# Electronic Detonators in Vibration Control

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QUARRY ACADEMY

Improving Processes. Instilling Expertise.

DYNO Dyno Nobel

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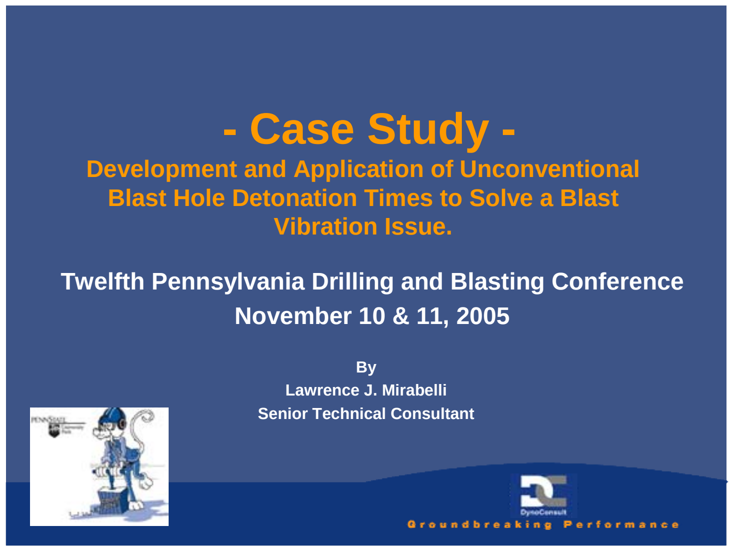
# Electronic Detonators in Vibration Control

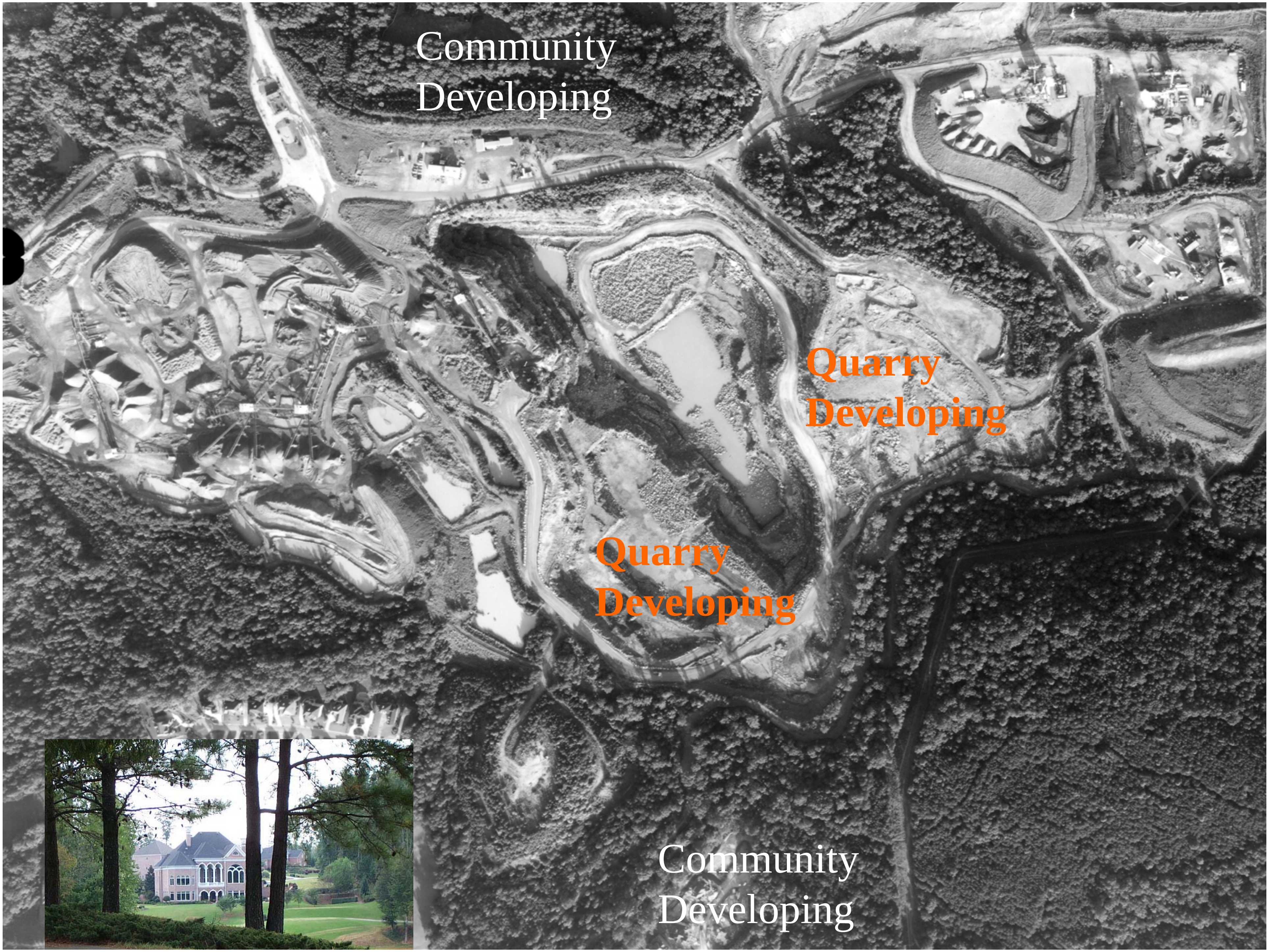
- **This information was extracted from a “Case Study” presented at the Twelfth Pennsylvania Drilling and Blasting Conference on November 10 & 11, 2005.**



