

PERSOONIA HINDII: SPECIES, DISTRIBUTION AND SECURITY ON THE NEWNES PLATEAU

Dr Peter Erskine¹, Dr Andrew Fletcher^{2*}, Dr Gretchen Brownstein³, Raymond Blick.⁴

¹ Level 5, Sir James Foots Building (BLDG 47A), Centre for Mined Land Rehabilitation, Sustainable Minerals Institute, University of Queensland, Brisbane, 4072; email: p.erskine@uq.edu.au, phone +61 7 3346 4065, mobile +61 4 18711306

^{2*} Corresponding Author email: andrew.fletcher@uq.edu.au, phone +61 7 3346 4052, mobile +61 4 00221497

³ email: , phone: +61 7

⁴ email: , phone: +61 7

A proposal to conduct research for

**Centennial Coal Pty Ltd
c/o Bernie Kirsch**

Proposal Summary

A variation to the existing CMLR/Centennial Coal research program (GR556) is proposed to address the requirement for research of the protection and management options for the endangered shrub, *Persoonia hindii*. A number of individuals of this species may be destroyed in the construction of Bore 8 on Springvale Colliery lease within the Newnes Plateau State Forest. The goals of this research are (1) quantitatively describe the distribution, population characteristics and habitat range of *P. hindii*, (2) collaborate with NSW Botanic Gardens to assess capacity to propagate and transplant plants from disturbed areas for germplasm preservation (3) based on population understanding identify potential cumulative impacts of development and other activities at a species range. The duration of this project will be approximately 12 months from acceptance and involves, field ecological surveys, field experimental work, desktop data collation and glasshouse propagation experimentation. A subsequent low intensity monitoring program will continue for a further four years. The outcomes will (1) provide a means for reassessing key threatening processes and likely impacts for this species, (2) describe appropriate methods of retaining viable populations of *P. hindii* where development occurs, (3) expand mapping and understanding of species population size, distribution and characteristics in the region to allow effective conservation.

© Centre for Mined Land Rehabilitation (The University of Queensland)

Copyright protects this document. Except as provided by the Copyright Act 1968, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means without the prior written permission of Centre for Mined Land Rehabilitation (The University of Queensland).

This document is and shall remain the property of Centre for Mined Land Rehabilitation (The University of Queensland). This proposal is confidential and may only be used by Centennial Coal Pty Ltd in accordance with the agreed terms of the commission.

Table of Contents

Proposal Summary	1
Table of Contents	2
Introduction	3
Research Questions	4
What is the population size, spatial distribution and clustering of <i>Persoonia hindii</i> ?	4
What are the extents of suitable habitat and vegetation associations for <i>Persoonia hindii</i> ?.....	4
Does this species reproduce via seed and if so under what conditions?	4
Can individuals of this species be rescued through cutting collection or transplantation to prevent genetic loss?	4
For identified at risk populations/clusters what are appropriate monitoring methods for ensuring population protection?	4
Literature Review.....	4
Experimental Design	5
Habitat mapping and population description (Condition 19C c&j)	5
Data collection method.....	5
Data analysis	6
Method Development and Field Testing	6
Field work and knowledge dissemination (Condition 19C j)	7
Propagation and Germplasm Rescue.....	8
Seed ecology (Not included in Condition 19C)	8
Cutting propagation (Not included in Condition 19C)	9
Translocation of stolons (Condition 19C d&e).....	9
Population Viability Assessment in Proximity of the Development (Condition 19C h)	10
Output and measures of program success	10
Publication of Results.....	10
Industry Reports.....	10
Site Specific – Confidential.....	10
Regulatory - Compliance	10
Strategic or Industry.....	11
Scientific Publications	11
Peer Reviewed Papers	11
Conference Presentations.....	11
References	11
Related Publications of Proposal Authors	11
Appendix A. Communication with Daniel Bishop – RBG Sydney, Mt Annan: 18 April 2013.....	12

Introduction

Persoonia hindii is a multi-stemmed suckering shrub to 1m height that was formally described in 1997 from a collection made on the Newnes Plateau in 1989 (Weston and Johnson, 1997). The species was listed as endangered in New South Wales in late 2000 (NSW DEH a, 2013) but is not listed nationally. The listing states that this species is restricted to 9 locations of less than 1ha on the Newnes Plateau and is unknown in a conservation area (NSW DEH a, 2013). Key threatening processes are listed as forestry, sand mining and frequent fire regimes (NSW DEH a, 2013). As a multi-stemmed suckering shrub it is assumed that small clusters of plants are clonal in nature. The holotype specimen was collected near a quarry in 1989 (Weston and Johnson, 1997). Since 2009 CMLR has opportunistically identified a substantial number of *P. hindii* clusters across the Newnes Plateau. Recent searches for this species conducted by RPS and Roger Lembit have identified clusters of individuals in close proximity to the planned Centennial Coal mine dewatering pumping station (MOP SPV 2012). A development application by Angus Place Colliery identified up to 1200 plants/stems that may be impacted by a separate development (RPS, 2012).

