AUSTRALIAN NATIONAL UNIVERSITY

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# SKYMAPPER TELESCOPE
# SITE AND CIVIL ENGINEERING REQUIREMENTS

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**Revision History**

| Revision No. | Author & Date | Approval & Date | Description |
|---|---|---|---|
| Revision 1 | Peter Conroy | 01 May 2004 | Original document. |
| Revision 2 | Additions by Tim Borough & Peter Young | 06 May 2004 | Add section on Fiber Optics Link and a Fire Protection |
| Revision 3 | Additions by Michael Hanes | 11 May 2004 | Add section on Legal Requirements |
| Revision 4 | Peter Conroy | 11 June 2004 | Change preferred site to Summit Site following May 2004 site inspection. |
| Revision 5 | Peter Conroy | 19 Nov 2004 | Firm decision re Summit Site for best Science Outcome. |
| Revision 6 | Petkovic 28 July 2005 | Petkovic 28 July 2005 | Document header dates corrected |

**Contents**

## 1 Purpose

This document describes the site and civil engineering requirements for the SkyMapper telescope.

## 2 Applicable Documents

| Document ID | Source | Title |
|---|---|---|
| SkyMapper site drawing and images | active-desig/SkyMapper Telescope/Site Maps & Plans, | Various |

## 3 SkyMapper Project Description

The SkyMapper Telescope will be constructed on Siding Spring Mountain, an outstanding peak in the Warrrumbungle Mountains in northern New South Wales, Australia. This 1.3m telescope will carry a large CCD detector array and will image about five square degrees of sky at each five minute exposure. The large amount of digital data produced during observations will be passed through part of the data reduction process by large computers in the telescope enclosure and then transmitted over the internet to Mt Stromlo Observatory for further processing.

SkyMapper will run in an automated, pre-programmed manner. The telescope will open and commence observations each evening to a programmed schedule, and will close at dawn to a programmed schedule. Should the weather deteriorate the telescope will be automatically shut down by humidity, rain or wind sensors. Sufficient power will be stored in the dome to safely shut the telescope down in the event of total power failure. There will not normally be any personnel in the dome during nighttime observations though daytime site staff will call at the dome several times each week to check and repair telescope and instrument systems, and to administer computers.

## 4 Site and Civil Project Budget

GHD Consulting Engineers have already completed a site and civil works costing for the SkyMapper project. See GHD document 23/10743/52/28427 for additional detail. The projected cost of preparing the site, providing electrical, communications, hydraulics, fire protection & auxiliary services to the site is estimated to be $149,028.00.

## 5 Management, Planning & Legal Requirements

### *5.1 Project Management*

The project management for the site and civil part of the SkyMapper project will be undertaken by the ANU Facilities and Services division and GHD Consulting Engineers. ANU-F&S and GHD will asses the site suitability, obtain all necessary approvals to construct the telescope on the chosen site, and will oversee the provision of the site services. The telescope will then be constructed, from the bedrock up, by Electro Optical Systems Ltd. The SkyMapper CCD detector instrument and associated computer system will be supplied by the ANU-RSAA Advanced Instrumentation Group.

### *5.2 Telescope Site Location*

Our chosen site for the SkyMapper telescope is on an existing roadway just 20m NE of Woorut Trig, the summit of Siding Spring Mountain. The Australian Map Grid co-ordinates and altitude for the site are:

AMG 8735 ~ E 96.13 ~ N 38.2
Altitude ~1161m

A site inspection on the 06 May 2004 looked at several sites on the mountaintop and chose this site as likely to deliver the best science from the telescope and deliver the best outcome in the tradeoff between science requirements, and visual, environmental and cost requirements. This site is presently used as a bus turning area during mountaintop public access tours. The area is already graded and bitumen sealed and we expect suitable bedrock for construction of the telescope to be found less that 30cm below the bitumen seal. There is ample sealed area surrounding the telescope to stage the construction of the telescope. EOS Ltd. will assemble the telescope dome and ring-wall on the adjacent sealed roadway while pouring the telescope foundations. A large crane will then be used to stack these components to form the telescope enclosure. A new bus turning area will be constructed 40m north of the SkyMapper site and the small amount of excavated material from the SkyMapper site will be re-used at the new bus turning site.

This site is clear of large sources of heat such as the 2.3m Telescope and largely clear of the light pollution from the 16”Telescope. The dome is above the mountaintop access road and observations should not be seriously effected by the lights of cars on the mountaintop road. All sources of heat inside the dome are water cooled and this heat is carried 30m downhill to the plant and equipment pad and transferred to the surrounding air. This site requires a long mains power run from the mains substation but has shorter runs for fibre optic, fire hydrant, potable water and emergency telephone. This site is relatively cheap to develop, has the lowest physical impact on the mountaintop environment, and has a low visual impact when viewed from the popular Warrumbungle National Park west of Woorut trig station. Most importantly this site places the telescope out in a clean air flow and this is expected to give the telescope the best possible “Seeing” and the best science that Siding Spring mountain can deliver.

