NSW GOVERNMENT

Office of Sport

Southern Highlands Regional Shooting Complex

Soil and Water Management Plan

Construction and Operational Phases

August 2018

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1.1 General Purpose and Objective

The purpose of this Soil and Water Management Plan (SWMP) is to minimise the risk to human health or the environment during the construction and operational phases of the Southern Highlands Regional Shooting Complex (SHRSC, 'the Site') by reducing the potential for sediment, metal (and other) contamination to migrate to nearby sensitive receptors. The management plan includes details on:

- Aspects of range design associated with pollution control and minimisation;
- Stormwater and wastewater management structures;
- Erosion control measures;
- The application of soil amendments to reduce the risk of metal mobilisation and transport; and
- The environmental monitoring program.

This plan is prepared in accordance with US EPA (June 2005) Best management practices for lead outdoor shooting ranges, EPA-902-B-01-001 and NSW Landcom's Soils and Construction: Managing Urban Stormwater (2004) manual.

This plan should be read in conjunction with the Water Cycle Management Plan (WCMP) and Operational Environmental Management Plan (OEMP) also prepared for the SHRSC.

1.2 SWMP Requirements

This management plan addresses particular issues contained within the Minister's Determination MP 06_0232 MOD 5 for the SHRS, as listed in Table 1.

Table 1 Minister's Requirements

B3 Soil, Water and Contamination Requirements	Relevant Section
A detailed Water Cycle Management Plan (WCMP) for the operation of the complex must be prepared in consultation with the EPA and WaterNSW; and be submitted to the satisfaction of the Secretary prior to the construction of the new ranges, as approved under MOD 5.	All & Water Cycle Management Plan
The WCMP must be prepared by a suitably qualified person(s), incorporate the elements of Appendix E of the Environmental Assessment, and in accordance with the requirements outlined in Chapter 2 of the NSW Landcom's Soils and Construction: Managing Urban Stormwater (2004) manual – the "Blue Book".	Section 1.1 of the WCMP & SWMP
(a) water quality management and stormwater design including appropriately sized sedimentation ponds consistent with the memorandum and associated sketch SK024 addressed to NSW Sport and Recreation prepared by GHD (dated 7 May 2009);	Section 4.2.2 of the WCMP
(b) the management or disposal of overflow and/or water from the proposed water quality control sedimentation ponds located along the ranges;	Section 7.0, 7.1, 7.2, 7.3, 7.4 and 7.5 of the WCMP

B3 Soil, Water and Contamination Requirement	Relevant Section
(a) water quality management and stormwater design including appropriately sized sedimentation ponds consistent with the memorandum and associated sketch SK024 addressed to NSW Sport and Recreation prepared by GHD (dated 7 May 2009);	Section 4.2.2 of the WCMP
(c) the management of the existing dam located on the proposed shooting complex site;	Section 4.2.2 of the WCMP
(d) the management of risks associated with the use of water from the proposed water quality sedimentation ponds for fire-fighting purposes;	Section 1.7 of the WCMP
(e) procedures and responsibilities for inspection, monitoring and maintenance of all water quality management structures (swales, diversion channels or earth berms, sedimentation ponds, rainwater tanks and drainage works); and	Section 5 of the WCMP
(f) a Soil and Water Management Plan that includes:	SWMP
(i) the design capacity of the amended soil wastewater treatment and disposal system for the proposed shooting complex, including upgrade or transfer of the wastewater system at the existing Hill Top Rifle Range, based on average and peak wastewater loads expected to be generated at the site;	Section 4.2.4 of the WCMP Section 4.3 of the SWMP
(ii) evidence the amended soil mound will be located at least 100 metres form the Rocky Waterholes Creek or any other perennial or intermittent creek or watercourse, and at least 40 metres from any drainage depression and dam;	Section 4.2.4 of the WCMP Section 4.3 of the SWMP
(iii) details of the design, installation, operation, and maintenance of the wastewater treatment system (including irrigation scheduling, wet-weather storage and soil monitoring programs) to demonstrate the quantity of effluent/solids applied does not exceed the capacity of the amended soil mound to effectively utilise the effluent/solids;	Section 4.2.4 of the WCMP Section 4.3 of the SWMP
(iv) plans and procedures for the remediation of any contaminated soils on the site;	Section 4.2.5 and 4.2.6 of the WCMP Section 4.5 & 4.6 of the SWMP
(v) emergency procedures for spill management of any contaminants including diesel;	Section 3.1.4 of the WCMP Section 3.1 of the SWMP
(vi) an ongoing monitoring plan, including monitoring of vegetation health, soils within and around all ranges, stop butt material, sedimentation ponds, groundwater monitoring, rainwater and the pre and post construction water quality downstream of the stormwater detention basins at the site for the key contaminants associated with the Project. This plan must incorporate exception reporting as well as annual reporting of outcomes to WaterNSW with the reporting identifying appropriate mechanisms to modify management practices and procedure where deleterious impacts on land, vegetation and water quality are demonstrated; and	Section 5 of the WCMP Section 5 of the SWMP
(vii) methods for achieving neutral or beneficial impact on water quality.	Section 1.4 of the WCMP & SWMP

1.3 Mitigation Measures

The following mitigation measures (in general) would be implemented to combat the potential environmental impacts from the proposal to develop the SHRSC:

- The existing 800m range stopbutt at the SHRSC will be remediated in accordance with NSW EPA requirements so that it meets health and ecological investigation levels suitable for recreational open spaces. A Site Audit Statement prepared by a qualified site auditor to assess the existing stopbutt and confirm that it has been remediated and is suitable for its intended use;
- Engineering controls isolate areas routinely contaminated by bullet strike (primary and secondary impact) from the surrounding catchment.
- Future remediation of soils if monitoring indicates exceedance of relevant contamination assessment criteria based on the land use;
- Five (5) sediment control basins with a combined storage volume of 5,400m3 established at the commencement of construction have been retained for operational use of the SHRSC. Future development of the site will include another sediment control basin with a storage volume of 1,230m3;
- New stopbutts and target mounds are designed to reduce erosion, including the construction of a 3(h):1(v) slope to improve stability, to promote low-velocity sheet flow, and to assist with vegetation establishment. Note the angle of the forward slope is specified by NSW Police range guidelines as being at least 30^{o} but ideally 35^{o} in relation to the range fairway;
- New stopbutts have been constructed from suitable clean site soils or imported clean fill and all rocks and other debris removed to minimise the potential for ricochet;
- New stopbutts are designed to minimise contact between water and projectiles to reduce the rate of projectile deterioration and metal leaching; and
- The SHRSC Operation Environmental Management Plan (OEMP) includes the following measures:
    - The usage of firing lanes at rifle and pistol ranges would be staggered to minimise effects on stopbutt stability;
    - Surface Soils within Shot Fall zones (primary and secondary impacts) are monitored and treated as required to maintain Soil pH within the range of 6.5-8.5 to reduce the leaching and mobility of metals.
    - Grass cover is maintained over all areas other than primary impact zones as an erosion control. Vegetation cover also acts to mitigate movement of sediment in run off and migration of contaminants attached to sediments.
    - Fertiliser application and soil ameliorants are used where required to promote the maintenance of the protective grass cover. Regular soil testing is used to inform and confirm correct fertiliser application and avoid potential excessive application and offsite impacts.

- Where feasible the use of less toxic projectiles (i.e. non lead) would be promoted by the Office of Sport; and
- An operational monitoring program for the SHRSC is in place to monitor possible metal accumulation and migration in and around the site. The monitoring program is outlined in Section 5 of the WCMP.

1.4 NorBE Principles

Due to the nature of the Southern Highlands Regional Shooting Complex (SHRSC), a Neutral or Beneficial Effect (NorBE) analysis on water quality is not feasible to be modelled using commercially available water quality modelling software. The SHRSC's major pollutant generator (metal contaminants) cannot be modelled using the MUSIC program and the remaining site generated pollutants are minimal due to the operational management of the site. Nonetheless, consideration has been given to the NorBE principles.

The following operational management measures ensure a neutral effect on water quality:

- Water quality controls to divert clear water around the SHRSC location;
- Devices (trenches and sediment control basins) to capture water from cleared areas to ensure heavy metals and sediments do not leave the proposed location;
- Stopbutts designed in accordance with the US EPA (June 2005) Best management practices for lead outdoor shooting ranges, EPA-902-B-01-001; and
- An implemented maintenance management program.

