FREIGHT PERFORMANCE INDICATORS
W.E. #9500.04C

FINAL REPORT

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Southern California Association of Governments

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# TABLE OF CONTENTS

1 INTRODUCTION ........................................................................................................ 1
   1.1 RESULTS OF TASK 1 AND METHODOLOGY FOR SELECTING FINAL SET
       OF FREIGHT PERFORMANCE INDICATORS ........................................... 3

2 THE ROLE OF PERFORMANCE INDICATORS IN A PERFORMANCE-BASED
   PLANNING PROCESS .................................................................................. 7

3 REGIONAL GOALS AND OBJECTIVES AND RTIP SCORING PROCESSES..... 10
   3.1 REGIONAL GOALS AND OBJECTIVES.............................................. 10
   3.2 RTIP PROJECT SELECTION PROCESSES........................................ 11

4 RECOMMENDED PERFORMANCE INDICATORS............................................. 13
   4.1 MEASUREMENT UNITS .................................................................. 13
   4.2 PERFORMANCE INDICATORS ........................................................ 18
       4.2.1 Mobility and Level of Service Indicators .................................... 19
       4.2.2 Indicators of Goods Movement Performance Impacts on
            Regional Economic Health.......................................................... 23
       4.2.4 Accessibility Indicators ........................................................... 26
       4.3.5 Land Use Compatibility Indicators ....................................... 27
       4.3.6 Other Indicators ....................................................................... 27
   4.4 IMPACTS OF GOODS MOVEMENT ON PASSENGER MODE
       INDICATORS ................................................................................ 28
   4.5 USE OF THE FREIGHT PERFORMANCE INDICATORS FOR RTIP PROJECT
       SELECTION ...................................................................................... 28
       4.5.1 Regional Significance ............................................................. 28
       4.5.2 Cost Effectiveness ................................................................. 28
       4.5.3 Land Use and Environmental Compatibility ......................... 29
       4.5.4 Management of Existing Systems ........................................ 29
       4.5.5 Inter-modal Integration ......................................................... 29

5 CONCLUSIONS AND RECOMMENDATIONS ............................................... 30
1 INTRODUCTION

This report presents the results of a project conducted by Jack Faucett Associates (JFA) to develop freight performance indicators for use by the Southern California Association of Governments (SCAG). These performance indicators will be used as an integral part of the regional transportation planning process. The adopted Regional Transportation Plan (RTP) calls for a performance-based approach when evaluating transportation investments, consistent with various provisions of the federal Intermodal Surface Transportation Efficiency Act (ISTEA). This approach will use performance indicators to establish goals and objectives (in terms of measurable system performance standards), select projects and programs for inclusion in the Regional Transportation Improvement Plan (RTIP), and evaluate the performance of the system after projects and programs are implemented. Within the SCAG metropolitan region, the Regional Mobility Element (RME) of the Regional Comprehensive Plan constitutes the RTP.

Efforts have been undertaken by SCAG staff and advisors to develop multi-modal performance indicators and an initial set of indicators with broad applicability to the passenger movement component of the regional transportation system has been proposed. However, the measurement of freight transportation performance has been more elusive. The purpose of this project is to develop freight performance indicators that can be integrated into the overall performance-based planning process for regional transportation systems. The project was also expected to identify the data sources necessary and available to monitor these indicators and to recommend methods for maintaining the data and monitoring the freight movement indicators on a regular basis.

During the last year, SCAG formed a Goods Movement Advisory Committee (GMAC) and regional goals and objectives for freight transportation and goods movement are at an early stage of development. It is hoped that the process of developing freight performance indicators will help focus the formulation of regional goods movement objectives on measurable criteria for a successful goods movement system.

The project consists of three tasks. The objective of the first task was to develop a preliminary set of indicators and to identify the critical issues that need to be considered in the selection, use, and maintenance of freight indicators. This was done by reviewing the literature on freight performance measurement, models of freight system performance, and available data on...
freight system characteristics, and by contacting other metropolitan planning organizations (MPOs) and researchers in the field to determine the types and uses of freight performance indicators in actual planning practice. The potential uses of freight performance indicators in the context of the SCAG regional and sub-regional planning process were also investigated.

The result of the first task was the development of an exhaustive list of potential indicators and an analysis of the issues which should be considered in narrowing this list down to the final recommended indicators. The list of potential indicators were grouped in the following categories:

- mobility indicators (e.g., transit time, connectivity, traffic volumes, capacity)
- quality of service indicators (e.g., frequency of service, on-time performance, loss & damage levels)
- cost indicators
- environmental/energy indicators
- economic indicators
- safety indicators.

The second task involved the final section of recommended freight indicators for the SCAG region. A third task was added to the project after it was underway. The third task focused on a review of the Los Angeles County Metropolitan Transportation Authority’s (MTA) selection criteria for inclusion of projects in the RTIP to determine what types of freight indicators could assist in the evaluation and scoring of projects consistent with the overall selection process and the goals of the RME. In addition, the third task also called for coordination of the results of the study with the newly formed GMAC.

A number of issues identified at the conclusion of the first task in the study helped re-direct efforts in the second and third tasks. One of the most significant issues concerned the need to better integrate the process of selecting freight performance indicators with the goals and objectives of the regional planning process. The comprehensive list of potential freight indicators tended to be overwhelming for reviewers. They were usable to see the connection between many of the indicators and specific goals and objectives for the freight transportation system. These reviewers felt that a clear statement of goals and objectives was necessary prior to final selection of the indicators. For example, if a major regional planning goal was to sustain or improve the level of service of the goods movement system, then an indicator needed to be developed that measures the current level of service and can be used to develop a performance standard for level of service that the goods
movement system should meet in the future. In the absence of this statement of goals and objectives it was unclear whether the potential indicators would measure anything useful from a planning perspective. Therefore, in the second and third tasks an effort was made to define regional goals and objectives as they are currently expressed in the RME and to focus the selection of indicators on those that would measure performance relative to these goals. Other indicators that measure interesting attributes of the freight transportation system or provide indications of how well the system is operating strictly from the perspective of users (i.e., attributes of system performance over which SCAG, the sub-regions, and local agencies have little influence) were dropped from further consideration.

It was also clear from discussions with the GMAC, that there was a need to provide indicators that could be used to measure how well specific projects meet regional goals and objectives for goods movement. It was felt that this would increase the likelihood that goods movement projects would score high enough in the RTIP selection process to receive funding. This lead to the addition of the third task to examine how the freight indicators could be integrated into the RTIP project selection process.

This report presents the results of Tasks 2 and 3. The remainder of this chapter summarizes the major results of Task 1 and the methodology for selecting the final set of recommended indicators. Chapter 2 presents a discussion of the performance-based planning process and illustrates the role that performance indicators can play in regional goods movement planning. The planning process is characterized by four steps: 1) regional goal setting, 2) establishing current levels of performance and identifying system deficiencies, 3) identifying alternatives to correct deficiencies and selecting the alternatives which should be implemented, and 4) evaluating the performance of the system after improvements have been made. Chapter 3 focuses on Steps 1 and 3 in this process. Regional goods movement goals and objectives are defined and an example of how projects are selected is presented with a discussion of why freight performance indicators would aid in the selection process. Chapter 4 presents the final list of indicators that are recommended. This chapter discusses how the indicators are related to regional goods movement goals and objectives and project selection criteria. It also describes why specific measurement units were selected and discusses potential data sources that can be used to measure the indicators over time. Chapter 5 presents recommendations for further work that should be undertaken prior to implementing the freight performance measurement system.
1.1 RESULTS OF TASK 1 AND METHODOLOGY FOR SELECTING FINAL SET OF FREIGHT PERFORMANCE INDICATORS

The starting point for the development of the freight performance indicators was an analysis of goods moment system performance in terms of how well the system meets the needs of the users and the impacts that the goods movement system has on regional quality of life. Performance indicators of most importance to users included:

- cost of service
- door-to-door travel time
- reliability of service
- loss and damage levels
- frequency of service
- number of service options available
- accessibility of facilities
- connectivity of major shipping centers and receiving centers.

