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# LOGAIR AND QUICKTRANS:
# A MODEL IN COMBINATION

THESIS

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AFIT/GLM/LSM/90S-7

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The opinions and conclusions in this paper are those of the author and are not intended to represent the official position of the DOD, USAF, or any other government agency.

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Master of Science in Logistics Management

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Thomas J. Bruns

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## *Abstract*

With impending reductions in military personnel strengths and imminent defense budget cuts it is imperative that economies of operation be explored within the defense arena. This research focused on whether merging the LOGAIR and QUICKTRANS systems improves operations and reduces costs. Similarities and differences between LOGAIR and QUICKTRANS systems were explored in the following areas: production process, cost structure, procedural structure, and managerial structure. Additionally, a Spacefilling Curve algorithm was used to establish a route model for the QUICKTRANS, LOGAIR, and combined system to determine cost/benefits.

The research concluded that there appeared to be no significant impediments to merging the LOGAIR and QUICKTRANS systems into a single combined system. Both systems are historically linked to providing priority movement of spares in support of the services first-line weapon systems within the Defense Transportation System and are commonly governed by DOD Directive 4500.32R, *Military Standard Transportation and Movement Procedures*. Any unique operating characteristics are not impediments to merging as evidenced by the existing common route structure, LOGAIR 5Q, in Florida. Finally, the author's combined routing model indicates that there are sufficient opportunities for

rationalization and inherent capacity excesses, in both systems, to realize over 30 million dollars savings per year.

# LOGAIR AND QUICKTRANS: A MODEL IN COMBINATION

## I. *Introduction*

### Overview

On November 13th, 1989 Secretary of Defense Richard B. Cheney ordered the services to draft plans for $180 billion in spending cuts from 1992 through 1994 (Willis, 1989:3). It is becoming more apparent that with the sweeping reforms in the communist block countries and automatic deficit reducing programs the military system will need to "support and defend" with less. With impending reductions in military personnel strength and imminent defense budget cuts it is imperative that economies of operation be explored within the defense arena. One such area of possible economy is being explored by HQ MAC/TRP. Their focus is on merging the two contracted Continental United States (CONUS) based cargo airlift systems, LOGAIR and QUICKTRANS, into one single system (Quirk, 1989:1-2). HQ MAC/TRP expects several benefits from consolidation of the QUICKTRANS and LOGAIR systems, these include: operating efficiencies; reduced duplicate routes; and general economies of scale (Quirk, 1989:1).

In many instances the terms "efficiencies", "utilization", "performance" and "productivity" are used interchangeably when discussing transportation or distribution systems (Tyworth, 1987:444-445). However, the cited HQ MAC/TRP benefit of "improved efficiencies" is better characterized by improved productivity of a consolidated LOGAIR and QUICKTRANS system. Productivity is defined as the ratio of real output produced to real resources consumed. The measure of this performance improvement is commonly associated with ton-miles transported divided by the total actual transportation cost (Tyworth, 1987:445). The measurement ton-miles is the product of total freight tons hauled multiplied by the total distance traveled (Coyle, 1986:513).

HQ MAC/TRP's cited benefit of reduced duplicate routes with a consolidated system is not strongly supportable. However, a related benefit of reducing shared or common locations is much more plausible. Currently the LOGAIR system has approximately sixty locations from which cargo originates and is delivered while the QUICKTRANS system has approximately 30 locations. The two systems have eight common locations. Although, neither LOGAIR nor QUICKTRANS share facilities at these common locations the potential for shared use exists.

HQ MAC/TRP's cited benefit of achieving general economies of scale has mixed reviews. Economies of scale are said to occur when a system becomes larger and the output, in this case, cargo moved increases, the average cost per unit of output decreases because each succeeding unit consumes a lesser portion of the fixed costs (Chase, 1989:274).

Intuitively, this appears what would happen to a combined LOGAIR and QUICKTRANS system. However, Chase also warns of systems that because of their increased size, suffer from increased costs of staffing and increased costs of providing adequate coordination of material or cargo flow (Chase, 1989:275). Additionally, Jordon examined a total of 24 airline mergers that occurred between 1985 and 1987. He concluded that initially after a merger the newly combined system experienced increased costs per revenue ton-mile. It was not until the combined or newly merge system eliminated duplicate route structures and combined facilities at common terminals that average operating expenses dropped below the industry average (Jordon, 1988:26-27).

### *Background*

*LOGAIR.* LOGAIR is an Air Force contracted logistics cargo airlift system managed by the Air Force Logistics Command (AFLC). The LOGAIR system consists of a series of cargo hubs (Hub and Spoke system) strategically located at each Air Logistic Center (ALC) within the CONUS. Each cargo hub is connected by a series of airlift routes that provide the movement of cargo to the hubs, enroute locations, and Military Airlift Command (MAC) Aerial Port of Embarkations (APOEs) for delivery and pickup of additional cargo (See Figure 1). The primary objectives of the LOGAIR system are:

1. Provide a dedicated Air Force managed and controlled airlift system in the Contiguous United States.

2. Improve readiness support by providing daily logistic airlift to our major weapon system bases within CONUS and to

overseas activities through an effective interface with Military Airlift Command (MAC) international airlift system.

3. Reduce the number of spares required to maintain operational capability, by shortening the shipment time of Air Force items in the Defense Transportation System (DTS).

4. Improve the quality and reliability of the Air Force Logistics System through the increased use of aircraft and compatible ground support equipment. (AFR 76-1, 1990:20)

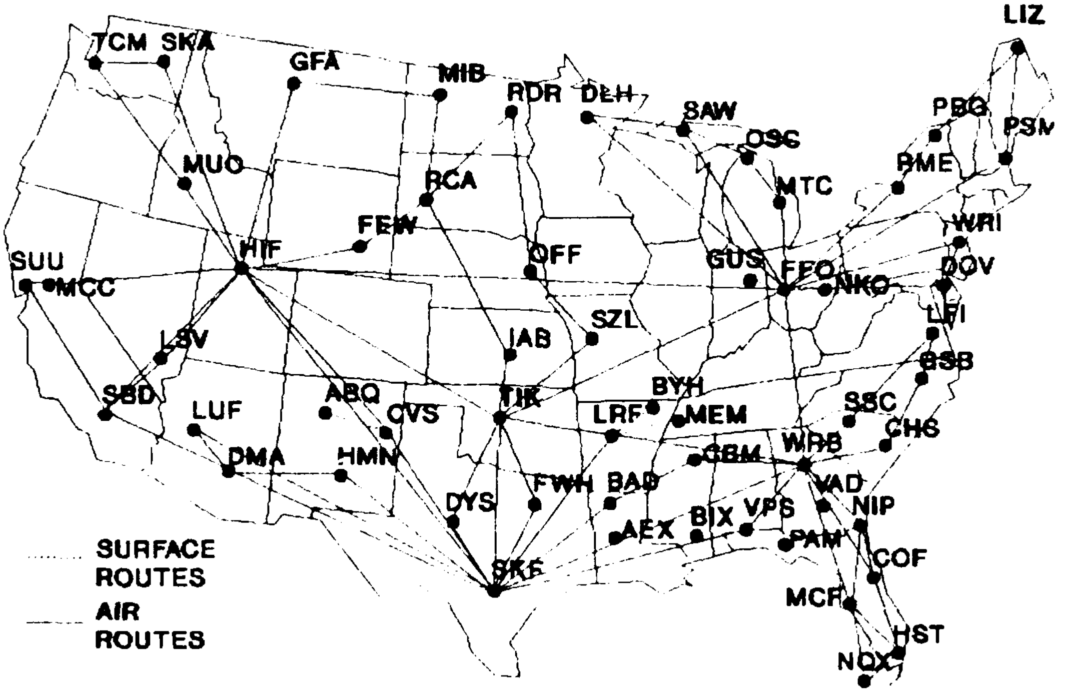

Figure 1: LOGAIR FY 90 route structure. Effective 1 October 1990.

The LOGAIR system was created in 1954 when it became clear that there was a need for a dedicated air transport system to support domestic Air Force weapon system in preparation for "D-day" (national emergencies) (Kipp, 1956:8). Originally coined the "Mercury Service" the LOGAIR system became a reality 5 February 1954 (Kipp, 1956:17).

The dedicated system was the preferred method of transport since, in 1954, there was not a dependable peacetime commercial air cargo carrier or carriers that had the capability to provide the service needed (Kipp, 1956:v-vi).

*QUICKTRANS.* QUICKTRANS is an Air Force contracted (airlift services) and Navy contracted (terminal services) logistics cargo airlift system managed by the Navy Material Transportation Office (NAVMTO) (Customer's Guide, 1984:6 and Navy, 1990:5). The QUICKTRANS system consists of two cargo routing systems, one on each coast. This system provides rapid movement of material between Naval Air Stations, U.S. Navy ships, MAC aerial ports, aircraft engine overhaul and repair facilities, major Navy shipyards, major supply activities, nuclear propulsion development and fabrication facilities, and weapon system fabrication and testing facilities (See Figure 2) (Hamann, 1983:9-10). The Mission of QUICKTRANS system is to move cargo via airlift and truck service in order to provide a controlled, flexible, and responsive method of expediting urgently required cargo between points of major Navy interest within the CONUS (Navy, 1990:5). The primary objectives of the QUICKTRANS system are:

1. Optimize the utilization of QUICKTRANS within CONUS to provide a single effective and efficient system for transporting high priority Navy material which directly or indirectly supports the fleet. This includes providing the lift capability for the CONUS segment shipments moving via the Military Airlift Command to overseas destinations.

2. Operate QUICKTRANS as a segment of the DOD Transportation System under the direction and control of NAVSUP.

3. Develop and guide the peacetime employment of the QUICKTRANS Airfreight System in a manner that will enhance emergency and wartime Navy and Marine Corps transportation, achieve greater flexibility and mobility of material and equipment, and increase logistics effectiveness and economy. (NAVSUP INST, 1988:1).

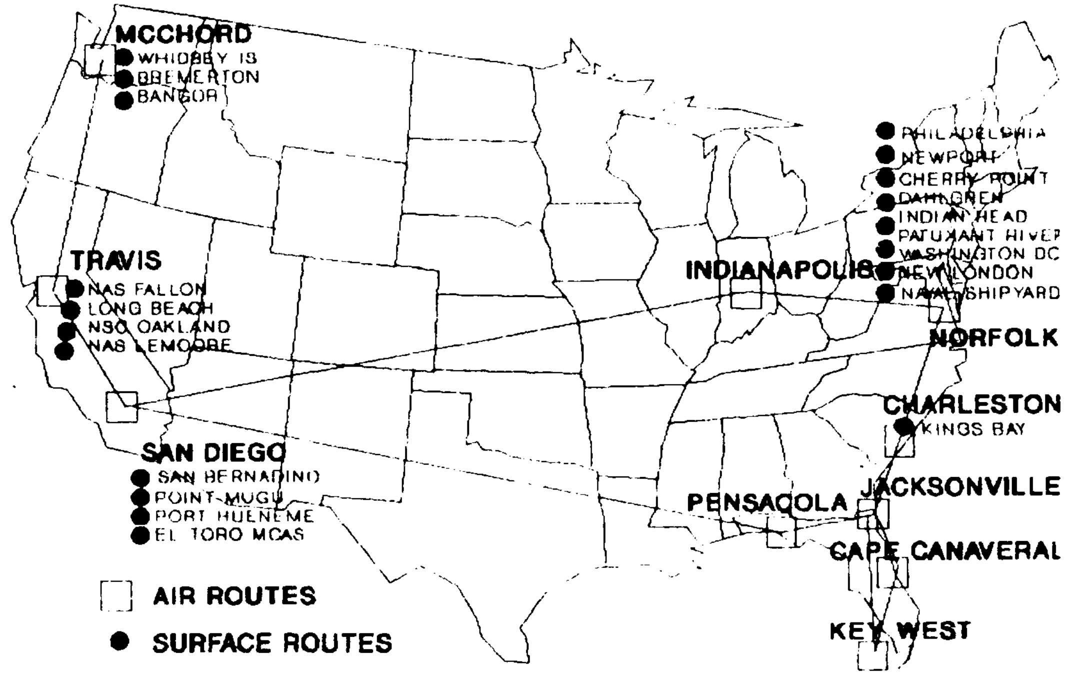

**Figure 2:** QUICKTRANS FY90 route structure. Effective 1 June 1990.

The Navy established the QUICKTRANS Contract Airlift Services in July, 1950, as a result of resupply crises during the Korean War. A clear need for a dedicated air transport system to improve transportation times and to achieve greater control, flexibility, and mobility of high priority Navy material and equipment was envisioned as the best solution. The dedicated air transport system was the preferred method of transport since, in 1950 there was not a dependable peacetime commercial air carrier that could provide the service required (Coon, 1986:20-21).

*Systems Comparison.* Although both LOGAIR and QUICKTRANS main objectives, the priority movement of spares in support of the services' weapon systems, are similar, their route structures are significantly different. LOGAIR is comprised of approximately 60 locations fairly evenly dispersed across the United States (See Figure 1). On the other hand, the approximately 30 QUICKTRANS locations are densely situated on either the east or west coast (See Figure 2). The dispersed LOGAIR system would seem to favor an aircraft-oriented system while the denser QUICKTRANS system would seem to favor a an truck-oriented system to satisfy the priority movement of cargo.

Additionally, the LOGAIR system uses a smorgasbord of different cargo aircraft including the L100, B-727, DC-9, L-188, and the CV640. This provides the LOGAIR system the capability to tailor the aircraft used to provide the type and range of aircraft service required. The QUICKTRANS system utilizes only the L-100 aircraft. The greatest benefit using only the L-100 is that it provides the largest cargo carrying versatility and capacity from small cargo to large aircraft engines.

Finally, all LOGAIR system locations or destinations are operated and manned by Air Force personnel. QUICKTRANS has opted to contract the terminal services for the aircraft transport services. The QUICKTRANS terminal services may take some of the flexibility out of scheduling cargo movement since it must coordinated and negotiated as part of the service contract. On the other hand, the terminal service contract may be a less expensive alternative to the LOGAIR system which maintains the entire personnel force and facilities internally.

*Previous Research Efforts.* The purpose of this section is to provide a review or summary of the accomplished research efforts on the QUICKTRANS and LOGAIR systems. In this manner the author hopes to avoid duplicating other research efforts.

In 1961 Huff and others researched the concept of high speed transportation (air) and the effects on critical cargo movement within the Department of Defense (DOD). This research focused on the responsiveness and economy of cargo movement. One of the main conclusions of this research effort was that the contract air transportation systems, LOGAIR and QUICKTRANS, should be consolidated into a single DOD system and placed under the management of the Single Manager for Airlift Service (MAC) (Huff, 1961:1-19).

On 30 July 1974 the Office of Assistant Secretary of Defense (OASD) tasked the Secretary of the Air Force to develop a proposal for a responsive, efficient, and consolidated (all services) contract airlift service. The contract airlift service was to be designed to be at least as efficient and as cost effective as the then current LOGAIR and QUICKTRANS systems. The result of the study proposed a consolidated systems which made MAC the operations manager while AFLC and the Navy split the responsibility for logistics management. Because of the Navy's nonconcurrence with the proposal and the fact both LOGAIR and QUICKTRANS had "demonstrated successful efforts to eliminate duplication of CONUS airlift services", implementation of the proposal was held in abeyance awaiting further data collection (Secretary of the Air Force, 1975:1-4). No further information could be located on this subject.

In 1975 Melton designed a "FORTRAN" computer model called the QUICKTRANS Economic Simulation and Tabulation (QUEST) model. The system was designed to forecast the QUICKTRANS system costs and logistics parameters including load factors and vehicle utilization. The author concluded that, by using QUEST, an analyst may predict the efficiency of potential route patterns (Melton, 1975:1-12).

The following year, Melton provided a follow-on computer model called QUICKTRANS Airlift Model (QUAM). QUAM was designed to forecast the system's cost, vehicle utilization, and route/schedule load factors for proposed routes. Again the author concluded that by using QUAM a proposed system route pattern efficiency may be predicted (Melton, 1976:1-11).

Palmatier and Prescott, in 1975, developed a computer model to determine an optimal LOGAIR route structure. The model developed was a mixed integer distribution algorithm. The algorithm was not able to reach an optimal solution, however it was able to provide a route structure that totaled less mileage than the then current LOGAIR structure (Palmatier, 1975:1-6, 42-44).

McPherson and O'Hara provided follow-on research to Palmatier and Prescott in 1976. The authors utilized a mixed-integer branch-and-bound algorithm to improve the previous LOGAIR route structure. The final routes were compared against the existing routes used by AFLC during FY 75 and FY 76. The authors concluded that the computer method is a useful tool for developing route structures and recommended adoption by AFLC (McPherson, 1976:1-20, 36-38).

Also in 1976, Moberly and Gorychka designed a mathematical model which reduced pipeline times incurred by cargo moving through the LOGAIR system. However, the model did not select the best flight combination needed to move the cargo. Nor did it account for statistical fluctuation of daily cargo movement requirements and therefore only accounted for average cargo tonnages. The model was deemed useful by the authors, for planning and evaluating the existing LOGAIR route structure (Moberly, 1976:1-6, 46-49).

Bourdreaux and Olansen in 1977 developed a mathematical model that devised and tested methods of minimizing LOGAIR feeder route transportation costs. The LOGAIR system, in

1977, was completely airlift oriented with no provisions for surface transportation. The authors concluded that the introduction of surface vehicles along with the relaxation of certain performance measurements Uniform Material Movement and Issue Priority System (UMMIPS) would result in significant costs savings for the Air Force (Bourdreaux, 1977:1-8, 38-56).

In 1979 Valkenburgh concluded a study focusing on the use of airlift to improve the readiness of combat forces. The study merged the LOGAIR concept with the single hub concept of the Federal Express Corporation. The author concluded that a single hub concept reduced the cargo transit times significantly. However, along with the reduction of transit time there was a noticeable increase in the overall cost of the route structure (Valkenburgh, 1979:1-9, 67-69).

Like the Valkenburgh study, Payne and Scott examined the feasibility of a single hub concept for LOGAIR in 1980. The authors concluded that a single hub system would provide next day delivery of practically all cargo within the system. However, operating costs rose by 19.6 percent. The authors reasoned that the increased operating costs would be more than offset by money saved with an anticipated reduced inventory (Payne, 1980:1-6, 51-54).

In 1981 Magowan and Richardson analyzed the historical data of one LOGAIR route attempting to find an accurate and reliable avenue of forecasting base level airlift requirements. The methodology the authors chose involved relatively uncomplicated and easy to use statistical tools. They concluded that there was little correlation between most variables examined and the best forecast was obtained by using the simple moving average (Magowan, 1981:38-45).

The Logistics Management Institute (LMI) completed an evaluation of the Air Force LOGAIR system in 1981. The report was in response to an Office of the Secretary of Defense (OSD) request earlier in the year. The major conclusion of the report indicated that the LOGAIR system needed to be improved to meet existing DOD time standards and make the system more competitive with alternative transportation modes. Recommendations included a more efficient network concept and enhancing the LOGAIR management information and control systems (Dienemann, 1981:1-8).

LMI also completed an evaluation of the QUICKTRANS system in 1981. The evaluation consisted of a direct comparison of the existing structure contrasted with commercial alternatives based on costs, transit time and overall effectiveness. LMI concluded that the QUICKTRANS system was efficiently operated and that the dedicated air and truck system should be "retained in its present form" (An Evaluation, 1981:1-9).

In 1983 Holden and Weber examined the development of the QUICKTRANS system and the concurrent growth of the commercial air cargo industry. The authors concluded that the commercial system represents an effective and cost efficient alternative to QUICKTRANS. However, to implement a commercial air cargo system would necessarily require a complete revamping of the existing QUICKTRANS process and an all new way of thinking for the Navy relative to cargo transport (Holden, 1983:93-100).

Hamann reviewed the 1983 QUICKTRANS system with respect to cargo loss and damage. The author concluded the system is reasonably effective based on computerized material control and the way the system was designed to be implemented (Hamann, 1983:49-50).

In 1985 Garret and MacPherson completed an extensive study of the LOGAIR system in comparison to commercial air carriers. The study examined cargo movement data including frequency distributions for weight, volume, number of pieces, and priority of shipments. The study examined costs for shipments under the hundred pound limit rather than taking a linear average of hundred weight costs. The authors concluded that LOGAIR costs were competitive with commercial cargo carriers for similar services. The analysis also provided a foundation upon which to build a model for an Air Force CONUS freight shipment network (Garrett, 1985:1-22, 158-164).

A 1986 thesis by Coon contrasted the services provided by commercial air freight services, the QUICKTRANS system, and the Military Airlift Command (MAC). The author concluded from his research that the commercial sector offers significant improvements for transit time and shipment traceability over that available from the both QUICKTRANS and MAC (Coon, 1986:87-90).

*Justification of Research.* The importance of the logistics support provided by the QUICKTRANS and LOGAIR systems can not be under-estimated primarily for two reasons. The first is the operational costs of maintaining the QUICKTRANS and LOGAIR systems during a period of shrinking defense budgets. The cost for operating the LOGAIR system for Fiscal Year (FY) 1989 was nearly 86 million dollars while the operational cost for operating the QUICKTRANS system for FY 89 was nearly 38 million dollars (QUICKTRANS, 1990:x and LOGAIR, 1990:x). With over 120 million defense dollars used to support the CONUS movement of high priority DOD cargo through these two contract airlift systems, the need for cost effective and efficient operations becomes more obvious.

The second important factor is the logistic support itself in providing a strong defense for the country. The movement of men and equipment to a battlefield adds value to those resources. Although neither LOGAIR and QUICKTRANS directly support movement directly to the battlefield, they are part of logistics system that supports movement of spares to ensure that the first-line weapon systems are prepared. Without effective transportation, those men and materials could not be par of the defensive action and would not be able to deter the enemy. In his book, *The Art of War*, Jomini provides the association between logistics, tactics, and strategy. All three are important to success on the battlefield, favoring one area over the others has resulted in undeniable defeat (Jomini, 1958:120-140). Winston Churchill made a pointed comparison to the role of logistics when he said "Victory is the bright-colored flower. Transport is the stem without which it could never have blossomed." (Churchill, 1899:viii).

Combining the LOGAIR and QUICKTRANS system may result in a potential larger and more efficient cargo movement system. A cursory review of both systems already indicates eight common locations. Additionally, the LOGAIR 5Q route provides cargo service to both Navy and Air Force components along the Florida peninsula. Both systems provide cargo movement to either coast, however the QUICKTRANS must fly virtually non-stop from coast to coast since they have no intermediate locations. The diverse infrastructure of the LOGAIR system may have existing capacity to move Navy cargo coast-to-coast thus avoiding the long-haul QUICKTRANS movement.

### *Research Objective*

The focus of this research or the research question for this study is: Would merging the LOGAIR and QUICKTRANS systems improve operations and reduce costs?

### *Investigative Questions*

The following investigative questions will be used to answer the research question. The investigative questions are tailored to provide insight into the concept of whether the merging both contract air cargo systems will provide the benefits desired. The ultimate benefits to be derived from a combined system would be improved productivity and reduced costs.

1. What are the similarities and differences between LOGAIR and QUICKTRANS:

A. In the production process (labor resources, material handling, facilities, and route structure).

B. In the cost structure (shipping rates and maintenance of aircraft).

C. In the procedural structure (cargo movement selection and method of routing cargo).

D. In the managerial structure (public law, DOD regulation, and service regulation).

2. What methods could be used to effectively combine the QUICKTRANS and LOGAIR systems?

3. What would be the costs/benefits of combining the QUICKTRANS and LOGAIR systems?

### *Scope of the Research*

The limit of this research is bounded by the limitations of the LOGAIR and QUICKTRANS cargo systems. Both systems include surface transportation as part of the overall cargo service. Since it would be difficult to limit the analysis to only air eligible all cargo moved within either system will be used as part of the evaluation process. Ultimately the evaluation process will look at the total costs of the current and proposed systems based upon the number of miles the cargo was transported. The research will focus on developing a combined route structure model that optimizes the resources of both systems. The limits of the combined route structure will be the physical and policy constraints residing internally within each system. These constraints will ensure that the model developed will provide realistic use of the combined resources and any benefits realized will be because of a combined system and not attributable to the efficiency of modeling the system.

### *Plan of Analysis*

The entire thesis will cover five separate chapters. Each chapter has a specific objective in providing insight and understanding of the research question. Chapter 2 is a review of the literature covering; the policy and procedures of the QUICKTRANS and LOGAIR system; hub and spoke efficiencies; and routing and location theory. This chapter will provide the reader with the necessary background to understand the methodology of formulating the combined cargo route structure. Chapter 3 explains the methodology in determining the combined route structure. Additionally, this chapter will detail the rule based procedures for answering the investigative questions. Chapter 4 will provide the results and analysis of the research effort. Finally, the research findings, conclusions, and recommended actions are presented in Chapter 5.

# II. *Literature Review*

## *Introduction*

In order to understand and provide an insight into the investigative questions and ultimately the research question, a survey of literature was accomplished. The survey concentrated on five major areas: the policy and procedure of both systems, an examination of the route structures with a discussion of hub and spoke efficiencies, a review of location theory, an examination of routing theory, and a review of productivity measures. These specific areas will provide the background for devising the combined routing model presented in chapter 3.

## *Policy and Procedures*

*Authorizing Laws.* A review of specific legal sources was unsuccessful in surfacing any specific laws or statutes that specifically authorize either the LOGAIR or QUICKTRANS systems. However, according to Mr Andy Figueroa Chief, Transportation Management Division, HQ AFLC, LOGAIR (and QUICKTRANS) are allowed to exist by interpretation through their funding in the Defense Authorization and Appropriation Acts. Both systems are contained within the funding of Second Destination Transportation (SDT) and are not separate line items (Figueroa, 1990).

*DOD Regulation.* Both QUICKTRANS and LOGAIR fall within the purview of the DOD Directive 4500.32R, *Military*

*Standard Transportation and Movement Procedures* (MILSTAMP). MILSTAMP provides generalized guidelines for the movement of cargo within the Defense Transportation System (DTS). This regulation provides definitive performance standards for the movement of cargo dependent upon the transportation priority of the cargo. These standards are outlined under the Uniform Material Movement and Issue Priority System (UMMIPS) within the MILSTAMP regulation (DOD 4500.32, 1988:4-60). Both LOGAIR and QUICKTRANS are subject to and, in most cases, their performance is evaluated on, the ability to satisfy the applicable performance standards. Relative to QUICKTRANS and LOGAIR the four transportation priorities and their corresponding movement standards are listed below:

A. MICAP/999: must be moved by the transportation method that provides the earliest delivery to the customer (Dept of the Air Force AFR 75-1, 1989:Para 34-4).

B. Transportation Priority One (TP-1): must arrive within 3 days of shipment.

C. Transportation Priority Two (TP-2): must arrive within 6 days of shipment.

D. Transportation Priority Three (TP-3): must arrive within 13 days of shipment. (DOD 4500.32R, 1988:4-13)

*Service Regulations.* Besides the more generalized DOD regulation, both LOGAIR and QUICKTRANS operations are subject to individual service regulations. Specific guidance on LOGAIR operation is contained in AFR 76-1, *Military Airlift and USAF LOGISTICS AIRLIFT (LOGAIR)*, while a more broad guidance for QUICKTRANS is contained in NAVSUP Instruction 4610.37A, *QUICKTRANS Airfreight System*.

AFR 76-1 provides explicit details of how and what cargo can be shipped within the LOGAIR system. Cargo to be moved within the LOGAIR system must be "air eligible". Air eligible cargo is any cargo that qualifies for one of the top three transportation priorities; MICAP/999, TP-1, and TP-2. In addition, TP-3 cargo is moved by LOGAIR to ensure high cargo load factors are achieved (Dept of the Air Force AFR 76-1, 1990:Para 5.3). All "air eligible" DOD cargo is authorized to move within the LOGAIR system. This authority is implied since the funding authority falls under the heading SDT in the Defense Authorization Acts, and is explicitly authorized by MILSTAMP since LOGAIR is a part of the Defense Transportation System (DTS) (DOD MILSTAMP, 1988:1-C-4). However, if the "air eligibility" of the cargo is unknown the airlift clearance authorization can be obtained through the LOGAIR air terminal manager or the Air Force Distribution and Control Office (AFDCO) located at Wright-Patterson AFB, OH (Dept of the Air Force AFR 76-1, 1990:Para 7-2 and 7-5). The purpose of the Airlift Clearance Authority (ACA) is to establish and control the entry or acceptance of "air eligible" cargo into the Defense Transportation System (DOD MILSTAMP, 1988:2-B-17). In addition, the Air Force Distribution and Control Office provides detailed tracking and tracing of all cargo within the LOGAIR system (Dept of the Air Force AFR 76-1, 1990, Chap 3).

Unlike the detailed procedures identified in the Air Force Regulation 76-1, the Navy's NAVSUPINST 4610.37A provides only generalized policy guidance. QUICKTRANS is afforded the flexibility for movement of "air eligible" cargo anywhere within the CONUS and nearby offshore areas when deemed "necessary for reason of national security". All Department of Defense cargo is eligible for movement within the QUICKTRANS system on a reimbursable basis (Dept of the Navy, 1988:1-3). Airlift clearance authority for the Navy is provided by Navy Material Transportation Office (NAVMTO), Code 031 (Bryan, 1990). Additionally, NAVMTO provides detailed tracking and tracing of cargo within the QUICKTRANS system (Customer's Guide, 1984:4-5). According to Mr Bob Warren, QUICKTRANS Contracting Officer and Technical Representative (Alt), the ability to provide accurate and timely tracking and tracing of QUICKTRANS cargo is very important to the management of the system, amd is required by the customers (Warren, 1990).

Although the QUICKTRANS and LOGAIR systems are separate systems attending the basic high priority cargo requirements of different services, there are several commonalities. Both QUICKTRANS and LOGAIR derive their basic policy and procedures from the Department of Defense Directive 4500.32R (MILSTAMP). Additionally, both systems are funded by the Defense Authorization and Appropriation Acts, not as separate line item, i.e. QUICKTRANS or LOGAIR, but under the broader line item heading as Second Destination

Transportation. Further, as implied by their funding origins, both are an inseparable part of Defense Transportation System.

*Cost Structure.* Both LOGAIR and QUICKTRANS provide cargo movement on a reimbursable basis. The Navy provides monthly computation of a rate structure that will provide reimbursement to the Navy Management Fund by QUICKTRANS users (Dept of the Navy, 1988:3). The Air Force possesses a similar system. However, the LOGAIR system provides a tariff structure, annually, that indicates cost per pound between the Air Logistic Centers, MAC Aerial Ports of Embarkation, and other selected LOGAIR points (Dept of A.F. AFR 76-1, 1990:Chap 1). Additionally, the LOGAIR rate charge is based on a density factor often pounds per cubic foot. This means that anything weighing less than ten pounds but larger than one cubic foot is charged an applicable rate of ten pounds per cubic foot (Wiese, 1990).

Aircraft maintenance costs, for both LOGAIR and QUICKTRANS, are satisfied by the owner of the aircraft. Therefore the actual cost of maintenance is satisfied as part of the Navy's and Air Force's payment to the contractor for cargo moved. Additionally, the contractor is paid based on the number of Great Circle Statute Miles (GCSM) the aircraft travels and not the amount of cargo moved. However, the contractor is required to guarantee a minimum amount of cargo tonnage for each contracted aircraft type (MAC Contract, 90:B-1).

Finally, the aircraft terminals are contracted by the Navy in support of the QUICKTRANS system. Therefore, those costs are separable from the other Navy operational costs (Naval Supply, 90:5-10). The LOGAIR air terminal costs are a separable cost of the system, but are not a factor in formulating the LOGAIR tariff rates. The approximately 25 million dollars, per year, expended for terminal operations are derived from SDT Operations and Maintenance (O&M) sources (Figueroa, 1990 and Wiese, 1990).

### *Route Structures*

The discussion of the LOGAIR and QUICKTRANS route structures (Chapter 1) would be incomplete without a discussion of the effectiveness of the hub and spoke system. Both systems use the hub and spoke, to a degree, for movement of the cargo within their systems.

*Hub and Spoke.* The most significant development in the airline industry is thought to be the establishment of the hub and spoke route networks (Kahn, 1988:318 and Toh, 1985:16). The hub and spoke radial pattern is similar to the hub and spoke pattern of a bicycle wheel (See Figure 3). The central location operates as the hub of the wheel with radial spokes connecting the outlying feeder locations. This pattern design consolidates aircraft flight operations at the hub to provide optimum traffic flow for all arriving and departing aircraft (Phillips, 1985:18). Toh found that there where at least the following operational efficiencies when using a hub and spoke network:

1. By acting as collection and dissemination points, hubs permit indirect connections between numerous city pairs that by themselves cannot generate enough traffic to justify direct flights.

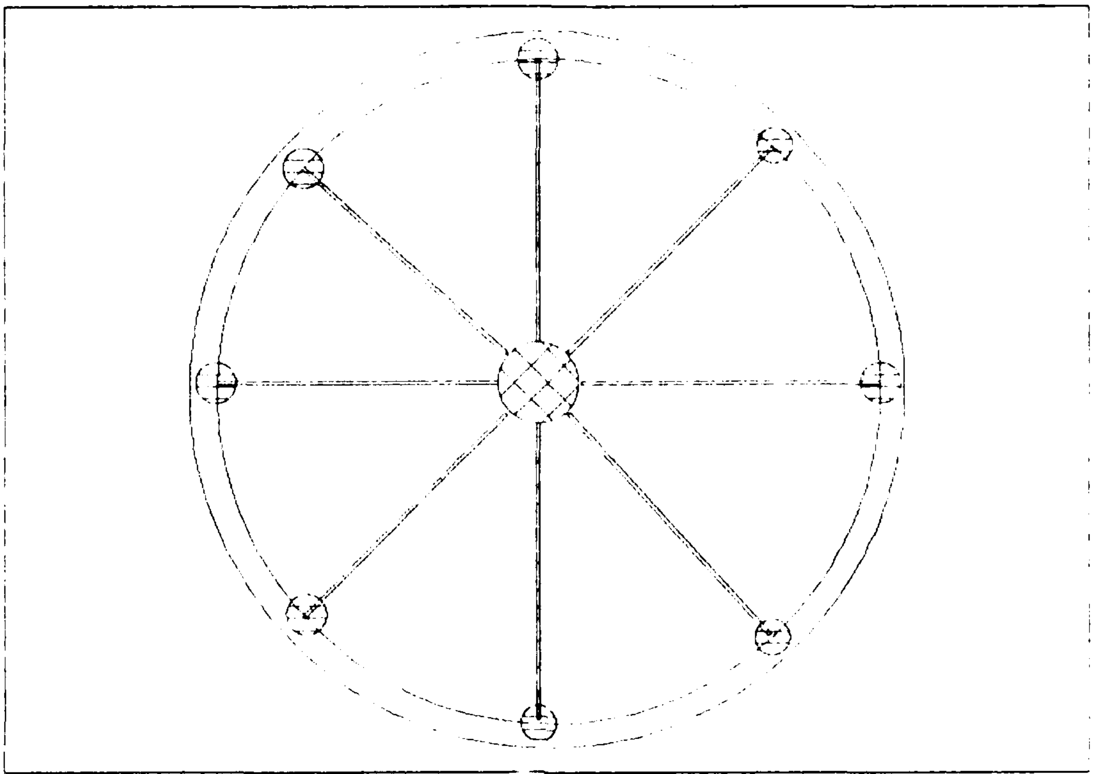

Figure 3: Hub and spoke radial network pattern.

2. A hub and spoke pattern allows all the operating stations to be served by a minimum of aircraft and flight sectors.

3. The shortness of the sectors allows for the use of smaller aircraft with greater frequency and therefore higher utilization rates.

4. Maintenance, servicing, and apron (ramp) services can be economically centralized at the hub city.

5. Aircraft arrivals and departures at the hub city can be judiciously synchronized so that passengers (or cargo) brought in from the outlying cities can be transferred to the airlines's other flights departing from the hub; thus a system of cross-feeder traffic is generated, effectively elevating load factors on all the airline's routes. (Toh, 1985:17)

One important aspect of hub and spoke efficiency is the centrality of the spoke. Centrality of the spoke refers to the number of enroute stops an aircraft makes prior to reaching or after leaving the hub. As an example, if an airlines's scheduled aircraft all have direct flights into and out of the hub, the hub's centrality is 1.0. But, if the airlines's scheduled aircraft all make one enroute stop prior to landing at the hub and make one enroute stop after leaving the hub, the hub's centrality is 2.0. Two separate studies, one by Toh and Higgins and one by Talley and Eckroade, found the more profitable the airlines the closer the centrality was to 1.0 (Talley, 1984:74 and Toh, 1985:22).

*LOGAIR Route System.* LOGAIR has been described as an extensive, high speed transportation network using a combination of air cargo and surface cargo modes to reduce inventory levels and to reduce pipeline times between supplier and user organizations. The design was precipitated by a need to ensure operational readiness of the U.S. Air Force's first-line weapon systems through rapid delivery of essential material (USAF, 1978:2). First-line weapon system include any weapon system that could be used as a primary means of defending United States resources. As a result, a good portion of Air Force cargo is classified as high-priority cargo by the UMMIPS (DOD MILSTAMP, 1988:Figure 2-B-1).

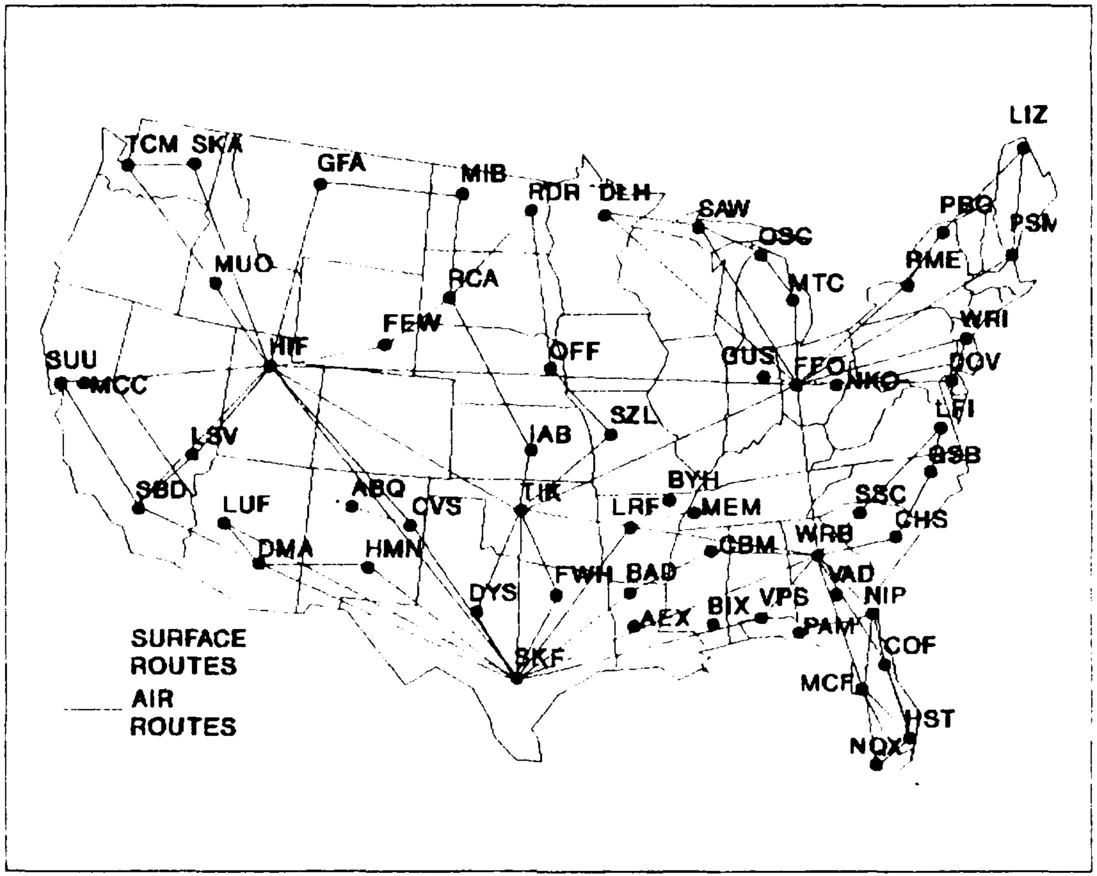

Figure 4: LOGAIR Route Structure, Effective 1 October 1989.

The LOGAIR route structure revolves primarily around the Air Force Logistics Command's (AFLC's) Air Logistic Centers (ALCs), including Wright-Patterson AFB, and CONUS MAC's Aerial Ports of Embarkation (APOE). The ALCs include: Sacramento ALC at McClellan AFB CA, Ogden ALC at Hill AFB UT, Oklahoma ALC at Tinker AFB OK, San Antonio ALC at Kelly AFB TX, and Warner Robins ALC at Robins AFB GA. The ALCs provide depot repair capabilities for many weapon systems and each is the location of large depot warehouses which supply many of spares required by the first-line weapon systems. The CONUS MAC APOEs are essential to the LOGAIR structure since they serve as overseas air cargo ports supporting the first-line weapon systems located outside the CONUS.

Finally, the LOGAIR system consists of on-line routings and off-line routings. The on-line routings are the bases that included in the official route structure and are served directly by a LOGAIR flight or LOGAIR integrated truck (See Figure 4). The off-line routings are activities that are served by a LOGAIR station, but are not part of the LOGAIR route structure (United States, 1989:8).

*QUICKTRANS Route System.* The QUICKTRANS Airfreight System is a contractor operated, CONUS-wide system of cargo terminals, connected by a scheduled air service, connecting trucks, and an elaborate communications network. The Operations Control Center is located in Code 03 at Navy Material Transportation Office (NAVMTO) in Norfolk, Virginia (NAVMTO,1984:2). Trucks are used to supplement the air transport system on both line haul and for short cargo movements prior or following to a scheduled air cargo transport. QUICKTRANS cargo scheduling is centrally managed from Norfolk (Navy data, 90). The system was designed to move cargo via airlift and truck service to provide a controlled, flexible, and responsive CONUS system for expediting required material for the Navy's first-line weapon systems (Naval Supply, 90:5).

The QUICKTRANS route structure revolves primarily around the Navy's aircraft engine overhaul and repair facilities,

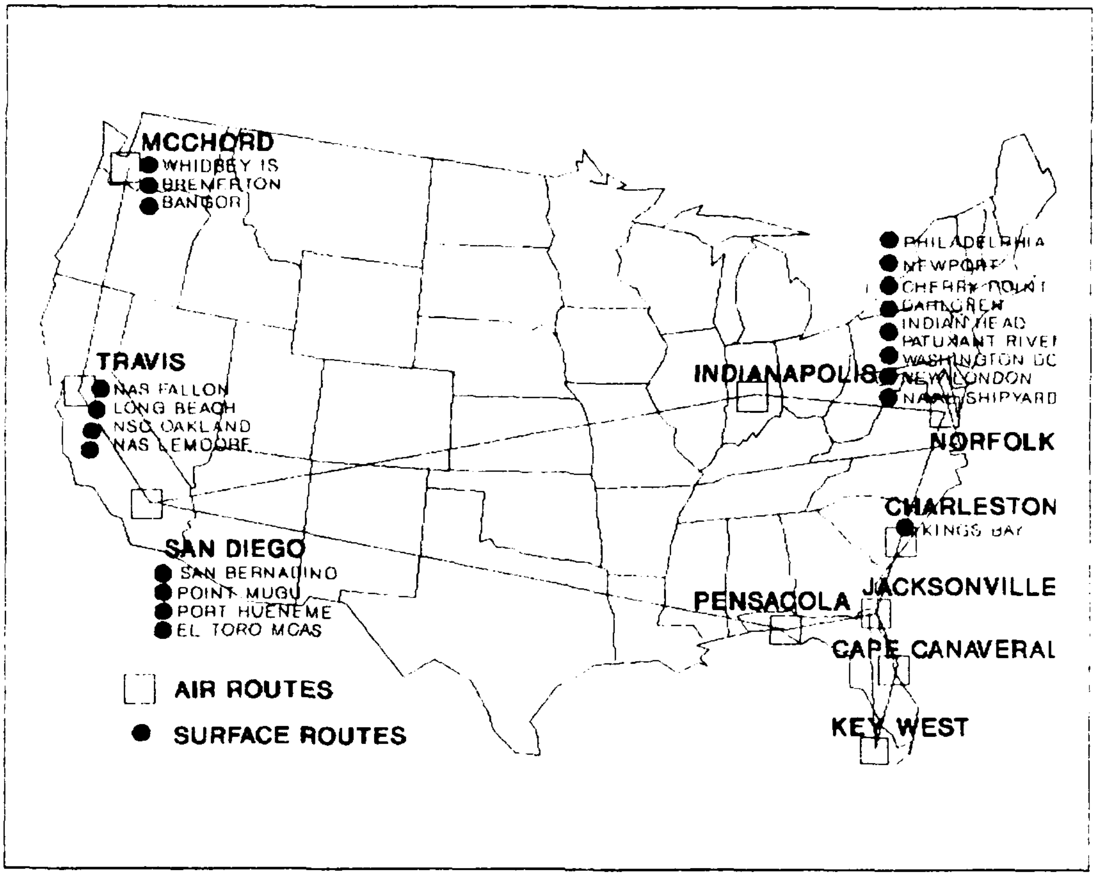

Figure 5: *QUICKTRANS Route Structure, Effective* 1 June 1990.

major supply activities, and several CONUS MAC APOE's (See Figure 5). The major hubs of the QUICKTRANS system provide depot overhaul capability along with large warehouses which provide many of the spares required by the Navy's first-line weapon systems.

### *Location Theory*

One of the most important factors when considering a distribution system is where to locate facilities for distribution of goods. Costs such as transportation of raw materials and finished goods affect the profitability of individual companies. Additionally, the time used to cover the distances between warehouses, or in the case of LOGAIR and QUICKTRANS, depots, affects inventory levels and the probability for stockouts. A survey of several location techniques and theories are presented for the reader.

One of the earliest location theories was presented by the German agriculturalist, Johann Henrich Von Thunen. Von Thunen simplified the "complexity" of the location problem by assuming an isolated city state was surrounded by a zone of equal fertility. All agricultural goods could be produced equally well in any portion of the zone. The isolated city was the only market for the harvest. Transportation was assumed equally accessible to all locations within the zone. Von Thunen's least cost theory focused on transportation costs as a determining factor on where individual agricultural products should be produced. Locations at a greater distance from the city would realize greater transportation costs. For low value and high weight goods it would not be profitable to produce these goods at the greater distances from the city because of the high transportation costs incurred. Additionally, perishable items, Von Thunen concluded, needed to be produced close to the city (market) to minimize transit time. Although Von Thunen's theory is of classical origin, much of what he theorized is still used today and represents the foundation of more contemporary research (Coyle, 1986:29-30).

Alfred Weber, a German economist, formulated a theory that focused on the location of industrial plants. Like Von Thunen, Weber defined the best location as the one yielding the least cost. The least cost location is defined as the location that minimizes the cost of moving raw materials to the plant and finished goods to the market. According to Weber, raw materials were classified by geographic availability and the weight lost in processing. The geographic availability classification implied that the raw material was either abundant, "ubiquitous", or found at certain locations, "localized". Raw materials which were ubiquitous or did not lose weight in processing allowed processing facilities to be located near the market. Raw materials that were localized or lost weight in processing required plant locations close to source of materials to minimize transportation costs (Coyle, 1986:30).

Edgar M. Hoover, an American theorist, developed a least cost approach to facility location that included the cost of transportation on the product and relative market demand for the product. Hoover's theory differed from Von Thunen's and Weber's in three major areas. First, Hoover recognized that transportation rates were not linear with distance. Transportation rates were shown to increase with distance, but not proportional to the relative distance. This nonlinearity of rates is called the tapering rate principle. Second, Hoover discovered that cargo carriers were not evenly dispersed or "homogenous" throughout the country. He recognized that some locations had a greater density of potential cargo carriers thus affecting the competitive price structure. Third, Hoover pointed out that the importance of transportation costs varied with individual companies. Product characteristics and volume of shipments made the importance of transportation costs variable for each company (Coyle, 1986:31-33).

According to Chase and Aquilano, the objective in location selection is minimization of three classes of costs: regional costs, distribution costs, and raw material and supply costs. Regional costs include construction labor, land costs, and state and local expenses. Distribution costs are costs of shipping products to markets and other segments of the distribution system. Raw material and supply costs include production necessities such as water, energy, and production lead time (Chase, 1989:285). Additionally, Chase and Aquilano identify several techniques for determining facility locations; these include: factor-rating systems, detailed cost analysis, and center of gravity methods.

The factor-rating system is described as one of the most widely used of the general location techniques. Its popularity is attributed to its ability to combine dissimilar factors in an easily understood format. The technique yields a range of potential points for each preidentified factor. Each potential location is evaluated on these factors and points are assessed per factor and location relative to all locations. The sums of assigned points for each location are compared and the location with the highest point value is selected. Critics of this methodology insist that factor-rating systems do not account for the wide range of costs that may occur within each factor (Chase, 1989:287).

The detailed cost analysis, as the name implies, compares actual costs for the predetermined factors for each proposed location. Cost factors that are normally compared include: transportation, labor, plant overhead, utilities, taxes, and workmen's compensation insurance. Usually present-value calculations are included for each factor resulting in a more detailed comparison (Chase, 1989:287-289).

A technique for determining a facility location that considers the existing market or nodal locations and the volume of goods required to be shipped is called the center of gravity method. Some literature referred to this technique as the grid technique. This method places existing locations on a coordinate grid system with the purpose of establishing relative distances between nodes. The center of gravity, ideal facility location, is found by calculating X and Y coordinates that will provide the least cost of transportation. The limitations to this method include: assumptions of linear transportation costs, solutions are static and must be reaccomplished with the introduction of new information, and topographic and directional orientation of transportation modes are ignored (Chase, 1989:289-291).

### *Routing Methods*

Once a distribution system facilities have been located, such as QUICKTRANS and LOGAIR terminals, a topic which comes to the forefront is how to effectively route cargo vehicles to efficiently interchange needed materials or services. Routing analysis normally considers routing of populations or cargo though an established transportation network, such as bus systems or airline networks. One of the best and comprehensive audits of contemporary routing methods and techniques was conducted by Chan and Rowell. Much of the presented routing methodologies was extracted from their comprehensive review, *Integrated Location-and-Routing Models Part I: A Review of Model Formulations*. In this review Chan says that basic routing problem can be stated as follows:

> Given a set of nodes and/or arcs, construct a feasible set of routes to optimize some objective, such as minimizing the cost of travelling from origin m to destination n, allowing for the case where m and n are the same node. A feasible route may be required to visit a sequence of locations to provide a specific service at these locations. (Chan, 1990:13)

One of the simplest route models is the shortest route. The objective of this model is to find the shortest route from origin m to destination n in the shortest distance with m not equal to n. The final solution will yield a desired set of arcs which link m to n. A variation to this problem is where the length of arcs are time dependent. These formulations are motivated by applications like "peak travel hours where it takes longer than off-peak travel" (Chan, 1990:13-14).

When the shortest path problem includes the destination, where m=n=1, this is called a traveling salesman problem (TSP). The objective of the traveling salesman problem is find the shortest route from origin through all locations and back to the origin. A variation of the TSP is the Multiple Traveling Salesman Problem (MTSP). The MTSP uses more than one tour to cover all nodes using the origin as a depot. In this manner all nodes are visited based on the number of tours, salesmen, that are required (Chan, 1990:14-15).

When delivery requirements (cargo) are inserted at the demand nodes of the TSP, the problem becomes a Vehicle Routing Problem (VRP). The objective of the VRP is to find the route or routes, dependent on the number of vehicles, from the origin through all nodes and returning to the origin. The problem provides for limitations such as: vehicle capacity, nodal service limited to one vehicle, and time constraints on the length of each tour. The final solution yields a set of arcs linking the origin and to a set of nodes. These solution arcs are the least-cost tours available (Chan, 1990:15-17).

The minimal-spanning tree problem attempts to find a way to reach all nodes in a network from a particular node, the origin, in a manner that the total length of all branches (arcs) used is minimal. This differs from the classical Traveling Salesman Problem which seeks to visit all locations and return to the origin resulting in the shortest tour length. A variation to the minimal-spanning tree problem, the Chinese Postman Problem (CPP), attempts to determine the minimal cost tours which pass through every node, at least once, in the network. Variations include a vehicle capacity limitation which Chan indicated could be transformed into a Vehicle Routing Problem (Chan, 1990:17-20).

By placing time window constraints on the Traveling Salesman Problem it is transformed into a Time Constrained Traveling Salesman Problem (TCTSP). The ultimate objective remains to find the shortest route from origin through all locations and back to the origin. However, now some locations are limited to operating times that they can be visited (Chan, 1990:21-22). This problem adds a note of realism to a routing problem since many operations do not operate 24 hours per day.

The complexity of these routing problems becomes considerable if parameters such as multiple origins and deterministic or probalistic demand characteristics are added. Deterministic factors infer that they are by nature static or constant. These factors can be relied upon not to change and can be accurately scheduled. Distances between locations are deterministic. Probalistic factors infer that they are by nature ever changing. These factors may be difficult to forecast with great accuracy. In many cases averages of the factors are used and some attempt is made to measure the range by which it varies. LOGAIR and QUICKTRANS cargo demands are probablistic factors.

As part of Chan's conclusions, he states:

> When the combined location/routing models include time windows, tour/route length, and other realistic routing considerations the formulations (mathematical algorithms) becomes prohibitively complex. (Chan, 1990:33).

One alternative he suggests for the "prohibitively complex" problems is the use of heuristic approximation techniques. In his opinion, most appear to perform quite well for operational needs (Chan, 1990:33).

As an example of the power of heuristics to arrive at good operational answers for Traveling Salesman Problems, Chan cites the 1989 research effort of Merrill. Merill was able to execute a Spacefilling Curve (SFC) heuristic for a Probalistic Multiple Traveling Salesman Facility Location Problem (PMTSFLP) for 75 cities using up to 4 aircraft (Chan, 1990:9-10). In his thesis, Merrill concluded that the Spacefilling Curve would arrive at solutions that were within 25% of the optimal Traveling Salesman Problem solution. Merrill's actual results were within 10% of optimum and required only 1% of the computer time required by more conventional means (Merrill, 1989:75).

*LOGAIR Routing Method.* The current LOGAIR route structure is a result of two studies accomplished at Southern Methodist University and sponsored by the Air Force

Office of Scientific Research. The research resulted in an optimization model that uses mathematical programming, network theory, and distribution statistics to arrive at the least cost set of cargo routes which satisfy the point-to-point cargo demands (Kennington, 1981:1-10). The Air Force Logistics Command, Transportation Directorate has implemented the modeling system as the D065 process of "Logistics Air Lift Computer Model."

Routing of cargo is performed by an optimization model and expert system designed specifically for Air Force Cargo. This system is called ALLOCATE. ALLOCATE is comprehensive computer-based system for allocating cargo pallets to aircraft (Nygard, 1989:1). The system was installed for daily use at Wright-Patterson AFB, OH in 1989.

The "heart" of the system is an automatic allocator that combines a highly structured generalized assignment optimization model called ASSIGN and an expert system named REVISE (Nygard, 1989:1). The entire cargo allocation process is characterized by the following decision factors:

1. Pallets are categorized into high, medium and low priority classes.

2. Often there are several alternative flights to which particular pallets can be assigned.

3. Pallets are of 2 basic sizes, with one large pallet being equal in length to a small pallet, but having twice the width.

4. Pallets of the same size are often clamped together to form inline pallets used to transport long items.

5. The system has a choice of three aircraft types: L-100, L-188, and DC-9. Each aircraft differs in capability.

6. There are always many more pallets available than can possibly be allocated. As a result, low priority pallets are often diverted to surface transportation, and some pallets must wait and be allocated on a later day.

7. Each aircraft type has geometric layout and loading limitations.

8. Pallets may hold hazardous cargo that is categorized into 29 possible types. Incompatible types cannot be allocated to the same aircraft, some types are allowed to land only at authorized stations, and there are weight limits by hazardous type that apply to both aircraft and to certain stations.

9. There are circumstances under which cargo is allowed to be shipped to an intermediate station rather than a final station (Nygard, 1989:4).

The system maximizes the number of high priority pallets allocated, followed by medium and low priority pallets. If alternative ways exist to allocate the same pallets in a priority sequence, a secondary goal of minimizing total pallet-miles applies (Nygard, 1989:3).

The two goals, maximize priority pallets and minimize pallet-miles, together with decision factors 1-6 are supported by the ASSIGN model. The ASSIGN model, in itself, produces what is considered a good allocation of airlift capability. The REVISE expert system modifies the allocation provided by ASSIGN and results in a revised allocation decision based on decision factors 7-9 (Nygard, 1989:3).

*QUICKTRANS Routing Method.* The QUICKTRANS system utilizes judgemental factors to establish the current routing system. Additionlly, the less complex and more densely concentrated QUICKTRANS system is routed to satisfy demands at each hub location. Essentially, the QUICKTRANS systems has evolved (and continues to do so) to satisfy point-to-point demand (Bryan, 1990).

### *Productivity*

The objective of the research is to determine whether combining the QUICKTRANS and LOGAIR systems would result in improved operations and reduce costs. The best measure of effectiveness of the combined systems appears to be a measure of productivity. Tyworth and others define productivity as "the ratio of real output produced to real resources consumed" (Tyworth, 1987:444). Chase and Aquilano define productivity as a measure of output divided by inputs (Chase, 1989:30). In both LOGAIR and QUICKTRANS outputs are tons of cargo moved over a measured mileage. A common measurement for freight (cargo) is the ton-mile. A ton-mile reflects the weight of the shipment and distance it is hauled; or multiplication of total tons (cargo) moved and the distance (mileage) traveled (Coyle, 1986:513). Finally, the "real resources consumed" for the LOGAIR and QUICKTRANS system are money.

### *Summary*

The literature review provided a broad range of factors that affect the combining of the LOGAIR and QUICKTRANS systems. The legal and procedural aspects were examined along with analysis of the separate route structures. The review of the location and routing theories served as the foundation from which the chapter three (methodology) used to build the route models. Finally, the discussion of productivity measurements provided the foundation for the measure of merits of the route models.

# III. Methodology

## Introduction

With the anticipated reductions in military personnel strengths and impending budget cuts it is imperative that economies of operation be explored within the defense arena. The focus of this research was to investigate whether merging the LOGAIR and QUICKTRANS systems improves operations and reduces cost.

This chapter provides insight into the benefits of a combined, QUICKTRANS and LOGAIR, route structure. This section was required since, unlike many of the benefits of the combined contract air cargo system, the combined route structure cannot be generated through the interpretation of a literature review.

The methodology chapter was subdivided into three main topics: a general description of the methods used to collect the data, a description of the methodology used to determine a combined LOGAIR and QUICKTRANS system or model, and a summary of the application of this methodology used to answer the investigative questions.

## Collection of the Data

To establish a benchmark for evaluating a combined routing system required that the current route locations, costing data, cargo demands, planning factors, and cargo carrying aircraft operating characteristics be collected. The following paragraphs detail this collection process.

*Route Locations and Cargo Demand.* Current route locations and originating and terminating cargo demands were requested from both LOGAIR and QUICKTRANS operations. It was initially assumed that both LOGAIR and QUICKTRANS data characteristics would remain static or constant as originally reported at the beginning of the Fiscal Year (1990). However, both QUICKTRANS and LOGAIR route structures are dynamic and robust. Both QUICKTRANS and LOGAIR were highly responsive to changing cargo demands and their respective route structures had been modified, several times since 1 October 1989, to provide more responsive cargo delivery (Wiese, 1990 and Warren, 1990). To deal with the dynamic nature of the route structure the existing patterns and corresponding nodal locations as 1 June 1990 were utilized.

Historical cargo demand data for Fiscal Year 1989 was used, since this was the most complete and readily available data from both QUICKTRANS and LOGAIR. In some cases, cargo demands for route locations were not available or the location was considered a marginal location so it was ignored and not listed as part of the route structure. Several locations within the QUICKTRANS system, although identified as part of route, did not have readily available cargo demand data since these locations were tracked through a separate monitoring system. In these cases dummy cargo demands were used, as a mechanism to evaluate the productivity of the original route and the route model stemming from this research. The combined route structure, 81 locations, summed both contract air cargo system's demands at common locations together. In cases where both the QUICKTRANS and LOGAIR systems had the same three letter airport code the sum of combined total cargo demand is listed. Finally, to provide a relative distance data indicator, the Longitude and Latitude of each location was researched and listed. The individual and combined route or nodal locations along with the originating and destination (terminating) cargo demands are listed in appendix A.

*Aircraft Operating Data.* Aircraft operating data were provided by AFLC and NAVMTO for the LOGAIR and QUICKTRANS systems respectively. The LOGAIR system uses a larger mix of aircraft than the QUICKTRANS system. The LOGAIR aircraft include the L-100, DC-9, B-727, L-188, and the CV-640. The QUICKTRANS system uses the L-100 almost exclusively on all aircraft route patterns. However, there are provisions for substitution with the L-188 within the QUICKTRANS system (Warren, 1990). The aircraft performance data is listed in appendix B. The aircraft performance data, excluding the CV-640, were extracted from the Part III of the AFLC *FY 90 Flight Schedules and Routing Guide*. The QUICKTRANS L-100 contract with Southern Air Transport, Inc. references the same operating characteristics that the LOGAIR system uses.

so there is no conflict. The CV-640 (Convair-640) performance data were extracted from a Convair-640 performance data book provided to HQ AFLC by Zantop International Airlines, Inc.

*Planning Factors.* The goal of generating a combined routing model was to determine whether there was inherent excess capacity, from either system, that could be eliminated to result in more productive system. It was the expectation that by using planning factors similar or common to either QUICKTRANS or LOGAIR the resultant model would recognize any efficiencies of a combined system. The planning factors used are listed in Appendix C.

The LOGAIR system uses the Enhanced Transportation Automated System (ETADS) to perform or generate many of their planning tasks. The ETADS is an advanced worldwide Air Force cargo management system. It provides AFLC with an on-line responsive management information system (Dept of the Air Force AFR 76-1, 1990:Chap 15). ETADS provides planning factors, for commercially contracted aircraft, that recognize that pallet/net weight and any unique aircraft or cargo configuration reduce the contracted Allowable Cabin Load (ACL) to what is termed "available cargo weight". As an example, the L-100 aircraft has an initially contracted ACL of 46,000 pounds of guaranteed cargo carrying capacity. When the weight of the pallets/nets and the requirement for a enhanced aisleway are factored out of this guaranteed cargo weight, the "available cargo weight" is reduced to

40,981 pounds (Dept of the Air Force AFR 76-1, 1990:Chap 6). Additionally, the "available cargo weight" for trucks is established at 24,000 lbs for LOGAIR planning purposes (Wiese, 1990).

Since this routing problem is a type of traveling salesman problem, factors such as the tour length limits, service time at each node, and the speed of the cargo vehicles must be quantified. Appendix B provides the cruising speed of all aircraft as reported in *FY 90 Flight Schedules and Routing Guide*. A common planning factor for determining the cruising speed of trucks is reported to be approximately 40 to 45 miles per hour (mph) (Wiese, 1990). The time expended by the cruising aircraft to circle, land, taxi, and takeoff are not considered in the individual aircraft cruising speeds. A useful tool for determining the relative time elapsed by cruising aircraft is the block hour. The block hour takes into account the time an aircraft spends taxing before and after landing. However, the LOGAIR and QUICKTRANS routes normally have multiple stops and each route has various lengths of flight between each location. With this type of route sequence the block hour formulation loses much of its dependability. For the purposes of this route formulation, the planned service time at each location was used along with the "rule of thumb" time for taxing (after landing and prior to takeoff). The cargo service times are also included in Appendix C and were extracted from the MAC contracts per section B. The normal, "rule of thumb", taxi times are 20 minutes after landing (before block in) and 20 minutes before takeoff (after block out) (Peschka, 1990).

Additionally, all routes are constrained by the traveling salesman requirement. Thus all salesmen (aircraft crews and truck operators) are required to return to the origin (hub), rest, or be replaced by another crew within the normal crew or operator day. For aircraft crews, crew day is defined as eight hours flying or sixteen hours total crew time, which ever comes first. For truck operators, crew day is defined as eight to ten hours of driving. However, a dual driver concept can lengthen this time to between sixteen to twenty hours (Wiese, 1990).

*Costing Factors.* The costing factors for the LOGAIR and QUICKTRANS system were extracted from the MAC aircraft contracts, the NAVMTO terminal contract, and surface freight costing factors as reported by QUICKTRANS and LOGAIR personnel. The costing factors are listed in Appendix D. The aircraft costing factors are reported in terms of dollars per Great Circle Statue Mile (GSCM) and dollars per directed landing. Based on this formulation, the LOGAIR and QUICKTRANS contractors are paid not on the volume or tonnages of cargo moved, but on the number of miles flown. The contractor would still get the same payment regardless of the utilization of available Allowable Cabin Load (ACL).

### *Model Methodology*

A basic goal of the methodology was to use a relatively easy routing method that provided accurate results in a very short period of time. The QUICKTRANS and LOGAIR systems fall within the category of a "prohibitively complex" routing problem. The one alternative suggested by Chan for "prohibitively complex" routing problems was the use of heuristic approximation techniques. In his opinion, these heuristics perform quite well for operational needs (Chan, 1990:33). Two separate research studies, one by Merrill and another by Carter, use a Spacefilling Curve (SFC) heuristic for the purposes of routing aircraft. Merrill found the SFC to be no more than 10% from the optimum route possible (Merrill, 1989:65-66). Carter found the SFC heuristic provided the identical aircraft routes as provided by the more conventional linear program method. However, he found the SFC arrived at solution in a fraction of the time that it took the linear program. In one case, the SFC provided a route solution when the linear program could not arrive at an answer (Carter, 1990:52-56). Merrill also indicated that the SFC provided rapid results. He concluded the SFC provided good results while only requiring 1% of time needed using more conventional methods (Merrill, 1989:75).

The simplicity and usefulness of the SFC heuristic is described by Bartholdi et al. (1983) where a commercial routing system was implemented without the use of a computer. The system provided for the daily routing of four vehicles to 200-300 locations. The system was maintained by one person and required the use of only two Rolodex card files. The system cost less than $50 and shortened the average travel times by 13% over the previous method (Bartholdi, 1983:1-7).

Bartholdi and Platzman indicate that SFC heuristics would be useful for solving Vehicle Routing Problems (VRPs) (Bartholdi, 1988:296). VRPs are capacity constrained Traveling Salesmen Problems (TSPs) and simulate, very well, the conditions of the QUICKTRANS and LOGAIR systems separately and combined. Bartholdi and Platzman indicate that TSPs with precedence and/or capacity constraints can be solved (via heuristics such as "nearest neighbor") after the problem has been converted from the unit square to the linear unit interval (Bartholdi, 1988:296).

*Spacefilling Curve Heuristic.* The selection of the Spacefilling Curve heuristic as the method of providing a combined route structure requires some detail presentation of how this heuristic functions. The Spacefilling Curves were introduced by mathematicians Peano (1890), Hilbert (1891), and Sierpinski (1912). Initially this family of heuristics were described as "topological monsters" since they defied intuition by allowing a lower-dimensional space to be mapped continuously onto a higher-dimensional space. However, spacefilling curves continue to interest mathematicians and computer scientist because of their recursive structure, and for the surprise and visual delight they provide (Bartholdi, 1984:4).

A spacefilling curve is a continuous mapping of the unit interval onto the n-dimensional unit hypercube. Likewise, they are also described as continuous mappings from the unit interval onto the unit square (Bartholdi, 1984:3-4). This may not seem like the same comparison, however if the n-dimensional hypercube is *n=1*, then the n-dimensional form is a unit square. More simply explained, the spacefilling curve is a continuous line that connects all points within a space (n-dimensional unit hypercube). The following figure provides a 2-dimensional example. The space, a unit square, is partitioned into four quarters, each a square in itself. As the spacefilling curve progresses through each unit

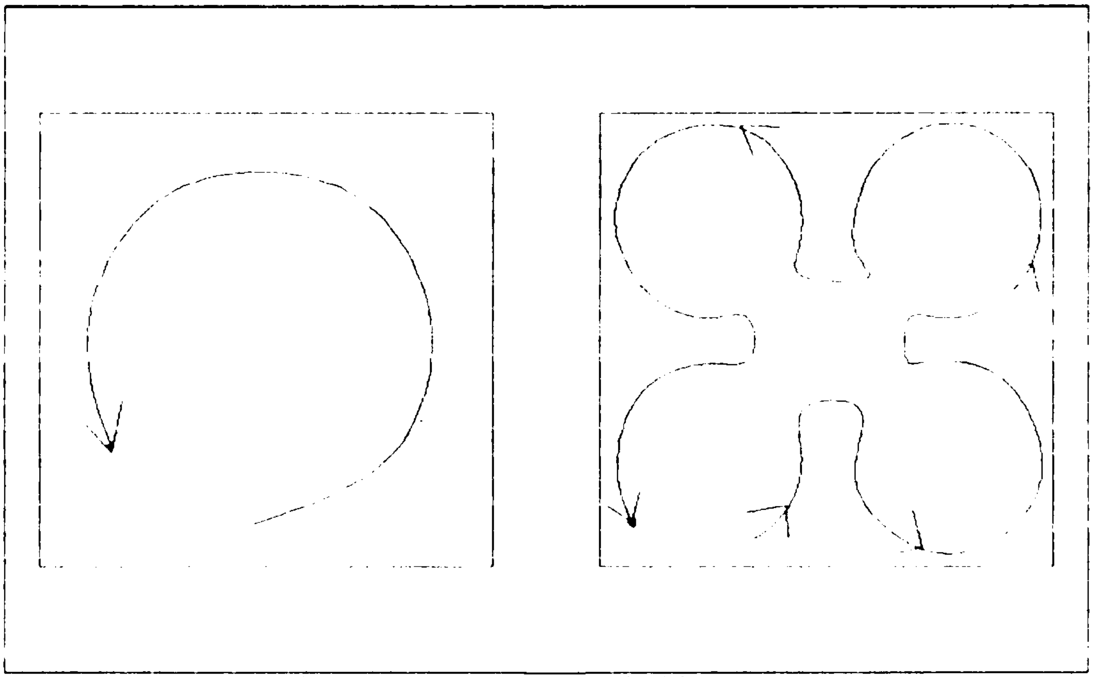

Figure 6: Two-dimensional Spacefilling Curve.

square it specifies the same value to all locations within the same quarter of the unit square. To provide a relative sequence within the square, the quarter can be broken down into additional quarters. The additional partitioning can continue in the series 4, 16, 64, .... until each location has a unique value on the curve.

A unique property of the spacefilling curves is that they tend to maintain "nearness" among points. It follows that, if two points are close on a curve then they are close in the plane. Conversely, if two points are close in the plane, then they are likely to be close on the curve. This capacity to preserve nearness is provided by the highly convulted shape of the spacefilling curve. The spacefilling curve tends to visit all locations in one region of the plane before travelling to a new region (Bartholdi, 1984:4). As the previous figure indicated, the curve (line) continues to fill the square until all locations are accounted for and each location is recognized by a unit interval value.

The spacefilling curve can also provide answers on a 3-dimensional space (n-dimensional hypercube). As figure 7 illustrates, a 3-dimensional curve would operate similar to the 2-dimensional curve except it would initially have 8 separate cubes to tour. Again the cubes could be partitioned to provide a unique value for each location on the curve. 3-dimensional spacefilling curves have been successfully used to control cuts on flat surfaces by numerically-controlled machines and to direct the movement of a mechanical plotter pen in real time. The advantage of using this type heuristic in comparison to a similar linear program solution is the overall speed of the spacefilling curve. The linear program will require $O(n^3)$ steps while the spacefilling curve only requires $O(n)$ steps (Bartholdi, 1988:295-296). $O$ is nodal locations while n indicates the additional corollary nodal information like longitude, latitude, and distances between points.

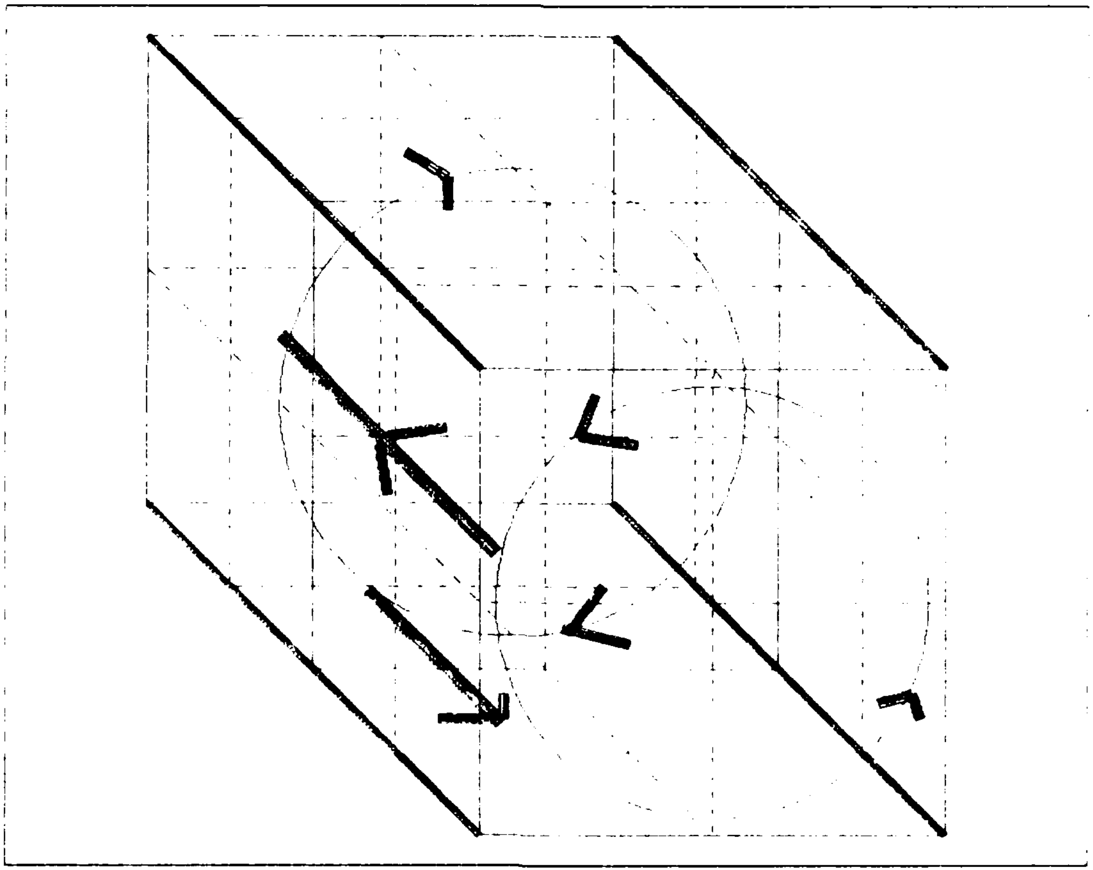

**Figure 7:** 3-Dimensional Spacefilling Curve

Finally, the spacefilling curve transforms the locations in the unit square, via the spacefilling curve (Figure 6 and 7), to a corresponding or unique value on the unit interval. Once all points are assigned a unit interval, along the continuous spacefilling curve, these points are sorted according to their relative position on the unit interval (Bartholdi, 1988:293-294). As figure 8 illustrates a randomly scattered set of locations that is transformed through the use of the spacefilling curve to a set of values on a unit (line) interval. As previously mentioned, the lower line set of values preserves the "nearness" of points from the unit square. And the lower line provides an order sequence that the each location should be visited by the traveling salesman or vehicle that results in the shortest route through all locations.

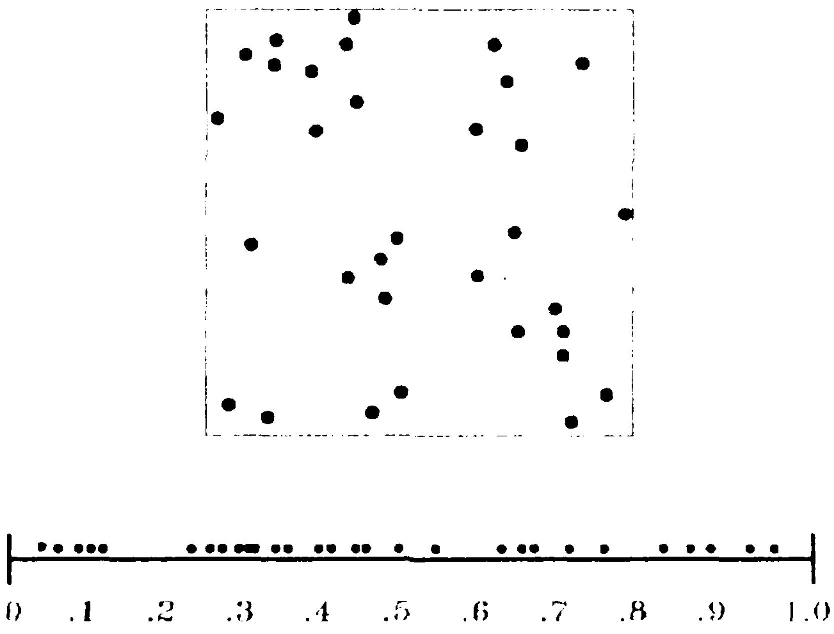

Figure 8: A set of locations in the square transformed to unit interval set on the line through the use of the spacefilling curve.

The spacefilling curve is described as the route of an obsessive salesman who visits all points in the unit square. The actual route visits only those locations required, but in the same sequence as reported on the unit interval (Bartholdi, 1984:8-9). As figure 9 illustrates, the actual route indicated by the continuous line through the points results in the shortest route. The sequence of the locations visited is determined by the sequence from the unit interval.

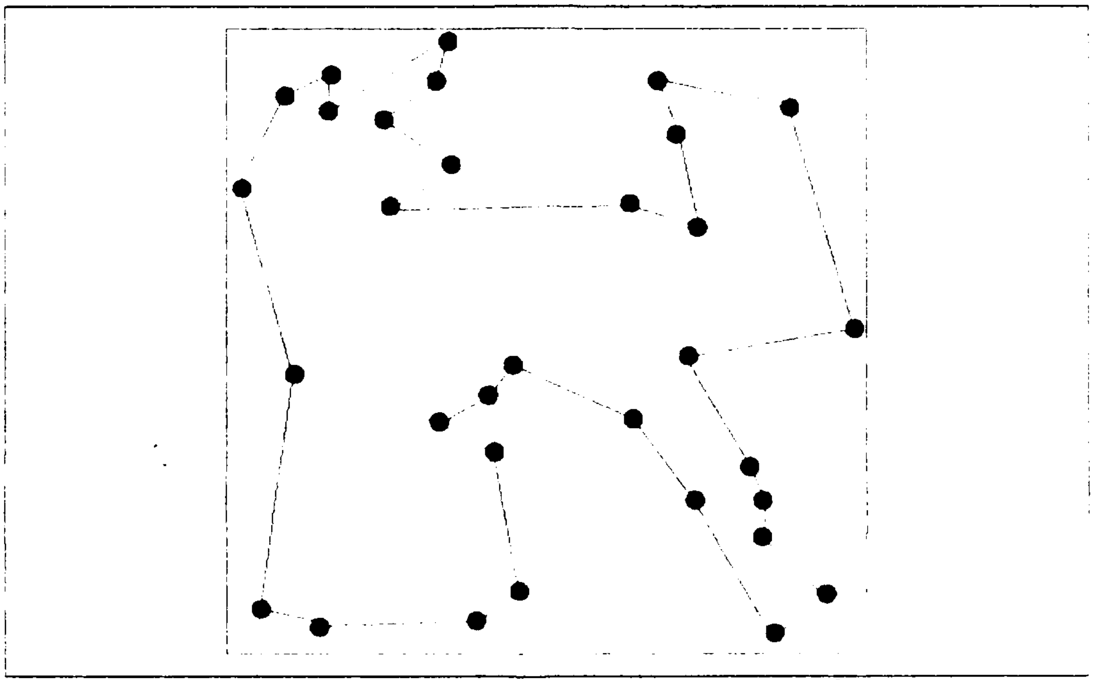

**Figure 9:** The heuristic traveling salesman's tour of all locations based on the sequence from the unit interval.

The spacefilling curve has numerous features that make it attractive for operational uses such as the routing of the LOGAIR and QUICKTRANS systems. First the heuristic is abstemious in its data requirements. It only requires the $O(n)$ coordinates of the points to be visited. In most cases a grid location such as longitude and latitude of each location is all that is required to specify these locations. The $O(n^2)$ distance between each location is not required.

By not requiring the $O(n^2)$ data the user is freed from the expense, time and money, of collecting that information. Second, the algorithm is extremely fast. Essentially, the algorithm consists of sorting, and so can be implemented to run in $O(n \log n)$ steps (worst case), and $O(n)$ steps (expected case). Next, the algorithm is agile. It can quickly update solutions in response to small changes in the problem. As an example: locations may inserted or deleted from the heuristic tour within $O(\log n)$ steps. In comparison, solutions provided by linear programs may need to be entirely re-solved when a location is added or deleted. Finally, the heuristic is "trivial to code". The actual code only requires about 20 lines of BASIC code (Bartholdi, 1988:293-294).

*The LOGAIR and QUICKTRANS routes.* The Spacefilling Curve heuristic was used to determine the combined route structure. However, as a control mechanism and to validate that any benefits realized from a combined route system were because of the inherent efficiencies of the combined system rather than the effectiveness of the route algorithm, a routing model was generated on the separate LOGAIR and QUICKTRANS systems. The effectiveness of the individual LOGAIR and QUICKTRANS systems was assumed at 100%, thus comparing the author's routes would provide a measure of effectiveness of the combined route.

The first step in the route algorithm, was to calculate for each location a corresponding position on the unit interval. The locations were then sorted according to their positions on the unit interval. The unit interval for the Spacefilling Curve is between 0 and 1. Since this is a continuous line the unit interval 0 is closer to 1 than .9 is. In fact, the furthest distance from either 0 or 1 is .5. The route locations for the LOGAIR, QUICKTRANS, and combined systems were calculated and sorted by Spacefilling curve, the results are listed in Appendix E. The unit interval in Appendix E is called theta. As indicated previously, if two points are close in the plane they are likely to be close on the curve (Bartholdi, 1984:4). In this case the curve is the unit interval (theta) sorted in ascending order of precedence. Once the unit interval is sorted, the shortest route is, most likely, the route that visits each location in the order of precedence. However, the LOGAIR, QUICKTRANS, and combined systems are not shortest route problems, but a multiple traveling salesman (MTSP) and simple vehicle routing problems (SVRP) combined. In these cases the sorted unit intervals, theta, provide convenient groupings of locations that should be visited together; this assumption is valid as long as the vehicle capacity constraints and traveling salesman time constraints are not violated. For a perspective of the relative location groupings a graph of the theta versus the Spacefilling Curve rankings is provided in Appendix E.

The next step was a partitioning problem. This step determined which locations within the closely related groupings would serve as the distribution points or the central hubs for other closely related locations. This step consisted of two parts: part one identified the central hub locations; and part two identified the locations to be serviced from a particular hub. As for the first part, the hubs could be considered restricted to the current hub locations in LOGAIR and QUICKTRANS systems. This was primarily because the current hubs serve as depot repair centers or logistic warehouse centers and generated or attracted a significant amount of cargo tonnages. However, as previously mentioned, the Spacefilling Curve can group and sort locational problems using a third dimension, in this case cargo demand. Appendix F exhibits the results of the three dimensional Spacefilling Curve algorithm on the LOGAIR, QUICKTRANS, and combined systems. As a further qualifier of the hub selection process, only those locations that could physically handle the processes of a hub were ultimately considered as a hub.

The second part to this step was to identify the individual locations that would be serviced from the potential hub locations. Both LOGAIR and QUICKTRANS systems attempt to minimize costs by minimizing the number of miles traveled by the cargo vehicles, aircraft and truck. This goal coincides with the classic location theories, presented in Chapter Two, that attempted to provide a least cost approach by minimizing the transportation cost on the product (Coyle, 1986:31-33). Relevant to this research, LOGAIR and QUICKTRANS air transportation costs are based upon dollars per mile traveled rather than dollars per ton-mile (MAC Contract, 1990:Sect B). A method of minimizing costs attributable to transportation distances is to service those locations which are closest to a potential hub location.

The author found there was no readily available source of mileages, between all locations, that could be instantly and easily used for this task. As a result, the author resorted to building an inter-mileage matrix for the LOGAIR, QUICKTRANS, and combined systems. The results of this effort are accounted for in Appendix G. The actual methodology to produce this inter-mileage matrix required calculating the distances by the means of spherical trigonometry.

*Distances on the Terrestrial Sphere.* The earth is not perfectly spherical. But, normally in evaluating reality with the use of mathematics, we replace a complicated reality with a simpler model which approximates it with acceptable accuracy. In the navigational problems the actual earth is replaced by a simpler approximation called the terrestrial sphere (Richardson, 1950:332-333). Historically, by observing the positions of the sun and stars, navigators were able determine their location, latitude and longitude, on the earth's surface. Knowing the longitude and latitude of their location and any other location the number of miles separating the two locations can be calculated by the means of the following spherical trigonometry formula:

$$\cos p = (\cos a \times \cos b) + (\sin a \times \sin b \times \cos P) \qquad (1)$$

where

$a = 90^\circ -$ latitude of location B

$b = 90^\circ -$ latitude of location A

$P = |$longitude of A $-$ longitude of B$|$

where $p$ is the complement of the angle APB or the *great-circle track* joining location A to B (See Figure 10), $a$ is the angular arc distance for location B from the north pole P, $b$ is the angular arc distance for location A from the north pole P (Welchons, 1943:206).

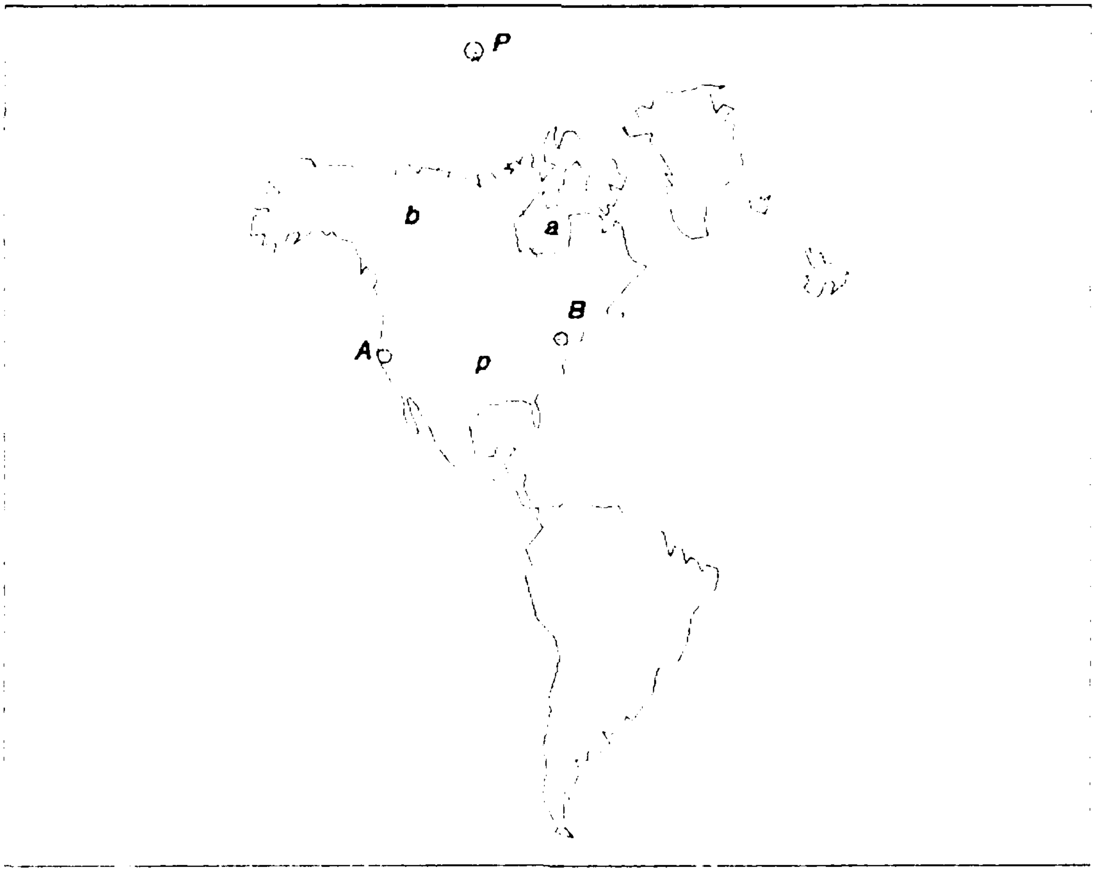

Figure 10: Distances on the Terrestrial Sphere.

