MTRC WEST RAIL
Contract No. TSA-026

WEST RAIL ECOLOGICAL MONITORING AND ADAPTIVE MANAGEMENT SERVICES 2009

QUARTERLY REPORT – SUMMER 2009

September 2009

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September 2009

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EXECUTIVE SUMMARY

This is the 3rd quarterly report under the extension of contract TSA-026, covering the ecological monitoring requirements of the West Rail Operational EM&A manual. It covers the period June – August 2009.

The radio-tracking of Greater Painted-snipe was carried out on four individuals trapped on 11th August 2009 and radio-tracked from 13th – 22nd August and 1st – 10th September 2009. Favoured sites included the seasonally wet grassland in the Buffalo Fields, inactive agricultural fields north of Shui Mei and a pond and marsh near Fung Kat Heung.

No radio-tracked Greater Painted-snipe were recorded in the West Rail mitigation wetlands. No Greater Painted-snipe were recorded in the wetlands on bird surveys or at other times.

A total of 38 bird species was recorded from the mitigation wetlands during Summer 2009, of which 15 species (39%) are considered to be wetland-dependent.

One species of mammal was recorded during the monitoring period.

Eight species of amphibian and nine species of reptile were recorded from the mitigation wetlands. Although the total number of amphibian species was slightly lower than recorded in Summer 2008, this is not thought to be a cause for concern.

A total of 23 dragonfly species was recorded as adults from the wetlands and three species were recorded as exuviae. The exuviae of three species were collected from exuviae traps (including one not recorded on other surveys).

A total of 30 butterfly species have been recorded in the land parcels. All are common species in Hong Kong.

Water quality was measured in July and August 2009 and the results were not considered to be a cause for concern.

Vegetation monitoring was carried out in June 2009. Conditions were found to be comparable to previous monitoring, although the ongoing control of invasive vegetation was found to be having a beneficial impact. Recommendations from the vegetation monitoring include the continuing management of invasive species, management of water levels in land parcels to benefit wetland vegetation, monitoring of *Typha* in Land Parcels B1 and D and monitoring of shrubs impacted by fire in Land Parcel L.

Habitat mapping was carried out in all land parcels during the wet season. Results are not included in this report and will be presented in the Annual Report for 2009.

Site management carried out during Summer 2009 has included control of invasive plant species, planting of Lotus in Land Parcel J and stocking of Mosquito Fish in Land Parcel J to help control mosquito larvae.

1. INTRODUCTION

1.1 Many of the lowland wetland areas of Hong Kong have been lost to human development over recent decades, resulting in a reduction in species diversity. The construction of KCRC West Rail had the potential to hasten this decline through direct habitat loss in the Kam Tin valley, one of the remaining freshwater wetland areas with a comparatively rich fauna. To mitigate for the loss of wetland habitats, the West Rail EIA study recommended the creation of compensatory wetlands on a 'like-for-like' basis (ERM 2001).

1.2 A total of 12 discrete land parcels have been established as compensatory wetlands within the Kam Tin area, all close to MTRC West Rail (for locations, see AEC 2009a). Each of these has a range of target species which are monitored on a regular basis; the list of targets for each land parcel is given in Table 1.

Table 1. *Target species/groups for the different land parcels*

Land Parcel	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Greater Painted-snipe	✓	✓		✓	✓							
Wetland dependent birds	✓	✓		✓								
Reptiles and amphibians		✓		✓	✓			✓	✓	✓	✓	✓
Dragonflies	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

1.3 Wetland habitat was created in the land parcels between 2002 and 2003; monitoring of Land Parcels B and D (the first to be established) started during Autumn 2002, while the other land parcels have been monitored since Winter 2003/04 (AEC 2006). Reprofiling and replanting works have subsequently been carried out in Land Parcels B, D and C, to improve the habitats available for the target species (AEC 2009a).

1.4 This is the 3rd quarterly monitoring report under the extension of contract TSA-026, which continues the monitoring stipulated by the KCRC WR Operational EM&A Manual (KCRC 2003). Monitoring reported here covers the period Summer 2009 (June – August 2009), including results from the radio-tracking of Greater Painted-snipe, monitoring of other bird species, herpetofauna, dragonflies, butterflies, water quality and vegetation.

2. RADIO-TRACKING OF GREATER PAINTED-SNIPE

2.1 Background

2.1.1 Greater Painted-snipe *Rostratula benghalensis* is a scarce breeding resident in Hong Kong, with the population probably augmented during autumn and winter by birds from outside Hong Kong (Carey *et al.* 2001). The species was formerly more abundant and was frequently found in paddy fields. With the reduction in rice farming, the species has declined significantly and has been listed as locally threatened (Fellowes *et al.* 2002). It is found mostly in wet agricultural land, typically in sites with dense emergent vegetation (Leader 1999). Since the early 1990s, the only sites with regular records throughout the year have been Kam Tin and Long Valley, although other sites are used sporadically, including breeding at both Mai Po and Lok Ma Chau during recent years.

2.1.2 The Kam Tin valley is particularly important, and the peak counts in recent years have been in this area. Most of the valley is unprotected and much of the agricultural land is under threat from rapid development. The construction of West Rail close to sites occupied by the species had the potential to disturb key habitats, therefore Greater Painted-snipe has been designated as one of the target species to attract into the mitigation areas, primarily into Land Parcels A, B and D, but also into Land Parcel E for night-time foraging (AEC 2009a).

2.1.3 The study of Greater Painted-snipe is difficult because of their secretive nature and nocturnal foraging behaviour; the species is difficult to observe and is generally only seen when flushed from daytime roost sites, which inevitably causes disturbance to the birds. Radio-tracking provides a method whereby individual birds can be followed by day without causing disturbance and also by night when the birds are most active. This allows a better understanding of the habitat preferences of the species, which can be used in habitat creation and enhancement within the mitigation wetlands. Radio-tracking also allows the species, use of the mitigation wetlands to be monitored by day and night without causing unnecessary disturbance.

2.2 Trapping Sites and Study Area

2.2.1 Trapping was carried out by mist-netting on 11th August 2009 in the Buffalo Fields.

2.2.2 During radio-tracking, searches for tagged birds were carried out close to the trapping site and at nearby sites known to be used by Greater Painted-snipe, including the Buffalo Fields and areas close to Shui Mei, Sha Po and Fung Kat Heung villages. When no signal was found, these searches were extended through the lowlands around Kam Tin, especially those areas within 1.5km of the mitigation wetlands.

2.3 Methods

2.3.1 Four birds (all female) were trapped on 11th August 2009. All were fitted with a 2.5g gauze-mounted TW-4 single button celled tag (radio-transmitter) (Biotrack Ltd., Dorset, UK), which was attached on the back with epoxy glue (Hirons and Johnson 1987, Kenward 2001).

2.3.3 Tracking was carried out during two periods of ten days, from 13th – 22nd August 2009 and from 1st – 10th September 2009. During these periods, each bird was located twice per day; once during the daytime and once at night. The survey period extended slightly beyond the spring season (normally June – August) but this is not considered to have significantly affected the results of the radio-tracking.

2.3.4 The birds were located using an M57 receiver (Mariner Radar Ltd, Suffolk, UK) and a hand-held flexible 3-element yagi antenna (Lintec, Dorset, UK), and could be detected up to a maximum of 3.25km. The location of each bird was determined as accurately as possible through triangulation (Heezen and Tester 1967) and the locations of detected birds were recorded using a hand-held GPS. The distance between the receiver and tag was kept low (generally <50 m), in order to reduce triangulation error (White and Garrott 1986), but every effort was made not to flush the birds.

2.4 Results of Radio-tracking

2.4.1 Number and Distribution of Detections

2.4.1.1 A total of 89 detections was recorded for all birds, including 44 during the day and 45 at night.

2.4.1.2 Females 3 and 4 were present throughout the tracking period, until the last day of tracking on 10th September 2009. Female 1 was recorded only on the first two days of tracking (until 14th August 2009) and Female 2 was present on 13th August and again on 19th-20th August 2009. Apart from these dates, no signal was received from these birds. Due to the low number of records received, data from these two individuals are not included for further analysis.

2.4.1.3 The distribution of detections of Greater Painted-snipe in Spring 2009 is shown in Figure 1. Favoured areas included the Buffalo Fields, abandoned ponds/marshes near Fung Kat Heung and agricultural land north of Shui Mei village. No birds were recorded using the West Rail mitigation wetlands.

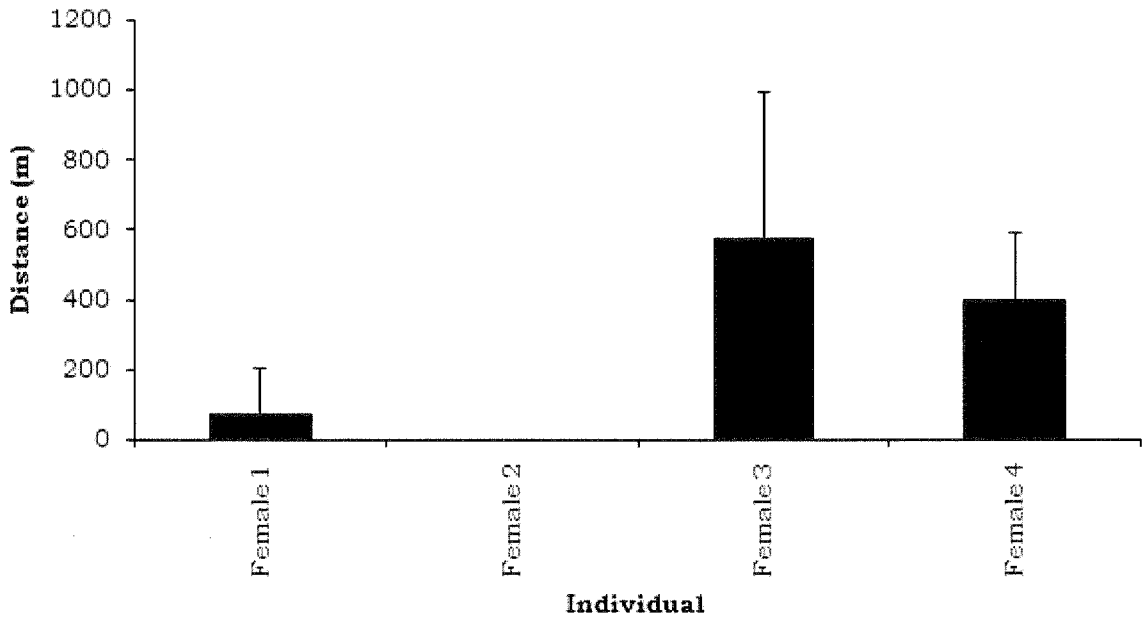
Table 2. *Number of detections made for each bird and date of last detection.*

Individual	No. of detections	Trapping Location	Date Trapped	Date of last detection
Female 1	4	Buffalo Fields	11/08/09	14/08/09
Female 2	6	Buffalo Fields	11/08/09	20/08/09
Female 3	39	Buffalo Fields	11/08/09	10/09/09
Female 4	40	Buffalo Fields	11/08/09	10/09/09

