
Masters Theses

Student Theses and Dissertations

1968

Computer simulation of scraper-pusher behavior during early open pit mining operations

Martin Alan Thieme

Follow this and additional works at: https://scholarsmine.mst.edu/masters_theses



Part of the [Mining Engineering Commons](#)

Department:

Recommended Citation

Thieme, Martin Alan, "Computer simulation of scraper-pusher behavior during early open pit mining operations" (1968). *Masters Theses*. 6999.

https://scholarsmine.mst.edu/masters_theses/6999

This thesis is brought to you by Scholars' Mine, a service of the Missouri S&T Library and Learning Resources. This work is protected by U. S. Copyright Law. Unauthorized use including reproduction for redistribution requires the permission of the copyright holder. For more information, please contact scholarsmine@mst.edu.

COMPUTER SIMULATION OF SCRAPER-PUSHER BEHAVIOR
DURING EARLY OPEN PIT MINING OPERATIONS

BY
MARTIN ALAN THIEME

A
THESIS
submitted to the faculty of
THE UNIVERSITY OF MISSOURI - ROLLA
in partial fulfillment of the requirements for the
Degree of
MASTER OF SCIENCE IN MINING ENGINEERING
Rolla, Missouri
1968

Approved by
Ernest W. Spohr (advisor) *R. F. Bruzewski*
Ralph E. Lee

ABSTRACT

A method has been developed for study and evaluation of overburden removal systems in open pit mining. The computer simulation method shows the effect of vehicle and course characteristics and the control of loading time on overall production and cost per unit of overburden removed.

Data are available from vehicle manufacturers and from past mining experience. The data are punched onto processing cards and the system is then simulated and analyzed using a digital computer.

The products of the system simulation consist of a tabulated listing of all control variables after each simulated vehicle loading and a system summary predicting shift production, cost per ton, vehicle delay times, and average queue lengths at the load and dump facilities. Mine management can use the results of the system simulation as a tool to help determine optimum fleet size and type for maximum production and minimum cost.

PREFACE

The author would like to express his sincere gratitude to the following people and organizations whose help and support made the completion of this thesis possible:

To Dr. Ernest M. Spokes, Thesis Advisor and Head of the Department of Mining, for suggesting this study and for his willing advice and criticism during the preparation of this thesis.

To Robert F. Bruzewski, Associate Professor of Mining Engineering, and Dr. Billy E. Gillett, Assistant Professor of Computer Science and Mathematics, for their guidance and helpful comments.

To William C. Morgan, Caterpillar Tractor Company, for his assistance and encouragement in this study.

To Caterpillar Tractor Company for the use of their Travel Time and Earthmoving Production Computer Program and for the wealth of information and vehicle characteristics made available to the author.

To Mrs. Theodore Hoger, who so willingly typed this thesis.

To the National Science Foundation for financial support in the form of a Traineeship.

TABLE OF CONTENTS

	Page
ABSTRACT.....	1
PREFACE.....	11
LIST OF ILLUSTRATIONS.....	v
LIST OF TABLES.....	vi
CHAPTER	
I. INTRODUCTION.....	1
IMPORTANCE OF PROBLEM.....	1
PROBLEM STATEMENT.....	3
SCOPE OF PROBLEM.....	5
RELATED STUDIES.....	7
II. SCRAPER SIMULATOR.....	10
THEORY AND ASSUMPTIONS.....	10
LOGIC DEVELOPMENT.....	19
APPLICATIONS.....	22
INPUT DESCRIPTION.....	26
III. SYSTEM SIMULATOR.....	31
THEORY AND ASSUMPTIONS.....	31
LOGIC DEVELOPMENT.....	36
APPLICATIONS.....	40
INPUT DESCRIPTION.....	43

	Page
IV. CONCLUSIONS.....	51
SUGGESTED FUTURE RESEARCH.....	51
SUMMARY.....	52
APPENDIX	
A. SIMULATION PROGRAM VARIABLES AND THEIR DEFINITIONS.....	54
B. EXAMPLE PROBLEM AND SOLUTION.....	62
C. SIMULATION PROGRAM LISTING AND OUTPUT.	71
BIBLIOGRAPHY.....	111
VITA.....	114

LIST OF ILLUSTRATIONS

Figure		Page
1.	Scraper Cycle.....	5
2.	Assumed Braking Rate vs. Total Motion Resistance.....	13
3.	Approximate Mass Correction Factor.....	16
4.	Scraper Simulator Logic Flow Chart.....	21
5.	641 Tractor Scraper Payload vs. Haul Time..	23
6.	Load-Growth Curves For 666 Tractor Scraper In Sandy Gravel.....	34
7.	Typical Pusher Cycle.....	37
8.	System Simulator Logic Flow Chart.....	41
9.	Course Evaluated In Example Problem.....	63

LIST OF TABLES

Table		Page
1.	Scraper Type - Cat 641 Shifting Speed And Mass Correction Factor.....	17
2.	Typical Scraper Simulator Output Listing..	24
3.	Scraper Simulator Variables Available For Output.....	25
4.	Repetitious Characteristic System Cycle...	44

I. INTRODUCTION

Open pit mining is an increasingly important method of mineral exploitation that is applicable to ore bodies which lie near the surface. The history of surface mining is generally associated with the mining of coal, iron and copper ores, and non-metallic minerals such as gypsum, sand, gravel, clays, phosphates, and stone.

The advantages of surface mining override those of underground mining with respect to grade control, ore recovery ratio, operation flexibility, safety, working conditions and economy. Of these advantages, economy is probably the most important factor. Many ore deposits are at such a depth that the amount of overburden to be handled imposes economic limits to existing open pit mining techniques. When these limits are reached the mine must either be abandoned or converted to an underground operation. If technology can increase the economic efficiency of handling overburden removal, it is obvious that the depth to which a deposit may be economically mined by surface methods may be increased.

IMPORTANCE OF PROBLEM

The open pit mining industry is faced with more problems today than at any other time in its history. Present and future demands for minerals are ever on

the increase and have put a tremendous pressure on the industry. As the higher grade, near surface ore bodies become exploited, mineral demands are forcing the open pit mining industry to turn to the leaner, deeper ore deposits. With these ventures come greater geological complexities and greater demand for technically trained labor forces resulting in higher wage rates. In order to improve on the bulk material handling concept, many problems present themselves for consideration.

One of these problems is the need for economically efficient overburden removal in open pit development. Large volumes of material must be handled quickly, efficiently and at less cost. Two-thirds of the 8.8 billion tons of ores mined throughout the world (1964) come from surface operations. If the stripping ratio for the United States is assumed to apply equally to world production, then over 21 billion tons of waste, or a total of almost 27 billion tons of material, are mined annually in the world by surface methods.^{1/}

The Anaconda Company at its Twin Buttes, Arizona, project is currently engaged in the largest known pre-production stripping operation in the history of mining. The development of the pit may reach dimensions of one by one and one-half miles at the surface with a possible

depth of 1,800 feet. To accomplish their goal by 1969, Anaconda must strip 200 million tons of overburden to reach the ore deposit approximately 460 feet below the surface.^{2/} It is apparent that no ore can be mined and no return on investment realized until after the overburden has been removed. Therefore, it is essential that the overburden be removed as swiftly as is economically feasible.

PROBLEM STATEMENT

As in many other open pit operations, the geology of the Twin Buttes project lends itself nicely to removal of overburden by a team of rubber-tired scrapers utilizing tractor pushers during the load cycle for additional horsepower and traction.

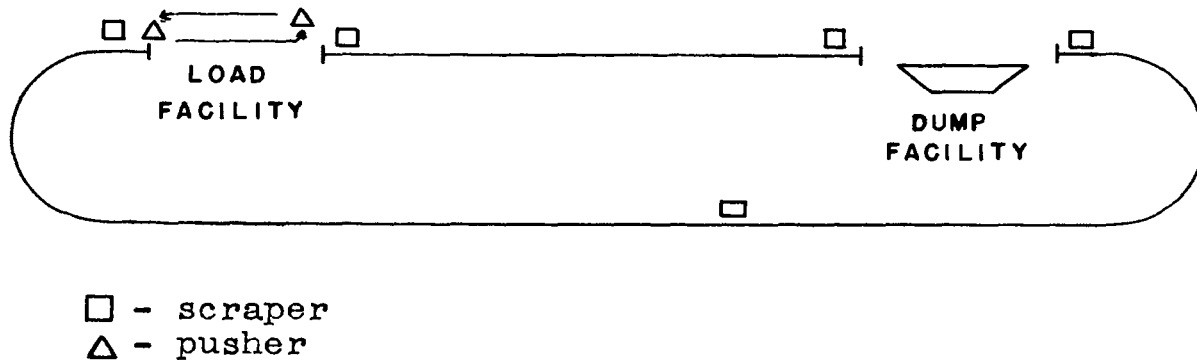
These scraper and pusher units, though expensive, are the heart of the overburden removal system. They must handle large tonnages quickly and efficiently. Since time is of paramount importance, any breakdown or delay in the scraper operation causes the entire project to suffer a setback. The whole project must be operated efficiently and consequently the scraper utilization should be the strongest link in the chain of overburden removal.

Queue time at both the loading and dumping points is the chief cause for delays in the scraper cycle. Figure 1 schematically represents the scraper cycle. The loading time of a scraper is in some instances greater than the haulage time of the scraper from the load point to the dump point. This phenomenon usually creates inherent queues both at the load and dump points. Although it is near to impossible to economically eliminate queueing altogether, it can be brought to a minimum and thus increase the efficiency of overburden removal and maintain or decrease the cost per unit of material handled.

This paper describes a simulation model developed to analyze scraper-pusher utilization in open pit mining systems. The mining simulator discussed here was developed as a tool to aid management in evaluating alternative open pit haulage schemes and to reduce the risk involved in the selection of equipment in open pit mining operations.

There are two simulators referred to in this paper. The first is the scraper simulator which describes the behavior of the rubber-tired tractor-scraper travel time over a given course. The second simulator is a system simulator which pertains to the entire overburden

removal operation (system). As a necessary portion of the system simulator, the scraper simulator is treated as a subroutine in the computer program.



Scraper Cycle

Figure 1

SCOPE OF PROBLEM

It may sometimes be beneficial to management to know when new or additional equipment may be needed and what affect this change may have on the system in part and as a whole. Where a large number of alternatives must be investigated prior to arriving at a final decision regarding materials handling problems, computer application may be found especially useful. It is for this reason that a computer simulation program of the type described in this paper is necessary and important.

Some constructors are of the opinion that in order to maximize production, every haulage vehicle must be loaded to and in many cases past its maximum rated load capability. Besides being a false assumption, this constant overloading of a haulage vehicle not only increases the haul time but also increases the wear on the mechanical parts of a vehicle obviously designed for a specific maximum rated load. Machinery breakdown causes excessive maintenance costs, reduced availability of the machine and lower mine production.

The volume of material loaded by a scraper is dependent on the length of the loading time. Theoretically, maximum production and minimum cost occur when the loading time is adjusted to yield zero waiting time for both the scrapers and the pushers, or at that loading time which minimizes the waiting times.

The haulage system considered in this study is that of a single loading point and a single dumping point. The haul road and the return road of the system may be one and the same or they may be separate. In either case, the haul and return roads must be described by segments of several constant characteristics throughout each segment. These characteristics are length, grade, rolling resistance, and maximum allowable velocity.

It is assumed that the scrapers empty their payloads into a hopper or some similar facility. The material is then removed from the facility by truck or conveyor in such a manner that no delay is caused in the system. It is further assumed that the dump time is constant regardless of the load size being dumped. The computer simulator allows management to view the entire overburden removal system after each scraper has been loaded. Management has the opportunity to observe such system characteristics as queue length at the load point, queue length at the dump point, scraper type loaded, pusher type used for loading, load time, payload, haul time, total tonnage loaded at time t , total tonnage dumped at time t , and the total accumulated shift time.

RELATED STUDIES

In recent years operations research techniques have played an ever increasing role in problem approach and solution in the mining industry. With the increased complexity of today's open pit mining, mine management has turned to computers for the quick and efficient problem-solving techniques. Of the many operations research techniques, computer simulation and queuing theory have gained important recognition by mine management as tools to help solve mining problems of a cyclic

nature (Van Voorhis, Ware).

Computers have been used to aid management in the area of open pit mine design (O'Brien and Nowak), reserve estimation, and material handling. In 1964, an article by Madge^{7/} described the computer simulation of truck movement in an open pit mine operation consisting of two pits symmetrically located with respect to the concentrator site. The purpose of the simulation was to help determine fleet requirements and to examine the effects of alternate ore removal procedures at the pits. In 1963, Eisen and Tainiter^{8/} discussed queuing processes with two mean arrival and service rates in which the units arrived at random and required varying amounts of service. They obtained analytical expressions for generating average queue length and average waiting time.

In 1966, O'Neill^{9/} presented a stochastic approach to the open pit material handling problem. This model simulated more complex systems than previous models by considering transportation of material from multiple mine faces to multiple mine destinations and by being adaptable to a wide variety of mine designs. However, as in previous simulation attempts, random number generation was utilized to determine the value of a random variable through the use of either a probability distribution

function or a cumulative frequency polygon plot of the particular element.

Probability distribution functions and cumulative frequency polygons are necessarily obtained from time studies of existing operations or from reasonably accurate predictions based on similar operations under similar conditions. Since the program presented in this paper was developed to aid management in the evaluation of either an existing mine operation or a proposed mine operation, an attempt was made to divorce the computer logic from complete dependence on time studies of existing operations. Another important characteristic of this study is the method by which the loading time and queue lengths are controlled. The scraper loading time is adjusted to maximize production while minimizing cost. Not only is the load time dependent on the queue lengths at both the load and dump facilities, but also on the estimated haul time of the scraper being loaded.

II. SCRAPER SIMULATOR

THEORY AND ASSUMPTIONS

In order to make an overburden removal system study meaningful, it was necessary to develop a computer simulation program for the purpose of calculating the haul time and return time for a given vehicle on a given course. Discussion in this chapter is devoted to the development of such a program based on a similar effort by Caterpillar Tractor Company entitled, "Travel Time And Earthmoving Production Program." The principal use of the scraper simulation program is to predict the performance of the various scraper types used in conjunction with a given mining plan. The calculated travel times are the maximum potential of the scraper since vehicle interference, mechanical reliability, and operator efficiency are not considered in the program. However, an allowance is made in the system simulation program enabling management to apply an efficiency correction factor to the calculated travel times. The following discussion includes the needed input information for both the scraper and the course to be traveled including the various assumptions used in the scraper simulator.

At any given velocity, the net force available for acceleration is the difference between the rimpull (that

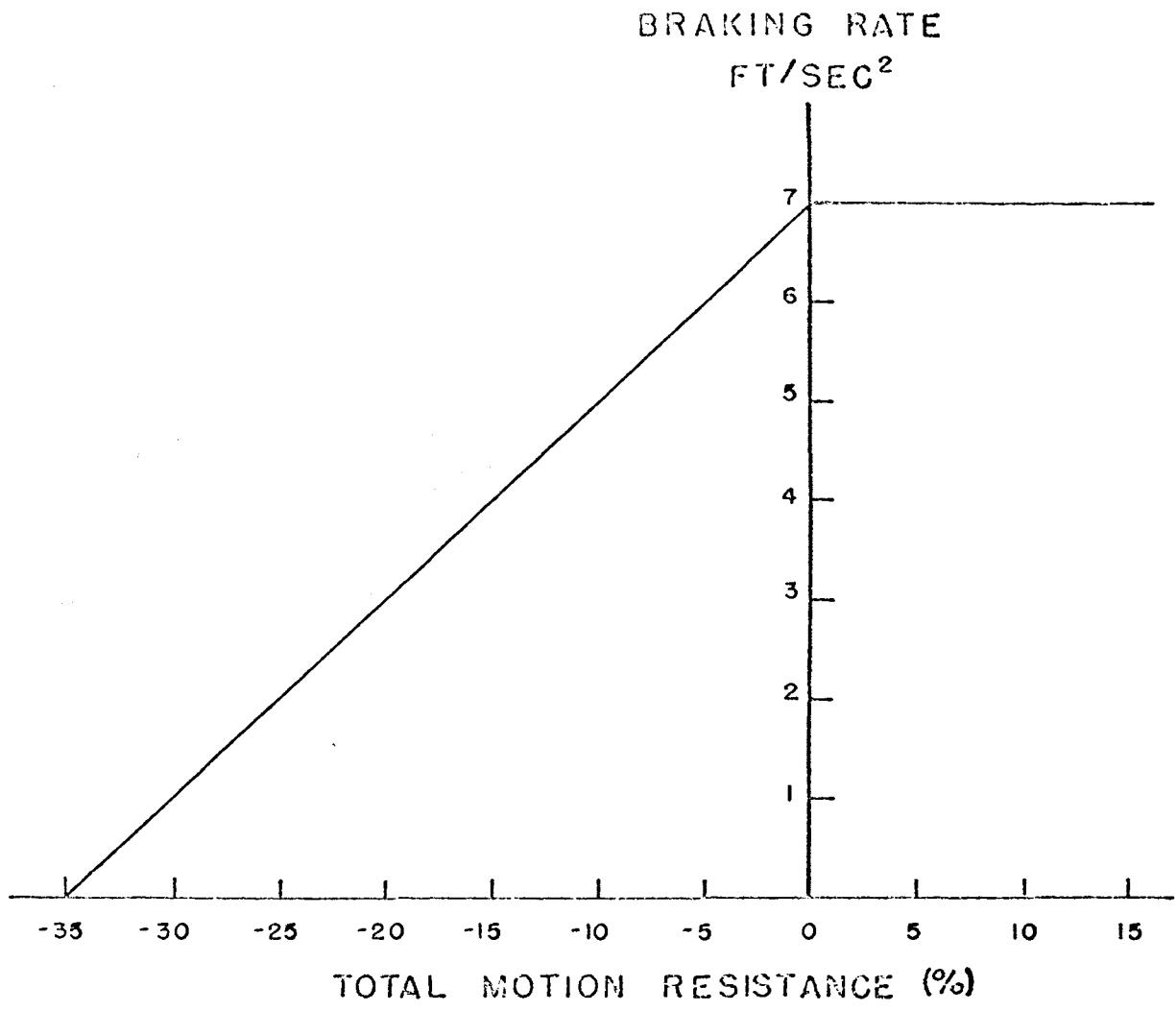
force made available for motion at the wheel rim) and the motion resistance. The acceleration at any instant then becomes the net force divided by the total scraper mass. This scraper acceleration applied over a suitably small time increment, .3 to 3 seconds, increases the stored values of velocity, distance traveled, and elapsed time. The acceleration is recalculated at the new velocity and the process is repeated until the course is completed. This process produces the time necessary to travel either the haul or return portion of the course. The travel time is also influenced by the shifting time. However, the computer program only considers powershift vehicles and regards the resulting shift time between gears as negligible.

Braking is usually required at the end of the haul road or return road or if it is necessary for the scraper to slow down due to sharp turns, narrow roadways, rough ground, or possible speed restrictions in the next road segment. The rate of braking depends largely on vehicle limitations and operator comfort. DeVahl (1960) estimates that operator discomfort is realized at a deceleration rate of 8-12 ft/sec². It was assumed in this program that the rate of deceleration will not exceed 7 ft/sec².

When braking is to occur on a road segment with zero

or positive motion resistance (grade plus rolling), the deceleration rate will be 7 ft/sec^2 . However, on a road segment with a negative total motion resistance an adjustment in the braking capability must be introduced. As the negative slope of a road segment increases there is less traction available to the scraper for braking. To adjust for this loss in traction the deceleration rate was decreased linearly with an increase in negative total motion resistance (Figure 2). It was assumed that the braking ability of the scraper would be zero at a total negative resistance of minus 35 percent. Therefore, a scraper would not be able to slow itself down on a road segment with a total negative resistance equal to or greater than minus 35 percent. This is somewhat of a conservative estimate since a scraper could be slowed down on steeper grades with good brakes, good traction and experienced operator control. However, it was felt that the operator should have to do no more than to drag the scraper bowl as an extra braking effort on very steep grades.

At the end of each small time increment in the scraper simulator, a check is made to determine if braking should begin. The point at which braking is to begin is influenced by the speed restrictions of the next segment or at the end of the course. At the point where braking is to begin the scraper is slowed down to its intended speed.



ASSUMED BRAKING RATE
VS
TOTAL MOTION RESISTANCE

FIGURE 2

When a scraper or any vehicle is accelerated linearly the rotary parts must also be accelerated in rotation. This rotary acceleration requires an additional force or energy than that needed for mere linear acceleration. The force needed to accelerate a body linearly is described by:

$$F = MA \quad \text{where: } F - \text{force}$$

$$M - \text{mass}$$

$$A - \text{acceleration}$$

The force needed to accelerate a body in rotation is given by:

$$T = I\alpha \quad \text{where: } T = \text{torque,}$$

$$I = \text{moment of inertia about}$$

$$\text{the rotational axis, and}$$

$$\alpha = \text{angular acceleration.}$$

The torque applied to a flywheel is greater than the torque delivered from the flywheel. This difference in torque is that force necessary to develop the angular acceleration of the flywheel. This difference in torque is proportional to the flywheel inertia and its radial acceleration. In effect, this means that the force delivered to the ground by the wheels of a vehicle is less than the steady state force at any given speed. Understandably, in lower gears this effect is more pronounced. In some cases the actual force delivered to the ground can be less than one-half the steady state force. In higher gears, the effect is rapidly lessened and the overall acceleration is not drastically affected. However, consideration of rotary mass will yield more

accurate acceleration and travel time calculations.

In the computer program this loss of available acceleration is accounted for by adding a correction factor to the mass of the scraper and assuming that the force required for acceleration remains equal to the steady state rimpull. In the standard motion equation ($F = MA$), an increase in the effective mass while assuming constant force (rimpull) results in a decrease in available acceleration.

The mass correction factor (M.C.F.) varies with the type of drive whether it be mechanical, torque converter, or electrical and with the gear reduction between the rotating mass and the wheel. This M.C.F. varies as the square of the gear reduction.

Although the M.C.F. varies with machine type, its variation is considered negligible. The graph in Figure 3, made available by Caterpillar Tractor Company, shows the relationship of the M.C.F. with various top speeds in selected gears and for the various types of drive mechanisms. An M.C.F. will be required for each of the forward gears of a scraper. It is assumed that the rotary inertia of scraper wheels and tires will never allow the M.C.F. to drop below an approximate value of .05. For illustrative purposes Table 1 shows the M.C.F. for the nine

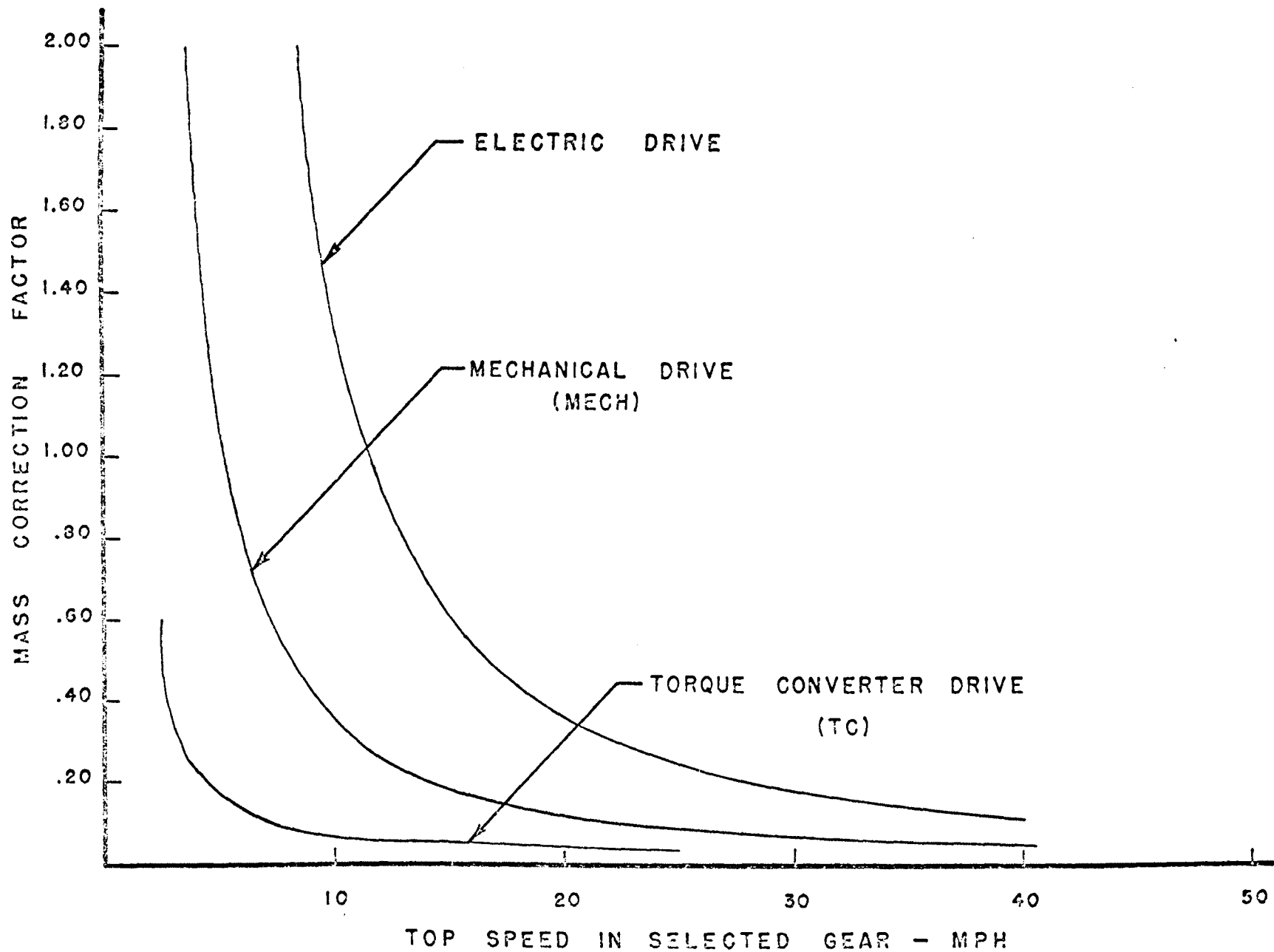


FIGURE 3 — APPROXIMATE MASS CORRECTION FACTOR

forward gears of the Caterpillar 641 tractor scraper used in the example program in Appendix B.

Table 1

Scraper Type - Cat 641

<u>Shifting Speed</u>	<u>Mass Correction Factor</u>	<u>Drive</u>
2.42	.58	TC
3.70	2.00	MECH
5.17	1.02	MECH
5.56	.15	TC
8.48	.48	MECH
11.86	.27	MECH
13.72	.06	TC
20.95	.12	MECH
30.65	.08	MECH

The forces that offer resistance to motion must also be taken into consideration. The computer program regards three forces as significant - grade resistance, air resistance, and tire-ground resistance. Since these motion resistances are dependent on scraper size they may be expressed in percent of gross scraper weight or in pounds per ton of scraper weight.

Tire-ground resistance and air resistance vary with speed. Tire-ground resistance increases only slightly with speed while air resistance increases as the square of the speed. However, air resistance is very small at lower speeds and does not have a large affect until a vehicle reaches speeds greater than 40 miles per hour. Therefore, it is easier to combine air resistance and tire-ground resistance into one rolling resistance, since

scraper speeds generally never exceed 40 miles per hour. In tests run by Caterpillar Tractor Company, it was found that rolling resistance could be expected to increase .025 percent/MPH, or 1.0 percent over the 0-40 MPH speed range. However, for speeds in excess of 40 MPH this linear relationship would not hold true due to the significant increase in air resistance.

