for departures were to be available, the runway with which it is intersected being used for landings. This should tend to reduce (a) and might have some beneficial effect on (b). The third factor (c), could be improved by using high speed turn-offs.

* These figures come from WP-73 presented at the IATA Conference in Lucerne (1967) by the Board of Trade.

### 2.2.4.2 Peak Spreading

The table below shows how the "peaky" characteristics of aircraft movements have varied from 1955 to 1963.

TABLE 1

| | 1955 | 1959 | 1963 (1966) |
|---|---|---|---|
| Peak 3 hours to average 3 hours in a day | 1.58 | 1.51 | 1.59(1.58) |
| Peak day to average day in week. | 1.28 | 1.18 | 1.15 |
| Peak 3 months to average 3 months in a year. | 1.47 | 1.37 | 1.35 |

One can see from looking at this table that there is unlikely to be any improvement in the hourly peaks if present trends are anything to go by.

However, both the peak day to average day and peak 3 months to average 3 months ratios seem to be reducing with time, the former by 10% and the latter by some 8% in 8 years.

However, a further look into this reveals drawbacks! The peak day of the week is Saturday, and in 1963 (from analysis of the Saturdays in the summer months) it was found that these movements were only 15% above the unattainable ideal proportion of one-seventh of the weeks flow. The scope here for any further peak spreading seem negligible.

The trend shown on the last line of table 1 (peak 3 month situation) should also be treated with caution. There may be some chance of inducing a larger proportion of people to move in less popular quarters, but one must remember that the non-business is the most growing element of London air traffic and that the summer months will always be the most popular time of the year for holidays.

This, so far, has been rather a negative approach to the problem and its solution. How can these peaks be reduced? The only answer that I can see at the moment is to introduce even larger fare restrictions than are used at present It is certain, anyway, that any reduction of the peak will increase the capacity of the airport and thus delay the need for a third London Airport.

2.2.5 Effect of increases in SBR for Heathrow and Gatwick on the requirement for a Third London Airport

It has been shown that various factors can increase the capacity (in terms of movements) of an airport, and just how important it is to increase its capacity is discussed below.

The key parameter in assessing traffic demand of an airport and air traffic control system is the Standard Busy Rate (SBR) of aircraft movements, defined as the hourly rate reached or exceeded 30 times during the summer - in fact the 30th busiest hour of the year. It is normally equivalent to about 80% of the peak hour figure of the year. The SBR in current United Kingdon planning is based on 64 movements/hour from two parallel runways at least 5000 ft. apart. (Heathrow SBR = 64, Gatwick SBR = 40). It should be emphasised that these rates are consistent with PRESENT DAY airport design and ATC procedures. How these rates would change if ATC and airport designs were improved is the $64,000 question - nevertheless these questions MUST be answered.

Figure 7 shows just how important this criteria is when estimating the time when a Third London Airport will be required. One can see, in the extreme, if the theoretical maximum of 96 a/c movements per hour could be attained with perfect sequencing, and perfect alternate take-offs and landings from each of the two runways at Heathrow (and improving Gatwick up to 60a/c movements/hour maximum) then a third London Airport would be required in 1983 - no less than 11 years after the requirement assuming present day techniques and design. Obviously this would not be achievable in practice but even a 10% improvement in SBR would delay the requirement for 2 years during which time further improvements in SBR would be investigated and/or extensive cost-benefit studies could be undertaken to decide on the "best" location for the third London Airport.

2.2.6 Air Traffic Control and the Possible Sites for a Third London Airport

The Report of the Inter-Departmental Committee on the Third London Airport (C.A.P.199) gives the inner limits that a Third London Airport could be positioned in order that:

(a) Heathrow and the Third London Airport could operate at 64 movements per hour in all directions.

and (b) Both Heathrow and the Third London Airport could operate at 64 movements per hour but both being restricted in the number of routes they could serve.

Fig. 8 shows these limits and the possible locations for a Third London Airport. This shows that all the sites being considered (viz. Stansted, Silverstone, Sheppey and Foulness) lie very close to the inner limit (b).

It is interesting to note here an American view: "The location of several airports in a metropolitan area can greatly influence their repsective capacities. If they are located too close to each other, they can hinder one another to the extend that the two airports will have no more capacity during IFR weather than a single airport. Although there are no firm criteria concerning the spacing of airports used simultaneously in IFR weather, it has been suggested as a planning guide that the spacing should be of the order of 16 miles. An airport should not be located along the extended centerline of the instrument approach to another airport unless the distance between the airports is at least 40 miles". This suggestion is shown on Fig. 8 also.

If we accept the criteria outlined in C.A.P.199 then it would seem that whichever of these sites is chosen, for Heathrow, Gatwick and the Third London Airport to operate at capacity, reorganisation of routes would have to be enforced. On this assumption, let us look at each individual site (not necessarily in order of preference!)

2.2.6.1 Silverstone

The proposed site at Silverstone is located beneath and in between Airlanes Amber One and Amber Two. The flight levels quoted for these two lanes are 4,500 ft. to 25,000 ft. and 3,500 ft. to 25,000 ft. repsectively. These lanes feed traffic from London to Birmingham, Manchester and the North. It would seem that if Silverstone were accepted as the Third London Airport, then it could ideally feed traffic to the northern parts of the United Kingdom, to the northern parts of Europe, and could also without much interference to Heathrow accept and feed traffic from and to the North Atlantic. This would greatly reduce the burdens now incurred by Heathrow. The ideal alignment as far as terrain and noise are concerned is NE - SW and unfortunately, the aerodrome at Bedford is almost in direct line though some 25 s.m. away which does not present any serious problems.

2.2.6.2 Stansted

The existing airport at Stansted lies a few miles to the north of Airlane Red One, the flight levels of which are 3,000 ft. to 25,000 ft. Stansted has a distinct advantage over the other sites since it is already in existence and from an ATC point of view, this is a clear advantage. However, re-alignment of the runways will present problems. Stansted lies 42 s.m. direct NE of Heathrow, and the revised runway alignment is approximately NNE - SSW, thus some interference with Heathrow and possibly Gatwick could be expected. Stansted, like Silverstone, is situated in good position for feeding traffic to norther United Kingdom and northern parts of Europe. However, it is not as ideally situated with regard to North Atlantic traffic which would have to fly in the region of Heathrow, Bovingdon and possibly Luton.

2.2.6.3 Foulness

Foulness lies very close to Southend airport and could certainly affect the operation of the latter to the extent that Southend would have to close. It lies approximately 60 s.m. East of Heathrow and almost in a direct line. The best runway alignment as far as noise and wind directions are concerned is approximately NE to SW. The site is situated such that it could fee traffic to north and south Europe and possibly the northern reaches of the United Kingdom. The site would probably be capable of accepting 64 aircraft movements per hour.

2. 2.6.4 Sheppey

Sheppey is in a similar position to Foulness with regard to ATC problems, although it is further away from Southend.

2.2.7 Recommendations

From an ATC point of view it seems possible (neglecting military airfield interactions) that any of these sites could be used for the Third London Airport provided that sectorisation of routes were enforced. Probably the best two sites are Silverstone and Stansted.

However, these factors seems of secondary importance to the question of airport capacity. This is where our resources should be concentrated. It has been shown that the requirement of a Third London Airport is greatly affected by the capacities of Heathrow and Gatwick and in fact each 5% improvement in airport capacity in terms of aircraft movements delays the need for a Third London Airport by one year.

It is suggested therefore that the following areas should be looked into in great detail.

1. Methods of increasing runway utilisation and their effects on the SBR.

2. Methods of increasing airport capacity with improved ATC techniques and their effects on the SBR.

3. Possibilities and effects on SBR of peak spreading.

(Each of these items should be applied not to any airport but specifically to Heathrow and Gatwick).

## 2.3 Noise

### 2.3.1. The Current Situation

The noise generated by aircraft taking-off and landing is a major source of annoyance to people living in the vicinity of a major airport e.g. Heathrow. Its effect is felt over a very large area and many thousand of people are upset by it. Although the noise causes annoyance there is very little evidence to suggest that it can be a hazard to health for the vast majority of people. It can, however, disturb sleep and cause problems in hospitals and schools. Thus it is mainly a problem of amenity and how it affects peoples' well-being. What is an acceptable level of noise is very difficult to determine and the amount of annoyance it causes varies from person to person. Both the loudness of the noise and the number of occurences are factors in determining the amount of annoyance.

At the moment there are no regulations, in the airworthiness sense, governing the amount of noise an aircraft may emit. However, certain individual airports do have regulations governing the amount of noise an aircraft can generate. For example, at London Heathrow the maximum noise allowed during take-off at a point on the ground 4 miles from start of take-off is 110 PNdB by day and 102 PNdB by night (11 p.m. - 7 a.m.). Similarly the Port of New York Authority limits the noise to 112 PNdB. Most aircraft conform to these limits by reducing the engine power during the climb after take-off so as to achieve a $3^{\circ}$ climb gradient. Further alleviation of the noise can be obtained by arranging that the take-off and landing paths do not pass over heavily inhabitated areas. The scope for this however, is somewhat limited by aircraft manoeuvrability and performance. The areas where the greatest noise disturbance occurs are those in line with the runways.

### 2.3.2. The Future Situation

The noise problem at a new airport is likely to be worse than that currently at Heathrow because the new airport will have more aircraft movements. The increase in number of movements is illustrated by the following statistics:

Jet movements per day at Heathrow:

| | |
|---|---|
| 1960 | 90 |
| 1965 | 260 |
| 1970 | 440 |

At new 2 runway airport - 600 movements/day
At new 4 runway airport - 1,200 movements/day

### 2.3.3. Possible Reduction in Noise from Future Aircraft

As stated previously there are no noise regulations which aircraft have to meet in order to obtain a certificate of airworthiness. However, the American F.A.A. are proposing that at sometime in the future new aircraft will have to meet certain noise criteria in order to obtain a certificate of airworthiness. The noise levels tentatively proposed could be up to 10 PNdB below those now allowed at Heathrow. Also, several new aircraft which will come into service in the early 1970's will have lower noise levels than those currently in service. The importance of this reduction in noise is illustrated by the fact that a reduction of 9 PNdB would mean that the aircraft movements could be increased fourfold without increasing the annoyance factor, i.e. the noise and number index (N.N.I.) would remain the same. (The noise and number index establishes a relationship between total noise exposure and annoyance).

The merit of certificating authorities enforcing noise regulations is:

a) the noise is regulated at source (aircraft)
b) there are effectively only two authorities (namely, American F.A.A. and British A.R.B.) and this should reduce the problem of international agreement.

Hence studies required:

1) What is the possibility of noise regulations coming into being and what will be their level.

2) What will be the noise level of the aircraft in service in the 1970's.

Other methods of noise alleviation are:

a) the flight path of the aircraft after take-off could be arranged so that it did not pass over heavily populated areas. Aircraft performance, manoeuvrability safety and air traffic control will usually limit the amount which the aircraft can turn.

b) the runway can be aligned such that the take-off and landing paths do not pass over heavily populated areas. This is limited by the fact that the runway direction is usually determined by the direction of the prevailing wind (mostly south-west) and that aircraft can only operate in cross-wind of up to a certain strength (usually about 30 knots). Thus if the runway direction is very much different from that of the prevailing winds there will be times when aircraft cannot use the runway.

Hence studies are required:

3) Aircraft turning performance after take-off

4) Aircraft cross-wind take-off and landing limits

The noise below an aircraft approaching to land also causes annoyance and the area of a given annoyance level tends to be larger than that at take-off because the aircraft approaches at a very shallow angle. The aircraft usually approaches along a $3^{\circ}$ flight path and if this could be increased it would mean that the aircraft would be higher at a given distance from the runway and hence give less noise on the ground.

Hence a study is required:

5) Possibility of increasing the approach angle

2.3.4. Cost of Reducing Noise

2.3.4.1. Aircraft Noise

Apart from the noise reduction achieved by having a more efficient engine (i.e. higher by-pass ratio), noise can be reduced by fitting a special nozzle onto the jet pipe and by fitting sound absorbing material around the inlet duct and around the engine casing. The Wilson Report quotes estimates varying from £16,500 to £43,000 for the increase in annual operating cost of fitting noise suppressors to the Boeing 707. The annual direct operating cost of a 707 is about £1,000,000 and thus there would appear to be some scope for fitting noise reducing devices without significantly increasing the aircraft operating costs.

Noise emitted during ground running engine tests can also be a nuisance. BOAC quote a figure of £407,000 for the capital cost of installing mufflers and earthbanks which is a small percentage of the cost of constructing a new airport (£50-100 million).

Hence studies are required:

6) Possibilities for fitting noise reducing devices to engines and their effect on aircraft operating costs.

7) Scope and cost of reducing ground running noise at airports.

2.3.4.2. Soundproofing of Buildings

Very considerable noise reduction between the inside and outside of a building can be achieved by suitable design; for example, double glazing plus a mechanical ventilation system can give a noise reduction of up to 45 PNdB. This is a large reduction in noise level and in practice would mean that aircraft noise would hardly be heard inside the building.

The Wilson report quotes an average figure of £300 as the additional cost of providing double glazing and mechanical ventilation in a private house. This seems a rather low figure for present day costs so take a figure of £500 and consider the extreme case of sound-proofing 10,000 houses (enough for 35,000 people). The total cost would be £5 million plus the additional cost of soundproofing schools, hospitals offices etc. - say another £5 million. This is still a relatively small proportion of the total cost of the airport. Buildings insulated in this manner would have the advantage of lower heating costs and the mechanical ventilation system could be part of the central heating system.

Hence studies are required:

8) Feasibility and cost of insulating buildings against noise.

9) Number of buildings to be insulated at each proposed site

Soundproofing the buildings in the more noisy areas around an airport will still mean that the inhabitants will have to endure full noise when out of doors. There does not seem to be any way around this problem and this will be one of the penalties of living close to an airport.

2.3.5. The Siting Problem

When a particular area is being considered as a site for a new airport the noise problem will have a considerable influence on deciding whether the site is suitable. Besides being suitable in terms of terrain and available area, the problem of runway alignment will have to be considered. This will depend on:
a) distribution of wind direction
b) cross-wind take-off and landing capability of the aircraft using the airport
c) A.T.C. requirements
d) available space
e) minimizing the noise problem.

These requirements are very likely to be conflicting and this section will only consider the noise problem.

Ideally the runway alignment should be such that the take-off and landing paths do not pass over inhabitated areas because it is below these paths that the greatest amount of noise occurs. Areas on either side of the runway and flight path are hardly affected by noise. Thus when considering a potential site one should determine not only whether existing inhabitants will be affected by noise but also whether there is sufficient room in relatively noise free areas for the increased number of people to live who will be associated with the airport. The noisy areas below the flight path should not be allowed to be developed for house, schools, hospitals etc. but only used for industrial purposes.

The size of the noise contours will depend on the number of traffic movements and the results of studies 1-7 and these will have to be determined for each site considered. Then knowing the present population distribution and estimating the future population distribution the runway can be aligned so as to minimize the noise effects bearing in mind the other considerations mentioned previously.

Hence studies required:

10) Present and future distribution of population

11) Size and position of noise contours, for 2 runway and 4 runway layouts

Knowing the size and position of the noise contours and the distribution of the population, the number of buildings to be soundproofed and the cost can be determined. These costs plus those associated with reducing the noise should be added to the cost of constructing the airport.

Hence study required:

12) The cost of noise and cost of the airport

2.3.6. An airport for supersonic aircraft

It has been suggested that supersonic aircraft will require a special airport situated on the west coast of England because they will not be allowed to fly supersonically over the main habitated regions. This does not seem a reasonable proposition because a supersonic aircraft such as the Concorde will cover a distance of over a hundred miles during the climb and acceleration phase before it reaches a point where the sonic boom will be noticed by people on the ground. Thus if it takes-off from a site near London to fly to New York it will nearly reach the Bristol Channel before it starts producing the boom. Also, for quite some considerable time there will not be sufficient supersonic aircraft to justify a special airport and having an airport so far from London would mean that a lot of the speed advantage over subsonic aircraft would be lost.

As far as noise around the airport is concerned it seems that supersonic aircraft will make no more noise than current jet aircraft so this will not be a reason for needing a special airport.

2.3.7. Noise of V.T.O.L. Aircraft

It is currently proposed that the noise generated by V.T.O.L. aircraft should not be more than 90 PNdB at a point 1,500 ft from the centre of the take-off site. Most studies on the problems of siting an airport for V.T.O.L. aircraft assume that the position of site should be such that there are no private dwellings within a circle of radius 1,500 ft about the centre of the site. Hence if there are 300 movements a day the noise number index will be 47 at the 1,500 ft point and this represents a moderate degree of annoyance. Thus the noise problem should not be serious provided that a V.T.O.L. aircraft can be designed and operated with a noise level less than 90 PNdB at 1,500 ft from the centre of the site.

2.3.8. The Sites to be Considered

2.3.8.1. Stansted (Fig.9)

The proposed realignment of the runways will considerably alleviate the noise problems compared with the existing scheme. There will be no large centres of population within the 45 N.N.I. countour. However, if in the future two more runways are added one each side of the proposed runways, then it would seem that places like Bishop's Stratford, Sawbridgeworth, Harlow, Saffron Walden and Haverhill will come within the 45 N.N.I. contour.

2.3.8.2 Sheppey (Fig. 10)

If the runways are aligned approximately east/west there will be no large centres of population within the 45 N.N.I. contour provided that aircraft turn after take-off so as to avoid passing over Gillingham and Chatham. If four runways are required then it will probably be very difficult to avoid causing annoyance to a large number of people.

2.3.8.3. Foulness (Fig 11)

At this site the runways can be arranged approximately north-east/ south-west (i.e. in the direction of the prevailing wind) and there will be no areas of population within the 45 N.N.I. contour as it is mostly over the sea. If four runways are required, there should be a small noise problem at Shoeburyness.

2.3.8.4. Silverstone (Fig. 12)

A runway alignment approximately north-east/south-west appears to minimize the noise nuisance and no large centres of population lie within the 45 N.N.I. contour. Again adding two more runways at this site will considerably increase the noise nuisance at places like Buckingham, Brackley and Towcester.

2.3.8.5. Conclusion

Only the Foulness site is almost entirely free from noise problems even with four runways. The other three sites are probably acceptable with two runways but not with four runways. Even though the noise envelope of these three sites do not enclose large centres of population there will still be several thousand people who will have to suffer a very large amount of noise. Therefore there will be substantial amounts of money required for soundproofing homes. The noise contours shown at each of the sites is only very approximate and it will require the studies listed previously to be completed before the contours can be determined accurately. A further point concerning the Stansted site is that a better site from the noise point of view could probably be obtained by siting the runways several miles to the north of the current site and aligning them approximately north-east/south-west.

2.4. V.T.O.L. Economics and its Impact On Air Traffic Movements in the London Area

2.4.1 Introduction

This section of the report discusses the impact of all-weather VTOL aircraft on air traffic within the U.K. A very brief description of a study aircraft is given with its main operational characteristics, payload range, block time and turnround time, utilisation productivity and first cost. An assumed date of introduction is late 1975 or early 1976 and with an assumed rate of production its impact on London air traffic is given.

A further part of this report describes briefly a conception of a VTOL port and gives an estimate of the total cost of installing VTOL ports within the major cities of the United Kingdom. Finally an indication is given of the research required to prove the feasibility of the concept in engineering terms and to estimate its market and optimum siting of ports.

2.4.2. Description of Aircraft

Out of the many configurations for VTOL aircraft, e.g. convertible rotor, tilt-wing, compound helicopter, N.G.T.E. rotor, etc. of varying size and speed, one has been selected in order to study the impact of VTOL on the internal services of the U.K. and its effect on the air traffic movements through London's conventional airports of Heathrow, Gatwick and the proposed third London Airport for the late 1970's and early 1980's.

A fan lift, swept wing configuration containing the fans in pods on the wing has been selected for this study. The aircraft has been designed to cruise at 500 knots between 20,000 and 30,000 ft. over a stage length of 630 s.m. with a full payload of 100 passengers. The aircraft has been so designed as to have a safety level at least ten times greater than that required today. It is also designed to meet a stringent noise level of 90 PNdb at 1500 ft. horizontal distance.

The following series of graphs (Figs. 13 to 16) give the block time, utilisation, payload range and productivity of this aircraft, being those parameters required to estimate its operational performance.

The first cost of this aircraft has been estimated to be £3.1 million* at 1967 cost levels.

2.4.3 Description of a VTOL Port

The VTOL port described here, see Fig. 17, has been designed to be able to turn a VTOL airliner round in 20 minutes, in which time the passengers have disembarked, the passenger cabin cleaned, catering restocked, etc., on line maintenance carried out, aircraft refuelled and finally, passengers embarked.

The VTOL port is designed on the lines of an aircraft carrier with separated landing and take-off pads connected by a more lightly stressed deck. This port has several decks; ground level

*This figure allows for amortisation of launching costs from sales throughout Europe.

where the access roads and pavements enter, a car park for 600 cars on the first floor, second floor containing the passenger concourse, check-in desks, restaurants, etc., third floor maintenance, and finally, the deck on which the aircraft land, manoeuvre, load and unload, refuel and take-off.

This type of VTOL port, covering an area of eight acres, is designed to have a peak aircraft movement rate of 48 movements an hour*. Instead of taking all the services and passengers to the aircraft, the aircraft is taken to the services. The philosophy is for the aircraft to touch down on the landing grid, taxi forward onto a 80ft. x 100ft. flat,rigid, air cushion pad and shut down its engines. The pad then lifts, driven either by a linear induction motor or a compressed air ram, and carries the aircraft to the disembarkation station where, through covered gangways containing escalators, the passengers leave the aircraft. At the same time, the maintenance, cleaning and catering staff step onto the pad and for the next 14 minutes carry out their duties. Just before the aircraft enters the refueling bay, they step off with their equipment. To improve the safety levels, the refueling bay is surrounded by a wall which rises out of the deck after an aircraft has entered. The bay also contains high pressure foam nozzles as well as the high capacity fuel hydrants. At the last but one station, the passengers embark as they disembarked on escalators, then with the aircraft still on the pad, it is moved to the edge of the take-off grid during which time the engines are started and checked. Finally, the aircraft taxies onto the take-off grid and lifts off.

If at any stage, a fault is discovered in the aircraft which cannot be rectified on the spot, the aircraft is taken out of the line and down to the maintenance bay.

Further features of this port are that

(a) the landing and take-off pads are steel grids to duct away the airflow from the lifting units,

(b) both pads are surrounded by high pressure foam nozzles, and

(c) equipment is installed for removing any broken down aircraft from the pads.

2.4.4. Breakdown of cost of a VTOL Port

The cost of a London VTOL port has been broken down into three parts:-

| | | |
|---|---|---|
| (a) | the cost of the land at £0.5M/acre | = £ 4.0 million |
| (b) | the cost of the structure | = £13.0 million |
| (c) | the cost of the equipment installed | = £ 3.0 million |
| | | £20.0 million |

The above costs are open to criticism but they are given in order to obtain a guide to the overall costs of installing VTOL ports within London and the main provincial cities on the United Kingdom.

*This will cater for 8,400,000 passengers movements per year.

For provincial cities, the ground costs are reduced by half and the size of the VTOL port is made proportional to the populations of the cities served. These sizes of VTOL port are considered and listed below:-

| Population | Capital Cost |
|---|---|
| 2 to 4 million | £18 - £20 million * |
| 1 to 2 million | £11 million |
| 0.2 to 1 million | £ 8 million |

(* £20 million for London only)

2.4.5 Air Traffic Control

The VTOL aircraft is under general Air Traffic Control until it approaches within 10 miles of its destination, where the local A.T.C. of the VTOL port takes control. At this point, the VTOL aircraft is flying in a corridor bounded by the maximum allowing for the overflying of conventional aircraft and the minimum ceiling to meet the noise requirement of 90 PNdb on the ground. The VTOL port A.T.C. guides the aircraft automatically to give all-weather operations, and to minimise fuel consumption during transition, while not exceeding the noise restrictions. The same philosophy is followed for the take-off transition.

2.4.6 Production Rate

For the purpose of this study, it has been assumed that the first three aircraft will go into service at the end of 1975 or early 1976, twenty more will be in service at the end of 1976, the rate rising to thirty-six per annum in 1978. Therefore, by the end of 1980, 161 aircraft will be in service within Europe and the United Kingdom, with a throughout capacity of 40 million passengers per annum.

Fig. 18 shows the amount of traffic four VTOL ports in London will be able to handle and the upper limit of predicted short haul and feeder traffic plotted against the year. This figure is based on the assumption that:-

(a) all short-haul and feeder passengers* transfer to the VTOL airliner, i.e. the fares are attractive compared with conventional airliners.

(b) 50% to 100% of the VTOL airliners produced are assigned to the London run.

Therefore, as can be seen from Fig. 18, the VTOL airliners will have the capacity to carry all short-haul and feeder traffic by 1979 at the earliest if all the aircraft produced are assigned to the routes radiating from London to the rest of the United Kingdom and Western Europe with a radius of 630 st. miles. A curve assigning 50% of the production to the London run is also given, in which case the date when VTOL capacity will be able to handle all the short haul and feeder traffic through London has moved five years further into the future, i.e. 1984. This is considered the more likely situation.

*These produce about 40% of the total passenger movements per year in the London area.

## 2.4.7 Capital Cost of an Internal United Kingdom VTOL System

This section outlines the assumptions made and the estimated investment required for the VTOL ports and for a fleet of about 90 VTOL airliners which would be needed to provide a comprehensive internal United Kingdom VTOL service.

The assumptions are as follows:-

(a) VTOL ports to be installed in all cities and conurbations with populations greater than 200,000 (see fig.19).

(b) London has four VTOL ports. Other towns have single ports.

(c) The cost of producing the VTOL airliners required on internal routes allows for the amortisation of R.& D. and tooling costs over a much larger production run i.e. for sales in continental Europe.

(d) The programme could be split between the United Kingdom, France and Western Germany equally with a surcharge on launching cost for collaboration

or,

(e) financed by the United Kingdom only.

In either case the investment apportioned to the U.K. internal VTOL fleet would be about the same.

Thus the investment would be (at 1967 cost levels)

| | |
|---|---|
| VTOL Ports: | £315 million |
| VTOL Aircraft: | £280 million |
| Total: | £595 million |

## 2.4.8 Cost Effectiveness of VTOL

It is not proposed here to give absolute fares in d./passenger s.m. but to discuss the allowable increase in a VTOL fare above that for a conventional aircraft which would give a 50% traffic split using the concepts of 'Time Value' and 'Total Effective Fare'.

(1) Time and Cost

Comparing the VTOL aircraft against a conventional aircraft with the same cruise speed, the CTOL* block time for all ranges will be some eleven minutes longer, due to the extra time required for taxying along the runways.