Performance indicators that measure impacts of the goods movement system on regional quality of life include:

- economic impact indicators (e.g., regional employment and income impacts, regional economic competitiveness)
- air quality impacts
- energy consumption impacts
- congestion impacts
- safety impacts.

A review of the literature on freight transportation performance measurement in both the public and private sectors showed that most aspects of performance that are of interest can be grouped into these categories. The literature review also showed that there are many different choices of measurement in each of the broad categories of indicators listed above. JFA compiled a reasonably comprehensive listing of many of the potential measurements.

The literature review also showed that there was very limited published data available with which planners could actually measure performance with respect...
to the potential performance indicators if any level of geographic disaggregation beyond region-wide information is required. Those MPOs that are trying to adapt performance-based planning processes to freight transportation systems are doing so largely with new primary data collection efforts. This is resource intensive and should only be applied to collecting data for a more limited set of indicators.

Once the comprehensive list of potential indicators had been developed, it was clear that they would need to be narrowed down to a much smaller and more manageable list. One of the first issues raised with respect to selecting performance measures was very fundamental and in many ways brought the study back to its beginning. Performance measures needed to be developed that could be used to set performance standards corresponding to the regional goods movement goals and objectives. There are broad regional goals and objectives with applicability to goods movement that are presented in the RME and JFA felt that this was the appropriate place to start in looking for ways to narrow down the list of potential indicators. This process ensured that there was at least one performance indicator for each RME goal and that the number of performance indicators associated with each goal was minimized. After reviewing the RME goals and objectives and specific sub-regional goals or project priorities, JFA felt that indicators associated with the broader RME goals would generally be useful in evaluating more specific sub-regional goals and project priorities. This process also tended to reduce the number of strictly operational indicators (such as service reliability, on-time performance), which while they may be useful for private sector users of the system, often are a function of factors outside the control of regional planning agencies.

A preliminary screening of the list of potential indicators was conducted using the RME goals and objectives and this was shared with the GMAC. Since the goods movement goals and objectives in the RME were developed primarily by SCAG staff, the GMAC members were often confused about what a particular goal/objective in the RME means and why specific goals and objectives were selected for the RME. The process of the GMAC reviewing performance indicators has turned out to be a useful way of getting the GMAC members to provide input on the RME goods movement goals and objectives and this should be continued after the project is completed.

Once an initial screening of the potential indicators was conducted to determine which were the best measures of the RME goals and objectives, JFA tried to determine if these indicators would prove useful in the RTIP project selection process. This was done by looking at one of the county...
transportation commission's (CTC) "Call for Projects" to determine what the selection criteria are and what freight performance indicators could be used to measure projected performance of the system with and without the project. In most cases, the performance indicators identified in the initial screening process using RME goals and objectives provided a good match to the performance measure needs of the project selection process.

JFA reviewed this revised list of indicators to determine data requirements for using the indicators for the various planning functions for which they were developed. As noted above, data is often not available to measure the indicators at the corridor or facility level. JFA had conducted an extensive review of federal data sources in Task 1 of the study. Some of these data sources provide information on goods movement at the regional level but little is available at the sub-regional level. In some cases raw data from federal sources can be compiled in a more geographically disaggregated format, but when the data is collected through surveys, this disaggregation process often leads to data sets that lack statistical validity at the sub-regional level. JFA also reviewed data from the Caltrans Intermodal Transportation Management System (ITMS), other Caltrans and California Highway Patrol (CHP) data sets, the California Trade and Goods Movement Study (being managed for Caltrans by SANDAG), the SCAG Interregional Goods Movement Study, and contacts with staff at SCAG. Contacts were also made with several other MPOs to determine what they were doing with respect to performance measurement for freight and goods movement. The potential performance indicators were also reviewed with selected members of the goods movement industries and with the GMAC to determine if there are private sector data sources that can be used in performance measurement. At the conclusion of this data review, JFA was able to identify several data sources and estimation techniques using existing data sources that could be applied to the recommended performance indicators for SCAG. However, in several cases, existing data sets may need to be expanded. In the recommendations chapter of this report, the issue of data gaps is discussed in more detail.

The next chapter provides an overview of a performance-based planning process and the role of performance indicators in this process. Use of performance indicators for specific regional planning functions (such as RTP development and RTIP project selection) is discussed to provide the reader with a framework for understanding how the final list of indicators was selected.
2 THE ROLE OF PERFORMANCE INDICATORS IN A PERFORMANCE-BASED PLANNING PROCESS

Performance-based planning, as called for in ISTEA and adopted by resolution of the SCAG Regional Council, is a method by which planning can be made more results oriented. The basic idea is to develop goals and objectives in terms of measurable performance attributes of the system and to plan and program transportation investments and programs that move system performance towards these goals. System performance can be assessed to identify those situations in which performance goals are not being met. Since system performance can be forecasted, projects can be selected which achieve the greatest measure of projected performance improvements for the dollars invested. After projects are implemented, measurement of performance indicators can be used to evaluate the effectiveness of system improvements.

This process can be divided into four major steps. These steps are illustrated in Exhibit 1. The exhibit also lists examples of planning tools and functions which are developed at each step in the process and the organizations that are responsible for these tools and functions. The first step in the process is the definition of goals and objectives. Goals are generally broad-based but they can be made more operational with the use of performance indicators. For example, a regional goal for goods movement might be to improve goods mobility or enhance regional competitiveness. But how can planners determine if these goals are being met? The use of performance indicators allows regional planners to define what improved mobility means in terms of measurable standards that the system must meet. For example, improvement in the rate at which goods can be moved through the system may be an appropriate measure of mobility. Goals and objectives can be set for region-wide system performance (e.g., emissions from all goods movement activities should not exceed a certain level) or they can be for specific facilities (e.g., wait times at weigh stations should not exceed a certain level).

Regional goals and objectives for goods movement are contained in a variety of planning documents. The most significant of these is the RME. But other plans, such as the Congestion Management Plans (CMP) and the Air Quality Management Plan (AQMP), contain goals and objectives relevant to freight and goods movements.

Once measurable goals and objectives have been established, current performance conditions can be measured in the system for the same indicators.
used to quantify goals and objectives. Again, measures can be system-wide or for individual facilities. Measurement of current performance conditions allows planners to identify deficient conditions/problems that need to be addressed in the planning and programming process. The RME should contain an assessment of current conditions as the basis for programming regional transportation projects and programs. The Highway Performance Monitoring System is another example of a planning tool which is used to assess current roadway conditions in terms of measurable performance indicators, although as currently configured it has only limited application to freight and goods movement. The
### Exhibit 1: Performance Indicators and Planning Process

<table>
<thead>
<tr>
<th>Role of Indicators</th>
<th>Planning Process</th>
<th>Planning Tools</th>
<th>Responsible Entities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurable Standards</td>
<td>Goals &amp; Objectives</td>
<td>RME</td>
<td>SCAG</td>
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<td>CMP</td>
<td>GMAC</td>
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<td>AQMP</td>
<td>SCAQMD</td>
</tr>
<tr>
<td>Level of Current Performance - Deficient Conditions</td>
<td>Condition of System- Problem Identification</td>
<td>RME</td>
<td>SCAG</td>
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<td></td>
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<td>HPMS</td>
<td>CTCs</td>
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<td></td>
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<td>Emission Inventory</td>
<td>SCAQMD</td>
</tr>
<tr>
<td>Measurable Criteria Project Scoring</td>
<td>Proposed Solutions</td>
<td>RTIP</td>
<td>SCAG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MIS</td>
<td>CTCs</td>
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<td></td>
<td></td>
<td>TCMs</td>
<td>Cities</td>
</tr>
<tr>
<td>Evaluation Measures</td>
<td>Implement and Evaluate</td>
<td></td>
<td>Modal Operators</td>
</tr>
</tbody>
</table>
emission inventory developed for air quality planning is another example of an assessment of current performance conditions. To the extent that emissions from different goods movement modes are accounted for as different source categories, this can be a useful tool for developing priorities for mobile source control measures that apply to goods movement modes.