Present knowledge demonstrates that *P. hindii* far exceeds the 9 populations listed in its determination as an endangered species; however, it is crucial that Centennial Coal's activities do not contribute to a cumulative reduction of species viability. It is currently unknown whether this species exists within nearby conservation areas, namely Gardens of Stone (GoS), Wollemi and Blue Mountains National Parks. Combining locations of collections and observations of *P. hindii* with WBM VIS mapping indicates initial habitat suitability extends into GoS, Wollemi and Blue Mountains National Parks. Knowledge of overall abundance, distribution and habitats across the Newnes Plateau is unknown and prevents a reasonable assessment of this species viability.

The formal description of this shrub lists propagating method development as a key priority (Weston and Johnson, 1997) so this project will address a significant conservation requirement for this species. The ability to translocate or propagate *P. hindii* is as yet undetermined and represents a significant knowledge gap in Centennial Coal's stated goal to avoid negative impacts on the viability of this species. Rescue of individuals and germplasm where prior to development activities should be considered the minimum standard for this species until its ecology, habitat and distribution are understood.

Formal conditions of the development approval to be addressed as a requirement of the research program are listed in Figure 1.

19C. <i>Persoonia hindii</i> Management and Research Program
The Applicant shall prepare and implement a <i>Persoonia hindii</i> Management and Research Program. This Program must:
(a) be prepared in consultation with OEH and Forests NSW by suitably qualified and experienced persons whose appointment has been approved by the Director-General;
(b) be submitted for approval to the Director-General prior to the commencement of construction activities for Bore 8 or widening of the access tracks to Bore 8 that involve clearing of <i>Persoonia hindii</i> stems (ramets);
(c) include a timetable to undertake surveys and mapping of <i>Persoonia hindii</i> to establish its distribution and population across the Newnes Plateau;
(d) include measures for the translocation of all stems (ramets) of <i>Persoonia Hindii</i> found in the area of disturbance associated with the widening of access tracks for Bore 8, to nearby areas with similar physical and biological habitat features;
(e) include trials to assess whether such translocated <i>Persoonia hindii</i> stems can be successfully returned to their original locations as a component of the rehabilitation of these areas;
(f) include a study of the rhizomatous habit of <i>Persoonia hindii</i> and how this may affect the success of the species in translocation and/or re-colonising disturbed areas;
(g) include a monitoring program to study the <i>Persoonia hindii</i> stems before and after translocation;
(h) include a monitoring program to measure the ability of the residual <i>Persoonia hindii</i> population along the disturbed areas of the Bore 8 access track and construction site to regenerate;
(i) include short and long-term goals to measure the effectiveness of the Program; and
(j) provide for the transfer of information obtained as a result of implementing the Program to OEH, Forests NSW and the Department.

Figure 1. Condition 19C. of Bore 8 Development application research requirements.

Research Questions

*What is the population size, spatial distribution and clustering of *Persoonia hindii*?*

To date, mapping of *P. hindii* appears to be largely opportunistic with recorded sightings largely restricted to roads, fire trails and common foot and recreational access pathways on the Newnes Plateau. Recent surveys for development applications have identified many *P. hindii* clusters related to development footprints. To date all recordings are point data provided with assumed handheld GPS accuracies and varying estimates of stolon number. In addition, search intensity and extents have been unreported preventing an assessment of distribution, density and population structure for this species. (Condition 19C.c)

*What are the extents of suitable habitat and vegetation associations for *Persoonia hindii*?*

The small size and clustering habit of *P. hindii* will be explored using ancillary data collected with mapping data from the previous research question. An assessment of shrubs and ground cover species positively and negatively associated with *P. hindii* will be recorded for each sampling location. Sampling intensity and distribution will improve knowledge of vegetation associations with *P. hindii* dramatically improving the habitat suitability assessment of this species. (Condition 19C.c)

Does this species reproduce via seed and if so under what conditions?

A large number of *P. hindii* were observed to be carrying fruit in the fieldwork for the development of this proposal. The significance of sexual reproduction in the maintenance of this species will be explored in conjunction with NSW Botanical Gardens. (Not included in 19C.c)

Can individuals of this species be rescued through cutting collection or transplantation to prevent genetic loss?

Individuals facing destruction from development activities and small/individual plants from large clusters will be sampled in collaboration with NSW Botanic Gardens to determine cutting propagability and potential for translocation of plants. This work will aim to establish plants in greenhouse/nursery conditions and may extend to reintroduction activities dependent on result. (Conditions 19C. d-h)

For identified at risk populations/clusters what are appropriate monitoring methods for ensuring population protection?

Quantitative methods are required that allow application of statistical principles with known confidence and sensitivity.