The other major difference between the two systems is due to the elimination by VTOL of the ground journey time and the cost incurred by the"conventional" airline passenger between the airline's city centre termini and the airports. This journey time can vary greatly and in some cases can be as high as two hours, but a more typical value is 75 minutes with a cost of 7/6d. The other two sectors of the total journey are (a) the ground journey times to and from the city termini and (b) the processing times and costs in the terminals themselves. All these are assumed to be the same for the two concepts.

*Conventional take-off and landing aircraft

(2) Time value.

The assumption in this comparison is that the average traveller in the U.K. values his time at £1/hour.

(3) Total Effective Fare (i.e. Cost + Value of time)

Based on B.E.A.'s average internal fare level (1967) of 5.8d/pass. s.m. and, assuming an average range of 200 s.m. the cost to the CTOL passenger in fare and time in travelling between the airports' city termini is £7 2s. 6d: the cost of time to the VTOL passenger travelling between the same two city centres is 9s. 6d. Hence for the VTOL passenger to have the same total effective fare, his fare can be £6. 13s. 0d. compared with £4 16. 6d., i.e. 38% higher.

(4) Operating Costs.

From the data published on comparisons between VTOL and conventional airliners, of which that published by the Boeing Company is a typical example, it appears that the VTOL system with the highest D.O.C.*, excluding the helicopter, has a D.O.C. some 7% to 14% greater than a CTOL over the stage band 200 to 300 s.m.

However if we assume:-

(a) a VTOL airliner built with present day technology will increase the gap to 14% to 28%.

(b) The indirect cost is the same for the two systems.

From the above figures, it appears most unlikely that a VTOL fare would be 38% above a CTOL fare, the increase is more likely to be less than 15%. The implications of the above figures, if substantiated by a Research and Development Programme upon an advanced VTOL aircraft design, are that the VTOL system would take over a large proportion of the short-haul market.

2.4.9 Research Programme

This section lists the Research and Development required to substantiate the economic viability of the VTOL system.

(a) To prove by theory and experimental work that the noise generated will meet the community requirements

(b) To develop all-weather control of the VTOL airliner during its take-off and landing transitions.

(c) A study into the parameters controlling the magnitude and characteristics of the passenger transport market.

(d) Theoretical and experimental study into the aerodynamic characteristics peculiar to the selected VTOL aircraft configuration particularly during the transition phases.

(e) Normal research and development to bring the aircraft into airline service.

*Direct Operating Cost.

2.4.10 Conclusions

From this preliminary study into the impact of VTOL on the air traffic movements, the following conclusions emerge :-

(a) The technical viability of VTOL aircraft is now becoming established and there are good prospects of economic designs being brought to an operational stage within about ten years. Accordingly it seems highly probable that VTOL will have a significant impact on the air passenger movements in London area in the late 1970's and early 1980's. On present assumptions 40% of total passenger movements in the London area could be diverted onto a VTOL service operating from urban sites.

(b) The total investment in an internal VTOL system (VTOL ports, equipment and aircraft), would be in the region of £600 million, spread over 10 to 15 years (at 1967 cost levels).

(c) In the wider context additional sales of VTOL transport aircraft for European routes in the period up to 1990 could amount to a value of about £1250 million. This would require additional investment in launching costs of the order of 10% of sales. The U.K.'s share of this investment and their return on sales would be dependent on whether the programme is domestic or carried out by a European consortium.

(d) The economic fare for VTOL from this brief summary is unlikely to be greater than 15% above conventional aircraft fares, and total journey costs to the passenger will be comparable.

2.4.11 Implications of VTOL on Future Airport Planning for London

(a) In the late 70's and early 80's VTOL, will have a significant effect on the planning of the Air transport system in the U.K. and Europe, and once established will undoubtedly attract a high proportion of the whole short haul traffic, arising out of the large time savings possible, the convenience and the competitive economics as compared with conventional aviation.

(b) Hence full consideration must be given to VTOL in the deliberation on the third (and fourth) London Airport.

(c) Initial estimates suggest that the VTOL system (including terminals, systems aircraft etc.) will be cheaper than the equivalent conventional airport and aircraft developments required to provide the same increase of capacity, arising from the expansion of air transport in the future.

(d) V.T.O.L. promises significant savings in land acquisition, reduction in interference to the general public due to fundamentally lower noise levels confined to infinitely smaller areas of the community as compared with conventional aviation. It also gives a system with greater flexibility to match the changing needs arising from shifts of population and industry.

References


(1) "The Prospects of Civil VTOL Aircraft" Aircraft Engineering May 1966.

(2) British European Airways Annual Report and Accounts 1966/67

(3) "Study of Aircraft in Short-Haul Transportation Systems for 1985" ARC 30096, Boeing Aircraft Company.

## 2.5 Competition between modes

Recent developments now offer the prospect of new modes of transport such as VTOL aircraft, high speed trains and air cushion vehicles. These new modes could possibly play important roles in the transportation system of the future. Indeed, it has been claimed that the whole short haul travel market for CTOL aircraft may be taken over by them. Such an eventuality would seem likely to modify the requirements for a third London airport.

However, because of the paucity of data available on the characteristics of travellers and journeys, past assessments of the extent of the market penetration by such new modes have involved key assumptions which have been largely notional particularly relative to those characteristics which affect the choice of mode of transport. Predictions of the total transport system in the future incorporating these new modes are unlikely to be plausible unless based on a greater knowledge and understanding of the structure of past and present travel patterns than has been currently achieved.

### 2.5.1 Studies of Travel Characteristics

Thus it appears that studies must be undertaken to acquire such knowledge and understanding. Such studies would probably involve

(a) identifying and quantifying characteristics of circumstances and attributes of individuals which influence their travel and choice of mode.

(b) formulating quantitative relationships between these characteristics which can adequately account for the past and present travel patterns.

(c) assessing how these characteristics will change in the future.

(d) estimating the overall use and nature of use of different total transport systems.

(e) assessing which particular total transport system meets needs best, taking due account of <u>all</u> factors; in particular the role of the third London Airport (if any) would be identified.

#### 2.5.1.1 Geographical region appropriate to studies

It may be necessary to consider the competitive positions of some of the modes throughout a much wider region than London and its environs to assess their viability. The amount of VTOL traffic into London, for example, is likely to be sensitive to the extent to which VTOL penetrates the whole Western European travel market. It could be completely misleading to consider its competitive position only in the context of U.K. travel to or from London.

#### 2.5.1.2 Some travel characteristics of possible relevance

The following information on particular journeys may be, in aggregate, of relevance to the understanding of the structure of the current travel pattern.

(a) Characteristics of available modes:
1. Speed
2. Convenience
3. Comfort
4. Safety
5. Fare and other costs
6. Frequency of service
7. Passengers carried (i.e. traffic)
8. Load factors
9. Locations of termini

(b) Characteristics of journey:
1. Purpose
2. Time and place of {origin, destination}
3. Modes used
4. Reasons for choice of mode
5. Payer

(c) Characteristics of traveller:
1. Occupation
2. Education
3. Income
4. Overheads
5. Sex
6. Age
7. Baggage
8. Attitudes to and experience with available modes
9. Car ownership

(d) Characteristics of community:
1. Population
2. Growth of population
3. Age distribution
4. Occupation distribution
5. Economic activity
6. Income distribution

2.5.2 Some methods of acquiring information on travel

Some ways now in current use for acquiring such information on travel are:

(a) to question suitably selected individuals in their homes or at their place of work,

(b) to question suitably selected individuals while they are travelling,

(c) to question employers for whom employees travel in the course of their work,

(d) to ask the carriers for statistics and such details of their passengers and vehicles as they possess, and

(e) to ask the appropriate international, national and local government statistical offices for information on travel and the characteristics of communities.

### 2.5.2.1 Commercial Security Considerations

Methods (b) and (d) above require the co-operation of the carriers. Commercial security considerations have in the past inhibited and may still inhibit the response of carriers to requests for information. However, such studies as are proposed for the present purpose would also identify more clearly the characteristics of the total transport system of the future and might, in addition, help to match its evolution to community needs in the most effective way. It would be to the ultimate benefit of carriers to be informed on this for planning their future operations.

### 2.5.3 Basis of Comparison of Different Total Transport Systems

It will be necessary to establish a basis for comparing different total transport systems. This will involve identifying factors relevant to costs and benefits and defining them in monetary and social terms. These factors in the present context would be expected to include:

(a) flexibility of the total system with respect to possible changes in community requirements. This can obviously be achieved at some cost. For example, one could make provision for each of several competing modes to carry all traffic.

(b) the effect of the total transport system on the competitive position of U.K. industry relative to that of other communities. This is likely to be difficult but its consideration is fundamental to the future well-being of the community.

(c) the cost required to develop and introduce each particular new mode.

(d) the retention or acquisition of the expertise and capability within industry of developing and manufacturing certain advanced transport vehicles.

(e) the reactions of the community at large to the use of a particular mode (for example, its reactions to aircraft noise, noise and vibration generated by high-speed trains or pollution of the atmosphere by motor-car exhaust.)

### 2.5.4 Organisation for Executing Studies

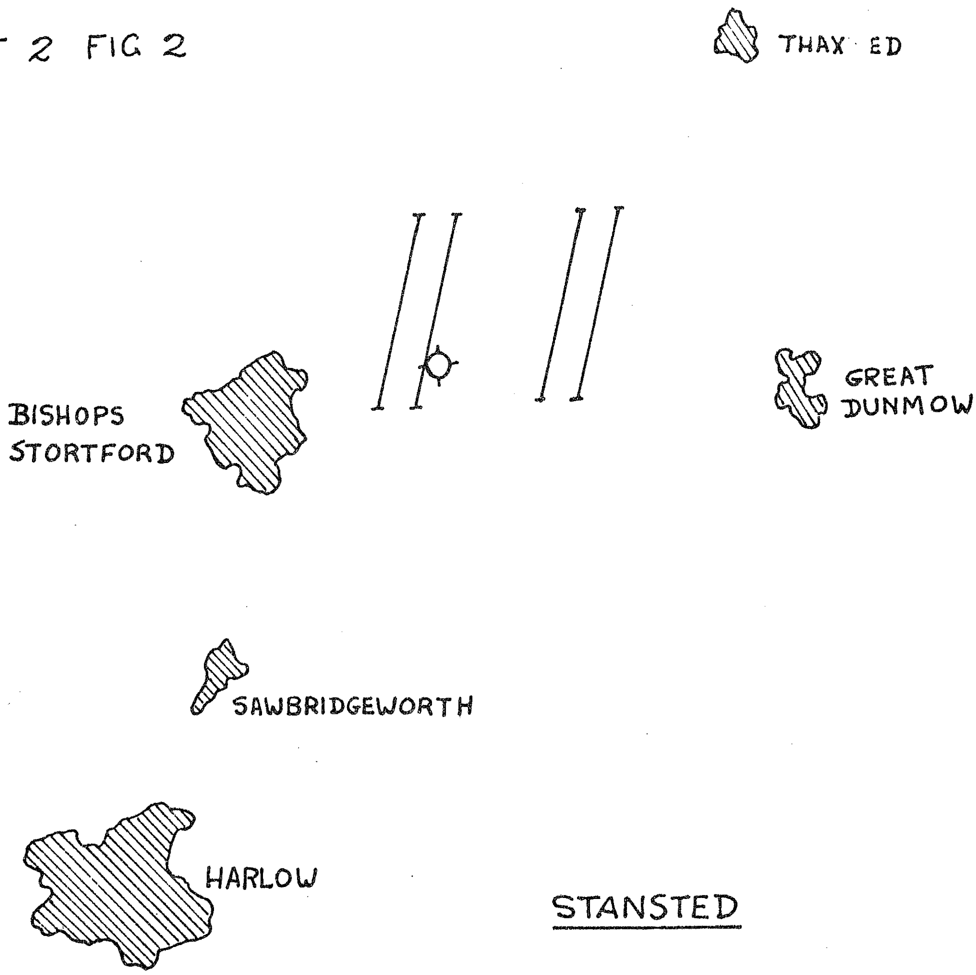
By some standards the work implied above and its cost of execution are substantial. However, it should be kept in mind that the output is relevant to the future total transport system as well as to the Third London Airport. Som £6,000,000,000, per year is being spent currently in the U.K. on transport. It would seem to be well worthwhile devoting a substantial sum to examining whether it is being spent in the best way. Indeed, since at least over the next decade or so there is likely to be a continuously changing background of technology and travel habits, consideration should be given to making the study of the transport system in all its aspects including the prediction of its evolution the responsibility of some permanently established national organisation of adequate size and with adequate facilities in which the various requisite disciplines would be welded together.

It is doubtful whether such an organisation could approach its full potential within the time scale of the present enquiry. However, through the evolution of modelling, operational analysis, data gathering and other relevant techniques, it would be expected over the years to steadily acquire an improving prediction capability and become an increasingly effective tool for assessing further problems similar to that of the Third London Airport which must surely arise in the future and which may be even more far-reaching in their impact on the community.

PART 2 FIG.1

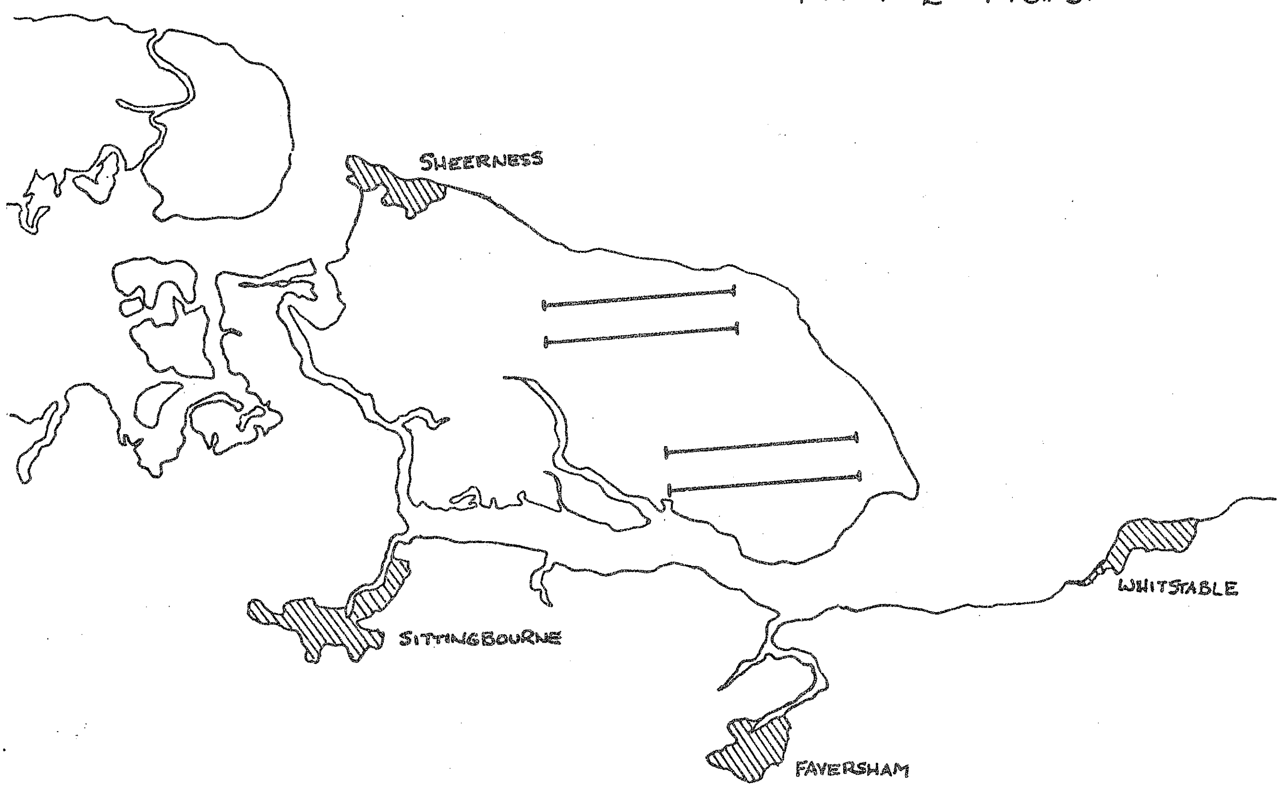

LOCATIONS OF AIRPORT SITES

PART 2 FIG 2



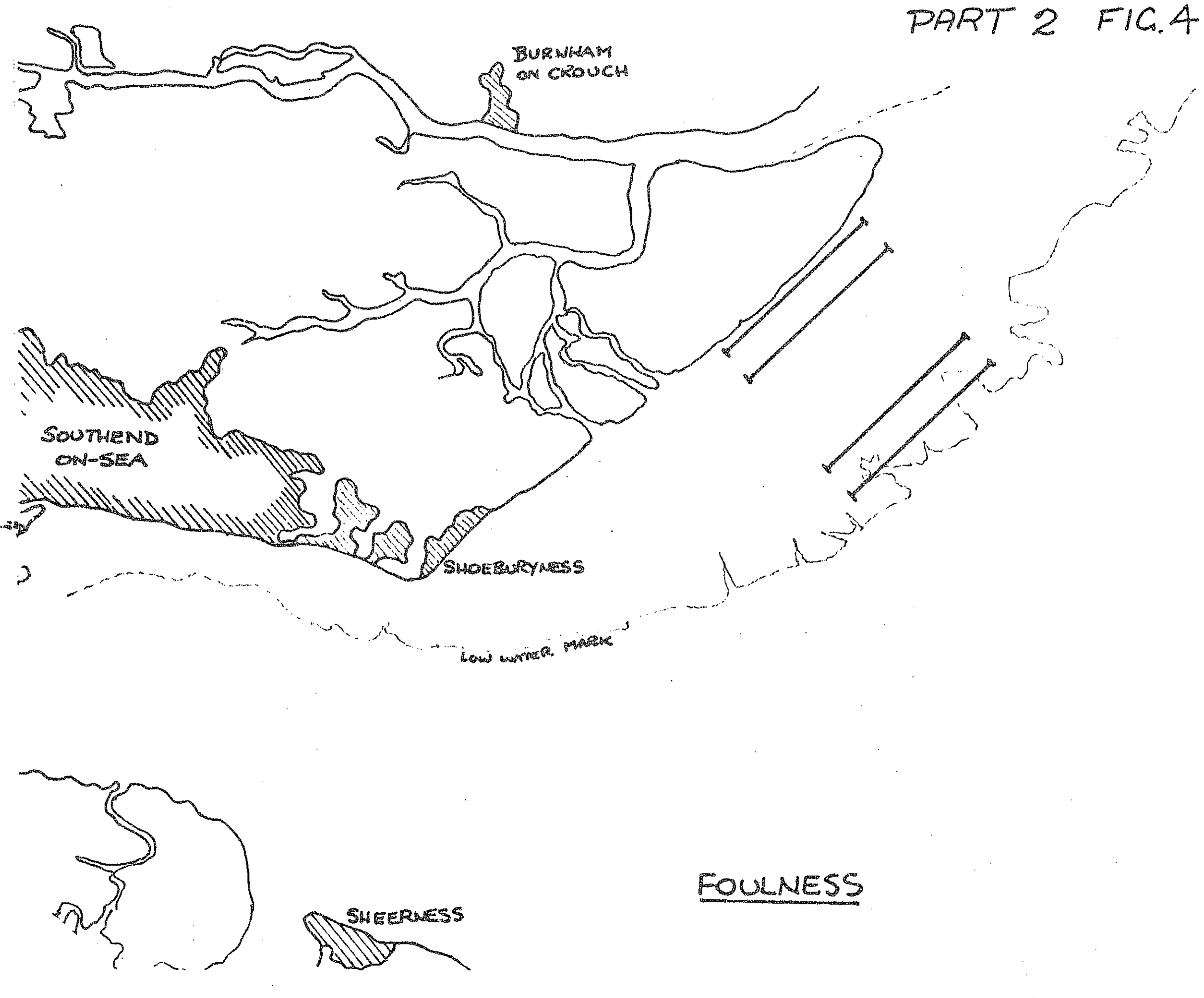

STANSTED

PART 2 FIG. 3.




SHEPPEY

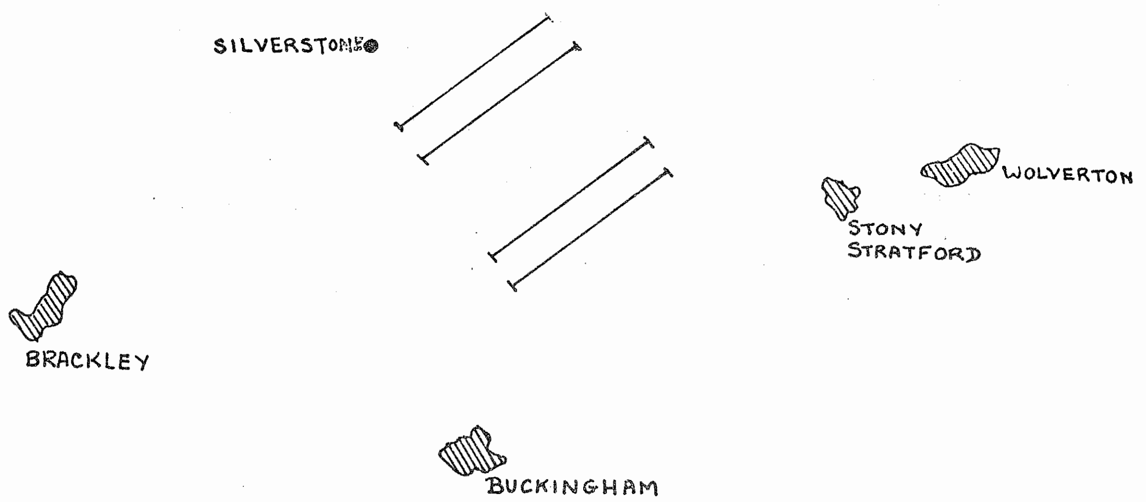
PART 2 FIG. 4




FOULNESS

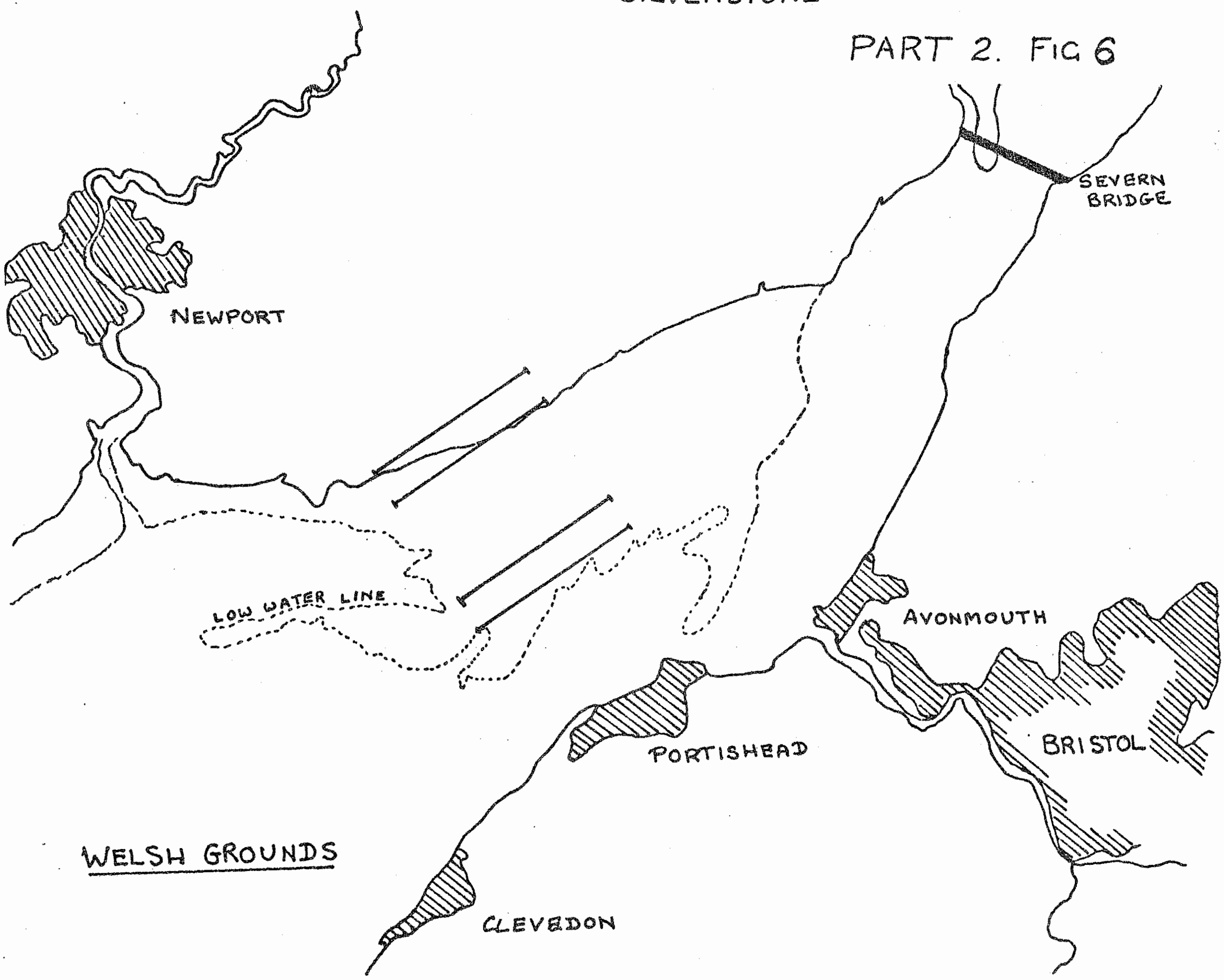
PART 2. FIG. 5

N




SILVERSTONE

PART 2. FIG 6

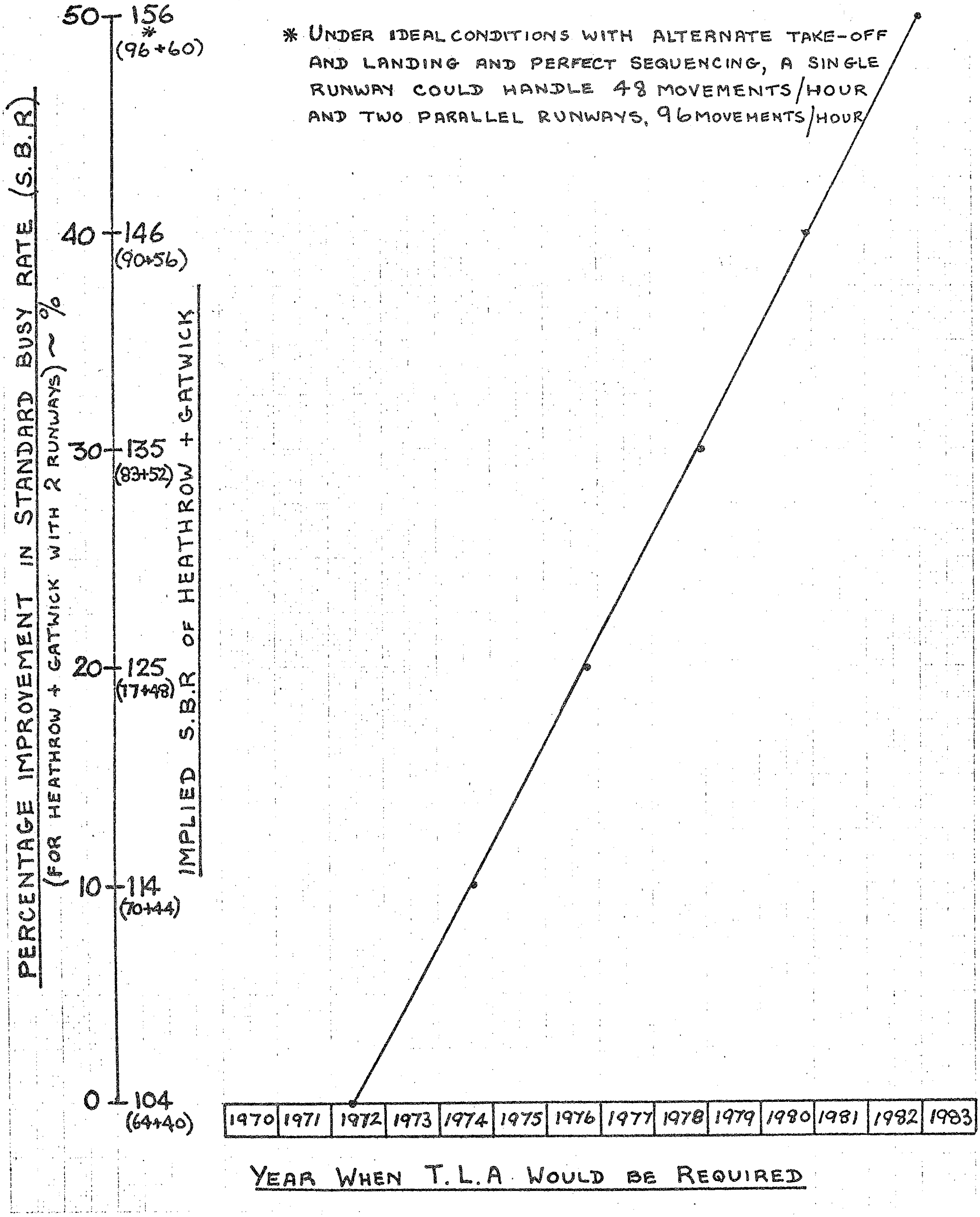



WELSH GROUNDS

PART 2. FIG:7.

