Ord-East Kimberley Expansion Project - Weaber Plain Development Area

Gouldian Finch Breeding Surveys (2013)

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By Save The Gouldian Fund

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Summary

As part of the requirement for State approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Gouldian Finch Management Plan (GFMP), a baseline assessment and on-going monitoring of the endangered Gouldian finch (*Erythrura gouldiae*) is required during the construction and operation of the Ord River Irrigation Area Weaber Plain Development Project in the eastern Kimberley, Western Australia. This report details the findings from surveys of Gouldian finches during their annual breeding season (Feb-May 2013).

In accordance with conditions from the EPBC Act (6AII) and GFMP (2-5, 3-3, 3-7), this work specifically addresses:

1) *Gouldian finch counts of the breeding population within the Buffer Area and immediate surrounding reserves.*
2) *Annual monitoring of breeding populations, including timing and reproductive outputs (i.e. clutch size and fledging success).*
3) *Install salvaged tree hollows, as appropriate, in the Buffer Area and/or adjacent conservation reserves.*

Key results included:

1) Total of 13 Gouldian finch active nests; the reduced number of breeding Gouldian finches is likely due to a combination of extensive wildfire and cattle damage, increased disturbance (through land clearing) and reduced rainfall in the region (dry wet season).
2) Initiation of the breeding season was early and there were substantially fewer re-nesting attempts than previous years; most likely because of ecological factors (e.g. late rainfall) and wildfire and cattle damage to the breeding habitats.
3) 14 Gouldian finches were located feeding during transect surveys, all in the breeding habitats
4) Birds were sighted feeding predominantly on native *Sarga* species (sorghum);
5) No Gouldian finches banded in previous years were resighted.
6) Total of 120 nest-boxes were installed in the 5 breeding habitats at the end of the breeding season.

Overall, this work provides the required annual data for (1) long-term monitoring of breeding Gouldian finches within the Weaber Plain Development Project, and (2) the conditions detailed in the EPBC Act and GFMP. This work also provides important on-going and baseline data to ensure appropriate management of the endangered Gouldian finch and its habitat during the construction and operation of the Ord River Irrigation Area – Weaber Plain Development Project.

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1 Introduction

As a requirement for State approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Gouldian finch (*Erythrura gouldiae*) populations need to be regularly surveyed during the construction and operation of the Ord River Irrigation Area (ORIA) Weaber Plain Development Project (the Project) in the eastern Kimberley, Western Australia. This is to ensure appropriate management of the endangered Gouldian finch and its habitat before, during and after completion of the development. The Gouldian finch is currently listed as *Endangered and Migratory* under the *Environment Protection and Biodiversity Conservation Act 1999* and listed as "rare or likely to become extinct" under the *Wildlife Conservation Act 1950*.

1.1 Gouldian Finch Distribution

The Gouldian finch (*Erythrura gouldiae*) is a medium-sized (length ca. 130 mm) granivorous (seed eating) bird that lives only in the northern savannas region of Australia. Formerly ranging from Cape York Peninsula in Queensland, through the northern half of the Northern Territory, to the Kimberley region in Western Australia, Gouldian finches were once believed to be amongst the most common finches of the region ((O'Malley, 2006)). However, within the last century (and 30-40 years in particular), Gouldian finch populations have undergone population declines and a severe contraction of their range. The species is now recorded reliably at only a few sites within the Northern Territory and Western Australia, while in Queensland Gouldian finches are rarely observed in the wild (O'Malley, 2006). Current key populations of Gouldian finches are located in the Wyndham area, about 100 km west of the Weaber Plain Development Project area.

Current national Gouldian finch estimates suggest a population of less than 2500 individuals with no more than 250 birds (and frequently much less) where sub-populations occur (O'Malley, 2006). The Gouldian finch is also specifically listed as a matter of *National Environment Significance* ((NES); sections 18, 18a), under the EPBC Act. Therefore, the knowledge of distribution patterns, density estimates and migratory patterns are vital to be able to implement a sustainable management plan for Gouldian finch populations.

1.2 General Habitat

Gouldian finches currently utilise only a small percentage of the range they formerly occupied (outlined in 1.1, (O'Malley, 2006)), and it is likely that most habitats currently used are not optimal (Brazill-Boast and Pryke, 2011). Gouldian finch habitat varies between the dry breeding season (ca. January – June) (detailed in 1.2.1) and non-breeding seasons (ca. July – January) (detailed in 1.2.2).

1.2.1 Breeding habitat

Known breeding habitat for Gouldian finches includes rocky hills with hollow-bearing *Eucalyptus* (e.g. *Eucalyptus brevifolia*, *E. tintinnans*) and *Corymbia* species (e.g. *Corymbia dichromophloia*). Gouldian finches have very specific nesting requirements and require robust and deep hollows with small diameters (Brazill-Boast et al., 2010; Tidemann et al., 1992a). Because of localised tree suitability, individuals may breed in small colonies (e.g. nest densities of 1.36 per hectare (Brazill-Boast et al., 2010) and 0.5 per hectare (Tidemann et al., 1992a). Birds often appear to rely on feeding habitat located within or immediately adjacent to breeding habitats (Brazill-Boast and Pryke, 2011), however, they will move up to 5 km (or potentially further) to find suitable feeding grounds. During this time (January – June), birds feed predominantly on annual spear grass or native Sorghum (e.g. *Sorghum stipoideum*, *S. intrans, S. plumosum*) and Spinifex (e.g. *Triodia bitextura; T. acutispicula; T. bynoei; T. schinzii*) ((Dostine et al., 2001)). Accessibility to water is also factor influencing the Gouldian finch's decision as to where to nest. In general, birds generally nest within 1-2 km to small perennial waterholes or springs (Brazill-Boast and Pryke, 2011).