Literature Review

Conventional methods such as random meander, quadrats or point intercept method are not appropriate for detecting rare plants such as *Persoonia hindii*. To determine the population size and distribution, it is necessary to collect data regarding local clustering, which is common for *P. hindii*, over wider geographic ranges including ridge tops, slopes, seepage points and shrub swamp boundaries (including locations where *P. hindii* is absent). Ignoring simple demographic information and search intensity undermines all population estimates made to-date. The strip adaptive cluster method (SAC) was designed over two decades ago to collect data for single rare species (Magnussen et al. 2005, Turk and Borkowski 2005, Khan 2008). Therefore SAC is a valuable survey tool to record the distribution of *P. hindii*. Application of SAC provides distinct advantages in quantifying time efficiency and search effort during the development of large scale demographic surveys. In this proposal we demonstrate application of SAC to, evaluate a ridgeline between Sunnyside East and West Carne in proximity to Bore 8 construction.

Propagation by cutting may be difficult for the genus *Persoonia* for a range of possible reasons including season and age (Bauer et al, 1999). Traditional cutting hormone treatments may yield result in reduced survival of cuttings (Ketelhohn et al, 1995). Propagation is listed as a key knowledge deficiency in the conservation of *P. hindii* (Weston and Johnson, 1997). *Persoonia* cutting propagation varies by species but may be improved by the application of synthetic auxins and the use of young shoots (Ketelhohn et al, 1995).

Field observations on 26-27 March indicated a large number of mature plants carrying fruit. While *Persoonia* have also been found to have seed dormancy mechanisms that reduce germination rates, these may be overcome (Bauer et al 2004). Demonstrable and practical methods for effectively propagating *P. hindii* urgently require research.

Ramet transplant is the focus of Conditions 19C.c-h, but, no peer reviewed literature exists on transplantation of the genus *Persoonia*. Conference abstracts and websites maintained by native plant enthusiasts indicate that potential for transplantation of mature *Persoonia* plants is low (eg: http://www.gardensonline.com.au/GardenShed/PlantFinder/Show_1593.aspx (24 April 2013), <http://www.pubhort.org/ipps/31/49.htm> (24 April 2013)). While this will be attempted in the current proposal it would be imprudent to attempt retranslocation (Condition 19C e) given the nature of the impact is trenching (complete destruction of soil profile), the number of impacted plants is <10 (Springvale Colliery Project Manager pers. Comm.) and opportunity for disease or damage to destroy plants is doubled.

Experimental Design

Habitat mapping and population description (Condition 19C c&j)

Data collection method

SAC can detect local clustering and landscape level distribution of *P. hindii*. Start points for transects are generated randomly and spaced to prevent overlap and therefore resampling errors. A bearing for each transect is generated randomly at 1 degree level. This process eliminates observer bias from transect placement and propagation. Due to the circular nature and random placement of this method there will be a proportion of the total landscape that is excluded from potential sampling.

The transect line defined as start and bearing was then followed for 100m using one meter 'subplots'. If *P. hindii* was detected within a subplot, the existing design was modified and surrounding areas inspected (Figure 2; ref). To ensure this method was rapid and sampled evenly, we restricted the maximum search area to 1100m² (i.e. five meters either side of each central subplot).

In this design, abundance and density are determined by counting the number of subplots that *P. hindii* occupies in the landscape. As *P. hindii* is multi-stemmed, suckering shrub with extensive stolon-like rhizomes (Weston and Johnson 1997) determining what constitutes an individual ramet is difficult. Here, rather than counts of 'primary stems', we consider the frequency of occupied space in subplots as an accurate measure of local populations and spatial distribution. The current accepted ecology for *P. hindii* considers rooted stems that are greater than one metre apart to be separate ramets, while this remains to be tested, we use this as a starting point for population mapping. Frequency is then interpreted using mapping tools and probability sampling to evaluate the size and density of different populations in the landscape.

Dominant shrub and ground cover species encountered in each transect will be recorded to provide vegetation assemblage information for presence of *P. hindii*.

Data analysis

The frequency of subplots along each SAC is determined as the area occupied. Total frequency is then predicted using a probability map generated in ArcMap 10 (Esri). Importantly, where searches are conducted and *P. hindii* is not detected provides valuable ecological information regarding suitable habitat and allows improved confidence in habitat suitability estimation.