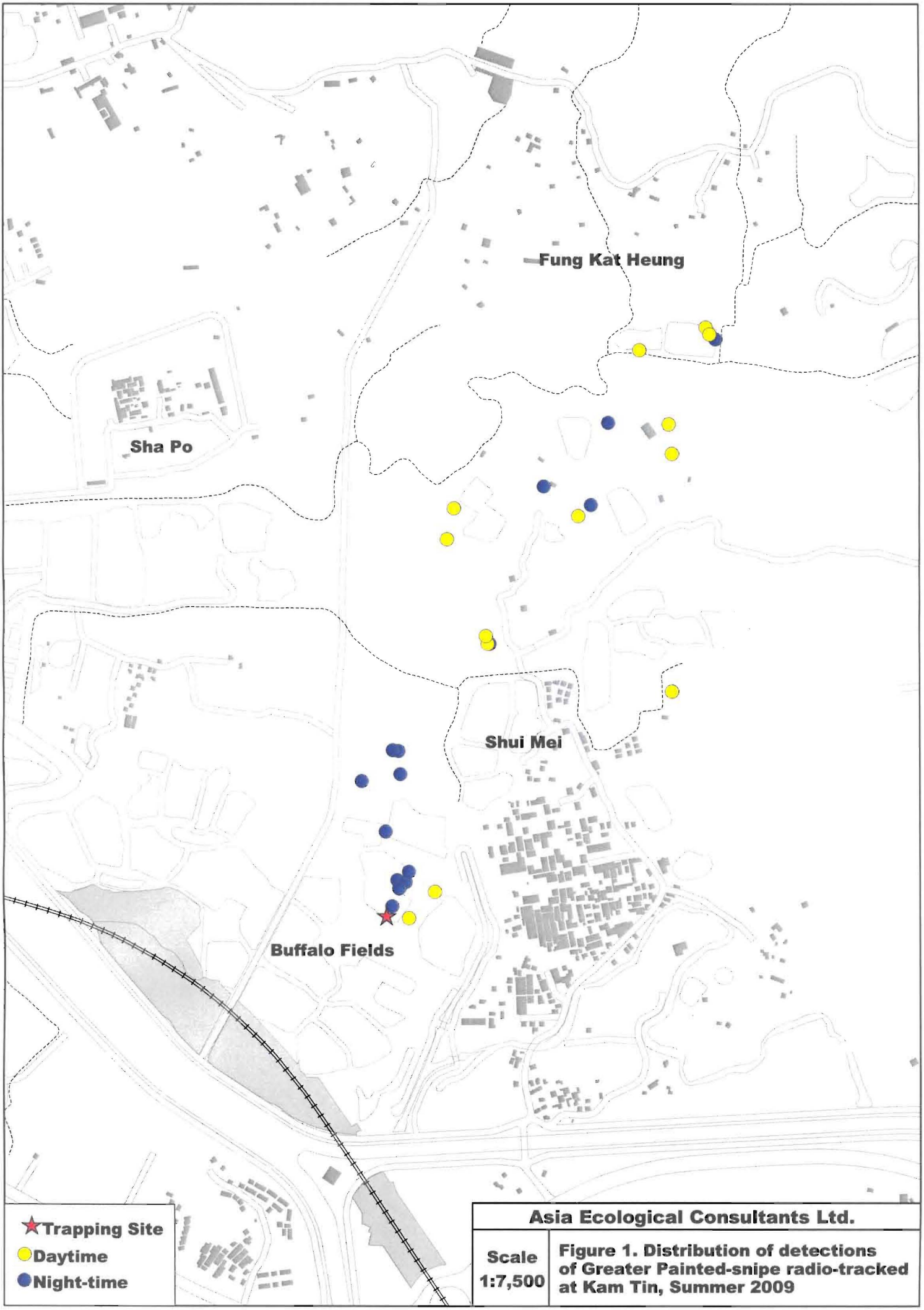
2.4.2 Commuting Distance and Range Size

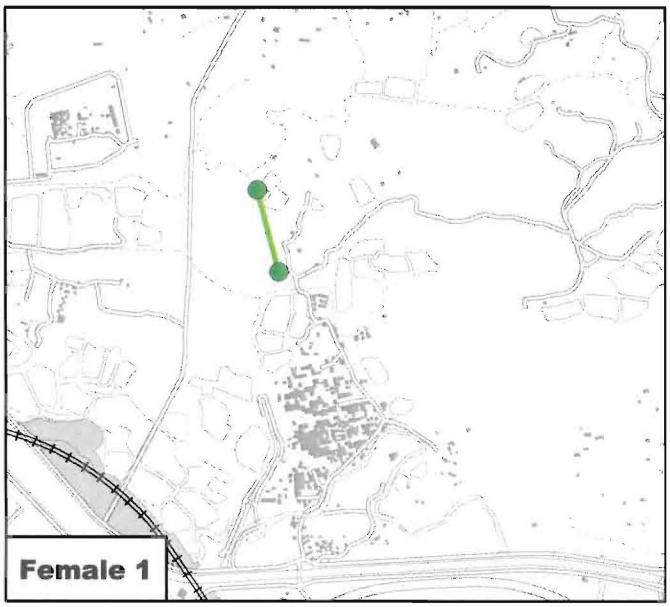
2.4.2.1 The mean (± 1s.d.) commuting distance between daytime and night-time sites was 487 ± 124m (excluding results from Females 1 and 2); the distances for each bird are presented in Figure 2 and Table 3. This is within the range of values previously obtained in summer (Table 4). Similar commuting distances have also been obtained for other terrestrial and freshwater wader species (Hirons and Johnson 1987, Green *et al.* 1990, Krementz *et al.* 1995, Duriez *et al.* 2005).

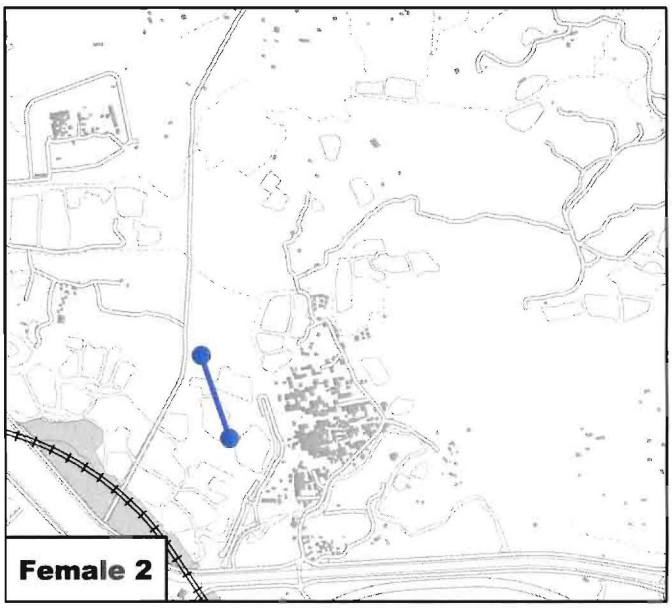
Figure 2. *Mean (± 1s.d.) distance between daytime and night-time locations for individual Greater Painted-snipe at Kam Tin during Summer 2009.*

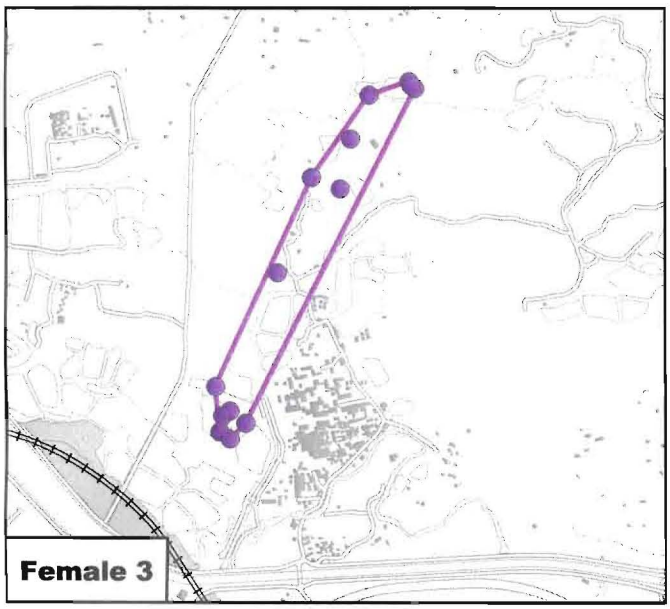


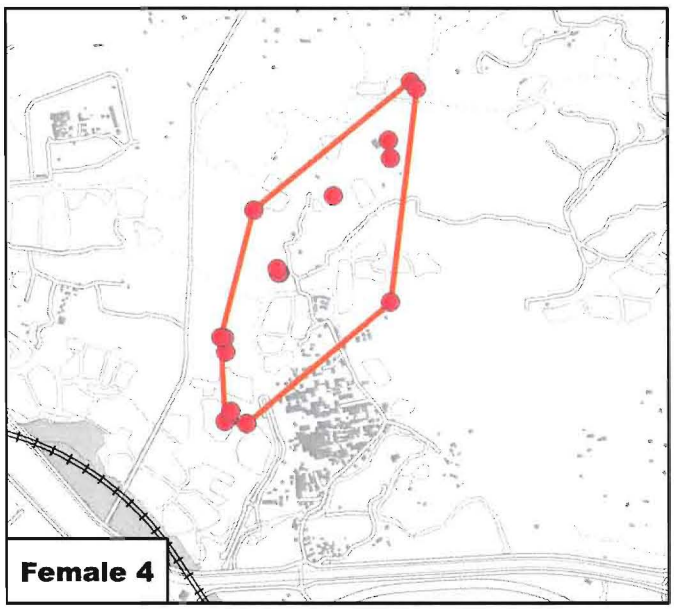
2.4.2.2 Home ranges were calculated in Ranges VI (Anatrack Ltd., UK), using a Minimum Convex Polygon technique (MCP). This technique finds the home range by connecting the outermost points, allowing easy


Fung Kat Heung
Sha Po
Shui Mei
Buffalo Fields
Trapping Site
Daytime
Night-time
Asia Ecological Consultants Ltd.
Scale
1:7,500
Figure 1. Distribution of detections of Greater Painted-snipe radio-tracked at Kam Tin, Summer 2009









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Scale 1:20,000	Figure 3. MCP home ranges of Greater Painted-snipe radio-tracked at Kam Tin, Summer 2009

comparison of the total areas covered by each individual; ranges for each individual are shown in Figure 3.

2.4.2.3 Discounting the results from Females 1 and 2 (due to the low number of detections), the area of individual ranges were 12.17ha and 24.84ha (Table 3), with a mean of 18.50 ± 8.96ha. This is smaller than in most previous summers (Table 4), probably due to individual variation; had it been possible to locate the other individuals, the mean home range size would probably have been larger.

Table 3. *Commuting Distances and Area of MCP Home Ranges for individual Greater Painted-snipe at Kam Tin during Summer 2009.*

Individual	Number of Detections	Mean Commuting Distance (m)	MCP Home Range Area (ha)
Female 1	4	75 ± 129*	0.02*
Female 2	6	0 ± 0*	0.02*
Female 3	39	574 ± 422	12.17
Female 4	40	399 ± 192	24.84

* Commuting distance and home range considered unrepresentative due to small number of records

2.4.2.4 Separate MCP ranges were calculated for daytime and night-time records; there were no significant differences between the size of daytime and night-time ranges (14.22 ± 11.17ha by day, 6.58 ± 6.48ha at night; Wilcoxon Sign Rank test, df=1, p>0.1).

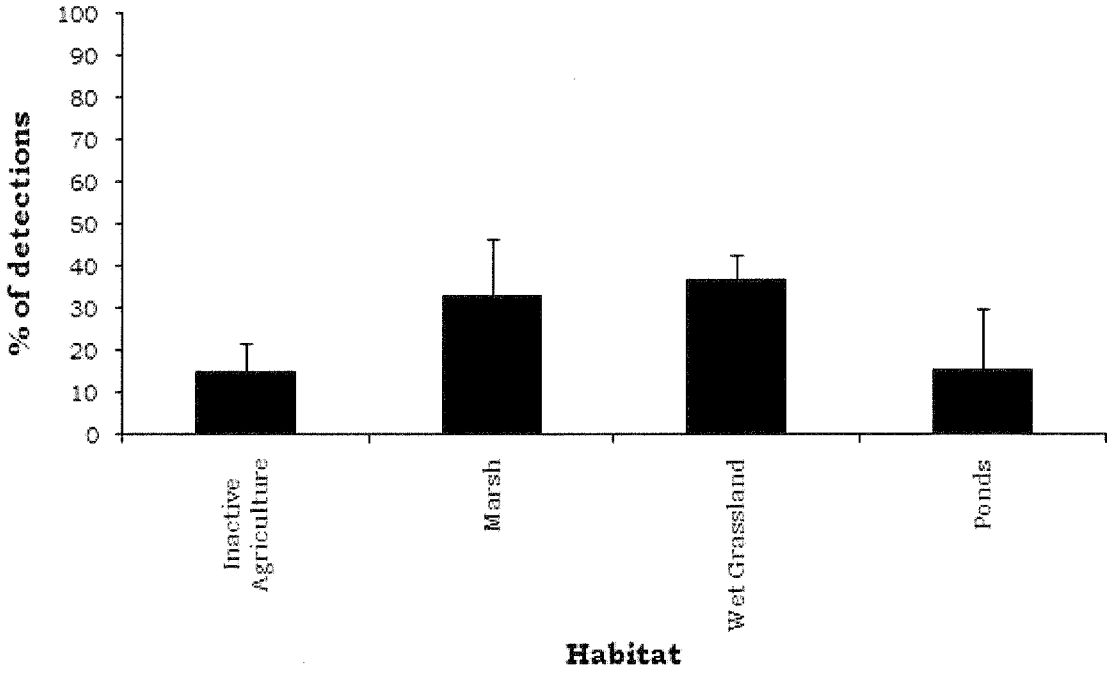
Table 4. *Mean commuting distance and mean area of MCP home range of radio-tracked Greater Painted-snipe at Kam Tin for the past four years (Autumn 2005 – Summer 2009).*

Season	Mean Day/Night Distance (m)	Mean MCP Home Range Area (ha)
Autumn 2005	176 ± 103	19.7 ± 22.6
Winter 2005/06	206 ± 225	7.4 ± 8.2
Spring 2006	207 ± 119	20.7 ± 26.1
Summer 2006	241 ± 223	51.6 ± 98.5
Autumn 2006	185 ± 138	65.0 ± 120.7
Winter 2006/07	246 ± 108	6.1 ± 2.7
Spring 2007	353 ± 125	68.6 ± 104.3
Summer 2007	312 ± 120	48.3 ± 55.5
Autumn 2007	161 ± 127	7.4 ± 8.1
Winter 2007/08	235 ± 177	15.4 ± 13.4
Spring 2008	114 ± 76	3.2 ± 2.9
Summer 2008	633 ± 647	54.4 ± 63.7
Autumn 2008	310 ± 180	20.4 ± 28.7
Winter 2008/09	235 ± 243	5.3 ± 4.1
Spring 2009	786 ± 294	59.4 ±33.0
Summer 2009	487 ± 124	18.5 ± 9.0

2.4.3 Habitat Utilisation

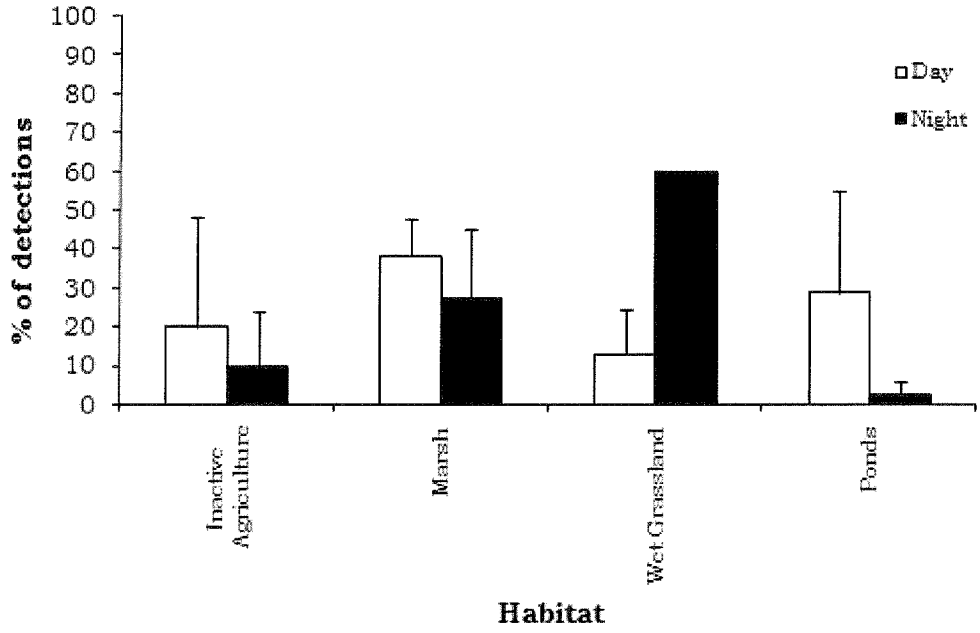
2.4.3.1 Favoured habitats during Summer 2009 were marshes and seasonally wet grassland; inactive wet agriculture and ponds were used less frequently (Figure 4). Flooded wasteground was used on two occasions by Female 2.