For example, the distance from A (Travis AFB, CA), 38.16° North latitude and 121.56° West longitude, from B (Dover AFB, DE), 39.08° North latitude and 75.28° West longitude, can be calculated by using Eq(1). From figure 10,

$$a = 90^\circ - 39.08^\circ = 50.92^\circ$$

and

$$b = 90^\circ - 38.16^\circ = 51.84^\circ$$

and

$$P = |121.56^\circ - 75.28^\circ| = 46.28^\circ.$$

Substituting in the formula (Eq(1)),

$$\cos p = (\cos 50.92^\circ \times \cos 51.84^\circ) + (\sin 50.92^\circ \times \sin 51.84^\circ \times \cos 46.28^\circ).$$

$$\cos p = (.6304 \times .6178) + (.7762 \times .7862 \times .6911).$$

$$\cos p = .3895 + .4218.$$

$$\cos p = .8113$$

$$p = 35.77^\circ$$

Since 1° is approximately 69 miles, $p$ =2468 Great Circle Statute Miles (GCSMs) (Welchons, 1943:206).

A random check of several of the mileage figures in Appendix G with known distances figures (AFLC) found that this formula resulted in no greater than a 3% deviation from in use sources. However, the 3% deviations were found to be the exception while most mileage figures deviated by less than 1%.

Additionally, the author required a reasonable method of calculating surface mileage between locations. The surface distances were required to determine overall mileages for each route structure and was needed to permit the evaluation of the existing routes and models. AFLC has determined that a good representation of surface mileage is 120 percent of the air miles (Wiese, 1990). The surface mileage were calculated, with the aid of a spreadsheet. The results are contained in Appendix G.

*Hub Selection.* Once the distance figures were made accessible, the locations with the minimal distance to the servicing hubs were found with the use of a spreadsheet. The locations were sorted according to those hubs which they were closest to (Appendix H). Individual locations were manually reassigned if, according to the Spacefilling Curve (Appendix E), a location was in a grouping that was serviced by another hub.

As an example, in both the LOGAIR and combined models BYH (Ira Eaker AFB AR) was identified through the Spacefilling Curve, Appendix E, as belonging to a related group of MEM (Memphis TN) and others. However, BYH was identified by the spreadsheet as being closer in distance to FFO (Wright-Patterson AFB OH) than any other hub. Rather than violate the Spacefilling Curve groupings BYH was manually moved to be served by WRB (Robins AFB GA) which also serves MEM. This methodology maintains the convenient groupings of the Spacefilling Curve and still provides a good representation of distance minimization from the servicing hub. This methodology was used several times in rationalizing the best locations to be serviced by the required hubs. In several instances, hubs were identified as servicing one or less locations. In these instances, these hubs were maintained as part of a master hub route but the single service locations were reallocated to the hub which serviced the most closely related location groupings in Appendix E. Finally, after all locations were allocated to specific hub locations, new unit intervals were calculated through the Spacefilling Curve. The results are indicated in Appendix I. Additionally, Appendix I results contain the average daily demand, in pounds, for cargo for all locations. The average daily demand was calculated by dividing the Fiscal Year 1989 yearly demand by 365. This daily demand was required to determine when the cargo vehicles, aircraft and truck, have exceeded their carrying capacities on each route.

*Route Selection.* Bartholdi and Platzman provide a method of solving Vehicle Routing Problems with the use of a 2-dimensional Spacefilling curve. Their procedure indicated that closely related locations should be grouped according to their demands without violating the cargo vehicles, aircraft and truck, capacity (Bartholdi, 1988:296). Carter in his 1990 thesis, *Allocation and Routing of CRAF MD80 Aircraft*, used this procedure for the allocation of patients for aeromedical evacuation. The procedure provided the same results as the more conventional linear program, and one case was able to provide a route structure when the linear program could not (Carter, 1990:53-54).

Table 1 was extracted from Appendix I and shows the location groupings around the FFO hub (Wright-Patterson AFB OH) as sorted by the Spacefilling curve. As mentioned before, the daily cargo demand is provided in the last column to help indicate when the vehicle capacity is reached.

TABLE 1

Location Grouping for Wright-Patterson AFB
Using the Spacefilling Curve

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY POUNDS |
|---|---|---|---|---|---|---|
| 1 | NKO | NEWARK | 40.04 | 82.24 | 0.00000 | 127 |
| 2 | FFO | WPAFB (HUB) | 39.49 | 84.03 | 0.01563 | 14867 |
| 3 | IND | WEIR COOK AP | 39.43 | 86.16 | 0.06250 | 4135 |
| 4 | GUS | GRISSOM | 40.39 | 86.08 | 0.06250 | 90 |
| 5 | DLH | DULUTH | 46.50 | 92.11 | 0.45313 | 525 |
| 6 | SAW | K.I. SAWYER | 46.21 | 87.23 | 0.60938 | 1507 |
| 7 | OSC | WURTSMITH | 44.27 | 83.24 | 0.93750 | 1821 |
| 8 | MTC | SELFRIDGE | 42.36 | 82.50 | 0.95313 | 896 |

TOTAL POUNDS CARGO LESS WPAFB = 9101

To further strengthen the route selection procedure Carter enhanced the 2-dimensional Spacefilling curve results by graphing the theta results (x-axis) against the demand or cargo tonnages (y-axis) (Carter, 1990:52). Figure 11 is extracted from Appendix I and depicts the 2-dimensional Spacefilling results (theta), for FFO hub (WPAFB) location grouping, on the x-axis and the daily cargo tonnages on the y-axis. Simply explained, the route selection procedure was to route a selected vehicle around a group of closely related (theta) locations without exceeding the capacity

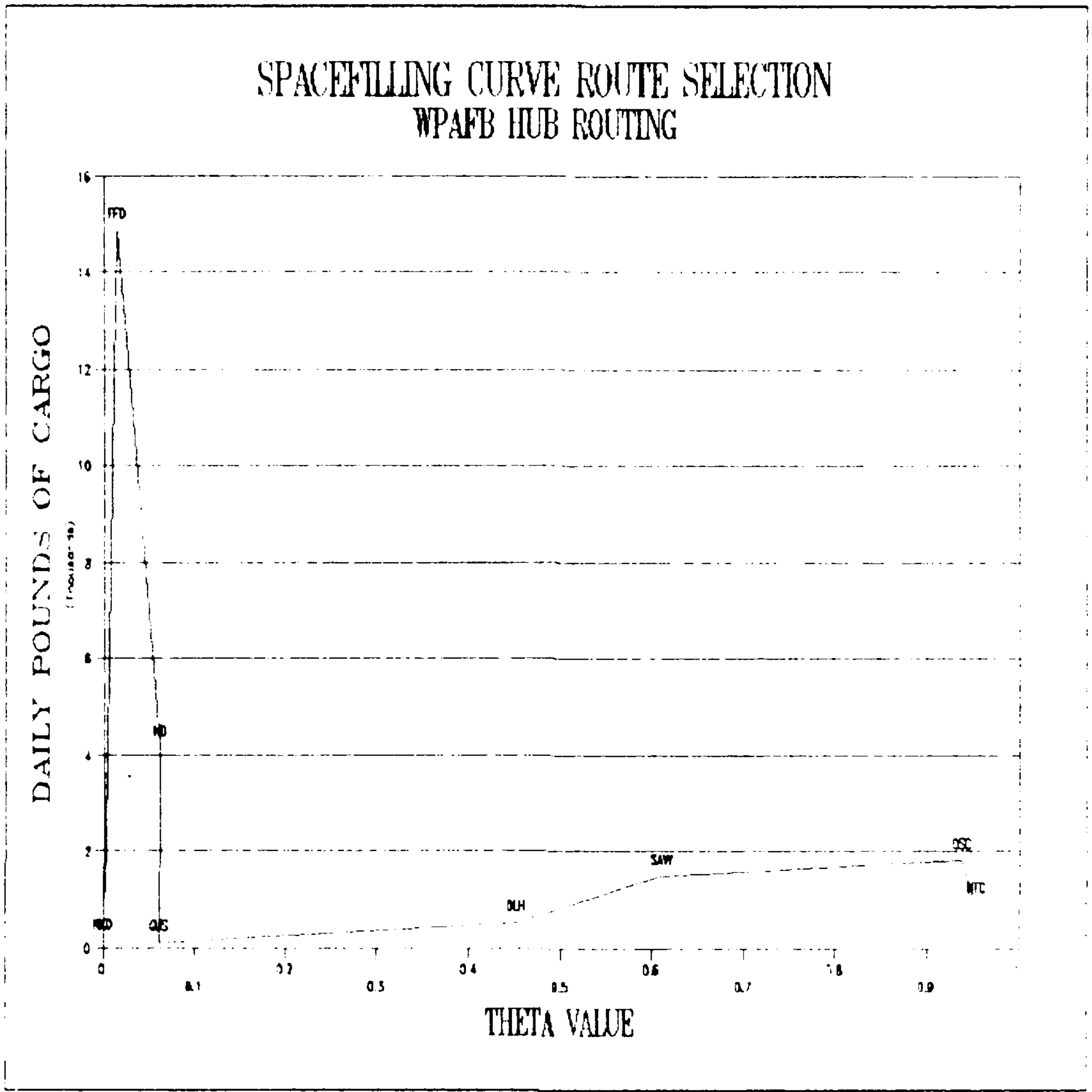

Figure 11: Extract from Appendix I showing 2-dimensional Spacefilling curve (theta) results graphed against daily cargo demand for service locations.

(planning factors) of the selected vehicle or operators. The capacity or planning factors for the vehicles and operators can be found in Appendix C. The current LOGAIR and QUICKTRANS systems operate about 6 days per week (Wiese, 1990 and Warren, 1990). This route selection focused on the 6 day planning factors for the route selection to more closely mimic the current routing structures of LOGAIR and QUICKTRANS.

By starting at the hub FFO (See Table 1 and Figure 11), the locations are fairly well separated except for a small group of locations: IND (Weir Cook AP), NKO (Newark), and GUS (Grissom). Because of their close proximity to the hub the vehicle chosen for the cargo delivery for IND, NKO, and GUS was truck transportation. Accordingly, the closely related theta values of GUS, IND, and NKO indicate they can be effectively routed in one trip. However, since the total mileage exceeds the traveling salesman requirement of 360 miles (8 hours operator time x 45 miles/hour = 360 miles) the route was satisfied by two trucks. Since GUS and IND shared the same theta value, truck route 7 was dedicated to these locations while truck route 8 was dedicated to NKO. Table 2 below provides an extract from Appendix J documenting the final routes.

TABLE 2

Selected Routes from Combined Route Structure
Extract from Appendix J.

| Routes | | Distances(MILES) |
|---|---|---|
| TRUCKS 7 | MACK | |
| FFO IND | | 136 |
| IND GUS | | 80 |
| GUS FFO | | 151 |
| TRUCKS 8 | MACK | |
| FFO NKO | | 123 |
| NKO FFO | | 123 |

DLH (Duluth), SAW (K. I. Sawyer), OSC (Wurtsmith), and MTC (Selfridge) are fairly well separated from the hub location, theta, and fairly well separated from each other. Since the daily cargo demand for all four locations was less than 5000 pounds the vehicle selected was the smaller CV640 (Convair 640) aircraft with an ETADS six day cargo factor of 13,434 pounds of cargo (Appendix C). All crews have a traveling salesman restriction of 8 hours actual flight time or 16 hours total operational time, whichever is reached first. Operational time includes: flight time, taxiing (landing and takeoff), and aircraft service time (after block-in and before block-out) (Wiese, 1990).

The total flight distance for the remaining locations was 1451 statute miles. The CV640, with a cruising speed of 300 miles per hour, will experience just slightly less than 5 hours of flight time. Taxiing and service time per location, not including the hub, will contribute approximately 8 hours and 40 minutes to the operational time. A general rule for service time can be rounded to 1.5 hours per location. The originating and terminating location do not provide service time for the crews since the aircraft are loaded, at the flight origination, prior to crew arrival and downloaded after crew departure at the flight terminating location. Since no limiting factors or constraints were violated this route was documented as route 19 for the combined system in Appendix J (See table 3).

## TABLE 3

Selected Routes from Combined Route Structure
Extract from Appendix J.

| Routes | | Distances(MILES) |
|---|---|---|
| ROUTE 19 | CV640 | |
| FFO MTC | | 213 |
| MTC OSC | | 137 |
| OSC SAW | | 236 |
| SAW DLH | | 233 |
| DLH FFO | | 632 |

Several of the selected routes, especially the hub routes exceeded the weight capacity of the selected aircraft. In these cases, the author had the option to stop the route short and reroute a second aircraft for the remainder of the flight or route a second aircraft over the same route to deliver and pickup the excess. In most cases the routing of a second aircraft over the same route provided better service with less overall mileage. All completed routes can be found in Appendix J.

*Spacefilling Curve Route Evaluation.* The intent of routing methodology was to build a model that closely resembled the factors that resulted in the existing LOGAIR and QUICKTRANS systems. By doing so, the author hoped avoiding building a combined route model where all measurable efficiencies were attributable to the routing methodology. Also by measuring the efficiency of the author's LOGAIR and QUICKTRANS models a measure of merit was determined for the combined route model.

AFLC currently uses the DO65 modeling system to evaluate potential routes. The system is quite versatile and only requires inter-location fiscal cargo demand, distances between locations, and the names of the locations to give an evaluation of the potential routes. The DO65 provides a report indicating amount of cargo moved and cargo load factors per route. The DO65 was used to determine the effectiveness of the Spacefilling Curve to provide adequate routes and provided the author with a measure of merit of how well the routes were constructed.

The DO65 modeling system worked well with two limitations. First, the QUICKTRANS inter-locational cargo demand was not readily available from the NAVMTO sources. In lieu of actual data, an inter-locational cargo demand was built based upon the percentage allocation of cargo presented in the FY 89 total tonnages, Appendix A, per location. As an example, NGU (Norfolk, VI) received 10% of the total Fiscal Year cargo tonnages. As such, the it was assumed that NGU, on the average, received 10% of originating tonnages from all locations. Although this assumption is not totally realistic it does provide an initial starting point for evaluation of the QUICKTRANS system and the author's QUICKTRANS model. The inter-locational cargo demand for the LOGAIR and QUICKTRANS systems are provided in Appendix K.

Second, the DO65 is restricted to a route model containing no more than 62 locations. This was fine for evaluating either the QUICKTRANS or LOGAIR system, but the combined model containing 81 locations could not be evaluated using the DO65 system. However, the DO65 did provide a measure of efficiency (Percent of cargo moved and cargo load factors per route) of the LOGAIR and QUICKTRANS system that could be interpolated for the combined model.

### *Evaluation of Investigative Questions*

The purpose of this section was to provide some generalized direction for answering the investigative questions. The investigative questions were answered through either the information provided in the literature review or through the interpretation of the provided route models in Chapter 4.

*Question One*. What are the similarities and differences between LOGAIR and QUICKTRANS:

A. In the production process (labor resources, material handling, facilities, and route structure).

B. In the cost structure (shipping rates and maintenance of the aircraft).

C. In the procedural structure (cargo movement selection and method of routing cargo).

D. In the managerial structure (public law, DOD regulation, and service regulation).

The information provided in the literature review was sufficient to provide answers to the inquiries in question one.

*Question Two*. What methods could be used to effectively combine the QUICKTRANS and LOGAIR system?

The results of the Spacefilling Curve model were used to determine whether the combined system was beneficial (reduced costs with no apparent loss of service). Additionally, the DO65 model was used to determine how effective the Spacefilling Curve models were compared to current LOGAIR and QUICKTRANS systems.

*Question Three.* What would be the cost/benefits of combining the QUICKTRANS and LOGAIR systems?

This analysis focused on apparent efficiencies of sharing common locations and any derived efficiency of the shared route structure. A true measure of benefits directly tied to costs would be a reduction in the total route air mileage. This assumption is based upon air cargo costs being linked to the total mileage per route and not the amount of cargo tons moved.

## *Summary*

Chapter Three provided the insight into the benefits of a combined, LOGAIR and QUICKTRANS, route structure. It established the parameters for building the route structure based on the current route characteristics and readily available cargo data. It introduced an amazingly fast and accurate heuristic, the Spacefilling Curve algorithm, for building the route models. And it established a method through the DO65 Logistics Air Lift Computer Model for evaluating the effectiveness of the author's route models.

Finally, it established the generalized rules for analysis of the results.

# IV. *Results and Analysis*

## *Introduction*

This section answers the investigative questions posed in chapter one through the interpretation of the literature review and analysis of the results from the routing models. This chapter was organized around the investigative questions to provide a logical continuity to the rest of the thesis. The focus of the investigative questions was to determine whether merging the LOGAIR and QUICKTRANS systems would improve operations and reduce costs.

## *Question One. What are the Similarities and Differences Between LOGAIR and QUICKTRANS:*

The interpretation of the literature review, in most cases, was sufficient to answer the sub-questions and, ultimately, Question One. Surprisingly, the similarities were more common than the differences within the LOGAIR and QUICKTRANS systems. This was more attributable to the common governance by the same Department of Defense regulation, DOD 4500.32R, than anything else.

### *Similarities and Differences in the Production Process (Labor Resources, Material Handling, Facilities, and Route Structure)*

Labor resources for the two systems are significantly different. Other than the vehicle operators, pilots and truck drivers, the LOGAIR system maintains its entire labor force composed of active duty military and civil servants.

This includes the management force and aircraft terminal labor force (Wiese, 1990). Unlike LOGAIR, the QUICKTRANS system is nearly all contract labor. This includes all terminal services (except Charleston AFB) and all other associated labor resources excluding upper management (Bryan, 1990). The amount of contract services performed for the QUICKTRANS system may detract from a perceived capability to provide flexible cargo movement service. On the other hand, the large amount of contract services may be a less expensive alternative to the LOGAIR system which maintains the entire personnel force internally.

The LOGAIR system supports its large mix of contract aircraft (L100, L-188, DC-9, and CV-640) with a sufficient variety of materials handling equipment. This entire fleet of materials handling equipment is provided and maintained by the individual Air Force bases on which the LOGAIR stations are located (Wiese, 1990). Conversely, QUICKTRANS as part of their terminal facilities contract, have the contractor provide the necessary materials handling equipment (Bryan, 1990). However, since the QUICKTRANS system is almost exclusively serviced by L-100 aircraft and truck, the variety of material handling equipment is not as great as the LOGAIR system (Only on the LOGAIR and QUICKTRANS shared route in Florida, 5Q, does the QUICKTRANS system routinely service the L-188 aircraft). However, the QUICKTRANS terminal services contract does require the contractor to service substitute or diverted aircraft (Navy, 1990:IIA2.1.).

Both the LOGAIR and QUICKTRANS facilities, since both are located on government reservations, are provided by the Navy and Air Force (Warren, 1990 and Wiese, 1990).

Although the LOGAIR and QUICKTRANS systems have basically the same mission, the priority movement of spares in support of the services first-line weapon systems, their route structures are significantly different. First, the LOGAIR system is comprised of approximately 60 locations fairly well evenly dispersed across the United States. Because of the significant distances between locations, this favors the resultant use of aircraft as the cargo vehicle of choice. Conversely, the QUICKTRANS system is comprised of approximately 30 locations densely stationed on both the east and west coasts. The relatively short distances between most locations favors the extensive use of the surface transportation system.

Although the QUICKTRANS and LOGAIR route structures are significantly different, both use basically the same general rules to establish the structure to provide rapid movement of spares in support of first-line weapon systems. These are evidenced by the contemporary route structures. Densely or closely situated locations are serviced by surface transportation modes while widely separated and high cargo traffic (hub) locations are serviced by air transportation modes. Basically, the significantly different route structures of the QUICKTRANS and LOGAIR systems are not the result of by any established directive, but are as the result of good traffic management decisions to provide rapid movement of high priority cargo.

### *Similarities and Differences in the Cost Structure (Shipping Rates and Maintenance of the Aircraft*

Both LOGAIR and QUICKTRANS provide cargo movement on a reimbursable basis. The QUICKTRANS system provides monthly computation of a rate structure that will provide reimbursement to the Navy Management Fund by QUICKTRANS users (Dept of the Navy, 1988:3 and Bryan, 1990). The LOGAIR system establishes a tariff structure, distributed annually, that documents the cost per pound for cargo moved between Air Logistic Centers, MAC Aerial Ports of Embarkation, and other selected LOGAIR points (Dept of A.F. AFR 76-1, 1990:Chap 1). The only difference between the two systems is that while the QUICKTRANS system is immediately reimbursed for all charges following the month of movement, the LOGAIR system uses, essentially, a standard cost that would result in reimbursement if the forecasted cargo demand is consistent. From a customer's point of view the up-front LOGAIR tariff cost may be preferable to the anticipated reimbursement charge tendered by the QUICKTRANS system. However, this should not represent a severe obstacle to a combined system, since it represents only a method of reimbursement for services provided.

The costs for maintaining the contracted aircraft are identical. The contractor is responsible for maintaining the aircraft for both the LOGAIR and QUICKTRANS systems. Additionally, both QUICKTRANS and LOGAIR aircraft contractors are reimbursed dependent upon the number of Great Circle Statute Miles covered not on the number of tons of cargo transported (MAC Contracts, 1989 & 1990:Sect A). Surface transportation costs are represented by standard commercial tariff rates which are essentially dollars per hundred-weight of cargo moved (Wiese, 1990 and Warren, 1990). Basicly all outlays for purchased cargo service by both QUICKTRANS and LOGAIR are identical and pose no significant barrier to a merged system.

### *Similarities and Differences in the Procedural Structure (Cargo Movement Selection and Method of Routing Aircraft)*

Selection of cargo for movement along either system, QUICKTRANS and LOGAIR, is governed by a common regulation. DOD Directive 4500.32R, *Military Standard Transportation and Movement Procedures*. As part of the Defense Transportation System (DTS), cargo entering either contract airlift system, either for surface (export) or air movement, requires clearance into the DTS (DOD MILSTAMP, 1988:2-B-15). All cargo offered to shipped by QUICKTRANS and LOGAIR, must be cleared by the Air Clearance Authority (ACA) for each service. This common DOD governing directive essentially results in both QUICKTRANS and LOGAIR air transporting the same priority classes of cargo: MICAP/999, TP-1, TP-2, and

TP-3. TP-3 is not normally recognized, by either system, as readily "air eligible", but MILSTAMP permits TP-3 movement by air unless expressly disapproved (DOD MILSTAMP, 1988:2-B-17) and LOGAIR increases the airplane load factors with the movement of TP-3 cargo (Wiese, 1990).

Actual routing of the aircraft or trucks for movement of the high priority cargo is done by selectively different methods in both the QUICKTRANS and LOGAIR systems. LOGAIR uses the DO65 modeling system to establish and evaluate potential routes and route structures. Once a route is established the Allocate system is used to distribute cargo pallets to aircraft. The model provides maximum shipment of priority pallets and minimizes the pallet-miles (Nygard, 1989:3).

The more densely concentrated QUICKTRANS system satisfies demand through the hub network and then satisfies the point-to-point demand onward (Bryan, 1990). Although less sophisticated than the LOGAIR routing process, the QUICKTRANS process provides the same results, a useable routing system. However, if combined, the processes used by LOGAIR system may be more advantageous to formulating the combined route structure.

### *Similarities and Differences in the Managerial Structure (Public Law, DOD Regulation, and Service Regulation)*

Both QUICKTRANS and LOGAIR are not specifically authorized by any public law. However, they are permitted to exist through an interpretation of the funding by the

Defense Authorization and Appropriation Acts. Neither system is a separate line item, but they are collectively funded within realm of Second Destination Transportation (Figueroa, 1990).

As mentioned previously, QUICKTRANS and LOGAIR are governed by a common regulation, DOD Directive 4500.32R, *Military Standard Transportation and Movement Procedures*. Given this common DOD governance, the individual service regulations are, by legacy, very similar in scope and policy. The original premise for initiating the LOGAIR and QUICKTRANS systems was to provide dedicated air transport service (for spares) for each services first-line weapon systems (Navy, 1990:5 and Dept of A.F. AFR 76-1, 1990:20). However, since both systems are a component of the larger Defense Transportation System (DTS), movement of "other" services high priority cargo is authorized.

*Question Two. What methods could be used to effectively combine the QUICKTRANS and LOGAIR system?*

Following the recommendation of Chan and the guidance from two separate research studies, one by Merrill (1989) and other by Carter (1990) the Spacefilling Curve was used to combine the LOGAIR and QUICKTRANS systems. The use of the Spacefilling Curve Heuristic provided responsive and easily interpreted results to formulate a combined routing model and individual, LOGAIR and QUICKTRANS, routing models. The author found the two greatest attributes of the

Spacefilling Curve were that it was abstemious in its data requirements and the algorithm was extremely fast.

Being abstemious for data requirements made the Spacefilling Curve, in retrospect, the only algorithm available to provide a good model of the combine route structure. The data collection results did not provide many data points that were common to both the LOGAIR and QUICKTRANS. Thus, the Spacefilling Curve abstemious attribute was the difference between research success and failure.

The speed of the Spacefilling Curve Heuristic (each iteration of the program took less than 20 seconds) allowed for many practice attempts while becoming proficient at understanding algorithm output.

The final routing models provided results that were comparable to the current routes used. Using the DO65 modeling system to evaluate the route models, developed for the QUICKTRANS and LOGAIR systems, provided a measure of effectiveness of the Spacefilling Curve. The results of the DO65 analysis is contained in Appendix L (QUICKTRANS) and Appendix M (LOGAIR).

The DO65 analysis of the current QUICKTRANS system indicated that 64 percent of the total demand of 480,455 pounds (daily cargo) was satisfied. Although this does not appear very good it is important to remember that a portion of the QUICKTRANS cargo data requirements were interpolated to fit the needs of the DO65 system. The inter-locational cargo demands, for QUICKTRANS, (Appendix F) were interpolated from the FY 89 total cargo demands and probably do not reflect the realistic cargo movements. However, this serves to establish a baseline from which the author's routing models can be evaluated.

The author's QUICKTRANS model generated a DO65 report (Appendix L) indicating 58.54 percent of the total demand of 480,455 pounds (daily cargo) was satisfied. However, this result is quite good considering that the current QUICKTRANS system is assumed to have transported 100 percent of all cargo, yet yielded only a 64 percent of total demand. Consequently the author's QUICKTRANS model yielded results only 5.46 percent less than the current optimum.

The DO65 analysis of the current LOGAIR system indicated that 100 percent of the total demand of 316,258 pounds (daily cargo) was satisfied. The difference in the analysis, between LOGAIR and QUICKTRANS, was the availability of the inter-locational cargo data for the LOGAIR system. The actual cargo movements could be evaluated with better effectiveness with this data file.

The author's LOGAIR model generated a DO65 report (Appendix M) indicating 98.89 percent of the total demand of 316,258 pounds (daily cargo) was satisfied. Consequently the author's LOGAIR model yielded results only 1.11 percent less than the current optimum.

The DO65 also provided the opportunity to evaluate individual routes and modify the route structure to improve the percentage of cargo moved. However, since the combined route, containing 81 locations, was too large to use the DO65 modeling system, the author's LOGAIR and QUICKTRANS systems were not modified. In this manner, a comparable analysis of the combined route model with the author's LOGAIR and QUICKTRANS models could be justified.

Since cost for both LOGAIR and QUICKTRANS systems are more associated with miles traveled rather than tons of cargo moved the length of the routes were compared. The current QUICKTRANS system (Appendix J) yielded a total daily mileage of 22,708. Of this total, air mileage comprised 15,022 miles and surface mileage consisted of 7,686 miles. The author's QUICKTRANS model (Appendix J) yielded a total daily mileage of 16,440. Of this total, air mileage comprised 9,597 miles and surface mileage consisted of 6,843 miles. In comparison, the author's model used approximately 36 percent less airlift resulting in 5.46 percent less cargo being transported.

The current LOGAIR system (Appendix J) yielded a total daily mileage of 43,873. Of this total, air mileage comprised 41,893 miles and surface mileage consisted of 1,980 miles. The author's LOGAIR model (Appendix J) yielded a total daily mileage of 32,766. Of this total, air mileage comprised 25,792 miles and surface mileage consisted of 6,974 miles. In comparison, the author's model used approximately 38 percent less airlift and 352 percent more surface transport resulting in 1.11 percent less cargo being transported.

A cursory review of the D065 report shows that the author's cargo load factors for the hub routes are higher than the current systems and in some cases in excess of 100 percent. This quickly accounts for the slightly less than optimum cargo movement and accounts for significant difference in total mileage.

Using the above results it was assumed that the combined routing model would provide results that would be approximately 1 to 6 percent off the optimum route model. Additionally, the author's combined route model (Appendix J) yielded a total mileage of 48,449. Of this total, air mileage comprised 42,316 and surface mileage consisted of 6,133. This compares extremely well against the combined mileage of the current LOGAIR and QUICKTRANS systems. For convenience the results for the current systems and the author's model are provided in Table 4. The total of

TABLE 4

Tabulation of Routing Analysis
Indicates Mileage Consumed by Different Routes

| | Current Routes | | Author's Models | | |
|---|---|---|---|---|---|
| | QTRANS | LOGAIR | QTRANS | LOGAIR | COMBINED |
| Air: | 15,022 | 41,893 | 9,597 | 25,792 | 42,316 |
| Surface: | 7,686 | 1,980 | 6,843 | 6,974 | 9,666 |
| Total: | 22,708 | 43,873 | 16,440 | 32,766 | 48,449 |

current systems yielded a total daily mileage of 66,581. Of this total, air mileage comprised 56,915 miles and surface mileage consisted of 9,666 miles. Based on the effectiveness of the first two models, it was not surprising that the author's model used 27 percent less mileage to accomplish the same task.

*Question Three. What would be the cost/benefits of combining the QUICKTRANS and LOGAIR systems?*

The first benefit of the proposed combined system was location rationalization. Combining the locations into the combined model reduced the sum of locations, QUICKTRANS and LOGAIR, from 89 locations to 81. These eight locations were common to both the individual cargo systems. Assuming the eight common locations duties can be absorbed by the existing LOGAIR structure, then a 3 million dollar savings is realized since the eight locations comprise 25.8 percent of the FY 89 QUICKTRANS Terminal Services Cost (Appendix D) of nearly 12 million dollars. However, this costing analysis does not imply that the LOGAIR organic terminal structure is more favorable than the QUICKTRANS contracted terminal services. It merely indicates that the QUICKTRANS terminal services costing figure were more convenient to use.

Again, since the cargo contractor was reimbursed, generally, on the basis of number of miles traveled rather than the number of tons transported, an analysis of cost of the reduced miles was required. The author's combined route model yielded 27 percent less mileage than the sum of the two current stand alone systems. Assuming all other factors are equal, the author's combined system would cost 27 percent less than the combined stand alone systems. With nearly 114 million dollars (Appendix D) attributable to cargo movement, LOGAIR and QUICKTRANS, the 27 percent reduction in mileage equates to over a 30 million dollars savings per year.

A derived benefit of the combined system would be enhanced use of the separate systems excess capacities. Since the LOGAIR and QUICKTRANS are regularly scheduled routes, excess capacity is inherently built into the system to ensure all cargo is moved within a certain time frame. A combined system could use these excess capacities to improve load factors on parallel route structures and reduce the required route structure to provide the same service. The 27 percent reduction of mileage with author's route model was an example of this excess capacity.

### Summary

This chapter provided results and analysis of the research effort formatted to answer the original investigative questions. The similarities and differences of the LOGAIR and QUICKTRANS system were examined and the results indicated there were significantly more similarities than differences. The similarities of two systems can be directly linked to a common membership within DTS and by common governance by DOD Directive 4500.32R, MILSTAMP. The Spacefilling Curve algorithm furnished routing models that, when compared against the current systems, resulted in cargo movement that was within 1 to 6 percent of optimum. Additionally, the combined model yielded a total daily mileage that was 27 percent less than the combined total of the current LOGAIR and QUICKTRANS systems. Finally, the combined model was comprised of 8 fewer locations than the current LOGAIR and QUICKTRANS systems and this combined with the reduced mileage equated to approximately 30 million dollars savings per year.

# V. *Conclusions and Recommendations*

## *Overview*

The purpose of this chapter is to provide conclusions based upon the results of the research effort and to provide insight into where or what type of research efforts should proceed from this effort.

## *Conclusions*

There appear to be no significant impediments to merging the LOGAIR and QUICKTRANS systems into a single combined system. Both systems are historically linked to providing priority movement of spares in support of the services first-line weapon systems within the DTS and are commonly governed by DOD Directive 4500.32R, *Military Standard Transportation and Movement Procedures*. Any unique operating characteristics, of either system, are not impediments to merging as evidenced by the existing common route structure, LOGAIR 5Q, in Florida. Finally, the author's combined routing model indicates there are sufficient opportunities for rationalization and inherent capacity excesses, in both systems, to realize over 30 million dollars savings per year.

## *Limitations of Study*

As indicated in chapter one, this research effort was bounded by the limitations of the LOGAIR and QUICKTRANS cargo systems. Additionally, it was bounded by the ready availability of data. This was a direct result of research time constraints and not a result of the willingness or research participation by LOGAIR and QUICKTRANS personnel, which was exceptional. Finally, the research was arguably parochial in nature, since it was narrowed in scope to several limited topics. However, this too was also a direct result of research time constraints.

The limits imposed focused the research on existing policies and procedures that have established the current LOGAIR and QUICKTRANS route structures. Time constraints did not allow research into topics like cargo origination points, vehicle and mode substitution, or augmentation by civilian industry. These topics may have resulted in radically different route structures yielding additional benefits in time or money.

### *Recommendations*

The results of this research and the budgetary need for economies within the military structure indicate that there are sufficient opportunities for further study. Further research into related topics and corollary topics are areas of relevance. Additionally, the results of this effort provide sufficient stimulus to support the need for a policy reassessment on the separate LOGAIR and QUICKTRANS systems.

Additional research incorporating the inter-locational cargo data for QUICKTRANS along with additional emphasis on route structure focusing on the economies of surface transport versus air transport may yield further economies. Although the QUICKTRANS inter-locational cargo data was not readily available for this effort, the new on-line QUICKTRANS computer system is advertised to deliver the required data much more readily (Bryan, 1990).

Throughout this effort, the author's interest was continually attracted by the common historical origins for the QUICKTRANS and LOGAIR systems. Both systems were created because there was not a dependable peacetime commercial air cargo carrier or carriers that had the capability to provide the service required during the early 1950's (Kipp, 1956:v-vi and Coon, 1986:20-21). Since the 1950's, the services offered and the capabilities of the commercial air cargo carriers have increased significantly. Research focusing on the whether the current contract cargo system is economically viable or if there is still a valid need for dedicated air transport, considering the commercial cargo capabilities, for the military services should be explored.

Finally, the commonality of goals and governance complemented by the economies highlighted by this research effort should provide a renewed emphasis for a policy review on the need for the separate LOGAIR and QUICKTRANS systems. Without a doubt, numerous assertions exist on the need for separate cargo systems. However, the capability for either system to benefit from the inherent excess capacity of both systems exist. Reluctance to at least review the possibility while presented with reduced military budgets may not be an acceptable option. The alternative could be a complete loss of the current dedicated system, favoring instead the increased capacity and services of the deregulated cargo industry.

## *Appendix A: Location and Cargo Information*

*LOGAIR Stations*

Provides destination and orgin cargo tonnages for FY 89.

| CODE | BASE | DESTIN CARGO | ORIGIN CARGO | LAT | LONG |
|---|---|---|---|---|---|
| ABQ | KIRTLAND | 169.20 | 102.90 | 35.02 | 106.36 |
| AEX | ENGLAND | 144.80 | 81.50 | 31.20 | 92.33 |
| BAD | BARKSDALE | 586.90 | 106.60 | 32.30 | 93.40 |
| BIX | KEESLER | 264.90 | 233.30 | 30.25 | 88.55 |
| BYH | IRA EAKER | 242.40 | 298.10 | 35.58 | 89.57 |
| CBM | COLUMBUS MS | 163.40 | 104.00 | 33.39 | 88.27 |
| CHS | CHARLESTON | 1094.30 | 959.40 | 32.54 | 80.02 |
| COF | PATRICK | 189.10 | 99.40 | 28.14 | 80.36 |
| CVS | CANNON | 277.50 | 223.90 | 34.23 | 103.19 |
| DLH | DULUTH | 95.80 | 46.90 | 46.50 | 92.11 |
| DMA | DAVIS-MONTHAM | 469.00 | 574.80 | 32.10 | 110.53 |
| DOV | DOVER | 1476.60 | 1178.40 | 39.08 | 75.28 |
| DYS | DYESS | 471.60 | 199.00 | 32.25 | 99.51 |
| FEW | FRANCIS E.W. | 442.30 | 346.70 | 41.08 | 104.52 |
| FFO | WRIGHT-PATTERSON | 2713.20 | 3733.80 | 39.49 | 84.03 |
| FWH | CARSWELL | 662.30 | 474.10 | 32.46 | 97.26 |
| GFA | MALMSTROM | 552.60 | 402.70 | 47.30 | 111.11 |
| GSB | SEYMOUR JOHNSON | 653.30 | 487.60 | 35.20 | 77.58 |
| GUS | GRISSOM | 16.40 | 0.00 | 40.39 | 86.09 |
| HIF | HILL | 4910.50 | 8525.90 | 41.08 | 111.58 |
| HMN | HOLLOMAN | 624.30 | 498.40 | 32.51 | 106.06 |
| HST | HOMESTEAD | 469.40 | 452.80 | 25.29 | 80.23 |
| IAB | MCCONNELL | 399.70 | 279.80 | 37.37 | 97.16 |
| LFI | LANGLEY | 665.20 | 459.30 | 37.05 | 76.22 |
| LIZ | LORING | 366.30 | 476.60 | 46.57 | 67.53 |
| LRF | LITTLE ROCK | 622.80 | 291.50 | 34.55 | 92.09 |
| LSV | NELLIS | 537.60 | 372.10 | 36.14 | 115.02 |
| LUF | LUKE | 749.00 | 242.40 | 33.32 | 112.23 |
| MCC | MCCLELLAN | 4181.40 | 5146.40 | 38.40 | 121.24 |
| MCF | MACDILL | 318.00 | 286.60 | 27.51 | 82.31 |
| MEM | MEMPHIS | 109.40 | 627.80 | 35.03 | 89.59 |
| MIB | MINOT | 535.50 | 326.40 | 48.25 | 101.21 |
| MTC | SELFRIDGE | 163.60 | 112.30 | 42.36 | 82.50 |
| MUO | MOUNTAIN HOME | 362.20 | 274.60 | 43.03 | 115.52 |
| NIP | JACKSONVILLE | 307.30 | 213.20 | 30.14 | 81.40 |
| NKO | NEWARK | 23.20 | 0.00 | 40.04 | 82.24 |
| NQX | KEY WEST | 16.40 | 3.10 | 24.34 | 81.41 |
| OFF | OFFUTT | 419.60 | 237.40 | 41.07 | 95.55 |
| OSC | WURTSMITH | 332.40 | 354.90 | 44.27 | 83.24 |
| PAM | TYNDALL | 353.90 | 323.00 | 30.04 | 85.35 |
| PBG | PLATTSBURGH | 567.30 | 450.20 | 44.39 | 73.28 |

| | | | | | |
|---|---|---|---|---|---|
| PSM | PEASE | 652.20 | 493.80 | 43.04 | 70.49 |
| RCA | ELLSWORTH | 679.00 | 663.70 | 44.09 | 103.06 |
| RDR | GRAND FORKS | 442.30 | 315.60 | 47.57 | 97.24 |
| RME | GRIFFISS | 514.60 | 469.30 | 43.14 | 75.24 |
| SAW | K.I. SAWYER | 275.10 | 213.10 | 46.21 | 87.23 |
| SBD | NORTON | 2368.00 | 1872.00 | 34.06 | 117.14 |
| SKA | FAIRCHILD | 336.60 | 290.90 | 47.37 | 117.39 |
| SKF | KELLY | 5832.50 | 6936.40 | 29.23 | 98.35 |
| SSC | SHAW | 630.50 | 503.40 | 33.58 | 80.28 |
| SUU | TRAVIS | 2108.90 | 1455.50 | 38.16 | 121.56 |
| SZL | WHITEMAN | 314.30 | 223.30 | 38.44 | 93.33 |
| TCM | MCCHORD | 1351.60 | 1052.40 | 47.08 | 122.28 |
| TIK | TINKER | 6261.20 | 5134.00 | 35.25 | 97.23 |
| VAD | MOODY | 295.20 | 240.10 | 30.58 | 83.12 |
| VPS | EGLIN | 946.90 | 754.90 | 30.29 | 86.32 |
| WRB | ROBINS | 4135.60 | 5202.60 | 32.38 | 83.35 |
| WRI | MCGUIRE | 1548.70 | 990.00 | 40.01 | 74.35 |

*QUICKTRANS Stations*

Provides destination and orgin cargo tonnages for FY 89.

| CODE | BASE | DESTIN CARGO | ORIGIN CARGO | LAT | LONG |
|---|---|---|---|---|---|
| CHS | CHARLESTON, SC | 3234.40 | 3560.30 | 32.53 | 80.02 |
| COF | CAPE CANAVERAL, | 198.72 | 179.70 | 28.14 | 80.36 |
| DAG | DAHLGREN, VA | 200.00 | 200.00 | 38.20 | 77.03 |
| DCA | WASHINGTON, DC | 661.50 | 985.40 | 38.51 | 77.00 |
| GON | NEW LONDON, CT | 801.90 | 829.20 | 41.21 | 72.07 |
| IND | WEIR COOK AP, IN | 754.70 | 597.70 | 39.43 | 86.16 |
| INH | INDIAN HEAD, MD | 200.00 | 200.00 | 38.30 | 77.03 |
| KBY | KINGS BAY, GA | 257.00 | 0.00 | 30.48 | 81.40 |
| LGB | LONG BEACH, CA | 1939.20 | 894.30 | 33.45 | 118.14 |
| NCO | NEWPORT, RI | 276.40 | 130.20 | 41.28 | 71.20 |
| NFL | FALLON, NV | 242.60 | 210.90 | 39.28 | 118.47 |
| NGU | NORFOLK, VA | 9741.40 | 10999.80 | 36.57 | 76.18 |
| NGZ | OAKLAND, CA | 770.70 | 681.70 | 37.47 | 122.13 |
| NHK | PATUXENT RIVER, | 848.40 | 875.00 | 38.17 | 76.25 |
| NIP | JACKSONVILLE, FL | 3748.70 | 3750.10 | 30.14 | 81.40 |
| NKT | CHERRY POINT, NC | 1799.90 | 2265.40 | 34.54 | 76.54 |
| NLC | LEMOORE, CA | 594.10 | 913.50 | 36.15 | 119.57 |
| NPA | PENSOCOLA, FL | 1935.80 | 1756.60 | 30.21 | 87.19 |
| NQX | KEY WEST, FL | 305.60 | 284.90 | 24.34 | 81.41 |
| NTD | NAS POINT MUGU | 655.60 | 1127.80 | 34.07 | 119.07 |
| NUW | WHIDBEY ISLAND, | 730.10 | 841.50 | 48.17 | 122.37 |
| NZJ | EL TORO, CA | 100.00 | 100.00 | 33.36 | 117.40 |
| NZY | SAN DIEGO, CA | 7313.20 | 6584.40 | 32.42 | 117.12 |
| PHL | PHILADELPHIA-1, | 650.00 | 504.60 | 39.57 | 75.07 |
| PNE | PHILADELPHIA-2, | 48.60 | 327.70 | 39.57 | 75.07 |
| PWT | BREMERTON, WA | 1005.60 | 1823.60 | 47.34 | 122.38 |
| SBD | SAN BERNADINO, CA | 585.10 | 1439.60 | 34.06 | 117.17 |
| SUU | TRAVIS AFB, CA | 7043.40 | 5488.00 | 38.16 | 121.56 |
| TCM | MCCHORD AFB, WA | 1313.30 | 1169.00 | 47.08 | 122.28 |
| TWH | NAVAL SHIPYARD, | 214.40 | 377.70 | 36.49 | 76.18 |
| WRI | MCGUIRE AFB | 363.30 | 448.80 | 40.01 | 74.36 |

*Combined Stations*

Provides destination and orgin cargo tonnages for FY 89.

| CODE | BASE | DESTIN CARGO | ORIGIN CARGO | LAT | LONG |
|---|---|---|---|---|---|
| ABQ | KIRTLAND | 169.20 | 102.90 | 35.02 | 106.36 |
| AEX | ENGLAND | 144.80 | 81.50 | 31.20 | 92.33 |
| BAD | BARKSDALE | 586.90 | 106.60 | 32.30 | 93.40 |
| BIX | KEESLER | 264.90 | 233.30 | 30.25 | 88.55 |
| BYH | IRA EAKER | 242.40 | 298.10 | 35.58 | 89.57 |
| CBM | COLUMBUS MS | 163.40 | 104.00 | 33.39 | 88.27 |
| CHS | CHARLESTON | 4328.70 | 4519.70 | 32.54 | 80.02 |
| COF | PATRICK | 387.82 | 279.10 | 28.14 | 80.36 |
| CVS | CANNON | 277.50 | 223.90 | 34.23 | 103.19 |
| DAG | DAHLGREN, VA | 200.00 | 200.00 | 38.20 | 77.03 |
| DCA | WASHINGTON, DC | 661.50 | 985.40 | 38.51 | 77.00 |
| DLH | DULUTH | 95.80 | 46.90 | 46.50 | 92.11 |
| DMA | DAVIS-MONTHAM | 469.00 | 574.80 | 32.10 | 110.53 |
| DOV | DOVER | 1476.60 | 1178.40 | 39.08 | 75.28 |
| DYS | DYESS | 471.60 | 199.00 | 32.25 | 99.51 |
| FEW | FRANCIS E.W. | 442.30 | 346.70 | 41.08 | 104.52 |
| FFO | WRIGHT-PATTERSON | 2713.20 | 3733.80 | 39.49 | 84.03 |
| FWH | CARSWELL | 662.30 | 474.10 | 32.46 | 97.26 |
| GFA | MALMSTROM | 552.60 | 402.70 | 47.30 | 111.11 |
| GON | NEW LONDON, CT | 801.90 | 829.20 | 41.21 | 72.07 |
| GSB | SEYMOUR JOHNSON | 653.30 | 487.60 | 35.20 | 77.58 |
| GUS | GRISSOM | 16.40 | 0.00 | 40.39 | 86.09 |
| HIF | HILL | 4910.50 | 8525.90 | 41.08 | 111.58 |
| HMN | HOLLOMAN | 624.30 | 498.40 | 32.51 | 106.06 |
| HST | HOMESTEAD | 469.40 | 452.80 | 25.29 | 80.23 |
| IAB | MCCONNELL | 399.70 | 279.80 | 37.37 | 97.16 |
| IND | WEIR COOK AP, IN | 754.70 | 597.70 | 39.43 | 86.16 |
| INH | INDIAN HEAD, MD | 200.00 | 200.00 | 38.30 | 77.03 |
| KBY | KINGS BAY, GA | 257.00 | 0.00 | 30.48 | 81.40 |
| LFI | LANGLEY | 665.20 | 459.30 | 37.05 | 76.22 |
| LGB | LONG BEACH, CA | 1939.20 | 894.30 | 33.45 | 118.14 |
| LIZ | LORING | 366.30 | 476.60 | 46.57 | 67.53 |
| LRF | LITTLE ROCK | 622.80 | 291.50 | 34.55 | 92.09 |
| LSV | NELLIS | 537.60 | 372.10 | 36.14 | 115.02 |
| LUF | LUKE | 749.00 | 242.40 | 33.32 | 112.23 |
| MCC | MCCLELLAN | 4181.40 | 5146.40 | 38.40 | 121.24 |
| MCF | MACDILL | 318.00 | 286.60 | 27.51 | 82.31 |
| MEM | MEMPHIS | 109.40 | 627.80 | 35.03 | 89.59 |
| MIB | MINOT | 535.50 | 326.40 | 48.25 | 101.21 |
| MTC | SELFRIDGE | 163.60 | 112.30 | 42.36 | 82.50 |
| MUO | MOUNTAIN HOME | 362.20 | 274.60 | 43.03 | 115.52 |
| NCO | NEWPORT, RI | 276.40 | 130.20 | 41.28 | 71.20 |
| NFL | FALLON, NV | 242.60 | 210.90 | 39.28 | 118.47 |
| NGU | NORFOLK, VA | 9741.40 | 10999.80 | 36.57 | 76.18 |
| NGZ | OAKLAND, CA | 770.70 | 681.70 | 37.47 | 122.13 |
| NHK | PATUXENT RIVER, | 848.40 | 875.00 | 38.17 | 76.25 |

| | | | | | |
|---|---|---|---|---|---|
| NIP | JACKSONVILLE, FL | 4056.00 | 3963.30 | 30.14 | 81.40 |
| NKO | NEWARK | 23.20 | 0.00 | 40.04 | 82.24 |
| NKT | CHERRY POINT, NC | 1799.90 | 2265.40 | 34.54 | 76.54 |
| NLC | LEMOORE, CA | 594.10 | 913.50 | 36.15 | 119.57 |
| NPA | PENSOCOLA, FL | 1935.80 | 1756.60 | 30.21 | 87.19 |
| NQX | KEY WEST | 322.00 | 208.00 | 24.34 | 81.41 |
| NTD | NAS POINT MUGU | 655.60 | 1127.80 | 34.07 | 119.07 |
| NUW | WHIDBEY ISLAND, | 730.10 | 841.50 | 48.17 | 122.37 |
| NZJ | EL TORO, CA | 100.00 | 100.00 | 33.36 | 117.40 |
| NZY | SAN DIEGO, CA | 7313.20 | 6584.40 | 32.42 | 117.12 |
| OFF | OFFUTT | 419.60 | 237.40 | 41.07 | 95.55 |
| OSC | WURTSMITH | 332.40 | 354.90 | 44.27 | 83.24 |
| PAM | TYNDALL | 353.90 | 323.00 | 30.04 | 85.35 |
| PBG | PLATTSBURGH | 567.30 | 450.20 | 44.39 | 73.28 |
| PHL | PHILADELPHIA-1, | 650.00 | 504.60 | 39.57 | 75.07 |
| PNE | PHILADELPHIA-2, | 48.60 | 327.70 | 39.57 | 75.07 |
| PSM | PEASE | 652.20 | 493.80 | 43.04 | 70.49 |
| PWT | BREMERTON, WA | 1005.60 | 1823.60 | 47.34 | 122.38 |
| RCA | ELLSWORTH | 679.00 | 663.70 | 44.09 | 103.06 |
| RDR | GRAND FORKS | 442.30 | 315.60 | 47.57 | 97.24 |
| RME | GRIFFISS | 514.60 | 469.30 | 43.14 | 75.24 |
| SAW | K.I. SAWYER | 275.10 | 213.10 | 46.21 | 87.23 |
| SBD | NORTON | 2953.10 | 3311.60 | 34.06 | 117.14 |
| SKA | FAIRCHILD | 336.60 | 290.90 | 47.37 | 117.39 |
| SKF | KELLY | 5832.50 | 6936.40 | 29.23 | 98.35 |
| SSC | SHAW | 630.50 | 503.40 | 33.58 | 80.28 |
| SUU | TRAVIS | 9152.30 | 6943.50 | 38.16 | 121.56 |
| SZL | WHITEMAN | 314.30 | 223.30 | 38.44 | 93.33 |
| TCM | MCCHORD AFB, WA | 2664.90 | 2221.40 | 47.08 | 122.28 |
| TIK | TINKER | 6261.20 | 5134.00 | 35.25 | 97.23 |
| TWH | NAVAL SHIPYARD, | 214.40 | 377.70 | 36.49 | 76.18 |
| VAD | MOODY | 295.20 | 240.10 | 30.58 | 83.12 |
| VPS | EGLIN | 946.90 | 754.90 | 30.29 | 86.32 |
| WRB | ROBINS | 4135.60 | 5202.60 | 32.38 | 83.35 |
| WRI | MCGUIRE | 1912.00 | 1438.80 | 40.01 | 74.35 |

## *Appendix B: Aircraft Operating Characteristics*

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L-188 C/F (1 dr)

PAYLOAD - 34,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

| | |
|---|---|
| Palletized Volume | 3,139 cubic feet |
| Dimensions | 68'9" L x 9'6" W x 7'3" H |
| Floor Area | 652 square feet |
| Forward Cargo Door (Front Loading) | 90" H x 140" W |
| Aft Cargo Door (Rear Loading) | 80" H x 142" W |
| Floor Height Above Ground | 102" Forward - 110" Aft |
| Cruising Speed | 350 MPH |

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L-188 C/F (2 dr)

PAYLOAD - 34,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

| | |
|---|---|
| Palletized Volume | 3,139 cubic feet |
| Dimensions | 68'9" L x 9'6" W x 7'3" H |
| Floor Area | 652 square feet |
| Forward Cargo Door (Front Loading) | 90" H x 140" W |
| Aft Cargo Door (Rear Loading) | 80" H x 98" W |
| Floor Height Above Ground | 102" Forward - 110" Aft |
| Cruising Speed | 350 MPH |

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L-100-30

PAYLOAD - 46,000 lbs minimum (including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

| | |
|---|---|
| Palletized Volume | 4,356 cubic feet |
| Dimensions | 55'9" L x 10' W x 9' H |
| Floor Area | 675 square feet |
| Cargo Door Dimension | 120" H x 108" W |
| Floor Height Above Ground | 41" |
| Cruising Speed | 326 MPH |

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### B-727-100C

PAYLOAD - 34,000 lbs (contract) 44,400 lbs (capability)

MAIN CARGO COMPARTMENT:

| | |
|---|---|
| Palletized Volume | 2,800 cubic feet[*] |
| Dimensions | 72'8"L x 11'7" W x 7'2" H |
| Floor Area | 851 square feet |
| Cargo Door Dimension | 84" H x 134" W |
| Floor Height Above Ground | 117" |
| Cruising Speed | 525 MPH |

[*] When 16 54 x 88 pallet configuration is used.

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### DC-9-30

PAYLOAD - 34,000 lbs minimum ( including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

| | |
|---|---|
| Palletized Volume | 3,151 cubic feet |
| Dimensions | 68'6" L x 9'6" W x 6'9" H |
| Floor Area | 650 square feet |
| Cargo Door Dimension | 81" H x 136" W |
| Floor Height Above Ground | 84" |
| Cruising Speed | 540 MPH |

---

### CV-640

PAYLOAD - 18,000 lbs minimum ( including weight of pallets and nets)

MAIN CARGO COMPARTMENT:

| | |
|---|---|
| Palletized Volume | 2,515 cubic feet |
| Dimensions | 48'9" L x 7'6" W x 6' H |
| Floor Area | 399 square feet |
| Cargo Door Dimension | 72" H x 108" W |
| Floor Height Above Ground | ??? |
| Cruising Speed | 300 MPH |

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# *Appendix C: Planning Factors*

## *Contract Versus ETADS Comparison*

| ACFT | CONTRACT TONNAGES | ETADS FACTOR | PERCENT AVAILABLE | AVG PER DAY |
|---|---|---|---|---|
| L-100 | 46,000 | 40,981 | 89.1% | 5,854 |
| L-188 | 34,000 | 28,640 | 84.2% | 4,091 |
| B-727 | 34,000 | 30,950 | 91.0% | 4,421 |
| DC-9 | 34,000 | 28,541 | 83.9% | 4,077 |
| CV640 | 18,000 | 15,673 | 87.1% | 2,239 |
| TRUCKS | 24,000 | N/A | 100.0% | 24,000 |

## *Daily Weighted Factors*

| L100 FACTORS | | L188 FACTORS | | B-727 FACTORS | |
|---|---|---|---|---|---|
| SCHEDULED DAYS | CARGO TONNAGES | SCHEDULED DAYS | CARGO TONNAGES | SCHEDULED DAYS | CARGO TONNAGES |
| 1 | 5,854 | 1 | 4,091 | 1 | 4,421 |
| 2 | 11,709 | 2 | 8,183 | 2 | 8,843 |
| 3 | 17,563 | 3 | 12,274 | 3 | 13,264 |
| 4 | 23,418 | 4 | 16,366 | 4 | 17,686 |
| 5 | 29,272 | 5 | 20,457 | 5 | 22,107 |
| 6 | 35,127 | 6 | 24,549 | 6 | 26,529 |
| 7 | 40,981 | 7 | 28,640 | 7 | 30,950 |

| DC-9 FACTORS | | CV640 FACTORS | |
|---|---|---|---|
| SCHEDULED DAYS | CARGO TONNAGES | SCHEDULED DAYS | CARGO TONNAGES |
| 1 | 4,077 | 1 | 2,239 |
| 2 | 8,155 | 2 | 4,478 |
| 3 | 12,232 | 3 | 6,717 |
| 4 | 16,309 | 4 | 8,956 |
| 5 | 20,386 | 5 | 11,195 |
| 6 | 24,464 | 6 | 13,434 |
| 7 | 28,541 | 7 | 15,673 |

### *Cruising Speeds (MPH)*

| | |
|---|---|
| CV640 | 300 |
| L-188 | 350 |
| L-100 | 326 |
| B-727 | 525 |
| DC-9 | 540 |

### *Taxiing Times (Minutes)*

| | |
|---|---|
| AFTER LANDING | 20 |
| BEFORE TAKEOFF | 20 |

### *Standard Ground Times*

| Aircraft Type | Base | Normal Ground Time | Ground Time if Designated Resequencing Station |
|---|---|---|---|
| 2 dr L-188, Dc-9 | Mission | 0 plus 45 | 1 plus 00 |
| | ALC/APOE | 1 plus 30 | 1 plus 45 |
| 1 dr (FWD) L-188 | Mission | 1 plus 00 | 1 plus 15 |
| | ALC/APOE | 1 plus 45 | 2 plus 00 |
| L-100-30 | Mission | 1 plus 00 | 1 plus 15 |
| | ALC/APOE | 1 plus 30 | 1 plus 45 |

### *Truck Data*

MILEAGE = 120% of Euclidean Statute Miles

HOURS = Normally restricted to 8-10 driving
(Dual drivers can double the effective driving times)

SPEED = 40-45 MPH

# Appendix D: Cost Factors

## LOGAIR Costs Factors

FY89 Mile/Tonmiles

| | miles | tonmiles |
|---|---|---|
| OCT 88 | 968,406 | 9,158,125.30 |
| NOV | 898,496 | 8,648,226.18 |
| DEC | 902,419 | 8,650,707.91 |
| JAN 89 | 943,017 | 8,781,158.29 |
| FEB | 882,445 | 8,467,527.52 |
| MAR | 1,036,694 | 10,090,506.25 |
| APR | 981,209 | 9,693,873.65 |
| MAY | 1,004,928 | 9,621,481.08 |
| JUN | 993,968 | 9,278,913.67 |
| JUL | 949,211 | 8,810,794.75 |
| AUG | 1,042,153 | 9,668,373.10 |
| SEP 89 | 999,524 | 9,126,746.62 |
| TOTAL | 11,602,470 | 109,996,434.32 |

FY89 Costs

| | |
|---|---|
| Miles | $64,413,711.37 |
| Taxes(est) | $2,977,389.51 |
| Landings | $1,750,500.00 |
| fuel | $16,691,328.93 |
| Total | $85,832,929.81 |
| $$ / ton | $795.63929 |
| $$ / pound | $0.39782 |
| $$ / tonmile | $0.78032 |
| $$ / lb-mile | $0.0003901623 |
| $ per mile | $7.3978 |

*QUICKTRANS Cost Factors*

1. MONTHLY COSTS FOR QUICKTRANS SERVICE

| MONTH | AIR CARRIER COST | TERMINAL CONTRACTOR COST | TRUCK CARRIER COST | SYSTEMS DEVELOPMENT COST |
|---|---|---|---|---|
| OCT 88 | $2,233,565.67 | $1,008,761.08 | $263,033.41 | |
| NOV 88 | $2,173,988.42 | $976,220.40 | $263,529.48 | |
| DEC 88 | $2,118,160.99 | $1,008,761.08 | $258,805.00 | |
| JAN 89 | $2,066,409.23 | $1,008,761.08 | $219,657.84 | |
| FEB 89 | $1,957,549.87 | $911,139.04 | $232,256.14 | |
| MAR 89 | $2,203,177.64 | $1,008,761.08 | $280,605.69 | |
| APR 89 | $2,160,235.16 | $976,222.40 | $244,350.41 | $60,000.00 |
| MAY 89 | $2,133,852.72 | $1,008,761.08 | $254,914.43 | |
| JUN 89 | $2,140,617.89 | $976,222.40 | $252,922.20 | $50,000.00 |
| JUL 89 | $2,130,228.34 | $1,008,761.08 | $230,213.30 | $50,000.00 |
| AUG 89 | $2,202,360.91 | $1,008,761.08 | $275,674.92 | $50,000.00 |
| SEP 89 | $2,072,590.52 | $976,222.40 | $228,592.54 | $69,244.00 |
| TOTAL | $25,592,737.36 | $11,877,354.20 | $3,004,555.36 | $279,244.00 |

TOTAL COSTS: $40,753,890.92

## *Common Aircraft Cost Factors*

Each aircraft contractor is paid for number of Great Circle Statute Miles (GCSMs) that the cargo is transported and for directed landings. The following is an extract from the applicable contracts for LOGAIR and QUICKTRANS:

Contract Number: F11626-90-D0022 (QUICKTRANS)
Contractor's Name: Southern Air Transport, Inc
Type Aircraft: L-100-30
Dollars per GCSM Rate: $7.3305
Dollars per Landing: $250.00

Contract Number: F11626-90-D0023 (LOGAIR)
Contractor's Name: Southern Air Transport, Inc
Type Aircraft: L-100-30
Dollars per GCSM Rate: $7.1963
Dollars per Landing: $250.00

Contract Number: F11626-90-D0030 (LOGAIR)
Contractor's Name: Evergreen International Airlines
Type Aircraft: B-727-100
DC-9-30
Dollars per GCSM Rate: $5.558
(Depends on Route) $5.514
$5.558
Dollars per Landing: N/A

Contract Number: F11626-90-D0031 (LOGAIR)
Contractor's Name: TPI International Airways, Inc
Type Aircraft: L-188
Dollars per GCSM Rate: $5.402
Dollars per Landing: N/A

Contract Number: F11626-90-D0032 (LOGAIR)
Contractor's Name: Zantop International Airlines
Type Aircraft: L-188
Dollars per GCSM Rate: $6.1181
Dollars per Landing: N/A

Contract Number: F11626-90-D0059 (LOGAIR)
Contractor's Name: Zantop International Airlines
Type Aircraft: CV-640
Dollars per GCSM Rate: $5.3499
Dollars per Landing: N/A

## *Appendix E: Two-Dimensional Spacefilling Results*

### *QUICKTRANS Locations Sorted by Theta*

Results show Spacefilling groupings by Theta presented by rank and by graphing theta (x-axis) against rankings (y-axis).

| RANK | CODE | LOCATION | LONG | LAT | THETA |
|---|---|---|---|---|---|
| 1 | COF | CAPE CANAVERAL, FL | 28.14 | 80.36 | 0.007813 |
| 2 | NQX | KEY WEST FL | 24.34 | 81.41 | 0.015625 |
| 3 | NIP | JACKSONVILLE FL | 30.14 | 81.40 | 0.019531 |
| 4 | KBY | KINGS BAY GA | 30.48 | 81.40 | 0.019531 |
| 5 | CHS | CHARLESTON SC | 32.53 | 80.02 | 0.023438 |
| 6 | NPA | PENSOCOLA FL | 30.21 | 87.19 | 0.042969 |
| 7 | IND | WEIR COOK AP IN | 39.43 | 86.16 | 0.093750 |
| 8 | NZY | SAN DIEGO CA | 32.42 | 117.12 | 0.257813 |
| 9 | NZJ | EL TORO CA | 33.36 | 117.40 | 0.257813 |
| 10 | LGB | LONG BEACH CA | 33.45 | 118.14 | 0.257813 |
| 11 | NLC | LEMOORE CA | 36.15 | 119.57 | 0.265625 |
| 12 | SBD | SAN BERNADINO CA | 34.06 | 117.17 | 0.269531 |
| 13 | NTD | NAS POINT MUGU | 34.07 | 119.07 | 0.269531 |
| 14 | NFL | FALLON NV | 39.28 | 118.47 | 0.292969 |
| 15 | NGZ | OAKLAND CA | 37.47 | 122.13 | 0.296875 |
| 16 | SUU | TRAVIS AFB CA | 38.16 | 121.56 | 0.296875 |
| 17 | PWT | BREMERTON WA | 47.34 | 122.38 | 0.312500 |
| 18 | NUW | WHIDBEY ISLAND WA | 48.17 | 122.37 | 0.312500 |
| 19 | TCM | MCCHORD AFB WA | 47.08 | 122.28 | 0.312500 |
| 20 | NCO | NEWPORT RI | 41.28 | 71.20 | 0.949219 |
| 21 | GON | NEW LONDON CT | 41.21 | 72.07 | 0.949219 |
| 22 | WRI | MCGUIRE AFB | 40.01 | 74.36 | 0.953125 |
| 23 | INH | INDIAN HEAD MD | 38.30 | 77.03 | 0.957031 |
| 24 | NHK | PATUXENT RIVER MD | 38.17 | 76.25 | 0.957031 |
| 25 | PNE | PHILADELPHIA-2 PA | 39.57 | 75.07 | 0.957031 |
| 26 | PHL | PHILADELPHIA-1 PA | 39.57 | 75.07 | 0.957031 |
| 27 | DAG | DAHLGREN VA | 38.20 | 77.03 | 0.957031 |
| 28 | DCA | WASHINGTON DC | 38.51 | 77.00 | 0.957031 |
| 29 | TWH | NAVAL SHIPYARD VA | 36.49 | 76.18 | 0.980469 |
| 30 | NGU | NORFOLK VA | 36.57 | 76.18 | 0.980469 |
| 31 | NKT | CHERRY POINT NC | 34.54 | 76.54 | 0.980469 |

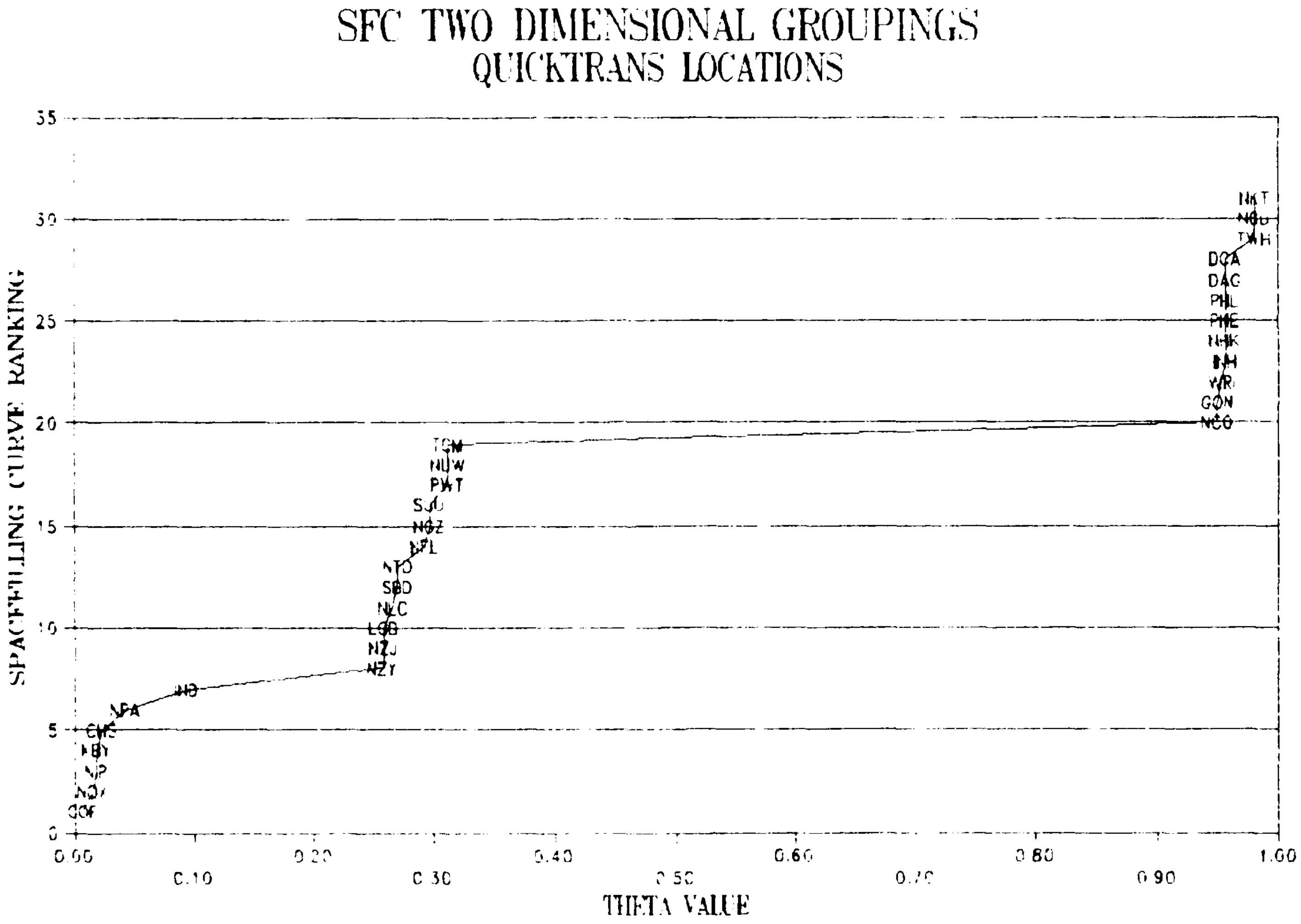

Figure 12: QUICKTRANS Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

## *LOGAIR Locations Sorted by Theta*

Results show Spacefilling groupings by Theta presented by rank and by graphing theta (x-axis) against rankings (y-axis).

| RANK | CODE | LOCATION | LONG | LAT | THETA |
|---|---|---|---|---|---|
| 1 | HST | HOMESTEAD | 25.29 | 80.23 | 0.015625 |
| 2 | COF | PATRICK | 28.14 | 80.36 | 0.019531 |
| 3 | CHS | CHARLESTON | 32.54 | 80.02 | 0.027344 |
| 4 | SSC | SHAW | 33.58 | 80.28 | 0.027344 |
| 5 | WRB | ROBINS | 32.38 | 83.35 | 0.035156 |
| 6 | VPS | EGLIN | 30.29 | 86.32 | 0.039063 |
| 7 | PAM | TYNDALL | 30.04 | 85.35 | 0.039063 |
| 8 | NIP | JACKSONVILLE | 30.14 | 81.40 | 0.042969 |
| 9 | VAD | MOODY | 30.58 | 83.12 | 0.042969 |
| 10 | MCF | MACDILL | 27.51 | 82.31 | 0.046875 |
| 11 | NQX | KEY WEST | 24.34 | 81.41 | 0.046875 |
| 12 | BIX | KEESLER | 30.25 | 88.55 | 0.054688 |
| 13 | CBM | COLUMBUS MS | 33.39 | 88.27 | 0.070313 |
| 14 | BAD | BARKSDALE | 32.30 | 93.40 | 0.074219 |
| 15 | AEX | ENGLAND | 31.20 | 92.33 | 0.074219 |
| 16 | LRF | LITTLE ROCK | 34.55 | 92.09 | 0.074219 |
| 17 | BYH | IRA EAKER | 35.58 | 89.57 | 0.082031 |
| 18 | MEM | MEMPHIS | 35.03 | 89.59 | 0.082031 |
| 19 | FFO | WRIGHT-PATTERSON | 39.49 | 84.03 | 0.093750 |
| 20 | NKO | NEWARK | 40.04 | 82.24 | 0.093750 |
| 21 | GUS | GRISSOM | 40.39 | 86.09 | 0.097656 |
| 22 | SZL | WHITEMAN | 38.44 | 93.33 | 0.109375 |
| 23 | DLH | DULUTH | 46.50 | 92.11 | 0.121094 |
| 24 | RDR | GRAND FORKS | 47.57 | 97.24 | 0.128906 |
| 25 | OFF | OFFUTT | 41.07 | 95.55 | 0.140625 |
| 26 | RCA | ELLSWORTH | 44.09 | 103.06 | 0.148438 |
| 27 | FEW | FRANCIS E.W. | 41.08 | 104.52 | 0.152344 |
| 28 | ABQ | KIRTLAND | 35.02 | 106.36 | 0.156250 |
| 29 | DYS | DYESS | 32.25 | 99.51 | 0.164063 |
| 30 | TIK | TINKER | 35.25 | 97.23 | 0.171875 |
| 31 | IAB | MCCONNELL | 37.37 | 97.16 | 0.171875 |
| 32 | FWH | CARSWELL | 32.46 | 97.26 | 0.175781 |
| 33 | SKF | KELLY | 29.23 | 98.35 | 0.183594 |
| 34 | CVS | CANNON | 34.23 | 103.19 | 0.210938 |
| 35 | HMN | HOLLOMAN | 32.51 | 106.06 | 0.214844 |
| 36 | DMA | DAVIS-MONTHAM | 32.10 | 110.53 | 0.222656 |
| 37 | SBD | NORTON | 34.06 | 117.14 | 0.257813 |
| 38 | LUF | LUKE | 33.32 | 112.23 | 0.273438 |
| 39 | LSV | NELLIS | 36.14 | 115.02 | 0.277344 |
| 40 | HIF | HILL | 41.08 | 111.58 | 0.281250 |
| 41 | MCC | MCCLELLAN | 38.40 | 121.24 | 0.296875 |
| 42 | SUU | TRAVIS | 38.16 | 121.56 | 0.296875 |
| 43 | SKA | FAIRCHILD | 47.37 | 117.39 | 0.304688 |
| 44 | TCM | MCCHORD | 47.08 | 122.28 | 0.308594 |
| 45 | GFA | MALMSTROM | 47.30 | 111.11 | 0.332031 |
| 46 | MUO | MOUNTAIN HOME | 43.03 | 115.52 | 0.335938 |

| | | | | | |
|---|---|---|---|---|---|
| 47 | MIB | MINOT | 48.25 | 101.21 | 0.367188 |
| 48 | SAW | K.I. SAWYER | 46.21 | 87.23 | 0.882813 |
| 49 | OSC | WURTSMITH | 44.27 | 83.24 | 0.902344 |
| 50 | MTC | SELFRIDGE | 42.36 | 82.50 | 0.902344 |
| 51 | LIZ | LORING | 46.57 | 67.53 | 0.941406 |
| 52 | PBG | PLATTSBURGH | 44.39 | 73.28 | 0.945313 |
| 53 | PSM | PEASE | 43.04 | 70.49 | 0.949219 |
| 54 | WRI | MCGUIRE | 40.01 | 74.35 | 0.957031 |
| 55 | RME | GRIFFISS | 43.14 | 75.24 | 0.960938 |
| 56 | DOV | DOVER | 39.08 | 75.28 | 0.964844 |
| 57 | LFI | LANGLEY | 37.05 | 76.22 | 0.972656 |
| 58 | GSB | SEYMOUR JOHNSON | 35.20 | 77.58 | 0.972656 |

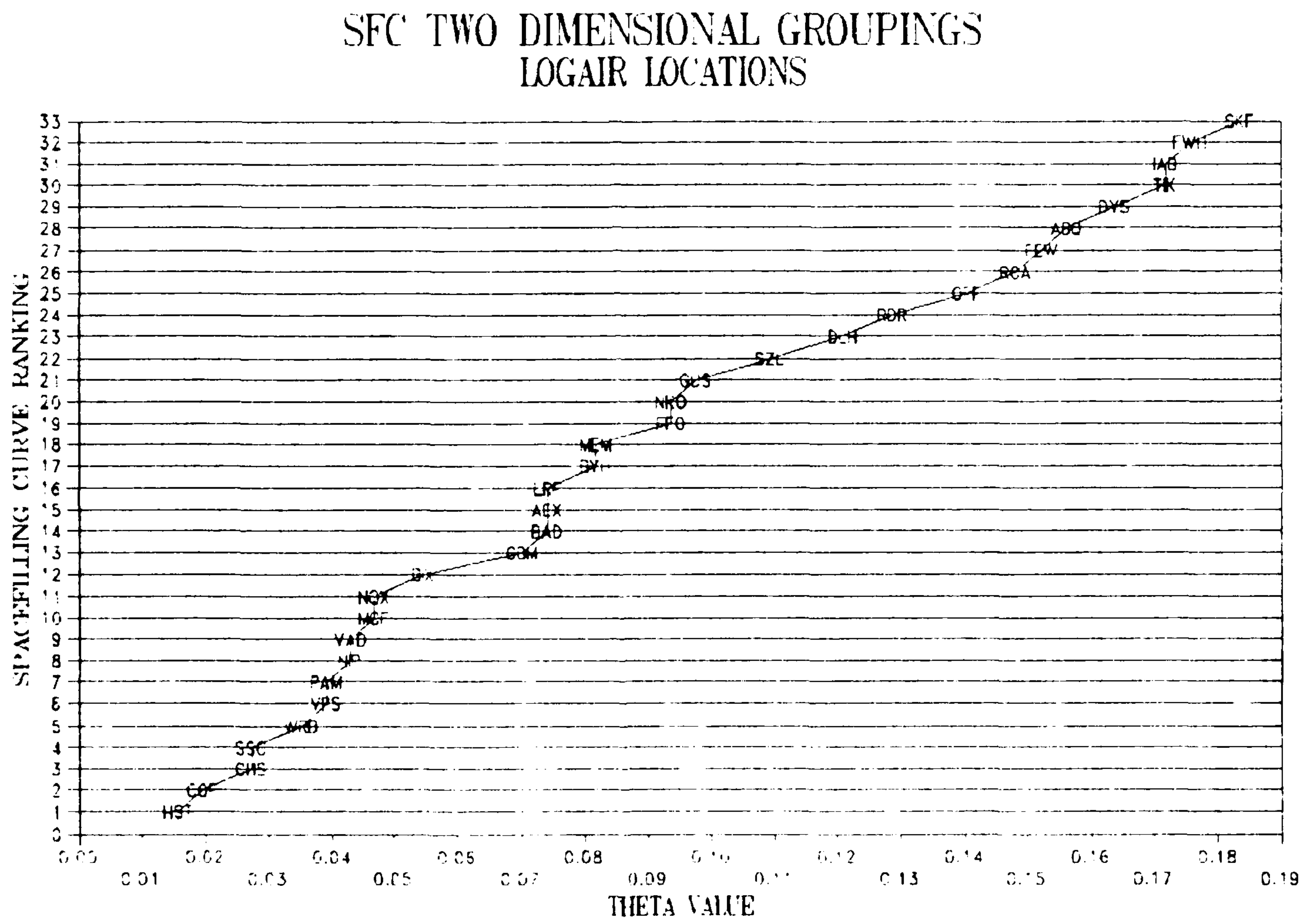

Figure 13: Partial LOGAIR Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

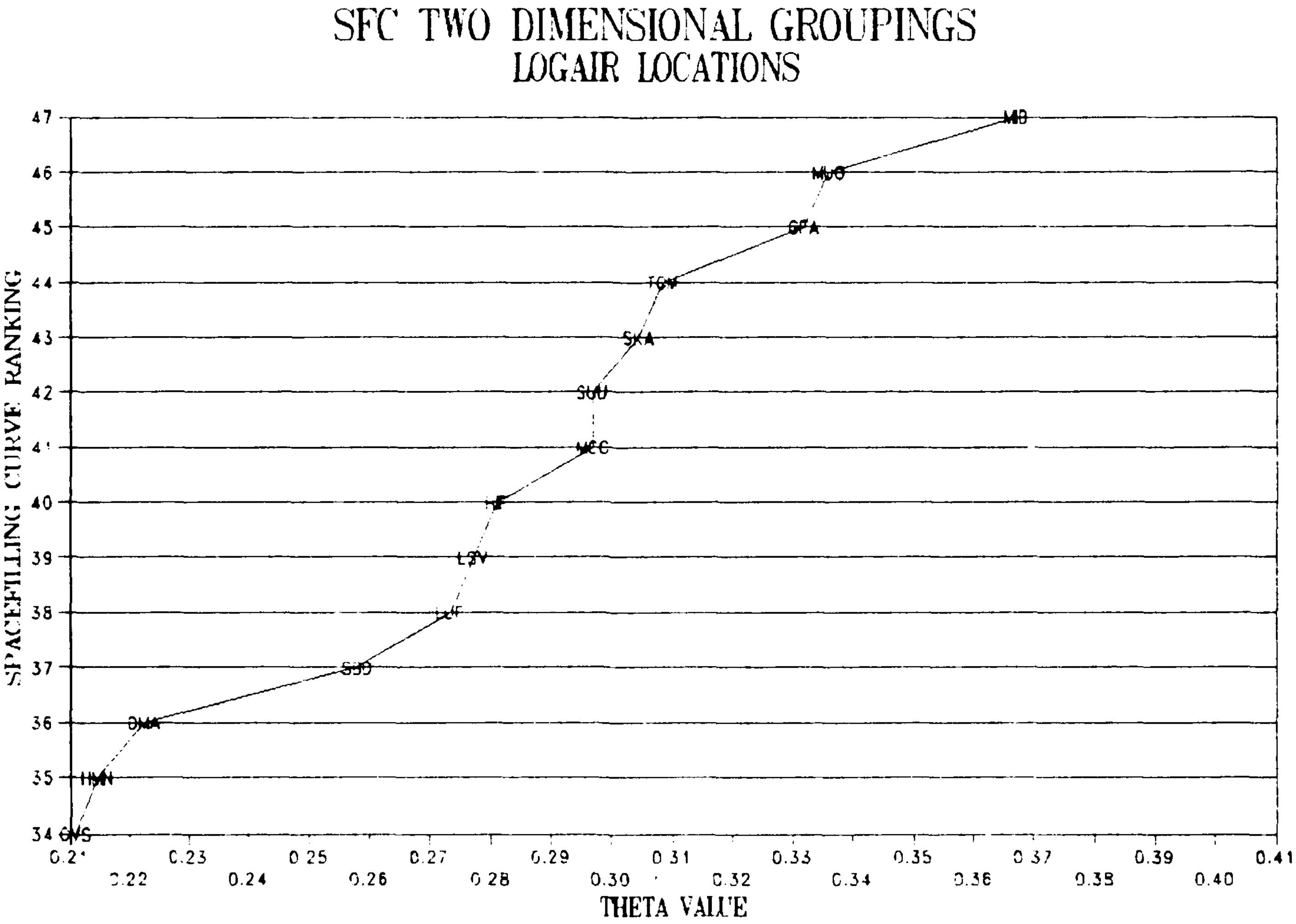

Figure 14: Partial LOGAIR Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

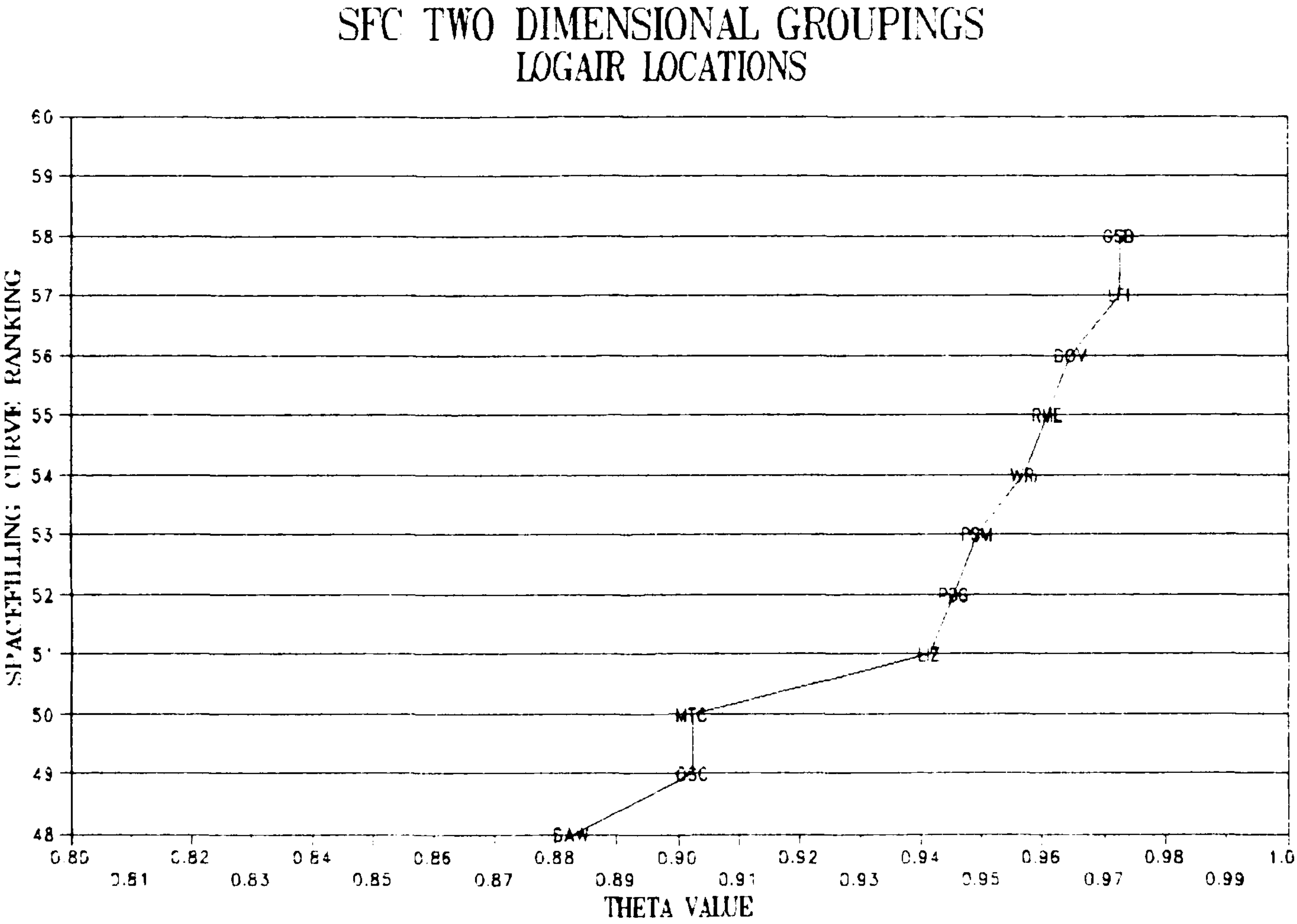

Figure 15: Partial LOGAIR Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

## *Combined Model Locations Sorted by Theta*

Results show Spacefilling groupings by Theta presented by rank and by graphing theta (x-axis) against rankings (y-axis).

