Termite Report 2012

Prepared by: Tim Myles, Ph.D. Termite Control Officer
Planning & Building, Engineering and Environment
Building Services, City of Guelph

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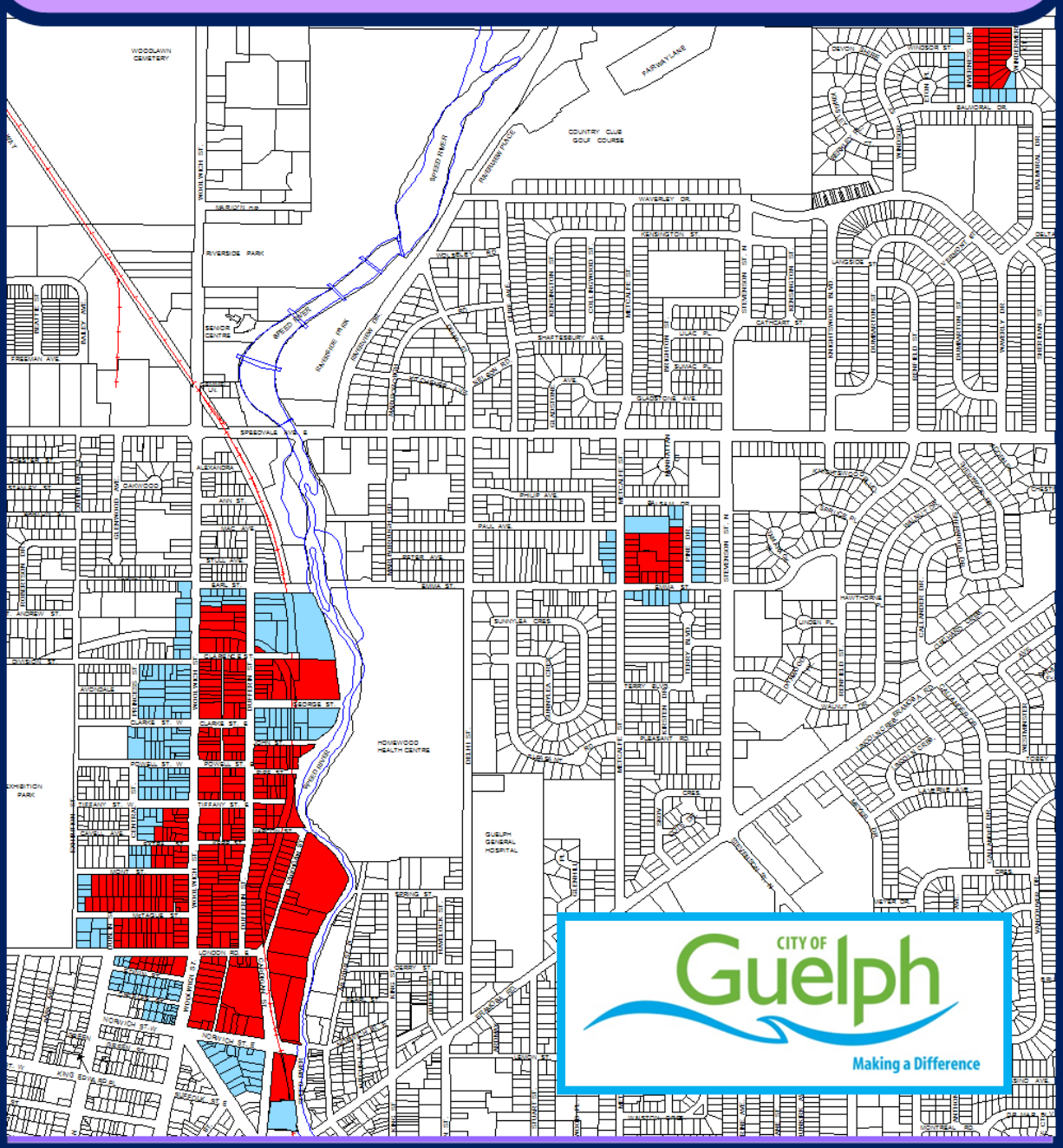

Executive Summary

Guelph's Termite Management Areas Guelph has three termite management areas which have introduced populations of the eastern subterranean termite. The management areas are divided into red and blue zones. Red zone areas have had known termite infestations while blue zones are buffer areas. Each block is assigned a sector number (Figure 1). Approximately 3,055 termite monitoring traps are installed in the red zones and inner blue zones and are checked on a regular basis from spring through fall.

Third Year of Suppression with Zinc Borate 2012 was the third year of treatments with zinc borate. In 2012 a slightly modified formulation was used containing less resin. This was the second year for comparing year over year trap yield as a way of assessing the efficacy of the zinc borate treatments. The total number of termites trapped in 2010 was 928,495 compared to 683,793 in 2011, and 535,565 in 2012. This represents a 21.7% reduction in the termite population over the previous year and a 42.4% reduction since 2010 (Figure 2). Comparison of the first and second halves of 2012 suggests an even sharper rate of decline. The number of termites trapped in May, June, and July was 395,365 compared to 140,200 collected in August, September and October (Figure 3). This represents a within-year decline of 64.54%. These measures of suppression are also supported by the continuous downward trend in the average number of termites trapped per inspection (Figure 4). This year over year suppression shows that zinc borate applied topically to trapped and released termites is an effective tool for area-wide termite population suppression.

Decline in Number of Active Blocks and Properties In 2012 there was no activity on five of the 22 red zone sectors, namely, sectors 19, 22, 25, 30, and 41. There were another seven sectors with only one or two active properties, sectors 3, 20, 21, 23, 27, 36, and 42. There were five sectors which had three or four active properties and another five sectors had six or more active properties. Overall there was a decline in the number of active properties from 104 in 2011 to 88 in 2012.

Contraction of the Termite Management Areas Continuous inactivity for several years in some peripheral red zones and blue zones allows for a further contraction of the termite management areas. In total 139 properties are re-designated (compare Figures 1 and 5). In the Woolwich Area, west of Woolwich Street 81 properties that were formerly designated as blue are now designated as white and thus removed from the termite management area. In this area, another 48 properties, formerly designated as red, are now designated as blue. One property on sector 3 converted from blue to red. In the Windermere management area, although a small amount of re-newed activity was discovered at the north end of sector 42, the remainder of the area remained inactive allowing for a further contraction of this area with six formerly blue properties converting to white and three formerly red properties converting to blue. There was also a decline in the number of active properties in the Emma-Pine management area from 20 in 2011 to 12 in 2012, however a longer period of inactivity on these properties will be required before re-designating the status of these properties.

Detection and Treatment of Structural Infestations Five active structural (house) infestations were discovered during 2012 and three were chemically treated while two treatments were postponed until 2013. This was a decrease from the seven discovered in 2011. In addition there were four preventative spot treatments in structures with old inactive damage, and two preventative treatments in structures with renovations. The ongoing process of discovery and remediation of hidden structural infestations will continue to be an important component of the program, as such infestations are likely to be a critical factor in sustaining the current pattern of infestation.

Termite Habitat Reduction Further progress was made in the removal of critical habitat. About 30 infested trees or stumps were identified and removed. This included several large infested stumps removed from the corner of Dufferin and Clarence St. of sector 7, where a large retaining wall was also installed to shore up the affected slope. 550 borate rods were installed in retaining walls in sectors 7 and 42. Disposal permits were

provided to area residents to defray the cost of disposing of yard wood and demolition debris. A total of 208 disposal permits were issued in 2012, up from the 200 permits issued in 2011.

Termite Inspections In 2012, the number of termite inspections for real estate transfers was 18, down from 41 in 2010. The number of termite inspections related to building permits was 21, down from the record high of 48 in 2011.

Trap Removals In 2012, traps were removed from the 98 properties which had been re-designated from blue to white. On another 35 properties, that converted from red to blue, traps were reduced, usually to three per property. The number of traps was slightly increased in active red zone areas, to an average of about 7 traps per property. Overall there was a slight reduction in the total number of traps installed, from 3,124 in 2011 to 3,055 in 2012, a net reduction of 69 traps.

Lab Evaluations of Termite Control Substances Lab studies were conducted to evaluate two additional termite control actives: the insect-specific fungal pathogen *Metarhizium* and the termiticide, fipronil. Three strains of *Metarhizium* were evaluated both in dust formulations and in various oil suspensions of the fungal spores. Two commercial formulations and technical grade fipronil were obtained and evaluated in dust and resin formulations. Both *Metarhizium* and fipronil showed promise in lab tests with high kill ratios. However, for both actives, the time lapse after treatment to mortality of the treated termites was less than 24 hours, compared to the over 72 hours for zinc borate. Such a short time lag may inhibit effectiveness under field conditions where the treated termites would need to live long enough to disperse from the release point and interact with untreated termites before the onset of mortality. Field testing is needed to better evaluate the potential of these actives in a trap-treat-release approach.

2012 Report As with previous annual reports, the full 2012 report will be posted on the City's termite web site at: www.guelph.ca > termites > Reference Materials, by the first week of April.

Goals for the 2013 Season The goals for the upcoming season will be similar to 2012:

- This executive summary and graphs will be sent to residents by the second week of April as an annual progress report.
- Two part- time summer technicians will be hired and will start work in late April. Traps will be removed from those properties newly designated as white and reduced on those newly designated as blue. Traps will be refurbished with new cardboard rolls and any missing traps replaced during April and May. Bricks will be placed on all monitoring trap lids this year to reduce the incidence of disturbance by wildlife.
- As in 2011 and 2012, the central focus of the season will be to continue doing trap-treat-release treatments with zinc borate. Traps will be checked periodically and trapped termites will be treated with a resinous coating containing zinc borate and released back into active traps. Any trap used as a release port will be secured with plastic cable ties and identified with a treatment lid label and a labelled brick.
- Starting in July, letters will be sent to properties in the vicinity of ongoing activity to schedule indoor inspections of those properties that have not yet been inspected.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Table 1. Extent of Guelph's Three Termite Management Areas in 2012 (at start of year)

(Zones, Properties and Blocks)

Zones	Red		Blue		Red + Blue		White*		Total (R+B+W)		
Management Areas:	zones	properties	zones	properties	zones	properties	zones	properties	zones	properties	blocks
1) Woolwich Area	20	355	16	201	36	556	21	337	57	893	42
2) Windermere Area	1	20	3	13	4	33	3	27	7	60	4
3) Emma - Pine Area	1	22	4	26	5	48	0	0	5	48	4
Totals	22	397	23	240	45	637	24	364	69	1001	50

* historically included

Table 2. Extent of Guelph's Three Termite Management Areas in 2012 (at end of year)

(Zones, Properties and Blocks)

Zones	Red**		Blue		Red + Blue		White*		Total (R+B+W)		
Management Areas:	zones	properties	zones	properties	zones	properties	zones	properties	zones	properties	blocks
1) Woolwich Area	20	399	16	202	36	601	21	324	57	925	42
2) Windermere Area	1	20	3	13	4	33	3	27	8	60	4
3) Emma - Pine Area	1	22	4	26	5	49	0	0	5	49	4
Totals	22	441	23	241	45	683	25	351	70	1034	50

* historically included

** increases due to completion of townhouses and counting municipal lots

Table 3. Woolwich Termite Management Area for 2012
(with trap removals & replacements at end of year)

Sector Number	Sector Name (SE corner)	Sector Type	Number Properties	Properties Installed	Number Traps Installed	Traps per Installed Property
000	Verney x Woolwich	White	14	0	0	0.0
00	Earl x Dufferin	White	18	0	0	0.0
0	Earl x GJR	White	10	0	0	0.0
1	Division x Woolwich	White	32	0	0	0.0
1	Division x Woolwich	Blue	8	5	15	3.0
2	Clarence x Dufferin	Blue	10	9	23	2.6
2	Clarence x Dufferin	Red	13	13	103	7.9
3	Clarence x Speed R.	Blue	7	2	17	8.5
3	Clarence x Speed R.	Red	2	2	23	11.5
4	Avondale x Princess	White	16	0	0	0.0
5	Clarke x Princess	White	13	0	0	0.0
6	Clarke x Woowich	Blue	26	9	27	3.0
7	Clarke x Dufferin	Red	26	26	245	9.4
8	George x Speed R.	Red	12	11	102	9.3
9	Powell x Woolwich	White	1	0	0	0.0
9	Powell x Woolwich	Blue	21	7	17	2.4
10	Powell x Dufferin	Red	21	21	121	5.8
11	John x Speed R.	Blue	18	16	49	3.1
12	Pipe x Speed R.	Red	14	13	99	7.6
13	Tiffany x Central	White	22	0	0	0.0
14	Tiffany x Woolwich	Blue	22	6	17	2.8
15	Tiffany x Dufferin	Red	15	15	130	8.7
16	Tiffany x Speed R.	Red	13	13	97	7.5
17	London x Exhibition	White	1	0	0	0.0
18	Cavell x Central	White	20	0	0	0.0
19	Extra x Woolwich	Blue	7	7	24	3.4
19	Extra x Woolwich	Red	12	12	47	3.9
20	Kerr x Dufferin	Red	15	14	96	6.9
21	Marcon x Speed R.	Red	10	10	85	8.5
22	Mont x Woolwich	White	17	0	0	0.0
22	Mont x Woolwich	Blue	8	8	23	2.9
22	Mont x Woolwich	Red	13	13	47	3.6
23	London x Dufferin	Red	44	43	222	5.2
24	London x Cardigan	Red	37	35	183	5.2
25	McTague x Woolwich	Blue	5	5	17	3.4
25	McTague x Woolwich	Red	35	35	179	5.1
26	London x Dublin	Blue	7	0	0	0.0
27	London x Woolwich	Red	28	27	135	5.0
28	Suffolk x Park	White	32	0	0	0.0
29	K. Edwd x Dublin	White	43	0	0	0.0
30	Edwin x Woolwich	Blue	4	4	14	3.5
30	Edwin x Woolwich	Red	15	15	75	5.0
31	Charles x Woolwich	Blue	25	9	19	2.1
32	Norwich x Norfolk	White	7	0	0	0.0
32	Norwich x Norfolk	Blue	18	3	6	2.0
33	Green x Norfolk	White	19	0	0	0.0
34	Green x Woolwich	White	26	0	0	0.0
35	Liverpool x Norwich	White	22	0	0	0.0
36	Norwich x Speed R.	Red	10	9	80	8.9
37	Norwich x Cardigan	Red*	62	62	220	3.5
38	Suffolk x Woolwich	White	12	0	0	0.0
39	Yarmouth x Norwich	White	18	0	0	0.0
40	Woolwich x Cardigan	Blue	14	5	15	3.0
40	Woolwich x Cardigan	White	4	0	0	0.0
41	Eramosa x Speed R.	Red	2	2	6	3.0
41	Eramosa x Speed R.	Blue	2	0	0	0.0
41	Eramosa x Speed R.	White	1	0	0	0.0
Subtotals		Red	399	391	2295	5.9
		Blue	202	95	283	3.0
		White	324	0	0	0.0
TOTALS		R+B+W	925	486	2578	5.3
		R+B	601	486	2578	5.3

Table 4. Windermere Termite Management Area at End of 2012

Sector Number	Sector Name	Sector Type	Number Properties	Properties Installed	Number Traps Installed	Traps per Installed Property
42	Balmoral x Windermere	Red	20	20	138	6.9
42	Balmoral x Windermere	Blue	6	6	18	3.0
42	Balmoral x Windermere	White	16	0	0	0.0
43	Windsor x Inverness	Blue	2	2	6	3.0
44	Balmoral x Inverness	Blue	5	5	15	3.0
44	Balmoral x Inverness	White	1	0	0	0.0
45	Balmoral x Balmoral	White	8	0	0	0.0
46	Balmoral x Victoria	White	2	0	0	0.0
Subtotals		Red	20	20	138	6.9
		Blue	13	13	39	3.0
		White	27	0	0	0.0
	TOTALS	**R+B+W**	**60**	**33**	**177**	

Table 5. Emma - Pine Termite Management Area at End of 2012

Sector Number	Sector Name	Sector Type	Number Properties	Properties Installed	Number Traps Installed	Traps/ Installed Property
47	Emma x Pine	Red	22	22	221	10.0
48	Metcalfe x Balsam	Blue	4	4	16	4.0
49	Emma (south side)	Blue	8	8	24	3.0
50	Pine (east side)	Blue	8	8	24	3.0
51	Emma X Metcalfe	Blue	7	5	15	3.0
Subtotals		Red	22	22	221	10.0
		Blue	27	25	79	3.2
	TOTALS	**R + B**	**49**	**47**	**300**	

Table 6. Summary of Property and Trap Activity in Red Zone Blocks (1998-2012)

No.	Sec. No.	Number of Active Properties										Number of Active Traps									Number of Termites Trapped*									2012 Status
		1998▪	1999▫	2000▫	2001▫	2007◊	2008	2009	2010	2011	2012	1999	2000	2001	2007	2008	2009	2010	2011	2012	1999	2000	2001	2007	2008	2009	2010	2011	2012	
1	2	--	--	--	--	4	4	4	4	6	3	--	--	--	3	19	15	20	16	7	--	--	--	2,069	100,316	43,297	117,978	73,541	32,377	Sup.
2	3	--	--	--	--	--	--	--	--	2	2	--	--	--	--	--	--	--	3	3	--	--	--	--	--	--	--	2,864	10,128	New
3	7	9	4	10	5	17	23	23	25	25	24	6	11	6	22	61	41	88	75	64	1,112	22,623	20,534	8,112	307,782	246,585	389,776	298,183	223,814	Sup.
4	8	--	--	--	--	3	6	5	7	5	3	--	--	--	3	7	4	8	9	2	--	--	--	1,838	37,295	13,120	33,383	10,596	18,687	New
5	10	--	--	--	--	--	--	4	4	5	4	--	--	--	--	--	1	6	8	5	--	--	--	--	--	1,133	13,293	15,275	9,163	Sup.
6	12	--	--	--	--	0	3	4	4	1	3	--	--	--	0	1	3	3	1	2	--	--	--	--	279	11,923	8,485	50	4,693	New
7	15	--	--	--	--	4	7	8	13	12	10	--	--	--	4	8	14	33	24	19	--	--	--	4,186	16,753	16,221	32,430	29,633	32,039	New
8	16	1	1	4	1	8	6	4	6	3	6	1	5	1	4	4	3	11	2	7	10	4,097	606	2,817	23,061	5,573	32,269	19,816	18,329	Sup.
9	19	--	--	--	--	0	0	0	0	0	0	--	--	--	0	0	0	0	0	0	--	--	--	0	0	0	0	0	0	New
10	20	1	1	1	0	1	2	6	4	6	2	1	2	0	0	5	7	10	9	5	3,100	19,227	0	0	26,610	31,406	70,521	35,309	21,395	Sup.
11	21	7	4	3	3	1	1	1	1	1	2	6	5	3	0	2	2	1	1	1	5,526	25,532	9,672	0	1,603	0	25	434	724	Sup.
12	22	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Erad.?
13	23	20	19	12	0	3	2	2	1	3	2	42	23	0	0	4	4	2	3	2	203,918	171,769	0	0	15,742	4,231	1,241	4,131	969	Sup.
14	24	15	12	12	1	1	0	1	3	4	4	37	15	1	0	0	2	4	6	7	121,087	46,767	3,211	0	0	1,245	2,375	9,467	19,020	Resurg.
15	25	14	4	2	1	3	3	3	0	0	0	6	2	3	1	1	1	0	0	0	54,380	572	4,465	1,848	3,985	3,934	0	0	0	Erad.?
16	27	11	12	13	10	0	0	0	0	0	1	24	28	14	0	0	0	0	0	0	54,485	56,725	39,594	0	0	0	0	0	0	Erad.?
17	30	--	--	--	--	4	2	2	3	2	0	--	--	--	0	0	2	2	1	0	--	--	--	0	0	395	1,042	0	0	Erad.?
18	36	10	4	4	3	2	1	1	2	2	2	25	21	5	0	1	2	0	1	2	148,856	179,156	25,059	0	3,542	3,513	0	4,806	6,048	Resurg.
19	37	11	7	9	4	3	3	4	4	6	6	11	18	6	0	5	2	10	14	10	45,985	132,158	34,886	0	6,590	4,521	10,121	22,887	19,418	Sup.
20	41	1	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	4,332	0	0	0	0	0	0	0	0	Erad.?
21	42	--	--	17	2	0	1	1	1	0	2	--	33	4	0	2	1	1	0	3	--	155,148	5,285	0	1,520	1,693	741	0	10,519	Resurg.
22	47	--	--	--	--	13	12	14	18	21	12	--	--	--	7	24	28	54	59	37	--	--	--	1,333	160,183	101,020	215,556	156,801	108,242	Sup.
Totals		**101**	**69**	**87**	**30**	**68**	**77**	**87**	**100**	**104**	**88**	**160**	**163**	**43**	**44**	**144**	**132**	**253**	**232**	**176**	**642,791**	**813,774**	**143,312**	**22,203**	**705,261**	**489,810**	**929,236**	**683,793**	**535,565**	5 New 3 Resurg. 7 Sup. 5 Erad.?

-- 13 blocks known to be infested and managed from 1999-2001

-- 9 additional new blocks infested after 2001

* Inter-year trap yields are not strictly comparable because traps were installed late in the year in 2007 and were checked more frequently in 2010 and 2011

▪ properties with live termites or termite damage ▫ properties with active traps ◊ properties with live termites or active traps

Table 7. Termites Trapped Per Inspection (2008-2012).