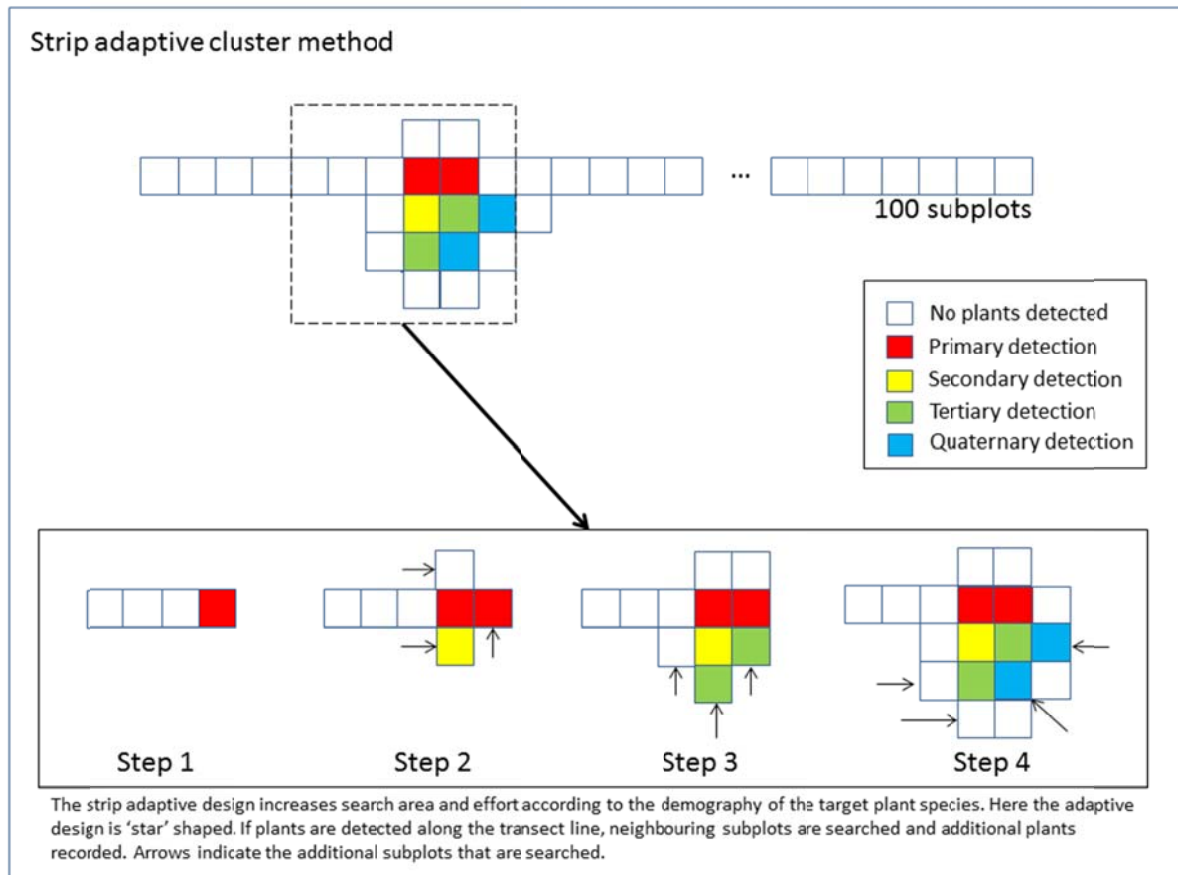


Figure 2. The strip adaptive cluster method where the conventional transect approach is modified to capture neighbouring plants.

Method Development and Field Testing

To confirm the application of the SAC method (example data set Figure 2) was conducted at 20 randomly located positions in the landscape around a known cluster of *P. hindii* were sampled using the proposed method on 27th March 2013. In total four researchers (two pairs) covered these plots in 6 hours (24 person hours). Each SAC took an average of 14 ± 7 (1sd, $n=16$) minutes to complete, showing this method is rapid and easily to be carried out. Of the 2118sqm area searched 66sqm of *P. hindii* was mapped. A second and important advantage of the SAC method is that it allows search intensity to be quantified as both presence and absence of the species is recorded, which gives a clearer picture of the habitat suitability and population connectivity. Preliminary data on the location of searches and probability of locating *Persoonia* have been developed in the 48hrs since data collection (Figure 3).

This trial shows the SAC method could be applied with rapid and quantitative results at the landscape scale across the Newnes Plateau and nearby conservation areas. Mapping populations at this scale would not only fill a crucial knowledge gap about this species but is required to make reasonable assessment of the potential cumulative impacts of activities like infrastructure improvement and expansion on the Newnes Plateau by Centennial Coal.