Figure 1: Is a map of the entire Siding Spring Observatory. Woorut trig is at the extreme left of the figure. The SkyMapper site is about 650m WNW of the mountaintop administration centre. The administration centre is shown in red near the lower middle of the figure.

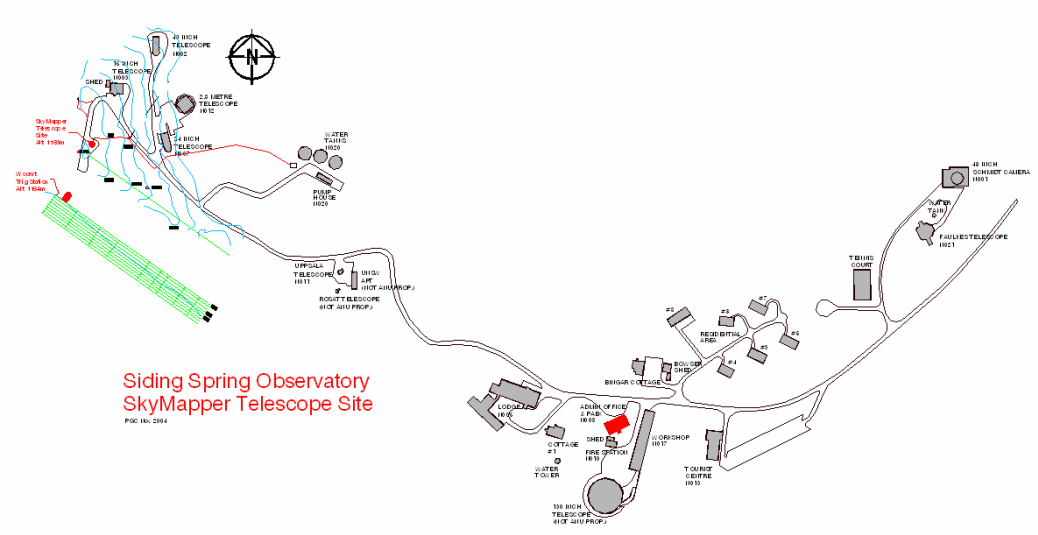


**Figure 1: Site map of Siding Spring Observatory. Woorut Trig is at the extreme left. The mountaintop administration centre is shown in red at the lower middle of the figure.**

Figure 2: Shows the SkyMapper site 20m NE of Woorut trig station. The longest of the required service runs to the SkyMapper enclose is 260m over ground to the mains power sub station. Fibre optic, emergency telephone, fire hydrant and potable water runs are relatively short. A slender 3m high tower located 15m NE of the enclosure will carry metrological sensors.