Sector	2008			2009			2010			2011			2012		
	total	inspections	per insp.	total	inspections	per insp.	total	inspections	per insp.	total	inspections	per insp.	total	inspections	per insp.
2	100,316	7	14,331	43,297	7	6,185	117,978	17	6,940	73,536	16	4,596	32,377	12	2,698
3	-	-	-	-	-	-	-	-	-	2,864	8	358	10,128	10	1,013
7	307,782	9	34,198	246,585	8	30,823	389,776	18	21,654	298,183	19	15,694	223,814	15	14,921
8	37,295	7	5,328	13,120	7	1,874	33,383	14	2,385	10,596	14	757	18,687	9	2,076
10	0	1	0	1,133	3	378	13,293	9	1,477	15,275	14	1,091	9,163	11	833
12	279	3	93	11,923	5	2,385	8,485	7	1,212	50	7	7	4,693	8	587
15	16,753	7	2,393	16,221	6	2,704	32,430	8	4,054	29,633	16	1,852	32,039	12	2,670
16	23,061	6	3,844	5,573	6	929	32,369	9	3,597	19,626	9	2,181	18,329	11	1,666
19	0	5	0	0	5	0	0	4	0	0	4	0	0	6	0
20	26,610	7	3,801	31,406	5	6,281	70,521	10	7,052	34,978	11	3,180	21,395	10	2,140
21	1,603	6	267	0	5	0	25	7	4	434	7	62	724	7	103
22	0	6	0	0	5	0	0	5	0	0	5	0	0	5	0
23	15,742	8	1,968	4,231	4	1,058	1,241	6	207	4,131	8	516	969	7	138
24	0	5	0	1,245	5	249	2,375	6	396	9,487	12	791	19,020	12	1,585
25	3,985	7	569	3,934	5	787	0	5	0	0	7	0	0	5	0
27	0	6	0	0	5	0	0	4	0	0	5	0	0	5	0
30	0	8	0	395	5	79	1,042	5	208	2	8	0	0	6	0
36	3,542	7	506	3,513	5	703	0	5	0	4,151	8	519	6,048	8	756
37	6,590	6	1,098	4,521	5	904	10,121	7	1,446	22,473	18	1,249	19,418	15	1,295
41	0	5	0	0	5	0	0	4	0	0	5	0	0	6	0
42	1,520	7	217	1,693	5	339	741	7	106	0	6	0	10,519	9	1,169
47	160,183	8	20,023	101,020	7	14,431	215,556	16	13,472	156,801	20	7,840	108,242	15	7,216

Table 8. Required Tree or Stump Removals or Other Debris Removals

No.	Sector	Address	Material
1	3	34 Clarence	branches & woody debris
2	7	154 Dufferin	branches
3	7	156 Dufferin	trees & branches
4	7	166 Dufferin	several large infested stumps
5	7	20 Clarke	trees & branches
6	7	21 Clarence	old fence
7	7	23 Clarence	parts of retaining wall
8	7	26 Clarke	fence & debris
9	7	467 Woolwich	dead tree
10	7	471 Woolwich	boards
11	8	161 Dufferin	stump & branches
12	8	44 George St.	tree trimmings
13	10	23 Clarke St.	boards & debris
14	10	30 Powell St. E.	old deck
15	10	439 Woolwich	yard wood & debris
16	11	37 Dufferin	tree trimmings
17	12	123 Dufferin	old damaged stairs
18	12	16/20 Pipe	infested stump in fence line
19	15	116 Dufferin	infested stump
20	15	16 Tiffany St. E.	branches, old boxes, debris
21	15	19 Powell St. E.	garage demo, infested boards
22	15	409 Woolwich	dead branches, stump
23	16	105 Dufferin	wood pile, mulch
24	16	52 Tiffany St. E.	wood chip mulch
25	16	56 Tiffany St. E.	woody debris
26	16	58 Tiffany St. E.	brush pile
27	19	26 Tiffany St. W.	construction debris
28	20	14 Kerr St.	branches & brush
29	20	22 Kerr St.	construction debris
30	20	31 Tiffany St. E.	old tree house & yard wood
31	21	101 Dufferin St.	infested stump
32	21	95 Dufferin St.	woody debris, large stump
33	21	99 Dufferin St.	brush & woody debris
34	23	70 Dufferin	woody debris, branches
35	23	16 Dufferin	dead trees
36	23	50 Dufferin St.	fallen branches
37	24	27 Dufferin	infested stump
38	24	65 Dufferin	yard debris
39	24	79 Dufferin	stump in front yard
40	25	43 McTague	construction debris
41	25	51 Exhibition	wood chips
42	25	57 McTague	construction debris
43	27	22 McTague	demolition debris
44	30	London Rd W.	yard debris
45	31	264 Woolwich	woody debris
46	36	Goldie Mill	infested dead crab tree
47	37	255 Woolwich	form boards & wood in basement
48	40	44 Cardigan	dead tree
49	47	126 Emma	dead trees & stumps
50	47	128 Emma	old window frames
51	47	130 Emma	old retaining wall
52	47	251 Metcalfe	stump
53	47	259 Metcalfe	infested boards

Table 9. Impel Borate Rod Installations in 2012

No.	Sector	Address	No. Rods Installed
1	7	23 Clarence St E	500
2	42	23 Inverness	50
Total			550

Table 10. Tim-Bor Spray Treatments in 2012

No.	Sector	Address	Treatment
1	7	26 Clarke St. E.	shed
2	15	19 Powell St. E	garage
3	42	23 Inverness	shed

Table 11. Termite Inspections by Year and Type

Year	Real Estate	Building Permits	Material Disposal	Total
2007	25	17	100	142
2008	44	19	128	191
2009	40	19	256	315
2010	38	24	156	218
2011	41	48	200	289
2012	18	21	208	247

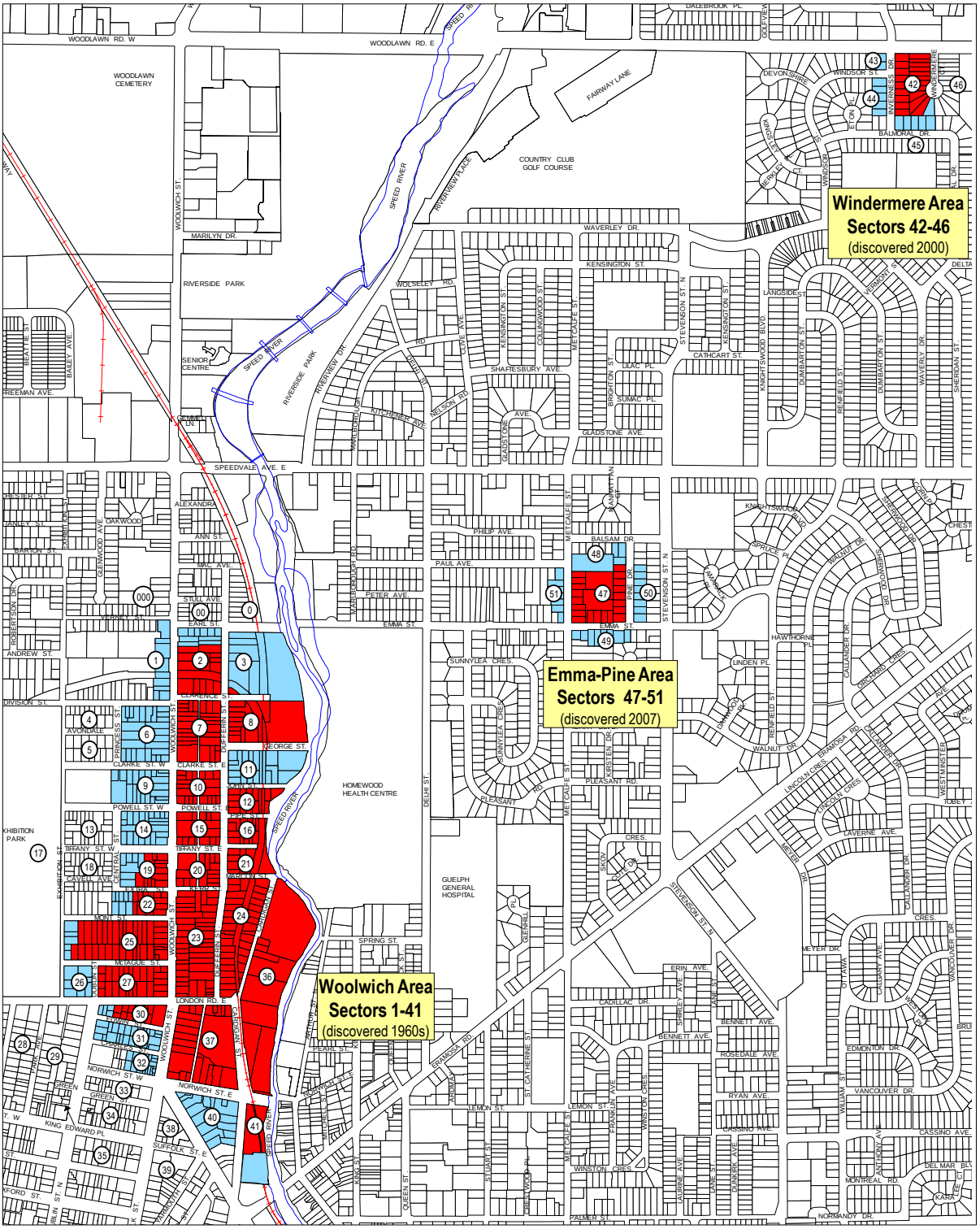

Figure 1. Boundaries of Guelph termite management areas in 2012.

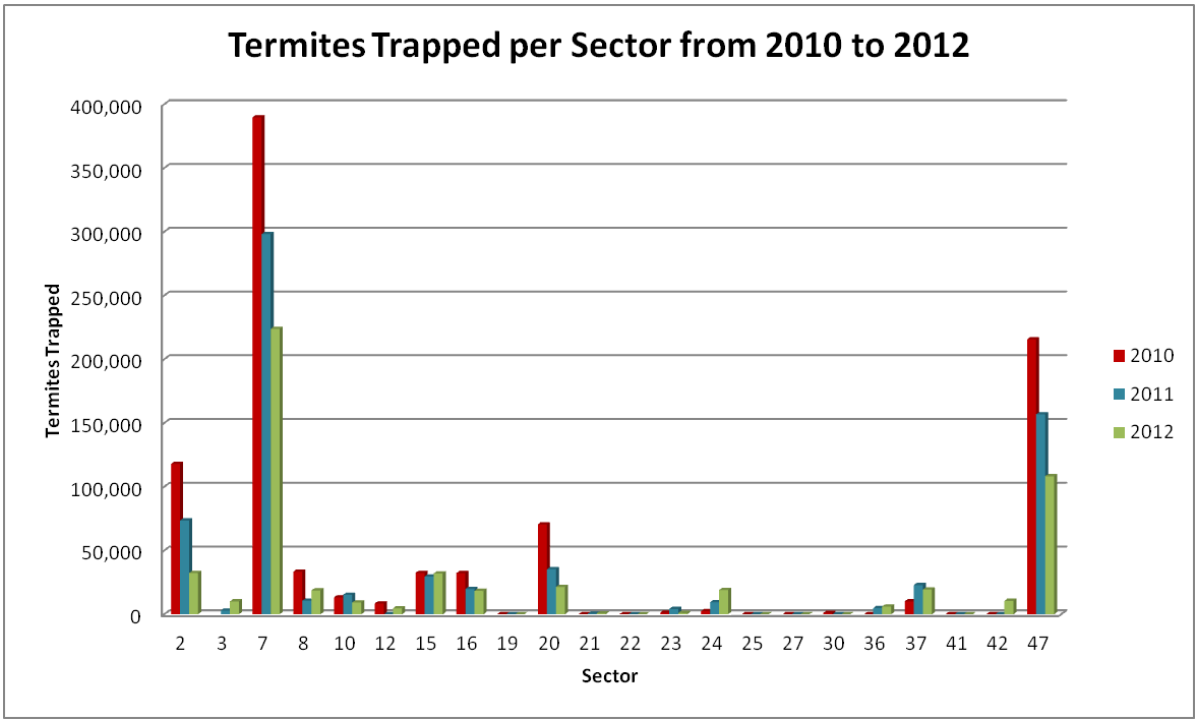

Figure 2. Comparison of total termites trapped per sector from 2010 to 2012.

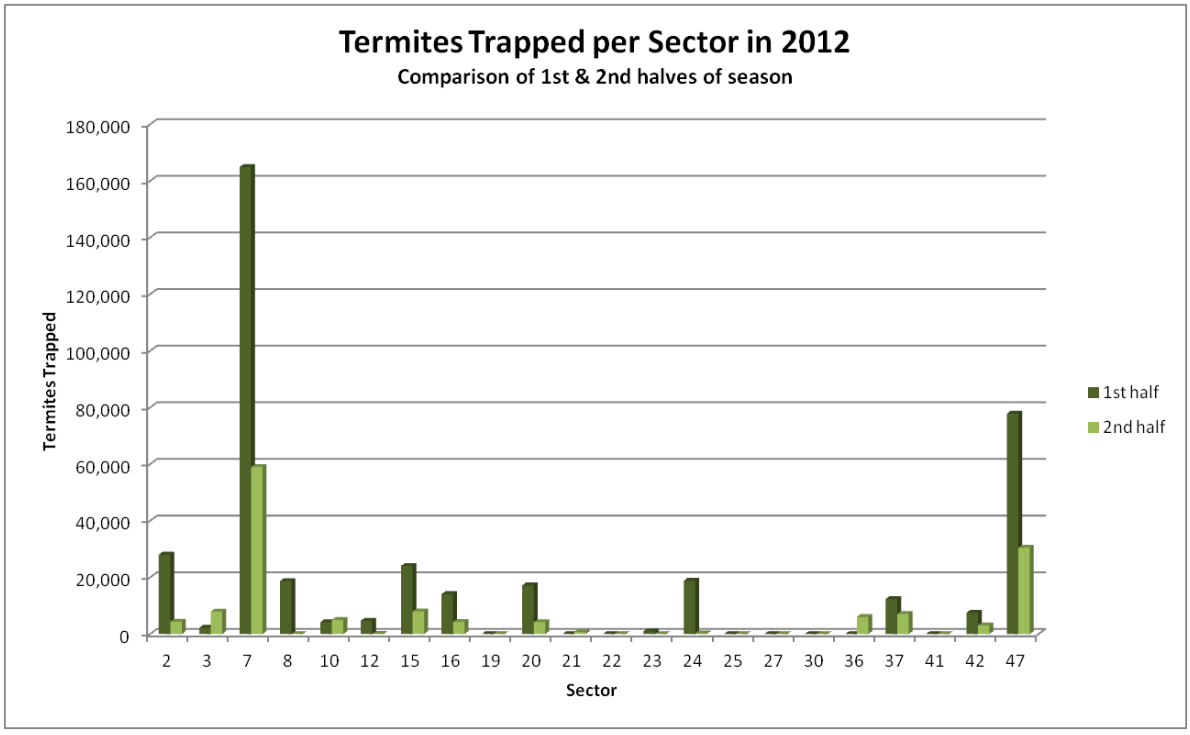

Figure 3. Comparison of termite trapped in first and second halves of 2012 by sector.

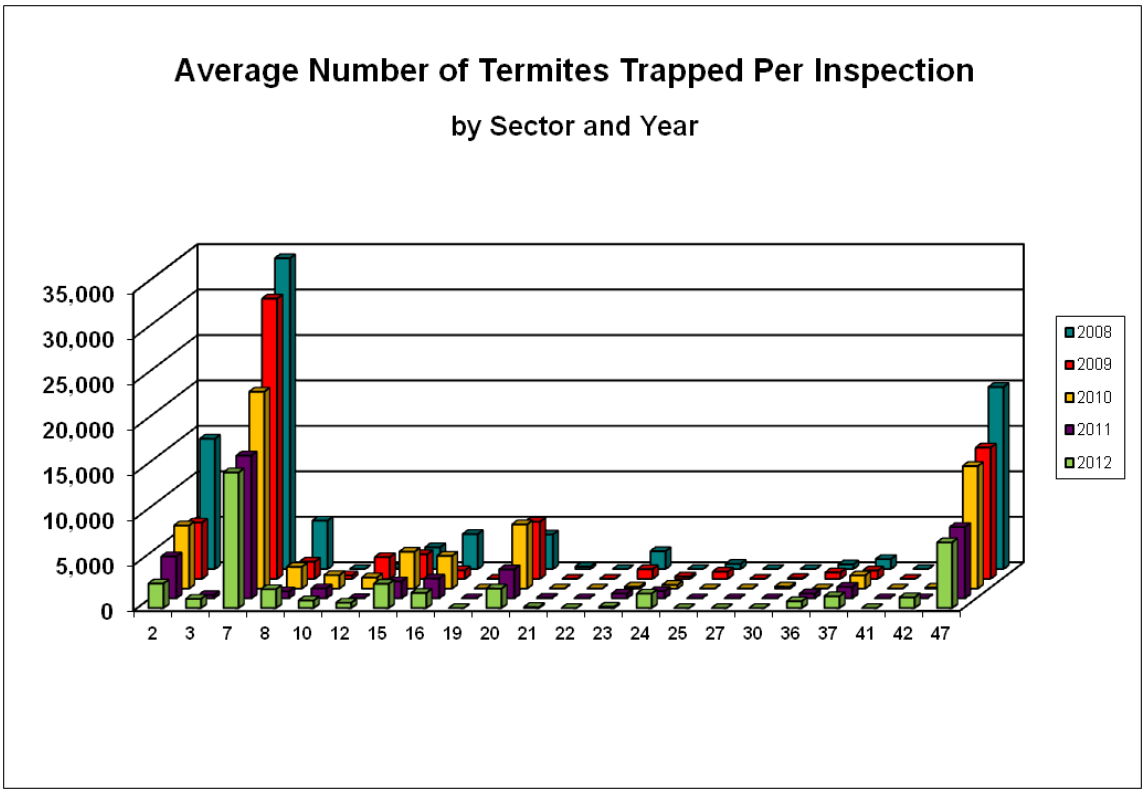

Figure 4. Average number of termites trapped per inspection by sector (2008-2012).

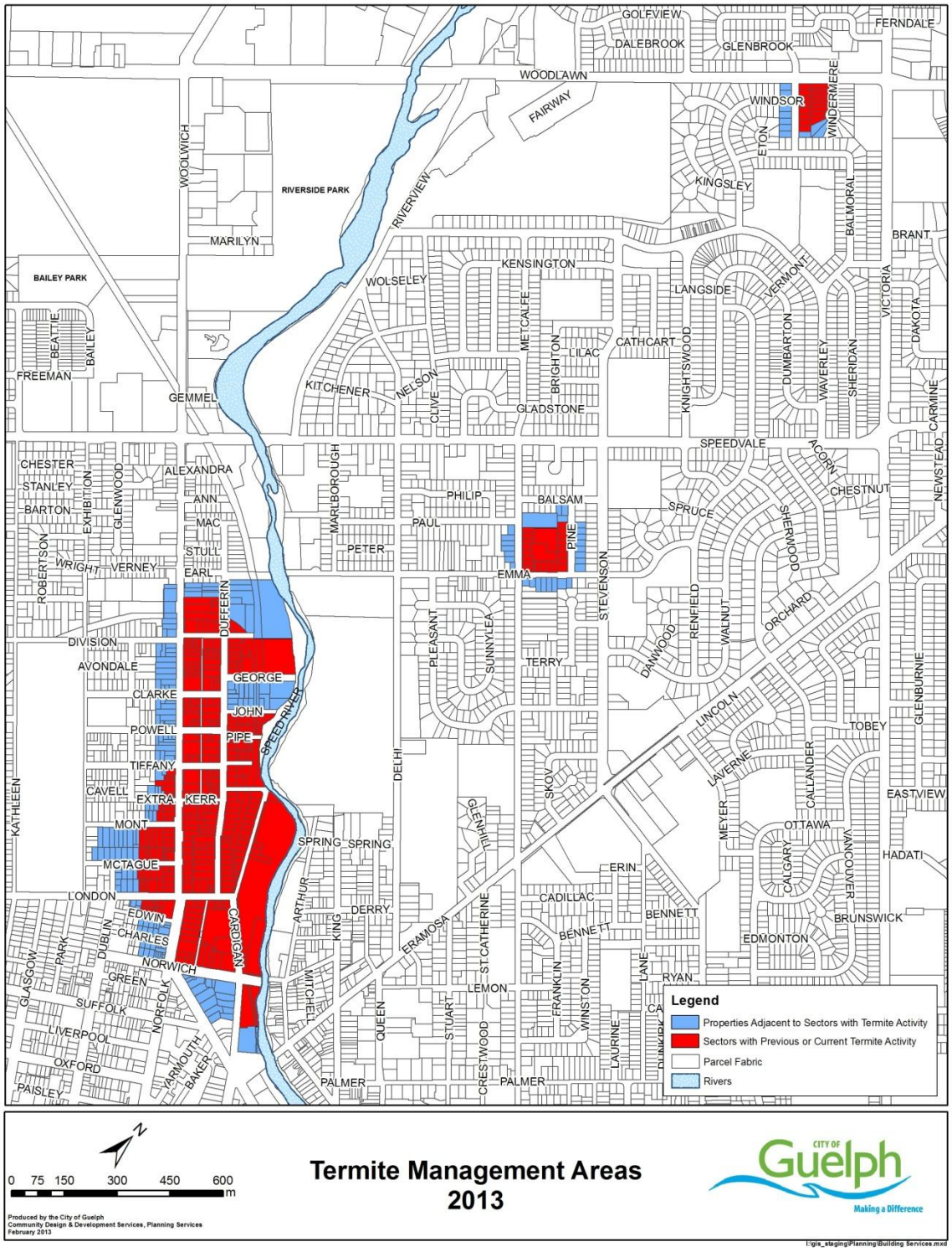

Figure 5. New boundaries of the Guelph termite management areas for 2013.

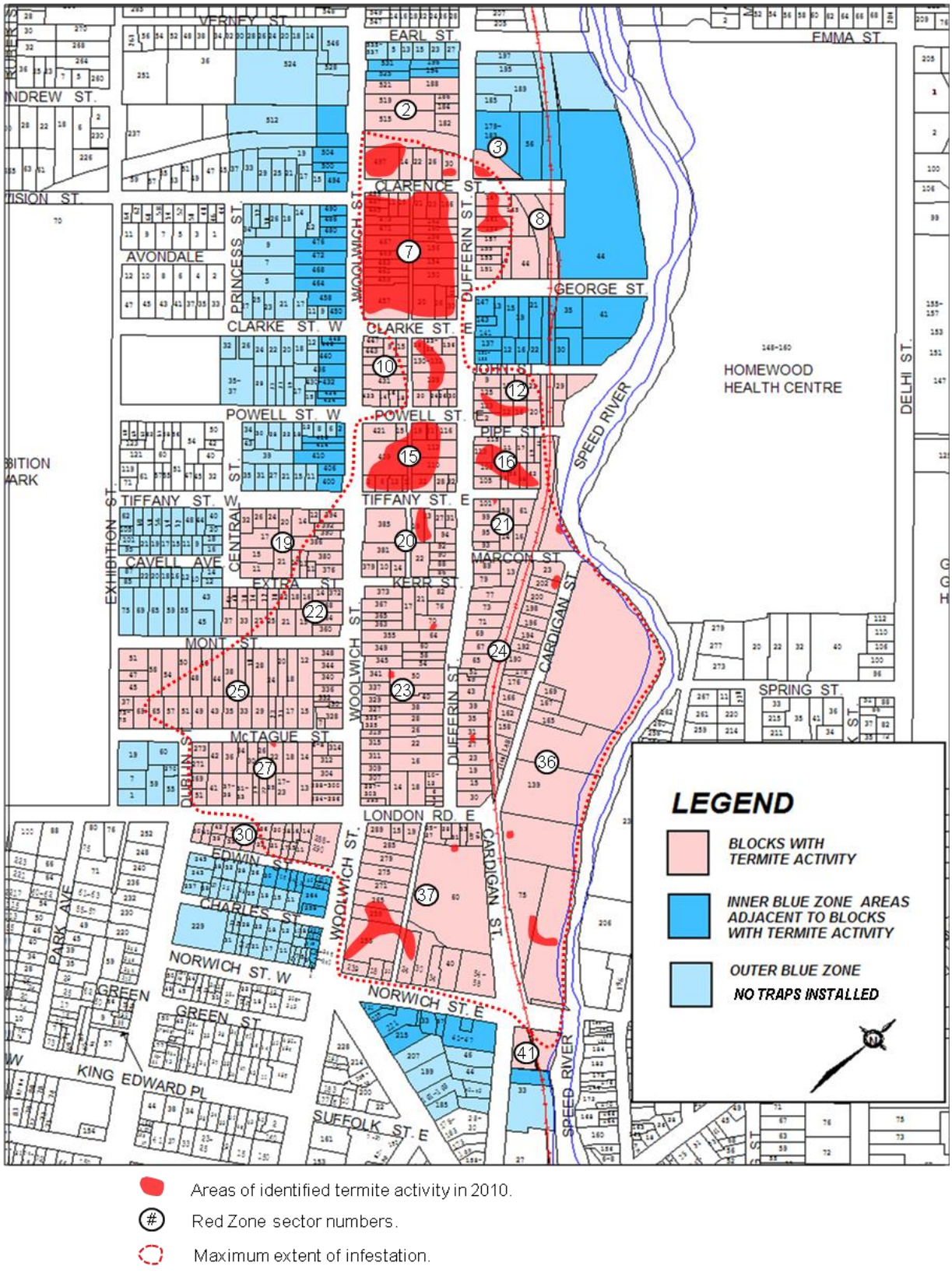

Figure 6. Areas of detected termite activity in the Woolwich management area in 2012.