It becomes necessary to define the rolling resistance at a given speed. In 1962, Caterpillar Tractor Company conducted tests to establish such a relationship. A Cat 631B tractor scraper with rated load was selected as the base machine and the top speeds for various levels of ground-tire resistance were established. The test showed that although the accepted ground-tire resistance describing the particular ground condition tested was 2 percent, the actual resistance including air resistance was only 1.25 percent at zero MPH; while at 40 MPH it was 2.25 percent. It was found that the ground-tire resistance versus rolling resistance at 0 MPH could be described by the following equation:

$$RR_0 = 1.075 \times RR_{g-t} - .90\%$$

where: RR_0 = Rolling Resistance at 0 MPH (%)

RR_{g-t} = Ground-Tire Rolling Resistance (%)

In the computer program, the rolling resistance at 0 MPH is assumed equal to the ground-tire resistance for any

$RR_{g-t} > 12\%$. In effect, this means that a vehicle capable of traveling 40 MPH will have to overcome a greater resistance than a linear interpolation from the resistance at 30 MPH. The increased effect of air resistance at higher speeds is in this way aptly accounted for.

The grade of each road segment is to be given in percent. The grade resistance is the sine of the grade angle and is calculated by the computer.

The computer program calculates acceleration under maximum horsepower until the scraper reaches its maximum velocity and the scraper then travels the remaining portion of the segment at that maximum velocity. However, if management feels that the scraper should not exceed certain speeds in certain segments, provision is made for such control. Management may limit scraper speed for such reasons as: safety, narrow roadways, sharp turns, road intersections, and steep grades. If the computer finds that the scraper can travel faster than management's limiting velocity in the next segment, it will decelerate properly, enabling it to enter the next segment at the limited speed.

LOGIC DEVELOPMENT

The scraper simulator concerns itself primarily with the haul road and the return road travel times. Scraper

loading and dumping times are controlled by the system simulator, the input of which consists of all scraper and course characteristics. The scraper simulator is referred to in the system simulator as subroutine SIM.

After the proper data have been entered, the scraper simulator will approximate the most efficient travel of this specific machine over the given haul and return courses. The scraper simulator was incorporated into the system simulator as a subroutine since management may elect to compare production and cost results with more than one type of scraper in the proposed fleet. All scrapers of one type are therefore expected to perform similarly. However, this is usually the exception to the rule because of differences in driver abilities, machine wear, etc. Subsequently, an efficiency factor, to be determined by management, is incorporated into the program which may increase the expected scraper travel times to more realistic values.

The logic used in the scraper simulator can best be understood through the use of a logic flow chart (Figure 4). Various comment statements have been placed in the computer program to help persons with little programming experience understand the program logic. When braking is to occur, the value of deceleration is calculated in subroutine RETARD.

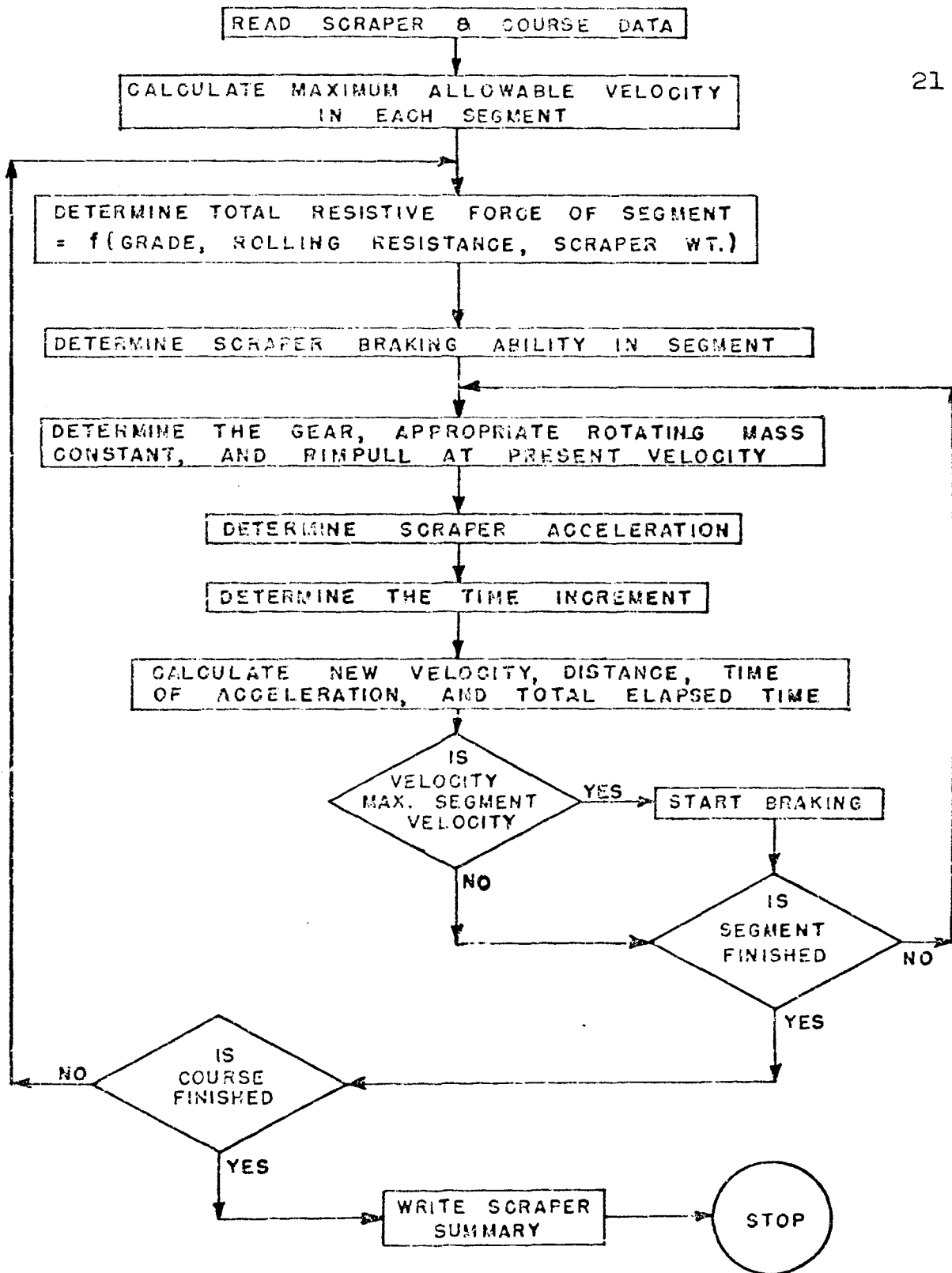


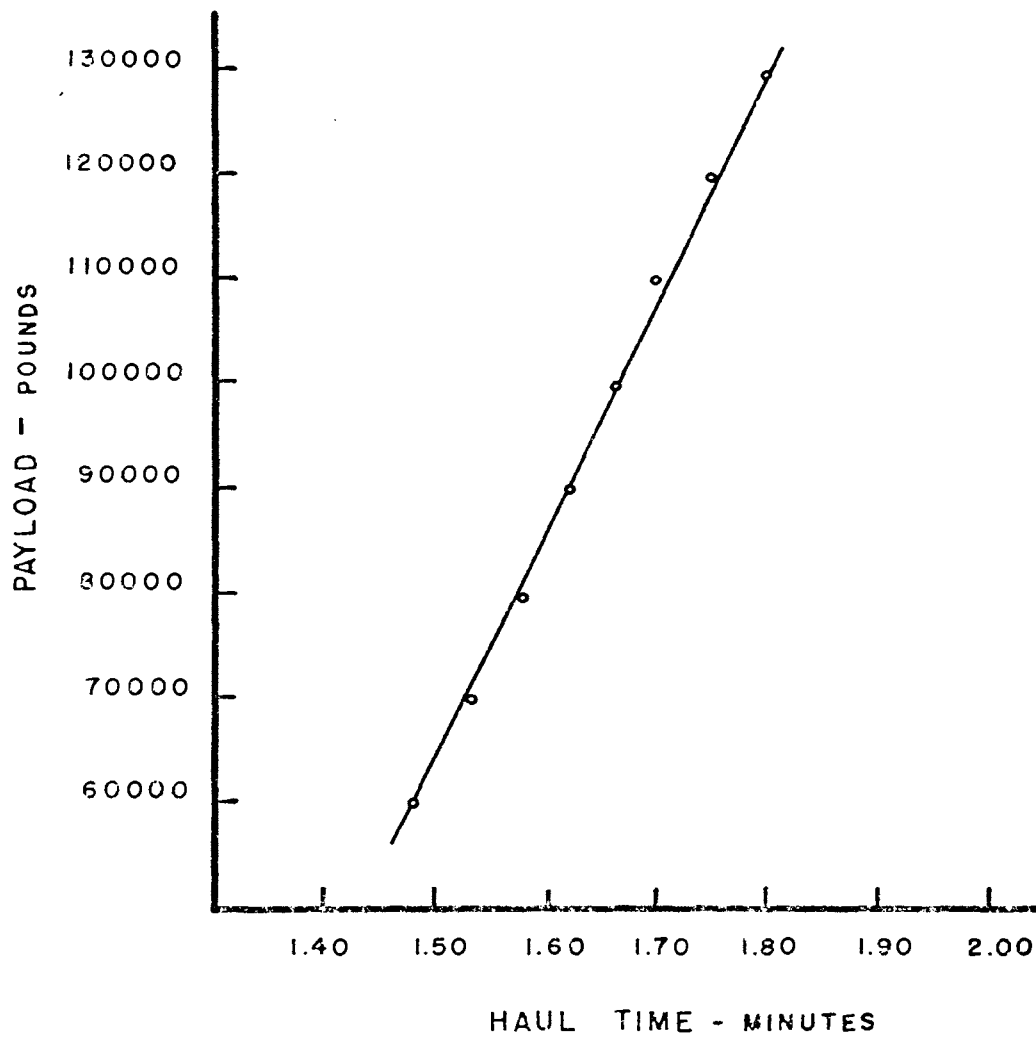
FIGURE 4 - SCRAPER SIMULATOR LOGIC FLOW CHART

APPLICATIONS

The scraper simulator was used as a separate program to help determine a relationship between payload and haul time. It was found that for short hauls of favorable grade the haul time varied only slightly over a wide range of payloads. However, if the haul course is somewhat lengthy or adverse grades are encountered (both of which are common in open pit mining), then a definite relationship is detected between payload and haul time. Figure 5 shows such a relationship for the haul course described. Although the relationship is not linear, little error is encountered if linearity is assumed. For example, using the two extreme payloads and their respective haul times as the two points to establish the linear relation, it is apparent that the estimated haul time at a payload of 120,000 pounds is 1.758 minutes, whereas the calculated haul time at the same payload is 1.750 minutes. The relative error is thus:

$$\frac{1.758 - 1.750}{1.750} \times 100\% = 0.458\%$$

Since this error is small with respect to the calculated haul time it is considered negligible, thus a linear relationship between payload and haul time may be assumed.



AT 110000 POUND PAYLOAD:

ACTUAL HAUL TIME = 1.70

APPROXIMATE HAUL TIME = 1.71

RELATIVE ERROR = 0.589%

AT 1.70 MINUTE HAUL TIME:

ACTUAL PAYLOAD = 110000

APPROXIMATE PAYLOAD = 108000

RELATIVE ERROR = 1.82%

FIGURE 5 - 641 TRACTOR SCRAPER PAYLOAD
vs. HAUL TIME

The scraper simulator is so designed in the computer program that a relationship between payload and haul time is established for each different type of scraper comprising the overburden removal fleet. Using this relationship, the proper haul time may be estimated for any scraper payload over the given course.

Table 2 shows the output listed from the scraper simulator. A more detailed output on the scraper and course is available to management by simply incorporating the appropriate printout statements in the scraper simulator. For this reason several input variables that have not been utilized are available for output. Table 3 lists these variables and indicates whether they are optional or necessary as input.

TABLE 2
Typical Scraper Simulator
Output Listing

TRACTOR SCRAPER TYPE - 641
PAYLOAD - 114000 POUNDS
TOTAL HAUL TIME - .84 MINUTES
TOTAL RETURN TIME - 1.49 MINUTES

<u>HAUL ROAD SEGMENT</u>	<u>ACCUMULATED TIME</u>
1	0.20
2	0.38
3	0.63
4	0.84

TABLE 3

Scraper Simulator Variables Available For Output

(O) - Optional As Input
 (N) - Necessary As Input

<u>Variable</u>		<u>Description</u>
XIDENT	(O)	Available for scraper or course identification. (A format)
SHIFT	(N)	Represents shifting velocities of scrapers.
ROT	(N)	Represents rotating mass constants for corresponding shifting velocities.
VEL	(N)	Represents velocity increments obtained from rimpull chart.
RIMP	(N)	Represents values of rimpull corresponding to those velocities in VEL.
SCRPWT	(N)	Represents empty scraper weight.
SCRPHP	(O)	Represents scraper horsepower.
SCRPPL	(N)	Represents scraper payload used in haul time calculations.
FIXT	(O)	Represents the fixed time in scraper cycle - expected cycle time less haul and return time.
BD	(O)	Represents the bench density of overburden.

INPUT DESCRIPTION

Some of the input data are optional for the scraper simulator and may be left blank. Since a relationship between payload and haul time is established through the use of subroutine SIM (a listing of subroutine SIM appears in Appendix C), it necessarily must calculate the haul time at, first, the minimum scraper payload, and then at the maximum scraper payload. Thus certain data must be entered twice as is shown below.

The following is a discussion of the data required by the scraper simulator. Data listed are data used in the example system evaluated in Appendix B. Four format statements are available for data input; the appropriate format is identified after the input variable. The four formats are:

<u>Format Statement Number</u>	<u>Format</u>
(1)	18A4
(2)	4F10.0
(3)	8F9.0
(4)	2I5,2F5.0

Data Input 1: This variable represents scraper or course identification or any alphameric identification desired, the length of which may not exceed 72 characters, for example:

XIDENT (1)

Example System Evaluation

Data Input 2: The various velocities at which shifting occurs are represented by this variable.

SHIFT								(3)
2.42	3.70	5.17	5.56	8.48	11.86	13.72	20.95	
30.6								

Data Input 3: Contains the rotating mass constants for the above corresponding velocities.

ROT								(3)
.58	2.00	1.02	.15	.48	.27	.06	.12	
.08								

Data Input 4: The velocity coordinates of the rimpull curve.

VEL								(3)
0.18	1.27	1.82	2.42	3.09	3.46	3.70	4.19	
4.73	4.92	5.17	5.56	6.68	7.94	8.48	9.61	
10.86	11.86	13.72	16.51	19.61	20.95	23.73	26.31	
28.89	30.65							

Data Input 5: The rimpull coordinates of the rimpull curve.

RIMP								(3)
112384	81569	64711	47974	45529	42072	35717	34519	
31233	28666	22977	20910	20344	18338	15568	15045	
13613	10015	8463	8234	7422	6301	6090	5718	
4614	0							

Data Input 6: The number of different types of scrapers.

NRUN	(4)
2	

Data Input 7: The empty weight of the scraper, the scraper horsepower, the minimum scraper payload to be considered.

SCRPWT	SCRPHP	SCRPPL	(2)
98000	500	60000	

Data Input 8: The number of payloads the computer will be required to consider for each scraper type, usually 2.

NCORSE (4)

Data Input 9: The haul road code number identification (haul road - 0, return road - 1) is represented by IHAUL; the number of segments in the haul road, if IHAUL is 0 or the number of segments in the return road, if IHAUL is 1, is represented by NSEGH; the scraper fixed time in the cycle is represented by FIXT; the bench density of the material being removed is represented by BD.

IHAUL NSEGH FIXT BD (4)

Data Input 10: The characteristics of each segment; the distance in feet (DIST), the grade in percent (GRADE), the rolling resistance in percent [$1\% = 20\#/ton$] (RRES), and the speed restriction for the segment, if any (VMAX).

DIST	GRADE	RRES	VMAX
200	-6.0	2.0	
300	-4.0	2.0	30.0
365	-4.0	2.0	30.0
215	1.0	2.0	

(2)

Data Input 11: The initial velocity of the scraper as it enters the road being considered and its final velocity at the end of the road in MPH.

VO	VF	(2)
5.0	5.0	

Data Input 12-14: These data are a repetition of data input 9-11 for the return course.

IHAUL	NSEGH	FIXT	BD
1	8		

DIST	GRADE	RRES	VMAX
270	4.0	2.0	
240	2.0	2.0	
220	0.0	2.0	
400	-4.0	2.0	20.0
315	2.0	2.0	
280	4.0	2.0	
300	6.0	2.0	
100	0.0	2.0	

VO	VF
5.0	5.0

Data Input 15-22: These data are a repetition of data input 7-14 for the maximum scraper payload.

SCRPWT	SCRPHP	SCRPPL
98000	500	114000

NCORSE
2

IHAUL	NSEGH	FIXT	BD
0	4		

DIST	GRADE	RRES	VMAX
200	-6.0	2.0	
300	-4.0	2.0	30.0
365	-4.0	2.0	30.0
215	1.0	2.0	

Data Input 15-22 (continued):

VO		VF	
5.0		5.0	
IHAUL	NSEGH	FIXT	BD
1	8		
DIST	GRADE	RRES	VMAX
270	4.0	2.0	
240	2.0	2.0	
220	0.0	2.0	
400	-4.0	2.0	20.0
315	2.0	2.0	
280	4.0	2.0	
300	6.0	2.0	
100	0.0	2.0	

VO	VF
5.0	5.0

Data Input 7-22 are hereafter repeated for each type of scraper in the fleet. It is recommended that the haul road data be considered previous to the return course for reasons of clarity, although the computer program is prepared to handle either situation.

III. SYSTEM SIMULATOR

THEORY AND ASSUMPTIONS

The approach used in the system simulator is not one involving complicated theoretical mathematics, but rather a logical engineering approach that is more practical than theoretical in nature. If a stochastic approach were utilized where random number generation would be employed to approximate loading times, travel times, dump times, etc., it would become necessary to have frequency distributions available or predictable for the various scraper-pusher actions and interactions. An approach of this type seems somewhat questionable since time studies of the existing overburden removal system would be necessary for the purpose of obtaining the frequency distributions. Any proposed change in the overburden removal fleet or course make-up would have a direct effect on the various frequency distributions. If these effects are reasonably predictable, then a stochastic approach of this type might be applicable. However, an approach which is independent of time studies from the existing operation would seem more desirable, advantageous, and efficient. Such is the case in the system simulator presented in this chapter.

Not only must the simulator properly represent the system, but it must also attempt to minimize the queuing

time at the load and dump facilities. Theoretically, queue minimization may mean increased production resulting in a lower cost per unit of material handled. In the case in question, queue minimization may be accomplished by varying the time a scraper spends in one or more of its system facilities (loading, dumping, travel time). This computer program controls the queue length by operating on only one of the system facilities, i.e., the loading cycle.

It is logical that the queue at the loading point may be brought to zero if the loading time of each scraper in an existing loading point queue is adjusted so that the next scraper to arrive and those thereafter may be loaded immediately upon arrival. However, this solution is not without its consequences. For example, scraper payload is proportional to load time and scraper arrival times may be distributed such that several scrapers are only allowed to be loaded to 25 percent of their rated capacity. This is not only impractical but the cost per unit of material handled rises prohibitively.

Obviously, there should be some minimum acceptable loading time designated. A good rule of thumb is to use the time required for the pusher to return to the load point after loading. The computer program in Appendix C

uses a minimum load time of 0.4 minute. The graph in Figure 6 shows the load growth curves for a Caterpillar 641 tractor scraper using various combinations of D9G pushers for additional power and traction. This relationship of payload versus loading time indicates that as the load time increases the corresponding percent increase in payload decreases significantly. It then becomes quite apparent that some maximum load time should be established for each scraper-pusher combination.

Again, the designation of a maximum load time is left to management, however, due to the increased maintenance costs imposed by scraper wear and tear, the payload at the maximum load time should not greatly exceed the maximum rated scraper capacity. The computer program uses a maximum load time of 1.2 minutes for the 2-D9G and 3-D9G pusher in combination with the 641 tractor scraper. Therefore, the load time of the Cat 641 tractor scraper is bounded by a minimum and a maximum load time:

$$0.4 < \text{load time (minutes)} < 1.2$$

The scraper cycle considered in this paper is assumed to have a single load and single dump facility. The system is further restricted that two scrapers may not be loaded or unloaded simultaneously. If more than one scraper is in queue at the load facility, the first scraper must leave the load facility before the next

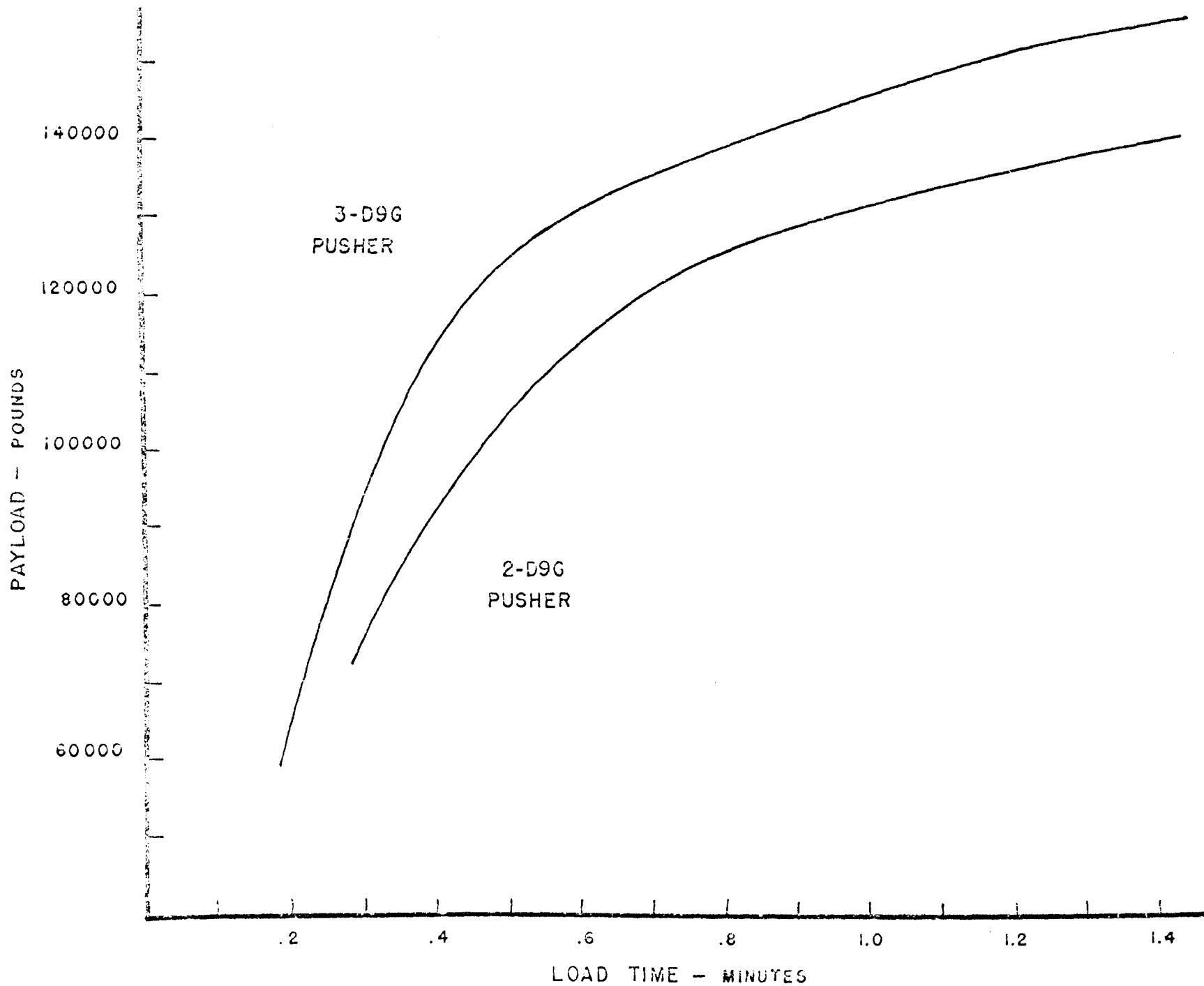


FIGURE 6 - LOAD GROWTH CURVES FOR 666 TRACTOR SCRAPER IN SANDY GRAVEL

scraper may enter. Control of the dump facility is handled in the same manner.

Since the mechanics involved in dumping a scraper payload into a hopper are similar with average variations in the size of the payload, the dump time is considered to be constant. The computer program for the example system uses a dump time of 0.38 minute. It is further assumed that the dump facility can be emptied at a rate which permits scrapers to unload without danger of overloading the hopper.

Shift time is assumed to be a normal eight-hour shift and costs are computed on an eight-hour basis. However, production is calculated on a six-hour working day. In other words, the system simulator describes the production achieved in a continuous six-hour period.

Management must have available as input the hourly owning and operating costs of each type of scraper and pusher used in the overburden removal fleet. Hourly owning and operating costs are handled in this manner since management may elect to consider various overhead costs in addition to the depreciation, interest, insurance, and tax costs normally considered in the owning costs.

LOGIC DEVELOPMENT

In many open pit mining operations the haul and return roads often have blind turns or are necessarily narrow. Because of these possible dangers the computer program restricts the scrapers such that they are not allowed to pass one another.

Figure 7 shows the typical pusher cycle. The return time in the pusher cycle is defined as that amount of time necessary for the pusher to turn around after loading is completed, return to the entrance to the loading facility and maneuver into position ready to load the next scraper to arrive. For computer simplification, the pusher turn around time after loading is assumed to be 0.15 minute. The return time is obviously dependent on the load time because of the difference in distance traveled and it is assumed to be 0.4 of the load time. Maneuver time at the entrance to the load facility is considered to be 0.10 minute. For example, a load time of 1.0 minute would result in a pusher cycle time of 1.65 minutes:

$$PCT = LT + 0.4xLT + TT + MT$$

$$PCT = 1.0 + 0.4x1.0 + 0.15 + 0.10$$

$$PCT = 1.65 \text{ minutes}$$

where: PCT - Pusher Cycle Time
 LT - Load Time
 TT - Turn Around Time
 MT - Maneuver Time

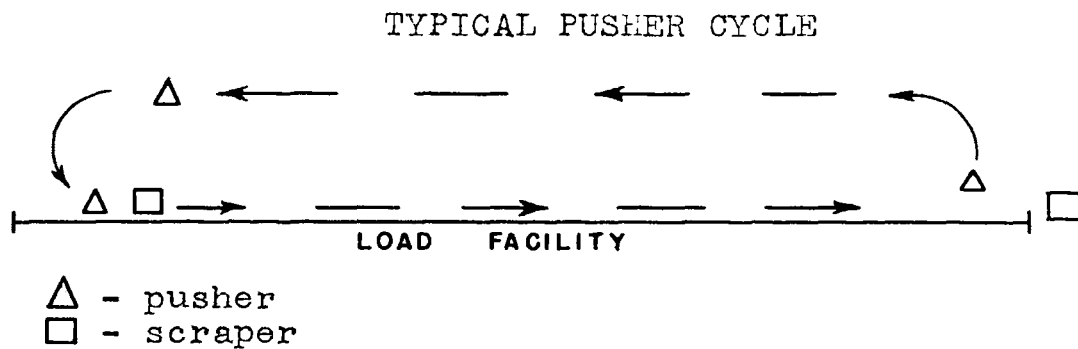


FIGURE 7

In addition to the minimum and maximum restrictions on the scraper load time one other important controlling factor is to be considered. If a loaded scraper must queue at the dump point, it should be loaded to its maximum. In other words, if a scraper must wait to dump whether it was loaded for the minimum load time or maximum load time, it then should be required to be loaded the maximum allowable time. The load time is dependent on the queues at both the load and dump facilities and the course position of the next scraper to arrive at the load point.