1.2.2 Non-breeding habitat

Following breeding (July – January), Gouldian finches move away from their breeding habitats (because of limited seed availability) and form mixed species flocks, moving over lowland granite soil areas feeding on a range of grass species, including cockatoo grass (*Alloteropsis semialata*), golden beard grass (*Chrysopogon fallax*), giant spear grass (*Heteropogon triticeus*), white grass (*Sehima nervosum*), ricegrass (*Xerochloa laniflora*), kangaroo grass (*Themeda triandra*) and Spinifex species (*Triodia spp).*

1.3 Key Threats

A multitude of processes have historically been attributed to Gouldian finch declines (Tidemann, 1996), including excessive trapping for aviculture (Franklin et al., 1999), infestation with airsac mite ((Tidemann et al., 1992b)), low survivorship (Woinarski and

Tidemann, 1992), inappropriate fire management (Dostine et al., 2001), mining activities (Garnett and Crowley, 2000) and pastoral intensification (Franklin, 1999; Franklin et al., 2005). However, the recent National Species Recovery Plan for the Gouldian finch (O'Malley, 2006) specifically highlights that "*habitat change through landscape destruction and inappropriate fire regimes are the factors most likely contributing to ongoing declines or absence of recovery*". Habitat destruction through landscape clearing and inappropriate fire management alters seed diversity, directly affecting foraging ecology and survival (Dostine et al., 2001), and also affects the availability and production of tree cavities, directly affecting breeding ecology and local recruitment of the Gouldian finch (Brazill-Boast et al., 2010; Brazill-Boast et al., 2011).

1.3.1 Food Availability

Compared to other finches, Gouldian finches have a very restricted diet, feeding predominantly on a limited range of seeding grasses with no alternative source of protein (e.g. insects) (Dostine and Franklin, 2002). Over the course of the tropical dry season (January – June), the availability of these seeds on the soil surface is steadily reduced by wind, rainfall run-off, fire, germination, and consumption (e.g. (Woinarski et al., 2005)). After breeding, Gouldian finches must switch to feeding on a variety of annual and perennial grasses that produce seed at the appropriate times, in order to bridge this bottleneck in food supply (Dostine et al., 2001). However, increasing anthropogenic disturbances, such as land clearing, grazing, and inappropriate fire regimes have reduced the availability of these grass species (O'Malley, 2006). Thus, their restricted diet, combined with their annual lifecycle, makes them particularly vulnerable to the seed shortages that can occur at the onset of the wet season (non-breeding season).

1.3.2 Nest-site Availability

Gouldian finches are the only obligate cavity-nesting finch in Australia and rely on naturally formed hollows of specific dimensions in the branches of smooth-barked *Eucalyptus* and *Corymbia* tree species for breeding (Brazill-Boast et al., 2010). Increasing evidence indicates that increased land clearing and uncontrolled wild fires have affected the size/age profile of woodland habitat in the northern savannas by removing many young and very old stems (Lehmann et al., 2008). In addition, most *Eucalyptus* and *Corymbia* trees will not begin producing cavities for approximately 80-100 years (Ambrose, 1982). Furthermore, interspecific (between species) competition for optimal nesting cavities is a factor that may affect Gouldian finch breeding opportunities. For instance, competition from the sympatric (habitat/ecological

overlapping) long-tailed finch (*Poephila acuticauda*) over prime nest sites (Brazill-Boast et al., 2010)). Together, this has limited the number of available nesting hollows in some areas (Brazill-Boast et al., 2010). However, to compensate for limited nest-site availability, artificial nest-boxes, which are specifically designed for Gouldian finches, can be a highly effective management tool to increase nest-site availability and local population densities (Brazill-Boast et al., 2013).

1.3.3 Susceptibility of Small Populations

Small and isolated populations are particularly susceptible to localised extinction. This is because in small isolated populations, finding a genetically compatible partner may be time constraining and breeding with an incompatible mate could lead to detrimental population effects (Pryke and Griffith, 2009b). The Gouldian finch has a genetic colour polymorphic, displaying three distinct head-colour morphs (black, red and yellow), which prefer to breed with a mate of the same head-colour morph. Inter-breeding between different genetically incompatible head-colour morphs of the Gouldian finch results in very low offspring survival (20-40%) (Pryke and Griffith, 2009b). In small populations, Gouldian finches are often unable to locate suitable (compatible) breeding partners and are often constrained to breeding with incompatible partners of a different head-colour (20-50% of birds) (Pryke, 2010b; Pryke and Griffith, 2007), which is likely to limit and negatively affect population growth and sustainability.

1.4 Ord River Irrigation Area – Weaber Plain Development Area

The Western Australian Minister for State Development is developing an area of land for irrigated agriculture across the Weaber Plain in the Kimberley region of Western Australia, approximately 30 km north-northeast of Kununurra, adjoining the existing Ord River Irrigation Area.

The Ord Phase Two Expansion Project requires land clearing for irrigated agricultural land and the addition of infrastructure for secondary roads, irrigation, flood protection and drainage. Approximately 9260 ha vegetation for farms and infrastructure are being cleared, including approximately 8205 ha for farmland. As required by the State Approval of the Project, on the ranges and rocky slopes surrounding and within the proposed Development Area, a designated Buffer Area of approximately 11, 470 ha of native vegetation will be set aside to protect watercourses and surrounding conservation reserves, and help offset disturbance in the Development Area.

The Project is part of the Ord River Irrigation Area (ORIA) and is covered by the Ord

Final Agreement (OFA), which includes the protection of vegetation and fauna habitat in six areas across the East Kimberley region over a total area of approximately 188 200 ha (Livistona Range Conservation Area, Pincombe Range Conservation Area, Ningbing Range Conservation Area, Weaber Range Conservation Area, Mt Zimmerman Conservation Area and Packsaddle Swamp Conservation Area).

The Weaber Plain Development Project has been approved by the State subject to a number of conditions (outlined in Statement 830, May 2010). Specifically, the EPBC Act was required as the proposed development was considered to potentially have a significant impact on a number of Matters of *National Environmental Significance* (NES).

1.5 Weaber Plain Development Area and Gouldian Finches

Areas of breeding and non-breeding (foraging) Gouldian finch habitat exist within the Weaber Plain Development Area, the Pincombe Range Conservation Area and Point Springs Nature Reserve (Shedley, 2012), as well as within the Buffer Area to be established for the Weaber Plain Development Project (Pryke, 2010a; Save The Gouldian Fund, 2011a).

