POWER DECK OPTIMIZATION

POWER DECK COMPANY

MAY, 2004

PREPARED BY:

Blast Dynamics

improving productivity with the use of efficient blast designs

01001010 01001100 01000110

jfloyd@blastdynamics.com

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Blast Dynamics, Inc. was contracted by the Power Deck Company to quantify the advantages of Power Decks at a major gold mine in northern Nevada. Mr. John Floyd conducted an onsite review at the operation in May of 2004 and documented the use and benefits of Power Decks. This report presents the findings of the study.

The mine studied is currently using approximately 36,000 units a year to optimize the blast performance in waste material. Prior to the use of the Power Decks, the typical blasthole length was 48 feet including 8 feet of subdrill. After two years of analysis and optimization, the blastholes are currently drilled 44 feet deep which reduces the annual waste drilling requirements by 144,000 feet. In addition, the air deck and plug takes the place of 4 feet of explosives so the combined charge reduction is approximately 8 feet or 225.8 lb per hole. This equates to a decrease of over 8,128,000 lb in annual explosive consumption.

From an economic standpoint, the benefits of using Power Decks are illustrated by the annual cost relationships shown below:

Power Deck Cost	$297,000
Drill Savings	$183,240
Explosive Savings	$1,080,000
Annual Savings	**$966,240**

Obviously, any savings in annual drilling and blasting costs must not be offset by increases in other operational costs in order to provide the operation with a net benefit. Careful excavator productivity studies have been conducted which led to the current state of blast design optimization. Historical data indicates that the existing blast design does not adversely affect excavator performance. The pit floors had very little deviation from the desired grade and the reduction in subdrill improved the integrity of the next bench's blasthole collars. As a result, the annual savings shown above are achieved without any downstream operational losses.

In summary, this study showed that the use of Power Decks allowed this operation to reduce explosive consumption for waste blasts by 31% without sacrificing excavator performance. In addition, the annual waste drilling requirements was reduced by approximately 131 drill shifts.

1.0 INTRODUCTION

Blast Dynamics, Inc. was contracted by the Power Deck Company to quantify the advantages of Power Decks at a major gold mine in northern Nevada. A site visit was conducted in May of 2004 to document the background and current use of the bottom hole air decks.

The mine began the evaluation and use of Power Decks in March of 2001. Currently around 36,000 units are used per year in waste material.

Figure 1. Power Deck installation

Typically, the Power Deck plug and wooden support stake is dropped into the hole to create a three foot air deck at the bottom of the hole. One foot of stemming is then placed on top of the plug.

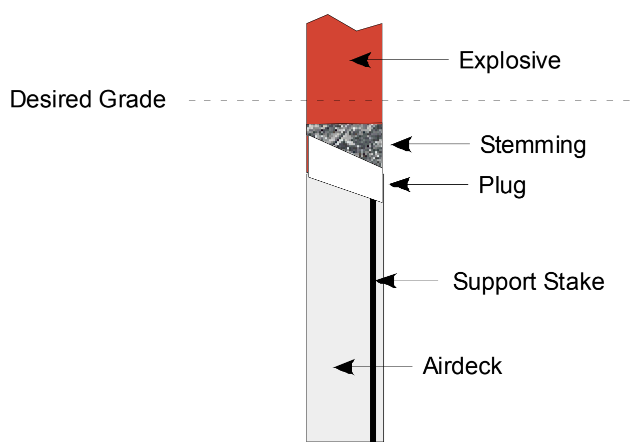


Figure 2. Power Deck configuration

The material blasted was comprised of relatively weak, closely bedded siltstone, mudstone and limestone as shown below:

Figure 3. Weak waste material

Figure 4. Typical waste loading

2.0 EVALUATION PROCEDURES

The use of Power Decks has the potential for reducing drilling and blasting costs. However, to determine the ultimate benefit it is imperative that the excavator's performance be carefully monitored.

At the operation where this study was conducted, a software package called ProDig is used to evaluate each cycle of the excavation process.

