Central Control Facility

SCRTD METRO RAIL PROJECT

SPECIAL STUDY OF THE INTEGRATION OF BUS AND RAIL OPERATIONS CONTROL CENTERS

FINAL REPORT

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1.0 INTRODUCTION

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The Southern California Rapid Transit District (SCRTD) is currently planning its Metro Rail Central Control Facility. The expansion of this facility to include bus and light rail control operations is being considered. This report was prepared to assess the advantages and disadvantages of the integration of bus, light rail, and heavy rail control into one multi-modal control facility.

1.1 PURPOSE

The purpose of this report is to detail the advantages and disadvantages of integrating bus, light rail and heavy rail operations control. Four alternatives for operations control are evaluated:

- Separate Bus, Heavy Rail and Light Rail Facilities
- Separate Light Rail, Joint Bus and Heavy Rail Facilities
- Separate Bus, Joint Light and Heavy Rail Facilities
- Joint Bus, Heavy Rail and Light Rail Facilities.

Each alternative is assessed based on its performance against a set of cost and operational criteria.

1.2 APPROACH

This study was originally undertaken to evaluate bus and heavy rail control integration only. A six task work plan was devised to accomplish this:

Task 1: Review the present SCRTD Bus Central Control Facility's space, staffing, equipment and functions, and evaluate future requirements.

Task 2: Review the facility space, staffing, equipment and functions planned for the Metro Rail Central Control Facility.

Task 3: Evaluate the Central Control Facility space, staffing, equipment and functions at other selected North American transit systems.

Task 4: Evaluate the space, staffing and equipment required by a combined bus/rail Central Control Facility.

Task 5: Evaluate existing plans for both bus and rail Central Control Facilities on the basis of data gathered at other transit properties.

Task 6: Evaluate the Central Control Facility options open to SCRTD and make recommendations.

Booz, Allen was also commissioned by the SCRTD to conduct a study of the advantages and disadvantages of integrating the planned light rail central control facilities.

During the course of both studies three reports have been produced:

- Interim Report on Task 1: Review of SCRTD Bus Dispatch Operations
- Interim Report on Task 3: Documentation of Control Facilities and Operations at Selected North American Transit Systems
- Special Study of Metro Rail/Light Rail Central Control Facility Integration.

This final report integrates all of the previous work into a set of functional alternatives for the central control facilities and evaluates those alternatives against performance criteria.

1.3 FINAL REPORT ORGANIZATION

This report contains five other chapters:

- Chapter 2 presents the space and staffing requirements for independent bus, light rail and Metro Rail control facilities.

- Chapter 3 performs an analysis of the information which was obtained during the site visits to peer properties.
- Chapter 4 establishes and describes alternatives for the central control functions including staffing and support facilities requirements.
- Chapter 5 evaluates the alternatives against the performance criteria.
- Chapter 6 provides the final conclusions and recommendations.

2.0 SCRTD CENTRAL CONTROL FACILITY REQUIREMENTS

2.0 SCRTD CENTRAL CONTROL FACILITY REQUIREMENTS

The staff and space requirements for independent bus, heavy rail and light rail control facilities are presented in this chapter. The information is supported by the previous tasks of this study, a special study of heavy rail and LRT control integration, and preliminary analyses performed by the SCRTD.

2.1 BUS CONTROL

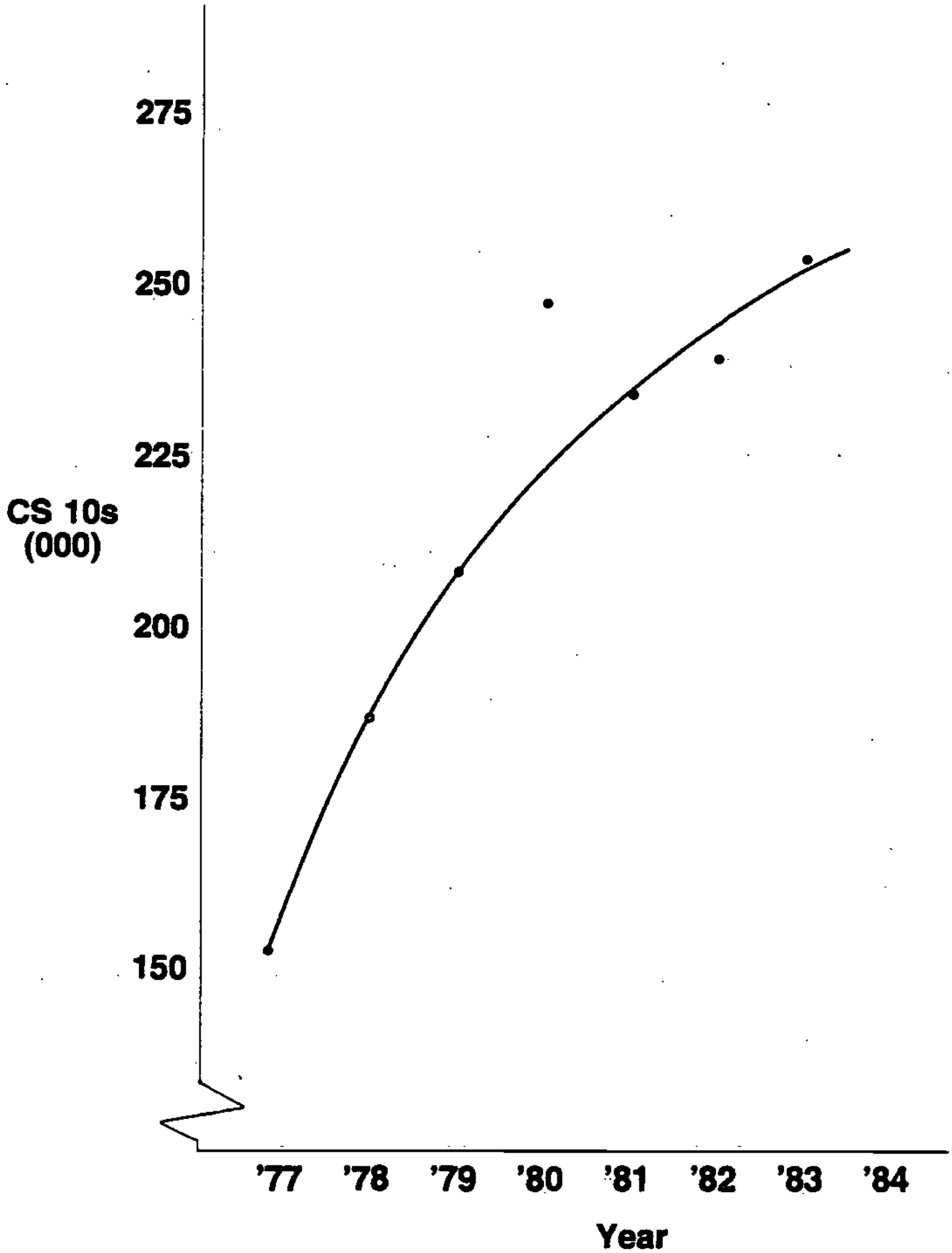
A comprehensive analysis of current bus operations was conducted in Task 1 of this study. The workload and operational performance of the bus control center was documented and the factors influencing these were identified and quantified. Relationships were developed and applied to future SCRTD level of service plans and control facility requirements were determined. The analysis was complicated, because the bus control center is currently undergoing significant changes such as the revamping of the computer-aided dispatch (CAD) system and the implementation of the vehicle maintenance system (VMS).

The staffing and space requirements determined through the Task 1 analysis are presented below.

2.1.1 Staffing

Peak dispatcher requirements are a function of the demand placed on the control center and the productivity of each dispatcher. The workload on the center, as measured by the number of incidents reported (CS 10 reports), has risen dramatically in recent years. As Exhibit 2-1 shows, the trend is still increasing, but at a decreasing rate. Assuming operating policy does not change and service levels remain relatively constant the demand on the control center will remain at least at its current level, and could be slightly higher. Recommendations, then, are based on the present level of demand. The current level of incidents is extremely high. This has prompted an investigation by the SCRTD. Should operational or procedural inefficiencies be identified and remedied, bus control staffing requirements might be reduced. If this occurs, a re-evaluation of staffing needs is necessary.

EXHIBIT 2-1
ANNUAL PRODUCTION OF CS 10 REPORTS



There are significant technological changes which are planned for the bus control center:

- A vehicle maintenance system for electronically communicating revenue service failures from the control center to the various bus maintenance divisions.

- An automatic vehicle location system which will allow the bus dispatch personnel to monitor the position of buses in the SCRTD network.

- An automatic call distributing system which will assign incoming calls to the first available bus dispatcher.

These changes are intended to provide the bus control center with a greater measure of control of the bus operations. However, the increased workload is expected to require additional personnel to effect that control. There are presently 10 peak dispatchers in the center an it is estimated that a 40 percent increase in that level will be required to accommodate the increasing number of bus incidents and the planned technological changes. To allow a growth contingency the bus control center should provide space for 16 dispatch personnel and a supervisor.

2.1.2 Space

The space requirements of the bus control center are driven by the number of peak dispatchers and the size of each workstation.

Workstation size is dependent upon the technology employed. Currently, each workstation occupies approximately 84 square feet. This estimate is generous and includes a 3 foot maintenance clearance in front of the workstation, and a 2 foot aisle clearance behind. The new control technology will not affect this estimate, as the current workstation shells are to be modified to house the new consoles. Therefore, the space requirement estimated per workstation is 84 square feet.

The supervisor's workstation is the same size as the dispatchers' stations, however, two tables used for information support are utilized. The supervisory workstation, again including a provision for maintenance and aisle clearance, occupies approximately 138 square feet.

The total space requirement for the bus control center can be determined by calculating the total dispatcher workstation requirements, adding the supervisor requirements, and providing for personnel circulation. As shown in Exhibit 2-2, this yields a requirement of 2,223 square feet. Conceptual layouts of the bus control center are provided as Exhibits 2-3 and 2-4.

Computer and equipment rooms are necessary to support bus control. Current space allocated to these functions is 344 square feet. SCRTD personnel estimate, however, that the new communications system will require 1,500 square feet for a computer and equipment room.

The total space required for the bus control facility is the sum of the dispatch and the equipment/computer room space allocations. Therefore, 3,723 feet is needed for bus operations control.

A summary table of bus control staffing and space requirements is provided as Exhibit 2-5.

2.2 METRO RAIL CONTROL

A Central Control Facility Functional Plan is in preparation, and preliminary results from that plan are used to assess the baseline system[1] rail control staffing and space requirements are discussed below. The Metro Rail Central Control Facility will monitor and control train movements and also monitor station operations via closed circuit television (CCTV).

2.2.1 Staffing

A peak staff of 5 is estimated for Metro Rail train control:

- 2 train control operators
- 1 traction power operator
- 1 communications operator
- 1 supervisor of train control.

Two train control operators will oversee train operation and monitor train movements throughout the route network. They will provide a direct communications interface with field personnel.

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1 The baseline system is defined as 18.6 route miles serving 18 passenger stations.

EXHIBIT 2-2
Determination of Bus Control Space Requirements

1. (Peak Dispatchers) (Space Per Workstation) = (Dispatcher Space Requirement)

16 84 Sq. Ft. = 1,344 Sq. Ft.

2. (Dispatcher Space Requirement) + (Supervisory Workstation Space Requirement) = (Total Functional Space)

1,344 Sq. Ft. + 138 Sq. Ft. = 1,482 Sq. Ft.

3. (Functional Space Requirement) (Circulation Factor) = (Total Control Facility Requirements)

1,482 Sq. Ft. 1.50 = 2,223 Sq. Ft.

EXHIBIT 2-3
BUS CENTRAL CONTROL
CONCEPTUAL LAYOUT 1

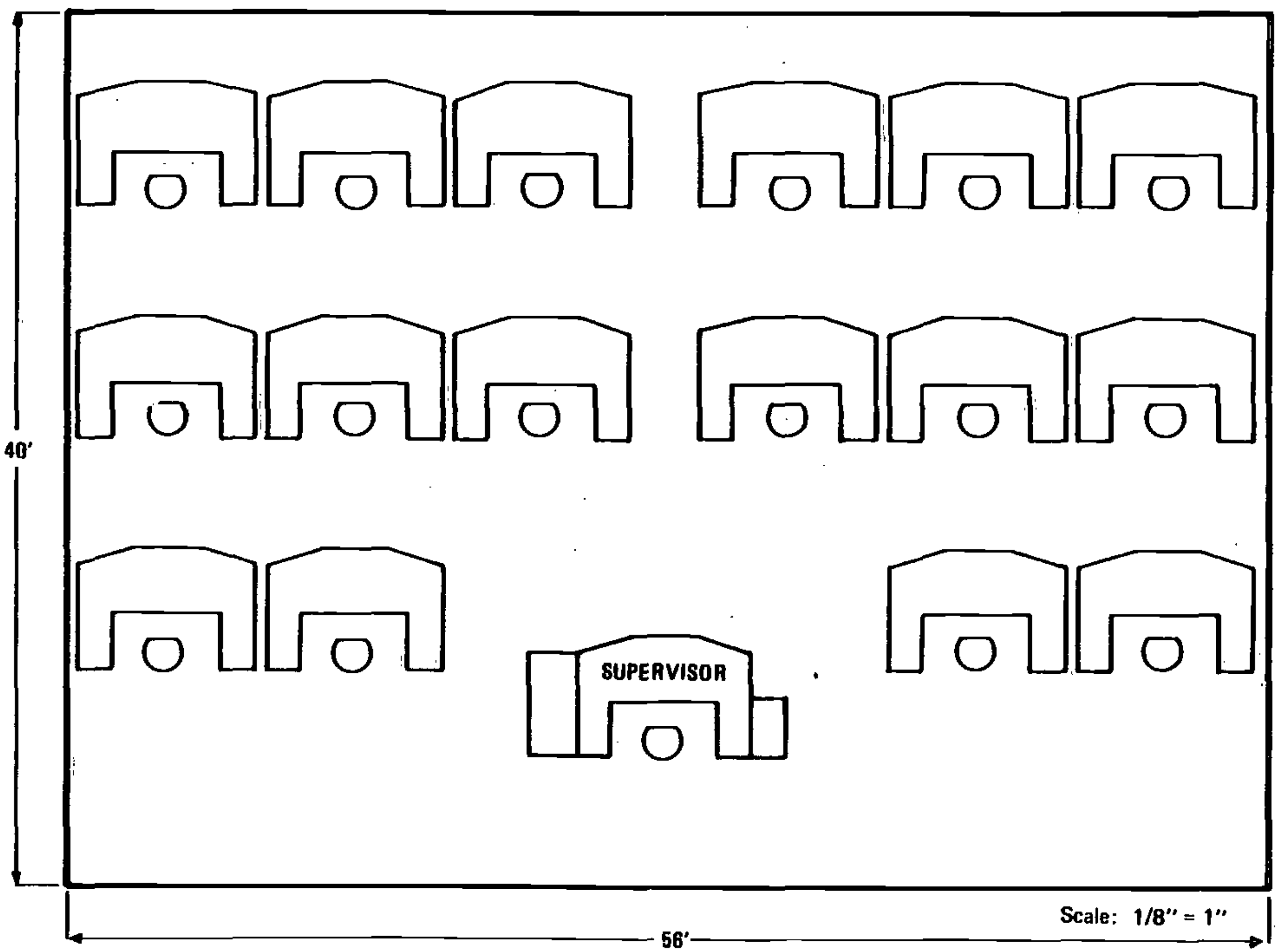

EXHIBIT 2-4
BUS CENTRAL CONTROL CONCEPTUAL LAYOUT 2

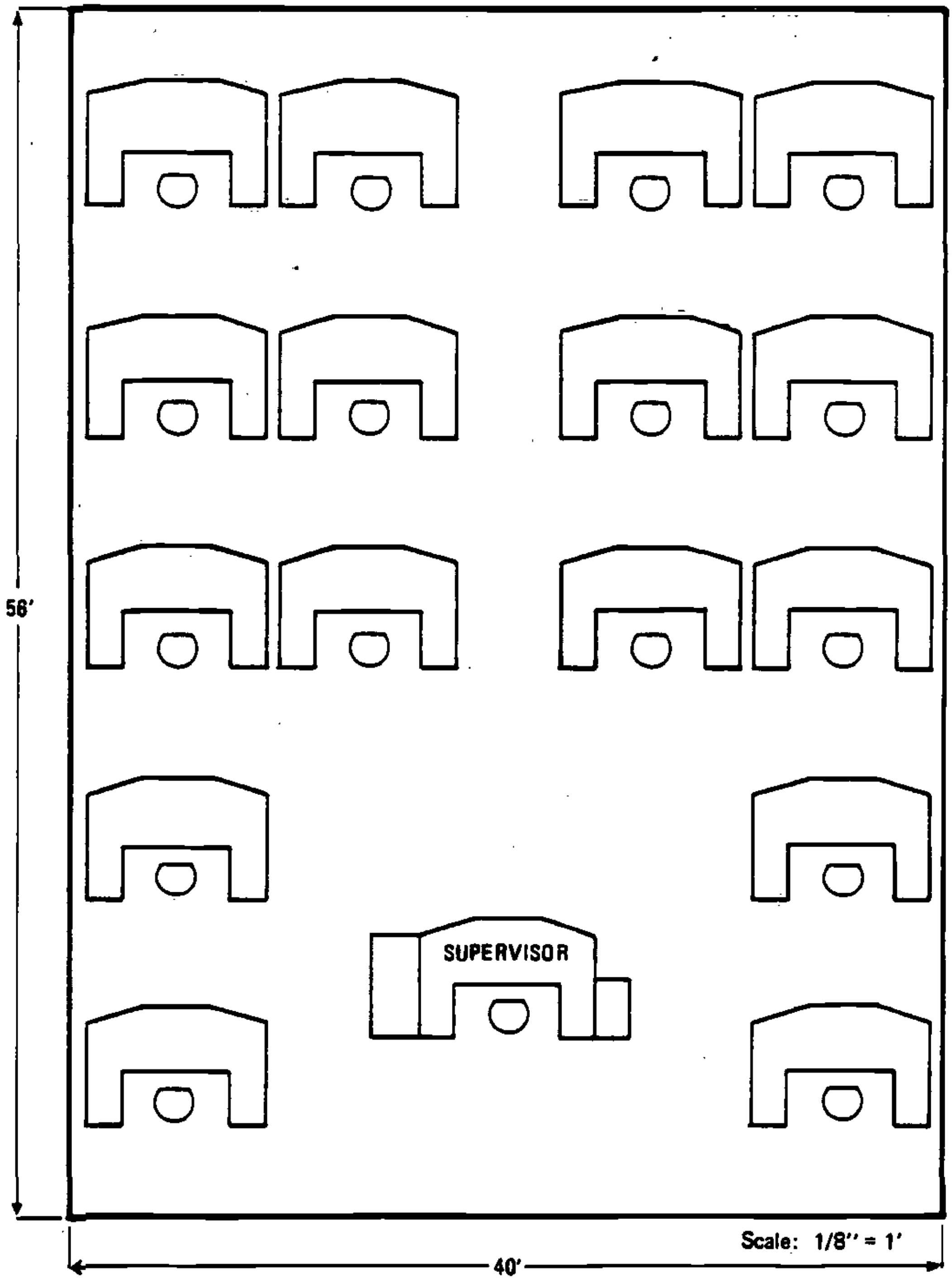

EXHIBIT 2-5
Summary of Bus Control Requirements

STAFFING

Peak Dispatchers	14
Contingency	2
Supervisors	1
Total Staff	17

SPACE

Dispatch	2,223 Square Feet
Computer	1,500 Square Feet
Equipment	*
Total Space	3,723 Sqaure Feet

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* Included in computer space allocation

A traction power operator will monitor and control all traction power circuits throughout the system. He receives and monitors all maintenance calls and dispatches maintenance personnel in response to wayside equipment failures.