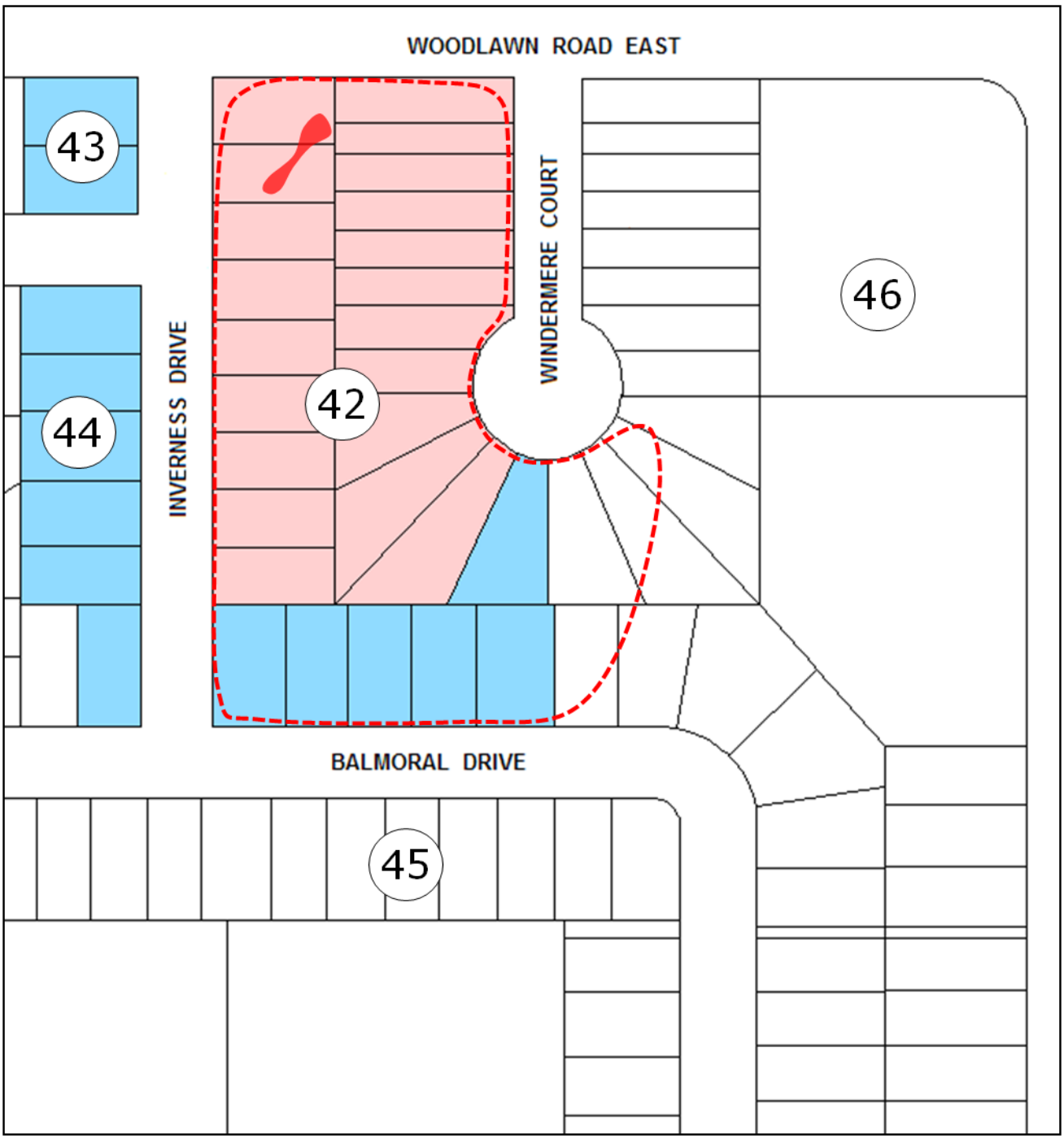

Figure 7. Areas of detected termite activity in the Windermere management area in 2012.

Figure 8. Areas of detected termite activity in the Emma-Pine management area in 2012.

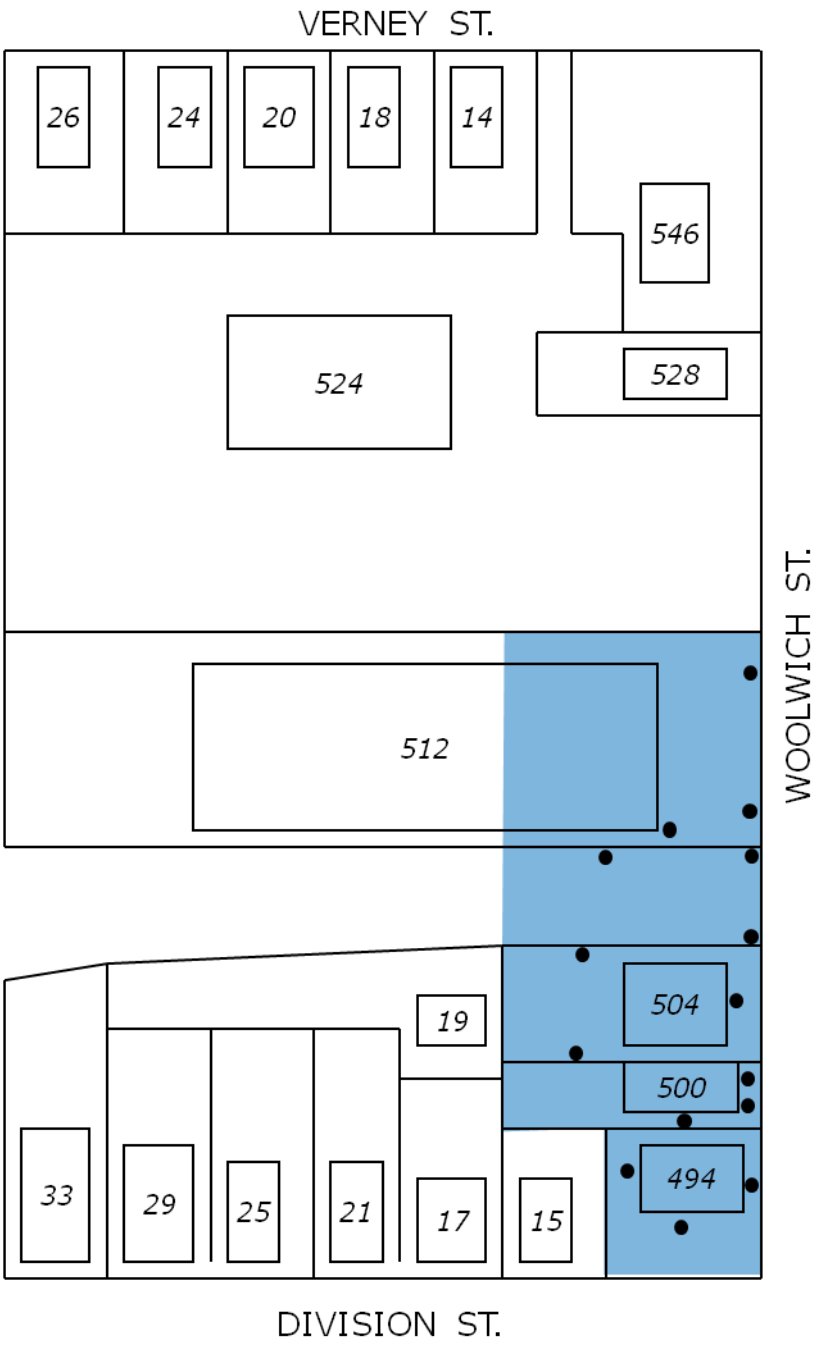

Figure 9. Trap locations in sector 1 in 2012.

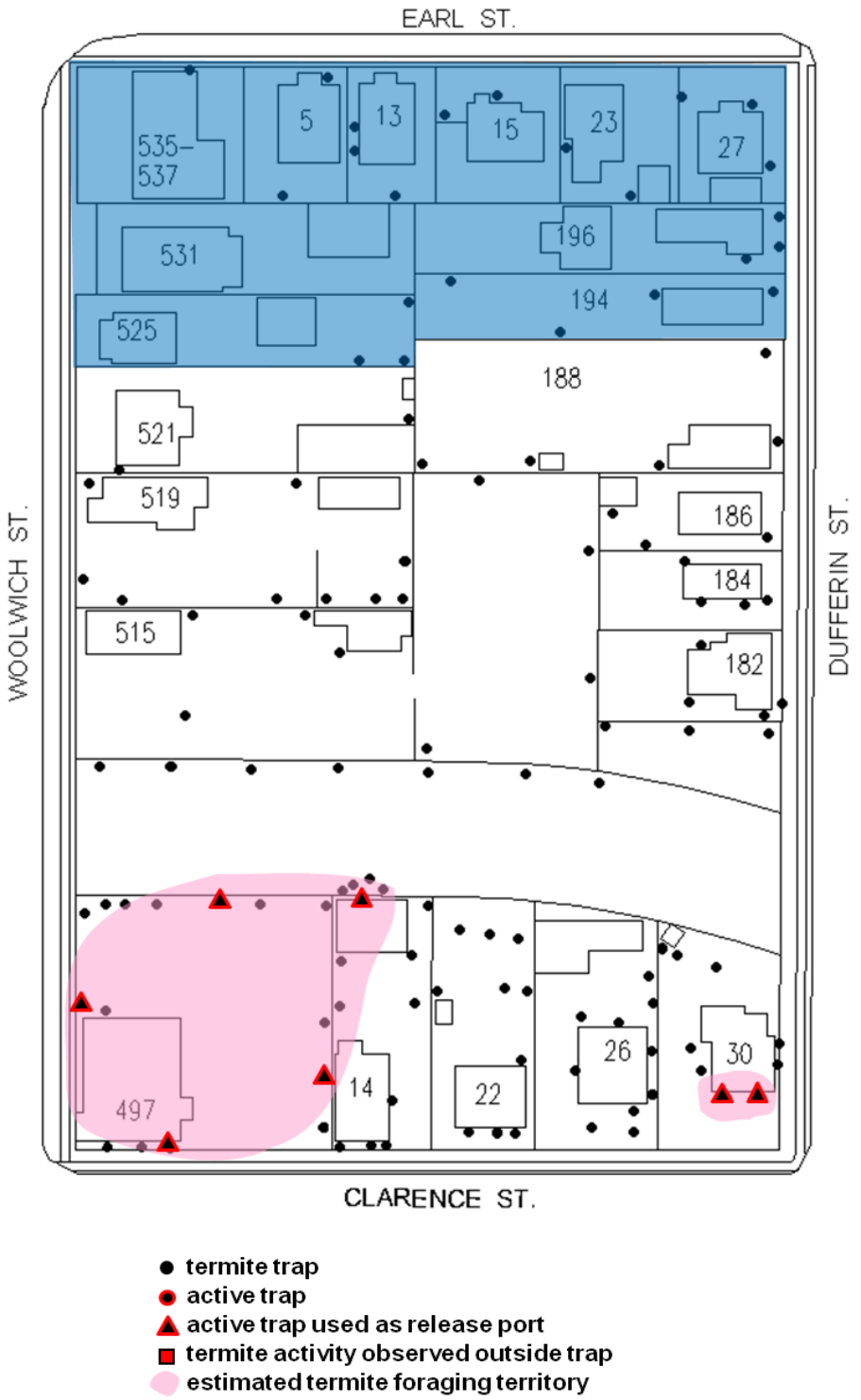

Figure 10. Trap activity in sector 2 in 2012.

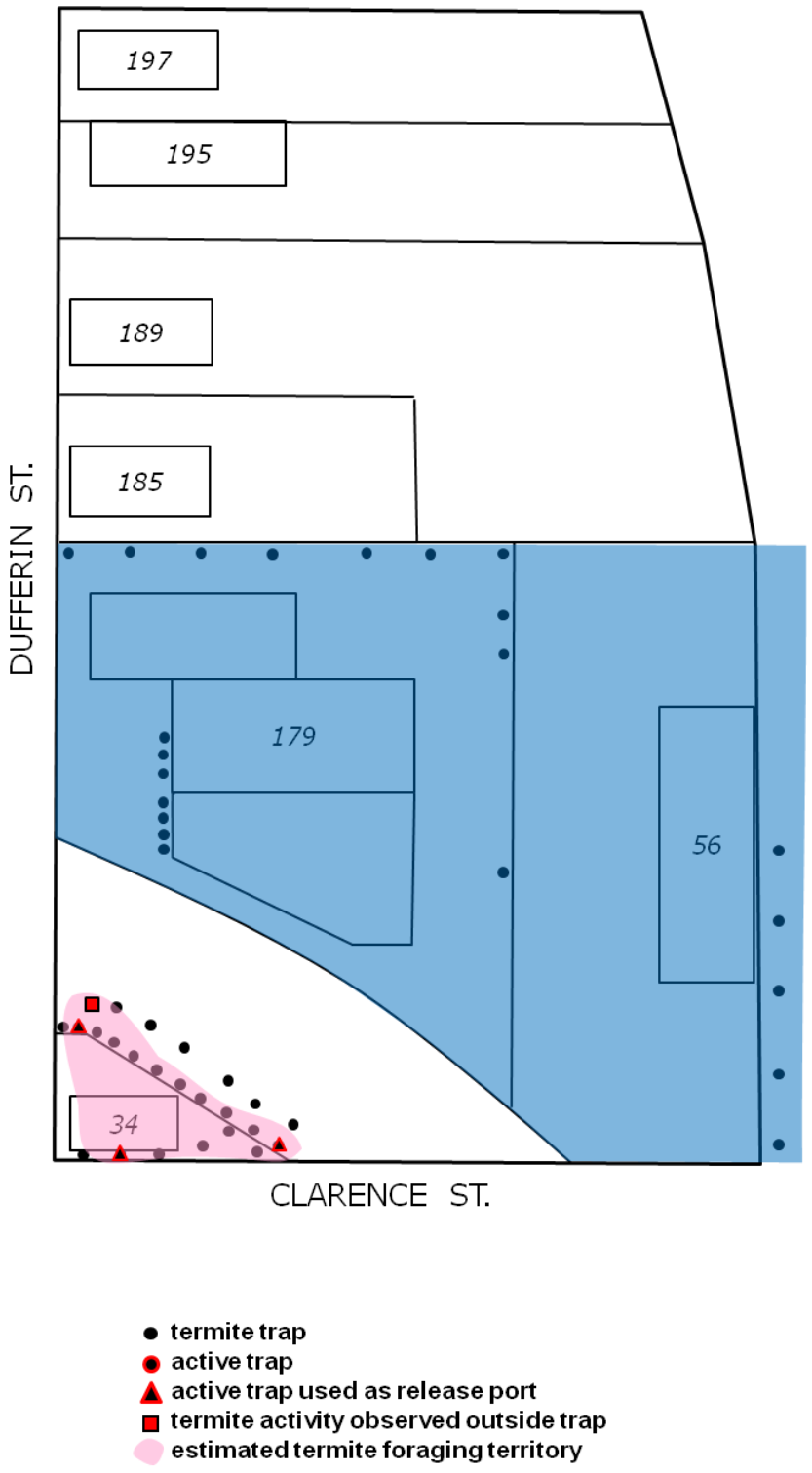

Figure 11. Trap activity in sector 3 in 2012.

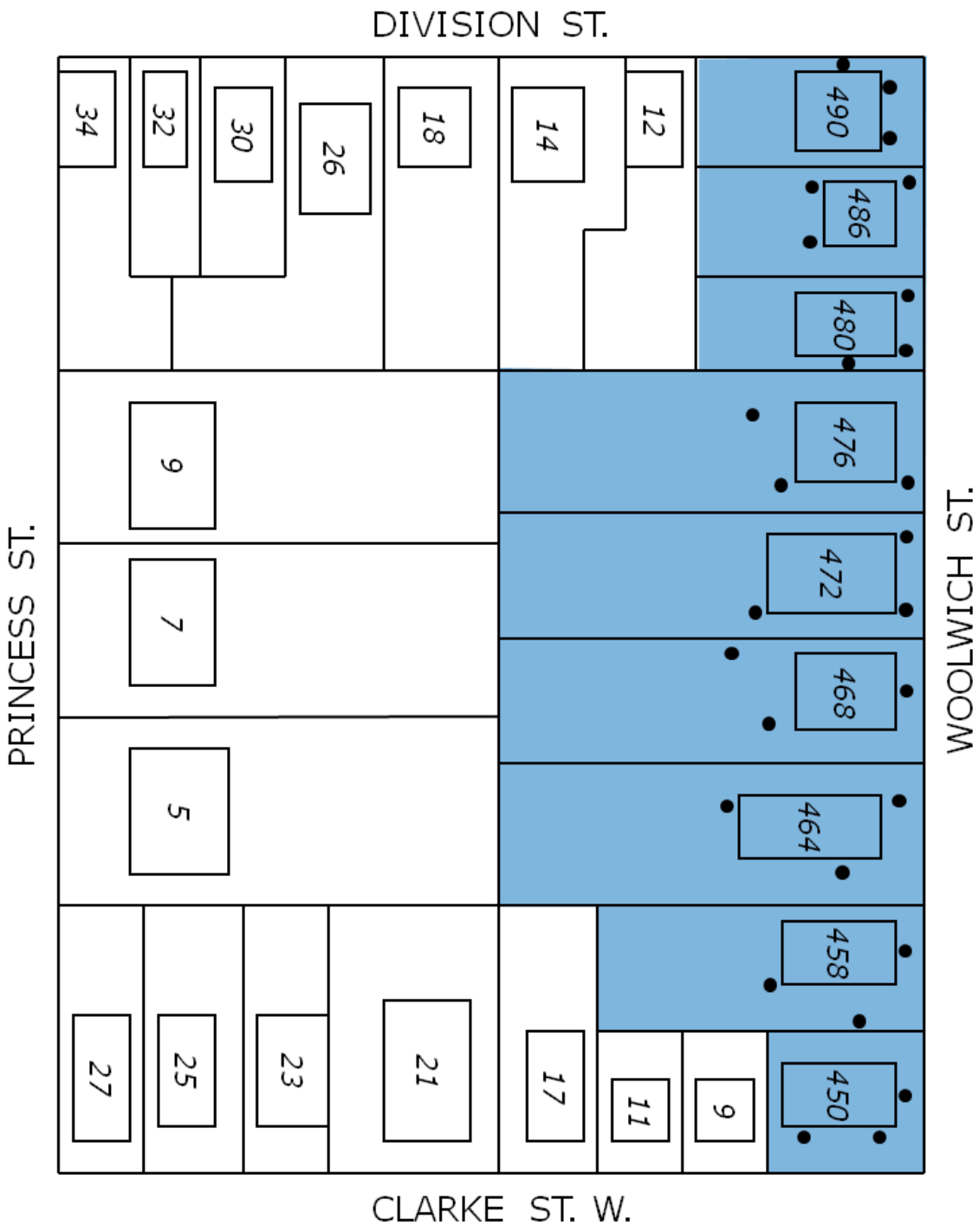

Figure 12. Trap locations in sector 6 in 2012.

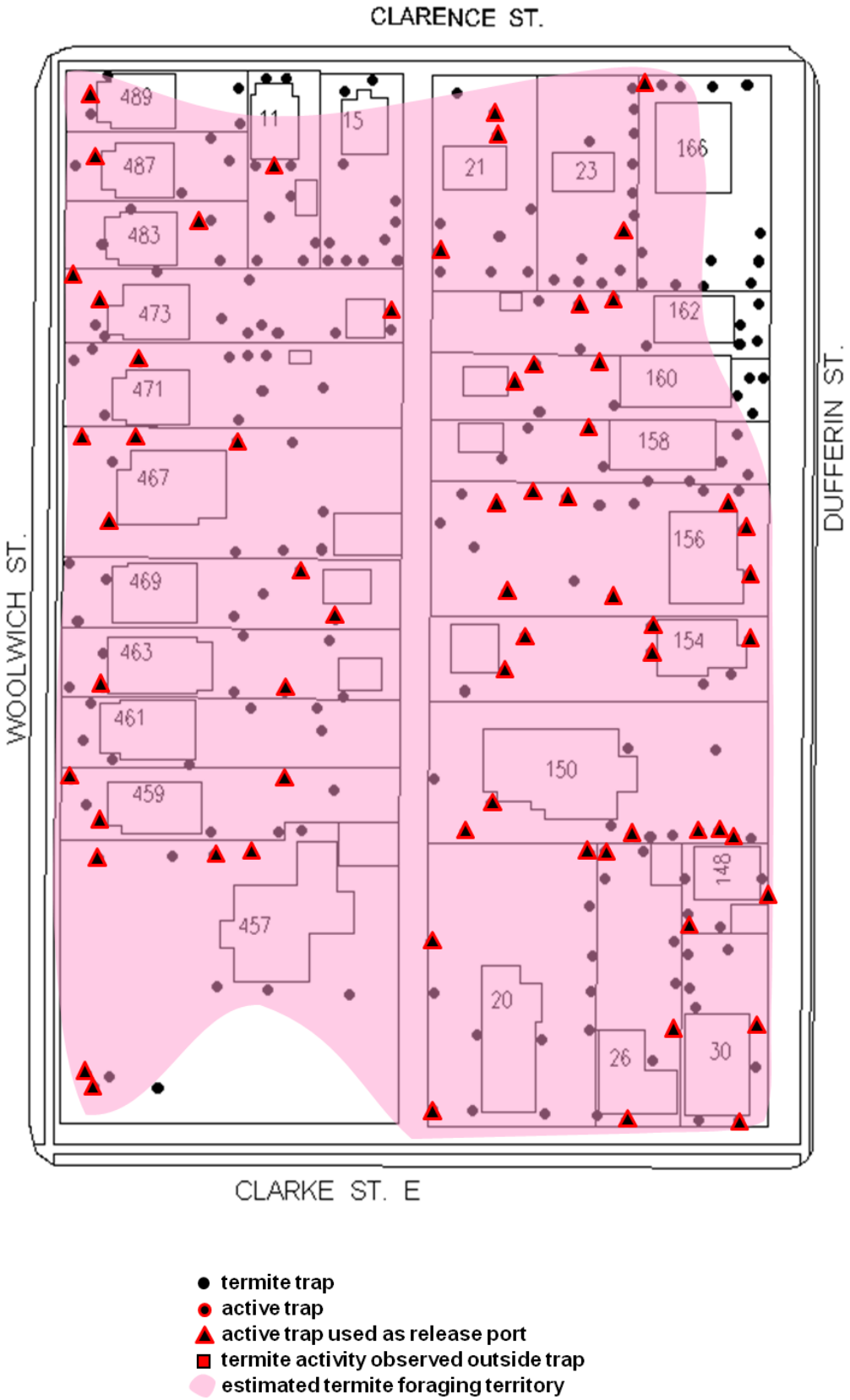

Figure 13. Trap activity in sector 7 in 2012.