Figure 4. *Mean (± 1 s.d.) percentage of detections in different habitats per individual Greater Painted-snipe at Kam Tin during Summer 2009.*



2.4.3.2 There were no statistically significant differences between daytime and night-time habitat use (paired t-tests of arcsine-transformed values, $p>0.05$, $df=1$), but wet grassland was generally used more at night and ponds were used more during the day (Figure 5). Diurnal variation in habitat use has been recorded in most previous seasons (AEC 2006, AEC 2007, AEC 2008a, AEC 2009b) and is typical of terrestrial and freshwater wader species including Common Snipe *Gallinago gallinago*, American Woodcock *Scolopax minor* and Eurasian Woodcock *Scolopax rusticola* (Krementz *et al.* 1995, Hoodless *et al.* 2000, Duriez *et al.* 2005), for which daytime sites are selected by the amount of cover provided and night-time sites are selected on the basis of food availability (Green *et al.* 1990).

Figure 5. *Mean (± 1s.d.) percentage of daytime and night-time detections in each habitat per individual Greater Painted-snipe at Kam Tin during Summer 2009.*



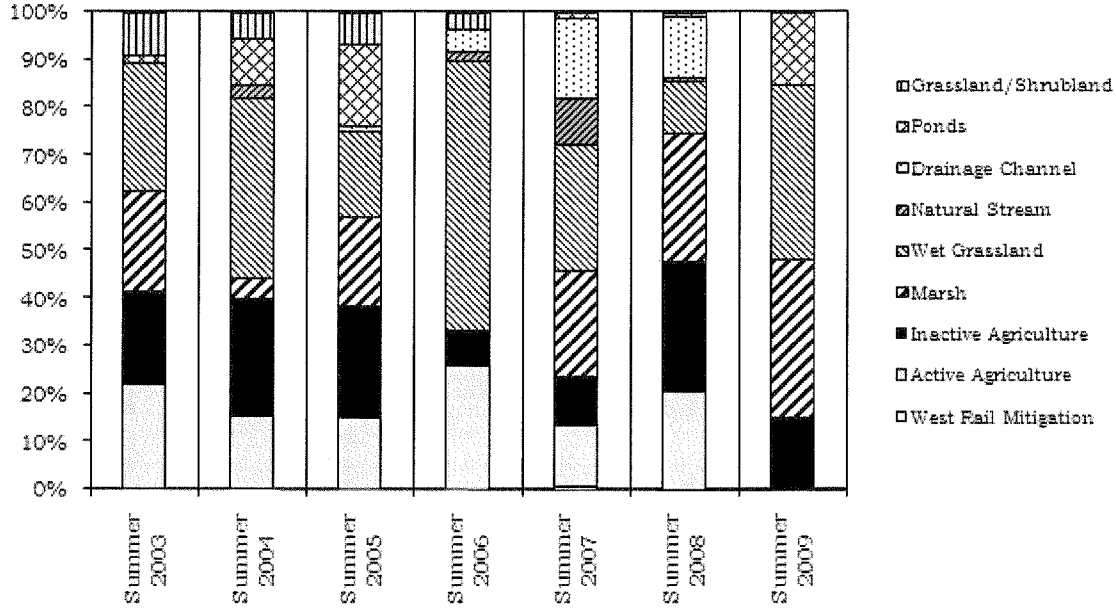
2.4.5 Comparison with the results from previous seasons

2.4.5.1 The distributions of radio-tracked Greater Painted-snipe during the last four summers are shown in Figure 6. Birds are generally fairly mobile at this time of year, and in most years are detected at various locations through the Kam Tin Valley. Despite searches throughout the valley, no birds were detected away from the Buffalo Fields/Shui Mei area during Summer 2009, although Females 1 and 2 disappeared and may have been wandering more widely through the area. As in previous years, the Buffalo Fields and nearby agricultural fields were well used during Summer 2009.

2.4.5.2 The habitat selection in each summer since 2003 is shown in Figure 7. Unlike previous summers, birds were not recorded in active agricultural land during 2009. The use of ponds was higher than in previous years, but otherwise the habitat selection was fairly similar between years.

2.4.5.4 There was no significant difference between Summer 2009 and previous summers in terms of commuting distance between sites used by day and at night (mean values for previous summers range from 240m to 633m, Summer 2009 487m: Wilcoxon/Kruskal-Wallis Rank Sum test, df=6, $p>0.1$) or home range size (mean values for previous summers range from 13.0ha to 54.4ha, Summer 2009 18.5ha: Wilcoxon/Kruskal-Wallis Rank Sum tests, df=6, $p>0.1$).

Figure 7. *Habitat selection of Greater Painted-snipe at Kam Tin during each summer since 2003.*



2.4.5.5 Two individuals trapped during Summer 2009 have previously been radio-tracked (Females 3 and 4). The distribution of detections for each of these birds is shown in Figure 8. The behavior of these birds and sites used was similar to that observed when these individuals have been tracked previously; such site-fidelity has been observed on many Greater Painted-snipe at Kam Tin.

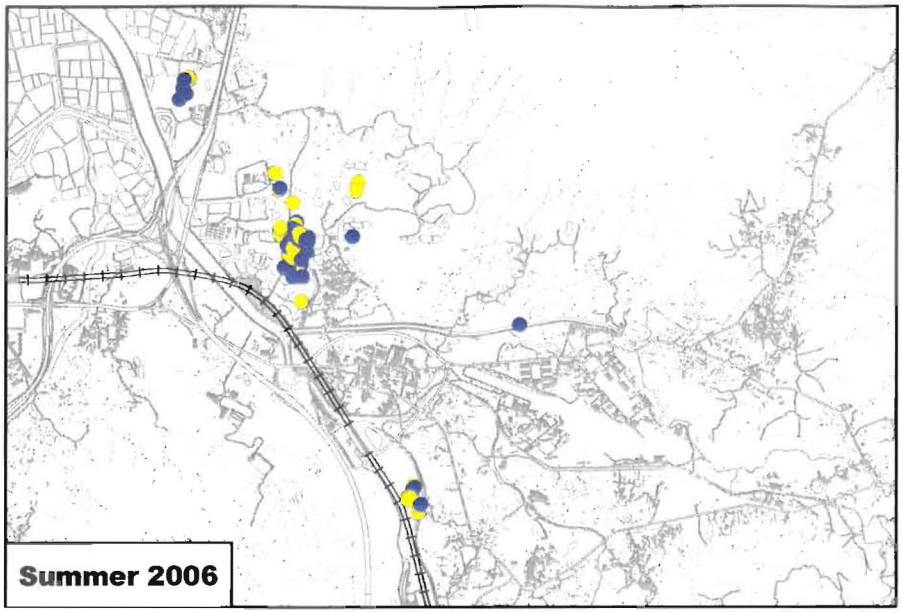
2.5 Monitoring of Greater Painted-snipe core sites

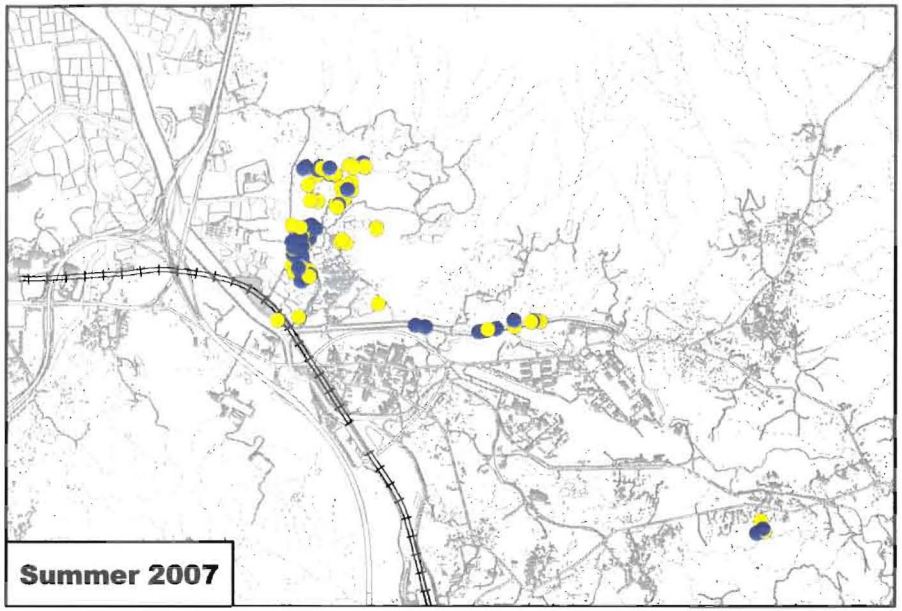
2.5.1 The monitoring schedule for the Greater Painted-snipe core sites has been revised so that these sites are now only surveyed once during the wet and once during the dry season. Wet season surveys were carried out during July 2009. The results of these surveys will be included in the annual report at the end of the year.

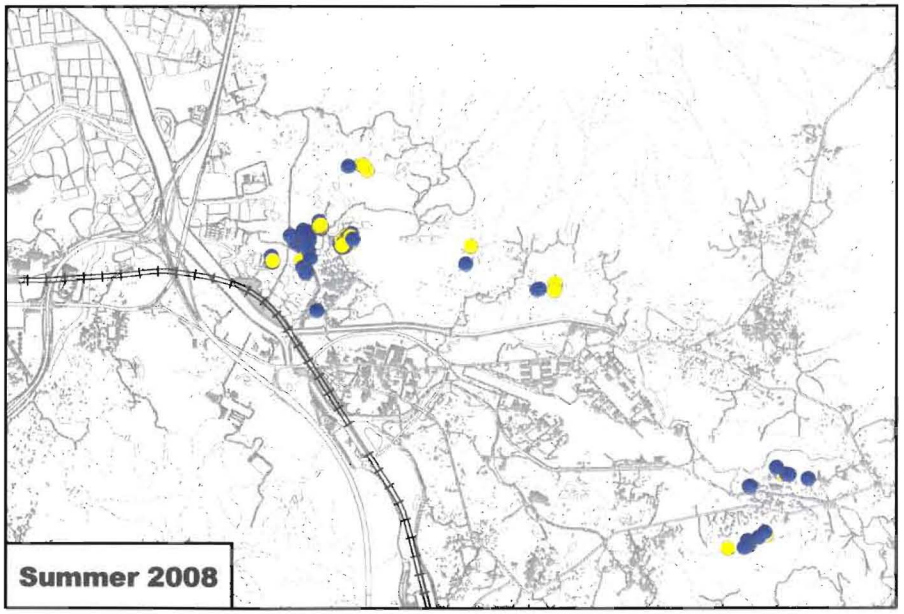
2.6 Records of Greater Painted-snipe from within the Created Wetlands

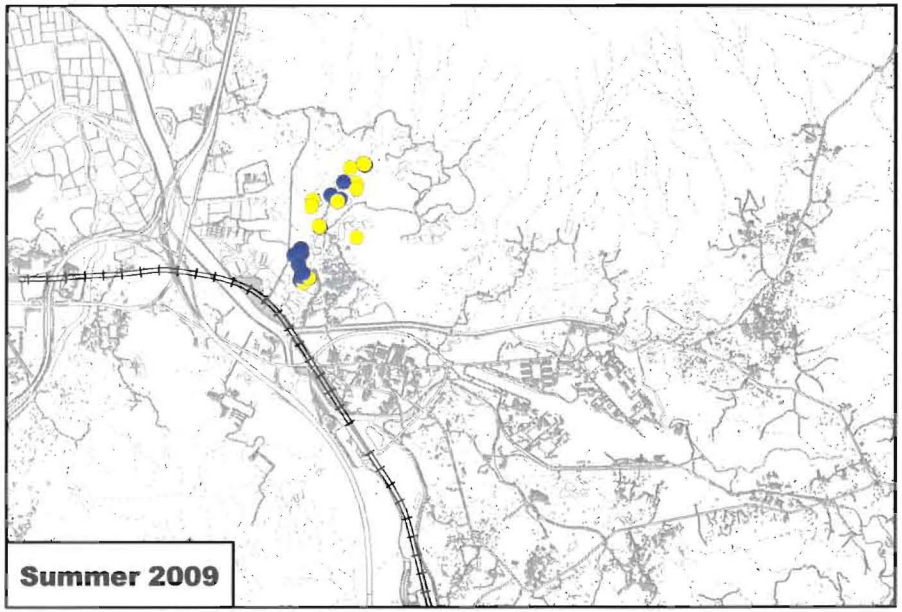
2.6.1 Greater Painted-snipe are the primary target species for the created wetlands in Land Parcels A, B, B1 and D; in addition, the provision of nocturnal foraging sites is considered a possibility in Land Parcel E (ERM 2001, AEC 2009a). In previous seasons, the species has been recorded in each of these land parcels, as well as Land Parcels C, F, I and J.