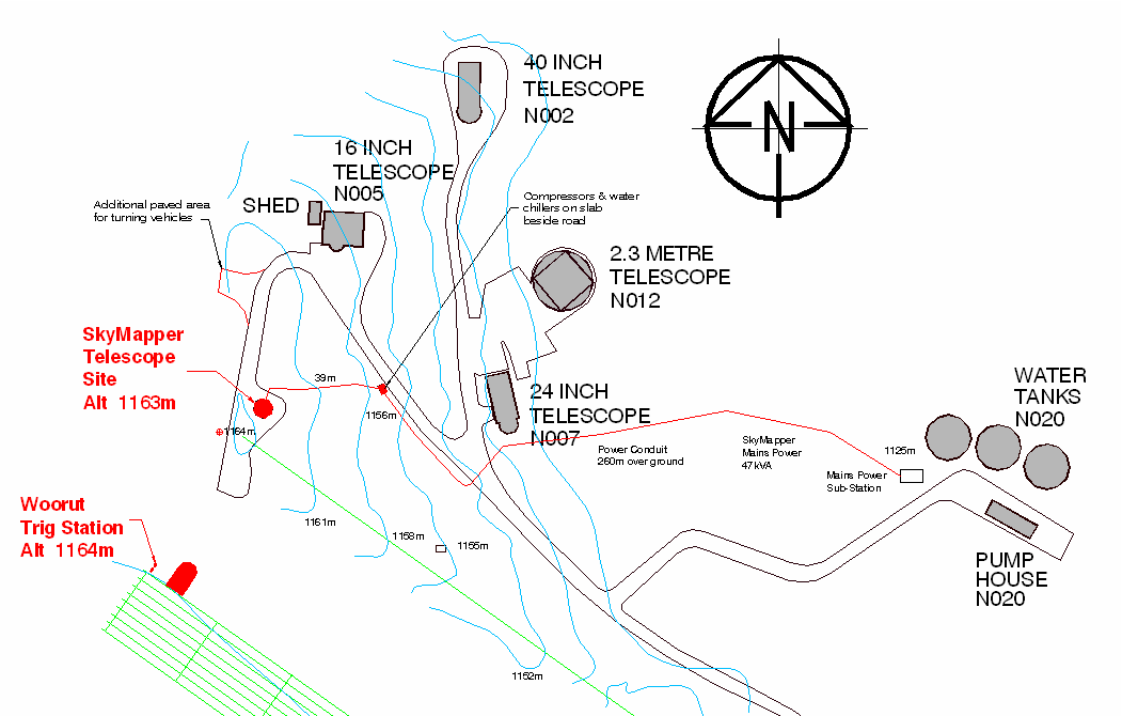


**Figure 2: SkyMapper site North East and slightly below Woorut trig.**

### *5.3 Environmental Impact, Visual Impact*

Figure 3: Is a panorama of the SkyMapper site viewed from the roof of the 2.3m Telescope. The SkyMapper enclose enclosure is ~10.75m high and the base of the enclosure is about 1m below the summit ridge. The Woorut trig station, hidden behind the telescope enclosure, is 3.3m high and the tallest trees on the summit ridge are ~9m high.

**Figure 3: SkyMapper enclosure on the summit, as seen from the roof of the 2.3m Telescope.**

Figure 4: Shows a close up of the telescope enclosure and plant and ancillary equipment pad. The plant and ancillary equipment pad is ~40m from and ~10m below the telescope enclosure. The SkyMapper enclosure is 6.3m in diameter and ~10.75m high. This figure shows the slender Mets-Mast to the right of the enclosure, this mast is ~3m high and will carry temperature, pressure, humidity, and wind velocity and direction sensors. Rain sensors are separately located on and in the SkyMapper enclosure.

**Figure 4: SkyMapper enclosure on the summit. The plant and ancillary equipment pad is ~40m from and ~10m below the telescope enclosure.**

We are concerned about the visual effects of the SkyMapper enclosure on the adjacent Warrumbungle National Park. The dominant view from camp Blackman in the Warrumbungle National Park is southwards across the open plain of Spirey Creek towards Belougery Spire and Bluff Mountain. The principal man made objects in this view are foreground power lines and the tall television transmission towers on Needle Mountain. The less obvious view from Camp Blackman is eastwards towards Siding Spring Mountain and Figure 5 shows this view. The SkyMapper enclosure is 7.1km from and 685m above the camp. From this distance the SkyMapper enclosure will subtend and angle of 3 arc minutes and while the enclosure will be visible from the camp, it will be small.


**Figure 5: View of Siding Spring Mountain from Camp Blackman.**

Figure 6: Is a view taken with a 120mm focal length lens from 22km west of, and ~700m below Woorut trig station at the western boundary of the Warrumbungle National Park. The SkyMappper enclosure is a red dot on the skyline at the centre of the figure. The dominant man made feature on the skyline is the 55m high Anglo Australian Telescope enclosure, the AAT enclosure is ~5 times the diameter and ~5 times the height of the SkyMapper enclosure. From this distance the SkyMapper enclosure will only barely reach above the tree tops, will subtend about one arc minute of angle, the nominal limit of human vision, and may not be visible to the unaided eye.

**Figure 6: SkyMapper location as seen from 22km west of Woorut trig station. From this distance the enclosure will subtend about one arc minute of angle and may not be visible to the unaided eye.**

### *5.4 Environmental Impact Study*

An environmental impact study will be prepared for this site. ANU Facilities and Services will contract a consultant to prepare the necessary study and pursue the final report.

### *5.5 Site Surveying*

A site survey may not be necessary for this site as it is located adjacent to Woorut trig station.

### *5.6 Geotechnical Survey*

Our chosen site is located on extremely hard volcanic rock, the rock type is probably Rhyolite. Raw bedrock outcrops around most of the site and bedrock is expected to be found just below the bitumen seal covering the chosen site.

See Section 6.1 for telescope pier and dome ground loading parameters. Large additional forces will be applied to the site bedrock by wind loading on the dome, at what can be a very windy site. Ring wall foundation load and telescope pier load can be provided by EOS Ltd. Wind data can be extracted from 2.3m weather logs.

### *5.7 Planning Approval*

Planning approval to construct the telescope on the preferred or alternate site will be sought from the ANU Buildings and Grounds Committee and the Warrumbungle Shire Council at the earliest opportunity. (See http://www.coolah.local-e.nsw.gov.au/)

### *5.8 Legal*

Appropriate building and environmental approvals are required through the State and local council, and ANU Facilities & Services are of this. We note in the lease for SSO that approvals in writing should be sought before construction starts. The lease requires approvals before the felling of trees etc; including due regard against soil erosion and in the minimization of fire risks. There is also the National Parks and Wildlife authority who may need to be consulted. If during the approval process various legislations need to be adhered to then we will seek further legal assistance.