The following measures ensure a beneficial effect on water quality:

- The septic system at the existing club house has been upgraded;
- The existing stopbutt will be rebuilt to the same standard as the new stopbutts;
- Areas of erosion around the existing firing mounds have been rehabilitated.

2 SHRSC Description

The SHRSC is a regional recreational shooting complex incorporating the existing 800 metre Hill Top Rifle Range (which continues to operate), and includes:

- A (500 metres by 100 metres) shooting range;
- A (50 metres by 115 metres) shooting range;
- Supporting facilities and infrastructure, including:
  - Range control and Toilet facilities;
  - Access roads (designed for two-wheel drive vehicle access) connecting to Wattle Ridge Road and between the ranges;
  - Diesel generator, solar panels, water supply tanks and septic system;
  - Informal parking for 160 cars; and
  - Basins to contain water for water quality control purposes.
- Future facilities include:
  - A (200 metres by 85 metres) shooting range;
  - A shotgun range;
  - An indoor air range (21 metres by 17 metres by 6.5 metres); and
  - A Clubhouse

2.1 Site Location and Description

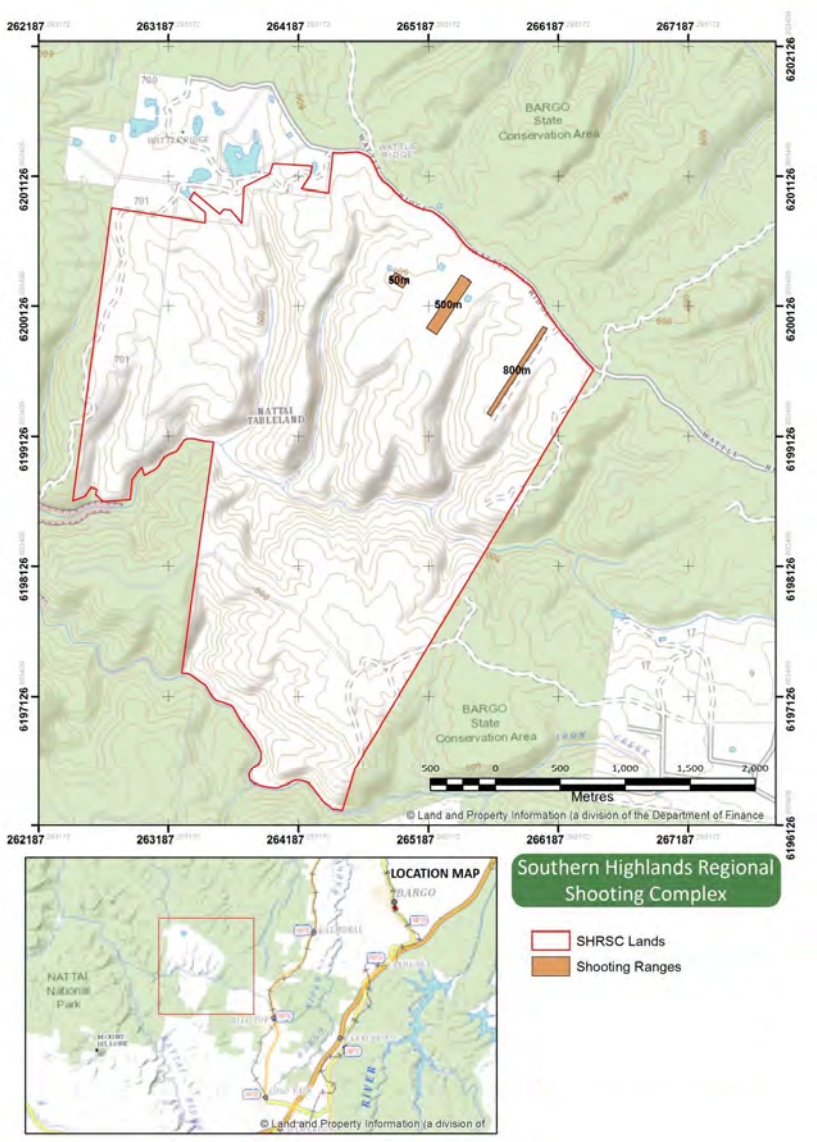
The SHRSC is located in the Wingecarribee LGA on Wattle Ridge Road, approximately 5.5 km northwest of the centre of the village of Hill Top in the southern highlands of New South Wales, approximately 11 km north of Mittagong. Mittagong is located at the south-western end of the Sydney Basin between the upper reaches of the Nepean River and other rivers such as the Wollondilly, Nattai, Bargo and Wingecarribee. These rivers flow into the Nepean River further to the north. See Figure 1 – Site Location.

The Wingecarribee Local Environmental Plan 1989 (the LEP) applies to the site.

The site is currently the location of the Hill Top Rifle Range. The Southern Highlands Rifle Club licensed land on which the range is located, from the National Parks and Wildlife Service, on 3 June 1993. The existing Hilltop Rifle Range consists of a seven-target rifle range 800 m long, with firing mounds at 100 m intervals. A small clubhouse, toilet facilities and informal car parking are also located on site.

1,036 hectares (ha) of land has been excised from the Bargo State Conservation Area by means of the National Parks and Wildlife (Adjustment of Areas) Act 2006. The SHRSC when complete occupies an area of approximately 16 ha within this land. The area occupied by the 50m and 500m ranges and associated facilities was cleared as per the Conditions of Approval. The remainder of the land on the site (approximately 1,000 ha) has been retained in its existing condition as a vegetation buffer zone. This area acts as a safety zone for the SHRSC.

Figure 1 Site Location



2.2 Conservation Agreement

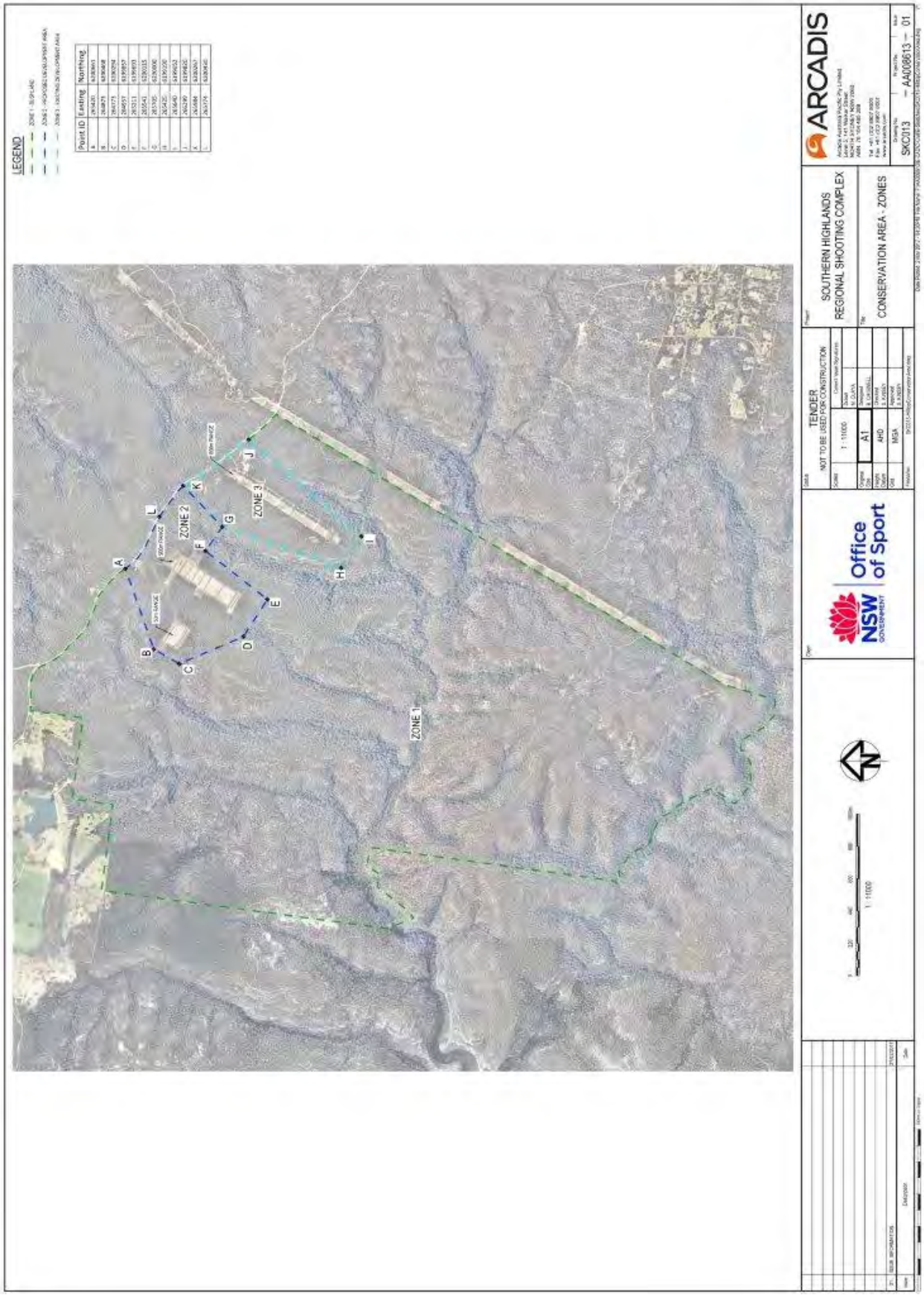
The site is subject to a Conservation Agreement under the National Parks and Wildlife Act 1974. The Conservation Agreement defines 3 zones across the site:

- Zone 1 – Bushland;
- Zone 2 - Proposed Development Area; and
- Zone 3 - Existing Development Area.

The Conservation Agreement does not permit any development in Zone 1.

The Conservation Agreement Zone 1 boundary general follows the E2 Environmental Conservation land use zone boundary and Zones 2 and 3 the SP1 Special Activities land use zone boundary. The Conservation Agreement is an identified mitigation /management measure under the current Statement of Commitments in the Minister's approval. See Figure 2 – Conservation Area – Zones.

Figure 2 Conservation Area - Zones



2.3 Surrounding Land Uses and Sensitive Receptors

The site is bounded by:

- Wattle Ridge – a grazing property/residence which adjoins the site to the northwest (located approximately 2.5 km north of the existing range);
- Bargo State Conservation Area to the southwest;
- A 330 kV cleared electricity easement (Transgrid) to the southeast; and
- Wattle Ridge Road to the northeast.

Bargo State Conservation Area is located further southwest, southeast and northeast. Nattai National Park is located further to the northwest, on the opposite site of the Wattle Ridge property. Nattai National Park is accessible from the end of Wattle Ridge Road approximately 3 km away.

Sensitive receptors include Rocky Waterholes Creek, located approximately 1.5 km south of the site. The creek is a tributary of the Nattai River. The Nattai River is located approximately 7.5 km west of the site.

2.4 Geology, Soils and Topography

Topographically and geologically the area is transitional between the Cumberland Plain of the Sydney Basin, and the southern uplands.

The underlying geology of the site comprises the Hawkesbury Sandstone of the Mittagong Formation (Herbert and Helby, 1980). The site lies within an outcrop of the Narrabeen group, which comprises sandstone, claystone and siltstone. The Hawkesbury sandstone overlies a Triassic shale unit, the Wianamatta Group.

The site is characterised by relatively flat topography, being situated on a spurline that trends to the north from the Wattle Ridge Range. This spurline occupies a position between two tributaries of the Rocky Waterholes Creek. All watercourses are upper tributaries of the Nattai River.

The three main groups of soils that occur within the region are (NPWS, 2001):

- Sandstone tableland soils;
- Valley soils (sandstone derived); and
- Soils associated with nutrient rich shales and igneous rocks.

Land surfaces in the site do not appear to have been significantly transformed. These soil landscape types are unstable when disturbed. They are highly susceptible to mass movement, such as slides and rock falls, as well as wind and water erosion (Hazelton and Tille, 1990). A major cause of erosion in an area of this type is fire. After a fire in which the crowns are consumed, the loose sandy soils remain bare for a long period. If rain then shortly follows a fire, there is a resulting increase in surface run-off, causing increased erosion, and a reduction in plant propagation and animal habitats.

2.5 Hydrogeology

The site is located within the Hawkesbury Sandstone – southeast groundwater flow system, which consists of a layered aquifer system with yields ranging from less than one to 50 ML/day. Basalt caps are expected to occur in some areas of the Mittagong Ranges, with groundwater from this horizon discharging into seeps, springs and rivers (Sydney Catchment Authority, 2006).

According to the Department of Natural Resources Groundwater Licence database, groundwater within the Hilltop area was found to be present at depths of approximately 20 metres in the sandstone aquifer. The depths to groundwater within the aquifers are expected to be dependent on rainfall and therefore are likely to vary seasonally. A borehole on site near the proposed clubhouse was terminated at 50 m depth with no water detection.

2.6 Hydrology

The nearest pluviograph station to the site is located at Moss Vale, which is considered too distant to provide representative hydrology data for the study area. A number of daily rainfall stations are located in close proximity to the study area. Table 2 summarises these stations, providing station number, name and recording start and end years.

Table 2 BOM Daily Rainfall Data

Station Number	Station Name	Start Date	End Date	Max mean monthly rainfall (mm)	Min mean monthly rainfall (mm)
068044	Mittagong (Beatrice St)	1886	2015	93.5	52.6
068052	Picton Council Depot	1880	2015	90.7	44.0

An analysis undertaken on this data indicated that there is some variability in the rainfall with the maximum mean monthly rainfall of 93.5 mm in March, while the minimum mean monthly rainfall recorded is about 44.0 mm in September. The annual average of the rainfall gauges is 857.45 mm. The mild seasonal variability would indicate that rainwater collection via rainwater tanks is viable.

Mean monthly evaporation data for the region ranges from 40-50 mm in June to 200-250 mm in December, with an annual evaporation rate of approximately 1600 mm. The annual evaporation rate exceeds the average annual rainfall for the region; however, the existing erosion control basins still contained water during a site inspection in December 2006 despite a prolonged period with only limited rainfall.

2.6.1 Waterways

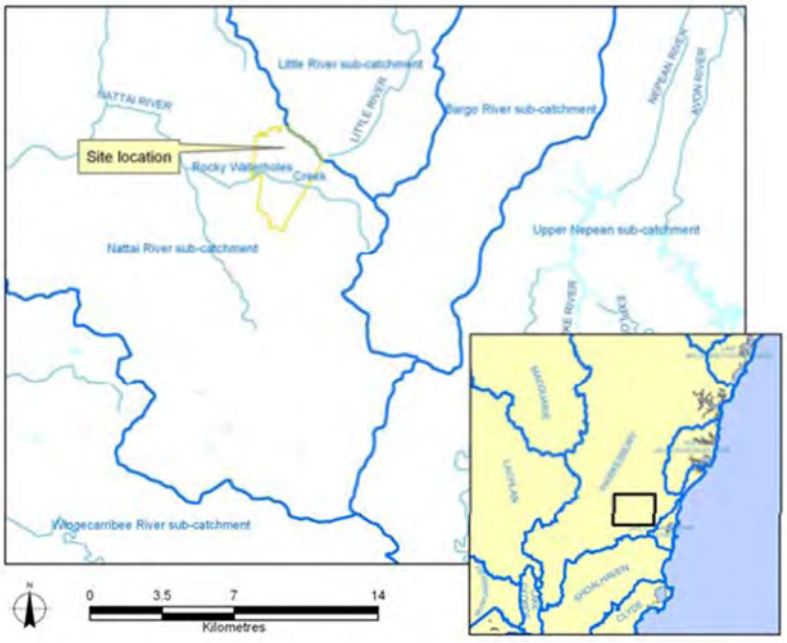
Rocky Waterholes Creek, which is immediately south of the SHRSC drains directly to the Nattai River approximately 6 km to the west of the existing Hilltop Rifle Range. The Nattai River drains north to Lake Burragorang. The catchment of Rocky Waterholes Creek is approximately 23.5 square kilometres, while the catchment of the Nattai River upstream of the junction with Rocky Waterholes Creek is some 240 square kilometres. The total catchment area of the Nattai River upstream of Lake Burragorang is 480 square kilometres. Figure 2 below illustrates the major regional catchments within the vicinity of the site.