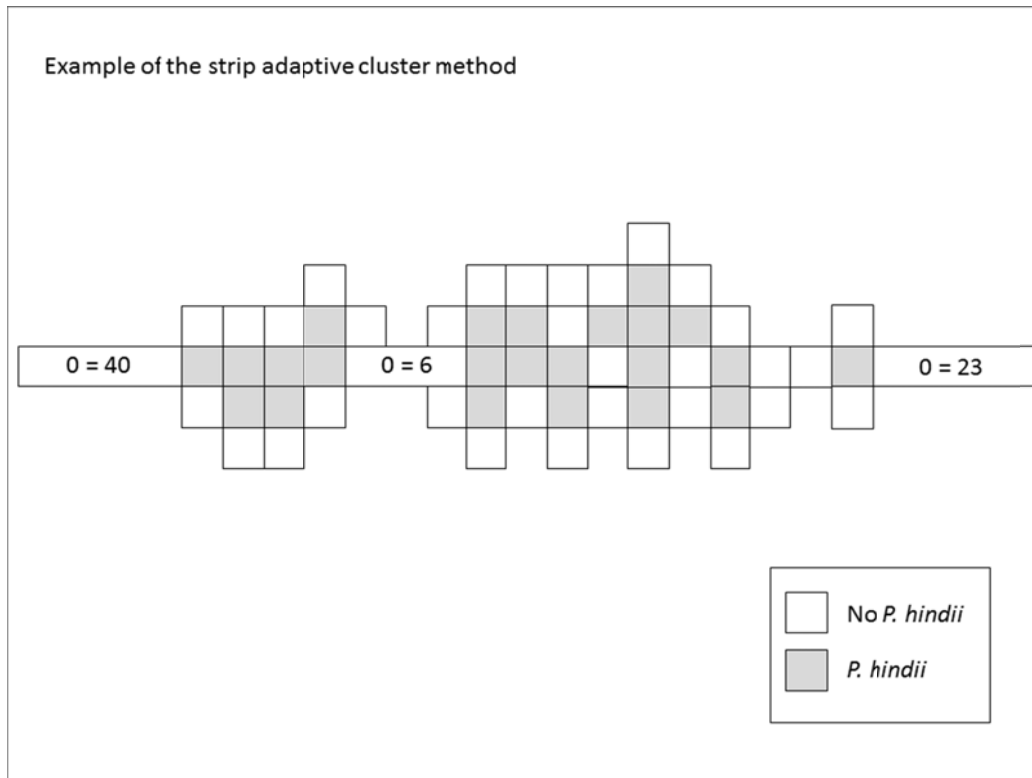


Figure 2. An example of data collected on Newnes Plateau using the strip adaptive cluster method. When *P. hindii* is detected, stems are typically clumped together in one location on the transect line. Each square represents 1m² and shading represents the presence of *P. hindii*. Multiple absence subplots along the central transect have been condensed for clarity.

Field work and knowledge dissemination (Condition 19C j)

Field work will be conducted in addition to current monitoring activities conducted by CMLR on the Newnes Plateau. This project involves a number of weeks of field work in total which will be conducted between May and December 2013. SAC transect data collected for *P. hindii* presence/absence will be analysed statistically to describe density and distribution of this species at a landscape scale. Vegetation assemblage at the transect scale will be included to inform future habitat searches and descriptions of suitable habitat extents.

The work will be drafted as a scientific paper describing the method and results of the field work. Publication sections at present:

1. Application of SAC methodology to population distribution of *P. hindii*
 - a. Search intensity and coverage, clump sizes and distributions
 - b. Quantitative distribution mapping using SAC
2. Description of positive and negative vegetation assemblage associations
3. Estimated population size and distribution for this species
4. Based on knowledge of population size, species association and extent propose key threatening processes and conservation activities.

The manuscript will be provided to DoPI, OEH and FCNSW prior to journal submission.

