

**BRISTOL CITY COUNCIL  
CABINET**

**22 March 2007**

**Report of: Director of Planning, Transport and Sustainable  
Development**

**Title: Bus Punctuality Improvement Partnership**

**Ward: Citywide**

**Officer presenting report:** Colin Knight  
Head of Transport Operations

**Contact telephone number: (0117) 0117 92 22940**

**RECOMMENDATION**

It is recommended that the Cabinet endorse the approach to improving bus services within Bristol laid out in the report, and agree to entering into the Punctuality Improvement Partnership (BusPIP) with First Bus, as detailed in the document appended.

**Summary**

The aim of a BusPIP is to improve the reliability and punctuality of bus services. There are two parties to a BusPIP – the Bus Operators and the Local Authority.

The BusPIP comprises a statement of intent, objectives and a summary of commitment. It is backed up by a series of schedules which include targets for improvement actions for both parties, to ensure the targets are met.

Monitoring is a key aspect of the BusPIP. The Traffic Commissioner can take action against the Bus Operator in the event of poor performance, whilst the DfT could penalise the City Council for poor performance through LTP settlements.

**The significant issues in the report are:**

- Agreement to the actions by Bristol City Council and First as set out in Schedule F to the BusPIP
- Failure to deliver could result in less LTP money being made available.

- These actions must be achievable within the specified timescales.
- Successful implementation of bus priority measures (as evidenced by improved performance and increased patronage) is linked to a commitment from First to invest in services and hold down fares.

## **Policy**

1. This BusPIP supports the achievement of the targets in the Joint Local Transport Plan – particularly those to increase bus patronage, improve punctuality, reduce congestion and improve air quality.

## **Consultation**

### **Internal**

2. Transport Operations  
Finance  
Legal Services

### **External**

3. First Bristol  
GOSW

## **Context**

4. The concept of a BusPIP was developed by the Bus Partnership Forum, in conjunction with the Traffic Commissioners, following an investigation into how to improve the punctuality of bus services. The Department for Transport issued guidance in 2005 endorsing this approach; this was backed up by the requirement to set targets for improving bus punctuality in the new Local Transport Plans.
5. The Network Management Guidance issued pursuant to section 18 of the Traffic Management Act 2004 states that: *“Where necessary, LTAs (Local Transport Authorities) should work with the relevant parties, including Traffic Commissioners and bus operators, in formulating and implementing improvement plans for bus punctuality.”*
6. This guidance, and the work of the Bus Partnership Forum, recognises that both local authorities and bus operators have roles to play in improving punctuality and that data sharing is vital to achieving this. The Traffic Commissioner has the power to take action against bus operators who fail to meet punctuality targets and,

as a consequence, operators are wary of sharing data; however, the Traffic Commissioner will take an operator's participation in a partnership into account in determining penalties thus making data sharing more realistic.

7. Bristol City Council is fully committed to tackling the significant traffic and transport problems in the city, in the interests of economic prosperity and to improve the local environment. Our Transport Strategy is predicated on achieving a shift away from car use in the city to alternative modes such as cycling, walking, rail and bus. Such a change will contribute to the achievement of our objectives, as set out in the Community Strategy and Corporate Plan, of reducing congestion, road accidents, improving air quality and accessibility.
8. Bus punctuality, and other targets set out in the Joint Local Transport Plan, need to be achieved if these aspirations are to be met. Another incentive is that failure to achieve the targets, and the absence of a BusPIP, could lead to penalties being applied to the indicative settlement for local transport funding in future years. Failure to hit Local Transport Plan targets will in turn impact negatively on the council's CPA score.
9. The reliability and punctuality of bus services in Bristol is a major concern in the city and is an often quoted reason why people will not use bus services. It is essential to tackle this issue if we are to increase ridership.
10. The high level of fares in the city is a major factor in deterring bus use and therefore contributes to the failure to achieve targets. Fare levels reflect operating costs, and congestion makes Bristol an expensive city in which to operate. The high fares drive down ridership, decreasing income whilst increasing road traffic and congestion, thus providing another justification for further fare increases.
11. To break out of this vicious circle it is essential to work with First to improve the reliability and punctuality of services to reduce operating costs, attract patronage and thereby release funding for the operator to invest in service improvements and hold fares down. This commitment is included in the BusPIP.
12. It should be noted that the implementation of Showcase 1 has improved punctuality and reliability resulting in an increase in ridership of 12%.
13. BusPIPs could also be entered into with other operators in the city and these will be pursued. It should be noted BusPIPs are also being developed by the other authorities in the sub-region and the

idea of a sub-regional BusPIP could be considered as a possible future development.