| RANK | CODE | LOCATION | LONG | LAT | THETA |
|---|---|---|---|---|---|
| 1 | HST | HOMESTEAD | 25.29 | 80.23 | 0.015625 |
| 2 | COF | PATRICK | 28.14 | 80.36 | 0.019531 |
| 3 | NKT | CHERRY POINT | 34.54 | 76.54 | 0.023438 |
| 4 | SSC | SHAW | 33.58 | 80.28 | 0.027344 |
| 5 | CHS | CHARLESTON | 32.54 | 80.02 | 0.027344 |
| 6 | WRB | ROBINS | 32.38 | 83.35 | 0.035156 |
| 7 | VPS | EGLIN | 30.29 | 86.32 | 0.039063 |
| 8 | PAM | TYNDALL | 30.04 | 85.35 | 0.039063 |
| 9 | NPA | PENSOCOLA | 30.21 | 87.19 | 0.039063 |
| 10 | VAD | MOODY | 30.58 | 83.12 | 0.042969 |
| 11 | NIP | JACKSONVILLE | 30.14 | 81.40 | 0.042969 |
| 12 | KBY | KINGS BAY | 30.48 | 81.40 | 0.042969 |
| 13 | NQX | KEY WEST | 24.34 | 81.41 | 0.046875 |
| 14 | MCF | MACDILL | 27.51 | 82.31 | 0.046875 |
| 15 | BIX | KEESLER | 30.25 | 88.55 | 0.054688 |
| 16 | AEX | ENGLAND | 31.20 | 92.33 | 0.066406 |
| 17 | CBM | COLUMBUS MS | 33.39 | 88.27 | 0.070313 |
| 18 | BAD | BARKSDALE | 32.30 | 93.40 | 0.074219 |
| 19 | LRF | LITTLE ROCK | 34.55 | 92.09 | 0.074219 |
| 20 | BYH | IRA EAKER | 35.58 | 89.57 | 0.082031 |
| 21 | MEM | MEMPHIS | 35.03 | 89.59 | 0.082031 |
| 22 | NKO | NEWARK | 40.04 | 82.24 | 0.093750 |
| 23 | FFO | WRIGHT-PATTERSON | 39.49 | 84.03 | 0.093750 |
| 24 | GUS | GRISSOM | 40.39 | 86.09 | 0.097656 |
| 25 | IND | WEIR COOK AP | 39.43 | 86.16 | 0.097656 |
| 26 | SZL | WHITEMAN | 38.44 | 93.33 | 0.109375 |
| 27 | DLH | DULUTH | 46.50 | 92.11 | 0.121094 |
| 28 | RDR | GRAND FORKS | 47.57 | 97.24 | 0.128906 |
| 29 | OFF | OFFUTT | 41.07 | 95.55 | 0.140625 |
| 30 | RCA | ELLSWORTH | 44.09 | 103.06 | 0.148438 |
| 31 | FEW | FRANCIS E.W. | 41.08 | 104.52 | 0.152344 |
| 32 | ABQ | KIRTLAND | 35.02 | 106.36 | 0.156250 |
| 33 | DYS | DYESS | 32.25 | 99.51 | 0.164063 |
| 34 | IAB | MCCONNELL | 37.37 | 97.16 | 0.171875 |
| 35 | TIK | TINKER | 35.25 | 97.23 | 0.171875 |
| 36 | FWH | CARSWELL | 32.46 | 97.26 | 0.175781 |
| 37 | SKF | KELLY | 29.23 | 98.35 | 0.183594 |
| 38 | CVS | CANNON | 34.23 | 103.19 | 0.210938 |
| 39 | HMN | HOLLOMAN | 32.51 | 106.06 | 0.214844 |
| 40 | DMA | DAVIS-MONTHAM | 32.10 | 110.53 | 0.222656 |
| 41 | LGB | LONG BEACH | 33.45 | 118.14 | 0.257813 |
| 42 | NZY | SAN DIEGO | 32.42 | 117.12 | 0.257813 |
| 43 | NZJ | EL TORO | 33.36 | 117.40 | 0.257813 |
| 44 | SBD | NORTON | 34.06 | 117.14 | 0.257813 |
| 45 | NTD | POINT MUGU | 34.07 | 119.07 | 0.261719 |
| 46 | NLC | LEMOORE | 36.15 | 119.57 | 0.265625 |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| 47 | NGZ | OAKLAND | 37.47 | 122.13 | 0.265625 |
| 48 | LUF | LUKE | 33.32 | 112.23 | 0.273438 |
| 49 | LSV | NELLIS | 36.14 | 115.02 | 0.277344 |
| 50 | HIF | HILL | 41.08 | 111.58 | 0.281250 |
| 51 | NFL | FALLON | 39.28 | 118.47 | 0.292969 |
| 52 | SUU | TRAVIS AFB | 38.16 | 121.56 | 0.296875 |
| 53 | MCC | MCCLELLAN | 38.40 | 121.24 | 0.296875 |
| 54 | SKA | FAIRCHILD | 47.37 | 117.39 | 0.304688 |
| 55 | NUW | WHIDBEY ISLAND | 48.17 | 122.37 | 0.308594 |
| 56 | TCM | MCCHORD AFB | 47.08 | 122.28 | 0.308594 |
| 57 | PWT | BREMERTON | 47.34 | 122.38 | 0.308594 |
| 58 | GFA | MALMSTROM | 47.30 | 111.11 | 0.332031 |
| 59 | MUO | MOUNTAIN HOME | 43.03 | 115.52 | 0.335938 |
| 60 | MIB | MINOT | 48.25 | 101.21 | 0.367188 |
| 61 | SAW | K.I. SAWYER | 46.21 | 87.23 | 0.882813 |
| 62 | OSC | WURTSMITH | 44.27 | 83.24 | 0.902344 |
| 63 | MTC | SELFRIDGE | 42.36 | 82.50 | 0.902344 |
| 64 | LIZ | LORING | 46.57 | 67.53 | 0.941406 |
| 65 | PBG | PLATTSBURGH | 44.39 | 73.28 | 0.945313 |
| 66 | PSM | PEASE | 43.04 | 70.49 | 0.949219 |
| 67 | NCO | NEWPORT | 41.28 | 71.20 | 0.957031 |
| 68 | WRI | MCGUIRE | 40.01 | 74.35 | 0.957031 |
| 69 | GON | NEW LONDON | 41.21 | 72.07 | 0.957031 |
| 70 | RME | GRIFFISS | 43.14 | 75.24 | 0.960938 |
| 71 | PNE | PHILADELPHIA-2 | 39.57 | 75.07 | 0.964844 |
| 72 | PHL | PHILADELPHIA-1 | 39.57 | 75.07 | 0.964844 |
| 73 | INH | INDIAN HEAD | 38.30 | 77.03 | 0.964844 |
| 74 | DOV | DOVER | 39.08 | 75.28 | 0.964844 |
| 75 | NHK | PATUXENT RIVER | 38.17 | 76.25 | 0.964844 |
| 76 | DCA | WASHINGTON | 38.51 | 77.00 | 0.964844 |
| 77 | DAG | DAHLGREN | 38.20 | 77.03 | 0.964844 |
| 78 | LFI | LANGLEY | 37.05 | 76.22 | 0.972656 |
| 79 | NGU | NORFOLK | 36.57 | 76.18 | 0.972656 |
| 80 | GSB | SEYMOUR JOHNSON | 35.20 | 77.58 | 0.972656 |
| 81 | TWH | NAVAL SHIPYARD | 36.49 | 76.18 | 0.972656 |

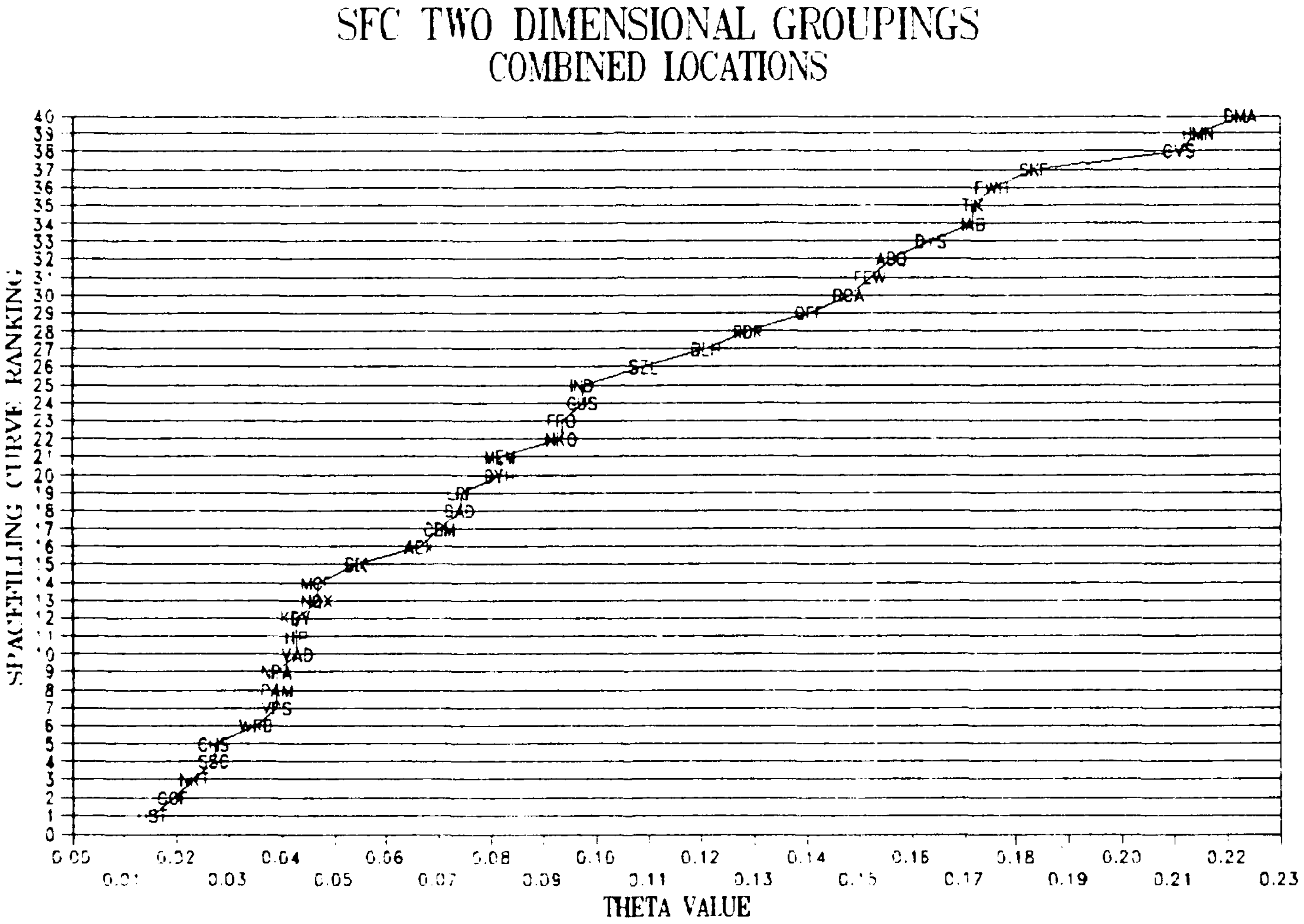

Figure 16: Partial Combined system Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

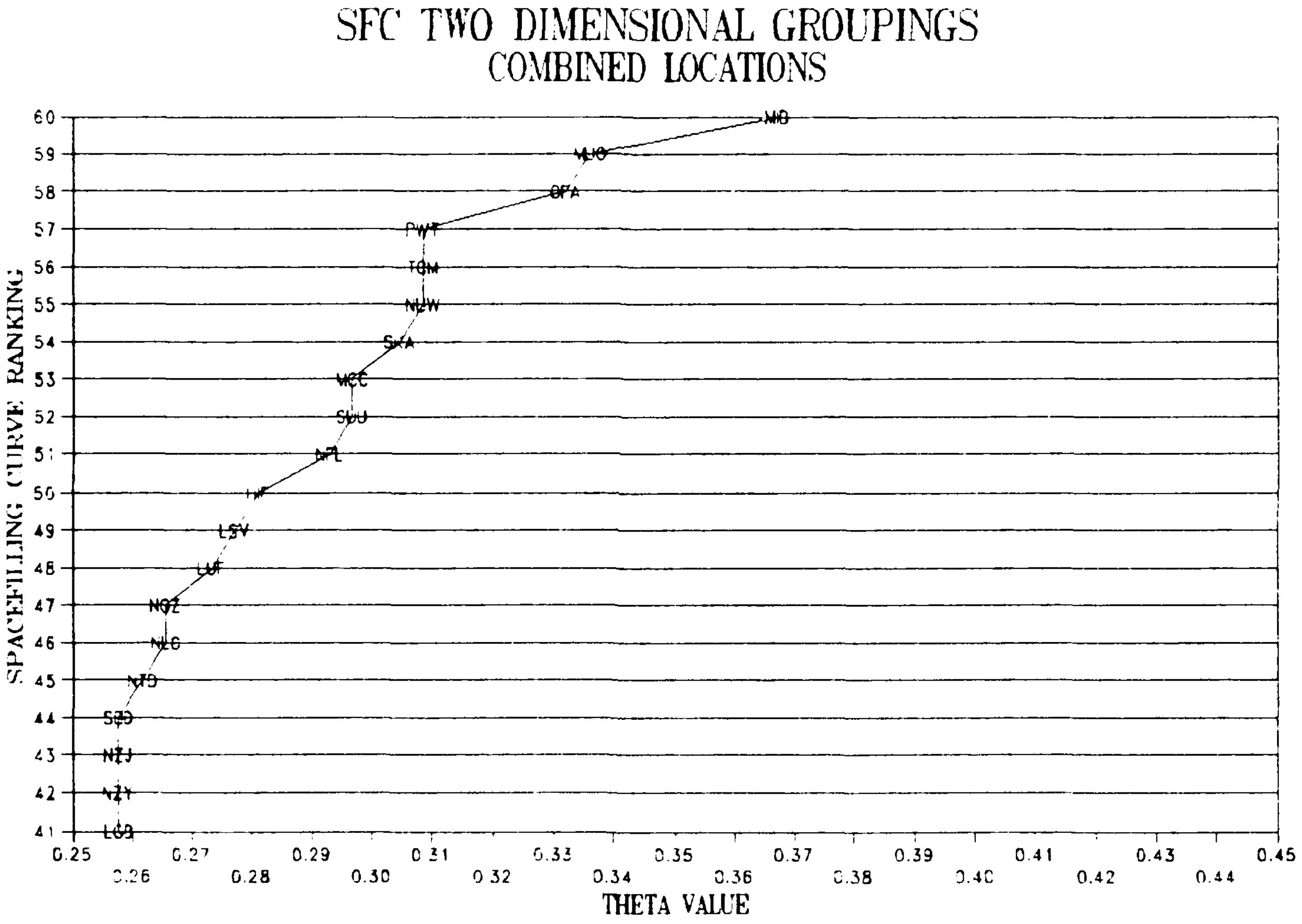

Figure 17: Partial Combined system Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

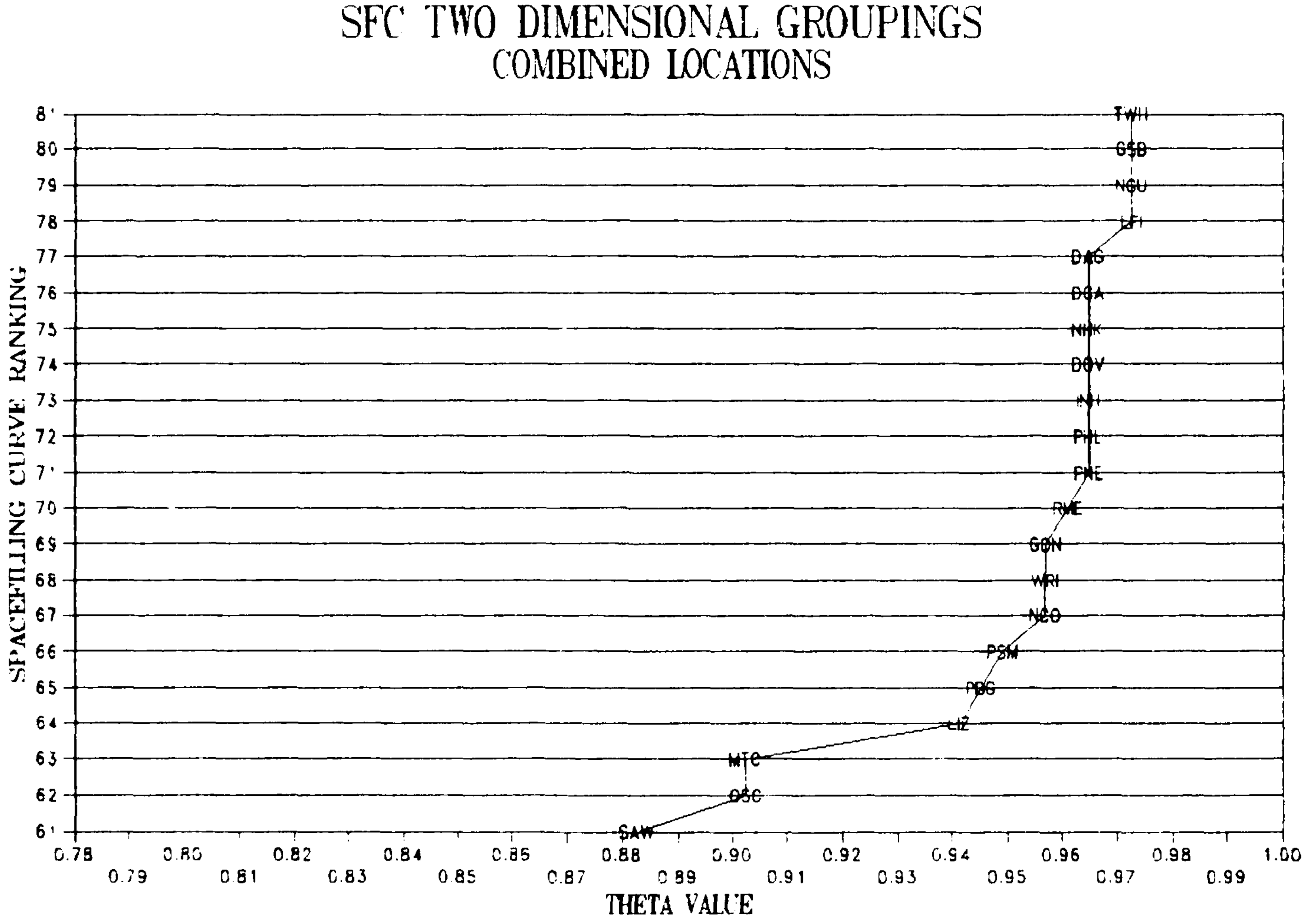

Figure 18: Partial Combined system Two-Dimensional Spacefilling Curve results showing theta (x-axis) plotted against the Spacefilling Curve ranking (y-axis).

## *Appendix F: Three-Dimensional Spacefilling Curve Results*

### *QUICKTRANS Destination Cargo Tonnages*

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

| RANK | NAME | LONG | LAT | TONNAGES | THETA |
|---|---|---|---|---|---|
| 1 | NIP JACKSONVILLE | 30.14 | 81.4 | 3748.7 | .015625 |
| 2 | CHS CHARLESTON SC | 32.53 | 80.02 | 3234.4 | .015625 |
| 3 | WRI MCGUIRE AFB | 40.01 | 74.36 | 363.3 | .03125 |
| 4 | COF CAPE CANAVERAL | 28.14 | 80.36 | 198.72 | .03125 |
| 5 | IND WEIR COOK AP | 39.43 | 86.16 | 754.7 | .03125 |
| 6 | DAHLGREN VA | 38.2 | 77.03 | 200 | .03125 |
| 7 | LGB LONG BEACH CA | 33.45 | 118.14 | 1939.2 | .03125 |
| 8 | NLC LEMOORE CA | 36.15 | 119.57 | 594.1 | .03125 |
| 9 | NCO NEWPORT RI | 41.28 | 71.2 | 276.4 | .03125 |
| 10 | GON NEW LONDON CT | 41.21 | 72.07 | 801.9 | .03125 |
| 11 | PHL PHILADELPHIA-1 | 39.57 | 75.07 | 650 | .03125 |
| 12 | NGZ OAKLAND CA | 37.47 | 122.13 | 770.7 | .03125 |
| 13 | INH INDIAN HEAD MD | 38.3 | 77.03 | 200 | .03125 |
| 14 | TWH NAVAL SHIPYARD | 36.49 | 76.18 | 214.4 | .03125 |
| 15 | NKT CHERRY POINT | 34.54 | 76.54 | 1799.9 | .03125 |
| 16 | KBY KINGS BAY GA | 30.48 | 81.4 | 257 | .03125 |
| 17 | NPA PENSOCOLA FL | 30.21 | 87.19 | 1935.8 | .03125 |
| 18 | NQX KEY WEST FL | 24.34 | 81.41 | 305.6 | .03125 |
| 19 | NTD NAS POINT MUGU | 34.07 | 119.07 | 655.6 | .03125 |
| 20 | NUW WHIDBEY ISLAND | 48.17 | 122.37 | 730.1 | .03125 |
| 21 | NZJ EL TORO CA | 33.36 | 117.4 | 100 | .03125 |
| 22 | NFL FALLON NV | 39.28 | 118.47 | 242.6 | .03125 |
| 23 | DCA WASHINGTON DC | 38.51 | 77 | 661.5 | .03125 |
| 24 | PNE PHILADELPHIA-2 | 39.57 | 75.07 | 48.6 | .03125 |
| 25 | PWT BREMERTON WA | 47.34 | 122.38 | 1005.6 | .03125 |
| 26 | SBD SAN BERNADINO | 34.06 | 117.17 | 585.1 | .03125 |
| 27 | NHK PATUXENT RIVER | 38.17 | 76.25 | 848.4 | .03125 |
| 28 | TCM MCCHORD AFB WA | 47.08 | 122.28 | 1313.3 | .03125 |
| 29 | NGU NORFOLK VA | 36.57 | 76.18 | 9741.40 | .90625 |
| 30 | SUU TRAVIS AFB CA | 38.16 | 121.56 | 7043.4 | .921875 |
| 31 | NZY SAN DIEGO CA | 32.42 | 117.12 | 7313.2 | .921875 |

*QUICKTRANS Origin Cargo Tonnages*

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

| RANK | NAME | LONG | LAT | TONNAGES | THETA |
|---|---|---|---|---|---|
| 1 | SUU TRAVIS AFB CA | 38.16 | 121.56 | 5488 | .015625 |
| 2 | NIP JACKSONVILLE | 30.14 | 81.4 | 3750.1 | .015625 |
| 3 | CHS CHARLESTON SC | 32.53 | 80.02 | 3560.3 | .015625 |
| 4 | WRI MCGUIRE AFB | 40.01 | 74.36 | 448.8 | .03125 |
| 5 | DAHLGREN VA | 38.2 | 77.03 | 200 | .03125 |
| 6 | INH INDIAN HEAD MD | 38.3 | 77.03 | 200 | .03125 |
| 7 | COF CAPE CANAVERAL | 28.14 | 80.36 | 179.7 | .03125 |
| 8 | LGB LONG BEACH CA | 33.45 | 118.14 | 894.3 | .03125 |
| 9 | NCO NEWPORT RI | 41.28 | 71.2 | 130.2 | .03125 |
| 10 | GON NEW LONDON CT | 41.21 | 72.07 | 829.2 | .03125 |
| 11 | IND WEIR COOK AP | 39.43 | 86.16 | 597.7 | .03125 |
| 12 | NGZ OAKLAND CA | 37.47 | 122.13 | 681.7 | .03125 |
| 13 | NHK PATUXENT RIVER | 38.17 | 76.25 | 875 | .03125 |
| 14 | TWH NAVAL SHIPYARD | 36.49 | 76.18 | 377.7 | .03125 |
| 15 | NLC LEMOORE CA | 36.15 | 119.57 | 913.5 | .03125 |
| 16 | NKT CHERRY POINT | 34.54 | 76.54 | 2265.1 | .03125 |
| 17 | NPA PENSOCOLA FL | 30.21 | 87.19 | 1756.6 | .03125 |
| 18 | NQX KEY WEST FL | 24.34 | 81.41 | 284.9 | .03125 |
| 19 | NTD NAS POINT MUGU | 34.07 | 119.07 | 1127.8 | .03125 |
| 20 | NUW WHIDBEY ISLAND | 48.17 | 122.37 | 841.5 | .03125 |
| 21 | NZJ EL TORO CA | 33.36 | 117.4 | 100 | .03125 |
| 22 | NFL FALLON NV | 39.28 | 118.47 | 210.9 | .03125 |
| 23 | PHL PHILADELPHIA-1 | 39.57 | 75.07 | 504.6 | .03125 |
| 24 | PNE PHILADELPHIA-2 | 39.57 | 75.07 | 327.7 | .03125 |
| 25 | PWT BREMERTON WA | 47.34 | 122.38 | 1823.6 | .03125 |
| 26 | SBD SAN BERNADINO | 34.06 | 117.17 | 1439.6 | .03125 |
| 27 | KBY KINGS BAY GA | 30.48 | 81.4 | 0 | .03125 |
| 28 | TCM MCCHORD AFB WA | 47.08 | 122.28 | 1169 | .03125 |
| 29 | DCA WASHINGTON DC | 38.51 | 77 | 985.4 | .03125 |
| 30 | NGU NORFOLK VA | 36.57 | 76.18 | 10999.8 | .90625 |
| 31 | NZY SAN DIEGO CA | 32.42 | 117.12 | 6584.4 | .921875 |

## *LOGAIR Destination Cargo Tonnages*

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

| RANK | NAME | LONG | LAT | TONNAGES | THETA |
|---|---|---|---|---|---|
| 1 | FFO WRIGHT-PATT | 39.49 | 84.03 | 2713.2 | .015625 |
| 2 | SUU TRAVIS | 38.16 | 121.56 | 2108.9 | .015625 |
| 3 | SBD NORTON | 34.06 | 117.14 | 2368 | .015625 |
| 4 | VAD MOODY | 30.58 | 83.12 | 295.2 | .03125 |
| 5 | VPS EGLIN | 30.29 | 86.32 | 946.9 | .03125 |
| 6 | ABQ KIRTLAND | 35.02 | 106.36 | 169.2 | .03125 |
| 7 | AEX ENGLAND | 31.2 | 92.33 | 144.8 | .03125 |
| 8 | CVS CANNON | 34.23 | 103.19 | 277.5 | .03125 |
| 9 | BYH IRA EAKER | 35.58 | 89.57 | 242.4 | .03125 |
| 10 | DMA DAVIS-MONTHAM | 32.1 | 110.53 | 469 | .03125 |
| 11 | CBM COLUMBUS MS | 33.39 | 88.26 | 163.4 | .03125 |
| 12 | WRI MCGUIRE | 40.01 | 74.35 | 1548.7 | .03125 |
| 13 | BAD BARKSDALE | 32.3 | 93.4 | 586.9 | .03125 |
| 14 | MCF MACDILL | 27.51 | 82.31 | 318 | .03125 |
| 15 | GFA MALMSTROM | 47.3 | 111.11 | 552.6 | .03125 |
| 16 | MTC SELFRIDGE | 42.36 | 82.5 | 163.6 | .03125 |
| 17 | GSB SEYMOUR JOHNSON | 35.2 | 77.58 | 653.3 | .03125 |
| 18 | GUS GRISSOM | 40.39 | 86.08 | 16.4 | .03125 |
| 19 | DLH DULUTH | 46.5 | 92.11 | 95.8 | .03125 |
| 20 | HMN HOLLOMAN | 32.51 | 106.06 | 624 | .03125 |
| 21 | HST HOMESTEAD | 25.29 | 80.23 | 469.4 | .03125 |
| 22 | IAB MCCONNELL | 37.37 | 97.16 | 399.7 | .03125 |
| 23 | DOV DOVER | 39.08 | 75.28 | 1476.6 | .03125 |
| 24 | LIZ LORING | 46.57 | 67.53 | 366.3 | .03125 |
| 25 | LRF LITTLE ROCK | 34.55 | 92.08 | 622.8 | .03125 |
| 26 | DYS DYESS | 32.25 | 99.51 | 471.6 | .03125 |
| 27 | FEW FRANCIS E.W. | 41.08 | 104.52 | 442.3 | .03125 |
| 28 | CHS CHARLESTON | 32.54 | 80.02 | 1094.3 | .03125 |
| 29 | MIB MINOT | 48.25 | 101.21 | 535.5 | .03125 |
| 30 | MEM MEMPHIS | 35.03 | 89.58 | 109.4 | .03125 |
| 31 | FWH CARSWELL | 32.46 | 97.26 | 662.3 | .03125 |
| 32 | COF PATRICK | 28.14 | 80.36 | 189.1 | .03125 |
| 33 | MUO MOUNTAIN HOME | 43.03 | 115.52 | 362.2 | .03125 |
| 34 | NIP JACKSONVILLE | 30.14 | 81.4 | 307.3 | .03125 |
| 35 | NKO NEWARK | 40.04 | 82.24 | 23.2 | .03125 |
| 36 | NQX KEY WEST | 24.34 | 81.41 | 16.4 | .03125 |
| 37 | OFF OFFUTT | 41.07 | 95.55 | 419.6 | .03125 |
| 38 | OSC WURTSMITH | 44.27 | 83.24 | 332.4 | .03125 |
| 39 | PAM TYNDALL | 30.04 | 85.35 | 353.9 | .03125 |
| 40 | PBG PLATTSBURGH | 44.39 | 73.28 | 567.3 | .03125 |
| 41 | PSM PEASE | 43.04 | 70.49 | 652.2 | .03125 |
| 42 | RCA ELLSWORTH | 44.09 | 103.06 | 679.0 | .03125 |
| 43 | RDR GRAND FORKS | 47.57 | 97.24 | 442.3 | .03125 |
| 44 | RME GRIFFISS | 43.14 | 75.24 | 514.6 | .03125 |
| 45 | SAW K.I. SAWYER | 46.21 | 87.23 | 275.1 | .03125 |
| 46 | BIX KEESLER | 30.25 | 88.55 | 264.9 | .03125 |

| | | | | | |
|---|---|---|---|---|---|
| 47 | SKA FAIRCHILD | 47.37 | 117.39 | 336.6 | .03125 |
| 48 | LFI LANGLEY | 37.05 | 76.22 | 665.2 | .03125 |
| 49 | SSC SHAW | 33.58 | 80.28 | 630.5 | .03125 |
| 50 | LUF LUKE | 33.32 | 112.23 | 749.0 | .03125 |
| 51 | SZL WHITEMAN | 38.44 | 93.33 | 314.3 | .03125 |
| 52 | TCM MCCHORD | 47.08 | 122.28 | 1351.6 | .03125 |
| 53 | LSV NELLIS | 36.14 | 115.02 | 537.6 | .03125 |
| 54 | TIK TINKER | 35.25 | 97.23 | 6261.2 | .90625 |
| 55 | SKF KELLY | 29.23 | 98.35 | 5832.5 | .90625 |
| 56 | HIF HILL | 41.08 | 111.58 | 4910.5 | .90625 |
| 57 | MCC MCCLELLAN | 38.4 | 121.24 | 4181.4 | .921875 |
| 58 | WRB ROBINS | 32.38 | 83.35 | 4135.6 | .921875 |

## *LOGAIR Origin Cargo Tonnages*

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

| RANK | NAME | LONG | LAT | TONNAGES | THETA |
|---|---|---|---|---|---|
| 1 | FFO WRIGHT-PATT | 39.49 | 84.03 | 3733.8 | .015625 |
| 2 | VAD MOODY | 30.58 | 83.12 | 240.1 | .03125 |
| 3 | FWH CARSWELL | 32.46 | 97.26 | 474.1 | .03125 |
| 4 | AEX ENGLAND | 31.2 | 92.33 | 81.5 | .03125 |
| 5 | LUF LUKE | 33.32 | 112.23 | 242.4 | .03125 |
| 6 | WRI MCGUIRE | 40.01 | 74.35 | 990 | .03125 |
| 7 | COF PATRICK | 28.14 | 80.36 | 99.4 | .03125 |
| 8 | CVS CANNON | 34.23 | 103.19 | 223.9 | .03125 |
| 9 | BYH IRA EAKER | 35.58 | 89.57 | 298.1 | .03125 |
| 10 | DMA DAVIS-MONTHAM | 32.1 | 110.53 | 574.8 | .03125 |
| 11 | BAD BARKSDALE | 32.3 | 93.4 | 106.6 | .03125 |
| 12 | CBM COLUMBUS MS | 33.39 | 88.26 | 104 | .03125 |
| 13 | ABQ KIRTLAND | 35.02 | 106.36 | 102.9 | .03125 |
| 14 | MCF MACDILL | 27.51 | 82.31 | 286.6 | .03125 |
| 15 | BIX KEESLER | 30.25 | 88.55 | 233.3 | .03125 |
| 16 | GFA MALMSTROM | 47.3 | 111.11 | 402.7 | .03125 |
| 17 | GSB SEYMOUR JOHNSON | 35.2 | 77.58 | 487.6 | .03125 |
| 18 | GUS GRISSOM | 40.39 | 86.08 | 0 | .03125 |
| 19 | DLH DULUTH | 46.5 | 92.11 | 46.9 | .03125 |
| 20 | HMN HOLLOMAN | 32.51 | 106.06 | 498.4 | .03125 |
| 21 | HST HOMESTEAD | 25.29 | 80.23 | 452.8 | .03125 |
| 22 | IAB MCCONNELL | 37.37 | 97.16 | 279.8 | .03125 |
| 23 | DOV DOVER | 39.08 | 75.28 | 1178.4 | .03125 |
| 24 | LIZ LORING | 46.57 | 67.53 | 476.6 | .03125 |
| 25 | LRF LITTLE ROCK | 34.55 | 92.08 | 291.5 | .03125 |
| 26 | DYS DYESS | 32.25 | 99.51 | 199 | .03125 |
| 27 | FEW FRANCIS E.W. | 41.08 | 104.52 | 346.7 | .03125 |
| 28 | CHS CHARLESTON | 32.54 | 80.02 | 959.4 | .03125 |
| 29 | VPS EGLIN | 30.29 | 86.32 | 754.9 | .03125 |
| 30 | MEM MEMPHIS | 35.03 | 89.58 | 627.8 | .03125 |
| 31 | MIB MINOT | 48.25 | 101.21 | 326.4 | .03125 |
| 32 | MTC SELFRIDGE | 42.36 | 82.5 | 112.3 | .03125 |
| 33 | MUO MOUNTAIN HOME | 43.03 | 115.52 | 274.6 | .03125 |
| 34 | NIP JACKSONVILLE | 30.14 | 81.4 | 213.2 | .03125 |
| 35 | NKO NEWARK | 40.04 | 82.24 | 0 | .03125 |
| 36 | NQX KEY WEST | 24.34 | 81.41 | 3.1 | .03125 |
| 37 | OFF OFFUTT | 41.07 | 95.55 | 237.4 | .03125 |
| 38 | OSC WURTSMITH | 44.27 | 83.24 | 354.9 | .03125 |
| 39 | PAM TYNDALL | 30.04 | 85.35 | 323 | .03125 |
| 40 | PBG PLATTSBURGH | 44.39 | 73.28 | 450.2 | .03125 |
| 41 | PSM PEASE | 43.04 | 70.49 | 493.8 | .03125 |
| 42 | RCA ELLSWORTH | 44.09 | 103.06 | 663.7 | .03125 |
| 43 | RDR GRAND FORKS | 47.57 | 97.24 | 315.6 | .03125 |
| 44 | RME GRIFFISS | 43.14 | 75.24 | 469.3 | .03125 |
| 45 | SAW K.I. SAWYER | 46.21 | 87.23 | 213.1 | .03125 |
| 46 | SBD NORTON | 34.06 | 117.14 | 1872 | .03125 |

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|---|---|---|---|---|---|
| 47 | SKA FAIRCHILD | 47.37 | 117.39 | 290.9 | .03125 |
| 48 | LFI LANGLEY | 37.05 | 76.22 | 459.3 | .03125 |
| 49 | SSC SHAW | 33.58 | 80.28 | 503.4 | .03125 |
| 50 | SUU TRAVIS | 38.16 | 121.56 | 1455.5 | .03125 |
| 51 | SZL WHITEMAN | 38.44 | 93.33 | 223.3 | .03125 |
| 52 | TCM MCCHORD | 47.08 | 122.28 | 1052.4 | .03125 |
| 53 | LSV NELLIS | 36.14 | 115.02 | 372.1 | .03125 |
| 54 | SKF KELLY | 29.23 | 98.35 | 6936.4 | .90625 |
| 55 | HIF HILL | 41.08 | 111.58 | 8525.9 | .90625 |
| 56 | MCC MCCLELLAN | 38.4 | 121.24 | 5146.4 | .921875 |
| 57 | WRB ROBINS | 32.38 | 83.35 | 5202.6 | .921875 |
| 58 | TIK TINKER | 35.25 | 97.23 | 5134 | .921875 |

*Combined Model (Q & L) Destination Cargo Tonnages*

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

| RANK | NAME | LONG | LAT | TONNAGES | THETA |
|---|---|---|---|---|---|
| 1 | DOV DOVER | 39.08 | 75.28 | 1476.6 | .015625 |
| 2 | LGB LONG BEACH | 33.45 | 118.14 | 1939.2 | .015625 |
| 3 | WRI MCGUIRE | 40.01 | 74.35 | 1912 | .015625 |
| 4 | NKT CHERRY POINT | 34.54 | 76.54 | 1799.9 | .015625 |
| 5 | NPA PENSOCOLA | 30.21 | 87.19 | 1935.8 | .015625 |
| 6 | NZY SAN DIEGO | 32.42 | 117.12 | 7313.2 | .015625 |
| 7 | TIK TINKER | 35.25 | 97.23 | 6261.2 | .015625 |
| 8 | BAD BARKSDALE | 32.3 | 93.4 | 586.9 | .03125 |
| 9 | CBM COLUMBUS MS | 33.39 | 88.26 | 163.4 | .03125 |
| 10 | SZL WHITEMAN | 38.44 | 93.33 | 314.3 | .03125 |
| 11 | DLH DULUTH | 46.5 | 92.11 | 95.8 | .03125 |
| 12 | DMA DAVIS-MONTHAM | 32.1 | 110.53 | 469 | .03125 |
| 13 | INH INDIAN HEAD | 38.3 | 77.03 | 200 | .03125 |
| 14 | DYS DYESS | 32.25 | 99.51 | 471.6 | .03125 |
| 15 | TWH NAVAL SHIPYARD | 36.49 | 76.18 | 214.4 | .03125 |
| 16 | DAG DAHLGREN | 38.2 | 77.03 | 200 | .03125 |
| 17 | BYH IRA EAKER | 35.58 | 89.57 | 242.4 | .03125 |
| 18 | GFA MALMSTROM | 47.3 | 111.11 | 552.6 | .03125 |
| 19 | GON NEW LONDON | 41.21 | 72.07 | 801.9 | .03125 |
| 20 | GSB SEYMOUR JOHNSON | 35.2 | 77.58 | 653.3 | .03125 |
| 21 | DCA WASHINGTON | 38.51 | 77 | 661.5 | .03125 |
| 22 | VAD MOODY | 30.58 | 83.12 | 295.2 | .03125 |
| 23 | HMN HOLLOMAN | 32.51 | 106.06 | 624.3 | .03125 |
| 24 | HST HOMESTEAD | 25.29 | 80.23 | 469.4 | .03125 |
| 25 | IAB MCCONNELL | 37.37 | 97.16 | 399.7 | .03125 |
| 26 | IND WEIR COOK AP | 39.43 | 86.16 | 754.7 | .03125 |
| 27 | OFF OFFUTT | 41.07 | 95.55 | 419.6 | .03125 |
| 28 | KBY KINGS BAY | 30.48 | 81.4 | 257 | .03125 |
| 29 | LFI LANGLEY | 37.05 | 76.22 | 665.2 | .03125 |
| 30 | PNE PHILADELPHIA-2 | 39.57 | 75.07 | 48.6 | .03125 |
| 31 | ABQ KIRTLAND | 35.02 | 106.36 | 169.2 | .03125 |
| 32 | MTC SELFRIDGE | 42.36 | 82.5 | 163.6 | .03125 |
| 33 | LUF LUKE | 33.32 | 112.23 | 749 | .03125 |
| 34 | COF PATRICK | 28.14 | 80.36 | 387.82 | .03125 |
| 35 | SSC SHAW | 33.58 | 80.28 | 630.5 | .03125 |
| 36 | FWH CARSWELL | 32.46 | 97.26 | 662.3 | .03125 |
| 37 | MEM MEMPHIS | 35.03 | 89.58 | 109.4 | .03125 |
| 38 | MIB MINOT | 48.25 | 101.21 | 535.5 | .03125 |
| 39 | BIX KEESLER | 30.25 | 88.55 | 264.9 | .03125 |
| 40 | MUO MOUNTAIN HOME | 43.03 | 115.52 | 362.2 | .03125 |
| 41 | NCO NEWPORT | 41.28 | 71.2 | 276.4 | .03125 |
| 42 | NFL FALLON | 39.28 | 118.47 | 242.6 | .03125 |
| 43 | GUS GRISSOM | 40.39 | 86.08 | 16.4 | .03125 |
| 44 | NGZ OAKLAND | 37.47 | 122.13 | 770.7 | .03125 |
| 45 | NHK PATUXENT RIVER | 38.17 | 76.25 | 848.4 | .03125 |
| 46 | HIF HILL | 41.08 | 111.58 | 4910.5 | .03125 |

|  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|
| 47 | NKO | NEWARK | 40.04 | 82.24 | 23.2 | .03125 |
| 48 | LRF | LITTLE ROCK | 34.55 | 92.08 | 622.8 | .03125 |
| 49 | NLC | LEMOORE | 36.15 | 119.57 | 594.1 | .03125 |
| 50 | PWT | BREMERTON | 47.34 | 122.38 | 1005.6 | .03125 |
| 51 | NQX | KEY WEST | 24.34 | 81.41 | 322 | .03125 |
| 52 | NTD | POINT MUGU | 34.07 | 119.07 | 655.6 | .03125 |
| 53 | NUW | WHIDBEY ISLAND | 48.17 | 122.37 | 730.1 | .03125 |
| 54 | NZJ | EL TORO | 33.36 | 117.4 | 100 | .03125 |
| 55 | LIZ | LORING | 46.57 | 67.53 | 366.3 | .03125 |
| 56 | FEW | FRANCIS E.W. | 41.08 | 104.52 | 442.3 | .03125 |
| 57 | OSC | WURTSMITH | 44.27 | 83.24 | 332.4 | .03125 |
| 58 | PAM | TYNDALL | 30.04 | 85.35 | 353.9 | .03125 |
| 59 | PBG | PLATTSBURGH | 44.39 | 73.28 | 567.3 | .03125 |
| 60 | PHL | PHILADELPHIA-1 | 39.57 | 75.07 | 650 | .03125 |
| 61 | AEX | ENGLAND | 31.2 | 92.33 | 144.8 | .03125 |
| 62 | PSM | PEASE | 43.04 | 70.49 | 652.2 | .03125 |
| 63 | VPS | EGLIN | 30.29 | 86.32 | 946.9 | .03125 |
| 64 | RCA | ELLSWORTH | 44.09 | 103.06 | 679 | .03125 |
| 65 | RDR | GRAND FORKS | 47.57 | 97.24 | 442.3 | .03125 |
| 66 | RME | GRIFFISS | 43.14 | 75.24 | 514.6 | .03125 |
| 67 | SAW | K.I. SAWYER | 46.21 | 87.23 | 275.1 | .03125 |
| 68 | LSV | NELLIS | 36.14 | 115.02 | 537.6 | .03125 |
| 69 | SKA | FAIRCHILD | 47.37 | 117.39 | 336.6 | .03125 |
| 70 | SKF | KELLY | 29.23 | 98.35 | 5832.5 | .03125 |
| 71 | MCF | MACDILL | 27.51 | 82.31 | 318 | .03125 |
| 72 | CVS | CANNON | 34.23 | 103.19 | 277.5 | .03125 |
| 73 | CHS | CHARLESTON | 32.54 | 80.02 | 4328.7 | .90625 |
| 74 | NIP | JACKSONVILLE | 30.14 | 81.4 | 4056 | .90625 |
| 75 | NGU | NORFOLK | 36.57 | 76.18 | 9741.401 | .90625 |
| 76 | WRB | ROBINS | 32.38 | 83.35 | 4135.6 | .90625 |
| 77 | SUU | TRAVIS AFB | 38.16 | 121.56 | 9152.3 | .90625 |
| 78 | MCC | MCCLELLAN | 38.4 | 121.24 | 4181.4 | .90625 |
| 79 | TCM | MCCHORD AFB | 47.08 | 122.28 | 2664.9 | .921875 |
| 80 | SBD | NORTON | 34.06 | 117.14 | 2953.1 | .921875 |
| 81 | FFO | WRIGHT-PATT | 39.49 | 84.03 | 2713.2 | .921875 |

*Combined Model (Q & L) Origin Cargo Tonnages*

Three-dimensional results provide convient groupings for potential hub locations. Tonnage factors are for FY 89.

| RANK | NAME | LONG | LAT | TONNAGES | THETA |
|---|---|---|---|---|---|
| 1 | TCM MCCHORD AFB | 47.08 | 122.28 | 2221.4 | .015625 |
| 2 | SKF KELLY | 29.23 | 98.35 | 6936.4 | .015625 |
| 3 | SUU TRAVIS AFB | 38.16 | 121.56 | 6943.5 | .015625 |
| 4 | NKT CHERRY POINT | 34.54 | 76.54 | 2265.4 | .015625 |
| 5 | NPA PENSOCOLA | 30.21 | 87.19 | 1756.6 | .015625 |
| 6 | PWT BREMERTON | 47.34 | 122.38 | 1823.6 | .015625 |
| 7 | WRI MCGUIRE | 40.01 | 74.35 | 1438.8 | .015625 |
| 8 | BAD BARKSDALE | 32.3 | 93.4 | 106.6 | .03125 |
| 9 | CBM COLUMBUS MS | 33.39 | 88.26 | 104 | .03125 |
| 10 | SZL WHITEMAN | 38.44 | 93.33 | 223.3 | .03125 |
| 11 | DLH DULUTH | 46.5 | 92.11 | 46.9 | .03125 |
| 12 | DMA DAVIS-MONTHAM | 32.1 | 110.53 | 574.8 | .03125 |
| 13 | DOV DOVER | 39.08 | 75.28 | 1178.4 | .03125 |
| 14 | DYS DYESS | 32.25 | 99.51 | 199 | .03125 |
| 15 | TWH NAVAL SHIPYARD | 36.49 | 76.18 | 377.7 | .03125 |
| 16 | MTC SELFRIDGE | 42.36 | 82.5 | 112.3 | .03125 |
| 17 | MEM MEMPHIS | 35.03 | 89.58 | 627.8 | .03125 |
| 18 | ABQ KIRTLAND | 35.02 | 106.36 | 102.9 | .03125 |
| 19 | DAG DAHLGREN | 38.2 | 77.03 | 200 | .03125 |
| 20 | GSB SEYMOUR JOHNSON | 35.2 | 77.58 | 487.6 | .03125 |
| 21 | GUS GRISSOM | 40.39 | 86.08 | 0 | .03125 |
| 22 | BYH IRA EAKER | 35.58 | 89.57 | 298.1 | .03125 |
| 23 | HMN HOLLOMAN | 32.51 | 106.06 | 498.4 | .03125 |
| 24 | HST HOMESTEAD | 25.29 | 80.23 | 452.8 | .03125 |
| 25 | IAB MCCONNELL | 37.37 | 97.16 | 279.8 | .03125 |
| 26 | IND WEIR COOK AP | 39.43 | 86.16 | 597.7 | .03125 |
| 27 | INH INDIAN HEAD | 38.3 | 77.03 | 200 | .03125 |
| 28 | KBY KINGS BAY | 30.48 | 81.4 | 0 | .03125 |
| 29 | LFI LANGLEY | 37.05 | 76.22 | 459.3 | .03125 |
| 30 | LGB LONG BEACH | 33.45 | 118.14 | 894.3 | .03125 |
| 31 | CVS CANNON | 34.23 | 103.19 | 223.9 | .03125 |
| 32 | VPS EGLIN | 30.29 | 86.32 | 754.9 | .03125 |
| 33 | LUF LUKE | 33.32 | 112.23 | 242.4 | .03125 |
| 34 | COF PATRICK | 28.14 | 80.36 | 279.1 | .03125 |
| 35 | FWH CARSWELL | 32.46 | 97.26 | 474.1 | .03125 |
| 36 | MCF MACDILL | 27.51 | 82.31 | 286.6 | .03125 |
| 37 | GFA MALMSTROM | 47.3 | 111.11 | 402.7 | .03125 |
| 38 | MIB MINOT | 48.25 | 101.21 | 326.4 | .03125 |
| 39 | GON NEW LONDON | 41.21 | 72.07 | 829.2 | .03125 |
| 40 | MUO MOUNTAIN HOME | 43.03 | 115.52 | 274.6 | .03125 |
| 41 | NCO NEWPORT | 41.28 | 71.2 | 130.2 | .03125 |
| 42 | NFL FALLON | 39.28 | 118.47 | 210.9 | .03125 |
| 43 | BIX KEESLER | 30.25 | 88.55 | 233.3 | .03125 |
| 44 | NGZ OAKLAND | 37.47 | 122.13 | 681.7 | .03125 |
| 45 | NHK PATUXENT RIVER | 38.17 | 76.25 | 875 | .03125 |
| 46 | DCA WASHINGTON | 38.51 | 77 | 985.4 | .03125 |

|  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|
| 47 | NKO | NEWARK | 40.04 | 82.24 | 0 | .03125 |
| 48 | RDR | GRAND FORKS | 47.57 | 97.24 | 315.6 | .03125 |
| 49 | NLC | LEMOORE | 36.15 | 119.57 | 913.5 | .03125 |
| 50 | LRF | LITTLE ROCK | 34.55 | 92.08 | 291.5 | .03125 |
| 51 | NQX | KEY WEST | 24.34 | 81.41 | 288 | .03125 |
| 52 | NTD | POINT MUGU | 34.07 | 119.07 | 1127.8 | .03125 |
| 53 | NUW | WHIDBEY ISLAND | 48.17 | 122.37 | 841.5 | .03125 |
| 54 | NZJ | EL TORO | 33.36 | 117.4 | 100 | .03125 |
| 55 | NZY | SAN DIEGO | 32.42 | 117.12 | 6584.4 | .03125 |
| 56 | OFF | OFFUTT | 41.07 | 95.55 | 237.4 | .03125 |
| 57 | OSC | WURTSMITH | 44.27 | 83.24 | 354.9 | .03125 |
| 58 | PAM | TYNDALL | 30.04 | 85.35 | 323 | .03125 |
| 59 | PBG | PLATTSBURGH | 44.39 | 73.28 | 450.2 | .03125 |
| 60 | PHL | PHILADELPHIA-1 | 39.57 | 75.07 | 504.6 | .03125 |
| 61 | PNE | PHILADELPHIA-2 | 39.57 | 75.07 | 327.7 | .03125 |
| 62 | PSM | PEASE | 43.04 | 70.49 | 493.8 | .03125 |
| 63 | RCA | ELLSWORTH | 44.09 | 103.06 | 663.7 | .03125 |
| 64 | LIZ | LORING | 46.57 | 67.53 | 476.6 | .03125 |
| 65 | FEW | FRANCIS E.W. | 41.08 | 104.52 | 346.7 | .03125 |
| 66 | RME | GRIFFISS | 43.14 | 75.24 | 469.3 | .03125 |
| 67 | SAW | K.I. SAWYER | 46.21 | 87.23 | 213.1 | .03125 |
| 68 | LSV | NELLIS | 36.14 | 115.02 | 372.1 | .03125 |
| 69 | SKA | FAIRCHILD | 47.37 | 117.39 | 290.9 | .03125 |
| 70 | AEX | ENGLAND | 31.2 | 92.33 | 81.5 | .03125 |
| 71 | SSC | SHAW | 33.58 | 80.28 | 503.4 | .03125 |
| 72 | VAD | MOODY | 30.58 | 83.12 | 240.1 | .03125 |
| 73 | CHS | CHARLESTON | 32.54 | 80.02 | 4519.7 | .90625 |
| 74 | NGU | NORFOLK | 36.57 | 76.18 | 10999.8 | .90625 |
| 75 | WRB | ROBINS | 32.38 | 83.35 | 5202.6 | .90625 |
| 76 | TIK | TINKER | 35.25 | 97.23 | 5134 | .90625 |
| 77 | MCC | MCCLELLAN | 38.4 | 121.24 | 5146.4 | .90625 |
| 78 | NIP | JACKSONVILLE | 30.14 | 81.4 | 3963.3 | .921875 |
| 79 | HIF | HILL | 41.08 | 111.58 | 8525.901 | .921875 |
| 80 | SBD | NORTON | 34.06 | 117.14 | 3311.6 | .921875 |
| 81 | FFO | WRIGHT-PATT | 39.49 | 84.03 | 3733.8 | .921875 |

# Appendix G: Inter-locational mileage

## *QUICKTRANS Inter-locational air statute mileage*

| LOC | CHS | COF | DAG | DCA | GON | IND | INH | KBY | LGB | NCO | NFL | NGU | NGZ | NHK | NIP | NKT | NLC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHS | 0 | 304 | 426 | 446 | 742 | 586 | 432 | 163 | 2195 | 775 | 2182 | 354 | 2385 | 443 | 184 | 243 | 2252 |
| COF | 304 | 0 | 720 | 741 | 1016 | 847 | 727 | 173 | 2257 | 1044 | 2299 | 630 | 2485 | 731 | 152 | 496 | 2340 |
| DAG | 426 | 720 | 0 | 21 | 335 | 498 | 7 | 588 | 2304 | 375 | 2212 | 122 | 2433 | 42 | 609 | 254 | 2322 |
| DCA | 446 | 741 | 21 | 0 | 321 | 495 | 15 | 608 | 2304 | 362 | 2208 | 141 | 2430 | 47 | 629 | 275 | 2320 |
| GON | 742 | 1016 | 335 | 321 | 0 | 750 | 331 | 905 | 2553 | 45 | 2418 | 389 | 2647 | 305 | 924 | 520 | 2550 |
| IND | 586 | 847 | 498 | 495 | 750 | 0 | 496 | 673 | 1812 | 796 | 1715 | 577 | 1936 | 540 | 695 | 628 | 1825 |
| INH | 432 | 727 | 7 | 15 | 331 | 496 | 0 | 594 | 2304 | 371 | 2210 | 128 | 2432 | 43 | 616 | 261 | 2321 |
| KBY | 163 | 173 | 588 | 608 | 905 | 673 | 594 | 0 | 2149 | 937 | 2168 | 516 | 2361 | 606 | 23 | 398 | 2221 |
| LGB | 2195 | 2257 | 2304 | 2304 | 2553 | 1812 | 2304 | 2149 | 0 | 2598 | 403 | 2362 | 357 | 2347 | 2156 | 2364 | 203 |
| NCO | 775 | 1044 | 375 | 362 | 45 | 796 | 371 | 937 | 2598 | 0 | 2461 | 421 | 2690 | 343 | 956 | 548 | 2594 |
| NFL | 2182 | 2299 | 2212 | 2208 | 2418 | 1715 | 2210 | 2168 | 403 | 2461 | 0 | 2288 | 234 | 2253 | 2178 | 2316 | 224 |
| NGU | 354 | 630 | 122 | 141 | 389 | 577 | 128 | 516 | 2362 | 421 | 2288 | 0 | 2507 | 110 | 536 | 142 | 2390 |
| NGZ | 2385 | 2485 | 2433 | 2430 | 2647 | 1936 | 2432 | 2361 | 357 | 2690 | 234 | 2507 | 0 | 2475 | 2370 | 2528 | 168 |
| NHK | 443 | 731 | 42 | 47 | 305 | 540 | 43 | 606 | 2347 | 343 | 2253 | 110 | 2475 | 0 | 627 | 251 | 2365 |
| NIP | 184 | 152 | 609 | 629 | 924 | 695 | 616 | 23 | 2156 | 956 | 2178 | 536 | 2370 | 627 | 0 | 415 | 2229 |
| NKT | 243 | 496 | 254 | 275 | 520 | 628 | 261 | 398 | 2364 | 548 | 2316 | 142 | 2528 | 251 | 415 | 0 | 2404 |
| NLC | 2252 | 2340 | 2322 | 2320 | 2550 | 1825 | 2321 | 2221 | 203 | 2594 | 224 | 2390 | 168 | 2365 | 2229 | 2404 | 0 |
| NPA | 452 | 435 | 799 | 814 | 1134 | 639 | 804 | 345 | 1821 | 1174 | 1869 | 770 | 2052 | 830 | 345 | 688 | 1905 |
| NQX | 571 | 270 | 990 | 1011 | 1282 | 1077 | 997 | 424 | 2293 | 1308 | 2383 | 899 | 2552 | 1001 | 400 | 762 | 2398 |
| NTD | 2241 | 2309 | 2340 | 2339 | 2583 | 1846 | 2339 | 2199 | 68 | 2627 | 361 | 2401 | 290 | 2382 | 2206 | 2406 | 146 |
| NUW | 2435 | 2620 | 2345 | 2335 | 2468 | 1881 | 2341 | 2464 | 1039 | 2505 | 643 | 2445 | 738 | 2382 | 2480 | 2509 | 841 |
| NZJ | 2153 | 2214 | 2266 | 2267 | 2517 | 1775 | 2266 | 2107 | 43 | 2562 | 413 | 2324 | 389 | 2309 | 2113 | 2324 | 228 |
| NZY | 2148 | 2199 | 2274 | 2275 | 2532 | 1786 | 2274 | 2097 | 92 | 2577 | 479 | 2328 | 449 | 2317 | 2103 | 2324 | 293 |
| PHL | 559 | 844 | 141 | 127 | 194 | 590 | 137 | 722 | 2402 | 235 | 2290 | 216 | 2516 | 116 | 742 | 356 | 2411 |
| PNE | 559 | 844 | 141 | 127 | 194 | 590 | 137 | 722 | 2402 | 235 | 2290 | 216 | 2516 | 116 | 742 | 356 | 2411 |
| PWT | 2426 | 2604 | 2346 | 2337 | 2477 | 1877 | 2343 | 2451 | 984 | 2515 | 590 | 2445 | 681 | 2384 | 2466 | 2505 | 785 |
| SBD | 2133 | 2201 | 2238 | 2237 | 2485 | 1745 | 2237 | 2091 | 70 | 2529 | 367 | 2297 | 364 | 2280 | 2098 | 2300 | 198 |
| SUU | 2350 | 2457 | 2391 | 2388 | 2601 | 1894 | 2390 | 2330 | 377 | 2644 | 183 | 2466 | 57 | 2433 | 2340 | 2490 | 177 |
| TCM | 2418 | 2595 | 2342 | 2333 | 2475 | 1872 | 2338 | 2442 | 965 | 2513 | 571 | 2440 | 663 | 2380 | 2457 | 2500 | 767 |
| TWH | 350 | 625 | 127 | 146 | 393 | 579 | 133 | 512 | 2363 | 425 | 2290 | 6 | 2508 | 116 | 531 | 136 | 2391 |
| WRI | 604 | 887 | 190 | 175 | 146 | 627 | 185 | 767 | 2438 | 187 | 2320 | 257 | 2546 | 162 | 788 | 396 | 2444 |

| LOC | NPA | NQX | NTD | NUW | NZJ | NZY | PHL | PNE | PWT | SBD | SUU | TCM | TWH | WRI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHS | 452 | 571 | 2241 | 2435 | 2153 | 2148 | 559 | 559 | 2426 | 2133 | 2350 | 2418 | 350 | 604 |
| COF | 435 | 270 | 2309 | 2620 | 2214 | 2199 | 844 | 844 | 2604 | 2201 | 2457 | 2595 | 625 | 887 |
| DAG | 799 | 990 | 2340 | 2345 | 2266 | 2274 | 141 | 141 | 2346 | 2238 | 2391 | 2342 | 127 | 190 |
| DCA | 814 | 1011 | 2339 | 2335 | 2267 | 2275 | 127 | 127 | 2337 | 2237 | 2388 | 2333 | 146 | 175 |
| GON | 1134 | 1282 | 2583 | 2468 | 2517 | 2532 | 194 | 194 | 2477 | 2485 | 2601 | 2475 | 393 | 146 |
| IND | 639 | 1077 | 1846 | 1881 | 1775 | 1786 | 590 | 590 | 1877 | 1745 | 1894 | 1872 | 579 | 627 |
| INH | 804 | 997 | 2339 | 2341 | 2266 | 2274 | 137 | 137 | 2343 | 2237 | 2390 | 2338 | 133 | 185 |
| KBY | 345 | 424 | 2199 | 2464 | 2107 | 2097 | 722 | 722 | 2451 | 2091 | 2330 | 2442 | 512 | 767 |
| LGB | 1821 | 2293 | 68 | 1039 | 43 | 92 | 2402 | 2402 | 984 | 70 | 377 | 965 | 2363 | 2438 |
| NCO | 1174 | 1308 | 2627 | 2505 | 2562 | 2577 | 235 | 235 | 2515 | 2529 | 2644 | 2513 | 425 | 187 |
| NFL | 1869 | 2383 | 361 | 643 | 413 | 479 | 2290 | 2290 | 590 | 367 | 183 | 571 | 2290 | 2320 |
| NGU | 770 | 899 | 2401 | 2445 | 2324 | 2328 | 216 | 216 | 2445 | 2297 | 2466 | 2440 | 6 | 257 |
| NGZ | 2052 | 2552 | 290 | 738 | 389 | 449 | 2516 | 2516 | 681 | 364 | 57 | 663 | 2508 | 2546 |
| NHK | 830 | 1001 | 2382 | 2382 | 2309 | 2317 | 116 | 116 | 2384 | 2280 | 2433 | 2380 | 116 | 162 |
| NIP | 345 | 400 | 2206 | 2480 | 2113 | 2103 | 742 | 742 | 2466 | 2098 | 2340 | 2457 | 531 | 788 |
| NKT | 688 | 762 | 2406 | 2509 | 2324 | 2324 | 356 | 356 | 2505 | 2300 | 2490 | 2500 | 136 | 396 |
| NLC | 1905 | 2398 | 146 | 841 | 228 | 293 | 2411 | 2411 | 785 | 198 | 177 | 767 | 2391 | 2444 |
| NPA | 0 | 538 | 1874 | 2223 | 1779 | 1765 | 940 | 940 | 2204 | 1765 | 2024 | 2193 | 768 | 989 |
| NQX | 538 | 0 | 2351 | 2760 | 2250 | 2227 | 1114 | 1114 | 2740 | 2243 | 2529 | 2729 | 894 | 1156 |
| NTD | 1874 | 2351 | 0 | 988 | 108 | 160 | 2435 | 2435 | 932 | 109 | 314 | 913 | 2402 | 2470 |
| NUW | 2223 | 2760 | 988 | 0 | 1054 | 1121 | 2386 | 2386 | 57 | 1010 | 692 | 75 | 2448 | 2404 |
| NZJ | 1779 | 2250 | 108 | 1054 | 0 | 67 | 2365 | 2365 | 999 | 50 | 405 | 980 | 2324 | 2401 |
| NZY | 1765 | 2227 | 160 | 1121 | 67 | 0 | 2376 | 2376 | 1066 | 113 | 468 | 1047 | 2329 | 2413 |
| PHL | 940 | 1114 | 2435 | 2386 | 2365 | 2376 | 0 | 0 | 2391 | 2335 | 2471 | 2388 | 221 | 48 |
| PNE | 940 | 1114 | 2435 | 2386 | 2365 | 2376 | 0 | 0 | 2391 | 2335 | 2471 | 2388 | 221 | 48 |
| PWT | 2204 | 2740 | 932 | 57 | 999 | 1066 | 2391 | 2391 | 0 | 955 | 635 | 19 | 2448 | 2409 |
| SBD | 1765 | 2243 | 109 | 1010 | 50 | 113 | 2335 | 2335 | 955 | 0 | 374 | 937 | 2298 | 2370 |
| SUU | 2024 | 2529 | 314 | 692 | 405 | 468 | 2471 | 2471 | 635 | 374 | 0 | 617 | 2468 | 2501 |
| TCM | 2193 | 2729 | 913 | 75 | 980 | 1047 | 2388 | 2388 | 19 | 937 | 617 | 0 | 2443 | 2407 |
| TWH | 768 | 894 | 2402 | 2448 | 2324 | 2329 | 221 | 221 | 2448 | 2298 | 2468 | 2443 | 0 | 262 |
| WRI | 989 | 1156 | 2470 | 2404 | 2401 | 2413 | 48 | 48 | 2409 | 2370 | 2501 | 2407 | 262 | 0 |

QUICKTRANS Inter-locational surface statute mileage

| LOC | CHS | COP | DAG | DCA | GON | IND | INH | KBY | LGB | NCO | NPL | NGU | NGZ | NHK | NIP | NKT | NLC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHS | 0 | 364 | 511 | 535 | 890 | 704 | 519 | 196 | 2634 | 929 | 2618 | 425 | 2861 | 532 | 221 | 292 | 2702 |
| COP | 364 | 0 | 864 | 889 | 1219 | 1016 | 872 | 208 | 2708 | 1252 | 2759 | 757 | 2982 | 878 | 182 | 595 | 2808 |
| DAG | 511 | 864 | 0 | 26 | 402 | 597 | 8 | 705 | 2765 | 450 | 2654 | 146 | 2920 | 51 | 731 | 305 | 2787 |
| DCA | 535 | 889 | 26 | 0 | 385 | 594 | 17 | 729 | 2765 | 434 | 2649 | 169 | 2916 | 56 | 755 | 330 | 2785 |
| GON | 890 | 1219 | 402 | 385 | 0 | 901 | 397 | 1085 | 3064 | 54 | 2902 | 467 | 3176 | 366 | 1109 | 625 | 3060 |
| IND | 704 | 1016 | 597 | 594 | 901 | 0 | 596 | 808 | 2175 | 955 | 2057 | 692 | 2323 | 648 | 834 | 754 | 2190 |
| INH | 519 | 872 | 8 | 17 | 397 | 596 | 0 | 713 | 2764 | 445 | 2652 | 154 | 2918 | 52 | 739 | 313 | 2786 |
| KBY | 196 | 208 | 705 | 729 | 1085 | 808 | 713 | 0 | 2579 | 1124 | 2601 | 620 | 2833 | 727 | 28 | 478 | 2665 |
| LGB | 2634 | 2708 | 2765 | 2765 | 3064 | 2175 | 2764 | 2579 | 0 | 3117 | 483 | 2835 | 428 | 2816 | 2587 | 2837 | 244 |
| NCO | 929 | 1252 | 450 | 434 | 54 | 955 | 445 | 1124 | 3117 | 0 | 2953 | 505 | 3228 | 412 | 1148 | 658 | 3113 |
| NPL | 2618 | 2759 | 2654 | 2649 | 2902 | 2057 | 2652 | 2601 | 483 | 2953 | 0 | 2746 | 281 | 2704 | 2614 | 2779 | 269 |
| NGU | 425 | 757 | 146 | 169 | 467 | 692 | 154 | 620 | 2835 | 505 | 2746 | 0 | 3008 | 133 | 643 | 170 | 2868 |
| NGZ | 2861 | 2982 | 2920 | 2916 | 3176 | 2323 | 2918 | 2833 | 428 | 3228 | 281 | 3008 | 0 | 2970 | 2844 | 3034 | 202 |
| NHK | 532 | 878 | 51 | 56 | 366 | 648 | 52 | 727 | 2816 | 412 | 2704 | 133 | 2970 | 0 | 752 | 301 | 2837 |
| NIP | 221 | 182 | 731 | 755 | 1109 | 834 | 739 | 28 | 2587 | 1148 | 2614 | 643 | 2844 | 752 | 0 | 498 | 2675 |
| NKT | 292 | 595 | 305 | 330 | 625 | 754 | 313 | 478 | 2837 | 658 | 2779 | 170 | 3034 | 301 | 498 | 0 | 2885 |
| NLC | 2702 | 2808 | 2787 | 2785 | 3060 | 2190 | 2786 | 2665 | 244 | 3113 | 269 | 2868 | 202 | 2837 | 2675 | 2885 | 0 |
| NPA | 542 | 523 | 959 | 977 | 1361 | 767 | 964 | 414 | 2186 | 1408 | 2243 | 925 | 2462 | 997 | 414 | 826 | 2286 |
| NQX | 686 | 324 | 1188 | 1214 | 1538 | 1293 | 1196 | 508 | 2752 | 1570 | 2860 | 1079 | 3062 | 1201 | 480 | 914 | 2878 |
| NTD | 2689 | 2771 | 2808 | 2807 | 3099 | 2215 | 2807 | 2639 | 82 | 3153 | 433 | 2881 | 349 | 2859 | 2647 | 2887 | 176 |
| NUW | 2922 | 3143 | 2814 | 2802 | 2962 | 2258 | 2810 | 2957 | 1247 | 3006 | 772 | 2934 | 886 | 2858 | 2976 | 3011 | 1010 |
| NZJ | 2584 | 2657 | 2720 | 2720 | 3021 | 2130 | 2719 | 2529 | 52 | 3075 | 495 | 2788 | 466 | 2770 | 2536 | 2789 | 274 |
| NZY | 2578 | 2639 | 2729 | 2730 | 3038 | 2144 | 2729 | 2517 | 111 | 3092 | 575 | 2794 | 539 | 2780 | 2523 | 2789 | 351 |
| PHL | 670 | 1013 | 170 | 152 | 233 | 708 | 164 | 866 | 2883 | 282 | 2748 | 259 | 3019 | 139 | 891 | 428 | 2893 |
| PNE | 670 | 1013 | 170 | 152 | 233 | 708 | 164 | 866 | 2883 | 282 | 2748 | 259 | 3019 | 139 | 891 | 428 | 2893 |
| PWT | 2911 | 3125 | 2815 | 2804 | 2972 | 2253 | 2811 | 2941 | 1180 | 3018 | 707 | 2933 | 817 | 2860 | 2959 | 3006 | 942 |
| SBD | 2560 | 2641 | 2685 | 2685 | 2982 | 2094 | 2684 | 2509 | 84 | 3035 | 441 | 2756 | 437 | 2736 | 2517 | 2760 | 237 |
| SCU | 2820 | 2948 | 2869 | 2865 | 3121 | 2272 | 2867 | 2796 | 452 | 3173 | 220 | 2959 | 68 | 2919 | 2808 | 2988 | 212 |
| TCM | 2902 | 3114 | 2810 | 2799 | 2970 | 2246 | 2806 | 2931 | 1158 | 3016 | 685 | 2928 | 796 | 2855 | 2949 | 3000 | 920 |
| TWH | 420 | 750 | 152 | 176 | 472 | 695 | 160 | 614 | 2836 | 510 | 2748 | 7 | 3010 | 139 | 638 | 163 | 2870 |
| WRI | 725 | 1065 | 228 | 210 | 175 | 752 | 222 | 921 | 2926 | 225 | 2784 | 308 | 3055 | 195 | 945 | 475 | 2932 |

| LOC | NPA | NQX | NTD | NUW | NZJ | NZY | PHL | PNE | PWT | SBD | SUU | TCM | TWH | WRI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHS | 542 | 686 | 2689 | 2922 | 2584 | 2578 | 670 | 670 | 2911 | 2560 | 2820 | 2902 | 420 | 725 |
| COF | 523 | 324 | 2771 | 3143 | 2657 | 2639 | 1013 | 1013 | 3125 | 2641 | 2948 | 3114 | 750 | 1065 |
| DAG | 959 | 1188 | 2808 | 2814 | 2720 | 2729 | 170 | 170 | 2815 | 2685 | 2869 | 2810 | 152 | 228 |
| DCA | 977 | 1214 | 2807 | 2802 | 2720 | 2730 | 152 | 152 | 2804 | 2685 | 2865 | 2799 | 176 | 210 |
| GON | 1361 | 1538 | 3099 | 2962 | 3021 | 3038 | 233 | 233 | 2972 | 2982 | 3121 | 2970 | 472 | 175 |
| IND | 767 | 1293 | 2215 | 2258 | 2130 | 2144 | 708 | 708 | 2253 | 2094 | 2272 | 2246 | 695 | 752 |
| INH | 964 | 1196 | 2807 | 2810 | 2719 | 2729 | 164 | 164 | 2811 | 2684 | 2867 | 2806 | 160 | 222 |
| KBY | 414 | 508 | 2639 | 2957 | 2529 | 2517 | 866 | 866 | 2941 | 2509 | 2796 | 2931 | 614 | 921 |
| LGB | 2186 | 2752 | 82 | 1247 | 52 | 111 | 2883 | 2883 | 1180 | 84 | 452 | 1158 | 2836 | 2926 |
| NCO | 1408 | 1570 | 3153 | 3006 | 3075 | 3092 | 282 | 282 | 3018 | 3035 | 3173 | 3016 | 510 | 225 |
| NPL | 2243 | 2860 | 433 | 772 | 495 | 575 | 2748 | 2748 | 707 | 441 | 220 | 685 | 2748 | 2784 |
| NGU | 925 | 1079 | 2881 | 2934 | 2788 | 2794 | 259 | 259 | 2933 | 2756 | 2959 | 2928 | 7 | 308 |
| NGZ | 2462 | 3062 | 349 | 886 | 466 | 539 | 3019 | 3019 | 817 | 437 | 68 | 796 | 3010 | 3055 |
| NHK | 997 | 1201 | 2859 | 2858 | 2770 | 2780 | 139 | 139 | 2860 | 2736 | 2919 | 2855 | 139 | 195 |
| NIP | 414 | 480 | 2647 | 2976 | 2536 | 2523 | 891 | 891 | 2959 | 2517 | 2808 | 2949 | 638 | 945 |
| NKT | 826 | 914 | 2887 | 3011 | 2789 | 2789 | 428 | 428 | 3006 | 2760 | 2988 | 3000 | 163 | 475 |
| NLC | 2286 | 2878 | 176 | 1010 | 274 | 351 | 2893 | 2893 | 942 | 237 | 212 | 920 | 2870 | 2932 |
| NPA | 0 | 646 | 2249 | 2668 | 2135 | 2118 | 1129 | 1129 | 2645 | 2118 | 2429 | 2632 | 921 | 1187 |
| NQX | 646 | 0 | 2821 | 3312 | 2700 | 2673 | 1336 | 1336 | 3288 | 2691 | 3035 | 3275 | 1073 | 1387 |
| NTD | 2249 | 2821 | 0 | 1185 | 129 | 192 | 2922 | 2922 | 1118 | 130 | 377 | 1096 | 2882 | 2964 |
| NUW | 2668 | 3312 | 1185 | 0 | 1265 | 1345 | 2864 | 2864 | 69 | 1212 | 830 | 90 | 2938 | 2884 |
| NZJ | 2135 | 2700 | 129 | 1265 | 0 | 80 | 2839 | 2839 | 1199 | 60 | 486 | 1177 | 2789 | 2882 |
| NZY | 2118 | 2673 | 192 | 1345 | 80 | 0 | 2852 | 2852 | 1279 | 136 | 562 | 1257 | 2794 | 2896 |
| PHL | 1129 | 1336 | 2922 | 2864 | 2839 | 2852 | 0 | 0 | 2869 | 2802 | 2966 | 2865 | 265 | 58 |
| PNE | 1129 | 1336 | 2922 | 2864 | 2839 | 2852 | 0 | 0 | 2869 | 2802 | 2966 | 2865 | 265 | 58 |
| PWT | 2645 | 3288 | 1118 | 69 | 1199 | 1279 | 2869 | 2869 | 0 | 1147 | 762 | 22 | 2937 | 2891 |
| SBD | 2118 | 2691 | 130 | 1212 | 60 | 136 | 2802 | 2802 | 1147 | 0 | 449 | 1124 | 2757 | 2844 |
| SUU | 2429 | 3035 | 377 | 830 | 486 | 562 | 2966 | 2966 | 762 | 449 | 0 | 740 | 2961 | 3002 |
| TCM | 2632 | 3275 | 1096 | 90 | 1177 | 1257 | 2865 | 2865 | 22 | 1124 | 740 | 0 | 2931 | 2888 |
| TWH | 921 | 1073 | 2882 | 2938 | 2789 | 2794 | 265 | 265 | 2937 | 2757 | 2961 | 2931 | 0 | 315 |
| WRI | 1187 | 1387 | 2964 | 2884 | 2882 | 2896 | 58 | 58 | 2891 | 2844 | 3002 | 2888 | 315 | 0 |