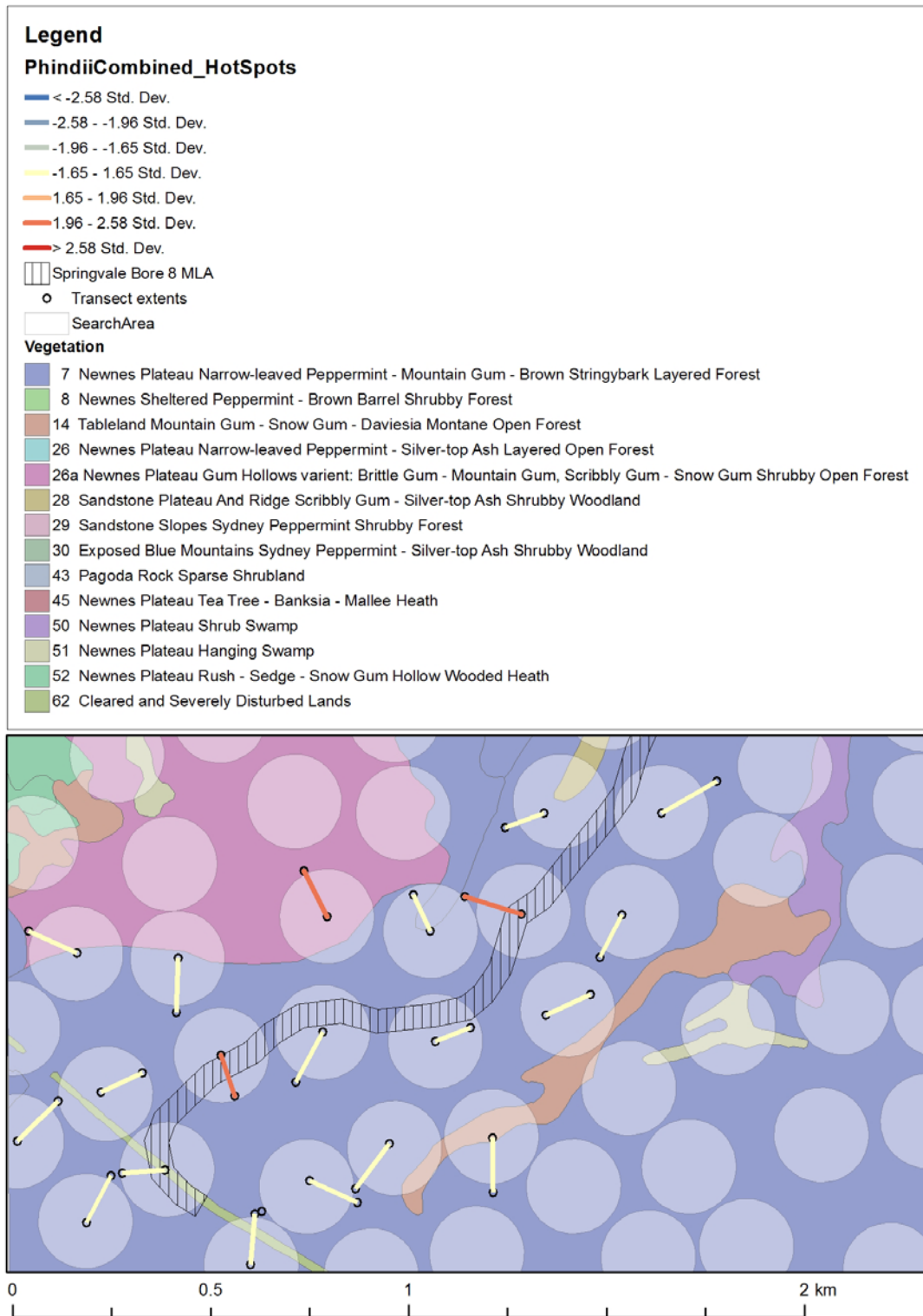


Figure 3. Results of SAC method at 20 transects showing random start location, bearing and potential search area. Significance of *P. hindii* observations shown as transect line colour.

Propagation and Germplasm Rescue

Seed ecology (Not included in Condition 19C)

In collaboration with NSW Botanic Gardens (Mt Annan) seed collected from local *P. hindii* populations on the Newnes Plateau will be examined for viability and germination characteristics

including potential dormancy. This will assist the knowledge of this species reproduction and distribution. This work will be restricted by conditions of collection that will be determined through Botanic Gardens to minimise risk of negative impacts on species viability.

Cutting propagation (Not included in Condition 19C)

Plants that face destruction through development activities or isolation and selected plants within large identified clusters will have shoot tissue collected to conduct propagation experiments. Traditional plant hormone applications and media type will form the basis of this research to determine if *P. hindii* propagation is possible to rescue plants for future reintroduction to local habitat.

Translocation of stolons (Condition 19C d&e)

Plants facing unavoidable destruction due to Bore 8 development activities on the Newnes Plateau will be identified in direct consultation with Centennial Coal project management. Detailed notes and locations of plants will be collected. Ramet movement will be conducted by the minimum distance necessary to remove plants from impact zone (<20m). Individual ramets will therefore remain well within suitable habitat. Anecdotal evidence suggests that *Persoonia* are intolerant of transplantation so plants will be translocated with the root zone retained intact as far as possible. Due to the small footprint of the proposed activity and sensitivity of this genus to transplant, retranslocation will not be attempted following trenching as this effectively doubles the risk of plant loss.

Translocation method:

1. Plants facing destruction will be identified, marked and GPS coordinates recorded
2. The limits of disturbance from development near these plants will be identified
3. Suitable habitat and conditions will be identified as close as possible beyond the impact area for transplant sites
4. A hole will be dug to contain the transplanted ramet at the chosen location
5. A trench will be dug around the target ramet and the root zone wrapped with clean hessian to contain the soil.
6. The ramet will be lifted and carried to the pre-dug hole and backfilled to surface level and watered to field capacity.
7. Fencing will be erected to prevent herbivory and inadvertent damage.

Monitoring of transplanted material:

The small number of plants to be disturbed (<10 total pers. comm. Tony King, Springvale Coal) will allow a simple monitoring design. Plant health will be assessed by photo and observation at weekly intervals for the first month and monthly for the following year. Beyond the first year, seasonal (4) monitoring events will be conducted annually for 5 years to determine long term viability. Records will include, visual assessment of plant health, evidence of active shoot growth and/or ramet establishment beyond transplanted material. As far as possible, monitoring will be non-physical to prevent additional damage during reestablishment. It should be noted that the site occurs in state forest and therefore experiences a higher than usual level of recreational use. Acts of vandalism may result in compromised data.

Knowledge transfer:

Short reports will be provided to OEH, FCNSW and DoPI at commencement (number, location, size ramet number, etc of impacted plants and sites of translocation), after 1 month and subsequently on an annual basis.

Population Viability Assessment in Proximity of the Development (Condition 19C h)

Fixed transects will be established transecting clusters of *P. hindii* occurring in close proximity to Bore 8 development. SAC methodology will be applied to determine maintenance of spatial coverage by *P. hindii* through time. Seasonal measures will be conducted in the year following bore development activities followed by annual monitoring for 5 years. The results of this monitoring will be provided to FCNSW, OEH and DoPI on an annual basis in conjunction with transplant monitoring.

Output and measures of program success

The primary goal of this research is the protection of viable *P. hindii* populations on the Newnes Plateau. The project addresses conceptually achievable goals of the conditions set out in 19C for Bore 8 approval.

