Sustainable agricultural communities

James Millner, Martin Hale, Jacqueline LeLievre, Hayden Asmussen and John Gallagher

Introduction – Department of Sustainability and Environment

The Department of Sustainability and Environment (DSE) is Victoria’s lead government agency for:

- Sustainable management of water resources
- Climate change
- Bushfires
- Public land, and
- Forests & ecosystems
Victoria’s Spatial Data Infrastructure

Spatial Information Infrastructure Division of DSE

- Positioning Policy - Endorsed by Victorian Spatial Council
- Maximise the environmental, economic and social benefits of positioning
- Products & Services: Vicmap Position – GPSnet™
- Achieve broad positioning take up across Victoria, particularly in agriculture

Vision and Objectives

Our policy has been governed by clear objectives and principles

Our vision for Vicmap Position – GPSnet™
Spatial Information Infrastructure will develop and manage a world-class, high accuracy positioning utility that delivers significant economic, environmental and social value to the State of Victoria

In addition to enabling this broad vision, we have 5 specific objectives:
1. Accelerate GNSS precise positioning adoption where the economic and environmental benefits to the State are substantial, particularly in agriculture
2. Cooperate/partner with the private sector to minimise duplication of infrastructure within Victoria and reduce cost and risk to Government
3. Promote open standards and deliver solutions that can be integrated with multiple brands and products
4. Secure sufficient annual revenue to cover operating costs and create a sustainable service, including maintaining service levels and functionality so that solutions remain competitive in the longer term
5. Ensure products are available and affordable to Government and other non-commercial beneficiaries, e.g. for emergency services, environment management, and social wellbeing, particularly regional community development
Productive, Competitive and Sustainable

Benefits identified for:
- Agriculture
- Construction
- Mining

Facing the Challenges:

Network growth

- Background to Victoria’s CORS network expansion
- Since 1996 DSE has coordinated and facilitated the development of Vicmap Position-GPSnet in cooperation with industry, all levels of government, academia and the community
- GPSnet™ is a network of Continuously Operating Reference Station (CORS) that provides state-wide GNSS satellite position correction data to users
- Prior to the Future Farming initiated Positioning Regional Victoria (PRV) program in 2007/8 Vicmap Position-GPSnet had 34 CORS operating across Victoria, largely for the surveying and construction industries
Growth of Victoria’s CORS network

- First GPSnet Data Centre Operational (NRTK)
- Selective Availability Set to Zero
- GPSnet on the Internet (Post Processing)
- Substantial investment (skills and tools) in service level assurance
- Positioning Regional Victoria CORS Station Rollout
- GLONASS compatible receivers installed
- Second GPSnet Data Centre Install Commenced

Positioning Regional Victoria Project

- Funding partners:
  - Department of Innovation, Industry and Regional Development
  - Department of Primary Industries “Future Farming”
- 57 new PRV sites
- Stage 1: complete
- Stage 2: commenced
- State wide coverage by: 2011
Current Status > 50% Complete

Current Status: 69 CORS on line
http://gnss.vicpos.com.au
Positioning benefits extending to agriculture

- Environmental benefits
  - better water use efficiency
  - improved off site water quality
  - reduced soil erosion and
  - reduced carbon emissions
- Economic benefits
  - reduced input costs
  - improved productivity
  - higher yields
- Quality of life
  - improved occupational health and safety
  - less stress
  - prosperous community

Economic Benefits of Controlled Traffic Farming:
Yield Increase – 10%

<table>
<thead>
<tr>
<th>Source</th>
<th>Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tullberg (1997)</td>
<td>22.8% increase over three years (wheat)</td>
</tr>
<tr>
<td></td>
<td>5% increase over three years (Sorghum)</td>
</tr>
<tr>
<td></td>
<td>14.9% increase over three years (maize)</td>
</tr>
<tr>
<td>Grant (1998)</td>
<td>30% to 50% increase</td>
</tr>
<tr>
<td>Ball (1998)</td>
<td>30% to 50% increase</td>
</tr>
<tr>
<td>Krampf (1998)</td>
<td>15% increase</td>
</tr>
<tr>
<td>Tullberg, Ziebarth, and Li (2001)</td>
<td>14% increase</td>
</tr>
<tr>
<td>Rohde and Yule (2003)</td>
<td>22% increase</td>
</tr>
<tr>
<td>Li et. al (1998)</td>
<td>27% increase</td>
</tr>
<tr>
<td>Gaffney and Wilson (2003)</td>
<td>15% increase</td>
</tr>
</tbody>
</table>
Economic Benefit of Controlled Traffic Farming:
Input Cost Savings – 15%