## *LOGAIR Inter-locational air statute mileage*

| | ABQ | AEX | BAD | BIX | BYH | CBM | CHS | COF | CVS | DLH | DMA | DOV | DYS | FEW | FFO | FWH | GFA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 0 | 852 | 767 | 1084 | 945 | 1037 | 1516 | 1595 | 188 | 1084 | 313 | 1726 | 437 | 430 | 1261 | 551 | 882 |
| AEX | 852 | 0 | 98 | 234 | 341 | 281 | 727 | 748 | 664 | 1056 | 1070 | 1102 | 427 | 960 | 738 | 302 | 1489 |
| BAD | 767 | 98 | 0 | 319 | 315 | 307 | 779 | 828 | 580 | 982 | 999 | 1115 | 356 | 862 | 721 | 225 | 1391 |
| BIX | 1084 | 234 | 319 | 0 | 372 | 217 | 526 | 514 | 896 | 1137 | 1302 | 967 | 661 | 1163 | 687 | 535 | 1678 |
| BYH | 945 | 341 | 315 | 372 | 0 | 168 | 584 | 744 | 776 | 765 | 1223 | 819 | 613 | 892 | 406 | 489 | 1369 |
| CBM | 1037 | 281 | 307 | 217 | 168 | 0 | 481 | 592 | 857 | 927 | 1292 | 822 | 656 | 1036 | 482 | 524 | 1528 |
| CHS | 1516 | 727 | 779 | 526 | 584 | 481 | 0 | 304 | 1337 | 1155 | 1773 | 523 | 1134 | 1470 | 529 | 1002 | 1916 |
| COF | 1595 | 748 | 828 | 514 | 744 | 592 | 304 | 0 | 1408 | 1418 | 1815 | 809 | 1175 | 1628 | 811 | 1049 | 2113 |
| CVS | 188 | 664 | 580 | 896 | 776 | 857 | 1337 | 1408 | 0 | 1025 | 449 | 1574 | 252 | 478 | 1116 | 363 | 991 |
| DLH | 1084 | 1056 | 982 | 1137 | 765 | 927 | 1155 | 1418 | 1025 | 0 | 1391 | 991 | 1058 | 721 | 632 | 1006 | 895 |
| DMA | 313 | 1070 | 999 | 1302 | 1223 | 1292 | 1773 | 1815 | 449 | 1391 | 0 | 2022 | 643 | 703 | 1561 | 774 | 1049 |
| DOV | 1726 | 1102 | 1115 | 967 | 819 | 822 | 523 | 809 | 1574 | 991 | 2022 | 0 | 1432 | 1543 | 468 | 1308 | 1871 |
| DYS | 437 | 427 | 356 | 661 | 613 | 656 | 1134 | 1175 | 252 | 1058 | 643 | 1432 | 0 | 669 | 997 | 132 | 1204 |
| FEW | 430 | 960 | 862 | 1163 | 892 | 1036 | 1470 | 1628 | 478 | 721 | 703 | 1543 | 669 | 0 | 1082 | 717 | 539 |
| FFO | 1261 | 738 | 721 | 687 | 406 | 482 | 529 | 811 | 1116 | 632 | 1561 | 468 | 997 | 1082 | 0 | 882 | 1452 |
| FWH | 551 | 302 | 225 | 535 | 489 | 524 | 1002 | 1049 | 363 | 1006 | 774 | 1308 | 132 | 717 | 882 | 0 | 1255 |
| GFA | 882 | 1489 | 1391 | 1678 | 1369 | 1528 | 1916 | 2113 | 991 | 895 | 1049 | 1871 | 1204 | 539 | 1452 | 1255 | 0 |
| GSB | 1619 | 894 | 928 | 722 | 675 | 622 | 231 | 514 | 1450 | 1084 | 1896 | 296 | 1272 | 1510 | 461 | 1142 | 1910 |
| GUS | 1164 | 723 | 690 | 713 | 382 | 498 | 637 | 906 | 1028 | 518 | 1469 | 580 | 932 | 963 | 125 | 826 | 1326 |
| HIF | 505 | 1267 | 1171 | 1485 | 1246 | 1381 | 1829 | 1970 | 658 | 1036 | 622 | 1908 | 903 | 367 | 1448 | 988 | 430 |
| HMN | 174 | 809 | 737 | 1042 | 965 | 1031 | 1511 | 1556 | 204 | 1214 | 262 | 1772 | 382 | 597 | 1316 | 512 | 1054 |
| HST | 1691 | 840 | 931 | 612 | 901 | 739 | 500 | 197 | 1503 | 1603 | 1886 | 994 | 1259 | 1765 | 1004 | 1140 | 2266 |
| IAB | 537 | 507 | 409 | 696 | 439 | 570 | 1023 | 1162 | 401 | 681 | 840 | 1189 | 377 | 469 | 724 | 339 | 985 |
| LFI | 1681 | 1003 | 1027 | 848 | 748 | 724 | 378 | 660 | 1520 | 1042 | 1968 | 149 | 1359 | 1534 | 455 | 1231 | 1900 |
| LIZ | 2153 | 1690 | 1681 | 1590 | 1367 | 1417 | 1171 | 1449 | 2036 | 1162 | 2465 | 648 | 1951 | 1862 | 962 | 1841 | 2027 |
| LRF | 809 | 232 | 173 | 361 | 159 | 233 | 707 | 820 | 632 | 825 | 1075 | 978 | 456 | 812 | 559 | 331 | 1319 |
| LSV | 492 | 1343 | 1259 | 1576 | 1420 | 1523 | 1999 | 2087 | 680 | 1378 | 379 | 2164 | 924 | 660 | 1697 | 1042 | 796 |
| LUF | 355 | 1169 | 1093 | 1402 | 1296 | 1378 | 1859 | 1916 | 522 | 1393 | 130 | 2081 | 741 | 682 | 1616 | 869 | 966 |
| MCC | 834 | 1704 | 1615 | 1934 | 1748 | 1865 | 2332 | 2440 | 1042 | 1574 | 743 | 2447 | 1291 | 905 | 1984 | 1404 | 798 |
| MCF | 1505 | 654 | 741 | 422 | 701 | 539 | 373 | 127 | 1318 | 1415 | 1714 | 895 | 1078 | 1567 | 832 | 955 | 2066 |
| MEM | 946 | 308 | 289 | 335 | 38 | 136 | 575 | 721 | 774 | 802 | 1218 | 835 | 601 | 911 | 433 | 474 | 1394 |
| MIB | 950 | 1265 | 1173 | 1410 | 1056 | 1224 | 1544 | 1778 | 973 | 442 | 1216 | 1431 | 1108 | 521 | 1043 | 1109 | 463 |
| MTC | 1375 | 941 | 915 | 900 | 602 | 694 | 691 | 988 | 1248 | 552 | 1685 | 440 | 1162 | 1134 | 213 | 1056 | 1432 |
| MUO | 738 | 1507 | 1410 | 1723 | 1471 | 1611 | 2048 | 2202 | 898 | 1167 | 802 | 2091 | 1145 | 579 | 1642 | 1230 | 364 |
| NIP | 1486 | 653 | 723 | 426 | 604 | 461 | 184 | 152 | 1301 | 1266 | 1721 | 708 | 1077 | 1494 | 662 | 948 | 1970 |
| NKO | 1360 | 831 | 818 | 763 | 504 | 567 | 532 | 823 | 1217 | 666 | 1662 | 376 | 1099 | 1167 | 102 | 984 | 1512 |
| NQX | 1661 | 817 | 911 | 598 | 915 | 749 | 572 | 270 | 1473 | 1640 | 1843 | 1078 | 1225 | 1760 | 1056 | 1111 | 2270 |
| OFF | 720 | 704 | 617 | 843 | 498 | 663 | 1038 | 1237 | 630 | 412 | 1033 | 1077 | 647 | 466 | 616 | 602 | 879 |
| OSC | 1378 | 1028 | 991 | 1010 | 686 | 798 | 828 | 1124 | 1266 | 456 | 1690 | 544 | 1206 | 1098 | 332 | 1110 | 1350 |
| PAM | 1267 | 422 | 500 | 191 | 434 | 288 | 358 | 328 | 1080 | 1192 | 1492 | 845 | 849 | 1314 | 656 | 722 | 1813 |
| PBG | 1856 | 1375 | 1365 | 1282 | 1051 | 1103 | 894 | 1187 | 1731 | 921 | 2166 | 381 | 1638 | 1590 | 646 | 1527 | 1811 |
| PSM | 1984 | 1446 | 1447 | 1328 | 1138 | 1168 | 890 | 1166 | 1851 | 1082 | 2291 | 370 | 1740 | 1737 | 743 | 1623 | 1975 |
| RCA | 650 | 1063 | 966 | 1240 | 923 | 1083 | 1472 | 1667 | 680 | 556 | 920 | 1467 | 839 | 221 | 1026 | 861 | 446 |
| RDR | 985 | 1159 | 1073 | 1281 | 916 | 1084 | 1373 | 1618 | 971 | 252 | 1275 | 1242 | 1064 | 574 | 863 | 1043 | 647 |
| RME | 1747 | 1245 | 1237 | 1152 | 923 | 973 | 776 | 1074 | 1617 | 856 | 2055 | 280 | 1515 | 1498 | 520 | 1402 | 1751 |
| SAW | 1259 | 1071 | 1014 | 1104 | 743 | 886 | 1018 | 1302 | 1175 | 233 | 1572 | 779 | 1163 | 931 | 491 | 1087 | 1127 |
| SBD | 616 | 1452 | 1373 | 1685 | 1560 | 1652 | 2132 | 2199 | 796 | 1562 | 405 | 2325 | 1025 | 842 | 1857 | 1150 | 966 |
| SKA | 1024 | 1729 | 1630 | 1930 | 1639 | 1793 | 2197 | 2383 | 1168 | 1187 | 1114 | 2164 | 1403 | 769 | 1742 | 1473 | 294 |
| SKF | 615 | 394 | 362 | 591 | 673 | 659 | 1108 | 1090 | 447 | 1238 | 749 | 1476 | 219 | 888 | 1078 | 232 | 1421 |
| SSC | 1486 | 721 | 764 | 536 | 547 | 460 | 73 | 375 | 1310 | 1086 | 1750 | 470 | 1116 | 1421 | 458 | 984 | 1874 |
| SUU | 868 | 1719 | 1631 | 1950 | 1766 | 1882 | 2350 | 2457 | 1056 | 1597 | 749 | 2468 | 1307 | 926 | 2005 | 1419 | 822 |
| TBN | 757 | 503 | 424 | 627 | 286 | 449 | 850 | 1030 | 620 | 560 | 1061 | 971 | 551 | 620 | 504 | 463 | 1033 |
| TCM | 1170 | 1923 | 1825 | 2131 | 1854 | 2003 | 2418 | 2595 | 1329 | 1417 | 1205 | 2394 | 1574 | 970 | 1979 | 1654 | 524 |
| TIK | 515 | 397 | 299 | 610 | 431 | 526 | 1002 | 1103 | 345 | 820 | 793 | 1232 | 245 | 564 | 780 | 193 | 1094 |
| VAD | 1379 | 547 | 616 | 324 | 508 | 358 | 227 | 236 | 1194 | 1199 | 1614 | 735 | 971 | 1394 | 617 | 841 | 1677 |
| VPS | 1207 | 362 | 440 | 133 | 411 | 243 | 402 | 388 | 1020 | 1161 | 1431 | 871 | 789 | 1259 | 648 | 661 | 1762 |
| WRB | 1333 | 533 | 586 | 340 | 419 | 293 | 194 | 343 | 1149 | 1079 | 1582 | 646 | 941 | 1311 | 492 | 810 | 1786 |
| WRI | 1775 | 1174 | 1184 | 1044 | 883 | 894 | 604 | 888 | 1628 | 995 | 2075 | 81 | 1495 | 1576 | 515 | 1372 | 1884 |

|  | GSB | GUS | HIF | HMN | HST | IAB | LFI | LIZ | LRP | LSV | LUF | MCC | MCP | MEM | MIB | MTC | MUO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 1619 | 1164 | 505 | 174 | 1691 | 537 | 1681 | 2153 | 809 | 492 | 355 | 854 | 1505 | 946 | 950 | 1375 | 738 |
| AEX | 894 | 723 | 1267 | 809 | 840 | 507 | 1003 | 1690 | 232 | 1343 | 1169 | 1704 | 654 | 308 | 1265 | 941 | 1507 |
| BAD | 928 | 690 | 1171 | 737 | 931 | 409 | 1027 | 1681 | 173 | 1259 | 1093 | 1615 | 741 | 289 | 1173 | 915 | 1410 |
| BIX | 722 | 713 | 1485 | 1042 | 612 | 696 | 848 | 1590 | 361 | 1576 | 1402 | 1934 | 422 | 335 | 1410 | 900 | 1723 |
| BYH | 675 | 382 | 1246 | 965 | 901 | 439 | 748 | 1367 | 159 | 1420 | 1296 | 1748 | 701 | 38 | 1056 | 602 | 1471 |
| CBM | 622 | 498 | 1381 | 1031 | 739 | 570 | 724 | 1417 | 233 | 1523 | 1378 | 1865 | 539 | 136 | 1224 | 694 | 1611 |
| CHS | 231 | 637 | 1829 | 1511 | 500 | 1023 | 378 | 1171 | 707 | 1999 | 1859 | 2332 | 373 | 575 | 1544 | 691 | 2048 |
| COF | 514 | 906 | 1970 | 1556 | 197 | 1162 | 660 | 1449 | 820 | 2087 | 1916 | 2440 | 127 | 721 | 1778 | 988 | 2202 |
| CVS | 1450 | 1028 | 658 | 204 | 1503 | 401 | 1520 | 2036 | 632 | 680 | 522 | 1042 | 1318 | 774 | 973 | 1248 | 898 |
| DLH | 1084 | 518 | 1036 | 1214 | 1603 | 681 | 1042 | 1162 | 825 | 1378 | 1393 | 1574 | 1415 | 802 | 442 | 552 | 1167 |
| DMA | 1896 | 1469 | 622 | 262 | 1886 | 840 | 1968 | 2465 | 1075 | 379 | 130 | 743 | 1714 | 1218 | 1216 | 1685 | 802 |
| DOV | 296 | 580 | 1908 | 1772 | 994 | 1189 | 149 | 648 | 978 | 2164 | 2081 | 2447 | 895 | 835 | 1431 | 440 | 2091 |
| DYS | 1272 | 932 | 903 | 382 | 1259 | 377 | 1359 | 1951 | 456 | 924 | 741 | 1291 | 1078 | 601 | 1108 | 1162 | 1145 |
| FEW | 1510 | 963 | 367 | 597 | 1765 | 469 | 1534 | 1862 | 812 | 660 | 682 | 905 | 1567 | 911 | 521 | 1134 | 579 |
| FFO | 461 | 125 | 1448 | 1316 | 1004 | 724 | 455 | 962 | 559 | 1697 | 1616 | 1984 | 832 | 433 | 1043 | 213 | 1642 |
| FWH | 1142 | 826 | 988 | 512 | 1140 | 339 | 1231 | 1841 | 331 | 1042 | 869 | 1404 | 955 | 474 | 1109 | 1056 | 1230 |
| GFA | 1910 | 1326 | 430 | 1054 | 2266 | 985 | 1900 | 2027 | 1319 | 796 | 966 | 798 | 2066 | 1394 | 463 | 1432 | 364 |
| GSB | 0 | 586 | 1877 | 1637 | 702 | 1097 | 148 | 942 | 822 | 2087 | 1970 | 2400 | 599 | 678 | 1504 | 560 | 2083 |
| GUS | 586 | 0 | 1329 | 1231 | 1095 | 630 | 579 | 1019 | 520 | 1587 | 1517 | 1867 | 914 | 416 | 920 | 230 | 1519 |
| HIF | 1877 | 1329 | 0 | 665 | 2096 | 811 | 1901 | 2196 | 1151 | 388 | 537 | 545 | 1900 | 1261 | 709 | 1493 | 243 |
| HMN | 1637 | 1231 | 665 | 0 | 1633 | 604 | 1713 | 2239 | 815 | 568 | 362 | 943 | 1457 | 959 | 1115 | 1452 | 889 |
| HST | 702 | 1095 | 2096 | 1633 | 0 | 1296 | 845 | 1626 | 953 | 2181 | 1995 | 2544 | 200 | 873 | 1949 | 1185 | 2332 |
| IAB | 1097 | 630 | 811 | 604 | 1296 | 0 | 1149 | 1635 | 343 | 990 | 892 | 1310 | 1098 | 451 | 778 | 848 | 1041 |
| LFI | 148 | 579 | 1901 | 1713 | 845 | 1149 | 0 | 793 | 904 | 2135 | 2035 | 2434 | 748 | 758 | 1475 | 495 | 2097 |
| LIZ | 942 | 1019 | 2196 | 2239 | 1626 | 1635 | 793 | 0 | 1522 | 2521 | 2496 | 2736 | 1541 | 1393 | 1564 | 791 | 2326 |
| LRF | 822 | 520 | 1151 | 815 | 953 | 343 | 904 | 1522 | 0 | 1292 | 1154 | 1632 | 754 | 145 | 1055 | 747 | 1383 |
| LSV | 2087 | 1587 | 388 | 568 | 2181 | 990 | 2135 | 2521 | 1292 | 0 | 251 | 375 | 1997 | 1425 | 1090 | 1778 | 476 |
| LUF | 1970 | 1517 | 537 | 362 | 1995 | 892 | 2035 | 2496 | 1154 | 251 | 0 | 613 | 1818 | 1295 | 1177 | 1725 | 693 |
| MCC | 2400 | 1867 | 545 | 943 | 2544 | 1310 | 2434 | 2736 | 1632 | 375 | 613 | 0 | 2356 | 1757 | 1208 | 2037 | 437 |
| MCF | 599 | 914 | 1900 | 1457 | 200 | 1098 | 748 | 1541 | 754 | 1997 | 1818 | 2356 | 0 | 673 | 1752 | 1025 | 2135 |
| MEM | 678 | 416 | 1261 | 959 | 873 | 451 | 758 | 1393 | 145 | 1425 | 1295 | 1757 | 673 | 0 | 1089 | 633 | 1488 |
| MIB | 1504 | 920 | 709 | 1115 | 1949 | 778 | 1475 | 1564 | 1055 | 1090 | 1177 | 1208 | 1752 | 1089 | 0 | 991 | 777 |
| MTC | 560 | 230 | 1493 | 1452 | 1185 | 848 | 495 | 791 | 747 | 1778 | 1725 | 2037 | 1025 | 633 | 991 | 0 | 1664 |
| MUO | 2083 | 1519 | 243 | 889 | 2332 | 1041 | 2097 | 2326 | 1383 | 476 | 693 | 437 | 2135 | 1488 | 777 | 1664 | 0 |
| NIP | 414 | 755 | 1841 | 1459 | 342 | 1031 | 562 | 1355 | 693 | 1976 | 1816 | 2323 | 190 | 583 | 1628 | 845 | 2070 |
| NKO | 429 | 204 | 1532 | 1418 | 1024 | 823 | 385 | 863 | 660 | 1790 | 1714 | 2071 | 865 | 530 | 1092 | 161 | 1720 |
| NQX | 783 | 1140 | 2081 | 1594 | 99 | 1292 | 929 | 1715 | 952 | 2149 | 1955 | 2515 | 226 | 885 | 1971 | 1245 | 2320 |
| OFF | 1053 | 497 | 833 | 827 | 1398 | 269 | 1070 | 1437 | 488 | 1101 | 1059 | 1370 | 1199 | 527 | 568 | 677 | 1030 |
| OSC | 694 | 305 | 1447 | 1469 | 1320 | 867 | 619 | 776 | 819 | 1753 | 1720 | 1991 | 1158 | 721 | 898 | 137 | 1603 |
| PAM | 575 | 715 | 1649 | 1231 | 453 | 845 | 713 | 1487 | 501 | 1759 | 1590 | 2113 | 254 | 423 | 1510 | 865 | 1882 |
| PBG | 674 | 708 | 1937 | 1935 | 1374 | 1331 | 529 | 316 | 1206 | 2244 | 2204 | 2481 | 1267 | 1077 | 1349 | 483 | 2085 |
| PSM | 660 | 823 | 2088 | 2053 | 1343 | 1452 | 512 | 283 | 1296 | 2386 | 2335 | 2633 | 1259 | 1160 | 1514 | 610 | 2243 |
| RCA | 1478 | 902 | 480 | 815 | 1821 | 557 | 1480 | 1717 | 879 | 835 | 891 | 1019 | 1621 | 949 | 300 | 1038 | 627 |
| RDR | 1322 | 742 | 836 | 1137 | 1795 | 704 | 1288 | 1389 | 937 | 1202 | 1255 | 1359 | 1601 | 951 | 189 | 803 | 938 |
| RME | 562 | 539 | 1851 | 1820 | 1264 | 1217 | 423 | 445 | 1079 | 2147 | 2097 | 2396 | 1148 | 949 | 1293 | 372 | 2010 |
| SAW | 911 | 406 | 1261 | 1373 | 1494 | 794 | 848 | 935 | 844 | 1591 | 1586 | 1802 | 1318 | 781 | 669 | 354 | 1399 |
| SBD | 2232 | 1751 | 572 | 648 | 2281 | 1140 | 2289 | 2700 | 1425 | 187 | 286 | 376 | 2103 | 1562 | 1277 | 1948 | 623 |
| SKA | 2199 | 1617 | 520 | 1185 | 2529 | 1235 | 2192 | 2307 | 1576 | 784 | 1006 | 649 | 2329 | 1662 | 751 | 1726 | 317 |
| SPS | 1279 | 1035 | 1104 | 509 | 1142 | 166 | 1283 | 2040 | 519 | 1077 | 865 | 1451 | 980 | 649 | 1321 | 1264 | 1247 |
| SSC | 190 | 568 | 1733 | 1489 | 572 | 982 | 331 | 1118 | 673 | 1964 | 1832 | 2292 | 436 | 540 | 1479 | 618 | [illegible] |
| SUU | 2427 | 1898 | 567 | 954 | 2558 | 1329 | 2457 | 2759 | 1649 | 386 | 625 | 24 | 2371 | 1775 | 1232 | 2259 | [illegible] |
| SZL | 897 | 409 | 983 | 823 | 1196 | 221 | 937 | 1419 | 277 | 1198 | 1112 | 1503 | 986 | 313 | 787 | 629 | [illegible] |
| TCM | 2427 | [illegible] | 672 | 1317 | 2731 | 1439 | 2420 | 2531 | 1782 | 842 | 1083 | 601 | 2537 | 1873 | 979 | 1956 | [illegible] |
| TIK | 1106 | 702 | 877 | 540 | 1221 | 146 | 1175 | 1720 | 295 | 997 | 865 | 1340 | 1027 | 431 | 927 | 972 | [illegible] |
| VAD | 452 | 647 | 1739 | 1353 | 405 | 429 | 596 | 1382 | 589 | 1869 | 1709 | 2217 | 217 | 485 | 1546 | 814 | [illegible] |
| VPS | 610 | 697 | 1591 | 1171 | 507 | 739 | 743 | 1507 | 446 | 1698 | 1530 | 2053 | 309 | 378 | 1467 | 859 | 1826 |
| WRB | 384 | 573 | 1663 | 1320 | 524 | 853 | 517 | 1287 | 525 | 1816 | 1670 | 2156 | 342 | 402 | 1436 | 690 | 1889 |
| WRI | 376 | 619 | 1939 | 1828 | 1071 | 1238 | 228 | 567 | 1042 | 2206 | 2130 | 2480 | 975 | 901 | 1437 | 453 | 2116 |

|  | NIP | NKO | NQX | OFF | OSC | PAM | PBG | PSM | RCA | RDR | RME | SAW | SBD | SKA | SKF | SSC | SUU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 1486 | 1360 | 1661 | 720 | 1378 | 1267 | 1856 | 1984 | 650 | 985 | 1747 | 1259 | 616 | 1024 | 615 | 1486 | 868 |
| AEX | 653 | 831 | 817 | 704 | 1028 | 422 | 1375 | 1446 | 1063 | 1159 | 1245 | 1071 | 1452 | 1729 | 384 | 721 | 1719 |
| BAD | 723 | 818 | 911 | 617 | 991 | 500 | 1365 | 1447 | 966 | 1073 | 1237 | 1014 | 1373 | 1630 | 362 | 764 | 1631 |
| BIX | 426 | 763 | 598 | 843 | 1010 | 191 | 1282 | 1328 | 1240 | 1281 | 1152 | 1104 | 1685 | 1930 | 591 | 536 | 1950 |
| BYH | 604 | 504 | 915 | 498 | 686 | 454 | 1051 | 1138 | 923 | 916 | 923 | 743 | 1560 | 1639 | 673 | 545 | 1766 |
| CBM | 461 | 567 | 749 | 663 | 798 | 288 | 1103 | 1168 | 1083 | 1084 | 973 | 886 | 1652 | 1793 | 659 | 460 | 1882 |
| CHS | 184 | 532 | 572 | 1038 | 828 | 358 | 894 | 890 | 1472 | 1373 | 776 | 1018 | 2132 | 2197 | 1108 | 73 | 2350 |
| COF | 152 | 828 | 270 | 1237 | 1124 | 328 | 1187 | 1166 | 1667 | 1618 | 1074 | 1302 | 2199 | 2383 | 1090 | 375 | 2457 |
| CVS | 1301 | 1217 | 1473 | 630 | 1266 | 1080 | 1731 | 1851 | 680 | 971 | 1617 | 1175 | 796 | 1168 | 447 | 1310 | 1056 |
| DLH | 1266 | 666 | 1640 | 412 | 456 | 1192 | 921 | 1082 | 556 | 252 | 856 | 233 | 1562 | 1187 | 1238 | 1086 | 1597 |
| DMA | 1721 | 1662 | 1843 | 1033 | 1690 | 1492 | 2166 | 2291 | 920 | 1275 | 2055 | 1572 | 405 | 1114 | 749 | 1750 | 749 |
| DOV | 708 | 376 | 1078 | 1077 | 544 | 845 | 381 | 370 | 1467 | 1242 | 280 | 779 | 2325 | 2164 | 1476 | 470 | 2468 |
| DYS | 1077 | 1099 | 1225 | 647 | 1206 | 849 | 1638 | 1740 | 839 | 1064 | 1515 | 1163 | 1025 | 1403 | 219 | 1116 | 1305 |
| FEW | 1494 | 1167 | 1760 | 466 | 1098 | 1314 | 1590 | 1737 | 221 | 574 | 1498 | 931 | 842 | 769 | 888 | 1421 | 926 |
| FFO | 662 | 102 | 1056 | 616 | 332 | 656 | 646 | 743 | 1026 | 863 | 520 | 491 | 1857 | 1742 | 1078 | 458 | 2005 |
| FWH | 948 | 984 | 1111 | 602 | 1110 | 722 | 1527 | 1623 | 861 | 1043 | 1402 | 1087 | 1150 | 1473 | 232 | 984 | 1419 |
| GFA | 1970 | 1515 | 2270 | 879 | 1350 | 1813 | 1811 | 1975 | 446 | 647 | 1751 | 1127 | 966 | 294 | 1421 | 1858 | 822 |
| GSB | 414 | 420 | 783 | 1053 | 694 | 575 | 674 | 660 | 1478 | 1322 | 562 | 911 | 2232 | 2199 | 1278 | 190 | 2423 |
| GUS | 755 | 204 | 1140 | 497 | 305 | 715 | 708 | 823 | 902 | 742 | 589 | 406 | 1751 | 1617 | 1035 | 568 | 1888 |
| HIF | 1841 | 1532 | 2081 | 833 | 1447 | 1649 | 1937 | 2088 | 480 | 836 | 1851 | 1261 | 572 | 520 | 1104 | 1783 | 567 |
| HMN | 1459 | 1418 | 1594 | 827 | 1469 | 1231 | 1935 | 2053 | 815 | 1137 | 1820 | 1373 | 648 | 1183 | 509 | 1489 | 954 |
| HST | 342 | 1024 | 99 | 1398 | 1320 | 453 | 1374 | 1343 | 1821 | 1795 | 1264 | 1494 | 2281 | 2529 | 1143 | 572 | 2558 |
| IAB | 1031 | 823 | 1292 | 269 | 867 | 845 | 1331 | 1452 | 557 | 704 | 1217 | 794 | 1140 | 1235 | 566 | 982 | 1328 |
| LFI | 562 | 385 | 929 | 1070 | 619 | 713 | 529 | 512 | 1480 | 1288 | 423 | 848 | 2289 | 2192 | 1383 | 331 | 2455 |
| LIZ | 1355 | 863 | 1715 | 1437 | 776 | 1487 | 316 | 283 | 1717 | 1389 | 445 | 935 | 2700 | 2307 | 2040 | 1118 | 2759 |
| LRF | 693 | 660 | 952 | 488 | 819 | 501 | 1206 | 1296 | 879 | 937 | 1079 | 844 | 1425 | 1576 | 519 | 678 | 1649 |
| LSV | 1976 | 1790 | 2149 | 1101 | 1753 | 1759 | 2244 | 2386 | 835 | 1202 | 2147 | 1591 | 187 | 784 | 1077 | 1964 | 386 |
| LUF | 1816 | 1714 | 1955 | 1059 | 1720 | 1590 | 2204 | 2335 | 891 | 1255 | 2097 | 1586 | 286 | 1006 | 865 | 1832 | 620 |
| MCC | 2323 | 2071 | 2515 | 1370 | 1991 | 2113 | 2481 | 2633 | 1019 | 1359 | 2396 | 1802 | 376 | 649 | 1451 | 2292 | 24 |
| MCF | 190 | 865 | 226 | 1199 | 1158 | 254 | 1267 | 1259 | 1621 | 1601 | 1148 | 1318 | 2103 | 2329 | 980 | 436 | 2271 |
| MEM | 583 | 530 | 885 | 527 | 721 | 423 | 1077 | 1160 | 949 | 951 | 949 | 781 | 1562 | 1662 | 649 | 540 | 1775 |
| MIB | 1628 | 1092 | 1971 | 568 | 898 | 1510 | 1369 | 1514 | 300 | 189 | 1293 | 669 | 1277 | 751 | 1321 | 1479 | 1232 |
| MTC | 845 | 161 | 1245 | 677 | 137 | 865 | 483 | 610 | 1038 | 803 | 372 | 354 | 1948 | 1726 | 1264 | 618 | 2059 |
| MUO | 2070 | 1720 | 2320 | 1030 | 1603 | 1883 | 2085 | 2243 | 627 | 938 | 2010 | 1399 | 625 | 313 | 1345 | 1999 | 461 |
| NIP | 0 | 635 | 430 | 1092 | 980 | 236 | 1079 | 1074 | 1524 | 1467 | 959 | 1152 | 2096 | 2243 | 1017 | 246 | 2346 |
| NKO | 685 | 0 | 1084 | 701 | 296 | 712 | 547 | 641 | 1099 | 907 | 420 | 494 | 1953 | 1808 | 1177 | 479 | 2092 |
| NQX | 430 | 1084 | 0 | 1412 | 1379 | 462 | 1457 | 1432 | 1828 | 1822 | 1344 | 1543 | 2241 | 2227 | 1047 | 641 | 2524 |
| OFF | 1092 | 701 | 1412 | 0 | 662 | 951 | 1148 | 1286 | 435 | 456 | 1047 | 546 | 1272 | 1159 | 832 | 942 | 1392 |
| OSC | 980 | 296 | 1379 | 662 | 0 | 989 | 491 | 641 | 978 | 708 | 406 | 236 | 1929 | 1643 | 1328 | 774 | 2014 |
| PAM | 236 | 712 | 462 | 951 | 989 | 0 | 1189 | 1214 | 1369 | 1364 | 1062 | 1120 | 1872 | 2076 | 781 | 385 | 2129 |
| PBG | 1079 | 547 | 1457 | 1148 | 491 | 1189 | 0 | 167 | 1464 | 1165 | 130 | 688 | 2419 | 2100 | 1724 | 834 | 2503 |
| PSM | 1074 | 641 | 1432 | 1286 | 641 | 1214 | 167 | 0 | 1619 | 1328 | 239 | 849 | 2558 | 2265 | 1809 | 840 | 2655 |
| RCA | 1524 | 1099 | 1828 | 435 | 978 | 1369 | 1464 | 1619 | 0 | 369 | 1385 | 783 | 1021 | 725 | 1057 | 1416 | 1042 |
| RDR | 1467 | 907 | 1822 | 456 | 708 | 1364 | 1165 | 1328 | 369 | 0 | 1105 | 481 | 1389 | 937 | 1267 | 1306 | 1383 |
| RME | 959 | 420 | 1344 | 1047 | 406 | 1062 | 130 | 239 | 1385 | 1105 | 0 | 625 | 2319 | 2043 | 1596 | 713 | 2413 |
| SAW | 1152 | 494 | 1543 | 546 | 236 | 1120 | 688 | 849 | 783 | 481 | 625 | 0 | 1772 | 1418 | 1316 | 945 | 1827 |
| SBD | 2096 | 1953 | 2241 | 1272 | 1929 | 1872 | 2419 | 2558 | 1021 | 1389 | 2319 | 1772 | 0 | 918 | 1151 | 2102 | 377 |
| SKA | 2243 | 1808 | 2227 | 1159 | 1643 | 2076 | 2100 | 2265 | 725 | 937 | 2043 | 1418 | 918 | 0 | 1613 | 2141 | 669 |
| SKF | 1017 | 1177 | 1047 | 832 | 1328 | 781 | 1724 | 1809 | 1057 | 1267 | 1596 | 1316 | 1151 | 1613 | 0 | 1174 | 1463 |
| SSC | 246 | 479 | 641 | 942 | 774 | 385 | 834 | 840 | 1416 | 1306 | 713 | 945 | 2102 | 2141 | 1174 | 0 | 2211 |
| SUU | 2346 | 2092 | 2524 | 1392 | 2014 | 2129 | 2503 | 2655 | 1042 | 1383 | 2413 | 1827 | 377 | 669 | 1463 | 2211 | 0 |
| SZL | 992 | 662 | 1147 | 219 | 613 | 776 | 1112 | 1231 | 637 | 667 | 997 | 619 | 1277 | 1276 | 607 | [illegible] | [illegible] |
| TCM | 2477 | 2036 | 2729 | 1341 | 1872 | 2243 | 2728 | 2493 | 948 | 1167 | 2272 | 1647 | 947 | [illegible] | [illegible] | [illegible] | 617 |
| TIK | 983 | 892 | 1277 | 412 | 866 | 777 | 1410 | 1521 | 684 | 870 | 1291 | 918 | 1121 | 1371 | [illegible] | [illegible] | 1377 |
| VAD | [illegible] | [illegible] | 443 | [illegible] | [illegible] | 178 | 1093 | 1105 | 1430 | 1366 | 969 | 1101 | 1949 | 2147 | 919 | 267 | 2234 |
| VPS | 294 | 711 | 500 | 905 | 973 | 60 | 1204 | 1237 | 1319 | 1326 | 1076 | 1109 | 1812 | 2022 | 724 | 427 | 2044 |
| WRB | 197 | 532 | 567 | 901 | 821 | 209 | 990 | 1014 | 1334 | 1276 | 863 | 976 | 1947 | 2055 | 914 | 196 | 2177 |
| WRI | 788 | 417 | 1156 | 1111 | 541 | 926 | 207 | 289 | 1490 | 1248 | 221 | 776 | 2369 | 2177 | 1545 | 551 | 2512 |

| | SZL | TCM | TIK | VAD | VPS | WRB | WRI |
|---|---|---|---|---|---|---|---|
| ABQ | 757 | 1170 | 515 | 1379 | 1207 | 1330 | 1775 |
| AEX | 503 | 1923 | 397 | 547 | 362 | 533 | 1174 |
| BAD | 424 | 1825 | 299 | 616 | 440 | 586 | 1184 |
| BIX | 627 | 2131 | 610 | 324 | 133 | 340 | 1044 |
| BYH | 286 | 1854 | 431 | 508 | 411 | 417 | 883 |
| CBM | 449 | 2003 | 526 | 358 | 243 | 293 | 894 |
| CHS | 850 | 2418 | 1002 | 227 | 402 | 194 | 604 |
| COF | 1030 | 2595 | 1103 | 236 | 388 | 343 | 888 |
| CVS | 620 | 1329 | 345 | 1194 | 1020 | 1149 | 1628 |
| DLH | 560 | 1417 | 820 | 1199 | 1161 | 1079 | 995 |
| DMA | 1061 | 1205 | 793 | 1614 | 1431 | 1582 | 2075 |
| DOV | 971 | 2394 | 1232 | 735 | 871 | 646 | 81 |
| DYS | 551 | 1574 | 245 | 971 | 789 | 941 | 1495 |
| FEW | 620 | 970 | 564 | 1394 | 1259 | 1311 | 1576 |
| FFO | 504 | 1970 | 780 | 617 | 648 | 492 | 515 |
| FWH | 468 | 1654 | 193 | 841 | 661 | 810 | 1372 |
| GFA | 1083 | 524 | 1096 | 1877 | 1742 | 1780 | 1884 |
| GSB | 897 | 2425 | 1106 | 452 | 610 | 384 | 376 |
| GUS | 409 | 1845 | 702 | 697 | 697 | 573 | 619 |
| HIF | 983 | 672 | 875 | 1739 | 1591 | 1663 | 1939 |
| HMN | 823 | 1317 | 540 | 1353 | 1171 | 1320 | 1828 |
| HST | 1186 | 2735 | 1221 | 405 | 507 | 524 | 1071 |
| IAB | 221 | 1439 | 146 | 929 | 789 | 853 | 1238 |
| LFI | 937 | 2420 | 1175 | 596 | 743 | 517 | 228 |
| LIZ | 1419 | 2531 | 1720 | 1382 | 1507 | 1287 | 567 |
| LRF | 277 | 1782 | 295 | 589 | 446 | 525 | 1042 |
| LSV | 1198 | 842 | 997 | 1869 | 1698 | 1816 | 2206 |
| LUF | 1112 | 1085 | 865 | 1709 | 1530 | 1670 | 2130 |
| MCC | 1503 | 601 | 1340 | 2217 | 2053 | 2156 | 2480 |
| MCF | 986 | 2537 | 1027 | 217 | 309 | 342 | 975 |
| MEM | 313 | 1875 | 431 | 485 | 378 | 402 | 901 |
| MIB | 783 | 979 | 920 | 1546 | 1467 | 1436 | 1637 |
| MTC | 629 | 1956 | 930 | 814 | 859 | 690 | 453 |
| MUO | 1199 | 432 | 1113 | 1969 | 1826 | 1889 | 2116 |
| NIP | 888 | 2457 | 983 | 107 | 294 | 193 | 788 |
| NFO | 602 | 2036 | 882 | 655 | 711 | 522 | 417 |
| NQX | 1197 | 2729 | 1207 | 443 | 309 | 567 | 1156 |
| OFF | 216 | 1381 | 412 | 1092 | 963 | 901 | 1111 |
| OSC | 659 | 1872 | 966 | 945 | 979 | 820 | 541 |
| PAM | 736 | 2283 | 777 | 138 | 60 | 200 | 926 |
| PBG | 1112 | 2328 | 1410 | 1093 | 1294 | 990 | 307 |
| PSM | 1231 | 2493 | 1521 | 1105 | 1227 | 1014 | 289 |
| RCA | 637 | 948 | 684 | 1430 | 1319 | 1334 | 1490 |
| RDR | 660 | 1167 | 850 | 1390 | 1326 | 1276 | 1243 |
| RME | 997 | 2272 | 1291 | 969 | 1076 | 863 | 221 |
| SAW | 619 | 1647 | 913 | 1101 | 1109 | 976 | 776 |
| SBD | 1355 | 937 | 1131 | 1989 | 1612 | 1945 | 2369 |
| SKA | 1376 | 230 | 1331 | 2167 | 2022 | [illegible] | 2177 |
| SKF | 697 | 1776 | 429 | 915 | 724 | 914 | 1545 |
| SSC | 901 | 2763 | [illegible] | 263 | [illegible] | 196 | [illegible] |
| SUU | 1523 | 617 | 1157 | 2274 | [illegible] | 2173 | 2092 |
| SZL | 0 | 1572 | 303 | 743 | 689 | 699 | 1018 |
| TCM | 1572 | 0 | 1526 | 2259 | 2221 | 2271 | 2407 |
| TIK | 303 | 1526 | 0 | 877 | 719 | 819 | 1289 |
| VAD | 743 | 2259 | 877 | 0 | 191 | 125 | 816 |
| VPS | 689 | 2221 | 719 | 191 | 0 | 227 | 950 |
| WRB | 699 | 2271 | 819 | 125 | 227 | 0 | 726 |
| WRI | 1018 | 2407 | 1289 | 816 | 950 | 726 | 0 |

## LOGAIR Inter-locational surface statute mileage

| LOC | ABQ | AEX | BAD | BIX | BYH | CBM | CHS | COF | CVS | DLH | DMA | DOV | DYS | FEW | FFO | FWH | GFA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 0 | 1022 | 920 | 1301 | 1134 | 1244 | 1819 | 1914 | 226 | 1301 | 376 | 2071 | 525 | 516 | 1513 | 661 | 1058 |
| AEX | 1022 | 0 | 118 | 280 | 410 | 337 | 872 | 897 | 797 | 1267 | 1283 | 1323 | 513 | 1153 | 885 | 362 | 1787 |
| BAD | 920 | 118 | 0 | 383 | 378 | 368 | 935 | 994 | 696 | 1179 | 1199 | 1338 | 428 | 1034 | 865 | 270 | 1669 |
| BIX | 1301 | 280 | 383 | 0 | 447 | 261 | 632 | 617 | 1076 | 1365 | 1562 | 1160 | 793 | 1395 | 824 | 642 | 2014 |
| BYH | 1134 | 410 | 378 | 447 | 0 | 202 | 701 | 893 | 931 | 918 | 1467 | 983 | 736 | 1071 | 487 | 587 | 1643 |
| CBM | 1244 | 337 | 368 | 261 | 202 | 0 | 577 | 711 | 1028 | 1112 | 1551 | 986 | 787 | 1243 | 578 | 629 | 1833 |
| CHS | 1819 | 872 | 935 | 632 | 701 | 577 | 0 | 365 | 1605 | 1387 | 2128 | 628 | 1361 | 1764 | 635 | 1203 | 2299 |
| COF | 1914 | 897 | 994 | 617 | 893 | 711 | 365 | 0 | 1690 | 1701 | 2178 | 971 | 1410 | 1954 | 973 | 1258 | 2536 |
| CVS | 226 | 797 | 696 | 1076 | 931 | 1028 | 1605 | 1690 | 0 | 1231 | 538 | 1889 | 303 | 574 | 1339 | 435 | 1189 |
| DLH | 1301 | 1267 | 1179 | 1365 | 918 | 1112 | 1387 | 1701 | 1231 | 0 | 1670 | 1189 | 1270 | 865 | 758 | 1208 | 1074 |
| DMA | 376 | 1283 | 1199 | 1562 | 1467 | 1551 | 2128 | 2178 | 538 | 1670 | 0 | 2427 | 772 | 844 | 1874 | 929 | 1259 |
| DOV | 2071 | 1323 | 1338 | 1160 | 983 | 986 | 628 | 971 | 1889 | 1189 | 2427 | 0 | 1719 | 1851 | 562 | 1570 | 2245 |
| DYS | 525 | 513 | 428 | 793 | 736 | 787 | 1361 | 1410 | 303 | 1270 | 772 | 1719 | 0 | 803 | 1197 | 158 | 1445 |
| FEW | 516 | 1153 | 1034 | 1395 | 1071 | 1243 | 1764 | 1954 | 574 | 865 | 844 | 1851 | 803 | 0 | 1298 | 860 | 646 |
| FFO | 1513 | 885 | 865 | 824 | 487 | 578 | 635 | 973 | 1339 | 758 | 1874 | 562 | 1197 | 1298 | 0 | 1059 | 1742 |
| FWH | 661 | 362 | 270 | 642 | 587 | 629 | 1203 | 1258 | 435 | 1208 | 929 | 1570 | 158 | 860 | 1059 | 0 | 1506 |
| GFA | 1058 | 1787 | 1669 | 2014 | 1643 | 1833 | 2299 | 2536 | 1189 | 1074 | 1259 | 2245 | 1445 | 646 | 1742 | 1506 | 0 |
| GSB | 1943 | 1073 | 1114 | 866 | 809 | 746 | 277 | 616 | 1740 | 1301 | 2275 | 355 | 1527 | 1813 | 553 | 1370 | 2292 |
| GUS | 1397 | 868 | 828 | 856 | 458 | 597 | 765 | 1087 | 1234 | 622 | 1763 | 696 | 1118 | 1156 | 151 | 991 | 1591 |
| HIF | 606 | 1520 | 1405 | 1782 | 1496 | 1657 | 2194 | 2264 | 789 | 1243 | 747 | 2289 | 1083 | 441 | 1738 | 1185 | 516 |
| HMN | 209 | 971 | 885 | 1250 | 1158 | 1237 | 1813 | 1867 | 244 | 1457 | 315 | 2126 | 458 | 717 | 1580 | 614 | 1263 |
| HST | 2029 | 1008 | 1117 | 735 | 1081 | 886 | 600 | 236 | 1803 | 1923 | 2264 | 1193 | 1510 | 2119 | 1205 | 1368 | 2719 |
| IAB | 644 | 608 | 491 | 835 | 526 | 684 | 1228 | 1394 | 481 | 817 | 1008 | 1427 | 453 | 563 | 869 | 407 | 1182 |
| LFI | 2017 | 1204 | 1232 | 1018 | 898 | 869 | 454 | 792 | 1824 | 1251 | 2362 | 179 | 1631 | 1841 | 546 | 1477 | 2280 |
| LIZ | 2584 | 2028 | 2018 | 1908 | 1641 | 1700 | 1405 | 1739 | 2443 | 1394 | 2958 | 778 | 2341 | 2234 | 1155 | 2210 | 2432 |
| LRF | 970 | 278 | 207 | 434 | 191 | 279 | 849 | 984 | 759 | 989 | 1290 | 1174 | 547 | 975 | 671 | 397 | 1583 |
| LSV | 590 | 1612 | 1511 | 1891 | 1704 | 1828 | 2398 | 2504 | 815 | 1654 | 454 | 2597 | 1109 | 792 | 2036 | 1250 | 955 |
| LTS | 426 | 1402 | 1311 | 1682 | 1555 | 1653 | 2230 | 2299 | 627 | 1672 | 156 | 2497 | 889 | 819 | 1939 | 1042 | 1160 |
| MCC | 1025 | 2044 | 1939 | 2321 | 2097 | 2238 | 2798 | 2928 | 1250 | 1889 | 891 | 2936 | 1549 | 1086 | 2381 | 1685 | 938 |
| MCF | 1807 | 785 | 889 | 506 | 841 | 646 | 448 | 152 | 1581 | 1697 | 2057 | 1074 | 1294 | 1880 | 999 | 1147 | 2479 |
| MEM | 1136 | 370 | 346 | 402 | 66 | 163 | 690 | 865 | 928 | 963 | 1462 | 1002 | 721 | 1093 | 520 | 569 | 1677 |
| MIB | 1140 | 1518 | 1408 | 1692 | 1268 | 1469 | 1853 | 2133 | 1167 | 530 | 1459 | 1717 | 1329 | 625 | 1251 | 1330 | 516 |
| MTC | 1651 | 1129 | 1098 | 1080 | 722 | 832 | 829 | 1186 | 1498 | 663 | 2024 | 528 | 1294 | 1261 | 256 | 1267 | 1719 |
| MUO | 886 | 1808 | 1692 | 2067 | 1765 | 1933 | 2458 | 2643 | 1078 | 1400 | 962 | 2509 | 1374 | 695 | 1970 | 1476 | 437 |
| NIP | 1793 | 783 | 868 | 512 | 725 | 553 | 221 | 182 | 1561 | 1520 | 2065 | 849 | 1293 | 1792 | 794 | 1137 | 2264 |
| NKO | 1642 | 997 | 982 | 916 | 607 | 680 | 638 | 994 | 1660 | 799 | 1994 | 451 | 1319 | 1400 | 123 | 1141 | 131 |
| [illegible] | 1993 | 980 | 1093 | 718 | 1058 | 409 | 686 | 324 | 1768 | 1967 | 2212 | 1294 | 1470 | 2112 | 1268 | [illegible] | 2724 |
| OFF | 864 | 845 | 740 | 1011 | 598 | 796 | 1246 | 1485 | 755 | 494 | 1239 | 1292 | 776 | 560 | 739 | 722 | [illegible] |
| OQC | 1622 | 1233 | 1189 | 1212 | 824 | 957 | 993 | 1349 | 1519 | 543 | 2028 | 653 | 1447 | 1318 | 399 | 1332 | 1627 |
| PAM | 1520 | 506 | 600 | 240 | [illegible] | 145 | 430 | 394 | 1296 | 1431 | 1790 | 1014 | 1019 | 1576 | 788 | 866 | 217 |
| PBG | 2227 | 1650 | 1639 | 1538 | 1261 | 1324 | 1073 | 1425 | 2078 | 1105 | 2600 | 457 | 1965 | 1908 | 776 | 1832 | 217 |
| PSM | 2381 | 1735 | 1777 | 1594 | 1365 | 1401 | 1068 | 1399 | 2221 | 1298 | 2750 | 444 | 2088 | 2084 | 891 | 1948 | 237 |
| RCA | 780 | 1276 | 1159 | 1489 | 1108 | 1299 | 1767 | 2000 | 816 | 666 | 1105 | 1761 | 1007 | 265 | 1232 | 1033 | [illegible] |
| RDR | 1182 | 1391 | 1237 | 1537 | 1099 | 1301 | 1648 | 1942 | 1165 | 303 | 1530 | 1491 | 1277 | 688 | 1035 | 1251 | [illegible] |
| RME | 2096 | 1494 | 1485 | 1382 | 1108 | 1168 | 921 | 1288 | 1940 | 1027 | 2466 | 326 | 1818 | 1797 | 624 | 1463 | 21 |
| SAW | 1711 | 1285 | 1217 | 1324 | 892 | 1064 | 1221 | 1562 | 1419 | 280 | 1886 | 935 | 1395 | 1117 | 589 | 1205 | 1572 |
| SBD | 734 | 1742 | 1648 | 2022 | 1872 | 1982 | 2574 | 2639 | 955 | 1874 | 486 | 2790 | 1230 | 1010 | 2228 | 1391 | [illegible] |
| SKA | 1229 | 2074 | 1957 | 2317 | 1967 | 2152 | 2637 | 2860 | 1401 | 1425 | 1336 | 2597 | 1683 | 922 | 2091 | 1767 | [illegible] |
| SKF | 718 | 461 | 414 | 709 | 867 | 791 | 1129 | 1309 | 526 | 1486 | 899 | 1772 | 263 | 1066 | 1293 | 273 | [illegible] |
| [illegible] | 1793 | 965 | 917 | [illegible] | [illegible] | [illegible] | [illegible] | 450 | 1572 | 1203 | 2101 | 564 | 1339 | 1707 | 749 | 1181 | 222 |
| [illegible] | 1142 | 2962 | 1967 | [illegible] | 211 | [illegible] | [illegible] | 2943 | 1268 | 1917 | 899 | 2962 | 1566 | 1111 | 2366 | [illegible] | 96 |
| [illegible] | [illegible] | 661 | [illegible] | 772 | [illegible] | [illegible] | 1023 | 1236 | 744 | 671 | 1273 | 1165 | 661 | 744 | 607 | 761 | [illegible] |
| TCM | [illegible] | 2907 | 219 | 2558 | 222 | [illegible] | 2901 | 311 | 1595 | 1780 | 1446 | 2873 | 1889 | 11 | [illegible] | [illegible] | [illegible] |
| TIK | 619 | 477 | 399 | 772 | 517 | 632 | 1202 | 132 | 51 | 995 | 952 | 1479 | 29 | 676 | 936 | [illegible] | [illegible] |
| VAD | 1675 | 676 | 740 | 38 | [illegible] | 439 | 272 | 29 | 1633 | 1439 | 1937 | 882 | 1163 | 1672 | 74 | [illegible] | 227 |
| VPS | 1443 | 494 | 529 | 160 | 442 | 291 | 482 | 466 | 1224 | 1393 | 1718 | 1045 | 947 | 1510 | 777 | 794 | 211 |
| WRB | 1[illegible] | 694 | 703 | 408 | 502 | 352 | 233 | 411 | 1379 | 1294 | 1899 | 775 | 1130 | 1573 | 590 | 472 | 21 |
| WRI | 2131 | 1409 | 1421 | 1273 | 1060 | 1073 | 725 | 1065 | 1954 | 1195 | 2490 | 97 | 1764 | 1891 | 617 | 1647 | 22 |

| LOC | GSB | GUS | HIF | HMN | HST | IAB | LFI | LIZ | LRF | LSV | LUF | MCC | MCF | MEM | MIB | MTC | MUO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 1943 | 1397 | 606 | 209 | 2029 | 644 | 2017 | 2584 | 970 | 590 | 426 | 1025 | 1807 | 1136 | 1140 | 1651 | 886 |
| AEX | 1073 | 868 | 1520 | 971 | 1008 | 608 | 1204 | 2028 | 278 | 1612 | 1402 | 2044 | 785 | 370 | 1518 | 1129 | 1808 |
| BAD | 1114 | 828 | 1405 | 885 | 1117 | 491 | 1232 | 2018 | 207 | 1511 | 1311 | 1939 | 889 | 346 | 1408 | 1098 | 1692 |
| BIX | 866 | 856 | 1782 | 1250 | 735 | 835 | 1018 | 1908 | 434 | 1891 | 1682 | 2321 | 506 | 402 | 1692 | 1080 | 2067 |
| BYH | 809 | 458 | 1496 | 1158 | 1081 | 526 | 898 | 1641 | 191 | 1704 | 1555 | 2097 | 841 | 46 | 1268 | 722 | 1765 |
| CBM | 746 | 597 | 1657 | 1237 | 886 | 684 | 869 | 1700 | 279 | 1828 | 1653 | 2238 | 646 | 163 | 1469 | 832 | 1933 |
| CHS | 277 | 765 | 2194 | 1813 | 600 | 1228 | 454 | 1405 | 849 | 2398 | 2230 | 2798 | 448 | 690 | 1853 | 829 | 2458 |
| COF | 616 | 1087 | 2364 | 1867 | 236 | 1394 | 792 | 1739 | 984 | 2504 | 2299 | 2928 | 152 | 865 | 2133 | 1186 | 2643 |
| CVS | 1740 | 1234 | 789 | 244 | 1803 | 481 | 1824 | 2443 | 759 | 815 | 627 | 1250 | 1581 | 928 | 1167 | 1498 | 1078 |
| DLH | 1301 | 622 | 1243 | 1457 | 1923 | 817 | 1251 | 1394 | 989 | 1654 | 1672 | 1889 | 1697 | 963 | 530 | 663 | 1400 |
| DMA | 2275 | 1763 | 747 | 315 | 2264 | 1008 | 2362 | 2958 | 1290 | 454 | 156 | 891 | 2057 | 1462 | 1459 | 2021 | 962 |
| DOV | 355 | 696 | 2289 | 2126 | 1193 | 1427 | 179 | 778 | 1174 | 2597 | 2497 | 2936 | 1074 | 1002 | 1717 | 528 | 2509 |
| DYS | 1527 | 1118 | 1083 | 458 | 1510 | 453 | 1631 | 2341 | 547 | 1109 | 889 | 1549 | 1294 | 721 | 1329 | 1394 | 1374 |
| FEW | 1813 | 1156 | 441 | 717 | 2119 | 563 | 1841 | 2234 | 975 | 792 | 819 | 1086 | 1880 | 1093 | 625 | 1361 | 695 |
| FFO | 553 | 151 | 1738 | 1580 | 1205 | 869 | 546 | 1155 | 671 | 2036 | 1939 | 2381 | 999 | 520 | 1251 | 256 | 1970 |
| FWH | 1370 | 991 | 1185 | 614 | 1368 | 407 | 1477 | 2210 | 397 | 1250 | 1042 | 1685 | 1147 | 569 | 1330 | 1267 | 1476 |
| GFA | 2292 | 1591 | 516 | 1265 | 2719 | 1182 | 2280 | 2432 | 1583 | 955 | 1160 | 958 | 2479 | 1673 | 556 | 1719 | 437 |
| GSB | 0 | 703 | 2252 | 1964 | 842 | 1317 | 178 | 1130 | 986 | 2504 | 2364 | 2880 | 719 | 813 | 1804 | 672 | 2499 |
| GUS | 703 | 0 | 1595 | 1477 | 1314 | 755 | 694 | 1223 | 624 | 1905 | 1820 | 2240 | 1097 | 499 | 1104 | 276 | 1823 |
| HIF | 2252 | 1595 | 0 | 798 | 2515 | 973 | 2282 | 2635 | 1381 | 466 | 644 | 653 | 2280 | 1514 | 850 | 1792 | 291 |
| HMN | 1964 | 1477 | 798 | 0 | 1960 | 725 | 2055 | 2687 | 978 | 682 | 434 | 1132 | 1748 | 1151 | 1338 | 1742 | 1067 |
| HST | 842 | 1314 | 2515 | 1960 | 0 | 1556 | 1014 | 1951 | 1144 | 2618 | 2394 | 3052 | 240 | 1047 | 2339 | 1422 | 2799 |
| IAB | 1317 | 755 | 973 | 725 | 1556 | 0 | 1378 | 1962 | 412 | 1187 | 1070 | 1571 | 1317 | 541 | 933 | 1017 | 1249 |
| LFI | 178 | 694 | 2282 | 2055 | 1014 | 1378 | 0 | 952 | 1084 | 2562 | 2442 | 2921 | 897 | 910 | 1770 | 594 | 2516 |
| LIZ | 1130 | 1223 | 2635 | 2687 | 1951 | 1962 | 952 | 0 | 1826 | 3026 | 2995 | 3283 | 1849 | 1671 | 1877 | 949 | 2791 |
| LRF | 986 | 624 | 1381 | 978 | 1144 | 412 | 1084 | 1826 | 0 | 1551 | 1385 | 1958 | 905 | 175 | 1266 | 896 | 1660 |
| LSV | 2504 | 1905 | 466 | 682 | 2618 | 1187 | 2562 | 3026 | 1551 | 0 | 301 | 450 | 2397 | 1710 | 1309 | 2134 | 571 |
| LUF | 2364 | 1820 | 644 | 434 | 2394 | 1070 | 2442 | 2995 | 1385 | 301 | 0 | 736 | 2182 | 1554 | 1413 | 2070 | 832 |
| MCC | 2880 | 2240 | 653 | 1132 | 3052 | 1571 | 2921 | 3283 | 1958 | 450 | 736 | 0 | 2827 | 2109 | 1449 | 2444 | 525 |
| MCF | 719 | 1097 | 2280 | 1748 | 240 | 1317 | 897 | 1849 | 905 | 2397 | 2182 | 2827 | 0 | 808 | 2103 | 1230 | 2562 |
| MEM | 813 | 499 | 1514 | 1151 | 1047 | 541 | 910 | 1671 | 175 | 1710 | 1554 | 2109 | 808 | 0 | 1306 | 760 | 1787 |
| MIB | 1804 | 1104 | 850 | 1338 | 2339 | 933 | 1770 | 1877 | 1266 | 1309 | 1413 | 1449 | 2103 | 1306 | 0 | 1190 | 932 |
| MTC | 672 | 276 | 1792 | 1742 | 1422 | 1017 | 594 | 947 | 396 | 2134 | 2070 | 2444 | 1230 | 760 | 1190 | 0 | 1997 |
| MUO | 2499 | 1823 | 291 | 1067 | 2799 | 1249 | 2516 | 2791 | 1660 | 571 | 832 | 525 | 2562 | 1785 | 932 | 1997 | 0 |
| NIP | 496 | 906 | 2210 | 1751 | 411 | 1237 | 674 | 1626 | 832 | 2371 | 2179 | 2788 | 228 | 700 | 1954 | 1014 | 2484 |
| NFO | 504 | 245 | 1939 | 1701 | 1229 | 988 | 462 | 1036 | 791 | 2148 | 2057 | 2485 | 1037 | 636 | 1211 | 193 | 2944 |
| NQX | 940 | 1068 | 2498 | 1913 | 119 | 1559 | 1115 | 2028 | 1142 | 2579 | 2146 | 3018 | 271 | 1062 | 2367 | 1494 | 2784 |
| OFF | 1264 | 596 | 999 | 993 | 1678 | 323 | 1284 | 1725 | 585 | 1321 | 1270 | 1645 | 1439 | 633 | 681 | 813 | 1226 |
| OSC | 832 | 366 | 1736 | 1763 | 1580 | 1040 | 742 | 931 | 983 | 2104 | 2064 | 2390 | 1389 | 865 | 1077 | 164 | 1924 |
| PAM | 690 | 853 | 1978 | 1477 | 544 | 1014 | 856 | 1784 | 601 | 2110 | 1908 | 2535 | 304 | 508 | 1812 | 1938 | 2260 |
| PBG | 808 | 849 | 2324 | 2322 | 1649 | 1597 | 635 | 379 | 1447 | 2693 | 2644 | 2977 | 1521 | 1292 | 1619 | 579 | 2502 |
| PCM | 792 | 987 | 2506 | 2464 | 1611 | 1742 | 614 | 340 | 1555 | 2864 | 2802 | 3159 | 1510 | 1291 | 1817 | 732 | 2692 |
| RCA | 1774 | 1082 | 576 | 978 | 2195 | 668 | 1776 | 2061 | 1055 | 1032 | 1069 | 1223 | 1945 | 1128 | 360 | 1245 | 722 |
| RDR | 1586 | 690 | 1003 | 1364 | 2154 | 845 | 1546 | 1667 | 1124 | 1442 | 1506 | 1631 | 1921 | 1141 | 227 | 963 | 1126 |
| RME | 674 | 797 | 2221 | 2183 | 1516 | 1460 | 508 | 534 | 1295 | 2576 | 2516 | 2875 | 1378 | 1138 | 1552 | 446 | 2412 |
| SAW | 1093 | 487 | 1513 | 1647 | 1793 | 953 | 1018 | 1123 | 1012 | 1909 | 1903 | 2162 | 1581 | 937 | 803 | 424 | 1679 |
| SBD | 2679 | 2101 | 686 | 777 | 2737 | 1368 | 2746 | 3240 | 1709 | 224 | 344 | 452 | 2523 | 1875 | 1532 | 2339 | 770 |
| SEA | 2679 | 1940 | 624 | 1422 | 3034 | 1482 | 2630 | 2769 | 1891 | 941 | 1207 | 778 | 2795 | 1995 | 901 | 2071 | 376 |
| SFF | 1531 | 1242 | 1325 | 611 | 1371 | 679 | 1660 | 2443 | 622 | 1292 | 1034 | 1742 | 1176 | 779 | 1181 | 1217 | 1414 |
| SSC | 223 | 682 | 2139 | 1787 | 686 | 1179 | 297 | 1351 | 811 | 2357 | 2199 | 2750 | 523 | 646 | 1775 | 741 | 2394 |
| SUU | 2933 | 2266 | 680 | 1147 | 3070 | 1774 | 2946 | 3111 | 1473 | [illegible] | [illegible] | 29 | 2946 | 2130 | [illegible] | [illegible] | [illegible] |
| SZL | 1076 | 490 | 1130 | 983 | 1422 | 265 | 1127 | [illegible] | 332 | 1448 | 1114 | 1904 | 1135 | 376 | 944 | 757 | [illegible] |
| TCM | 2410 | 2210 | 806 | 1581 | 3282 | 1727 | 2965 | 3037 | 2139 | 1010 | 1212 | 721 | 3044 | 2250 | 1177 | 2747 | [illegible] |
| TIK | 1327 | 843 | 1070 | 648 | 1565 | 176 | 1410 | 2067 | 354 | 1197 | 1038 | 1608 | 1232 | 517 | 1104 | 1116 | [illegible] |
| VAD | 543 | 836 | 2087 | 1623 | 386 | 1114 | 715 | 1674 | 797 | 2243 | 2071 | 2661 | 261 | 582 | 1855 | 974 | [illegible] |
| VPS | 731 | 836 | 1910 | 1405 | 608 | 947 | 692 | 1808 | 536 | 2038 | 1826 | 2464 | 371 | 454 | 1760 | 1331 | 2142 |
| WRB | 460 | 688 | 1996 | 1584 | 629 | 1024 | 620 | 1544 | 630 | 2180 | 2004 | 2587 | 410 | 482 | 1723 | 828 | 2267 |
| WRI | 451 | 743 | 2326 | 2191 | 1285 | 1486 | 273 | 681 | 1250 | 2647 | 2556 | 2976 | 1170 | 1081 | 1725 | 544 | 2534 |

| LOC | NIP | NKO | NQX | OFF | OSC | PAM | PBG | PSM | RCA | RDR | RME | SAW | SBD | SKA | SKF | SSC | SUU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 1783 | 1632 | 1993 | 864 | 1653 | 1520 | 2227 | 2381 | 780 | 1182 | 2096 | 1511 | 739 | 1229 | 738 | 1783 | 1042 |
| AEX | 783 | 997 | 980 | 845 | 1233 | 506 | 1650 | 1735 | 1276 | 1391 | 1494 | 1285 | 1742 | 2074 | 461 | 865 | 2062 |
| BAD | 868 | 982 | 1093 | 740 | 1189 | 600 | 1638 | 1737 | 1159 | 1287 | 1485 | 1217 | 1648 | 1957 | 434 | 917 | 1957 |
| BIX | 512 | 916 | 718 | 1011 | 1212 | 230 | 1538 | 1594 | 1489 | 1537 | 1382 | 1324 | 2022 | 2317 | 709 | 643 | 2340 |
| BYH | 725 | 605 | 1098 | 598 | 824 | 545 | 1261 | 1365 | 1108 | 1099 | 1108 | 892 | 1872 | 1967 | 808 | 654 | 2119 |
| CBM | 553 | 680 | 899 | 796 | 957 | 345 | 1324 | 1401 | 1299 | 1301 | 1168 | 1064 | 1982 | 2152 | 791 | 552 | 2258 |
| CHS | 221 | 638 | 686 | 1246 | 993 | 430 | 1073 | 1068 | 1767 | 1648 | 931 | 1221 | 2558 | 2637 | 1329 | 88 | 2820 |
| COF | 182 | 994 | 324 | 1485 | 1349 | 394 | 1425 | 1399 | 2000 | 1942 | 1288 | 1562 | 2639 | 2860 | 1309 | 450 | 2948 |
| CVS | 1561 | 1460 | 1768 | 755 | 1519 | 1296 | 2078 | 2221 | 816 | 1165 | 1940 | 1410 | 955 | 1401 | 536 | 1572 | 1268 |
| DLH | 1520 | 799 | 1967 | 494 | 548 | 1431 | 1105 | 1298 | 668 | 303 | 1027 | 280 | 1874 | 1425 | 1486 | 1303 | 1917 |
| DMA | 2065 | 1994 | 2212 | 1239 | 2028 | 1790 | 2600 | 2750 | 1105 | 1530 | 2466 | 1886 | 486 | 1336 | 899 | 2101 | 899 |
| DOV | 849 | 451 | 1294 | 1292 | 653 | 1014 | 457 | 444 | 1761 | 1491 | 336 | 935 | 2790 | 2597 | 1772 | 564 | 2962 |
| DYS | 1293 | 1319 | 1470 | 776 | 1447 | 1019 | 1965 | 2088 | 1007 | 1277 | 1818 | 1395 | 1230 | 1683 | 263 | 1339 | 1566 |
| FEW | 1792 | 1400 | 2112 | 560 | 1318 | 1576 | 1908 | 2084 | 265 | 688 | 1797 | 1117 | 1010 | 922 | 1066 | 1705 | 1111 |
| FFO | 794 | 123 | 1268 | 739 | 399 | 788 | 776 | 891 | 1232 | 1035 | 624 | 589 | 2228 | 2091 | 1293 | 549 | 2406 |
| FWH | 1137 | 1181 | 1334 | 722 | 1332 | 866 | 1832 | 1948 | 1033 | 1251 | 1683 | 1305 | 1381 | 1767 | 278 | 1181 | 1703 |
| GFA | 2364 | 1818 | 2724 | 1055 | 1620 | 2176 | 2174 | 2370 | 536 | 776 | 2101 | 1352 | 1159 | 352 | 1706 | 2229 | 986 |
| GSB | 496 | 504 | 940 | 1264 | 832 | 690 | 808 | 792 | 1774 | 1586 | 674 | 1093 | 2679 | 2639 | 1533 | 228 | 2903 |
| GUS | 906 | 245 | 1368 | 596 | 366 | 858 | 849 | 987 | 1082 | 890 | 707 | 487 | 2101 | 1940 | 1242 | 682 | 2266 |
| HIF | 2210 | 1839 | 2498 | 999 | 1736 | 1978 | 2324 | 2506 | 576 | 1003 | 2221 | 1513 | 686 | 624 | 1325 | 2139 | 680 |
| HMN | 1751 | 1701 | 1913 | 993 | 1763 | 1477 | 2322 | 2464 | 978 | 1364 | 2183 | 1647 | 777 | 1422 | 611 | 1787 | 1145 |
| HST | 411 | 1229 | 119 | 1678 | 1585 | 544 | 1649 | 1611 | 2185 | 2154 | 1516 | 1793 | 2737 | 3034 | 1371 | 686 | 3070 |
| IAB | 1237 | 988 | 1550 | 323 | 1040 | 1014 | 1597 | 1742 | 668 | 845 | 1460 | 953 | 1368 | 1482 | 679 | 1179 | 1594 |
| LFI | 674 | 462 | 1115 | 1284 | 742 | 856 | 635 | 614 | 1776 | 1546 | 508 | 1018 | 2746 | 2630 | 1660 | 397 | 2946 |
| LIZ | 1626 | 1036 | 2058 | 1725 | 931 | 1784 | 379 | 340 | 2061 | 1667 | 534 | 1123 | 3240 | 2769 | 2448 | 1341 | 3311 |
| LRF | 832 | 791 | 1142 | 585 | 983 | 601 | 1447 | 1555 | 1055 | 1124 | 1295 | 1012 | 1709 | 1891 | 622 | 814 | 1979 |
| LSV | 2371 | 2148 | 2579 | 1321 | 2104 | 2110 | 2693 | 2864 | 1002 | 1442 | 2576 | 1909 | 224 | 941 | 1292 | 2357 | 463 |
| LUF | 2179 | 2057 | 2346 | 1270 | 2064 | 1908 | 2644 | 2802 | 1069 | 1506 | 2516 | 1903 | 344 | 1207 | 1038 | 2199 | 744 |
| MCC | 2788 | 2485 | 3018 | 1645 | 2390 | 2535 | 2977 | 3159 | 1223 | 1631 | 2875 | 2162 | 452 | 773 | 1742 | 2750 | 29 |
| MCF | 228 | 1037 | 271 | 1439 | 1389 | 304 | 1521 | 1510 | 1945 | 1921 | 1378 | 1581 | 2523 | 2795 | 1176 | 523 | 2846 |
| MTN | 700 | 636 | 1062 | 633 | 865 | 508 | 1292 | 1391 | 1138 | 1141 | 1138 | 937 | 1875 | 1995 | 779 | 648 | 2123 |
| MIB | 1954 | 1311 | 2265 | 681 | 1077 | 1812 | 1619 | 1817 | 360 | 227 | 1552 | 803 | 1532 | 901 | 1585 | 1775 | 1478 |
| MTC | 1014 | 193 | 1494 | 813 | 164 | 1038 | 579 | 732 | 1245 | 963 | 446 | 424 | 2338 | 2071 | 1317 | 741 | 2473 |
| MUO | 2484 | 2064 | 2784 | 1236 | 1924 | 2260 | 2502 | 2692 | 752 | 1126 | 2412 | 1679 | 750 | 376 | 1614 | 2399 | 554 |
| NIP | 0 | 822 | 480 | 1311 | 1176 | 283 | 1294 | 1289 | 1828 | 1761 | 1151 | 1383 | 2515 | 2692 | 1220 | 296 | 2803 |
| NKO | 822 | 0 | 1301 | 341 | 356 | 854 | 656 | 769 | 1319 | 1089 | 504 | 593 | 2343 | 2169 | 1412 | 550 | 2711 |
| NQX | 480 | 1301 | 0 | 1695 | 1655 | 554 | 1748 | 1718 | 2193 | 2187 | 1612 | 1852 | 2689 | 3032 | 1214 | 760 | 3017 |
| OFF | 1311 | 341 | 1695 | 0 | 794 | 1141 | 1378 | 1543 | 521 | 547 | 1256 | 655 | 1526 | 1391 | 498 | 1179 | 1670 |
| OSC | 1176 | 356 | 1655 | 794 | 0 | 1186 | 590 | 770 | 1174 | 850 | 488 | 283 | 2315 | 1971 | 1393 | 901 | 2417 |
| PAM | 283 | 854 | 554 | 1141 | 1186 | 0 | 1427 | 1457 | 1643 | 1637 | 1274 | 1344 | 2247 | 2491 | 937 | 462 | 2554 |
| PBG | 1294 | 656 | 1748 | 1378 | 590 | 1427 | 0 | 201 | 1757 | 1398 | 156 | 825 | 2902 | 2520 | 2068 | 1001 | 3004 |
| PSM | 1289 | 769 | 1718 | 1543 | 770 | 1457 | 201 | 0 | 1943 | 1594 | 287 | 1019 | 3069 | 2718 | 2170 | 1008 | 3186 |
| RCA | 1828 | 1319 | 2193 | 521 | 1174 | 1643 | 1757 | 1943 | 0 | 442 | 1662 | 939 | 1225 | 870 | 1269 | 1699 | 1276 |
| RDR | 1761 | 1089 | 2187 | 547 | 850 | 1637 | 1398 | 1594 | 442 | 0 | 1326 | 577 | 1666 | 1125 | 1520 | 1568 | 1679 |
| RME | 1151 | 504 | 1612 | 1256 | 488 | 1274 | 156 | 287 | 1662 | 1326 | 0 | 749 | 2782 | 2451 | 1316 | 876 | 2902 |
| SAW | 1383 | 593 | 1852 | 655 | 283 | 1344 | 825 | 1019 | 939 | 577 | 749 | 0 | 2126 | 1702 | 1580 | 1134 | 2193 |
| SBD | 2515 | 2343 | 2689 | 1726 | 2315 | 2247 | 2902 | 3069 | 1225 | 1666 | 2782 | 2126 | 0 | 1102 | 1771 | 2522 | [illegible] |
| SKA | 2692 | 2169 | 3032 | 1391 | 1971 | 2491 | 2520 | 2718 | 870 | 1125 | 2451 | 1702 | 1102 | 0 | 1937 | 2569 | [illegible] |
| SKF | 1220 | 1412 | 1214 | 498 | 1393 | 937 | 2068 | 2170 | 1269 | 1520 | 1316 | 1580 | 1771 | 1937 | 0 | 1225 | 1777 |
| SSC | 296 | 550 | 760 | 1179 | 901 | 462 | 1001 | 1008 | 1699 | 1568 | 876 | 1134 | 2522 | 2569 | 1225 | 0 | 2777 |
| SUU | 2803 | 2711 | 3017 | 1670 | 2417 | 2554 | 3004 | 3186 | 1276 | 1679 | 2902 | 2193 | [illegible] | [illegible] | 1777 | 2777 | [illegible] |
| TIK | [illegible] | 725 | [illegible] | 266 | 790 | 884 | 1335 | 1478 | 764 | 792 | 1186 | 763 | 1626 | 1627 | [illegible] | 961 | 1527 |
| TCM | 2049 | 2444 | 3277 | 1657 | 2247 | 2740 | 2794 | 2992 | 1159 | 1400 | 2726 | 1377 | 1127 | 276 | 2141 | 2577 | [illegible] |
| [illegible] | 1190 | 1078 | 1449 | 414 | 1159 | 933 | 1692 | 1825 | 820 | 1020 | 1749 | 1301 | 1757 | 1708 | 765 | 1163 | [illegible] |
| VAD | 128 | 786 | 712 | 1292 | 1124 | 156 | 1311 | 1325 | 1716 | 1668 | 1162 | 1321 | [illegible] | 2576 | [illegible] | [illegible] | [illegible] |
| VPS | [illegible] | 851 | 611 | 1086 | 1177 | 72 | 1445 | 1485 | 1583 | 1591 | 1291 | 1219 | 2174 | 2427 | [illegible] | [illegible] | [illegible] |
| WRB | [illegible] | 639 | 681 | 1081 | 985 | 240 | 1188 | 1217 | 1600 | 1531 | 1036 | 1171 | 2334 | 2466 | 1097 | 235 | [illegible] |
| WRI | 946 | 500 | 1387 | 1334 | 649 | 1111 | 369 | 347 | 1738 | 1497 | 265 | 931 | [illegible] | 2613 | 1854 | 661 | [illegible] |

| LOC | SZL | TCM | TIK | VAD | VPS | WRB | WRI |
|---|---|---|---|---|---|---|---|
| ABQ | 909 | 1404 | 618 | 1655 | 1448 | 1596 | 2131 |
| AEX | 603 | 2307 | 477 | 656 | 434 | 639 | 1409 |
| BAD | 508 | 2190 | 359 | 740 | 528 | 703 | 1421 |
| BIX | 752 | 2558 | 732 | 389 | 160 | 408 | 1253 |
| BYH | 343 | 2224 | 517 | 609 | 493 | 502 | 1060 |
| CBM | 538 | 2404 | 632 | 430 | 291 | 352 | 1073 |
| CHS | 1020 | 2901 | 1202 | 272 | 482 | 233 | 725 |
| COF | 1236 | 3114 | 1324 | 284 | 466 | 411 | 1065 |
| CVS | 744 | 1595 | 414 | 1433 | 1224 | 1379 | 1954 |
| DLH | 671 | 1700 | 985 | 1439 | 1393 | 1294 | 1195 |
| DMA | 1273 | 1446 | 952 | 1937 | 1718 | 1899 | 2490 |
| DOV | 1165 | 2873 | 1479 | 882 | 1045 | 775 | 97 |
| DYS | 661 | 1889 | 294 | 1165 | 947 | 1130 | 1794 |
| FEW | 744 | 1164 | 676 | 1672 | 1510 | 1573 | 1891 |
| FFO | 605 | 2364 | 936 | 740 | 777 | 590 | 617 |
| FWH | 561 | 1985 | 231 | 1009 | 794 | 972 | 1647 |
| GFA | 1300 | 628 | 1316 | 2252 | 2115 | 2136 | 2260 |
| GSB | 1076 | 2910 | 1327 | 543 | 731 | 460 | 451 |
| GUS | 490 | 2213 | 843 | 836 | 836 | 688 | 743 |
| HIF | 1180 | 806 | 1050 | 2087 | 1910 | 1996 | 2326 |
| HMN | 988 | 1581 | 648 | 1623 | 1405 | 1584 | 2193 |
| HST | 1423 | 3282 | 1465 | 486 | 608 | 629 | 1285 |
| IAB | 265 | 1727 | 176 | 1114 | 947 | 1024 | 1486 |
| LFI | 1125 | 2905 | 1410 | 715 | 892 | 620 | 273 |
| LIZ | 1703 | 3037 | 2065 | 1658 | 1808 | 1544 | 681 |
| LRF | 332 | 2139 | 354 | 707 | 536 | 630 | 1250 |
| LSV | 1438 | 1010 | 1197 | 2243 | 2038 | 2180 | 2647 |
| LUF | 1334 | 1202 | 1038 | 2051 | 1836 | 2004 | 2556 |
| MCC | 1804 | 721 | 1608 | 2661 | 2464 | 2587 | 2976 |
| MCF | 1183 | 3044 | 1232 | 261 | 371 | 410 | 1170 |
| MEM | 376 | 2250 | 517 | 582 | 454 | 482 | 1081 |
| MIB | 940 | 1175 | 1104 | 1855 | 1760 | 1723 | 1725 |
| MTC | 755 | 2347 | 1116 | 976 | 1031 | 828 | 544 |
| MUO | 1438 | 513 | 1336 | 2363 | 2192 | 2267 | 2539 |
| NIP | 1065 | 2949 | 1130 | 128 | 352 | 231 | 946 |
| NKO | 723 | 2444 | 1038 | 786 | 353 | 639 | 500 |
| NOX | 1537 | 3275 | 1449 | 532 | 611 | 681 | 1387 |
| OFF | 260 | 1657 | 494 | 1202 | 1036 | 1081 | 1334 |
| OSC | 790 | 2247 | 1159 | 1134 | 1275 | 985 | 649 |
| PAM | 884 | 2740 | 933 | 166 | 72 | 240 | 1111 |
| PBG | 1335 | 2794 | 1692 | 1311 | 1445 | 1188 | 369 |
| PSM | 1478 | 2992 | 1825 | 1325 | 1485 | 1217 | 347 |
| RCA | 764 | 1178 | 820 | 1716 | 1583 | 1600 | 1788 |
| RDR | 792 | 1400 | 1029 | 1668 | 1591 | 1531 | 1497 |
| RME | 1196 | 2726 | 1549 | 1162 | 1291 | 1036 | 265 |
| SAW | 743 | 1977 | 1101 | 1321 | 1319 | 1171 | 931 |
| SBD | 1626 | 1125 | 1357 | 2387 | 2174 | 2334 | 2843 |
| SKA | 1627 | 276 | 1398 | 2376 | 2427 | 2466 | 2613 |
| SKF | 837 | 2131 | 505 | 1048 | 869 | 1097 | 1855 |
| SSC | 961 | 2335 | 1165 | 418 | 504 | 235 | 661 |
| SUU | 1527 | 746 | 1428 | 2081 | 2181 | 2208 | 3002 |
| SZL | 0 | 1536 | 364 | 972 | 827 | 839 | 1222 |
| TCM | 1536 | 0 | 1531 | 2831 | 2674 | 2725 | 2889 |
| TIK | 364 | 1531 | 0 | 1053 | 863 | 983 | 1546 |
| VAD | 972 | 2831 | 1053 | 0 | 220 | 150 | 979 |
| VPS | 827 | 2674 | 863 | 220 | 0 | 272 | 1140 |
| WRB | 839 | 2725 | 983 | 150 | 272 | 0 | 871 |
| WRI | 1222 | 2889 | 1546 | 979 | 1140 | 871 | 0 |

# Combined Surface Inter-locational air statute mileage

| | ABQ | AEX | BAD | BIX | BYH | CBM | CHS | COF | CVS | DAG | DCA | DLH | DMA | DOV | DYS | FEW | FFO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 0 | 852 | 767 | 1084 | 945 | 1037 | 1516 | 1595 | 188 | 1632 | 1634 | 1084 | 313 | 1726 | 437 | 430 | 1261 |
| AEX | 852 | 0 | 98 | 234 | 341 | 281 | 727 | 748 | 664 | 991 | 1002 | 1056 | 1070 | 1102 | 427 | 960 | 738 |
| BAD | 767 | 98 | 0 | 319 | 315 | 307 | 779 | 828 | 580 | 1006 | 1015 | 982 | 999 | 1115 | 356 | 862 | 721 |
| BIX | 1084 | 234 | 319 | 0 | 372 | 217 | 526 | 514 | 896 | 855 | 869 | 1137 | 1302 | 967 | 661 | 1163 | 687 |
| BYH | 945 | 341 | 315 | 372 | 0 | 168 | 584 | 744 | 776 | 715 | 721 | 765 | 1223 | 819 | 613 | 892 | 406 |
| CBM | 1037 | 281 | 307 | 217 | 168 | 0 | 481 | 592 | 857 | 711 | 721 | 927 | 1292 | 822 | 656 | 1036 | 482 |
| CHS | 1516 | 727 | 779 | 526 | 584 | 481 | 0 | 304 | 1337 | 425 | 445 | 1155 | 1773 | 523 | 1134 | 1470 | 529 |
| COF | 1595 | 748 | 828 | 514 | 744 | 592 | 304 | 0 | 1408 | 720 | 741 | 1418 | 1815 | 809 | 1175 | 1628 | 911 |
| CVS | 188 | 664 | 580 | 896 | 776 | 857 | 1337 | 1408 | 0 | 1477 | 1479 | 1025 | 449 | 1574 | 252 | 478 | 1116 |
| DAG | 1632 | 991 | 1006 | 855 | 715 | 711 | 425 | 720 | 1477 | 0 | 21 | 956 | 1925 | 112 | 1328 | 1468 | 386 |
| DCA | 1634 | 1002 | 1015 | 869 | 721 | 721 | 445 | 741 | 1479 | 21 | 0 | 943 | 1928 | 101 | 1334 | 1464 | 383 |
| DLH | 1084 | 1056 | 982 | 1137 | 765 | 927 | 1155 | 1418 | 1025 | 956 | 943 | 0 | 1391 | 991 | 1058 | 721 | 632 |
| DMA | 313 | 1070 | 999 | 1302 | 1223 | 1292 | 1773 | 1815 | 449 | 1925 | 1928 | 1391 | 0 | 2022 | 643 | 703 | 1561 |
| DOV | 1726 | 1102 | 1115 | 967 | 819 | 822 | 523 | 809 | 1574 | 112 | 101 | 991 | 2022 | 0 | 1432 | 1543 | 468 |
| DYS | 437 | 427 | 356 | 661 | 613 | 656 | 1134 | 1175 | 252 | 1328 | 1334 | 1058 | 643 | 1432 | 0 | 669 | 997 |
| FEW | 430 | 960 | 862 | 1163 | 892 | 1036 | 1470 | 1628 | 478 | 1468 | 1464 | 721 | 703 | 1543 | 669 | 0 | 1082 |
| FFO | 1261 | 738 | 721 | 687 | 406 | 482 | 529 | 811 | 1116 | 386 | 383 | 632 | 1561 | 468 | 997 | 1082 | 0 |
| FWH | 551 | 302 | 225 | 535 | 489 | 524 | 1002 | 1049 | 363 | 1203 | 1209 | 1006 | 774 | 1308 | 132 | 717 | 882 |
| GFA | 882 | 1489 | 1391 | 1678 | 1369 | 1528 | 1916 | 2113 | 991 | 1820 | 1810 | 895 | 1049 | 1871 | 1204 | 539 | 1452 |
| GON | 1897 | 1318 | 1325 | 1190 | 1021 | 1038 | 741 | 1016 | 1755 | 335 | 321 | 1058 | 2200 | 224 | 1630 | 1676 | 639 |
| GSB | 1619 | 894 | 928 | 722 | 675 | 622 | 231 | 514 | 1450 | 209 | 231 | 1084 | 1896 | 296 | 1272 | 1510 | 461 |
| GUS | 1164 | 723 | 690 | 713 | 382 | 498 | 637 | 906 | 1028 | 507 | 501 | 518 | 1469 | 580 | 932 | 963 | 125 |
| HIF | 505 | 1267 | 1171 | 1485 | 1246 | 1381 | 1829 | 1970 | 658 | 1834 | 1830 | 1036 | 622 | 1908 | 903 | 367 | 1448 |
| HMN | 174 | 809 | 737 | 1042 | 965 | 1031 | 1511 | 1556 | 204 | 1673 | 1676 | 1214 | 262 | 1772 | 382 | 597 | 1316 |
| HST | 1691 | 840 | 931 | 612 | 901 | 739 | 500 | 197 | 1503 | 910 | 931 | 1603 | 1886 | 994 | 1259 | 1765 | 1004 |
| IAB | 537 | 507 | 409 | 696 | 439 | 570 | 1023 | 1162 | 401 | 1097 | 1098 | 681 | 840 | 1139 | 377 | 469 | 724 |
| IND | 1148 | 665 | 637 | 648 | 325 | 433 | 586 | 847 | 1005 | 498 | 495 | 573 | 1450 | 581 | 895 | 972 | 11[illegible] |
| INH | 1632 | 994 | 1009 | 859 | 716 | 713 | 431 | 727 | 1477 | 7 | 15 | 952 | 1926 | 109 | 1329 | 1466 | 385 |
| KBY | 1478 | 649 | 717 | 426 | 589 | 449 | 164 | 173 | 1294 | 588 | 608 | 1245 | 1716 | 687 | 1073 | 1480 | 639 |
| LFI | 1681 | 1003 | 1027 | 848 | 748 | 724 | 378 | 660 | 1520 | 91 | 109 | 1042 | 1968 | 149 | 1359 | 1534 | 477 |
| LGB | 680 | 1509 | 1433 | 1742 | 1625 | 1714 | 2194 | 2257 | 858 | 2304 | 2304 | 1633 | 451 | 2394 | 1082 | 913 | 1924 |
| LIZ | 2153 | 1690 | 1681 | 1590 | 1367 | 1417 | 1171 | 1449 | 2036 | 753 | 735 | 1162 | 2465 | 648 | 1951 | 1862 | 962 |
| LRF | 809 | 232 | 173 | 361 | 159 | 233 | 707 | 820 | 632 | 873 | 879 | 825 | 1075 | 978 | 456 | 812 | 554 |
| LSV | 492 | 1343 | 1259 | 1574 | 1420 | 1523 | 1999 | 2087 | 680 | 2079 | 2078 | 1378 | 379 | 2164 | 924 | 660 | 1637 |
| LUF | 355 | 1169 | 1093 | 1402 | 1296 | 1378 | 1859 | 1916 | 522 | 1987 | 1989 | 1393 | 130 | 2081 | 741 | 682 | 1614 |
| MCC | 854 | 1704 | 1615 | 1934 | 1748 | 1865 | 2332 | 2440 | 1042 | 2370 | 2367 | 1574 | 743 | 2447 | 1291 | 905 | 19[illegible] |
| MCF | 1505 | 654 | 741 | 422 | 791 | 539 | 373 | 127 | 1318 | 798 | 818 | 1415 | 1714 | 895 | 1074 | 1567 | [illegible] |
| MEM | 946 | 308 | 289 | 335 | 78 | 136 | 575 | 721 | 774 | 728 | 735 | 802 | 1218 | 835 | 601 | 911 | 4[illegible] |
| MIB | 950 | 1265 | 1173 | 1410 | 1056 | 1224 | 1544 | 1778 | 973 | 1391 | 1379 | 442 | 1216 | 1431 | 1108 | 521 | 12[illegible] |
| MTC | 1375 | 941 | 915 | 900 | 602 | 694 | 691 | 988 | 1248 | 406 | 392 | 552 | 1685 | 440 | 1162 | 1134 | 213 |
| MUO | 778 | 1707 | 1610 | 1723 | 1471 | 1611 | 2048 | 2202 | 898 | 2025 | 2019 | 1167 | 802 | 2091 | 1145 | 579 | 1642 |
| NCO | 1942 | 1361 | 1369 | 1230 | 1065 | 1080 | 774 | 1044 | 1800 | 375 | 362 | 1096 | 2245 | 263 | 1675 | 1720 | [illegible] |
| NFL | 727 | 1768 | 1478 | 1797 | 1597 | 1718 | 2181 | 2299 | 912 | 2212 | 2208 | 1415 | 665 | 2288 | 1164 | 745 | [illegible] |
| NGU | 1686 | 995 | 1022 | 834 | [illegible] | 717 | 353 | 630 | 1523 | 122 | 141 | 1067 | 1971 | 180 | 1357 | [illegible] | [illegible] |
| NGZ | 893 | 1744 | 1658 | 1976 | 1801 | 1914 | 2384 | 2485 | 1081 | 2433 | 2430 | 1648 | 754 | 2512 | 1327 | 971 | [illegible] |
| NHK | 1675 | 1029 | 1046 | 888 | 726 | 749 | 443 | 731 | 1519 | 42 | 47 | 989 | 1967 | 82 | 1369 | [illegible] | [illegible] |
| NIP | 1486 | 653 | 723 | 426 | 604 | 461 | 184 | 152 | 1301 | 609 | 629 | 1266 | 1721 | 708 | 1077 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 813 | [illegible] | [illegible] | [illegible] | 532 | 828 | 1217 | 306 | 299 | 666 | 1662 | 376 | [illegible] | 1167 | [illegible] |
| NKT | [illegible] | [illegible] | 982 | [illegible] | [illegible] | 676 | [illegible] | [illegible] | 1513 | 254 | 275 | 1157 | 1958 | 321 | [illegible] | [illegible] | [illegible] |
| [illegible] | 745 | 1795 | 1712 | 1828 | 1671 | [illegible] | 2271 | 2340 | 932 | 2322 | 2320 | 1581 | 587 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 394 | [illegible] | [illegible] | 223 | 452 | 437 | 973 | 799 | 814 | 1155 | 1382 | 910 | 740 | 1224 | [illegible] |
| [illegible] | [illegible] | 417 | 911 | [illegible] | 915 | 749 | 572 | 270 | [illegible] | 990 | 1011 | 1640 | [illegible] | [illegible] | 1225 | 1760 | [illegible] |
| [illegible] | 725 | 1562 | 1483 | 1795 | 1668 | 1761 | 2241 | 2309 | 906 | 2340 | 2339 | 1646 | 512 | 2427 | [illegible] | 924 | [illegible] |
| [illegible] | 1222 | [illegible] | [illegible] | 2163 | 1876 | 2029 | [illegible] | 2620 | 1377 | 2345 | 2335 | 1411 | 1269 | 2394 | 1619 | [illegible] | [illegible] |
| [illegible] | 640 | 1467 | [illegible] | [illegible] | [illegible] | 1673 | 2153 | 2214 | 816 | 2266 | 2267 | 1605 | 408 | 2356 | 1039 | [illegible] | [illegible] |
| NZY | 663 | 1453 | 1380 | 1685 | 1586 | 1667 | 2148 | 2199 | 812 | 2274 | 2275 | 1637 | 385 | 2366 | 1026 | 916 | [illegible] |
| OFF | 720 | 704 | 617 | 843 | 498 | 663 | 1038 | 1237 | 630 | 1002 | 997 | 412 | 1033 | 1077 | 647 | 466 | 614 |
| OSC | 1378 | 1028 | 991 | 1010 | 686 | 798 | 828 | 1124 | 1266 | 528 | 512 | 456 | 1699 | 544 | 1206 | 1098 | [illegible] |

| | ABQ | AEX | BAD | BIX | BYH | CBM | CHS | COF | CVS | DAG | DCA | DLH | DMA | DOV | DYS | FFW | FFO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 1267 | 422 | 500 | 191 | 454 | 288 | 358 | 328 | 1080 | 736 | 753 | 1192 | 1492 | 845 | 849 | 1314 | 656 |
| PBG | 1856 | 1375 | 1365 | 1282 | 1051 | 1103 | 894 | 1187 | 1731 | 469 | 449 | 921 | 2166 | 381 | 1638 | 1590 | 646 |
| PHL | 1737 | 1127 | 1137 | 996 | 838 | 846 | 558 | 844 | 1588 | 141 | 127 | 981 | 2035 | 36 | 1451 | 1545 | 477 |
| PNE | 1737 | 1127 | 1137 | 996 | 838 | 846 | 558 | 844 | 1588 | 141 | 127 | 981 | 2035 | 36 | 1451 | 1545 | 477 |
| PSM | 1984 | 1446 | 1447 | 1328 | 1138 | 1168 | 890 | 1166 | 1851 | 478 | 462 | 1082 | 2291 | 370 | 1740 | 1737 | 743 |
| PWT | 1185 | 1934 | 1837 | 2142 | 1862 | 2013 | 2425 | 2604 | 1344 | 2346 | 2337 | 1419 | 1222 | 2398 | 1587 | 980 | 1975 |
| RCA | 650 | 1063 | 966 | 1240 | 923 | 1083 | 1472 | 1667 | 680 | 1406 | 1398 | 556 | 920 | 1467 | 839 | 221 | 1026 |
| RDR | 985 | 1159 | 1073 | 1281 | 916 | 1084 | 1373 | 1618 | 971 | 1204 | 1192 | 252 | 1275 | 1242 | 1064 | 574 | 863 |
| RME | 1747 | 1245 | 1237 | 1152 | 923 | 973 | 776 | 1074 | 1617 | 353 | 332 | 856 | 2055 | 280 | 1515 | 1498 | 520 |
| SAW | 1259 | 1071 | 1014 | 1104 | 743 | 886 | 1018 | 1302 | 1175 | 759 | 743 | 233 | 1572 | 779 | 1163 | 931 | 491 |
| SBD | 616 | 1452 | 1373 | 1685 | 1560 | 1652 | 2132 | 2199 | 796 | 2236 | 2236 | 1562 | 405 | 2325 | 1025 | 842 | 1857 |
| SKA | 1024 | 1729 | 1630 | 1930 | 1639 | 1793 | 2197 | 2383 | 1168 | 2113 | 2104 | 1187 | 1114 | 2164 | 1403 | 769 | 1742 |
| SKF | 615 | 384 | 362 | 591 | 673 | 659 | 1108 | 1090 | 447 | 1367 | 1376 | 1238 | 749 | 1476 | 219 | 888 | 1078 |
| SSC | 1486 | 721 | 764 | 536 | 545 | 460 | 73 | 375 | 1310 | 367 | 386 | 1086 | 1750 | 470 | 1116 | 1421 | 458 |
| SUU | 868 | 1719 | 1631 | 1950 | 1766 | 1882 | 2350 | 2457 | 1056 | 2391 | 2388 | 1597 | 749 | 2468 | 1305 | 926 | 2005 |
| SZL | 757 | 503 | 424 | 627 | 286 | 449 | 850 | 1030 | 620 | 881 | 881 | 560 | 1061 | 971 | 551 | 620 | 504 |
| TCM | 1170 | 1923 | 1825 | 2131 | 1854 | 2003 | 2418 | 2595 | 1329 | 2342 | 2333 | 1417 | 1205 | 2394 | 1574 | 970 | 1970 |
| TIK | 515 | 397 | 299 | 610 | 431 | 526 | 1002 | 1103 | 345 | 1133 | 1137 | 820 | 793 | 1232 | 245 | 564 | 780 |
| TWH | 1686 | 993 | 1021 | 832 | 749 | 716 | 349 | 625 | 1523 | 127 | 146 | 1071 | 1971 | 185 | 1357 | 1550 | 474 |
| VAD | 1379 | 547 | 616 | 524 | 508 | 358 | 227 | 236 | 1194 | 629 | 648 | 1199 | 1614 | 735 | 971 | 1394 | 617 |
| VPS | 1207 | 362 | 440 | 133 | 411 | 243 | 402 | 388 | 1020 | 760 | 776 | 1161 | 1431 | 871 | 789 | 1259 | 648 |
| WRB | 1330 | 533 | 586 | 340 | 419 | 293 | 194 | 343 | 1149 | 536 | 553 | 1079 | 1582 | 646 | 941 | 1311 | 492 |
| WRI | 1775 | 1174 | 1184 | 1044 | 883 | 894 | 604 | 888 | 1628 | 190 | 175 | 995 | 2075 | 81 | 1495 | 1576 | 515 |

