Implementation of Surface Water Management

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Precision Cropping Technologies

The Williams workshop is supported by Peel-Harvey Catchment Council, through funding from the Australian Government's National Landcare Program

Contents

- Identification of Priority Areas
- Data Collection
- Controlled Traffic Farming
- Construction Methods
- Drainage Options
- Decision Process
- Construction Process
- Farm Operations and Maintenance

Prioritising Areas

Local knowledge

- Worst Fields
- Gilgai/Melon Holes
- Slow to drain
- Wetland/lakes

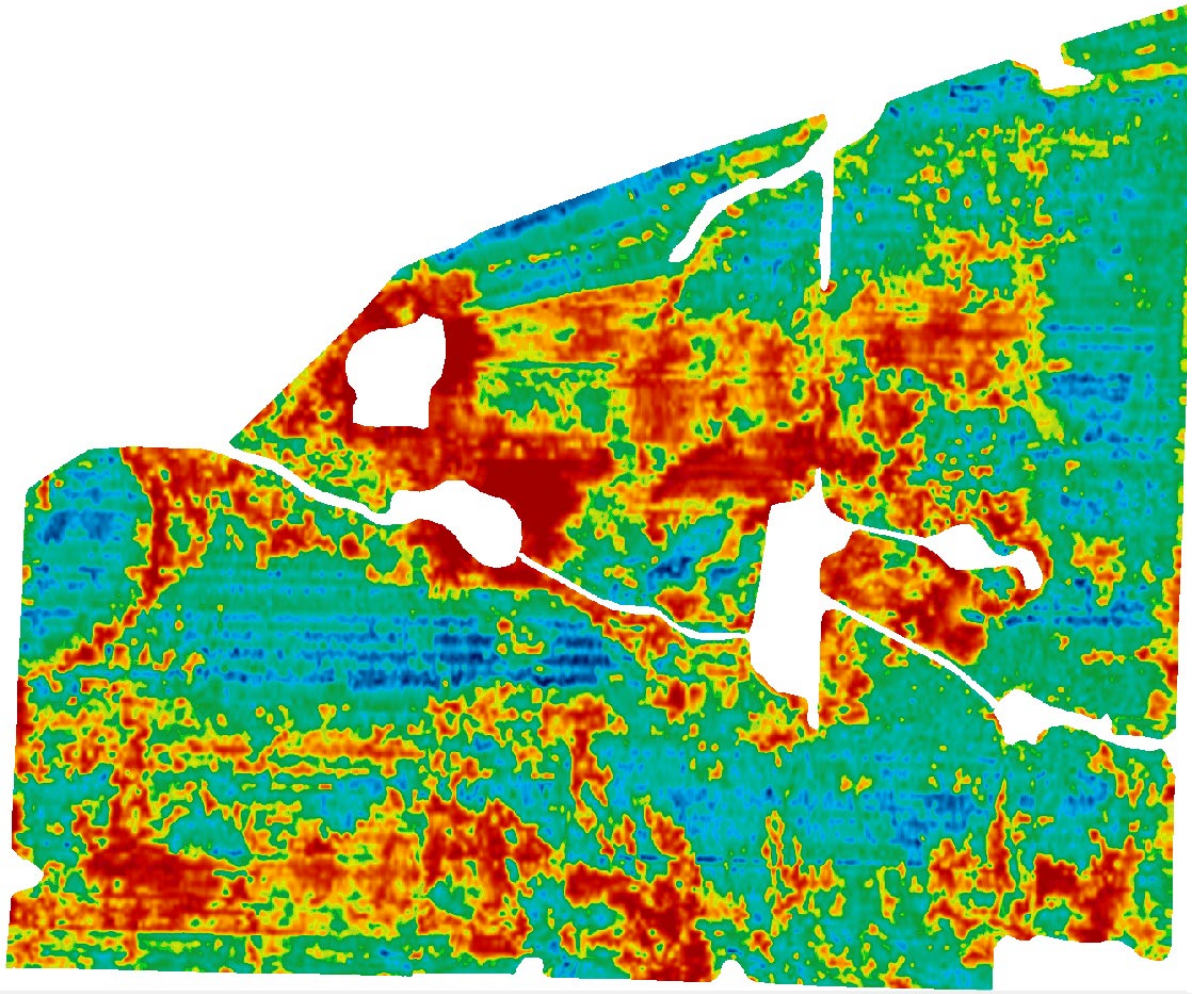
Prioritising Areas

Yield and Elevation Data

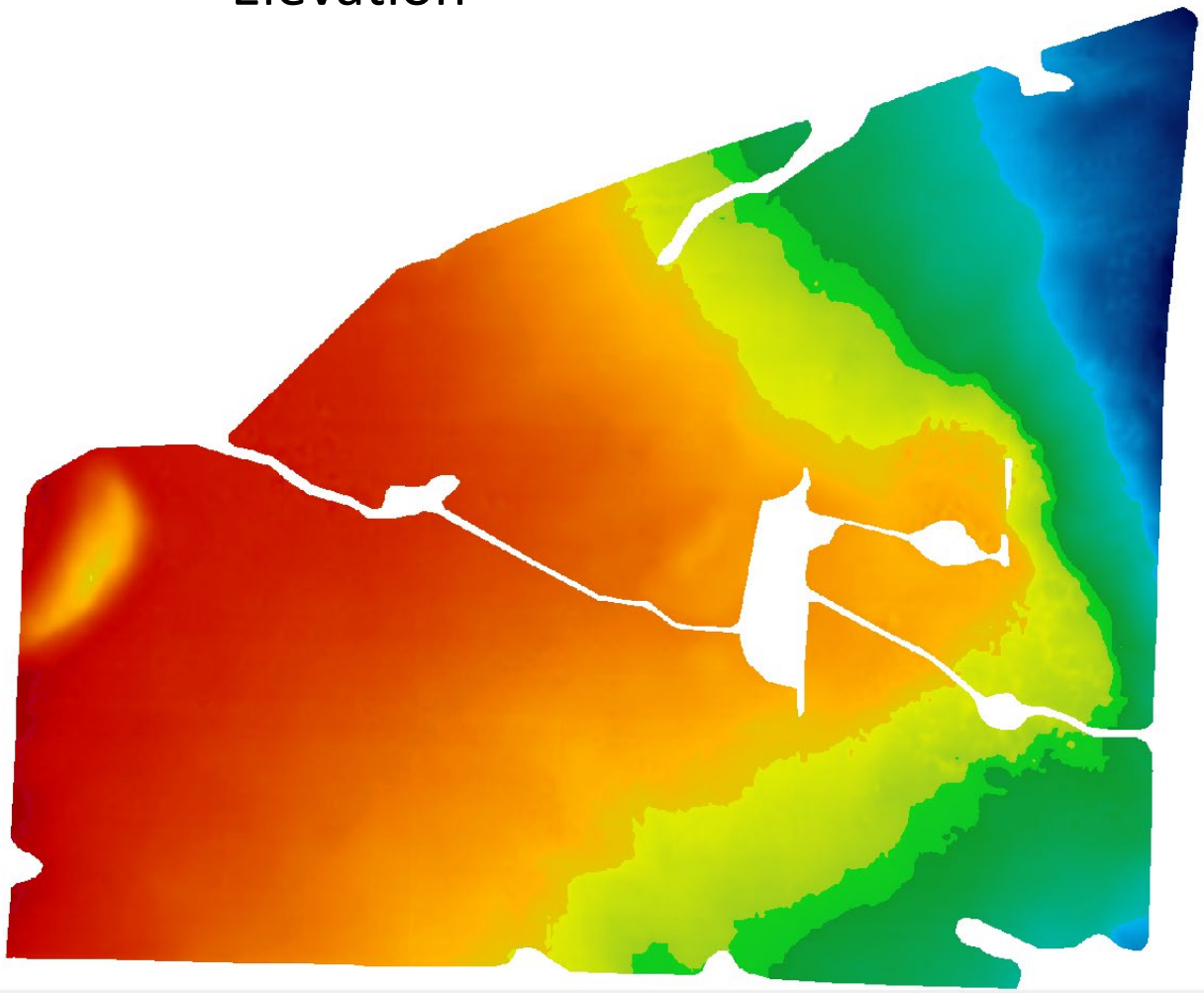
- Can pinpoint affected areas
- Can be used to justify earthwork budgets
- Oftentimes overkill (affected areas obvious)
- Elevation data crucial for design process

