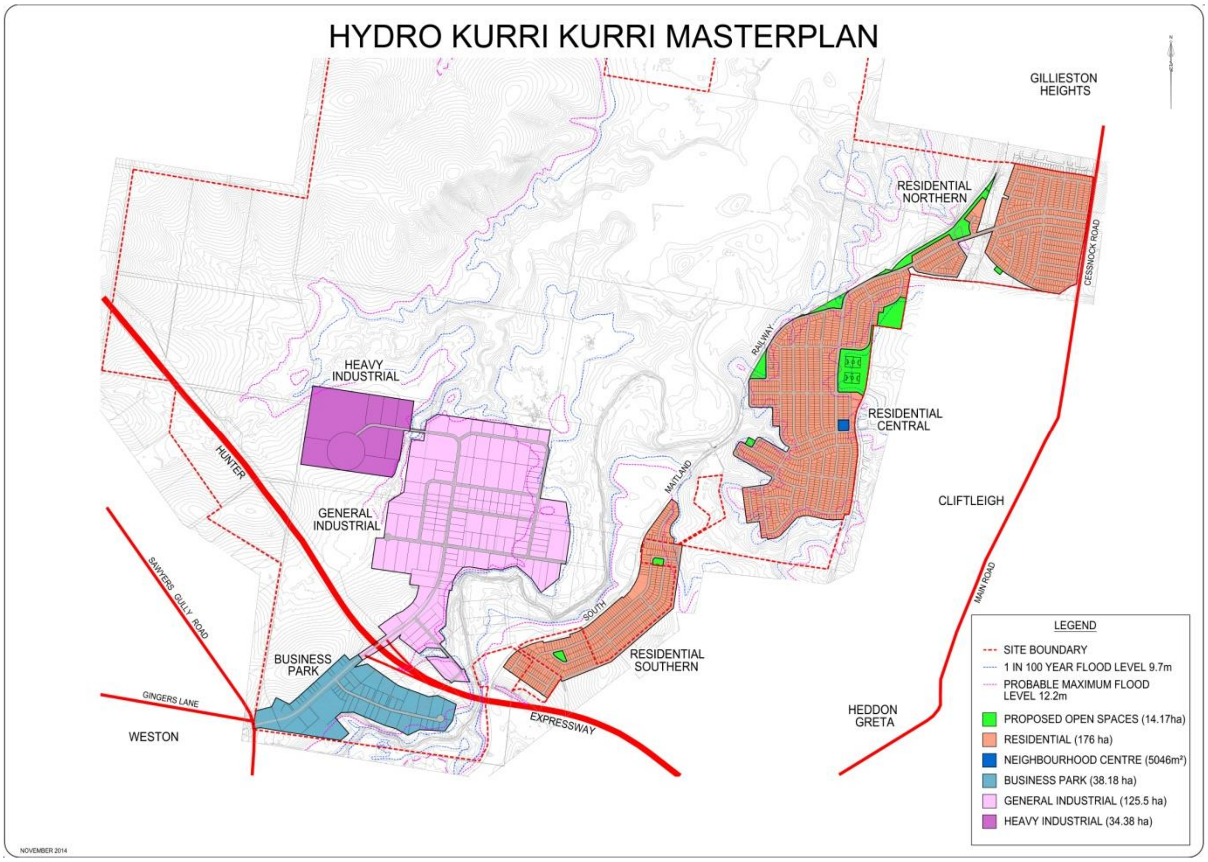
Hydro Aluminium Kurri Kurri Flooding and Stormwater Impact Assessment



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Attachments

Residential - Northern Precinct Staging Plan
Residential - Northern Catchment Plan

Residential - Southern Precinct Staging Plan
Residential - Southern Catchment Plan

Industrial - Staging Plan
Industrial - Catchment Plan

Overview

The purpose of this report is to provide both Hydro and Council with an understanding of the flooding and stormwater impact on Hydro's land development potential and support an application to rezone the site. This has been done by refining a previous study of the flooding and stormwater impacts relating to the proposed industrial and residential re-development of the Hydro landholdings (the subject land).

Flooding on the subject land is primarily caused by inundation associated with flooding in the Hunter River. This report has adopted the flood level RL9.7 as the 1% Average Exceedance Probability (AEP) tail water level for the site. A brief commentary of the flood planning controls is also provided.

Proposed re-development of the subject land would also necessitate the dedication of low-lying portions of the subdivision for storm water controls, including any combination of gross pollutant traps, detention basins, constructed wetlands and riparian corridor rehabilitation. Commentary is also provided on indicative costs associated with storm water management facilities.

1 Introduction

Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) owns approximately 2,080 hectares of land on Hart Road, Kurri Kurri containing a disused aluminium smelter and associated buffer lands. The smelter operations were suspended in September 2012 with decommissioning of the smelter expected to occur over the next several years. Hydro have begun discussions with the NSW Department of Planning & Environment and both Cessnock City Council and Maitland City Council regarding the potential for redevelopment of the site to other uses.

The site encompasses approximately 80ha of a disused smelter plant and some 2,0000ha of buffer lands located on the border of both Maitland and Cessnock Local Government areas. The landform over the site varies, however the vast majority of the potential development land is of gentle slope up to 1v:20h, suitable for residential and industrial development.

Preliminary plans have been prepared showing the potential for residential development at Gillieston Heights in the north east through to Cliftleigh in the East as well as the subdivision of the smelter site, after decommissioning, as potential industrial land.

The purpose of this Flooding and Stormwater Impact Assessment is to present a greater level of detailed advice to supplement proposed plans of subdivision that would support a planning proposal for rezoning.