**Input cost savings**

<table>
<thead>
<tr>
<th>Item</th>
<th>Source</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insecticide use</td>
<td>Brownhill (1998)</td>
<td>33 per cent reduction due to reduced overlapping</td>
</tr>
<tr>
<td>Labour costs</td>
<td>Mason et. al (1995)</td>
<td>28 per cent to nearly 50 per cent reduction with zero tillage</td>
</tr>
<tr>
<td>Seed, spray and labour</td>
<td>Birch (1999)</td>
<td>15 per cent reduction</td>
</tr>
<tr>
<td>Labour and fuel</td>
<td>Krampf (1998)</td>
<td>25% reduction in labour cost and 33 % reduction in fuel costs</td>
</tr>
<tr>
<td>Machinery investment</td>
<td>Mason et. al (1995)</td>
<td>25 per cent reduction in capital investment</td>
</tr>
</tbody>
</table>

Business Case to Expand CORS Network to Rural Victoria – $418 million benefit

- Benefit to Victoria **$418m**
- Annualised benefit of **$36m**
- Reductions in Carbon dioxide at **$15m**

The estimated financial benefit for the national agriculture industry is:

**between $1 billion and $1.4 billion annually**
Facilitate innovation uptake in agriculture

Proportion of cropped area under CTF

What is Controlled Traffic Farming?

Dr. Don Yule Control Traffic Farming Solutions

For all Crops
What is Controlled Traffic Farming?

Dr. Don Yule Control Traffic Farming Solutions

CTF defines the spatial footprint

Farmers need only to stay on track

CTF with spatial technologies will contribute more to cropping productivity than all other technologies

What is Controlled Traffic Farming?

Dr. Don Yule Control Traffic Farming Solutions

Controlled traffic makes no-till easy and optimises soil surface management
What is Controlled Traffic Farming?

Dr. Don Yule Control Traffic Farming Solutions

Community: CTF offers a future, a clear path for progress

Ewen Peel, Inverleigh

Andrew Weidemann, President VFF

K Penfold, Coretext

Progress: Stage 1 sites and hosts

- 23 new CORS built, installed and now operational
- Site hosting agreements negotiated and signed with
  - CFA
  - Parks Victoria
  - Councils
  - Farmers
  - Water authorities
  - Community and land care groups

<table>
<thead>
<tr>
<th>Town</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboyd</td>
<td>CFA</td>
</tr>
<tr>
<td>Barmup</td>
<td>Water Authority</td>
</tr>
<tr>
<td>Boorowa</td>
<td>Local Council</td>
</tr>
<tr>
<td>Coburna</td>
<td>Community Hall</td>
</tr>
<tr>
<td>Gnowangerup</td>
<td>Local Council</td>
</tr>
<tr>
<td>Goulburn</td>
<td>CFA</td>
</tr>
<tr>
<td>Goulburn</td>
<td>Yea Office</td>
</tr>
<tr>
<td>Hattah Kilkyra National Park</td>
<td>Yea Vicinity</td>
</tr>
<tr>
<td>Latrobe</td>
<td>CFA</td>
</tr>
<tr>
<td>Landy Ford</td>
<td>Enviro Land Business</td>
</tr>
<tr>
<td>Munga North</td>
<td>Farmer</td>
</tr>
<tr>
<td>Whiteman North</td>
<td>Farmer</td>
</tr>
<tr>
<td>Wimmera</td>
<td>CFA</td>
</tr>
<tr>
<td>Murrumine</td>
<td>Community Facility</td>
</tr>
<tr>
<td>Narracoota</td>
<td>CFA</td>
</tr>
<tr>
<td>Pangandah</td>
<td>Water Authority</td>
</tr>
<tr>
<td>Rainbow</td>
<td>Water Authority</td>
</tr>
<tr>
<td>Sea Lake</td>
<td>Enviro Land Business</td>
</tr>
<tr>
<td>Toolgoora River</td>
<td>Farmer</td>
</tr>
<tr>
<td>Underwood</td>
<td>Water Authority</td>
</tr>
<tr>
<td>Wycheproof</td>
<td>Local Council</td>
</tr>
<tr>
<td>Yea North</td>
<td>Farmer</td>
</tr>
</tbody>
</table>

FIG Congress 2010
Facing the Challenges – Building the Capacity
Sydney, Australia, 11-16 April 2010
Benefits of Controlled Traffic Farming

*Dr. Don Yule Control Traffic Farming Solutions*

Recent study by Bowman (2008):

**Environmental**
- Soil erosion reduced by: 90% - 195,000 tonnes/year
- Diesel reduced by: 60% - 138,000 to 130,000 L/yr
- Nitrogen reduced by: 90% - 119 to 9 t
- Carbon dioxide reduction: 70% - 1,199 to 373 t

**Labour**
- Labour reduced by: 60% - 4,590 to 1,744 hours

**Costs**
- Annual income increase: +44%
- Gross Margin: +68%

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Engagement with the agricultural community