Prioritising Areas

Canola Yield



Elevation

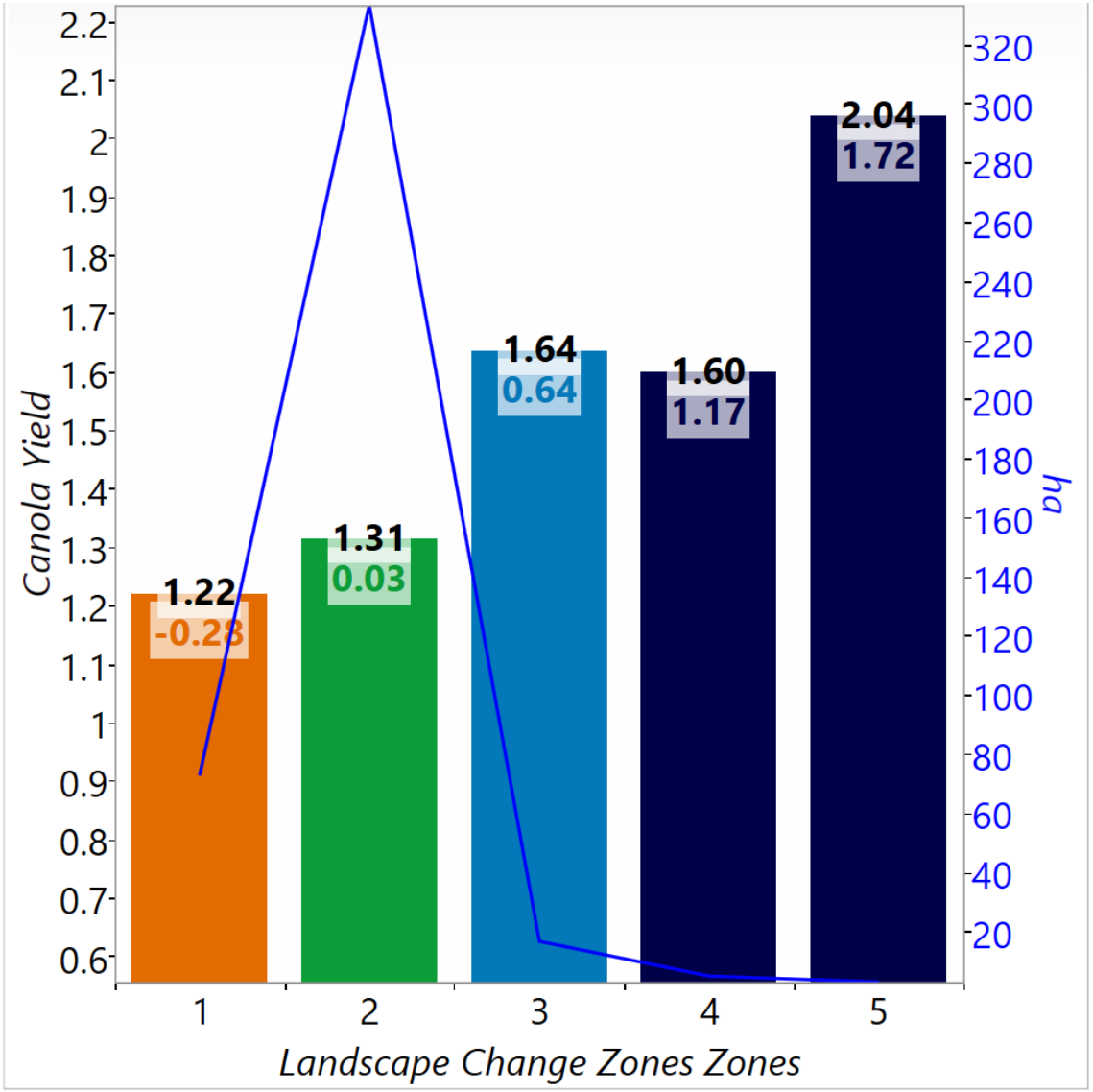


Prioritising Areas

Yield vs
Landscape Change

Negative is water accumulating areas

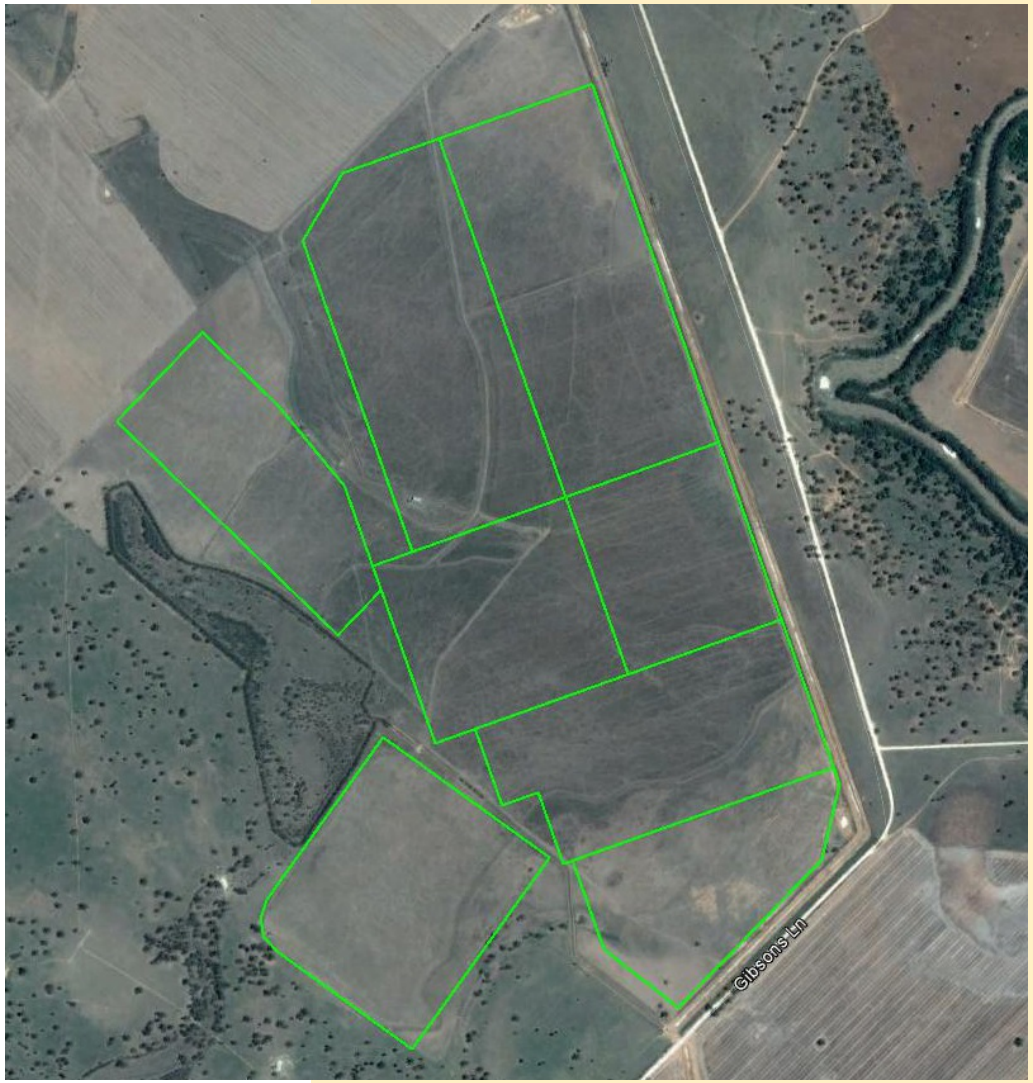
0.4 tonnes/ha difference



Prioritising Areas

Full Farm Scope

- Timeframe and budget for works
- What construction methods do you have available?
- What happens upstream/downstream of affected area?
- What happens outside your farm boundary?