2.6.2 Onsite Creeks

As the site sits on the top of a spurline that runs from north to south, the natural fall is from the centre of the spurline to the east and to the west into steep gullies. The gullies drop from the level of Rocky Waterholes Creek Road down to Rocky Waterholes Creek, a fall of approximately 100 metres over a distance of less than 1 km. As a result of the topography, the site is not subjected to flooding.

A small number of ephemeral drainage lines commence in the vicinity of the Spurline. These flow following rainfall only.

Figure 3 Water Catchment



2.7 Water Quality

The Hawkesbury Nepean Catchment Management Authority has classified 98% of the Nattai River as being 'Near Intact'. The Draft Hawkesbury Nepean Catchment Action Plan (2007) identifies a strategy for managing the entire catchment and sets out procedures for looking after the near intact systems such as the Nattai River.

3 Environmental Impact

Potential environmental impacts resulting from the construction and operational phases of the project are likely to be associated with soil and erosion of the site. These impacts will be addressed by following the requirements within NSW Landcom's Soils and Construction: Managing Urban Stormwater (2004) manual – the "Blue Book", through the Mitigation and Control strategies detailed in Section 4 of this plan.

3.1 Other Contaminants

Other contaminant sources include stored substances such as domestic chemicals, and oil and fuel from vehicles visiting the site.

Containment and isolation of any spills of these substances should be priority, should a spill occur. Containment measures would include bundled storage areas for large volume stored chemicals such as diesel so that any spills can be contained and disposed of appropriately, prior to any discharge to the environment.

In instances where chemical substances are discharged into the environment, procedures are to be in place for clean-up of the spill using chemical spill kits. Due to the relatively small volumes of chemical substances that are expected to be stored at the site, the use of personal spill kits should be sufficient. Otherwise, emergency procedures for chemical spill should include the need to contact Emergency Services during spill incidents which are a potential environmental or health concern by a site management representative or a suitably qualified person.

Any chemicals which cannot be removed following clean up would be subjected to the water cycle management processes implemented.

4 Mitigation and Control

4.1 Stormwater Management

In the context of Water Sensitive Urban Design (WSUD), the planning and design sets out to minimise the hydrological impacts of development on the surrounding environment. The management of stormwater encompasses:

- Water quality management;
- Flood management;
- Flow management; and
- Flow attenuation.

Key planning and design objectives are:

- Protect and enhance natural water systems following development;
- Integrate stormwater treatment into the landscape by incorporating multiple-use corridors, that maximise the visual and recreational amenity of the development;
- Protect water quality draining from development areas;
- Reduce runoff and peak flows from developments by employing local detention measures, minimising impervious areas and maximising re-use (for example through rain water tanks).

Stormwater management for the SHRSC is designed to prevent an increase in the amount of stormwater leaving the site, maintaining the water balance, and to slow the transmission of stormwater to receiving waters to match the existing predevelopment conditions.

Additionally, the stormwater management system prevents the transportation of gross and sediment-born pollutants as much as possible.

Specific strategies include:

- Provision of storm water infrastructure in a ‘treatment train’ approach which provides controls which successively reduces erosion and sediment transport, mitigates leaching and transport of contaminants and final basins to manage water quality.
- Promotion of sheet flow of runoff water over the range surface. Sheet flow lowers the water velocity, which will lower the water’s sediment load–carrying capacity. It avoids potential point source discharge issues and monitoring requirements that may occur with channeled flow. Promoting sheet flow is accomplished by regrading and flattening out the slope of the land surfaces and by creating broad, very shallow drainage pathways to replace ditches or deep, narrow channels;
- Prevention of storm water from impacting on berms or other engineering elements.
- Construction of sedimentation/water quality basins which serve as a final containment measure for water leaving the ranges. The basins are designed and

sized properly to effectively slow the water and allow the suspended solids to settle out.

- The drainage area that the basins will serve is well defined, and the calculated volume of water the basin must handle is accurate; otherwise, the basin's effectiveness will be minimal. It is proposed that when complete the SHRSC will have six basins, three located at the 500 m / future 200 m range, one each at the future shotgun and 50 m pistol range and one at the future clubhouse. The basins have been sized in accordance with the requirements of Landcom Soils and Construction Volume 1 (Landcom; 2004). Basin sizes are as follows:
  - Basin 1 at future 200 m range – 2,000 m^3;
  - Basin 2 at 500 m range – 660 m^3;
  - Basin 3 at 500 m range – 1,380 m^3;
  - Basin 4 at the future carpark and clubhouse 270 m^3 (existing basin to be retained to for erosion control basin during construction);
  - Basin 5 at 50 m range – 2,000 m^3; and
  - Basin 6 at future Shotgun range – 660 m^3 (Not constructed).

  The capacity of the basins to contain all runoff expected has been designed based on the 5-day 85th percentile storm depth and for type D/F soils.

  The basins will be utilised for the life of the SHRSC and the water quality monitored as set out in Section 5 – Monitoring Programs.

  Where possible captured stormwater is to be disposed of in accordance with WCMP Section 7.3 to maintain vegetation across ranges areas for erosion control.

  Where the available range areas become saturated by either rainfall or irrigation, surplus captured stormwater is to be disposed of in accordance with WCMP Section 7.4.
- Stopbutts and target mounds are designed to reduce erosion, including the construction of a 3(h):1(v) slope to improve stability, to promote low-velocity sheet flow, and to assist with vegetation establishment.
- In an effort to minimise impact to stopbutt stability usage of range firing lanes are staggered.
- Grass is maintained over the ranges and stopbutts for erosion control.
- Stopbutt maintenance between lead recovery and recycling operations involves:
  - Replacement of eroded areas, reseeding bare areas, maintaining vegetation.
  - Placement of temporary erosion controls measures as required to promote stabilization.
- The stopbutt is routinely inspected and filling undertaken to repair areas of concentrated impact points.

4.2 Post Development Runoff

Sedimentation basins will remain following the construction phase. Refer WCMP.

4.3 Wastewater Management System

Portable toilets will be brought to site for the duration of the construction period. Sewerage wastes will be removed from the portable toilets as required and the toilets will be removed from site at the end of construction.

The SHRSC when complete will have an Ecomax Septic System or equivalent at all locations where wastewater is generated. The SHRSC currently only involves the construction of the 500m and 50m ranges, with the other ranges developed at a later date.

The design capacity of the amended soil wastewater treatment and disposal system for the SHRSC has been calculated based on average and peak wastewater loads expected to be generated at the site.

Wastewater Flows and Loads

As per AS/NZS 1547:2012 the design wastewater flow allowance for restroom facilities (toilets and hand basins only) is 15 L / equivalent population (EP) / day (roof water supply) in this instance as the proposed facility will be a used for members attending the shooting range between 10.00am to 5.00pm with an expected maximum occupancy of 220 EP per day –15 L per p / day has been applied in the design calculations.

Land Application Design Parameters and Sizing

Data has been selected from the WaterNSW data from Bureau of Meteorology, rainfall calculation station Mittagong, Evaporation Station WaterNSW Zone 4. The total land disposal area of 387.04 m² is required to dispose a maximum 3,300 L / day and provides a zero overflow. The delineated land application area requires a minimum area of 23.6m x 16.4m, the internal cell dimensions are 11.6m L x 4.4m W x 1 plus a perimeter sand bed of 6.0m.

Tertiary Treatment –Amended Soil Mound (ECOMAX)

The Ecomax in this design allows for an inflow of up to 3,300L / day. The Ecomax process is best described as "solid matrix filtration" with effluent renovation by processes which include sorption, oxidation/reduction, volatilization, filtration, biological uptake and detention. Each system consists of a NSW Health Approved septic tank and one Ecomax cell fed from the septic tank.

Each Ecomax system consists of one amended soil mound located within the cleared range areas remote from the Rocky Waterholes Creek or any other perennial or intermittent creek or watercourse, and at least 40 metres from any drainage depression and dam.

Location – Amended Soil Mound (ECOMAX)

The Amended Soil Mound (ECOMAX) on the 50m range is 138 metres from Sediment Basin 3 and is surrounded on three sides by a 0.5m high earth bund separating it from local surface falls. The Ecomax is located 225 metres from various ephemeral drainage

lines and tributaries within the dense bushland and 1.75 kilometres from Rocky Waterholes Creek.

The Amended Soil Mound (ECOMAX) on the 50m range is 42.5 metres from Sediment Basin 5 and is separated from same by a 0.5m high earth bund. The Ecomax is located 295 metres from various ephemeral drainage lines and tributaries within the dense bushland and 1.87 kilometres from Rocky Waterholes Creek.