Gouldian finches have been recorded within the Weaber Plain Development Area. Preliminary surveys during the non-breeding season of 2010 identified suitable breeding habitat for this species (Pryke, 2010a). In-depth surveys during the 2011-breeding season (March-June) located five distinct breeding Gouldian finch populations, all of which were located within the Buffer Area (Appendix 1). In 2011, 43 active Gouldian finch nests were located within these habitats (Save The Gouldian Fund, 2011a), and during 2012, 29 active Gouldian finch nests were located in these five breeding habitats (Save The Gouldian Fund, 2012a).

Gouldian finches have also been located within the Weaber Plain Development Area during the non-breeding season. In August 2010, birds were observed during general bird surveys (by Animal Plants Minerals). Furthermore, 63 Gouldian finches were sighted (in 2 days of survey work) within both the proposed Development and Buffer Areas during a preliminary survey of the area in September 2010 (Pryke, 2010a). In 2011, in-depth surveys located a total of 73 Gouldian finches feeding in the area; 61 in the Buffer Area (protected) and 8 in the Development Area (Save The Gouldian Fund, 2011b). In contrast, in 2012, these surveys failed to locate any Gouldian finches in either the Buffer or Development Areas (Save The Gouldian Fund, 2012b). The absence of birds during 2012 was likely due to a combination of extensive grazing damage by

cattle and late dry season wildlife removing all critical feeding grasses from the breeding and feeding areas (Save The Gouldian Fund, 2012b).

In response to the presence of Gouldian finches in the area, the Gouldian Finch Management Plan (GFMP) was developed (Strategen, 2011). The purpose of the GFMP is to ensure the protection of the endangered Gouldian finch by preserving and maintaining habitat and ensuring the retention of vegetation corridors linking feeding areas across the Project.

1.6 Purpose of the Current Survey

To ensure protection and aid in the sustainable management of Gouldian finch populations within the Weaber Plain Development Area, the presence, distribution and population numbers of Gouldian finches, as well as the quality of their habitat and condition/health needs to be regularly assessed. This report details the findings from surveys of breeding populations of Gouldian finches during the 2013 breeding season (surveys performed during February-May 2013).

Specifically, this work addressed specific conditions of both the EPBC Act and GFMP:

(A) Undertake Gouldian Finch counts of the breeding population within the Buffer Area and immediate surrounding reserves
GFMP Monitoring Regime (Table 3, Item 3)

(B) Annual monitoring of breeding populations, including timing and reproductive outputs (i.e. clutch size and fledging success)
EPBC Act (Condition 6AII) and GFMP Monitoring Regime (Table 3, Item 7)

(C) Install salvaged tree hollows, as appropriate, in the Buffer Area and/or adjacent conservation reserves
GFMP Management Actions (Table 2, Item 5)

2 Methods

2.1 Study Site

The Weaber Plain Development Area and Buffer Area of the Ord-East Expansion Project is situated within the East Kimberley region of Western Australia. The area is located 30 km north-east of Kununurra on the Weaber Plains Road.

Habitat surveys were conducted in areas that have previously been identified as potential breeding habitat (Pryke, 2010a; Save The Gouldian Fund, 2011a). In total, 11 areas of suitable breeding habitats were located within the area. The suitability of the breeding habitat was assessed on a number of variables, and only included areas that were (Brazill-Boast and Pryke, 2011; Brazill-Boast et al., 2010):

- Situated on gently sloping and rocky hills, and dominated by open woodland;
- Supported *Eucalyptus* and/or *Corymbia* tree species (Figure 1);
- Contained suitable feeding grasses in accessible proximity (within a 5 km radius).

Figure 1. Breeding habitat in the Project area showing suitable nesting trees.

Within the breeding habitats identified as suitable for Gouldian finches, 5 breeding populations were located, all within the Buffer Area. Appendix 1 shows the outer perimeter/boundaries of these 5 breeding areas. Breeding area 1, 2, and 3 are situated in close proximity to the irrigation channel and a road (and current land clearing and activity in 2013), breeding area 4 is located at the outer perimeter of the Buffer Area and breeding area 5 is also located near a road (and current land clearing and development in 2013) (Appendix 1).

2.2 Breeding Surveys

Breeding surveys were conducted between February and May 2013. Within all known/identified suitable breeding areas, nest hollows and breeding Gouldian finches were located by two methods. First, by visiting all suitable tree hollows that had been identified in previous surveys (Save The Gouldian Fund, 2011a) and searching for new hollows within the area (Brazill-Boast et al., 2010). This included initially assessing the potential of new hollows using binoculars. All trees that supported potential nest hollows with entrance diameters between 25 and 100 mm were marked, and assessed closely by climbing a ladder (4.5 m in extension) and using a custom-built extendable and flexible camera and light source to view the contents. Second, nests were occasionally located by either sighting parents calling and entering their nest or through the vocalisations of chicks begging in the nest (nestling begging calls are very loud and can be heard from a distance of 50–100 m).

2.3 Timing and Reproductive Output

In active Gouldian finch nests (active = tree hollows with a nest containing eggs or chicks), the number of eggs and nestlings were recorded, and nestling age was estimated (as a measure to infer start date of breeding attempt). Five active nests were inaccessible due to their narrow entrances and deep nest cavity (> 50 cm) and the contents (i.e. eggs or nestlings) could not be reliably quantified.

2.4 Morphology and health assessment

To measure morphology and health of the Gouldian finch populations, birds were caught at water sources (using mist-nets) or at their nests (using hand-nets) during the breeding season. All birds were banded with a standard ABBBS individually numbered metal bands (Australian Bird and Bat Banding Scheme) and a unique combination of

three plastic colour bands (for remote individual identification in the field). Birds were also weighed (to the nearest 0.1 g), measured (e.g. wing, tail lengths and tarsus length mm) and a small blood sample was taken (150 μl). Caught birds were also assessed for ectoparasites (rank scored (1-5) based on number of lice and mites). In addition, fat score was determined using an estimation of the volume of fat stored in each bird's furculum using a scale of 0 - 5. A fat score of 0 indicated no fat was seen in the furculum, 1 indicated 1 – 10% of the furculum full of fat, 2 indicated 10 – 60% full, 3 indicated 60 – 90% full (concave surface of fat in furculum), 4 indicated greater than 90% full (fat bulging over rim of furculum), and 5 indicated fat overflowing from furculum and connecting with other body fat stores.