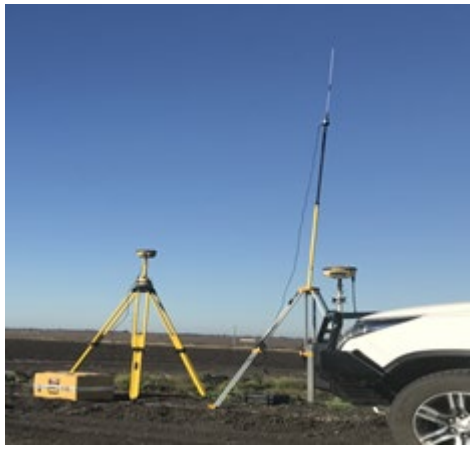


Data Collection

Data Collection Options

RTK Survey Gear

High Quality with all necessary points surveyed

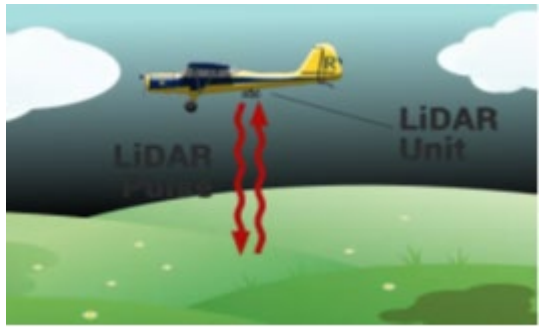


RTK Tractor

Data already available but only has field information

Traditional Survey

Easier and cheaper to access equipment



LiDAR

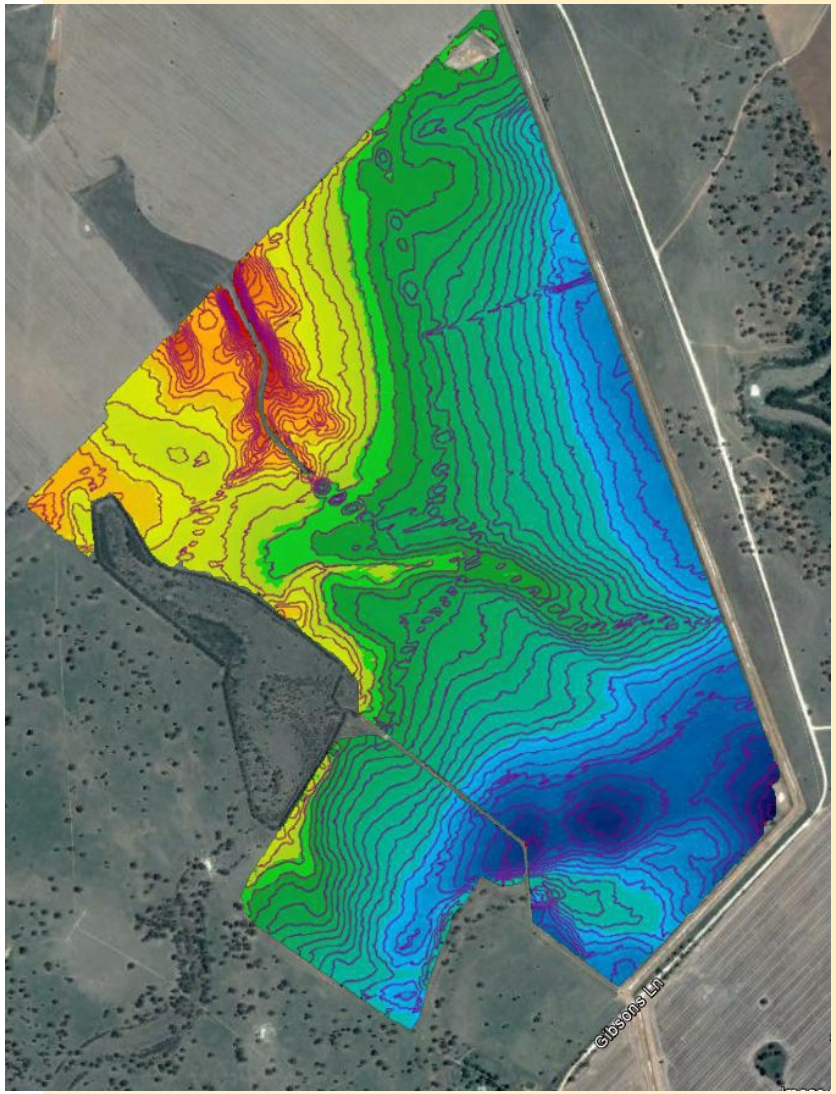
Lots of detail across whole farm

Data Collection

Data Collection Considerations

- Elevation datums
- Bench marking
- Tying elevation data sets together
- Knowing the limits of the equipment collecting the data

- It all starts with good data!



Data Collection

Bad Data

- Corrupt Files
- Missing Data
- Different machines/base stations
- Changing height of machine
- Time/Distance Lag