2.6.2 None of the radio-tracked Greater Painted-snipe were recorded in the land parcels during the day or at night.

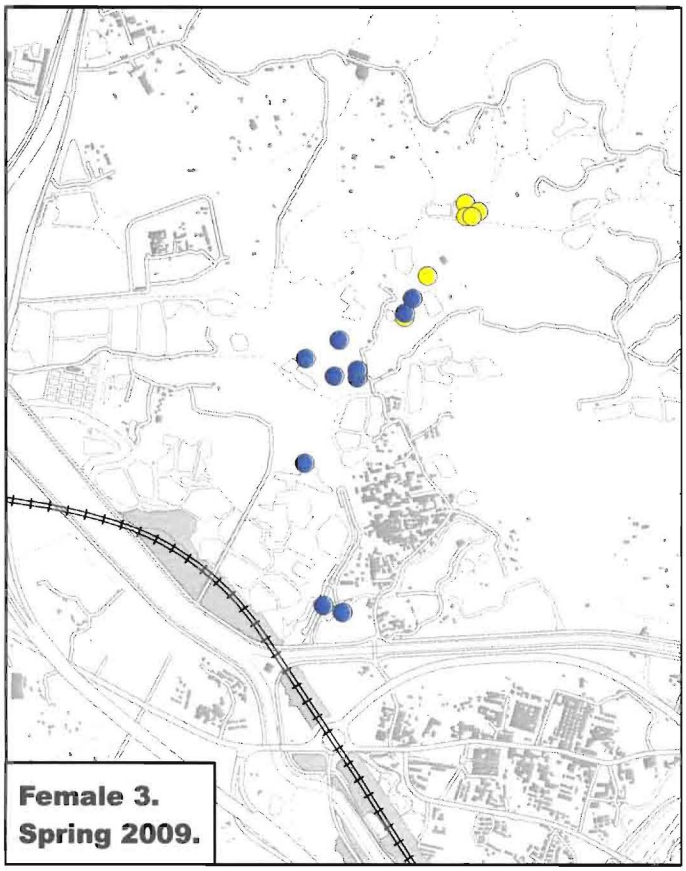


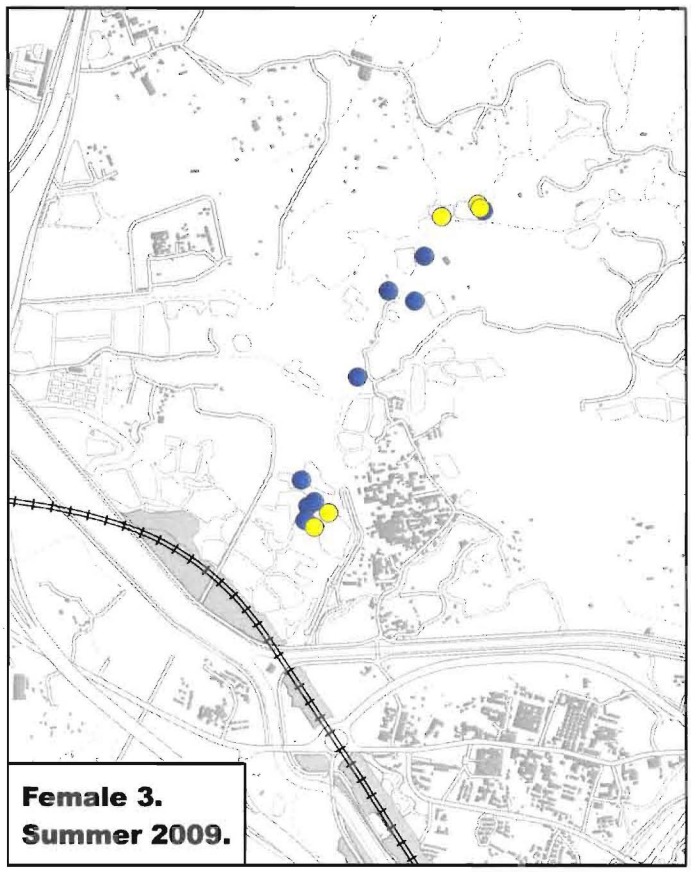


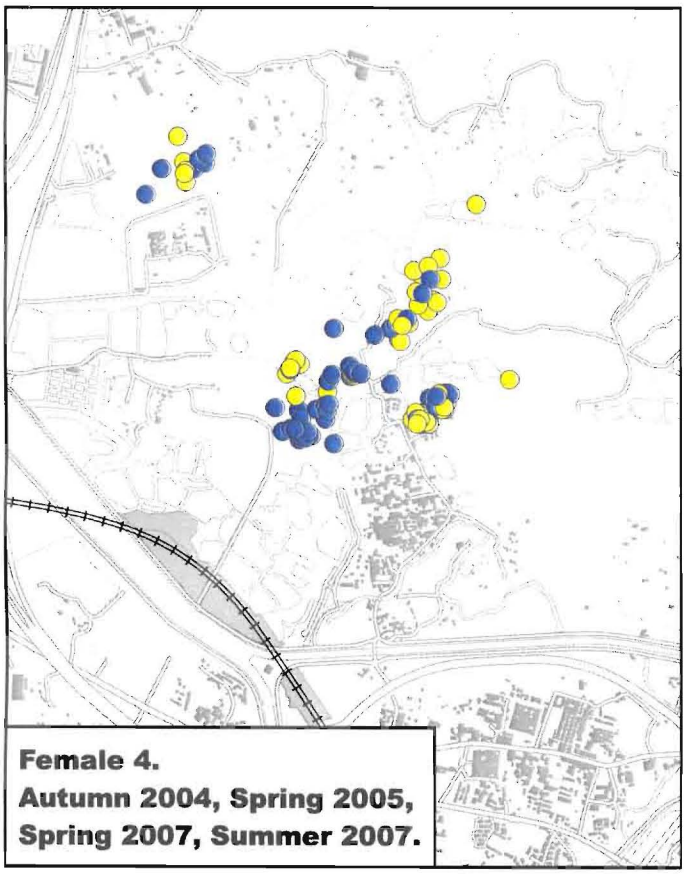


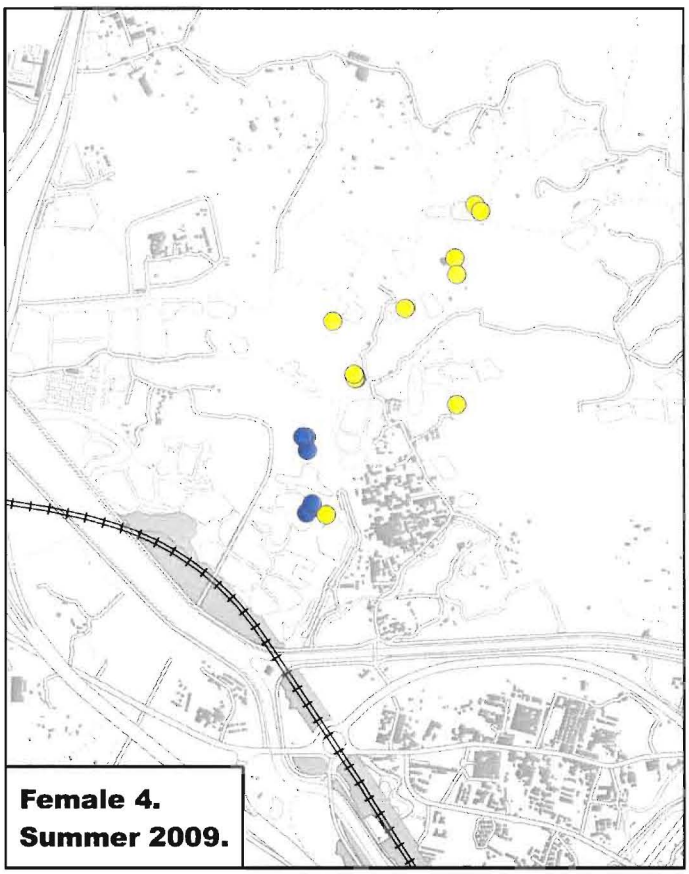


Asia Ecological Consultants Ltd.	
Scale 1:60,000	**Figure 6. Locations of radio-tracked Greater Painted-snipe in the Kam Tin area during the last four summers**









Asia Ecological Consultants Ltd.	
Scale 1:20,000	Figure 8. Locations of individual Greater Painted-snipe radio-tracked during Summer 2009 and previous seasons

2.6.3 There were no records of Greater Painted-snipe within the West Rail land parcels during Summer 2009. The species is not often recorded from the land parcels during summer, probably because water levels are not suitable at this time of year.

2.7 Conclusions

2.7.1 There was no evidence of Greater Painted-snipe using the West Rail wetlands during Summer 2009. No birds were observed during bird surveys and no radio-tracked individuals were recorded within the land parcels. Water levels are high at this time of year as a result of normal wet season rainfall. Due to the profile of the land parcels, this reduces the area of habitat available for Greater Painted-snipe (shallow water with or soft mud with wetland vegetation). It is expected that when water levels fall with the onset of the dry season, birds will return to the land parcels where suitable vegetation exists, especially in Land Parcel D.

2.7.2 Greater Painted-snipe remain in the area close to West Rail. Radio-tracked birds were regularly recorded from the southern end of the Buffalo Fields, close to Land Parcels B and D. It is expected that these birds will find suitable habitat in the land parcels when it becomes available.

3. WETLAND BIRDS

3.1 Bird surveys were started within one hour of sunrise and followed transects which covered both wetland habitats and terrestrial habitats, where these were present. Six visits were made to those land parcels targeting bird species (Land Parcels A, B, B1, D and E), on 5th and 19th June, 3rd and 27th July and 14th and 24th August 2009. Three visits were made to the remaining land parcels, on 9th June, 4th August and 18th August 2009. Results are given in Appendix 1 and summarised in Table 5. Full species lists for all land parcels will be included in the annual report at the end of 2009.

3.2 A total of 38 species were recorded from the MTRC mitigation wetlands on bird surveys during Spring 2009. Of these, 15 are considered to be wetland-dependent (39%).

Table 5. *Total number of bird species and number of wetland-dependent bird species recorded in each land parcel, Summer 2009.*

Land Parcel	Total number of species	Number of wetland-dependent species	% of wetland-dependent species
A	21	10	48
B	16	4	25
B1	4	0	0
C	6	2	33
D	22	5	23
E	21	4	19
F	2	0	0
G	6	0	0
H	10	1	10
I	5	0	0
J	17	4	24
K	11	1	9
L	4	1	25
All Land Parcels	**38**	**15**	**39**

4. MAMMALS

4.1 One Ryukyu Mouse *Mus caroli* was recorded from Land Parcel B during July 2009. This species is uncommon in Hong Kong, occurring mostly in the north-west New Territories (Shek 2006).

5. HERPETOFAUNA

5.1 Daytime herpetofauna surveys were conducted in most land parcels on 9th and 29th June, 13th and 27th July and 10th and 26th August 2009. Land Parcels A, C, F and G do not target herpetofauna and were only surveyed on 9th June, 13th July and 10th August 2009.

5.2 Night-time herpetofauna surveys were conducted in most land parcels on 9th and 29th June, 13th and 27th July and 12th and 26th August 2009. Land Parcels A, C, F and G were surveyed on 9th June, 13th July and 12th August 2009.

5.3 Herpetofauna, especially reptiles, are relatively difficult to observe, so the results of the scheduled surveys were supplemented by any casual observations over the course of the season. Results are summarised in Table 6. Full species lists for these groups, and comparisons with previous years, will be included in the annual report at the end of 2009.

Table 6. *Total number of herpetofauna species recorded in each land parcel during Summer 2009.*

Land Parcel	Number of amphibian species recorded	Number of reptile species recorded
A	0	0
B	4	1
B1	2	1
C	1	0
D	3	3
E	6	1
F	0	1
G	1	1
H	5	0
I	5	1
J	5	3
K1	4	0
K2	4	0
K3	0	0
L	4	0
All Land Parcels	**8**	**9**

5.2 Eight amphibian species were recorded from the wetlands during Summer 2009. This is slightly lower than the total for Summer 2008, when ten species were recorded (AEC 2008b), but this is not considered to be a cause for concern. American Bullfrog *Rana catesbeiana*, which has previously been recorded and is an exotic species which may cause problems for native amphibians, was not recorded during Summer 2009.

5.4 Nine reptile species were recorded from the land parcels during Summer 2009. This is equal to the total diversity recorded in Summer 2008 (AEC 2008b).

6. DRAGONFLIES

6.1 Dragonfly adults and exuviae were surveyed in all land parcels on 9th and 29th June, 13th and 27th July and 10th and 26th August 2009. During the surveys a fixed transect covering terrestrial habitats and the wetland margin was walked, and any species observed was identified. Results are summarised in Table 7.

6.2 A total of 23 dragonfly species was recorded from the West Rail wetlands during Summer 2009. Although this is slightly lower than during Summer 2008, when 27 species were recorded (AEC 2008b), it is not thought to be a cause for concern.

Table 7. *Total number of dragonfly species recorded during surveys in each land parcel during Summer 2009.*

Land Parcel	Number of species recorded as adults	Number of species recorded as exuviae
A	6	0
B	10	0
B1	11	3
C	12	0
D	16	1
E	14	4
F	1	0
G	4	0
H	9	1
I	16	3
J	11	0
K1	12	0
K2	15	0
K3	1	0
L	15	3
All Land Parcels	**23**	**3**

6.3 Dragonfly exuviae (discarded larval skins) were also recorded when these were found during dragonfly surveys. The exuviae of only three species were recorded during Summer 2009.

6.4 Dragonfly exuviae traps in Land Parcels D and E were monitored on a weekly basis throughout Summer 2009. One species was recorded using the traps in Land Parcel D and three species in Land Parcel E (including one species not recorded on other surveys). Three species were also recorded during Summer 2008 (AEC 2008b).

6.5 Full dragonfly species lists for all land parcels, and comparison of dragonfly abundance with results from previous years, will be included in the annual report at the end of 2009.

7. BUTTERFLIES

7.1 No scheduled surveys for butterflies were carried out. Adult butterflies were incidentally recorded during surveys for other faunal groups or during site visits. The number of species recorded in each land parcel during Summer 2009 is shown in Table 8. Full species lists for all land parcels will be included in the annual report at the end of 2009.

7.2 A total of 30 butterfly species was observed in the land parcels between June and August 2009. This total is relatively high compared to previous seasons. No species of conservation importance were recorded.

Table 8. *Number of butterfly species recorded in each land parcel, Summer 2009.*

Land Parcel	Number of butterfly species recorded
A	8
B	8
B1	3
C	9
D	13
E	14
F	4
G	1
H	3
I	8
J	12
K1	13
K2	4
K3	2
L	4
All Land Parcels	**30**

8. WATER QUALITY

8.1 Water quality was measured in all land parcels on 13th July and 10th August 2009. Parameters measured were temperature, pH, conductivity, turbidity and dissolved oxygen (DO). Results (the mean of three values taken within the land parcel) are presented in Tables 9 and 10. Water depths were also recorded from permanent markers in each land parcel on both of these dates, where these depth markers are present and legible.

8.2 Low pH and high conductivity in some land parcels (especially Land Parcels B1 and E) was highlighted during the Spring 2009 report (AEC 2009c). The results from Summer 2009 show that these values have returned to more normal levels following wet season rainfall. The current water quality values do not give any cause for concern.