The Amended Soil Mound (cell) contains an Ecomax storage drain (tunnel) and amended soil medium contained within an area, between the amended soil medium and impervious layer. The above ground construction provides a large surface area exposure both vertically and laterally, and insulated internal temperature

The treatment processes which are applied to the effluent as it is driven through the amended soil include: filtration, PH adjustment, on exchange, volatilization, biological water and nutrient uptake, oxidation and reduction, absorption, chemical precipitation, detention and evaporation or dilution depending on rainfall/evaporation balance.

The treated effluent is clear, colourless and effectively. Phosphorus removal by Ecomax septic systems, at 99%, is substantially higher than can be achieved by any other practical domestic treatment process. Nitrogen removal is generally very high. High ammonia removal is also a key feature as this contaminant is undesirable in aquatic ecosystems, even at low concentrations. Biological oxygen removal is very high and final effluent concentrations will generally meet drinking water standards. In terms of faecal bacteria, Ecomax effluent meets the national health and medical research council guidelines for "reclaimed effluent" but it is not potable.

4.4 Permanent Erosion Control

Stopbutts and target mounds are designed to reduce erosion, including the construction of a 3(h):1(v) slope to improve stability, to promote low-velocity sheet flow, and to assist with vegetation establishment.

To minimise impact to stopbutt stability usage of range firing lanes are staggered.

Grass is maintained over the ranges and stopbutts for erosion control.

Construction stage sediment basins have been left in place.

Diversion and sediment control drains are shown in Appendix A.

4.5 Application of Soil Amendments

Based on preliminary assessment, the risk of groundwater contamination from site use is considered likely to be minimal given the considerable depth to groundwater on the site, the shallow depth at which natural bedrock is encountered and the general elevation and topography of the site.

Migration of surface contamination may occur through dissolution of heavy metals via rainfall and transport through surface water runoff. To mitigate contaminant migration, fine agricultural grade lime would be applied to soils within the range, shot fall zones, stopbutts and collection trenches to reduce the mobility of metals by increasing soil pH to within the range of 6.5 to 8.5. The dose of lime required would be determined by laboratory testing and specifications provided for individual lime products.

Re-application of lime will be undertaken when soil pHs is found to drop below pH 6.5.

4.6 Projectile Clean-Up and Contaminated Soil Remediation

Projectiles are regularly recovered and recycled from fall zones and stopbutts through raking, sifting and screening methods.

The removal of projectiles from the stopbutts is focused primarily around the bullet pocket/toe of the berm.

The regularity of projectile recovery is dependent upon the level of activity at the shooting complex (Office of Sport keep records of the number of projectiles fired), but as a minimum is undertaken annually.

Inspections of the complex and buffer zones is undertaken annually to identify any additional zones that may require clean-up.

The quantity of projectiles recovered from the complex is compared with firing records to monitor the effectiveness of range operational and engineering controls.

Appropriate personal protective equipment, including gloves, eye protection, and respiratory protection, will be worn by those handling the projectiles during collection to minimise exposure risks. Office of Sport will confirm a safe work method statement is provided by any contractor engaged in activities to remove or retrieve munitions at the ranges.

The collected projectiles are to be held in appropriately labelled covered storage containers prior to recycling to prevent leaching and migration of contaminants. Projectiles would be stored on site for no longer than one month before being moved to a licensed recycling facility.

Soil testing and monitoring is undertaken in accordance with the monitoring program detailed in Section 5. Exceedance of the any assessment criteria indicated in the program is not necessarily intended to indicate when remediation is required but rather when a management response (such as further sampling, remediation planning or remediation works) should occur.

5 Monitoring Programs

5.1 Operational Phase Monitoring

Details of the Operational Phase Monitoring Program have been set out in Section 5 of the Water Cycle Management Plan. The monitoring program has been initiated at the site to:

- Monitor possible metal accumulation and migration from the site during operation. Monitoring includes:
  - Soil monitoring;
  - Sediment monitoring;
  - Surface water monitoring;
- Monitor the function of engineered structures as well as other factors relevant to erosion risk. Monitoring includes:
  - Inspection of stop butts, shot fall zones and erosion control structures; and
  - Inspection of vegetation health and density.

Descriptions and requirements for the monitoring program are summarised in the Water Cycle Management Plan Tables 3 – 6:

- Table 3 - Monitoring program for Soils
- Table 4 - Monitoring program for Sediments
- Table 5 - Monitoring program for Surface Waters
- Table 6 - Monitoring program inspections of infrastructure/engineering controls and evidence of ricochet.

Analytes presented within the monitoring program are those metals common in the composition of projectiles. Other Analytes presented are those which may be associated with the effects of range management practices such as fertilizer application and site drainage.

The frequency and intensity of sampling and the selection of the analytes monitored may be adjusted commensurate with the risks observed following implementation of appropriate mitigations measures or following consideration of specific works or activities at the range.

Model sampling plans are presented in Appendix A for the various ranges at the SHRSC. The plans guide sampling requirements, location and number and should be confirmed within the plan for each sampling event.

No monitoring of groundwater is proposed during the operational phase of the project as a borehole undertaken as part of the initial assessment for the range was terminated at 50 m depth with no ground water detection.

5.2 Constraints to Operational Monitoring Program

Rocky Waterholes Creek is located approximately 1.5km from the SHRSC with thick bushland, steep terrain, gullies and escarpments separating the sites.

Preliminary sampling exercises have confirmed that routine sampling of Rocky Waterholes Creek is not practical or safe given the constraints of terrain and access.

A borehole on site near the proposed clubhouse was terminated at 50 m depth with no ground water detection. Any migration of possible range contaminants is then via surface water flows from basin discharge. Basin water discharge is required to travel 2.5 kilometres along various ephemeral drainage lines and tributaries through dense bushland in order to reach Rocky Waterholes Creek.

Therefore, Rocky Waterholes Creek is too remote from the facility to readily identify contamination issues given the time and distance required for contamination migration and would not allow practical management response.

Water and sediment samples will be taken from the headwaters of small creeks which form an accessible distance from the various outlets of the basins. As these creeks are ephemeral and may only be sampled following rainfall or when there is water available in natural pools.

5.3 Construction Monitoring Program

A construction monitoring program will be implemented at the site to monitor the implemented controls. The monitoring program includes:

- Surface water monitoring; and
- Inspection of engineering controls.

Descriptions and requirements for the monitoring program are summarised in Tables 3 and 4. The results of the monitoring are to be incorporated into an annual report to be prepared by Office of Sport and submitted to Water New South Wales.

The report will highlight any failed tests or issues that may have arisen during monitoring and will identify remedial actions or modified management practices to prevent recurrence of any failures.

5.3.1 Assessment Criteria Adopted

The criteria used to assess levels of contamination within surface water retained by sediment basins include:

- ANZECC PFWS Protection of fresh water species - 95% trigger value (Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council, 2000) (note the ANZECC PFWS guidelines adopt the NEPM GILs for Freshwater)

- ANZECC RWCG Recreational Water Quality Guidelines (Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council, 2000)
- NEPM National Environment Protection (Assessment of Site Contamination) Measure (1999 Amended 2013) Ground Water Investigation Levels (GILs) for Freshwater.

  Note: As GILs for Antimony (Sb) are not available due to insufficient data, a Low Reliability Trigger Value is adopted from Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 2. Aquatic Ecosystems — Rationale and Background Information (Chapter 8) 2000.

Table 3 Construction Surface Water Quality Program

Construction Surface Water Quality Program				
Analytes/Suite	**Criteria**	**Locations**	**Number of Samples**	**Frequency**
pH	pH 6.0-8.0	Car park (Basin 4)	1	Prior to Dewatering of Basin.
		50m (Basin 5)	1	
Turbidity /SS	50mg/L Or confirmed by Nephelometric Turbidity Units following laboratory Correlation	500m East (Basin 3)	1	
		500m West (Basin 2)	1	
		200m (Basin 1)	1	
		Creek waters off range (if available)	2	

Notes

1. The pH of creek waters below the site have been shown to have pH just below 6.0 (5.8 & 5.9)
2. During the construction activities at the SHRSC the basins are to be used as sediment control structures. As such appropriate capacity is to be retained within the structure to accommodate runoff from the works areas during a nominated rain fall event.