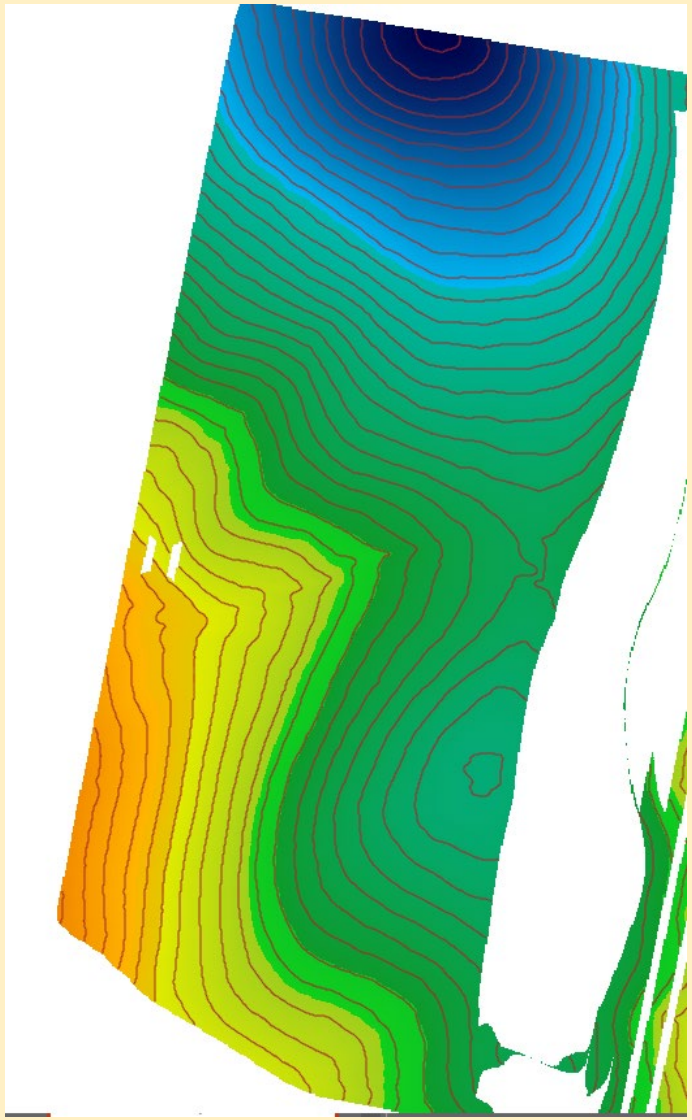
Avoid Harvest

& Spraying

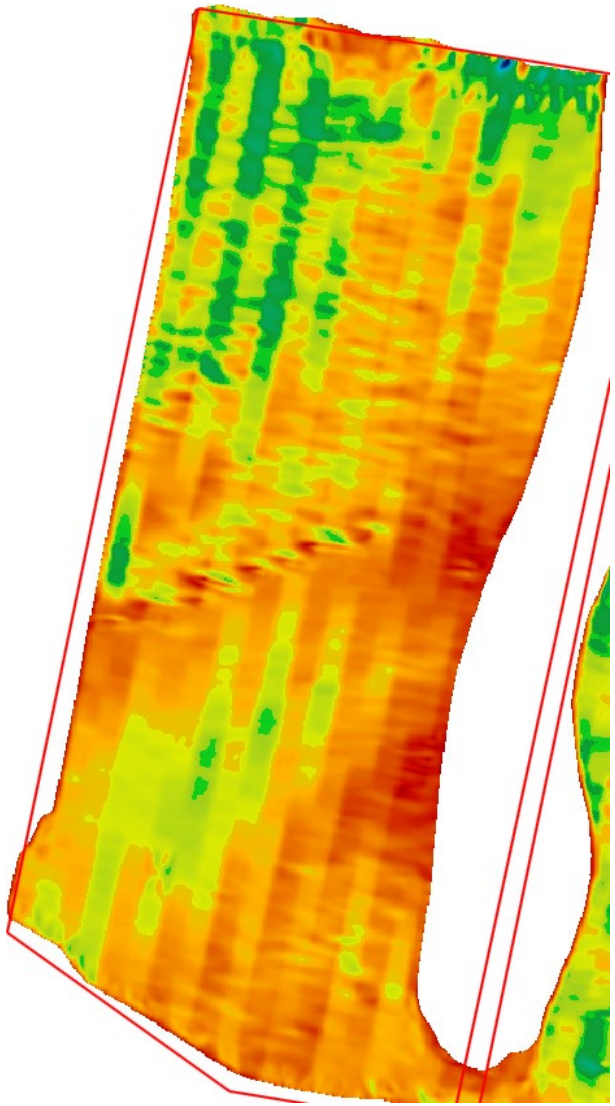
Data Collection

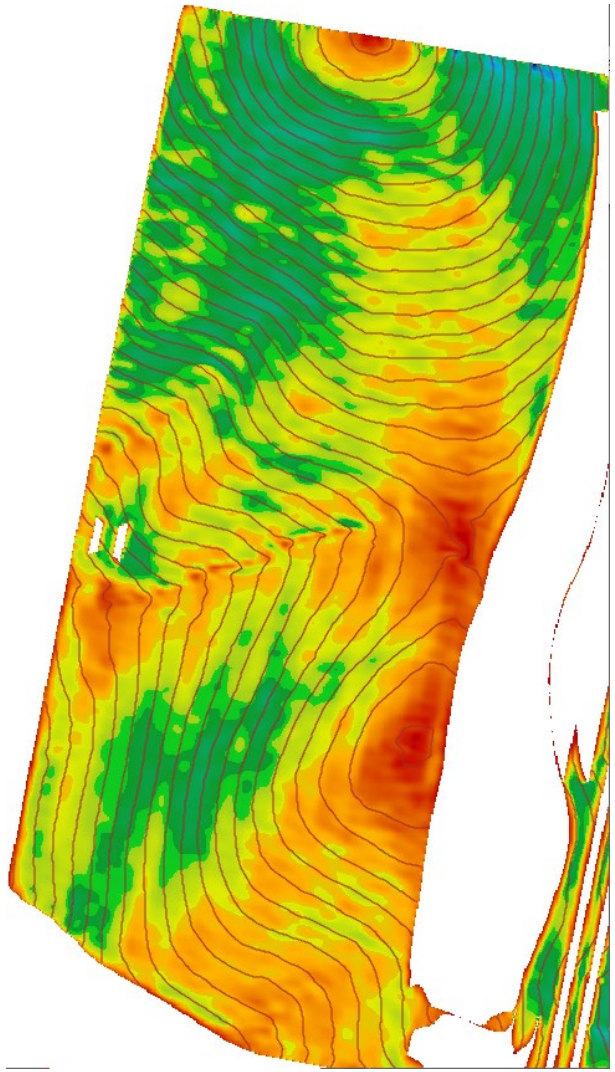
Good Data

- Same machine, same base station
- Weight of machine doesn’t change
- Distance between passes – most operations okay
- Area of survey – may need data outside green area
- Overlap on stable ground to collate data (washpads, roads, multiple field passes)
- Planting data ideal



Data Collection





Slope Maps

Same Field

Different Pass

Data Collection

Fit for Purpose

- Is the data appropriate for the task?
- Has the data been collected to a standard for the task?
- Is the data corrupt?
- Is more information needed?
- Does the data require some ground truthing?

(how can we work back to this data from a construction point of view, LiDAR and tractor data will need this)

Controlled Traffic Farming

- 1st thing to look at. Easiest to Implement
- Compromise with run length (Yield trumps run efficiency)
- Consider slope for orientation (< 1 in 600) and run length (<2km)
- Risk of erosion combatted by minimising volume/speed of water
- Combine with drains and/or contour banks

Construction Methods

Contractor	DIY
Skilled	Can be cheaper @ scale
Correct gear for the job	Option to hire out gear or use for maintenance
Employees can continue normal duty	Control timing of job

GPS	Laser
Flexibility for changes in slope	Not all equipment is GPS equipped
When set up allows for easy use	Fit for purpose (but can affect design)

Affects all stages of design process

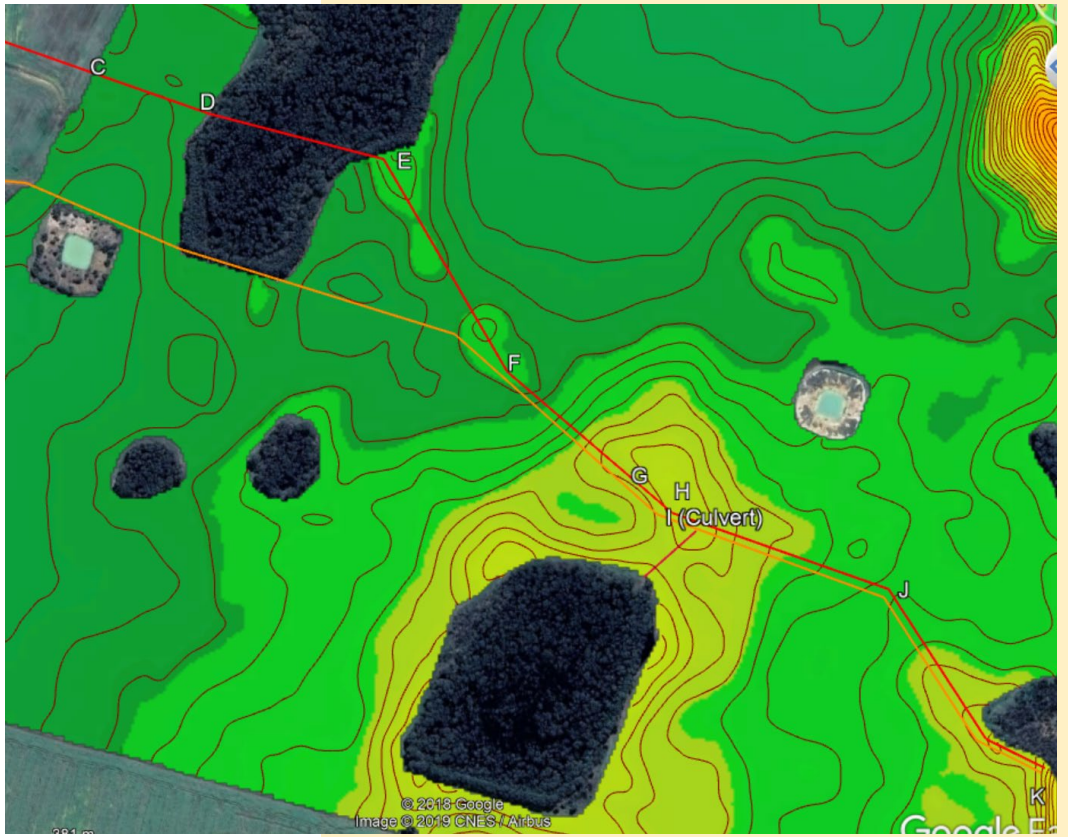
Construction Methods

Machine	Pros	Cons
Bucket	Utilise own tractor Fill in depressions with cut	More expensive than some options
Dozer	Cheap Move large amounts of dirt	Rough finish Dirt stays near cut
Grader	Cheap for some purposes Neat finish	Dirt stays near cut Specialist machinery
Excavator	Cheapest way of moving dirt (deeper drains)	Dirt stays near cut
Wolverine	Easily dig drains and spread dirt	Limited availability. Not efficient for larger drains