Once system deficiencies and problems are identified, the next step in the process involves identifying potential system improvements and solutions to problems. This is a step in the process which draws considerable attention because it is in this step that decisions are made about funding for specific projects. Now that ISTEA has broadened the ability of MPOs to fund goods movement projects, the freight and goods movement industries have sought to become more active in the process of competing for project funding. The most visible planning process that focuses on project funding is the RTIP process. CTC’s have primary responsibility for project selection in the RTIP process and most use a set of criteria and project scoring methodologies to select projects for inclusion in the RTIP. Scoring criteria are generally somewhat flexible, allowing project proponents the opportunity to describe in their own terms how their projects meet the scoring criteria. To the extent that project proponents can quantify expected project performance as a means of showing how they meet the project scoring criteria, this can make it easier for project reviewers to objectively score the project. This is also an area where direct connections between regional goals and objectives and project selection criteria can be established by using the same performance indicators to establish performance standards and scoring criteria. CTCs have generally not established measurable performance criteria for project selection that are directed at freight and goods movement and SCAG hopes to provide leadership by offering examples of how performance indicators can be used in the RTIP project selection process.

Finally, in the last step of the process, projects are implemented. In this step, performance indicators are used to evaluate how effective projects and programs have been in helping to achieve the regional goals and objectives. This provides feedback that is used to revise goals and objectives and to identify new problem areas to be addressed in future plans.

The next chapter focuses on the first and third steps in this process. The regional goals and objectives for goods movement are described as is an example of project scoring criteria.
3  REGIONAL GOALS AND OBJECTIVES AND RTIP SCORING PROCESSES

3.1 REGIONAL GOALS AND OBJECTIVES

In order to narrow the list of potential freight indicators to be recommended to SCAG, JFA focused on the goals and objectives for the regional goods movement system as expressed in the RME. There were few objectives in the RME that are specific to freight and goods movement although there are a number of general goals and objectives that can be applied to both passenger and goods movement. JFA identified the following major goals and subgoals in the RME that are applicable to freight and goods movement:

• Sustain or better levels of service for the movement of goods – implies the need for an indicator of level of service for goods movement
• Ensure that investments in freight transportation infrastructure provide the greatest possible goods mobility benefit – implies the need for an indicator of mobility benefits and possibly a cost effectiveness indicator
• Promote strategies that encourage economic vitality within the region – implies the need for an indicator of the impacts of goods movement performance on economic health of the region
• Promote strategies that reduce public and private sector costs and enhance the region’s competitive position – implies the need for an indicator of public and private costs, regional competitiveness with respect to goods movement, and possibly cost–effectiveness
• Support freight transportation activities that encourage production of goods and services for local consumption as well as for export to other regions – this suggests the potential need for separate indicators for urban goods movement distinct from long haul freight transportation.
• Support freight strategies that minimize impacts on the environment and which help meet state and federal air quality goals – implies the need for indicators of environmental impacts (specifically air quality impacts)
• Support strategies that decrease regional dependence on traditional fossil fuels – implies the need for an indicator of fossil fuel use.
Encourage land-use development patterns that complement freight transportation investments – implies the need for indicators of the impacts of land use-use development on goods movement mobility and efficiency

Improve access to effective goods movement in different parts of the region – implies the need for indicators of access to service by sub-region.

Each of the sub-regions also have objectives and program priorities related to goods movement that are included in the RME. These tend to be more project and program specific than the goals and subgoals listed above. JFA determined that indicators developed to provide measurable standards for the regional goals and subgoals would be generally useful for sub-regional planning and would provide a more manageable set of indicators with which to begin a performance monitoring program. This would also be consistent with the level of detail being developed for the passenger mode performance indicators.

None of the regional goals and subgoals suggested the need for indicators that were not included in the original set of potential indicators that had been presented in the Task 1 report, although some consolidation and the creation of new composite indicators was thought to be appropriate. Mobility indicators would be applicable to the first, second, and last goals; economic indicators would be applicable to the third goal; cost indicators would be applicable to the fourth goal; and environmental/energy indicators would be applicable to the sixth and seventh goals. Only the goal related to land use compatibility seemed to be unrelated to any of the original potential performance indicators. Quality of service indicators, as developed in the original list of potential indicators, did not appear to offer performance information that was particularly relevant to SCAG’s goals, objectives, and planning responsibilities even though they do characterize performance attributes that are very important to users. None of the regional goals and subgoals addressed safety issues but JFA included safety indicators in the final list of indicators because this is an important concern of SCAG’s.

3.2 RTIP PROJECT SELECTION PROCESSES

Each of the CTC’s have their own procedures for selecting projects for inclusion in the RTIP. While CTC’s have primary responsibility for project selection, SCAG staff felt that it would be useful to the CTC’s if freight performance indicators were developed by SCAG that could potentially be used in project screening. In
order to determine how this might be done, SCAG requested that JFA review the MTA RTIP project selection process to see how the types of indicators that were being developed for the RME process might be applied to the RTIP process.

MTA's FY 1995–96 through FY 1998–99 TIP Call for Projects identified six different project categories for funding eligibility:

- Freeway – HOV, TSM, and Gap Closures
- Regional Surface Transportation Improvements
- Signal Synchronization and Bus Speed Improvements
- Transportation Demand Management (TDM)
- Regional Bikeways and Transportation Enhancements
- Transit Capital.

Goods movement projects were grouped in the Regional Surface Transportation Improvements category along with regional arterials, interchanges, and grade separations.

All of the projects were to be scored against eight criteria:

- Regional Significance
- Cost Effectiveness
- Land Use and Environmental Compatibility
- Benefit to Transit Users
- Management of Existing Systems
- Inter-Modal Integration
- Long-Term Project Development
- Project Readiness.

In the case of regional significance, the scoring criteria for regional surface transportation improvements asks about data such as Average Daily Traffic, number of lanes, functional classification, and mobility and congestion benefits. Cost effectiveness asks for information on benefits per dollar expended and cost–sharing. Land use and environmental compatibility is scored in terms of how well the project supports local land use goals, air quality, and energy conservation. Management of existing systems asks for existing level of service and how the project will maintain or improve level of service, travel times, or eliminate gaps on the route and in the corridor. Data such as peak hour volume, volume/capacity, peak hour speed, peak period duration, number of accidents are the types of data that can be used to demonstrate improvements in the management of existing services. Inter–modal integration asks how the project will contribute to a balanced and integrated transportation system.
Long-term project development addresses the long-term value of the project and project readiness addresses how far along the project is in its planning and implementation.

The descriptions of how project proponents should document the benefits of their projects with respect to the criteria are sufficiently broad so that goods movement projects can be easily accommodated. We believe that the identification of performance measures for each of the scoring criteria that are specific to freight and goods movement could help to evaluate the benefits of goods movement projects in a consistent manner. In most cases, the indicators that are selected based on the regional goals and objectives would also appear to be applicable to project scoring for freight and goods movement projects. Therefore, as part of the process of selecting the final set of performance indicators, JFA considered their applicability to the MTA RTIP scoring criteria. This is described in the next chapter.
4  RECOMMENDED PERFORMANCE INDICATORS

The recommended freight performance indicators are listed in Exhibit 2. The next section of this chapter provides a brief discussion of the problem of selecting appropriate units of measurement for freight and goods movement and the potential necessity of treating long haul and local goods movement separately. This is followed by a more in-depth discussion of the specific indicators and the rationale for their selection. The indicators are presented in terms of the regional goals and sub-goals that they address. The next section of the chapter describes how the indicators could be applied to project scoring based on the MTA scoring process.

4.1 MEASUREMENT UNITS

One of the first issues that must be addressed in defining freight performance indicators is what units to use when measuring a quantity of freight or freight transportation. Unlike the case of passenger transportation where only people are being moved (person-trips and person-miles being relevant measurement units of passenger transportation) there are many different types of freight and not all are fungible. In much of the literature on transportation demand, tons and ton-miles are the preferred units of measurement. But trucking industry sources have complained about this unit saying that it is biased towards bulk goods shipment and was developed for use in the rail industry. They argue that measuring freight quantities in terms of tons provides little information that is relevant to congestion management, a major issue in the regional transportation planning process. Tonnage data has little relevance for local goods movement and is very difficult to measure or estimate at the facility level.