# Case Study

- Well established granite quarry in southeast is faced with the challenge of continuing the development of the available reserves present on their permit while an aspiring community develops around it.
- Quarry managemen needs to continue to maintain the strong "good neighbor" policy they have achieved while continuing to profitably develop their reserves.

**Sound unique? Didn't think so!**

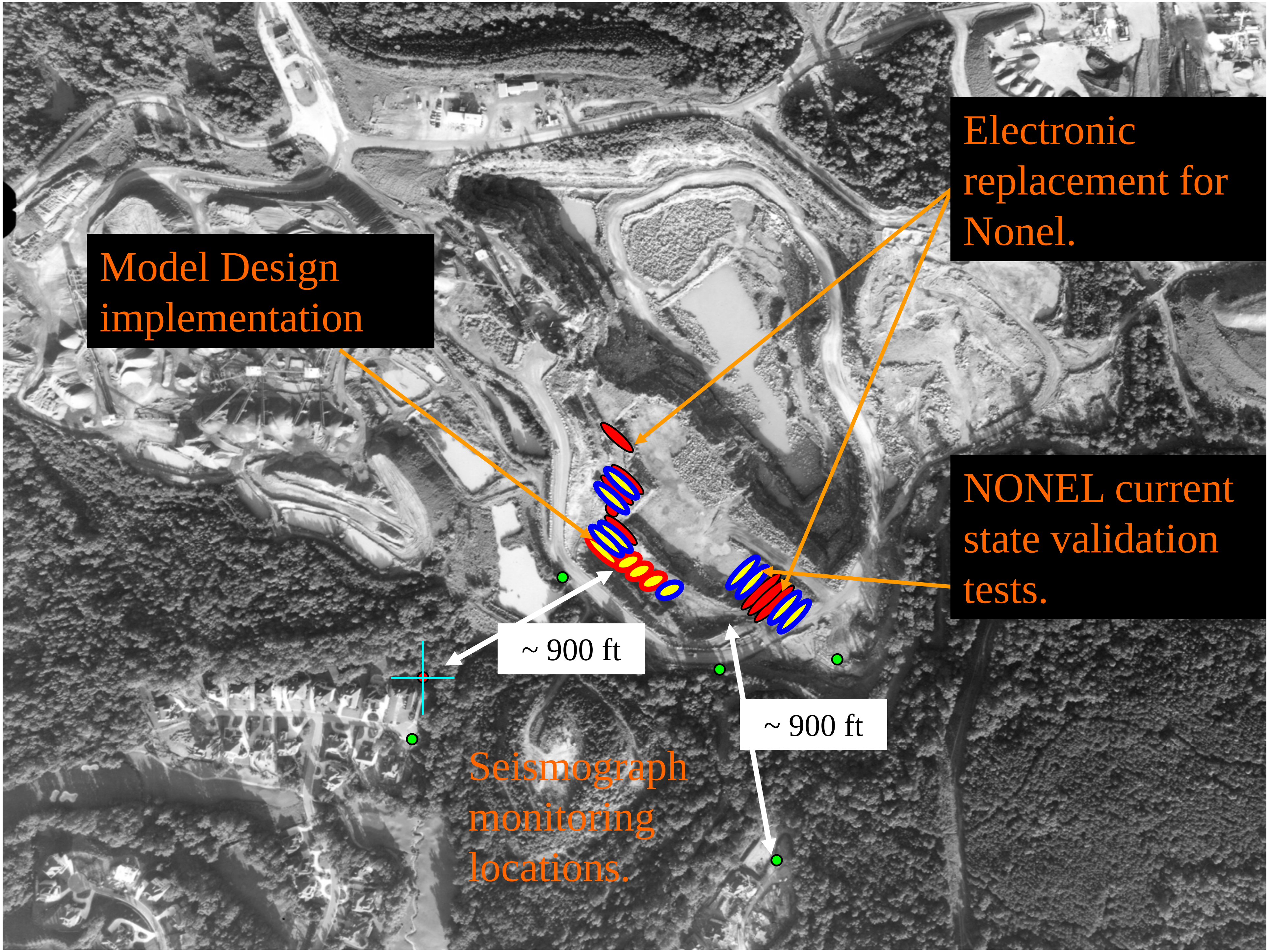

Community
Developing
Quarry
Developing
Quarry
Developing
Community
Developing

# Blast Vibration Issue

- Pit development is advancing closer to established community and communities continue to develop closer in and around the quarry.  Blasting required for stripping has been done with small diameter drill holes to control vibrations and expedite excavation.
- As production blasting has progressed in the developing areas of pit, it has become obvious that better management of blast vibrations will be necessary to continue the “good neighbor” policy without inhibiting production and reducing profits.