Construction Methods

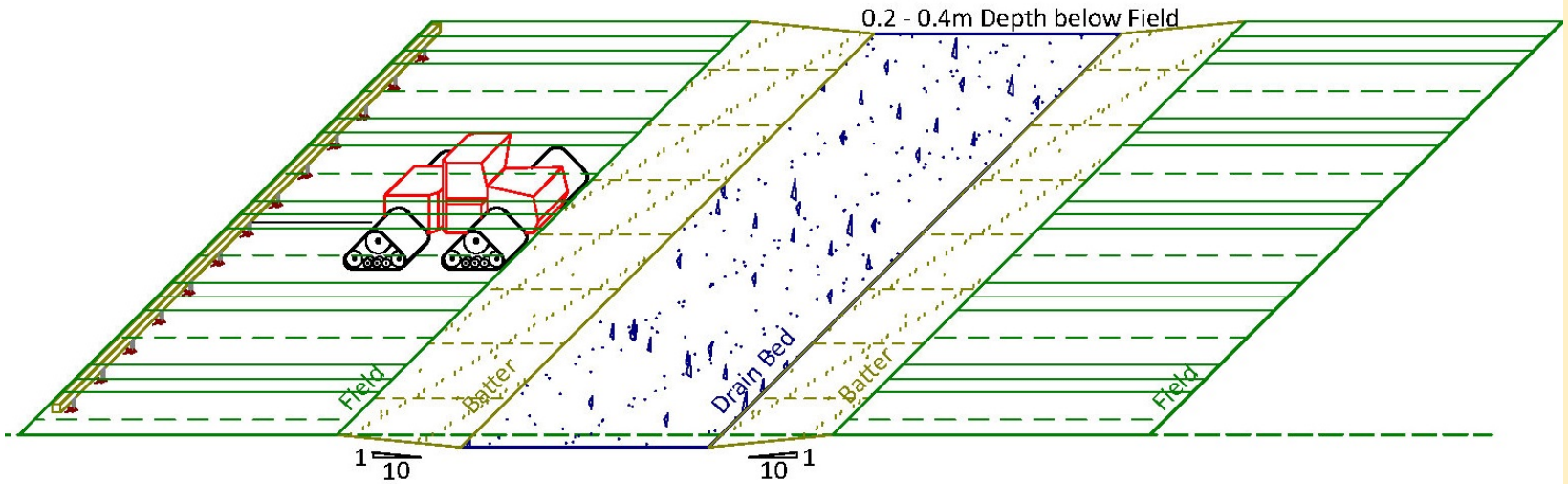
Data required for construction

- Communication with all parties
- Hard copy plans – Long Section, Typical Cross Section, Topographic maps
- Machine control files
- GPS guidance lines / KMZ
- Pegging?



Drainage Options

- Wheel Tracks
- Contour Banks
- Drive through drains
- V (and other) Ditches
- Filling depressions
- Levelling Fields
- Water ways/Tail water drains
- Subsurface drains



Farm Through Drain Typical

Drainage Options

To Consider

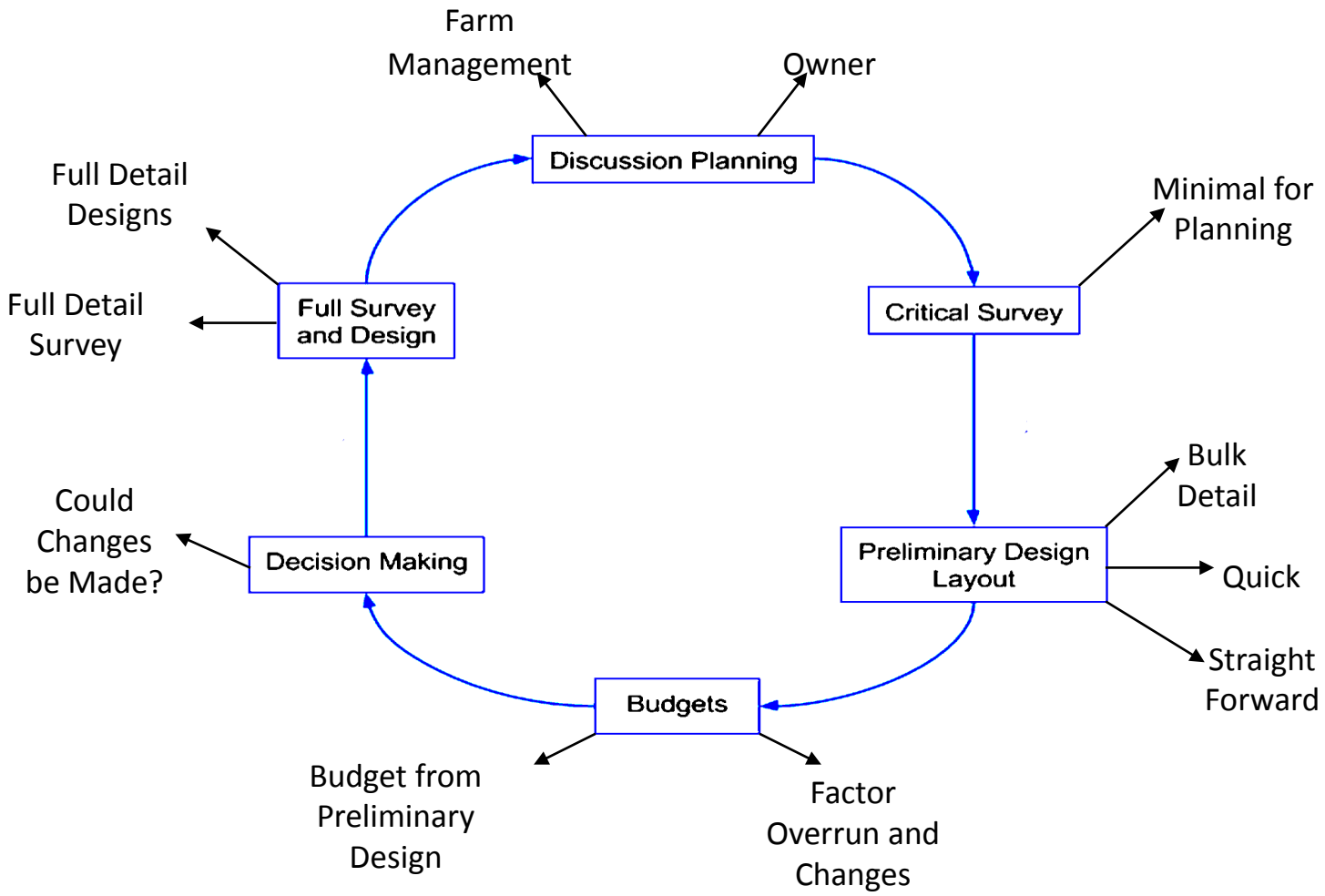
- Farming Operations
- Slope
- Erosion risks
- Where will the water go?
- Budget vs Yield improvements
- Wet Harvest?
- Exposing subsoil
- OHS risks & machinery wear

Decision Process

- Planning cycle
- Digital Models
- Compromise
- Timespan
- A good plan helps weigh up options
- Equipment Used (Hardware & Software)