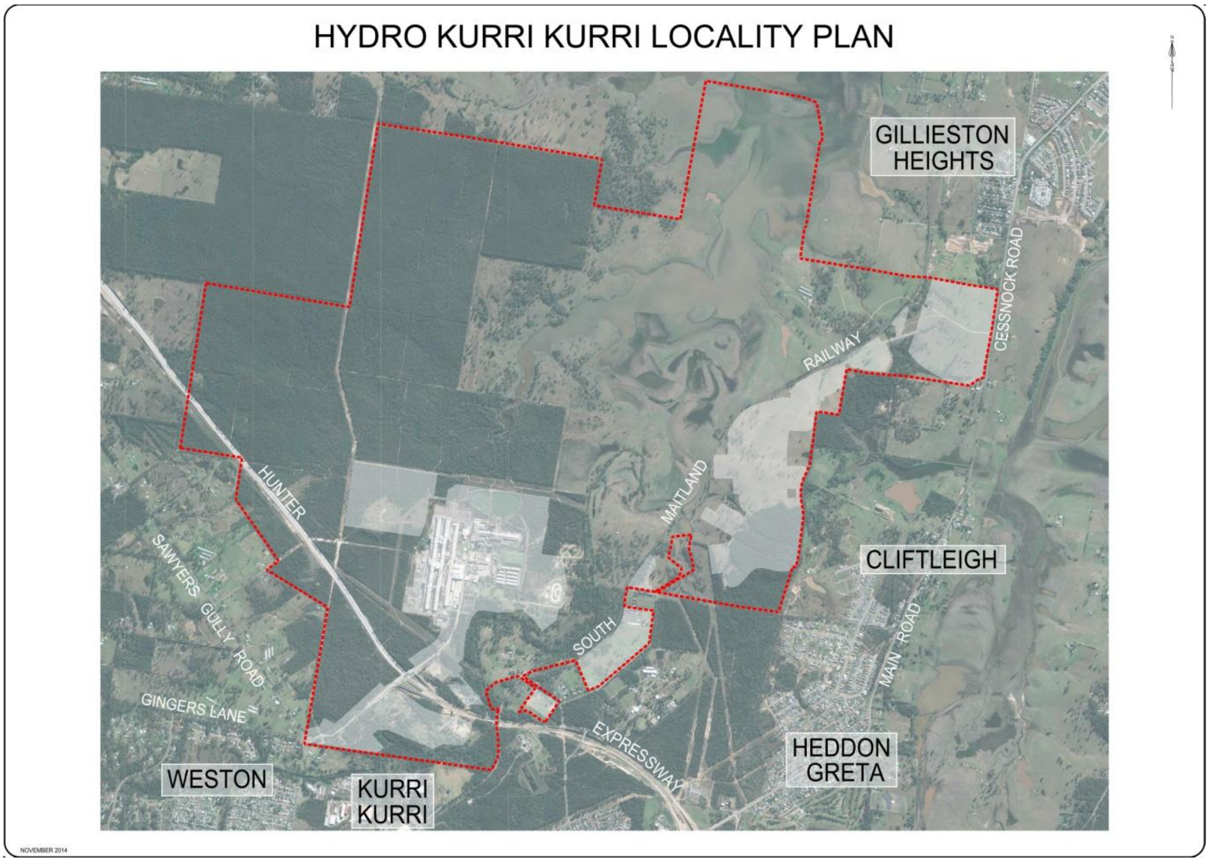

Figure 1 - Location and Surrounds

2 Flooding Assessment

The subject land contains substantially low-lying flood prone land split between the Swamp/Fishery Creek and Wallis Creek catchments. The context of the Hydro landholdings in relation to sub-regional topography and hydrologic features is presented in Figure 2.

The Hydro landholdings are situated within the Swamp Creek catchment of the Hunter Valley, with the exception of a small portion of the landholdings in the east that fall into the Wallis Creek catchment at Testers Hollow. The Swamp Creek catchment extends from Abernathy in the south, west to Kearsley, Neath and Sawyers Gulley, and from Elrington through to Kurri Kurri and Cliftleigh in the east. Swamp Creek joins with Wallis Creek in the north at Louth Park, before joining the Hunter River near Horseshoe Bend and Lorn.

Within the Hydro landholdings, Swamp Creek enters into a low-lying extent that is prone to inundation, before continuing into a formalised creek channel to join with Wallis Creek.

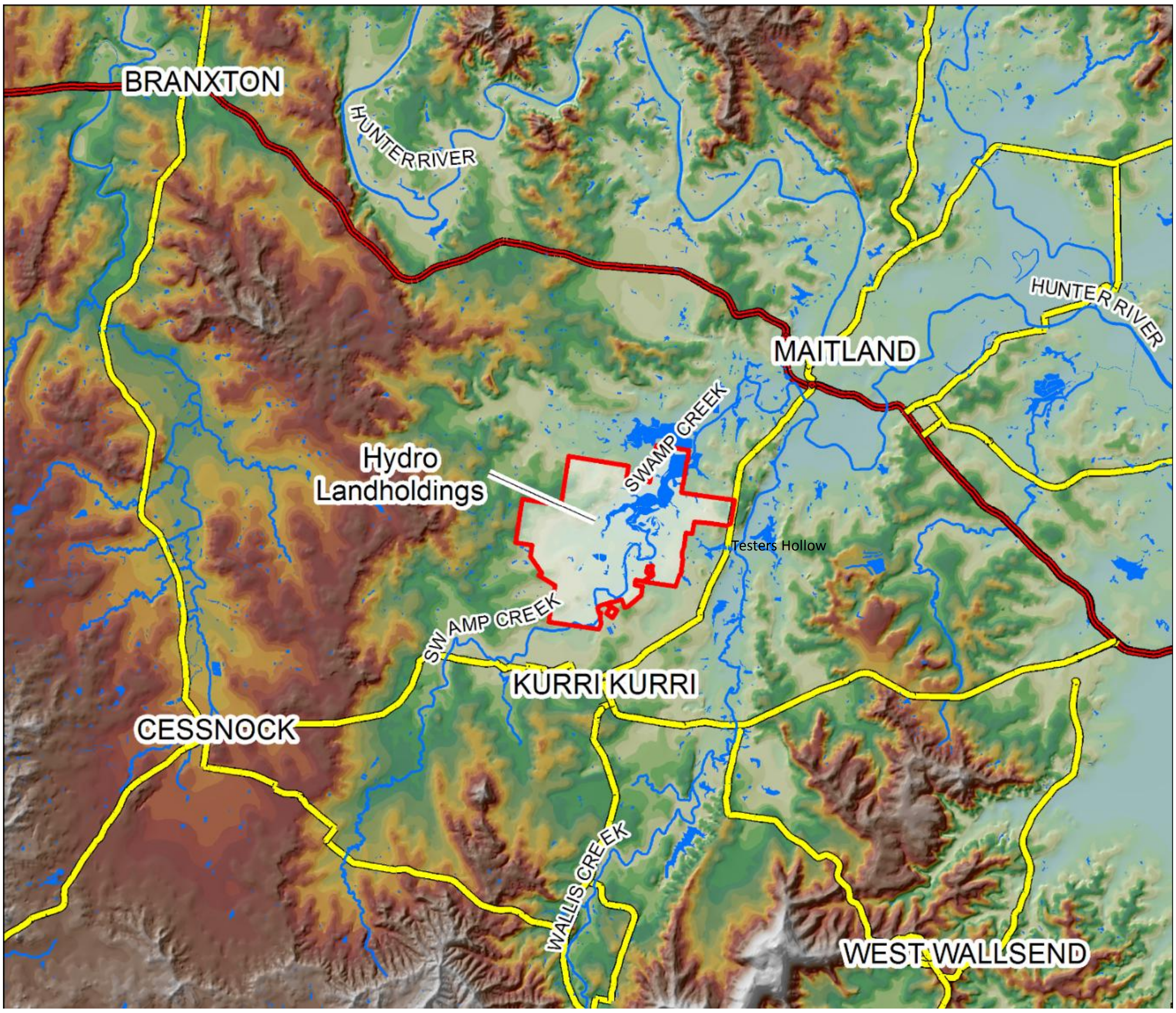

Figure 2: Hydro Landholdings in Relation to Sub-Regional Topography and Hydrology

2.1 Detailed Site Survey and Hydrologic Features

Detailed topographic analysis of the Hydro landholdings has been undertaken on LIDAR (*Light Detection and Range*) and aerial imagery provided by Monteath and Powys Pty Ltd.

