Local knowledge  Global knowhow
Delivering targeted solutions

PrecisionAgriculture.com.au is an independent consulting company offering advice, training and products associated with precision farming industries. With a strong understanding of the complexities associated with farming systems we foster partnerships with key stakeholders in order to deliver targeted solutions.

We're a team of people with a passion for integrating spatial technologies with the management processes of cropping systems.

We value the concept of measuring to manage as being critical for continual farm improvement and provide the products and services to enable farmers to strategically respond to the challenges of crop production relative to space and time.

We believe precision agriculture techniques need to be implemented in association with the understanding of interactions at the farming system, whole farm, and sub-paddock levels. We therefore view our services as being complementary to existing farmer consultants/agronomists, providing opportunities for all to be involved in the process.
**DIRECTOR – TIM NEALE**

Tim has a degree in Rural Technology from the University of Queensland, Australia. During the seven years working with the Queensland Primary Industries Department, Tim researched the impact of tractor and harvester wheels on grain yield. This drove Tim to start his own business consulting to farmers and completing projects on developing ways to a more productive farming future based on Precision Agriculture.

Tim works all over the world delivering Precision Ag products and services. His work has helped change over five million hectares to more profitable and sustainable farming systems and kick started the revolution in auto-steer tractor guidance technology. He’s been working as a consultant for more than ten years.

**DIRECTOR – ANDREW WHITLOCK**

An Agricultural Science (Hons) student from Melbourne University (Parkville campus), Andrew began his working career with DPI Victoria as the statewide precision agriculture agronomist. This role involved significant training, study, domestic and international study fast-tracking his influence within the Victorian Grains Industry.

Andrew’s passion for Australian agriculture and commitment to developing precision agriculture was recognised by the Australian Society of Agronomy as the inaugural Young Agronomist of the Year (2006).

Andrew works closely with farmers and agronomists to implement site specific crop management, particularly throughout Victoria, Tasmania and Southern NSW. Over the past eight years this work has included strategic soil sampling, designing variable rate applications, crop sensor mapping, yield map analysis/interpretation, running on-farm trials, farm drainage designs, soil pH mapping, delivering PA workshops and participating in a range of industry projects.
DIGITAL FARM MAPS
GREAT TO HAVE A FARM MAP FOR THE OFFICE WALL, TEAR PAD FOR CONTRACTORS & ELECTRONIC COPY
- Maps include areas & names of paddocks, accurate scale, grid coordinates for use with GPS, laneways, buildings, water points etc...

CROP AND PASTURE GROWTH MAPS (ISAT30)
LOOK AT CHANGES TO YOUR FARM OVER TIME THROUGH SATELLITE IMAGERY
- Up to 8 years of data readily available (2003 – 2011)
- Crop/pasture biomass map per season plus an average biomass map

TOPOGRAPHY MAPS
CREATE WHOLE FARM ELEVATION MAPS FOR DRAINAGE AND LAYOUT DESIGNS
- For farmers with 2cm accurate autosteer, we can use your existing data
- Receive as large hard copy and digital map formats and advice

VARIABLE RATE PRESCRIPTION MAPS
WANT TO IMPLEMENT VARIABLE RATE USING VR CONTROLLER?
- We can assist you with determining the management zones using either yield, biomass, elevation or soil maps
- Plus create the data file required to be loaded into a VR controller
SOIL pH MAPS & VARIABLE RATE LIME

OUR IN-FIELD RAPID pH DETECTORS HAS YOU COVERED
- Grid sampling to create a soil pH map
- Convert into a lime prescription map with assistance of strategic soil tests

CROP & PASTURE SENSING

REAL TIME NDVI FOR THE FULL PICTURE
- In crop sensing for rapid assessment of crop progress and health
- Fertilising strategies, decision making and problem diagnosis

ELECTROMAGNETIC SURVEYS

COST EFFECTIVE RAPID SOIL ASSESSMENT
- Get a better understanding of soil conductivity to create zones
- High accuracy elevation collected at the same time

precisionagriculture.com.au
Got yield monitor data and don’t know what to do with?