Decision Process

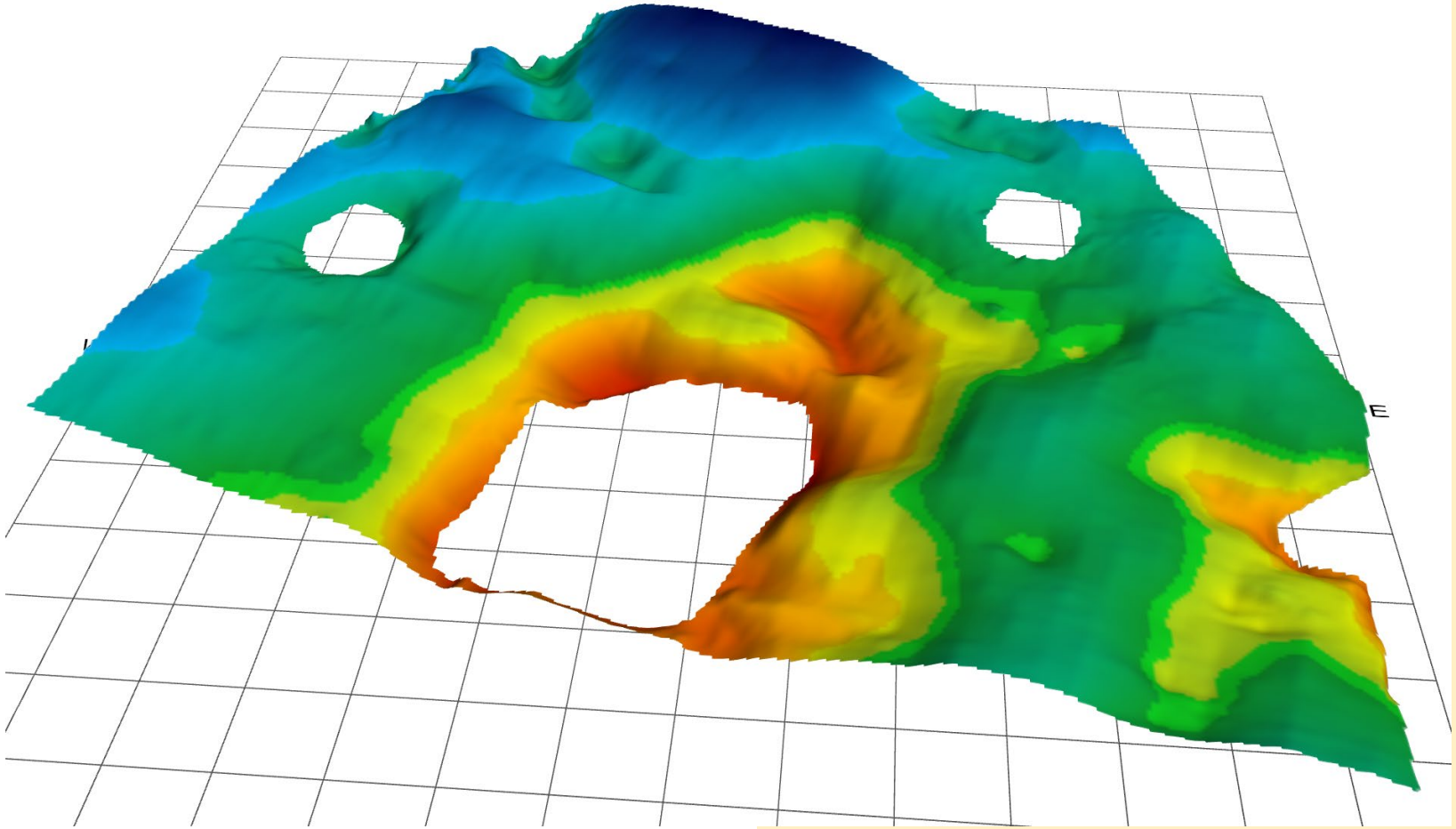
Planning cycle



Decision Process

Digital Models

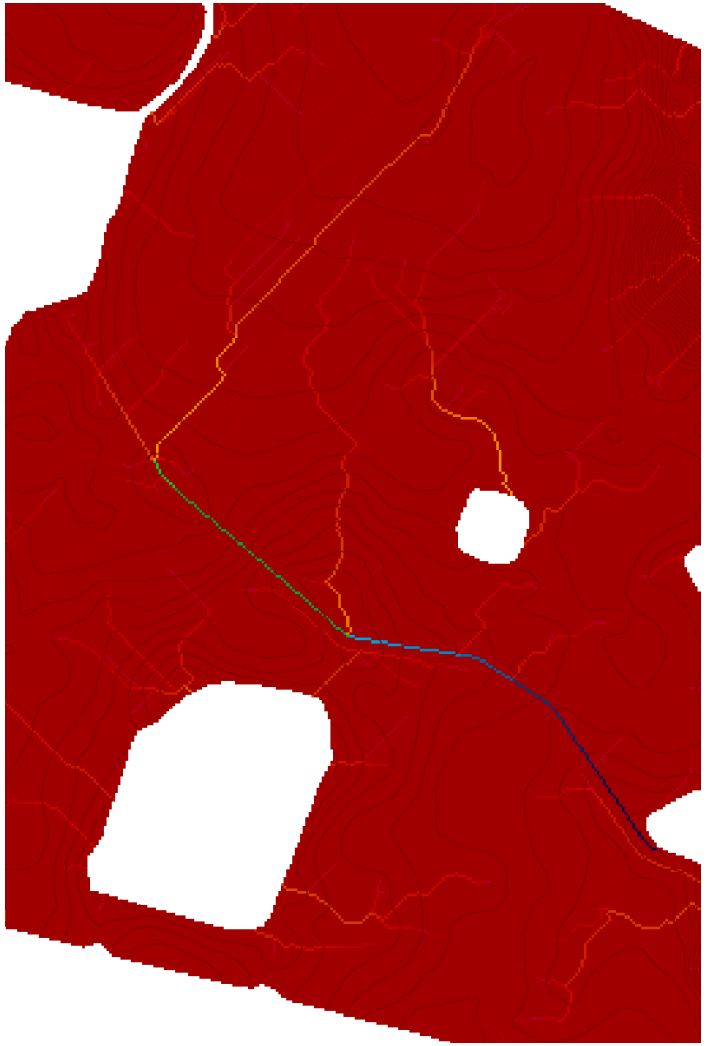
- Crucial in design stage (options and calculations)
- Help visualise design options
- Weigh up multiple options
- T3rra, Optisurface

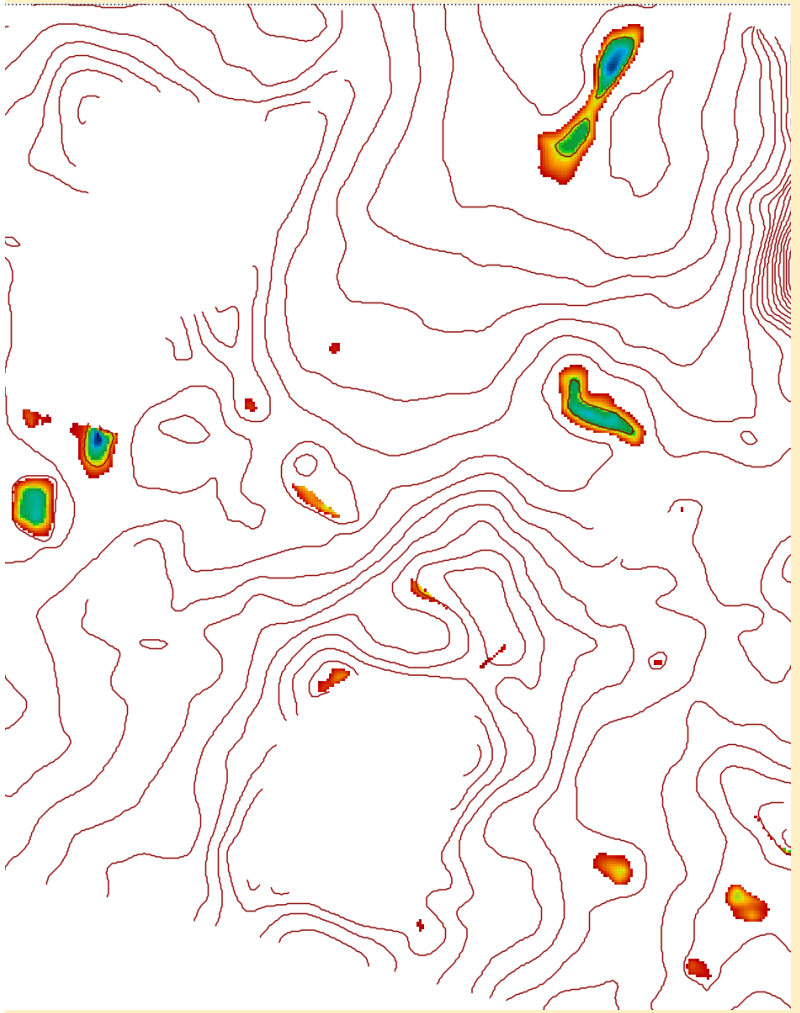


Decision Process

Digital Models

- Identify accumulated flow area
- Calculate volume of depressions (Cut used to fill)
- Know the limitations





Decision Process

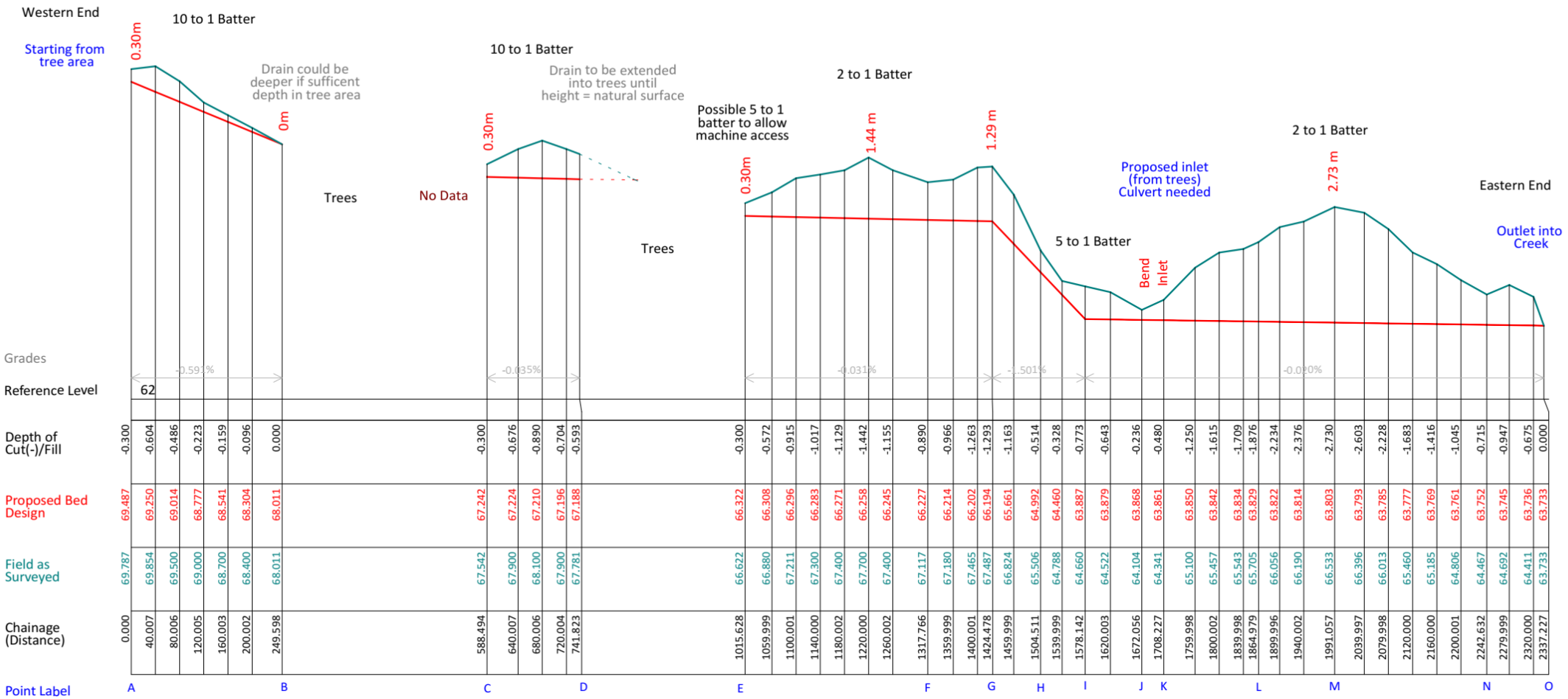
- Design work on a full farm level
- Plans are good for multiple years
- Construction spread out over multiple years
- Use local knowledge (Neighbours, Contractors)
- Involve Neighbours, Local government