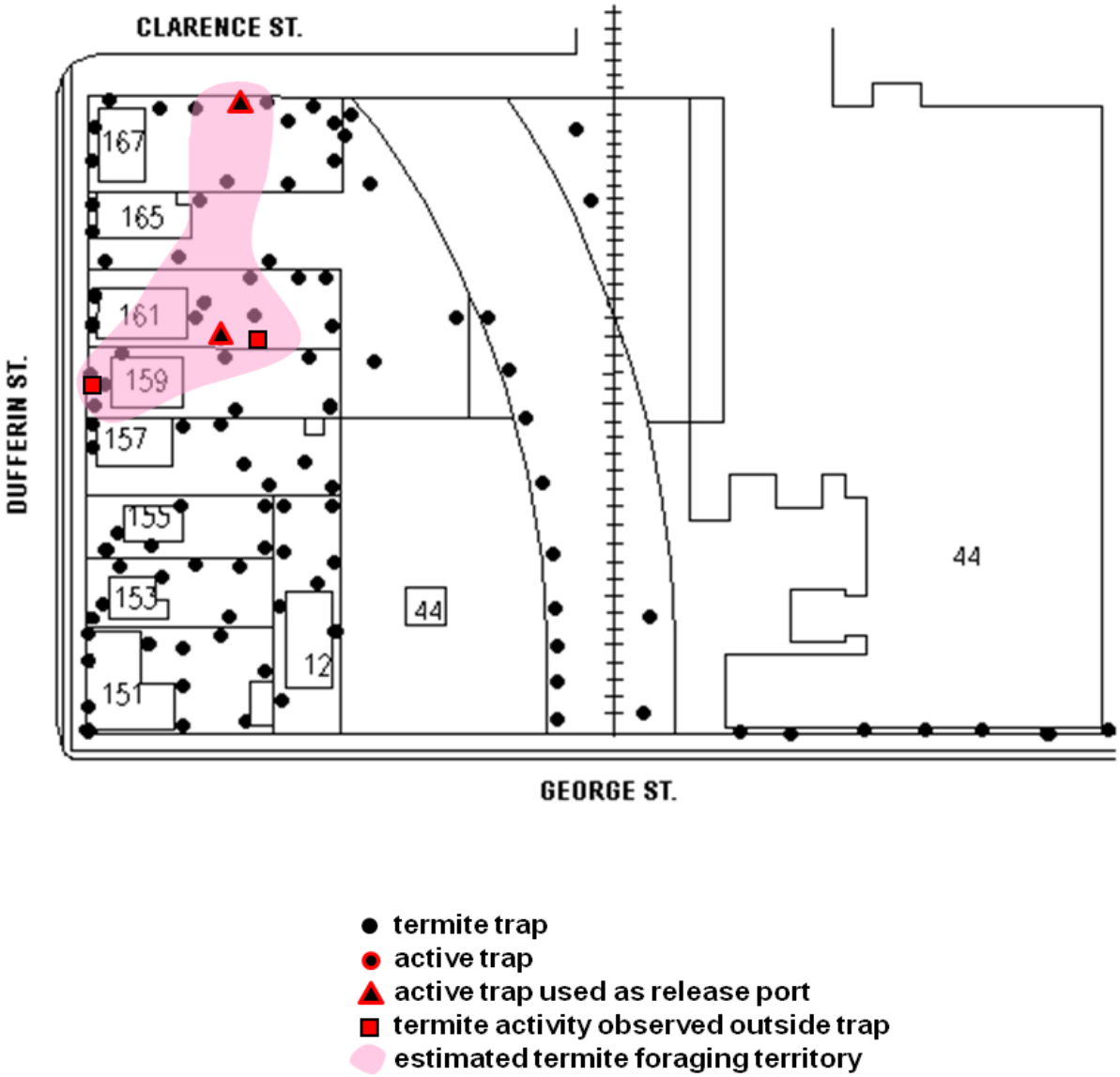

Figure 14. Trap activity in sector 8 in 2012.

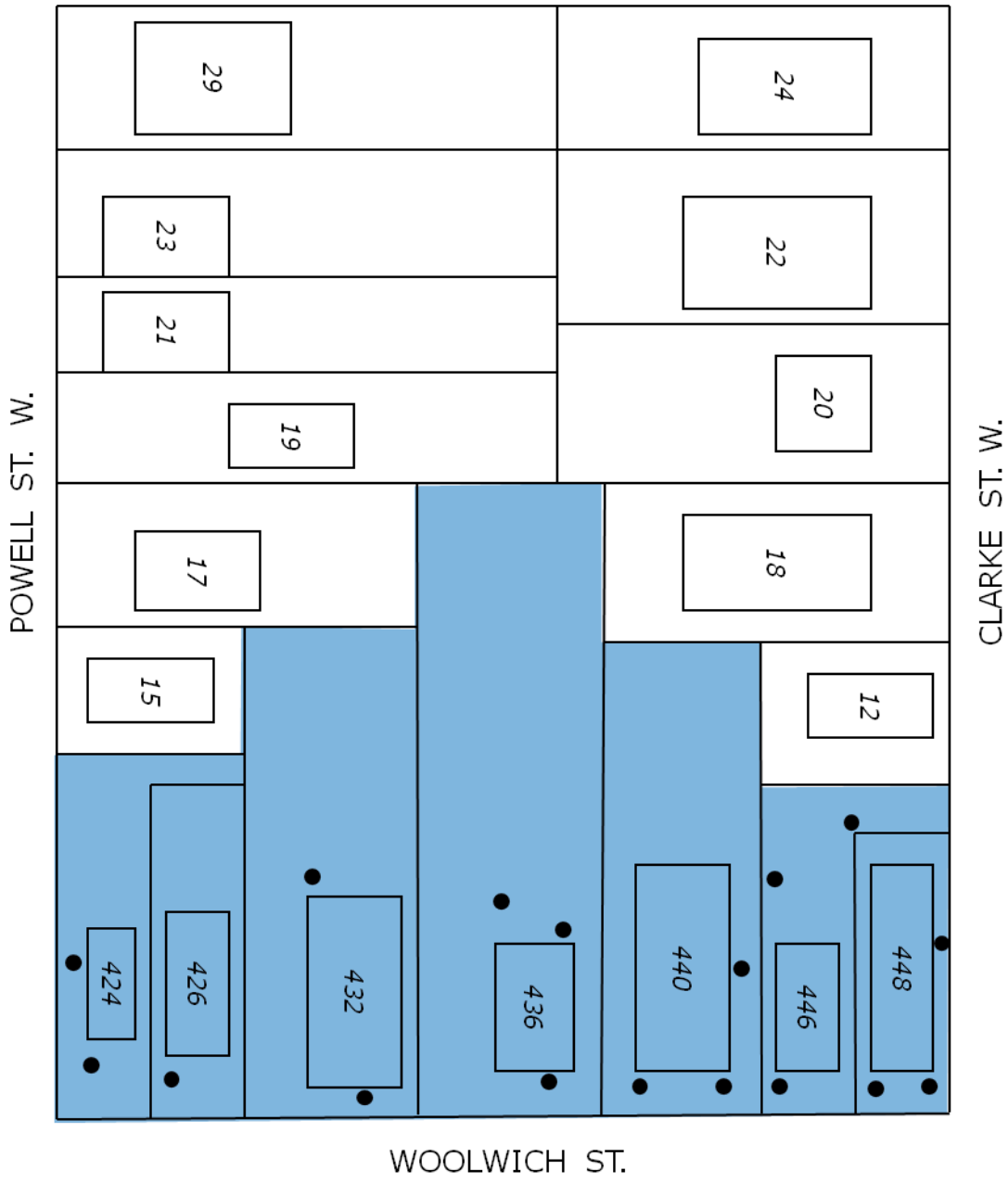

Figure 15. Trap locations in sector 9 in 2012.

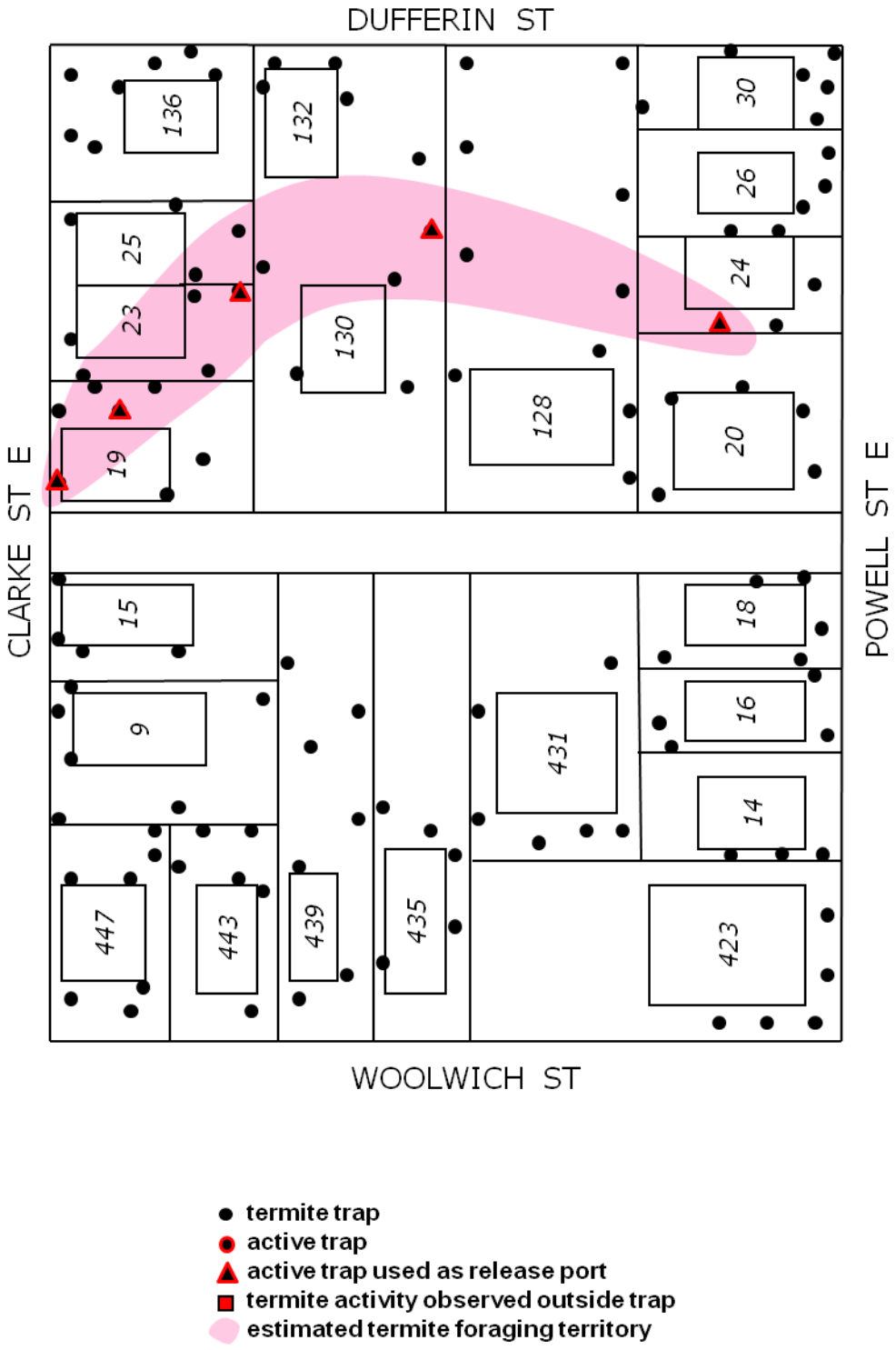

Figure 16. Trap activity in sector 10 in 2012.

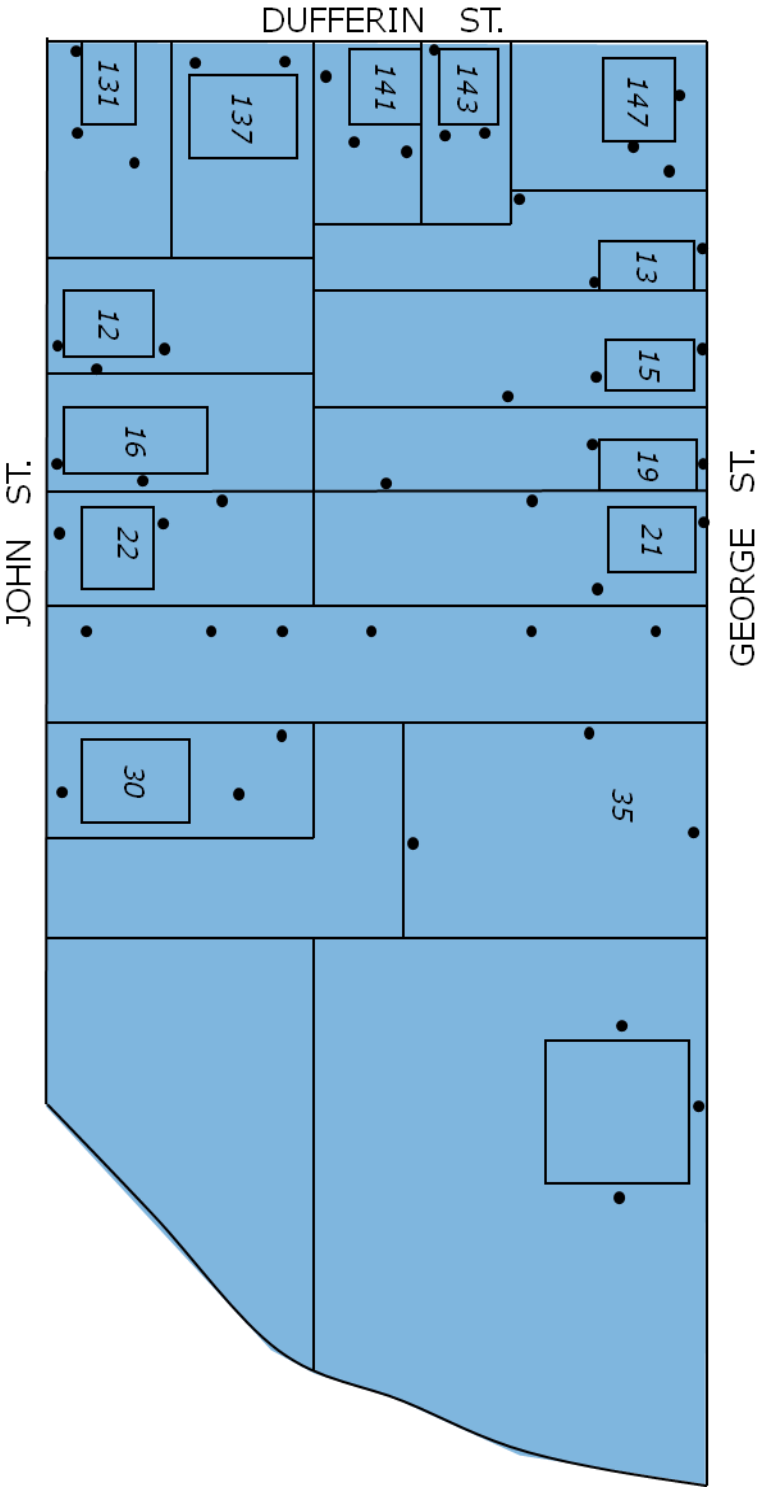

Figure 17. Trap locations in sector 11 in 2012.

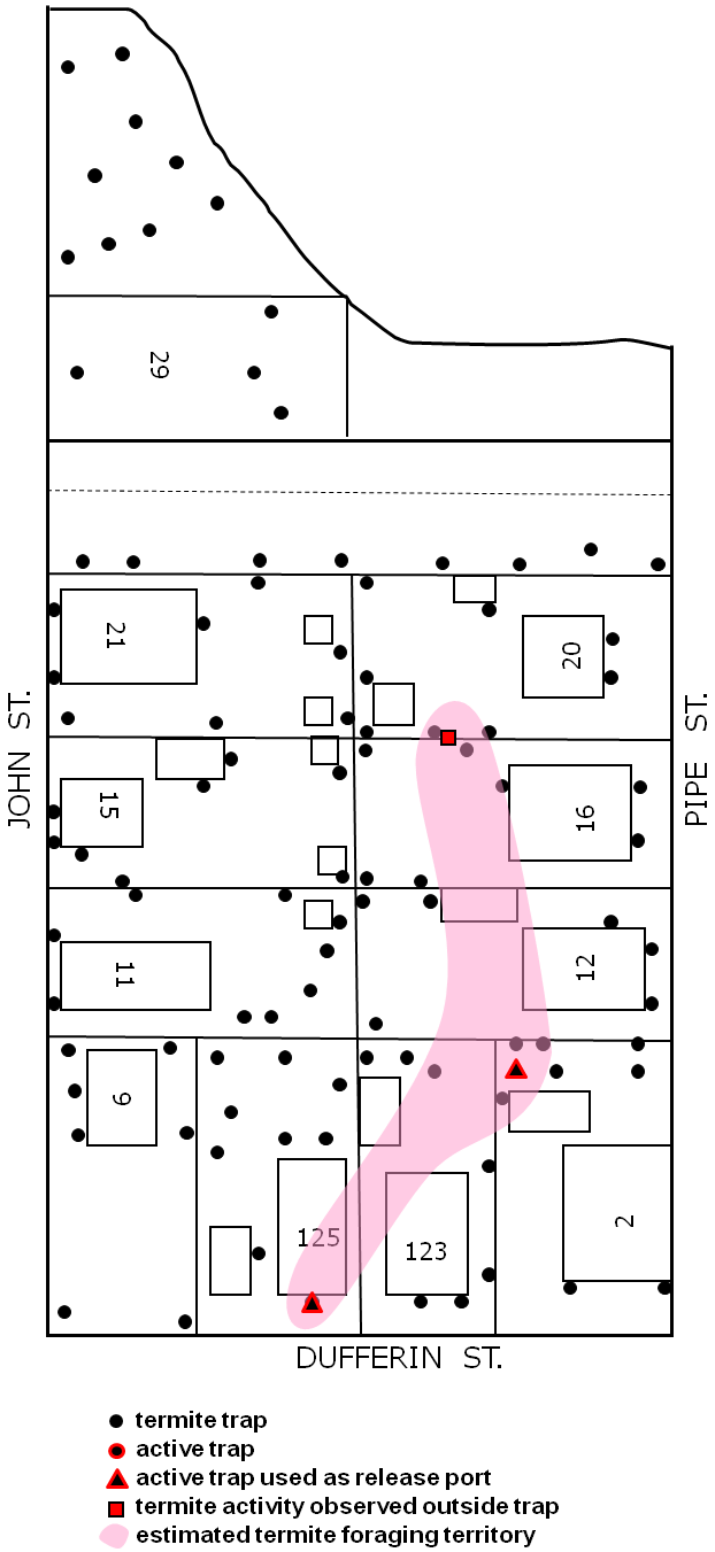

Figure 18. Trap activity in sector 12 in 2012.

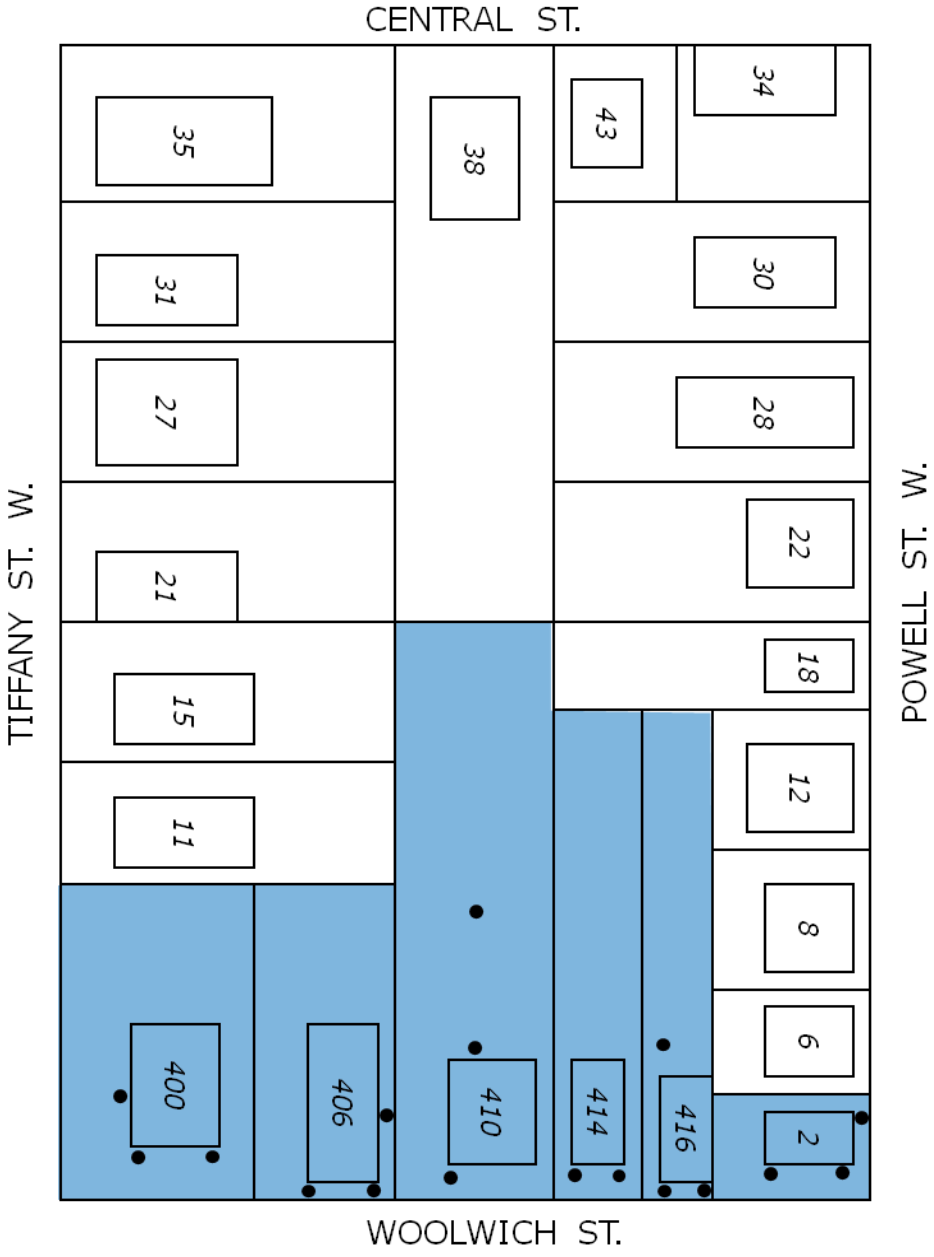

Figure 19. Trap locations in sector 14 in 2012.