YIELD MAPS

MEASURE YOUR PRODUCTIVITY
- Great for zoning, targeted soil and tissue testing or crop monitoring
- We format yield data cards for all manufacturers
- Clean errors in maps and present maps in hard and electronic copies

LOSS ASSESSMENT

WHEN THINGS GO WRONG PRECISION AGRICULTURE CAN HELP
- Utilise spatial data to assess affected areas
- Get unbiased information for court proceedings or insurance claims

HIGH RESOLUTION SATELLITE IMAGERY

DETECTION OF CROP EFFECTS FROM SPACE
- Measure water logging, disease, nutrition, soil types, machinery impacts & trials
- Around late tillering is ideal for N decision making, using 5m pixel imagery
- High quality imagery for farm maps and detailed crop management using 50cm or 80cm pixel imagery
ON-FARM TRIALS
TREAT YOUR FARM AS A RESEARCH STATION
✧ We offer assistance with designing and locating trials
✧ Trials are evaluated based on yield data & satellite imagery

The most powerful learning occurs on-farm!

precisionagriculture.com.au
INTRODUCTORY PA PACKAGE

Designed for farmers wanting to get started with limited data. Take the first step towards understanding potential benefits of PA.

✧ Map all paddock boundaries
✧ Obtain all available spring crop/pasture biomass maps from existing database of satellite imagery (30m pixel imagery, one annual image plus an average map)
✧ Integration of local knowledge with maps (yield, crop growth and soil maps)
✧ Fast-track evolution of crop agronomy through design & analysis of on-farm trials
✧ Strategic monitoring of crop development across major soil management zones

DIG YOUR DATA

Designed for farmers with existing data (i.e. yield, imagery, elevation etc). Begin to utilise this information in partnership with your agronomist to implement PA.

✧ Gathering of ALL spatial data collected on-farm
✧ Clean up existing yield data and present for further analysis
✧ Obtain all available spring crop/pasture biomass maps from existing database of satellite imagery (30m pixel imagery, one annual image plus one average map)
✧ Integration of local knowledge to define paddock management zones
✧ Fast-track evolution of crop agronomy through design & analysis of two on-farm trials
✧ Design strategic soil sampling across major soil management zones
✧ 12 months unlimited phone and email support (Mon-Fri, 9am-5pm)
Guaranteed answers to all your PA questions...

ANNUAL SUPPORT PACKAGES
INVEST IN A PACKAGE AND SAVE
✧ Yield processing
✧ In-season imagery
✧ Evaluating trials
✧ Phone and email support

IMPLEMENTING PRECISION AG SUPPORT
✧ Guaranteed answers to all your PA related questions
✧ We utilise our international networks to help answer your PA queries
✧ Support includes: GPS guidance, inter-row sowing set-ups, variable rate controllers, PA software, controlled traffic farming (CTF) and hardware connectivity
✧ 12 months phone and email support (Mon-Fri, 9am-5pm)

precisionagriculture.com.au
Crop sensor mapping

**PROFILE**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>South West Victoria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREA</td>
<td>1100ha</td>
</tr>
<tr>
<td>ANNUAL RAINFALL</td>
<td>500mm</td>
</tr>
<tr>
<td>SOIL TYPES</td>
<td>50% loam, 50% clay</td>
</tr>
<tr>
<td>TOPOGRAPHY</td>
<td>Undulating</td>
</tr>
<tr>
<td>ENTERPRISES</td>
<td>Wheat, barley, canola, faba beans, lupins, prime lambs, pigs</td>
</tr>
<tr>
<td>AVERAGE CROP YIELDS</td>
<td>Wheat – 5t/ha, Barley – 4.5t/ha, Canola – 2t/ha</td>
</tr>
</tbody>
</table>

**CROP SENSOR - CASE STUDY**

**PA INVESTMENT**

Aerial photographs and satellite imagery captured over the Inverleigh property in 2005 kick started the PA journey for this farm manager in south west Victoria. The imagery opened his eyes as it highlighted the high degree of spatial variability in crop performance across the property. He commented that the imagery allowed him to view the effects of soil compaction, fence line removal (paddock history effects), paddock obstacles and waterlogging.

With rising input costs, the manager wanted to improve key crop input efficiency and optimise application timing, especially regarding nitrogen. While satellite (biomass) imagery was captured over the property each season, the low amount of clear days during winter and early spring in the region affected satellite imagery timing and thus was difficult for reviewing for N application.

**INTRODUCTION OF CROP SENSORS**

In 2009 he mounted a Crop Circle optical sensor to the front of the main cropping tractor as a part of a project conducted in the district by PA. Cropping paddocks were mapped 6-7 times throughout the season. Wheat crops were mapped at the following stages during spraying and spreading operations:

- Pre-establishment
- GS15 (seedling growth)
- GS23-25 (tilling)
- GS30-31 (stem elongation)
- GS37-39 (flag leaf)
- GS90 (ripening)

**HOW THEY WORK**

Crop sensors work by placing red and near infrared (NIR) light on crops and measuring the amount of light reflectance from these two light wavebands. Healthy, vigorous crops reflect a high level of NIR light and a low amount of red light while unhealthy, low vigour crops reflect a greater amount of red light and less NIR light. Since crop sensors contain their own light source, they can be used at both day and night and cloudy conditions.