Construction Process

Hard Copy Plans

- Topographic & Schematic maps
- Long Section (Areas of erosion risk, Drains work together)
- Cross Section (Farming operations, Earthwork Volumes)
- Useful for quotes/budgeting

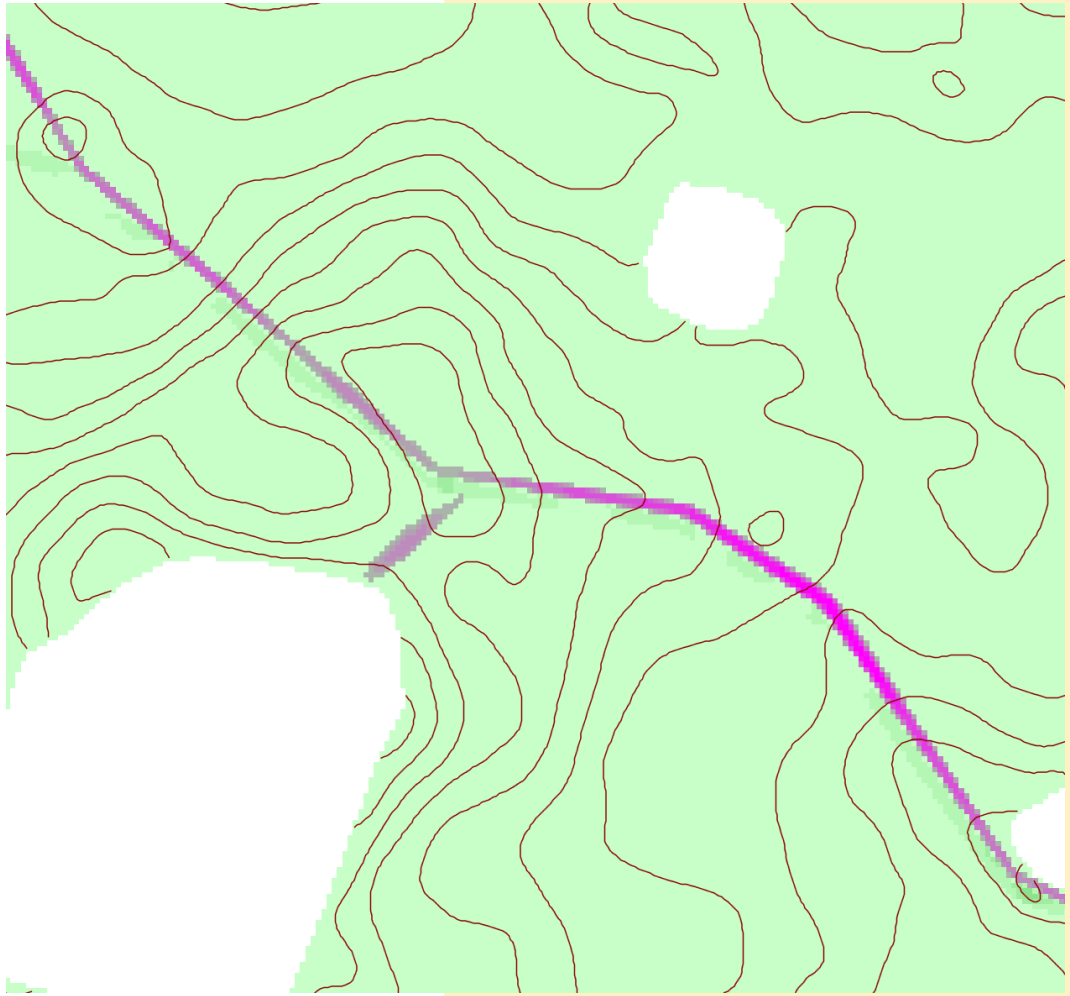
Construction Process



Construction Process

Digital Plans

- KMZ, Geotiffs
- Helps visualise drainage network in field
- Useful for marking drainage lines
- Shows areas of cut/fill