1. Condition 19C a: Demonstrated in the iterative nature of the proposal and inclusion of comments and collaboration with RBG Sydney.
2. Condition 19C b: NA
3. Condition 19C c: Peer reviewed publication describing *P. hindii* population characteristics
4. Condition 19C d: Translocation experiment and subsequent monitoring of *P. hindii* survival and reproduction.
5. Condition 19C e: This requirement imposes unnecessary disturbance on plants through (a) retranslocating surviving individuals and (b) returns these individuals to a substrate that is unlikely to be suitable for growth (completely destroyed soil profile due to trenching).
6. Condition 19C f: This requirement will require sacrifice of *P. hindii* clumps in order to study the below ground growth habit of this species. It is imprudent to attempt this given the current paucity of information regarding this species. A rational and sensitive design will be proposed in 2014 dependent on outcomes of Condition 19C c.
7. Condition 19C g: Addressed in 4. above. Due to the limited number of plants affected, monitoring is simple and complete.
8. Condition 19C h: Fixed transects monitored using SAC methodology provide a quantitative assessment of distribution of *P. hindii* through time without requiring invasive or opinion based assessment of ramet number.
9. Condition 19C i: Short term success in translocation of *P. hindii* is measured by survival of ramets. This is not certain given the poor transplant capacity of *Persoonia* and *Proteaceae* in general. Long term success would be demonstrated by subsequent expansion of transplanted ramets and will be monitored over 5 years. Mapping and population distribution will be deemed successful with acceptance of peer reviewed publication arising from this research.
10. Condition 19 j: Communication with DoPI, FCNSW and OEH are explicitly outlined in plan above.

Publication of Results

Industry Reports

Site Specific – Confidential

Title- Update on *P. hindii* research program, submitted to B. Kirsch monthly from acceptance.

Regulatory - Compliance

Reports:

1. Location, ramet number and translocation method for *Persoonia hindii* ramets (FCNSW, OEH, DoPI)
2. Transplant assessment (images and assessment) 1 month after transplant

3. Short report: Assessment of transplant success and local population viability 1 year
4. Short reports: annual per point 3.

Strategic or Industry

None planned at this stage

Scientific Publications

Peer Reviewed Papers

Journal: Austral Ecology Title: Application of Strip Adaptive Clustering to population estimation of an endangered plant species. Corresponding Author: R. Blick

Journal: Telopea Title: Population distribution, habitat range and extents of *Persoonia hindii*. Corresponding Author: To be determined

Journal: TBD Title: Reproductive ecology of *Persoonia hindii* Corresponding Author: TBD

Conference Presentations

None planned at this stage

References

Bauer L.M., Johnston M.E. and Williams R.R. (1999) Plant genotype, juvenility and mechanisms of inhibition of rooting *Persoonia virgata* R. Br. Cuttings. Australian Journal of Experimental Agriculture 39, 1029-34

Ketelhohn L.M., Johnston M.E. and Gage J. (1995) Propagation of *Persoonia* species by seeds and cuttings. *International Plant Propagators' Society: Combined Proceedings* 44, 72-76

MOP SPV (2012) Mining Operations Plan Springvale Colliery: Variation December 2012, Attachment C.

NSW DEH a (2013) *Persoonia hindii*: Endangered Species Listing (link as at 13 March 2013) <http://www.environment.nsw.gov.au/determinations/PersooniaHindiiEndSpListing.htm>

RPS (2012) Appendix A: Flora and Fauna Impact Assessment July 2012 http://www.resources.nsw.gov.au/_data/assets/pdf_file/0003/450885/INW12-49661-Angus-Place-Colliery-REF-for-Ventilation-Shaft-and-Service-Boreholes-Appendix-A-Flora-and-Fauna.pdf (Accessed 28 March 2013)

Weston P.H. and Johnson L.A.S. (1997) *Persoonia hindii* (Proteaceae), a new species from the Newnes Plateau, New South Wales. *Telopea* 7 (3) 199-203

Related Publications of Proposal Authors

Fletcher A.T. and Erskine P.D. (2012) Mapping of a rare plant species (*Boronia deanei*) using hyper-resolution remote sensing and concurrent ground observation. *Ecological Management and Restoration* 13, 195-198

Blick R.A.J. and Burns K.C. (2011) Liana co-occurrence patterns in a temperate rainforest. *Journal of Vegetation Science* 22, 868-77

Brownstein G., Steel J.B., Porter S., Gray A., Wilson C., Wilson P.G. and Bastow J. (2012) Chance in plant communities: a new approach to its measurement using the nugget from spatial autocorrelation. *Journal of Ecology* 100, 987-996

Appendix A. Communication with Daniel Bishop – RBG Sydney, Mt Annan: 18 April 2013

Request for cost estimates of collaborative research program - Conservation of *Persoonia hindii*

Contacts: Dr Peter Erskine (C.I.), Dr Andrew Fletcher (correspondence), Dr Gretchen Brownstein and Raymond Blick.

Centre for Mined Land Rehabilitation- University of Queensland.

andrew.fletcher@uq.edu.au, 0400221497

Background

We wish to request a cost estimate to undertake two experiments investigating the endangered species *Persoonia hindii*.

Propagation of *P. hindii*

Location:

Newnes Plateau State Forest/Centennial Coal Springvale, Angus Place and Clarence Collieries (Figure 1)

Activities:

Collect cutting material from field

Test common cutting types and treatment methods to assess the ability to propagate *P. hindii*.