The responsibility for monitoring the fire and security alarms and displays at the facilities resides with a communications operator. He also dispatches maintenance personnel in response to these incidents, and provides public address announcements to passengers regarding delays or unusual situations.

The final control position is the supervisor of train control. He is in charge of all activities within operations control.

In addition to train operations and control, CCTV monitoring is to be included in the Metro Rail Control Facility. Each observer will monitor two stations during the peak for an initial peak position requirement of 9. Expansion of the Metro Rail system will increase the peak requirement by 9 positions. A supervisor of CCTV monitoring is necessary on all shifts.

An optional position which might be included within Metro Rail Control is a maintenance coordinator. This staff member would be a dedicated maintenance dispatcher, organizationally within the maintenance division or at least with extensive maintenance experience. His function would be to receive maintenance requests and coordinate maintenance response. For optimal efficiency, he should be supported by a real-time file of vehicle, personnel, and shop availability. The maintenance coordinator could be located within Metro Rail Control or a rail maintenance headquarters.

The utilization of a central rail maintenance dispatcher does not significantly affect staffing or space requirements of the rail control center. The requirements of maintenance dispatching are independent of the four alternative control alignments of this study and therefore do not effect subsequent evaluations and comparisons. As such, central rail maintenance dispatch is excluded from further discussions. While this approach has apparent operational advantages and should be considered, a more detailed investigation is needed for verification and cost justification.

2.2.2 Space

The Rail Control Center will contain four main consoles. The train operators' console will be centrally located and in close proximity to the systems status display board. Behind this, but also with visual access to the display board, are the traction power operator's console and the communications console. An additional position is included in the latter console for the Fire Marshall. The final tier of the layout is the supervisor's console--possibly elevated--oriented to visually monitor all staff and individual console functions.

The conceptual layout of the Rail Control Center is shown as Exhibit 2-6. The space requirement for this center is estimated at 2,000 square feet.

The space for equipment and computer support for the four operations control consoles is an estimated 3,500 square feet: 2,000 square feet for the equipment room; and 1,500 square feet for the computer room. An additional 1000 square feet of equipment space is estimated for the expansion of Metro Rail operations.

The CCTV observation area will consist of 5 workstations for viewing TV monitors and 1 supervisory station. Each workstation will include 2 positions for observers and be positioned in front of 2 monitoring racks, each containing approximately 10 video screens. The total space requirement for this is estimated at 2,000 square feet, as shown in the conceptual layout of Exhibit 2-7. The expansion of the Metro Rail system to serve Santa Monica and Norwalk will require an additional 1250 square feet (see Exhibit 2-8).

A summary of the Rail Control Center staffing and space requirements is provided as Exhibit 2-9.

2.3 LRT CONTROL

The LRT operations control requirements are very similar to those of heavy rail. Identification and discussion of these requirements follows.

EXHIBIT 2-6
METRO RAIL CONTROL CENTER
CONCEPTUAL LAYOUT

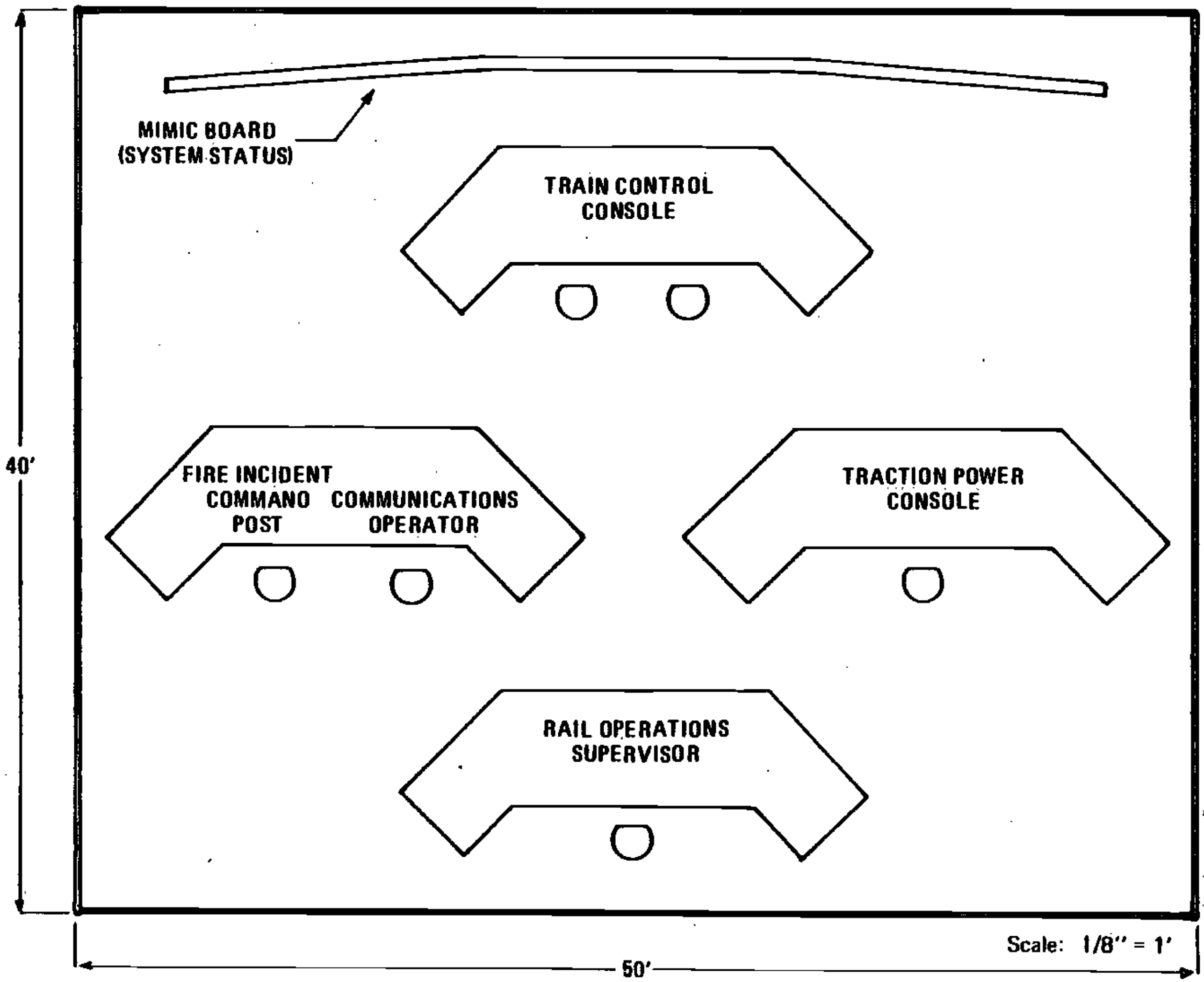


EXHIBIT 2-7
CCTV OBSERVATION CONCEPTUAL LAYOUT

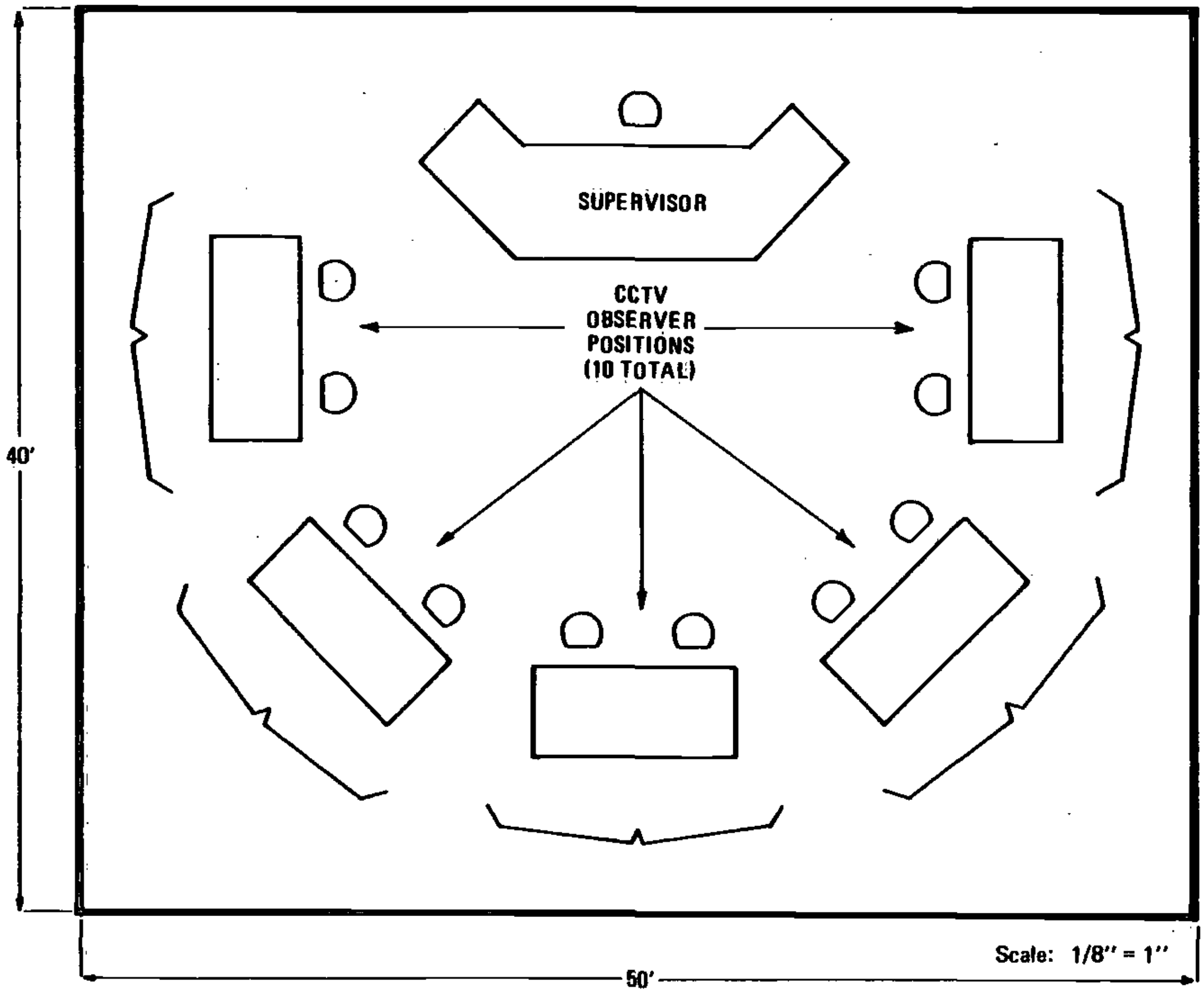


EXHIBIT 2-8

CCTV OBSERVATION (EXPANDED)
CONCEPTUAL LAYOUT

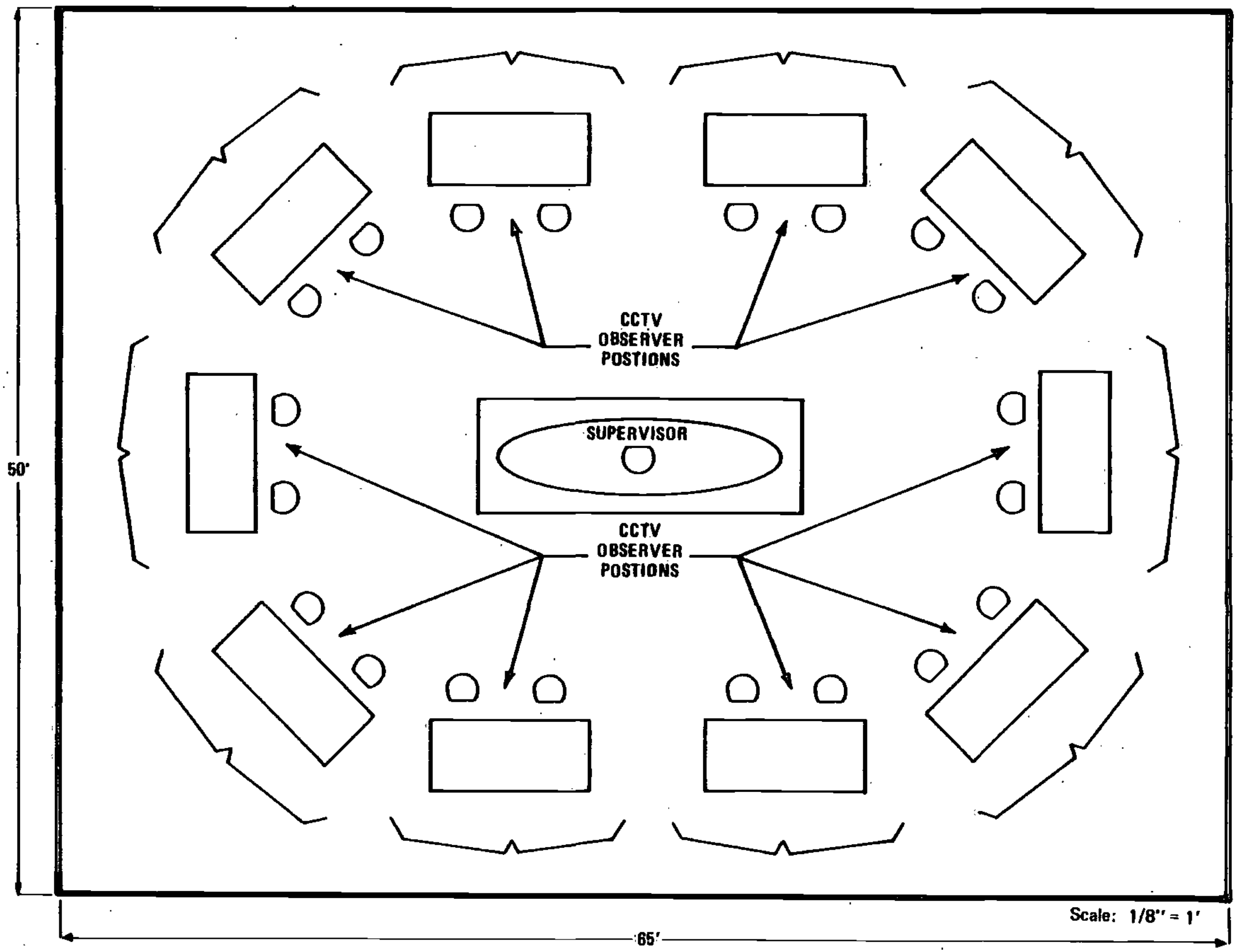


EXHIBIT 2-9
Summary of Metro Rail Control Requirements

PEAK STAFFING

Rail Control:	
Train Control Operators	2
Traction Power Operator	1
Communications Operator	1
Rail Operations Supervisor	1
CCTV:	
Monitors*	18
Supervisor	1
Total Peak Staff	24

SPACE

Rail Control	2,000 Square Feet
Computer	1,500 Square Feet
Equipment*	3,000 Square Feet
CCTV*	3,250 Square Feet
Total Space	9,750 Square Feet

* Includes Metro Rail Expansion requirements.

2.3.1 Staffing

The peak staffing requirements for LRT operations control is 4 people, consisting of:

- 1 Train Control Operator
- 1 Traction Power Operator
- 1 Communications Operator
- 1 LRT Operations Supervisor.