Table 9. *Water quality measurements in West Rail mitigation wetlands, 13th July 2009.*

Land Parcel	Temp. °C	pH	Conduct. %	Turbidity mg/l	DO mg/l	Depth m
A	33.3	7.02	0.377	15	1.33	-
B	32.7	6.89	0.080	2	4.20	x
B1	38.6	6.49	0.183	11	2.74	-
C	34.3	7.04	0.087	25	8.08	-
D	34.0	6.83	0.083	3	3.98	x
E	31.9	5.30	0.103	1	3.13	0.45
F	No Water					
G	No Water					
H	32.7	6.27	0.040	11	2.14	-
I	31.6	6.67	0.040	6	1.90	x
J	31.8	6.50	0.043	7	3.88	0.9
K1	31.7	6.94	0.053	32	1.98	2.5
K2	31.5	7.97	0.090	27	4.93	-
L	31.3	6.75	0.100	2	0.75	x

x Water depth marker illegible

Table 10. *Water quality measurements in West Rail mitigation wetlands, 10th August 2009.*

Land Parcel	Temp. °C	pH	Conduct. %	Turbidity mg/l	DO mg/l	Depth m
A	Low Tide – insufficient water					
B	31.8	6.73	0.070	5	2.74	x
B1	32.4	6.49	0.097	6	2.74	-
C	32.2	7.06	0.120	25	2.54	-
D	32.7	6.67	0.083	9	2.68	x
E	32.3	6.43	0.050	11	2.75	1.0
F	No Water					
G	No Water					
H	30.8	5.98	0.037	5	3.02	-
I	32.4	6.30	0.023	14	2.80	1.2
J	32.9	6.20	0.030	5	2.56	1.0
K1	32.4	6.82	0.047	22	2.64	2.6
K2	32.8	7.21	0.070	13	2.60	-
L	31.4	6.69	0.090	5	2.92	x

x Water depth marker illegible

9. VEGETATION MONITORING

9.1 Wet season vegetation monitoring was conducted in June 2009, comprising vegetation survey along a fixed number of transects and quadrats in the land parcels. Walk-over surveys covering all vegetation in the terrestrial and wetland habitats in land parcels were also conducted to provide a full list of vegetation established in these managed mitigation wetland.

9.2 A total of 240 plant species were recorded in the 2009 wet season, including 158 native and 82 exotic plant species. The vegetation composition and pattern recorded from the quadrat surveys are comparable with those recorded in previous monitoring. Tables 11 and 12 summarize the number of species recorded in each land parcel and in each surveyed habitat (terrestrial, seasonal marsh and marsh).

9.3 The vegetation composition and pattern remained similar to the last dry season monitoring in 2008. The terrestrial habitat of the land parcels are generally covered by fast-growing grass (such as *Panicum maximum*, *Brachiaria mutica* and *Imperata koenigii*), weedy herbs (*Bidens alba*, *Eupatorium catarium* and *Mikania micrantha*) and planted shrubs and small trees (such as *Rhaphiolepis indica*, *Gardenia jasminoides* var. *fortuniana* and *Ilex rotunda*). The marshy area, which includes both seasonal marsh and marsh habitats, is largely covered by grassy vegetation (such as *Panicum repens*, *Paspalum paspaloides*, *Leersia hexandra* and *Paspalum conjugatum*) and patches of planted or naturally-established wetland species (such as *Cyperus malaccensis*, *Lepironia articulata*, *Polygonum barbatum* and *Commelina diffusa*). The overall plant species recorded in the current survey is comparable with the previous monitoring, but more patches of wetland plant groups (for example Cyperaceae spp. and *Polygonum* spp.) were present around the ponds and marshy areas. Appendices 2 and 3 show the full plant list of the vegetation recorded in the land parcels and plant survey data of the surveyed habitats.

Table 11. *Total number of plant species recorded in each land parcel, June 2009.*

	Land Parcel														
	A	**B**	**B1**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K1**	**K2**	**K3**	**L**
Total no. of species	69	92	62	78	82	99	53	39	58	76	129	66	34	13	73
No. native species	44	59	43	49	54	66	30	25	32	43	86	42	15	7	51
No. exotic species	25	33	19	29	28	33	23	14	26	33	43	24	19	6	22

Table 12. *Number of plant species recorded in quadrats in the habitat zones of each land parcel, June 2009.*

	Land Parcel														
	A	**B**	**B1**	**C**	**D**	**E**	**F**	**G***	**H**	**I**	**J**	**K1**	**K2**	**K3***	**L**
Terrestrial	20	22	11	15	7	19	7	7	4	10	33	10	12	3	9
Seasonal marsh	5	17	7	7	12	15	6	-	9	10	15	12	4	-	11
Marsh	5	9	7	1	11	8	5	-	6	7	15	8	2	-	5

* No seasonal marsh and marsh habitats in G due to the current drainage construction work and no seasonal marsh and marsh habitats have been sustained in K3.

9.4 Except in Land Parcels D, I and H, the current monitoring was conducted prior to the regular vegetation management (such as grass cutting and removal of weedy exotic herbs and climbers). More comprehensive information on plant growth and vegetation change from dry to wet seasons could be observed. The vegetation management has generally maintained sustainable and healthy plant colonies, with appropriate regular removal of weedy herbs (*Bidens alba* and *Sesbania cannabina*), grass (*Brachiaria mutica*) and small trees (*Leucaena leucocephala*). The management also enhances the microhabitats for wildlife usage (for example, management of emergent vegetation around ponds for herpetofauna and dragonflies).

Maintenance of water in ponds and marshy area

9.5 Ponds and marshes are important elements in mitigation wetlands and most land parcels contain ponds, open water or marshes of various sizes. Rain water in wet season is a major source for these wetland habitats. The 2009 has been relatively dry and water levels have been lower in the mitigation wetlands than in previous years. This has been particularly noticeable in the seasonal wetlands in Land Parcels D, E, H, J and K2. Grassy vegetation is more tolerant to drier environment, while prolonged drought and exposed conditions reduce the vigor of some wetland species such as *Ipomoea aquatica, Polygonum barbatum, Polygonum glabrum, Polygonum plebeium* and *Cyperus malaccensis.* Maintaining at least a damp marsh area can sustain the wetland plants, and the health of these species will require monitoring in future surveys.

Vegetation control

9.6 Vegetation control of unwanted plants is critical in wetland management since the mitigation wetlands are often dominated by fast-growing herbaceous plants. The colonization and spread of a number of unwanted plants (such as exotic climbers *Mikania micrantha* and *Ipomoea cairica*, herbs *Bidens alba, Mimosa pudica* and *Sesbania cannabina* and tree *Leucaena leucocephala*) requires regular vegetation management within

the land parcels. As an example of the effectiveness of this management, comparison with previous monitoring data shows that the abundance of *Sesbania cannabina* and *Leucaena leucocephala* in Land Parcels I and G has been progressively reduced as a result of ongoing vegetation management.

9.7 Grassy vegetation in terrestrial habitats is cut on a fairly regular basis in the land parcels. Despite this, the invasive large grass *Brachiaria mutica* has spread extensively through Land Parcel A. Rapid regrowth of grasses and herbs in Land Parcel C has also been noted despite very regular and extensive cutting in this land parcel. The small ponds located at the southeastern corner in Land Parcel C are often covered by extensive herbaceous plants. Unlike the other land parcels, the soil profile and vegetation along the rivers in Land Parcels A and C has not been significantly modified since the land was obtained by MTRC. It is believed that seed of these aggressive grass and herbs were retained in this undisturbed soil and hence provide abundant seed sources for the regeneration of these herbs. Trees planted in the terrestrial area of Land Parcel C have assisted in limiting the regrowth of grasses, and some re-profiling of this land parcel has also been discussed, which would help to encourage the growth of wetland species in preference to the aggressive terrestrial species currently present.

9.8 Colonies of exotic weedy herb *Typha angustifolia* continue to spread around the pond and marshy areas in Land Parcels B1 and D. *Typha angustifolia* can spread through vegetative reproduction by its extensive rhizome systems and its wind-pollinated seeds can easily geminate in any moist areas. This species has not become a problem in Land Parcel B despite years of presence, and small stands of *Typha* provide some shelter for Greater Painted-snipe, one of the main targets for these land parcels. Nevertheless, it is recommended that the spread of this species in Land Parcels B1 and D should be monitored and controlled if necessary.

Maintenance of mitigation wetlands in Land Parcels F and G

9.9 Despite being created as a reservoir for Land Parcels E and J, no water has been stored in Land Parcel F during the current wet season. The dry land present has become dominated by grassy vegetation (mainly *Brachiaria mutica*) and limited herbs (such as reed *Phragmites australis*, herbs *Rumex trisetifer* and *Polygonum lapathifolium*). Previous years have shown that water cannot be retained at a satisfactory level in the land parcel, and it is anticipated that in the long term the dry land would be progressively colonized by grassy vegetation due to its easier establishment. The future management of this land parcel to permit the establishment of wetland habitats has been discussed and it is likely that some reprofiling will take place, probably involving the planting of *Phragmites* to create reedbed habitat.

9.10 Drainage construction work was still being undertaken in Land Parcel G during the current monitoring. During the construction period no wetland can be retained within the land parcel, leaving terrestrial habitats dominated by shrubby planting, grass (such as *Digitaria ciliaris* and *Panicum maximum*) and herbs, especially invasive *Bidens alba*. As the construction work is now completed, it is expected that the lower-lying land at this construction area may be able to retain water in the future. It is recommended to consider the need for replanting of the land parcel to improve the vegetation composition and structure and thus enhance any wetland function in Land Parcel G.

Fire in Land Parcel L

9.11 A fire was reported on 5th May 2009 in Land Parcel L (AEC 2009c). Approximate 50 % of vegetation within the Land Parcel was burnt, including the planted shrubs (*Gardenia jasminoides* var. *fortuniana* and *Rhaphiolepis indica*) and grassy vegetation along the southwestern boundary. Evidence of the fire in the form of burnt vegetation was obvious during the vegetation monitoring. The burnt grass (such as *Panicum maximum* and *Imperata koenigii*) was found to regenerate quickly, but the shrubs were more significantly impacted, with leaves and branches killed by the fire. Burnt soil provides an unfavorable growth medium for woody species, especially in summer when the exposed soil dehydrates rapidly under the sun. A small number of shrubs have been killed by this fire or the subsequent drought, but regeneration of new buds and leaves were observed on some burnt shrubs. Regular checking of the regeneration of these affected shrubs is suggested. If no regeneration sign of these shrubs were observed before the 2010 wet season, replacement planting of shrubs may be required.

10. GENERAL HABITAT CHARACTERISTICS OF LAND PARCELS

10.1 The availability of habitats in the land parcels is to be determined by mapping of each land parcel during the wet and dry season. Habitat mapping for the wet season was carried out in August 2009. The results have not yet been fully digitized and are not included in this report. Results from the wet and dry season habitat mapping will be included in the annual report.

10.2 No observations during the habitat mapping exercise gave cause for concern about the management of the land parcels.

11. MANAGEMENT OF WEST RAIL MITIGATION WETLANDS

11.1 Weeding has been carried out in Land Parcels B (July), C (July), D (June), F (August), G (July), H (June), I (June), J (August) and K (August). Grass cutting was carried out in Land Parcel A during July 2009. This vegetation management has concentrated on the removal of exotic species to limit the spread of these species and prevent problems arising from competition with other vegetation. Main problem species requiring control in this period have included *Mikania micrantha*, *Bidens alba*, *Brachiaria mutica*, *Wedelia trilobata*, *Sesbania cannabina*, *Desmodium tortuosum* and *Leucaena leucocephala*.

11.2 Lotus *Nelumbo nucifera* was planted in the area of Land Parcel J adjacent to Kat Hing Garden during July 2009. It is hoped that this species will spread through this area to provide a visual benefit to local residents, to reduce the problem of mosquito breeding (especially through control of dense, grassy vegetation) and to provide an alternative habitat for wetland-dependent birds, herpetofauna and dragonflies. Plants were obtained from the mitigation wetlands for MTRC Lok Ma Chau Spur Line.

11.3 In order to help control mosquito breeding which may cause nuisance to local residents, mosquito fish *Gambusia affinis* were released into Land Parcel J on 8th July 2009. These were obtained from the breeding stock at the mitigation wetlands for MTRC Lok Ma Chau Spur Line.

11.4 Much of Land Parcel L was burnt during early May 2009 (AEC 2009c). Grasses have recovered rapidly from this fire and have since regrown. Some shrubs have started to regrow but others appear to have been largely or entirely killed by the fire. It is not presently considered necessary to replace these shrubs.