Since haul time is a function of payload and since the payload is a function of load time, the system simulator, after calculating a load time, will then determine if the scraper must wait in queue at the dump facility. If the scraper must wait, the load time is increased by .05 minute, a new payload is calculated, the haul time is adjusted and a check is made to determine if

the scraper must queue again. This process is repeated until it is found that either the scraper will not have to wait at the dump or that the maximum allowable loading time has been reached. This added control is necessary since it is desirable to have the cost of an unavoidable delay distributed over as much tonnage as possible. If a scraper must queue at the dump, it may as well wait with as large a payload as possible.

The load growth curves, an example of which appears in Figure 6, are an important element of this study. Data points along each curve are stored in a three dimensional array in the computer program. A payload may then be calculated after determining the scraper type loaded, the pusher type, and the load time. A set of load growth curves are needed for each different type of soil encountered. For this reason, two arrays (LGC1 and LGC2) are available in the computer program to cope with a mining situation involving two soil types. If the load growth curves are not available from the scraper manufacturer, onsite field tests are required. Investigation is currently in process at the University of Missouri - Rolla to help predict load growth curves with relationship to various soil characteristics.

The positions of all vehicles in the system are recorded on a time basis. All vehicles are advanced by

time increments calculated by the computer. For example, if the expected haul time of a scraper is 0.84 minute, that scraper is assumed to be in the haul road until 0.84 minute have elapsed at which time the scraper is regarded as being in the queue at the dump point. The time-positions of all scrapers in the system simulation are recorded through the use of a doubly subscripted array in the computer program:

VEHTIM(I,K)

where for the haul road $I = 1$
 $K = 1$, Number of scrapers
in road

and for the return road $I = 2$
 $K = 1$, Number of scrapers
in road

Since time is the basis of this study, the system simulator, after predicting the travel times for each variety of scraper (subroutine SIM), will determine a load time for the first scraper in queue at the load point. The corresponding payload is calculated in subroutine LOAD from the proper load growth curve and the scraper is advanced to the beginning of the haul road. By the use of subroutine ADD, all scrapers are advanced along the course a time-distance equivalent to the load time. A check is then made through the use of subroutine DQDUMP to determine how many scrapers have emptied their loads, the tonnages dumped, and the respective positions

of these scrapers now in the return road. If both a scraper and pusher are now in queue at the load point, the process is repeated. However, if both scraper and pusher are not simultaneously available, a delay occurs equivalent to that amount of time necessary for the availability of both scraper and pusher. The delay is charged to the proper machine and is so noted in the output. This delay time is added to all vehicles in the course and advances them accordingly. Both a scraper and pusher should then be in queue at the load point; a load time is calculated and the process becomes iterative for the duration of the shift. A very general logic flow chart of the system simulator appears in Figure 8.

APPLICATIONS

One important advantage of this open pit mining system simulator is that no time studies need be taken to facilitate evaluation. Time studies are not only costly but they obviously must be made of an existing system. The system simulator requires only a proposed overburden removal system. Thus, the system may be evaluated before construction begins with a responsible degree of accuracy. The simulator's main disadvantage is that load growth curves are necessary for each type of soil to be encountered. If these curves are not

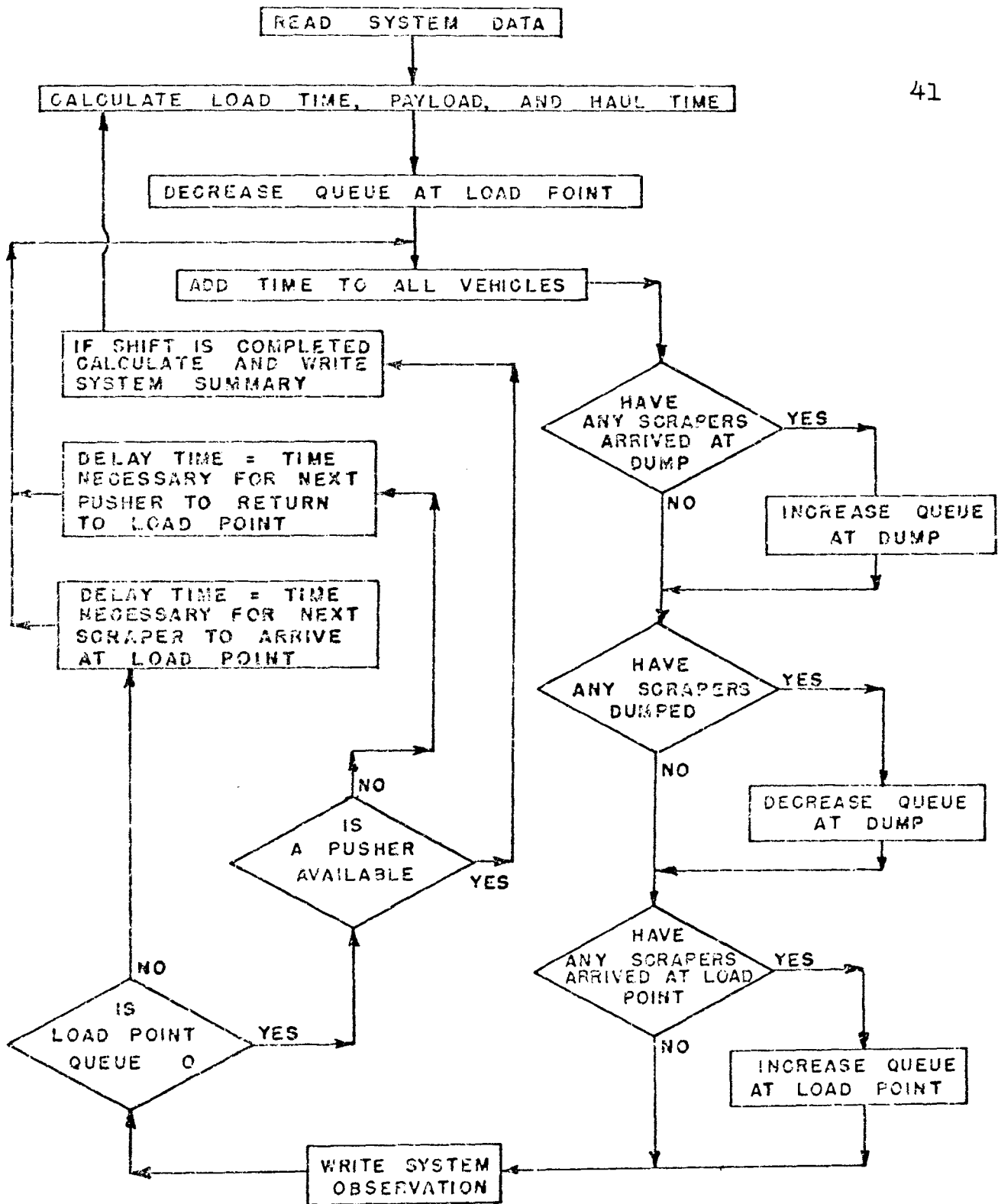


FIGURE 8 - SYSTEM SIMULATOR LOGIC FLOW CHART

available from the scraper manufacturer, they must be calculated through observation in a soil type similar to that at the mine site. The computer program is equipped to handle load growth curves for two types of soil. Changing from one soil type to another requires altering only one data card rather than an entire data set.

Since the required computing time for this program is less than two and one-half minutes, a quick and inexpensive evaluation of a proposed overburden removal system is possible. Management may elect to vary such items as course characteristics, fleet size and type, expected scraper efficiencies, and maximum scraper velocities, to name a few, while observing their respective effects upon production, cost per ton of overburden handled, and delays attributed to scrapers and pushers.

If, during the use of the simulation program, an unexplainable error appears in the output, a built-in error analysis is available. By simply following the directions described in the various computer listing comment statements, a much more detailed output is displayed. The error may then be located easily by following the computer logic using a desk calculator and comparing these results to those of the computer.

Close scrutinization of the output listing in Appendix C will testify to the fact that the system will

stabilize to a constant repetitious cycle after several loadings take place (Table 4). Each cycle will indicate the proposed load times for various scraper-pusher combinations depending on the queue lengths at the load and dump facilities. These conditions may be duplicated in practice, thereby assuring maximum production. It should also be noted that each cyclic output indicates the expected cycle delays attributed to scrapers or pushers. The System Summary in the output listing indicates the total scraper and pusher delay times to aid management in a possible decision regarding an increase or decrease in fleet machinery.

INPUT DESCRIPTION

Although two arrays are available for load growth curve input, only one is necessary when the overburden to be removed is of one soil type. The example used for computer evaluation in this paper contains only one type of soil - a damp sandy gravel - and as a result the first load growth curve array (LGCl) was loaded with blanks. It should be noted that in entering the values for the load growth curves the subscripts represent the following curve characteristics:

TABLE 4

Repetitious Characteristic System Cycle

<u>Queue Length</u>		<u>Scrapper</u>			<u>Cause</u>	
<u>Load</u>	<u>Dump</u>	<u>Type</u>	<u>Pusher</u>	<u>Load</u>	<u>of</u>	<u>Delay</u>
<u>Point</u>	<u>Point</u>	<u>Loaded</u>	<u>Type</u>	<u>Time</u>	<u>Delay</u>	<u>Time</u>
1	1	1	1	0.88	NONE	0.0
0	0	2	2	0.60	NONE	0.0
1	1	0	0	0.0	SCPR	0.40
1	0	2	1	0.40	NONE	0.0
1	1	0	0	0.0	PUSH	0.09
1	0	1	2	0.40	NONE	0.0
1	0	0	0	0.0	PUSH	0.09
1	1	2	1	0.51	NONE	0.0
1	1	1	2	0.40	NONE	0.0
1	1	0	0	0.0	PUSH	0.09
0	1	2	1	0.89	NONE	0.0
1	0	0	0	0.0	SCPR	0.40
2	1	2	2	0.69	NONE	0.0
2	0	1	1	0.40	NONE	0.0
2	0	0	0	0.0	PUSH	0.09
1	1	2	2	0.45	NONE	0.0
1	1	0	0	0.0	PUSH	0.05
1	1	1	1	0.40	NONE	0.0
1	1	0	0	0.0	PUSH	0.09
0	1	2	2	0.89	NONE	0.0
1	0	0	0	0.0	SCPR	0.40
2	1	2	1	0.69	NONE	0.0
2	0	1	2	0.40	NONE	0.0
2	0	0	0	0.0	PUSH	0.09
1	1	2	1	0.45	NONE	0.0
1	1	0	0	0.0	PUSH	0.05

Note: A zero listed under scrapper and pusher type indicates that a delay has occurred.

LGC2(I,J,K) ((K=2,14),J=1,NPT),I=1,M)

where: I represents the scraper type code
 J represents the pusher type code
 K represents the load time multiplied by 10
 M represents the number of scraper types
 NPT represents the number of pusher types

Note: Since K may have values from 2-14, the load time may exist between .2 and 1.4 minutes. The parameters of K may be increased if a larger load time is required.

It is most convenient if the scraper and pusher types used in the fleet are represented by integer code numbers in the computer program. In the example problem Caterpillar 641 and 666 tractor scrapers constitute the scraper types and are represented by scraper code numbers 1 and 2, respectively. Similarly, the two pusher types 2-D9G and 3-D9G are represented by pusher code numbers 1 and 2, respectively.

The following is a discussion of the input required by the system simulator. Data input for the example problem in Appendix B are listed for illustrative purposes. Three format statements are available for variable input; the applicable format is designated after the input variable is identified.

<u>Format Number</u>	<u>Format</u>
(100)	7F10.0
(101)	10I5
(102)	7(A4,6X)

Data Input 1: The code number for the type of soil encountered for the system to be evaluated is the first input item. Values of ISOIL may be 1 or 2 and should correspond to the fourth character of the appropriate load growth curve name (LGC1 or LGC2). For example, LGC2 is used for the evaluation in Appendix B, therefore, ISOIL is represented as follows:

ISOIL	(101)
2	

Data Input 2: It is necessary to know the number of different types of vehicles in the fleet as well as the total number of these vehicles.

- M - The number of scraper types
- NH - The number of scrapers in the haul road
- NR - The number of scrapers in return road
- NP - The number of pushers
- NPT - The number of pusher types
- NS - The number of scrapers
- NSEG - The number of segments in haul road

M	NH	NR	NP	NPT	NS	NSEG	(101)
2	3	3	2	2	6	4	

Data Input 3: Numeric identification of the scraper types used; SCRTYP(I), where I=1,M are entered as follows:

SCRTYP	(101)
641	666

Data Input 4: Numeric identification of the different pusher types used; PUSH(I), where I=1,NPT are entered as follows:

PUSH		(102)
2D9G	3D9G	

Data Input 5: The number of scrapers at the load point (NOSALP) and the number of scrapers at the dump point (NOSADP) at the beginning of the proposed shift are entered as follows:

NOSALP	NOSADP	(101)
3	3	

Data Input 6: Code numbers of the types of scrapers in queue at the load point at the beginning of the shift represented by STYPLP(I), where I=1,NOSALP are entered as follows:

STYPLP			(101)
1	1	2	

↑ First scraper in queue

Data Input 7: Code numbers of the types of scrapers in queue at the dump point at the beginning of the shift, represented by STYPDP (I), where I=1, NOSADP, are entered as follows:

STYPDP			(101)
2	1	2	

↑ First scraper in queue

Data Input 8: Code numbers of the types of pushers available at the load point represented by $PUSHER(I)$, where $I=1, NP$ are entered as follows:

$PUSHER$	(101)
1	2
↑	
First pusher in queue	

Data Input 9: Maximum loading times for various scraper types (M) and pusher types (NPT) in combination are represented by $MAXLDT(I,K)$, where $K=1, NPT$ and $I=1, M$ and are entered as follows:

$MAXLDT$	(100)			
1.2	1.2	1.4	1.4	
(1,1)	(1,2)	(2,1)	(2,2)	(I,K)

Data Input 10: The minimum load time is entered in hundredths of minutes as follows:

$LTMIN$	(101)
0.4	

Data Input 11: The various payloads of the loaded scrapers at the beginning of the shift are represented by $SLOAD(I)$ where $I=1, NOSHR$ and are entered as follows:

$SLOAD$	(100)		
114000	114000	114000	

Data Input 12: Payloads from load growth curves for various pusher-scraper combinations versus time (K) for soil type 1 are represented by LGC1(I,J,K), where K=2,14; J=1,NPT; I=1,M. Payloads (pounds) are entered continuously under Format 100 as follows:

LGC1						(100)

Data Input 13: Payloads from load growth curves for various pusher-scraper combinations versus time (K) for soil type 2 are represented by LGC2(I,J,K), where K=2,14; J=1,NPT; I=1,M. Payloads (pounds) are entered continuously under Format 100 as follows:

LGC2						(100)
60000	80000	90000	95000	100000	103500	106000
108000	109500	110500	111000	111500	112000	69000
90000	101500	107000	110000	112500	114500	116000
117000	117500	118000	118200	118400	55000	75000
92000	104000	114000	121000	125000	128000	130500
133000	136000	138000	140000	64000	83000	112500
125000	130500	135000	139000	142000	145500	148000
151000	152500	155000				

Data Input 14: Dump time is considered constant and
is entered in hundredths of minutes as follows:

DUMPT	(100)
0.38	

Data Input 15: The scraper efficiency factor necessary
to adjust the calculated scraper travel times
is entered as a decimal:

EFF	(100)
.80	

Data Input 16: Scraper hourly owning and operating costs
COST(I) and the corresponding number of scrapers
of each type STN(I), where I=1,M are entered as
follows in \$/Hour:

COST	(100)
27.70	41.25

STN	(100)
3	3

Data Input 17: Pusher hourly owning and operating costs
for each pusher type PCOST(I) and the corres-
ponding number of pushers of each type PTN(I),
where I=1,NPT are entered as follows in \$/Hour:

PCOST	(100)
15.00	20.00

PTN	(100)
1	1

IV. CONCLUSIONS

SUGGESTED FUTURE RESEARCH

This study was limited to a single dump and load system. In today's large open pit mining operations, pit design, geological restrictions, and available equipment have caused mine management to utilize a common dump facility to service several loading facilities. Therefore, a multi-load and multi-dump situation integrated into a system simulation program is greatly needed. Since equipment operators tend to load arriving scrapers immediately, consideration should be given to continuous loading in the load facility and an allowance for scraper passing when possible.

It was assumed in this study that the dump facility could handle all material deposited therein. However, since certain unavoidable breakdowns or delays do occur in the removal of material from the dump facility by conveyor, delays in conveyor operation can seriously affect total production. If this latter portion of the overburden removal system were incorporated such that overburden removal could be simulated from pit to final destination, a more comprehensive system evaluation could be realized.

Further suggestions for improvement may entail calculation of monthly prediction of equipment needed to

maintain or increase production. Design predictions of future course characteristics insuring maximum production would be invaluable. Since various costs fluctuate from season to season or increase steadily, it is recommended that computer determination and prediction of future equipment owning and operating costs be considered for future investigation.

SUMMARY

The complexity and ever-increasing material-handling problems of modern day open pit mining create an urgent need for other than commonsense and trial-and-error methods for solving mine planning problems. Mine management needs to pass from subjective to objective decision making. Various operations research techniques are available to management explicitly for this purpose. However, many of these techniques are theoretical in nature rather than practical. For this reason, an attempt was made to provide mine administration with a practical computer simulation program as a tool for enabling evaluation of existing or proposed overburden removal systems.

Although a specific system was evaluated, the computer program prepared is of a general nature for the purpose of making a more versatile and practical program available to industry. The program is general enough to

handle any single load, single dump open pit mining operation. The model provides several areas of system improvement investigation - scraper delay time, pusher delay time, production, and cost per ton of material handled.

Results of such a simulation evaluation would give management a sound basis on which to plan further expansion and development. Computer simulation provides fast, inexpensive plan evaluations otherwise unattainable. Fortran IV was the language chosen for the simulation program since this is the computer language most widely understood by today's mining engineers and because of its simplicity and adaptability to current engineering evaluation techniques. The program as listed in Appendix C operates on the IBM system 360, model 50 computer, operating system Fortran G level.

APPENDIX A
SIMULATION PROGRAM VARIABLES
AND THEIR DEFINITIONS

<u>VARIABLE</u>	<u>DESCRIPTION</u>
ACCEL	- The calculated acceleration of the corrected scraper mass.
ACCTIM(I,K) ((K=1,2),I=1,M)	- The array which represents the calculated scraper travel times for the haul (K=1) and return (K=2) roads for each scraper type (M).
AQL	- Average load-point queue length.
AQD	- Average dump-point queue length.
BD	- Bench density of material to be handled.
BRAKE	- Scraper deceleration rate ft/sec ² .
COST(I) (I=1,M)	- Hourly owning and operating cost of each scraper type (M).
D	- Total distance traveled to the end of an acceleration increment.
DD	- Total distance traveled to the beginning of an acceleration increment.
DBRAKE	- Total segment distance traveled during braking.
DELAY	- Indicates the cause of delay (scraper, pusher, none).
DELAYT	- Cumulative delay time.
DELTA	- Time increment of scraper acceleration.
DIST(I)	- Length of each course segment in feet.
DUMP	- Time control variable in dump cycle.

<u>VARIABLE</u>	<u>DESCRIPTION</u>
DUMPT	- Constant dumping time in minutes.
EFF	- Scraper efficiency factor in decimal form.
FIXT	- The fixed time of the scraper cycle in minutes.
GRADE(I)	- The grade of each course segment in percent.
HT	- Scraper haul time.
HTIM(I)	- The expected haul time of the scraper just loaded.
HTMAX	- The scraper haul time at maximum payload.
HTMIN	- The scraper haul time at minimum payload.
IGEAR	- The gear in which the scraper is traveling.
IHAUL	- Indicates the road in which the scraper is operating. Haul road (0), Return road (1).
ISOIL	- Indicates the soil type corresponding to the proper load growth curve.
LG1(I,J,K)	((K=2,14),J=1,NPT),I=1,M) - The payload corresponding to the proper scraper-pusher combination (I,J) at the calculated load time (K) for soil type 1.
LG2(I,J,K)	((K=2,14),J=1,NPT),I=1,M) - The payload corresponding to the proper scraper-pusher combination (I,J) at the calculated load time (K) for soil type 2.
M	- The number of scraper types.

<u>VARIABLE</u>	<u>DESCRIPTION</u>
MAXLDT(I,K)	((K=1,NPT),I=1,M) - The maximum load time for various pusher-scraper combinations.
NH	- The number of scrapers in the haul road at the beginning of the shift.
NR	- The number of scrapers in the return road at the beginning of the shift.
NP	- The total number of pushers in the fleet.
NS	- The total number of scrapers in the fleet.
NOP	- The number of pushers in queue at the load point.
NPT	- The number of pusher types in the fleet.
NRUN	- The number of scraper types in the fleet.
NSEGH	- The number of course segments in the road under consideration.
NOSHR	- The number of scrapers in the haul road at the beginning of the shift.
NOSRR	- The number of scrapers in the return road at the beginning of the shift.
NOSALP	- The number of scrapers in queue at the load point.
NOSADP	- The number of scrapers in queue at the dump point.
PAY	- The scraper payload determined from the load growth curves.

<u>VARIABLE</u>	<u>DESCRIPTION</u>
PER	- The total segment rolling resistance.
PTN(I)	- The number of each pusher type in the fleet.
PROD	- The shift production.
PUSH(I)	- Indicates the identification of each pusher type.
PHOLD	- Indicates the pusher type used for each scraper loading.
PLOAD	- The cumulative tonnage loaded.
PLMIN	- The minimum acceptable load time.
PCOST(I)	- The hourly owning and operating costs of each pusher type.
PSAVE(I)	- The time control variable used in the pusher cycle for each pusher type.
PDCOST	- Total production cost.
PUSHER(I)	- Represents the order in which the pushers queue.
Q	- The total number of scrapers loaded during shift.
QL	- Cumulative queue length at the load point.
QD	- Cumulative queue length at the dump point.
RT	- Scraper return time.
RIM	- The rimpull at the present scraper velocity.
RIMP(I)	- The rimpull coordinates of the rimpull curve.

<u>VARIABLE</u>	<u>DESCRIPTION</u>
ROT(I)	- The rotating mass constant at the present scraper velocity and gear.
RRES(I)	- The course segment rolling resistance in percent.
RESFOR	- The total course segment resistive force.
S	- The interpolation factor for the load growth curve.
STN(I)	- The number of each type of scraper in fleet.
SHIFT(I)	- The various shifting speeds of the scraper.
SLOAD(I)	- Represents the payloads of the scrapers in the haul road.
SCRPWT	- The empty scraper weight.
SCRPHP	- The scraper horsepower.
SCRPPL	- The scraper payload for determining the expected travel times.
SEGTIM(I,K)	- Represents the cumulative course segment travel times for each scraper type.
SCRTP(I)	- The identification of each scraper type.
STYPHR(I)	- Indicates the order of the scrapers in the haul road.
STYPRR(I)	- Indicates the order of the scrapers in the return road.
STYPLP(I)	- Indicates the order of the scrapers in queue at the load point.

<u>VARIABLE</u>	<u>DESCRIPTION</u>
STYPDP(I)	- Indicates the order of the scrapers in queue at the dump point.
T	- Total elapsed time after acceleration.
TT	- Total elapsed time before acceleration.
TH	- Total time in the haul road.
TR	- Total time in the return road.
TIME(I)	- Total accumulative travel time in each course segment.
TOPV(I)	- The top velocity attained in each course segment.
TTIME	- Total cumulative shift time.
TLOAD	- The calculated load time.
TLEFT	- The calculated delay time caused by either scraper or pusher.
TSAVE(I)	- Time control variable in pusher cycle.
TCOST	- The total owning and operating costs for all vehicles in the fleet.
TOTWT	- The total scraper weight including any payload.
TOPVEL	- Represents the top scraper velocity during each course segment simulation.
TONAGE	- Represents the cumulative tonnage dumped during shift.
VO	- Initial scraper velocity for the road under consideration.

<u>VARIABLE</u>	<u>DESCRIPTION</u>
VF	- The final scraper velocity for the road under consideration.
V	- Scraper velocity after acceleration.
VEL(I)	- The scraper shifting velocities.
VMAX(I)	- The scraper speed restriction for each course segment.
VLAST(I)	- The scraper velocity as it finishes each segment.
VFSEG	- Represents the final scraper velocity on the course segment under consideration.
VMASS	- The calculated scraper mass after correcting for rotating mass.
VB4AC	- The scraper velocity before acceleration.
VEHTIM(I,K)	- The array used to control the time-positions of each scraper in the haul road (I=1) and the return road (I=2).
VELMAX(I)	- The maximum allowable course segment velocity calculated by the computer.
WAIT	- Cumulative delay time.
WAITP	- Cumulative delay time caused by pusher.
WAITS	- Total cumulative delay time caused by scraper.
XIDENT	- Represents scraper or course identification.
Y(I)	- Represents the slope of the payload-haul time curve for each scraper type.

APPENDIX B
EXAMPLE PROBLEM AND SOLUTION

COURSE EVALUATED IN
EXAMPLE PROBLEM

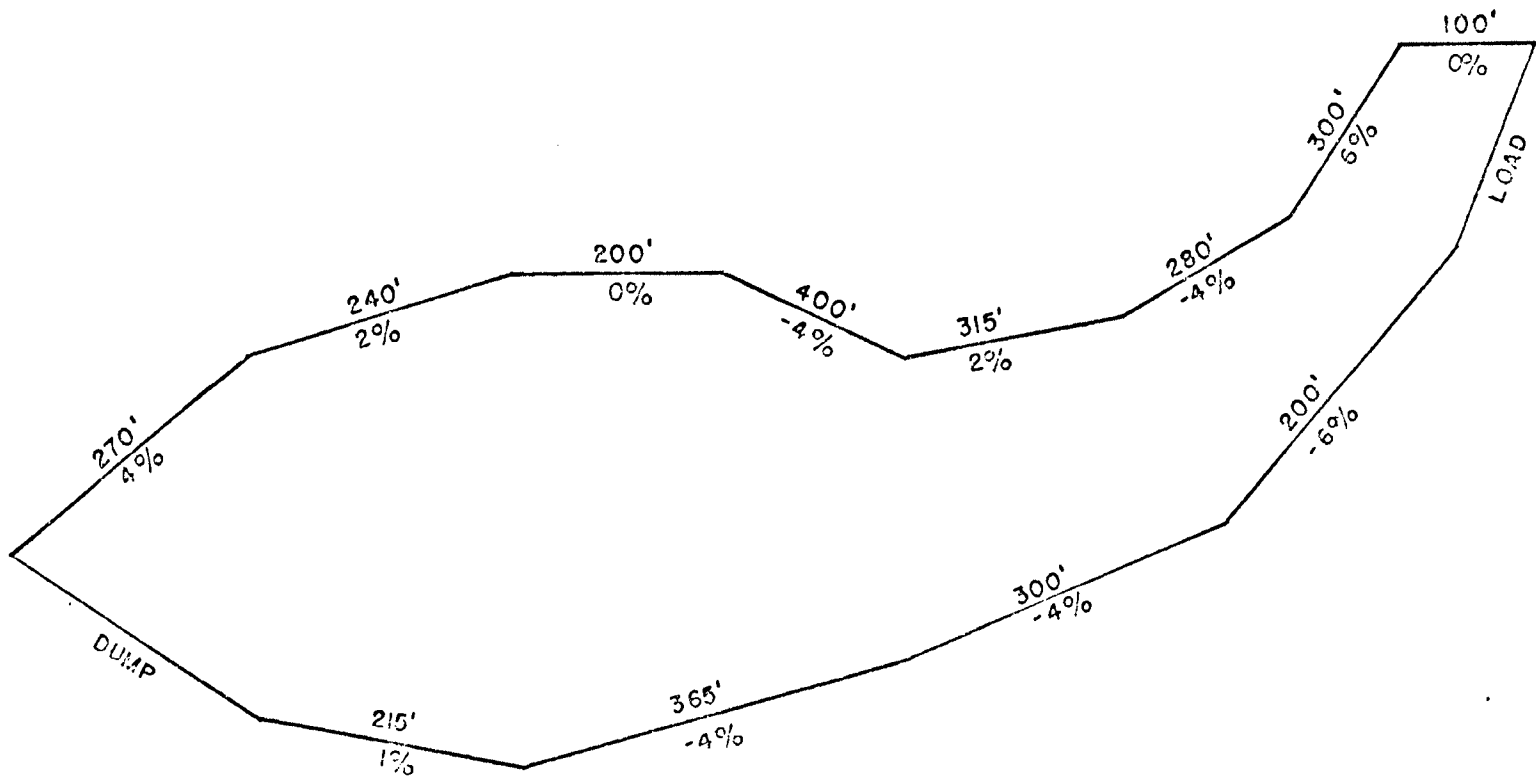


FIGURE 9

EXAMPLE EVALUATION

Figure 9 shows the course configuration and characteristics to be evaluated. It is assumed for illustrative purposes that mine management wishes to utilize Caterpillar tractor scraper types 641 and 666, and also pusher types 2-D9G and 3-D9G.