14. As part of the Greater Bristol Bus Network (GBBN) major scheme bid it is also proposed that the four Unitary Authorities enter into a Statutory Quality Partnership (SQPs) with the bus operator upon the completion of each corridor. The purpose of this is to obtain a legally binding agreement to ensure operators provide an appropriately high quality of service on the GBBN routes, to protect our investment, whilst guaranteeing to the operators (and the Department for Transport) that the routes will be maintained to an appropriate standard for at least 5 years. The SQP will be supplemented by a Quality Bus Partnership Agreement (QBPA) for that particular route specifying minimum service frequencies in return for a commitment from the city council to use its powers under the Traffic Management Act to protect buses from the adverse affects of congestion. It should be noted that the SQPs and QBPA's are route specific, do not affect other routes and can only be implemented once the route has been built. It is possible, depending on negotiations with the bus operator, that higher performance standards than those set out in the BusPIP may be set. In this case the higher standards would apply to the route in question with the BusPIP remaining valid across the rest of the network.

### **Proposal**

15. The proposed BusPIP is appended to this report. It is essentially a statement of intent, containing objectives and commitments together with schedules setting out targets, and Bristol City Council's and First's proposed actions (up to March 2008) designed to achieve these targets. The key commitments are contained in Schedule F of appendix A. Further schedules cover duration and terminations, monitoring, targets, data sharing and definitions.
16. The main points of note are:
  - the targets for improving punctuality and reliability and current performance – achievement of these targets will represent a major improvement in service quality.
  - the link between Bristol City Council and First investment.
  - the pledge from First that if, as a consequence of the City Council's investment, there is an increase in patronage and a reduction in operating costs, they will hold down or reduce fares in real terms (with the proviso of ensuring an adequate return on investment for the operator).

17. The Council's actions have been selected on the basis of their deliverability and a number were covered in the 2006/7 PT&SD Capital Programme that went as part of the Corporate Capital Programme to Cabinet on 15<sup>th</sup> June 2006. In particular:
- Showcase 2, due for completion in summer 2007, will deliver major benefits for those services using the A420. Other Showcase routes have not been included in the schedule because DfT have not yet confirmed the major scheme funding.
  - Traffic management: there is a programme for investment in UTMC (Urban Traffic Management and Control) and this needs to be expedited. It is essential that we work towards a proactive system of traffic management utilising real-time data and increased CCTV coverage. One of the key ways to achieve this will be through supporting First to fully kit out the Bristol fleet with GPS, 70 vehicles out of 325 are currently fitted with GPS (Global Positioning System). GPS will also permit real time passenger information and intelligent bus priorities. A report on Real Time Passenger Information (RTPI) was approved by Cabinet on 8<sup>th</sup> February 2007 where it was agreed to work in partnership with First to ensure the entire Bristol fleet is fitted; South Gloucestershire Council are also working with First to ensure all buses serving their area are fitted. Both councils are using the same supplier to ensure compatibility across the sub-region.
  - Allied to a more pro-active approach to traffic management will be changes to parking enforcement following the implementation of the parking review. The background to this review was set out in the Parking Policy report tabled at cabinet on 13<sup>th</sup> October 2005. This recognised that parking enforcement should help deliver the council's transport policy; as a major element of that policy is the promotion of public transport, enforcement activity will be focussed on showcase bus routes and major radial routes.
  - Upgrades to existing signal controlled junctions to improve overall traffic flow and to provide bus priority where appropriate
  - Specific schemes such as Jacobs Well roundabout and the identified hot spots referred to earlier
18. It should be noted that whilst much of the above is aimed at improving the reliability and punctuality of buses, the measures are also being designed to improve overall traffic flow. This is a requirement of the Traffic Management Act 2004 (traffic being defined as covering all modes – including cyclists and pedestrians as

well as cars and buses). Furthermore, improvement in bus operation can, in many cases, only be achieved through ensuring all traffic flows more freely due to the restricted widths of many of Bristol's roads.