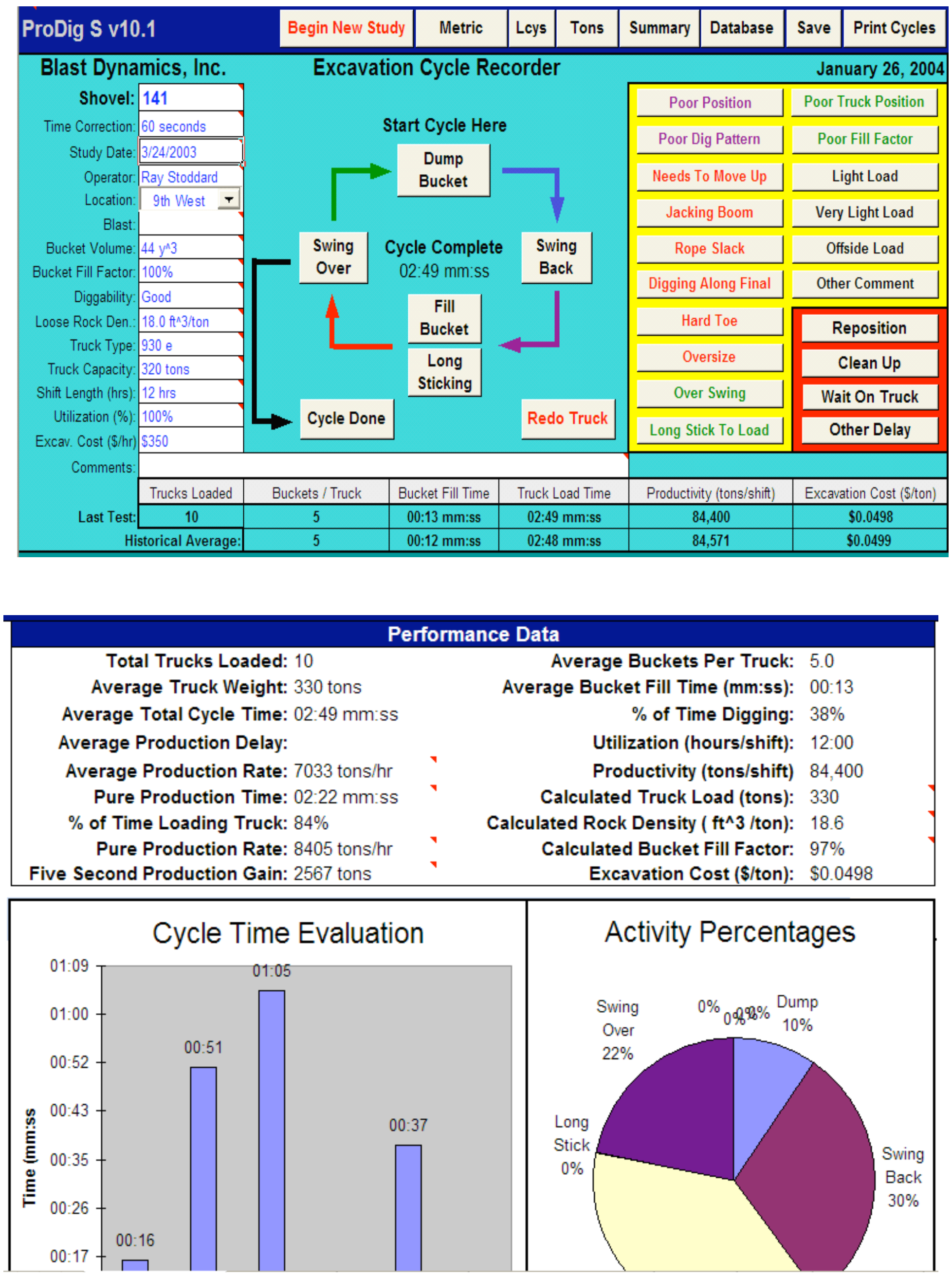


Figure 5. ProDig evaluations

ProDig allows the operation to precisely quantify the influence that different blast designs have on excavator productivity.

The use of Power Decks typically provides a reduction in drilling costs. However, it is important that the true savings in drill time is used to determine the actual benefit. A software package called ProDrill was used to evaluate each cycle of the drilling process and determine the ultimate cost benefit that results when Power Decks are used.