Blood samples were cold-stored for later centrifugation and analysis in the laboratory. From the blood samples, haematocrit (ratio of red blood cells to the total volume of plasma) and haemoglobin concentrations (HemoCue, g/dl) were measured ((Pryke et al., 2012)). Haematological measures provide useful indicators of physiological status and have long been used as indicators of animal metabolic activity, disease, stress and nutritional status. Red blood cells contain haemoglobin, an oxygen-binding protein that is essential for oxygen transport throughout the body. Generally, low levels are indicative of unhealthy or less active individuals.

2.5 Foraging surveys

The distribution and number of Gouldian finches feeding in recognised breeding habitats were assessed using standardised transect-plots. Transect surveys were undertaken between 5:30 and 9:30am to coincide with the period of peak feeding activity. Following guidelines by the International Union for Conservation of Nature (IUCN), and recommendations for surveying rare or cryptic species ((Joseph and Possingham, 2008)), the 20 minute 2-ha count method was used ((Roberts and Schnell, 2006)). This method provides resolution at a relatively fine scale and still enables a large number of grids to be appropriately surveyed in the stated time frame. For each chosen 2-ha plot, the perimeter of the area was first walked, and then parallel lines/transects 20m apart are walked inside the area (in a grid line fashion), recording all birds observed (visual and acoustic identification) during this time.

For each of the 5 breeding habitats (described in 2.1), a number of 2-ha sample grids were placed over the breeding habitats (grids placed at least 100 m apart), such that at least 70% of the breeding habitat (including a 500 m buffer around the breeding habitat) was sampled. In total, 45 plots were surveyed within the 5 breeding habitats and a further 45 plots were also sampled in the surrounding Buffer Areas.

Because the current vegetation mapping of the area is incomplete (and erroneous for some areas), the location of feeding grasses potentially utilised by Gouldian finches is unknown. Although some feeding areas have previously been located in the breeding habitats (Save The Gouldian Fund, 2011a, 2012a), most of the regional habitat types identified for the area host at least one potential feeding grass (e.g. habitat types: C21, D10, D26, H3) (Strategen, 2011). As a result, 2-ha sample grids were chosen across the Buffer Area, ensuring that each habitat type was included, and thus no specific habitat was favoured for assessment that may lead to a bias in population numbers.

2.6 Feeding Activity and Critical Feeding Grasses

As the Gouldian finch is an obligate seedeater, the accessibility and availability of appropriate feeding grasses is vital for population persistence. To be able to assess feeding behavior and preferred/available grass species during each survey, the activity of the bird was recorded. In particular, when birds were sighted feeding, the species of grass was recorded to identify the critical grass species used in the area.

2.7 Installation of Artificial Nest-boxes

At the end of the breeding season (late April to early May 2013), nest-boxes were erected in the 5 breeding areas. Nest-boxes were specifically designed and constructed to meet the specialised requirements of the Gouldian finch (Brazill-Boast et al., 2013). They were constructed using hollow branches (collected from the surrounding area during land clearing in 2012) to make entrance tunnels, with a standardised, square detachable nest chamber (7-mm-thick ply; internal volume = 1000 cm^3) attached to one end. The branches used for entrance tunnels varied in size and shape, but depth, width, thickness and fragility morphometrics were within the ranges preferred by Gouldian finches (Brazill-Boast et al., 2010). Each nest-box was placed in a preferred tree species (*C. dichromophloia* or *E. miniata*), by fastening the log entrance to a branch or fork using wire. Nest-boxes were distributed as evenly as possible across each plot (minimum 20 m apart), contingent on the distribution of suitable trees.

3 Results

3.1 Breeding Gouldian Finches

All breeding Gouldian finches from the current survey (2013) were located in the same 5 breeding populations identified in the previous 2010, 2011 and 2012 surveys (Appendix 1, all located within in the Buffer area and immediate surrounding reserves). No breeding Gouldian finches were found in any of the other areas where suitable habitat has been located (Pryke, 2010a). All breeding birds were found within the Buffer Area, although four of these populations are situated in very close proximity (< 200 m) to current development and the proposed Development Area, roads or drainage system (breeding areas 1, 2, 3 & 5 (Appendix 1)).

In addition to the 158 potential nest sites (suitable tree hollows) located during previous surveys (Save The Gouldian Fund, 2011a, 2012a), an additional 3 potential nest sites (tree hollows) were located in 2013 (in breeding area 5).

A total of 13 active Gouldian finch nests (i.e. eggs or nestlings present in the nest) were found throughout the breeding season, with breeding populations varying in size from 1 to 7 active nests (Table 1).

During the 2013 breeding season, Gouldian finches reused 4 of the 43 (2011) and 8 (2012) identified nest sites used in previous years.

All active Gouldian finch nests were situated within 2 km from a suitable water source (mean ± SD: 169 ± 303.8m; range 29 – 1698 m). All suitable water sources were situated in the Buffer Area and included running creeks, floodplains, springs and an artificial quarry. During this survey, a total of 5 Gouldian finches were sighted drinking from these water sources.

3.2 Timing and Reproductive Output

The first active nests were located during breeding surveys during February 2013. Using the standard incubation period for Gouldian finches (13 days), it is estimated that the first nest was initiated on 19 February 2013 (i.e. began egg-laying). For the last clutch located during the 2013 survey, the start of egg-laying was estimated to 19 April 2013 (with offspring fledging in May).

Of the 13 active Gouldian finch nests, 12 (92.3%) contained eggs and 1 (7.7%) had nestlings when discovered. Of the 12 nests with eggs, all (100%) successfully produced a brood of nestlings; no nests were predated or abandoned. Brood size varied from 3 to 6 nestlings (mean ± SD: 5.1 ± 0.3 nestlings per brood; *n* = 13 nests).

Table 1. Summary of the number of potential nest hollows and breeding birds (active nest sites) recorded in the 5 breeding areas in 2013 (population numbers correspond to those provided on map; see Appendix 1).

