

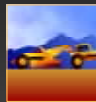
Safety Applications for GPS in the Mining Industry

Queensland Health and Safety Conference
Townsville 5th August 2003





Safety Applications for GPS in the Mining Industry
Scrapers



Define Cut/Fill Areas and Display
 Cut/Fill Numerically
 Remove overburden to design levels



Safety Applications for GPS in the Mining Industry
Machine Control Products



System installed by APS on excavator doing subdivision work.





Safety Applications for GPS in the Mining Industry

What makes it possible

- High Precision GPS technology
- Reliable solid state sensors
- Rugged dependable computers
- Inexpensive high capacity IP telemetry systems






Safety Applications for GPS in the Mining Industry

Safety Implications

- Fewer people on the ground
- Operators don't need to consult pegs
- Job of the surveyor is changed



Safety Applications for GPS in the Mining Industry


Other Safety Advantages

- Equipment Location is known at all times
- Equipment can send distress alarm
- "No Go" areas can be identified
- Collision Avoidance
- Operator can concentrate on steering
- Accident Reconstruction

Safety Applications for GPS in the Mining Industry

Types of GPS

- Stand Alone GPS
 - Accuracy 5 to 10 metres
 - SA (Selective Availability) no longer applies
 - Good enough for truck dispatch



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Types of GPS

- Differential GPS (DGPS)
 - Accurate to 1 metre
 - Uses free to air or paid correction signals
 - Good enough for hazard avoidance applications



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Types of GPS

- Real Time Kinematic
 - Accurate to 1 to 2 centimetres
 - Uses custom correction signals
 - Required for survey applications and high precision machine guidance



Safety Applications for GPS in the Mining Industry

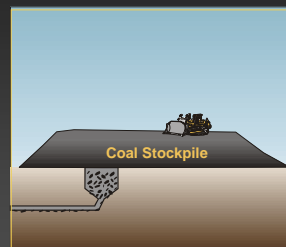
GPS Signals

- Satellites transmit on two frequencies – L1 and L2
- Better receivers can track both frequencies
- Stand alone and DGPS use the transmitted code
- RTK also uses the carrier wave frequency itself to get better resolution

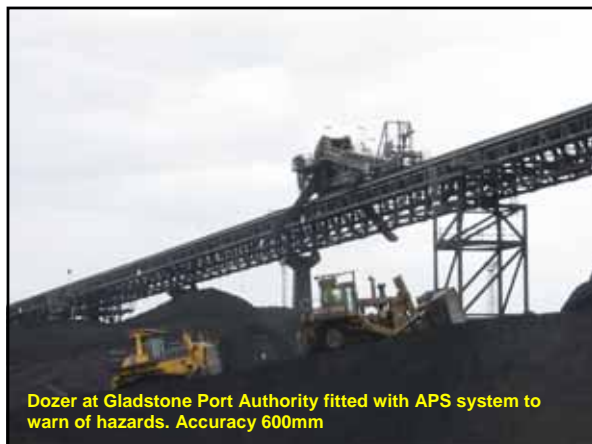


Safety Applications for GPS in the Mining Industry

Stockpile Dozer



- Uses DGPS with accuracy of about 1 metre
- Will warn operator when dozer gets close to hopper danger zone



Dozer at Gladstone Port Authority fitted with APS system to warn of hazards. Accuracy 600mm



Haznav Operator Display

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Navigating around Old Workings



Safety Applications for GPS in the Mining Industry

Issues

- **Lack of Satellites**
 - Even on a flat plane there may be insufficient satellites to get a fix.
 - In a pit with part of the sky obscured the situation is worse.
 - May be as little as 16 hours a day in deeper pits

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Other Solutions

- Pseudolites
- Inertial
- GLONASS



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GPS Plus GLONASS

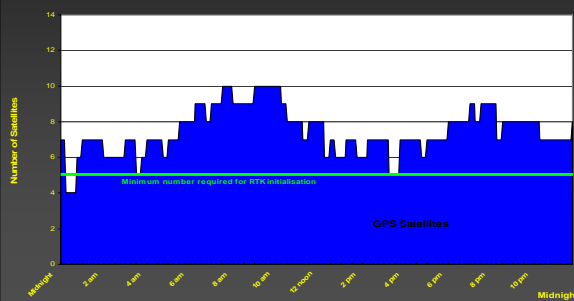


- GLONASS is the Russian GPS
- 27 active GPS satellites
- 9 GLONASS satellites.
- With dual access 36 total
- 3 due for launch in September
- Full constellation (24) by 2005
- Galileo will add another 30 satellites by 2008

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Availability of Satellites

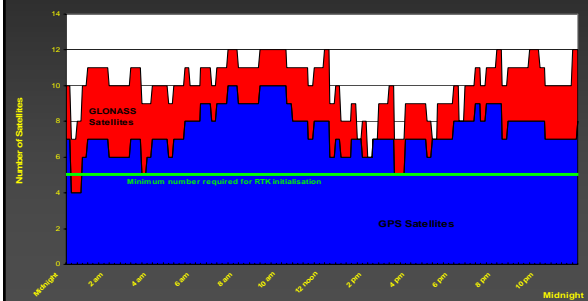
Sheridan (106 58 W 44 46 N) 20th June 2003



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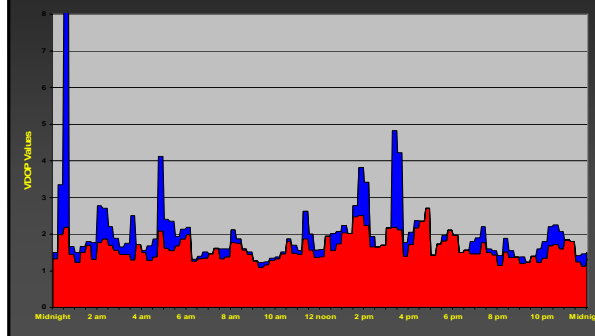
Availability of Satellites

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Vertical Dilution of Precision
Sheridan 20 June 2003



Safety Applications for GPS in the Mining Industry

Conclusions

- GPS systems installed for guidance, elevation control, productivity monitoring and other reasons bring positive safety benefits.
- GPS guidance systems have some pure safety applications
- These applications are marred by the inability to offer 24/7 availability
- Solutions to the availability problem are on the way.