Construction Process

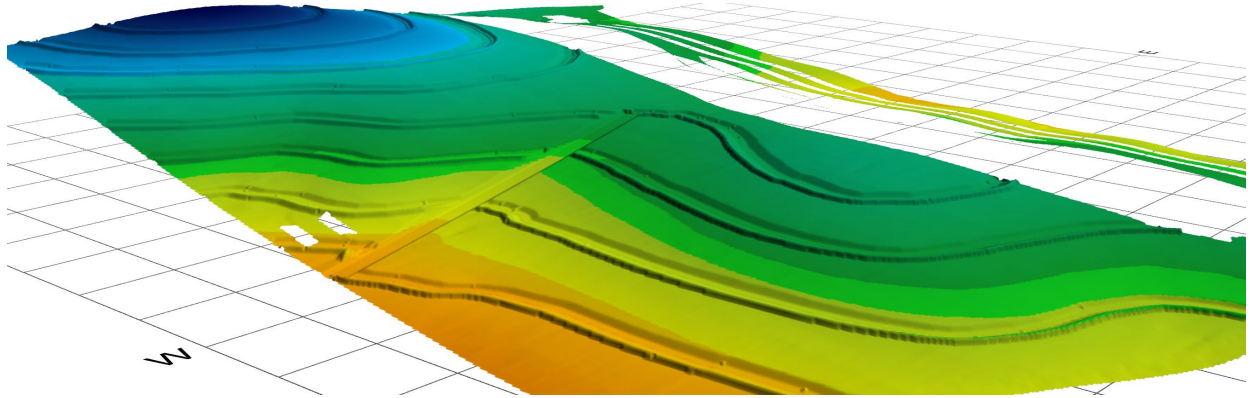
Benchmarks

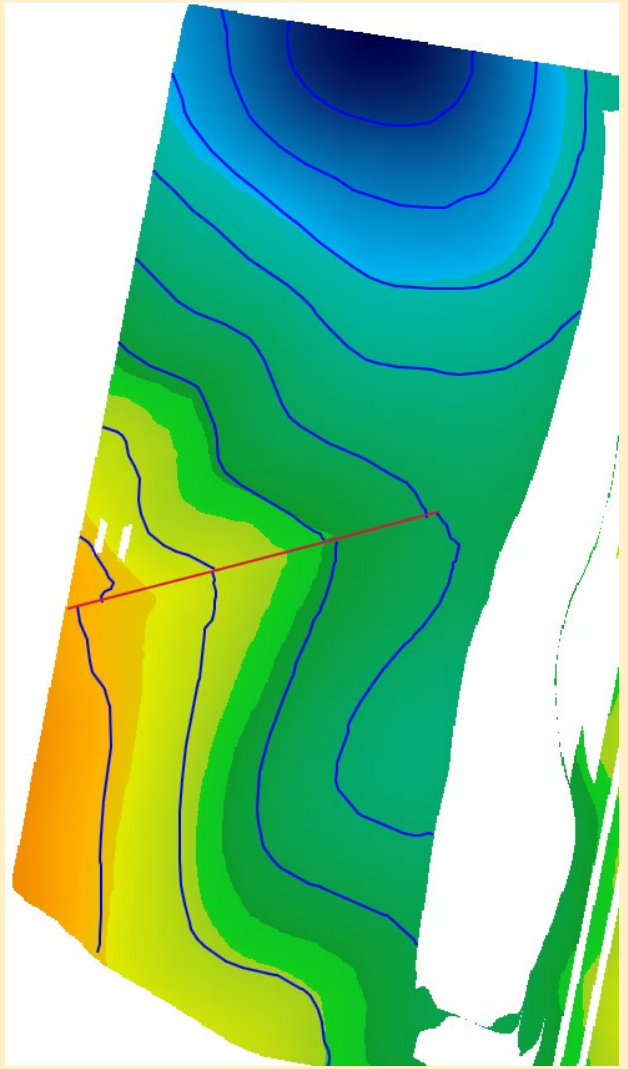
- Necessary for accurate implantation of design
- Ties in multiple surveys
- Repetition across years – Farm Datum
- Tractor data only limited – Need stable areas to repeat benchmarks

Construction Process

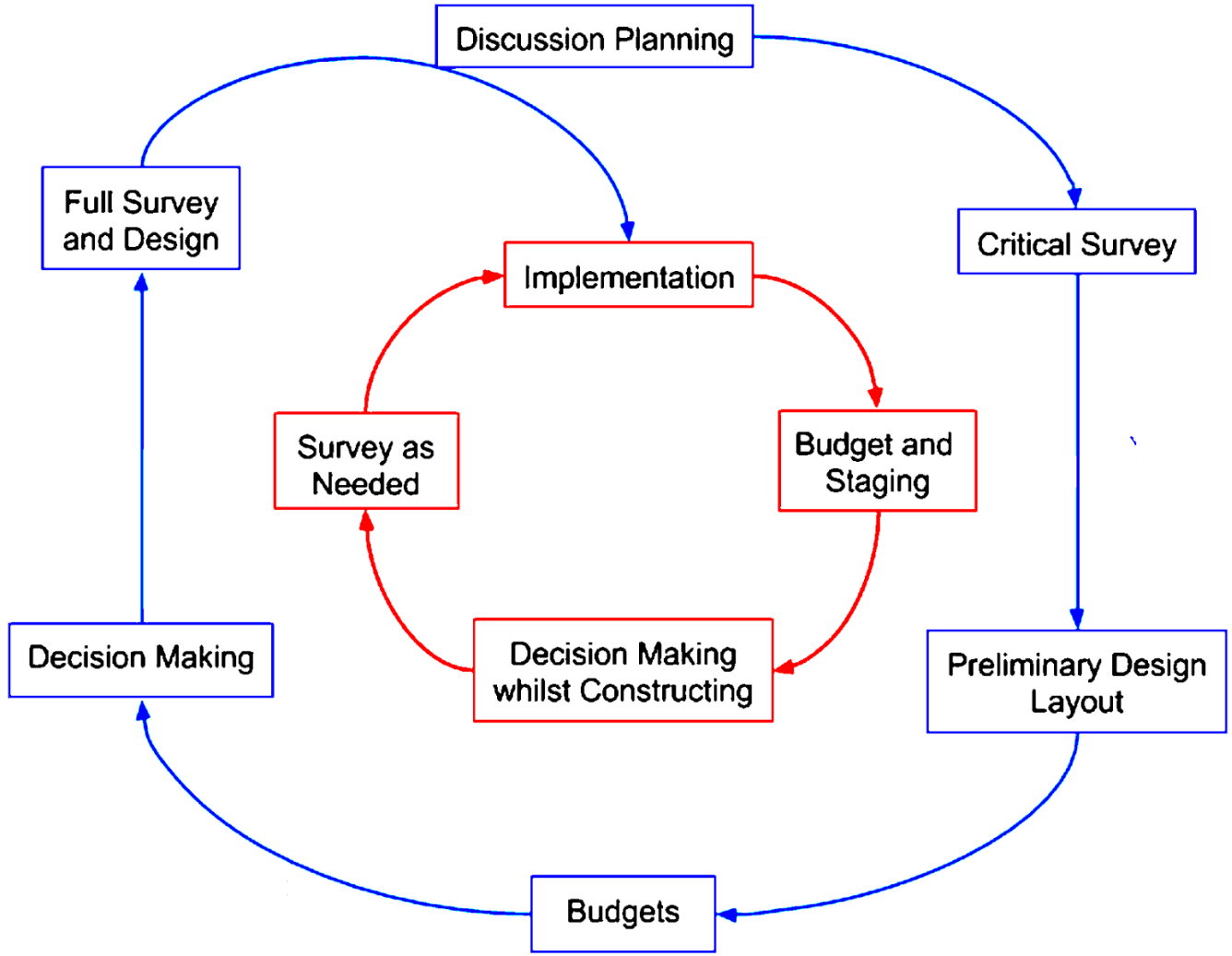
Machine Control

- Guidance lines – easily implemented, saves time
- Full machine control – accurate and easy
- i-grade + T3rra Cutta, Optisurface
- Verify with eyes in field





Construction Process



Operation and Maintenance

- Grassed up
- Livestock
- Lifespan
- Large storm events
- Erosion
- Cleaning up

Questions?

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pct services

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Appendix - Contours

Gradient in the contour bed

Normally expressed as a percentage

0.1m drop in 100m is 0.1 percent

Anywhere from 0.1 to 0.4 percent is common to see

You can convert the percentage to a 1 in number easily:

100 / 0.20% = 1 in 500

100 / 500 = 0.20%

Appendix - Contours

Spacing of banks

Spacing type depends on paddock condition

Spacing designed to reduce water velocity and volume in field

Slope (%)	Single spacing		Double spacing	
	VI (m)	HI (m)	VI (m)	HI (m)
1	0.9	90	1.8	180
2	1.2	60	2.4	120
3	1.4	45	2.8	90
4	1.6	40	3.2	80
5	1.8	36	3.6	72
6	1.9	32	3.8	64
7	2.1	30	4.2	60
8	2.4	30	4.8	60
9	2.7	30	5.4	60
10	3.0	30	6.0	60

Recommended contour bank spacings
VI = Vertical interval; HI = Horizontal interval

Appendix - Contours

Length of the banks

Based on recommended bank spacings (well maintained)

Assumes run-off is traveling in one direction

Recommended maximum bank lengths for various land slopes and single contour bank spacing

Land slope (%)	Maximum bank length (metres)
1	2500
1.5	2000
2	1750
3	1500
4	1000
5	750
6	600
7	450
8	400
9	350
10	300

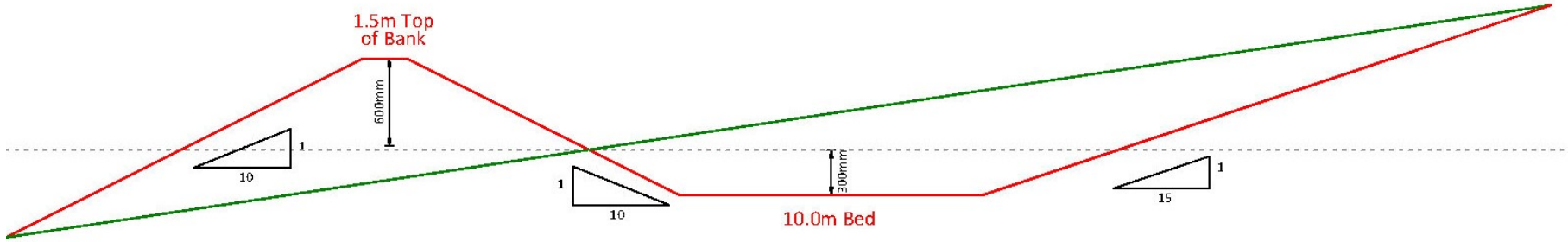
Appendix - Contours

Proposed Bank Shape and Dimensions

Can be as steep as 3-1 batters, but won't be trafficable

Farm-over requires flatter batters, 10-1 preferred

0.7m to 0.9m from bed to top of bank allow for slump and silt



Cross Section Balancing

Hill Slope

Bank Volume & Borrow Volume

Compaction (Cut/Fill Ratio)

Exported dirt