19. A whole range of demand management measures are being introduced to promote alternative travel modes. However, smoothing and controlling the traffic flow that does exist is essential for improving driver behaviour, improving road safety and air quality.
20. First Bus are undertaking to utilise the RTPI system to monitor and improve the performance of their services through more pro-active management utilising the talk facility for example. To achieve this regular timing points will be adopted and problem sections of route made known to the city council; we will use our UTMC system to reduce bus delays wherever possible. This will require the sharing of data so that the impact of interventions can be assessed. Ultimately it will be for First to use the data from the RTPI system to ensure timetables are robust. First will be responsible for ensuring their drivers use the RTPI system correctly; this will be monitored. They will also be responsible for ensuring that drivers and buses are available on time. First will investigate means of reducing delay through the sale of tickets at stops.

### **Other Options Considered**

21.
  - Continue with present informal working arrangements;
  - Quality Bus Partnership;
  - Quality Contract;
22. To continue with the present informal working arrangement is less likely to change the present rate of progress. We need to be able to exchange data with First to enable proper monitoring and management of the network and this requires a formal framework for the reasons given in paragraph 6.
23. The other advantage of a formal agreement is that it provides greater certainty to the bus company in order to encourage them to invest. Bus companies are more likely to invest where they see a real commitment from the local authority.
24. Quality Bus Partnerships are voluntary agreements and have been used in Bristol. Typically they lack firm commitments and 'teeth' and a more robust agreement is needed. A busPIP is an over-arching agreement and agreements/partnerships can be entered into in respect of specific routes as discussed in paragraph 14.

25. No authority nationally has yet entered into a Quality Contract due to the timescales involved and uncertainties over cost. Whilst superficially attractive as they offer control over networks, timetables and fares, there are potential major downfalls, the chief one being the risk of major increases in cost.

### **Risk Assessment**

26. A risk assessment has been completed for this project and summary of the major risks is detailed below.

27. The main risks of not agreeing to this course of action are as follows:-

- No improvement/decline in punctuality and reliability of services.
- Could discourage bus operators from investing in Bristol's bus services.
- Could be used to justify any future fare rises.
- Could result in a further decline in patronage and consequent failure to meet JLTP targets.
- Sends the wrong message to GOSW/DfT and could impact on future LTP settlements.

28. The main risks of agreeing to this course of action are as follows:-

- If not all of the proposed actions are implemented by Bristol City Council, the Council could be 'held to account' by GOSW/DfT and First with a consequent impact on settlements.
- Performance (or lack of) will be more transparent.
- The Council may be seen to be favouring one operator at the expense of others.

29. The action taken to mitigate these risks is:-

- The actions for the Council are listed in Schedule F. These have been selected on the basis of their deliverability and impact on reliability and punctuality.
- The Council will offer to enter into BusPIPs with other operators.

### **Equalities Impact Assessment**

30. Although the focus of a BusPIP is on improving punctuality and reliability, the investment envisaged by First will increase the rate of replacement of the bus fleet resulting in more DDA compliant vehicles running in Bristol. The improvements in service will benefit people who are reliant on buses. The development of a more effective public transport system in Bristol, which this proposal will contribute to, will undoubtedly have positive equality impact benefits, particularly arising from the accessibility and local environment improvements.

### **Legal and Resource Implications:**

**Legal** Reference has already been made in this report to the Traffic Management Act 2004. This Act places a new network management duty on all traffic authorities to manage their road network to secure the expeditious movement of traffic on that network and to facilitate the same on networks of other traffic authorities. In addition, they are required to make arrangements to plan and carry out this duty. The proposed Bus Punctuality Improvement Partnership (PIP) clearly has a key role to play in the discharge of the new duty in aiming to increase bus patronage and ease traffic congestion. Such objectives is also a key element in the Joint Local Transport Plan and its related Bus Strategy under the terms of the Transport Act 2000. Whilst the PIP will not be directly legally binding - in cases where registered bus services are not being run in accordance with specified time tables, the Traffic Commissioner does have powers under the Transport Act 1985 to impose penalties on the relevant operator. It should perhaps also be noted that in instances where authorities are judged to have failed in the discharge of the duty, the Secretary of State can intervene directly in the discharge of the traffic authority function. Clearly, the City Council as traffic authority for its area must ensure that its duty is properly complied with. The PIP will have an important role to play in this regard.