Management has elected to evaluate their current system for possible improvements in fleet size and type. The computer program in Appendix C was utilized to evaluate the effects of several fleet combinations on the system. The results of the evaluation study are listed on the following pages.

The initial overburden removal system was assumed to contain the following vehicles:

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	2
Scraper	666	3
Pusher	2-D9G	1
Pusher	3-D9G	1

Examination of the various system summaries indicates that the existing production was 29255 tons per shift at a cost of \$ 0.05856 per ton. However, the production is increased to 36195 tons per shift at a cost of \$ 0.05345 per ton when another 641 scraper is added to the system. Further changes in the fleet may increase the production, however, the evaluation indicates that the cost per ton

increases to an undesirable level. Management feels that their construction deadline can be suitably obtained with a production of 36195 tons per shift, therefore, the optimum fleet size and type is:

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	3
Scraper	666	3
Pusher	2-D9G	1
Pusher	3-D9G	1

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	2
Scraper	666	2
Pusher	2-D9G	1
Pusher	3-D9G	1

PRODUCTION - 19385 TONS PER SHIFT

COST PER TON - \$ 0.07135

DELAY TIME CAUSED BY SCRAPER - 132.20 MINUTES

DELAY TIME CAUSED BY PUSHER - 7.79 MINUTES

TOTAL DELAY TIME - 139.99 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 0.9

AVERAGE DUMP POINT QUEUE LENGTH - 0.4

NUMBER OF SCRAPERS LOADED DURING SHIFT - 356

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	2
Scraper	666	3
Pusher	2-D9G	1
Pusher	3-D9G	1

PRODUCTION - 29255 TONS PER SHIFT

COST PER TON - \$ 0.05856

DELAY TIME CAUSED BY SCRAPER - 41.6 MINUTES

DELAY TIME CAUSED BY PUSHER - 23.61 MINUTES

TOTAL DELAY TIME - 65.21 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 1.2

AVERAGE DUMP POINT QUEUE LENGTH - 0.8

NUMBER OF SCRAPERS LOADED DURING SHIFT - 520

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	3
Scraper	666	3
Pusher	2-D9G	1
Pusher	3-D9G	1

PRODUCTION - 36195 TONS PER SHIFT

COST PER TON - \$ 0.05345

DELAY TIME CAUSED BY SCRAPER - 22.4 MINUTES

DELAY TIME CAUSED BY PUSHER - 13.2 MINUTES

TOTAL DELAY TIME - 35.6 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 1.0

AVERAGE DUMP POINT QUEUE LENGTH - 0.7

NUMBER OF SCRAPERS LOADED DURING SHIFT - 678

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	4
Scraper	666	3
Pusher	2-D9G	1
Pusher	3-D9G	1

PRODUCTION - 36082 TONS PER SHIFT

COST PER TON - \$ 0.05976

DELAY TIME CAUSED BY SCRAPER - 0.0 MINUTES

DELAY TIME CAUSED BY PUSHER - 4.22 MINUTES

TOTAL DELAY TIME - 4.22 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 1.2

AVERAGE DUMP POINT QUEUE LENGTH - 1.1

NUMBER OF SCRAPERS LOADED DURING SHIFT - 684

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	4
Scraper	666	4
Pusher	2-D9G	1
Pusher	3-D9G	1

PRODUCTION - 33445 TONS PER SHIFT

COST PER TON - \$ 0.7434

DELAY TIME CAUSED BY SCRAPER - 0.0 MINUTES

DELAY TIME CAUSED BY PUSHER - 87.87 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 2.7

AVERAGE DUMP POINT QUEUE LENGTH - 1.0

NUMBER OF SCRAPERS LOADED DURING SHIFT - 679

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	2
Scraper	666	3
Pusher	2-D9G	2
Pusher	3-D9G	1

PRODUCTION - 29276 TONS PER SHIFT

COST PER TON - \$ 0.06261

DELAY TIME CAUSED BY SCRAPER - 0.40 MINUTES

DELAY TIME CAUSED BY PUSHER - 0.0 MINUTES

TOTAL DELAY TIME - 0.40 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 1.2

AVERAGE DUMP POINT QUEUE LENGTH - 0.6

NUMBER OF SCRAPERS LOADED DURING SHIFT - 520

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	3
Scraper	666	3
Pusher	2-D9G	2
Pusher	3-D9G	1

PRODUCTION - 32401 TONS PER SHIFT

COST PER TON - \$ 0.06341

DELAY TIME CAUSED BY SCRAPER - 0.0 MINUTES

DELAY TIME CAUSED BY PUSHER - 0.0 MINUTES

TOTAL DELAY TIME - 0.0 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 1.2

AVERAGE DUMP POINT QUEUE LENGTH - 0.8

NUMBER OF SCRAPERS LOADED DURING SHIFT - 597

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	3
Scraper	666	4
Pusher	2-D9G	2
Pusher	3-D9G	1

PRODUCTION - 35794 TONS PER SHIFT

COST PER TON - \$ 0.06662

DELAY TIME CAUSED BY SCRAPER - 0.0 MINUTES

DELAY TIME CAUSED BY PUSHER - 0.0 MINUTES

TOTAL DELAY TIME - 0.0 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 1.2

AVERAGE DUMP POINT QUEUE LENGTH - 1.0

NUMBER OF SCRAPERS LOADED DURING SHIFT - 680

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	4
Scraper	666	4
Pusher	2-D9G	2
Pusher	3-D9G	1

PRODUCTION - 35564 TONS PER SHIFT

COST PER TON - \$ 0.07328

DELAY TIME CAUSED BY SCRAPER - 0.0 MINUTES

DELAY TIME CAUSED BY PUSHER - 0.0 MINUTES

TOTAL DELAY TIME - 0.0 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 2.2

AVERAGE DUMP POINT QUEUE LENGTH - 1.0

NUMBER OF SCRAPERS LOADED DURING SHIFT - 678

***** SYSTEM SUMMARY *****

<u>VEHICLE</u>	<u>TYPE</u>	<u>NUMBER IN FLEET</u>
Scraper	641	5
Scraper	666	4
Pusher	2-D9G	2
Pusher	3-D9G	1

PRODUCTION - 35920 TONS PER SHIFT

COST PER TON - \$ 0.0787

DELAY TIME CAUSED BY SCRAPER - 0.0 MINUTES

DELAY TIME CAUSED BY PUSHER - 0.0 MINUTES

TOTAL DELAY TIME - 0.0 MINUTES

AVERAGE LOAD POINT QUEUE LENGTH - 3.2

AVERAGE DUMP POINT QUEUE LENGTH - 1.0

NUMBER OF SCRAPERS LOADED DURING SHIFT - 680

APPENDIX C

SIMULATION PROGRAM
LISTING AND OUTPUT

G LEVEL 1, MOD 1

MAIN

DATE = 68122

22/20/1

```

DIMENSION SCRTYP(4),STYPLP(20),STYPPD(20),PUSHER(10),
1 MAXLDT(4,3),LGC1(14,3,50),LGC2(14,3,50),SLOAD(15),STYPHR(20),
2 VEHTIM(2,15),PUSH(7), STYPRR(20),PSAVE(10),TSAVE(10),ACCTIM(4,2),
3 SEGTIM(3,30),TIME(30),TOPV(30),VLAST(30),DIST(30),GRADE(30),
4 VMAX(30),RRES(30),VELMAX(30),VEL(32),RIMP(32),XIDENT(18),STN(4),
5 SHIFT(12),ROT(12),HTIME(20),Y(5),HTMAX(5),HTMIN(5),COST(4),PTN(5),
6 PCOST(5)
REAL MAXLDT, LGC1, LGC2, LTMIN
INTEGER SCRTYP,STYPLP,STYPPD,PUSHER,SCRAPL,STYPHR,STYPRR,
1 HOLD,PHOLD
DATA WOS/4HSCPR/,WOP/4HPUSH/,WON/4HNONE/

```

```

C
C INITIALIZE ALL ARRAYS.
C

```

```

DO 201 I=1,10
VEHTIM(1,I) = 0.0
VEHTIM(2,I) = 0.0
STYPHR(I) = 0
STYPRR(I) = 0
STYPLP(I) = 0
STYPPD(I) = 0
PUSHER(I) = 0
SLOAD(I) = 0.0
201 HTIME(I) = 0.0

```

```

C
C INITIALIZE ALL SUMMATION VARIABLES
C

```

```

DUMP = 0.0
TONAGE = 0.0
TTIME = 0.0
WAIT = 0.0
WAITS = 0.0
WAITP = 0.0
DELAYT = 0.0
O = 0.0
PLOAD = 0.0
PHOLD = 0

```

```

C
C READ COURSE AND VEHICLE DATA
C

```

```

READ(1,101) ISOTL
READ(1,101) M, NH, NR, NP, NPT, NS, NSEG
READ(1,101) (SCRTYP(I), I=1, M)
READ(1,102) (PUSH(I), I=1, NPT)
READ(1,101) NOSALP, NOSADP
NOSRR = NOSALP
NOSHR = NOSADP
READ(1,101) (STYPLP(I), I=1, NOSALP)
PEAD(1,101) (STYPPD(I), I=1, NOSADP)
READ(1,101) (PUSHER(I), I=1, NP)
READ(1,100) ((MAXLDT(I,K), K=1, NPT), I=1, M)
READ(1,100) LTMIN
READ(1,100) (SLOAD(I), I=1, NOSHR)
READ(1,100) (((LGC1(I,J,K), K=2, 14), J=1, NPT), I=1, M)
READ(1,100) (((LGC2(I,J,K), K=2, 14), J=1, NPT), I=1, M)
READ(1,100) DUMPT

```



```

READ(1,100) EFF
READ(1,100) (COST(I),I=1,M)
READ(1,100) (STN(I),I=1,M)
READ(1,100) (PCOST(I),I=1,NPT)
READ(1,100) (PTN(I),I=1,NPT)

```

```

100 FORMAT(7F10.0)
101 FORMAT(10I5)
102 FORMAT(7(A4,6X))
QL = NOSALP
QD = NOSADP
NOP = NP
DELAY = WON

```

C IDENTIFY SCRAPER TYPES IN THE HAUL AND RETURN ROADS.
C HAUL ROAD BEGINS AFTER THE LOAD FACILITY AND ENDS AFTER THE DUMP
C FACILITY. RETURN ROAD IS BOUNDED BY THE END OF THE DUMP FACILITY
C AND THE BEGINNING OF THE LOAD FACILITY.

```

DO 230 I=1,NOSHR
230 STYPHR(I) = STYDPD(I)
DO 231 I=1,NOSRR
231 STYPRR(I) = STYPLP(I)

```

***** ERROR ANALYSIS *****

REMOVE (C) FROM COLUMN 1 OF CARDS WITH EA100 IN COLUMNS 76-80
OUTPUT REPRESENTS CODE NUMBERS OF SCRAPERS IN QUEUE AT DUMP
AND LOAD POINTS AT BEGINNING OF SHIFT.

```

WRITE(3,500) (STYPLP(I),I=1,NOSALP) EA100
WRITE(3,500) (STYDPD(I),I=1,NOSADP) EA100
500 FORMAT(15X,'500',10X,I5)

```

```

DO 232 I=1,NP
PSAVE(I) = 0.0
232 TSAVE(I) = 0.0

```

C DETERMINE TRAVEL TIMES FOR VARIOUS SCRAPER TYPES.

```

DO 200 ICOUNT=1,M
CALL SIM(TIME, TOPV, VLAST, DIST, GRADE, VMAX, RRES, VELMAX, VEL, RIMP,
IXIDENT, SHIFT, ROT, SEGTIM, HT, RT, ICOUNT, SCRPL, HTMIN, HTMAX, NSEGH, EFF,
2PLMIN)

```

```

Y(ICOUNT) = (HTMAX(ICOUNT)-HTMIN(ICOUNT))/(SCRPL-PLMIN)
ACCTIM(ICOUNT,1) = HT
ACCTIM(ICOUNT,2) = RT
WRITE(3,104) SCRTYP(ICOUNT), SCRPL, HT, RT

```

```

104 FORMAT(1H1, ' TRACTOR SCRAPER TYPE - ', I5, '///', ' PAYLOAD = ', F10.0, '3X
1, ' POUNDS', '///', ' TOTAL HAUL TIME = ', F7.2, '3X, ' MINUTES', '///', ' TOTAL RE
2TURN TIME = ', F7.2, '3X, ' MINUTES')
200 WRITE(3,105) (I, SEGTIM(ICOUNT, I), I=1, NSEG)

```

```

105 FORMAT(/////, ' HAUL ROAD SEGMENT', 5X, ' ACCUMULATED TIME', /, (8X, I3,
116X, F7.2))
WRITE(3,109)

```

```

109 FORMAT(1H1)
DO 269 I=1,M
269 WRITE(3,108) I, SCRTYP(I), STN(I)

```

108 FORMAT(5X, 'SCRAPER OUTPUT CODE NUMBER - ', I3, 2X, 'REPRESENTS SCRAP
IR TYPE - ', I5, 3X, 'NUMBER IN FLEET - ', F3.0)

WRITE(3,110) NS

110 FORMAT(/, 10X, 'NUMBER OF SCRAPERS IN SYSTEM - ', I5, / (//)

DO 270 I=1, NPT

270 WRITE(3,111) I, PUSH(I), PTN(I)

111 FORMAT(5X, 'PUSHER OUTPUT CODE NUMBER - ' I3, 2X, 'REPRESENTS PUSHER
TYPE - ', I1, A4, 4X, 'NUMBER IN FLEET - ', F3.0)

WRITE(3,113) NP

113 EORMAT(/, 10X, 'NUMBER OF PUSHERS IN SYSTEM - ', I5)

WRITE(3,107)

107 FORMAT(// // // // //, ' LOAD POINT DUMP POINT SCRAPER TYPE PUSHER
1 LOAD HAUL TONNAGE TONNAGE TOTAL ACC CAUSE OF
2 DELAY', /, ' QUEUE LENGTH QUEUE LENGTH LOADED TYPE TIME
3 PAYLOAD TIME LOADED DUMPED TIME DELAY TIME
4F')

C
C ASSIGN TIME-POSITIONS TO SCRAPERS IN QUEUE.
C

DO 233 I=1, NOSRR
233 VEHTIM(2, I) = ACCTIM(1, 2)

DO 234 I=1, NOSHR
HTIME(I) = HTMAX(1)
234 VEHTIM(1, I) = ACCTIM(1, 1)

C
C DETERMINE LOAD TIME FOR FIRST SCRAPER IN QUEUE AT LOAD POINT.
C

L = STYPOP(1)
RT = ACCTIM(L, 2)
TLOAD = (RT + DUMPT) / NOSALP
IF(TLOAD.GE.LTMIN) GO TO 203
TLOAD = LTMIN

C
C DETERMINE PUSHER AND SCRAPER TYPES AT LOAD POINT.
C

203 LP = PUSHER(1)
L = STYPLP(1)
IF(TLOAD.LE.MAXLDT(L, LP)) GO TO 207

TLOAD = MAXLDT(L, LP)
207 TTIME = TTIME + TLOAD

C
C ADVANCE PUSHER QUEUE.
C

J = PUSHER(1)
PHOLD = J
DO 208 I=1, NP
IF(I.EQ.NP) GO TO 209
208 PUSHER(I) = PUSHER(I+1)
209 PUSHER(I) = J

C
C CALCULATE PAYLOAD AT PRESENT LOAD TIME.
C

IF(ISOIL.EQ.2) GO TO 204
CALL LOAD (TLOAD, J, L, PAY, LGC1)
GO TO 205
204 CALL LOAD (TLOAD, J, L, PAY, LGC2)

C
C DETERMINE THE EXPECTED HAUL TIME AT PRESENT PAYLOAD.

C 205 HT = Y(L)*(PAY-PLMIN) + HTMIN(L)
C 263 KEEP = STYPLP(1)

C ADVANCE QUEUE AT THE LOAD POINT.

C NOSALP = NOSALP - 1
C IF(NOSALP.EQ.0) GO TO 211
C DO 210 I=1,NOSALP
C 210 STYPLP(I) = STYPLP(I+1)

C ***** ERROR ANALYSIS *****

C REMOVE (C) FROM COLUMN 1 OF CARDS WITH EA101 IN COLUMNS 76-80
C OUTPUT REPRESENTS CODE NUMBERS OF SCRAPERS IN QUEUE AT LOAD
C POINT AFTER LOADING HAS OCCURED.

C WRITE(3,502) (STYPLP(I),I=1,NOSALP) EA101
C 502 FORMAT(20X,'502',10X,I5)

C ADD LOAD TIME TO ALL VEHICLES.

C 211 CALL ADD(NOSHR,VEHTIM,TLOAD,NOSRR)

C ADJUST QUEUE AT THE DUMP POINT.

C CALL DODUMP(NOSADP,DUMP,TLOAD,DUMPT,NOSRR,VEHTIM,STYPRR,NOSHR,
C ISLOAD,TONAGE,HOLD,HTIME,STYPHR,STYPOP)
C NOSHR = NOSHR + 1
C NOSRR = NOSRR - 1
C VEHTIM(1,NOSHR) = 0.0
C STYPHR(NOSHR) = KEEP

C ADVANCE ALL SCRAPERS IN RETURN ROAD.

C DO 206 I = 1,NOSRR
C VEHTIM(2,I) = VEHTIM(2,I+1)
C 206 STYPRR(I) = STYPRR(I+1)

C ***** ERROR ANALYSIS *****

C REMOVE (C) FROM COLUMN 1 OF CARDS WITH EA102 IN COLUMNS 76-8
C OUTPUT REPRESENTS CODE NUMBERS OF SCRAPERS IN RETURN ROAD
C INCLUDING THOSE SCRAPERS IN QUEUE AT THE LOAD POINT.

C WRITE(3,503) (I, STYPRR(I), I=1,NOSRR) EA102
C 503 FORMAT(25X,'503',10X,2I5)

C VEHTIM(2,NOSRR+1) = 0.0
C SLOAD(NOSHR) = PAY
C HTIME(NOSHR) = HT

C INCREASE QUEUE AT LOAD POINT IF SCRAPERS HAVE ARRIVED DURING LOAD

IV G LEVEL 1, MOD 1

MAIN

DATE = 68122

22/20/1

C TIME INCREMENT.

C
C
212 JRR = NOSALP + 1
KRR = STYPRR(JRR)

C
C ***** ERROR ANALYSIS *****

C REMOVE (C) FROM COLUMN 1 OF CARDS WITH FA103 IN COLUMNS 76-8
C OUTPUT REPRESENTS THE NEXT SCRAPER TYPE THAT WILL REACH THE
C LOAD POINT (KRR), AND THE TOTAL EXPECTED RETURN TIME OF THAT
C SCRAPER (ACCTIM).

C WRITE(3,504) KRR, ACCTIM(KRR,2)
C 504 FORMAT(30X,'504',10X,I5,5X,F6.2)

EA103

C
C A = ACCTIM(KRR,2) - LTMIN
C IF(VFHTIM(2,JRR).LT.A) GO TO 213
C NOSALP = NOSALP + 1
C STYPLP(NOSALP) = KRR
C GO TO 212

213 PLOAD = PLOAD + PAY
IF(HT.EQ.0.0) GO TO 272
QL = QL + NOSALP*1.
QD = QD + NOSADP*1.
Q = Q + 1.
GO TO 273

272 DELAYT = TLOAD
TLOAD = 0.0

C
C WRITE SYSTEM OBSERVATIONS AFTER EACH LOADING IS COMPLETED.

C
C 273 WRITE(3,106) NOSALP, NOSADP, KEEP, PHOLD,TLOAD, PAY, HT, PLOAD,
C 1TONAGE, TTIME, DELAY, DELAYT
C 106 FORMAT (3X,I5,2(9X,I5),8X,I3,2X,F6.2,F10.0,F7.2,2F10.0,F10.2,7X,A4
C 1,3X,F6.2)
C DELAYT = 0.0
C DELAY = WDN

C
C IS THERE A SCRAPER IN QUEUE AT THE LOAD POINT?

C
C IF(NOSALP.GT.0) GO TO 240
C IF(NOSRR.GT.0) GO TO 266

C
C DETERMINE TIME NECESSARY FOR NEXT SCRAPER TO ARRIVE AT LOAD POINT.

C
C JD = STYDPP(1)
C TLEFT = ACCTIM(JD,2) + DUMPT
C TLOAD = TLEFT
C DFLAY = WOS
C WAITS = WAITS + TLEFT
C GO TO 267

266 JD = STYPRR(1)
TLEFT = ACCTIM(JD,2) - VEHTIM(2,1)
TLOAD = TLEFT
DFLAY = WOS
WAITS = WAITS + TLEFT

267 PAY = 0.0
WAIT = WAIT + TLOAD

KEEP = 0
PHOLD = 0
HT = 0.0

241 TTIME = TTIME + TLOAD

C
C ADD DELAY TIME TO ALL VEHICLES.

C CALL ADD(NOSHR,VEHTIM,TLOAD,NOSRR)

C
C ADJUST DUMP POINT QUEUE LENGTH.

C CALL DDUMP(NOSADP,DUMP,TLOAD,DUMPT,NOSRR,VEHTIM,STYPRR,NOSHR,
ISLOAD,TONAGE,HOLD,HTIME,STYPHR,STYDPD)
GO TO 212

C
C IS A PUSHER IN QUEUE AT THE LOAD POINT?

C
C 240 IF(NOP.GT.0) GO TO 242

C
C DETERMINE DELAY CAUSED BY PUSHER.

C TLOAD = PSAVE(1) - TSAVE(1)
DELAY = WOP
WAITP = WAITP + TLOAD

DO 251 K=1,NP
TSAVE(K) = TSAVE(K) + TLOAD
IF(TSAVE(K).LT.PSAVE(K)) GO TO 251
NOP = NOP + 1
TSAVE(NOP) = 0.0

251 CONTINUE
GO TO 267

242 K = STYPRR(1)

C
C DETERMINE LOAD TIME FOR NEXT SCRAPER.

C TLEFT = ACCTIM(KRR,2)-VEHTIM(2,JRR)-LTMIN
IF(TLEFT.GT.0.0) GO TO 245
TLEFT = 1.0

245 TLOAD = TLEFT/NOSALP
LPUSH = PUSHER(1)

IF(TLOAD.LE.MAXLOT(K,LPUSH)) GO TO 243
TLOAD = MAXLOT(K,LPUSH)

243 IF(TLOAD.GE.LTMIN) GO TO 244
TLOAD = LTMIN

C
C ADVANCE PUSHER QUEUE.

C
C 244 J = PUSHER(1)

L=K

PHOLD = J

DO 246 I=1,NP

246 PUSHER(I) = PUSHER(I+1)

247 PUSHER(I) = J

261 IF(ISOIL.EQ.?) GO TO 248

IV G LEVEL 1, MOD 1

MAIN

DATE = 68122

22/20

C
C CALCULATE PAYLOAD AT THIS LOAD TIME.

C
CALL LOAD (TLOAD,J,L,PAY,LGC1)
GO TO 249
248 CALL LOAD (TLOAD,J,L,PAY,LGC2)

C
C DETERMINE EXPECTED HAUL TIME AT THIS PAYLOAD.

C
249 HT = Y(L)*(PAY - PLMIN) + HTMIN(L)

C
C IF SCRAPER MUST QUEUE AT DUMP POINT, INCREASE LOAD TIME BY .05
C MINUTES AND RECHECK LOAD TIME BOUNDARIES.

C
R = NOSHR*DUMPT
IF((TLOAD+HT).GE.R) GO TO 260
TLOAD = TLOAD + 0.05
IF(TLOAD.LT.MAXLDT(K,I,PUSH)) GO TO 261

260 NOP = NOP - 1

C
C ADVANCE PUSHERS IN CYCLE BY LOAD TIME.

C
I = NP - NOP
PSAVE(I) = 0.4*TLOAD + .15 + .10
TSAVE(I) = 0.0
IF(I.EQ.1) GO TO 265
II = I-1
DO 262 K=1,II
TSAVE(K) = TSAVE(K) + TLOAD
IF(TSAVE(K).LT.PSAVE(K)) GO TO 262
NOP = NOP + 1
TSAVE(NOP) = 0.0
262 CONTINUE
265 TTIME = TTIME + TLOAD

C
C CHECK FOR END OF SHIFT.

C
IF(TTIME.GE.360.) GO TO 264
GO TO 263

C
C CALCULATE PRODUCTION.

264 PROD = TONAGE/2000.
TCOST = 0.0

C
C CALCULATE TOTAL COST OF SCRAPERS AND PUSHERS.

C
DO 268 I=1,M
268 TCOST = TCOST + COST(I)*STN(I) *8.
DO 271 I=1,NPT
271 TCOST = TCOST + PCOST(I)*PTN(I)*8.
PCOST = TCOST/PROD

C
C WRITE SYSTEM SUMMARY.