- Start with the users: researchers, young professional farmers and community land care groups
- What do these users expect from a CORS network?
Facing the Challenges:

*What do agricultural users expect from a CORS network?*

- Accurate, (2cm @ 95%)
- Reliable, (consistent: row by row, day by day and year by year!)
- Continuous, (available 99.9% of the time, government backed)

Building the Capacity

Testing Dynamic Accuracy (2cm @ 95%)
After 3 days of continual measurements...

testing automatic machine guidance on a tractor (Balliang, Vic 2007)

Building the Capacity

Reliability and Continuity - CORS Network Operations
Building the Capacity

Reliability and Continuity - Quality CORS sites

Satellite tracking:
- Clear view of sky
- All satellites are available
- No inference, minimal multipath

GPSnet Buxton - bush fire recovery operation
Building the Capacity

Reliability and Continuity - Availability CORS sites

Building the Capacity: Communications

Vic Gov DSE/DPI
Wide Area Network

Optus
Digital Subscriber Line

NewSat
Satellite VSAT
Building the Capacity

Reliability and Continuity – Availability CORS sites

Dual Streaming data into two independent data centres

Building the Capacity: Communications

Reliability and Continuity – Availability CORS sites

Managing CORS bandwidth
### Building the Capacity

#### Reliability and Continuity – Availability CORS sites

<table>
<thead>
<tr>
<th>Location</th>
<th>Code</th>
<th>Coordinates</th>
<th>Latency</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkville</td>
<td>FVPL</td>
<td>2133300</td>
<td>239</td>
<td>229</td>
</tr>
<tr>
<td>Portland</td>
<td>FELL</td>
<td>2111540</td>
<td>243</td>
<td>273</td>
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<tr>
<td>Siwan Hill</td>
<td>DWAN</td>
<td>2160044</td>
<td>197</td>
<td>312</td>
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<tr>
<td>Melbourne</td>
<td>NELJ</td>
<td>2166534</td>
<td>152</td>
<td>630</td>
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<td>Albury</td>
<td>ALBR</td>
<td>2163350</td>
<td>124</td>
<td>141</td>
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<tr>
<td>Musquill</td>
<td>NISPR</td>
<td>2163352</td>
<td>124</td>
<td>119</td>
</tr>
</tbody>
</table>

Monitoring CORS data stream latency

### Building the Capacity

#### Reliability and Continuity – Availability CORS corrections

**Primary Data Centre**

Primary Data Centre - high availability, dual power, dual communication, redundant hardware and applications
Building the Capacity

Reliability and Continuity – Availability CORS corrections

Disaster Recovery

Dual data streams into 2 independent data centres, Disaster Recovery (DR) & Testing (UAT)

Building the Capacity

Reliability and Continuity – Quality CORS sites

GPSnet™ - Swan Hill (SWAN)

<table>
<thead>
<tr>
<th>Item</th>
<th>Coordinate</th>
<th>Datum/Frame Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude</td>
<td>31° 29' 51.6215&quot; S</td>
<td></td>
</tr>
<tr>
<td>longitude</td>
<td>141° 30' 23.1794&quot; E</td>
<td></td>
</tr>
<tr>
<td>Elevation (True M)</td>
<td>272.434499 F</td>
<td></td>
</tr>
<tr>
<td>Conting (True M)</td>
<td>1015.86174 N</td>
<td></td>
</tr>
<tr>
<td>Conting (True M)</td>
<td>712.51892 F</td>
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</tr>
<tr>
<td>Conting (True M)</td>
<td>508.38132 N</td>
<td></td>
</tr>
</tbody>
</table>

Regulation 13 Certificates
Building the Capacity

Reliability - Quality Monitoring CORS Coordinates

Monitoring station coordinates (GDA)

Building the Capacity

Reliability and Continuity - Quality CORS sites

System Information, Warnings and Alerts
Building the Capacity

Reliability and Continuity – Service Availability

Monitoring bandwidth and connectivity
Building the Capacity with industry, research partners and institutions

Real Time Quality Control (RTQC)

CRC-SI development and implement a robust, independent, real-time system that will inform users and CORS operators of the quality, dependability, and fitness for purpose of NRTK positioning results.

Users: broad range to ensure service sustainability

User Management for over 770 registered users.
Wide range of applications and users

- Channel Deepening
- Pipeline Construction
- Rail Crossing Upgrades
- Survey
- Transport
- Machine Guidance
- Emergency Services
- Precise Tracking
- Air Crash Investigation
- Controlled Traffic Engineering
- Slope monitoring

User needs, reference groups and forums

- Free Newsletter and Magazine
- Free DVD

PRV Funding has been provided by the following government departments:

Department of Sustainability and Environment
Department of primary Industries - "Future Faming" initiative
Department of Innovation, Industry and Regional Development's "Regional Infrastructure Development Fund; and
Supported by the Australian Federal Government