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APPENDICES

APPENDIX 1. *Bird species recorded during bird surveys within the West Rail mitigation areas during Summer 2009 (June – August 2009).*

APPENDIX 2. *Plant species recorded during vegetation surveys in West Rail mitigation wetlands, June 2009.*

APPENDIX 3. *Plant species recorded in quadrats in the terrestrial, seasonal marsh and marsh zones of the West Rail mitigation wetlands, June 2009.*

Appendix 1. *Bird species recorded during bird surveys within the West Rail mitigation areas during Summer 2009 (June – August 2009). Values are means of all counts, with the range for the number recorded on each survey given in parentheses. Wetland-dependent species are highlighted in bold.*

Species	**Land Parcel**												
	A	**B**	**B1**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Little Grebe ***Tachybaptus ruficollis***		**0.2 (0-1)**			**0.2 (0-1)**								
Great Cormorant ***Phalacrocorax carbo***													
Great Egret ***Egretta alba***	**1.5 (0-6)**												
Little Egret ***Egretta garzetta***	**3.2 (0-8)**				**0.3 (0-2)**						**0.3 (0-1)**		
Cattle Egret ***Bubulcus ibis***		**X**			**X**	**0.2 (0-1)**							
Chinese Pond Heron ***Ardeola bacchus***	**0.2 (0-1)**			**0.3 (0-1)**		**1.2 (0-5)**					**0.7 (0-2)**		**1.0 (0-2)**
Black-crowned Night Heron ***Nycticorax nycticorax***	**2.0 (0-10)**												
Yellow Bittern ***Ixobrychus sinensis***											**0.7 (0-2)**		
White-breasted Waterhen ***Amaurornis phoenicurus***	**1.7 (0-3)**	**0.3 (0-2)**		**0.7 (0-2)**	**1.8 (0-4)**	**2.0 (0-5)**			**0.3 (0-1)**		**2.3 (1-4)**	**0.3 (0-1)**	
Little Ringed Plover ***Charadrius dubius***	**1.2 (0-4)**												
Green Sandpiper ***Tringa ochruros***	**0.2 (0-1)**												
Wood Sandpiper ***Tringa glareola***	**0.5 (0-3)**												
Common Sandpiper ***Actitis hypoleucos***	**0.2 (0-1)**												
Pintail/Swinhoe's Snipe# ***Gallinago stenura/megala***	**0.5 (0-3)**												
Rock Dove *Columba livia*										1.0 (0-3)			
Spotted Dove *Streptopelia chinensis*		0.2 (0-1)			0.3 (0-2)	0.8 (0-2)				0.3 (0-1)			
Common Koel *Eudynamys scolopaceus*					0.2 (0-1)	0.3 (0-2)							
Greater Coucal *Centropus sinensis*				0.3 (0-1)									
Little Swift *Apus affinis*											1.0 (0-3)		

Species	Land Parcel												
	A	**B**	**B1**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
Common Kingfisher ***Alcedo atthis***		**0.7 (0-1)**			**0.3 (0-1)**								
Pied Kingfisher ***Ceryle rudis***						**0.2 (0-1)**							
Barn Swallow *Hirundo rustica*	0.2 (0-1)					0.3 (0-1)					2.0 (0-6)		
White Wagtail *Motacilla alba*	0.5 (0-1)								0.7 (0-1)		0.3 (0-1)	0.7 (0-2)	
Red-whiskered Bulbul *Pycnonotus jocosus*	1.0 (0-6)			0.3 (0-1)	0.5 (0-2)	2.3 (0-8)			0.3 (0-1)		0.3 (0-1)	0.3 (0-1)	
Chinese Bulbul *Pycnonotus sinensis*	0.7 (0-2)	1.2 (0-3)			0.5 (0-2)	1.0 (0-3)		0.7 (0-2)	1.3 (0-4)		2.3 (0-4)	1.7 (0-4)	
Sooty-headed Bulbul *Pycnonotus aurigaster*		0.2 (0-1)			X	0.7 (0-2)						0.3 (0-1)	
Long-tailed Shrike *Lanius schach*	0.3 (0-1)	0.5 (0-1)			0.3 (0-1)	1.3 (0-3)			0.3 (0-1)			0.3 (0-1)	
Oriental Magpie Robin *Copsychus saularis*	1.2 (0-2)	0.7 (0-3)			0.7 (0-2)			0.7 (0-2)	0.3 (0-1)		2.0 (1-3)		0.7 (0-1)
Masked Laughingthrush *Garrulax personata*	0.5 (0-3)	0.5 (0-3)			0.7 (0-4)	2.0 (0-6)				1.0 (0-2)	0.7 (0-2)	X	
Yellow-bellied Prinia *Prinia flaviventris*	1.7 (0-4)	0.7 (0-2)	0.5 (0-2)		0.8 (0-2)	0.3 (0-1)	0.7 (0-1)	X	1.3 (0-4)	1.7 (1-2)	2.0 (1-3)	1.3 (0-2)	0.7 (0-2)
Plain Prinia *Prinia inornata*	0.2 (0-1)	1.5 (0-5)	0.5 (0-2)		0.2 (0-1)	0.7 (0-4)			4.0 (2-5)		1.0 (0-2)	0.3 (0-1)	
Common Tailorbird *Orthotomus sutorius*	0.2 (0-1)			0.7 (0-1)	0.2 (0-1)	0.3 (0-2)				0.7 (0-2)			
Great Tit *Parus major*						0.3 (0-2)							
Japanese White-eye *Zosterops japonicus*				1.0 (0-3)	1.8 (0-5)	0.8 (0-4)		0.3 (0-1)			0.7 (0-2)	1.7 (0-5)	
Scaly-breasted Munia *Lonchura punctulata*		0.3 (0-2)	1.5 (0-7)		0.5 (0-2)	0.2 (0-1)			7.0 (2-10)				
Eurasian Tree Sparrow *Passer montanus*					0.8 (0-5)	0.2 (0-1)		2.3 (2-3)	0.7 (0-2)		7.3 (4-9)	1.3 (0-4)	0.7 (0-2)
Black-collared Starling *Sturnus nigricollis*		0.3 (0-2)			0.2 (0-1)						0.3 (0-1)		
White-shouldered Starling *Sturnus sinensis*		1.5 (0-9)			2.8 (0-12)	1.3 (0-8)							
Crested Myna *Acridotheres cristatellus*	0.8 (0-4)	2.5 (0-6)	0.5 (0-3)		3.0 (1-6)	3.2 (0-9)	0.7 (0-2)	0.3 (0-1)			3.3 (2-5)		

X Species recorded outside standard survey

These two species are considered to be inseperable in the field.

Appendix 2. *Plant species recorded during vegetation surveys in West Rail mitigation wetlands, June 2009.*

Species	Native/ Exotic	A	B	B1	C	D	E	F	G	H	I	J	K1	K2	K3	L
Abrus mollis	N															Y
Acacia auriculiformis	E											Y				
Acacia confusa	E	Y	Y			Y	Y				Y	Y	Y	Y		Y
Acacia mangium	E		Y				Y			Y						
Acacia pennata	N											Y				
Acanthus ilicifolius	N	Y														
Achyranthes aspera	N	Y	Y				Y				Y					
Aeschynomene indica	N	Y	Y	Y	Y	Y	Y					Y				
Ageratum conyzoides	E				Y					Y	Y	Y				Y
Albizia lebbeck	E	Y			Y		Y					Y				
Alchornea trewioides	N						Y								Y	
Aleurites moluccana	E				Y											
Alocasia odara	N	Y			Y		Y					Y				Y
Alternanthera paronychioide	E		Y									Y				
Alternanthera philoxeriodes	N	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y			Y
Alternanthera sessilis	N		Y	Y	Y	Y	Y					Y				
Alysicarpus vaginalis	N		Y										Y	Y		
Amaranthus spinosus	E											Y				
Amaranthus viridis	N	Y			Y							Y				
Aster subulatus	E	Y	Y	Y	Y	Y	Y			Y	Y	Y				Y
Bacopa monnieri	N					Y										Y
Bambusa spp.	E	Y	Y			Y										
Bauhinia variegata	E						Y						Y			Y
Benincasa hispida	E										Y					
Bidens alba	E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Bidens pilosus	E											Y				
Bombax ceiba	E		Y		Y	Y	Y	Y				Y				
Bothriochloa bladhii	N	Y	Y	Y	Y	Y			Y			Y	Y			
Bothriochloa ischaemum	N						Y	Y					Y	Y		Y
Brachiaria mutica	E	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y
Bridelia tomentosa	N	Y					Y	Y				Y	Y	Y		Y
Broussonetia papyrifera	N											Y				
Cajanus scarabaeoides	N	Y						Y		Y	Y		Y	Y		Y
Callicarpa kochiana	N															Y
Camellia spp.	N/E								Y							
Carica papaya	E				Y						Y					
Cassia alata	E							Y								
Cassia surattensis	E						Y									
Casuarina equisetifolia	E												Y			
Cayratia corniculata	N											Y				
Celosia argentea	N					Y		Y								
Celtis sinensis	N	Y	Y		Y	Y	Y		Y	Y	Y	Y		Y		Y
Cenchrus echinatus	E										Y					
Centella asiatica	N			Y		Y	Y			Y	Y	Y				
Chenopodium album	N											Y				
Chloris barbata	N	Y	Y		Y				y			Y				
Chloris formosana	N		Y						Y							
Cinnamomum burmannii	N				Y					Y		Y				
Cinnamomum camphora	N											Y				

Species	Native/ Exotic	A	B	B1	C	D	E	F	G	H	I	J	K1	K2	K3	L
Citrus maxima	E						Y									
Clausena lansium	E										Y					
Cleistocalyx operculatus	N								Y							
Colocasia esculenta	N				Y		Y					Y				
Commelina diffusa	N	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y			Y
Conyza canadensis	E				Y						Y		Y			
Conyza sumatrensis	E											Y				
Crassocephalum crepidioides	E				Y		Y									
Crinum asiaticum	N	Y														
Crotalaria pallida	E												Y			
Cuphea petiolata	E				Y					Y	Y	Y		Y		
Curcuma aromatica	N											Y				
Cuscuta australis	N						Y		Y			Y		Y		Y
Cuscuta chinensis	N		Y		Y											
Cyclosorus interruptus	N		Y			Y	Y					Y				
Cyclosorus spp.	N											Y				
Cynodon dactylon	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Cyperus difformis	N			Y												
Cyperus distans	N	Y														
Cyperus exaltatus	N		Y	Y			Y					Y				
Cyperus flabelliformis	E			Y	Y		Y					Y				
Cyperus haspan	N		Y	Y		Y	Y		Y		Y		Y			
Cyperus imbricatus	N		Y	Y	Y	Y	Y						Y			
Cyperus iria	N		Y	Y	Y	Y		Y								Y
Cyperus malaccensis	N	Y	Y	Y		Y	Y			Y		Y	Y			Y
Cyperus pilosus	N		Y	Y		Y	Y									
Cyperus rotundus	N				Y					Y		Y				
Dactyloctenium aegyptium	N				Y				Y			Y				
Desmodium gangeticum	N		Y				Y					Y	Y	Y		Y
Desmodium heterocarpon	N						Y									
Desmodium heterophyllum	N									Y	Y					Y
Desmodium tortuosum	E					Y	Y		Y	Y			Y	Y		
Desmodium velutinum	N												Y			
Digitaria ciliaris	N	Y	Y					Y	Y	Y		Y				
Digitaria longiflora	N						Y									
Digitaria sanguinalis	N	Y		Y	Y							Y	Y			
Dimocarpus longan	E						Y									
Dioscorea cirrhosa	N										Y					
Echinochloa colona	N	Y	Y		Y	Y	Y	Y		Y		Y				
Echinochloa crusgalli	N		Y	Y	Y	Y	Y	Y		Y	Y	Y				
Eclipta prostrata	N	Y	Y	Y							Y	Y				Y
Eleocharis dulcis	E		Y	Y												
Eleocharis spiralis	N			Y			Y									
Eleusine indica	E	Y	Y		Y			Y			Y					
Emilia sonchifolia	N			Y	Y		Y		Y	Y	Y	Y	Y	Y		Y
Endospermum chinense	N				Y											
Epipremnum aureum	E											Y				
Eupatorium catarium	E	Y	Y	Y	Y		Y			Y	Y	Y	Y	Y		Y
Euphorbia hirta	E							Y	Y	Y	Y	Y	Y	Y		Y
Euphorbia thymifolia	E				Y			Y					Y			
Ficus benjamina	E		Y			Y										
Ficus hispida	N				Y	Y						Y				Y

Species	Native/ Exotic	A	B	B1	C	D	E	F	G	H	I	J	K1	K2	K3	L
Ficus microcarpa	N			Y		Y	Y		Y			Y	Y			
Ficus pumila	N											Y				
Ficus tinctoria	N			Y												
Ficus variegata var. *chlorocarpa*	N														Y	
Ficus virens var. *sublanceolata*	N												Y			
Fimbristylis aestivalis	N					Y	Y									
Fimbristylis ferruginea	N					Y				Y						
Fimbristylis miliacea	N		Y			Y										
Flueggea virosa	N	Y	Y	Y	Y	Y	Y	Y	Y			Y		Y		Y
Fuirena umbellata	N			Y									Y			Y
Gardenia jasminoides var. *fortuniana*	E	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Hedychium coronarium	E					Y				Y						
Hedyotis auricularia	N		Y				Y			Y	Y	Y	Y			Y
Hedyotis diffusa	N		Y		Y		Y				Y		Y			
Hibiscus rosa-sinensis	E	Y														
Hibiscus tiliaceus	N				Y											
Hydrocotyle sibthorpioides	N															Y
Hymenocallis littoralis	E											Y				
Ilex asprella	N	Y					Y			Y						
Ilex rotunda	N		Y		Y	Y	Y	Y		Y	Y					Y
Imperata koenigii	N	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y	Y		Y
Indigofera suffruticosa	N									Y			Y			
Ipomoea aqautica	E	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y		Y		Y
Ipomoea cairica	E		Y				Y				Y	Y				
Ipomoea triloba	E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Juncus effusus	E					Y										
Kyllinga aromatica	E	Y	Y	Y		Y	Y			Y	Y	Y	Y			
Kyllinga brevifolia	N	Y		Y	Y	Y	Y				Y	Y				Y
Kyllinga monocephala	N	Y	Y	Y	Y							Y	Y			
Lagerstroemia speciosa	E							Y			Y					
Lantana camara	E	Y	Y	Y	Y	Y		Y			Y	Y		Y	Y	Y
Leersia haxandra	N					Y	Y			Y		Y	Y			Y
Lepironia articulata	N		Y		Y	Y				Y		Y	Y			Y
Leptochloa chinensis	N		Y	Y		Y	Y	Y			Y	Y				
Leucaena leucocephala	E	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y
Ligustrum sinense	N										Y		Y			
Lindernia antipoda	N		Y								Y	Y				Y
Lindernia procumbens	N										Y					
Liquidambar formosana	N											Y				
Litsea glutinosa	N	Y										Y	Y			
Ludwigia adscendens	N			Y							Y					
Ludwigia octovalvis	N			Y	Y	Y	Y				Y	Y				Y
Ludwigia perennis	N		Y	Y	Y	Y	Y	Y		Y	Y	Y				Y
Ludwigia x taiwanensis	E		Y			Y		Y				Y				
Lygodium japonicum	N		Y	Y		Y	Y	Y		Y		Y		Y		Y
Lygodium scandens	N						Y									
Macaranga tanarius	N				Y	Y	Y				Y	Y	Y		Y	Y
Macroptilium atropurpureum	E							Y								
Macroptilium lathyroides	E	Y	Y			Y	Y	Y			Y	Y				
Maesa perlarius	N		Y													