# Requirements for quantification of electronic detonator value.

- **Establishment of a quantification team.**
  - ✓ **Lead by project manager. (technically competent, experience with project management)**
  - ✓ **Membership composed of individuals directly involved the process. (line management, blasters, quality control, equipment operators etc.)**
- **Coordinated effort between pit operations/production and the quantification team.**
- **Methodic and Deliberate plan to develop baseline information, to control implementation of change and to measure that the process remains in control.**
  - ✓ **Consistent metrics.**



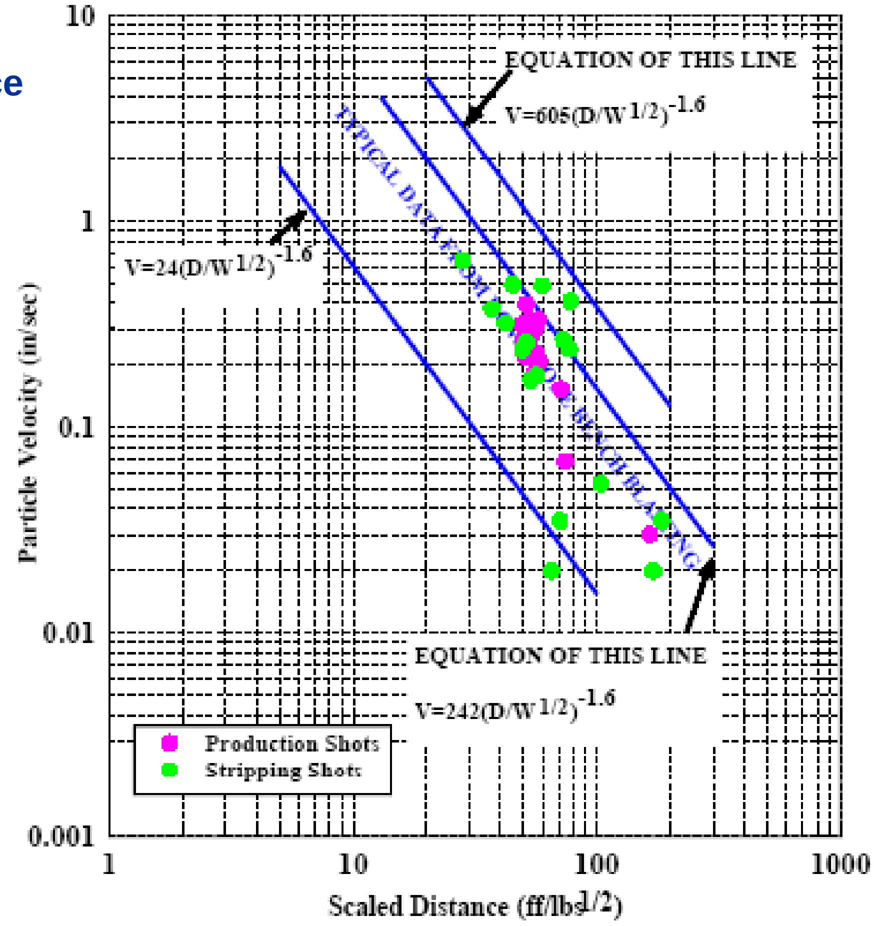
Electronic replacement for Nonel.
Model Design implementation
NONEL current state validation tests.
~ 900 ft
~ 900 ft
Seismograph monitoring locations.