These trucking industry sources favor a vehicle-based measurement such as truckloads or truck trips. The problem with this measurement is obvious. Truckload sizes vary depending on the equipment and this measurement is irrelevant for non-trucking modes. However, in some cases, it may be appropriate to calculate mode-specific performance measures and in these cases, vehicle-based measurement units may make sense. While every attempt has been made in this study to identify multi-modal performance measures, it must be recognized that certain types of freight and movements will always be associated with a particular mode and when examining the performance of the system with respect to this type of freight, mode-specific measurement units will be preferred.
After much debate on this topic, we have elected to use twenty-foot equivalent units (TEU) as the common unit of freight quantity in cases where a multi-modal measurement is desirable. TEU is a term that was developed to measure quantities of containerized cargoes. Like tonnage, it is a unit that has been applied to every mode that carries containerized cargoes. Unlike tonnage, it has the advantage of being a volume-based measurement. Thus it provides a better
# EXHIBIT 2 - RECOMMENDED INDICATORS

<table>
<thead>
<tr>
<th>INDICATOR TYPE</th>
<th>INDICATOR</th>
<th>POTENTIAL SOURCES</th>
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<tbody>
<tr>
<td>MOBILITY/LEVEL OF SERVICE</td>
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<tr>
<td>LINKS/CORRIDORS</td>
<td>• TRUCK/RAIL</td>
<td>• TRUCK COUNTS (CALTRANS, HPMS, ITMS, LOCAL AGENCIES)</td>
</tr>
<tr>
<td></td>
<td>MOBILITY INDEX = TEU–MILES/HR.</td>
<td>• AVG. ROAD SPEED (SCAG MODELS, HPMS, FIELD OBSERVATION)</td>
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<tr>
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<td>OR TON–MILES/HR.</td>
<td>• TONS BY MODE (ITMS, INTER–REGIONAL GOODS MOVEMENT STUDY)</td>
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<td></td>
<td>OR VEHICLE–MILES/HR.</td>
<td>• RAIL TONS (RAIL CARRIERS)</td>
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<td>(DAILY FREIGHT VOL.)*(AVG. SPEED)</td>
<td>• AVG. RAIL SPEED (FRA RAIL NETWORK, RAIL CARRIERS)</td>
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<td><strong>NOTE:</strong> HRS. OF DELAY PER TON CAN BE USED</td>
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<td>**SAME DATA SOURCES FOR TRUCKS AS MOBILITY INDEX</td>
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<td><strong>RAIL CARGO VOLUMES – SAME DATA SOURCES AS MOBILITY INDEX</strong></td>
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<td><strong>RAIL DELAY DATA (RAIL CARRIERS, RAIL NETWORK MODELS)</strong></td>
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<td>• TRUCK/RAIL</td>
<td><strong>PORT CAPACITY DATA</strong></td>
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<td>HRS. OF DELAY PER TEU (TRUCK LOAD)</td>
<td>MAX. THROUGHPUT/ACRE (PORTS)</td>
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<tr>
<td></td>
<td>= [(VMT)/ffs–os]}*[TEU/VEHICLE]/TEU TOTAL</td>
<td>BERTHING CAPACITY (CORPS OF ENGINEERS, NPWI)</td>
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<td></td>
<td>OR (TOTAL TRAIN HRS. OF DELAY)*[TEU/TRAIN]/TEU TOTAL</td>
<td>OTHER MODES CAPACITY DATA (SURVEY OF FACILITIES)</td>
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<td>= (TOTAL TRAIN HRS. OF DELAY)*[TEU/TRAIN]/TEU TOTAL</td>
<td>PORT VOLUMES (CORPS OF ENGINEERS, CENSUS, ITMS)</td>
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<td>OTHER MODES (ITMS, SURVEY OF</td>
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<td>TRANSFER FACILITIES V/C</td>
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### EXHIBIT 2 - RECOMMENDED INDICATORS (CONT'D)

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<th>POTENTIAL DATA SOURCES</th>
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<td>PROCESSING FACILITIES</td>
<td>DELAY = HRS./TEU (OR TON)</td>
<td>• SURVEY FACILITY OPERATORS (CHP, CUSTOMS)</td>
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<td>OTHER MOBILITY/LEVEL OF SERVICE INDICATORS</td>
<td>• RELIABILITY = STD. DEVIATION IN TRAVEL TIME</td>
<td>• STATISTICAL METHODS USING FIELD SURVEYS</td>
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<td>• HOLDING CAPACITY</td>
<td>• TRUCK PARKING SPACES (LOCAL AGENCIES)</td>
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<td>OR</td>
<td>• TRUCKS IN AND OUT (FIELD STUDIES)</td>
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<td></td>
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<td>• TEU STORAGE (TRANSFER FACILITIES)</td>
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<td>• TEUS IN AND OUT (FIELD STUDIES)</td>
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<td>• REQUIRES SPECIAL FIELD STUDIES</td>
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<td>• LOSS OF EFFECTIVE CAPACITY</td>
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<td>ECONOMIC CONTRIBUTION/COMPETITIVENESS</td>
<td>COST PER TON</td>
<td>• FREIGHT RATES (NATIONAL TRANSPORTATION STATISTICS, FREIGHT RATE SURVEYS)</td>
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<td>• BY COMMODITY</td>
<td>• PROPRIETARY COST MODELS</td>
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<td>• BY LENGTH OF HAUL</td>
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<td>DELAY COSTS</td>
<td>• LABOR COSTS * HRS. OF DELAY</td>
<td>• LABOR COSTS (EDD)</td>
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<td>• VALUE PER TON * HRS. OF DELAY</td>
<td>• VALUE PER TON (1993 CFS)</td>
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<td></td>
<td>• HOURS OF DELAY (SEE MOBILITY INDICATORS)</td>
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<td>PUBLIC COSTS PER TON–MILE OR COSTS PER TON</td>
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<td>• CALTRANS COST ALLOCATION STUDIES</td>
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<td>• PORTS</td>
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## EXHIBIT 2 - RECOMMENDED INDICATORS (CONT'D)

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<tr>
<th>INDICATOR TYPE</th>
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<th>POTENTIAL DATA SOURCES</th>
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<td>VALUE ADDED PER TON</td>
<td>• VALUE ADDED AND EMPLOYMENT – INPUT/OUTPUT MODEL DATA BASES (BY COUNTY)</td>
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<td>EMPLOYMENT PER TON</td>
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<td>• TOTAL FREIGHT VOLUMES (SEE MOBILITY INDICATORS)</td>
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<td>EMISSION FACTORS</td>
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<td>= g/TEU-MILE</td>
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<td>= g/TON-MILE</td>
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<td>OR</td>
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<td>BY CRITERIA POLLUTANT</td>
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<td>• FREIGHT VOLUMES (ITMS, ARB ACTIVITY DATA)</td>
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<td>= gal/TEU-MILE (TON-MILE)</td>
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<td>• NATIONAL TRANSPORTATION DATA BOOK</td>
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<td>• CEC ADJUSTMENTS FOR REGIONAL CONGESTION</td>
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<td>ACRES OF SENSITIVE HABITAT REMOVED</td>
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<td>• LOCAL AGENCIES, SCAG</td>
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<tr>
<td>ACCESSIBILITY</td>
<td>NUMBER OF LINKS TO NHS AND AVG. DISTANCE (TIME) TO NHS LINK (BY AREA)</td>
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<td>NUMBER AND LOCATION OF FACILITIES – GIS – BASED DATA (ITMS, SCAG INTER-REGIONAL GOODS MOVEMENT STUDY, SCAG GIS PROJECT)</td>
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<td>NUMBER OF INTERMODAL Lifts AND AVG. DISTANCE (TIME) TO INTERMODAL LIFT</td>
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<td></td>
<td>AVG. DISTANCE (TIME) TO PORT AND AIR CARGO TERMINAL</td>
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_Southern California Association of Governments Freight Performance Indicators: Final Report_
### EXHIBIT 2 - RECOMMENDED INDICATORS