A Digital Elevation Model (DEM) was built based on the LIDAR information and used in conjunction with 1:25,000 topographic data to derive the drainage lines presented in Figure 3.

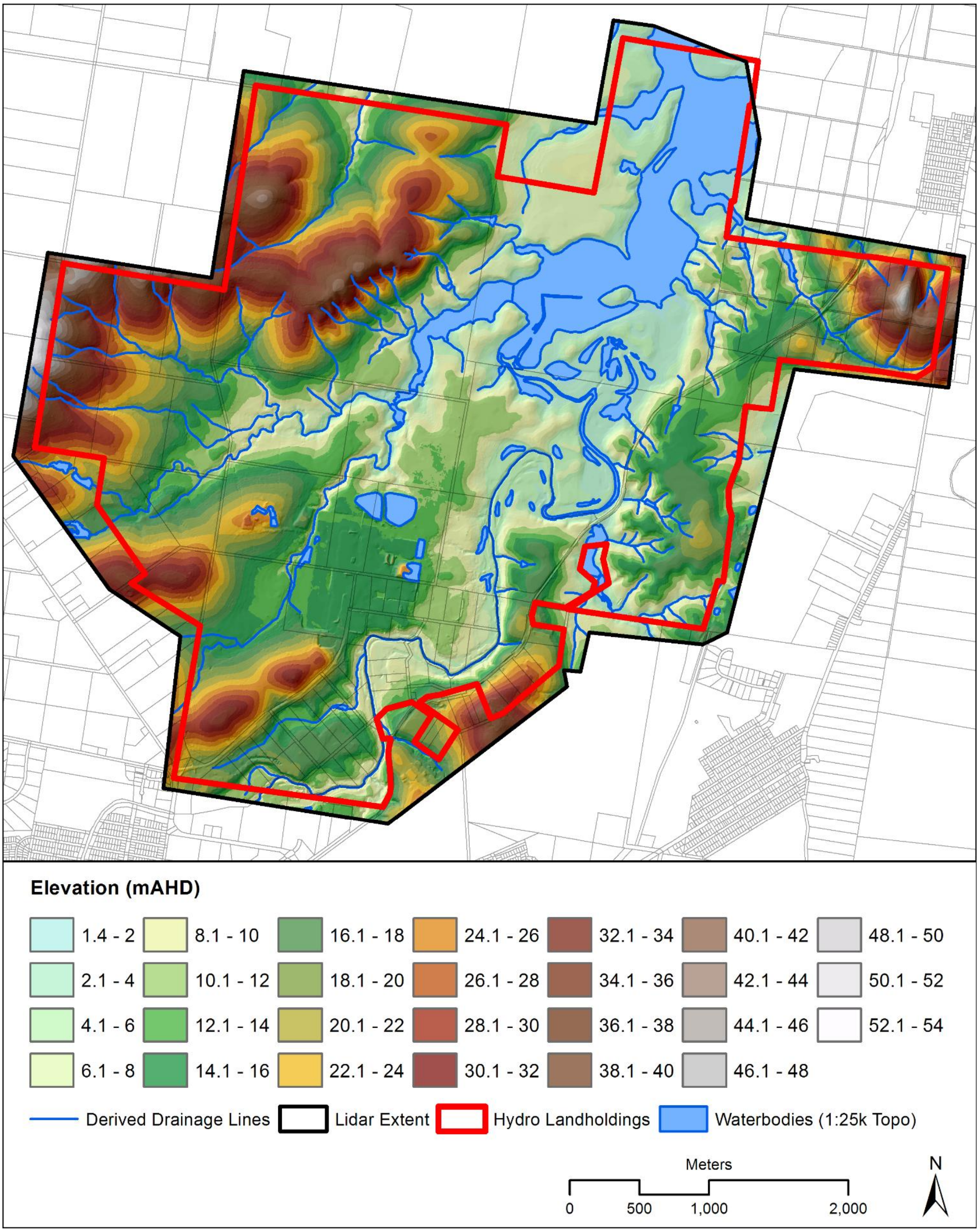

Figure 3: Elevation and Drainage Lines from LIDAR and Waterbodies from Topographic Data

2.2 Flood Studies

Two recent studies of the lower Hunter River and the Wallis and Swamp Creek tributaries were reviewed in preparation of this Flooding and Stormwater Impact Assessment.

The *Branxton to Green Rocks Flood Study* (2010)[1] utilised a hydraulic model tool to simulate flood depths through the Hunter River between Branxton and Green Rocks (near Hinton). This flood study updated an earlier hydraulic model of the Hunter River, the *Lower Hunter Valley (Oakhampton to Green Rocks) Supplementary Flood Study* (1998)[2], covering the same geographic area. The essential differences between the two studies were that the recent study utilised a more complex hydraulic model with additional data for calibration and a higher quality survey data set.

Results and conclusions from the *Wallis and Swamp/Fishery Creeks Flood Study* (2011)[3] were also viewed and included in this assessment.

2.3 Flood Controls

A complex system of banks, levees, spillways and flood control gates have been constructed around the Maitland area since the 1950's to reduce the impact of flooding events at Maitland and further downstream. These control structures channel flood peaks from the Hunter River into flood storage areas located in low-lying areas south of the river. The flood storage areas, namely the Wentworth and Dagworth Swamps, are partially represented in Figure 3.

Peak water levels within Swamp Creek and Wallis Creek are hydraulically goverened by tailwater levels due to flooding from the Hunter River. The flooding regime produced by the Swamp Creek and Wallis Creek systems cause flooding of the Hydro landholdings to be predominately backwater flooding and inundation with a very flat hydraulic grade line and low flow velocities.

Dagworth Bridge, located adjacent to the New England Highway at Maitland and approximately 500m upstream of the Cessnock Road intersection, was adopted as the tailwater level for this study. The adopted tail water levels were based off the more recent flood study. A comparison of the tailwater levels at the adopted control are outlined in Table 1.