|  | FWH | GFA | GON | GSB | GUS | HIF | HMN | HST | IAB | IND | INH | KBY | LFI | LGB | LIZ | LRF | LSV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 551 | 882 | 1897 | 1619 | 1164 | 505 | 174 | 1691 | 537 | 1148 | 1632 | 1478 | 1681 | 680 | 2153 | 809 | 492 |
| AEX | 302 | 1489 | 1318 | 894 | 723 | 1267 | 809 | 840 | 507 | 665 | 994 | 649 | 1003 | 1509 | 1690 | 232 | 1343 |
| BAD | 225 | 1391 | 1325 | 928 | 690 | 1171 | 737 | 931 | 409 | 637 | 1009 | 717 | 1027 | 1433 | 1681 | 173 | 1259 |
| BIX | 535 | 1678 | 1190 | 722 | 713 | 1485 | 1042 | 612 | 696 | 648 | 859 | 426 | 848 | 1742 | 1590 | 361 | 1576 |
| BYH | 489 | 1369 | 1021 | 675 | 382 | 1246 | 965 | 901 | 439 | 325 | 716 | 589 | 748 | 1625 | 1367 | 159 | 1420 |
| CBM | 524 | 1528 | 1038 | 622 | 498 | 1381 | 1031 | 739 | 570 | 433 | 713 | 449 | 724 | 1714 | 1417 | 233 | 1523 |
| CHS | 1002 | 1916 | 741 | 231 | 637 | 1829 | 1511 | 500 | 1023 | 586 | 431 | 164 | 378 | 2194 | 1171 | 707 | 1999 |
| COF | 1049 | 2113 | 1016 | 514 | 906 | 1970 | 1556 | 197 | 1162 | 847 | 727 | 173 | 660 | 2257 | 1449 | 820 | 2087 |
| CVS | 363 | 991 | 1755 | 1450 | 1028 | 658 | 204 | 1503 | 401 | 1005 | 1477 | 1294 | 1520 | 858 | 2036 | 632 | 680 |
| DAG | 1203 | 1820 | 335 | 209 | 507 | 1834 | 1673 | 910 | 1097 | 498 | 7 | 588 | 91 | 2304 | 753 | 873 | 2079 |
| DCA | 1209 | 1810 | 321 | 231 | 501 | 1830 | 1676 | 931 | 1098 | 495 | 15 | 608 | 109 | 2304 | 735 | 879 | 2078 |
| DLH | 1006 | 895 | 1058 | 1084 | 518 | 1036 | 1214 | 1603 | 681 | 573 | 952 | 1245 | 1042 | 1633 | 1162 | 825 | 1378 |
| DMA | 774 | 1049 | 2200 | 1896 | 1469 | 622 | 262 | 1886 | 840 | 1450 | 1926 | 1716 | 1968 | 451 | 2465 | 1075 | 379 |
| DOV | 1308 | 1871 | 224 | 296 | 580 | 1908 | 1772 | 994 | 1189 | 581 | 109 | 687 | 149 | 2394 | 648 | 978 | 2164 |
| DYS | 132 | 1204 | 1630 | 1272 | 932 | 903 | 382 | 1259 | 377 | 895 | 1329 | 1073 | 1359 | 1082 | 1951 | 456 | 924 |
| FEW | 717 | 539 | 1676 | 1510 | 963 | 367 | 597 | 1765 | 469 | 972 | 1466 | 1480 | 1534 | 913 | 1862 | 812 | 660 |
| FFO | 882 | 1452 | 639 | 461 | 125 | 1448 | 1316 | 1004 | 724 | 114 | 385 | 639 | 455 | 1926 | 962 | 559 | 1697 |
| FWH | 0 | 1255 | 1509 | 1142 | 826 | 988 | 512 | 1140 | 339 | 784 | 1204 | 942 | 1231 | 1209 | 1841 | 331 | 1042 |
| GFA | 1255 | 0 | 1953 | 1910 | 1326 | 430 | 1054 | 2266 | 985 | 1357 | 1816 | 1953 | 1900 | 1024 | 2027 | 1319 | 796 |
| GON | 1509 | 1953 | 0 | 511 | 734 | 2035 | 1956 | 1194 | 1361 | 750 | 331 | 905 | 363 | 2553 | 433 | 1180 | 2316 |
| GSB | 1142 | 1910 | 511 | 0 | 586 | 1877 | 1637 | 702 | 1097 | 554 | 216 | 394 | 148 | 2298 | 942 | 822 | 2087 |
| GUS | 826 | 1326 | 734 | 586 | 0 | 1329 | 1231 | 1095 | 630 | 66 | 504 | 733 | 579 | 1821 | 1019 | 520 | 1587 |
| HIF | 988 | 430 | 2035 | 1877 | 1329 | 0 | 665 | 2096 | 811 | 1339 | 1832 | 1829 | 1901 | 637 | 2196 | 1151 | 388 |
| HMN | 512 | 1054 | 1956 | 1637 | 1231 | 665 | 0 | 1633 | 604 | 1206 | 1673 | 1454 | 1713 | 702 | 2239 | 815 | 568 |
| HST | 1140 | 2266 | 1194 | 702 | 1095 | 2096 | 1633 | 0 | 1296 | 1034 | 917 | 365 | 845 | 2334 | 1626 | 953 | 2181 |
| IAB | 339 | 985 | 1361 | 1097 | 630 | 811 | 604 | 1296 | 0 | 611 | 1097 | 1018 | 1149 | 1208 | 1635 | 343 | 990 |
| IND | 784 | 1357 | 750 | 554 | 66 | 1339 | 1206 | 1034 | 611 | 0 | 496 | 673 | 563 | 1812 | 1058 | 469 | 1583 |
| INH | 1204 | 1816 | 331 | 216 | 504 | 1832 | 1673 | 917 | 1097 | 496 | 0 | 594 | 97 | 2304 | 747 | 874 | 2078 |
| KBY | 942 | 1953 | 905 | 394 | 733 | 1829 | 1454 | 365 | 1018 | 673 | 594 | 0 | 542 | 2149 | 1335 | 682 | 1967 |
| LFI | 1231 | 1900 | 363 | 148 | 579 | 1901 | 1713 | 845 | 1149 | 563 | 97 | 542 | 0 | 2356 | 793 | 904 | 2135 |
| LGB | 1209 | 1024 | 2553 | 2298 | 1821 | 637 | 702 | 2334 | 1208 | 1812 | 2304 | 2149 | 2356 | 0 | 2771 | 1488 | 256 |
| LIZ | 1841 | 2027 | 433 | 942 | 1019 | 2196 | 2239 | 1626 | 1635 | 1058 | 747 | 1335 | 793 | 2771 | 0 | 1522 | 2521 |
| LRF | 331 | 1319 | 1180 | 822 | 520 | 1151 | 815 | 953 | 343 | 469 | 874 | 682 | 904 | 1488 | 1522 | 0 | 1292 |
| LSV | 1042 | 796 | 2316 | 2087 | 1587 | 388 | 568 | 2181 | 990 | 1583 | 2078 | 1967 | 2135 | 256 | 2521 | 1292 | 0 |
| LUF | 369 | 966 | 2250 | 1970 | 1517 | 537 | 362 | 1995 | 892 | 1502 | 1987 | 1810 | 2035 | 341 | 2496 | 1154 | 251 |
| MCC | 1564 | 798 | 2579 | 2309 | 1367 | [illegible] | [illegible] | [illegible] | 1310 | 1873 | 2369 | 2313 | [illegible] | 383 | 2736 | 1632 | 371 |
| MCF | 955 | 2066 | 1109 | 599 | 914 | 1900 | 1457 | 200 | 1098 | 852 | 804 | 212 | 748 | 2159 | 1541 | 755 | 1997 |
| MEM | 474 | 1394 | 1040 | 678 | 416 | 1261 | 959 | 873 | 451 | 357 | 730 | 569 | 758 | 1627 | 1293 | 145 | 1427 |
| MIB | 1109 | 463 | 1498 | 1504 | 920 | 709 | 1115 | 1969 | 778 | 962 | 1387 | 1609 | 1475 | 1344 | 1564 | 1075 | [illegible] |
| MTC | 1056 | 1532 | 542 | 560 | 270 | 1493 | 1452 | 1185 | 848 | 278 | 401 | 822 | 495 | 2019 | 791 | 747 | 1779 |
| MUO | 1230 | 364 | 2202 | 2083 | 1519 | 243 | 859 | 2332 | 1041 | 1536 | 2023 | 2057 | 2097 | 676 | 2326 | 1383 | 476 |
| [illegible] | 1554 | 1992 | 45 | 543 | 779 | 2078 | 1991 | 1218 | 1506 | 796 | 371 | 937 | 396 | 2599 | 408 | 1224 | 2261 |
| NFL | 1272 | 665 | 2419 | 2245 | 1708 | 384 | 835 | 2408 | 1158 | 1715 | 2210 | 2168 | 2276 | 403 | 2576 | 1486 | 237 |
| NGU | 1229 | 1929 | 389 | 123 | 496 | 1915 | 1714 | 814 | 1156 | 577 | 128 | 716 | 33 | 2362 | 821 | 903 | 2144 |
| NKX | 1444 | 379 | 2647 | 2454 | 1932 | 616 | 969 | 2583 | 1364 | 1936 | 2432 | 2361 | 2496 | 357 | 2810 | 1652 | 407 |
| NHK | 1244 | 1857 | 305 | 214 | 567 | 1927 | 1715 | 919 | 1139 | 540 | 43 | 606 | 77 | 2347 | 729 | 914 | 2121 |
| NIP | 948 | 1479 | 924 | 414 | 775 | 1941 | 1579 | 342 | 1031 | 645 | 616 | 23 | 562 | 2156 | 1355 | 643 | 1976 |
| [illegible] | [illegible] | 1517 | [illegible] | 429 | 204 | [illegible] | [illegible] | 1024 | 823 | 212 | 703 | 661 | 385 | 2022 | 863 | 660 | 1760 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 675 | 1166 | [illegible] | 261 | 395 | 174 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2221 | 2381 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2199 | [illegible] | 68 | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2764 | 1568 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 1516 | [illegible] | [illegible] | [illegible] | 621 | [illegible] | [illegible] | 1109 | [illegible] | 2266 | 2107 | [illegible] | 43 | [illegible] | [illegible] | [illegible] |
| [illegible] | 1175 | [illegible] | [illegible] | [illegible] | [illegible] | 671 | [illegible] | 2271 | 1177 | 1786 | [illegible] | 2097 | [illegible] | 92 | 2763 | [illegible] | [illegible] |
| [illegible] | 662 | 879 | 1216 | [illegible] | [illegible] | [illegible] | [illegible] | 1398 | [illegible] | [illegible] | [illegible] | 1075 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1457 | [illegible] | 1120 | 867 | 366 | [illegible] | [illegible] | 619 | 2000 | 776 | 919 | [illegible] |

|  | FWH | GFA | GON | GSB | GUS | HIF | HMN | HST | IAB | IND | INH | KBY | LFI | LGB | LIZ | LRF | LSV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 722 | 1813 | 1069 | 575 | 715 | 1649 | 1231 | 453 | 845 | 650 | 741 | 237 | 713 | 1930 | 1487 | 501 | 1759 |
| PBG | 1527 | 1811 | 228 | 674 | 708 | 1937 | 1935 | 1374 | 1331 | 744 | 463 | 1057 | 529 | 2489 | 316 | 1206 | 2244 |
| PHL | 1328 | 1864 | 194 | 331 | 585 | 1909 | 1786 | 1030 | 1200 | 590 | 137 | 722 | 185 | 2402 | 614 | 997 | 2171 |
| PNE | 1328 | 1864 | 194 | 331 | 585 | 1909 | 1786 | 1030 | 1200 | 590 | 137 | 722 | 185 | 2402 | 614 | 997 | 2171 |
| PSM | 1623 | 1975 | 150 | 660 | 823 | 2088 | 2053 | 1343 | 1452 | 849 | 473 | 1054 | 512 | 2628 | 283 | 1296 | 2386 |
| PWT | 1667 | 527 | 2477 | 2431 | 1850 | 686 | 1333 | 2745 | 1449 | 1877 | 2343 | 2451 | 2425 | 986 | 2529 | 1792 | 860 |
| RCA | 861 | 446 | 1576 | 1478 | 902 | 480 | 815 | 1821 | 557 | 925 | 1403 | 1507 | 1480 | 1091 | 1717 | 879 | 835 |
| RDR | 1043 | 647 | 1309 | 1322 | 742 | 836 | 1137 | 1795 | 704 | 788 | 1199 | 1447 | 1288 | 1458 | 1389 | 937 | 1202 |
| RME | 1502 | 1751 | 210 | 562 | 589 | 1851 | 1820 | 1264 | 1217 | 621 | 347 | 937 | 423 | 2389 | 445 | 1079 | 2147 |
| SAW | 1087 | 1127 | 829 | 911 | 406 | 1261 | 1373 | 1494 | 794 | 471 | 753 | 1129 | 848 | 1843 | 935 | 844 | 1591 |
| SBD | 1150 | 966 | 2483 | 2232 | 1751 | 572 | 648 | 2281 | 1140 | 1743 | 2235 | 2089 | 2289 | 71 | 2700 | 1425 | 182 |
| SKA | 1473 | 294 | 2256 | 2199 | 1617 | 520 | 1185 | 2529 | 1235 | 1646 | 2109 | 2227 | 2192 | 961 | 2307 | 1576 | 284 |
| SKF | 232 | 1421 | 1687 | 1278 | 1035 | 1104 | 509 | 1143 | 566 | 987 | 1369 | 1017 | 1383 | 1200 | 2040 | 519 | 1077 |
| SSC | 984 | 1858 | 692 | 190 | 568 | 1783 | 1489 | 572 | 982 | 519 | 373 | 224 | 331 | 2166 | 1118 | 678 | 1966 |
| SUU | 1419 | 822 | 2601 | 2430 | 1888 | 567 | 954 | 2558 | 1328 | 1894 | 2390 | 2330 | 2455 | 377 | 2759 | 1649 | 386 |
| SZL | 468 | 1083 | 1140 | 897 | 409 | 983 | 823 | 1186 | 221 | 391 | 881 | 872 | 937 | 1423 | 1419 | 277 | 1198 |
| TCM | 1654 | 524 | 2475 | 2425 | 1845 | 672 | 1317 | 2735 | 1439 | 1872 | 2338 | 2442 | 2420 | 965 | 2531 | 1782 | 842 |
| TIK | 193 | 1096 | 1419 | 1106 | 702 | 875 | 540 | 1221 | 146 | 672 | 1134 | 973 | 1175 | 1195 | 1720 | 295 | 997 |
| TWH | 1228 | 1923 | 393 | 119 | 599 | 1917 | 1714 | 809 | 1156 | 579 | 133 | 512 | 39 | 2363 | 826 | 902 | 2144 |
| VAD | 341 | 1827 | 957 | 552 | 697 | 1729 | 1353 | 405 | 929 | 634 | 635 | 102 | 596 | 2049 | 1352 | [illegible] | 1969 |
| VPS | 661 | 1762 | 1095 | 610 | 697 | 1591 | 1171 | 507 | 789 | 631 | 765 | 293 | 743 | 1379 | 1507 | 446 | 1608 |
| WRB | 810 | 1780 | 820 | 385 | 573 | 1663 | 1329 | 524 | 853 | 511 | 561 | 174 | 517 | 2087 | 1237 | 525 | [illegible] |
| WRI | 1372 | 1884 | 145 | 376 | 619 | 1939 | 1828 | 1071 | 1238 | 628 | 186 | 768 | 228 | 2439 | 567 | 1042 | [illegible] |

| | LUF | MCC | MCF | MEM | MIB | MTC | MUO | NCO | NFL | NGU | NGZ | NHK | NIP | NKO | NKT | NLC | NPA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 355 | 854 | 1505 | 946 | 950 | 1375 | 738 | 1942 | 727 | 1686 | 893 | 1675 | 1486 | 1360 | 1684 | 745 | 1160 |
| AEX | 1169 | 1704 | 654 | 308 | 1265 | 941 | 1507 | 1361 | 1568 | 995 | 1744 | 1029 | 653 | 831 | 943 | 1595 | 312 |
| BAD | 1093 | 1615 | 741 | 289 | 1173 | 915 | 1410 | 1369 | 1478 | 1022 | 1658 | 1046 | 723 | 818 | 982 | 1512 | 394 |
| BIX | 1402 | 1934 | 422 | 335 | 1410 | 900 | 1723 | 1230 | 1797 | 834 | 1976 | 888 | 426 | 763 | 759 | 1828 | 81 |
| BYH | 1296 | 1748 | 701 | 38 | 1056 | 602 | 1471 | 1065 | 1597 | 749 | 1801 | 756 | 604 | 504 | 739 | 1671 | 395 |
| CBM | 1378 | 1865 | 539 | 136 | 1224 | 694 | 1611 | 1080 | 1718 | 717 | 1914 | 749 | 461 | 567 | 676 | 1777 | 228 |
| CHS | 1859 | 2332 | 373 | 575 | 1544 | 691 | 2048 | 774 | 2181 | 353 | 2384 | 443 | 184 | 532 | 243 | 2251 | 452 |
| COF | 1916 | 2440 | 127 | 721 | 1778 | 938 | 2202 | 1044 | 2299 | 630 | 2485 | 731 | 152 | 828 | 496 | 2340 | 435 |
| CVS | 522 | 1042 | 1318 | 774 | 973 | 1248 | 898 | 1800 | 912 | 1523 | 1081 | 1519 | 1301 | 1217 | 1513 | 932 | 973 |
| DAG | 1987 | 2370 | 798 | 728 | 1391 | 406 | 2025 | 375 | 2212 | 122 | 2433 | 42 | 609 | 306 | 254 | 2322 | 799 |
| DCA | 1989 | 2367 | 818 | 735 | 1379 | 392 | 2019 | 362 | 2208 | 141 | 2430 | 47 | 629 | 299 | 275 | 2320 | 814 |
| DLH | 1393 | 1574 | 1415 | 802 | 442 | 552 | 1167 | 1096 | 1415 | 1067 | 1648 | 989 | 1266 | 666 | 1157 | 1581 | 1155 |
| DMA | 130 | 743 | 1714 | 1218 | 1216 | 1685 | 802 | 2245 | 665 | 1971 | 754 | 1967 | 1721 | 1662 | 1958 | 587 | 1382 |
| DOV | 2081 | 2447 | 895 | 835 | 1431 | 440 | 2091 | 263 | 2288 | 180 | 2512 | 82 | 708 | 376 | 321 | 2405 | 910 |
| DYS | 741 | 1291 | 1078 | 601 | 1108 | 1162 | 1145 | 1675 | 1164 | 1357 | 1327 | 1369 | 1077 | 1099 | 1330 | 1174 | 740 |
| FEW | 682 | 905 | 1567 | 911 | 521 | 1134 | 579 | 1720 | 745 | 1548 | 971 | 1509 | 1494 | 1167 | 1583 | 878 | 1224 |
| FFO | 1616 | 1984 | 832 | 433 | 1043 | 213 | 1642 | 685 | 1825 | 472 | 2047 | 428 | 662 | 102 | 535 | 1938 | 665 |
| FWH | 869 | 1404 | 955 | 474 | 1109 | 1056 | 1230 | 1554 | 1272 | 1229 | 1444 | 1244 | 948 | 984 | 1199 | 1294 | 613 |
| GFA | 966 | 798 | 2066 | 1394 | 463 | 1432 | 364 | 1992 | 665 | 1920 | 879 | 1857 | 1970 | 1515 | 1984 | 883 | 1732 |
| GON | 2250 | 2579 | 1109 | 1040 | 1498 | 542 | 2202 | 45 | 2418 | 389 | 2647 | 305 | 924 | 538 | 520 | 2550 | 1134 |
| GSB | 1970 | 2400 | 599 | 678 | 1504 | 560 | 2083 | 543 | 2245 | 123 | 2458 | 218 | 414 | 420 | 74 | 2336 | 655 |
| GUS | 1517 | 1867 | 914 | 416 | 920 | 230 | 1519 | 779 | 1708 | 596 | 1932 | 547 | 755 | 204 | 660 | 1826 | 705 |
| HIF | 537 | 545 | 1900 | 1261 | 709 | 1493 | 243 | 2078 | 384 | 1915 | 616 | 1875 | 1841 | 1532 | 1949 | 548 | 1552 |
| HMN | 362 | 943 | 1457 | 959 | 1115 | 1452 | 889 | 2001 | 835 | 1714 | 969 | 1715 | 1459 | 1418 | 1698 | 809 | 1122 |
| HST | 1995 | 2544 | 200 | 873 | 1949 | 1185 | 2332 | 1218 | 2408 | 814 | 2583 | 919 | 342 | 1024 | 675 | 2432 | 544 |
| IAB | 892 | 1310 | 1098 | 451 | 778 | 848 | 1041 | 1406 | 1158 | 1156 | 1364 | 1139 | 1031 | 823 | 1166 | 1239 | 755 |
| IND | 1502 | 1873 | 852 | 357 | 962 | 278 | 1536 | 796 | 1715 | 577 | 1936 | 540 | 695 | 212 | 628 | 1825 | 639 |
| INH | 1987 | 2369 | 804 | 730 | 1387 | 401 | 2023 | 371 | 2210 | 128 | 2432 | 43 | 616 | 303 | 261 | 2321 | 804 |
| KBY | 1810 | 2313 | 212 | 569 | 1609 | 822 | 2057 | 937 | 2168 | 516 | 2361 | 606 | 23 | 661 | 398 | 2221 | 345 |
| LFI | 2035 | 2434 | 748 | 758 | 1475 | 495 | 2097 | 396 | 2276 | 33 | 2496 | 77 | 562 | 385 | 174 | 2381 | 786 |
| LGB | 341 | 383 | 2159 | 1627 | 1344 | 2019 | 676 | 2598 | 403 | 2362 | 357 | 2347 | 2156 | 2022 | 2364 | 203 | 1821 |
| LIZ | 2496 | 2736 | 1541 | 1393 | 1564 | 791 | 2326 | 408 | 2576 | 821 | 2810 | 729 | 1355 | 863 | 954 | 2737 | 1542 |
| LRF | 1154 | 1632 | 754 | 145 | 1055 | 747 | 1383 | 1224 | 1486 | 903 | 1682 | 914 | 693 | 660 | 883 | 1545 | 414 |
| LSV | 251 | 375 | 1997 | 1425 | 1090 | 1778 | 476 | 2361 | 287 | 2144 | 403 | 2121 | 1976 | 1790 | 2155 | 254 | 1622 |
| LUF | 0 | 613 | 1818 | 1295 | 1177 | 1725 | 693 | 2295 | 538 | 2039 | 626 | 2030 | 1816 | 1714 | 2034 | 460 | 1481 |
| MCC | 613 | 0 | 2356 | 1757 | 1208 | 2037 | 437 | 2622 | 161 | 2546 | 80 | 2412 | 2323 | 2071 | 2470 | 180 | 2099 |
| MCF | 1818 | 2356 | 0 | 673 | 1752 | 1025 | 2135 | 1139 | 2218 | 720 | 2398 | 815 | 190 | 865 | 593 | 2249 | 349 |
| MEM | 1295 | 1757 | 673 | 0 | 1089 | 633 | 1488 | 1084 | 1608 | 757 | 1809 | 769 | 583 | 530 | 740 | 1677 | 361 |
| MIB | 1177 | 1208 | 1752 | 1089 | 0 | 991 | 777 | 1535 | 1056 | 1498 | 1287 | 1426 | 1628 | 1092 | 1577 | 1250 | 1443 |
| MTC | 1725 | 2037 | 1025 | 633 | 991 | 0 | 1664 | 585 | 1876 | 522 | 2105 | 438 | 845 | 161 | 628 | 2010 | 878 |
| MUO | 693 | 437 | 2135 | 1488 | 777 | 1664 | 0 | 2244 | 301 | 2112 | 518 | 2065 | 2070 | 1720 | 2156 | 521 | 1788 |
| NCO | 2295 | 2622 | 1139 | 1084 | 1535 | 585 | 2244 | 0 | 2461 | 421 | 2690 | 343 | 956 | 584 | 548 | 2594 | 1174 |
| NFL | 538 | 161 | 2218 | 1608 | 1056 | 1876 | 301 | 2461 | 0 | 2288 | 234 | 2253 | 2178 | 1912 | 2316 | 224 | 1864 |
| NGU | 2039 | 2546 | 720 | 757 | 1498 | 522 | 2112 | 421 | 2288 | 0 | 2507 | 110 | 536 | 406 | 142 | 2390 | 770 |
| NGZ | 626 | 80 | 2398 | 1809 | 1287 | 2105 | 518 | 2690 | 234 | 2507 | 0 | 2475 | 2370 | 2136 | 2528 | 168 | 2052 |
| NHK | 2030 | 2412 | 815 | 769 | 1426 | 438 | 2065 | 343 | 2253 | 110 | 2475 | 0 | 627 | 346 | 251 | 2365 | 830 |
| NIP | 1816 | 2323 | 190 | 583 | 1628 | 845 | 2070 | 956 | 2178 | 536 | 2370 | 627 | 0 | 685 | 415 | 2229 | 345 |
| NKO | 1714 | 2071 | 865 | 530 | 1092 | 161 | 1720 | 584 | 1912 | 406 | 2136 | 346 | 685 | 0 | 432 | 2010 | 734 |
| NKT | 2034 | 2470 | 593 | 740 | 1577 | 628 | 2156 | 548 | 2316 | 142 | 2528 | 251 | 415 | 432 | 0 | 2364 | 684 |
| NLC | 460 | 180 | 2249 | 1677 | 1250 | 2010 | 521 | 2594 | 224 | 2390 | 168 | 2365 | 2229 | 2010 | 2364 | 0 | 1547 |
| NPA | 1481 | 2099 | 349 | 361 | 1443 | 878 | 1788 | 1174 | 1864 | 770 | 2052 | 830 | 345 | 734 | 684 | 1547 | [illegible] |
| NQX | 1955 | 2715 | 226 | 385 | 1971 | 1245 | 2320 | 1308 | 2283 | 899 | 2552 | 1001 | 400 | 1044 | 742 | 2298 | [illegible] |
| NTD | 296 | 222 | 2213 | 1671 | 1342 | 2046 | 647 | 2627 | 361 | 2501 | 200 | 2382 | 2214 | 2054 | 2464 | 146 | [illegible] |
| NUW | 1151 | 676 | 2564 | 1899 | 970 | 1954 | 785 | 2505 | 643 | 2445 | 738 | 2382 | 2480 | 2040 | 2504 | 643 | [illegible] |
| NZJ | 298 | 409 | 2116 | 1586 | 1325 | 1984 | 675 | 2562 | 413 | 2324 | 389 | 2309 | 2113 | 1985 | 2324 | 224 | 1774 |
| NZY | 290 | 473 | 2099 | 1585 | 1379 | 2002 | 737 | 2577 | 479 | 2328 | 449 | 2317 | 2103 | 1997 | 2324 | 243 | [illegible] |
| OFF | 1059 | 1370 | 1199 | 527 | 568 | 677 | 1030 | 1261 | 1211 | 1086 | 1436 | 1043 | 1092 | 701 | 1127 | 1344 | [illegible] |
| OSC | 1720 | 1991 | 1158 | 721 | 898 | 137 | 1603 | 643 | 1831 | 647 | 2062 | 555 | 980 | 296 | 760 | 1977 | [illegible] |

| | LUF | MCC | MCP | MEM | MIB | MTC | MUO | NCO | NFL | NGU | NGZ | NHK | NIP | NKO | NKT | NLC | NPA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 1590 | 2113 | 254 | 423 | 1510 | 865 | 1883 | 1107 | 1972 | 694 | 2157 | 764 | 236 | 712 | 600 | 2012 | 110 |
| PBG | 2204 | 2481 | 1267 | 1077 | 1349 | 483 | 2085 | 239 | 2320 | 561 | 2552 | 456 | 1078 | 547 | 701 | 2468 | 1237 |
| PHL | 2092 | 2450 | 930 | 855 | 1422 | 432 | 2090 | 235 | 2290 | 216 | 2516 | 116 | 742 | 381 | 356 | 2411 | 940 |
| PNE | 2092 | 2450 | 930 | 855 | 1422 | 432 | 2090 | 235 | 2290 | 216 | 2516 | 116 | 742 | 381 | 356 | 2411 | 940 |
| PSM | 2335 | 2633 | 1259 | 1160 | 1514 | 610 | 2243 | 127 | 2472 | 538 | 2703 | 451 | 1074 | 641 | 670 | 2615 | 1276 |
| PWT | 1103 | 620 | 2547 | 1884 | 980 | 1959 | 447 | 2515 | 590 | 2445 | 681 | 2384 | 2466 | 2041 | 2505 | 785 | 2204 |
| RCA | 891 | 1019 | 1621 | 949 | 300 | 1038 | 627 | 1617 | 859 | 1498 | 1093 | 1445 | 1524 | 1099 | 1552 | 1026 | 1291 |
| RDR | 1255 | 1359 | 1601 | 951 | 189 | 803 | 938 | 1347 | 1202 | 1312 | 1436 | 1238 | 1467 | 907 | 1395 | 1384 | 1311 |
| RME | 2097 | 2396 | 1148 | 949 | 1293 | 372 | 2010 | 243 | 2235 | 456 | 2466 | 347 | 959 | 420 | 597 | 2376 | 1108 |
| SAW | 1586 | 1802 | 1318 | 781 | 669 | 354 | 1399 | 866 | 1642 | 876 | 1875 | 788 | 1152 | 494 | 980 | 1802 | 1104 |
| SBD | 286 | 376 | 2103 | 1562 | 1277 | 1948 | 625 | 2528 | 368 | 2295 | 365 | 2278 | 2096 | 1953 | 2299 | 199 | 1764 |
| SKA | 1006 | 649 | 2329 | 1662 | 751 | 1726 | 313 | 2284 | 561 | 2212 | 724 | 2150 | 2243 | 1808 | 2274 | 782 | 1989 |
| SKF | 865 | 1451 | 980 | 649 | 1321 | 1264 | 1345 | 1731 | 1336 | 1377 | 1479 | 1406 | 1017 | 1177 | 1326 | 1318 | 672 |
| SSC | 1832 | 2292 | 436 | 540 | 1479 | 618 | 1999 | 727 | 2140 | 310 | 2346 | 389 | 246 | 459 | 224 | 2216 | 467 |
| SUU | 620 | 24 | 2371 | 1775 | 1232 | 2059 | 461 | 2644 | 183 | 2466 | 57 | 2433 | 2340 | 2092 | 2490 | 177 | 2024 |
| SZL | 1112 | 1503 | 986 | 313 | 783 | 629 | 1199 | 1185 | 1348 | 946 | 1562 | 924 | 888 | 602 | 968 | 1444 | 667 |
| TCM | 1085 | 601 | 2537 | 1875 | 979 | 1956 | 432 | 2513 | 571 | 2440 | 663 | 2380 | 2457 | 2036 | 2500 | 767 | 2193 |
| TIK | 865 | 1340 | 1027 | 431 | 920 | 930 | 1113 | 1464 | 1196 | 1178 | 1388 | 1175 | 983 | 882 | 1170 | 1251 | 678 |
| TWH | 2040 | 2447 | 716 | 757 | 1502 | 526 | 2115 | 425 | 2290 | 6 | 2508 | 116 | 531 | 409 | 136 | 2391 | 768 |
| VAD | 1709 | 2217 | 217 | 485 | 1546 | 814 | 1969 | 992 | 2073 | 574 | 2264 | 653 | 107 | 655 | 470 | 2123 | 244 |
| VPS | 1530 | 2053 | 309 | 378 | 1467 | 859 | 1826 | 1133 | 1913 | 726 | 2097 | 790 | 294 | 711 | 640 | 1951 | 52 |
| WRB | 1670 | 2156 | 342 | 402 | 1436 | 690 | 1889 | 908 | 2008 | 500 | 2206 | 565 | 193 | 532 | 419 | 2070 | 271 |
| WRI | 2130 | 2480 | 975 | 901 | 1437 | 453 | 2116 | 187 | 2320 | 257 | 2547 | 163 | 788 | 417 | 396 | 2444 | 989 |

| | NQX | NTD | NUW | NZJ | NZY | OFF | OSC | PAM | PBG | PHL | PNE | PSM | PWT | RCA | RDR | RME | SAW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 1661 | 725 | 1222 | 640 | 643 | 720 | 1378 | 1267 | 1856 | 1737 | 1737 | 1984 | 1185 | 650 | 985 | 1747 | 1259 |
| AEX | 817 | 1562 | 1958 | 1467 | 1453 | 704 | 1028 | 422 | 1375 | 1127 | 1127 | 1446 | 1934 | 1063 | 1159 | 1245 | 1071 |
| BAD | 911 | 1483 | 1860 | 1390 | 1380 | 617 | 991 | 500 | 1365 | 1137 | 1137 | 1447 | 1837 | 966 | 1073 | 1237 | 1014 |
| BIX | 598 | 1795 | 2163 | 1700 | 1685 | 843 | 1010 | 191 | 1282 | 996 | 996 | 1328 | 2142 | 1240 | 1281 | 1152 | 1104 |
| BYH | 915 | 1668 | 1876 | 1585 | 1586 | 498 | 686 | 454 | 1051 | 838 | 838 | 1138 | 1862 | 923 | 916 | 923 | 743 |
| CBM | 749 | 1761 | 2029 | 1673 | 1667 | 663 | 798 | 288 | 1103 | 846 | 846 | 1168 | 2013 | 1083 | 1084 | 973 | 886 |
| CHS | 572 | 2241 | 2435 | 2153 | 2148 | 1038 | 828 | 358 | 894 | 558 | 558 | 890 | 2425 | 1472 | 1373 | 776 | 1018 |
| COF | 270 | 2309 | 2620 | 2214 | 2199 | 1237 | 1124 | 328 | 1187 | 844 | 844 | 1166 | 2604 | 1667 | 1618 | 1074 | 1302 |
| CVS | 1473 | 906 | 1377 | 816 | 812 | 630 | 1266 | 1080 | 1731 | 1588 | 1588 | 1851 | 1344 | 680 | 971 | 1617 | 1175 |
| DAG | 990 | 2340 | 2345 | 2266 | 2274 | 1002 | 528 | 736 | 469 | 141 | 141 | 478 | 2346 | 1406 | 1204 | 353 | 759 |
| DCA | 1011 | 2339 | 2335 | 2267 | 2275 | 997 | 512 | 753 | 449 | 127 | 127 | 462 | 2337 | 1398 | 1192 | 332 | 743 |
| DLH | 1640 | 1646 | 1411 | 1605 | 1637 | 412 | 456 | 1192 | 921 | 981 | 981 | 1082 | 1419 | 556 | 252 | 856 | 233 |
| DMA | 1843 | 512 | 1269 | 408 | 385 | 1033 | 1690 | 1492 | 2166 | 2035 | 2035 | 2291 | 1222 | 920 | 1275 | 2055 | 1572 |
| DOV | 1078 | 2427 | 2394 | 2356 | 2366 | 1077 | 544 | 845 | 381 | 36 | 36 | 370 | 2398 | 1467 | 1242 | 280 | 779 |
| DYS | 1225 | 1135 | 1619 | 1039 | 1026 | 647 | 1206 | 849 | 1638 | 1451 | 1451 | 1740 | 1587 | 839 | 1064 | 1515 | 1163 |
| FEW | 1760 | 929 | 1000 | 884 | 916 | 466 | 1098 | 1314 | 1590 | 1545 | 1545 | 1737 | 980 | 221 | 574 | 1498 | 931 |
| FFO | 1056 | 1959 | 1977 | 1889 | 1900 | 616 | 332 | 656 | 646 | 477 | 477 | 743 | 1975 | 1026 | 863 | 520 | 491 |
| FWH | 1111 | 1261 | 1695 | 1166 | 1155 | 602 | 1110 | 722 | 1527 | 1328 | 1328 | 1623 | 1667 | 861 | 1043 | 1402 | 1087 |
| GFA | 2270 | 1002 | 525 | 1016 | 1074 | 879 | 1350 | 1813 | 1811 | 1864 | 1864 | 1975 | 527 | 446 | 647 | 1751 | 1127 |
| GON | 1282 | 2583 | 2468 | 2517 | 2532 | 1216 | 604 | 1069 | 228 | 194 | 194 | 150 | 2477 | 1576 | 1309 | 210 | 829 |
| GSB | 783 | 2340 | 2435 | 2259 | 2260 | 1053 | 694 | 575 | 674 | 331 | 331 | 660 | 2431 | 1478 | 1322 | 562 | 911 |
| GUS | 1140 | 1852 | 1852 | 1785 | 1798 | 497 | 305 | 715 | 708 | 585 | 585 | 823 | 1850 | 902 | 742 | 589 | 406 |
| HIF | 2081 | 633 | 720 | 621 | 671 | 833 | 1447 | 1649 | 1937 | 1909 | 1909 | 2088 | 686 | 480 | 836 | 1851 | 1261 |
| HMN | 1594 | 758 | 1374 | 659 | 644 | 827 | 1469 | 1231 | 1935 | 1786 | 1786 | 2053 | 1333 | 815 | 1137 | 1820 | 1373 |
| HST | 99 | 2391 | 2764 | 2291 | 2271 | 1398 | 1320 | 453 | 1374 | 1030 | 1030 | 1343 | 2745 | 1821 | 1795 | 1264 | 1494 |
| IAB | 1292 | 1245 | 1468 | 1169 | 1177 | 269 | 867 | 845 | 1331 | 1200 | 1200 | 1452 | 1449 | 557 | 704 | 1217 | 794 |
| IND | 1077 | 1846 | 1881 | 1775 | 1786 | 507 | 366 | 650 | 744 | 590 | 590 | 849 | 1877 | 925 | 788 | 621 | 471 |
| INH | 997 | 2339 | 2341 | 2266 | 2274 | 1000 | 522 | 741 | 463 | 137 | 137 | 473 | 2343 | 1403 | 1199 | 347 | 753 |
| KBY | 424 | 2199 | 2464 | 2107 | 2097 | 1075 | 957 | 237 | 1057 | 722 | 722 | 1054 | 2451 | 1507 | 1447 | 937 | 1129 |
| LFI | 929 | 2394 | 2425 | 2318 | 2323 | 1070 | 619 | 713 | 529 | 185 | 185 | 512 | 2425 | 1480 | 1288 | 423 | 848 |
| LGB | 2293 | 68 | 1039 | 43 | 92 | 1342 | 2000 | 1930 | 2489 | 2402 | 2402 | 2628 | 984 | 1091 | 1458 | 2389 | 1843 |
| LIZ | 1715 | 2791 | 2510 | 2739 | 2763 | 1437 | 776 | 1487 | 316 | 614 | 614 | 283 | 2529 | 1717 | 1389 | 445 | 935 |
| LRF | 952 | 1533 | 1811 | 1447 | 1444 | 488 | 819 | 501 | 1206 | 997 | 997 | 1296 | 1792 | 879 | 937 | 1079 | 844 |
| LSV | 2149 | 270 | 910 | 235 | 283 | 1101 | 1753 | 1759 | 2244 | 2171 | 2171 | 2386 | 860 | 835 | 1202 | 2147 | 1591 |
| LUF | 1955 | 396 | 1151 | 298 | 290 | 1059 | 1720 | 1590 | 2204 | 2092 | 2092 | 2335 | 1103 | 891 | 1255 | 2097 | 1586 |
| MCC | 2515 | 322 | 676 | 409 | 473 | 1370 | 1991 | 2113 | 2481 | 2450 | 2450 | 2635 | 620 | 1019 | 1359 | 2396 | 1802 |
| MCF | 226 | 2213 | 2566 | 2116 | 2099 | 1199 | 1158 | 254 | 1267 | 930 | 930 | 1259 | 2547 | 1621 | 1601 | 1148 | 1316 |
| MEM | 885 | 1671 | 1899 | 1586 | 1585 | 527 | 721 | 423 | 1077 | 855 | 855 | 1160 | 1884 | 949 | 951 | 949 | 781 |
| MIB | 1971 | 1342 | 970 | 1325 | 1379 | 568 | 898 | 1510 | 1349 | 1422 | 1422 | 1514 | 980 | 300 | 189 | 1293 | 669 |
| MTC | 1245 | 2046 | 1954 | 1984 | 2002 | 677 | 137 | 865 | 483 | 432 | 432 | 610 | 1959 | 1038 | 803 | 372 | 334 |
| MUO | 2320 | 647 | 485 | 675 | 737 | 1030 | 1603 | 1883 | 2085 | 2090 | 2090 | 2243 | 447 | 627 | 938 | 2010 | 1394 |
| NCO | 1308 | 2627 | 2505 | 2562 | 2577 | 1261 | 643 | 1107 | 239 | 235 | 235 | 127 | 2515 | 1617 | 1347 | 243 | 866 |
| NFL | 2383 | 361 | 643 | 413 | 479 | 1211 | 1831 | 1972 | 2320 | 2290 | 2290 | 2472 | 590 | 859 | 1202 | 2235 | 1642 |
| NGU | 899 | 2401 | 2445 | 2324 | 2329 | 1084 | 647 | 694 | 561 | 216 | 216 | 538 | 2445 | 1498 | 1312 | 456 | 876 |
| NGZ | 2552 | 290 | 738 | 389 | 449 | 1436 | 2062 | 2157 | 2552 | 2516 | 2516 | 2703 | 681 | 1093 | 1436 | 2466 | 1875 |
| NHK | 1001 | 2382 | 2382 | 2309 | 2317 | 1043 | 555 | 764 | 456 | 116 | 116 | 451 | 2384 | 1445 | 1238 | 347 | 788 |
| NIP | 400 | 2206 | 2480 | 2112 | 2103 | 1092 | 980 | 236 | 1078 | 742 | 742 | 1074 | 2466 | 1524 | 1467 | 959 | 1152 |
| NKO | 1094 | 2054 | 2040 | 1985 | 1997 | 701 | 296 | 712 | 547 | 381 | 381 | 641 | 2041 | 1099 | 907 | 420 | 494 |
| NKT | 762 | 2406 | 2509 | 2324 | 2324 | 1127 | 760 | 600 | 701 | 356 | 356 | 670 | 2505 | 1552 | 1395 | 537 | [illegible] |
| NLC | 2398 | 146 | 841 | 228 | 293 | 1334 | 1977 | 2012 | 2468 | 2411 | 2411 | 2615 | 785 | 1026 | 1384 | 2276 | 1802 |
| NPA | 578 | 1874 | 2223 | 1779 | 1765 | 883 | 994 | 110 | 1237 | 940 | 940 | 1276 | 2204 | 1291 | 1311 | 1105 | [illegible] |
| NQX | 0 | 2371 | 2760 | 2250 | 2227 | 1412 | 1379 | 462 | 1457 | 1114 | 1114 | 1432 | 2740 | 1828 | 1822 | 1344 | [illegible] |
| NTD | 2371 | 0 | 988 | 108 | 160 | 1369 | 2023 | 1982 | 2513 | 2435 | 2435 | 2655 | 932 | 1098 | 1463 | 2415 | 1866 |
| NUW | 2760 | 988 | 0 | 1054 | 1121 | 1397 | 1867 | 2311 | 2315 | 2386 | 2386 | 2481 | 57 | 962 | 1159 | 2263 | 1639 |
| NZJ | 2250 | 108 | 1054 | 0 | 67 | 1309 | 1967 | 1888 | 2456 | 2365 | 2365 | 2594 | 999 | 1067 | 1435 | 2255 | 1811 |
| NZY | 2227 | 160 | 1121 | 67 | 0 | 1329 | 1989 | 1875 | 2477 | 2376 | 2376 | 2612 | 1066 | 1105 | 1474 | 2373 | 1841 |
| OFF | 1412 | 1369 | 1397 | 1309 | 1329 | 0 | 662 | 951 | 1148 | 1080 | 1080 | 1286 | 1388 | 435 | 456 | 1047 | 546 |
| OSC | 1379 | 2023 | 1867 | 1967 | 1989 | 662 | 0 | 989 | 491 | 530 | 530 | 641 | 1875 | 978 | 708 | 406 | 236 |

|  | NQX | NTD | NUW | NZJ | NZY | OPP | OSC | PAM | PBG | PHL | PNE | PSM | PWT | RCA | RDR | RME | SAW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 462 | 1982 | 2311 | 1888 | 1875 | 951 | 989 | 0 | 1189 | 877 | 877 | 1214 | 2293 | 1369 | 1364 | 1062 | 1120 |
| PBG | 1457 | 2513 | 2315 | 2456 | 2477 | 1148 | 491 | 1189 | 0 | 345 | 345 | 167 | 2329 | 1464 | 1165 | 130 | 688 |
| PHL | 1114 | 2435 | 2386 | 2365 | 2376 | 1080 | 530 | 877 | 345 | 0 | 0 | 337 | 2391 | 1465 | 1232 | 246 | 765 |
| PNE | 1114 | 2435 | 2386 | 2365 | 2376 | 1080 | 530 | 877 | 345 | 0 | 0 | 337 | 2391 | 1465 | 1232 | 246 | 765 |
| PSM | 1432 | 2655 | 2481 | 2594 | 2612 | 1286 | 641 | 1214 | 167 | 337 | 337 | 0 | 2494 | 1619 | 1328 | 239 | 849 |
| PWT | 2740 | 932 | 57 | 999 | 1066 | 1388 | 1875 | 2293 | 2329 | 2391 | 2391 | 2494 | 0 | 955 | 1168 | 2273 | 1649 |
| RCA | 1828 | 1098 | 962 | 1067 | 1105 | 435 | 978 | 1369 | 1464 | 1465 | 1465 | 1619 | 955 | 0 | 369 | 1385 | 783 |
| RDR | 1822 | 1463 | 1159 | 1435 | 1474 | 456 | 708 | 1364 | 1165 | 1232 | 1232 | 1328 | 1168 | 369 | 0 | 1105 | 481 |
| RME | 1344 | 2415 | 2263 | 2355 | 2373 | 1047 | 406 | 1062 | 130 | 246 | 246 | 239 | 2273 | 1385 | 1105 | 0 | 625 |
| SAW | 1543 | 1860 | 1639 | 1813 | 1841 | 546 | 236 | 1120 | 688 | 765 | 765 | 849 | 1649 | 783 | 481 | 625 | 0 |
| SBD | 2241 | 110 | 1010 | 51 | 113 | 1272 | 1929 | 1872 | 2419 | 2333 | 2333 | 2558 | 956 | 1021 | 1389 | 2319 | 1772 |
| SKA | 2527 | 922 | 237 | 967 | 1032 | 1159 | 1643 | 2076 | 2100 | 2158 | 2158 | 2265 | 233 | 725 | 937 | 2043 | 1418 |
| SKF | 1095 | 1260 | 1824 | 1157 | 1132 | 832 | 1328 | 781 | 1724 | 1499 | 1499 | 1809 | 1790 | 1057 | 1267 | 1596 | 1316 |
| SSC | 641 | 2210 | 2378 | 2125 | 2122 | 982 | 754 | 385 | 834 | 504 | 504 | 840 | 2370 | 1416 | 1306 | 713 | 945 |
| SCU | 2529 | 314 | 692 | 405 | 468 | 1392 | 2014 | 2129 | 2503 | 2471 | 2471 | 2655 | 635 | 1042 | 1383 | 2418 | 1825 |
| SZL | 1197 | 1459 | 1593 | 1386 | 1396 | 216 | 659 | 736 | 1112 | 980 | 980 | 1231 | 1580 | 637 | 660 | 997 | 619 |
| TCM | 2729 | 913 | 75 | 980 | 1047 | 1381 | 1872 | 2283 | 2328 | 2388 | 2388 | 2493 | 19 | 948 | 1167 | 2272 | 1647 |
| TIK | 1207 | 1240 | 1561 | 1155 | 1155 | 412 | 966 | 777 | 1410 | 1247 | 1247 | 1521 | 1537 | 684 | 850 | 1291 | 918 |
| TWH | 894 | 2402 | 2448 | 2324 | 2329 | 1086 | 652 | 691 | 566 | 221 | 221 | 543 | 2448 | 1501 | 1316 | 462 | 880 |
| VAD | 443 | 2099 | 2383 | 2007 | 1996 | 1002 | 945 | 138 | 1093 | 768 | 768 | 1105 | 2369 | 1430 | 1390 | 969 | 1101 |
| VPS | 509 | 1922 | 2257 | 1828 | 1815 | 905 | 979 | 60 | 1204 | 901 | 901 | 1237 | 2238 | 1319 | 1326 | 1076 | 1100 |
| WRB | 567 | 2055 | 2292 | 1966 | 1959 | 901 | 820 | 200 | 990 | 678 | 678 | 1014 | 2279 | 1334 | 1276 | 863 | 976 |
| WRI | 1156 | 2471 | 2404 | 2402 | 2414 | 1111 | 541 | 926 | 307 | 49 | 49 | 289 | 2410 | 1490 | 1248 | 221 | 776 |

| | SBD | SKA | SKF | SSC | SUU | SZL | TCM | TIK | TWH | VAD | VPS | WRB | WRI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 616 | 1024 | 615 | 1486 | 868 | 757 | 1170 | 515 | 1686 | 1379 | 1207 | 1330 | 1775 |
| AEX | 1452 | 1729 | 384 | 721 | 1719 | 503 | 1923 | 397 | 993 | 547 | 362 | 533 | 1174 |
| BAD | 1373 | 1630 | 362 | 764 | 1631 | 424 | 1825 | 299 | 1021 | 616 | 440 | 586 | 1184 |
| BIX | 1685 | 1930 | 591 | 536 | 1950 | 627 | 2131 | 610 | 832 | 324 | 133 | 340 | 1044 |
| BYH | 1560 | 1639 | 673 | 545 | 1766 | 286 | 1854 | 431 | 749 | 508 | 411 | 419 | 883 |
| CBM | 1652 | 1793 | 659 | 460 | 1882 | 449 | 2003 | 526 | 716 | 358 | 243 | 293 | 894 |
| CHS | 2132 | 2197 | 1108 | 73 | 2350 | 850 | 2418 | 1002 | 349 | 227 | 402 | 194 | 604 |
| COF | 2199 | 2383 | 1090 | 375 | 2457 | 1030 | 2595 | 1103 | 625 | 236 | 388 | 343 | 888 |
| CVS | 796 | 1168 | 447 | 1310 | 1056 | 620 | 1329 | 345 | 1523 | 1194 | 1020 | 1149 | 1628 |
| DAG | 2236 | 2113 | 1367 | 367 | 2391 | 881 | 2342 | 1133 | 127 | 629 | 760 | 536 | 190 |
| DCA | 2236 | 2104 | 1376 | 386 | 2388 | 881 | 2333 | 1137 | 146 | 648 | 776 | 553 | 175 |
| DLH | 1562 | 1187 | 1238 | 1086 | 1597 | 560 | 1417 | 820 | 1071 | 1199 | 1161 | 1079 | 995 |
| DMA | 405 | 1114 | 749 | 1750 | 749 | 1061 | 1205 | 793 | 1971 | 1614 | 1431 | 1582 | 2075 |
| DOV | 2325 | 2164 | 1476 | 470 | 2468 | 971 | 2394 | 1232 | 185 | 735 | 871 | 646 | 81 |
| DYS | 1025 | 1403 | 219 | 1116 | 1305 | 551 | 1574 | 245 | 1357 | 971 | 789 | 941 | 1495 |
| FEW | 842 | 769 | 888 | 1421 | 926 | 620 | 970 | 564 | 1550 | 1394 | 1259 | 1311 | 1576 |
| FFO | 1857 | 1742 | 1078 | 458 | 2005 | 504 | 1970 | 780 | 474 | 617 | 648 | 492 | 515 |
| FWH | 1150 | 1473 | 232 | 984 | 1419 | 468 | 1654 | 193 | 1228 | 841 | 661 | 810 | 1372 |
| GFA | 966 | 294 | 1421 | 1858 | 822 | 1083 | 524 | 1096 | 1923 | 1877 | 1762 | 1780 | 1884 |
| GON | 2483 | 2246 | 1687 | 692 | 2601 | 1140 | 2475 | 1419 | 393 | 957 | 1095 | 870 | 145 |
| GSB | 2232 | 2199 | 1278 | 190 | 2420 | 897 | 2425 | 1106 | 119 | 452 | 610 | 384 | 376 |
| GUS | 1751 | 1617 | 1035 | 568 | 1888 | 409 | 1845 | 702 | 599 | 697 | 697 | 573 | 619 |
| HIF | 572 | 520 | 1104 | 1783 | 567 | 983 | 672 | 875 | 1917 | 1739 | 1591 | 1663 | 1939 |
| HMN | 648 | 1185 | 509 | 1489 | 954 | 823 | 1317 | 540 | 1714 | 1353 | 1171 | 1320 | 1828 |
| HST | 2281 | 2529 | 1143 | 572 | 2558 | 1186 | 2735 | 1221 | 809 | 405 | 507 | 524 | 1071 |
| IAB | 1140 | 1235 | 566 | 982 | 1228 | 221 | 1439 | 146 | 1156 | 929 | 789 | 853 | 1238 |
| IND | 1743 | 1646 | 987 | 519 | 1894 | 391 | 1872 | 672 | 579 | 634 | 631 | 511 | 628 |
| INH | 2235 | 2109 | 1369 | 373 | 2390 | 881 | 2338 | 1134 | 133 | 635 | 765 | 541 | 186 |
| KBY | 2089 | 2227 | 1017 | 224 | 2330 | 872 | 2442 | 973 | 512 | 102 | 293 | 174 | 768 |
| LFI | 2289 | 2192 | 1383 | 331 | 2455 | 937 | 2420 | 1175 | 39 | 596 | 743 | 517 | 228 |
| LGB | 71 | 961 | 1200 | 2166 | 377 | 1423 | 965 | 1195 | 2363 | 2049 | 1870 | 2007 | 2439 |
| LIZ | 2700 | 2307 | 2040 | 1118 | 2759 | 1419 | 2531 | 1720 | 826 | 1382 | 1507 | 1287 | 567 |
| LRF | 1425 | 1576 | 519 | 678 | 1649 | 277 | 1782 | 295 | 902 | 589 | 446 | 525 | 1042 |
| LSV | 187 | 784 | 1077 | 1964 | 386 | 1198 | 842 | 997 | 2145 | 1869 | 1698 | 1816 | 2206 |
| LUF | 286 | 1006 | 865 | 1832 | 620 | 1112 | 1085 | 865 | 2040 | 1709 | 1530 | 1670 | 2100 |
| MCC | 376 | 449 | 1451 | 2292 | 24 | 1503 | 601 | 1340 | 2447 | 2217 | 2053 | 2156 | 2480 |
| MCF | 2103 | 2329 | 980 | 436 | 2371 | 986 | 2537 | 1027 | 716 | 217 | 309 | 342 | 971 |
| MEM | 1562 | 1662 | 649 | 540 | 1775 | 313 | 1875 | 431 | 757 | 485 | 378 | 402 | 901 |
| MIB | 1277 | 751 | 1321 | 1479 | 1232 | 783 | 979 | 920 | 1502 | 1546 | 1467 | 1436 | 1437 |
| MTC | 1948 | 1726 | 1264 | 618 | 2079 | 529 | 1956 | 930 | 526 | 814 | 859 | 690 | 453 |
| MUO | 625 | 313 | 1345 | 1999 | 461 | 1199 | 432 | 1113 | 2115 | 1969 | 1826 | 1889 | 2116 |
| NCO | 2528 | 2234 | 1731 | 727 | 2644 | 1185 | 2513 | 1464 | 425 | 992 | 1133 | 908 | 187 |
| NFL | 368 | 561 | 1336 | 2140 | 183 | 1358 | 571 | 1196 | 2290 | 2073 | 1913 | 2008 | 2320 |
| NGU | 2295 | 2212 | 1377 | 310 | 2466 | 946 | 2440 | 1178 | 6 | 574 | 726 | 500 | 257 |
| NGZ | 365 | 724 | 1679 | 2346 | 57 | 1562 | 663 | 1388 | 2508 | 2264 | 2097 | 2206 | 2547 |
| NHK | 2278 | 2150 | 1466 | 389 | 2433 | 924 | 2380 | 1175 | 116 | 653 | 790 | 565 | 163 |
| NIP | 2046 | 2253 | 1017 | 246 | 2340 | 808 | 2457 | 983 | 531 | 107 | 294 | 193 | 788 |
| NBG | 1953 | 1898 | 1177 | 574 | 2092 | 602 | 2036 | 882 | 409 | 655 | 711 | 532 | 417 |
| NKT | 2209 | 2274 | 1326 | 224 | 2441 | 968 | 2550 | 1170 | 136 | 470 | 640 | 419 | 396 |
| NLC | 199 | 762 | 1319 | 2214 | 177 | 1444 | 767 | 1251 | 2391 | 2123 | 1931 | 2073 | 2444 |
| NPA | 1744 | 1939 | 672 | 462 | 2024 | 467 | 2133 | 674 | 768 | 244 | 52 | 271 | 989 |
| NQX | 2241 | 2527 | 1047 | 641 | 2524 | 1137 | 2729 | 1207 | 894 | 443 | 509 | 567 | 1156 |
| NTD | 110 | 922 | 1260 | 2219 | 314 | 1479 | 913 | 1240 | 2402 | 2099 | 1922 | 2055 | 2471 |
| NUW | 1013 | 237 | 1824 | 2370 | 642 | 1543 | 75 | 1561 | 2448 | 2383 | 2257 | 2292 | 2404 |
| NZJ | 51 | 967 | 1157 | 2125 | 445 | 1386 | 959 | 1155 | 2324 | 2007 | 1829 | 1966 | 2402 |
| NZY | 113 | 1032 | 1132 | 2122 | 468 | 1396 | 1047 | 1155 | 2329 | 1996 | 1815 | 1959 | 2414 |
| OFF | 1272 | 1159 | 832 | 982 | 1392 | 216 | 1381 | 412 | 1086 | 1002 | 905 | 901 | 1111 |
| OSC | 1929 | 1643 | 1328 | 754 | 2014 | 659 | 1872 | 966 | 652 | 945 | 979 | 820 | 541 |

|  | SBD | SKA | SKF | SSC | SUU | SZL | TCM | TIK | TWH | VAD | VPS | WRB | WRI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 1872 | 2076 | 781 | 385 | 2129 | 736 | 2283 | 777 | 691 | 138 | 60 | 200 | 926 |
| PBG | 2419 | 2100 | 1724 | 834 | 2503 | 1112 | 2328 | 1410 | 566 | 1093 | 1204 | 990 | 307 |
| PHL | 2333 | 2158 | 1499 | 504 | 2471 | 980 | 2388 | 1247 | 221 | 768 | 901 | 678 | 49 |
| PNE | 2333 | 2158 | 1499 | 504 | 2471 | 980 | 2388 | 1247 | 221 | 768 | 901 | 678 | 49 |
| PSM | 2558 | 2265 | 1809 | 840 | 2655 | 1231 | 2493 | 1521 | 543 | 1105 | 1237 | 1014 | 289 |
| PWT | 956 | 233 | 1790 | 2370 | 635 | 1580 | 19 | 1537 | 2448 | 2369 | 2238 | 2279 | 2410 |
| RCA | 1021 | 725 | 1057 | 1416 | 1042 | 637 | 948 | 684 | 1501 | 1430 | 1319 | 1334 | 1490 |
| RDR | 1389 | 937 | 1267 | 1306 | 1383 | 660 | 1167 | 850 | 1316 | 1390 | 1326 | 1276 | 1248 |
| RME | 2319 | 2043 | 1596 | 713 | 2418 | 997 | 2272 | 1291 | 462 | 969 | 1076 | 863 | 221 |
| SAW | 1772 | 1418 | 1316 | 945 | 1825 | 619 | 1647 | 918 | 880 | 1101 | 1100 | 976 | 776 |
| SBD | 0 | 918 | 1151 | 2102 | 375 | 1355 | 937 | 1131 | 2296 | 1989 | 1812 | 1945 | 2369 |
| SKA | 918 | 0 | 1613 | 2141 | 669 | 1356 | 230 | 1331 | 2215 | 2147 | 2022 | 2055 | 2177 |
| SKF | 1151 | 1613 | 0 | 1104 | 1463 | 697 | 1776 | 420 | 1375 | 915 | 724 | 914 | 1545 |
| SSC | 2102 | 2141 | 1104 | 0 | 2311 | 801 | 2363 | 970 | 306 | 265 | 420 | 196 | 551 |
| SUU | 375 | 669 | 1463 | 2311 | 0 | 1523 | 617 | 1357 | 2468 | 2234 | 2069 | 2173 | 2502 |
| SZL | 1355 | 1356 | 697 | 801 | 1523 | 0 | 1572 | 308 | 947 | 793 | 689 | 699 | 1018 |
| TCM | 937 | 230 | 1776 | 2363 | 617 | 1572 | 0 | 1526 | 2443 | 2359 | 2228 | 2271 | 2407 |
| TIK | 1131 | 1331 | 420 | 970 | 1357 | 308 | 1526 | 0 | 1178 | 877 | 719 | 819 | 1289 |
| TWH | 2296 | 2215 | 1375 | 306 | 2468 | 947 | 2443 | 1178 | 0 | 570 | 723 | 497 | 262 |
| VAD | 1989 | 2147 | 915 | 265 | 2234 | 793 | 2359 | 877 | 570 | 0 | 191 | 125 | 816 |
| VPS | 1812 | 2022 | 724 | 420 | 2069 | 689 | 2228 | 719 | 723 | 191 | 0 | 227 | 950 |
| WRB | 1945 | 2055 | 914 | 196 | 2173 | 699 | 2271 | 819 | 497 | 125 | 227 | 0 | 726 |
| WRI | 2369 | 2177 | 1545 | 551 | 2502 | 1018 | 2407 | 1289 | 262 | 816 | 950 | 726 | 0 |

## Combined System Inter-locational surface statute mileage

| LOC | ABQ | AEX | BAD | BIX | BYH | CBM | CHS | COF | CVS | DAG | DCA | DLH | DMA | DOV | DYS | PEW | FFO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 0 | 1022 | 920 | 1301 | 1134 | 1244 | 1819 | 1914 | 226 | 1959 | 1960 | 1301 | 376 | 2071 | 525 | 516 | 1513 |
| AEX | 1022 | 0 | 118 | 280 | 410 | 337 | 872 | 897 | 797 | 1190 | 1202 | 1267 | 1283 | 1323 | 513 | 1153 | 885 |
| BAD | 920 | 118 | 0 | 383 | 378 | 368 | 935 | 994 | 696 | 1208 | 1218 | 1179 | 1199 | 1338 | 428 | 1034 | 865 |
| BIX | 1301 | 280 | 383 | 0 | 447 | 261 | 632 | 617 | 1076 | 1026 | 1043 | 1365 | 1562 | 1160 | 793 | 1395 | 824 |
| BYH | 1134 | 410 | 378 | 447 | 0 | 202 | 701 | 893 | 931 | 858 | 865 | 918 | 1467 | 983 | 736 | 1071 | 487 |
| CBM | 1244 | 337 | 368 | 261 | 202 | 0 | 577 | 711 | 1028 | 853 | 865 | 1112 | 1551 | 986 | 787 | 1243 | 578 |
| CHS | 1819 | 872 | 935 | 632 | 701 | 577 | 0 | 365 | 1605 | 510 | 534 | 1387 | 2128 | 628 | 1361 | 1764 | 635 |
| COF | 1914 | 897 | 994 | 617 | 893 | 711 | 365 | 0 | 1690 | 864 | 889 | 1701 | 2178 | 971 | 1410 | 1954 | 973 |
| CVS | 226 | 797 | 696 | 1076 | 931 | 1028 | 1605 | 1690 | 0 | 1772 | 1775 | 1231 | 538 | 1889 | 303 | 574 | 1339 |
| DAG | 1959 | 1190 | 1208 | 1026 | 858 | 853 | 510 | 864 | 1772 | 0 | 26 | 1147 | 2310 | 135 | 1594 | 1762 | 464 |
| DCA | 1960 | 1202 | 1218 | 1043 | 865 | 865 | 534 | 889 | 1775 | 26 | 0 | 1132 | 2313 | 121 | 1601 | 1756 | 459 |
| DLH | 1301 | 1267 | 1179 | 1365 | 918 | 1112 | 1387 | 1701 | 1231 | 1147 | 1132 | 0 | 1670 | 1189 | 1270 | 865 | 758 |
| DMA | 376 | 1283 | 1199 | 1562 | 1467 | 1551 | 2128 | 2178 | 538 | 2310 | 2313 | 1670 | 0 | 2427 | 772 | 844 | 1874 |
| DOV | 2071 | 1323 | 1338 | 1160 | 983 | 986 | 628 | 971 | 1889 | 135 | 121 | 1189 | 2427 | 0 | 1719 | 1851 | 562 |
| DYS | 525 | 513 | 428 | 793 | 736 | 787 | 1361 | 1410 | 303 | 1594 | 1601 | 1270 | 772 | 1719 | 0 | 803 | 1197 |
| PEW | 516 | 1153 | 1034 | 1395 | 1071 | 1243 | 1764 | 1954 | 574 | 1762 | 1756 | 865 | 844 | 1851 | 803 | 0 | 1298 |
| FFO | 1513 | 885 | 865 | 824 | 487 | 578 | 635 | 973 | 1339 | 464 | 459 | 758 | 1874 | 562 | 1197 | 1298 | 0 |
| FWH | 661 | 362 | 270 | 642 | 587 | 629 | 1203 | 1258 | 435 | 1443 | 1451 | 1208 | 929 | 1570 | 158 | 860 | 1059 |
| GFA | 1058 | 1787 | 1669 | 2014 | 1643 | 1833 | 2299 | 2536 | 1189 | 2184 | 2173 | 1074 | 1259 | 2245 | 1445 | 646 | 1742 |
| GON | 2276 | 1581 | 1590 | 1428 | 1225 | 1245 | 889 | 1219 | 2196 | 402 | 385 | 1270 | 2640 | 269 | 1956 | 2011 | 767 |
| GSB | 1943 | 1073 | 1114 | 866 | 809 | 746 | 277 | 616 | 1740 | 251 | 277 | 1301 | 2275 | 355 | 1527 | 1813 | 553 |
| GUS | 1397 | 868 | 828 | 856 | 458 | 597 | 765 | 1087 | 1234 | 608 | 601 | 622 | 1763 | 696 | 1118 | 1156 | 151 |
| HIF | 606 | 1520 | 1405 | 1782 | 1496 | 1657 | 2194 | 2364 | 789 | 2201 | 2196 | 1243 | 747 | 2289 | 1083 | 441 | 1738 |
| HMN | 209 | 971 | 885 | 1250 | 1158 | 1237 | 1813 | 1867 | 244 | 2007 | 2011 | 1457 | 315 | 2126 | 458 | 717 | 1580 |
| HST | 2029 | 1008 | 1117 | 735 | 1081 | 886 | 600 | 236 | 1803 | 1092 | 1118 | 1923 | 2264 | 1193 | 1510 | 2119 | 1205 |
| IAB | 644 | 608 | 491 | 835 | 526 | 684 | 1228 | 1394 | 481 | 1316 | 1317 | 817 | 1008 | 1427 | 453 | 563 | 869 |
| IND | 1378 | 798 | 764 | 777 | 390 | 519 | 703 | 1016 | 1206 | 597 | 594 | 687 | 1739 | 698 | 1074 | 1166 | 136 |
| INH | 1959 | 1193 | 1210 | 1031 | 859 | 856 | 518 | 872 | 1772 | 8 | 17 | 1142 | 2311 | 130 | 1595 | 1759 | 462 |
| KBY | 1773 | 779 | 861 | 511 | 707 | 539 | 196 | 208 | 1552 | 705 | 729 | 1494 | 2059 | 824 | 1287 | 1776 | 767 |
| LFI | 2017 | 1204 | 1232 | 1018 | 898 | 869 | 454 | 792 | 1824 | 109 | 131 | 1251 | 2362 | 179 | 1631 | 1841 | 546 |
| LGB | 816 | 1811 | 1719 | 2091 | 1950 | 2057 | 2633 | 2708 | 1029 | 2765 | 2765 | 1959 | 541 | 2872 | 1298 | 1095 | 2311 |
| LIZ | 2584 | 2028 | 2018 | 1908 | 1641 | 1700 | 1405 | 1739 | 2443 | 903 | 881 | 1394 | 2958 | 778 | 2341 | 2234 | 1155 |
| LRF | 970 | 278 | 207 | 434 | 191 | 279 | 849 | 984 | 759 | 1047 | 1055 | 989 | 1290 | 1174 | 547 | 975 | 671 |
| LSV | 590 | 1612 | 1511 | 1891 | 1704 | 1828 | 2398 | 2504 | 815 | 2495 | 2493 | 1654 | 454 | 2597 | 1109 | 792 | 2036 |
| LUF | 426 | 1402 | 1311 | 1682 | 1555 | 1653 | 2230 | 2299 | 627 | 2385 | 2386 | 1672 | 156 | 2497 | 889 | 819 | 1939 |
| MCC | 1025 | 2044 | 1939 | 2321 | 2097 | 2238 | 2798 | 2928 | 1250 | 2844 | 2840 | 1889 | 891 | 2936 | 1549 | 1086 | 2331 |
| MCF | 1307 | 785 | 889 | 506 | 841 | 646 | 448 | 152 | 1581 | 958 | 982 | 1697 | 2057 | 1074 | 1294 | 1980 | 999 |
| MEM | 1136 | 370 | 346 | 402 | 46 | 163 | 690 | 865 | 928 | 874 | 882 | 963 | 1462 | 1002 | 721 | 1093 | 523 |
| MIB | 1140 | 1518 | 1408 | 1692 | 1268 | 1469 | 1853 | 2133 | 1167 | 1669 | 1655 | 530 | 1459 | 1717 | 1329 | 625 | 1251 |
| MTC | 1651 | 1129 | 1098 | 1080 | 722 | 832 | 829 | 1186 | 1498 | 488 | 471 | 663 | 2021 | 528 | 1394 | 1361 | 276 |
| MUO | 886 | 1808 | 1692 | 2067 | 1765 | 1933 | 2458 | 2643 | 1078 | 2430 | 2423 | 1400 | 962 | 2509 | 1374 | 695 | 1970 |
| NCO | 2330 | 1633 | 1643 | 1476 | 1278 | 1296 | 929 | 1252 | 2160 | 450 | 434 | 1316 | 2694 | 316 | 2010 | 2064 | 822 |
| NFL | 873 | 1892 | 1773 | 2156 | 1916 | 2062 | 2618 | 2759 | 1095 | 2654 | 2649 | 1697 | 798 | 2745 | 1397 | 894 | 2130 |
| NGP | 2023 | 1194 | 1226 | 1001 | 899 | 861 | 424 | 757 | 1827 | 146 | 169 | 1281 | 2365 | 216 | 1629 | 1857 | 566 |
| NGZ | 1071 | 2093 | 1990 | 2371 | 2161 | 2297 | 2861 | 2982 | 1297 | 2920 | 2916 | 1978 | 905 | 3014 | 1592 | 1165 | 2457 |
| NHK | 2010 | 1235 | 1255 | 1066 | 907 | 898 | 531 | 878 | 1823 | 51 | 56 | 1187 | 2361 | 98 | 1643 | 1811 | 513 |
| NIP | 1793 | 783 | 868 | 512 | 725 | 553 | 221 | 182 | 1561 | 731 | 755 | 1520 | 2065 | 849 | 1293 | 1792 | 794 |
| NKO | 1632 | 997 | 982 | 916 | 605 | 680 | 638 | 994 | 1460 | 368 | 359 | 799 | 1995 | 451 | 1319 | 1430 | 122 |
| NKT | 2021 | 1131 | 1173 | 911 | 887 | 811 | 292 | 595 | 1816 | 305 | 330 | 1388 | 2349 | 385 | 1596 | 1899 | 642 |
| NLC | [illegible] | 1914 | 1814 | 2194 | 2006 | 2192 | 2702 | 2808 | 1118 | 2747 | [illegible] | 1897 | 704 | 2886 | 1408 | 1054 | [illegible] |
| NMA | 1392 | [illegible] | 472 | [illegible] | 474 | 274 | 542 | 523 | 1168 | 959 | 977 | 1385 | 1678 | 1093 | 855 | 1463 | [illegible] |
| NQX | [illegible] | [illegible] | [illegible] | 718 | 1094 | 999 | 686 | 324 | 1763 | 1188 | 1214 | 1967 | 2212 | 1294 | 1679 | 2112 | [illegible] |
| NTD | [illegible] | 1674 | 1740 | 2174 | [illegible] | 2114 | 2689 | 2771 | 1087 | 2808 | 2807 | 1975 | 614 | 2913 | 1362 | 1115 | [illegible] |
| NUW | 1467 | [illegible] | 2292 | 2596 | 2252 | [illegible] | 2921 | 3143 | 1653 | 2814 | 2802 | 1693 | [illegible] | [illegible] | 1942 | [illegible] | [illegible] |
| NZJ | [illegible] | 1760 | 1668 | 2046 | 1902 | 2098 | 2584 | 2657 | 980 | 2720 | 2720 | 1926 | 490 | 2828 | 1247 | 1701 | [illegible] |
| NZY | 771 | 1743 | 1656 | 2023 | 1903 | 2001 | 2578 | 2639 | 975 | 2729 | 2730 | 1965 | 462 | 2839 | 1231 | 1099 | [illegible] |
| OFF | 864 | 845 | 740 | 1011 | 598 | 796 | 1246 | 1485 | 755 | 1202 | 1197 | 494 | 1239 | 1292 | 776 | 560 | 739 |
| OZR | 1653 | 1233 | 1189 | 1212 | 824 | 957 | 993 | 1349 | 1519 | 634 | 614 | 548 | 2028 | 653 | 1447 | 1318 | 399 |

| LOC | ABQ | AEX | BAD | BIX | BYH | CBM | CHS | COF | CVS | DAG | DCA | DLH | DMA | DOV | DYS | PEW | PPO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 1520 | 506 | 600 | 230 | 545 | 345 | 430 | 394 | 1296 | 883 | 904 | 1431 | 1790 | 1014 | 1019 | 1576 | 788 |
| PBG | 2227 | 1650 | 1638 | 1538 | 1261 | 1324 | 1073 | 1425 | 2078 | 563 | 539 | 1105 | 2600 | 457 | 1965 | 1908 | 776 |
| PHL | 2084 | 1352 | 1365 | 1195 | 1006 | 1015 | 670 | 1013 | 1905 | 170 | 152 | 1177 | 2442 | 43 | 1741 | 1854 | 572 |
| PNE | 2084 | 1352 | 1365 | 1195 | 1006 | 1015 | 670 | 1013 | 1905 | 170 | 152 | 1177 | 2442 | 43 | 1741 | 1854 | 572 |
| PSM | 2381 | 1735 | 1737 | 1594 | 1365 | 1401 | 1068 | 1399 | 2221 | 574 | 554 | 1298 | 2750 | 444 | 2088 | 2084 | 891 |
| PWT | 1422 | 2321 | 2204 | 2571 | 2235 | 2415 | 2910 | 3125 | 1612 | 2815 | 2804 | 1703 | 1467 | 2877 | 1905 | 1176 | 2370 |
| RCA | 780 | 1276 | 1159 | 1489 | 1108 | 1299 | 1767 | 2000 | 816 | 1687 | 1678 | 668 | 1105 | 1761 | 1007 | 265 | 1232 |
| RDR | 1182 | 1391 | 1287 | 1537 | 1099 | 1301 | 1648 | 1942 | 1165 | 1444 | 1430 | 303 | 1530 | 1491 | 1277 | 688 | 1035 |
| RME | 2096 | 1494 | 1485 | 1382 | 1108 | 1168 | 931 | 1288 | 1940 | 424 | 399 | 1027 | 2466 | 336 | 1818 | 1797 | 624 |
| SAW | 1511 | 1285 | 1217 | 1324 | 892 | 1064 | 1221 | 1562 | 1410 | 910 | 892 | 280 | 1886 | 935 | 1395 | 1117 | 589 |
| SBD | 739 | 1742 | 1648 | 2022 | 1872 | 1982 | 2558 | 2639 | 955 | 2683 | 2683 | 1874 | 486 | 2790 | 1230 | 1010 | 2228 |
| SKA | 1229 | 2074 | 1957 | 2317 | 1967 | 2152 | 2637 | 2860 | 1401 | 2536 | 2524 | 1425 | 1336 | 2597 | 1683 | 922 | 2091 |
| SKF | 738 | 461 | 434 | 709 | 808 | 791 | 1329 | 1309 | 536 | 1640 | 1651 | 1486 | 899 | 1772 | 263 | 1066 | 1293 |
| SSC | 1783 | 865 | 917 | 643 | 654 | 552 | 88 | 450 | 1572 | 440 | 463 | 1303 | 2101 | 564 | 1339 | 1705 | 549 |
| SUU | 1042 | 2062 | 1957 | 2340 | 2119 | 2258 | 2820 | 2948 | 1268 | 2869 | 2865 | 1917 | 899 | 2962 | 1566 | 1111 | 2406 |
| SZL | 909 | 603 | 508 | 752 | 343 | 538 | 1020 | 1236 | 744 | 1058 | 1057 | 671 | 1273 | 1165 | 661 | 744 | 605 |
| TCM | 1404 | 2307 | 2190 | 2558 | 2224 | 2404 | 2901 | 3114 | 1595 | 2810 | 2799 | 1700 | 1446 | 2873 | 1889 | 1164 | 2364 |
| TIK | 618 | 477 | 359 | 732 | 517 | 632 | 1202 | 1324 | 414 | 1360 | 1364 | 985 | 952 | 1479 | 294 | 676 | 936 |
| TWH | 2023 | 1192 | 1225 | 998 | 899 | 859 | 419 | 750 | 1827 | 152 | 176 | 1285 | 2365 | 222 | 1628 | 1860 | 569 |
| VAD | 1655 | 656 | 740 | 389 | 609 | 430 | 272 | 284 | 1433 | 755 | 778 | 1439 | 1937 | 882 | 1165 | 1672 | 740 |
| VPS | 1448 | 434 | 528 | 160 | 493 | 291 | 482 | 466 | 1224 | 912 | 931 | 1393 | 1718 | 1045 | 947 | 1510 | 777 |
| WRB | 1596 | 639 | 703 | 408 | 502 | 352 | 233 | 411 | 1379 | 644 | 664 | 1294 | 1899 | 775 | 1130 | 1573 | 590 |
| WRI | 2131 | 1409 | 1421 | 1253 | 1060 | 1073 | 725 | 1065 | 1954 | 228 | 210 | 1195 | 2490 | 97 | 1794 | 1891 | 617 |

| LOC | FWH | GPA | GON | GSB | GUS | HIP | HMN | HST | IAB | IND | INH | KBY | LPI | LGB | LIZ | LRF | LSV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 661 | 1058 | 2276 | 1943 | 1397 | 606 | 209 | 2029 | 644 | 1378 | 1959 | 1773 | 2017 | 816 | 2584 | 970 | 590 |
| AEX | 362 | 1787 | 1581 | 1073 | 868 | 1520 | 971 | 1008 | 608 | 798 | 1193 | 779 | 1204 | 1811 | 2028 | 278 | 1612 |
| BAD | 270 | 1669 | 1590 | 1114 | 828 | 1405 | 885 | 1117 | 491 | 764 | 1210 | 861 | 1232 | 1719 | 2018 | 207 | 1511 |
| BIX | 642 | 2014 | 1428 | 866 | 856 | 1782 | 1250 | 735 | 835 | 777 | 1031 | 511 | 1018 | 2091 | 1908 | 434 | 1891 |
| BYH | 587 | 1643 | 1225 | 809 | 458 | 1496 | 1158 | 1081 | 526 | 390 | 859 | 707 | 898 | 1950 | 1641 | 191 | 1704 |
| CBM | 629 | 1833 | 1245 | 746 | 597 | 1657 | 1237 | 886 | 684 | 519 | 856 | 539 | 869 | 2057 | 1700 | 279 | 1828 |
| CHS | 1203 | 2299 | 889 | 277 | 765 | 2194 | 1813 | 600 | 1228 | 703 | 518 | 196 | 454 | 2633 | 1405 | 849 | 2398 |
| COF | 1258 | 2536 | 1219 | 616 | 1087 | 2364 | 1867 | 236 | 1394 | 1016 | 872 | 208 | 792 | 2708 | 1739 | 984 | 2504 |
| CVS | 435 | 1189 | 2106 | 1740 | 1234 | 789 | 244 | 1803 | 481 | 1206 | 1772 | 1552 | 1824 | 1029 | 2443 | 759 | 815 |
| DAG | 1443 | 2184 | 402 | 251 | 608 | 2201 | 2007 | 1092 | 1316 | 597 | 8 | 705 | 109 | 2765 | 903 | 1047 | 2495 |
| DCA | 1451 | 2173 | 385 | 277 | 601 | 2196 | 2011 | 1118 | 1317 | 594 | 17 | 729 | 131 | 2765 | 881 | 1055 | 2493 |
| DLH | 1208 | 1074 | 1270 | 1301 | 622 | 1243 | 1457 | 1923 | 817 | 687 | 1142 | 1494 | 1251 | 1959 | 1394 | 989 | 1654 |
| DMA | 929 | 1259 | 2640 | 2275 | 1763 | 747 | 315 | 2264 | 1008 | 1739 | 2311 | 2059 | 2362 | 541 | 2958 | 1290 | 454 |
| DOV | 1570 | 2245 | 269 | 355 | 696 | 2289 | 2126 | 1193 | 1427 | 698 | 130 | 824 | 179 | 2872 | 778 | 1174 | 2597 |
| DYS | 158 | 1445 | 1956 | 1527 | 1118 | 1083 | 458 | 1510 | 453 | 1074 | 1595 | 1287 | 1631 | 1298 | 2341 | 547 | 1109 |
| FEW | 860 | 646 | 2011 | 1813 | 1156 | 441 | 717 | 2119 | 563 | 1166 | 1759 | 1776 | 1841 | 1095 | 2234 | 975 | 792 |
| FFO | 1059 | 1742 | 767 | 553 | 151 | 1738 | 1580 | 1205 | 869 | 136 | 462 | 767 | 546 | 2311 | 1155 | 671 | 2036 |
| FWH | 0 | 1506 | 1811 | 1370 | 991 | 1185 | 614 | 1368 | 407 | 940 | 1445 | 1131 | 1477 | 1451 | 2210 | 397 | 1250 |
| GFA | 1506 | 0 | 2344 | 2292 | 1591 | 516 | 1265 | 2719 | 1182 | 1628 | 2180 | 2344 | 2280 | 1228 | 2432 | 1583 | 955 |
| GON | 1811 | 2344 | 0 | 613 | 880 | 2442 | 2347 | 1432 | 1633 | 901 | 397 | 1085 | 435 | 3064 | 520 | 1416 | 2779 |
| GSB | 1370 | 2292 | 613 | 0 | 703 | 2252 | 1964 | 842 | 1317 | 664 | 259 | 473 | 178 | 2758 | 1130 | 986 | 2504 |
| GUS | 991 | 1591 | 880 | 703 | 0 | 1595 | 1477 | 1314 | 755 | 80 | 605 | 879 | 694 | 2185 | 1223 | 624 | 1905 |
| HIF | 1185 | 516 | 2442 | 2252 | 1595 | 0 | 798 | 2515 | 973 | 1606 | 2199 | 2195 | 2282 | 765 | 2635 | 1381 | 466 |
| HMN | 614 | 1265 | 2347 | 1964 | 1477 | 798 | 0 | 1960 | 725 | 1447 | 2008 | 1745 | 2055 | 842 | 2687 | 978 | 682 |
| HST | 1368 | 2719 | 1432 | 842 | 1314 | 2515 | 1960 | 0 | 1556 | 1241 | 1100 | 438 | 1014 | 2801 | 1951 | 1144 | 2618 |
| IAB | 407 | 1182 | 1633 | 1317 | 755 | 973 | 725 | 1556 | 0 | 733 | 1316 | 1222 | 1378 | 1449 | 1962 | 412 | 1187 |
| IND | 940 | 1628 | 901 | 664 | 80 | 1606 | 1447 | 1241 | 733 | 0 | 596 | 808 | 675 | 2175 | 1269 | 563 | 1900 |
| INH | 1445 | 2180 | 397 | 259 | 605 | 2199 | 2008 | 1100 | 1316 | 596 | 0 | 713 | 116 | 2764 | 896 | 1049 | 2494 |
| KBY | 1131 | 2344 | 1085 | 473 | 879 | 2195 | 1745 | 438 | 1222 | 808 | 713 | 0 | 650 | 2579 | 1602 | 818 | 2361 |
| LFI | 1477 | 2280 | 435 | 178 | 694 | 2282 | 2055 | 1014 | 1378 | 675 | 116 | 650 | 0 | 2827 | 952 | 1084 | 2562 |
| LGB | 1451 | 1228 | 3064 | 2758 | 2185 | 765 | 842 | 2801 | 1449 | 2175 | 2764 | 2579 | 2827 | 0 | 3325 | 1786 | 308 |
| LIZ | 2210 | 2432 | 520 | 1130 | 1223 | 2635 | 2687 | 1951 | 1962 | 1269 | 896 | 1602 | 952 | 3325 | 0 | 1826 | 3026 |
| LRF | 397 | 1583 | 1416 | 986 | 624 | 1381 | 978 | 1144 | 412 | 563 | 1049 | 818 | 1084 | 1786 | 1826 | 0 | 1551 |
| LSV | 1250 | 955 | 2779 | 2504 | 1905 | 466 | 682 | 2618 | 1187 | 1900 | 2494 | 2361 | 2562 | 308 | 3026 | 1551 | 0 |
| LUF | 1042 | 1160 | 2700 | 2364 | 1820 | 644 | 434 | 2394 | 1070 | 1803 | 2385 | 2172 | 2442 | 409 | 2995 | 1385 | 301 |
| MCC | 1685 | 958 | 3095 | 2880 | 2240 | 653 | 1132 | 3052 | 1571 | 2247 | 2842 | 2776 | 2921 | 459 | 3283 | 1958 | [illegible] |
| MCF | 1147 | 2479 | 1331 | 719 | 1097 | 2280 | 1748 | 240 | 1317 | 1022 | 965 | 255 | 897 | 2590 | 1849 | 905 | 2397 |
| MEM | 569 | 1673 | 1248 | 813 | 499 | 1514 | 1151 | 1047 | 541 | 429 | 876 | 683 | 910 | 1952 | 1671 | 175 | [illegible] |
| MIB | 1330 | 556 | 1798 | 1804 | 1104 | 850 | 1338 | 2339 | 933 | 1155 | 1664 | 1931 | 1770 | 1613 | 1877 | 1266 | 1309 |
| MTC | 1267 | 1719 | 651 | 672 | 276 | 1792 | 1742 | 1422 | 1017 | 334 | 482 | 986 | 594 | 2422 | 949 | 896 | [illegible] |
| MUO | 1476 | 437 | 2643 | 2499 | 1823 | 291 | 1067 | 2799 | 1249 | 1843 | 2427 | 2468 | 2516 | 811 | 2791 | 1660 | 571 |
| NCO | 1865 | 2390 | 54 | 652 | 935 | 2493 | 2402 | 1462 | 1687 | 955 | 445 | 1124 | 476 | 3117 | 490 | 1469 | 2833 |
| NFL | 1526 | 798 | 2902 | 2693 | 2049 | 460 | 1002 | 2890 | 1390 | 2057 | 2652 | 2601 | 2732 | 483 | 3091 | 1783 | 344 |
| NGU | 1475 | 2304 | 467 | 147 | 715 | 2298 | 2057 | 977 | 1387 | 692 | 154 | 620 | 40 | 2835 | 985 | 1083 | 2572 |
| NGZ | 1732 | 1055 | 3176 | 2950 | 2318 | 739 | 1163 | 3100 | 1637 | 2323 | 2918 | 2833 | 2995 | 428 | 3372 | 2018 | [illegible] |
| NHK | 1492 | 2229 | 366 | 261 | 656 | 2251 | 2058 | 1102 | 1367 | 648 | 52 | 727 | 93 | 2816 | 875 | 1096 | 2545 |
| NIP | 1137 | 2364 | 1109 | 496 | 906 | 2210 | 1751 | 411 | 1237 | 834 | 739 | 28 | 674 | 2587 | 1626 | 832 | 2371 |
| NEO | 1181 | 1818 | 646 | 504 | 245 | 1839 | 1701 | 1229 | 988 | 255 | 364 | 794 | 462 | 2426 | 1036 | 791 | [illegible] |
| NKT | 1438 | 2381 | 625 | 89 | 792 | 2338 | 2037 | 810 | 1399 | 754 | 313 | 478 | 209 | 2837 | 1144 | 1059 | [illegible] |
| NKX | 1553 | 1059 | 3060 | 2803 | 2191 | 658 | 971 | 2919 | 1487 | 2190 | 2786 | 2665 | 2857 | 244 | 3224 | 1854 | [illegible] |
| NPA | 726 | 2079 | 1361 | 736 | 946 | 1362 | 1346 | 652 | 906 | 767 | 964 | 414 | 944 | 2186 | 1951 | 486 | [illegible] |
| NQX | 1734 | 2724 | 1538 | 960 | 1368 | 2498 | 1913 | 119 | 1550 | 1293 | 1196 | 508 | 1115 | 2752 | 2058 | 1142 | [illegible] |
| NTD | 1513 | 1207 | 3049 | 2807 | 2222 | 760 | 909 | 2869 | 1494 | 2215 | 2807 | 2639 | 2873 | 82 | 3349 | 1840 | [illegible] |
| NUW | 2033 | 631 | 2962 | 2922 | 2222 | 464 | 1648 | 3316 | 1762 | 2258 | 2810 | 2957 | 2910 | 1247 | 3012 | 2173 | [illegible] |
| NZJ | 1490 | 1220 | 3021 | 2710 | 2141 | 745 | 791 | 2750 | 1403 | 2130 | 2719 | 2529 | 2781 | 52 | 3287 | 1737 | [illegible] |
| NZY | 1386 | 1289 | 3038 | 2712 | 2158 | 805 | 772 | 2726 | 1413 | 2144 | 2729 | 2517 | 2788 | 111 | 3316 | 1733 | [illegible] |
| OFF | 722 | 1055 | 1460 | 1264 | 596 | 999 | 993 | 1678 | 323 | 608 | 1200 | 1290 | 1284 | 1611 | 1725 | 585 | 1321 |
| OSC | 1332 | 1620 | 724 | 832 | 366 | 1736 | 1763 | 1585 | 1040 | 439 | 627 | 1148 | 742 | 2400 | 931 | 983 | [illegible] |