Species	Native/ Exotic	A	B	B1	C	D	E	F	G	H	I	J	K1	K2	K3	L
Mallotus paniculatus	N				Y		Y									
Malvastrum coromandelianum	N	Y							Y		Y	Y				
Mariscus umbellatus	N	Y														
Melaleuca quinquenervia	E		Y									Y				
Melastoma candidum	N				Y		Y					Y				
Melia azedarach	E		Y	Y		Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
Merremia hederacea	N	Y	Y		Y		Y	Y	Y			Y				Y
Macaranga tanarius	N															Y
Microstegium ciliatum	N														Y	
Mikania micrantha	E	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y
Mimosa pudica	E	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Miscanthus floridulus	N												Y			
Miscanthus sinensis	N		Y			Y	Y			Y	Y	Y				Y
Morus alba	N	Y	Y		Y	Y	Y	Y	Y			Y				
Musa x paradisiaca	E				Y		Y		Y							
Neyraudia reynaudiana	N	Y	Y					Y				Y			Y	
Nymphaeae spp.	E						Y									
Oxalis corniculata	N	Y	Y									Y				Y
Oxalis corymbosa	E		Y									Y				
Paederia scandens	N	Y	Y	Y		Y		Y	Y		Y	Y		Y		Y
Palhinhaea cernua	N				Y											
Panicum maximum	E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Panicum paludosum	N		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y
Panicum repens	N	Y	Y	Y		Y	Y			Y	Y	Y	Y	Y		
Parthenocissus dalzielii	E						Y					Y				
Paspalum conjugatum	E	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y		Y
Paspalum notatum	E	Y	Y			Y	Y	Y					Y	Y		
Paspalum orbiculare	N	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y			Y
Paspalum paspaloides	N		Y	Y		Y	Y	Y			Y	Y				Y
Paspalum repens	E												Y			
Phragmites australis	N		Y			Y							Y			
Phyllanthus urinaria	N					Y	Y					Y				
Pistia stratiotes	E	Y														
Plantago major	N										Y					
Polygonum barbatum	N		Y	Y		Y	Y				Y	Y	Y			Y
Polygonum dichotomum	N							Y	Y			Y				
Polygonum glabrum	N		Y		Y	Y	Y	Y			Y	Y				
Polygonum hastato-sagittatum	N										Y					
Polygonum japonicum	N							Y			Y	Y				
Polygonum lapathifolium	N		Y	Y	Y		Y	Y			Y	Y				
Polygonum tenellum var. *micranthum*	N											Y				
Psidium guajava	E							Y		Y						
Pteris spp.	N															
Pterocypsela indica	N					Y	Y					Y				
Pueraria lobata	N				Y					Y	Y	Y			Y	Y
Pycreus flavidus	N			Y		Y							Y			
Pycreus polystachyus	N	Y	Y	Y		Y	Y					Y	Y			
Rhaphiolepis indica	N		Y			Y	Y		Y	Y	Y	Y	Y			Y
Rhododendron pulchrum	E											Y				Y
Rhododendron simsii	N					Y		Y				Y				
Rhodomyrtus tomentosa	N											Y				Y

Species	Native/ Exotic	A	B	B1	C	D	E	F	G	H	I	J	K1	K2	K3	L
Rhus chinensis	N														Y	
Rhynchelytrum repens	E	Y	Y		Y			Y	Y	Y		Y	Y			
Ricinus communis	E				Y											
Rorippa indica	N										Y					
Rumex trisetifer	N						Y	Y			Y	Y				Y
Sacciolepis indica	N										Y					
Sapium discolor	N						Y				Y					
Sapium sebiferum	N	Y	Y	Y		Y	Y					Y				
Saururus chinensis	N			Y								Y	Y			
Schefflera arboricola	E											Y				
Schefflera heptaphylla	N					Y	Y			Y			Y	Y		
Schoenoplectus validus	E		Y			Y										Y
Scirpus mucronatus	N															Y
Scoparia dulcis	E						Y			Y	Y					
Sesbania cannabina	E	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y
Setaria viridis	N	Y				Y	Y	Y					Y			
Sida acuta	N	Y	Y		Y							Y				
Smilax china	N							Y								
Smilax glabra	N	Y														
Solanum nigrum	N	Y	Y		Y	Y	Y		Y			Y				
Solanum torvum	E				Y							Y				
Sonchus oleraceus	E											Y				Y
Spathodea campanulata	E											Y				
Spilanthes paniculata	N				Y					Y	Y	Y				Y
Sporobolus fertilis	N	Y	Y										Y			
Syzygium jambos	E				Y											Y
Tadehagi triquetrum	N															Y
Torulinium odoratum	E			Y												
Trema tomentosa	N				Y											
Tridax procumbens	E								Y	Y	Y					
Tutcheria spectabilis	N												Y			
Typha angustifolia	E		Y	Y		Y										
Urena lobata	N	Y										Y				Y
Vernonia cinerea	N		Y	Y			Y					Y				
Vernonia solanifolia	N	Y														
Vitis balanseana	N							Y								
Wedelia trilobata	E	Y	Y		Y	Y	Y			Y	Y	Y				
Youngia japonica	N				Y							Y				Y

Appendix 3. *Plant species recorded in quadrats in the terrestrial, seasonal marsh and marsh zones of the West Rail mitigation wetlands, November – December 2009.*

Table 1. *Plant species recorded in Land Parcel A.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	6	7.50		0	0		0	0	
Leaf litter (%)	0	0		0	0		0	0	
Dry Mud (%)	8	100		0	0		0	0	
Wet Mud (%)	0	0		8	100		8	100	
Open water (%)	0	0		4	3.75		6	52.50	
Aeschynomene indica	1	0.13	0.39						
Alocasia odora	1	0.13	0.34						
Alternanthera philoxeriodes				4	3.38	0.55	2	2.00	0.49
Aster subulatus							1	0.13	1.30
Bambusa spp.	1	0.25	4.00						
Bidens alba	8	7.75	1.06						
Brachiaria mutica	1	0.13	0.53	6	5.25	1.74	3	3.38	1.70
Commelina diffusa				1	0.13	0.44			
Cynodon dactylon	1	0.25	0.35						
Cyperus distans				2	0.50	1.68	1	0.13	1.22
Eleusine indica	3	0.50	0.79						
Eupatorium catarium	1	0.13	0.55						
Hibiscus rosa-sinensis	2	0.75	1.68						
Kylinga aromatica	1	0.13	0.41						
Lantana camara	2	1.38	0.72						
Leucaena leucocephala	5	0.75	0.44						
Mikania micrantha	7	0.88	1.68						
Mimosa pudica	2	0.50	0.58						
Panicum maximum	3	1.13	0.63						
Panicum repens	1	0.13	1.01						
Paspalum coenjugatum	3	0.88	0.46						
Paspalum notatum	2	1.13	0.74						
Sesbania cannabina	3	0.50	0.68				1	0.13	0.55
Wedelia trilobata	1	0.88	0.13	2	2.13	0.25			

Table 2. *Plant species recorded in Land Parcel B.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	2	11.25		0	0		0	0	
Leaf litter (%)	0	0		6	2.63		0	0	
Dry Mud (%)	8	98.75		4	38.75		0	0	
Wet Mud (%)	2	1.25		5	61.25		8	100	
Open water (%)	0	0		4	3.13		6	30	
Aeschynomene indica				1	0.13	0.38			
Alternanthera philoxeroides	1	0.88	0.30	1	0.13	0.64	3	0.63	0.48
Aster subulatus	2	0.25	1.54	2	0.25	1.36	1	0.13	0.69
Bidens alba	7	4.38	0.84	1	0.13	0.13			
Brachiaria mutica	1	0.13	1.21	2	0.25	1.24			
Commelina diffusa	1	0.13	0.06	1	0.13	0.53			
Cynodon dactylon				1	1.00	0.35			
Desmodium gangeticum							1	0.13	0.30
Eleusine indica	1	0.13	1.40						
Eupatorium catarium	1	0.13	0.34						
Gardenia jasminoides var. *fortuniana*	2	0.50	1.37						
Ilex rotunda	1	0.13	1.78						
Imperata koenigii	2	1.63	0.93						
Ipomoea aquatica	2	0.50	0.48	5	1.00	0.50	3	0.50	0.27
Kylinga aromatica	1	0.13	0.36						
Lantana camara	1	0.13	0.69						
Lepironia articulata				3	2.38	1.68	2	1.88	1.60
Macroptilium lathyroides	1	0.13	1.55						
Mikania micrantha	5	0.63	1.60	1	0.13	0.41			
Mimosa pudica	2	0.75	0.21						
Panicum paludosum				1	0.13	0.46			
Panicum repens				4	3.75	1.40	6	3.88	1.05
Paspalum conjugatum	4	2.38	0.90	3	1.50	1.10			
Paspalum orbiculare	1	0.13	0.24	1	0.13	0.57	2	0.25	0.76
Polygonum barbatum				5	1.88	0.87	7	4.38	0.64
Polygonum glabrum							1	0.13	0.23
Rhaphiolepis indica	2	0.88	1.48						
Rhynchelytrum repens	1	0.25	1.20						
Sesbania cannabina	6	1.50	1.75	4	0.88	0.59			
Solanum nigrum	1	0.13	0.47						
Vernonia cinerea				1	0.13	0.56			

Table 3. *Plant species recorded in Land Parcel B1.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	2	0.5		0	0		0	0	
Leaf litter (%)	3	1.25		1	0.25		1	0.25	
Dry Mud (%)	4	100		0	0		0	0	
Wet Mud (%)	0	0		4	100		4	100	
Open water (%)	0	0		4	13.75		4	23.75	
Alternanthera philoxeriodes							1	0.25	0.23
Bidens alba	3	5.25	0.52						
Cyperus pilosus	1	0.25	0.42						
Echinochloa crusgalli				1	0.50	1.02	1	0.50	0.93
Emilia sonchifolia	3	0.75	0.47						
Eupatorium catarium	2	0.50	0.50						
Ipomoea aquatica	4	3.00	0.44	3	2.50	0.42	1	1.00	0.38
Leptochloa chinensis	2	2.00	1.02	1	0.25	0.66			
Ludwigia adscendens				1	0.50	0.27	1	0.25	0.10
Lygodium japonicum	4	1.00	0.34						
Mikania micrantha	3	0.75	0.56						
Panicum paludosum	3	4.25	0.56	4	6.75	1.04	4	8.25	0.77
Panicum repens				1	2.00	0.86	1	0.25	0.67
Paspalum conjugatum	2	0.75	0.74						
Sesbania cannabina	1	0.25	0.93						
Torulinium odoratum				1	1.75	0.43			
Typha angustifolia							1	1.25	1.78

Table 4. *Plant species recorded in Land Parcel C.*

Species	Terrestrial*			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	0	0		0	0		0	0	
Leaf litter (%)	1	2		0	0		0	0	
Dry Mud (%)	2	5		0	0		0	0	
Wet Mud (%)	2	95		2	100		2	100	
Open water (%)	0	0		0	0		2	99	
Alternanthera sessilis				1	1.00	0.51			
Amaranthus viridis	1	1.00	1.10						
Bidens alba	2	7.00	1.10	1	1.00	0.65			
Brachiaria mutica	2	1.00	2.80	2	4.00	1.22	1	0.50	0.64
Colocasia esculenta	1	0.50	0.75						
Commelina diffusa				2	4.00	0.56			
Digitaria sanguinalis	2	1.50	0.89						
Eupatorium catarium	1	0.50	0.60						

Species	Terrestrial*			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Ilex rotunda	1	2.50	3.20						
Imperata koenigii	2	3.00	1.46						
Ludwigia perennis				1	0.50	0.78			
Macaranga tanarius	1	2.50	2.70						
Merremia hederacea	1	0.50	0.62						
Mikania micrantha	2	1.00	1.80	2	6.50	0.54			
Morus alba	1	0.50	0.52						
Panicum maximum	1	2.50	2.00						
Paspalum conjugatum	1	0.50	0.39						
Polygonum lapathifolium				1	2.00	1.07			
Sesbania cannabiana	1	0.50	0.36						

Table 5. *Plant species recorded in Land Parcel D.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	2	0.25		1	7.5		0	0	
Leaf litter (%)	8	80.25		4	0.63		1	0.25	
Dry Mud (%)	8	100		0	0		0	0	
Wet Mud (%)	0	0		8	100		8	100	
Open water (%)	0	0		8	7.5		8	49.38	
Centella asiatica				1	0.13	0.10			
Cyperus imbricatus				2	1.25	0.81	5	2.25	0.82
Cyperus malaccensis							1	0.13	0.65
Echinochloa crusgalli				2	0.25	1.36	3	0.38	0.89
Imperata koenigii	4	1.88	1.54	1	1.00	0.87			
Lantana camara	1	0.25	0.77						
Ludwigia x taiwanensis				4	1.13	0.50	4	1.50	0.42
Mikania micrantha	5	0.88	0.70						
Mimosa pudica	2	0.38	0.86						
Panicum maximum	2	1.25	1.36						
Panicum paludosum				2	0.38	0.90	1	0.13	0.57
Panicum repens				3	3.50	1.24	2	1.88	0.44
Paspalum conjugatum	2	0.38	0.95	1	0.13	0.62			
Paspalum orbiculare				6	2.63	0.96	3	0.38	0.71
Paspalum paludosum							2	1.13	0.53
Phragmites australis				1	0.13	1.07	1	0.63	1.11
Polygonum barbatum				2	1.25	0.67	1	0.63	0.28
Polygonum glabrum							3	0.38	0.70
Sesbania cannabina	1	0.13	0.54	2	0.75	1.44			