The normalised difference vegetation index (NDVI) formula calculates this reflectance data and produces a scale of 0 to 1 (0.1 = dead plant, 0.8 = healthy plant). The NDVI data is used to create a crop sensor map with a colour scale applied (i.e. blue = high biomass, red = low biomass).

**CROP SENSOR BENEFITS**

The first benefit the manager noticed from using the crop sensor was the pre-establishment map (captured during knockdown spraying) provided an ‘accidental weed map’, where areas of the paddock with intense weed density (particularly ryegrass) were identified.
The main benefit gained from using the crop sensors throughout the growing season was that the maps produced from the data were able to be instantly analysed after capture to assist with key input decisions particularly nitrogen application (in season management calibration).

The crop sensor maps further highlighted to the manager the impact of crop management on performance including crop variety selection, weed management, manure use, and waterlogging effects. Crop sensors also allow the performance of on-farm trials to be measured throughout the growing season, which provides a greater insight into the effects of trialled practices and treatments.

The use of crop sensors has allowed Josh to more effectively manage crops throughout the growing season. Adjustments can be made to the in-season crop management plan from the information gained. Crop nutrient deficiencies, insect pressure and diseases leading to yield penalties are able to be identified often prior to causing visible crop stress /yield reduction and be managed effectively.

He states that the use of crop sensors has improved the timeliness of cropping operations which has led to significant improvements in efficiency and productivity.

**FUTURE PLANS FOR CROP SENSOR USE**

The manager plans to use crop sensors in the future to conduct weed mapping across paddocks during summer spraying operations. This will allow high density weed patches to be identified and this information could be used to vary herbicide and seeding rates.

Since zoning his paddocks based on soil type, he also plans to use crop sensors to monitor crop performance in the soil zones throughout the growing season to assist in site-specific management.

**PRECISIONAGRICULTURE.COM.AU CROP SENSOR MAPPING**

PrecisionAgriculture.com.au offers a crop sensor mapping service to farmers. Services are offered throughout Australia using GreenSeeker technology.
THE SITUATION

Imagery highlighted the high degree of spatial variability in crop performance across the property and the significant effect waterlogging and poor paddock drainage was having on crop performance.

On a 140ha block of the property, up to 50ha (36%) of the block suffered from waterlogging damage annually. In 2010 36ha of canola was completely lost on the block due to waterlogging. Josh decided enough was enough and began work on improving drainage on this block.

MANAGEMENT

In conjunction with PA consultant Andrew Whitlock Josh used PA technology and data to redesign the block and improve drainage. Josh and Andrew analysed the block topography maps collected off the property’s RTK autosteer system as well as crop sensor and yield maps to assess where water moves and the associated waterlogging impacts. Photos taken from waterlogged areas were also used to review affected area locations and water movement.

After review of all the data a diagonal drainage line was designed across the block. The drainage line was drawn in Farm Work Office software as an AB line and downloaded onto the autosteer system. A plough was used to mark out the drainage line as the tractor steered along the designed AB line. A drainage contractor with a scraper and excavator was employed to cut the drain.

BLOCK REDESIGN

After the drain was cut, the block was redesigned to further improve drainage and increase efficiency. The block was divided into three paddocks (from five) and paddock traffic directions (AB lines) were changed. The traffic direction changes were based off topography maps and the aim was for the controlled traffic tram tracks to drain water.

BENEFITS

Josh estimates the average area of crop loss from waterlogging on the block has reduced from 50ha (36%) to only 5ha (4%). The significant return on investment (1890%) from the block redesign and drainage works. Nearly $100,000 in two years!

Redesigning the block for improved water management also provided unforeseen benefits. Reducing the paddock number from five to three increased the arable area of the block and led to improvements in paddock operation efficiency.
34,000 tonnes of soil movement in a single paddock

THE SITUATION

High precision RTK GPS was used to calculate the soil movement in a paddock on the eastern Darling Downs in Queensland where floodwaters broke over a creek bank and travelled across a cropping paddock.

The depth of water can be seen on the fence post pictured below.

Fortunately sorghum stubble protected land upstream, however due to the presence of a failed chickpea crop, parts of the paddock eroded badly.