C
WRITE(3,116)

TV G LEVEL 1, MOD 1

MAIN

DATE = 68122

22/20/1

```
116 FORMAT(1H1,//////////,20X,'*****  
1*****') SYSTEM SUMMARY **  
WRITE(3,112) PROD, TCOST, PDCOST  
112 FORMAT(////,20X,'PRODUCTION PER SHIFT = ',F16.0,2X,'TONS',//,15X,'  
1TOTAL COST (PRODUCTION, MAINTENENCE, AND OVERHEAD) = $',F10.3,///  
2,25X,'TOTAL COST PER TON DUMPED = $',F12.8,//)  
WRITE(3,114) WATTS, WATTP, WAIT  
114 FORMAT(20X,'DELAY TIME CAUSED BY SCRAPER -',F7.2,3X,'MINUTES',//,  
120X,'DELAY TIME CAUSED BY PUSHER -',F7.2,3X,'MINUTES',///,30X,'TOT  
2AL DELAY TIME -',F7.2,3X,'MINUTES')  
AQL = QL/Q  
AQD = QD/Q  
WRITE(3,115) AQL, AQD, Q  
115 FORMAT(////,20X,'AVERAGE QUEUE LENGTH AT LOAD POINT -',F4.1,//,20X  
1'AVERAGE QUEUE LENGTH AT DUMP POINT -',F4.1,///,20X,'TOTAL NUMBER  
2OF SCRAPERS LOADED DURING SHIFT -',F6.0)  
CALL EXIT  
END
```

IV G LEVEL 1, MOD 1

LOAD

DATE = 68122

22/20/

SUBROUTINE LOAD (TLOAD, J, L, PAY, X)

DIMENSION X(14, 3, 50)

T = TLOAD*10. + .005

JK = T

IK = JK + 1

P = JK

S = T-P

***** ERROR ANALYSIS *****

REMOVE (C) FROM COLUMN 1 OF CARDS WITH EA104 IN COLUMNS 76-8
 OUTPUT REPRESENTS THE TWO PAYLOADS FROM THE LOAD GROWTH
 CURVES BETWEEN WHICH INTERPOLATION IS TO OCCUR FOR THE LOAD
 TIME CALCULATED, S IS THE INTERPOLATION MULTIPLIER.

WRITE(3, 505) X(JK, J, L), X(IK, J, L), S
 505 FORMAT(35X, '505', 3(5X, F12.1))

EA104

IF (S.GT.0.0) GO TO 302

PAY = X(L, J, JK)

GO TO 301

302 PAY = X(L, J, JK) + (X(L, J, IK) - X(L, J, JK))*S

301 CONTINUE

RETURN

END

IV G LEVEL 1, MOD 1

ADD

DATE = 68122

22/20

```
SUBROUTINE ADD (NOSHR,VEHTIM,TLOAD,NOSRR)
DIMENSION VEHTIM(2,15)
```

```
DO 303 I=1,NOSHR
303 VEHTIM(1,I)=VEHTIM(1,I) + TLOAD
DO 304 I=1,NOSRR
304 VEHTIM(2,I)=VEHTIM(2,I) + TLOAD
RETURN
END
```

IV G LEVEL 1, MOD 1

DQDUMP

DATE = 68122

22/20/

SUBROUTINE DQDUMP (NOSADP,DUMP,TLOAD,DUMPT,NOSRR,VEHTIM,STYPRR,
 1NOSHR,SLOAD,TONAGE,HOLD,HTIME,STYPHR,STYDPD)
 DIMENSION VEHTIM(2,15),STYPRR(20),SLOAD(15),HTIME(20),STYPHR(20),
 1STYDPD(20)
 ICHECK = NOSRR

C

C

C

ARE ANY SCRAPERS IN QUEUE AT THE DUMP POINT?

IF(NOSADP.EQ.0) GO TO 410
 DUMP = DUMP + TLOAD

C

C

C

DECREASE DUMP POINT QUEUE IF ANY SCRAPERS HAVE DUMPED.

412 IF(DUMP.LT.DUMPT) GO TO 410

NOSADP = NOSADP - 1
 DO 413 I = 1,NOSADP

413 STYDPD(I) = STYDPD(I+1)

NOSRR = NOSRR + 1

IF((NOSRR-ICHECK).LT.2) GO TO 421

ID = ICHECK + 1

IE = NOSRR - 1

C

C

ADVANCE SCRAPERS ALONG RETURN ROAD AFTER DUMPING.

DO 423 I = ID,IE

423 VEHTIM(2,ID) = VEHTIM(2,ID) + DUMPT

421 VEHTIM(2,NOSRR) = 0.0

STYPRR(NOSRR) = STYPHR(1)

TONAGE = TONAGE + SLOAD(1)

KNOSHR = NOSHR - 1

DO 411 I=1,KNOSHR

STYPHR(I) = STYPHR(I+1)

C

C

C

C

C

C

C

C

C

C

***** ERROR ANALYSIS *****

REMOVE (C) FROM COLUMN 1 OF CARDS WITH EA105 IN COLUMNS 76-80

OUTPUT REPRESENTS CODE NUMBERS OF SCRAPERS REMANING IN HAUL

ROAD INCLUDING QUEUE AT DUMP POINT AFTER A SCRAPER HAS DUMPED

WRITE(3,506) STYPHR(I)

506 FORMAT(40X,'506',5X,I5)

VEHTIM(1,I) = VEHTIM(1,I+1)

HTIME(I) = HTIME(I+1)

411 SLOAD(I) = SLOAD(I+1)

VEHTIM(1,NOSHR) = 0.0

NOSHR = NOSHR - 1

DUMP = DUMP - DUMPT

IF(NOSADP.GT.0) GO TO 412

410 IF(NOSHR.EQ.NOSADP) GO TO 420

HOLD = NOSADP

414 K = NOSADP + 1

C

C

C

HAVE ANY SCRAPERS ARRIVED AT DUMP POINT?

IF(VEHTIM(1,K).LT.HTIME(K)) GO TO 415

NOSADP = NOSADP + 1

IV G LEVEL 1, MOD 1

DQDUMP

DATE = 68122

22/20

STYPDP(NOSADP) = STYPHR(NOSADP)

GO TO 414

415 IF(NOSADP.EQ.HOLD) GO TO 420

417 IF(DUMP.LT.DUMPT) GO TO 420

C
C
C

DETERMINE THE NUMBER OF NEW ARRIVALS THAT HAVE DUMPED.

NOSADP = NOSADP - 1

DO 416 I=1,NOSADP

416 STYPDP(I) = STYPDP(I+1)

NOSRR = NOSRR + 1

IF((NOSRR-ICHECK).LT.2) GO TO 422

ID = CHECK + 1

IE = NOSRR - 1

DO 424 I = ID,IE

424 VEHTIM(2,ID) = VEHTIM(2,ID) + DUMPT

422 VEHTIM(2,NOSRR) = 0.0

STYPHR(NOSRR) = STYPHR(I)

TONAGE = TONAGE + SLOAD(I)

KNOSHR = NOSHR - 1

DO 419 I=1,KNOSHR

STYPHR(I) = STYPHR(I+1)

C
C
C
C
C
C
C
C
C
C
C
C

***** ERROR ANALYSIS *****

REMOVE (C) FROM COLUMN 1 OF CARDS WITH EA105 IN COLUMNS 76-8.

OUTPUT REPRESENTS CODE NUMBERS OF SCRAPERS REMANING IN HAUL

ROAD INCLUDING QUEUE AT DUMP POINT AFTER A SCRAPER HAS DUMPED

WRITE(3,507) STYPHR(I)

507 FORMAT(40X,'507',5X,I5)

EA105

VEHTIM(1,I) = VEHTIM(1,I+1)

HTIME(I) = HTIME(I+1)

410 SLOAD(I) = SLOAD(I+1)

VEHTIM(1,NOSHR) = 0.0

NOSHR = NOSHR - 1

DUMP = DUMP - DUMPT

IF(NOSADP.GT.0) GO TO 417

420 IF(NOSADP.GT.0) GO TO 418

DUMP = 0.0

418 CONTINUE

C
C
C

IF LOAD OR DELAY TIME INTERVAL HAS BEEN EXHAUSTED, RETURN TO MAIN.

RETURN

END

IV G LEVEL 1, MOD 1

SIM

DATE = 68122

22/20/

SUBROUTINE SIM (TIME, TOPV, VLAST, DIST, GRADE, VMAX, RRES, VELMAX, VEL,
 IRIMP, XIDENT, SHIFT, ROT, SEGTIM, HT, RT, ICOUNT, SCRPP1, HTMIN, HTMAX,
 2NSEGH, EFF, PLMIN)

DIMENSION TIME(30), TOPV(30), VLAST(30), DIST(30), GRADE(30),
 1VMAX(30), RRES(30), VELMAX(30), VEL(32), RIMP(32), XIDENT(18),
 2SHIFT(12), ROT(12), SEGTIM(3,30), HTMIN(5), HTMAX(5)

READ(1,1) XIDENT
 1 FORMAT(18A4)
 READ(1,3) SHIFT
 READ(1,3) ROT
 READ(1,3) VEL
 READ(1,3) RIMP
 3 FORMAT(8F9.0)
 READ(1,4) NRUN
 DO 99 IRUN = 1, NRUN
 READ(1,2) SCRPP1, SCRPP2, SCRPP3
 2 FORMAT(4F10.0)
 READ(1,4) NCORSE
 4 FORMAT(2I5, 2F5.0)
 DO 99 IHR=1, NCORSE
 READ(1,4) IHAUL, NSEGH, FIXT, RD

C
C
C

WHEN IHAUL=0 PROCESS HAUL ROAD, WHEN IHAUL=1 PROCESS RETURN ROAD

READ(1,2) (DIST(I), GRADE(I), RRES(I), VMAX(I), I=1, NSEGH)
 READ(1,2) VD, VF
 DO 20 I=1, 32
 IF(RIMP(I).EQ.0.0) GO TO 21
 20 CONTINUE
 K=32
 GO TO 22
 21 K=I
 22 SAVE = VF
 IGEAR = 0

C
C
C

INITIALIZE SUMMATION VARRIABLES

DD = 0.0
 TT = 0.0

C
C
C

CALCULATE MAXIMUM ALLOWABLE SEGMENT VELOCITY

DO 23 KSEG = 1, NSEGH
 ISEG = NSEGH+1-KSEG
 CALL RETARD (RRES(ISEG), GRADE(ISEG), BRAKE)
 VELMAX(ISEG) = SQRT(VF*VF-BRAKE*DIST(ISEG)/1.0756)
 IF(VMAX(ISEG).EQ.0.0) GO TO 26
 IF(VMAX(ISEG).GE.VELMAX(ISEG)) GO TO 26
 VELMAX(ISEG) = VMAX(ISEG)
 26 VE = VELMAX(ISEG)
 23 CONTINUE

C
C
C

IMPOSE SPEED RESTRICTIONS IN SEGMENTS, IF GIVEN

VF = SAVE
 DO 27 ISEG = 1, NSEGH

TV G LEVEL 1, MOD 1

SIM

DATE = 68122

22/207

IF(VELMAX(ISEG).LE.VEL(K)) GO TO 27
 VELMAX(ISEG) = VEL(K)

27 CONTINUE

ESTABLISH INITIAL VELOCITY - VO

IF(VELMAX(1).GT.VO) GO TO 28
 VO = VELMAX(1)

28 DO 29 I=2,NSEGH

29 DIST(I) = DIST(I-1)+DIST(I)

VB4AC = VO

DETERMINE EFFECTIVE WEIGHT OF SCRAPER

IF(IHAUL.GT.0) GO TO 30
 TOTWT = SCRPPPL+ SCRPPWT
 GO TO 31

30 TOTWT = SCRPPWT

CALCULATE TOTAL RESISTIVE FORCE OF SEGMENT - RESFOR

31 DO 32 ISEG = 1,NSEGH

IF(RRES(ISEG).GT.12.) GO TO 33
 PER = -.9 + 1.075*RRES(ISEG)
 GO TO 34

33 PER = RRES(ISEG)

34 RESFOR = (TOTWT*(PER+GRADE(ISEG)))/SQRT(10000.+GRADE(ISEG)*GRADE(ISEG))

CALCULATE BRAKING CAPABILITY IN SEGMENT

CALL RETARD (RRES(ISEG), GRADE(ISEG), BRAKE)
 TOPVEL = 0.

LOCATE THE PROPER GEAR AND ROTATING MASS CONSTANT (RMASSC) FOR
 PRESENT VELOCITY - VB4AC

47 DO 57 KK=1,12

IF(SHIFT(KK).GE.VB4AC) GO TO 58

57 CONTINUE

58 RMASSC = ROT(KK)

IF(TOPVEL.GE.VB4AC) GO TO 35

TOPVEL = VB4AC

35 IF(KK.EQ.IGEAR) GO TO 59

IGEAR = KK

CALCULATE EFFECTIVE SCRAPER MASS

59 VMASS = (TOTWT + RMASSC*TOTWT)/32.2

DO 36 L=1,K

IF(VB4AC.LE.VEL(L)) GO TO 37

36 CONTINUE

CALCULATE RIMPULL FOR PRESENT VELOCITY

37 PIM = RIMP(L-1) + (RIMP(L)-RIMP(L-1))*(VB4AC-VEL(L-1))/(VEL(L)-

IV G LEVEL 1, MOD 1

SIM

DATE = 68122

22/20

1VEL(L-1))

C
C
C
CALCULATE ACCELERATIONC
C
ACCEL = (RIM-RESFOR-TOTWT*.00025*VB4AC)/VMASSC
C
DEPENDING ON ACCELERATION, DETERMINE TIME INCREMENTC
C
IF (ABS(ACCEL).GT.1.) GO TO 38

DELTA = 3.0

GO TO 39

38 DELTA = .3/ABS(ACCEL) + .3

C
C
C
CALCULATE NEW VELOCITY (V), TIME FOR ACCELERATION (DELTA), TOTAL
ELAPSED TIME (T), AND DISTANCE TRAVELED (D)39 V = VB4AC + DELTA*ACCEL*.6818
IF (V.LT.VELMAX(ISEG)) GO TO 40

V = VELMAX(ISEG)

DELTA = (V-VB4AC) / (ACCEL*.6818)

40 T = TT + DELTA/60.

D = DD + VB4AC*DELTA*1.4667 + ACCEL*DELTA*DELTA/2.

C
C
C
CHECK CALCULATED VELOCITY AGAINST MAXIMUM ALLOWABLE SEGMENT VEL.

IF (ISEG.EQ.NSEGH) GO TO 41

VFSEG = VELMAX(ISEG+1)

GO TO 42

41 VFSEG = V

C
C
C
DETERMINE IF BRAKING SHOULD TAKE PLACE

42 IF (V.GT.VFSEG) GO TO 43

DBRAKE = 0.

GO TO 44

43 DBRAKE = (V*V - VFSEG*VFSEG)*1.0756 / (-1.*BRAKE)

C
C
C
CHECK FOR COMPLETION OF SEGMENT TRAVEL

44 IF ((D+DBRAKE).GE.DIST(ISEG)) GO TO 45

IF (V.GE.VELMAX(ISEG)) GO TO 46

VB4AC = V

DD = D

TT = T

C
C
C
SEGMENT NOT COMPLETED - GO TO 47

GO TO 47

C
C
C
VEHICLE HAS ATTAINED MAXIMUM SPEED - CONTINUE AT THIS VELOCITY

46 DDD = DIST(ISEG) - DBRAKE

TT = T + (DDD-D)/(V*88.) + DBRAKE/((V+VFSEG)*44.)

VB4AC = V

GO TO 48

45 IF (DBRAKE.GT.0.) GO TO 49

IV G LEVEL 1, MOD 1

SIM

DATE = 68122

22/2

```

VB4AC = VB4AC + ((V-VB4AC)/(D-DD))*(DIST(ISEG)-DD)
TT = TT + ((T-TT)/(D-DD))*(DIST(ISEG)-DD)
48 IF(VB4AC.LE.TOPVEL) GO TO 50
TOPVEL = VB4AC
GO TO 50
49 TT = TT + (DIST(ISEG)-DD) / (44.*(VB4AC+VFSEG))
50 DD = DIST(ISEG)
IF(DBRAKE.LE.0.) GO TO 51
VB4AC = VFSEG
51 TIME(ISEG) = TT/FFF
TOPV(ISEG) = TOPVEL
32 VLAST(ISEG) = VB4AC
C
C SEGMENT HAS BEEN COMPLETED, START NEXT SEGMENT
C
DO 52 I = 2,NSEGH
52 DIST(2-I+NSEGH) = DIST(2-I+NSEGH) - DIST(1-I+NSEGH)
IF(IHAUL.GT.0) GO TO 53
DO 56 I = 1,NSEGH
56 SEGTIM(ICOUNT,I) = TIME(I)
HT = TIME(NSEGH)
GO TO 54
53 PT = TIME(NSEGH)
54 IF(IHAUL.GT.0) GO TO 55
IF(SCRPPPL.GT.100000.) GO TO 98
HTMIN(ICOUNT)=HT
PLMIN=SCRPPPL
98 TH=TT
HTMAX(ICOUNT)=HT
GO TO 99
55 TR = TT
99 CONTINUE
RETURN
END

```

RAN IV G LEVEL 1, MOD 1

RETARD

DATE = 68122

22/20/

SUBROUTINE RETARD (PER1, PER2, BRAKE)

RGRES = PER1 + PER2

IF (RGRES.GE.0.01) GO TO 24

BRAKE = -7. - .2*RGRES

IF (BRAKE.LE.-.5) GO TO 25

BRAKE = -.5 ?

GO TO 25

24 BRAKE = -7.

25 RETURN

END

TRACTOR SCRAPER TYPE - 641

PAYLOAD = 114000. POUNDS

TOTAL HAUL TIME = 0.84 MINUTES

TOTAL RETURN TIME = 1.49 MINUTES

HAUL ROAD SEGMENT	ACCUMULATED TIME
1	0.20
2	0.38
3	0.63
4	0.84

TRACTOR SCRAPER TYPE - 666

PAYLOAD = 162000. POUNDS

TOTAL HAUL TIME = 0.82 MINUTES

TOTAL RETURN TIME = 1.37 MINUTES

HAUL ROAD SEGMENT	ACCUMULATED TIME
1	0.19
2	0.36
3	0.62
4	0.82

SCRAPER OUTPUT CODE NUMBER - 1 REPRESENTS SCRAPER TYPE - 641 NUMBER IN FLEET - 3.
 SCRAPER OUTPUT CODE NUMBER - 2 REPRESENTS SCRAPER TYPE - 666 NUMBER IN FLEET - 3.

NUMBER OF SCRAPERS IN SYSTEM - 6

PUSHER OUTPUT CODE NUMBER - 1 REPRESENTS PUSHER TYPE - 2D9G NUMBER IN FLEET - 1.
 PUSHER OUTPUT CODE NUMBER - 2 REPRESENTS PUSHER TYPE - 3D9G NUMBER IN FLEET - 1.

NUMBER OF PUSHERS IN SYSTEM - 2

LOAD POINT QUEUE LENGTH	DUMP POINT QUEUE LENGTH	SCRAPER TYPE LOADED	PUSHER TYPE	LOAD TIME	PAYLOAD	HAUL TIME	TONNAGE LOADED	TONNAGE DUMPED	TOTAL ACC TIME	CAUSE OF DELAY	DELAY TIME
2	2	1	1	0.58	99405.	0.83	99405.	114000.	0.58	NONE	0.0
1	1	1	2	0.49	106310.	0.83	205715.	228000.	1.07	NONE	0.0
1	0	2	1	0.49	102494.	0.80	308209.	441405.	1.56	NONE	0.0
1	1	2	2	0.60	130443.	0.81	438653.	441405.	2.16	NONE	0.0
1	1	1	1	0.40	90030.	0.83	528683.	547715.	2.56	NONE	0.0
1	1	0	0	0.0	0.0	0.0	528683.	547715.	2.60	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	641245.	650209.	3.00	NONE	0.0
1	1	0	0	0.0	0.0	0.0	641245.	650209.	3.05	PUSH	0.04
1	1	1	1	0.60	99854.	0.83	741100.	780653.	3.64	NONE	0.0
1	1	1	2	0.40	101527.	0.83	842627.	870683.	4.04	NONE	0.0
1	0	0	0	0.0	0.0	0.0	842627.	983245.	4.09	PUSH	0.04
1	1	2	1	0.53	106962.	0.80	949589.	983245.	4.62	NONE	0.0
2	1	2	2	0.51	125661.	0.81	1075250.	1083099.	5.13	NONE	0.0
1	1	1	1	0.54	97728.	0.83	1172978.	1184626.	5.67	NONE	0.0
1	0	2	2	0.54	127377.	0.81	1300354.	1417249.	6.21	NONE	0.0
1	1	1	1	0.54	97728.	0.83	1398082.	1417249.	6.76	NONE	0.0
2	1	1	2	0.43	103243.	0.83	1501325.	1514977.	7.19	NONE	0.0
2	1	0	0	0.0	0.0	0.0	1501325.	1514977.	7.20	PUSH	0.01
1	1	2	1	0.54	107642.	0.80	1608966.	1642353.	7.74	NONE	0.0
1	1	2	2	0.54	127003.	0.81	1735968.	1740081.	8.27	NONE	0.0
1	0	1	1	0.44	92309.	0.83	1828277.	1950965.	8.71	NONE	0.0
1	0	0	0	0.0	0.0	0.0	1828277.	1950965.	8.72	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	1960628.	1950965.	9.36	NONE	0.0
1	1	0	0	0.0	0.0	0.0	1960628.	2077967.	9.76	SCRPR	0.40
2	0	1	1	0.40	90030.	0.83	2050657.	2170276.	10.16	NONE	0.0
2	1	0	0	0.0	0.0	0.0	2050657.	2170276.	10.20	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	2152184.	2302627.	10.60	NONE	0.0
1	0	0	0	0.0	0.0	0.0	2152184.	2302627.	10.65	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	2244243.	2302627.	11.05	NONE	0.0
1	1	0	0	0.0	0.0	0.0	2244243.	2302627.	11.09	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	2356805.	2392656.	11.49	NONE	0.0
1	1	0	0	0.0	0.0	0.0	2356805.	2392656.	11.54	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	2446834.	2494183.	11.94	NONE	0.0
1	1	0	0	0.0	0.0	0.0	2446834.	2494183.	11.98	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	2577134.	2698804.	12.58	NONE	0.0
1	1	1	1	0.44	92717.	0.83	2669850.	2698804.	13.02	NONE	0.0
2	1	1	2	0.53	107889.	0.84	2777738.	2788833.	13.55	NONE	0.0
1	1	2	1	0.54	108321.	0.80	2886059.	2919133.	14.09	NONE	0.0
1	0	2	2	0.54	127377.	0.81	3013435.	3119737.	14.64	NONE	0.0
1	1	1	1	0.43	91901.	0.83	3105336.	3119737.	15.07	NONE	0.0

1	1	0	0	0.0	0.0	0.0	3105336.	3119737.	15.08	PUSH	0.01
2	1	0	2	0.64	132351.	0.81	3237687.	3228058.	15.72	NONE	0.0
1	0	1	0	0.0	0.0	0.0	3237687.	3355434.	16.12	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	3327716.	3447335.	16.52	NONE	0.0
1	1	0	0	0.0	0.0	0.0	3327716.	3447335.	16.57	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	3429243.	3579686.	16.97	NONE	0.0
1	1	0	0	0.0	0.0	0.0	3429243.	3579686.	17.01	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	3521302.	3579686.	17.41	NONE	0.0
1	1	0	0	0.0	0.0	0.0	3521302.	3579686.	17.46	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	3633864.	3669715.	17.86	NONE	0.0
1	1	0	0	0.0	0.0	0.0	3633864.	3669715.	17.90	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	3723893.	3771242.	18.30	NONE	0.0
1	1	0	0	0.0	0.0	0.0	3723893.	3771242.	18.35	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	3854193.	3975863.	18.94	NONE	0.0
1	1	1	1	0.44	92717.	0.83	3946909.	3975863.	19.39	NONE	0.0
2	1	1	2	0.53	107889.	0.84	4054797.	4065892.	19.92	NONE	0.0
1	1	2	1	0.54	108321.	0.80	4163118.	4196192.	20.46	NONE	0.0
1	0	2	2	0.54	127377.	0.81	4290494.	4396796.	21.00	NONE	0.0
1	1	1	1	0.43	91901.	0.83	4382395.	4396796.	21.43	NONE	0.0
1	1	0	0	0.0	0.0	0.0	4382395.	4396796.	21.45	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	4514746.	4505117.	22.09	NONE	0.0
2	1	0	0	0.0	0.0	0.0	4514746.	4632493.	22.49	SCPR	0.40
1	1	1	1	0.40	90030.	0.83	4604775.	4724394.	22.89	NONE	0.0
1	1	0	0	0.0	0.0	0.0	4604775.	4724394.	22.93	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	4706302.	4856745.	23.33	NONE	0.0
1	0	0	0	0.0	0.0	0.0	4706302.	4856745.	23.38	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	4798361.	4856745.	23.78	NONE	0.0
1	1	0	0	0.0	0.0	0.0	4798361.	4856745.	23.82	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	4910923.	4946774.	24.22	NONE	0.0
1	1	0	0	0.0	0.0	0.0	4910923.	4946774.	24.27	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	5000952.	5048301.	24.67	NONE	0.0
1	1	0	0	0.0	0.0	0.0	5000952.	5048301.	24.71	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	5131252.	5252922.	25.31	NONE	0.0
1	1	1	1	0.44	92717.	0.83	5223968.	5252922.	25.75	NONE	0.0
2	1	1	2	0.53	107889.	0.84	5331856.	5342951.	26.28	NONE	0.0
1	1	2	1	0.54	108321.	0.80	5440177.	5473251.	26.82	NONE	0.0
1	0	2	2	0.54	127377.	0.81	5567553.	5673855.	27.37	NONE	0.0
1	1	1	1	0.43	91901.	0.83	5659454.	5673855.	27.80	NONE	0.0
1	1	0	0	0.0	0.0	0.0	5659454.	5673855.	27.81	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	5791805.	5782176.	28.45	NONE	0.0
2	1	0	0	0.0	0.0	0.0	5791805.	5909552.	28.85	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	5881834.	6001453.	29.25	NONE	0.0
1	1	0	0	0.0	0.0	0.0	5881834.	6001453.	29.30	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	5983361.	6133804.	29.70	NONE	0.0
1	1	0	0	0.0	0.0	0.0	5983361.	6133804.	29.74	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	6075420.	6133804.	30.14	NONE	0.0
1	1	0	0	0.0	0.0	0.0	6075420.	6133804.	30.19	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	6187982.	6223833.	30.59	NONE	0.0
1	1	0	0	0.0	0.0	0.0	6187982.	6223833.	30.63	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	6278011.	6325360.	31.03	NONE	0.0
1	1	0	0	0.0	0.0	0.0	6278011.	6325360.	31.08	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	6408311.	6529981.	31.67	NONE	0.0
1	1	1	1	0.44	92717.	0.83	6501027.	6529981.	32.12	NONE	0.0
2	1	1	2	0.53	107889.	0.84	6608915.	6620010.	32.64	NONE	0.0
1	1	2	1	0.54	108321.	0.80	6717236.	6750310.	33.19	NONE	0.0
1	1	2	2	0.54	127377.	0.81	6844612.	6950914.	33.73	NONE	0.0
1	1	1	1	0.43	91901.	0.83	6936513.	6950914.	34.16	NONE	0.0
1	1	0	0	0.0	0.0	0.0	6936513.	6950914.	34.18	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	7068864.	7059235.	34.82	NONE	0.0
2	1	0	0	0.0	0.0	0.0	7068864.	7186611.	35.22	SCPR	0.40