Table 6. *Plant species recorded in Land Parcel E.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	**Mean Domin**	**Height (m)**	**No of quadrat**	**Mean Domin**	**Height (m)**	**No of quadrat**	**Mean Domin**	**Height (m)**
Bare (%)	6	1.25		2	0.25		0	0	
Leaf litter (%)	7	2.5		6	4.75		4	1.38	
Dry Mud (%)	8	100		8	100		4	50	
Wet Mud (%)	0	0		0	0		4	50	
Open water (%)	0	0		0	0		2	14.38	
Alternanthera philoxeriodes	1	0.13	0.17	2	0.50	0.57	1	0.25	0.33
Bidens alba	6	2.00	0.16						
Bothriochloa ischaemun	1	0.13	0.70						
Brachiaria mutica	3	1.00	0.91						
Centella asiatica	1	0.25	0.05						
Commelina diffusa				1	0.13	0.13			
Cynodon dactylon				2	1.50	0.38	5	3.50	0.50
Cyperus imbricatus				1	1.25	0.51			
Cyperus malaccensis				1	0.13	0.99	1	1.13	1.60
Echinochloa crusgalli							2	1.38	0.99
Emilia sonchifolia	1	0.38	0.24						
Eupatorium catarium	3	0.50	0.35	1	0.13	0.36			
Gardenia jasminoides var. *fortuniana*	2	0.63	1.68						
Ilex rotunda	2	0.88	1.71						
Imperata koenigii	2	1.25	1.40						
Ipomoea cairica	2	0.25	0.14	2	0.25	0.61			
Leptochloa chinensis	2	0.88	0.97	2	0.75	0.64	4	2.63	0.66
Ludwigia octovalvis				1	0.13	0.37			
Melastoma candidum	2	0.25	0.35						
Mikania micrantha	4	1.88	0.38	2	0.25	0.45			
Mimosa pudica	4	1.38	0.08	2	0.75	0.45			
Panicum maximum	1	0.13	0.71						
Paspalum conjugatum	3	0.50	0.45	7	6.13	0.95	4	2.50	0.87
Paspalum orbiculare				4	2.75	0.68	3	0.75	0.48
Polygonum barbatum				1	0.13	0.54	1	0.88	0.49
Polygonum glabrum				1	0.13	0.97			
Rhaphiolepis indica	3	2.50	1.72						
Sesbania cannabina	1	0.13	0.15						

Table 7. *Plant species recorded in Land Parcel F.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	0	0		2	6		0	0	
Leaf litter (%)	0	0		2	45		2	10	
Dry Mud (%)	2	100		2	100		2	100	
Wet Mud (%)	0	0		0	0		0	0	
Open water (%)	0	0		0	0		0	0	
Bidens alba	2	6.50	1.36	1	3.50	0.66			
Brachiaria mutica				2	1.00	0.75	2	4.00	1.11
Echinochloa colona				1	0.50	0.61			
Echinochloa crusgalli				1	3.00	0.50			
Ipomoea aquatica							2	4.50	0.23
Lantana camara	1	2.50	2.00						
Leucaena leucocephala	2	5.50	1.80				1	0.50	0.20
Mimosa pudica	1	2.50	0.85						
Panicum maximum	2	3.50	1.52						
Paspalum orbiculare							1	4.00	0.60
Polygonum glabrum				1	1.00	0.23			
Polygonum lapathifolium							1	2.50	0.80
Rhynchelytrum repens	2	1.50	1.12						
Rumex trisetifer				1	2.00	0.30			
Sesbania cannabina	1	1.00	0.67						

Table 8. *Plant species recorded in Land Parcel G.*

Species	Terrestrial			Seasonal Marsh*			Marsh*		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	0	0		-	-	-	-	-	-
Leaf litter (%)	0	0		-	-	-	-	-	-
Dry mud (%)	2	100		-	-	-	-	-	-
Wet mud (%)	0	0		-	-	-	-	-	-
Open water (%)	0	0		-	-	-	-	-	-
Bidens alba	2	6.50	1.35						
Cuscuta australis	1	0.50	0.60						
Digitaria ciliaris	2	6.00	1.55						
Gardenia jasminoides var. *fortuniana*	2	4.00	1.90						
Ipomoea triloba	2	1.00	1.58						
Leucaena leucocephala	2	1.00	1.02						
Mimosa pudica	1	1.00	0.75						

* Seasonal marsh and marsh habitats not surveyed due to ongoing construction work.

Table 9. *Plant species recorded in Land Parcel H.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	2	1.5		2	0.5		0	0	
Leaf litter (%)	4	29		4	2.5		0	0	
Dry Mud (%)	4	28.75		1	1.25		0	0	
Wet Mud (%)	3	71.25		4	98.75		4	100	
Open water (%)	0	0		2	2.5		4	43	
Alternanthera philoxeroides				1	0.25	0.43	2	0.50	0.40
Brachiaria mutica	1	0.25	0.27						
Commelina diffusa				1	0.50	0.16			
Cyperus halacecensis				1	1.75	1.35			
Eupatorium catarium				1	0.50	0.86			
Ilex rotunda	1	0.75	2.00						
Impomoea aquatica							1	0.25	0.34
Leersia hexandra							3	3.75	1.40
Lepironia articulata				1	1.75	1.17	1	0.50	1.45
Mimosa pudica	4	1.75	0.15	2	1.50	0.53			
Panicum repens				1	0.25	0.93	1	2.00	0.75
Paspalum conjugatum				4	8.25	1.04	2	2.25	0.89
Rhaphiolepis indica	2	0.50	1.28						
Sesbania cannabina				1	0.25	0.34			

Table 10. *Plant species recorded in Land Parcel I.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	3	1		0	0		0	0	
Leaf litter (%)	4	1.75		4	4.25		0	0	
Dry Mud (%)	3	48.75		1	1.25		0	0	
Wet Mud (%)	4	51.25		4	98.75		4	100	
Open water (%)	0	0		4	7.75		4	60.75	
Aster subulatus				1	0.25	0.63	3	1.00	0.52
Bidens alba	2	0.50	0.06	1	0.25	0.24			
Brachiaria mutica	1	0.25	0.28						
Carica papaya	1	1.25	1.50						
Cynodon dactylon	1	0.25	0.10	3	5.00	0.28			
Eupatorium catarium	1	0.25	0.04						
Gardenia jasminoides var. *fortuniana*	2	0.50	1.68						
Ilex rotunda	1	0.75	2.60						
Leptochloa chinensis				1	1.00	1.19			
Ludwigia adscendens							1	0.25	0.06
Ludwigia octovalvis				3	1.75	0.37			

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Ludwigia perennis				1	0.25	0.14			
Mimosa pudica	3	1.00	0.17				1	1.00	0.32
Panicum repens				2	3.50	0.68	1	0.50	0.26
Paspalum conjugatum				4	4.75	0.77	3	3.25	0.46
Polygonum glabrum				1	0.25	0.68	2	2.50	0.86
Polygonum lapathifolium							1	0.25	0.34
Rhaphiolepis indica	2	0.75	1.50						
Rumex trisetifer	1	0.50	0.28						
Sesbania cannabina				2	2.50	0.56			

Table 11. *Plant species recorded in Land Parcel J.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	7	2.19		0	0		0	0	
Leaf litter (%)	9	10.63		11	3.5		4	0.44	
Dry Mud (%)	14	87.5		6	25.63		1	6.25	
Wet Mud (%)	2	11.56		12	74.38		15	93.75	
Open water (%)	0	0		4	1.88		14	35.56	
Ageratum conyzoides	1	0.06	0.71						
Alternanthera paronychioides	1	0.06	0.17						
Alternanthera philoxeriodes				3	0.69	0.43	1	0.06	0.36
Alternanthera sessilis	1	0.06	0.44						
Aster subulatus				3	0.19	1.45	5	0.81	0.84
Bidens alba	14	2.94	0.85	2	0.13	0.49			
Bomex ceiba	1	0.56	2.10						
Brachiaria mutica	1	0.31	0.87	1	0.06	0.81			
Centella asiatica				1	0.25	0.11			
Commelina diffusa	1	0.06	0.50	2	0.38	0.54	1	0.31	0.27
Cynodon dactylon	3	0.25	0.34	2	0.69	0.30	1	0.13	0.26
Digitaria sanguinalis	1	0.06	0.65						
Echinochloa crusgalli							1	0.19	0.57
Eclipta prostrata	1	0.06	0.40						
Emilia sonchofolia	1	0.06	0.41						
Ficus hispida	2	0.19	0.39						
Fluggea virosa	1	0.13	1.02						
Imperata koenigii	4	1.38	1.40						
Ipomoea aquatica				3	0.31	0.34	1	0.06	0.33
Ipomoea cairica	2	0.31	0.37						
Kylinga aromatica	1	0.13	0.58						
Lantana camara	1	0.13	1.75						

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Leersia hexandra							1	0.06	0.50
Leptochloa chinensis				3	1.31	1.34	1	0.13	0.70
Leucaena leucocephala	1	0.06	0.65						
Ludwigia octovalvis				1	0.13	0.16			
Ludwigia perennis	1	0.06	0.23						
Melastorna candidum	1	0.50	1.80						
Mikania micrantha	6	0.38	0.53	3	0.19	0.67			
Mimosa pudica	8	1.13	0.56						
Oxalis corymbosa	1	0.06	0.04						
Paederia scandens	1	0.06	0.33						
Panicum maximum	7	2.38	1.60						
Panicum paludosum	1	0.31	0.73	1	0.06	1.30	2	0.63	1.20
Panicum repens	1	0.13	0.83	2	1.06	1.20	2	0.44	0.33
Paspalum conjugatum	6	1.19	0.93	11	4.69	1.04	10	3.88	0.93
Paspalum orbiculare				8	2.88	0.82	7	1.44	0.86
Paspalum paspaloides	1	0.25	0.21						
Polygonum japonicum							1	0.06	0.76
Rhaphiolepis indica	5	0.88	1.80						
Rumex trisetifer	2	0.13	0.79				4	1.19	0.92
Schefflera arboricola	2	1.00	3.00						
Sesbania cannabina	7	0.44	0.58						
Solanum nigrum							1	0.06	0.36

Table 12. *Plant species recorded in Land Parcel K1.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	0	0		0	0		0	0	
Leaf litter (%)	1	0.5		2	0.5		3	1.25	
Dry mud (%)	2	2.5		0	0		0	0	
Wet mud (%)	4	97.5		4	100		4	100	
Open water (%)	0	0		0	0		4	25	
Bidens alba	4	4.75	0.33	3	5.00	0.51			
Brachiaria mutica				1	2.50	1.19	1	0.25	0.36
Commelina diffusa				2	0.50	0.53	3	2.75	0.43
Cynodon dactylon	2	1.00	0.46	2	0.75	0.40			
Cyperus malaccensis							2	3.50	1.00
Desmodium gangeticum	3	2.75	0.30	2	1.00	0.24			
Emilia sonchifolia	1	0.25	0.24						
Imperata koenigii				1	2.00	0.85			
Kylinga aromatica				1	0.25	0.82			

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Melia azedarach	1	0.25	0.61						
Mikania micrantha	1	0.25	0.60	1	1.00	0.19	2	2.00	0.95
Mimosa pudica	4	3.00	0.29	4	2.25	0.68	2	1.25	0.41
Panicum paludosum							2	3.25	1.00
Paspalum conjugatum				1	0.25	0.31	1	1.00	0.79
Paspalum notatum	2	3.75	0.70						
Paspalum repens				1	1.00	0.72			
Polygonum barbatum							3	3.50	0.61
Rhaphiolepis indica	4	1.75	1.95	2	0.75	1.69			
Sesbania cannabina	1	1.00	0.48						

Table 13. *Plant species recorded in Land Parcel K2.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	1	0.25		0	0		0	0	
Leaf litter (%)	3	1.5		4	27.5		0	0	
Dry Mud (%)	4	52.5		1	1.25		0	0	
Wet Mud (%)	2	47.5		4	98.75		4	100	
Open water (%)	0	0		0	0		4	94.75	
Bidens alba	4	2.75	1.03	3	0.75	0.54			
Bothriochloa ischaemun	3	1.00	0.92						
Brachiaria mutica							1	0.25	0.49
Cynodon dactylon	1	0.50	0.25						
Desmodium gangeticum	1	0.25	0.22						
Eupatorium catarium	2	0.50	0.43						
Fluggea virosa	1	0.25	0.14						
Imperata koenigii	1	1.75	1.27	4	8.25	1.51			
Ipomoea aquatica							4	2.00	0.21
Leucaena leucocephala	3	2.75	0.78	1	1.25	1.08			
Mikania micrantha	1	0.50	0.97						
Mimosa pudica	2	0.75	0.44						
Panicum maximum	2	4.50	2.06						
Sesbania cannabina	2	1.50	0.50	1	0.50	0.78			

Table 14. *Plant species recorded in Land Parcel K3.*

Species	Terrestrial			Seasonal Marsh*			Marsh*		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	0	0		-	-	-	-	-	-
Leaf litter (%)	0	0		-	-	-	-	-	-
Dry Mud (%)	2	100		-	-	-	-	-	-
Wet Mud (%)	0	0		-	-	-	-	-	-
Open water (%)	0	0		-	-	-	-	-	-
Bidens alba	1	0.50	1.00						
Microstegium ciliatum	2	6.50	1.20						
Pueraria lobata	2	8.00	1.50						

* Seasonal Marsh and Marsh habitats not present in Land Parcel K3.

Table 15. *Plant species recorded in Land Parcel L.*

Species	Terrestrial			Seasonal Marsh			Marsh		
	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)	No of quadrat	Mean Domin	Height (m)
Bare (%)	4	4.25		2	0.5		0	0	
Leaf litter (%)	4	3.25		4	1		0	0	
Dry Mud (%)	4	100		3	5		0	0	
Wet Mud (%)	0	0		4	78.75		4	100	
Open water (%)	0	0		4	18.75		4	28.75	
Aster subulatus	2	0.50	0.31						
Brachiaria mutica				4	2.75	0.75	1	0.25	0.97
Cajanus scarabaeoides				1	0.25	0.06			
Commelina diffusa							1	0.25	0.33
Eupatorium catarium				1	0.25	0.12			
Gardenia jasminoides var. *fortuniana*	2	1.25	1.75						
Imperata koenigii	3	4.75	1.30	2	2.25	1.28			
Leersia hexandra				2	2.50	0.42	4	8.50	0.80
Lepironia articulata							1	0.50	1.03
Ludwigia octovalvis				2	0.50	0.34			
Ludwigia perennis				2	0.50	0.22			
Melia azedaracn	1	0.25	6.00						
Micaranga tanarius	1	0.25	3.00						
Mikania micrantha	2	0.50	0.83	4	2.50	0.48			
Mimosa pudica	3	0.75	0.62	2	0.50	0.08			
Paspalum paspaloides				1	2.00	0.27			
Polygonum barbatum							3	1.00	0.64
Rhaphiolepis indica	2	0.50	0.07						
Sesbania cannabina	1	0.25	0.08	1	0.50	0.17			