   Unless otherwise accepted by the Office of Sport the following rainfall data should be used in calculation of basin design capacity for erosion and sediment control;

   - 5 day 85th percentile rain fall depth = 36.2mm (value for Mittagong from Managing Urban Stormwater Vol 1, 2004)
   - Rainfall Erosivity Factor (R)=2500
3. During construction the contractor will be responsible for monitoring capacity within the basins prior to rainfall and post rainfall. If sufficient capacity is not within the basin, water shall be tested against the criteria in Table 3 and, if required, treated with Gypsum or another approved flocculent so that sufficient capacity can be returned within 5 days of cessation of the rainfall period.

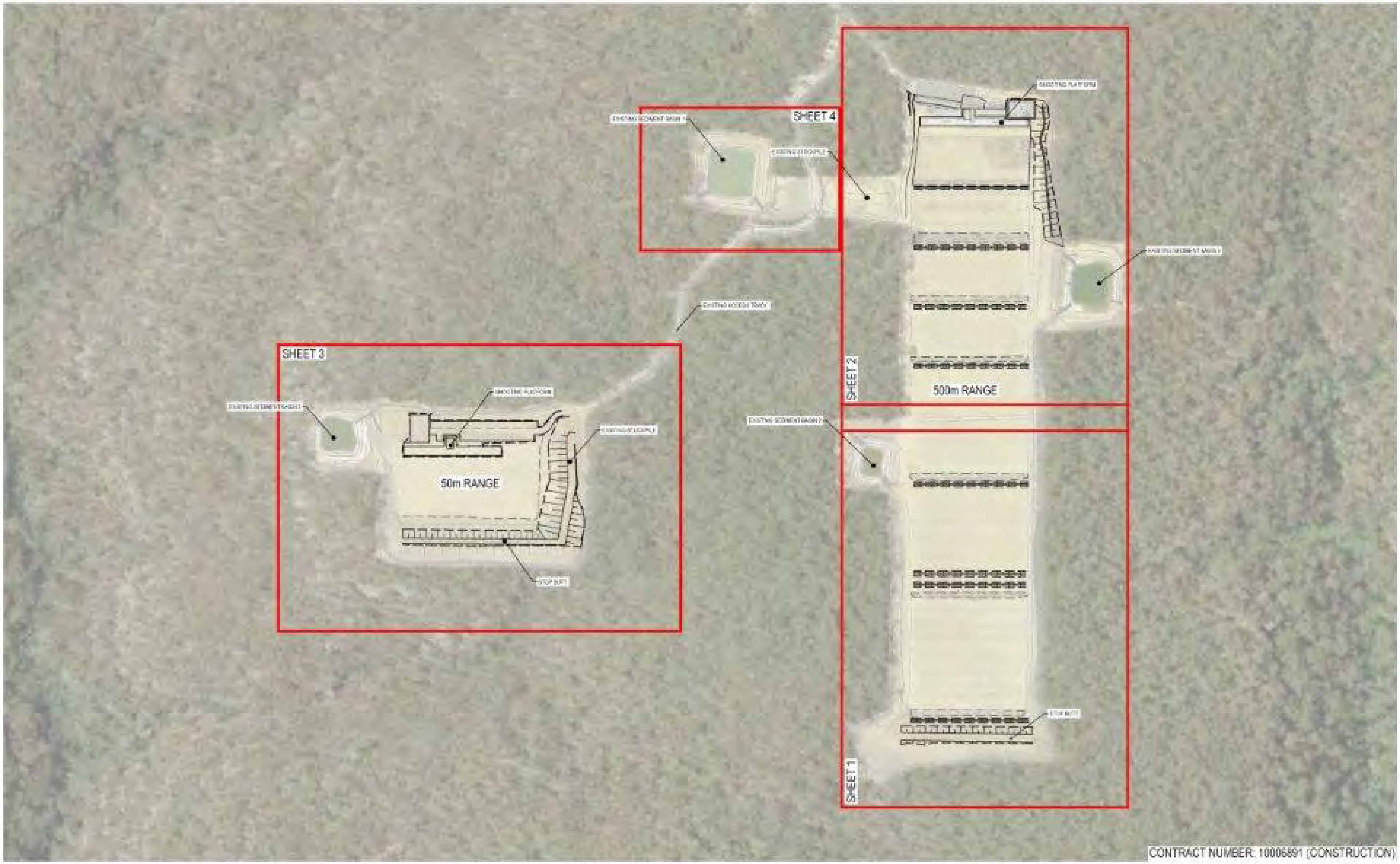
   Treatment shall be in accordance with section 7.2 of the SHRSC Water Cycle Management Plan.

Table 4 Construction Monitoring Program – Visual Inspections

Visual Inspections		
Where	**Search for**	**When**
Water Quality Basin Outlets, inlets and Surrounds	Evidence of scour/ failure of structure	Six monthly and after any severe storm events
Engineering controls including berms, drains, channels, stopbutts, access tracks and culverts	Evidence of damage, erosion, sediment outside controlled areas.	Six Monthly and after any severe storm events
Range perimeter	Evidence of construction impact on adjacent native bushland.	Annually
Vegetation Health	Evidence of dead, dying, disturbed or missing planting.	Fortnightly during vegetation maintenance period

Appendix A

Soil and Water Management Plan Drawings



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03	FOR INFORMATION	[illegible]
02	[illegible]	[illegible]
01	[illegible]	[illegible]

1 : 1500

NSW GOVERNMENT | Office of Sport

TENDER
NOT TO BE USED FOR CONSTRUCTION

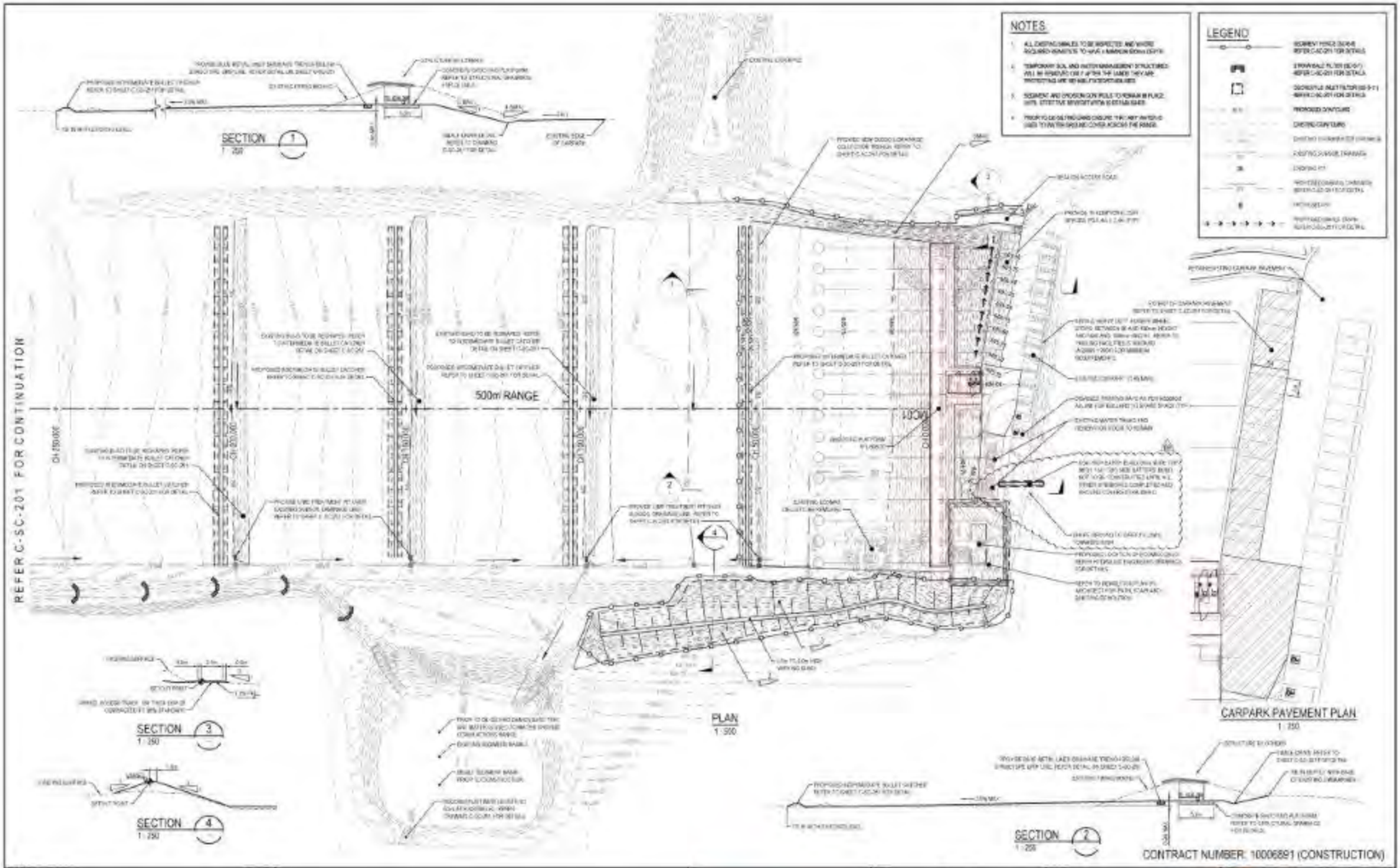
Scale	1 : 2500
Original Size	A1
Height Datum	AHD
Grid	MGA