Population	Number of nest sites	Number of active Gouldian finch nests
Population 1	33	2
Population 2	19	0
Population 3	27	0
Population 4	28	7
Population 5	54	4
Total	**161**	**13**
Average per site	**32.2**	**2.6**
Average per Ha of breeding habitat	**0.85**	**0.07**

3.3 Health and Condition

Table 2 provides condition and health scores for adults and for nestlings (nestling age ranging from 11-18 days), including haematocrit and haemoglobin concentrations. All Gouldian finches handled were in fair to good condition (e.g. above fat rank score 2) and had low ectoparasite loads. Haematocrit and haemoglobin concentrations were measured from blood samples from a total of 46 breeding birds (19 adults and 27 nestlings) and were lower than those recorded for birds in previous years (Save The Gouldian Fund, 2011a, 2012a).

Table 2. Summary of the health and condition of adults and nestlings during the breeding season 2012. Values are presented as means ± SD.

Measure	Adults	Nestlings
Condition score (rank score; 1-5)	3.2 ± 0.3	3.7 ± 0.3
Ectoparasite load (rank score; 1-5)	1.2 ± 1.3	2.7 ± 1.9
Haematocrit (relative packed cell volume; mm)	57.8 ± 7.2	53.2 ± 6.8
Haemoglobin (g/dl)	15.2 ± 3.1	12.9 ± 4.3

3.4 Survival and Resightings

Of the 171 Gouldian finches banded during the previous 2011-breeding season, and the 64 birds banded during 2012, none were resighted breeding in 2013.

3.5 Feeding Habitats

A total of 14 Gouldian finches were located during the standardised transect surveys of the feeding habitats located in the Buffer area. Birds were observed in breeding areas 1, 4 and 5, but not in breeding areas 2 and 3 or in the general Buffer Area (Table 3). No birds were located outside of the identified breeding areas.

Table 3. Summary of the number of Gouldian finches recorded in the 5 breeding habitats in 2012.

Area	Number of surveys	Number of Gouldian finches
Breeding Population 1	10	2
Breeding Population 2	9	0
Breeding Population 3	5	0
Breeding Population 4	9	8
Breeding Population 5	12	2
Buffer Area (adjacent breeding populations)	28	0
Buffer Area (within the Development Area)	17	0
Total	**90**	**14**

3.6 Feeding Grasses

Of the 14 Gouldian finches sighted, 10 were observed feeding. All feeding birds were found feeding on native sorghum (*Sarga* species) (Table 4). In addition, a further 2 birds were sighted feeding on seeds on the ground. Although the grass species of these ground-feeding birds could not be reliably identified, most birds were seen feeding in amongst *Sarga* species.

Table 4. Summary of the number of Gouldian finches recorded feeding on different grass species in 2012.

Grass species	Number of Gouldian finches feeding
Sarga	10
Triodia	0
Other grasses	0

3.7 Installation of Artificial Nest-boxes

A total of 120 nest-boxes were erected in the 5 breeding areas (Table 5). The mean (± SD) height of nest-box placement was 4.3 ± 0.6 m, corresponding to the height of nests in natural hollows (4.2 ± 0.8 m) (Brazill-Boast et al., 2010). Nest-boxes were randomly positioned with the entrance at an angle of 0–45° from the horizontal and oriented facing a randomly chosen direction (Brazill-Boast et al., 2010). Appendix 1 provides details of the tree height, tree circumference, nest-box height, orientation, and placement (shade/open) for each nest-box.

Table 5. Distribution of artificial nest-boxes in the five breeding habitats.

Area	Number of nest-boxes
Breeding Population 1	30
Breeding Population 2	0
Breeding Population 3	10
Breeding Population 4	40
Breeding Population 5	40
Total	**120**

4 Discussion and Implications

As part of the Gouldian Finch Management Plan (Strategen, 2011) and as a requirement for State approval under the EPBC Act and the GFMP, regular assessments of Gouldian finch populations are to be carried out during the construction and operation of the Ord River Irrigation Area Weaber Plain Development Project in the Eastern Kimberley. In concurrence with these conditions, this report summarises the results of the 2013 breeding season surveys, which specifically monitored the presence, distribution, health and breeding ecology of Gouldian finches, as well as their feeding habits.

4.1 Breeding Gouldian Finches

In the Buffer area and surrounding reserves, a total of 13 active Gouldian finch nests were found during the 2013 breeding surveys. Based on the minimum breeding areas used by birds, this amounts to an average breeding density of 0.07 per hectare, which is lower than breeding densities recorded for Gouldian finches breeding in the same areas in the last two years (2011: 29 active nests and 0.15 per hectare; 2010: 43 active nests and 0.22 per hectare), and in nearby Wyndham (Western Australia) populations (1.3 – 1.8 per ha).

The lower breeding densities recorded in 2012 may be due to ecological factors, especially the lower rainfall recorded during the wet season, which is likely to have affected seed production of important feeding grasses utilised by the Gouldian finch. This is also evident by earlier clutch initiation dates this year; birds initiated egg-laying in February compared to late March in 2012. Furthermore, only one breeding pair had two breeding attempts this season (7.7%). This is low, especially compared to that previously recorded in the area; 10.1% in 2012 (Save The Gouldian Fund, 2012a) 27.9% in 2011 (Save The Gouldian Fund, 2011a); and in other local populations: 39-68% (Pryke, pers. obs.), suggesting that there was insufficient seed and/or time for a second clutch this year. These findings are also comparable to other Gouldian finch populations breeding in the eastern Kimberley this year (2013). In nearby Wyndham (Western Australia) and Newry (Northern Territory) populations, similar early clutch initiation dates, shorter breeding seasons, lower breeding densities and fewer re-nesting attempts were also recorded.

Reproductive output (e.g. number of fledged offspring) for breeding birds in the Buffer area was similar to that recorded in the last two years (2011 and 2012) and similar to other known Gouldian finch populations. Broods compromised an average of 5 offspring, which is comparable to findings from previous studies (Brazill-Boast et al., 2010; Pryke and Griffith, 2009a; Pryke et al., 2010). Predation rates on active nests vary

from 20.3-60.4%, depending on aspects of tree cavity morphometry (e.g. length and diameter of hollow), the presence and densities of main predators (e.g. goannas and snakes) and the location of the nest (Brazill-Boast and Pryke, 2011). Predation rates this year (0%) were much lower than those recorded in previous years (2012: 7.4%; 2011: 34%). This is likely due to the lower number of active nests (13) recorded.