| LOC | PWH | GPA | GON | GSB | GUS | HIF | HMN | HST | IAB | IND | INH | KBY | LPI | LGB | LIZ | LRP | LSV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 866 | 2176 | 1283 | 690 | 858 | 1978 | 1477 | 544 | 1014 | 779 | 889 | 285 | 856 | 2316 | 1784 | 601 | 2110 |
| PBG | 1832 | 2174 | 273 | 808 | 849 | 2324 | 2322 | 1649 | 1597 | 892 | 555 | 1268 | 635 | 2987 | 379 | 1447 | 2693 |
| PHL | 1593 | 2237 | 233 | 398 | 702 | 2291 | 2144 | 1236 | 1440 | 708 | 164 | 866 | 222 | 2883 | 737 | 1197 | 2606 |
| PNE | 1593 | 2237 | 233 | 398 | 702 | 2291 | 2144 | 1236 | 1440 | 708 | 164 | 866 | 222 | 2883 | 737 | 1197 | 2606 |
| PSM | 1948 | 2370 | 180 | 792 | 987 | 2506 | 2464 | 1611 | 1742 | 1019 | 568 | 1265 | 614 | 3154 | 340 | 1555 | 2864 |
| PWT | 2001 | 632 | 2972 | 2917 | 2220 | 823 | 1600 | 3295 | 1739 | 2253 | 2811 | 2941 | 2910 | 1180 | 3035 | 2151 | 1032 |
| RCA | 1033 | 536 | 1891 | 1774 | 1082 | 576 | 978 | 2185 | 668 | 1110 | 1683 | 1809 | 1776 | 1309 | 2061 | 1055 | 1002 |
| RDR | 1251 | 776 | 1571 | 1586 | 890 | 1003 | 1364 | 2154 | 845 | 945 | 1439 | 1736 | 1546 | 1750 | 1667 | 1124 | 1442 |
| RME | 1683 | 2101 | 252 | 674 | 707 | 2221 | 2183 | 1516 | 1460 | 745 | 416 | 1124 | 508 | 2867 | 534 | 1295 | 2576 |
| SAW | 1305 | 1352 | 995 | 1093 | 487 | 1513 | 1647 | 1793 | 953 | 565 | 904 | 1355 | 1018 | 2212 | 1123 | 1012 | 1909 |
| SBD | 1381 | 1159 | 2980 | 2679 | 2101 | 686 | 777 | 2737 | 1368 | 2092 | 2682 | 2507 | 2746 | 85 | 3240 | 1709 | 224 |
| SKA | 1767 | 352 | 2695 | 2639 | 1940 | 624 | 1422 | 3034 | 1482 | 1975 | 2531 | 2673 | 2630 | 1154 | 2769 | 1891 | 941 |
| SKF | 278 | 1706 | 2024 | 1533 | 1242 | 1325 | 611 | 1371 | 679 | 1184 | 1643 | 1220 | 1660 | 1440 | 2448 | 622 | 1292 |
| SSC | 1181 | 2229 | 830 | 228 | 682 | 2139 | 1787 | 686 | 1179 | 622 | 447 | 268 | 397 | 2599 | 1341 | 814 | 2357 |
| SUU | 1703 | 986 | 3121 | 2903 | 2266 | 680 | 1145 | 3070 | 1594 | 2272 | 2867 | 2796 | 2946 | 452 | 3311 | 1979 | 463 |
| SZL | 561 | 1300 | 1368 | 1076 | 490 | 1180 | 988 | 1423 | 265 | 469 | 1057 | 1046 | 1125 | 1708 | 1703 | 332 | 1438 |
| TCM | 1985 | 628 | 2970 | 2910 | 2213 | 806 | 1581 | 3282 | 1727 | 2246 | 2806 | 2931 | 2905 | 1158 | 3037 | 2139 | 1010 |
| TIK | 231 | 1316 | 1702 | 1327 | 843 | 1050 | 648 | 1465 | 176 | 806 | 1360 | 1168 | 1410 | 1434 | 2065 | 354 | 1197 |
| TWH | 1474 | 2307 | 472 | 142 | 719 | 2300 | 2057 | 971 | 1388 | 695 | 160 | 614 | 46 | 2836 | 991 | 1083 | 2574 |
| VAD | 1009 | 2252 | 1149 | 543 | 836 | 2087 | 1623 | 486 | 1114 | 761 | 762 | 123 | 715 | 2459 | 1658 | 707 | 2243 |
| VPS | 794 | 2115 | 1314 | 731 | 836 | 1910 | 1405 | 608 | 947 | 757 | 918 | 352 | 892 | 2244 | 1808 | 536 | 2038 |
| WRB | 972 | 2136 | 1044 | 460 | 688 | 1996 | 1584 | 629 | 1024 | 613 | 650 | 209 | 620 | 2409 | 1544 | 630 | 2180 |
| WRI | 1647 | 2260 | 174 | 451 | 743 | 2326 | 2193 | 1285 | 1486 | 753 | 223 | 921 | 273 | 2926 | 681 | 1250 | 2647 |

| LOC | LUF | MCC | MCF | MEM | MIB | MTC | MUO | NCO | NFL | NGU | NGZ | NHK | NIP | NKO | NKT | NLC | NPA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 426 | 1025 | 1807 | 1136 | 1140 | 1651 | 886 | 2330 | 873 | 2023 | 1071 | 2010 | 1783 | 1632 | 2021 | 894 | 1392 |
| AEX | 1402 | 2044 | 785 | 370 | 1518 | 1129 | 1808 | 1633 | 1882 | 1194 | 2093 | 1235 | 783 | 997 | 1131 | 1914 | 375 |
| BAD | 1311 | 1939 | 889 | 346 | 1408 | 1098 | 1692 | 1643 | 1773 | 1226 | 1990 | 1255 | 868 | 982 | 1178 | 1814 | 472 |
| BIX | 1682 | 2321 | 506 | 402 | 1692 | 1080 | 2067 | 1476 | 2156 | 1001 | 2371 | 1066 | 512 | 916 | 911 | 2194 | 97 |
| BYH | 1555 | 2097 | 841 | 46 | 1268 | 722 | 1765 | 1278 | 1916 | 899 | 2161 | 907 | 725 | 605 | 887 | 2006 | 474 |
| CBM | 1653 | 2238 | 646 | 163 | 1469 | 832 | 1933 | 1296 | 2062 | 861 | 2297 | 898 | 553 | 680 | 811 | 2132 | 274 |
| CHS | 2230 | 2798 | 443 | 690 | 1853 | 829 | 2458 | 929 | 2618 | 424 | 2861 | 531 | 221 | 638 | 292 | 2702 | 542 |
| COP | 2299 | 2928 | 152 | 865 | 2133 | 1186 | 2643 | 1252 | 2759 | 757 | 2982 | 878 | 182 | 994 | 595 | 2808 | 523 |
| CVS | 627 | 1250 | 1581 | 928 | 1167 | 1498 | 1078 | 2160 | 1095 | 1827 | 1297 | 1823 | 1561 | 1460 | 1816 | 1118 | 1168 |
| DAG | 2385 | 2844 | 958 | 874 | 1669 | 488 | 2430 | 450 | 2654 | 146 | 2920 | 51 | 731 | 368 | 305 | 2787 | 959 |
| DCA | 2386 | 2840 | 982 | 882 | 1655 | 471 | 2423 | 434 | 2649 | 169 | 2916 | 56 | 755 | 359 | 330 | 2785 | 977 |
| DLH | 1672 | 1889 | 1697 | 963 | 530 | 663 | 1400 | 1316 | 1697 | 1281 | 1978 | 1187 | 1520 | 799 | 1388 | 1897 | 1385 |
| DMA | 156 | 891 | 2057 | 1462 | 1459 | 2021 | 962 | 2694 | 798 | 2365 | 905 | 2361 | 2065 | 1994 | 2349 | 704 | 1658 |
| DOV | 2497 | 2936 | 1074 | 1002 | 1717 | 528 | 2509 | 316 | 2745 | 216 | 3014 | 98 | 849 | 451 | 385 | 2886 | 1093 |
| DYS | 889 | 1549 | 1294 | 721 | 1329 | 1394 | 1374 | 2010 | 1397 | 1629 | 1592 | 1643 | 1293 | 1319 | 1596 | 1408 | 888 |
| FFW | 819 | 1086 | 1880 | 1093 | 625 | 1361 | 695 | 2064 | 894 | 1857 | 1165 | 1811 | 1792 | 1400 | 1899 | 1054 | 1468 |
| FFO | 1939 | 2381 | 999 | 520 | 1251 | 256 | 1970 | 822 | 2190 | 566 | 2457 | 513 | 794 | 123 | 642 | 2326 | 798 |
| FWH | 1042 | 1685 | 1147 | 569 | 1330 | 1267 | 1476 | 1865 | 1526 | 1475 | 1732 | 1492 | 1137 | 1181 | 1438 | 1553 | 736 |
| GFA | 1160 | 958 | 2479 | 1673 | 556 | 1719 | 437 | 2390 | 798 | 2304 | 1055 | 2229 | 2364 | 1818 | 2381 | 1059 | 2079 |
| GON | 2700 | 3095 | 1331 | 1248 | 1798 | 651 | 2643 | 54 | 2902 | 467 | 3176 | 366 | 1109 | 646 | 625 | 3060 | 1361 |
| GSB | 2364 | 2880 | 719 | 813 | 1804 | 672 | 2499 | 652 | 2693 | 147 | 2950 | 261 | 496 | 504 | 89 | 2803 | 786 |
| GUS | 1820 | 2240 | 1097 | 499 | 1104 | 276 | 1823 | 935 | 2049 | 715 | 2318 | 656 | 906 | 245 | 792 | 2191 | 846 |
| HIF | 644 | 653 | 2280 | 1514 | 850 | 1792 | 291 | 2493 | 460 | 2298 | 739 | 2251 | 2210 | 1839 | 2338 | 658 | 1862 |
| HMN | 434 | 1132 | 1748 | 1151 | 1338 | 1742 | 1067 | 2402 | 1002 | 2057 | 1163 | 2058 | 1751 | 1701 | 2037 | 971 | 1346 |
| HST | 2394 | 3052 | 240 | 1047 | 2339 | 1422 | 2799 | 1462 | 2890 | 977 | 3100 | 1102 | 411 | 1229 | 810 | 2919 | 652 |
| IAB | 1070 | 1571 | 1317 | 541 | 933 | 1017 | 1249 | 1687 | 1390 | 1387 | 1637 | 1367 | 1237 | 988 | 1399 | 1487 | 906 |
| IND | 1803 | 2247 | 1022 | 429 | 1155 | 334 | 1843 | 955 | 2057 | 692 | 2323 | 648 | 834 | 255 | 754 | 2190 | 767 |
| INH | 2385 | 2842 | 965 | 876 | 1664 | 482 | 2427 | 445 | 2652 | 154 | 2918 | 52 | 739 | 364 | 313 | 2786 | 964 |
| KBY | 2172 | 2776 | 255 | 683 | 1931 | 986 | 2468 | 1124 | 2601 | 620 | 2833 | 727 | 28 | 794 | 478 | 2665 | 414 |
| LFI | 2442 | 2921 | 897 | 910 | 1770 | 594 | 2516 | 476 | 2732 | 40 | 2995 | 93 | 674 | 462 | 209 | 2857 | 944 |
| LGB | 409 | 459 | 2590 | 1952 | 1613 | 2422 | 811 | 3117 | 483 | 2835 | 428 | 2816 | 2587 | 2426 | 2837 | 244 | 2186 |
| LIZ | 2995 | 3283 | 1849 | 1671 | 1877 | 949 | 2791 | 490 | 3091 | 985 | 3372 | 875 | 1626 | 1036 | 1144 | 3284 | 1851 |
| LRF | 1385 | 1958 | 905 | 175 | 1266 | 896 | 1660 | 1469 | 1783 | 1083 | 2018 | 1096 | 832 | 791 | 1059 | 1854 | 496 |
| LSV | 301 | 450 | 2397 | 1710 | 1309 | 2134 | 571 | 2833 | 344 | 2572 | 484 | 2545 | 2371 | 2148 | 2585 | 304 | 1983 |
| LUF | 0 | 736 | 2182 | 1554 | 1413 | 2070 | 832 | 2755 | 645 | 2447 | 751 | 2436 | 2179 | 2057 | 2441 | 551 | 1777 |
| MCC | 736 | 0 | 2827 | 2109 | 1449 | 2444 | 525 | 3146 | 193 | 2935 | 96 | 2894 | 2788 | 2485 | 2964 | 216 | 2410 |
| MCF | 2182 | 2827 | 0 | 808 | 2103 | 1230 | 2562 | 1367 | 2661 | 864 | 2877 | 978 | 228 | 1037 | 711 | 2699 | 419 |
| MEM | 1554 | 2109 | 808 | 0 | 1306 | 760 | 1785 | 1301 | 1930 | 909 | 2171 | 923 | 700 | 636 | 888 | 2013 | 433 |
| MIB | 1413 | 1449 | 2103 | 1306 | 0 | 1190 | 932 | 1843 | 1267 | 1798 | 1544 | 1711 | 1954 | 1311 | 1893 | 1500 | 1737 |
| MTC | 2070 | 2444 | 1230 | 760 | 1190 | 0 | 1997 | 702 | 2251 | 627 | 2526 | 525 | 1014 | 193 | 754 | 2412 | 1053 |
| MUO | 822 | 525 | 2562 | 1785 | 932 | 1997 | 0 | 2693 | 361 | 2535 | 621 | 2478 | 2484 | 2064 | 2587 | 625 | 2146 |
| NCO | 2755 | 3146 | 1367 | 1301 | 1843 | 702 | 2693 | 0 | 2953 | 505 | 3228 | 412 | 1148 | 701 | 658 | 3113 | 1508 |
| NFL | 645 | 193 | 2661 | 1930 | 1267 | 2251 | 361 | 2953 | 0 | 2746 | 281 | 2704 | 2614 | 2294 | 2779 | 269 | 2243 |
| NGU | 2447 | 2935 | 864 | 909 | 1798 | 627 | 2535 | 505 | 2746 | 0 | 3008 | 133 | 643 | 487 | 170 | 2868 | 925 |
| NGZ | 751 | 96 | 2877 | 2171 | 1544 | 2526 | 621 | 3228 | 281 | 3008 | 0 | 2970 | 2844 | 2563 | 3034 | 202 | 2462 |
| NHK | 2436 | 2894 | 978 | 923 | 1711 | 525 | 2478 | 412 | 2704 | 133 | 2970 | 0 | 752 | 415 | 301 | 2837 | 997 |
| NIP | 2179 | 2788 | 228 | 700 | 1954 | 1014 | 2484 | 1148 | 2614 | 643 | 2844 | 752 | 0 | 822 | 498 | 2675 | 414 |
| NKO | 2057 | 2485 | 1037 | 636 | 1311 | 193 | 2064 | 701 | 2294 | 487 | 2563 | 415 | 822 | 0 | 590 | 2436 | 880 |
| NKT | 2441 | 2964 | 711 | 888 | 1893 | 754 | 2587 | 658 | 2779 | 170 | 3034 | 301 | 498 | 590 | 0 | 2885 | 826 |
| NLC | 551 | 216 | 2699 | 2013 | 1500 | 2412 | 625 | 3113 | 269 | 2868 | 202 | 2837 | 2675 | 2436 | 2885 | 0 | 2286 |
| NPA | 1777 | 2410 | 419 | 433 | 1737 | 1053 | 2146 | 1508 | 2243 | 925 | 2462 | 997 | 414 | 880 | 826 | 2286 | 0 |
| NQX | 2346 | 3014 | 271 | 1062 | [illegible] | 1495 | 2784 | 1570 | 2860 | 1079 | 3062 | 1201 | 480 | 1301 | 914 | 2878 | [illegible] |
| NTD | 475 | 387 | 2656 | 2005 | [illegible] | 2455 | 776 | 3153 | 433 | 2981 | 349 | 2859 | 2647 | 2467 | 2987 | 176 | [illegible] |
| NUW | 1382 | 812 | 3077 | 2279 | [illegible] | 2765 | 581 | 3006 | 772 | 2934 | 886 | 2858 | 2976 | 2548 | 3011 | 1010 | [illegible] |
| NZJ | 358 | 490 | 2539 | 1903 | 1560 | 2381 | 810 | 3075 | 495 | 2788 | 466 | 2770 | 2536 | 2382 | 2789 | 274 | [illegible] |
| NZY | 348 | 568 | 2519 | 1902 | 1644 | 2402 | 885 | 3092 | 575 | 2794 | 539 | 2780 | 2523 | 2397 | 2789 | 351 | 2112 |
| OPF | 1270 | 1645 | 1439 | 633 | 681 | 813 | 1236 | 1513 | 1453 | 1301 | 1723 | 1251 | 1311 | 841 | 1352 | 1601 | [illegible] |
| OSC | 2064 | 2390 | 1289 | 865 | 1077 | 164 | 1924 | 772 | 2197 | 777 | 2475 | 666 | 1176 | 356 | 912 | 2372 | [illegible] |

| LOC | LUP | MCC | MCP | MEM | MIB | MTC | MUO | NCO | NFL | NGU | NGZ | NHK | NIP | NKO | NKT | NLC | NPA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 1908 | 2535 | 304 | 508 | 1812 | 1038 | 2260 | 1328 | 2366 | 833 | 2588 | 917 | 283 | 854 | 720 | 2414 | 133 |
| PBG | 2644 | 2977 | 1521 | 1292 | 1619 | 579 | 2502 | 287 | 2784 | 673 | 3063 | 547 | 1294 | 656 | 842 | 2962 | 1485 |
| PHL | 2510 | 2940 | 1116 | 1026 | 1706 | 519 | 2508 | 282 | 2748 | 259 | 3019 | 139 | 891 | 458 | 428 | 2893 | 1129 |
| PNE | 2510 | 2940 | 1116 | 1026 | 1706 | 519 | 2508 | 282 | 2748 | 259 | 3019 | 139 | 891 | 458 | 428 | 2893 | 1129 |
| PSM | 2802 | 3159 | 1510 | 1391 | 1817 | 732 | 2692 | 152 | 2966 | 646 | 3244 | 542 | 1289 | 769 | 804 | 3137 | 1531 |
| PWT | 1323 | 743 | 3056 | 2261 | 1176 | 2351 | 536 | 3018 | 707 | 2933 | 817 | 2860 | 2959 | 2449 | 3006 | 942 | 2645 |
| RCA | 1069 | 1223 | 1945 | 1138 | 360 | 1245 | 752 | 1941 | 1031 | 1798 | 1311 | 1734 | 1828 | 1319 | 1863 | 1231 | 1549 |
| RDR | 1506 | 1631 | 1921 | 1141 | 227 | 963 | 1126 | 1616 | 1443 | 1574 | 1723 | 1486 | 1761 | 1089 | 1674 | 1661 | 1573 |
| RME | 2516 | 2875 | 1378 | 1138 | 1552 | 446 | 2412 | 292 | 2682 | 547 | 2959 | 416 | 1151 | 504 | 717 | 2851 | 1330 |
| SAW | 1903 | 2162 | 1581 | 937 | 803 | 424 | 1679 | 1040 | 1970 | 1051 | 2250 | 945 | 1383 | 593 | 1176 | 2162 | 1325 |
| SBD | 344 | 452 | 2523 | 1875 | 1532 | 2338 | 750 | 3033 | 441 | 2754 | 438 | 2734 | 2515 | 2343 | 2758 | 239 | 2116 |
| SKA | 1207 | 778 | 2795 | 1995 | 901 | 2071 | 376 | 2741 | 673 | 2654 | 869 | 2580 | 2692 | 2169 | 2728 | 939 | 2387 |
| SKF | 1038 | 1742 | 1176 | 779 | 1585 | 1517 | 1614 | 2077 | 1603 | 1652 | 1774 | 1687 | 1220 | 1412 | 1592 | 1582 | 806 |
| SSC | 2199 | 2750 | 523 | 648 | 1775 | 741 | 2399 | 872 | 2568 | 372 | 2815 | 466 | 296 | 550 | 269 | 2660 | 560 |
| SUU | 744 | 29 | 2846 | 2130 | 1478 | 2470 | 554 | 3173 | 220 | 2959 | 68 | 2919 | 2808 | 2511 | 2988 | 212 | 2429 |
| STL | 1334 | 1804 | 1183 | 376 | 940 | 755 | 1438 | 1422 | 1617 | 1135 | 1874 | 1108 | 1065 | 723 | 1161 | 1733 | 800 |
| TCM | 1302 | 721 | 3044 | 2250 | 1175 | 2347 | 518 | 3016 | 685 | 2928 | 796 | 2855 | 2949 | 2444 | 3000 | 920 | 2632 |
| TIK | 1038 | 1608 | 1232 | 517 | 1104 | 1116 | 1336 | 1757 | 1435 | 1413 | 1666 | 1410 | 1180 | 1058 | 1404 | 1501 | 814 |
| TWH | 2448 | 2937 | 859 | 908 | 1802 | 632 | 2538 | 510 | 2748 | 7 | 3010 | 139 | 638 | 491 | 163 | 2870 | 921 |
| VAD | 2051 | 2661 | 261 | 582 | 1855 | 976 | 2363 | 1191 | 2488 | 689 | 2717 | 784 | 128 | 786 | 564 | 2547 | 292 |
| VPS | 1836 | 2464 | 371 | 454 | 1760 | 1031 | 2192 | 1360 | 2295 | 872 | 2516 | 948 | 352 | 853 | 768 | 2342 | 63 |
| WRB | 2004 | 2587 | 410 | 482 | 1723 | 828 | 2267 | 1090 | 2410 | 600 | 2647 | 678 | 231 | 639 | 503 | 2484 | 326 |
| WRI | 2556 | 2976 | 1170 | 1081 | 1725 | 544 | 2539 | 224 | 2784 | 309 | 3056 | 195 | 946 | 500 | 475 | 2933 | 1187 |

| LOC | NQX | NTD | NUW | NZJ | NZY | OFF | OSC | PAM | PBG | PHL | PNE | PSM | PWT | RCA | RDR | RME | SAW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 1993 | 870 | 1467 | 768 | 771 | 864 | 1653 | 1520 | 2227 | 2084 | 2084 | 2381 | 1422 | 780 | 1182 | 2096 | 1511 |
| AEX | 980 | 1874 | 2350 | 1760 | 1743 | 845 | 1233 | 506 | 1650 | 1352 | 1352 | 1735 | 2321 | 1276 | 1391 | 1494 | 1285 |
| BAD | 1093 | 1780 | 2232 | 1668 | 1656 | 740 | 1189 | 600 | 1638 | 1365 | 1365 | 1737 | 2204 | 1159 | 1287 | 1485 | 1217 |
| BIX | 718 | 2154 | 2596 | 2040 | 2023 | 1011 | 1212 | 230 | 1538 | 1195 | 1195 | 1594 | 2571 | 1489 | 1537 | 1382 | 1324 |
| BYH | 1098 | 2002 | 2252 | 1902 | 1903 | 598 | 824 | 545 | 1261 | 1006 | 1006 | 1365 | 2235 | 1108 | 1099 | 1108 | 892 |
| CBM | 899 | 2114 | 2435 | 2008 | 2001 | 796 | 957 | 345 | 1324 | 1015 | 1015 | 1401 | 2415 | 1299 | 1301 | 1168 | 1064 |
| CHS | 686 | 2689 | 2921 | 2584 | 2578 | 1246 | 993 | 430 | 1073 | 670 | 670 | 1068 | 2910 | 1767 | 1648 | 931 | 1221 |
| COF | 324 | 2771 | 3143 | 2657 | 2639 | 1485 | 1349 | 394 | 1425 | 1013 | 1013 | 1399 | 3125 | 2000 | 1942 | 1288 | 1562 |
| CVS | 1768 | 1087 | 1653 | 980 | 975 | 755 | 1519 | 1296 | 2078 | 1905 | 1905 | 2221 | 1612 | 816 | 1165 | 1940 | 1410 |
| DAG | 1188 | 2808 | 2814 | 2720 | 2729 | 1202 | 634 | 883 | 563 | 170 | 170 | 574 | 2815 | 1687 | 1444 | 424 | 910 |
| DCA | 1214 | 2807 | 2802 | 2720 | 2730 | 1197 | 614 | 904 | 539 | 152 | 152 | 554 | 2804 | 1678 | 1430 | 399 | 892 |
| DLH | 1967 | 1975 | 1693 | 1926 | 1965 | 494 | 548 | 1431 | 1105 | 1177 | 1177 | 1298 | 1703 | 668 | 303 | 1027 | 280 |
| DMA | 2212 | 614 | 1523 | 490 | 462 | 1239 | 2028 | 1790 | 2600 | 2442 | 2442 | 2750 | 1467 | 1105 | 1530 | 2466 | 1886 |
| DOV | 1294 | 2913 | 2873 | 2828 | 2839 | 1292 | 653 | 1014 | 457 | 43 | 43 | 444 | 2877 | 1761 | 1491 | 336 | 935 |
| DYS | 1470 | 1362 | 1942 | 1247 | 1231 | 776 | 1447 | 1019 | 1965 | 1741 | 1741 | 2088 | 1905 | 1007 | 1277 | 1818 | 1395 |
| FEW | 2112 | 1115 | 1200 | 1061 | 1099 | 560 | 1318 | 1576 | 1908 | 1854 | 1854 | 2084 | 1176 | 265 | 688 | 1797 | 1117 |
| FFO | 1268 | 2351 | 2372 | 2267 | 2280 | 739 | 399 | 788 | 776 | 572 | 572 | 891 | 2370 | 1232 | 1035 | 624 | 589 |
| FWH | 1334 | 1513 | 2024 | 1400 | 1386 | 722 | 1332 | 866 | 1832 | 1593 | 1593 | 1948 | 2001 | 1033 | 1251 | 1683 | 1305 |
| GFA | 2724 | 1203 | 631 | 1220 | 1289 | 1055 | 1620 | 2176 | 2174 | 2237 | 2237 | 2370 | 632 | 536 | 776 | 2101 | 1352 |
| [illegible] | 1538 | [illegible] | 2962 | 3021 | 3038 | 1460 | 724 | 1283 | 273 | 233 | 233 | 180 | 2972 | 1891 | 1571 | 252 | 945 |
| GSB | 940 | 2907 | 2922 | 2710 | 2712 | 1264 | 832 | 690 | 808 | 398 | 398 | 792 | 2917 | 1774 | 1586 | 674 | [illegible] |
| GUS | 1368 | 2222 | 2222 | 2141 | 2158 | 596 | 366 | 858 | 849 | 702 | 702 | 987 | 2220 | 1082 | 890 | 707 | 487 |
| HIF | 2498 | 760 | 866 | 745 | 805 | 999 | 1736 | 1978 | 2324 | 2291 | 2291 | 2506 | 823 | 576 | 1003 | 2221 | 1513 |
| HMN | 1913 | 909 | 1648 | 791 | 772 | 993 | 1763 | 1477 | 2322 | 2144 | 2144 | 2464 | 1600 | 978 | 1364 | 2183 | 1647 |
| HST | 119 | 2869 | 3316 | 2750 | 2726 | 1678 | 1585 | 544 | 1649 | 1236 | 1236 | 1611 | 3295 | 2185 | 2154 | 1516 | 1793 |
| IAB | 1550 | 1494 | 1762 | 1403 | 1413 | 323 | 1040 | 1014 | 1597 | 1440 | 1440 | 1742 | 1739 | 668 | 845 | 1460 | 952 |
| IND | 1293 | 2215 | 2258 | 2130 | 2144 | 608 | 439 | 779 | 892 | 708 | 708 | 1019 | 2253 | 1110 | 945 | 745 | 565 |
| [illegible] | 1196 | 2807 | 2810 | 2719 | 2729 | 1200 | 627 | 889 | 555 | 164 | 164 | 568 | 2811 | 1683 | 1439 | 416 | 904 |
| [illegible] | 508 | 2639 | 2957 | 2529 | 2517 | 1290 | 1148 | 285 | 1268 | 866 | 866 | 1265 | 2941 | 1809 | 1736 | 1124 | [illegible] |
| LFI | 1115 | 2873 | 2910 | 2781 | 2798 | 1284 | 742 | 856 | 635 | 222 | 222 | 614 | 2910 | 1776 | 1546 | 508 | [illegible] |
| LGB | 2752 | 82 | 1247 | 52 | 111 | 1611 | 2400 | 2316 | 2967 | 2883 | 2883 | 3154 | 1180 | 1309 | 1750 | 2867 | [illegible] |
| LIZ | 2058 | 2249 | 3012 | 3287 | 3316 | 1725 | 931 | 1784 | 379 | 737 | 737 | 340 | 3035 | 2061 | 1667 | 534 | [illegible] |
| LRF | 1142 | 1940 | 2173 | 1737 | 1733 | 585 | 983 | 601 | 1447 | 1197 | 1197 | 1555 | 2131 | 1055 | 1124 | 1295 | 1312 |
| LSV | 2579 | 323 | 1092 | 281 | 340 | 1321 | 2104 | 2110 | 2693 | 2606 | 2606 | 2864 | 1032 | 1002 | 1442 | 2576 | [illegible] |
| LUF | 2346 | 475 | 1382 | 358 | 348 | 1273 | 2064 | 1908 | 2644 | 2510 | 2510 | 2802 | 1323 | 1069 | [illegible] | 2516 | [illegible] |
| [illegible] | [illegible] | 387 | 812 | 400 | 568 | 1645 | 2390 | 2535 | 2977 | 2940 | 2940 | 3159 | [illegible] | 1223 | 1631 | 2875 | [illegible] |
| MCF | 271 | 2656 | 3077 | 2539 | 2519 | 1439 | [illegible] | 304 | 1521 | 1116 | 1116 | 1510 | 3056 | 1945 | 1921 | 1278 | [illegible] |
| MEM | 1062 | 2095 | 2279 | 1903 | 1902 | 633 | 865 | 508 | 1292 | 1026 | 1026 | 1391 | 2261 | 1138 | 1141 | 1128 | 937 |
| MIB | 2365 | 1610 | 1164 | 1590 | 1644 | 681 | 1077 | 1812 | 1619 | 1706 | 1706 | 1817 | 1176 | 360 | 227 | 1552 | [illegible] |
| MTC | 1194 | 2355 | 2345 | 2281 | 2242 | 817 | 164 | 1038 | 579 | 519 | 519 | 732 | 2351 | 1255 | 963 | 446 | [illegible] |
| MUO | 2784 | 726 | 581 | 810 | 885 | 1236 | 1924 | 2260 | 2502 | [illegible] | 2508 | 2692 | 535 | 752 | 1126 | 2412 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 772 | 1328 | 287 | 282 | 292 | 152 | 3018 | 1941 | 1616 | 292 | [illegible] |
| NFL | [illegible] | 433 | 772 | 425 | [illegible] | [illegible] | 2197 | 2366 | 2794 | 2748 | 2748 | 2966 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1079 | [illegible] | [illegible] | [illegible] | [illegible] | 1301 | 777 | 833 | 673 | 259 | 259 | 646 | 2933 | 1798 | 1574 | 547 | [illegible] |
| [illegible] | 3062 | [illegible] | 886 | 466 | 539 | [illegible] | [illegible] | 2588 | 3063 | 3019 | 3019 | 3244 | 817 | 1311 | 1723 | [illegible] | [illegible] |
| [illegible] | 1201 | 2959 | 2958 | 2770 | [illegible] | 1251 | [illegible] | 917 | 547 | 139 | 139 | 542 | 2860 | 1734 | 1486 | 416 | [illegible] |
| [illegible] | [illegible] | [illegible] | 2976 | [illegible] | [illegible] | [illegible] | 1176 | [illegible] | 1294 | 891 | 891 | 1289 | 2959 | 1828 | 1761 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 656 | 458 | 458 | 769 | [illegible] | 1319 | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 912 | [illegible] | 842 | 428 | 428 | [illegible] | [illegible] | 1863 | [illegible] | 717 | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1129 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1718 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 2922 | 2922 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | 0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | 192 | [illegible] | [illegible] | 0 | [illegible] | [illegible] | [illegible] | 2972 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | 1676 | [illegible] | [illegible] | 0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 547 | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 0 | [illegible] | [illegible] | [illegible] | [illegible] | 770 | [illegible] | [illegible] | 850 | [illegible] | [illegible] |

| LOC | NQX | NTD | NUW | NZJ | NZY | OPF | OSC | PAM | PBG | PHL | PNE | PSM | PWT | RCA | RDR | RME | SAW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 554 | 2379 | 2773 | 2266 | 2250 | 1141 | 1186 | 0 | 1427 | 1053 | 1053 | 1457 | 2752 | 1643 | 1637 | 1274 | 1344 |
| PBG | 1748 | 3016 | 2778 | 2947 | 2972 | 1378 | 590 | 1427 | 0 | 414 | 414 | 201 | 2794 | 1757 | 1398 | 156 | 825 |
| PHL | 1336 | 2922 | 2864 | 2839 | 2852 | 1296 | 636 | 1053 | 414 | 0 | 0 | 404 | 2869 | 1758 | 1479 | 296 | 918 |
| PNE | 1336 | 2922 | 2864 | 2839 | 2852 | 1296 | 636 | 1053 | 414 | 0 | 0 | 404 | 2869 | 1758 | 1479 | 296 | 918 |
| PSM | 1718 | 3186 | 2977 | 3113 | 3134 | 1543 | 770 | 1457 | 201 | 404 | 404 | 0 | 2992 | 1943 | 1594 | 287 | 1019 |
| PWT | 3288 | 1138 | 69 | 1199 | 1279 | 1665 | 2249 | 2752 | 2794 | 2869 | 2869 | 2992 | 0 | 1146 | 1401 | 2728 | 1978 |
| RCA | 2193 | 1318 | 1155 | 1290 | 1326 | 521 | 1174 | 1643 | 1757 | 1758 | 1758 | 1943 | 1146 | 0 | 442 | 1662 | 939 |
| RDR | 2187 | 1756 | 1390 | 1722 | 1769 | 547 | 850 | 1637 | 1398 | 1479 | 1479 | 1594 | 1401 | 442 | 0 | 1326 | 577 |
| RME | 1612 | 2898 | 2716 | 2826 | 2848 | 1256 | 488 | 1274 | 156 | 296 | 296 | 287 | 2728 | 1662 | 1326 | 0 | 759 |
| SAW | 1852 | 2232 | 1967 | 2176 | 2210 | 655 | 283 | 1344 | 825 | 918 | 918 | 1019 | 1978 | 939 | 577 | 749 | 0 |
| SBD | 2689 | 132 | 1212 | 61 | 136 | 1526 | 2315 | 2267 | 2902 | 2800 | 2800 | 3069 | 1147 | 1225 | 1666 | 2782 | 2126 |
| SEA | 3032 | 1156 | 285 | 1160 | 1238 | 1391 | 1971 | 2591 | 2520 | 2589 | 2589 | 2718 | 280 | 870 | 1125 | 2451 | 1702 |
| SEP | 1316 | 1511 | 2189 | 1388 | 1359 | 998 | 1593 | 937 | 2068 | 1799 | 1799 | 2170 | 2148 | 1269 | 1520 | 1916 | 1589 |
| SSC | 769 | 2652 | 2855 | 2550 | 2547 | 1179 | 905 | 462 | 1001 | 605 | 605 | 1008 | 2844 | 1699 | 1568 | 856 | 1135 |
| SUU | 3035 | 377 | 830 | 436 | 562 | 1670 | 2617 | 2554 | 3005 | 2966 | 2966 | 3186 | 762 | 1250 | 1659 | 2902 | 2190 |
| SZL | 1437 | 1750 | 1911 | 1663 | 1675 | 260 | 790 | 884 | 1335 | 1177 | 1177 | 1478 | 1896 | 764 | 792 | 1196 | 753 |
| TCM | 3275 | 1096 | 90 | 1177 | 1257 | 1657 | 2247 | 2740 | 2796 | 2865 | 2865 | 2992 | 22 | 1138 | 1400 | 2726 | 1977 |
| TIK | 1549 | 1588 | 1873 | 1386 | 1385 | 594 | 1159 | 933 | 1692 | 1496 | 1496 | 1825 | 1845 | 820 | 1020 | 1569 | 1101 |
| TWH | 1073 | 2882 | 2938 | 2729 | 2794 | 1503 | 782 | 829 | 679 | 265 | 265 | 652 | 2937 | 1801 | 1579 | 554 | 1056 |
| VAD | 532 | 2519 | 2860 | 2508 | 2395 | 1202 | 1134 | 166 | 1311 | 922 | 922 | 1325 | 2842 | 1716 | 1668 | 1162 | 1221 |
| VPS | 611 | 2306 | 2708 | 2193 | 2177 | 1086 | 1175 | 72 | 1545 | 1082 | 1082 | 1485 | 2686 | 1583 | 1591 | 1291 | 1319 |
| WRB | 681 | 2566 | 2750 | 2359 | 2351 | 1031 | 985 | 250 | 1188 | 813 | 813 | 1217 | 2735 | 1600 | 1531 | 1036 | 1133 |
| WRI | 1387 | 2965 | 2885 | 2832 | 2897 | 1334 | 669 | 1111 | 369 | 59 | 59 | 347 | 2892 | 1788 | 1597 | 265 | 933 |

| LOC | SBD | SKA | SKF | SSC | SUU | SZL | TCM | TIK | TWH | VAD | VPS | WRB | WRI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABQ | 739 | 1229 | 738 | 1783 | 1042 | 909 | 1404 | 618 | 2023 | 1655 | 1448 | 1596 | 2131 |
| AEX | 1742 | 2074 | 461 | 865 | 2062 | 603 | 2307 | 477 | 1192 | 656 | 434 | 639 | 1409 |
| BAD | 1648 | 1957 | 434 | 917 | 1957 | 508 | 2190 | 359 | 1225 | 740 | 528 | 703 | 1421 |
| BIX | 2022 | 2317 | 709 | 643 | 2340 | 752 | 2558 | 732 | 998 | 389 | 160 | 408 | 1253 |
| BYH | 1872 | 1967 | 808 | 654 | 2119 | 343 | 2224 | 517 | 899 | 609 | 493 | 502 | 1060 |
| CBM | 1982 | 2152 | 791 | 552 | 2258 | 538 | 2404 | 632 | 859 | 430 | 291 | 352 | 1073 |
| CHS | 2558 | 2637 | 1329 | 88 | 2820 | 1020 | 2901 | 1202 | 419 | 272 | 482 | 233 | 725 |
| COF | 2639 | 2860 | 1309 | 450 | 2948 | 1236 | 3114 | 1324 | 750 | 284 | 466 | 411 | 1065 |
| CVS | 955 | 1401 | 536 | 1572 | 1268 | 744 | 1595 | 414 | 1827 | 1433 | 1224 | 1379 | 1954 |
| DAG | 2683 | 2536 | 1640 | 440 | 2869 | 1058 | 2810 | 1360 | 152 | 755 | 912 | 644 | 228 |
| DCA | 2683 | 2524 | 1651 | 463 | 2865 | 1057 | 2799 | 1364 | 176 | 778 | 931 | 664 | 210 |
| DLH | 1874 | 1425 | 1486 | 1303 | 1917 | 671 | 1700 | 985 | 1285 | 1439 | 1393 | 1294 | 1195 |
| DMA | 486 | 1336 | 899 | 2101 | 899 | 1273 | 1446 | 952 | 2365 | 1937 | 1718 | 1899 | 2490 |
| DOV | 2790 | 2597 | 1772 | 564 | 2962 | 1165 | 2873 | 1479 | 222 | 882 | 1045 | 775 | 97 |
| DYS | 1230 | 1683 | 263 | 1339 | 1566 | 661 | 1889 | 294 | 1628 | 1165 | 947 | 1130 | 1794 |
| FEW | 1010 | 922 | 1066 | 1705 | 1111 | 744 | 1164 | 676 | 1860 | 1672 | 1510 | 1573 | 1891 |
| FFO | 2228 | 2091 | 1293 | 549 | 2406 | 605 | 2364 | 936 | 569 | 740 | 777 | 590 | 617 |
| FWH | 1381 | 1767 | 278 | 1181 | 1703 | 561 | 1985 | 231 | 1474 | 1009 | 794 | 972 | 1647 |
| GFA | 1159 | 352 | 1706 | 2229 | 986 | 1300 | 628 | 1316 | 2307 | 2252 | 2115 | 2136 | 2260 |
| GON | 2980 | 2695 | 2024 | 830 | 3121 | 1368 | 2970 | 1702 | 472 | 1149 | 1314 | 1044 | 174 |
| GSB | 2679 | 2639 | 1533 | 228 | 2903 | 1076 | 2910 | 1327 | 142 | 543 | 731 | 460 | 451 |
| GUS | 2101 | 1940 | 1242 | 682 | 2266 | 490 | 2213 | 843 | 719 | 836 | 836 | 688 | 743 |
| HIF | 686 | 624 | 1325 | 2139 | 680 | 1180 | 806 | 1050 | 2300 | 2087 | 1910 | 1996 | 2326 |
| HMN | 777 | 1422 | 611 | 1787 | 1145 | 988 | 1581 | 648 | 2057 | 1623 | 1405 | 1584 | 2193 |
| HST | 2737 | 3034 | 1371 | 686 | 3070 | 1423 | 3282 | 1465 | 971 | 486 | 608 | 629 | 1285 |
| IAB | 1368 | 1482 | 679 | 1179 | 1594 | 265 | 1727 | 176 | 1388 | 1114 | 947 | 1024 | 1486 |
| IND | 2092 | 1975 | 1184 | 622 | 2272 | 469 | 2246 | 806 | 695 | 761 | 757 | 613 | 753 |
| INH | 2682 | 2531 | 1643 | 447 | 2867 | 1057 | 2806 | 1360 | 160 | 762 | 918 | 650 | 223 |
| KBY | 2507 | 2673 | 1220 | 268 | 2796 | 1046 | 2931 | 1168 | 614 | 123 | 352 | 209 | 921 |
| LFI | 2746 | 2630 | 1660 | 397 | 2946 | 1125 | 2905 | 1410 | 46 | 715 | 892 | 620 | 273 |
| LGB | 85 | 1154 | 1440 | 2599 | 452 | 1708 | 1158 | 1434 | 2836 | 2459 | 2244 | 2409 | 2926 |
| LIZ | 3240 | 2769 | 2448 | 1341 | 3311 | 1703 | 3037 | 2065 | 991 | 1658 | 1808 | 1544 | 681 |
| LRF | 1709 | 1891 | 622 | 814 | 1979 | 332 | 2139 | 354 | 1083 | 707 | 536 | 630 | 1250 |
| LSV | 224 | 941 | 1292 | 2357 | 463 | 1438 | 1010 | 1197 | 2574 | 2243 | 2038 | 2180 | 2647 |
| LUF | 344 | 1207 | 1038 | 2199 | 744 | 1334 | 1302 | 1028 | 2448 | 2051 | 1836 | 2004 | 2556 |
| MCC | 452 | 778 | 1742 | 2750 | 29 | 1804 | 721 | 1608 | 2937 | 2661 | 2464 | 2587 | 2976 |
| MCF | 2523 | 2795 | 1176 | 523 | 2846 | 1183 | 3044 | 1232 | 859 | 261 | 371 | 410 | 1170 |
| MEM | 1875 | 1995 | 779 | 648 | 2130 | 376 | 2250 | 517 | 908 | 532 | 454 | 482 | 1081 |
| MIB | 1532 | 901 | 1585 | 1775 | 1478 | 940 | 1175 | 1104 | 1802 | 1855 | 1760 | 1723 | 1725 |
| MTC | 2338 | 2071 | 1517 | 741 | 2470 | 755 | 2347 | 1116 | 632 | 976 | 1031 | 828 | 544 |
| MUO | 750 | 376 | 1614 | 2399 | 554 | 1438 | 518 | 1336 | 2538 | 2363 | 2192 | 2267 | 2539 |
| NCO | 3033 | 2741 | 2077 | 872 | 3173 | 1422 | 3016 | 1757 | 510 | 1191 | 1360 | 1090 | 224 |
| NFL | 441 | 673 | 1603 | 2568 | 220 | 1617 | 685 | 1435 | 2748 | 2488 | 2295 | 2410 | 2784 |
| NGU | 2754 | 2654 | 1692 | 372 | 2959 | 1135 | 2928 | 1413 | 7 | 689 | 872 | 600 | 309 |
| NGZ | 438 | 869 | 1774 | 2815 | 68 | 1874 | 796 | 1666 | 3010 | 2717 | 2516 | 2647 | 3056 |
| NHK | 2734 | 2580 | 1687 | 466 | 2919 | 1108 | 2855 | 1410 | 139 | 784 | 948 | 678 | 195 |
| NIP | 2515 | 2692 | 1220 | 296 | 2808 | 1065 | 2949 | 1180 | 638 | 128 | 352 | 231 | 946 |
| NFO | 2743 | 2169 | 1412 | 550 | 2511 | 722 | 2444 | 1058 | 491 | 786 | 853 | 639 | 500 |
| NKT | 2754 | 2728 | 1592 | 269 | 2988 | 1161 | 3000 | 1404 | 163 | 564 | 768 | 503 | 475 |
| NLC | 239 | 939 | 1592 | 2666 | 212 | 1733 | 920 | 1501 | 2870 | 2547 | 2342 | 2484 | 2933 |
| NPA | 2116 | 2347 | 806 | 560 | 2529 | 490 | 2632 | 814 | 921 | 292 | 63 | 326 | 1187 |
| NQX | 2689 | 3032 | 1314 | 769 | 3022 | 1477 | 3275 | 1449 | 1073 | 532 | 611 | 681 | 1387 |
| NTD | 152 | 1196 | 1511 | 2652 | 377 | 1770 | 1096 | 1488 | 2882 | 2519 | 2306 | 2466 | 2965 |
| NUW | 1212 | 285 | 2139 | 2574 | 800 | 1911 | 90 | 1873 | 2935 | 2960 | 2708 | 2750 | 2885 |
| NZJ | 61 | 1160 | 1384 | 2550 | 456 | 1663 | 1177 | 1386 | 2789 | 2408 | 2193 | 2359 | 2882 |
| NZY | 136 | 1238 | 1359 | 2547 | 562 | 1675 | 1257 | 1385 | 2794 | 2395 | 2177 | 2351 | 2897 |
| OFF | 1526 | 1391 | 998 | 1179 | 1673 | 240 | 1657 | 494 | 1203 | 1202 | 1086 | 1081 | 1334 |
| OZR | 2315 | 1971 | 1593 | 965 | 2417 | 790 | 2267 | 1159 | 792 | 1134 | 1175 | 985 | 649 |

| LOC | SBD | SKA | SKF | SSC | SUU | SZL | TCM | TIK | TWH | VAD | VPS | WRB | WRI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAM | 2247 | 2491 | 937 | 462 | 2554 | 884 | 2740 | 933 | 829 | 166 | 72 | 240 | 1111 |
| PBG | 2902 | 2520 | 2068 | 1001 | 3004 | 1335 | 2794 | 1692 | 679 | 1311 | 1445 | 1188 | 369 |
| PHL | 2800 | 2589 | 1799 | 605 | 2966 | 1177 | 2865 | 1496 | 265 | 922 | 1082 | 813 | 59 |
| PNB | 2800 | 2589 | 1799 | 605 | 2966 | 1177 | 2865 | 1496 | 265 | 922 | 1082 | 813 | 59 |
| PSM | 3069 | 2718 | 2170 | 1008 | 3186 | 1478 | 2992 | 1825 | 652 | 1325 | 1485 | 1217 | 347 |
| PWT | 1147 | 280 | 2148 | 2844 | 762 | 1896 | 22 | 1845 | 2937 | 2842 | 2686 | 2735 | 2892 |
| RCA | 1225 | 870 | 1269 | 1699 | 1250 | 764 | 1138 | 820 | 1801 | 1716 | 1583 | 1600 | 1788 |
| RDR | 1666 | 1125 | 1520 | 1568 | 1659 | 792 | 1400 | 1020 | 1579 | 1668 | 1591 | 1531 | 1497 |
| RME | 2782 | 2451 | 1916 | 856 | 2902 | 1196 | 2726 | 1549 | 554 | 1162 | 1291 | 1036 | 265 |
| SAW | 2126 | 1702 | 1580 | 1134 | 2190 | 743 | 1977 | 1101 | 1056 | 1321 | 1319 | 1171 | 931 |
| SBD | 0 | 1102 | 1381 | 2522 | 450 | 1626 | 1125 | 1357 | 2755 | 2387 | 2174 | 2334 | 2843 |
| SKA | 1102 | 0 | 1935 | 2569 | 803 | 1627 | 276 | 1598 | 2658 | 2576 | 2427 | 2466 | 2613 |
| SKP | 1381 | 1935 | 0 | 1325 | 1755 | 837 | 2131 | 505 | 1650 | 1098 | 869 | 1097 | 1854 |
| SSC | 2522 | 2569 | 1325 | 0 | 2773 | 961 | 2835 | 1165 | 368 | 318 | 504 | 235 | 661 |
| SUU | 450 | 803 | 1755 | 2773 | 0 | 1827 | 740 | 1628 | 2961 | 2681 | 2483 | 2608 | 3002 |
| SZL | 1626 | 1627 | 837 | 961 | 1827 | 0 | 1886 | 369 | 1137 | 952 | 827 | 839 | 1222 |
| TCM | 1125 | 276 | 2131 | 2835 | 740 | 1886 | 0 | 1831 | 2931 | 2831 | 2674 | 2725 | 2889 |
| TIK | 1357 | 1598 | 505 | 1165 | 1628 | 369 | 1831 | 0 | 1413 | 1053 | 863 | 983 | 1546 |
| TWH | 2755 | 2658 | 1650 | 368 | 2961 | 1137 | 2931 | 1413 | 0 | 684 | 868 | 596 | 315 |
| VAD | 2387 | 2576 | 1098 | 318 | 2681 | 952 | 2831 | 1053 | 684 | 0 | 230 | 150 | 979 |
| VPS | 2174 | 2427 | 869 | 504 | 2483 | 827 | 2674 | 863 | 868 | 230 | 0 | 272 | 1140 |
| WRB | 2334 | 2466 | 1097 | 235 | 2608 | 839 | 2725 | 983 | 596 | 150 | 272 | 0 | 871 |
| WRI | 2843 | 2613 | 1854 | 661 | 3002 | 1222 | 2889 | 1546 | 315 | 979 | 1140 | 871 | 0 |

# *Appendix H: Hub Locations*

## *QUICKTRANS Hub Locations*

Shows potential hub locations with closest associated delivery locations and air statute miles.

| NIP | | CHS | | NGU | | SUU | | NZY | |
|---|---|---|---|---|---|---|---|---|---|
| LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles |
| COF | 152 | CHS | 0 | DAG | 122 | NFL | 183 | LGB | 92 |
| KBY | 23 | | | DCA | 141 | NGZ | 57 | NTD | 160 |
| NIP | 0 | | | GON | 389 | NLC | 177 | NZJ | 67 |
| NPA | 345 | | | IND | 577 | NUW | 692 | NZY | 0 |
| NQX | 400 | | | INH | 128 | PWT | 635 | SBD | 113 |
| | | | | NCO | 421 | SUU | 0 | | |
| | | | | NGU | 0 | TCM | 617 | | |
| | | | | NHK | 110 | | | | |
| | | | | NKT | 142 | | | | |
| | | | | PHL | 216 | | | | |
| | | | | PNE | 216 | | | | |
| | | | | TWH | 6 | | | | |
| | | | | WRI | 257 | | | | |

*LOGAIR Hub Locations*

Shows potential hub locations with closest associated delivery locations and air statute miles.

| FFO | | SUU | | SBD | | TIK | | SKF | | HIF | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles |
| BYH | 406 | SUU | 0 | DMA | 405 | BAD | 299 | AEX | 384 | ABQ | 505 |
| DLH | 632 | | | LSV | 187 | CVS | 345 | DYS | 219 | FEW | 367 |
| DOV | 468 | | | LUF | 286 | FWH | 193 | HMN | 509 | GFA | 430 |
| FFO | 0 | | | SBD | 0 | IAB | 146 | SKF | 0 | HIF | 0 |
| GUS | 125 | | | | | LRF | 295 | | | MIB | 709 |
| LFI | 455 | | | | | OFF | 412 | | | MUO | 243 |
| LIZ | 962 | | | | | SZL | 308 | | | RCA | 480 |
| MTC | 213 | | | | | TIK | 0 | | | RDR | 836 |
| NKO | 102 | | | | | | | | | SKA | 520 |
| OSC | 332 | | | | | | | | | | |
| PBG | 646 | | | | | | | | | | |
| PSM | 743 | | | | | | | | | | |
| RME | 520 | | | | | | | | | | |
| SAW | 491 | | | | | | | | | | |
| WRI | 515 | | | | | | | | | | |

| MCC | | WRB | |
|---|---|---|---|
| LOC | Miles | LOC | Miles |
| MCC | 0 | BIX | 340 |
| TCM | 601 | CBM | 293 |
| | | CHS | 194 |
| | | COF | 343 |
| | | GSB | 384 |
| | | HST | 524 |
| | | MCF | 342 |
| | | MEM | 402 |
| | | NIP | 193 |
| | | NQX | 567 |
| | | PAM | 200 |
| | | SSC | 196 |
| | | VAD | 125 |
| | | VPS | 227 |
| | | WRB | 0 |

## *Combined Route Structure Hub Locations*

Shows potential hub locations with closest associated delivery locations and air statute miles.

| CHS | | DOV | | FFO | | HIF | | MCC | | NGU | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles |
| CHS | 0 | DAG | 112 | BYH | 406 | ABQ | 505 | MCC | 0 | GSB | 123 |
| SSC | 73 | DCA | 101 | DLH | 632 | FEW | 367 | NFL | 161 | LFI | 33 |
| | | DOV | 0 | FFO | 0 | GFA | 430 | | | NGU | 0 |
| | | INH | 109 | GUS | 125 | HIF | 0 | | | NKT | 142 |
| | | NHK | 82 | IND | 114 | MIB | 709 | | | TWH | 6 |
| | | PHL | 36 | MTC | 213 | MUO | 243 | | | | |
| | | PNE | 36 | NKO | 102 | RCA | 480 | | | | |
| | | | | OSC | 332 | RDR | 836 | | | | |
| | | | | SAW | 491 | | | | | | |

| NIP | | NZY | | SBD | | SKF | | SUU | | TCM | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles | LOC | Miles |
| COF | 152 | DMA | 385 | LGB | 71 | AEX | 384 | NGZ | 57 | NUW | 75 |
| HST | 342 | NZY | 0 | LSV | 187 | DYS | 219 | NLC | 177 | PWT | 19 |
| KBY | 23 | | | LUF | 286 | HMN | 509 | SUU | 0 | SKA | 230 |
| MCF | 190 | | | NTD | 110 | SKF | 0 | | | TCM | 0 |
| NIP | 0 | | | NZJ | 51 | | | | | | |
| NQX | 400 | | | SBD | 0 | | | | | | |
| VAD | 107 | | | | | | | | | | |

| TIK | | WRB | | WRI | |
|---|---|---|---|---|---|
| LOC | Miles | LOC | Miles | LOC | Miles |
| BAD | 299 | BIX | 340 | GON | 145 |
| CVS | 345 | CBM | 293 | LIZ | 567 |
| FWH | 193 | MEM | 402 | NCO | 187 |
| IAB | 146 | NPA | 271 | PBG | 307 |
| LRF | 295 | PAM | 200 | PSM | 289 |
| OFF | 412 | VPS | 227 | RME | 221 |
| SZL | 308 | WRB | 0 | WRI | 0 |
| TIK | 0 | | | | |

# Appendix I: Sorted Hub Groupings

*QUICKTRANS Hub Routings*

1. QUICKTRANS TRAVIS HUB ROUTING.

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NLC | LEMOORE | 36.15 | 119.57 | 0.0000 | 3,255 |
| 2 | SUU | TRAVIS (HUB) | 38.16 | 121.56 | 0.0625 | 38,594 |
| 3 | NGZ | OAKLAND | 37.47 | 122.13 | 0.0625 | 4,223 |
| 4 | TCM | MCCHORD AFB | 47.08 | 122.28 | 0.6875 | 7,196 |
| 5 | PWT | BREMERTON | 47.34 | 122.38 | 0.6875 | 5,510 |
| 6 | NUW | WHIDBEY ISL | 48.17 | 122.37 | 0.6875 | 4,001 |
| 7 | NFL | FALLON | 39.28 | 118.47 | 0.9375 | 1,329 |

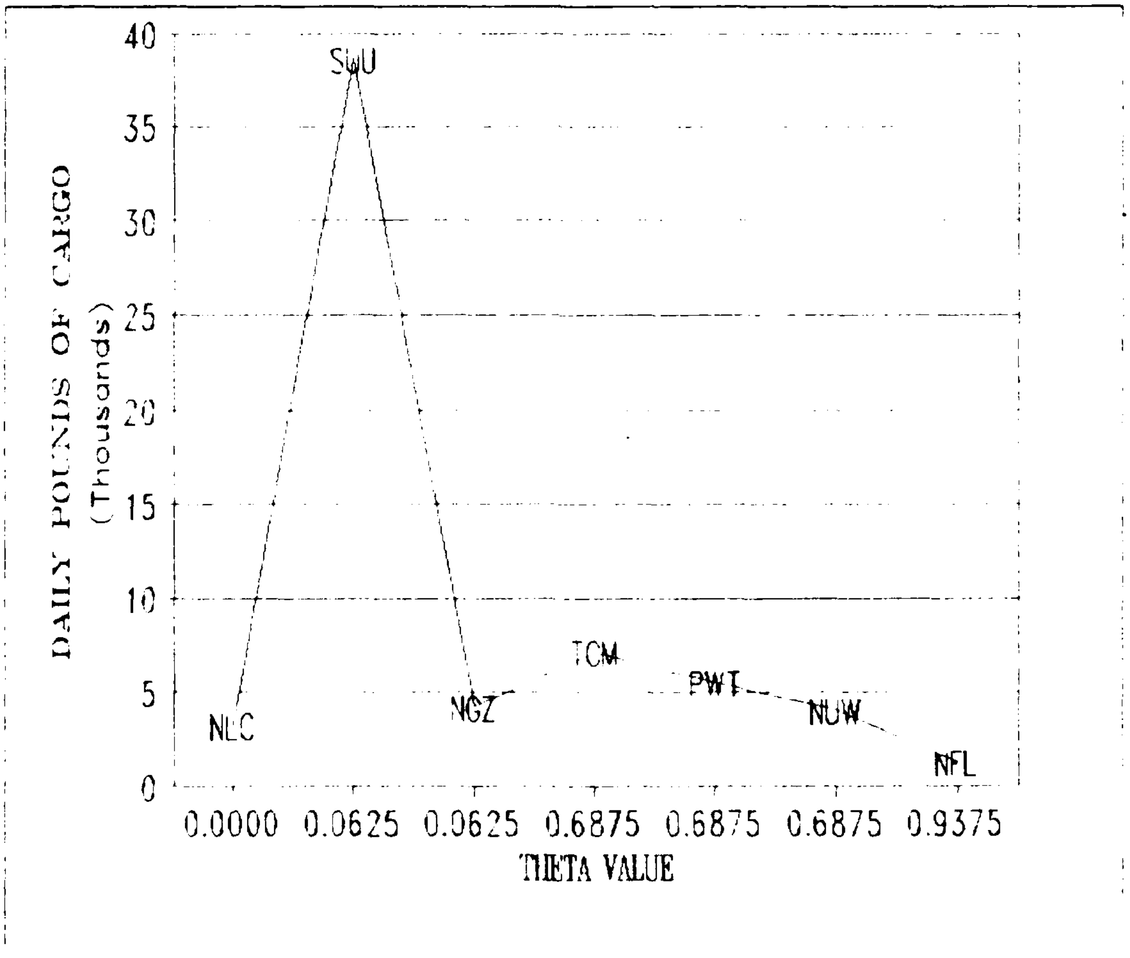

Figure 19: Spacefilling Curve QUICKTRANS Travis hub routing

## 2. QUICKTRANS SAN DIEGO HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NZY | SAN DIEGO (HUB) | 32.42 | 117.12 | 0.0000 | 40,072 |
| 2 | LGB | LONG BEACH | 33.45 | 118.14 | 0.3750 | 10,626 |
| 3 | NTD | POINT MUGU | 34.07 | 119.07 | 0.5000 | 3,592 |
| 4 | SBD | SAN BERNADINO | 34.06 | 117.17 | 0.7500 | 3,206 |
| 5 | NZJ | EL TORO | 33.36 | 117.40 | 0.9375 | 548 |

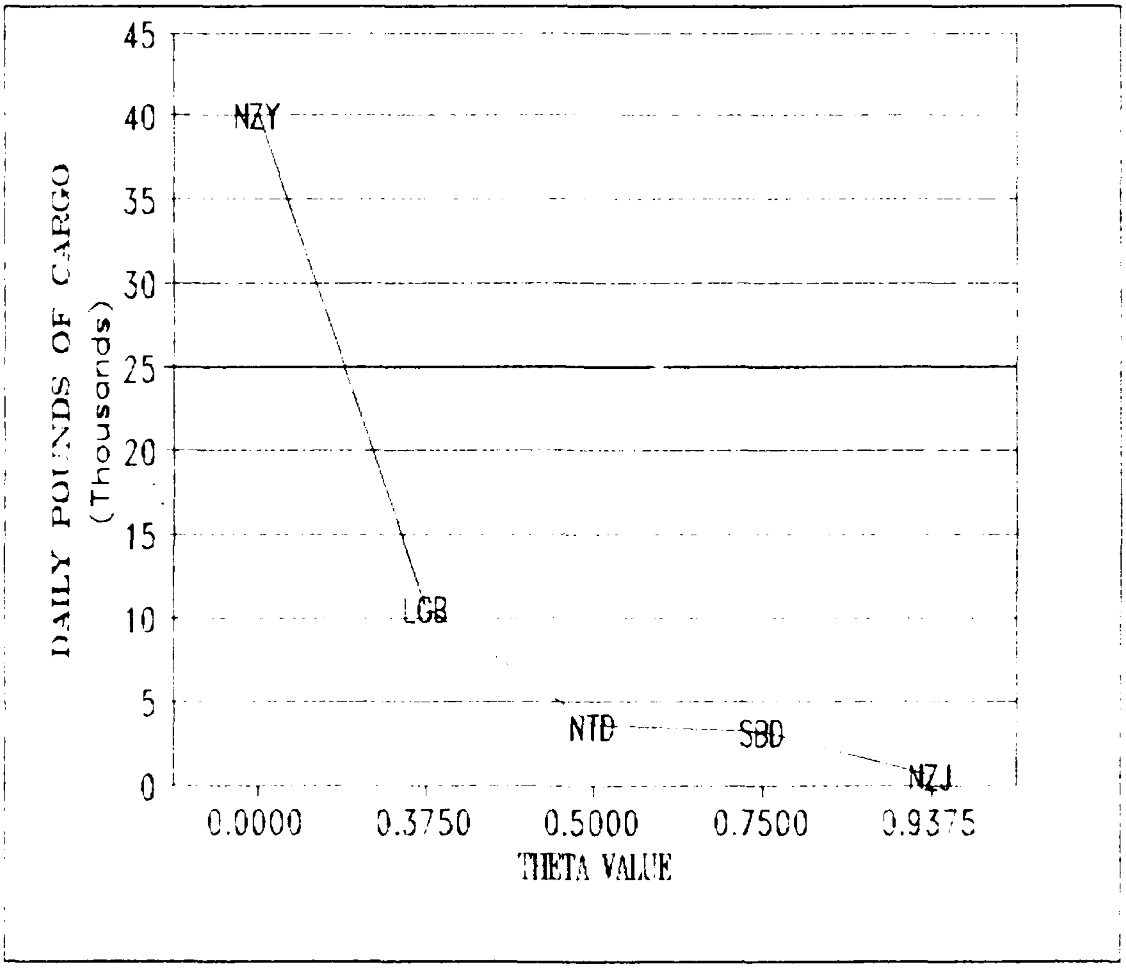

Figure 20: Spacefilling Curve QUICKTRANS San Diego hub routing

### 3. QUICKTRANS NORFOLK HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NGU | NORFOLK (HUB) | 36.57 | 76.18 | 0.0625 | 53,378 |
| 2 | TWH | NAVAL SHIPYARD | 36.49 | 76.18 | 0.0625 | 1,175 |
| 3 | NHK | PATUXENT RIVER | 38.17 | 76.25 | 0.0625 | 4,649 |
| 4 | NKT | CHERRY POINT | 34.54 | 76.54 | 0.0625 | 9,862 |
| 5 | DAG | DAHLGREN | 38.20 | 77.03 | 0.0625 | 1,096 |
| 6 | IND | WEIR COOK AP | 39.43 | 86.16 | 0.3125 | 4,135 |
| 7 | INH | INDIAN HEAD | 38.30 | 77.03 | 0.8750 | 1,096 |
| 8 | DCA | WASHINGTON | 38.51 | 77.00 | 0.8750 | 3,625 |
| 9 | PHL | PHILADELPHIA-1 | 39.57 | 75.07 | 0.8750 | 3,562 |
| 10 | PNE | PHILADELPHIA-2 | 39.57 | 75.07 | 0.8750 | 266 |
| 11 | WRI | MCGUIRE AFB | 40.01 | 74.36 | 0.9375 | 1,991 |
| 12 | NCO | NEWPORT | 41.28 | 71.20 | 0.9375 | 1,515 |
| 13 | GON | NEW LONDON | 41.21 | 72.07 | 0.9375 | 4,394 |

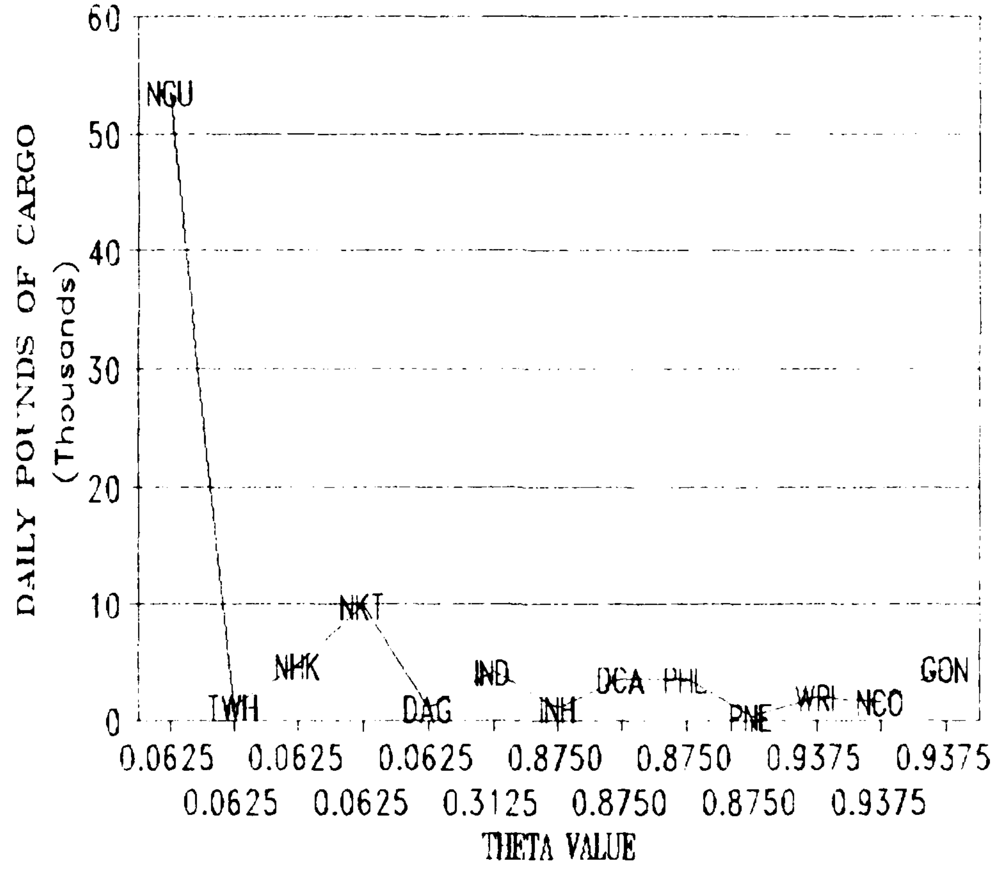

Figure 21: Spacefilling Curve QUICKTRANS Norfolk hub routing

### 4. QUICKTRANS JACKSONVILLE HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NQX | KEY WEST | 24.34 | 81.41 | 0.0000 | 1,675 |
| 2 | NPA | PENSOCOLA | 30.21 | 87.19 | 0.5000 | 10,607 |
| 3 | NIP | JACKSONVILL(HUB) | 30.14 | 81.40 | 0.7500 | 20,541 |
| 4 | KBY | KINGS BAY | 30.48 | 81.40 | 0.7500 | 1,408 |
| 5 | COF | CAPE CANAVERAL | 28.14 | 80.36 | 0.8125 | 1,089 |

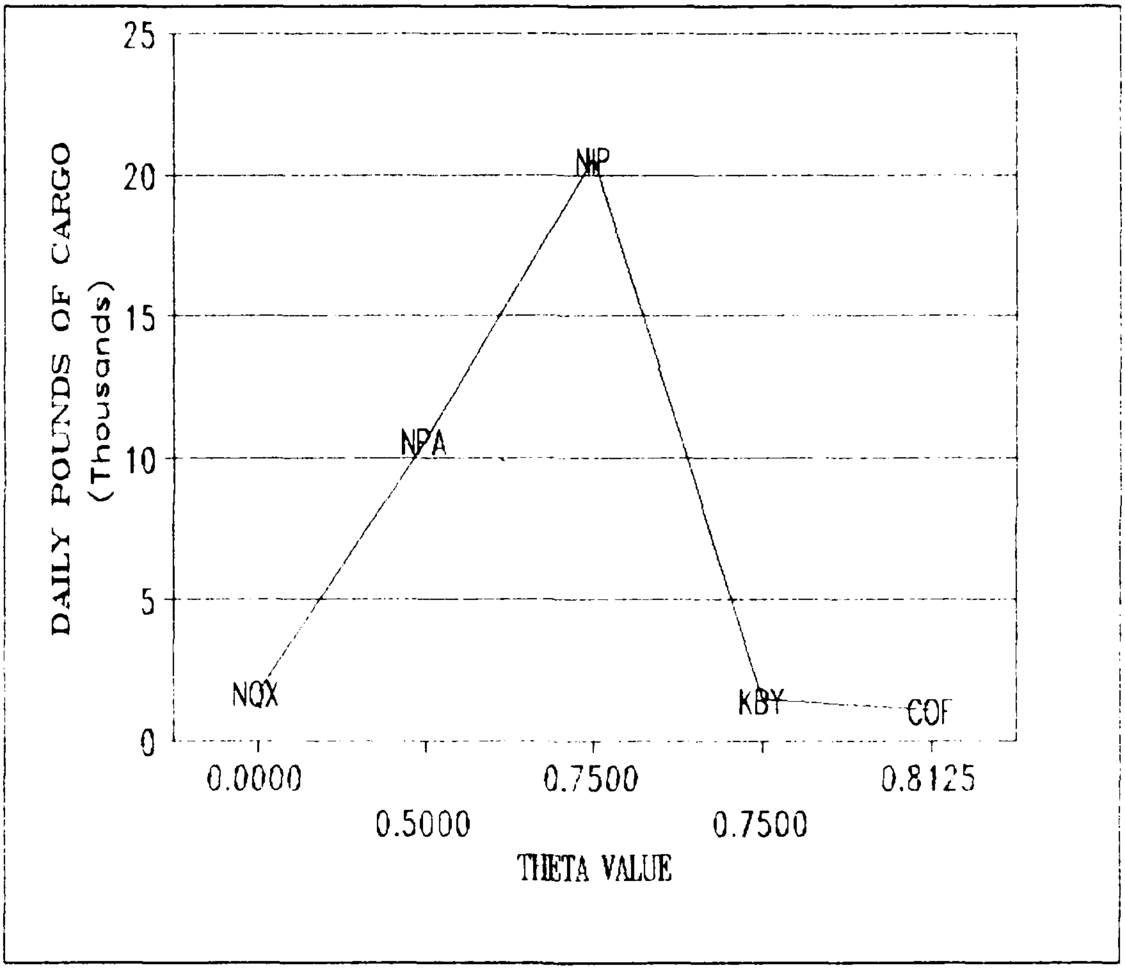

Figure 22: Spacefilling Curve QUICKTRANS Jacksonville hub routing

### 5. QUICKTRANS MAIN HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NIP | JACKSONVILLE | 30.14 | 81.40 | 0.0000 | 20,541 |
| 2 | CHS | CHARLESTON | 32.53 | 80.02 | 0.0000 | 17,723 |
| 3 | NZY | SAN DIEGO | 32.42 | 117.12 | 0.2500 | 40,072 |
| 4 | NGZ | OAKLAND | 37.47 | 122.13 | 0.2656 | 4,223 |
| 5 | SUU | TRAVIS AFB | 38.16 | 121.56 | 0.2656 | 38,594 |
| 6 | NGU | NORFOLK | 36.57 | 76.18 | 0.9844 | 53,378 |

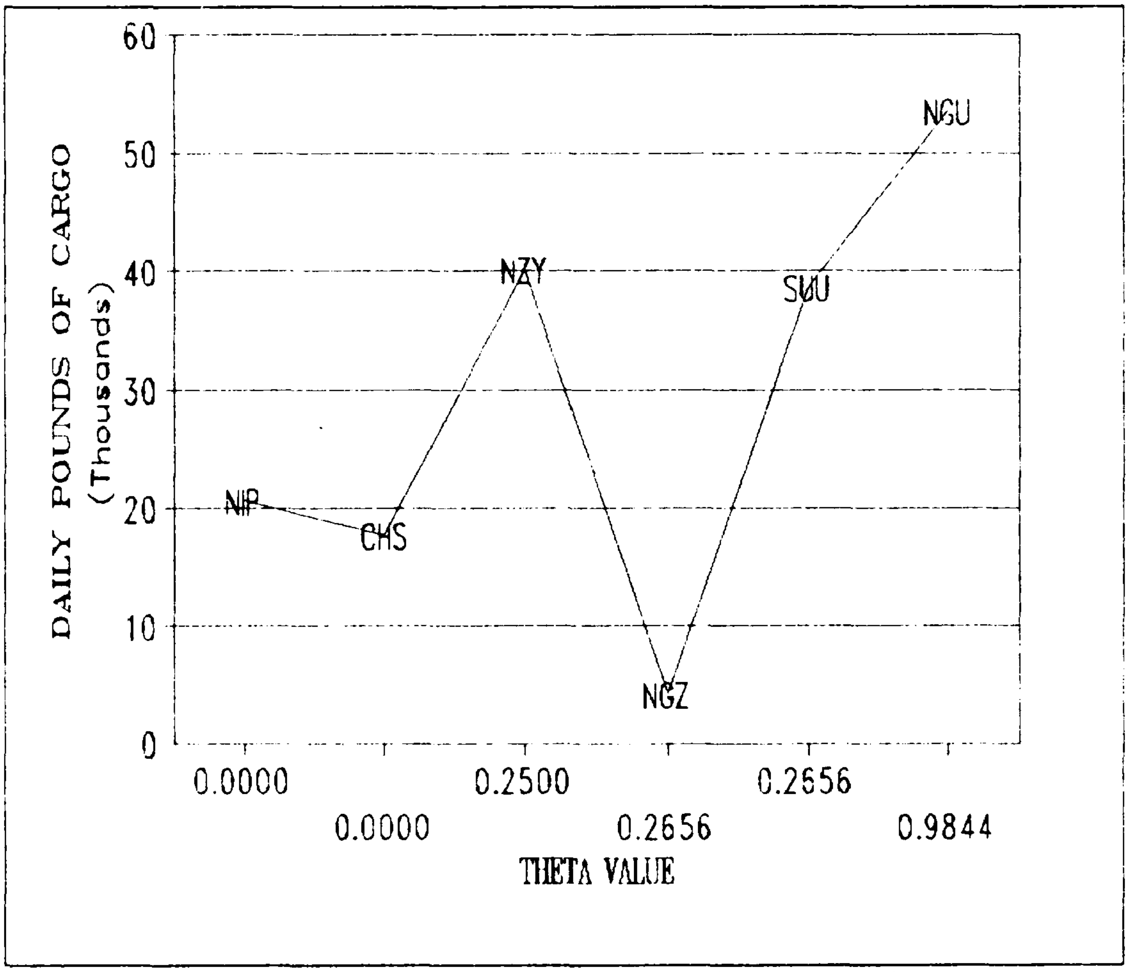

**Figure 23:** Spacefilling Curve QUICKTRANS main hub routing

*LOGAIR Hub Routings*

1. LOGAIR MAIN HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | WRB | ROBINS | 32.38 | 83.35 | 0.0000 | 22,661 |
| 2 | TIK | TINKER | 35.25 | 97.23 | 0.0625 | 34,308 |
| 3 | SKF | KELLY | 29.23 | 98.35 | 0.0625 | 31,959 |
| 4 | HIF | HILL | 41.08 | 111.58 | 0.1250 | 26,907 |
| 5 | SUU | TRAVIS | 38.16 | 121.56 | 0.2500 | 11,556 |
| 6 | MCC | MCCLELLAN | 38.40 | 121.24 | 0.2500 | 22,912 |
| 7 | SBD | NORTON | 34.06 | 117.14 | 0.2500 | 12,975 |
| 8 | FFO | WRIGHT-PATT | 39.49 | 84.03 | 0.9375 | 14,867 |

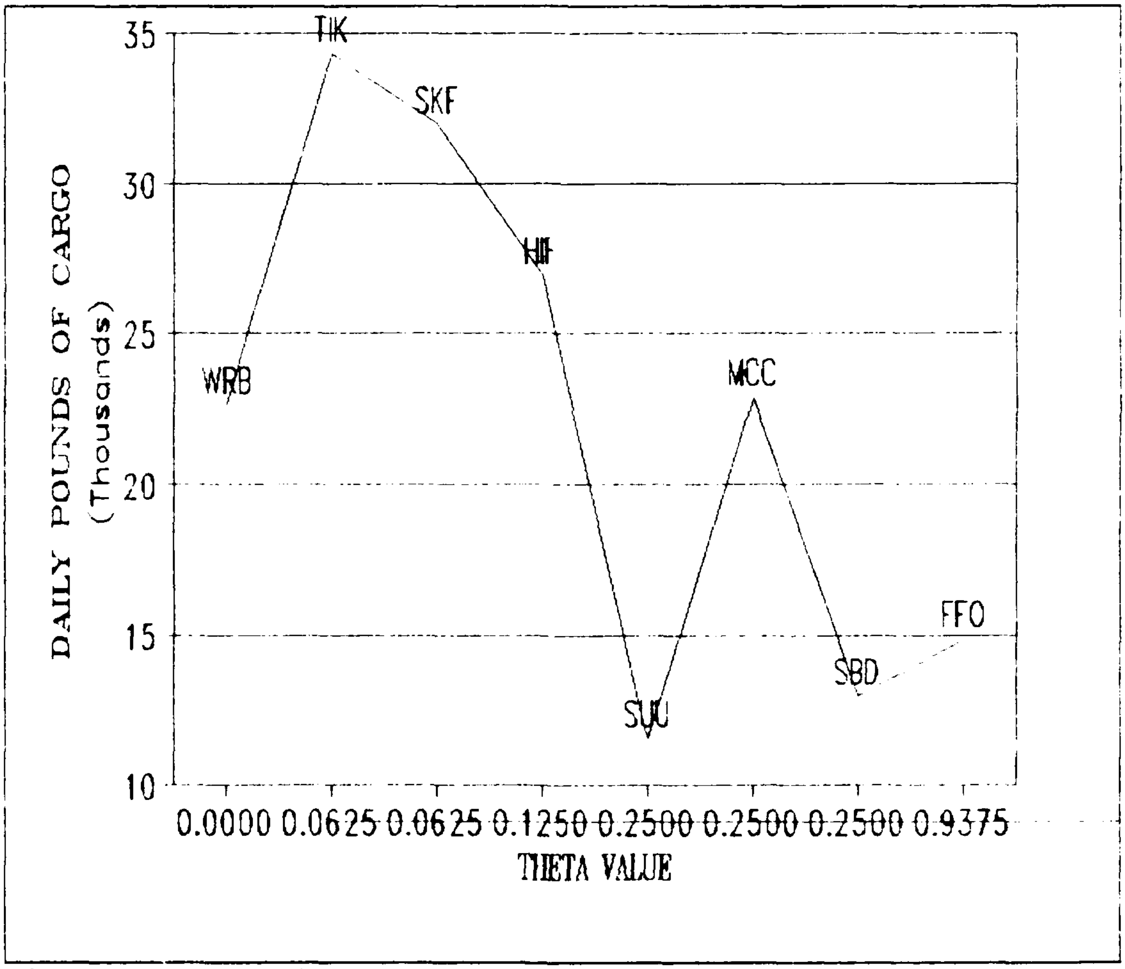

**Figure 24:** Spacefilling Curve LOGAIR main hub routing

## 2. LOGAIR WRIGHT-PATTERSON AFB HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | RME | GRIFFISS | 43.14 | 75.24 | 0.0313 | 2,820 |
| 2 | LFI | LANGLEY | 37.05 | 76.22 | 0.4688 | 3,645 |
| 3 | WRI | MCGUIRE | 40.01 | 74.35 | 0.4688 | 8,486 |
| 4 | DOV | DOVER | 39.08 | 75.28 | 0.4688 | 8,091 |
| 5 | MTC | SELFRIDGE | 42.36 | 82.50 | 0.1719 | 896 |
| 6 | NKO | NEWARK | 40.04 | 82.24 | 0.1875 | 127 |
| 7 | FFO | WPAFB (HUB) | 39.49 | 84.03 | 0.2031 | 14,867 |
| 8 | GUS | GRISSOM | 40.39 | 86.08 | 0.2188 | 90 |
| 9 | SAW | K.I. SAWYER | 46.21 | 87.23 | 0.2813 | 1,50[illegible] |
| 10 | DLH | DULUTH | 46.50 | 92.11 | 0.3125 | 525 |
| 11 | OSC | WURTSMITH | 44.27 | 83.24 | 0.3438 | 1,821 |
| 12 | PBG | PLATTSBURGH | 44.39 | 73.28 | 0.9063 | 3,108 |
| 13 | LIZ | LORING | 46.57 | 67.53 | 0.9375 | 2,007 |
| 14 | PSM | PEASE | 43.04 | 70.49 | 0.9844 | 3,574 |