The functional responsibilities of each of these individuals are the same as their Metro Rail counterparts.

Monitoring of light rail station activity is also to be conducted through the utilization of CCTV equipment. However, this function is to be separate from operations control. A remote LRT security center will be devoted to station safety and security.

2.3.2 Space

The space requirements for LRT operations control is the same as for Metro Rail control: 2,000 square feet. The layout is shown in Exhibit 2-10. For improved visual access, the supervisor's console could be elevated.

The equipment and computer support for light rail control is not yet defined but probably requires a smaller space allocation than for Metro Rail. The floor area estimated for these functions is 2,200 square feet, including 1,200 square feet for the equipment room, and 1,000 square feet for the computer room. Total space requirements for LRT operations control is the sum of the functional and support facility requirements--4,200 square feet.

A summary of staffing and space requirements is shown in Exhibit 2-11.

2.4 POLICE DISPATCH

The SCRTD Transit Police Force has stated a need for one central Police Command Center, located within the Metro Rail Central Control Facility. Communications and security dispatching would be accomplished from this center for bus, heavy rail, and LRT operations, regardless of the location of the individual control centers.

EXHIBIT 2-10
LRT CONTROL CENTER
CONCEPTUAL LAYOUT

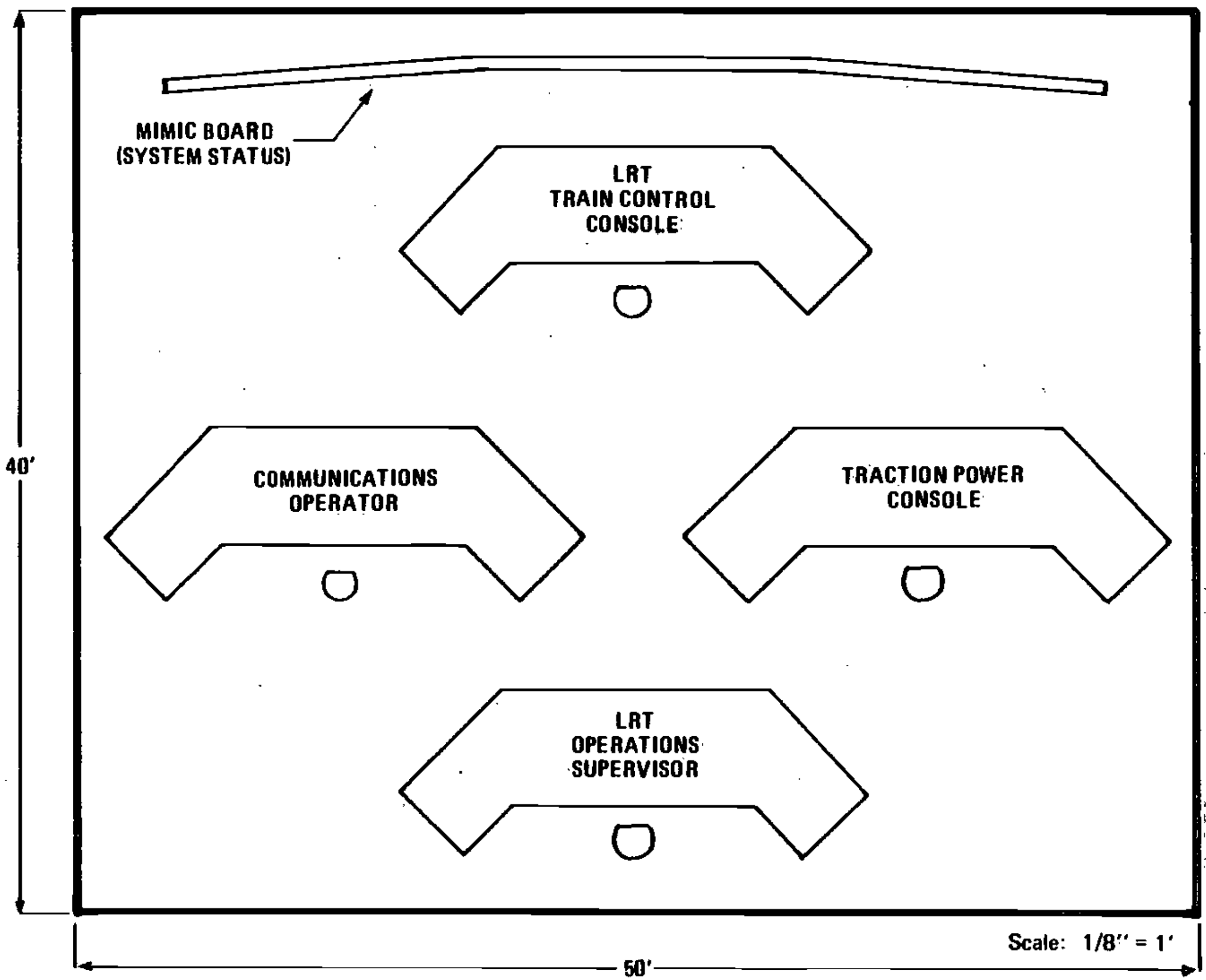


EXHIBIT 2-11
Summary of LRT Control Requirements

PEAK STAFFING

LRT Control

Train Control Operators	1
Traction Power Operator	1
Communications Operator	1
LRT Operations Supervisor	1
Total Peak Staff	4

SPACE

LRT Control	2,000 sq. ft.
Computer	1,000 sq. ft.
Equipment	1,200 sq. ft.
	4,200 sq. ft.

2.4.1 Staffing

Security dispatching is to be accomplished by a peak staff of 4 police officers. One officer would be responsible for performing the administrative functions of the center (e.g., filing, answering the telephone, etc.). Two officers would monitor the radios and dispatch police in response to incidents. One of these dispatchers would be dedicated to rail operations (including LRT), and one would be dedicated to bus. The final position is the Sergeant-of-the-Watch. He would have overall responsibility for the Police Command Center and would coordinate with the operations control centers in emergencies.

2.4.2 Space

The current police dispatch center located within the bus control area occupies 360 square feet. Included within this room is one large console for security dispatching which also includes criminal investigation equipment. The room is usually staffed by one police officer, although a second is employed during peak periods to perform administrative functions. The room easily accommodates the second policeman.

The room for the new Police Command Center should allow sufficient space for a second dispatching console, and a command console for the Watch-Sergeant. SCRTD estimates that 800 square feet is an appropriate allocation for this center.

The actual console sizes and arrangement have not yet been specified. It is assumed that a single desk is sufficient for the officer performing the administrative duties of the command center; that each dispatching console is similar in size to the bus dispatcher's console; and the Watch Sergeant's console is similar in size to that of the rail operations control supervisor's console in size. Based on these assumptions and the SCRTD estimate of 800 square feet, conceptual layouts of the Police Command Center were developed and are provided as Exhibits 2-12 and 2-13.

EXHIBIT 2-12
POLICE COMMAND CENTER
CONCEPTUAL LAYOUT 1

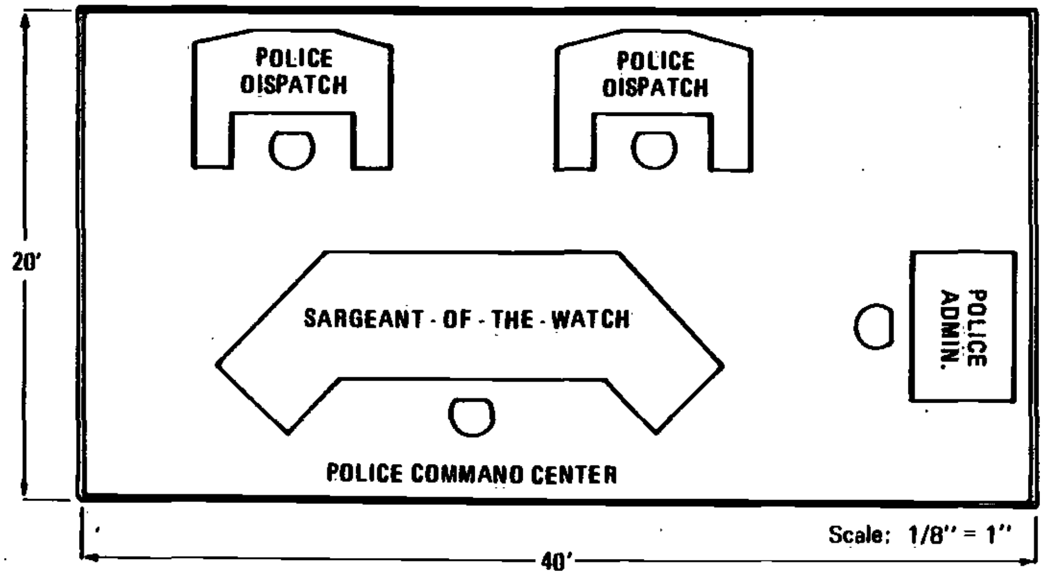
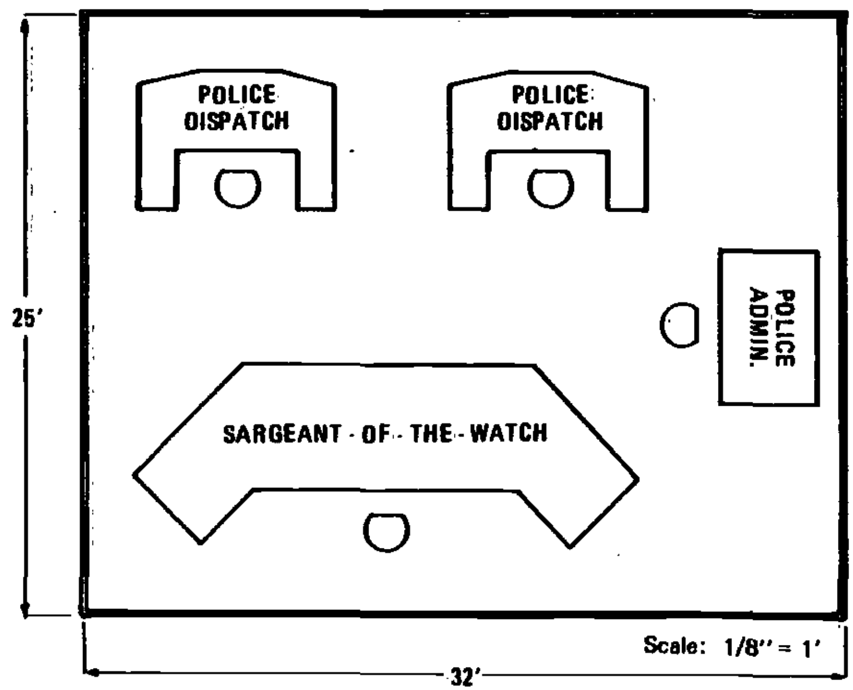


EXHIBIT 2-13

POLICE COMMAND CENTER
CONCEPTUAL LAYOUT 2



3.0 PEER PROPERTY ANALYSIS

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Peer property site visits were conducted at five North American transit systems in April 1984:

- Metropolitan Atlanta Rapid Transit Authority (MARTA)
- Washington Metropolitan Area Transit Authority (WMATA)
- Chicago Transit Authority (CTA)
- Greater Cleveland Regional Transit Authority (GCRTA)
- Toronto Transit Commission (TTC)

The visits were made to obtain information concerning staffing levels and space allocations, and to gain insights into the procedures conducive to efficient and effective operations control. The detailed documentation of the information attained from these visits is provided in the Task 3 Report.

This chapter compares from the peer properties staffing and space allocation data to SCRTD preliminary assessments. Based on these data, modifications and adjustments are made to the baseline estimates established in Chapter 2.

3.1 BUS CONTROL

The SCRTD bus control staffing and space requirements are markedly different from those of the peer properties. To verify and support the interpretation of these variation, information was solicited from six additional transit properties--Seattle Metro, Metropolitan Transit Commission (St. Paul), Massachusetts Bay Transportation Authority (Boston), AC Transit (Alameda Contra Costa Transit District) (Oakland), Bi-State Development Agency (St. Louis), and Metropolitan Transit Authority (Houston). Discussion and possible explanations of the SCRTD's comparatively large staffing and space requirements are presented in ensuing sections.

3.1.1 Staffing

The SCRTD peak control staff is very large in comparison to other North American Transit properties. As shown in Exhibit 3-1, the SCRTD's planned level of 16 peak dispatchers is inconsistent, relative to fleet size, with the peak staff employed at the other systems. Possible explanations for this are highlighted and explored in detail below.

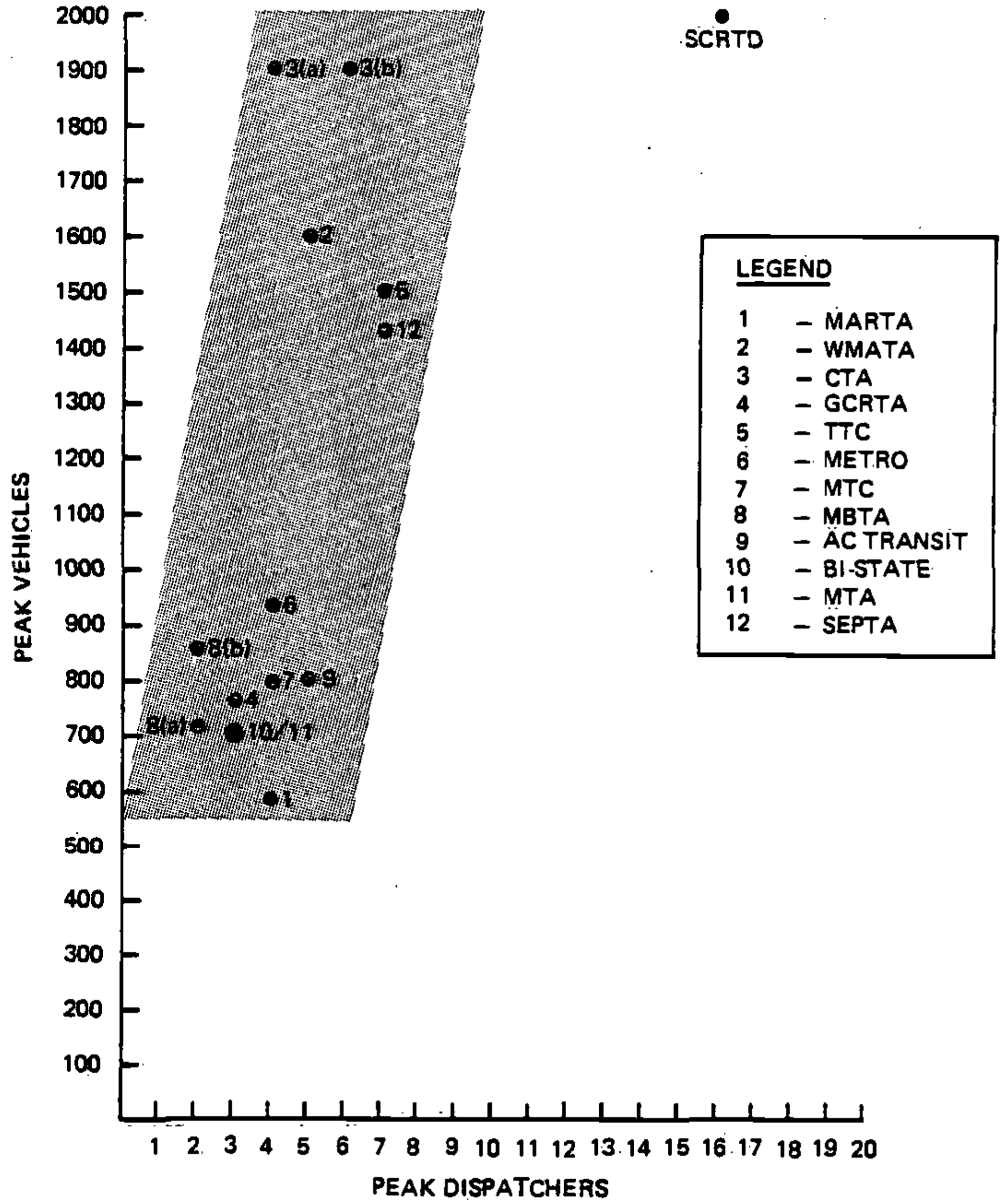
The SCRTD Employs a Very Small Field Supervisory Force. As Exhibit 3-2 shows, the number of street supervisors differs considerably from the peak supervisory staff at other properties. The effect of this is that the responsibility for operations control resides almost exclusively with the Bus Control Center. Due to their small number, street supervisors can not actively control street operations to the extent of their counterparts at other properties. Some possible implications of this are:

- Situations requiring routine assistance are prompting calls to the Control Center. If street supervisory staff were increased, operators could wait until a street supervisor is encountered enroute, at fixed locations. Thus, certain calls to dispatchers could be eliminated and the workload on the Center reduced.

- The response time for action calls requiring immediate street supervisory assistance increases as supervisory staff decreases. After a vehicle operator requests assistance he must wait until an available supervisor is dispatched and arrives at the scene. This delay may be prompting follow-up calls to dispatchers which are increasing the workload on the Center.