4.2 Health and Condition of Gouldian Finches

Birds assessed had lower body condition and immune function than Gouldian finches measured in other nearby populations during this time of the year (Pryke, pers. obs). Both haemotocrit and haemoglobin concentrations were lower than those recorded for Gouldian finches in conservation and protected areas in both Western Australia and Northern Territory (Pryke, pers. obs; Maute 2011). This suggests that breeding birds were more stressed and in lower condition than birds breeding in previous years. This may be related to the lower rainfall (and seed available) (see section 4.1) and/or increased disturbance in the area (see section 4.5 and 4.6).

Higher haematological indices for adults compared to juveniles is common, especially as adults are often captured after returning to their nest (i.e. after expending energy flying and searching for food), and because haematological measures are generally higher in active (adults) than inactive individuals (chicks in the nest).

4.3 Feeding Habitat and Grasses

A total of 14 Gouldian finches were found in 45 2-ha survey plots in the Buffer area. All birds were found feeding on native sorghum grasses. This is expected because sorghum is a critical dry season seed for Gouldian finches, and often forms the basis of their breeding diet. Indeed, crop samples from nestlings show that sorghum seeds often comprise 90% of the diet that adults feed their chicks.

Adults breeding in the area were sighted feeding in the local breeding habitats. No birds were located feeding outside of the identified breeding habitats. This suggests that sufficient feeding grasses are present in these areas to support the current breeding Gouldian finch populations. This also highlights the importance of managing both the Buffer areas and Buffer corridors (within the Development Area) to retain and promote these dry-season feeding grasses.

It should be noted that, because land clearing had started before the commencement of the Gouldian finch breeding survey, none of the areas proposed for development (agriculture) were surveyed this year.

4.4 Survival

No banded birds were resighted during the 2013 breeding season. Although the resighting rate of Gouldian finches is generally low (9-54%), this is much lower than recorded for other nearby populations (e.g. Wyndham, WA; Newry, NT).

There are a number of potential reasons for the low resighting rate. (1) No birds were sighted in the Buffer Area and surrounding reserves during the previous 2012 non-breeding surveys (late dry season – wet season). Therefore, birds may have dispersed to other areas (outside the designated survey area) in search of new breeding/feeding areas. (2) Birds may not have survived through the wet season. From mark-recapture data collected over the last five years in the eastern Kimberley, the Gouldian finch is considered to be a largely annual species, with only a small proportion (< 8%) of breeding adults surviving to breed the following season. It is thought that a combination of food shortages during the early wet season (O'Malley, 2006), deleterious genetic incompatibilities (Pryke and Griffith, 2009a) and high stress associated with reproduction (such as finding compatible mates, competing for nest hollows and food shortages (Brazill-Boast et al., 2010; Brazill-Boast et al., 2011; Pryke et al., 2007; Pryke et al., 2012)) are the main reasons for their largely annual lifespan.

Unfortunately, because little is known about the dispersal patterns and survival of Gouldian finches in general, the reasons for the absence of resightings are unclear at this stage. Future management plans need to recognise the lack of knowledge of critical behaviours, such as foraging movements and migration patterns linked to the distribution of Gouldian finch populations. Nevertheless, the information from the current survey provides fundamental baseline data for further long-term studies on the survival and recruitment of breeding and non-breeding birds.

4.5 Potential Effect of Cattle and Fire

During the non-breeding surveys in 2012 (prior to the 2013 breeding surveys), there was evidence of extensive damage from late dry season wildfire in all of the 5 breeding habitats, as well as in the adjoining feeding areas (Save The Gouldian Fund, 2012b). Furthermore, in 81% of the breeding areas, and in all of the surveyed Buffer areas, there was evidence of heavy grazing (much of which was classified as ‘extreme’; 85%) in the

general Buffer Area. Consequently, there were few to no grasses in many of the surveyed areas.

The lack of seeding grasses (from the combination of late dry season wildfires and cattle grazing) is a likely explanation for the absence of Gouldian finches in the 2012 surveys. The combination of fire damage and grazing may also have contributed to the lower number of breeding Gouldian finches recorded in 2013. Many critical feeding grasses used by Gouldian finches are fire-sensitive, which means that the wildfire that burnt through all of the five habitats may have resulted in reduced availability, smaller distributions and reduced seed viability. Furthermore, although erection of the cattle fence was initiated in November 2012, and there was a substantial reduction in the distribution and intensity of grazing over the wet season (Save The Gouldian Fund, 2013), considerable grazing damage was still recorded in 39% of the transects during surveys in April 2013. Therefore, cattle (although reduced) were still causing severe damage to the feeding habitats. Together, these effects are likely to negatively impact the number of breeding Gouldian finches in the area.

4.6 Potential Effect of Land Clearing and Increased Disturbance

Along with increasing land clearing and construction, there has been a substantial increase in machinery, excavation and road activity (and their associated noise) to the area. Unfortunately, Gouldian finches have received little study (and none in relation to anthropogenic disturbance), and there is no published data on the movement of this species in response to various anthropogenic disturbances. Although Gouldians will move into built-up areas to locate fresh water during the dry season (when water is scarce), they generally inhabit and feed in remote and undisturbed habitats.

In addition to the current land clearing, some areas potentially important to Gouldian finches have been cleared and/or disturbed. For example, the Raw Material Site is on a Gouldian finch feeding areas that was identified in previous baseline surveys (see Figure 1 in Save The Gouldian Fund 2011b). The Site Office is also positioned in the Buffer Area directly opposite a breeding area (breeding habitat 3), and the constant activity and noise from this main hub may, at least to some extent, affect the presence of birds in the area. This may explain why no breeding Gouldian finches were recorded in these areas.