<table>
<thead>
<tr>
<th>INDICATOR TYPE</th>
<th>INDICATOR</th>
<th>POTENTIAL DATA SOURCES</th>
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<tr>
<td>LAND USE COMPATIBILITY</td>
<td>CAPACITY EXPANSION FACTOR = PROJECTED CARGO VOLUME/[(MAX. THROUGHPUT PER ACRE)² (ACRES OF USEABLE LAND)]</td>
<td>• CARGO VOLUME PROJECTIONS (FACILITY OPERATIONS)</td>
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<td></td>
<td></td>
<td>• MAX. THROUGHPUT PER ACRE (FACILITY OPERATORS)</td>
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<td></td>
<td></td>
<td>• ACRES OF USEABLE LAND (LOCAL LAND USE DATA, SCAG LAND USE MODELS)</td>
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<td>SAFETY</td>
<td>INJURY/ACCIDENTS/TEU–MILE (TON–MILE)</td>
<td>• CHP</td>
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<td>• RAIRS</td>
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<td>• FAA</td>
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<td>CONNECTIVITY</td>
<td>TRUCKING</td>
<td>• SCAG NETWORK MODELS</td>
</tr>
<tr>
<td></td>
<td>• AVG. TRUCK ROUTE TIME, AREA TO AREA</td>
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measure of the impact that freight movement has on system capacity. Whether freight moving equipment is full or empty, carrying dense or light cargo, it still requires the same facilities and a volume-based measurement unit captures this. Even though TEUs are not applied to non-containerized cargoes, it should be possible to express the volume equivalent of a particular cargo in terms of TEUs. It would be appropriate to make this conversion when measuring freight volumes for which different modes compete.

If it is not necessary to express all freight performance indicators in terms of the same units, we would suggest the following units:

- TEUs for containerized freight or freight that competes among modes
- Tons for bulk cargo or non-containerized rail/ship cargoes
- truckloads (truck–miles, truck trips) for urban goods movement.

A second issue that needs to be dealt with in selecting measurement units is whether long-haul and local urban goods movement need to be dealt with separately. As already alluded to, local goods movement will always be by truck and measurements that are vehicle–based may be the most relevant. Vehicle based measurements are more difficult to apply to long-haul movements where there is a much wider variety of modes and equipment that is used. While transit time is a critical performance indicator for all types of freight movement, average speed may be a more appropriate indicator of transit time in local goods movement than it is for long-haul movements where transfer times between modes or other equipment exchanges may be more significant. In this report we have presented a set of performance indicators that we believe can be applied to both long-haul and local goods movement. However, we do believe that in selected situations it will be appropriate to apply these measures separately to evaluate long-haul and local goods movement performance.

4.2 PERFORMANCE INDICATORS

The recommended performance indicators are discussed below in terms of the specific regional goals and sub-goals that they address. Included in the discussion is the rationale for selecting these indicators while rejecting others from the original list. In each case a set of primary indicators are provided. In selected cases, additional subsidiary measures are provided. The subsidiary measures address specific problem areas of interest in freight transportation and the indicators have been useful for diagnosing these problems in other...
regions. If resources allow and these problem areas are critical in certain sub-regions, these subsidiary indicators should receive further consideration.

4.2.1 **Mobility and Level of Service Indicators**

A variety of approaches have been suggested for measuring goods movement mobility and level of service. Fundamentally, there are two attributes of the goods movement system that indicate level of service: how quickly goods can be moved from point to point (including delays at transfer and processing points) and how reliable scheduled service is (how often is freight delivered within a specified window of time). Unfortunately, most indicators of these attributes are difficult to measure with available data. Door-to-door travel time must be specific to an origin-destination (O-D) pair which makes it difficult to use in practice and on-time performance is not a statistic that is generally reported in published data series.

An alternative measure of mobility is delay time. As delay time increases, mobility decreases. Delay time can reflect a variety of mobility problems including congestion, scheduling inefficiencies, inefficient utilization of facilities, and incidents and accidents. When dealing with delay time along corridors (or along specific links within corridors) total hours of delay is a difficult indicator to appreciate intuitively if it is not normalized with respect to units of freight (TEUs, tons, truckloads) and mileage. In other words, the indicator of delay might be measured in delay hours per TEU-mile. It would be preferable to have an indicator of mobility which increases with increasing mobility and decreases with decreasing mobility. To this end we have proposed a Mobility Index for links and corridors which measures the rate at which freight is moved in the corridor (along the link). The preferred units are TEU-miles/hour (or ton-miles/hour). This can be calculated by multiplying the average number of TEUs shipped daily by average speed. This index is most meaningful for trucks and could be applied regionally or on specific links. Average TEUs can be estimated using truck count data on highways. Truck classification counts by axle number can be used with a TEU equivalency factor to estimate the average daily TEU traffic on a link and average speed data can be obtained from the SCAG models or field observation. Caltrans provides truck classification counts on state highways and HPMS provides counts for federal aid highways. Some truck counts have been conducted by local jurisdictions but these are rare. One of the advantages of this indicator over
one which is weight–based is that it is not necessary to know anything about the cargo, information which is generally not available at the facility level.

The corridor/link Mobility Index could theoretically be applied to rail movements as well as truck movements but average speed data would be less meaningful in determining mobility unless it was adjusted for the significant amounts of train idling time due to track usage conflicts, delays at grade crossings, and delays at switching yards. Some industry sources we have talked to felt that it would be more useful to simply measure the delay time directly for specific portions of a corridor within the SCAG region. In this case, normalization would be on the basis of TEUs or carloads only since the mileage in the corridor would already be known. For comparison purposes, it would be possible to calculate delay times for truck shipments traveling over the same distance using the following formula:

\[
\text{Hours of delay per TEU} = \frac{\text{VMT}}{(\text{ffs} - \text{os})} \times \frac{\text{TEU/vehicle}}{\text{TEU total}}
\]

where

- VMT = truck vehicle miles travelled
- ffs = free flow speed
- os = operating speed.

In most cases TEU/vehicle is likely to be one or a fraction between 0 and 1.

We have already described the potential data sources that can be used to measure mobility for trucking.

For freight moving by rail data, from the Census' Commodity Flow Survey (CFS) can be used to estimate daily freight volumes and average speed data can be obtained from the carriers (freight volumes may also be available from carriers). Some analysts have used the ICC Carload Waybill Sample to estimate cargo volumes on links but the statistical validity of the data at this level of detail is questionable. Data on cargo volumes by corridor are also available for selected corridors in the region from the Caltrans ITMS data base and the SCAG Inter–regional Goods Movement Study (which uses a similar data base as the ITMS). In other regional freight studies that we have conducted we have found that the railroads are generally able and willing to provide freight volumes (in tons) for specific rail lines. Freight volumes are expressed in these data bases in terms of tonnages (TEU data may not be available).
Delay time for rail would be measured as follows:

\[
\text{Hours of Delay per TEU} = (\text{Total train hours of delay}) \times \frac{\text{(TEU/train)/TEU total}}}{\text{TEU total}}
\]

Total train hours of delay at the corridor or link level is not published in any publicly available data set. Data on delay based on missed schedules obtained from shippers would be an inappropriate measure of total train hours of delay for a corridor because shippers would not be able to distinguish delays that occurred outside of the SCAG region from delays that occurred within the SCAG region. Rail companies may be able to provide this information from operating records. If this data is not available directly, delays can be obtained from rail network modeling studies. The Port of Long Beach reports that such efforts are currently underway to identify sources of delay for rail entering and leaving the San Pedro Bay ports and this data may be available to SCAG.

Mobility is not just an issue within corridors and along links. Mobility indicators may also be desirable at major transfer locations (ports, air cargo terminals, rail yards, truck terminals, intermodal terminals). While mobility at transfer locations has a critical impact on overall freight system performance, SCAG and local transportation agencies may have a more limited role to play in improving mobility at these facilities. For example, while landside access to the ports is clearly an area where public transportation investment can be productive, regional public transportation investments within the port itself may not be appropriate or possible. Nonetheless, we have addressed potential mobility indicators for these facilities because their performance may affect regional competitiveness, a critical concern for SCAG. Given the difficulties in getting access to this data it should not be a high priority in the early phases of implementing a regional freight performance indicator system.