***Legal advice given by: Peter Malarby, Senior Solicitor (Highways and Transport)***

**Financial**

**Revenue** Additional maintenance costs to support Bus Showcases 1 and 2 is included in the Medium Term Financial Plan (£100,000) in 2008/09 and (a further £100,000) in 2009/10 and additional staff resources to monitor traffic flows (including buses) and manage the UTMC system (£50,000) is included in the approved 2007/08 revenue budget and a further £50,000 is included in the Medium Term Financial Plan for 2008/09. Further Medium Term Financial bids will be made in respect of the maintenance of future showcase/GBBN routes. The costs of maintaining the RTPI system have been capitalised.

**Capital** The costs of the short term measures, including RTPI, are being built into the 2007/8 capital programme; the programme set out in the BusPIP has been based on deliverability. The success of the GBBN has not been assumed for the purposes of the BusPIP.

***Financial advice given by:** Mike Harding,  
Financial Services and Business Planning PTSD  
and CLS finance*

**Land** None

**Personnel** None

**Appendices:** Appendix A - BusPIP

## **ACCESS TO INFORMATION**

### **Background Papers**

Report of the Task and Finish Group of the Bus Partnership Forum  
2006-07 Capital Programme (Report to Cabinet 15/06/06)

Parking Policy (Report to Cabinet 13/10/05)

Real Time Passenger Information (Report to Cabinet 8/2/07)

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*9 March 2007*

**BRISTOL  
BUS PUNCTUALITY IMPROVEMENT PARTNERSHIP  
(Bus PIP)**

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## **Introduction:**

Reflecting the national situation, bus travel in Bristol has been declining in recent years. This is undesirable for both the local authority and operator partners. It runs counter to the authority's desire to limit and eventually reverse the growth in car use (with its attendant environmental, economic and social costs). It also runs counter to the operators' interest as rising costs and a declining passenger base will lead to a spiral of decline. This is characterised by falling profits, lower levels of investment, higher fares, and the withdrawal of marginal services. There are many reasons for this decline in bus use but the passenger growth resulting from investment in the Park & Ride services and the 76/77 Showcase Bus Route are a clear indication that it can be arrested and then reversed.

In accordance with the provisions of the Joint Local Transport Plan (JLTP), and within the context of a wider Quality Bus Partnership, through this Bus Punctuality Improvement Partnership the partners seek to build on the improvements already made and achieve a continuous citywide growth in bus passenger numbers. This document focuses on the standards to be achieved, and the measures that the partners propose to implement, within the key areas of reliability and punctuality. However, in doing so it is recognised that other areas of bus service provision, e.g. the quality of information, are also important and will be the subject of separate agreement(s).

## **Reliability and Punctuality:**

Reliability is:

- The operation of the timetabled service.
- The provision of a vehicle to meet the reasonable travel expectations of a passenger (by vehicle type and capacity).

Punctuality is:

- Adherence to the published timetable at all timings points on route.

Reliability and punctuality are currently far short of the standard expected by the public. Extensive surveys were undertaken in the autumn of 2005 and these form the basis against which performance will be measured (see Schedules C & D).

## **Aim:**

The aim of the Bristol *Bus Punctuality Improvement Partnership (Bus PIP)* is, as part of an improved public transport offer, to continually improve and then maintain the punctuality and reliability of bus services operating within or originating/terminating within the administrative area of the City of Bristol.

## **Objectives:** For the parties to jointly work:

1. To achieve the Traffic Commissioner's target of the specified percentage of journeys arriving within the window of 1 minute early to 5 minutes late at published timing points, in accordance with the Traffic Commissioner's Practice Direction.
2. To ensure that at least 99% of advertised journeys are operated each year.
3. To reduce journey times and increase the frequency of bus services where this is possible and sustainable.
4. To reduce operating costs and increase patronage sufficiently to enable continued investment in services and the holding down and/or reduction of fares in real terms (on routes where Council investment stimulates real growth) whilst providing an adequate return on investment for the operator.
5. To reduce vehicle emissions (resulting from more consistent speeds and reduced delay).

## **Commitments**

The objectives will be achieved by:

- A. Joint usage of data from monitoring surveys and any other relevant sources (subject to the provisions of the separate data sharing agreement) to establish levels of compliance, the reasons for any shortcomings and to identify means of improvement.