# Program Summary

| Blast # | | | Hole Dia. inch | Tons Produced | Powder Factor tons/lb | holes/delay | lbs/delay | PPV ips | Air dB | SD |
|---|---|---|---|---|---|---|---|---|---|---|
| | To the East | | | | | | | | | |
| 20 | Nonel | | 5.75 | 19,600 | 1.28 | 1 | 450 | 0.523 | 128.0 | 47.28 |
| 19 | HotShot | Model | 5.75 | 17,220 | 1.27 | 2 | 910 | 0.345 | 122.0 | 33.2 |
| 18 | HotShot | Model | 5.75 | 22,344 | 1.31 | 2 | 960 | 0.158 | 122.0 | 30.7 |
| 17 | HotShot | Model | 5.75 | 20,580 | 1.44 | 1 | 490 | 0.198 | 122 | 40.52 |
| | Key cut to the South | | | | | | | | | |
| 16 | HotShot | Model | 5.75 | 11,172 | 1.29 | 1 | 453 | 0.225 | 126 | 40 |
| 15 | Nonel | Decked | 5.75 | 14,700 | 1.72 | 0.5 | 250 | 0.250 | 111 | 53.44 |
| 14 | Nonel | Decked | 5.75 | 21,168 | 1.4 | 0.5 | 230 | 0.365 | 118 | 55.65 |
| 13 | HotShot | Alt time | 5.75 | 23,534 | 1.25 | 1 | 480 | 0.403 | 125 | 40.94 |
| 12 | HotShot | Alt time | 5.75 | 574 | 1.28 | 1 | 445 | 0.163 | 108 | 53.52 |
| | To the South | | | | | | | | | |
| 11 | HotShot | Alt time | 5.75 | 13,524 | 1.22 | 1 | 485 | 0.173 | 124 | 44.78 |
| 10 | Nonel | | 5 | 15,120 | 1.08 | 1 | 395 | 0.288 | 116 | 50.5 |
| 9 | HotShot | Alt time | 5.75 | 24,108 | 1.36 | 1 | 432 | 0.275 | 123 | 50.0 |
| 8 | HotShot | Alt time | 5.75 | 18,662 | 1.26 | 1 | 477 | 0.175 | 123 | 45.5 |
| | To the East with Ramp to North | | | | | | | | | |
| 7 | Nonel | | 5.75 | 20,202 | 1.29 | 1 | 455 | 0.310 | 127 | 47.0 |
| 6 | Nonel | | 5.75 | 20,290 | 1.3 | 1 | 500 | 0.235 | 122 | 66.1 |
| 5 | HotShot | Alt time | 5.75 | 18,368 | 1.34 | 1 | 427 | 0.118 | 129 | 65.5 |
| 4 | HotShot | Alt time | 5.75 | 20,412 | 1.21 | 1 | 490 | 0.140 | 123 | 59.6 |
| 3 | HotShot | | 5.75 | 22,344 | 1.28 | 1 | 490 | 0.138 | 123 | 57.2 |
| 2 | Nonel | | 5.75 | 18,088 | 1.4 | 1 | 485 | 0.123 | 126 | 57.5 |
| 1 | Nonel | | 5.75 | 17,556 | 1.18 | 1 | 485 | 0.148 | 120 | 57.5 |