The Workload on the SCRTD Bus Control Center is Excessive--A dramatic rise has occurred in the workload of the Bus Control Center in recent years. As was shown on Exhibit 2-1, more than a quarter million incidents were documented in 1983, and the load continues to increase. Task 1 of this study included an investigation of this trend and resulted in the identification and quantification of the causing factors. Subsequent to the Task 1 report a Trouble Report Analysis was conducted by the SCRTD (included as Appendix A). This survey of CS10 reports shows that poor vehicle performance is the primary factor

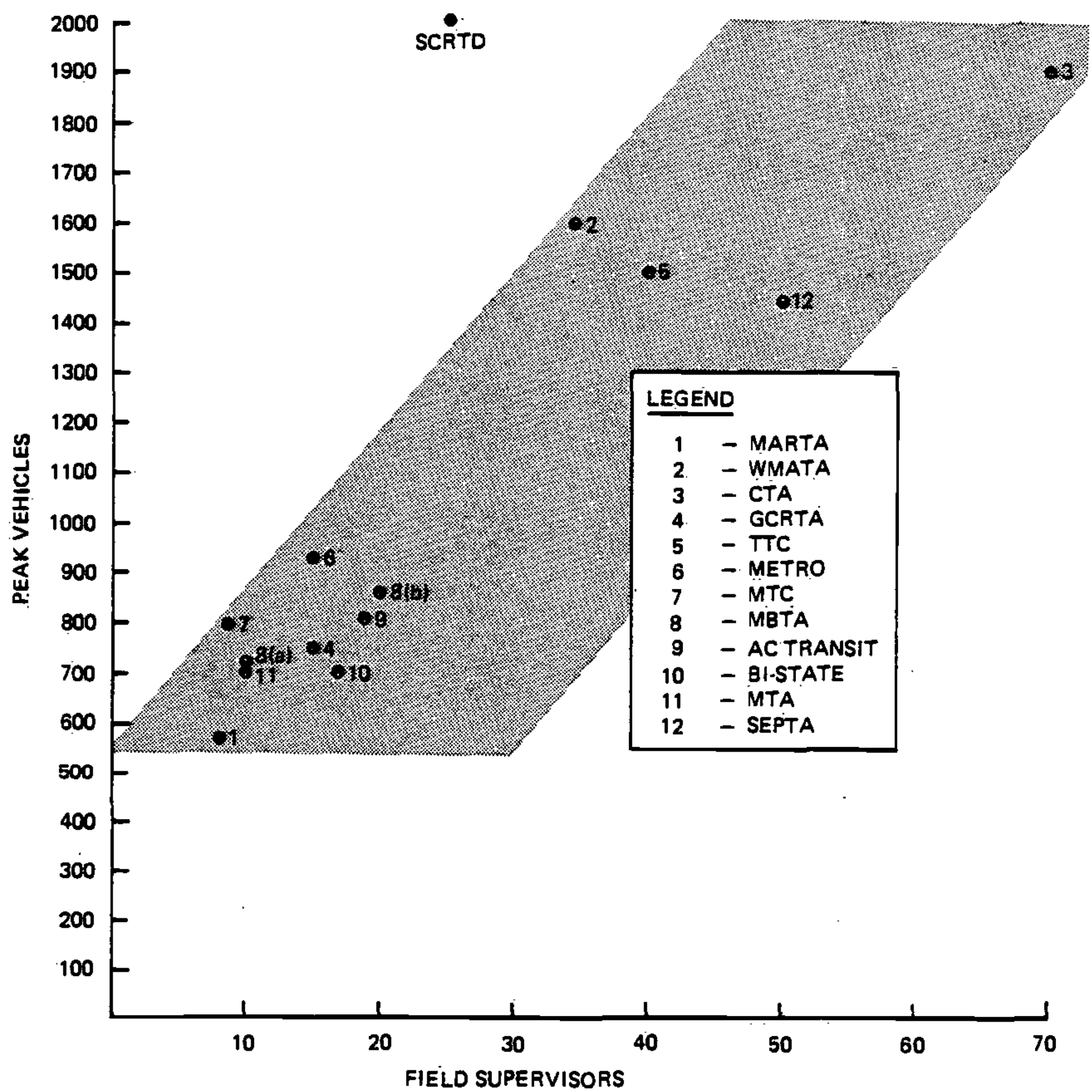
EXHIBIT 3-1
BUS CONTROL CENTER STAFFING



NOTE

3(a) - CTA (Dispatchers only)
3(b) - CTA (Includes 2 supervisors)
8(a) - MBTA (Bus only)
8(b) - MBTA (Includes 82 LRVs, 42 PCCs & 25 trackless trolleys)

EXHIBIT 3-2
FIELD SUPERVISOR STAFFING



NOTE

8(a) - MBTA (Bus only)
8(b) - MBTA (Includes 82 LRVs, 42 PCCs & 25 trackless trolleys)

driving the workload of the Control Center. Over 50 percent of all transactions result from bus changes or mechanical defects, as vehicles are achieving only about 1150 average miles between road calls. The peer property fleets are said to achieve an average miles between road calls from 2400 to 2800 miles--more than twice that of the SCRTD, although those records have not been independently verified.

The Planned Technology for Bus Control Center is Advanced--The SCRTD's planned communications system substantially increases dispatcher staffing requirements--40 percent based on SCRTD estimates. Quantitative support for this increase has not been found, nor has a detailed assessment of the costs and benefits of this system. It is recommended that these issues be investigated and resolved, as significant impacts on staffing and also on space requirements directly result from implementation of this communications system.

A required staff of 16 dispatchers is assumed to be appropriate throughout the remainder of this report. Should the above issues be investigated and modifications made, a reduction in staff requirements may be achieved.

3.1.2 Space

The space required for the Control Center is a function of the staff required and the console size. Given a staffing level of 16 dispatchers and one supervisor, and a workstation similar in size to those currently utilized, the floor space required for the dispatch area is as presented in Chapter 2--2223 square feet. This is a very large allocation in comparison to the peer group (Exhibit 3-3) but results directly from staff size.

The computer space required to support the proposed communication system is substantially greater than the space utilized at other properties, with the exception of the TTC, and more than 4 times greater than the current floor space utilized. As Exhibit 3-3 illustrates, the SCRTD requirement of 1500 square feet is less than the 2500 square feet which will house the TTC's computers. The TTC allocation however, represents a primary and redundant computer at each of 10 divisions--individual computer rooms being 250 square feet and comparable in size to the other peer properties.

EXHIBIT 3-3
Peak Vehicles and Bus Control Facility Space Allocation
(in square feet)

	MARTA	WMATA	CTA	GCRTA	TTC	SCRTD
Peak Vehicles	580	1,600	1,900	750	1,500	2,000
Bus Control (in square feet)						
Dispatch	600	500	1,350	1,500	2,200(a)	2,223
Computer	(b)	350	250	150	2,500(a)	1,500
Equipment	(b)	(c)	165	(b)	(b)	(d)
TOTAL	600	850	1,765	1,650	4,700	3,723

(a) Represents planned Automatic Vehicle Monitoring Communication System; space distribution between 10 separate divisions (e.g., each division will have approximately 220 square feet for dispatch and 250 square feet for computers).

(b) Included in bus dispatch room allocation.

(c) Included in rail equipment room.

(d) included in computer room allocation.

SCRTD's large computer space requirement results from the deployment of the new communication system. A cost-benefit analysis of this new system is highly recommended prior to the final planning of the bus control facility.

3.2 RAIL CONTROL

The heavy rail staffing and space requirements are very similar to those of the peer group. As such, the staffing levels and floor space allocation estimates of the rail control baseline seem appropriate. Support for this is presented and discussed below.

3.2.1 Staffing

The peak staff employed by the rail control centers of the peer properties and the estimated levels required at the SCRTD are presented in Exhibit 3-4. After accounting for discrepancies in technology and system size--detailed in the Task 3 report--the staff size utilized by each for actual control of train operations is very similar. Therefore, adjustments to the baseline staffing estimates requirement are unwarranted.

3.2.2 Space

The total space allocated to rail control is reasonably consistent with that of the peer group, considering variations in the technology deployed and the property sizes. As Exhibit 3-5 illustrates, train/power control allocations range from about 2000 to 3000 square feet. SCRTD's plan for 2000 square feet is appropriate for their staff size and consistent with the peer systems.

The computer space requirement is consistent for all systems but one, ranging from 1200 square feet to 1680 square feet. The exception to this is the CTA where a vastly different control technology exists. The computer space allocated at the SCRTD seems appropriate.

A build up approach was used (by the Metro Rail Transit Consultants) to determine the requirements. Therefore, a peer comparison was not conducted. The number of equipment racks needed was determined, and then multiplied by the space required per rack to yield total floor space. Although the space allocation of 3000 square feet (including expansion) is somewhat high, it can be justified.

EXHIBIT 3-4
Rail Control Peak Staffing Levels
Peer Group and SCRTD

	MARTA	WMATA	CTA	GCRTA	TTC	SCRTD
Train Control	2	3	4	3	2	2
Power Control	1	1	2	1	2	1
Communications/ P.A. Announcer	2	1	1	-	-	1
Control Supervisor	1	1	2	1	1	1
TOTAL	6	6	9	5	5	5

EXHIBIT 3-5
Rail Control Space Requirements
Peer Group and SCRTD
(in square feet)

	MARTA	WMATA	CTA	GCRTA	TTC	SCRTD
RAIL CONTROL						
Train/Power Control	2700	1000[a]	1930	2900	3200	2000
Computer	1200	1680[b]	325	1280	1250	1500
Equipment	900	2310	1650	1800	3025[c]	3000
TOTAL	4800	4990	3905	5980	7475	6500
CCTV MONITORING	2100	(d)	--	--	(d)	2000

(a) Physically constrained; currently studying expansion.

(b) An additional 1000 square feet of computer support area is utilized.

(c) Includes LRT equipment.

(d) Monitoring in stations, by station attendants.

3.3 LRT CONTROL

Of the peer properties, only the GCRTA and TTC operate light rail vehicles. A detailed comparison of the SCRTD with the peer group is therefore inappropriate and also because of the lack of detailed definition of the operations and control requirements for the LRT system.

3.3.1 Staffing

A staffing comparison is not conducted due to a shortage of data and functional variations in the data that is available. The GCRTA's LRT and heavy rail control is completely integrated and modal separation of staff is impossible. At the TTC, control of all surface modes is maintained by a joint dispatching pool and again, a modal breakdown is not possible.

The SCRTD staffing estimate can be supported, however. Rail control staff size, either for heavy rail or LRT, is dependent primarily upon the functions of the control center, rather that system size or technology. Based on the functional responsibilities of control personnel as discussed in Section 2.3, the staff size estimate for SCRTD LRT operations control is appropriate.

3.3.2 Space

Direct comparison of SCRTD's LRT space requirements and the peer group is not possible, as both the GCRTA and TTC have integrated systems. However, the space required for control is readily verifiable because it is dependent upon the peak staff size and the technology deployed. Because staff size is known and reasonable estimates of work station size have been made (as shown previously in Exhibit 2-9), control facility requirements are supported.

Equipment and computer space requirements for LRT control are estimates based on preliminary SCRTD assessments. Comparative data is unavailable.

3.4 POLICE COMMAND CENTER

The peer property site visits did not yield a substantial amount of information on the requirements or operations of a Police Command Center. Only WMATA provides a Center similar to the planned Command Center of the SCRTD. A comparison of these two systems follows below.

3.4.1 Staffing

WMATA is the only peer property with a police command center functionally similar to the SCRTD's. A peak staff of four is provided and includes one security dispatcher, one administrative position, one CCTV monitoring position for the security of the Administration Facility, and one supervisor. This staffing level is comparable in size and function to the SCRTD's and, since WMATA's bus and rail system is of comparable size, the SCRTD staffing level seems appropriate. However, the need for a second dispatcher at the SCRTD is not operationally supportable. It is assumed that a central pool of policemen will be dispatched for incidents occurring on any mode. Therefore, a dedicated police dispatcher for each mode, as the SCRTD Transit Police have requested, seems unnecessary. Also, the total load is not expected to be excessive[1], and one police dispatcher seems sufficient. Pending further study, however, the provision for the second police dispatcher will be included.

3.4.2 Space

SCRTD's estimate of 800 square feet exceeds the 350 square feet at WMATA's police command center; however, WMATA's is admittedly constrained. Even with the elimination of one dispatcher position at the SCRTD, the space allocated to this function will remain at 800 square feet. This will ensure that access control to this center can be maintained without unnecessarily confining the occupants. It also provides space for the inclusion of the second dispatcher.

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1 Included in the Task 1 report of this study is an estimate of 22,000 security incidents occurring per year on the bus system. Approximately half of these, however, are handled directly by the bus dispatcher, without security assistance. The incidents requiring security dispatching total less than 40 per day. The inclusion of heavy rail and LRT operations should not add a sufficient number of incidents to warrant an additional dispatcher or an additional station.

4.0 SCRTD CONTROL ALTERNATIVES

4.0 SCRTD CONTROL ALTERNATIVES

This chapter defines the alternatives available to the SCRTD for controlling bus, LRT, and heavy rail operations. For each alternative, the control staffing and space requirements are given. Facility layout options are provided and organizational structures are defined. Supporting functions and facilities are included within each alternative description, as is a functional discussion of emergency procedural requirements.

In order to establish alternatives, the current SCRTD organizational chart was modified to include rail and LRT operations. Currently, bus operations control is contained within the Transportation Division in the Transportation Services Section (see Exhibit 4-1). As this section will probably expand to include LRT and rail services, a new section within the Transportation Division is needed for the operations control of all modes. Overall responsibility for this section would reside with an Operations Superintendent, and each control center would be directly managed by a Control Manager (equivalent to the SCRTD's Bus Dispatch Manager for bus operations) for that mode.

This proposed structure is supported by the recommendations of the peer properties. The revised organizational chart is presented in Exhibit 4-2.

4.1 ALTERNATIVE 1: SEPARATE BUS, RAIL, AND LIGHT RAIL CONTROL FACILITIES

The first alternative for operations control is separate facilities for each mode. This alternative will closely correspond to the baseline established in Chapter 2, but will include modifications resulting from the peer analysis in Chapter 3.

4.1.1 Staffing

Independent operations control centers require that controllers (e.g., dispatchers) and supervisors be dedicated to one respective mode. The complete separation of control operations does not allow for