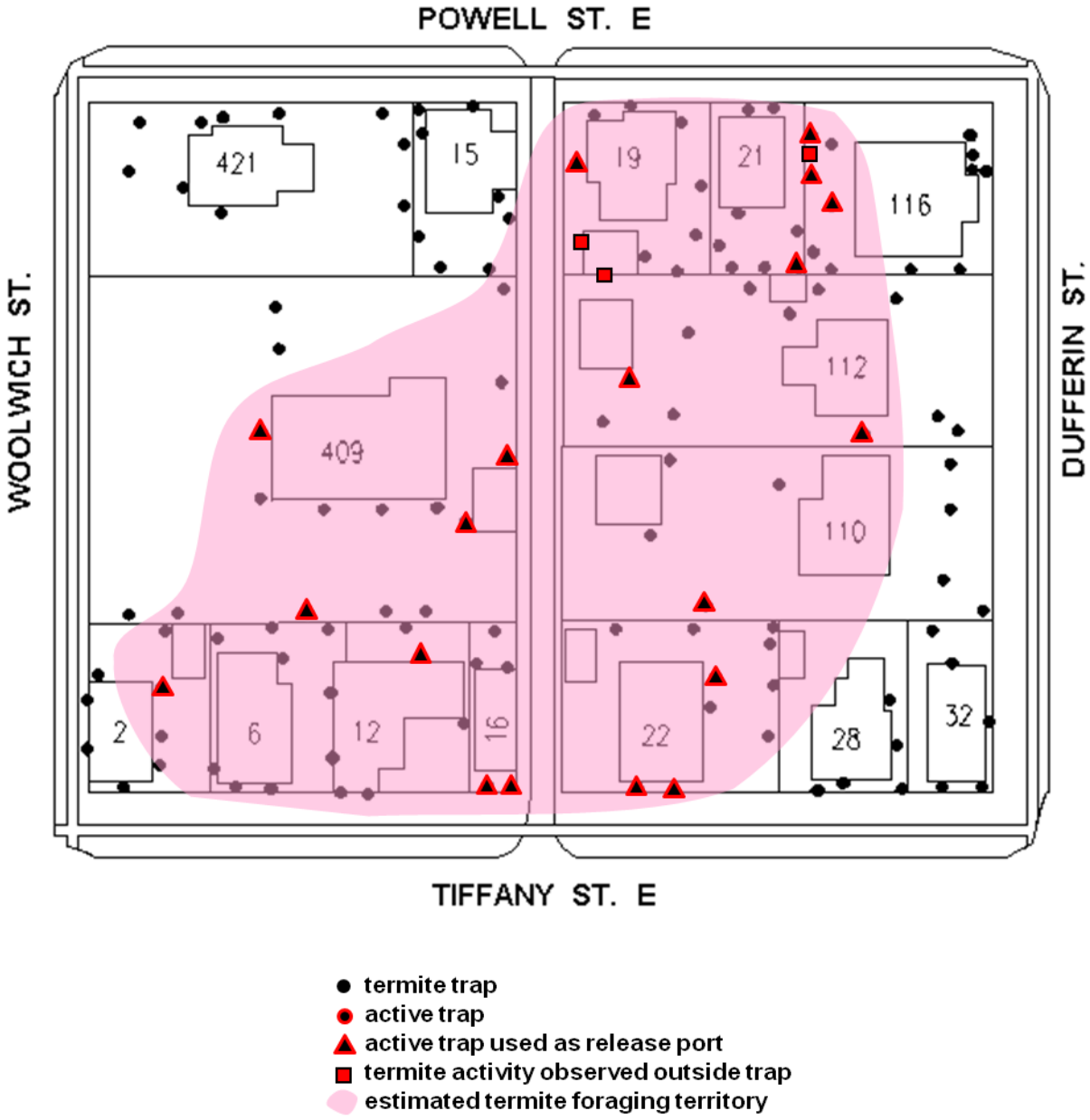

Figure 20. Trap activity in sector 15 in 2012.

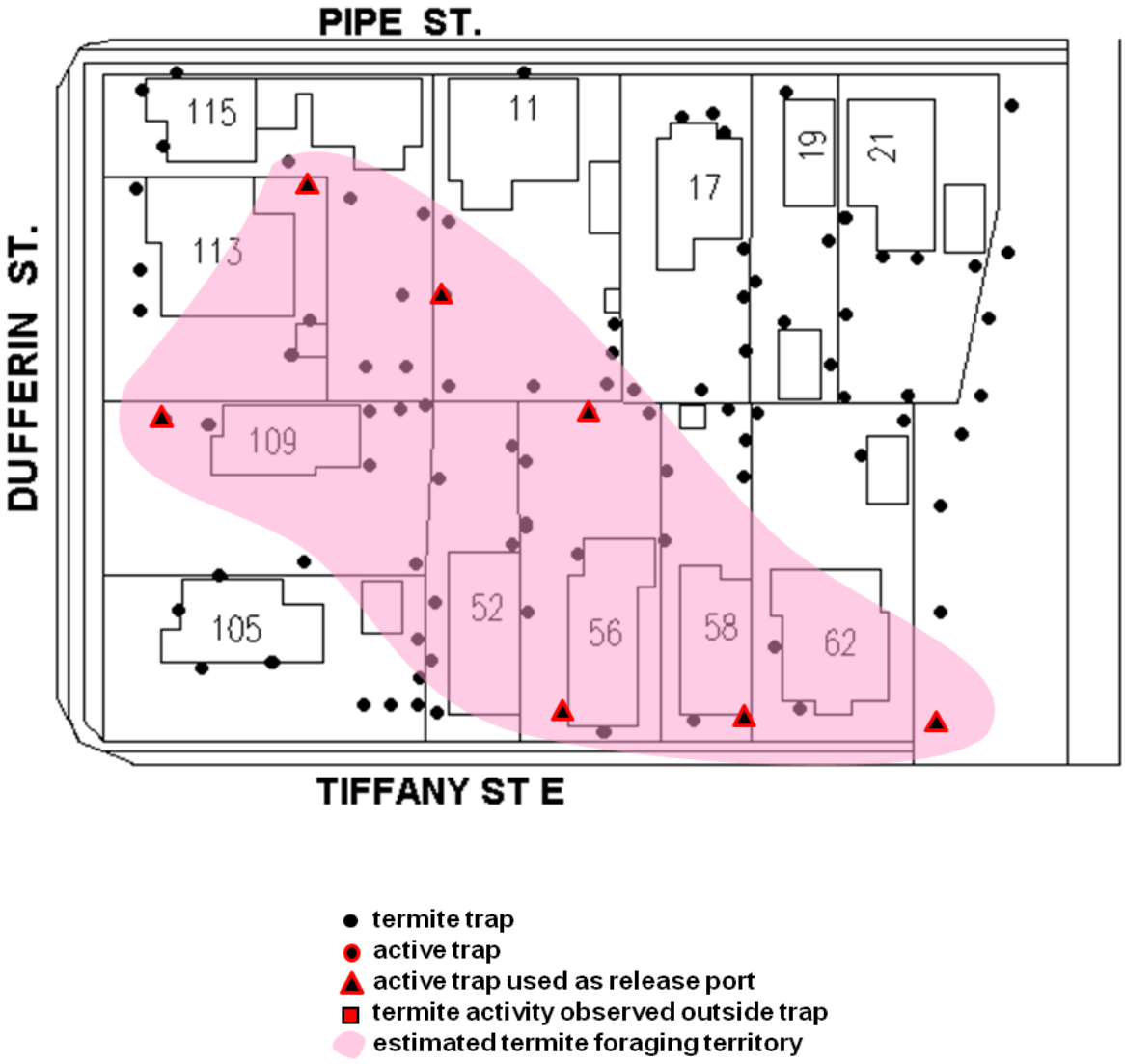

Figure 21. Trap activity in sector 16 in 2012.

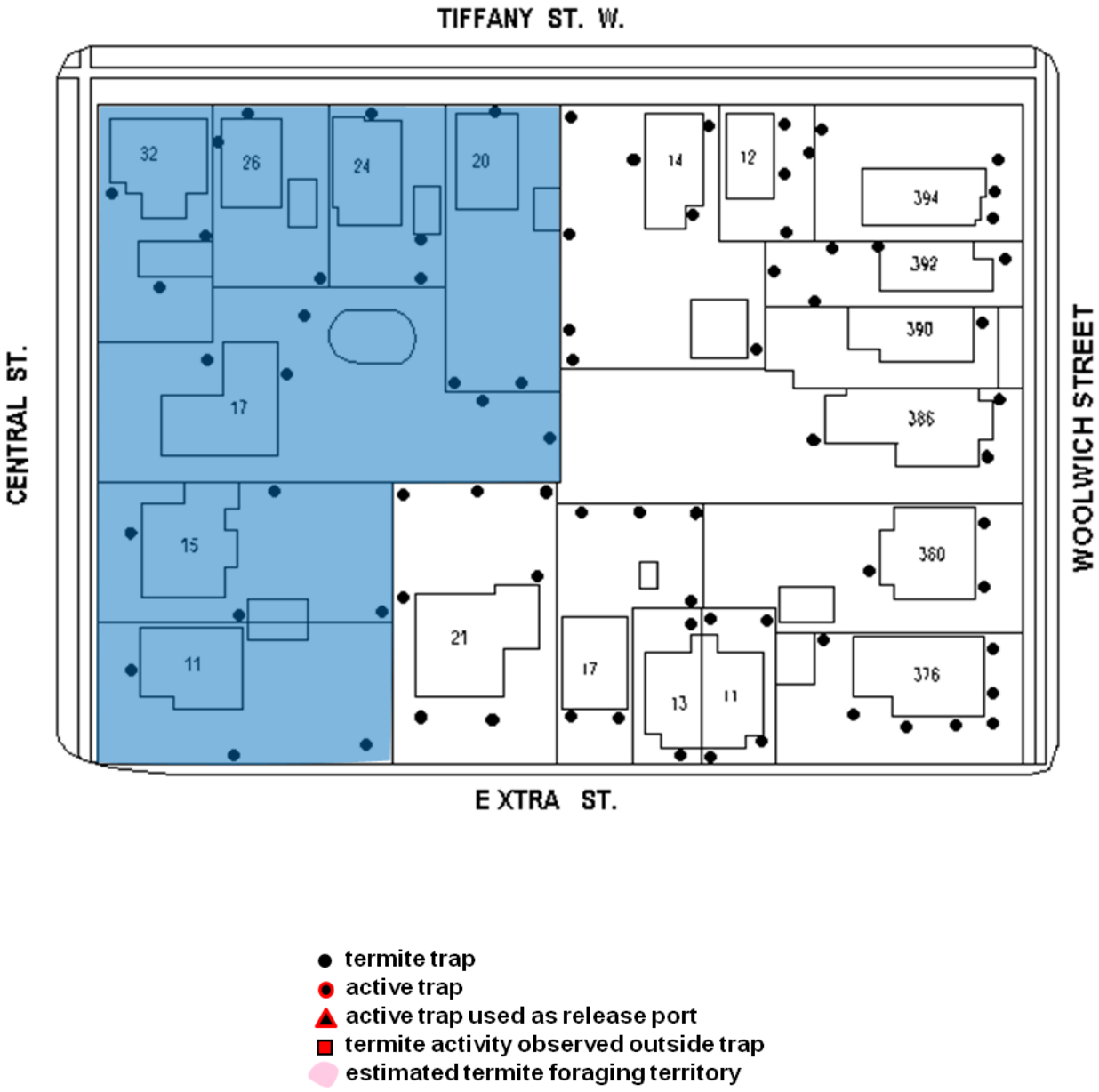

Figure 22. Trap activity in sector 19 in 2012.

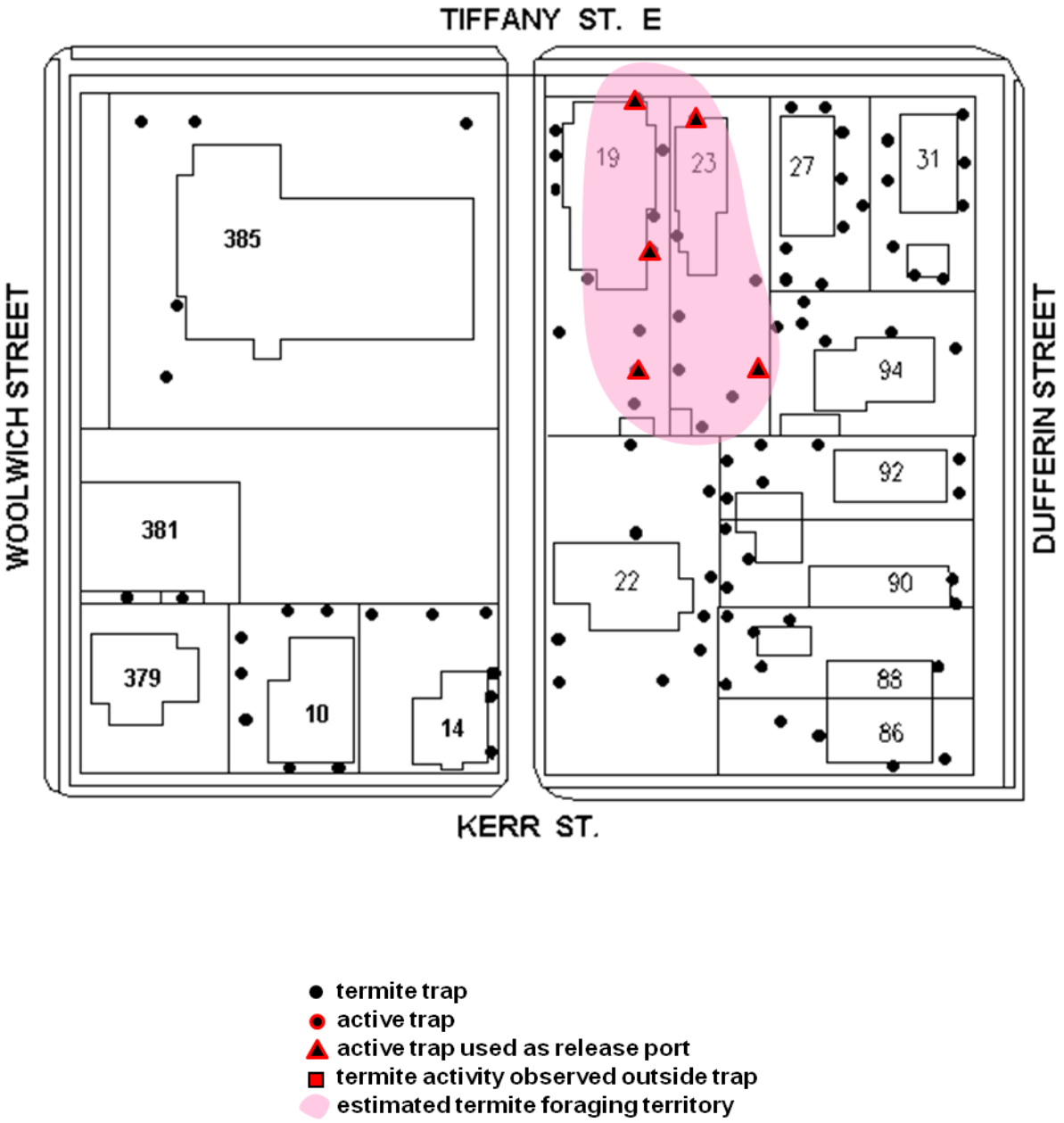

Figure 23. Trap activity in sector 20 in 2012.

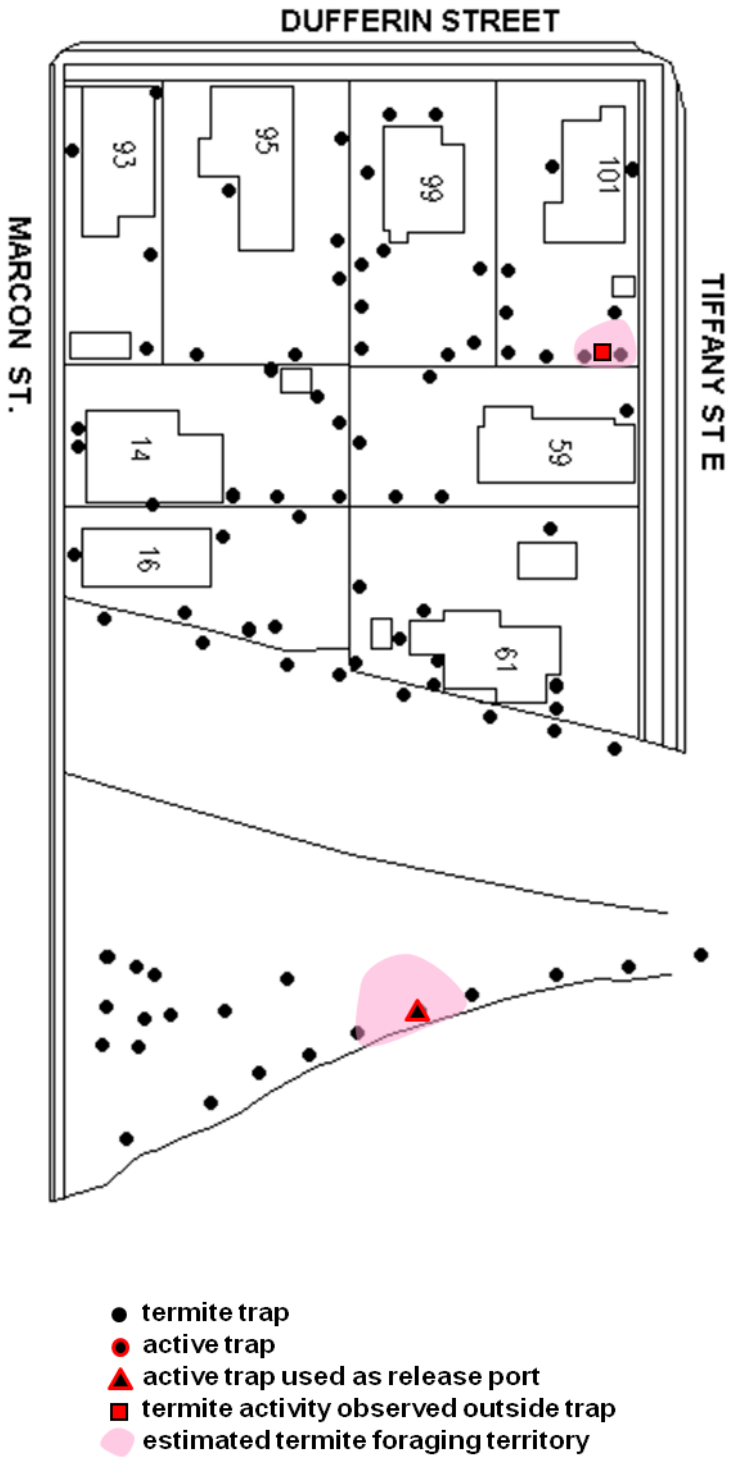

Figure 24. Trap activity in sector 21 in 2012.

Figure 25. Trap activity in sector 22 in 2012.

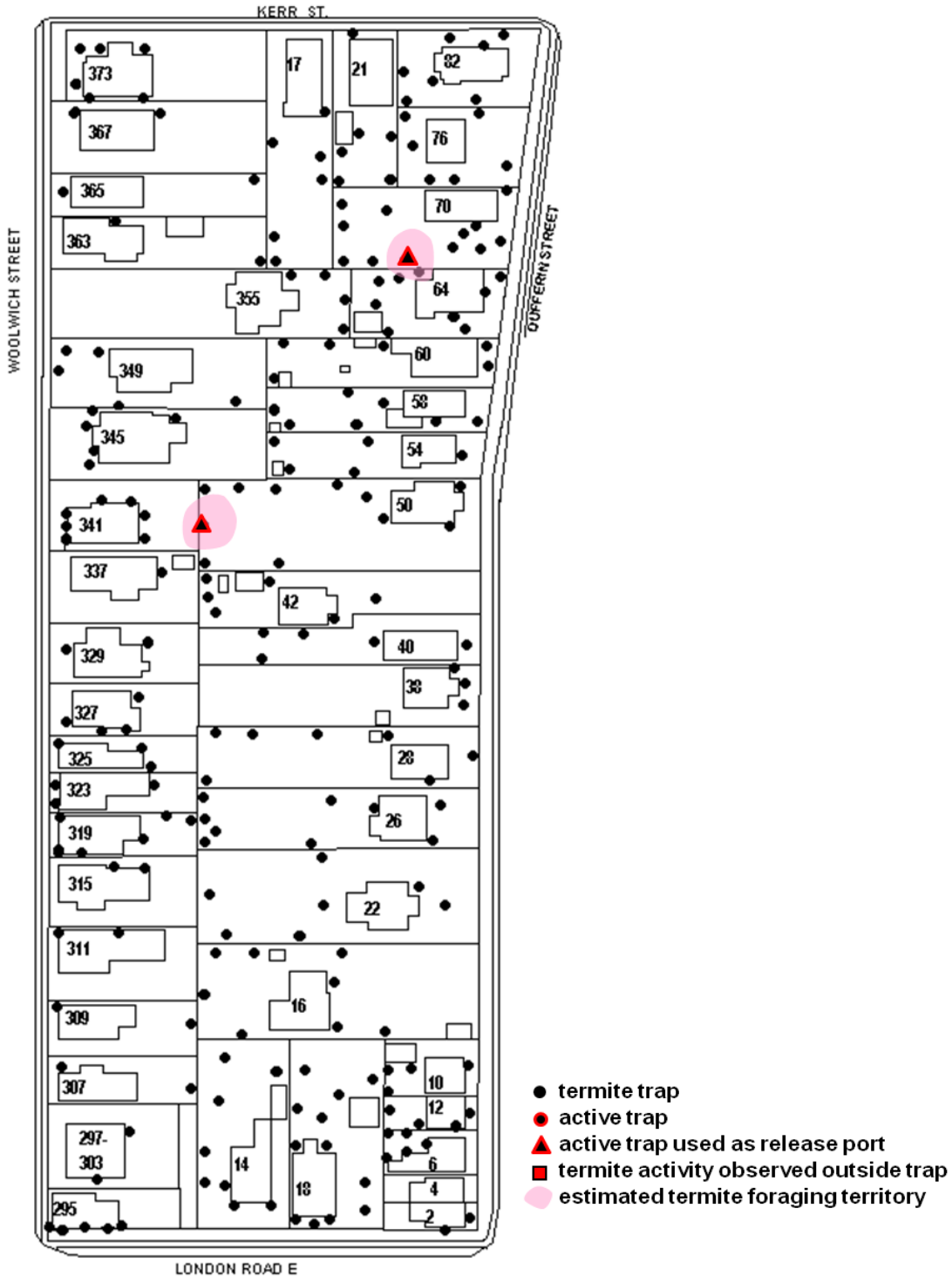

Figure 26. Trap activity in sector 23 in 2012.

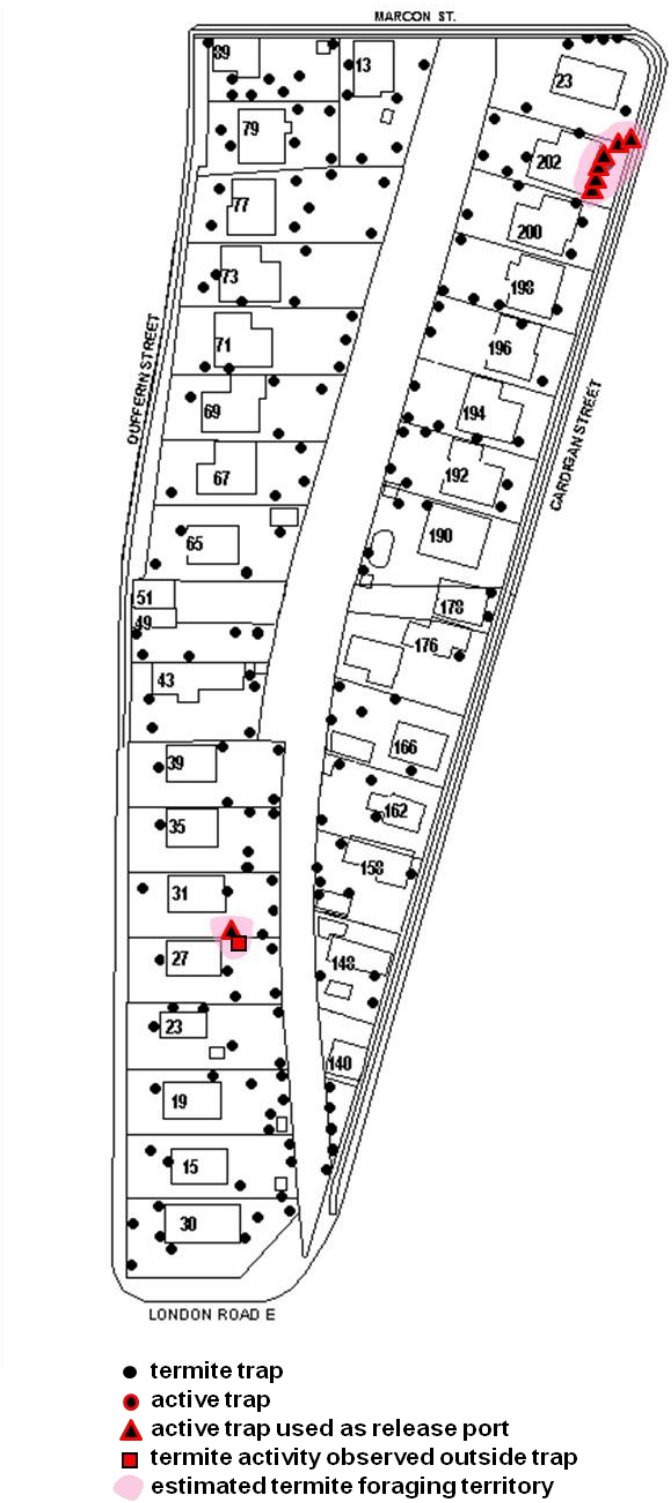

Figure 27. Trap activity in sector 24 in 2012.