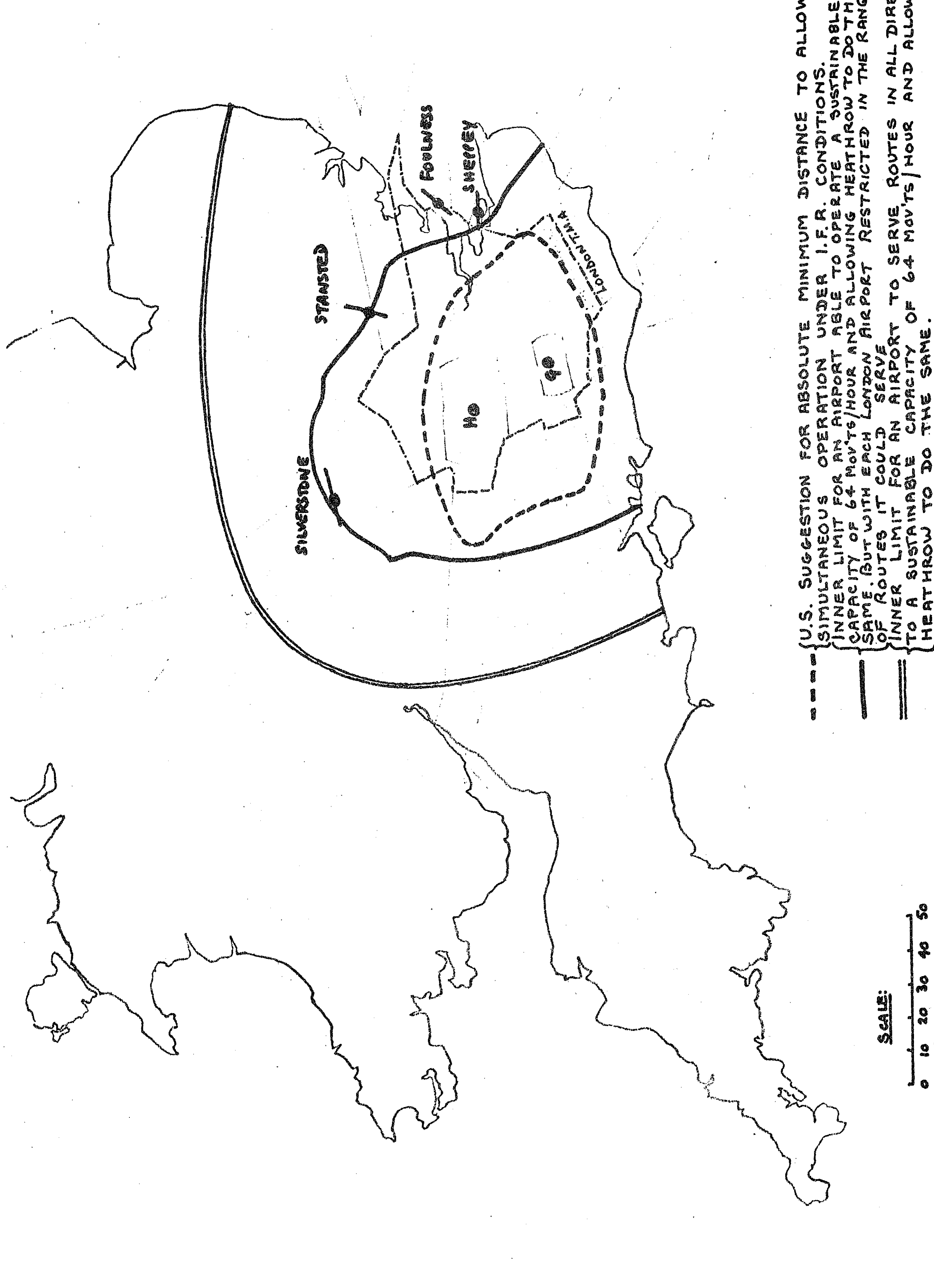
EFFECT ON T.L.A REQUIREMENT OF IMPROVEMENTS IN S.B.R.

(NB. THE "MOST LIKELY" FORECAST FOR TRAFFIC HAS BEEN USED IN COMPILING THIS GRAPH)

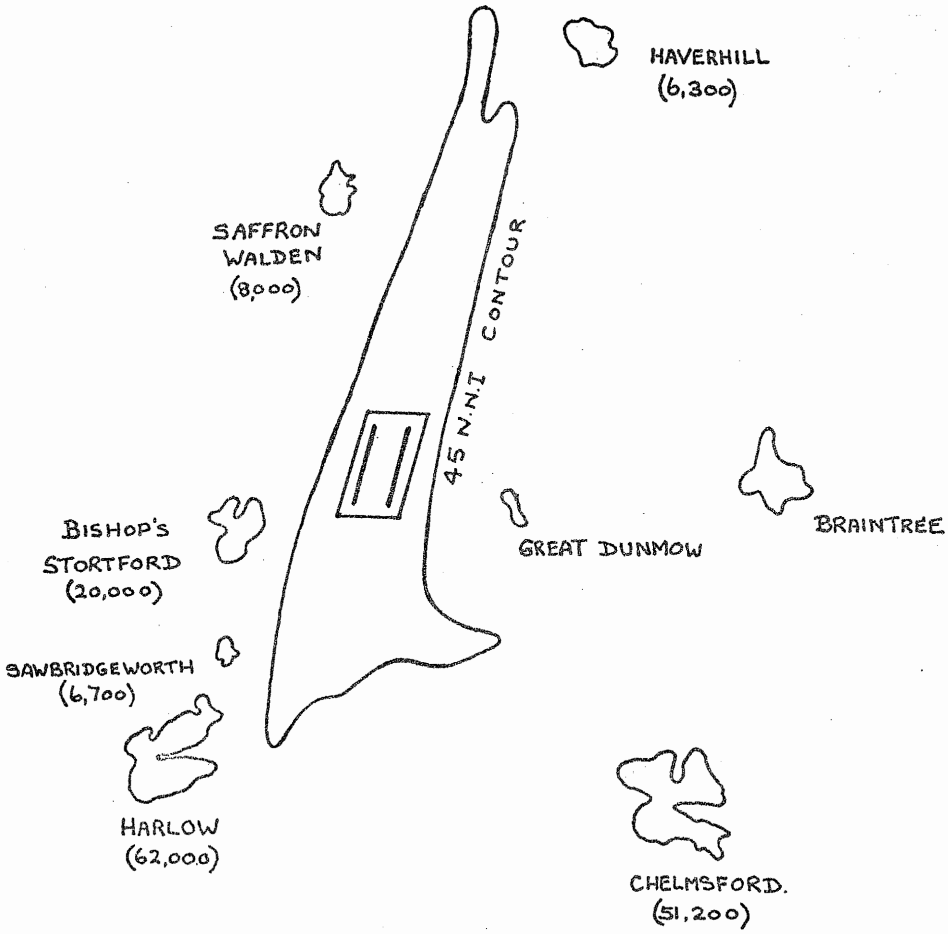


PART 2. FIG: 8

## THE POSSIBLE SITES IN RELATION TO THE PRESENT ATC PATTERNS

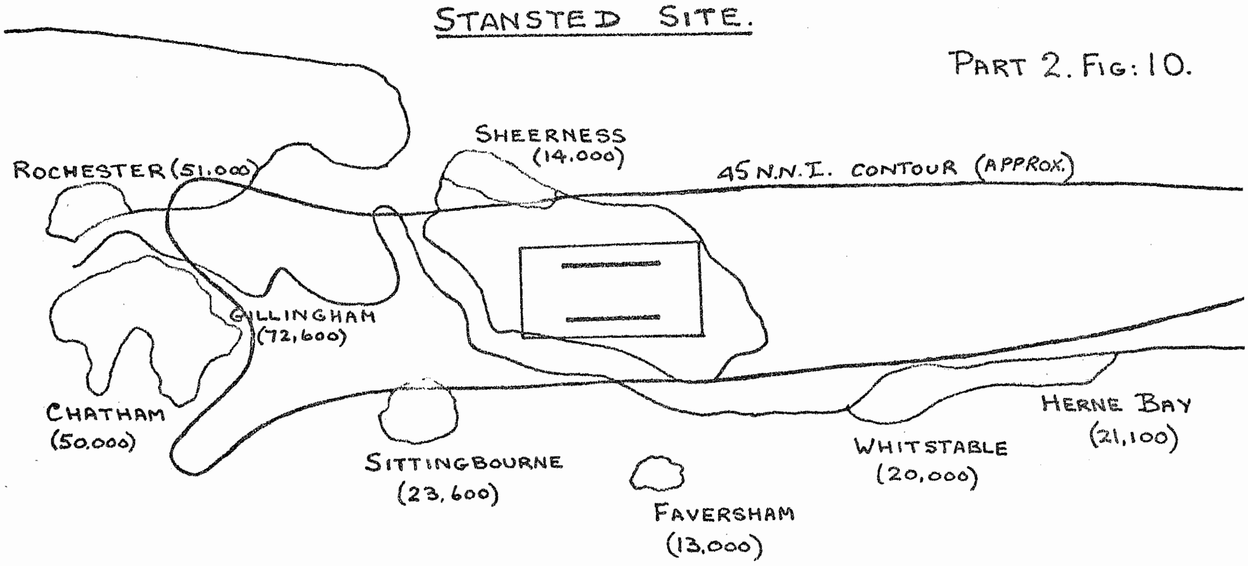


Part 2. Fig: 9.



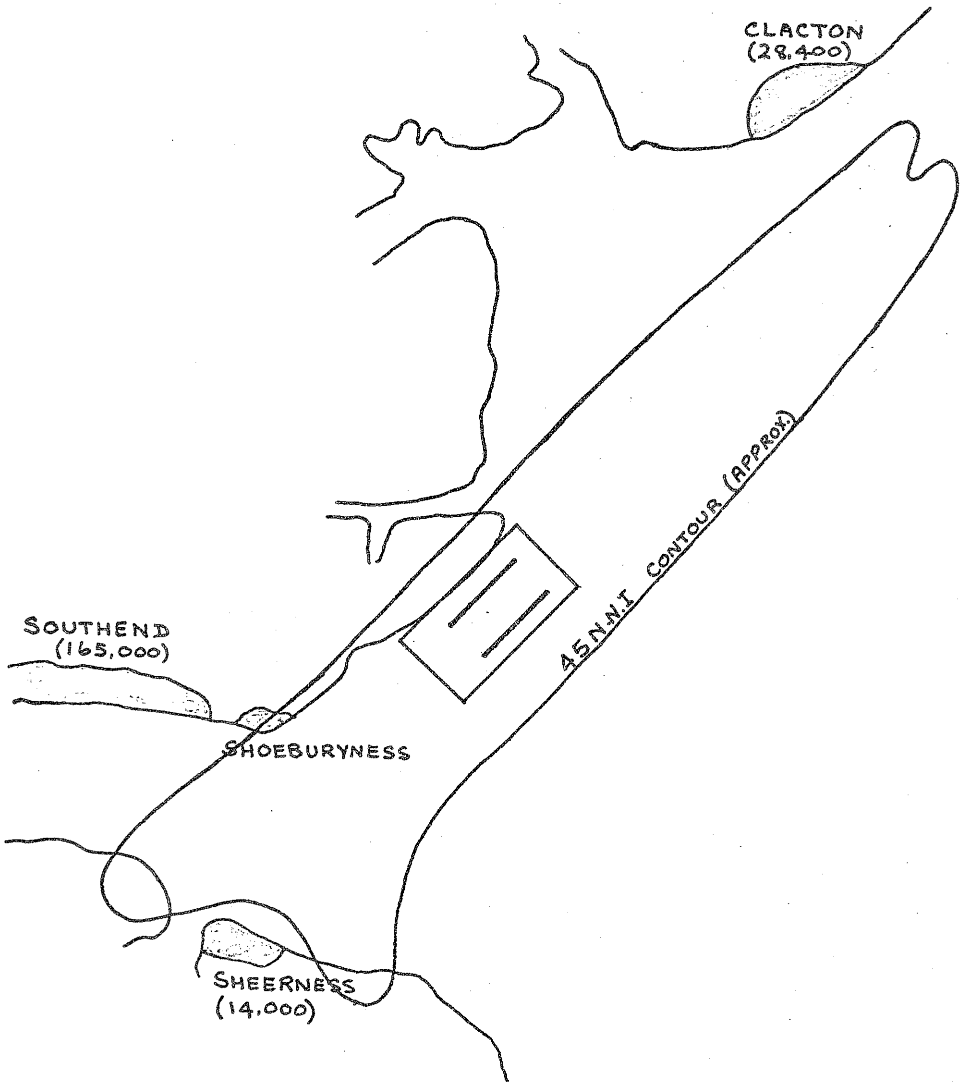

Stansted Site.

Part 2. Fig: 10.



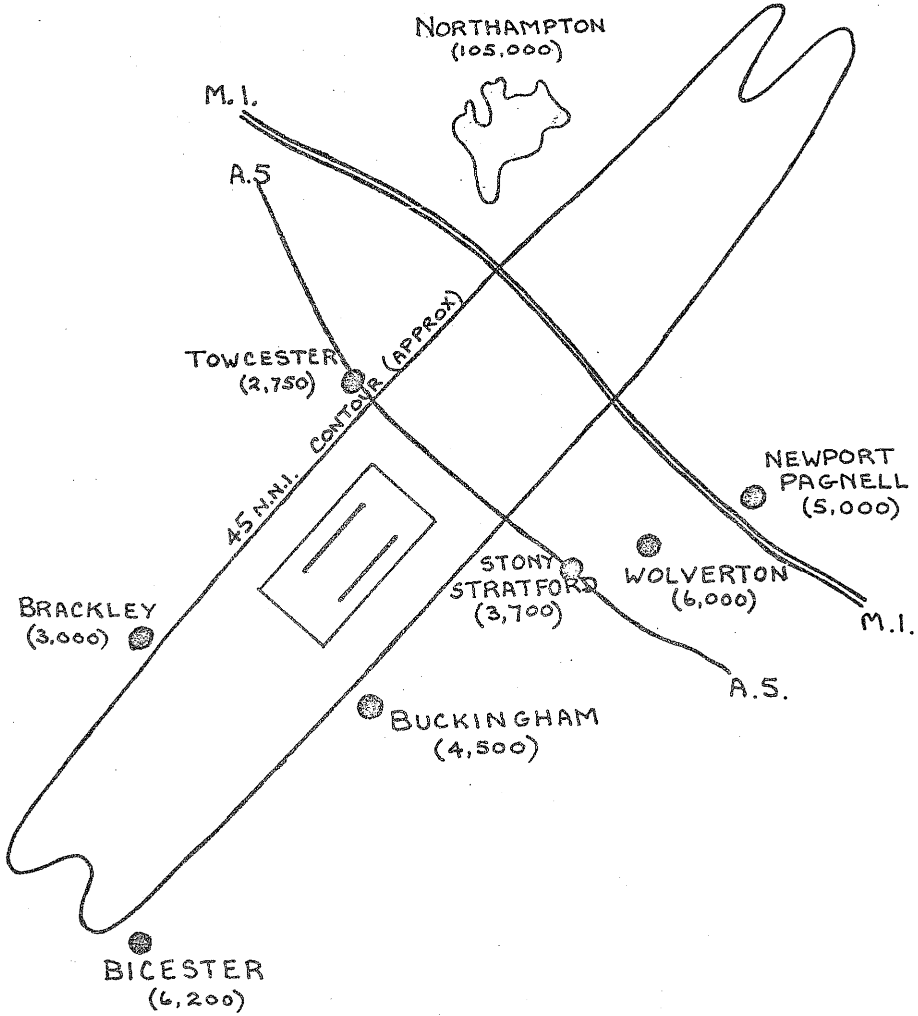

Sheppey Site

PART 2. FIG: 11.




FOULNESS SITE

PART 2. FIG: 12.




SILVERSTONE SITE.

PAYLOAD - RANGE

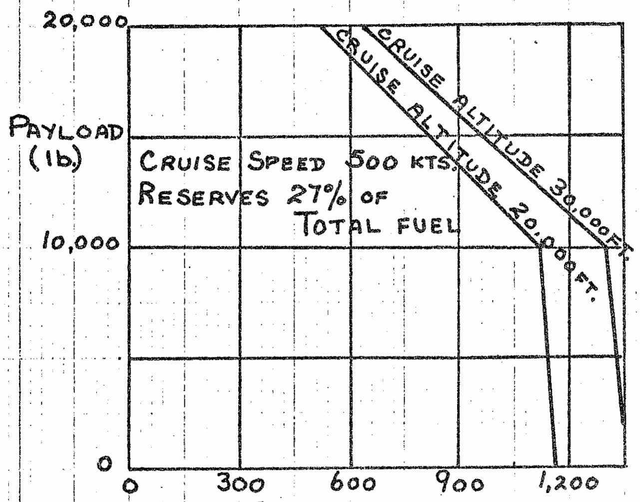



Fig: 13

BLOCK TIME

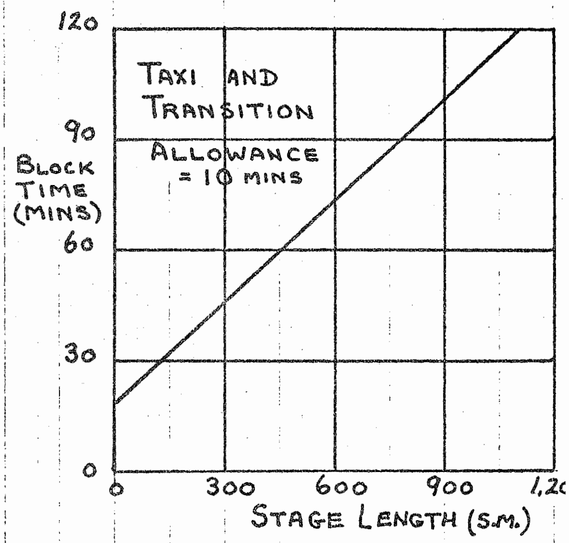



Fig: 14

UTILISATION

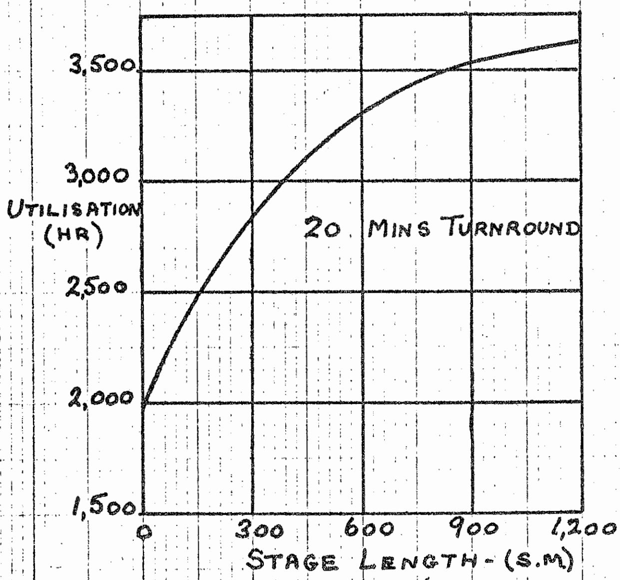



Fig. 15

PRODUCTIVITY.

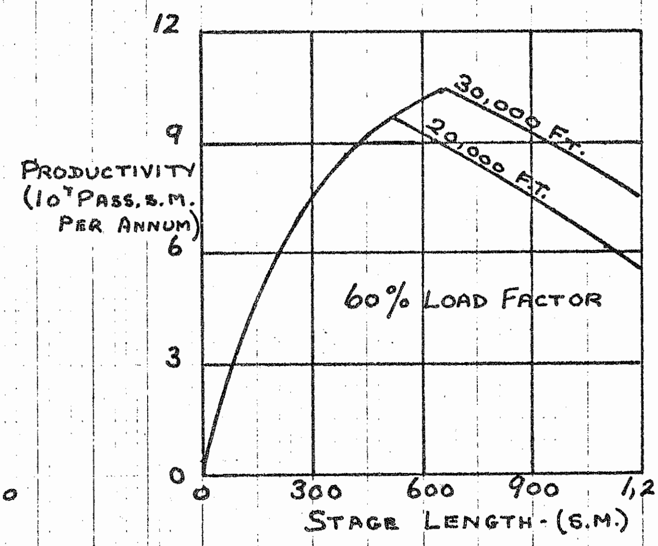
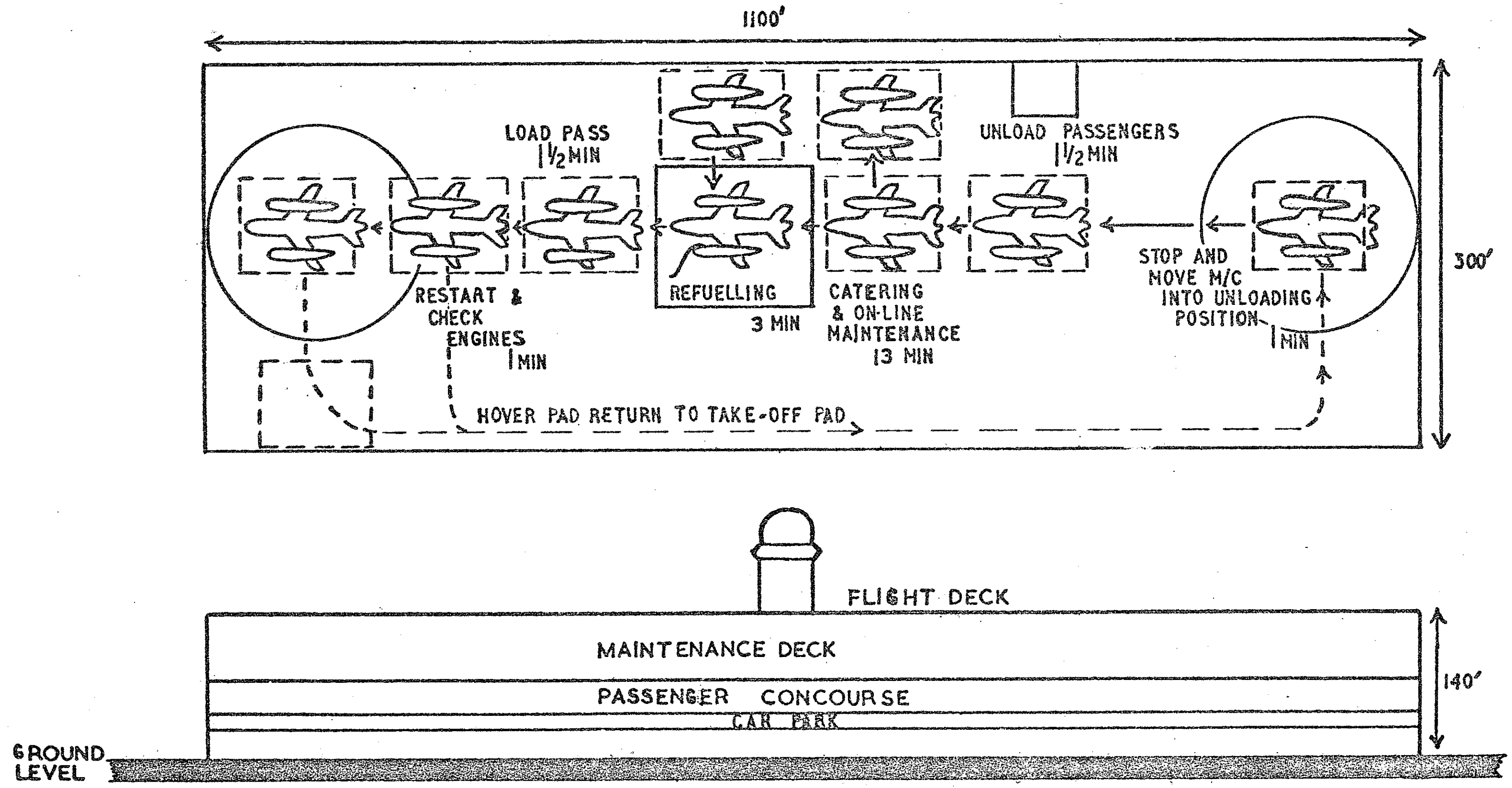