EXHIBIT 4-1

ORGANIZATION CHART: SCRTD OPERATIONS

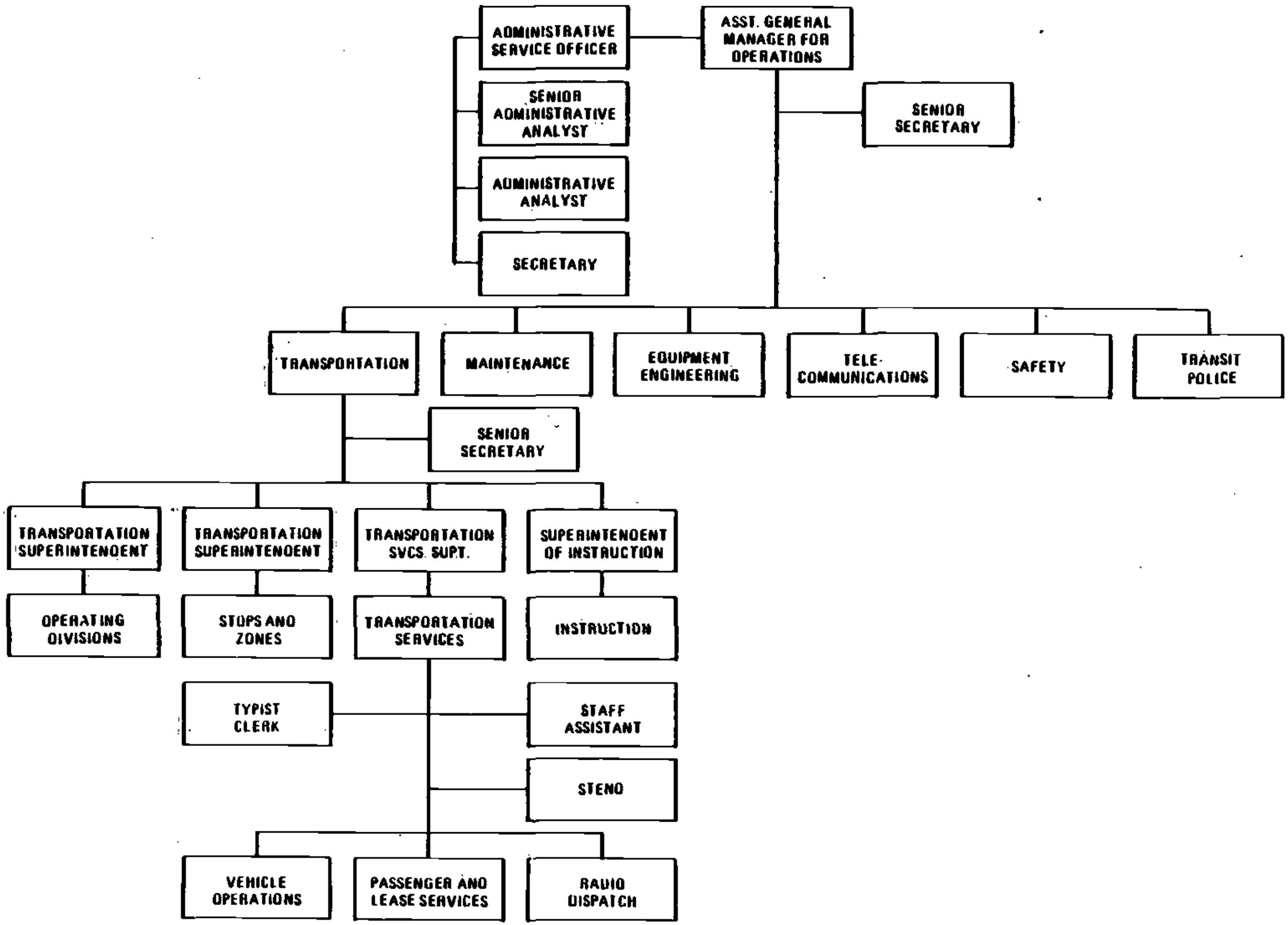
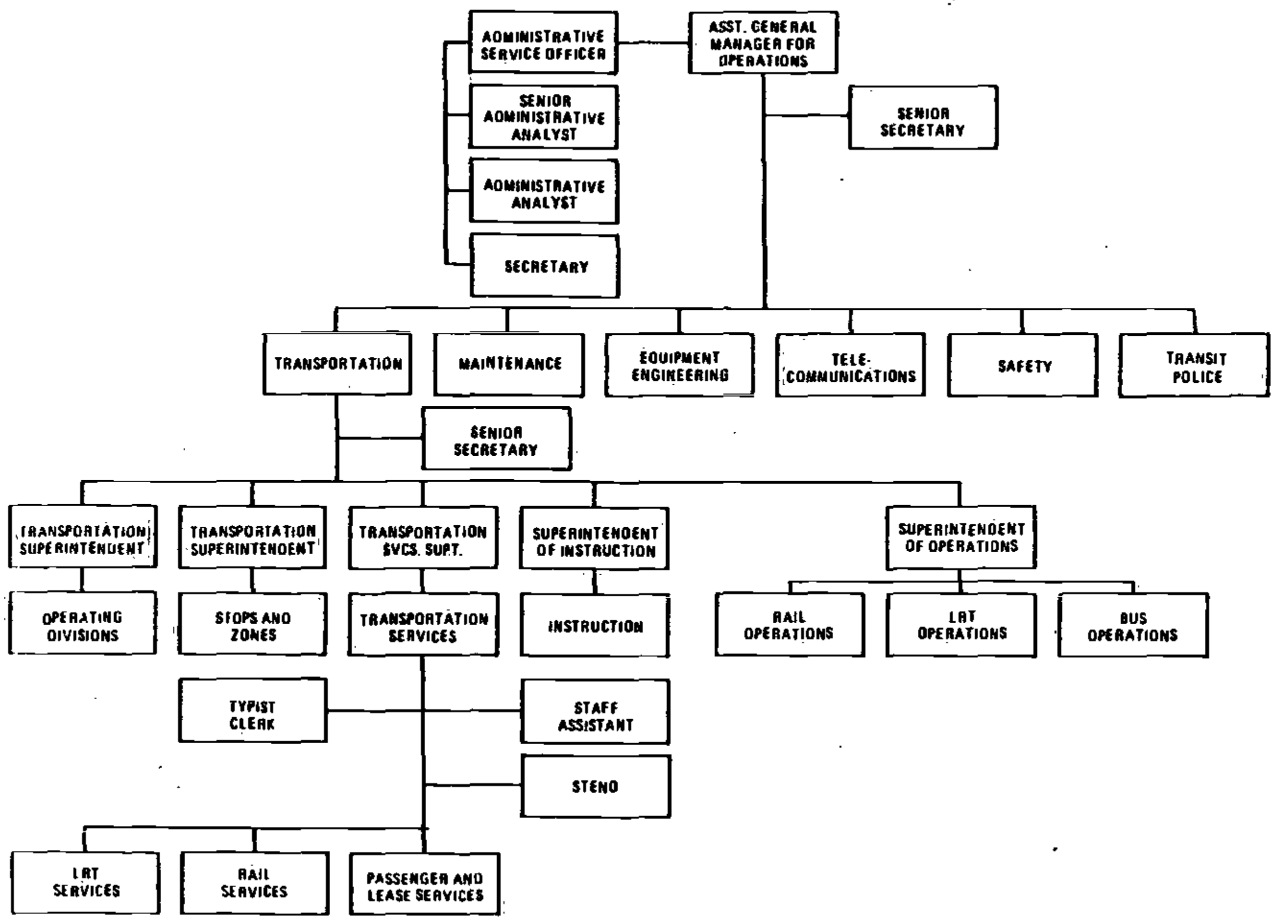


EXHIBIT 4-2

MODIFIED ORGANIZATION CHART: SCRTD OPERATIONS



staff-sharing across modes. The control staffing requirements are those presented for the baseline in Chapter 2. Total staff for bus control is 17; rail control is 5; and LRT control is 4.

The Police Command Center will be located at the Metro Rail operations control center and will be staffed, per the baseline, by one sergeant of the watch, 2 dispatchers, and one clerk. There is also a functional need for security dispatching in the two disjoint control centers. This is to ensure swift and accurate communications in response to security related incidents. Additional personnel for this function are probably unnecessary, and it assumed that the existing dispatch personnel could handle the security liaison duties.

A maintenance technician should be readily accessible for communication and electrical equipment failures at each control facility. The management personnel of the peer properties of this study highly recommended that these technicians be on-site. Maintaining communications is particularly vital for intermodal coordination between physically separated control centers. Therefore, the staff of each operations control center includes a communication/electrical maintenance technician.

Computer and equipment technicians and administrative support staff would also be needed at each control center. A combined staff of four computer technicians are estimated for the three control centers and two support personnel are estimated for each control center.

Additionally, guards are required for facility security. Only one per facility is necessary during the peak, although 24 hour surveillance is mandatory. Since the Bus Control Center is located within an existing, secure SCRTD facility, no additional security guards are required for the Center.

A summary of the staffing levels required for separate operations control centers is shown in Exhibit 4-3.

Organizationally, three distinct but parallel structures provide management of operations control. Responsibilities for intermodal activities are distributed between the individual control supervisors.

EXHIBIT 4-3
Staffing Summary
Separate Bus, Rail and LRT Control Facilities

RAIL CONTROL CENTER

Manager of Rail Operations	1
Operations Control	5
Security	
. Police	4
. CCTV	19
. Facility	1
Communications Technician	2
Computer Support	1
Clerical/Administrative Support	2
FACILITY TOTAL	35

BUS CONTROL CENTER

Manager of Bus Operations	1
Operations Control	17
Communications Technician	1
Computer Support	1
Clerical/Administrative Support	2
FACILITY TOTAL	22

LRT CONTROL CENTER

Manager of LRT Operations	1
Operations Control	4
Communications Technician	1
Computer Support	1
Clerical/Administrative Support	2
Facility Security	1
FACILITY TOTAL	10

CONTROL TOTAL	67

The organizational structure supporting separate control facilities is illustrated in Exhibit 4-4. As shown, a supervisor has immediate responsibility for the operations control of each mode. Management of the individual control centers is accomplished by Managers of Bus, Rail and LRT Operations. These individuals are located within the control centers and oversee operations. They report directly to the Superintendent of Operations.

4.1.2 Space

The floor space requirements for operations control are those presented for the baseline in Chapter 2. Support facility requirements have been added and include a conference room (180 square feet), a lunch room (200 square feet); and wash rooms (200 square feet). A summary of space requirements is shown in Exhibit 4-5.

4.1.3 Operations

Operational exceptions or emergencies requiring intermodal coordination are facilitated through radio communication by the Supervisors of Control for the modes involved. The responsibility for control performance in these situations is distributed among the supervisors, who report directly to their respective Managers of Operations. The central or focal point of responsibility for multi-modal operations control is the Superintendent of Operations (Exhibit 4-4).

4.2 ALTERNATIVE 2: SEPARATE LIGHT RAIL, JOINT BUS/RAIL CONTROL FACILITIES

The second control alternative is a separate LRT control center and a joint control center for bus and rail operations. The LRT control center requirements will be the same as for Alternative 1. To reduce redundancy, only a summary of LRT requirements is presented in this section.

The requirements for the bus/rail control center will be discussed in more detail. Staff and facility sharing possibilities are highlighted and a conceptual floor plan is provided.

EXHIBIT 4-4
ORGANIZATIONAL STRUCTURE
SEPARATE BUS, RAIL AND LRT CONTROL FACILITIES

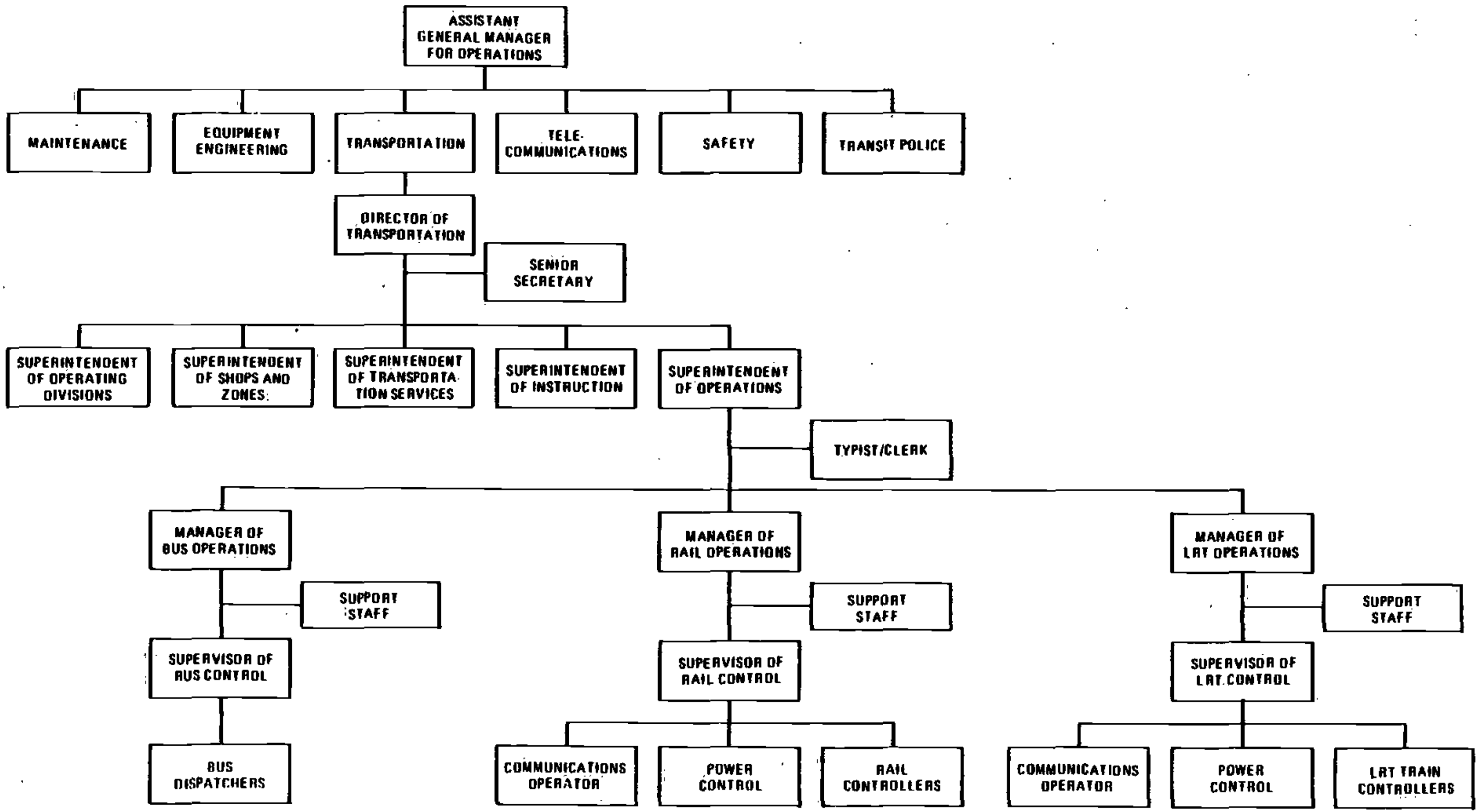


EXHIBIT 4-5
Space Summary
Separate Bus, Rail and LRT Control Facilities

	Square Feet
RAIL CONTROL CENTER	
Operations Control	2000
Computer	1500
Equipment	3000
Security:	
. Police Command Center	800
. CCTV Monitoring	2000
. CCTV Expansion	1250
Support Facilities	580
FACILITY TOTAL	11130
BUS CONTROL CENTER	
Operations Control	2240
Computer	1500
Equipment	(a)
Support Facilities	580
FACILITY TOTAL	4320
LRT CONTROL CENTER	
Operations Control	2000
Computer	1000
Equipment	1200
Support Facilities[a]	580
FACILITY TOTAL	4780
CONTROL TOTAL	20230

(a) Included in computer room allocation.

4.2.1 Staffing

As the functional responsibilities of bus and rail operations control personnel differs significantly, staff sharing of dispatchers, controllers and supervisors is precluded. Support staff reductions can be achieved however. One on-site communications technician is sufficient for equipment maintenance, and computer support staff can be reduced to two on-site personnel. Likewise, three clerical support positions are required and two peak security guards. Thus, a total of three peak positions have been eliminated.

Operational and organizational concerns require the addition of a supervisor of bus/rail control. He reports to the Superintendent of Operations, who has overall responsibility for the performance and administration of the facility. A summary of staffing requirements for this alternative is shown as Exhibit 4-6. The management structure supporting this alternative is provided as Exhibit 4-7.

4.2.2 Space

The operations control areas do not provide space sharing opportunities, but support areas can be shared. A single conference room can satisfy both modes, as can one lunch room and one set of rest rooms. Joint utilization of redundant computers seems viable, although technological specifications must be prepared prior to assessing the feasibility of this consolidation. Potentially significant space reductions could result.

A conceptual floor plan of the operations control areas of the facility has been prepared and includes the Police Command Center and CCTV monitoring area. The layout is illustrated in Exhibit 4-8.

Total space requirements for operations control is 19,650 square feet, including 14,870 square feet for the joint facility and 4,780 square feet for the LRT facility. A summary of space requirements is provided as Exhibit 4-9.

EXHIBIT 4-6
Staffing Summary
Separate Light Rail, Joint Bus/Rail Control Facilities

BUS/RAIL CONTROL CENTER	
Manager of Bus Operations	1
Manager of Rail Operations	1
Supervisor of Control	1
Operations Control	5
Security:	
. Police	4
. CCTV	19
. Facility	1
Bus Control	17
Communications Technician	2
Computer Support	1
Clerical/Administrative Support	3
FACILITY TOTAL	55
LRT CONTROL CENTER	
Manager of LRT Operations	1
Operations Control	4
Communications Technician	1
Computer Support	1
Clerical/Administrative Support	2
Facility Security	1
FACILITY TOTAL	10
CONTROL TOTAL	65