# Electronic Detonators
# Can they make a difference?

PPV vs Scaled Distance




**Historical Production blasts are all used 5 ¾ inch diameter holes. Stripping Shots used 4 inch diameter holes.**

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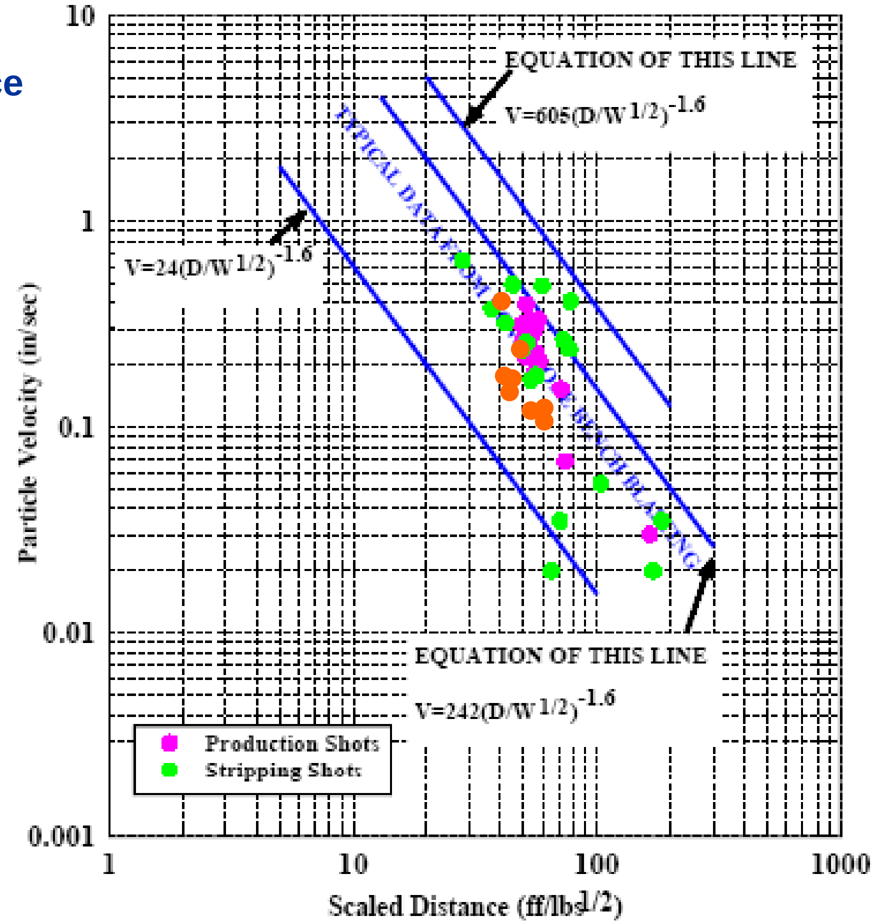


● Electronic replacement blasts

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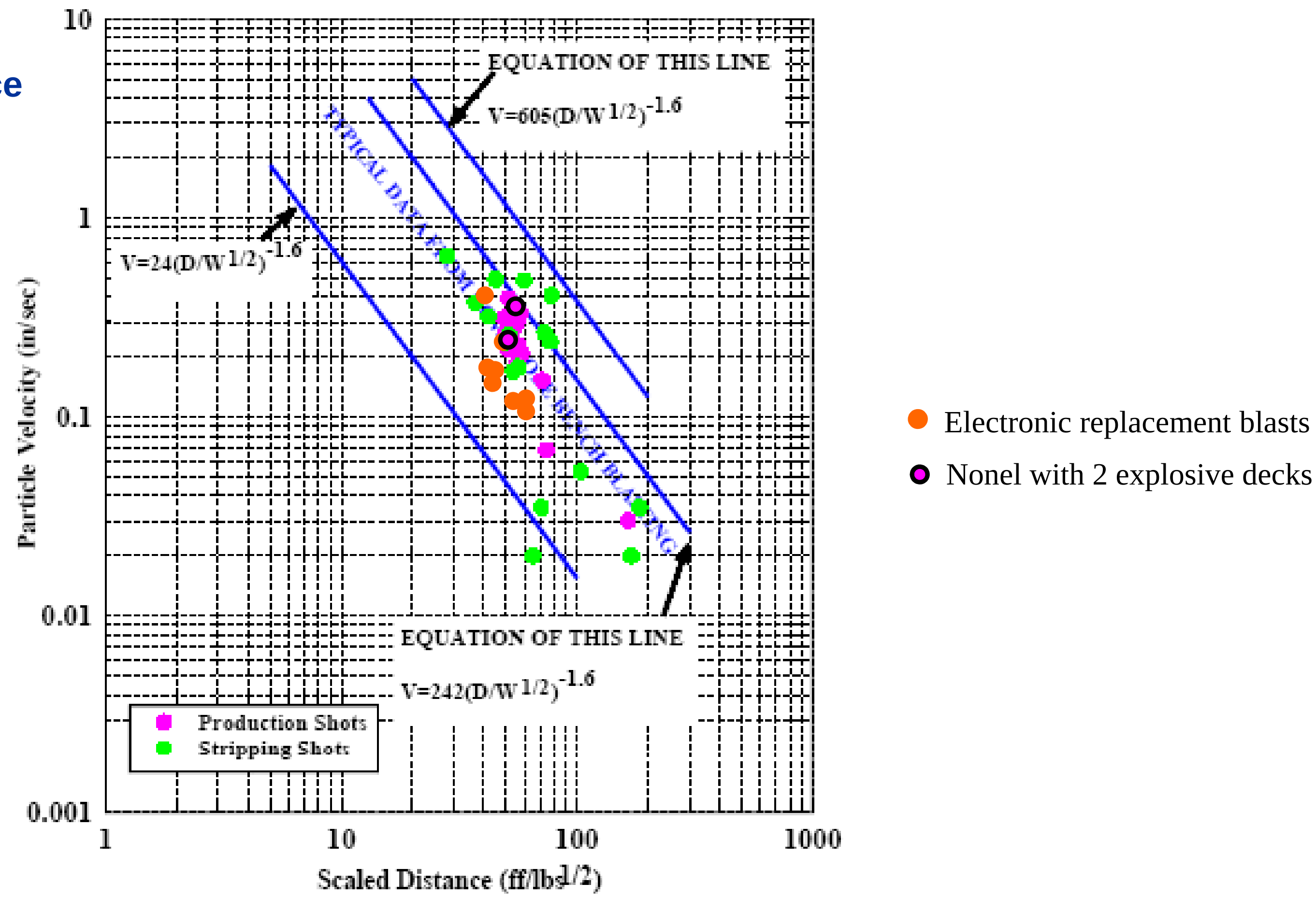