Table 1: Adopted Flood Levels (mAHD) – Dagworth Bridge

	Annual Exceedance Probability (AEP)				
Status	Extreme (PMF)	0.5% (1 in 200 year)	1% (1 in 100 year)	2% (1 in 50 year)	5% (1 in 20 year)
Original Study	13.4	11.1	10.3	9.3	7.5
Current Study (Adopted)	12.2	10.8	9.7	8.5	7.6

Hydraulic modelling of Swamp Creek showed a flat hydraulic grade line (HGL) extending through Wentworth Swamp to the approximate location of the Hunter Expressway bridge. Upstream of this

[1] Maitland City Council, Hunter River: Branxton to Green Rocks Flood Study, WMAWater, September 2010
[2] Maitland City Council, Lower Hunter Valley (Oakhampton to Green Rocks) Supplementary Flood Study, Webb, McKeown & Associates Pty Ltd, October 1998
[3] Cessnock City Council, *Wallis and Swamp/Fishery Creeks Flood Study,* Worley Parsons, April 2011

point, flows from the contributing catchment extend a hydraulic grade at approximately 0.5m per kilometre. This equates to flooding up to 500mm above the tailwater levels adjacent to the southern most area of the industrial precinct.

The level of flooding associated with the Probable Maximum Flood (PMF) within the subject land are coincident with the adopted tailwater level at the downstream control (Dagworth Bridge). The flood mapping extents and flood depths across the Hydro landholdings based on these flood levels are shown in Figure 4: Aerial Imagery and Flood Extents, below.

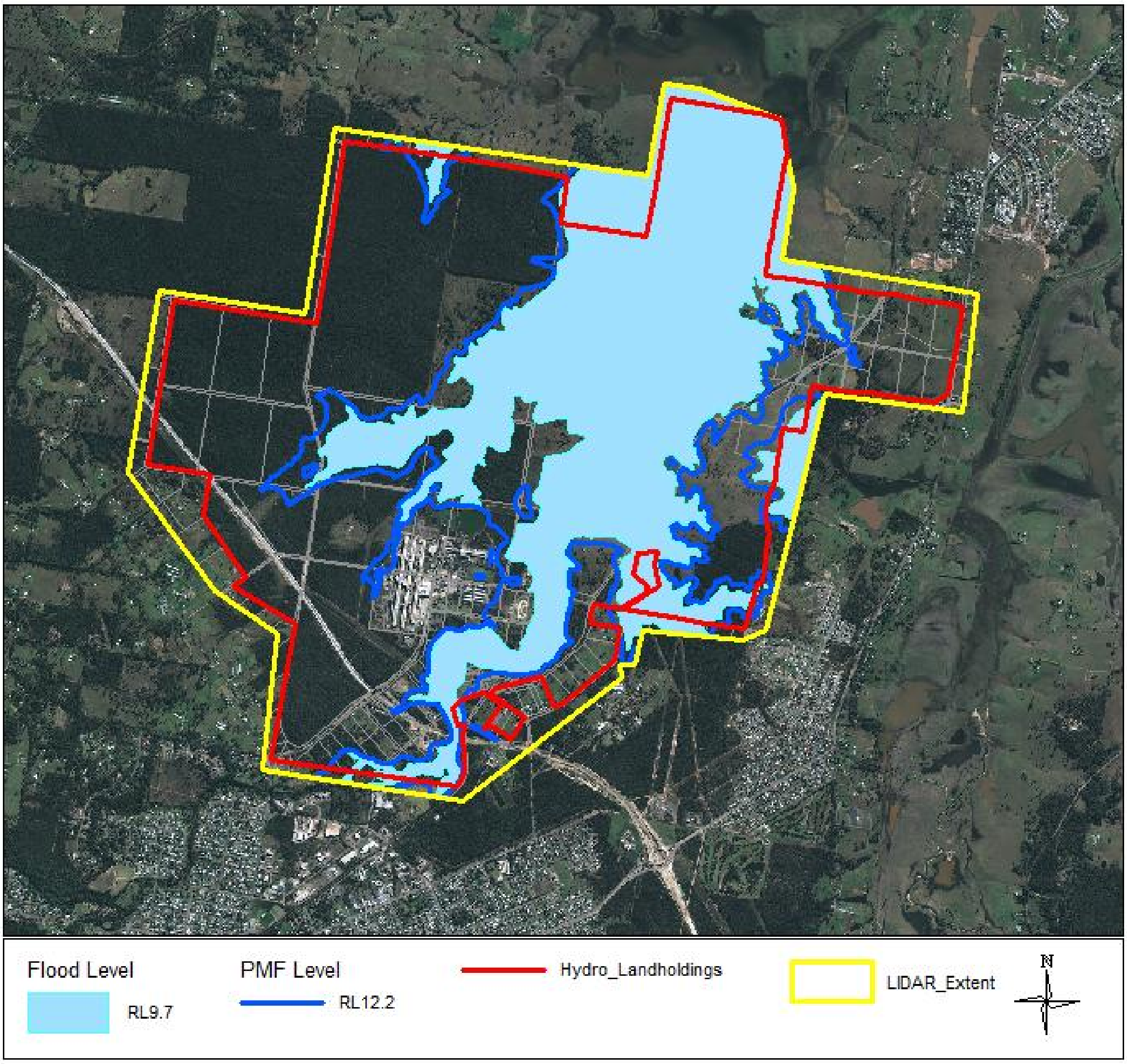

Figure 4: Aerial Imagery and Flood Extents

2.4 Development Controls

2.4.1 Flood Levels

Minimum habitable floor levels are principally defined as being 500mm above the 1% AEP flood level. For non-domestic structures, the minimum height of electrical fixtures is set by the same control.

2.4.2 Probable Maximum Flood (PMF)

Levels of flood inundation associated with the statistically rare PMF are often substantially higher than the levels of flooding associated with the 1% AEP event. It is for this reason that the 1% AEP is adopted as the flood control for developments in both Cessnock and Maitland City Council LGA's.

Conversely, the PMF is often estimated for assessing flood impacts on major critical infrastructure, including bridges, dams or trunk drainage lines. The PMF can also be utilised for emergency route planning as part of an overall emergency risk assessment plan.

Figure 4 shows the extent of PMF flooding across the site. Flooding extends beyond the LIDAR boundary into Testers Hollow to the east of the subject land.

It is noted that Cessnock Road is occasionally cut-off due to flood waters between Gillieston Heights and Cliftleigh. The proposed residential development of the site would have the benefit of providing an alternate access route between Kurri Kurri and Maitland that is flood free as the development land spans between Testers Hollow (flowing east) and the wetlands, bypassing Testers Hollow flood prone area.

2.4.3 Riparian Corridors

The New South Wales Office of Water recommends vegetated riparian zones based on watercourse order classified under the Strahler System and using the current 1:25,000 topographic maps defining watercourses. The riparian corridor widths recommended by the Office of Water are presented in Table 2, with the mapped riparian corridors impacting the devlopable areas of the Hydro landholdings presented in Figure 3.

Table 2: Riparian Corridor Widths Recommended by NSW Office of Water

Watercourse Type	Vegetated Riparian Zone (each side of watercourse)	Total Riparian Corridor Width
1st Order	10 metres	20 metres plus channel width
2nd Order	20 metres	40 metres plus channel width
3rd Order	30 metres	60 metres plus channel width
4th Order and Greater	40 metres	80 metres plus channel width

The Office of Water's Riparian Corridor matrix provides a summary of structures and infrastructure permissible within the riparian zone of each stream type.