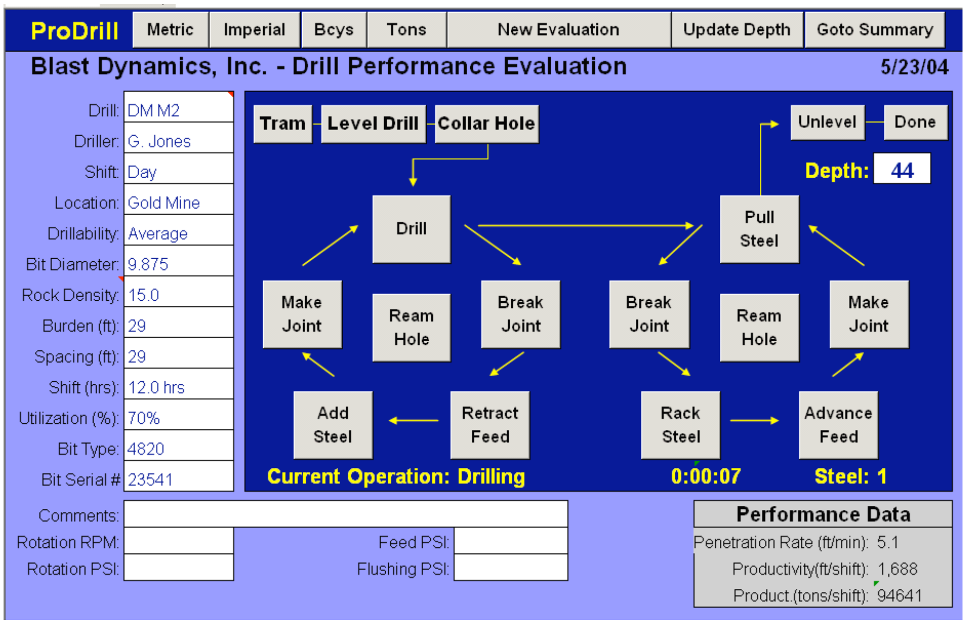


Figure 6. ProDrill evaluation

A break-even cost analysis model was also developed to determine the relationships between drilling, loading, blasting and excavation costs.

3.0 TEST PROCEDURES

3.1 Initial Blast Design

The waste blast design parameters before the use of Power Decks were:

Bench Height	40 ft
Hole Diameter	9 7/8”
Explosive Type	typically ANFO, depending on conditions
Burden	29 ft
Spacing	29 ft
Stemming	22 ft
Subdrill	8 ft
Powder Factor	.29 lb/ton
Energy Factor	119 kcal/ton

An illustration of this design is shown below:

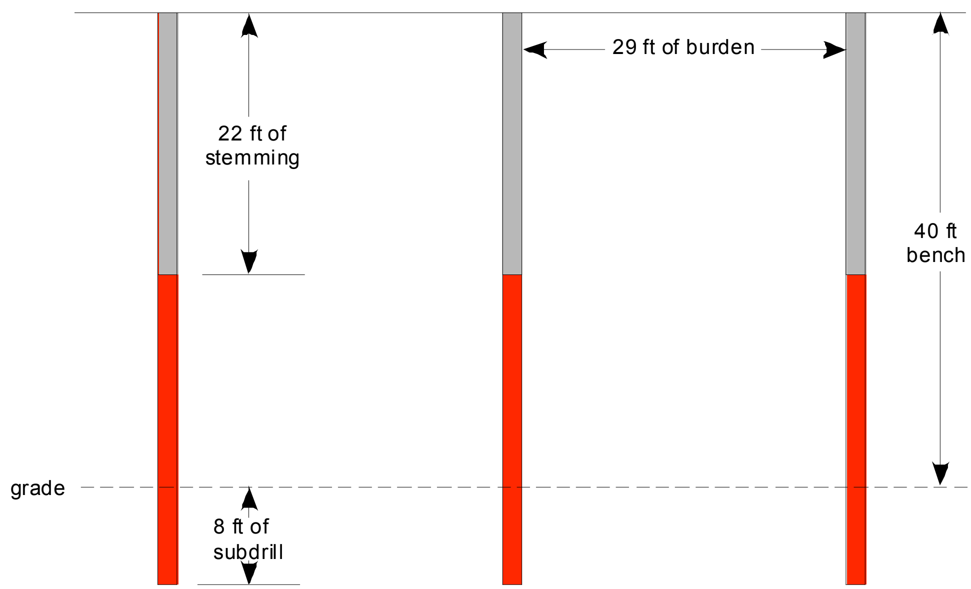


Figure 7. Waste design before use Power Decks

3.2 Power Deck Tests

The first blast that used Power Decks was shot in March of 2001. This blast consisted of approximately 100 blastholes and incorporated the following design:

Bench Height	40 ft
Hole Diameter	9 7/8”
Explosive Type	typically ANFO, depending on conditions
Burden	29 ft
Spacing	29 ft
Stemming	22 ft
Subdrill	0 ft - Power Deck placed at grade
Powder Factor	.16 lb/ton
Energy Factor	64 kcal/ton

An illustration of this design is shown below:

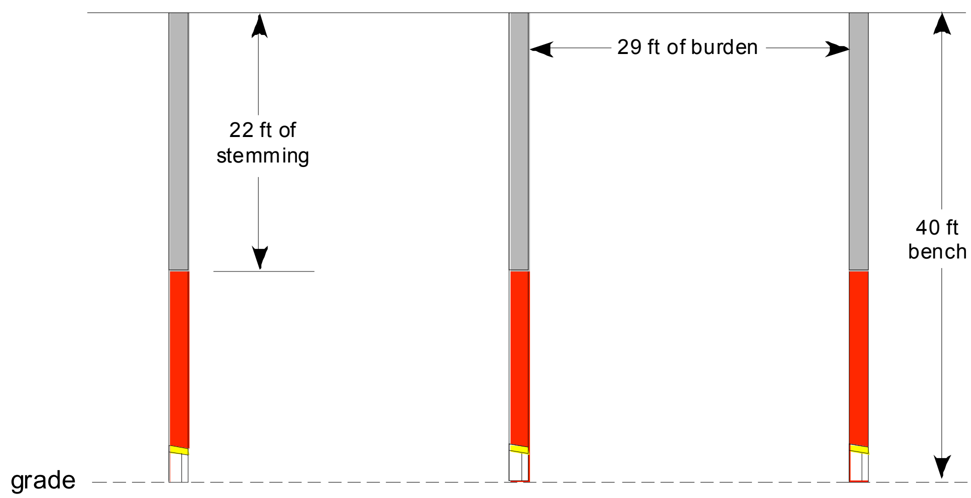


Figure 8. Initial Power Deck design

This test reduced the charge by 12 feet and the energy factor by 46%. A careful evaluation of excavator productivity indicated that the bottom two feet of the bench was difficult to dig. As a result, the design was modified to include 2 feet of subdrill.

The second blast that used Power Decks was shot in April of 2001. This blast also consisted of approximately 100 blastholes and incorporated the following design:

Bench Height	40 ft
Hole Diameter	9 7/8”
Explosive Type	typically ANFO, depending on conditions
Burden	29 ft
Spacing	29 ft
Stemming	22 ft
Subdrill	2 ft - with Power Deck
Powder Factor	.18 lb/ton
Energy Factor	73 kcal/ton

An illustration of this design is shown below:

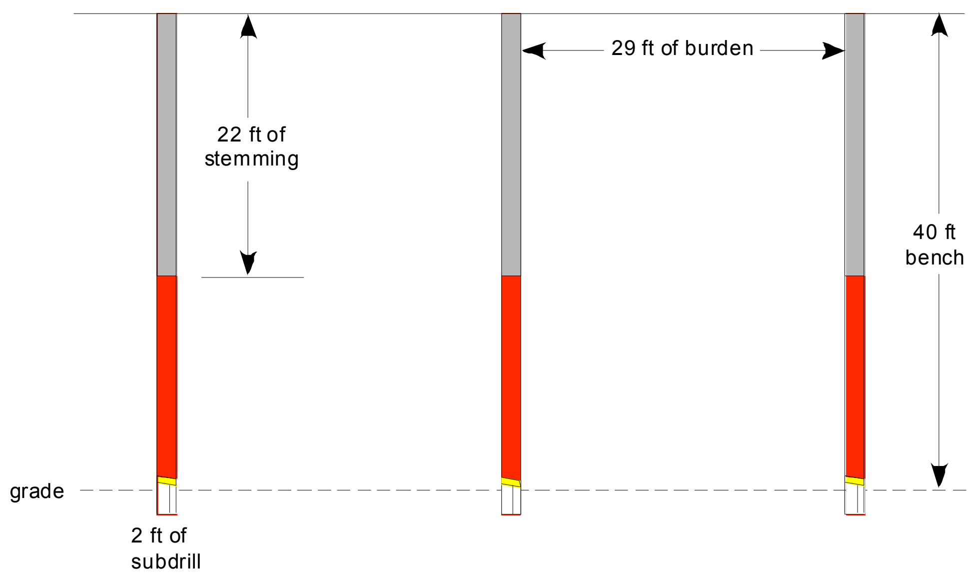


Figure 9. Second Power Deck design

This design produced normal digging rates and was adopted for further evaluation.

During May of 2001, a blast was loaded with 2 feet of subdrill and bottom hole Power Decks. There was not enough Power Decks in stock to load the entire blast so one row was loaded conventionally as shown below:

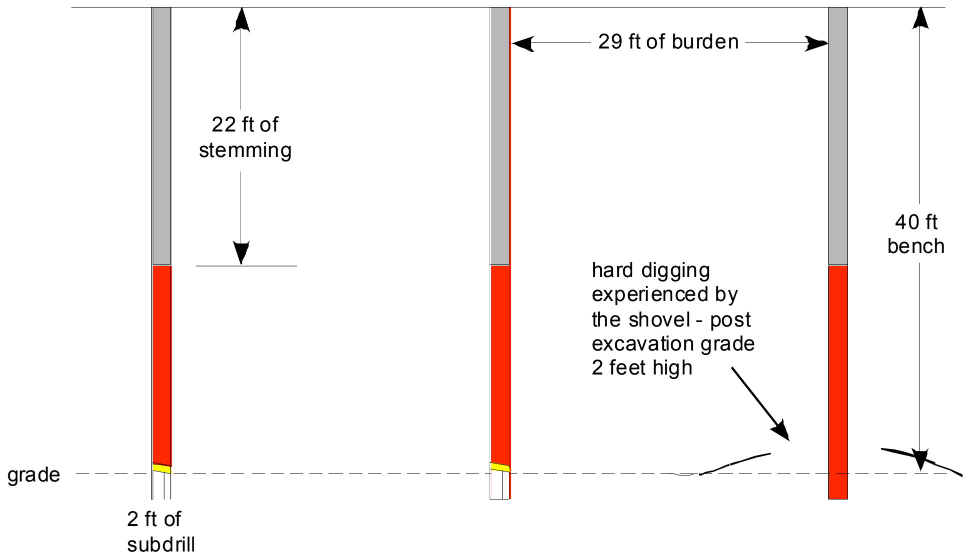


Figure 10. Waste pattern without power deck in one row

When the blast was excavated, the shovel's performance was reduced in the area without the Power Deck and the final grade achieved was 2 feet high. Interestingly, the energy factor in the region without the Power Deck was 18 percent higher than the rest of the blast. This seems to indicate that there was a fragmentation benefit provided by the Power Deck.

During the initial stages of testing, the Power Decks designed for 9.875" blastholes were difficult to install. As a result, the plug diameter was reduced and testing was resumed with 2 feet of subdrill. On the next blast, this initial modification inadvertently allowed explosives to fill the air space below the plug. When this blast was excavated it also produced a high floor. Once again this would indicate that the bottom hole air deck enhances floor fragmentation. Further refinements in the plug design provided quick loading and created the intended air deck.