EXHIBIT 4-7
ORGANIZATIONAL STRUCTURE
SEPARATE LRT, JOINT BUS/RAIL CONTROL FACILITIES

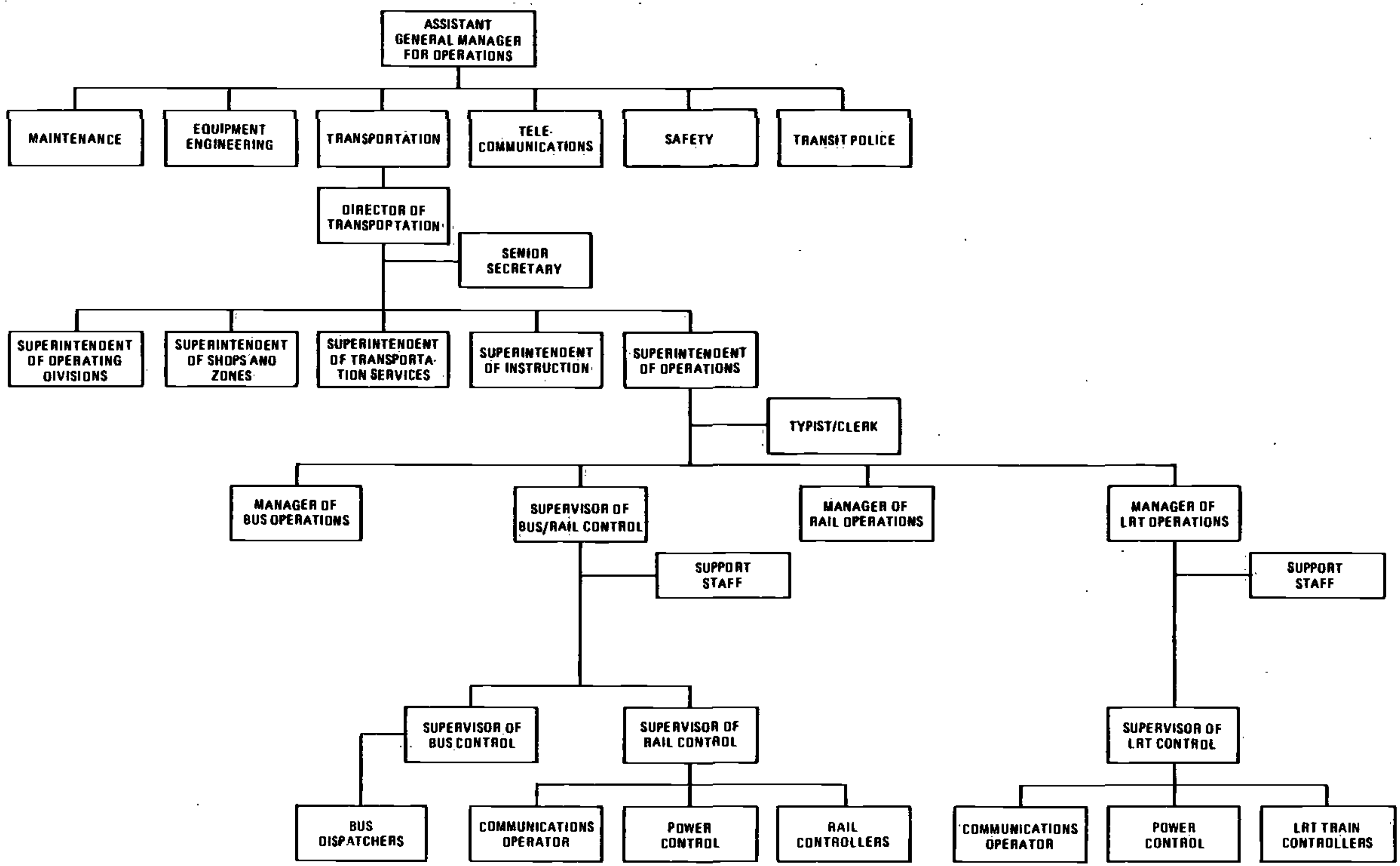


EXHIBIT 4-8

JOINT BUS/RAIL CONTROL CONCEPTUAL LAYOUT

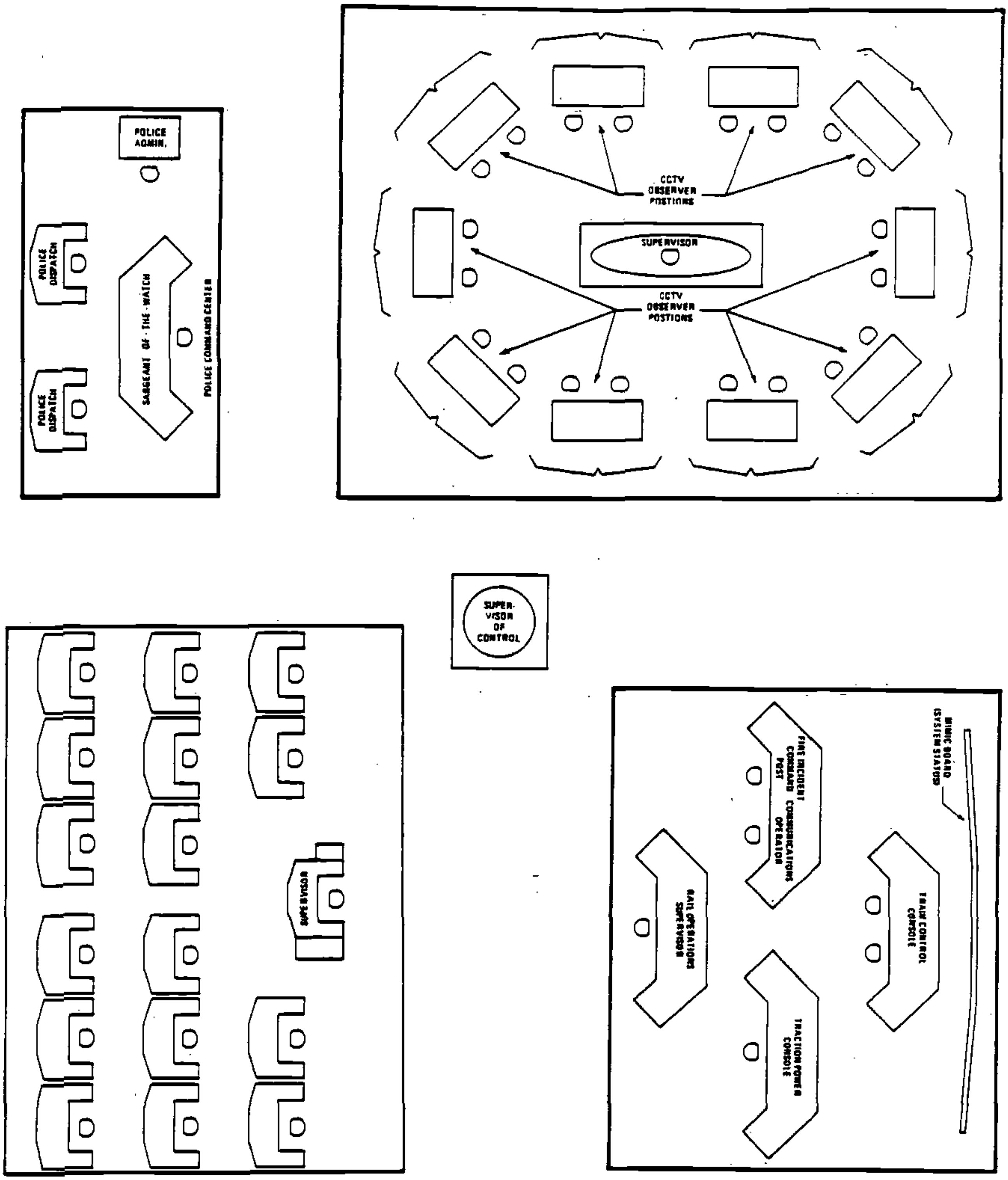


EXHIBIT 4-9
Space Summary
Separate LRT, Joint Bus/Rail Control Facilities

	Square Feet
BUS/RAIL CONTROL CENTER	
Operations Control (Rail)	2000
Operations Control (Bus)	2240
Computer (Rail)	1500(a)
Computer (Bus)	1500(a)
Equipment (Rail)	3000
Equipment (Bus)	(b)
Security	
. Police Command Center	800
. CCTV Monitoring	2000
. CCTV Expansion	1250
Support Facilities	580
FACILITY TOTAL	14,870
LRT CONTROL CENTER	
Operations Control	2000
Computer	1000
Equipment	1200
Support Facilities	580
FACILITY TOTAL	4780
CONTROL TOTAL	19,650

(a) Computer sharing is feasible and should be explored; potentially substantial space reduction exists, but estimates can not be prepared or supported until computer specifications have been developed.

(b) Included in computer allocation.

4.2.3 Operations

Control incidents requiring bus and rail intermodal coordination are facilitated by the Supervisor of Bus/Rail Control. He is directly responsible for the response to an incident and for monitoring problem resolution. When an operational (or security) incident occurs, he meets face-to-face with the Supervisors of Bus and Rail control (or with the Watch Sergeant and appropriate supervisor(s)) and decides on a course-of-action. He is in-charge in emergency situations.

Coordination between bus or rail and LRT is accomplished by the individual control supervisors via radio communications. The responsibility is distributed between the appropriate supervisors, and the focal point of responsibility for response is the Superintendent of Operations.

4.3 ALTERNATIVE 3: SEPARATE BUS, JOINT LIGHT/HEAVY RAIL CONTROL FACILITIES

An integrated rail operations control center and a separate bus control facility represent the third alternative for SCRTD control. The bus control staffing and space requirements are only summarized in subsequent text, since a detailed description of a separate bus control facility was provided within Alternative 1.

The requirements for the integrated rail facility are reviewed more thoroughly. Particular attention is paid to equipment and facility sharing possibilities. An organizational chart is provided indicating staff sharing/reduction, and a conceptual layout of the facility is included.

4.3.1 Staffing

The integration of operations control for the two rail modes allows reductions in support staffing and also in actual train control personnel. While dedicated train controllers are required for each mode, one Traction Power Operator can monitor both heavy rail and LRT power equipment status, and one Communications Operator can provide dispatching and P.A. support for both modes. A single supervisor can oversee all functions within the integrated control center, provided he has multi-modal experience, and is trained in both modes.

The support staff savings are the same as for the bus/rail control facility of Alternative 2. One communication technican is eliminated, as are one computer operator and one administrative clerk.

Separate rail and LRT managers are maintained for primary responsibility of modal operations, but facility management and intermodal events fall functionally within the responsibilities of the Supervisor of Rail/LRT Control (see Exhibit 4-10).

A summary of the staffing requirements for the bus and the integrated heavy rail/LRT control facilities is shown in Exhibit 4-11. A total SCRTD peak staff of 62 are required in support of this alternative.

4.3.2 Space

Significant floor space reduction results from rail/LRT control integration. As depicted in the conceptual floor plan (Exhibit 4-12), a room approximately 65 X 50 feet easily accommodates both rail and LRT operations control and satisfies the visual orientation requirements of the power controller and rail/LRT supervisor. This space allocation represents a reduction of 750 square feet as compared to separate heavy and light rail control centers.

Additional space savings results from shared support facilities. A conference room, lunch room, and rest rooms can all be jointly utilized reducing space by 580 square feet. Total space reduction through this alternative is 1,330 square feet. It should be noted that back-up computers could potentially be shared and additional space reduction would result. A summary of control space requirements, including the bus operations control facility, is provided as Exhibit 4-13.

4.3.3 Operations

One supervisor has direct responsibility for rail and LRT train control. As such, decisions concering rail and light rail coordination are made unilaterally. Coordination between the separate rail and bus control centers is facilitated through radio contact, with the two modal (e.g., rail and bus) supervisors jointly responsibility for incident resolution. The central point of responsibility for overcoming these incidents is the Superintendent of Operations.

EXHIBIT 4-10
ORGANIZATIONAL STRUCTURE
SEPARATE BUS, JOINT RAIL/LRT CONTROL FACILITIES

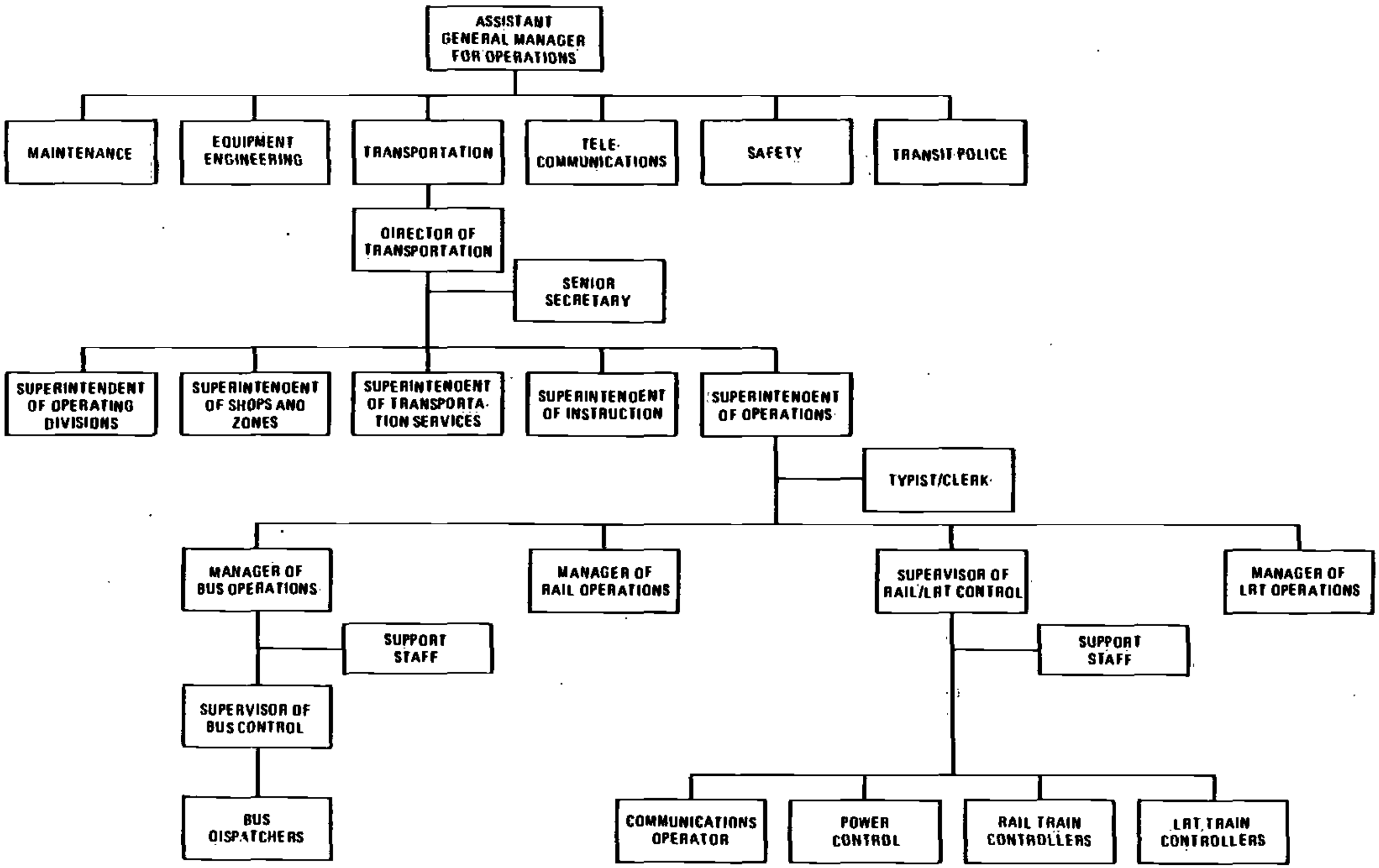


EXHIBIT 4-11
Staffing Summary
Separate Bus, Joint Rail/LRT Control Facilities

RAIL/LRT CONTROL CENTER

Manager of Rail Operations	1
Manager of LRT Operations	1
Operations Control	7
Security	
. Police	4
. CCTV	19
. Facility	1
Communications Technician	2
Computer Support	1
Clerical/Administrative Support	3
FACILITY TOTAL	39

BUS CONTROL CENTER

Manager of Bus Operations	1
Operations Control	17
Communications Technician	1
Computer Support	1
Clerical/Administrative Support	2
FACILITY TOTAL	22

CONTROL TOTAL	61

EXHIBIT 4-12

JOINT RAIL/LRT CONTROL CENTER CONCEPTUAL LAYOUT

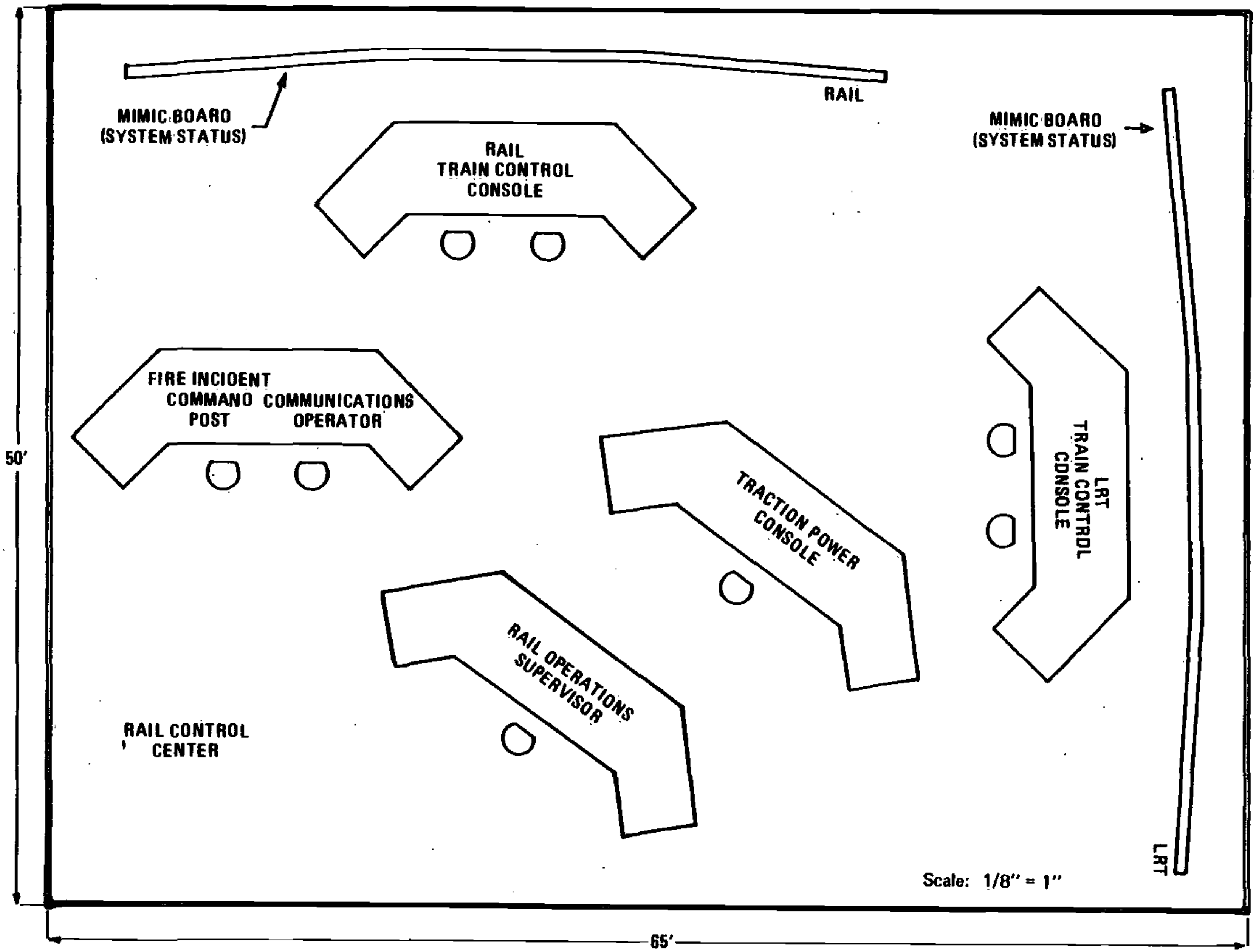


EXHIBIT 4-13
Space Summary
Separate Bus, Joint Rail/LRT Control Facilities

	Square Feet
RAIL/LRT CONTROL CENTER	
Operations Control	3250
Computer[(a)]	2500
Equipment[(a)]	4200
Security	
. Police Command Center	800
. CCTV Monitoring	2000
. CCTV Expansion	1250
Support Facilities	580
FACILITY TOTAL	14580
BUS CONTROL CENTER	
Operations Control	2240
Computer	1500
Equipment	(b)
Support Facilities	580
FACILITY TOTAL	4320
CONTROL TOTAL	18900

(a) Represents the sum of rail and LRT requirements.