Table 3: NSW Office of Water Riparian Corridor Matrix

Stream Order	Cycleways and Pathways	Detention Basins	Stormwater Outlet Structures and Essential Services	Stream Re-alignment	Road Crossings
1st	Yes	Online	Yes	Yes	Bridge/Culvert
2nd	Yes	Online	Yes	No	Bridge/Culvert
3rd	Yes	Offline	Yes	No	Bridge/Culvert
4th +	Yes	Offline	Yes	No	Bridge/Culvert

All riparian corridors within the developable region of the residential precincts are class 2 stream order or less. Swamp Creek is at least a fourth order stream; so no detention basins or major structures are permitted online. The small watercourse on the western side of the Hydro Smelter appears to be a second order stream.

2.5 Overview of Flooding

Tail water flood levels from the Hunter River are the hydraulic controls adjacent to the site. The constant level RL9.7mAHD is adopted level of flooding due to the 1% AEP event as modelled in previous flood studies of the Hunter River and nearby tributaries.

The current subdivision layout is sensitive to the flood impacts and riparian corridors.

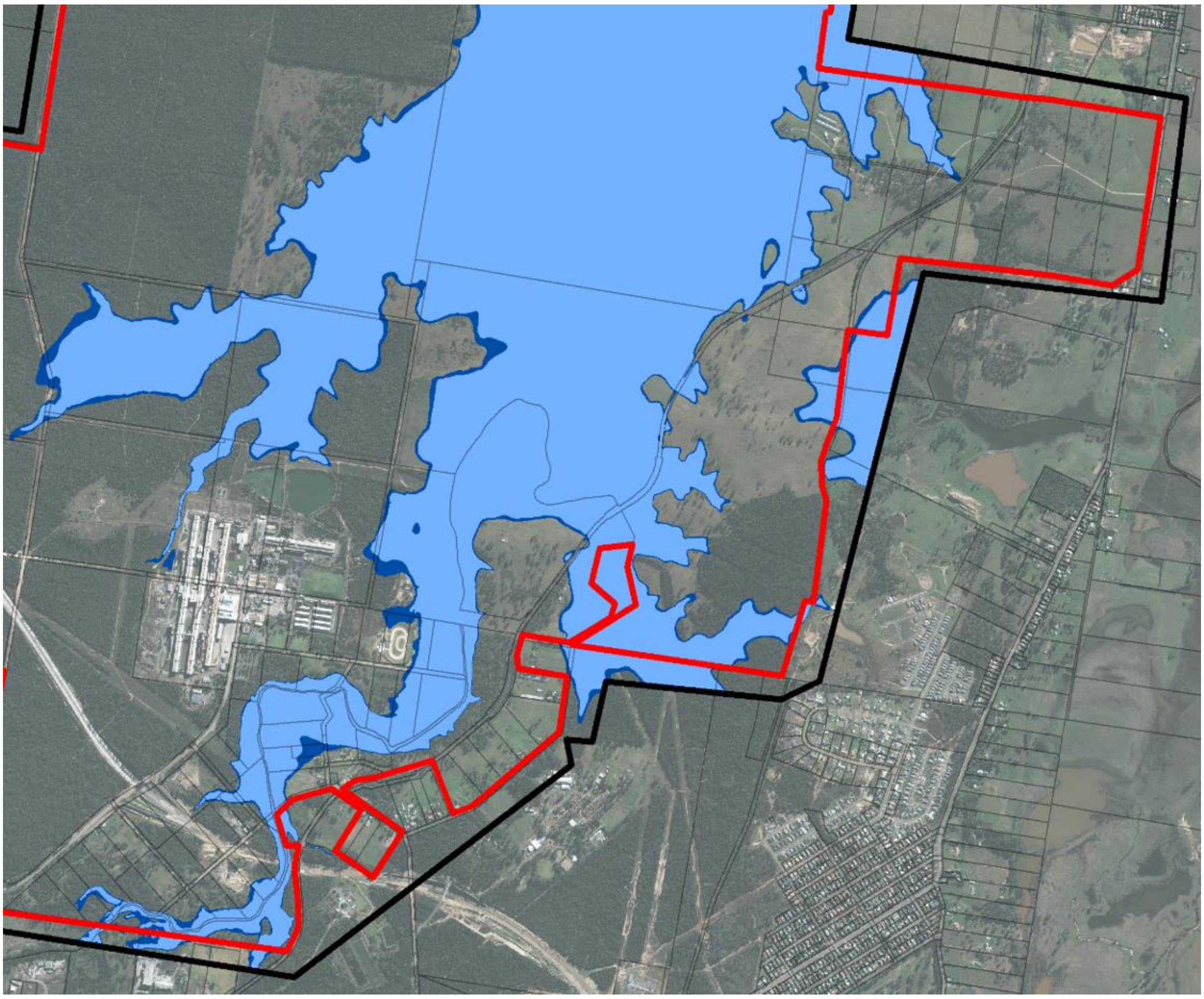

Figure 5: Flood Extents in areas considered for Industrial and Residential Development

3 Stormwater Management

3.1 Water Cycle Management

Developments of the scale of this site require consideration to stormwater in the broader context of the water cycle, which includes rainwater, groundwater, potable water, and stormwater quality both on-site and downstream. Increased development results in an increase in stormwater runoff, decrease in ground water flow and an increase in pollutants in both stormwater runoff and ground water flow.

Water Cycle Management gives consideration to water harvesting and re-use, water infrastructure systems, wastewater re-use, source, conveyance and discharge controls, erosion and sedimentation controls and low-impact subdivision, road, landscape and drainage design. Construction related impacts are also identified as relevant to the proposal.

3.1.1 Water Harvesting and Re-use

The principles of storing rain water on site through above or below ground rainwater tanks have been shown to have a beneficial effect through reduced mains water (potable) demand and decrease in storm water runoff, to counter the impacts of urbanisation.

Rainwater tanks are typically required for residential development to comply with the NSW State Government's Building Sustainability Index (BASIX) requirements to provide water efficiency among other building efficiency measures.

Industrial developments have a higher variability in potable water demand. Consequently water harvesting must be considered as part of future design.

3.1.2 Water Infrastructure

Potable water will be supplied through both the industrial and residential developments to provide adequate water pressure for drinking water and fire-fighting purposes. This is to be separately considered as part of an Infrastructure Servicing Strategy.

3.1.3 Waste Water Re-use

In Hunter Water Corporation's operations area, waste water re-use is not generally supported except for large-scale industry with a government regulated system. Residential development will be directly connected to the HWC sewer transportation system and is considered as part of a separate Infrastructure Servicing Strategy.

3.1.4 Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is considered as part of new development work intrinsically part of whole life of a development, including the planning phase. The principals of WSUD include consideration to improving water efficiency, water harvesting, reducing impervious surfaces, and implementation of stormwater controls as part of a subdivision design to reduce stormwater runoff and improve stormwater quality.