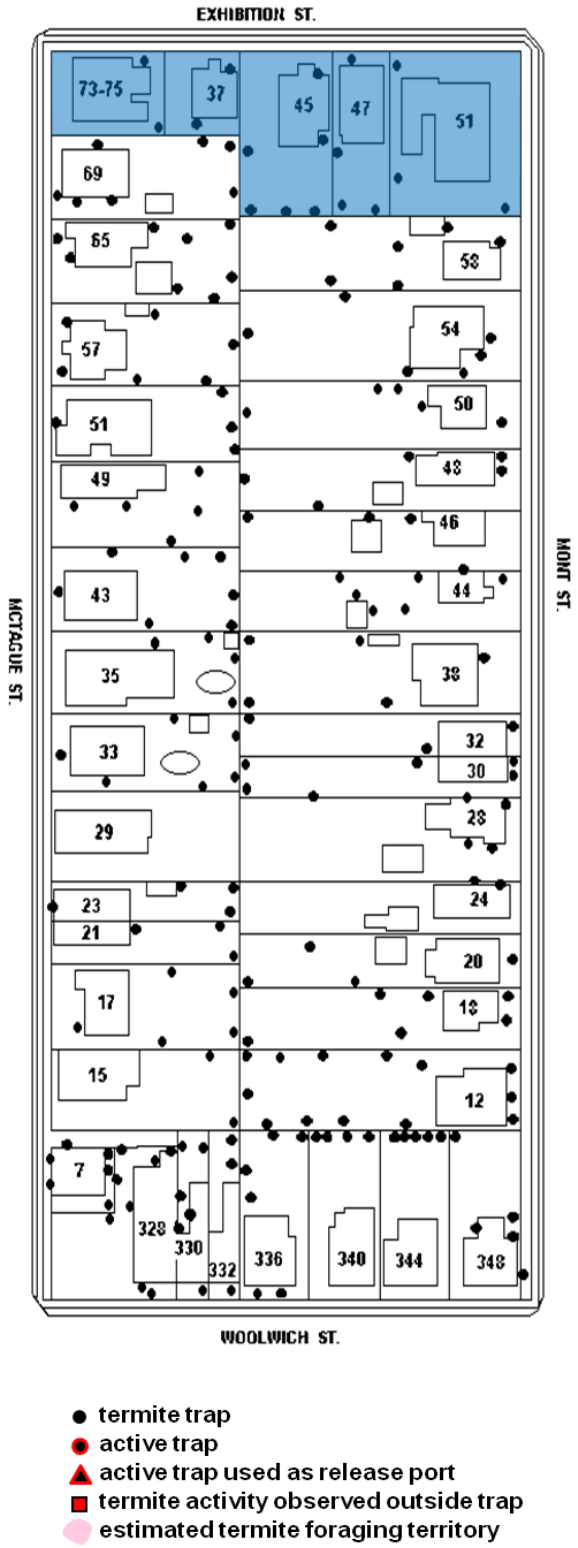

Figure 28. Trap activity in sector 25 in 2012.

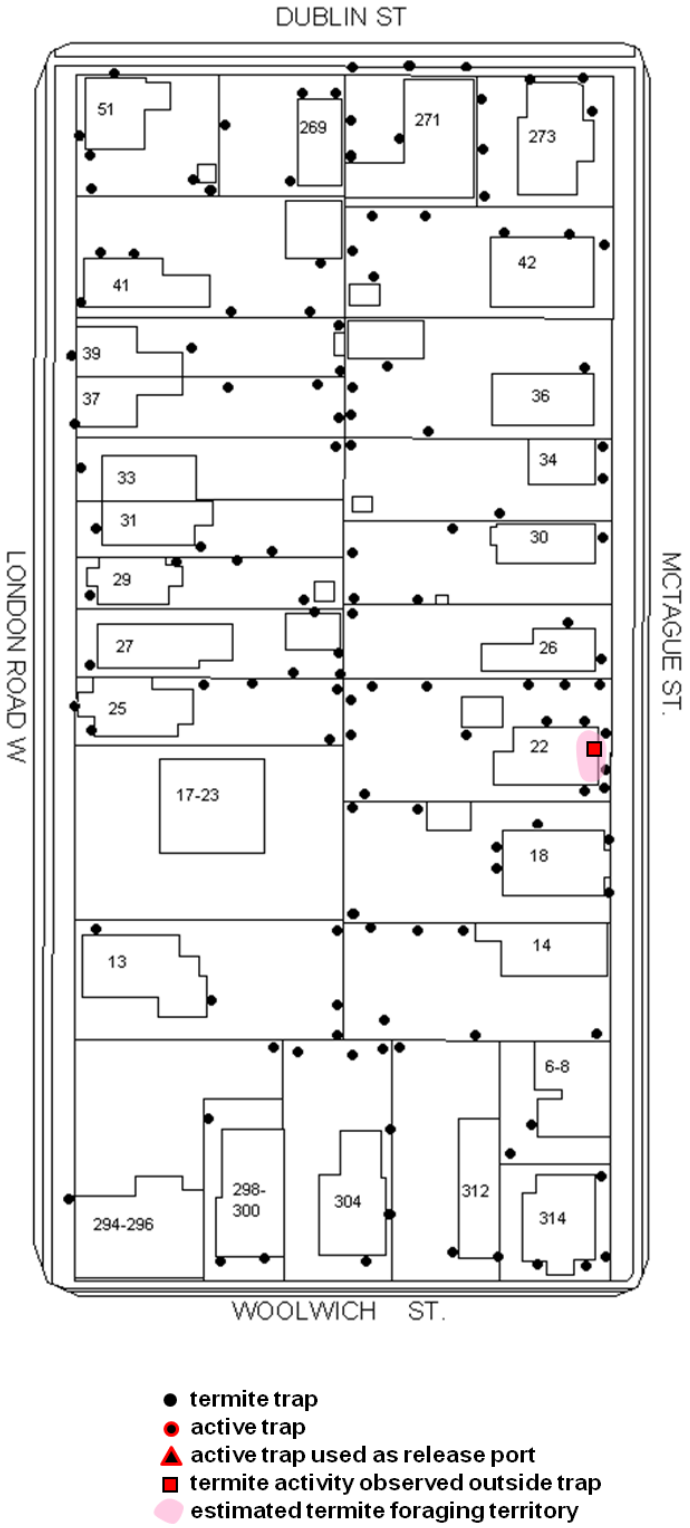

Figure 29. Trap activity in sector 27 in 2012.

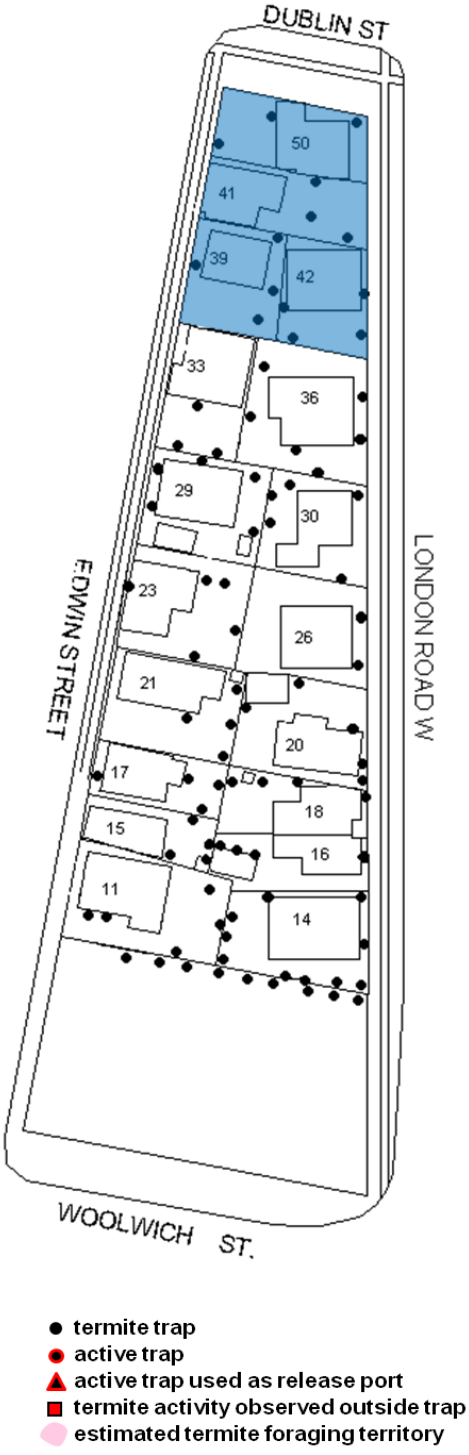

Figure 30. Trap activity in sector 30 in 2012.

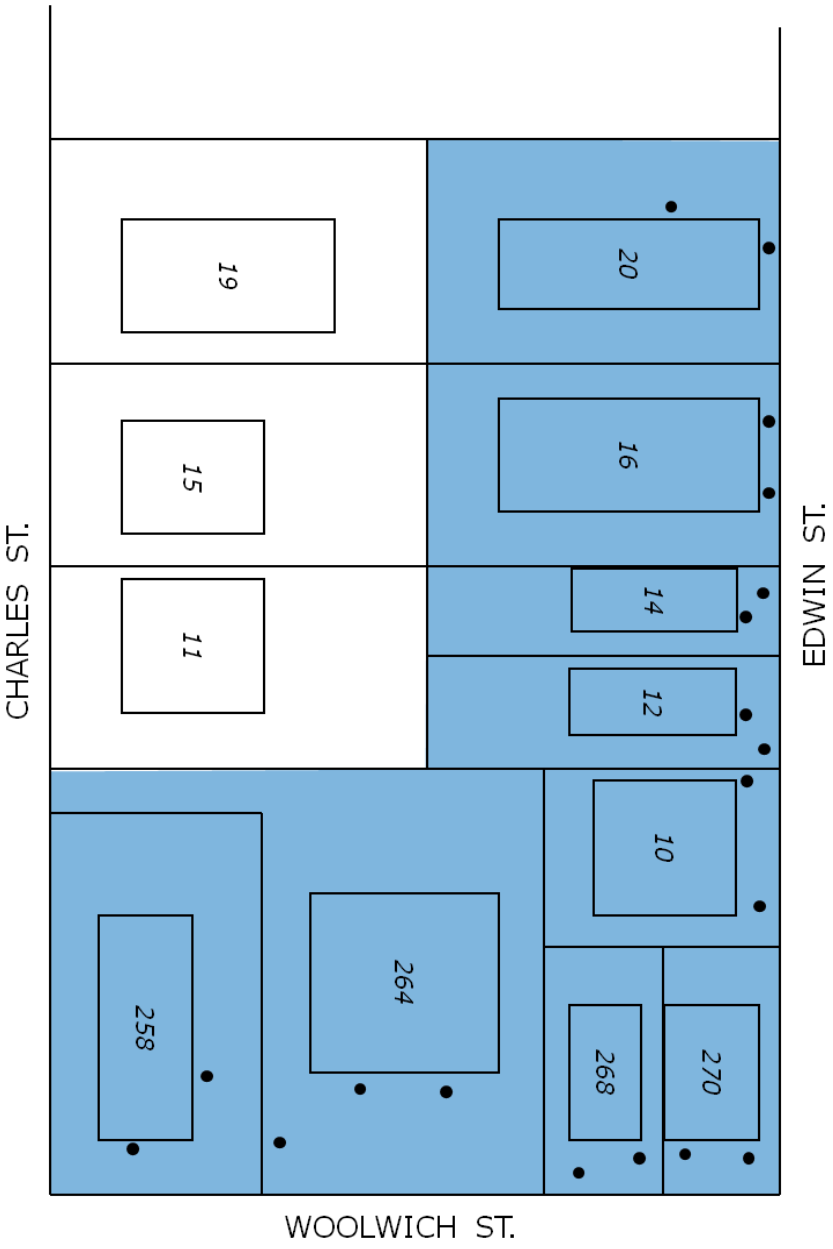

Figure 31. Trap locations in sector 31 in 2012.

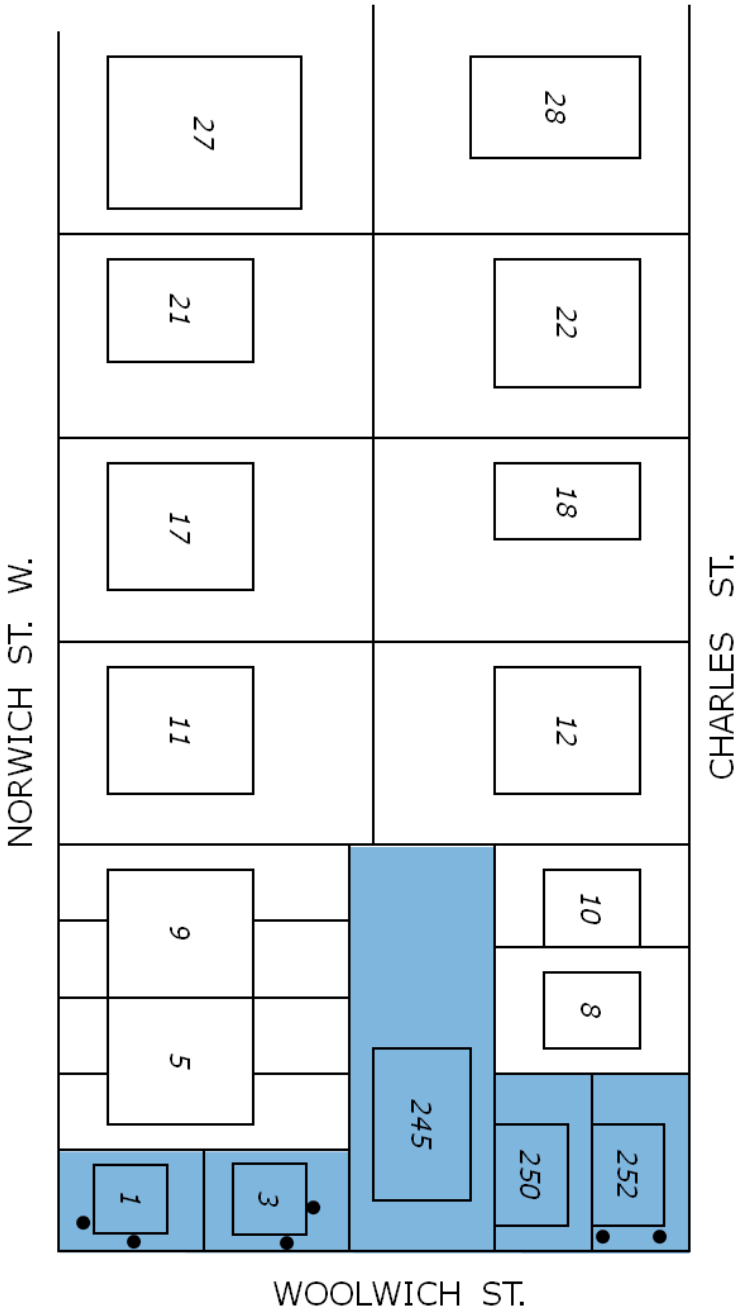

Figure 32. Trap locations in sector 32 in 2012.

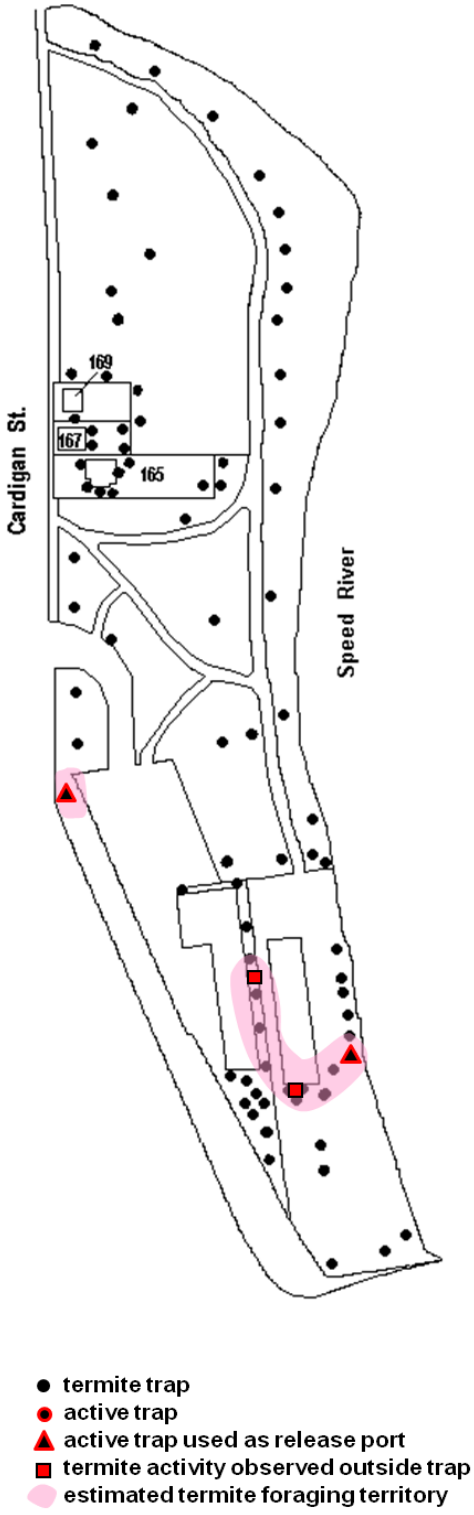

Figure 33. Trap activity in sector 36 in 2012.

Figure 34. Trap activity in sector 37 in 2012.

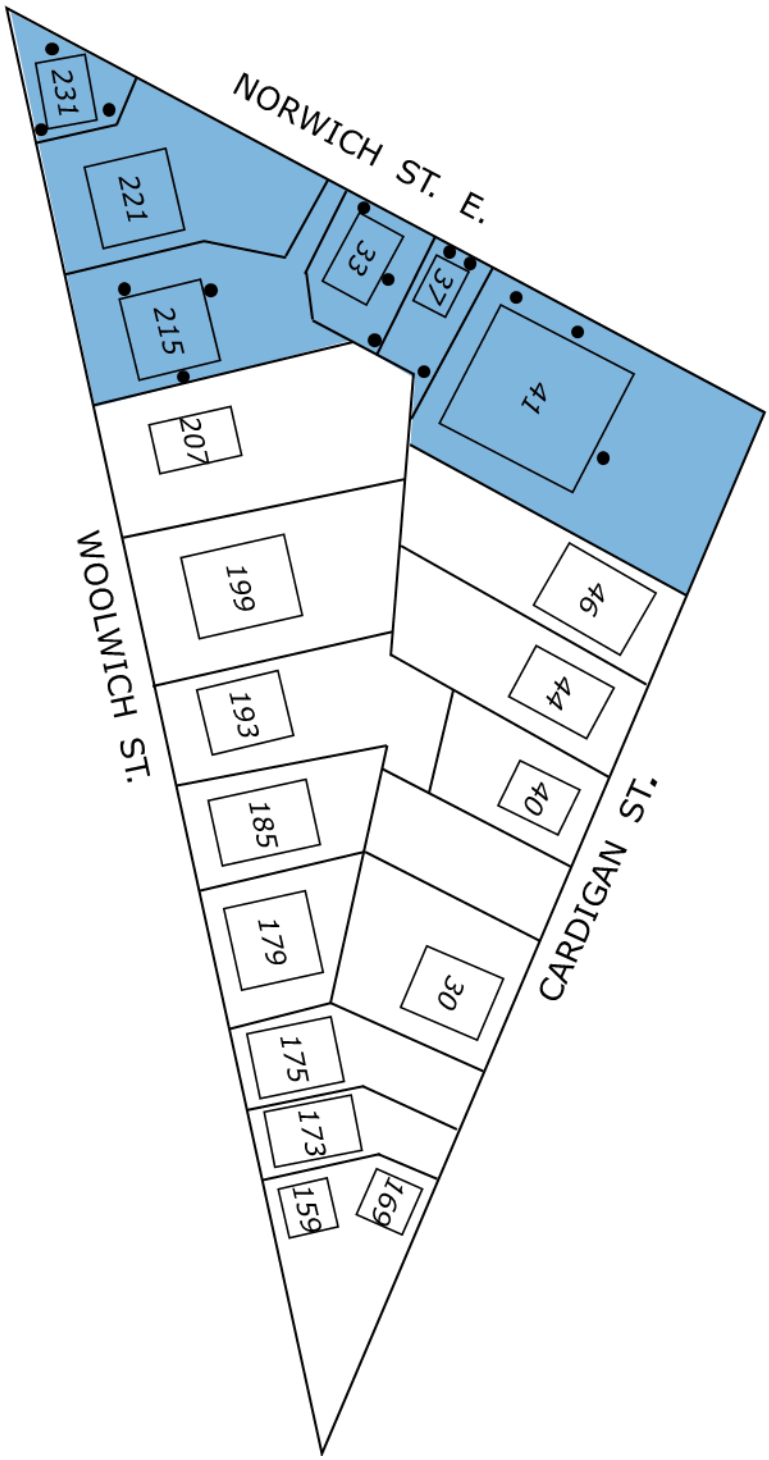

Figure 35. Trap locations in sector 40 in 2012.

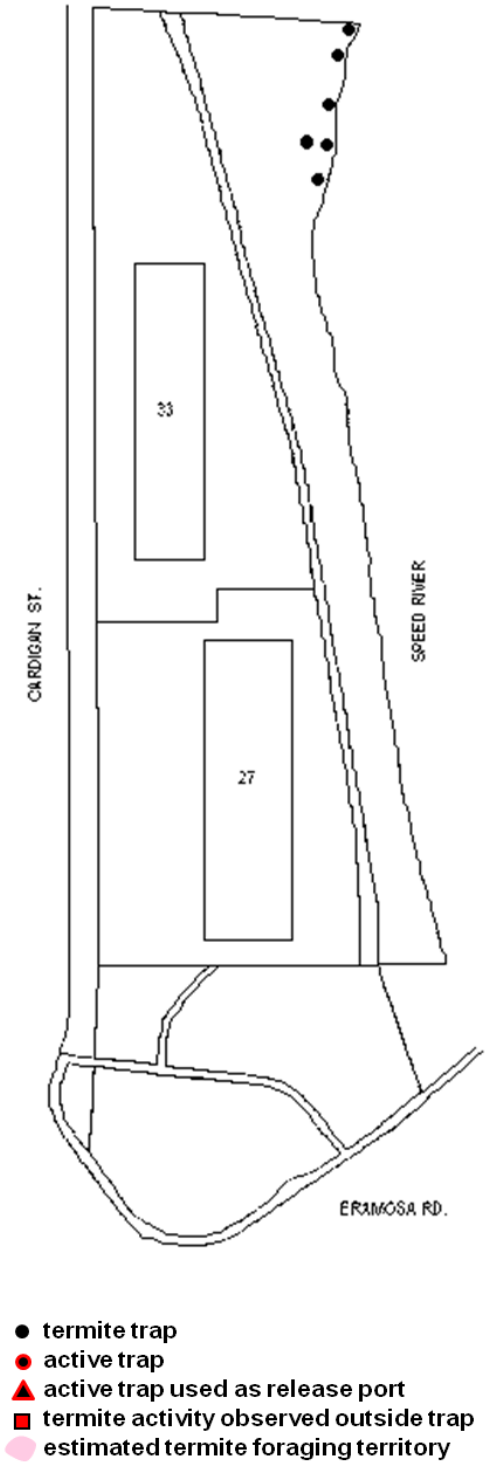

Figure 36. Trap activity in sector 41 in 2012.