Fig. 16

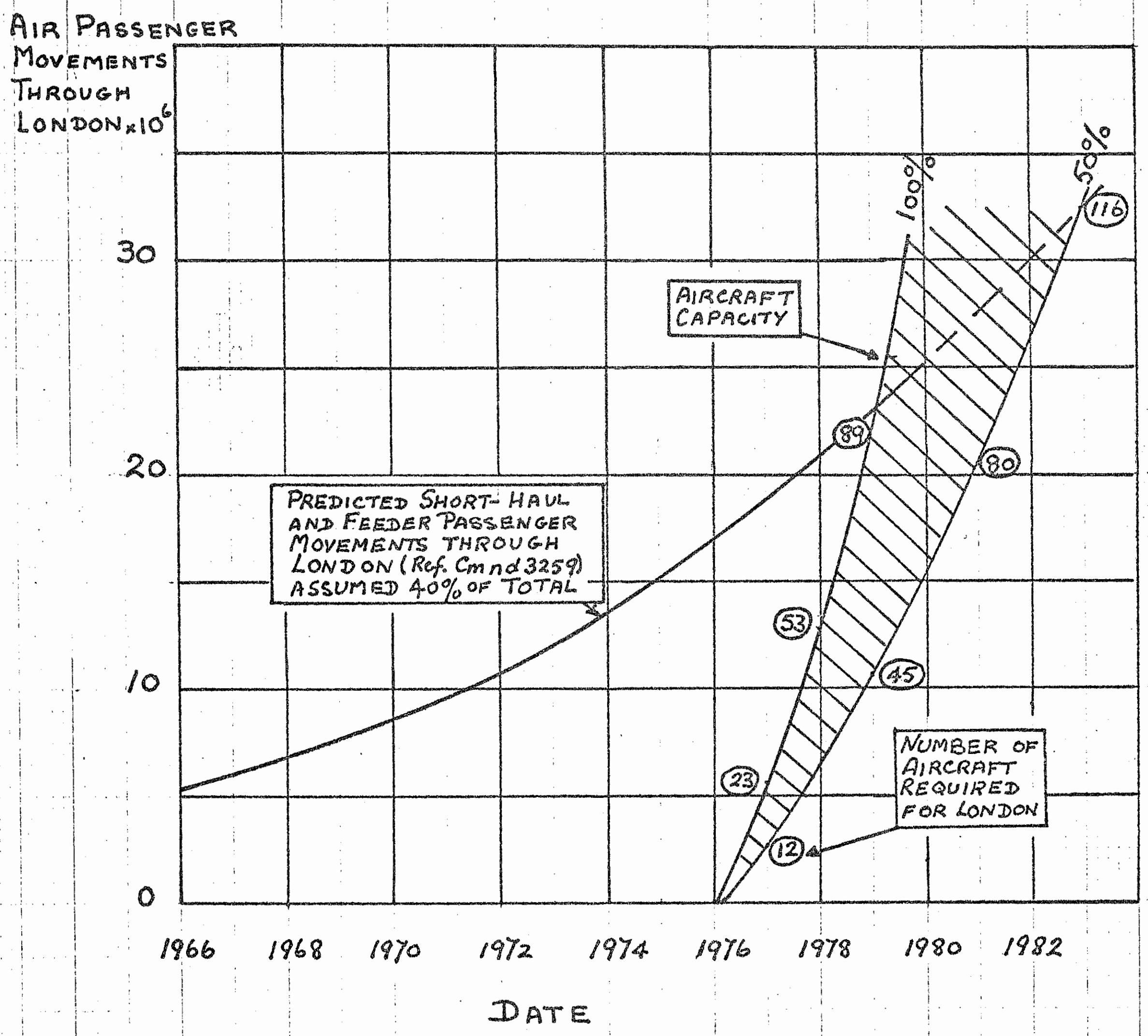
VTOL Aircraft Performance Characteristics

# VTOL PORT

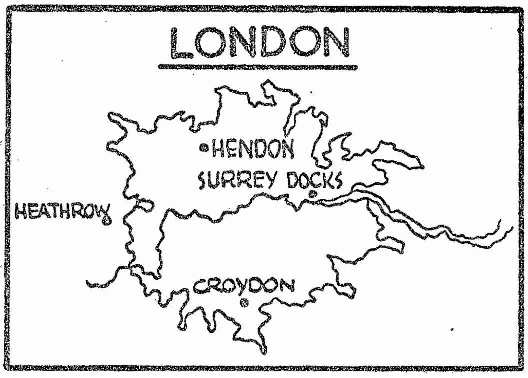



PART 2. FIG: 17.

PREDICTED SHORT-HAUL AND FEEDER PASSENGER MOVEMENTS THROUGH LONDON



## VTOL SITES WITHIN THE U.K.

# PART 3. GROUND MOVEMENT ASPECTS OF THE THIRD LONDON AIRPORT

## 3.1 Traffic Aspects

### 3.1.1 Growth of air traffic movements at the Third London Airport

The demand for ground transport of passengers and freight to and from the Third London Airport and Central London, and other places, will depend on the growth of traffic there. Following the traffic forecasts in Part 1, we have estimated the number of passengers diverted to the Third London Airport and the number of transport aircraft movements for the years 1975 and 1980. These figures, in table 1, assume that Heathrow and Gatwick together can take traffic corresponding to a (joint) Standard Busy Rate of 104. The basic traffic estimate used is the "most likely" forecast in the White Paper.

The implications are that, by 1980, the Third London Airport will be handling the same number of passengers as Heathrow did in 1965, but with only about half the aircraft movements, because of the assumed increase in size of aircraft.

There is, therefore, a considerable excess capacity available at the Third London Airport. Guessing at the increase in aircraft size after 1980, and assuming an achievable SBR of 64 for 2 runways, and 128 for four runways, we can estimate the capacity of the Third London Airport as nearly 30 million passengers per year, and nearly 80 million respectively, as shown in table 1. This last figure is the result of an average aircraft size of 200 seats, which may be somewhat excessive.

The effect of extra movements by specialised freight aircraft may also tend to reduce the capacity passenger estimates at the Third London Airport, but this may not be as large an effect as appears at first. Much freight will continue to be carried in passenger aircraft, as at present, giving a substantial freight capacity without increasing the aircraft movements. Also, the movements of special freighters may be fitted into off-peak periods of the airport, and so enable an increase in annual movements without a corresponding increase in SBR.

However, if the growth of airfreight is as large as forecast in Part 1, (i.e. 19.6% per year), the implications on aircraft movements and ground transport will be enormous. The predicted 4.7 million short ton of cargo handled in 1980 would mean over 300 ISO. 8 x 8 x 20 $ft.^3$ containers being sent to and collected from the airports every day. This could not be superimposed on a passenger airport, but could justify a special freight only airport, not necessarily in the London area.

Finally, these traffic forecasts have not taken into account the possible effect of a commercially successful VTOL airliner, capable of operating into city centres without causing unacceptable noise disturbance. It appears (from Part 2.4) that such an aircraft could attract something like 40% of the passenger traffic in the London airports area. It would have such far reaching effects on air and ground traffic that the technical and social feasibility needs careful study.

3.1.2 Growth of Passengers, friends, spectators and airport employees

The estimated growth rate of passengers at the Third London Airport has been shown on table 1. Associated with these air passengers are their friends, who come to the airport to meet them or see them depart. There are also a substantial number of spectators who visit an airport just for the spectacle. All these people will make some demand on ground transport, though it is assumed that the majority will travel by car rather than by airport coach (or rail link) from the centre of London. They therefore represent a traffic demand on road space and not on mass transit link.

The London Airports Traffic Study (Heathrow) notes that the following people entered the Central Terminal Area of Heathrow on an August Sunday:-

| | | |
|---|---|---|
| Air passengers | = | 17,000 |
| Friends | = | 22,000 |
| Spectators | = | 12,500 |

Other categories (i.e. journey to work) to total 73.000.

Thus each air passenger "generated" 1.25 friends and 0.7 spectators on this peak day. The Third London Airport will be further from London that Heathrow, and it would be expected that there will be fewer friends and many fewer spectators than at Heathrow. If we assume that half the present friends and one quarter the spectators as a proportion of the air passengers, we have:-

Number of friends and spectators = 0.80 x Number of air passengers.

This relation is used in table . 2 to give estimates of numbers of these classes of people.

The airport employees also make demands on transport facilities, either by road or public transport. The Third London Airport will have one significant difference from Heathrow in that there will be no provision by B.O.A.C. and B.E.A. of major maintenance areas. About 40% of the 37,350 Heathrow employees work in the Maintenance Area; if these are removed, the equivalent number of employees is 0.60 x 37,350 = 22,400.

Some of these workers provide services to passengers; others maintain and provide crew for aircraft. The numbers of each will therefore depend both on passenger numbers and aircraft movements. We have assumed arbitrarily that there are, at Heathrow, at present, equal numbers of each class of employee. We can then find the constants in the relation:-

$$E = k_1 P + k_2 M$$

where $E$ = Number of employees
$P$ = Annual number of passengers handled
$M$ = Annual number of aircraft movements
$k_1$, $k_2$ = constants

For Heathrow at the moment:-

$$k_1 = \frac{1}{1000}$$

$$k_2 = \frac{52}{1000}$$

That is, one "passenger" employee is required per thousand passengers handled per year, and 52 "maintenance" employees per thousand aircraft movements.

In the future, the employees per passenger will tend to be reduced with increasing mechanisation of ticketing, baggage handling, etc. We assume that the reduction is to 0.8/1000 in 1975 and 0.5/1000 in 1980 and after. On the other hand, it is assumed that the "maintenance" employees will remain at the current level, the potential reduction with improved reliability being absorbed by the increased size of aircraft with time.

These assumptions lead to the numbers of employees estimated for the Third London Airport in table 2. It should be noted that freight handling is assumed to be at the 1966 Heathrow level, and to account for about 13% of employees.

3.1.3 Peak travel demand for passengers, etc., travelling to the airport

This is an area where this is a lack of reliable information, and we can do no better than assume that conditions at Heathrow (as shown in the London Airports Traffic Study) are representative of the Third London Airport.

Consider first the demand for ground transport to the airport by air passengers. The annual passenger flow can be reduced to an average hour's flow in one direction by dividing the numbers in table 1.2 by 15 × 365 × 2 for a 15 hour traffic day. The average flow is then factored for the peak hour of the peak day by multiplying by 2.64, as derived from Heathrow data.

The friends and spectators figures, being already for a peak day, only have to be factored for the peak hour by 1.7. The employees' peak travel occurs in the morning journey to work; about 64% of employees travel to work on a typical day and the peak hour (08.00) sees the arrival of 20% of the workers.

3.1.4 Modal Split of journeys to the airport

Here we need information on the proportion of passengers, employees, etc. who are going to use public transport and private cars. In particular, the demand for mass transport facilities to central London by airline coach, rail link or new hovertrain service will determine what ground transport system is economic. This is an area requiring further study, and for the present we have made assumptions based on Heathrow experience of the possible modal split. We have assumed the proposed sites for the new airport at Stansted, Foulness, and Sheppey and will have similar patterns to Heathrow. For the airports further from London (Silverstone and Wels. Sands), we have assumed that a greater proportion of travel is by the mass transit link.

The results (and assumptions) are shown in tables 1.4 and 1.5. It will be noted that an approximate peak hour loading for traffic of different kinds has been obtained by summing the peaks and factoring by 0.75 to allow, roughly, for the fact that the peaks do not coincide in time. The corresponding annual flows (not peak hour) are given in tables 6 and 7. Selected topics from these tables are illustrated in figs. 1, 2 and 3.

These estimates of passenger traffic clearly are rough and ready, and are used to indicate the order of capacity required for any ground transport system associated with a new airport.

### 3.1.5 Conclusions

(a) The kind of ground transport system needed at the new airport depends critically on the year which is chosen for assessment of travel demand. On the figures given in this section, a fixed track link to central London could hardly be justified in 1980, but probably could be when a 2-runway airport is running to capacity.

(b) Not only air passengers need ground transport to the airport. Friends, spectators and (more important) employees all make a substantial demand for transport. This aspect needs further investigation on the basis of more refined traffic surveys and forecasts.

(c) Even if a good mass transit link with London is provided, there will still be a great deal of travel by road to the airport. The quantity will depend on where employees live, and whether the airport attracts friends and spectators. The capacity of the road network linking local towns and the airport needs further study based on forecasts of local traffic patterns.

## TABLE 1

## ESTIMATES OF THIRD LONDON AIRPORT TRAFFIC

| | 1975 | 1980 | ULTIMATE CAPACITY | |
|---|---|---|---|---|
| | | | 2-Runway | 4-Runway |
| Terminal Passengers (M/YR) | 29.6 | 43.6 | (76.3) | (141.0) |
| Air transport movements (K/YR) | 353 | 430 | (509) | (703) |
| Passengers per movement | 84 | 102 | 150? | 200? |
| At Third London Airport | | | | |
| Terminal passengers (M/YR) | 3.3 | 11.7 | 29 | 78 |
| Air Transport movements (K/YR) | 39 | 115 | 194 | 388 |
| Standard Busy Rate (Movements/Hour) | 13 | 38 | 64 | 128 |

## TABLE 2

## ESTIMATES OF NUMBERS OF PASSENGERS, FRIENDS, SPECTATORS AND EMPLOYEES AT THE THIRD LONDON AIRPORT

| | 1975 | 1980 | ULTIMATE CAPACITY | |
|---|---|---|---|---|
| | | | 2-Runway | 4-Runway |
| Terminal Passengers (M/YR) | 3.3 | 11.7 | 29 | 78 |
| Friends, Spectators (M/YR) (Based on Peak Sunday) | 2.6 | 9.4 | 23.2 | 62.4 |
| Employees | 4.7 | 12.0 | 24.6 | 59.2 |

## TABLE 3

## PEAK HOUR TRAVEL DEMAND FOR VARIOUS CLASSES INTO THE THIRD LONDON AIRPORT

| | 1975 | 1980 | ULTIMATE CAPACITY | |
|---|---|---|---|---|
| | | | 2-Runway | 4-Runway |
| Air Passengers | 800 | 2,820 | 7,000 | 18,800 |
| Friends and Spectators | 400 | 1,460 | 3,600 | 9,700 |
| Employees | 600 | 1,540 | 3,120 | 7,600 |

Note: The travel peaks do not coincide.

TABLE 4

MODAL SPLIT FOR PEAK HOUR PERSON JOURNEY INTO THIRD LONDON AIRPORT

(For Stansted and the estuary sites)

| | 1975 | 1980 | ULTIMATE CAPACITY | |
|---|---|---|---|---|
| | | | 2-Runway | 4-Runway |
| (1) AIR PASSENGERS | | | | |
| Peak Demand | 800 | 2,820 | 7,000 | 18,800 |
| Mass Transit (41%) | 330 | 1,160 | 2,870 | 7,700 |
| Private (59%) | 470 | 1,660 | 4,130 | 11,100 |
| (2) FRIENDS AND SPECTATORS | | | | |
| Peak Demand | 400 | 1,460 | 3,600 | 9,700 |
| Public Transport (10%) | 40 | 150 | 360 | 970 |
| Private (90%) | 360 | 1,310 | 3,240 | 8,730 |
| (3) EMPLOYEES | | | | |
| Peak Demand | 600 | 1,540 | 3,120 | 7,600 |
| Public Transport (24%) | 140 | 370 | 750 | 1,830 |
| Private (76%) | 460 | 1,170 | 2,370 | 5,770 |
| TOTALS | | | | |
| (Peak Total = 0.75 x sum of Peaks) | | | | |
| Mass Transit | 330 | 1,160 | 2,870 | 7,700 |
| Public Transport | 140 | 390 | 830 | 2,100 |
| Private | 970 | 3,100 | 7,200 | 19,200 |

TABLE 5

MODAL SPLIT FOR PEAK HOUR PERSON HOURNEYS INTO THE THIRD LONDON AIRPORT

(For Silverstone and Welsh Sands)

| | 1975 | 1980 | ULTIMATE CAPACITY | |
|---|---|---|---|---|
| | | | 2-Runway | 4-Runway |
| (1) AIR PASSENGERS | | | | |
| Mass Transit (70%) | 560 | 1,970 | 4,900 | 13,100 |
| Private (30%) | 240 | 850 | 2,100 | 5,700 |
| (2) (3) As Table Above | | | | |
| TOTALS | | | | |
| Mass Transit | 560 | 1,970 | 4,900 | 13,100 |
| Public Transport | 140 | 390 | 830 | 210 |
| Private | 700 | 2,510 | 5,800 | 15,100 |

## TABLE 6

### MODAL SPLIT FOR ANNUAL PERSON JOURNEYS INTO THE THIRD LONDON AIRPORT

(For Stansted and the estuary sites)

| | 1975 | 1980 | ULTIMATE CAPACITY | |
|---|---|---|---|---|
| | | | 2-Runway | 4-Runway |
| (1) AIR PASSENGERS | | | | |
| Annual | 3.3M | 11.7M | 29M | 78M |
| Mass Transit (41%) | 1.4M | 9.8M | 11.9M | 32M |
| Private (59%) | 1.9M | 6.9M | 17.1M | 46M |
| (2) FRIENDS AND SPECTATORS | | | | |
| Annual | 2.6M | 9.4M | 23.2M | 62.4M |
| Public Transport (10%) | .3M | .9M | 2.3M | 6.2M |
| Private (90%) | 2.3M | 8.5M | 20.9M | 56.2M |
| (3) EMPLOYEES | | | | |
| Annual | 4,700 | 12,000 | 24,600 | 59,200 |
| Public Transport (24%) | 1,100 | 2,900 | 5,900 | 14,200 |
| Private (76%) | 3,600 | 9,100 | 18,700 | 45,000 |
| TOTALS | | | | |
| Mass Transit | 1,400,000 | 4,800,000 | 11,900,000 | 32,000,000 |
| Public Transport | 301,100 | 902,900 | 2,305,900 | 6,214,200 |
| Private Transport | 4,203,600 | 15,409,100 | 38,018,700 | 102,245,000 |

## TABLE 7

### MODAL SPLIT FOR ANNUAL PERSON HOURNEYS INTO THE THIRD LONDON AIRPORT

(For Silverstone and Welsh Sands)

| | 1975 | 1980 | ULTIMATE CAPACITY | |
|---|---|---|---|---|
| | | | 2-Runway | 4-Runway |
| (1) AIR PASSENGERS | | | | |
| Annual | 3.3M | 11.7M | 29M | 78M |
| Mass Transit (70%) | 2.3M | 6.2M | 21.3M | 54.6M |
| Private (30%) | 1M | 3.5M | 8.7M | 23.4M |
| (2) (3) as table above | | | | |
| TOTALS | | | | |
| Mass Transit | 2,300,000 | 6,200,000 | 21,300,000 | 54,600,000 |
| Public Transport | 301,100 | 902,900 | 2,305,900 | 6,214,200 |
| Private Transport | 3,303,600 | 12,009,100 | 29,618,700 | 79,695,000 |

## 3.2 Consideration of existing and planned transport links

### 3.2.1 Roads

#### 3.2.1.1. Basic Characteristics

| Site | Distance from Grosvenor Square (Miles) | | Current Journey Time (2) (mins.) | Proposed Route | Route Capacity (3) | Traffic on Route (1) | |
|---|---|---|---|---|---|---|---|
| | Direct | Road | | | | 1962 | 1981 |
| Stansted | 30 | 36 | 80 | M.11 | D.3L(M) | 23,000 | 62,000 |
| Sheppey | 45 | 53 | 103 | A.2/M.2 | D.3L(A/M) | 38,000 | 103,000 |
| Foulness | 46 | 52 | 88 | A.127<br>A.13(4) | D.2L(A)<br>D.3L(A) | 57,000<br>48,000 | 159,000<br>125,000 |
| Silverstone | 52 | 58 | 90 | M.1. | D.3L(M) | 52,000 | 129,000 |

NOTES:

(1) Figures taken from the London Traffic Survey. They represent August daily average flows leaving the London Metropolitan Area in 1962 and 1981 as assigned to the proposed 1981 highway network.

(2) Using existing roads. These times will be expected to improve with the construction of M.11. and improvements to M.1, A.2, and A.13. The time quoted for Foulness appears to assume the existence of an as yet unplanned motorway from London.

(3) Incorporating improvements already proposed.

(4) Design proposals for improving A.13. are not yet published but with the traffic flows predicted, it is thought advisable to consider both Southend roads as complementary parts of the airport route.

#### 3.2.1.2. Stansted

The main part of the route will be the proposed dual 3-lane M.11, the Bishops' Stortford Motorway. A proposed reserve route, if the M.11. becomes overloaded would follow the line of the Lea Valley, but no specification has yet been suggested. It seems reasonable to assume that private transport would not generally follow one specific route between the Motorway and the various London destinations, but a coach route to the Terminal would be necessary, at least until such time as all passengers willing to use public transport could be carried by rail, or other means. Assuming a Terminal at Victoria, the route would use the Eastern Avenue extension and two sides of the Inner Ring Road, with this latter section probably taking a considerable time to travel. A more logical terminal siting would be Kings Cross, both for the development of a rail link and because of the expected overload at Victoria, and the design currently proposed for the Eastern Avenue extension would provide near motorway conditions as far as the Angel, Islington.

A new link to carry all airport traffic to and from the M.11. would be required and this would be some one and a half miles in length with an interchange near Birchanger. One minor bridge structure would be needed to cross Burylodge Lane.

3.2.1.3. Sheppey

The existing dual 3-lane M.2, the Medway towns Motorway, will provide the major portion of this route and improvements already in hand, or planned, will bring this to near motorway standard as far as Greenwich, on the proposed Motorway Box. Current proposals allow for high capacity routes both to Kings Cross, via the East Cross route and Eastern Avenue or via the St. Johns/Stamford Hill link and to Victoria via the South Cross route. The short sections from the Angel to Kings Cross and from Brixton to Victoria will be on urban main roads.

A new motorway standard link will need to be provided between the M.2. and the site and this will have to incorporate a bridge across the Swale. A temporary solution for the early stages of development would be the use of the existing A.249, A.250 route from the Stockbury Interchange, but this incorporates two difficult bottlenecks, the A.2. crossing and Kingsferry Bridge, and some improvement would be needed. Three possible new route locations offer themselves and it should be borne in mind that the preferred solution may be determined by the location of any rail links, provided that the most economic means of crossing the Swale may be by means of a combined road/rail bridge, similar to the existing Kingsferry Bridge.

One possible route follows the A.249, A.250. line and requires structures for connection at the Stockbury Interchange, for crossing the A.2, the Kent Coast railway line and the Sheerness railway line, together with a new Kingsferry Bridge, some quarter of a mile long, which would probably have to be considerably elevated to give clearance for navigation on the West Swale in connection with the paper mills at Kemsley. The total length of new road works would be eleven and a half miles, including all structures. A second route would require a completely new interchange on the M.2. at Broadoak together with bridge structures over the A.2, the Kent Coast railway and probably Windmill Creek on Sheppey, as well as a three quarters of a mile viaduct over the Swale which should not, at this point, require navigation clearance. This link would use three miles of the M.2. from Stockbury to Broadoak and eight and a half miles of new highway including structures.

The third possibility follows the M.2. for nine miles from Stockbury to a new interchange at The Oaks and then requires six miles of new route, including bridges, over the A.2. and the Kent Coast railway, and one and a quarter miles of low level viaduct over the Swale. On all three routes, allowance must be made for the fact that some two thirds of the new construction work may be expected to be over unsuitable, perhaps highly compressible, sub-soil.

3.2.1.4. Foulness

There are no current proposals for a motorway between London and the Southend area and it is therefore thought that the A.13. and the A.127. should be considered as complementary in providing the route to the airport site. Proposals exist for improving the A.13. to a dual 3-lane highway with limited intersections between Grays Thurrock and the Motorway Box, and the A.127, the Southend Arterial, is already of a similar standard. In Central London, Victoria would be reached most conveniently via the Embankment, which is scheduled for some improvement, while the Eastern Avenue extension/East Cross route would be satisfactory for Kings Cross.

To link the airport site with the Southend roads would require a ten mile length of new highway of motorway standard, with some eight miles over rather poor quality terrain. A form of interchange would need to be provided on the A.127. near Eastwood and the route would pass across or around the existing Southend Airport and then follow the south bank of the River Roach with bridges over Potton and Yokefleet Creeks, B.1013. and the Southend railway line. Use of the A.13, even if only to remove Dartford Tunnel traffic from the A.127, would necessitate a two mile link road near North Benfleet, or less satisfactorily, improvement of the A.129.

3.2.1.5. Silverstone

The M.1. widened to three lanes over the Watford section, and extended into London as far as the North Circular Road or possibly the Motorway Box, will form the main part of the route between London and Silverstone. However, it may also be expected that a proportion of traffic will use the M.1. northwards to connect with the Midlands directly and this should have the advantage of reducing the traffic forced to travel through Central London to reach the airport. It is worth noting that the travel time from either London or Birmingham is unlikely to be less than 90 minutes which, with the prospect of increasing traffic congestion, would appear to offer good prospects for a competing mass rapid transit link.

A new link of motorway would need to be some nine miles in length and a connection could most conveniently be provided to the Collingtree Interchange on the M.1. Neither the A.508, a rather twisty road, nor the nearby A.43. which passes through the already congested centre of Towcester, would be suitable even for a temporary link. Bridge structures on the airport motorway would be required over the River Tove, the A.413, the A.5. and probably five B roads. The London Euston to Rugby/Northampton electrified railway line would have to be crossed once, and possibly twice.

3.2.1.6. Other Sites

It is considered that a similar appreciation of the road transport links should be carried out in respect of any further sites which may be recommended for consideration.

3.2.2 Rail Links

3.2.2.1 All four sites considered lie close to existing through lines to a London terminal. The characteristics of each route are summarised in Table 8.

From the traffic forecasts of paragraphs 3.1.2 and 3.1.3, the likely demand for public transport to the Third London Airport in 1975 and 1980 has been plotted on an hourly basis in Fig. 4. Traffic demand beyond 1980 is discussed in a later paragraph. It has been assumed that employees will use either private transport or public road transport and that friends will use private transport, acting as chauffeur to the air traveller.

3.2.2.2 The assessment of available capacity on an existing system having complicated intersections and carrying mixed traffic requires sophisticated computing facilities and only a broad indication has been attempted for each of the four principal sites. This has been done by plotting the number of trains passing a representative point on the route on an hourly basis and the results are shown in Figs. 5, 6, 7 and 8. Superimposed on each of these have been plotted additional 300-seat capacity trains required in 1975 and 1980.

3.2.2.3 It is fortunate that the peak demand for airport travellers does not coincide with the peak commuter demand. However, the additional airport traffi will increase congestion in the environs of the London terminal and it will be necessary to investigate the recasting of the complete service to ensure the possibility of absorbing the extra trains.

3.2.2.4 The forecasts for ultimate capacities of a 2-runway and of a 4-runway airp indicate factors of 2.5 and 6.6 over the 1980 requirements. Thus, at the commuter peak hour, 12 and 22 trains will be required respectively, additional to the trains scheduled at present.