In 2002, the use of the Power Decks was expanded to harder waste rock types while continuing to monitor excavator productivity. After further evaluation, the following design was adopted for all waste material in April of 2003.

Bench Height	40 ft

Hole Diameter	9 7/8”
Explosive Type	typically ANFO, depending on conditions
Burden	29 ft
Spacing	29 ft
Stemming	22 ft
Subdrill	4 ft - with Bottom Power Deck
Powder Factor	.20 lb/ton
Energy Factor	82 kcal/ton

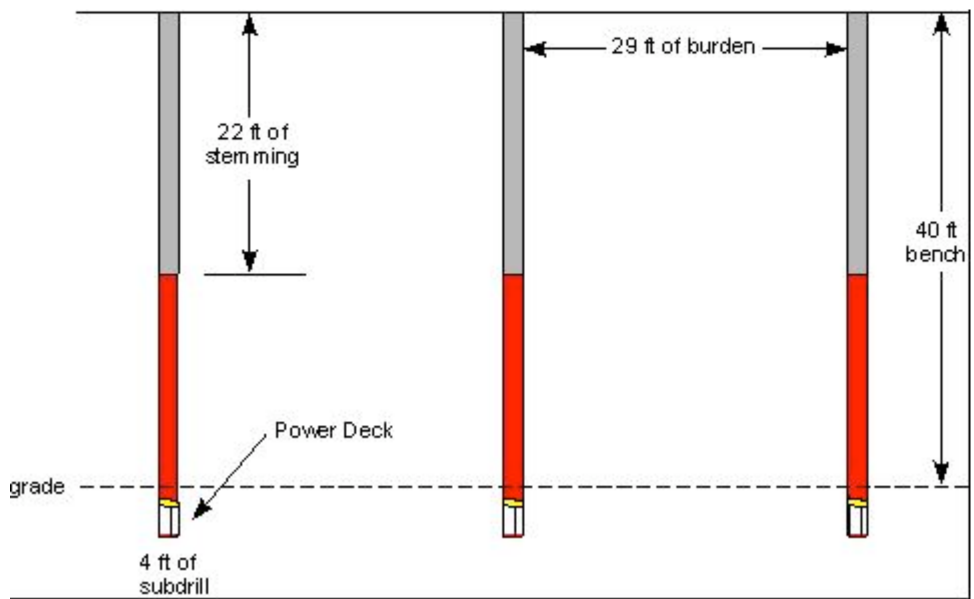


Figure 11. Current waste pattern

This design is still currently used (as of May, 2004) for all of the waste blasts.

4.0 PERFORMANCE EVALUATION

The performance of Power Decks was evaluated in the following ways:

- Drill Performance
- Labor Considerations

- Excavator Productivity
- Floor Elevation
- Cost/Benefit Analysis

4.1 Drill Performance

A study was conducted to determine the current drill productivity in waste material. The average time required to drill a 44 ft blasthole was 12 minutes and 40 seconds (760 seconds). This time includes tramming from hole-to-hole. Currently the drill cost is $80.52 per hole or $0.106 per second. It was determined that the time spent drilling averaged 8 minutes and 48 seconds or 12 seconds per foot of hole. If the holes were drilled to the previous depth of 48 feet, it would take an average of 48 seconds more to drill the hole. As a result, the drilling cost would increase by $5.09 per hole (48 sec x $0.106 per sec). Since 36,000 blastholes are drilled in waste per year, the annual drill savings currently is $183,240.

4.2 Labor Considerations

Initially, the hole plugs were difficult and time consuming to install. This problem was alleviated after modifications to the diameter and design. Currently, the labor required to install the plugs is not significant and has not required additional personnel on the blast crew.

4.3 Excavator Performance

Detailed assessments of excavator performance were conducted during the evaluation of the Power Decks. The performance, in terms of overall cycle time, is shown on the following page.