A Mobility Index similar to that suggested above for links and corridors could be applied to transfer facilities. However, in the case of transfer facilities, it is not sufficient to measure the rate at which freight is moved through the facility. Both the rate at which freight enters the facility and the rate at which it is removed must be measured. For example, in the case of inbound cargo at a port, it is necessary to know the rate at which freight is offloaded from ships and the rate at which it departs by rail and truck. A ratio of freight leaving to freight entering the facility would provide a measure of how much delay is experienced. While data is available from a number of sources on the volume of freight that is processed by transfer facilities, this is usually only available on an annual basis. Seasonal and daily peaks may be significant and this type of
information will only be available from the facilities themselves via survey. In addition, the rate at which freight is removed from a facility on a daily or hourly basis is generally not available from published sources and may only be obtainable by survey. This may also not be that useful a measure without taking into account the relative importance of just-in-time inventory practices vs. low-cost warehousing options for specific commodities. Taking all of these factors into account, we recommend against the use of this type of mobility indicator.

Likewise, hours of delay per TEU (or ton) may not be a viable indicator of mobility problems at a transfer facility. While some facilities may be able to provide this type of data by survey, it will never be clear the extent to which delays are associated with congestion or inefficiencies at the facility or on the links entering and exiting the facility. Therefore, this indicator was rejected as well.

In the case of transfer facilities, the most useful indicator of level of service and mobility may be the traditional volume to capacity ratio (V/C). While capacity measurements at ports, airports, and intermodal facilities seem to be subject to some uncertainty (for example, the ICTF is currently operating above its design capacity), it is possible to make reasonable estimates of capacity and to compare them with current or projected freight volumes in order to get an idea if congestion is occurring and mobility is being impeded. For example, the Port of Long Beach reports that for planning purposes at container terminals they estimate capacity based on maximum throughput per acre at a terminal that is operating at what is perceived to be near capacity and this is adjusted for potential efficiency and technology gains. Similar information on capacity can be obtained for non-containerized commodities at ports based on berthing capacities (this data is available from the U.S. Corps of Engineers Port Series, Port Profiles from the National Ports and Waterways Institute, or directly from the ports). There are no published data on capacity of rail yards, intermodal terminals, or airports although we have seen this data reported from individual facilities in the literature. This is usually collected directly from the facilities. Intermodal terminals frequently report in terms of lifts per hour and air cargo is reported in terms of tonnage and TEUs. Given the number of facilities in the region we believe that this information would be feasible and desirable to collect.

There are a number of sources that provide annual data on cargo volumes through major transfer facilities. The U.S. Army Corps of Engineers Waterborne Commerce of the United States and the waterborne

*Southern California Association of Government* Freight Performance Indicators: Final Report
commerce data series from the U.S. Census Foreign Trade Division provides port data (tonnages only). The ports themselves may be able to provide data on hourly transfer rates and seasonal variations in traffic as well as cargo volumes expressed in terms of TEUs. With information from the ports it may also be possible to estimate TEU equivalency factors for non-containerized cargoes. Similar data on total air cargo tonnages by airport is available from the FAA in *Airport Activity Statistics*. Again, contacting the air cargo terminals directly may be the best way to get better daily rate information. Total freight volumes through intermodal yards, rail yards, and truck terminals is available in the Caltrans ITMS data base.

A third type of facility for which an indicator of mobility should be developed are processing facilities, such as weigh stations, customs processing facilities, and inspection stations. At these facilities the most useful mobility indicator is delay time measured as indicated above in hours/TEU (or ton). This data is not published but other states have been able to collect this relatively easily from the relevant operating agencies.

The other travel attribute associated with level of service is reliability. Reliability can be measured as variability in travel time or standard deviation in travel time between representative O–D pairs. This indicator is a very important measure of mobility and level of service from a user’s perspective. However, this measure has two major disadvantages from an implementation perspective. Travel time variability only has meaning at the O–D level and a decision must be made as to what the most appropriate O–D pairs are for measurement purposes. In addition, there is no existing data set for which this information is routinely collected and published. To implement this indicator would require a significant data collection effort involving statistical methodologies. While we agree that this measure is important, it may represent an impractical place to start the process of building useable performance measures. Further discussion with users of the goods movement system as to the importance of this measure is needed before measures can be adopted.

In addition there are two subsidiary mobility/level of service indicators that should be considered in special cases if resources are available. The first measures the holding capability of an area or facility when demand exceeds the capacity of the facility to move freight. This is becoming a particularly significant problem for trucking in areas in which transfer facilities are operating on a just–in–time basis and parking is limited. The indicator, in this case is the number of truck parking spaces divided by the number of trucks entering the defined area per day minus the number of trucks leaving. A
similar indicator can be developed for all freight by using TEUs in place of trucks and TEU storage space in place of parking spaces although we think this indicator may be more ambiguous and of less use.

The second subsidiary measure is the loss of effective capacity in an area which is congested due to inadequate loading areas (e.g., a downtown areas with a high level of double parked trucks). This would be a standard roadway capacity measurement taking into account the loss associated with frequent double parking.

Both of the subsidiary measures could require significant field observation and primary data collection. Given their limited applicability, this may not be feasible.

The mobility and level of service indicators should be useful in creating performance standards and measuring effectiveness of programs associated with the following regional goals:

- Sustaining or bettering levels of service
- Ensuring that investments provide the greatest possible goods mobility benefits.

4.2.2 Indicators of Goods Movement Performance Impacts on Regional Economic Health

Many MPOs look to efficient freight and goods movement as a means for maintaining or improving the region’s economic competitiveness. If the region provides efficient and cost-competitive transportation, it is more likely to attract and retain businesses that rely on cost-efficient freight transportation, all other things being equal. In addition, goods movement activities in and of themselves are a significant economic activity within the region which contributes to overall economic health.

Cost-competitiveness of freight transportation would ideally be measured by total normalized costs (e.g., dollars per ton) which could be compared with other regions. There are a number of drawbacks to this measure. Costs vary considerably by mode and the modal mix in the region is dependent on the mix of commodities shipped and the distribution of lengths of haul of shipments. Therefore a composite cost per ton–mile indicator would not offer adequate information on cost-competitiveness. Cost per ton would be more useful if it were given on a commodity basis for several length of haul groupings (e.g.,
cost per ton for shipments of commodity \( x \) traveling 50–500 miles). This cost per ton measure could then be a composite cost for all modes competing for each category's shipments. This indicator might only be meaningful at the region-wide level since it would be difficult to discern any reasonable cost-differentials at different facilities within the region. Therefore, the use of this indicator for project specific analysis appears to be impossible.

Another problem with the cost per ton indicator is that measures of cost are difficult to come by. There are no good sources of published information on freight costs at the regional level. Some MPOs and state DOTs have turned to freight rate information as a surrogate for costs. National freight rate data is available from Federal DOT's National Transportation Statistics and this may provide data on rates that begin or end within the region. Some MPOs also conduct rate surveys although these can be expensive to conduct. On long-haul shipments, it is unclear whether rates reflect regional cost differentials since carriers have many options for pricing services in a particular shipping lane and spreading costs over other shipping lanes or services. For intra-regional goods movement one problem is that many of the movements may be made by private (as opposed to for-hire) fleets for which freight rates do not exist.

Even with all of these shortcomings, we believe that using freight rates to measure costs per ton by commodity and length of haul as a region-wide indicator may be the best approach to establishing an economic competitiveness measure. Alternative approaches to measuring cost per ton include proprietary costing models that could be used to establish actual costs.

Another approach to defining cost-competitiveness indicators is to focus on certain components of costs that reflect unique local conditions. For example, indicators of congestion costs per ton–mile would include the following:

- labor costs for vehicle operating personnel multiplied by hours of delay
- value per ton multiplied by hours of delay (reflecting the higher carrying costs for high value products experiencing significant delays).

Labor costs by occupational category for the region may be available from California EDD.
Value per ton can be determined on a commodity basis from various economic data sources or from shipper surveys. The 1993 Commodity Flow Survey may
prove valuable in providing estimates of value per ton for various commodities that is reasonably up-to-date. Fuel costs per ton-mile would also be a useful indicator of cost competitiveness.

Public costs for goods movement facilities can be calculated independent of private costs. In the case of trucking, cost allocation formulas for highways developed for Caltrans should be used. Total costs per ton-mile is the preferred indicator.