3.2.2.5 Methods of increasing line capacity should be investigated for the early years of airport operation and also the possibility of providing additional tracks or passing loops for the ultimate airport demand. Increasing train speed within existing signalling distances by the introduction of the Advanced Passenger Train and the introduction of an inductive system of train signalling should be investigated for the short term, and also the period over which such methods would continue to be sufficient. The justification and timing for a completely new route to each of the sites should be assessed using these new techniques.

3.2.2.6 Geographically, the four sites have differing features from the aspect of rail communication. Foulness and Sheppey are both situated on opposite sides of the Thames estuary and hence there is no opportunity to route provincial traffic other than through London. Silverstone and, to a lesser extent, Stansted, are situated on trunk lines, the former providing speedy access to Manchester, Liverpool and Birmingham, and also connections could be made (or restored) to lines serving Bristol and the North East, Fig. 9.

Stansted - Connections to the main line north of Bishops Stortford involve little civil engineering work and a redundant line could be restored. The new line would involve half a mile of new line.

Sheppey - Connection to an existing line could be made at Kings Ferry Bridge by a link approximately 5 miles long over low lying country.

Foulness - Access by a 4 mile extension of the Fenchurch Street to Shoeburyness line involving little civil engineering work beyond that necessary to reclaim land for the airport itself.

Silverstone - Access would be by a 6 mile link to the London (Euston) to Birmingham, Liverpool and Manchester line. The airport end of the link would probably involve a 1 mile length of tunnel with the station below the terminal buildings.

3.2.2.7 Links from Trunk Routes to City Centre Terminals, Fig. 10.

Victoria

(a) Stansted - Connection can be made by a circuitous route via South Tottenham, the Metropolitan Widened Lines and Loughborough Junction. A changeover point from 25KVAC Overhead collection to 750 VDC third rail collection en route and special dual voltage trains would be required.

(b) Sheppey - Victoria is the terminal for the present service.

(c) Foulness - Access to Victoria would be via South Tottenham and then as for Stansted. Dual voltage systems would again be required.

(d) Silverstone - A route via Willesden and Clapham Junction would involve a dual voltage system.

Kings Cross

(a) Stansted - Connection to Kings Cross via South Tottenham could be powered from 25KVAC system throughout on completion of the planned Kings Cross Suburban electrification.

(b) Sheppey - Access would be very difficult and electrification problems would be encountered when the suburban electrification is completed.

(c) Foulness - Access via South Tottenham; no conflict of electrification systems.

(d) Silverstone - Access would be difficult but if achieved, the electrification systems would be compatible.

Euston

(a) Stansted - Access would be possible via South Tottenham and Willesden and electrification systems would be compatible.

(b) Sheppey - Access would be very difficult and would involve en route changeover of electrical systems.

(c) Foulness - Access could be achieved via South Tottenham and Willesden involving no changeover of electrical systems.

(d) Silverstone - Trains could work straight into Euston.

TABLE 8

SUMMARY OF RAIL ACCESS CHARACTERISTICS

| | Stansted | Sheppey | Foulness | Silverstone |
|---|---|---|---|---|
| Length of link to airport | 1/2 mile | 5 miles | 4 miles | 6 miles |
| Total length of route | 31 miles | 51 miles | 44 miles | 60 miles |
| Number of tracks in each direction | 1 | 1 | 1 | 2 |
| Assumed maximum speed for conventional trains | 90 m.p.h. | 75 m.p.h. | 75 m.p.h. | 100 m.p.h. |
| Journey time (mins.) | 37 - 58 | 85 (all stops) | 60 | 45 - 55 |
| Access to provinces | Possible via Cambridge | No | No | Good see Fig.9 |
| Access to Victoria | Via Kings Cross Tunnel | Direct | Via Kings Cross Tunnel | Via Clapham Junction |
| Access to Kings Cross | Via South Tottenham | Very Difficult | Via South Tottenham | Difficult |
| Access to Euston | Via South Tottenham & Willesden | Very Difficult | Via South Tottenham & Willesden | Direct |

### 3.2.3. Tracked Hovercraft

3.2.3.1 One of the most important factors determining the suitability of a particular location for use as an airport for London is the connection which can be achieved between the site and the city terminal. This link is significant to the passenger in terms of the time and cost involved. The use of existing transport routes, or extensions from them, will involve delays if airport traffic is allowed to mix with slower traffic.

The more distant is the airport from the city centre, the greater is the need for a special connection to ensure a regular service with minimum journey time and adequate frequency. Conversely, more distant sites can be considered for airports by the inclusion of a transport system which ensures reliable, minimum time connection with the city terminal.

For sites remote from London a relatively high speed operation is required. However, account must be taken of the fact that the city terminal is likely to be situated in the heavily developed central area of London. On this basis a likely speed profile for such a route is that shown in Fig.11. This shows the use of two different cruising speeds. "London" cruise and "Open Country" cruise. The latter is the high speed condition whilst a lower speed is used to negotiate what is likely to be a restricted route through a highly developed area.

3.2.3.2 Using this approach an assessment can be made of possible journey times from London to various sites. This is summarised on Fig.12.

A speed limitation of 50 m.p.h. is imposed for the first five miles of the journey Curves are shown giving journey times when operating at various speeds over the main ("Open Country") section of the route.

A suburban stop at the end of the "London" cruise section would increase journey times by two or three minutes.

Journey lengths to two Paris airports, the two existing London airports and the four sites selected for this report are shown on the horizontal scale.

Current journey times to London Airport (Heathrow) along the M 4 motorway are between 25 and 30 minutes. The rail link between Victoria Station and the central area of Heathrow will, when built, give a journey time estimated at 22 minutes.

Journey times of approximately one hour have been mentioned in connection with Stansted Airport. Times of this magnitude will clearly not encourage passengers to use Stansted instead of Heathrow and it also obvious that with this situation airlines will resist a move from Heathrow to Stansted. Thus it is essential to bring journey times near to those that will apply at Heathrow. This approach requires a separate high speed system.

In order to bring journey times to the same as that for Heathrow, the speeds in the "Open Country" section of the routes to each of the four sites under consideration will vary between 130 m.p.h. for Stansted and 260 m.p.h. for Silverstone.

3.2.3.3 Public funds are already being invested in the development of Tracked Hovercraft operating over this speed range and results of this work will be available in the next few years. Commercial development of the system is feasible within the time scale of the development of the Third London Airport.

The availability of such a system gives a much greater flexibility in the choice of a suitable site than previously and as such should be taken into account.

### 3.2.4. Marine Hovercraft

3.2.4.1 The two estuary sites, Foulness and Sheppey are situated such that a number of important connections from them to other areas of the country can be achieved by using marine Hovercraft. With an airport at one of these two sites there may be a large number of people who would be very keen to use a service across the Thames estuary to Essex or Kent avoiding the necessity of making a journey into London.

London tends to be crowded with people because "all routes lead to London". The use of Hovercraft in this way would reduce congestion (and investment required to deal with it) in a large London terminal and its associated approach routes as well as providing considerable time saving, cost saving and convenience to many people.

Of the two estuary sites, Foulness would probably provide the greater amount of traffic in this respect as it has been shown that more of the traffic for the present London airports is generated south of the Thames than north of the Thames. There would also be a certain amount of transfer traffic between Foulness and Gatwick. Such a link would require to be run in conjunction with transport facilities at each end. For people living in the area south of the Thames a car park run in conjunction with a Hovercraft terminal on the Kent coast (with parking rates substantially less than those on the airport) would seem to form the basis of a realistic co-ordinated transport system.

Another possible route would be along the Thames to a site to the east of central London convenient to public transport connections and the proposed primary road system. There are now available quieter, more controllable and more economic Hovercraft than those more generally in use at the present time. These would be applicable to operation along the river.

Other potential routes worthy of examination would be from these two estuary sites to continental terminals.

The use of these routes requires co-operation with shipping using the Thames and the establishment of procedures in this respect. Should however, a sea port be established at Foulness then a reduction of shipping in the Thames estuary would take place.

3.2.4.2 Studies are required to investigate:

a) the potential traffic on these routes
b) the operational implications
c) the additional investment required for the Hovercraft facilities compared with the consequent reduction in investment in other transport facilities.

## 3.3 Other Transport Considerations

### 3.3.1 Transfer passengers

These are passengers who transfer from one aircraft to another instead of joining a flight at the airport. Where there is only one airport at a city, this only involves, at worst, a change of terminal buildings. Where there are more than one (as at Heathrow and Gatwick at present) some passengers may have to travel from one airport to another.

An indication of demand for transfer between aircraft at one airport, where presumably it is not inhibited by any geographical difficulty, is obtained from Heathrow data in 1966. About 20% of total departing passengers have transfered from another aircraft, about 60% being foreign nationals, and most of the rest being from Northern England and Scotland.

While this proportion is not negligible, it represents unrestrained demand: the numbers travelling between Heathrow and Gatwick are believed to be very small.

The tentative conclusion is that the numbers of passengers wishing to transfer between airports will be too small to justify any special transport link, except perhaps inter-airport road coaches.

### 3.3.2 Transport for Airport Employees

As a basis for a first estimate, the breakdown of employees by work place and transport mode from the Heathrow Airport Traffic Study has been used. The total number of employees is obtained from a consideration of the numbers of aircraft movements and passenger flows with allowance made for changes and improvements in operating and handling techniques. At Heathrow, 90% of employees work in the Maintenance Area and the total is reduced by this amount for the third Airport as major maintenance facilities are not expected to be provided.

The percentage values given in the table are used to obtain the numbers of both persons and vehicles arriving during the morning peak hour as well as the corresponding numbers for an average hour outside the morning peak. This average figure is required to correlate with the air passenger peak arrival hour, 10.00 to 11.00. The values used for modal split have been based upon the same split as at Heathrow between car owning and non-car owning households since it is thought that the attractions of public transport in any third airport location is unlikely to be greater than at Heathrow. It might well be valid to expect it to be less. The effects of location of household and provision of public transport in the area have been shown in the Heathrow study to be significant. In studies of specific location for the third London Airport, it is therefore suggested that the modal split factors might bear re-examination, with particular reference to the community considerations discussed in part 4.1. of this report.

| Ref. | Description | | Factor | Ref. | 1980 | | Ultimate (2-Runway) | |
|---|---|---|---|---|---|---|---|---|
| 1 | Total Employees | | | | 12,000 | | 24,600 | |
| 2 | Total Work Arrival per 15 hour day | | 64% | 1 | 7,700 | | 15,700 | |
| 3 | Arrivals during morning peak 0600 - 1000. | | 53% | 2 | 4,100 | | 8,300 | |
| 4 | Arrivals during peak hour 0800 - 0900 | | 16% | 2 | 1,200 | | 2,500 | |
| 5 | Arrivals outside morning peak. Average per hour. | | 47%/11 | 2 | 330 | | 670 | |
| | | | | | Peak | Av. | Peak | Av. |
| 6 | Modal Split | Private | 76% | 4.5 | 910 | 250 | 1,900 | 510 |
| | | Public | 24% | 4.5 | 290 | 80 | 600 | 160 |
| 7 | Number of private vehicles | | 76% | 6 | 690 | 190 | 1,450 | 390 |
| 8 | Number of public vehicles | | /40./20(1) | 6 | 17 | 10 | 36 | 20 |

(1) Assuming 50 seat buses at 80% to 40% load factor respectively.

### 3.3.3. Consideration of complete journey

Study of the siting of an airport and its relation to the areas generating traffic leads to a consideration of how that traffic reaches the airport from its point of origin and how traffic from the airport reaches its destination. Such a consideration reveals how complicated and disjointed are the methods used over this phase of the total journey.

On the basis that the airport under consideration is indeed a "London" airport then a diagrammatic layout of a journey from the suburbs to the airport can be made (Fig 13). This diagram shows the various stages in the journey and the lines in between those stages represent the occasions when the traveller walks and also, usually carries luggage. A journey made all the way by public transport can be represented by the central column. It is obvious why many travellers wish to use a private car or taxi.

When it is realised that a similar procedure is probably involved at both ends of the air journey, the scope for improvement in the total journey is apparent.

Unless improvement can be made in this situation then it seems probable that the present trend of an increasing percentage of passengers arriving by car will continue. This in turn will lead to continuing or worsening congestion on the roads or increased investment in roads and car parks to accommodate the traffic.

There are two approaches which may bring some alleviation to the road congestion. The first is to provide a transport system directly linking the suburbs with the airport. The second is to improve the connection between the city terminal and the airport, Fig.13.

The first approach is illustrated by the proposed connection of Heathrow with the London Underground Railway System. This should provide some alleviation to the magnitude of the interchange being created at Victoria.

The second is to attract more traffic to the airport link from the city terminal by improving the service. The portion of the journey which possibly causes most concern for passengers is the processing through the terminal buildings. Systems of transport which could take passengers from the city terminal to a point as near to their aircraft as possible would be a considerable improvement on present day handling. With aircraft unit size increasing there is more scope for handling passengers destined for individual aircraft as a group all the way from the city terminal. An indication of the improvement in method of handling would be to consider the passenger appeal of a service from the West London Air Terminal today, where, instead of the current system of depositing passengers to join the crowds in the airport terminal buildings, coaches departed with loads of passengers destined for specific flights and unloaded at a point close to the aircraft stand. This method of handling means a dispersion of passenger processing and facilities instead of a centralized method as at present but it is worthy of study because of the benefits that it brings.

## 3.4 Baggage Handling and City Centre Terminals

### 3.4.1. Baggage Handling

Future developments may bring about a change in the traditional airline approach by which the passenger is deparated from his baggage. However, for the Third London airport, current aircraft will clearly be used and this separation must be accepted. The system used will depend largely on whether the check-in procedure is undertaken at the Town Terminal or at the airport.

There is much discussion on this point. Airlines are understandably reluctant to accept responsibility for baggage any earlier than is strictly necessary. On the other hand, it would appear more convenient, from the passenger's point of view, to be relieved of baggage as soon as possible. Both possibilities are examined.

#### 3.4.1.1. Check-in at Town Terminal

For 1980, an hourly peak of 1160 departure passengers per hour can be expected. The check-in process takes, on average, 1.5 minutes so that:

$$\text{Number of check-in desks} = \frac{1160 \times 1.5}{60} = 29$$

Allowing for the fact that many airlines will be concerned, it would be reasonable to base initial planning on 40 desks.

Future expansion indicates that an ultimate peak of 2800 passengers per hour can be expected implying a need for 70 desks. However, it is reasonable to suppose that a form of automatic check-in will have been accepted by then. The reduction in time thus produced should permit handling of the increased numbers by the 40 desks suggested. Some airlines prefer a "flight"check-in routine which requires the passenger to locate the desk or desks designated for a particular flight. No baggage sorting is needed in this case only a conveyor system to take the baggage away. Other airlines require "common" check-in by which the passenger can be dealt with at any desk. Baggage taken in this way must be sorted by flight number. This requires an automated system giving rapid processing and a high degree of accuracy. At present, the coded tray . appears to offer the best solution but continuous investigation is required to take full advantage of any more advnaced developments which may arise.

The baggage then arrives in a baggage hall in flight sorted order and a container system is probably the best approach totthe rest of the handling. A container capacity of about 60 bags is reasonable. The containers would be filled manually and a system of coding applied. They will be conveyed to the trains where a further mechanism will load them on to the special vehicle on the train.

At the airport, similar automatic mechanical devices would be used to used to pass the containers, and possibly passengers too, to the appropriate terminal building. Here, the containers would join others for towing to the aircraft and when empty would be returned via the train to the Town Terminal.

This latter movement highlights another of the problems of town check-in. Airline experience indicates that, when a passenger claims his baggage at the airport for Customs check, he will be very reluctant to confine it, once more, to a mechanical system for conveyance to London. It is, in fact, suggested that only 5% of the passengers would wish to use a mechanised return system. Such a small number does not justify the provision of an elaborate handling system and it is therefore better to assume that, for the return journey, passengers use the railway in conventional manner. The difficulty is that, in effect, baggage space on the trains is provived twice - hardly desirable from the operators point of view.

In all, this is a complex mechanical handling project and could be expected to cost about £2.5 million.

A further relevant point arises regarding train timing. Since airlines are formally accepting passengers, they must ensure that those passengers arrive on time at the aircraft. Thus each train would be designated the last train for a listed number of flights and a strict train timing would be essential. In addition, airlines would not wish to ask passengers to check-in too far ahead of the flight departure time. This requires very frequent trains and a ten minute interval is suggested. A very low train load factor is inevitable in these conditions.

3.4.1.2 Airport Check-In

In this case the journey to and from the airport is a normal rail journey and no special baggage arrangements are involved. However, as passengers will be carrying baggage a high degree of mechanical assistance (i.e. moving pavements, etc) would be required in town and at the airport. The baggage system, as such, would begin at the airport terminal and the only requirement is an increase in capacity. Baggage handling costs attributable to passenger traffic from the in-town terminal would be reduced considerably - possibly to about £½ million.

The main advantage of this system falls to the rail operator who is no longer required to relate his timetable to flight departure times. Nor is it necessary for him to provide particularly frequent trains. So long as trains are related to the expected passenger flow rates it becomes the passenger's responsibility to ensure that he reaches the airport terminal in time for his flight.

3.4.1.3. Airport Terminal

The baggage system provided in the airport terminals needs to be accurate, quick, capable of operation with a minimum of staff and easy for the passenger to follow. New ideas are continually arising but, on current information, the most effective system uses coded trays. Check-in desks are arranged in long lines on the comb prin-ciple in that passengers pass through them directly to a corridor leading to the aircraft. At the check-in desk, the passenger puts his bags into a tray which is provided on the end of a conveyor. The clerk carries out the usual procedure and uses a key board to set-up the flight number. This is converted electrically to a coded signal which is automatically applied to the tray carrying the baggage. The baggage is locked into the tray which then passes into a conveyor system which takes it to the baggage hall. Here, the tray passes along a sorting conveyor until its code is recognised electrically. It is then automatically diverted to a baggage loading point appropriate to the flight. Porters then load the baggage on to trailers or into aircraft containers for towing out to the aircraft. The empty tray is put on to a secondary conveyor system which returns it to the line of check-in desks.

This is a thoroughly practical system whose only disadvantage is the need for the secondary return conveyor system.

The design of the terminal building should permit the baggage re-claim area to be adjacent to the airside off-loading area. Flat pallet type conveyors with a somewhat triangular track layout and a height of about 15" would be installed so that a short leg of the triangle is on the airside and the remainder, through holes in the wall, in the re-claim area. Arrivals baggage is then loaded on to the conveyor from trailers or aircraft containers, and moves through the wall for display and collection by the passengers.

This has given a brief outline of a possible baggage handling system. Such a system needs most careful planning since, apart from its high cost, it is an aspect of air travelling which is very much in front of the passenger. He could well judge the efficiency of the airport, however unjustly, from the performance of such facilities.

3.4.2. City Centre Terminal without VTOL

As can be seen from the comment on baggage handling, a study of town terminal requirements immediately raises the problem of whether check-in is to be carried out or not.

If it is decided to provide all check-in at the airport then there would appear to be no requirement for a town terminal. Some airlines may wish to have a small office at the relevant railway station but there is little justification for providing more than this. The railway authority would, however, need to ensure that its station facilities were suitable for the increased traffic. Thus, the simple conclusion is that if there is no check-in facility then no terminal is required.

If check-in facilities are to be provided, the terminal building becomes important since it is the passenger's introduction to air travel and a favourable impression must be given. To some extent, this building must sell the idea of air travelling. A lavish appearance would obviously be wrong but so would anything which implied cheapness or cut price. A general air of calm, pleasant efficiency is required. However, in addition to these somewhat intangible qualities, the terminal must provide:

a) clearly defined passenger movement with well designed direction indicators and a clear public address system.
b) adequate lounges with restaurant facilities and a selection of shops
c) car parking
d) adequate kerb length for setting down passengers from taxis and private cars
e) easy access to and from buses and underground trains.

These requirements can be met by designing to suit the expected rate of passenger flow and it would be prudent to allow for some expansion. A comprehensive traffic survey would be required and this would assist in clarifying (c) and (d) above.

Sites in London will certainly be restricted but it is, nevertheless, desirable to minimise the extent to which passengers are expected to change level within the building. Where passengers are carrying baggage such changes in level should be by conveyors rather than escalators.

A major factor in designing the building is the baggage handling system which tends to dictate the relative positions of the main areas.

In the short time available it is not possible to give more than a very rough indication of the possible cost of such a terminal but a figure of £7 million is thought to be a reasonable guess.

Consideration of possible siting introduces the basic criterion that the terminal must be directly connected to the railway station appropriate to the airport site.

Thus, for Stansted, Kings Cross is really the only suitable London site and a detailed study would be necessary to establish whether:
a) the necessary plot is available.
b) the extra road and rail traffic an be accepted.

Trains for Foulness would normally operate from Liverpool Street Station which is unlikely to be able to accept the increased traffic and is also badly placed in relation to the London hotel area. It appears likely that airport trains would operate from Kings Cross but this would require further investigation and could be a serious difficulty in the proposed use of the Foulness site.

Trains for Sheppey operate from Victoria which raises a particular difficulty. The Victoria site is already under active consideration for complete reconstruction to deal with a Victoria/Heathrow rail link and Channel Tunnel traffic. It is unlikely that traffic for a third airport could be added to these commitments but this would have to be fully investigated as there appears to be no other suitable railway station.

Silverstone trains operate from Euston where considerable development is already in hand. It was proposed to have a large office block on top of the new station but planningpermission was refused . An investigation is required to establish whether any advantage could be taken of this design potential. Alternatively it may be possible to route these trains to Kings Cross.

In summary, Euston and Kings Cross are the favoured sites for the Town Terminal. Both are well placed in relation to thehotel area and have good connections with the underground railway system. They are also conveniently near the motorway box and far enough away from Victoria that they are unlikely to complicate the road traffic in that area.

### 3.4.3. City Centre Terminal with VTOL

The report from the Air Group indicates that, if the expected progress with VTOL development materialises, these aircraft can take over the majority of the short haul domestic and international traffic. This development will not take place in time to avoid the need for a third London airport, but, with this potential in mind, it would be unwise to construct a terminal in the City centre. Possible sites for VTOL operation have already been dealt with in section 2.4.

## 3.5 Outline example of a cost benefit analysis procedure

### 3.5.1 Operational Planning

Scenario - A site on the Isle of Sheppey is proposed for the Third London Airport. An assessment of surface transport links to this site is to be made. The assessment should include provisionfor traffic from a London terminal as well as from the surrounding area, and for passengers and freight as well as employees and other classes of airport user.

### 3.5.1.2 Political Assumptions

Certain aspects of government policy, beyond those directly relating to the siting and development of the airport, could affect the form of surface transport links. In particular, any curtailment of investment in motorway and rural highway construction or further definitive injections of finance into new forms of land or marine transportation might be expected to affect the movement of passengers to and from the airport. It is assumed, for the purposes of this study, that no major change in current policy will occur.

### 3.5.1.3 Study Restraints

The political assumptions referred to above require that all forms of mass rapid transit considered,be it conventional duorail or any other, should be economically justified for the actual level of traffic demand, including assimilation of any research and development costs. In any such consideration, it is convenient to assume a common London Terminal and, for the purposes of the study, the proposed site at Victoria Station will be used. It is realised that the introduction of VTOL aircraft will have a considerable effect upon both these matters.

### 3.5.1.4 Preliminary Feasibility studies

Provision of traffic from a London Terminal is required to be assessed and, as discussed above, the proposed site at Victoria is to be used as a common base for transport by all modes. It has been thought advisable, however, to organise a feasibility study of the whole problem of terminal siting in London and this is discussed in part 3, section 4, of this document.

The political assumptions regarding government investment in surface transport systems have been discussed and some attempt should be made to verify these. In the consideration of new forms of mass rapid transit, studies should be initiated to assess both the operational feasibility of each system at the present time and the possible development potential. This has been discussed in section 2.3 of this part of the study.

The impact of the introduction of VTOL aircraft upon the surface transport situation requires to be assessed and this has been discussed in part 2, section 4 under the general heading of aircraft and airports. Some consideration of the effect upon city centre terminal siting has been made in section 4 of this part.

The effect of the expected growth in air freight traffic should also be taken into account and a discussion of this appears in part 1, section 4.

### 3.5.1.5 Re-Consideration of Scenario

The recommended preliminary studies are all outside the scope of the original scenario. All, however, have considerable bearing upon the task and it is thought, therefore, that the results of these studies, together with feedback information from an analysis based primarily upon the proposed scenario, should form the starting point for a wider ranging study.

3.5.2 Analysis

3.5.2.1 Estimates of Traffic Demand

The traffic demand figures are obtained from section 1, and at this stage, analysis is confined to the 1980 case when the new airport will be only partially operational, and the ultimate situation for a two runway airport. All demand in the first instance is assigned to the new links. An order of magnitude estimate of demand on local roads is obtained on the assumption of use by all employees, 50% of passengers, friends and spectators using private transport, and 50% of friends and spectators using public transport. A modifying factor is applied to the peak hour figures to compensate for the non-coincidence of the different peaks. A second, and more accurate, estimate of these demands would need to take into account planning considerations as well as the discussion in section 3 on airport employees and transfer passengers. All the factors used to operate upon the figures are of a general nature and suitable for the development of comparative matter than absolute values. The traffic assigned to existing surface routes is the difference between the two preceding figures. The existing capacity and demand on these routes is summarised in the table in section 2.1.

ESTIMATE OF TRAFFIC DEMAND

(1) Number of Passengers

| | 1980 | | Ultimate (2R) | |
|---|---|---|---|---|
| 1 New links | Peak | Annual | Peak | Annual |
| Private transport | 3,100 | 15,403,100 | 7,200 | 38,018,700 |
| Public transport | 390 | 902,900 | 830 | 7,305,900 |
| Mass transport | 1,160 | 4,800,000 | 3,870 | 11,900,000 |
| 2 Local Roads | | | | |
| Private transport | 1,990 | 7,709,100 | 4,540 | 19,018,700 |
| Public transport | 345 | 452,900 | 700 | 1,655,900 |
| 3 Existing Routes | | | | |
| Private transport | 1,110 | 7,700,000 | 2,660 | 9,000,000 |
| Private transport | 45 | 450,000 | 130 | 650,000 |
| Mass Transit | 1,160 | 4,800,000 | 2,870 | 11,900,000 |

Assumptions relating to vehicle occupancy numbers

Passenger Cars: 1 p.c.u. 1.5 persons/vehicle.
Local buses : 3 p.c.u. 50 seats at 80% load factor (peak)
at 40% load factor (average)
Airline coaches: 3 p.c.u. 50 seats at 60% load factor.