3.1.5 Stormwater Controls

Controls are devices, structures or materials used to contain, convey or treat stormwater. The following controls may be implemented as part of the future design of the subdivisions. Additional controls should be temporarily implemented (erosion and sedimentation controls) during construction.

Source controls, such as those implemented on a small (lot) scale include:

- Porous paving;
- On-site detention;
- Rainwater tanks;
- Rain gardens;
- Oil/grease separators;
- Leaf and rubbish traps.

Conveyance controls include:

- Conventional kerb and gutter;
- Stormwater pits and pipes;
- Grassed Swales;
- Bio-retention swales.

Storm water controls located at the end of the system, prior to discharge to a natural waterway include:

- Gross pollutant traps;
- Stormwater detention basins;
- Constructed wetlands.

As part of the development process, discharge controls are considered for inclusion in the subdivision design.

3.2 Subdivision Developments

Pending further investigation, storm water management is expected to be limited to larger areas in the low-lying areas of each catchment for water quality control and stormwater detention. The enclosed Precinct Staging Plans show each of the designated water quality areas as detention basins Note that the catchment areas are not the same as the Precincts shown on these plans.

Calculations for sizing these water quality features are based initially on 5% of the contributing catchment area. Typically a dedicated area being 5% of the contributing catchment is sufficient for locating a constructed wetland including gross pollutant trap(s), inlet pond(s), batters, landscaping, outlet structures and overflow spillway. Constructed wetlands are viewed as being a tertiary treatment control and typically occupy the largest plan area per contributing catchment when compared to other primary or secondary treatment controls.

3.3 Residential Developments

Source controls for residential developments are not explicitly required, as the development density up to 60% impervious fraction are allowed in the subdivision layout. Any further re-development within residential areas that result in increased density, such as dual-occupancy dwellings would require additional controls as follows:

Roof Surface→Rainwater tank→On-Site Detention→Discharge

Table 4: Residential Water Quality Areas

CATCHMENT	AREA (ha)	Fraction Impervious	Minimum Water Quality Area (ha)
Catchment NR1	4.06	60%	2.44
Catchment NR2	11.24	60%	6.74
Catchment NR3	33.15	60%	19.89
Catchment NR4	8.92	60%	5.35
Catchment NR5	8.89	60%	5.34
Catchment NR6	8.85	60%	5.31
Catchment NR7	30.75	60%	18.45
Catchment NR8	15.29	60%	9.17
Catchment NR9	8.23	60%	4.94
Catchment NR10	4.02	60%	2.41
Catchment NR11	13.84	60%	8.30
Catchment SR1	14.14	60%	8.48
Catchment SR2	14.15	60%	8.49
Catchment SR3	14.17	60%	8.50

3.4 Industrial Developments

Additional source controls would be considered necessary to retain peak stormwater flows from the increased density associated with impervious surfaces. Conceptually, water quality control structures are sized to adequately detain and treat excess stormwater and pollutants of a 60% developed surface.

As industrial developments are developed to an impervious fraction much closer to 90%, the increased flows and potential increase in pollutants must be treated on-site. It is normally expected that this would be implemented in an on-site treatment train as follows:

Roof Surface→Rainwater tank→On-Site Detention→Discharge

Hardstand→Gross Pollutant trap→On-Site Detention→Discharge

Table 5: Industrial Water Quality Areas

CATCHMENT	AREA (ha)	Fraction Impervious	Minimum Water Quality Area (ha)
Catchment ID1	24.84	90%	22.36
Catchment ID2	13.49	90%	12.14
Catchment ID3	12.1	90%	10.89
Catchment ID4	19.49	90%	17.54
Catchment ID5	45.03	90%	40.53
Catchment ID6	17.74	90%	15.97
Catchment ID7	29.69	90%	26.72
Catchment ID8	15.81	90%	14.23
Catchment ID9	18.49	90%	16.64

Further assessment would be considered as part of the end-use of the site as to whether additional stormwater controls would be required so as to treat nutrients, preventing these from entering the stormwater system.

4 Conclusion

Tail water levels from the Hunter River downstream is the hydraulic control adjacent to the site. The constant level RL9.7mAHD is adopted level of flooding due to the 1% AEP event as modelled in previous flood studies of the Hunter River and nearby tributaries.

The flood and riparian zones represent constraints that can be negotiated around the fringes of their extents.

The current subdivision layout is responsive to the flood impacts and riparian corridors.

Areas identified on the subdivision plan for stormwater management are representative of the scale of land area required to adequately treat and control storm water to acceptable standards.

As a result of this assessment of flooding and stormwater a significant area of the Hydro land holdings is capable of being developed for the residential and industrial purposes.

5 APPENDIX – Build-up of LIDAR Data

The following images show how the LIDAR information was built upon to provide input to the formulation of elevation and drainage lines.