(b) Included in computer allocation.

4.4 ALTERNATIVE 4: JOINT BUS, RAIL, AND LIGHT RAIL CONTROL FACILITY

A completely integrated multimodal control facility is the fourth alternative for SCRTD control. The discussion of this alternative includes many of the issues presented in the first three sections of this chapter, particularly the sharing of staff and facilities across modes. Additional savings resulting from complete integration of control are also identified and highlighted. A functional organizational structure is provided and a conceptual layout is prepared.

4.4.1 Staffing

The complete integration of bus, LRT and rail operations control allows control staff sharing across the rail modes and support staff sharing between all three modes. Specifically, the Power Controller, Communications Operator, and Control Supervisor perform both rail and LRT functions, thus reducing staff requirements by three personnel. Also, only one on-site communications technician, two computer support personnel, and four administrative support personnel are needed.

A Supervisor of Operations Control coordinates all intermodal control incidents and has the real-time responsibility for maintaining operations. He should be centrally located in the facility and readily accessible to the rail/LRT Control Supervisor, the Bus Control Supervisor, the Watch Sergeant, and the CCTV Security Supervisor. He reports to the Superintendent of Operations who has overall responsibility for the multi-modal control facility. The organization supporting this alternative is depicted in Exhibit 4-14, with a summary of staff requirements provided as Exhibit 4-15.

4.4.2 Space

Integrating bus, rail and LRT operations control provides space savings in the rail/LRT control area, as well as in supporting areas. As identified within Alternative 3, a reduction of 750 square feet can be realized by consolidating heavy and light rail control.

An additional 1,160 square feet is saved as a single conference room, lunch room, and set of rest rooms can accommodate all three modes. Two back-up computers could possibly be eliminated and additional space savings would result, although further investigation is warranted to confirm this.

EXHIBIT 4-14

ORGANIZATIONAL STRUCTURE
JOINT BUS/RAIL/LRT CONTROL FACILITIES

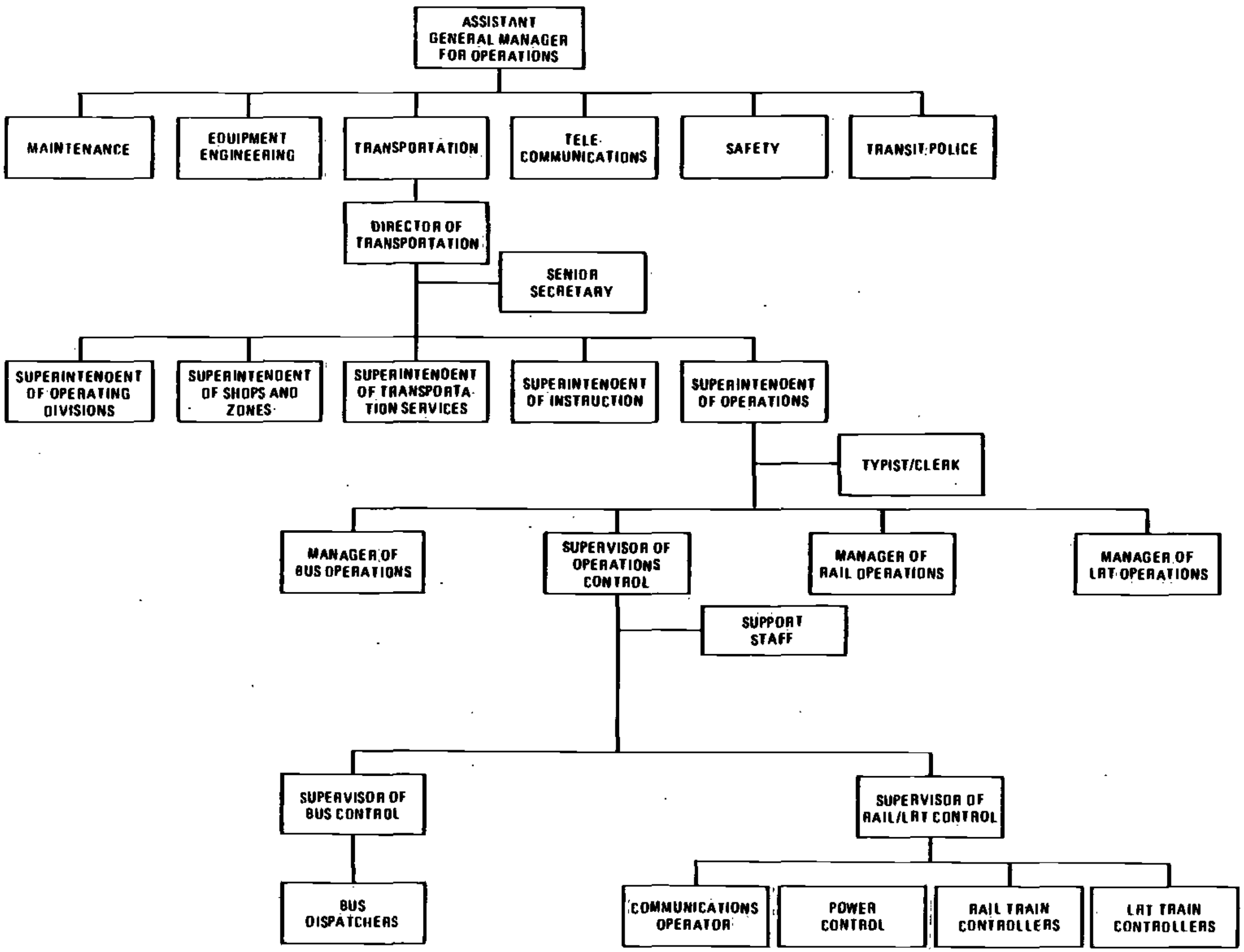


EXHIBIT 4-15
Staffing Summary
Joint Bus/Rail/LRT Control Facilities

CENTRAL CONTROL

Manager of Bus Operations	1
Manager of Rail Operations	1
Manager of LRT Operations	1
Supervisor of Operations Control	1
Operations Control (Rail)	7
Security:	
. Police	4
. CCTV	19
. Facility	1
Operations Control (Bus)	17
Communications Technician	2
Computer Support	1
Clerical/Administrative Support	4
CONTROL TOTAL	59

A summary of the space requirements at this intermodal control facility is provided as Exhibit 4-16, and a conceptual layout of the operations control area is depicted in Exhibit 4-17.

4.4.3 Operations

Emergency situations are remedied by an on-site supervisor of operations control. A face-to-face meeting with the Bus and Rail/LRT control supervisors facilitates his decision making and problem resolution. He provides an immediate focal point of responsibility for all intermodal activities, and his control supercedes that of the individual modal supervisors.

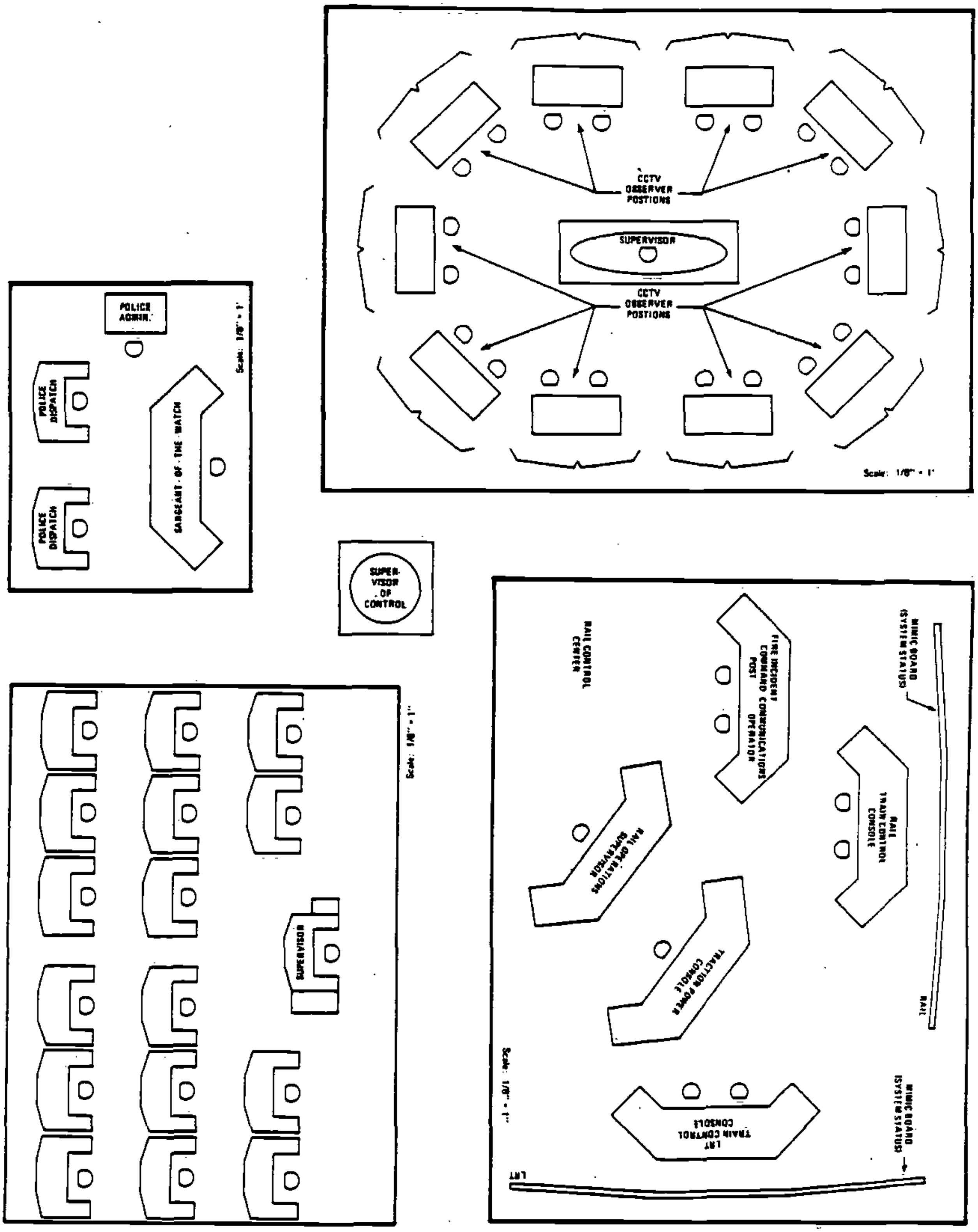
EXHIBIT 4-16
Space Summary
Joint Bus/Rail/LRT Control Facilities

	Square Feet
CENTRAL CONTROL	
Operations Control (Rail and LRT)	3250
Operations Control (Bus)	2240
Computer:	
. Rail	1500(a)
. Bus	1500(a)
. LRT	1000(a)
Equipment	
. Rail	3000
. Bus	(b)
. LRT	1200
Security	
. Police Command Center	800
. CCTV Monitoring	2000
. CCTV Expansion	1250
Support Facilities	580
FACILITY AND CONTROL TOTAL	18,320

(a) Computer sharing is feasible and should be explored; potentially substantial space reduction exists, but estimates can not be prepared or supported until computer specifications have been developed.

(b) Included in computer allocation.

EXHIBIT 4-17
CENTRAL CONTROL CONCEPTUAL LAYOUT



5.0 EVALUATION OF ALTERNATIVES

5.0 EVALUATION OF ALTERNATIVES

The four alternatives of control are compared and evaluated within this chapter. Operational and cost criteria are specified and the alternatives are evaluated by their performance against these criteria.

5.1 CAPITAL COSTS

The capital cost analysis includes facility and equipment costs. Facility costs represent construction requirements and are determined based on an estimated cost per square foot. A qualitative discussion of equipment costs will follow. Quantification of these costs at this early planning stage are precluded, as technology decisions are yet to be made.

5.1.1 Facility

The floor space requirements of the four alternatives exhibit market variations. As shown in summary in Exhibit 5-1, space requirements range from 20,230 square feet for three separate control centers to 18,320 square feet for an integrated multi-modal facility. Using these space allocations and allowing for building services and amenities, Metro Rail Transit Consultants have developed detailed facility concept drawings for some of the alternatives. For example:

- A stand alone Metro Rail Control Facility is estimated at approximately $3,300,000.
- A fully integrated Central Control Facility is estimated at approximately $5,060,000.
- An integrated Metro Rail/LRT Control Facility is estimated at approximately $3,900,000.

Using the MRTC cost estimates, the data in Exhibit 5-1, and our professional judgment, the capital cost of each alternative has been estimated.

EXHIBIT 5-1
Space Requirements Summary
(in square feet)

	Alternative 1 (Separate)	Alternative 2 (Joint Bus/Rail)	Alternative 3 (Joint Rail/LRT)	Alternative 4 (Integrated)
OPERATIONS				
Operations Control				
Bus	2,240	2,240	2,240	2,240
Rail	2,000	2,000	3,250	3,250
LRT	2,000	2,000	(a)	(a)
Security	4,050	4,050	4,050	4,050
Support	1,740	1,160	1,160	580
TOTAL	12,030	11,450	10,700	10,120
TECHNOLOGY				
Equipment				
Bus	(b)	(b)	(b)	(b)
Rail	3,000	3,000	3,000	3,000
LRT	1,200	1,200	1,200	1,200
Computer				
Bus	1,500	1,500	1,500	1,500
Rail	1,500	1,500	1,500	1,500
LRT	1,000	1,000	1,000	1,000
TOTAL	8,200	8,200[c]	8,200[c]	8,200[c]
CONTROL TOTAL	20,230	19,650	18,900	18,320

(a) Included in rail operations control allocation.
(b) Included in bus computer allocation.
(c) Possibly significant space reductions exist through computer sharing.

Recognizing that a Bus Control Facility already exists, the capital costs of the alternatives are estimated to be:

Alternative 1:	Metro Rail Facility	$3,300,000
	LRT Facility	$2,300,000
	Bus Facility	$ 0
	Total	$5,600,000
Alternative 2:	Metro Rail/Bus Facility	$4,500,000
	LRT Facility	$2,300,000
	Total	$6,800,000
Alternative 3:	Metro Rail/LRT Facility	$3,900,000
	Bus Facility	$ 0
	Total	$3,900,000
Alternative 4:	Joint Metro Rail/LRT/ Bus Facility	$5,060,000

Therefore, the lowest capital cost alternative is a joint Metro Rail/LRT Control Facility and the highest capital cost alternative involves a new joint Metro Rail/Bus Control Facility and a new LRT Control Facility.

5.1.2 Equipment

Consolidation of operations control provides equipment sharing opportunities. A joint rail central control facility (Alternatives 3 and 4) requires only one power control work station and one supervisor's work station. Although modifications to these work stations might be needed to support both modes (particularly the power control console), cost savings would result. Quantification of the savings is not possible at this time.

Capital expenses for computers are also reduced through integration. Separate facilities require each mode to have a back-up computer. Through consolidation however, back-up computers could possibly be shared. Integration between two modes (e.g., alternatives 2 and 3) results in a savings of one computer; integration of three modes (e.g., Alternative 4) results in a savings of two computers. While the capacity requirements of a joint back-up computer would increase, costs would assuredly decrease. Quantifying this savings is impossible at this time, pending specific technology identification and verification of operational feasibility.

5.2 OPERATING COSTS

The operating cost of each alternative is evaluated in this section. Personnel and training costs are identified, and a discussion of miscellaneous costs is also included.

5.2.1 Personnel

Peak staffing requirements, as discussed in Chapter 4 and summarized on Exhibit 5-2, vary from 67 at separate facilities to 59 at the multimodal facility. These numbers must be adjusted prior to calculating operating costs however, as all shifts must be represented. Also, since certain staffing requirements remain constant for each alternative (e.g., police, CCTV, bus operations control), only those staff positions exhibiting variations are included in further analyses. The cost difference, rather than absolute cost, is of concern in this study.

Using Alternative 1--separate facilities--as a base for comparison, variations in peak staffing requirements are determined by job category. As shown in Exhibit 5-3, modal integration prompts reductions in all personnel categories except supervisor of control--a multimodal supervisor is required at joint facilities. Daily variations in personnel are then determined by adding shift requirements. It is assumed that support staff are utilized on one shift only; operations control staff are needed for two shifts and facility security requires 24-hours each day (e.g., 3 shifts). A summary of daily variations in personnel is shown in Exhibit 5-4.

The results of this are substantial, as complete integration of operations control reduces the daily staffing requirements needed for separate facilities by 11. A joint bus/rail facility reduces requirements by 1; while a joint rail/LRT facility yields a reduction in staff of 10.