(2) Number of Vehicles

| | 1980 | | Ultimate (2R) | |
|---|---|---|---|---|
| | Peak | Annual | Peak | Annual |
| 1 New Links | | | | |
| Private transport | 2,100 | 10,300,000 | 4,800 | 25,320,000 |
| Public transport | 29 | 135,500 | 62 | 346,000 |
| Mass transit | 116 | 480,000 | 287 | 1,130,000 |
| 2 Local Roads | | | | |
| Private transport | 1,320 | 5,140,000 | 3,020 | 12,600,000 |
| Public transport | 26 | 68,000 | 53 | 248,000 |
| 3 Existing Routes | | | | |
| Private transport | 730 | 5,130,000 | 1,770 | 12,660,000 |
| Public transport | 3 | 67,500 | 10 | 97,500 |
| Mass transit | 116 | 480,000 | 287 | 1,190,000 |

Note: The figures for mass transit refer to the use of airline coaches. In the event of the introduction of any new form of mass rapid transit such as tracked hovercraft, or the development of a special rail link, the major proportion of passengers may be assigned to the new mode, hence reducing the figures for airline coaches to effectively nothing.

3.5.2.2 Estimates of Capital Costs

A comparison of the traffic assigned to the existing road and rail routes with the existing predicted capacity and demand summarised in section 2, indicates the requirements for new works and improvements. In the case of road works, the 1980 assigned traffic for the M.2. is 103,000 p.c.u.'s which is the 24 hour weekday average flow. Using the London Traffic Survey peak relationship of 990 this may be converted to a 2-way peak hour flow of 9,260 p.c.u. The airport traffic may be seen from the previous section to amount to an additional 849 p.c.u. including coaches or 733 p.c.u. assuming an alternative rapid transit mode. This is sufficient to load a dual 3-lane motorway to, or probably beyond, its limit and thus an assessment may be made of the improvement and widening works required. By means of a similar analysis, capital costs may be obtained for each of the highway alternatives discussed in section 2, together with the proposals for rail and other forms of mass transit.

3.5.2.3 Continuation of Analysis

The four tables which follow give an outline of the build up of costs which is intended to form the basis for comparison of the different alternative modes and proposals. The relevant traffic figures and an example of the cost build up for the highway situation may be taken as an indication of the manner in which this information required to be collated.

3.5.3 Cost Benefit Analysis Tables

GROUND MOVEMENT SYSTEMS

COST-BENEFIT ANALYSIS TABLE

| | | £M |
|---|---|---|
| 1. CAPITAL COSTS | | |
| 1.1 Construction | | |
| - ROADS (i) Extra links from M.2. to airport with allowances for bridges and interchanges | = | |
| (ii) Extra Capacity for M.2.(if required) | = | |
| (iii) Additions to local roads in Medway towns for employees and other airport users | = | |
| - RAIL (i) Track improvements for extra traffic | = | |
| (ii) Additional track length, bridges and stations | = | |
| (iii) Cost of additional terminal facilities in London | = | |
| (iv) Major lengths of new track (if required) | = | |
| - NEW TRANSPORT SYSTEMS (e.g.tracked hovercraft) | | |
| (i) New track, stations, signalling, termini | = | |
| (ii) Consequential modifications and additions to existing rail system | = | |
| TOTAL CONSTRUCTION CAPITAL | | |
| 1.2 Vehicles | | |
| - ROAD (i) Airline coaches | = | |
| - RAIL (i) Extra rolling stock | = | |
| (ii) Extra locomotives (if required) | = | |
| - NEW (i) Vehicles | = | |
| TOTAL VEHICLE CAPITAL | | |
| 1.3 Annual Costs | | |
| Amortisation period for construction | = | |
| Amortisation period for vehicles | = | |
| Interest Rate | = | |
| Capital Recovery Factor (Construction) | = | |
| Capital Recovery Factor (Vehicles) | = | |
| TOTAL ANNUAL COSTS (Construction + Vehicles) | = | |

| COST-BENEFIT ANALYSIS TABLE | |
|---|---|
| 2. Running Costs Per Year | £M |
| 2.1 ROADS (i) ... Airline passenger car travel = | |
| [... vehicle miles at ... per mile] | |
| (ii) ... airline passenger coach travel = | |
| [... vehicle miles at ... per mile] | |
| (iii) Friends and spectators car travel = | |
| [... vehicle miles at ... per mile] | |
| (iv) Employees car travel = | |
| [... vehicle miles at ... per mile] | |
| (v) Additional maintenance cost of roads = | |
| (vi) Employees and spectators public transport travel = | |
| 2.2 RAIL (i) Extra running cost of trains = | |
| (ii) Extra staff costs at stations, etc. = | |
| (iii) Extra track maintenance = | |
| 2.3 NEW TRANSPORT | |
| (i) Running costs = | |
| (ii) Staff costs = | |
| (iii) Track maintenance = | |
| TOTAL ANNUAL RUNNING COSTS | |

## COST-BENEFIT ANALYSIS TABLE

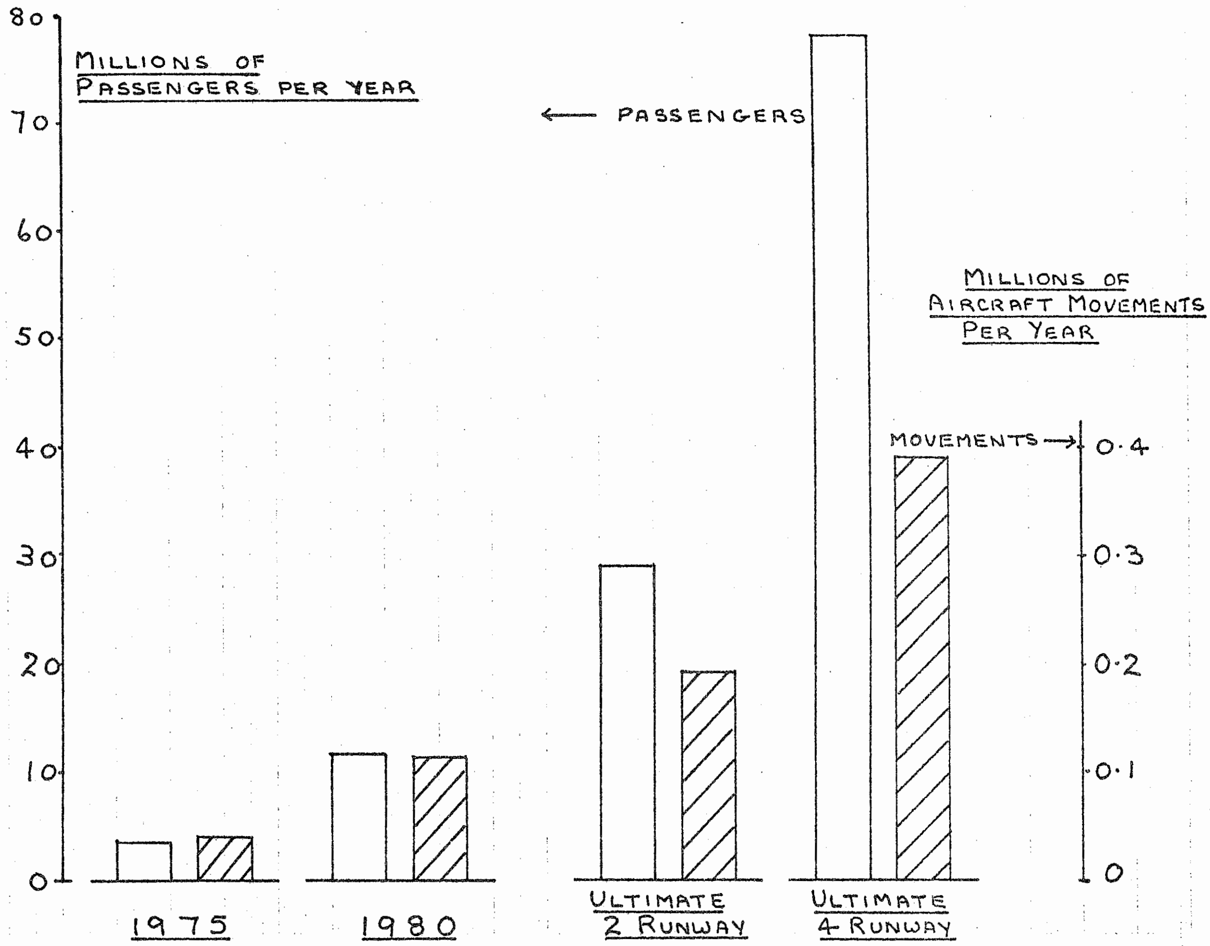
| | No. of Trips | Trip Time | Value per Hr. | £M |
|---|---|---|---|---|
| 3. Social Costs per Year | | | | |
| 3.1 Value of Travelling Time by Car | | | | |
| (i) Airline passengers - | | | | |
| Business | | | | |
| Other | | | | |
| (ii) Friends & Spectators | | | | |
| (iii) Employees | | | | |
| 3.2 Value of Travelling time by Coach* | | | | |
| (i) Airline passengers - | | | | |
| Business | | | | |
| Other | | | | |
| (ii) Spectators | | | | |
| (iii) Employees | | | | |
| 3.3 Cost of Accidents | | | | |
| (i) Road Vehicle Miles ... | | | | = |
| [Accident rate 5 P.I. accidents per $10^6$VM cost per P]I] accident £1000] | | | | |
| (ii) Rail and other Mass Transport - Negligible - | | | | |

* Includes new mass transit systems

| 4. Total Costs | | £M |
|---|---|---|
| 4.1 Annual Capital Costs | = | |
| 4.2 Annual Running Costs | = | |
| 4.3 Annual Social Costs | = | |
| TOTAL | | |

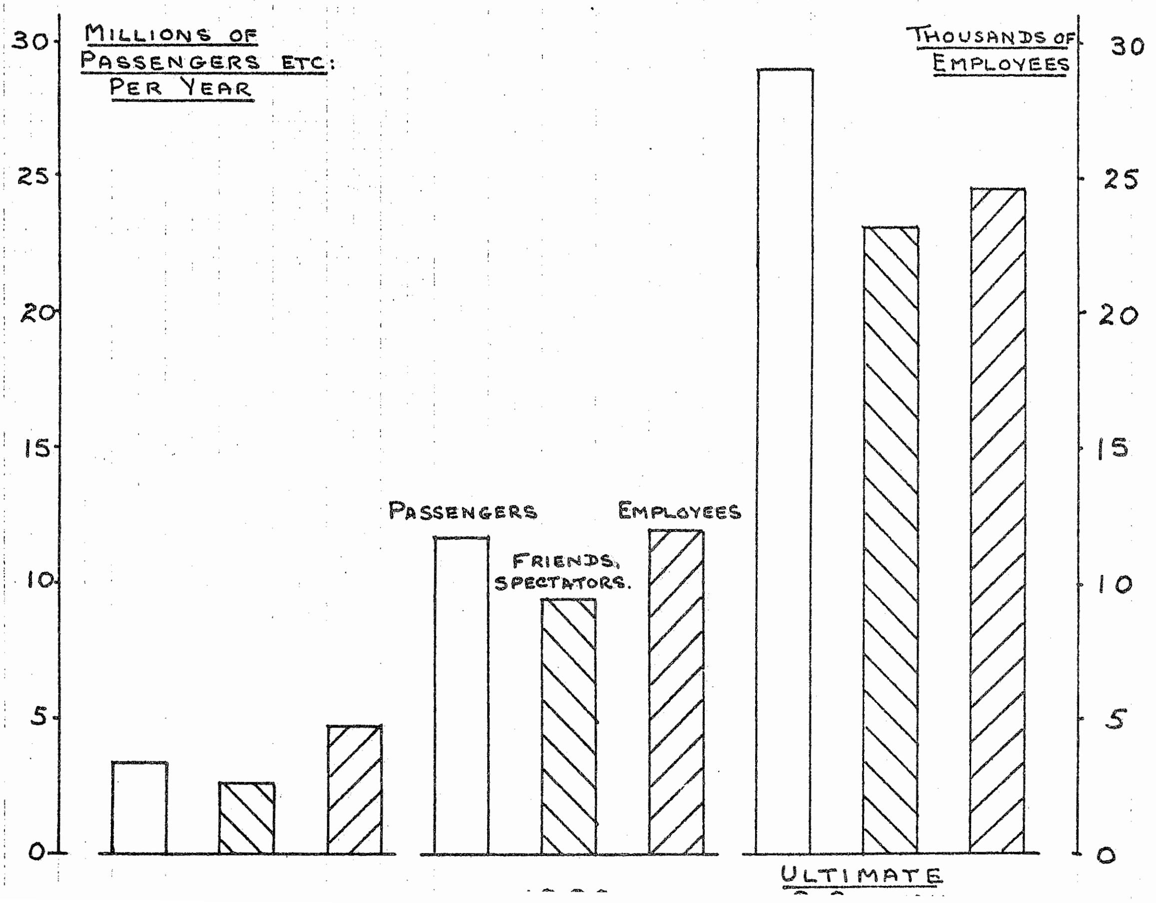
PART. 3 FIG. 1

## TRAFFIC GROWTH AT THIRD LONDON AIRPORT

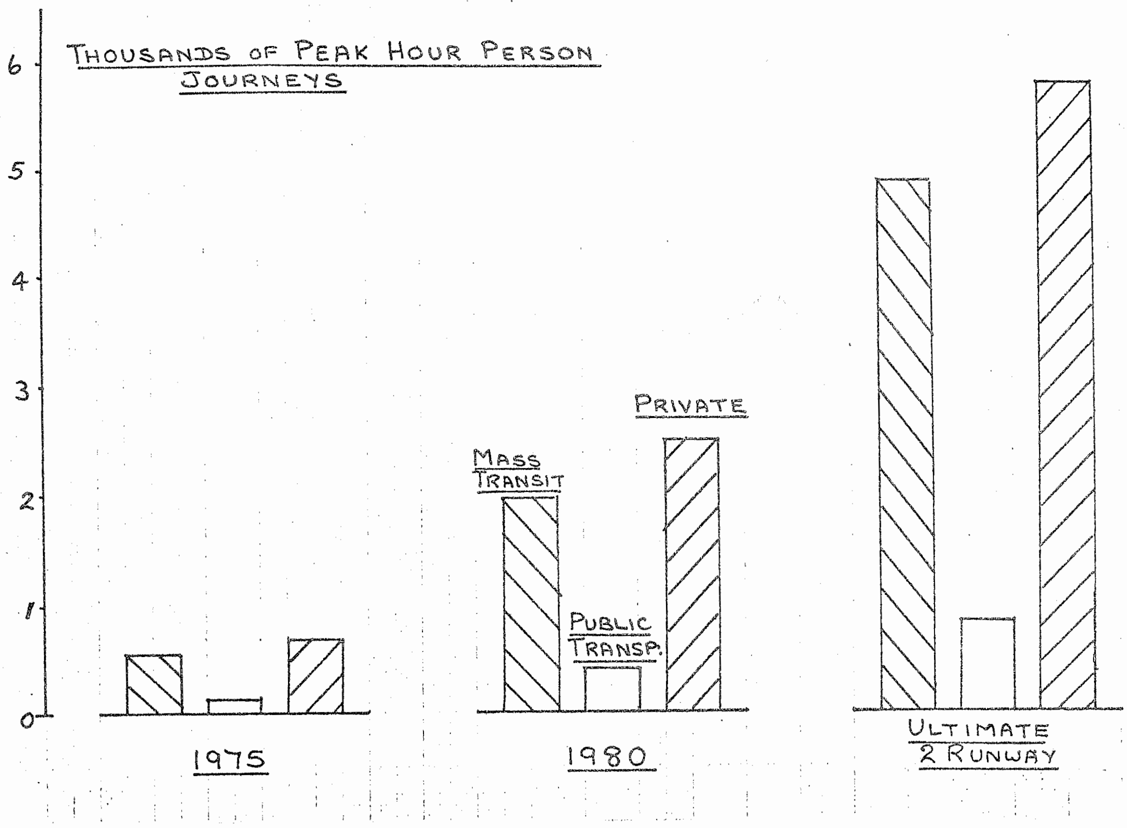



PART 3. FIG. 2

## PASSENGERS, VISITORS AND EMPLOYEES AT THE THIRD LONDON AIRPORT

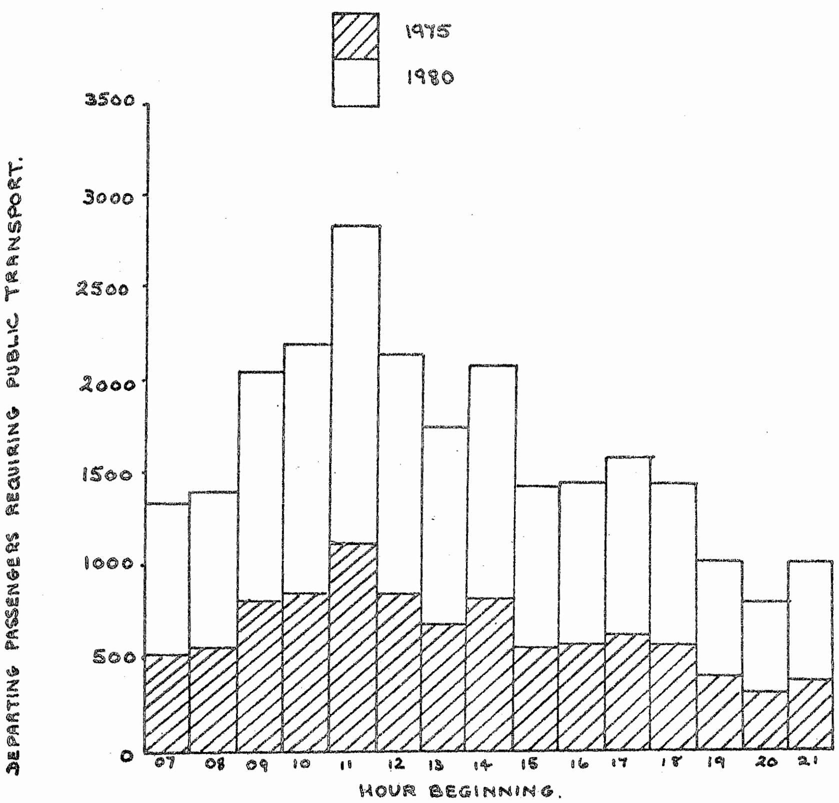


## PEAK HOUR TRAVEL DEMAND INTO THE THIRD LONDON AIRPORT (FOR SILVERSTONE OR WELSH SANDS)




PART 3. FIG: 4.

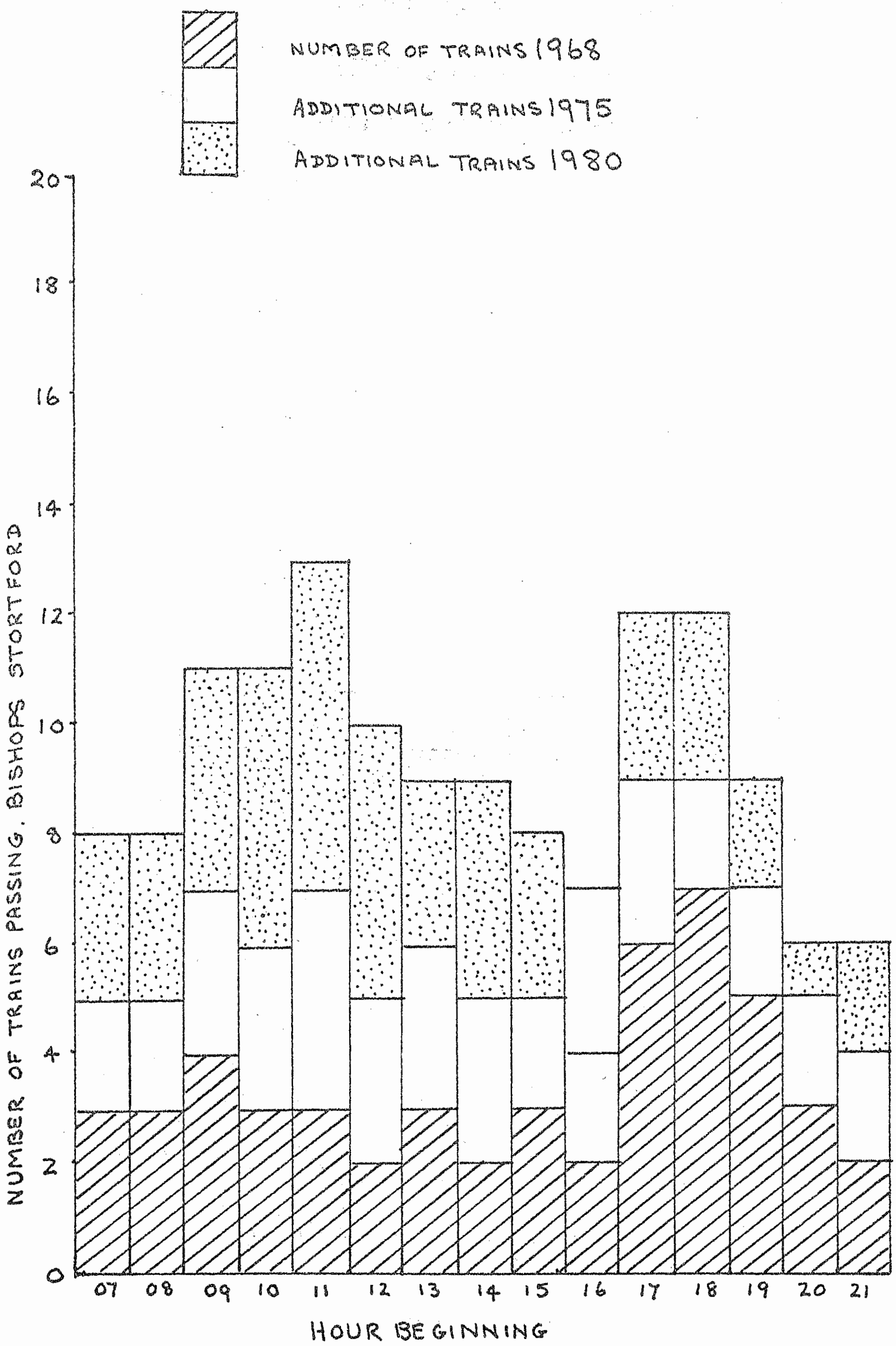
## PUBLIC TRANSPORT DEMAND IN 1975 AND 1980



Part 3. Fig.5

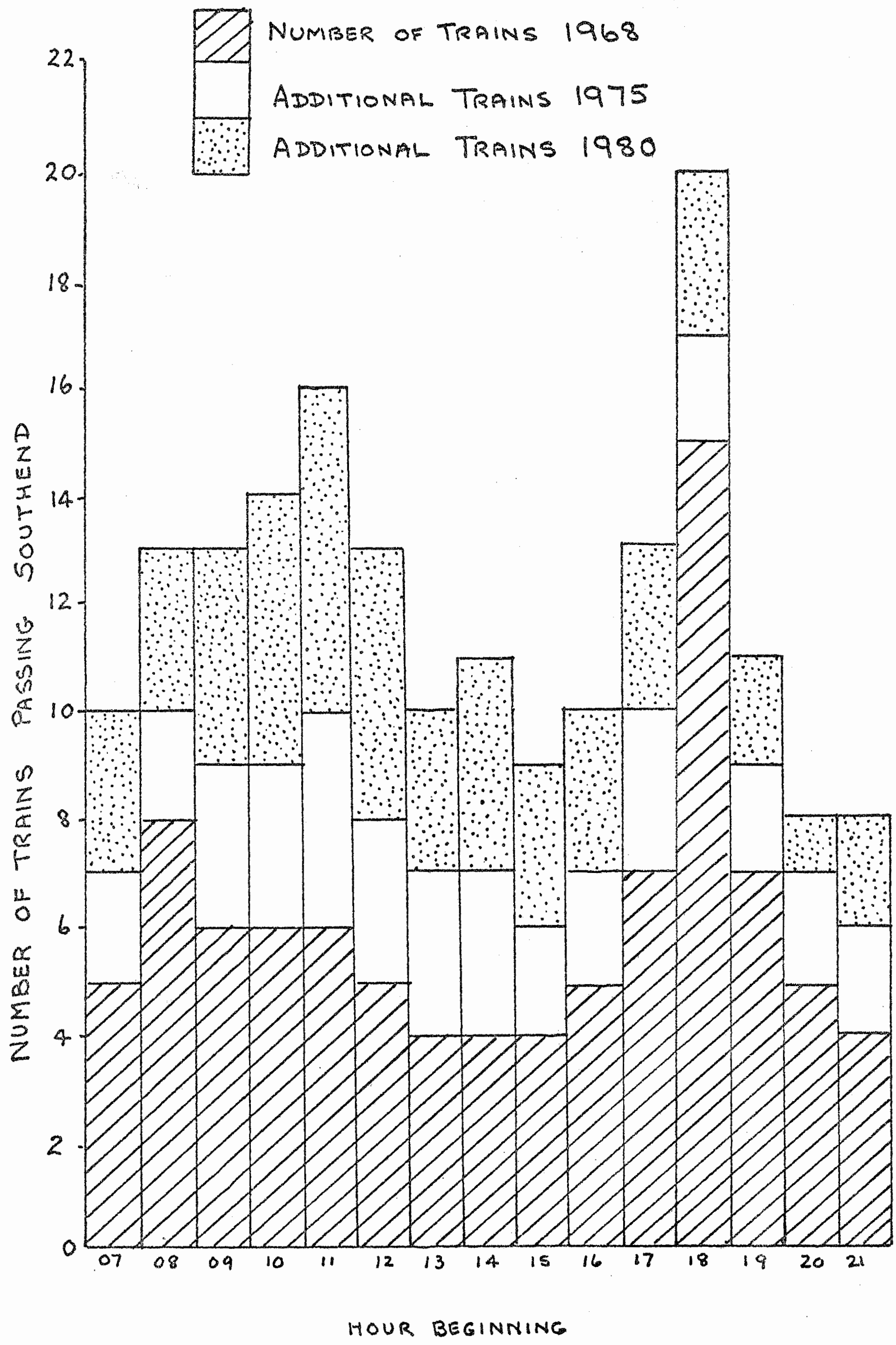
## STANSTED

NUMBER OF TRAINS FROM LONDON PASSING BISHOPS STORTFORD



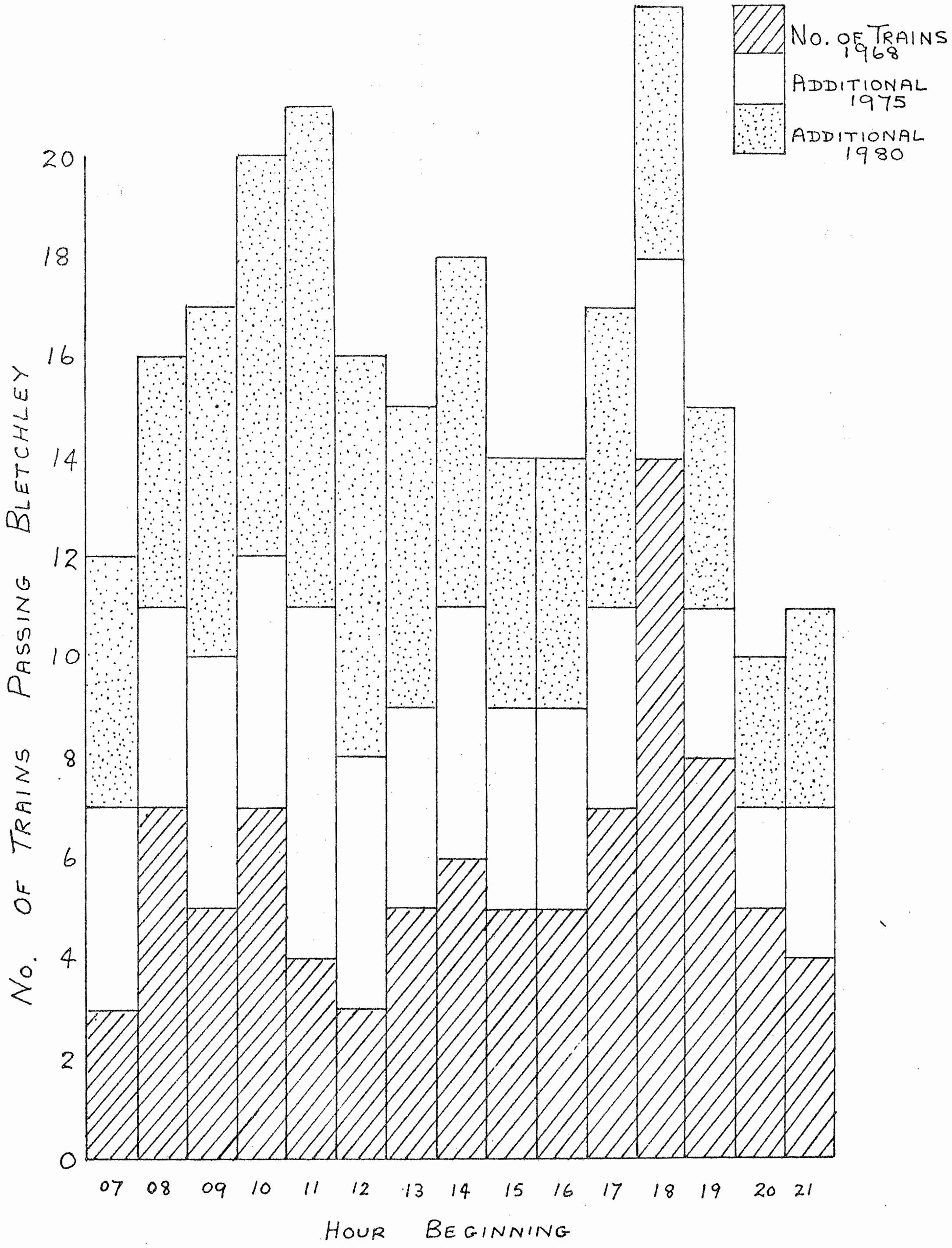
## FOULNESS

NUMBER OF TRAINS FROM LONDON PASSING SOUTHEND.