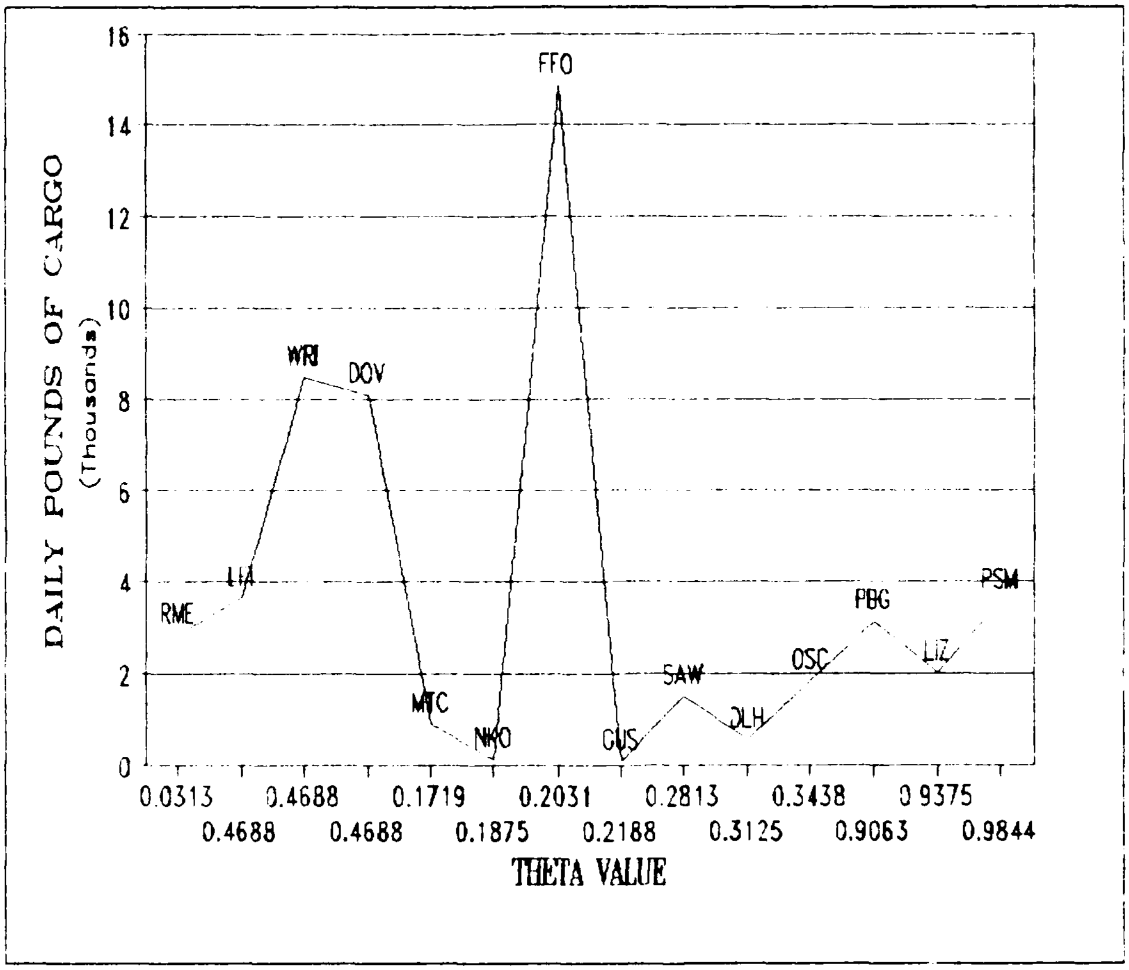

Figure 25: Spacefilling Curve LOGAIR Wright-Patterson hub routing

## 3. LOGAIR HILL AFB HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | FEW | FRANCIS E.W. | 41.08 | 104.52 | 0.0625 | 2,424 |
| 2 | ABQ | KIRTLAND | 35.02 | 106.36 | 0.0625 | 927 |
| 3 | MUO | MOUNTAIN HOME | 43.03 | 115.52 | 0.1250 | 1,985 |
| 4 | GFA | MALMSTROM | 47.30 | 111.11 | 0.1250 | 3,028 |
| 5 | HIF | HILL (HUB) | 41.08 | 111.58 | 0.1875 | 26,907 |
| 6 | TCM | MCCHORD | 47.08 | 122.28 | 0.3125 | 7,406 |
| 7 | SKA | FAIRCHILD | 47.37 | 117.39 | 0.3125 | 1,844 |
| 8 | MIB | MINOT | 48.25 | 101.21 | 0.8125 | 2,934 |
| 9 | RDR | GRAND FORKS | 47.57 | 97.24 | 0.8125 | 2,424 |
| 10 | RCA | ELLSWORTH | 44.09 | 103.06 | 0.9375 | 3,721 |

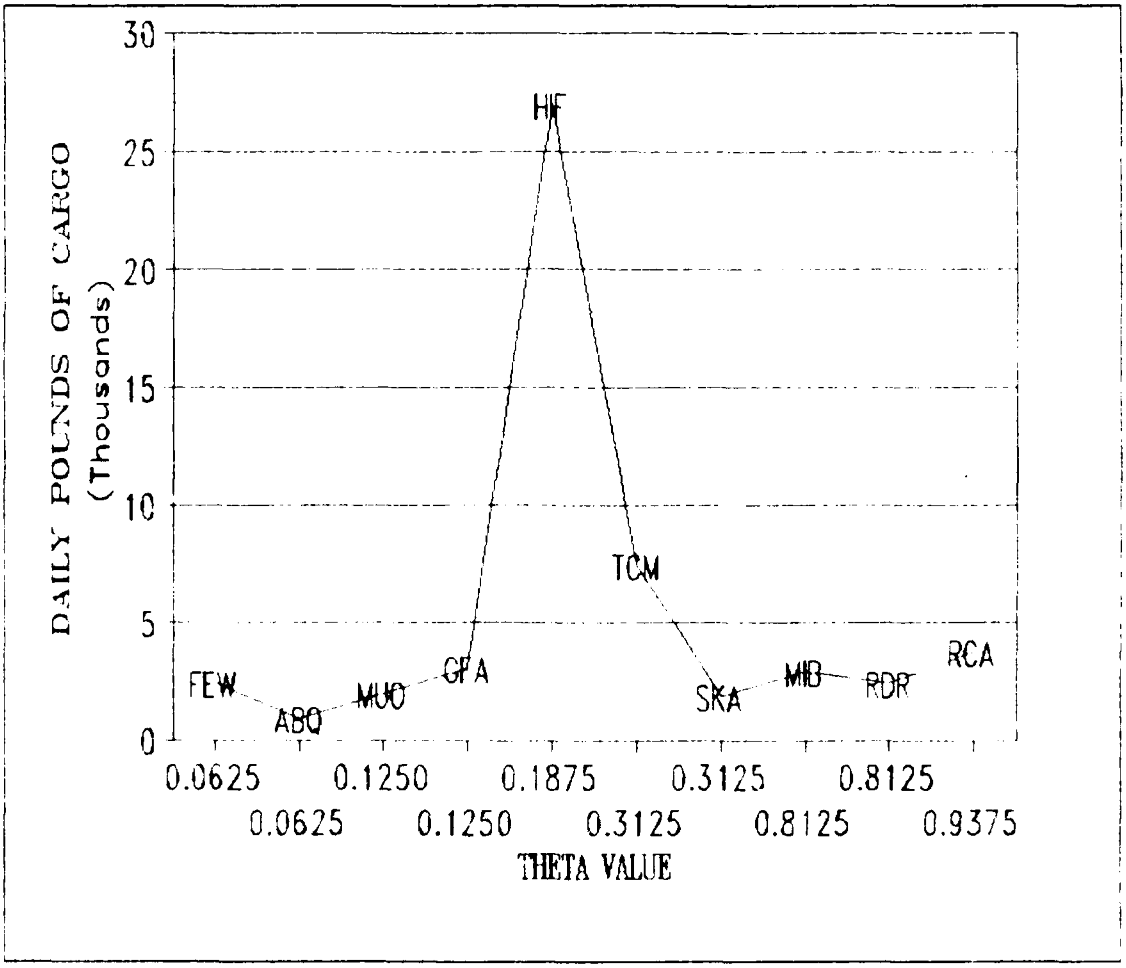

Figure 26: Spacefilling Curve LOGAIR Hill hub routing

### 4. LOGAIR NORTON AFB HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | DMA | DAVIS-MONTHAM | 32.10 | 110.53 | 0.0000 | 2,570 |
| 2 | LUF | LUKE | 33.32 | 112.23 | 0.0625 | 4,104 |
| 3 | SBD | NORTON (HUB) | 34.06 | 117.14 | 0.3125 | 12,975 |
| 4 | LSV | NELLIS | 36.14 | 115.02 | 0.3750 | 2,946 |

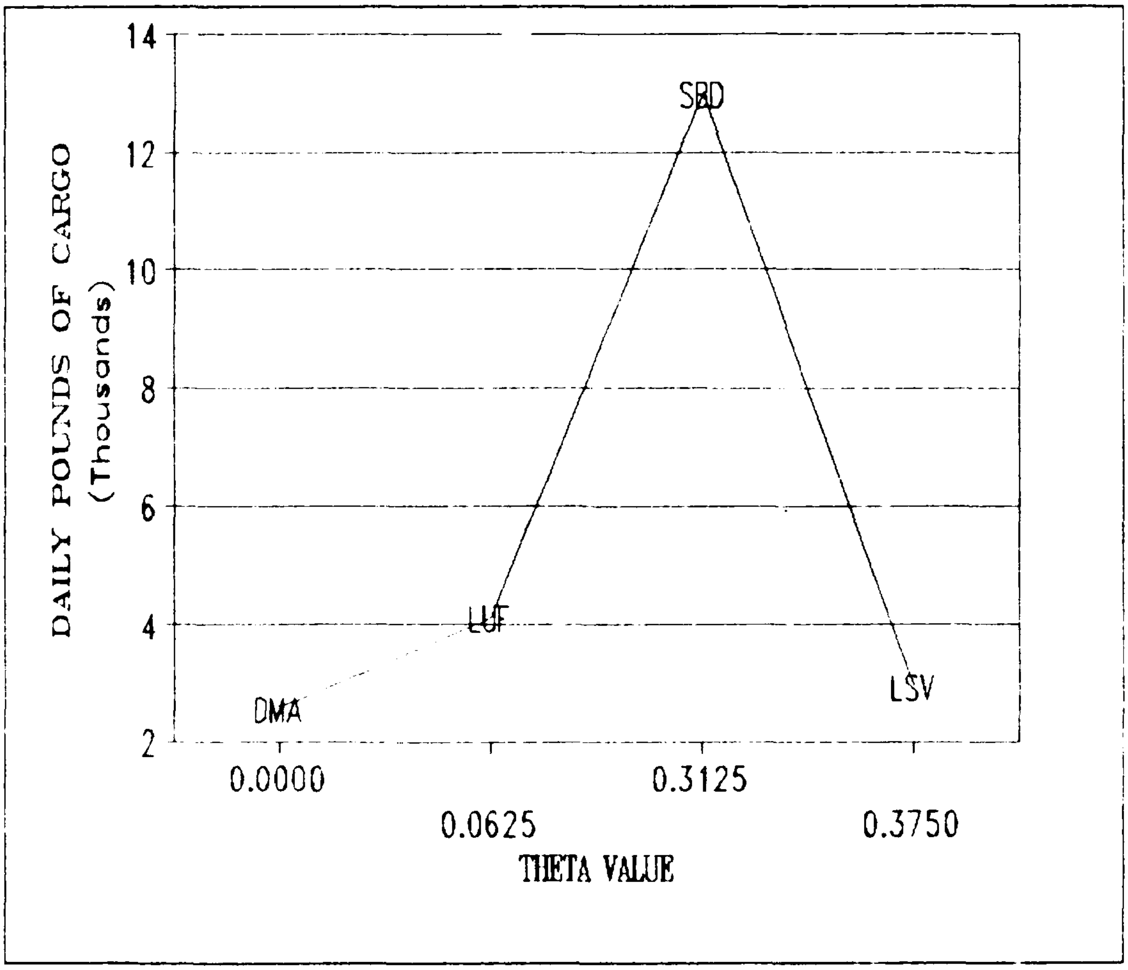

Figure 27: Spacefilling Curve LOGAIR Norton hub routing

5. LOGAIR KELLY AFB HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | AEX | ENGLAND | 31.20 | 92.33 | 0.0000 | 793 |
| 2 | SKF | KELLY (HUB) | 29.23 | 98.35 | 0.0625 | 31,959 |
| 3 | DYS | DYESS | 32.25 | 99.51 | 0.1875 | 2,584 |
| 4 | HMN | HOLLOMAN | 32.51 | 106.06 | 0.2500 | 3,421 |

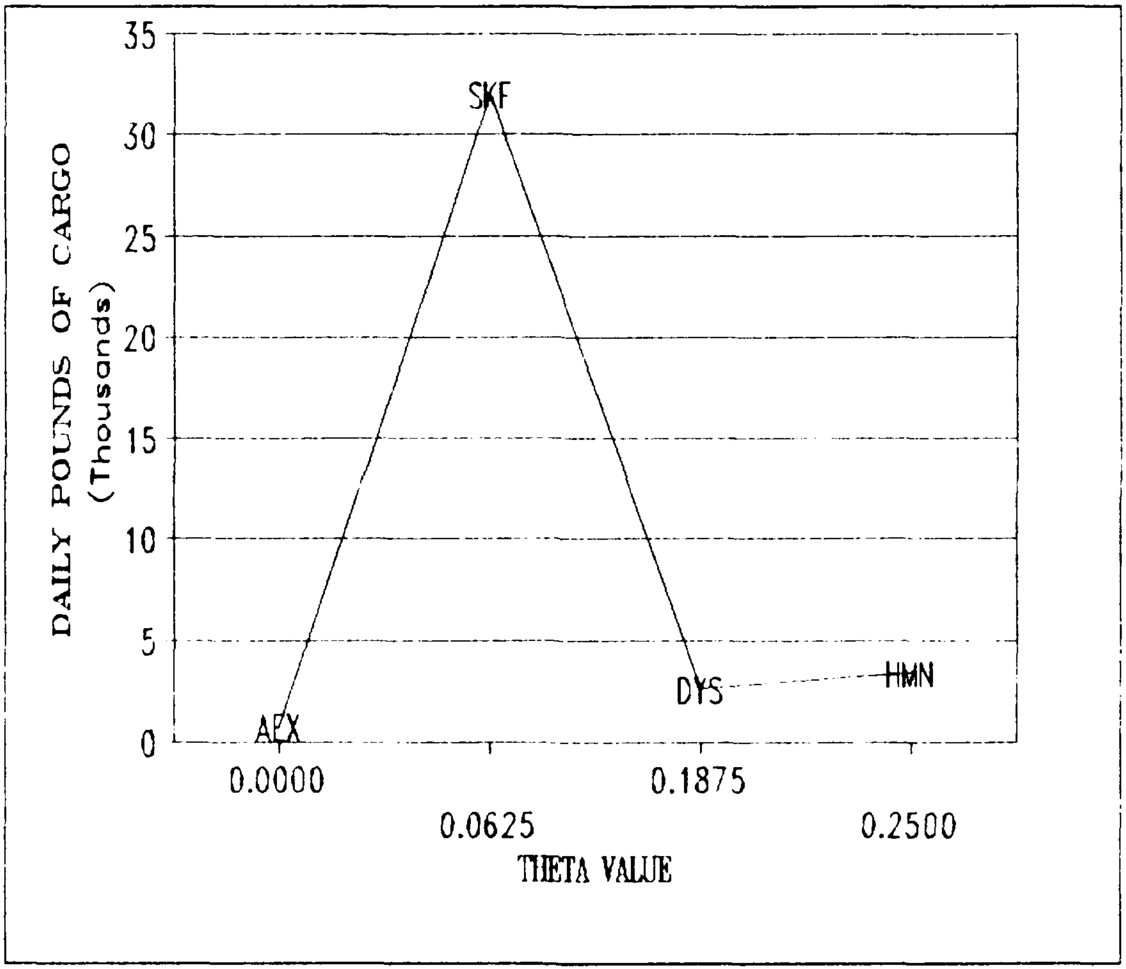

Figure 28: Spacefilling Curve LOGAIR Kelly hub routing

## 6. LOGAIR TINKER AFB HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | LRF | LITTLE ROCK | 34.55 | 92.08 | 0.0000 | 3,413 |
| 2 | BAD | BARKSDALE | 32.30 | 93.40 | 0.0000 | 3,216 |
| 3 | FWH | CARSWELL | 32.46 | 97.26 | 0.0625 | 3,629 |
| 4 | CVS | CANNON | 34.23 | 103.19 | 0.2500 | 1,521 |
| 5 | OFF | OFFUTT | 41.07 | 95.55 | 0.6875 | 2,299 |
| 6 | SZL | WHITEMAN | 38.44 | 93.33 | 0.8125 | 1,722 |
| 7 | TIK | TINKER (HUB) | 35.25 | 97.23 | 0.8750 | 34,308 |
| 8 | IAB | MCCONNELL | 37.37 | 97.16 | 0.8750 | 2,190 |

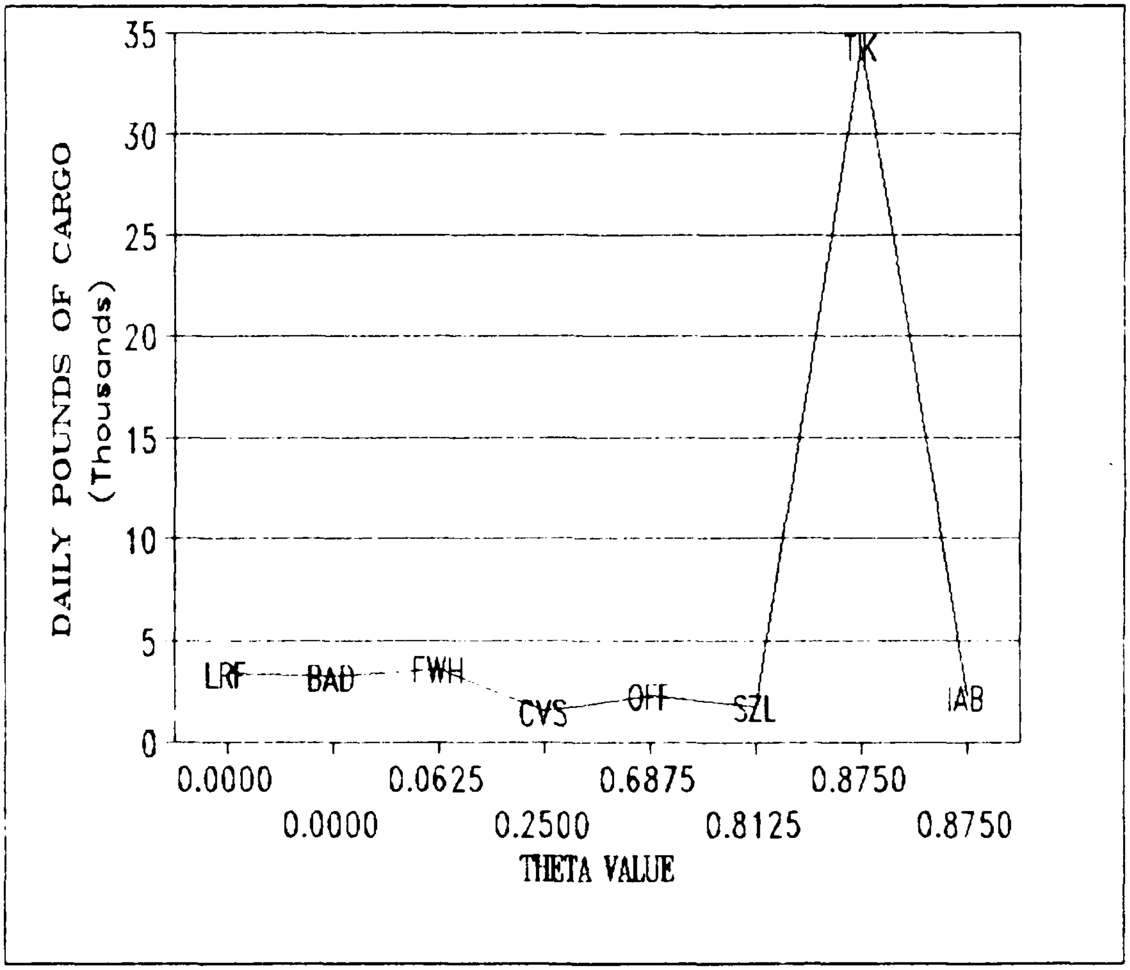

Figure 29: Spacefilling Curve LOGAIR Tinker hub routing

### 7. LOGAIR WARNER ROBINS AFB HUB ROUTING

| RANK | CODE | BASE | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | HST | HOMESTEAD | 25.29 | 80.23 | 0.0156 | 2,572 |
| 2 | NQX | KEY WEST | 24.34 | 81.41 | 0.0469 | 90 |
| 3 | MCF | MACDILL | 27.51 | 82.31 | 0.1094 | 1,742 |
| 4 | BIX | KEESLER | 30.25 | 88.55 | 0.3125 | 1,452 |
| 5 | PAM | TYNDALL | 30.04 | 85.35 | 0.3594 | 1,939 |
| 6 | VPS | EGLIN | 30.29 | 86.32 | 0.3594 | 5,188 |
| 7 | CBM | COLUMBUS MS | 33.39 | 88.26 | 0.4844 | 895 |
| 8 | BYH | IRA EAKER | 35.58 | 89.57 | 0.5000 | 1,328 |
| 9 | MEM | MEMPHIS | 35.03 | 89.58 | 0.5000 | 599 |
| 10 | VAD | MOODY | 30.58 | 83.12 | 0.6250 | 1,618 |
| 11 | WRB | ROBINS (HUB) | 32.38 | 83.35 | 0.6406 | 22,661 |
| 12 | SSC | SHAW | 33.58 | 80.28 | 0.7188 | 3,455 |
| 13 | GSB | SEYMOUR JOHNSON | 35.20 | 77.58 | 0.7500 | 3,580 |
| 14 | CHS | CHARLESTON | 32.54 | 80.02 | 0.7813 | 5,996 |
| 15 | NIP | JACKSONVILLE | 30.14 | 81.40 | 0.8906 | 1,684 |
| 16 | CCF | PATRICK | 28.14 | 80.36 | 0.9063 | 1,036 |

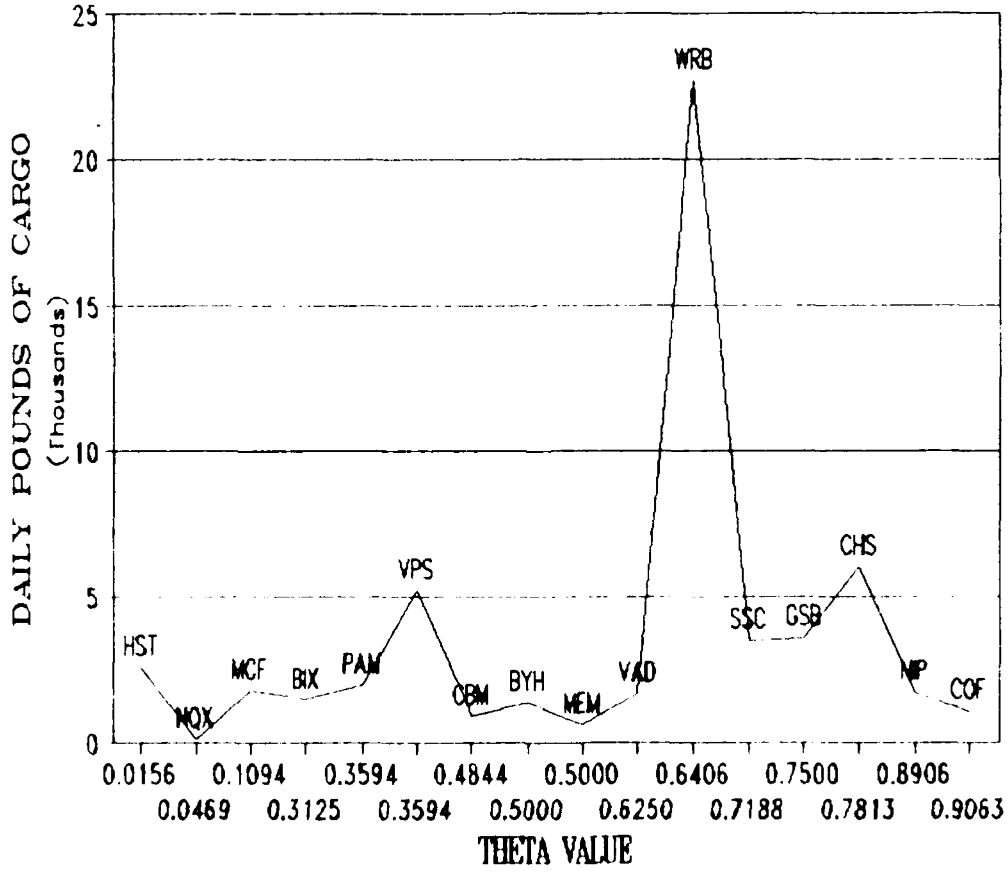

Figure 30: Spacefilling Curve LOGAIR Robins hub routing

*Combined Route Model Hub Routings*

1. Combined Route Model Combined Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | CHS | CHARLESTON | 32.54 | 80.02 | 0.00000 | 23,719 |
| 2 | WRB | ROBINS | 32.38 | 83.35 | 0.01563 | 22,661 |
| 3 | NIP | JACKSONVILLE | 30.14 | 81.40 | 0.01563 | 22,225 |
| 4 | SKF | KELLY | 29.23 | 98.35 | 0.06250 | 31,959 |
| 5 | TIK | TINKER | 35.25 | 97.23 | 0.07813 | 34,308 |
| 6 | HIF | HILL | 41.08 | 111.58 | 0.21875 | 26,907 |
| 7 | LGB | LONG BEACH | 33.45 | 118.14 | 0.25000 | 10,626 |
| 8 | NZY | SAN DIEGO | 32.42 | 117.12 | 0.25000 | 40,072 |
| 9 | SBD | NORTON | 34.06 | 117.14 | 0.25000 | 16,181 |
| 10 | SUU | TRAVIS AFB | 38.16 | 121.56 | 0.26563 | 50,150 |
| 11 | MCC | MCCLELLAN | 38.40 | 121.24 | 0.26563 | 22,912 |
| 12 | TCM | MCCHORD AFB | 47.08 | 122.28 | 0.29688 | 14,602 |
| 13 | FFO | WRIGHT-PATTERSON | 39.49 | 84.03 | 0.96875 | 14,867 |
| 14 | NGU | NORFOLK | 36.57 | 76.18 | 0.98438 | 53,378 |
| 15 | WRI | MCGUIRE | 40.01 | 74.35 | 0.98438 | 10,477 |
| 16 | DOV | DOVER | 39.08 | 75.28 | 0.98438 | 8,091 |

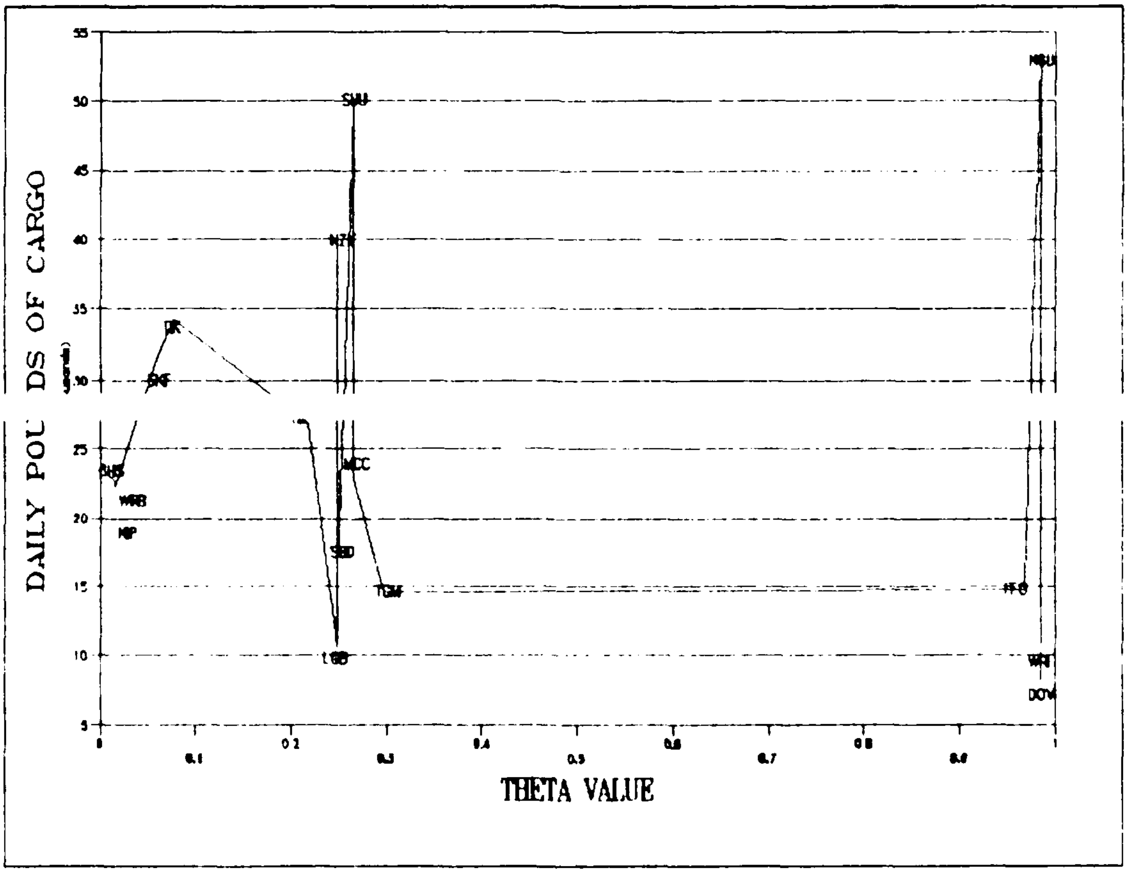

Figure 31: Spacefilling Curve Combined Route Model hub routings

### 2. Combined Route Model Dover Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NHK | PATUXENT RIVER | 38.17 | 76.25 | 0.18750 | 4,649 |
| 2 | DAG | DAHLGREN | 38.20 | 77.03 | 0.25000 | 1,096 |
| 3 | INH | INDIAN HEAD | 38.30 | 77.03 | 0.25000 | 1,096 |
| 4 | DCA | WASHINGTON | 38.51 | 77.00 | 0.26563 | 3,625 |
| 5 | PHL | PHILADELPHIA-1 | 39.57 | 75.07 | 0.79688 | 3,562 |
| 6 | PNE | PHILADELPHIA-2 | 39.57 | 75.07 | 0.79688 | 266 |
| 7 | DOV | DOVER (HUB) | 39.08 | 75.28 | 0.93750 | 8,091 |

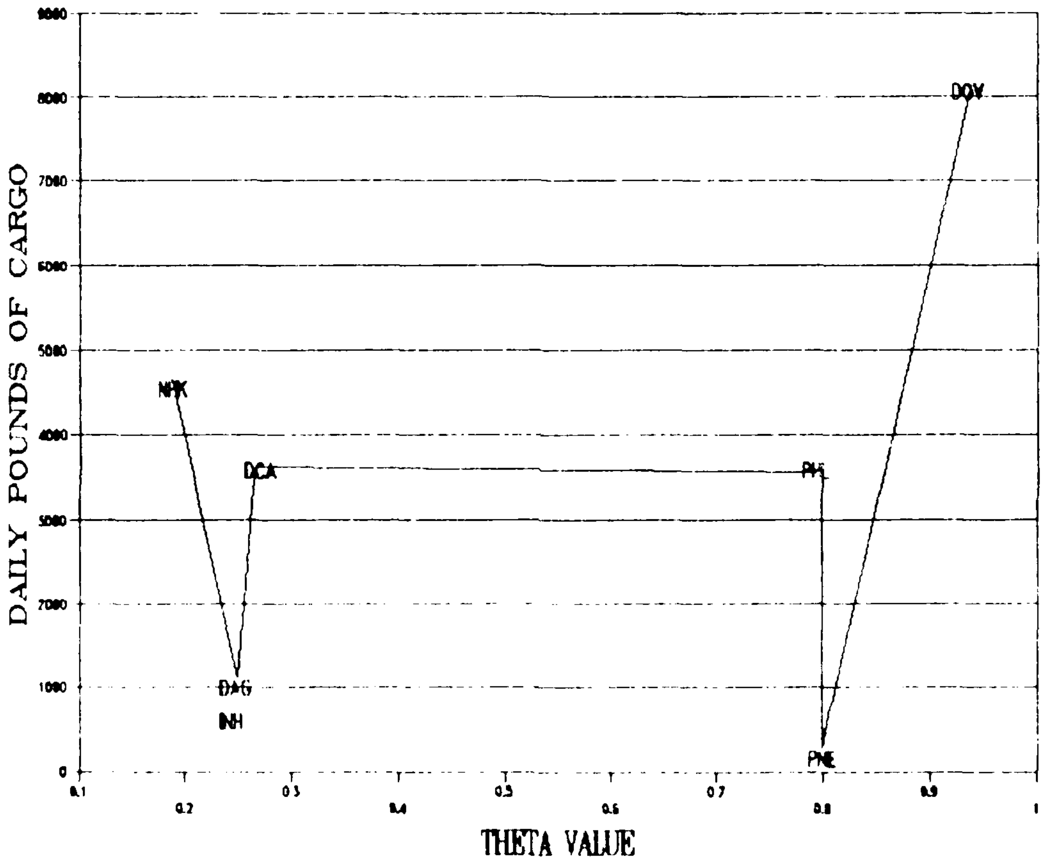

Figure 32: Spacefilling Curve Combined Route Model Dover hub routing

3. Combined Route Model WPAFB Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NKO | NEWARK | 40.04 | 82.24 | 0.00000 | 127 |
| 2 | FFO | WPAFB (HUB) | 39.49 | 84.03 | 0.01563 | 14,867 |
| 3 | IND | WEIR COOK AP | 39.43 | 86.16 | 0.06250 | 4,135 |
| 4 | GUS | GRISSOM | 40.39 | 86.08 | 0.06250 | 90 |
| 5 | DLH | DULUTH | 46.50 | 92.11 | 0.45313 | 525 |
| 6 | SAW | K.I. SAWYER | 46.21 | 87.23 | 0.60938 | 1,507 |
| 7 | OSC | WURTSMITH | 44.27 | 83.24 | 0.93750 | 1,821 |
| 8 | MTC | SELFRIDGE | 42.36 | 82.50 | 0.95313 | 896 |

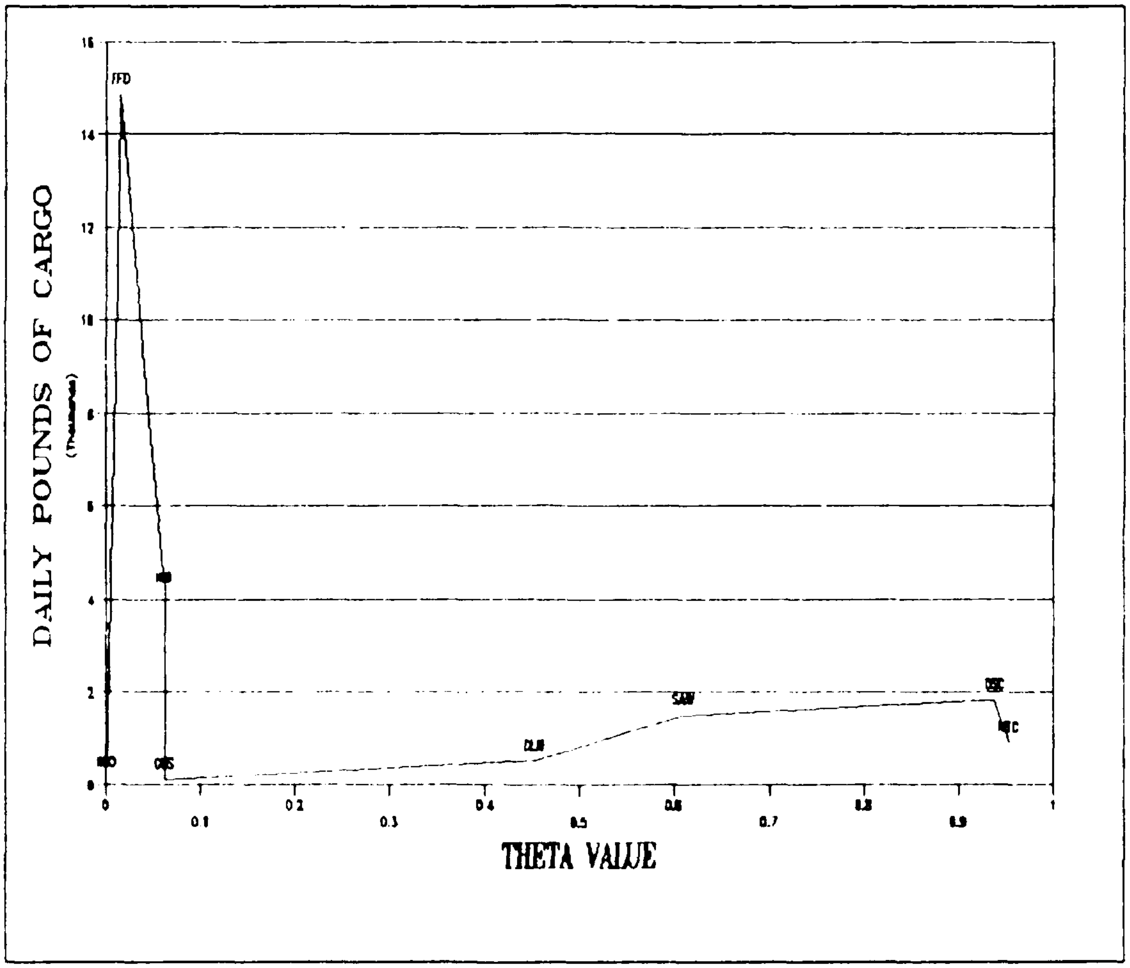

Figure 33: Spacefilling Curve Combined Route Model Wright-Patterson hub routing

4. Combined Route Model Hill Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | RCA | ELLSWORTH | 44.09 | 103.06 | 0.03125 | 3,721 |
| 2 | FEW | FRANCIS E.W. | 41.08 | 104.52 | 0.06250 | 2,424 |
| 3 | HIF | HILL (HUB) | 41.08 | 111.58 | 0.23438 | 26,907 |
| 4 | MUO | MOUNTAIN HOME | 43.03 | 115.52 | 0.25000 | 1,985 |
| 5 | GFA | MALMSTROM | 47.30 | 111.11 | 0.28125 | 3,028 |
| 6 | MIB | MINOT | 48.25 | 101.21 | 0.92188 | 2,934 |
| 7 | RDR | GRAND FORKS | 47.57 | 97.24 | 0.95313 | 2,424 |

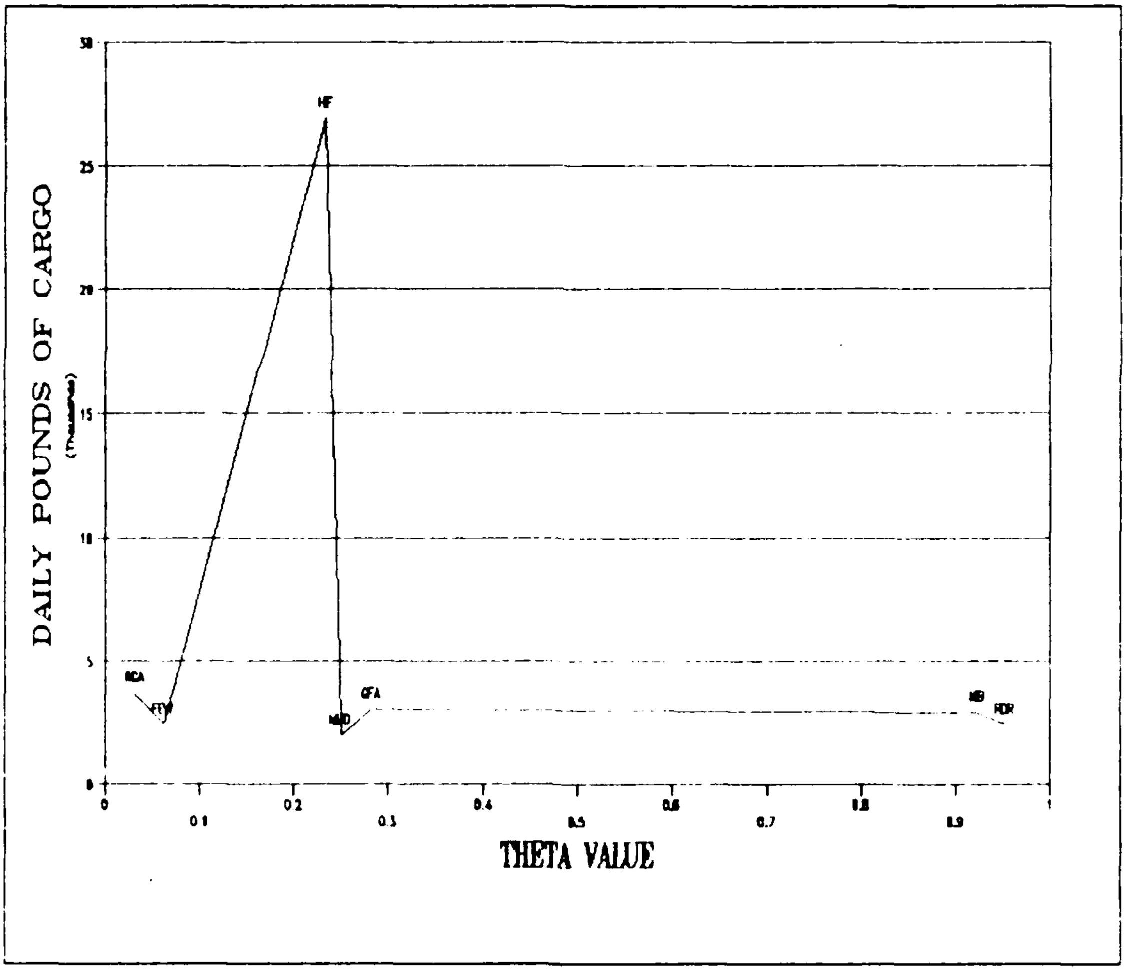

Figure 34: Spacefilling Curve Combined Route Model Hill hub routing

### 5. Combined Route Model Norfolk Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | GSB | SEYMOUR JOHNSON | 35.20 | 77.58 | 0.06250 | 3,580 |
| 2 | NHK | PATUXENT RIVER | 38.17 | 76.25 | 0.75000 | 4,649 |
| 3 | LFI | LANGLEY | 37.05 | 76.22 | 0.81250 | 3,645 |
| 4 | NGU | NORFOLK (HUB) | 36.57 | 76.18 | 0.93750 | 53,378 |
| 5 | TWH | NAVAL SHIPYARD | 36.49 | 76.18 | 0.93750 | 1,175 |

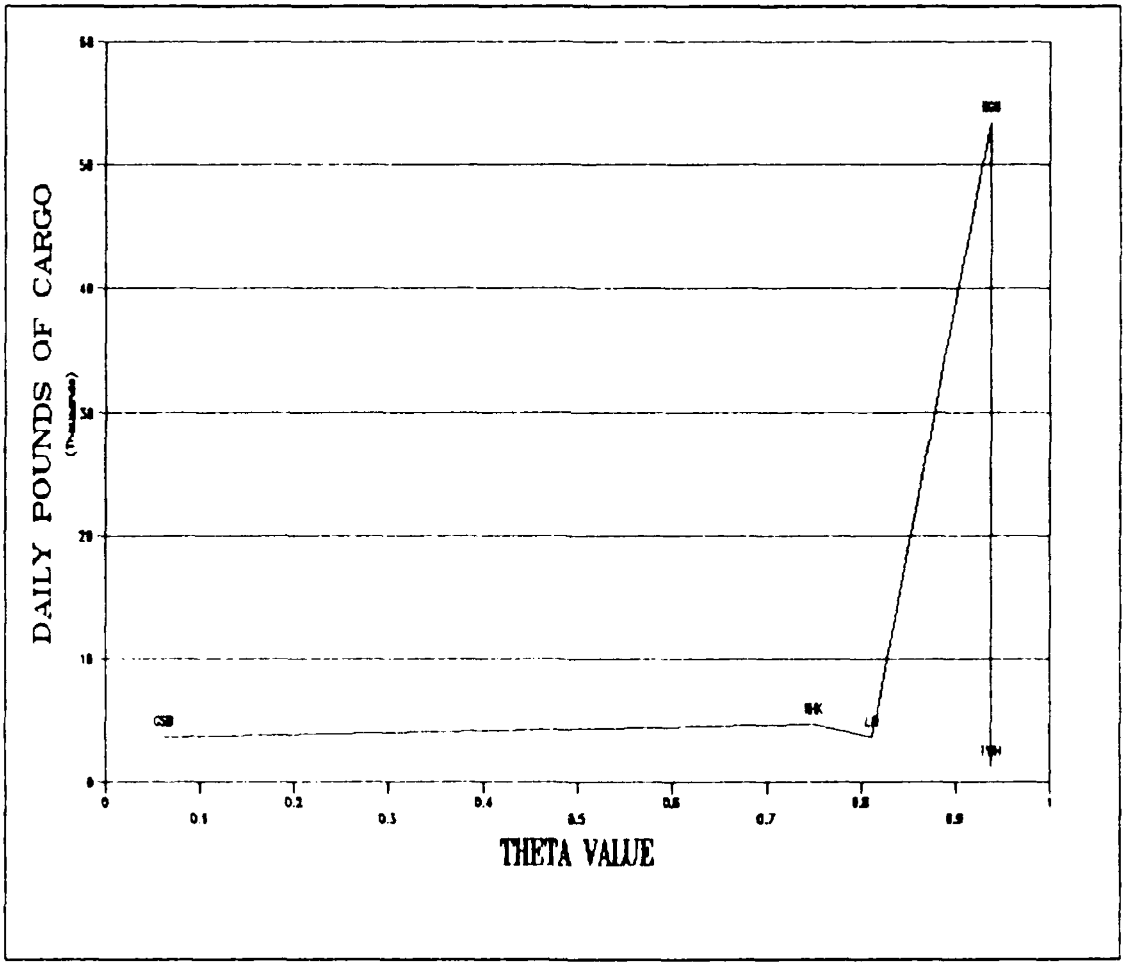

Figure 35: Spacefilling Curve Combined Route Model Norfolk hub routing

6. Combined Route Model Jacksonville Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NQX | KEY WEST | 24.34 | 81.40 | 0.01563 | 1,764 |
| 2 | VAD | MOODY | 30.58 | 83.12 | 0.68750 | 1,618 |
| 3 | KBY | KINGS BAY | 30.48 | 81.40 | 0.73438 | 1,408 |
| 4 | NIP | JACKSONVI (HUB) | 30.14 | 81.40 | 0.73438 | 22,225 |
| 5 | COF | PATRICK | 28.14 | 80.36 | 0.81250 | 2,125 |
| 6 | MCF | MACDILL | 27.51 | 82.31 | 0.85938 | 1,742 |
| 7 | HST | HOMESTEAD | 25.29 | 80.23 | 0.98438 | 2,572 |

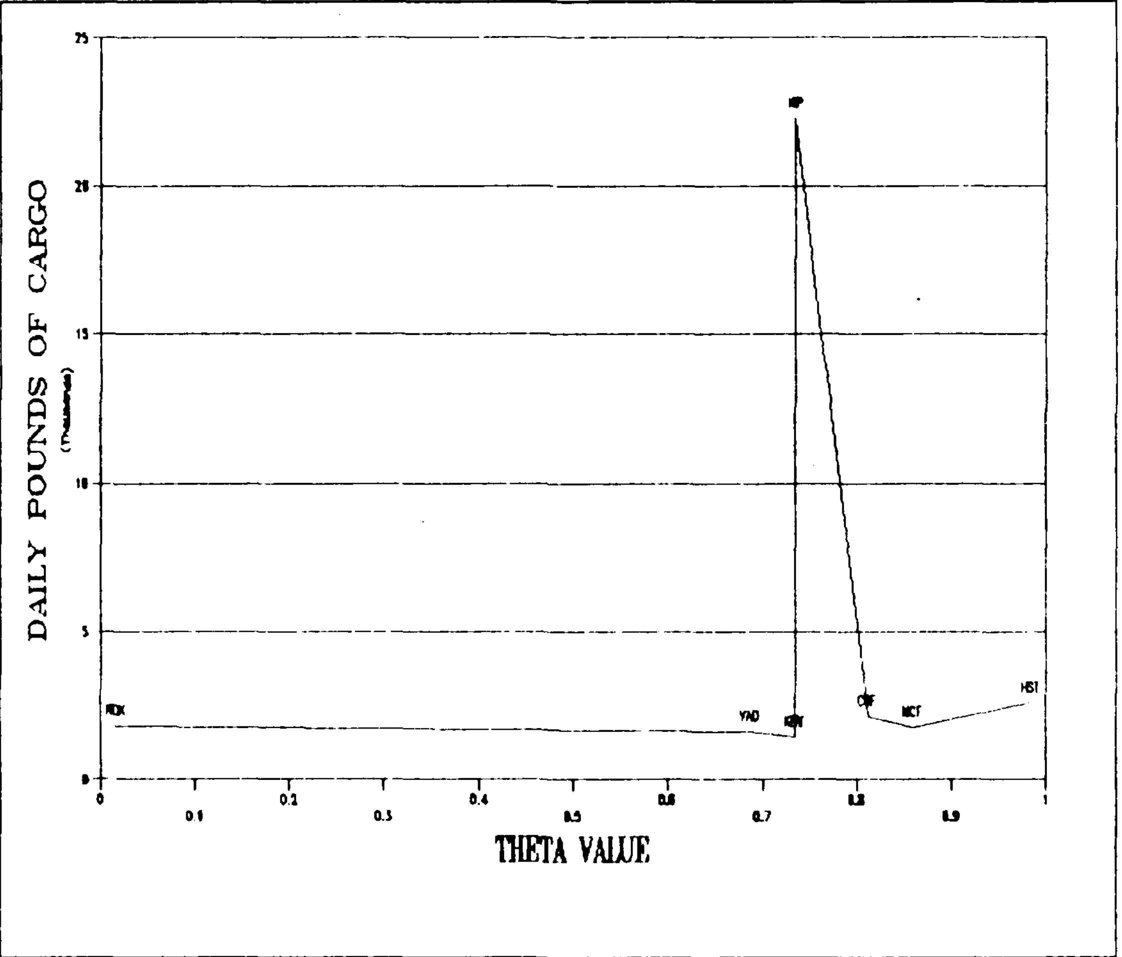

**Figure 36:** Spacefilling Curve Combined Route Model Jacksonville hub routing

### 7. Combined Route Model Norton Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | DMA | DAVIS-MONTHAM | 32.10 | 110.53 | 0.00000 | 2,570 |
| 2 | LSV | NELLIS | 36.14 | 115.02 | 0.12500 | 2,946 |
| 3 | NZJ | EL TORO | 33.36 | 117.40 | 0.21875 | 548 |
| 4 | SBD | NORTON (HUB) | 34.06 | 117.14 | 0.21875 | 16,181 |
| 5 | NTD | POINT MUGU | 34.07 | 119.07 | 0.26563 | 3,592 |
| 6 | LGB | LONG BEACH | 33.45 | 118.14 | 0.26563 | 10,626 |
| 7 | LUF | LUKE | 33.32 | 112.23 | 0.96875 | 4,104 |

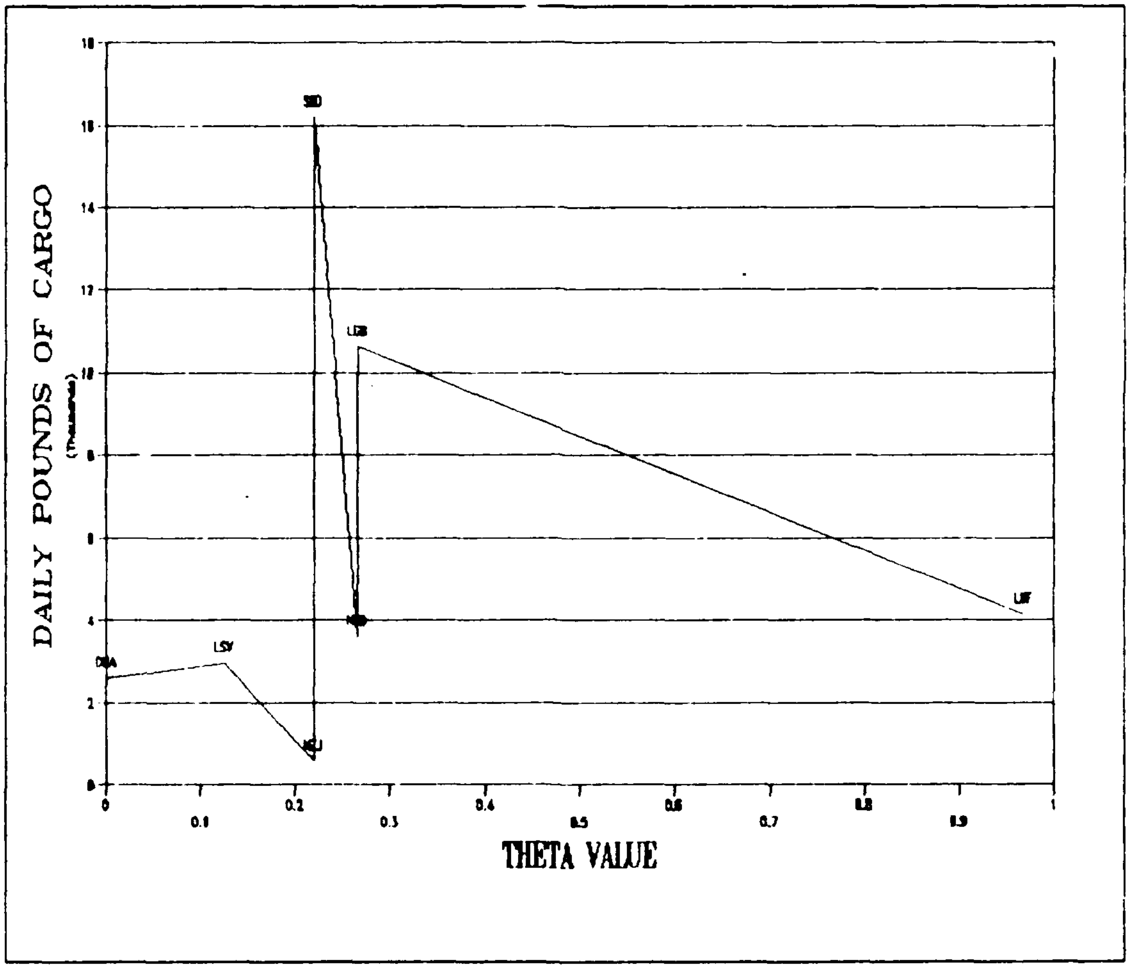

Figure 37: Spacefilling Curve Combined Route Model Norton hub routing

8. Combined Route Model Kelly Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | SKF | KELLY (HUB) | 29.23 | 98.35 | 0.00000 | 31,959 |
| 2 | HMN | HOLLOMAN | 32.51 | 106.06 | 0.31250 | 3,421 |
| 3 | CVS | CANNON | 34.23 | 103.19 | 0.37500 | 1,521 |
| 4 | ABQ | KIRTLAND | 35.02 | 106.36 | 0.45313 | 927 |
| 5 | DYS | DYESS | 32.25 | 99.51 | 0.92188 | 2,584 |

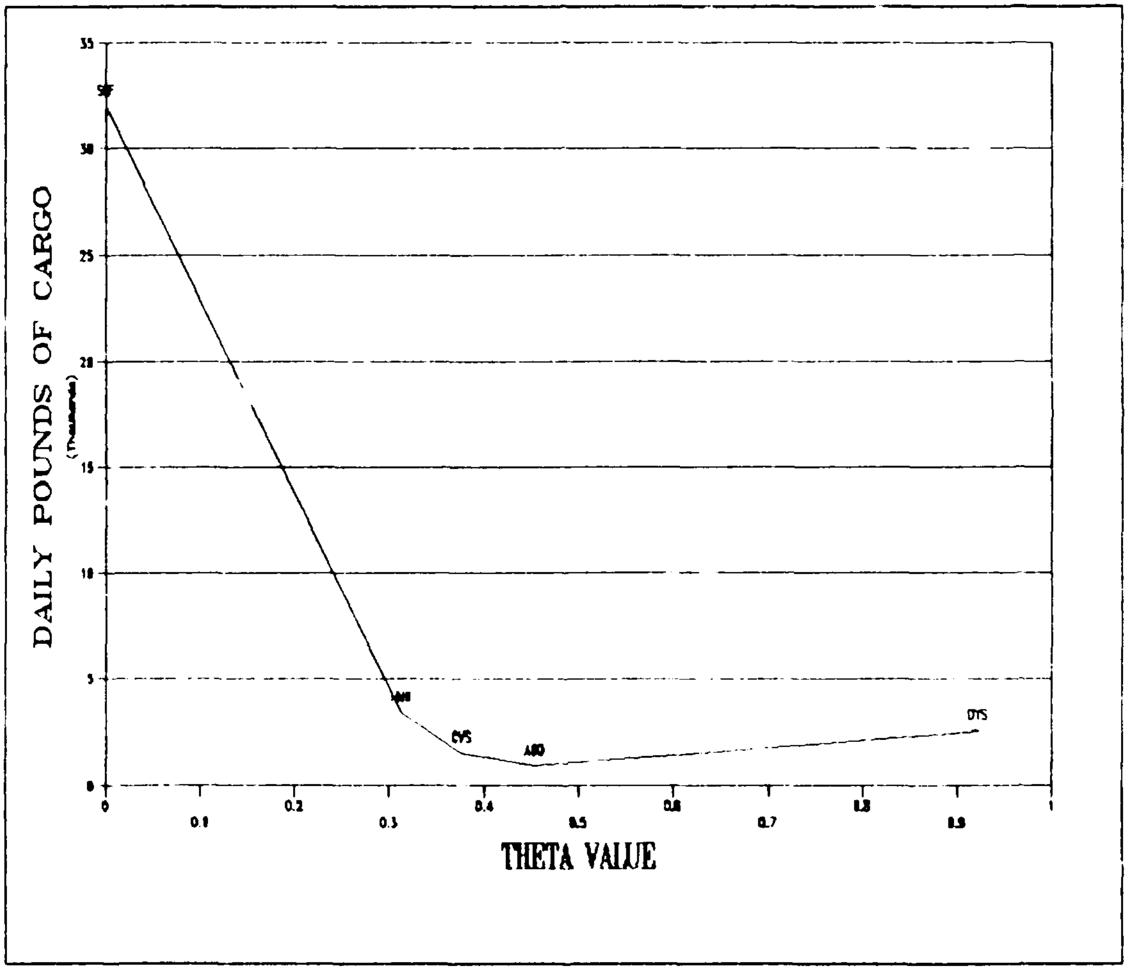

Figure 38: Spacefilling Curve Combined Route Model Kelly hub routing

9. Combined Route Model Travis Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NLC | LEMOORE | 36.15 | 119.57 | 0.00000 | 3,255 |
| 2 | NGZ | OAKLAND | 37.47 | 122.13 | 0.43750 | 4,223 |
| 3 | SUU | TRAVIS AFB (HUB) | 38.16 | 121.56 | 0.46875 | 50,150 |

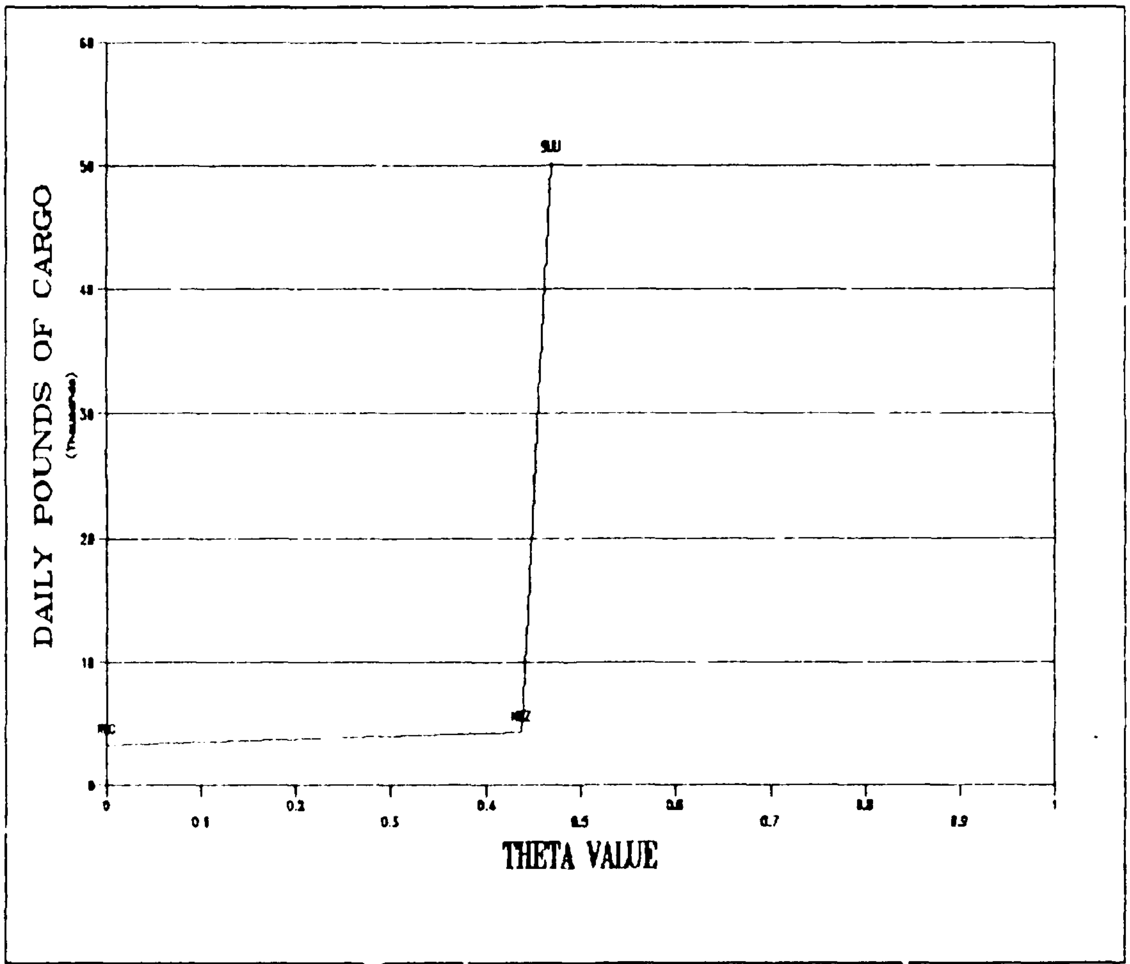

Figure 39: Spacefilling Curve Combined Route Model Travis hub routing

### 10. Combined Route Model McChord Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | SKA | FAIRCHILD | 47.37 | 117.39 | 0.00000 | 1,844 |
| 2 | PWT | BREMERTON | 47.34 | 122.38 | 0.25000 | 5,510 |
| 3 | TCM | MCCHORD (HUB) | 47.08 | 122.28 | 0.25000 | 14,602 |
| 4 | NUW | WHIDBEY ISLAND | 48.17 | 122.37 | 0.26563 | 4,001 |

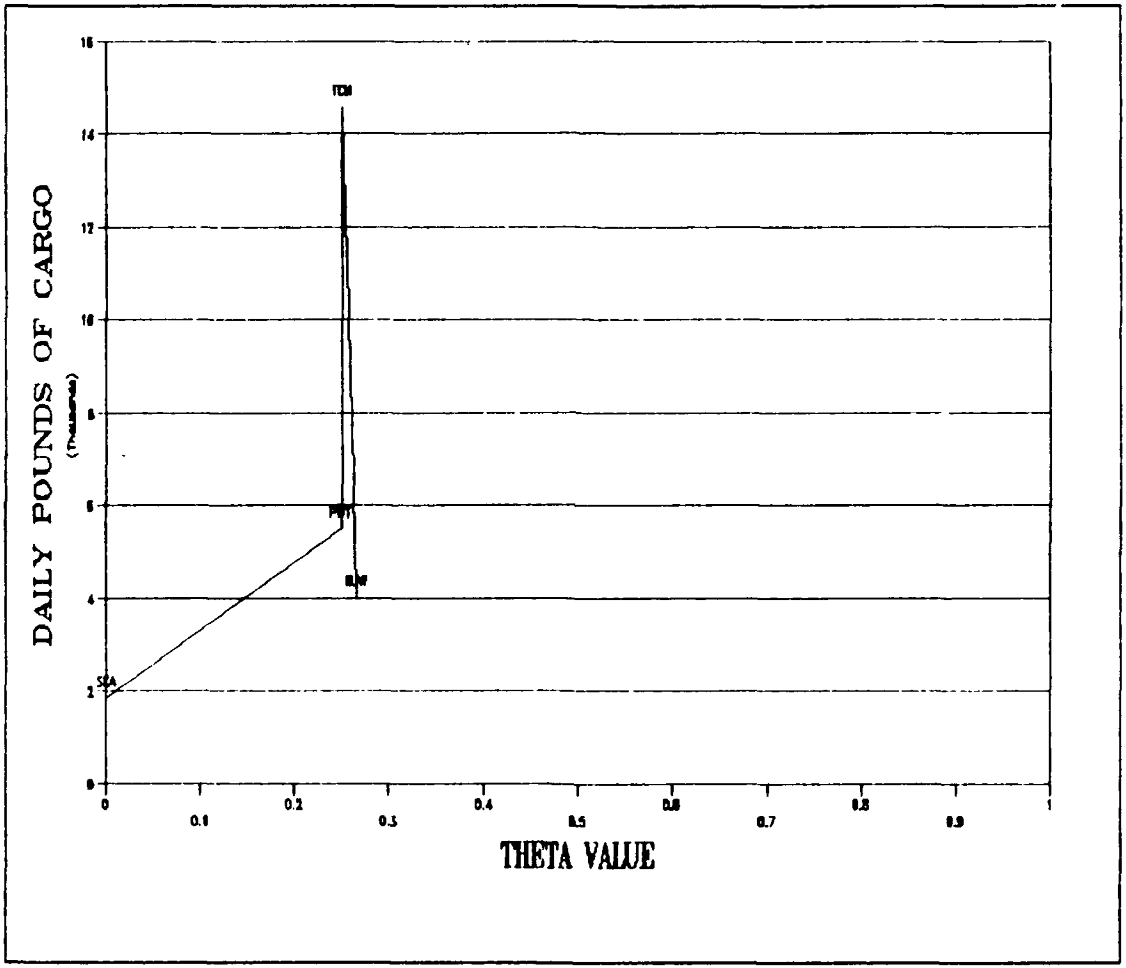

Figure 40: Spacefilling Curve Combined Route Model McChord hub routing

11. Combined Route Model Robins Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | PAM | TYNDALL | 30.04 | 85.35 | 0.04688 | 1,939 |
| 2 | VPS | EGLIN | 30.29 | 86.32 | 0.06250 | 5,188 |
| 3 | NPA | PENSOCOLA | 30.21 | 87.19 | 0.18750 | 10,607 |
| 4 | BIX | KEESLER | 30.25 | 88.55 | 0.23438 | 1,452 |
| 5 | CBM | COLUMBUS MS | 33.39 | 88.26 | 0.42188 | 895 |
| 6 | MEM | MEMPHIS | 35.03 | 89.58 | 0.48438 | 599 |
| 7 | BYH | IRA EAKER | 35.58 | 89.57 | 0.50000 | 1,328 |
| 8 | WRB | ROBINS (HUB) | 32.38 | 83.35 | 0.95313 | 22,661 |

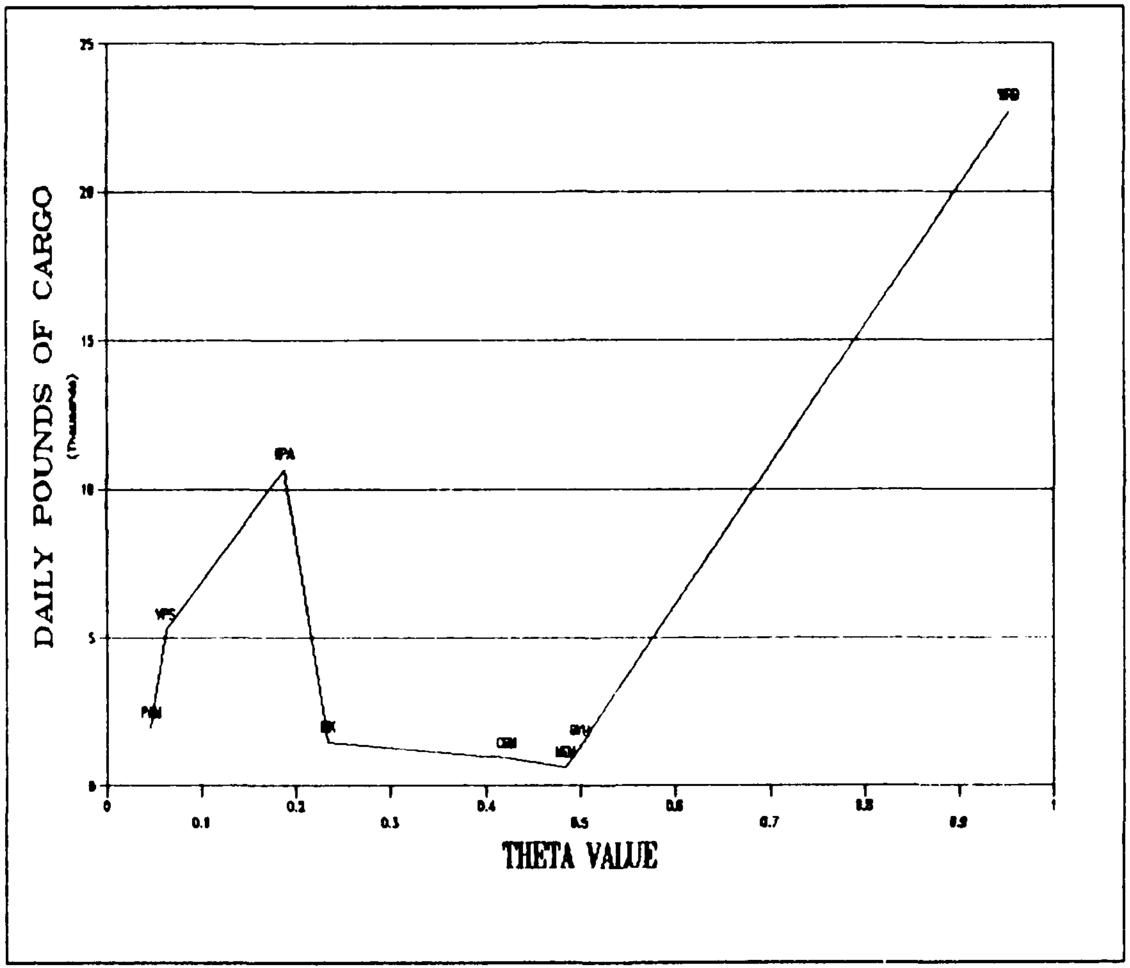

Figure 41: Spacefilling Curve Combined Route Model Robins hub routing

### 12. Combined Route Model McGuire Hub Routings

| RANK | CODE | NAME | LAT | LONG | THETA | DAILY LBS |
|---|---|---|---|---|---|---|
| 1 | NCO | NEWPORT | 41.28 | 71.20 | 0.07813 | 1,515 |
| 2 | GON | NEW LONDON | 41.21 | 72.07 | 0.17188 | 4,394 |
| 3 | WRI | MCGUIRE (HUB) | 40.01 | 74.35 | 0.25000 | 10,477 |
| 4 | RME | GRIFFISS | 43.14 | 75.24 | 0.31250 | 2,820 |
| 5 | PBG | PLATTSBURGH | 44.39 | 73.28 | 0.39063 | 3,108 |
| 6 | LIZ | LORING | 46.57 | 67.53 | 0.76563 | 2,007 |
| 7 | PSM | PEASE | 43.04 | 70.49 | 0.87500 | 3,574 |

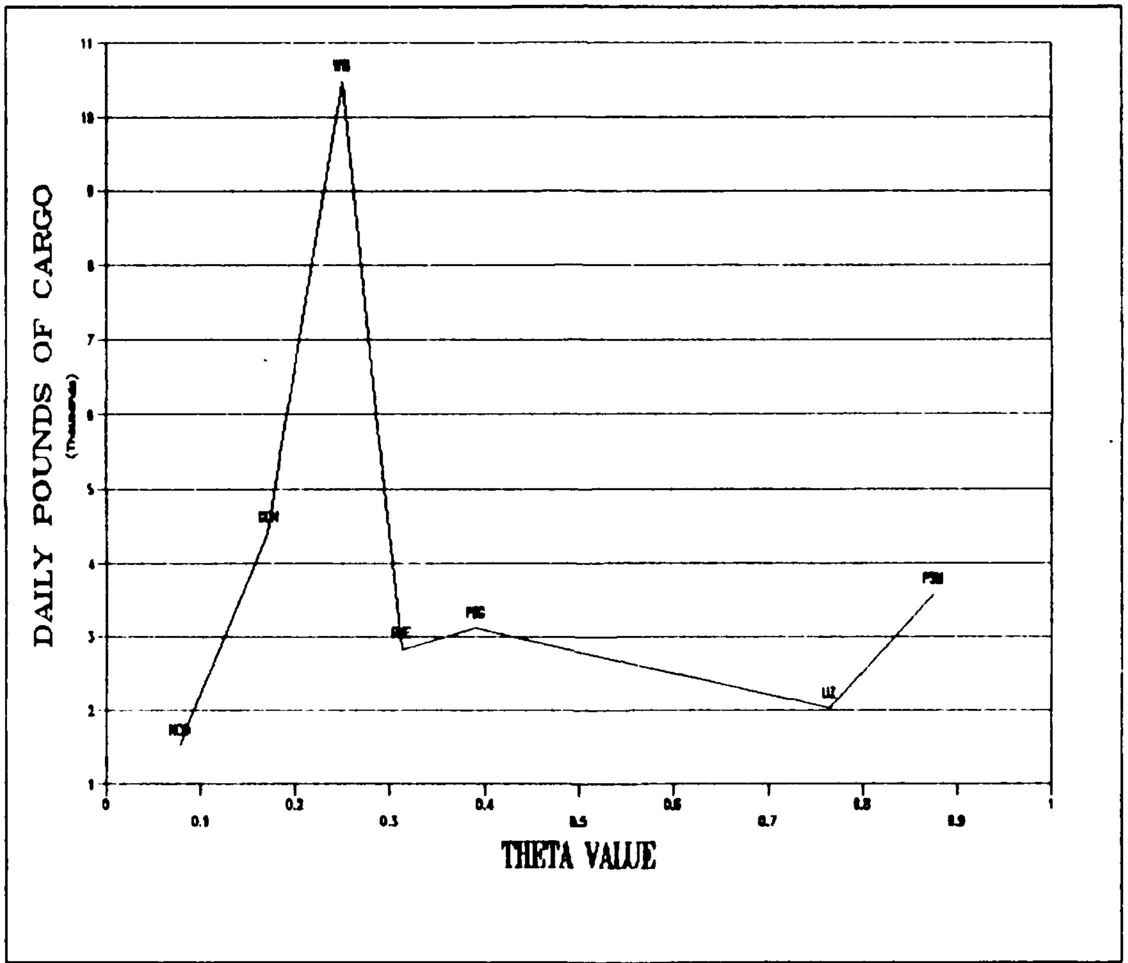

Figure 42: Spacefilling Curve Combined Route Model McGuire hub routing

# Appendix J: Route Structures

## Current LOGAIR Structure

Routes are for 6 day/week systems.

| Route # & Orig | Dest | Vehicle & Mileage | # Stops | DO65 Tonnages |
|---|---|---|---|---|
| ROUTE 1 | | L100 | 4 | 35127 |
| MCC | HIF | 529 | | |
| HIF | TIK | 884 | | |
| TIK | FFO | 792 | | |
| FFO | WRB | 496 | | |
| ROUTE 2 | | L100 | 5 | 35127 |
| WRB | SSC | 202 | | |
| SSC | LFI | 316 | | |
| LFI | GSB | 150 | | |
| GSB | CHS | 208 | | |
| CHS | WRB | 206 | | |
| ROUTE 3 | | L100 | 4 | 35127 |
| WRB | SKF | 917 | | |
| SKF | SBD | 1143 | | |
| SBD | SUU | 389 | | |
| SUU | MCC | 40 | | |
| ROUTE 4 | | L100 | 5 | 35127 |
| SUU | MCC | 40 | | |
| MCC | HIF | 529 | | |
| HIF | SKF | 1106 | | |
| SKF | WRB | 917 | | |
| WRB | FFO | 496 | | |
| ROUTE 5 | | L100 | 3 | 35127 |
| FFO | DOV | 461 | | |
| DOV | WRI | 77 | | |
| WRI | FFO | 502 | | |
| ROUTE 6 | | L100 | 4 | 35127 |
| FFO | TIK | 792 | | |
| TIK | HIF | 884 | | |
| HIF | MCC | 529 | | |
| MCC | SUU | 40 | | |
| ROUTE 7 | | L188 | 3 | 24549 |
| HIF | SBD | 564 | | |
| SBD | LSV | 193 | | |
| LSV | HIF | 376 | | |
| ROUTE 8 | | DC-9 | 2 | 16309 |
| FFO | HIF | 1468 | | |
| HIF | FFO | 1468 | | |
| ROUT | | DC-9 | 5 | 24464 |
| FFO | PSM | 721 | | |
| PSM | LIZ | 304 | | |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| LIZ | PBG |  | 313 |  |  |
| PBG | RME |  | 138 |  |  |
| RME | FFO |  | 506 |  |  |
| ROUTE 10 |  | C640 |  | 5 | 11195 |
| FFO | MTC |  | 202 |  |  |
| MTC | OSC |  | 131 |  |  |
| OSC | SAW |  | 235 |  |  |
| SAW | DLH |  | 231 |  |  |
| DLH | FFO |  | 634 |  |  |
| ROUTE 10b |  | C640 |  | 4 | 2239 |
| FFO | MTC |  | 202 |  |  |
| MTC | OSC |  | 131 |  |  |
| OSC | SAW |  | 235 |  |  |
| SAW | FFO |  | 481 |  |  |
| ROUTE 11 |  | L188 |  | 5 | 24549 |
| HIF | GFA |  | 442 |  |  |
| GFA | MIB |  | 460 |  |  |
| MIB | RCA |  | 307 |  |  |
| RCA | FEW |  | 224 |  |  |
| FEW | HIF |  | 373 |  |  |
| ROUTE 12 |  | DC-9 |  | 4 | 24464 |
| SKF | HMN |  | 506 |  |  |
| HMN | LUF |  | 367 |  |  |
| LUF | DMA |  | 129 |  |  |
| DMA | SKF |  | 756 |  |  |
| ROUTE 13 |  | L188 |  | 7 | 20457 |
| WRB | NIP |  | 201 |  |  |
| NIP | COF |  | 152 |  |  |
| COF | HST |  | 190 |  |  |
| HST | NQX |  | 103 |  |  |
| NQX | MCF |  | 231 |  |  |
| MCF | NIP |  | 172 |  |  |
| NIP | WRB |  | 201 |  |  |
| ROUTE 14 |  | L188 |  | 4 | 4091 |
| WRB | COF |  | 352 |  |  |
| COF | HST |  | 190 |  |  |
| HST | MCF |  | 210 |  |  |
| MCF | WRB |  | 336 |  |  |
| ROUTE 14b |  | L188 |  | 5 | 24549 |
| WRB | VPS |  | 228 |  |  |
| VPS | SKF |  | 727 |  |  |
| SKF | BAD |  | 363 |  |  |
| BAD | CBM |  | 313 |  |  |
| CBM | WRB |  | 290 |  |  |
| ROUTE 15 |  | L188 |  | 2 | 24549 |
| WRB | TIK |  | 814 |  |  |
| TIK | HIF |  | 884 |  |  |
| ROUTE 16 |  | L188 |  | 4 | 24549 |
| HIF | MUO |  | 238 |  |  |
| MUO | TCM |  | 431 |  |  |
| TCM | SKA |  | 229 |  |  |
| SKA | HIF |  | 529 |  |  |
| ROUTE 17 |  | L188 |  | 2 | 24549 |

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| HIF | TIK |  | 884 |  |  |
| TIK | WRB |  | 814 |  |  |
| ROUTE 18 |  | L188 |  | 6 | 24549 |
| TIK | SZL |  | 312 |  |  |
| SZL | OFF |  | 207 |  |  |
| OFF | RDR |  | 477 |  |  |
| RDR | RCA |  | 379 |  |  |
| RCA | IAB |  | 544 |  |  |
| IAB | TIK |  | 153 |  |  |
| ROUTE 19 |  | L188 |  | 4 | 24549 |
| TIK | DYS |  | 250 |  |  |
| DYS | SKF |  | 223 |  |  |
| SKF | FWH |  | 243 |  |  |
| FWH | TIK |  | 182 |  |  |
| ROUTE 20 |  | L188 |  | 6 | 24549 |
| TIK | FFO |  | 792 |  |  |
| FFO | BYH |  | 418 |  |  |
| BYH | TIK |  | 421 |  |  |
| TIK | SKF |  | 421 |  |  |
| SKF | LRF |  | 536 |  |  |
| LRF | TIK |  | 299 |  |  |
| ROUTE 21 |  | DC-9 |  | 3 | 24464 |
| SKF | HIF |  | 1106 |  |  |
| HIF | CVS |  | 663 |  |  |
| CVS | SKF |  | 443 |  |  |
| TRUCKS 1 |  | MACK |  | 2 | 24000 |
| ABQ | CVS |  | 193 |  |  |
| CVS | ABQ |  | 193 |  |  |
| TRUCKS 2 |  | MACK |  | 2 | 24000 |
| BAD | AEX |  | 104 |  |  |
| AEX | BAD |  | 104 |  |  |
| TRUCKS 3 |  | MACK |  | 2 | 24000 |
| LRF | MEM |  | 123 |  |  |
| MEM | LRF |  | 123 |  |  |
| TRUCKS 4 |  | MACK |  | 2 | 24000 |
| VPS | BIX |  | 143 |  |  |
| BIX | VPS |  | 143 |  |  |
| TRUCKS 5 |  | MACK |  | 2 | 24000 |
| VPS | PAM |  | 64 |  |  |
| PAM | VPS |  | 64 |  |  |
| TRUCKS 6 |  | MACK |  | 2 | 24000 |
| WRB | VAD |  | 118 |  |  |
| VAD | WRB |  | 118 |  |  |
| TRUCKS 7 |  | MACK |  | 2 | 24000 |
| NKO | FFO |  | 120 |  |  |
| FFO | NKO |  | 120 |  |  |
| TRUCKS 8 |  | MACK |  | 2 | 24000 |
| GUS | FFO |  | 125 |  |  |
| FFO | GUS |  | 125 |  |  |

TOTAL MILEAGE: 43,873
AIR MILEAGE: 41,893
TRUCK MILEAGE: 1,980

*Author's LOGAIR Structure*

Routes are for 6 day/week systems.

| Route # & Orig | Dest | Vehicle & Mileage | # Stops | D065 Tonnages |
|---|---|---|---|---|
| ROUTE 1 | | L100 | 3 | 35127 |
| TIK | SBD | 1131 | | |
| SBD | HIF | 572 | | |
| HIF | TIK | 875 | | |
| ROUTE 2 | | L100 | 3 | 35127 |
| TIK | HIF | 875 | | |
| HIF | MCC | 545 | | |
| MCC | SUU | 24 | | |
| ROUTE 3 | | L100 | 3 | 35127 |
| TIK | HIF | 875 | | |
| HIF | SBD | 572 | | |
| SBD | TIK | 1311 | | |
| ROUTE 4 | | L100 | 3 | 35127 |
| SUU | MCC | 40 | | |
| MCC | HIF | 529 | | |
| HIF | TIK | 875 | | |
| ROUTE 5 | | L100 | 4 | 35127 |
| TIK | SKF | 420 | | |
| SKF | WRB | 196 | | |
| WRB | FFO | 492 | | |
| FFO | TIK | 780 | | |
| ROUTE 6 | | L100 | 4 | 35127 |
| TIK | FFO | 780 | | |
| FFO | WRB | 492 | | |
| WRB | SKF | 196 | | |
| SKF | TIK | 420 | | |
| ROUTE 7 | | C640 | 5 | 13434 |
| FFO | MTC | 213 | | |
| MTC | OSC | 137 | | |
| OSC | SAW | 236 | | |
| SAW | DLH | 233 | | |
| DLH | FFO | 632 | | |
| ROUTE 8 | | L100 | 5 | 35127 |
| FFO | RME | 520 | | |
| RME | PBG | 130 | | |
| PBG | LIZ | 316 | | |
| LIZ | PSM | 283 | | |
| PSM | FFO | 743 | | |
| ROUTE 9 | | L100 | 4 | 35127 |
| FFO | WRI | 515 | | |
| WRI | DOV | 81 | | |
| DOV | LFI | 149 | | |
| LFI | FFO | 455 | | |
| ROUTE 10 | | L188 | 4 | 25549 |
| HIF | MUO | 243 | | |
| MUO | TCM | 432 | | |

```
TCM       SKA              230
SKA       HIF              520
ROUTE 11            L188                 6      34549
HIF       GFA              430
GFA       MIB              463
MIB       RDR              189
RDR       RCA              369
RCA       FEW              221
FEW       HIF              367
ROUTE 12            C640                 4      13434
SBD       DMA              405
DMA       LUF              130
LUF       LSV              251
LSV       SBD              187
ROUTE 13            L188                 5      24549
TIK       OFF              412
OFF       SZL              216
SZL       IAB              221
IAB       LRF              343
LRF       TIK              295
ROUTE 14            L188                 5      24549
WRB       BYH              419
BYH       CBM              168
CBM       BIX              217
BIX       VPS              133
VPS       WRB              227
ROUTE 15            L188                 4      24549
WRB       SSC              196
SSC       GSB              190
GSB       CHS              231
CHS       WRB              194
ROUTE 16            L100                 7      35127
WRB       NIP              193
NIP       COF              152
COF       HST              197
HST       NQX               99
NQX       MCF              226
MCF       NIP              190
NIP       WRB              193
TRUCKS 1            MACK                 2      24000
FFO       NKO              123
NKO       FFO              123
TRUCKS 2            MACK                 2      24000
FFO       GUS              151
GUS       FFO              151
TRUCKS 3            MACK                 1      24000
HIF       ABQ              606
TRUCKS 4            MACK                 1      24000
ABQ       HIF              606
TRUCKS 5            MACK                 1      24000
SKF       HMN              611
TRUCKS 6            MACK                 1      24000
HMN       SKF              611
```

```
TRUCKS 7          MACK              1    24000
SKF      DYS           263
TRUCKS 8          MACK              1    24000
DYS      SKF           263
TRUCKS 9          MACK              1    24000
AEX      SKF           461
TRUCKS 10         MACK              1    24000
SKF      AEX           461
TRUCKS 11         MACK              1    24000
TIK      CVS           414
TRUCKS 12         MACK              1    24000
CVS      TIK           414
TRUCKS 13         MACK              1    24000
TIK      FWH           231
TRUCKS 14         MACK              1    24000
FWH      TIK           231
TRUCKS 15         MACK              1    24000
TIK      BAD           359
TRUCKS 16         MACK              1    24000
BAD      TIK           359
TRUCKS 17         MACK              2    24000
WRB      VAD           150
VAD      WRB           150
TRUCKS 18         MACK              2    24000
BYH      MEM            46
MEM      BYH            46
TRUCKS 19         MACK              2    24000
VPS      PAM            72
PAM      VPS            72

TOTAL MILEAGE:      32,766
AIR MILEAGE:        25,792
TRUCK MILEAGE:       6,974
```