Coincidentally an RTK GPS survey was conducted several years ago for property planning purposes. A follow-up survey was completed post flood (below left), and the two datasets were compared to identify areas of erosion and deposition (below right).

Over the 35 hectares of re-mapped area, the data showed that around 34,000 tonnes of soil was eroded and 30,000 tonnes of soil deposited. Therefore 4,000 tonnes had left the paddock.

The deepest erosion was 75cm and the deepest deposition was 95cm.

OPTIONS FOR REMEDIATION INCLUDED

- Do no earthworks and return to pasture;
- Earthworks to move most of the productive soil back and allow drainage of the paddock; or
- Moving enough soil to make the paddock drain properly and then remediate the eroded area with manures/compost.

Post flood topography map left (blue = higher, red = lower) and erosion/deposition map right (white = erosion, bright blue/yellow = deposition, brown = little change)
Integrating precision agriculture technology

THE DRIVERS TO INTEGRATE PA TECHNOLOGY WITH AGRONOMY

Lachlan Fertilisers began aiming to deliver agronomy to a sub-paddock level as broadacre farming management has increasingly shifted to a managing micro-variability approach.

The company looked to precision agriculture (PA) to fine tune agronomy and add value to their services. The company views this approach as a significant opportunity to replace the traditional blanket application agronomy service. Their aim in delivering a PA focused agronomy service is “to maximise our clients’ economic returns, while also maximising yields in the favourable seasons.”

YIELD STABILITY ANALYSIS

Creating yield stability maps was seen as the first important step in understanding sub-paddock variability. Yield stability maps incorporate 3+ years of yield data and calculate four zones (high, medium, low and unstable). The high, medium and low zones identify areas of paddocks that are consistently high, medium or low yielding, while the unstable zone identifies areas of paddocks that have produced inconsistent yields.

HOW IS THE TECHNOLOGY BEING USED?

The yield stability maps allow Lachlan Fertilisers’ agronomists to identify stable yield performance variability across their clients’ paddocks in different seasons. The maps have shown to correlate well with differing soil types and water holding capacities (WHC). This information allowed strategic soil sampling and analysis in these zones and provided a greater insight into soil knowledge for both agronomists and their clients. Grid pH mapping was also conducted on client focus paddocks to add another layer of information and determine if soil pH was a yield limiting factor.

pH variability across paddocks correlated well with soil type, but soil pH has not shown to be the yield limiting factor on farms with a good history of soil ameliorant application. This information has proven to be very powerful as it has informed the agronomists to shift their focus to paddock soil and water holding capacity variability, which is emerging as the key yield limiting factor.

MAKING INFORMED AGRONOMY DECISIONS

After gathering this detailed paddock information, Lachlan Fertilisers’ agronomists can confidently identify the location of light and heavy soil zones across paddocks.
Since the lighter soil zones will have poorer nutrient availability early in the season (lower cation exchange capacity), these zones will be closely monitored to ensure tiller numbers are maximised to ensure these zones have high yield potential. Variable rate (VR) fertiliser applications at sowing and early post emergence nitrogen applications focused on higher rates in these zones will likely occur.

When crops are approaching stem elongation, soil moisture content and predicted soil water availability will be determined in the defined paddock zones via review of soil water holding capacity maps and soil test data. From this information yield potential and nutrient budgets for these zones will be determined. The process aims to match nutrient supply to crop water availability.

FUTURE PLANS FOR INTEGRATING PA WITH AGRONOMY SERVICES

Lachlan Fertilisers’ agronomists aim to continue to map soil variability across their clients’ paddocks to understand what is driving yield variability. The aim is to collect enough paddock data to make more informed agronomy decisions. They believe the next step in the process is to use crop sensors (e.g., GreenSeekers) and satellite imagery (both measure crop biomass via NDVI readings) during the growing season to monitor crop zones and understand their in-season performance.

The company is currently investigating using iPhone/android apps such as PASource and Precision Earth that will enable data layers (e.g., pH, EM38, yield and satellite imagery maps) to be viewed on his iPad along with his current location in the paddock via the in-built iPad GPS. These apps will enable in-season site-specific ground truthing and crop monitoring in paddock zones.

Lachlan states that “you can’t manage what you can’t measure” and that “informed decision making is profitable decision making.” They believe that offering a PA agronomy package will provide their company with a competitive edge in their agronomy services.

THE PA AGRONOMY PACKAGE

When delivering their PA agronomy package, Lachlan Fertilisers’ agronomists and their clients choose a small number of focus paddocks which have historically shown significant yield variability and where there is 3+ years of good quality yield data available.