Provide report detailing results of treatments against control with regard cutting strike proportions and analysis of suitability for cutting propagation or subsequent research options.

Material:

A selection of shoot material, plant hormone treatments, glasshouse space and consumables

Personnel time (Field, glasshouse and reporting)

Outcomes:

Short collaborative publication detailing methods tested and an assessment the use of cuttings for propagation of *P. hindii*.

Reproductive biology of *P. hindii*

Location:

Newnes Plateau State Forest/Centennial Coal Springvale, Angus Place and Clarence Collieries

Activities:

Collect fruit from field

Test seed viability using x-ray and/or microscopic techniques as appropriate.

Germination experiment if sufficient material is available.

Provide report detailing results and analysis of seed viability for this species.

Material:

Reproductive material from Newnes Plateau, Laboratory consumables, glasshouse space and consumables

Personnel time (Field, Laboratory, Glasshouse and reporting)

Outcomes:

Short collaborative publication detailing methods tested and an assessment of seed ecology and reproductive potential of *P. hindii*.

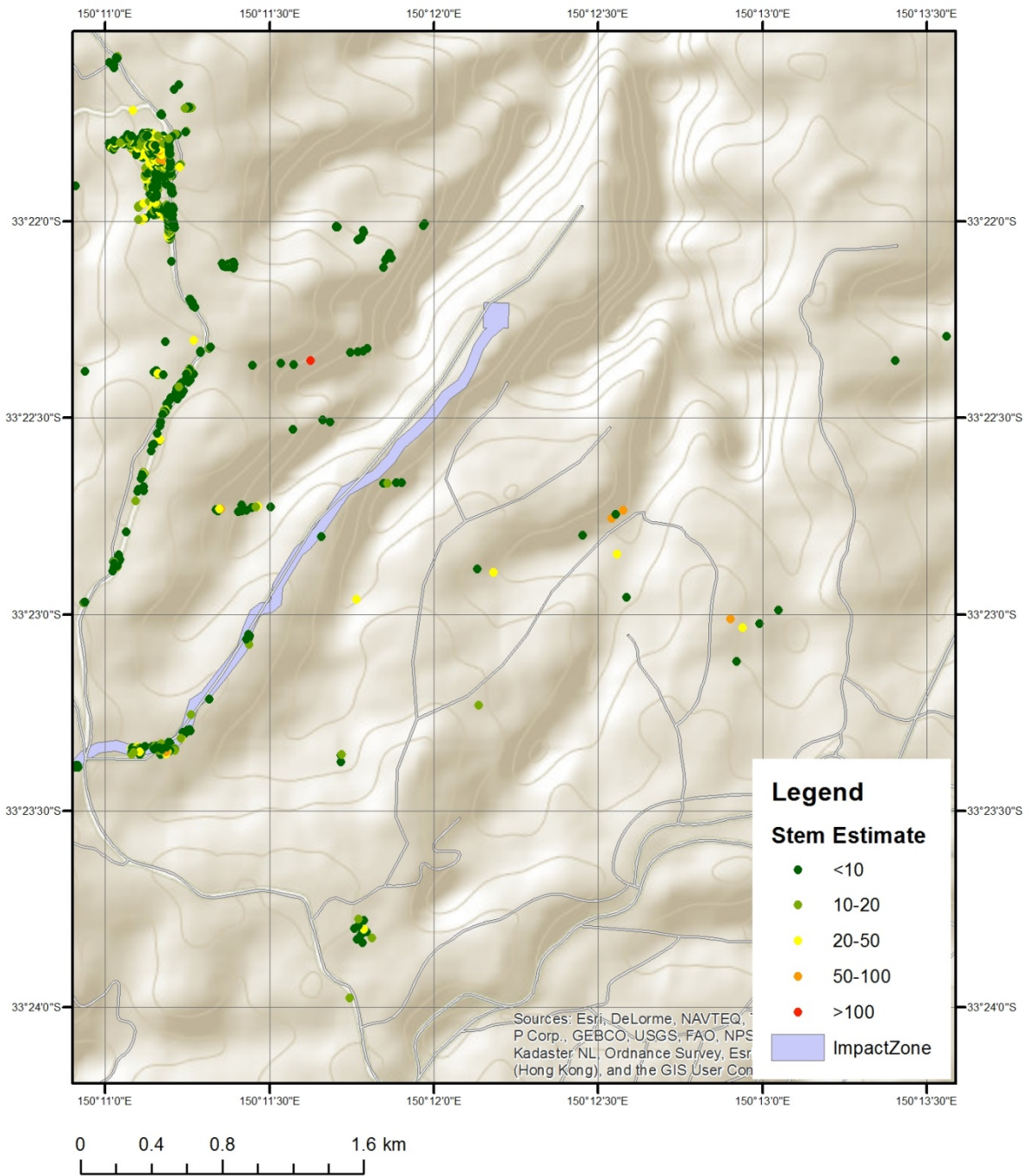


Figure 1. Current recorded locations of *P. hindii* and access roads on the Newnes Plateau