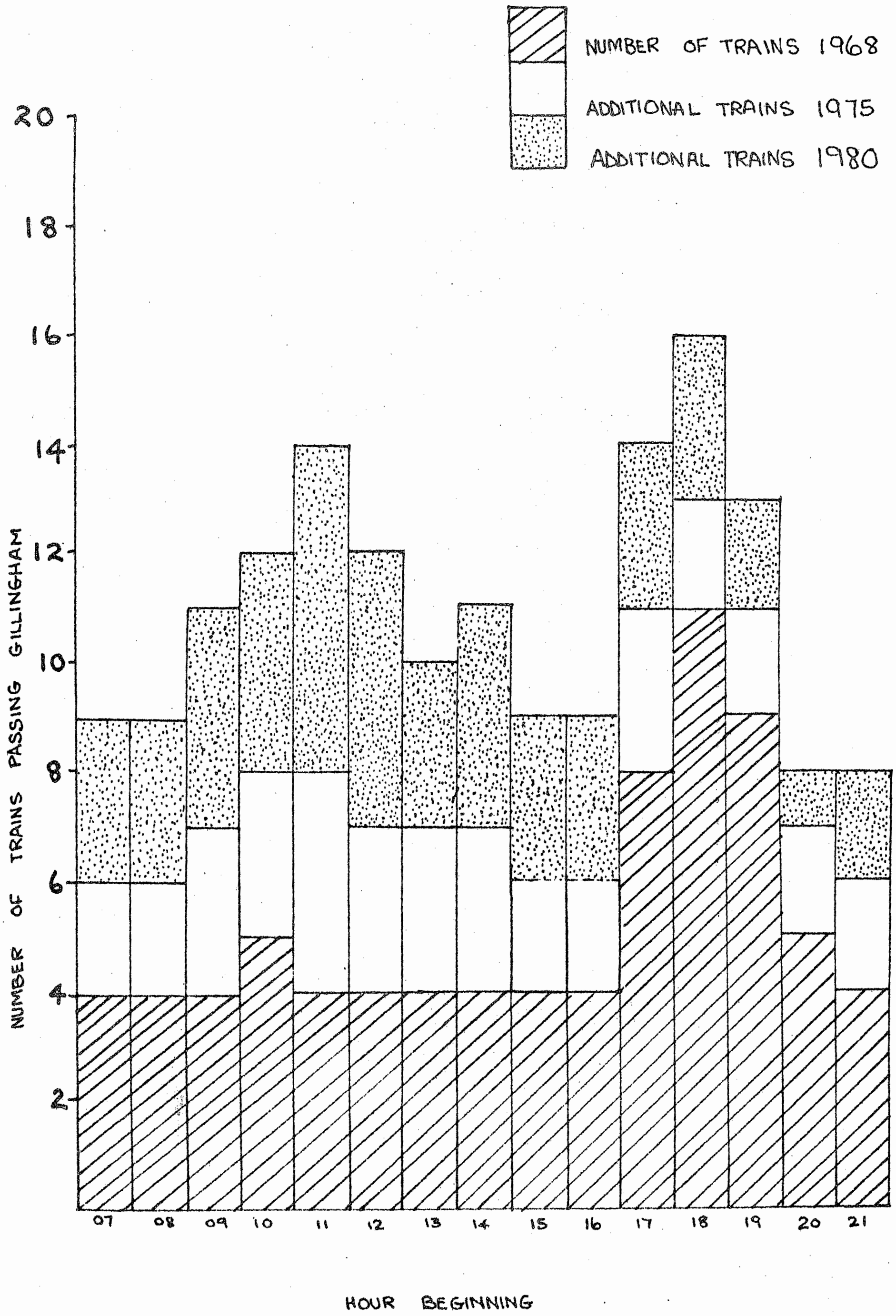
# SILVERSTONE

NUMBER OF TRAINS FROM LONDON PASSING BLETCHLEY

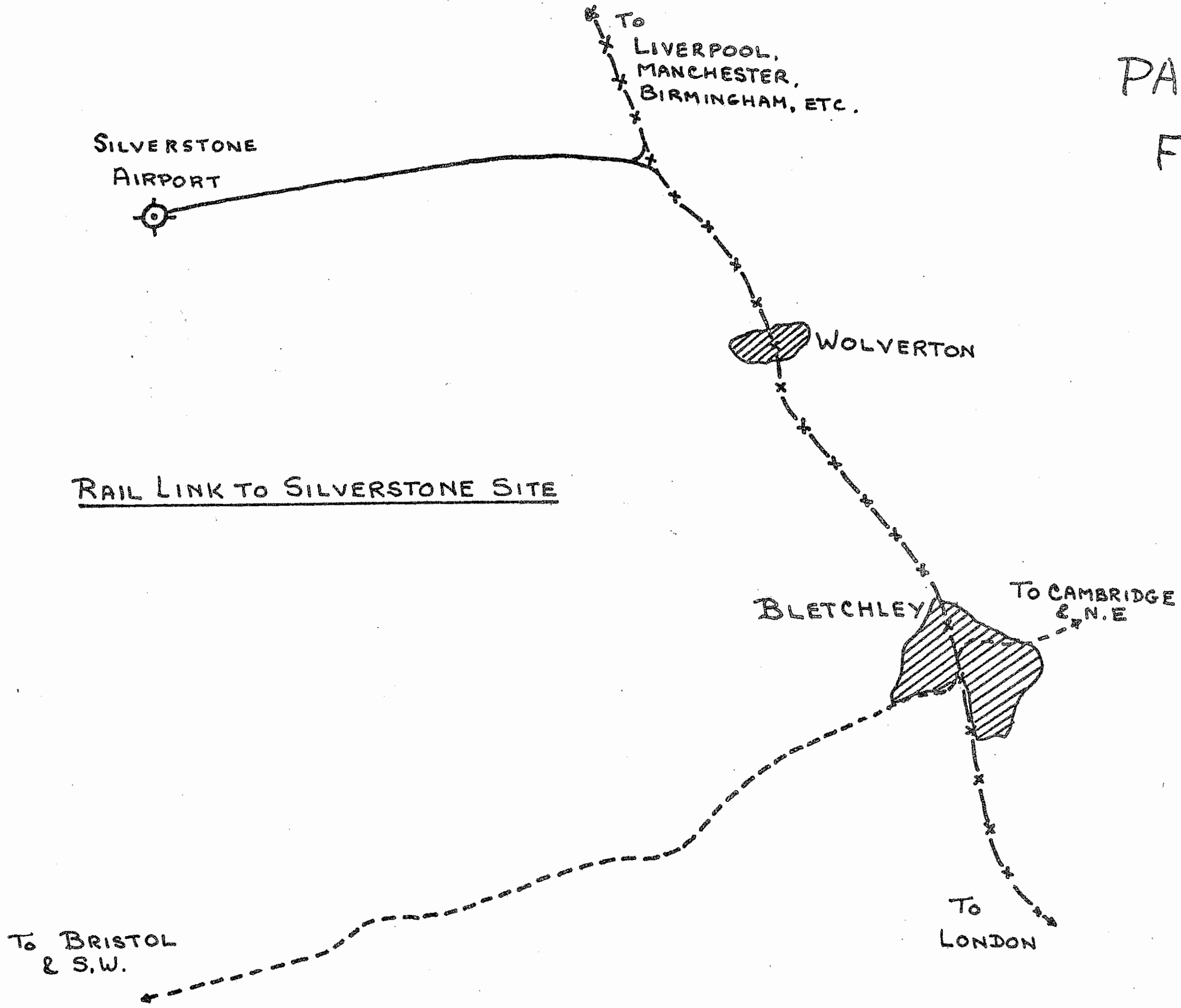


# SHEPPEY

## NUMBER OF TRAINS FROM LONDON PASSING GILLINGHAM

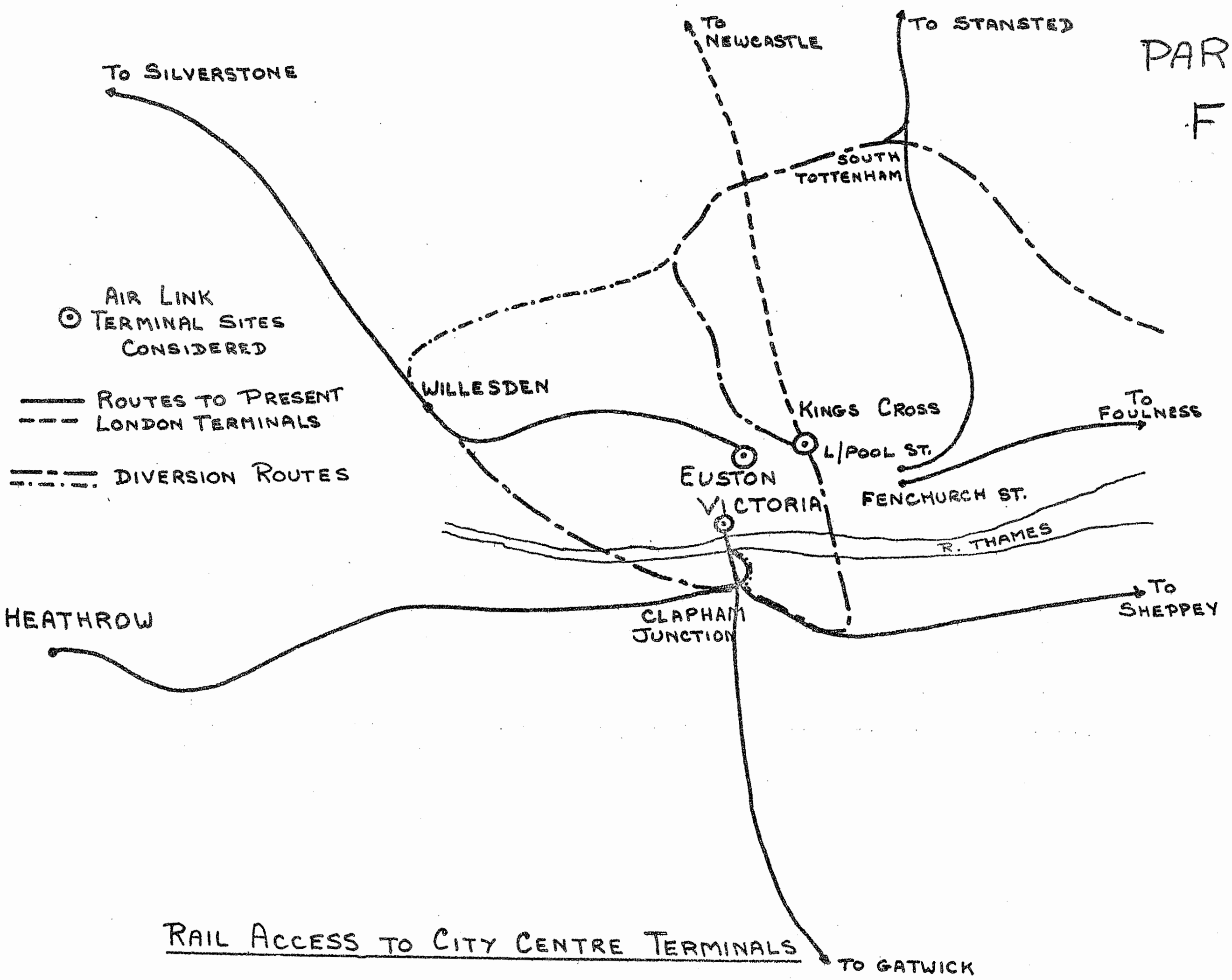


PART 3
FIG. 9



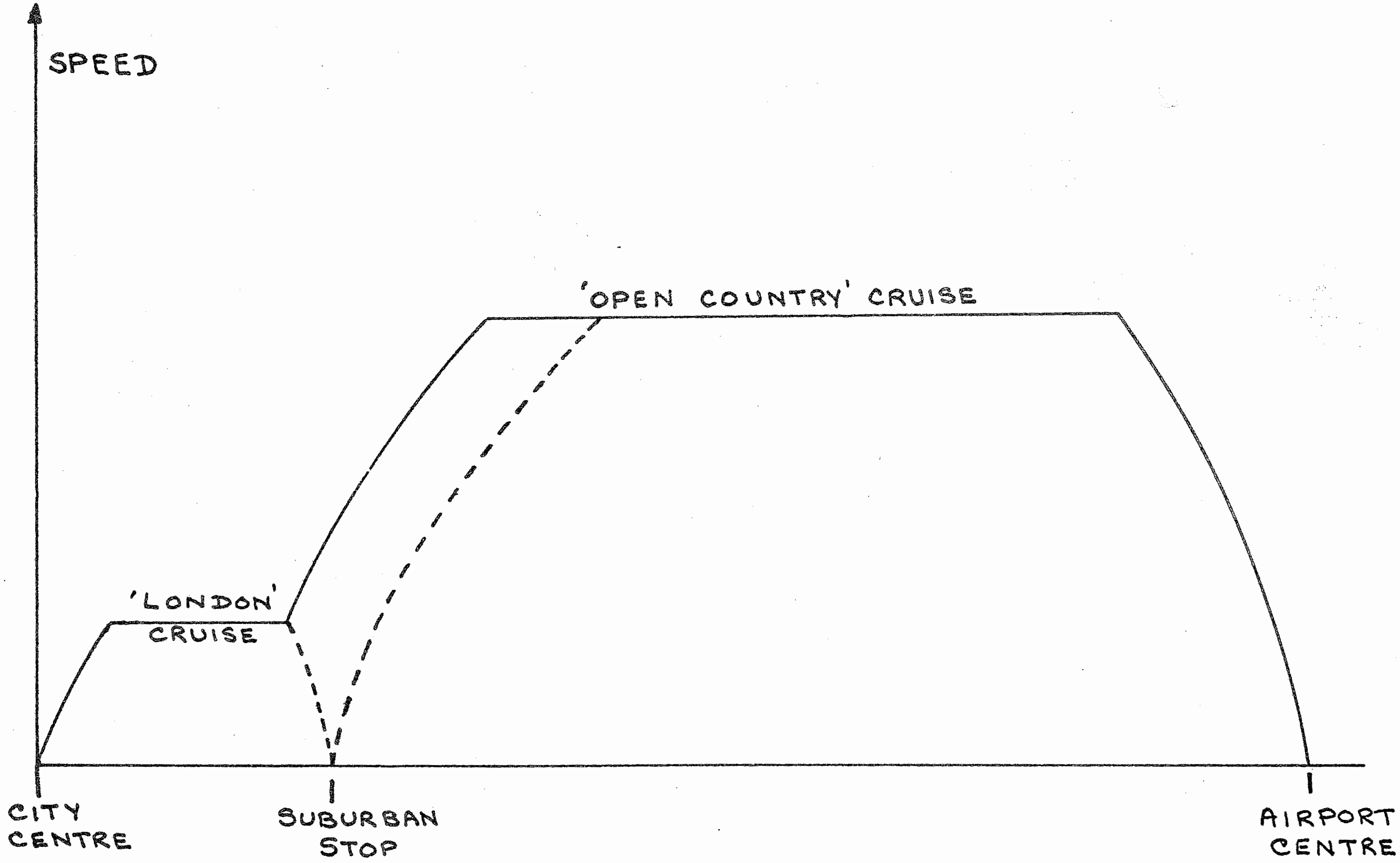

RAIL LINK TO SILVERSTONE SITE

PART. 3
FIG. 10

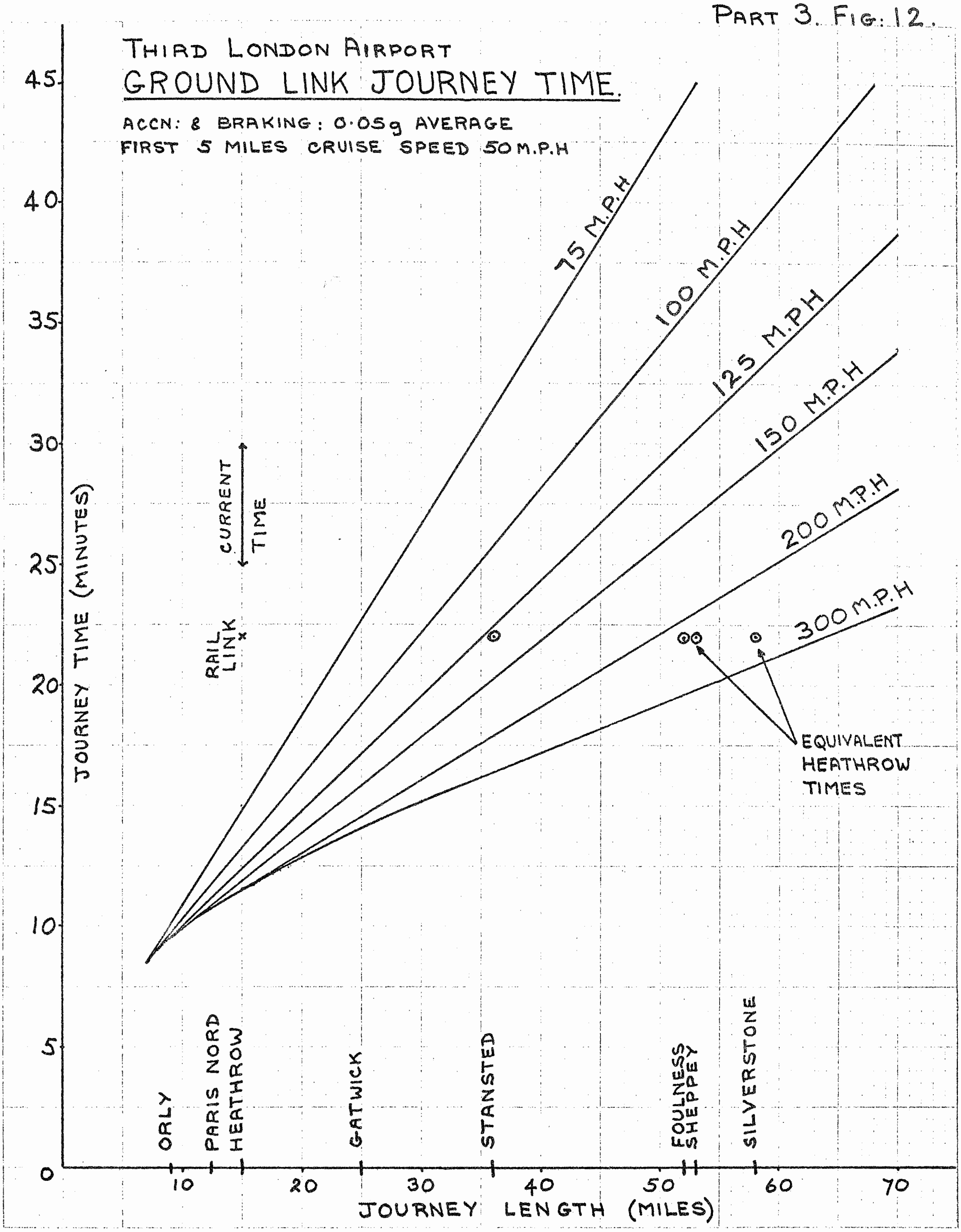


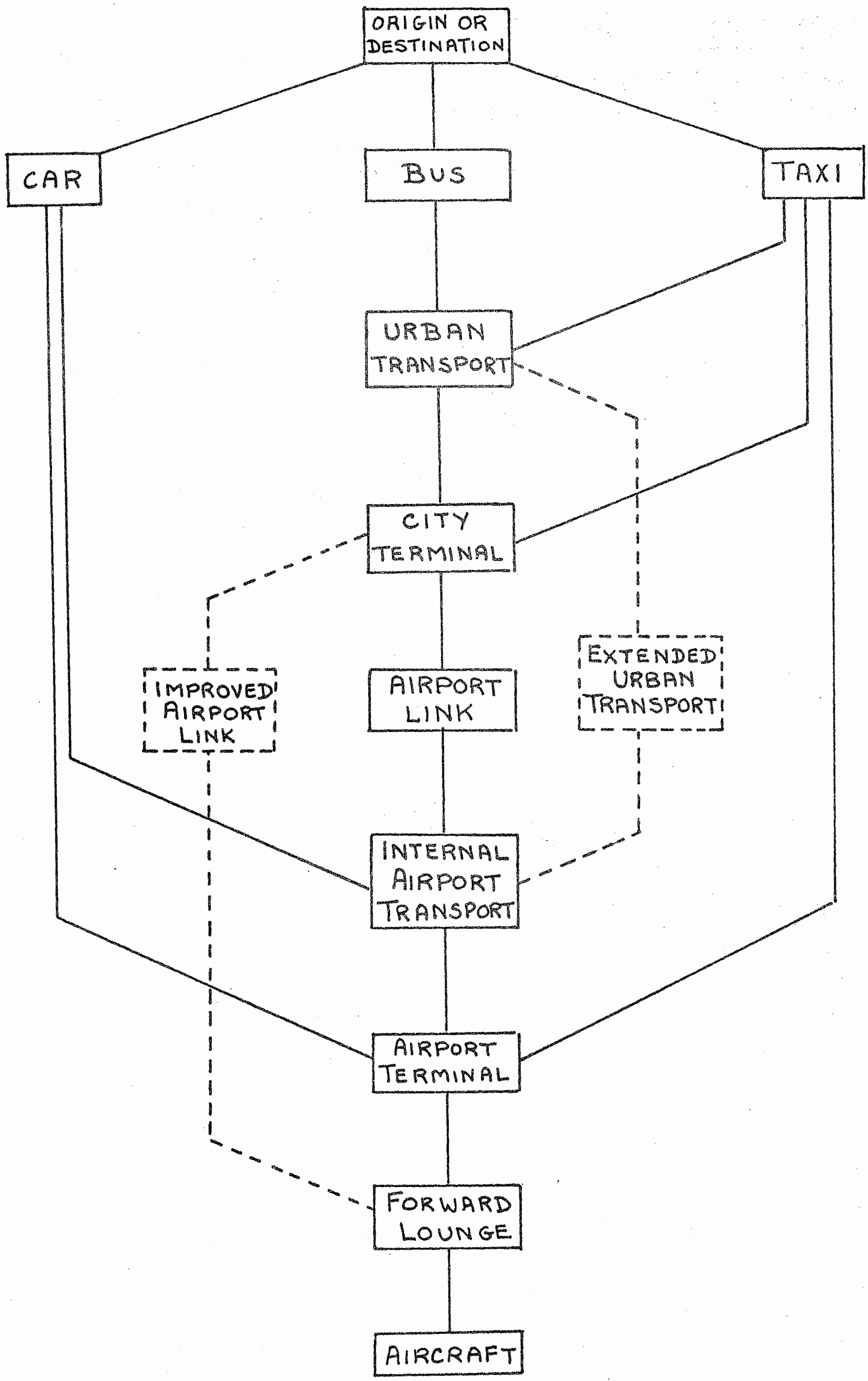

RAIL ACCESS TO CITY CENTRE TERMINALS

## SPEED PROFILE




PART 3. FIG. 11.