However, at this stage, it is not possible to fully assess the relative effect of land clearing, and its associated disturbances, on the movement and habitat-use of Gouldian finches. If such disturbances are affecting Gouldian finches, it is expected that the birds would be absent or scarce in the habitats located adjacent to current development areas

(and the associated noise, dust, etc.), but be present in the more protected, undisturbed areas that are remote from current development (e.g. northern areas, such as Gouldian finch breeding habitats 4 and 5). This is evident, at least to some extent, as the relatively undisturbed areas (e.g. 4 & 5) supported more Gouldian finches than the other areas. However, 2 breeding pairs were located in breeding habitat 1, which is in close proximity to current development and disturbance. Further surveys in both the breeding and non-breeding season, and when wildfires and cattle grazing are controlled and/or eliminated, should permit further insight into the relative effects of land clearing and development on the presence and distribution of Gouldian finches in the area.

4.7 Artificial nest boxes

Suitable nest-site densities within the Buffer area comprised about 0.83 per hectare, which is substantially lower than the 3.2–4.6 per hectare reported for other nearby breeding populations (Brazill-Boast et al., 2010). Gouldian finches have very specialised nest-site requirements, only utilising tree hollows of specific depth, size and sturdiness (Brazill-Boast et al., 2010). Gouldian finches also face intense competition from a more dominant and sympatric competitor, the long-tailed finch. Together, the limited availability of suitable nest sites and strong interspecific competition can severely reduce both the relative proportion of the population that are able to successfully breed (Brazill-Boast et al., 2010) and an individual Gouldian finches' reproductive success (Brazill-Boast et al., 2011).

As a way to enhance breeding opportunities and help reduce nest-site limitation, artificial nest-boxes have been very successfully used in other Gouldian finch populations (Brazill-Boast et al., 2013). To aid in the sustainability of Gouldian finch populations within the Project area, and as stipulated in the GFMP, artificial nest-boxes were erected in the breeding habitats. During on-going land clearing of areas designated for agriculture, hollow logs have been salvaged and used to make the custom-designed nest-boxes. Nest-boxes will be monitored in future years, and further boxes will likely be erected in different areas, to help promote the current nest-site limited populations.

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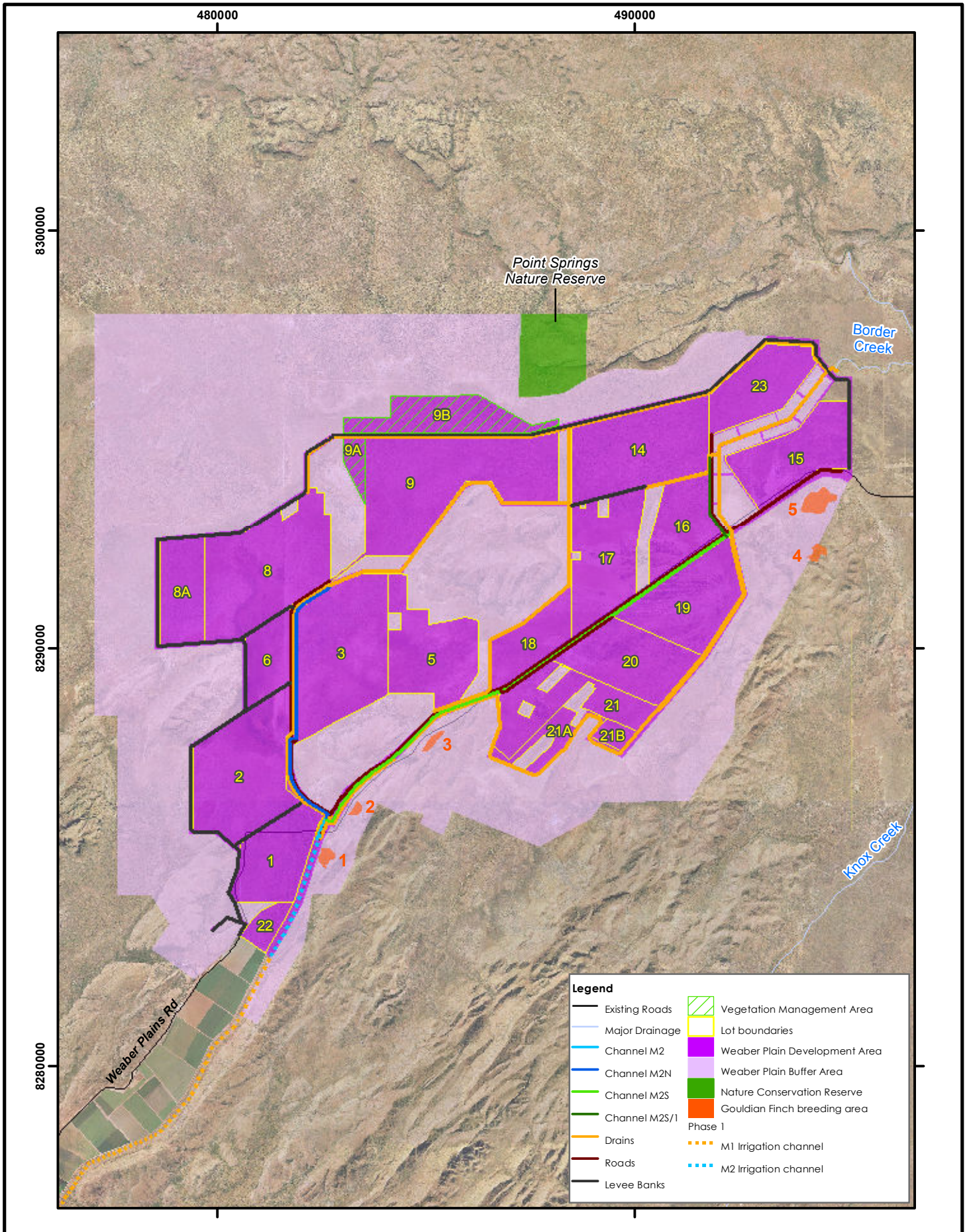

Appendix 1 **Location of Gouldian Finch breeding areas**

STRATEGEN
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Scale

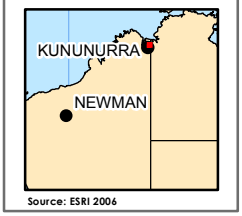
0 1 2
Kilometres

1:120,000
at A4

Coordinate System: GDA 1994 MGA Zone 52
Date: 18/07/2011
Author: atomeo
Path: Q:\Consult\2010\LAN\LAN10119.01\Correspondence\Out\Figure_Request_For_SarahPryke_20110712\F001_GouldianFinch_Survey.mxd

Source: Geoscience Australia 2006, SunWater 04/2011
Finch survey results supplied by North Survey.
Note that positional errors may occur in some areas

Regional



Appendix 2. Metrics and placement of the nest-boxes erected in breeding areas 1, 3, 4 and 5.