Other indicators of the extent to which freight transportation contributes to the economic health of the region are total value added and employment in the freight transportation industry regionally. There is some data on value added and employment by transportation industry segments contained in various regional input–output models. For example, the IMPLAN model developed by the U.S. Forest Service includes data on value added and employment in the for–hire segment of the transportation industry. Some of the industry groups for which this data is available may be distinguishable as exclusively freight–related (e.g., trucking) but others would not (airline operations). In those cases where these data are available, it may be possible to develop regional factors on value added per ton or employment per ton and apply these to any increases in freight demand associated with a particular project in order to get project–specific indicators of this type.

The economic health indicators can be applied to the following regional goals:

- Promote strategies that encourage economic vitality within the region.
- Promote strategies that reduce public and private sector costs and enhance the region's competitive position.

4.2.3 Environmental/Energy Indicators

Perhaps the most significant environmental impact of goods movement in the SCAG region is impact on air quality. Therefore, the environmental performance indicators are focused on air quality impacts. The most commonly used indicators of air quality impacts are impacts on emissions. These are most frequently expressed in terms of grams/ton–mile. To be consistent with the volume–based measurements suggested for mobility indicators, we recommend conversion to grams/TEU–mile.
For trucking, the emission factors would be developed directly from the EMFAC model used by ARB, specified for the South Coast Air Basin. Using both EMFAC/BURDEN, total emissions are developed for inventory purposes and these can be divided by the total ton–miles or TEU–miles for the area in question. An alternative approach at the facility level would be to use emission outputs from DTIM2. Inventory data for rail, marine, and air cargo modes have also been developed by ARB and are in use by the AQMD. While these have not been routinely updated, the inclusion of these freight modes in the air basin’s emission inventory should allow for consistent measurement of emission factors.

A similar approach should be used for measuring energy consumption rates. Energy usage in terms of Btu/ton–mile (Btu/TEU–mile) or gallons of fuel used/ton–mile is the preferred measurement. The advantage of Btu/ton–mile is that it is not fuel specific and can provide more flexibility as different fuel options are introduced. If electric transportation options are considered, the primary energy conversion efficiency should be used. Energy consumption rates for different transportation modes can be obtained from the Department of Energy's National Transportation Data Book. One of the disadvantages of this data source is that it is not specific to the region and does not take into account the differences in fuel consumption rates for urban vs. non–urban travel. At present, we are unaware of any alternative sources other than direct survey of fuel consumption data from carriers, which may be impractical.

Another, environmental indicator that has been suggested in the literature which should be considered at the facility level is acres of sensitive habitat removed. This is only recommended on a case–by–case basis. These indicators can be applied to the following regional goals and objectives:

- Support freight strategies that minimize impacts on the environment and which help meet state and federal air quality goals.
- Support strategies that decrease regional dependence on traditional fossil fuels.

### 4.2.4 Accessibility Indicators

Indicators of accessibility are an important measure of how well each part of the region is served by all freight modes. In general, two types of accessibility indicators are provided: indicators that measure the number of access points to each mode and indicators that measure the distance from major shipping...
centers to these points. The use of these measures can be greatly facilitated by GIS–based information on concentrations of commercial and industrial shipping activity and the freight transportation network. GIS–based information on the freight transportation network is now available through the Caltrans ITMS system. SCAG is making major efforts at this time to provide GIS–based information on regional employment and economic activity which will also be useful.

The following indicators are recommended and should be applied at the area level:

• number of links to the National Highway System (NHS) and average distance to a NHS link
• number of rail loading points and average distance to rail loading points
• number of intermodal lifts and average distance to an intermodal lift
• average distance to port and air freight terminal.

It would be preferable to use average times instead of average distances and this may be estimated using the SCAG transportation network models.

These indicators can be applied to the following regional freight transportation goal:

• Improve access to effective goods movement in different parts of the region.

4.3.5 Land Use Compatibility Indicators

One land use issue of critical concern to major freight transfer facilities (ports, air cargo terminals, intermodal yards, etc.) is whether there will be sufficient land to expand to meet future demand. A useful land use indicator would then be a capacity expansion factor to be calculated as follows:

\[
\text{Capacity Expansion Factor} = \frac{\text{projected cargo volume at facility}}{[(\text{maximum throughput per acre}) \times (\text{acres of useable land})]}
\]
The acres of useable land should be adjacent to the facility and should be zoned appropriately or have the potential for re-zoning for transportation needs.

4.3.6 Other Indicators

There were two aspects of system performance that JFA believed where of critical interest to SCAG but which were not related to any specific regional transportation goals and objectives. The first is safety of the goods movement system. Indicators which were suggested in the Task 1 report included number of injury accidents per ton–mile (or TEU–mile) and value of claims per ton–mile (TEU–mile). Data to support the latter indicator does not appear to be available from any source. Data for the former does appear to be available for certain modes. CHP does maintain detailed incident data by location which can be accessed for evaluation of truck safety and trucking accidents can be segregated from non–truck traffic. FRA maintains the Rail Accident/Incident Reporting System (RAIRS) which provides similar information for rail accidents and FAA provides air safety data. It is not clear that either source can segregate accidents involving freight carrying equipment from those involving passenger transport. We have not been able to identify any corresponding data set for marine accidents/incidents.

A second issue of concern that is not addressed in any of the previously mentioned indicators is connectivity of the freight system within the region. This addresses the ease with which freight can be transported from one part of the region to another. This is primarily a trucking issue and can best be handled with an indicator of time between O–D pairs. The best approach to measuring this indicator would be estimates of travel time using the SCAG network models.

4.4 IMPACTS OF GOODS MOVEMENT ON PASSENGER MODE INDICATORS

All of the indicators identified above relate to how well the goods movement system performs in and of itself. Another important concern in measuring goods movement system performance is the impact which goods movement has on the rest of the regional transportation system. Therefore, we recommend that once the passenger mode performance indicators have been
finalized, the impact of the goods movement system on total regional mobility and reliability be considered as part of the goods movement performance monitoring activity.

4.5 USE OF THE FREIGHT PERFORMANCE INDICATORS FOR RTIP PROJECT SELECTION

This section describes how the freight performance indicators can be used in the context of MTA's TIP project selection process. Those criteria for which the freight performance indicators are not applicable (benefits to transit users, long-term project development, and project readiness) are not discussed below. The approaches suggested in the Call for Projects for demonstrating project advantages with respect to these criteria are adequate for freight transportation projects.

4.5.1 Regional Significance

The regional significance criteria for MTA's project selection process refers to data such as the AADT, number of lanes, and other measures that are appropriate for passenger travel. We believe that freight projects should provide data on the following indicators of regional significance:

- TEUs or total tonnage moved by the facility (daily or annual basis)
- Value of goods moved by the facility.

4.5.2 Cost Effectiveness

Because the benefits of a project can be increased mobility, reduced environmental impacts, improved accessibility, etc. and since each of these has different indicators, it will be impossible to establish a single cost-effectiveness measure for direct comparison purposes. The only reasonable approach is to look at changes in all indicators and the total project cost and to compare the magnitude of changes in indicators relative to costs as well as the mix of different changes. The relative value of one set of benefits vs. another must be determined qualitatively by project reviewers.

4.5.3 Land Use and Environmental Compatibility

The air quality, energy consumption, and sensitive habitat indicators can be used to assess the land use and environmental compatibility of the project.
4.5.4 Management of Existing Systems

Again, improvements in mobility, economic, reliability, and accessibility indicators would show improvements in the management of existing systems.

4.5.5 Inter-modal Integration

The most effective freight performance indicator for demonstrating inter-modal integration is the Mobility Index for transfer facilities used in conjunction with a delay time measure. If a project improves the match between how rapidly TEUs are entering a facility and how rapidly they can be removed, inter-modal integration is improved. However, data limitations may make this difficult to use. Distance to the NHS from non-truck modal facilities and delay time on links connecting to transfer facilities are potentially useable indicators of intermodal integration.
5 CONCLUSIONS AND RECOMMENDATIONS

In an on-going state-of-the-art project for NCHRP on performance-based planning methodologies, Cambridge Systematics, Inc. observes that MPOs are often data driven in their development of performance oriented goals and objectives. They argue that MPOs will tend to define performance-based goals and objectives in terms of data that they have available or know they can collect rather than developing goals and objectives based on what transportation systems are being designed to achieve. In their work, Cambridge Systematics has defined a typology for regional transportation goals and objectives that has three elements:

- Efficiency measures that focus on outputs of the system
- Effectiveness measures that focus on outcomes (e.g., mobility, economic competitiveness)
- Externality measures that focus on external impacts of the system (e.g., air quality).