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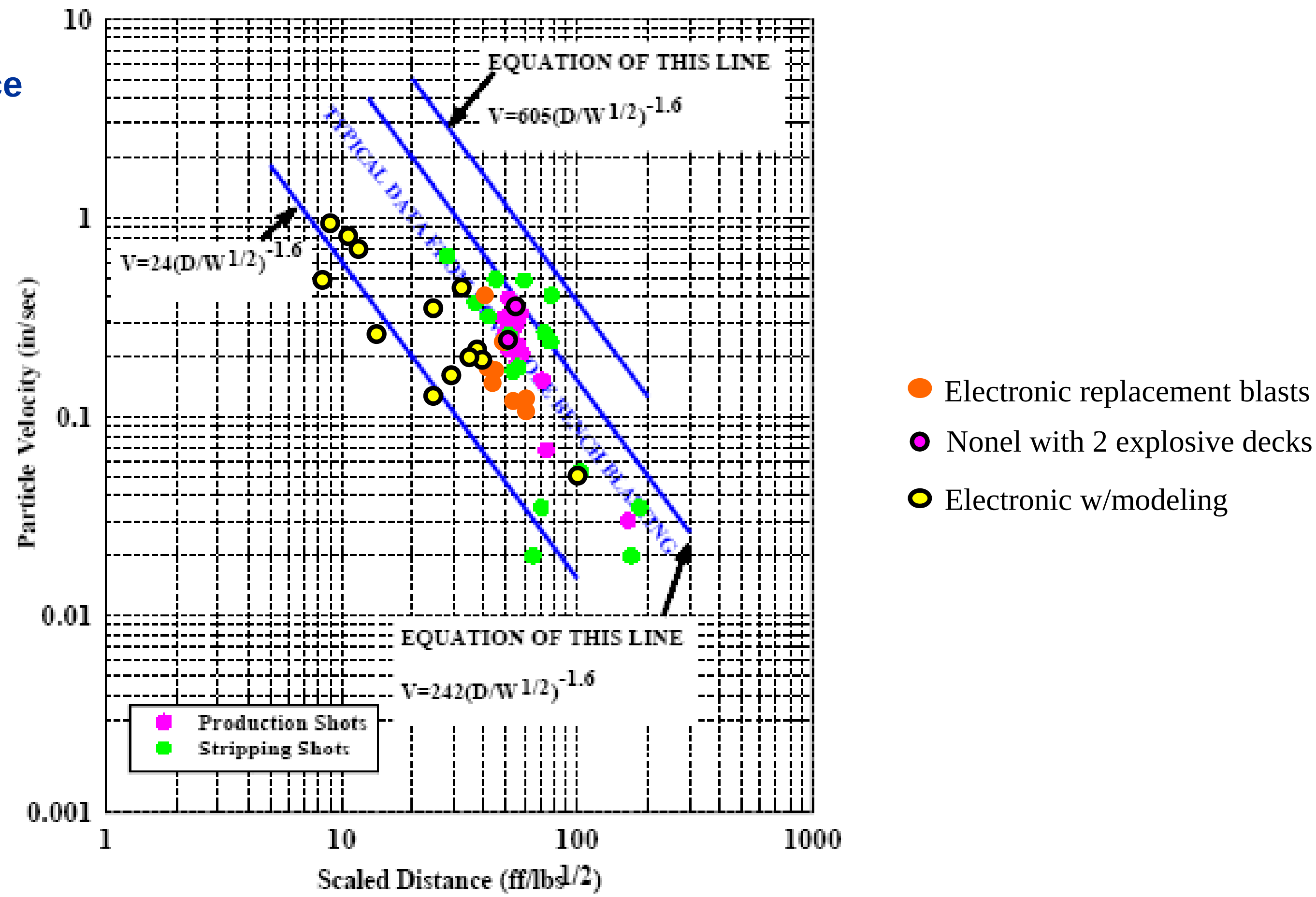