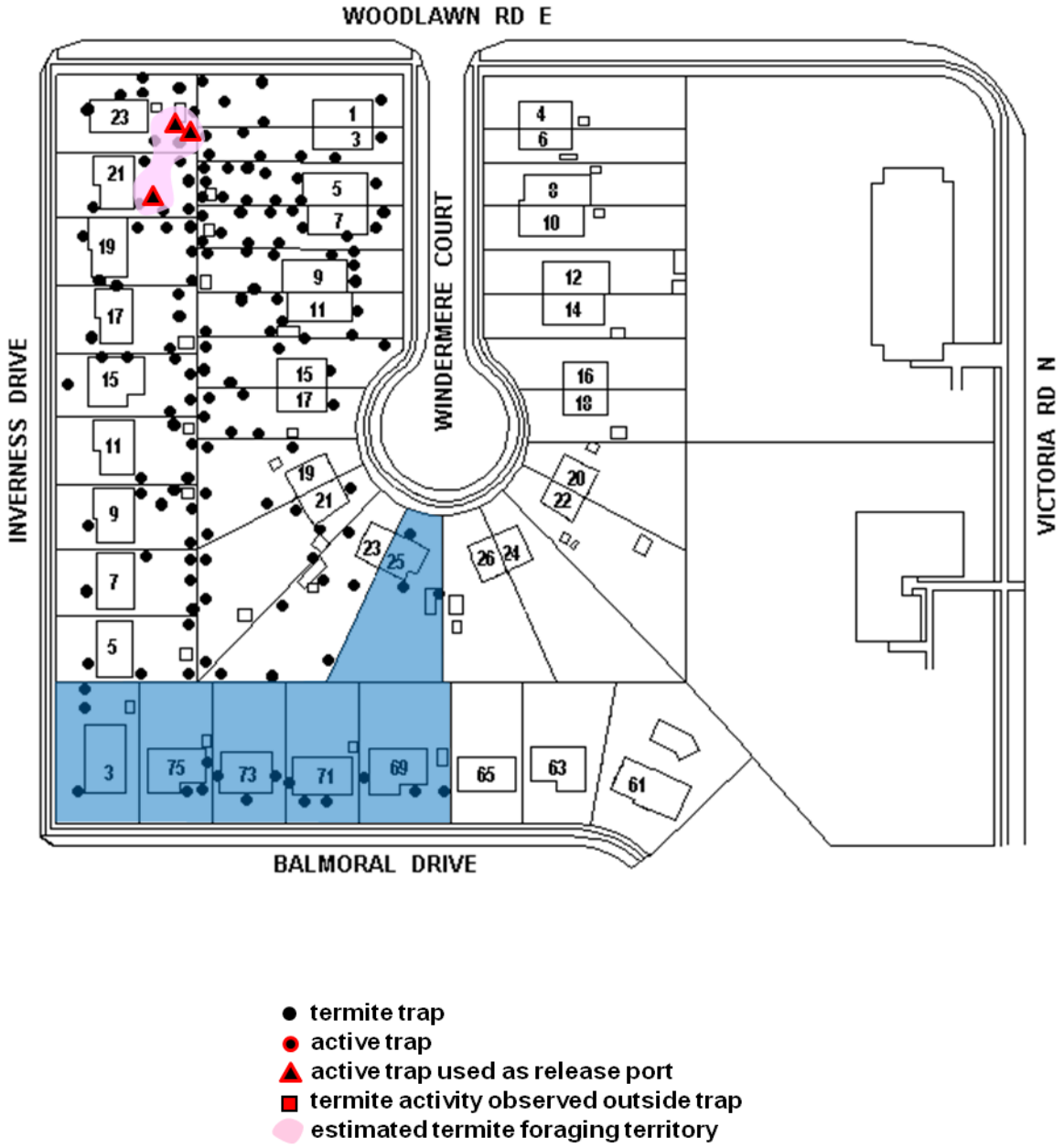

Figure 37. Trap activity in sector 42 in 2012.

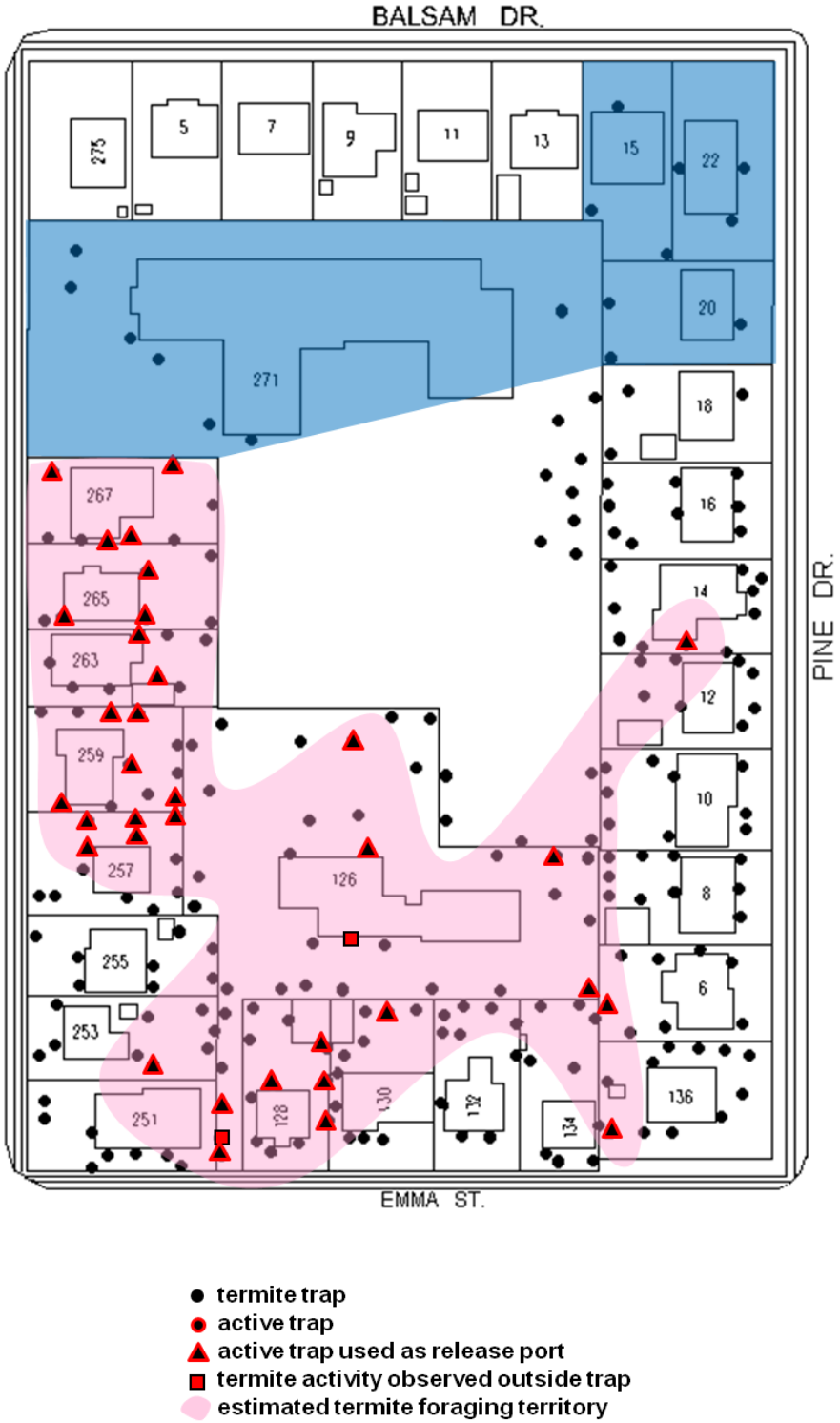

Figure 38. Trap activity in sector 47 in 2012.

Appendix 1.

Laboratory Evaluation of Zinc Borate and Fipronil for control of the eastern subterranean termite, *Reticulitermes flavipes*

Timothy G. Myles, Ph.D.
Termite Control Officer

City of Guelph, 1 Carden St., Guelph, Ontario, Canada N1H 3A1
tim.myles@guelph.ca 519-837-5615 ext 2840, 519-827-4383 (cell)

Abstract Zinc borate was compared to fipronil as both a dust and a resinous coating for treatment of termites in petri dish tests. As a dust, zinc borate had a maximum kill ratio of 1:100 after 10 days, while as a coating its maximum kill ratio was 1:35. Fipronil killed faster with greater than 70% mortality after one day and greater than 95% mortality after two days for both dust and coatings at kill ratios up to 1:100.

Introduction Fipronil is a broad-spectrum phenylpyrazole insecticide, originally registered by BASF, and now off patent. It has many applications in agriculture as well as for urban entomology pests as a slow-acting bait toxicant for cockroach and ant bait stations. In the USA, it is used as a soil termiticide under the trade name Termidor®. Termidor Dry, a new BASF product containing 0.5% fipronil, and 99.5% microcrystalline cellulose dust has recently been registered in the in US for control of the drywood and subterranean termites but has already been used in Australia for control of subterranean termites for several years. In Australia it is used in conjunction with various trap or bait systems such as the Green Bait System. When bait stations become active, Termidor Dry is injected as a powder, and then dispersed by the treated population in the trap to untreated termites in the foraging galleries and nests. Operators have claimed success in control subterranean termites by this method. In the current study, fipronil was compared with zinc borate. Each active was applied both as a dust and as a resinous coating at various ratios of treated to untreated termites.

Materials and Methods A standard resin formulation (proprietary composition) was made up using zinc borate or Termidor 80WG and applied to treated termites as a topical fast-drying coating. Zinc borate dust was used at 100% concentration versus Termidor Dry (0.5% fipronil). Treated termites (TT) were set up in groups with untreated termites (UT) at ratios of 10TT: 100UT, 5TT:100UT, 2TT:100UT, 1TT:100UT, and 0TT:100UT (control). Each treatment group was held in a standard 6.5 cm plastic petri dish with one water-saturated filter paper disc, and sealed with Parafilm. There were three replicates for each treatment and ratio. Termite mortality was recorded daily.

Results See Figures 1 & 2.

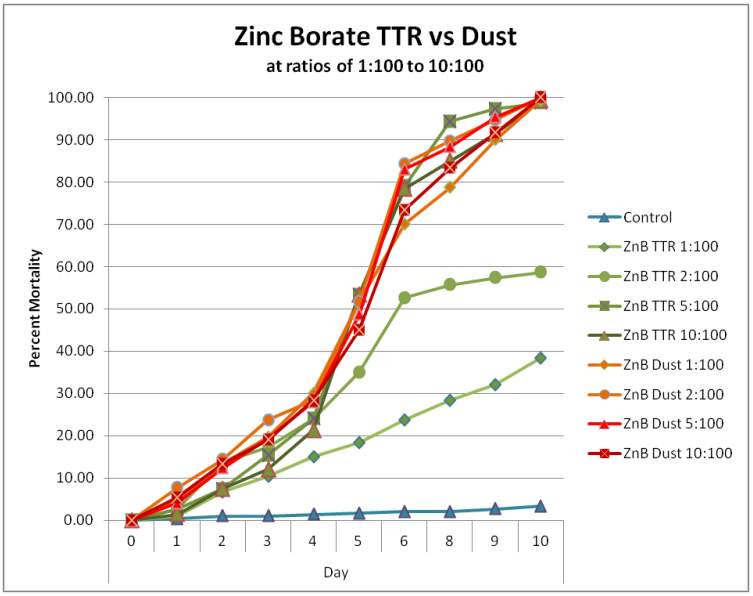

Figure 1. Mortality curves for termites treated with zinc borate as a dust or resinous coating (TTR) at various ratios of treated to untreated termites.

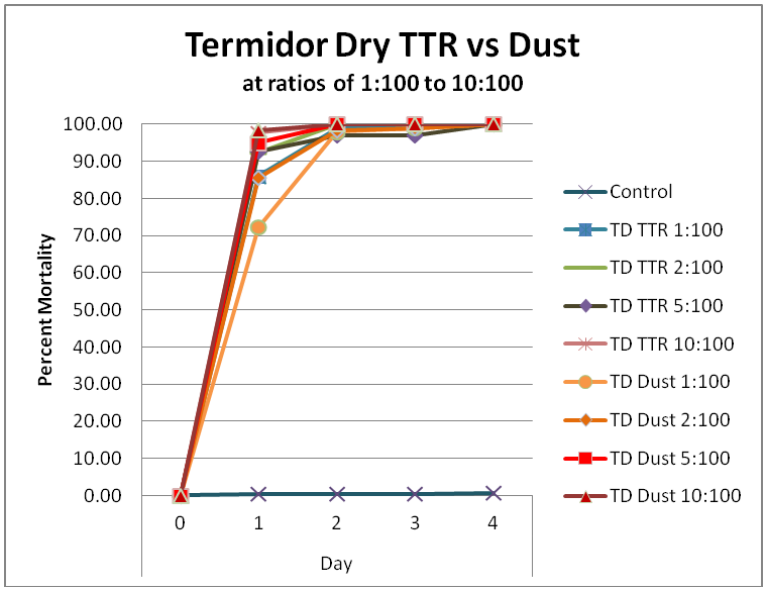

Figure 2. Mortality curves for termites treated with fipronil as a dust or resinous coating (TTR) at various ratios of treated to untreated termites.

Conclusion As a dust, zinc borate had a maximum kill ratio of 1:100 after 10 days, while as a coating its maximum kill ratio was 1:35. The higher kill ratio as a dust is probably due to greater circulation and enforced feeding on dust contaminated filter paper in the confines of

the petri dish. Such effect would not likely translate to field conditions where the dust would fall to the soil tunnels and not be eaten as in the petri dish test.

Fipronil killed faster than zinc borate, with greater than 70% mortality after one day and greater than 95% mortality after two days for both dust and coatings at kill ratios up to 1:100. While this seems promising, the lack of delay in the onset of mortality would likely diminish the impact of treatment under field conditions. The BASF product brochure has a table which indicates that treated termite (donor) mortality is 67-93% within only four hours, and recipient mortality is 100% within 48 hours for test groups up to 1T:30UT (one donor to 30 recipients).

The apparent absence of grooming and ingestion of fiproniol, shows that the mode of action, is very different than for zinc borate. Fipronil is a GABA inhibitor, thus its mode of action is on the nervous system of the insect. The mode of social transfer prior to onset of toxic effects in the untreated termites is not clear. Grooming and ingestion may not be involved, transfer may instead be by simple contact or short range volatility. With the possibility of mortality induced by volatility, the high kill ratio could have more to do with the small size of the test chamber than to actual social transmission.

Appendix 2.

Soil Cup Test of Zinc Borate and Fipronil for Control of the eastern subterranean termite, *Reticulitermes flavipes*

Timothy G. Myles, Ph.D.
Termite Control Officer

City of Guelph, 1 Carden St., Guelph, Ontario, Canada N1H 3A1
tim.myles@guelph.ca 519-837-5615 ext 2840, 519-827-4383 (cell)

Abstract Soil cup tests were performed to further evaluate fipronil and zinc borate. In the zinc borate test, in which 10% were treated, mortality reached 70% by the twelfth day. In the Termidor Dry treatments mortality was greater than 95% on the first day in the 5%, 10% and 30% treated groups, reaching nearly 100% by the second day. In the group in which only 2% were treated with the Termidor Dry formulation, mortality reach 65% on the first day and 100% by the fifth day. This shows that at least a 1:50 kill ratio was achievable with the Termidor Dry formulation in a soil tunnel type of test chamber.

Introduction A previous test conducted with termites on filter paper in petri dishes showed the high kill ratio potential of fipronil. In this test, a larger chamber filled with sand was used to simulate more realistic conditions.

Materials and Methods Screw cap Ziploc food containers (473 ml) were used as test chambers. Each container had 200 grams of sand, 30 ml of water, one small block of pine wood (2 X 2 X 0.5 cm) as food, and 1 gram (ca. 345 untreated termites). The untreated termites were allowed to tunnel in the soil for 24 hours before the treated termites were introduced. The standard topical resinous formulation with either zinc borate or Termidor Dry as the active was used to treat 0.3, 0.1, 0.05, or 0.02, grams (30%, 10%, 5%, or 2% treated) of termites which were then introduced into each of 3 replicates. Zinc borate was only tested at the 10% level. After set up, the lids of the cups were screwed on. Mortality was recorded daily by counting dead termites on the sand surface and in visible tunnels. The test ran for 12 days.

Results See Figure 1.

Conclusion In the zinc borate test, in which 10% were treated, mortality reached 70% by the twelfth day. In the Termidor Dry treatments mortality was greater than 95% on the first day in the 5%, 10% and 30% treated groups, reaching nearly 100% by the second day. In the group in which only 2% were treated with the Termidor Dry formulation, mortality reach

65% on the first day and 100% by the fifth day. This shows that at least a 1:50 kill ratio was achievable with the Termidor Dry formulation in a soil tunnel type of test chamber.

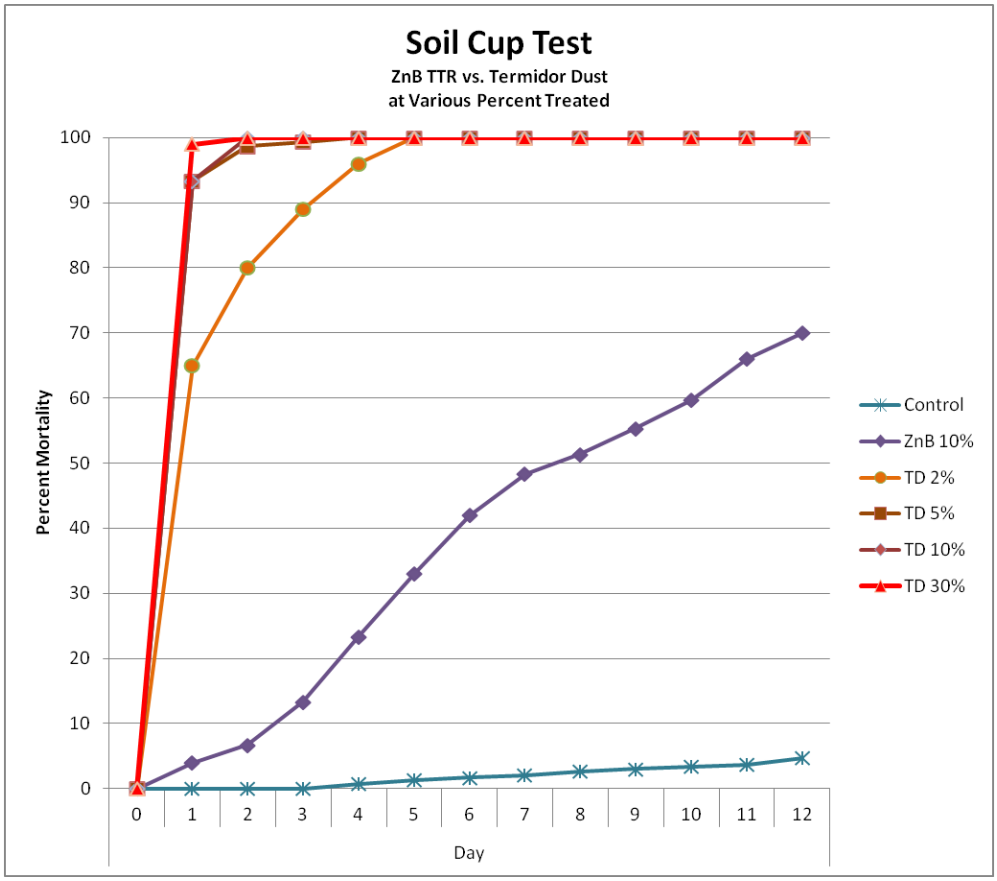

Figure 1. Soil cup test of zinc borate and Termidor Dry.

Appendix 3.

Laboratory Evaluation of the Maximum Kill Ratio of fipronil against the eastern subterranean termite, *Reticulitermes flavipes*

Timothy G. Myles, Ph.D.
Termite Control Officer

City of Guelph, 1 Carden St., Guelph, Ontario, Canada N1H 3A1
tim.myles@guelph.ca 519-837-5615 ext 2840, 519-827-4383 (cell)

Abstract The kill ratio, or the number of termites treated to the number of termites killed, was evaluated at 1:100, 1:200, 1:400, 1:600, 1:800 and 1:1000 in 14 cm petri dishes for fipronil in two formulations. In all tests, mortality level was delayed about one day in the dust formulation compared to the resin formulation (at a higher concentration). Both formulations achieved 100% mortality by day 5 at the 1:1000 ratio.

Introduction Previous tests have shown the high kill ratio potential of fipronil in small petri dish and large soil cup tests. In this test, untreated termites were exposed to treated termites at higher ratios to assess the maximum kill ratio of fipronil.

Materials and Methods Tests were set up in large (14 cm) plastic petri dishes. Each dish had 2 9 cm VWR filter paper discs, saturated with 2 ml water. Termidor Dry with a 0.5% concentration of fipronil was used to dust the treated termites by swirling the treated termite in a glass dish with an excess of Termidor Dry. Termidor 80 WG was used to prepare a resinous formulation in which Termidor 80 WG represented 34% of the formulation. The coating was applied using a foam rubber applicator to the dorsal surface of a group of termites. A single treated termites was then selected and introduced by forceps into the treatment groups. After introducing the termites the dishes were sealed with Parafilm. There was one replicate per treatment and control. Mortality was recorded daily.

Results See Figure 1-6.

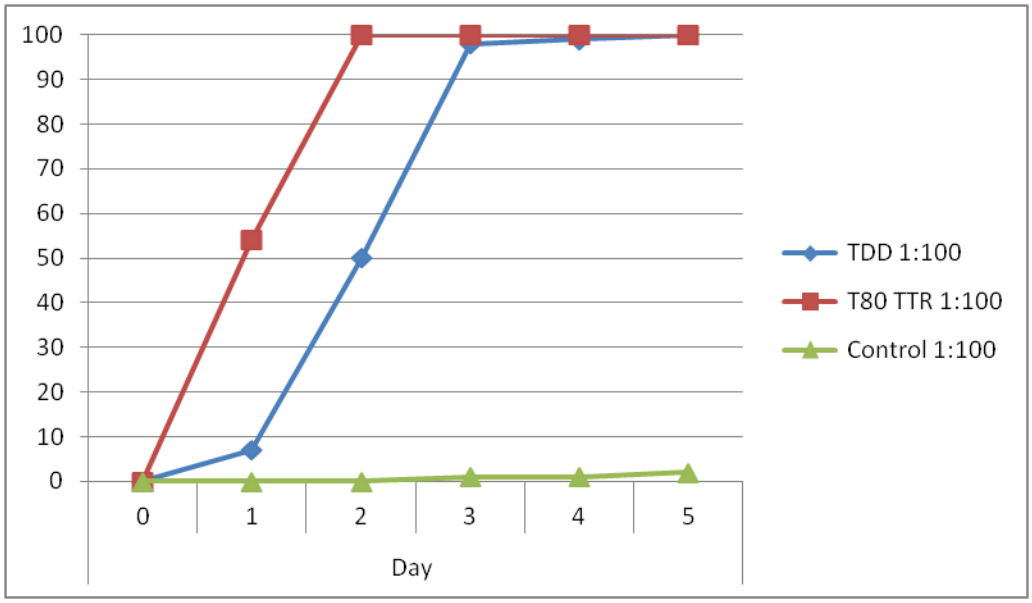

Figure 1. Mortality curves for Termidor Dry and Termidor 80 WG in TTR formulation at 1 treated termite to 100 untreated termites.