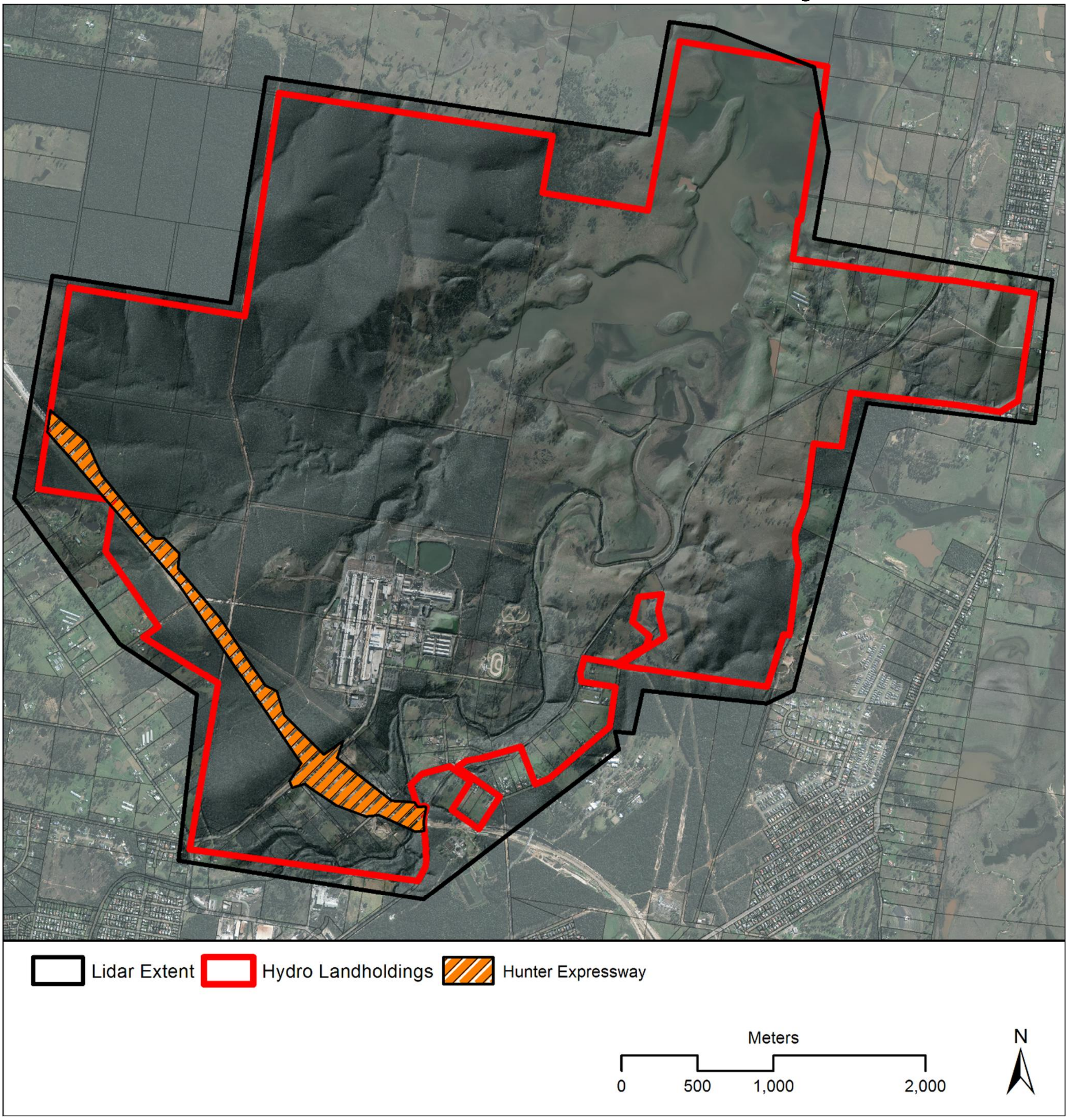

Figure 6: Extent of Lidar, Hydro Landholdings and Hunter Expressway

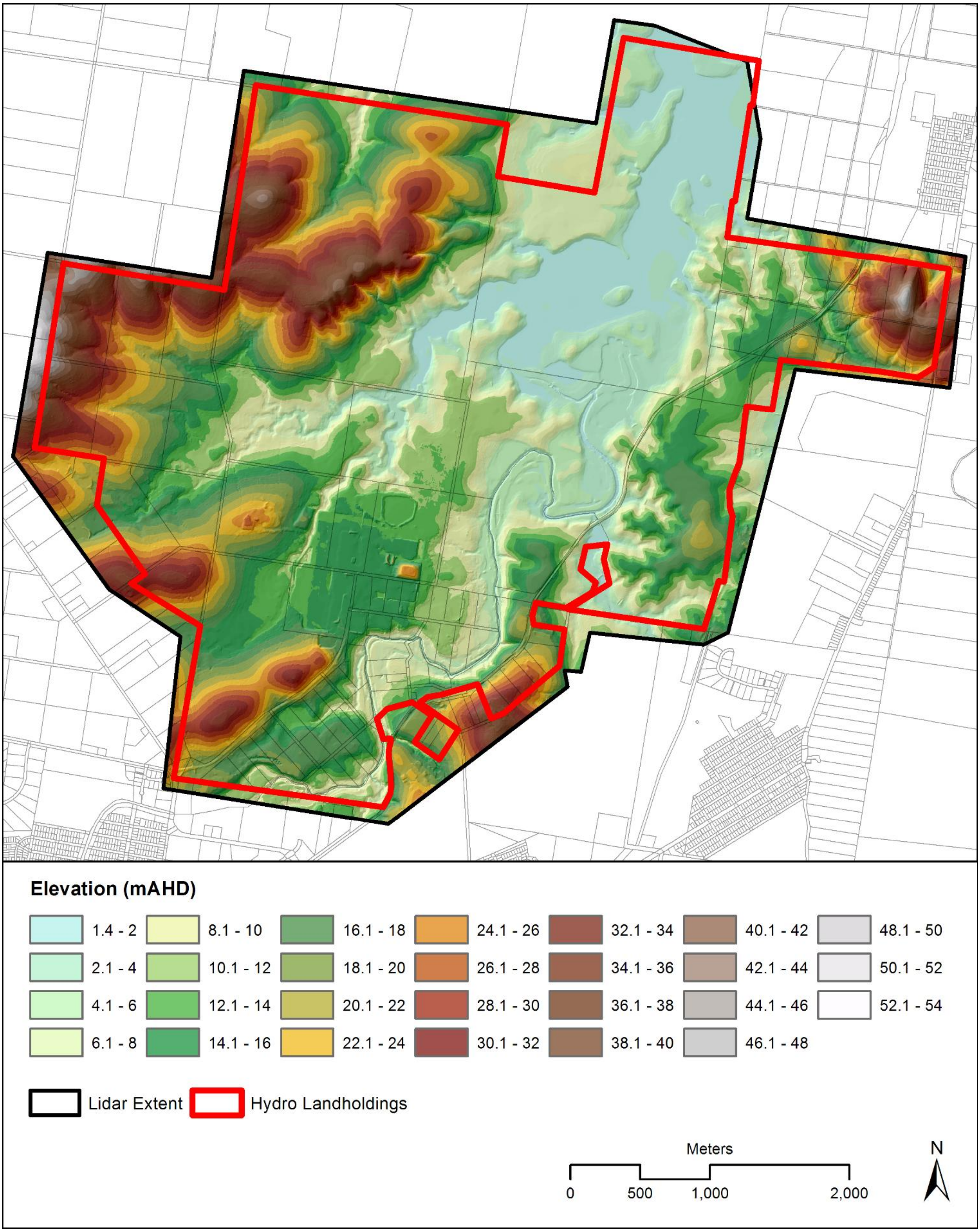

Figure 7: Elevation (mAHD) Across the Hydro Landholdings Based on Lidar

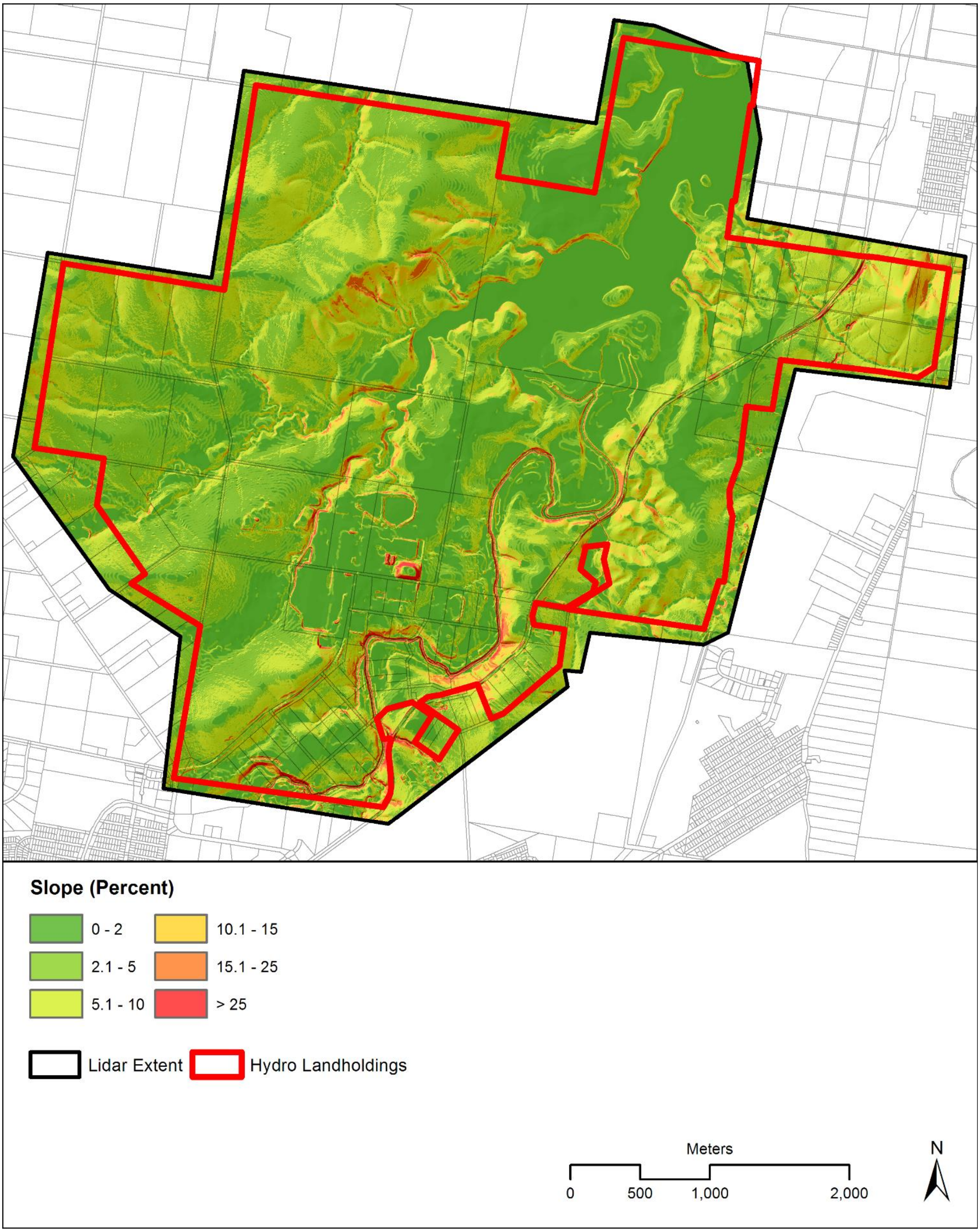