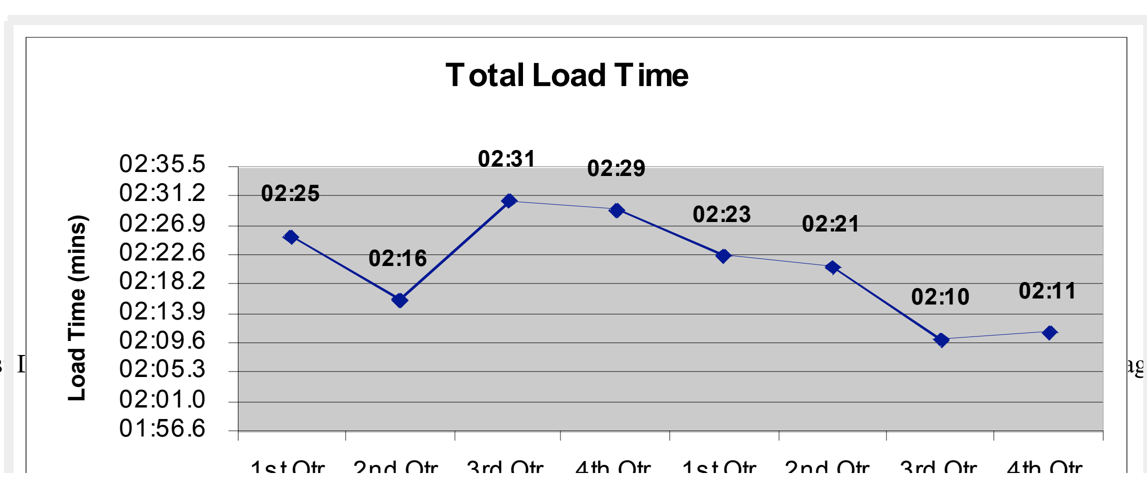


Figure 12. Truck loading analysis

In addition, an analysis was performed on the individual bucket load cycles for the same time period.

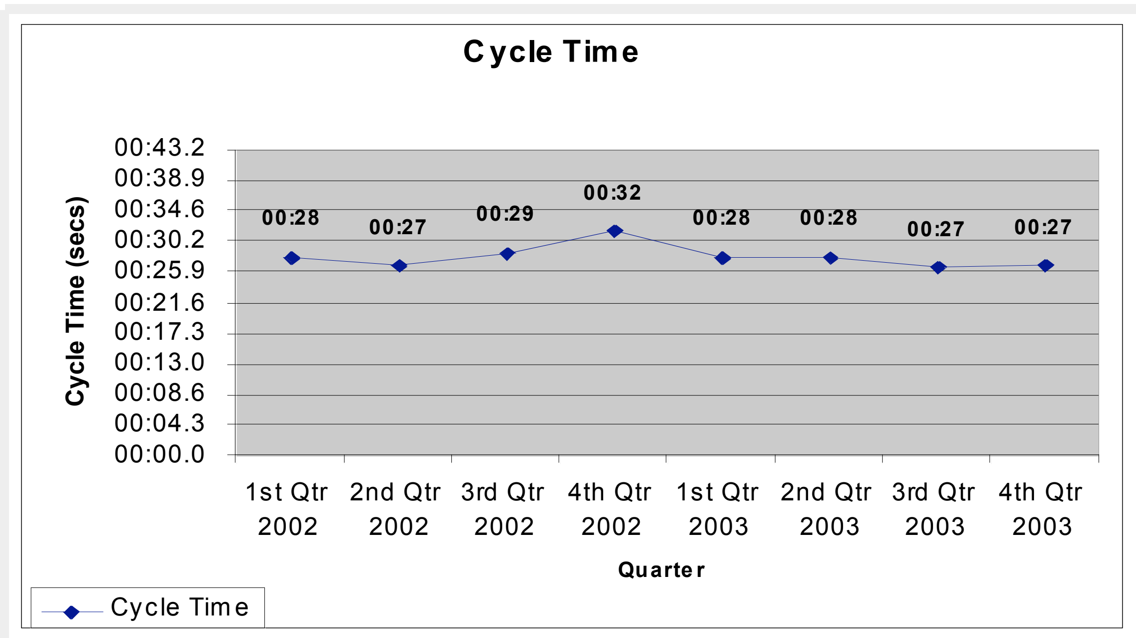


Figure 13. Load cycle analysis

It is evident from these evaluations that the use of Power Decks did not adversely affect excavator productivity.