1	0	1	1	0.40	90030.	0.83	7158893.	7278512.	35.62	NONE	0.0
1	0	1	0	0.0	0.0	0.0	7158893.	7278512.	35.66	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	7260420.	7410863.	36.06	NONE	0.0
1	0	0	0	0.0	0.0	0.0	7260420.	7410863.	36.11	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	7352479.	7410863.	36.51	NONE	0.0
1	1	0	0	0.0	0.0	0.0	7352479.	7410863.	36.55	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	7465041.	7500892.	36.95	NONE	0.0
1	1	0	0	0.0	0.0	0.0	7465041.	7500892.	36.99	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	7555070.	7602419.	37.39	NONE	0.0
1	1	0	0	0.0	0.0	0.0	7555070.	7602419.	37.44	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	7685370.	7807040.	38.04	NONE	0.0
1	1	1	1	0.44	92717.	0.83	7778086.	7807040.	38.48	NONE	0.0
2	1	1	2	0.53	107889.	0.84	7885974.	7897069.	39.01	NONE	0.0
1	1	2	1	0.54	108321.	0.80	7994295.	8027369.	39.55	NONE	0.0
1	0	2	2	0.54	127377.	0.81	8121671.	8227973.	40.09	NONE	0.0
1	1	1	1	0.43	91901.	0.83	8213572.	8227973.	40.53	NONE	0.0
1	1	0	0	0.0	0.0	0.0	8213572.	8227973.	40.54	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	8345923.	8336294.	41.18	NONE	0.0
2	1	0	0	0.0	0.0	0.0	8345923.	8463670.	41.58	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	8435952.	8555571.	41.98	NONE	0.0
1	1	0	0	0.0	0.0	0.0	8435952.	8555571.	42.02	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	8537479.	8687922.	42.42	NONE	0.0
1	0	0	0	0.0	0.0	0.0	8537479.	8687922.	42.47	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	8629538.	8687922.	42.87	NONE	0.0
1	1	0	0	0.0	0.0	0.0	8629538.	8687922.	42.91	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	8742100.	8777951.	43.31	NONE	0.0
1	1	0	0	0.0	0.0	0.0	8742100.	8777951.	43.36	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	8832129.	8879478.	43.76	NONE	0.0
1	1	0	0	0.0	0.0	0.0	8832129.	8879478.	43.80	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	8962429.	9084099.	44.40	NONE	0.0
1	1	1	1	0.44	92717.	0.83	9055145.	9084099.	44.84	NONE	0.0
2	1	1	2	0.53	107889.	0.84	9163033.	9174128.	45.37	NONE	0.0
1	1	2	1	0.54	108321.	0.80	9271354.	9304428.	45.92	NONE	0.0
1	0	2	2	0.54	127377.	0.81	9398730.	9505032.	46.46	NONE	0.0
1	1	1	1	0.43	91901.	0.83	9490631.	9505032.	46.89	NONE	0.0
1	1	0	0	0.0	0.0	0.0	9490631.	9505032.	46.90	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	9622982.	9613353.	47.54	NONE	0.0
2	1	0	0	0.0	0.0	0.0	9622982.	9740729.	47.94	SC PR	0.40
1	1	1	1	0.40	90030.	0.83	9713011.	9832630.	48.34	NONE	0.0
1	1	0	0	0.0	0.0	0.0	9713011.	9832630.	48.39	PUSH	0.04
1	1	2	2	0.40	101527.	0.83	9814538.	9964981.	48.79	NONE	0.0
1	1	0	0	0.0	0.0	0.0	9814538.	9964981.	48.83	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	9906597.	9964981.	49.23	NONE	0.0
1	1	0	0	0.0	0.0	0.0	9906597.	9964981.	49.28	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	10019159.	10055010.	49.68	NONE	0.0
1	1	0	0	0.0	0.0	0.0	10019159.	10055010.	49.72	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	10109188.	10156537.	50.12	NONE	0.0
1	1	0	0	0.0	0.0	0.0	10109188.	10156537.	50.17	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	10239488.	10361158.	50.76	NONE	0.0
1	1	1	1	0.44	92717.	0.83	10332204.	10361158.	51.21	NONE	0.0
2	1	1	2	0.53	107889.	0.84	10440092.	10451187.	51.74	NONE	0.0
1	1	2	1	0.54	108321.	0.80	10548413.	10581487.	52.28	NONE	0.0
1	1	2	2	0.54	127377.	0.81	10675789.	10782091.	52.82	NONE	0.0
1	1	1	1	0.43	91901.	0.83	10767690.	10782091.	53.25	NONE	0.0
1	1	0	0	0.0	0.0	0.0	10767690.	10782091.	53.27	PUSH	0.01
0	1	2	2	0.54	132351.	0.81	10900041.	10890412.	53.91	NONE	0.0
2	1	0	0	0.0	0.0	0.0	10900041.	11017788.	54.31	SC PR	0.40
1	1	1	1	0.40	90030.	0.83	10990070.	11109689.	54.71	NONE	0.0
1	1	0	0	0.0	0.0	0.0	10990070.	11109689.	54.75	PUSH	0.04
1	1	2	2	0.40	101527.	0.83	11091597.	11242040.	55.15	NONE	0.0

1	0	0	0	0.0	0.0	0.0	11091597.	11242040.	55.20	PUSH	0.04
1	1	0	0	0.40	92060.	0.79	11183656.	11242040.	55.60	NONE	0.0
1	1	0	0	0.0	0.0	0.0	11183656.	11242040.	55.64	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	11296218.	11332069.	56.04	NONE	0.0
1	1	0	0	0.0	0.0	0.0	11296218.	11332069.	56.09	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	11386247.	11433596.	56.49	NONE	0.0
1	1	0	0	0.0	0.0	0.0	11386247.	11433596.	56.53	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	11516547.	11638217.	57.13	NONE	0.0
1	1	1	1	0.44	92717.	0.83	11609263.	11638217.	57.57	NONE	0.0
2	1	1	2	0.53	107889.	0.84	11717151.	11728246.	58.10	NONE	0.0
1	1	1	1	0.54	108321.	0.80	11825472.	11858546.	58.65	NONE	0.0
1	0	2	2	0.54	127377.	0.81	11952848.	12059150.	59.19	NONE	0.0
1	1	1	1	0.43	91901.	0.83	12044749.	12059150.	59.62	NONE	0.0
1	1	0	0	0.0	0.0	0.0	12044749.	12059150.	59.63	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	12177100.	12167471.	60.27	NONE	0.0
2	1	0	0	0.0	0.0	0.0	12177100.	12294847.	60.67	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	12267129.	12386748.	61.07	NONE	0.0
1	1	0	0	0.0	0.0	0.0	12267129.	12386748.	61.12	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	12368656.	12519099.	61.52	NONE	0.0
1	0	0	0	0.0	0.0	0.0	12368656.	12519099.	61.56	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	12460715.	12519099.	61.96	NONE	0.0
1	1	0	0	0.0	0.0	0.0	12460715.	12519099.	62.01	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	12573277.	12609128.	62.41	NONE	0.0
1	1	0	0	0.0	0.0	0.0	12573277.	12609128.	62.45	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	12663306.	12710655.	62.85	NONE	0.0
1	1	0	0	0.0	0.0	0.0	12663306.	12710655.	62.90	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	12793606.	12915276.	63.49	NONE	0.0
1	1	1	1	0.44	92717.	0.83	12886322.	12915276.	63.94	NONE	0.0
2	1	1	2	0.53	107889.	0.84	12994210.	13005305.	64.47	NONE	0.0
1	1	1	1	0.54	108321.	0.80	13102531.	13135605.	65.01	NONE	0.0
1	0	2	2	0.54	127377.	0.81	13229907.	13336209.	65.55	NONE	0.0
1	1	1	1	0.43	91901.	0.83	13321808.	13336209.	65.98	NONE	0.0
1	1	0	0	0.0	0.0	0.0	13321808.	13336209.	66.00	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	13454159.	13444530.	66.64	NONE	0.0
2	1	0	0	0.0	0.0	0.0	13454159.	13571906.	67.04	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	13544188.	13663807.	67.44	NONE	0.0
1	1	0	0	0.0	0.0	0.0	13544188.	13663807.	67.48	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	13645715.	13796158.	67.88	NONE	0.0
1	0	0	0	0.0	0.0	0.0	13645715.	13796158.	67.93	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	13737774.	13796158.	68.33	NONE	0.0
1	1	0	0	0.0	0.0	0.0	13737774.	13796158.	68.37	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	13850336.	13886187.	68.77	NONE	0.0
1	1	0	0	0.0	0.0	0.0	13850336.	13886187.	68.82	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	13940365.	13987714.	69.22	NONE	0.0
1	1	0	0	0.0	0.0	0.0	13940365.	13987714.	69.26	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	14070665.	14192335.	69.86	NONE	0.0
1	1	1	1	0.44	92717.	0.83	14163381.	14192335.	70.30	NONE	0.0
2	1	1	2	0.53	107889.	0.84	14271269.	14282364.	70.83	NONE	0.0
1	1	2	1	0.54	108321.	0.80	14379590.	14412664.	71.37	NONE	0.0
1	0	2	2	0.54	127377.	0.81	14506966.	14613268.	71.92	NONE	0.0
1	1	1	1	0.43	91901.	0.83	14598867.	14613268.	72.35	NONE	0.0
1	1	0	0	0.0	0.0	0.0	14598867.	14613268.	72.36	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	14731218.	14721589.	73.00	NONE	0.0
2	1	0	0	0.0	0.0	0.0	14731218.	14848965.	73.40	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	14821247.	14940866.	73.80	NONE	0.0
1	1	0	0	0.0	0.0	0.0	14821247.	14940866.	73.85	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	14922774.	15073217.	74.25	NONE	0.0
1	0	0	0	0.0	0.0	0.0	14922774.	15073217.	74.29	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	15014833.	15073217.	74.69	NONE	0.0
1	1	0	0	0.0	0.0	0.0	15014833.	15073217.	74.74	PUSH	0.04

1	1	2	2	0.40	112562.	0.80	15127395.	15163246.	75.14	NONE	0.0
1	1	0	0	0.0	0.0	0.0	15127395.	15163246.	75.18	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	15217424.	15264773.	75.58	NONE	0.0
1	1	0	0	0.0	0.0	0.0	15217424.	15264773.	75.63	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	15347724.	15469394.	76.22	NONE	0.0
1	1	1	1	0.44	92717.	0.83	15440440.	15469394.	76.67	NONE	0.0
2	1	1	2	0.53	107889.	0.84	15548328.	15559423.	77.20	NONE	0.0
1	1	2	1	0.54	108321.	0.80	15656649.	15689723.	77.74	NONE	0.0
1	0	2	2	0.54	127377.	0.81	15784025.	15890327.	78.28	NONE	0.0
1	1	1	1	0.43	91901.	0.83	15875926.	15890327.	78.71	NONE	0.0
1	1	0	0	0.0	0.0	0.0	15875926.	15890327.	78.73	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	16008277.	15998648.	79.37	NONE	0.0
2	1	0	0	0.0	0.0	0.0	16008277.	16126024.	79.77	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	16098306.	16217925.	80.17	NONE	0.0
1	1	0	0	0.0	0.0	0.0	16098306.	16217925.	80.21	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	16199833.	16350276.	80.61	NONE	0.0
1	0	0	0	0.0	0.0	0.0	16199833.	16350276.	80.66	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	16291892.	16350276.	81.06	NONE	0.0
1	1	0	0	0.0	0.0	0.0	16291892.	16350276.	81.10	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	16404454.	16440305.	81.50	NONE	0.0
1	1	0	0	0.0	0.0	0.0	16404454.	16440305.	81.55	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	16494483.	16541832.	81.95	NONE	0.0
1	1	0	0	0.0	0.0	0.0	16494483.	16541832.	81.99	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	16624783.	16746453.	82.59	NONE	0.0
1	1	1	1	0.44	92717.	0.83	16717499.	16746453.	83.03	NONE	0.0
2	1	1	2	0.53	107889.	0.84	16825376.	16836480.	83.56	NONE	0.0
1	1	2	1	0.54	108321.	0.80	16933696.	16966768.	84.10	NONE	0.0
1	0	2	2	0.54	127377.	0.81	17061072.	17167360.	84.65	NONE	0.0
1	1	1	1	0.43	91901.	0.83	17152960.	17167360.	85.08	NONE	0.0
1	1	0	0	0.0	0.0	0.0	17152960.	17167360.	85.09	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	17285296.	17275680.	85.73	NONE	0.0
2	1	0	0	0.0	0.0	0.0	17285296.	17403056.	86.13	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	17375312.	17494944.	86.53	NONE	0.0
1	1	0	0	0.0	0.0	0.0	17375312.	17494944.	86.58	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	17476832.	17627280.	86.98	NONE	0.0
1	0	0	0	0.0	0.0	0.0	17476832.	17627280.	87.02	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	17568880.	17627280.	87.42	NONE	0.0
1	1	0	0	0.0	0.0	0.0	17568880.	17627280.	87.46	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	17681440.	17717296.	87.86	NONE	0.0
1	1	0	0	0.0	0.0	0.0	17681440.	17717296.	87.91	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	17771456.	17818816.	88.31	NONE	0.0
1	1	0	0	0.0	0.0	0.0	17771456.	17818816.	88.35	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	17901744.	18023424.	88.95	NONE	0.0
1	1	1	1	0.44	92717.	0.83	17994448.	18023424.	89.40	NONE	0.0
2	1	1	2	0.53	107889.	0.84	18102336.	18113440.	89.92	NONE	0.0
1	1	2	1	0.54	108321.	0.80	18210656.	18243728.	90.47	NONE	0.0
1	0	2	2	0.54	127377.	0.81	18338032.	18444320.	91.01	NONE	0.0
1	1	1	1	0.43	91901.	0.83	18429920.	18444320.	91.44	NONE	0.0
1	1	0	0	0.0	0.0	0.0	18429920.	18444320.	91.45	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	18562256.	18552640.	92.10	NONE	0.0
2	1	0	0	0.0	0.0	0.0	18562256.	18680016.	92.50	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	18652272.	18771904.	92.90	NONE	0.0
1	1	0	0	0.0	0.0	0.0	18652272.	18771904.	92.94	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	18753792.	18904240.	93.34	NONE	0.0
1	0	0	0	0.0	0.0	0.0	18753792.	18904240.	93.38	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	18845840.	18904240.	93.78	NONE	0.0
1	1	0	0	0.0	0.0	0.0	18845840.	18904240.	93.83	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	18958400.	18994256.	94.23	NONE	0.0
1	1	0	0	0.0	0.0	0.0	18958400.	18994256.	94.27	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	19048416.	19095776.	94.67	NONE	0.0

1	1	0	0	0.0	0.0	0.0	19048416.	19095776.	94.72	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	19178704.	19300384.	95.31	NONE	0.0
1	1	1	1	0.44	92717.	0.83	19271408.	19300384.	95.76	NONE	0.0
2	1	2	2	0.53	107889.	0.84	19379296.	19390400.	96.29	NONE	0.0
1	1	1	1	0.54	108321.	0.80	19487616.	19520688.	96.83	NONE	0.0
1	0	2	2	0.54	127377.	0.81	19614992.	19721280.	97.37	NONE	0.0
1	1	1	1	0.43	91901.	0.83	19706880.	19721280.	97.81	NONE	0.0
1	1	0	0	0.0	0.0	0.0	19706880.	19721280.	97.82	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	19839216.	19829600.	98.46	NONE	0.0
2	1	0	0	0.0	0.0	0.0	19839216.	19956976.	98.86	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	19929232.	20048864.	99.26	NONE	0.0
1	1	0	0	0.0	0.0	0.0	19929232.	20048864.	99.30	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	20030752.	20181200.	99.70	NONE	0.0
1	0	0	0	0.0	0.0	0.0	20030752.	20181200.	99.75	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	20122800.	20181200.	100.15	NONE	0.0
1	1	0	0	0.0	0.0	0.0	20122800.	20181200.	100.19	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	20235360.	20271216.	100.59	NONE	0.0
1	1	0	0	0.0	0.0	0.0	20235360.	20271216.	100.64	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	20325376.	20372736.	101.04	NONE	0.0
1	1	0	0	0.0	0.0	0.0	20325376.	20372736.	101.08	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	20455664.	20577344.	101.68	NONE	0.0
1	1	1	1	0.44	92717.	0.83	20548368.	20577344.	102.12	NONE	0.0
2	1	1	2	0.53	107889.	0.84	20656256.	20667360.	102.65	NONE	0.0
1	1	2	1	0.54	108321.	0.80	20764576.	20797648.	103.20	NONE	0.0
1	0	2	2	0.54	127377.	0.81	20891952.	20998240.	103.74	NONE	0.0
1	1	1	1	0.43	91901.	0.83	20983840.	20998240.	104.17	NONE	0.0
1	1	0	0	0.0	0.0	0.0	20983840.	20998240.	104.18	PUSH	0.01
2	1	2	2	0.64	132351.	0.81	21116176.	21106560.	104.82	NONE	0.0
2	1	0	0	0.0	0.0	0.0	21116176.	21233936.	105.22	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	21206192.	21325824.	105.62	NONE	0.0
1	1	0	0	0.0	0.0	0.0	21206192.	21325824.	105.67	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	21307712.	21458160.	106.07	NONE	0.0
1	0	0	0	0.0	0.0	0.0	21307712.	21458160.	106.11	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	21399760.	21458160.	106.51	NONE	0.0
1	1	0	0	0.0	0.0	0.0	21399760.	21458160.	106.56	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	21512320.	21548176.	106.96	NONE	0.0
1	1	0	0	0.0	0.0	0.0	21512320.	21548176.	107.00	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	21602336.	21649696.	107.40	NONE	0.0
1	1	0	0	0.0	0.0	0.0	21602336.	21649696.	107.45	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	21732624.	21854304.	108.04	NONE	0.0
1	1	1	1	0.44	92717.	0.83	21825328.	21854304.	108.49	NONE	0.0
2	1	1	2	0.53	107889.	0.84	21933216.	21944320.	109.02	NONE	0.0
1	1	2	1	0.54	108321.	0.80	22041536.	22074608.	109.56	NONE	0.0
1	0	2	2	0.54	127377.	0.81	22168912.	22275200.	110.10	NONE	0.0
1	1	1	1	0.43	91901.	0.83	22260800.	22275200.	110.53	NONE	0.0
1	1	0	0	0.0	0.0	0.0	22260800.	22275200.	110.55	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	22393136.	22383520.	111.19	NONE	0.0
2	1	0	0	0.0	0.0	0.0	22393136.	22510896.	111.59	SC PR	0.40
1	2	1	1	0.40	90030.	0.83	22483152.	22602784.	111.99	NONE	0.0
1	1	0	0	0.0	0.0	0.0	22483152.	22602784.	112.03	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	22584672.	22735120.	112.43	NONE	0.0
1	0	0	0	0.0	0.0	0.0	22584672.	22735120.	112.48	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	22676720.	22735120.	112.88	NONE	0.0
1	1	0	0	0.0	0.0	0.0	22676720.	22735120.	112.92	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	22789280.	22825136.	113.32	NONE	0.0
1	1	0	0	0.0	0.0	0.0	22789280.	22825136.	113.37	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	22879296.	22926656.	113.77	NONE	0.0
1	1	0	0	0.0	0.0	0.0	22879296.	22926656.	113.81	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	23009584.	23131264.	114.41	NONE	0.0
1	1	1	1	0.44	92717.	0.83	23102288.	23131264.	114.85	NONE	0.0

2	1	1	2	0.53	107889.	0.84	23210176.	23221280.	115.38	NONE	0.0
1	1	2	1	0.54	108321.	0.80	23318496.	23351568.	115.92	NONE	0.0
1	0	2	2	0.54	127377.	0.81	23445872.	23552160.	116.47	NONE	0.0
1	1	1	1	0.43	91901.	0.83	23537760.	23552160.	116.90	NONE	0.0
1	1	0	0	0.0	0.0	0.0	23537760.	23552160.	116.91	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	23670096.	23660480.	117.55	NONE	0.0
2	1	0	0	0.0	0.0	0.0	23670096.	23787856.	117.95	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	23760112.	23879744.	118.35	NONE	0.0
1	1	0	0	0.0	0.0	0.0	23760112.	23879744.	118.40	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	23861632.	24012080.	118.80	NONE	0.0
1	0	0	0	0.0	0.0	0.0	23861632.	24012080.	118.84	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	23953680.	24012080.	119.24	NONE	0.0
1	1	0	0	0.0	0.0	0.0	23953680.	24012080.	119.29	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	24066240.	24102096.	119.69	NONE	0.0
1	1	0	0	0.0	0.0	0.0	24066240.	24102096.	119.73	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	24156256.	24203616.	120.13	NONE	0.0
1	1	0	0	0.0	0.0	0.0	24156256.	24203616.	120.18	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	24286544.	24408224.	120.77	NONE	0.0
1	1	1	1	0.44	92717.	0.83	24379248.	24408224.	121.22	NONE	0.0
2	1	1	2	0.53	107889.	0.84	24487136.	24498240.	121.75	NONE	0.0
1	1	2	1	0.54	108321.	0.80	24595456.	24628528.	122.29	NONE	0.0
1	0	2	2	0.54	127377.	0.81	24722832.	24829120.	122.83	NONE	0.0
1	1	1	1	0.43	91901.	0.83	24814720.	24829120.	123.26	NONE	0.0
1	1	0	0	0.0	0.0	0.0	24814720.	24829120.	123.28	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	24947056.	24937440.	123.92	NONE	0.0
2	1	0	0	0.0	0.0	0.0	24947056.	25064816.	124.32	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	25037072.	25156704.	124.72	NONE	0.0
1	1	0	0	0.0	0.0	0.0	25037072.	25156704.	124.76	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	25138592.	25289040.	125.16	NONE	0.0
1	0	0	0	0.0	0.0	0.0	25138592.	25289040.	125.21	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	25230640.	25289040.	125.61	NONE	0.0
1	1	0	0	0.0	0.0	0.0	25230640.	25289040.	125.65	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	25343200.	25379056.	126.05	NONE	0.0
1	1	0	0	0.0	0.0	0.0	25343200.	25379056.	126.10	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	25433216.	25480576.	126.50	NONE	0.0
1	1	0	0	0.0	0.0	0.0	25433216.	25480576.	126.54	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	25563504.	25685184.	127.14	NONE	0.0
1	1	1	1	0.44	92717.	0.83	25656208.	25685184.	127.58	NONE	0.0
2	1	1	2	0.53	107889.	0.84	25764096.	25775200.	128.11	NONE	0.0
1	1	2	1	0.54	108321.	0.80	25872416.	25905488.	128.65	NONE	0.0
1	0	2	2	0.54	127377.	0.81	25999792.	26106080.	129.20	NONE	0.0
1	1	1	1	0.43	91901.	0.83	26091680.	26106080.	129.63	NONE	0.0
1	1	0	0	0.0	0.0	0.0	26091680.	26106080.	129.64	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	26224016.	26214400.	130.28	NONE	0.0
2	1	0	0	0.0	0.0	0.0	26224016.	26341776.	130.68	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	26314032.	26433664.	131.08	NONE	0.0
1	1	0	0	0.0	0.0	0.0	26314032.	26433664.	131.13	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	26415552.	26566000.	131.53	NONE	0.0
1	0	0	0	0.0	0.0	0.0	26415552.	26566000.	131.57	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	26507600.	26566000.	131.97	NONE	0.0
1	1	0	0	0.0	0.0	0.0	26507600.	26566000.	132.02	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	26620160.	26656016.	132.42	NONE	0.0
1	1	0	0	0.0	0.0	0.0	26620160.	26656016.	132.46	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	26710176.	26757536.	132.86	NONE	0.0
1	1	0	0	0.0	0.0	0.0	26710176.	26757536.	132.91	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	26840464.	26962144.	133.50	NONE	0.0
1	1	1	1	0.44	92717.	0.83	26933168.	26962144.	133.95	NONE	0.0
2	1	1	2	0.53	107889.	0.84	27041056.	27052160.	134.47	NONE	0.0
1	1	2	1	0.54	108321.	0.80	27149376.	27182448.	135.02	NONE	0.0
1	0	2	2	0.54	127377.	0.81	27276752.	27383040.	135.56	NONE	0.0

1	1	1	1	0.43	91901.	0.83	27368640.	27383040.	135.99	NONE	0.0
0	1	0	0	0.0	0.0	0.0	27368640.	27383040.	136.01	PUSH	0.01
2	1	2	2	0.64	132351.	0.81	27500976.	27491360.	136.65	NONE	0.0
1	0	0	0	0.0	0.0	0.0	27500976.	27618736.	137.05	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	27590992.	27710624.	137.45	NONE	0.0
1	1	0	0	0.0	0.0	0.0	27590992.	27710624.	137.49	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	27692512.	27842960.	137.89	NONE	0.0
1	0	0	0	0.0	0.0	0.0	27692512.	27842960.	137.94	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	27784560.	27842960.	138.34	NONE	0.0
1	1	0	0	0.0	0.0	0.0	27784560.	27842960.	138.38	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	27897120.	27932976.	138.78	NONE	0.0
1	1	0	0	0.0	0.0	0.0	27897120.	27932976.	138.82	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	27987136.	28034496.	139.22	NONE	0.0
1	1	0	0	0.0	0.0	0.0	27987136.	28034496.	139.27	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	28117424.	28239104.	139.87	NONE	0.0
1	1	1	1	0.44	92717.	0.83	28210128.	28239104.	140.31	NONE	0.0
2	1	1	2	0.53	107889.	0.84	28318016.	28329120.	140.84	NONE	0.0
1	1	1	1	0.54	108321.	0.80	28426336.	28459408.	141.38	NONE	0.0
1	0	2	2	0.54	127377.	0.81	28553712.	28660000.	141.92	NONE	0.0
1	1	1	1	0.43	91901.	0.83	28645600.	28660000.	142.36	NONE	0.0
1	1	0	0	0.0	0.0	0.0	28645600.	28660000.	142.37	PUSH	0.01
0	1	1	2	0.64	132351.	0.81	28777936.	28768320.	143.01	NONE	0.0
2	1	0	0	0.0	0.0	0.0	28777936.	28895696.	143.41	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	28867952.	28987584.	143.81	NONE	0.0
1	1	0	0	0.0	0.0	0.0	28867952.	28987584.	143.85	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	28969472.	29119920.	144.25	NONE	0.0
1	0	0	0	0.0	0.0	0.0	28969472.	29119920.	144.30	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	29061520.	29119920.	144.70	NONE	0.0
1	1	0	0	0.0	0.0	0.0	29061520.	29119920.	144.74	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	29174080.	29209936.	145.14	NONE	0.0
1	1	0	0	0.0	0.0	0.0	29174080.	29209936.	145.19	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	29264096.	29311456.	145.59	NONE	0.0
1	1	0	0	0.0	0.0	0.0	29264096.	29311456.	145.63	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	29394384.	29516064.	146.23	NONE	0.0
1	1	1	1	0.44	92717.	0.83	29487088.	29516064.	146.67	NONE	0.0
2	1	1	2	0.53	107889.	0.84	29594976.	29606080.	147.20	NONE	0.0
1	1	1	1	0.54	108321.	0.80	29703296.	29736368.	147.75	NONE	0.0
1	0	2	2	0.54	127377.	0.81	29830672.	29936960.	148.29	NONE	0.0
1	1	1	1	0.43	91901.	0.83	29922560.	29936960.	148.72	NONE	0.0
1	1	0	0	0.0	0.0	0.0	29922560.	29936960.	148.73	PUSH	0.01
0	1	1	2	0.64	132351.	0.81	30054896.	30045280.	149.37	NONE	0.0
2	1	0	0	0.0	0.0	0.0	30054896.	30172656.	149.77	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	30144912.	30264544.	150.17	NONE	0.0
1	1	0	0	0.0	0.0	0.0	30144912.	30264544.	150.22	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	30246432.	30396880.	150.62	NONE	0.0
1	0	0	0	0.0	0.0	0.0	30246432.	30396880.	150.66	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	30338480.	30396880.	151.06	NONE	0.0
1	1	0	0	0.0	0.0	0.0	30338480.	30396880.	151.11	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	30451040.	30486896.	151.51	NONE	0.0
1	1	0	0	0.0	0.0	0.0	30451040.	30486896.	151.55	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	30541056.	30588416.	151.95	NONE	0.0
1	1	0	0	0.0	0.0	0.0	30541056.	30588416.	152.00	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	30671344.	30793024.	152.59	NONE	0.0
1	1	1	1	0.44	92717.	0.83	30764048.	30793024.	153.04	NONE	0.0
2	1	1	2	0.53	107889.	0.84	30871936.	30883040.	153.57	NONE	0.0
1	1	1	1	0.54	108321.	0.80	30980256.	31013328.	154.11	NONE	0.0
1	0	2	2	0.54	127377.	0.81	31107632.	31213920.	154.65	NONE	0.0
1	1	1	1	0.43	91901.	0.83	31199520.	31213920.	155.08	NONE	0.0
0	1	0	0	0.0	0.0	0.0	31199520.	31213920.	155.10	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	31331856.	31322240.	155.74	NONE	0.0