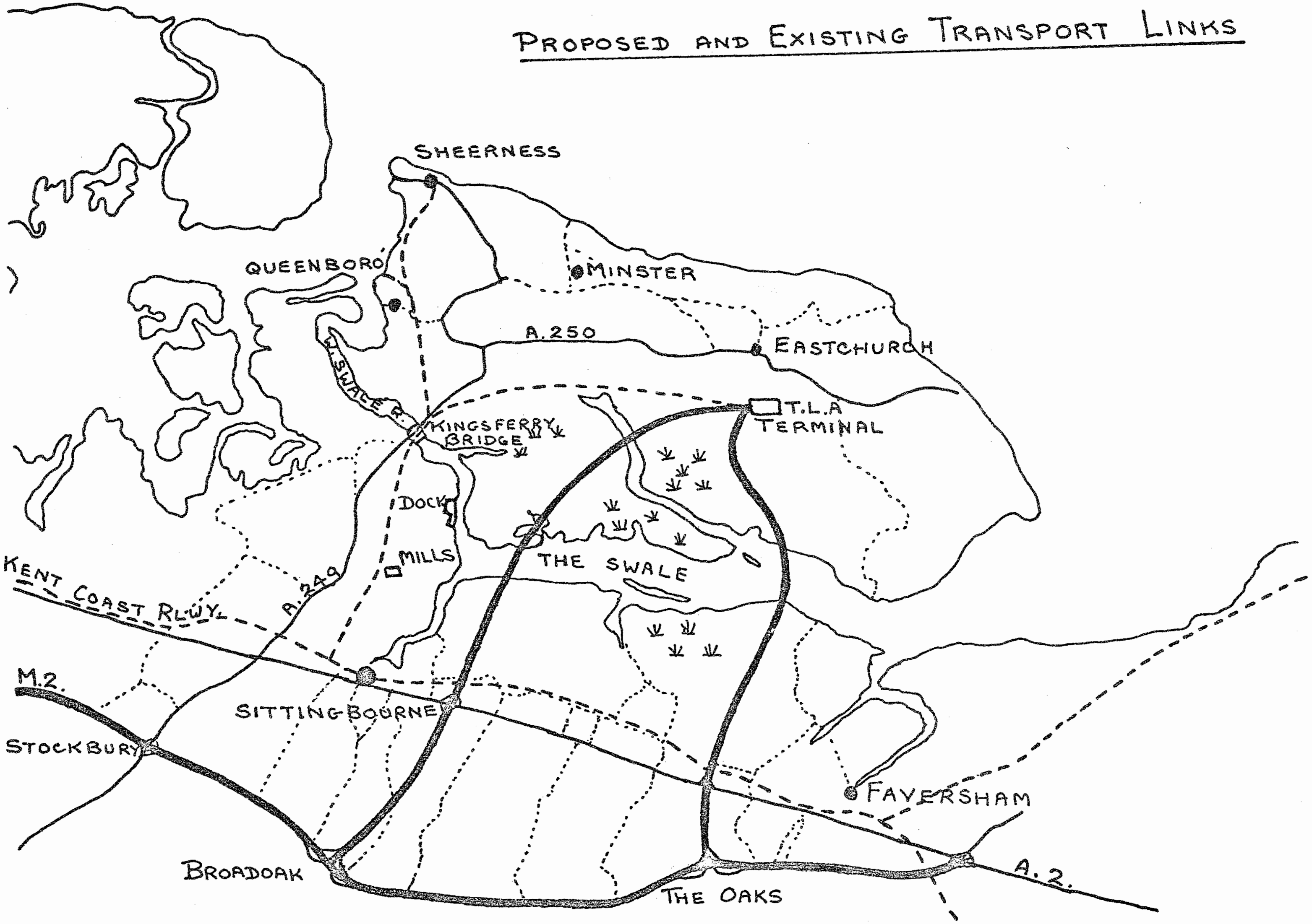

THIRD LONDON AIRPORT
GROUND LINK JOURNEY TIME.
ACCN: & BRAKING: 0·05g AVERAGE
FIRST 5 MILES CRUISE SPEED 50 M.P.H
75 M.P.H
100 M.P.H
125 M.P.H
150 M.P.H
200 M.P.H
300 M.P.H
CURRENT TIME
RAIL LINK
EQUIVALENT HEATHROW TIMES
JOURNEY TIME (MINUTES)
JOURNEY LENGTH (MILES)
ORLY
PARIS NORD
HEATHROW
GATWICK
STANSTED
FOULNESS
SHEPPEY
SILVERSTONE
0
5
10
15
20
25
30
35
40
45
10
20
30
40
50
60
70




BREAKDOWN OF PASSENGER JOURNEY
(GROUND BASED SECTION)

# T.L.A. SHEPPEY

## PROPOSED AND EXISTING TRANSPORT LINKS




PART. 3. FIG. 14.

PART 4 CONCLUSIONS

## 4.1 International Airport Location - Planning Considerations

4.1.1 Introduction

The purpose of this paper is to try to assess in general terms or at least to highlight the problems which a four-runway international airport will create on any one of four sites, namely, Stansted, Foulness, Sheppey and Silverstone. Such an assessment willtake into account the negative factors, namely the number of buildings to be demolished for the airport itself or affected by the noise corridor, and also the positive factors, such as the amount of employment both direct and indirect, population and their demands for housing and other services. Having assessed these local planning effects, the regional planning effects of each site would also be considered to assess the wider effects of the large scale development which will result from the airport and the desirability of such developments in a particular area.

4.1.2 The White Paper - 1967

4.1.2.1 Following the public enquiry into the proposal to develop a 2-runway at Stansted, the Government said "the strongest of the objections to Stansted is on regional planning grounds". (para. 67).

4.1.2.2 The Inspector's report, published at the same time as the White Paper concluded "it would be a calamity for the neighbourhood if a major airport were placed at Stansted. Such a decision could only be justified by national necessity. Necessity was not proved by evidence at this enquiry". (para. 21 - Report)

4.1.2.3 He went on to say that there were strong arguments against it (i.e. the airport) on the grounds of (inter alia):

"(a) Town and Country Planning. No evidence was produced that Stansted was the right place for a traffic focus of of this kind and all that goes with it. The evidence was to the contrary". (Para. 23 - Report)

4.2.4 The Inspector concluded that the proposal succeeded on air traffic grounds but not on (a) road access to London, (b) noise, (c) change of character of the land and (d) loss of good agricultural land.

4.1.2.5 The case for the Essex County Council and the North West Essex and East Herts Preservation Society was that other sites such as estuary sites at Cliffe(K and Sheppey were worthy of investigation, and with this view the Inspector agreed, recommending that'a review of the whole problem should be undertaken by a committee equally interested in traffic in the air, traffic on the ground, regional planning and national planning". (para. 49 - Report).

4.1.3 Choice of sites for investigation by Project Group

4.1.3.1 The criticism by the Inspector of Stansted is sufficient to justify its inclusion in the short list of sites, if only to see what the plannin implications are of establishing an airport in the vicinity.

4.1.3.2 The White Paper goes on "The Government are satisfied that of the Thames Estuary sites, Sheppey is the most promising". (Para 48).

4.1.3.3 Foulness was not actively canvassed at the first public enquiry, mainly because of the insistance by the Ministry of Defence that the Shoeburyness range could not be moved. (This is outside the terms of reference of this particular project). However, Mr. Sharman, for Essex County Council "suggested" that the natural site for a new airport should be in the region roughly bounded by Basildon, Dartford, Chatham and Southend" (para. 179 Inspectors Report, Appendix 3). Since the Enquiry, reports by the Noise Abatement Society and Bernard Clarke have both proposed Foulness.

4.1.3.4 In assessing the Inspector's report, the Government carried out an appraisal of alternative sites including "those north-west of London, towards Birmingham because of the particular attractiveness from a regional planning aspect". (para. 54 White Paper). The White Paper concludes "the principal advantage of Silverstone is on grounds of regional planning" (para. 55). It highlights the advantages, namely the proposed expansion nearby at Northampton and Milton Keynes, good surface access north and west, reasonable noise and agricultural land of lower quality than Stansted.

4.1.4 Location of sites and local factors

4.1.4.1 Stansted - Stansted is north of Bishops Stortford, close to the A.11. and main Cambridge-Liverpool Street line; the proposed M.11. will pass nearby. The area is a generally flat watershed at about 300 - 350 ft. above sea level. The agricultural value is good. Bishops Stortford is the nearest town (21,000) and Harlow is 8 miles to the south ( opn. 70,000, proposed 80,000 possible expansion 120,000). Generally the settlements are small and in many instances they have historic roots and many listed buildings (see Inspector's report page 35)

4.1.4.2 Foulness - The centre of Foulness Island is about 8 miles north-east of central Southend, the nearest town (166,000). The A.13. trunk road terminates at Shoeburyness at the southern end of the island as does the Fenchurch Street railway line. The area is just above sea level and the agricultural value varies between good and poor in very short distances. The Rochford Hundred, immediately west is very good farming land.

4.1.4.3 Sheppey - Sheppey Island is about 9 miles long and 4 miles wide, access by road and rail being at the south west corner with Sheerness, the main settlement (14,000) at the western end. There is an area of high ground (up to 200 ft.) at the northern end; the rest of the island is flat and is poor agricultural quality, There are connections to M.2/A.2. and the main railway line around Sittingbourne.

4.1.4.4 Silverstone - Silverstone is 12 miles south west of Northampton (122,000) and 12 miles north west of Milton Keynes (40,000); it is 3 miles west of the A.5., 6 miles west of the Manchester-Bletchely-Euston railway line and 8 miles west of the M.1. motorway. The site is fairly level and 450 - 500 feet above sea level. The land is well wooded and the agricultural value moderate. The general quality of the environment and of the individual settlements is not known.

4.1.4.5 With regard to access and distance from London, this is dealt with in section 3; in summary, the distance from Central London by road is as follows: Stansted - 36 miles, Foulness - 52, Sheppey-53, and Silverstone - 58.

4.1.4.6 It is difficult to give accurate data on the number and nature of properties within the airport perimeter for any one of the four sites or for properties outside the airport boundary but within the 45 N.N.I. contour. (The question of actual sites and noise are discussed more fully in Part 2).. However, it is quite apparent that the coastal sites will both affect fewer properties in terms of actual acquisition and for noise disturbance than the inland sites, and Foulness will undoubtedly be the most acceptable as far as noise is concerned.

4.1.4.7 The proposed re-alignment of the runways at Stansted reduced the population within the 45 NNI contour from 28,000 to 10,000; this number will obviously be greater for a four-runway airport but it is not possible to say by how much without detail of parish populations in the vicinity. Similarly, it is not possible to give details of the number of people within the 45 N.N.I. contour at Silverstone but it is unlikely to be substantially different from that at Stansted.

4.1.5 Employment and Population

4.1.5.1 "An airport and the activities associates with it are likely to provide employment directly for upwards of 20,000 people and indirectly for many more in service trades". (White Paper, para. 74). This estimate was made on the basis of a 2-runway airport.

4.1.5.2 The total number employed at Heathrow is now almost 40,000, of whom 16,000 are engaged by B.E.A. and B.O.A.C. in aircraft maintenance. It is understood that there is not likely to be a similar (or substantial) number employed in aircraft maintenance at the Third London Airport. On this assumption, this leaves a balance of 24,000 at Heathrow engaged in non-maintenance activities.

4.1.5.3 In view of the fact that the Third Airport will be a 4-runway airport and may ultimately carry twice the number of passengers and handle twice the aircraft movements as Heathrow, A figure of 30,000 is assumed as the number being employed at the airport; substantial variations on this figure will have profound effects on housing and other associated demands.

4.1.5.4 As a rough guide a ratio of 1:1 is assumed for airport workers:service workers, that is those employed in servicing the airport workers, both on the airport and in their homes.

4.1.5.5 Each of these two groups(airport and service workers) will have dependents: if the total for these two groups (i.e. 60,000 workers) is multiplied by three, this will give some idea of the potential population, that is 180,000. The number employed at the airport is substantially above this figure, say 40,000, and the consequent population would be about 240,000. These calculations are crude and elementary and is obviously one field which the Commission of Enquiry will have to examine carefully.

4.1.5.6 Another topic of equal complexity is the amount of manufacturing industry which is attracted to its location because of nearness to the airport. Evidence on this subject is scant at present and is discussed more fully in Section 7, below. Suffice it to say at this stage that for every worker engaged in manufacturing industry there will be a demand for an additional service worker, both having their dependents. Thus, when fully developed, the airport may support directly and indirectly upwards of 250,000 people; this indeed is the figu currently given for Heathrow.

4.1.5.7 A population of this magnitude will obviously have a profound effect over a wide area wherever the airport is located. The first consideration is the existing population of the areas around the four airport sites under consideration. Within 20 miles of Stansted, the population is about 190,000, Foulness 365,000, Sheppey 255,000 and Silverstone 195,000 (including half of Northampton C.B.) This estimate was made from the Registrar Generals 1967 estimates but without a map showing local government administrative boundaries; it is therefore liable to some error.

4.1.5.8 The second consideration is the proposal as set down in the Local Planning Authorities development plans; these were not available to give quantitative figures but it can be said with certainty that only very limited growth is proposed around Stansted, while moderate growth is proposed around Foulness and Sheppey and a very large growth around Silverstone with the development of Milton Keynes (150,000, 75,00 by 1981) and Northampton (100,000 50,000 by 1981).

4.1.5.9 A further consideration is the ability of an area to absorb part of the growth generated by the airport, thereby saving costs, particularly in the initial stages of the airport's development. This 'absorption' can take place in a number of ways; part of the proposed growth of the area could be taken up by the airport, there may be spare capacity in service trades or service trades which could change to serve the airport, under occupancy in houses, under or employment and inbalanced age/sex structure with many old people, often associated with under-occupancy of houses, a large number of commuters who would find employment locally if it were suitable and available; all these factors could materially effect the actual population requiring housing and services. The saving would be twofold, firstly in land and secondly in capital to provide the services required of a large urban concentration. (Buchanan in his Ashford study gives a figure of £3,000 per head for the cost of providing services). This is obviously an aspect into which the Commission must carry out a careful cost-benefit analysis as the overall cost may be profoundly affected.

4.1.5.10 Not only is the amount of population and the consequent land requirements important, but also the location of population in relation to the airport, on any one of the four sites. The majority of airport workers will wish to live fairly close to the airport, as at Heathrow, with convenient communication links to the airport, particularly because of the shift pattern of work and the number of unskilled workers. A sizeable number will, however, be able to live at some distance from the airport which may have an effect on a large number of small towns and villages within a 20 mile radius.

4.1.6 Land Requirements

4.1.6.1 A community of 250,000 makes a tremendous demand for land, particularly for housing and education. In the absence of information about, for example manufacturing industry, it is not possible to give meaningful space requirements for this particular element and the actual location of the airport site will affect the area required for, for example, central area shopping (i.e. primarily durable goods); a large shopping centre which already fulfils a subregional function may be able to absorb much of the potential demand.

4.1.6.2 At a net density of 30 persons per acre, a population of 250,000 will require an area of 8,300 acres, one and a half times as much as the airport site itself.

4.1.6.3 Another major land use component will be education, both primary and secondary. This will depend on the age/sex composition of the population. If the birth rate is 20/1000 population per annum, then for a population of 250,000 there will be a yearly intake of 5000 children into the schools. The figure of 20/1000 is slightly higher than the national average (17-18/1000) to take account of the probable make up of the community - this is a field which will have to be carefully looked into.

4.1.6.4 On this basis a two form entry primary school will be needed for every 4000 persons and a ten form entry comprehensive secondary school for every 15000 persons. If a primary school requires six acres and a secondary school requires 25 acres, then an additional 360 acres and 400 acres are needed respectively for primary and secondary education. Further education needs must also be taken into account.

4.1.6.5 At the standard 7 acres/1000 population for open space, an additional 1750 acres of open space will be needed.

4.1.6.6 The spending potential of a community of 250,000 people will be very high; the South East figure for retail spending given by the Board of Trade was £207 in 1961. Keeping to 1961 figures, this gives a total potential spending of £51.7 million. If the turnover per square foot is £40 (gross) then this creates a demand for 1.3 million square feet of floor space; the Census of Distribution does, however, ignore spending in service trades which require shop premises (such as launderettes, fish and chip shops, licensed betting offices, booking offices) and this may add up to 50% to the actual floor area. An overall floor area of 2 million square feet may therefore be required; its distribution would depend on distribution of population and of existing shopping centres. (cf 1.6.1.)

4.1.6.7 The average income at Heathrow is about £1400, probably above the average for south east England, although it is not possible to check this figure for this particular study; this may mean more consumer spending particularly on durables and also on recreation pursuits.

4.1.6.8 There will also be a demand for civic, cultural and commercial facilities including offices, to cater for the population; here again, disposition of existing uses will determine to a large extent the amount and distribution of new facilities.

4.1.6.9 The service and manufacturing industry, a gross figure of 40 workers per acre is reasonable; manufacturing industry attracted to the airport will undoubtedly produce highly specialised products of high value requiring highly skilled workers.

4.1.6.10 Other services such as public utilities and local roads will also require a considerable amount of land, so that the final requirement could be in the order of 15,000 acres (25 square miles), three times that of the actual airport site.

4.1.6.11 In assessing land requirements second generation demands must be borne in mind, that is the families of those initially moving into the area, most of whom will be at school but who in time will themselves require accommodation.

4.1.7 Regional Planning

4.1.7.1 The objection to Stansted on regional planning grounds has been quoted earlier (2.1 above). The White Paper goes on "He (i.e. the Inspectpr) thought that if full value was to be obtained from the cost of creating a new major traffic focus, suitable industries would also have to be accommodated". (para. 67 ibid).

4.1.7.2 At the same time, the question of further growth in the south east is dismissed on the grounds of the need for a third London airport. This theme will not be developed except to say that the precise role of the airport, i.e. a national airport or a London airport, must be one of the first issues which the Commission considers as it is fundamental to the planning case.

4.1.7.3 There three main ways in which to consider the site of Third London Airport. (i) the regional plan says.... therefore ..... (ii) the criteria for a regional plan are .... (iii) the regional implications of site A are ...... With regard to (i) the latest and nearest effort to a regional plan is "A Strategy for the South East" a report by the South East Economic Planning Council, published by the Department of Economic Affairs in 1967. (ii) and (iii) will be discussed more fully below as indeed will "A Strategy for the South East".

4.1.7.4 With regard to the criteria, basically there are three: the distribution of economic activity (employment), the distribution of population and the distribution of transport links. Of these, the most important in that it directly affects the others, is employment, particularly manufacturing industry. One of the reasons for the rapid growth of the south east has been the concentration of new science based industries - "the growth firms". The reasons for this suggested in "A Strategy for the South East" are:

"(a) Centre of internal communication network; proximity to major sea and airports; attractive to selling organisations, importers and exporters, and therefore in a special position to recognise and exploit new manufacturing opportunities.

(b) proximity to a large consumer market with higher average incomes than in other regions.

(c) largest concentration of labour in the country with a range of skilled manpower.

(d) attractions of capital cities; proximity to government and financial services in the city.

(e) existence of major universities, military and civil research establishments." (para. 82).

4.1.7.5 With specific regard to the attraction of airports the report goes on "Industrialists recognise the advantage of air transport for maintaining fast direct communication with their customers and in extending their market research to potential European markets. This will be even more important if we join the Common Market". (para. 116.) The question of an increase in air freight is not mentioned but is equally important.

4.1.7.6 The trends in national economic activity show a growth in service industries which is likely to continue, highlighting the need for a careful assessment of the number of service jobs created by the new airport. With regard to manufacturing industries, the "growth firms" are mainly engineering and electrical goods which show a concentration in the South East and which, incidentally, are the main source of exports by air.

4.1.7.7 This is a particularly important aspect into which the Commission should look most carefully; work by Keeble in a Ph.D. thesis suggests that of the 700 firms in North West London, only 50 - 100 are influenced in their location by the airport at Heathrow, and this is not the major factor (the general attractiveness of South East England for economic activity is the main factor). However, these firms are the "growth firms" and if the real cost of air freight decrease there may be pressure for industrial activity in the vicinity of the airport as airport location becomes an increasingly important location factor for certain firms. Such a trend could materially add to the population indirectly dependent on the airport, and the consequent size of the airport complex. (See 7.1. above).

4.1.7.8 There are three main proposals in "A Strategy for the South East"; to concentrate growth on radial axes out of London, to conserve "green zones" in between, to create counter magnets of employment opportunity (e.g. Ipswich, see para. 42), at the outermost end of the axis.

4.1.7.9 The complementary ideas of a growth corridor and a country zone are explained in para. 32 and 33; with regard to the country zones the Council states "We clearly could not suggest a total prohibition on all development since existing towns and villages will grow; but our objective is to prevent by stronger planning discipline any further major or industrial expansion in these green sectors". (para. 33). With regard to the counter magnet the report states "The most promising method of achieving an ordered development of the South East is to develop city regions around the periphery. This is the only means we see of creating of effective counter magnets that will attract population and industries away from London". (Para. 6). With regard to communications, forming the axis for growth the report states "with a growing efficiemcy of modern transport, centres for future growth can be located further away from the major conurbations without losing the economic advantages of concentration, provided they have rapid and frequent access to the metropolis". (Pars. 26). These four considerations must be borne in mind when considering a site for a large airport which is in itself a considerable counter magnet

4.1.7.10 The Council's report was published after the Stansted White Paper but before the Government's decision to set up a Commission of Enquiry. Stansted itself is in a green zone (see 7.9) and Council puts foward its views as follows: "The Government's announcement that the Third London Airport is to be located at Stansted in Essex would present major difficulties in the light of our strategy proposals .... The new airport is likely to provide direct employment for over 20,000 people eventually. A substantial influx of population to the area, probably about 100,000, would need to be accommodated over a period, and we must also make adequate provision for the industrial and commercial enterprises that need to bd located in the vicinity of such a major airport. As the White Paper indicates, there are strong objections to Stansted on regional planning grounds; and the implementation of the decision would require major planning studies to be carried out in which the Council would participate in order to mitigate the adverse effects on the area as far as possible". (Para.37)

4.1.7.11 The estimate of 100,000 is almost certainly too low; the figure is more likely to be upwards of 200,000 people. Quite how one "mitigates the adverse effects" of 200,000 or even 100,000 people into a mainly rural area, the Council does not attempt to explain.

4.1.7.12 Foulness and Sheppey are similar from a regional planning view point in many ways. Both are on the Thames Estuary and are equal distance from London, both are shown on the Council's strategy map as being in growth corridors, the areas at present consisting of fragmented urban development. On both sides of the Thames Estuary new port facilities for bulk handling of oil and associated oil refineries have been a feature of recent development and on the north side considerable port development at Tilbury for containerised goods may further promote industrial growth. Containerisation is designed to handle high value goods - the top 25% of exports and imports by sea in terms of their value ; this is the market into which air freight is now moving so the industrialists will have the choice of the two modes of transport for his goods - containerisation and air freight. Thus for both areas, the establishment of an airport at the end of an axis (Foulness) and at the mid-point but some distance from London (Sheppey) would act as a powerful counter-magnet and each area would be, from a regional view point, suitable to meet the resultant indirect pressures.

4.1.7.13 Silverstone lies at the edge of the M.1. motorway growth axis and close to major expansion schemes at Northampton and Milton Keynes which could absorb much of the indirect growth. It also has the advantage ofhaving the best national accessibility both for passengers and freight. In any event, consideration of a local airport with a concentration on air freight to serve the Midlands would be a useful exercise.

4.1.8 Summary and Conclusions

4.1.8.1 In a complete planning study of this kind far greater emphasis would be placed on the local effects of noise and the actual site and also communications. Their absence is explained by the deliniation of work for this project study (see 4.1.4.5. and 4.1.4.6.).

4.1.8.2 The task of the Commission will also involve specialist surveys to consider, for example, the effects of siltation by reclaiming land from the Thames Estuary. Such undertakings have been ignored for the purpose of this paper.

4.1.8.3 The purpose of the Commission of Enquiry is to assess the relative merits of alternative sites from the planning view point; this means the effect over a wide area of land - probably within a 20 mile radius of any one site, although the effect will decrease with distance. Wherever the airport is located it will result in profound changes in the economy and the environment of that area. Thus, the planning case in essence is to assess the relative advantages and disadvantages of any one site; for example, the loss of agricultural land, the change in nature of villages, small towns and the land-scape as against the economic advantages at the local level and the relative advantages of one area of growth over another from the regional view point.

4.1.8.4 The local and regional effects will stem from the employment opportunities; these opportunities are of three types, those on the airport itself, those serving the population resulting from the airport, and those engaged in industry attracted by the growth area around the airport (together with the service workers which they require). This will cause demands for a regional and local communications network to cater for passengers and the complex urban services caused by the airport.

4.1.8.5 This provides the basis of the planning study; it will produce a demand in terms of total population which can in turn be translated into land use requirements. The ability of any one area to "absorb" part of the anticipated growth may produce significant differences in the net demand (see 5.9 above).

4.1.8.6 The planning evidence should be presented in the form of a cost-benefit analysis, a technique still comparatively new to the planning profession; the the planning cost-benefit analysis will form an important part of the overall cost-benefit study into the relative advantages and disadvantages of the short-listed sites for the airport.

## 4.2 Recommendations

### 4.2.1. Traffic Forecasting

Changing the assumptions will obviously alter the forecast traffic levels: and as has been shown, these are good reasons for checking the assumptions and up-dating the forecast in the White Paper. Such factors as recent economic trends, aircraft size, ATC procedures, and peak spreading will affect aircraft movements. Competition from other transport modes, such as the Channel Tunnel, high-speed tracked vehicles and VTOL aircraft may influence traffic levels considerably. The whole potential of air cargo may have been seriously under-estimated.

There will be a considerable chain reaction from the traffic forecast, so it is essential that a detailed forecast be prepared as quickly as possible.

### 4.2.2. Airport

Consideration should be given to the merits and demerits of a functional airport, either principally long-haul or principally short/medium haul, and to the factors affecting its siting.

### 4.2.3. Air Traffic Control

Ways of increasing airport capacity should be investigated by improving the use of airspace and runway techniques. These should be divided into those aspects which may be within the control of U.K. authorities and those of a longer term nature, which will need multilateral agreement.

### 4.2.4. Noise

That there is a problem in quantifying the noise problem. The cost of the following must be calculated for each site: compensation for loss of amenities, reduction of rateable values, and cost of sound-proofing.

### 4.2.5. V.T.O.L.

V.T.O.L. aircraft could well seize a sizeable part of the short haul market. Whether sufficient V.T.O.L. aircraft are likely to be in service in time to delay the introduction of a third(CTOL) airfield seems unlikely, but could affect its capacity. VTOL is unlikely to diminish the total problem, but could well transfer parts of the problem elsewhere.

### 4.2.6. Transport Systems

A thorough and detailed study of total transport systems, including competing modes, in geographical areas bearing on traffic through London's airports needs to be made.

### 4.2.7. Matching Ground and Air Traffic Flows

Thought must be given to the selection of the critical year in which to assess the matching of ground and air traffic. For example a fixed track system may be justified in 1985 but not in 1975.

### 4.2.8. Growth of Travelling Public

The number of people other than passengers is considerable, possibly as many again; to which must be added the airport employees. The total needs careful assessment.

4.2.9. Town Terminals

The merits of single and multiple town terminals need to be assessed.

4.2.10 Community Considerations - Local

These are of positive and negative nature, and can be quantified to a considerable extent.

4. 2.11. Community Considerations - Regional

Careful attention to these must be paid, from the very onset of the enquiry.

4.2.12. Cost Benefit Studies

Given time and expert advice, the relative advantages and disadvantages of each site can and must be quantified far more thoroughly than ever before. There is a ripple effect from the impact of a new airport. How far out the effects of the ripples should be measured is a matter of policy which must be defined as soon as possible.