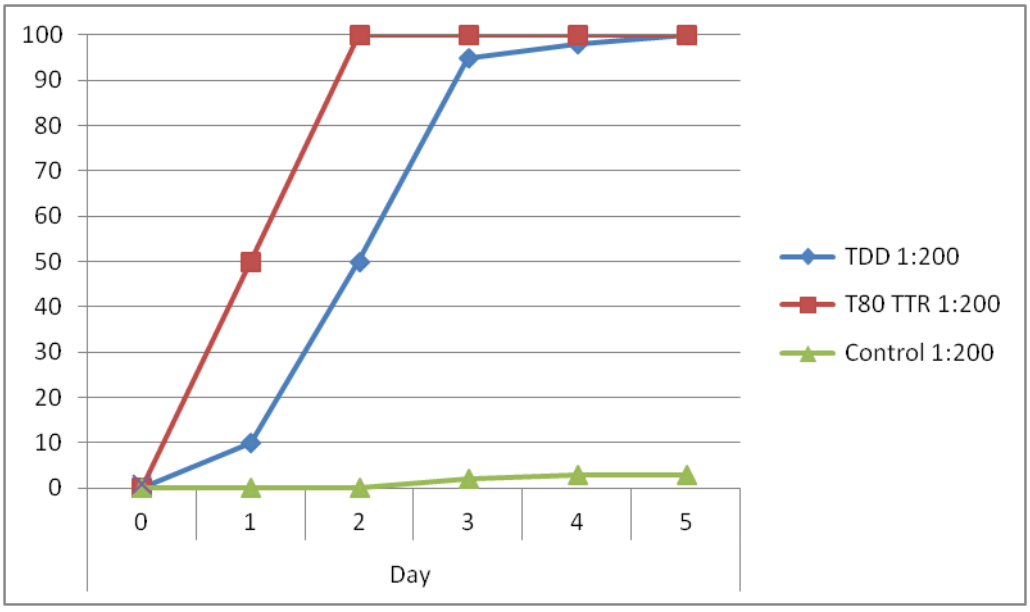

Figure 2. Mortality curves for Termidor Dry and Termidor 80 WG in TTR formulation at 1 treated termite to 200 untreated termites.

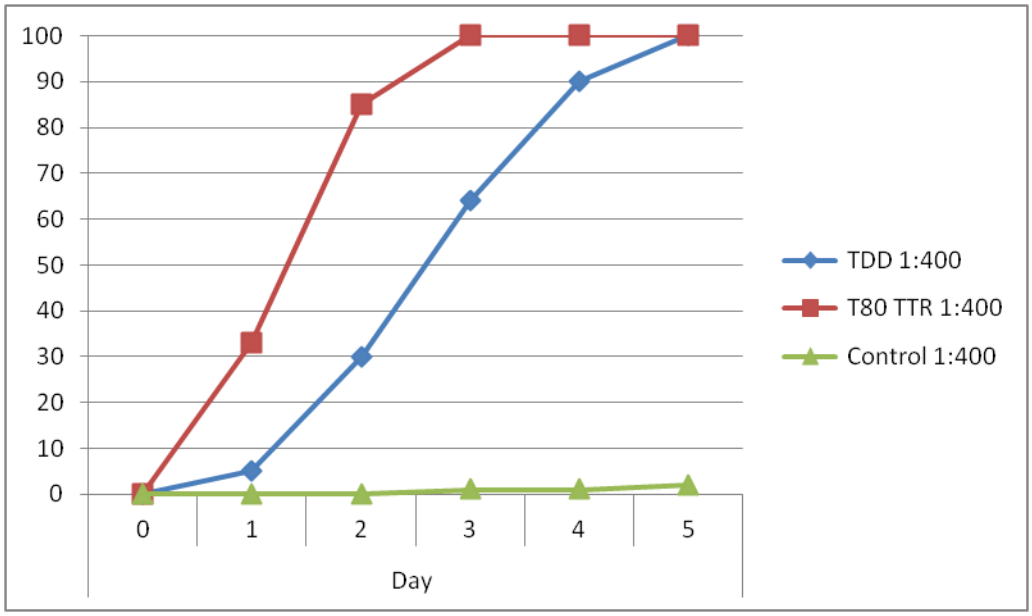

Figure 3. Mortality curves for Termidor Dry and Termidor 80 WG in TTR formulation at 1 treated termite to 400 untreated termites.

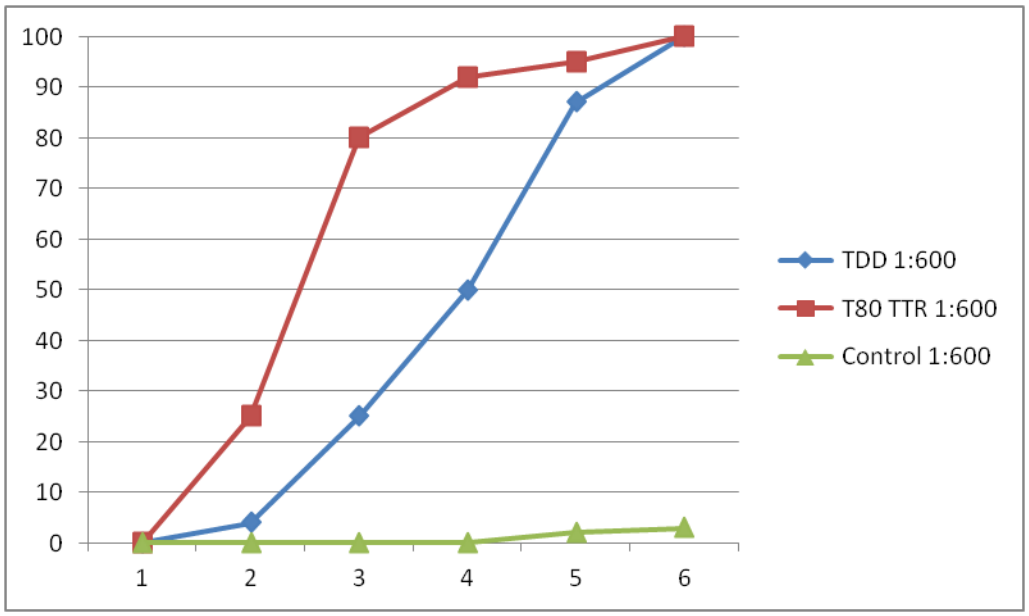

Figure 4. Mortality curves for Termidor Dry and Termidor 80 WG in TTR formulation at 1 treated termite to 600 untreated termites.

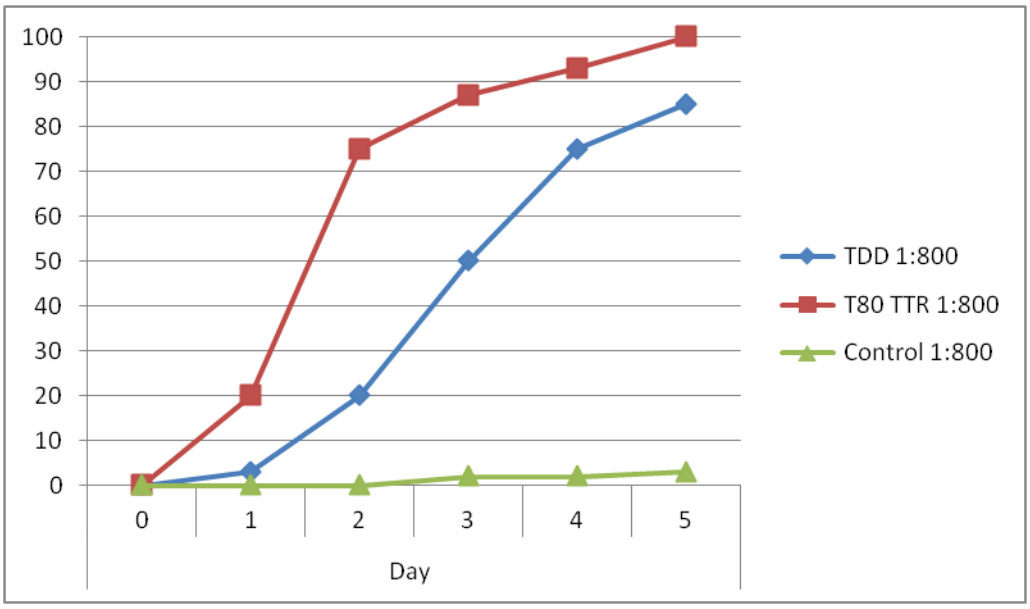

Figure 5. Mortality curves for Termidor Dry and Termidor 80 WG in TTR formulation at 1 treated termite to 800 untreated termites.

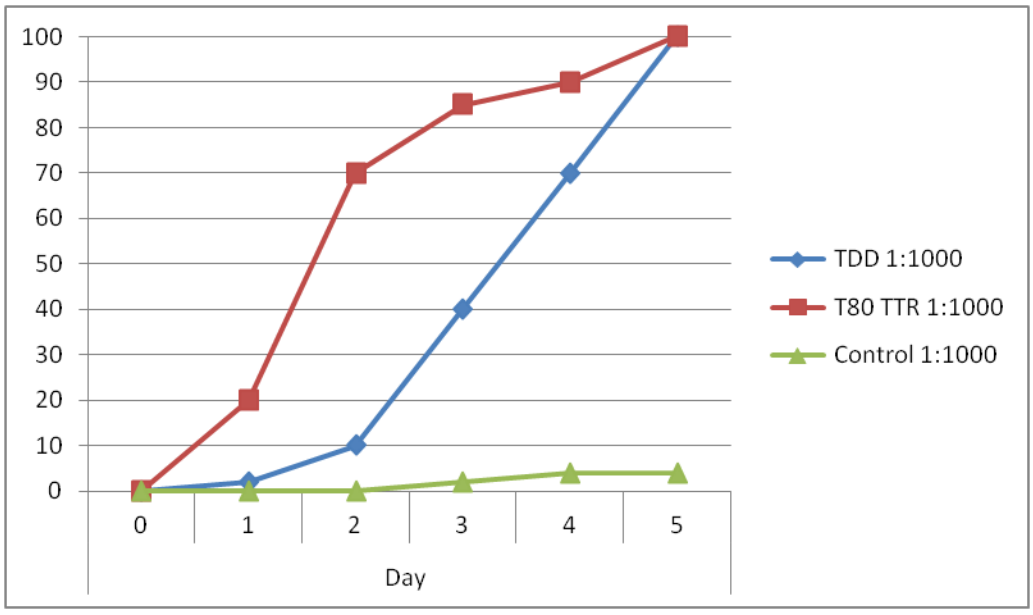

Figure 6. Mortality curves for Termidor Dry and Termidor 80 WG in TTR formulation at 1 treated termite to 1,000 untreated termites.

Conclusion Under the test conditions the maximum kill ratio is evidently over 1:1000 even at the low concentration of 0.5% in the Termidor Dry dust formulation. Given the short longevity of the carriers and the mode of action, either by contact or short range volatility, it is doubtful that such high kill ratios would be achieved under field conditions. The nature of the mode of action or transmission needs to be further evaluated.

Appendix 4.

Laboratory Evaluation of Fipronil as a Fumigant of the eastern subterranean termite, *Reticulitermes flavipes*

Timothy G. Myles, Ph.D.
Termite Control Officer

City of Guelph, 1 Carden St., Guelph, Ontario, Canada N1H 3A1
tim.myles@guelph.ca 519-837-5615 ext 2840, 519-827-4383 (cell)

Abstract Termites were exposed vapours arising from to a resinous formulation of fipronil which was applied to the inside of test chamber lids. The test showed that termites died by a fumigation effect, without any direct contact by the termites with the treated resinous surface. This shows that although fipronil does not act as a slow-ingested bait toxicant, it may still have potential as a termite dispersed fumigant. A dispersed fumigant effect could also be very lethal to a dispersed foraging population depending on the dynamics of the dispersal and subsequent interaction of termites with the dead termites. The exciting potential of this active requires further lab and field evaluation.

Introduction Previous lab tests showed that when fipronil was applied to termites either as a dust or as a resinous coating and then the treated termites exposed to untreated termites held in petri dishes or soil cups, high kill ratios were consistently obtained. However, in the case of the resinous coating, it was observed that the treated termites themselves were ungroomed, that is to say, the coating was not licked off by the untreated termites which nevertheless died. Therefore the mode of action did not appear to be due to grooming and ingestion but instead either by contact or short range volatility (fumigation). Experiments were set up in two sizes of test chamber to evaluate the fumigation hypothesis.

Materials and Methods Test chambers of two sizes were used. The small chambers were 6.5 X 1 cm Falcon plastic petri dishes sealed with parafilm (ca 33 ml capacity). The large size chambers were Ziploc screw cap containers (473 ml capacity). Thus the large chamber was 14 times the capacity of the smaller chamber. For each size chamber there were three treatments, consisting of 1, 2 or 3 daubs of the resinous fipronil formulation to the inside lid of the chamber. Each daub was equivalent to about 0.5 mg of fipronil. 100 termites were placed inside each container on a water saturated piece of filter paper. There was one replicate per treatment. Mortality was recorded daily.

Results See Figure 1.

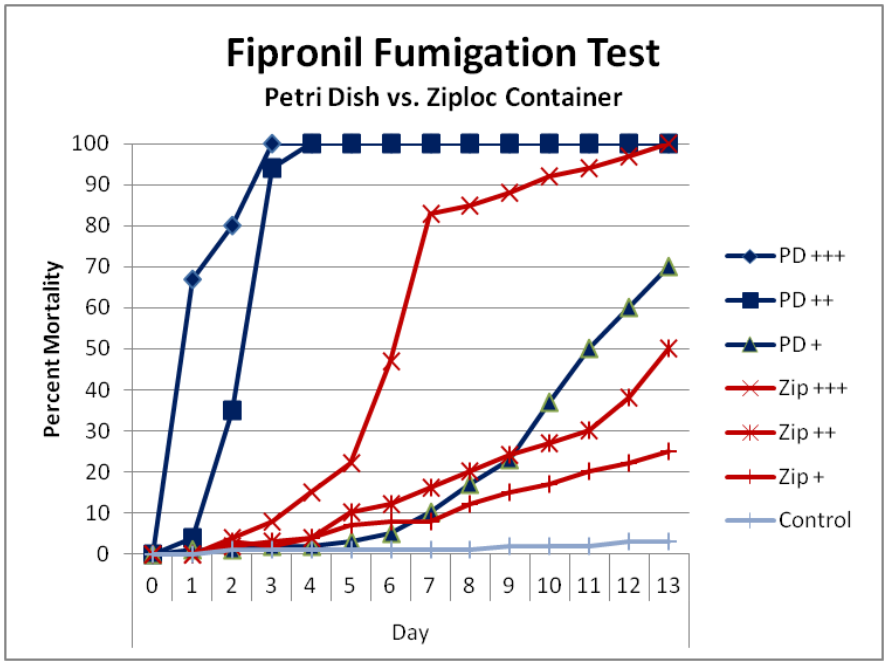

Figure 1. Termite mortality curves when a fipronil resinous formulation was applied as one, two or three daubs (+, ++, or +++) to the inside lids of petri dishes (PD) or Ziploc containers (Zip).

Conclusions The test showed that termites died by a fumigation effect, without any direct contact by the termites with the treated resinous surface, which was beyond their reach on the inside lid of the test chambers. Thus, although fipronil occurs as a non-volatile white powder and has a low vapour pressure of 2.8×10^{-9} mmHg at 25 °C, this is evidently sufficient in small spaces to act as a short range fumigant of termites. The test showed that, as expected for a fumigant effect, in the smaller chamber the termites died faster than in the larger chambers and also that there was dose-response relationship in the rate of mortality.

Given the fact that mortality is not dependent on ingestion, then the effect of the treated termites would presumably be very fast, perhaps only minutes to hours before they become ataxic and moribund. Given this mode of action, it is not surprising that galleries or treatment ports would become permanently inactive following treatment, just as they would if a liquid soil termiticide had been applied. However, how widespread would the effect be on the untreated population at a considerable distance from the release point?

In retrospect we can see that the previously reported high kill ratios did not reflect social transmission between termites but instead localized fumigation. The localized impact of fipronil treatments could give a false positive impression of its efficacy in the field. One would need to see previously active monitoring traps become inactive after release at nearby traps.

Different experiments will be required to evaluate the dispersal potential of fipronil treated termites. If, in fact, they are able to disperse up to 20 or 30 meters in soil tunnels before becoming ataxic, then their impact on the colony, or a sector of the foraging population, may be substantial, even in the absence of grooming, ingestion, and social transmission. A

dispersed fumigant effect could also be very lethal to a dispersed foraging population depending on the dynamics of the dispersal and subsequent interaction of termites with the dead termites. Also, at this point, one cannot rule out an additional contact and contact transmission effect. Could a very low topical concentration result in a very slow but widespread fumigation effect? The exciting potential of this active requires further laboratory and field evaluation.

Appendix 5.

Laboratory Evaluation of an oily conidial paste of *Metarhizium flavoviride* against the eastern subterranean termite, *Reticulitermes flavipes*

Timothy G. Myles, Ph.D.
Termite Control Officer

City of Guelph, 1 Carden St., Guelph, Ontario, Canada N1H 3A1
tim.myles@guelph.ca 519-837-5615 ext 2840, 519-827-4383 (cell)

Abstract Various oils were tested and found to be non-toxic to spores of *Metarhizium flavoviride* and non-toxic to termites. An oily paste formulation containing 2.5% *M. flavoviride* conidia was applied to termites and evaluated at various ratios of treated to untreated termites. A maximum kill ratio of 1:40 was recorded for this formulation. The onset and rate of mortality was delayed by the oil formulation compared to earlier tests of dust formulations. These effects would likely enhance field efficacy.

Introduction Previous experiments evaluated various strains of the entomopathogenic fungus, *Metarhizium*, applied as a conidial dust. In this experiment *Metarhizium flavoviride* conidia were mixed with vegetable oil and activated charcoal powder creating a black oily paste and evaluated at various ratios of treated to untreated termites.

Materials and Methods Three oils: canola, olive and immersion oil were applied by foam rubber blotter to termites to evaluate their potential toxic effect on termites for one week. None showed toxicity to termites. The oils were then mixed with conidia and activated charcoal powder to make a paste. The conidia of a two month old cultures of *Metarhizium flavoviride* grown on Potato Dextrose Agar (PDA) were collected by inverting the culture dish and tapping to dislodge the conidia into a clean glass dish. 0.1 g conidia were and 1.9 g of activated charcoal powder were mixed with 2 ml oil to make up a 2.5% concentration of *Metarhizium* conidial paste. After one week, the paste was then applied to PDA culture plates to confirm that the conidia retained viability in the paste formulation. Germination was observed after two days, followed by healthy culture development. The canola oil paste formulation was applied to termites, which were then set up in groups of treated (T) to untreated termites (UT) at the following ratios: 10T: 100UT, 5T:100UT, 1T:100UT, 1T:200UT, 1T:400UT. Groups were held in petri dishes on saturated filter paper, and wrapped with Parafilm. There was one replicate per ratio. Mortality was recorded daily for 17 days.

Results See Figure 1.

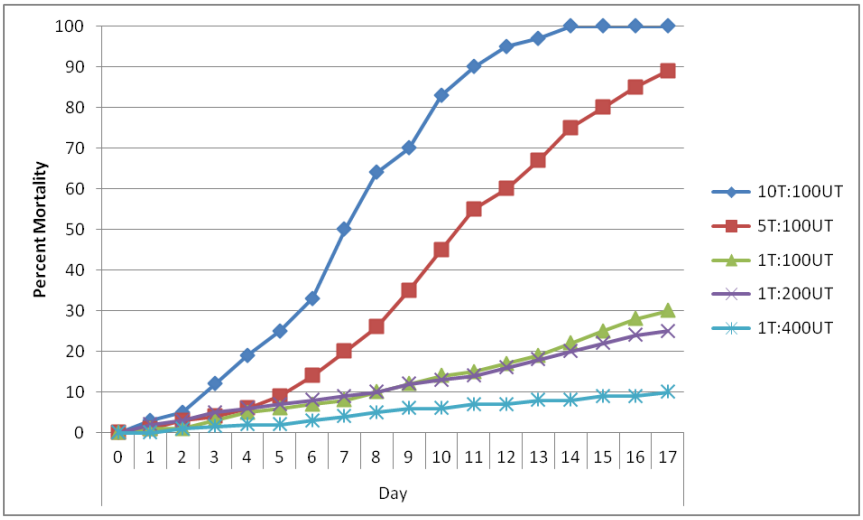

Figure 1. Mortality curves for groups exposed to *Metarhizium flavoviride* conidia paste at various rations of treated (T) to untreated (UT) termites.

Conclusions Mortality reached 100% after 14 days at the 10T:100UT ratio after 14 days, 88% in the 5T:100UT ratio, 30% at the 1T:100UT, and 25% at the 1T:200UT after 17 days. Control mortality after the same period was 5%. Thus the maximum kill ratio was recorded in the 1:200 test (25% = 50 dead termites – 10 (5% mortality) means that the one treated termite killed 40 untreated termites or a 1:40 kill ratio.

Previous studies showed that conidial dust induced 100% mortality at 1:100 within four days, and dust dilutions down to 5-10% delayed 100% mortality to two weeks. This experiment demonstrated that further moderation of the onset of mortality could be achieved by dilution in an oily paste. The oily nature of this topically applied formulation is likely to flow well onto the waxy epi-cuticle of the termites and facilitate social transmission by simple contact which is likely to enhance the rate of social transmission. Oil is commonly used to submerge and preserved fungal isolates in slants. Oil formulations are also increasingly being used as a means of diluting and dispersing fungal spores for bio-control or bio-remediation (Beattie, 2002). For example, wood rotting fungal spores have been mixed with chain saw oil to enhance the inoculation of the stump with wood rotting fungi (Stamets, 2005).

Incorporation of the conidia in oil probably delays germination on the carrier and thus prolongs carrier longevity, further enhancing social transmission. This demonstrated the moderating effect on the onset of mortality of the oily paste formulation in comparison with dust formulations. Both the delay of conidia germination and the facilitation of contact transmission are likely to enhance efficacy under field conditions.

Further evaluation of the concentration and thickness of the oily paste are needed to fine tune the formulation. Ideally one would want to see a mortality curve with a 2 or 3 day delay of onset, reaching 100% within two weeks, at a ratio of about 1T:100UT.

References

Beattie, A. et al. (eds) 2002. Spray Oils Beyond 2000, Sustainable Pest and Disease Management. Univ. Western Syndey, Aust.

Stamets, P. 2005. Mycelium Running, How Mushrooms Can Help Save the World. Ten Speed Press.