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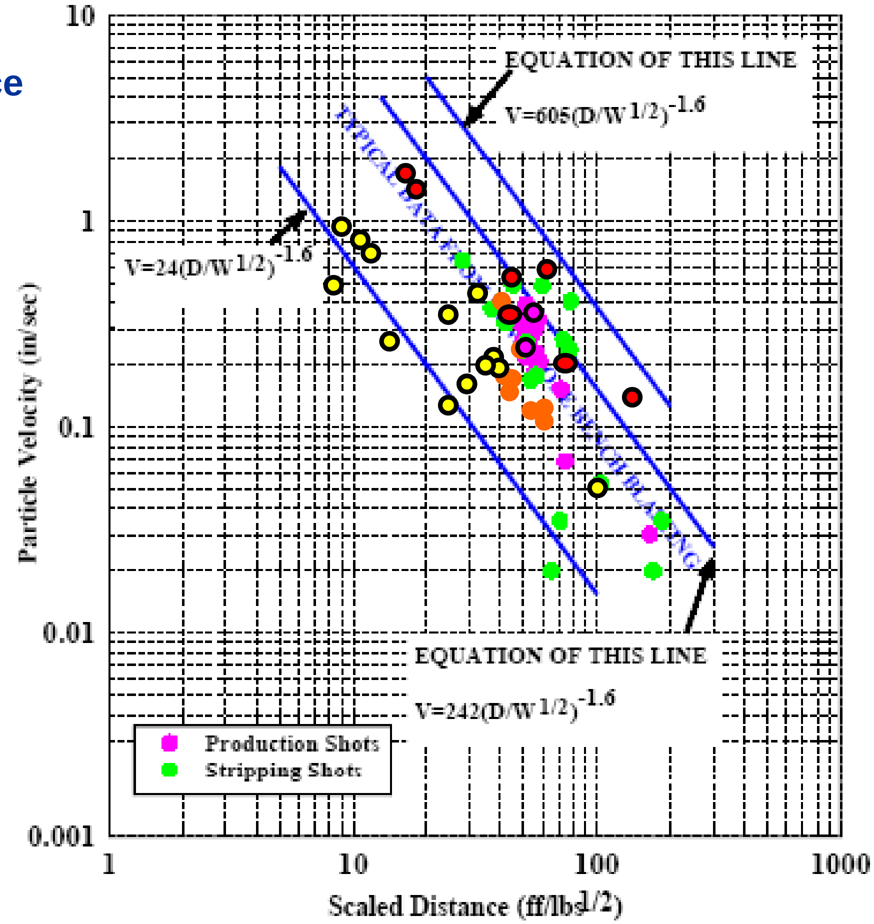
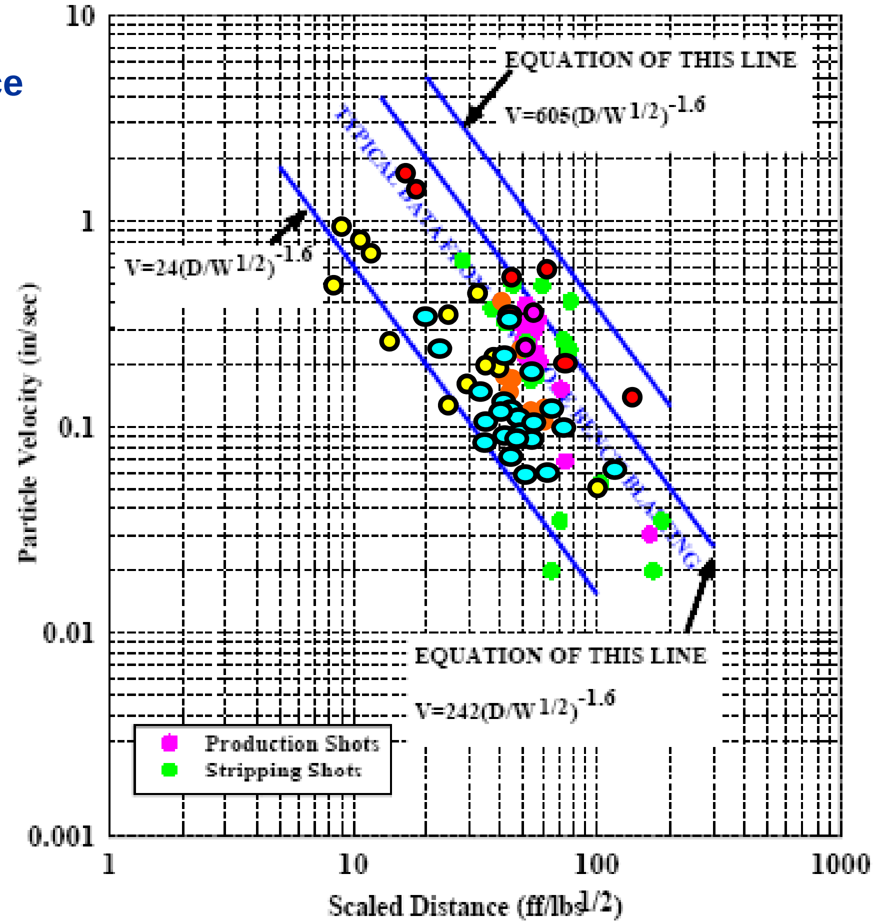