They believe that in their effort to measure performance indicators for which data is readily available, MPOs often ignore effectiveness measures that are critical elements of regional transportation goals.

In this project, we have tried to balance these three types of goals and objectives in the development of performance indicators and we have offered performance indicators that fall in each of the three categories. However, we recognize that SCAG cannot ignore the issue of data availability. Even though performance indicators related to effectiveness measures are critical to regional freight transportation planning, if data is not available or is too costly to collect, a performance-based planning process which relies too heavily on these indicators cannot be successful.

This tension between the need to develop meaningful indicators that reflect the wide range of regional goals and objectives but that can be measured with reasonably available data has been at the center of this project. Unfortunately, the issue is not completely resolved in all cases. There are some indicators suggested in this report for which there are currently no readily available data sources. Freight transportation planning at the MPO level is clearly pushing the envelope of current data collection and planning methodologies available to MPOs.
We therefore recommend that SCAG proceed incrementally in implementing the performance measure system suggested by this report. There is a set of performance indicators recommended in this report that can be implemented with readily available data sets and at reasonable compilation and analysis costs and these should be implemented first. This will leave holes in the performance-based planning process that will need to be filled as resources for new data collection efforts become available. However, by moving ahead with these indicators first, SCAG will not be paralyzed by the data limitations inherent in freight transportation system performance measurement.

Exhibit 3 groups indicators into two categories: those that can be implemented with readily available data and those that have highest priority for development with reasonable data collection costs. Implementation of the first set of indicators will require expenditure of additional resources by SCAG but these indicators can be successfully implemented in the near term and will result in valuable planning information. Not all categories of indicator types will be present in the system after the first set of indicators are implemented and some modes will have spotty coverage. The priorities developed for the second group of indicators take this into account and focus on ensuring that a more complete set of indicator types are included in the system and that more complete coverage of modes is achieved. For example, the second group of indicators was selected to ensure that all modes and types of facilities are covered for mobility/level of service indicators (one of the most critical categories of RME goals) and that there are at least a reasonable set of economic indicators (another of the more critical categories of RME goals).

This leads to a second observation about freight performance indicators. It is inappropriate to develop a set of indicators that can be applied uniformly to all freight modes, facility types, levels of geographic disaggregation, and shipment types (i.e., long haul vs. local). There are simply too many differences in freight system performance requirements and attributes to ignore these characteristics in the design of performance indicators. Thus, different units may be appropriate for the same indicator applied to different freight modes and shipment types, performance standards for the same indicator may vary across freight modes and shipment types, and different indicators are necessary in some cases for different modes, shipment types, facility types, and levels of geographic disaggregation. This is a key feature of the performance indicators recommended in this report.

Prior to final adoption of the performance indicators, we recommend that the following steps be taken in a second phase of this effort:
• The indicators should be thoroughly reviewed by members of the GMAC that represent different freight modes and public sector entities. The indicators should be critiqued based on how well they capture the concepts embodied in the goals and objectives from the perspective of system users, whether the units of measurement are appropriate, and whether the observations about available private sector data sources are accurate. Some modifications may be necessary at this point.
EXHIBIT 3 - PRIORITIES FOR IMPLEMENTING FREIGHT PERFORMANCE INDICATORS

INDICATORS TO BE DEVELOPED WITH READILY AVAILABLE DATA

Mobility
- Link/Corridor Mobility Index
- Truck Link/Corridor Hrs. of Delay
- Delay Costs for Trucking

Economic
- Value Added, Employment/Ton

Env./Energy
- Emission Factors
- Energy Consumption Rates
- Acres Sensitive Habitat Removed

Accessibility
- All Accessibility Indicators

Safety
- Injury Accidents/TEU–Mile (Ton–Mile)

Connectivity
- Avg. Truck Route Time

HIGHEST PRIORITY INDICATORS TO BE DEVELOPED WITH REASONABLE DATA COLLECTION COSTS

Mobility
- Rail Link/Corridor Hrs. of Delay
- Transfer Facility V/C
- Processing Facility Hrs. of Delay

Economic
- Cost Per Ton
- Delay Costs
- Public Costs
Land Use Compatibility
  • Capacity Expansion Factor
• The entire GMAC should review the goals and objectives gleaned from the RME. These should be prioritized and the GMAC members should be free to suggest alternative goals where appropriate. The priorities among goals established by the GMAC will be helpful in prioritizing any necessary data collection efforts particularly where significant resources are required.

• The highest priority indicators should be tested in case studies. These should include evaluation of the value of indicators for some high visibility projects and on an area wide basis to ensure that the measured values of the indicators reflect the perceived attributes of the projects/areas based on the observations of a selected group of industry and public sector officials familiar with system performance related to the projects/areas. For example, an analysis of the Alameda Corridor project using the performance indicators would be instructive. If critical attributes of the project are not captured properly by the indicators this may provide the basis for modifying the measurement approach, the data sources, or the indicators themselves.

• After this review process is complete and the indicators have been finalized, a broad effort to use the indicators to characterize the current condition of major elements of the goods movement system should be undertaken with the highest priority indicators. This would include applying the indicators for region–wide measurements and measurements for critical goods movement facilities in the region. The GMAC should be used to provide input on the selection of the appropriate goods movement facilities. The status of current conditions should be reviewed and should provide the basis for establishing performance standards for the system, again with GMAC input.

This project has taken the first step towards establishing meaningful freight performance indicators for the SCAG region. While this was an important first step, it is nonetheless only the first step. If the program outlined above is implemented, SCAG should have the basis for performance–based freight transportation planning. This will be ground–breaking work, not without pitfalls, but given the importance of freight transportation to the region, it is work well worth undertaking.
# TABLE OF CONTENTS

1 INTRODUCTION........................................................................................................ 1  
1.1 RESULTS OF TASK 1 AND METHODOLOGY FOR SELECTING FINAL SET OF FREIGHT PERFORMANCE INDICATORS ......................................................... 3  

2 THE ROLE OF PERFORMANCE INDICATORS IN A PERFORMANCE–BASED PLANNING PROCESS ........................................................................................................... 7  

3 REGIONAL GOALS AND OBJECTIVES AND RTIP SCORING PROCESSES….. 10  
3.1 REGIONAL GOALS AND OBJECTIVES................................................................. 10  
3.2 RTIP PROJECT SELECTION PROCESSES..................................................... 11  

4 RECOMMENDED PERFORMANCE INDICATORS.................................................. 13  
4.1 MEASUREMENT UNITS .................................................................................. 13  
4.2 PERFORMANCE INDICATORS ........................................................................ 18  
4.2.1 Mobility and Level of Service Indicators ................................................. 19  
4.2.2 Indicators of Goods Movement Performance Impacts on Regional Economic Health .................................................................................................... 23  
4.2.4 Accessibility Indicators............................................................................... 26  
4.3.5 Land Use Compatibility Indicators ......................................................... 27  
4.3.6 Other Indicators ..................................................................................... 27  
4.4 IMPACTS OF GOODS MOVEMENT ON PASSENGER MODE INDICATORS .................................................................................................................. 28  
4.5 USE OF THE FREIGHT PERFORMANCE INDICATORS FOR RTIP PROJECT SELECTION ................................................................................................. 28  
4.5.1 Regional Significance ............................................................................... 28  
4.5.2 Cost Effectiveness ................................................................................... 28  
4.5.3 Land Use and Environmental Compatibility ......................................... 29  
4.5.4 Management of Existing Systems ....................................................... 29  
4.5.5 Inter-modal Integration ........................................................................... 29  

5 CONCLUSIONS AND RECOMMENDATIONS..................................................... 30