Box ID	Orientation	Box height (m)	Tree height (m)	Tree circumference (cm)	Shade/Open	Area
O100	S	3.2	6	119	shade	3
O101	E	5.2	14	120	open	1
O102	NW	3.7	12	95	open	4
O103	E	3.45	8	93	shade	4
O104	W	4	10	85	shade	3
O105	S	4	10	71	open	4
O106	S	3.5	7	55	open	4
O107	NW	4.3	7	90	open	4
O108	S	3.45	14	135	open	4
O109	E	4	8	105	open	4
O110	SE	3.6	12	148	shade	4
O111	SE	4.1	8	68	shade	4
O112	NW	4.5	8	60	shade	3
O113	NW	4.4	7	80	open	4
O114	W	4.3	9	98	shade	5
O115	NE	4	9	80	open	1
O116	E	4.5	11	100	shade	1
O117	NE	3.9	8	90	open	1
O118	N	3.7	9	98	shade	5
O119	N	4.2	9	102	open	1
O120	NE	3.6	7	110	open	1
O121	SW	3.9	9	120	shade	4
O122	S	3.6	10	103	shade	5
O123	S	3	7	63	shade	3
O124	NE	4	9	83	shade	5
O125	N	3.8	10	124	open	4
O126	SW	3.8	7.5	76	open	1
O127	S	3.5	7	61	open	5
O128	N	4.5	7	140	open	4
O129	E	4.1	8	79	shade	5
O130	E	4.4	6	100	shade	4
O131	SE	3.9	7	113	shade	4
O132	NW	3.7	8	82	shade	5
O133	SE	2.9	6	70	open	5
O134	SW	4.3	10	134	open	4
O135	SE	4.4	7	70	open	4
O136	SW	4.3	8	100	open	4
O137	NW	3.7	12	140	open	4
O138	W	3.8	8.5	63	open	1
O139	N	3	6	70	open	3
O140	NE	4.8	10	90	open	1
O141	SW	4	10	104	open	5
O142	SW	4.3	8	120	shade	4
O143	E	4.7	10	131	open	4
O144	E	3.9	10	190	shade	4
O145	NE	4.39	9	90	open	1
O146	NE	3.9	8	135	open	1
O147	SE	3.7	10	75	open	1
O148	S	4.2	6	137	open	4
O149	NE	3.8	10	120	open	1

Box ID	Orientation	Box height (m)	Tree height (m)	Tree circumference (cm)	Shade/Open	Area
O150	N	4	8	70	open	4
O151	W	4.1	9	107	open	1
O152	E	4	8	150	open	4
O153	NE	4.2	9	70	open	1
O154	SW	4.4	7	110	shade	4
O155	N	4	7	130	open	5
O156	SE	4.32	8	115	open	4
O157	NE	4.1	9	150	shade	4
O158	S	3.68	8	118	open	5
O159	SE	4.7	12	109	shade	5
O160	E	4.1	8	84	open	5
O161	W	3.3	7	72	open	4
O162	NE	4	15	116	open	4
O163	NE	4.1	9	130	open	4
O164	N	3	8	105	open	3
O165	N	4.1	8	115	shade	4
O166	W	4.6	7	80	open	4
O167	W	3.67	11	104	open	5
O168	S	3.8	7	128	open	1
O169	SW	4.7	9	14	shade	4
O170	NW	4.5	9	93	open	5
O171	SE	3.95	8	57	open	5
O172	NE	4	8	73	shade	3
O173	W	3.7	7.5	130	shade	4
O174	N	4.9	8	73	open	1
O175	E	4.1	8	81	shade	5
O176	S	3.95	6	80	open	4
O177	S	3.8	9	85	open	5
O178	SE	3.7	6	81	open	5
O179	NE	4.4	8	110	open	4
O180	NW	3.7	8	80	shade	5
O181	SE	4.4	6	75	open	1
O182	W	3.55	8	96	open	5
O183	E	3.66	11	91	open	5
O184	W	3.9	9	91	shade	5
O185	NW	3.65	7.5	58	open	5
O186	SW	3.12	9	94	open	5
O187	NW	3.7	8	91	open	1
O188	W	3.5	9	89	open	5
O189	W	3.31	7	93	open	5
O190	E	3.9	8	92	shade	5
O191	S	4.1	8	95	open	1
O192	S	3.41	9	82	open	4
O193	SE	3.5	6	75	open	5
O194	NE	3.5	7	73	open	5
O195	SE	4.2	12	166	open	1
O196	SW	4	7	120	shade	5
O197	NW	4.4	8	100	open	4
O198	SW	4.3	8	110	open	1
O199	N	4.2	11	115	open	1
O200	N	3.7	7	83	shade	5
O201	W	4.05	10	84	open	4
O202	N	3.5	7.5	79	open	3
O203	W	4	8	85	shade	3
O204	E	4.4	8	82	open	5
O205	S	4	7	83	open	1
O206	N	4	7	72	open	5

Box ID	Orientation	Box height (m)	Tree height (m)	Tree circumference (cm)	Shade/Open	Area
O207	S	3.86	9	100	shade	5
O208	S	3.2	7	81	shade	5
O209	NW	3.17	8	60	open	5
O210	E	4.8	8	70	open	1
O211	SW	4.2	9	98	open	1
O212	W	3.45	11	99	open	5
O213	SW	4	7	60	open	1
O214	N	3.48	11	80	open	5
O215	E	4.2	10	90	shade	1
O216	NE	4.15	20	120	open	1
O218	SW	4	7	60	open	1
O219	N	4	10	100	open	1
O220	S	4.5	7	120	shade	3