- B. Realistic timetabling by First (& the Council on contracted services) bearing in mind the generally prevailing traffic conditions.
- C. Timely exchange of information and regular liaison so as to plan for any disruption to the highway network and to inform the public of significant reliability or punctuality shortcomings. To include where practicable, provision by the Council of estimates of delay to bus journeys and, where it is not possible to quantify such delay, to provide a statement to that effect.
- D. Jointly identify causes and locations ('Hot Spots') of delays to services and targeted action by the Council to improve conditions.
- E. The Council to give its enforcement priority to traffic regulation orders on bus routes, particularly in the morning and evening peaks.
- F. Investment to increase the level of off-bus payment with a view to the reduction of on-bus payment to the lowest practicable level. The intent is eventually to eliminate on-bus ticketing.
- G. Investment by First in vehicles designed to minimise boarding and alighting times, particularly for people with a mobility impairment.
- H. Investment by First in vehicles and maintenance facilities and the improvement of maintenance methods to maintain a high level of vehicle availability, including assistance from the Council in finding sites that meet operational needs and accord with planning policy.
- I. First to maintain sufficient levels of suitably trained and available staff to deliver the timetabled service and actively manage disruptions.
- J. The Council to maintain sufficient levels of suitably trained and available staff to efficiently manage the highway network.
- K. A joint commitment to the maintenance and further roll out of real time passenger information thereby reducing perceived waiting times and allowing passengers to make informed choices about their journey options.
- L. A joint commitment to comprehensive route upgrading of the radial corridors including extensive bus priority to reduce both journey time variability and journey times. To include the A420/A431 corridor and

then, subject to the funding award by Government, the routes as set out in the Major Scheme Bid.

M. The Council and First to work together to equip vehicles with a suitable tracking and schedule adherence system/systems incorporating intelligent bus priority to take maximum advantage of the Urban Traffic Management and Control (UTMC) capability. To include a tool/tools to facilitate both real time fleet and service management, and to undertake historic schedule adherence analysis to identify hotspots and enable schedule enhancement.

N. The Council to continue to invest in UTMC, and further, to enhance its control room functionality to achieve pro-active management of the network.

### **Interpretation**

The details of the agreement are set out in the Schedules. The whole document is to be taken in its entirety when interpreting and applying the agreement.

### **Signed on behalf of:**

#### **Bristol City Council**

.....

Name: .....

Position: .....

#### **First in Bristol**

.....

Name: .....

Position: .....

# Schedule A

## Agreement Duration

1. This agreement runs for a period of five years from 1 April 2007 until 31 March 2012.
2. The agreement is amendable by mutual consent between the parties at any time. The proposed actions are subject to amendment as frequently as is necessary to improve and maintain the reliability and punctuality of bus services.
3. The partners will jointly communicate with the Traffic Commissioner in writing setting out the details of this agreement, the standards and targets and any agreed amendments to them.
4. The agreement can be terminated on three months notice in writing by one party to the other. The terminating party will concurrently provide a copy of the notice to the Traffic Commissioner.

# Schedule B

## Monitoring and Methodology

1. The signatories agree to adopt a co-operative approach to the monitoring and reporting of the reliability and punctuality of bus services in the administrative area of the City of Bristol.
2. The methodology to be applied will be agreed between the parties.
3. The targets for reliability improvements are set out in Schedule C.
4. The targets for punctuality improvements are set out in Schedule D.

# Schedule C

## Reliability Improvement Targets

Percentage of scheduled mileage operated:

Current: 99.1% (2006/07)

Target: 99.8% (2010/11)

Vehicle Availability:

Number of vehicles available at peak periods versus the company's Peak Vehicle Requirement (PVR):

Current: 100.0% (2006/07)

Target: 100.0% ( On Going)

## Schedule D

### Punctuality Improvement Targets

	Base Year										
		2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
% of Buses Starting Route on Time Trajectory	66.5	67.5	68.5	70.5	71.5	74.5	78.4	82.3	86.1	90.0	
	51.5	53.1	54.8	58.4	60.0	64.6	71.0	77.3	83.7	90.0	
% of Buses on time at intermediate timing points Trajectory	2.92	2.75	2.6	2.3	2.15	1.85	1.7	1.55	1.4	1.25	
<p><b>On Time:- This is defined as operating between one minute early and up to five minutes late</b></p>											

## Schedule E

### Supplementary Targets

No.	Target	Reasoning
(i)	At least 97% of vehicles on RTI enabled routes will have fully operational RTI equipment.	Operational RTI equipment is necessary to enable late running services to be given traffic signal priority as well as to enable intending passengers to make informed choices when disruption occurs.
(ii)	Buses on routes with raised kerbs at stops will dock at the raised kerbs over 95% of the time.	To facilitate boarding/alighting and to minimise the time taken by passengers with a mobility impairment.