4.4 Floor Grade Analysis

Another blast performance indicator is the amount of variation in floor elevations. During the study, the collar elevations of approximately 400 blastholes were determined using real time corrected GPS surveying. This data was used to define the topographic image shown below.

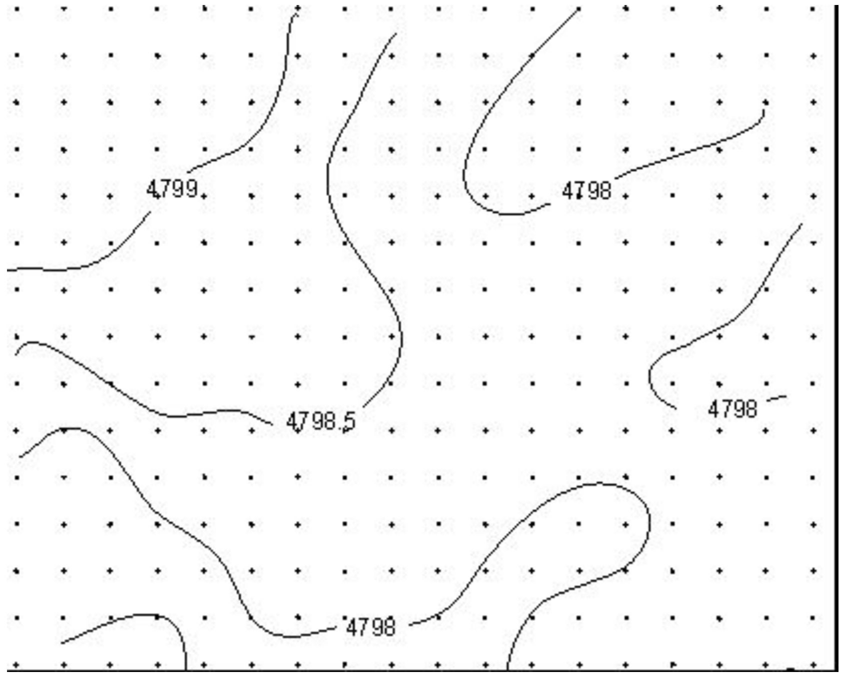


Figure 14. blasthole collar elevation survey

Figure 15. Typical bench grade

The data provided by the topographical study indicated that the use of Power Decks allowed the excavator to achieve a level floor.

4.5 Cost Analysis

A cost/benefit analysis was performed to quantify the current savings in overall costs that can be attributed to the use of bottom hole air decking. As noted earlier, the estimated drill savings are

$5.09 per blasthole. With the Power Deck the explosive column length was reduced by 8 feet. This equates to an explosive cost reduction of $27.28 per hole. The resultant cost/benefit relationships are:

Drill cost savings	$5.09
Explosive cost savings	$27.28
Combined savings:	$32.37
Power Deck cost:	$8.25
Net savings ($per blasthole):	$24.12
Waste blastholes shot per year:	36,000
Annual savings per year:	**$868,320**

Even if the Power Deck is used without any reduction in hole depth, the net annual savings due to the reduction in explosive costs would be $194,000.

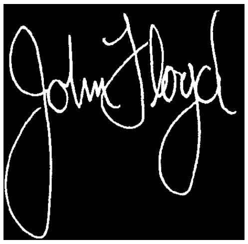
5.0 FUTURE CONSIDERATIONS

Currently, the operation is evaluating the possible applications of Power Decks for ore and wall control applications. As in the past, a detailed analysis will be performed to determine the suitability of using the power decks mine-wide.

6.0 CONCLUSIONS

This study revealed significant cost benefits that could be directly attributed to the use of Power Decks. By carefully analyzing excavator performance the mine was able to optimize the technique to the point where the amount of waste drilling required each year was reduced by 144,000 ft (approximately 131 drill shifts). In addition, the annual waste blasting explosive consumption was reduced by 31 percent (over 8,128,000 lb per year).

Prepared by:



John L. Floyd

President, Blast Dynamics