- Electronic replacement blasts
- Nonel with 2 explosive decks
- Electronic w/modeling
- NONEL after electronics

# Electronic Detonators
# Can they make a difference?

**PPV vs Scaled Distance**

**Considering the results attained with electronics in the quarry development area to the southeast. Hole diameter was able to be increased for quarry development to the northeast!**




Electronic replacement blasts

Nonel with 2 explosive decks

Electronic w/modeling

NONEL after electronics

Electronic w/modeling 2006
6 ½ inch diameter holes

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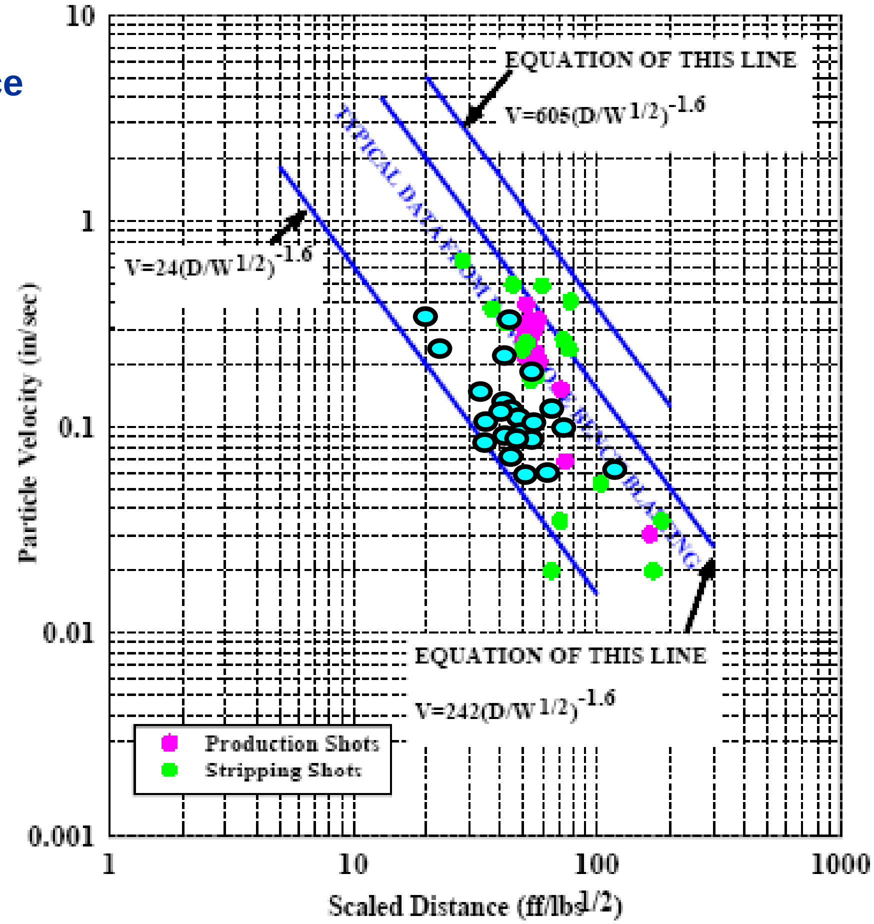
**PPV vs Scaled Distance**




**Historical Production blasts are all used 5 ¾ inch diameter holes. Stripping Shots used 4 inch diameter holes.**

Electronic w/modeling 2006
6 ½ inch diameter holes

# What are the obstacles to implementation of a cost effective explosive technology change like electronic detonators?

- Difficulty seeing value past line item costs.
  - ✓ Install metrics to identify real value.
- Natural "human" resistance to change
  - ✓ Be innovative. Strive to do it better tomorrow. Look beyond the: "we tried that before and it did not work attitude!"
- Natural fear of breaking the "old rules" that we have survived on for years.
  - ✓ Use models to test new designs. Think "out of the box!". Remember that with electronics you need no longer be bounded by conventional delay times.
  - ✓ Always use best explosive engineering judgment to evaluate and select realistic model outputs before attempting implementation!

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