Yield stability analysis maps are then created for the focus paddocks in consultation with Lachlan Fertilisers’ PA consulting partner PrecisionAgriculture.com.au. GPS referenced strategic deep N soil tests are then conducted in the defined zones created from the yield stability analysis. Photos are taken of the intact cores to understand the differences in soil type, texture and structure across the paddock. The soil tests from each zone are used to determine soil water holding capacity levels and plant counts are also conducted in the individual zones.

Following this work, both a soil texture and water holding capacity map will be produced for the paddock to assist with future agronomy work conducted there.

PRECISIONAGRICULTURE.COM.AU

YIELD STABILITY ANALYSIS, pH AND CROP BIOMASS MAPPING

PrecisionAgriculture.com.au can conduct yield stability analysis, soil pH mapping, paddock zoning, strategic soil testing and plant establishment measurements. Our company also sells in-season satellite imagery (crop biomass maps) and now offers a crop biomass mapping service to farmers.
Flood costs farmer $1260/ha

THE SITUATION

A yield monitor used during the sorghum harvest (April 2011), in combination with satellite imagery taken immediately after the January 2011 floods, shows a yield loss of 6.3t/ha (8t/ha to 1.7t/ha); which equates to $1260/ha assuming sorghum is $200/t.

The paddock, shown in the map right, is located on the flood plains of Darling Downs. Yield monitor data (red to blue colours) are overlaying the satellite image. Water can be seen in grey.

Some other paddocks on the Downs suffered 100% yield loss. Given record cotton prices, losses in cotton could be in the order of $6,000 - $8,000/ha.

This case study demonstrates the value of collecting yield data to quantify variability in your fields.

This then provides farmers with the information to justify expenditure on remediating the problem - whatever that may be.

After-market yield monitors can now be purchased for as little as $5,000. Making it a worthwhile investment.
“The information and services provided by precision ag complements the agronomy packages we offer to clients. Given the complexity involved with PA we prefer to leave it up to specialists in the field such as Andrew and Tim which we can then relate back to local agronomy issues”.

Greg Condon
Grassroots Agronomy

“The guys at PrecisionAgriculture.com.au have developed some simple but effective tools to begin to understand paddock variability. We now have target soil sampling and improved fertiliser recommendations based on historical data such as stacked yield maps and satellite imagery”.

Graham Spackman
Spackman Iker Ag Consulting

“Many of our clients now have some form of precision ag equipment on their machinery. But very few know how to use the data they are collecting. I have found the guys at PrecisionAgriculture.com.au offer a fantastic affordable service to collate and interpret all this great information into farmer language. In particular the drainage maps and land-forming design maps that they have been able to produce have been valuable for my clients who have had them done”.

Craig Drum
Tatyoon Rural

“In today’s modern world of agriculture, where gross margin and profitability are getting tighter, it is important to look for techniques and technologies that can reduce our costs without decreasing production. One of these new technologies is the soil pH mapping services from PrecisionAgriculture.com.au. It has reduced our liming costs by 18% with the added potential to increase crop yields”

Adrian Roles
JMAJ Roles Pty Ltd
"The team at PrecisionAgriculture.com.au are the valuable third link between our clients and the precision agronomy approach we use in our advisory services. The precise collection and analysis of spatial data within paddocks allows us as advisors to make informed decisions on inputs and profitability, as well as providing the opportunity to conduct intensive on farm strip trials. PrecisionAgriculture.com.au support our approach through such services as analysing yield data, extracting elevation maps, providing 0.8m satellite NDVI imagery, conducting soil pH mapping and developing multiple zone application maps for rate controllers to name a few. They are the leaders in their field and are a pleasure to deal with”.

Lachlan Caldwell
Lachlan Fertilisers

With the assistance of PrecisionAgriculture.com.au the Balliang Cropping Group (BCG) were successful in receiving a significant grant from the Vision for Werribee Plains. With this grant the BCG conducted a number of trials under Andrew’s guidance and utilised a wide range of Precision Ag tools including satellite imagery, yield mapping, EM38 mapping, soil moisture probes, strategic soil cores and soil pH mapping. The trials found large variation across paddocks, highlighting the need for variable rate management. Andrew offered a strong understanding of the latest technologies, but more importantly how to put these tools into practice. BCG have the belief that if you can’t measure it, you can’t manage it”.

Chris Sharkey
Balliang Cropping Group

precisionagriculture.com.au