*Current QUICKTRANS Structure*

Routes are for 6 day/week systems.

| Route # & Orig | Dest | Vehicle & Mileage | # Stops | DO65 Tonnages |
|---|---|---|---|---|
| ROUTE 1 | | L100 | 2 | 29272 |
| SUU | TCM | 617 | | |
| TCM | SUU | 617 | | |
| ROUTE 2 | | L100 | 3 | 11709 |
| NGU | IND | 577 | | |
| IND | NZY | 1786 | | |
| NZY | SUU | 468 | | |
| ROUTE 3 | | L100 | 5 | 29272 |
| NGU | CHS | 353 | | |
| CHS | NIP | 184 | | |
| NIP | NPA | 345 | | |
| NPA | NZY | 1765 | | |
| NZY | SUU | 468 | | |
| ROUTE 4 | | L100 | 5 | 29272 |
| SUU | NZY | 468 | | |
| NZY | NPA | 1765 | | |
| NPA | NIP | 345 | | |
| NIP | CHS | 184 | | |
| CHS | NGU | 353 | | |
| ROUTE 5 | | L100 | 5 | 11709 |
| SUU | NZY | 468 | | |
| NZY | IND | 1786 | | |
| IND | NGU | 577 | | |
| NGU | CHS | 353 | | |
| CHS | NIP | 184 | | |
| ROUTE 6 | | L100 | 2 | 11709 |
| NIP | CHS | 184 | | |
| CHS | NGU | 353 | | |
| ROUT | | L100 | 3 | 23418 |
| NIP | COF | 152 | | |
| COF | NQX | 270 | | |
| NQX | NIP | 400 | | |
| TRUCKS 1 | | MACK | 1 | 24000 |
| CHS | KBY | 196 | | |
| TRUCKS 2 | | MACK | 2 | 24000 |
| NIP | NPA | 414 | | |
| NPA | NIP | 414 | | |
| TRUCKS 3 | | MACK | 3 | 24000 |
| NGU | DAG | 146 | | |
| DAG | INH | 8 | | |
| INH | NHK | 52 | | |
| TRUCKS 3A | | MACK | 3 | 24000 |
| NHK | INH | 52 | | |
| INH | DAG | 8 | | |
| DAG | NGU | 146 | | |
| TRUCKS 4 | | MACK | 4 | 24000 |

```
NGU      NHK           133
NHK      DCA            56
DCA      NHK            56
NHK      NGU           133
TRUCKS 5          MACK             2    24000
NGU      NKT           170
NKT      NGU           170
TRUCKS 6          MACK             2    24000
SUU      NFL           220
NFL      SUU           220
TRUCKS 7          MACK             2    24000
SUU      NFL           220
NFL      SUU           220
TRUCKS 8          MACK             2    24000
TCM      PWT            22
PWT      TCM            22
TRUCKS 9          MACK             1    24000
TCM      PWT            22
TRUCKS 10         MACK             2    24000
TCM      NUW            90
NUW      TCM            90
TRUCKS 11         MACK             2    24000
NZY      SBD           136
SBD      NZY           136
TRUCKS 12         MACK             2    24000
SUU      NLC           212
NLC      SUU           212
TRUCKS 13         MACK             2    24000
NGZ      SUU            68
SUU      NGZ            68
TRUCKS 14         MACK             5    24000
NZY      LGB           111
LGB      NTD            82
NTD      LGB            82
LGB      NZJ            52
NZJ      NZY            80
TRUCKS 15         MACK             5    24000
NZY      LGB           111
LGB      SUU           452
SUU      NGZ            68
NGZ      LGB           428
LGB      NZY           111
TRUCKS 16         MACK             3    24000
NGU      DAG           146
DAG      INH             8
INH      NGU           154
TRUCKS 17         MACK             4    24000
NGU      PNE           259
PNE      PHL            10
PHL      WRI            58
WRI      NGU           308
TRUCKS 18         MACK             3    24000
NGU      GON           467
```

```
GON      NCO              54
NCO      NGU             505
TRUCKS 19         MACK            2    24000
NGU      TWH               7
TWH      NGU               7
TRUCKS 20         MACK            2    24000
NGU      TWH               7
TWH      NGU               7

TOTAL MILEAGE:      22,708
AIR MILEAGE:        15,022
TRUCK MILEAGE:       7,686
```

*Author's QUICKTRANS Structure*

Routes are for 6 day/week systems.

| Route # & Orig | Dest | Vehicle & Mileage | # Stops | DO65 Tonnages |
|---|---|---|---|---|
| ROUTE 1 | | L100 | 1 | 35127 |
| NIP | NZY | 2523 | | |
| ROUTE 2 | | L100 | 4 | 35127 |
| NZY | SUU | 468 | | |
| SUU | TCM | 617 | | |
| TCM | SUU | 617 | | |
| SUU | NZY | 468 | | |
| ROUTE 3 | | L100 | 1 | 35127 |
| NZY | NIP | 2523 | | |
| ROUTE 4 | | L100 | 2 | 35127 |
| NGU | CHS | 354 | | |
| CHS | NIP | 184 | | |
| ROUTE 5 | | L100 | 2 | 35127 |
| NIP | CHS | 184 | | |
| CHS | NGU | 354 | | |
| ROUTE 6 | | L100 | 4 | 35127 |
| NIP | COF | 152 | | |
| COF | NQX | 270 | | |
| NQX | NPA | 538 | | |
| NPA | NIP | 345 | | |
| TRUCKS 1 | | MACK | 2 | 24000 |
| SUU | NGZ | 68 | | |
| NGZ | SUU | 68 | | |
| TRUCKS 2 | | MACK | 2 | 24000 |
| SUU | NGZ | 68 | | |
| NGZ | SUU | 68 | | |
| TRUCKS 3 | | MACK | 2 | 24000 |
| NIP | KBY | 28 | | |
| KBY | NIP | 28 | | |
| TRUCKS 4 | | MACK | 3 | 24000 |
| TCM | PWT | 22 | | |
| PWT | NUW | 69 | | |
| NUW | TCM | 90 | | |
| TRUCKS 5 | | MACK | 1 | 24000 |
| SUU | NLC | 212 | | |
| TRUCKS 6 | | MACK | 1 | 24000 |
| NLC | SUU | 212 | | |
| TRUCKS 7 | | MACK | 1 | 24000 |
| SUU | NFL | 220 | | |
| TRUCKS 8 | | MACK | 1 | 24000 |
| NFL | SUU | 220 | | |
| TRUCKS 9 | | MACK | 3 | 24000 |
| NZY | NZJ | 80 | | |
| NZJ | SBD | 60 | | |
| SBD | NZY | 136 | | |
| TRUCKS 10 | | MACK | 2 | 24000 |

```
NZY      LGB           111
LGB      NTD            82
TRUCKS 11         MACK            2    24000
NTD      LGB            82
LGB      NZY           111
TRUCKS 12         MACK            2    24000
NGU      TWH             7
TWH      NGU             7
TRUCKS 13         MACK            2    24000
NGU      GON           467
GON      NCO            54
TRUCKS 14         MACK            2    24000
GON      NCO            54
NCO      NGU           467
TRUCKS 15         MACK            1    24000
NGU      WRI           308
TRUCKS 16         MACK            1    24000
WRI      NGU           308
TRUCKS 17         MACK            1    24000
NGU      IND           692
TRUCKS 18         MACK            1    24000
IND      NGU           692
TRUCKS 19         MACK            3    24000
NGU      INH           154
INH      DCA            17
DCA      NGU           169
TRUCKS 20         MACK            3    24000
NGU      DCA           169
DCA      INH            17
INH      NGU           154
TRUCKS 21         MACK            3    24000
DAG      INH             8
INH      DCA            17
DCA      NGU           169
TRUCKS 22         MACK            2    24000
NGU      NKT           170
NKT      NGU           170
TRUCKS 23         MACK            2    24000
NGU      PHL           259
PHL      PNE            10
TRUCKS 24          MACK           2    24000
PNE      PHL            10
PHL      NGU           259

TOTAL MILEAGE:      16,440
AIR MILEAGE:         9,597
TRUCK MILEAGE:       6,843
```

Author's Combined *LOGAIR/QUICKTRANS* Structure

Routes are for 6 day/week systems.

| Route # & Orig | Dest | Vehicle & Mileage | # Stops | DO65 Tonnages |
|---|---|---|---|---|
| ROUTE 1 | | L100 | 2 | 35127 |
| TIK | FFO | 780 | | |
| FFO | TIK | 780 | | |
| ROUTE 2 | | L100 | 2 | 35127 |
| FFO | TIK | 780 | | |
| TIK | FFO | 780 | | |
| ROUTE 3 | | L100 | 4 | 35127 |
| FFO | WRI | 515 | | |
| WRI | NGU | 257 | | |
| NGU | WRB | 500 | | |
| WRB | FFO | 810 | | |
| ROUTE 4 | | L100 | 4 | 35127 |
| FFO | WRB | 810 | | |
| WRB | NGU | 500 | | |
| NGU | WRI | 257 | | |
| WRI | FFO | 515 | | |
| ROUTE 5 | | L100 | 4 | 35127 |
| WRB | NIP | 193 | | |
| NIP | CHS | 184 | | |
| CHS | NGU | 353 | | |
| NGU | WRB | 500 | | |
| ROUTE 6 | | L100 | 4 | 35127 |
| WRB | NGU | 500 | | |
| NGU | CHS | 353 | | |
| CHS | NIP | 184 | | |
| NIP | WRB | 193 | | |
| ROUTE 7 | | L100 | 2 | 35127 |
| TIK | WRB | 819 | | |
| WRB | TIK | 819 | | |
| ROUTE 8 | | L100 | 2 | 35127 |
| WRB | TIK | 819 | | |
| TIK | WRB | 819 | | |
| ROUTE 9 | | L100 | 2 | 35127 |
| TIK | SKF | 420 | | |
| SKF | TIK | 420 | | |
| ROUTE 10 | | L100 | 2 | 35127 |
| TIK | SKF | 420 | | |
| SKF | TIK | 420 | | |
| ROUTE 11 | | L100 | 4 | 35127 |
| HIF | TCM | 672 | | |
| TCM | SUU | 617 | | |
| SUU | MCC | 24 | | |
| MCC | HIF | 545 | | |
| ROUTE 12 | | L100 | 4 | 35127 |
| HIF | MCC | 545 | | |
| MCC | SUU | 24 | | |

```
SUU      TCM              617
TCM      HIF              672
ROUTE 13          L100            5    35127
HIF      NZY              671
NZY      SBD              113
SBD      SUU              375
SUU      MCC               24
MCC      HIF              545
ROUTE 14          L100            5    35127
HIF      MCC              545
MCC      SUU               24
SUU      SBD              375
SBD      NZY              113
NZY      HIF              671
ROUTE 15          L100            2    35127
TIK      HIF             1050
HIF      TIK             1050
ROUTE 16          L100            2    35127
TIK      HIF             1050
HIF      TIK             1050
ROUTE 17          L100            2    35127
TIK      HIF             1050
HIF      TIK             1050
ROUTE 18          L100            2    35127
TIK      HIF             1050
HIF      TIK             1050
ROUTE 19          C640            5    13434
FFO      MTC              213
MTC      OSC              137
OSC      SAW              236
SAW      DLH              233
DLH      FFO              632
ROUTE 20          L188            6    24549
HIF      GFA              430
GFA      MIB              463
MIB      RDR              189
RDR      RCA              369
RCA      FEW              221
FEW      HIF              367
ROUTE 21          L100            5    35127
NIP      COF              152
COF      MCF              127
MCF      HST              200
HST      NQX               99
NQX      NIP              400
ROUTE 22          C640            4    13434
SBD      LSV              187
LSV      LUF              251
LUF      DMA              130
DMA      SBD              405
ROUTE 23          C640            5    13434
SKF      DYS              219
DYS      CVS              252
```

```
CVS      ABQ           188
ABQ      HMN           174
HMN      SKF           509
ROUTE 24          L100                5    35127
WRB      BYH           419
BYH      CBM           168
CBM      NPA           228
NPA      VPS            52
VPS      WRB           227
ROUTE 25          L188                5    24549
WRI      PSM           289
PSM      LIZ           283
LIZ      PBG           316
PBG      RME           130
RME      WRI           221
ROUTE 26          L100                3    35127
WRB      NGU           500
NGU      FFO           472
FFO      WRB           492
ROUTE 27          L100                3    35127
WRB      NGU           500
NGU      FFO           472
FFO      WRB           492
TRUCKS 1          MACK                2    24000
DOV      WRI            97
WRI      DOV            97
TRUCKS 2          MACK                2    24000
DOV      WRI            97
WRI      DOV            97
TRUCKS 3          MACK                2    24000
SBD      LGB            85
LGB      SBD            85
TRUCKS 4          MACK                2    24000
NZY      LGB           111
LGB      NZY           111
TRUCKS 5          MACK                4    24000
DOV      NHK            98
NHK      DAG            51
DAG      INH             8
INH      DOV           130
TRUCKS 6          MACK                3    24000
DOV      PHL            43
PHL      PNE            10
PNE      DOV            43
TRUCKS 7          MACK                3    24000
FFO      IND           136
IND      GUS            80
GUS      FFO           151
TRUCKS 8          MACK                2    24000
FFO      NKO           123
NKO      FFO           123
TRUCKS 9          MACK                1    24000
HIF      MUO           291
```

```
TRUCKS 10         MACK             1    24000
MUO      HIF           291
TRUCKS 11         MACK             2    24000
NGU      NKT           170
NKT      NGU           170
TRUCKS 12         MACK             2    24000
NGU      GSB           147
GSB      NGU           147
TRUCKS 13         MACK             6    24000
NGU      LFI            40
LFI      TWH            46
TWH      NGU             7
NGU      LFI            40
LFI      TWH            46
TWH      NGU             7
TRUCKS 14         MACK             3    24000
NIP      KBY            28
KBY      VAD           123
VAD      NIP           128
TRUCKS 15         MACK             3    24000
SBD      LGB            85
LGB      NZJ            52
NZJ      SBD            61
TRUCKS 16         MACK             3    24000
SBD      NTD           132
NTD      LGB            82
LGB      SBD            85
TRUCKS 17         MACK             2    24000
SUU      NGZ            68
NGZ      SUU            68
TRUCKS 18         MACK             1    24000
SUU      NLC           212
TRUCKS 19         MACK             1    24000
NLC      SUU           212
TRUCKS 20         MACK             1    24000
TCM      SKA           276
TRUCKS 21         MACK             1    24000
SKA      TCM           276
TRUCKS 22         MACK             3    24000
TCM      PWT            22
PWT      NUW            69
NUW      TCM            90
TRUCKS 23         MACK             2    24000
BYH      MEM            46
MEM      BYH            46
TRUCKS 24         MACK             2    24000
VPS      PAM            72
PAM      VPS            72
TRUCKS 25         MACK             2    24000
NPA      BIX            97
BIX      NPA            97
TRUCKS 26         MACK             2    24000
WRI      GON           174
```

```
GON      NCO              54
TRUCKS 27         MACK            2    24000
NCO      GON              54
GON      WRI             174

TOTAL MILEAGE:        48,449
AIR MILEAGE:          42,316
TRUCK MILEAGE:         6,133
```

# *Appendix K:*
# *Extracts of the Inter-Locational Cargo Demand Files*

## *QUICKTRANS File (Interpolated from FY 89 Data)*

File used by the DO65 model to evaluate route structures. Cargo tons are for FY 89. List represents only a small portion of the entire inter-locational cargo demand file.

| FY | FROM | TO | TONS | N/A | TONS |
|---|---|---|---|---|---|
| F89 | CHS | COF | 14.1 | 0.0 | 14.1 |
| F89 | CHS | DAG | 14.2 | 0.0 | 14.2 |
| F89 | CHS | DCA | 47.0 | 0.0 | 47.0 |
| F89 | CHS | GON | 57.0 | 0.0 | 57.0 |
| F89 | CHS | IND | 53.6 | 0.0 | 53.6 |
| F89 | CHS | INH | 14.2 | 0.0 | 14.2 |
| F89 | CHS | KBY | 18.3 | 0.0 | 18.3 |
| F89 | CHS | LGB | 137.8 | 0.0 | 137.8 |
| F89 | CHS | NCO | 19.6 | 0.0 | 19.6 |
| F89 | CHS | NFL | 17.2 | 0.0 | 17.2 |
| F89 | CHS | NGU | 692.5 | 0.0 | 692.5 |
| F89 | CHS | NGZ | 54.8 | 0.0 | 54.8 |
| F89 | CHS | NHK | 60.3 | 0.0 | 60.3 |
| F89 | CHS | NIP | 266.5 | 0.0 | 266.5 |
| F89 | CHS | NKT | 127.9 | 0.0 | 127.9 |
| F89 | CHS | NLC | 42.2 | 0.0 | 42.2 |
| F89 | CHS | NPA | 137.6 | 0.0 | 137.6 |
| F89 | CHS | NQX | 21.7 | 0.0 | 21.7 |
| F89 | CHS | NTD | 46.6 | 0.0 | 46.6 |
| F89 | CHS | NUW | 51.9 | 0.0 | 51.9 |
| F89 | CHS | NZJ | 7.1 | 0.0 | 7.1 |
| F89 | CHS | NZY | 519.8 | 0.0 | 519.8 |
| F89 | CHS | PHL | 46.2 | 0.0 | 46.2 |
| F89 | CHS | PNE | 3.5 | 0.0 | 3.5 |
| F89 | CHS | PWT | 71.5 | 0.0 | 71.5 |
| F89 | CHS | SBD | 41.6 | 0.0 | 41.6 |
| F89 | CHS | SUU | 500.7 | 0.0 | 500.7 |
| F89 | CHS | TCM | 93.4 | 0.0 | 93.4 |
| F89 | CHS | TWH | 15.2 | 0.0 | 15.2 |
| F89 | CHS | WRI | 25.8 | 0.0 | 25.8 |
| F89 | COF | CHS | 13.3 | 0.0 | 13.3 |
| F89 | COF | DAG | 0.8 | 0.0 | 0.8 |
| F89 | COF | DCA | 2.7 | 0.0 | 2.7 |
| F89 | COF | GON | 3.3 | 0.0 | 3.3 |
| F89 | COF | IND | 3.1 | 0.0 | 3.1 |
| F89 | COF | INH | 0.8 | 0.0 | 0.8 |
| F89 | COF | KBY | 1.1 | 0.0 | 1.1 |
| F89 | COF | LGB | 8.0 | 0.0 | 8.0 |
| F89 | COF | NCO | 1.1 | 0.0 | 1.1 |

*LOGAIR File FY 89 Data*

File used by the DO65 model to evaluate route structures. Cargo tons are for FY 89. List represents only a small portion of the entire inter-locational cargo demand file.

| FY | FROM | TO | TONS | N/A | TONS |
|---|---|---|---|---|---|
| F89 | ABQ | BAD | 1.6 | 0.0 | 1.6 |
| F89 | ABQ | BIX | 0.4 | 0.0 | 0.4 |
| F89 | ABQ | BYH | 0.1 | 0.0 | 0.1 |
| F89 | ABQ | CBM | 0.4 | 0.0 | 0.4 |
| F89 | ABQ | CHS | 0.2 | 0.0 | 0.2 |
| F89 | ABQ | COF | 3.2 | 0.0 | 3.2 |
| F89 | ABQ | CVS | 0.2 | 0.0 | 0.2 |
| F89 | ABQ | DMA | 1.9 | 0.0 | 1.9 |
| F89 | ABQ | DOV | 1.5 | 0.0 | 1.5 |
| F89 | ABQ | DYS | 2.5 | 0.0 | 2.5 |
| F89 | ABQ | FEW | 1.0 | 0.0 | 1.0 |
| F89 | ABQ | FFO | 4.1 | 0.0 | 4.1 |
| F89 | ABQ | FWH | 0.5 | 0.0 | 0.5 |
| F89 | ABQ | GFA | 2.6 | 0.0 | 2.6 |
| F89 | ABQ | GSB | 2.9 | 0.0 | 2.9 |
| F89 | ABQ | HIF | 8.4 | 0.0 | 8.4 |
| F89 | ABQ | HMN | 0.3 | 0.0 | 0.3 |
| F89 | ABQ | HST | 1.7 | 0.0 | 1.7 |
| F89 | ABQ | IAB | 0.5 | 0.0 | 0.5 |
| F89 | ABQ | LFI | 0.6 | 0.0 | 0.6 |
| F89 | ABQ | LRF | 1.0 | 0.0 | 1.0 |
| F89 | ABQ | LSV | 2.6 | 0.0 | 2.6 |
| F89 | ABQ | LUF | 2.1 | 0.0 | 2.1 |
| F89 | ABQ | MCC | 4.8 | 0.0 | 4.8 |
| F89 | ABQ | MCF | 0.3 | 0.0 | 0.3 |
| F89 | ABQ | MIB | 0.8 | 0.0 | 0.8 |
| F89 | ABQ | MTC | 0.4 | 0.0 | 0.4 |
| F89 | ABQ | MUO | 0.8 | 0.0 | 0.8 |
| F89 | ABQ | NIP | 6.5 | 0.0 | 6.5 |
| F89 | ABQ | NQX | 0.2 | 0.0 | 0.2 |
| F89 | ABQ | OFF | 0.0 | 0.0 | 0.0 |
| F89 | ABQ | OSC | 0.0 | 0.0 | 0.0 |
| F89 | ABQ | PAM | 0.0 | 0.0 | 0.0 |
| F89 | ABQ | PBG | 0.2 | 0.0 | 0.2 |
| F89 | ABQ | PSM | 0.7 | 0.0 | 0.7 |
| F89 | ABQ | RCA | 0.4 | 0.0 | 0.4 |
| F89 | ABQ | RDR | 0.3 | 0.0 | 0.3 |
| F89 | ABQ | RME | 0.6 | 0.0 | 0.6 |
| F89 | ABQ | SBD | 9.4 | 0.0 | 9.4 |
| F89 | ABQ | SKA | 0.5 | 0.0 | 0.5 |
| F89 | ABQ | SKF | 10.0 | 0.0 | 10.0 |
| F89 | ABQ | SSC | 0.3 | 0.0 | 0.3 |
| F89 | ABQ | SUU | 6.5 | 0.0 | 6.5 |
| F89 | ABQ | SZL | 0.6 | 0.0 | 0.6 |

# *Appendix L: D065 Evaluation of QUICKTRANS Routes*

## *D065 Results of Current QUICKTRANS Route*

The following represents only extracts of the actual *LOGISTICS AIR LIFT COMPUTER MODEL REPORT* commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 64.40 percent of total demand of 480455. pounds
unsatisfied total - 171058. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| SUU-TCM | 617. | 29272. | 15835.62 | 54. |
| TCM-SUU | 617. | 29272. | 14142.47 | 48. |

TOTAL DISTANCE = 1234.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 36121650.

ACTUAL LOAD = (DIST.)(LOAD) = 18496480.

ROUTE UTILIZATION = 51.

ROUTE 2 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| NGU-IND | 577. | 11709. | 11709.00 | 100. |
| IND-NZY | 1786. | 11709. | 10185.71 | 87. |
| NZY-SUU | 468. | 11709. | 11709.00 | 100. |

TOTAL DISTANCE = 2831.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 33148180.

ACTUAL LOAD = (DIST.)(LOAD) = 30427590.

ROUTE UTILIZATION = 92.

```
                         ROUTE 3   L100

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 NGU-CHS         353.              29272.         29272.00           100.
 CHS-NIP         184.              29272.         29272.00           100.
 NIP-NPA         345.              29272.         29272.00           100.
 NPA-NZY        1765.              29272.         29272.00           100.
 NZY-SUU         468.              29272.         19573.78            67.

                  TOTAL DISTANCE =  3115.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =   91182280.

                  ACTUAL LOAD = (DIST.)(LOAD) =  86643510.

                  ROUTE UTILIZATION =  95.

                         ROUTE 4   L100

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 SUU-NZY         468.              29272.         19468.49            67.
 NZY-NPA        1765.              29272.         29272.00           100.
 NPA-NIP         345.              29272.         29272.00           100.
 NIP-CHS         184.              29272.         26690.41            91.
 CHS-NGU         353.              29272.         23502.73            80.

                  TOTAL DISTANCE =  3115.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =   91182280.

                  ACTUAL LOAD = (DIST.)(LOAD) =  84082670.

                  ROUTE UTILIZATION =  92.
```

### ROUTE 5 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| SUU-NZY | 468. | 11709. | 4821.92 | 41. |
| NZY-IND | 1786. | 11709. | 10026.81 | 86. |
| IND-NGU | 577. | 11709. | 11709.00 | 100. |
| NGU-CHS | 353. | 11709. | 11709.00 | 100. |
| CHS-NIP | 184. | 11709. | 10734.25 | 92. |

TOTAL DISTANCE = 3368.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 39435910.

ACTUAL LOAD = (DIST.)(LOAD) = 33029010.

ROUTE UTILIZATION = 84.

### ROUTE 6 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| NIP-CHS | 184. | 11709. | 10641.86 | 91. |
| CHS-NGU | 353. | 11709. | 11709.00 | 100. |

TOTAL DISTANCE = 537.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6287733.

ACTUAL LOAD = (DIST.)(LOAD) = 6091380.

ROUTE UTILIZATION = 97.

### ROUTE 7 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| NIP-COF | 152. | 23418. | 12536.99 | 54. |
| COF-NQX | 270. | 23418. | 10158.90 | 43. |
| NQX-NIP | 400. | 23418. | 11019.18 | 47. |

TOTAL DISTANCE = 822.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 19249600.

ACTUAL LOAD = (DIST.)(LOAD) = 9056198.

ROUTE UTILIZATION = 47.

```
                         TRUCKS  1   MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

   CHS-KBY          196.              24000.          6695.88               28.

                      TOTAL DISTANCE =   196.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    4704000.

                      ACTUAL LOAD = (DIST.)(LOAD) =   1312393.

                      ROUTE UTILIZATION =  28.


                         TRUCKS  2   MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

   NIP-NPA          414.              24000.          2767.13               12.
   NPA-NIP          414.              24000.          2241.10                9.

                      TOTAL DISTANCE =   828.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =   19872000.

                      ACTUAL LOAD = (DIST.)(LOAD) =   2073404.

                      ROUTE UTILIZATION =  10.


                         TRUCKS  3   MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

   NGU-DAG          146.              24000.          3747.95               16.
   DAG-INH            8.              24000.          2926.03               12.
   INH-NHK           52.              24000.          1369.86                6.

                      TOTAL DISTANCE =   206.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    4944000.

                      ACTUAL LOAD = (DIST.)(LOAD) =    641841.

                      ROUTE UTILIZATION =  13.
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                        TRUCKS 3a MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 NHK-INH          52.              24000.           1589.04               7.
 INH-DAG           8.              24000.           1232.88               5.
 DAG-NGU         146.              24000.           3589.04              15.

                      TOTAL DISTANCE =   206.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =     4944000.

                      ACTUAL LOAD = (DIST.)(LOAD) =     616493.

                      ROUTE UTILIZATION =  12.

                        TRUCKS 4  MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 NGU-NHK         133.              24000.          11002.74              46.
 NHK-DCA          56.              24000.           5989.04              25.
 DCA-NHK          56.              24000.           7090.41              30.
 NHK-NGU         133.              24000.          12350.69              51.

                      TOTAL DISTANCE =   378.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =     9072000.

                      ACTUAL LOAD = (DIST.)(LOAD) =    3838455.

                      ROUTE UTILIZATION =  42.

                        TRUCKS 5  MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 NGU-NKT         170.              24000.           9841.10              41.
 NKT-NGU         170.              24000.          10032.88              42.

                      TOTAL DISTANCE =   340.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =     8160000.

                      ACTUAL LOAD = (DIST.)(LOAD) =    3378576.

                      ROUTE UTILIZATION =  41.
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                         TRUCKS 6   MACK

    LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 SUU-NFL          220.              24000.          1610.96                7.
 NFL-SUU          220.              24000.          4641.10               19.

                      TOTAL DISTANCE =    440.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    10560000.

                      ACTUAL LOAD = (DIST.)(LOAD) =    1375453.

                      ROUTE UTILIZATION =  13.

                         TRUCKS 7   MACK

    LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 SUU-NFL          220.              24000.          1846.57                8.
 NFL-SUU          220.              24000.              .00                0.

                      TOTAL DISTANCE =    440.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    10560000.

                      ACTUAL LOAD = (DIST.)(LOAD) =     406246.

                      ROUTE UTILIZATION =   4.

                         TRUCKS 8   MACK

    LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 TCM-PWT           22.              24000.          4213.70               18.
 PWT-TCM           22.              24000.          4887.67               20.

                      TOTAL DISTANCE =     44.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =     1056000.

                      ACTUAL LOAD = (DIST.)(LOAD) =     200230.

                      ROUTE UTILIZATION =  19.
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                      TRUCKS 9  MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 TCM-PWT          22.               24000.           2142.47                9.

                   TOTAL DISTANCE =    22.

                   POTENTIAL LOAD = (DIST.)(CAPACITY) =      528000.

                   ACTUAL LOAD = (DIST.)(LOAD) =      47134.

                   ROUTE UTILIZATION =    9.

                      TRUCKS 10 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 TCM-NUW          90.               24000.           4904.11               20.
 NUW-TCM          90.               24000.           5013.70               21.

                   TOTAL DISTANCE =   180.

                   POTENTIAL LOAD = (DIST.)(CAPACITY) =    4320000.

                   ACTUAL LOAD = (DIST.)(LOAD) =     892603.

                   ROUTE UTILIZATION =  21.

                      TRUCKS 11 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 NZY-SBD         136.               24000.           5917.81               25.
 SBD-NZY         136.               24000.           5545.21               23.

                   TOTAL DISTANCE =   272.

                   POTENTIAL LOAD = (DIST.)(CAPACITY) =    6528000.

                   ACTUAL LOAD = (DIST.)(LOAD) =    1558970.

                   ROUTE UTILIZATION =  24.
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                    TRUCKS 12 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

SUU-NLC           212.               24000.           4832.88               20.
NLC-SUU           212.               24000.           3336.99               14.

                TOTAL DISTANCE =   424.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =   10176000.

                ACTUAL LOAD = (DIST.)(LOAD) =   1732011.

                ROUTE UTILIZATION =  17.


                    TRUCKS 13 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NGZ-SUU            68.               24000.           4728.77               20.
SUU-NGZ            68.               24000.           7534.84               31.

                TOTAL DISTANCE =   136.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =    3264000.

                ACTUAL LOAD = (DIST.)(LOAD) =    833925.

                ROUTE UTILIZATION =  26.

                    TRUCKS 14 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NZY-LGB           111.               24000.           6027.40               25.
LGB-NTD            82.               24000.           5430.14               23.
NTD-LGB            82.               24000.           5238.36               22.
LGB-NZJ            52.               24000.           3704.11               15.
NZJ-NZY            80.               24000.           4328.77               18.

                TOTAL DISTANCE =   407.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =    9768000.

                ACTUAL LOAD = (DIST.)(LOAD) =   2082773.

                ROUTE UTILIZATION =  21.
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                          TRUCKS 15 MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NZY-LGB          111.             24000.          4624.66               19.
LGB-SUU          452.             24000.          6471.23               27.
SUU-NGZ           68.             24000.          6060.27               25.
NGZ-LGB          428.             24000.          8345.21               35.
LGB-NZY          111.             24000.          9358.90               39.

                       TOTAL DISTANCE =  1170.

                       POTENTIAL LOAD = (DIST.)(CAPACITY) =   28080000.

                       ACTUAL LOAD = (DIST.)(LOAD) =   8461019.

                       ROUTE UTILIZATION =  30.

                          TRUCKS 16 MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NGU-DAG          146.             24000.          4854.79               20.
DAG-INH            8.             24000.          2498.63               10.
INH-NGU          154.             24000.          3589.04               15.

                       TOTAL DISTANCE =   308.

                       POTENTIAL LOAD = (DIST.)(CAPACITY) =    7392000.

                       ACTUAL LOAD = (DIST.)(LOAD) =   1281502.

                       ROUTE UTILIZATION =  17.

                          TRUCKS 17 MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NGU-PNE          259.             24000.         14931.51               62.
PNE-PHL           10.             24000.         15786.30               66.
PHL-WRI           58.             24000.         16783.56               70.
WRI-NGU          308.             24000.         17189.04               72.


                       TOTAL DISTANCE =   635.

                       POTENTIAL LOAD = (DIST.)(CAPACITY) =   15240000.

                       ACTUAL LOAD = (DIST.)(LOAD) =  10292800.

                       ROUTE UTILIZATION =  68.
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                              TRUCKS 18 MACK

       LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

     NGU-GON          467.             24000.          11123.29             46.
     GON-NCO           54.             24000.          10794.52             45.
     NCO-NGU          505.             24000.          11375.34             47.

                         TOTAL DISTANCE =  1026.

                         POTENTIAL LOAD = (DIST.)(CAPACITY) =   24624000.

                         ACTUAL LOAD = (DIST.)(LOAD) =  11522030.

                         ROUTE UTILIZATION =  47.


                              TRUCKS 19 MACK

       LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

     NGU-TWH            7.             24000.           2920.55             12.
     TWH-NGU            7.             24000.           5786.30             24.

                         TOTAL DISTANCE =    14.

                         POTENTIAL LOAD = (DIST.)(CAPACITY) =     336000.

                         ACTUAL LOAD = (DIST.)(LOAD) =     60948.

                         ROUTE UTILIZATION =  18.


                              TRUCKS 20 MACK

       LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

     NGU-TWH            7.             24000.           2991.78             12.
     TWH-NGU            7.             24000.               .00              0.

                         TOTAL DISTANCE =    14.

                         POTENTIAL LOAD = (DIST.)(CAPACITY) =     336000.

                         ACTUAL LOAD = (DIST.)(LOAD) =     20942.

                         ROUTE UTILIZATION =   6.
```

*D065 Results of Author's QUICKTRANS Route Model*

The following represents only extracts of the actual *LOGISTICS AIR LIFT COMPUTER MODEL REPORT* commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 58.54 percent of total demand of 480455. pounds
unsatisfied total - 199180. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| NIP-NZY | 2523. | 35127. | 31170.84 | 89. |

TOTAL DISTANCE = 2523.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 88625420.

ACTUAL LOAD = (DIST.)(LOAD) = 78644020.

ROUTE UTILIZATION = 89.

ROUTE 2 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| NZY-SUU | 468. | 35127. | 35127.00 | 100. |
| SUU-TCM | 617. | 35127. | 16666.72 | 47. |
| TCM-SUU | 617. | 35127. | 16602.74 | 47. |
| SUU-NZY | 468. | 35127. | 35127.00 | 100. |

TOTAL DISTANCE = 2170.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 76225590.

ACTUAL LOAD = (DIST.)(LOAD) = 53406130.

ROUTE UTILIZATION = 70.

```
                        ROUTE 3    L100

    LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

  NZY-NIP        2523.              35127.         34818.39            99.

                     TOTAL DISTANCE =  2523.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =   88625420.

                     ACTUAL LOAD = (DIST.)(LOAD) =  87846790.

                     ROUTE UTILIZATION =  99.

                        ROUTE 4    L100

    LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

  NGU-CHS         354.              35127.         35127.00           100.
  CHS-NIP         184.              35127.         35127.00           100.

                     TOTAL DISTANCE =   538.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =   18898330.

                     ACTUAL LOAD = (DIST.)(LOAD) =  18898330.

                     ROUTE UTILIZATION = 100.

                        ROUTE 5    L100

    LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

  NIP-CHS         184.              35127.         35127.00           100.
  CHS-NGU         354.              35127.         34644.81            99.

                     TOTAL DISTANCE =   538.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =   18898330.

                     ACTUAL LOAD = (DIST.)(LOAD) =  18727630.

                     ROUTE UTILIZATION =  99.
```

```
                         ROUTE 6   L100

      LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

    NIP-COP         152.              35127.         26610.17             76.
    COP-NQX         270.              35127.         23574.55             67.
    NQX-NPA         538.              35127.         22522.50             64.
    NPA-NIP         345.              35127.         25822.89             74.

                      TOTAL DISTANCE =  1305.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =   45840740.

                      ACTUAL LOAD = (DIST.)(LOAD) =  31435870.

                      ROUTE UTILIZATION =  69.


                         TRUCKS 1   MACK

      LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

    SUU-NGZ          68.              24000.          4295.89             18.
    NGZ-SUU          68.              24000.          6043.84             25.

                      TOTAL DISTANCE =   136.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    3264000.

                      ACTUAL LOAD = (DIST.)(LOAD) =    703101.

                      ROUTE UTILIZATION =  22.


                         TRUCKS 2   MACK

      LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

    SUU-NGZ          68.              24000.          1769.86              7.
    NGZ-SUU          68.              24000.              .00              0.


                      TOTAL DISTANCE =   136.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    3264000.

                      ACTUAL LOAD = (DIST.)(LOAD) =    120351.

                      ROUTE UTILIZATION =   4.
```

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                        TRUCKS 3  MACK

LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)      UTILIZATION

NIP-KBY        28.               24000.          8471.23              35.
KBY-NIP        28.               24000.          7128.77              30.

                   TOTAL DISTANCE =    56.

                   POTENTIAL LOAD = (DIST.)(CAPACITY) =    1344000.

                   ACTUAL LOAD = (DIST.)(LOAD) =    436800.

                   ROUTE UTILIZATION =  32.

                        TRUCKS 4  MACK

LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)      UTILIZATION

TCM-PWT        22.               24000.         11747.94              49.
PWT-NUW        69.               24000.         11265.75              47.
NUW-TCM        90.               24000.         11101.37              46.

                   TOTAL DISTANCE =   181.

                   POTENTIAL LOAD = (DIST.)(CAPACITY) =    4344000.

                   ACTUAL LOAD = (DIST.)(LOAD) =   2034915.

                   ROUTE UTILIZATION =  47.

                        TRUCKS 5  MACK

LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)      UTILIZATION

SUU-NLC       212.               24000.          4690.41              20.

                   TOTAL DISTANCE =   212.

                   POTENTIAL LOAD = (DIST.)(CAPACITY) =    5088000.

                   ACTUAL LOAD = (DIST.)(LOAD) =    994367.

                   ROUTE UTILIZATION =  20.
```

```
                   TRUCKS 6  MACK

   LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

NLC-SUU         212.              24000.         4273.97           18.

                TOTAL DISTANCE =   212.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =    5088000.

                ACTUAL LOAD = (DIST.)(LOAD) =    906082.

                ROUTE UTILIZATION =  18.

                   TRUCKS 7  MACK

   LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

SUU-NFL         220.              24000.         3172.60           13.

                TOTAL DISTANCE =   220.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =    5280000.

                ACTUAL LOAD = (DIST.)(LOAD) =    697973.

                ROUTE UTILIZATION =  13.

                   TRUCKS 8  MACK

   LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

NFL-SUU         220.              24000.         4745.21           20.

                TOTAL DISTANCE =   220.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =    5280000.

                ACTUAL LOAD = (DIST.)(LOAD) =   1043945.

                ROUTE UTILIZATION =  20.
```

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                         TRUCKS 9  MACK

    LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

  NZY-NZJ          80.               24000.           9808.22              41.
  NZJ-SBD          60.               24000.           9939.72              41.
  SBD-NZY         136.               24000.           9665.75              40.

                       TOTAL DISTANCE =    276.

                       POTENTIAL LOAD = (DIST.)(CAPACITY) =    6624000.

                       ACTUAL LOAD = (DIST.)(LOAD) =    2695584.

                       ROUTE UTILIZATION =  41.

                         TRUCKS 10 MACK

    LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

  NZY-LGB         111.               24000.          15819.18              66.
  LGB-NTD          82.               24000.           5830.14              24.

                       TOTAL DISTANCE =    193.

                       POTENTIAL LOAD = (DIST.)(CAPACITY) =    4632000.

                       ACTUAL LOAD = (DIST.)(LOAD) =    2234001.

                       ROUTE UTILIZATION =  48.

                         TRUCKS 11 MACK

    LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

  NTD-LGB          82.               24000.           5441.10              23.
  LGB-NZY         111.               24000.          16000.00              67.

                       TOTAL DISTANCE =    193.

                       POTENTIAL LOAD = (DIST.)(CAPACITY) =    4632000.

                       ACTUAL LOAD = (DIST.)(LOAD) =    2222170.

                       ROUTE UTILIZATION =  48.
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                    TRUCKS 12 MACK

  LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NGU-TWH          7.                24000.           5517.81             23.
TWH-NGU          7.                24000.           4838.36             20.

                  TOTAL DISTANCE =     14.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =      336000.

                  ACTUAL LOAD = (DIST.)(LOAD) =      72493.

                  ROUTE UTILIZATION =  22.

                    TRUCKS 13 MACK

  LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NGU-GON        467.                24000.          10832.88             45.
GON-NCO         54.                24000.           9238.36             38.

                  TOTAL DISTANCE =    521.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =    12504000.

                  ACTUAL LOAD = (DIST.)(LOAD) =    5557824.

                  ROUTE UTILIZATION =  44.

                    TRUCKS 14 MACK

  LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

GON-NCO         54.                24000.            449.31              2.
NCO-NGU        467.                24000.           9589.04             40.

                  TOTAL DISTANCE =    521.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =    12504000.

                  ACTUAL LOAD = (DIST.)(LOAD) =    4502345.

                  ROUTE UTILIZATION =  36.
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                         TRUCKS 15 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NGU-WRI          308.               24000.            5304.11               22.

                      TOTAL DISTANCE =   308.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    7392000.

                      ACTUAL LOAD = (DIST.)(LOAD) =   1633665.

                      ROUTE UTILIZATION =  22.

                         TRUCKS 16 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

WRI-NGU          308.               24000.            4580.82               19.

                      TOTAL DISTANCE =   308.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    7392000.

                      ACTUAL LOAD = (DIST.)(LOAD) =   1410893.

                      ROUTE UTILIZATION =  19.

                         TRUCKS 17 MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

NGU-IND          692.               24000.            6438.35               27.

                      TOTAL DISTANCE =   692.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =   16608000.

                      ACTUAL LOAD = (DIST.)(LOAD) =   4455340.

                      ROUTE UTILIZATION =  27.
```

```
                    TRUCKS 18 MACK

  LEG      DISTANCE(MILES)      CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

IND-NGU         692.               24000.          5419.18             23.

                  TOTAL DISTANCE =   692.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =   16608000.

                  ACTUAL LOAD = (DIST.)(LOAD) =   3750071.

                  ROUTE UTILIZATION =  23.

                    TRUCKS 19 MACK

  LEG      DISTANCE(MILES)      CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

NGU-INH         154.               24000.          4361.64             18.
INH-DCA          17.               24000.           789.04              3.
DCA-NGU         169.               24000.          5747.95             24.

                  TOTAL DISTANCE =   340.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =    8160000.

                  ACTUAL LOAD = (DIST.)(LOAD) =   1656510.

                  ROUTE UTILIZATION =  20.


                    TRUCKS 20 MACK

  LEG      DISTANCE(MILES)      CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

NGU-DCA         169.               24000.          4991.78             21.
DCA-INH          17.               24000.           449.31              2.
INH-NGU         154.               24000.          7178.08             30.

                  TOTAL DISTANCE =   340.

                  POTENTIAL LOAD = (DIST.)(CAPACITY) =    8160000.

                  ACTUAL LOAD = (DIST.)(LOAD) =   1956674.

                  ROUTE UTILIZATION =  24.
```

```
                         TRUCKS 21 MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

   DAG-INH          8.               24000.          4421.92               18.
   INH-DCA         17.               24000.              .00                0.
   DCA-NGU        169.               24000.              .00                0.

                    TOTAL DISTANCE =   194.

                    POTENTIAL LOAD = (DIST.)(CAPACITY) =     4656000.

                    ACTUAL LOAD = (DIST.)(LOAD) =      35375.

                    ROUTE UTILIZATION =    1.

                         TRUCKS 22 MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

   NGU-NKT        170.               24000.         10043.84               42.
   NKT-NGU        170.               24000.          9072.21               38.

                    TOTAL DISTANCE =   340.

                    POTENTIAL LOAD = (DIST.)(CAPACITY) =     8160000.

                    ACTUAL LOAD = (DIST.)(LOAD) =    3249728.

                    ROUTE UTILIZATION =  40.

                         TRUCKS 23 MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

   NGU-PHL        259.               24000.          9742.46               41.
   PHL-PNE         10.               24000.          4115.07               17.

                    TOTAL DISTANCE =   269.

                    POTENTIAL LOAD = (DIST.)(CAPACITY) =     6456000.

                    ACTUAL LOAD = (DIST.)(LOAD) =    2564449.

                    ROUTE UTILIZATION =  40.
```

TRUCKS 24 MACK

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| PNE-PHL | 10. | 24000. | 4197.26 | 17. |
| PHL-NGU | 259. | 24000. | 9884.93 | 41. |

TOTAL DISTANCE = 269.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 6456000.

ACTUAL LOAD = (DIST.)(LOAD) = 2602170.

ROUTE UTILIZATION = 40.

# *Appendix M: D065 Evaluation of LOGAIR Routes*

## D065 Results of Current LOGAIR Route

The following represents only extracts of the actual *LOGISTICS AIR LIFT COMPUTER MODEL REPORT* commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 100.00 percent of total demand of 316258. pounds

unsatisfied total - 0. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| MCC-HIF | 529. | 35127. | 29200.00 | 83. |
| HIF-TIK | 884. | 35127. | 29528.77 | 84. |
| TIK-FFO | 792. | 35127. | 9934.24 | 28. |
| FFO-WRB | 496. | 35127. | 8805.48 | 25. |

TOTAL DISTANCE = 2701.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 94878020.

ACTUAL LOAD = (DIST.)(LOAD) = 53785670.

ROUTE UTILIZATION = 57.

ROUTE 2 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| WRB-SSC | 202. | 35127. | 16679.44 | 47. |
| SSC-LFI | 316. | 35127. | 15983.55 | 46. |
| LFI-GSB | 150. | 35127. | 14838.35 | 42. |
| GSB-CHS | 208. | 35127. | 13939.73 | 40. |
| CHS-WRB | 206. | 35127. | 13200.00 | 38. |

TOTAL DISTANCE = 1082.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 38007420.

ACTUAL LOAD = (DIST.)(LOAD) = 16264460.

ROUTE UTILIZATION = 43.

```
                    ROUTE 3    L100

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 WRB-SKF          917.             35127.         12312.33            35.
 SKF-SBD         1143.             35127.         12641.09            36.
 SBD-SUU          389.             35127.          8016.44            23.
 SUU-MCC           40.             35127.         13972.60            40.

                 TOTAL DISTANCE =  2489.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =   87431100.

                 ACTUAL LOAD = (DIST.)(LOAD) =  29416460.

                 ROUTE UTILIZATION =  34.

                     ROUTE 4    L100

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 SUU-MCC           40.             35127.              .00             0.
 MCC-HIF          529.             35127.              .00             0.
 HIF-SKF         1106.             35127.         18076.71            51.
 SKF-WRB          917.             35127.         11402.74            32.
 WRB-FFO          496.             35127.          9572.60            27.

                 TOTAL DISTANCE =  3088.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =  108472200.

                 ACTUAL LOAD = (DIST.)(LOAD) =  35197170.

                 ROUTE UTILIZATION =  32.


                     ROUTE 5    L100

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 FFO-DOV          461.             35127.         15950.67            45.
 DOV-WRI           77.             35127.         14290.39            41.
 WRI-FFO          502.             35127.         11254.79            32.

                 TOTAL DISTANCE =  1040.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =   36532080.

                 ACTUAL LOAD = (DIST.)(LOAD) =  14103530.

                 ROUTE UTILIZATION =  39.
```

ROUTE 6 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| FFO-TIK | 792. | 35127. | 19797.26 | 56. |
| TIK-HIF | 884. | 35127. | 20657.54 | 59. |
| HIF-MCC | 529. | 35127. | 19517.80 | 56. |
| MCC-SUU | 40. | 35127. | 9578.08 | 27. |

TOTAL DISTANCE = 2245.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 78860110.

ACTUAL LOAD = (DIST.)(LOAD) = 44648730.

ROUTE UTILIZATION = 57.

ROUTE 7 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| HIF-SBD | 564. | 24549. | 9731.50 | 40. |
| SBD-LSV | 193. | 24549. | 11621.91 | 47. |
| LSV-HIF | 376. | 24549. | 10712.33 | 44. |

TOTAL DISTANCE = 1133.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 27814020.

ACTUAL LOAD = (DIST.)(LOAD) = 11759430.

ROUTE UTILIZATION = 42.

ROUTE 8 DC-9

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| FFO-HIF | 1468. | 16309. | 9923.29 | 61. |
| HIF-FFO | 1468. | 16309. | 13446.57 | 82. |

TOTAL DISTANCE = 2936.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 47883220.

ACTUAL LOAD = (DIST.)(LOAD) = 34306950.

ROUTE UTILIZATION = 72.

ROUTE 9 DC-9

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| PFO-PSM | 721. | 24464. | 11583.55 | 47. |
| PSM-LIZ | 304. | 24464. | 10723.28 | 44. |
| LIZ-PBG | 313. | 24464. | 11326.02 | 46. |
| PBG-RME | 138. | 24464. | 10679.44 | 44. |
| RME-PFO | 506. | 24464. | 10438.36 | 43. |

TOTAL DISTANCE = 1982.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 48487650.

ACTUAL LOAD = (DIST.)(LOAD) = 21912230.

ROUTE UTILIZATION = 45.

ROUTE 10 C640

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| PFO-MTC | 202. | 11195. | 3375.34 | 30. |
| MTC-OSC | 131. | 11195. | 2745.21 | 25. |
| OSC-SAW | 235. | 11195. | 3901.37 | 35. |
| SAW-DLH | 231. | 11195. | 2462.37 | 22. |
| DLH-PFO | 634. | 11195. | 2171.96 | 19. |

TOTAL DISTANCE = 1433.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 16042440.

ACTUAL LOAD = (DIST.)(LOAD) = 3904094.

ROUTE UTILIZATION = 24.

## ROUTE 10b C640

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| PFO-MTC | 202. | 2239. | 1731.51 | 77. |
| MTC-OSC | 131. | 2239. | 2087.67 | 93. |
| OSC-SAW | 235. | 2239. | 1090.41 | 49. |
| SAW-PFO | 481. | 2239. | 2239.00 | 100. |

TOTAL DISTANCE = 1049.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 2348711.

ACTUAL LOAD = (DIST.)(LOAD) = 1956455.

ROUTE UTILIZATION = 83.

## ROUTE 11 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| HIF-GFA | 442. | 24549. | 10317.80 | 42. |
| GFA-MIB | 460. | 24549. | 9501.35 | 39. |
| MIB-RCA | 307. | 24549. | 8356.16 | 34. |
| RCA-FEW | 224. | 24549. | 8180.80 | 33. |
| FEW-HIF | 373. | 24549. | 7621.92 | 31. |

TOTAL DISTANCE = 1806.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 44335500.

ACTUAL LOAD = (DIST.)(LOAD) = 16171910.

ROUTE UTILIZATION = 36.

## ROUTE 12 DC-9

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| SKF-HMN | 506. | 24464. | 10383.55 | 42. |
| HMN-LUF | 367. | 24464. | 9726.02 | 40. |
| LUF-DMA | 129. | 24464. | 6915.05 | 28. |
| DMA-SKF | 756. | 24464. | 7523.29 | 31. |

TOTAL DISTANCE = 1758.

POTENTIAL LOAD = (DIST.)(CAPACITY) 43007710.

ACTUAL LOAD = (DIST.)(LOAD) = 15403170.

ROUTE UTILIZATION = 36.

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                         ROUTE 13  L188

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

WRB-NIP          201.               20457.           3300.77             16.
NIP-COF          152.               20457.           1761.05              9.
COF-HST          190.               20457.           4915.07             24.
HST-NQX          103.               20457.           1169.26              6.
NQX-MCF          231.               20457.           1092.55              5.
MCF-NIP          172.               20457.            922.70              5.
NIP-WRB          201.               20457.           1909.00              9.

                    TOTAL DISTANCE =  1250.

                    POTENTIAL LOAD = (DIST.)(CAPACITY) =   25571250.

                    ACTUAL LOAD = (DIST.)(LOAD) =   2780223.

                    ROUTE UTILIZATION =  11.

                         ROUTE 14  L188

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

WRB-COF          352.                4091.           4091.00            100.
COF-HST          190.                4091.            438.36             11.
HST-MCF          210.                4091.           4091.00            100.
MCF-WRB          336.                4091.           4091.00            100.

                    TOTAL DISTANCE =  1088.

                    POTENTIAL LOAD = (DIST.)(CAPACITY) =    4451008.

                    ACTUAL LOAD = (DIST.)(LOAD) =   3757006.

                    ROUTE UTILIZATION =  84.
```

## ROUTE 14b L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| WRB-VPS | 228. | 24549. | 8745.19 | 36. |
| VPS-SKF | 727. | 24549. | 7331.51 | 30. |
| SKF-BAD | 363. | 24549. | 5287.66 | 22. |
| BAD-CBM | 313. | 24549. | 2224.63 | 9. |
| CBM-WRB | 290. | 24549. | 1873.97 | 8. |

TOTAL DISTANCE = 1921.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 47158630.

ACTUAL LOAD = (DIST.)(LOAD) = 10483090.

ROUTE UTILIZATION = 22.

## ROUTE 15 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| WRB-TIK | 814. | 24549. | 16153.42 | 66. |
| TIK-HIF | 884. | 24549. | 1523.29 | 6. |

TOTAL DISTANCE = 1698.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 41684200.

ACTUAL LOAD = (DIST.)(LOAD) = 14495470.

ROUTE UTILIZATION = 35.

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                    ROUTE 16   L188

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 HIF-MUO          238.              24549.         11490.40             47.
 MUO-TCM          431.              24549.         11052.05             45.
 TCM-SKA          229.              24549.          9435.60             38.
 SKA-HIF          529.              24549.          9161.64             37.

                TOTAL DISTANCE =  1427.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =   35031420.

                ACTUAL LOAD = (DIST.)(LOAD) =  14505410.

                ROUTE UTILIZATION =  41.

                    ROUTE 17   L188

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 HIF-TIK          884.              24549.          1704.11              7.
 TIK-WRB          814.              24549.         23983.56             98.

                TOTAL DISTANCE =  1698.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =   41684200.

                ACTUAL LOAD = (DIST.)(LOAD) =  21029050.

                ROUTE UTILIZATION =  50.

                    ROUTE 18   L188

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 TIK-SZL          312.              24549.         11030.13             45.
 SZL-OFF          207.              24549.         10504.10             43.
 OFF-RDR          477.              24549.          9512.32             39.
 RDR-RCA          379.              24549.          8756.16             36.
 RCA-IAB          544.              24549.          8876.70             36.
 IAB-TIK          153.              24549.          8235.62             34.

                TOTAL DISTANCE =  2072.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =   50865530.

                ACTUAL LOAD = (DIST.)(LOAD) =  19560680.

                ROUTE UTILIZATION =  38.
```

ROUTE 19 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-DYS | 250. | 24549. | 2690.39 | 11. |
| DYS-SKF | 223. | 24549. | 1210.96 | 5. |
| SKF-FWH | 243. | 24549. | 18991.77 | 77. |
| FWH-TIK | 182. | 24549. | 17972.60 | 73. |

TOTAL DISTANCE = 898.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 22045000.

ACTUAL LOAD = (DIST.)(LOAD) = 8828653.

ROUTE UTILIZATION = 40.

ROUTE 20 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-FFO | 792. | 24549. | 8191.78 | 33. |
| FFO-BYH | 418. | 24549. | 1446.55 | 6. |
| BYH-TIK | 421. | 24549. | 1775.34 | 7. |
| TIK-SKF | 421. | 24549. | 16273.97 | 66. |
| SKF-LRF | 536. | 24549. | 4219.16 | 17. |
| LRF-TIK | 299. | 24549. | 5309.59 | 22. |

TOTAL DISTANCE = 2887.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 70872960.

ACTUAL LOAD = (DIST.)(LOAD) = 18540350.

ROUTE UTILIZATION = 26.

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                         ROUTE 21  DC-9

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

SKF-HIF          1106.             24464.          7901.37              32.
HIF-CVS           663.             24464.          2701.35              11.
CVS-SKF           443.             24464.          2038.36               8.

                     TOTAL DISTANCE =  2212.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =   54114370.

                     ACTUAL LOAD = (DIST.)(LOAD) =  11432900.

                     ROUTE UTILIZATION =  21.

                         TRUCKS 1  MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

ABQ-CVS           193.             24000.           690.41               3.
CVS-ABQ           193.             24000.          1062.99               4.

                     TOTAL DISTANCE =   386.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    9264000.

                     ACTUAL LOAD = (DIST.)(LOAD) =    338407.

                     ROUTE UTILIZATION =   4.


                         TRUCKS 2  MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

BAD-AEX           104.             24000.           920.52               4.
AEX-BAD           104.             24000.           536.99               2.

                     TOTAL DISTANCE =   208.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    4992000.

                     ACTUAL LOAD = (DIST.)(LOAD) =    151581.

                     ROUTE UTILIZATION =   3.
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                       TRUCKS 3  MACK

   LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 LRF-MEM        123.              24000.           673.96              3.
 MEM-LRF        123.              24000.          3589.04             15.

                     TOTAL DISTANCE =   246.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    5904000.

                     ACTUAL LOAD = (DIST.)(LOAD) =    524349.

                     ROUTE UTILIZATION =   9.

                       TRUCKS 4  MACK

   LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 VPS-BIX        143.              24000.          1594.50              7.
 BIX-VPS        143.              24000.          1424.66              6.

                     TOTAL DISTANCE =   286.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    6864000.

                     ACTUAL LOAD = (DIST.)(LOAD) =    431739.

                     ROUTE UTILIZATION =   6.

                       TRUCKS 5  MACK

   LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 VPS-PAM         64.              24000.          2071.21              9.
 PAM-VPS         64.              24000.          1879.45              8.

                     TOTAL DISTANCE =   128.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    3072000.

                     ACTUAL LOAD = (DIST.)(LOAD) =    252842.

                     ROUTE UTILIZATION =   8.
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                     TRUCKS 6   MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)     UTILIZATION

WRB-VAD          118.               24000.          1726.01              7.
VAD-WRB          118.               24000.          1452.05              6.

                 TOTAL DISTANCE =   236.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =    5664000.

                 ACTUAL LOAD = (DIST.)(LOAD) =    375011.

                 ROUTE UTILIZATION =   7.

                     TRUCKS 7   MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)     UTILIZATION

NKO-FFO          120.               24000.             .00               0.
FFO-NKO          120.               24000.           153.42              1.

                 TOTAL DISTANCE =   240.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =    5760000.

                 ACTUAL LOAD = (DIST.)(LOAD) =     18411.

                 ROUTE UTILIZATION =   0.

                     TRUCKS 8   MACK

   LEG      DISTANCE(MILES)     CAPACITY(LBS)      LOAD(LBS)     UTILIZATION

GUS-FFO          125.               24000.             .00               0.
FFO-GUS          125.               24000.            98.63              0.

                 TOTAL DISTANCE =   250.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =    6000000.

                 ACTUAL LOAD = (DIST.)(LOAD) =     12329.

                 ROUTE UTILIZATION =   0.
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## *D065 Results of Author's LOGAIR Route Model*

The following represents only extracts of the actual *LOGISTICS AIR LIFT COMPUTER MODEL REPORT* commonly known as the D065 report.

1. Results of Unsatisfied Demand Report

satisfied 98.89 percent of total demand of 316258. pounds

unsatisfied total - 3510. pounds

2. Results of the LOGAIR Route Utilization Report

ROUTE 1 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-SBD | 1131. | 35127. | 11895.89 | 34. |
| SBD-HIF | 572. | 35127. | 6734.25 | 19. |
| HIF-TIK | 875. | 35127. | 35127.00 | 100. |

TOTAL DISTANCE 2578.

POTENTIAL LOAD (DIST.)(CAPACITY) 90557410.

ACTUAL LOAD (DIST.)(LOAD) 48042370.

ROUTE UTILIZATION 53.

ROUTE 2 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-HIF | 875. | 35127. | 30549.88 | 87. |
| HIF-MCC | 545. | 35127. | 26297.82 | 75. |
| MCC-SUU | 24. | 35127. | 11282.18 | 32. |

TOTAL DISTANCE 1444.

POTENTIAL LOAD (DIST.)(CAPACITY) 50723390.

ACTUAL LOAD (DIST.)(LOAD) 41334240.

ROUTE UTILIZATION 81.

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                    ROUTE 3    L100

  LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

TIK-HIF        875.             35127.        12630.13           36.
HIF-SBD        572.             35127.         9764.38           28.
SBD-TIK       1311.             35127.         9978.08           28.

              TOTAL DISTANCE =  2758.

              POTENTIAL LOAD = (DIST.)(CAPACITY) =   96880260.

              ACTUAL LOAD = (DIST.)(LOAD) =  29717860.

              ROUTE UTILIZATION =  31.

                    ROUTE 4    L100

  LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

SUU-MCC         40.             35127.         8087.67           23.
MCC-HIF        529.             35127.        29200.00           83.
HIF-TIK        875.             35127.        23048.34           66.

              TOTAL DISTANCE =  1444.

              POTENTIAL LOAD = (DIST.)(CAPACITY) =   50723390.

              ACTUAL LOAD = (DIST.)(LOAD) =  35937610.

              ROUTE UTILIZATION =  71.

                    ROUTE 5    L100

  LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

TIK-SKF        420.             35127.        35127.00          100.
SKF-WRB        196.             35127.        30255.76           86.
WRB-FFO        492.             35127.        30354.40           86.
FFO-TIK        780.             35127.        35127.00          100.

              TOTAL DISTANCE =  1888.

              POTENTIAL LOAD = (DIST.)(CAPACITY) =   66319780.

              ACTUAL LOAD = (DIST.)(LOAD) =  63016900.

              ROUTE UTILIZATION =  95.
```

### ROUTE 6 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-FFO | 780. | 35127. | 34073.00 | 97. |
| FFO-WRB | 492. | 35127. | 25809.99 | 73. |
| WRB-SKF | 196. | 35127. | 27028.37 | 77. |
| SKF-TIK | 420. | 35127. | 35127.00 | 100. |

TOTAL DISTANCE = 1888.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 66319780.

ACTUAL LOAD = (DIST.)(LOAD) = 59326360.

ROUTE UTILIZATION = 89.

### ROUTE 7 C640

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| FFO-MTC | 213. | 13434. | 5106.85 | 38. |
| MTC-OSC | 137. | 13434. | 4728.77 | 35. |
| OSC-SAW | 236. | 13434. | 4794.52 | 36. |
| SAW-DLH | 233. | 13434. | 4427.40 | 33. |
| DLH-FFO | 632. | 13434. | 4131.51 | 31. |

TOTAL DISTANCE = 1451.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 19492730.

ACTUAL LOAD = (DIST.)(LOAD) = 6509806.

ROUTE UTILIZATION = 33.

### ROUTE 8 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| PFO-RME | 520. | 35127. | 11654.78 | 33. |
| RME-PBG | 130. | 35127. | 11046.56 | 31. |
| PBG-LIZ | 316. | 35127. | 10142.45 | 29. |
| LIZ-PSM | 283. | 35127. | 10619.16 | 30. |
| PSM-PFO | 743. | 35127. | 9731.51 | 28. |

TOTAL DISTANCE = 1992.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 69972980.

ACTUAL LOAD = (DIST.)(LOAD) = 20937280.

ROUTE UTILIZATION = 30.

### ROUTE 9 L100

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| PFO-WRI | 515. | 35127. | 19956.15 | 57. |
| WRI-DOV | 81. | 35127. | 16827.38 | 48. |
| DOV-LFI | 149. | 35127. | 15156.15 | 43. |
| LFI-PFO | 455. | 35127. | 14000.00 | 40. |

TOTAL DISTANCE = 1200.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 42152400.

ACTUAL LOAD = (DIST.)(LOAD) = 20268700.

ROUTE UTILIZATION = 48.

### ROUTE 10 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| HIF-MUO | 243. | 25549. | 11117.80 | 44. |
| MUO-TCM | 432. | 25549. | 10684.92 | 42. |
| TCM-SKA | 230. | 25549. | 9287.66 | 36. |
| SKA-HIF | 520. | 25549. | 9161.64 | 36. |

TOTAL DISTANCE = 1425.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 36407320.

ACTUAL LOAD = (DIST.)(LOAD) = 14217730.

ROUTE UTILIZATION = 39.

ROUTE 11 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| HIF-GFA | 430. | 34549. | 14087.65 | 41. |
| GFA-MIB | 463. | 34549. | 13304.11 | 39. |
| MIB-RDR | 189. | 34549. | 12306.84 | 36. |
| RDR-RCA | 369. | 34549. | 11742.46 | 34. |
| RCA-FEW | 221. | 34549. | 12027.39 | 35. |
| FEW-HIF | 367. | 34549. | 11583.56 | 34. |

TOTAL DISTANCE = 2039.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 70445410.

ACTUAL LOAD = (DIST.)(LOAD) = 25785670.

ROUTE UTILIZATION = 37.

ROUTE 12 C640

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| SBD-DMA | 405. | 13434. | 9167.13 | 68. |
| DMA-LUF | 130. | 13434. | 9852.06 | 73. |
| LUF-LSV | 251. | 13434. | 7320.55 | 54. |
| LSV-SBD | 187. | 13434. | 6849.32 | 51. |

TOTAL DISTANCE = 973.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 13071280.

ACTUAL LOAD = (DIST.)(LOAD) = 8111734.

ROUTE UTILIZATION = 62.

ROUTE 13 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-OFF | 412. | 24549. | 10054.79 | 41. |
| OFF-SZL | 216. | 24549. | 9063.00 | 37. |
| SZL-IAB | 221. | 24549. | 8536.96 | 35. |
| IAB-LRF | 343. | 24549. | 7895.87 | 32. |
| LRF-TIK | 295. | 24549. | 6104.11 | 25. |

TOTAL DISTANCE = 1487.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 36504360.

ACTUAL LOAD = (DIST.)(LOAD) = 12495850.

ROUTE UTILIZATION = 34.

ROUTE 14 L188

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| WRB-BYH | 419. | 24549. | 11676.71 | 48. |
| BYH-CBM | 168. | 24549. | 14115.07 | 57. |
| CBM-BIX | 217. | 24549. | 13731.50 | 56. |
| BIX-VPS | 133. | 24549. | 13539.73 | 55. |
| VPS-WRB | 227. | 24549. | 12219.18 | 50. |

TOTAL DISTANCE = 1164.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 28575040.

ACTUAL LOAD = (DIST.)(LOAD) = 14818150.

ROUTE UTILIZATION = 52.

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                             ROUTE 15   L188

      LEG       DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

    WRB-SSC          196.               24549.          13008.21                53.
    SSC-GSB          190.               24549.          11985.50                49.
    GSB-CHS          231.               24549.          11021.11                45.
    CHS-WRB          194.               24549.          10204.68                42.

                         TOTAL DISTANCE =    811.

                         POTENTIAL LOAD = (DIST.)(CAPACITY) =    19909240.

                         ACTUAL LOAD = (DIST.)(LOAD) =    9352438.

                         ROUTE UTILIZATION =  47.

                             ROUTE 16   L100

      LEG       DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

    WRB-NIP          193.               35127.           7391.78                21.
    NIP-COF          152.               35127.           5852.04                17.
    COF-HST          197.               35127.           5139.71                15.
    HST-NQX           99.               35127.           4805.47                14.
    NQX-MCF          226.               35127.           4728.76                13.
    MCF-NIP          190.               35127.           4432.88                13.
    NIP-WRB          193.               35127.           5397.26                15.

                         TOTAL DISTANCE =   1250.

                         POTENTIAL LOAD = (DIST.)(CAPACITY) =    43908750.

                         ACTUAL LOAD = (DIST.)(LOAD) =    6757005.

                         ROUTE UTILIZATION =  15.

                             TRUCKS 1   MACK

      LEG       DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

    FFO-NKO          123.               24000.            153.42                 1.
    NKO-FFO          123.               24000.               .00                 0.

                         TOTAL DISTANCE =    246.

                         POTENTIAL LOAD = (DIST.)(CAPACITY) =     5904000.

                         ACTUAL LOAD = (DIST.)(LOAD) =      18871.

                         ROUTE UTILIZATION =    0.
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                         TRUCKS 2   MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 PFO-GUS          151.              24000.             98.63                 0.
 GUS-PFO          151.              24000.               .00                 0.

                      TOTAL DISTANCE =    302.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =     7248000.

                      ACTUAL LOAD = (DIST.)(LOAD) =      14893.

                      ROUTE UTILIZATION =    0.

                         TRUCKS 3   MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 HIP-ABQ          606.              24000.            920.53                 4.

                      TOTAL DISTANCE =    606.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    14544000.

                      ACTUAL LOAD = (DIST.)(LOAD) =     557842.

                      ROUTE UTILIZATION =    4.

                         TRUCKS 4   MACK

   LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

 ABQ-HIP          606.              24000.            690.41                 3.

                      TOTAL DISTANCE =    606.

                      POTENTIAL LOAD = (DIST.)(CAPACITY) =    14544000.

                      ACTUAL LOAD = (DIST.)(LOAD) =     418389.

                      ROUTE UTILIZATION =    3.
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                           TRUCKS 5   MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

  SKF-HMN           611.               24000.           3550.67               15.

                        TOTAL DISTANCE =    611.

                        POTENTIAL LOAD = (DIST.)(CAPACITY) =    14664000.

                        ACTUAL LOAD = (DIST.)(LOAD) =    2169458.

                        ROUTE UTILIZATION =  15.

                           TRUCKS 6   MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

  HMN-SKF           611.               24000.           2772.60               12.

                        TOTAL DISTANCE =    611.

                        POTENTIAL LOAD = (DIST.)(CAPACITY) =    14664000.

                        ACTUAL LOAD = (DIST.)(LOAD) =    1694061.

                        ROUTE UTILIZATION =  12.

                           TRUCKS 7   MACK

     LEG      DISTANCE(MILES)      CAPACITY(LBS)      LOAD(LBS)      UTILIZATION

  SKF-DYS           263.               24000.           2690.39               11.

                        TOTAL DISTANCE =    263.

                        POTENTIAL LOAD = (DIST.)(CAPACITY) =     6312000.

                        ACTUAL LOAD = (DIST.)(LOAD) =     707573.

                        ROUTE UTILIZATION =  11.
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                    TRUCKS 8  MACK

  LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

DYS-SKF         263.              24000.         1035.62               4.

                TOTAL DISTANCE =   263.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =    6312000.

                ACTUAL LOAD = (DIST.)(LOAD) =    272367.

                ROUTE UTILIZATION =   4.

                    TRUCKS 9  MACK

  LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

AEX-SKF         461.              24000.          520.55               2.

                TOTAL DISTANCE =   461.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =   11064000.

                ACTUAL LOAD = (DIST.)(LOAD) =    239973.

                ROUTE UTILIZATION =   2.

                    TRUCKS 10 MACK

  LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

SKF-AEX         461.              24000.          920.52               4.

                TOTAL DISTANCE =   461.

                POTENTIAL LOAD = (DIST.)(CAPACITY) =   11064000.

                ACTUAL LOAD = (DIST.)(LOAD) =    424361.

                ROUTE UTILIZATION =   4.
```

TRUCKS 11 MACK

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-CVS | 414. | 24000. | 1643.82 | 7. |

TOTAL DISTANCE = 414.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 9936000.

ACTUAL LOAD = (DIST.)(LOAD) = 680540.

ROUTE UTILIZATION = 7.

TRUCKS 12 MACK

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| CVS-TIK | 414. | 24000. | 1353.42 | 6. |

TOTAL DISTANCE = 414.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 9936000.

ACTUAL LOAD = (DIST.)(LOAD) = 560317.

ROUTE UTILIZATION = 6.

TRUCKS 13 MACK

| LEG | DISTANCE(MILES) | CAPACITY(LBS) | LOAD(LBS) | UTILIZATION |
|---|---|---|---|---|
| TIK-FWH | 231. | 24000. | 3758.89 | 16. |

TOTAL DISTANCE = 231.

POTENTIAL LOAD = (DIST.)(CAPACITY) = 5544000.

ACTUAL LOAD = (DIST.)(LOAD) = 868303.

ROUTE UTILIZATION = 16.

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                         TRUCKS 14 MACK

   LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 FWH-TIK        231.              24000.          2739.73            11.

                     TOTAL DISTANCE =   231.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    5544000.

                     ACTUAL LOAD = (DIST.)(LOAD) =    632877.

                     ROUTE UTILIZATION =  11.

                         TRUCKS 15 MACK

   LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 TIK-BAD        359.              24000.          3353.40            14.

                     TOTAL DISTANCE =   359.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    8616000.

                     ACTUAL LOAD = (DIST.)(LOAD) =   1203872.

                     ROUTE UTILIZATION =  14.

                         TRUCKS 16 MACK

   LEG     DISTANCE(MILES)     CAPACITY(LBS)     LOAD(LBS)     UTILIZATION

 BAD-TIK        359.              24000.           673.97             3.

                     TOTAL DISTANCE =   359.

                     POTENTIAL LOAD = (DIST.)(CAPACITY) =    8616000.

                     ACTUAL LOAD = (DIST.)(LOAD) =    241956.

                     ROUTE UTILIZATION =   3.
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                       TRUCKS 17 MACK

 LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

WRB-VAD        150.             24000.         1726.01              7.
VAD-WRB        150.             24000.         1435.62              6.

                 TOTAL DISTANCE =   300.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =    7200000.

                 ACTUAL LOAD = (DIST.)(LOAD) =    474243.

                 ROUTE UTILIZATION =   7.

                       TRUCKS 18 MACK

 LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION


BYH-MEM         46.             24000.          673.96              3.
MEM-BYH         46.             24000.         2953.42             12.

                 TOTAL DISTANCE =    92.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =    2208000.

                 ACTUAL LOAD = (DIST.)(LOAD) =    166859.

                 ROUTE UTILIZATION =   8.

                       TRUCKS 19 MACK

 LEG     DISTANCE(MILES)    CAPACITY(LBS)    LOAD(LBS)    UTILIZATION

VPS-PAM         72.             24000.         2071.21              9.
PAM-VPS         72.             24000.         1863.01              8.

                 TOTAL DISTANCE =   144.

                 POTENTIAL LOAD = (DIST.)(CAPACITY) =    3456000.

                 ACTUAL LOAD = (DIST.)(LOAD) =    283264.

                 ROUTE UTILIZATION =   8.
```

## *Bibliography*

*An Evaluation of the QUICKTRANS Dedicated Transportation System.* Memorandum Report (LMI tasking ML016). Logistics Management Institute, 10 March 1981.

Bartholdi, John J. III and Loren K. Platzman. "Heuristics Based on Spacefilling Curves for Combinatorial Problems in Euclidean Space," *Management Science* 34:291-305 (March 1988).

-----.*Heuristics Based on Spacefilling Curves for Combinatorial Problems in the Plane*: September 1984. Contract N00014-83-K-0147. Georgia Institute of Technology, Atlanta GA (AD-A149320).

-----. et al. "A Minimal Technology Routing System for Meals on Wheels," *Interfaces*, 3:1-8 (3 June 1983).

Boudreaux, Maj Elie J. III and Maj John B. Olansen, Jr. *The Design of LOGAIR Feeder Routes.* MS thesis, LSSR-37-77A. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, June 1977 (AD-A044170).

Bryan, Bill. Contracting Officer and Technical Representative. Telephonic Interview. Navy Material Transportation Office (NAVMTO), Code 034, Norfolk VA, 3 August 1990.

Carter, Capt William B. *Allocation and Routing of CRAF MD80 Aircraft.* MS thesis, AFIT/GST/ENS/90M-4. School of Engineering, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, March 1990.

Chan, Yupo and William Rowell. *Integrated Location-and-Routing Models - Part I: A Review of Model Formulations.* Department of Operational Sciences, Air Force Institute of Technology (AU), Wright Patterson AFB OH, January 1990 (DRAFT).

-----. *Integrated Location-and-Routing Models - Part II: A Review of Solution Algorithms.* Department of Operational Sciences, Air Force Institute of Technology (AU), Wright Patterson AFB OH, January 1990 (DRAFT).

Chase, Richard B. and Nicholas J. Aquilano. *Production and Operations Management A Life Cycle Approach* (Fifth Edition). Homewood IL: Richard D. Irwin, Inc, 1989.

Churchill, Sir Winston S. *The River War*. London: Eyre and Spottiswood, 1899.

Coon, Wynn Lewis. *A Comparative Evaluation and Analysis of the United States Navy's West Coast and Western Pacific Program Tests Utilizing Commercial Air Freight Service*. MS thesis. Naval Postgraduate School, Monterey CA, June 1986 (AD-B104738).

Coyle, John J. et al. *Transportation* (Second Edition). New York: West Publishing Company, 1986.

"Customer's Guide to the Navy Material Transportation Office, A," *The Navy Supply Corps Newsletter*, Volume 47, Number 2:4-14 (March/April 1984).

Department of Defense. *Military Standard Transportation and Movement Procedures*. DOD Directive 4500.32R, Vol I (Change 1). Washington: Government Printing Office, 21 October 1988.

Department of the Air Force. *Military Airlift and USAF LOGISTICS AIRLIFT (LOGAIR) TRAFFIC*. AFR 76-1, Washington: HQ USAF, (Draft 1990).

-----. *Transportation of Traffic Management: Transportation of Material*. AFR 75-1 (Change 1). Washington: HQ USAF, 28 April 1989.

Department of the Navy. *QUICKTRANS Airfreight System*. NAVSUP Instruction 4610.37A. Philadelphia: NAVPUBFORMCEN, 25 November 1988.

Dienemann, Paul F. and Robert D. Kaiser. *An Evaluation of the LOGAIR Dedicated Transportation System*. Memorandum Report (LMI Tasking ML119). Logistics Management Institute, 13 October 1981.

Figueroa, Andrew E. Chief, Transportation Management Division. Personal and Electronic Mail Interviews. HQ AFLC/DSTM, Wright-Patterson AFB OH, January-August 1990.

Garrett, Capt Hugh H. and Maj Craig K. MacPherson. *An Analysis of Computer Modeling Parameters for USAF CONUS Cargo Movement Strategy*. MS thesis, AFIT/GLM/LSM/85S-26 (AU), Wright-Patterson AFB OH, September 1985 (AD-A161415).

Hamann, Donald K. *Loss and Damage in the QUICKTRANS System*. MS thesis. Naval Postgraduate School, Monterey CA, September 1983 (AD-A136839).

Holden, Lt Cmdr Arthur D. and Lt Charles J. Weber. *Contracting Initiatives to Obtain Commercial Air Cargo Service Alternatives to the Navy Quick Transportation System.* MS thesis. Naval Postgraduate School, Monterey CA, December 1983 (AD-A140472).

Hutt, Maj Donald Y. and others. *High Speed Transportation Its Present and Future Service under Changing Logistics Concepts.* An Advanced Logistics Report. School of Logistics, Institute of Technology (AU) Wright-Patterson AFB OH, 1 June 1961 (AD-266746).

Jomini, Antoine H. *The Art of War.* Harrisburg PA: Military Service Publishing Co, 1958.

Jordan, William A. "Problems Stemming from Airline Mergers and Aquisitions," *Transportation Journal*, 27:9-30 (Summer 1988).

Kahn, Alfred E. "Suprises of Airline Deregulation," *American Economic Review*, 78:316-322 (May 1988).

Kennington, Jeff L. *An Analysis of the LOGAIR Distribution System Using Optimization Priciples.* Final Scientific Report, Grant AFOSR 77-3151. Southern Methodist University, Dallas TX, November 1981 (AD-A110492).

LOGAIR Data. HQ AFLC/DSTMA, Wright-Patterson AFB OH, 1990.

Magowan, Capt William J., Jr. and Capt Thomas J. Ricardson. *An Examination of Selected Forecasting Models for Projecting LOGAIR Utilization Requirements for the 5Q Route.* MS thesis, LSSR 25-81. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, June 1981 (AD-A105190).

McPherson, Capt Michael F. and Capt Brian O'Hara. *A Computer Assisted Method for Determining LOGAIR Route Structures.* MS thesis, SLSR 17-76A. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, June 1976 (AD-A030288).

Melton, Raymond E. *QUAM: A Simulation Model for the Navy QUICKTRANS Systems User's Manual.* DINDRDC Report76-0136. David W. Taylor Naval Ship Research and Development Center, Bethesda MD, November 1976 (AD A033535).

. *QUEST: A Simulation Model for the Navy QUICKTRANS Systems User's Manual.* Report Number 4358. David W. Taylor Naval Ship Research and Development Center, Bethesda MD, Decemeber 1975 (AD-A020536).

Merrill, Maj David L. *Facility Location and Routing to Minimize the Enroute Distance of Flight Inspection Missions.* MS thesis, AFIT/GST/ENS/89M-13. School of Engineering, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, March 1989 (AD-B130845).

Military Airlift Command. Contract F11626-90-D0059, LOGAIR Airlift Services Contract, 1 June 90.

-----. Contracts F11626-90-D0030; F11626-90-D0031; F11626-90-D0032; LOGAIR Airlift Services Contracts, 1 December 1989.

-----. Contracts F11626-90-D0022; F11626-90-D0023; LOGAIR and QUICKTRANS Airlift Services Contracts, 1 November 1989.

"NAVMTO--Background, Command History and Organization," *The Navy Supply Corps Newsletter, Volume 47, Number 2*:1-4 (March/April 1984).

Navy Material Transportation Office. Contract N00600-90-C-0757, Terminal Services Contract. Norfolk VA, 1990.

Nygard, Kendall E. and others. *An Optimization and Expert System for Air Force Cargo Allocation.* Unpublished report No. NDSU-CS-TR-89-22. North Dakota State University, Fargo ND, 1989.

Palmatier, Lt Cmdr Phillip E. and Maj Gary T. Prescott. *The Feasibility of Developing and Solving a Model to Determine LOGAIR Routing Structures.* MS thesis, SLSR 30-75B. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, August 1975 (AD-A016341).

Payne, Capt Milton O. Jr., and Capt Darryl A. Scott. *The LOGAIR Route Structure: An Exploration of the Single - Hub Concept.* MS thesis, LSSR-40-80. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, 9 June 1980 (AD-A088775).

Peschka, Lt Debbie. Transportation Systems Analyst, Airlift Management Branch. Personal Interviews. HQ AFLC/DSTMA, Wright-Patterson AFB OH, May-August 1990.

Phillips, Laurence T. "Structural Change in the Airline Industry: Carrier Concentration at Large Hub Airports and Its Implications for Competitive Behavior," *Transportation Journal*, 25:18-28 (Winter 1985).

QUICKTRANS Data. Department of the Navy, Navy Material Transportation Office, Norfolk VA, 1990.

Quirk, Col John T. "Combining LOGAIR and QUICKTRANS into a Single System," Talking Paper. HQ MAC/TRP Scott AFB IL, 31 August 1989.

Richardson, Moses. *Plane and Spherical Trigonometry*. New York: The MacMillian Company, 1950.

Secretary of the Air Force. *Contract Cargo Airlift Service in CONUS*. Memorandum for the Assistant Secretary of Defense (Installation and Logistics). United States Air Force, Washington DC, 20 Feb 1975.

Talley, Wayne K. and William R. Eckroade. "Airline Passenger Demand in Monopoly Flight Segments of a Single Airline Under Deregulation," *Transportation Journal*, 24:73-79 (Winter 1984).

Toh, Rex S. and Richard G. Higgins. "Impact of Hub and Spoke Network Centralization and Route Monopoly on Domestic Airline Profitability," *Transportation Journal*, 24:16-27 (Summer 1985).

Tolman, Thomas E. (Title), (Section). Electronic Mail Interview. HQ AFLC/DSTL, Wright-Patterson AFB OH, 27 June 1990.

Tyworth, John E. and others. *Traffic Management: Planning, Operations and Control*. Reading MA: Addison-Wesley Publishing Comapany, 1987.

"United States Air Logistics Route Structure and Flight Schedule." Directorate of Transportation, Airlift Management Branch (DSTMA), Wright-Patterson AFB OH, 1 October 1988.

USAF, Air Force Audit Agency. "Summary Report of Audit: Effectiveness of the Operational Support Provided by Logistics Airlift (LOGAIR) System." Unpublished Report No. 87339, Air Force Audit Agency, Washington DC, 30 August 1978.

Valkenburgh, Maj Nicholas Van. *LOGAIR Mark 2 - An Alternative Logistics Airlift System*. Research Report 2470-79. Air Command and Staff College (AU), Maxwell AFB AL, 15 April 1979 (AD-B039213).

Warren, Bob. Contracting Officer and Technical Representative (Alt). Telephonic Interviews. Navy Material Transportation Office (NAVMTO), Code 034C, Norfolk VA, May-August 1990.

Welchons, Alvin M. and W.R. Krickenberger. *Solid Geometry* (Revised Edition). Boston: Ginn and Company, 1943.

Wiese, Robert D. Chief, Airlift Management Branch. Personal Interviews. HQ AFLC/DSTMA, Wright-Patterson AFB OH, December 1989-August 1990.

Willis, Grant. "Military Spending and Force Structure Would Shrink," *Air Force Times*. (4 December 1989).

# Vita

Captain Thomas James Bruns [redacted] [redacted] graduated from high school in Huber Heights, Ohio in 1973 and attended Wright State University from which he received a Bachelor of Science in Biology and Environmental Health in 1978. Consequently, he worked as an Environmental Consultant for Howard Laboratories located in Kettering, Ohio. In March 1980, he received a commission, through OTS, in the United States Air Force and completed Transportation Officer School in July 1980. After completion of school, Bruns was assigned to the Electronics System Division at Hanscom AFB, Massachusetts where he served as an Acquisition Transportation Officer. In October of 1982, he was reassigned to the 21st Tactical Fighter Wing Elmendorf AFB, Alaska, as the Vehicle Maintenance Officer. In Alaska, he gained experience in mobility, budgeting, and maintenance operations. In July 1986, he was assigned to Headquarter, Air Force Logistics Command Wright-Patterson AFB, Ohio, as a Plans and Programs Officer for Directorate of Distribution. This position provided experience in war planning and mobility training. Finally, in May 1989, Capt Bruns entered the School of Systems and Logistics, Air Force Institute of Technology.

Capt Bruns is married to the former Angela Lynn Smithson of Huber Heights, Ohio. Their children are Meghan (24 Jun 84) and Laura (18 Dec 86).

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**13. ABSTRACT** *(Maximum 200 words)*

This research focused on whether merging the LOGAIR and QUICKTRANS systems improves operations and reduces costs. Similarities and differences between LOGAIR and QUICKTRANS systems were explored in the following areas: production process, cost structure, procedural structure, and managerial structure. Additionally, a Spacefilling Curve algorithm was used to establish a route model for the QUICKTRANS, LOGAIR, and combined system to determine cost/benefits.

The research concluded that there appear to be no significant impediments to merging the LOGAIR and QUICKTRANS systems into a single combined system. Both systems are historically linked to providing priority movement of spares in support of the services first-line weapon systems within the Defense Transportation System, ~~and are commonly governed by DOD Directive 4500.32R, Military Standard Transportation and Movement Procedures.~~ Any unique operating characteristics are not impediments to merging as evidenced by the existing common route structure, LOGAIR 5Q, in Florida. Finally, the ~~author's~~ combined routing model indicates that there are sufficient opportunties for rationalization and inherent capacity excesses to realize over 30 million dollars savings per year.

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