# Schedule F

## Joint Proposed Actions

### **Route Upgrades**

First and BCC will continue to work together to plan and implement the comprehensive improvement of bus routes. This includes the completion of the A420/A431 Showcase Route and the network of routes set out in the GBBN proposals.

### **City Centre Service Routing**

First and BCC to work together to improve city centre bus service routing, including stop and crew change arrangements, to reduce susceptibility to delay.

### **Timing Points**

All services on all routes to have identified timing points no more than 15 minutes apart (generally a max of 10 minutes apart). Common timing points will be adopted on common sections of route. Sufficient and appropriate timing points give drivers clear guidance on the performance expected.

### **Bus Stops**

BCC to implement Bus Stop Clearway Orders and associated application of the Traffic Signs Regulations for 100% of bus stops by 31/12/07. BCC to inform the public of the need not to obstruct bus stops and to take robust enforcement action where obstruction occurs.

First to improve driver training and control with respect to docking at stops.

### **Bus Lanes & Parking Restrictions**

BCC to focus parking/loading enforcement on bus routes. When type approved digital cameras are available, this will be extended to moving traffic offences in bus lanes.

### **Real Time Information System**

The fitting of Real Time Information (RTI) equipment to the bus fleet enables the provision of traffic signal priority, real time data on bus service operation to be provided to service controllers and the public, schedule adherence information to drivers, and the provision of performance reports to aid service planning and timetabling. BCC will provide RTI equipment for the First fleet operating the Bristol network with First covering the maintenance costs. The system will be expanded to interurban routes as part of GBBN.

### **Traffic Control**

Urban Traffic Management and Control (UTMC) can minimise delays to general traffic and give priority to bus services. Through the Showcase and GBBN programme additional routes will be covered by the system. BCC will also upgrade its control room and increase the hours when it is staffed. To ensure due attention is given to the needs of bus services and to passenger information BCC Traffic Control and Public Transport Staff, together with First staff, will work together in the control room.

### **Congestion 'Hotspots'**

In addition to the Showcase and GBBN programme of works, BCC will give priority to addressing localised congestion problems on other routes.

## Schedule G

### Excess Waiting Time Worked Example

Excess Waiting Time is the difference between the average waiting time actually experienced by passengers and the waiting time one would expect from the schedule. If buses on a route are expected to run every 10 minutes, then statistically the average waiting time is this half this gap or headway, i.e. 5 minutes. If the buses run exactly to schedule then the average waiting time experienced by passengers will be 5 minutes and there will be no excess waiting time. The target suggested by the Bus Partnership Forum and set out in the Traffic Commissioner's Practice Direction is 1.25 minutes. This means that, for a service registered as every 10 minutes the average wait experienced by passengers should be no more than 6 minutes 15 seconds.

The example on the following page shows how it is calculated.

# Schedule G (cont)

## Worked Example

Time of Bus arrivals at a given timing point (a)	Headway in minutes (b)	Average wait time for each bus $(b)/2 = (c)$	Weighted average wait time $((b)*(c)) = (d)$
0800	---	---	---
0811	11	5.5	60.5
0819	8	4	32.0
0830	11	5.5	60.5
0850	20	10	200.
0900	10	5	50.
0913	13	6.5	84.5
0918	5	2.5	12.5
0930	12	6	72.0
0941	11	5.5	60.5
0950	9	4.5	40.5
1000	10	5	50.
1020	20	10	2000
1020	0	0	0.0
1030	10	5	50.0
1038	8	4	32.0
1050	12	6	72.0
1100	10	5	50.0
Number of buses scheduled per hour = 6 (e)	$\Sigma^n(b) = 180$		$\Sigma^n(d) = 1,127.0$
Headway = $60/(e)$ = 10 minutes (f)			Operational weighted average waiting time = $\Sigma^n(d) / \Sigma^n(b) =$ 6.26 minutes
Scheduled waiting time = $(f)/2 = 5$ minutes (g)			Excess waiting time = $(\Sigma^n(d) / \Sigma^n(b)) - (g)$ = 1.26 minutes