## 6 Civil Engineering Requirements

### *6.1 Access Roadway*

The access roadway to the SkyMapper site already exists, is bitumen sealed, and is in good repair, no additional roadwork's are required too access the telescope site. The chosen site is on extremely hard rock, raw bedrock under lays the entire site. We do not envisage any major earthworks, nor do we envisage any major foundation problems. As noted previously a new bus turning area will be constructed 40m north of the SkyMapper site and the small amount of excavated material from the SkyMapper site will be re-used at the new bus turning site. There is sufficient space south of the preferred site to turn cars and small trucks.

### *6.2 Telescope and Dome Pad*

The telescope and dome pad will carry the 1.5m diameter telescope pier and the concentric 6.5m ring wall foundation. Direct ground load from the mass of the telescope and pier and direct mass plus wind loading

from the ring wall and dome will form a major load on this pad. EOS Ltd will drill ~5m down and grout multiple Y24 reinforcing bars to the bedrock to securely anchor the telescope enclosure.

### *6.3 Plant and Ancillary Equipment Pad*

This pad will be located next to the mountaintop access road and it is intended that it will be set on the high edge of the road batter such that it is level with a truck parked on the road. This will allow easy transfer of equipment to and from the pad.

The pad will carry one or more water chiller units to cool the dome equipment room and any instrumentation inside the dome, and to cool the adjacent Helium compressor. Sharing the pad will be the helium compressor and the dry air compressor. Compressed helium is used to cool the CCD detector array while the dry air compressor supplies dry low pressure air to keep the Cassegrain instrument clean, to keep the CCD cryostat window clear of condensate, and to supply high pressure air to drive pneumatic locks inside the SkyMapper Cassegrain instrument. Most of these units will sit uncovered on the pad as they require copious amounts of free air.

### *6.4 Electrical Mains Power and Emergency Mountaintop Power*

The most important utility that SkyMapper will require is three phase and single phase mains power. The projected power requirement for SkyMapper is ~47kVA. Somewhat more than half of this will be used at the plant and ancillary equipment pad, the remainder will be used in the SkyMapper dome. The preferred summit site it is approximately 220m from the mains power sub station, located near the mountaintop water treatment plant, to the SkyMapper plant pad and a further 40m to the SkyMapper dome. We envisage running the mains cables above ground in steel conduit as are most of the other mains cable feeds on the mountaintop. Some trenching may be required to pass under the mountaintop road and the ring road at the dome ring wall

SkyMapper will be connected to the mountaintop emergency power generator. We do not necessarily need to continue observing during a mains power outage but we would like to maintain the helium compressor, water chiller and cryocoolers so that we do not unnecessarily temperature cycle the CCD mosaic. The mountaintop power generator is currently committed to supply ~350kVA and with SkyMapper connected this will approach ~400kVA, this is still below the maximum 500kVA that the generator can supply.

### *6.5 Lightning Protection*

Siding Spring Mountain can be exposed to severe lightning storms. The area surrounding the summit site is largely outcropping bedrock and is expected to provide poor grounding. A suitable ground point will be located during the construction phase. .

### *6.6 Fibre Optics Link.*

The Skymapper telescope will be connected to the SSO LAN via fibre-optic cable. This cable will be linked to the network switch/router located in the Administration building. The SSO Administration building is located about 650m from the SkyMapper dome. Access to the internet (and MSO) will be from the Administration building via the Australian Research and Education Network (AREN) to be commissioned in late 2004. Details and costings of how to complete this installation will need to be confirmed by the ANU Network Services group of the Division of Information.

### *6.7 Site Repair, Landscaping, Signage*

It is unlikely that any landscaping will be required for the summit site though some repair of the bitumen seal to the surrounding roadways will be necessary. A safety rail is already in place at the downhill edge of the summit site.

Appropriate signage pointing to the SkyMapper telescope will be added, both at the SSO observatory boundary and on the mountaintop road.

### *6.8 Fire Safety*

Due to the siting of the Siding Spring Mountain, the area is exposed to a high level of risk from wildfire. The surrounding bush land is high density native forest that is managed by the NSW National Parks and Wildlife Service.

The building will be built to withstand a major firestorm. The building will also have a fully compliant (AS1670) fire detection system, connected to the sites monitoring system. Full Fire Hydrant coverage will also be provided and adequate provisions for Fire Brigade access will be provided.

## 7 Closure

After several inspections and due consideration we believe the summit site shown here will deliver the minimum environmental impact, the best science outcome and the lowest cost for the SkyMapper project.