2	1	0	0	0.0	0.0	0.0	31331856.	31449616.	156.14	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	31421872.	31541504.	156.54	NONE	0.0
1	0	0	0	0.0	0.0	0.0	31421872.	31541504.	156.58	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	31523392.	31673840.	156.98	NONE	0.0
1	0	0	0	0.0	0.0	0.0	31523392.	31673840.	157.03	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	31615440.	31673840.	157.43	NONE	0.0
1	1	0	0	0.0	0.0	0.0	31615440.	31673840.	157.47	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	31728000.	31763856.	157.87	NONE	0.0
1	1	0	0	0.0	0.0	0.0	31728000.	31763856.	157.92	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	31818016.	31865376.	158.32	NONE	0.0
1	1	0	0	0.0	0.0	0.0	31818016.	31865376.	158.36	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	31948304.	32069984.	158.96	NONE	0.0
1	1	1	1	0.44	92717.	0.83	32041008.	32069984.	159.40	NONE	0.0
2	1	1	2	0.53	107889.	0.84	32148896.	32160000.	159.93	NONE	0.0
1	1	2	1	0.54	108321.	0.80	32257216.	32290288.	160.48	NONE	0.0
1	0	2	2	0.54	127377.	0.81	32384592.	32490880.	161.02	NONE	0.0
1	1	1	1	0.43	91901.	0.83	32476480.	32490880.	161.45	NONE	0.0
1	1	0	0	0.0	0.0	0.0	32476480.	32490880.	161.46	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	32608816.	32599200.	162.10	NONE	0.0
2	1	0	0	0.0	0.0	0.0	32608816.	32726576.	162.50	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	32698832.	32818464.	162.90	NONE	0.0
1	1	0	0	0.0	0.0	0.0	32698832.	32818464.	162.95	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	32800352.	32950800.	163.35	NONE	0.0
1	0	0	0	0.0	0.0	0.0	32800352.	32950800.	163.39	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	32892400.	32950800.	163.79	NONE	0.0
1	1	0	0	0.0	0.0	0.0	32892400.	32950800.	163.84	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	33004960.	33040816.	164.24	NONE	0.0
1	1	0	0	0.0	0.0	0.0	33004960.	33040816.	164.28	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	33094976.	33142336.	164.68	NONE	0.0
1	1	0	0	0.0	0.0	0.0	33094976.	33142336.	164.73	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	33275264.	33346944.	165.32	NONE	0.0
1	1	1	1	0.44	92717.	0.83	33317968.	33346944.	165.77	NONE	0.0
2	1	1	2	0.53	107889.	0.84	33425856.	33436960.	166.30	NONE	0.0
1	1	2	1	0.54	108321.	0.80	33534176.	33567248.	166.84	NONE	0.0
1	0	2	2	0.54	127377.	0.81	33661552.	33767840.	167.38	NONE	0.0
1	1	1	1	0.43	91901.	0.83	33753440.	33767840.	167.81	NONE	0.0
1	1	0	0	0.0	0.0	0.0	33753440.	33767840.	167.83	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	33885776.	33876160.	168.47	NONE	0.0
2	1	0	0	0.0	0.0	0.0	33885776.	34003536.	168.87	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	33975792.	34095424.	169.27	NONE	0.0
1	1	0	0	0.0	0.0	0.0	33975792.	34095424.	169.31	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	34077312.	34227760.	169.71	NONE	0.0
1	0	0	0	0.0	0.0	0.0	34077312.	34227760.	169.76	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	34169360.	34227760.	170.16	NONE	0.0
1	1	0	0	0.0	0.0	0.0	34169360.	34227760.	170.20	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	34281920.	34317776.	170.60	NONE	0.0
1	1	0	0	0.0	0.0	0.0	34281920.	34317776.	170.65	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	34371936.	34419296.	171.05	NONE	0.0
1	1	0	0	0.0	0.0	0.0	34371936.	34419296.	171.09	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	34502224.	34623904.	171.69	NONE	0.0
1	1	1	1	0.44	92717.	0.83	34594928.	34623904.	172.13	NONE	0.0
2	1	1	2	0.53	107889.	0.84	34702816.	34713920.	172.66	NONE	0.0
1	1	2	1	0.54	108321.	0.80	34811136.	34844208.	173.20	NONE	0.0
1	1	2	2	0.54	127377.	0.81	34938512.	35044800.	173.75	NONE	0.0
1	1	1	1	0.43	91901.	0.83	35030400.	35044800.	174.18	NONE	0.0
1	1	0	0	0.0	0.0	0.0	35030400.	35044800.	174.19	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	35162736.	35153120.	174.83	NONE	0.0
2	1	0	0	0.0	0.0	0.0	35162736.	35280496.	175.23	SCPR	0.40
1	1	1	1	0.40	90030.	0.83	35252752.	35372384.	175.63	NONE	0.0
1	1	0	0	0.0	0.0	0.0	35252752.	35372384.	175.68	PUSH	0.04

1	0	1	2	0.40	101527.	0.83	35354272.	35504720.	176.08	NONE	0.0
1	0	0	0	0.0	0.0	0.0	35354272.	35504720.	176.12	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	35448320.	35504720.	176.52	NONE	0.0
1	1	0	0	0.0	0.0	0.0	35448320.	35504720.	176.57	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	35558880.	35594736.	176.97	NONE	0.0
1	1	0	0	0.0	0.0	0.0	35558880.	35594736.	177.01	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	35648896.	35696256.	177.41	NONE	0.0
1	1	0	0	0.0	0.0	0.0	35648896.	35696256.	177.46	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	35779184.	35900864.	178.05	NONE	0.0
1	1	1	1	0.44	92717.	0.83	35871888.	35900864.	178.50	NONE	0.0
2	1	1	2	0.53	107889.	0.84	35979776.	35990880.	179.03	NONE	0.0
1	1	2	1	0.54	108321.	0.80	36088096.	36121168.	179.57	NONE	0.0
1	0	2	2	0.54	127377.	0.81	36215472.	36321760.	180.11	NONE	0.0
1	1	1	1	0.43	91901.	0.83	36307360.	36321760.	180.54	NONE	0.0
1	1	0	0	0.0	0.0	0.0	36307360.	36321760.	180.56	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	36439696.	36430080.	181.20	NONE	0.0
2	1	0	0	0.0	0.0	0.0	36439696.	36557456.	181.60	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	36529712.	36649344.	182.00	NONE	0.0
1	1	0	0	0.0	0.0	0.0	36529712.	36649344.	182.04	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	36631232.	36781680.	182.44	NONE	0.0
1	0	0	0	0.0	0.0	0.0	36631232.	36781680.	182.49	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	36723280.	36781680.	182.89	NONE	0.0
1	1	0	0	0.0	0.0	0.0	36723280.	36781680.	182.93	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	36835840.	36871696.	183.33	NONE	0.0
1	0	0	0	0.0	0.0	0.0	36835840.	36871696.	183.38	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	36925856.	36973216.	183.78	NONE	0.0
1	1	0	0	0.0	0.0	0.0	36925856.	36973216.	183.82	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	37056144.	37177824.	184.42	NONE	0.0
1	1	1	1	0.44	92717.	0.83	37148848.	37177824.	184.86	NONE	0.0
2	1	1	2	0.53	107889.	0.84	37256736.	37267840.	185.39	NONE	0.0
1	1	2	1	0.54	108321.	0.80	37365056.	37398128.	185.93	NONE	0.0
1	0	2	2	0.54	127377.	0.81	37492432.	37598720.	186.48	NONE	0.0
1	1	1	1	0.43	91901.	0.83	37584320.	37598720.	186.91	NONE	0.0
1	0	0	0	0.0	0.0	0.0	37584320.	37598720.	186.92	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	37716656.	37707040.	187.56	NONE	0.0
2	1	0	0	0.0	0.0	0.0	37716656.	37834416.	187.96	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	37806672.	37926304.	188.36	NONE	0.0
1	1	0	0	0.0	0.0	0.0	37806672.	37926304.	188.41	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	37908192.	38058640.	188.81	NONE	0.0
1	0	0	0	0.0	0.0	0.0	37908192.	38058640.	188.85	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	38000240.	38058640.	189.25	NONE	0.0
1	1	0	0	0.0	0.0	0.0	38000240.	38058640.	189.30	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	38112800.	38148656.	189.70	NONE	0.0
1	1	0	0	0.0	0.0	0.0	38112800.	38148656.	189.74	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	38202816.	38250176.	190.14	NONE	0.0
1	1	0	0	0.0	0.0	0.0	38202816.	38250176.	190.18	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	38333104.	38454784.	190.78	NONE	0.0
1	1	1	1	0.44	92717.	0.83	38425808.	38454784.	191.23	NONE	0.0
2	1	1	2	0.53	107889.	0.84	38533696.	38544800.	191.75	NONE	0.0
1	1	2	1	0.54	108321.	0.80	38642016.	38675088.	192.30	NONE	0.0
1	1	2	2	0.54	127377.	0.81	38769392.	38875680.	192.84	NONE	0.0
1	1	1	1	0.43	91901.	0.83	38861280.	38875680.	193.27	NONE	0.0
1	0	0	0	0.0	0.0	0.0	38861280.	38875680.	193.28	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	38993616.	38984000.	193.93	NONE	0.0
2	1	0	0	0.0	0.0	0.0	38993616.	39111376.	194.33	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	39083632.	39203264.	194.73	NONE	0.0
1	1	0	0	0.0	0.0	0.0	39083632.	39203264.	194.77	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	39185152.	39335600.	195.17	NONE	0.0
1	0	0	0	0.0	0.0	0.0	39185152.	39335600.	195.21	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	39277200.	39335600.	195.61	NONE	0.0

1	1	0	0	0.0	0.0	0.0	39277200.	39335600.	195.66	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	39389760.	39425616.	196.06	NONE	0.0
1	1	0	0	0.0	0.0	0.0	39389760.	39425616.	196.10	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	39479776.	39527136.	196.50	NONE	0.0
1	1	0	0	0.0	0.0	0.0	39479776.	39527136.	196.55	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	39610064.	39731744.	197.14	NONE	0.0
1	1	1	1	0.44	92717.	0.83	39702768.	39731744.	197.59	NONE	0.0
2	1	1	2	0.53	107889.	0.84	39810656.	39821760.	198.12	NONE	0.0
1	1	2	1	0.54	108321.	0.80	39918976.	39952048.	198.66	NONE	0.0
1	0	2	2	0.54	127377.	0.81	40046352.	40152640.	199.20	NONE	0.0
1	1	1	1	0.43	91901.	0.83	40138240.	40152640.	199.64	NONE	0.0
1	1	0	0	0.0	0.0	0.0	40138240.	40152640.	199.65	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	40270576.	40260960.	200.29	NONE	0.0
2	1	0	0	0.0	0.0	0.0	40270576.	40388336.	200.69	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	40360592.	40480224.	201.09	NONE	0.0
1	1	0	0	0.0	0.0	0.0	40360592.	40480224.	201.13	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	40462112.	40612560.	201.53	NONE	0.0
1	0	0	0	0.0	0.0	0.0	40462112.	40612560.	201.58	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	40554160.	40612560.	201.98	NONE	0.0
1	1	0	0	0.0	0.0	0.0	40554160.	40612560.	202.02	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	40666720.	40702576.	202.42	NONE	0.0
1	1	0	0	0.0	0.0	0.0	40666720.	40702576.	202.47	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	40756736.	40804096.	202.87	NONE	0.0
1	1	0	0	0.0	0.0	0.0	40756736.	40804096.	202.91	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	40887024.	41008704.	203.51	NONE	0.0
1	1	1	1	0.44	92717.	0.83	40979728.	41008704.	203.95	NONE	0.0
2	1	1	2	0.53	107889.	0.84	41087616.	41098720.	204.48	NONE	0.0
1	1	2	1	0.54	108321.	0.80	41195936.	41229008.	205.03	NONE	0.0
1	0	2	2	0.54	127377.	0.81	41323312.	41429600.	205.57	NONE	0.0
1	1	1	1	0.43	91901.	0.83	41415200.	41429600.	206.00	NONE	0.0
1	1	0	0	0.0	0.0	0.0	41415200.	41429600.	206.01	PUSH	0.01
2	1	2	2	0.64	132351.	0.81	41547536.	41537920.	206.65	NONE	0.0
2	1	0	0	0.0	0.0	0.0	41547536.	41665296.	207.05	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	41637552.	41757184.	207.45	NONE	0.0
1	1	0	0	0.0	0.0	0.0	41637552.	41757184.	207.50	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	41739072.	41889520.	207.90	NONE	0.0
1	0	0	0	0.0	0.0	0.0	41739072.	41889520.	207.94	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	41831120.	41889520.	208.34	NONE	0.0
1	1	0	0	0.0	0.0	0.0	41831120.	41889520.	208.39	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	41943680.	41979536.	208.79	NONE	0.0
1	1	0	0	0.0	0.0	0.0	41943680.	41979536.	208.83	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	42033696.	42081056.	209.23	NONE	0.0
1	1	0	0	0.0	0.0	0.0	42033696.	42081056.	209.28	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	42163984.	42285664.	209.87	NONE	0.0
1	1	1	1	0.44	92717.	0.83	42256688.	42285664.	210.32	NONE	0.0
2	1	1	2	0.53	107889.	0.84	42364576.	42375680.	210.85	NONE	0.0
1	1	2	1	0.54	108321.	0.80	42472896.	42505968.	211.39	NONE	0.0
1	0	2	2	0.54	127377.	0.81	42600272.	42706560.	211.93	NONE	0.0
1	1	1	1	0.43	91901.	0.83	42692160.	42706560.	212.36	NONE	0.0
1	1	0	0	0.0	0.0	0.0	42692160.	42706560.	212.38	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	42824496.	42814880.	213.02	NONE	0.0
2	1	0	0	0.0	0.0	0.0	42824496.	42942256.	213.42	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	42914512.	43034144.	213.82	NONE	0.0
1	1	0	0	0.0	0.0	0.0	42914512.	43034144.	213.86	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	43016032.	43166480.	214.26	NONE	0.0
1	0	0	0	0.0	0.0	0.0	43016032.	43166480.	214.31	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	43108080.	43166480.	214.71	NONE	0.0
1	1	0	0	0.0	0.0	0.0	43108080.	43166480.	214.75	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	43220640.	43256496.	215.15	NONE	0.0
1	1	0	0	0.0	0.0	0.0	43220640.	43256496.	215.20	PUSH	0.04

1	1	1	1	0.40	90030.	0.83	43310656.	43358016.	215.60	NONE	0.0
1	1	1	1	0.0	0.0	0.0	43310656.	43358016.	215.64	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	43440944.	43562624.	216.24	NONE	0.0
1	1	1	1	0.44	92717.	0.83	43533648.	43562624.	216.68	NONE	0.0
2	1	1	2	0.53	107889.	0.84	43641536.	43652640.	217.21	NONE	0.0
1	1	2	1	0.54	108321.	0.80	43749856.	43782928.	217.75	NONE	0.0
1	0	2	2	0.54	127377.	0.81	43877232.	43983520.	218.30	NONE	0.0
1	1	1	1	0.43	91901.	0.83	43969120.	43983520.	218.73	NONE	0.0
1	1	0	0	0.0	0.0	0.0	43969120.	43983520.	218.74	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	44101456.	44091840.	219.38	NONE	0.0
2	1	0	0	0.0	0.0	0.0	44101456.	44219216.	219.78	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	44191472.	44311104.	220.18	NONE	0.0
1	1	0	0	0.0	0.0	0.0	44191472.	44311104.	220.23	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	44292992.	44443440.	220.63	NONE	0.0
1	0	0	0	0.0	0.0	0.0	44292992.	44443440.	220.67	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	44385040.	44443440.	221.07	NONE	0.0
1	1	0	0	0.0	0.0	0.0	44385040.	44443440.	221.12	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	44497600.	44533456.	221.52	NONE	0.0
1	1	0	0	0.0	0.0	0.0	44497600.	44533456.	221.56	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	44587616.	44634976.	221.96	NONE	0.0
1	1	0	0	0.0	0.0	0.0	44587616.	44634976.	222.01	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	44717904.	44839584.	222.60	NONE	0.0
1	1	1	1	0.44	92717.	0.83	44810608.	44839584.	223.05	NONE	0.0
2	1	1	2	0.53	107889.	0.84	44918496.	44929600.	223.58	NONE	0.0
1	1	2	1	0.54	108321.	0.80	45026816.	45059888.	224.12	NONE	0.0
1	0	2	2	0.54	127377.	0.81	45154192.	45260480.	224.66	NONE	0.0
1	1	1	1	0.43	91901.	0.83	45246080.	45260480.	225.09	NONE	0.0
1	1	0	0	0.0	0.0	0.0	45246080.	45260480.	225.11	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	45378416.	45368800.	225.75	NONE	0.0
2	1	0	0	0.0	0.0	0.0	45378416.	45496176.	226.15	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	45468432.	45588064.	226.55	NONE	0.0
1	1	0	0	0.0	0.0	0.0	45468432.	45588064.	226.59	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	45569952.	45720400.	226.99	NONE	0.0
1	0	0	0	0.0	0.0	0.0	45569952.	45720400.	227.04	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	45662000.	45720400.	227.44	NONE	0.0
1	1	0	0	0.0	0.0	0.0	45662000.	45720400.	227.48	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	45774560.	45810416.	227.88	NONE	0.0
1	1	0	0	0.0	0.0	0.0	45774560.	45810416.	227.93	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	45864576.	45911936.	228.33	NONE	0.0
1	1	0	0	0.0	0.0	0.0	45864576.	45911936.	228.37	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	45994864.	46116544.	228.97	NONE	0.0
1	1	1	1	0.44	92717.	0.83	46087568.	46116544.	229.41	NONE	0.0
2	1	1	2	0.53	107889.	0.84	46195456.	46206560.	229.94	NONE	0.0
1	1	2	1	0.54	108321.	0.80	46303776.	46336848.	230.48	NONE	0.0
1	0	2	2	0.54	127377.	0.81	46431152.	46537440.	231.03	NONE	0.0
1	1	1	1	0.43	91901.	0.83	46523040.	46537440.	231.46	NONE	0.0
1	1	0	0	0.0	0.0	0.0	46523040.	46537440.	231.47	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	46655376.	46645760.	232.11	NONE	0.0
2	1	0	0	0.0	0.0	0.0	46655376.	46773136.	232.51	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	46745392.	46865024.	232.91	NONE	0.0
1	1	0	0	0.0	0.0	0.0	46745392.	46865024.	232.96	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	46846912.	46997360.	233.36	NONE	0.0
1	0	0	0	0.0	0.0	0.0	46846912.	46997360.	233.40	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	46938960.	46997360.	233.80	NONE	0.0
1	1	0	0	0.0	0.0	0.0	46938960.	46997360.	233.85	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	47051520.	47087376.	234.25	NONE	0.0
1	1	0	0	0.0	0.0	0.0	47051520.	47087376.	234.29	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	47141536.	47188896.	234.69	NONE	0.0
1	1	0	0	0.0	0.0	0.0	47141536.	47188896.	234.74	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	47271824.	47393504.	235.33	NONE	0.0

1	1	1	1	0.44	92717.	0.83	47364528.	47393504.	235.78	NONE	0.0
2	1	1	2	0.53	107889.	0.84	47472416.	47483520.	236.31	NONE	0.0
1	1	2	1	0.54	108321.	0.80	47580736.	47613808.	236.85	NONE	0.0
1	0	2	2	0.54	127377.	0.81	47708112.	47814400.	237.39	NONE	0.0
1	1	1	1	0.43	91901.	0.83	47800000.	47814400.	237.82	NONE	0.0
1	1	0	0	0.0	0.0	0.0	47800000.	47814400.	237.84	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	47932336.	47922720.	238.48	NONE	0.0
2	1	0	0	0.0	0.0	0.0	47932336.	48050096.	238.88	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	48022352.	48141984.	239.28	NONE	0.0
1	1	0	0	0.0	0.0	0.0	48022352.	48141984.	239.32	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	48123872.	48274320.	239.72	NONE	0.0
1	0	0	0	0.0	0.0	0.0	48123872.	48274320.	239.77	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	48215920.	48274320.	240.17	NONE	0.0
1	1	0	0	0.0	0.0	0.0	48215920.	48274320.	240.21	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	48328480.	48364336.	240.61	NONE	0.0
1	1	0	0	0.0	0.0	0.0	48328480.	48364336.	240.65	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	48418496.	48465856.	241.05	NONE	0.0
1	1	0	0	0.0	0.0	0.0	48418496.	48465856.	241.10	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	48548784.	48670464.	241.70	NONE	0.0
1	1	1	1	0.44	92717.	0.83	48641488.	48670464.	242.14	NONE	0.0
2	1	1	2	0.53	107889.	0.84	48749376.	48760480.	242.67	NONE	0.0
1	1	1	1	0.54	108321.	0.80	48857696.	48890768.	243.21	NONE	0.0
1	0	2	2	0.54	127377.	0.81	48985072.	49091360.	243.75	NONE	0.0
1	1	1	1	0.43	91901.	0.83	49076960.	49091360.	244.19	NONE	0.0
1	1	0	0	0.0	0.0	0.0	49076960.	49091360.	244.20	PUSH	0.01
0	1	2	2	0.54	132351.	0.81	49209296.	49199680.	244.84	NONE	0.0
2	1	0	0	0.0	0.0	0.0	49209296.	49327056.	245.24	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	49299312.	49418944.	245.64	NONE	0.0
1	1	0	0	0.0	0.0	0.0	49299312.	49418944.	245.68	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	49400832.	49551280.	246.08	NONE	0.0
1	0	0	0	0.0	0.0	0.0	49400832.	49551280.	246.13	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	49492880.	49551280.	246.53	NONE	0.0
1	1	0	0	0.0	0.0	0.0	49492880.	49551280.	246.57	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	49605440.	49641296.	246.97	NONE	0.0
1	1	0	0	0.0	0.0	0.0	49605440.	49641296.	247.02	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	49695456.	49742816.	247.42	NONE	0.0
1	1	0	0	0.0	0.0	0.0	49695456.	49742816.	247.46	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	49825744.	49947424.	248.06	NONE	0.0
1	1	1	1	0.44	92717.	0.83	49918448.	49947424.	248.50	NONE	0.0
2	1	1	2	0.53	107889.	0.84	50026336.	50037440.	249.03	NONE	0.0
1	1	2	1	0.54	108321.	0.80	50134656.	50167728.	249.58	NONE	0.0
1	0	2	2	0.54	127377.	0.81	50262032.	50368320.	250.12	NONE	0.0
1	1	1	1	0.43	91901.	0.83	50353920.	50368320.	250.55	NONE	0.0
1	1	0	0	0.0	0.0	0.0	50353920.	50368320.	250.56	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	50486256.	50476640.	251.20	NONE	0.0
2	1	0	0	0.0	0.0	0.0	50486256.	50604016.	251.60	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	50576272.	50695904.	252.00	NONE	0.0
1	1	0	0	0.0	0.0	0.0	50576272.	50695904.	252.05	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	50677792.	50828240.	252.45	NONE	0.0
1	0	0	0	0.0	0.0	0.0	50677792.	50828240.	252.49	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	50769840.	50828240.	252.89	NONE	0.0
1	1	0	0	0.0	0.0	0.0	50769840.	50828240.	252.94	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	50882400.	50918256.	253.34	NONE	0.0
1	1	0	0	0.0	0.0	0.0	50882400.	50918256.	253.38	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	50972416.	51019776.	253.78	NONE	0.0
1	1	0	0	0.0	0.0	0.0	50972416.	51019776.	253.83	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	51102704.	51224384.	254.42	NONE	0.0
1	1	1	1	0.44	92717.	0.83	51195408.	51224384.	254.87	NONE	0.0
2	1	1	2	0.53	107889.	0.84	51303296.	51314400.	255.40	NONE	0.0
1	1	2	1	0.54	108321.	0.80	51411616.	51444688.	255.94	NONE	0.0

1	0	2	2	0.54	127377.	0.81	51538992.	51645280.	256.48	NONE	0.0
1	1	1	1	0.43	91901.	0.83	51630880.	51645280.	256.91	NONE	0.0
1	1	0	0	0.0	0.0	0.0	51630880.	51645280.	256.93	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	51763216.	51753600.	257.57	NONE	0.0
2	1	0	0	0.0	0.0	0.0	51763216.	51880976.	257.97	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	51853232.	51972864.	258.37	NONE	0.0
1	1	0	0	0.0	0.0	0.0	51853232.	51972864.	258.41	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	51954752.	52105200.	258.81	NONE	0.0
1	0	0	0	0.0	0.0	0.0	51954752.	52105200.	258.86	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	52046800.	52105200.	259.26	NONE	0.0
1	1	0	0	0.0	0.0	0.0	52046800.	52105200.	259.30	PUSH	0.04
1	2	2	2	0.40	112562.	0.80	52159360.	52195216.	259.70	NONE	0.0
1	1	0	0	0.0	0.0	0.0	52159360.	52195216.	259.75	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	52249376.	52296736.	260.15	NONE	0.0
1	1	0	0	0.0	0.0	0.0	52249376.	52296736.	260.19	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	52379664.	52501344.	260.79	NONE	0.0
1	1	1	1	0.44	92717.	0.83	52472368.	52501344.	261.23	NONE	0.0
2	1	1	2	0.53	107889.	0.84	52580256.	52591360.	261.76	NONE	0.0
1	1	2	1	0.54	108321.	0.80	52688576.	52721648.	262.30	NONE	0.0
1	0	2	2	0.54	127377.	0.81	52815952.	52922240.	262.85	NONE	0.0
1	1	1	1	0.43	91901.	0.83	52907840.	52922240.	263.28	NONE	0.0
1	1	0	0	0.0	0.0	0.0	52907840.	52922240.	263.29	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	53040176.	53030560.	263.93	NONE	0.0
2	1	0	0	0.0	0.0	0.0	53040176.	53157936.	264.33	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	53130192.	53249824.	264.73	NONE	0.0
1	1	0	0	0.0	0.0	0.0	53130192.	53249824.	264.78	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	53231712.	53382160.	265.18	NONE	0.0
1	0	0	0	0.0	0.0	0.0	53231712.	53382160.	265.22	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	53323760.	53382160.	265.62	NONE	0.0
1	1	0	0	0.0	0.0	0.0	53323760.	53382160.	265.66	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	53436320.	53472176.	266.06	NONE	0.0
1	1	0	0	0.0	0.0	0.0	53436320.	53472176.	266.11	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	53526336.	53573696.	266.51	NONE	0.0
1	1	0	0	0.0	0.0	0.0	53526336.	53573696.	266.55	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	53656624.	53778304.	267.15	NONE	0.0
1	1	1	1	0.44	92717.	0.83	53749328.	53778304.	267.59	NONE	0.0
2	1	1	2	0.53	107889.	0.84	53857216.	53868320.	268.12	NONE	0.0
1	1	2	1	0.54	108321.	0.80	53965536.	53998608.	268.67	NONE	0.0
1	1	2	2	0.54	127377.	0.81	54092912.	54199200.	269.21	NONE	0.0
1	1	1	1	0.43	91901.	0.83	54184800.	54199200.	269.64	NONE	0.0
1	1	0	0	0.0	0.0	0.0	54184800.	54199200.	269.65	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	54317136.	54307520.	270.29	NONE	0.0
2	1	0	0	0.0	0.0	0.0	54317136.	54434896.	270.69	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	54407152.	54526784.	271.09	NONE	0.0
1	1	0	0	0.0	0.0	0.0	54407152.	54526784.	271.14	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	54508672.	54659120.	271.54	NONE	0.0
1	1	0	0	0.0	0.0	0.0	54508672.	54659120.	271.58	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	54600720.	54659120.	271.98	NONE	0.0
1	1	0	0	0.0	0.0	0.0	54600720.	54659120.	272.03	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	54713280.	54749136.	272.43	NONE	0.0
1	1	0	0	0.0	0.0	0.0	54713280.	54749136.	272.47	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	54803296.	54850656.	272.87	NONE	0.0
1	1	0	0	0.0	0.0	0.0	54803296.	54850656.	272.92	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	54933584.	55055264.	273.51	NONE	0.0
1	1	1	1	0.44	92717.	0.83	55026288.	55055264.	273.96	NONE	0.0
2	1	2	2	0.53	107889.	0.84	55134176.	55145280.	274.49	NONE	0.0
1	1	2	1	0.54	108321.	0.80	55242496.	55275568.	275.03	NONE	0.0
1	1	2	2	0.54	127377.	0.81	55369872.	55476160.	275.57	NONE	0.0
1	1	1	1	0.43	91901.	0.83	55461760.	55476160.	276.00	NONE	0.0
1	1	0	0	0.0	0.0	0.0	55461760.	55476160.	276.01	PUSH	0.01