The operating costs directly attributable to personnel are now determined. Using the compensation assumptions of Exhibit 5-5, annual personnel cost reductions, as compared to separate facilities, are as follows:

Separate Bus, Rail and LRT Facilities	$ 0
Separate LRT, Joint Bus/Rail Facilities	$ 3,872
Separate Bus, Joint Rail/LRT Facilities	$386,474
Joint Bus/Rail/LRT Facility	$385,064

EXHIBIT 5-2
Peak Staffing Summary

	Alternative 1 (Separate)	Alternative 2 (Joint Bus/Rail)	Alternative 3 (Joint Rail/LRT)	Alternative 4 (Integrated)
Operations Managers	3	3	3	3
Operations Control	26	27	24	25
Security				
Police	4	4	4	4
CCTV	19	19	19	19
Facility	2	2	1	1
Communications Technicians	4	3	3	2
Computer Support	3	2	2	1
Clerical/Administrative Support	6	5	5	4
TOTAL	67	65	61	59

EXHIBIT 5-3
Variations in Peak Staffing
(As Compared to Alternative 1)

	Alternative 1 (Separate)	Alternative 2 (Joint Bus/Rail)	Alternative 3 (Joint Rail/LRT)	Alternative 4 (Integrated)
Supervisor of Control				
1 Mode	--	--	(2)	(2)
2 Modes	--	1	1	1
3 Modes	--	--	--	1
LRT Operations Control	--	--	(1)	(1)
Facility Security	--	--	(1)	(1)
Communications Technician	--	(1)	(1)	(2)
Computer Support	--	(1)	(1)	(2)
Clerical/Administrative Support	--	(1)	(1)	(2)
PEAK STAFF SAVINGS	--	(2)	(6)	(8)

EXHIBIT 5-4
Variations in Daily Staffing
(As Compared to Alternative 1)

	Alternative 1 (Separate)	Alternative 2 (Joint Bus/Rail)	Alternative 3 (Joint Rail/LRT)	Alternative 4 (Integrated)
Supervisor of Control[(a)]				
1 Mode	--	--	(4)	(4)
2 Modes	--	2	2	2
3 Modes	--	--	--	2
LRT Operations Control[(a)]	--	--	(2)	(2)
Facility Security[(b)]	--	--	(3)	(3)
Communications Technician	--	(1)	(1)	(2)
Computer Support	--	(1)	(1)	(2)
Clerical/Administrative Support --	--	(1)	(1)	(2)
DAILY STAFF SAVINGS	--	(1)	(10)	(11)

(a) Two shifts per day.

(b) Three shifts per day.

EXHIBIT 5-5
Salary Assumptions

Title	Base Rate Salary	Position/ Skill Level	Fringe Benefits	Compensation
Supervisor				
1 mode	$ 38,688	Manager III	.30	$ 50,294
2 mode	40,622	*	.30	52,809
3 mode	42,654	**	.30	55,450
LRT Operations Control	$ 30,168	Lead Dispatcher	.30	39,218
Facility Security	$ 11.30/hr.	Security Guard	.455	34,330
Communications Technician	$ 13.20/hr.	Repairperson II	.455	40,102
Clerical/Administrative Support	10.84/hr.	Clerk II	.455	32,932
Computer Support	12.00/hr.	***	.455	36,456

Source: Operating and Maintenance Cost Report, WBS 17BAB, SCRTD Metro Rail Project, Booz, Allen & Hamilton Inc., June 1983.

Assumptions:

* 5% increase of single mode supervisor.

** 10% increase of single mode supervisor.

*** New position (hourly rate is estimated).

The supporting calculations for this are provided as Appendix B.

5.2.2 Training

Training requirements increase as operations control is integrated across modes. The Supervisor of Control of a bus/rail or rail/LRT facility must be qualified and experienced in the operations control of both modes. Likewise, the supervisor of a fully integrated control facility must be qualified in all modes. A list of the training requirements for each alternative follows below, in order of expected increasing costs:

- Separate Facilities
  - 3 separate supervisor pools
  - Each pool qualified in single mode
- Separate Bus, Joint Rail/LRT Facilities
  - 2 supervisor pools
  - 1 pool qualified in bus
  - 1 pool qualified in rail/LRT
- Separate LRT, Joint Bus/Rail Facilities
  - 4 supervisor pools
  - 1 pool qualified in LRT
  - 1 pool qualified in bus
  - 1 pool qualified in rail
  - 1 pool qualified in bus and rail
- Joint Bus/Rail/LRT Facility
  - 3 supervisor pools
  - 1 pool qualified in bus
  - 1 pool qualified in rail/LRT
  - 1 pool qualified in rail/LRT and bus.

Quantification of training costs cannot be accomplished at this time.

5.2.3 Miscellaneous

The integration of bus, rail and LRT control centers provides additional cost saving opportunities, including:

- Facility maintenance--as the number of facilities and total overall size is reduced, facility maintenance could marginally decrease.

- Facility administration--the inventory of administrative supplies would be reduced, and the distribution costs decreased.

Actual cost estimates are not readily attainable at present.

5.3 OPERATIONS

The routine and emergency operational considerations of each alternative are discussed in this section.

5.3.1 Routine Operations

Routine control of operations is readily accomplished under any of the alternatives. Comparatively, no advantages or disadvantages exist for any alternative in this regard.

The administration of control is simplified when control centers are consolidated. Therefore, the preferred alternative, from an administrative perspective, is the complete integration of operations control.

5.3.2 Emergency Operations

Intermodal coordination of operations is necessary in many emergency situations. Rail system failures or unusual delays often require supplemental service from surface modes. Likewise, LRT emergencies are overcome through support from bus operations. Security incidents often involve intermodal transfers and require coordination for resolution.

Time efficiency is critical to restore service to an acceptable level, or coordinate security response. The factors that facilitate this are:

- Effective communication
  - Accurate information must be relayed between key personnel.
  - The urgency of the situation must be conveyed.
  - External communication (e.g., calls to fire, local police, Coroner's office; press releases, etc.) must be informed and consistent.

- Effective organization
  - Responsibilities should be clearly defined.
  - A focal point of responsibility is desirable:
    - Efficiency in decision making
    - Accountability of actions.

The alternative that best satisfies the above criteria is Alternative 4--complete integration of control, because:

- Face-to-face communication insures that accurate information is provided and that the urgency of a situation is understood.

- A central point of control ensures that press releases or public announcements are appropriate and consistent.

- Organizationally, integration provides a focal point of responsibility and decision making.

- Responsibility for intermodal coordination can be clearly established, thus promoting personnel accountability.

5.4 OVERALL EVALUATION

Exhibit 5-6 shows the overall evaluation of alternatives using a ranking method to distinguish between alternatives. A rank of 1 indicates that alternative which best suits the criterion. A rank of 4 indicates that alternative which least satisfies the criterion.

Alternative 4--the integrated control facility--ranks first among most criteria. However, Alternative 4 ranks second to Alternative 3 on the construction cost criterion and is comparable to Alternative 3 on the operating cost criteria.

The ultimate choice depends on the trade-off between capital costs and operations efficiencies. Overall, the increased operating efficiencies and effectiveness which is associated with Alternative 4 appears to merit the incremental capital cost and is therefore preferred.

EXHIBIT 5-6
Evaluation of Alternatives Summary

	Alternative 1 (Separate)	Alternative 2 (Joint Bus/Rail)	Alternative 3 (Joint Rail/LRT)	Alternative 4 (Integrated)
COST				
Capital Cost				
Construction	3	4	1	2
Equipment	4	3	2	1
Operating Cost				
Personnel	4	3	1	1
Training	1	2	3	4
OPERATIONS				
Routine Operations	1	1	1	1
Facility Administration	4	2	2	1
Emergency Operations				
Effective Communications	4	2	2	1
Effective Organization	4	3	2	1

RANKING: Most efficient = 1
Least efficient = 4

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter contains the primary recommendation resulting from the Special Study of the Integration of Bus, LRT, and Metro Rail Operations Control Centers. Secondary recommendations from this and previous phases of the study are also provided.

6.1 PRIMARY RECOMMENDATION

To achieve the operational and cost advantages provided in Chapter 5:

The SCRTD should have a multimodal central control facility, with completely integrated bus, heavy rail, and LRT operations control.

Significant operational advantages are attained, and annual operating expenditures are reduced through efficient staff utilization.

6.2 SECONDARY RECOMMENDATIONS

Secondary and supporting recommendations drawn from this and previous reports are presented below. Issues of particular concern or requiring additional study are also included.

6.2.1 Staffing

- The delineation of responsibilities among control personnel for emergency situations should be clearly defined, with a supervisor of control in command.

- The number of peak dispatchers required for bus operations control is larger in comparison to peer properties, and should be re-evaluated. As this is driven by the proposed bus dispatching technology, a cost-benefit analysis of this system is recommended.

- Field supervisory experience is recommended as a prerequisite for operations control personnel.

- Recommended training requirements for operations control personnel:

  - Dispatching or train control experience is recommended as a prerequisite for the control supervisor position.

  - Control supervisor experience in all modes is recommended as a prerequisite for the position of Supervisor of Control. Periodically rotating the best controllers between train and power control functions is recommended to allow them to qualify for Heavy/Light Rail Operations Control Supervisor. Rotating supervisors between the bus and rail modes is recommended to allow them to qualify for Supervisor of Control.

  - Bus Dispatcher--One month on-the-job (OJT) training

  - Heavy and Light Rail Controllers--One week of classroom instruction, plus 3 to 4 months of OJT

  - The Bus Operations Control Supervisor must be qualified and experienced in bus control

  - The Rail Operations Control Supervisor must be qualified and experienced in heavy and light rail train control and power control

  - The Supervisor of Control must be qualified and experienced in supervising heavy and light rail, train control and power control, and bus control.

  - Control supervisors should receive periodic field assignments so thay can maintain hands-on experience and remain knowledgeable of field operations. This is particularly appropriate when implementing equipment or procedural changes.

- A formal requalification process should be conducted on an annual basis for all control and supervisory personnel. Written tests should be administered and should address operations, procedures, safety, security, maintenance (including troubleshooting) and equipment. A high minimum grade should be required of each individual to pass, with failure resulting in retraining, retesting, or dismissal, depending upon the circumstances. Supplemental training for refamiliarization with infrequently used procedures, or to coincide with equipment or procedural changes should also be conducted.

6.2.2 Facility

- Selection of either mimic boards or CRTs for train control should be based on preference, as each technology offers distinct advantages.

- The physical layout of the central control facility should provide visual accessibility between key personnel:

  - Operations managers and control personnel

  - Supervisor of Control and

    - Bus Control Supervisor
    - Metro Rail/Light Rail Control Supervisor
    - Watch Sergeant, and
    - CCTV Supervisor

  - Watch Sergeant and CCTV Supervisor

- The benefits of providing a dedicated viewing area do not warrant the additional construction costs. Strategically located glass panels in the halls of the facility can provide sufficient visual access to the operations control areas to casual tour groups, and guided entrance into the control areas during off-peak periods can also be allowed. Public or press access during emergencies should be restricted.

- An investigation should be undertaken to assess the feasibility of computer sharing as the current space allocation of 4,000 square feet might be reduced significantly.

6.2.3 Operations

- A rail maintenance coordinator should be utilized and located either within the train control area or a centrally located maintenance headquarters. Automated accessibility to real-time information on vehicle, personnel, and shop availability could significantly enhance productivity and should be investigated.

- The cost/benefit and operational advantages of the proposed technology for bus control and communication should be investigated.

- The monitoring of bus incident reports (CS 10s) should be conducted periodically to identify operational or procedural inefficiencies.

APPENDIX A

TROUBLE REPORT ANALYSIS

TROUBLE REPORT ANALYSIS

Trouble Report Analysis Monday, April 23-Friday, April 27

Call Type	No. of Calls	Total Copies	Percent of Call Total
Bus Changes	1,455	0	37
Mechanical Defects	567	0	15
Wheelchair Lift = MLS-SMA-DM-MM-TS	314	1,570	8
Transit Police = TP	200	200	5
Out Late = TS-OCS-DM-SMA	184	736	5
Operator Assistance	140	0	4
Information	78	0	2
Public Assistance	76	0	2
Diversions = VOM	63	63	2
No Relief = DM	55	55	1
Operator Error = DM-SDI	47	94	1
Instruction (BOL)	47	0	1
Faulty Radio = RDM-SCS	45	90	1
Alarms = OCS-RDM-TP-SDI-TS-DM-SMA	45	315	1
Transit Police = TP-DM	43	86	1
Blockade	42	0	1
Sick Operator = DM	39	39	1
Overloads = OCS-SAS	39	78	1

Call Type	No. of Calls	Total Copies	Percent of Call Total
Contact Operator = DM	33	33	1
Train Delays = RDM	29	29	1
Faulty Headsign = SCS	28	28	1
Unsafe for Service = DM-TS-SEM	27	81	1
Minor Accidents = DM	24	24	1
Division Assistance	24	0	1
Lost Article = LAT	23	23	.05
Bus on Fwy. = SEM-OCS-SMA	19	57	.05
Bus Zone = SSZ-VOM	18	36	.05
Cancellations = TS-OCS-SMA-DM	16	64	.05
Complaint on Oper. = DM-VOM	16	32	.05
Industrial Injuries = IM-DM	15	30	.05
Channel Problems = RDM-SCS	15	30	.05
Transfers = DM-TS	12	24	.05
Operator Assistance = DM	12	12	.05
Out of Fuel = SEM	12	12	.05
Maintenance Error = SEM-MM	10	20	--
Faulty Supervisors Unit = VOM	9	9	--
Park and Ride = OCS-BP	9	18	--
Computer Problems = RDM-SCS-MCO	9	27	--
Loaner Punch = VOM-DM	7	14	--
Special Events = SED	6	6	--
Fare Overpayment = LAT-CCC-PA	6	18	--

Call Type	No. of Calls	Total Copies	Percent of Call Total
Out of Equipment = SEM	5	5	--
Serious Acc. = DS-SEM-NB-DM-MM-LJR DT-MO-OCS-TS	5	50	--
Sick Div. Disp. = PC-DM	5	10	--
Sick Ticket Clerk = SSA	3	3	--
Busway Problems = OCS	3	3	--
	3,879	4,027	100

1,455 bus changes represents 1,162 average miles between road calls.

567 additional mechanical calls were either repaired on the road or the operator agreed to complete with bus.

Trouble Report Analysis Monday, May 21-Friday, May 25

Call Type	No. of Calls	Total Copies	Percent of Call Total
Bus Changes	1,479	0	51
Mechanical Defects	201	0	15
Wheelchair Lift = SEM-TS	260	520	9
Transit Police	185	185	6
Out Late = OCS	148	148	5
Operator Assistance	64	64	2
Diversions = VOM	67	67	2
No Relief = DM	54	54	2
Operator Error = DM-SDI	53	106	2
Alarms = OCS-RDM-TP-SDI-TS-DM-SEM	23	161	1
Sick Operator = DM	37	37	1
Overloads = OCS-SAS	30	60	1
Contact Operator = DM	23	23	1
Minor Accidents = DM	176	176	6
Lost Article = LAT	21	21	1
Bus Zone = SSZ	11	11	.05
Cancellations = TS-OCS-SMA-DM	21	84	1
Complaint on Oper. = DM-VOM	16	32	1
Transfers = DM-TS	11	22	.05
Operator Assistance = DM	6	6	--
	2,886	1,777	100

1,479 bus changes represent 1,143 average miles between changes.

5 (days) x 338,119 (daily veh. miles) = 1,690,595
divided by 1,479 bus changes.

201 additional mechanical calls were either repaired on the road or the operator agreed to complete with bus.

The number of trouble reports produced by the Radio Dispatcher Center has been reduced by approximately 200 per day. The work load of the dispatchers has not been reduced by this paper reduction, due to the fact that scratch paper is used to log the call, and later discarded if documentation is not required.

The number of copies produced has been reduced by approximately 400 per day by trimming the number of persons or departments receiving copies.

APPENDIX B

CALCULATION OF ANNUAL PERSONNEL COST SAVINGS

CALCULATION OF ANNUAL PERSONNEL COST SAVINGS

METHODOLOGY

The following process was used to determine the annual personnel cost savings (as compared to Alternative 1):

- Identify variations in peak staff requirements by job category (Exhibit 5-3)
- Determine total daily staff variations (Exhibit 5-4)
- Multiply daily staff variations by appropriate salary level (sample calculation on Exhibit B-1)
- Add the savings from all job categories.

This process yields the total cost savings in personnel for each alternative.

A summary of cost savings by job category is provided on Exhibit B-2, for all alternatives.

EXHIBIT B-1
Sample Calculation of Annual Personnel Cost Savings
Alternative 4

	Variation in Daily Staff Requirements	X	Annual Compensation	=	Change in Annual Personnel Costs
Supervisor of Control					
1 Mode	(4)		$50,294		($201,176)
2 Modes	2		52,809		105,618
3 Modes	2		55,450		110,900
LRT Operations Control	(2)		39,218		(78,436)
Facility Security	(3)		34,330		(102,990)
Communications Technician	(2)		40,102		(80,204)
Computer Support	(2)		36,456		(72,912)
Clerical/Administrative Support	(2)		32,932		(65,864)
TOTAL					($385,064)

EXHIBIT B-2
Personnel Costs

	Alternative 1 (Separate)	Alternative 2 (Joint Bus/Rail)	Alternative 3 (Joint Rail/LRT)	Alternative 4 (Integrated)
Supervisor of Control				
1 Mode	-	-	($201,176)	($201,176)
2 Modes	-	$105,618	105,618	105,618
3 Modes	-	-	-	110,900
LRT Operations Control	-	-	(78,436)	(78,436)
Facility Security	-	-	(102,990)	(102,990)
Communications Technician	-	(40,102)	(40,102)	(80,204)
Computer Support	-	(36,456)	(36,456)	(72,912)
Clerical/Administrative Support	-	(32,932)	(32,932)	(65,864)
TOTAL	-	($ 3,872)	($386,474)	($385,064)