Figure 8: Derived Slope (Percent) Across the Hydro Landholdings Based on Lidar

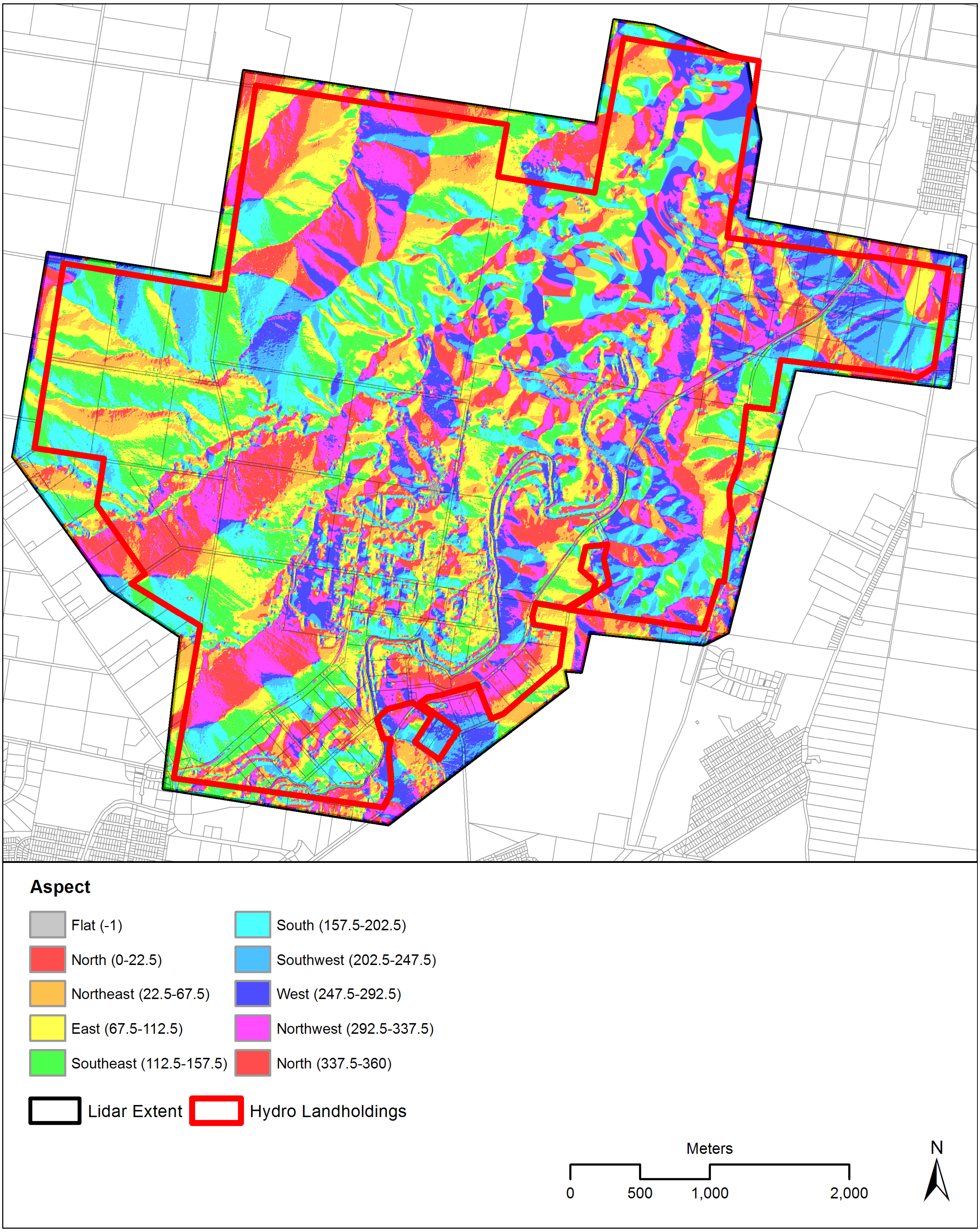

Figure 9: Derived Aspect Across the Hydro Landholdings Based on Lidar

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