0	1	2	2	0.64	132351.	0.81	55594096.	55584480.	276.66	NONE	0.0
2	1	0	0	0.0	0.0	0.0	55594096.	55711856.	277.06	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	55684112.	55803744.	277.46	NONE	0.0
1	1	0	0	0.0	0.0	0.0	55684112.	55803744.	277.50	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	55785632.	55936080.	277.90	NONE	0.0
1	0	0	0	0.0	0.0	0.0	55785632.	55936080.	277.94	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	55877680.	55936080.	278.34	NONE	0.0
1	1	0	0	0.0	0.0	0.0	55877680.	55936080.	278.39	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	55990240.	56026096.	278.79	NONE	0.0
1	1	0	0	0.0	0.0	0.0	55990240.	56026096.	278.83	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	56080256.	56127616.	279.23	NONE	0.0
1	1	0	0	0.0	0.0	0.0	56080256.	56127616.	279.28	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	56210544.	56332224.	279.87	NONE	0.0
1	1	1	1	0.44	92717.	0.83	56303248.	56332224.	280.32	NONE	0.0
2	1	1	2	0.53	107889.	0.84	56411136.	56422240.	280.85	NONE	0.0
1	1	2	1	0.54	108321.	0.80	56519456.	56552528.	281.39	NONE	0.0
1	0	2	2	0.54	127377.	0.81	56646832.	56753120.	281.93	NONE	0.0
1	1	1	1	0.43	91901.	0.83	56738720.	56753120.	282.36	NONE	0.0
1	1	0	0	0.0	0.0	0.0	56738720.	56753120.	282.38	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	56871056.	56861440.	283.02	NONE	0.0
2	1	0	0	0.0	0.0	0.0	56871056.	56988816.	283.42	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	56961072.	57080704.	283.82	NONE	0.0
1	1	0	0	0.0	0.0	0.0	56961072.	57080704.	283.86	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	57062592.	57213040.	284.26	NONE	0.0
1	0	0	0	0.0	0.0	0.0	57062592.	57213040.	284.31	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	57154640.	57213040.	284.71	NONE	0.0
1	1	0	0	0.0	0.0	0.0	57154640.	57213040.	284.75	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	57267200.	57303056.	285.15	NONE	0.0
1	1	0	0	0.0	0.0	0.0	57267200.	57303056.	285.20	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	57357216.	57404576.	285.60	NONE	0.0
1	1	0	0	0.0	0.0	0.0	57357216.	57404576.	285.64	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	57487504.	57609184.	286.24	NONE**	0.0
1	1	1	1	0.44	92717.	0.83	57580208.	57609184.	286.68	NONE	0.0
2	1	1	2	0.53	107889.	0.84	57688096.	57699200.	287.21	NONE	0.0
1	1	2	1	0.54	108321.	0.80	57796416.	57829488.	287.75	NONE	0.0
1	0	2	2	0.54	127377.	0.81	57923792.	58030080.	288.29	NONE	0.0
1	1	1	1	0.43	91901.	0.83	58015680.	58030080.	288.73	NONE	0.0
1	1	0	0	0.0	0.0	0.0	58015680.	58030080.	288.74	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	58148016.	58138400.	289.38	NONE	0.0
2	1	0	0	0.0	0.0	0.0	58148016.	58265776.	289.78	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	58238032.	58357664.	290.18	NONE	0.0
1	1	0	0	0.0	0.0	0.0	58238032.	58357664.	290.22	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	58339552.	58490000.	290.62	NONE	0.0
1	0	0	0	0.0	0.0	0.0	58339552.	58490000.	290.67	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	58431600.	58490000.	291.07	NONE	0.0
1	1	0	0	0.0	0.0	0.0	58431600.	58490000.	291.11	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	58544160.	58580016.	291.51	NONE	0.0
1	1	0	0	0.0	0.0	0.0	58544160.	58580016.	291.56	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	58634176.	58681536.	291.96	NONE	0.0
1	1	0	0	0.0	0.0	0.0	58634176.	58681536.	292.00	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	58764464.	58886144.	292.60	NONE	0.0
1	1	1	1	0.44	92717.	0.83	58857168.	58886144.	293.04	NONE	0.0
2	1	1	2	0.53	107889.	0.84	58965056.	58976160.	293.57	NONE	0.0
1	1	2	1	0.54	108321.	0.80	59073376.	59106448.	294.11	NONE	0.0
1	0	2	2	0.54	127377.	0.81	59200752.	59307040.	294.66	NONE	0.0
1	1	1	1	0.43	91901.	0.83	59292640.	59307040.	295.09	NONE	0.0
1	1	0	0	0.0	0.0	0.0	59292640.	59307040.	295.10	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	59424976.	59415360.	295.74	NONE	0.0
2	1	0	0	0.0	0.0	0.0	59424976.	59542736.	296.14	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	59514992.	59634624.	296.54	NONE	0.0

1	1	0	0	0.0	0.0	0.0	59514992.	59634624.	296.59	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	59616512.	59766960.	296.99	NONE	0.0
1	0	0	0	0.0	0.0	0.0	59616512.	59766960.	297.03	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	59708560.	59766960.	297.43	NONE	0.0
1	1	0	0	0.0	0.0	0.0	59708560.	59766960.	297.48	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	59821120.	59856976.	297.88	NONE	0.0
1	1	0	0	0.0	0.0	0.0	59821120.	59856976.	297.92	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	59911136.	59958496.	298.32	NONE	0.0
1	1	0	0	0.0	0.0	0.0	59911136.	59958496.	298.37	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	60041424.	60163104.	298.96	NONE	0.0
1	1	1	1	0.44	92717.	0.83	60134128.	60163104.	299.41	NONE	0.0
2	1	1	2	0.53	107889.	0.84	60242016.	60253120.	299.93	NONE	0.0
1	1	2	1	0.54	108321.	0.80	60350336.	60383408.	300.48	NONE	0.0
1	0	2	2	0.54	127377.	0.81	60477712.	60584000.	301.02	NONE	0.0
1	1	1	1	0.43	91901.	0.83	60569600.	60584000.	301.45	NONE	0.0
1	1	0	0	0.0	0.0	0.0	60569600.	60584000.	301.46	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	60701936.	60692320.	302.10	NONE	0.0
2	1	0	0	0.0	0.0	0.0	60701936.	60819696.	302.50	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	60791952.	60911584.	302.90	NONE	0.0
1	1	0	0	0.0	0.0	0.0	60791952.	60911584.	302.95	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	60893472.	61043920.	303.35	NONE	0.0
1	0	0	0	0.0	0.0	0.0	60893472.	61043920.	303.39	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	60985520.	61043920.	303.79	NONE	0.0
1	1	0	0	0.0	0.0	0.0	60985520.	61043920.	303.84	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	61098080.	61133936.	304.24	NONE	0.0
1	1	0	0	0.0	0.0	0.0	61098080.	61133936.	304.28	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	61188096.	61235456.	304.68	NONE	0.0
1	1	0	0	0.0	0.0	0.0	61188096.	61235456.	304.73	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	61318384.	61440064.	305.32	NONE	0.0
1	1	1	1	0.44	92717.	0.83	61411088.	61440064.	305.77	NONE	0.0
2	1	1	2	0.53	107889.	0.84	61518976.	61530080.	306.30	NONE	0.0
1	1	2	1	0.54	108321.	0.80	61627296.	61660368.	306.84	NONE	0.0
1	0	2	2	0.54	127377.	0.81	61754672.	61860960.	307.38	NONE	0.0
1	1	1	1	0.43	91901.	0.83	61846560.	61860960.	307.81	NONE	0.0
1	1	0	0	0.0	0.0	0.0	61846560.	61860960.	307.83	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	61978896.	61969280.	308.47	NONE	0.0
2	1	0	0	0.0	0.0	0.0	61978896.	62096656.	308.87	SC PR	0.40
1	0	1	1	0.40	90030.	0.83	62068912.	62188544.	309.27	NONE	0.0
1	1	0	0	0.0	0.0	0.0	62068912.	62188544.	309.31	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	62170432.	62320880.	309.71	NONE	0.0
1	0	0	0	0.0	0.0	0.0	62170432.	62320880.	309.76	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	62262480.	62320880.	310.16	NONE	0.0
1	1	0	0	0.0	0.0	0.0	62262480.	62320880.	310.20	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	62375040.	62410896.	310.60	NONE	0.0
1	1	0	0	0.0	0.0	0.0	62375040.	62410896.	310.65	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	62465056.	62512416.	311.05	NONE	0.0
1	1	0	0	0.0	0.0	0.0	62465056.	62512416.	311.09	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	62595344.	62717024.	311.69	NONE	0.0
1	1	1	1	0.44	92717.	0.83	62688048.	62717024.	312.13	NONE	0.0
2	1	1	2	0.53	107889.	0.84	62795936.	62807040.	312.66	NONE	0.0
1	1	2	1	0.54	108321.	0.80	62904256.	62937328.	313.20	NONE	0.0
1	0	2	2	0.54	127377.	0.81	63031632.	63137920.	313.74	NONE	0.0
1	1	1	1	0.43	91901.	0.83	63123520.	63137920.	314.18	NONE	0.0
1	0	0	0	0.0	0.0	0.0	63123520.	63137920.	314.19	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	63255856.	63246240.	314.83	NONE	0.0
2	1	0	0	0.0	0.0	0.0	63255856.	63373616.	315.23	SC PR	0.40
1	1	1	1	0.40	90030.	0.83	63345872.	63465504.	315.63	NONE	0.0
1	1	0	0	0.0	0.0	0.0	63345872.	63465504.	315.67	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	63447392.	63597840.	316.07	NONE	0.0
1	0	0	0	0.0	0.0	0.0	63447392.	63597840.	316.12	PUSH	0.04

1	1	2	1	0.40	92060.	0.79	63539440.	63597840.	316.52	NONE	0.0
1	1	0	0	0.0	0.0	0.0	63539440.	63597840.	316.56	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	63652000.	63687856.	316.96	NONE	0.0
1	1	0	0	0.0	0.0	0.0	63652000.	63687856.	317.01	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	63742016.	63789376.	317.41	NONE	0.0
1	1	0	0	0.0	0.0	0.0	63742016.	63789376.	317.45	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	63872304.	63993984.	318.05	NONE	0.0
1	1	1	1	0.44	92717.	0.83	63965008.	63993984.	318.49	NONE	0.0
2	1	1	2	0.53	107889.	0.84	64072896.	64084000.	319.02	NONE	0.0
1	1	2	1	0.54	108321.	0.80	64181216.	64214288.	319.56	NONE	0.0
1	0	2	2	0.54	127377.	0.81	64308592.	64414880.	320.11	NONE	0.0
1	1	1	1	0.43	91901.	0.83	64400480.	64414880.	320.54	NONE	0.0
1	1	0	0	0.0	0.0	0.0	64400480.	64414880.	320.55	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	64532816.	64523200.	321.19	NONE	0.0
2	1	0	0	0.0	0.0	0.0	64532816.	64650576.	321.59	SCPR	0.40
1	1	1	1	0.40	90030.	0.83	64622832.	64742464.	321.99	NONE	0.0
1	1	0	0	0.0	0.0	0.0	64622832.	64742464.	322.04	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	64724352.	64874800.	322.44	NONE	0.0
1	0	0	0	0.0	0.0	0.0	64724352.	64874800.	322.48	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	64816400.	64874800.	322.88	NONE	0.0
1	1	0	0	0.0	0.0	0.0	64816400.	64874800.	322.93	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	64928960.	64964816.	323.33	NONE	0.0
1	1	0	0	0.0	0.0	0.0	64928960.	64964816.	323.37	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	65018976.	65066336.	323.77	NONE	0.0
1	1	0	0	0.0	0.0	0.0	65018976.	65066336.	323.81	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	65149264.	65270944.	324.41	NONE	0.0
1	1	1	1	0.44	92717.	0.83	65241968.	65270944.	324.85	NONE	0.0
2	1	1	2	0.53	107889.	0.84	65349856.	65360960.	325.38	NONE	0.0
1	1	2	1	0.54	108321.	0.80	65458176.	65491248.	325.93	NONE	0.0
1	1	2	2	0.54	127377.	0.81	65585552.	65691840.	326.47	NONE	0.0
1	1	1	1	0.43	91901.	0.83	65677440.	65691840.	326.90	NONE	0.0
1	1	0	0	0.0	0.0	0.0	65677440.	65691840.	326.91	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	65809776.	65800160.	327.55	NONE	0.0
2	1	0	0	0.0	0.0	0.0	65809776.	65927536.	327.95	SCPR	0.40
1	1	1	1	0.40	90030.	0.83	65899792.	66019424.	328.35	NONE	0.0
1	1	0	0	0.0	0.0	0.0	65899792.	66019424.	328.40	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	66001312.	66151760.	328.80	NONE	0.0
1	1	0	0	0.0	0.0	0.0	66001312.	66151760.	328.84	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	66093360.	66151760.	329.24	NONE	0.0
1	1	0	0	0.0	0.0	0.0	66093360.	66151760.	329.29	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	66205920.	66241776.	329.69	NONE	0.0
1	1	0	0	0.0	0.0	0.0	66205920.	66241776.	329.73	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	66295936.	66343296.	330.13	NONE	0.0
1	1	0	0	0.0	0.0	0.0	66295936.	66343296.	330.18	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	66426224.	66547904.	330.77	NONE	0.0
1	1	1	1	0.44	92717.	0.83	66518928.	66547904.	331.22	NONE	0.0
2	1	1	2	0.53	107889.	0.84	66626816.	66637920.	331.75	NONE	0.0
1	1	1	1	0.54	108321.	0.80	66735136.	66768208.	332.29	NONE	0.0
1	1	2	2	0.54	127377.	0.81	66862512.	66968800.	332.83	NONE	0.0
1	1	1	1	0.43	91901.	0.83	66954400.	66968800.	333.26	NONE	0.0
1	1	0	0	0.0	0.0	0.0	66954400.	66968800.	333.28	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	67086736.	67077120.	333.92	NONE	0.0
2	1	0	0	0.0	0.0	0.0	67086736.	67204496.	334.32	SCPR	0.40
1	1	1	1	0.40	90030.	0.83	67176752.	67296384.	334.72	NONE	0.0
1	1	0	0	0.0	0.0	0.0	67176752.	67296384.	334.76	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	67278272.	67428720.	335.16	NONE	0.0
1	1	0	0	0.0	0.0	0.0	67278272.	67428720.	335.21	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	67370320.	67428720.	335.61	NONE	0.0
1	1	0	0	0.0	0.0	0.0	67370320.	67428720.	335.65	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	67482880.	67518736.	336.05	NONE	0.0

1	1	0	0	0.0	0.0	0.0	67482880.	67518736.	336.09	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	67572896.	67620256.	336.49	NONE	0.0
1	1	0	0	0.0	0.0	0.0	67572896.	67620256.	336.54	PUSH	0.04
1	0	2	2	0.60	130300.	0.81	67703184.	67824864.	337.13	NONE	0.0
2	1	1	1	0.44	92717.	0.83	67795888.	67824864.	337.58	NONE	0.0
1	1	1	2	0.53	107889.	0.84	67903776.	67914880.	338.11	NONE	0.0
1	1	2	1	0.54	108321.	0.80	68012096.	68045168.	338.65	NONE	0.0
1	0	2	2	0.54	127377.	0.81	68139472.	68245760.	339.19	NONE	0.0
1	1	1	1	0.43	91901.	0.83	68231360.	68245760.	339.62	NONE	0.0
0	1	1	0	0.0	0.0	0.0	68231360.	68245760.	339.64	PUSH	0.01
2	1	2	2	0.64	132351.	0.81	68363696.	68354080.	340.28	NONE	0.0
1	1	0	0	0.0	0.0	0.0	68363696.	68481456.	340.68	SCPR	0.40
1	0	1	1	0.40	90030.	0.83	68453712.	68573344.	341.08	NONE	0.0
1	1	0	0	0.0	0.0	0.0	68453712.	68573344.	341.12	PUSH	0.04
1	0	1	2	0.40	101527.	0.83	68555232.	68705680.	341.52	NONE	0.0
1	0	0	0	0.0	0.0	0.0	68555232.	68705680.	341.57	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	68647280.	68705680.	341.97	NONE	0.0
1	1	0	0	0.0	0.0	0.0	68647280.	68705680.	342.01	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	68759840.	68795696.	342.41	NONE	0.0
1	1	0	0	0.0	0.0	0.0	68759840.	68795696.	342.46	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	68849856.	68897216.	342.86	NONE	0.0
1	1	0	0	0.0	0.0	0.0	68849856.	68897216.	342.90	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	68980144.	69101824.	343.50	NONE	0.0
1	1	1	1	0.44	92717.	0.83	69072848.	69101824.	343.94	NONE	0.0
2	1	1	2	0.53	107889.	0.84	69180736.	69191840.	344.47	NONE	0.0
1	1	2	1	0.54	108321.	0.80	69289056.	69322128.	345.01	NONE	0.0
1	1	2	2	0.54	127377.	0.81	69416432.	69522720.	345.56	NONE	0.0
1	1	1	1	0.43	91901.	0.83	69508320.	69522720.	345.99	NONE	0.0
1	1	0	0	0.0	0.0	0.0	69508320.	69522720.	346.00	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	69640656.	69631040.	346.64	NONE	0.0
2	1	0	0	0.0	0.0	0.0	69640656.	69758416.	347.04	SCPR	0.40
1	1	1	1	0.40	90030.	0.83	69730672.	69850304.	347.44	NONE	0.0
1	1	0	0	0.0	0.0	0.0	69730672.	69850304.	347.49	PUSH	0.04
1	1	1	2	0.40	101527.	0.83	69832192.	69982640.	347.89	NONE	0.0
1	1	0	0	0.0	0.0	0.0	69832192.	69982640.	347.93	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	69924240.	69982640.	348.33	NONE	0.0
1	1	0	0	0.0	0.0	0.0	69924240.	69982640.	348.37	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	70036800.	70072656.	348.77	NONE	0.0
1	1	0	0	0.0	0.0	0.0	70036800.	70072656.	348.82	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	70126816.	70174176.	349.22	NONE	0.0
1	1	0	0	0.0	0.0	0.0	70126816.	70174176.	349.26	PUSH	0.04
1	1	2	2	0.60	130300.	0.81	70257104.	70378784.	349.86	NONE	0.0
1	1	1	1	0.44	92717.	0.83	70349808.	70378784.	350.30	NONE	0.0
2	1	1	2	0.53	107889.	0.84	70457696.	70468800.	350.83	NONE	0.0
1	1	2	1	0.54	108321.	0.80	70566016.	70599088.	351.38	NONE	0.0
1	1	2	2	0.54	127377.	0.81	70693392.	70799680.	351.92	NONE	0.0
1	1	1	1	0.43	91901.	0.83	70785280.	70799680.	352.35	NONE	0.0
1	1	0	0	0.0	0.0	0.0	70785280.	70799680.	352.36	PUSH	0.01
0	2	2	2	0.64	132351.	0.81	70917616.	70908000.	353.00	NONE	0.0
1	1	0	0	0.0	0.0	0.0	70917616.	71035376.	353.40	SCPR	0.40
1	1	1	1	0.40	90030.	0.83	71007632.	71127264.	353.80	NONE	0.0
1	1	0	0	0.0	0.0	0.0	71007632.	71127264.	353.85	PUSH	0.04
1	1	2	2	0.40	101527.	0.83	71109152.	71259600.	354.25	NONE	0.0
1	1	0	0	0.0	0.0	0.0	71109152.	71259600.	354.29	PUSH	0.04
1	1	2	1	0.40	92060.	0.79	71201200.	71259600.	354.69	NONE	0.0
1	1	0	0	0.0	0.0	0.0	71201200.	71259600.	354.74	PUSH	0.04
1	1	2	2	0.40	112562.	0.80	71313760.	71349616.	355.14	NONE	0.0
1	1	0	0	0.0	0.0	0.0	71313760.	71349616.	355.18	PUSH	0.04
1	1	1	1	0.40	90030.	0.83	71403776.	71451136.	355.58	NONE	0.0
1	1	0	0	0.0	0.0	0.0	71403776.	71451136.	355.63	PUSH	0.04

1	0	2	2	0.60	130300.	0.81	71534064.	71655744.	356.22	NONE	0.0
1	1	1	1	0.44	92717.	0.83	71626768.	71655744.	356.67	NONE	0.0
2	1	1	2	0.53	107889.	0.84	71734656.	71745760.	357.20	NONE	0.0
1	1	2	1	0.54	108321.	0.80	71842976.	71876048.	357.74	NONE	0.0
1	0	2	2	0.54	127377.	0.81	71970352.	72076640.	358.28	NONE	0.0
1	1	1	1	0.43	91901.	0.83	72062240.	72076640.	358.71	NONE	0.0
1	1	0	0	0.0	0.0	0.0	72062240.	72076640.	358.72	PUSH	0.01
0	1	2	2	0.64	132351.	0.81	72194576.	72184960.	359.37	NONE	0.0
2	1	0	0	0.0	0.0	0.0	72194576.	72312336.	359.77	SCPR	0.40

SYSTEM SUMMARY

PRODUCTION PER SHIFT = 36156. TONS
TOTAL COST (PRODUCTION, MAINTENANCE, AND OVERHEAD) = \$ 1934.800

TOTAL COST PER TON DUMPED = \$ 0.05351230

DELAY TIME CAUSED BY SCRAPER - 22.40 MINUTES
DELAY TIME CAUSED BY PUSHER - 13.22 MINUTES

TOTAL DELAY TIME - 35.61 MINUTES

AVERAGE QUEUE LENGTH AT LOAD POINT - 1.0

AVERAGE QUEUE LENGTH AT DUMP POINT - 0.7

TOTAL NUMBER OF SCRAPERS LOADED DURING SHIFT - 678.

BIBLIOGRAPHY

1. ----- (1967). Surface Mining Continues To Grow. Mining Engineering, Vol. 19, No. 10, October.
2. ----- (1967). A New Look in Mine Stripping. Engineering and Mining Journal, Vol. 168, No. 4, April.
3. VAN VOORHIS, W. R. (1956). Waiting-Line Theory as a Management Tool. Operations Research, Vol. 4, No. 2, April.
4. WARE, T. M. (1955). Operations Research and the Mine of Tomorrow. Engineering and Mining Journal, Vol. 156, No. 8, August.
5. WARE, T. M. (1956). Winning Management Acceptance of Operations Research. American Management Association, Special Report No. 13.
6. O'BRIEN, N., and NOWAK, F. J. (1965). Application of Computer to Open Pit Mine Design. Can. Mining and Metallurgical Bull. Vol. 58, No. 638, June.
7. MADGE, D. N. (1964). Simulation of Truck Movement in Open Pit Mining Operations. Can. Operational Research Society Journal, Vol. 2, No. 1, June.

8. EISEN, M., and TAINITER, M. (1963). Stochastic Variations in Queuing Processes. Operations Research, Vol. 11, No. 6, Nov.-Dec.
9. O'NEIL, T. J. (1966). Computer Simulation of Materials Handling In Open Pit Mining. Master's Thesis, The Pennsylvania State University.
10. ----- (1965). Economics Of Proper Load Time. Caterpillar Tractor Company.
11. DREVDAHL, E. R. (1961). Profitable Use Of Excavation Equipment. Technical Publishers, Tucson, Arizona.
12. ----- (1968). Efficiency and Speed - The Keys to Mining Technology - Open Pit Developments. Mining Engineering, Vol. 20, No. 2, Feb.
13. GUENTHER, K. W. (1964). How Good Haul Roads Can Cut Mining Costs. Engineering and Mining Journal, Vol. 165, No. 11, November.
14. CHAUDHRY, M. L. (1965). Correlated Queuing. Can. Operational Research Society Journal, Vol. 3, No. 3, November.
15. CHANG, W. (1965). Preemptive Priority Queues. Operations Research, Vol. 13, No. 5, September-October.

16. HAWKES, A. G. (1965). Time-Dependent Solution of Priority Queue With Bulk Arrival. Operations Research, Vol. 13, No. 4, July-Aug.
17. HILLIER, F. S. (1965). Cost Models For Application Of Priority Waiting Line Theory To Industrial Problems. Journal of Industrial Engineering, Vol. 16, No. 3, May-June.
18. HARE, VAN COURT, Jr. (1964). Systems Analysis. Operation Research Society of America, Publication No. 9 - Progress in Operations Research, Vol. 2.
19. ----- (1965). Open Pit Mining In 1965. Engineering and Mining Journal, Vol. 166, No. 9, Sept.
20. RUMFELT, H. (1965). Recent Developments In Surface Mining. Mining Congress Journal, Vol. 51, No. 9, September.
21. FULLER, J. A., and RUBLY, G. R. (1965). Selection of Stripping Equipment. Mining Congress Journal, Vol. 51, No. 10, October.
22. MORGAN, W. C. (1968). Personal Communication.

VITA

The author was born on November 1, 1944, in Chicago, Illinois, where he received his primary and secondary education. He received a Bachelor of Science Degree in Mining Engineering from the University of Missouri at Rolla in June, 1966.

He has been enrolled in the Graduate School of the University of Missouri at Rolla since September, 1966, and has held a National Science Foundation Traineeship for the duration of his study.