Project: SOUTHERN HIGHLANDS REGIONAL SHOOTING COMPLEX

Title: GENERAL ARRANGEMENT PLAN

ARCADIS

Drawing No: C-SC-003 — Project No: AA008613 — Issue: 05



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Issue	Description	Date

NSW GOVERNMENT Office of Sport

TENDER
NOT TO BE USED FOR CONSTRUCTION

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Original Size	A1
Design Datum	AHD
Grid	MGA
Drawn	[illegible]
Designed	[illegible]
Checked	[illegible]
Approved	A. BYRNE

Project: SOUTHERN HIGHLANDS REGIONAL SHOOTING COMPLEX

Title: CIVIL WORKS PLAN SHEET 2

ARCADIS

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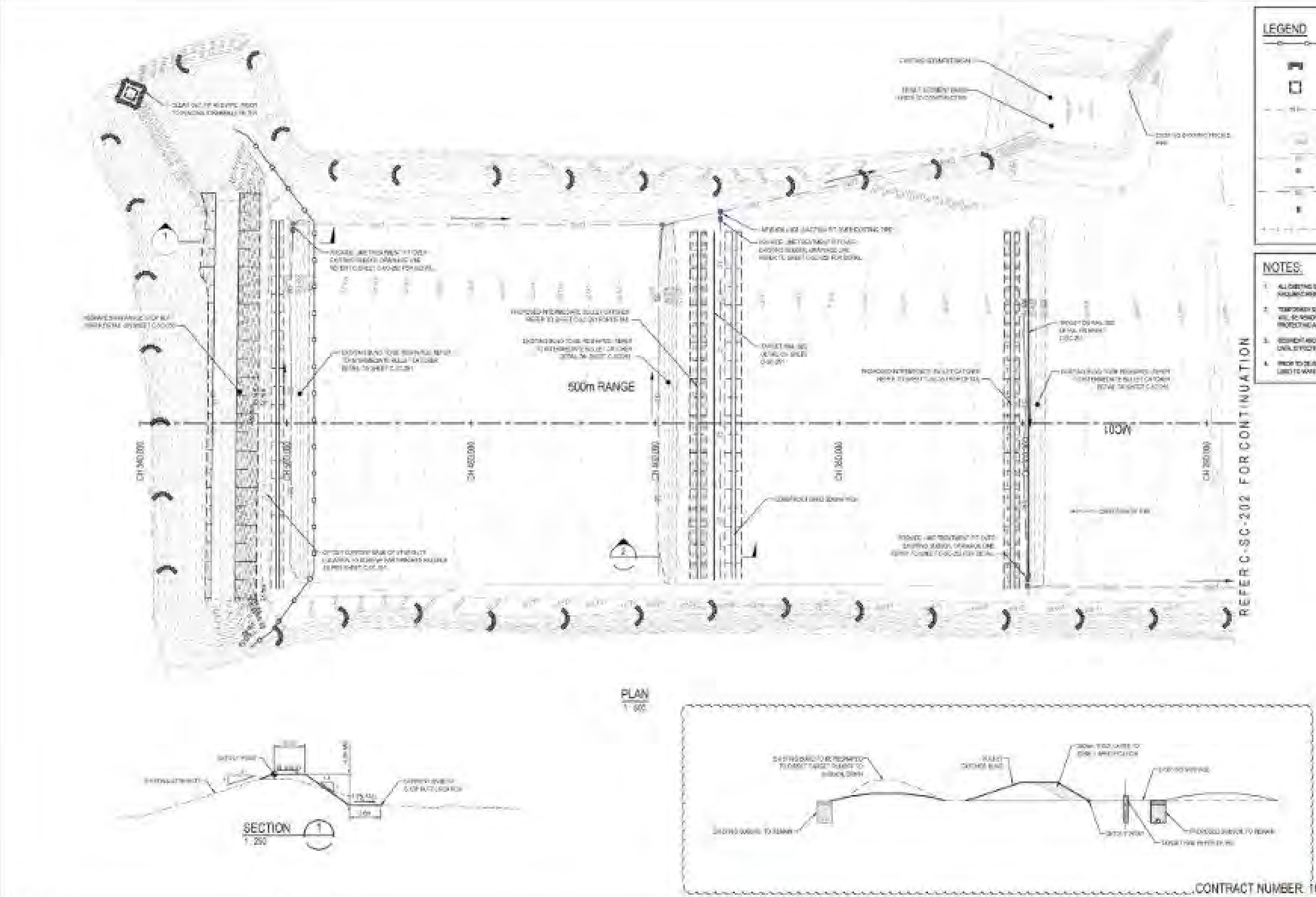
Drawing No.: C-SC-202 | Project No.: AA008613 | Issue: 09



LEGEND

NOTES:

CONTRACT NUMBER: 10006891 (CONSTRUCTION)

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1 : 250

NSW GOVERNMENT Office of Sport

TENDER
NOT TO BE USED FOR CONSTRUCTION

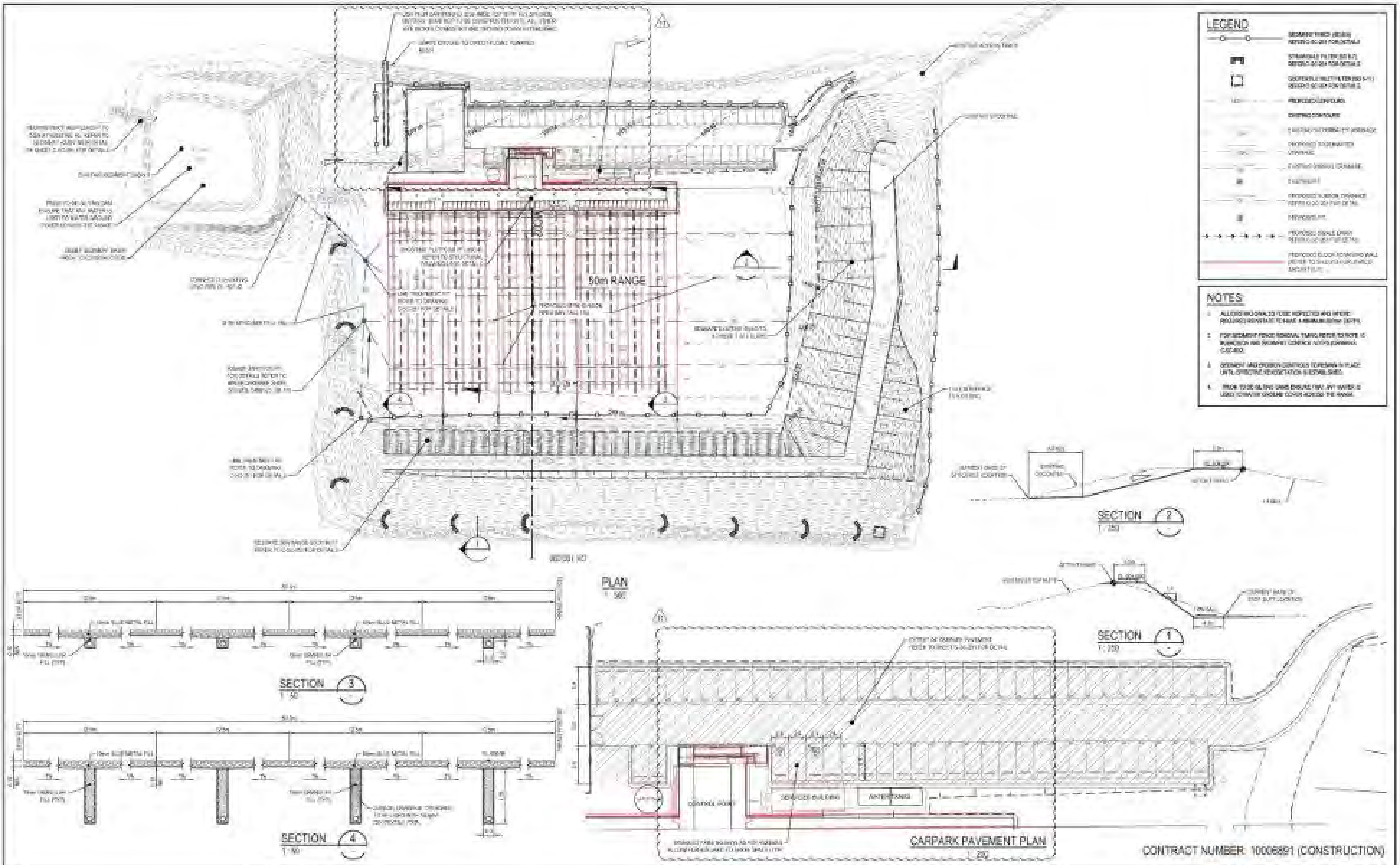
Scales	1 : 500 1 : 250 1 : 50
Original Size	A1
	AHC
	MDA

SOUTHERN HIGHLANDS
REGIONAL SHOOTING COMPLEX

CIVIL WORKS PLAN
SHEET 1

ARCADIS

C-SC-201 — AA008613 — 10



CONTRACT NUMBER: 10006891 (CONSTRUCTION)

TENDER
NOT TO BE USED FOR CONSTRUCTION

1 : 500
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A1

AHD

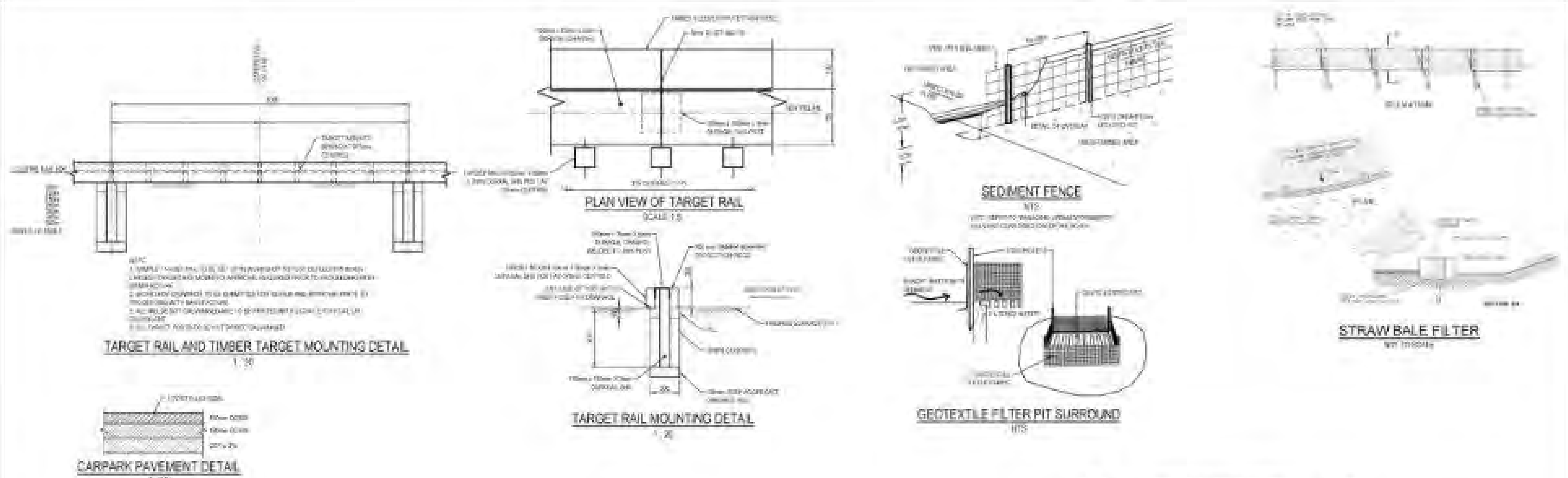
MGA

SOUTHERN HIGHLANDS
REGIONAL SHOOTING COMPLEX

CIVIL WORKS PLAN
SHEET 3

ARCADIS

C-SC-203 — AA008613 — 11



TARGET RAIL AND TIMBER TARGET MOUNTING DETAIL
1 : 20

PLAN VIEW OF TARGET RAIL
SCALE 1:5

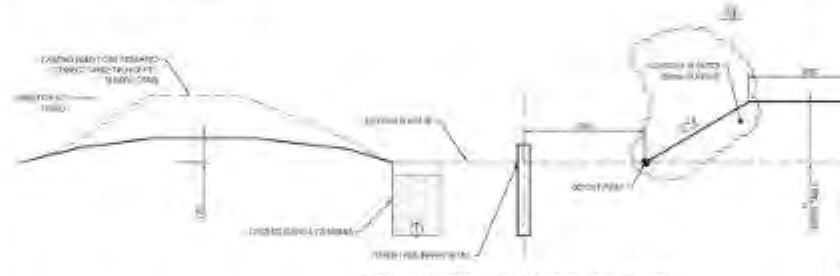
TARGET RAIL MOUNTING DETAIL
1 : 20

SEDIMENT FENCE
NTS

GEOTEXTILE FILTER PIT SURROUND
NTS

STRAW BALE FILTER
NOT TO SCALE

CARPARK PAVEMENT DETAIL
1 : 20



INTERMEDIATE BULLET CATCHER DETAIL FOR 50m, 100m, 150m, 200m, 300m & 365m TARGETS
BULLET CATCHER BATTER FRONT ANGLE TO BE NO LESS THAN 35°
1 : 20

500m RANGE	
	BULLET CATCHER HEIGHT (H)
[illegible] TARGET MOUND	[illegible]
[illegible] TARGET MOUND	[illegible]
[illegible] TARGET MOUND	[illegible]
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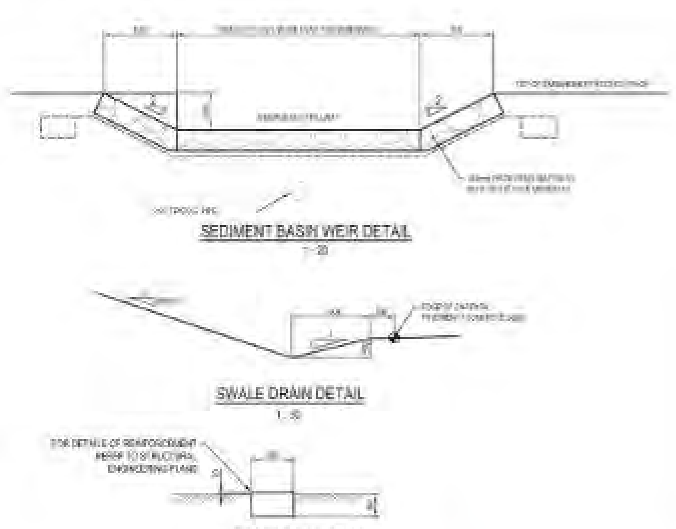

SEDIMENT BASIN WEIR DETAIL
1 : 20

SWALE DRAIN DETAIL
1 : 50

TARGET RAIL DETAIL
1 : 20

PROPOSED SUBSOIL DRAINAGE COLLECTION TRENCH
1 : 20

BLUE METAL LINED DRAINAGE TRENCH TO STRUCTURE DRIPLINE
1 : 20

CONTRACT NUMBER: 10006891 (CONSTRUCTION)

TENDER
NOT TO BE USED FOR CONSTRUCTION

Scale: AS SHOWN
Original Size: A1

SOUTHERN HIGHLANDS REGIONAL SHOOTING COMPLEX

SITEWORKS DETAILS
SHEET 1

ARCADIS

C-SC-251 — AA008613 — 10